DEPARTMENT OF THE ARMY TECHNICAL MANUAL

This copy is a reprint which includes current pages from Changes 1 through 3.

TECHNICAL MANUAL

DIRECT AND GENERAL SUPPORT

MAINTENANCE MANUAL

LIGHTER, AMPHIBIOUS (LARC-LX)

SELF-PROPELLED,

DIESEL STEEL, 60 TON, 61 FT. DESIGN 2303

NSN 1930-00 -392-2981

Approved for public release. Distribution is unlimited.

This manual supersedes TM 55-1930-203-34, 6 April 1971, including change 1.

HEADQUARTERS, DEPARTMENT OF THE ARMY
21 MARCH 1988

CHANGE

NO. 3

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 16 JULY 1992

Direct and General Support Maintenance Manual

LIGHTER, AMPHIBIOUS (LARC-LX)
SELF-PROPELLED, DIESEL,
STEEL, 60-TON, 61 FT, DESIGN 2303,
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By Order of the Secretary of the Army:

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General, United States Army
Chief of Staff

Official:

MILTON H. HAMILTON
Administrative Assistant to the
Secretary of the Army
01998

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CHANGE

NO. 2

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 18 MAY 1992

Direct and General Support Maintenance Manual
LIGHTER, AMPHIBIOUS (LARC-LX)
SELF-PROPELLED, DIESEL
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CHANGE NO. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 27 July 1988

Direct and General Support Maintenance Manual

**LIGHTER, AMPHIBIOUS (LARC-LX)
SELF-PROPELLED; DIESEL;
STEEL; 60-TON; 61 FT; DESIGN 2303,
NSN 1930-00-392-2981**

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General, United States Army
Chief of Staff

Official:

R. L. DILWORTH
Brigadier General, United States Army
7he Adjutant General

DISTRIBUTION:

To be distributed in accordance with DA Form 12-25A, Direct and General Support Maintenance requirements for Lighter, Amphibious (LARC-LX), Diesel, Self Propelled, Steel, 60-T, 61 Ft (Design 2303)

WARNING

RADIATION HAZARD

This equipment contains the following radioactive items:

COMPASS	Located on Operator's Control Panel.
ARBITRARY SCALE METER	Located on Operator's Control Panel.

Instructions for safe handling, maintenance, storage, and disposition of these items are contained in TM 750-248.

FIRE HAZARD

Fire hazard exists during refueling operations, while performing maintenance on electrical components or while welding aboard the LARC.

SERIOUS INJURY OR DEATH may result if personnel fail to observe safety precautions.

When refueling, shut down the electrical system on the LARC. Observe the no smoking rule.

Do not permit anyone to operate tools or equipment which may produce sparks near the refueling operation.

Before working on any electrical equipment, make sure the circuits have been deenergized and the cables have been disconnected from the battery.

When cutting with a torch, or when welding, always station fire watches, ready with fire extinguishers, in the vicinity on both sides of the plate that is being cut or welded.

TRANSPORTATION HAZARD

Failure to observe this warning may result in SERIOUS INJURY OR DEATH to personnel.

Do NOT go under craft or near propellers while engines are running

Before hoisting large pieces of machinery or equipment, make sure all rigging is secure.

Keep a tight line on the load while it is suspended from the hoist.

Do not permit anyone to stand or walk beneath the load.

AIR AND HYDRAULIC FLUID UNDER PRESSURE

DEATH or severe injury may result if personnel fail to observe safety precautions.

Before breaking line in the hydraulic or compressed air system, bleed the pressure from that portion of the line.

DANGEROUS CHEMICALS

DANGEROUS CHEMICALS are used in this equipment.

SERIOUS INJURY OR DEATH may result if personnel fail to observe safety precautions.

Avoid contact with the battery electrolyte.

If solution comes in contact with the skin, rinse the area immediately with clear water to avoid skin burns.

Do not smoke or use an open flame in the vicinity when servicing batteries as hydrogen gas, an explosive, is generated.

DANGER OF EXPLOSION

Prior to cutting or welding on the ramp, remove drain plugs on both sides of the ramp and check if ramp interior is primer coated. If primer coated, flush thoroughly with steam, carbon dioxide, or water. Do not reinstall drain plugs until the cutting and/or welding operation is completed. Failure to take this precaution may result in explosion of accumulated primer vapors.

Fuel oil and other petroleum products are highly volatile in extreme heat. To minimize the possibility of explosion, wipe up all spills at once, see that fuel lines and valves are not leaking and pump bilges regularly.

RAMP MAINTENANCE

Ramp hinge pins must be replaced one at a time, allowing three remaining pins to support ramp. Removal of two or more hinge pins may result in the weight of the ramp misallgning the remaining hinges, resulting in damage to ramp and possible injury or death to maintenance personnel.

DANGEROUS FUMES

When working inside the hydraulic oil supply tank, a portable -type circulating blower should be used to prevent vapor accumulation. For extended work periods inside the tank, an air line tube respirator should be worn. Station an observer outside tank in case worker is overcome by fumes.

BURNS

Acids can cause serious burns or blindness. Avoid contact with eyes, skin, or clothing. Do not breathe vapors. Wear rubber gloves, goggles, and a rubber apron when handling them. When diluting acids, do not add water to acid; the acid must be added to the mixture slowly and with constant mixing. In case of contact with acid, flush the affected area with plenty of water and obtain medical aid immediately.

TECHNICAL MANUAL
NO. 55-1930-203-34

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 21 March 1988

DIRECT AND GENERAL SUPPORT MAINTENANCE MANUAL

LIGHTER, AMPHIBIOUS (LARC-LX) SELF-PROPELLED,

DIESEL STEEL, 60 TON, 61 FT, DESIGN 2303

NSN 1930-00-392-2981

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*This manual supersedes TM 55-1930-203-34, 6 April 1971, including Change 1.

LIST OF ILLUSTRATIONS

LIST OF TABLES

CHAPTER 1
INTRODUCTION

Section I. GENERAL

1-1. Scope
These instructions cover the amphibious lighter (LARC-LX). They provide information on the maintenance of the equipment which is beyond the scope of the tools, equipment, personnel, or supplies normally available at the organization maintenance level.

1-2. Forms and Records
Maintenance forms, records, and reports which are to be used by maintenance personnel at all maintenance levels are listed in and prescribed by DA Pam 738-750.

1-3. Reporting of Errors
You can help improve this manual. If you find any mistake or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual directly to: Commander, U.S. Army Troop Support Command, ATTN: AMSTR-MCTS, 4300 Goodfellow Boulevard, St. Louis, MO 63120-1798. A reply will be furnished directly to you.

Section II. DESCRIPTION AND DATA

1-4. Description
For a complete description of the LARC.LX refer to TM 55-1930-203-10 and TM 55-1930-203-20.

1-5. Difference in Models
For any information relative to difference in models, refer to TM 55-1930-203-20.

1-6. Tabulated Data
The tabulated data listed gives dimensions, tolerances and clearances, nut and bolt torque, and pertinent data necessary for direct and general support maintenance personnel to properly adjust, repair, or overhaul the equipment.

a. General

Nomenclature	Lighter, Amphibious (LARC-LX), Self-Propelled, Diesel, Steel 60 Ton, 61 Ft., Design 2303, FSN 1930-392-2981
Ambient temperature range	125° F to -25° F
Gradeability	60 % slope
Hull construction	Welded Steel
Overall length	62 ft. 6½ in.
Overall height	19 ft. 6 in.
Overall width	26 ft. 7 in.
Wheel base	28 ft. 6 in.
Dry weight (approx)	194,000 lbs.
Curb weight (approx)	199,000 lbs.
Performance:	
Land operation:	
Forward speed. Empty	15.2 mph
Forward speed, 60 ton lead	14 mph
Forward speed, 100 ton load	12.75 mph
Reverse speed, 60 ton load	2.85 mph
Turning radius	75 ft
Water operation:	
Forward speed empty	7.5 mph
Forward speed, 60 ton load	7 mph
Forward speed, 100 ton load	6.5 mph

b. Diesel Engines.

(1) Engine (starboard side forward and portside aft).

Manufacturer	Detroit Diesel Engine Div of GMC
Model	6080 RA
Series	6-71
Type	Industrial
No. of cylinders	6
Cycle	2
Bore and stroke	4¼ in. x 5 in.
Displacement	425.6 cu. in.
Compression ratio	17:1
Minimum compression pressure at 600 rpm	400
Maximum premissible variation between cylinder	25 psi at 600 rpm
Rating	165 hp cont. at 2100 rpm
Governed speed	2100 rpm
Maximum rpm (no load)	2120 rpm
Idle speed	550 rpm
Crankshaft rotation (from flywheel end)	CCW
Firing order	1-5-3-6-2-4
Starting method	Compressed air
Lubrication system	Forced feed
Fuel	Diesel oil
Fuel system	Unit injectors
Cooling system:	
Marine operation	Cooling coils
Land operation	Radiator
New weight, dry (approximate)	2610 lbs.

(*2) Engine (port side forward and starboard side aft).*

Manufacturer	Detroit Diesel Engine Division of GMC
Model	6081 RC
Series	6-7 1
Type	Industrial

Note. The specifications and rating for these engines are identical to the Model 6080 RA Engines. The only difference is the location of certain components and accessories.

(3) Air cleaners.

Manufacturer	Detroit Diesel Engine Division of GMC
Type	Oil, bath, light duty
Diameter	10 in.
Mfr. No	5183248

(4) Air starting motor.

Manufacturer	Ingersoll-Rand Co.
Model	
Hulls 5 through 18	A31-RH6
Hulls 19 through 60	B21-RH6
Size	
Hulls 5 through 18	9BM
Hulls 19 through 60	10BM
Drive assembly manufacturer	Eclipse Machine Div. Of Bendix Aviation Corp.
Type	Friction Clutch
Operating pressure	
Maximum	150 psi
Minimum	45 psi

(5) Fuel filters.

Primary fuel filter:	
Manufacturer	AC Spark Plug Div of GMC
Mfr. No. (Hulls 5-18)	5182041
Mfr. No. (Hulls 19.60)	5575568
Element	Type T-553
Secondary fuel filter:	
Manufacturer	AC Spark Plug Div of GMC
Type (Hulls 5.18)	141
Type (Hulls 19-24)	T67
Type (Hulls 25-60)	T-65
Element (Hulls 5-18)	Type TP-512
Element (Hulls 19-24	Type T-552
Element (Hulb 2540)	TP540X

(*6) Fuel injectors.*

Manufacturer	Detroit Diesel Engine Div of GMC
Model	HV7
Type	Volume metering

(*7) Fuel pumps.*

Manufacturer	Detroit Diesel Engine Div of GMC
Type	Gear-Position displacement
Mfr. No. (Engine Model 6080RA)	5184531
Mfr. No. (Engine Model 6081RC)	5184532
Fuel pressure at fuel manifold (1600 rpm engine speed)	
Minimum	35 psi
Maximum	65-70 psi

(*8) Governors.*

Manufacturer	Detroit Diesel Engine Div of GMC
Type	Limiting speed, mechanical
Mfr. No. (Engine Model 6080RA)	5182567
Mfr. No. (Engine Model 6081RC)	51825(68

(*9) Oil filters.*

Bypass oil filter:	
Manufacturer	AC Spark Plug Div of GMC
Type	S-2
Element	Type P-1I 1
Full flow oil filter:	
Manufacturer	AC Spark Plug Div of GMC
Type	PM 13
Mfr. No. (Engine Model 6080RA)	5194287
Mfr. No. Engine Model 6081RC)	5194288
Element ..... Type PF-132	

(10) Water pumps.

Manufacturer	Detroit Diesel Engine Div of GMC
Type	Centrifugal
Capacity	8 gpm
Mfr. No. (Engine Model 6080RA)	5113108
Mfr. No. (Engine Model 6081RC)	5113109
Clearance between pump body and impeller hub	0.100 in.

(11) Thermostat.

Manufacturer	Detroit Diesel Engine Div of GMC
Starts opening	173° F (78.3° C)
Fully open	Approx. 185° F (85° C)

c. Electrical System.

(1) Battery charging generator.

Manufacturer	Delco-Remy Div of GMC
Model	1117478
Type	Heavy duty, ventilated
Voltage	24 volt dc
Amps	40
Rotation (from driven-end)	clockwise
Ground polarity	negative
Control	voltage regulator
Maximum operating speed	4000 rpm
Number of units	2

(2) Generator drive belt.

Manufacturer	Dayton Rubber Co.
Type	B
Mfr. No.	VX21
Number of units	2

(3) Generator regulator.

Voltage	24 volts dc
Amps	40
Ground polarity	Negative
Military standard	MS13803-1
Number of units	2

(4) Battery-generator indicator.

Manufacturer	AC Spark Plug Div of GMC .
Type	Indicating
Mfr. No	1501371
Ordinance No	7354232
Number of units	1

(5) Batteries.

Type	6TN
Volts	12
Rated capacity at 20 hour rate	100 amp hour
Military standard	MS35000-3
Number of units	2

(6) Circuit breakers.

Type	Automatic reset
15 ampere:	
Military standard	MS39062-1
Number of units	6
20 ampere:	
Military standard	MS39062-2
Number of units	4

(7) Master control relay.

Voltage	24 volts, dc
Ordinance No.	752778
Number of units	1

(8) Tachometer indicator.

Manufacturer	General Electric Co.
Model	8DJ120AAG1
Range	0 to 2,250 rpm
Pointers	Dual
Number of units	2

(9) Tachometer generator.

Manufacturer	General Electric Co.
Model	2CM9ABX6
Rotation (from drive end)	CCW
Number of units	4

(10) Pressure switches.

Engine low oil pressure switch:	
Manufacturer	AC Spark Plug Div of GMC
Range	Opens at 8 to 12 psi
Mfr. No.	1507289
Number of units	4
Marine gear oil pressure switch:	
Manufacturer	AC Spark Plug Div of GMC
Range	Opens at 120 to 130 psi
Mfr. No	1508724
Number of units	2
Transmission low oll pressure switch:	
Manufacturer	AC Spark Plug Div of GMC
Range	Opens at 60 to 65 psi
Mfr. No.	1507379
Number of units	4

(11) Thermostatic switches.

Engine high water temperature switch:	
Manufacturer	AC Spark Plug Div of GMC
Range	Closes at 215 to 225°F
Mfr. No.	1513346
Number of units	4
Gathering box high oil temperature:	
Manufacturer	AC Spark Plug Div of GMC
Range	Closes at 240 to 250° F
Mfr. No.	1512366
Number of units	2
Marine gear high oil temperature switch:	
Manufacturer	AC Spark Plug Div of GMC
Range	Closes at 240 to 250° F
Mfr. No	1512366
Number of units	2
Transmission high oil temperature switch:	
Manufacture	AC Spark Plug Div of GMC
Range	Closes at 240 to 250° F
Mfr. No	1512366
Number of units	4

(12) Searchlight.

Manufacturer Portable Light Co.	
Model	18
Size	8 in.
Voltage	24
Rotation	3600
Range	½ mile

(13) Cab ventilating fan.

Manufacturer	Perfection Div, of Hupp Corp.
Mfr. No.	95-24E
Volts	24 volts, dc
Type of base	Swivel
Radio suppression capacitor:	
Manufacturer	Cornell-Dubilier
Mfr. No	NF-10299
Capacitance	0.25 MFD
Work voltage	100 volts dc at 20
Number of units	2 amperes

(14) Wiring Size and type

Main circuits leading from power source to master relay and following relay to first multiple connector	No. 2, AWG (single conductor)
First multiple connector from master relay to circuit breaker	No. 12, AWG (single conductor)
All lighting including master warning light, heater ventilating fan, and warning light feeder circuits	
Tachometer circuits	No. 16, AWG (Single conductor)
Trunk cables	No. 14, AWG (12 conductor)

d. Cooling System.

(1) Radiator (land operation).

Manufacturer's:	
Hulls 5 through 18	Perflex Corp.
Hulls 19 through 24	Young Radiator Corp.
Hulls 25 through 60	Yates American Radiator Co.
DA drawing No.	2303-12-40
Water flow	8 gpm
Heat rejection rate (maximum)	10,250 BTU per minute
Allowable pressure drop	3.6 in. of water

Normal operating pressure ..... 9 psi
Test pressure ..... 14 psi air
Number of units..... 4

(2)Cooling coils (marine operation).

Location..... Aft wheel wells
Copper pipe size ..... 2 in.

(3)Oil coolers (gathering box and marine gear).

Manufacturer (Hulls 5 through 24)..... Rose Heater and Mfg. co.
Model .. 301-2BFC
Manufacturer (Hulls 25 through 60)..... Yates-American Machine Co.
Model FB-1-3250-2
Type ..... Single pass
Number of units..... 8

(4) Radiator fan.

Manufacturer ..... Joy Manufacturing Co.
Model ..... Axivane, 29¼–17½–2000
Series..... 1000
Number of units..... 4

(5) Radiator fan motor.

Manufacturer..... Parker Hannifin Corp.
Mfr. No MD677939
Type ..... Hydraulic, vane
Horsepower..... 20 HP at 1850 rpm and 900 psi

(6)Expansion tank pressure cap.

Manufacturer..... Stant Manufacturing Co.
Mfr. No. (Hulls 5 through 48)..... R-6
Mfr. No. (Hulls 49 through 601 ..... AAX-0432
Pressure rating..... 7 psi
Number of units..... 4

e. Fuel System.

(1) Fuel system filter.

Manufacturer..... Marvel Engineering Co.
Model ..... SLD-3 / 4-8-100
Type ..... Line type
Inlet and outlet pipe size ..... ¾ in-NPTF
Capacity ..... 8 gpm
Pressure drop..... 0.50 psi
Weight (approximate) ..... 7 lbs.
Element No..... SLD-3 / 4-8pt 6 100 mesh
Number of units..... 2

(2)Check valve (fuel supply line).

Manufacturer..... Crane Co.
Size ..... ¼ in.
Mfr. No 20
Number of units..... 6

(3)Check valve (fuel tank vent).

Manufacturer..... Jenkins Bros., Inc.
Size ..... ¼ in.
Mfr. No ..... 54 (see note)
Number of units..... 2
Note. Refitted with bronze spring to release at 4 to 6 oz. vacuum,

(4)Plug valve (fuel return and supply lines).

Manufacturer.....Republic Mfr. Co.
Size ..... ¼ in.
Mfr. No..... 702GG
Number of units 11

(5) Plug valve (fuel supply line).

Manufacturer..... Republic Mfg. Co.
Size ..... 2 in.
Mfr. No. 702GG
Number of units 3

(f) Land Drive System.

(1) Torque converters.

Manufacturer..... Allison Div of GMC
Model TC-654
Horse power range..... 75 to 300 hp
Stall torque ratio (maximum) ..... 3.70 : 1
Number of stages..... 1
Number of phases..... 3
Number of elements..... 4 (pump, turbine, first stator, second stator)
Model ..... TC-554 14 element):
Horse power range..... 150 to 350 hp
Stall torque ratio (maximum) ..... 3.40 : I
Number of stages..... 1
Number of phases..... 3
Number of elements..... 4 (pump, turbine, first stator, second stator)
Model ..... TC-554 (3 element):
Horse power range..... 200 to 400 hp
Stall torque ratio (maximum) 3.40: 1
Number of stages..... 1
Number phases..... 2
Number of elements..... 3 (pump, turbine, stator)
Maximum input speed ..... 2500 rpm
Maximum input torque..... 850 ft-lb
Charging oil pump capacity..... 21 gpm at 1800 rpm converter input speed
Charging oil pump pressure:
Minimum full throttle stall..... 50 psi
Maximum full throttle stall..... 80 psi
Maximum full throttle no load..... 120 psi
Converter oil outlet maximum temperature ..... 250° F
Oil cooled by . ..... Heat exchanger
Output shaft . ..... Automotive
Flywheel housing..... SAE 1
Weight (dry) ..... 420 lb

(2) Flexible coupling (torque converter to transmission).

Manufacturer..... Philadelphia Gear Works
Mfr. dwg ..... C684071 REV C
Number of units 4

(3) Transmission.

Manufacturer..... Allison Div of GMC
Model TG603RM
Type ..... Torgmatic, Planetary gear
Speeds..... Three forwarded, one reverse
Input rotation ..... Right-hand
Maximum input speed ..... 2100 rpm
Maximum input torque ..... 3000 ft-lbs.
Output rotation ..... Same as input
Gear train ..... Constant mesh compound planetray
Gears ..... Spur-type

Drive range ratios
Low ..... 4.375 : 1
Intermediate..... 2.33: 1
High ..... 1 : 1
Reverse..... 3.50: 1
Clutch type Multiple disk, automatic wear compensated
Clutch operation Hydraulically actuated, spring released, oil cooled
Number of clutch packs 4
Control ..... Air operated
Oil system Interconnected with torque converter
Weight (approximate)..... 1,185 lbs.

(4) Flexible coupling (transmission to miter box).

Manufacturer..... Philadelphia Gear Works
Mfr. Dwg ..... C684036 REV B
Number of units..... 4

(5) Oil filter (transmission-torque contverter).

Manufacturer..... Wm. W. Nugent and Co., Inc.
Figure No 1116PY
Size ..... IS
Number of units..... 4

(6) Miter box.

Manufacturer..... Western Gear Corp.
DA dwg No. 2303-09-100
Input rotation..... Left-hand for forward direction
Gearing..... Right-angle bevel
Number of gears 2 (location of input gear changes for starboard and port installations)
Gear backlash ..... 0.008 to 0.012 in.
Drive ratio ..... 1 : 1
Male or female gear coupling:
Pitch ..... 8 in.
Pitch diameter ..... 5½ in.
Number of teeth..... 44
Type ..... 14 ½° involute
Addendum..... 0.125 in.
Flange coupling spline:
Number of teeth..... 19
Type ..... 300 involute
Pitch diameter ..... 2.375 in.
Pitch ..... 0.5 in.
Major diameter..... 2.500 / 2.501 in.
Miter gear, left-hand:
Number of teeth..... 30
Diametral pitch ..... 3 in.
Pressure angle ..... 14½°
Addendum..... 0.333 in.
Deddendum..... 0.396 in.
Type ..... Zerol
Carburize..... 0.040 to 0.050 in. deep
Heat treat..... 55-60 Rockwell C
Miter, gear, right-hand:
Same as for left-hand (except that rotation would be right-hand)
Input shaft splne:
Type ..... 300 involute
Number of teeth..... 19
Diametral pitch ..... 0.5 in.
Pitch diameter ..... 2.375 in.
Minor diameter..... 2.240 in.
Pin diameter ..... 0.240 in.
Weight (approximate)..... 1000 lbs.

(7) Air brakes, parking and service.

Manufacturer..... B.F. Goodrich Co.
Model H500-1
Type ..... 360° segmented shoe type
Actuated by..... Expander tube
Number of units 8

(8) Column and wheel drive.

Manufacturer ..... Western Gear Corp.
DA dwg No..... 2303-09-12
Column height (overall) ..... 97 ¾ in.
Base dimensions:
Length ..... 27 in.
Width ..... 14 in.
Drive ratio:
Spiral bevel ..... 6.375 : 1
Planetary ..... 5.21 : 1
Total reduction (engine to wheel, including transmission..... 33.2: 1
Planetary ring gear:
Number of teeth 80
Diametral pitch ..... ¾ in.
Pitch diameter..... 26.66 in.
Addendum ..... 0.250 in.
Planet gear:
Number of teeth 30
Diametral pitch . ..... ¾ in.
Pitch diameter.. ..... 10.000 in.
Addendum ..... 0.250 in.
Whole depth..... 0.562 in.
Spur pinion gear:
Number of teeth 19
Diametral pitch ..... ¾ in.
Pitch diameter..... 6.666 in.
Addendum ..... 0.250 in.
Whole depth..... 0.562 in.
Spline:
Number of teeth 16
Diametral pitch ..... 0.5 in.
Pitch diameter..... 4.000 in.
Reaction member gear:
Number of teeth 80
Addendum ..... 0.250 in.
Pitch ..... ¾ in.
Gear spider:
Number of teeth 180
Diametral pitch ..... 8 / 10 stub
Pitch diameter..... 22.500 in.
Addendum ..... 0.100 in.
Axle spline:
Number of teeth 81
Diametral pitch ..... ½
Pitch diameter..... 16.200 in.
Addendum..... 0.080 in.
Bevel gear spline:
Number of teeth 16
Diametral pitch ..... ½
Pitch diameter..... 4.000 in.
Addendum ..... 0.125 in.

Note. For gear spider dimensions and wear limits, see figure 7-115.

Bevel pinion:
Number of teeth 8

Diametral pitch 2.198
Pitch diameter 3.639
Addendum 0.562
Dedendum 0.226
Bevel gear:
Number of teeth 51
Diametral pitch 2.198
Pitch diameter 23.200
Addendum..... 0.154
Dedendum 0.654
Weight (approximate) ..... 4,290 lbs.
(9) Tires.
Manufacturer ..... Firestone Tire and Rubber Co.
Mfr. No 36.00ANSDWGAD
..... 16925
Type ..... Tubeless, non-directional
Size ..... 36.00 by 41
Ply rating ..... 48 ply nylon cord
Tread:
Type ..... Non-skid
Depth ..... 1 in.
Rim diameter ..... 41 in.
Rim size (width)..... 26 in.
Over-all width..... 38.90 in.
Over-all diameter ..... 9 ft 6 ½h in.
Weight..... 3325
g. Marine Drive System.
(1) Flexible coupling (engine and gathering box to fluid coupling).
Manufacturer ..... Philadelphia Gear Works
Mfr. Dwg..... D6840T2A REV B
Number of units..... 12
(2) Fluid couplings.
Manufacturer ..... Twin Disc Clutch Co.
Model..... 17.5 HM
Type output ..... Splined
Maximum speed ..... 2340 rpm
Number of units..... 4
(3) Pillow blocks.
Manufacturer ..... SKF Industries Inc.
Mfr. No ..... SAF 1513 x 2 1/4
Type ..... Split housing
Number of units..... 8
(4) Gathering box.
Manufacturer ..... Western Gear Corp.
DA drawing No 2303-09-102
Gear ratio..... 1.214 : 1
Maximum output torque ..... 12,480 in-lbs.
Input shaft spline:
Number of teeth 19
Diametral pitch ..... 0.500 in.
Pitch diameter ..... 1.900 in.
Pitch angle ..... 30°
Pin diameter..... 0.1920 in.
Input shaft pinion:
Number of teeth 28
Diametral pitch ..... 4 in.
Pitch diameter ..... 7.000 in.
Addendum..... 0.245 in.
Dedendum ..... 0.227 in.
Circular thickness ..... 0.4123 in.
Face angle ..... 42° 1^{1}
Pitch angle ..... 39 28^{1}
Root angle..... 37 6^{1}
Output shaft gear:
Number of teeth 34
Diametral pitch..... 4 in.
Pitch diameter..... 8.500 in.
Addendum ..... 0.180 in.
Dedendum ..... 0.292 in.
Circular thickness ..... 0.3733 in.
Face angle ..... 52° 25^{1}
Pitch angle..... 50° 32^{1}
Root angle..... 47° 30^{1}
Oil pump:
Manufacturer ..... Tuthill Pump Co.
Model..... IRCS (modified)
Army drawing No LX09-102-028
Capacity ..... 2 gpm
Sprag clutch:
Manufacturer ..... Borg Warner Corp.
Mfr. No..... X 136865
Type ..... One-way
Capacity..... 1423 ft-lbs
Accessory drive ..... Vee belt pulley
Number of units 2
(5) Flexible coupling (gathering box. To marine gear).
Manufacturer ..... Philadelphia Gear Works
Mfr. dwg ..... C684037 REV G
Number of units 2
(6) Marine gears.
Manufacturer..... Western Gear Corp
Model ..... 48B-LH (starboard side)
48B-RH (port side)
Reduction ratio (fwd and rev) ..... 2 : 1
Angle drive gear ratio ..... 1.473 : 1
Lubrication ..... Forced, oil pump mounted (on unit)
Number of units 2
(7) Oil sediment strainer.
Manufacturer..... Marvel Engineering Co.
Model 1 ..... SLB- 1 1/4 -20-100
Type..... Line type
Inlet and outlet pipe size..... 1 1/4 in.-NPTF
Capacity..... 20 gpm
Pressure drop ..... 0.50 psi
Weight (approximate)..... 12 1/2 lbs.
Number of units 2
(8) Propeller shafts.
Main shaft:
Mfr. (Hulls 5 through 18)..... Treadwell Construction Co.
Mfr. (Hulls 19 through 24)..... Transval Electronic Corp.
Mfr. (Hulls 25 through 60)..... Western Gear Corp.
Over-all length ..... 11 ft. 7 1/8 in.
Material ..... Carbon steel
Shaft sleeve:
Material..... Nickel alloy
Length..... 17 1/4 in.
Outside diameter ..... 2.778 to 2.782 in.
Army drawing No..... LX09-019-017
Weight (approximate)..... 205 lbs.
Number of units 2

Intermediate shaft {Marine gear to propeller shaft)
- Manufacturer ..... Thomas Flexible Coupling Co.
- Mfr. No 31897
- Model ..... 375 special (modified)
- Type ..... Thrust
- Material ..... Carbon steel
- Over-all length ..... 5 ft, 7 15/ 16 in.
- Number of units 2

(9) Propellers.

Mfr. (Hulls 5 through 24 & 49 through 60) ..... Columbian Bronze Co.
Mfr. (Hulls 25 through 48) ..... Coolidge Propeller Co. Army drawing No.
- Right hand propeller LX09-032-ORH
- Left hand propeller LXO9-032-OLH

Diameter ..... 48 in.
Number of blades 4
Pitch ..... 30 in.
Material ..... Cast manganese bronze
Weight (approximate) ..... 400 lbs.

h. Compressed Air System.

(1) Air compressors.

Manufacturer ..... Le-Roi Div., of Westinghouse Air Brake Co.
Model numbers ..... 14A-3YC-1-3 and 3VC-Spec 454-5 LARC
Type ..... 2 stage
Bore
- Low pressure cylinder ..... 5 in.
- High pressure cylinder ..... 2 ½ in.

Stroke ..... 3 ½ in.
Crankshaft rotation (from drive end) .. CCW
Intercooler safety valve setting ..... 70 psi
Free air actually delivered at 1174 rpm ..... 30 cfm
Maximum build-up time for 10.7 cu. ft. tank form 0 to 155 psi at 1174 rpm ..... 5 minutes

Note. When LARC engine speed is 2100 rpm's the compressor shaft rotation is 1174 rpm's.

Oil capacity ..... 2 ½ qts.
Dry weight (approximate)
- Model 3YC ..... 350 lbs.
- Model 3VC ..... 235 lbs.

Distance from bottom of base to center line of crankshaft:
- Model 3YC ..... 6 ¼ in.
- Model 3VC ..... 6 ¼ in.

(2) Compressor flexible drive coupling.

Manufacturer ..... Lovejoy flexible coupling Co.
Mfr. No. (Model 3YC Compressor) .. 101661-C
Mfr. No. (Model 3VC Compressor) .. 020767-C
Type ..... Heavy duty
Model C-226
Type inserts ..... Rubber cushions
Maximum parallel misalignment ..... 0.015 in.
Maximum angular misalignment ..... ½
Gap between end of jaws and opposite flange ..... 1/8 in.
Number of units 2

(3) Air compressor governor.

Manufacturer ..... Westinghouse Air Brake Co.
Type NS-16
Mfr. No 85270
Pressure range ..... 80 to 250 psi
Required setting
- Cut-in pressure ..... 135 psi
- Cut-out pressure ..... 155 psi
- Range differential ..... 20 psi

Number of units 1

(4) Actuator positioner.

Manufacturer ..... Westinghouse Air Brake Co.
Mfr. No P50631-2
Type AB-1
Lever starting control pressure ..... 10 psi
Lever maximum travel pressure ..... 60 psi
Optimum distance from connecting link to rod end ..... 6 in.
Optimum distance between actuator positioner and governor ..... 16 19/32 in.
Number of units 4

(5) Air starting lubricator.

Manufacturer ..... C.A. Norgren Co.
Model 30-41-8L
Oil capacity ..... ½ pt.
Number of units 4

(6) Air starting air filter

Manufacturer ..... C.A. Norgren Co.
Model 30-AE-8
Number of units 4

(7) Main air supply filter.

Manufacturer ..... Westinghouse Air Brake Co.
Type ..... E
Strainer
- Mfr. No 502904
- Type ..... Combination curled hair and felt

Number of units 1

(8) Air horn.

Manufacturer ..... Westinghouse Air Brake Co.
Type DD-5
Number of units 1

(9) Windshield wiper motor.

Manufacturer ..... Trico Products Co.
Type ..... Air operated
Model FPD-60L
Sweep 60
Number of units 1

(10) Wiper control regulating valve.

Manufacturer ..... Trico Products Co.
Mfr. No 75470-5C
Number of units 1

(11) Air cylinder (cargo well pump and ramp cylinder control).

Manufacturer ..... Westinghouse Air Brake Co.

Mfr. No..... ..... P-50092
Type..... ..... ABO 2 position)
Stroke..... ..... 7/8 in.
Number of units..... 4

(12) Air cylinder (radiator fan control).

Manufacturer .... Westinghouse Air Brake Co.
Mfr. No 523159
Type .... Single acting
Stroke .... ½ in.
Number of units 1

(13) Air cylinder (transmission shifting control).

Manufacturer..... ..... Westinghouse Air Brake Co.
Mfr. No..... ..... 192-d58
Model ..... KS (5 position)
Number of units..... 4

(14) Check valve.

Manufacturer .... Westinghouse Air Brake Co.
Mfr. No..... ..... P55027
Type .... Inline type
Pipe tap size .... ¾ in.
Number of units 2

(15) Check valve.

Manufacturer .... Westinghouse Air Brake Co.
Mfr. No 520096
Type .... Inline type
Pipe tap size .... 1 ¼ in.
Number of units 1

(16) Foot control valves (brake and throttle)

Manufacturer .... Westinghouse Air Brake Co.
Mfr. No P50208-4
Type H-1
Pressure range .... 0 to 150 psi
Number of units 2

(17) Hand throttle control valves.

Manufacturer .... Westinghouse Air Broke Co.
Mfr. No P50494-11
Type H-2-FX
Pressure range .... 10 to 65 psi
Weight .... 6 ¾ lbs.
Number of units 4

(18) Marine shifting and throttle control valves.

Manufacturer .... Westinghouse Air Brake Co.
Mfr. No P51121-1
Type HD-2-FM
Pressure range .... 0 to 65 psi
Number of units 2

(19) Globe valve (air tank drain).

Manufacturer .... Crane Co.
Mfr. No. 7
Size ..... ¼ in.
Pressure rating ..... 150 psi
Number of units 2

(20) Globe valves (brake airline).

Manufacturer .... Crane Co.
Mfr. No. 362E
Size .... 1 in.
Pressure rating ..... 300 psi
Number of units 2

(21) Globe valves (portable airlines).

Manufacturer .... Crane Co.
Mfr. No 362E
Size .... ¾ in.
Pressure rating..... 300 psi
Number of units 3

(22) Globe valve (:ire air starting cross-over line).

Manufacturer .... Crane Co.
Mfr. No 362E
Size .... 1 in.
Pressure rating ..... 300 psi
Number of units 1

(23) Angle valves (tire inflation line).

Manufacturer .... Crane Co.
Mfr. No..... 17
Size .... 1 in.
Pressure rating ..... 150 psi
Number of units 4

(24) Globe valves (air tank shut-off).

Manufacturer .... Crane Co.
Mfr. No 362E
Size .... 1¼ in.
Pressure rating ..... 300 psi
Number of units 2

(25) Plug valves (ramp seal airline shut-off).

Manufacturer .... Crane Co.
Mfr. No. 319
Size .... ½ in.
Number of units 2

(26) Pilot air valve (engine starting and air horn control.

Manufacturer .... Westinghouse Air Brake Co.
Mfr. No P54692
Type 2-BA-1
Number of units 9

(27) Pilot air valves (cargo well pump control, engine cutout, ramp control, and tire inflation-deflation control).

Manufacturer .... Westinghouse Air Brake Co.
Mfr. No P544260312
Type 2-HA-2
Number of units 9

(28) Quick opening - self closing valve (ramp seal control).

Manufacturer .... Crane Co.
Mfr. N o .... 12 ½
Size .... ½ in
Number of units 2

(29) Quick release valves (starting and transmission air line).

Manufacturer	Westinghouse Air Brake Co.
Mfr. No	P52935-3
Size	3/8 in.
Number of units	10

(30) Reducing valve (ramp seal pressure).

Manufacturer	Westinghouse Air Brake Co.
Mfr. No	P55503-0015
Type	N-1
Pressure range	5 to 60 psi, set at 15 psi
Number of units	1

(31) Relay valves (tire inflation-deflation line).

Manufacturer	Westinghouse Air Brake Co.
Mfr. No	501251
Type	A-1-B
Number of units	2

(32) Relay valves (brake air line).

Manufacturer	Westinghouse Air Brake Co.
Mfr. No.	538975
Type	C-2
Number of units	4

(33) Relay valves (engine starting air line).

Manufacturer	Westinghouse Air Brake Co.
Mfr. No.	850723
Type	D--A
Number of units	4

(34) Relay valves (transmission and throttle air line).

Manufacturer	Westinghouse Air Brake Co.
Mfr. No	528681
Type	H-5
Number of units	8

(35) Transmission shifting control valve.

Manufacturer	Westinghouse Air Brake Co.
Mfr. No	192797
Type	5-P-1B
Number of units	1

(36) Shuttle valves (air supply, fan throttle, transmission, and engine starting air lines).

Manufacturer	Westinghouse Air Brake Co.
Mfr. No	P54340-2
Size	4 in.
Number of units	28

(37) Safety relief valve (tire air line).

Manufacturer	Westinghouse Air Brake Co.
Mfr. No	10526
Type	E-1
Pressure range	35 to 75 psi, set at 70 psi
Male pipe thread size	½ in.
Number of units	1

(38) Safety relief valves (air tank).

Manufacturer	Westinghouse Air Brake Co.
Mfr. No	850159
Type	FA
Pressure range	130 to 1 75 psi, set at 165 psi
Male pipe thread size	/4 in.
Number of units	2

i. Hydraulic System.

(1) Bilge pumps.

Manufacturer	Deming Co.
Model	4707FIG4305-3IN
Size discharge	3 in.
Type	Centrifugal, self-priming
Capacity	100 gpm
Motor	
Manufacturer	Pesco Products Div of Borg-Warner Corp.
Mfr. No	062547-010-01
Type	Hydraulic, gear
Rating	3 hp at 1800 rpm
Operating pressure	550 psi
Shaft rotation (from drive end)	CW
Number of units	3

(2) Cargowell pumps.

Manufacturer	Byron Jackson Div. of Borg-Warner Corp.
Mfr. No	265916
Type	76-D
Size	12 in.
Capacity	2000 gpm
Motor	
Manufacturer	Vickers Inc.
Model	MF-2008-30-38-21 (special)
Type	Hydraulic, Piston
Maximum speed	2200 rpm
Displacement	2.41 cu. in.
Torque at 1000 psi	383.5 in. lb.
Model	M2B-40-FLS-15
Type	Hydraulic gear
Maximum speed	1800 rpm
Displacement	2.51 cu. in.
Torque at 1000 psi	360 in. lb.
Operating speed	1200 rpm
Operating pressure	1000 psi

(3) Liquid indicators (steering cylinder line).

Manufacturer	Muller Brass Co.
Mfr. No	A13469
Size	/4 in.
Number of units	2

(4) Supply tank filters.

Manufacturer	Marvel Engineering Co.
Model	A-3-100
Type	Sump
Capacity	100 gpm
Screen	100 mesh wire
Weight (approximate)	5½ lbs.
Number of units	8

(5) Master pressure pumps.

Manufacturer ..... Vickers Inc.
Type ..... Double unit, vane type
Model V4235-28-8-11A-LH
Capacity ..... 28 and 8 gpm
Model V4235-36-11-11A-LH
Capacity ..... 36 and 11 gpm
Shaft ..... Splined
Shaft rotation (from drive end)..... CCW

(6) Steering cylinders.

DA drawing No..... 2303-08-17
Bore ..... 6 in.
Stroke ..... 17 in.
Operating pressure ..... 1300 psi
Number of units 8

(7) Ramp cylinders.

DA drawing No..... 2303-05-21
Bore ..... 4 in.
Stroke ..... 42 in.
Operating pressure..... 1000 psi
Number of units 2

(8) Check valves (steering cylinder lines).

Manufacturer ..... Vickers Inc.
Mfr. No DT8P1-02-O5-10
Cracking pressure ..... 5 psi
Capacity ..... 3.2 gpm
Pipe tread ..... ¼ in.
Over-all length ..... 2 ¼ in.
Weight ..... *6* ½ oz.
Number of units 8

(9) Check valves (pump discharge lines).

Manufacturer ..... Vickers Inc.
Mfr. No..... DT8P1-06-5-11
Cracking pressure ..... 5 psi
Capacity ..... 20 gpm
Pipe thread ..... ¾ in.
Over-all length ..... 3 7 / 8 in.
Weight ..... 1 ½ lbs.
Number of units 8

(10) Check valves (ramp cylinder lines).

Manufacturer ..... Vickers Inc.
Mfr. No DT8P1-06-65-11
Cracking pressure ..... 65 psi
Capacity ..... 20 gpm
Pipe thread ..... ¾ in.
Over-all length ..... 3 7 / 8 in.
Weight ..... 1 ½ lbs.
Number of units 6

(11) Check valves (pump discharge lines).

Manufacturer ..... Vickers Inc.
Mfr. No. DT8P1-10-5-11
Cracking pressure ..... 5 psi
Capacity ..... 50 gpm
Pipe thread ..... 1 ¼ in.
Over-all length..... 5 ¼ in.
Weight ..... 5 lbs.
Number of units 4

(12) Check valve (winch lines).

Manufacturer ..... Vickers -Inc.
Model C2-830
Cracking pressure ..... 5 psi
Capacity ..... 65 gpm
Pipe thread ..... 1 ½ in.
Weight (approximate) ..... 10 ½ lbs.
Number of units 1

(13) Flow control valves (bilge pump).

Manufacturer ..... Vickers Inc.
Model FRG-06-15-1O
Maximum operating pressure..... 2000 psi
Relief valve setting ..... 550 psi
Maximum capacity ..... 15 gpm
Flow rate ..... gpm
Dial setting 4
Weight (approximate) ..... 58 lbs.
Number of units 3

(14) Flow control valves (cargo well pump).

Manufacturer ..... Vickers Inc
Model FRG-06-2412
Maximum operating pressure..... 2000 psi
Relief valve setting ..... 1000 psi
Maximum capacity ..... 24 gpm
Flow rate ..... 16 gpm
Dial setting 7-8
Weight (approximate) ..... 58 lbs.
Number of units 2

(15) Four-way control valve (radiator fan).

Manufacturer ..... Vickers Inc.
Model C-572-KNS-MI
Maximum capacity ..... 3 gpm
Maximum operating pressure..... 2000 psi
Weight (approximate) ..... 5 lbs.
Number of units 4

(16) Four-way control valve (winch).

Manufacturer ..... Vickers Inc.
Model C-145VA-M1
Type ..... 3 position, spring centered
Maximum back pressure on tank outlet connection ..... 5 psi
Maximum capacity ..... 65 gpm
Maximum operating pressure ..... 2000 psi
Weight (approximate) ..... 72 lbs.
Number of units..... 1

(17) Four-way control valve (steering follow- up).

Manufacturer..... Vickers Inc.
Mfr. No 823064
Model..... C-14540M1
Type ..... Spring centered
Maximum back pressure on tank outlet connection ..... 1000 psi
Maximum capacity..... 65 gpm
Maximum operating pressure ..... 2000 psi
Weight (approximate) ..... 77 lbs.
Number of units 2

(18) Gate valve (hydraulic oil tank drain).

Manufacturer..... Crane Co.
Mfr. No 410
Size..... 1 in.
Number of units 1

(19) Gate valve (hydraulic oil tank supply lines).

Manufacturer..... Crane Co.

Mfr. No 410
Size ..... 2 in.
Number of units 8

(20) Restrictor (ramp descent control).

DA drawing No. LX12-037-060
Orifice size ..... 0.156 in.
Number of units 2

(21) Needle valves (steering cylinder lines)

Manufacturer ..... Crane Co.
Model 222H
Size ..... 1/4 in.
Number of units 4

(22) Needle valves (steering cylinder bleed off) .

Manufacturer ..... Vickers Inc.
Model DTNS3-02-10
Size ..... ¼ in.
Number of units 14

(23) Multiple unit valve (port side).

Manufacturer ..... Vickers Inc.
Model CM2-06-RTDDL-10
Number of control valve section..... 3'
Maximum capacity . ..... 24 gpm
Maximum operating pressure ..... 1400 psi
Relief valve setting..... 1000 psi
Number of units 1

(24) Multiple unit valve (starboard side).

Manufacturer ..... Vickers Inc.
Model CM2-06-RTTDDL-10
Number of control valve sections 4
Maximum capacity ..... 20 gpm
Maximum operating pressure .... 1400 psi
Relief valve setting ..... 1000 psi
Number of units 1

(25) Relief valve (forward steering. Cylinder line).

Manufacturer ..... Vickers Inc.
Model CF-16-C-10
Type ..... Balanced piston type
Pressure range ..... 500 to 2000 psi, set at 1300 psi
Maximum capacity ..... 125 gpm
Weight (approximate) ..... 36 lbs.
Number of units 1

(26) Relief valves (radiator fan motor).

Manufacturer ..... Vickers Inc.
Model CT-10-B-10
Type ..... Balanced piston type
Pressure range ..... 75 to 1000 psi, set at 1000 psi
Weight (approximate) ..... 20 lbs.
Number of units 4

(*27) Relief valves (aft steering cylinder and winch lines).*

Manufacturer ..... Vickers Inc.
Model CT-10-C-10
Type ..... Balanced piston type
Pressure range ..... 500 to 2000 psi, set at 1300 psi
Weight (approximate)) ..... 20 lbs.
Number of units 2

(28) Cargo winch.

Manufacturer ..... Pacific Car and Foundry Co.
Model ..... E-24 (modified)
Capacity ..... 23,500 lbs.
Cable:
Diameter ..... 5/8 in.
Number of strands 6
Number of wires per stand..... 19
Core ..... Fiber
Length ..... 380 ft.
Motor:
Manufacturer ..... Vickers Inc.
Mfr. No..... 838964
Model LM2-540-150-OFC-13
Type ..... Hydraulic, vane
Horsepower ..... 27.3 hp
Maximum speed ..... 1500 rpm
Torque ..... 150 in. lbs.
Shaft rotation
(from drive end) ..... CCW
Operating pressure ..... 1300 psi

J. Gages.

(1) Air pressure gage (tire and main air).

Manufacturer ..... U.S. Gauge Div. of Ametek Inc.
Mfr. No 644
Range ..... 0 to 200 psi
Dial size ..... 2 in.
Number of units 2

(2) Air pressure gage (ramp seal).

Manufacturer ..... Enterprise Div of ..... General Metals Corp.
Mfr. No B3365
Range..... 0 to 60 psi
Dial size ..... 3 ½ in.
Number of units 1

(3) Hydraulic pressure gage (steering).

Manufacturer ..... Instrument and Gauge Div of Electric Auto-Lite Co.
Model 12882-A
Range ..... 0 to 2000 psi
Dial size ..... 1 7/8 in.
Number of units 2

(*4) Oil pressure gage (engine).*

Manufacturer ..... Dresser Industries Inc.
Mfr. No ..... 7A478-1776 LARC
Type 111
Range ..... 0 to 10 psi
Dial size ..... 3 in.
Number of units 4

(5) Oil pressure gage (gathering box).

Manufacturer ..... Dresser Industries Inc.
Mfr. No ..... 70A478-1774 LARC
Type 1010
Range ..... 0 to 60 psi
Dial size ..... 3 ½ in.
Number of units 2

(6) Oil pressure gage (marine gear).

Manufacturer ..... U.S. Gauge Co.
Model 805

Range ..... 0 to 300 psi
Dial size ..... 2 ½ in.
Number of units 2
(7) Oil pressure gage (transmission).
Manufacturer ..... Dresser Industries Inc.
Mfr. No. ..... 70A478-1777 LARC
Range ..... 0 to 300 psi
Dial size ..... 3½ in.
Number of units 4
(8) Oil temperature gage (engine and transmission).
Manufacturer ..... Dresser Industries Inc. Type
Hulls 5 through 48 ..... 6170 TW
Hulls 49 through 60 ..... 6142 TW
Capillary length
Hulls 5 through 48 ..... 12 ft.
Hulls 49 through 60 ..... 18 ft.
Range ..... 100° to 300° F
Dial size ..... 3½ in.
Number of units 8
(9) Oil temperature gage (gathering box and marine gear).
Manufacturer ..... Dresser Industries Inc. Type
Hulls 5 through 48 ..... 6170 TW
Hulls 49 through 60 ..... 6142 TW
Capillary length
Hulls 5 through 48 ..... 12 ft.
Hulls 49 through 60 ..... 18 ft.
Range ..... 20° to 220° F
Dial size ..... 3 ½ in.
Number of units 4
*(10) Quantity gage (fuel tan*k).
Manufacturer ..... Liquidometer Corp.
Model D6-209
Range ..... 0 to 300 gal.
Number of units 2
(*11) Sight level gage (hydraulic oil* tank).
Manufacturer ..... Vickers Inc.
Mfr. No 22576
Model G-L1
Range ..... High-low
Number of units 1
(12) Water temperature gage (engine).
Manufacturer ..... Dresser Industries Inc. Type
Hulls 5 through 48 ..... 6170 TW
Hulls 49 through 60 ..... 6142 TW
Capillary length
Hulls 5 through 48 ..... 15 ft.
Hulls 49 through 60 ..... 18 ft.
Range ..... 20° to 220° F
Dial size ..... 3 ½ in.
Number of units 4

k. Cab and Hull Components.
(1) Cab heater.
Manufacturer ..... Kysor Heater Co.
Model K695-4
Type ..... Hot water
Motor (radio suppressed)
Mfr. No 9637
Volts . ..... 24 volts, dc
Shaft rotation (from shaft end) ..... CCW
(2) Cab window glass.
Type ..... Laminated, safety
Color ..... green-tinted
Thickness ..... ½ in.
Number of units 12
(3) Bilge drain valves.
Manufacturer ..... Crane Co.
Mfr. No 7
Size ..... 2 ½ in. (less body)
Number of units 11
(*4) Life lines.*
Material ..... steel wire rope, plastic covered
Diameter ..... 5 / 16 in.
Number of strands 6
Number of wires per strand 19
(*5) Ramp cable.*
Diameter ..... 5/8 in.
Number of strands 6
Number of wires per strand 19
Core ..... Fiber
(*6) Ramp seal*
Manufacturer ..... Huntington Rubber Mills
Type
Hulls 5 through 18 ..... Pneumatic, single lip
Hulls 19 through 60 ..... Pneumatic, double lip
Durometer hardness 45
Length ..... 37 ft.
Number of units 1
l. Capacities.
Fuel oil tanks (2) ..... 300 gal. each, 600 gal. total
Hydraulic oil tank ..... 300 gal.
Spare lube oil tanks (2) ..... 30 gal. each, 60 gal. total
Water cooling systems (4) ..... 52 ½ gal. each, 210 gal. total
Air compressor crankcases (2) ..... 2 ½ qt. each
Cargo well pump lubricators (2) ..... 4 qt. each
Engine Crankcases (4) . ..... 20 qt. each
Fluid couplings (4) ..... 4.7 gal. each
Gathering boxes (2) ..... 12 qt. each
Marine gears (2) ..... 60 qt. each
Miter, boxes (4) ..... 15 qt. each
Strating motor lubricators (4) ..... ¼ qt. each
Transmission-torque converter (4) ..... 52 qt. each
Wheel columns (4) ..... 35 gal. each

Table 1-1. Engine Repair and Replacement Standards

Part or assembly	Manufacturer's dimensions and tolerances in inches		Desired clearance		Maximum allowable wear and clearance
	Minimum	Maximum	Minimum	Maximum	
CYLINDER BLOCK					
Block bore:					
Diameter	4.6265	4.6275			4.6280
Out-of-round		0.0010			0.0030
Taper	.	0.0010			0.0020
Surface of cylinder block:					
Traverse flatness (top)				.	0.0030
Longitudinal flatness (top)	.				0.0090
Blower mounting pad flatness					0.0040
Cylinder liner counterbore:					
Diameter	5.0460	5.0485			
Depth	0.4785	0.4795			
Depth of counterbore (top surface) .					
Cylinder head seal strip groove .	0.0920	0.1070			
Large water holes (between cylinders	0.1090	0.1200			
Small water holes (at ends) .	0.0870	0.0980			
Combination water and oil holes. .	0.0870	0.0980			
Main bearing bore:					
Inside diameter (vertical axis) .	3.8120	3.8130			
PISTONS					
Piston skin-to-4iner clearance			0.0040	0.0078	0.0120
Length (measured from centerline of piston pin)	3.5130	3.5180			
Diameter at top	4.2190	4.2220			
Diameter at skirt (below compression ring grooves to bottom)	4.2433	4.2455			
Out-of-round		0.0005			
Taper		0.0050			
PISTON PINS					
Diameter	1.4996	1.5000			1.4980
Length	3.6050	3.6200			
Piston pin bushing inside diameter	1.5025	1.5030			1.5050
Pin-to piston bushing clearance			0.0025	0.0034	0.0100
Pin-to-rod bushing clearance			0.0015	0.0024	0.0100
Pin-to-retainer end clearance (retainer with lock ring)	.		0.0160	0.0640	0.0640
PISTON RINGS					
Compression rings:					
Gap			0.0180	0.0430	0.0600
Ring-to groove clearances:					
No. 1 (top)			0.0100	0.0125	0.0220
No. 2			0.0080	0.0105	0.0150
No. 3 and No. 4			0.0060	0.0085	0.0130
Oil control rings:					
Gap .			0.0080	0.0230	0.0430
Ring-to-groove clearance .			0.0015	0.0055	0.0080
CRANKSHAFT AND CRANKSHAFT MAIN BEARING					
End thrust clearance (end play)			0.0040	0.0110	0.0180
Main bearing journal diameter	3.4990	3.5000			
Connecting rod journal diameter	2.7490	2.7500			
Journal out-of-round		0.00025			0.0030
Journal taper		0.0005			0.0030
Total indicator reading runout on journal					
At No. 2 and No. 6 journals .		0.0020			
At No. 3 and No. 5 journals		0.0040			
At No. 4 journal		0.0060			
When the runout on adjacent journals is in the opposite direction, the sum must not exceed 0.003 in. total indicator reading. When the runout on adjacent journals is in the same direction, the difference must not exceed 0.003 in. total indicator reading.					

Table 1-1. Engine Repair and Replacement Standards-Continued

Part or assembly	Manufacturer's dimensions and tolerances in inches		Desired clearance		Maximum allowable wear and clearance
	Minimum	Maximum	Minimum	Maximum	
Bearing thickness 90° from parting line			0.1548	0.1553	0.1530
Bearing inside diameter (vertical axis)	3.5014	3.5034			
Thrust washer thickness	0.1205	0.1220			
CRANKSHAFT TIMING GEAR					
Backlash			0.0030	0.0080	0.0100
Gear inside diameter	4.7490	4.7500			
Gear-to-crankshaft clearance			0.0010 press	0.0010 loose	
Connecting rod and connecting rod bearings					
Upper bushing inside diameter	1.5015	1.5020			1.5080
Bearing-to-crankshaft journal clearance			0.0014	0.0044	0.0060
Center-to-center length	10.1240	10.1260			
Lower bore diameter	3.0620	3.0630			
Upper bore diameter	1.7490	1.7510			
Normal rod end thrust	0.0060	0.0120			
Bearing thickness 90° from parting line			0.1548	0.1553	0.1530
Bearing inside diameter	2.7514	2.7534			
CAMSHAFT AND BALANCE SHAFT					
Thrust bearing end journal length	2.8740	2.8760			
End thrust			0.0040	0.0120	0.0180
Bushing-to-balance weight hub					0.0035
Camshaft diameter at bearings:.					
Front and rear	1.4970	1.4975			
Center and intermediate	1.4980	1.4985			
Camshaft diameter at gear	1.1875	1.1880	.		
Camshaft and balance shaft thrust washer thickness	0.1200	0.1220			
Balance shaft diameter at bearings	1.4970	1.4975			
Balance shaft diameter at gear	1.1875	1.1880			
CAMSHAFT AND BALANCE SHAFT BEARINGS					
Inside diameter:					
Front and rear	1.5000	1.5010			
Center and Intermediate	1.5010	1.5030			
Bearing-to-shaft clearance:					
Front and rear (next to flange)			0.0025	0.0040	0.0060
Center and intermediate			0.0025	0.0050	0.0090
Outside diameter of bearings:					
Front and rear	2.1880	2.1885			
Intermediate	2.1840	2.1860			
Diameter of block bore	2.1875	2.1885			
Bearings-to-block clearance:					
Front and rear			0 .0010 press	0.0015 loose	
Intermediate			0.0015	0.0045	
Camshaft and balance shaft gears .					
Backlash			0.0030	0.0080	0.0100
Gear inside diameter	1.1865	1.1875			
Gear-to-shaft clearance			0.0015 press	0.0000	
IDLER GEAR					
Backlash			0.0030	0.0080	0.0100
Preload (variation on pull 2 lb 11 oz)	½ lb	6¾ lb			½-6¾ lb
BLOWER TIMING					
Clearance between trailing side of upper rotor and lower side of lower rotor:					
Inlet side maximum	0.0060				
Inlet side minimum (desireable)-	0.0020				
Outlet side minimum	1.0140				
Clearance between rotor and housing	0.0020	0.0060			
CYLINDER LINERS					
Outside diameter	4.6250	4.6260			

Table 1-1. Engine Repair and Replacement Standards-Continued

Part or assembly	Manufacturer's dimensions and tolerances in inches		Desired clearance		Maximum allowable wear and clearance
	Minimum	Maximum	Minimum	Maximum	
Inside diameter	4.2495	4.2511			
Liner-to-block bore clearance			0.0005	0.0025	0.0030
Liner inside diameter out-of-round		0.0020			0.0030
Liner inside of diameter taper		0.0010			0.0020
Depth of liner flange below block			0.0465	0.0500	0.0500
Variation in height between adjacent liners		0.0020			
CYLINDER HEAD					
Distance between, top deck and fire deck	3.5560	3.5680			3.5360
Transverse flatness					0.0040
Longitudinal flatness					0.0100
Can follower bore	1.0620	1.0630			1.0650
Valve seat inserts-to-cylinder head	0.0005	0.0025			
Water nozzles	1/32	flush			
	Recessed				
Exhaust valve seat insert counterbores:					
Diameter	1.6260	1.6270			
Depth	0.3705	0.3845			
VALVE SEAT INSERTS (30° SEAT ANGLE)					
Outside diameter	1.6275	1.6285			
Seat width	1/16	3/32			3 / 32
Valve seat runout	0.0020	0.0020			
EXHAUST VALVES (30°SEAT ANGLE)					
Diameter of head	1.5790	1.5890			
Stem diameter	0.3417	0.3425			0.3405
Valve head-to-cylinder head.	0.0020	0.0280			
	Recessed	Protrusion			
VALVE GUIDES					
Inside diameter	0.3445	0.3445			0.3465
Stem-to guide clearance			0.0020	0.0040	0.0060
Height above cylinder head		1 19 / 32			
CAM FOLLOWERS					
Diameter	1.0600	1.0610			
Follower-to-head clearance			0.0010	0.0030	0.0060
Width of roller slot	0.5635	0.5685			
Roller pin hole diameter	0.4362	0.4370			
CAM FOLLOWER ROLLERS AND PINS					
Pin-to-bushing clearance			0.0013	0.0021	0.0100 (horiz)
Pin outside diameter	0.4374	0.4377			
Roller outside diameter	0.9020	0.9070			
Roller bushing inside diameter	0.4390	0.4395			
Roller in follower side clearance			0.0150	0.0230	0.0230
Blower Drive Gear:					
Backlash			0.0030	0.0080	0.010
Gear to hub clearance			0.0005	0.0010	
			tight	loose	
Blower Drive Gear Support:					
Support to end plate			0.005	0.0025	
			tight	loose	
Bearing	1.6260	1.6265			
Bearing-to-hub clearance			0.0010	0.0025	0.0050
Blower Drive Gear Hub:					
Diameter at bearing	1.6240	1.6250			
Hub to cam clearance			0.0020	0070	
Gear hub-to-thrust washer clearance			0.0050	0.0080	0.0100
Rocker Arms and Shafts:					
Rocker shaft diameter	0.8725	0.8740			
Rocker arm shaft bushing id	0.8750	0.8760			
Rocker shaft to bushing clearance			0.001	0.0025	0.004
Rocker arm outer bushing id	0.564	0.565			
Rocker arm inner bushing od	0.562	0.5625			
Outer-to inner bushing clearance			0.0015	0.003	
Rocker arm inner bushing id.	0.4375	0.4385			

Table 1-1. Engine Repair and Replacement Standards Continued

Part or assembly	Manufacturer's dimensions and tolerances in inches		Desired clearance		Maximum allowable wear and clearance
	Minimum	Maximum	Minimum	Maximum	
Push rod clevis pin od	0.4380	0.4385			
Pin-to-bushing clearance			0.001 tight	0.0005 loose	
Push rod clevis id	0.4370	0.4385			
Pin-to-clevis clearance			0.0015 tight	0.0005 loose	
Clevis-to-rocker arm end play			0.008	0.017	
End thrush clearance			0.0040	0.0110	0.0180
Main bearing to journal clearance			0.0014	0.0044	0.0060
Connecting rod bearing to journal clearance			0.0014	0.0044	0.0060
Journal out of round		0.00025			0.0030
Journal taper		0.0005			0.0030
Runnout, total indicator reading, (mounted on No. 1 and No. 7 journals) at No. 2 and No. 6 journals		0.0020			0.0020*
At No. 3 and No. 5 journals		0.0040			0.0040*
At No. 4 journal		0.0060			0.0060*

* When runout on adjacent journals is in the opposite direction, the sum must not exceed 0.0030-inch total indicator reading. When runout on adjacent journals is in the same direction, the difference must not exceed 0.0030-inch total indicator reading.

Table 1-2. Model TC-554 (3 and 4 Element) Torque Converter Repair and Replacement Standards

Part or assembly	Nominal new dimensions	Wear limits
Oil Pump Drive Gear:		
Bore	4.162	4.172in.
Gear thickness	0.520	0.006 in. perface
Stator Assembly:		
Thrust washer thickness	0.127	0.117 in.
Bore diameter	4.764	4.767 in.
Freewheel side washer thickness	0.058	0.048 in.
Stator race outside diameter	4.749	4.739 in.
Stator back plate thickness	0.298	0.288 in.
Freewheel roller spring. (3 element converter)	70 lbs ± 0.07 lbs at 1.07 in. operating height, free height 1.57	
Free wheel roller spring (4 element converter)..	1.17 lb ± 0.11 lb at 0.94 in. operating height, free height 1.92 in.	
Output Shaft:		
Seal ring bore	0.9995-1.0005	1.0025 in.
Flywheel:		
Pilot diameter	2.435	2.425 in.
Turbine:		
Turbine hub	0.570	0.550 in.
Charging Oil Pump:		
Clutch pressure regulating valve clearance with oil pump cover		0.006
Clutch pressure regulating spring	26 lb ± 2 percent at 1.75 in. operating height, free height 2.397	
Converter pressure regulating valve clearance with oil pump cover		0.006
Converter pressure regulating spring	88.6 lb ± 4.4 percent at 3.52 in. operating height, free height 4.72	
Gear end clearance		0.002

° Replace if not within dimension given.

Table 1-3. Model TC-654 Torque Converter Repair and Replacement Standards

Part or assembly	Nominal new dimensions	Wear limits
Oil Pump Drive Gear		
Bore	4.162	4.172
Gear thickness	0.520	0.006 in. per face
Stator assembly		
Thrust washer thickness	.....	0.1 10 in.
Stator retaining snapring thickness	.....	0.1 10 in.
Bushing bore		3.119 in.
Freewheel roller spring	0.25 lb ± 0.0075 lb at 0.74 in. operating height, free height 0.92	
Flywheel		
Pilot diameter	2.435	2.425 in.

Table 1-3. Model TC-654 Torque Converter Repair and Replacement Standards–Continued

Part or assembly	Nominal new dimensions	Wear limits
Ground Sleeve		
Flywheel diameter		3.078 in.
Bushing diameter		4.150 in.
Seal ring bore		2.755 in.
Pump Hub Assembly		
Bushing bore		4.175 in.
Seal ring bore		4.191 in.
Charging Oil Pump		
Clutch pressure regulating valve clearance with oil pump cover		0.006 in.
Clutch pressure regulating spring	82 lb ±4 load at 2.22 in. operating height, free height 2.93	
Converter pressure regulating valve clearance with oil pump cover	0.006 in.	
Converter pressure regulating spring	88.6 lb ± 4.4 load percent at 3.52 in. operating height, free height 4.72	

* Replace if not within dimension given.

Table 1-4. Torque Converter Stall Speed Chart

Engine governed (RPM)	Converter torque	Converter Model	Stall (RPM)	Transmission lube oil pressure	Converter charging oil pressure
2100	3.6 to I	TC-654	1710	8-25 psi	50-80 psi
2100	3.13 to 1	TC-554	1840	8-25 psi	50-80 psi

Table 1-5. Hull and Cab Welding Data

Location	Weld
Shell, deck, and bulkhead lap joints	Thickness of lightest plate, double continuous fillet.
Shell, deck, and bulkhead seams and butts	Thickness of lightest plate, continuous bead.
Flat bar and tee bulkhead boundry bars to plating in watertight spaces	Thickness of plate, double continuous fillet.
Flat bar and tee bulkhead boundry bars to plating in non-watertight spaces	thickness of plate, 3 inch x 6 inch intermittent chain fillet with 6 inch double continuous fillet at ends.
Collar plates	Thickness of plate, fillet all round both sides.
Brackets, chocks, and joints between shapes	Thickness of lightest member, fillet all round.

Note. Minimum thickness of fillet weld–1/8 inch.

Table 1-6. Transmission Wear Limits

	Wear limits
Transmission housing:	
Bearing housing seal ring bore	3.552 in.
Transmission main shaft:	
Main shaft journal diameter	1.9684 in.
Low range clutch:	
Piston thickness	0.845 in.
Piston plate thickness	0.414 in.
Friction plate thickness	0.153 in.
Reaction plate thickness	0.109 in.
Back plate assembly thickness	0.615 in.

Table 1-6. Transmission Wear Limits Continued

	Wear limits
Intermediate range clutch:	
Piston thickness	0.9195 in.
Friction plate thickness	0.170 in.
Reaction plate thickness	0.113 in.
Back plate assembly thickness	0.620 in.
High range clutch:	
Piston thickness	0.537 in.
Friction plate thickness	0.153 in.
Reaction plate thickness	0109 in.
Back plate assembly thickness	0.646 in.
Reverse range clutch:	
External snap ring thickness	0.115 in.
Back plate assembly thickness	0.619 in.
Friction plate thickness	0.153 in.
Reaction plate thickness	0.109 in.
Piston thickness	0.9125 in.
Clutch pin diameter	0.485 in.
Planetary gearing:	
Thrust washer thickness	0.050 in.
Planetary assembly-planetary gear end clearance with unit	0.063 in. maximum

Table 1-7. Miter Box Repair and *Replacement Standards*

Part or assembly	Manufacturer's dimensions and tolerance in inches		Maximum allowable wear and clearance in inches
	Minimum	Maximum	
Column and wheel Drive Bearing Carrier			
Bearing area dia	13.383	13.385	13.386
Seal area dia	12.498	12.500	12.502
Column and Wheel Drive Intermediate Shaft			
Spline od (both ends of shaft)	2.734	2.735	2.733
Coupling Flange			
Spline id between teeth			2.503
Groove depth in mating seal area			0.005
Coupling Gear (Female))			
Spline id between teeth	2.739	2.740	2.741
Gear teeth			5.390 between 0.180 dia pins
Coupling Gear (Male)			
Spline id between teeth	2.739	2.740	2.741
Gear teeth			1.716 chordal measure over five teeth
Input Shaft			
Bearing area od (2 places)	2.5010	2.5015	2.5007
Gear area od	2.7560	2.7570	2.7557
Input Shaft Bearing Retainer			
Bearing area dia	5.375	5.376	5.377
Output Shaft			
Top hearing area od	2.1660	2.1666	2.1657
Gear and center bearing area od	2.7560	2.7565	2.7557
Spline od	2.734	2.735	2.733
Output Shaft Bearing Carrier			
Bearing area dia	4.9211	4.9223	4.9226
Output Shaft Bearing Yoke			
Bearing area dia*	3.9365	3.9375	3.9378
Output Shaft Coupling Gear (Male)			
Spline id between teeth	2.739	2.740	2.741
Gear teeth			1.716 chordal measure over five teeth
Groove depth in mating seal area			0.005
Gear Backlash	0.008	0.012	

Table 1-8. Air Brake Assembly Repair and *Replacement Standards*

Part or assembly	Manufacturer's dimensions and tolerance in inches		Maximum allowable wear and clearance in inches
	Minimum	Maximum	
Brake Shoe Assembly			
Lining thickness UI2			0.172
Wear in retractor spring area			0.0625
Brake Retractor Spring			
Free spring height			0.0625
Brake Drum			
Diameter	15.060	15.07	15.150

Table 1-9. Column and Wheel Drive Repair and Replacement Standards

Part or assembly	Manufacturer's dimensions and tolerance in inches		Maximum allowable wear and clearance in inches
	Minimum	Maximum	
Planetary:			
Idler shaft	4.000	4.001	3.999
Planetary Ring Gear			
Gear teeth (measurement between 0480 dia pins)	26.248	26.253	26.258
Backlash	0.010	0.012	
Bearing end play		0.005	
Planet Gear			
Gear teeth (chordal measurement over four teeth)	3.582	3.586	3.578
Note Planet gears should be the same size within 0.004 in If one planet is worn, all three planet gears should be replaced			
Reaction member:			
Gear teeth (chordal measurement over 9 teeth)	8.718	8.123	8.713
Spur Pinion:			
Gear teeth (measurement over O576 dia wires)	7.103	7.107	7.100
Spline (Measurement between 0360 dia pins)	3.605	3.607	3.610
Backlash	0.004	0.007	
Main Axle:			
Spline (Measurement over 04800 dia pins)	4.7300	4.7320	4.7280
Bevel Pinion Coupling:			
Upper spline diameter (measurement between 0180 pins)	5.358	5.360	5.370
Lower spline distance between teeth	0.4100	0.4120	0.4170
Spider Bearing Housing:			
Bearing area diameter	7.0864	7.0876	7.0880
Bevel Pinion Bearing Adapter:			
Bearing area diameter	7.8750	7.8770	7.8780
Spider Bearing Carrier:			
Bearing area diameter	9.8425	9.8436	9.8440
Bearing carrier od	23.9900	2.39950	2.39870
Bevel Gear Set			
Bevel Pinion (fig. 7-114)			
Bevel gear:			
Spider-to-bevel gear area diameter	16.4990	16.5010	16.5020
Spline diameter (Measurement between 03750 dia pins)	15.613	15.617	15.6250
Backlash	0.012	0.016	
Gear Spider (fig. 7-115)			
Oil Pump Gear			
Chordal measurement over three teeth	0.959	0.961	0.957
Backlash	0.004	0.006	
Steering Post			
Spider bearing carrier outer area diameter	24.0000	24.0050	24.0080
Lower Pivot Bearing Assembly			
Bushing id	7.506	7.510	7.525

Table 1-10. Gathering Box Repair and Replacement Standards

Part or assembly	Manufacturer's dimensions and tolerance in inches		Maximum allowable wear and clearance in inches
	Minimum	Maximum	
Clutch, Inner Race Shaft:			
Outer bearing area od			2.9525
Inner bearing area od			2.3619
Clutch Outer Race:			
outer bearing area od	4.5274	4.5278	4.5280
Inner bearing area od	3.7400	3.7404	3.7406
Groove depth in mating seal area			0.005
Output Coupling:			
Groove depth in mating seal area			0.005
Output Shaft:			
Bearing area dia	2.2510	2.2515	2.2508
Bevel gear area dia	2.5015	2.5020	2.5013
Spline area od	2.2490	2.2500	2.2470
Bearing adapter id	5.3450	5.3460	5.3470
Pump bearing adapter id	5.3450	5.3460	5.3465
Input Shaft:			
Bearing carrier:			
Bearing area id	5.9047	5.9057	5.9062
Ball bearing area id	5.1180	5.1190	5.1195
Bevel pinion area dia	2.3765	2.3770	2.3762
Bearing area dia	2.7563	2.7568	2.7560
Ball bearing area dia	2.3621	2.3627	2.3618
Spline area dia			2.1810 over 0.1920 pins
Gear Backlash	0.008	0.012	

Table 1-11. Marine Gear Repair and Replacement Standards

Part or assembly	Manufacturer's dimensions and tolerance in inches		Maximum allowable wear and clearance in inches
	Minimum	Maximum	
BEVEL DRIVE ASSEMBLY			
Bearing carrier:			
Outer bevel pinion bearing area dia	4.4375	4.4385	4.4390
Inner bevel pinion bearing area dia.	6.3750	6.3760	6.3765
Bevel pinion id	3.0000	3.0010	3.0013
Bevel pinion shaft (fig. 7-122)			
INPUT SHAFT ASSEMBLY			
Planetary gear:			
Chordal measurement over six teeth .	.....	.....	2.5950
Planetary gear id	2.4990	2.5000	2.5005
Forward pinion:			
Chordal measurement	.....	.....	1.7600
Forward pinion id	3.2650	3.2660	3.2665
Reverse pinion:			
Chordal measurement	.....	.....	3.1630
Reverse pinion id	3.9840	3.9850	3.9853
Bevel gear id	7.6000	7.6010	7.6030
Forward bearing adapter id	5.8760	5.8770	5.8775
Aft bearing adapter id	7.0858	7.0872	7.0876
Input shaft (fig. 7-123)			
PUMP PLANETARY DRIVE ASSEMBLY			
Planetary pinion:			
Chordal measurement over five teeth			2.1080
Spline teeth thickness	0.5610	0.5630	0.5750
Planetary pinion shaft:			
Forward bearing area dia	1.7500	1.7505	1.7495
Aft bearing area dia	1.7505	1.7510	1.7500
Planetary housing adapter:			
Bearing area id	3.5428	3.5438	3.5443
Bearing area od	3.9990	3.0000	3.9980

Table 1-11. Marine Gear Repair and Replacement Standards-Continued

Part or assembly	Manufacturer's dimensions and tolerance in inches		Maximum allowable wear and clearance in inches
	Minimum	Maximum	
Forward bearing adapter id	3.1855	3.1865	3.1870
Aft bearing adapter id	3.1855	3.1865	3.1870
IDLER SHAFT ASSEMBLY			
Idler gear:			
Chordal measurement			2.4720
Idler gear id	3.2390	3.2400	3.2420
Forward bearing adapter id	4.7264	4.7274	4.7279
Aft bearing adapter id	5.1174	5.1186	5.1190
Idler shaft (fig. 7-125)			
CONTROL TUBE ASSEMBLY			
Valve bushing od	1.8765	1.8770	1.8760
Valve bushing id	1.3760	1.3770	1.3790
Spacer od	1.3490	1.3690	1.3460
Spacer id	1.0000	1.0020	1.0040
Beveled washer od	1.3490	1.3690	1.3460
Beveled washer id	0.5420	0.5430	0.5450
Forward oil valve (fig. 7-126)			
Reverse oil valve:			
Valve od	1.3490	1.3690	1.3460
Valve id	0.5420	0.5430	0.5450
Outer tube:			
Spacer area dia	0.9980	1.0000	0.9960
Separator box area dia	1.1190	1.1200	1.1180
OUTPUT SHAFT ASSEMBLY			
Forward bearing adapter id	6.6921	6.6935	6.6940
Forward output gear (fig. 7-120)			
Reverse output gear (fig. 7-121)			
Aft output shaft adapter id	7.8750	7.8770	7.8773
Clutch assembly:			
Piston ring on forward plate (side clearance)	0.005	0.010	
Piston rings in forward and reverse plate of drum (side clearance)	0.008	0.012	
Pressure plate to clutch plate ..	0.035	0.050	0.120
Bevel gears maximum allowable backlash	0.008	0.012	
Clutch forward plate (fig. 7-118)			
Clutch bushing cup:			
Cup od	1.5005	1.5010	1.5003
Cup id	1.2505	1.2515	1.2535
Clutch reverse plate:			
Face flatness			0.0040
Plate id	5.2510	5.2520	5.2540
Clutch piston (fig. 7-119)			
Clutch spring retainer:			
Retainer outer area dia	1.2405	1.2410	1.2400
Retainer inner area dia .	1.5020	1.5025	1.5015
Clutch friction plates:			
Thickness	0.2450	0.2500	0.2300
Variation in thickness			0.0060
Deviation from true plane			0.0150
Backlash		.	0.0300
Clutch pressure plates:			
Thickness	0.2450	0.2500	0.2000
Deviation from true plane			0.0060
Backlash			0.0250
Output shaft (fig. 7-124)			

Table 1-12. Model 3VC Air Compressor Tolerances and Clearances

Part or assembly	Manufacturer's dimensions and tolerance in inches	
	Minimum	Maximum
Piston to cylinder clearance:		
High pressure at skirt	0.002	0.0035
Low pressure at skirt	0.0045	0.0065
Piston ring gap:		
High pressure compression rings	0.007	0.017
High pressure oil ring	0.007	0.015
Low pressure compression rings	0.017	0.027
Low pressure oil ring	0.017	0.027
Piston ring clearance in ring groove:		
High pressure compression rings	0.0020	0.0035
High pressure oil control ring	0.0015	0.0030
Low pressure compression rings	0.0025	0.0045
Low pressure oil control ring	0.0020	0.0040
Top of piston to top of cylinder clearance	-0.007	+0.017
Connecting rod bearing to crankshaft clearance	0.0025	0.0044
Connecting rod bushing to piston pin clearance	0.0002	0.0006
Crankshaft end play	0.003	0.005
Oil Pump:		
Clearance between face of rotor and cover	0.0035	0.0055

Table 1-13. Model 3YC Air Compressor Tolerances and Clearances

Part or assembly	Manufacturer's dimensions and tolerance in inches	
	Minimum	Maximum
Crankshaft connecting rod journal diameter	1.7485	1.7490
Connecting rod bearing bore	1.7500	1.7505
Crankshaft to connecting rod clearance	0.001	0.002
Low pressure piston to cylinder clearance:		
Skirt top	0.004	0.0075*
Skirt bottom	0.003	0.006
Top land	0.013	0.016
Bottom land	0.013	0.016**
High pressure piston to cylinder clearance:		
Skirt top	0.0020	0.0025
Skirt bottom	0.0020	0.0025
Top land	0.0020	0.0025
Bottom land	0.0020	0.0025
Piston ring gap:		
High pressure compression rings	0.007	0.017
High pressure oil control ring	0.007	0.015
Low pressure compression rings	0.017	0.027
Low pressure oil control rings	0.017	0.027

* Clearance measurement must be made on thrust side of piston.
** Clearance measurement must be made above wrist pin.

Table 1-14. Model 3VC and 3YC Air Compressor Torque Specifications

Application	Torque
Model 3VC Air Compressor	
Connecting rod nuts	350 in - lb.
Cylinder bolts	142 ft - lb.
High pressure cylinder head:	
Suction valve cap	7Oft- lb.
Suction valve sleeve	70 ft - lb.
Discharge valve cap	7O ft - lb.
Discharge valve plug	70 ft - lb.
Cylinder head bolts	30 ft lb.

Table 1-14. Model 3VC and 3YC Air Compressor Torque Specifications-Continued

Application	Torque
Low pressure cylinder head:	
Suction valve cap	100 ft - lb.
Suction valve sleeve	100 ft - lb.
Discharge valve cap	100 ft - lb.
Discharge valve plug	100 ft - lb.
Cylinder head bolts	30 ft - lb.
Oil pump cover bolts	9 ft - lb.
Rear retainer bolts	30 ft - lb.
Model 3YC Air Compressor	
Connecting rod nuts	350 in - lb.
Cylinder bolts	142 ft - lb.
High pressure cylinder head:	
Unloader capnut	70 ft - lb.
Unloader body	70 ft - lb.
Suction valve plug	70 ft - lb.
Discharge valve cap	70 ft - lb.
Discharge valve plug	70 ft - lb.
Cylinder head bolts	30 ft- lb.
Low pressure cylinder head:	
Unloader capnut	100 ft - lb.
Unloader cover	100 ft - lb.
Suction valve plug	100 ft - lb.
Discharge valve cap	100 ft - lb.
Discharge valve plug	100 ft - lb.
Cylinder head bolts	30 ft - lb.

Table 1-15. Propeller Shaft, Stern Tube, and Propeller Strut Repair and Replacement Standards

Part or assembly	Manufacturer's dimensions and tolerance in inches		Maximum allowable wear and clearance in inches
	Minimum	Maximum	
Propeller shaft sleeve od	2.778	2.782	0.010
Stern tube or propeller strut bushing id	2.787	2.788	0.020
Propeller shaft sleeve to bushing clearance			0.040

Table 1-16. Ramp Cylinder Dimensions and Tolerances

Part or assembly	Manufacturer's dimensions and tolerance in inches	
	Minimum	Maximum
Ramp Cylinder Assembly		
Body inside diameter	4.000	4.004
Piston diameter	3.994	3.996
Piston rod diameter	1.500	1.502
Bushing inside diameter	1.503	1.504

Table 1-17. Steering Cylinder Dimensions and Tolerances

Part or assembly	Manufacturer's dimensions and tolerance in inches	
	Minimum	Maximum
Steering cylinder assembly		
Body inside diameter	6.001	6.005
Piston diameter	5.994	5.996
Piston rod diameter	2.745	2.747
Bushing inside diameter	3.000	3.002

Table 1-18. Nut, Bolt, Screw, and Stud Torque Specifications

Application	Size nut or bolt	Torque (ft-lb)
Engine		
Balance weight-to-hub bolt	3/8-24	25-30
Balance weight-to-timing gear bolt	3/8-24	25-30
Blower drive coupling to gear hub bolt	5/16-24	20-25
Blower drive gear bolt	1/4-20	55-65
Blower to cylinder block bolt	7/16-14	55-60
Blower drive gear hub bearing support bolt	3/8-24	25-30
Blower drive gear hub nut	1 1/2-16	55-60
Blower rotor gear retaining nut	1/2-20	55-65
Cam and balance shaft end bearing bolt	3/8-16	35-40
Cam follower guide bolt	1/4-20	12-15
Camshaft and balance shaft nut	1 1/8-18	300-325
Camshaft intermediate bearing setscrew	3/8-24	15-20
Connecting rod nuts	7/16-20	65-75
Crankshaft end bolt	1-14	290-310
Crankshaft front cover bolt	3/8-24	25-30
Crankshaft front cover bolt	1/2-13	80-90
Cylinder head bolts	5/8-11	175-185
Cylinder head nuts	5/8-18	175-185
Cylinder head stud		35-75
Engine lifter bracket bolt	7/16-14	55-60
Exhaust manifold bolt	7/16-20	30-35
Exhaust manifold stud		25-40
Flywheel housing bolts	3/8-16	25-30
Flywheel housing bolts	1/2-13	90-100
Flywheel housing to idler gear hub and spacer (wired bolt only)	3/8-16	25-40
Fuel injector filter cap	3/8-24	65-75
Fuel manifold connectors	7/16-20	30-35
Fuel manifold connector nuts	7/16-20	30-35
Fuel pipe nut	3/8-24	12-15
Handhole cover bolt	3/8-16	10-15
Idler gear and dummy hub bolt	1/2-13	80-90
Injector clamp bolt	3/8-16	20-25
Injector clamp nut	3/8-24	20-25
Injector clamp stud		10-25
Injector control shaft bracket bolt	1/4-20	10-12
Main bearing bolt	5/8-11	180-190
Oil pan bolt	5/16-18	10-12
Rocker arm bracket bolt	1/2-13	90-100
Water manifold nut	3/8-24	25-30
Water manifold stud		10-25
Wheel Bolts		
Beadseat ring bolts	1-14 x 2 1/2 in. lg.	600

Table 1-19. General Bolt and Screw Torque Specifications for Torque Converters

Size	Threads per inch	Torque ft. lbs., for standard heat-treated bolts and screws	Torque ft. lbs., for special heat-treated bolts, screws, Allen-headscrews, and self-locking capscrews
1/4	20	6-8	9-11
	28	8-10	10-12
5/16	18	15-18	17-20
	24	17-20	19-23
3/8	16	26-32	36-43
	24	33-40	41-49
7/16	14	42-50	54-65
	20	50-60	64-77

Table 1-19. General Bolt and Screw Torque Specifications for Torque Converters-Continued

Size	Threads per inch	Torque ft. lbs., for standard heat-treated bolts and screws	Torque ft. lbs., for special heat-treated bolts, screws, Allen- headscrews, and self-locking capscrews
1/2	13	67-80	81-97
	20	83-100	96-115
9/16	12	85-100	103-123
	18	100-120	122-146
5/8	11	117-140	164-192
	18	134-160	193-225
3/4	10	180-210	284-325
	16	215-250	337-385
7/8	9	372-425	575-650
	14	372-425	575-650
1	8	445-500	685-770
	14	535-600	830-925

Table 1-20. Standard Nut and Bolt Torque Specification

Size nut or bolt Torque (ft-lb)	Torque (ft-lb)
1/4...- 20	7-9
1/4... - 28	8-10
5/16 - 18	13-17
5/16 - 24	15-19-
3/8...- 16	3-35
3/8...- 24	35-39
7/16.- 14	46-50
7/16 - 20	57-61
1/2...- 13	7-75
1/2 - 20	83-93
9/16 12	90-100
9/16 - 18	107-117
5/8 11	7-147
5/8. 18	18-178
3/4. -10	240-250
3/4. -16	290-30(
7/8. - 9	410-420
7/8. - 14	475-485
1 .. - 8	580-590
1.. - 14	685-695

Table 1-21. Piping and tubing color coding

Item	Color	Color Shade No. Fed-Std-595
Fuel lines	**Red**	**11105**
Lube oil lines	**Orange**	**22246**
Bilge drainage lines	**Green**	**14110**
Hydraulic power lines	**Blue**	**15102**
Cooling water	**Gray**	**16187**
Ven ts	**Yellow**	**13655**
Main air	**Brown**	**10266**
Control air	**Black**	**17038**

CHAPTER 2
DIRECT SUPPORT AND GENERAL SUPPORT

MAINTENANCE INSTRUCTIONS

Section I. REPAIR PARTS, SPECIAL TOOLS, AND EQUIPMENT

2-1. Tools and Equipment

Direct support and general support repair parts and tools are listed and illustrated in TM 55-1930-203-35P.

2-2 Special tools and Equipment

The special tools and equipment required to perform direct and general support maintenance are listed in table 2-1.

Table 2-1. Special Tools and Equipment

Item	Part No.	References Figure	References Paragraph	Use
Valve guide remover	J267		3-6	Removing valve guides.
Injector removerJ1227-01		3-24	3-10	Fuel injector removal.
Tool set	J1241-05		3-10	Servicing injector.
Oil seal expander	J1359	3-79	3-29	Flywheel housing installation.
Piston support fixture bushings.	J1513-1	3-90	3-32	Removing or installing piston pin
Driver handle bushings.	J1513-2	3-90	3-32	Removing or installing piston pin
Bushing remover	J1513-3	3-90	3-32	Removing piston pin bushing.
Fixture, reaming connecting rod.	J1686-02	3-94	3-32	Reaming connecting rod bushing
Reaming fixture and arbor connecting rod.	J1686-9		3-32	Reaming connecting rod bushing in
Reamer connecting rod.	J1686-10		3-32	Reaming connecting rod bushing
Front guide bushing connecting rod.	J1686-11		3-32	Reaming connecting rod bushing in
Valve seat insert driver	J1 736	3-19	3-6	Installing valve seat inserts.
Gear installing too]	J1903		3-31	Installing gears on camshaft.
Cylinder liner remover	J1918	3-103	3-34	Removing cylinder liner.
Aligning stud	J1927-01	3-79	3-29	Flywheel housing installation.
Bearing and bushing driver coupling.	J1930		3-17	Removal of water pump drive
Piston bushing reamer	J3071-6		3-32	Reaming piston pin bushing.
Push rod remover installation.	J3092-01	3-5	3-5	Rocker arm assembly removal and
Oil seal remover and installer seal.	J3154-04		3-29	Replacement of flywheel housing oil,
Injector lapping block set.	J3179		3-10	Lapping the injector.
Valve guide installer	J4144	3-20	3-6	Installing valve guides.
Assembling tool converter pump.	J4236		7-2	Assembling converter pump hub into
Stator assembly sleeve torque converter stators.	J4237		7-2	Assembling and disassembling
Spray tip orifice cleaner	J4298-1	3-32		Cleaning injector spray tip.
Bearing replacer bearing in torque converter oil pump.	J4523		7-2	Installation of drive shaft needle
Mechanical puller cone.	J4558		7-6	Removal of vibration damper outer
Ball attachment micrometer bearing shells.	J4757	3-102	3-33	Checking wear of crankshaft main
Valve seat insert remover	J4824-01	3-11	3-6	Removing valve seat inserts.

Item	Part No.	References		Use
		Figure	Paragraph	
Bearing and bushing driver plug	14850		7-2	Removal of needle bearing from torque converter oil pump body; installation of needle bearing in pump driver gear, and installation of sleeve into pump body.
Bearing remover	J4852		7-2	Removal of rear oil pump bearing sleeve from torque converter oil pump.
letter nut spray tip seat reamer	J4986-01	3-33		Cleaning injector nut spray tip seat.
Reaming fixture	J5273	3-93	3-32	Reaming piston pin bushings.
bleetor tube installer body	J52864	3-13		Removing injector tube from cylinder head.
Injector tube pilot installer	J5286-5	3-13		Removing injector tube from cylinder head.
Flaring die iastater	J52864		3-6	Installing injector tube.
Injector tube reamer	J5286-7	3-16		Reaming injector tube for injector body nut and spray tip.
Tube tip refinisher	J52868		3-6	Refinishing injector tibe tip.
Injector tube reamer	J5286-9	3-18		Reaming bevel seat in injector tube.
Valve guide leaner	J5437		3-6	Cleaning valve guide.
Gage wet	J5438	3-95	3-32	Checking piston to liner clearance.
Cam follower holder fixture	J5840	3-9		Removing and installing cam follower roller and pin.
Side hammer remover and adapter	J5901		7-2	Removing charging oil pump idler shaft.
Gear end plate puller	J6270-1		3-22	Removing blower end plate.
Bearing and seal installer	J6270-3		3-22	Installing blower bearing and seal.
'Shaft pilot	J6270-5		3-22	Installing rotors in blower housing.
Gear and role bearing installer	J62706	3-69	3-22	Installing gear and roller bearings.
Gear and baD bearing installer	J6270-7		3-22	Installing blower gear and rear bearings.
Spanner wrench	J6534	7-44	7-2	Removing or installing freewheel roller race retaining nut.
Piers set, with 30° and 45° interchangeable tips	J6843		7-2	Removal and installation of retaining rings.
Injector Resemble fixture	J6868		3-10	Holding injector assembly during disassembly.
Wrench set, torque multiplier	J6985		3-6	Tightening bolts and nuts.
Comparator	J7041		3-10	Testing fuel output of injector assembly.
Injector valve seat lapping tool	J 7 I 74		3-11	Removing irregularities from injector valve seat.
Holding fixture	J7452	3-82	3-29	Holding dial indicator for checking flywheel housing concentricity.
Pump hub bushing installer	J7464		7-2	Torque converter pump hub bushing installer.
Spanner wrench	J7466		7-6	Removing and installing transmission bearing locknut.
Puller	J7468		7-6	Transmission bearing puller.
Clutch spring compressor	J7470	7-70	7-6	Compressing strings on low-range and reverme-range clutch backplate.
Peening tool	J7473		7-2	Installing and peening clutch release springs and retainers into clutch backplates.
Converter pump hub seal replacer	J7475		7-2	Pressing pump hub oil seal into torque converter.
Impeller instafer	J9303	3-47	3-11	Installation of water pump impeller on shaft.
Propeller puller	LXO9-032-OO1		2-28	Propeller removal.

Section II. TROUBLESHOOTING

2-3. General

This section provides information useful to direct and general support maintenance personnel in diagnosing and correcting unsatisfactory operation or failure of the LARC-LX or its components.

2-4 Troubleshooting Chart

Chart 2-1 lists the malfunction, probable cause and he corrective action to be taken in correcting failures in the equipment. To list all of the possible malfunction that may occur in the equipment is impossible. Refer to Chart 2-1 for the most common malfunctions that may occur in the equipment.

Chart 2-1. Troubleshooting

Malfunction	Probable Cause	Corrective Action
1. Engine fails to turn over.	a. Faulty valve in air starting system.	a. Repair or replace defective valve (para 3-18).
	b. Defective air starting motor.	b. Repair or replace the air starting motor (para 3-18).
2. Engine turns over but will not start.	a. Defective fuel pump.	a. Replace (para 3-19).
	b. Defective governor.	b. Replace (para 3-13).
3. Engine starts hard, runs uneven, or lacks power.	a. Defective governor.	a. Replace (para 3-13).
	b. Defective fuel injector.	b. Replace (para 3-10).
	c. Damper valves in air inlet housing not fully opening	c. Repair air inlet housing (para 3-21).
	d. Defective blower drive assembly.	d. Repair blower drive assembly (para 3-23).
	e. Defective blower.	e. Replace (para 3-22).
4. Engine temperature excessive	a. Defective thermostat.	a. Replace (para 3-8).
	b. Water pump not operating.	b. Repair or replace (para 3-17).
	c. Coolant leakage in lines or at radiator.	c. Locate source of leak and repair Replace a leaking radiator (para 5-3 and 5-6).
5. Fuel detonation.	a. Faulty fuel injector.	a. Replace (para 3-10).
	b. Defective blower-to-cylinder block gasket.	b. Replace gasket (para 3-22).
	c. Blower oil seal leaking.	c. Replace blower (para 3-22).
6. High engine oil consumption.	a. Oil cooler core leaking.	a. Replace oil cooler core (para 3-15).
	b. Blower oil seal leaking.	b. Replace blower (para 3-22).
	c. Scored liners, pistons, or oil rings.	c. Replace defective parts (para 3-32 and 3-34)
	d. Piston and rod misalignment.	d. Replace defective parts (para 3-32).
	e. Oil control rings worn, broken or improperly installed	e. Replace damaged oil control rings (para 3-32).
7. Low engine oil pressure.	a. Oil cooler clogged.	a. Remove and clean oil cleaner (para 3-7).
	b. Oil pump inlet screens clogged.	b. Remove and clean oil inlet screens (para 3-25).
	c. Oil pressure regulator not working properly.	c. Remove and repair or replace oil pressure regulator valve (para 3-27).
	d. Excessive wear on crankshaft bearings.	d. Replace bearings (para 3-33).
	e. Oil pump damaged or worn.	e. Repair or replace (para 3-26).
8. Excessive exhaust smoke.	a. Faulty blower, blower drive, or clogged air inlet screen.	a. Replace or repair faulty component (para 3-21, 3-22 and 3-23).
	b. Faulty fuel injector.	b. Replace (para 3-10).
9. Low transmission oil pressure (Temperature normal).	Clutch pressure regulating spring or	Repair or replace oil pump valve in oil pump defective. (para 7-2).
10. Low transmission oil pressure and / or high torque converter-transmission oil temperature.	a. Clogged or leaking oil cooler.	a. Repair or replace oil cooler (para 3-15).
	b. Excessive oil flow to transmission.	b. Repair or replace manifold assembly (para 7-6).

Chart 2-1. Troubleshooting-Continued

Malfunction	Probable Cause	Corrective Action
	c. Low converter charging pressure.	c. Repair or replace oil pump (para 7-2).
	d. One or both stators locked.	*d.* Replace torque converter (para 2-12).
11. Torque converter inoperative (No oil pressure).	a. Damaged gears in oil pump.	a. Repair or replace oil pump (para 7-2).
	b. Damaged oil pump drive gear in torque converter.	b. Replace torque converter (para 2-12).
12. Oil leaking from engine flywheel housing drain hole.	Defective pump hub seal in torque converter.	Replace torque converter (para 2-12).
13. Loss of power from torque converter	a. Low converter charging pressure.	a. Repair or replace oil pump (para 7-2).
	b. One or both stators locked.	*b.* Replace torque converter (para 2-12).
14. Loss of power from transmission.	a. Clutch plate slipping in transmission.	a. Check for low clutch pressure. Disassemble transmission and replace worn piston seals (para 7-6).
	b. Converter failure.	*b.* Check for low converter charging oil pressure. Disassemble converter and replace damaged parts (para 7-2).
	c. Stators interchanged in torque converter.	c. Install stators properly (para 7-2).
	d. Stators installed in torque converter without rollers, (low stall speed).	*d.* Install rollers properly (para 7-2).
15. Low engine compression.	a. Exhaust valve sticking or burned.	*a.* Repair or replace exhaust valves(para 3-6).
	b. Compression rings worn or broken.	*b.* Replace compression rings (para 3-32).
	c. Cylinder head gasket leaking.	c. Replace defective gasket (para 3-6).
16. No output from transmission in one range.	a. Defective selector valve assembly	a. Replace selector valve assembly (para 7-6).
	b. Faulty clutch.	*b.* Replace transmission (para 2-13).
	c. Low clutch pressure in one range only.	c. Disassemble transmission and replace piston seals or broken back plate (para 7-6).
17. No power from transmission in any range.	a. Faulty transmission planetary gearing.	*a.* Replace planetary gearing (para 7-6).
	b. Converter failure or malfunction.	*b.* Replace damaged converter parts (para 7-2).
18. Transmission locked in all ranges.	Failed transmission parts.	Replace failed transmission parts (para 7-6).
19. Slow clutch engagement in transmission.	Worn piston seals.	Replace worn piston seals (para 7-6).
20. Transmission and/or torque converter high oil temperature.	a. Converter malfunction.	a. Replace any damaged parts (para 7-2).
	b. One or both stators in torque converter locked.	*b.* Disassemble converter and replace stators as necessary (para 7-2).
	c. Stators interchanged in torque converter (low stall speed)	c. Reinstall stators properly (para 7-2).
	d. Stator(s) installed in torque converter without rollers or spring (low stall speed(.	d. Reinstall rollers and/or springs properly (para 7-2).
21. High engine speed at converter stall.	*a.* Converter malfunction.	*a.* Disassemble converter and replace damaged parts (para 7-2).
	b. Clutch slipping.	*b.* Disassemble transmission and replace clutch (para 7-6).
22. Low engine speed at converter stall.	a. Converter malfunction.	a. Check for noise at stall. Disassemble converter and replace damaged parts (para 7-2).
	b. Stators interchanged.	*b.* Check for loss of power at stall. Install stators properly (para 7-2).

Chart 2-1. Troubleshooting-Continued

Malfunction	Probable Cause	Corrective Action
	c. Stator installed without rollers.	c. Install rollers (para 7-2).
23. Vehicle drives in low range, creeps forward in neutral but stalls when shifted to any other range.	Low-range clutch inoperative.	Disassemble transmission and replace low-range clutch (para 7-6).
24. Vehicle drives in intermediate range, creeps forward in neutral, but stalls when shifted to any other range.	Intermediate-range clutch inoperative.	Disassemble transmission and replace intermediate range clutch (para 7-6).
25. Vehicle drives in high range, creeps forward in neutral, but stalls when shifted to other range.	High-range clutch inoperative.	Disassemble transmission and replace high range clutch (para 7-6).
26. Vehicle drives in reverse range, creeps backward in neutral, but stalls when shifted to any other range.	Reverse-range clutch inoperative.	Disassemble transmission and replace reverse range clutch (para 7-6).
27. Transmission input shaft does not turn freely by hand.	a. Range clutch failure.	a. Disassemble transmission and replace range clutch (para 7-6).
	b. Converter failure.	*b.* Disassemble converter and replace damaged parts (para 7-6).
28. Erratic or reduced braking force.	a. Worn out brake lining.	a. Replace brake shoe assemblies (para 7-7).
	b. Air leak at expander tube nozzle.	*b.* Replace preformed packing at expander tube nozzle (para 7-7).
	c. Elongated holes in brake drum mounting plate or brake drum.	c. Replace mounting plate or brake drum (para 7-7).
29. Excessive braking force.	a. Oil or grease on brake lining.	a. Remove air brake assembly (para 2-14), and clean brake drum and lining.
	b. Broken, missing, or deformed retractor springs.	*b* Replace damaged retractor springs (para 7-7).
30. Brakes drag.	a. Excessive cracks in brake drum	a. Replace brake drum (para 2-14).
	b. Elongated holes in brake drum mounting plate or brake drum.	*b.* Replace mounting plate or brake drum (para 7-7).
31. Noisy or vibrating miter box.	a. Oil leakage around input coupling flange.	a. Remove air brake assembly (para 2-14), and replace leaking input seal in miter box bearing retainer assembly (para 2-15).
	b. Oil leakage around output shaft into column and wheel drive.	*b.* Replace output shaft bearing seal in miter box (para 2-15).
	c. Damage gears or bearings.	c. Repair miter box (para 2-15).
32. Noisy or vibrating column and wheel drive.	Defective bearings or gears.	Replace bearing or gears (para 2-15).
33. Noisy or vibrating wheel.	a. Worn bushing in lower pivot bearing assembly.	a. Replace bushing (para 2-15).
	b. Defective column and wheel drive bearing in miter box.	*b.* Replace bearing (para 2-15).
	c. Broken teeth on planetary ring gear or gears in planet spider assembly.	c. Replace gears (para 2-15).
34. Wheel wobbles.	Broken wheel bearings	Replace bearings (para 7-10).
35. Loss of power at wheel.	a. Broken pinion shaft or stripped gear coupling.	a. Replace pinion shaft or gear coupling (para 7-10).
	b. Stripped pinion or bevel gear.	*b.* Replace pinion or bevel gear (para 7-10).
	c. Broken intermediate shaft or stripped gear coupling between miter box and column and wheel drive.	c. Replace intermediate shaft or gear coupling (para 2-15).
	d. Broken axle.	d. Replace axle (para 7-10).
	e. Stripped planetary ring gear or gears in planet spider assembly.	e. Replace gears (para 7-10).
36. Excessive water accumulation in column and wheel drive.	Defective seals between column and wheel drive and wheel assembly.	Replace seals (para 7-10).
37. Water accumulates in area beneath miter box.	Defective boot assembly.	Replace boot and gasket (para 2-17).

Chart 2-1. Troubleshooting-Continued

Malfunction	Probable Cause	Corrective Action
38. Grease leakage from lower pivot bearing assembly at base of Column and wheel drive.	Worn seal or bushing in lower pivot bearing assembly..	Replace seal or bushing (para 7-10)
39. Leakage around output shaft of fluid coupling.	a. Abrasive material between sealing faces of carbon mating ring and seal nose piece.	a. Replace seal parts (para 7-14).
	b. Poor contact by copper gasket between baffle and bearing.	b. Replace baffle and copper gasket (para 7-14).
40. Loss of, or sluggish shaft motion between gathering box and fluid coupling.	Fluid coupling inoperative or leaking around output shaft..	Replace fluid coupling (para 2-21)
41. Shaft between gathering box and fluid coupling vibrates excessively.	Excessively worn flexible coupling.	Replace flexible coupling (para 2-21) .
42. No power at output shaft of gathering box.	a. Output gear stripped, output shaft broken. or output shaft key sheared.	a. Replace defective parts (para 7-16).
	b. Input pinions stripped or input shafts keys sheared.	*b.* Replace defective parts (para 7-16).
43. High gathering box operating temperature.	a. Bearing failure within gathering box.	a. Replace defective bearing (para 7-16).
	b. Clogged or restricted oil passage ways in oil cooler.	*b.* Repair or replace oil cooler (para 7-18).
44. Low marine gear oil pressure.	a. Oil leakage at input shaft, bevel gear input shaft, output shaft, power take-off, shaft, or bevel gear hole cover.	a. Replace defective seals (para 7-17).
	b. Oil cooler leaking.	*b.* Repair or replace oil cooler (para 7-18).
	c. Defective oil pump.	c. Replace oil pump (para 7-17).
	d. Defective regulator valve.	*d.* Replace regulator valve (para 7-17).
45. Low gathering box oil pressure.	a. Oil leakage around input coupling.	a. Remove over-running clutch assembly and replace seal (para 7-16).
	b. Oil leakage around output coupling.	*b.* Remove output coupling and replace seal (para 7-16).
	c. Oil cooler leaking.	*c.* Repair or replace oil cooler (para 7-18).
46. Grease leaking from flexible coupling around engine adapter plate or where shaft between fluid coupling and gathering box enter flexible coupling.	Defective seal in flexible coupling.	Replace seal in flexible coupling (para 7-13).
47. Loss of shaft motion between gathering box and marine gear.	a. Defective gathering box overruning clutch assembly.	a. Repair overrunning clutch assembly (para 7-16).
	b. Gear failure in gathering box.	*b.* Replace gathering box lpara 2-22).
48. High marine gear operating temperature.	a. Clogged or restricted oil passageways in oil cooler.	*a.* Repair or replace oil cooler (para 7-18).
	b. Clogged or restricted oil passageways in lube manifold..	*b.* Replace lube manifold (para 7-17).
49. Power input to marine gear, but master pressure pumps and power take-off inoperative.	a. Bevel gear input shaft broken, or bevel gear input shaft key sheared.	a. Replace bevel pinion shaft or bevel pinion shaft key (para 7-17).
	b. Input bevel gear or bevel pinion stripped.	*b.* Replace bevel pinion and bevel gear para 7-17).
50. Power input to marine gear power take-off operative but master pressure pump inoperative.	a. Planetary sun gear stripped.	a. Replace planetary sun gear and damaged planet pinions (para 7-17).
	b. Planetary sun gear key sheared.	*b.* Replace planetary aun gear key (para 7-17).
51. Power input to marine gear from gathering box but power take-off shaft inoperative.	Sheared key in marine gear coupling half of coupling assembly.	Replace key at marine gear end of coupling assembly (para 7-17).

Chart 2-1. Troubleshooting-Continued

Malfunction	Probable Cause	Corrective Action
52. No power at propeller (marine gear inoperative).	a. Missing propeller.	a. Install propeller (para 2-28).
	b. Sheared propeller shaft key.	b. Replace propeller shaft key (para 2-28).
	c. Broken propeller shaft.	c. Replace propeller (para 2-28).
53. No power at coupling half in forward or reverse drive.	a. Coupling half key sheared.	a. Replace coupling half key (para 2-28).
	b. Clutch failure.	b. Repair or replace clutch (para 7-17).
54. No power at coupling half in forward drive.	a. Forward clutch mechanism defective.	a. Repair or replace defective clutch parts (para 7-17).
	b. Idler gear stripped or idler shaft key sheared.	b. Replace idler gear or idler shaft key (para 7-17).
	c. Forward pinion stripped or forward pinion input shaft key sheared	c. Replace pinion or pinion input shaft key (para 7-17).
	d. Control tube forward valve clogged.	d. Repair or replace forward valve (para 7-17).
55. No power at coupling half in reverse drive.	a. Reverse clutch mechanism defective.	a. Repair or replace defective clutch
	or input shaft aft pinion key sheared.	b. Replace aft pinion and aft pinion key (para 7-17).
	c. Control tube reverse valve clogged.	c. Repair or replace reverse valve (para 7-17).
56. Excessive propeller shaft vibration.	a. Bent or broken propeller.	a. Replace propeller (para 2-28).
	b. Bent propeller shaft or worn propeller shaft sleeves.	b. Replace propeller shaft (para 2-28).
	c. Worn propeller shaft bushing.	c. Replace bushing (para 2-28).
	d. Bent intermediate shaft.	d. Replace shaft (para 2-28).
	e. Worn bushing in intermediate shaft.	e. Replace bushing (para 2-28).
	f. Broken flexible inserts.	f. Replace flexible inserts (para 2-28).
57. Grease leakage around propeller shaft at stern tube or strut.	Worn seals in stern tube or strut.	Replace seals (para 2-28).
58. Marine gear will not shift (oil) pressure normal)).	a. Defect air control valve on marine gear	a. Replace air control valve (para 7-17).
	b. Control tube passageways restricted.	b. Repair or replace control tube (para 7-17).
	c. Clutch failure.	c. Repair or replace clutch (para 7-17).
59. Forward or reverse gear of marine gear output shaft engages but will not release.	a. Clutch failure.	a. Repair or replace defective clutch parts (para 7-17).
	b. Control tube defective.	b. Repair or replace control tube (para 7-17).
60. Master pressure pump noisy.	a. Defective pump.	a. Replace pump (para 2-26).
	b. Excessive pressure.	b. Check system relief valve for proper setting (para 10-40 and 10-41).
61. Air compressor knocking.	a. Bent connecting rod.	a. Replace connecting rod (para 9-2 and 9-3).
	b. Oil pump plunger too tight in its cylinder.	b. Replace oil pump plunger (para 9-2 and 9-3).
	c. Wrist pin worn.	c. Replace wrist pin (para 9-2 and 9-3)
	d. Piston hitting head.	d. Add gaskets between cylinder and crankcase (para 9-2 and 9-3).
62. Air compressor unloader tube overheating.	a. Oil pump failure.	a. Repair or replace oil pump (para 9-2 and 9-3).
	b. Leaking crankshaft relief valve.	b. Repair or replace relief valve (para 9-2 and 9-3).
	c. Unloader valve leaking.	c. Replace unloader valve (para 9-2 and 9-3).
63. Air compressor slinging oil around crankshaft.	Defective crankshaft seal or gasket.	Replace seal or gasket (para 9-2 and 9-3).

Chart 2-1. Troubleshooting-Continued

Malfunction	Probable Cause	Corrective Action
64. Cargo winch clutch shaft will not engage.	Clutch shaft bent.	Replace clutch shaft (para 10-10)
65. Excessive noise from cargo winch.	a. Gears not meshing properly	a. Repair or replace gears (para 10-10).
	b. Bearing failure	b. Replace defective bearings (para 10-10).
66. Clutch disengages with cargo winch in operation.	Worn detent ball or loss of spring tension on bal..	Replace spring and ball (para 10-10)
67. Cargo winch will not operate or has insufficient power.	a. Defective eargo winch hydraulic motor.	a. Replace motor (para 10-11).
	b. Cargo winch to hydraulic motor adapter bearing defective.	b. Remove cargo winch and replace bearing (para 10-10).
	c. Bevel drive gear stripped.	c. Replace gear (para 10-1).
68. Cargo winch brake will not hold.	a. Brake lining worn out.	a. Replace brake lining lpara 10-8).
	b. Brake cable broken.	b. Replace brake cable (para 10-9).
	c. Brake pivot pin or adjustment pin broken.	c. Replace damaged part (para 10-8).
69. Hydraulic relief valve chatters.	a. Piston or valve seat damaged.	a. Replace damaged parts (para 10-40 and 10-41).
	b. Foreign matter between piston and seat.	b. Disassemble and clean valve (para 10-40 and 10-41).
70. Hydraulic control valve inoperative.	a. Piston sticking.	a. Disassemble and clean valve. Replace defective parts (para 10-40 and 10-41).
	b. Piston or valve seat damaged.	b. Replace damaged parts (para 10-40 and 10-41).
71. Hydraulic control valve inoperative.	Valve spool sticking.	Disassemble and clean valve (para 10-40 and 10-41).
72. No pressure or fluctuating pressure to all hydraulic systems (all engines operating).	Hydraulic oil supply tank filters clogged.	Remove and clean filters (para 10-13).
73. No pressure on all hydraulic systems with engines operating on one side only.	Defective marine gear.	Replace marine gear (para 2-27)
74. No pressure or fluctuating pressure to one hydraulic system.	a. Leak in hydraulic line.	a. Replace defective components (para 10-39).
	b. Defective master pressure pump.	b. Replace pump (para 2-26).
	c. Control valve leaking at spool.	c. Repair or replace control valve (para 10-39).
	d. Check valve not opening or not opening fully.	d. Replace check valve (para 10-35).
75. No pressure or fluctuating Pressure to ramp, bhige pump, and / or cargo well pump systems when operated from one side: Systems normal when operated from other side.	Defective relief valve in inlet unit of multiple unit valve.	Replace defective components (para 10-39).
76. Ramp will not raise or raises slowly.	a. Ramp cylinder leaking at rod end.	a. Replace rod end packing (para 10-18).
	b. Ramp cylinder leaking internally.	b. Replace ramp cylinder (para 2-29).
77. Ramp lowers too fast.	a. Leak in hydraulic line.	a. Replace defective line or lines.
	b. Ramp cylinder leaking at rod end.	b. Replace rod end packing (para 10-18).
	c. Ramp cylinder leaking internally.	c. Replace ramp cylinder (para 2-29).
	d. Defective hydraulic check valve.	d. Replace check valve (para 10-35).
78. Bilge pump will not operate or runs slowly.	a. Flow control valve out of ad-justment.	a. Adjust flow control valve to obtain 1,800 rpm at bilge pump hydraulic motor (para 10-32).
	b. Defective flow control valve.	b. Remove, disassemble, and clean valve; replace defective parts (para 10-32).
	c. Defective bilge pump hydraulic motor.	c. Replace motor (para 10-41.

Chart 2-1. Troubleshooting-Continued

Malfunction	Probable Cause	Corrective Action
79. Cargo well pump will not operate or runs slowly.	a. Flow control valve out of adjustment.	a. Adjust flow control valve to obtain 1200 rpm at cargo well pump hydraulic motor (para 10-5).
	b. Defective flow control valve.	b. Remove, disassemble, and clean valve; replace defective parts (para 10-32).
	c. Defective cargo well pump hydraulic motor.	c. Replace motor (para 10-5).
80. Radiator fan will not run or runs. slowly	Defective radiator fan hydraulic motor.	Replace motor (para 10-31).
81. Wheels will not align or alignment will not hold.	a. Leak in hydraulic line.	a. Replace defective line or lines.
	b. Defective needle valve.	b. Replace needle valve (para 10-37).
	c. Defective steering alignment cylinder.	c. Replace cylinder (para 2-30).
82. Forward steering normal, aft steering fails to respond.	a. Aft follow-up link-age disconnected or broken.	a. Repair follow-up linkage (para 8-2).
	b. Defective control valve.	b. Repair or replace control valve (para 10-33).
83. Aft steering normal, forward steering fails to respond.	a. Forward follow-up linkage disconnected or broken.	a. Repair follow-up linkage (para 8-2).
	b. Defective control valve.	b. Repair or replace control valve (para 10-33).
84. Forward steering normal, aft steering responds slowly or erratically.	a. Cargo winch control valve offset spring defective.	a. Repair valve (para 10-20).
	b. Defective steering cylinder.	b. Replace steering cylinder (para 2-30).
85. Aft steering normal, forward steering slowly or erratically.	Defective steering cylinder.	Replace steering cylinder (para 2-30).
86. Steering lever hard to move.	Defective bearings on steering column or in jackshaft box.	Replace bearings (para 8-2).
87. Air pressure too high (adjusting governor will not bring pressure within limits).	Defective air compressor governor.	Repair or replace governor (para 9-5)
88. Air pressure too low (adjusting governor will not bring pressure within limits).	a. Defective air compressor governor.	a. Repair or replace governor (para 9-5).
	b. Badly worn rings, pistons, and cylinders in air compressor.	b. Replace air compressor (para 9-2).
89. Generator voltage output fails.	Open circuit, short circuit, or ground in generator.	Test and repair generator (para 6-1).
90. Generator output high, low, or erratic.	a. Worn generator brushes.	a. Replace brushes (para 6-1).
	b. Poor commutator or brush contact.	b. Refinish commutator, undercut mica, seat brushes properly, and adjust tension of springs (para 6-1).
	c. Loose connections.	c. Tighten all connections.
91. Generator overheats.	a. Short circuit in windings.	a. Trace short circuit and repair or replace generator (para 6-1).
	b. Overload.	b. Reduce overload in output circuit.
92. Noisy generator.	a. Worn generator bearings.	a. Replace bearings (para 6-1).
	b. Improperly seated or worn generator brushes	b. Seat brushes properly or replace brushes (para 6-1).
93. Tachometer indicator inoperative.	a. Defective wiring or connector.	a. Replace wiring or connector (para 6-3).
	b. Defective indicator.	b. Replace indicator (para 6-3).
94. No reading on battery generator indicator.	a. Loose or broken connection.	a. Repair wiring.
	b. Defective battery generator in- .	b. Replace battery generator indicator (para 6-5).
95. Lights will not illuminate.	a. Defective switch.	a. Replace faulty switch (para 6-1). (See para 6-9 for replacement of wing compartment light switches).
	b. Defective socket.	b. Replace or repair socket.
	c. Loose connection.	c. Tighten all connections.
	d. Open wiring.	d.. Repair wiring

Chart 2-1. Troubleshooting-Continued

Malfunction	Probable Cause	Corrective Action
96. All lights stop burning.	a. Master control relay defective.	a. Replace master control relay (para 6-4).
	b. Master control switch defective	b. Replace master control switch (para 6-4).
97. Headlights inoperative (high, low bean, or both).	a. Headlight switch defective.	a. Replace switch (para 6-4).
	b. Headlight wire assembly defective.	b. Replace headlight wire assembly (para 6-10).
98. High beam indicator inoperative.	Dimmer switch defective.	Replace dimmer switch (para 6-4).
99. Hull and cab wiring defective.	a. Poor insulation.	a. Replace wiring.
	b. Broken conductors.	b. Repair wiring.
	c. Grounded or shorted conductors.	c. Trace short and repair.
100.Cab ventilating fan inoperative.	a. Faulty wiring.	a. Trace and repair short or open in wiring.
	b. Radio suppression capacitor shorted.	b. Replace capacitor (para 6-6).
101.Heater fan inoperative.	a. Faulty wiring.	a. Trace and repair short or open in wiring.
	b. Radio suppression capacitor shorted.	b. Replace capacitor (para 6-6).
	c. Defective blower motor.	c. Replace motor (para 6-6).

Section III. GENERAL MAINTENANCE

2-5. General

a. The information contained in this section is not detailed in nature. However, the text is written with enough detail to assist all qualified maintenance personnel to adequately perform disassemble, repair reassembly, adjustments, and testing of the LARC-LX, its components, and/or attachments.

b. Repair and replacement standards specified within the text of tables are the maximum clearance or wear allowed. This is not the only factor in determining part replacement. Factors such as age, mileage, and/ or hours of operation and usage remaining in part or component will be considered in the final determination.

c. Sheet metal distortion in the form of waves, sags, bulges, or buckles on the cab and/or hull assembly, that exceed 0.017 inches times the distance (in inches) between framing members mist be repaired.

2-6. Ball and Roller Bearings

a. General. Anti-friction bearings receive special handling. Wash bearing in non-flammable cleaning solution and inspect the races, balls, or rollers. If bearing is serviceable, coat it with light oil and wrap it in clean paper.

b. Removal. Always use proper tools or fixtures for pressing out bearings. Special tools and fixtures are referenced throughout the text where their use is recommended.

c. Installation. When installing a bearing against a shoulder on a shaft, be sure the chamfered side is towards the shoulder. When a bearing is to be pressed in lubricate mating surfaces prior to assembly. Some bearings have oil holes which must be carefully aligned with the corresponding oil hole in housing or shaft.

2-7. Oil Seals

a. Removal. Oil seals should not be removed unless absolutely necessary for gaining access to another item or unless they are to be replaced due to damage or wear. Never use cork seals a second time. Once removed, they must be discarded and replaced with new ones.

b. Installation. When possible, soak new rawhide seals in warm oil for one half hour before installing. Install seals with the wiping edge turned in the recommended direction. Do not cut leather seal as it is installed or when installing a shaft through the seal. Use shim stock if necessary to protect seal from shoulders or sharp edges during installation. Packing-type seals should always be renewed if contacting part is removed. Lubricant must be applied to lip of all shaft-type rubber seals before installation. This will prevent damage to seal during initial running until oil has contacted sealing face.

2-8. Gears, Shims, and Gaskets

a. Gears. Always use tools recommended (or

equivalent) in text for removal and installation. Gears must be carefully inspected for damaged or worn teeth. Remove burrs using an approved method before installing. Lubricate mating surfaces of gear and shaft when pressing gear on shaft.

b. Shims. Be sure to remove all shims wherever used. Keep the shims together and identify them as to location. Keep shims clean and flat until they are reinstalled.

c. Gaskets. Install gaskets where required and use new ones where necessary. Never use cork or felt gaskets or seals a second time. Be sure holes in gaskets correspond with lubricant passages in mating parts. If it is necessary to make gaskets, select stock with proper type and thickness and be sure to cut sufficient holes in the right places. Blank gaskets can cause serious damage.

2-9. Sleeve Bearings

Do not remove sleeve bearings unless inspection reveals damage or wear that exceeds the specified clearance or if the bearing is loose in its mating bore. Sleeve bearings should be pressed out whenever possible. When pressing or driving (in or out) apply pressure directly in line with bore. If the bearing must be driven, use bearing driver or a bar with a smooth, flat end. Never drive bearing with a hammer. If bearing has an oil hole, be sure to line up with oil hole in part with which it is assembled.

2-10. Shafts

Shafts that offer unexpected resistance to removal, should be checked carefully to see that all nuts and capscrews have been removed before using force. Always check possibility that another part is interfering which must be removed first. Shaft fitted to other parts with tapered splines are always very tight. If they are not tight when disassembled, inspect tapered splines and discard part if splines are worn. Before assembling shafts with tapered splines, be sure splines are clean, dry. and free of burrs. Press mating parts together tightly. Clean rust preventive compound from all machined surfaces on new parts before installing.

Section IV. REMOVAL AND INSTALLATION OF MAJOR COMPONENTS AND AUXILIARIES

2-11. Engine

a. Removal. Refer to figure 2-1 and remove engine as follows:

(1) Close plug valve in fuel supply hose (2) and fuel return hose (29) and disconnect hoses from engine.

(2) Drain oil from torque converter, transmission, and engine crankcase.

(3) Drain engine cooling system below level of the engine. (TM 55-1930-203-20).

(4) Remove oil temperature sensing bulb (19 from cover on oil pan.

(5) Disconnect hoses (5, 23, 24 and 28) from torque converter.

(6) Disconnect starting air supply hose (30) from starting motor.

(7) Close globe valves located in air lines above air supply tanks and open service connection globe valve in upper machinery area to release pressure from air lines**.**

(8) Disconnect air hoses from pilot air valve on side of engine.

(9) Disconnect hoses (1 and 27) from actuator positioner.

(10) Disconnect electrical connection (4) from tachometer generator.

(11) If equipped with dual tachometer drive, disconnect flexible shaft (3).

(12) Disconnect electrical connection from low oil pressure sending unit (26), and disconnect oil pressure gage tubing (25) from tee on cylinder block.

(13) Remove water temperature sending unit (11) and sensing element (10) from water manifold.

(14) Remove flexible hose (13) from water manifold and water inlet hose (35) from oil cooler.

(15) Disconnect hoses (32 and 33) from oil cooler.

(16) Remove bolts securing exhaust piping to exhaust manifold, and remove gasket.

(17) Remove fluid coupling, flexible coupling, and engine adapter flange as outlined in paragraph 2-21.

(18) Remove transmission-to-engine flexible coupling.

(19) Using a suitable hoist, remove slack from hoisting sling, then remove nuts (14) and lock-washers (15) from bolts (17 and 31).

(20) Take up on hoist slowly and guide engine out through hatch opening.

b. Installation.

(1) Install engine in reverse order of removal.

NOTE

Use shims (16 and 18) to raise or lower engine for alignment.

(2) Fill cooling system as outlined in TM 55-1930-203-20.

(3) Remove rocker cover and pour 2 quarts of lubricating oil as specified in LO 55-1930-203-12

over rocker arms and push rods. Lubricate engine, torque converter, and transmission as directed in LO 55-1930-203-12.

(4) Start .engine (TM 55-1930-203-10) and check for leaks.

(5) Allow engine to warm up and adjust governor idling and overspeed settings as outlined in TM 55-1930-203-20.

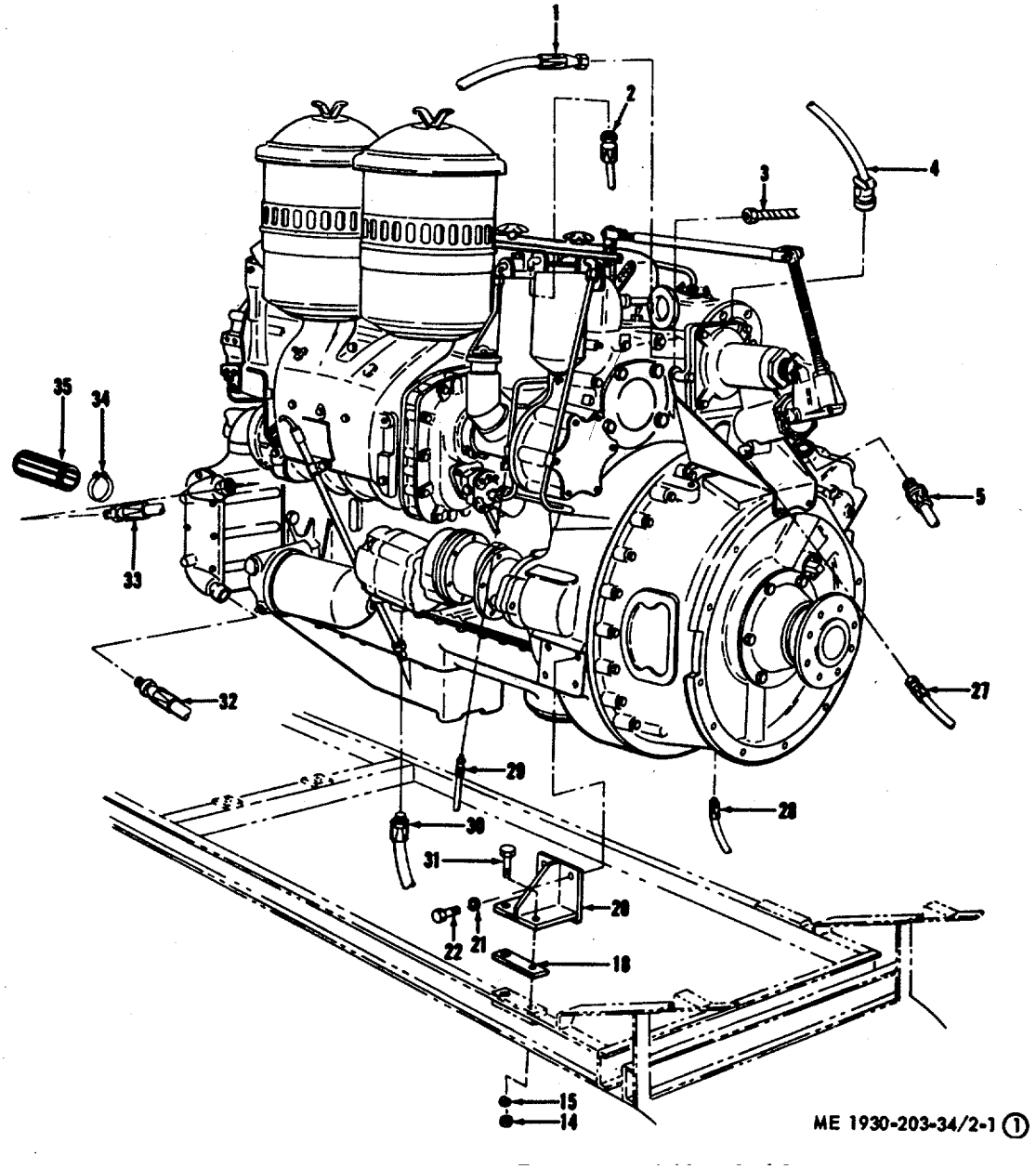
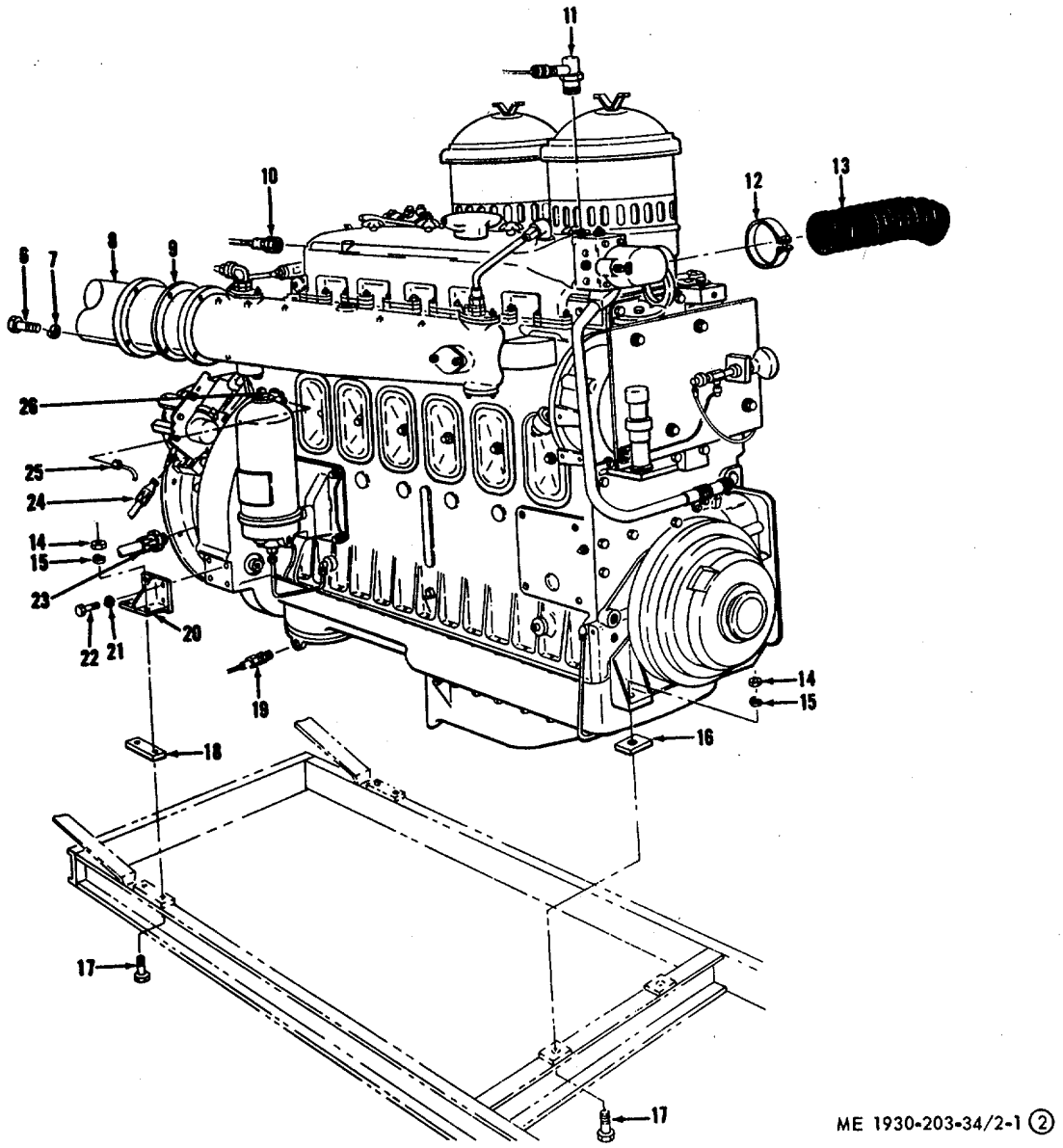


Figure 2-1. Engine removal (sheet 1 of 2).



Key to figure 2-1 (sheets 1 and 2)

1 Hose, actuator positioner-to-engine cutout valve
2 Hose, fuel supply
3 Flexible shaft
4 Tachometer generator electrical connection
5 Hose, torque converter pump-to-transmission selector valve
6 Bolt
7 Lockwasher
8 Exhaust piping
9 Gasket, exhaust piping-to-exhaust manifold
10 Water temperature sensing element
11 Water temperature sending unit
12 Clamp
13 Hose, water manifold-to-expansion tank
14 Nut
15 Lockwasher
16 Shim, mounting
17 Bolt, fitted mounting
18 Shim, mounting bracket
19 Oil temperature sensing bulb
20 Engine mounting bracket
21 Lockwasher
22 Bolt, machine
23 Hose, torque converter-to-filter
24 Hose, torque converter pump-to-transmission selector valve
25 Tubing, low oil pressure sending unit-to-pressure gage
26 Low oil pressure sending unit
27 Hose, actuator positioner-to-relay air valve
28 Hose, seal drain, torque converter-to-transmission
29 Hose, fuel return
30 Hose, starting air supply
31 Bolt, machine
32 Hose, oil cooler-to-transmission
33 Hose, filter-to-oil cooler
34 Clamp
35 Hose, water inlet

Figure 2-1. Engine removal (sheet 2 of 2).

2-12. Torque Converter

a. General

(1) The Allison Torqmatic Converter Model TC-654 is used on hulls 5 through 18. Converter Model TC-554 is used on hulls 19 through 60. Model TC-654 can be replaced with Model TC-554 on hulls 5 through 18 whenever replacement of a converter assembly is necessary.

(2) Two different Model TC-554 converters are used on the LARC-LX. Assembly number 6758244 is a four-element converter with two stator members; while assembly number 6830815 is a three-element converter with one stator member. Both of the converters are completely interchangeable, though some of the internal parts are different. (fig. 2-2, 2-3, & 2-4).

b. Removal. Refer to figure 2-5 and proceed as follows:

(1) Remove engine (para 2-11).

(2) Remove most accessible 1 inch pipe plug (13) in flywheel housing (12).

(3) Slowly rotate engine clockwise, using bolt in vibration damper end of crankshaft, until 1 of the 12 capscrews (1) is visible through pipe plug hole in flywheel housing (12).

(4) Remove capscrew through pipe plug hole in flywheel housing**.**

CAUTION

Take care not to drop capscrews into the flywheel housing as it may prevent rotation of the flywheel.

(5) Repeat steps 3 and 4 above until all 12 capscrews are removed.

(6) Install a lifting eye (5) in top of torque converter housing.

(7) Attach a suitable lifting sling and hoist to lifting eye and take up slack in hoist.

(8) Remove capscrews (7) and lockwashers (6), and pull torque converter (4) clear of flywheel housing.

(9) Remove capscrews (3) and remove flexible flywheel disk assembly (2) from crankshaft.

(10) Remove lifting sling, hoist, and lifting eye from torque converter.

c. Installation (fig. 2-5).

(1) If a <u>new</u> torque converter is to be installed, remove 12 capscrews (1) and remove flexible disk assembly (2) from torque converter (4).

NOTE

New torque converters have flexible disk assembly attached to them.

(2) Position flexible flywheel disk assembly on crankshaft in flywheel housing (12), making certain that dowel pins on crankshaft align with corresponding holes in flexible flywheel disk assembly.

(3) Install six capscrews (3). Tighten capscrews to a torque of 150 to 160 foot-pounds.

NOTE

If drilled head capscrews are used secure with lockwire.

(4) Install lifting eye (5) in top of torque converter housing.

(5) Attach a suitable lifting sling and hoist to lifting eye and hoist torque converter.

(6) Position torque converter on flywheel housing, aligning bolt holes on torque converter housing and flywheel housing.

(7) Install all capscrews (7) and lockwashers (6) loosely, then tighten capscrews to a torque of 42 to 50 foot-pounds.

(8) Remove bolts (11) and lockwashers (10) securing converter housing cover (9) and gasket (8).

(9) Lift off converter housing cover and gasket and place a 3/8 inch socket wrench through opening on an accessible pump to flywheel capscrew to prevent flywheel from turning when crankshaft is rotated.

(10) Slowly rotate engine clockwise, using bolt in vibration damper end of crankshaft, until holes in flywheel and flexible flywheel disk assembly are lined up as viewed through pipe plug (I 3) opening in flywheel housing.

(11) Working through pipe plug opening, install 1 of 12 capscrews (Do not tighten capscrews.)

(12) Remove 3/8 inch socket wrench from access hole in torque converter housing and repeat steps (10 and (11) above until all 12 capscrews are installed.

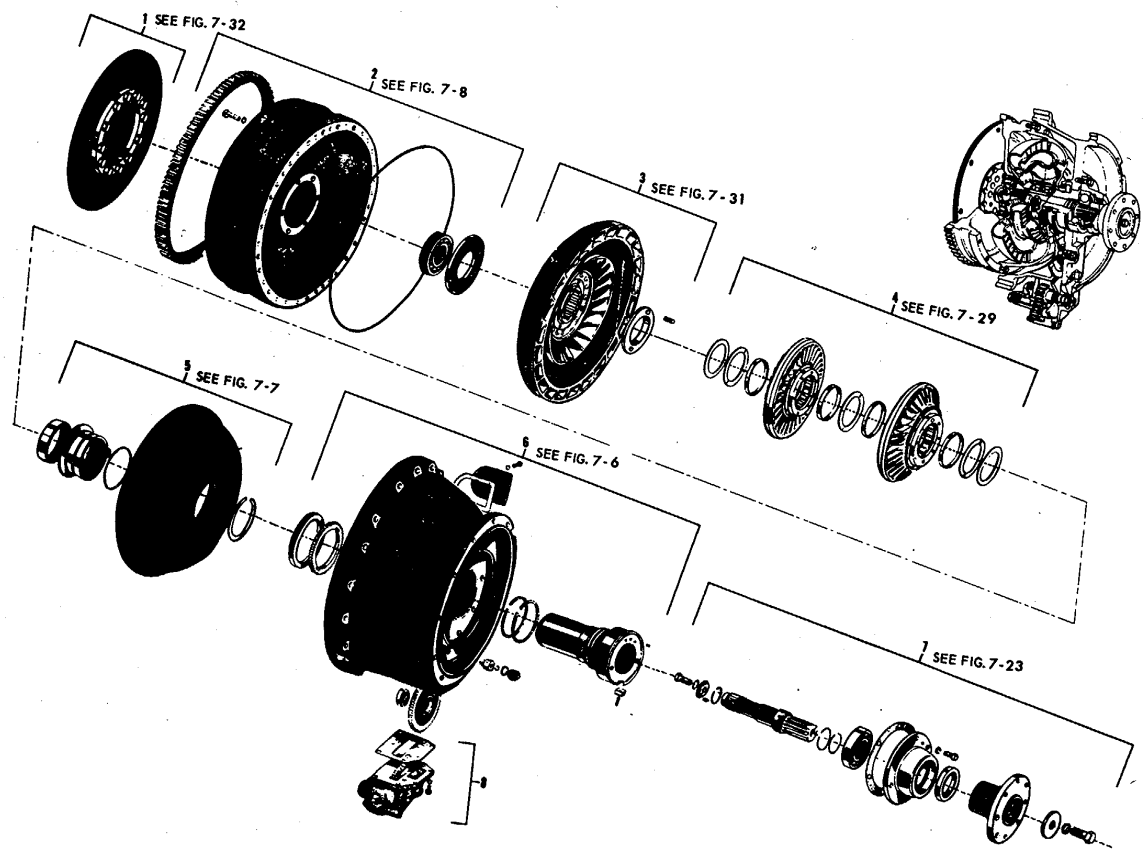
(13) Rotate engine and tighten all 12 capscrews to a torque of 70 to 75 foot-pounds, working through pipe plug opening in flywheel housing.

(14) Install converter housing cover (9) and gasket (8), using bolts (11) and lockwashers (10).

(15) Install pipe plug (13) in flywheel housing.

(16) Remove lifting sling, hoist, and lifting eye from torque converter.

(17) Install engine (para 2-11).



1 Flexible flywheel disk assembly
2 Flywheel assembly
3 Turbine assembly
4 Stator assembly
5 Converter pump and hub assembly
6 Housing assembly
7 Output shaft and flange assembly
8 Charging oil pump assembly

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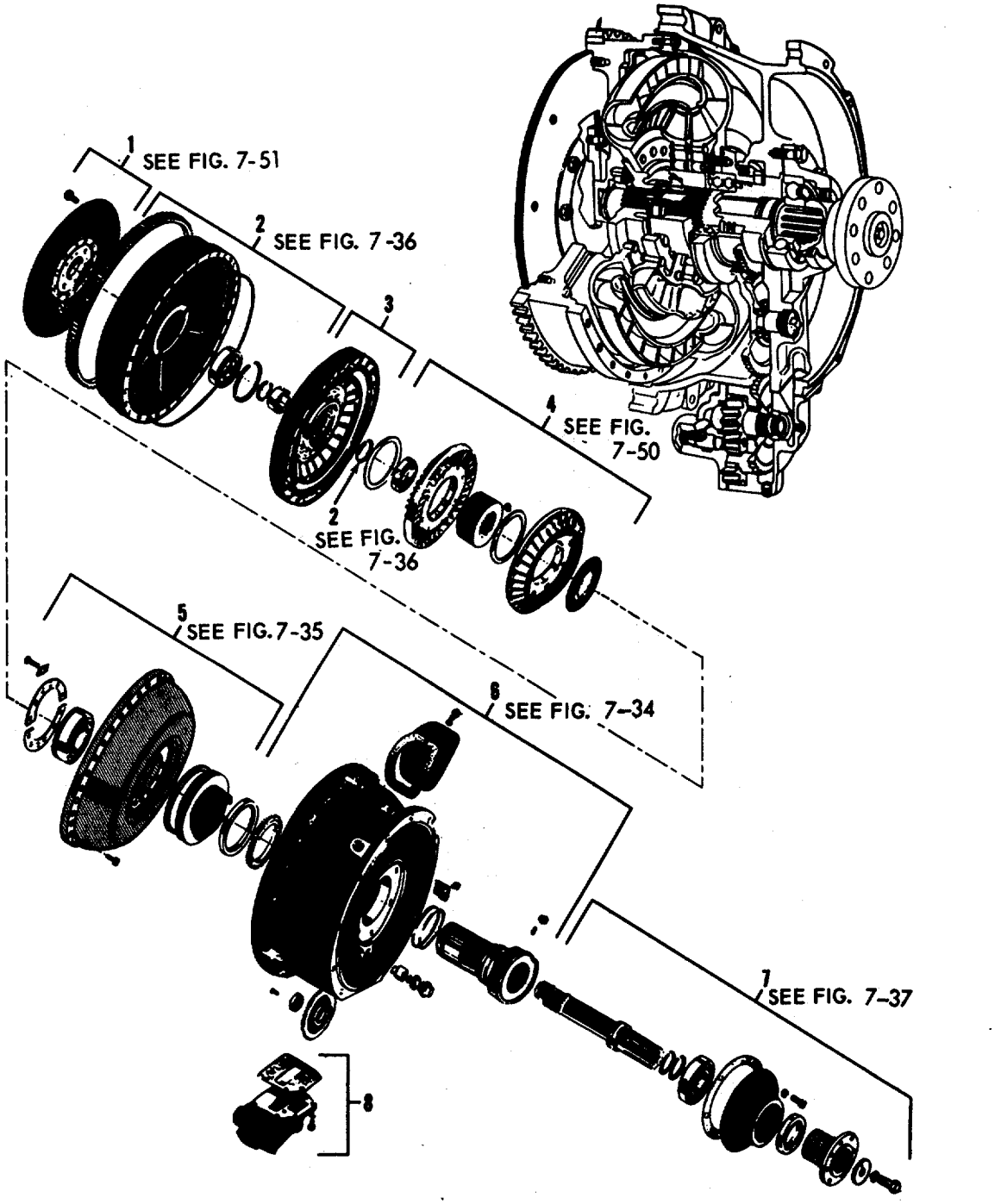
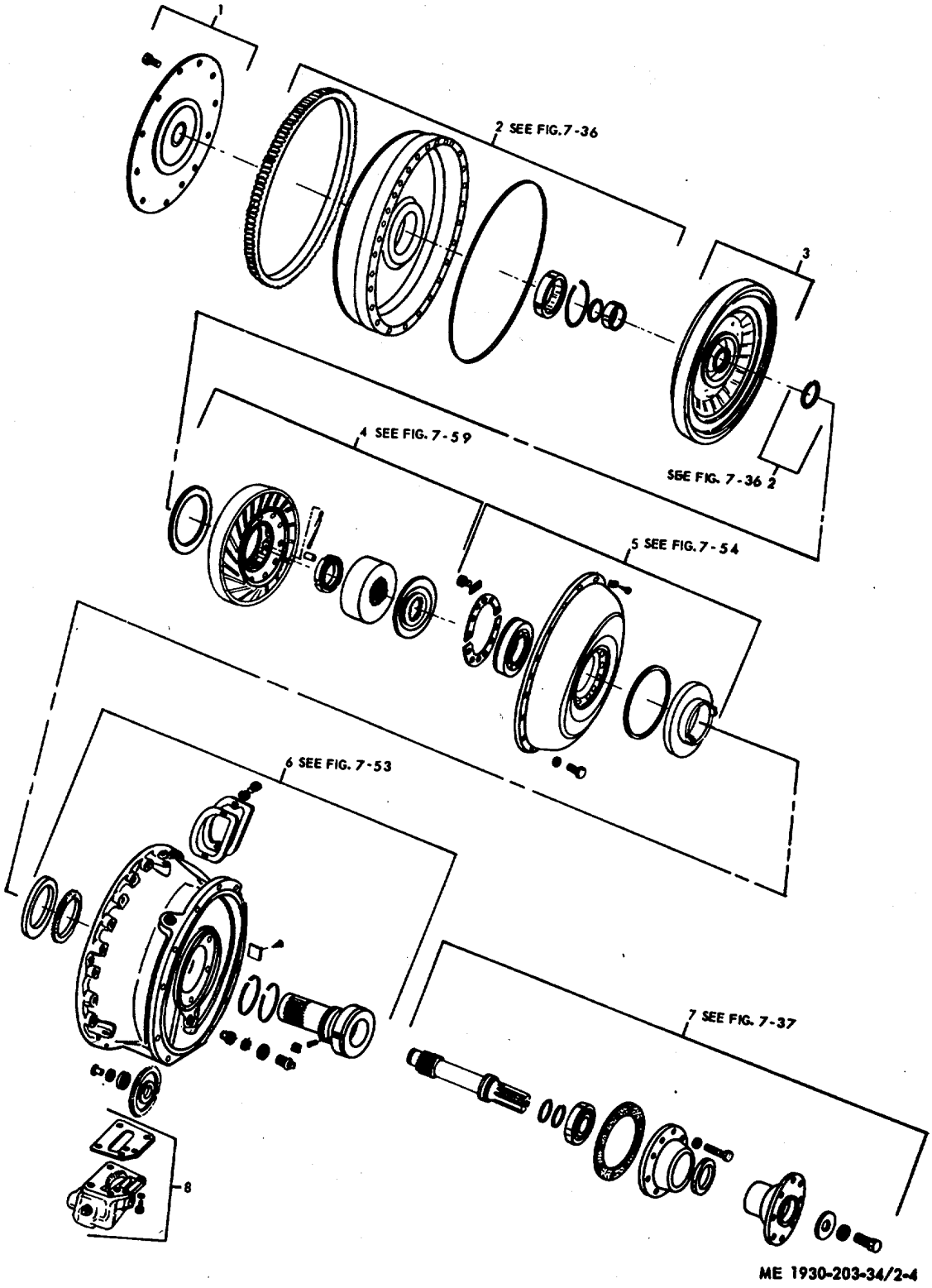
Figure 2-2. Torque converter (model TC-654)



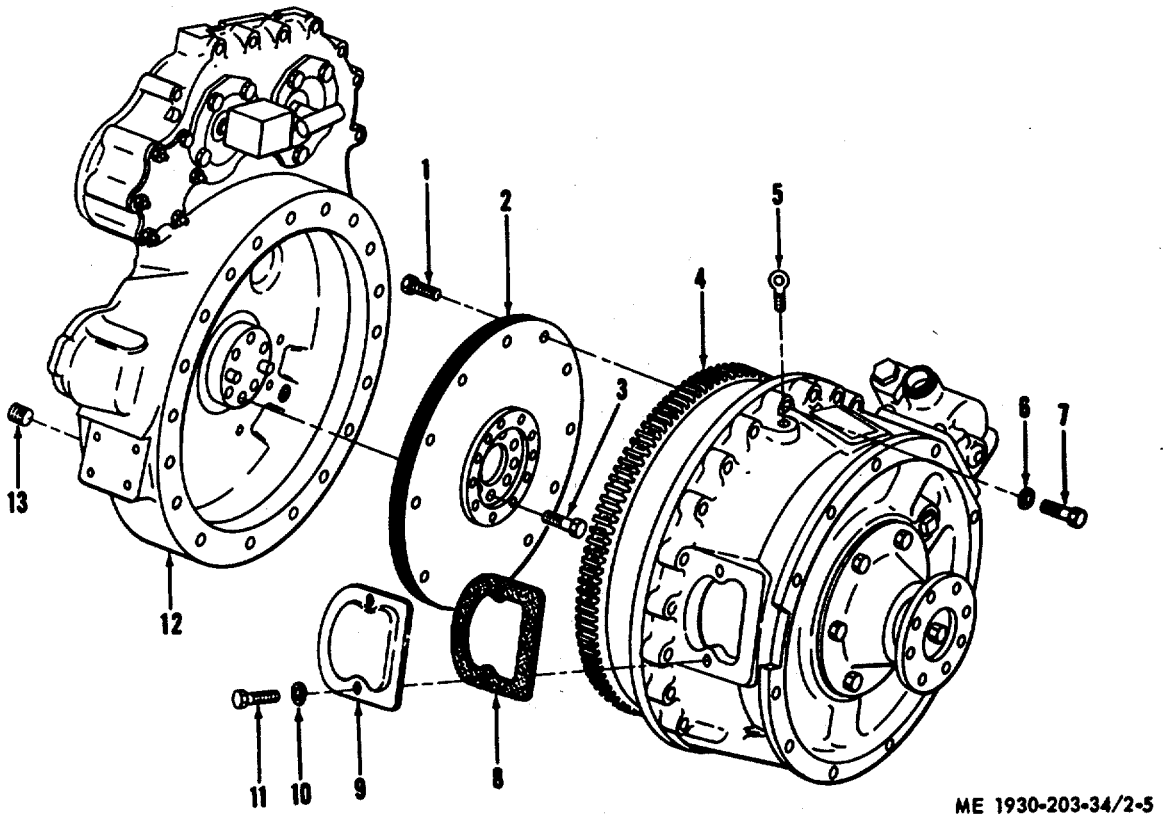
1 Flexible flywheel disk assembly
2 Flywheel assembly
3 Turbine assembly
4 Stator assembly
5 Converter pump and hub assembly
6 Housing assembly
7 Output shaft and flange assembly
8 Charging oil pump assembly

Figure 2-3. Torque converter (Model TC-554) (4 element)



1 Flywheel disk assembly
2 Flywheel assembly
3 Turbine assembly
4 Stator assembly
5 Converter pump assembly
6 Housing assembly
7 Output shaft and flange assembly
8 Charging oil pump assembly

Figure 2-4. Torque converter (Model TC-554-3 element)



1 Capscrew
2 Flexible flywheel disk
3 Capscrew
4 Torque converter
5 Lifting eye
6 Lockwasher
7 Capscrew
8 Gasket
9 Converter housing cover
10 Lockwasher
11 Bolt
12 Flywheel housing
13 Pipe plug

Figure 2-5. Removal and installation of torque converter.

NOTE

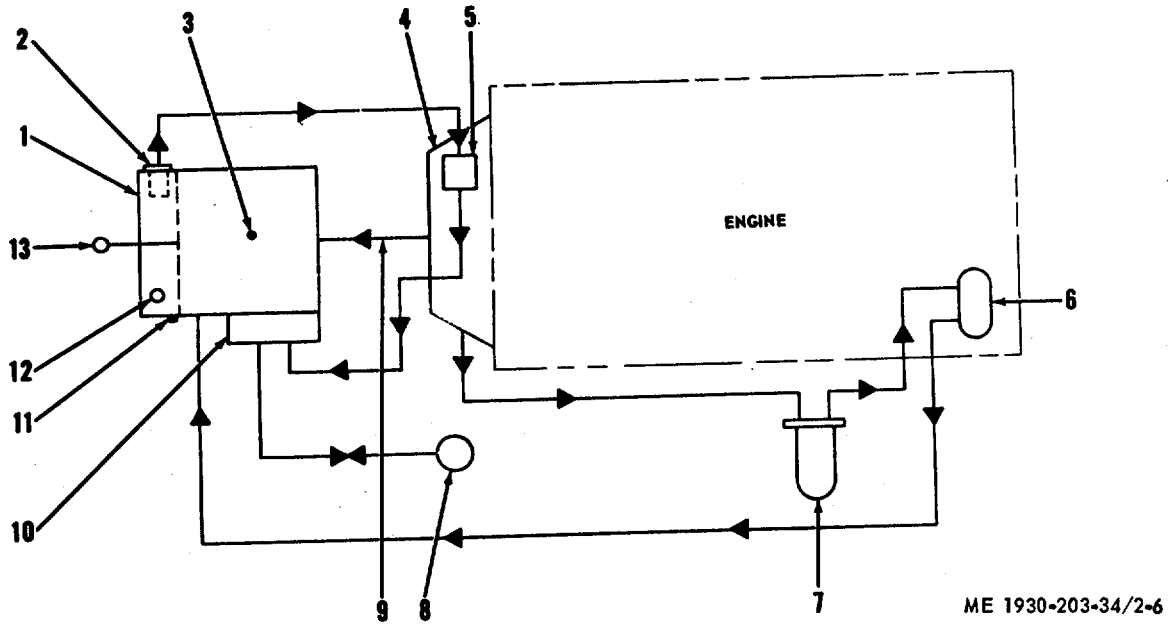
Removal and installation of all models of torque converters used in this equipment is performed in a similar manner.

2-13. Transmission Assembly

a. General. The LARC transmission is an Allison Torqmatic Model TG-603RM (FO-1) (Fold-Out 1. (located in back of manual)). Torque from the torque converter is transmitted to the transmission main shaft through the input flange assembly. Four multiple-disk range clutches, (low, intermediate, high and reverse) are compactly arranged within the transmission housing and transmit power to the planetary carrier assembly. The adapter assembly provides an external support for connecting the planetary carrier assembly to the output flange assembly. The oil strainer assembly filters the oil in the transmission sump which serves as the reservoir for the torque converter and transmission oil system. The transmission planetary gearing is a compound planetary gear train in constant mesh. The four multiple-disk, oil-cooled, friction clutches which are hydraulic applied and spring-released control the planetary gear train. The friction plates and reaction plates are hydraulically-applied through a manual range selector. The clutches automatically compensate for normal wear.

b. Removal. If the same transmission is to be reinstalled, perform steps (1) through (19) below. If a new transmission is to be installed, perform additional steps (20) through (29) below. Retain parts removed in steps 119) through 129) for installation of new transmission.

(1) Remove pipe plugs (3 and 11, fig. 2-6) and drain transmission oil into a suitable container.



1 Transmission
2 Oil strainer
3 Plug, pipe
4 Torque converter
5 Oil pump
6 Oil cooler
7 Oil filter
8 Pressure gage
9 Seal drain line
10 Selector valve
11 Plug, pipe
12 Oil level indicator
13 Breather cap

Figure 2-6. Transmission-Torque converter oil lines.

(2) Remove transmission-to-miter box flexible coupling (TM 55-1930-203-20).
(3) Remove transmission-to-torque converter flexible coupling (TM 55-1930-203-20).
(4) Disconnect transmission-to-oil cooler flexible hose (9, fig. 2-7).
(5) Disconnect selector valve-to-oil pump flexible hose (21).
(6) Disconnect transmission-to-oil pump flexible hose (7).
(7) Disconnect transmission-to-torque converter seal drain flexible hose (44).
(8) Remove cotter pin (16) and pin (15).
(9) Remove two bolts (13), bolt (12), and lockwashers (11), and move transmission shifting control air cylinder and mounting bracket (14) away from front of transmission.
(10) Disconnect low oil pressure sending unit connector and cable assembly (22).
(11) Disconnect transmission oil pressure line (101 and move clear of transmission.
(12) Install lifting eyes (8) in transmission.
(13) Attach suitable hoisting equipment to lifting eyes and take up slack in hoisting equipment.
(14) Remove eight nuts (27) and lockwashers (26) and four bolts (1).
(15) Remove four fitted mounting bolts (2) and mark bolts so they may be installed in the same position from which they were removed.
(16) Lift transmission sufficiently to facilitate removal of mounting shims (20). Remove shims and mark them so they may be installed in the same position from which they were removed. The outside hole on each shim is reamed to fit the corresponding fitted mounting bolt (2).
(17) Remove four bolts (25) and lockwashers (24) and remove upper mounting plate (23).
(18) Remove four bolts (18) and lockwashers and remove lower mounting plate (17).
(19) Secure handling lines to prevent transmission from swinging and remove transmission.
(20) Remove bolts (43) and lockwashers (42) and remove manifold assembly (40) and gasket (39).
(21) Remove elbow (41) from manifold assembly and reinstall manifold and gasket on transmission with bolts (43) and lockwashers (42). Retain elbow (41) for installation.

(22) Remove low oil pressure sending unit 128) from elbow (33).
(23) Remove elbow (33), bushing (29), and close nipple (30) from tee (31).
(24) Remove elbow (32) from tee (31).
(25) Remove tee, close nipple (34), and bushing (35) from selector valve.
(26) Remove adapter (38), reducer (37), and close nipple (36) from selector valve.
(27) Remove straight adapter (6) from elbow (5).
(28) Remove close nipple (4) and bushing (3).
(29) Remove adapter (45) and elbow (46).

c. Installation.

(1) Install lifting eyes (8), in transmission.

(2) Attach suitable hoisting equipment to lifting eyes and position transmission above foundation with breather cap end facing miter box.

(3) Position upper mounting plate (23) on breather cap end of transmission and install four bolts (25) and lockwashers (24).

(4) Position lower mounting plate (17) on transmission and install four bolts (18) and lock-washers (19).

(5) Position shims (20) on foundation in same location from which they were removed in a (16) above.

(6) Lower transmission onto foundation and install four fitted mounting bolts (2) in same location from which they were removed in a (15) above.

(7) Install four bolts (1), eight lockwashers (26), and eight nuts (27).

(8) Install bushing (3), close nipple (4), elbow 15), and straight adapter (6) on transmission oil strainer assembly.

(9) Connect transmission-to-oil pump flexible hose (7) to straight adapter (6).

(10) Connect elbow (46) and adapter (45) on transmission below input flange.

CAUTION

The seal drain flexible hose routing from the torque converter to the transmission oil pump is critical. The hose must be installed 3 1/2 inches or more below the centerline of the torque converter at every point in the line. There must never be any kinks or tight bends in the line. Improper installation will result in excessive leakage past the torque converter pump hub seal or output shaft dual oil seal.

(11) Connect transmission-to-torque converter seal drain flexible hose (44) to adapter (45).
(12) Remove bolts (43) and lockwashers (42) and remove manifold assembly (40) and gasket (39).
(13) Install elbow (41) in manifold assembly (40) and reinstall manifold and gasket on transmission with bolts (43) and lockwashers (42).
(14) Connect transmission-to-oil cooler flexible hose (9) to manifold assembly (40).
(15) Install close nipple (36), reducer (37), and adapter (38) on selector valve.
(16) Connect selector valve-to-oil pump flexible hose (21) to adapter (38).
(17) Install bushing (35), close nipple (34), and tee (31) on selector valve.
(18) Install close nipple (30), bushing (29), elbow (33), and low oil pressure sending unit (28) on tee (31**).**
(19) Connect connector and cable assembly (22) to low oil pressure sending unit (28**).**
(20) Install elbow (32) on tee (31).
(21) Connect transmission oil pressure line (10) to elbow (32).
(22) Remove two bolts (13), bolt (12), and lockwashers (11) from transmission.
(23) Position transmission shifting control air cylinder and mounting bracket (14) on front of transmission and install bolts (12 and 13) and lockwashers (11).
(24) Position transmission shifting control air cylinder coupling on selector valve lever and install pin (15).
(25) Install cotter pin (16) in pin (15).
(26) Install transmission-to-torque converter flexible coupling (TM 55-1930-203-20)**.**
(27) Install transmission-to-miter box flexible coupling (TM 55-1930-203-20).
(28) Fill transmission and torque converter with proper lubricant (LO 55-1930-203-12).
(29) Perform torque converter-transmission stall test (para 7-3).

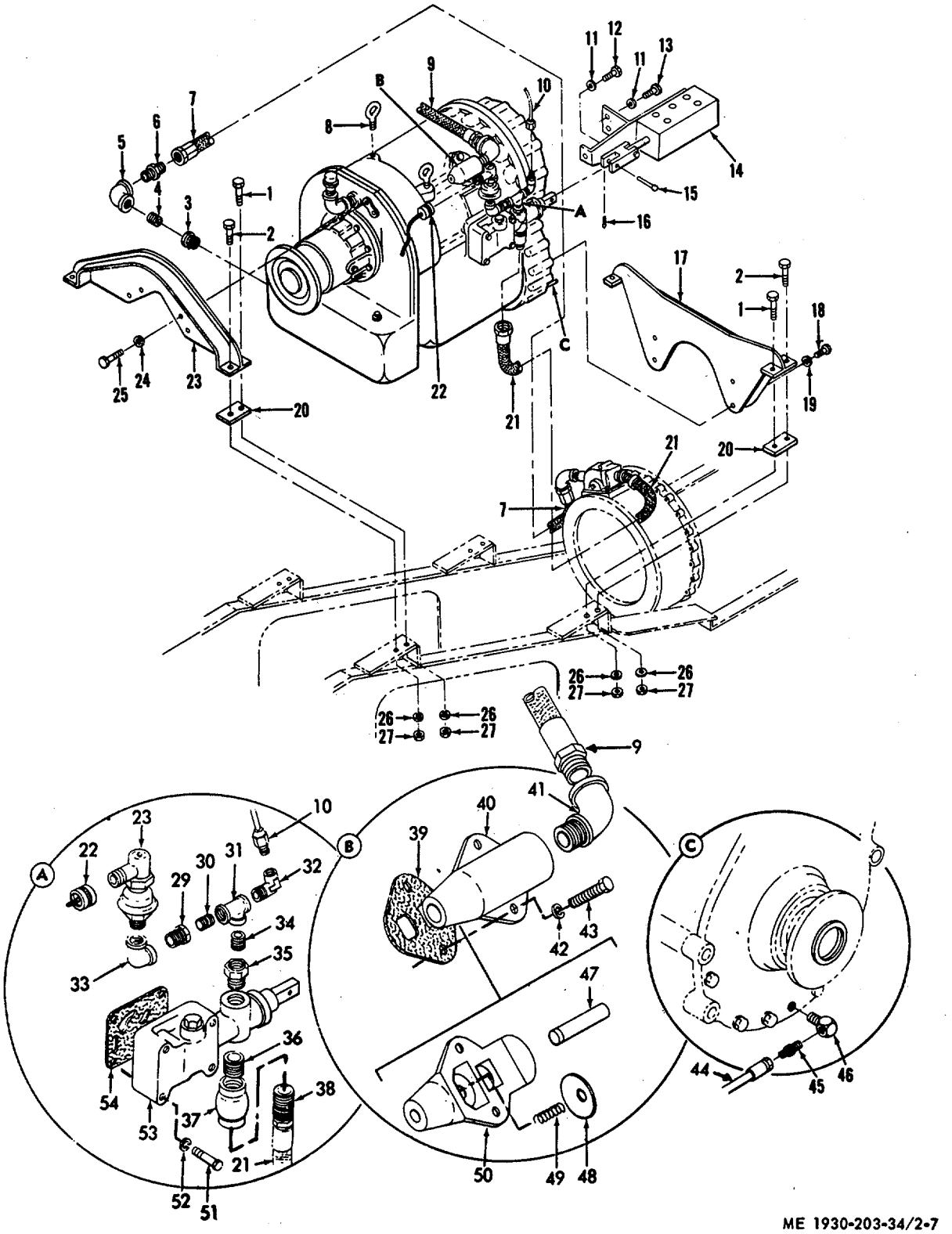


Figure 2-7. Removal and transmission assembly.

Key to figure 2-7

1 Bolt, machine
2 Bolt, mounting, fitted
3 Bushing
4 Nipple, close
5 Elbow, 90°
6 Adapter, straight
7 Hose, flexible transmission-to-oil pump
8 Lifting eye
9 Hose, flexible, transmission-to-oil cooler
10 Pressure line, transmission oil
11 Lockwasher
12 Bolt, machine
13 Bolt, machine
14 Cylinder and mounting bracket, transmission shifting control air
15 Pin
16 Pin, cotter
17 Lower mounting plate
18 Bolt, machine
19 Lockwasher
20 Shim, mounting
21 Hose, flexible, selector valve-to-oil pump
22 Connector and cable assembly, low-oil pressure sending unit
23 Upper mounting plate
24 Lockwasher
25 Bolt, machine
26 Lockwasher
27 Nut
28 Sending unit, low oil pressure
29 Bushing
30 Nipple, close
31 Tee
32 Elbow, male
33 Elbow, 50°
34 Nipple, close
35 Bushing
36 Nipple, close
37 Reducer, bell
38 Adapter, straight
39 Gasket, manifold assembly
40 Manifold assembly
41 Elbow, street, 90°
42 Lockwasher
43 Bolt, machine
44 Hose, flexible, transmission-to-torque converter seal drain
45 Adapter
46 Elbow, street, 90°, 3/8 in.
47 Pin, spring guide
48 Washer, saddle
49 Compression spring
50 Manifold body
51 Bolt, machine
52 Lockwasher
53 Selector valve assembly
54 Gasket, selector valve assembly

2-14. Air Brake Assembly

a. Removal. To remove air brake assembly on input side of miter box (17, fig.2-8), perform (1) through (4) and (7) through (10) below. To remove air brake assembly on opposite side, perform (1) and (5) through (10) below.

(1) Provide a suitable container and remove drain plug (18), and drain lubricant from miter box. Install drain plug after lubricant is drained.

(2) Remove tire air shut-off valve handle (1), bolts (2), lockwashers (20), and nuts (19), and remove miter box-to-transmission machinery guard (3).

(3) Remove capscrews (24) and lockwashers (23), and remove transmission-to-miter box flexible coupling (TM 55-1930-203-20).

(4) Remove brake drum assembly (22) and gasket (21) from input side of miter box.

(5) Remove bolts (5), lockwashers (15), and nuts (16), and remove machinery guard (4).

(6) Remove bolts (12) and lockwashers (11), and remove brake drum assembly (10).

(7) Disconnect air brake pneumatic line (6) at fitting on brake assembly (7).

(8) Remove lock wire from capscrews (9) and remove capscrews, end plate (13), and coupling flange (14).

(9) Remove lock wire from bolts (8) and remove bolts.

(10) Remove brake assembly (7).

b. Installation. Install air brake assembly in the reverse order of removal. After brake assemblies are installed, fill miter box with approved lubricant (LO 55-1930-203-12).

Key to figure 2-8

1 Air shut-off valve handle
2 Bolt, machine
3 Miter box-to-transmission machinery guard
4 Machinery guard
5 Bolt, machine
6 Air brake pneumatic line
7 Brake assembly
8 Bolt, machine
9 Capscrew
10 Brake drum assembly
11 Lockwasher
12 Bolt, machine
13 End plate
14 Coupling flange
15 Lockwasher
16 Nut
17 Miter box
18 Plug, drain
19 Nut
20 Lockwasher
21 Gasket
22 Miter box input brake drum assembly

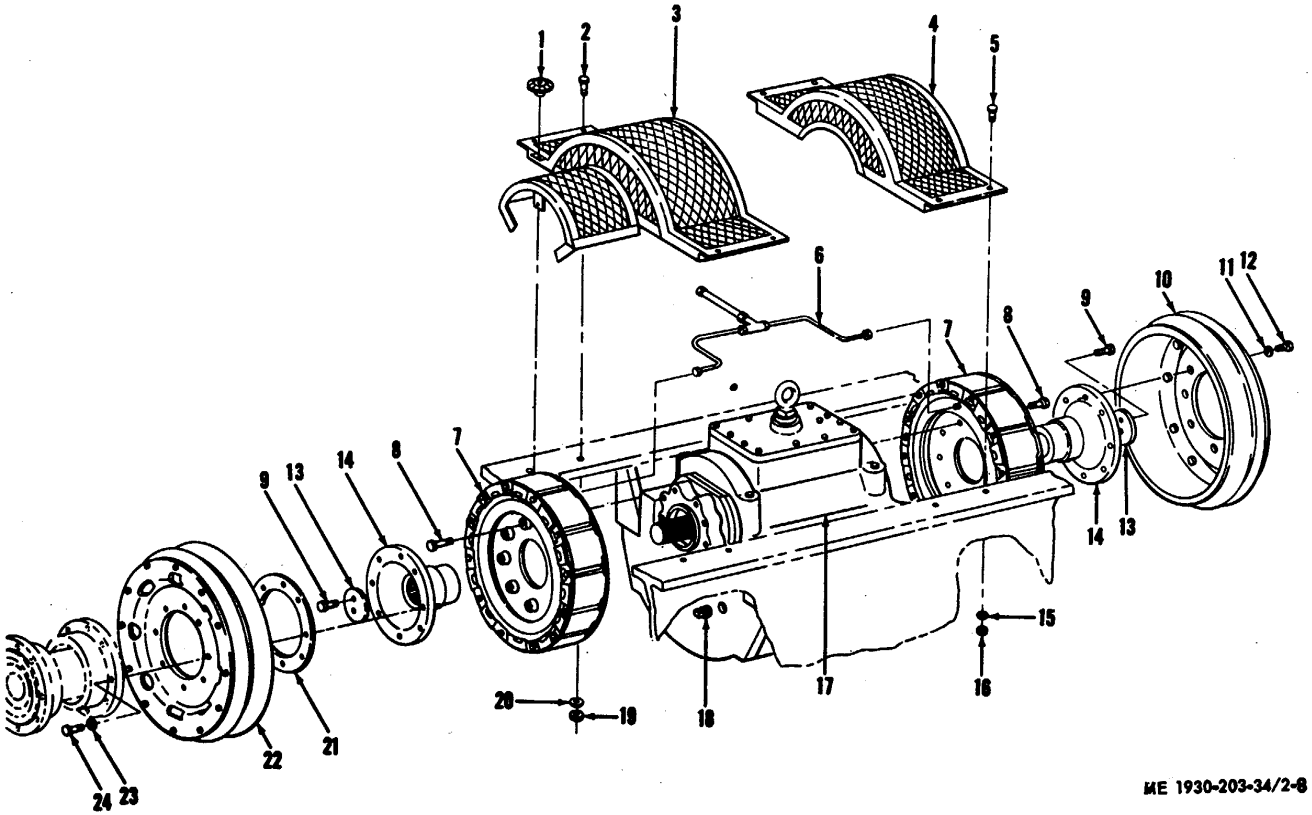


Figure 2-8. Air brake assembly removal and installation.

2-15. Miter Box Assembly

a. Description. There are four miter box assemblies installed on the LARC and each miter box assembly connects to a column and wheel drive. The function of the miter box assembly is to convert horizontal rotation of the transmission output flange into vertical rotation for the column and wheel drive. A right angle bevel gear set on the miter box assembly converts the horizontal input rotation to vertical output rotation. The miter box case forms an oil sump into which the gears dip. Sufficient oil splash is obtained for adequate gear and bearing lubrication. The miter box case also serves as an upper support for the column and wheel drive. All four miter box assemblies contain identical parts; however, placement of the left- and right-hand bevel gears, input shaft, bearing yoke, and breather differ between port and starboard miter box installations (fig. 2-9).

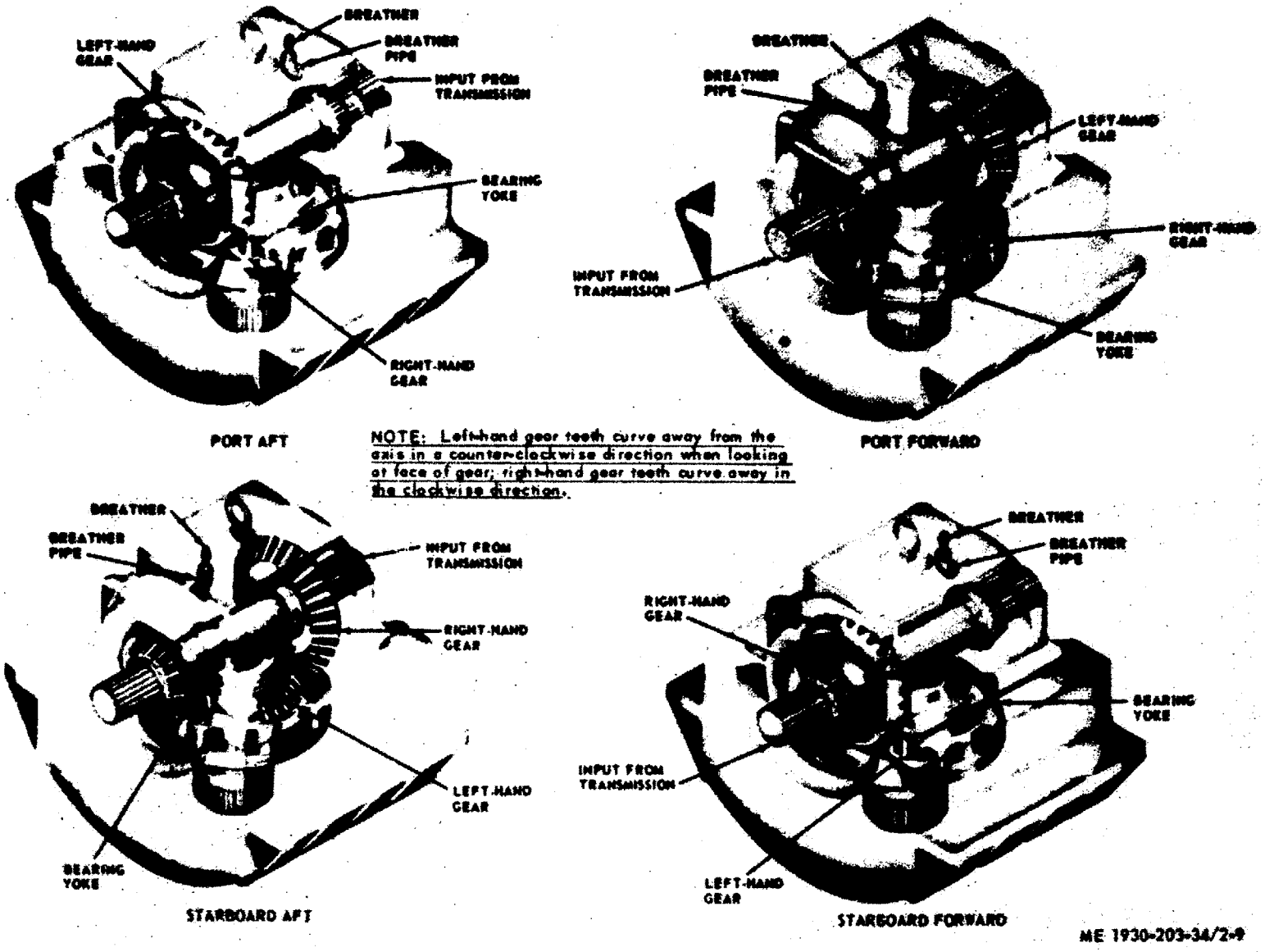


Figure 2-9. Miter box assembly.

CAUTION

It is extremely important that the miter box assembly be built up properly for the particular location; otherwise, serious damage to the LARC may result. If the miter box assembly input shaft and gears are improperly assembled for a particular location, it is possible for the one wheel to rotate in opposite direction from the other three.

NOTE

In order to perform any major repair on or to remove the miter box assembly, the miter box assembly must be disassembled in place on board the LARC. Also if the column and wheel drive or steering arm is to be removed. the miter box assembly must be disassembled in place.

b. Removal and Disassembly.

(1) Removal. In order to remove the miter box assembly, it is necessary to disassemble the miter box assembly in place as outlined below.

(*2)* Disassembly.

(a) Disassembly in place.

1. Remove air brake assemblies (para 2-14)
2. Remove ten capscrews (22. FO-2) (located in back of manual) and two capscrews (23) from bearing retainer assemblies (4).
3. Remove four capscrews (2) and eight capscrews (3).
4. Install two of the eight capscrews (3) in tapped holes provided in mounting flange of case cover assembly (1). Using the two capscrews as jacking bolts, remove case cover assembly, then remove two capserews from case cover assembly.
5. Remove bearing retainer assemblies (4). shim set l5), and input shaft assembly (6).

NOTE

Extreme care must be taken during disassembly that no damage occurs to shims sets. Keep each shim set with its respective bearing retainer assembly and mark bearing retainer assemblies as to location on case (19). Note relationship of gear on inpuit shaft assembly with respect to drive or transmission end of miter box assembly.

6. Remove six capscrews (7) and two capscrews (2) and lift out output shaft assembly (20) and shim set (8).

NOTE

Extreme care must be taken during disassembly that no damage occurs to shim set. Note relationship of bearing yoke (29) with respect to drive or transmission end of miter box assembly.

7. To remove self-aligning bearing (53). remove column and wheel drive as outlined in paragraph 2-1 6a (2) through (11). Remove capscrews (51) and remove bearing carrier (52). Remove seal (50) from bearing carrier and press bearing out of bearing carrier.

NOTE

Removal and inspection of self-aligning bearing (53) can only be accomplished after removal of column and wheel drive. Unless structure damage has occured to destroy unit alignment case (19) need not be removed from LARC.

8. To remove case (19) remove column and wheel drive as outlined in paragraph 2-16a. Steps (2) through (11) and steering arm as outlined in paragraph 8-2. Attach suitable hoisting tackle to case and take up slack.
9. Remove eight nuts (12) and lock washers (13) and six bolts (17). Lower case slightly and remove shims (15). Mark shims as to location.
10. Remove two fitted mounting bolts (16) and fitted shims (14), located on extreme opposite ends of miter box mounting. Mark bolts and shims so they may be installed in dame position from which they were removed.

NOTE

FO-2 shows the starboard forward miter box assembly. The fitted mounting bolts (16)are located as shown in the fixture for the starboard forward and port aft miter box assemblies. On the starboard aft and port forward miter box assemblies, the fitted mounting bolts are located on opposite diagonal corners.

11. Lower case, tilt sideways, and lift case out of foundation using hoisting tackle.

(b) Case cover assembly disassembly.

1. Remove eye bolt (55) and breather (56) from inspection cover (57).
2. Remove capscrew (54) and remove inspection cover and gasket (58).
3. Remove two nuts (60) and taper pins (61) from case cover (59).

(c) Bearing retainer assembly disassembly. Remove seal (24) from bearing retainer (4) and press bearing cup (26) out of bearing retainer.

NOTE

Keep bearing cups (26) with their respective bearing retainer.

(d) Input shaft assembly disassembly. Press gear (63) and bearing cone (62) on same end of input shaft (64) off input shaft simultaneously. Remove key (65) and press the other bearing cone off input shaft.

NOTE

Keep each bearing cone (62) with its respective bearing cup (26)

(e) Output shaft assembly disassembly.

1. Lift off bearing yoke (29), remove snap ring (27) and press bearing outer race (28) out of bearing yoke.

2. Remove cotter pin (43), nut (42), and washer (41) , and pull coupling gear (40) from output shaft (32).
3. Support subassembly on upper hub of gear (34), being careful not to damage bearing inner race (31), and press output shaft out of subassernbly.
4. Remove key (33) and snap ring (30) from output shaft and press bearing inner race (31) off output shaft.
5. Remove eight capscrews (35) securing bearing (36) and remove bearing stop.
6. Remove seal (38) and press bearings (37) out of bearing carrier (39) from seal end.

c. Reassembly and Installation.

(1) Reassembly.

(a) Output shaft assembly reassembly.

1. Install seal (38, FO-2) in bearing carrier (39).
2. Install bearings (37) in bearing carrier.

NOTE

These are angular contact matched bearing sets and must be mounted face to face.

3. Install bearing stop (36) using cap-screws (35). Make certain bearings are clamped in bore of bearing carrier, then secure capscrews with lockwire.
4. Install key (33) in output shaft (32) and press right-hand gear (63) or left-hand gear (34) onto output shaft.

NOTE

If output shaft assembly is being built up for port miter box assembly installation, press right-hand gear (63) onto output shaft. If output shaft is being built up for starboard miter box assembly installation, press left-hand gear (34) onto output shaft (fig. 2-9).

5. Press output shaft with gear into bearings (37, FO-2), making certain that hub of gear seats against inner race of bearing.
6. Install coupling gear (40) on spline of output shaft, being careful not to damage seal.
7. Install washer (41) and nut 142). Tighten nut securely making certain coupling gear hub clamps inner race of bearing (37). Install cotter pin (43).
8. Press bearing inner race (31) onto upper end of output shaft, then install snap ring (30).

NOTE

Turn gear over by hand to make certain there is no binding. A light preload feel will be normal with the use of matched bearing set.

9. Press bearing outer race (28) into bearing yoke (29), then install snap ring (27).
10. Install preformed packing (44) on gear coupling (40).
11. Position bearing yoke and bearing outer race onto output shaft and bearing carrier.

(b) Input shaft assembly reassembly.

1. Install key (65, FO-2) on input shaft (64) and press left-hand gear (34) or right-hand gear (63) onto input shaft.

NOTE

If input shaft is being built up for port miter box assembly installation, press left-hand gear (341 onto input shaft. If input shaft is being built up for starboard miter box assembly installation, press right-hand gear (63) onto input shaft (fig. 2-9).

2. Heat bearing cones (62) in an oil bath at 250°F (121.1°C) to 300°F (148.8°C) and install bearing cones on input shaft.

NOTE

Install bearing cones on ends of input shaft corresponding to matching bearing cups (26) in bearing retainer assemblies (4). See figure 2-9 for input shaft and gear orientation for port or starboard miter box assembly installation.

(c) Bearing retainer assembly reassembly. Press bearing cup (26, FO-2) into bearing retainer (25), then install seal (24).

NOTE

Make certain that matching bearing cup for bearing cone (62 is installed in corresponding bearing retainer. Assure that seal lip is facing toward bearing and that the seal is flush with the bearing retainer, not bottomed.

(d) Case cover assembly reassembly.

1. Install taper pin (61, FO-2) and nut (60) on case cover (59).
2. Install breather (56) in inspection cover (57) and install inspection cover and gasket, using capscrews (54).

NOTE

Determine from taper pins in case cover which position case cover will assume when mounted on case (19), then install inspection cover so that breather is opposite gear on input shaft (fig. 2-9).

(e) Reassembly in place.

1. If self-aligning bearing (53, FO-2) was removed, lubricate bearing with grease, Military Specification MIL-G-10924, and press bearing into bearing carrier (52). Install seal (50) in bearing carrier and install bearing carrier with capscrews (51). Secure capscrews with lockwire. Install column and wheel drive as outlined in paragraph 2-16e, (2) through (12) and (14).

NOTE

Self-aligning bearing (53) has a tapered inner race and must be installed in bearing carrier (52) correctly. Press bearing into bearing carrier so that large end of inner race faces down.

2. If case (19) was removed, attach suitable hoisting tackle, orient case so that fitted mounting holes on extreme diagonal corners of case

correspond with fitted mounting holes in foundation, tilt case sideways, and lower into foundation. With case mounting holes lined up with holes in foundation, insert shims (14 and 15) in their original positions. Install two fitted mounting bolts (16) and six bolts (17) and secure with lock- washers (13) and nuts (12). Install steering arm as outlined in paragraph 8-2 steps (a) through (d) and column and wheel drive as outlined in paragraph 2-9 e, steps (3) through (12) and (14).

3. Position shim set (8) in case (19), being careful not to damage shim set. 4. Pack female coupling gear (49) with grease, Military Specification MIL-G-10924, then lower output shaft assembly (20) into position, making certain male coupling gear (40) mates with female coupling gear.

NOTE

If bearing is) or gear in output or input shaft assembly has been replaced, it will be necessary to adjust gear mesh and bearings as outlined in paragraph 7-8 d

5. Position bearing yoke (29) opening as shown in figure 2-9 for the particular miter box installation involved. Install two capscrews (21, FO-2) and six capscrews (7). Secure capscrews with lock wire.

6. Position input shaft assembly (6) over output shaft assembly and assemble each bearing retainer assembly (4), with corresponding shim set i5), on respective end of input shaft assembly and case. Secure each bearing retainer with two cap- screws (22). Do not tighten capscrews.

7. Lower case cover assembly (1) onto case being careful not to damage shim sets (5).

NOTE

Make certain inspection cover (57) is installed correctly. Breather (56) should be opposite gear on input shaft assembly (fig. 2-9).

8. Install capscrews (2, FO-2) in case cover assembly and tighten capscrews.

9. Install remainder of capscrews (22) to total ten, and two capscrews (23) in each bearing retainer assembly. Tighten capscrews and secure with lock wire.

10. Install eight capscrews (3) in case cover assembly flange and tighten capscrews.*1*1. Install air brake assemblies (para 2- 14).

(2*)* **Installation.** If a new miter box assernbly is to be installed, it will be necessary to determine if the miter box assembly is built up properly for the particular location. Since the miter box assembly must be disassembled to be installed, this can be determined during disassembly.

(a) Remove lock wire from capscrews (9, fig. 2-8) and remove capscrews, end plates (13), and coupling flanges (14). (b) Disassemble miter box assembly as outlined in b*(2)* (a), 2 through 6 above.

(c) Determine if input shaft assembly (6, fig. 2-9) and output shaft assembly (20) are built properly for the particular location (fig. 2-9).

*(*d) If shaft assemblies are not built up properly, disassemble shaft assemblies as outlined in b (2) (*d)* and (e) above and reassemble shaft assemblies as outlined in d (1) (*a)* and (b) above.

(e) Reassemble miter box assembly as outlined in *d(l) (e)* above.

2-16. Column and Wheel Drive Assembly

a. Removal.

(1) Disassemble miter box assembly (para 2-15 *b* (2) (*a) 1* through *6*).
(2) Drain lubricant from column and wheel drive assembly.
(3) Jack and shore up LARC at wheel well
(4) Remove tire (para 2-19).
(5) Support weight of column and wheel drive with a forklift truck or similar piece of equipment.
(6) Disconnect flexible hose (3, fig. 7-113) and remove swivel coupling (4) and nipple (5).
(7) Remove capscrew (9, FO-2) and remove column (10).
(8) Match-mark column and wheel drive assembly steering post and steering arm.

WARNING

Prior to removing lower pivot bearing assembly in step (9) below, make certain column and wheel drive assembly is properly secured and supported on a forklift truck or similar piece of equipment.

(9) Remove lower pivot bearing (para 2-17).

10) Lower column and wheel drive assembly slowly. Column and wheel drive should pass through bearing (53, FO-2).

(11) Remove coupling gears (46 and 49) and intermediate shaft (48) from column and wheel drive.
(12) Remove column and wheel drive boot assembly (para 2-18).

b Installation.

(1) Remove capscrews (51, FO-2) and remove bearing carrier (52). Remove seal (50) from bearing carrier and press bearing (53) out of bearing carrier. Inspect bearing for pitted, scored, or burned condition. Replace if defective.

(2) Lubricate bearing with grease, Military Specification MIL-G-10924, and press bearing into bearing carrier (52). Install a new seal (50) in bearing carrier and install bearing carrier with capscrews (51). Secure capscrews with lock wire.

(3) Install a new preformed packing (47) on male coupling gear 146). Pack female coupling on inside of column and wheel drive steering post with grease Military Specification MIL-G-10924, and install male coupling gear (46) in female coupling gear. Install intermediate shaft (48), and female coupling gear (49) inside column and wheel drive steering post.

(4) Install boot assembly on steering post (para 2-18).

(5) Position column and wheel drive assembly on a support frame. Using a suitable lifting device, preferably a forklift truck, maneuver column into position in wheel well.

(6) Slowly raise column into miter box case, aligning match marks on steering arm and steering post and being extremely careful not to damage seal 150), as steering post passes through bearing (53).

(7) Install column nut (10) on steering post and tighten nut while raising column. After nut is tightened, install capscrew (9).

(8) Install lower pivot bearing assembly (para 2-17).

(9) Remove forklift truck; coat threads of nipple 15, fig. 7-113) and swivel coupling (4) with Permatex, Military Specification MIL-S-7916, and install nipple and swivel coupling on bevel gear spider bearing cover. Connect flexible hose (3).

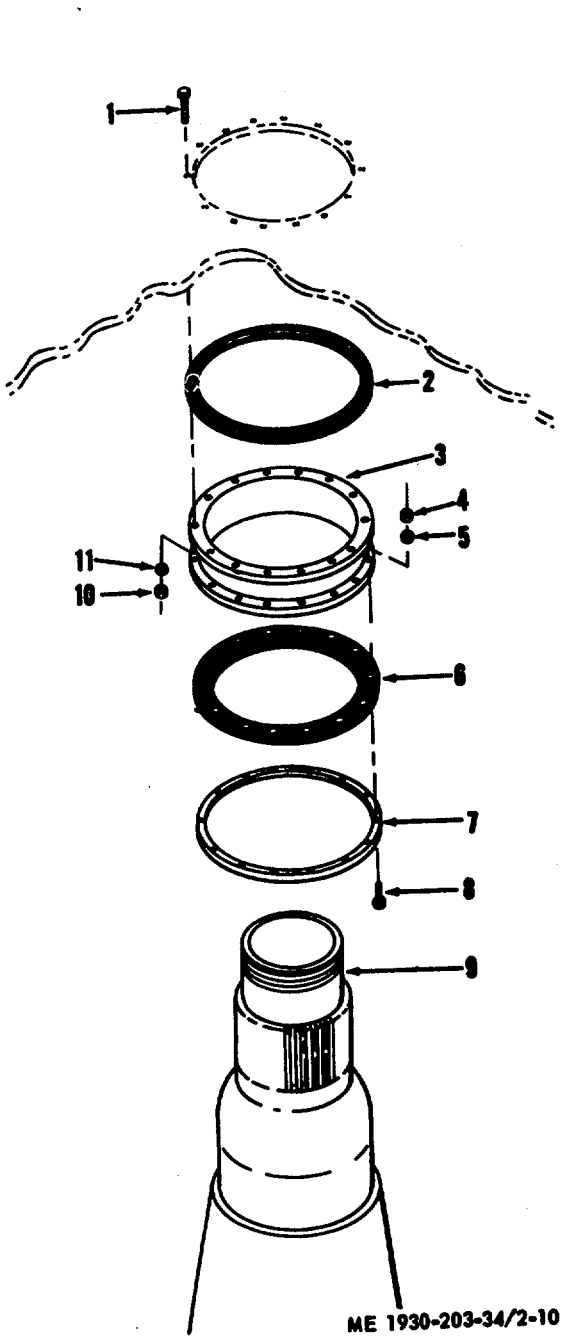
(10) Install tire (para 2-19).

(11) Fill column and wheel drive with proper lubricant and lubricate wheel seals (LO 55-1930- 203-12).

(12) Remove jack and shoring from LARC.

(13) Reassemble miter box assembly (para 2-15).

(14) Secure mounting ring (3, fig. 2-10) and gasket 12) to top of wheel well using 14 bolts (1), lockwashers (11), and nuts (10).



1 Bolt, machine
2 Gasket
3 Boot mounting ring
4 Nut
5 Lockwasher
6 Column and wheel drive boot
7 Boot retainer ring
8 Bolt, machine
9 Column and wheel drive
10 Nut
11 Lockwasher

Figure 2-10. Removal of column and wheel drive boot assembly.

2-17.Column and Wheel Drive Lower Pivot Bearing Assembly

a. Removal and Disassembly (fig. 2-11)

(1) Remove 29 nuts (8) and lockwashers 17), 25 bolts (9), and 4 fitted bolts (5).

(2) Remove lower pivot bearing mounting bracket (6) and shim (10), being careful not to damage shim.

(3) Remove seal (3) and if necessary pull lower pivot bushing (4) from lower pivot bearing mounting bracket.

b. Reassembly and Installation.

(1) If column and wheel drive assembly was removed, inspect steering post bushing (2) for damage during handling of column and wheel drive. If bushing is damaged, pull off old bushing and install a new one.

(2) Press lower pivot bushing (4) into lower pivot bearing mounting bracket (6), then install seal (3).

(3) Install lower pivot bearing mounting bracket and shim (10), using 29 nuts (8) and lock-washers (7), 25 bolts (91, and four fitted bolts (5).

Key to figure 2-11

1 Column and wheel drive assembly
2 Bushing, steering post
3 Seal
4 Bushing, lower pivot
5 Bolt, fitted
6 Bracket, lower pivot bearing mounting
7 Lockwasher
8 Nut
9 Bolt
10 Shim

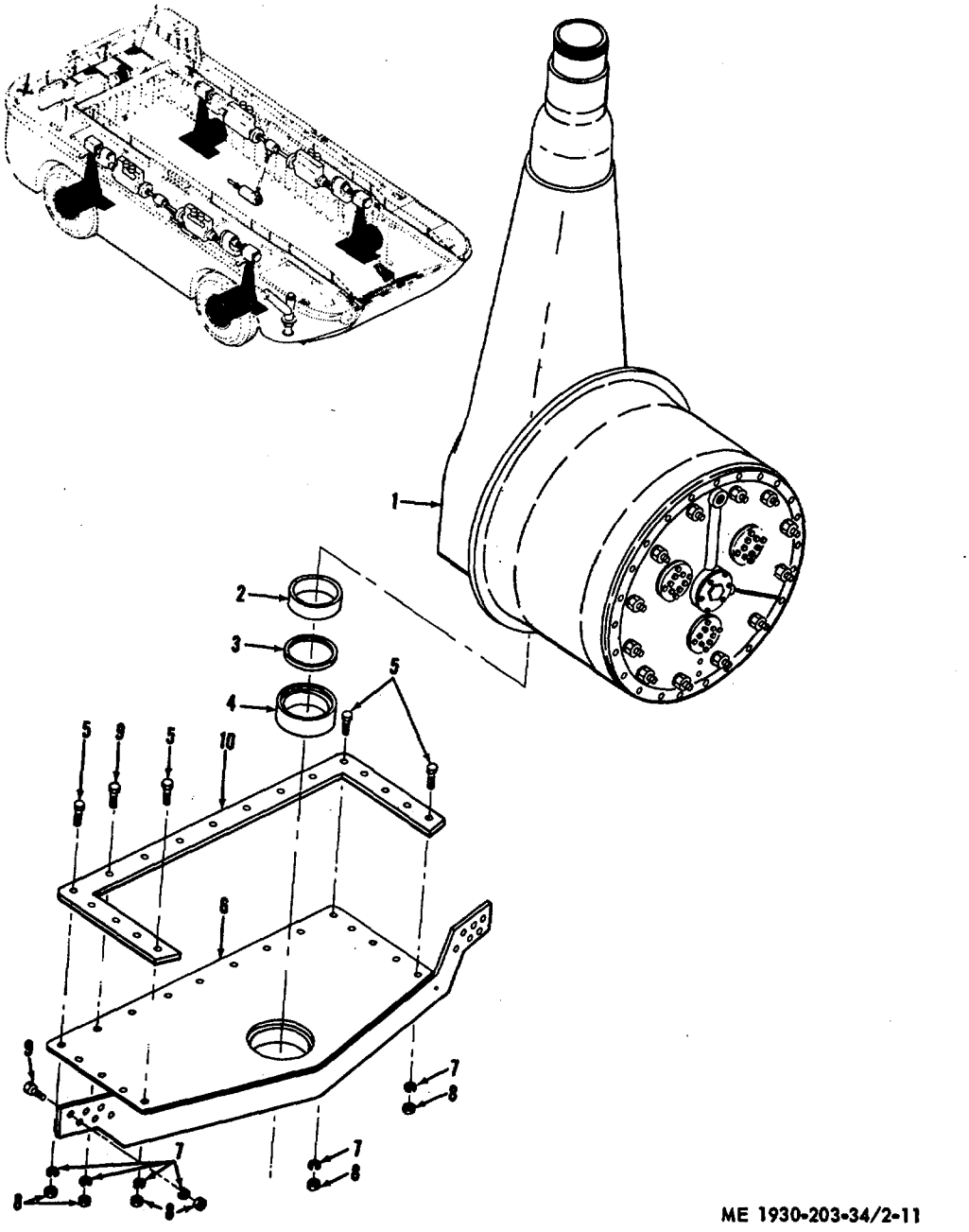


Figure 2-11. Column and wheel drive lower pivot bearing assembly.

2-18. Column and Wheel Drive Boot Assembly

a. Removal (fig. 2-10).

(1) Remove column and wheel drive assembly(para 2-16).

(2) Remove 14 bolts (8), lockwashers (5), and nuts 14); remove retainer ring (7) and boot (6).

(3) Remove 14 bolts (1), lockwashers (11), and nuts (10); remove mounting ring (3) and gasket (2).

b. Installation.

(1) Install retainer ring (7) and a new boot (6) on mounting ring (3) using 14 bolts (8), lock-washers (5), and nuts (4).

(2) Slip boot and mounting ring down over column and wheel drive steering post to boot area on steering post. Make certain lip of boot is toward outside to prevent water from entering around steering post.

(3) Position a new gasket (2) over steering post onto mounting ring.

(4) Install column and wheel drive assembly as outlined in paragraph 2-16 b (1) through (3) and (5) through (13). Secure mounting ring and gasket to top of wheel well using 14 bolts (1) lockwashers (11), and nuts (10).

2-19. Tires

a. .Removal. When replacing a tire, jack the LARC as follows:

NOTE

Be sure that all tire inflation valves are closed. (1) If tire at corner C, (fig. 2-12) is to be replaced, close globe valves installed in the airlines next to the miter boxes at corners A and C.

(2) Inflate tires at corners B and D to 69 psi.

(3) Close globe valves at corners B and D.

(4) Place jack under jacking pad at corner C on four 2 x 8 inch timbers at least 4 feet long.

CAUTION

The jack shall be used only to tilt the LARC to the. opposite corner of tire being removed. The jack will be damaged if used to lift the end of the LARC.

(5) Open tire inflation valve at corner A and slowly deflate tire with tire inflation-deflation pilot air valve located in the cab. At the same time jack the LARC at corner C.

CAUTION

Deflate tire at corner A only enough to allow tire at corner C to clear the ground. If tire at corner A is completely deflated, damage may occur to tire.

(6) Stop deflating the tire at corner A and jacking at corner C when the tire at corner C clears the ground. Close tire inflation valve at corner A.

NOTE

All wheels may be jacked by the procedure outlined in step (1) through (6) above by inflating and deflating respective tires and positioning the jack under the proper jacking pads.

(7) Open tire inflation valve at corner C and deflate tire with tire inflation-deflation pilot air valve located in the cab.

(8) Remove eight bolts 17, fig. 2-13) attaching side ring (15) to bead seat ring (13).

(9) Remove eight plug bolts (9) from bead seat ring (13) and replace eight side ring loosening bolts

(8) Screw in side ring loosening bolts until they make contact with side ring (15).

(10) Tighten each side ring loosening bolt (8) ½ turn in a circular sequence. Continue tightening until side ring (15) and side of tire (6) are free from wheel.

(11) Remove side ring loosening bolts (8) and replace plug bolts (9).

(12) Loosen opposite side ring (5) from wheel in a manner similar to steps (8) through (11) above.

(13) Remove 24bolts (12) attaching bead seat ring (13) to wheel.

(14) Remove three plug bolts (11) from bead seat ring (1 3) and replace with bead seat ring loosening bolts (10). Screw in- bead seat ring loosening bolts (10) until they make contact with the wheel.

(15) Tighten each bead seat ring loosening bolt (10) l/2 turn in a circular sequence. Continue tightening until bead seat ring (13) is loose.

(16) Remove bead seat ring loosening bolts (10) and replace plug bolts (11).

(17) Remove bead seat ring (13) and preformed packing (14 and 16).

(18) Run forks of a forklift truck under tire (6). Secure top and bottom of tire with a wire rope.

(19)Slightly lift tire and slowly back forklift away from LARC.

(20) Remove side rings (5 and-15) from tire (6).

CAUTION

Be extremely careful when removing side rings (5 and 15) so as not to damage the tire.

(21) Remove preformed packing (4) from wheel.

b. Installation.

(1) Using a wire brush, clean all metal surfaces that mate with the tire.

(2) Install preformed packing (4) and side ring (5). Attach side ring to wheel with bolts (3).

(3) Apply a coat of approved lubricant on wheel to aid installation of tire (6) to wheel.

(4) Place tire (6) on forklift.

(5) Raise tire to mounting position and press tire onto wheel.

(6) Install preformed packing 114) and side ring (15) onto bead seat ring (13). Secure side ring (151 to bead seat ring (I13) with bolts (7).

(7) Position preformed packing (16) and install bead seat ring (13) and side ring (15) on wheel. Secure bead seat ring (13) to wheel with 24 bolts (12). Tighten bolts to a torque of 600 foot- pounds.

(8) Slowly inflate tires at corners A and C (fig. 2-12) to 69 psi and slowly lower jack.

(9) Open globe valve at corners B and D. Deflate tires to normal operating pressure.

(10) Remove and stow jack and supporting timbers.

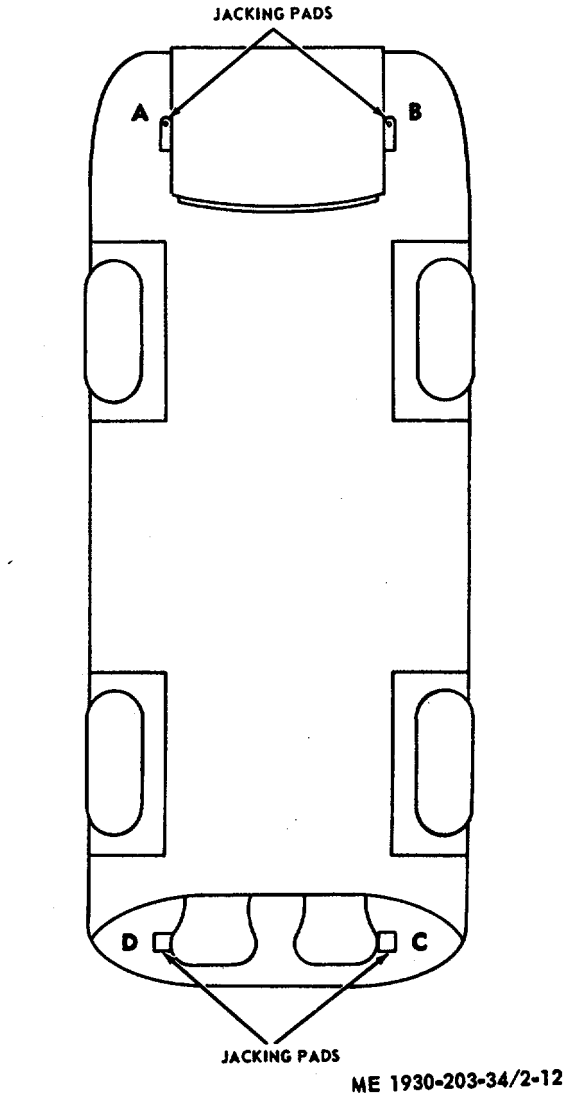
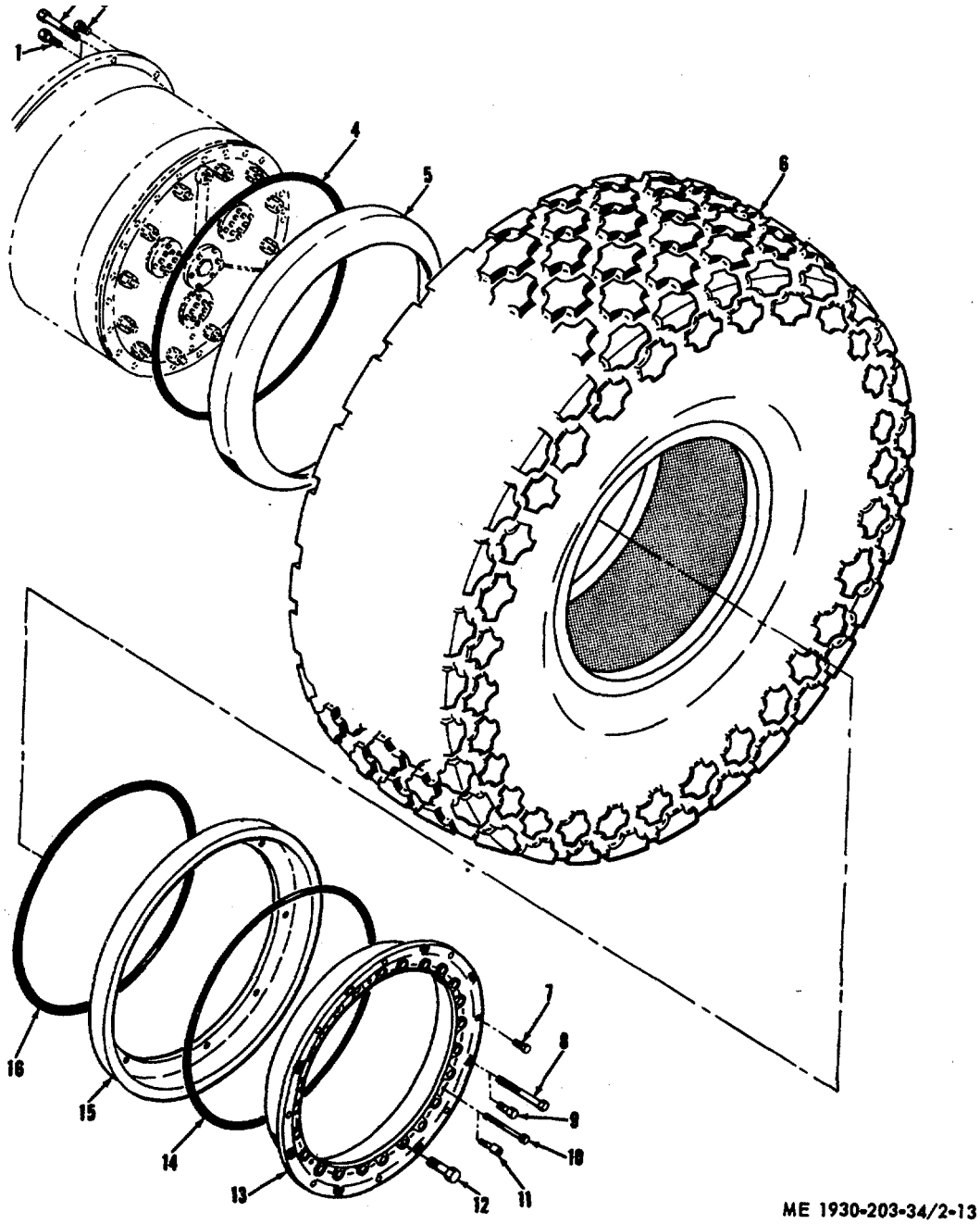


Figure 2-12. Jacking points.

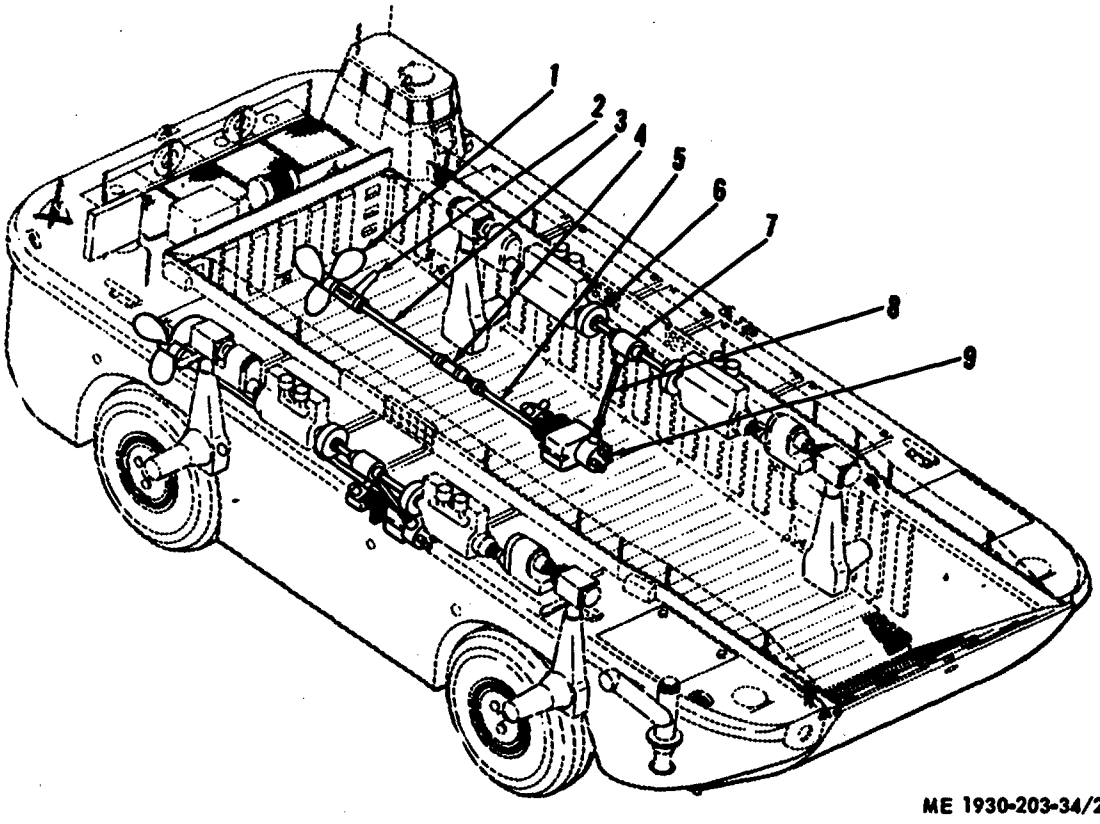


1 Bolt, plug
2 Bolt, side ring loosening
3 Bolt, side ring retaining
4 Packing, preformed
5 Side ring
6 Tire
7 Bolt, side ring retaining
8 Bolt, side ring loosening
9 Bolt, plug
10 Bolt, bead seat ring loosening
11 Bolt, plug
12 Bolt, bead set ring retaining
13 Bead set ring
14 Packing, preformed
15 Side ring
16 Packing, preformed

Figure 2-13. Tire removal

2-20. Marine Drive System

The marine drive system (fig. 2-14) consists of two dependent drive systems that are controlled separately. The marine drive system on the star- board side is basically the same as the port marine drive system. The marine gears control the direction of rotation for the propellers and also serve as power sources for the hydraulic and compressed air systems. Each marine gear has an independent oil system which lubricates and supplies. pressure for shifting of the gears. The marine drive system includes but is not limited to fluid coupling, gathering box, marine gear assembly, angle drive coop- ing, propeller and propeller shafting.



1 Propeller
2 Strut
3 Propeller shaft
4 Stern tube
5 Propeller intermediate shaft
6 Fluid coupling
7 Gathering box
8 Angle drive coupling
9 Marine gear

Figure 2-14. Marine drive system..

2-21. Fluid Coupling, Pillow Block, Flexible Coupling, and Engine Adapter Flange

a. Removal and Disassembly (fig. 2-15).

(1) Remove eight bolts (5), lockwashers (6), and nuts (7).

(2) Remove six bolts (3), lockwashers 12), and nuts (1); remove machinery guard (4).

(3) Drain fluid coupling (20).

(4) Remove four nuts (15), lockwashers (16), bolts (11), flat washers (12).

(5) Attach a suitable lifting sling and hoist to support fluid coupling (20), pillow blocks (21), flexible couplings (49 and 50), and shafts (43 and 48). Take up slack in hoist.

(6) Remove bolts (8) securing flanged shaft (48) to gathering box, and bolts (17) securing flexible coupling (511 to fluid coupling (20).

(7) Slide flanged shaft (48) and flexible coupling flange with closure plate (19) away from mating flanges.

(8) Lift fluid coupling (20), pillow blocks (21), flexible couplings (49 and 50), and shafts (43 and 48) from the LARC as an assembly.

(9) Remove chocks (13) and shims (14) and

mark so they may be installed in same position from which they were removed.

(10) Remove closure plate (19) and gasket (18) from flexible coupling (51).

(11) Remove flexible coupling (51) and machine key (36) from engine adapter flange (34).

(12) Remove bolts (35) and remove engine adapter flange (34). Using a puller, remove bearing (33) from engine adapter flange.

(13) Remove fluid coupling 120) from splined shaft (43).

(14) Remove nuts (47) and bolts (44) from flexible couplings (49 and 50). Separate flexible couplings and remove gasket (45) and spacer (46).

(15) Press hub gear (42) from flanged shaft (48) and remove machine key (36).

(16) Remove bolts (29) and lockwashers (30) from housing (28). Separate housings and remove from splined shaft (43).

NOTE

Mark upper and lower half of each pillow block housing (28) for proper reassemble. The upper halves and lower halves of pillow block housing are not interchangeable.

(17) Press hub gear (42) from splined shaft (43) and remove machine key (36).

(18) Remove ring seals (22 and 271, stabilizing rings (24A) locknuts (231, lockwashers (24), bearings (25), and sleeves (26)from splined shaft (43).

(19) Disassemble flexible couplings 149, 50, and 51) as follows:

(a) Separate gear hub (42 from flexible coupling flange (40).

(b) Remove lubrication fittings (39 and 41).

(c) Remove seal retainer (37) and seal (381 from flexible coupling flange (40).

Key to figure 2-15

1 Nut
2 Lockwasher
3 Bolt, machine
4 Machinery guard
5 Bolt, machine
6 Lockwasher
7 Nut
8 Bolt, machine
9 Gasket
10 Pin
11 Bolt, machine
12 Flatwasher
13 Chock
14 Shim
15 Nut
16 Lockwasher
1 7 Bolt, machine
18 Gasket
19 Closure
20 Fluid coupling
21 Pillow block
22 Ring seal
23 Locknut
24 Lockwasher
24A Stabilizing rings
25 Bearing
26 Sleeve
27 Ring seal
28 Housing, pillow block
29 Bolt
30 Lockwasher
31 Plug
32 Pin
33 Bearing
34 Engine adapter flange
35 Bolt, machine
36 Machine key
37' Seal retainer
38 Seal
39 Fitting, lubrication relief
40 Flexible coupling flange
41 Fitting, lubrication
42 Hub gear
43 Splined shaft
44 Bolt, machine
45 Gasket
46 Spacer
47 Nut
48 Flanged shaft
49 Coupling, flexible
50 Coupling, flexible
51 Coupling, flexible

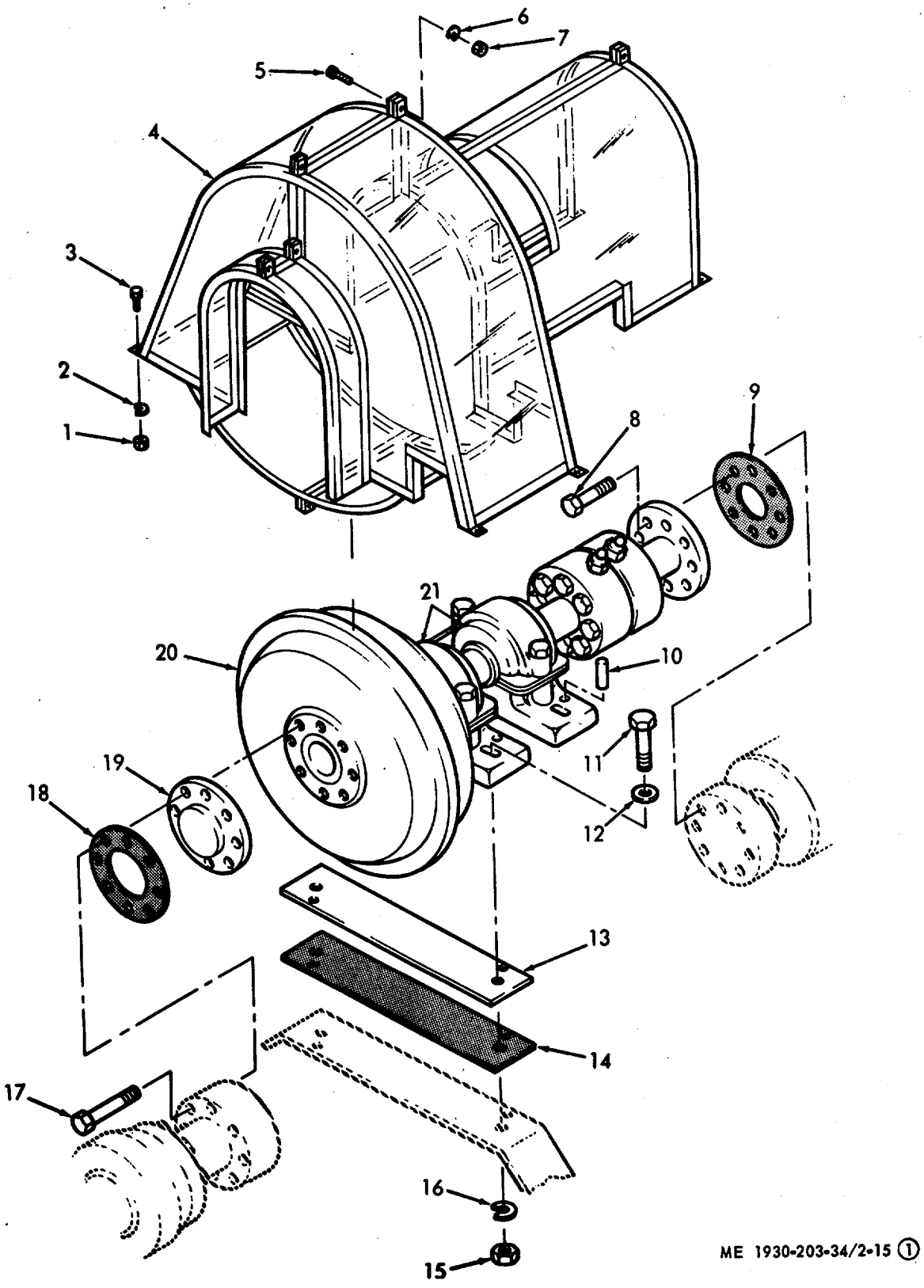


Figure 2-15. Fluid coupling, pillow block, flexible coupling and engine adapter flange (Sheet 1 of 3)

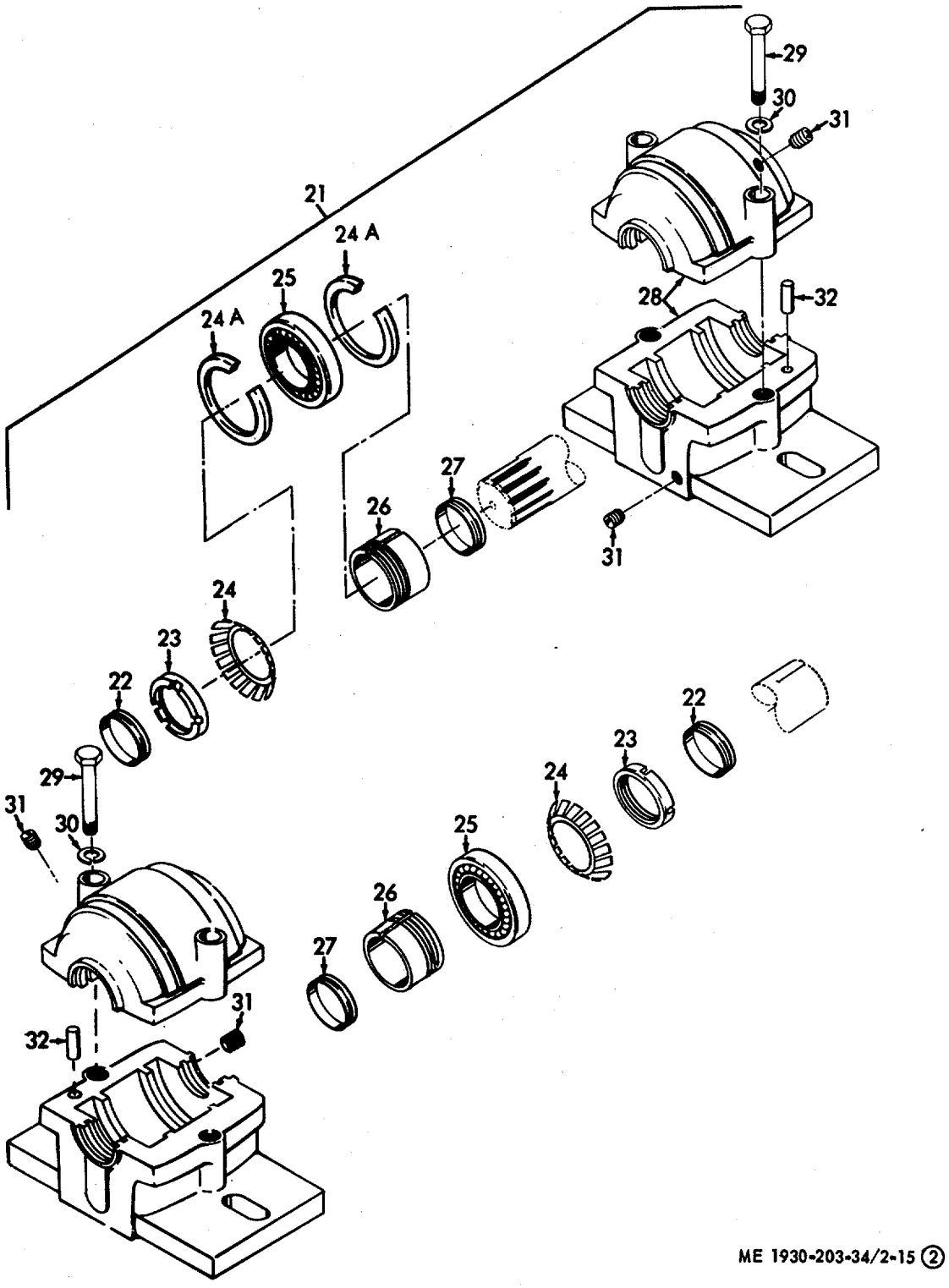


Figure 2-15. Fluid coupling, pillow block, flexible coupling and engine adapter flange (Sheet 2 of 3)

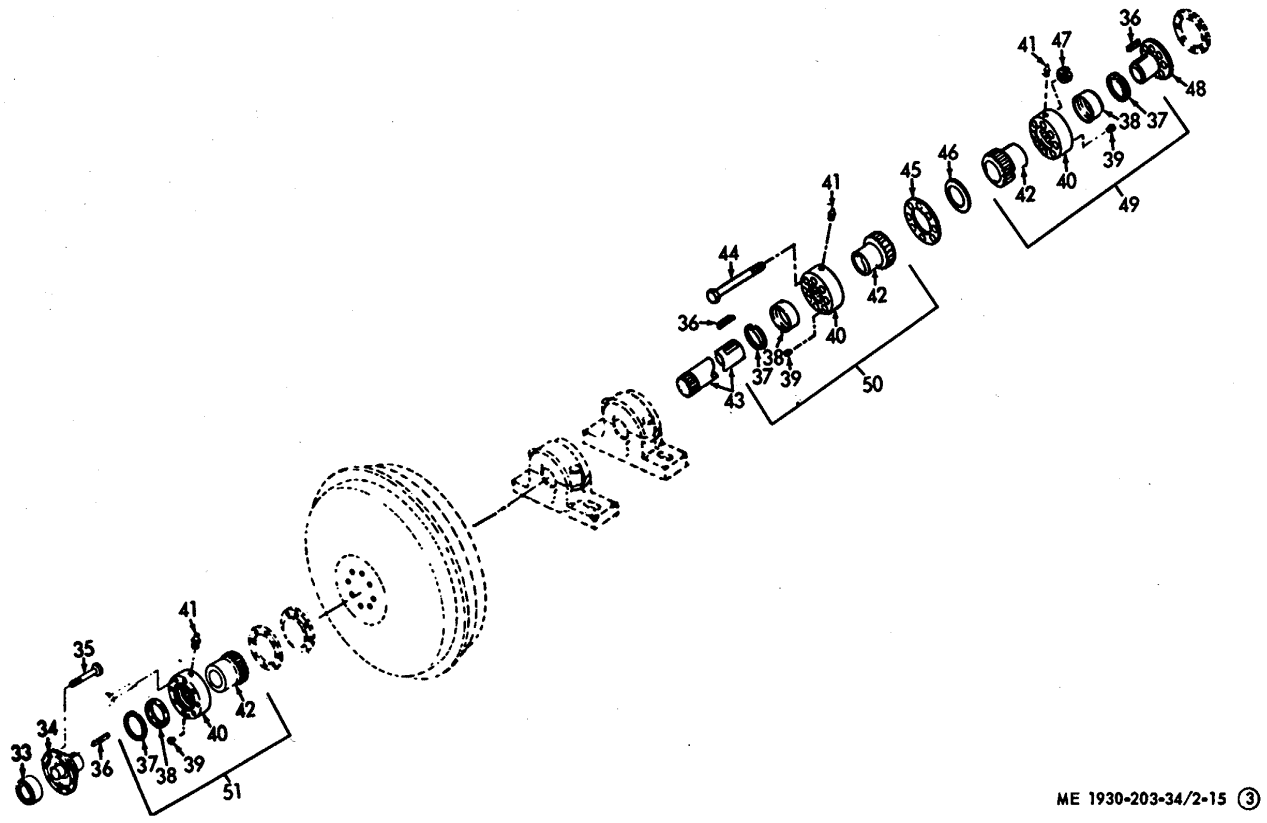


Figure 2-15. Fluid coupling, pillow block, flexible coupling, and engine adapter flange (sheet 3 of 3)

b. Reassembly and Installation.

(1) Reassemble flexible couplings (49, 50, 51, fig. 2-15) in reverse order of disassembly. Hand- pack couplings with grease, Military Specification MIL-G-23549, prior to installation.

(2) Press bearings 133) into engine adapter flange (34).

(3) Install machine key (36) on engine adapter flange (34) and press flexible coupling (51) onto the engine adapter flange.

(4) Install engine adapter flange with mounted flexible coupling using bolts (35). Tighten the bolts to a torque of 168-178 foot-pounds and install lockwire through bolt heads.

(5) Position shims (14) and chocks (13) in same location from which they were removed in a(9) above, and align lower half of pillow block housings (28) on foundation using tapered dowel pins (10). Bolt housings to foundation using bolts (11), flatwashers (12), lockwashers (16), and nuts (15). Tighten the bolts to a torque of 150 foot- pounds.

(6) Install machine keys (36) on splined shaft (43) and flanged shaft (48).

(7) Press flexible coupling (50) on splined shaft (43) and flexible coupling (49) on flanged shaft (48).

NOTE

It will be noted that stabilizing rings are used in only one of the pillow blocks as shown in figure 2-15.

(8) Assemble ring seals (27), sleeves (26), bearings (25), lockwashers (24), locknuts (23). ring seals (22), and stabilizing rings (24A) OD splined shaft (43) as shown in figure 2-15.

NOTE

Pack bearings (25) with grease, Military Specification MIL-G-23549, and lubricate chamfered face of locknuts (23) prior to installation.

NOTE

Locknuts (23) must be installed with chamfered face against lockwashers (24) and tightened only hand tight to allow alignment of bearings after installation in pillow block housings.

(9) Insert gasket (45) and spacer (46) between flexible couplings (49 and 501 and bolt the couplings together using bolts (44) and nuts (47). Tighten the nuts to a torque of 45 foot-pounds and install a cotter pin at nut end of each bolt and lock- wire through bolt heads.

(10) Slide the splined end of shaft (43) into fluid coupling (20).

(11) Attach a suitable lifting sling and hoist to the fluid coupling, shafts, and flexible couplings, and hoist the assembly into position over lower half of pillow block housings installed in (5) above. (12) Lower the assembly slowly and align bearings 125) with bearing seats and ring seals (22 and 27) with oil seal grooves in lower half of pillow block housings (28).

(13) Install gasket (18) and closure plate (19) on fluid coupling dowel pins. Bolt the flexible coupling (51) to the fluid coupling using bolts (17). Tighten the bolts to a torque of 45 foot-pounds and install lockwire through bolt heads.

(14) Insert gasket (9) between flanged shaft (48) and gathering box input flange, and bolt the shaft to the gathering box using bolts (8). Tighten the bolts to a torque of 45 foot-pounds and install lockwire through bolt heads.

(15) Center bearings (25) in lower pillow block housings and tighten locknuts (23) hand tight. With a spanner wrench, tighten the nuts an additional 1/8 turn.

CAUTION

Make certain that bearings 125) rotate freely to insure that locknuts (23) are not excessively tightened. (I 6) Bend tang of lockwasher (24) into slot of locknut (23).

NOTE

If slot of locknut is slightly past the tang of the lockwasher, do not loosen the locknut, but tighten the locknut to meet the nearest washer tang.

(17) Fill lower half of pillow block housings (28) half full of grease, Military Specification MIL- G-23549.

CAUTION

Do not over lubricate the pillow blocks as too much lubricant will result in high operating temperature due to churning of the lubricant.

(18) Apply non-hardening sealing compound, Military Specification MIL-S-45180, to the mating surfaces of the pillow block housings and install upper half of pillow block housings using bolts (29) and lockwashers (30).

NOTE

Insure that each upper half of pillow block housing (28) is assembled to the mating part from which it was removed in a (16) above.

(19) Fill fluid coupling (LO 55-1930-203-12).

(20) Position machinery guard (4) over fluid coupling.

(21) Install eight bolts (5), lockwashers (6), and nuts (7), and bolts (3), lockwashers (2), and nuts (1).

2-22. Gathering Box Assembly

a. Removal

(1) Remove bolts (9, fig. 2-16),nuts (11), and

lockwashers (10) and remove machinery guards (12 and 16).

(2) Remove capscrews (17) and lockwashers (18) from each flexible coupling flange (3).

(3) Slide flanges (3) back and remove marine gear angle drive coupling with gaskets (1).

(4) Remove four capscrews (21, fig. 2-11), lockwashers (22), and nuts (23); remove step guard (20).

(5) Disconnect cable assembly (5, fig. 6-1) from alternator.

(6) Remove cover (2) by removing three capscrews (1).

(7) Remove capscrew (6) and lockwasher (7) attaching generator to adjusting bracket.

(8) Loosen mounting bolts (11) and slightly move 'generator inward toward gathering box and slip belt (8) from fan pulley.

(9) Remove mounting bolts (11), lockwashers (10), and nut (9) securing generator to mounting bracket (14) and remove generator (13).

(10) Remove bolts (3 and 5, fig. 2-15), lockwashers (2 and 6), nuts (1 and 7), and remove machinery guards (4).

(11) Remove bolts (8) securing flanged shaft (48) to gathering box.

(12) Remove nuts (47) and bolts (44) from flexible couplings (49 and 50), and separate flexible coupling flanges (40).

(13) Remove flanged shaft (48) and flexible coupling (49) from the LARC as an assembly, and remove gaskets (9 and 45) and spacer (46).

(14) Remove drain plug (12, fig. 2-17), and drain lubricant from gathering box (3) into a suitable container. After lubricant is drained, replace drain plug.

(15) Remove drain plugs (18), one at a time, and drain lubricant from oil coolers (19). After lubricant is drained, replace drain plugs.

(16) Disconnect oil bypass flexible hose (1), oil supply-from-oil cooler flexible hose (4), and oil supply-to-oil cooler flexible hose (11). Tag hoses for identification.

(17) Disconnect oil temperature tube and thermometer (6).

(18) Disconnect cable from high temperature sending unit (15) and remove the sending unit.

(19) Remove adapters (2 and 10), reducer (9), nipple (8), elbow (7) and nipple (5) and retain for installation.

(20) Remove nuts (14) and lockwashers (13).

(21) Mark fitted mounting bolts (17) and shims (16) so they may be installed in the same position from which they were removed.

(22) Remove fitted mounting bolts (17).

(23) Using a suitable hoist and with necessary personnel, lift gathering box from mounting.

(24) Remove fitted shims (16).

b. Installation.

(1) Position gathering box (3) on mounting and install four fitted shims (16), fitted mounting bolts (17), lockwashers (13), and nuts (14).

(2) Install adapters (2), nipple (5), elbow (7), nipple (8), reducer (9), and adapter (10).

(3) Connect flexible hoses (1, 4, and 11) to gathering box.

(4) Install high temperature sending unit (15) and cable.

(5) Install oil temperature tube and thermometer (6).

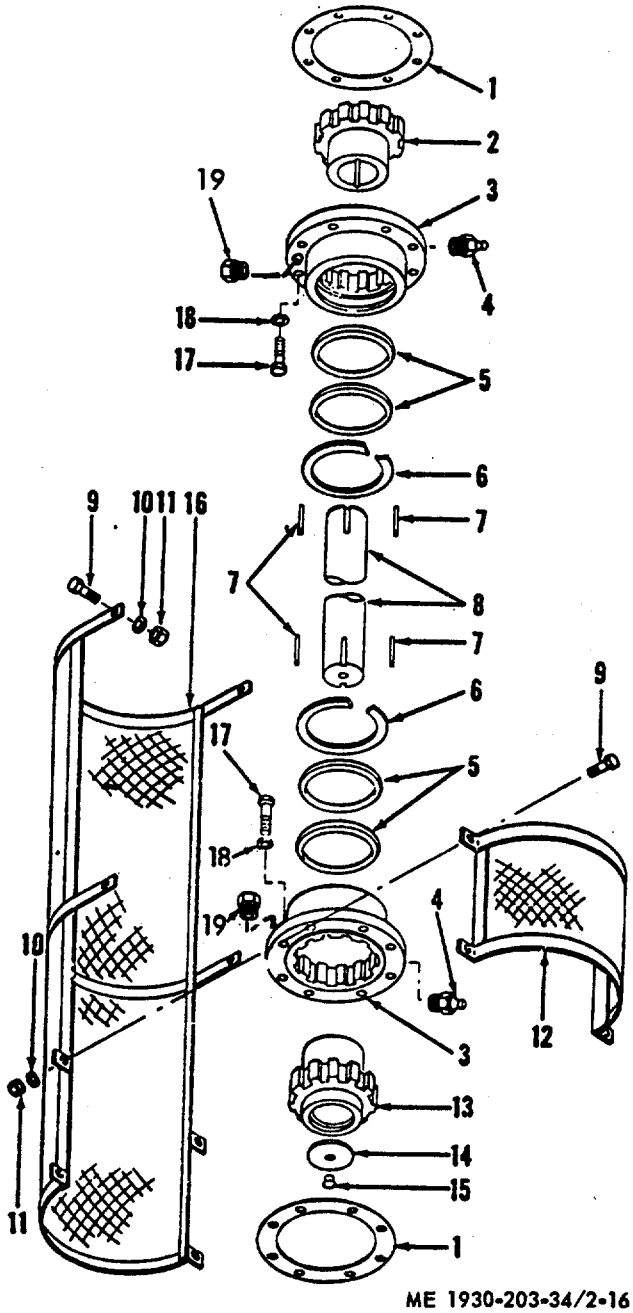
(6) Hand pack flexible couplings (49 and 50, fig. 2-15) with grease, Military Specification MIL-G-23549.

(7) Position flanged shaft (48) and flexible coupling (49) between the gathering box input flange and flexible coupling (50), and in conjunction insert gasket (45) and spacer (46) between flexible couplings (49 and 50) and gasket (9) between the flanged shaft and gathering box input flange.

(8) Bolt the flexible couplings together using bolts (44) and nuts (47), and bolt the flanged shaft to the gathering box input flange with bolts (8). Tighten nuts (47) and bolts (8) to a torque of 45 foot-pounds.

(9) Install a cotter pin at nut end of each bolt (44) and lockwire heads of bolts (8 and 44).

(10) Position machinery guards (4) over fluid coupling. Install eight bolts (5), lockwashers 16), and nuts (7), and six bolts (33), lockwashers (2), and nuts (1).



1 Gasket
2 Hug gear
3 Flange
4 Fitting, lubrication
5 Seal
6 Retaining ring
7 Key
8 Shaft
9 Bolt, machine
10 Lockwasher
11 Nut
12 Machine guard
13 Hub gear
14 Thrust plate
15 Button
16 Machinery guard
17 Capscrew
18 Lockwasher
19 Fitting, lubrication relief

Figure 2-16. Gathering box-marine gear angle drive coupling.

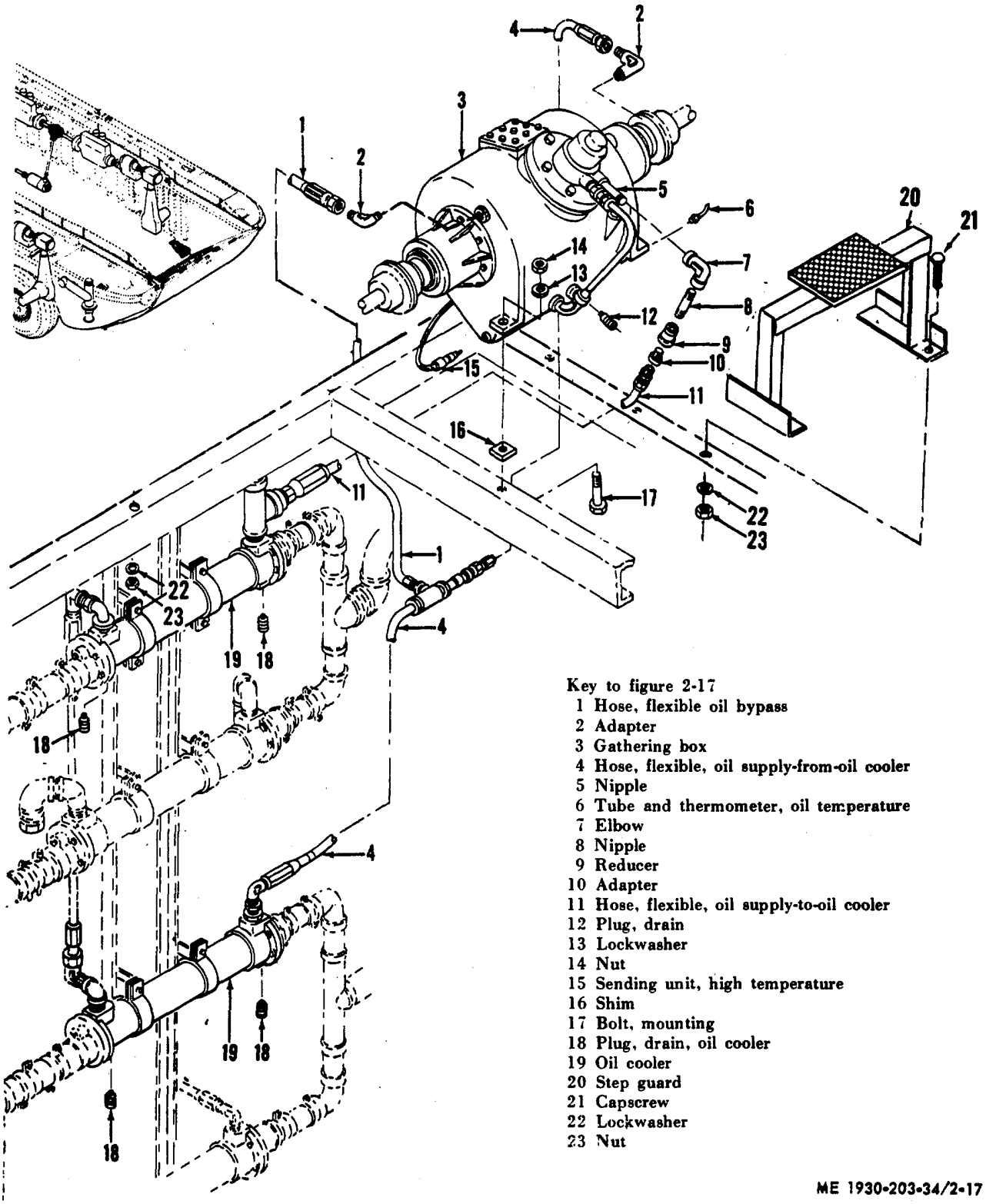


Figure 2-17. Gathering box, removal and installation.

(11) Install battery charging generator and V-belt on gathering box.
(12) Install gathering box-to-marine gear flexible coupling.
(13) Fill gathering box to proper level as shown on dipstick. Refer to LO 55-1930-203-12 for proper lubricant.
(14) Install step guard (20), using capscrews (21), lockwashers (22), and nuts (23).
(15) Run appropriate engine for a period sufficient to allow oil to circulate through oil coolers. Shut down engine and recheck oil level. Fill as necessary.

2-23. Air Compressor (Model 3YC) and Coupling Assembly

a. *Removal*

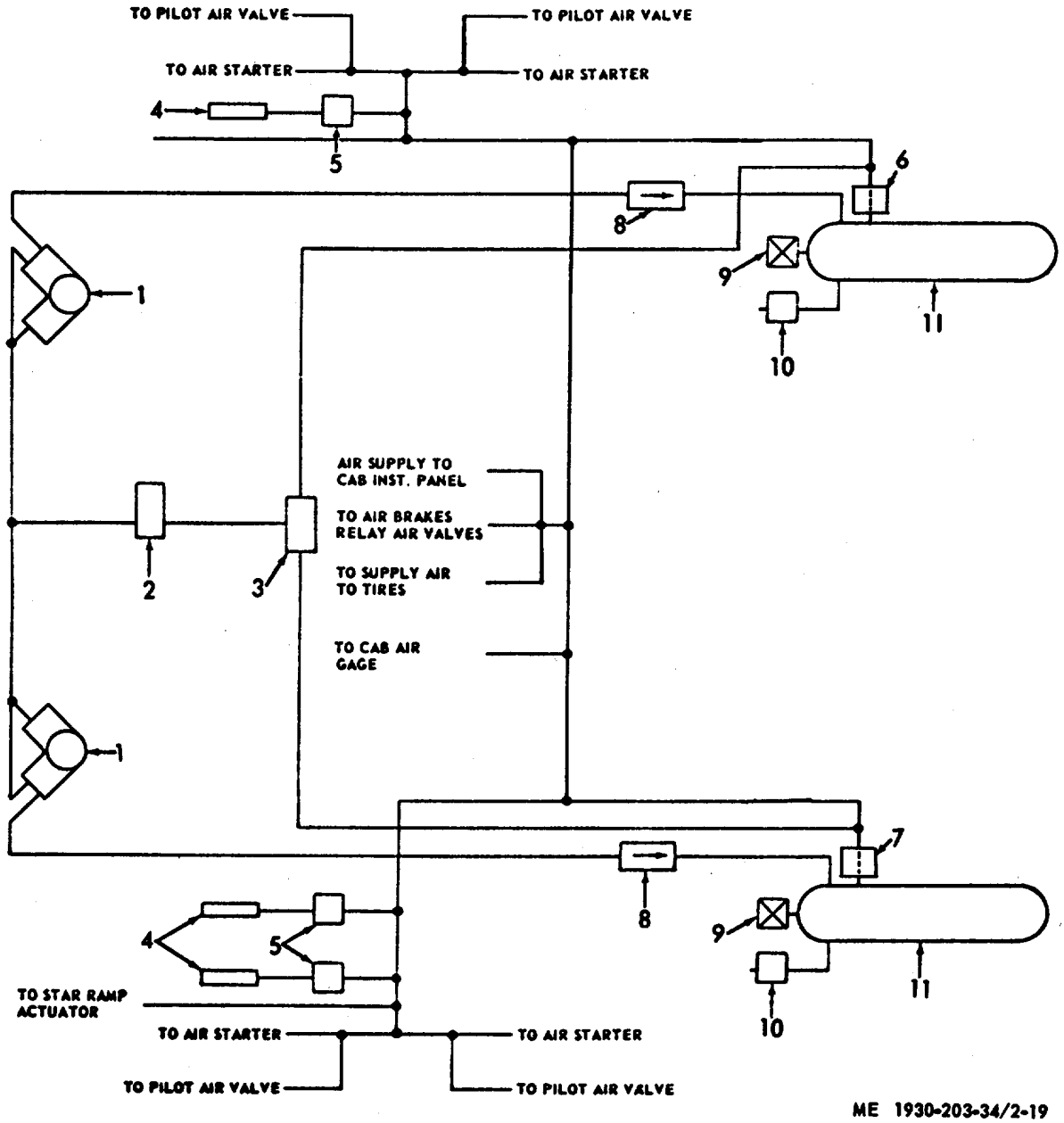
(1) Drain oil from air compressor. (TM 55-1930-203-20).
(2) Close globe valves (6 and 7, fig. 2-19) located in air lines above air supply tanks and open service connection globe valves (5) to vent compressed air from lines.

WARNING

Before attempting to remove any compressed air system lines or components, relieve pressure from system. Failure to do so may result in injury or death to maintenance personnel.

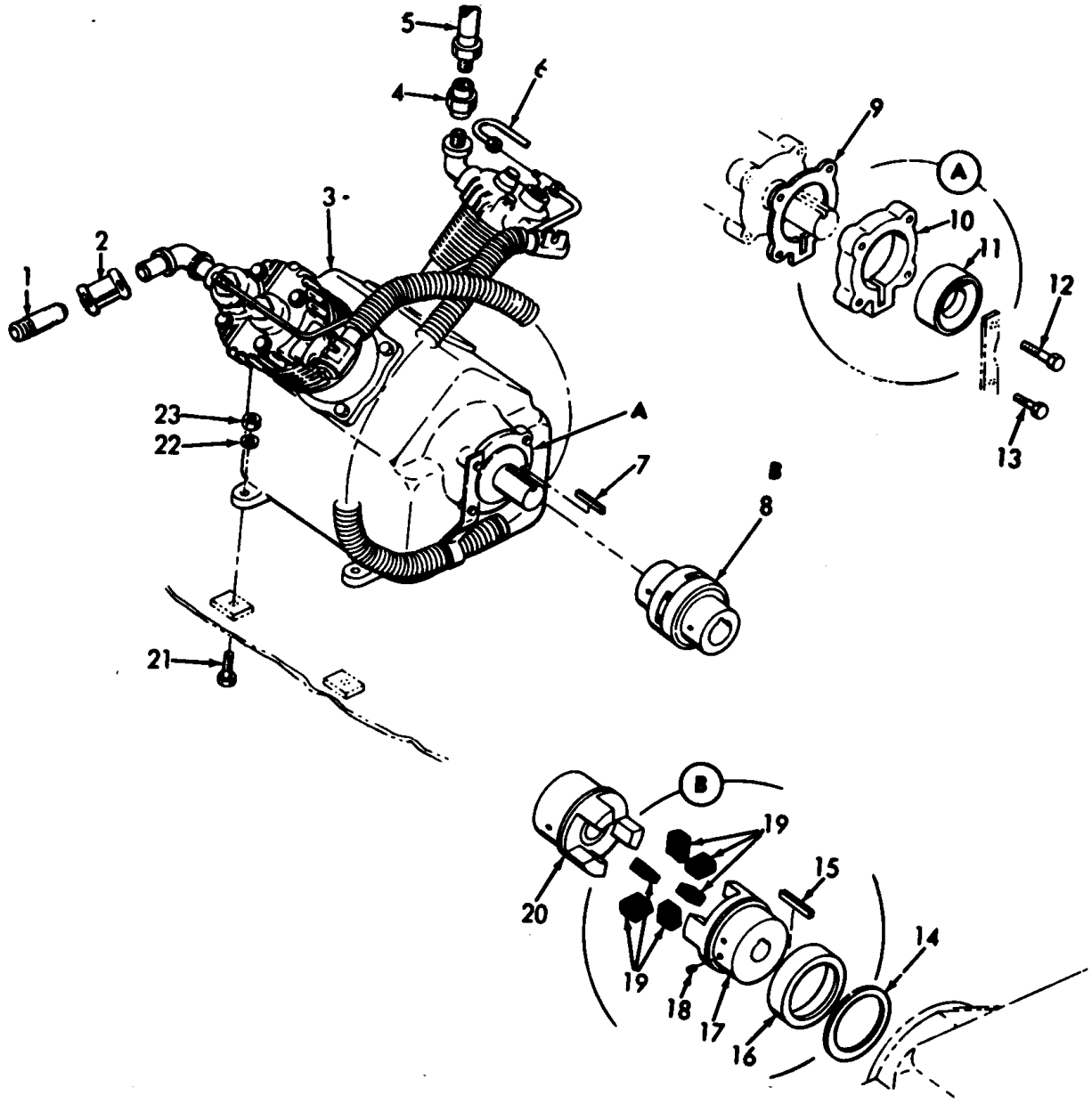
(3) Disconnect air compressor input and output tubes (1and 5, fig. 2-20) at pipe coupling (2) and union (4).
(4) Disconnect air compressor unloader to governor tube (6) at high pressure cylinder on air compressor.
(5) Loosen setscrews (18) in coupling half (20) of coupling assembly (8).
(6) Remove bolts (21), lockwashers (22), and nuts (23) and slide air compressor rearward until crankshaft is withdrawn from coupling assembly.
(7) Remove key (7) from air compressor.
(8) Remove air compressor.
(9) Loosen setscrews (18) in marine gear end coupling half (17) and remove coupling assembly (8) and key (15) from marine gear take-off shaft.

b. Installation. Install air compressor and coupling assembly in reverse order of removal.



1 Air compressor
2 Air compressor governor
3 Shuttle valve
4 Service connection
5 Service connection globe valve
6 Port globe valve
7 Starboard globe valve
8 Check valve
9 Safety relief valve
10 Drain valve
11 Air supply tank

Figure 2-19. Air supply system.



1 Tube, air compressor input
2 Pipe coupling
3 Air compressor
4 Union
5 Tube, air compressor output
6 Tube, air compressor unloader-to-governor
7 Key
8 Coupling assembly
9 Gasket
10 End flange
11 Seal
12 Capscrew
13 Capscrew
14 Retaining ring
15 Key, marine gear take-off shaft
16 Collar
17 Coupling half, marine gear end
18 Setscrew
19 Insert
20 Coupling half, compressor end
21 Bolt, machine
22 Lockwasher
23 Nut
24 Unloader tube

Figure 2-20. Air compressor, Model 3YC, and coupling assembly, removal and installation

2-24. Air Compressor (Model 3VC) and Coupling Assembly

a. Removal

(1) Drain oil from air compressor (TM 55-1930-203-20).

(2) Close globe valves (6 and 7, fig. 2-19) located in airlines above air supply tanks and open service connection globe valves (5) to vent air pressure from lines.

WARNING

Before attempting to remove any compressed air system lines or components, relieve air pressure from system. Failure to do so may result in injury or death to maintenance personnel.

(3) Disconnect air compressor input and output tubes 1 4 and 16, fig. 2-21) at pipe coupling (12) and union (15).

(4) Disconnect air compressor to governor tube (13).

(5) Remove retaining ring (1) from groove and slide retaining ring and collar (2) back. Remove inserts (5) from coupling.

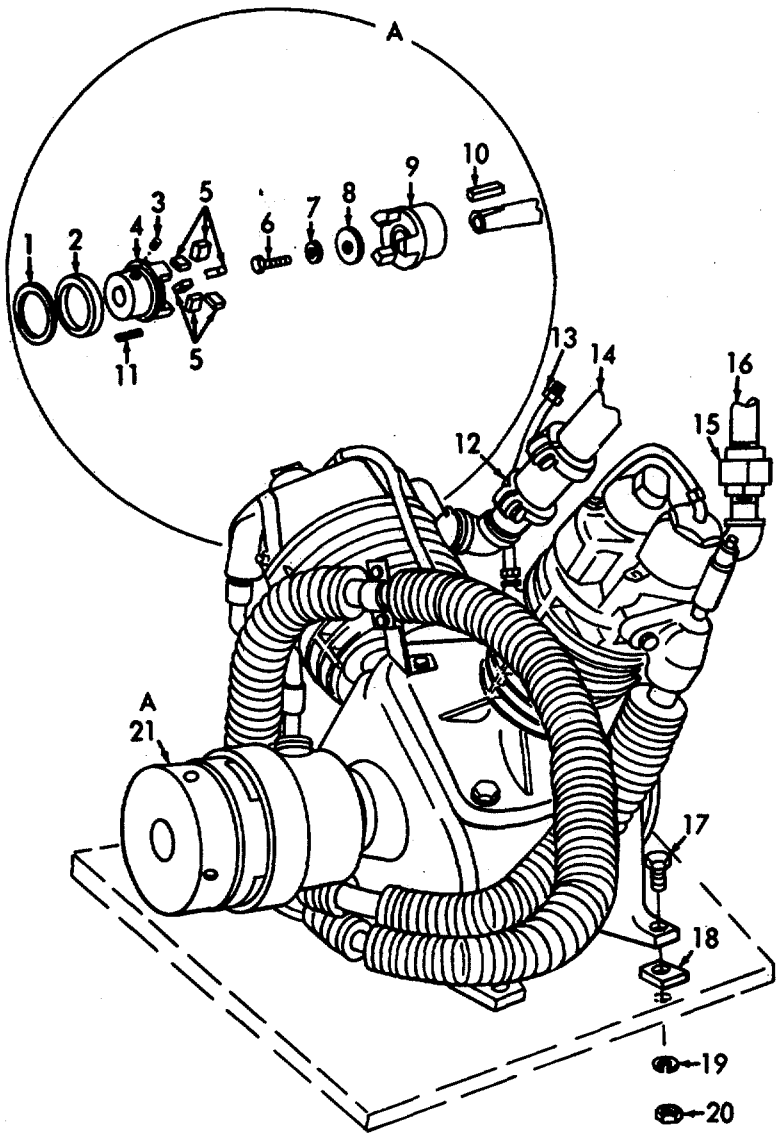
(6) Remove nuts (20), lockwashers (19), and capscrews (17).

(7) Remove air compressor and shims (18).

(8) Remove capscrew (6), lockwasher (7), flatwasher (8), coupling half (9), and key (10) from compressor shaft.

(9) Loosen setscrews (3) in marine gear coupling half (4) and remove coupling half and key (11) from marine gear take-off shaft.

b. Installation. Install the air compressor and coupling assembly in the reverse order of removal.



1 Retaining ring
2 Collar
3 Setscrew
4 Coupling half, marine gear end
5 Insert
6 Capscrew
7 Lockwasher
8 Flatwasher
9 Coupling half, compressor end
10 Key, air compressor shaft
11 Key, marine gear take-off shaft
12 Pipe coupling
13 Tube, air compressor unloader-to-governor
14 Tube, air compressor input
15 Union
16 Tube, air compressor output
17 Capscrew
18 Shim
19 Lockwasher
20 Nut
21 Coupling assembly

Figure 2-21. Air compressor, Model 3VC, and coupling assembly, removal and installation.

2-25. Procedures for Replacing Model3YC Air Compressor With Model 3VC Air Compressor

a. Model 3YC air compressors are obsolete, and when either the port or starboard air compressor becomes uneconomical to repair, both of the air compressors will be replaced with Model 3VC air compressors. Replacement of Model 3YC with Model 3VC require foundation changes and relocation of the air compressor governor. Some LARC's have air compressor foundations which have been previously changed; therefore, prior to work determine if the complete change has been accomplished. Measure the distance from the center line of the marine gear power take-off shaft to the top of the foundation. If the measurement is 7-1/4 inches or more and the foundation is mounted on a double plate, the change has been accomplished.

b. Remove the Model 3YC air compressor as outlined in paragraph 2-23.

c. Fabricate and install the air compressor foundation in accordance with figure 2-22.

d. Install the straight bore half of coupling (4) onto the marine gear power take-off shaft. Tighten coupling set screws.

e. Install the tapered bore half of the coupling on the air compressor shaft.

f. Set air compressor (1) with shims (5) on bed plate (7). Bring coupling halves together allowing 1/8 inch gap between the end of the jaws and the opposite flange.

g. Using a straight edge over the coupling halves, align to correct elevation within 0.003 inches. This alignment will be accomplished by appropriate machining of shims (5) or by adding other suitable shim material. The required parallelism in the vertical plain is also 0.003 inches. Angularity as measured at the edge of the coupling flanges will not be greater than 0.006 inches.

h. When the alignment has been determined to be within tolerances, scribe and drill four 17 / 32 inch compressor mounting holes in bed plate (7). Mount the air compressor on the bed plate with bolts (6), lockwashers (8), and nuts (9).

i. Assemble the flexible coupling and recheck alignment to insure that it is within tolerances.

j. Fabricate a new air compressor governor bracket (10) and weld to the 7 foot longitudinal bulkhead as shown in figure 2-22 (6). Mount the air compressor governor on the new bracket. The piping runs are less than those of the current governor installation; therefore, piping, fittings, and fastenings will be reused.

Key to figure 2-22 (sheets 1 thru 6)

ITEM	QTY	DESCRIPTION	MAT'L	FMS	VENDOR P/N	SPEC	FSN	REF
1	2	Air Compressor, 3VC		35301	3VC-SPEC-454-5		4310-917-7352	(1)
2	2	Pipe Coupling		98625	6500-1-1-4-325		4730-104-4380	(1)
3	4	Key 3/8 x2/8x 2 ½	Steel	16603	BK-18E		5315-506-1447	(1)
4	2	Coupling		75665	020767-C		4320-168-2023	(1)
5	8	Shim Plate 2" x 2"	Steel ½ PL			QQ-S-741	9515-222-5048	(1) (4)
6	8	½" - 13NC2-4 ½ Hex Screw	Steel			MS-90724-125	5305-716-8128	(1)
7	2	Bed Plate 15" x 15"	Steel 3/8 PL			QQ-S-741	9515-222-5040	(1) (2) (4)
8	8	½-Med Lockwasher	Steel			MS-35337-48	5310-045-3298	(1)
9	8	½-13NC2-Hex Nut	Steel			MS-35691-805	5310-816-1030	(1)
10	2	Bracket-Governor	Steel 10G			QQ-S-741	9515-237-1861	(4) (6)
11	2	Doubler Plate 21 x 24	Steel ½ PL			QQ-S-741	9515-222-5048	(2) (3)
12	2	End Plate 5 x 18	Steel ¼ PL			QQ-S-741	9515-222-5040	(2) (4)
13	2	End Plate 8 x 18	Steel ¼ PL			QQ-S-741	9515-222-5090	(2) (4)
14	4	Brace 3" x 16 1/	Steel ¼ PL			QQ-S-741	9515-222-5040	(2) (4)
15	6	Gussett 10" x 8"	Steel ¼ PL			QQ-S-741	9515-229-0196	(2) (5)
16	2	Gussett 5 ½" x 3 ½	Steel ¼ PL			QQ-S-741	9515-229-0196	(2) (5)

NOTES:
1. QUANTITIES ARE FOR ONE LARC LX.
2. MATERIAL NOT SHOWN IS FURNISHED WITH COMPRESSOR OR RECLAIMED FROM PRESENT INSTALLATION.

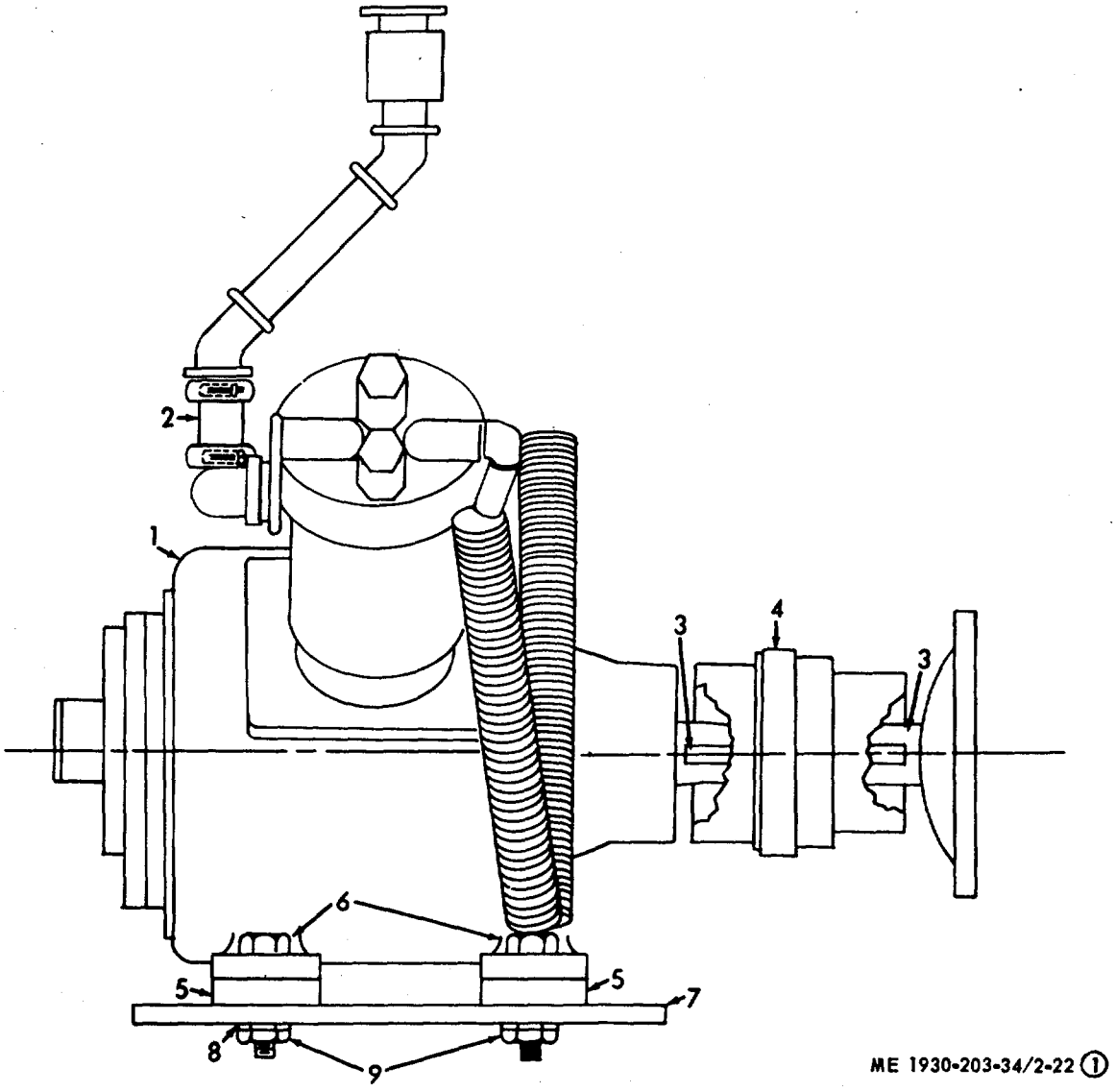


Figure 2-22. Installation of 3VC air compressor (Sheet 1 of 6).

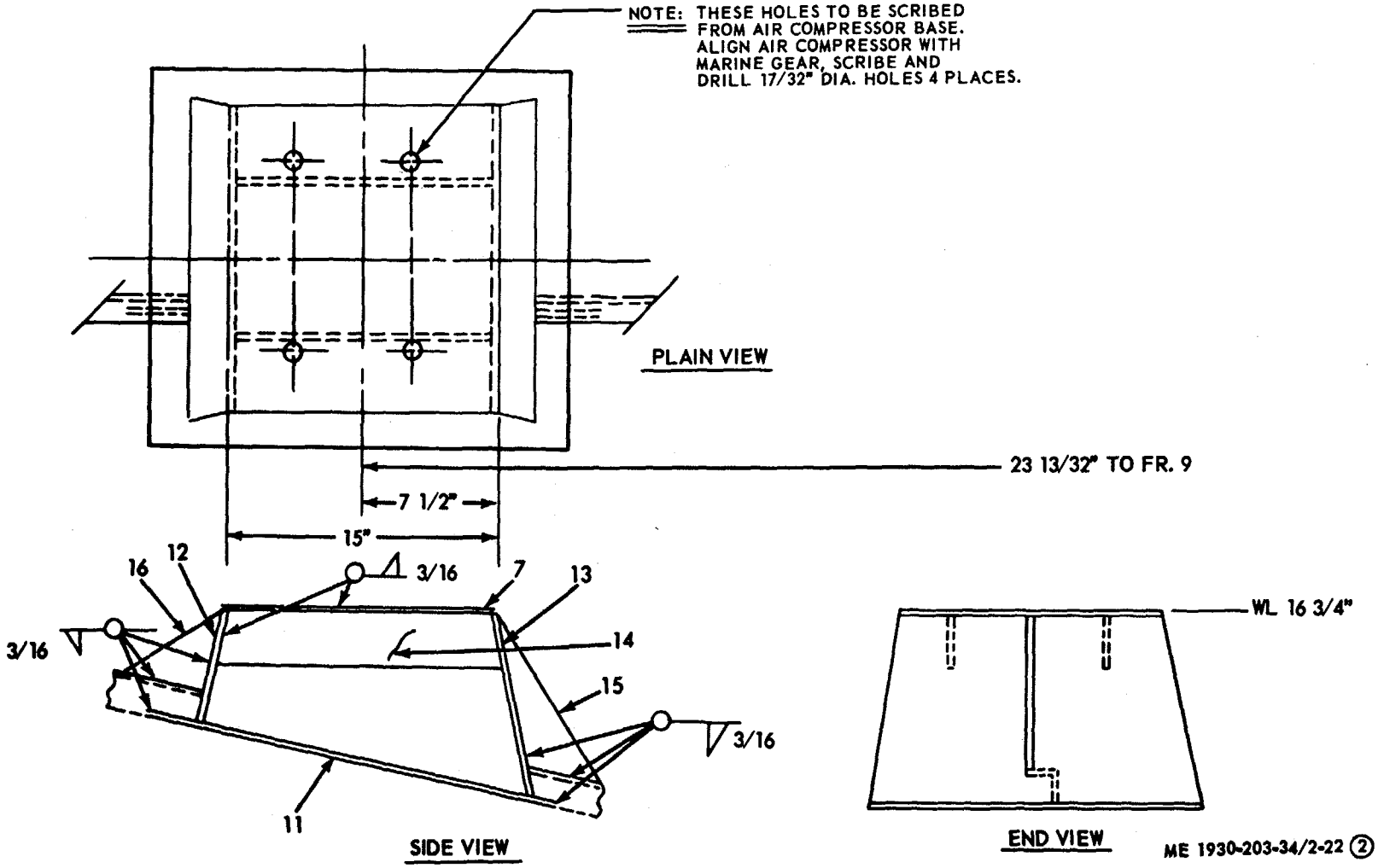


Figure 2-22. Installation of 3VC air compressor (Sheet 2 of 6).

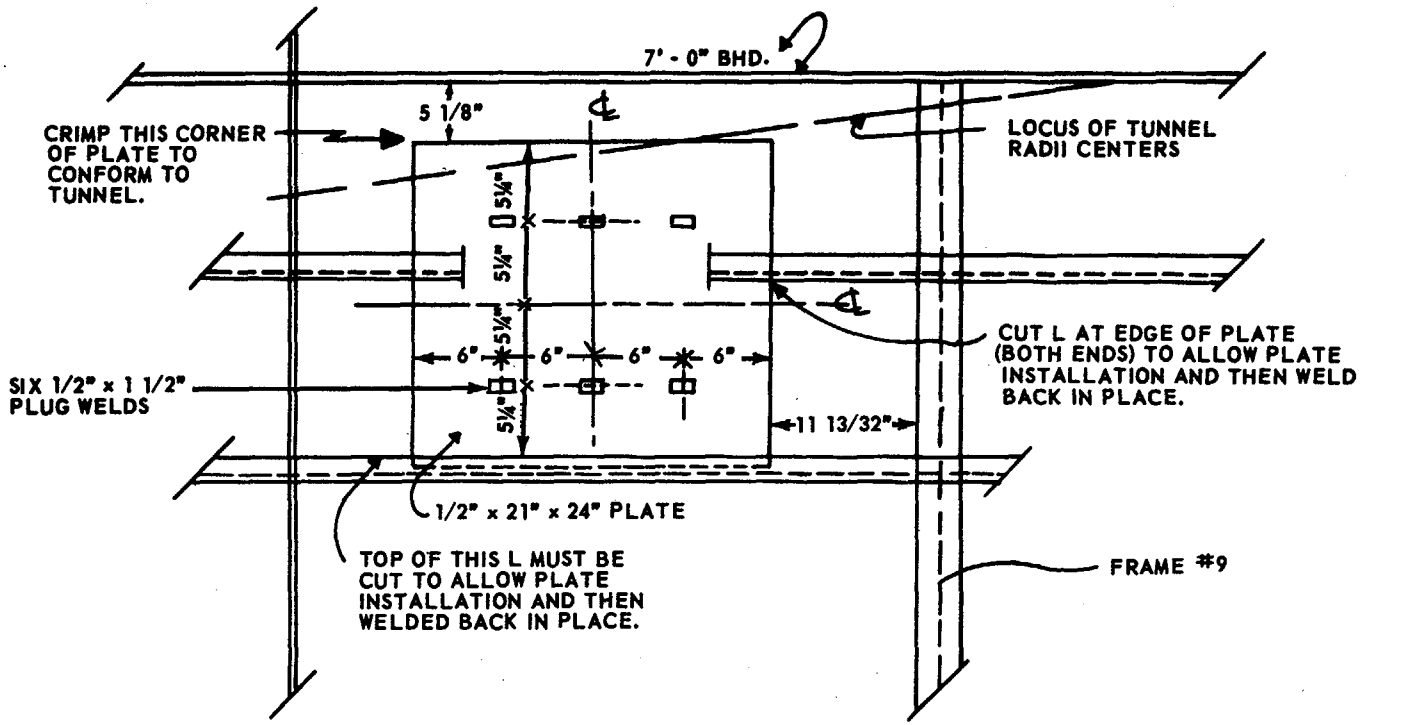


Figure 2-22. Installation of 3VC air compressor (sheet 3 of 6).

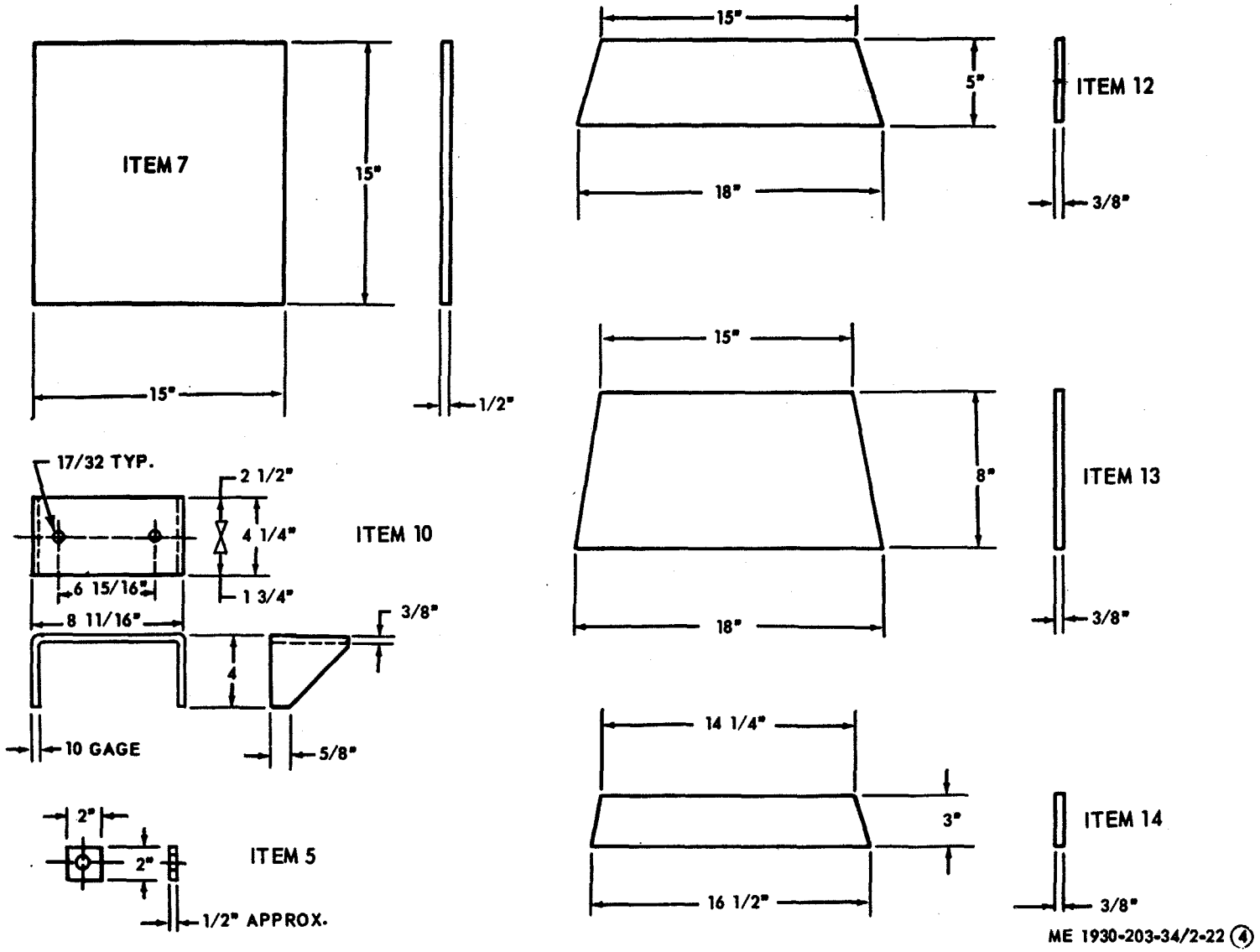


Figure 2-22. Installation of 3VC air compressor (sheet 4 of 6)

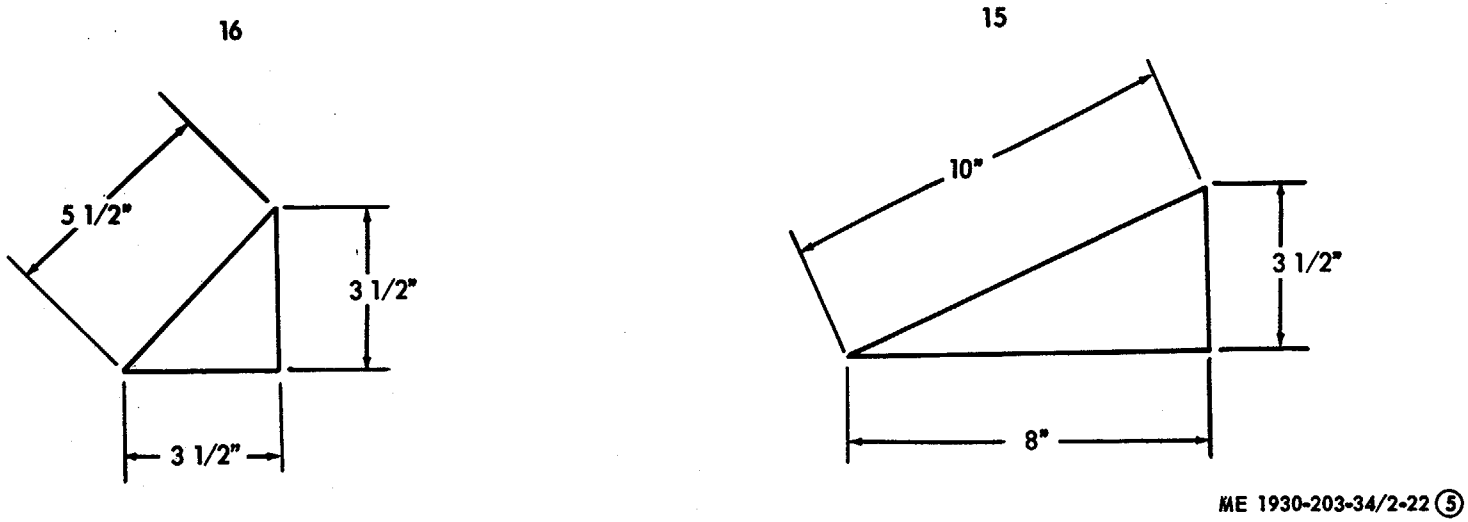


Figure 2-22. Installation of 3VC air compressor (Sheet 5 of 6).

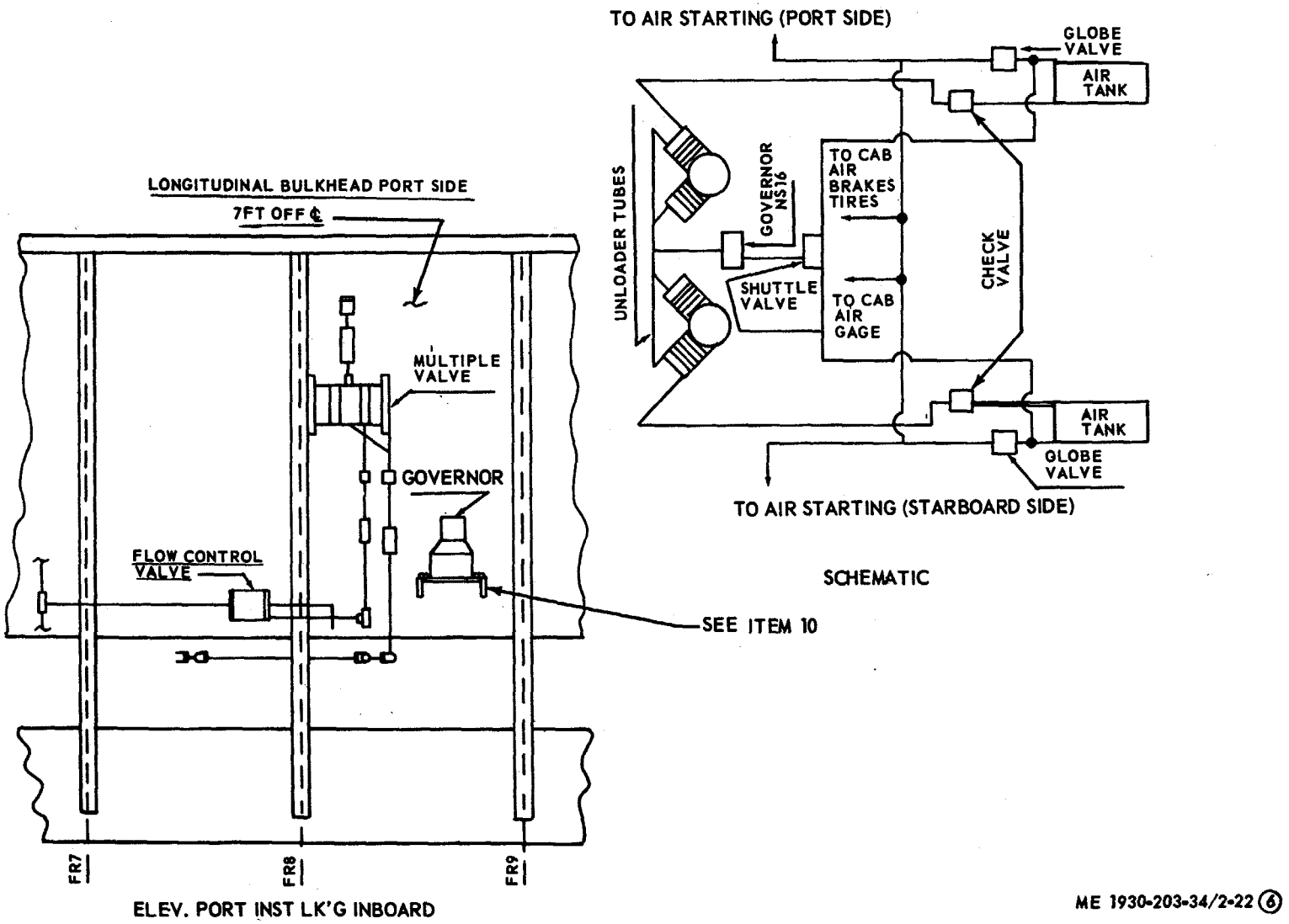


Figure 2-22. Installation of 3VC air compressor (Sheet 6 of 6)

2-26. Hydraulic Master Pressure Pumps

a. General. Eight master pressure pumps (6 and 9. fig. 2-23) provide power for all, LARC hydraulic systems. Four of the pumps have dual outlets rated at 36 and 11 gpm. The remaining pumps, also with dual outlets, are rated at 28 and 8 gpm. Four pumps, two of each configuration are mounted on each marine gear.

b. Removal.

(1) Close gate valve 110, fig. 2-23) in supply line to pump.

NOTE

When disconnecting flexible hoses in (2) and (3) below. provide a suitable container to drain hydraulic fluid from hose.

(2) Disconnect pump suction flexible hose (7).

(3) Disconnect flexible hoses (1 and 3 or 8).

(4) Remove six bolts (11) and lockwashers (12) that secure pump (6 or 9) to marine gear.

(5) Pull pump straight out of marine gear.

(6) If pump is to be replaced, remove elbows (2,4, and 5)or elbows (4 and 5) and adapter (18), elbows (16). nipple C17J), and close nipple (15) and retain for installation.

c. Installation.

(1) If a new pump is being installed, remove six screws (14, fig. 2-23) and position pump mounting plate (13) on pump body in the same location as the old pump mounting plate, then install screws (14).

(2) If a new pump is being installed, install elbows 12, 4, and 5) or elbows (4 and 5) and adapter (18), elbows (16), nipple (17), and close nipple (15) on pump.

(3) Position pump (6 or 9) on marine gear pump housing and install six bolts (11) and lockwashers (12).

NOTE

Make certain pump splined shaft fits properly into internal spline in marine gear. Figure 2-23 shows star-board pump arrangement. port is opposite.

(4) Connect pump suction flexible hose (7) and flexible hoses (1 and 3 or 8).

(5) Open gate valve (10) in supply line to pump.

(6) Operate marine gear and check hydraulic fluid level in hydraulic tank through sight gage. Replenish as necessary (LO 55-1930-203-12).

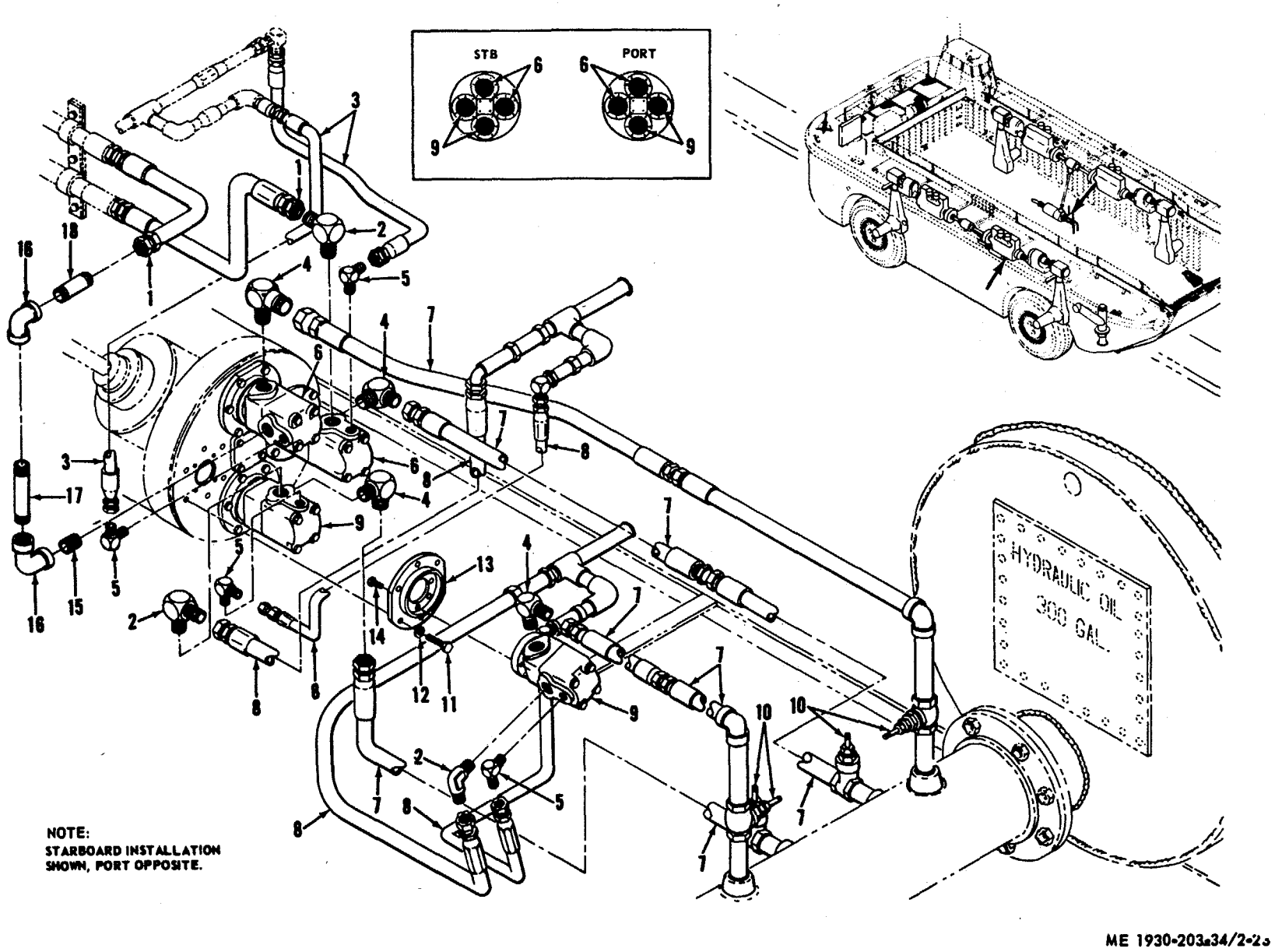


Figure 2-23. Hydraulic master pressure pump, removal and installation.

Key to figure 2-23

1 Hose, flexible fan supply
2 Elbow, 90°, 1 1/4 in.
3 Hose, flexible, ramp and bilge pump supply
4 Elbow, 90°, 2 in.
5 Elbow, 90°, 34 in.
6 Pump, pressure, hydraulic master (28 and 8 gpm)
7 Hose, flexible, pump suction
8 Hose, flexible, steering supply
9 Pump, pressure, hydraulic master (36 and 11 gpm)
10 Valve, gate
11 Bolt, pump mounting
12 Lockwasher
13 Plate, pump mounting
14 Screw
15 Nipple, close
16 Elbow,.90°, 1 1/4 in.
17 Nipple, long
18 Adapter

2-27. Marine Gear Assembly

a. Removal

(1) Drain lubricant from marine gear (TM 55-1930-203-20).
(2) Remove gathering box-to-marine gear flexible coupling (para 2-22).
(3) Remove intermediate shaft as outlined in paragraph 2-28.
(4) Remove marine gear-to-air compressor flexible coupling (para 2-24).
(5) Remove the four hydraulic master pressure pumps (para 2-26).
(6) Disconnect marine gear-to-filter flexible hose (24, fig. 2-24).
(7) Disconnect pump-to-filter flexible hose (23).
(8) Disconnect oil supply-to-oil cooler flexible hose (11).
(9) Remove adapter (18), reducer (17), and close nipple (16) from oil pump and retain for installation.
(10) Disconnect oil supply-from-oil cooler flexible hose (8).
(11) Remove adapter (7), reducer (6), close nipple (5), and elbow (4) from lubrication manifold and retain for installation.
(12) Disconnect marine gear grease line (12).
(13) Disconnect marine gear breather tube (3) and move clear of marine gear.
(14) Remove elbow (10) and bushing (9) and retain for installation.
(15) Disconnect control air tubes (13) at control valve and watertight bulkhead. Tag tubes so they may be installed in same position from which they were removed.
(16) Disconnect pneumatic tubes (2) from watertight bulkhead and move clear of marine gear. Tag tubes so they may be installed in same position from which they were removed.
(17) Remove bilge pump hydraulic lines (1)

NOTE

These lines are welded to watertight bulkhead and contain hydraulic fluid.

(18) Remove dunnage from cargo well deck area between frames 7 and 10 to afford access to steel deck-plating.

NOTE

The marine gear is located between frames 8 and 9.

(19) Remove marine gear access cover as outlined in paragraph 11-4. If the LARC is not equipped with marine gear access covers, a section of deck plating above each marine gear must be removed to gain access. With a cutting torch, cut a section of deck plating measuring 4 feet, 2 inches wide (measured from cargo well bulkhead on respective marine gear side) and 6 feet, 8 inches long, Remove section of deck plating.

NOTE

Cover marine gear with an asbestos blanket for protection from the cutting torch.

(20) With suitable hoisting equipment, attach hoisting slings to marine gear.
(21) Remove eight nuts (14, fig. 2-24) and lockwashers (15) and six bolts (20).
(22) Remove two fitted mounting bolts (22) and mark as to location.
(23) Remove two bolts (26) and lockwashers (25).
(24) Raise marine gear slightly and remove shims (19, 21, and 27) and mark asto location.
(25) Lift marine gear clear of LARC structure.

b. Installation.

(1) With suitable hoisting equipment, attach hoisting slings to marine gear.
(2) Position shims (19, 21, and 27, fig. 2-24) in proper position on marine gear foundation.
(3) Lift marine gear and lower into proper position on marine gear foundation.
(4) Install two fitted mounting bolts (22), six bolts (20) and eight lockwashers (15) and nuts (14).
(5) Install two bolts (26) and lockwashers (25).
(6) Connect marine gear-to-filter flexible hose (24).
(7) Connect pump-to4filter flexible hose (23).
(8) Install close nipple (16), reducer (17), and adapter (18) on oil pump.
(9) Connect oil supply-to-oil cooler flexible hose (I1).
(10) Install elbow (4), close nipple (5), reducer (6), and adapter (7), on lubrication manifold.
(11) Connect oil supply-from-oil cooler flexible hose (8).

(12) Connect marine gear grease line (12).
(13) Install bushing (9) and elbow (10) on marine gear.
(14) Connect marine gear breather tube (3).
(15) Connect bilge pump hydraulic line (1).
(16) Connect pneumatic tubes (2) to watertight bulkhead.
(17) Connect control air tubes (13) to control valve. and watertight bulkhead.
(18) Install the four hydraulic master pressure pumps (para 2-26).
(19) Install marine gear-to-air compressor flexible coupling (para 2-24).
(20) Install intermediate shaft as outlined in paragraph 2-28.
(21) Install gathering box-to-marine gear flexible coupling (para 2-22).
(22) Add proper lubricant to marine gear and fill hydraulic system (LO 55-1930-203-12).
(23) Install marine gear access cover (para 11-4). If the LARC is not equipped with marine gear access covers, replace deck plating and weld in place (para 11-3 for welding procedures).
(24) Replace dunnage in cargo well area.

Key to Figure 2-24

1 Line, hydraulic, bilge pump
2 Tube, pneumatic
3 Tube, breather, marine gear
4 Elbow, street, 90°
5 Nipple, close
6 Reducer, bell
7 Adapter
8 Hose, flexible, oil supply-from-oil cooler
9 Bushing
10 Elbow, 45°
11 Hose, flexible, oil supply-to-oil cooler
12 Line, grease, marine gear
13 Tube, control air
14 Nut
15 Lockwasher
16 Nipple, close
17 Reducer, bell
18 Adapter
19 Shim, mounting
20 Bolt, machine
21 Shim, mounting, fitted
22 Bolt, mounting, fitted
23 Hose, flexible, pump-to-filter
24 Hose, flexible, marine gear-to-filter
25 Lockwasher
26 Bolt, machine
27 Shim, mounting
28 Cable assembly
29 Switch, high temperature warning
30 Bushing
31 Bushing
32 Nipple
33 Pressure regulating valve
34 Bushing
35 Cable assembly
36 Sending unit, low pressure warning
37 Tubing, marine gear oil pressure
38 Tee
39 Bushing
40 Cross
41 Nipple
42 Reducer, bell
43 Adapter
44 Hose, flexible, lube manifold-to-bevel pinion input shaft bearings
45 Elbow, 90°
46 Elbow, 45°
47 Lube manifold
48 Capscrew
49 Lockwasher
50 Hose, flexible, lube manifold-to-reverse gear mesh
51 Hose, flexible, lube manifold-to4thrust bearing
52 Hose, flexible, lube manifold-to-idler gear mesh
53 Hose, flexible, lube manifold-to-high speed pinion shaft intermediate bearing
54 Hose, flexible, lube manifold-to-bevel gear mesh
55 Hose, flexible, lube manifold-to-pump cluster drive gears and bearings
56 Adapter, pipe-to-hose, 90°
57 Oil pump
58 Key
59 Gasket, oil pump mounting
60 Bearing
61 Adapter, pump mounting
62 Spur gear, oil pump drive
63 Setscrew
64 Hose, flexible,oil pump-to-control valve
65 Swivel joint
66 Capscrew
67 Elbow, 45°
68 Hose, flexible, marine gear clutch line-from-control valve
69 Elbow, 90°
70 Swivel joint
71 Hose, flexible, exhaust line from control valve-to-main housing
72 Hose, flexible, marine gear clutch line-from-control valve
73 Control valve
74 Lockwasher
75 Capscrew

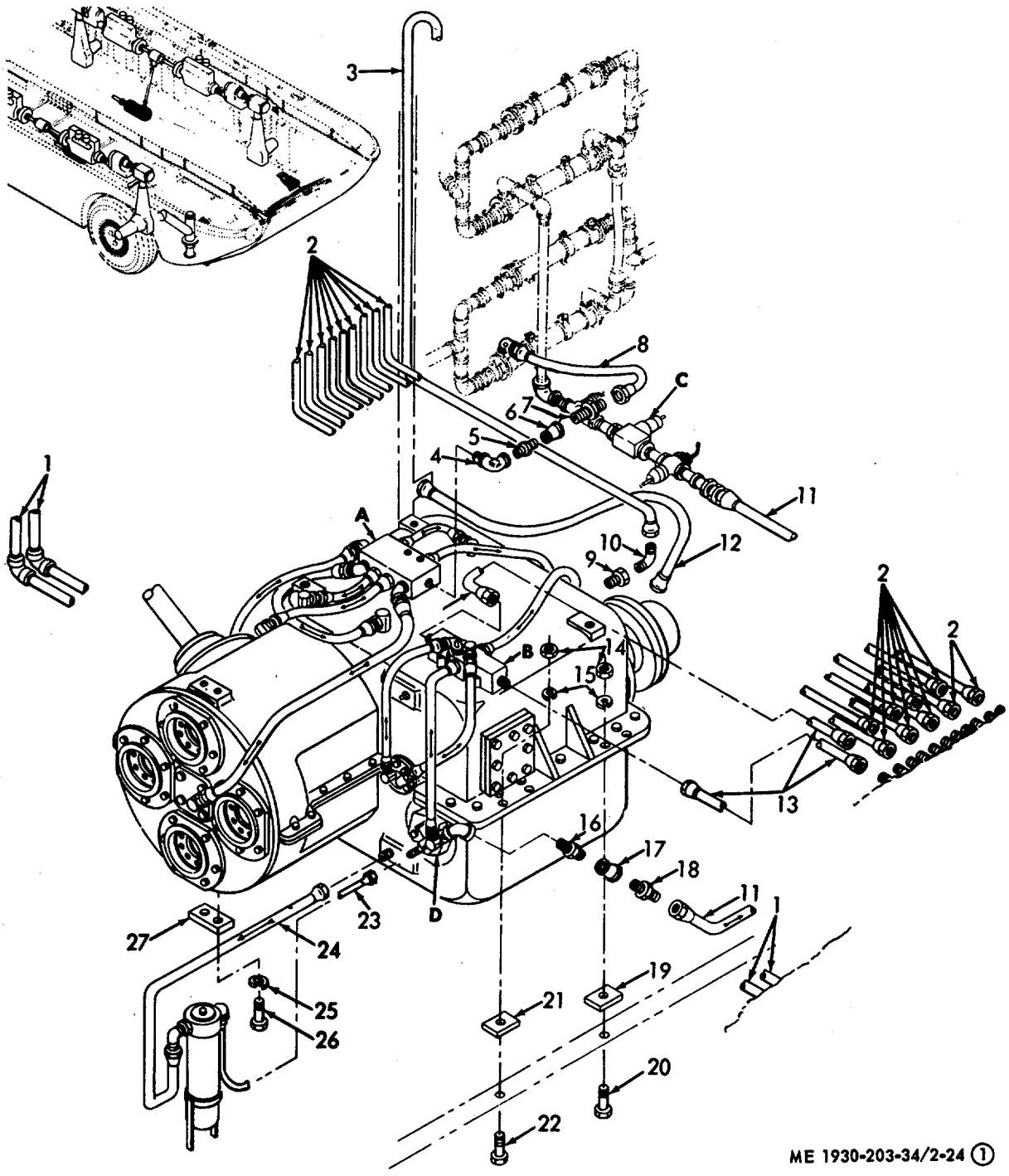


Figure 2-24. Marine gear, removal and installation (Sheet 1 of 2)

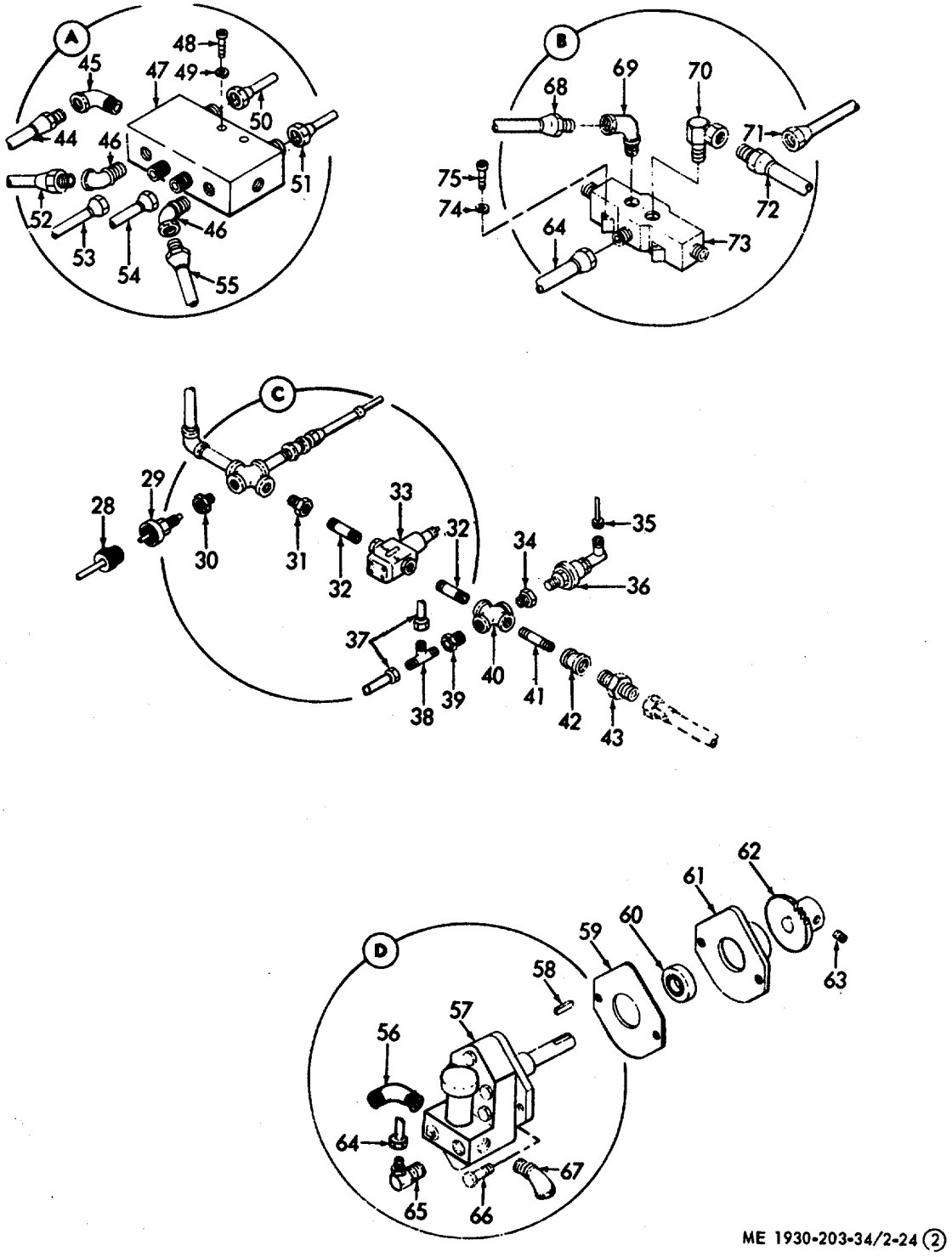


Figure 2-2. Marine gear, removal and installation (Sheet 2 of 2).

2-28. Propeller and Shafting

a. Propeller Removal (fig. 2-25).

(1) Remove lockwire from lockbolt (1) and fairwater nut (2) and remove lockbolt.

NOTE

On hulls 5 through 18, the starboard lockbolt had a right-hand thread, and the port lockbolt, a left-hand thread as original equipment. On hulls 19 through 60, both lockbolts have right-hand threads.

(2) Remove fairwater nut (2).

NOTE

On hulls 5 through 18, the starboard fairwater nut had left-hand threads, and the port fairwater nut, right-hand threads as original equipment. On hulls 19 through 60, both fairwater nuts have left-hand threads.

(3) Remove propeller (3), using propeller puller, part number LX09-032-001, and remove key (4) from keyway on propeller shaft (5).

b. Installation of Propeller. Install propeller in the reverse order of removal, except when installing propeller on shaft (5), press or tap with soft-faced hammer until propeller is flush with rope guard (7).

c. Intermediate Shaft Removal (fig. 2-25).

(1) Remove self-locking nuts (23) and shoulder bolts (15) from intermediate shaft (24) coupling closest to the propeller shaft.

(2) Slide propeller shaft aft slightly and remove flexible inserts (21).

(3) Remove self-locking nuts (25) and shoulder bolts (29) from intermediate shaft (24) coupling closest to marine gear hub (28). Remove intermediate shaft and flexible inserts (21 and 27).

d. Installation of the Intermediate Shaft. Install the intermediate shaft in reverse order of removal.

e. Propeller Shaft Removal (fig. 2-25).

(1) Remove propeller (para a above).

(21 Repeat steps c(1) and c(2) above if intermediate shaft has not been removed.

(3) Remove capscrews (20) and lockwashers (19) which secure nut lockwasher (18) and remove nut lockwasher.

(4) Remove shaft nut (17) and remove propeller shaft hub (16).

(5) Remove key (6) from propeller shaft (5) and slide propeller shaft aft out of stern tube (9) and propeller strut tube (8).

f Installation of the Propeller Shaft (fig. 2-25).

(1) Remove capscrews (14) and washers (13) and slide packing gland (12) out of stern tube 19).

(2) Remove packing retainer (11) and packing (I0).

(3) Insert propeller shaft (5) through propeller strut tube (8) and stern tube (9).

(4) Slide packing retainer (11) and packing gland (12) on propeller shaft.

(5) Install key (6) and propeller shaft hub (16) on propeller shaft and tighten shaft nut (17).

(6) Install nut lockwasher (18) and secure with capscrews (20) and lockwashers (19).

(7) Install flexible inserts (21) between propeller shaft and intermediate shaft (24), Using shoulder bolts (15) and self-locking nuts (23).

(8) Install propeller (para b above).

NOTE

Check fit of propeller to shaft with Prussian blue, Military Specification MIL-P-30501, fit must be at least 80 percent of total surface.

(9) Install packing (10) and slide packing retainer (11) and gland (12) down shaft into stern tube (9).

(10) Install capscrews (14) and washers (13) and tighten capscrews sufficiently to prevent leakage.

CAUTION

Do not overtighten capscrews as It will result in overheating of propeller shaft. If the propellers cannot, be turned by hand, packing gland is too tight.

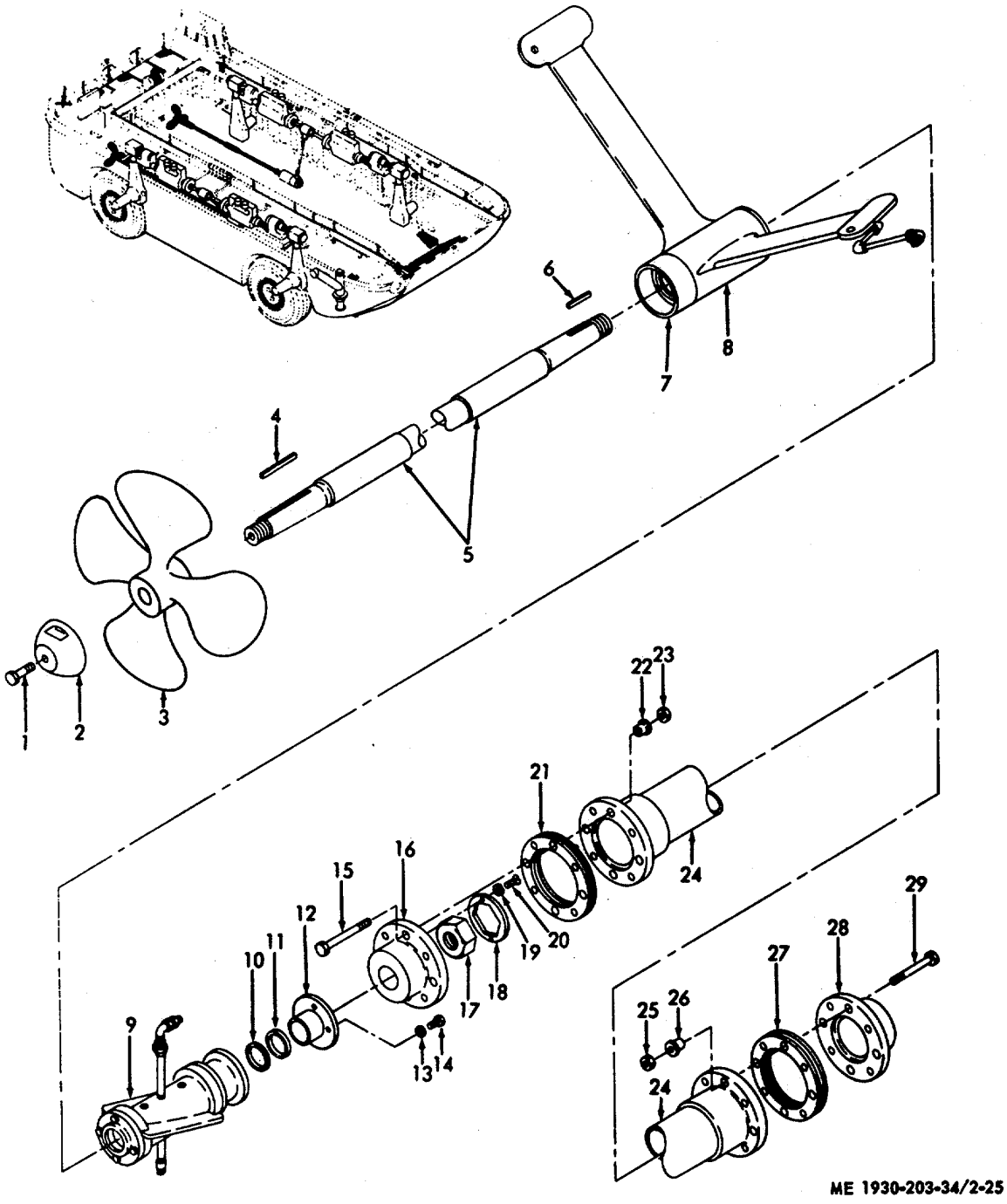


Figure 2-25. Propeller and shafting, removal and installation.

Key to figure 2-25

1 Lockbolt
2 Nut, fairwater
3 Propeller
4 Key, propeller
5 Propeller shaft
6 Key, propeller shaft hub
7 Rope guard
8 Strut tube,
9 Stern tube
10 Packing
11 Packing retainer
12 Packing gland
13 Washer
14 Capscrew
15 Bolt, shoulder
16 Propeller shaft hub
17 Nut, shaft
18 Nut lockwasher
19 Lockwasher
20 Capscrew
21 Flexible insert
22 Bushing, thrust
23 Nut, self-locking
24 Intermediate shaft
25 Nut, self-locking
26 Bushing, thrust
27 Flexible insert
28 Marine Gear hub
29 Bolt, shoulder

2-29. REPLACE RAMP CYLINDER.

a. Removal. (fig 2-26).

(1) Raise the ramp and engage both ramp latches (TM 55-1930-203-10).

WARNING

Tag ramp latches to indicate ramp hydraulic system is being repaired. Releasing latches with rampl-cy inder removed could result in major structural damage and injury to personnel.

WARNING

Failure to relieve cable tension could result in serious injury to personnel removing ramp cylinder.

(2) Place ramp control valve in lower position to relieve tension from ramp cables.
(3) Place ramp control valve in neutral position and shut down LARC engines (TM 55-1930-203- 10).
(4) Disconnect hose lines (1) and (2) at fittings in relief valve (3). Cap hydraulic hose lines.
(5) Remove relief valve assembly (3) and install a ¾ inch pipe plug in cylinder opening.
(6) Remove cotter pin (4) and clevis pin (5) at ramp cylinder upper end.
(7) Remove ramp cylinder air vent (6).
(8) Provide support for ramp cylinder lower end and remove cotter pin (7) and ram pin (8).
(9) Using suitable hoisting equipment, lift ramp cylinder (9) through scuttle opening in LARC deck.
(10) Remove pipe plug installed in step 5 above and drain cylinder.
(11) Remove pipe union (10).

b. Installation.

(1) Lower ramp cylinder (9) into position and secure lower end with ram pin (8), and cotter pin (7).
(2) Install pipe union (10) and ramp cylinder air vent (6).
(3) Connect ramp cylinder upper end to ramp cable block with clevis pin (5) and cotter pin (4).
(4) Fill ramp cylinder (9) with engine oil, OE-10.

NOTE

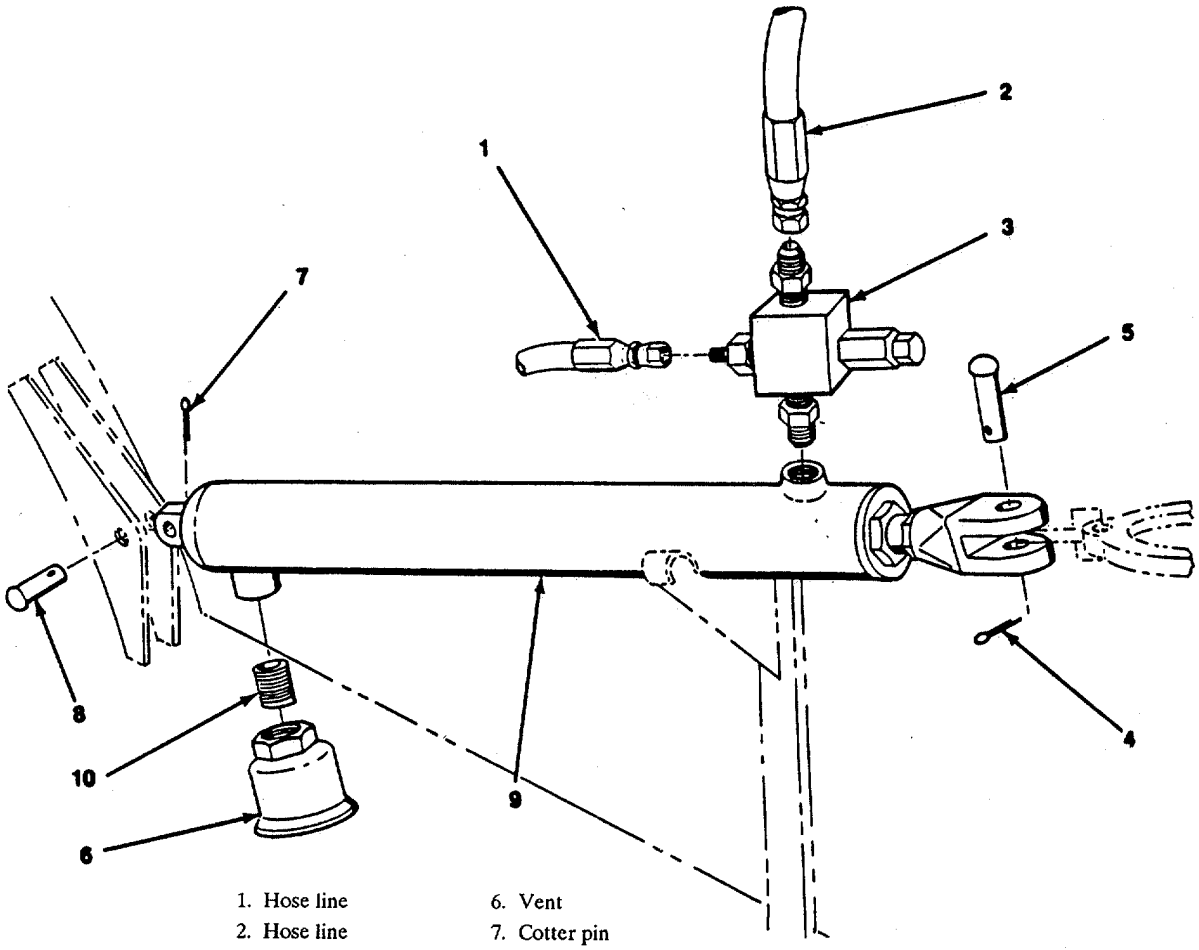
Cylinder should be in fully compressed position

(5) Install relief valve assembly (3) and connect hose lines (1) and (2) to fittings in relief valve assembly (3).
(6) Start one engine on side opposite cylinder being installed (TM 55-1930-20310).
(7) Place control valve on side with engine running in raise position.
(8) Place control valve on side opposite running engine in lower position for approximately 3 minutes to allow air to be forced from hydraulic lines. Return valve to neutral.

WARNING

If the ramp is not held fully closed by ramp cables, the weight of the ramp will cause the ramp latch lever to swing sharply forward, possible striking the latch operator or throwing him overboard.

(9) With control valve on side with engine running still in raise position, release ramp latches.



1. Hose line
2. Hose line
3. Relief valve assembly
4. Cotter pin
5. Clevis pin
6. Vent
7. Cotter pin
8. Ram pin
9. Cylinder
10. Pipe union

Figure 2-26. Ramp Cylinder, Replacement.

(10) Place control valve on side with engine running in neutral position. Using control valve on opposite side, lower the ramp. When ramp is fully lowered, leave valve in lower position and place control valve on side with engine running in raise position for approximately 3 minutes to insure that all air is forced from hydraulic lines.

(11) Raise the ramp and engage both ramp latches.

(12) Shut down engine.

2-29.1 REPLACE RELIEF VALVE, RAMP CYLINDER

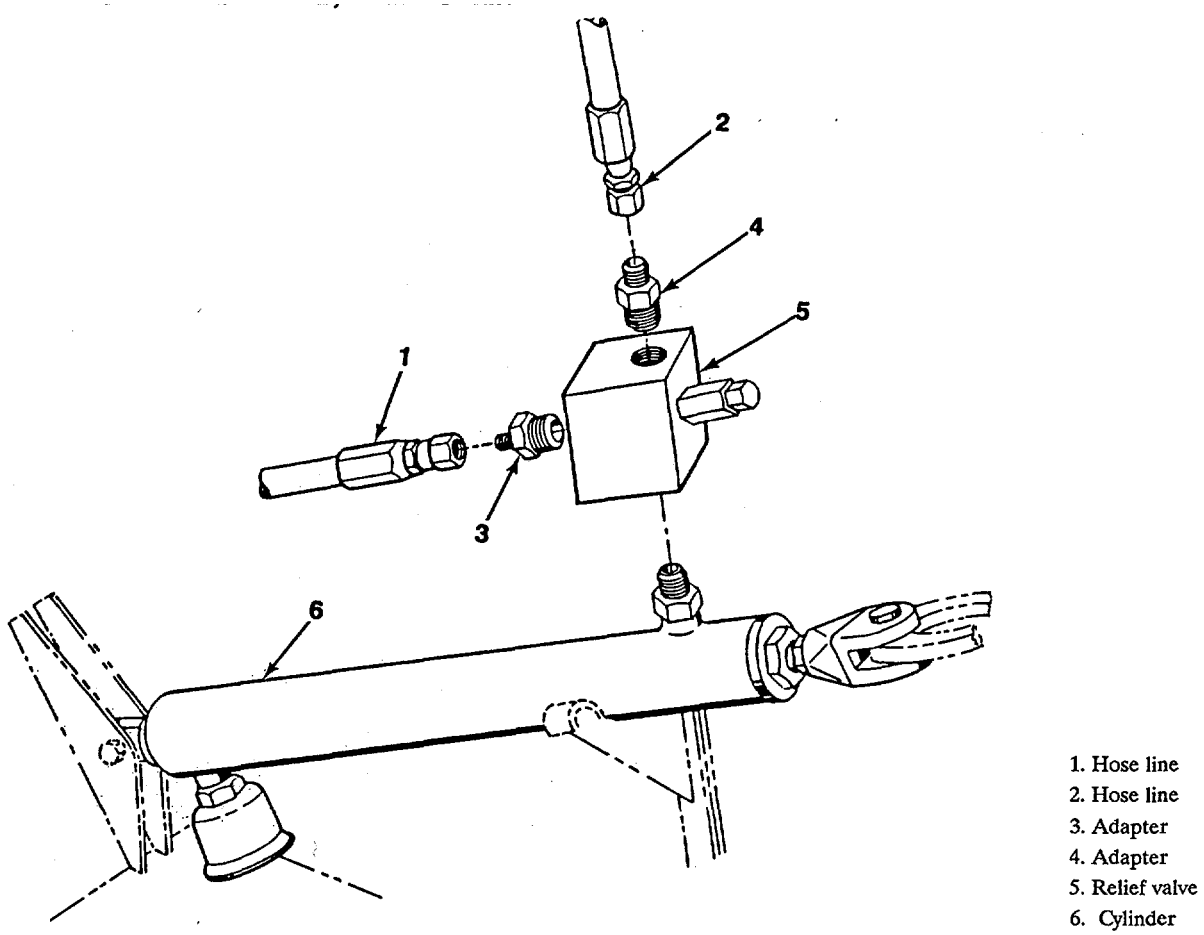


Figure 2-26.1. Relief Valve, Ramp Cylinder, Replacement.

a. Removal.

(1) Lower ramp to ground to relieve pressure in hydraulic lines.

(2) Slowly unscrew hose lines (1) and (2) from adapters (3) and (4), allowing hydraulic fluid to seep around the connection relieving any pressure in the lines. Disconnect hose lines (1) and (2).

(3) Remove adapters (3) and (4) from relief valve (5).

(4) Remove relief valve (5) from ramp cylinder (6).

b. Installation.

(1) Install new relief valve (5) on ramp cylinder (6).

(2) Install adapters (3) and (4) in relief valve (5).

(3) Connect hose lines (1) and (2) to adapters (3) and (4).

(4) While ramp is being raised, slightly loosen hose line fitting (2) off, allowing air in system to bleed out. Tighten fitting (2) when there is continuous seepage of hydraulic fluid without air or air bubbles.

2-30. Steering Cylinder

a. Removal.

(1) Provide a suitable control for spillage and disconnect hydraulic lines (fig. 10-7 and 10-8). Cap lines to prevent excessive leakage.

(2) Cap openings in steering cylinder.

(3) Remove retaining ring (9, fig. 2-27) and clevis pin (1).

(4) Remove retaining ring (7), clevis pin (5), and thrust washers (6).

(5) Using suitable hoisting equipment, lift steering cylinder through deck opening.

(6) Remove plugs from hydraulic ports and drain hydraulic fluid from cylinder.

(7) Remove bushing (8) if elongated or heavily scored.

b. Installation.

(1) If bushing (8, fig. 2-27) is removed, install new bushing and ream to 3.001 0.001 inch.

(2) Lower cylinder into position and install thrust washers (6), clevis pin (5), and retaining ring (7).

(3) Install clevis pin (1) and retaining ring (9).

(4) Fill cylinder with engine oil, OE-10. Remove caps and connect hydraulic lines.

(5) If cylinder being installed is in the alignment system, perform alignment procedures outlined in paragraph 10-3. If an actuating cylinder is being installed, perform the following:

(a) Start engines and put LARC in motion (TM 55-1930-203-10). Turn wheels so cylinder being installed in fully compressed.

(b) Open valve (3) on rod end and allow all air to bleed off. Close valve (3).

(c) Turn wheels so cylinder being installed is fully extended. Open valve (4) and allow all air to bleed off. Close valve (4).

(d) Shut down engines.

2-31. Radiator Assembly

a. Removal (fig. 2-28).
(1) Drain cooling system in which radiator is located (TM 55-1930-203-20).
(2) Remove bolts (1), lockwashers (2). and remove radiator access plate (3) and gasket (4).
(3) Remove clamps (6 and 18) and disconnect hoses (7 and 17) from radiator.
(4) Remove bolts (22) and lockwashers (21) and remove stern louvers (23).
(5) Gain access to adjacent radiator and fan area and remove bolts (13), lockwashers (15), and nuts (16) s curing vane assembly (14) and remove vane assembly
(6) Remove bolts (25), lockwashers (20), and nuts (19) securing radiator (5).
(7) Lift radiator, using a suitable hoist and sling attached to radiator lifting eyes, out through radiator access hole.
(8) Remove gaskets (24) and 8) from mounting supports.

b. Installation.
(1) Install gaskets (8 and 24), on mounting supports. Bottom gasket (8) must be watertight.
(2) Using a suitable hoist and sling attached to radiator lifting eyes, lower radiator (5)r in place on supports.

NOTE

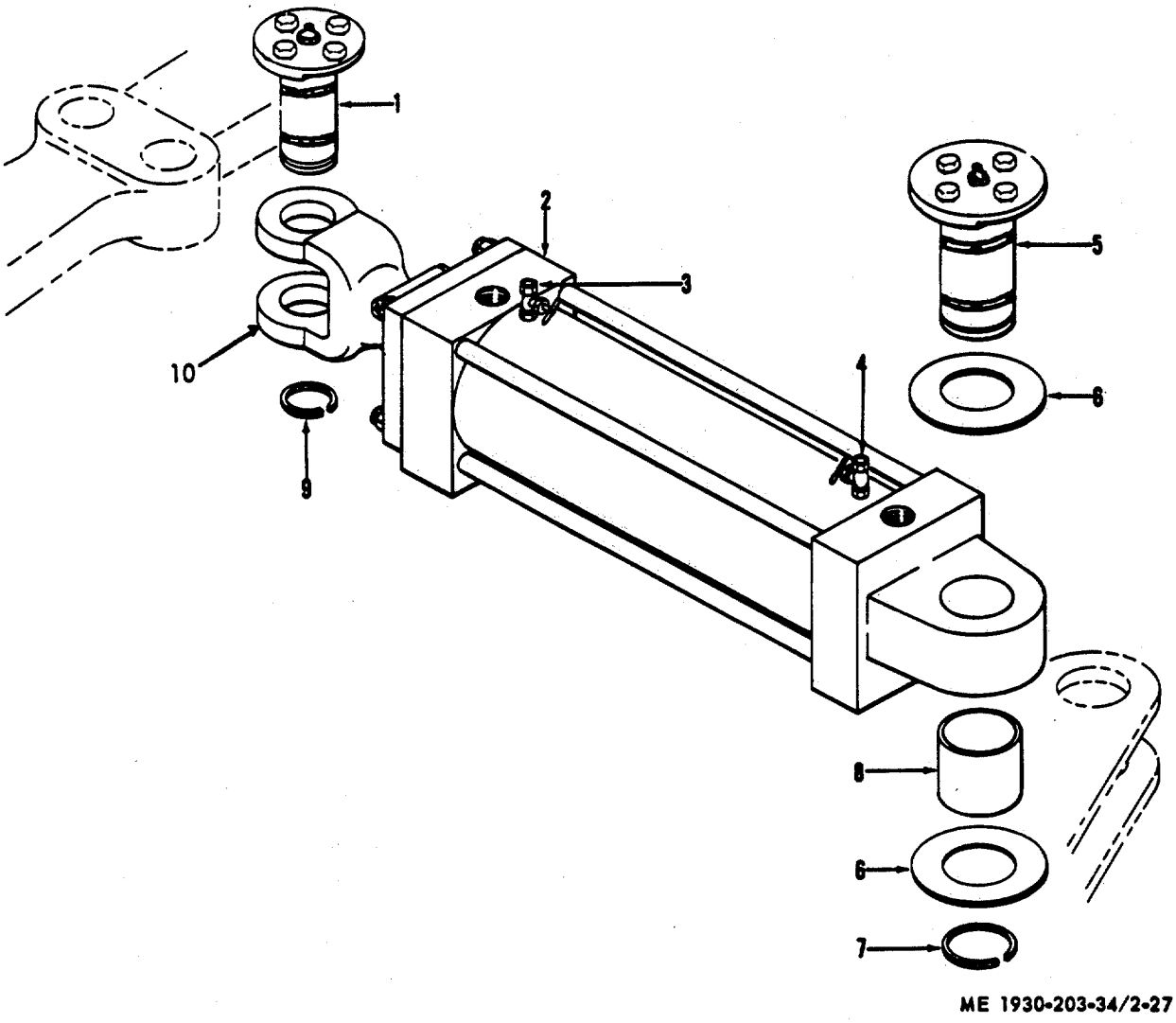
Insure proper fit of radiator on bottom support.

(3) Secure radiator in place with bolts (25), lockwashers (20), and nuts (19).
(4) Remove hoisting gear from radiator.
(5) Secure vane assembly (14) with bolts (13), lockwashers (25), and nuts (16).

NOTE

In order for vane assembly to be secured, access to the adjacent radiator and fan area or areas must be obtained.

(6) Connect hosed (7 and 17) to radiator and secure with clamps (6 and 18).
(7) Secure stern louvers (23) with bolts (22) and lockwashers (21).
(8) Position gaskets (4 and 9) and access plates (3 and 10) in place and secure with bolts (1 and 12) and lockwashers (2 and 11).
(9) Fill cooling system with coolant (TM 55-1930-203-20).



1 Clevis pin
2 Steering cylinder
3 Valve, rod end
4 Valve, head end
5 Clevis pin
6 Thrust washer
7 Retaining ring
8 Bushing
9 Retaining ring
10 Rod end clevis

Figure 2-27. Steering cylinder removal.

Key to figure 2-28

1 Bolt, machine
2 Lockwasher
3 Radiator access plate
4 Gasket, radiator access plate
5 Radiator
6 Clamp, hose
7 Hose, radiator inlet
8 Gasket, radiator mounting, lower
9 Gasket, duct access plate
10 Duct access plate
11 Lockwasher
12 Bolt, machine
13 Bolt, machine
14 Vane assembly, lower
15 Lockwasher
16 Nut
17 Hose, radiator outlet
18 Clamp hose
19 Nut
20 Lockwasher
21 Lockwasher
22 Bolt, machine
23 Stern louvers
24 Gasket, radiator mounting, upper
25 Bolt, machine

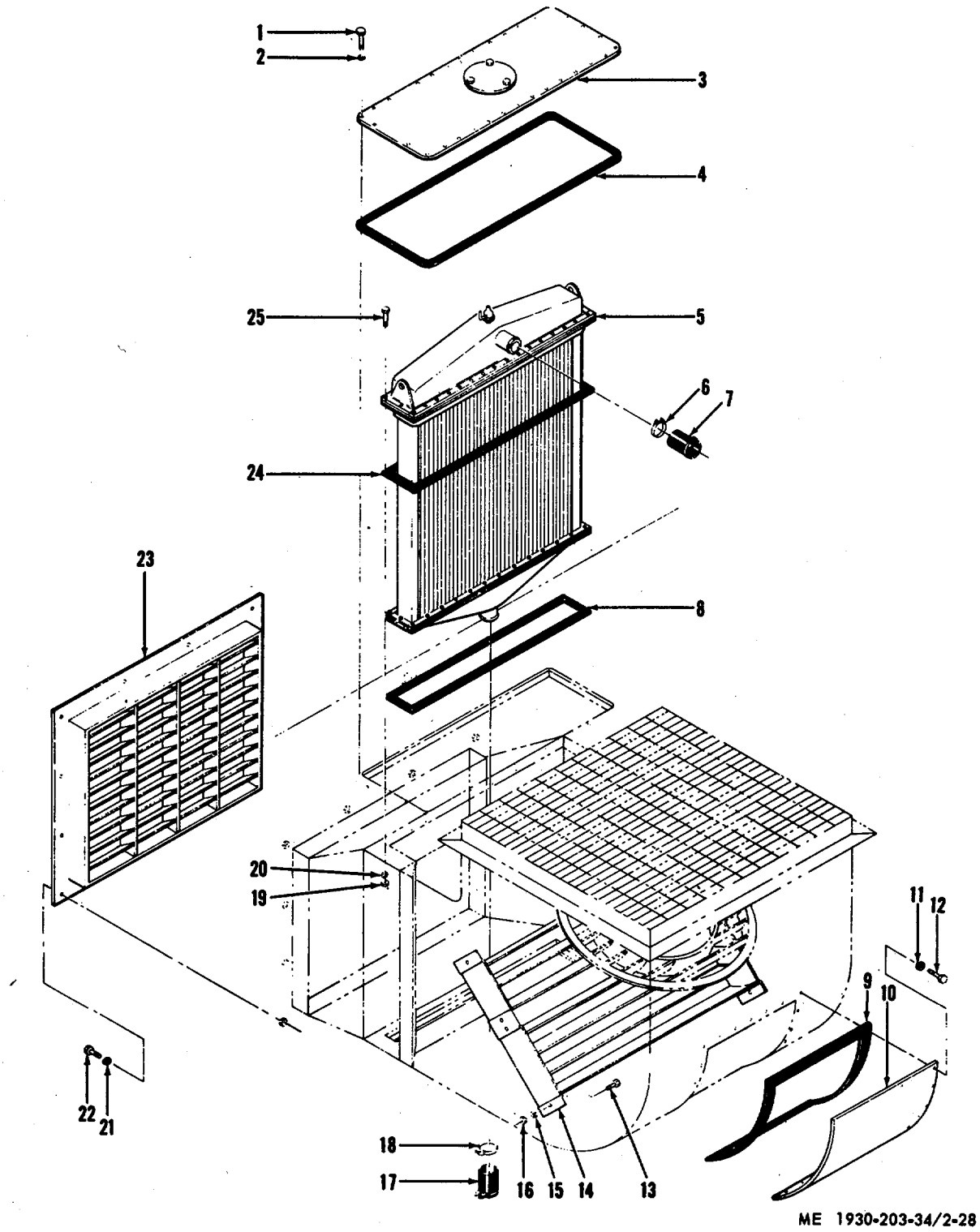


Figure 2-28. Radiator, removal and installation

2-32. Radiator Fan Assembly

a. Removal

(1) Remove access cover (10, fig. 2-28) to radiator fan area.
(2) Provide a suitable container for spillage and disconnect radiator fan motor outlet line and vent line at motor.
(3) Disconnect inlet line at flexible hose, (2, fig. 10-5).
(4) Remove bolts (1, fig. 2-29) and washers (2) securing grating (3) to LARC deck. Remove grating (3).
(5) Remove nuts (4) and washers (5).
(6) Using suitable hoisting equipment, lift radiator fan assembly through deck opening.

b. Installation. Install radiator fan assembly in reverse order of removal.

Key to figure 2-29

1 Bolt, grating-to-deck
2 Washer, grating-to-deck
3 Deck grating
4 Nut, inlet adapter-to-deck
5 Washer, inlet adapter-to-deck
6 Inlet adapter
7 Nut, nose piece-to-motor shaft
8 Lockwasher, nose piece-to-motor shaft
9 Seal
10 Seal retainer
11 Washer, adapter-to-casing
12 Pipe
13 Elbow
14 Pipe adapter
15 Hydraulic motor
16 Nut, van assembly-to-casing
17 Washer, vane assembly-to casing
18 Vane assembly
19 Key
20 Nut, adapter-to-casing
21 Bolt, vane assembly-to-casing
22 Casing
23 Washer, motor-to-casing
24 Nut, motor-to-casing
25 Cotter pin
26 Rotor assembly
27 Spacer
28 Nose piece
29 Washer, nose piece-to-rotor assembly
30 Screw, nose piece-to-rotor assembly
31 Bolt, adapter-to-casing

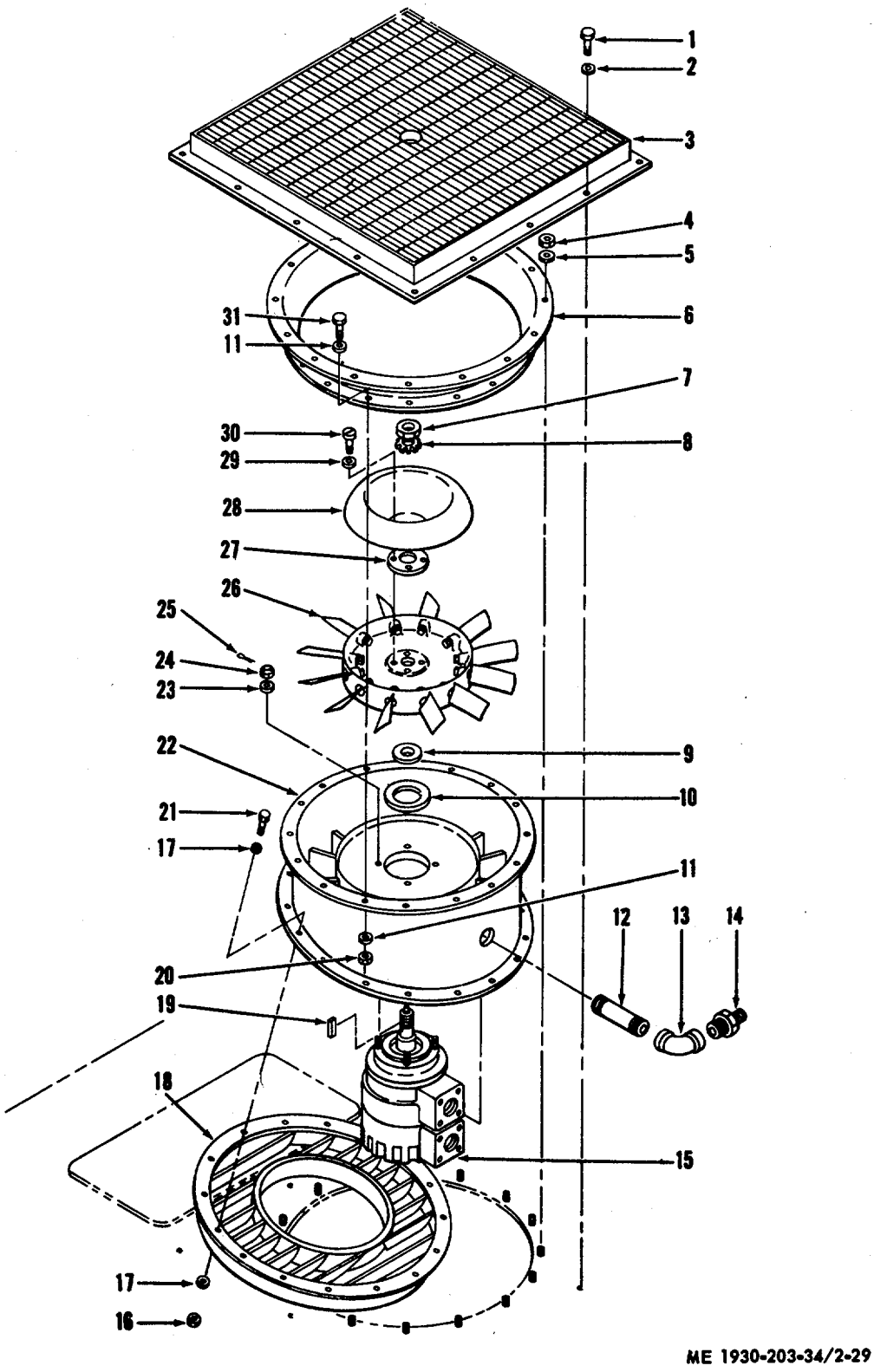


Figure 2-29. Radiator fan assembly, removal and installation

2-33. Cargo Winch Assembly and Hydraulic Motor

a. *Removal*

(1) Remove wire rope from drum (para 10-9) or wind wire rope completely in and fasten end.
(2) Remove drain plug (41, fig. 2.30) and drain lubricant from winch into a suitable container. Replace drain plug.
(3) Remove pin (36) and disconnect shift linkage rod (35).
(4) Remove wire rope guard (2) by removing bolts (1), lockwashers (6), and nuts (7).
(5) Remove capscrews (39) and lockwashers (40); loosen capscrews (38).
(6) Remove capscrews (3) and remove brake cover (4).

CAUTION

Care should be used when removing brake cover (4) to avoid damaging pins (43).

(7) Remove pins (43).
(8) Reach into brake drum and remove brake cable locking nut (42).
(9) Remove setscrews (37) and pull brake cable (34) from winch.
(10) Remove bolt (32), lockwasher (33), and nut (26) securing aft port leg of winch to deck.
(11) Remove bolts (8), lockwashers (9), and nuts (I 1) securing remaining three legs of winch to deck.
(12) Loosen nuts (23) as far as possible. Raise winch until nuts (23) are snug against adapter (15). Remove nuts (23) and lockwashers (22).
(13) Lift winch from deck.

CAUTION

Winch must be lifted straight up to avoid damage to bevel gear (16) or shaft of hydraulic motor (27).

NOTE

To remove the winch hydraulic motor perform steps (14) through (19).

(14) Remove gasket (19).
(15) Remove bevel gear (16).
(16) Make sure motor controls are in off position, provide a suitable container for spillage, and disconnect motor inlet hose (31).
(17) Disconnect motor outlet hose (30) and overflow hose (28).
(18) Remove adapter (10) and elbows (25 and 29).
(19) Remove capscrews (12) and lockwashers (13) and lift motor (27) and adapter (15) from deck.
(20) Remove gasket (14), nuts (20) and lockwashers (21).
(21) Remove snap ring (17).
(22) Using a sleeve to protect bearing races, pull adapter (15) away from motor (27) and off bearing (18). Remove gasket (24).
(23) Pull bearing (18) from shaft, exerting pressure on inner race.

b. *Installation.*

(1) Place snap ring (17) on bearing (18) and press bearing into adapter (15).
(2) Position gasket (24) on motor (27) and press adapter (15) and bearing (18) onto motor shaft.
(3) Install lockwashers (21) and nuts (20).
(4) Install gasket (14) and fasten adapter (15) to deck with capscrews (12) and lockwasher (13).
(5) Install elbows (25 and 29) and adapter (10).
(6) Connect outlet hose (30), inlet hose (31), and overflow hose (28).

Key to figure 2-30

1 Bolt, machine
2 Wire rope guard
3 Capscrew
4 Brake cover
5 Cargo winch
6 Lockwasher
7 Nut
8 Bolt, machine
9 Lockwasher
10 Adapter
11 Nut
12 Capscrew
13 Lockwasher
14 Gasket, adapter-to-deck
15 Winch adapter
16 Bevel gear
I7 Snap ring
18 Bearing
19 Gasket, adapter-to-winch
20 Nut
21 Lockwasher
22 Lockwasher
23 Nut
24 Gasket, motor4to-adapter
25 Elbow
26 Nut
27 Hydraulic motor
28 Overflow hose
29 Elbow
30 Outlet hose
31 Inlet hose
32 Bolt, machine
33 Lockwasher
34 Brake cable
35 Shift linkage rod
36 Shift linkage pin
37 Setscrew
38 Capscrew, drum shaft cover lower
39 Capscrew, drum shaft cover upper
40 Lockwasher
41 Drain plug
42 Nut
43 Brake cover pin

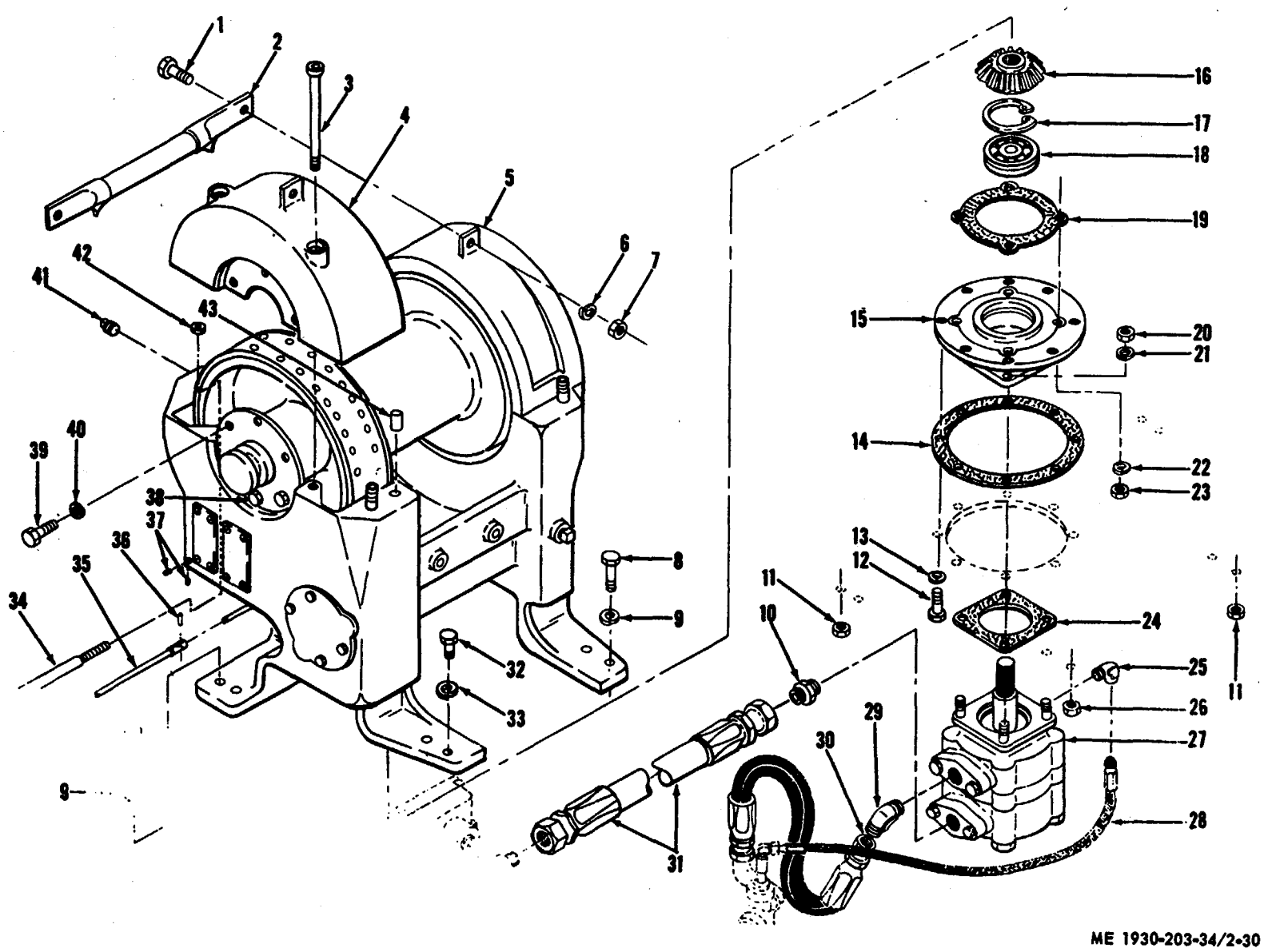


Figure 2-30. Cargo winch assembly and hydraulic motor, removal and installation

Install bevel gear (16).

(7) Place four shims, approximately ¼ inch thick, on deck over winch leg mounting holes. Position gasket (19).

(8) Lower winch so that legs rest on shims and winch mounting studs line up with holes in adapter (15).

CAUTION

Winch must be lowered from directly above mounting position to avoid damaging bevel gear (16) or shaft of hydraulic motor (27).

(9) Install lockwashers (2-2) and nuts (23), leaving nuts finger tight.

(10) Remove shims from under winch legs and lower winch to deck.

(11) Tighten nuts (23).

(12) Install bolt (32), lockwasher (33), and nut (26) securing aft port leg of winch to deck.

(13) Install bolts (8), lockwashers (9), and nuts (11 securing remaining three legs of winch to deck.

(14) Insert brake cable (34) into winch and install cable locking nut (42).

(15) Install setscrews (37).

(16) Insert pins (43) in winch housing and position brake cover (4) on housing, using pins (43) for alignment.

(17) Install capscrews (3 and 39) and lockwashers (40) and tighten capscrews (38).

(18) Install wire rope guard (2) with bolts (1), lockwashers (6), and nuts (7).

(19) Connect shift linkage rod (35) by inserting pin (36).

(20) Fill winch with proper grade lubricant (LO 55-1930-203-12).

(21) If wire rope was removed from drum, install wire rope (para 10-9).

2-34. Bilge Pump Assembly

a. *Removal (fig. 2-31).*

(1) Shut off gate valve in hydraulic feed line at pressure pump.

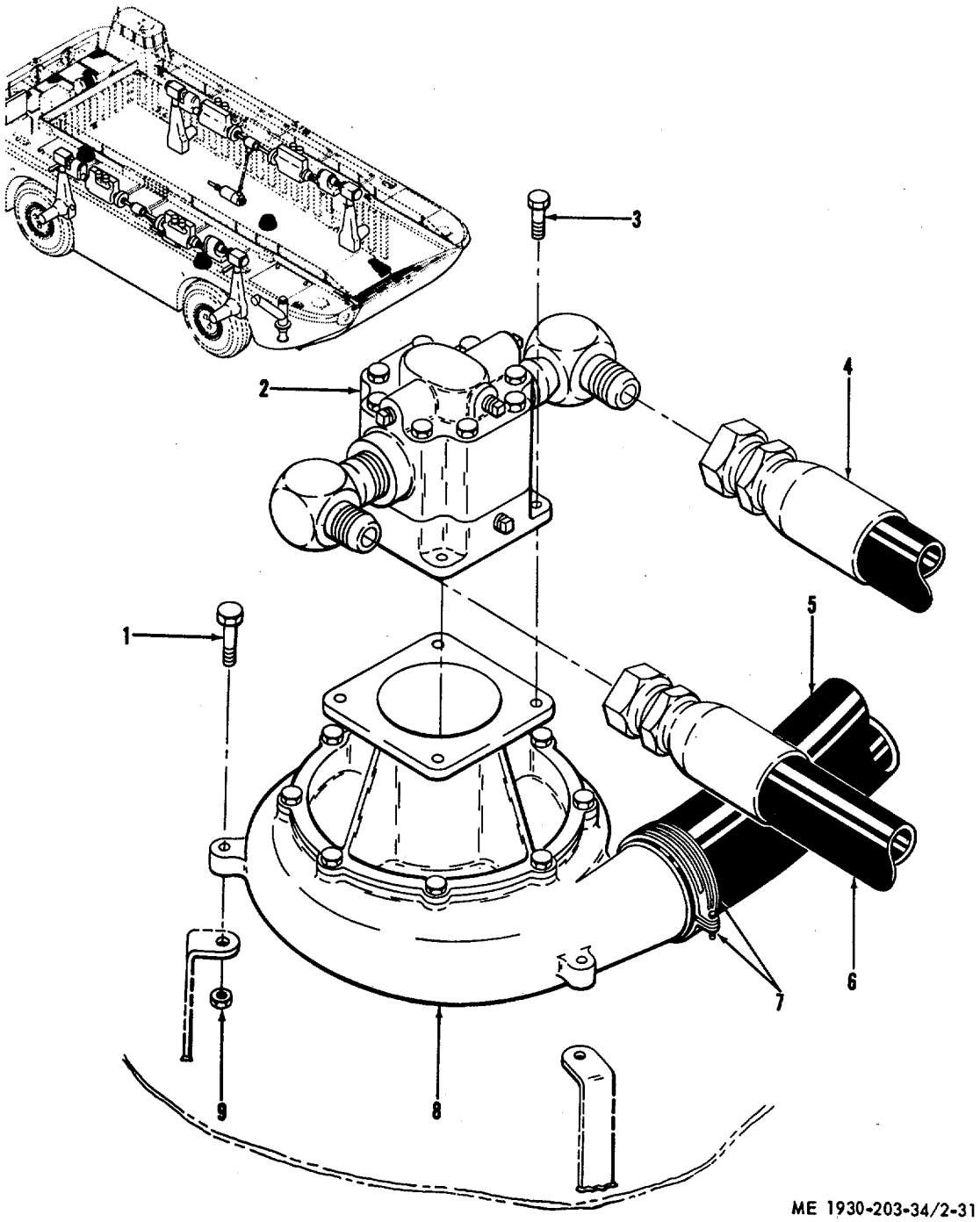
(2) Disconnect hydraulic return line 16) and hydraulic input line (4) from bilge pump motor (2) and tag for reassembly.

(3) Loosen hose clamps (7) from coupling hose (5) atdischarge side of pump.

(4) Remove three bolts (1) and nuts (9) that secure bilge pump (8) to support brackets and remove pump assembly.

(5) Separate pump motor (2) from pump by removing four bolts (31.

b. Installation. Install bilge pump assembly in reverse order of removal.



1 Bolt, machine
2 Bilge pump motor
3 Bolt, machine
4 Hydraulic input line
5 Coupling hose
6 Hydraulic return line
7 Hose clamp
8 Bilge pump
9 Nut

Figure 2-31. Bilge pump assembly, removal and installation

2-35. Cargo Well Pump Motor

a. *RemovaL*
(1) Disconnect hydraulic lines (2, fig. 2-32) and drain line (1) from pump motor (4).

NOTE
Provide a suitable container to catch hydraulic fluid trapped in lines.

(2) Remove coupling pin (5) and four socket-head capscrews (3) securing motor to pump.
(3) Work motor shaft out of pump coupling and lift off motor.
(4) Remove fittings from motor and retain for installation.

b. *Installation*. Install cargo well pump motor in reverse order of removal.

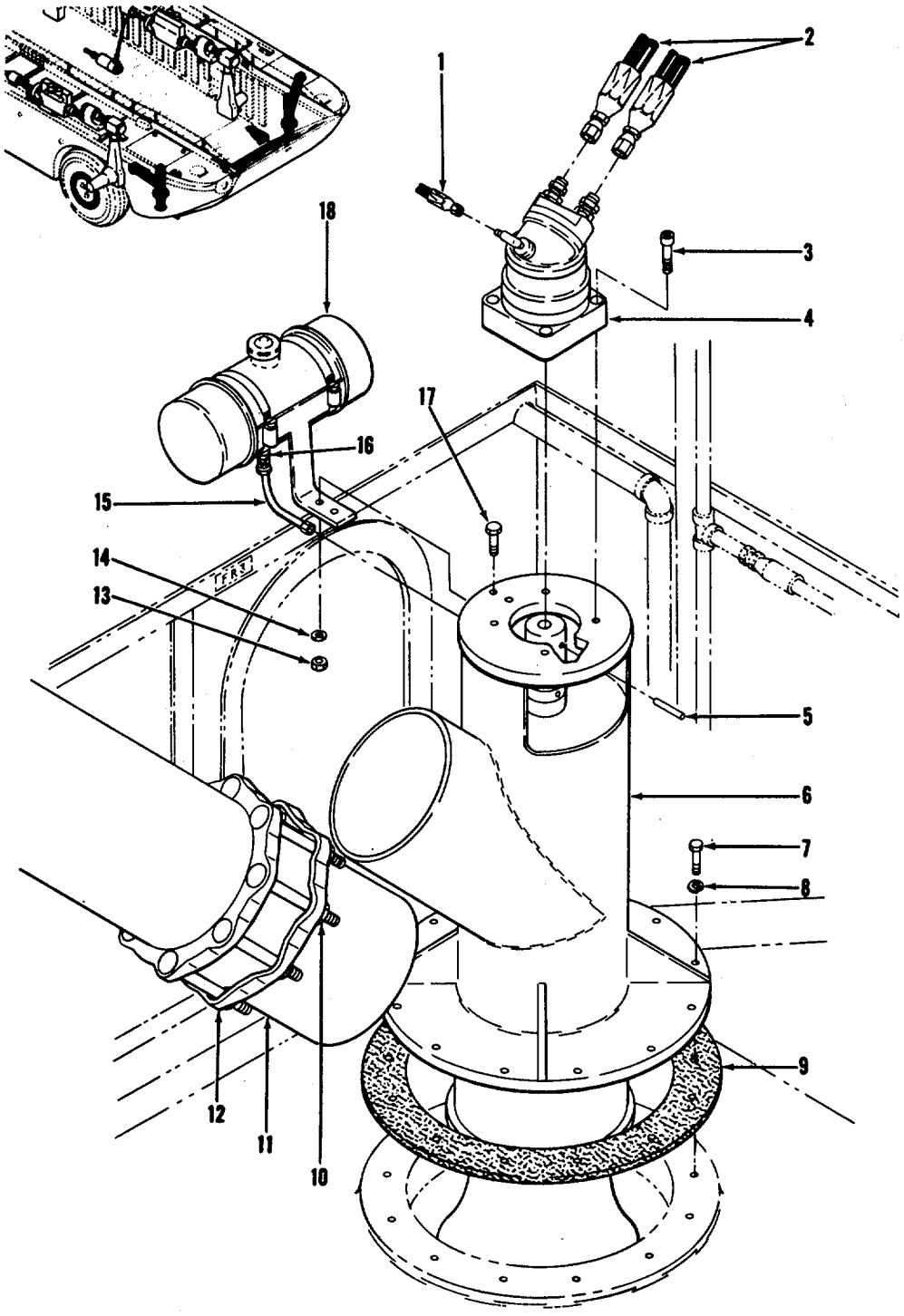


Figure 2-32. Cargo well pump and pump motor, removal and installation.

2-36. Cargo Well Pump Assembly

a. *Removal (fig. 2-32).*

(1) Remove fuel tank (para 4-2).
(2) Close oiler metering valve (16) in oiler line (15).
(3) Disconnect oiler line at packing ring on pump.
(4) Remove bolts (17), lockwashers (14), and nuts (13) and lift off oil tank (18).
(5) Disconnect hydraulic lines (2) and drain line (1) from pump motor (4).

NOTE

Provide a suitable container to catch hydraulic fluid trapped in lines.

(6) Loosen nuts (10) on coupling (12) between cargo well pump (6) and overboard tube (11). Slide coupling (12) up away from joint. Tighten several nuts slightly to prevent coupling from slipping off overboard tube.

(7) Remove bolts (7) and lockwashers (8) which secure pump flange to reinforcing ring. Be careful not to damage neoprene gasket (9).

CAUTION

Before proceeding, inspect both the inside and outside of the cargo well pump area to ascertain that any obstructions that could interfere with the lifting operation or could damage the equipment have been removed.

(8) Position crane boom, or other suitable hoist, directly over cargo well pump.
(9) Secure lifting cables to cargo well pump.
(10) Raise cargo well pump and position in predetermined area.

CAUTION

The cargo well pump should be guided by hand until it is clear, to prevent damage to the pump or surrounding area.

(11) Remove neoprene gasket (9).

b. Installation. Install cargo well pump in the reverse order of removal. Adjust oiler metering valve (16) to meter 3 to 5 drops per minute.

CHAPTER 3

REPAIR OF DIESEL ENGINE, EXHAUST PIPING

AND MUFFLER ASSEMBLY

Section I. INTRODUCTION

3-1. General

This chapter contains the repair and overhaul of the diesel engine assembly. Information is provided on disassembly, reassembly, testing and adjustment of the engine and engine components.

3-2. Engine Description

There are four series 71 Detroit Diesel Engines used on the LARC. The engines are two cycle, six cylinder, inline engines having a 165 continuous horsepower rating at 2100 rpm. Each engine is equipped with an air starting motor, a forced feed fuel injection system, a full pressure lubrication 3-3. Testing Engine For Misfiring Cylinder system. and a circulating fresh water cooling system. Engine speed is controlled by a limiting speed governor coupled to the engine fuel system to limit the flow of fuel oil for engine speed control. Two different models of the series 71 engine are used on the LARC. Specific model differences and engine model locations are contained in TM 55-1930-203-10. Component locations on the engines will vary due to the different model engines used and their physical locations on the LARC, but all systems, testing and repair procedures described herein will apply to both types of engines.

Section II. ENGINE TESTING

3-3. Testing Engine for Misfiring Cylinder

a. Start engine and run at 600 rpm until normal operating temperatures are obtained (TM 55-1930-203-10).

b. Remove rocker cover (TM 55-1930-203-20).

c. Run engine at idle speed (550 rpm) and check valve clearance. Valve clearance should be 0.009 inch.

d. Hold the number 1 injector follower down with a screwdriver as shown in figure 3-1. This prevents operation of the fuel injector so that the number 1 cylinder does not receive fuel and will not fire.

e. If cylinder number 1 has been firing properly, there will be a noticeable difference in the sound and operation of the engine. If number 1 cylinder has been misfiring, there will be no change in the sound and operation.

f. If number 1 cylinder is firing properly, repeat the procedure for the five other cylinders or until the misfiring cylinder is located.

3-4. Testing Engine Compression Pressure

a. Start engine and run at 600 rpm until normal operating temperatures are obtained (TM 55-1930-203-10).

b. Stop engine (TM 55-1930-203-10).

c. Remove fuel injector from cylinder number 1 (para 3-10).

d. Install compression pressure gage (1, fig. 3-2) in fuel injector port (2). Use a suitable adapter for port and gage.

e. Install one of the two fuel pipes removed as a jumper connection between the fuel inlet and return manifold, to permit fuel flow to bypas the removed injector.

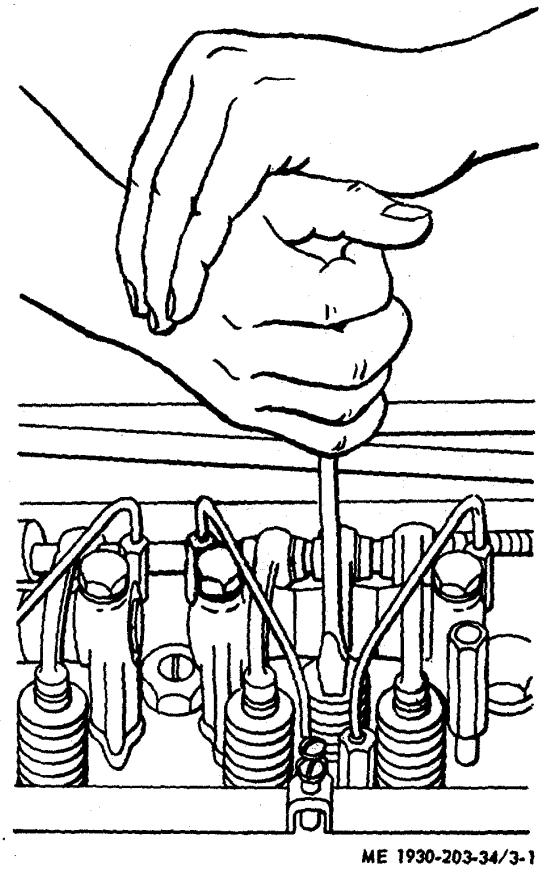
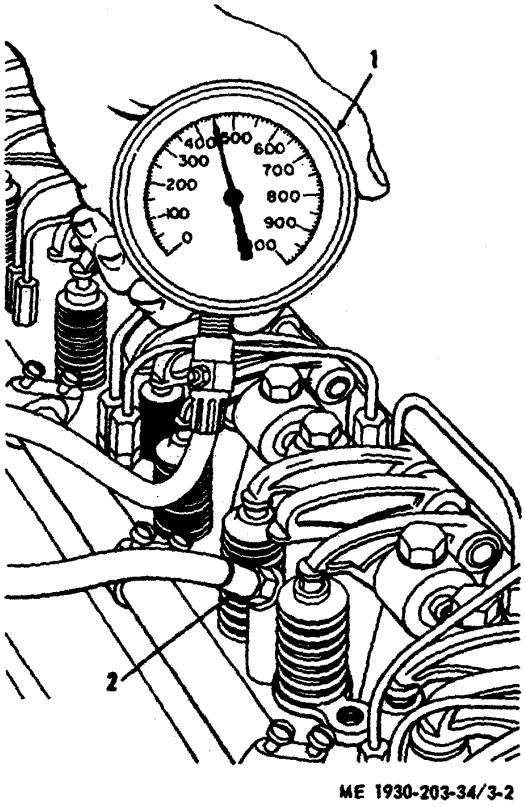
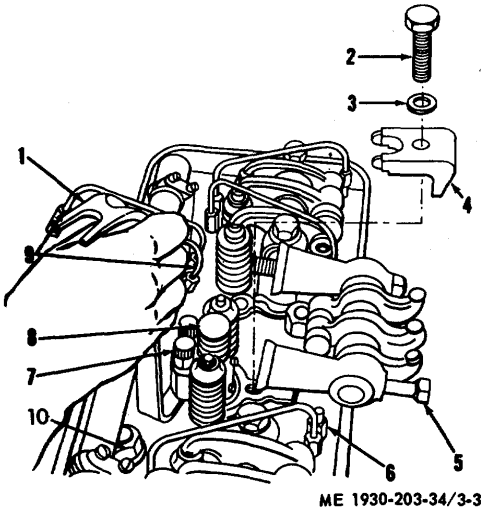


Figure 3-1. Locating & misfiring cylinder



1 Compression pressure gage
2 Fuel injector post

Figure 3-2. Testing compression pressure.



1 Injector remover, part No. J-1227-01
2 Bolt
3 Washer
4 Clamp
5 Bolt, rocker arm bracket
6 Connector, fuel
7 Shipping cap
8 Injector assembly
9 Fuel pipe
10 Nut, cylinder head stud

Figure 3-3. Fuel pipes and fuel connectors, removal and installation.

f. Start engine (TM 55-1930-203-10). Advance throttle until engine runs at 600 rpm. Observe and record compression pressure on number 1 cylinder.

NOTE

More accurate and informative readings are obtained if the compression pressure is taken while the engine is operating under a load condition. This condition can best be obtained with the LARC in the water and the marine gear engaged. The LARC can be held against a pier to simulate a full load condition.

g. After reading has been taken on the number 1 cylinder, install the number 1 injector (para 3-10) and repeat the procedure for the other five cylinders.

h. The compression pressure of any one cylinder should not be less than 400 psi at 600 rpm. In addition, the variation in pressure between any two cylinders must not exceed 25 psi at 600 rpm.

Section III. ROCKER ARM ASSEMBLY AND CYLINDER HEAD ASSEMBLY

3-5. Rocker Arm Assembly

a. Removal and disassembly.

(1) Remove rocker cover (TM 55-1930-203-20).

(2) Remove fuel pipes (9, fig. 3-3) from injector assembly (8) and fuel connectors (6). Install shipping caps (7) over fuel fittings on injector assembly.

(3) Remove bolts (1, fig. 3-4) securing rocker shaft brackets 12) to cylinder head. Remove rocker shaft brackets and rocker shaft (6).

CAUTION

When removing rocker shafts, fold back the three rocker arms just far enough so that the shaft may be removed. Do not force the rocker arms all the way back with the shaft in place as this may impose a load that could bend the push rods.

(4) Loosen locknuts (11) and unscrew rocker arms from push rods (16). Tag rocker arms for reassembly. Remove locknuts.

(5) Install push rod remover (4, fig. 3-5), flat washer (3), and locknut (2), with lower end of push rod remover resting on upper push rod spring seat (13, fig. 3-4).

(6) Screw locknut down on upper end of push rod, thus compressing push rod spring (14) and relieving tension on retaining ring (12).

(7) Snap retaining ring open with a screwdriver as shown in figure 3-4, and remove retaining ring.

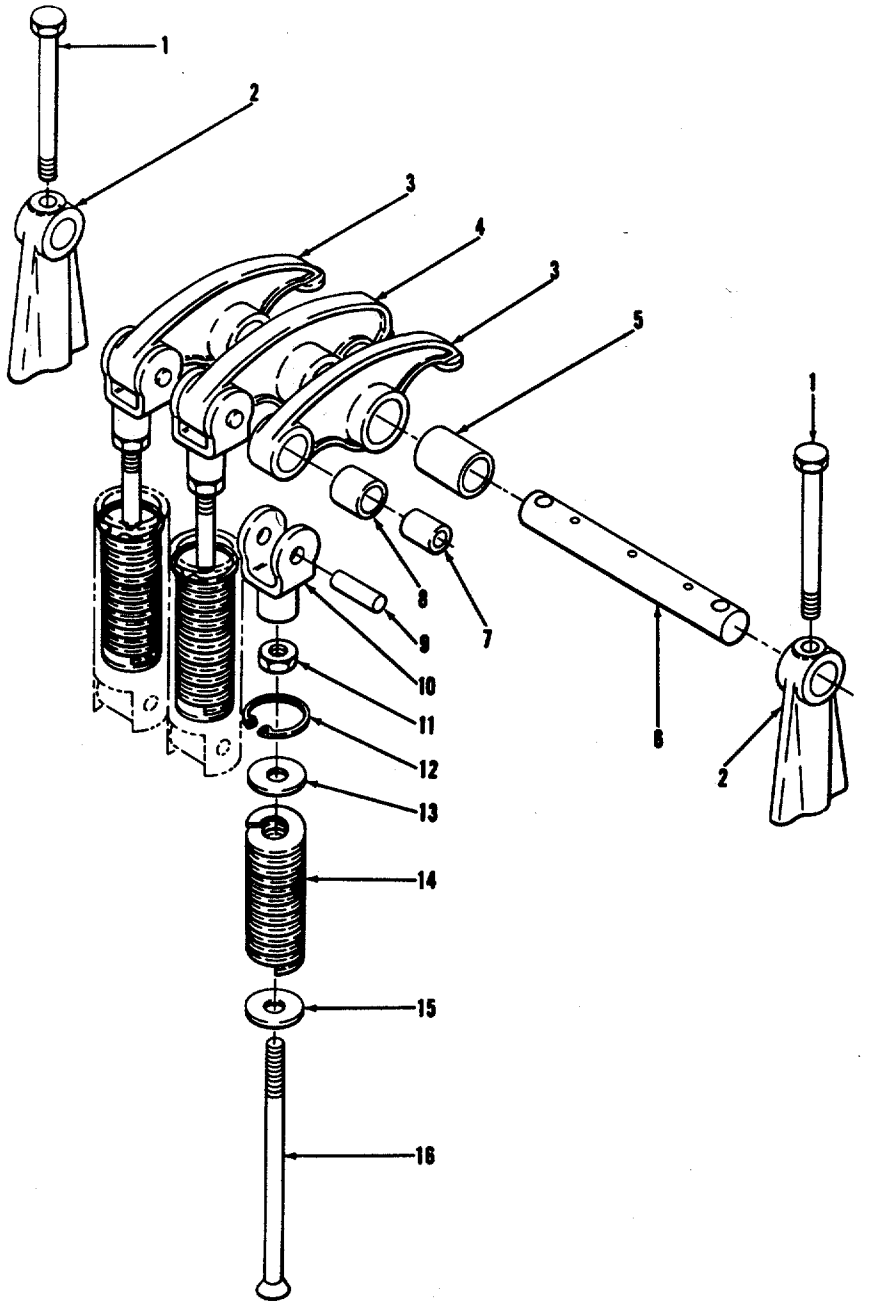
(8) Remove locknut and flat washer from push rod remover. Remove push rod remover.

(9) Pull push rod (16, fig. 3-4), spring. (14), and seats (13 and 15) out through top of cylinder head.

NOTE

When pulling the push rod through the opening, the cam follower assembly may come out of it.

(10) Repeat steps (5) through (9) above for removing the other two push rods on the cylinder.



1 Bolt, rocker shaft bracket
2 Rocker shaft bracket
3 Exhaust valve rocker arm
4 Injector rocker arm
5 Bushing, rocker shaft
6 Rocker shaft
7 Bushing, rocker arm clevis, inner
8 Bushing, rocker arm clevis, outer
9 Pin, clevis
10 Clevis, rocker arm
11 Locknut, push rod
12 Retaining ring
13 Push rod spring seat, upper
14 Push rod spring
15 Push rod spring seat, lower
16 Push rod.

Figure 3-4. Rocker arm assembly

b. Cleaning, Inspection, and Repair.

(1) Wash all parts in clean fuel oil and wipe them dry with a clean, lint-free cloth. Using a small wire, clean out oil passages in rocker arms (3 and 4, fig. 3-4), rocker shaft (6), and rocker shaft bracket bolts (1). Blow out each passage with compressed air.

(2) Inspect rocker shaft (6) and brackets (2) to see that they are not bent. Check bearing surfaces for scoring. Replace badly scored or damaged shafts or brackets.

(3) Examine hardened pallet on rocker arms (3 and 4). If pallet is pitted or shows signs of wear, replace rocker arm.

(4) Using a micrometer and caliper, check dimensions and clearances of shaft, rocker arm, and rocker arm bushings (table 1-1). If parts are worn beyond tolerances listed in table 1-1, replace worn parts.

(5) If the clearance between bushings is excessive. replace bushings. To replace a bushing proceed as follows:

(a) Secure rocker arm in a vise. Knock out old bus

(b) Press-fit new bushing into rocker arm.

(c) Ream inside diameter of bushing to produce desired clearance listed in table 1-1.

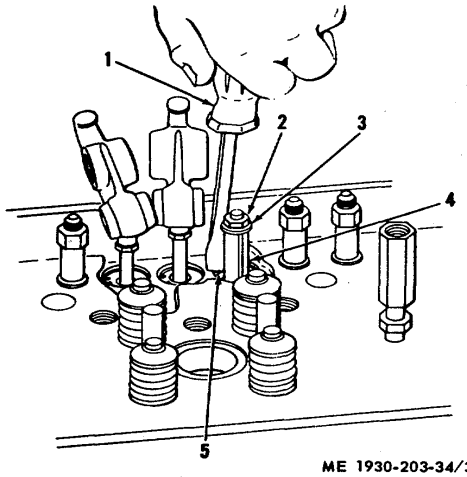


Figure 3-5. Removing push rod from cylinder head.

1 Screwdriver
4 Push rod remover, part no. J3092-01
5 Retaining ring

(6) Examine push rods (16) for being bent. Replace a bent push rod.

(7) Examine springs (14) and retaining rings (12) for loss of tension. Replace defective springsand retaining rings.

NOTE

Free length of spring is 2 5/8 inches. Replace spring when a load of less than 172 pounds will compress it to a length of 2 1/8 inches.

(8) Examine upper and lower push rod spring seats (13 and 15) for burring. See that springs fit properly in seats. Replace spring seats if defective.

c. Reassembly and Installation.

(1) Install lower push rod spring seat (15, fig. 3-4), spring (14), and upper rod spring seat (13) on push rod (16), and insert the assembly in bore in cylinder block and down into the cam follower.

NOTE

If cam follower was removed during disassembly, insert it into the bore first, positioned with oil hole in bottom of the follower over trailing edge of roller (hole toward outside of cylinder head).

(2) Install flat washer (3, fig. 3-5) and locknut (2) on push rod. Place push rod remover (4) on push rod between washer and upper spring seat.

(3) Screw locknut on push rod until spring is compressed sufficiently to permit retaining ring (5) to be inserted in bore.

(4) Partially collapse and install retaining ring.

(5) Remove locknut and flat washer on outer end of push rod remover and remove push rod remover.

(6) Screw locknut (11, fig. 3-4) down as far as possible on push rod (16). Screw rocker arm clevis (10) down on push rod, until end of push rod is flush with bottom of clevis.

NOTE

The injector rocker arm (4) is slightly different from the exhaust valve rocker arms (3). The boss for the shaft on the exhaust valve rocker arms is longer on one side of the arm than on the other. The extended boss of each exhaust valve rocker arm must face the injector rocker arm.

CAUTION

When a push rod has been disconnected from a clevis, the push rod must be screwed into the clevis until the end of the rod is flush with the bottom of the clevis yoke. If this is not done before valve clearance is adjusted, the valve may strike the piston when the crankshaft is turned and cause serious damage to the engine.

(7) Apply clean engine oil on surface of rocker arm shaft and slide shaft through rocker arms.

(8) Place brackets (2) over ends of rocker shaft with finished face of bracket next to rocker arm.

(9) Position rocker arm shaft bracket bolts (1) in place through brackets and shaft. Tighten bolts to a torque of 90 to 100 foot-pounds.

(10) Remove shipping caps from fuel fittings on injector assembly and connect fuel pipes from injector to fuel connectors. Tighten connectors to a torque of 12 to 15 foot-pounds.

CAUTION

Do not exceed the specified torque. Excessive tightening will twist or fracture the flared ends of the fuel pipes and result in leaks.

(11) Adjust valve clearance to O.012 inch with engine cold (TM 55-1930-203-20).

(12) Start engine (TM 55-1930-203-10).

(13) While engine is running in preparation for final valve adjustment, inspect fuel lines for possible leaks. If leaks at connections are discovered, tighten nut at fuel connection carefully to a torque of 12 to 15 foot-pounds.

CAUTION

Tighten all fuel leaks immediately. Fuel oil which leaks into the crankcase will dilute the lubricating oil and thus cause serious damage to the engine bearings.

(14) When engine has reached normal operating temperatures, adjust valve clearances to 0.009 inch and stop engine (TM 55-1930-203-20).

(15) Install rocker cover (TM 55-1930-203-20).

3-6. Cylinder Head

a. General. The cylinder head is a one-piece alloy iron casting securely held to the upper deck of the cylinder block by steel studs and nuts. Hardened exhaust valve seats pressed into the cylinder head furnish accurate seating or the valves and prolong cylinder head life. To insure efficient cooling, each injector tube, exhaust valve seat, and exhaust passage is surrounded by water. Nozzles installed in the cylinder head water inlet ports, direct water to the parts of the head subjected to the highest combustion temperatures. Compression is sealed by flat laminated metal gaskets, while oil and water leaks are prevented by seal rings. The cylinder head is removed as an assembly containing cam followers and guides, push rods, rocker arms, exhaust valves, and injectors.

b. Removal.

(1) Drain cooling system below level of engine (TM 55-1930-203-20).

(2) Disconnect exhaust piping and remove exhaust manifold from engine (para 3-7).

(3) Remove air cleaners (TM 55-1930-203-20).

(4) Remove rocker cover and gasket (TM 55-1930-203-20).

(5) Disconnect water hose and remove thermostat.

(6) Remove water temperature sending unit (11, fig. 3-6) and sensing unit (6) from water manifold.

(7) Remove fuel filters.

(8) Remove governor control housing assembly (para 3-13).

(9) Remove governor-throttle controls (fig. 3-7).

(10) Remove injector control tube assembly (para 3-9).

(11) Remove fuel pipes (9, fig. 3-3) from injectors (8) and fuel connectors (6).

(12) Loosen rocker arm shaft bracket bolts (5, fig. 3-3) to facilitate removal after cylinder head is removed from engine.

Key to figure 3-6.

1 Tube, 5/8 in. od
2 Gasket, water outlet manifold
3 Stud, water outlet manifold
4 Elbow
5 Socket, water temperature gage
6 Water temperature sensing unit
7 Lockwasher
8 Nut
9 Water manifold
10 Connector, electrical
11 Water temperature sending unit
12 Gasket, thermostat housing
13 Thermostat housing
14 Gasket, outlet manifold
15 Thermostat
16 Outlet elbow
17 Bolt, machine
18 Lockwasher
19 Tube

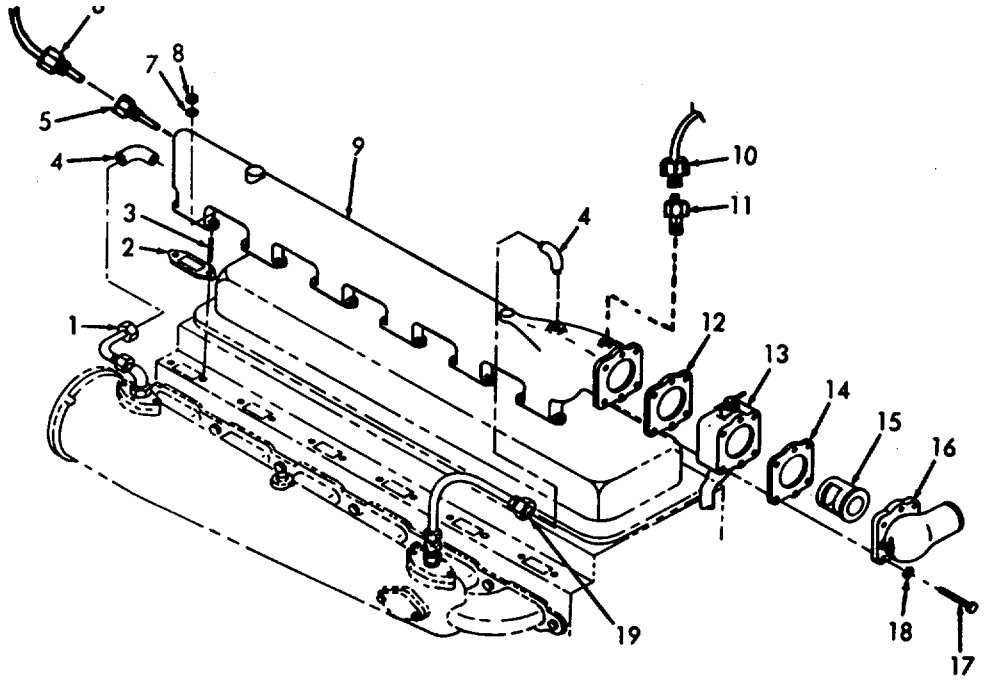
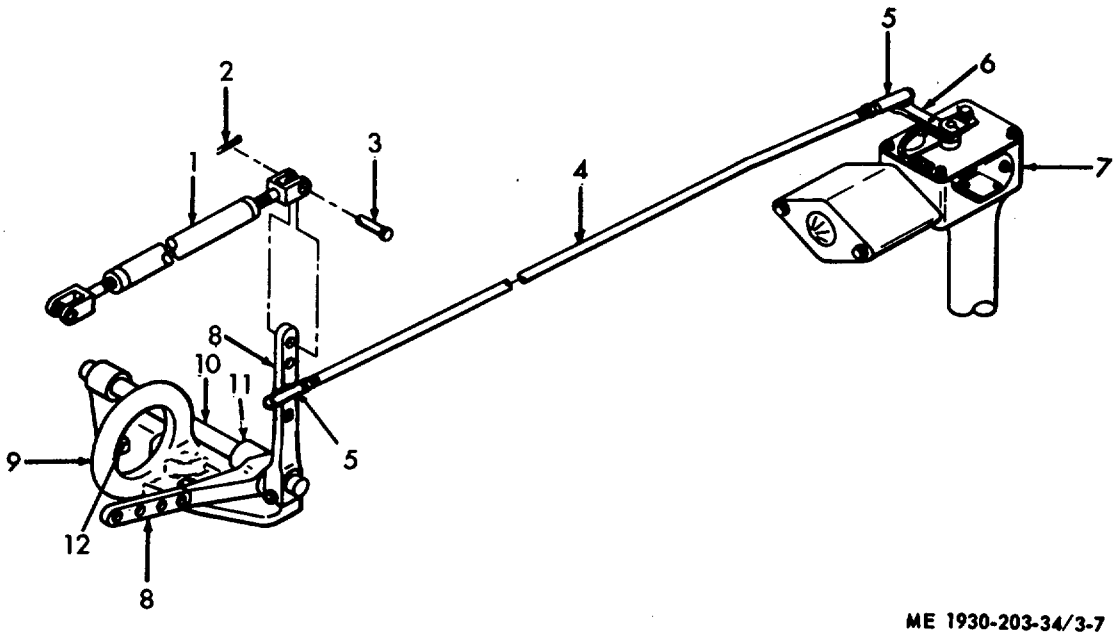


Figure 3-6. Water manifold.



1 Rod assembly
2 Pin, cotter
3 Pin, straight
4 Governor-throttle shaft
5 Ball joint
6 Governor speed control lever
7 Governor
8 Control lever
9 Lifting eye
10 Throttle control shaft
11 Shaft collar
12 Lifter bracket bolt

Figure 3-7. Governor-throttle controls

(13) Loosen two bolts which are directly below each lifter bracket and which attach balanceweight cover and flywheel housing to front and rear plates, respectively. This prevents threaded ends of bolts, which may be bearing against cylinder head, from interfering with cylinder head removal.

(14) Remove two bolts (12, fig. 3-37) which secure front lifter bracket to balance weight cover.

(15) Remove two bolts (12, fig. 3-7) which secure rear lifter bracket to flywheel housing.

(16) Remove cylinder head stud nuts (10, fig. 3-3).

(17) Insert lifting hooks of hoist in eyes of front and rearlifter brackets. Raise cylinder head uniformly off cylinder head studs.

(18) Remove cylinder head compression gaskets and oil and water seals.

(19) Set cylinder head on a suitable stand.

CAUTION

Do not set cylinder head with bottom face down on the bench; otherwise, the cam followers and injector spray tips which project below the bottom surface of the head will be damaged.

Key to figure 3-8.
1 Follower body
2 Roller pin
3 Cam roller
4 Cam follower
5 Lockwasher
6 Capscrew

c. Disassembly.

(1) Remove bolts attaching lifter brackets to cylinder head. Remove lifter brackets.

(2) Remove fuel injectors (para 3-10).

(3) Remove water manifold (para 3-8).

(4) Remove rocker arm assembly (para 3-5).

(5) Remove fuel oil connectors (4, fig. 3-35) and manifolds (7 and 10, fig. 3-35) if manifolds are not cast as part of the cylinder head (para 3-11).

(6) Remove and disassemble cam followers as follows:

(a) Rest cylinder head on its side and remove capscrews (6, fig. 3-8) that secure cam follower guide (4) to cylinder head. Remove guide.

(b) Pull cam follower from bottom of cylinder head.

(c) Place cam follower holder fixture, part no. J5840, in a vise and tighten securely (fig. 3-9).

(d) Place cam follower in groove in top of fixture with roller pin (2, fig. 3-8) resting on top of corresponding size plunger in fixture.

(e) Using suitable drift, drive roller pin (2, fig. 3-81 from roller (fig. 3-9) Exercise care in removing cam follower body (1, fig. 3-8) and cam roller (3) from fixture as follower pin is seated on top of a spring loader plunger in fixture body.

(f) Remove cam roller (31 from follower body (1).

(7) Remove exhaust valves as follows:

(a) Place cylinder head so that valve heads are resting on a block of wood.

(b) With a spring compressor, press down on spring retainer 13, fig. 3-10) to compress valve spring (7). Remove valve spring retainer lock (12).

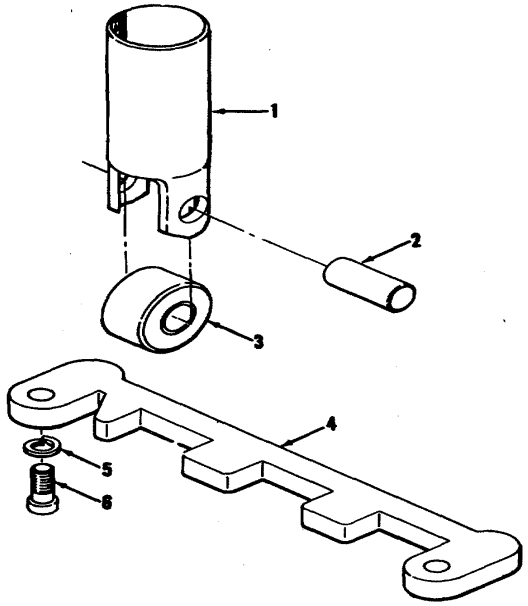


Figure 3-8. Cam follower assembly.

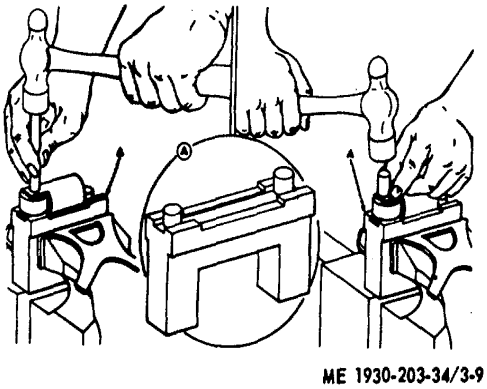
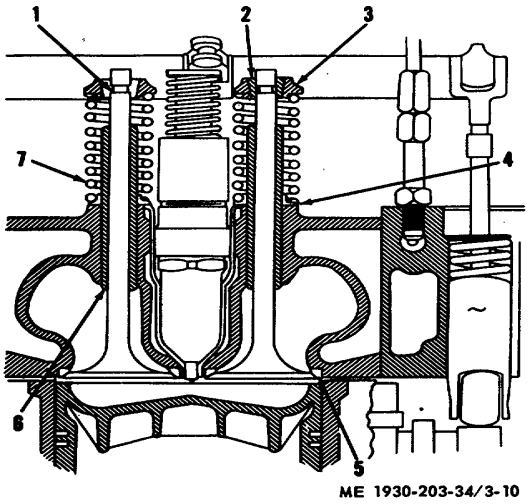


Figure 3-9. Removing or installing cam follower roller and pin with cam follower fixture, part No. J5840.

(c) Release spring compressor and remove retainer (3) valve spring (7), and washer (4).
(d) Repeat steps (b) and (c) above until all valve springs have been removed.
(e) Turn cylinder head over, -using care to prevent exhaust valves (1) from dropping out.
(f) Number each valve to assure reinstallation in the same valve seat insert. (5). Withdraw valves from cylinder head.



1 Exhaust valve
2 Valve spring retainer lock
3 Spring retainer
4 Washer
5 Valve seat insert
6 Valve Guide
7 Valve spring

Figure 3-10. Exhaust valve, guide, and seat insert

(8) Remove valve guides.

NOTE

Refer to subparagraph d and inspect valve guides in cylinder head to prevent unnecessary removal.

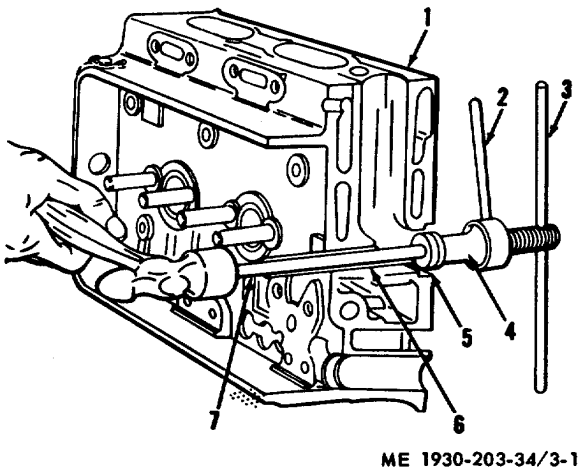
(a) Support cylinder head bottom up on wood blocks about 2 inches thick.
(b) Drive valve guides (6, fig. 3-10) out, using valve guide remover, part no. J267.

(9) Remove valve seat inserts.

NOTE

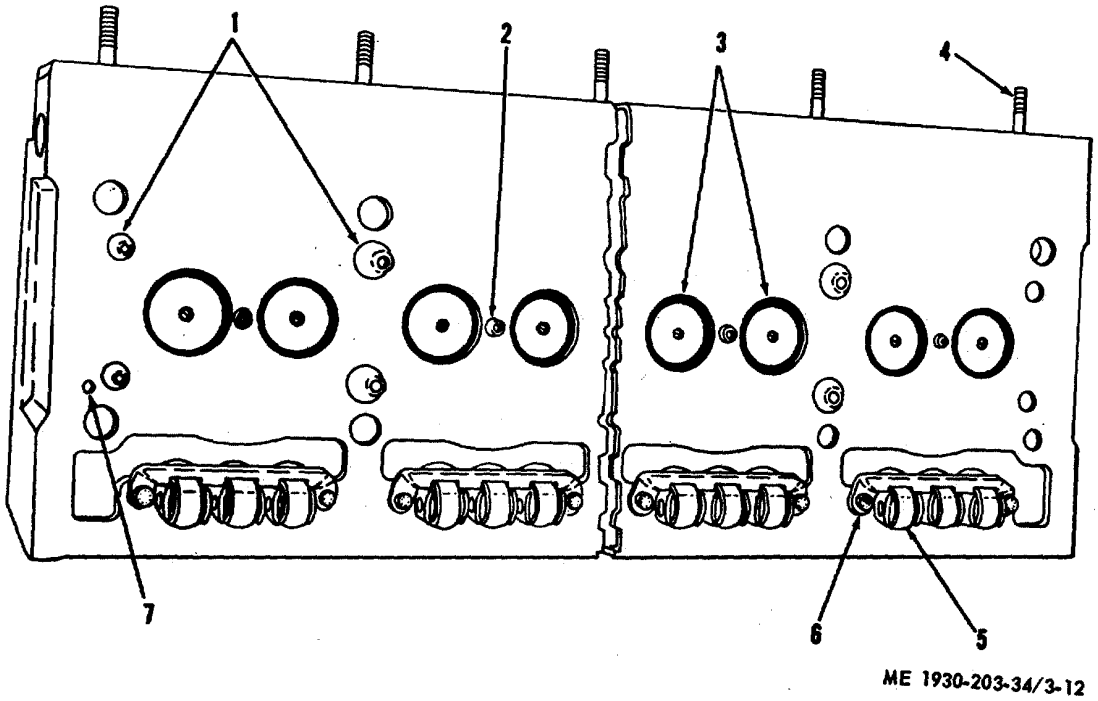
Refer to subparagraph d and inspect valve seat inserts in cylinder head to prevent unnecessary removal.

(a) Turn cylinder head on side and place collet (4, fig. 3-11) of valve seat insert remover, part No. J4824-01, inside valve seat inserts (5) so that bottom of collet is flush with bottom of insert.
(b) Hold collet handle (2) and turn tee handle (3) to expand collet-cone until insert is held securely by remover.
(c) Tap drive bar (7) once or twice to move insert 1 / 16 inch away from seat in cylinder head.
(d) Turn tee handle (3) to loosen collet cone. Move remover into insert slightly so that narrow flange at bottom collet is below valve seat insert (5).
(e) Tighten tee handle and drive insert out of cylinder head.
(f) Repeat (b) through (e) above until all valve seat inserts to be replaced are removed.



1 Cylinder head
2 Collet handle
3 Tee handle
4 Collet
5 Valve seat insert
6 Valve guide
7 Drive bar

Figure 3-11. Removing valve seat insert with valve seat insert remover, part no. J4824-01



1 Water nozzles
2 Injector
3 Exhaust valves
4 Exhaust manifold stud
5 Cam follower
6 Cam follower guide
7 Oil passage

Figure 3-12. Cylinder head assembly

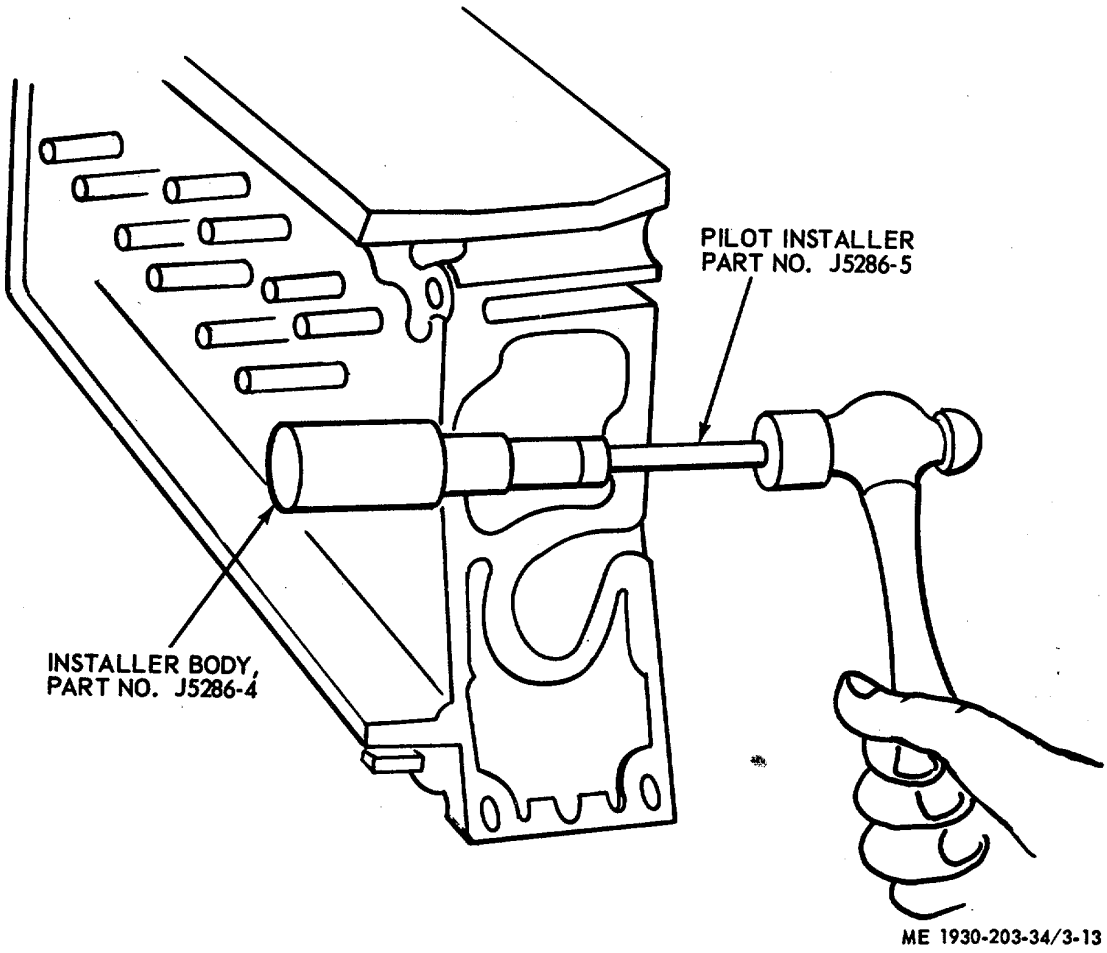


Figure 3-13. Removal and installation of injector tube

(10) Remove water nozzles (1, fig. 3-12) from water inlet ports by inserting a hook into nozzle opening and pulling from port. If a nozzle sticks and cannot be pulled from port, drill and ream out nozzle.

(11) Remove injector tubes as follows:

(a) Place installer body, part No. J5286-4 in injector tube. Thread pilot installer, part No. J5286-5, into end of installer body (fig. 3-13).

(b) Loosen injector tube with a hammer (fig. 3-13).

(c) Remove injector tube and tools from cylinder head.

d. Cleaning, Inspection, and Repair.

(1) *Cylinder head.*

(a) Remove all traces of old gasket from cylinder head.

(b) Steam clean head thoroughly.

WARNING

Acid can cause serious burns or blindness. Avoid contact with eyes, skin, or clothing. Do no breathe vapors. When diluting acids, do not add water to acids, the acid must be added to the mixture slowly with constant mixing. In case of bodily contact with acid, flush the affected part thoroughly with water and seek medical aid immediately.

(c) If water jackets are heavily scaled, clean as follows:

1. Agitate cylinder head in an approved acid bath.

2. Allow cylinder head to remain in acid bath until bubbling stops. This normally takes 30 minutes.

3. Lift cylinder head from bath, drain, and reimmerse in same solution for 10 minutes. Repeat this operation until all scale is removed.

4. Rinse cylinder head in clear hot water to remove solution.

5. Neutralize any remaining acid that may cling to cylinder head by immersing in approved alkaline bath. Wash in a bath of clean, hot water or steam clean.

6. Inspect cylinder head after cleaning to be certain that all ports, oil galleries, and drain holes have been cleaned thoroughly.

(d) Check bottom of cylinder head for flatness, using a heavy, accurate, straightedge and a feeler gage as follows:

1. Place straightedge across width of cylinder head and slip feeler gage between straightedge and fire deck (bottom of cylinder head) at maximum opening. Check for warpage at each end of fire deck and between all cylinders. If warpage exceeds 0.004 inch, replace cylinder head.

2. Place straightedge along length of fire deck and check for longitudinal warpage. Take measurements at each side of fire deck and along both sides of water ports. If warpage exceeds 0.010 inch, replace cylinder head.

(e) Check cylinder head for leaks as follows:

1. Seal off water holes by clamping holes with plates and rubber gaskets. Seals can be held in place with plate and bolts on the other side of head.

2. Install injector tubes.

3. Install scrap or dummy fuel injectors in cylinder head to insure proper seating of injector tubes.

4. Drill and tap one water hole cover plate for an airline fitting.

5. Connect a compressed air source to tapped water hole cover plate and apply 80- to 100-psi air pressure to water jacket.

6. Immerse cylinder head in a tank of water, preheated to 1800 to 2000F., for 15 to 20 minutes.

7. Check for leaks at bottom and top of injector holes tubes, oil gallery, cylinder head stud holes, exhaust ports, and top, bottom, and sides of head, by observing air bubbles.

8. Relieve air pressure and remove cylinder head from water.

9. Remove water hole plates and gaskets, and dry cylinder head with compressed air.

10. Replace any leaking injector hole tube. Replace cylinder head if inspection revealed cracks.

(2) *Exhaust valves.*

(a) Clean valve springs, retainers, and locks in dry-cleaning solvent, Federal Specification P-D-680, and dry with compressed air (10 psi).

(b) Clean carbon from valves and wash stems with clean drycleaning solvent.

(c) Inspect spring retainers and retainer locks for pitting or damage. Replace, if necessary.

(d) Inspect valve springs for pitted or fractured coils. Replace if pitted or damaged. Springs should have a free length of 23h inches and require a load of 146±4½ pounds to compress it to a length of 1 49 / 64 inches. Replace spring when a load of less than 135 pounds will compress it to 1 49 / 64 inches in length.

(e) Inspect valve heads. Heads must be square with valve stem and should not be warped. Replace defective valves.

(f) Inspect valve stems. Stems must be smooth and free from scratches or scuff marks and not warped, burned, or worn beyond 0.3415 inch in diameter. Replace a defective valve.

(g) Inspect valve faces to assure faces are smooth, unpitted, and free from ridges and cracks. Carbon on face of valve indicates a faulty seat and a resultant leak. Replace pitted or damaged valves. If leaking is indicated, reface valve to a 30-degree angle (fig. 3-14). Edge of valve at valve head must not be less than 0.030 inch in thickness after refacing. Replace valve if edge is less than 0.030 inch thick.

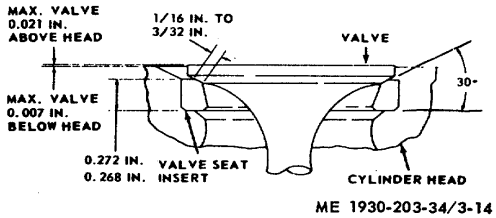


Figure 3-14. Relationship between exhaust valve, valve seat insert, and cylinder head

(3) *Valve guides.*

NOTE

Cleaning and inspection should be accomplished before valve guides are removed from cylinder head.

(a) Clean inside diameter of valve guides of gum and carbon deposits with valve guide cleaner, part no. J5437.

(b) Inspect valve guides for fractures, chipping, scoring, or excessive wear. Remove and replace valve guide if damaged or worn so that stem-to-guide clearance is greater than 0.006 inch.

(4) *Valve seat inserts.*

NOTE

Cleaning and inspection should be accomplished before valve guides are removed from cylinder head.

(a) Clean area around insert with dry cleaning solvent, Federal Specification P-D-680 and dry with compressed air.

(b) Inspect valve seat insert for pitting, cracking, improper seat angle, or extensive grinding. Remove and replace insert if serious pitting or cracking condition exists. Place valve into insert and check distance valve recedes into cylinder head. If valve recedes beyond 0.007 inch (fig. 3-14) or will recede beyond 0.007 inch after valve seat is ground, replace valve seat. If minor pitting or improper seat angle is noted, recondition insert in cylinder head as follows:

1. Using valve seat grinder set, part No. J8165, grind valve seat insert as follows.

(a) Use a 30-degree grinding wheel on valve seat (fig. 3-14).

(b) Use a 60-degree grinding wheel to open throat of insert.

(c) Grind top surface of insert with a 15-degree wheel to adjust width of valve seat. Width should be 1 / 16 to 3 / 32 inch (fig. 3-14).

2. Set dial indicator in position in valve guide and insert, and rotate indicator to determine concentricity of each valve seat insert relative to the valve guide. Total runout should not exceed 0.002 inch. If runout exceeds 0.002 inch check for bent valve guide before regrinding insert.

3. Determine position of contact area between valve and valve seat insert as follows:

(a) Apply a light coat of marking compound, Federal Specification TT-R-191, Type II, to valve seat insert.

(b) Place a valve with clean, smooth face in valve guide and bounce, but do not rotate, valve on insert. The marking compound will indicate area of contact on valve face. The most desirable area of contact is at the center of valve face. If contact is too close to top or bottom of valve face, regrind valve seat insert and recheck for concentricity and retest for area of contact.

(5) *Cam followers.*

(a) Clean cam follower assembly in dry cleaning solvent, Federal Specification P-D-680, and dry with compressed air.

(b) Inspect follower cam guide (4, fig. 3-8) for pitting or damage. Replace a defective cam follower guide.

(c) Inspect cam follower bores in cylinder head. Bores should be smooth and free of score marks. If score marks are noted, remove marks with crocus cloth, Federal Specification P-C-458.

(d) Check clearances between cam follower body and cylinder head bore. Maximum allowable clearance is 0.006 inch. If clearance is greater than 0.006 inch, replace cam follower body. Clearance between new cam follower body and cylinder head bore is 0.001 to 0.003 inch.

(e) Inspect cam roller 13, fig. 3-8). Roller must turn smoothly and freely on its pin and must be free from flat spots or scuff marks. If roller does not turn freely or has been scored or worn flat, replace roller and pin. Inspect cam on which damaged roller operates for wear or damage. Replace camshaft if defective.

(f) Measure diametric clearance between roller bushing and pin (fig. 3-15). If bushing is worn so that a diametric clearance greater than 0.010 inch exists, replace roller and pin.- Check side clearance between roller and follower body. If side clearance is less than 0.015 inch or greater than 0.023 inch, replace roller and pin.

NOTE

The cam roller and pin are serviced as a set only.

(g) If roller and pin are removed from follower body, remove any burrs that exist at pinholes of follower body with a fine hone or crocus cloth, Federal Specification P-C-458.

(6) Clean, inspect, and repair rocker arms and push rods (para 3-5).

(7) Clean, inspect, and repair fuel injectors (para 3-10).

e. Reassembly and Installation.

(1) *Reassembly.*

(a) Install water nozzles as follows:

1. Check to assure water inlet ports are free of all foreign material.

2. Press nozzles into water inlet ports with nozzle openings parallel to the longitudinal centerline of cylinder head. Install ½ inch diameter nozzles at ends of cylinder head with nozzle openings toward center of cylinder head.

3. If inlet ports have been enlarged by corrosion, preventing a press fit of nozzles and ports, tin outside diameter of nozzles with solder to provide a tight fit.

CAUTION

When tinning nozzles, do not allow nozzle openings to be closed with solder.

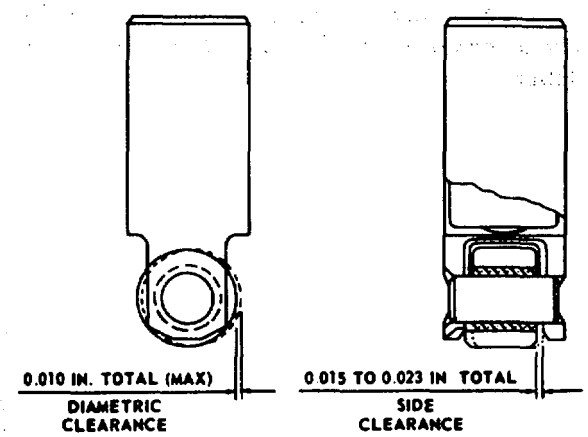


Figure 3-15. Cam roller wear and clearance

4. Press all nozzles flush to 1 / 32 inch below (recessed) bottom surface of cylinder head; otherwise, interference with proper seating of head on cylinder block may be encountered.

(b) Install injector tubes as follows:

1. Place new seal ring in counterbore of injector tube holed.

2. Place installer body in injector tube. Insert pilot installer through small opening of injector tube and thread pilot installer into tapped end of installer body.

3. Slip injector tube into bore in cylinder head and drive tube in place. Flange at upper end of tube will seat on seal ring when tube is properly positioned.

4. Turn cylinder head bottom side up, remove pilot installer, and thread flaring die installer, part No. J5286-6, into tapper end of installer body.

5. Using a torque wrench and socket, apply a torque of 30 foot-pounds on flaring die installer.

6. Remove injector tube installing tools from tube.

7. Use tool No. J5286-7 (fig. 3-16) and ream injector tube for injector nut and spray tip as follows:

NOTE

Ream carefully, without undue force or speed, to avoid cutting through thin wall of injector tube. Turn reamer in a clockwise direction only, both when inserting and when withdrawing reamer; otherwise, movement in opposite direction will dull cutting edges of flutes.

(a) Place cylinder head right side up.

(b) Place a few drops of light cutting oil on flutes and carefully position reamer in injector tube (fig. 3-16).

(c) Turn reamer in a clockwise direction, withdrawing it frequently to remove chips, until lower shoulder of reamer contacts injector tube.

(d) Clean chips from injector tube.

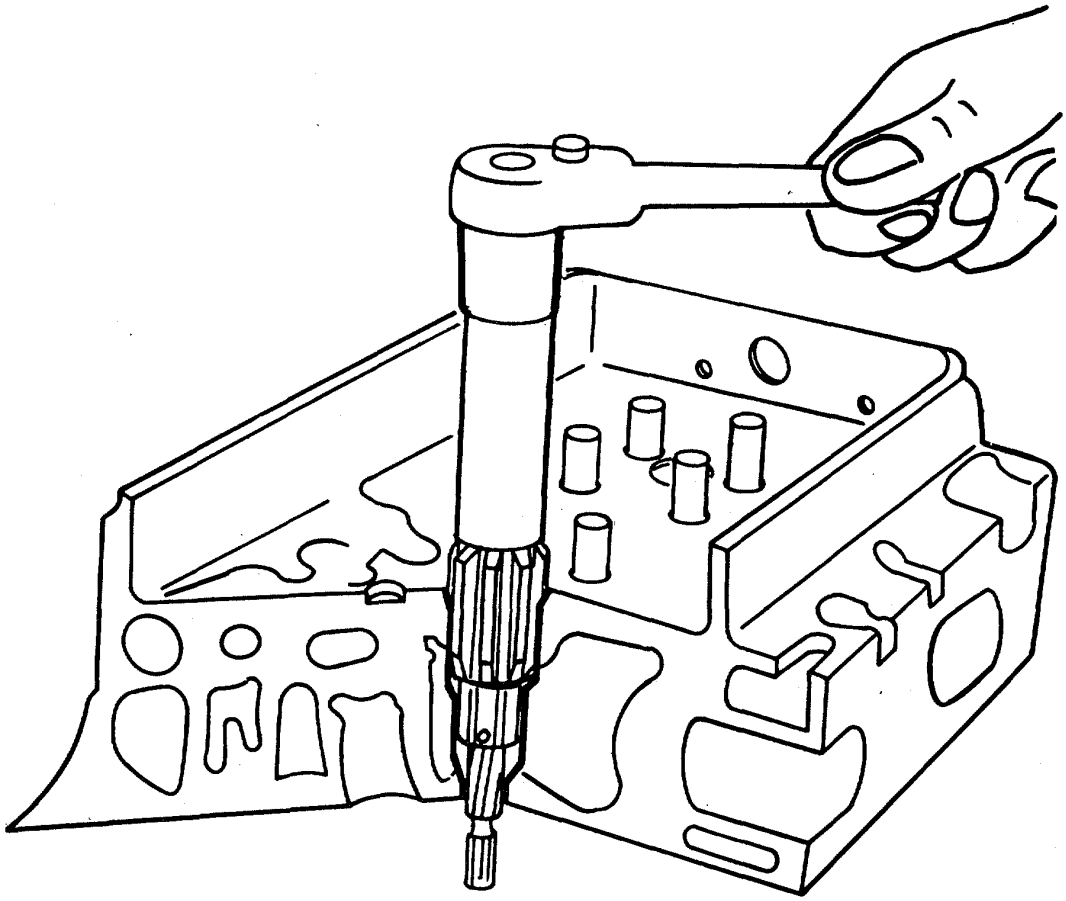


Figure 3-16. Reaming injector tube for injector body nut and spray tip with reamer, part no. J5286-7

8. Remove excess at lower end of tube as follows:

(a) With cylinder head bottom side up, insert pilot of tube tip refinisher, part No. J5286-8, into small hole of injector tube.

(b) Using a socket and speed handle, remove excess stock so that lower end of injector is flush to 0.005 inch recessed in surface of cylinder head.

9. Ream bevel seat in injector tube to provide a smooth and true seat for lower end of injector nut as follows:

(a) Install injector in tube and note relationship between numbered surface of spray tip to fire deck of cylinder head (fig. 3-17). This will determine amount of stock that must be reamed from bevel seat of tube.

(b) Wash interior of injector tube with dry-cleaning solvent, Federal Specification P-D-580, and dry with compressed air (10 psi).

(c) Place a few drops of cutting oil, Military Specification MIL-L-21041, on bevel seat of injector tube. Carefully lower reamer, part No. J5286-9, into tube until it contacts bevel seat (fig. 3-18).

(d) Without applying any downward force, make a trial cut by turning reamer steadily. Remove reamer, blow out chips, and note what portion of bevel seat has been cut.

(e) Proceed carefully with reaming operation. Withdraw reamer occasionally to check progress made.

(f) Remove chips from injector tube and using an injector as a gage, continue reaming operation until shoulder of spray tip is flush to 0.0 1 5 inch recessed in surface of cylinder head (fig. 3-17).

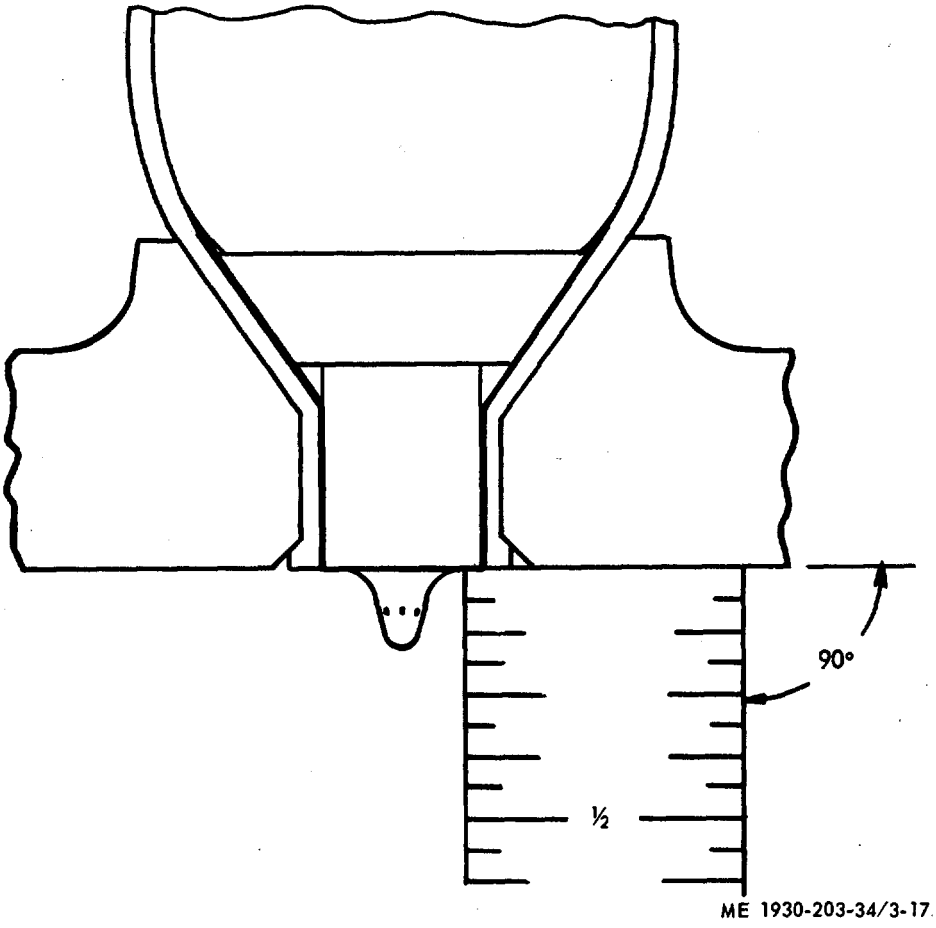


Figure 3-17. Checking location of injector spray tip relative to lower surface of cylinder head

(c) Install valve seat inserts as follows:

1. Clean valve insert counterbore in cylinder head with drycleaning solvent, Federal Specification P-D-680. Dry with compressed air (10 psi).

2. Immerse cylinder head for 30 minutes in water heated to a temperature of 180° to 200° F.

3. Rest cylinder head bottom up on work-bench and locate inserts squarely in counterbores, seating face up.

CAUTION

Install valve inserts in cylinder head while head is still hot and inserts are at room temperature; otherwise, installation will be difficult and parts may be damaged. Inserts are installed with a press fit of 0.0005 to 0.0025 inch in cylinder head (fig. 3-14).

4. Drive inserts in place with valve seat insert driver, part No. J1736, until they seat solidly in cylinder head (fig. 3-19).

5. Set dial indicator in position in each insert and check for concentricity in relation to valve guides. If total runout exceeds 0.002 inch, regrind valve seat insert.

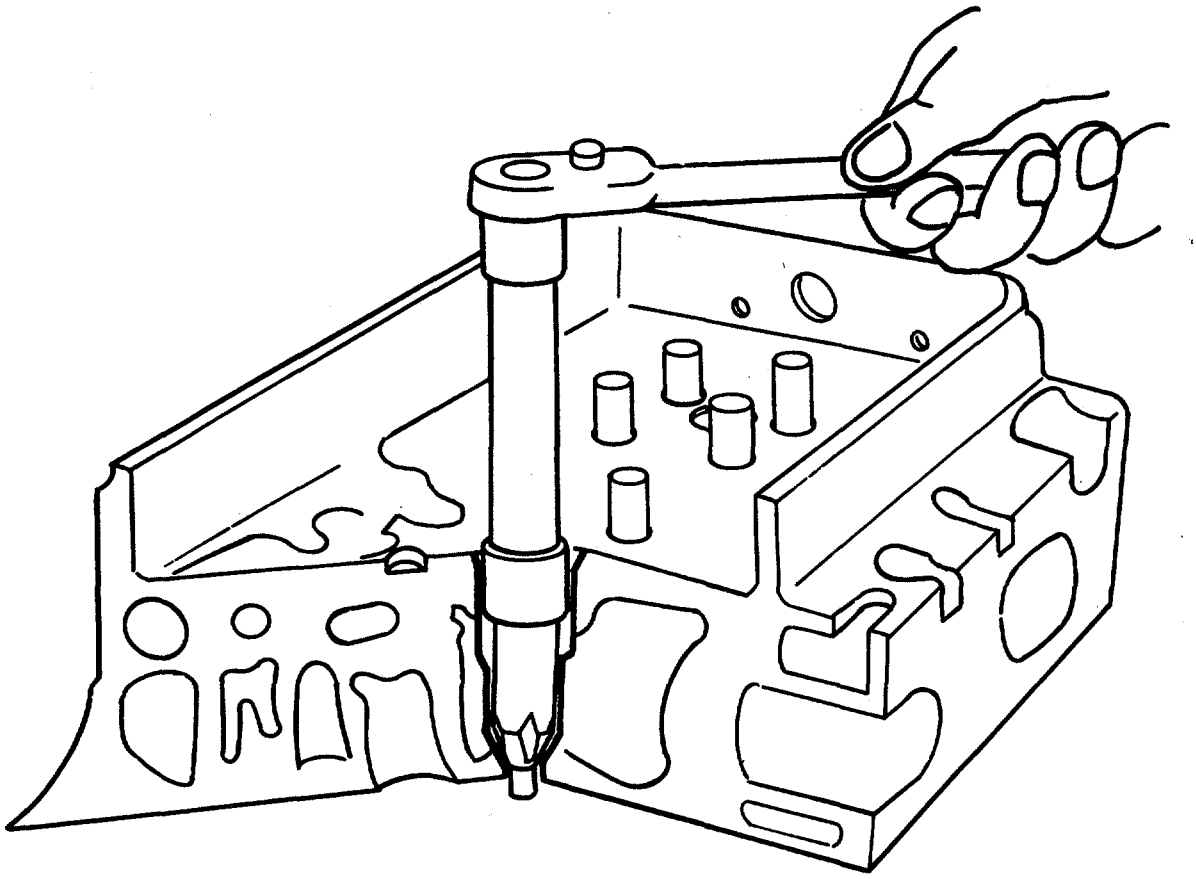


Figure 3-18. Reaming bevel seat in injector tube for injector nut with reamer, part no. J5286-9

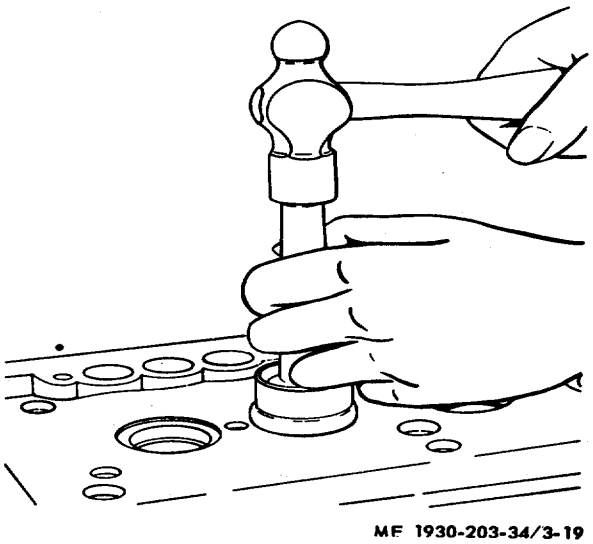


Figure 3-19. Installing valve seat insert with valve seat insert driver, part no. J1736

(d) Install valve guides as follows:

1. Rest bottom of cylinder head on work-bench.

2. Insert threaded end of valve guide (6, fig. 3-10) into valve guide installer.

3. Locate valve guide squarely in cylinder head and tap gently to start guide in place (fig. 3-20).

4. With guide properly started, drive guide into cylinder head until its upper end projects 1-19/32 inches above top of cylinder head. This dimension is automatically provided by valve guide installer.

5. Repeat steps I through 4 above until all guides are installed.

CAUTION

Use care not to bend valve guides during installation. Do not use valve guides as a means of turning cylinder head over or in handling cylinder head.

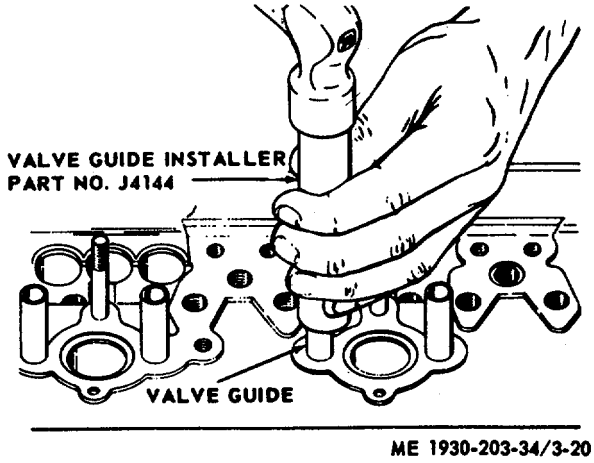


Figure 3-20. Installing valve guide with valve guide installer, part no. J4144

(e) Install exhaust valves as follows:

1. Lubricate valve stems with a light coat of engine oil, Military Specification MIL-L-2104, and slide valves into valve guides. If reconditioned valves are used, install them in same relative location from which they were removed.

2. Hold valves in place with a strip of masking tape, Federal Specification UU-T-106, and place a board between cylinder and head and workbench to support valves and to provide clearance for cam followers to avoid damaging rollers. Turn cylinder head right side up on bench and properly position on board.

3. Install washer (4, fig. 3-10), valve springs (7), and spring retainers (3) over valve stem and guide.

4. Using a spring compressor, compress valve spring (7) and install two-piece tapered valve spring retainer lock (2). Exercise care to avoid scoring valve stem with spring retainer (3) when compressing spring.

5. Install retainer locks on remaining exhaust valves in the same manner.

NOTE

After valves have been installed, check to make sure that heads of valves do not protrude more than 0.021 inch beyond the surface of the cylinder head when valves are fully closed (fig. 3-14).

(f) Reassemble and install cam followers as follows:

1. Reassembly.

(a) Position follower body (1, fig. 3-8) in groove of holding fixture with proper size plunger extending through roller pinhole in one of legs of follower body. Coat bushing in cam roller (3) and roller pin (2) with engine oil.

(b) Install cam roller (3) in position in cam follower body. The plunger in fixture will extend into roller bushing and assure accurate alignment of bushing' with roller pinholes in follower body.

(c) Start roller pin (2) squarely into follower. Carefully drive pin into assembly until pin is centered in legs of follower (fig. 3-9).

(d) Check side clearance between roller and follower body. Clearance must be 0.015 to 0.023 inch (fig. 3-15).

NOTE

Immerse new or cleaned cam follower assembly in clean engine oil for at least 5 minutes before placing in cylinder head. This will insure initial lubrication over full length of cam follower roller pin. Rotating cam roller during this period will aid in introduction of oil to cam roller pin.

2. Installation.

(a) Note l/8 inch oil hole in bottom of cam follower. With oil hole pointing away from exhaust valves and injectors, so that hole is not covered by cam follower guide, and with cam roller pointing across cylinder head, slide cam follower into position from bottom of head.

(b) Attach cam follower guide (4, fig. 3-8) to cylinder head to hold group of three cam followers in place. Check to assure there is clearance between cam followers and cam follower guide. Tighten capscrews (6) to a torque of 12 to 15 foot-pounds.

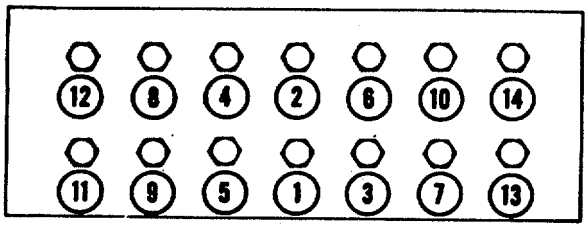


Figure 3-21. Cylinder head stud nut tightening sequence

(g) Install push rods and rocker arms (para 3-5).

(h) Install fuel oil connectors and manifolds if manifolds are not cast as part of cylinder head (para 3-6).

(i) Install fuel injectors (para 3-10).

(j) Attach lifter brackets temporarily to head to permit lifting head into position on engine.

(2) *Installation.*

(a) Place a new cylinder liner compression gasket on each cylinder liner.

(b) Place new seal rings in counterbores of water and oil holes in cylinder block.

(c) Install a new oil seal in groove at perimeter of cylinder clock. Do not stretch seal.

(d) Position hoist above cylinder head and attach hooks at lifting brackets on cylinder head. Lift head into position over cylinder block.

(e) Wipe underside of cylinder head clean and lower in place over studs on cylinder block.

(f) Remove hoisting hooks and loosen bolts attaching lifter brackets.

(g) Install a stud nut on each cylinder head mounting stud. Using cylinder head tightening sequence (fig. 3-21), tighten nuts to a torque of 165 to 175 foot-pounds.

(h) Tighten two bolts directly below each lifter bracket.

(i) Using a new gasket, secure rear lifter bracket to cylinder head and flywheel housing. Tighten bolts to a torque of 55 to 60 foot-pounds.

(j) Using a new gasket, secure front lifter bracket to cylinder head and flywheel housing. Tighten bolts to a torque of 55 to 60 foot-pounds.

(k) Align fuel pipes and connect pipes (9, fig. 3-3) to injectors (8) and fuel connectors (6).

Tighten connectors to a torque of 12 to 15 foot-pounds.

(l) Install governor control housing (para 3-12).
(m) Install injector control tube assembly (para 3-9).
(n) Install governor-throttle controls (fig. 3-7).
(o) Install fuel filters.
(p) Install water manifold (para 3-8).
(q) Install temperature gage sending unit (I1, fig. 3-6) and sensing unit (6) in water manifold.
(r) Connect water piping and thermostat.
(s) Install exhaust manifold (para 3-7) and connect exhaust piping (TM 55-1930-203-20).
(t) Install air cleaners (TM 55-1930-203-20).
(u) Adjust valve clearance, time injectors, and position injector control racks (TM 55-1930-203-20).
(v) Install rocker cover and gasket on cylinder head (TM 55-1930-203-20).
(w) Fill cooling system (TM 55-1930-203-20).

Section IV. EXHAUST MANIFOLD AND WATER MANIFOLD

3-7. Exhaust Manifold

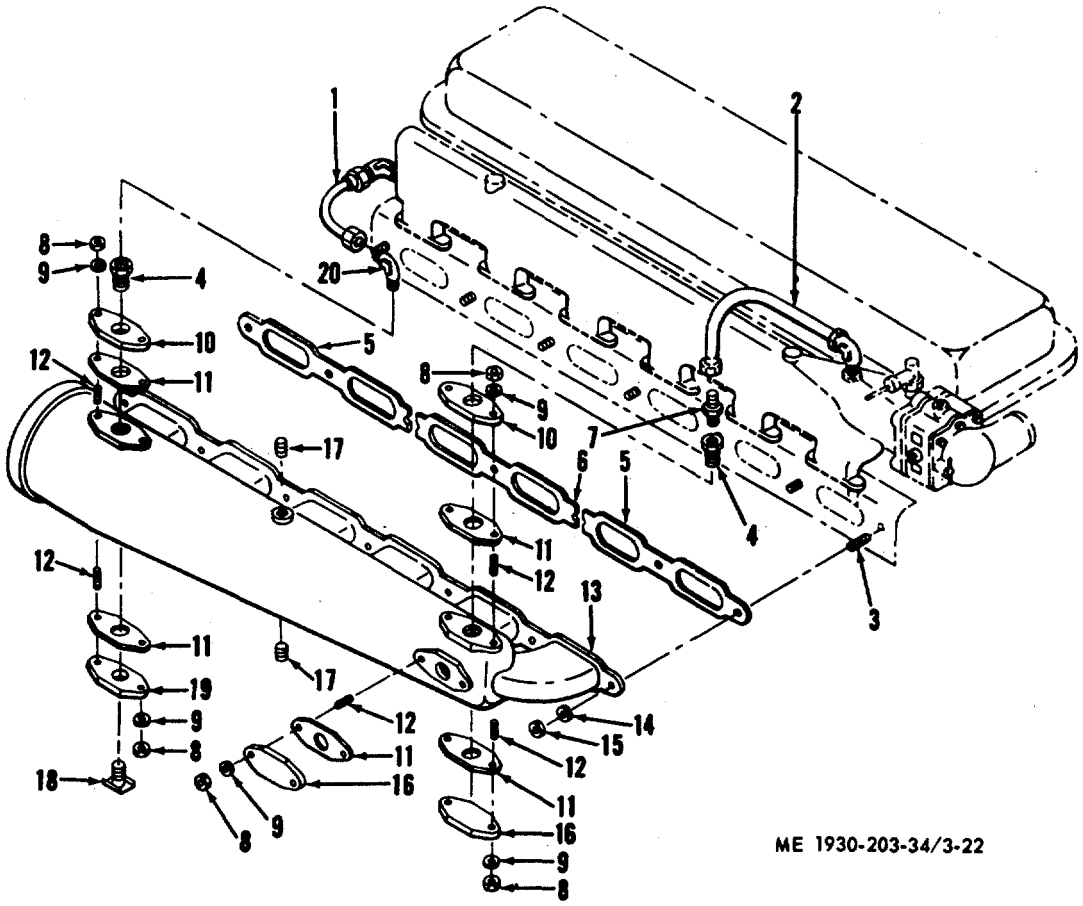
a. Removal.

(1) Drain cooling system below level of exhaust manifold (TM 55-1930-203-20).
(2) Disconnect tube (1, fig. 3-22) from elbow (20). Disconnect tube (2) from nipple (7).
(3) Open drain cock (18) and drain coolant from water jacket.
(4) Remove bolts and lockwashers attaching exhaust piping to exhaust manifold (TM 55-1930-203-20).
(5) Remove nuts (15) and washers (14) securing exhaust manifold (13) to cylinder block.

NOTE

To facilitate removal of number two stud nut (between the two forward manifold legs), unscrew nut to end of stud; remove all the other manifold nuts and washers; then pull exhaust manifold away from cylinder block and remove number two nut and washer.

(6) Remove gaskets (5 and 6).
(7) Remove nuts (8) and washers (9), and remove cover plates (10,16, and 19) and gaskets (11).



1 Tube
2 Tube
3 Stud, exhaust manifold to head
4 Bushing, reducing
5 Gasket, exhaust manifold mounting, end
6 Gasket, exhaust manifold mounting, intermediate
7 Nipple
8 Nut
9 Washer
10 Cover plate, tapped
11 Gasket, cover plate
12 Stud, cover plate
13 Exhaust manifold
14 Washer, bevel
15 Nut
16 Cover plate, plain
17 Plug, pipe
18 Drain cock
19 Cover plate, drain cock
20 Elbow

Figure 3-22. Exhaust manifold.

b. Cleaning, Inspection, and Repair.

(1) Clean exhaust manifold in fuel oil and wipe dry with a lintfree cloth. Scrape old gasket from gasket surfaces on manifold and on cylinder block with a wire brush.

(2) Inspect manifold for signs of cracking. Check closely the areas around gasket surfaces. Replace a cracked manifold.

(3) Check studs (3, fig. 3-22) for stripped threads and for being loose. If studs are damaged, install new studs and tighten to 25 to 40 foot-pounds.

(4) Replace gaskets (11).

(5) Check studs (12) for stripped threads and looseness. Replace damaged studs.

c. Installation.

(1) Position gaskets (11, fig. 3-22) and cover plates (10, 16, and 19) on manifold and secure with washers (9) and nuts (8).

(2) Install bushings (4) and install elbow (20) and nipple (7). Install drain cock (18).

(3) Position new gaskets (5 and 6) over studs (3).

(4) Position exhaust rnanifold on studs so that

about ½ inch of stud threads extend beyond mounting flanges of manifold legs.

(5) Place bevel washers (14) on studs and screw nuts (15) several turns on studs.

NOTE

Place bevel washers on studs so that the outer diameter will rest on manifold and crown at center will rest on studs.

(6) Slide manifold up against gaskets. Starting with center nut and working alternately toward ends of manifold, tighten nuts to a torque of 30 to 35 foot-pounds.

(7) Connect tubes (1 and 2).

(8) Attach exhaust piping to manifold with bolts and lockwashers.

(9) Fill cooling system and check for leaks (TM 55-1930-203-20).

3-8. Water Manifold

a. Removal.

(1) Drain cooling system below level of water manifold (TM 55-1930-203-20).

(2) Remove water temperature sending unit (11, fig. 3-6) and sensing element (6) from water manifold.

(3) Disconnect rubber hose from bypass tube at water pump and flexible hose fromoutlet elbow on water manifold.

(4) Remove bolts (17) and lockwashers (18); and remove outlet elbow (16), thermostat housing (13), and gaskets (12 and 14).

(5) Remove thermostat (15) from thermostat housing.

(6) Disconnect tubes (1 and 19) from elbow (4).

(7) Remove nuts (8) and lockwashers (7) securing water manifold to cylinder block.

(8) Lift water manifold (9) straight up and off studs. Remove and discard gaskets (2).

b. Cleaning, Inspection and Repair.

(1) Clean water manifold (9, fig. 3-6), outlet elbow (16), and thermostat housing (13) in an approved solvent and rinse thoroughly with clean water. Remove all traces of gasket material from cylinder head.

(2) Inspect water manifold outlet elbow and thermostat housing for cracks, breaks, or evidence of leaks. Replace defective parts.

(3) Replace gaskets (2, 12, and 14).

(4) Inspect studs (3) for defective threads and for being loose. If studs are defective, install new studs and tighten to 10 to 25 foot-pounds.

(5) Test thermostat (15) as follows:

(a) Place thermostat and a thermometer in a container of warm water.

NOTE

Do not allow thermometer to touch bottom of container.

(b) Agitate water to maintain an even temperature throughout container and gradually increase temperature of water. The thermostat should begin to open at 173°F (78.3°C) and be fully open at approximately 185°F (85°C). If thermostat fails to operate properly, replace thermostat.

(c) Install water manifold in reverse order of removal.

Section V. FUEL INJECTION CONTROLS, FUEL INJECTOR ASSEMBLY, AND FUEL MANIFOLDS

3-9. Fuel Injector Controls

a. Removal.

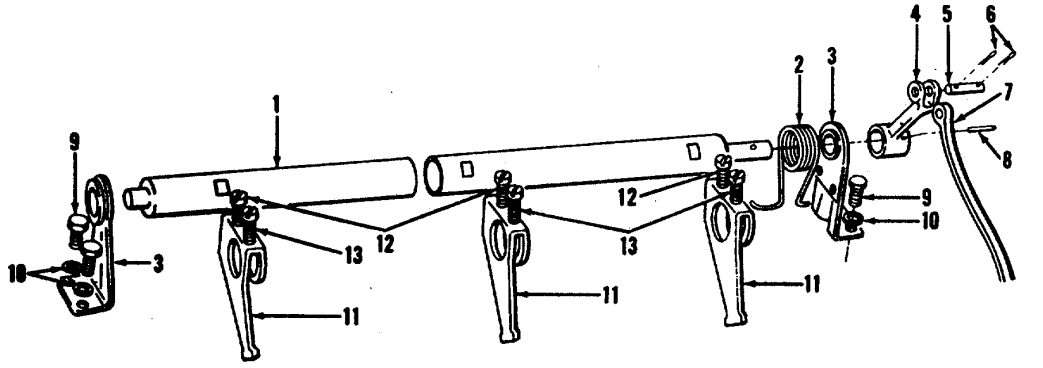
(1) Remove cotter pins (6, fig. 3-23) and link pin (5) attaching fuel rod (7) to injector control tube lever (4).

(2) Remove pin (8) attaching injector control tube lever (4) to injector control tube (1) and remove injector control tube lever.

(3) Remove machine bolts (9) and lock-washers (10) securing injector control tube brackets (3) to engine and remove injector control tube brackets and spring (2) from injector control tube (1).

(4) Loosen inner control lever adjusting screw (12) and outer control lever adjusting screws (13), and slip injector rack control levers (11) from injector control tube (1).

b. Installation. Install fuel injector controls in the reverse order of removal. After installation is accomplished, reposition injector rack control levers in the order outlined by paragraph 3-78 in TM 55-1930-203-20.



1 Injector control tube
2 Spring
3 Injector control tube bracket
4 Injector control tube lever
5 Link pin
6 Pin, cotter
7 Fuel rod
8 Pin, straight
9 Bolt, machine
10 Lockwasher
11 Injector rack control lever
12 Inner control lever adjusting screw
13 Outer control lever adjusting screw

Figure 3-23. Fuel injector controls

3-10. Fuel Injector Assembly

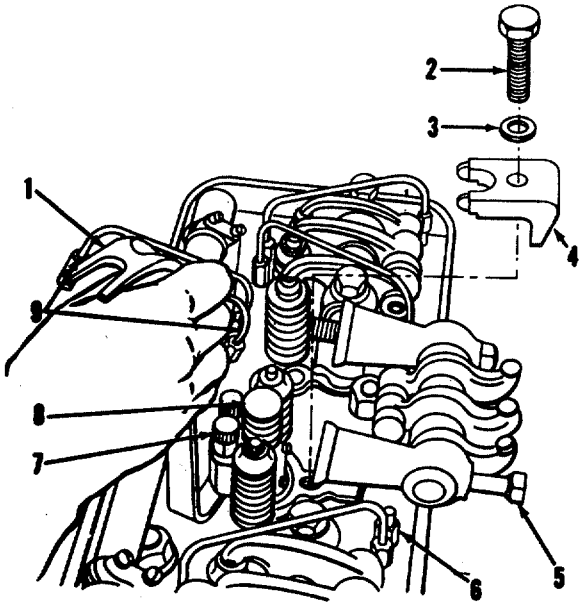
a. Removal, Testing, and Disassembly.

(1) *Removal.*

(a) Remove rocker cover (TM 55-1930-203-20).

(b) Disconnect fuel pipes (9, fig. 3-24) from injector assembly (8) and fuel connectors (6).

(c) Install shipping cap (7) over fuel fittings on injector assembly.



Key to figure 3-24.
1 Injector remover, part No. J1227-01
2 Bolt
3 Washer
4 Clamp
5 Bolt, rocker arm bracket
6 Connector, fuel
7 Shipping cap
8 Injector assembly
9 Fuel pipe

Figure 3-24. Fuel injector removal

CAUTION

Immediately after removal of fuel pipes, each fitting must be covered with a shipping cap to prevent dirt from entering injector assembly.

(d) Depress starter button in engine well to bring outer ends of push rods of injector assembly and valve rocker arms in line horizontally.

(e) Remove two rocker arm bracket bolts (5) and swing rocker assembly away from injector assembly and valves.

(f) On engines prior to serial No. 6A-84033, remove injector clamp nut, washer (3), and clamp (4). On engines serial No. 6A-84033 and subsequent, remove bolt (2), washer (3), and clamp (4).

(g) Loosen inner and outer adjusting screws on injector rack control lever and slide lever away from injector assembly.

(h) Pry injector assembly loose from its seat as shown in figure 3-24 using injector remover (1), and lift injector assembly from cylinder head.

(2) *Testing.* Perform the following series of tests to determine condition of fuel injector and to avoid unnecessary overhauling.

NOTE

Perform all tests before disassembling an injector to correct any one condition.

(a) Fuel injector rack and plunger movement test.

1. Check for free movement of plunger in bushing by placing injector against a bench or other hard surface and depressing follower to bottom of its stroke (fig. 3-25).
2. At same time follower is depressed, move rack back and forth.
3. Failure to produce a free plunger or rack movement indicates damaged or dirty internal injector parts.

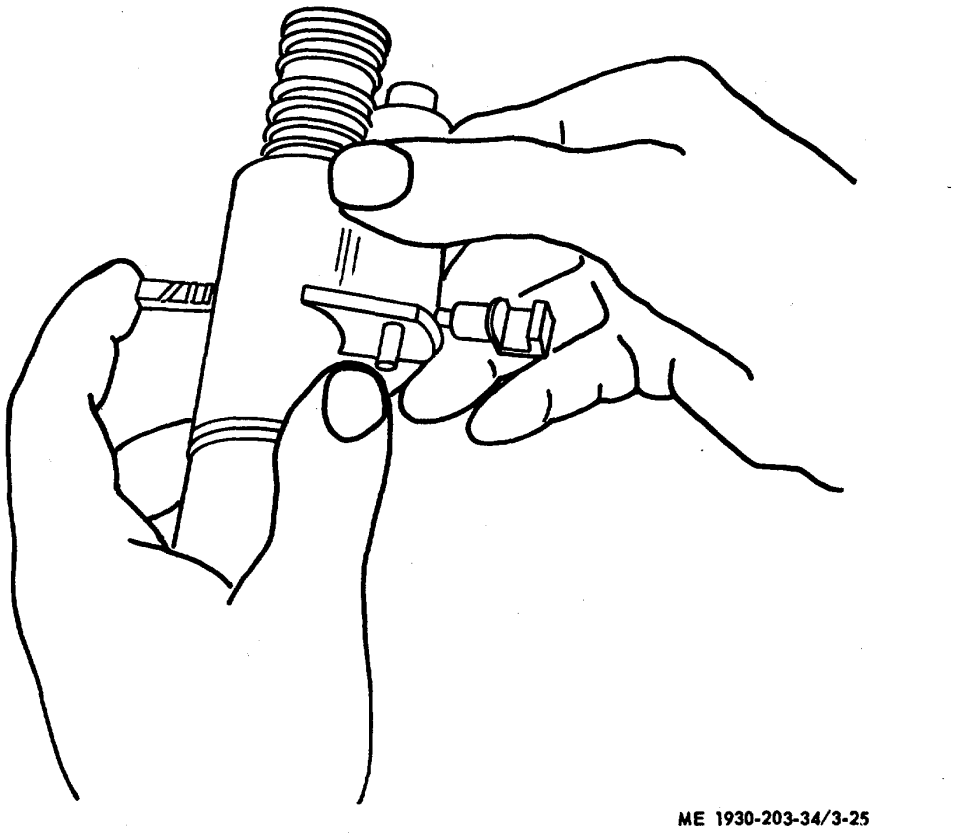


Figure 3-25. Checking rack and plunger for free movement

WARNING

Hold injector in such a way as to prevent any fuel spray from penetrating skin. Fuel oil which enters the blood stream can cause blood poisoning.

(b) Valve opening pressure test.

1. Place injector in injector tester, part No. J9787.
2. Position injector support plate and handle support to the proper height.

WARNING

Always place injector in proper position in relation to the spray deflector before it is tested, in order to prevent fuel spray from penetrating the skin.

3. Close inlet tube of injector by lowering inlet clamp handle.
4. Operate pump handle until all air is purged from test fixture and injector.
5. Close outlet clamp.
6. With injector rack in FULL FUEL position, pump handle of test fixture with smooth, even strokes.
7. Record injector valve opening pressure indicated when injector sprays fuel. Specified valve opening pressure is 450 to 850 psi.

(c) Valve holding pressure test.

1. Operate pump handle to bring pressure up to a point just before injector valve opening pressure as determined in the preceding test.
2. Close fuel shutoff valve.
3. Note pressure drop. Time for a pressure drop from 450 to 250 psi must not be less than 40 seconds.
4. Check injector as follows if pressure drops from 450 to 250 psi in less than 40 seconds.

(a) Dry injector with compressed air.
(b) Open test fixture fuel valve.
(c) Operate pump handle to maintain testing pressure (1 above.)
(d) Check for a leak at injector rack opening. If present, a poor bushing-to-body fit is indicated.
(e) Check for leaks around spray tip or seal ring. This is usually caused by a loose injector nut, damaged seal ring, or brinelled surface on injector nut or spray tip.
(f) Check for a leak around filter cap indicating a loose filter cap or damaged filter cap or damaged filter cap gasket.
(g) Check for leak at spray tip orifices, indicating a leaking valve assembly due to a damaged surface or dirt.

NOTE

If pressure drop from 450 to 250 psi did not exceed 40 seconds, a drop or two of fuel at spray tip is only an indication of fuel trapped in tip at beginning of test and is not detrimental.

(d) High pressure test.

1. Dry injector with compressed air.
2. Check fuel connections for leaks. If leaks occur, tighten connection, dry injector, and recheck.
3. With injector rack in FULL FUEL position and test fixture handle locked in position, operate pump handle to build up and maintain pressure.
4. Use adjusting screw in test fixture handle to depress injector plunger far enough to close both ports in injector, bushing. (Both ports are closed when injector spray decreases appreciably and a rise in pressure occurs).
5. Operate pump handle a few times. If pressure beyond normal valve opening pressure (established in valve opening pressure test) cannot be obtained, excessive clearance between plunger and bushing is present. Replacement of plunger and bushing is required.
6. Operate pump handle to obtain and maintain a pressure of 1600 to 2000 psi.
7. Inspect for leaks at injector filter cap gaskets, body plugs, injector nut seal ring area, and injector rack hole.

WARNING

Do not permit pressure in test fixture to equal or to exceed capacity of pressure gage.

(e) Spray pattern test.

1. With injector rack in FULL FUEL position, operate pump handle to maintain a fuel pressure just below valve opening pressure ((b) above).
2. Operate injector several times with pump handle and observe spray pattern emitted from tip orifices. Fuel should be discharged from each orifice and spray should produce uniform pattern.

(f) Fuel output test.

1. Place injector in comparator, part No. 17041, and tighten hand wheel to seal firmly.
2. Check to be sure counter on comparator is preset to 1000 strokes.
3. Pull injector rack out to NO FUEL position.
4. Start comparator.
5. Push injector rack to FULL FUEL position.
6. Allow injector to run approximately 30 seconds to purge air that may be in system.
7. Press fuel flow start button. This will start flow of fuel into vial. The comparator will automatically stop flow of fuel after 1000 strokes.
8. When fuel stops flowing into vial, pull injector rack out to NO FUEL position.
9. Turn comparator off.
10. Reset counter.

11. Observe reading on vial. To be within specified limits of HV7 injector, vial readings should fall between a minimum of 30 and a maximum of 36.

12. Record injector output. This information aids in selection of a set of injectors which will inject same amount of fuel in each cylinder at a given throttle setting. The result is a smooth running, well balanced engine.

(3) *Disassembly.* Consider injector assembly that passes all of tests outlined above to be satisfactory for service without further disassembly. Disassemble injector which fail to pass one or more of the tests as follows:

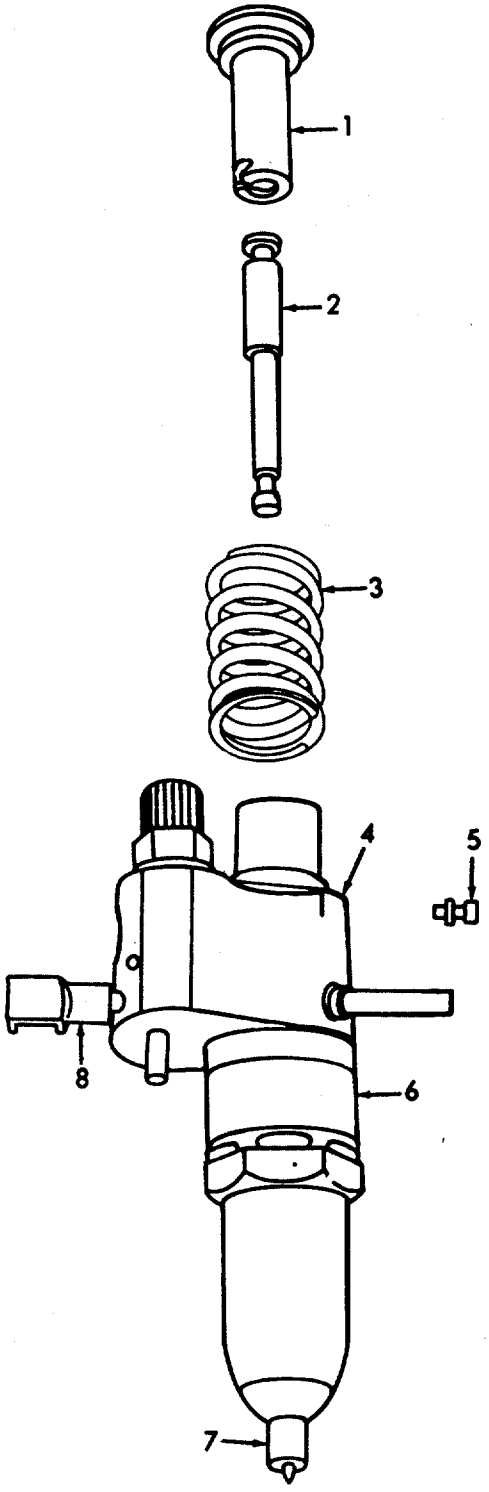
(a) Fuel injector plunger and follower assembly disassembly.

1. Support injector assembly upright in injector assembly fixture, part No. J6868-01.

2. Compress follower spring (3, fig. 3-26). Using a screwdriver, raise follower spring above stop pin 15) and withdraw pin (fig. 3-27).

3. Allow spring to rise gradually.

4.Remove plunger follower (1, fig. 3-26), follower spring (3), and plunger (2).



1 Follower
2 Plunger
3 Follower spring
4 Injector body
5 Stop pin
6 Nut, injector
7 Spray tip
8 Control rack

Figure 3-26. Injector plunger and follower assembly.

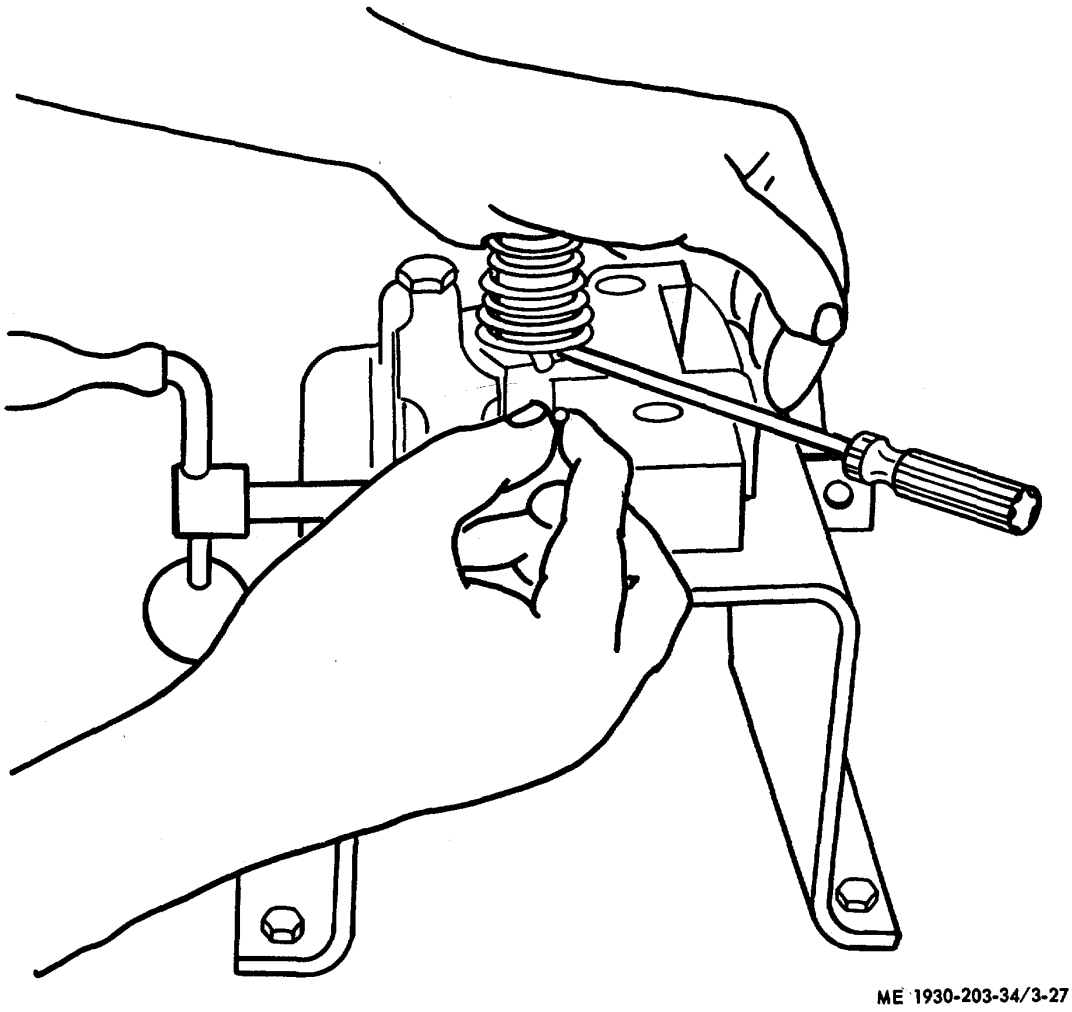


Figure 3-27. Removing injector follower stop pin

(b) Fuel injector valve assembly disassembly.

1. Invert injector in assembly fixture. Remove nut (15, fig. 3-28) from injector body (1).

2. Lift injector nut straight up, using care not to dislodge spray tip (12) and other small parts resting on end of bushing (5). If injector has been in use for some time, spray tip (12) will possibly be removed with nut.

3. Lift spray tip (if tip was not removed with nut), check valve (1), valve cage (10), valve stop (9), valve spring (8), injector valve (7), and valve seat (6) from bushing. (5).

4. If spray tip (12) sticks in nut, support nut on a wood block and drive tip down through nut using tip remover, part No. J1291-02 (fig. 3-29). Do not drive directly on end of spray tip as damage will occur.

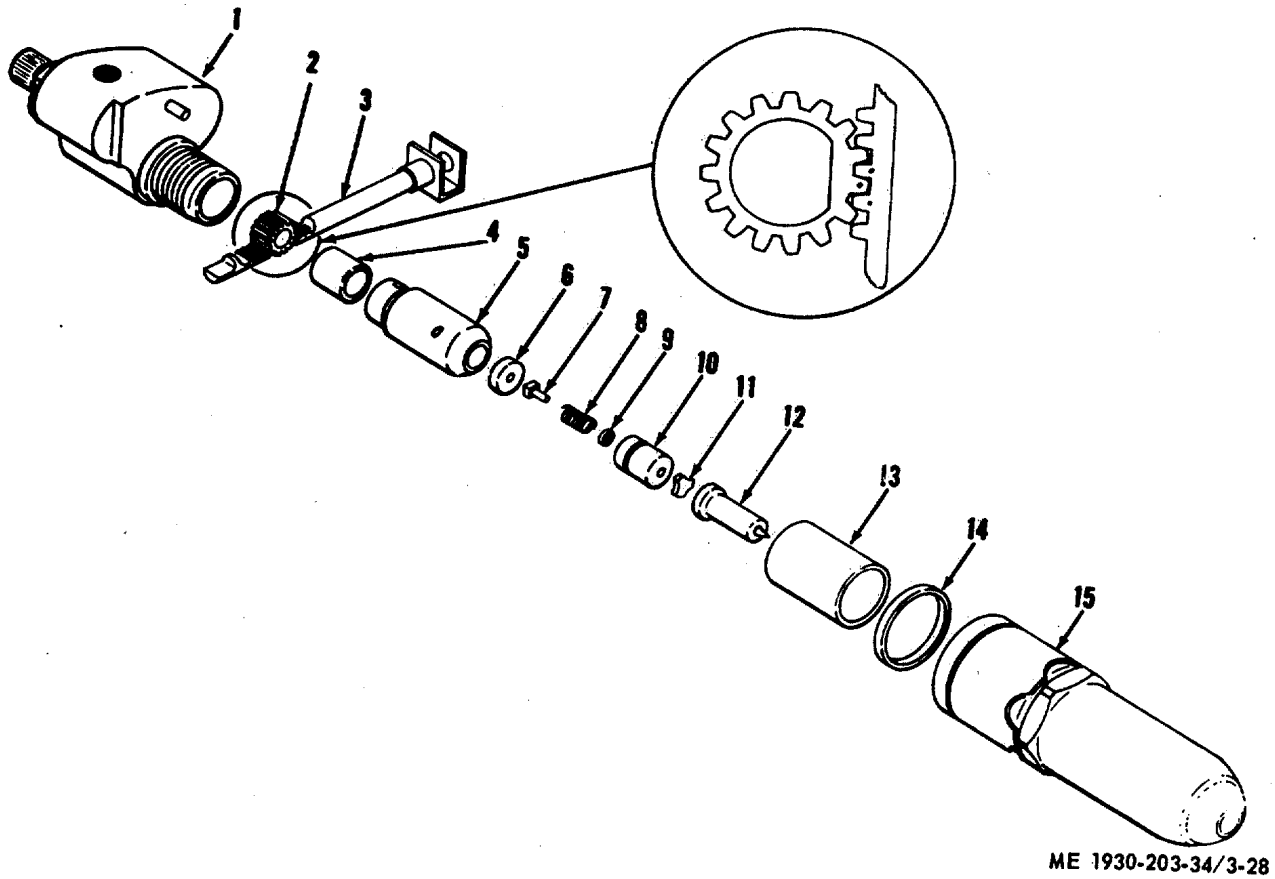
5. Jar and remove the spill deflector (13, fig. 3-28) and seal ring (14) from nut (15).

(c) Fuel injector rack and gear assembly disassembly.

1.Remove bushing (5) from injector body (1).

2.Jar gear retainer (4) and gear (2) from injector body.

3. Pull control rack (3) from injector body.



1 Injector body
2 Gear
3 Control rack
4 Gear retainer
5 Bushing
6 Valve seat
7 Injector valve
8 Valve spring
9 Valve stop
10 Valve cage
11 Check valve
12 Spray tip
13 Spill deflector
14 Seal ring
15 Nut, injector

Figure 3-28. Fuel injector rack and gear, and valve assemblies.

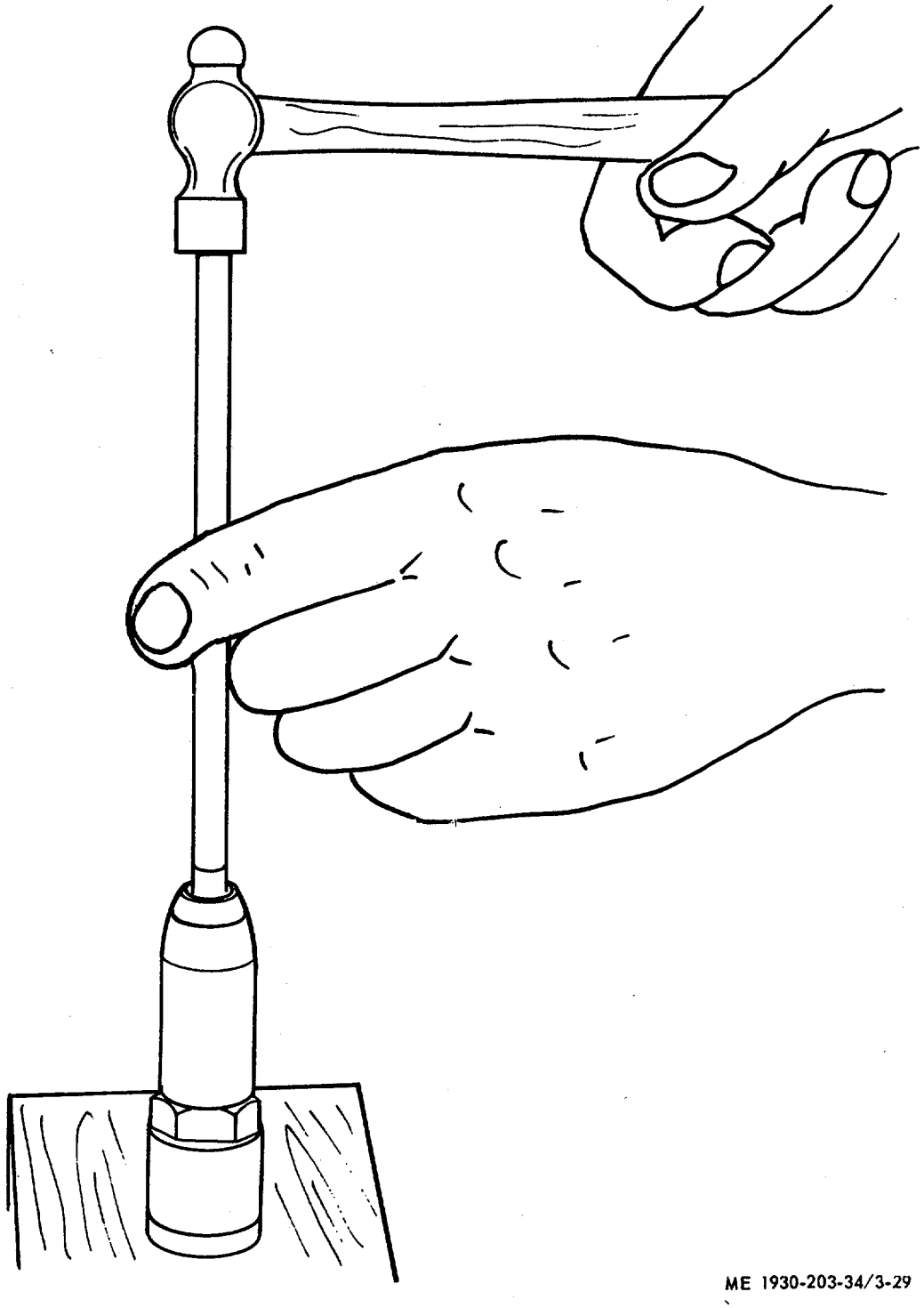
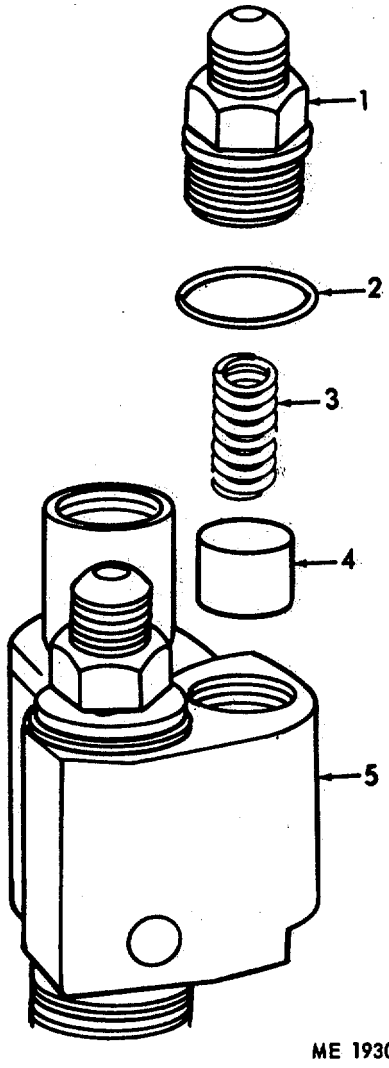


Figure 3-29. Removing spray tip from fuel injector nut with tip remover, part no. J1291-02

(d) Fuel injector assembly disassembly.

1. Loosen filter caps (1, fig. 3-30) with 9 / 16 inch deep socket and T-handle wrench.
2. Remove fuel filter caps (1), gaskets (2), springs (3), and filters (4) from injector body (5).
3. Discard filters and gaskets.



1 Filter cap
2 Gasket
3 Spring
4 Filter
5 Injector body

Figure 3-30. Fuel injector filter assembly.

b. Cleaning, Inspection, and Repair.

(1) Wash all parts with dry-cleaning solvent, Federal Specification P-D-680, and dry with clean, filtered, compressed air.

NOTE

Do not use waste or rags for cleaning purposes

(2) Clean out all passages, drilled holes, and slots in all injector parts.

(3) Clean spray tip with reamer, part No. J1243 (fig. 3-31). Turn reamer in a clockwise direction to remove carbon deposits. Wash spray tip and dry with compressed air.

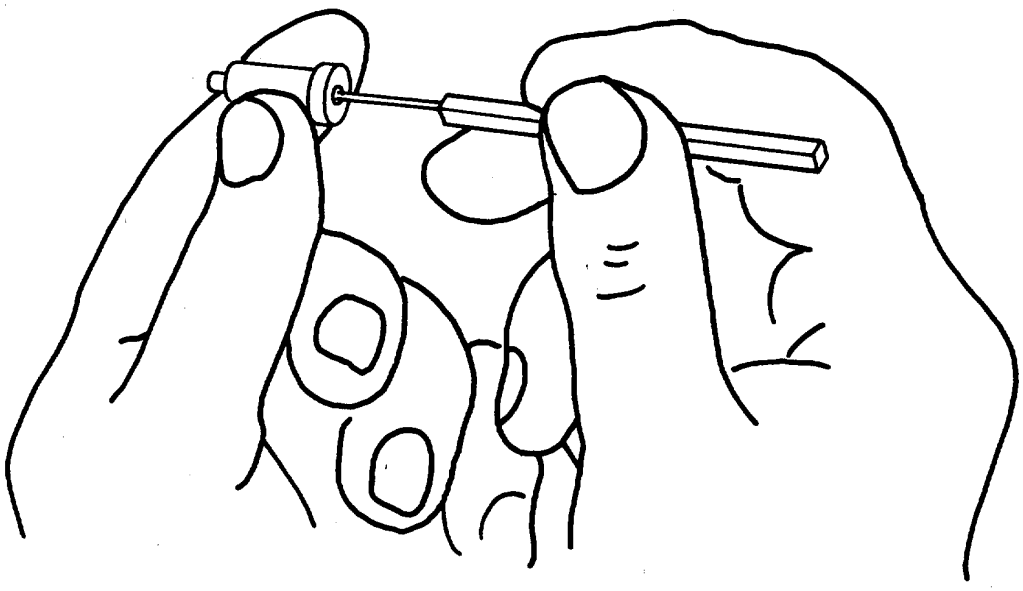


Figure 3-31. Reaming injector spray tip with reamer, part No. J1243.

(4) Clean spray tip orifices with orific cleaner, part No. J4298-1 (fig. 3-32), using a 0.006-inch diameter wire. Before using wire, hone end until smooth and free of burrs; and taper end a distance of 1/16 inch. Wash, clean, and dry spray tip.

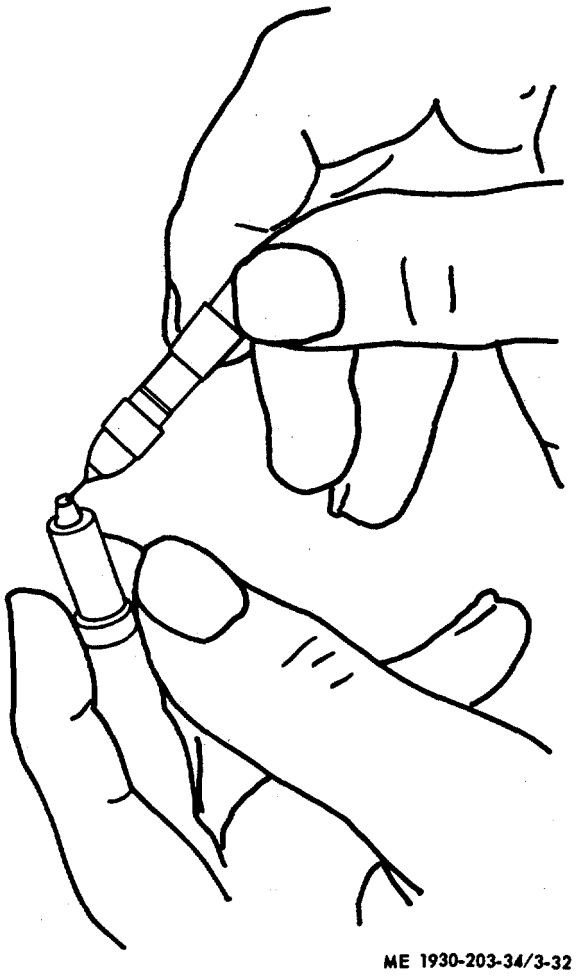
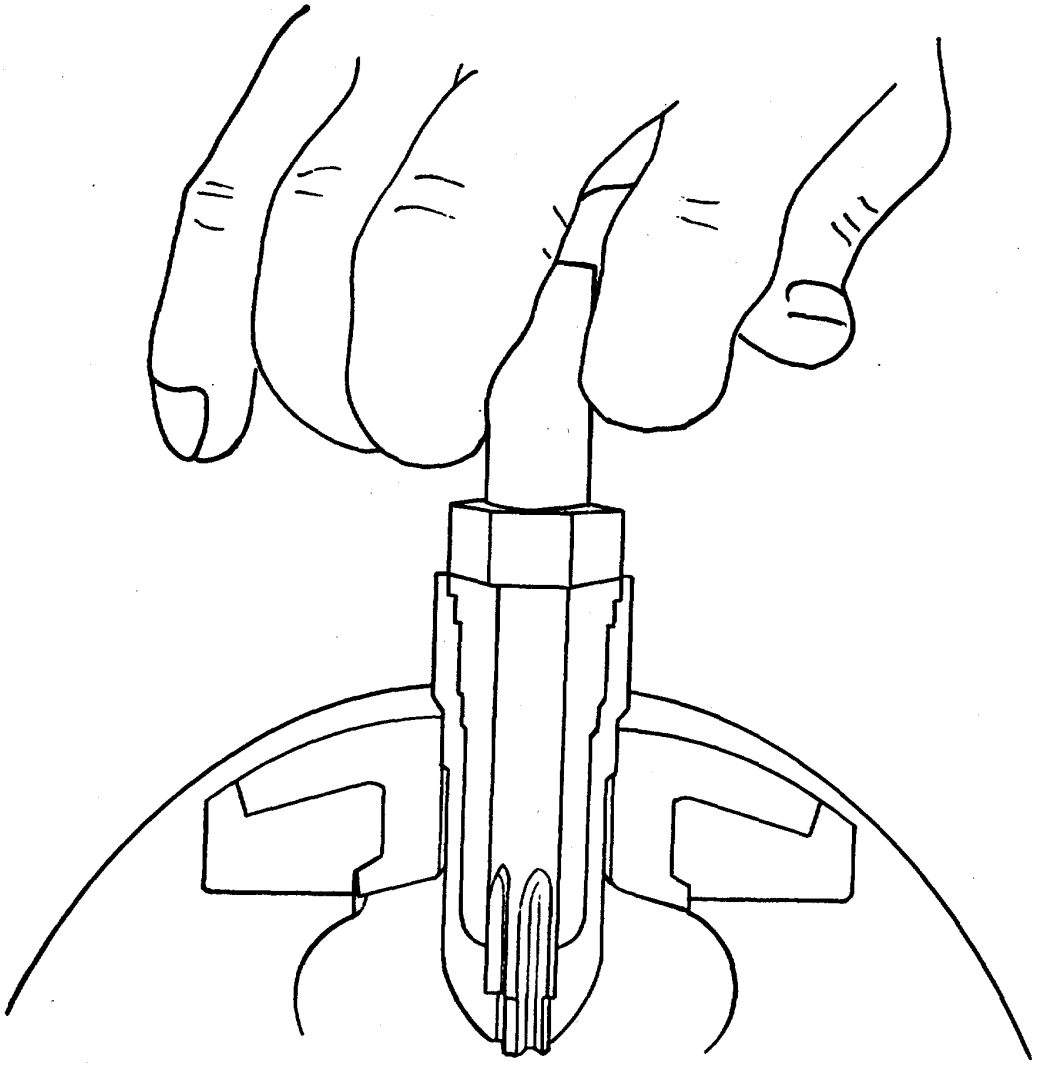


Figure 3-32. Cleaning spray tip orifices with orifice cleaner, part No. J4298-1

(5) Clean and brush all passages in injector body. Blow out passages and dry with compressed air.

(6) Remove carbon deposits from injector nut with reamer (fig. 3-33). Insert reamer carefully and turn in a clockwise direction. Use care in reaming to prevent removal of metal or setting up burrs on spray tip seat.



ME 1930-203-34/3-33

Figure 3-33. Cleaning injector nut spray tip seat with reamer, part No. J4986-01

(7) Wash injector nut in dry-cleaning solvent, Federal Specification P-D-680, and dry with compressed air.

(8) Wash plunger and bushing in fuel oil and dry with compressed air. When handling injector plunger, do not touch finished plunger surfaces with fingers.

(9) Final cleaning of plunger and bushing may be accomplished with soft tissue paper. Wrap tissue paper around cleaning tool, part No. J1291-02, and clean out bushing bore.

NOTE

Keep plunger and bushing together as they are mated parts. If more than one injector is disassembled. keep parts of each injector assembly together.

(10) After washing, submerge all parts in a

clean receptacle containing clean dry-cleaning solvent.

(11) Inspect teeth on control rack and control rack gear for damage. Check bore of gear for chipping or other damage. Replace damaged parts.

(12) Inspect gear retainer. Replace if damaged.

(13) Inspect injector follower and pin for damage. Replace if necessary.

(14) Inspect both ends of spill deflector for sharp edges or burrs. Remove burrs with a medium stone.

(15) Inspect follower spring for defects and measure free length. Free length should be approximately 2.039 inches. A load of 38 t 3 pounds should be required to compress spring to a length of 1.027 inch. Replace spring if a load of less than 30 pounds will compress it to 1.027 inch or if defects are found.

(16) Inspect seal ring area on injector body for burrs or scratches.

(1'7) Inspect surface of injector body which contacts injector bushing for scratches, scuff marks, or other damage. Lap this surface if necessary. A faulty sealing surface at this point will result in high fuel consumption and contamination of the lubricating oil.

(18) Replace any loose injector body plugs or a loose dowel pin.

(19) Inspect injector plunger for scoring, erosion, or chipping. Check for sharp edges on that portion of plunger which rides in gear. Remove any sharp edges with a 500 grit stone. Wash plunger after stoning.

(20) Inspect plunger bushing for cracks or chipping. Slip plunger into bushing and check for free movement.

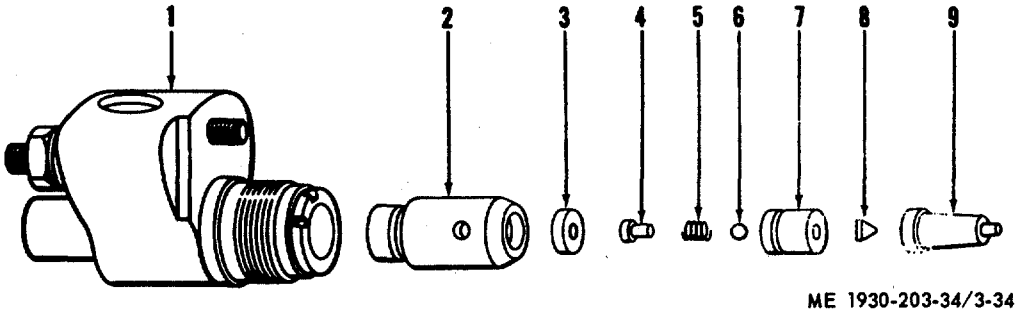
(21) Replace chipped, scored, or loose fitting plunger and bushing as an assembly since they are mated parts.

(22) Inspect spray tip seating surface of injector nut for nicks, burrs, or brinelling. Reseat surface or replace nut if it is severely damaged.

(23) Replace weak or broken injector valve springs. A load of 5 ¼ + ½ pounds should compress spring to a length of 0.240 inch. Replace spring if a load of less than 4 ¼ pounds will compress it to the 0.240 inch length.

(24) Inspect sealing surface indicated by heavy black arrows of injector body (J, fig. 3-341, bushing (2), valve seats (3), valve cage (7), check valve (8), and spray tip (9). Sealing surface should be examined with a magnifying glass for even the tightest imperfections will prevent injector from operating properly. Check for burrs, nicks, erosion, cracks, and chipping. Check for enlarged orifices in spray tip. Replace damaged or excessively worn parts.

(25) Lap all sealing surfaces when used valve parts are to be reinstalled in injector. It is a good practice to lightly lap new valve parts (except injector valve (4)) which may become burred or nicked during handling. Lapping procedures for sealing surfaces are as follows:



1 Injector body
2 Bushing
3 Valve seat
4 Injector valve
5 Valve spring
6 Stop valve
7 Valve cage
8 Check valve
9 Spray tip

Figure 3-34. Sealing surfaces which may require lapping

(a) Clean lapping blocks with compressed air. Do not use a cloth or any other material for this purpose.

(b) Spread a good quality 600 grit dry lapping powder on one of lapping blocks.

(c) Place part to be lapped flat on block; using a figure eight motion, move it back and forth across block. Do not press on the part, but use just enough pressure to keep part flat on block. It is important that part be kept flat on block at all times.

(d) After four or five passes, clean lapping powder from part by drawing it across a clean piece of tissue placed on a flat surface; and inspect part. Do not lap excessively.

(e) When part is flat, wash in dry-cleaning solvent, Federal Specification P-D-680, and dry with compressed air.

(f) Place dry part on second block. Apply lapping powder and move part lightly across block in a figure eight motion several times. Wash with dry-cleaning solvent, Federal Specification P-D-680, and dry with compressed air.

(g) Place dry part on third block. Do not use lapping powder on this block. Keep part flat and move it across block several times, using the figure eight motion. Lapping dry part in this manner gives it a mirror finish required for perfect sealing.

(h) Inspect edge of hole in injector valve seat under a magnifying glass. If edge shows small irregularities, lap hole with lapping tool, part No. J7174. Mount lapping tool in a drill motor and place a small amount of lapping powder and oil mixture on tool. Place valve seat over pilot of the tool and start drill motor. Touch valve seat lightly against rotating lapping tool to produce a uniform seat at the hole. After lapping edge of hole, flat lap face of seat lightly. Clean and examine width of chamfer produced at the edge of hole. Specified width is 0.002 to 0.005 inch. If width is in excess of these limits, replace valve seat.

(i) Wash all lapped parts in clean fuel oil and dry them with compressed air. Clean inside at injector bushing by wrapping clean tissue around cleaning tool, part No. J1291-02, and rotating it in and out through bushing.

c. Reassembly, Testing, and Installation.

(1) *Reassembly and testing.*

(a) Filter assembly reassembly.

1. With injector body (5, fig. 3-30) right side up, place a new filter (4), dimple end down, in each fuel cavity.
2. Place spring (3) above each filter.
3. Place a new gasket (2) against shoulder of each filter cap (1).
4. Lubricate threads of filter caps and install caps.
5. Tighten filter caps to a torque value of 65 to 75 foot-pounds, using 9/ 16 inch deep socket wrench.
6. Install clean shipping caps on filter caps to prevent dirt entering injector.

(b) Fuel injector rack and gear assembly reassembly.

1. Note drill spot marks on control rack (3, fig. 3-28) and gear (2).
2. With injector body (1) bottom end up, slide control rack (3) through hole in body.
3. Looking into bore for gear, move rack so that drill marks can be observed and hold rack in this position. Rack can be placed in only one position and have teeth marks show in opening for gear.
4. Slide gear into injector body so that marked tooth is engaged between two marked teeth on rack.
5. Slide gear retainer (4) on top of gear.
6. Slide plunger bushing (5) down onto gear retainer (4) with locating pin in bushing guided into slot of injector body.

(c) Fuel injector valve assembly reassembly.

1. Support injector body (1), bottom end up, in assembly fixture, part No. J6868-01.
2. Place a new seal ring (14) on shoulder of injector body.
3. Slide spill deflector (13) over barrel of bushing (5).
4. Place valve seat (6) on end of bushing.
5. Insert stem of injector valve (7) in one end of valve spring (8) and valve stop (9) in other end.
6. Lower valve cage (10) over assembly formed (5 above) so that valve stop (9) seats in cage.
7. Place valve cage assembly on valve seat (6).
8. Locate check valve (11) centrally on valve cage.
9. Place spray tip (12) over check valve (11) and against valve cage.
10. Lubricate threads and carefully pilot nut (15) over spray tip and valve assembly.
11. Screw nut (15) in place by hand, making sure that valve assembly does not shift. Do not use a wrench to tighten nut at this time. If valve parts are not centrally located on end of bushing they will not enter counterbore in injector nut. To facilitate assembly in such a case, turn end of spray tip while threading nut onto injector body.

(d) Fuel injector plunger and follower assembly reassembly.

1. Slide head of plunger (2, fig. 3-26) into follower (1) and insert through follower spring (3)
2. Invert injector in assembly fixture (filter cap end up) and push control rack (8) all the way in.
3. Insert free end of plunger (2) in injector body (4). Insert this assembly through follower spring (3).
4. Place stop pin (5) on injector body so that bottom coil of follower spring rests on narrow flange of pin.
5. Align slot in follower (1) with stop pinhole in injector body (4).

6. Align flat side of plunger (2) with flat in gear.

7. Press down on follower (1) and press stop pin (5) into position. When in place, spring will hold stop pin in position.

8. Invert injector assembly in holding fixture, part No. J6868-0] and tighten nut (6) to a torque valve of 55 to 65 foot-pounds.

CAUTION

Do not exceed specified torque. Otherwise, nut may be stretched and result in improper sealing of lapped surfaces in a subsequent injector overhaul.

(e) Testing repaired fuel injector assembly.

1. Test injector for correct alignment.

(a) Place injector in concentricity gage to check for correct alignment.

(b) Adjust dial indicator to zero.

(c) Rotate injector 360 degrees and note total run-out as indicated on dial.

(d) If total run-out exceeds 0.008 inch, remove injector from gage. Loosen injector nut and center spray tip. Tighten nut.

(e) Recheck spray tip concentricity.

(f) If, after several attempts, spray tip cannot be positioned satisfactorily check assembly of entire injector.

2. Test injector (subpara a(2)).

NOTE

If repaired injector is to be placed in stock, fill with test oil or any good rust preventive. Do not use fuel oil.

(2) *Installation.*

(a) Before installing injector assembly, be sure that beveled seat of injector tube in cylinder block is free from dirt and carbon deposits.

(b) Insert injector assembly into injector tube with the locating dowel registering with the locating hole in the cylinder head and with pin on injector control arm lever registering with the injector control rack lever.

(c) On engines prior to serial No. 6A-84033, place injector clamp (4, fig. 3-24) over stud and install washer (3) and nut. Tighten nut to a torque of 20 to 25 foot-pounds. On engines serial No. 6A-84033 and subsequent, secure clamp (4) with bolt (2) and washer (3); tighten bolt to a torque of 20 to 25 foot-pounds.

CAUTION

Excess torque will cause the injector rack to bind.

(d) Move rocker arm assembly into position and install rocker arm bracket bolts (5). Tighten bolts to a torque of 9b to 100 foot-pounds.

(e) Remove shipping caps. Connect fuel pipes (9) to injector assembly and fuel connectors. Tighten connectors to a torque of 12 to 15 foot-pounds.

NOTE

Before tightening the connector on the fuel outlet side of the injector assembly, set the injector rack in the NO FUEL position and crank the engine briefly. This will bleed any entrapped air from the injector assembly and avoid the possibility of scoring the injector parts, due to lack of lubrication upon initial starting.

CAUTION

Do not exceed the specified torque. Excessive tightening will twist or fracture the flared ends of the fuel pipes and result in leaks.

(f) Set valve clearance and time injector assembly. Readjust injector control racks (TM 55-1930-203-20).

3-11. Fuel Manifolds

a. General. The fuel manifolds on some model cylinder heads, part No. 5196310, are cast as an integral part of the cylinder head (fig. 3-36). Other engines with an earlier type cylinder head design, part No. 5185344, have the fuel manifolds externally mounted on the side of the cylinder head (fig. 3-35). These type of manifolds are secured to the cylinder head by threaded connectors which extend down through, and set into, tapered seat openings in the T-connectors on the fuel manifolds.

b. External Fuel Manifolds.

(1) *Removal*

(a) Remove air cleaners (TM 55-1930-203-20).

(b) Remove rocker cover and gasket (TM 55-1930-203-20).

(c) Disconnect fuel pipes (2 and 3, fig. 3-35) from the fuel injectors and the fuel connectors.

(d) Disconnect the fuel lines from the fittings at the ends of the fuel manifolds.

(e) Remove fuel connectors (4) from cylinder head.

(f) Withdraw fuel manifolds (5) carefully from the cylinder head.

(g) Remove pipe plugs (6) and fittings (9 and 11) from ends of fuel manifolds.

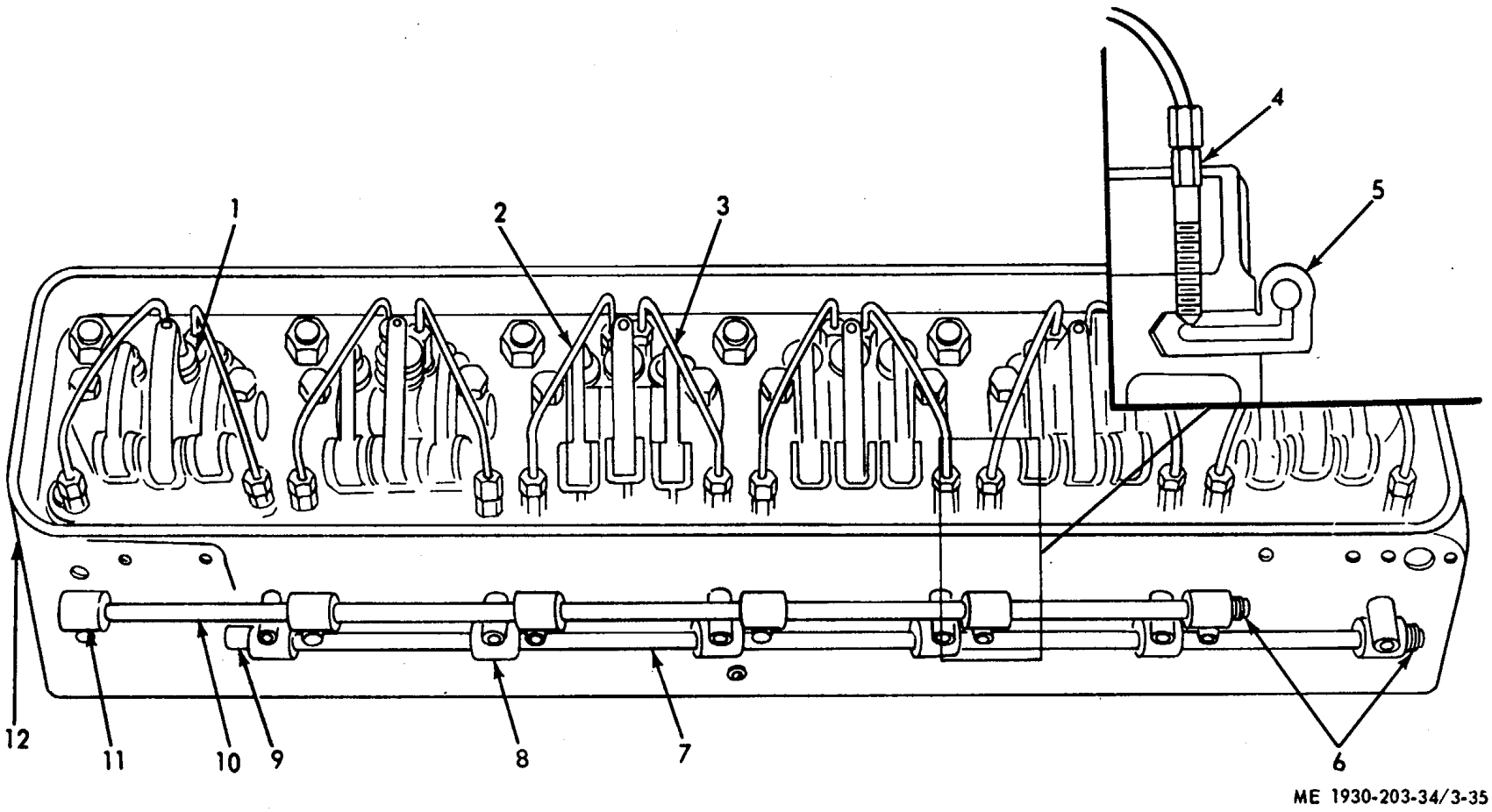
(2) *Cleaning and Inspection.*

(a) Clean all parts in dry-cleaning solvent, Federal Specification P-D-680, and dry with compressed air.

(b) Examine tapered seats of fuel connectors for scored condition. If scored, replace fuel connectors.

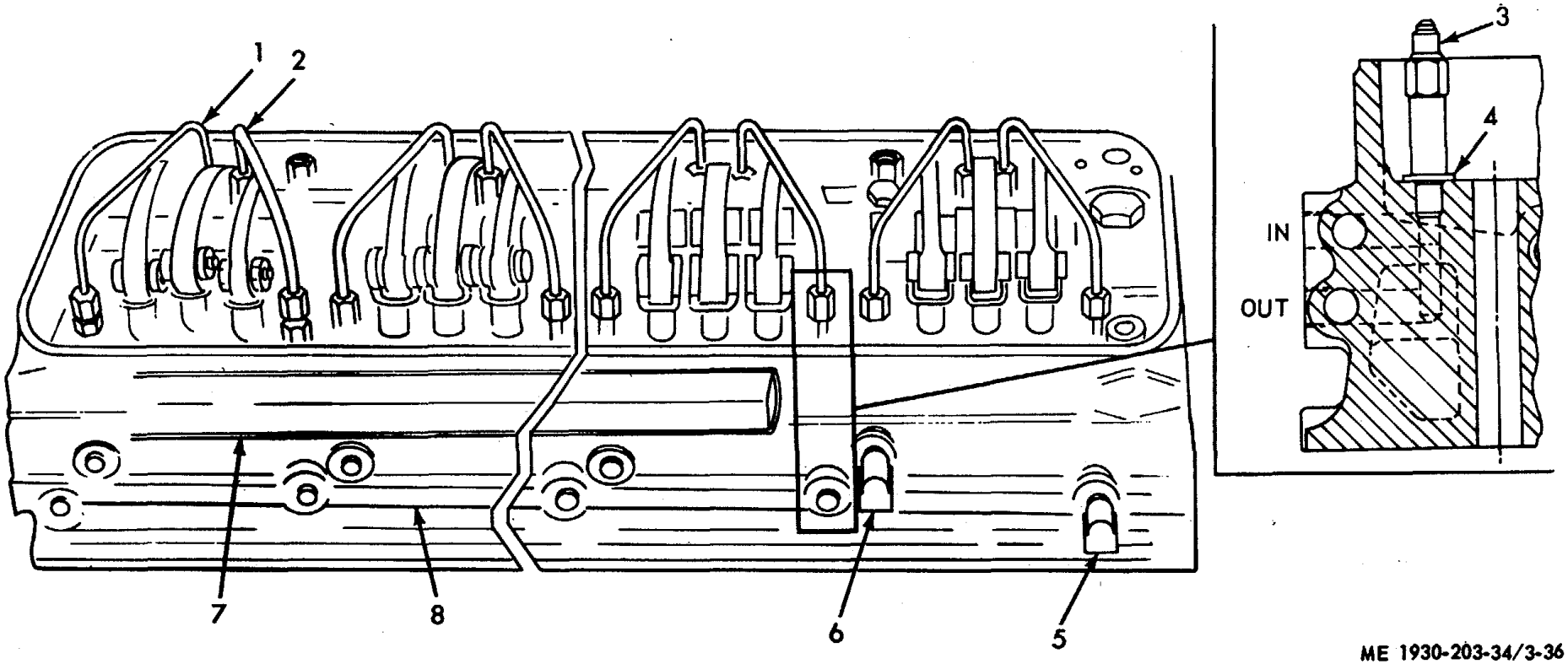
(c) Inspect fuel connector seats on T-connectors of fuel manifolds for scored condition. If scored, replace manifolds.

(d) Inspect the threads of all parts to insure they are in good condition.



1 Fuel injector	5 Fuel manifold	9 Adapter
2 Fuel outlet pipe	6 Pipe plug	10 Outlet fuel manifold
3 Fuel inlet pipe	7 Inlet fuel manifold	11 Restricted fitting
4 Fuel connector	8 T connector	12 Cylinder head

Figure 3-35. Cylinder head with external fuel manifolds.



1 Fuel inlet pipe	5 Restricted fitting
2 Fuel outlet pipe	6 Elbow, pipe to tube
3 Fuel connector	7 Inlet fuel manifold
4 Steel washer	8 Outlet fuel manifold

Figure 3-36. Cylinder head with integral fuel manifolds.

(3) *Installation.*

(a) Guide T-connectors (8, fig. 3-35) of the fuel manifolds into openings in side of cylinder head so that the tapered seats are in approximate alignment with the fuel connector openings in top of cylinder head.

(b) Lubricate threads of fuel connectors (4) equipped with a nylon type insert. Thread connectors, by hand, into tapped holes in top of cylinder head.

(c) Centralize T-connectors (8) of fuel manifolds (5) with fuel connectors (4) by alternately turning fuel connectors while moving fuel manifold in and out slightly.

CAUTION

Centering the T-connectors is important and necessary to insure 'leak proof joints.

NOTE

If a locknut is used with the fuel connector, install the locknut with the fiber end down. If the locknut, is staked, a new copper sealing washer must also he used.

(d) Tighten all fuel connectors (4) (and locknuts, if used) uniformly to a torque of 30 to 35 foot-pounds.

(e) Install pipe plugs (6) and fittings (9 and 11) in ends of fuel manifolds.

CAUTION

If restricted fitting (11) is replaced, insure replacement part has the same size orifice as the one removed. Failure to install correct size fitting will result in improper fuel pressure within the fuel system.

(f) Attach fuel outlet pipes (2) and fuel inlet pipes (3) to fuel connectors and fuel injectors. Tighten the connections to a torque of 12 to 15 foot pounds.

CAUTION

Insure that the flared ends of the fuel pipes are properly seated before tightening the connections. Excessive tightening can twist or fracture the flared ends of the pipes and result in fuel leaks.

(g) Connect the fuel lines to the fuel manifolds.

(h) Start engine (TM 55-1930-203-10) and check all fuel connections for leaks.

(i) Stop engine and install rocker cover and air cleaners (TM 55-1930-203-20).

c. Integral Fuel Manifolds.

(1) *Fuel connector removal*

(a) Remove air cleaners (TM 55-1930-203-20).

(b) Remove rocker cover and gasket (TM 55-1930-203-20)

(c) Disconnect fuel pipes (1 and 2, fig. 3-36) from fuel injectors and fuel connectors.

(d) Remove fuel connectors (3) and washers (4) from cylinder head.

(2) *Cleaning and inspection.*

(a) Clean all parts in dry-cleaning solvent, Federal Specification P-D-680, and dry with compressed air.

(b) Inspect the threads of all parts to insure they are in good condition.

CAUTION

If restricted fitting (5) is replaced, insure replacement part has the same size orifice as the one removed. Failure to install correct size fitting will result in improper fuel pressure within the fuel system.

(3) *Fuel connector installation.*

(a) Install fuel connectors (3, fig. 3-36) using new special steel washer (4) between fuel connector and cylinder head. Tighten fuel connectors to a torque of 30 to 35 foot-pounds.

(b) Attach fuel inlet pipes (1) and fuel outlet pipes (2) to fuel connectors and fuel injectors. Tighten connections to a torque of 12 to 15 foot pounds.

(c) Start engine (TM 55-1930-203-10) and check all fuel connections for leaks.

(d) Stop engine and install rocker cover and air cleaners (TM 55-1930-203-20).

Section VI. ENGINE ACCESSORIES

3-12. General

This section contains those items which are considered accessories to the engine. They consist of the governor assembly, fluid starting aid, lubricating oil cooler assembly, oil filter, water pump, air starting motor,. fuel pump, air inlet housing, blower assembly, and blower drive assembly.

3-13. Governor Assembly

a. Description. A single-weight, limiting speed, mechanical governor is used on each LARC engine. The governor controls idle speed and limits maximum operating speed while allowing manual control of intermediate 'engine speeds. During operation, centrifugal force of revolving weights inside the governor housing is transmitted through

shafts and levers to a spring assembly. The spring assembly, composed of a low speed spring and a high speed spring, controls idle and maximum engine speeds. The low speed spring holds the injector rack in full fuel position for starting. Immediately after starting, transmitted centrifugal force compresses the spring, permitting racks to return to idle speed position. With low speed spring fully compressed, the engine is manually controlled for intermediate speeds. If engine speed tends to exceed the allowable maximum, centrifugal force overcomes tension of the high speed spring. The high speed spring then compresses, overriding throttle controls and limiting flow of fuel. Thus maximum speed is not exceeded.

b. Removal

(1) Disconnect throttle linkage from throttle control lever (1, fig. 3-37).

(2) Remove four screws (11) and lockwashers, and lift governor cover (5) and gasket from housing,

(3) Remove rocker cover (TM 55-1930-203 20).

(4) Disconnect fuel rod (3) from injector control tube lever (2) and from lever inside governor control housing (6).

(5) Disconnect oil line at governor weight housing cover (9).

(6) Remove four bolts (8) and lockwashers and separate cover (9) from weight housing (7). Remove gasket.

(7) Remove two bolts (4) and lockwashers which secure governor to cylinder head.

(8) Pull upper end of control housing (6) away from cylinder head and remove lower end from weight housing (7). Remove gaskets.

(9) Remove six bolts (10) and copper washers securing governor weight housing to blower. Pull the weight housing away from blower. Remove gasket.

c. Disassembly.

(1) Governor cover assembly disassembly.

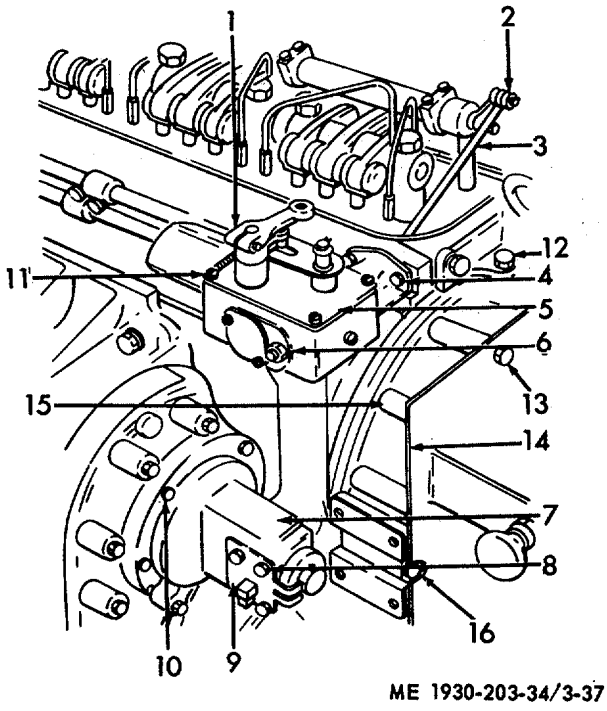
(a) Loosen capscrew (9, fig. 3-38) and lift throttle control lever (11) from throttle shaft (7).

(b) Remove pin (12) from throttle control (15). Lift lever and seal ring retainer (18) from throttle shaft (7).

(c) Withdraw throttle shaft (7) from cover.

(d) Remove spring retainer (13) and washer (14), and lift cam (17) off pin.

(e) Remove seal ring (19) from governor cover.



1 Throttle control lever
2 Injector control tube lever
3 Fuel rod
4 Bolt, cylinder head flange
5 Cover
6 Governor control housing
7 Weight housing
8 Bolt, cover
9 Governor weight housing cover
10 Bolt, governor mounting
11 Screw, cover
12 Bolt, lifter bracket
13 Bolt, starting aid mounting
14 Starting aid mounting plate
15 Balance weight cover
16 Bolt, balance weight cover

Figure 3-37. Governor mounting

(f) Wash cover assembly (containing needle bearing) in clean fuel oil and inspect needle bearing for damage. If throttle shaft bearings (8) are satisfactory, removal is unnecessary.

(g) If needle bearing removal is necessary,

place inner face of cover over opening in bed of press. Place bearing remover, part No. J4647, on top of bearing and under ram of press. Press both bearings out of cover.

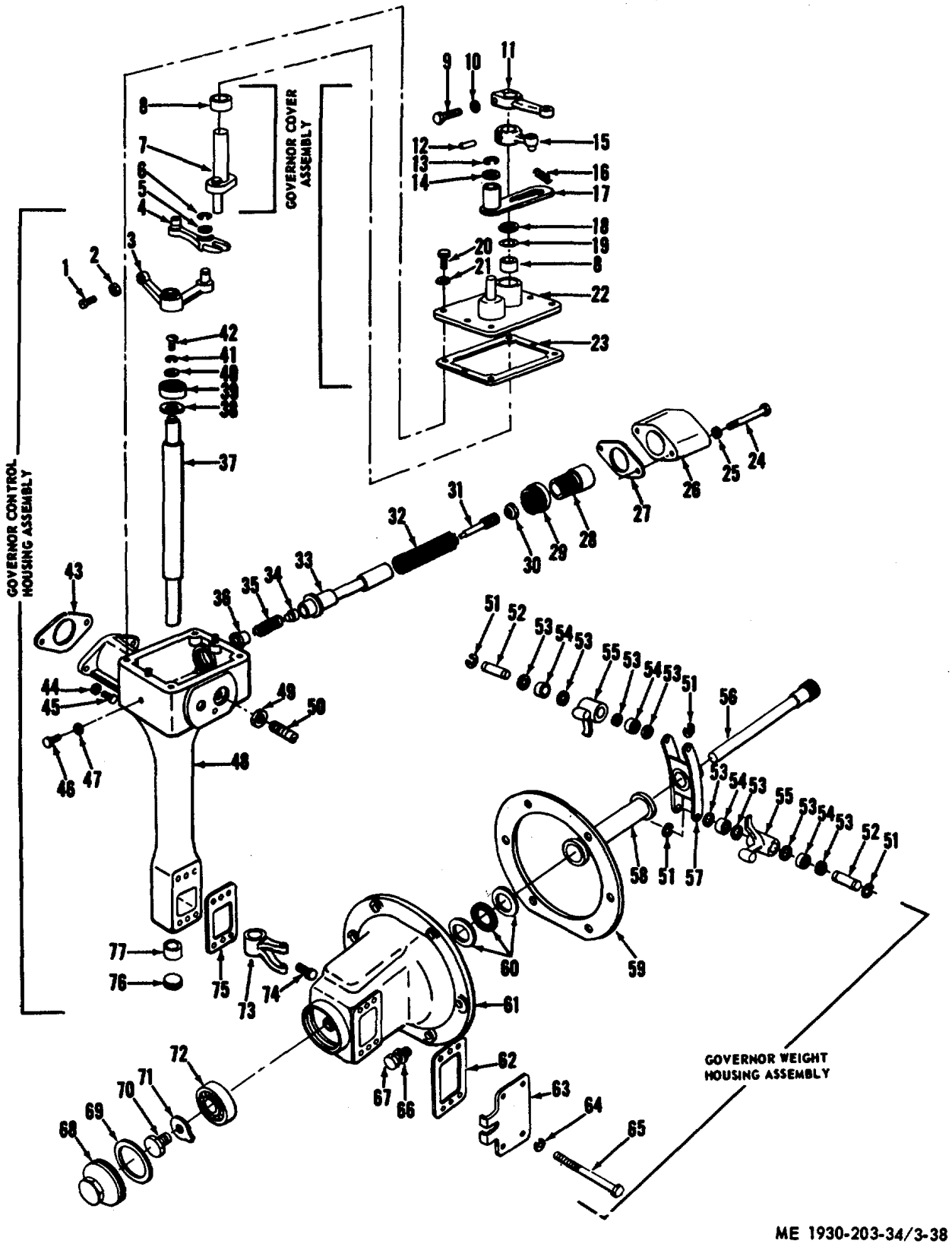


Figure 3-38. Single weight limiting governor assembly

Key to figure 3-38.

1 Setscrew
2 Locknut
3 Operating shaft lever
4 Differential lever
5 Washer
6 Spring retainer
7 Throttle shaft
8 Throttle shaft bearing
9 Capscrew
10 Lockwasher
11 Throttle control lever
12 Pin, tapered
13 Spring retainer
14 Washer
15 Throttle control
16 Cam control spring
17 Cam
18 Seal ring retainer
19 Seal ring
20 Screw
21 Lockwasher
22 Governor cover
23 Gasket cover
24 Bolt, machine
25 Lockwasher
26 High speed spring retainer cover
27 Gasket, high speed spring cover
28 High speed spring retainer
29 Locknut, spring retainer
30 Locknut
31 Screw, idle speed adjusting
32 High speed spring
33 High speed spring plunger
34 Low speed spring seat
35 Low speed spring
36 Low speed spring cap
37 Operating shaft
38 Washer, flat
39 Operating shaft bearing
40 Washer, flat
41 Lockwasher
42 Screw, machine
43 Gasket, governor
44 Washer, copper
45 Capscrew
46 Capscrew
47 Washer, flat
48 Governor control housing
49 Locknut
50 Screw, buffer
51 Retainer ring
52 Weight pin
53 Washer, flat
54 Governor bearing
55 Governor weight
56 Weight shaft
57 Weight carrier
58 Governor riser
59 Gasket, governor
60 Riser thrust bearing
61 Weight, housing
62 Gasket, weight housing cover
63 Weight housing cover
64 Lockwasher
65 Capscrew
66 Washer, copper
67 Bolt, weight housing
68 Weight housing plug
69 Gasket, weight housing cap
70 Bolt, machine
71 Lockwasher, key
72 Shaft end bearing
73 Operating shaft fork
74 Setscrew
75 Gasket, weight housing
76 Expansion plug
77 Operating shaft bushing

(2) *Governor control housing assembly disassembly.*

(a) Place governor control housing (48) in soft jaws of vise.

(b) Remove two bolts 124) and withdraw high speed spring retainer cover (26) and gasket (27).

(c) Loosen locknut (29). Remove high speed spring retainer (28), locknut (30), screw (31), high speed spring 132), high speed spring plunger (33), low speed spring (35), low speed spring seat (34), and low speed spring cap (33) as an assembly.

(d) Remove spring retainer (6 j and washer (5) from lever pin. Lift differential lever 14) from pin of operating shaft lever (3).

(e) Remove expansion plug (76) out of lower end of control housing.

(f) Remove bearing retaining screw (42), washer (40), and lockwasher (41).

(g) Loosen operating fork setscrew (74).

(h) Support control housing (48) bottom side up. Using a brass rod, press operating shaft (37) from operating shaft fork (73). Withdraw operating shaft lever (3), operating shaft bearing (39), and washer (38) as an assembly from control housing.

(i) Support operating shaft and lever on bed of press. Using a brass rod, press shaft (37) from operating lever (3), bearing (39), and remove washer (38).

(3) *Governor weight housing assembly disassembly.*

(a) Place weight housing (61) in soft jaws of vise. Remove weight housing plug (68) and gasket (69).

(b) Straighten tang of lockwasher (71) and remove bearing bolt (70).

(c) Thread a 5 / 16-24 x 3 inch-bolt into tapped end of weight shaft (56). Support weight housing (61) on bed of press. Press shaft from bearing (72).

(d) Slide riser thrust bearing (60) and governor riser (58) from weight shaft (56).

NOTE

This bearing is specially designed to absorb thrust loads; therefore, looseness between mating parts does not indicate excessive wear.

(e) Remove shaft end bearing (72) from weight housing (61).

(f) Mark governor weight (55) and weight carrier (57) with a center punch for identification. Note position of washers (53) between weights so parts can be replaced in original position.

(g) Remove retainer rings (51) and withdraw weight pins (52), washers (53), and governor weights (55).

(h) If weight carrier (57) is damaged, press carrier from governor weight shaft. It is unnecessary to remove carrier if no dam age is noted.

d. Cleaning, Inspection and Repair.

(1) Clean all governor parts in dry-cleaning solvent, Federal Specification P-D-680, and dry with compressed air.

(2) Inspect all bearings for corroded or pitted surfaces. If any damage is noted, replace bearing.

(3) Revolve operating shaft bearing and governor weight shaft bearing slowly by hand. Replace bearings if rough or tight spots are detected.

(4) Inspect spring seats, plungers, adjusting screws, locknuts, and other parts of control housing tor defects that might effect governor operation. Replace as necessary.

(5) Inspect operating shaft and shaft bushing for damage. If damage is noted, replace shaft and bushing.

(6) Inspect riser thrust bearing for flat spots; worn race, or corrosion. If any of these conditions exist, replace thrust bearing assembly.

(7) Inspect roller bearings and throttle shaft for damage or flat spots. If one or both conditions exist, replace bearings and throttle shaft.

(8) Inspect weight pins and bearings for damage or flat spots. If either condition is noted, replace defective parts. Assemble weights and check for free movement.

e. Reassembly.

(1) *Governor cover assembly reassembly.*

(a) If throttle shaft bearings (8, fig. 3-38) were removed from governor cover (22), place governor cover on bed of arbor press with inner face of cover down. Start upper bearing straight into bearing bore of cover with number on bearing up.

(b) Insert pilot of bearing installer, part No. J4649, into bearing and under ram of press and press bearing into cover until stop on tool contacts top of cover. Upper bearing should be approximately 1/8 inch below top surface of upper bearing boss.

(c) Reverse governor cover on bed of press (inner face of cover up). Start second bearing straight into bearing bore of cover with number on bearing up; place a flat washer over pilot of bearing remover, part No. J4647; insert pilot of tool into bearing and under ram of press.

(d) Press bearing down into cover until washer contacts boss on cover. Lower bearing should be flush with end of bearing boss.

(e) Apply lubricant to retaining pin and place cam (17) over pin with boss of cam up.

(f) Place washer (14) over pin and secure with spring retainer (13).

(g) Lubricate throttle shaft bearings (8) with clean engine oil. Insert throttle shaft (7) through bearings.

(h) Insert seal ring (19) over shaft and into counterbore against throttle shaft bearing (8). Place seal ring retainer (18) over shaft and against seal ring.

(i) Start throttle control (15) over throttle shaft (7) with holes in lever and shaft for pin (12) in alinement.

(j) Support lower end of throttle shaft on bed of arbor press. Place a hollow sleeve on throttle control (15) and under ram of press.

(k) Align slot in cam (17) with pin in throttle lever (15) and press lever down on shaft until hole in lever is in line with hole in shaft.

(l) Insert tapered pin (12) in hole of lever (15). Support lever and cover assembly on steel block and drive pin into place.

(m) Position throttle control lever (11) on throttle shaft (37) and tighten retaining capscrew (9).

(n) Attach one end of cam control spring (16) in small hole of cam (17).

(2) *Governor control housing assembly reassembly.*

(a) Place washer (38) over short finished end of operating shaft (37). Start operating shaft bearing (39) over end of shaft. Support opposite end of shaft on bed of press. Using a hollow sleeve having same diameter as bearing inner race, press bearing on shaft tight against washer.

(b) With pivot pin in operating shaft lever (3) up, start lever over end of shaft (37) with flat on shaft registering with flat surface in lever. Press lever on shaft tight against operating shaft bearing (39).

(c) Lubricate bearing (39) and operating shaft bushing (77) in housing with clean engine oil Military Specification MIL-L-2104.

(d) Insert lever and operating shaft assembly in control housing.

(e) Position operating shaft fork (73) over lower end of operating shaft (37) so finished side of fork finger will rest against riser thrust bearing (60) when assembled.

(f) Support operating shaft and control housing in an arbor press with upper end of the operating shaft resting on a steel block. Align flat in the operating fork with flat on operating shaft. Place a sleeve over end of shaft and rest it on fork.

Bring ram of press down on sleeve and press fork (73) straight down and tight against shoulder on shaft (37).

(g) Tighten fork setscrew (74).

(h) Apply sealant around periphery of expansion plug (76) and press plug into the lower end of control housing (48).

(i) Place lockwasher (41) and flat washer (40) over bearing retaining screw (42). Thread screw in control housing to secure operating shaft bearing (39).

(j) Place differential lever (4) over pivot pin of operating lever(3).Install washer (5) and spring retainer (6).

(k) Thread locknut (49) on screw (50) and thread screw into governor control housing (48).

(l) Thread locknut (29) on high speed spring retainer (28w approximately 1lh inches.

(m) Place high speed spring (32) over high speed spring plunger (33) with tightly wound end of spring against shoulder of plunger.

(n) Insert plunger and spring assembly in high speed spring retainer (28).

(o) Thread screw (31) about 1 inch into tapped end of plunger. Thread locknut (30) over screw.

(p) Insert low speed spring (35) in the low speed spring cap 136) and small end of spring seat (34) in opposite end of low speed spring.

(q) Insert low speed spring seat and low speed spring and cap assembly in high speed spring plunger (33) with low speed spring seat (34) against shoulder of screw (31).

(r) Insert governor high speed spring assembly into opening of control housing and thread the high speed spring retainer (28) in housing about 1 inch.

(s) Installation of high speed spring retainer cover (26) is not required until after governor has been installed on engine and tune-up procedures have been completed.

(3) *Governor weight housing assembly reassembly.*

(a) Install retainer ring (51) in groove of weight pin (52). Place a washer (53) over weight pin and against retainer ring.

(b) Start weight pin (52) through opening in weight carrier (57). Place a second washer (53) over weight pin and against projecting arm of weight carrier.

(c) Position governor weight (55) between projecting arms of weight carrier (57). Push weight pin (52) through governor weight.

(d) Place third washer (53) over weight pin (52) and against weight.

(e) Push pin completely through weight carrier and place fourth flat washer over pin and against projecting arm of weight carrier.

(f) Install retainer ring (51) in groove of weight pin (52).

(g) Install second governor weight (55) same as in (a) through (f)above.

(h) Slide weight shaft (56) through weight carrier (57) and governor riser (58). Slide weight shaft against finished surfaces of governor weights (55).

(i) Slide riser thrust bearing (601 on weight shaft (56) with bearing race having the smaller inside diameter against governor riser (58). Incorrect installation of riser thrust bearing will result in erratic operation of the governor.

(j) Insert assembly consisting of governor riser (58), weight carrier (57), add weight shaft (56) into weight housing (61).

CAUTION

This bearing has thrust capacity in one direction only. Install bearing so that thrust shoulder is toward governor weights. Otherwise, the force exerted by weights will pull the inner race and ball assembly away from the outer race and will result in damage to bearing and erratic governor operation.

(k) Place lockwasher (71) over bolt (70). Thread bolt into tapped end of weight shaft (56) and tighten.

(l) Bend tang of lockwasher against head of bolt.

(m) Place a gasket (69) in weight housing (61) against bearing.

(n) Apply sealant on threads of weight housing plug (68) and thread plug into tapped end of weight housing (611. Tighten plug.

f. Installation.

(1) Install new gasket on governor weight housing (7, fig. 3-37). Start splined end of drive shaft in upper blower rotor.

(2) Position housing against blower end plate. Install bolts (10), using a new copper washer on each bolt. Tighten bolts fingertight only.

(3) Install a new gasket over dowels on side of weight housing facing engine.

(4) Move thrust bearing (6, fig. 3-39) and riser (7) toward weight carrier (8) end of shaft.

(5) Position the lower end of control housing (2) over dowel pins on weight housing (1). Be sure that operating shaft fork (5) is positioned against thrust bearing (6) as shown in figure 3-39.

(6) Install new gasket and secure upper position of governor control housing (6, fig. 3-37) to cylinder head with two bolts (4) and lockwashers.

(7) Tighten governor mounting bolts (10).

(8) Install new gasket on weight housing cover (9) and install cover with four bolts (8J and lockwashers.

(9) Connect oil line to fitting on governor weights housing.

(10) Position fuel rod (31 over pin in control housing. Place washer over pin and secure with retainer.

(11) Attach fuel rod to injector control tube lever (2) and secure with pin and cotter pin.

(12) Install new cover gasket on governor control housing and mount cover (5) on housing. Be sure pin on throttle bracket shaft is engaged with slot in lever in housing as shown in figure 3-39.

(13) Secure cover to housing with four screws (11) and lockwashers.

NOTE

One end of cam spring is anchored to one cover screw.

(14) If injector controls were disturbed, readjust injector rack settings (TM 55-1930-203-20.) Start engine and adjust governor idling and overspeed settings (TM 55-1930-203-20).

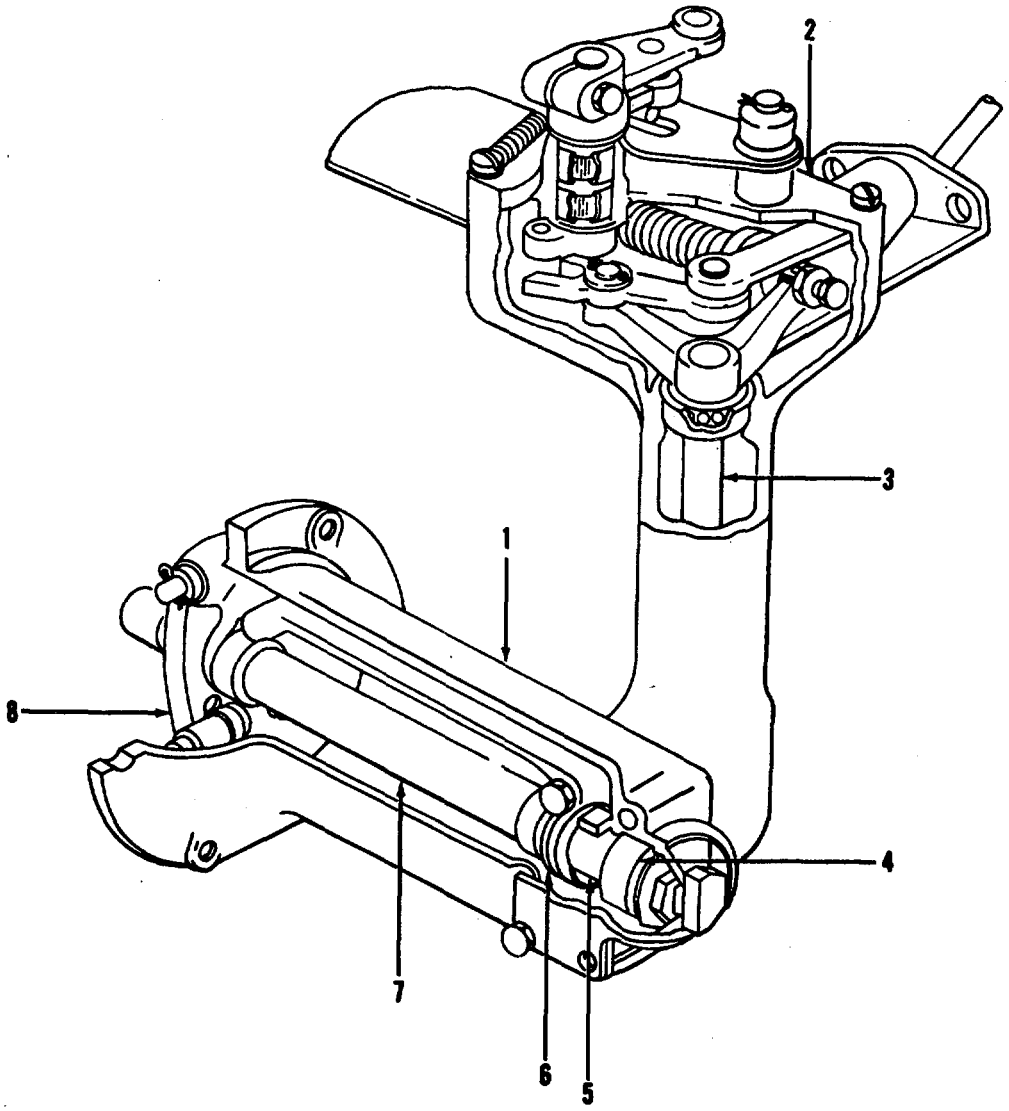
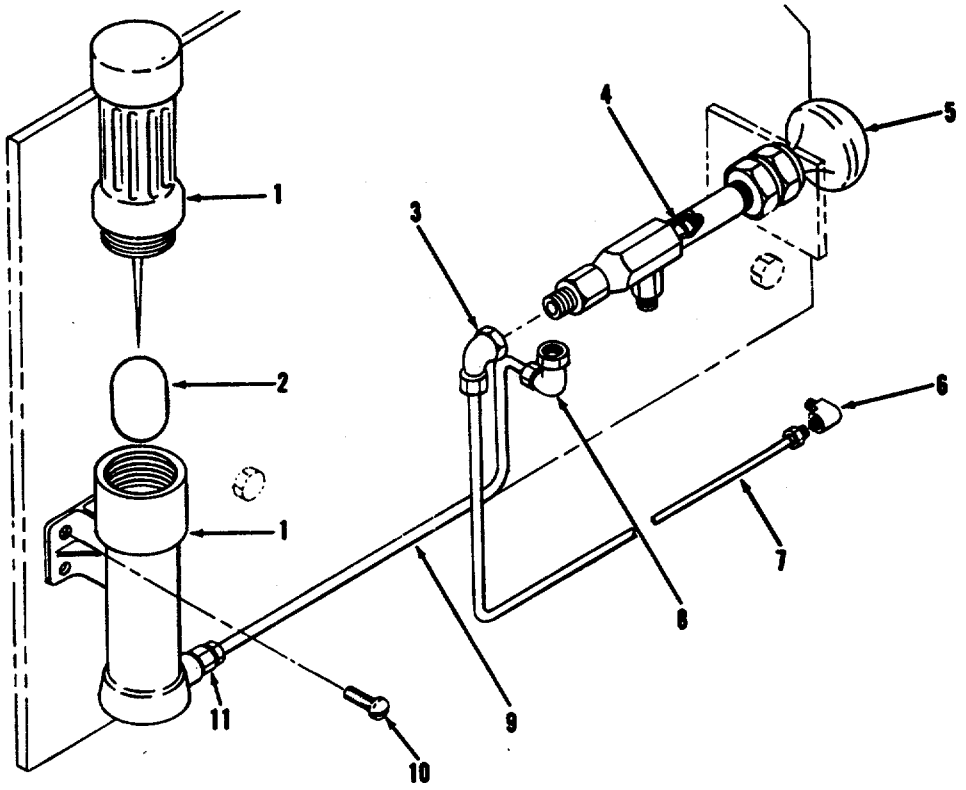


Figure 3-39. Governor assembly.

3-14. Fluid Starting Aid

a. Removal.

(1) Actuate pump assembly (5, fig. 3-40) approximately 20 times to insure puncturing tool assembly (1) is empty of ether.
(2) Slowly unscrew top of puncturing tool assembly (1) and remove ether capsule (2).
(3) Remove tubes (9 and 7).
(4) Remove spray nozzle elbow (6).
(5) Remove elbows (3 and 8) from pump assembly (5).
(6) Unscrew large nut next to pump assembly handle and remove pump plunger. Remove plunger seals (4) from plunger.
(7) Remove pump body from bracket.
(8) Remove fitting (11) from base of puncturing tool assembly (1).
(9) Remove base of puncturing tool assembly (1) by removing four machine screws (10).



1 Puncturing tool assembly
2 Ether capsule
3 Elbow, pipe to tube
4 Pump plunger seal
5 Pump assembly
6 Spray nozzle elbow
7 Pump assembly to spray nozzle tube
8 Elbow, pipe to tube
9 Puncturing tool to pump assembly tube
10 Screw, machine
11 Fitting

Figure 3-40. Fluid starting aid.

b. Cleaning, Inspection, and Repair.

(1) Clean all parts thoroughly by wiping parts with a cloth dampened in dry-cleaning solvent, Federal Specification P-D-680.

CAUTION

Do not immerse pump assembly in drycleaning solvent, as pump plunger seal may be damaged by solution.

(2) Inspect pump plunger seal (4, fig. 3-40) for condition. Seal should be pliable and fit snugly around end of pump plunger. Replace unserviceable seal.

(3) Inspect all tubing for crimped or ruptured condition. Replace tubing if damaged.

c. Installation. Install all removed parts in the reverse order of removal.

3-15. Lubricating Oil Cooler Assembly

a. Removal

(1) Open drain cock and drain coolant from oil cooler into a suitable container.

(2) Remove drain plug on oil cooler adapter (10, fig. 3-41) and drain oil from full flow filter into a suitable container.

(3) Remove clamp connecting oil cooler to water pump (7, fig. 3-43).

(4) Loosen screws and slide hose off engine water inlet.

(5) Disconnect filter-to-cooler and cooler to transmission oil hoses from oil cooler.

(6) Remove bolts (12 and 37, fig. 3-41) and lockwashers (11 and 38) attaching oil cooler to oil cooler adapter and remove oil cooler and gasket (9).

CAUTION

Do not drop or damage core assembly (8) when removing oil cooler from adapter.

(7) Remove plug (18), washer (17), bypass plunger spring (16), and bypass plunger (15) from oil cooler adapter.

b. Disassembly.

(1) Remove core assembly (8, fig. 3-41) and gasket (7) from oil cooler housing (6).

(2) Remove bolts (1) and lockwashers (2) securing oil cooler cover (36) to cooler housing.

(3) Remove oil cooler cover, gasket (3), core assembly (4), and gasket (5) from cooler housing.

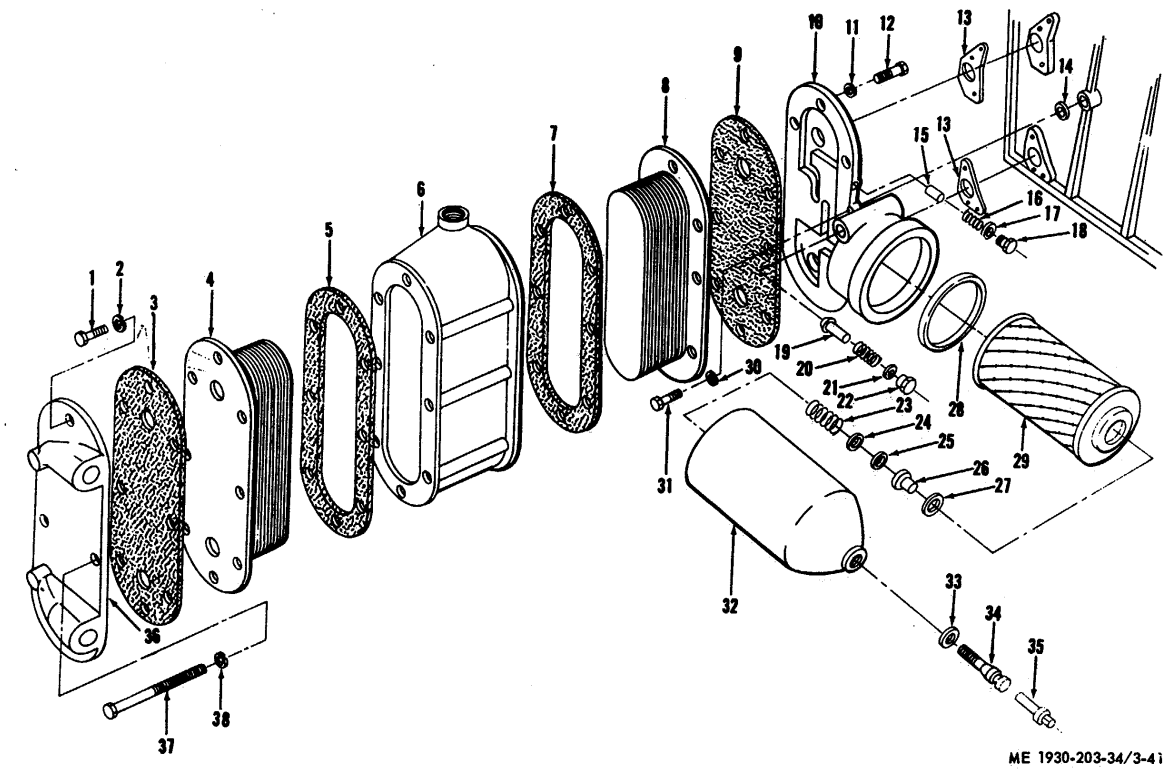


Figure 3-41. Lubricating oil cooler and full flow oil filter.

Key to figure 3-41.
1 Bolt, cooler housing
2 Lockwasher
3 Gasket, outer
4 Core assembly
5 Gasket, inner
6 Oil cooler housing
7 Gasket, inner
8 Core assembly
9 Gasket, outer
10 Oil cooler adapter
11 Lockwasher
12 Bolt, oil cooler adapter
13 Gasket, oil cooler adapter
14 Gasket, oil cooler adapter
15 Oil cooler bypass plunger
16 Oil cooler bypass plunger spring
17 Washer, bypass plug
18 Plug
19 Filter bypass valve
20 Filter bypass valve spring
21 Gasket, bypass plug
22 Plug
23 Filter element spring
24 Washer, filter element retainer
25 Preformed packing
26 Retainer, filter element
27 Washer, filter element retainer
28 Washer, nonmetallic
29 Filter element
30 Lockwasher
31 Bolt, oil cooler adapter
32 Filter shell
33 Gasket, filter shell nut
34 Stud, center
35 Nut, filter shell
36 Oil cooler cover
37 Bolt, cooler housing cover
38 Lockwasher

c. Cleaning, Inspection and Repair.

NOTE

Cleaning of core assemblies is not recommended where history of usage shows an engine failure which has released metal particles. In such a case, replace the core assemblies.

(1) Circulate dry-cleaning solvent, Federal Specification P-D-680, through oil passages of core assemblies (4 and 8, fig. 3-41). Force solution through core assemblies with a force pump. If oil passages are badly clogged, circulate an alkaline solution through core assemblies and flush with clean, hot water.

(2) To clean water side of core assemblies, immerse core assemblies in a solution consisting of ½ gallon of oxalic acid to each 2 ½, gallons of solution composed of 1/3 muriatic acid and 2/3 water.

WARNING

Acids can cause serious burns or blinding. Avoid contact with eyes, skin, or clothing. Do not breathe vapors. When diluting acids, do not add water to acid; acid must be added to the mixture slowly and with constant mixing. In case of contact with acid, flush the affected part thoroughly with water and seek medical aid immediately.

NOTE

The cleaning action is evidenced by bubbling and foaming. Watch process carefully and when bubbling stops, remove oil cooler. This usually takes from 30 to 60 seconds.

(3) After removing core assemblies from cleaning solution, flush core assemblies thoroughly with clean, hot water and dip in light oil.

(4) Wash cover (36), housing (6), bypass plunger (15), and bypass plunger spring (16) in clean fuel oil and then dry with compressed air.

(5) Inspect core assemblies (4 and 8) for cracks or any evidence of leakage between oil and coolant sides. Replace core assembly if leakage is suspected.

(6) Inspect housing (6), especially around water connections, for cracks. Replace cracked housing.

(7) Inspect bypass plunger (15). If plunger is scored or pitted, replace plunger.

(8) Check plunger spring (16) with a spring tester. The spring has a free length of approximately 2 1/64 inches. A force of 13 3/8 to 14 5/8 pounds is required to compress to a length of 1 51/64 inches. Replace a weak spring.

d. Reassembly.

(1) Apply clean engine oil to outside surface of bypass plunger (15, fig. 3-41) and place plunger in oil cooler adapter (10), closed end first.

(2) Place bypass plunger spring (16) in oil cooler adapter and install washer (17) and plug (18).

(3) Place inner gaskets (5 and 7) over core assemblies (4 and 8) and position core assemblies in oil cooler housing (6).

(4) Aline holes in outer gasket 13) with holes in core assembly (4) and secure oil cooler cover (36) and gasket to housing with bolts (1) and lock washers (2).

e. Installation.

(1) Aline holes in outer gasket (9, fig. 3-41) with holes in core assembly (8) and secure oil cooler to oil cooler adapter (10) with bolts (12 and 37) and lockwashers (11 and 38).

(2) Install clamp (7, fig. 3-43) connecting oil cooler to water pump.

(3) Connect water inlet hose to oil cooler.

(4) Connect filter-to-cooler and cooler-to-transmission hoses to oil cooler.

(5) Install drain plug in oil cooler adapter and fill engine crankcase in accordance with LO 55-1930-203-12.

(6) Fill cooling system with coolant (TM 55-930-203-20).

(7) Start engine and check for leaks (TM 55-1930-203-20).

3-16. Oil Filters

a. Full Flow Oil Filter.

(1) *Removal*

(a) Remove drain plug on oil cooler adapter (10, fig. 3-41) and drain oil from full flow oil filter into a suitable container.

(b) Loosen nut (35) and remove filter shell (32) and filter element (29) from oil cooler adapter. Remove nonmetallic washer (28).

(c) Remove oil cooler (para 3-15).

(d) Remove bolts (31) and lockwashers (30) securing oil cooler adapter to cylinder block. Remove oil cooler adapter and gaskets (13 and 14) from cylinder block.

(2) *Disassembly.*

(a) Withdraw filter element (29, fig. 3-41) from filter shell (32). Remove spring (23), retainer(26), washers (24 and 27), and packing (25) from filter element.

(b) Remove plug (22), gasket (21), bypass valve spring (20), and bypass valve (19) from oil cooler adapter.

(c) Remove plug (18), washer (17), bypass plunger spring (16), and oil cooler bypass plunger (15) from oil cooler adapter.

(3) *Cleaning, inspection and repair.*

(a) Wash oil cooler adapter (10, fig. 3-41), filter shell (32), springs (16, 20, and 23), valve (19), and plunger (15) in clean fuel oil and wipe dry with a lint-free cloth. Use a small wire to free oil ports in adapter of sludge and accumulations. Blow out ports with compressed air.

(b) Inspect adapter for signs of cracking or leaks. Replace adapter if damaged.

(c) Examine valve (19) and plunger (15) for signs of scoring or pitting. Replace a defective valve or plunger.

(d) Check oil cooler bypass plunger spring (para 3-15).

(e) Check filter bypass valve spring (20) with a spring tester. The spring has a free length of approximately 3 17/32 inches. A force of 10 ½ to 11 ½ pounds is required to compress spring to a length of 2 ½ inches. Replace a weak spring.

(f) Replace nonmetallic washer (28), gasket (33), packing (25), and filter element (29).

(g) Scrape oil gasket material from adapter mounting bosses on cylinder block.

(4) *Reassembly.*

(a) Apply clean engine oil to outside surface of bypass plunger (15, fig. 3-41) and place plunger in adapter (10), with closed end first.

(b) Install spring 116), washer (17), and plug (18).

(c) Install bypass valve (19), bypass valve spring (20), gasket (2 1), and plug (22) in oil cooler adapter.

(d) Install spring (23), washer (24), packing (25), retainer (26), washer (27), and filter element (29) in filter shell (32).

(5) *Installation.*

(a) Position gaskets (13 and 14, fig. 3-41) on bosses of cylinder clock and secure oil cooler adapter to cylinder block with bolts (311 and lockwashers (30).

(b) Place new washer (28) in oil cooler adapter and position assembled filter element and filter shell on oil cooler adapter.

(c) Install gasket (33), stud (34), and nut (35).

(d) Install engine oil cooler (para 3-15).

(e) Install drain plug in oil cooler adapter and fill engine crankcase in accordance with LO 55-1 930-203-12.

b. Bypass oil Filter.

(1) *Removal and disassembly.*

(a) Remove drain plug (11, fig. 3-42) from filter cover (10) and drain oil into a suitable container.

(b) Unscrew center stud (1) and lift filter housing, filter element, and stud oil filter cover. Remove gasket (6).

(c) Withdraw filter element (5) and filter spring (4) from filter housing (3).

(d) Withdraw stud from filter housing and remove gasket (2) from stud.

(e) Disconnect outlet and inlet tubes (12 and 13) from cover.

(f) Remove bolts (9) and lockwashers (8) attaching cover to cylinder block. Remove plug (7) from cover.

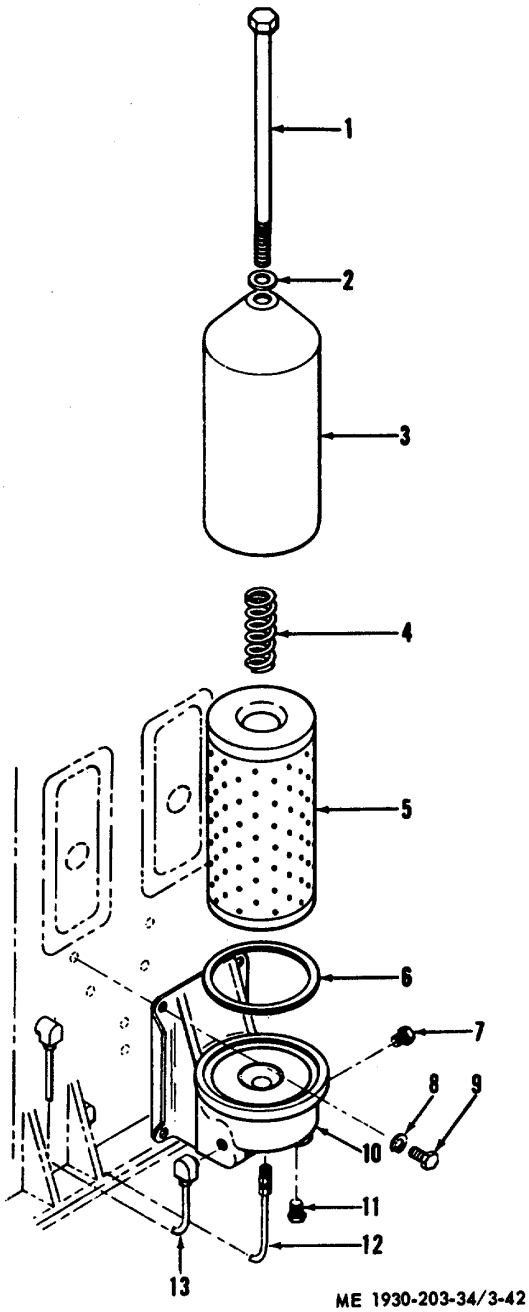
(2) *Cleaning, inspection and repair.*

(a) Wash filter cover (10, fig. 3-42), housing (3), and spring (4) in clean fuel oil and wipe them dry with a lint-free cloth.

(b) Inspect cover for cracks. Replace a cracked cover.

(c) Replace filter element (5) and gasket (2 and 6).

(3) *Reassembly and installation.* Reassemble and install in reverse order of disassembly and removal.



1 Stud, center
2 Gasket, stud
3 Housing, filter
4 Spring
5 Element, filter
6 Gasket, housing
7 Plug
8 Lockwasher
9 Bolt, filter mounting
10 Cover, filter
11 Plug, drain
12 Tube, outlet
13 Tube, inlet

Figure 3-42. Bypass oil filter.

3-17. Water Pump

a. Description. The high capacity water pump circulates the engine coolant through the engine cylinder block and cylinder head, and into the expansion tank. The drive end of the pump shaft is supported by a sealed, double-row combination radial and thrust ball bearing. The pump shaft serves as the inner race of the bearing. A spring-loaded seal assembly and a water slinger prevent coolant from passing along the shaft to the bearing. The drive coupling pressed on the end of the shaft has an integral oil thrower that shrouds the flange end of the pump body and deflects oil away from the bearing.

b. Removal

(1) Drain applicable cooling system (TM 55-1930-203-20).

(2) Loosen clamp (7, fig. 3-43) at top of oil cooler and remove clamps (6) on bypass hose to water manifold.

(3) Remove bolt and seal assemblies (1) attaching the water pump (11) to blower housing.

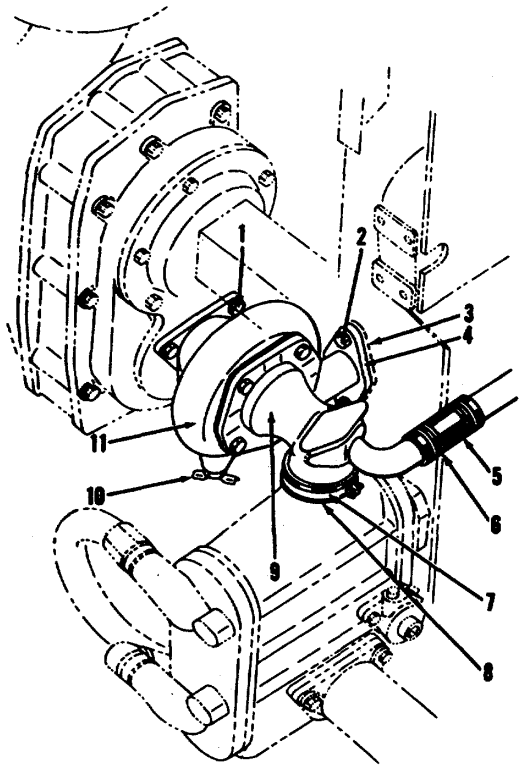
NOTE

Bolt and seal assemblies (1) attaching water pump (1) to blower require a special wrench, part No.J4242 or equivalent, to facilitate removal.

(4) Remove bolts and lockwashers attaching outlet flange (4) to cylinder block. Remove outlet flange and preformed packing (3) by removing bolts (2) and lockwashers.

(5) Remove water pump (11) and gasket.

(6) Remove clamp (7) and packing (8).



ME 1930-203-34/3-43

1 Bolt and seal assembly
2 Bolt, machine
3 Preformed packing (outlet)
4 Outlet flange
5 Hose
6 Clamp, hose
7 Clamp, hose
8 Preformed packing (inlet)
9 Water pump cover
10 Drain cock
11 Water pump

Figure 3-43. Water pump assembly, removal and installation.

c. Disassembly.

(1) Remove nuts (13, fig. 3-44) and lockwashers (14) securing water pump cover (12) to pump body (4). Remove cover and gasket (6).

(2) Remove drain cock (15) from pump body.

(3) Place pump on mounting flanges in an arbor press as shown in figure 3-45.

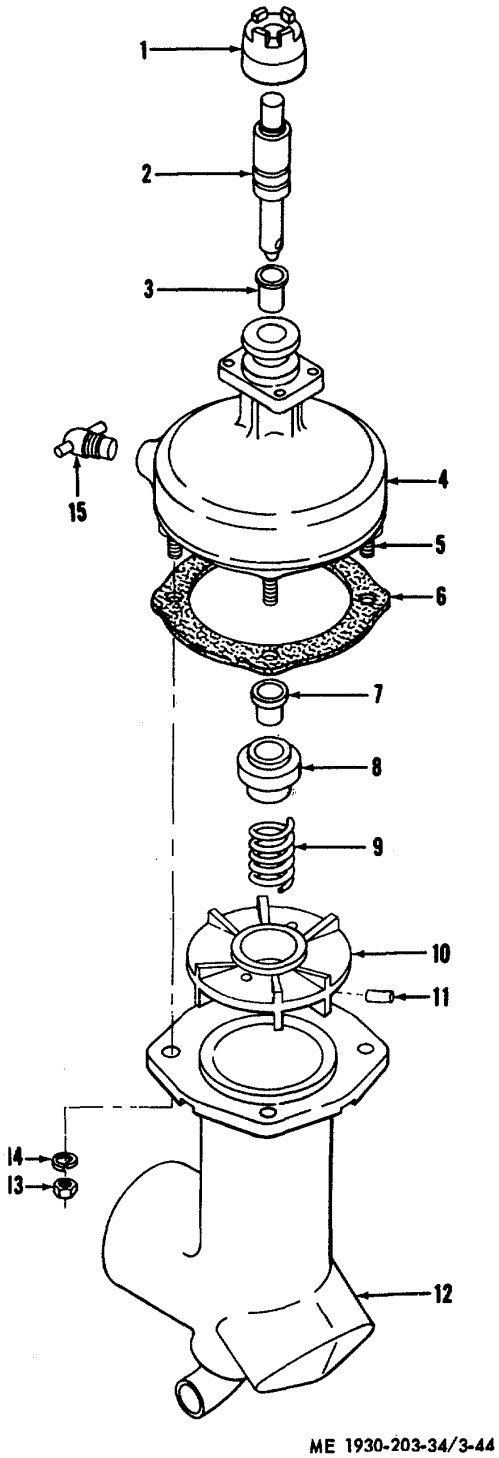
(4) Using a short steel bar (1), apply pressure to shaft until pin (11, fig. 3-44) shears. Separate shaft and bearing assembly from impeller, seal assembly, and pump body.

(5) Remove impeller (10), spring (9). and seal assembly (8).

(6) Remove water slinger from shaft.

(7) Remove sheared pin (11) from shaft and impeller.

(8) Remove drive coupling (1), as shown in figure 3-46, using bearing and bushing driver (2).

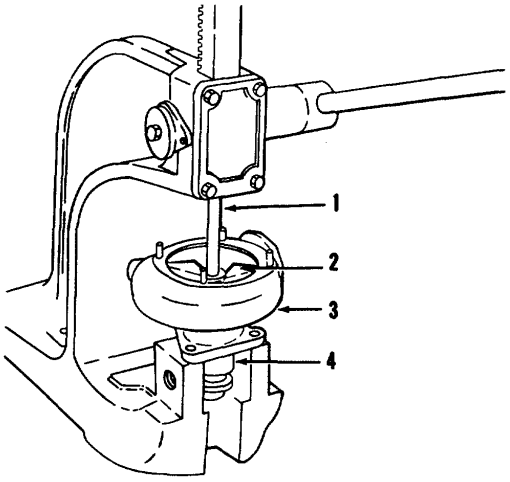


ME 1930-203-34/3-44

Figure 3-44. Water pump assembly

Key to figure 3-44.

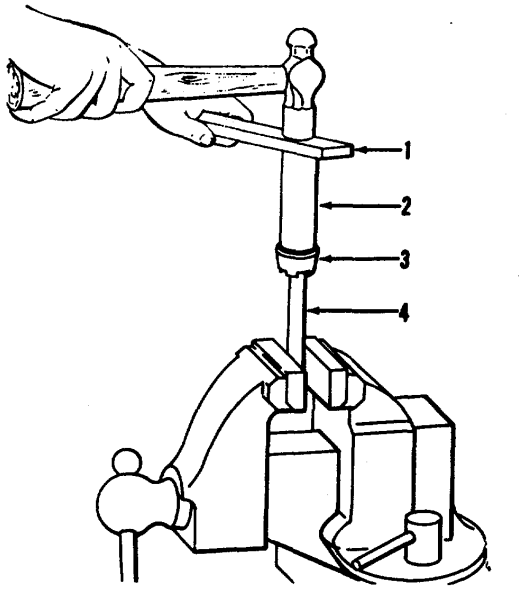
1 Drive coupling
2 Shaft and bearing assembly
3 Water slinger
4 Pump body
5 Stud, plain
6 Gasket, cover
7 Bushing
8 Seal assembly
9 Spring
10 Impeller
11 Pin, impeller
12 Water pump cover
13 Nut
14 Lockwasher
15 Drain cock



ME 1930-203-34/3-45

1 Steel Bar
2 Impeller
3 Pump body
4 Shaft and bearing assembly

Figure 3-45. Pressing water pump shaft from impeller



ME 1930-203-34/3-46

1 Steel bar
2 Bearing and bushing driver, part no. J1930
3 Drive coupling
4 Steel

Figure 3-46. Removing water pump drive coupling from shaft.

d. Cleaning, Inspection and Repair.

(1) Clean all metal parts except shaft and bearing assembly (2, fig. 3-44) in dry-cleaning solvent, Federal Specification P-D-680.

(2) Rotate pump shaft bearing on shaft and bearing assembly (2). If rough spots are detected, replace shaft and bearing assembly.

(3) Inspect drive coupling (1) for cracked or broken legs. Replace a defective drive coupling.

(4) Inspect impeller (10) for cracks or broken

blades. Check that hub is smooth and flat. Replace a defective impeller.

(5) Inspect that seal assembly (8) is not scratched or marred. Replace a scratched or marred seal assembly.

NOTE

Seal assembly is available as an assembly only and includes the carbon washer, seal, ring, guide, and spring. A seal assembly is included with a replacement impeller.

(6) Inspect pump body (4) for a cracked housing or loose or stripped studs (5). Replace housing if cracked, If studs are defective, install new studs and tighten to 10 to 12 foot-pounds.

NOTE

A replacement pump body includes studs and bushing (7).

(7) Check seal contact surface of bushing (7) for being marred. If seal contact surface of bushing is marred or if bushing is loose, replace bushing as follows:

(a) Press out old bushing.

(b) Thoroughly clean counterbore in pump body.

(c) Start the counterbored end of bushing into pump body.

(d) Press bushing in until bushing contacts shoulder in pump body.

NOTE

The bushing has a 0.0015 to 0.0035 inch press fit in pump body.

(8) Replace gasket (6).

e. Reassembly.

(1) Install water slinger (3, fig. 3-44) on shaft and bearing assembly (2) with flange of slinger approximately 3/16 inch from end of outer race of bearing.

(2) Support impeller end of pump body on an arbor press and insert slinger end of shaft and bearing assembly into pump body.

(3) Press against outer race of bearing until bearing contacts shoulder in pump body. Stake end of pump body in three places to prevent bearing from moving endwise.

(4) Apply a thin film of 10 weight oil to seal contact surface of bushing (7).

(5) Apply a thin coat of liquid soap on inside diameter of rubber seal of seal assembly (8).

(6) Slide seal assembly (8) on pump shaft and bearing assembly (2) until the carbon seal washer is seated firmly against bushing (7).

(7) Install spring (9) with small end toward seal assembly.

(8) Place impeller I1 0) on shaft with pin hole in shaft aligned midway between two adjacent blades of the impeller.

(9) Support bearing end of bearing and shaft assembly on an arbor press as shown in figure 3-47.

(10) Using impeller installer (1) as shown in figure 3-47, press impeller (2) on shaft.

NOTE

Impeller installer (1) is used to obtain specified distance of 0.099 to 0.101 inch between end of shaft and face of impeller hub.

(11) Insert a 0.184 inch drill in pin hole of shaft and bearing assembly (2, fig. 3-44) and drill through impeller hub. Secure impeller to shaft with pin (11).

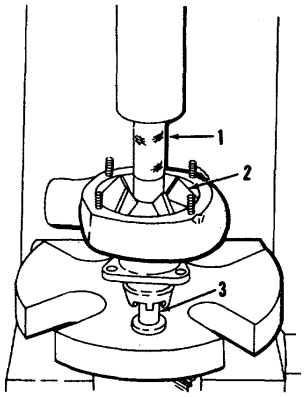
(12) Support impeller end of shaft on a suitable arbor and, using a brass hammer, tap drive coupling (1) onto shaft until coupling is flush with outer end.

NOTE

If installing a used coupling, check for a tight fit on shaft. If coupling is loose on shaft, replace coupling.

(13) Place cover gasket (6) on studs in pump body and secure water pump cover (12) to pump body with lockwashers (14) and nuts (13).

(14) Install drain cock (15) in pump body.



ME 1930-203-34/3-47

1 Impeller installer, part No. J9303
2 Impeller
3 Shaft support

Figure 3-47. Installing water pump impeller.

f. Installation. Install water pump in reverse order of removal using new gasket between water pump and blower housing and new preformed packing between outlet flange and cylinder block.

3-18. Air Starting Motor

a. Description. The air starting motor assembly

contains a rotor and a friction-clutch type drive assembly. The drive assembly consists of a series of driving and driven clutches that are spring-loaded by a small spiral spring. There are two series of air starting motors used, the A31RH6 and the B21RH6. The A31RH6 air starting motor was originally installed on the engines of hulls 5 through 18, and the B21RH6 on the engines of hulls 19 through 24. These motors differ structurally and
will be treated separately in disassembly and reassembly.

b. Removal.

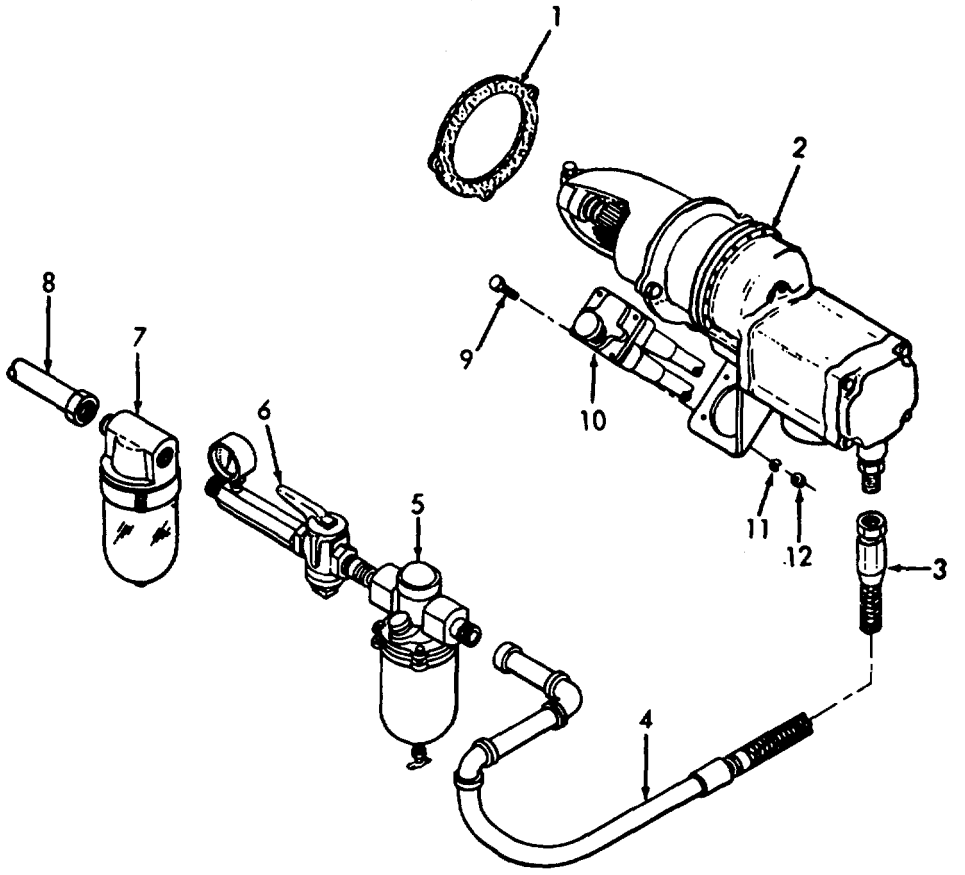
(1) Close globe valves located in air lines above air supply tanks and open service connection glove valve in upper machinery area to release pressure from air lines (para 2-11).

(2) Disconnect flexible hose (3, fig. 3-48) from starting motor (para 2-11).

(3) Disconnect air hoses from pilot air valve (10).

(4) Remove bolts (9), lockwashers (11), and nuts (12) securing pilot air valve to bracket and lift valve from bracket.

(5) Remove bolts and lockwashers securing air starting motor to flywheel housing, and remove air starting motor and gasket (1).



1 Gasket, motor housing	7 Air filter
2 Air starting motor assembly	8 Tubing
3 Flexible hose	9 Bolt, machine
4 Tubing	10 Pilot air valve
5 Lubricator	11 Lockwasher
6 Quick acting valve	12 Nut

Figure 3-48. Air starting motor assembly, air filter, and lubricator

c. Disassembly.

(1) Series A31RH6 motor disassembly.

NOTE

Reference marks listed in disassembly procedure will facilitate reassembly and insure assembly for proper direction of rotation.

(a) Place reference marks on housing cover (4, fig. 3-49), motor housing (19), gear case (27), and drive housing (35).

(b) Remove capscrews (22) and lockwashers (21), and remove gearcase (27) with assembled parts from motor housing (19).

(c) Remove capscrews (1) and lockwashers (2), and remove housing cover (4), housing cover gasket (6), and rotor bearing spring (5) from motor housing (19). Remove grease fitting (3) from housing cover (4). Mark rear end plate (10), cylinder (15), and motor housing (19) for position.

(d) Tap the end of rotor pinion (14) lightly with a soft hammer or block of wood until motor assembly is loose and can be withdrawn from motor housing (19), (fig. 3-50). Mark position of front end plate (16, fig. 3-49) with reference to cylinder (15).

(e) Push cylinder dowel (9) from dowel holes in rear and front end plates (10 and 16) and cylinder (151 with a punch or rod (fig. 3-51).

(f) Secure rotor pinion (14, fig. 3-49) in a soft-jawed vise, and unscrew lockscrew (7) from rotor. This lockscrew has a left-hand thread; turn clockwise to remove.

(g) Insert a 5/16 inch diameter steel rod about 5M2 inches long into the hole from which lockscrew (7) was removed. Grasp cylinder (15) with one hand and drive on rod until rear rotor bearing (8) and rear end plate (10) are free from rotor (13) (fig. 3-52). Press rear rotor bearing (8, fig. 3-49) from end plate (10).

NOTE

Do not clamp cylinder in a vise.

(h) Remove rotor bearing spacer (11), cylinder (15), and vanes (12) from rotor (13).

NOTE

Further disassembly is not necessary for vane replacement.

(i) Support front end plate (16) as close to rotor (13) as possible and press on end of rotor pinion (14) until front rotor bearing (17) and front end plate are free of rotor hub (fig. 3-53). Press front rotor bearing (17, fig. 3-49) from front end plate (16).

NOTE

Do not remove pinion unless broken or damaged.

(j) Press rotor pinion (14) out of rotor (13) with a 5/16-inch diameter arbor.

(k) Remove plug (20) and air port gasket (18). Note from which cavity gasket was removed.

(l) Remove bolts (41) and lockwashers (42) attaching drive housing (35) to gear case (27).

(m) Tap drive housing (35) loose from gear case (27) and remove starter drive (34).

(n) Remove bushing oiler plug (36) and bushing oiler (37), and press out drive housing (38) with arbor.

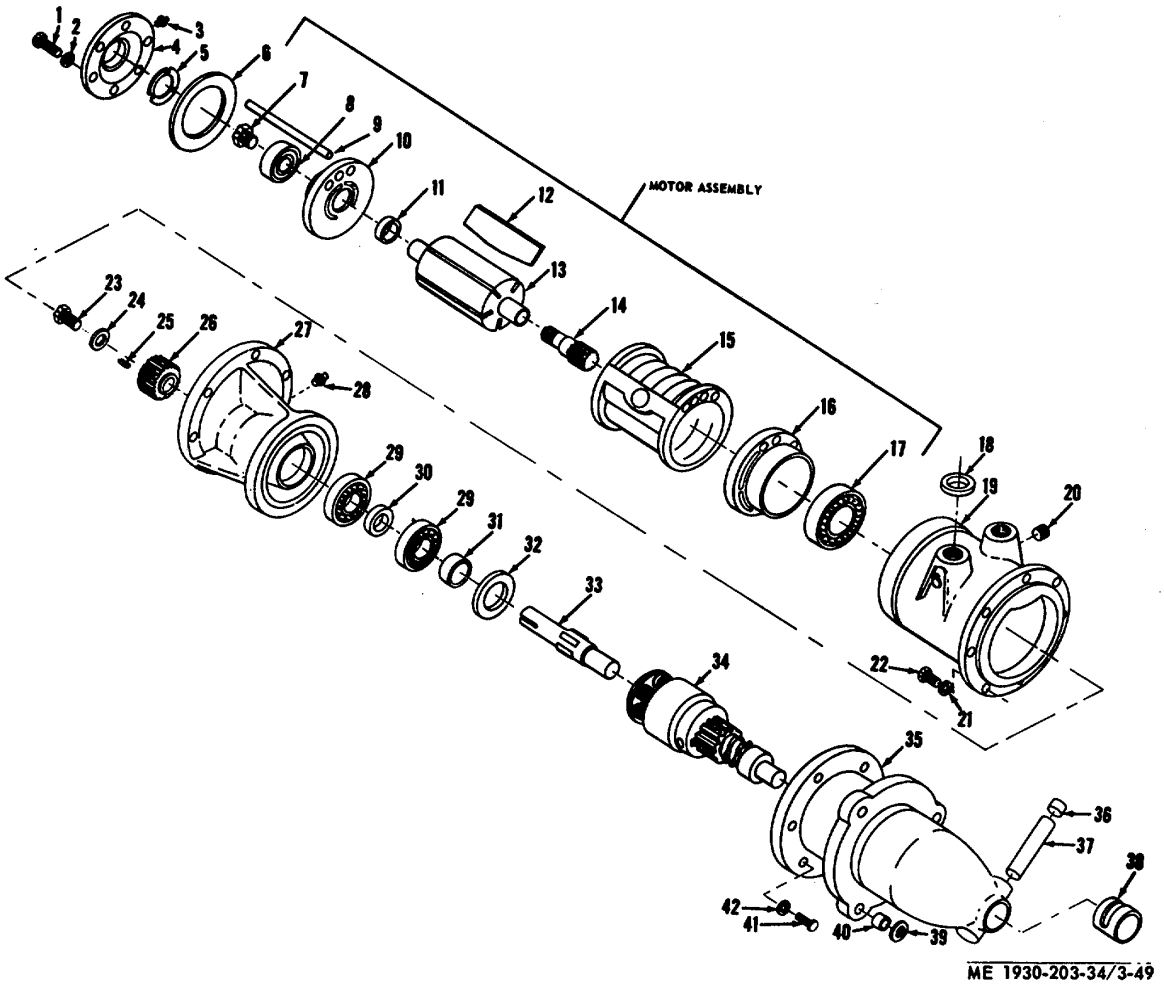
(o) Secure splines on drive shaft (33) in copper-covered vise jaws, unscrew drive gear retaining screw (23), and remove washer (24).

(p) Support front face of gearcase (27) outside gearcase grease seal (32). Place a suitable arbor against gear end of drive shaft (33), and press shaft from drive gear (26). The drive shaft bearing spacer (30), drive shaft bearings (29), drive shaft collar (31), and gear case grease seal (32) will remain on drive shaft.

NOTE

When drive shaft 133) in removed, the gearcase grease seal 1321 will be damaged. A new seal must be used when reassembling.

(q) Remove drive gear key (25) from end of drive shaft (33). Support face of drive shaft collar (31) and press end of shaft through bearings (29), drive shaft bearing spacer (301, and drive shaft collar (31). Remove gearcase grease seal (32) from drive shaft collar (31).



1 Capscrew, housing cover
2 Lockwasher
3 Grease fitting
4 Housing cover
5 Rotor bearing spring
6 Housing cover gasket
7 Lockscrew, rotor bearing
8 Rear rotor bearing
9 Cylinder dowel
10 Rear end plate
11 Rotor bearing spacer
12 Vane
13 Rotor
14 Rotor pinion
15 Cylinder
16 Front end plate
17 Front rotor bearing
18 Air port gasket
19 Motor housing
20 Plug
21 Lockwasher
22 Capscrew, housing
23 Screw
24 Washer, drive gear retaining
25 Drive gear key
26 Drive gear
27 Gearcase
28 Grease fitting
29 Drive shaft bearing
30 Drive shaft bearing spacer
31 Drive shaft collar
32 Gearcase grease seal
33 Drive shaft
34 Starter drive
35 Drive housing
36 Bushing oiler plug
37 Bushing oiler
38 Drive housing bushing
39 Lockwasher
40 Mounting bolt bushing
41 Capscrew, gear case
42 Lockwasher

Figure 3-49. Series A31RH6 air starting motor.

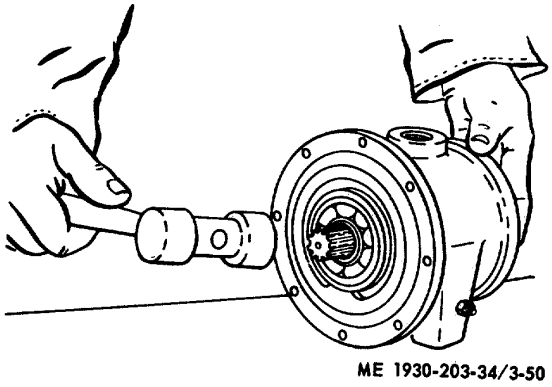


Figure 3-50. Removing motor assembly from motor housing.

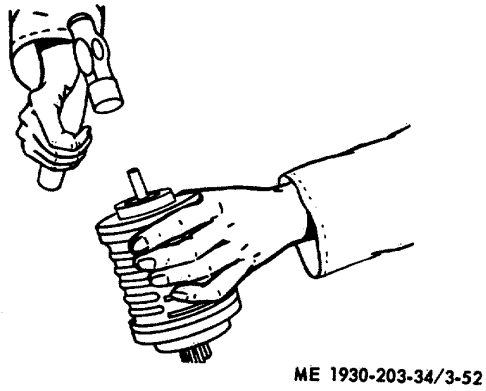


Figure 3-52. Removing rear bearing and end plate.

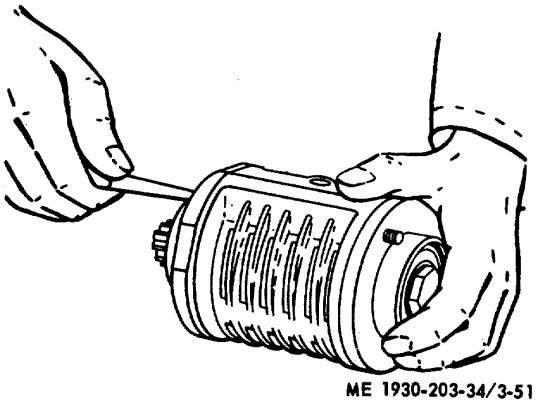


Figure 3-51. Removing cylinder dowels.

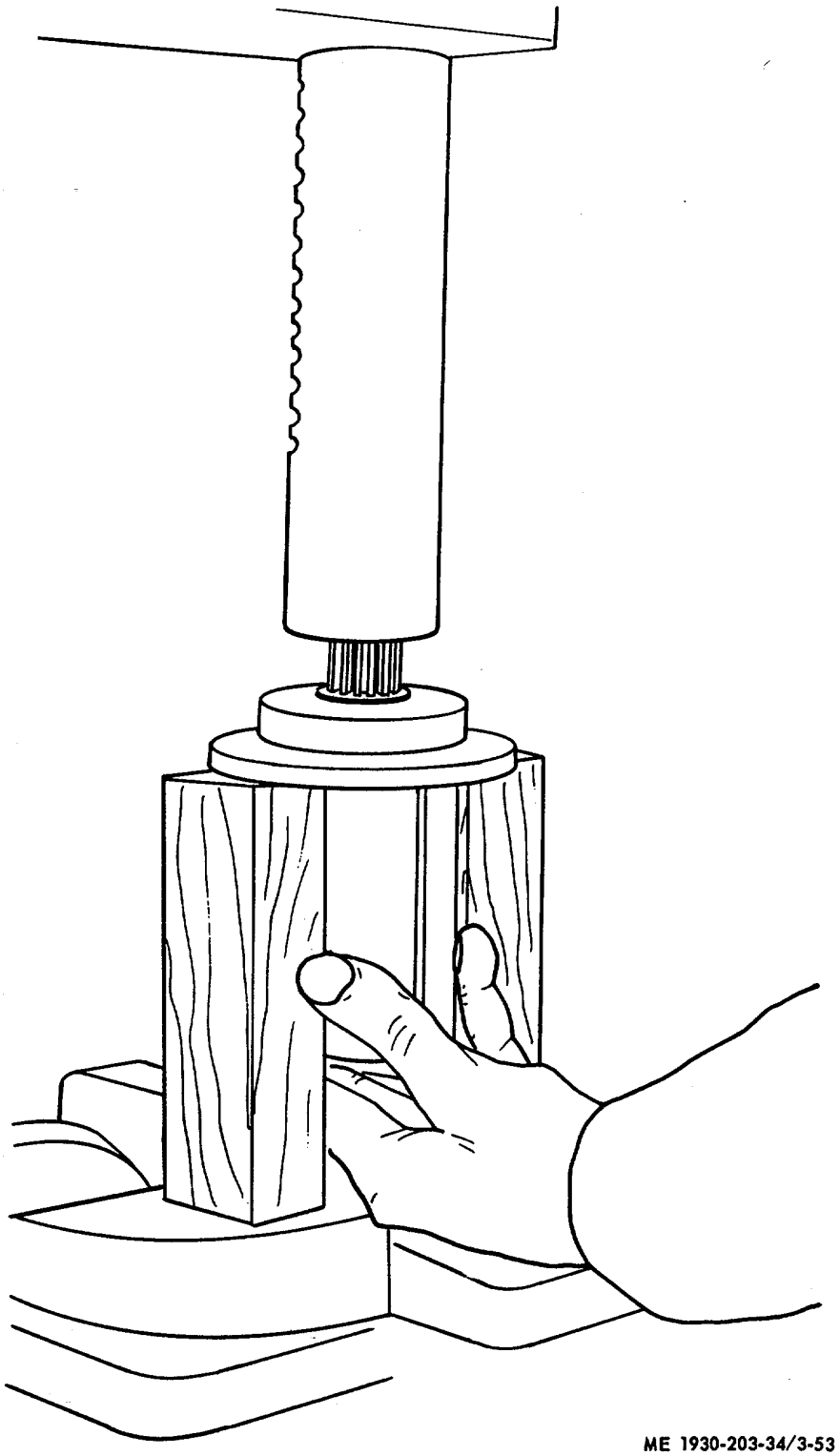


Figure 3-53. Removing front bearing and end plate.

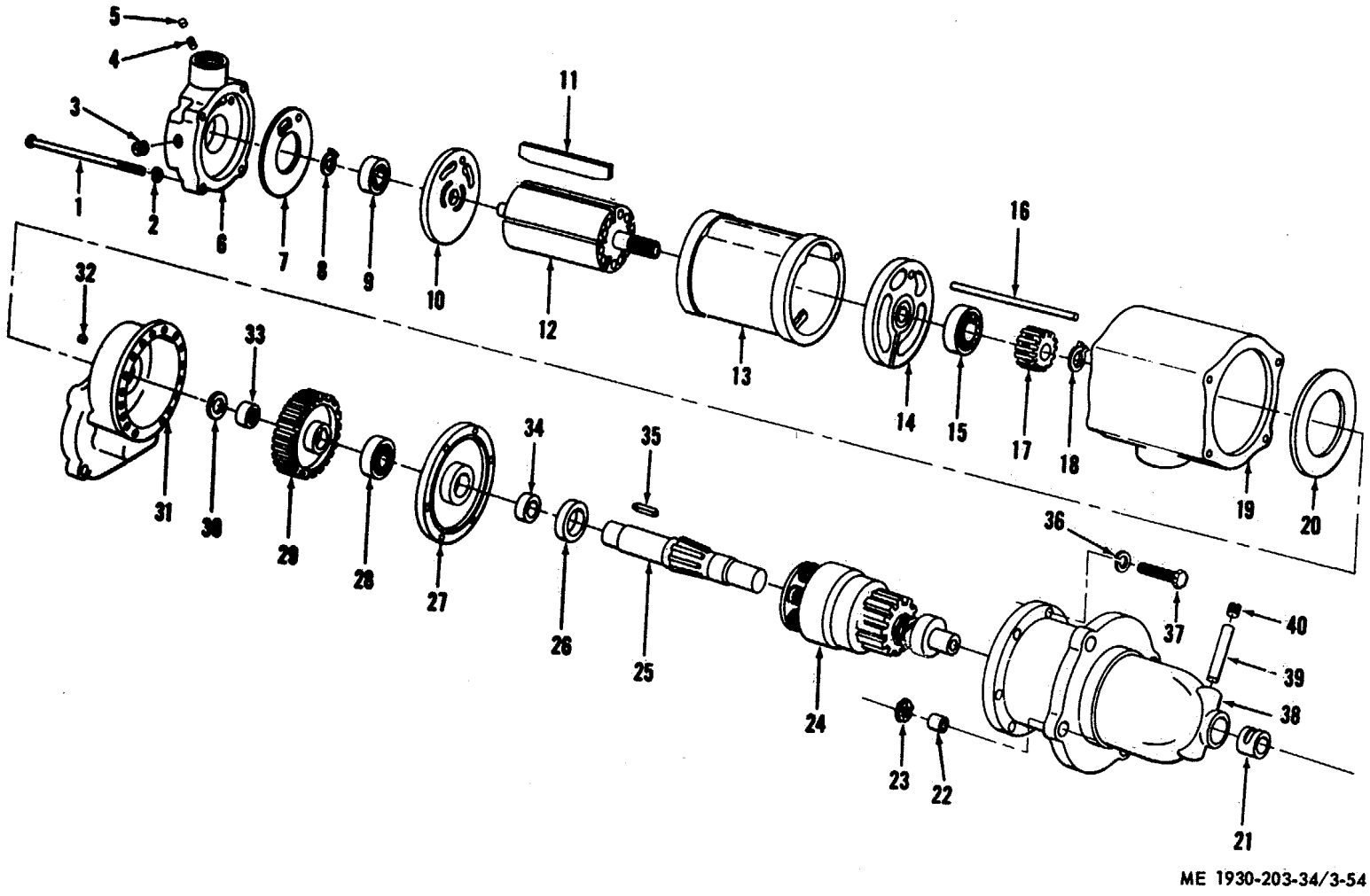


Figure 3-54. Series B21RH6 air starting motor.

Key to figure 3-54.

1 Capscrew, motor housing cover
2 Lockwasher, cover capscrew
3 Oil chamber plug
4 Oiler felt
5 Screw, oiler adjusting
6 Motor housing cover
7 Motor housing cover gasket
8 Rear rotor bearing retainer
9 Rear rotor bearing
10 Rear end plate
11 Vane
12 Rotor
13 Cylinder
14 Front end plate
15 Front rotor bearing
16 Cylinder dowel
17 Rotor pinion
18 Rotor pinion retainer
19 Motor housing
20 Gearcase gasket
21 Drive housing bushing
22 Mounting bolt bushing
23 Lockwasher, mounting bolt
24 Starter drive
25 Drive shaft
26 Drive shaft grease seal
27 Gearcase cover
28 Drive shaft front bearing
29 Drive gear
30 Washer, bearing ejecting
31 Gearcase
32 Angle grease fitting
33 Drive shaft rear bearing
34 Drive shaft collar
35 Drive gear key
36 Lockwasher
37 Capscrew, drive housing
38 Drive housing
39 Bushing oiler
40 Bushing oiler plug

(2) *Series 821RR6 motor disassembly.*

NOTE

Reference marks listed in disassembly procedure will facilitate reassembly and insure assembly for proper direction of rotation.

(a) Place reference marks on motor housing cover (6, fig. 3-54), motor housing (19), gearcase (31), gearcase cover (27), and drive housing (38).

(b) Remove motor housing capscrews (1) and lockwashers (2) and remove motor housing cover (6) and motor housing cover gasket (7) from motor housing (19). Remove oiler adjusting screw (5), oiler felt (4), and oil chamber plug (3) from motor housing cover (6).

(c) Mark rear end plate (10), cylinder (13), and motor housing (11) for position. Separate motor housing (19) from gearcase (31).

(d) Draw motor assembly out of motor housing (19) and mark front end plate (14) position with references to cylinder (13). Remove ,gearcase gasket (20) from front end plate (14).

(e) Position motor assembly vertically, grasping rotor pinion (17) in copper-covered vise jaws. Using retaining ring pliers (fig. 3-55), remove rear rotor bearing retainer (8, fig. 3-54), and lift off rear rotor bearing (9), rear end plate (10), and cylinder (13). Remove cylinder dowel (16).

(f) Remove vanes (11) from rotor (12).

NOTE

Further disassembly of the motor is not necessary for vane replacement.

(g) Position rotor (12) vertically, pinion end up, and hold bottom rotor hub in copper-covered vise jaws. Remove rotor pinion retainer (18) with a screwdriver (fig. 3-56).

(h) Support front end plate (14, fig. 3-54) on wooden blocks as close to rotor as possible and press rotor from rotor pinion (17), freeing front rotor bearing (15) and front end plate (14). Do not let rotor fall when pressed free (fig. 3-57).

(i) Remove bolts (37, fig. 3-54) and lockwashers (36) attaching drive housing (38) to gear case (3 1).

(j) Tap drive housing (38) loose from gearcase (31) and remove starter drive (24).

(k) Withdraw drive shaft (25) and drive gear (29) from gearcase (31).

(l) Pull gearcase cover (27) and drive shaft grease seal 126) from front end of drive shaft (25). Remove drive shaft grease seal (26) from gearcase cover and discard seal.

(m) Support drive gear (29) and press out drive shaft (25) (fig. 3-54). Remove drive gear key (35, fig. 3-54).

(n) Stand drive shaft (25), bearing end up, in a pressing sleeve (fig. 3-59). Press drive shaft (25, fig. 3-54) from bore of drive shaft from bearing (28) and drive shaft collar (34).

(o) Screw a 5/16 inch capscrew into bearing ejecting washer (30) and pull drive shaft rear bearing (33) from gearcase (31) Remove angle grease fitting (32) from gearcase.

(p) Press drive housing bushing (21) from end of drive housing (38). Remove bushingoiler plug (40) and bushing oiler (39) from drive housing.

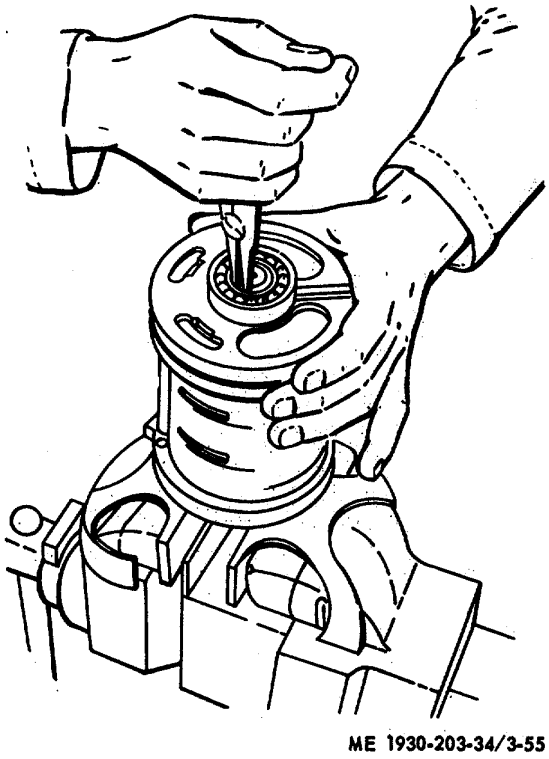


Figure 3-55. Removing bearing retainer.

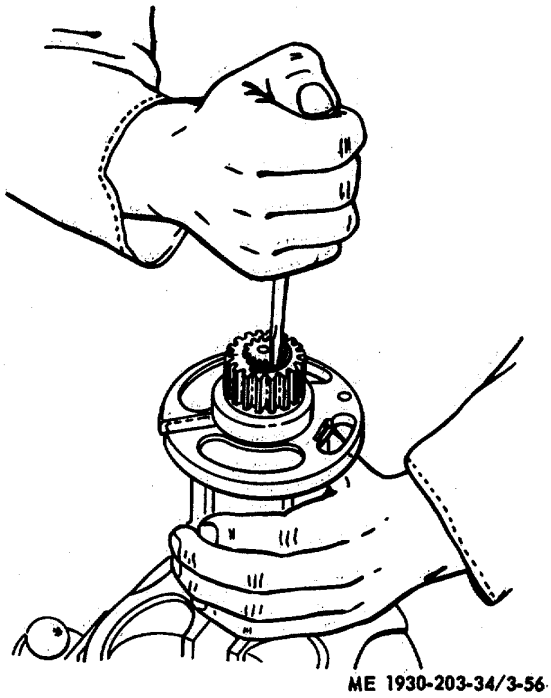


Figure 3-56. Removing rotor pinion retainer.

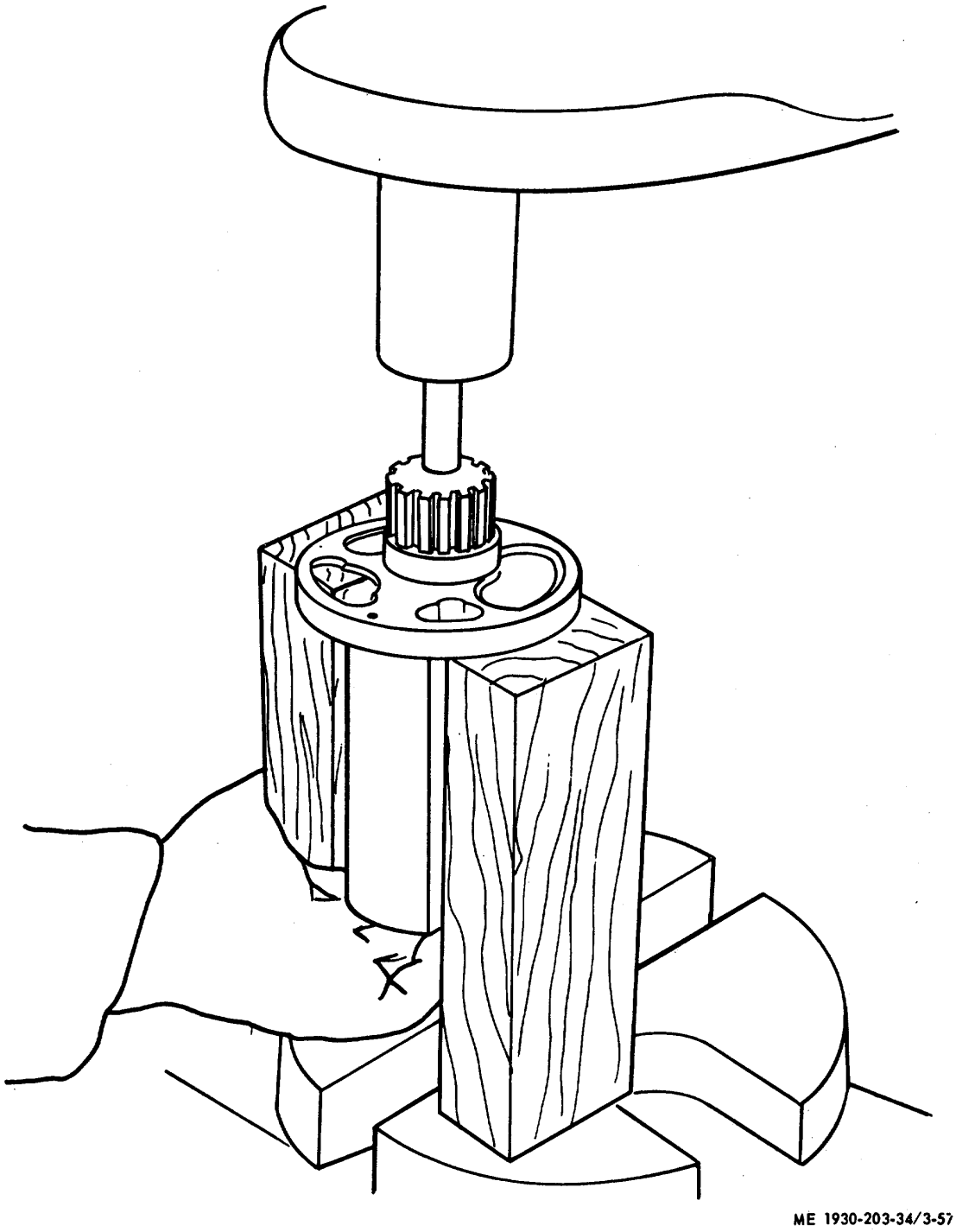


Figure 3-57. Removing front rotor bearing.

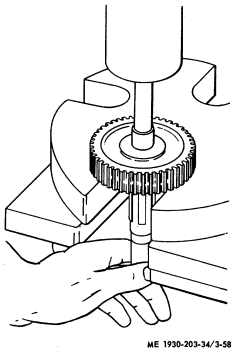


Figure 3-58. Removing drive gear.

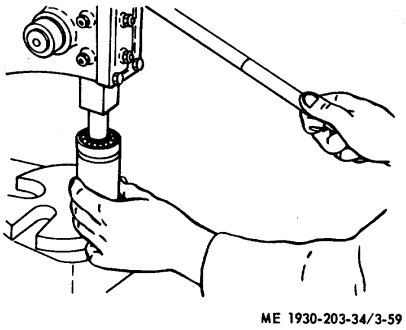


Figure 3-59. Removing drive shaft.

d. Cleaning, Inspection and Repair.

(1) Clean all parts in dry-cleaning solvent, Federal Specification I-D-680, and dry with compressed air (10 psi).

(2) Examine front end plate face for scoring. Clean with crocus cloth, Federal Specification P-C-458, if scoring is not too deep. Replace front end plate if necessary.

(3) Inspect rotor pinion for broken or chipped teeth. When only slight burrs exist, remove with soft stone, Military Specification MIL-S.2389. Replace pinion if teeth are chipped or broken.

(4) Examine drive housing bushing for excessive wear. Replace if worn or out-of-round.

(5) Inspect rubber air port gasket. Replace if defective.

(6) Examine all bearings for scored, scratched, cracked, pitted, or chipped races. Rotate manually and determine if rough. Replace if defective.

(7) Examine all bearing housings and shaft for grooved, burred, or galled conditions which would indicate that bearings have been turning in their housings or on their shafts. When damage cannot be repaired with crocus cloth, Federal Specification P-D-458, replace defective parts.

(8) Examine vanes for straightness, nicks, or burrs. When vanes are badly burned or bent, replace. Clean up minor imperfections with crocus cloth, Federal Specification P-C-458.

(9) Inspect cylinder bore to assure it is smooth and free of scores. Replace cylinder if necessary.

(10) Inspect reduction gears for scoring or chipped teeth. Replace damaged gears.

e. Reassembly.

(1) Series A31RH6 motor reassembly.

(a) If rotor pinion (14, fig. 3-49) was removed from rotor (13), align-serrations on the new pinion shank with grooves in rotor bore and start squarely into rotor. Support rear face and press in pinion until shoulder contacts rotor hub.

(b) Support front end plate (16). Use an arbor that will contact only the outer ring of front rotor bearing (17). Press bearing, shielded side first, into end plate recess. Replace rear rotor bearing (8) in rear end plate (10) by the same procedure.

(c) Slip front rotor bearing (17), in front end plate (16), over pinion. Use a sleeve that will pass over pinion and contact bearing inner ring. Press bearing onto rotor hub until only running clearances exist between faces of front end plate (16) and rotor (13).

(d) Hold rotor vertically and secure pinion in copper-covered or lead vise jaws. Enter vanes (12) into each slot in rotor. Make sure vances are all the same length.

(e) Place cylinder (15) over rotor (13). Reference marks made at disassembly should all agree. If cylinder is inverted, direction of rotation will be reversed.

(f) Install rotor bearing spacer (11), chamfered end first, over rotor rear hub.

(g) Remove rotor with assembled parts from vise and press rear rotor bearing (8), in rear end plate (10), onto rotor hub until bearing inner ring contacts spacer, but does not create a bind against rotor.

(h) Replace rotor with assembled parts in vise, clamping it by pinion (14), and screw lockscrew (7 into rotor tightly. This is a left-hand thread; turn counter clockwise to tighten.

(i) Replace rubber air port gasket (18), large open end first, into inlet air port. Install plug (20) in motor housing (19).

(j) Aline dowel holes in each end plate with hole in cylinder. The cylinder dowel is the smallest of four holes drilled lengthwise through cylinder wall. Insert a ¼/4 inch diameter by 12 inch long rod through aligned holes, allowing rod to protrude from pinion end of motor assembly.

NOTE

Reference marks made during disassembly should align.

(k) Enter rod into dowel hole at bottom motor housing bore and slide motor assembly, pinion end first, into motor housing (19). Tap housing lightly on front face to jar motor into position. Remove rod and replace it with cylinder dowel (9).

(l) Install housing cover gasket (6) on rear end plateface and position rotor bearing spring (5) with its prongs resting on outer ring or rear rotor bearing (8).

(m) Replace housing cover (4) on motor housing (19), and install capscrews (1) and lockwashers (2). Rotate pinion while tightening capscrews. Install grease fitting (3).

NOTE

Rotor must spin freely with the housing cover drawn tightly against the motor housing.

(n) Slide drive shaft collar (31) over drive gear end of drive shaft (33) until it contacts shoulder. Outer surface of this collar contacts lip of gearcase grease seal (32). Make sure collar is smooth and free from nicks or burrs which could cause damage to seal.

*(o)*Support inner ring of drive shaft bearing (29) and press drive shaft (33) through bearing until inner ring contacts drive shaft collar. Slide drive shaft bearing spacer (30) onto shaft until it contacts inner ring of bearing. Press second drive shaft bearing on shaft until inner ring contacts spacer. The collar, bearings, and spacer must contact each other along shaft.

(p) Replace drive gear key (25) in drive shaft keyway.

*(q)*Position drive shaft and assembled parts squarely in gearcase bore and press this assembly in until outer ring of leading drive shaft bearing seats on shoulder in gearcase.

*(r)*Support splined end of drive shaft, and align keyway in drive gear (26) with key. Press gear, hub side first, on drive shaft until it contacts inner ring of bearing.

*(s)*Place above assembly in a vise with soft copper or lead-covered jaws and grasp splines on drive shaft. Place washer (24), small hole side first, in gear counter bore and run drive gear retaining screw (23) into tapped hole in drive shaft. Tighten screw, and lock to prevent rotation by upsetting rim of washer into screw head slot with a punch or chisel.

(t) Coat surface of drive shaft collar (31) with lightweight grease, Military Specification MIL-G-10924. Place gearcase grease seal 132), lip side first, over collar, and with firm, even pressure, press seal into gearcase bore. Seal should seat square against bore shoulder.

(u) Match reference marks on flange of motor housing (19) and gearcase (27). Join both assemblies, meshing pinion with drive gear, and bolt them together with capscrews (22) and lockwashers (21).

(v) Install starter drive (34).

(w) If drive housing bushing (38) was removed, stand drive housing (35), small end up, on a table, and press a new bushing into the small bore. Position bushings so oil slot in side of bushing is alined with oil hole that breaks into drive housing bore. Press bushing until its leading face is flush with inner face of drive housing boss.

NOTE

Any excess in the bushing's length must protrude from the outer side of the boss.

*(x)*Saturate bushing oiler (37) with oil and insert into drive housing oil hole. Attach bushing oiler plug (36).

(y) Install drive housing (35).

(*2) Series B21RH6 motor reassembly.*

*(a)*Reverse disassembly procedure with the following exception.

NOTE

Refer to paragraph (b) through (e) below must be read carefully, and in order, before attempting to reassemble air starting motor assembly.

*(b)*Press drive shaft grease seal (26, fig. 3-54), Jip side first, into gearcase cover (27).

(c) Press drive shaft rear bearing (33) unstamped end first, into gearcase (31).

(d) Install front and rear end plates (14 and 10) and push front and rear rotor bearings (15 and 9), sealed side first, onto the rotor (12).

CAUTION

The three air ports in upper face

cylinder (13) must be to the left of dowel hole.

(e) Press drive housing bushing (21) into small end of drive housing (38). Position bushing so oil slot in side of bushing is alined with the oilhole that breaks into drive housing bore. Press bushing until its leading face is flush with inner face of drive housing boss.

(f) Install air starting motor on engine in reverse order of removal.

3-19. Fuel Pump Assembly

a. Description. The fuel pump is a positive displacement gear-type pump which transfers fuel oil from the supply tank to the engine intake manifold. Fuel enters the pump on the inlet side and fills the space between the gear teeth which are exposed at that instant. The gear teeth carry the fuel oil to the discharge or outlet side of the pump, and as the gear teeth mesh in the center of the pump, fuel is forced from the outlet. Since this is a continuous cycle and fuel is continuously being forced from the outlet. fuel flows through the engine fuel system under pressure.

b. General. Fuel pump rotation of Model 6080 engines is counterclockwise and for Model 6081 engines rotation is clockwise. A spring-loaded relief valve, set to operate at 65-70 psi. is installed in the outlet side of the pump to prevent excessive pressures in the event of a clogged filter or blocked line. When operating properly, the pump will maintain a fuel pressure at the fuel inlet manifold of 44) to 60 psi at 1800 rpm engine speed.

c. Removal. Refer to figure 3-60 and remove fuel pump assembly from blower assembly.

d. Disassembly.

(1) Place fuel pump in holding fixture, part No. J1508-10.
(2) Remove pump cover (5, fig. 3-61) from pump body (1). Use care not to damage finished faces of pump body and cover.
(3) Remove drive shaft, drive gear (4), and ball (9) as an assembly from pump body (1)

(4) Press drive shaft through gear just far enough to remove steel locking ball. Invert shaft and gear assembly in press and press shaft from gear. Do not misplace steel ball. Do not press Squared end of shaft through gear as slight score marks will damage oil seal contact surface.

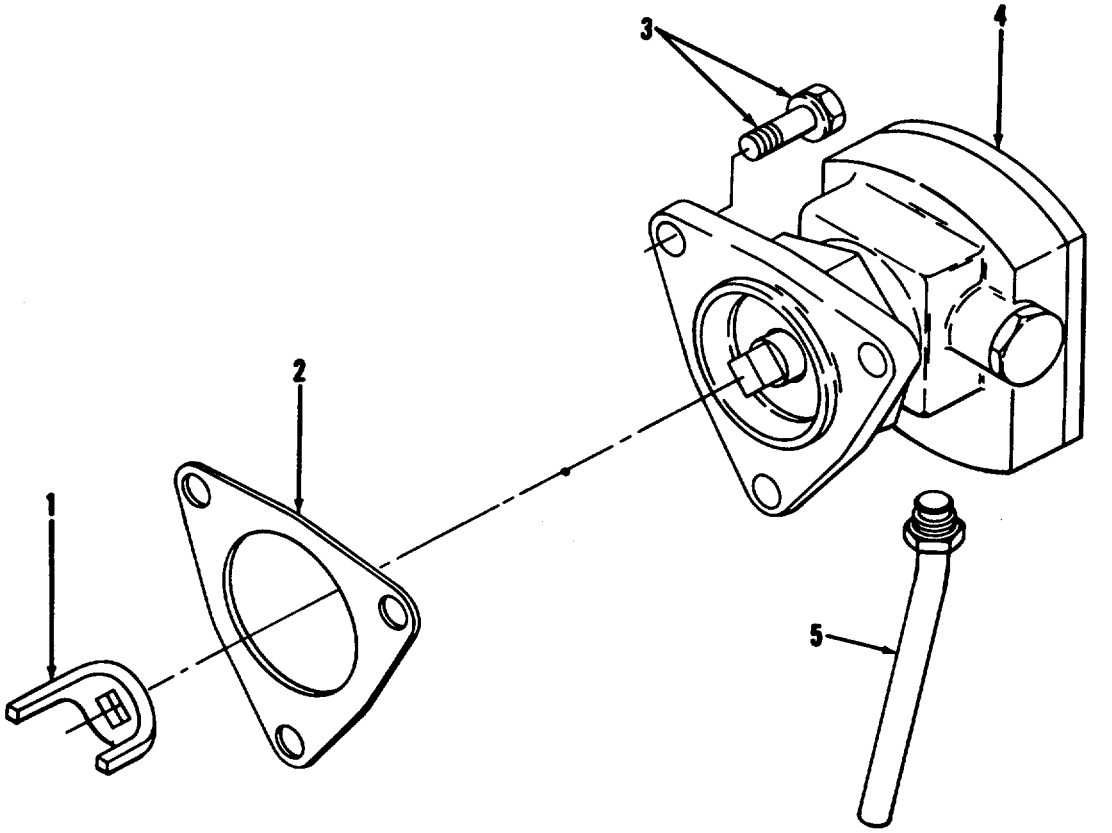
(5) Remove driven shaft (3) and driven gear

(8) as an assembly from pump body. Do not remove gear from shaft. Driven gear and shaft are serviced as an assembly only.

(6) Remove relief valve plug (14) and gasket (13), holding hand on plug to relieve valve spring tension.

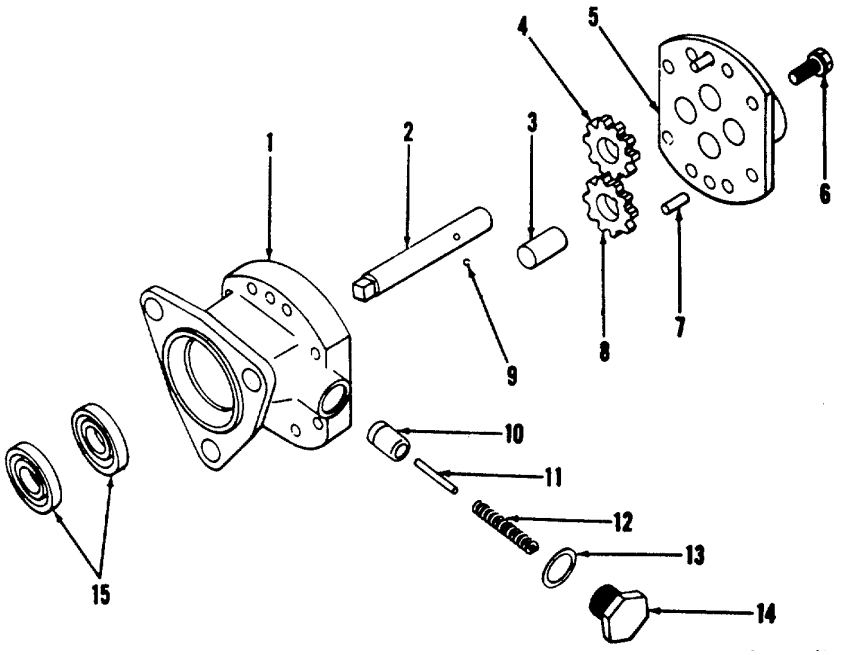
(7) Remove spring (12), pin (11), and relief valve (10) from valve cavity in pump body.

(8) Remove oil seals (15) with oil seal remover, part No. J1508-7 (fig. 3-62). Clamp pump body in bench vise and screw threaded end of tool shaft into outer oil seal (seal nearest bolting flange). Tap pilot end of shaft with hammer to remove seal. Repeat this operation to remove seal. Repeat this operation to remove inner oil seal.



1. Fuel pump coupling fork
2. Gasket
3. Bolt and seal washer assembly
4. Fuel pump
5. Drain line

Figure 3-60. Fuel pump.



1 Pump body	6 Bolt, machine	11 Pin
2 Drive shaft	7 Dowel pin	12 Spring
3 Driven shaft	8 Driven gear	13 Gasket
4 Drive gear	9 Ball, gear retaining	14 Plug
5 Pump cover	10 Relief valve	15 Oil seals

Figure 3-61. Fuel pump assembly, (right hand pump shown)

e. Cleaning, Inspection and Repair.

(1) Wash all parts in dry-cleaning solvent, Federal Specification P-D-680, and dry with compressed air.

(2) Discard old oil seals removed from pump body. New seals should fit snugly around pump shaft and must be free of nicks or cracks.

(3) Plump gear teeth should be checked for scoring, chipping, or cracks. Check retaining ball slot in gear for chipping or erosion. Replace gear if necessary.

(4) Inspect drive and driven shafts for scoring or erosion. Replace shafts if necessary. (Driven shaft is serviced as a gear and shaft assembly only).

(5) Inspect mating faces of pump body and cover. Mating faces must be flat and smooth and fit tightly together. Any scratches or slight damage may result in pressure leaks. Check for wear in areas of contact by gears and shafts. If cover and/or body is defective, replace pump.

(6) Inspect relief valve to assure that it is free from score marks and burrs and fits properly in pump body. If relief valve is scored and cannot be cleaned with fine emery cloth or crocus cloth, Federal Specification P-D-458, replace valve.

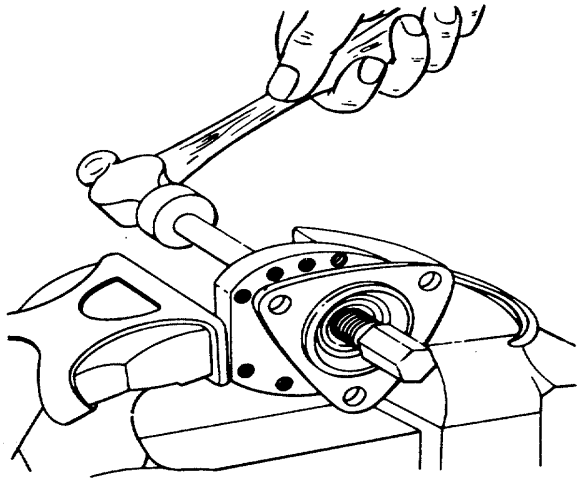


Figure 3-62. Removing oil seals from fuel pump body with oil seal remover, part No. J1508-7

(7) Check valve spring for a free length of 1.97 inch. Spring should require a load of 7.3± 0.2 pounds to compress it to a length of 1.18 inches. If spring falls below the above specifications, replace.

f. Reassembly.

(1) Place oil seals in pump body as follows:

(a) Lubricate lips of oil seals (15, fig. 3-61) with a light coat of vegetable oil.

(*b)* Place inner oil seal on pilot of installer handle so that lip of seal will face flanged end of pump.

(c) Insert pilot of installer handle into pump body so seal starts straight into pump flange.

(d) Support pump on wood blocks and drive seal into place in counterbore of flange until it bottoms.

(e) Place shorter end (end stamped 0.110) of adapter over pilot and against shoulder of installer handle (fig. 3-63).

(f) Place outer oil seal on pilot of installer handle with lip of seal facing adapter.

(g) Insert pilot of installer handle into pump so seal starts straight in pump flange, and drive seal into pump body until shoulder of adapter contacts pump body. Seals will then be positioned so that space between seals corresponds with drain holes in bottom of pump body.

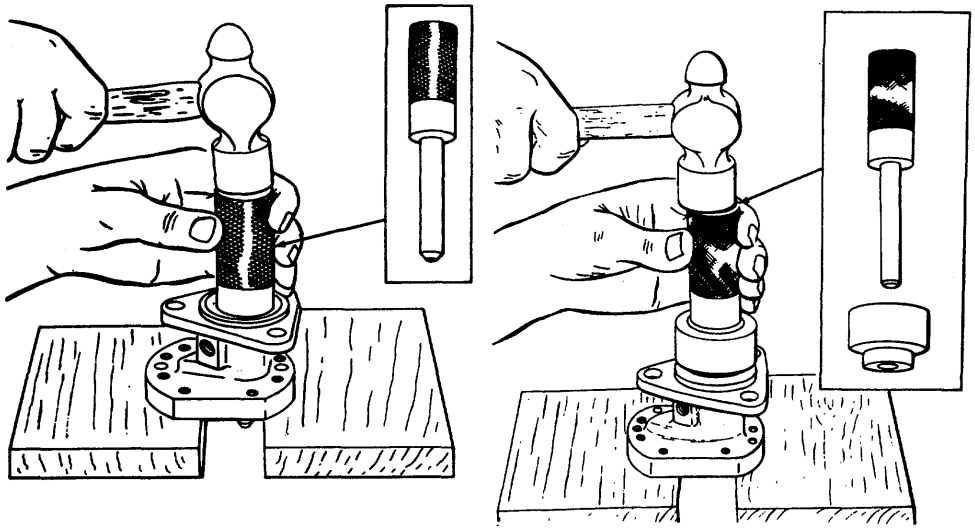


Figure 3-63. Installing outer oil seal in fuel oil pump body with handler part No. J1508-8 and adapter, part No. J1508-9.

(2) Install relief valve assembly in pump body as follows:

*(a)*Clamp pump body (1, fig. 3-61) in soft jaws of bench vise with relief valve (10) cavity up.

(b) Lubricate outside diameter of relief valve (IO), and place valve in cavity with hollow end up.

(c) Insert spring (12) inside valve and pin (11) inside spring.

(d) Place new gasket (13) next to head of plug (14).

(e) Place plug over spring and thread into pump body. Tighten plug.

(3) Install gear and shaft assemblies in pump body as follows:

(a) Place fuel pump drive gear (4) over end of drive shaft 42) which is not squared (so slot in gear will face plain end of shaft when installed). This step is very important; otherwise, fine score marks caused by pressing gear into position from square end of shaft may cause rapid wear of oil seals (15).

*(b)*Press drive gear (4) slightly beyond gear retaining ball detent.

(c) Place ball (9) in detent and press gear back until end of slot contacts ball. Place shaft assembly in pump body.

(d) Place driven shaft (3) and driven gear (8) in pump body.

NOTE

Driven gear must be centered on shaft to give proper end clearance. Also chamfered end of gear teeth must face pump body. If replacement gear with slot is used, slot must face toward pump cover.

(e) Lubricate gears and shafts with clear engine oil.

(4) Apply two thin coatings of approved sealer an face of pump cover (5) outside of gear pocket area. Place cover against pump body with two dowel pins (7) in cover entering holes in pump body (I). Pump cover (5) can be installed in only one position over the two shafts.

CAUTION

Coating of sealant must be extremely thin since pump clearances have been set up on basis of metal-to-metal contacts. Use care that sealant is not squeezed into gear compartment; otherwise, damage to gears and shafts may result.

(5) Secure pump cover in place with eight bolts (6) and lockwashers, tightening bolts alternately and evenly.

(6) Rotate pump shaft by hand to make certain that parts rotate freely. If binding exists, tap corner of pump with a hammer to relieve binding.

(7) Use plastic shipping plugs in inlet and outlet openings to prevent dirt or foreign material entering pump while it is not in use.

g. Installation.

(1) Install gasket (2, fig 3-60) on fuel pump mounting flange.

NOTE

Two types of fuel pumps are used on the LARC, one for Model 6080RA engines, and the other for Model 6081RC engines. These pumps are not interchangeable. When installing a new fuel pump on an engine, always check the markings on the pump. Use only pumps marked RH IN for Model 6081RC engines and LH IN for Model 6080RA engines.

(2) Place coupling fork (1) over squared end of pump drive shaft with prongs of fork directed away from pump.

(3) Place pump in position in blower assembly with inlet opening in pump cover (marked LH IN or RH IN) on side toward cylinder block. Be sure that prongs of coupling fork seat correctly in drive unit.

(4) Secure pump to blower with three bolt and seal washer assemblies (3).

(5) Connect fuel pipe from primary fuel filter to inlet opening (cylinder block side) on fuel pump.

(6) Connect fuel pipe from secondary fuel filter to outlet port on fuel pump.

(7) Connect drain line (5) to fuel pump.

3-20. Fuel Pump Assembly Testing

a. Disconnect flexible fuel return line at some point between fuel return manifold and supply tank. Hold open end of line in a 1-gallon container (fig. 3-64).

b. Start and run engine at 1200 rpm and measure fuel flow return from manifold for a period of I minute. Approximately 0.8 gallon of fuel per minute should flow from return line.

c. Immerse end of fuel line in container of fuel. Air bubbles rising to surface indicate air is being drawn into fuel system.

NOTE

If pump output is below amount specified above, disassemble and repair.

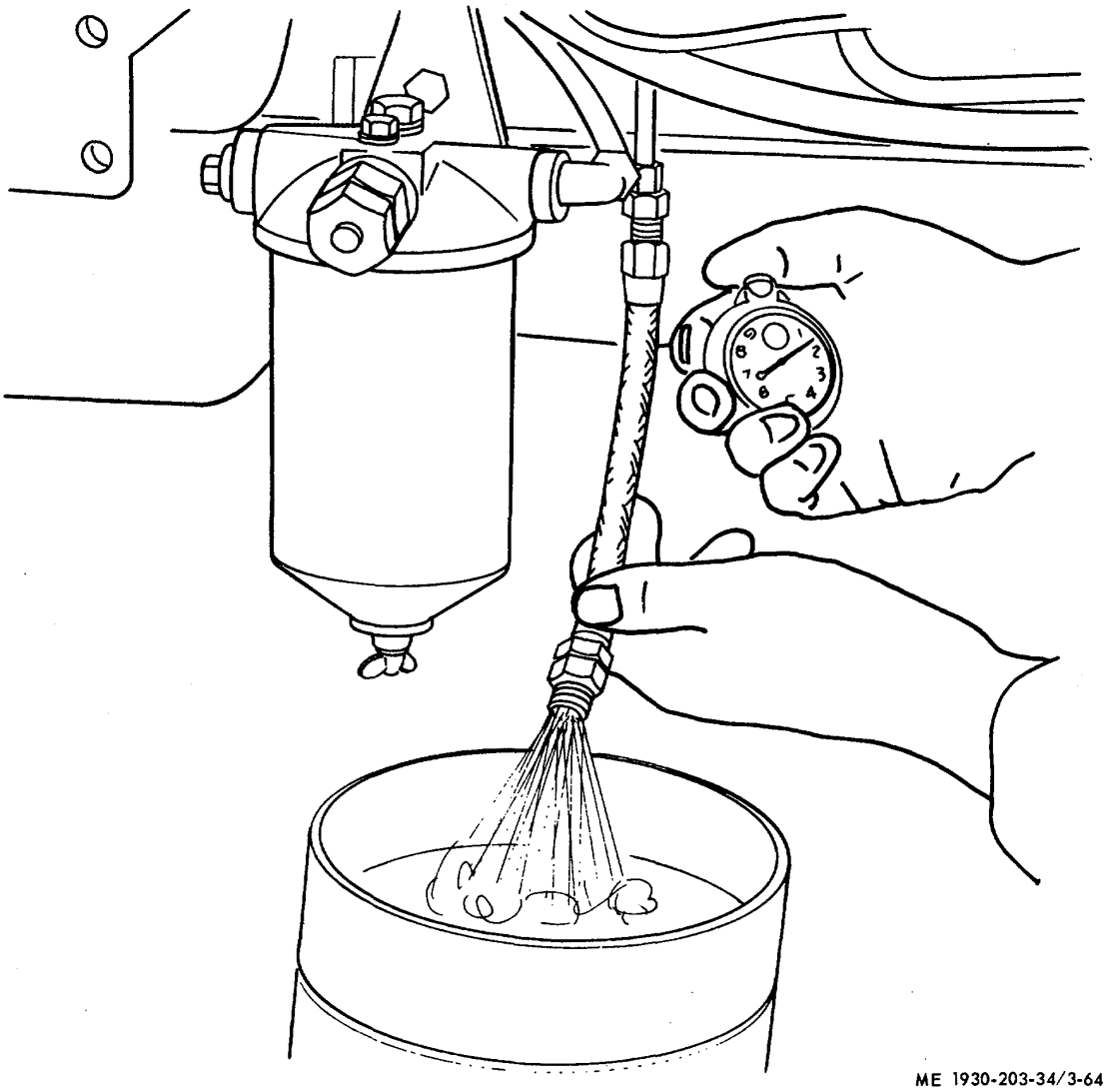


Figure 3-64. Measuring fuel flow from fuel return manifold

3-21. Air Inlet Housing

a. Description. The air inlet housing is mounted on the blower assembly and provides a passage for air from the air cleaners to the blowers. Air enters the air inlet housing through the air cleaners and passes through a fine mesh screen to the blower assembly. Two damper type valves are installed in the outlet openings of the housing on a common shaft connected to a lever mounted on the outside of the housing. Pulling upon the lever moves the damper valves up to a position that blocks all flow of air to the engine preventing further combustion, this acting as an emergency shutdown device,

b. Removal.

(1) Remove air cleaners from air inlet housing (TM 55-1930-203-20). Lift out air cleaner mounting tubes (2, fig. 3-65).

(2) Disconnect engine starting aid tube from nozzle assembly on air inlet housing and remove nozzle assembly (para 3-14).

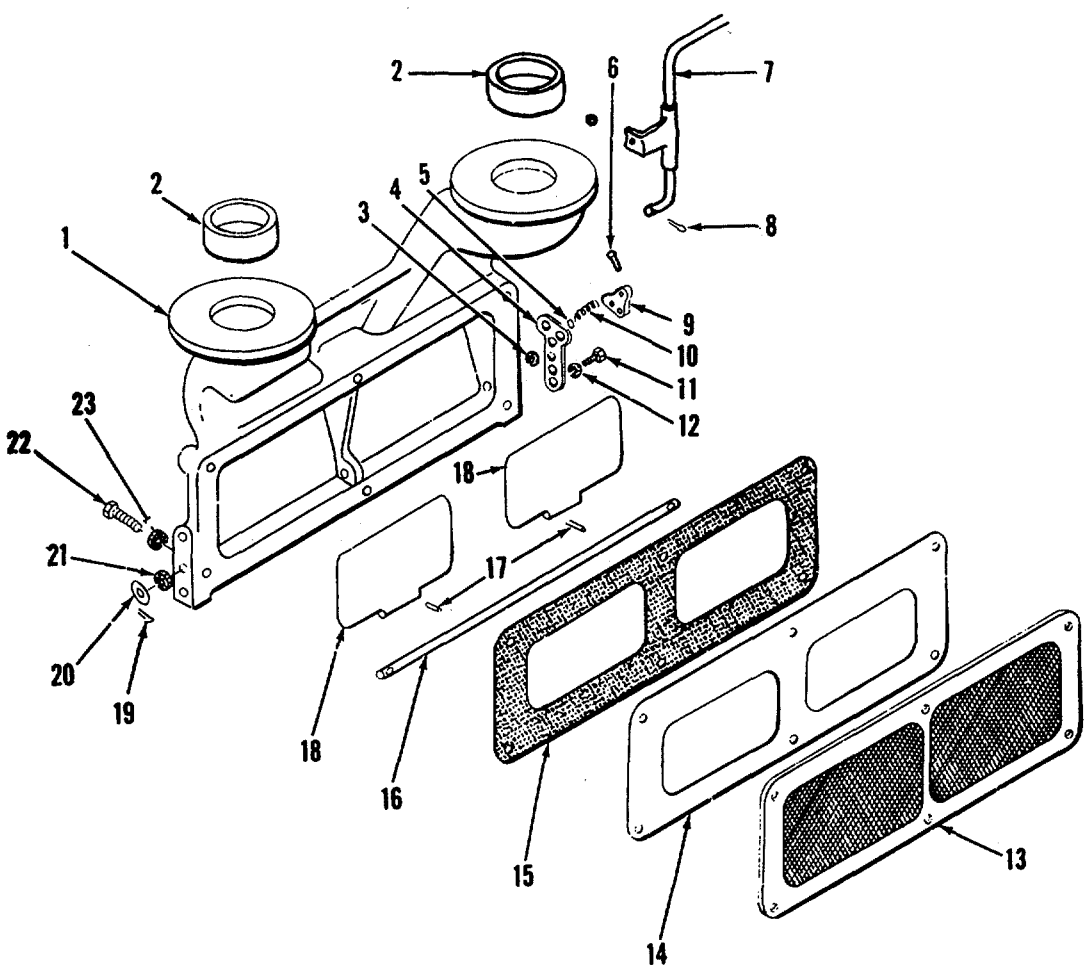
(3) Remove bolts (22) and lockwashers (23) securing housing (1) to blower and lift off housing.

(4) Remove gasket (15), striker plate (14), and screen (13).

c. Disassembly.

(1) Remove cotter pin (8, fig. 3-65) and remove emergency stop lever (7).

(2) Remove cotter pin (19), washer (20), and felt packing (2 1) from end of valve shaft (16).
(3) Knock out pins (17) securing shutdown valves (18) to valve shaft.
(4) Knock out pin 16) and remove valve lever (9), ball bearing (5), and spring (10).
(5) Remove two bolts (11), and lockwashers (12). Remove lock plate (4) and felt packing (3).
(6) Withdraw valve shaft (16) from air inlet housing (1) and remove shutdown valves (18).



1 Air inlet housing
2 Air cleaner mtg tube
3 Packing, felt
4 Lock plate
5 Ball bearing
6 Pin, valve lever
7 Emergency stop lever
8 Cotter pin
9 Valve lever
10 Spring
11 Bolt, machine
12 Lockwasher
13 Screen
14 Striker plate
15 Gasket, striker plate
16 Valve shaft
17 Pin
18 Valve, shutdown
19 Cotter pin
20 Washer, flat
21 Packing, felt
22 Bolt, housing mtg
23 Lockwasher

Figure 3-65. Air inlet housing.

d. Cleaning, Inspection and Repair.

(1) Clean all parts except gasket (15, fig. 3-65) and screen (13) in dry-cleaning solvent, Federal Specification P-D-680, and blow dry with compressed air. Remove particles lodged in screen (13) carefully, to avoid widening mesh.

(2) Inspect to see that screen is not pulling away from frame. Replace a damaged or defective screen.

(3) Inspect to see that striker plate (14) and finished face of valves (18) are perfectly flat. Replace a damaged striker plate or valve.

(4) Replace striker plate gasket (15).

(5) Replace valve shaft felt packings (3 and 21).

(6) Check spring (10) for breaks or distortion. Examine ball bearing for roundness. Replace a defective spring or ball bearing.

(7) Inspect housing (1) for cracks or other damage, especially around inlet and outlet flanges. Replace a defective housing.

(8) Inspect air cleaner mounting tubes (2) for being bent, cracked, or warped. Replace defective tubes.

e. Reassembly.

(1) Reassemble air inlet housing in reverse order of disassembly.

(2) Place a steel straightedge lengthwise on finished face of housing flange and close valves (18, fig. 3-65) against straightedge. The finished pads at each end of valves must be flush against straightedge when straightedge is moved from top to bottom of housing flange.

(3) Turn straightedge crosswise on housing flange and move straightedge from end to end on housing. The upper and lower finished pads of valves must be flush against straightedge throughout length of valves.

(4) If valves are not flush against straightedge freely or close completely, disassemble air inlet housing and replace the shutdown mechanism.

f. Installation. Install air inlet housing on blower in reverse order of removal. Tighten bolts (22, fig 3-65) to a torque of 17 to 20 foot-pounds.

3-22. Blower Assembly

a. Description. Each diesel engine on the LARC is equipped with a blower which supplies fresh air needed for combustion and scavenging. Its operation is similar to that of a gear-type oil pump. Two hollow three lobe rotors revolve with very close clearances within a housing bolted to the cylinder block. To provide continuous and uniform displacement of air, rotor lobes are made with a helical (spiral) form. Each rotor is supported in the doweled end plates of the blower housing by a roller bearing at the front end and a two-row preloaded radial and thrust ball bearing at the gear end. The rotors turn at approximately twice engine speed and are driven by the blower drive shaft which is coupled to the upper rotor timing gear by means of a flexible drive hub.

b. General The blower may be inspected for any of the following conditions without being removed from the engine. However, the air cleaners and air inlet housing must be removed (para 3-21).

(1) *Dirt or chips.* Dirt or chips drawn through the blower will make deep scratches in the rotors and housing and throw up burrs around such abrasions. With the engine stopped, examine the rotors for such abrasions. If the burrs cause interference between rotor or between rotor and housing, replace blower assembly.

(2) *Leaking oil seal* The presence of oil on the blower rotors or inside surfaces of the housing usually indicates a leaking oil seal. To check for this condition, run the engine at low speed and direct a light into the compartment at the end plates and oil seals. A thin film of oil radiating away from the seal indicates a defective seal. If seal is leaking, replace blower assembly.

WARNING

When inspecting a blower with the engine running, keep hands and clothing away from moving parts of the blower. Run engines at low speeds only.

(3) *Worn blower drive.* A worn blower drive, usually indicated by a rattling noise inside the blower, may be detected by grasping the top rotor (with the engine stopped) and rotating it by hand. Rotors should have only from 3/8 to 5/8 inch movement and should spring back at least I/4 inch when released. If the rotors do not move or move too freely, the blower drive coupling should be removed, inspected, and replaced if necessary (para 3-23).

(4) *Loose rotor shafts or damaged bearings.* With the engine stopped, inspect the blower for signs of rubbing or scoring. Rubbing and scoring of blower parts usually indicate a loose rotor shaft or damaged bearing. A loose rotor shaft will normally cause rubbing between the rotors and the end plates. A defective bearing will cause rubbing between rotor lobes or between rotor and housing, generally at the end where the bearings have failed. If rotor shafts are loose or bearing is defective, replace blower assembly.

(5) *Timing gear backlash.* Excessive backlash in timing gears will result in rotor lobes rubbing throughout their entire length. If rotor lobes are rubbing, replace blower assembly.

c. Removal

(1) Remove air cleaners (TM 55-1930-203-20).

(2) Remove air inlet housing (para 3-21).

(3) Remove water pump (para 3-17).

(4) Remove governor assembly (para 3-13).

(5) Remove fuel pump (para 3-19).

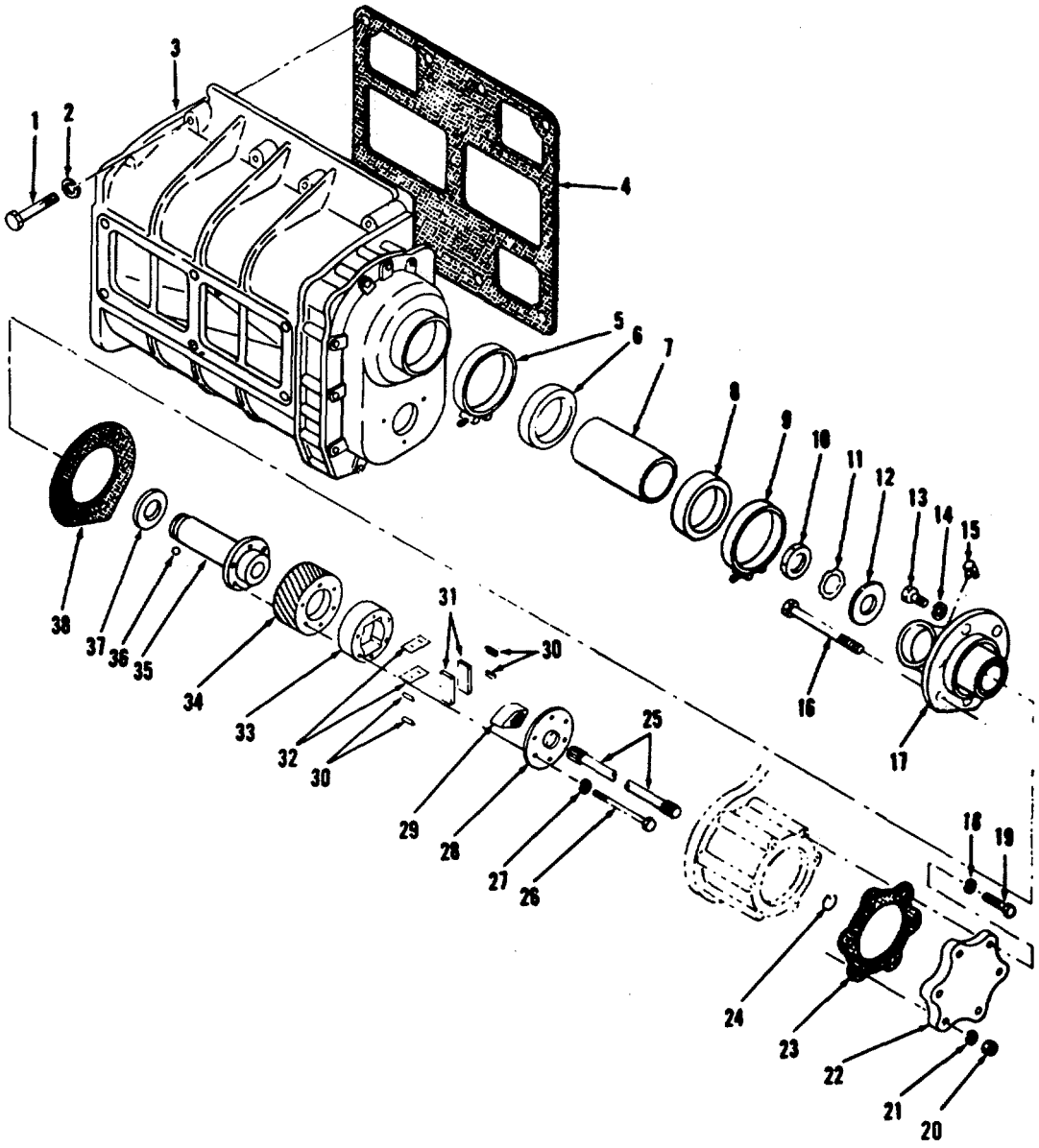
(6) Remove bolts (16 and 19, fig. 3-66), nuts (20), and lockwashers (18 and 21) securing cover (22) to flywheel housing. Remove cover and gasket (23).

(7) Remove retaining ring (24) and pull blower drive shaft (25) straight out from drive assembly.

(8) On blower assemblies, part No. 5120996 and 5120993, loosen clamp (51 on seal (6). On blower assemblies, part No. 5114472 and 5114469, remove bolts securing drive cover and gasket to blower.

(9) Support blower assembly (3) and remove mounting bolts (1) and lockwashers (2) at top and bottom of blower housing.

(10) Slide blower assembly away from flywheel housing and pull blower assembly away from cylinder block. Remove mounting gasket (4)



1 Bolt, machine, 7/16 x 2 in.
2 Lockwasher, 1/16 in.
3 Blower assembly
4 Gasket, blower mtg
5 Clamp
6 Seal, blower drive tube
7 Blower, drive cover tube.
8 Seal, blower drive cover
9 Clamp
10 Nut, blower drive gear hub
11 Washer, key
12 Washer, thrust
13 Bolt, machine, 3/8 x 7/8 in.
14 Lockwasher, 7/8 in.
15 Elbow, oil pipe
16 Bolt, machine, 38 x 5 in.
17 Drive gear hub support
18 Lockwasher, 7/8 in.
19 Bolt, machine, 3/8 x 7/8 in.
20 Nut, 3 / 8 in.
21 Lockwasher, 3/8 in.
22 Cover
23 Gasket, cover
24 Retaining ring
25 Blower drive shaft
26 Bolt, blower drive coupling
27 Lockwasher, 516 in.
28 Drive coupling retainer
29 Drive coupling cam
30 Spring seats
31 Spring pack
32 Spring end seat
33 Drive coupling support
34 Blower drive gear
35 Drive gear hub
36 Ball bearing
37 Thrust washer
38 Gasket, hub support

Figure 3-66. Blower assembly and drive assembly

d. Disassembly.

(1) Remove bolts (1, fig. 3-67) and lockwashers 12); pull front end plate cover (3) off dowel pins of front end plate (12). Remove gasket (4).

(2) Remove bolts (33) and lockwashers (32); pull rear end plate cover (31) off dowel pins of rear end plate 119). Remove gasket (30).

(3) Place a clean cloth between upper blower rotor (17) and lower blower rotor (18) to lock rotors in position. Remove capscrew (5) from shaft coupling (6). Pull coupling from shaft by threading a I / 2-20 inch bolt into tapped hole in coupling.

(4) Remove capscrews (29), lockwashers (28), and washers (27) attaching drive hub plates 126) to rear face of upper rotor gear (23). Remove drive hub plates, drive gear hub (34), and spacers (25) from upper rotor gear. Separate drive gear hub from drive hub plates by removing capscrews (37), lockwashers (36), and washers (35).

(5) Remove bolts (38), lockwashers (39), washer (24), and coupling disk (40) from center of rotor gears.

(6) Remove upper rotor gear (23) and lower rotor gear (411, using pullers, part No. J6270-1.

CAUTION

Be sure to pull the two rotor gears from rotor shafts at the same time.

(7) Remove rotor gear shims (20) from rotor shafts.

CAUTION

Note the number and thickness of shims on each rotor shaft. Reinstall accordingly when reassembling.

(8) Remove capscrews (22) and lockwashers (21), and lift rear bearing retainer (42) off rear end plate (19). Repeat procedure to remove other rear bearing retainer.

(9) Remove capscrews (7) and lockwashers (8), and lift front bearing retainer (9) off front end plate (12). Repeat procedure for other front bearing retainer.

(10) Remove screws (11) retaining front end plate (12) to blower housing (14), and loosen screws (44) securing rear end plate (19) to blower housing (approximately three turns).

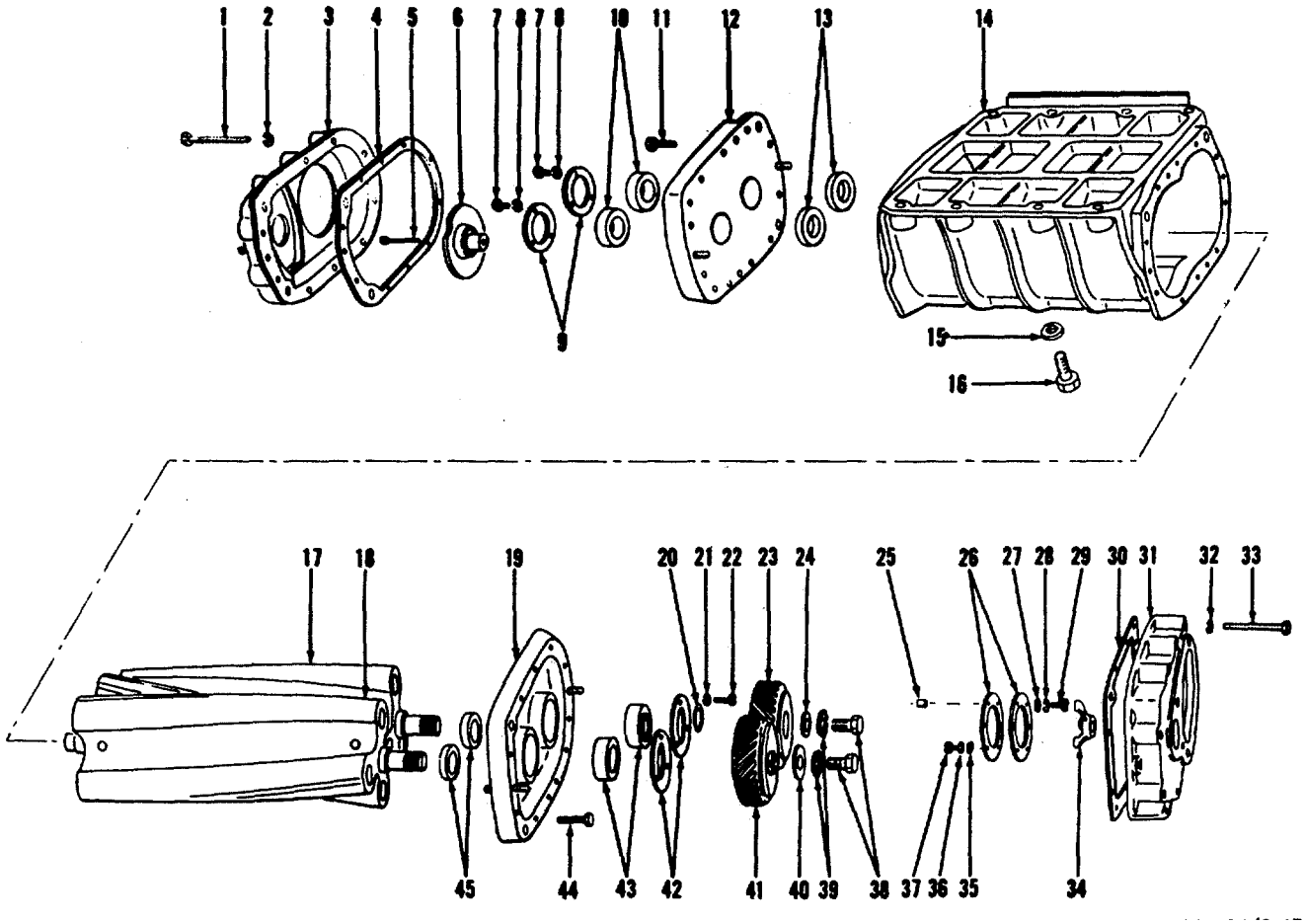
(11) Back out center screws of gear end plate pullers far enough to permit flange on each puller to lay flat on face of rear end plate. Align holes in each puller flange with tapped holes in end plate and secure pullers to end plate with six 5/16 inch bolts. Turn tow puller screws uniformly clockwise (fig. 3-68). Rotor shafts will be pushed from rear and plate. Front end plate, with rotor shafts still assembled in front rotor bearings (10, fig. 3-67) will be pushed away from blower housing (14).

(12) Remove pullers from rear end plate (19) and remove two screws (44). Pull rear end plate from blower housing (14) by hand.

(13) Remove rotor shafts from front end plate (12) in the same manner as described in step (10) above.

(14) Support outer face of front end plate (12) on wood blocks on bed of arbor press. Insert long end of bearing and seal installer, part No. J6270-3, through front end plate oil seal (13) and front rotor bearing (10). Press bearing and seal from end plate. Repeat procedure for other bearing and seal.

(15) Support outer face of rear end plate (19) on wood blocks on bed of arbor press. Insert long end of bearing and seal installer, part No. J6270-3, through rear end plate oil seal (45) and rear rotor bearing (43). Press bearing and seal from end plate. Repeat procedure for other bearing seal.



1 Bolt, machine, 5/16 x 3½ in.
2 Lockwasher, 5/16 in.
3 Front end plate cover
4 Gasket, front end plate
5 Capscrew, 5/16 x I½ in.
6 Shaft coupling
7 Capscrew I / 4 x 3 / 4 in.
8 Lockwasher, 1/ 4 in.
9 Front bearing retainers
10 Front rotor bearings
11 Screw, 5/16 x 1½ in.
12 Front end plate
13 Front end plate oil seals
14 Blower housing
15 Washer, plain, 7/16in.
16 Capscrew, 7/16 x 2in.
I7 Upper blower rotor
18 Lower blower rotor
19 Rear end plate
20 Shim
21 Lockwasher, I/4in.
22 Capscrew, I/4 x 3/4in.
23 Upper rotor gear
24 Washer, 1/4 in.
25 Spacer
26 Drive hub plates
27 Washer, plain, 5/16 in.
28 Lockwasher, 5/16 in.
29 Capscrew, plate-to-hub
30 Gasket, rear end plate
31 Rear end plate cover
32 Lockwasher, 5/16 in.
33 Bolt, machine, 5/16 x 3½in.
34 Drive gear hub
35 Washer, plain, 5/ 6in.
36 Lockwasher, 5/16in.
37 Capscrew, plate-to-gear
38 Bolts, 1/4 x 1¼in.
39 Lockwashers, 1/4in.
40 Coupling disk
41 Lower rotor gear
42 Rear bearing retainers
43 Rear rotor bearings
44 Screw, 5/16 x 1½/in.
45 Rear end plate oil seals

Figure 3-67. Blower assembly

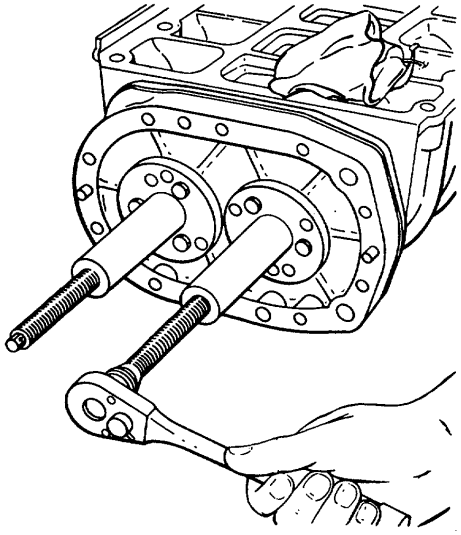


Figure 3-68. Removing blower end plate with gear end plate puller, part No. J6270-1

e. Cleaning; Inspection, and Repair.

(1) Clean all parts thoroughly in dry-cleaning solvent, Federal Specification P-D-680, and dry with compressed air

(2) Inspect blower housing for warps, cracks, burrs, or scoring. The inside of housing must be smooth for efficient operation of blower. Check cylinder block flange and end plate flanges to assure they are smooth and flat. Remove rough spots or burrs with fine mill file or scraper. Replace housing if badly scored, warped, or cracked.

(3) Inspect blower rotor lobes and sealing rib for burrs or scoring. If slightly scored or burred; rotor may be dressed down with crocus cloth, Federal Specification P-C-458. Replace badly scored rotors.

(4) Inspect rotor shaft serrations and bearing surfaces for burrs or other damage. Replace rotors if shafts are damaged.

(5) Check races and balls or rollers of bearings for corrosion or pitting. Apply light engine oil, Military Specification MIL-L-2104, to bearings and revolve outer race slowly while holding inner race from turning. Bearings should roll freely on races. Replace bearings if rough spots are present.

(6) Check blower gears for wear or damage. If gears are damaged or worn so that backlash exceeds 0.004 inch; replace gears.

NOTE

Gears should be replaced as a set.

(7) Inspect oil seals for score marks and signs of leaking. Replace. seals if damaged.

(8) Inspect end plates for cracks, especially around bearing bosses and bearing retainer holes. Flat faces of end plates must be smooth and unscored. Bearings should fit counterbores in plates with slight press fit. Remove all burrs or minor score marks by filing or scraping carefully. Replace plates that are cracked, badly scored, distorted, or have worn bearing counterbores.

(9) Check serrations in drive gear hub for damage. Replace hub if necessary.

f. Reassembly.

(1) Support front end plate (1 2, fig. 3-67) with finished surface facing up, on wood blocks on bed of arbor press. Start front end plate oil seals (13) straight into bore in front end plate with sealing edge facing down (toward bearing bore). Insert short end of bearing and seal installer, part No. J6270-3, in seal and press until flange of installer contacts front end plate.

(2) Support rear end plate (19) with finished surface facing up, on wood blocks on bed of arbor press. Start rear end plate oil seals (45) straight into bore in rear end plate with sealing edge facing down (toward bearing bore). Insert short end of bearing and seal installer, part No. J6270-3, in seal and press until flange of installer contacts rear end plate.

(3) Install blower front end plate (12) on blower housing (]4), making sure the mark TOP on outer ribbed side of end plate is at top of housing. Tap dowels and end plate lightly with rawhide hammer to fit end plate to housing.

(4) Insert screws (I 1) through front end plate (12) and thread into blower housing (14). Tighten screws securely. Do not use lockwashers with screws. Check for 3/8 inch dowel projection from outer face of front end plate to assure proper alignment.

(5) Install a shaft pilot, part No. J6270-5, over short, nonsplined end of each rotor shaft. With upper and lower blower rotors (17 and 18) in mesh and omitted serrations on the drive ends of rotor shafts toward top, slip rotors into blower housing (14) and short shaft ends into place in front end plate. Remove shaft pilots.

CAUTION

The upper rotor and gear must have right-hand helices and the lower rotor and gear must have left-hand helices.

(6) Install a shaft pilot over serrated end of each rotor shaft and mount rear end plate (19) on blower housing (14). Tap dowels and end plate lightly with rawhide hammer to fit end plate to housing.

(7) Insert screws (44) through rear end plate and thread into blower housing (14). Tighten

screws securely and check for 3/8 inch dowel projection from outer face of end plate. Remove shaft pilots.

(8) Start front rotor bearings (10) onto rotor shafts with numbered faces of bearings facing out from blower housing (14). Tap front rotor bearing into front end plate (12), using gear and roller bearing installer, part No. J6270-6 (fig. 3-69).

(9) Attach front bearing retainers (9, fig. 3-67) with capscrews (7) and lockwashers (8).tighten capscrews to a torque of 7 to 9 foot-pounds.

(10) Insert splined end of shaft coupling (16) into lower rotor shaft. Install capscrew (5) and draw shaft coupling tightly against bearing. Wedge a clean cloth between rotors and tighten capscrew to a torque of 18 foot-pounds with an Allen wrench.

(11) Attach a new gasket (4) to front endplate cover (3). Install end plate cover over dowel pins in end plate and secure with bolts (1) and lockwashers (2). Tighten bolts to a torque of 13 to 17 foot-pounds

(12) Reverse position of blower, resting it on front end cover on wood blocks. Start rear rotor bearings (43) onto rotor shaft with numbered face of bearings facing away from end plate. Tap rear rotor bearings into rear end plate (19), with gear and ball bearing installer, part No. J6270-7.

(13) Attach rear bearing retainers (42) with capscrews (22) and lockwashers (21) . Tightencapscrews securely.

(14) Install shims (20) on rotor shafts. Replace same number and thickness of shims as were removed in disassembly.

(15) Start upper and lower rotor gears (23 and 41) onto rotor shafts with omitted serrations of gears in alignment with omitted serrations of. A center punchmark in end of each rotor shaft at omitted serration will assist in aligning gears on shafts.

CAUTION

A right-hand helix gear must be used on right-hand helix rotor, and a left-hand helix gear must be used on a left-hand helix rotor.

(16) Use bolts (38) and lockwashers (39) to hold upper and lower rotor gears (23 and 41) onto upper and lower shafts. Turn bolts into ends of shafts uniformly, drawing gears into position tight against bearing races. Remove bolts and lockwashers.

(17) Place lockwasher (39) next to head of bolt (38). Slide washer (24) on bolt (38) to be used for upper rotor gear (23). Install bolt in gear, making certain that lugs on washer engage slots in gear hub and that ear lockwasher (39) will engage slot in washer (24). Tighten bolt to a torque of 55 to 60 foot-pounds.

(18) To lock lower rotor gear (41) install lockwasher (39) and coupling disk (40) on bolt (38). Install bolt in lower rotor gear (41) so lugs of disk engage slot in hub of gear and lockwasher ear engages in slot in coupling disk. Tighten bolt to a torque of 55 to 60 foot-pounds.

(19) Position upper and lower blower rotors (17 and 18) in blower housing (14) with a slight clearance between lobes. This clearance may be varied by moving one of the helical gears in or out the rotor shaft, by adding or removing shims (20) between gear hub and bearing. If the upper rotor gear is moved out. the upper rotor will turn counterclockwise when viewed from the gear end. If the lower rotor gear is moved out, the lower rotor will turn clockwise. This positioning of the rotor gear to obtain proper clearance between the rotor lobes is known as blower timing.

(20) Check rotor lobe clearance with 1/2 inch feeler ribbons. Measure from both inlet and outlet sides of blower, 1 inch from governor end of blower, at center of blower, and 1 inch from drive end of blower. Insert feeler ribbon through air outlet side of blower and between the leading edge of the lower rotor and the trailing edge of the upper rotor. Time rotors to have from 0.002-inch minimum to 0.006-inch maximum clearance, indicated by the CC dimension (fig. 3-70). Then check clearance between leading edge of upper rotor and trailing edge of lower rotor; minimum clearance is 0.014 inch, indicated by the C dimension.

(21) Having determined the amount one rotor must be revolved to obtain the proper clearance, add shims (20, fig. 3-67) back of either and upper or lower rotor gears (fig. 3-71). To do this, remove both rotor gears from the rotor shafts. Placing a 0.003-inch shim in back of a rotor gear will revolve the rotor 0.001 inch. Install required thickness of shims back of proper gear and draw gears tight into place. Recheck clearances between rotor lobes. After correct clearances are obtained, lock rotor gears in place as directed in (16) and (17) above.

(22) Insert feeler gage between end plates and rotors and check minimum clearance at indicated points A and B, on side view of blower (fig. 3-70). Minimum clearance is 0.007 inch at A and 0.014 inch at B. This operation must be performed at the ends of each rotor lobe, making 12 measures in all.

(23) Check clearance between each rotor lobe and blower housing at both inlet and outlet side, at points D and E. Minimum clearance is 0.016 inch at D and 0.004 inch at E (fig. 3-70).

(24) Using three capscrews (37, fig. 3-67), lockwashers (36), and washers (35), assemble drive hub plates (26) to drive gear hub (34). Using three capscrews (29), lockwashers (28), and washers (27), attach drive hub plates to outer face

of upper rotor gear (23), installing three spacers (25) between plate and face of gear.

(25) Affix a new gasket (30) to blower rear end plate cover (31). Start cover over dowel pins in rear end plate (19) and push it tightly against end plate. Install bolts (33) and lockwashers (32) and tighten to a torque of 13 to 17 foot-pounds.

CAUTION

Before installing end plate cover (31,fig. 3-67), oil the rotor bearings and gears with clean engine oil, Military Specification MIL-L-2104. If the bearings and gears are not lubricated, they could be damaged before oil reaches the blower through the engine lubrication system.

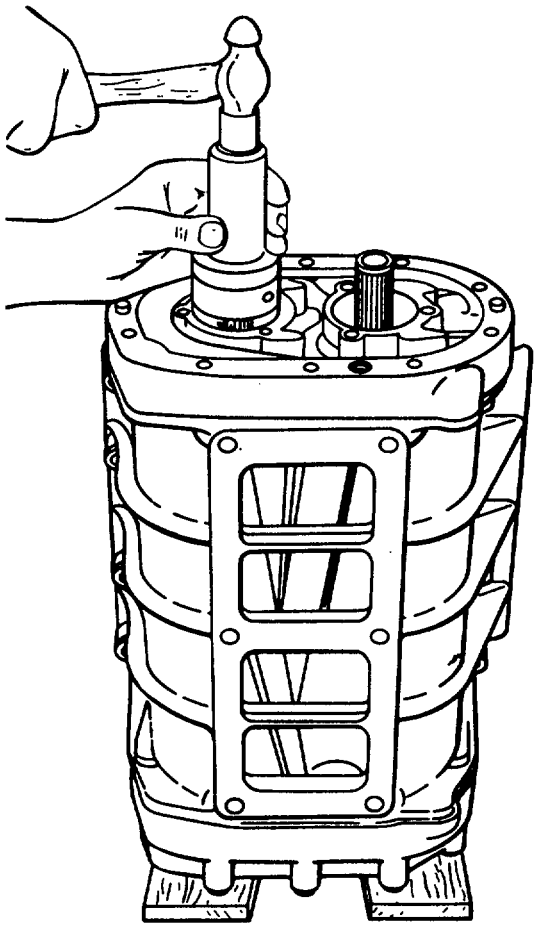
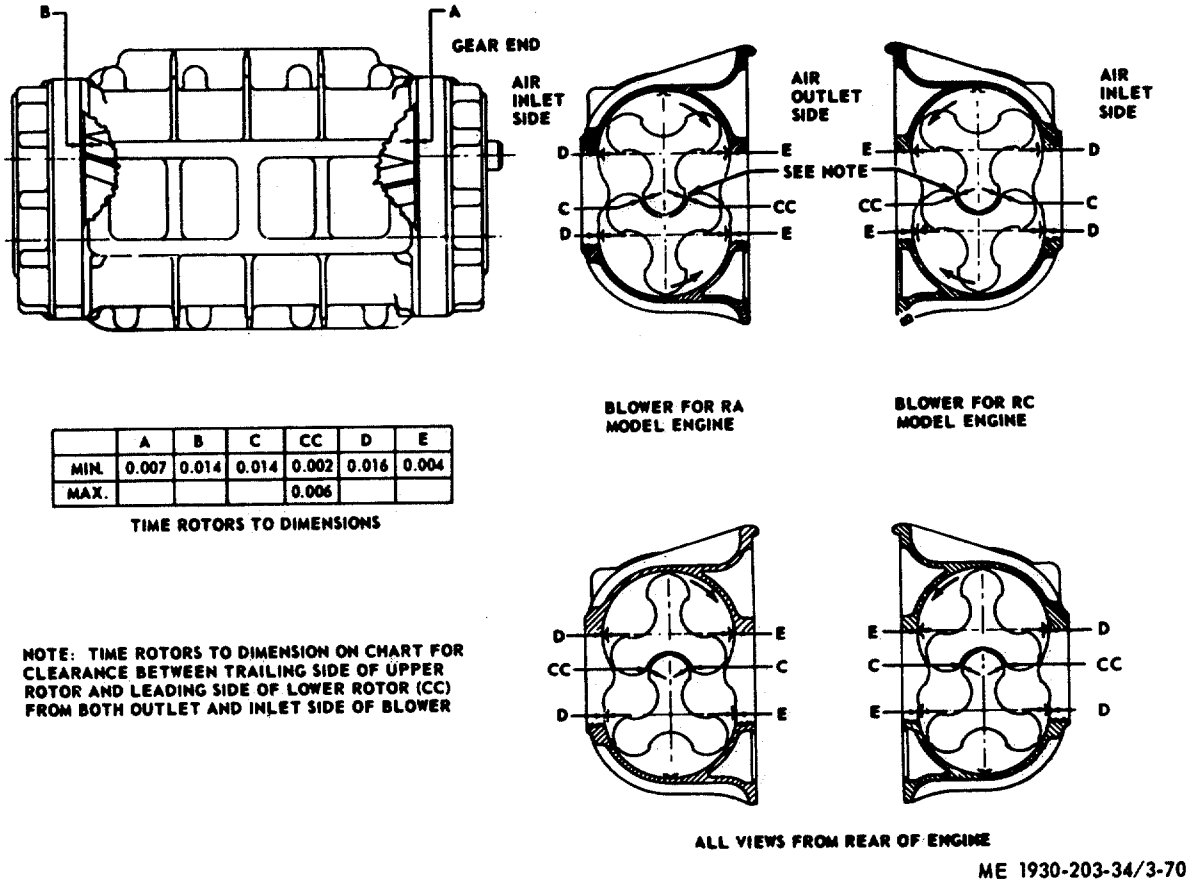


Figure 3-69. Installing roller bearings in front end plate, using gear and roller bearing installer, part No. J6270-6.

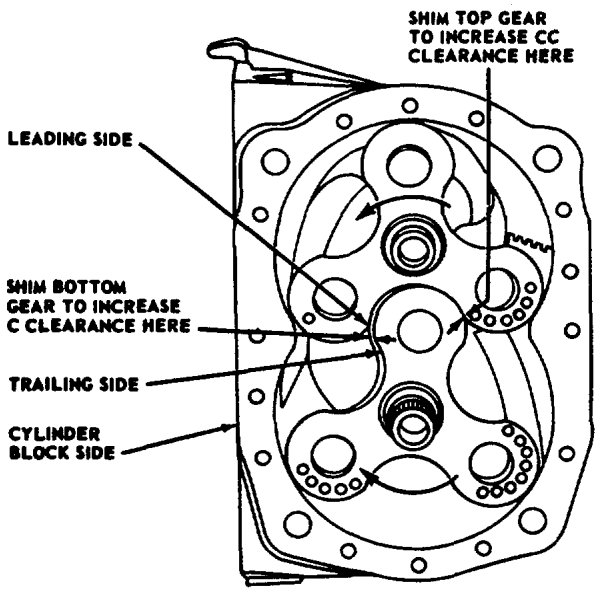


	A	B	C	CC	D	E
MIN.	0.007	0.014	0.014	0.002	0.016	0.004
MAX.				0.006		

TIME ROTORS TO DIMENSIONS

NOTE: TIME ROTORS TO DIMENSION ON CHART FOR CLEARANCE BETWEEN TRAILING SIDE OF UPPER ROTOR AND LEADING SIDE OF LOWER ROTOR (CC) FROM BOTH OUTLET AND INLET SIDE OF BLOWER

Figure 3-70. Minimum blower clearances.



SERIES 71 - VIEW FROM GEAR END

Figure 3-71. Proper location of shims for correct rotor lobe clearances

g. Installation.

(1) Before attaching blower assembly to engine, examine inside of blower assembly for foreign material. Turn rotors by hand, checking for smooth turning. If rotors turn hard, rub, or bind, report condition to depot maintenance personnel.

(2) Install a new gasket (4, fig. 3-66) on cylinder block mounting base using a nonhardening gasket cement on cylinder block side of gasket only.

(3) Slide a new seal (6) with clamp (5) over end of cover tube (7).

(4) Position blower assembly in place on cylinder block, being careful not to disturb mounting gasket, and install mounting bolts (1) and lockwashers (2). Tighten bolts to a torque of 55 to 60 foot-pounds.

(5) On blower assemblies, part No. 5120996 and 5120993, slide seal (6) and clamp (5) against blower and tighten clamp. On blower assemblies, part No. 5114472 and 5114469, secure drive cover and gasket to blower with bolts.

(6) Install blower drive shaft (25) from flywheel housing end of engine by pushing the plain end (end without square hole) of shaft through blower drive coupling. Mate shaft with splines in rotor gear hub.

NOTE

It may be necessary to revolve rotors slightly to engage splines of drive shaft with splines of gear hub.

(7) Secure shaft with retaining ring (24).

(8) Install gasket (23) and cover (22) or flywheel housing with bolts (16) and (19), nuts (20), and lockwashers (18 and 21).

(9) Install fuel pump (para 3-19).

(10) Install governor assembly (para 3-13).

(11) Install water pump (para 3-17).

(12) Install air inlet housing (para 3-21).

(13) Install air cleaners (TM 55-1930-203-20).

3-23. Blower Drive Assembly

a. Description. The blower drive assembly is driven from the engine gear train and drives the air intake blower. The governor, water pump, and fuel pump are also driven from the drive assembly through gearing on the blower. The blower drive is cushioned by a flexible coupling attached to the blower drive gear. This coupling is formed by an elliptical cam driven by two bundles of leaf springs riding on four semi-cylindrical supports. The coupling prevents the transfer of minor engine torque fluctuations to the blower rotors, assuring uniform rotation and a smooth flow of scavenging air.

b. Removal.

(1) Remove blower assembly (para 3-22).

(2) Loosen clamp (9. fig. 3-66) on seal (8) and withdraw cover tube (71 with clamp and seal.

(3) Disconnect blower drive oil line from elbow (15) on blower drive gear hub support (17).

(4) Straighten ears on washer (11) and loosen drive gear hub nut (10).

(5) Remove bolts (13) and lockwashers (14) securing blower drive gear hub support (17) to cylinder block end plate.

(6) Tap support lightly and withdraw drive assembly from cylinder block end plate. Remove gasket (38).

c. Disassembly.

(1) Remove bolts (26, fig. 3-66) and lockwashers (27), and remove drive coupling retainer (28) and support (33).

(2) Remove drive gear hub nut (10), washer (11), ball bearing (36), and thrust washer (12).

(3) Withdraw drive gear hub (35) with drive gear (34) from drive gear hub support (17).

(4) Remove thrust washer (37) from bearing on support (17).

(5) Press drive gear hub (35) out of drive gear (34).

(6) Remove oil pipe elbow (15) from support. (7) Press drive coupling cam (29), drive coupling spring packs (31), spring end seats (32), and spring seats (30) from support (33).

d. Cleaning, Inspection and Repair.

(1) Clean all metal parts in clean fuel oil and

blow dry with compressed air. Use a small wire to remove accumulations of dirt from oil passages.

(2) Check clearance between bearings in support (17, fig. 3-66) and hub (35). Clearance should not exceed 0.0050 inch. If clearance exceeds maximum limit of 0.0050 inch, press out bearings from support and press in new bearings. Bore inside Diameter of bearings to 1.6260 to 1.6265 inches after installation in support and check that clearance between new bearings and hub is 0.0010 to 0.0025 inch.

NOTE

On supports, part No. 5122528, install outer bearing with end flush to 0.030 inch below surface of face of support. Bearing on flywheel housing end of support should protrude 0.045 to 0.055 inch above surface of face to facilitate installation of blower drive thrust washer (37). Replacement bearings must withstand a 2,000-pound end load without turning and bearing bores must be square with the inner and outer faces of the support within 0.001-inch total indicator reading.

(3) Inspect thrust washers (12 and 37) for being scored or damaged. Replace scored or damaged thrust washers.

(4) Inspect blower drive coupling support (33), cam (29), and spring packs (31) for cracks and obvious defects. Replace defective parts.

(5) Inspect blower drive shaft (25) for being bent or having damaged serrations. Replace a defective drive shaft.

(6) Inspect blower drive gear (34) for scored or pitted gear teeth. Replace gear if damaged.

e. Reassembly.

(1) Press drive gear hub (35, fig. 3-66) into drive gear (34).

(2) Lubricate drive gear hub (35), bearings and thrust surfaces of support (17), and thrust washer (37) with clean engine oil.

(3) Place thrust washer (37) on protruding bearing on flywheel housing side of support and insert blower drive gear hub and gear assembly in support.

(4) Place ball bearing (36) on gear hub and slide thrust washer (12) with tapered face of washer toward threads on hub, into position over ball bearing (36).

(5) Place washer (11) and nut (10) on hub. Tighten nut finger tight.

(6) Install two bolts in threaded holes of drive gear hub (35). Place a suitable holding bar across bolts to keep hub from turning and tighten nut (10) to a torque 50 to 60 foot-pounds. Bend ears of washer (11) against flats on nut and remove the holding bar and two bolts.

(7) Assemble drive coupling as follows:

(a) Place drive coupling support (33) on two blocks of wood.

(b) Place spring end seats (32) on spring packs (31).

(c) Place spring seats (30) in coupling support (33).

(d) Lubricate spring packs (31) with clean engine oil and insert spring packs in coupling support.

(e) Using a spreader to spread spring packs apart, insert cam (29) in coupling support.

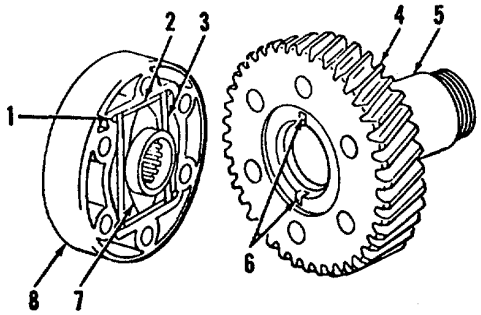
(8) Place coupling support against drive gear with blower drive shaft ring groove in cam (29) facing away from drive gear.

(9) Place coupling retainer (28) against coupling support with flared edge away from support.

(10) Revolve coupling assembly on hub flange until cam lobes are in line with oil grooves (6, fig. 3-72).

(11) Secure gear, coupling support, and retainer to drive gear hub with lockwashers (27, fig. 3-66) and bolts (26). Tighten bolts to a torque of 20 to 25 foot-pounds.

(12) Install elbow (15) on support.



1 Spring seats
2 Spring end seat
3 Spring pack
4 Blower drive gear
5 Drive gear hub
6 Oil grooves
7 Drive coupling cam
8 Drive coupling support

Figure 3-72. Blower drive gear and coupling

f. Installation.

(1) Place gasket (38, fig. 3-66) on mounting face of hub support.

(2) Attach blower drive gear and support assembly to cylinder block rear end plate with two bolts (13) and lockwashers (14).

(3) Connect blower drive gear oil line to elbow (15).

(4) Place cover tube (7) against support (17) and install seal (8) and clamp (9).

(5) Install blower (para 3-22).

Section VII. OIL PAN, OIL PUMP INLET SCREENS, LUBRICATING OIL PUMP ASSEMBLY, AND OIL PRESSURE REGULATOR ASSEMBLY

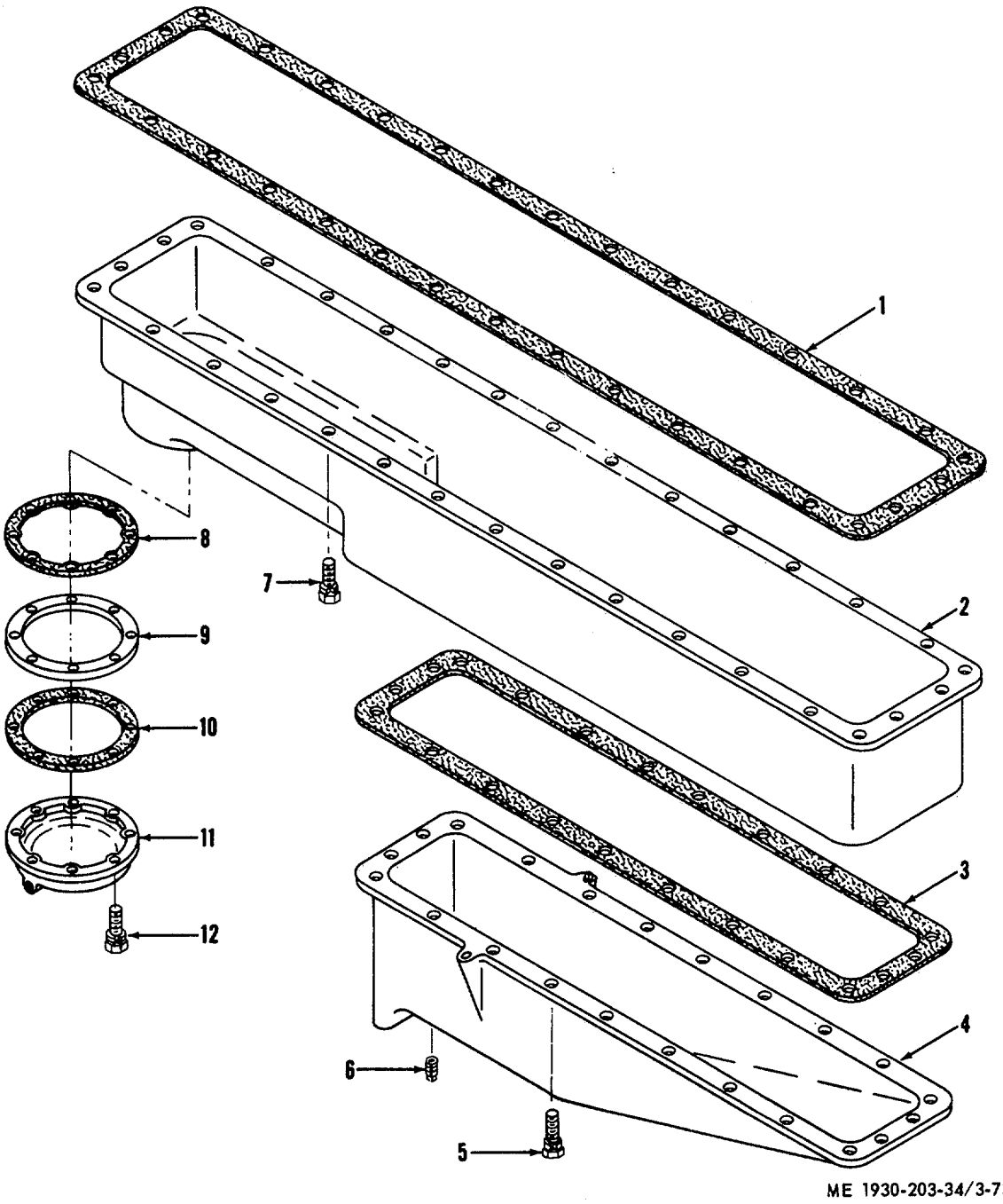
3-24. Oil Pan

a. Removal.

(1) Remove oil dipstick and disconnect oil dipstick guide from oil pan.
(2) Remove pipe plug (6, fig. 3-73) and allow lubricating oil to drain into a suitable container.
(3) Remove oil temperature thermometer bulb (para 2-11) from oil pan cover (11).
(4) Remove bolts (5) and remove lower oil pan (4) and gasket (3).
(5) Remove bolts (12) and remove cover (11), gasket (10), spacer (9), and gasket (8).
(6) Remove bolts (7) and remove upper oil pan (2) and gasket (1).

b. Cleaning, Inspection and Repair.

(1) Using a wire brush, remove sludge accumulations from oil pans and cover. Wash oil pans and cover in clean fuel oil and wipe dry with a lint free cloth. Remove all trace of gasket from gasket surfaces with wire brush.
(2) Examine all parts for cracks or evidence of leakage. Replace defective parts.



1. Gasket, upper oil pan
2. Oil pan, upper
3. Gasket, lower oil pan
4. Oil pan, lower
5. Bolt, machine, 5/16 x 1 in.
6. Plug, pipe, oil pan drain
7. Bolt, machine, 5/16 x 1 in
8. Gasket, cover
9. Spacer, steel
10. Gasket
11. Cover, oil pan
12. Bolt, machine, 5/6 x 1 ¼ in

Figure 3-73. Oil pan.

c. Installation.

(1) Place new gasket (1, fig. 3-73) on upper oil pan (2). Secure upper oil pan and gasket to engine with bolts (7). Tighten bolts snugly and then starting at the center and working toward each end, tighten bolts to a torque of 10 to 12 foot-pounds.

(2) Place new gasket (3) on lower oil pan (4). Secure lower oil pan to upper oil pan with bolts (5). Tighten bolts as outlined in (1) above.

(3) Secure gasket (8) spacer (9), gasket (10), and cover (11) to upper oil pan with bolts (I2). Tighten bolts to a torque of 10 to 12 foot-pounds.

(4) Replace pipe plug (61 and tighten to a torque of 3S to 40 foot-pounds.

(5) Install oil temperature thermometer bulb in oil pan cover (para 2-11).

(6) Secure oil dipstick guide to oil pan and replace oil dipstick.

(7) Fill crankcase with lubricating oil in accordance with LO 55-1930-203-12.

3-25. Oil Pump Inlet Screens

a. Upper Oil Pan Screen Removal

(1) Remove oil temperature thermometer bulb (para 2-11) from oil pan cover (I l, fig. 3-73).

(2) Remove bolts (12) and remove cover (11), gasket (10), spacer (9), and gasket (8).

(3) Unlock pump screen retainer and remove screen from cover.

(4) Remove bolts and washers securing cover to brackets and remove cover.

b. Lower Oil Pan Screen Removal.

(1) Remove pipe plug (6, fig. 3-73) and drain engine crankcase into a suitable container.

(2) Remove bolts (5) and remove lower oil pan (4) and gasket (3).

(3) Unhook pump screen retainer and remove screen from cover.

(41 Remove bolts and washers securing cover to brackets and remove cover.

c. Cleaning, Inspection and Repair.

(1) Remove accumulations of sludge from screen using dry-cleaning solvent, Federal Specifications P-D-680. Swish screen through a bath of solvent to remove all particles in mesh.

(2) Blow screen dry with low-pressure, compressed air.

CAUTION

Do not use high-pressure air, which may widen the screen mesh. Do not clean spaces in screen with any tool which may damage or widen the mesh.

(3) Examine screen for holes or rotting. Inspect closely around edges where screening meets frame to be sure that screen is not pulling away from frame. Replace screen if damaged.

(4) Wash screen cover in clean fuel oil and wipe dry with a lint free cloth. Inspect cover for being bent or warped, especially around the outlet port. If cover is damaged. replace it.

(5) Assemble screen into cover and lock in place with retainer. If retainer does not hold screen securely in place, replace retainer.

d. Installation.

(1) Install oil pump inlet screens in reverse order of removal.

(2) Fill crankcase with lubricating oil in accordance with LO 55-1930-203-12.

3-26. Lubricating Oil Pump Assembly

a. Description. The oil pump assembly consists of two separate gear type pumps, each with an individual set of gears in respective housings and driven from a common shaft. One is a pressure pump which is used to circulate oil through the lubricating system, and the other is a scavenge pump used to transfer oil from the upper oil pan to the lower oil pan. The pressure pump contains an integral plunger-type relief valve which bypasses excess oil to the inlet side when the pressure at the outlet exceeds 100 psi. The scavenge pump does not include a relief valve but in all other features is identical to the pressure pump. The pump assembly is mounted on the first and second main bearing caps and is gear driven from the front end of the crankshaft.

b Removal.

(1) Remove oil pan (para 3-24).

(2) Remove oil pump screens and screen holders (para 3-25).

(3) Remove two bolts and lockwashers securing tube assembly (3, fig. 3-74) and screen support (2) to inlet pipe (7). Remove tube assembly and screen support. Separate tube assembly and screen support by removing two connecting bolts and lockwashers. Remove gaskets.

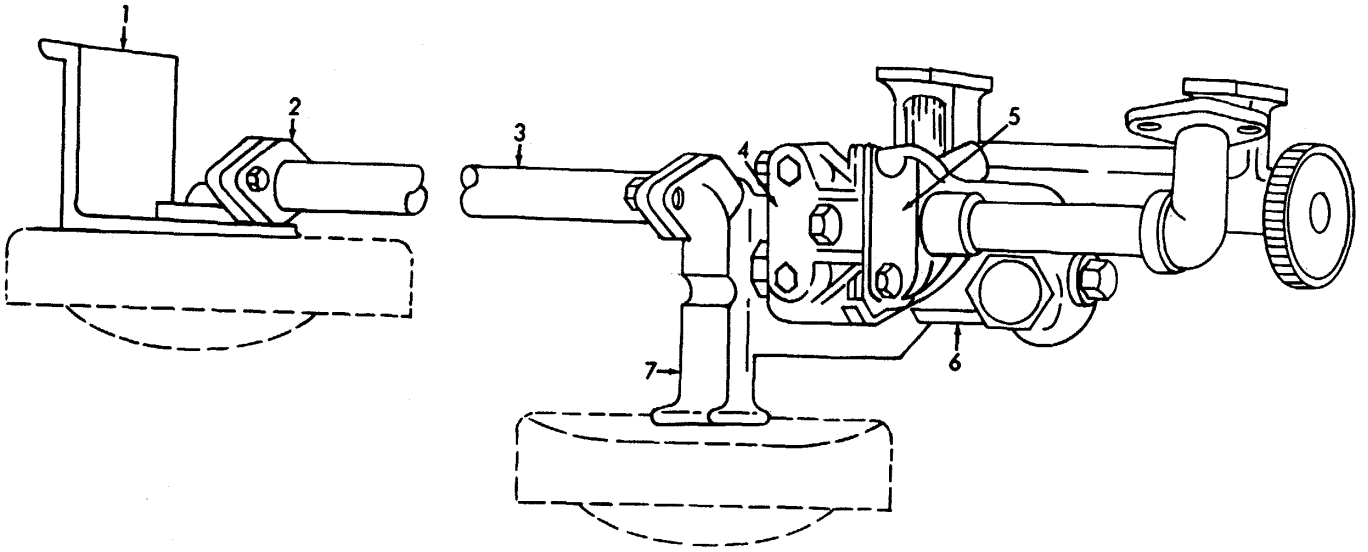
(4) Remove two bolts and lockwasher securing screen support bracket (1) to bottom of engine. Remove bracket.

(5) Remove four bolts and lockwashers connecting outlet pipe (5) to pump assembly (6) and oil pressure regulator. Lift away outlet pipe and gaskets.

(6) Loosen four bolts and lockwasher attaching inlet pipe (7) to pump assembly (6). Remove inlet pipe and gasket.

(7) Remove two bolts securing scavenging outlet pipe (4) to pump body and remove pipe and gasket.

(8) Remove four pump-to-bearing cap attaching capscrews and lockwashers, and remove pump assembly.



1. Screen support bracket
2. Screen support
3. Tube assembly
4. Scavenging outlet pipe
5. Outlet pipe
6. Pump assembly
7. Inlet pipe

Figure 3-74. Oil pump piping relative to lubricating oil pump assembly.

NOTE

Shims are used between the oil pump mounting feet and bearing cap to secure the necessary clearance of 0.005 to 0.012 inch between the idler gear and the pump drive gear. Note the number of shims under each mounting foot, as the same shims or an equal number of new identical shims must be reinstalled under each mounting foot. The number is then adjusted to obtain the proper clearance between gear teeth

c. Disassembly

(1) Remove relief valve plugs (20, fig. 3-75) and gaskets (19) from each side of pressure pump body (34), and jar relief valve spring (I 8) and relief valve (17) from body.

(2) Straighten lip of lockwasher (3) and unscrew bolt (2). Remove lockwasher (3), washer (4), and idler gear (5). Note that the side of idler gear, having extended hub, faces away from idler gear support (8).

(3) Clamp pressure pump body (34) in bench vise. Apply suitable gear puller and pull pump drive gear (6) from outer end of drive shaft (10). Remove key (35).

(4) Remove four bolts and lockwashers (29), and separate scavenging pump body from pressure pump body (34). Press drive shaft sleeve bearing (31) from scavenging pump body (28).

(5) Slide driven gear (24) off scavenging pump end of driven gear shaft (26). Remove driven gear sleeve bearing (25) from driven, gear. Slide driven gear shaft from pump body spacer (27).

(6) Remove pump body spacer (27) and drive shaft (10) with drive gears (33) assembled from pressure pump body (34).

(7) Withdraw second driven gear (24) from cavity in pressure pump body. Remove gear sleeve bearing (25) from driven gear.

(8) Position pump body spacer, drive shaft, and gears on bed of suitable press, and press drive gears (33) off drive shaft (10). Remove keys (32) and slide pump body spacer (27) off drive shaft (I0).

(9) Remove bolt (7) and idler gear support 48) from pressure pump body. Remove pins (1 and 9) from idler gear support.

Key to Figure 3-75.

1	Pin, locating	19	Gasket, copper
2	Bolt, 5/ 16 x 7 /8 in.	20	Relief valve plugs
3	Lockwasher, idler gear	21	Screw, inlet
4	Washer, thrust	22	Washer, inlet
5	Idler gear	23	Gasket, inlet pipe
6	Pump drive gear	24	Driven gears
7	Bolt, self-locking, 3/8 x 7/8 in.	25	Driven gear sleeve bearings
8	Idler gear support	26	Driven gear shaft
9	Pin, locating	27	Pump body spacer
10	Drive shaft	28	Scavenging pump body
11	Bolt, 5/16 x 3/4 in.	29	Lockwasher, 5/16 in.
12	Lockwasher, pad cover	30	Bolt, 5/ 16 x 3/4 in.
13	Capscrew, 3/8 x I in.	31	Drive shaft sleeve bearing
14	Lockwasher, 3/8 in	32	Keys, 1/8 x 5/8 in.
.15	Access cover plate	33	Drive gears
16	Gasket, pad cover	34	Pressure pump body
17	Relief valve	35	Key, 1/ 8 x 5 / 8 in.
18	Relief valve spring		

d. Cleaning, Inspection and Repair.

(1) Clean all parts in dry-cleaning solvent, Federal-Specification, P-D-680, and dry with compressed air.

(2) Inspect all gears for score marks, burrs, or broken teeth. Replace damaged gears.

NOTE

When one of the helical gears (24 or 33, fig. 3-75) is damaged, both should be replaced.

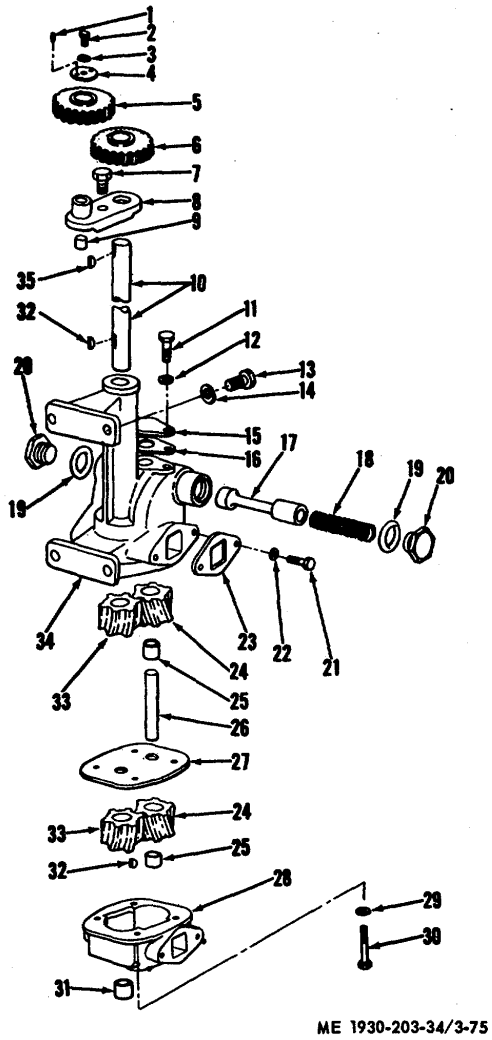


Figure 3-75. Lubricating oil pump assembly.

(3) Inspect driven gear bearings and drive shaft bearing for excessive wear. Bearing-to-shaft clearance should not exceed 0.0025 inch. If clearance exceeds 0.0025 inch, replace bearing.

NOTE

Replacement bearings in driven gears must be reamed after assembly to 0.625±0.0005 inch.

(4) Inspect pump bodies for splits or cracks; check inside pump bodies for signs of scoring. Replace if damaged.

(5) Inspect gear shafts for damage, scoring, or burrs. Replace if damaged. Remove scores or burrs with crocus cloth, Federal Specification P-C-458.

(6) Replace damaged screws, bolts, or oil piping.

(7) Inspect relief valve for damage. Replace if necessary.

(8) Inspect relief valve spring for damage of pitting. Valve spring has a free length of 2 23/64 inches, and should require a force of 48 to 53 pounds to compress it to a length of 1.596 inches. Replace spring if damaged or if a force of less than 48 pounds will compress it to a length of 1.596 inch.

(9) Replace all gaskets.

e. Reassembly.

(1) Set key (32, fig. 3-75) in drive shaft (10) and press drive gear (33), which is housed in pressure pump body (34), in place on shaft. When drive gear is positioned correctly, the distance between drive gear and the end of the drive shaft on which the pump drive gear (6) is located in 6 15/32 inches.

(2) Install pins (9 and 1) in idler gear support (8). Place idler gear support against forward end of pressure pump body (34) and secure support to pump body with bolt (7).

(3) Press driven gear sleeve bearings (25) into driven gears (24).

(4) Install end of driven gear shaft (26) onto shaft and into cavity in pressurepump body (34).

(5) Position drive gear (33) and drive shaft spacer (27) over shafts (10 and 26) and into position against pressure pump body (34).

(6) Slide second driven gear (24), into place on outer end of driven gear shaft (26). Set key (32) in outer end of drive shaft (10) and press second gear (33) in place on shaft.

(7) Install drive shaft sleeve bearing (31) in scavenging pump body (28).

(8) Mount scavenging pump body (28) on pressure pump body (34), and secure with four bolts (30) and lockwashers (29).

NOTE

No gaskets are used between pump bodies.

. (9) Support drive gear end of drive shaft on bed of an arbor press and insert key (35) in keyway of shaft. Position pump drive gear (6) on end of drive shaft with extended hub side up away from pump body. Insert a 0.005 inch feeler ribbon between pump drive gear and pump body to proper position gear on shaft. Press gear on shaft just far enough to allow 0.005 inch feeler to be readily slipped from between pump body and gear.

. (10) Lubricate idler gear bearing with engine oil and place idler gear (5) in position on idler gear support (8) with side of gear having face of hub flush with gear teeth facing support.

. (11) Place lockwasher (3) next to head of bolt (2) and washer (4) next to lockwasher. Start bolt into bearing boss of idler gear support (8) and rotate washer and lockwasher so that slot at inner diameter of each washer engages pin (1).

. (12) Tighten idler gear bolt (2) so that one side of bolt head will be over end of pin (1). Bendlockwasher (3) against one side of bolt head.

. (13) Screw relief valve plug (20), with gasket (19), into place at side of pressure pump body opposite inlet opening. Place relief valve (17) and relief valve spring (18) in bore at inlet side of pressure pump body. Install second relief valve plug (20) with gasket (19) into body. Tighten plug.

. (14) If access cover plate (15) and gasket (16) were removed from pressure pump body, reinstall plate and gasket and secure with two bolts (11) and lockwashers (12).

. *f. Installation.*

. (1) Hold pump assembly against main bearing caps so that idler gear (5, fig. 3-75) meshes with gear on crankshaft.

. (2) Insert four capscrews (13), with lockwashers (14), through mounting feet of pressure pump body (34) and into bearing caps. Aline pump so that teeth of gear on crankshaft and idler gear (5) are parallel and tighten bolts. Check clearance between gear teeth and a feeler gage. Proper clearance is from 0.005 to 0.012 inch. Replace shims, if used, between pump mounting feet and bearing caps. Adjust number of shims to obtain proper clearance between gear teeth. If installing new gears, a larger number of shims will be required under mounting feet.

NOTE

Maintain equal number of shims under each pump mounting foot so pump will always be level on cylinder block. Fill pump with engine oil to aid initial prime.

(3) Using a new gasket, attach scavenging outlet pipe (4, fig. 3-74) to scavenge pump body with two bolts and lockwashers.

(4) Secure inlet pipe (7) and gasket to pump assembly (6) with four bolts and lockwashers.

(5) Place new gaskets at outlet pipe con-

nections to pressure pump body and pressure regulator. Secure outlet pipe (5) to pump body regulator with four bolts and lockwashers.

(6) Install screen support bracket (1) to bottom of engine with two bolts and lockwashers.

(7) Using a new gasket, join tube assembly (3) to screen support (2) with two bolts and lockwashers.

(8) Place a new gasket between tube assembly (3) and inlet pipe (7). Secure tube assembly (3) to inlet pipe with two bolts and lockwashers.

(9) Replace oil pump screen-holders and screens (para 3-25).

(10) Replace oil pan (para 3-24).

3-27. Oil Pressure Regulator Assembly

a. Description. Stabilized lubricating oil pressure is maintained within the engine at all speeds, regardless of oil temperature, by an oil pressure regulator assembly installed between the oil pump outlet pipe and the cylinder block. The regulator assembly consists of a hollow piston-type valve, a compression spring, and a plug, all mounted in a housing. The valve is held on its seat by the spring which is compressed by the plug screwed into the regulator housing. The regulator assembly is bolted to the lower flange of the cylinder block and sealed against oil leaks by a gasket. When oil pressure at the valve exceeds 45 psi, the valve is forced from its seat and oil from the engine gallery is by-passed to the oil pan, dropping the oil pressure. When the pressure returns to normal, the valve closes and oil pressure builds up.

b. Removal.

(1) Drain engine crankcase and remove oil pan (para. 3-24).

(2) Remove bolts (6, fig. 3-76) and lockwashers (7) securing oil pump pipe to oil pressure regulator.

(3) Remove bolts (9) and lockwashers (10) securing regulator housing to cylinder block.

(4) Tap lower end of regulator housing lightly to loosen it from gasket and cylinder block.

(5) Remove regulator assembly and gaskets (I and 8).

c. Disassembly.

(1) Clamp flange of regulator housing (2, fig. 3-76) in a vise. Remove plug (5) from regulator housing.

(2) Lift out spring (4) and relief valve (3).

d. Cleaning, Inspection and Repair.

(1) Wash regulator parts in clean fuel oil and blow dry with compressed air. Use a wire brush to remove old gasket. Be sure that oil passages are clean and free of all sludge.

(2) Examine regulator housing (2, fig. 3-76) for cracks. Check valve seat for scoring or burrs. If

1 Gasket, oil pressure regulator
2 Oil pressure regulator housing
3 Relief valve
4 Spring, relief valve
5 Plug
6 Bolt, machine, 5/16 x 7/8 in.
7 Lockwasher, 5 / 16 in.
8 Gasket, oil pipe outlet
9 Bolt, machine, 5/16 x 1/8 in.
10 Lockwasher, 5/ 16 in.

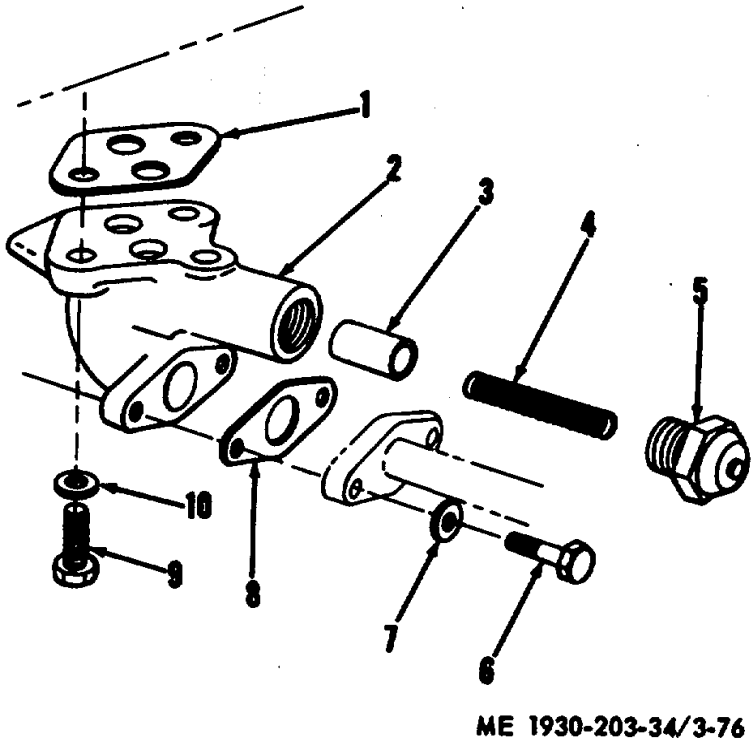


Figure 3-76. Oil pressure regulator assembly.

regulator housing or valve seat is damaged, replace entire regulator assembly.

(3) Examine relief valve (3) for pitting or burrs, especially on outside or seating surfaces. If valve surfaces are not smooth, replace valve.

(4) Apply a coating of engine oil to outer surface of relief valve and slide valve into housing. See that valve fits snugly against housing and moves freely. If valve binds or is too loose, replace entire regulator assembly.

(5) Using a spring tester, check spring tension of spring (4). Approximate free length of spring is 2 31/64 inches. The spring requires a force of 14-15 pounds to compress it to a length of 1 21/32 inches. If spring shows a loss of tension, replace.

e. Reassembly . Reassemble the oil pressure regulator assembly in reverse order of disassembly.

f. Installation.

(1) Remove all traces of old gasket from cylinder block and pump outlet pipe flange.

(2) Install a new gasket (1, fig. 3-76) on regulator housing (2) with oil passage holes in gasket in alinement with oil passages in regulator housing.

(3) Position regulator assembly on cylinder block and secure with bolts (9) and lockwashers (10).

(4) Place a new gasket (8) between regulator assembly and pump outlet pipe. Install bolts (6) and lockwashers (7).

(5) Install oil pan (para 3-24).

Section VIII. VIBRATION DAMPER ASSEMBLY, POWER TAKEOFF COUPLING AND FLYWHEEL HOUSING

3-28. Vibration Damper Assembly and Power Takeoff Coupling

a. Description. Each engine is equipped with a double vibration damper assembly to reduce crankshaft stresses. The dampers are made up of rubber blocks bonded to an inertia mass in the form of a metal ring on one side and a stamped metal disc on the other. The two metal parts are, therefore, free to move within prescribed limits set by the elasticity of the rubber and will absorb vibration set up in the crankshaft. The power takeoff coupling assembly serves to connect the
fluid and flexible coupling to the engine crankshaft and as a cone retainer for the outer cone of the vibration damper assembly.

b. Removal and Disassembly.

(1) Remove fluid coupling, flexible coupling, and engine adapter flange (para 2-21).

(2) Remove bolt (11, fig. 3-77) and washer (10) securing power takeoff coupling assembly (9) tocrankshaft and, using a puller, remove power takeoff coupling assembly. Remove keys (8).

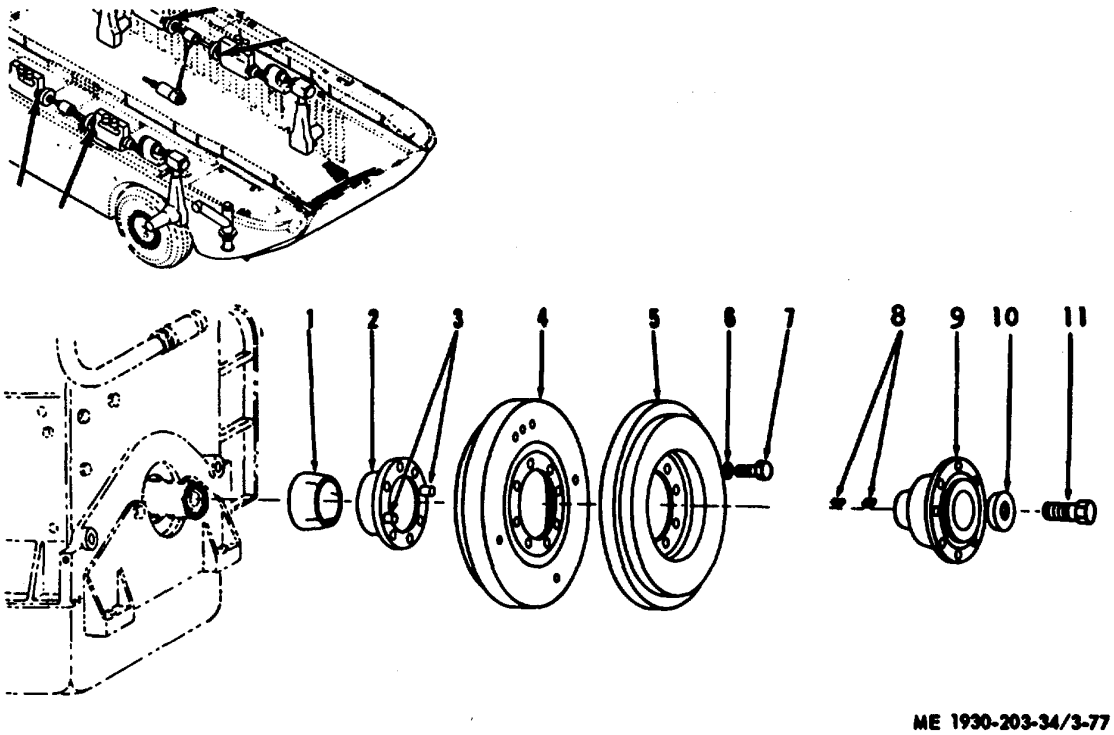
(3) Slide vibration dampers (5 and 4) and hub assembly (2) off crankshaft as an assembly.

(4) Insert a 1/8-inch hooked rod in each of the two puller holes in inner cone (1) and pull inner cone off crankshaft.

CAUTION

Do not damage front main bearing oil seal when removing inner cone from crankshaft.

(5) Remove bolts (7) and lockwashers (6) holding vibration dampers (4 and 5) to hub assembly (2). Pull vibration dampers off dowel pins (3) on hub assembly.



1. Cone, inner
2. Hub assembly
3. Pin, dowel
4. Vibration damper, heavy
5. Vibration damper, light
6. Lockwasher
7. Bolt. vibration damper
8 Key
9 Power take off coupling assembly
10. Washer, flat
11. Bolt. power takeoff coupling

Figure 3-77. Vibration damper assembly and power takeoff coupling assembly.

c. Cleaning, Inspection and Repair.

(1) Clean inner cone and hub assembly in clean fuel oil and wipe dry. Clean metal sides of vibration dampers and power takeoff coupling assembly with a cloth moistened with fuel oil and blow dry with compressed air.

CAUTION

Do not allow fuel oil to contact rubber portion of dampers or power takeoff coupling assembly as fuel oil will tend to loosen the rubber from metal.

(2) Inspect that rubber blocks of vibration dampers are firmly bonded on each side and that metal sides are not bent. Replace vibration dampers if rubber blocks have become loosened from metal sides or if metal sides are bent.

NOTE

A loose or defective vibration damper, after extended operation, may result in a cracked crankshaft.

(3) Inspect inner cone and hub assembly for signs of scoring. Replace a scored or damaged cone or hub assembly and examine crankshaft end for possible cause.

(4) Examine dowel pins in hub assembly for being bent or loose. Replace bent or loose dowel pins.

(5) Inspect power takeoff coupling assembly to see that rubber is firmly bonded to metal. Replace power takeoff coupling assembly if rubber has become loose.

d. Reassembly and Installation.

(1) Assemble dampers (4 and 5, fig. 3-77) over pins (3) and against hub assembly (2) with flat faces of dampers facing each other. Install bolts (7) and lockwashers 16).

(2) Apply a light coat of cup grease to front main bearing oil seal. Slide inner cone (1) into opening between crankshaft and front main bearing oil seal with tapered end of cone pointing toward front end of crankshaft.

(3) Slide assembled vibration dampers and hub assembly into position with long ends of hub assembly toward engine.

(4) Install keys (8) on crankshaft.

(5) Position power takeoff coupling assembly (9) on crankshaft and install washer (10) and bolt (11). Tighten bolt to a torque of 180 to 200 foot-pounds.

(6) Install fluid coupling, flexible coupling and engine adapter flange (para. 2-21).

3-29. Flywheel Housing

a. Description . The flywheel housing is a one-piece casting mounted against the rear end plate which, in turn, is mounted to the cylinder block. The flywheel housing provides a cover for the torque converter flywheel and gear train and also serves as a mounting for the torque converter assembly. The flywheel housing is counterbored for a lip-type seal that contacts the crankshaft.

b. Removal

(1) Remove engine from LARC (para. 2-11).

(2) Remove torque converter from engine (para. 2-12).

(3) Remove air starting motor (para. 3-18).

(4) Remove tachometer generator (para. 6-3).

(5) If equipped with a dual tachometer drive adapter, remove the adapter.

(6) Remove primary fuel filter.

(7) Remove oil pan (para. 3-24).

(8) Disconnect throttle control linkage from shaft in engine hoisting eye ITM 55-1930-203-201. Remove two bolts and lockwashers securing engine lifter bracket 14, fig. 3-78) to cylinder head.

NOTE

This will leave the lifter bracket attached to the flywheel housing for convenience in handling.

(9) Position hoist above flywheel housing with hoisting hook through eye of lifter bracket.

NOTE

Do not take slack out of hoisting gear until all mounting bolts have been loosened to prevent binding.

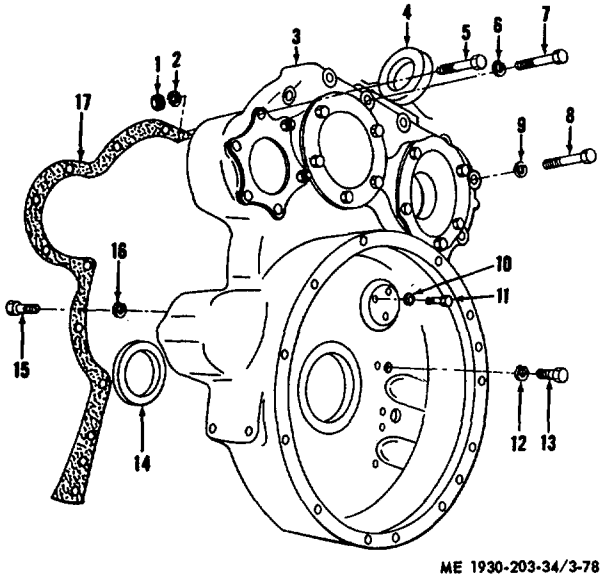
(10) Remove 12 bolts (11 and 13), lockwashers (12), and washer (10) in flywheel cavity. Tag bolts for reassembly.

(11) Remove bolts (5, 7, and 8), nuts (1), and lockwashers (2, 6, and 9) from around upper portion of flywheel housing. Tag bolts for reassembly.

(12) Remove two bolts (15) and lockwashers (16). Tag bolts for reassembly.

(13) Take up slack on chain hoist and strike front face of flywheel housing alternately on each side with a soft hammer to work flywheel housing off dowels.

(14) Guide flywheel housing away from end plate to a clear working area.



1	Nut, 3/8 in.	10	Washer, flat, 13/32 in.
2	Lockwasher, 3 / 8 in.	11	Bolt, machine, 3/8 x I in.
3	Flywheel housing	12	Lockwasher, 3 / 8 in.
4	Engine lifter bracket	13	Bolt, machine, 1½ x 31/4 in.
5	Bolt, machine, 3 / 8 x 5 in.	14	Seal, plain, encased
6	Lockwasher, 3 / 8 in.	15	Bolt, machine, 3/8 x 1 in.
7	Bolt, machine, 3/8 x 3 1/4 in.	16	Lockwasher, 3 / 8 in.
8	Bolt, machine, 3/8 x 4¼ in.	17	Gasket, mounting
9	Lockwasher, 3 / 8 in.		

Figure 3-78. Flywheel housing.

c. Cleaning, Inspection and Repair.

(1) Remove bolts and lockwashers securing covers and remove covers and gaskets.

(2) Clean flywheel housing with fuel oil and wipe dry with a lint-free cloth.

NOTE

Do not disturb oil seal when cleaning flywheel housing.

(3) Remove all traces of old gasket from flanges of flywheel housing and end plate with a wire brush.

(4) Inspect flywheel housing for cracks, damage, or any unusual conditions.

(5) Examine oil seal for scored, cracked, or charred surfaces and any hardness or brittleness. Press sealing lip of seal in with hand and check if sealing lip returns to proper position after being pressed in. If oil seal is defective, replace as follows:

(*a*) Support rear face of flywheel housing on wood blocks.

(*b*) Drive oil seal (14, fig. 3-78) out and clean seal bore in flywheel housing with clean fuel oil and wipe dry.

(*c*) Position new seal with lip pointed toward inner face (shoulder in counterbore) of flywheel housing.

NOTE

Do not remove plastic coating on outside diameter of seal.

(*d*) Using oil seal remover and installer, part No. J3154-04, drive seal into counterbore, flywheel housing until seal is seated on shoulder in counterbore.

(6) Inspect rear end of crankshaft for ridges Crankshaft surface must be clean and smooth. Remove slight ridges with 120 grit emery cloth followed by 240 grit emery cloth. Use crocus cloth wet with fuel oil, to polish surface.

NOTE

Rotate crankshaft occasionally to prevent an out-of-round condition.

d. Installation.

(1) Affix new cover gaskets to flywheel housing and install covers on flywheel housing. Affix new mounting gasket (17, fig. 3-78) to flywheel housing.

(2) Apply a coating of heavy cup grease to oil seal lip.

(3) Install studs (1, fig. 3-79), into cylinder block and set oil seal expander (2) over dowels on end of crankshaft as shown in figure 3-79.

(4) Using a hoist, guide flywheel housing into place, tight against end plate and gasket.

(5) Remove mounting studs and oil seal expander installed in (3) above.

(6) Install six bolts (11, fig. 3-78) and washers (10) in tapped holes of idler gear hub and idler gear hole spacer fingertight.

NOTE

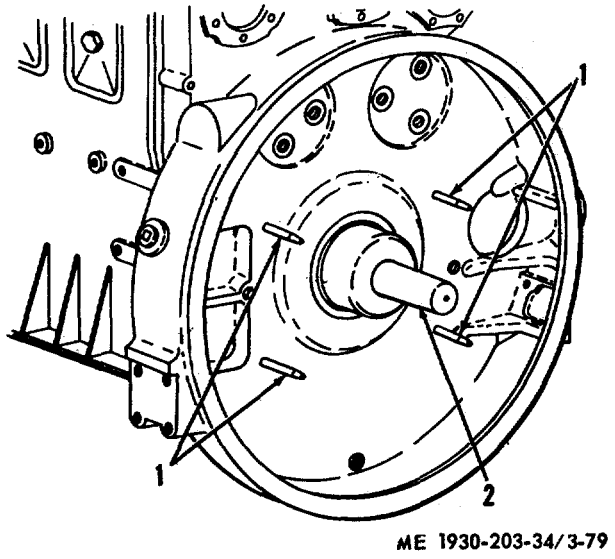
Self-locking type bolts and steel washers can be used in sets of three to attach the flywheel housing to the idler gear hub and hole spacer. If self-locking bolts are not used, the drilled head bolts must be secured with lockwire, in sets of three, after final tightening.

(7) Install six bolts (I3) and lockwashers (12) in flywheel housing cavity fingertight.

(8) Install bolts (5, 7, and 8) lockwashers (2, 6, and 9) and nuts (1), in upper portion of flywheel housing fingertight.

(9) Install bolts (15) and lockwashers (16) fingertight.

(10) Check that flywheel housing is properly alined and oil seal is correctly seated.



1. Alining stud, part No. J1927-01
2. Oil seal expander, No. J1359

Figure 3-79. Installing flywheel housing.

(11) Tighten bolts to within 10 to 15 foot-pounds of their specified torques in sequence shown in figure 3-80. Turn engine crankshaft when tightening bolts to prevent binding in the idler gear tapered bearing.

NOTE

Numbers indicated on figure 3-80 should not be mistaken for callouts. They are the order of sequence to be followed in installation of flywheel housing.

NOTE

The specified torque of the 3/8 inch idler gear hub and hole spacer bolts if 40 to 45 foot-pounds. All other 3/8 inch bolts require a torque of 25 to 30 foot-pounds. The 1/2 inch bolts require a torque of 90 to 100 foot-pounds.

(12) Tighten bolts and nuts to torque specified above in sequence shown it figure 3-81. Secure bolts (11, fig. 3-78) in sets of three with lockwire if self-locking bolts were not used.

(13) Check flywheel housing concentricity in relation to crankshaft as follows:

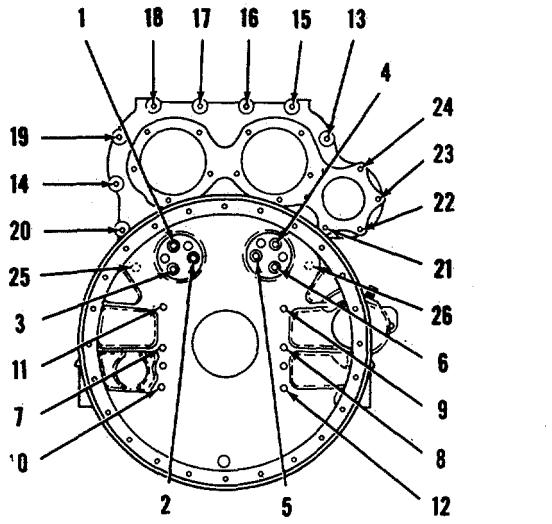


Figure 3-80. Initial flywheel housing bolt tightening sequence.

(a) Attach dial indicator holding fixture (2, fig. 3-82) across end of crankshaft with two bolts diametrically opposed to each other as shown in figure 3-82.

(b) Install a suitable dial indicator (1) as shown in figure 3-82 on holding fixture.

(c) Tap front end of crankshaft with a soft hammer to insure end play of crankshaft is in one direction only.

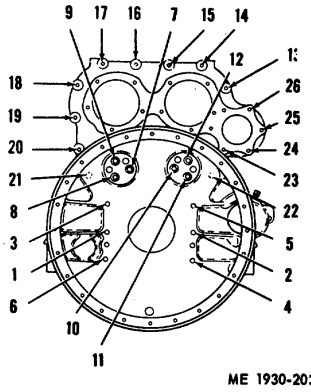


Figure 3-81. Final flywheel housing bolt tightening sequence

NOTE

Numbers indicated on figure 3-81 should not be mistaken for callouts. They are the order of sequence to be followed in installation of flywheel housing.

(d) Adjust dial indicator to read zero at 12 o'clock position of pilot (inner edge) of flywheel housing bell.

(*e*) Rotate crankshaft one complete revolution. Maximum total indicator reading should not exceed 0.013 inch.

(f) Adjust dial indicator to zero at 12 o'clock position on flywheel housing bolting flange face.

(*g*) Rotate crankshaft one complete revolution. Maximum run-out should not exceed 0.013 inch.

NOTE

If indicator readings exceed the above limits, remove flywheel housing and check for dirt or foreign material. such as old gasket material between end plate and flywheel housing. Reinstall flywheel housing and recheck flywheel housing concentricity.

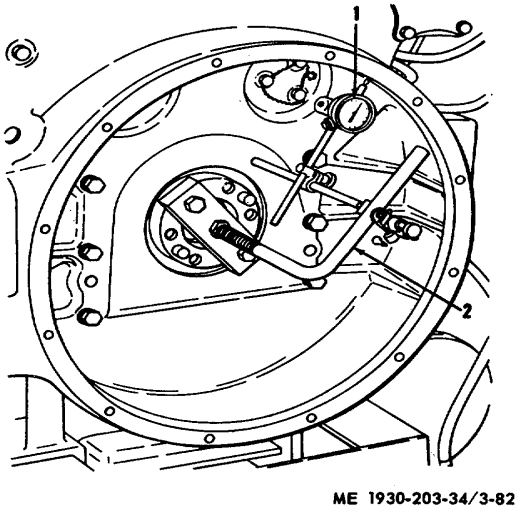
(14) Remove bolts and lockwashers securing engine lifter bracket to flywheel housing and remove hoisting eye and gasket.

(15) Remove all traces of old gasket material and affix a new gasket to lifter bracket.

(16) Attach lifter bracket to cylinder head and flywheel housing with bolts and lockwasher. Draw bolts down snugly and then tighten to a torque of 55 to 60 foot-pounds in sequence shown in figure 3-83.

NOTE

Numbers indicated on figure 3-83 should not be mistaken for callouts. They are the order of sequence to be followed in installation of flywheel housing.



1. Dial indicator
2. Holding fixture, part No. J7452

Figure 3-82. Checking flywheel housing concentricity

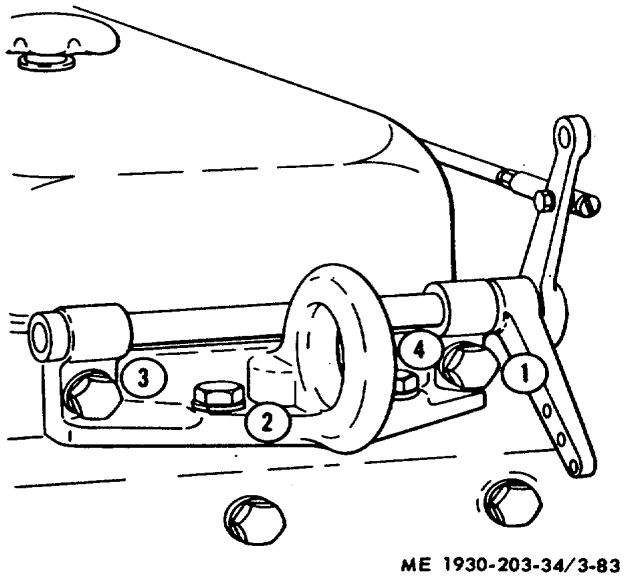


Figure 3-83. Engine lifter bracket bolt tightening sequence

(17) Connect throttle control linkage to shaft engine lifter bracket(TM 55-1930-203-20).
(18) Install oil pan (para. 3-24).
(19) Install primary fuel filter.
(20) Install dual tachometer drive adapter, if removed.
(21) Install air starting motor (para. 3-18).
(22) Install torque converter (para. 2-12).
(23) Install engine in LARC (para. 2-11).

Section IX. TIMING GEAR TRAIN, CAMSHAFT AND BALANCER SHAFT

3-30. Timing Gear Train

a. Description. A timing gear train composed of five helical gears is located at the rear end of the engine. A gear bolted to the crankshaft flange drives the camshaft and balancer shaft gears, as well as the blower drive gear, through an idler gear mounted between the crankshaft and balancer shaft gears on the RC engines, and between the crankshaft and camshaft on the RA engines. The camshaft gear and balancer shaft gear mesh with each other and run at the same speed as the crankshaft. Since these two gears must be in time with each other and the two as a unit in time with the crankshaft gear, a letter is placed on one tooth of each gear with a corresponding mark at the root of the mating teeth of the gear with which it meshes. The idler gear rotates on a double row, tapered roller bearing mounted on a stationary hollow hub. Identification marks are located on two teeth of the idler gear with corresponding match marks stamped on the crankshaft gear and the camshaft or balancer shaft gear, depending on engine model.

b. Removal.

(1) Remove engine (para. 2-11).
(2) Remove torque converter (para. 2-12) and flywheel housing (para. 3-29).
(3) Remove camshaft gear (para. 3-31).
(4) Remove balancer shaft drive gear (para 3-31).
(5) Remove bolt and lockwasher from center of idler gear hole spacer (3, fig. 3-84). Remove idler gear hole spacer from cylinder block end plate (5).
(6) Remove bolt and washer securing idler gear (7) to cylinder block end plate (5). Withdraw idler gear, and disassemble as follows:

(a) Remove six bolts (1, fig. 3-85) and three bolt locks (2) which secure bearing retainer (9) to idler gear (6).

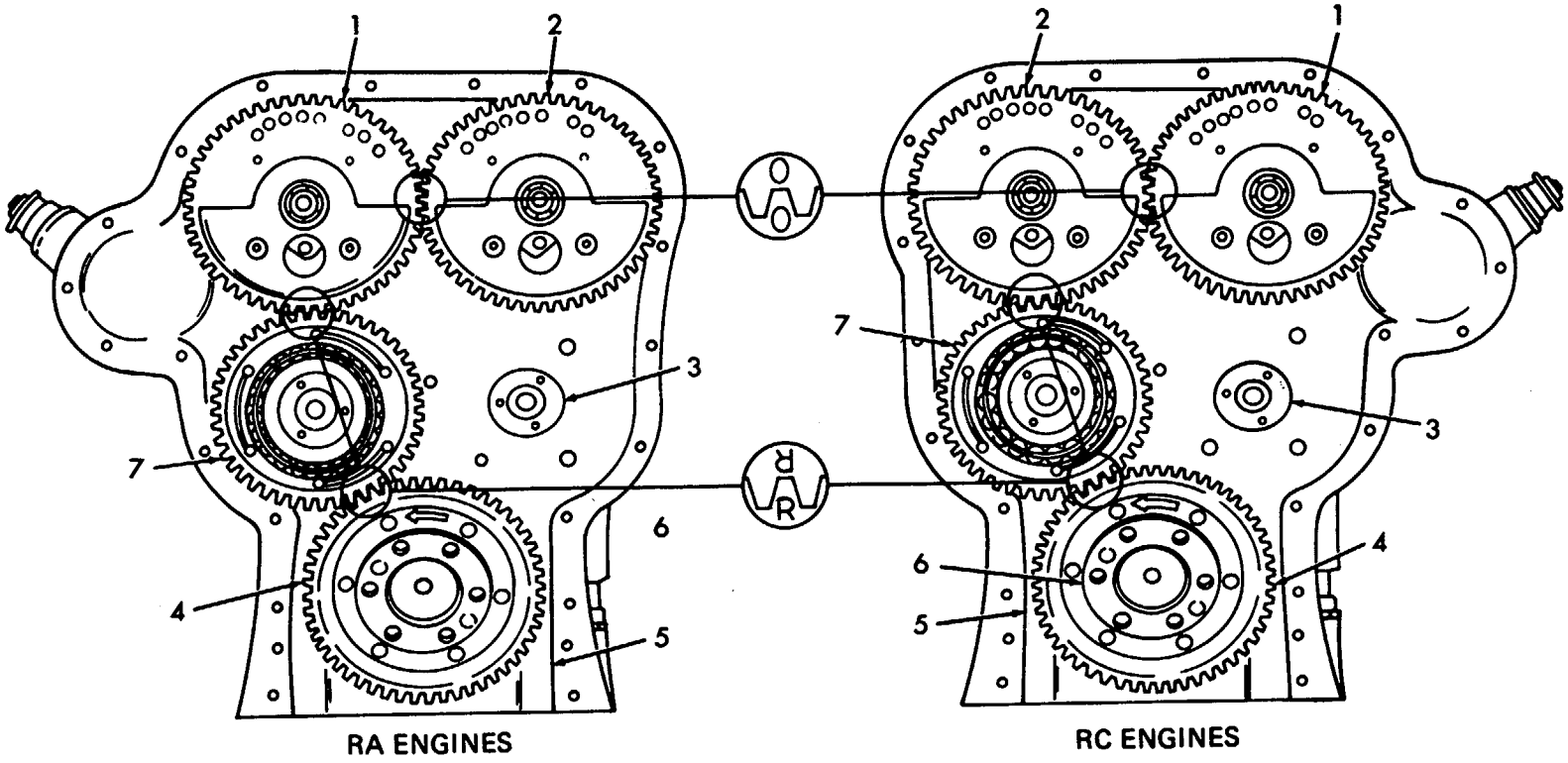
(b) Place idler gear (6) and bearing assembly in arbor press with inner race supported on steel blocks. While rotating gear assembly, press idler gear hub (3) out of bearing assembly. Remove gear assembly from arbor press and remove bearing cones (4) and spacer (7).

NOTE

Component parts of idler gear bearing are mated therefore, matchmark parts during disassembly to assure they will be reassembled in their original positions.

(c) Tap upper bearing race (5) from idler gear, (6), using a brass drift alternately at four notches provided around shoulder of idler gear.

(7) Remove six bolts and lockwashers retaining crankshaft timing gear (4, fig. 3-84) to crankshaft (6). Place a steel plate across large hole in end of crankshaft to provide a solid base and remove crankshaft gear using puller, part No. J3051.



ME 1930-203-34/3-84

1 Camshaft gear
2 Balance shaft gear
3 Idler gear hole spacer
4 Crankshaft timing gear
5 Cylinder block end plate
6 Crankshaft
7. Idler gear

Figure 3-84. Gear train and timing marks.

c. Cleaning, Inspection and Repair.

(1) Clean gears and related parts in dry-cleaning solvent, Federal Specification P-D-680, and dry with compressed air.

(2) Inspect gear teeth for evidence of scoring, pitting, or burning. Replace damaged gear.

(3) Inspect idler gear bearing for pitting, scoring, or flat spots on rollers or races. If damage is noted, replace bearing assembly.

(4) Inspect idler gear hub and idler gear bole spacer for pitting or other damage. Replace as necessary.

(5) Reassemble idler gear as follows:

(a) Support idler gear (6, fig. 3-85) with shoulder down, on bed of arbor press and start upper bearing race (5) squarely into bore of idler gear. Press bearing race tight against shoulder of gear, using a steel plate between ram of press and bearing race.

(b) Place a bearing cone (4), numbered side down, on bed of arbor press and lower idler gear (6) and upper bearing race (5) down over bearing cone.

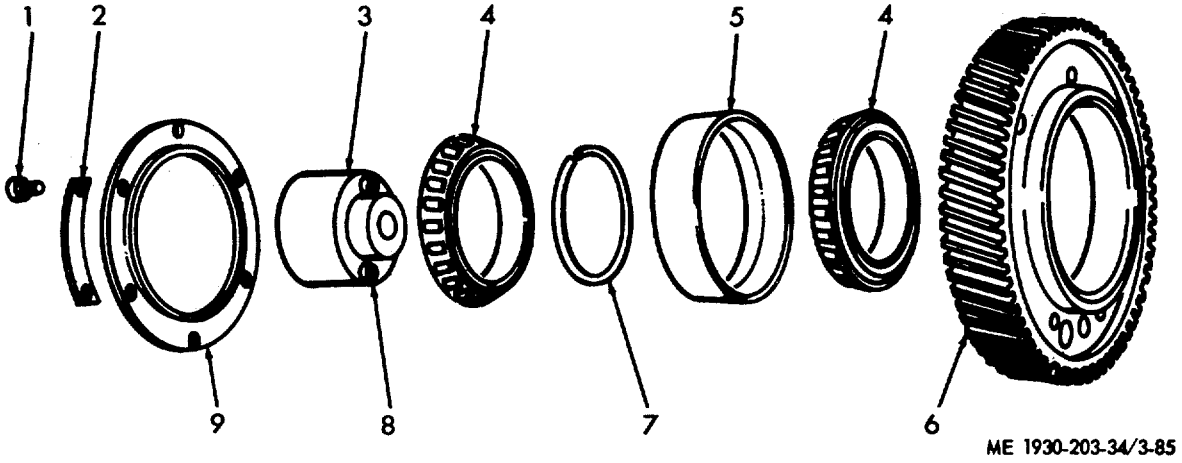
(c) Lay spacer (7) on face of bearing cone.

(d) Place second bearing cone (4), numbered side up, in idler gear and bearing cup assembly against spacer (7).

(e) Position idler gear hub (3) over bearing cones (4) so that oil hole in hub is 180 degrees from gap in spacer (7).

(f) Press idler gear hub (3) into idler gear bearing cones, while rotating idler gear (to seat rollers properly between cones), until face of hub which will be adjacent to cylinder block end plate (5, fig. 3-84) is flush with corresponding face of bearing cone.

(g) Secure bearing retainer (9, fig. 3-85) and bolt locks (2) to idler gear with six bolts (1).



1	Bolt	6	Idler gear
2	Bolt lock	7	Spacer
3	Idler gear hub	8	Pin, hollow
4	Bearing cone	9	Bearing retainer
5	Upper bearing race		

Figure 3-85. Idler gear details and relative location of parts.

NOTE

Bearing cones should be supported so as not to load bearing rollers during this operation.

(6) Check idler gear preload as follows:

(a) Mount idler gear assembly on engine.

(b) Install center bolt and washer through ,ear hub and thread into cylinder block. Tighten bolt to a torque of 80 to 90 foot-pounds.

(c) Place a steel plate against hub and bearing. Insert three 3/8 inch bolts through plate and thread into hub. Tighten bolts to a torque of 25 o 40 foot-pounds.

(d) Tie one end of a piece of lintless 1/8 inch cord around a 1/8 inch round piece of wood. Place wood between teeth of gear, then wrap cord around periphery of gear several times. Attach other end of cord to spring scale. See figure 3-86. Maintain a straight, steady pull on scale, 90 degrees to axis of hub, and note pull, in pounds and ounces, required to start gear rotating. Make several checks to obtain an average reading. If pull is from 1/2 pound to 6 pounds, 12 ounces and does not fluctuate more than 2 pounds 11 ounces, idler gear and bearing assembly are satisfactory for use. If scale ,reading is within specified limits but fluctuates

more than permissible 2 pounds 11 ounces, idler gear bearing assembly should be inspected for cause of fluctuation and corrected, or a new bearing assembly installed.

d. Installation.

(1) Position crankshaft timing gear (4, fig. 3-84) in rear of crankshaft with flat finished hub end of gear facing toward cylinder block and with all six bolt holes in timing gear alined with taped holes in crankshaft flange. Since one bolt hole is offset, the crankshaft timing gear can be attached. in only one position on crankshaft (6).

(2) Start six bolts and lockwashers through crankshaft timing gear (4) and into crankshaft. Draw gear tight against shoulder of crankshaft. Tighten bolts to a torque of 180 to 200 foot-pounds.

(3) Install camshaft gear (para 3-31).

(4) Install balancer shaft gear (para 3-31).

(5) Position crankshaft timing gear (4, fig. 3-84) and either balance shaft gear (2) or camshaft gear (1), depending on engine model, so that match marks will aline with those of idler gear 17).

(6) With marks in alinement, start idler gear (7) into mesh with crankshaft timing gear (4) and either camshaft gear or balancer shaft gear, and simultaneously rotate gear hub so hollow pin (8, fig. 3-85) at inner face of hub nearly registers with oil hole in end plate.

(7) Roll idler gear (6) into position; aline hollow pin with hole in end plate. Gently tap hub until it seats against end plate.

(8) Secure idler gear assembly in place with bolt and washer. Tighten bolt to a torque of 80 to 90 foot-pounds, and lubricate idler gear and bearing liberally with clean engine oil.

(9) Check backlash between mating gears. Backlash must be 0.003 to 0.008 inch.

(10) Install idler gear hole spacer (3, fig. 3-84) and secure with bolt and lockwasher. Tighten bolt to a torque of 80 to 90 foot-pounds.

(11) Install flywheel housing (para 3-29) and torque converter (para 2-12).

(12) Install engine (para 2-11).

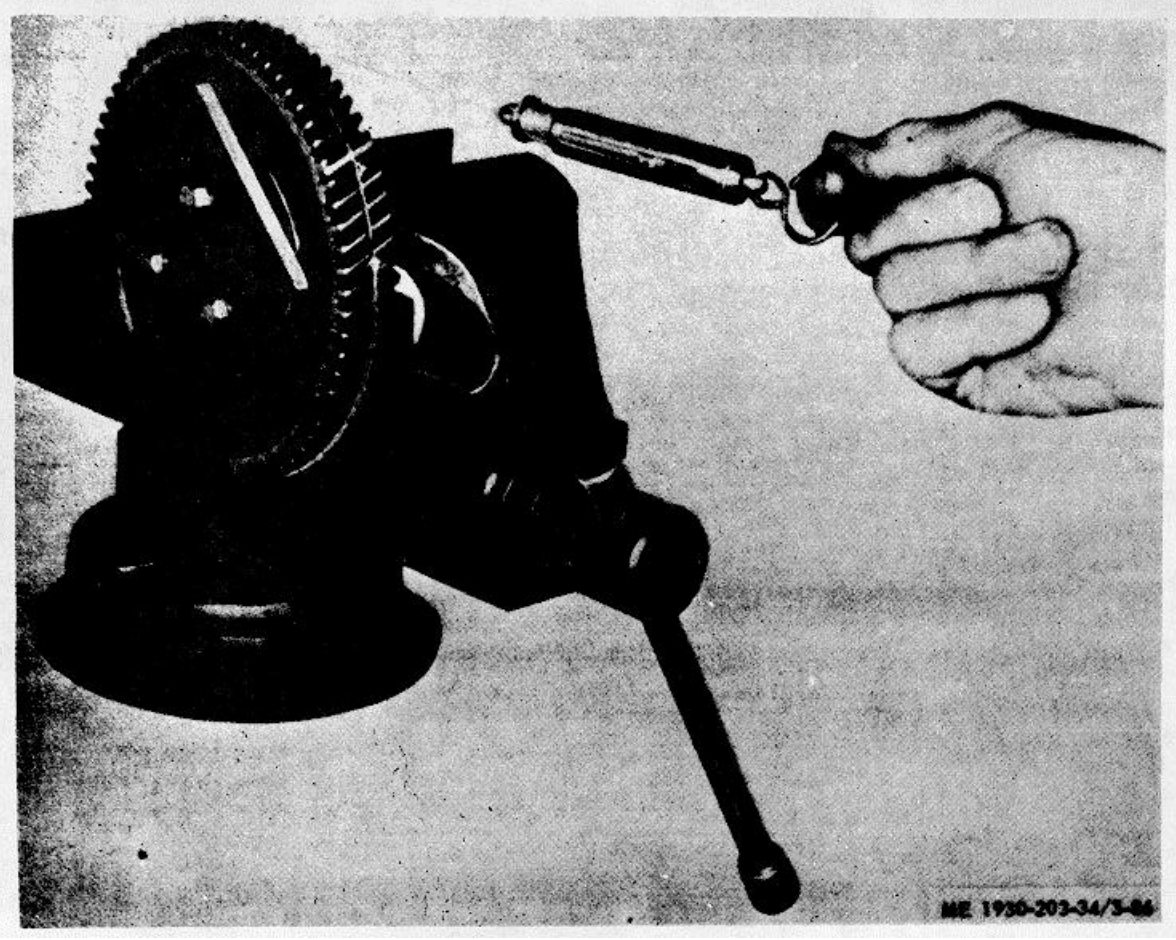


Figure 3-86. Checking preload of idler gear bearing.

3-31. Camshaft and Balancer Shaft

a. Description. A camshaft and balancer shaft are located near the top of the cylinder block and each may be located on either side of the engine, depending upon engine model (RC or RA). The camshaft operates the exhaust valves and injector assembly, is a one piece drop forging with case-hardened cams and journals. The balancer shaft runs parallel to the camshaft and is the same distance from the crankshaft. Both ends of the camshaft and balancer shaft are supported by bearing assemblies, each consisting of a flanged housing and two bushings. The eccentrically positioned weights at the front and rear ends of both camshaft and balancer shaft, are so designed to dampen out unbalanced forces within the engine. This permits the engine to operate smoothly and in balance throughout its entire speed range.

b. Removal.

(1) Remove engine (para 2-11).

(2) Remove cylinder head (para 3-6).

(3) Remove torque converter (para 2-12), and flywheel housing (para 3-29).

(4) Remove engine starting aid (para 3-14).

(5) Remove bolts (13, fig. 3-37) securing engine starting aid mounting plate (14) to balance weight cover (15) and remove plate.

(6) Remove bolts (16) and washers from balance weight cover (15). Lift cover from engine.

(7) Place a wood block between balance weight assemblies (14, fig. 3-87).

(8) Remove capscrews (1) and lockwashers (2) securing gear nut retainers (3) to camshaft gear (4) and balancer shaft gear (20). Remove gear nut retainers.

(9) Loosen nuts (15) on each end of camshaft (10) and balancer shaft (16). Remove nuts from balance weight assembly end of each shaft. Do not remove nuts from drive gear end of shafts.

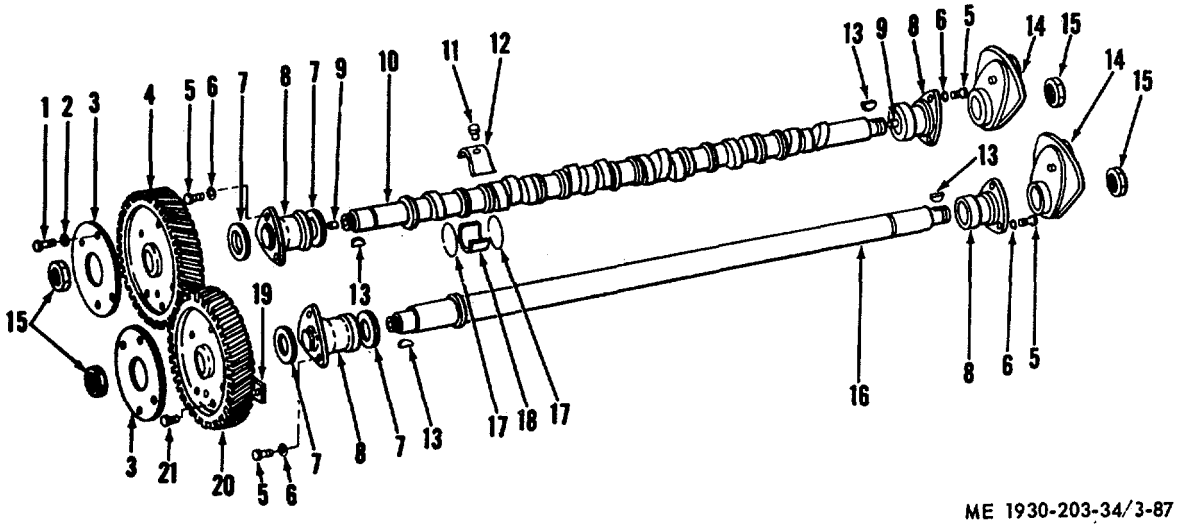
(10) Force balance weight assembly off end of each shaft, using two heavy screwdrivers between heads of bearing retaining capscrews (5) and balance weight assembly. Remove keys (13).

(11) Remove setscrews (11) securing camshaft intermediate bearings.

(12) Remove six capscrews (5) and lockwashers (6) that attach camshaft and balancer shaft bearing assemblies (8) to rear end plate of engine, by inserting a socket wrench through hole in web of camshaft and balancer shaft gears (4 and 20).

(13) Withdraw camshaft (10) and balancer shaft (16) from rear end of cylinder block.

(14) Remove six capscrews (5) and lockwashers (6) securing camshaft and balancer shaft bearing assemblies to front end plate and cylinder block. Pry under bearing flange with a suitable tool if bearing cannot be withdrawn by hand.



1 Capscrew, 3/8 x 1 in.
2 Lockwasher
3 Gear nut retainer
4 Camshaft gear
5 Capscrew, 3/8 x 1 ½ in.
6 Lockwasher
7 Washer
8 Bearing assembly
9 Camshaft plug
10 Camshaft
11 Setscrew
12 Upper camshaft bearing half
13 Key
14 Balance weight assembly
15 Nuts, extended washer
16 Balancer shaft
17 Retaining ring
18 Lower camshaft bearing half
19 Balance weight
20 Balancer shaft gear
21 Capscrew, 3/8 x 1 ½ in.

Figure 3-87. Camshaft and balancer shaft.

c. Disassembly.

(1) Support camshaft (10, fig. 3-87) in soft jaws of bench vise, being careful not to damage cams.

(2) Remove nut tl51 from camshaft.

(3) Using a suitable puller, remove camshaft gear (4) from camshaft (10).

(4) Remove balancer shaft gear as outlined in steps (1) through (3) above.

(5) Slide bearing assembly (8) and washers (7) from shafts.

(6) Remove retaining rings (17) from camshaft intermediate bearings and free upper and lower camshaft bearing halves (12 and 18) of each bearing.

(7) Drill and tap a 3, inch hole in one of camshaft plugs (9). Thread a 3h inch screw into hole and remove plug with suitable remover. Insert a 3/8 inch diameter steel rod into camshaft oil passage and drive remaining plug out.

(8) Disassemble balance weight assembly (14) as follows:

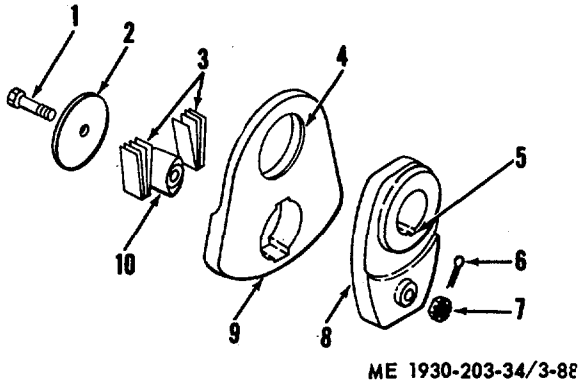
(a) Remove cotter pin (6, fig. 3-88) from nut (7).

(b) Remove bolt (1) and spring retainer (2).

(c) Separate balance weight (9) from balance weight hub (8).

(d) Push balance weight springs (3) and spring spacer (10) from balance weight (9).

(e) Press balance weight bushing (4) from balance weight (9).



1 Bolt, 3/8 x 1 13/32 in.
2 Spring retainer
3 Balance weight springs
4 Balance weight bushing
5 Keyway
6 Cotter pin
7 Nut, 3 / 8 in.
8 Balance weight hub
9 Balance weight
10 Spring spacer

Figure 3-88. Balance weight assembly.

d. Cleaning, Inspection and Repair.

(1) Clean camshaft, balancer shaft, and related parts in drycleaning solvent, Federal Specification P-D-680. Dry with compressed air (10 psi).

(2) Inspect camshaft cam and journals for uneven wear, scoring, pitting, or other damage, Replace camshaft if damaged.

(3) Inspect both faces of thrust washers for scoring or wear. Replace washers if damaged or worn so that thrust washer-to-thrust shoulder clearance exceeds 0.018 inch.

(4) Inspect faces of shaft end bearings and other surfaces that contact thrust washers for marring or scratches. Replace badly marred parts. Slight scratches may be cleaned up with an oil stone, Military Specification MIL-S-2389.

(5) Inspect bushings in shaft end bearing assemblies for wear or damage. Replace bearing assembly if damaged or worn so that end bearing bushing-to-end journals exceed 0.006 inch.

(6) Inspect camshaft intermediate bearings for excessive scoring or wear. Replace bearings if scored or worn so that camshaft journals-to-intermediate bearings exceeds 0.009 inch.

(7) Inspect balance weight and balance weight hub for damage. If either is damaged, replace entire balance weight assembly.

(8) Inspect balance weight bushing for wear. If worn so that bushing-to-balance weight hub exceeds 0.0035 inch, replace bushing.

(9) Examine balance weight springs for wear. Each spring should be 0.015 to 0.016 inch thick, and each of four packs containing 17 springs should measure 0.243 to 0.259 inch total thickness. Pack thickness should be measured while springs are clamped tightly in vise. Replace springs as required.

e. Reassembly

(1) Reassemble balance weight assembly as follows:

(a) Press balance weight bushing (4, fig. 3-88) into place in balance weight (9) until edge of bushing is flush with shoulder on drilled (balancing hole) side of balance weight.

(b) Place balance weight (9), machined face down, flat on workbench.

(c) Dip balance weight spring pack in lubricating oil, Military Specification MIIL-L-2104, completely coating all springs, and arrange one spring pack on either side of the balance weight spring cavity.

(d) Place spring spacer (10) on screwdriver blade and install spring spacer, tapered end first, between balance weight springs (3). As spring spacer moves downward, tilt it into upright

position, bolt hole up. Press spring spacer into place.

(e) Place journal of balance weight hub (8) into balance weight bushing (4) of balance weight (9). Balance weight should swing freely on balance weight hub (8). Burnish split bushing if required clearance of 0.005 inch to 0.0035 inch is not available.

(f) Place spring retainer (2) on spring spacer (10 and insert bolt (1) through spring retainer, spring spacer, and balance weight hub (8). Secure with nut (7) and cotter pin (6).

(g) Check clearance between balance weight (9) and balance weight hub (8), using a feeler gage. Clearance should be from 0.010 inch to 0.023 inch. Adjust clearance by tightening or loosening nut (7), then lock nut in position with cotter pin (6).

(2) Install new camshaft plugs (9, fig. 3-87) in camshaft (10).

(3) Apply grease, Military Specification MIL-G-10924, to steel face of washers (7). Place a washer against each end of camshaft and balancer shaft rear bearing assemblies (8). The steel faces of thrust washers must be toward bearing.

(4) Lubricate rear camshaft and balance shaft journals and slide bearing assemblies (8) on each shaft with mounting flange of bearing toward gear end of shaft.

(5) Install keys (13) for camshaft gear (4) and balancer shaft gear (20) in shafts.

NOTE

Note that the teeth of one gear form a right-hand helix and on the other a left-hand helix. When viewing engine from flywheel end, the gear with right-hand helical teeth is located on the left side and the gear with left-hand helical is located on the right side.

(6) Rest the nongear end of camshaft (10) on ablock of wood and start proper gear onto the other end of shaft so keyway alines with key (13) and with flat finished face of gear away from bearing.

(7) Using gear installer, part No. J1903, drive gears on camshaft and balancer shaft tight against shoulders of shafts.

(8) Start nuts (15) on their respective shafts and hand tighten.

(9) Lubricate camshaft intermediate bearing journals. Place upper and lower camshaft bearing half (12 and 18) of each intermediate bearing on a camshaft journal and lock halves together with retaining rings (17). Install each retaining ring with gap over upper camshaft bearing half and ends equal distance above split line of bearing halves.

f. Installation.

(1) Insert front end of camshaft (10, fig. 3-87) into cylinder block and push camshaft into cylinder block until camshaft gear teeth almost engage teeth of idler gear. Use care when installing camshaft to avoid damaging cam lobes.

(2) Aline timing marks on mating gears and slide camshaft gear (4) in place.

(3) Secure bearing assembly (8) to cylinder block with three capscrews (5) and lockwashers 6). Tighten capscrews to a torque of 35 to 40 foot-pounds.

(4) Insert balancer shaft (16) into bore in cylinder block and push it in until teeth of balancer shaft gear (20) almost engage camshaft gear teeth.

(5) Aline timing marks on mating gears and slide balancer shaft gear (20) into place.

(6) Secure bearing assembly 18) to cylinder block as in (3) above.

(7) Install camshaft and balancer shaft front end bearing assemblies with capscrews (5) and lockwashers (6). Tighten bolts to a torque of 35 to 40 foot-pounds.

(8) Turn camshaft intermediate bearings until holes in bearings are in alinement with threaded holes in cylinder block. Install setscrews (11) and tighten them to a torque of 15 to 20 foot-pounds.

(9) Install keys (13) in keyways at front end of camshaft (10) and balancer shaft (16).

(10) Aline keyway in balance weight assembly (14) with key in shaft. Slide balance weight assembly on shaft. Repeat operation of other shaft.

(11) Place a nut (15) on end of each shaft and hand tighten.

(12) Using a wood block between balance weights to prevent shaft from turning, tighten nuts (15) to a torque of 300 to 325 foot-pounds.

(13) Install gear nut retainers (3) with cap-screws (1) and lockwashers (2). Tighten bolts to a torque of 35 to 40 foot-pounds.

(14) Check backlash between mating gears. Backlash should be within a 0.003 to 0.010 inch limit.

(15) Install balance weight cover (15, fig. 3-37) and secure to cylinder block with bolts (16) and washers.

(16) Install engine starting aid mounting plate (14) and secure with bolts (13).

(17) Install engine starting aid (para 3-14).

(18) Install flywheel housing (para 3-29) and torque converter (para 2-12).

(19) Install cylinder head (para 3-6).

(20) Install engine (para 2-11).

Section X. PISTON, CONNECTING ROD, CRANKSHAFT, AND MAIN BEARING ASSEMBLIES

3-32. Piston and Connecting Rod Assembly

a. Description. The mallable cast iron piston is joined to the upper end of the drop-forged carbon steel connecting rod by a floating piston pin. The top of the piston forms a combustion chamber and is designed to displace air into close proximity to the fuel spray. Each piston is fitted with four chrome-plated steel compression rings and two 3-piece oil control rings. A protective tin plate has been applied to the piston skirt to provide a close piston-to-liner fit and prolong piston life. The piston and connecting rod assembly is attached to crankshaft by a cap at the lower end of the connecting rod.

b. Removal.

(1) Remove cylinder head (para 3-6).
(2) Remove oil pan assembly (para 3-24).
(3) Remove lubricating oil pump (para 3-26).
(4) Using a ridge cutter, remove any ridge in cylinder liner at top of piston ring travel.

CAUTION

Use holddown clamps to hold cylinder liners in place when rotating crankshaft to prevent moving of cylinder liners and possible breakage of oil control rings and damage to pistons.

NOTE

Move piston to bottom of its travel and place a cloth over the top of piston to collect cuttings. After ridge has been removed, turn crankshaft to bring piston to top of its stroke and carefully remove cloth with cuttings.

(5) Remove cotter pins (18, fig. 3-89) from end of bolts (5). Remove nuts (1) and slide connecting rod bearing cap (17) and lower connecting rod bearing shell (2) from lower end of connecting rod (4).
(6) Push piston and rod assembly out through top of cylinder block.

NOTE

Pistons cannot he removed from the bottom of cylinder block.

(7) With connecting rod (4) and piston (15) removed, reassemble connecting rod bearing cap (17) and lower connecting rod bearing shell (2) to connecting rod.
(8) Remove remaining piston and rod assemblies in a similar manner.

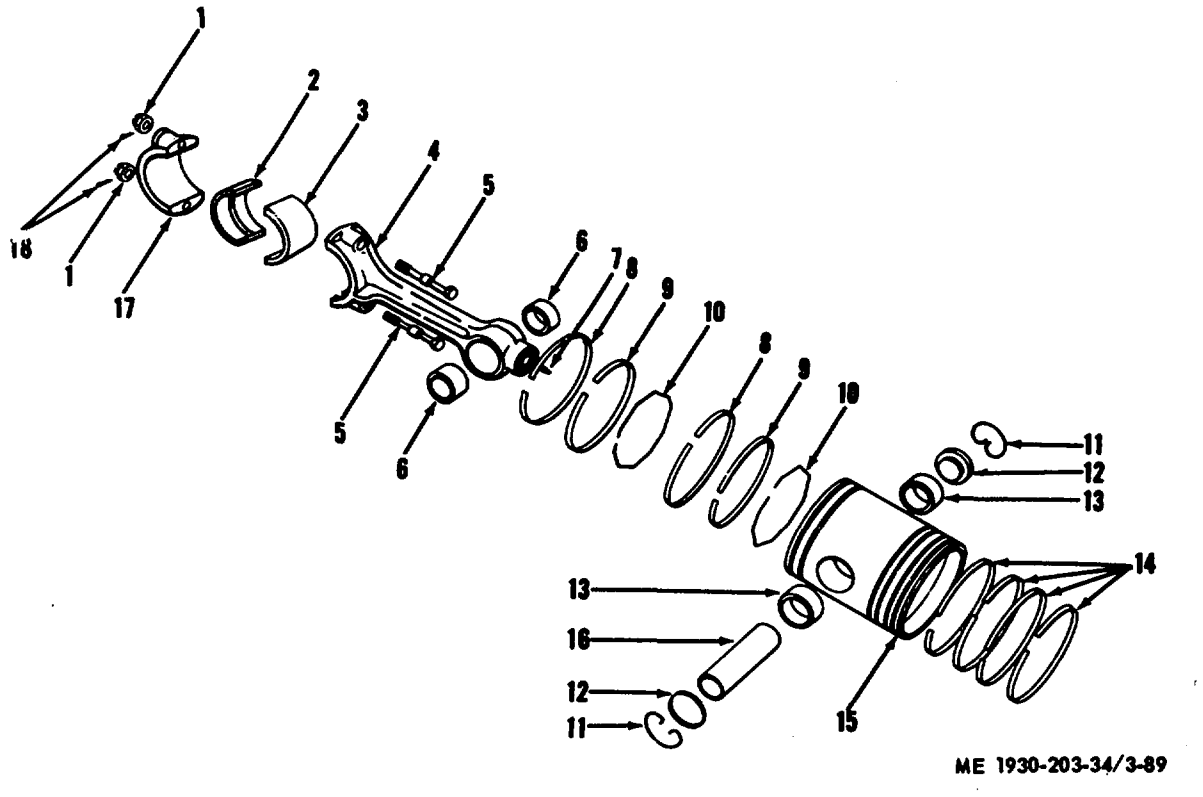


Figure 3-89. Piston and connecting rod assembly.

Key to figure 3-89.

1 Nut, slotted
2 Lower connecting rod bearing shell
3 Upper connecting rod bearing shell
4 Connecting rod
5 Bolt, connecting rod
6 Connecting rod bushing
T Connecting rod spray nozzle
8 Lower oil control ring
9 Upper oil control ring
10 Oil control ring expander
11 Retaining ring
12 Piston pin retainer
13 Piston pin bushing
14 Compression rings
15 Piston
16 Piston pin
17 Connecting rod bearing cap
18 Cotter pins

c. Disassembly.

(1) Remove lower and upper connecting rod bearing shells (2 and 3, fig. 3-89) from lower end of connecting rod (4) and connecting rod bearing cap (17).

(2) Secure connecting rod in vise equipped with soft jaws and remove piston rings.

(3) Using a pair of thin nose pliers, remove retaining ring (1) which holds piston pin retainer (12) at end of piston pin (16).

(4) Punch a hole through center of piston pin retainer (12) with a narrow chisel or punch, and pry retainer from piston (15), being careful not to damage piston.

(5) Remove piston (16) through open pinhole.

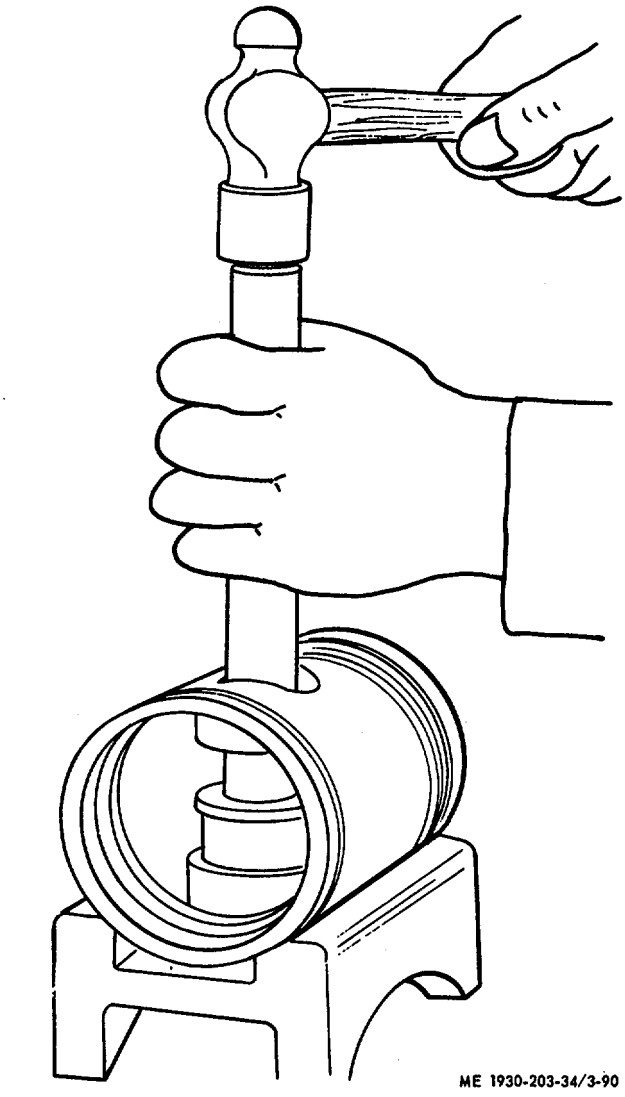
(6) Place piston (15) in piston support fixture, part No. J1513-1 (4, fig. 3-90), so that bore in piston pin bushings (13, fig. 3-89) alines with hole in base of fixture. Remove piston pin bushings from piston using driver handle, part No. J1513-2, (1, fig. 3-90), and bushing remover, part No. J1513-3(3).

(7) Place connecting rod in connecting rod holder so that connecting rod bushings (6, fig. 3-89) aline with hole in base of holder. Drive connecting rod bushings from connecting rod (4), using driver handle and bushing remover.

(8) Remove connecting rod spray nozzle (7) from connecting rod (4) as follows:

(a) Insert spray nozzle through upper end of connecting rod, and insert pin in curved side of remover in opening in bottom of connecting rod spray nozzle (7).

(b) Support connecting rod (4) and spray nozzle remover in an arbor press. Place a short sleeve directly over spray nozzle and press nozzle from connecting rod.



1 Driver handle, No. J1513-2
2 Installer
3 Bushing remover, part No. J1513-3
4 Piston support fixtures, part No. J1513-1

Figure 3-90. Removing or installing piston pin bushings in piston.

d. Cleaning, Inspection and Repair.

(1) Clean piston as follows:

(a) Clean all surfaces with dry-cleaning solvent, Federal Specification P-D-680.

(b) Using a wire brush, remove carbon and gum from upper part of piston that is not tin-plated.

(c) Clean ring grooves with a ring groove cleaner. If not available, a piece of used compression ring that has been ground to a level edge may be used.

(d) Clean oil return holes in lower half of piston skirt.

(e) Rewash in dry-cleaning solvent, Federal Specification P-D-680, and dry with compressed air.

CAUTION

When cleaning, use care not to damage tin plating on piston skirt or to enlarge oil return holes in lower half of skirt.

(2) Clean piston pin, connecting rod, bearing cap, bearing shells, spray nozzle, and bushings in clean, dry-cleaning solvent, Federal Specification P-D-680, and dry with compressed air. Using compressed air, blow out drilled oil passage in connecting rod to be sure it is clean and open.

(3) Inspect bearing shells for scoring, pitting, flaking, chipping, cracking, signs of overheating, or excessive wear. Check backs of bearing shells for bright spots which indicate shells have been shifting in their support. Discard shells if damaged, if right spots on back are noted, or if worn so that shell is less than 0.153 inch in thickness.

(4) Inspect piston pin for damage or wear. Replace pin if damaged or if pin-to-new-bushing clearance exceeds 0.010 inch. Check pin-to-retainer end clearance by subtracting length of piston pin from the dimension found by measuring distance from outer edge of one of piston bushings to outer edge of other bushing. Pin-to-retainer end clearance is not sufficient, grind end of piston pin opposite the end with stamp identification letters.

NOTE

During grinding operation, be sure end of piston pin is kept square and smooth.

(5) Inspect piston for scoring, cracks, damaged ring groove lands, and indications of having been overheated. A piston with score marks that can be cleaned may be reused (fig. 3-91). Replace piston if badly scored, overheated, or burned or if groove lands are damaged. Measure piston skirt diameter lengthwise and crosswise of piston pin bore. The taper and out-of-round, measured from a point approximately 1.88 inches from the top of the piston to the bottom of the piston. must not exceed 0.0005 inch.

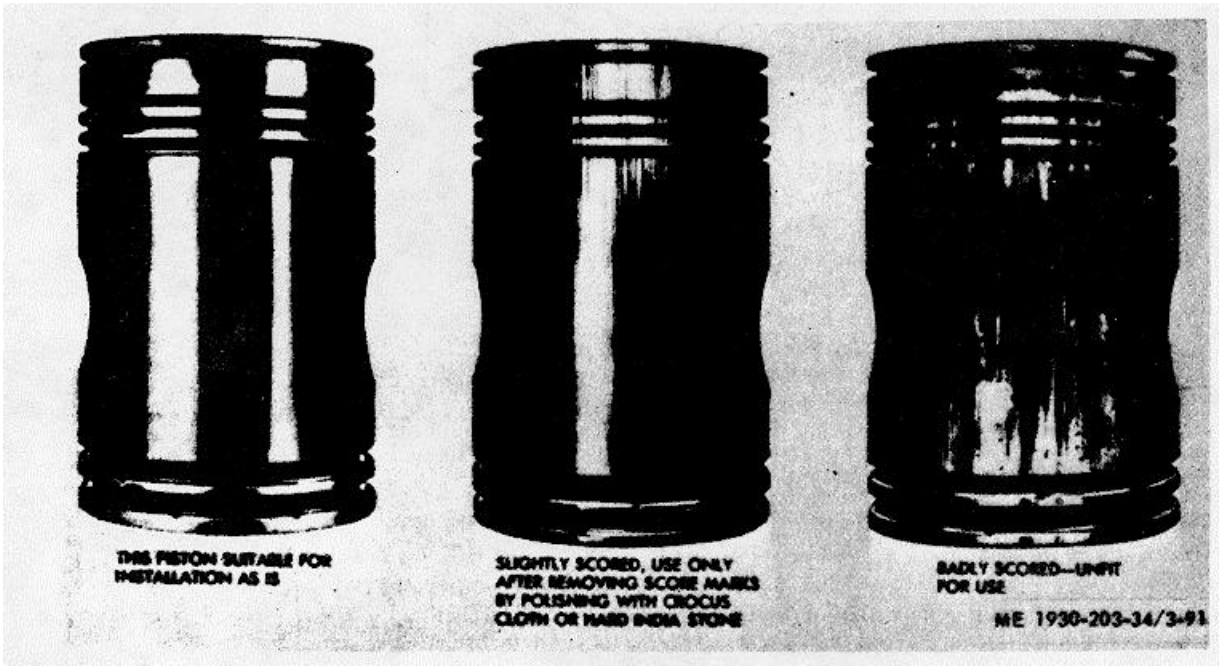


Figure 3-91. Comparison of used pistons.

NOTE

Examine cylinder liner and block bore for indications of being out-of-round, tapered, or having high spots which could cause piston failure.

(6) Inspect connecting rod for cracks by using magnetic particle method. Replace a defective connecting rod (fig. 3-92).

NOTE

If a new connecting rod is installed, stamp cylinder number on connecting rod and cap.

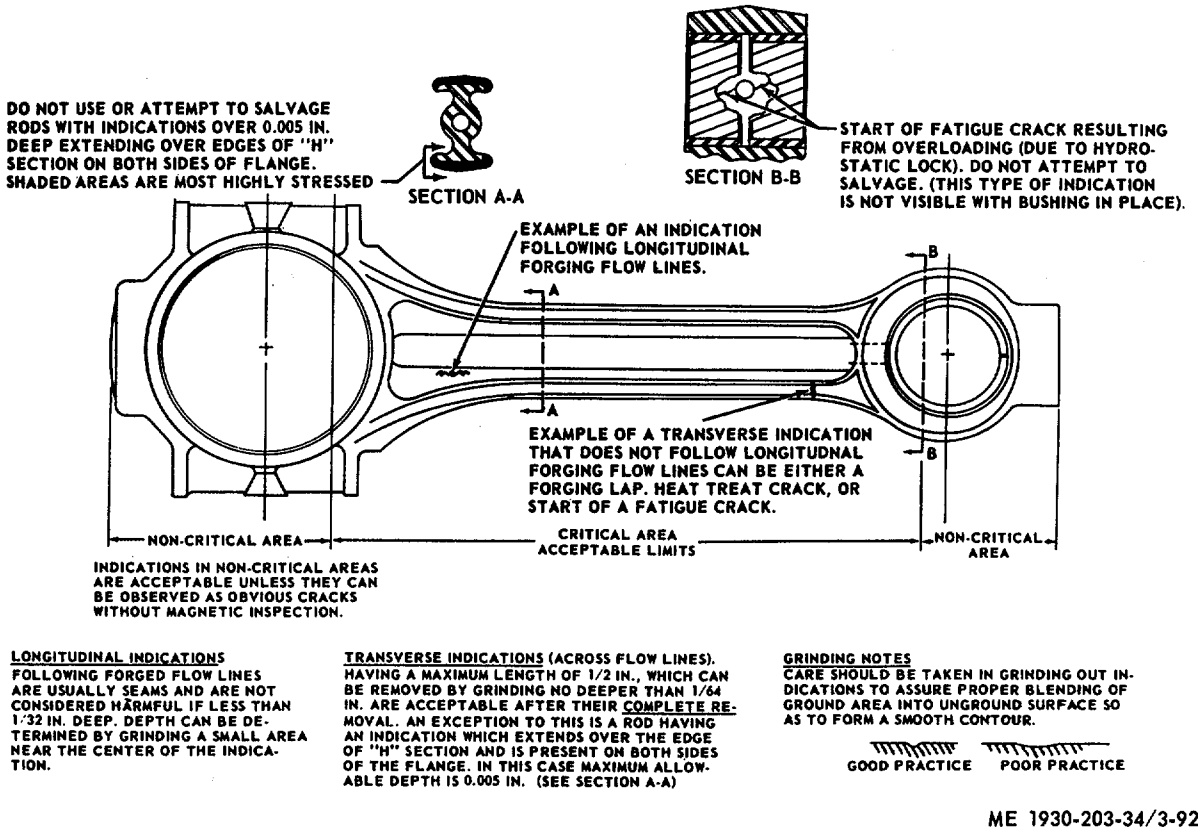


Figure 3-92. Magnetic particle inspection limits for connecting rod.

(7) Inspect piston pin for damage or wear. Outside diameter of new piston pin is 1.4996 to J.5000 inches. Maximum allowable pin-to-bushing clearance is 0.010 inch. Replace piston pin if necessary.

(8) Inspect spray nozzle for damage or closed nozzle holes. Replace nozzle if necessary.

(9) Inspect piston pin bushing and connecting rod bushing for damage or excessive wear. Inside diameter of new piston pin bushings is 1.5025 to 1.5030 inches and inside diameter of new connecting rod bushings is 1.5015 to 1.5020 inches. Maximum allowable pin-to-bushing clearance is 0.010 inch. Replace bushings if damaged, or if worn so that pin-to-bushing clearance exceeds 0.010 inch.

(10) Ream piston pin bushings as follows:

(a) Install piston pin bushings in piston as outlined in d(3) below.

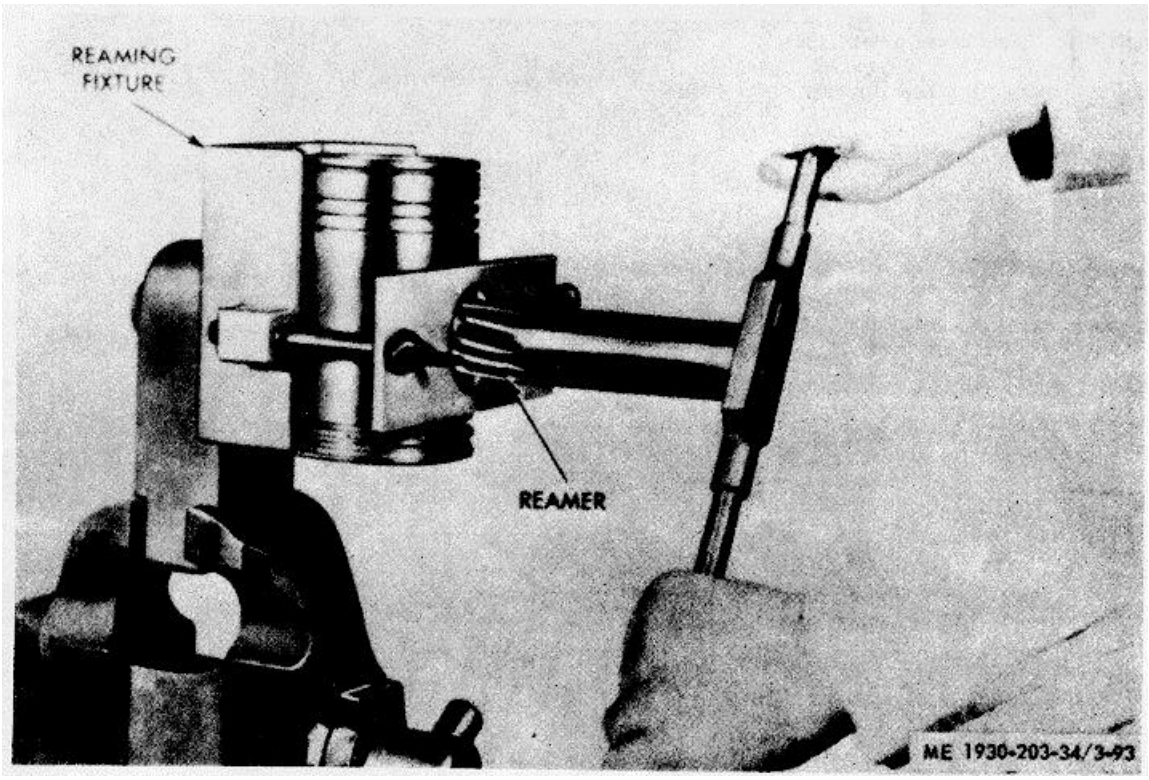
(b) Clamp reaming fixture, part No. J5273 (1, fig. 3-93) in a vise (4). Insert bushing guide in fixture and secure guide with setscrews.

(c) Place piston in fixture and insert pilot end of reamer part No. J3071-6 (3), through clamping bar, piston pin bushings, and into guide bushing.

(d) With piston (2), reaming fixture (1) and reamer (3) in alinement, tighten wing nuts securely.

(e) Ream bushings by turning reamer (3) in a clockwise direction only. Use only moderate pressure on reamer.

(f) Withdraw reamer (3) and remove piston (2) from reaming fixture (1). Remove chips with compressed air and measure inside diameter of bushings. Diameter must be 1.5025 to 1.5030 inches.



1 Reaming fixture, part No. J5273
2 Piston
3 Reamer, part No. J3071-6
4 Vise

Figure 3-93. Reaming bushing in piston.

(11) Ream connecting rod bushings as follows:

(a) Install connecting rod bushings in connecting rod as outlined in d (2) below.

(b) Clamp reamer fixture and arbor, part No. J1686-9 (2, fig. 3-94), in a vise (5).

(c) Place large end of connecting rod (3) over reamer fixture and arbor (2), and tighten connecting rod cap nuts to a torque of 65 to 75 foot-pounds.

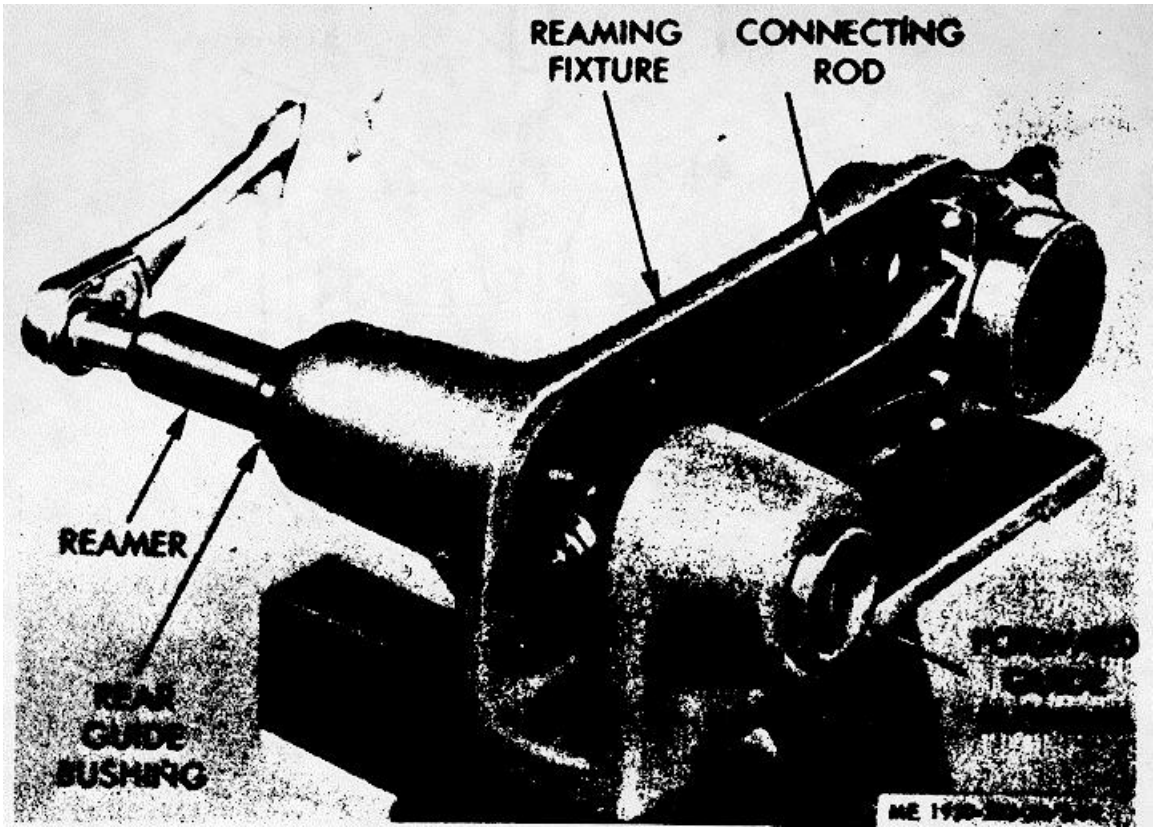
(d) Slide front guide bushing, part No. J1686-11 (4), into front guide boss with pin end facing out.

(e) Aline upper end of connecting rod (3) with opening in reaming fixture and arbor (2).

(f) Install rear guide bushing, part No. J1686-5 (6), on reamer, part No. J1686-10 (1), and insert reamer and bushing through rear guide boss of fixture.

(g)Turn reamer (1) in a clockwise direction only, when reaming or withdrawing reamer.

(h) Remove reamer (1) and connecting rod (3) from reamer fixture and arbor (2), blow out chips, and measure inside diameter of bushings. Inside diameter of bushings must, be 1.5015 to 1.5020 inches.



1 Reamer, part No. J1686-10
2 Reamer fixture and arbor part No. J1686-9
3 Connecting rod
4 Front guide bushing, part No. J1686-11
5 Vise
6 Rear guide bushing, part No. J1686-5

Figure 3-94. Reaming connecting rod bushing in connecting rod.

(12) Fit piston to cylinder liner as follows:

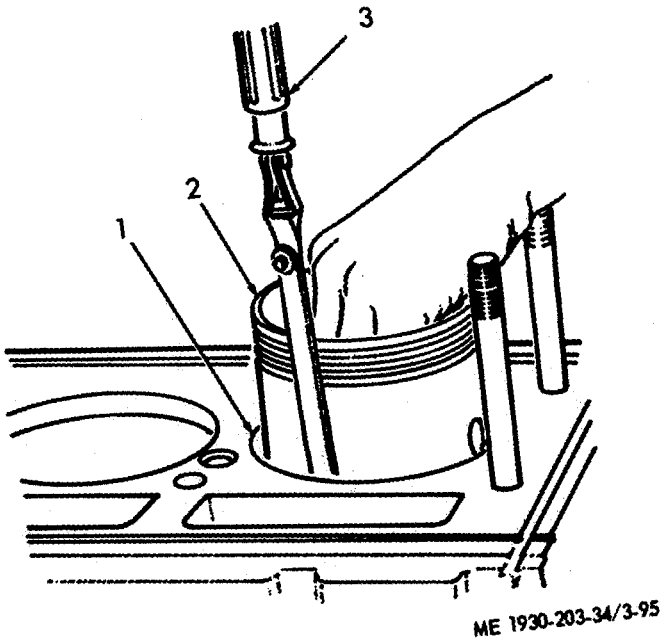
(a) Measure piston diameter and cylinder liner bore, preferably at a room temperature of 70° F.

(b) Hold piston (2, fig. 3-95) upside down in cylinder liner(1). Using gage set, part No. J5538 (3), check piston-to-liner clearance. Select a feeler gage with a thickness that will require a pull of 6 pounds to remove. Check clearance in four places, 90 degrees apart, around circumference of piston. Piston-to-liner clearance will be 0.001 inch greater than the thickness of feeler gage used. (A 0.004 inch feeler gage will indicate a 0.005 inch clearance when withdrawn with a 6 pound-pull). Maximum allowable piston-to-liner clearance is 0.012 inch. If maximum clearance is exceeded, replace cylinder liner (para 3-34).

NOTE

If binding occurs between piston and liner, remove piston and examine piston and liner for burrs. If marred, polish either part with fine hone before proceeding with clearance check.

(13) Fit piston ring to piston and liner as follows:



1 Cylinder liner
2 Piston
3 Gage set, part No. J5438

Figure 3-95. Measuring piston-to-liner clearance.

NOTE

Install new piston rings whenever a piston is removed, regardless of whether a new or used piston is installed.

(a) Insert one ring at a time inside cylinder liner bore far enough to be within normal area of ring travel. Use a piston to push ring down to assure ring is parallel with top of liner.

(b) Measure ring gap with a feeler gap with a feeler gage (fig. 3-96). Compression ring gap must be 0.018 to 0.043 inch and oil control ring gap, 0.008 to 0.023 inch. If piston ring gap is insufficient, increase gap by filling or stoning ends of ring. File or stone ring so that cutting action is from outer surface to inner surface. This prevents chipping or peeling of chrome plate on compression rings. Ends of ring must remain square and chamfer must be 0.015 on outer edge.

(c) Check ring clearance in piston ring grooves (fig. 3-97). Maximum ring-to-groove clearances for the compression rings are: top compression ring, 0.0220 inch; second compression ring, 0.0150 inch; third and fourth compression rings, 0.0130 inch. Oil control ring maximum allowable clearance is 0.0080 inch. If ring-to-groove clearances exceed maximum, replace piston.

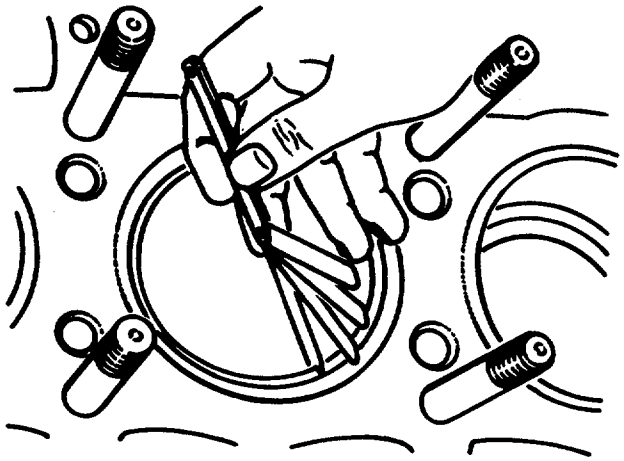


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Figure 3-96. Measuring piston ring gap with feeler gage.

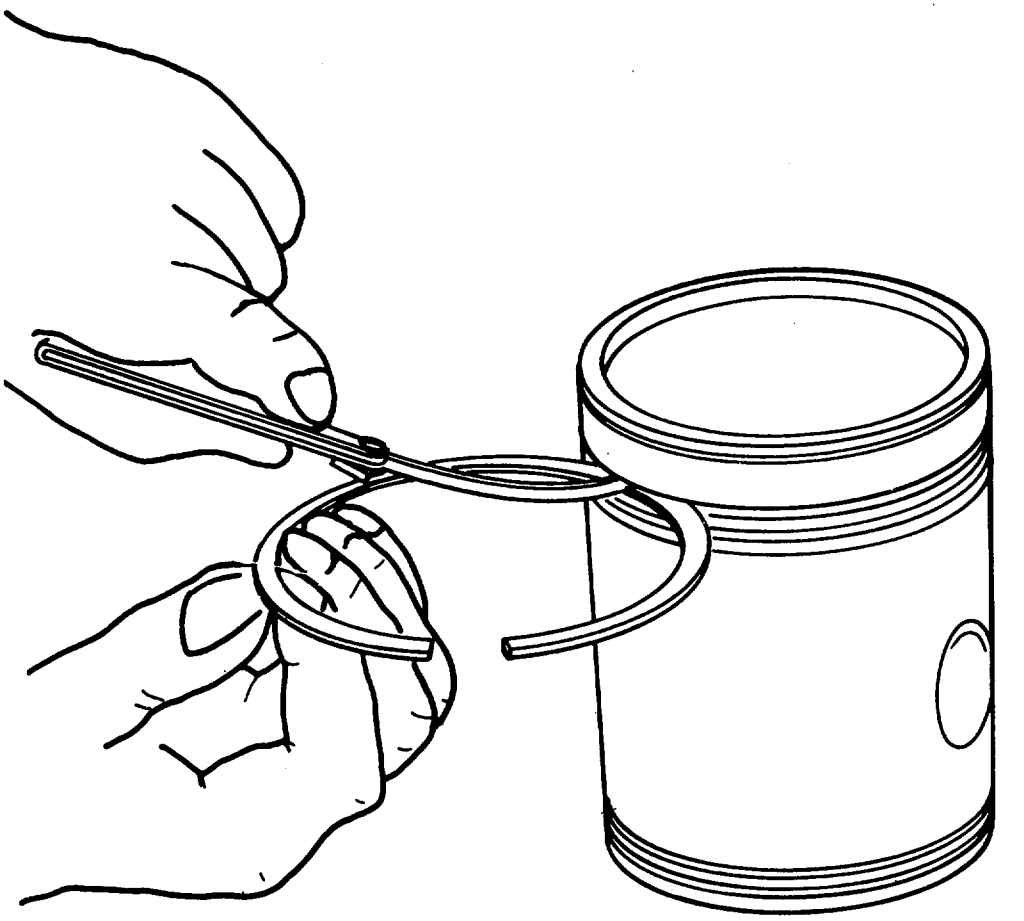

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Figure 3-97. Measuring piston ring side clearance.

e. Reassembly.

(1) Install connecting rod spray nozzle (7, fig. 3-89) in connecting rod (4) as follows:

(a) Start connecting rod spray nozzle, (7), with holes positioned as shown in figure 3-98, straight into counterbore in top of connecting rod (4, fig. 3-89).

(b) Support connecting rod in arbor press. Place a short 3/8 inch inside diameter sleeve on top of spray nozzle and under ram of press.

(c) Press connecting rod spray nozzle (7) into connecting rod (4) until it bottoms in counterbore.

(2) Install connecting rod bushing (6) in connecting rod 14) as follows:

(a) Start one connecting rod bushing (6) straight into bore of connecting rod.

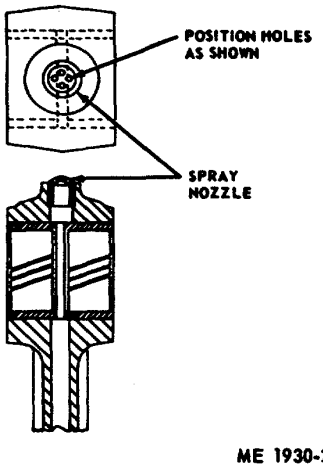


Figure 3-98. Installation of spray nozzle in connecting rod.

NOTE

This bushing joint must be toward the top of the connecting rod.

(b) Insert bushing installer, part No.J15 13-6, in bushing. Insert driver handle, part No. J1513-2 (1, fig. 3-90) in installer and drive connecting rod bushing 16, fig. 3-89) until flange of installer bottoms on connecting rod (4).

(c) Turn connecting rod over in holder, align bore in rod with hole in base of holder, and install second bushing as outlined in steps (a) and (b) above.

(3) Install piston pin bushings (13) in piston (15) as follows:

(a) Place spacer, part No. J1513-4, in hole in piston support fixture, part no. J1513-1 (4, fig. 3-90).

(b) Set piston on piston support fixture, part No. J1513-1 (4), so that spacer protrudes into bushing bore.

(c) Insert bushing installer, part No. J1513-6 in bushing. Position bushing and installer over lower bushing bore.

NOTE

The bushing joint should be located toward the bottom of the piston.

(d) Insert driver handle (1) in bushing installer (2) and drive bushing in until it bottoms on spacer.

(e) Install other bushing as outlined in (a) through (d) above.

(4) Rest piston in piston support fixture (4) and install a piston pin retainer (12, fig. 3-89) into one end of piston (15). Retainer-to-piston fit may vary from 0.001 inch loose to 0.005 inch press fit; therefore, it may be necessary to drive piston pin retainer in piston.

CAUTION

Do not drive too hard on retainer when installing piston pin retainer in piston, since bushing may move inward and decrease piston pin end clearance.

(5) Secure piston pin retainer (12) with retaining ring (11) and with prongs of ring bearing against piston pin retainer. Make sure retainer ring is seated firmly in groove.

(6) Coat piston pin and bushings with clean engine oil.

(7) Place upper end of connecting rod (4) between piston pin bosses and in line with piston pin holes. Slide piston pin (16) in place. If piston pin-to-bushing clearances are within specified limits, pin will slip into place without use of force.

(8) Install second piston pin retainer as outlined in (4) and (5) above.

(9) Install oil control rings on piston as follows:

NOTE

Scraping edges of rings must face toward bottom of piston.

(a) Place oil control ring expanders (10) in two ring grooves of piston (15) below piston pin.

(b) Install upper oil control rings (9) in grooves with gaps 180 degrees from gaps in oil control ring expanders (10).

(c) Install lower oil control rings (8) in grooves with gaps 45 degrees from gaps of upper oil control rings (9).

(10) Using piston ring remover and installer, install compression rings (14) on piston (15). Position compression rings so that gaps are staggered around piston.

CAUTION

When installing rings, do not spread them-any more than necessary to slip

them over piston. This will avoid breaking or overstressing piston rings.

f. Installation.

(1) Note that the lower end of each connecting rod and cap is marked in sequence, 1 to 6. These numbers identify caps with rods and show particular cylinder in which each rod is used.

(2) Make certain piston ring gaps are staggered around piston (15, fig. 3-89), then apply generous film of clean engine oil, Military Specification MIL-L-2104, to piston and rings.

(3) Place piston and connecting rod assembly on bench with head of piston (15) down and slide ring compressor down over the assembly with tapered end of tool toward head of piston, thus compressing piston rings.

(4) Rotate crankshaft until journal of connecting rod (4) is at bottom of its travel, wipe journal clean, and lubricate with engine oil.

(5) Install upper connecting rod bearing shell (3), the one with short groove and oil hole at each parting line, in connecting rod (4).

(6) Aline piston and connecting rod assembly with ring compressor in place, with top of cylinder liner and line up lower end of connecting rod (4) with crankshaft, then push piston (15) down into place.

(7) Install lower connecting rod bearing-shell (2) into connecting rod bearing shell (2) into connecting rod bearing cap (17) with tang or bearing shell in cap groove.

(8) Install connecting rod bearing cap (17), lock cap securely in place with bolts (5), nuts (1), and cotter pins (18); tighten nuts to a torque of 65 to 75 foot-pounds.

(9) Install lubricating oil pump (para 3-26).

(10) Install oil pan assembly (para 3-24).

(11) Install cylinder head (para 3-6).

3-33. Crankshaft and Main Bearing Assembly

a. Description. The crankshaft is a one-piece steel forging, heat treated to insure strength and durability. All main bearing, rod bearing, and oil seal surfaces are induction hardened. Complete static and dynamic balance of the crankshaft is achieved by the use of counterweights. Replaceable main bearing shells are used on each main bearing journal and consist of an upper and lower shell. Thrust washers, located on each side of the rear main bearing, absorb crankshaft thrust. Two oil seals, one pressed into the crankshaft front cover and the other pressed into flywheel housing, prevent oil from seeping out along the journals at either end of the crankshaft.

b. Removal

(1) Remove engine (para 2-11).

(2) Remove oil pan assembly (para 3-24).

(3) Remove lubricating oil pump assembly (para 3-26).

(4) Remove torque converter (para 2-12) and flywheel housing (para 3-29).

(5) Remove vibration damper and power takeoff coupling (para 3-28).

(6) Remove capscrews (4, fig. 3-99) lockwashers (5), and support assembly (6).

(7) Remove trunnion support ring (7) from crankshaft front cover (12).

(8) Remove capscrews securing crankshaft front cover (12) to engine block. Remove cover and gasket (13) with crankshaft front seal (1). Remove seal from cover.

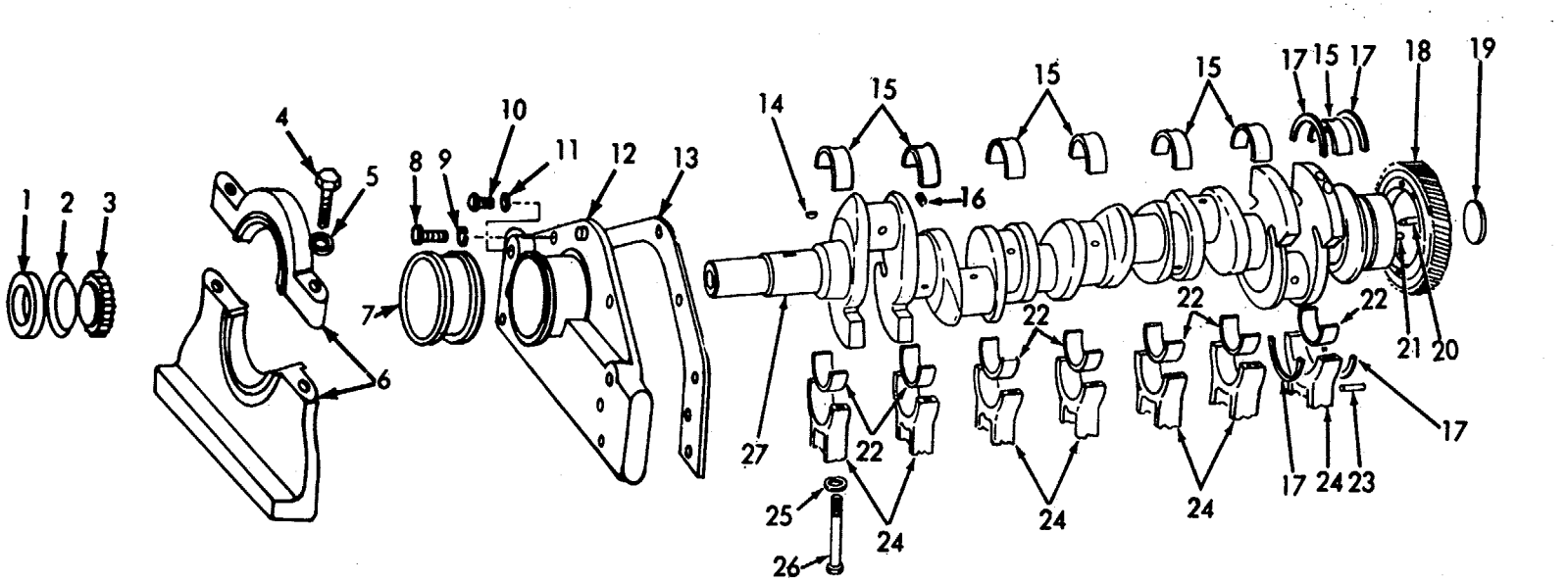
(9) Slide oil slinger (2) from crankshaft.

(10) Remove connecting rods and pistons (para 3-32).

(11) Remove two bolts (26) and lockwashers (25) from each main bearing cap (24) and remove bearing caps.

(12) Remove thrust washers from each side of rear main bearing.

(13) Remove crankshaft, including crankshaft timing gear (18) and oil pump drive gear (3).



1 Crankshaft front seal
2 Oil slinger
3 Oil pump drive gear
4 Capscrew, 7/16 x 2 ¼
5 Lockwasher, 7/16 in.
6 Support assembly, front trunnion
7 Ring, front trunnion support
8 Capscrew, 3/8 x 1 ¼
9 Lockwasher, 3/8 in.
10 Capscrew, ½ x 2 ¼
11 Lockwasher, ½ in.
12 Crankshaft front cover
13 Gasket, crankshaft front cover
14 Key
15 Upper bearing shelf
16 Plug
17 Washer
18 Crankshaft timing gear
19 Crankshaft oil baffle
20 Crankshaft dowel
21 Special plug
22 Lower bearing shell
23 Pin
24 Main bearing cap
25 Lockwasher
26 Bolt, main bearing cap
27 Crankshaft

Figure 3-99. Crankshaft and main bearing assembly.

c. Disassembly.

(1) Screw cone retainer bolt into tapped hole in front end of crankshaft (27, fig. 3-99). Attach jaws of gear puller behind oil pump drive gear (3) and locate point of puller screw in center of retainer bolt. Pull oil pump drive gear off crankshaft, and remove key (14) from crankshaft.

(2) Remove crankshaft timing gear (18) (para 3-30).

(3) Remove upper bearing shell (15) from cylinder block and lower bearing shells (22) from main bearing caps (24).

(4) Using a small punch, punch a hole in crankshaft oil baffle (19) and pry from crankshaft.

(5) Remove plugs (16) from crankshaft.

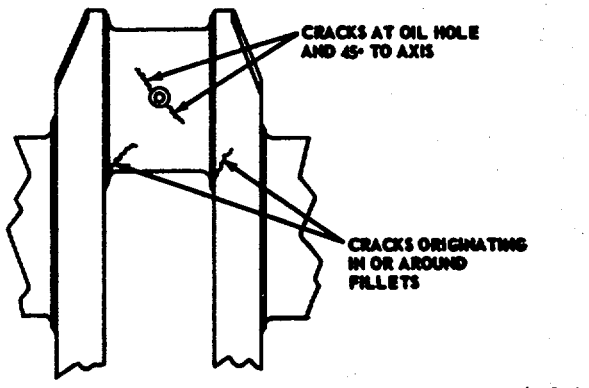


Figure 3-100. Crankshaft fatigue cracks.

d. Cleaning, Inspection and Repair.

(1) Clean crankshaft and related parts in dry-cleaning solvent, Federal Specification P-D-680. Clean out all oil passages in crankshaft. Dry with compressed air (10 psi).

(2) Place crankshaft on its front and rear journals in a lathe or blocks and check alinement at adjacent journals, using a dial indicator. If runout (total indicator reading) at number two and number six journals exceeds 0.002 inch, or at number three and number five journals exceeds 0.004 inch, or at number four journal exceeds 0.006 inch, replace crankshaft.

(3) Measure all main and connecting rod bearing journals. Journals should be measured at several places on circumference, in case journals have worn out-of-round condition. If taper or out-of-round condition exceeds the dimensions given in table 1-1, replace crankshaft.

(4) Inspect crankshaft main bearing journals for ridging caused by the groove in upper main bearing shell. Ridges exceeding 0.0002 inch must be removed. Remove ridges by working crocus cloth, Federal Specification P-C-458, wet with fuel oil, around the circumference of crankshaft journal. If ridges are greater than 0.0005 inch, first use 120 grit emery cloth to clean up ridge, followed by use of 240 grit emery cloth for finishing. Then wet crocus cloth, Federal Specification P-C-458, should be used for polishing. If ridges are greater than 0.001 inch, replace crankshaft.

(5) Inspect surfaces of crankshaft for evidence of cracks. Cracks originating in or around journal fillets and oilholes and running at an angle of 45° to axis (fig. 3-100) indicate torsional fatigue. Crankshafts with this condition are not suitable for repair and should be replaced. Use magnetic partical inspection process, Military Specification MIL-L-6868, to determine presence of minute cracks not visible to the eye. Demagnetize crankshaft in accordance with Military Specification MIL-I-6868. Replace a defective crankshaft.

(6) Inspect thrust surfaces for evidence of excessive wear or roughness. Grind thrust surfaces slightly to dress up a rough condition. If surface is worn so that new thrust washers will not hold end thrust clearance within specified maximum limit of 0.018 inch, use 0.005 inch oversize thrust washers; or regrind or replace crankshaft.

(7) Inspect thrust washers for scoring, damage, or wear. Replace thrust washers if scored, damaged, or worn so that crankshaft end thrust exceeds 0.018 inch.

(8) Inspect keyway for evidence of cracks or other damage. Replace a defective shaft.

(9) Inspect oil seals for scored, cracked, or charred surfaces. Check seals for hardness or brittleness. Replace seals if necessary. Inspect crankshaft in area of rear oil seal contact for evidence of rough or grooved condition. Crankshaft surface must be smooth to prevent damaging seal lip when oil seal is installed. Remove a slight groove with 120 grit emery cloth followed by 240 grit emery cloth, rotating crankshaft during operation to prevent out-of-round condition. Use crocus, Federal Specification P-C-458, wet with fuel oil, to polish surface. If crankshaft (3, fig. 3-101) or rear oil seal (1) surface is grooved excessively, spacer (2) may be installed between the counterbore in flywheel housing and oil seal to establish a new contact surface.

(10) Inspect crankshaft timing gear for chipped teeth or other damage. Replace a defective gear.

(11) Inspect oil pump gear for uneven wear of broken, or chipped teeth. Replace a defective gear.

(12) Replace a damaged shaft key.

(13) Inspect front cover for cracks and warpage. Replace defective cover. Replace front cover gasket.

(14) Inspect main bearing shells for scoring, pitting, flaking, chipping, cracking, or signs of

overheating. Check back of bearing shells for bright spots which indicate they have been moving in their caps or crankcase. If any of the above conditions are noted, replace bearings.

(15) Inspect bearing shells for excessive wear. Using ball attachment micrometer, part No. J4757 (3, fig. 3-102) place between main bearing shell (1) and micrometer (2), measure shell thickness at a point 90 degrees from parting line. The bearing shell thickness will be total thickness of steel ball in tool and shell, less diameter of ball. Minimum thickness of bearing shell is 0.153 inch. Check clearance between main bearing shells and crankshaft journals. The clearance is determined by measuring outside diameter of crankshaft main bearing journals and inside diameter of main bearing shells when installed in place with proper torque of 180 to 190 foot-pounds. Clearance between any crankshaft main bearing journal and its bearing shell should not exceed 0.006 inch. If shell thickness is less than minimum or bearing journal-to-shell clearance exceed 0.006 inch, replace all bearing shells.

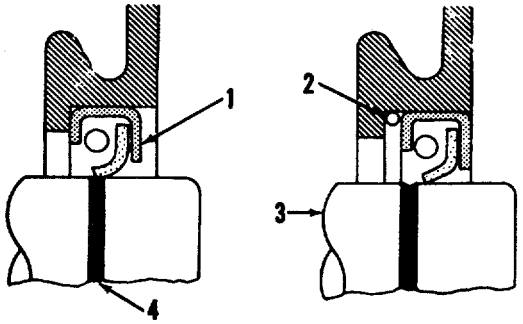


Figure 3-101. Use of spacer on grooved crankshaft.

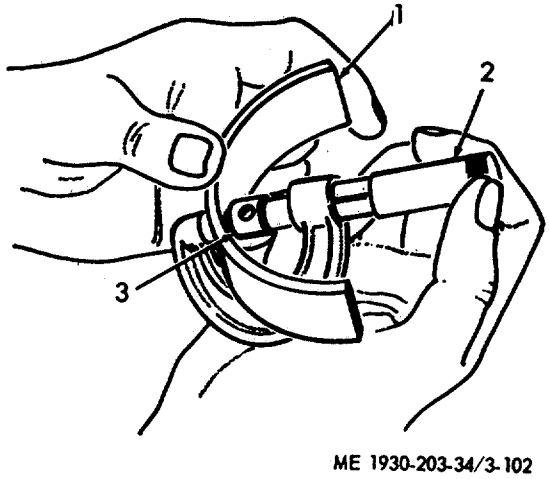


Figure 3-102. Measuring thickness of main bearing shell.

e. Reassembly.

(1) Replace plugs (1 6, fig. 3-99) in crankshaft.

(2) Repack grease in crank cavity and press crankshaft oil baffle (19) into crank cavity until it seats firmly against special plug (21).

(3) Install crankshaft timing gear (18) para 3-30).

(4) Install key (14) in crankshaft (27).

(5) Position oil pump drive gear (3) so that chamfer on gear hub is toward main bearing and start gear on crankshaft and over key (I14). Using a cup or pipe, drive oil pump drive gear (3) tight against shoulder on crankshaft.

(6) Install oil slinger (2) on crankshaft and in place next to oil pump drive gear (3) with dished outer diameter of oil slinger away from gear.

f. Installation.

(1) Install upper bearing shells (15, fig. 3-99) in cylinder block.

(2) Apply clean engine oil to all crankshaft journals and set crankshaft in place so that timing marks on crankshaft timing gear (18) and gear train idler gear match.

(3) Install upper half of rear main bearing washers (17) on each side of bearing, and doweled lower halves on each side of rear main bearing cap (24).

(4) Install lower bearing shells (22) in main bearing caps (24) and install caps in their original position and draw bolts (26) up snug. Tap caps sharply with a soft hammer to seat them properly. Draw bearing cap bolts tight and uniformly, starting with center cap and working alternately toward both ends of block, to a torque of 180 to 190 foot-pounds. Torque in 30-40 foot-pounds increments and rotate crankshaft at each increment to check for binding.

NOTE

Main bearing caps are bored in position and marked 1. 2. 3, etc. They must be replaced in their original positions with marked side of caps toward blower side of cylinder block.

(5) Check crankshaft end play at thrust washers. Clearance should be from 0.004 to 0.011 inch with new parts or a maximum of 0.18 inch with used parts. Insufficient clearance will usually denote misalinement of rear main bearing. Loosen and retighten rear main bearing and recheck clearance.

(6) Install connecting rods and pistons (para 3-32).

(7) Apply grease, Military Specification MIL-G-1 0924, to crankshaft front seal 111 and press into crankshaft front cover (12) so that lip of seal is pointed toward inner face of cover. Secure cover and gasket (13) to engine block.

(8) Install trunnion support ring (7), and support assembly (6), on crankshaft front cover (12).

(9) Install vibration damper and power takeoff coupling (para 3-28).

(10) Install flywheel housing (para 3-29) and torque converter (para 2-12).

(11) Install lubricating oil pump assembly (para 3-26).

(12) Install oil pan assembly (para 3-24).

(13) Install engine (para 2-11).

Section XI. CYLINDER LINER AND CYLINDER BLOCK ASSEMBLY

3-34. Cylinder Liner

a. Removal.

(1) Remove cylinder head (para 3-6).

(2) Remove piston and connecting rod assembly (para 3-32).

NOTE

Even though the cylinder liners are a loose fit in the engine block, after the engine has been in service for an extended period, considerable effort may be required to loosen the liners from their position.

(3) Using cylinder liner remover, part No. J1918-02, remove cylinder liner as follows:

(a) Slip lower puller clamp up puller rod and off its tapered seat. Tilt clamp on rod off its tapered seat and lower rod through center of cylinder liner. Clamp will drop into its proper position on tapered seat.

(b) Slide upper puller clamp down against top edge of cylinder liner.

(c) Strike a sharp blow with puller weight on upset head at top of puller rod. This will release liner.

(d) Remove cylinder liner from engine (fig. 3-103).

(4) Remove liner insert from cylinder block bore.

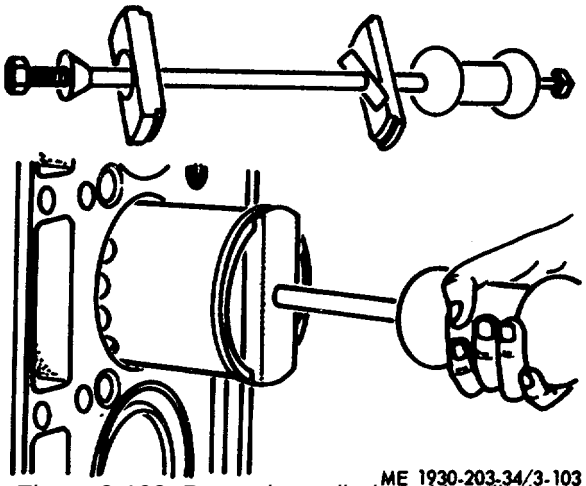


Figure 3-103. Removing cylinder with cylinder liner remover, part No. J1918-02.

b. Cleaning, Inspection and Repair.

(1) Clean cylinder liner with dry-cleaning solvent, Federal Specification P-D-680, and dry with compressed air.

(2) Inspect cylinder liners for cracks, scoring, nicks, scratches, or burrs. Replace liners if cracked or scored. Liners that are nicked, scratched, or burred may be cleaned with a soft stone, Military Specification MIL-S-2389, and reused.

(3) Inspect flange of cylinder liner to assure it is smooth and flat on both top and bottom surfaces. Check for cracks at liner flange. Replace liner if flange is damaged.

(4) Inspect outside diameter of cylinder liner for fretting. Fretting is caused by slight movement of liner in block bore during engine operation and causes material from block to adhere to liner. Remove these metal particles from liner with a coarse, flat stone.

(5) Measure inside diameter of cylinder liner bore and outside diameter of cylinder liner. Replace liner if maximum clearance of 0.003 inch is exceeded.

NOTE

Steps (6) through (7) will be performed with liner in cylinder block.

(6) Using bore gage, part No. J5347, check inside diameter of cylinder liner for wear, taper, and out-of-round condition (fig. 3-104). Taper must not exceed 0:002 inch and out-of-round must not exceed 0.003 inch. If liner inside diameter is more than 0.002 inch out-of-round, rotate liner 90 degrees and recheck. If inside diameter is tapered or out-of-round beyond specified limits or worn in excess of 4.251 1 inches, replace cylinder liner.

(7) If inside diameter wear, taper, or out-of-round condition does not exceed wear limits, hone liner to remove ridge at top of piston ring travel and remove glaze formed by rubbing action of piston rings. Remove glaze with a 120 grit stone in such a manner as to produce a criss-cross pattern with hone marks on 45 degrees axes.

NOTE

Do not modify the factory finish on the bore of a new service cylinder liner. Any change in a new surface finish will greatly affect ring seating. However. never install new rings in a used liner unless the glaze is broken.

(8) After honing cylinder liner, wash liner in clean fuel oil and dry with compressed air. Liner must still conform to same limits of taper and out-of-round condition as a standard size liner.

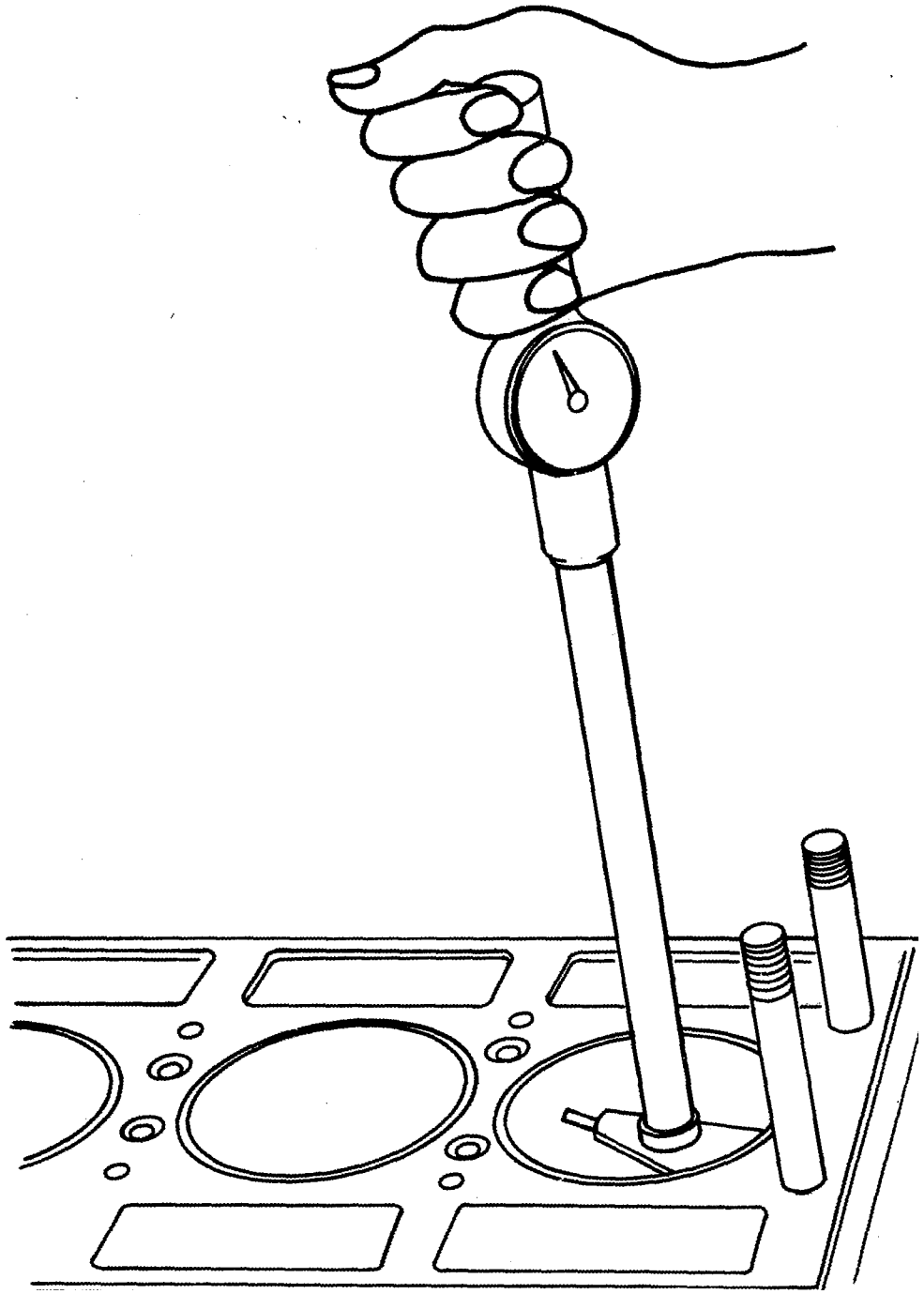


Figure 3-104. Checking diameter of cylinder liner with bore gage, part No. J5347.

c. Installation

(1) Wipe inside and outside of cylinder liner clean and be sure that bore in engine block is clean.

(2) Install a cylinder liner inset (3, fig. 3-105) into the counterbore to receive liner flange.

(3) Push cylinder liner into position in cylinder block by hand until flange rests on cylinder liner insert (3). When liner is in place, top face of liner upper flange should be from 0.0465 to 0.050 inch below top surface of cylinder block. The difference

in depth below top of block between any two adjacent liners must not exceed 0.002 inch.

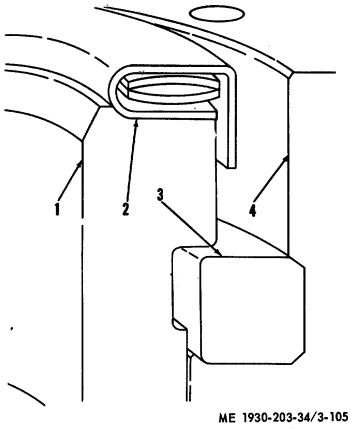
(4) Install compression gasket (2) on upper side of liner flange.

(5) Install pistons and connecting rod assemblies (para 3-32).

CAUTION

Use holddown clamps to hold each installed cylinder liner in place when rotating crankshaft to prevent moving of liner and possible breaking of oil control rings.

(6) Replace cylinder head (para 3-6).



1 Cylinder liner
2 Compression gasket
3 Cylinder liner insert
4 Cylinder block

Figure 3-105. Cylinder liner mounting in block.

3-35. Cylinder Block Assembly

a. Description. The cylinder block assembly is an integral casting forming the primary structure part of the engine. Both ends of the cylinder block are similar; the same flywheel housing and gear train can be installed on either end. Transverse members, cast integrally, provide rigidity and strength and insure alinement of bores and bearings under load. Water jackets extend full length of the cylinder bores and are divided into upper and lower sections connected by hollow struts. Drilled passages in the cylinder block carry lubricating oil to all moving parts, thus eliminating the need for external piping. Hand hole covers on the side opposite the blower permit access to the air chamber and inspection of pistons and rings through air intake parts in the cylinder walls.

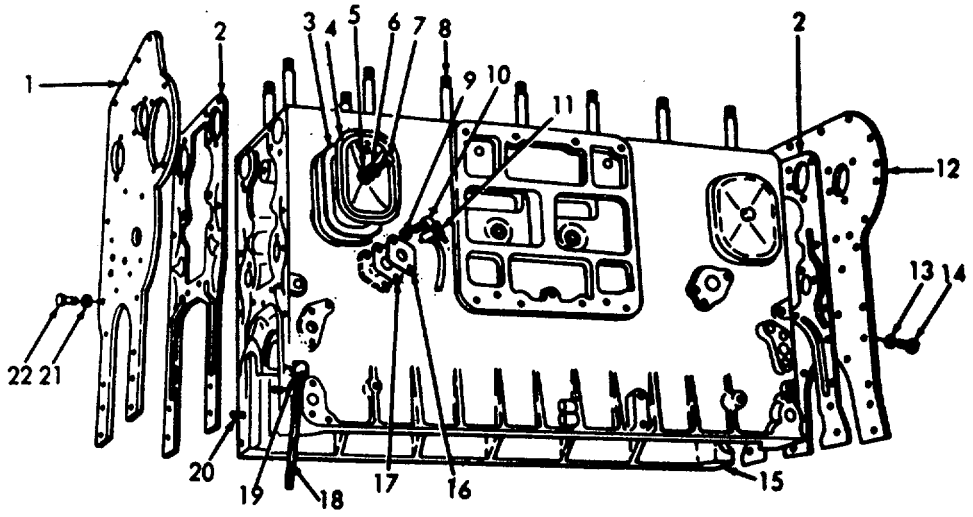
b. Removal Remove engine (para 2-11).

c. Disassembly.

(1) Remove governor (para 3-13).
(2) Remove cylinder head (para 3-6).
(3) Remove fluid starting aid (para 3-14).
(4) Remove lubricating oil cooler assembly (para 3-15).
(5) Remove oil filters (para 3-16).
(6) Remove blower (para 3-22).
(7) Remove blower drive (para 3-23).
(8) Remove flywheel housing (para 3-29).
(9) Remove power take-off coupling and vibration damper (para 3-28).
(10) Remove lubricating oil pump (para 3-26).
(11) Remove oil pressure regulator (para 3-27).
(12) Remove timing gear train (para 3-30).
(13) Remove camshaft and balance shaft (para 3-31).
(14) Remove pistons and connecting rods (para 3-32).
(15) Remove crankshaft and main bearings (para 3-33).
(16) Remove cylinder liners and inserts (para 3-34).
(17) Remove handhole covers (4, fig. 3-106) and water hole covers (16).
(18) Remove airbox drain tube (18, fig. 3-106) and elbow (19).
(19) Remove capscrews and lockwashers attaching rear end plate (1) to cylinder block. Lift end plate off dowel pins (20) and remove end plate gasket (2). Remove front end plate (12) and gasket in similar manner.
(20) Remove plugs from cylinder block.
(21) Remove dowel pins (20) if loose or damaged.
(22) Remove cylinder head studs (8) if damaged.

d. Cleaning, Inspection and Repair.

(1) Steam clean block to remove grease.



1 Rear end plate
2 End plate gasket
3 Gasket
4 Cover
5 Gasket (copper)
6 Washer, flat 3/8 in.
7 Capscrew, 3/8 x 2 1/8 in.
8 Stud, plain
9 Lockwasher
10 Capscrew, 5/ 16 x 3/4 in.
11 Drain cock
12 Front end plate
13 Lockwasher, ½ in.
14 Capscrew, ½ x 1 1/8 in.
15 Cylinder block
16 Water hole cover
17 Gasket
18 Air box drain tube
19 Elbow
20 Dowel pin
21 Lockwasher, 3/8 in.
22 Capscrew, 3/8 x 1 in.

Figure 3-106. Cylinder block assembly.

(2) If water jacket is heavily scaled, clean as follows:

(a) Agitate block in suitable acid bath.

(b) Allow block to remain in acid bath until bubbling action stops (approximately 30 minutes).

(c) Lift block, drain, andreimmerse in same acid solution for 10 minutes.

(d) Repeat operation in (c) above until all scale is removed.

(e) Rinse block in clear, hot water to remove acid solution. Neutralize remaining acid that may cling to casting by immersing in suitable alkaline bath.

(f) Wash in bath of clean water.

(3) Check cylinder block for leaks and cracks as follows:

(a) Install plugs in cylinder block.

(b) Make all water inlet and outlet openings air tight with cover plates. Drill and tap one cover plate to provide a connection for an air line.

(c) Immerse cylinder block for 20 minutes in a tank of water heated to 180° to 200° F.

(d) Connect airhose to fitting in cover plate and apply 80 to 1 0psi air pressure to water jacket. Observe water for bubbles which would indicate a crack or leak in block.

(e) Replace cylinder block if cracks or leaks are indicated.

(4) Inspect cylinder block face for flatness, using an accurate straightedge. Top face of block must not vary over 0.003 inch transversely or 0.009 inch longitudinally. Blower mounting pad must not vary more than 0.004 inch over its entire surface. Replace cylinder block if these tolerances are exceeded.

(5) Inspect cylinder block bores as follows:

(a) Hone cylinder bore throughout its entire length and check contact area as revealed by honed surface. There should be no low spots which are larger than a half dollar.

(b) Measure entire bore with a dial indicator. Block bore diameter should not exceed 4.6280 inches. Bore out-of-round should not exceed 0.003 inch, or taper exceed 0.002 inch.

(c) Replace block if bores do not meet specifications for diameter, taper, and out-of-round or if liner-to-block fit is greater than 0.003 inch.

(6) Inspect main bearing bores as follows:

(a) Measure main bearing bore inside diameter with main bearing caps secured in their proper location with bolts tightened to a torque of 180 to 190 foot- pounds. If bearing bore diameters exceed 3.813 inch, replace cylinder block.

(b) Check main bearing bores for alignment. If crankshaft can be rotated freely by hand after new main bearing shells have been installed, bearing bores may be considered properly alined. If any main bearing bore is more than 0.001 inch out of alinement, replace block.

(7) Inspect cylinder liner counterbore for squareness, proper depth, and correct diameter. Counterbores should have a depth of 0. 4785 to 0.4795 inch and diameter of 5.0460 to 5.0485 inch. Counterbored surfaces must not vary in depth more than 0.001 inch around entire circumference. Replace cylinder block if these tolerances are exceeded.

(8) Inspect both surfaces on each end plate for scratches or score marks. All surfaces must be smooth and flat. Remove slight scratches or nicks with a soft stone. Military Specification MIL-S-2389 and polish smooth with crocus cloth, Federal Specification P-C-458.

CAUTION

If cylinder block is not used immediately, spray machined surfaces with engine oil to prevent rust.

d. Reassembly.

(1) Install new dowel pins (20, fig. 3-106) and cylinder head studs (80 where damaged dowel pins and studs were removed.

(2) Attach new end plate gaskets (2) to each end of cylinder block (15), using nonhardening cement.

(3) Using dowel pins (20), set front end plate (12) next to cylinder block (15) and loosely install capscrews (I 4) and lockwashers (13). Insert a camshaft end bearing through small bearing bore in front end plate (12) and into bore of block to accurately aline end plate and cylinder block. Tighten capscrews to a torque of 71 to 75 foot-pounds. Reove camshaft end bearing.

(4) Install rear end plate (1) in the same manner as in step (3) above, except tighten capscrews (22) to a torque of 30 to 35 foot-pounds.

(5) Install handhole covers (4, fig. 3-106) and water hole covers (16).

(6) Install elbow (19) and air box drain tube (18).

(7) Install cylinder liners and inserts (para 3-34).

(8) Install crankshaft and main bearings (para 3-33).

(9) Install pistons and connecting rods (para 3-32)

(10) Install oil pressure regulator (para 3-27).

(11) Install lubricating oil pump (para 3-26).

(12) Install camshaft and balance shaft (para 3-31).

(13) Install timing gear train (para 3-30).

(14) Install flywheel housing (para 3-29).

(15) Install oil pan (para 3-24).

(16) Install vibration damper and power take-off coupling (para 3-28).

(17) Install torque converter (para 2-12).

(18) Install blower drive (para 3-23).

(19) Install blower (para 3-22).

(20) Install air starting motor (para 3-18).

(21) Install fuel pump assembly (para 3-19).

(22) Install water pump (para 3-17).

(23) Install lubricating oil cooler assembly (para 3-15).

(24) Install oil filters (para 3-16).

(25) Install cylinder head (para 3-6).

(26) Install governor assembly (para 3-13).

(27) Install electrical tachometer generator (para 6-3).

(28) Install fluid starting aid (para 3-14).

e. Installation. Install engine (para 2-11).

Section XII. EXHAUST PIPING AND MUFFLER ASSEMBLY

3-36. Exhaust Piping.

a. Description. The engine exhaust piping is composed of stainless steel tubing which carries the exhaust gages from the engines to the mufflers. The piping consists of replaceable tubes, elbows and flanges, and is insulated by fiberglass.

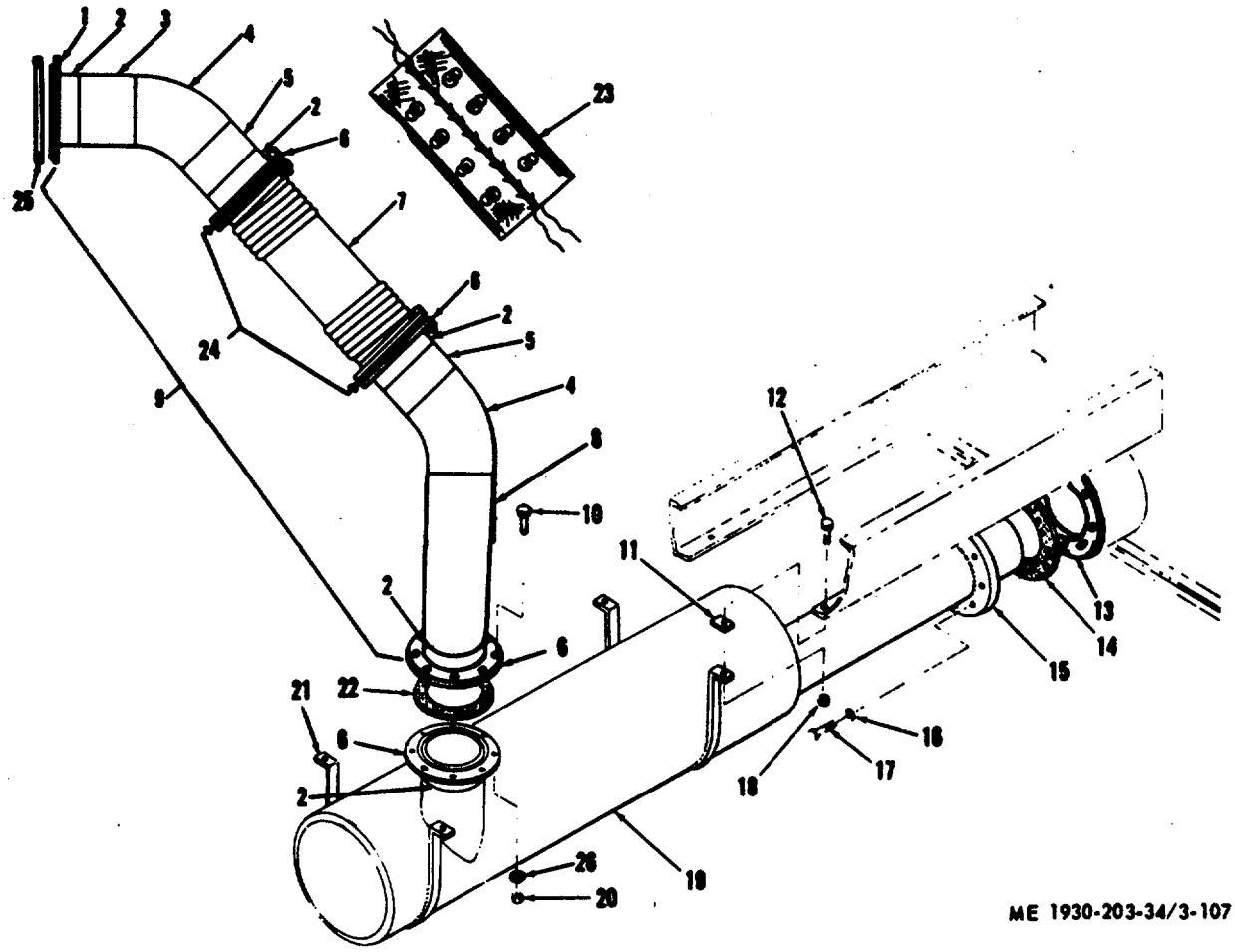
b. Removal

(1) Remove insulation.

(2) Remove bolts securing exhaust piping assembly (9, fig. 3-107) to exhaust manifold and muffler.

(3) Remove exhaust piping assembly and gaskets (22 and 25).

(4) Remove flexible hose assembly (7) from exhaust piping. Remove gaskets (24).



1 Backup flange
2 Flange stub
3 Exhaust pipe tube 7-13/16 in. lg
4 Elbow
5 Exhaust pipe tube, 2-3/16 in. lg
6 Backup flange
7 Flexible hose assembly
8 Exhaust pipe tube, 6-13/16 in. lg
9 Exhaust piping assembly
10 Bolt, machine, No. 10 x 1-1/4 in.
11 Insulation pad
12 Bolt. machine, 3/8 x 1-1/4 in
13 Seal plate
14 Gasket packing ring to hull connection
15 Packing ring
16 Lockwasher, 3/8 in.
17. Bolt, machine 3/8 x 1 in.
18 Nut, 3/8 in.
19 Muffler Assembly
20 Nut, No. 10
21 Hanger strap
22 Gasket. muffler to exhaust pipe
23 Insulating blanket
24 Gasket. exhaust pipe to flexible hose assembly
25 Gasket, exhaust pipe to manifold
26 Lockwasher

Figure 3-107. Exhaust piping and muffler

c. Cleaning, Inspection and Repair. Inspect exhaust piping for corrosion and cracks. Grind away and replace defective parts.

NOTE

If welded parts of the exhaust piping are being replaced, install piping in correct position to properly align connections before welding. For welding procedures refer to paragraph 11-3.

d Installation.

(1) Assemble flexible hose assembly (7, fig. 3-107) and gaskets (24) to backup flanges (6).
(2) Install exhaust piping assembly (9) and gaskets (22 and 25) between exhaust manifold and muffler.
(3) Install insulating blanket (23) on flexible hose assembly (7) and wrap balance of exhaust

piping with 1 inch thick insulation. Military Specification MIL-1-16411, Type 2.

(4) Cover insulation, except insulating blanket, with fibrous cloth, Military pecification MIL-1-16411, Type2.

3-37. Exhaust Muffler Assembly

a. Removal.

(1) Remove enough insulation from around exhaust muffler and piping to permit working on joints at exhaust muffler ends.

(2) Remove bolts (10, fig. 3-107), nuts (20), and lockwashers (26) attaching muffler assembly to exhaust piping. Remove gasket (22).

(3) Remove bolts (17) and lockwashers (16) attaching muffler assembly to hull connection.

(4) Support muffler assembly and remove bolts (12), insulation pad (11), and nuts (18) securing hanger straps (21) to main power train foundation.

(5) Pull muffler assembly away from hull connection until tail pipe is clear of connection and remove muffler assembly and gasket (14).

(6) Remove remainder of insulation from exhaust muffler.

(7) If muffler assembly is being replaced, remove weld from around packing ring (15) and slide packing ring off tail pipe.

b Cleaning, Inspection and Repair.

(1) Tap outside surfaces of muffler assembly with a wooden mallet or rubber hammer to break loose any deposits. Clean muffler assembly with a wire brush and compressed air.

(2) Inspect muffler assembly for corrosion and cracks. Replace a corroded or cracked muffler assembly.

(3) Inspect hanger straps on muffler assembly for breaks or distortion. If hanger straps are broken or distorted, remove weld from around hanger straps and remove hanger straps. Bend new hanger straps around muffler and weld in place with a double fillet weld.

(4) Inspect gaskets for cracks andbrittleness. Replace cracked or brittle gaskets

c. Installation.

(1) If seal plate (13, fig. 3-107) was removed, smooth welding area with grinder, and insert new seal plate. Weld seal plate in place.

NOTE

Install muffler in correct position to properly aline seal plate before welding. For welding procedures refer to paragraph 11-3.

(2) If packing ring (15) was removed, slide packing ring and gasket (14) over tail pipe, and insert tail pipe through hull connection.

NOTE

Tail pipe should be flush with outside shell plate.

(3) Position gasket (22) in place and secure muffler to exhaust piping with bolts (10),lockwashers (26), and nuts (20).

(4) Secure muffler hanger straps (21) to main power train foundation withbolts (12), insulation pads (11), and nuts (18).

(5) Secure packing ring (15) and gasket (14) to hull connection with bolts (17) andlockwashers (16) .

(6) Weld packing ring to tail pipe with a 1/4- inch single fillet weld.

(7) Wrap muffler assembly with 1 inch thick insulation fiberous, Military Specification MIL-1-6411, Type 2.

(8) Cover insulation with fiberous cloth, Military Specification MIL-1-16411, Type 2.

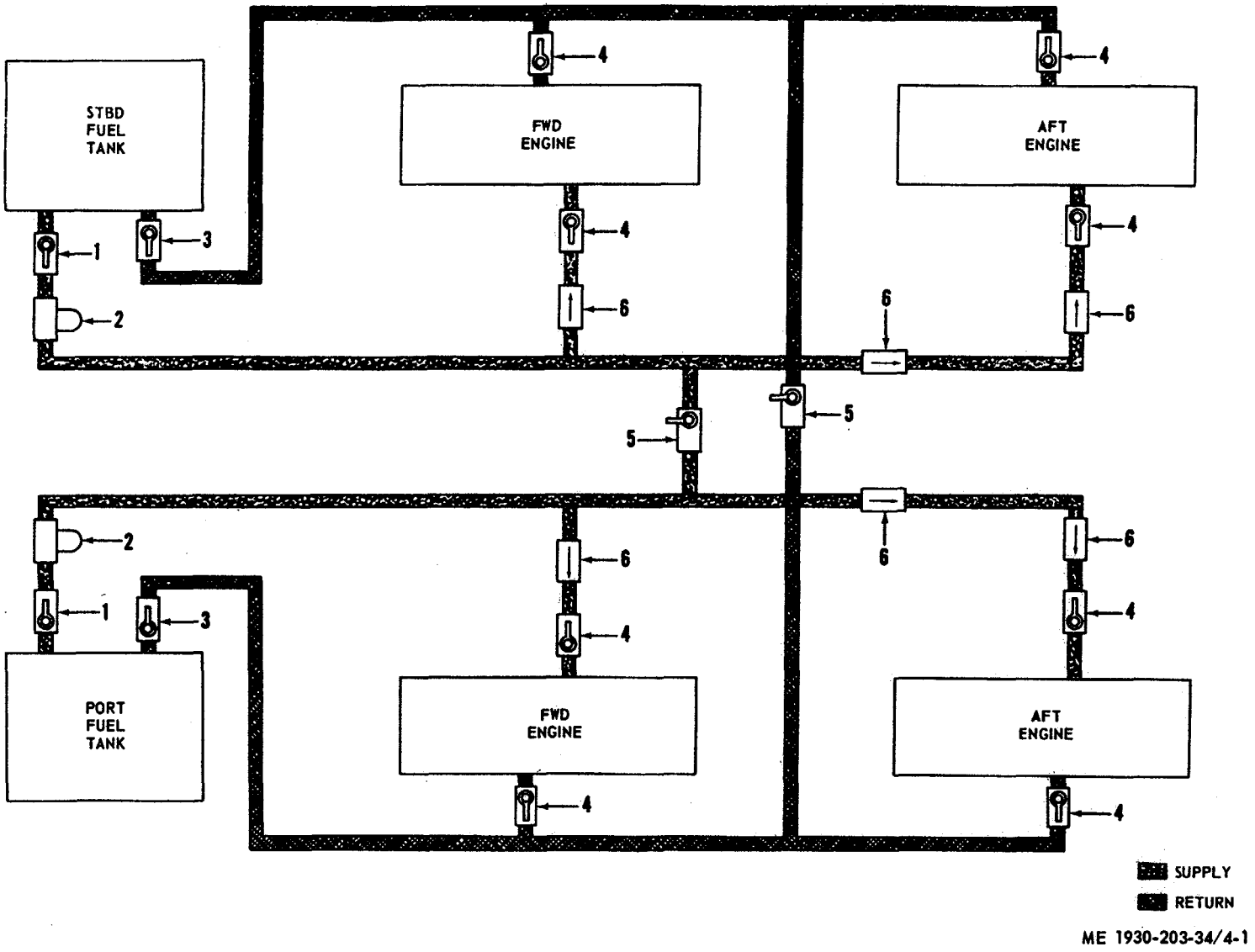
CHAPTER 4

REPAIR OF FUEL SYSTEM

Section I . FUEL TANK

4-1. Description

A 300-gallon fuel tank is located on the forward port and starboard sides, on the wing compartments. The tanks are constructed of 12-gage sheet Corten steel, and the top is covered by a 3 /16 inch thick steel plate. A vent valve fitted with a 4 to 6 ounce bronze spring is located on top of each fuel tank and is designed to open at a ,vacuum of 6.5 to 0.75 inch of water. Cross-over transfer lines connect the two tanks (fig. 4-1). Access to the tanks is provided through the scuttles at the forward port and starboard wing compartments.



1 Plug valve
2 Fluid pressure filter
3 Plug valve
4 Plug valve
5 Plug valve
6 Check valve

Figure 4-1. Fuel system schematic

4-2. Fuel Tank

a. Removal

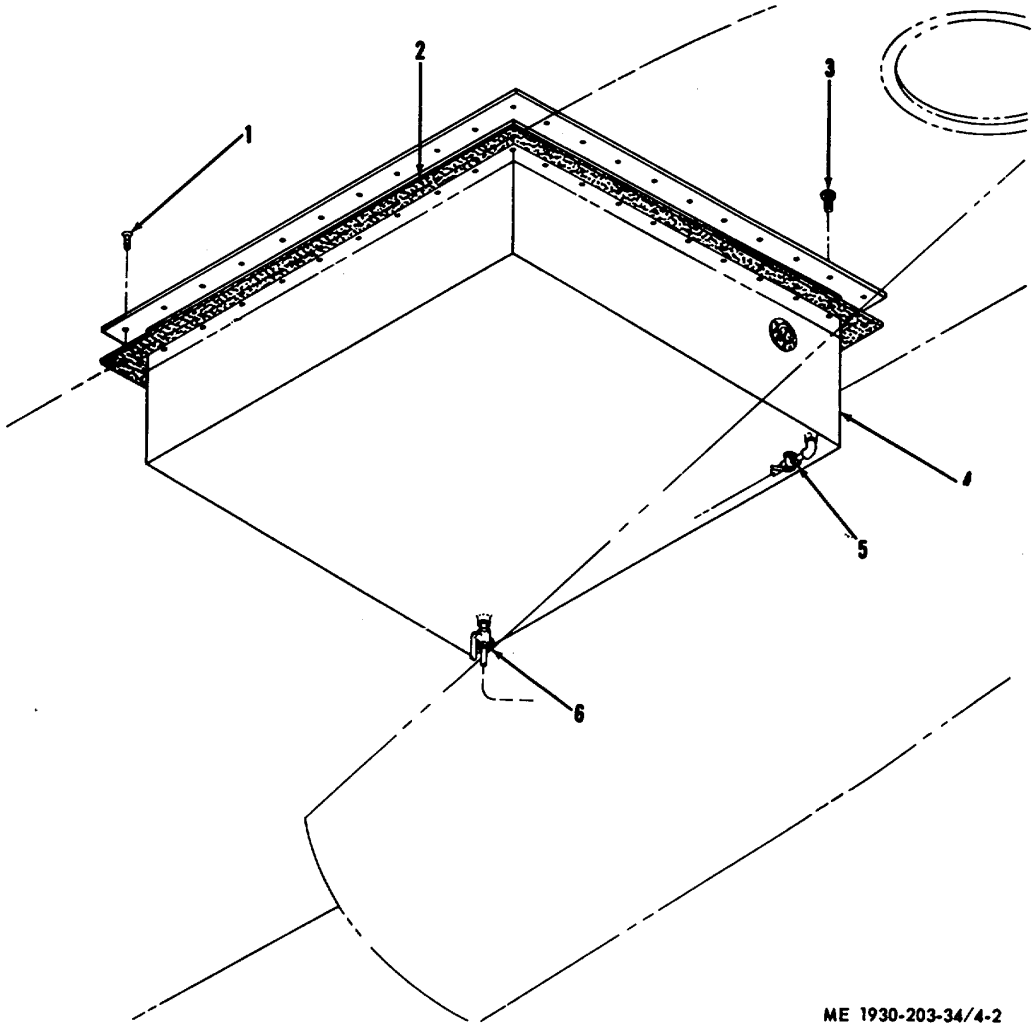
(1) Close plug valves (5 and 6, fig. 4-2).
(2) Disconnect fuel lines from plug valves.
(3) Remove capscrews (1) which secure fuel tank to deck.
(4) Remove capscrews (3) in the four corners of fuel tank top and insert four lifting eyes in their place.
(5) Using a crane, lift and remove fuel tank. Remove old gasket.

b. Cleaning, Inspection and Repair.

(1) Clean exterior of fuel tank with clean fuel oil and dry thoroughly.
(2) Flush interior of fuel tank with water and steam to remove sediment and foreign matter.
(3) Scrape gasket surfaces clean.
(4) Inspect all threaded surfaces for defective threads. Chase threads to remove minor damage. Replace badly damaged threaded parts.
(5) Inspect fuel tank for damage or signs of leakage. Repair fuel tank leaks by welding (para 11-3).

WARNING

Fill fuel tank with water before welding to prevent the danger of exploding fuel fumes which may be trapped in a tank.



1 Capscrew, flat head, 3/ 8 x 2 in.
2 Gasket
3 Capscrew, hex head, 3/ 4 x 1 in.
4 Fuel tank
5 Plug valve 1/4 in.
6 Plug valve 1/2 in.

Figure 4-2. Fuel tank

c. Installation

(1) Using fuel tank as a template, punch holes in new gasket and place in position.
(2) Lower fuel tank into position with a crane.
(3) Secure fuel tank to deck with capscrews (1, fig. 4-2).
(4) Remove four lifting eyes and install capscrews 13).
(5) Connect fuel lines to plug valves (5 and 6).

d. Fluid Pressure Filter Removal

(1) Close plug valve (1, fig. 3-64, TM 55-1930-203-20) in a supply line at base of fuel tank.
(2) Remove fuel oil lines and fittings from casting head (3, fig. 3-65, TM 55-1930-203-20).
(3) Loosen mounting bracket and remove fluid pressure filter.

e. Fluid Pressure Filter Installation. Install fluid pressure filter in reverse order of removal.

Section II ENGINE HAND THROTTLE CONTROLS

4-3. General

Four throttle control levers, one for each engine are located on the instrument board in the cab. Each throttle control lever is connected to a throttle control valve by a control rod. The throttle control levers revolve on needle bearings on a common shaft. Two outside control levers utilize two sets of needle bearings each, whereas the two inside control levers use only one set each. Rod end bearings must be adjusted to 21 13/32 inches between centers to provide full travel of the throttle control levers from idle to full throttle.

4-4. Maintenance

a. Removal and Disassembly (fig. 4-3).

(1) Remove bolts (15), lockwashers (18), and nuts (19) from both ends of control rods (14). Remove control rods.

(2) Loosen setscrews (4) and remove knobs

(3) Remove bolts (2) and lockwashers (1) and remove throttle control levers (5 through 8) as an assembly from beneath the instrument board.

(4) Loosen three setscrews (10) and remove the two outside throttle lever rod supports 111).

(5) Remove throttle control levers (5 through 8), washers (12), needle bearings (13), and center throttle lever rod support (11) from throttle lever rod (9).

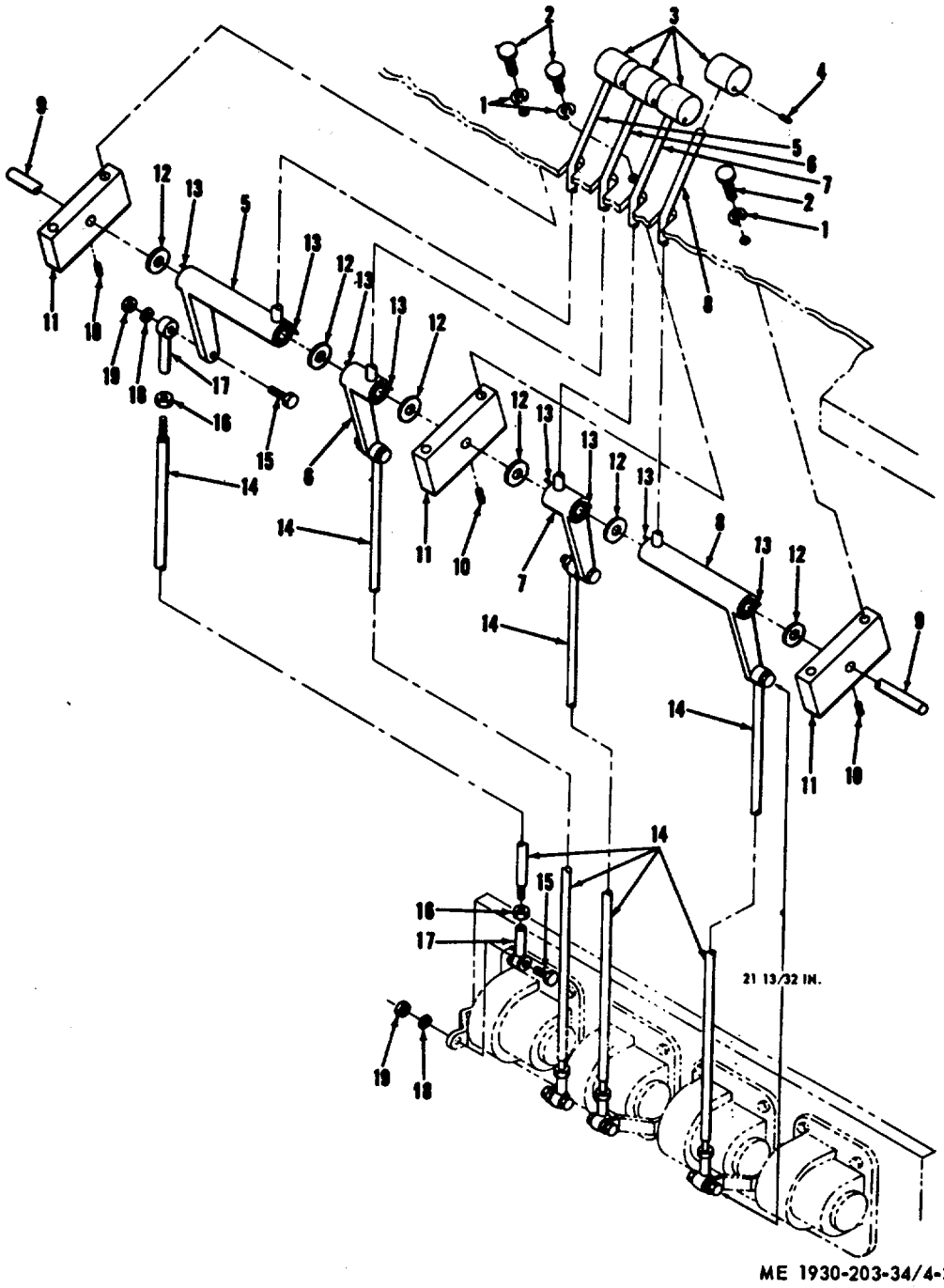
b. Cleaning, Inspection, and Repair.

(l) Clean all parts in dry-cleaning solvent, Federal Specification P-D-680, and dry with low pressure air (10 psi).

(2) Inspect condition of needle bearings 113, fig. 4-3) and rod end bearings, Replace if necessary.

(3) Inspect throttle control components for damage and repair or replace as necessary; fabricate new part using old part as a model.

c. *Reassembly and Installation.* Reassemble and install throttle controls in the reverse order of removal and disassembly. Pack needle bearings (13) with grease, Military Specification MIL-G- I 0924, prior to installation. Adjust rod end bearings (17) on control rod (14) to obtain 21 13 / 32 inches between rod end bearing centers and secure with jamnuts (16), prior to installation.



I Lockwasher
2 Bolt
3 Knob
4 Setscrew
5 Throttle control lever
6 Throttle control lever
7 Throttle control lever
8 Throttle control lever
9 Throttle control lever rod
10 Setscrew
11 Throttle control lever rod support
12 Washer
13 Needle bearing
14 Control rod.
15 Bolt
16 Jamnut
17 Rod end bearing
18 Lockwasher
19 Nut

Figure 4-3. Engine handle throttle controls.

CHAPTER 5

REPAIR OF COOLING SYSTEM

Section I. GENERAL

5-1. Description

The LARC cooling system is composed of four radiators, water pumps, expansion tanks, and cooling coil and oil cooler installations along with necessary tubing and fittings. The oil cooler installation consists of two oil-to-water heat exchangers connected in parallel in each engine cooling water system. They are used for cooling the marine gear and gathering box lubricating oil.

5-2. Cooling System Service

The procedures for draining, refilling, and cleaning the cooling system are contained in TM 55-1930-203-20.

Section II. RADIATOR ASSEMBLY AND EXPANSION TANK

5-3. Radiator

a. Description. The four radiators, one for each engine cooling system, are of copper and brass construction, and are mounted on the aft section of the LARC. During land operation the radiators expel heat to the atmosphere in the conventional manner. During marine operation heat is transferred- to surrounding water by submerged cooling coals in the aft wheel wells.

b. Removal. For radiator assembly removal, refer to paragraph 2-31.

c. *Disassembly*

(1 Remove flathead screws, nuts, and washers from around top flange of radiator.

(2) Pull off radiator top header and separate cork gasket.

(3) Remove bottom header in the same manner.

(4) Remove vibration damper in each side of radiator by loosening setscrew and nut, and unscrewing the damper.

(5) Pull side members off core.

c. Cleaning, Inspection and Repair.

(1l Flush radiator core with steam or hot water. If sediment within the core cannot be completely removed by this method, radiator should be rodded out. This procedure consists of passing a metal rod through the inside diameter of the tubing which makes up the radiator core, thereby removing trapped sediment.

(2) Clean top and bottom headers with steam or hot water. Dry with low pressure compressed air.

(3) Clean radiator fins with compressed air. Remove all foreign matter from air passages.

(4) Inspect radiator for visual signs of leakage, rust content, clogged cores, and bent cooling fins. Repair as necessary.

(5) Inspect interior and exterior radiator surfaces for corrosion and pitting. Repair or replace as necessary.

(6) Inspect inside surfaces of top and bottom headers. Make sure surfaces are clean and smooth.

(7) Inspect screws, nuts, and washers for cracks, deformation, structural damage, and corrosion. Replace as necessary.

(8) Inspect air vent petcock located on top of radiator. If petcock is inoperable or damaged, replace.

(9) Inspect painted surfaces of radiator for flaking, chipping, and scratches. Repair as necessary.

d. Reassembly. Reassembly is in reverse order of disassembly. In replacing gaskets, use cork strip 1 /4 inches wide by 1/16 inch thick. Coat both sides with an adhesive sealer, and place gasket over the bolting area of the top and bottom tanks. At the corners, be sure gasket strips are cut evenly where they join to provide a flush fitting watertight seal. Boltholes in gaskets are made with a gasket punch.

e. Testing. Plug up the inlet and outlet of radiator and immerse the radiator in water and apply air pressure approximately IO psi to radiator. Watch for air bubbles as an indication of leakage.

f. *Installation.* Refer to paragraph 2-31.

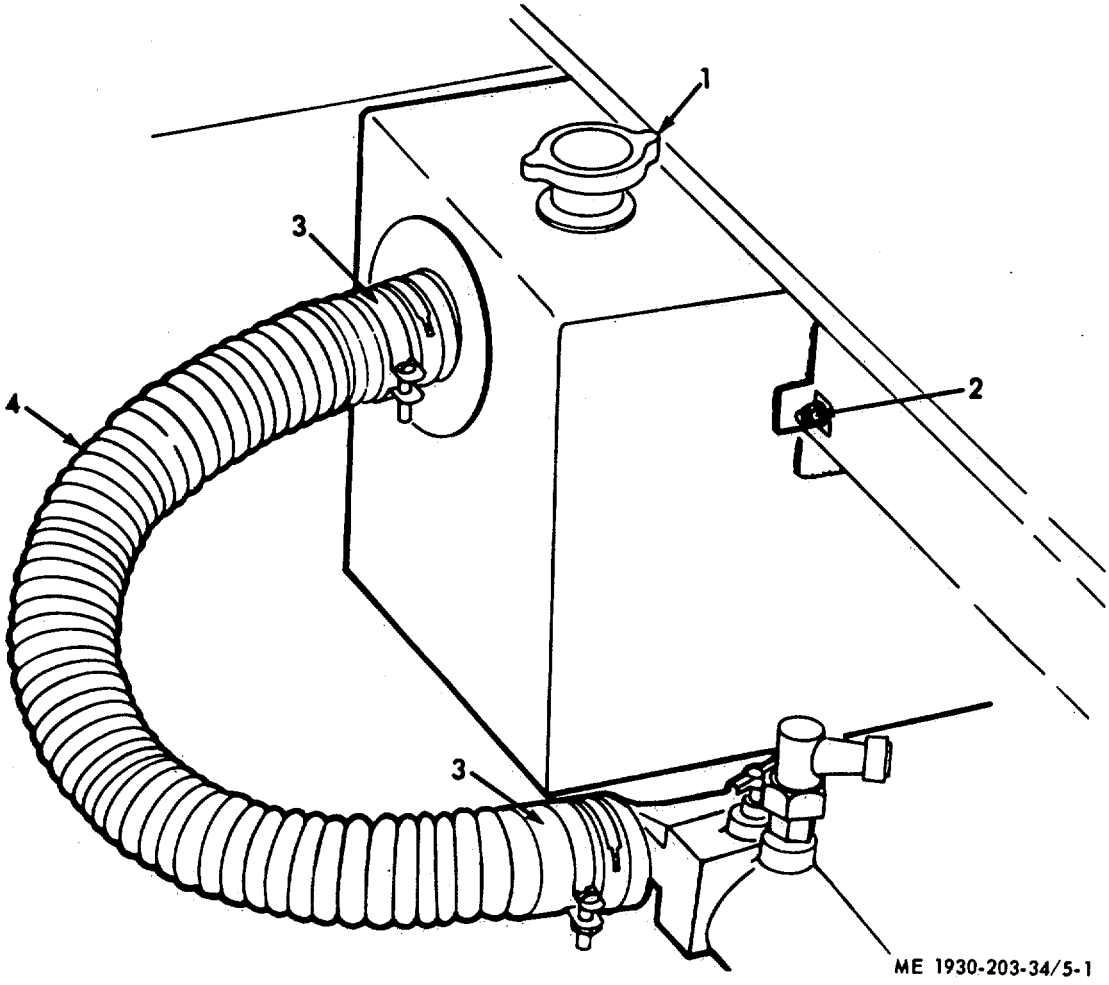
5-4. Expansion Tank

a. Description .An expansion tank (fig. 5-1), with a 7-psi pressure cap, is mounted by each engine. The expansion tanks are of welded steel construction and are used as reservoirs for maintaining a full system.

b. Removal.

(1) Drain cooling system below level of expansion tank (TM 55-1930-203-20).

(2) Disconnect expansion tank inlet and outlet hoses (3, fig. 5-1).
(3) Remove bolts (2) lockwashers, and nuts which secure expansion tank to bulkhead and lift off tank.
(4) Remove pressure cap (1)



1 Cap, radiator
2 Bolt, machine: tank mtg
3 Clamp, hose
4 Hose, rubber

Figure 5-1. Expansion tank and line.

c. *Cleaning, Inspection and Repair.*

(1) Flush interior of expansion tank with steam or hot water. Dry with low pressure compressed air.

(2) Clean exterior surfaces of expansion tank with a cloth moistened with dry-cleaning solvent, Federal Specification P-D-680. Dry with low pressure compressed air.

(3) Inspect expansion tank for cracks, breaks dents, loose welds, leaks, structural damage, and corrosion. Repair as necessary.

(4) Inspect painted surfaces on expansion tank for flaking, chipping, and scratches. Repaint as necessary.

(5) Inspect bolts, lockwashers, and nuts for cracks, deformation, structural damage, and corrosion. Replace as necessary.

d. Installation. Installation of expansion tank is in reverse order of removal.

Section III RADIATOR STERN LOUVRES, COOLING COILS , TUBING AND FITTINGS

5-5. Radiator Stern Louvers

a. Description. There are four radiator stern louvers installed on the aft end of the LARC. The louvers are of welded steel construction and are used to admit air to the radiator ducts and to keep foreign matter from entering the radiator air system

b. Removal.

(1) Remove bolts and lockwashers securing radiator louvers to the stern of the LARC.

(2) Lift off radiator louvers.

c. Cleaning, Inspection and Repair.

(1) Clean radiator louvers with a wire brush to remove foreign particles and loose paint.

(2) Inspect radiator louvers for dents, cracks, bends, broken welds, and structural damage. Repair as necessary.

(3) Repaint radiator louvers upon completion of repairs.

d. Installation. Installation of radiator stern louvers is in reverse order of removal.

5-6. Cooling Coils, Tubing and Fittings

a. Description. The cooling coils, located in the aft wheel wells; are constructed of copper tubing with bronze fittings. The cooling coils are secured to the inside plating of the wheel wells by steel straps and hangers. During marine operation, the cooling effect of the outside water is transferred to the engine cooling water as it circulates through the coils.

b. Removal and Disassembly.

(1) Drain cooling system (TM 55-1930-203-20).

(2) Remove bolts (12, fig. 5-2), lockwashers

(3), and nuts (4), and remove straps (1) from pipe hangers.

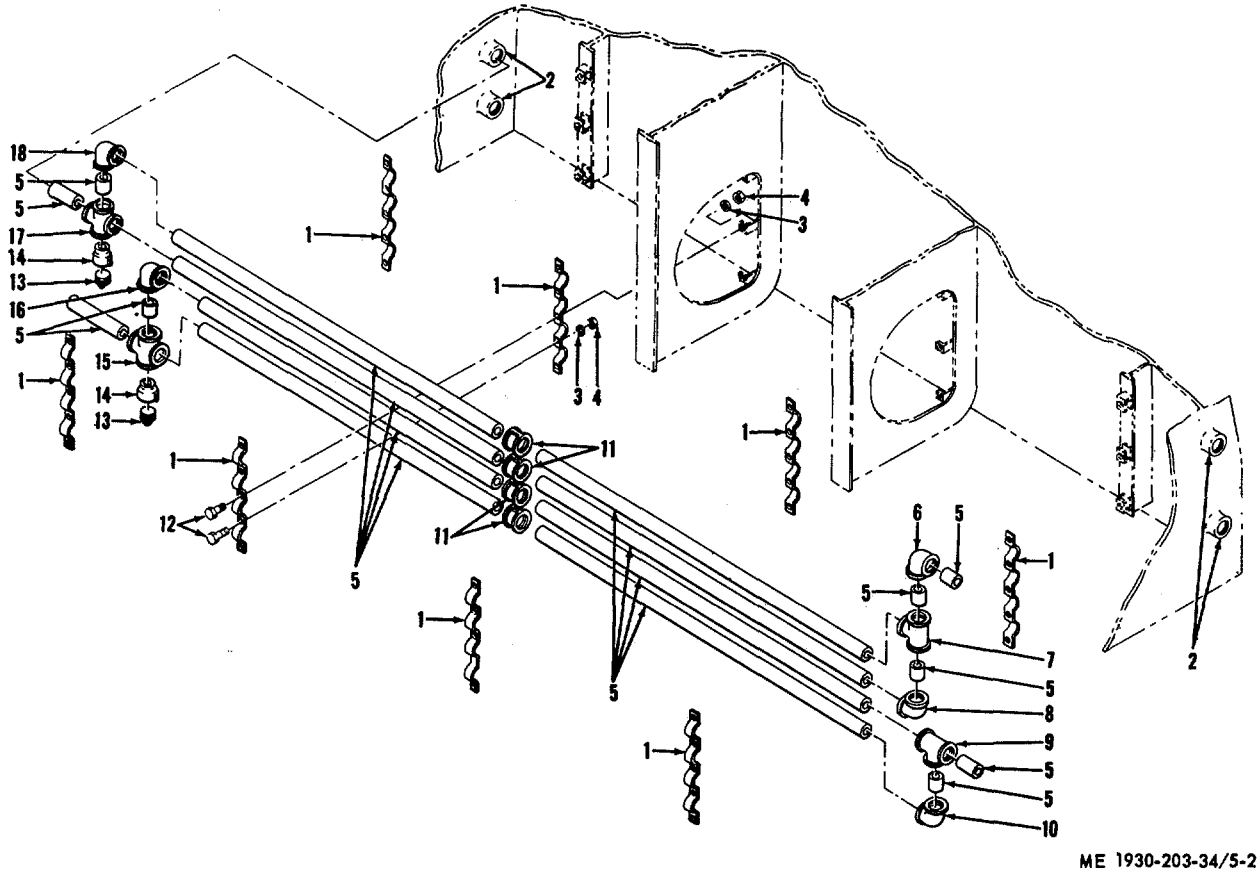
(3) Separate elbow (18) from tubing (5), connected to cross (17) by heating with an oxyacetylene flame to melt silver solder, and pulling up on elbow to free it from tubing.

(4) Remove elbow (8) in the same manner, and separate from tubing connected to tee (7).

(5) In a like manner remove elbows (10 and 16), and separate from tubing connected to tee (9),and cross (17).

(6) Unsolder tubing connected to couplings (I 1) and sleeves (2) and lift off cooling coils.

(7) Unsolder crosses (15 and 17), couplings (11), threaded adapters (I4), elbow (6), and tees (7 and 9) and remove from tubing (5).



I Strap , 1 x 3/16 x 20 in.	7 Tee tube 2 in.	13. Plug ,pipe , 2 in.
2 Sleeve, pipe,2 ½ in.	8 Elbow, tube, 90° 2 in.	14. Adapter pipe to tube, 2 in.
3 Lockwasher. 3/8 in.	9 Tee tube 2 in.	15.Cross tube , 2 in.
4 Nut. Plain 3/8 in.	10 Elbow, tube, 90° 2 in.	16 Elbow, tube, 90° 2 in.
5 Tubing copper 2 in.	11 Coupling tube ,2 in.	17.Cross tube , 2 in.
6 Elbow, tube, 90° 2 in.	12 Bolt ,machine, 3/8 x1 ¼ in.	18. Elbow, tube, 90° 2 in.

Figure 5-2. Cooling coils

c. Cleaning, Inspection and Repair.

(1) Clean removed parts with a wire brush to remove dirt and loose paint.

(2) Inspect drain plugs (13, fig. 5-2), and adapters 14) for cracks, breaks, corrosion, or damaged threads. Replace as required.

(3) Inspect all mating surfaces for burrs, scratches, and nicks. Remove such defects with crocus cloth, Federal Specification P-C-458, or a soft stone, Military Specification MIL-S-2389.

(4) Inspect tubing for dents, cracks, breaks, holes, and signs of corrosion. Replace as required. Use old tubing as a guide and cut to size. Make sure tubing is cut square and is free from burrs and is not out of round.

(5) Inspect straps (1) for cracks, breaks, and signs of corrosion. Replace as required.

(6) Inspect pipe hangers for loose welds, cracks, or breaks. Repair welds or replace pipe hangers as required.

(7) Inspect attaching hardware for stripped threads, cracks, and signs of corrosion. Replace as required.

d. Reassembly and Installation.

(1) Reassembly. Reassembly is essentially in reverse order or disassembly with the exception of the method employed for installing new silver brazing fittings (Walseal or equal). Install fittings in place of those removed as follows:

(a) With crocus cloth, Federal Specification

P-C-458, clean tubing ends a distance equal to twice the length of fitting recess.

(b) Thoroughly clean each fitting outlet.

(c) Flux both tubing and fitting recesses. Slide the fitting on the tubing until tubing contacts shoulder.

(d) When installing new fittings, the heating method requires an oxyacetylene torch equipped with a No. 8 tip. Apply heat to tubing approximately 1 1/2 inches back from fitting end for 21/4 minutes. Heating expands tubing. When sufficient heat has been applied, surface becomes blue-black and flux becomes liquid. Flame is then directed on bead of fitting and in direction of tubing, using a wiping motion, while traveling back and forth between fitting and pipe (this expands a section of fitting). As this motion is continued, a slight gap opens between fitting and tubing. When heating is stopped, fitting contracts, forcing out silver brazing alloy, and a fillet forms at edge of fitting. A 2 inch section only is heated at a time. When fillet is clearly visible, apply heat to next adjacent 2 inch segment. Do not heat joint in its entire circumference at one time.

NOTE

Excess heat. while enlarging the clearance. retards rather than hastens the flow of the alloy. If. in a section being heated. the fitting or tubing becomes bright in color remove torch.

(e) Joints must be well supported during silver brazing process, and they must not be strained while cooling. Parts must be permitted to cool until only hot to the hand before washing or quenching.

(f) Discolored tubing and fittings may be restored to their original color by brushing.

NOTE

Removed fittings may be reused(1 provided they are thoroughly cleaned and are in good condition.. However. they will have to be silver soldered in the conventional manner (TM 9-237) since the silver brazing alloy. which is an integral part o)f new fittings. will not be present in fittings which have been removed.

(2) Installation. Installation of cooling coils is in reverse order of removal. Do not paint cooling coils after installation.

CHAPTER 6

ELECTRICAL SYSTEM REPAIR INSTRUCTIONS

Section I. ALTERNATORS

6-1. REPLACE ALTERNATORS

1. Cap screw
2. Cover
3. Nut
4. Washer
5. Cable
6. Screw
7. Washer
8. Drive belt
9. Nut
10. Lock washer
11 Bolt
12. Washer
13 Alternator
14. Bracket

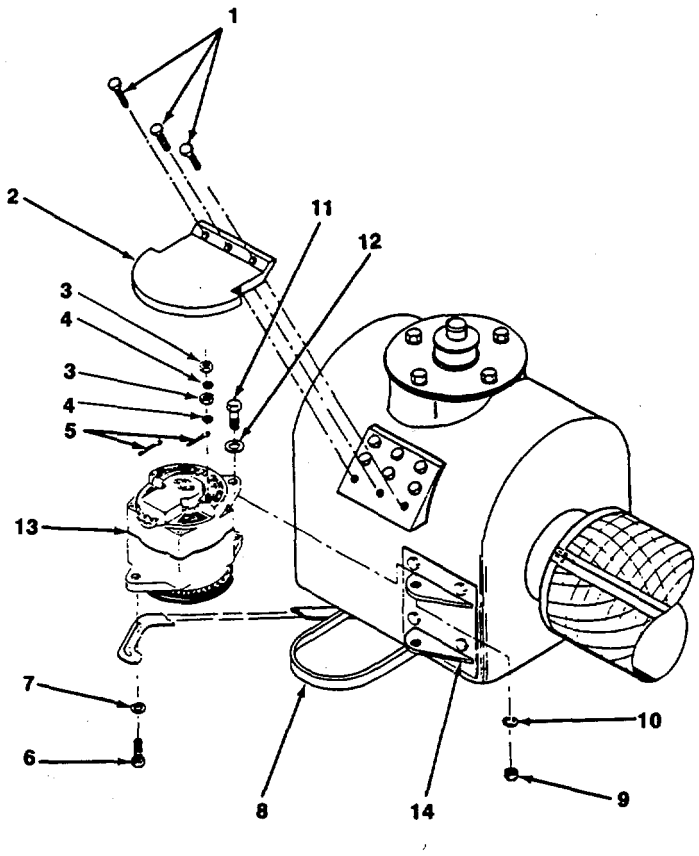


Figure 6-1. Alternator Replacement

a. Removal.

(1) Remove capscrews (1) and cover (2).

(2) Remove nuts (3), washers (4), and disconnect cables (5). Reinstall nuts (3) and washers (4) after cables (5) are disconnected.

(3) Remove screw (6) and washer (7) loosening tension drive belt (8) and remove belt from alternator pulley.

(4) Remove nuts (9), lockwasher (10), bolts (11), and washers (12).

(5) Remove alternator (13) from mounting bracket (14).

b. Reinstall.

(1) Place alternator (13) on mounting bracket (14) aligning alternator mounting holes with holes in bracket.

(2) Insert bolts (11) through washers (12) and mount- ing holes in bracket (14). Install lockwashers (10) and nuts (9) securing alternator (130 to bracket (14). Leave nuts (9) lossen until tensioning drive belt.

(3) Place drive belt (8) on alternator pulley. Install capscrew (6) through washer (7) and adjusting bracket (15) into alternator (13). Do not tighten until adjusting belt tension.

(4) Using wooden pry bar between gathering box (16) and alternator (13) pull alternator away from gathering box until belt tension allows only 7/8 to 1 inch deflection- . Hold alternator at this position.

(5) Tighten nuts (9) and capscrew (6) holding alternator (13) in position.

(6) Secure cables (5) to alternator (13) using nuts (3) and washer (4).

(7) Install cover (2) using capscrews (1).

6-2. REPLACEMENT ALTERNATOR PULLY.

1. Capscrew
2. Washer
3. Cover
4. Capscrew
5. Drive belt
6. Pulley
7. Locknut
8. Washer
9. Alternator
10 Gathering box

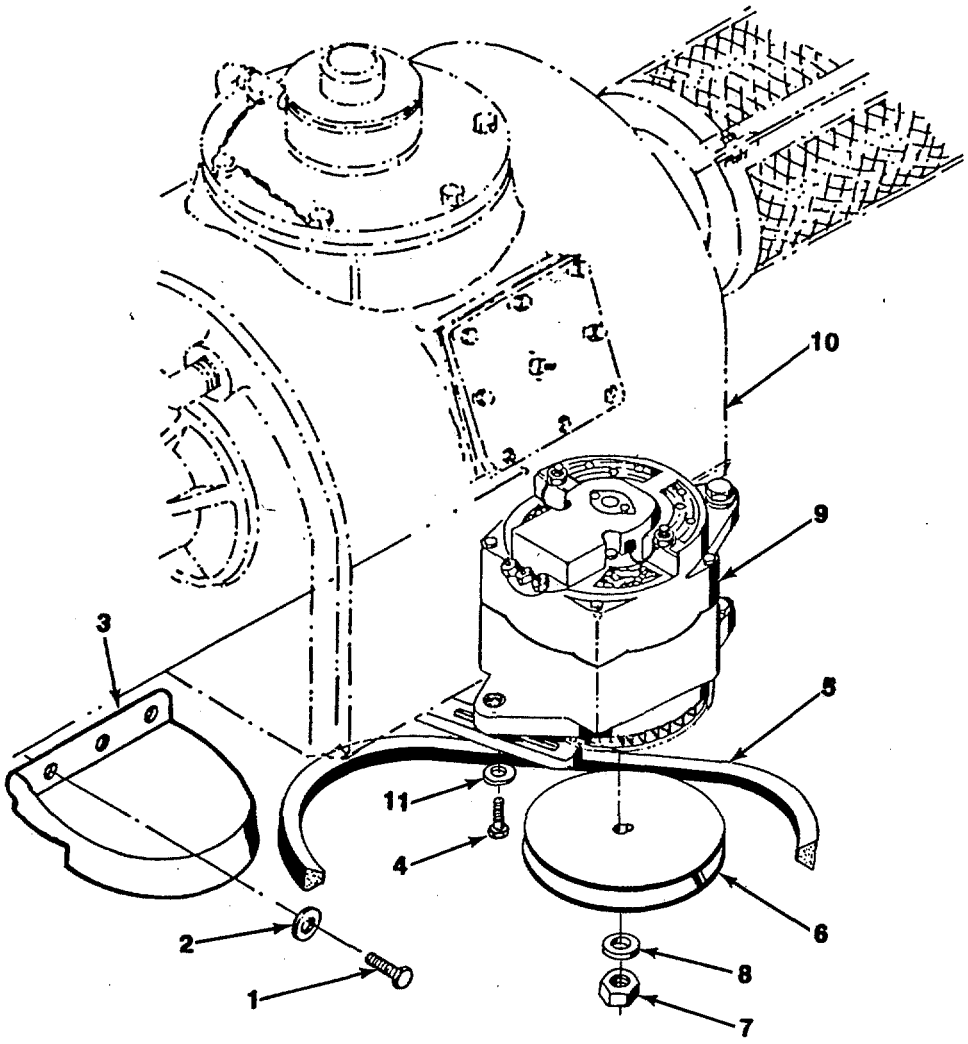


Figure 6-2. Alternator Pulley Replacement.

a. Remove.

(1) Remove capscrews (1), washers (2), and cover (3).
(2) Loosen capscrews (4), washers (11) releasing tension drive belt (5).
(3) Remove belt (5) from around pulley (6).
(4) Remove locknut (7), washer (8), and pulley (6).

b. Install.

(1) Place pulley (6) on alternator shaft. Install washer (8) and locknut (7) to secure pulley (6).
(2) Place drive belt (5) around pulley (6). Place a wooden rod between the alternator (9) and gathering box (10). Adjust belt (5) tension by levering alternator (9) away from gathering box (10) until belt (5) tension is 7/8 to 1 inch.
(3) Tighten capscrews (4) with washers (11) to hold alternator (9) in proper position for belt tension.
(4) Install cover (3) and secure to gathering box (10) washers (2) and capscrews (1).

Section II. SWITCHES , RELAYS AND LIGHTING

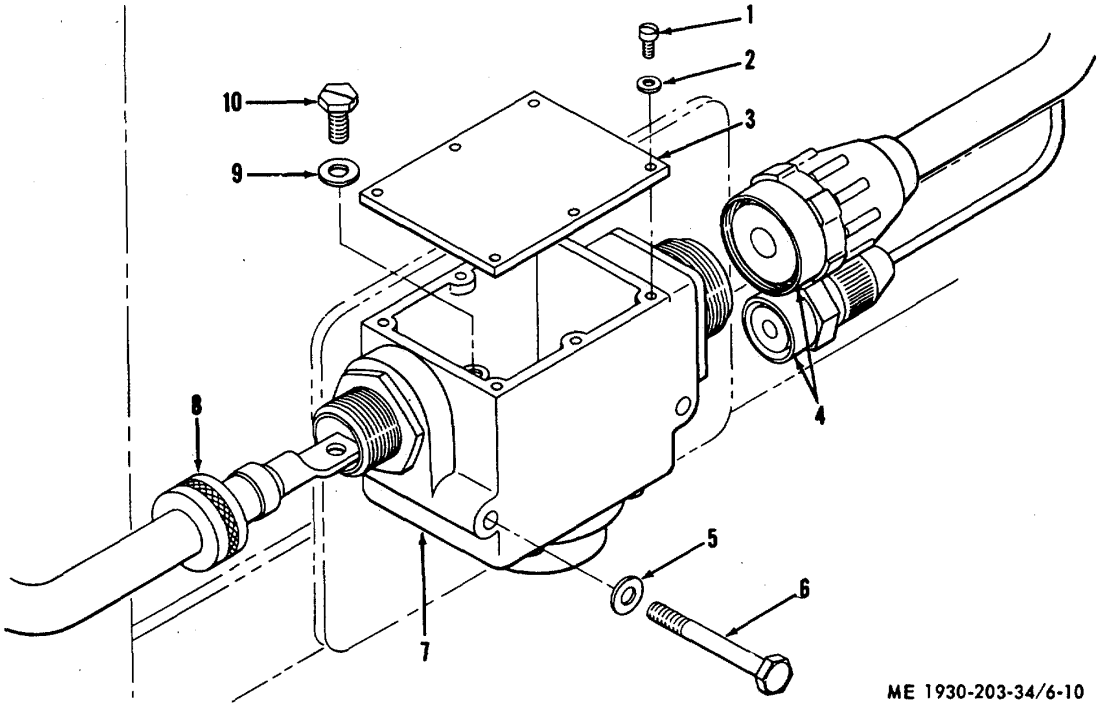
6-3. Switches and Master Control Relay

a. Master Control Relay.

(1) Testing
(a) Operate master control switch in cab to check operation of relay.
(b) Disconnect electrical power to relay. Remove cover (fig. 6-3).
(c) Inspect relay contacts for pitting and burning. If they are pitted, clean them. If they are badly worn, replace master control relay.
(d) Adjust contact surface between points to an opening of 0.040 inch by turning the tiedown capscrew clockwise to enlarge contact gap or counterclockwise to shorten gap.
(e) Inspect spring tension on movable contact with a scale. This should be between 10 to 15 ounces pull.
(f) Replace cover.
(2) Removal.
(a) Remove screws (1, fig. 6-3), lockwashers (2), and cover (3) from relay (7).
(b) Disconnect power cable terminal from relay unit by removing screw (10) and lockwasher (9).
(c) Unscrew cable adapter (8) at housing wall and withdraw cable.
(d) Disconnect two plug connectors (4) and tag for reassembly.

(e) Remove relay mounting bolts (6) and lockwashers (5) and remove relay.

WARNING
Disconnect battery leads before removing master control relay.



1 Screw	6 Bolt
2 Lockwasher	7 Relay
3 Cover	8 Cable Adapter
4 Connector	9 Lockwasher
5 Lockwasher	10 Screw

Figure 6-3. Master control relay, removal and installation

(3) Installation. Install master control in reverse order of removal.

b. Instrument Panel and Circuit Breaker Panel Switches.

(1) Removal.

(a) Remove screws securing switch to support frame.

(b) Pull out switch from back of panel, and disconnect wires by loosening retaining screws. Tag each wire removed for identification.

(2) Installation. Install switches in reverse order of removal.

c. Headlight Dimmer Switch.

(1) Removal.

(a) Remove electrica connectors from dimmer switch.

(b) Remove three capscrews and lockwashers securing dimmer switch to mounting plate.

(c) Lift out dimmer switch.

(2) Installation. Install headlight dimmer switch in reverse order of removal.

d. Machinery Compartment Light Switch.

(1) Removal.

(a) Disconnect wires from switch by loosening retaining screws.

(b) Remove two thread-cutting screws securing switch to mounting bracket.

(c) Lift off switch.

(2) Installation. Install machinery compartment light switch in reverse order of removal.

e. Hydraulic Supply Tank Liquid Level Switch Replacement.

(1) Removal.

(a) Disconnect liquid level switch ground wire at ground terminal.

(b) Disconnect liquid level switch lead wire at plug in port bilge machinery area inboard bulkhead.

(c) Drain hydraulic oil supply tank as follows:

1. Provide suitable containers and remove pipe plug located under the LARC in supply tank drain line.

2. Open supply tank gate valve and drain fluid from tank.

(d) Remove access covers from both ends of tank by removing attaching bolts and washers. Remove access cover gaskets.

(e) Remove packing gland nut (11, fig. 6-11) and spring washer (10) from packing gland washer (9).

(f) Remove packing gland washer (9) and packing gland gasket (8) from adapter (7).

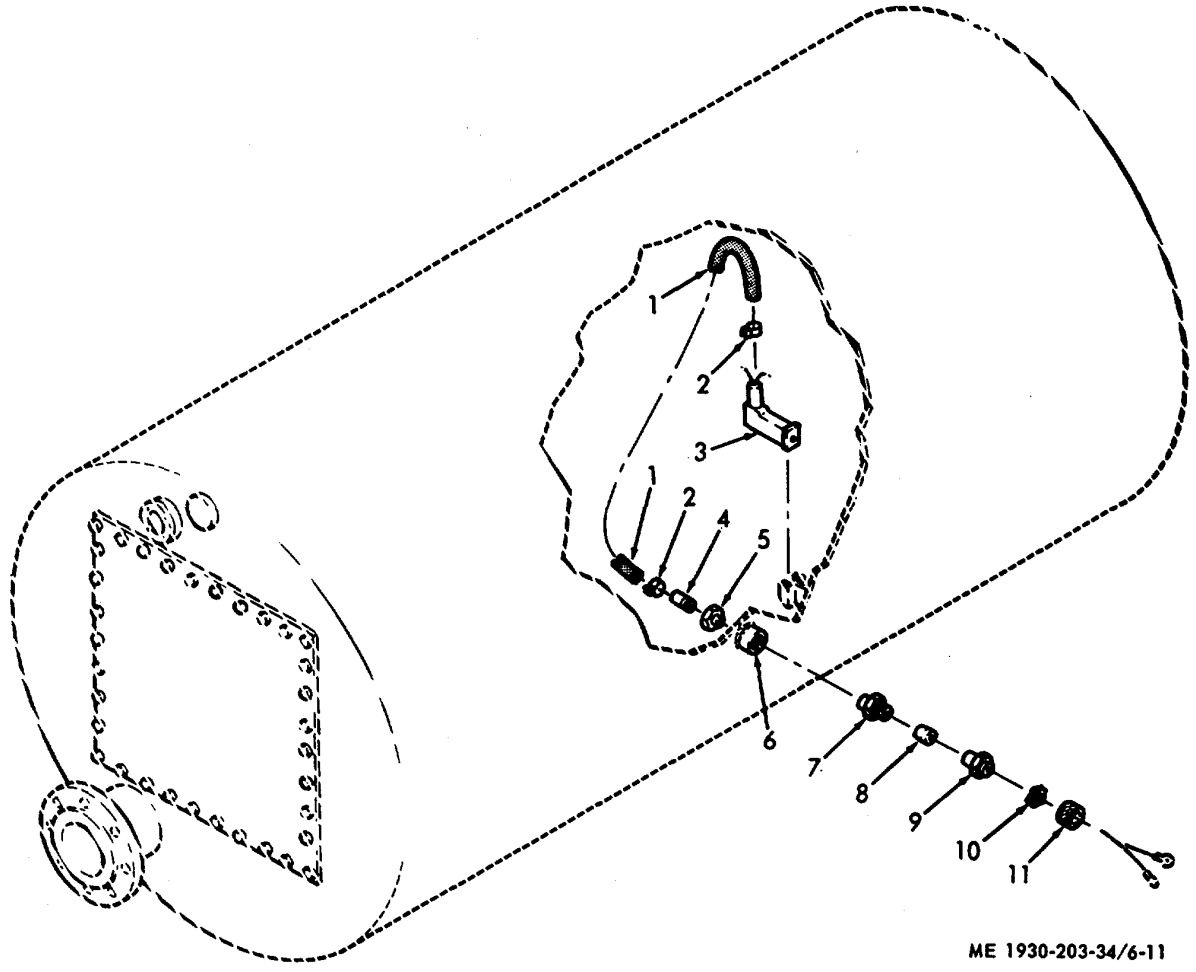
(g) Disconnect neoprene hose protecting switch wiring by removing clamp (2) at tank outlet end.

WARNING

While working inside the hydraulic oil supply tank, a portable-type circulating blower should be used to prevent vapor accumulation. For extended work periods inside the tank, an air line type respirator should be worn. Station an observer outside tank in case worker is overcome by fumes.

(h) Lift switch (3) from mounting bracket and remove, pulling wires through tank opening.

(i) Remove clamp (2) securing neoprene hose (1) to switch and remove hose.



1 Hose	7 Adapter
2 Clump	8 Gasket
3 Switch	9 Washer
4 Nipple	10 Washer
5 Bushing	11 Nut
6 Coupling	

Figure 6-4. Hydraulic supply tank liquid level switch replacement.

(*2*) *Installation.*

(a) Secure neoprene hose to new switch.

NOTE

If neoprene hose shows evidence of deterioration, install new hose.

(b) Install switch (3), in mounting bracket and feed wires through tank opening.
(c) Install clamp (2 on neoprene hose at tank opening.
(d) Install packing gland gasket (8) and packing gland washer (9) on adapter (7).
(e) Install spring washer (10) and packing gland nut (11) on packing gland washer (9).
(f) Connect ground wire to ground terminal. Connect lead wire to plug in port bilge machinery area inboard bulkhead.
(g) Install access covers and gaskets.

NOTE

If access cover gaskets are torn or deteriorated, install new gaskets.

(h) Close supply tank gate valve and install pipe plug in supply tank drain line under the LARC.
(i) Fill hydraulic oil supply tank (LO 55-1930-203-12).

6-4. Battery Generator Indicator

a. Removal

(1) Remove electrical connector from indicator.
(2) Remove two nuts, two lockwashers, and clamp.
(3) Lift indicator off instrument panel.

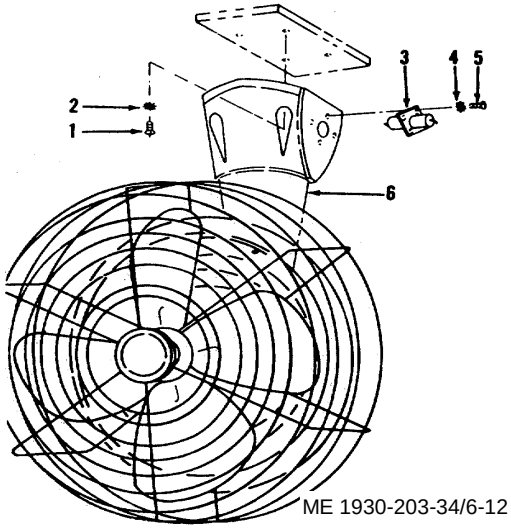
b. Installation. Install battery generator indicator in reverse order of removal.

6-5. Cab Ventilating Fans

a. General. The cab ventilating fans (6, fig. 6-5) contain a capacitor (3) connected in series with the 24-volt line and the positive brush for radio interference suppression. The capacitor bracket is bonded to the fan base by four tooth-type lockwashers (4), and the fan base is bonded to the cab frame by four tooth-type lockwashers (2).

b. Replacement of Fan Capacitor.

(1) Unsolder 24-volt supply lead from capacitor terminal.
(2) Remove screws (5), and tooth-type lock- washers (4) securing capacitor (3) to fan mounting base.
(3) Pull capacitor out of fan mounting base and unsolder wire from capacitor terminal.
(4) Solder wire from positive brush of fan to terminal of new capacitor.
(5) Insert capacitor (3) in fan mounting base and secure with screws (5) and tooth-type lock- washers (4).
(6) Solder 24-volt supply lead to capacitor terminal.



1 Screw
2 Lockwasher
3 Capacitor
4 Lockwasher
5 Screw
6 Fan

Figure 6-5. Hydraulic supply tank liquid level switch replacement

c. Fan Removal

(1) Disconnect cable connector.
(2) Remove screws and tooth-type lockwashers securing fan base to mounting pad and remove fan.

d. Fan Installation. Install ventilating fans in reverse order of removal.

6-6. Cab Heater

a. General. The cab heater blower motor is integrally suppressed by a capacitor connected in series with the 24-volt line and the positive brush at the heater motor housing. The cab heater capacitor mounting bracket is bonded to the motor housing by two plated tooth-type lockwashers. The heater motor is bonded to the heater housing with a plated tooth-type lockwasher at each of the two mounting screws. The heater housing is bonded to the fan housing by four tooth-type lockwashers and the fan housing is bonded to the deck with a tooth-type lockwasher at each of the four mounting bolts.

b. Removal and Disassembly

(1) Removal

(a) Drain the Aft Port Engine Cooling System (TM 55-1930-203-20).
(b) Disconnect electrical leads to heater motor (27, fig. 6-6) at connector assembly (24).
(c) Remove clamps (2) and rubber defrosted hose (1) from defroster outlets (3).
(d) Remove screws (17) and collar (18) from around hot water inlet and outlet tubes (12 and 13).
(e) Remove clamps (14) and rubber hose (15) from hot water inlet and outlet tubes (12 and 13).
(f) Remove screws (38) and tooth-type lockwashers (39) from heater intake flange (37) and remove flange.
(g) Remove capscrews (16) securing heater to steel angle under cab flooring.
(h) Lower heater through cab flooring.

(2) Disassembly.

(a) Remove screws (21). tooth-type lockwashers (20), and ground strap (22). Remove screws (25), tooth-type lockwashers (26), and radio suppression capacitor (23).
(b) Remove four screws (28) and four tooth-type lockwashers (29) securing motor mounting flange (30) to blower housing assembly (19).
(c) Remove setscrew (35) in impeller hub and remove impeller (36).
(d) Remove locknuts (32) and tooth-type lockwashers (31) securing motor flange (30) to motor (27) and separate them.
(e) Remove screws (33) and lockwashers (34) securing blower housing assembly (19) to core housing (4) and separate them.
(f) Remove setscrew (9) securing defroster control lever assembly (10) and remove assembly.
(g) Unsolder copper elbows (11) from hot water inlet tube (12) and outlet tube (13).
(h) Remove screws (8) securing cover (7) of core housing (4) and pullout core assembly (6) and core side spacers (1).
(i) Remove bolts, nuts, and lockwashers securing defroster tubing to cab top beneath windows.
(j) Lift out defroster tubing.

c. Cleaning, Inspection and Repair.

(1) Wash metal parts, except core assembly (6, fig. 8-142), with dry-cleaning solvent, Federal Specification P-D-680. Wash rubber parts with soap and water.
(2) Clean core assembly by blowing through openings with low-presort air. Remove any lodged particles.
(3) Check core assembly for pitting, corrosion, or leakage. Replace a badly pitted, corroded, or leaking core assembly.
(4) Replace a defective motor (27).
(5) Check impeller (36) for cracks or breaks. Replace a damaged impeller.
(6) Check hoses (1 and 15) for signs of deterioration. Replace a defective clamp.
(7) Check hose clamps (2 and 14) for good condition. Replace a defective clamp.
(8) If defroster is defective, replace as follows:
(a) Using 1-1/4 inch hard copper tubing and old defroster as a model, cut tubing to size.
(b) Fit points and braze them together. Seal ends with flat copper sheet.
(c) Cut slots in tubing similar to those in old tubing.

d. Reassembly and Installation. Reassemble and install cab heater in reverse order of disassembly and removal. Fill cooling system (TM 55-1930-203-20).

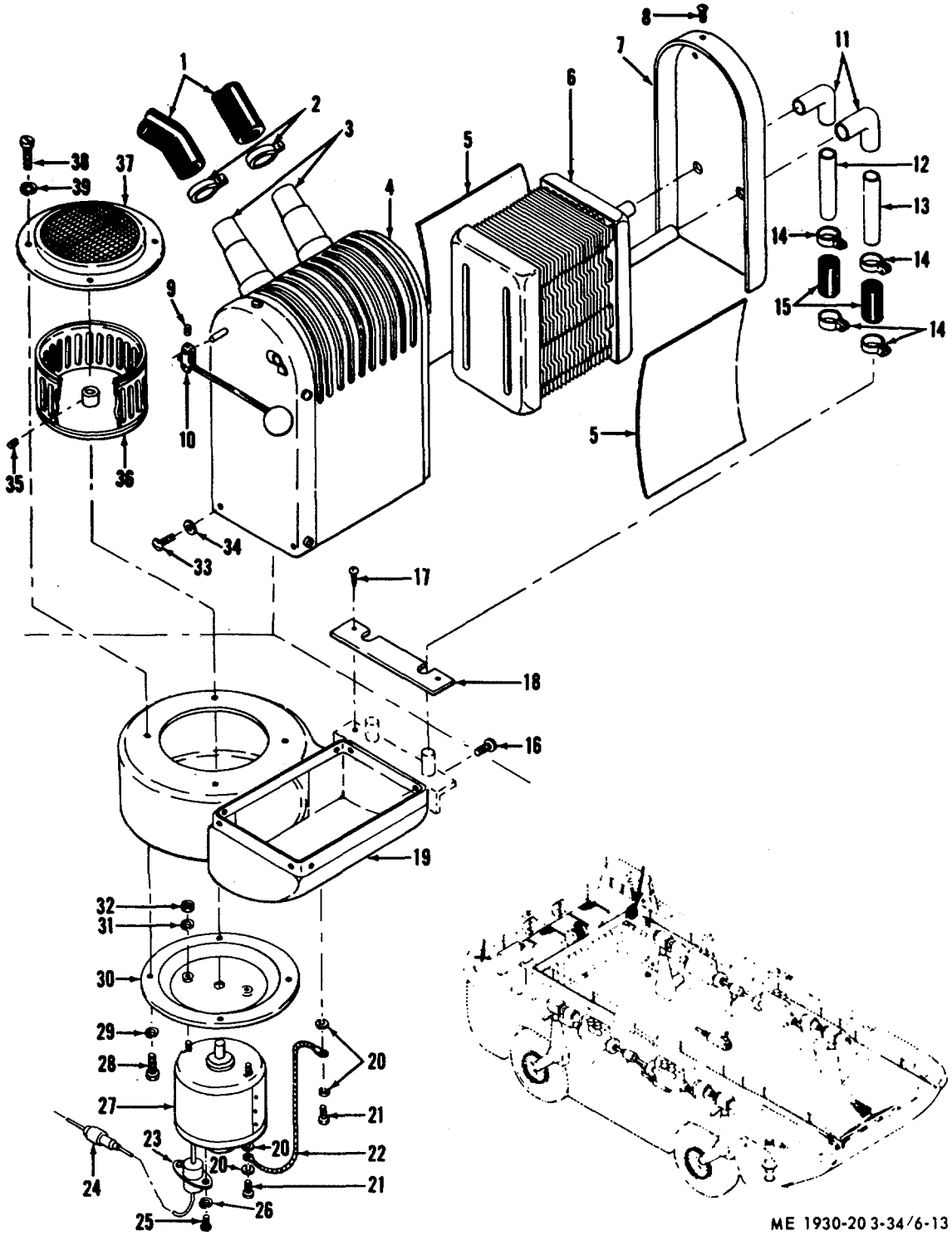


Figure 6-6. Cab heater , removal disassembly, reassembly and installation.

Key to Figure 6-6.

1 Hose, rubber, defroster
2 Clamp, hose
3 Defroster outlet
4 Core housing
5 Core side spacer
6 Core assembly
7 Cover
8 Screw
9 Setscrew
10 Defroster, control lever assembly
11 Elbow
12 Tube
13 Tube
14 Clamp
15 Hose, rubber, radiator to heater
16 Capscrew
17 Screw
18 Collar
19 Blower housing assembly
20 Lockwasher
21 Screw
22 Ground strap
23 Capacitor, feed-thru
24 Connector assembly
25 Screw
26 Lockwasher
27 Motor
28 Screw
29 Lockwasher
30 Motor mounting flange
31 Lockwasher
32 Locknut
33 Screw
34 Lockwasher
35 Setscrew
36 Impeller
37 Flange
38 Screw
39 Lockwasher

6-7. Machinery Compartment Lights

NOTE

Two types of machinery compartment lights were used on the LARC's as shown in figures 6-14 and 6-15. When the obsolete light in figure 6-14 cannot be repaired, it will be replaced with the light shown in figure 6-15.

a. Removal and Disassembly.

(1*) Figure 6*-7.

(a) Remove securing ring (7), slip ring (6), centering gasket (5), glove (4), and nonmetallic washer (3) from box assembly (2).

(b) Remove electric light lamp (1O) from lampholder (11).

(c) Remove screws securing wiring to lampholder (11).

(d) Remove two screws (8) and shakeproof washers (9) securing lampholder to mounting plate (14), and remove lampholder.

(e) Remove two screws (12) and shakeproof washers (13) securing mounting plate (14), and remove mounting plate.

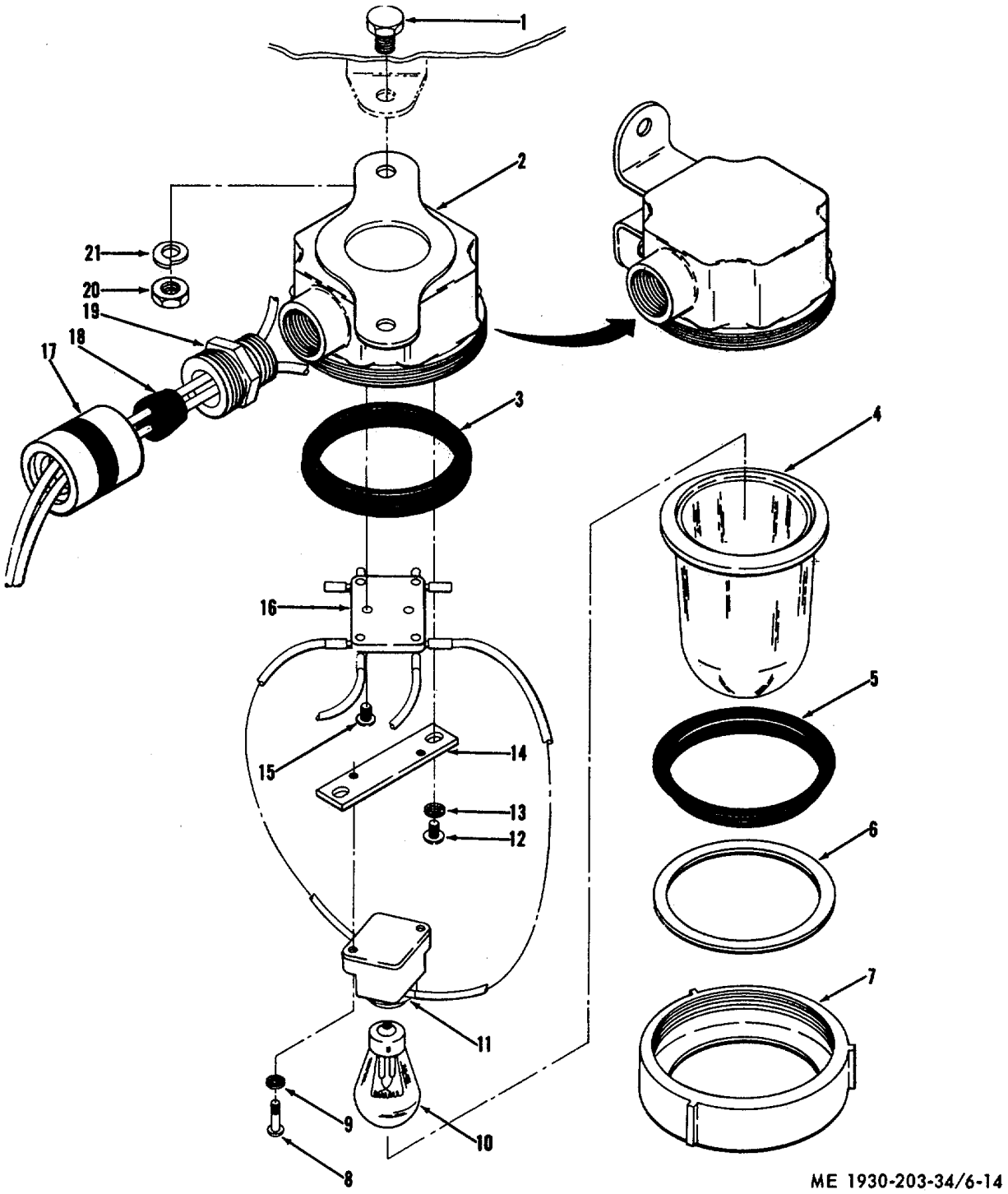
(f) Remove screws securing wiring to terminal block (16) and remove wiring.

(g) Remove two screws (15), securing terminal block (16) to box assembly (2), and remove terminal block.

(h) Remove bushing (19) and connector (17) from box assembly.

(i) Remove packing gland gasket (18) from connector (17).

(j) Remove bolt (1), lockwasher (21), and nut (20). Lift off box assembly.



1 Bolt	8 Screw	15 Screw
2 Box assembly	9 Washer	16 Terminal block
3 Washer	10 Lamp	17 Connector
4 Globe	11 Lampholder	18 Gasket
5 Centering gasket	12 Screw	19 Bushing
6 Slip ring	13 Washer	20 Nut
7 Securing ring	14 Plate	21 Washer

Figure 6-7. Machinery compartment light (old type), removal, disassembly, reassembly and installation.

(2) *Figure 6- 8.*

(a) Remove four window mounting screws (15), packings (16), window (17), and packing (18) from housing (20).

(b) Remove lamp (9) from lampholder (11).

(c) Remove two screws (10) securing reflector (19) to housing (20), and remove reflector.

(d) Remove terminal nuts (13) securing wiring to terminal board assembly (12).

(e) Remove screw (10 securing lampholder (11) to housing (20), and remove lampholder.

(f) Remove screws (14) securing terminal board assemblies (12) to housing (20), and remove the terminal board assemblies.

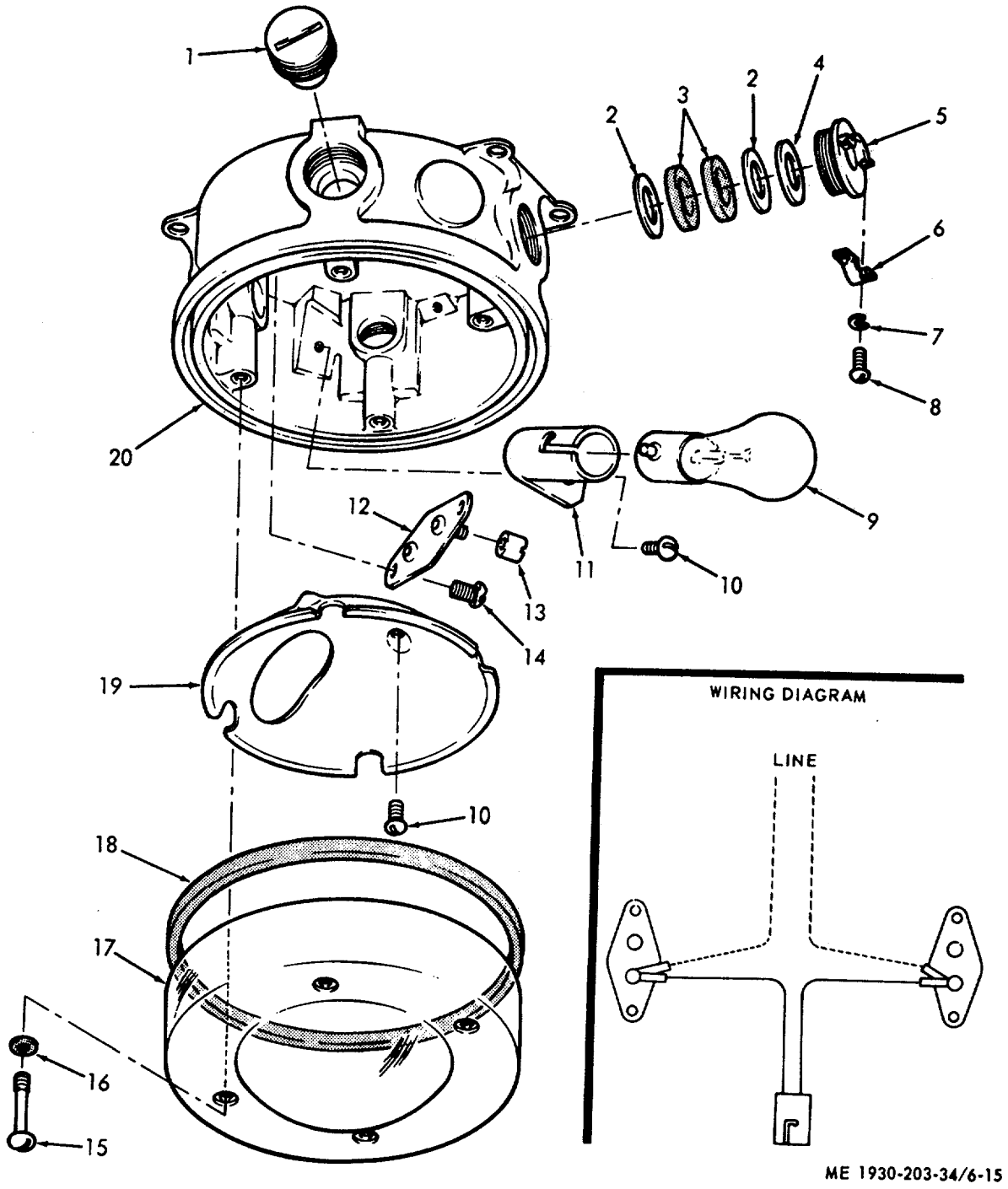
(g) Remove two screws (8), lockwashers (7), and cable clamp (6) from gland nut (5).

(h) Unscrew gland nut (5) from housing (20), and remove wiring.

(i) Remove gland gasket washer (4), gland gasket washer (2), gland gaskets (3), and second gland gasket washer (2) from housing (20).

(j) Remove four screws and washers which secure housing (20) to its mounting, and remove the housing.

b. Reassembly and Installation. Reassembly and install machinery compartment light in reverse order of disassembly and removal.



1	Plug	11	Lampholder
2	Washer	12	Terminal board assembly
3	Gasket	13	Nut
4	Washer	14	Screw
5	Gland nut	15	Screw
6	Clamp	16	Packing, performed
7	Lockwasher	17	Window
8	Screw	18	Packing, preformed
9	Lamp	19	Reflector
10	Screw	20	Housing

Figure 6-8. Machinery compartment light (new type) removal, disassembly, reassembly and installation.

6-8. Wing Compartment Lights

NOTE

Two types of wing compartment lights were used on the LARC's as shown in figures 6-9 and 6-10. When the obsolete light in figure 6-9 cannot be repaired, it will be replaced with the light shown in figure 6-10.

a. Removal and Disassembly.

(*l*) *Figure 6-9.*

(a) Remove securing ring (9), slip ring (8), centering gasket (7), globe (6), and nonmetallic washer (5) from box assembly (2).

(b) Remove electric light lamp (101 from lampholder (13).

(c) Remove screws securing wiring to lampholder (13).

(d) Remove two screws (1) and shakeproof washers (12) securing wiring to lampholder.

(e) Remove two screws (14) and shakeproof washers (15) securing mounting plate (16). Remove mounting plate.

(f) Remove screws securing wiring to terminal block and remove wiring.

(g) Remove nut (24) and withdraw switch (19) from box assembly (2).

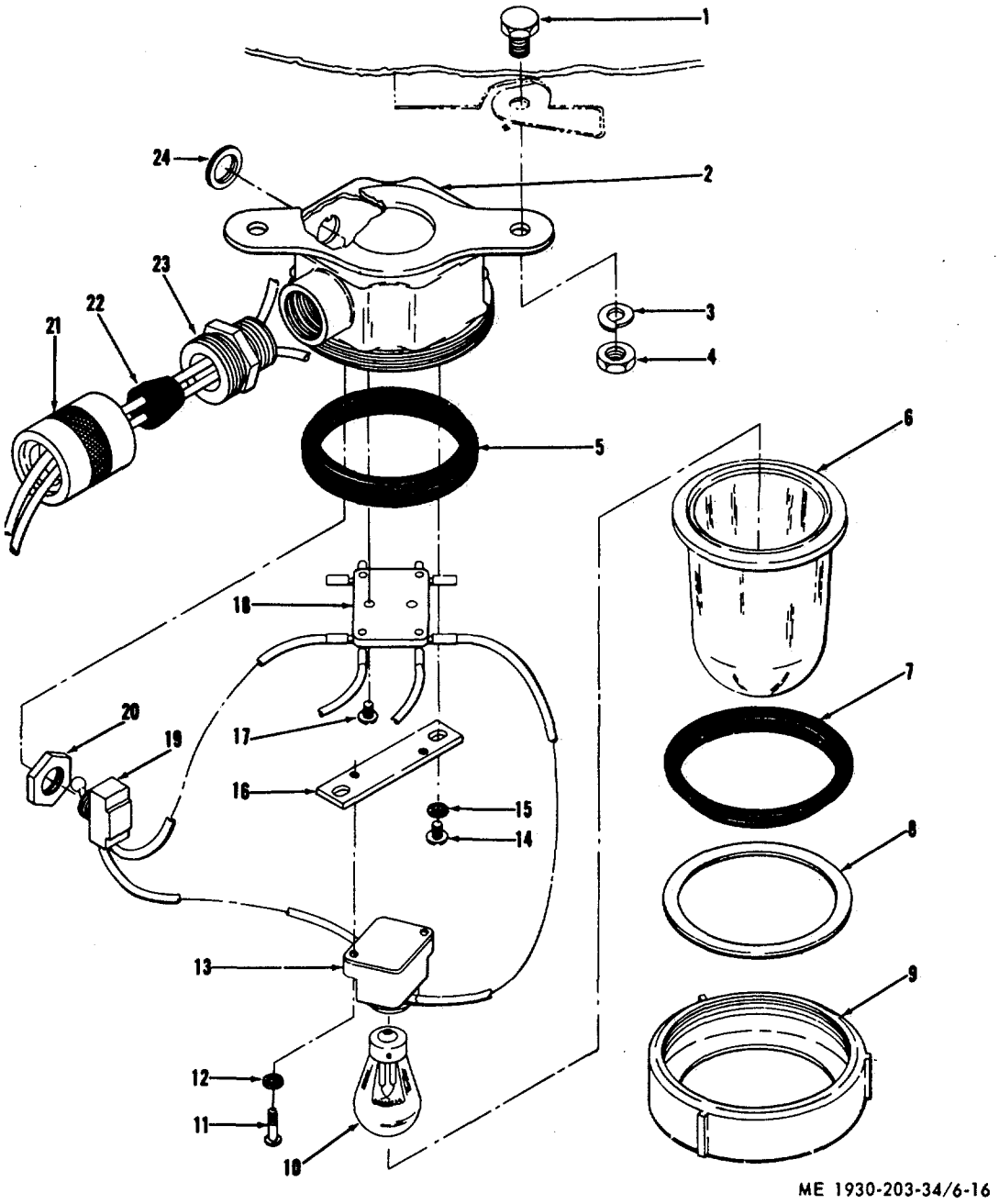
(h) Remove nut (20) from switch (19) .

(i) Remove two screws (17) securing terminal block (18) to box assembly (2) and remove terminal block.

(j) Remove bushing (23) and connector (21) from box assembly (2).

(k) Remove packing gland gasket (22) from connector (21).

(l) Remove bolt (1), lockwasher (3), and nut (4). Lift off box assembly (2).



1	Bolt	9	Securing ring	17	Screw
2	Box assembly	10	Lamp	18	Terminal block
3	Lockwasher	11	Screw	19	Switch
4	Nut	12	Washer	20	Nut
5	Washer	13	Lampholder	21	Connector
6	Globe	14	Screw	22	Gasket
7	Centering Gasket	15	Washer	23	Bushing
8	Slip ring	16	Mounting plate	24	Nut

Figure 6-9. Wing compartment light (old type), removal, disassembly, reassembly and installation.

(2) Figure 6- *10.*

(a) Remove four window mounting screws (17), packings (18), window (19), and packing (20) from housing (22).

(b) Remove lamp (11) from lampholder (13).

(c) Remove two screws (12) securing reflector (21) to housing (22) and remove reflector.

(d) Remove terminal nuts (15) securing wiring to terminal board assembly (14).

(e) Remove screw (12) securing lampholder (13) to housing (22), and remove lampholder.

(f) Remove sealnut (3) and toggle switch (1) from housing (22).

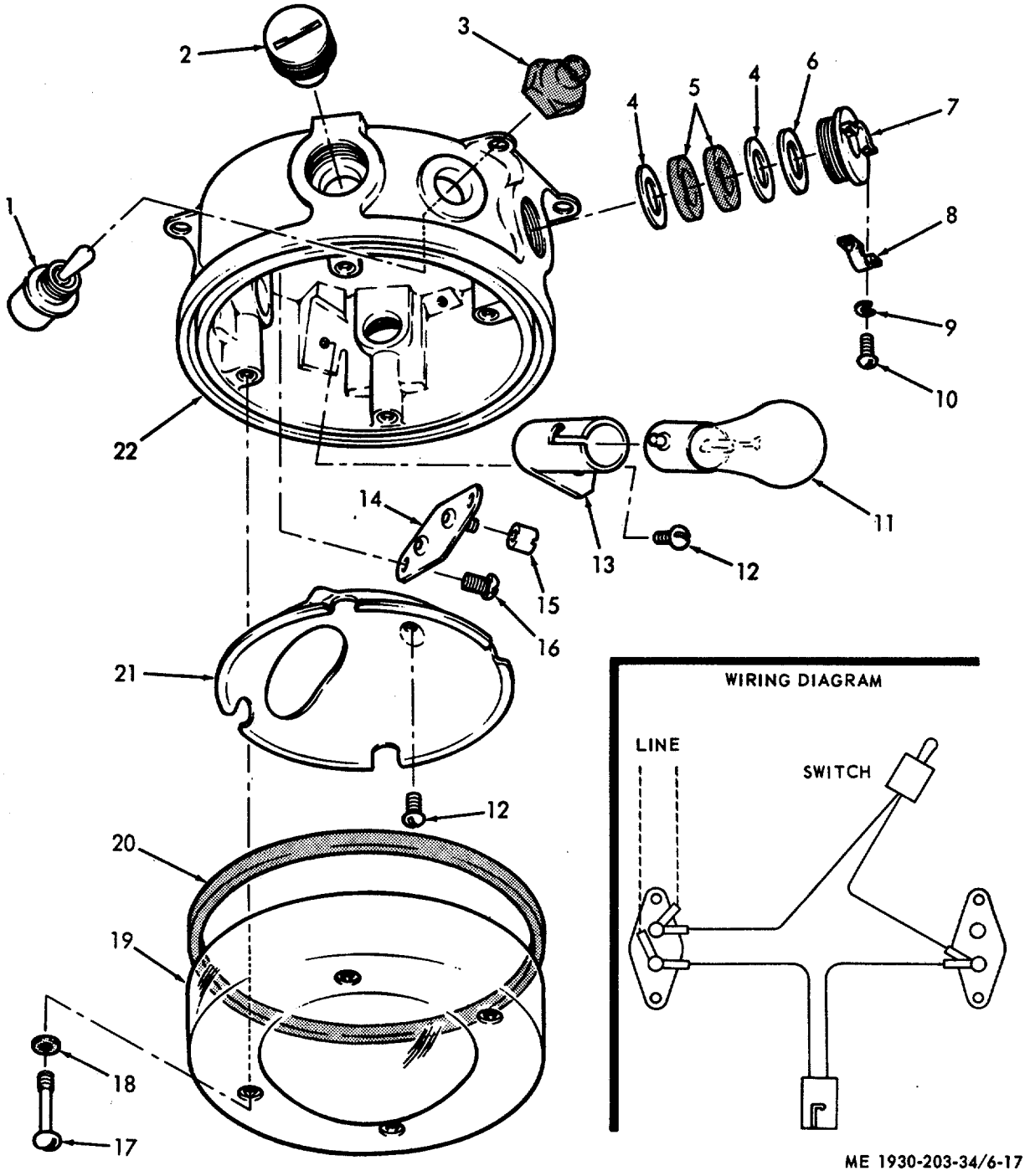
(g) Remove screws (16) securing terminal board assemblies (14) to housing (22), and remove the terminal board assemblies.

(h) Remove two screws (10), lockwashers (9), and cable clamp (8) from gland nut (7).

(i) Unscrew gland nut (7) from housing (22), and remove wiring.

(j) Remove gland gasket washer (6), gland gasket washer (4), gland gaskets (5), and second gland gasket washer (4) from housing (22).

(k) Remove four screws and washers which secure housing (22) to its mounting, and remove the housing.



1	Switch, toggle	9	Lockwasher	16	Screw
2	Plug	10	Screw	17	Screw
3	Sealnut	11	Lamp	18	Packing, preformed
4	Washer	12	Screw	19	Window
5	Gasket	13	Lampholder	20	Packing preformed
6	Washer	14	Terminal board	21	Reflector
7	Gland nut	15	Nut	22	Housing
8	Clamp				

Figure 6-10. Wing compartment light (new type) removal, disassembly, reassembly and installation.

b. Reassembly and Installation. Reassemble and install wing compartment light in reverse order of disassembly and removal.

6-9. Headlights

NOTE

Two types of headlights were used on the LARC's as shown in figures 6-11 and 6-12. When the light figure 6-11 requires replacement, it will be replaced with the light shown in figure 6-12.

a. Removal and Disassembly.

(1) *Figure 6-11.*

(a) Uncouple connectors (2) on headlight wire assembly (1), and remove nut and lockwasher securing ground terminal (3) to ground stud.

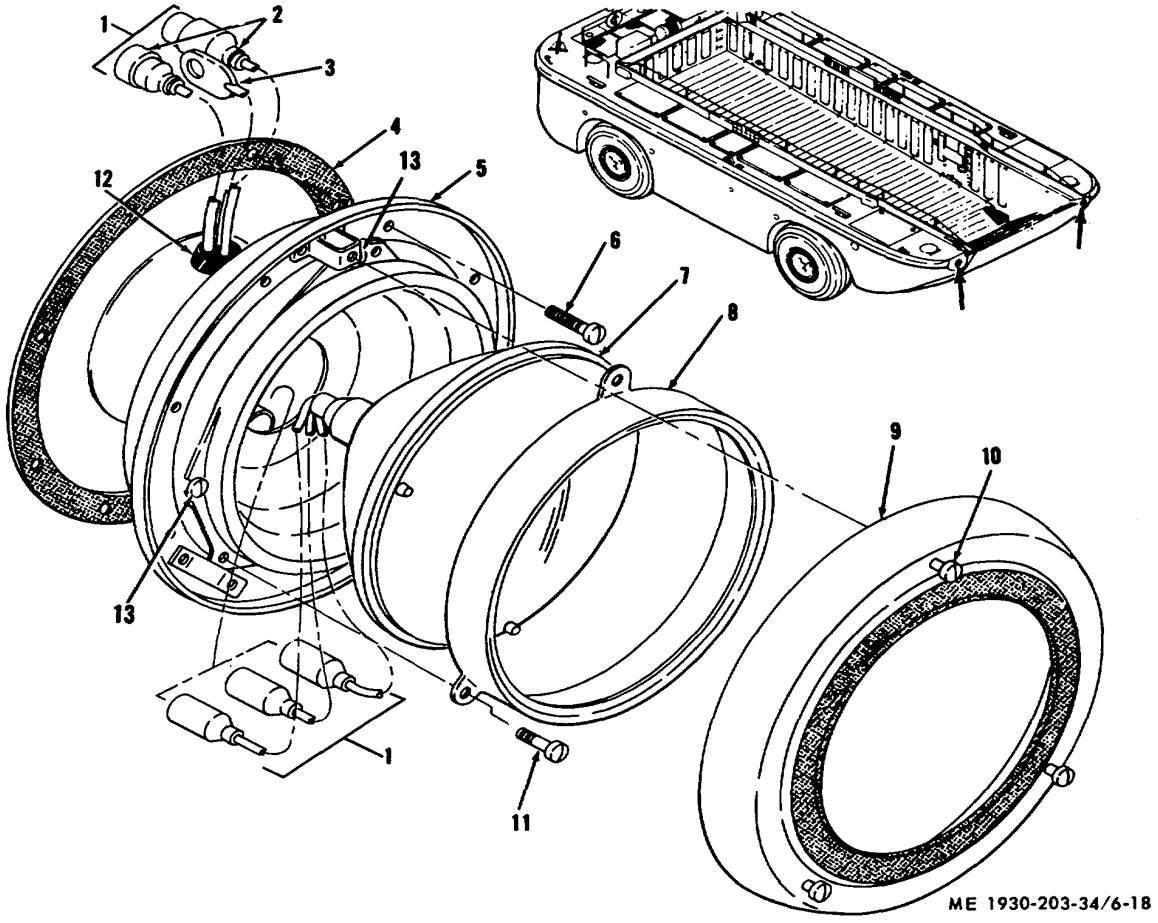
(b) Loosen three screws 1)01 securing door assembly (9) to body and mounting ring assembly (5). and remove door assembly.

(c) Remove eight self-tapping screws (6), and remove headlight and mounting gasket (4).

(d) Remove three screws (11) securing retaining ring (8) to body and mounting ring assembly (5), and remove retaining ring.

(e) Remove lamp (7) from body and mounting ring assembly (5) and uncouple and remove lower half of headlight wire assembly (1).

(f) Remove grommet (12) and withdraw upper half of headlight wire assembly (1) from body and mounting ring assembly (5).



1	Headlight wire assembly	6	Screw	10	Screw
2	Connector	7	Lamp	11	Screw
3	Ground terminal	8	Retaining ring	12	Grommet
4	Mounting gasket	9	Door assembly	13	Screw
5	Body and mounting ring assembly				

Figure 6-11. Headlight (old type), removal, disassembly, reassembly and installation.

(2) *Figure 6-12.*

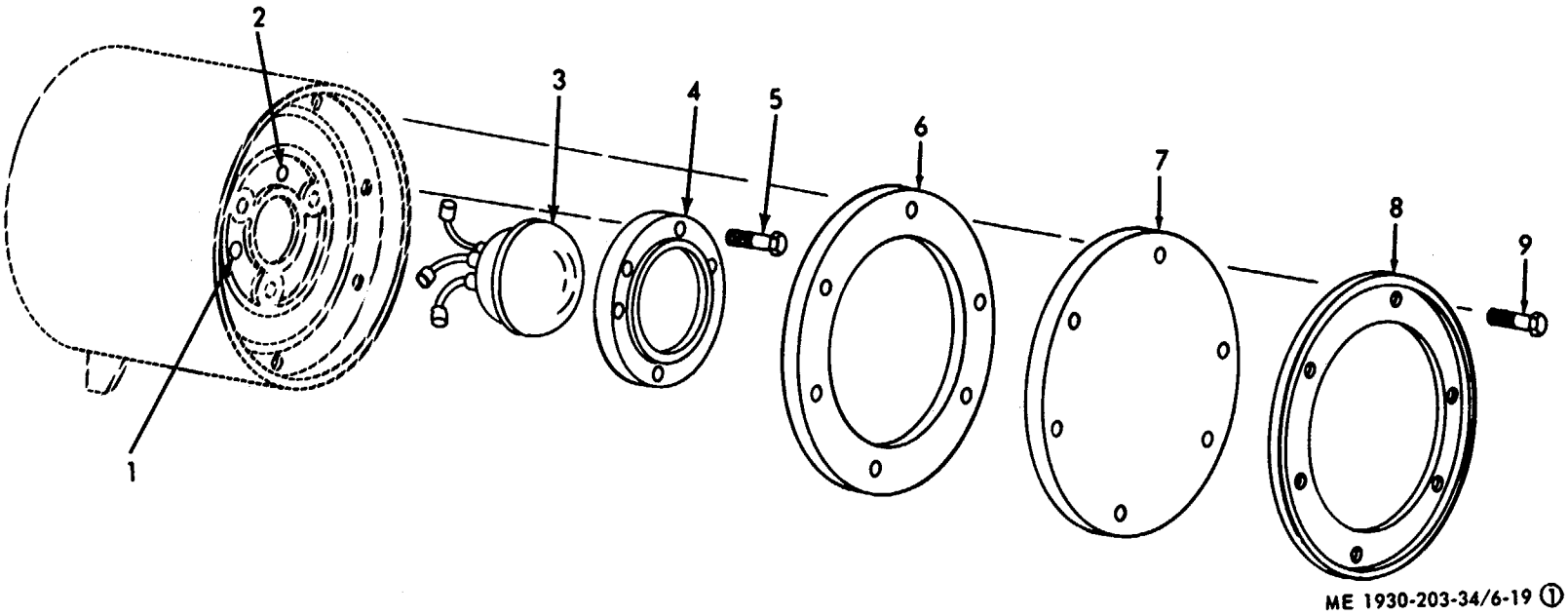
(a) Remove capscrews (9), retaining ring (8), lens (7), gasket (6), screws (5), and retaining ring (4).

(b) Remove lamp (3) from body of headlight.

(c) Uncouple connectors (16) from headlight.

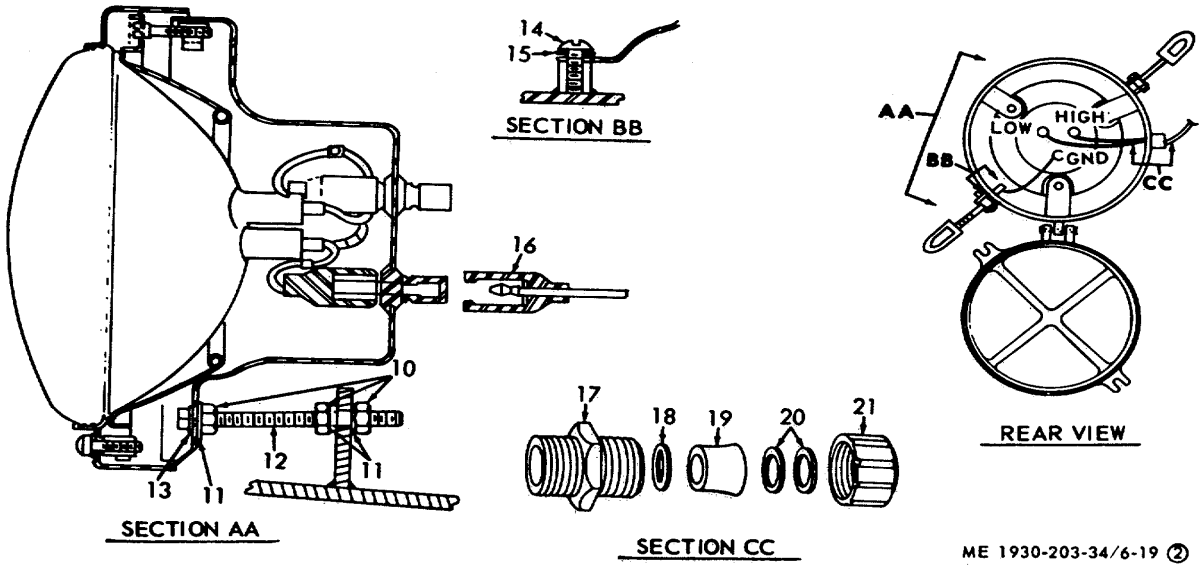
(d) Remove three nuts (10) and lock-washers (11) from end of capscrew (12). Withdraw headlight housing from the headlight casing.

b. Reassembly and Installation. Reassemble and install headlight in reverse order of disassembly and removal.



1 Screw, horizontal adjustment
2 Screw, vertical adjustment
3 Lamp
4 Retaining ring
5 Screw
6 Gasket
7 Lens
8 Retaining ring
9 Capscrew

Figure 6-12. Headlight (new type), removal, disassembly, reassembly and installation (Sheet 1 of 2).



10	Nut, hex	16	Connector
11	Washer, lock	17	Body, stuffing box
12	Capscrew	18	Washer, stuffing box, rubber
13	Washer, flat	19	Bushing, stuffing box, rubber
14	Screw	20	Washer, stuffing box, rubber
15	Washer, lock	21	Cap, stuffing box

Figure 6-12. Headlight (new type), removal, disassembly, reassembly and installation (Sheet 2 of 2).

c. Headlight Adjustment.

NOTE

Low beam should start to illuminate the roadway in front of the LARC, 142 feet from centerline of the front wheel.

(1) *Figure 6-11.*

(a) Remove door assembly (9).

(b) Adjust headlights by turning screws (13) in or out to vary the angle of lamp (7).

(c) Install door assembly.

(2) *Figure 6-12.*

(a) Adjust headlights by loosening nuts (10), and moving bolts (12) in or out to vary angle of headlight.

(b) If further adjustment is required, remove screws (9), retaining ring (8), lens (7), and gasket (6). Adjust headlights by turning screws (1 and 2) in or out to vary the angle of lamp (3).

(c) Install retaining ring, lens, and gasket in reverse order of removal.

6-10. High-Beam Indicator Light

a. Removal.

(1) Remove two screws, and two lockwashers securing high-beam indicator light assembly to instrument panel and remove high-beam indicator light assembly from rear of instrument panel.

(2) Disconnect cable wiring at electrical connector. Tag wiring for reassembly.

b. Installation. Install high-beam indicator light in reverse order of removal.

6-11. Cargo Well Lights

a. Removal and Disassembly.

(1) Remove capscrews (1, fig. 6-13), lock-washers (2), and protector plate (3).

(2) Remove screw 141 securing cover (5) and lens (6) to base (9).

(3) Remove four thread cutting screws (7) and lockwashers (8) securing base (9) and gasket (12) to side of cargo well.

(4) Disconnect wiring (10) at connector (11).

(5) Remove lampholder (13) from base (9). If lampholder shows signs of corrosion, loosen wiring, or other damage, replace with new component.

b. Reassembly and Installation. Reassemble and install cargo well light in reverse order of disassembly and removal.

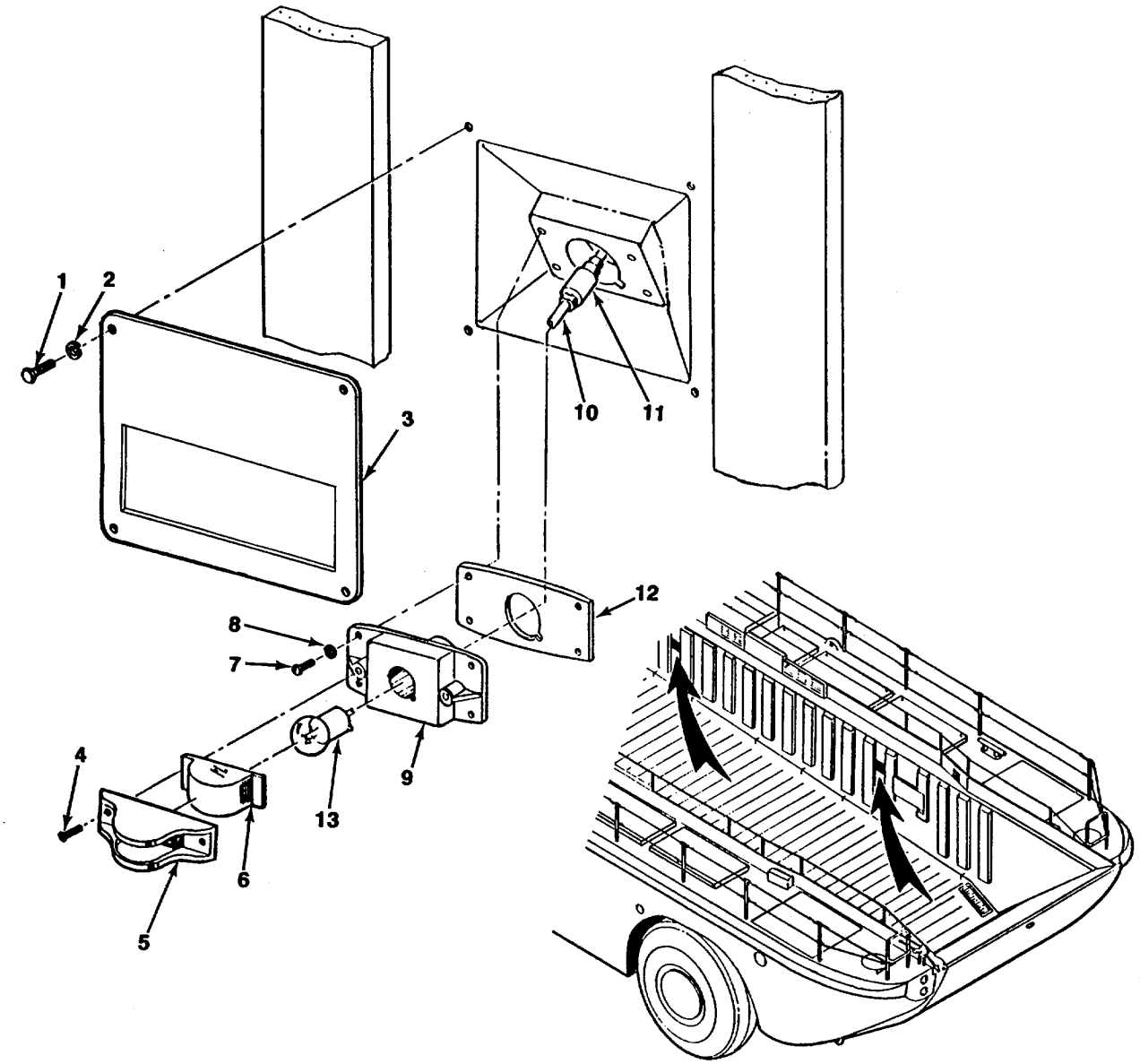


Figure 6-13. Cargo well light, replacement.

Key to Figure 6-13.

1 Capscrew
2 Lockwasher
3 Protector plate
4 Screw
5 Cover
6 Lens
7 Screw
8 Lockwasher
9 Base
10 Wiring
11 Electrical connector
12 Mounting gasket
13 Lampholder

6-12. Bow Light

a. *Removal and Disassembly.*

(1) Remove cable cap (16, fig. 6-14) from tube and retainer cap assembly (13), and remove packing (14) and washer (15).

(2) Remove tube and retainer cap assembly (13) from base (20), and remove gasket (12).

(3) Disconnect electrical wiring from lamp holder (4).

(4) Remove nut (11), washer (10), and spacer (9), from base (20) of light assembly.

(5) Loosen screw (6) and hinge up housing (5).

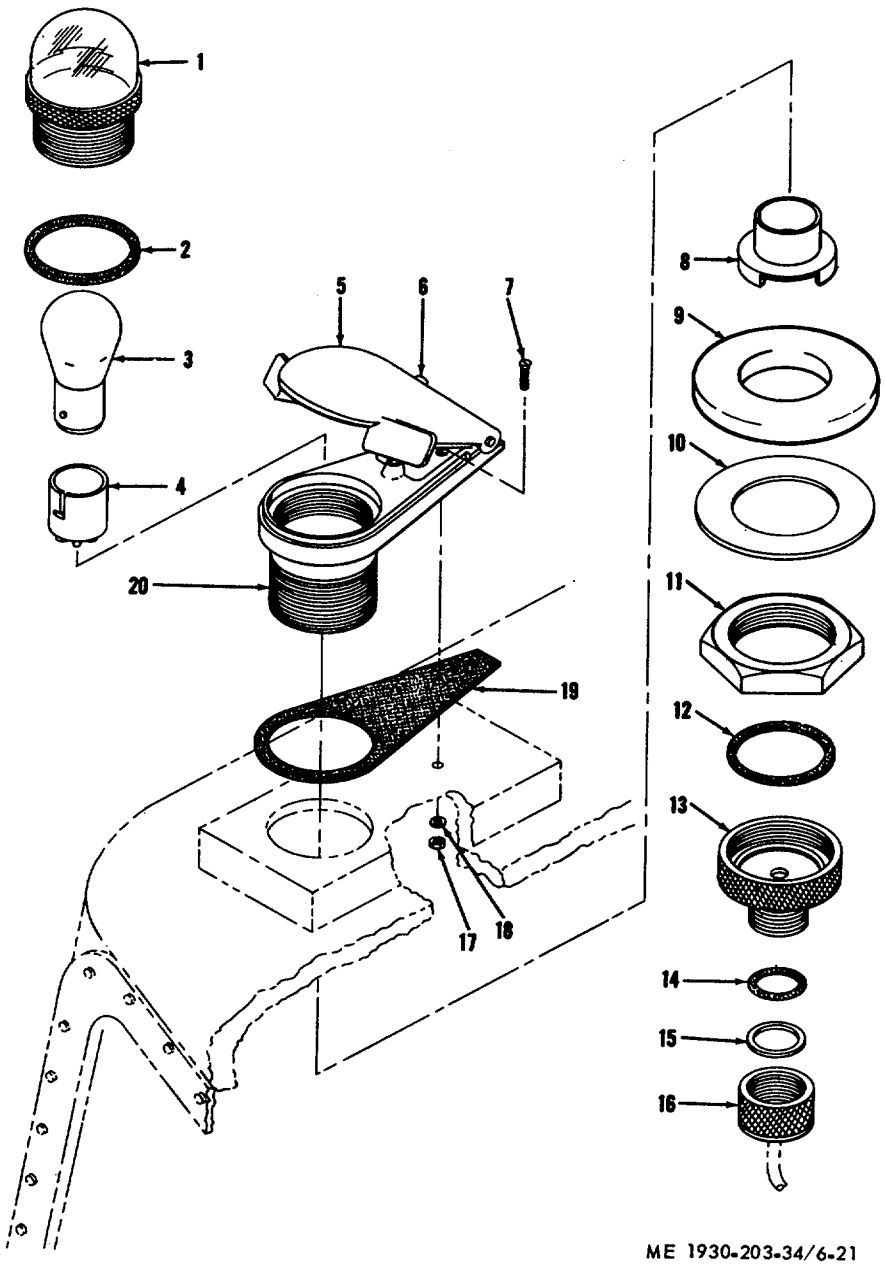
(6) Remove screw (7), shakeproof washer (18), and nut (17) securing base (20) to top of cab.

(7) Lift off light assembly and gasket (19).

(8) Remove globe assembly (1) and gasket (2).

(9) Remove lamp (3), lampholder (4), and lampholder adapter (8).

b. Reassembly and Installation. Reassemble and install bow light in reverse order of disassembly and removal.



1	Globe assembly	11	Nut
2	Gasket	12	Gasket
3	Lamp	13	Tube and retainer cap assembly
4	Lampholder	14	Packing, preformed
5	Housing	15	Washer
6	Screw	16	Cable cap
7	Screw	17	Nut
8	Lampholder adapter	18	Washer
9	Spacer	19	Gasket
10	Washer	20	Base

Figure 6-14. Bow light, removal, disassembly, reassembly and installation.

6-13. Range Light

a. Removal and Disassembly.

(1) Unthread and remove globe assembly (1, fig. 6-15) from base (5) at top of mast.

(2) Remove gasket(2).

(3) Remove lamp (3).

(4) Remove lampholder (4) from base (5) and disconnect electrical wiring.

(5) Remove four 1/2 inch bolts (7), lockwashers (9), and nuts (10) securing mast assembly (6) and gasket (8).

(6) Withdraw electrical wiring from bottom of mast and remove mast assembly (6) and gasket (8).

b. Cleaning, Inspection and Repair.

(1) Clean exterior of globe assembly (1) and mast assembly with a lint-free cloth dampened with dry-cleaning solvent, Federal Specification P-D-680. Wipe out inside of globe assembly (1) with a dry cloth. Wash rubber gaskets (2 and 8) with soap and water. Clean lampholder (4) with trichlorethylene, Military Specification MIL-T-7003. Dry with low-pressure compressed air. Wash base (5) in dry-cleaning solvent, Federal Specification P-D-680.

(2) Inspect globe assembly (1) for structural damage and broken or cracked globe. Replace globe assembly if damaged.

(3) Inspect gaskets (2 and 8) for breaks, cracks, and nonuniformity. Replace as required.

(4) Inspect lampholder (4) for signs of corrosion, contact damage, or loose wiring. Replace socket if damaged.

(5) Inspect base (5) for cracks or structural damage. Replace base if damaged.

(6) Inspect mast assembly (6) for cracks or structural damage. Replace any damaged part.

(7) Inspect wiring for breaks and cracked or frayed insulation. Replace wiring if damaged.

c. Reassembly and Installation. Reassemble and install range light in reverse order of disassembly and removal.

Key to Figure 6-15.

1 Globe assembly
2 Gasket
3 Lamp
4 Lampholder
5 Base
6 Mast assembly
7 Bolt
8 Gasket
9 Lockwasher
10 Nut

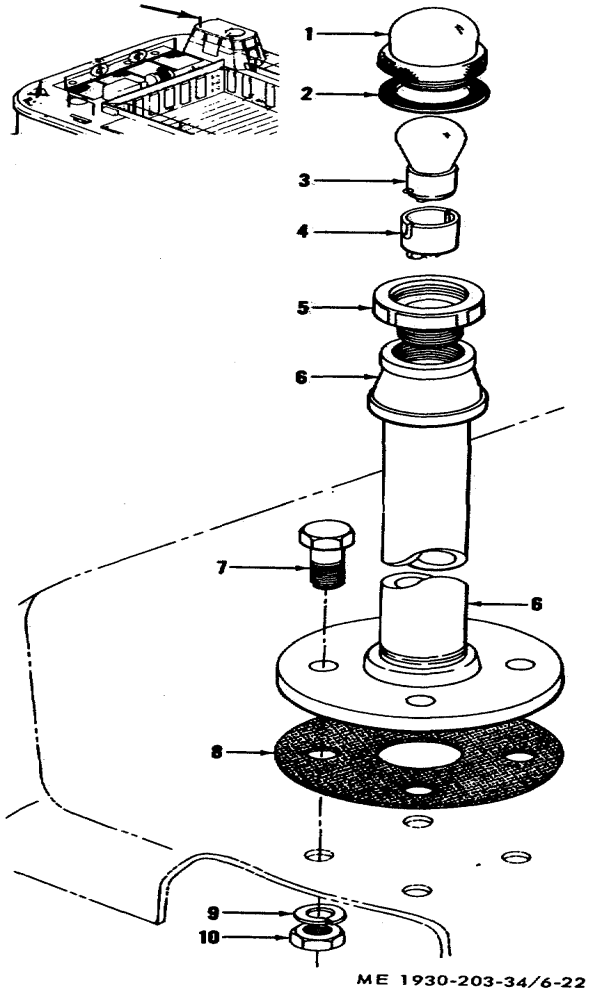


Figure 6-15. Range light removal, disassembly, reassembly, and installation.

6-14.Running Lights

a. Removal and Disassembly.

(1) Remove terminal box cover.

(2) Disconnect cable cap (9, fig. 6-16) from tube and retainer cap assembly (6), and remove packing (7) and washer (8).

(3) Remove tube and retainer cap assembly (6) from base (13), and remove gasket (5).

(4) Disconnect electrical wiring from lamp holder (20).

(5) Remove nut (4), washer (3), and spacer (2) from base (13) of light assembly.

(6) Loosen screw (15), and hinge up housing (16).

(7) Remove screw 1141. shakeproof washer (11) and nut (10) securing base (13) to mounting plate.

(8) Lift off light assembly and gasket (12).

(9) Remove globe assembly (17) and gasket (18).

(10) Remove lamp (19). lampholder (20), and lampholder adapter (1).

b. Reassembly and Installation. Reassemble and install running light in reverse order of disassembly and removal.

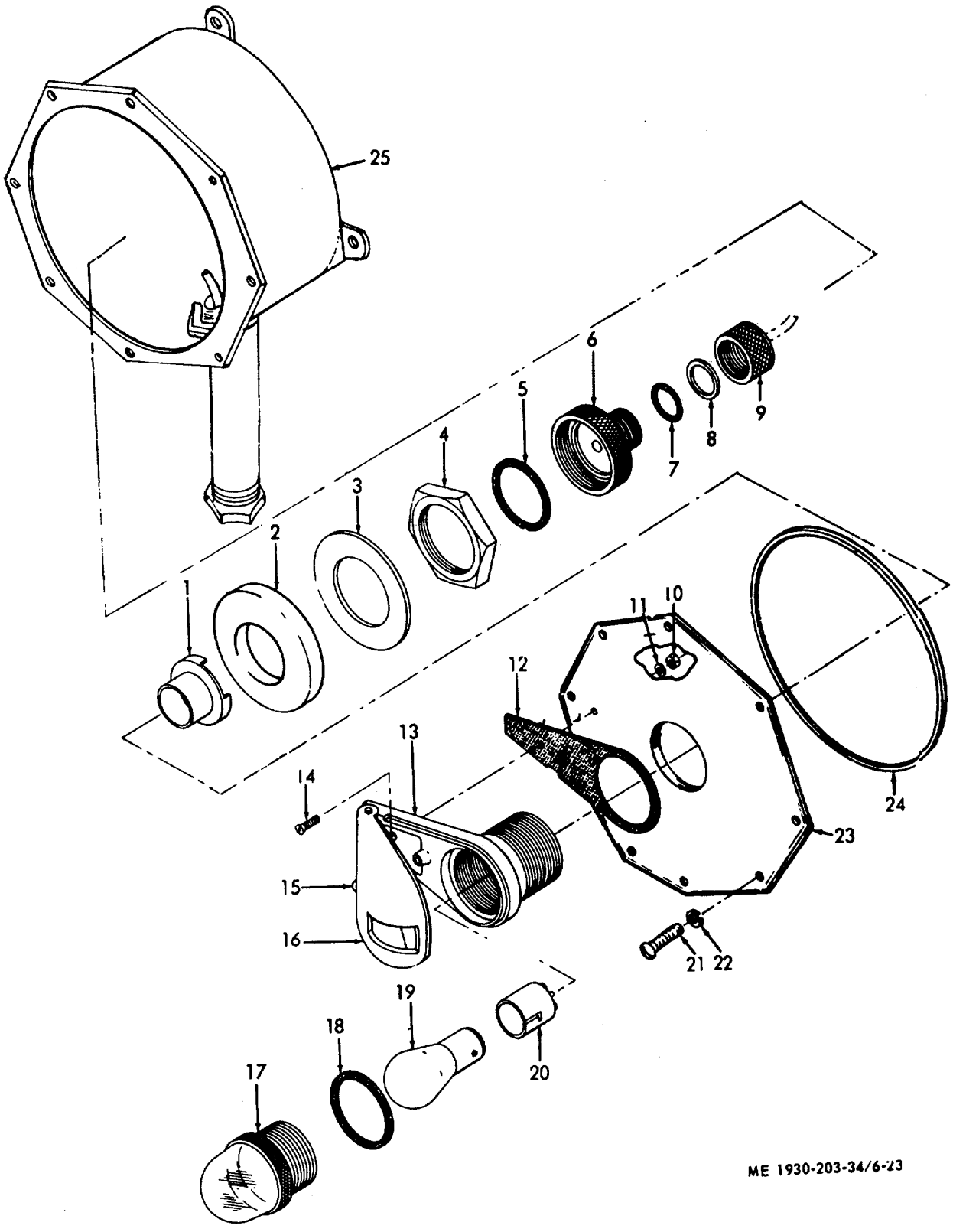


Figure 6-16. Running light, removal, disassembly, reassembly and installation

Key to Figure 6-16.
1. Lampholder adapter
2. Spacer
3. Washer
4. Nut
5. Gasket
6. Tube and retainer cap assembly
7. Packing, preformed
8. Washer
9. Cable cap
10. Nut
11. Washer
12. Gasket
13. Base
14. Screw
15. Screw
16. Housing
17. Globe
18. Gasket
19. Lamp
20-. Lampholder
21. Screw
22. Lockwasher
23. Cover
24. Packing, preformed
25. Terminal box

6-15. Replace Searchlight.

a. Removal.

(1) Disconnect electric wire (1).
(2) Remove rollpin (2) from control handle (3).
(3) Remove control handle (3), pivot bearing (4), control rod bracket (5) and nut (6).
(4) Loosen setscrews (7) and remove fulcrum (8).
(5) Remove screws (9) and lift searchlight (10) free of pilothouse roof. Remove gasket (11).

NOTE

Escutcheon plate was not removed from inside pilothouse. When replacing searchlight you can use the old escutcheon plate.

b. Installation.

(1) Prepare a replacement searchlight for installation by removing control handle (3), pivot bearing (4), control rod bracket (5) and nut (6) from end of vertical control rod (12).

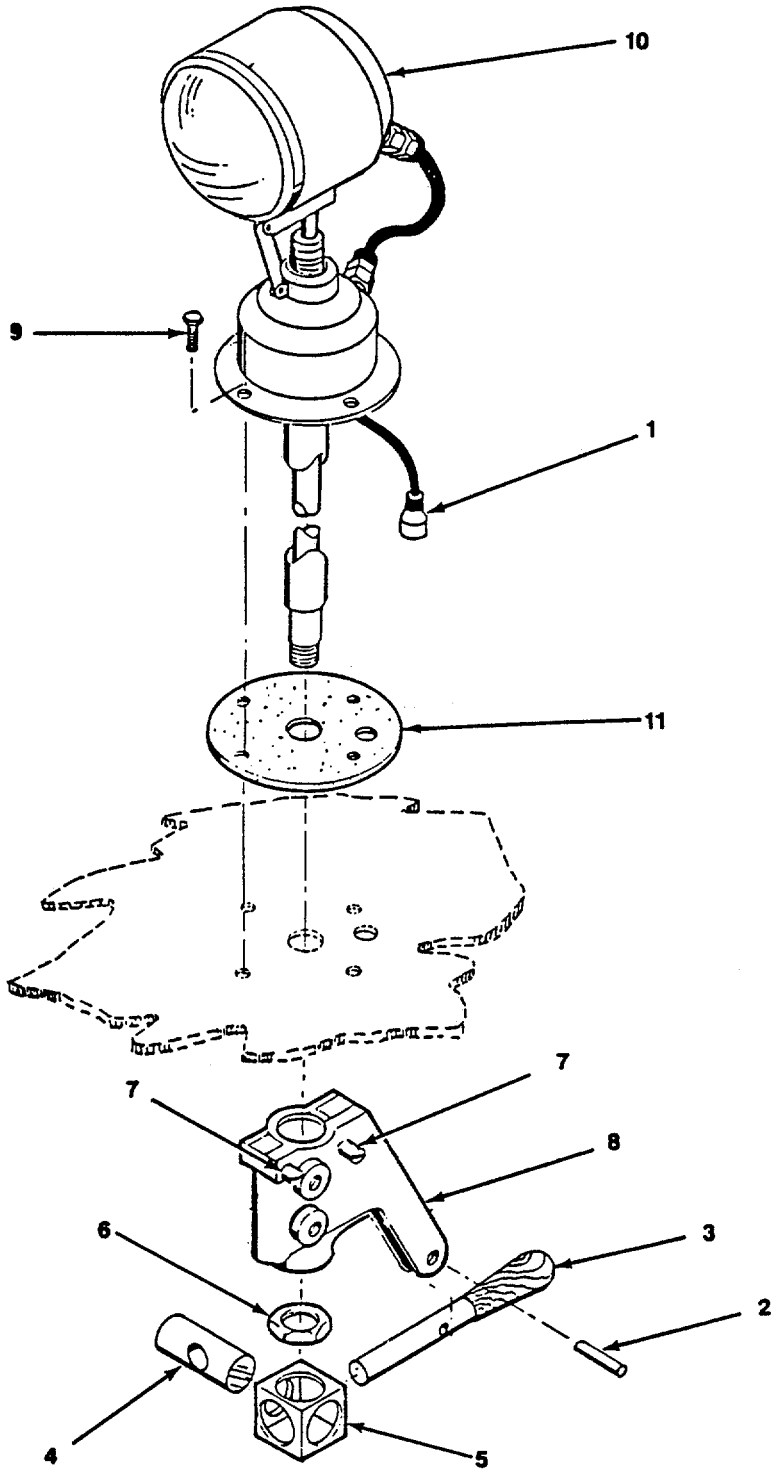
(2) Place a bead of sealant on pilothouse roof where gasket (11) seats. Place gasket (11) on pilothouse roof and line up holes in gasket with mounting holes for mounting screws (9).

(3) Place a second bead of sealant on base gasket (11) along outer edge of gasket. Then insert vertical control rod (12) and electrical cable (13) through holes in pilothouse roof and seat searchlight base (14) on mounting gasket (11) aligning mounting holes.

(4) Install screws (9) securing searchlight base (14) to pilothouse roof.
(5) Install fulcrum (8) on vertical control rod (12) and secure in place using setscrews (7).
(6) Install nut (6) and control rod bracket (5) on end of vertical control rod (12).

(7) Install pivot bearing (4) and control handle (3) in control rod bracket (5) and secure control handle (3) to fulcrum (8) using rollpin (2).

(8) Connect electric wire (1)



1. Wire
2. Rollpin
3. Handle
4. Pivot bearing
5. Rod bracket
6. Nut
7. Setscrew
8. Fulcrum
9. Screw
10. Searchlight
11. Gasket

Figure 6-17. Searchlight, removal and installation.

6-16. Cab Dome Light

a. Removal.

(1) Remove electrical connector (5, fig. 6-18) from cab dome light.

(2) Remove four screws (4), lockwashers (2), and nuts (1) securing dome light to ceiling straps.

(3) Lift off dome light.

b. Disassembly.

(1) Remove screw (22), lockwasher (21), and knob assembly (20) from switch shaft.

(2) Remove switch mounting nut assembly (19), washer (18), and gasket (17).

(3) Loosen eight screws (23) and separate door assembly (16) from body assembly (3).

(4) Remove screws (10) securing lamp socket wiring, and wire assembly (11) to switch (12).

(5) Remove four screws (7) securing socket, plate, and wire assemblies (8) to door assembly (16).

(6) Remove gasket (13) from door assembly (16).

(7) Remove screws (6) securing partition (27) and lift off partition.

(8) Remove screws (26) securing lens retaining plate (9) and lift out white lens (14), gasket (15), red lens (25), and gasket (24).

c. Cleaning, Inspection and Repair.

(1) Wash metal parts in dry-cleaning solvent, Federal Specification P-D-680. Wash rubber gaskets and lenses with soap and water, and dry with a lint-free cloth. Clear electrical connector, receptacle, and sockets with trichloroethylene, Military Specification MIL-T-7003. Dry with low-pressure compressed air.

(2) Inspect gaskets (13, 15, 17, and 24) for breaks, cracks, and nonuniformity. Replace any damaged gasket.

(3) Inspect body assembly (3) and door assembly (16) for cracks or structural damage. Replace if damaged.

(4) Inspect lenses (14 and 25) for breaks or cracks. Replace if damaged.

(5) Inspect socket, plate, and wire assemblies (8) for signs of corrosion, contact damage, or loose wiring. Replace if damaged.

(6) Inspect wiring for breaks and cracked or frayed insulation. Replace wiring if, damaged.

(7) Inspect terminals and lugs on wiring for corrosion and security of attachment. Replace as required.

(8) Inspect switch (12) for external contact corrosion and case damage. Operate switch through a complete cycle and ensure that a positive contact is made in all positions. This operation can best be performed by making a continuity check with an ohmmeter.

d. Reassembly and Installation. Reassemble and install dome light in reverse order of disassembly and removal.

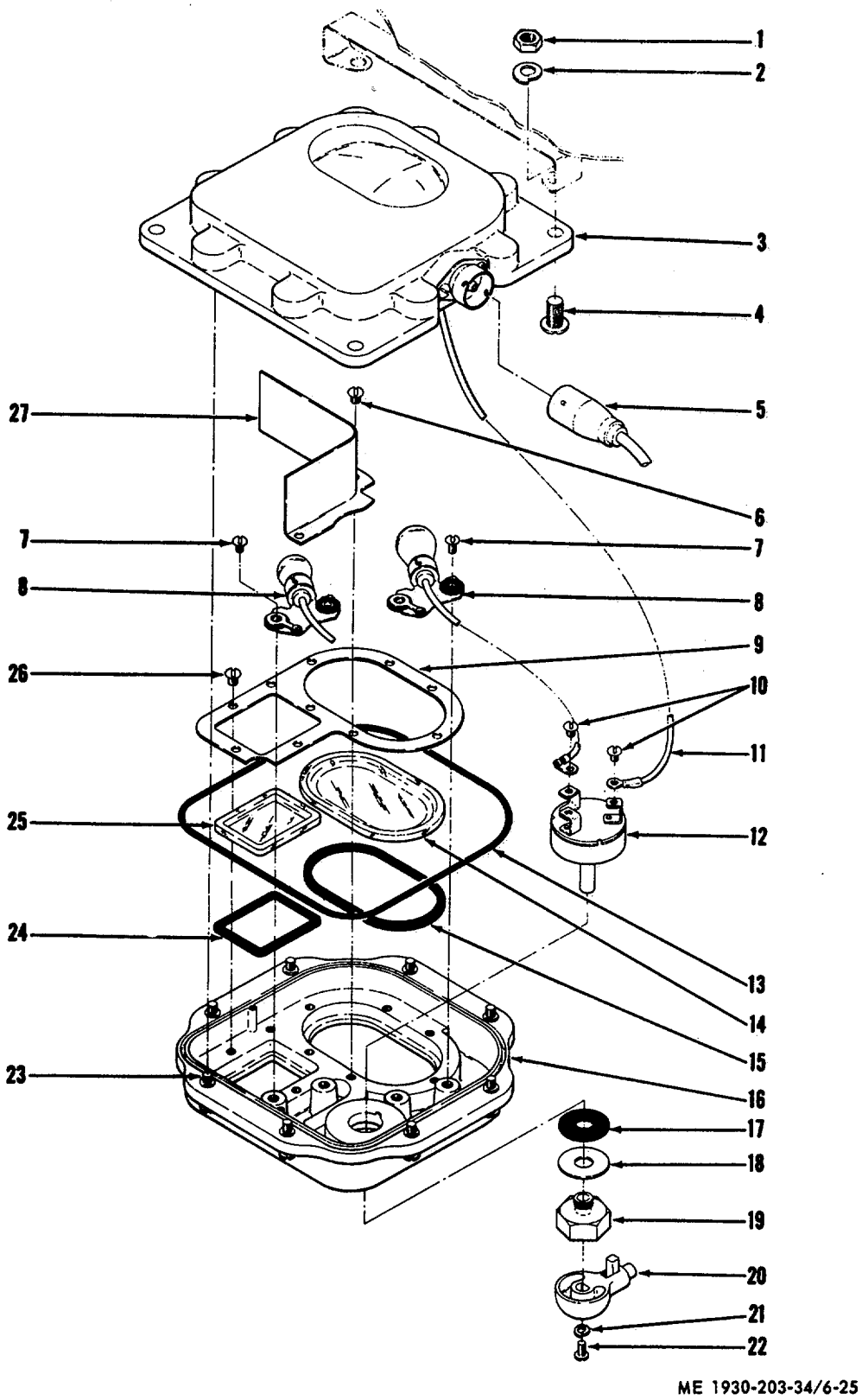


Figure 6-18. Cab dome light, removal, disassembly, reassembly, and installation.

Key to Figure 6-19
1 Nut
2 Lockwasher
3 Body assembly
4 Screw
5 Electrical connector
6 Screw
7 Screw
8 Socket
9 Lens retaining plate
10 Screw
11 Wire assembly
12 Switch
13 Gasket
14 Lens
15 Sealing gasket
16 Door assembly
17 Gasket
18 Washer
19 Switch mounting nut assembly
20 Knob assembly
21 Lockwasher
22 Screw
23 Screw
24 Sealing gasket
25 Lens
26 Screw
27 Partition

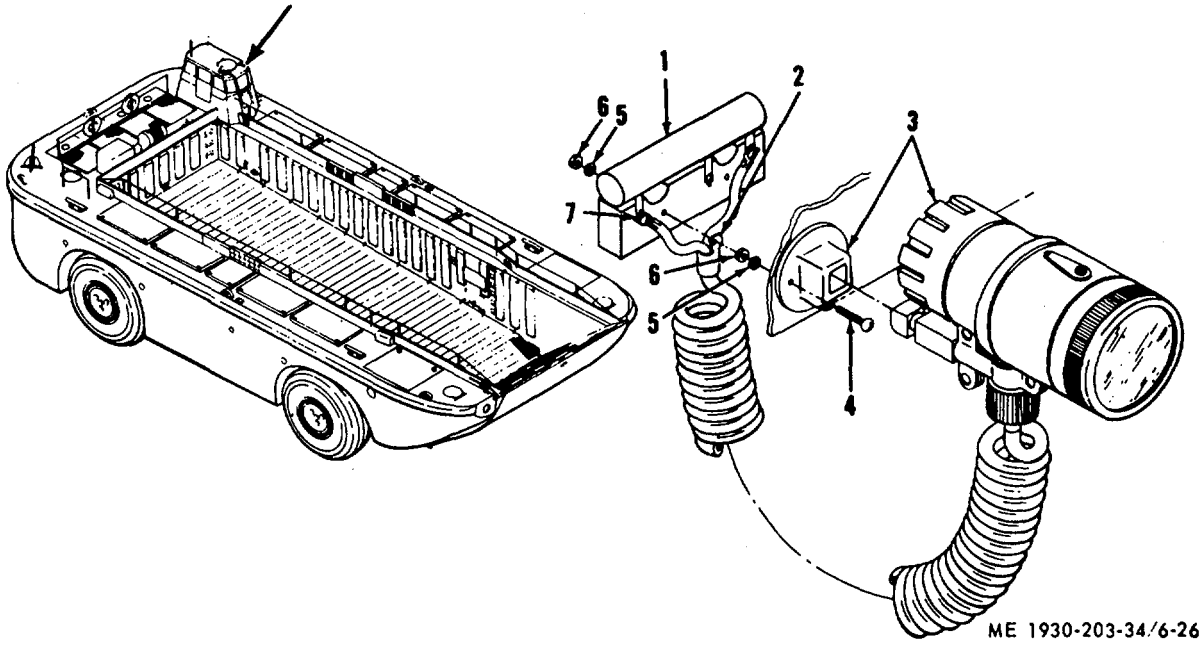
6-17. Instrument Panel Light

a. Removal.

(1) Remove screws (4, fig. 6-19), lockwashers (5), and nuts (6) securing light assembly (3) and resistor and base assembly (1) to cab roof stiffener. (Note position of ground lug (2) when removing screws).

(2) Disconnect wiring at resistor and base assembly (1) by removing screws (7).

b. Installation. Install instrument panel light in reverse order of removal.



1 Resistor and base assembly
2 Ground lug
3 Light assembly
4 Screw
5 Washer
6 Nut
7 Screw

Figure 6-19. Instrument panel light removal and installation.

6-18. Spot and Trouble Light and Reel Assembly

a. Spot and Trouble Light Removal.

(1) Separate spot and trouble light from trigger switch (8, fig. 6-20).

(2) Remove three screws (5), and lift off door assembly (6) and sealed unit assembly (7) from body assembly (2).

(3) Uncouple connector (1), and remove screw (9), lockwasher (3), and nut (4) securing ground lead to body assembly (2).

b. Reel Assembly Removal

(1) Remove connector (12) from reel assembly (13).

(2) Remove nut (11) and lockwasher (10) securing reel assembly (13) to studs.

(3) Remove reel assembly (13).

c. Cleaning, Inspection and Repair.

(1) Clean exterior of spot and trouble light, trigger switch (8), and reel assembly (13), with a lint-free cloth dampened with dry-cleaning solvent, Federal Specification P-D-680. Wipe out inside of body assembly (2) with a dry cloth. Clean connectors and receptacle with trichloroethylene, Military Specification MIL-T-7003. Dry with low-pressure compressed air.

(2) Inspect body assembly (2) and door assembly (6) for dents, cracks, or structural damage. Replace parts as required.

(3) Inspect sealed unit assembly (7) for dents, cracked glass, or defective lamp, reflector, socket, or electrical wiring. Replace sealed unit assembly if damaged.

(4) Inspect connector (1) for signs of corrosion or loose wiring. Replace connector or repair wiring if damaged.

(5) Inspect wiring for breaks and cracked or frayed insulation. Replace wiring if damaged.

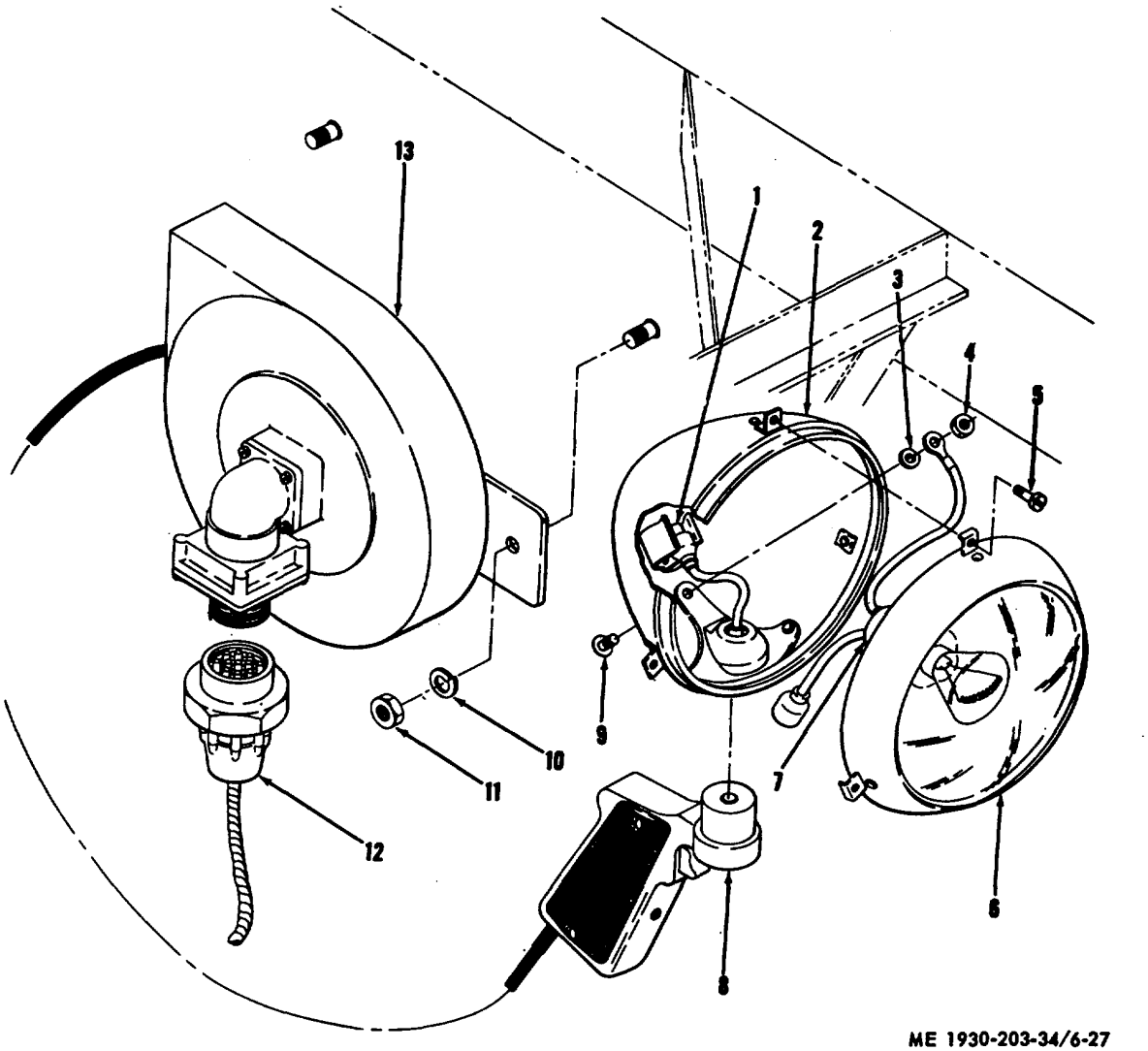
(6) Inspect trigger switch (8) for cracks or structural damage. Replace trigger switch if damaged.

(7) Inspect reel assembly for dents or structural damage. Insure that reel unit is operative by extending extension cord and observing that reel unit rewinds. Replace reel assembly if defective.

(8) Inspect reel assembly to connector (12) for signs of corrosion or loose wiring. Replace connector or repair wiring if damaged.

d. Spot and Trouble Light Installation. Install spot and trouble light in reverse order of removal.

e. Reel Assembly Installation. Install reel assembly in reverse order of removal.



1 Connector
2 Body assembly
3 Washer
4 Nut
5 Screw
6 Door assembly
7 Sealed unit
8 Trigger switch
9 Screw
10 Washer
11 Nut
12 Connector
13 Reel assembly

Figure 6-20. Spot and trouble light and reel assembly removal and installation.

6-19. Master Warning Light

a. General. The master warning light is located on the left side of the instrument panel in the cab. The master warning light will illuminate when any of the port or starboard warning lights located on the cab bulkheads illuminate. The lamp for the master warning light is 24-volt, bayonet base, single filament type.

b. Removal

(1) Remove two screws and two lockwashers securing warning light assembly to instrument panel and remove warning light assembly from the rear of the instrument panel.

(2) Disconnect cable wiring at electrical connectors. Tag wiring for reassembly.

c. Installation. Install master warning light in reverse order of removal.

6-20. Warning Lights

a. Removal

(1) Disconnect wiring at connector (17, fig. 6-21) in rear of warning light.

(2) Remove four screws (1) and lockwashers (2) securing light assembly to mounting bracket.

(3) Lift off warning light assembly.

b. Disassembly.

(1) Remove screws (19), frame (3), front assembly (4), and gasket (5) from top of box (6).

(2) Remove screws (13), cover (12), and gasket (9) from bottom of box (6).

(3) Remove screws (8) and socket and lamp assembly (7) from cover (12).

(4) Remove screws (10) securing lower and upper rectifiers (11 and 18) to cover (12) and remove rectifiers.

(5) Remove screws (16), electrical receptacle (15), and gasket (14) from cover (12).

c. Cleaning, Inspection and Repair.

(1) Wash metal parts in dry-cleaning solvent, Federal Specification P-D-680. Wash face and rubber parts with soap and water, and dry thoroughly. Clean electrical receptacle, connector, rectifiers, and sockets with trichloroethylene, Military Specification MIL-T-7003. Dry with low-pressure compressed air.

(2) Inspect frame (3) and front assembly (4) for cracks and breaks. Replace any damaged part.

(3) Inspect gaskets (5, 9, and 14) for breaks, cracks, and nonuniformity. Replace as required.

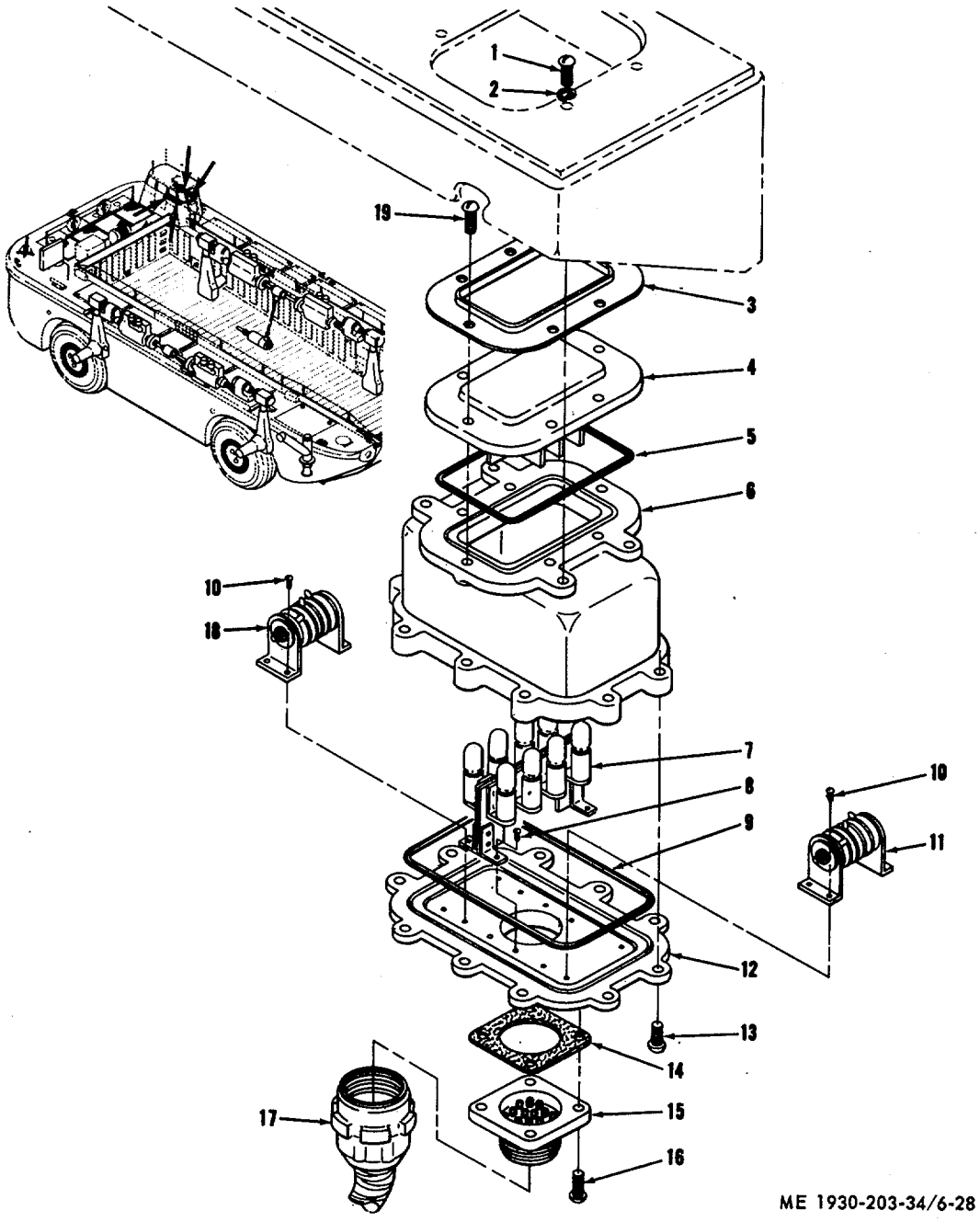
(4) Inspect box (6) and cover (12) for cracks, breaks, or other structural damage.

(5) Remove lamps from socket and lamp assembly (7) and inspect sockets for signs of corrosion, contact damage, or loose wiring. If sockets are damaged, unsolder associated wiring and tag each wire for reassembly. Replace sockets and resolder wiring.

(6) Inspect rectifiers (11 and 18) for signs of burning, corrosion, or arcing. If rectifiers are suspected of being defective, unsolder wiring from terminals, tag each wire and terminal with the appropriate color for reassembly, and check rectifiers.

(7) Inspect receptacle (15) for signs of corrosion, contact damage, or loose wiring. If receptacle is damaged, unsolder associated wiring and tag each wire for reassembly. Replace receptacle.

(8) Inspect wiring for breaks, cracked or frayed insulation, or bad solder joints. Replace wiring and resolder joints as necessary.



1 Screw	8 Screw	14 Gasket receptacle mounting
2 Lockwasher	9 Gasket	15 Receptacle
3 Frame	10 Screw	16 Screw
4 Front assembly	11 Rectifier	17 Connector
5 Gasket	12 Cover	18 Rectifier
6 Box	13 Screw	19 Screw
7 Socket and lamp assembly		

Figure 6-21. Warning light, removal, disassembly, reassembly and installation.

d. eassembly and Installation. Reassemble and install warning light in reverse order of disassembly and removal.

NOTE

When a warning light assembly is replaced by a new assembly the new assembly must be modified prior to installation. This modification is accomplished by rewiring a portion of the new assembly as shown in figure 6-22.

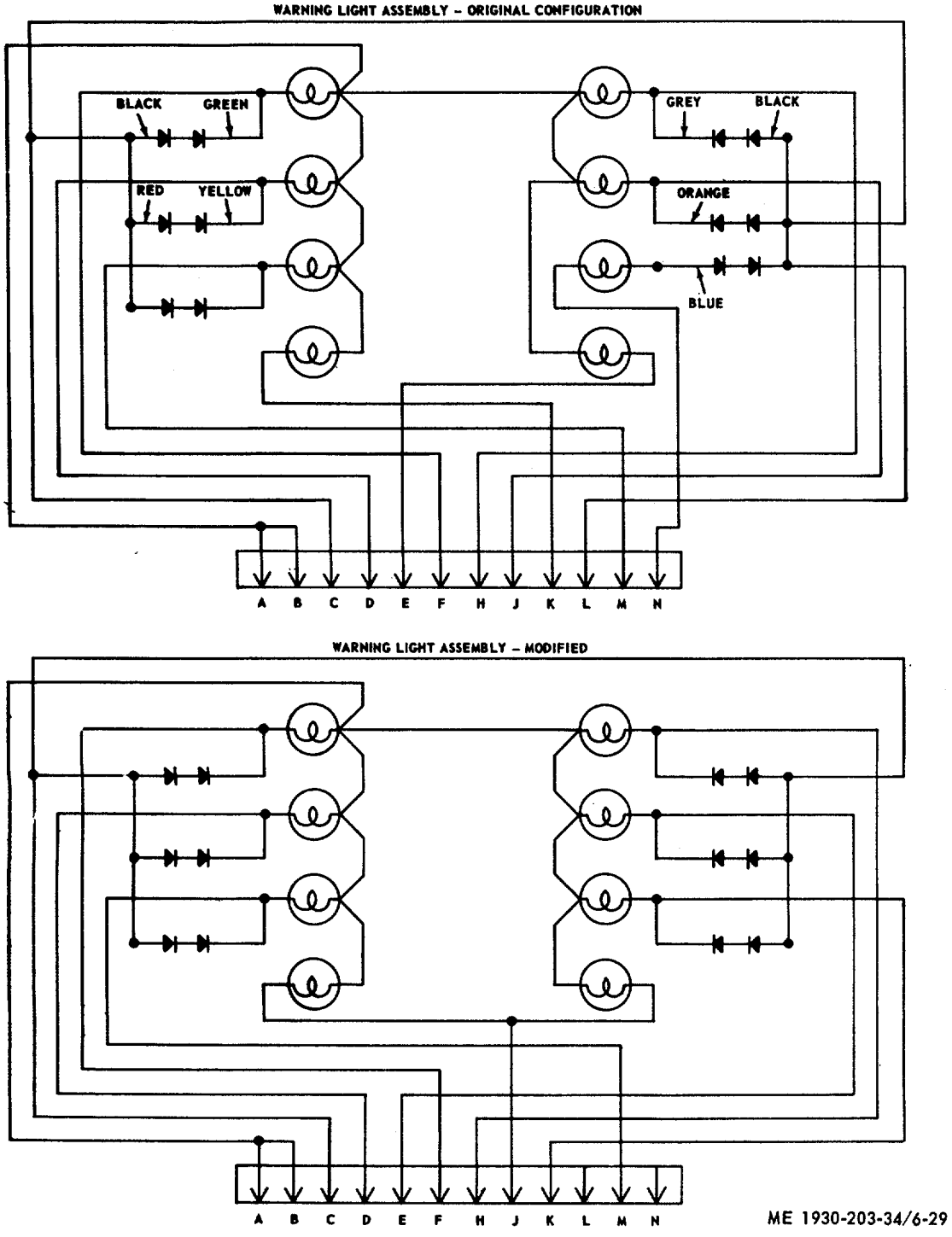


Figure 6-22. Warning light assembly wiring diagram.

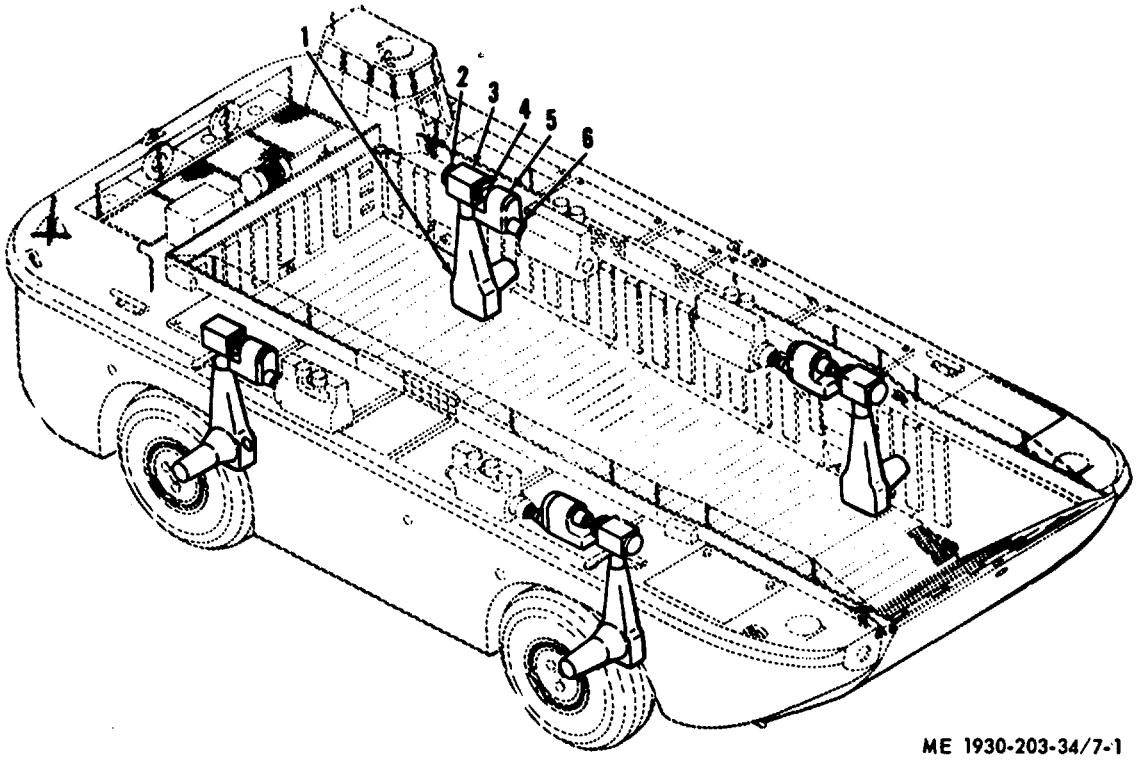
CHAPTER 7

REPAIR OF DRIVE SYSTEMS

Section I. LAND DRIVE SYSTEM

7-1. Description

The LARC is equipped with four wheel drive system (fig. 7-1). Each wheel is independently driven by a diesel engine. The four diesel engines transmit power from their flywheel ends through respective torque convertors. flexible couplings, transmissions, miter boxes, column and wheel drives, and wheels. Air brakes for the LARC are located on the forward and aft sides of each miter box.



1 Wheel column
2 Air brake
3 Miter box
4 Flexible coupling
5 Transmission
6 Flexible coupling

Figure 7-1. Land drive system

7-2. Torque Converter Assembly

a. Description.

(1) *General.* The torque converter assembly consists of a housing bolted to the engine, with a series of flexible flywheel disks connecting the engine crankshaft to the converter flywheel. There are two different model converters used on the LARC's. The earlier models contain four elements; a converter pump, a turbine, and two stators. The latter models contain three elements; a converter pump, a turbine, and one stator. The converter pump is the input member of the torque converter assembly and is connected to the converter flywheel. The turbine drives the output shaft which transmits power to the transmission. The stator(s) is a

reaction member necessary for torque multiplication. A charging oil pump, mounted on the converter housing, provides oil pressure for filling the converter and charging the hydraulic system of the transmission. The transmission sump serves as a reservoir for both converter and transmission. Flow of oil in the system is from the transmission sump through the charging pump to the converter and back to the transmission sump. The converter and transmission oil system contains an oil filter, oil cooler, pressure regulating valves, and pressure and temperature gages. Engine power is transmitted from the crankshaft, through flexible disks attached to the converter flywheel, then to the converter pump. The converter pump hub drives the charging oil pump which fills the converter with oil. Blades of the converter pump impel the oil smoothly but with tremendous force against the turbine outer blades. This causes the turbine to turn in the same direction as the pump. Oil leaves the turbine blades at the turbine's inner circumference, flowing in a direction opposite pump rotation. The stator(s) redirect this flow so the oil, with its unexpended energy, enters the pump in the same direction as its rotation. As turbine speed increases, torque ratio decreases and pump and turbine approach a 1 to 1 speed ratio. When this occurs, angle of oil flow through the stator(s) changes, causing oil to strike stator(s) on their opposite sides. In the four element converter, the first stator begins to freewheel on the ground sleeve in the direction of pump rotation and is soon followed by the second stator. In the three element converter, the single stator begins to freewheel. The converter then functions as a fluid coupling. The oil flows through the converter pump and turbine, then out between the turbine and stator, inside the ground sleeve along the turbine shaft, then out through a passage-way in the converter housing to the filter and cooler. From the cooler, the oil returns to the transmission sump.

(2) *Differences in models.*

(a) The Allison Torqmatic Converter (fig. 7-2) Model TC-654 is used on hulls 5 through 18. Converter Model TC-554 is used on hulls 19 through 60. Model TC-654 can he replaced with Model TC-554 on hulls 5 through 18 whenever replacement of a converter assembly is necessary.

(b) Two different Model TC-554 converters are used on the LARC's, converter assembly number 6758244 is a four element converter with two stator members; while assembly number 6830815 is a three element converter with one stator member. Both of the converters are completely interchangeable, though some of the internal parts are different.

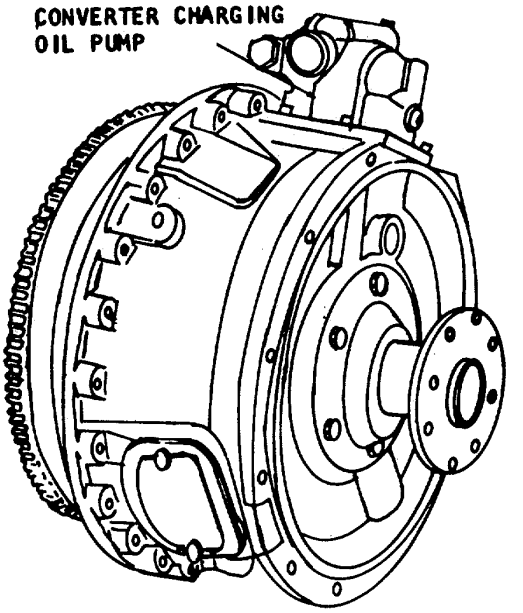


Figure 7-2. Torque converter (Models TC-554 and TC-654).

b. Charging Oil Pump Assembly.

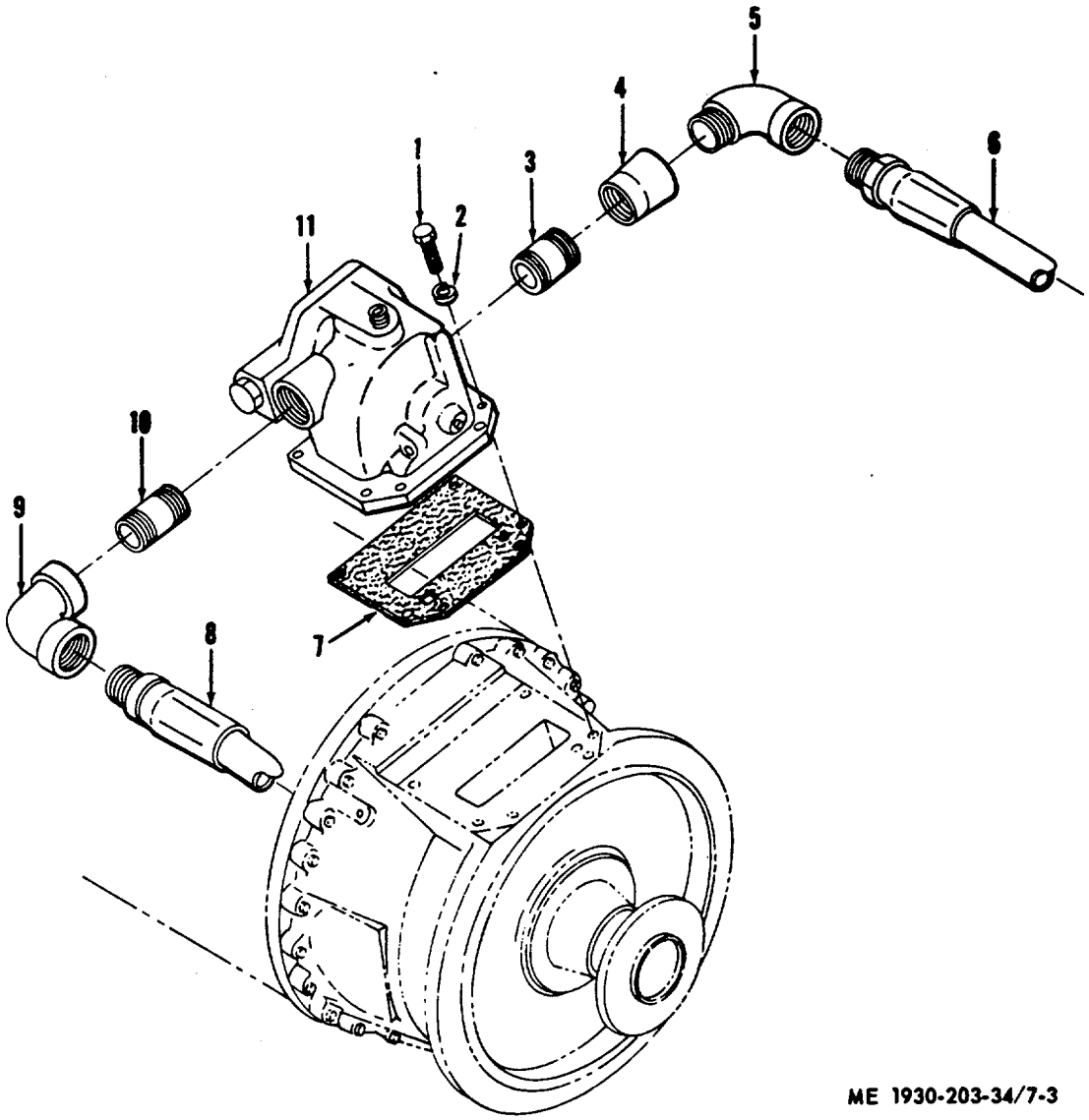
(1) *Removal*

(a) Drain transmission (LO 55-1930-203-12).

(b) Disconnect flexible hoses (6 and 8, fig. 7-3). Provide a suitable container to catch any oil remaining in hoses.

(c) Remove elbows (5 and 9), bell reducer (4), and nipples (3 and 10).

(d) Remove six bolts (1) and lockwashers (2) and lift off oil pump (11) and gasket (7).



1 Bolt, machine
2 Lockwasher
3 Nipple, close
4 Reducer, bell
5 Elbow, street
6 Hose, flexible, oil pump to transmission selector valve
7 Gasket, oil pump mounting
8 Hose, flexible, oil pump suction
9 Elbow, 90°
10 Nipple, close
11 Oil pump

Figure 7-3. Removal of oil pump.

(2) *Disassembly.*

(a) Remove plug (10, fig. 7-4) and annular gasket (9) from oil pump body cover (6).

(b) Remove converter pressure regulating spring (8) and valve (7).

(c) If oil pump has externally mounted clutch pressure regulating spring and valve, remove plug (1) and shim set (2) from oil pump body cover and remove spring (3) and valve (4).

(d) Remove six bolts (29) and lockwashers (28) which secure oil pump body cover to oil pump body (19), and remove cover and gasket (11).

(e) If oil pump has internally mounted clutch pressure regulating spring and valve, remove snap ring (30), valve (31), and spring (32) from cover (34).

(f) Remove oil pump driven gear (27) and needle bearing (26) as an assembly.

(g) Press needle bearing (26) from driven gear, only if bearing replacement is necessary.

(h) Remove oil pump driving gear shaft (13) and oil pump driving gear (18, fig. 7-5).

(i) Remove seal ring (16, fig. 7-4) from oil pump driving gear shaft.

(j) Press or drive seal ring (14) and needle bearing (15), using bearing and bushing driver plug, part No. J4850, out of bore into pump driving gear pocket in pump body, only if bearing replacement is necessary.

(k) If inspection shows replacement of pump bearing sleeve (17) is necessary, remove sleeve using bearing remover, part No. J4852. If this tool is not available, remove pipe plug (21) to gain access to sleeve. Place a disk, 1/8 to ¼ inch thick by 1.370 inches in diameter, in slot behind the sleeve, alining disk with the sleeve. Insert a drift through pipe plug hole in rear of pump body and place drift against disk. Press or drive sleeve out of its bore and into driving gear pocket.

(1) If replacement of needle bearing (12) is necessary, collapse needle bearing cage with a hammer and punch, and remove it from cover.

Key to figure 7-4.

1 Plug
2 Shim set
3 Regulating spring, clutch pressure
4 Regulating valve, clutch pressure
5 Plug, pipe
6 Cover, oil pump body
7 Regulating valve, converter pressure
8 Regulating spring, converter pressure
9 Gasket, annular
10 Plug
11 Gasket, oil pump body cover
12 Needle bearing
13 Gear shaft, oil pump driving
14 Seal ring
15 Needle bearing
16 Seal ring, input shaft
17 Sleeve, pump bearing
18 Gear, oil pump driving
19 Oil pump body
20 Plug, pipe, hexagon head socket
21 Plug, pipe hexagon socket
22 Plug, pipe, countersunk headless
23 Plug, pipe
24 Pin, dowel
25 Shaft, oil pump driven gear
26 Needle bearing
27 Gear, oil pump driven
28 Lockwasher, 3/8 in.
29 Bolt, machine
30 Snap ring
31 Regulating valve, clutch pressure
32 Regulating spring, clutch pressure
33 Plug, pipe
34 Cover, oil pump body

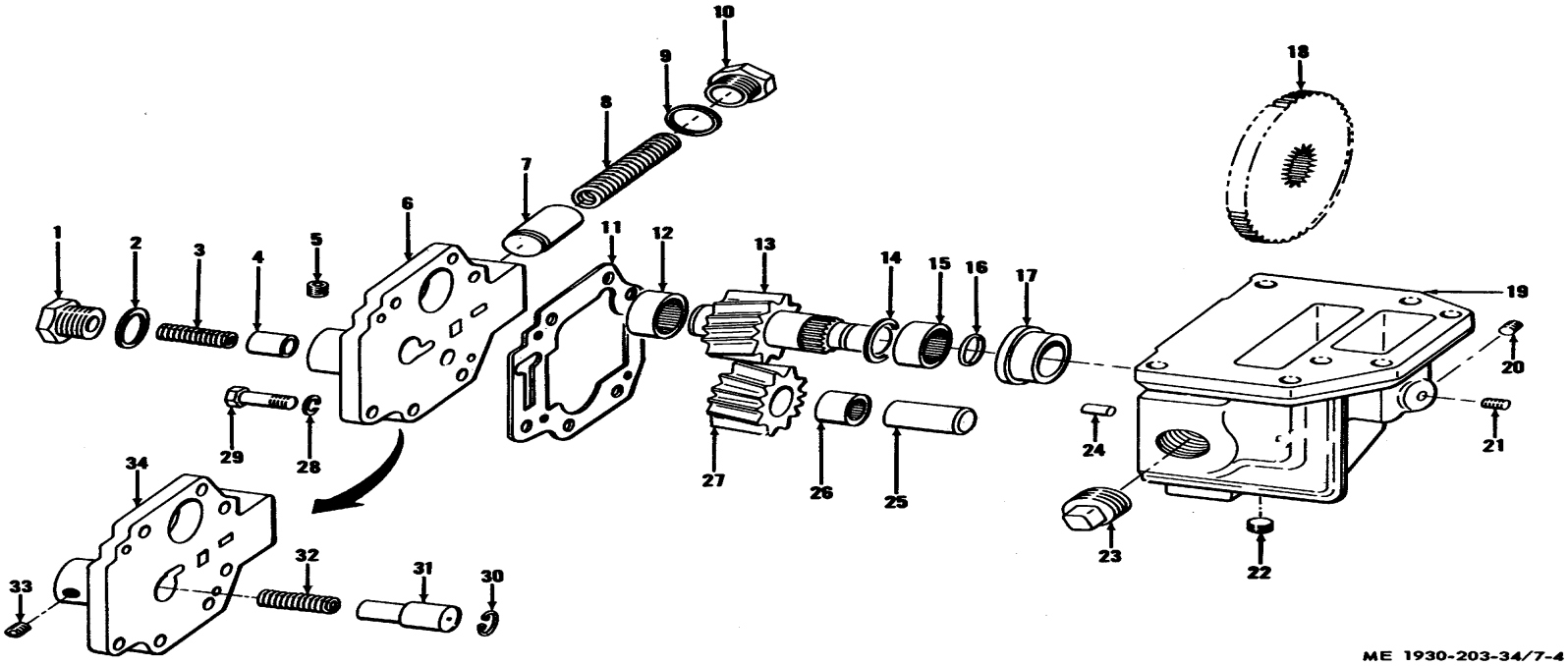


Figure 7-4. Oil pump.

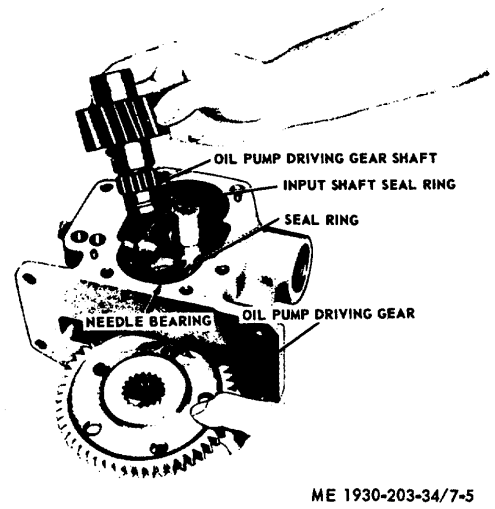


Figure 7-5. Removal of oil pump driving gear and shaft.

(3) *Cleaning, inspection and repair.*

(a) Clean all parts, except gasket (11, fig. 7-4) and seal rings (14 and 16), in dry-cleaning solvent, Federal Specification P-D-680, and dry with low pressure air (10 psi). Clean all oil passages in oil pump body (19) and cover (6) by working a wire back and forth through passages and flushing in dry-cleaning solvent.

(b) Replace gasket (11) and seal rings (14 and 16).

(c) Inspect needle bearings (12, 15 and 26) for pitted, scored, or burned condition. Replace if defective.

(d) Check that a pressure of 82±4.1 pounds is required to compress clutch pressure regulating spring (3) to a height of 2.22 inches. Replace spring if not within limits.

(e) Check that a pressure of 26 ± 0.52 pounds is required to compress clutch pressure regulating spring (32) to a height of 1.75 inches. Replace spring if not within limits.

(f) Check that a pressure of 88.6 ± 4.43 pounds is required to compress converter pressure regulating spring (8) to a height of 3.52 inches. Replace spring if not within limits.

(g) Check that a clearance of 0.006 inch is obtained between clutch pressure regulating valve (4) and oil pump body cover (6). If proper clearance is not obtained, replace valve.

(h) Check that a clearance of 0.006 inch is obtained between converter pressure regulating valve (7) and oil pump body cover. If proper clearance is not obtained, replace valve.

(i) Inspect gears (18 and 27) and gear shaft (13) for chipped or broken teeth or for wear that may have destroyed original tooth shape. If any of these conditions are found, replace gear or gear shaft.

(j) Check oil pump body (19), cover (6 or 34), plugs (1 and 10), and shim set (2) for good condition. Replace a defective part.

(4) *Reassembly*

(a) If needle bearing (12, fig. 7-4) in oil pump body cover (6) was removed, press a new needle bearing into bore in cover, using an arbor press and bearing and bushing driver plug, part No. J4850. Press only on numbered end of bearing.

(b) If pump bearing sleeve (17) was removed, install a new sleeve into bore in oil pump body (19), using an arbor press and bearing and bushing driver plug, part No. J4850.

(c) Press needle bearing (15) into bore in pump body, using bearing replacer, part No. J4523-01. Press on numbered end of bearing only. Press seal ring (14) into bore with lip of seal toward bearing, using bearing replacer, part No. J45 23-0 1. Seal edge should be 1 / 32 inch below surface.

(d) If needle bearing (26) was removed, place oil pump driven gear (27) on an arbor press so that beveled edge of bearing bore is up. Using bearing and bushing driver plug, part No. J4850, press new needle bearing into bore of gear. Press only on numbered end of bearing.

(e) Press new oil pump driven gear shaft (2 5) into pump body if shaft has been removed.

(f) Install seal ring (16) on oil pump driving gear shaft (13).

(g) Place driving gear (18) in pocket in pump body and insert driving gear shaft in pump and through driving gear (fig. 7-5). The seal ring should slip easily into bearing sleeve, since the sleeve is beveled to receive the seal ring.

(h) Install oil pump driven gear (27, fig. 7-4) with needle bearing (26) on driven gear shaft.

(i) If oil pump has internally mounted clutch pressure regulating spring and valve, install spring (32), valve (31), and snap ring (30) in oil pump body cover (34).

(j) Install oil pump body cover (6 or 34) and gasket (11) on oil pump body using six bolts (29) and lockwashers (28).

(k) Install converter pressure regulating valve (7) and spring (8).

(l) Install annular gasket (9) on plug (10) and install plug, making certain spring is properly seated in plug.

(m) If oil pump has externally mounted clutch pressure regulating spring and valve, install

(m) If oil pump has externally mounted clutch pressure regulating spring and valve, install valve (4), closed end first, and spring (3). Install shim set (2) and plug (1).

(5) *Installation.*

(a) Install oil pump (11, fig. 7-3) and a new gasket (7) on torque converter housing using six bolts (1) and lockwashers (2).

(b) Install nipple (10) and elbow (9) in pump intake port and nipple (3), reducer (4), and elbow (5) in discharge port.

NOTE

If a new pump is being installed, remove dust cover from intake port and pipe plug (22, fig. 7-4) from discharge port.

(c) Connect oil pump to transmission selector valve flexible hose (6, fig. 7-2) to elbow (5).

(d) Connect oil pump suction flexible hose (8) to elbow (9).

(e) Fill transmission with proper lubricant (LO 55-1930-203-12).

(f) Perform torque converter transmission stall test (para 7-3).

(g) If transmission oil pressure gage does not indicate proper pressure on oil pumps with externally mounted clutch pressure regulating valve and spring, stop engine and add shims to or remove shims from shim set (2. fig. 7-4) until proper pressure is obtained. Removing shims increases pressure; adding shims decreases pressure.

c. Torque Converter, Assembly Model TC-654 (fig. 2-2 and 7-2).

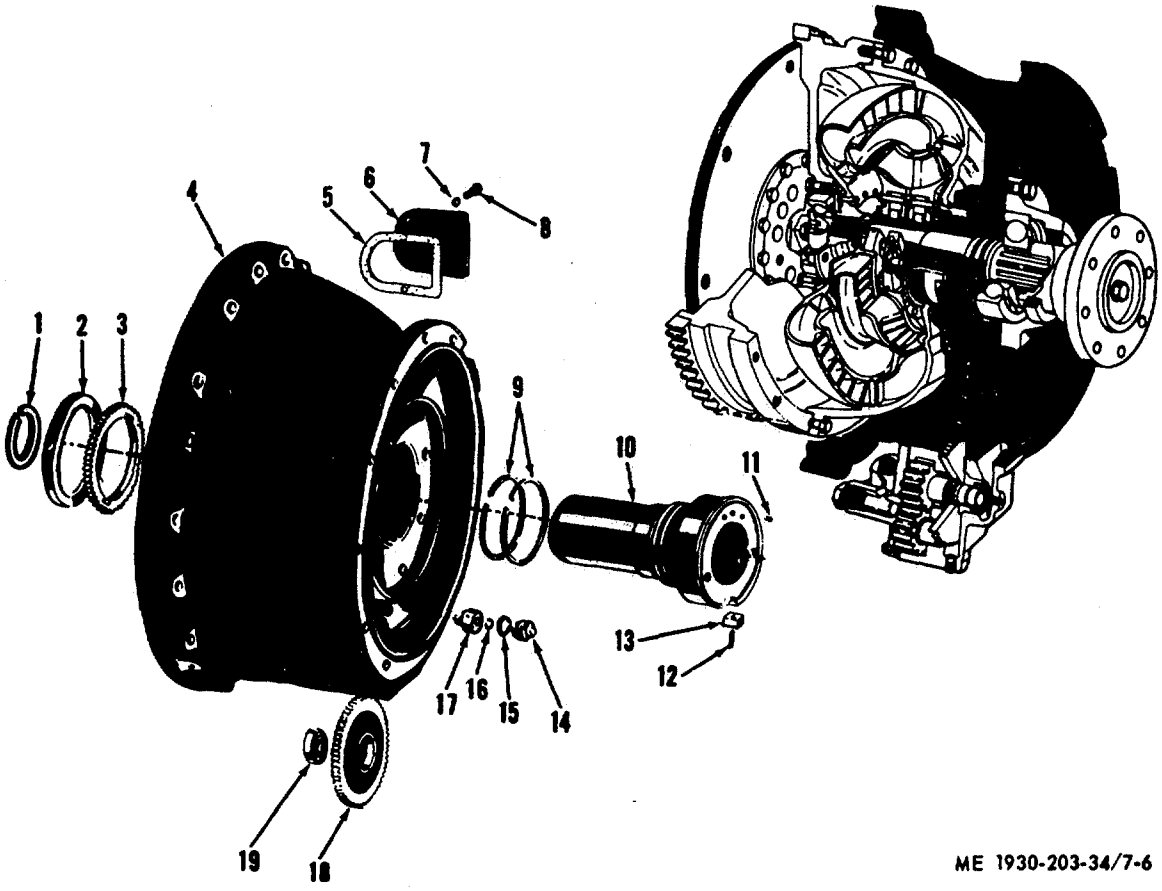
(1) *Removal.* Refer to paragraph 2-12.

(2) *Disassembly.*

(a) Charging oil pump assembly removal. Remove charging oil pump assembly, as outlined in b(1) above.

(b) Flywheel assembly removal.

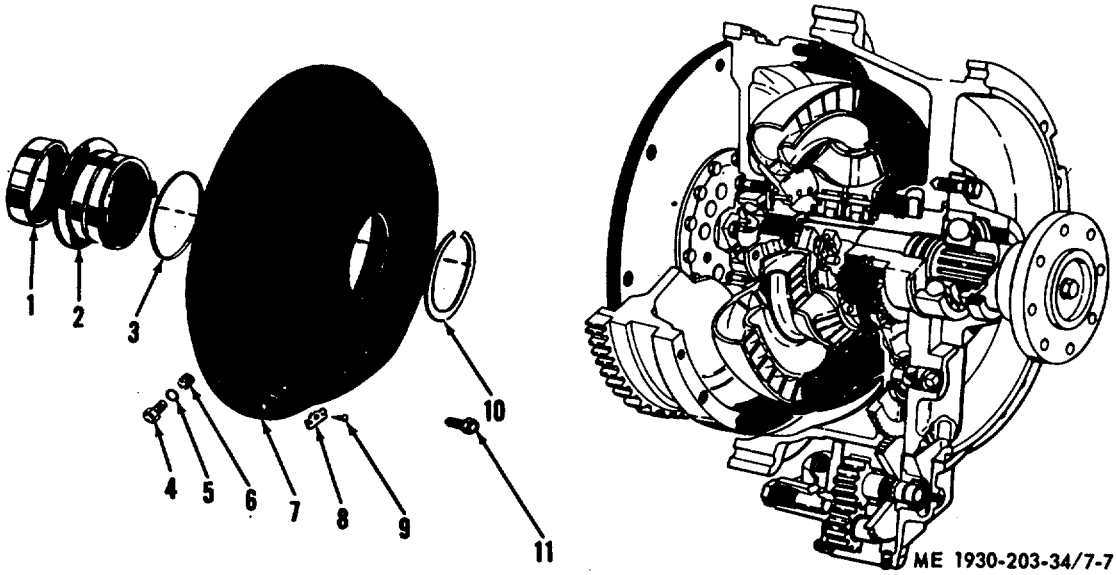
1. Position torque converter assembly with flywheel up.
2. Remove converter housing cover (6. fig. 7-6) and gasket (5).



1 Snapring
2 Converter pump hub oil seal
3 Oil pump drive gear
4 Converter housing
5 Converter housing cover gasket
6 Converter housing cover
7 Lockwasher
8 Bolt, machine
9 Hook type seal ring
10 Ground sleeve
11 Plug
12 Dowel pin
13 Ground sleeve key
14 Plug
15 Seal ring
16 Lockwasher
17 Oil pump idler gear shaft
18 Oil pump idler gear
19 Bearing assembly

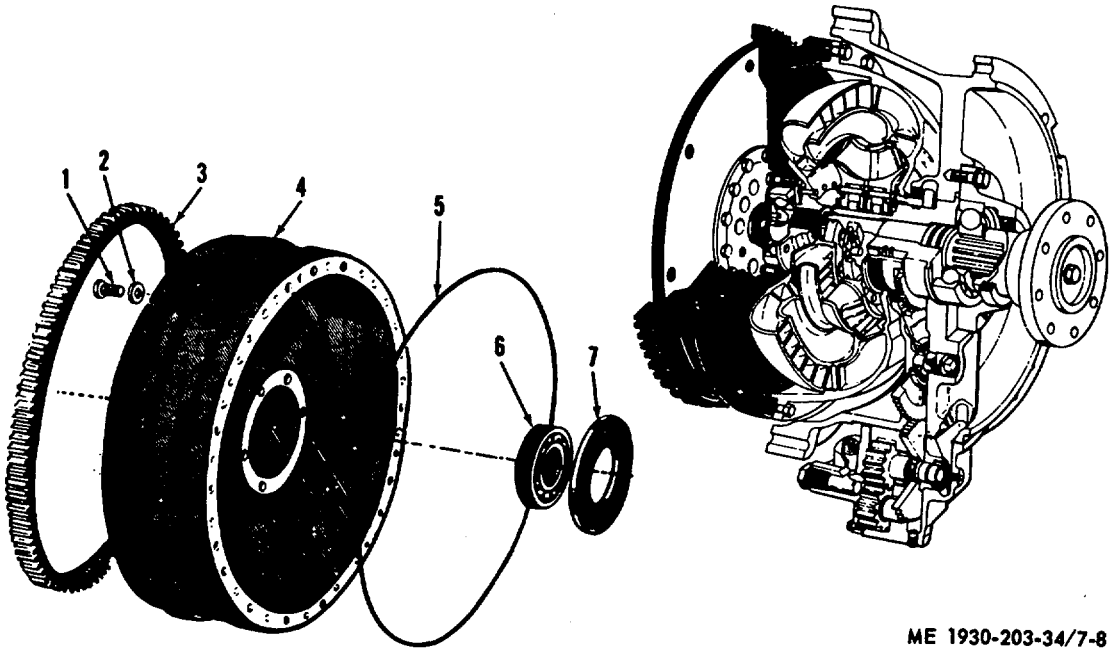
Figure 7-6. Housing assembly (model TC-654).

3. Using a long, thin-wall, 9/ 16 inch socket, and working through converter housing cover opening, remove 36 bolts (11, fig. 7-7) that secure converter pump (7) to flywheel (4, fig. 7-8), (fig. 7-9).



1 Converter pump hub bushing
2 Converter pump hub
3 Seal ring
4 Bolt, machine
5 Seal ring
6 Heli-coil insert
7 Converter pump
8 Converter balance weight
9 Screw, roundhead
10 Snapring
11 Bolt, machine

Figure 7-7. Converter pump and hub assembly.



1 Bolt, self-locking
2 Seal ring
3 Flywheel ring gear
4 Flywheel
5 Seal ring
6 Pilot bearing
7 Bearing retainer plate

Figure 7-8. Flywheel assembly (model TC-654)

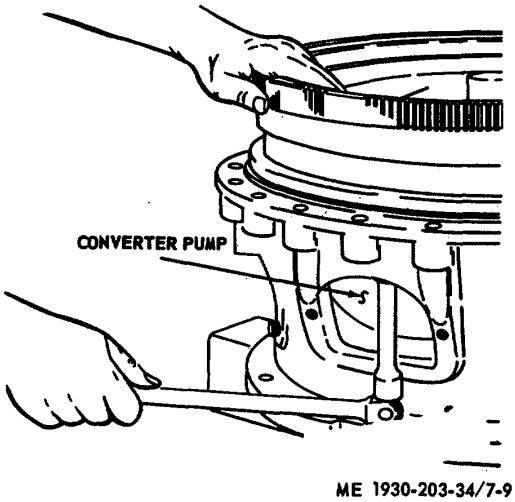


Figure 7-9. Converter pump-to-flywheel bolt removal and installation (model TC-654)

4. Using a 9/16 inch wrench, remove six bolts (1, fig. 7-8) and seal rings (2) from flywheel (4).

5. Install two ½-20 NF eyebolts or suitable lifting lugs 180 degrees apart in outer bolt circle of flywheel. Using a hoist and a suitable lifting sling, remove flywheel assembly from converter.

(c) *Torque converter elements removal*

1. Bend down edge of tabbed lockwasher that secures bolt in end of output shaft (fig. 7-10). Using a 1 inch wrench, remove bolt and lockwasher (fig. 7-11). Remove bearing retainer washer (fig. 7-12).

2. Use any suitable bearing puller to remove pilot bearing and bearing retainer plate (fig. 7-13).

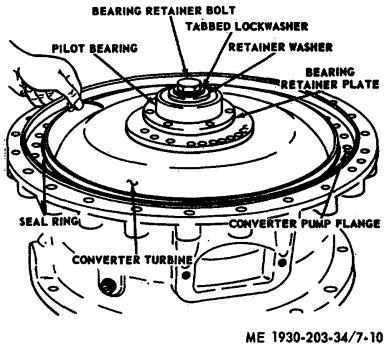


Figure 7-10. Pump-to-flywheel seal ring removal and installation

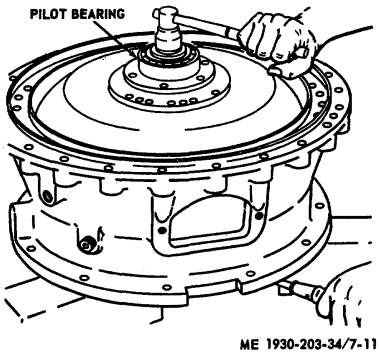


Figure 7-11. Bearing retainer bolt removal.

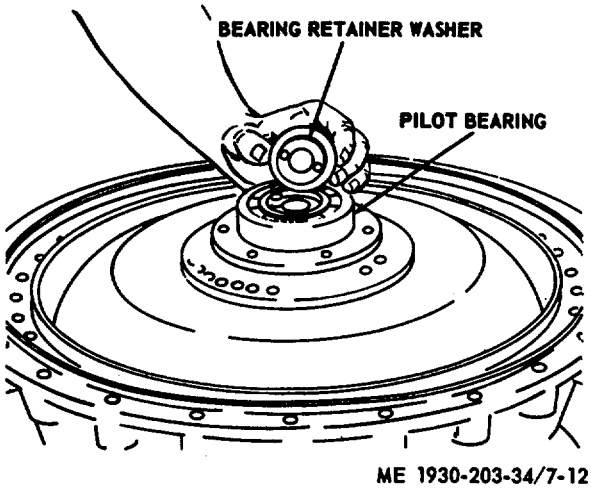


Figure 7-12. Bearing retainer washer removal and installation.

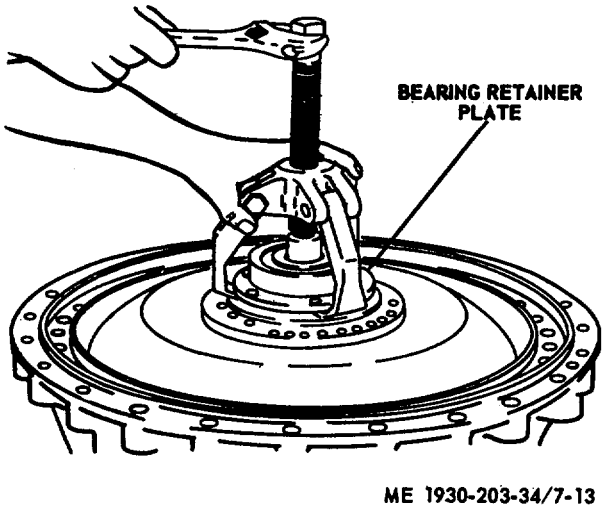


Figure 7-13. Pilot bearing and bearing retainer plate removal and installation.

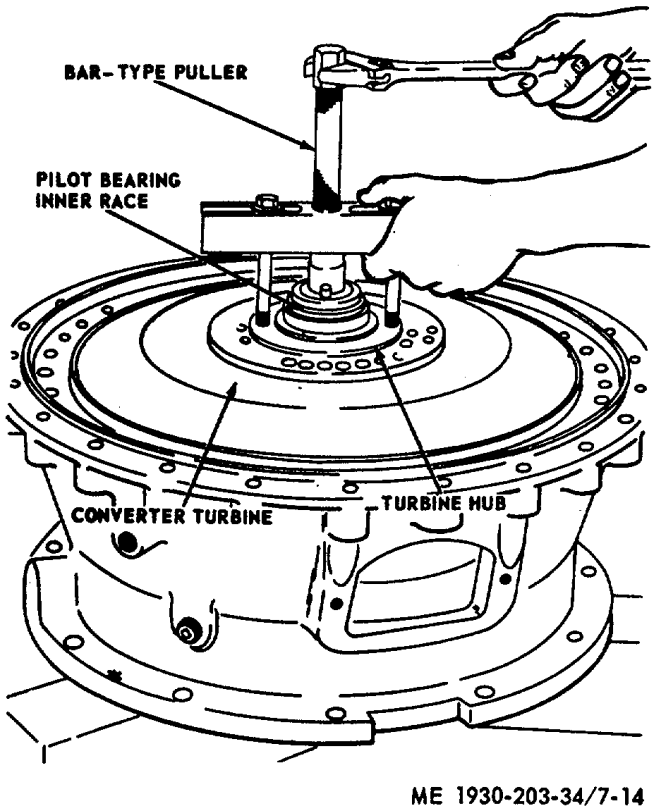


Figure 7-14. Turbine assembly removal (model TC-654).

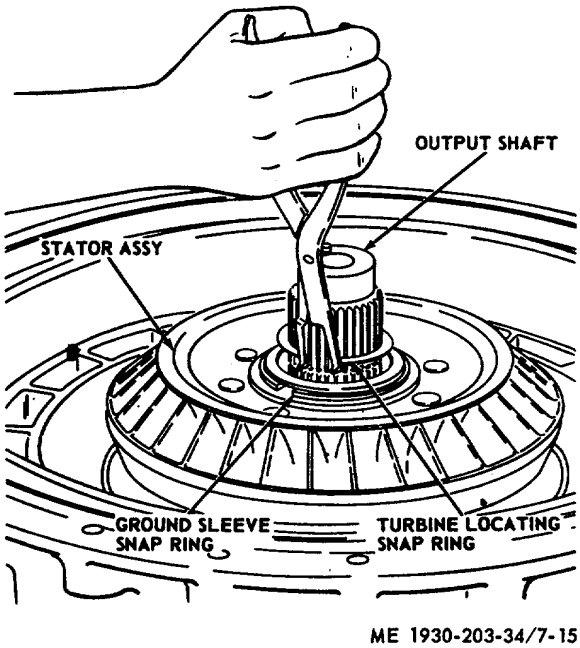


Figure 7-15. Snaprings removal and installation.

NOTE

The pilot bearing has a split inner race. The bottom half of the race will remain on output shaft and will he removed with converter turbine assembly.

3. Install bolts of any suitable bar-type puller in tapped holes provided in turbine hub (fig. 7-14). Remove remaining half of pilot bearing inner race and
4. Using snapring pliers, remove turbine locating snapring from output shaft (fig. 7-15).

5. Remove ground sleeve snapring from ground sleeve (fig. 7-15).

6. Remove steel thrust washer and bronze thrust washer (fig. 7-16).

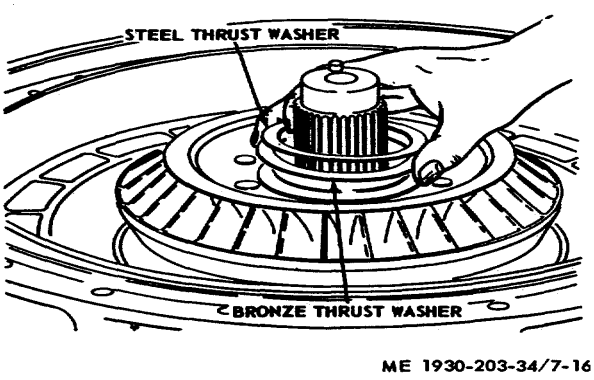


Figure 7-16. Steel and Bronze thrust washers removal and installation.

7. Pull first stator assembly half way off ground sleeve and insert stator assembly sleeve, part No. J-4237, to keep the rollers, springs, and cups from falling out of stator (fig. 7-17). Remove first stator assembly from ground sleeve by lifting it and rotating it clockwise.

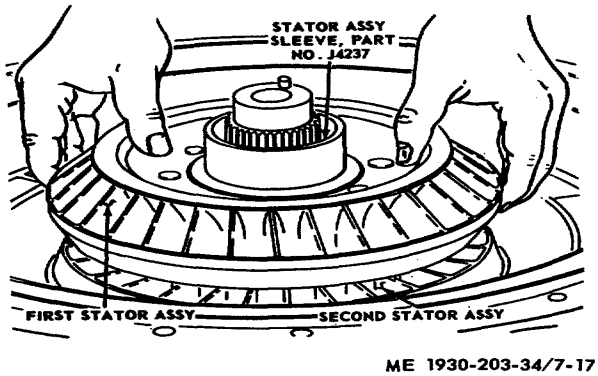


Figure 7-17. First stator assembly removal and installation.

NOTE

If stator assembly cannot be rotated, use a soft drift and drive against rivet heads on stator assembly to turn it clockwise. Do not drive nor apply force on stator blades. If this method fails, ground sleeve will have to be pressed out of stator assemblies. See 31(a) below for removal procedure

8. Remove bronze thrust washer if it did not stick to bottom of first stator assembly (fig. 7-18).

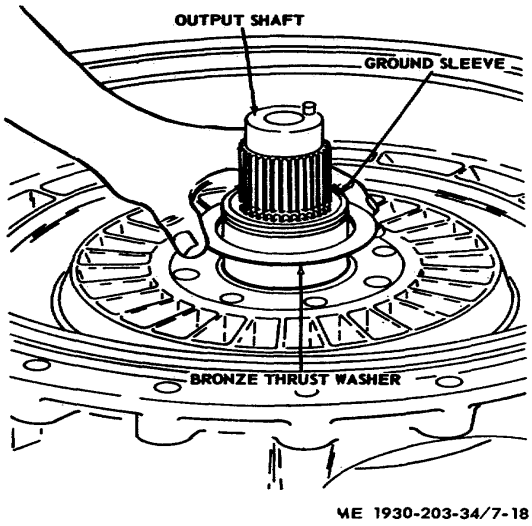


Figure 7-18. Bronze thrust washer removal.

9. Remove second stator assembly in the same manner as first stator assembly (fig. 7-19).

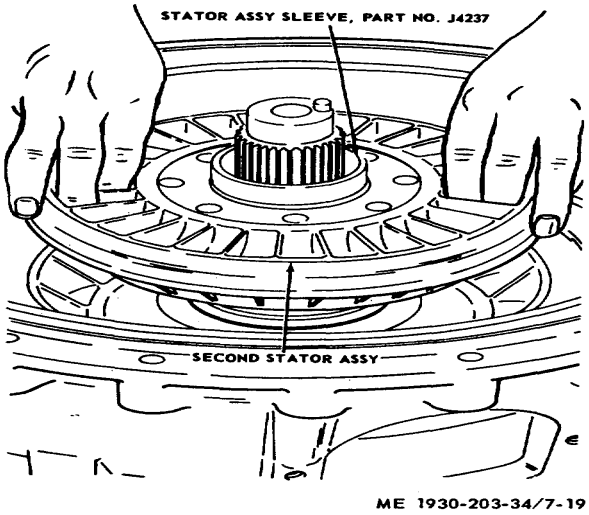


Figure 7-19. Second stator assembly removal and installation.

10. Remove bronze thrust washer and steel thrust washer if they did not come off with second stator assembly (fig. 7-20).

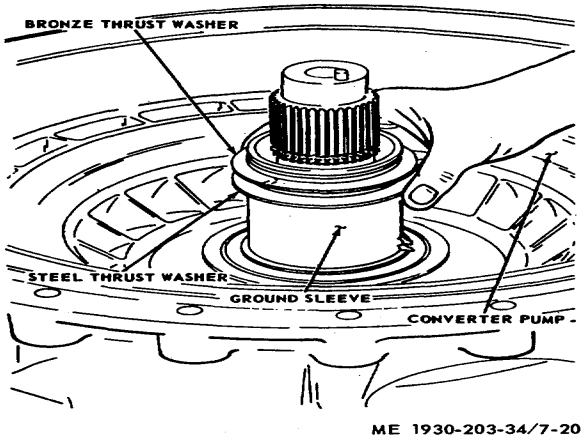


Figure 7-20. Bronze and steel washer removal and installation.

11. Converter pump can now be lifted from housing (fig. 7-21).

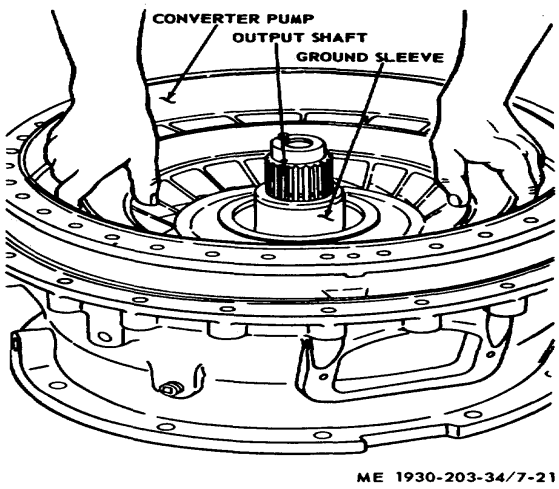


Figure 7-21. Converter pump removal and installation.

12. Remove two hook-type seal rings from ground sleeve (fig. 7-22).

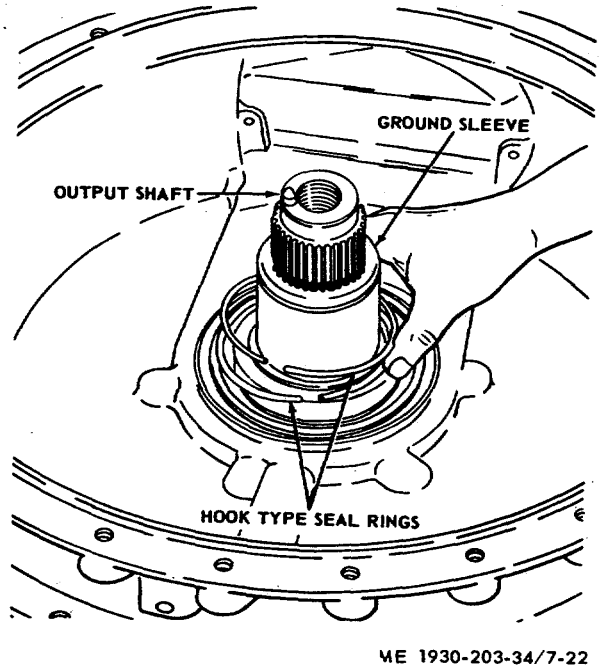
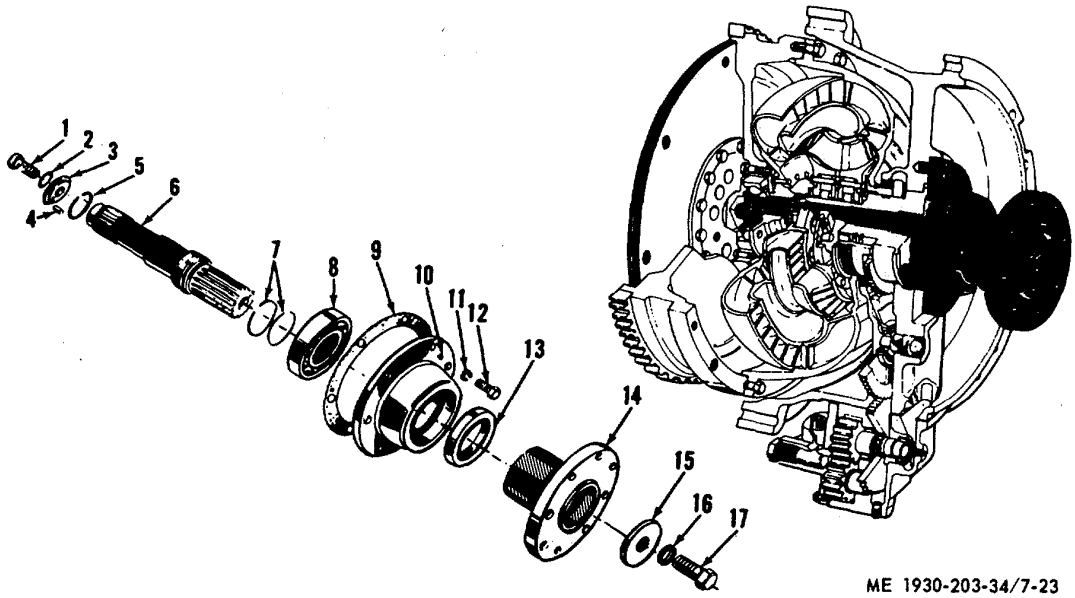


Figure 7-22. Hook-type seal ring removal and installation.

(d) Torque converter output shaft removal.
1. Position converter on table so output shaft is horizontal.
2. Remove six bolts (12, fig. 7-23) lockwashers (11) from bearing retainer (10).



1 Bolt, machine
2 Lockwasher, special
3 Bearing retainer washer
4 Dowel pin
5 Snapring
6 Output shaft
7 Hook type seal ring
8 Bearing assembly
9 Bearing retainer gasket
10 Bearing retainer
11 Lockwasher, plain
12 Bolt, machine
13 Output flange dual oil seal
14 Output flange
15 Output flange washer
16 Lockwasher, plain
17 Bolt, machine

Figure 7-23. Output Shaft and Flange Assembly (Model TC-654).

3. Tap lightly with soft hammer on opposite end of output shaft to loosen bearing retainer from converter housing.

4. Remove output shaft and flange assembly (parts 6 through 17, fig. 7-23).

(3) Subassemblies disassembly.

(a) Housing assembly disassembly.

1. Using a 3/4 inch wrench, remove charging oil pump idler gear shaft plug, seal ring, and lockwasher from rear of converter housing (fig. 7-24).

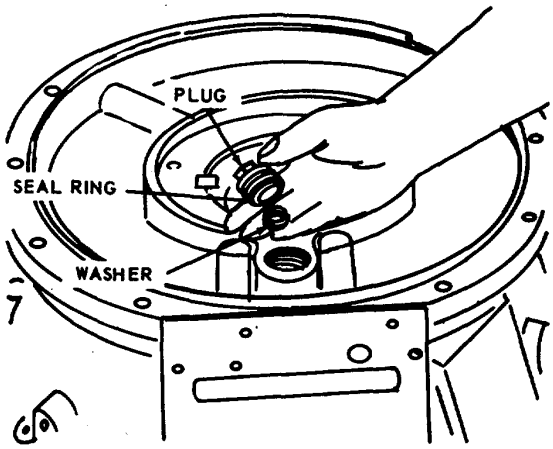


Figure 7-24. Plug, seal ring and lockwasher removal and installation.

2. Install slide hammer remover and adapter, part No. J5901, in the ½ -2ONF threaded hole in oil pump idler gear shaft (fig. 7-25).

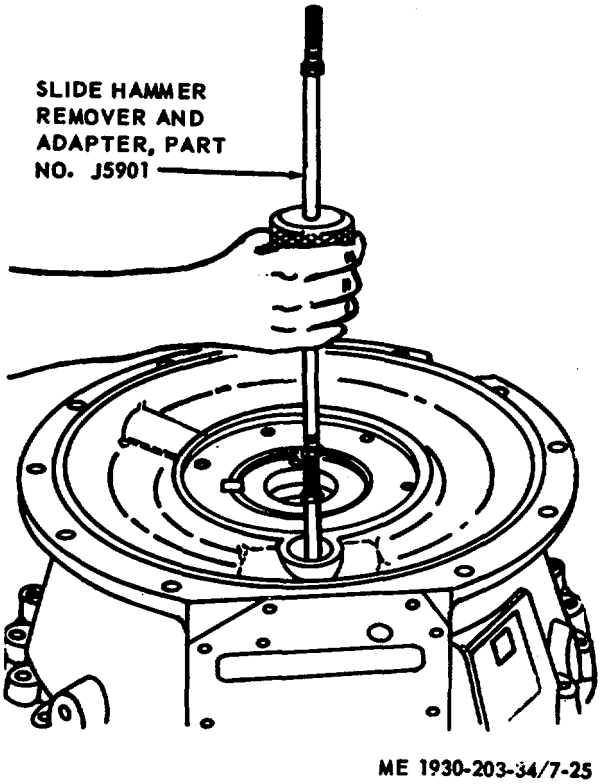


Figure 7-25. Charging oil pump idler gear shaft removal

3. Remove shaft (17, fig. 7-6), being careful charging oil pump idler gear (18) does not drop out.

4. Remove charging oil pump idler gear assembly (fig. 7-26). Do not remove bearing from gear.

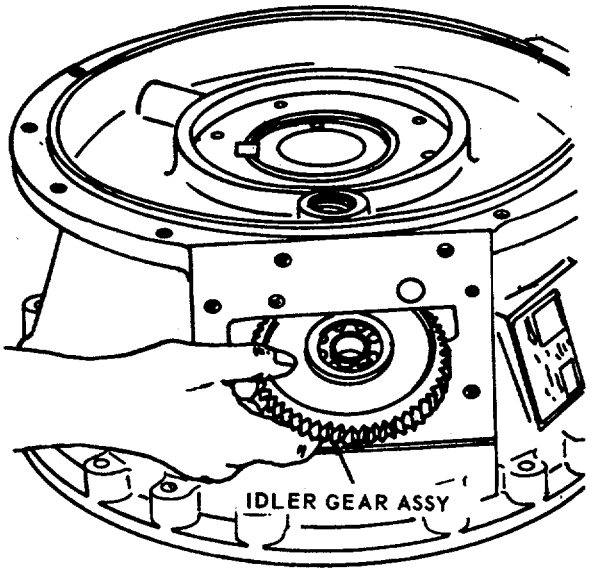


Figure 7-26. Charging oil pump idler gear assembly removal and installation.

5. The charging oil pump drive gear (3, fig. 7-6) and converter pump hub oil seal (2) are generally not removed. If gear or seal needs to be replaced, collapse oil seal with drift and hammer and remove oil seal. Gear can then be removed (fig. 7-27).

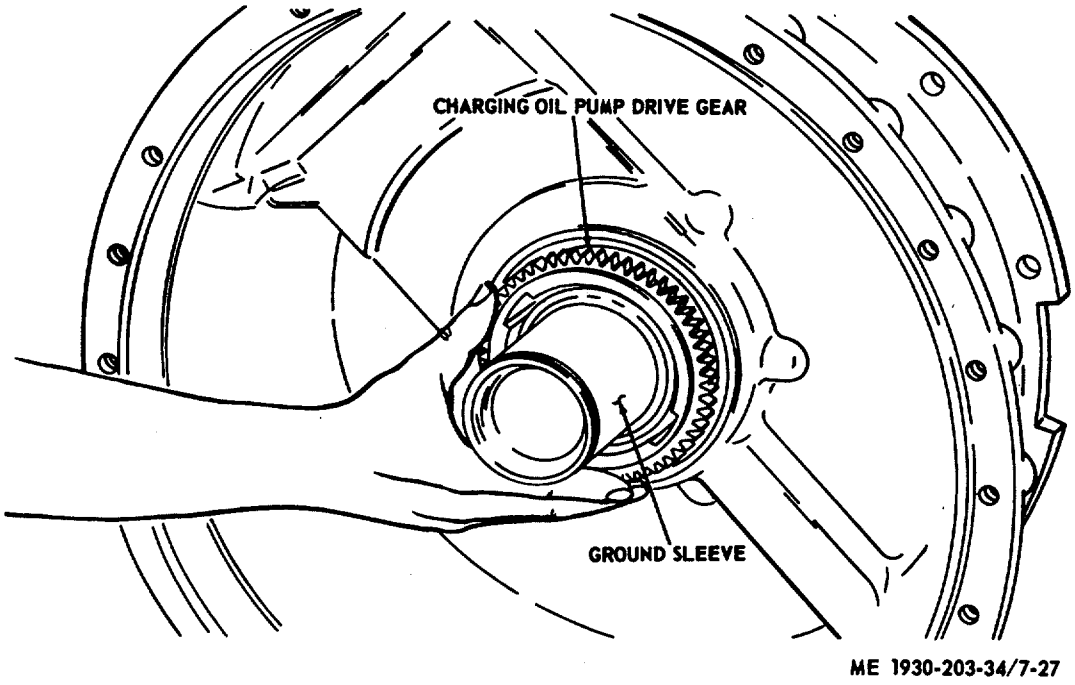


Figure 7-27. Charging oil pump drive gear removal.

6. Ordinarily, the converter ground sleeve is not removed. If it needs to be replaced, position converter housing in a press, front side up, and press ground sleeve out of housing (fig. 7-28). Remove ground sleeve key (13, fig. 7-6) and dowel pin (12) from ground sleeve.

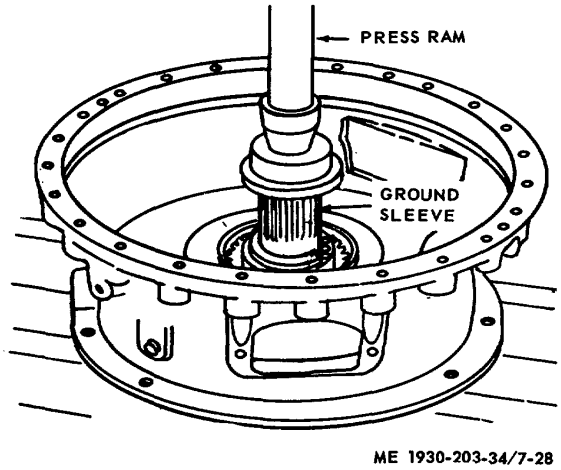


Figure 7-28. Ground sleeve removal.

7. Some converter models have an orifice in the converter oil out passage. No Service is required for this part under normal conditions.

(b) Converter pump and hub assembly disassembly.

1. Do not disassemble converter pump and hub assembly unless replacement of parts is needed (fig. 7-7).

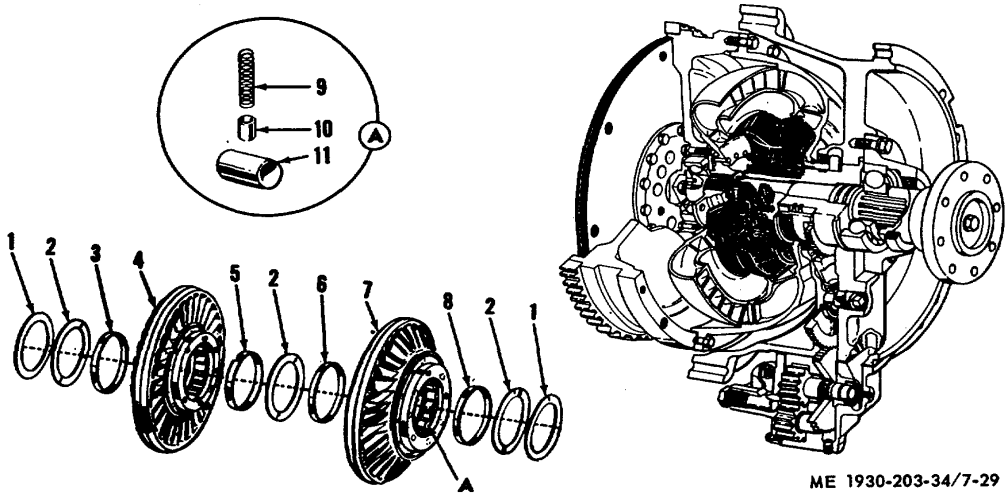
2. If converter pump hub bushing (1 needs replacing, cut out bushing.

3. If it is evident pump hub seal ring (3) has been leaking, disassemble converter pump and hub assembly by removing snapring (10) from converter pump hub (2). Support converter pump (7) as close to hub as possible and press against tang end of hub to remove hub. Remove seal ring.

NOTE

Do not remove converter balance weights (8). Do not remove bolts (4), unless seal rings (5) need replacing.

(c) Stator assemblies disassembly. Remove stator assembly sleeve, part No. J4237, used to retain rollers during disassembly of converter. Remove rollers (11, fig. 7-29), springs (9), and cups (10) (fig. 7-30).



1 Steel thrust washer
2 Bronze thrust washer
3 Bushing
4 First stator assembly
5 Bushing
6 Bushing
7 Second stator assembly
8 Bushing
9 Spring
10 Cup
11 Roller

Figure 7-29. Stator assembly (model TC-654).

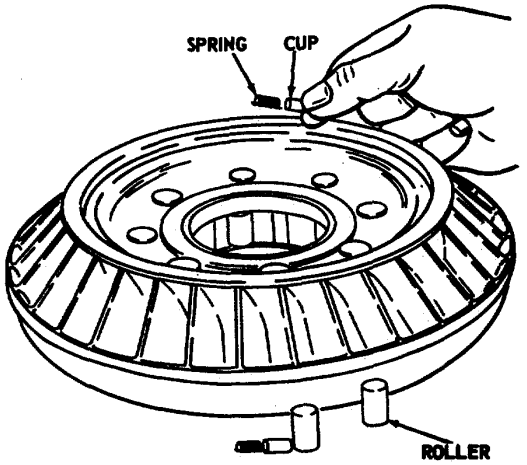
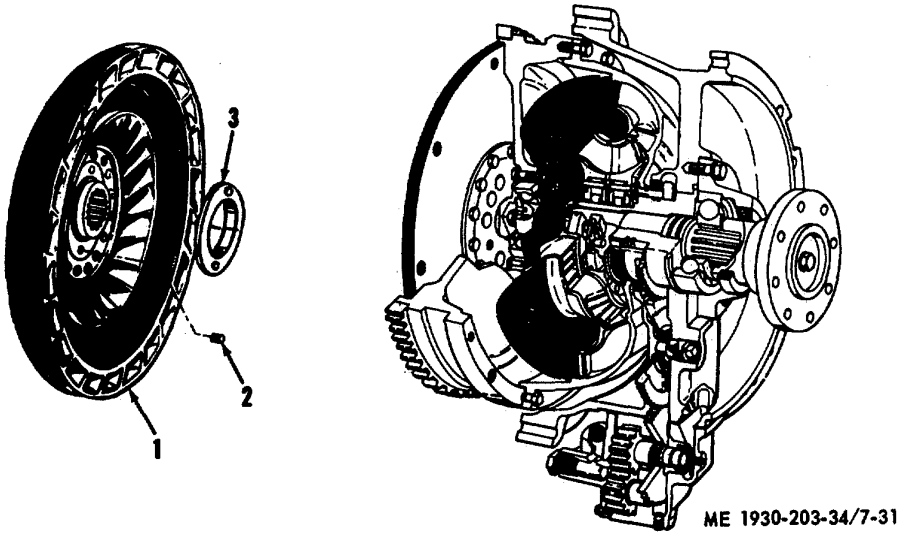


Figure 7-30. Stator with rollers, springs, and cups.

NOTE

Do not remove bushings (3, 5, 6, and 8, fig. 7-29) unless bushings must be replaced.

(d) Turbine assembly disassembly. The turbine assembly (1, fig. 7-31) is a riveted assembly consisting of a hub, turbine, and rivets. If any of these parts need replacing, replace entire assembly. If turbine hub adapter (3) requires replacing, remove two screws (2) and remove adapter.



1 Turbine assembly
2 Screw
3 Turbine hub adapter

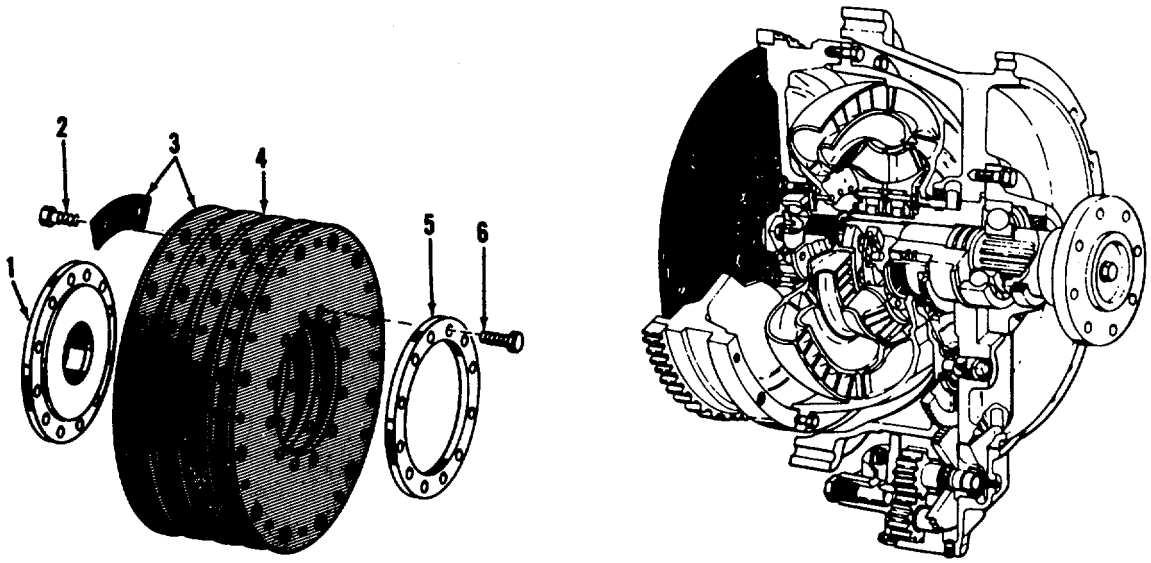
Figure 7-31. Turbine assemble (model TC-654).

(e) Output shaft and flange assembly disassembly.

1. Using a vise with soft jaws, clamp flange of output flange (14, fig. 7-23).
2. Using a ¾ inch wrench, remove bolt (17) that secures output flange to output shaft (6). Remove lockwasher (16), output flange washer (15), and output flange.
3. Use soft hammer to remove bearing retainer from output shaft assembly.
4. The output flange dual oil seal (13, fig. 7-23) is not removed unless replacement is necessary. When replacing, press seal out of bearing retainer (10).
5. Remove two-hook type seal rings from output shaft.
6. To remove bearing from output shaft. support bearing and output shaft assembly, rear end up, on bearing inner race. Press shaft out of bearing using arbor press.

(f) Flywheel assembly disassembly. Bolts (1, fig. 7-8), seal rings (2), pilot bearing (6), and bearing retainer plate (7) were removed in tear- down of converter into subassemblies. The flywheel ring gear (3) is not ordinarily disassembled from flywheel (4). If it needs replacement, press or drive ring gear off flywheel.

(g) Flexible flywheel disk assembly disassembly. The flexible flywheel disk assembly (fig. 7-32) is not disassembled. If components (1, 3. 4, or 5) require replacement, the flexible flywheel disk assembly must be replaced as an assembly.



ME 1930-203-34/7-32

1 Flexible flywheel disk hub
2 Bolt, machine
3 Flexible flywheel disk and washer assembly
4 Flexible flywheel disk
5 Flexible flywheel disk plate
6 Bolt, machine

Figure 7-32. Flexible flywheel disk assembly (model TC-654).

(4) Cleaning, inspection and repair.

(a) Dirt and other abrasive material. Whenever converter contains dirt or other abrasive material, unnecessary wear will result. Inspect all parts for abrasive material any time converter is disassembled. Thorough cleaning includes cleaning oil passages in oil cooler, and cleaning any other parts of hydraulic system common to the converter. Inspect parts for defects any time converter is disassembled.

NOTE

If oil in hydraulic system becomes contaminated with metal particles, all components of hydraulic system including the transmission, torque converter, oil lines, filters, screens, coolers, valves. and oil pumps. must be thoroughly cleaned. This usually means disassembly of components. Metal particles in the oil are evidence of failure of some part, either in the torque converter or transmission.

(b) Cleaning procedures. All metallic parts of converter, except bearings, should be thoroughly cleaned with dry-cleaning solvent, Federal Specification P-S-680, or by the steam-cleaning method. Parts cleaned in the dry-cleaning solvent should be dried with compressed air until they are entirely dry. Parts stearn-cleaned should be dried with compressed air, and then oiled immediately with lubricating oil. military Specification MIL-L- 2104. Examine housings and parts carefully for grit, dirt. and abrasive after cleaning and reclean if necessary. Clean oil passages by 'working a piece c)f wire back and forth through passages and flushing with dry-cleaning solvent. Dry passages with compressed air.

(c) Cleaning and inspecting bearings. Clean and inspect bearings for pitted, scored. or burned condition. Replace as necessary.

(d) Inspecting housings. cast parts. and machined surfaces.

1. Inspect bores for wear, grooves. scratches, and dirt. Remove burrs and scratches with crocus cloth. Federal Specification P-C-458. Remove foreign matter. Replace deeply grooved or scratched parts.

2. Inspect oil passages for obstructions. If an obstruction is found, remove it with compressed air or by working wire back and forth through passage and flushing with dry-cleaning solvent, Federal Specification P-D-680.

3. Inspect mounting faces for burrs, scratches, nicks, and foreign matter. Remove such defects with crocus cloth, Federal Specification P- C-458, or soft stone, Military Specification MIL-S- 2389. If scratches are deep, replace defective part.

4 .Inspect threaded openings for damaged threads. Chase damaged threads with correct size tap.

5. Replace housings or other cast parts that are cracked.

6. Inspect all machined surfaces for damage that could cause oil leakage or other malfunction of the part. Rework or replace defective parts.

(e) *Inspecting bushings and thrust washers.*

1. Inspect bushings for roundness, scores, burrs, sharp edges and evidence of overheating. Remove scores with crocus cloth, Federal Specification P-C-458. Remove burrs and sharp edges with a scraper or knife blade. If bushing is out-of-round, deeply scored, or excessively worn replace with proper size replacement.

NOTE

Sometimes it is necessary to cut out a defective bushing. Be careful not to damage bore into which bushing fits.

2. Inspect thrust washers for distortion, scores, burrs, and wear. Replace thrust washer if defective or worn.

(f) *Inspecting oil seals and gaskets.*

1. Inspect hook-type seal rings for wear, broken hooks, and distortion. Sides of seal ring should be smooth (0.005 inch maximum side wear). Sides of shaft groove (or bore) in which seal ring runs should be smooth (50 micro-inches equivalent) and square with axis of rotation within 0.002 inch. If side of ring grooves have to be reworked (0.20 inch maximum side wear), install new seal ring. Also install new seal ring if ring is worn so there is no gap between hooks of seal ring when installed.

2. Inspect seal rings for cuts and hardness. Replace seal rings if defects are found.

3. Replace lip-type seal rings, making sure spring-loaded side is toward oil to be sealed in (toward inside of unit). Use sealing compound, Military Specification MIL-S-7916, on outside diameter of seal to prevent oil leaks.

4. Install new composition gaskets.

(g) *Inspecting gears.*

1. Inspect gears for scuffed, nicked, burred, or broken teeth. If defect cannot be removed with soft stone, Military Specification MIL-S-2389, replace gear.

2. Inspect gear teeth for wear that rnay have destroyed original tooth shape. If this condition is found, replace gear.

3. Inspect thrust faces of geats for scores, scratches, and burrs. Remove defects with soft stone, Military Specification MIL-S-2389. If scores and scratches cannot be removed with soft stone, replace gear.

(h) *Inspecting splined parts.* Inspect splined parts for stripped, twisted, chipped, or burred splines. Remove burrs with soft stone, Military Specification MIL-S-2389. Replace part if other defects are found.

(i} *Inspecting threaded parts.* Inspect parts for burred or damaged threads. Remove burrs with soft stone, Military Specification MIL-S-2389, and chase damaged threads. Replace damaged parts.

(j) *Inspecting snaprings*. Inspect all snaprings for nicks, distortion and excessive wear. Replace part if one of these defects is found. The snapring mtust snap tight in its groove for proper functioning.

(k) *Inspecting springs.* Inspect all springs for signs of overheating. permanent set, or wear due to rubbing adjacent parts. Replace spring if any defects are found.

(l) *Stator assembly.*

1. Do not remove rivets from stator assemblies. If any part of a stator assembly is worn or damaged, the assembly must be replaced.

2. Inspect roller ramps on stator cam for wear, pits, or scores. If any of these conditions are found, replace stator assembly.

3. Inspect stator vanes for dents, nicks, or burrs. If these conditions are found, remove them with a fine file and soft stone, Military Specification MIL-S-2389. If there are dents that cannot be removed with a file or if there are cracks, replace stator assembly.

4. Inspect freewheel rollers for nicks, burrs, and signs of galling. If these conditions cannot be corrected with crocus cloth, Federal Specification P-C-458. replace rollers.

5. Inspect freewheel roller. springs for distortion. Replace if distorted.

6. Make sure freewheel rollers do not bind or drag in roller slots. 151 Subassemblies reassembly.

(a) *Flywheel assembly reassembly.*

1. To install flywheel ring gear 13, fig. 7- 8) on flywheel 14), heat ring gear and pressor drive it on flywheel.

NOTE

Be careful not to drive or press on rings gear teeth when installing ring gear. Do not heat ring gear to more than 400° F.

2. Bolts (I), seal rings (2J, pilot bearing (6), and bearing retainer plate (7) will be installed when converter is assembled.

(b) Output shaft and flange assembly reassembly.

1. Press bearing assembly on shaft, using an arbor press. Be certain to press only on bearing inner face.

NOTE

Bearing must be seated against shoulder on shaft.

2. Install two hook-type seal rings.

3. If output flange dual oil seal (13, fig. 7-23) was removed, press new seal in bearing retainer (IO1 from front (chamfered end) of bearing retainer bore using sealing compound, Military Specification MIL-S-7916, between seal outside diameter and bore of retainer. Spring side of seal must be toward front of retainer.

4. Install bearing retainer (10) on bearing (8J and output shaft (6).

5. Install output flange (14), output flange washer (15), lockwasher (16) and 3/4 inch bolt (17) on output shaft.

6. Support output flange (14) in vise and tighten bolt (17) to a torque of 120 to 140 foot-pounds.

(c) Stator assemblies reassembly. Install freewheel springs (9, fig. 7-29) in cups (10) and insert into bore in stator (fig. 7-30). Install rollers (11, fig. 7-29) and replace assembly sleeve, part No. J4237, to retain the rollers for assembly purposes.

(d) Converter pump and hub assembly reassembly.

1. Using an arbor press and pump hub bushing installer, part No. J7464, install new converter pump hub bushing (1, fig. 7-7). Bore bushing to 4.161 to 4.163 inches. Bore must be concentric with 4.750 inch hub inside ameter within 0.002 inch total indicator reading.

2. If converter pump hub assembly (2) was removed, heat converter pump (7) to 212:° F. (in oil) and cool converter pump hub assembly in dry ice for 2 hours.

NOTE

An alternate procedure for installing hub in pump is to heat converter pump to 240° to 250° F. and proceed with 3 below.

3. Install seal ring (3J on converter pump hub (2J and using assembling tool, part No. J4236- 01, press hub assembly in converter pump (7).

4. Remove assembling tool and install snapring (10J on converter pump hub (2).

5. Grease converter pump hub with grease, Military Specification MIL-G-10924, to prevent rust.

6. Install seal rings (5) and bolts (4) in converter pump (7). Tighten bolts to a torque of 25 to 32 foot-pounds.

(e) Housing assembly reassembly.

1. If ground sleeve (10, fig. 7-6) was removed, install dowel pin (12) in ground sleeve key (13), and install key on new ground sleeve so end of key is flush with face of ground sleeve. Notice dowel pinhole in the key is off center. Press ground sleeve and key into housing (fig. 7-33).

2. If oil pump drive gear (3, fig. 7-6) and converter pump hub oil seal (2) were removed, install gear. Using converter pump hub seal replace, part No. J7475, install oil seal with spring side toward gear.

3 Position converter with rear end up on table.

4. Install charging oil pump idler gear assembly by positioning gear (18, fig. 7-6) in housing, alining gear bore with housing bore, and installing oil pump idler gear shaft (17, fig. 7-6) in its bore. Use soft drift or bolt of proper size threaded into shaft and tap shaft in place.

5. Install lockwasher (16), seal ring (15), and plug (14) into oil pump idler gear shaft bore. (fig. 7-24). Tighten plug to a torque of 80 to 100 foot-pounds.

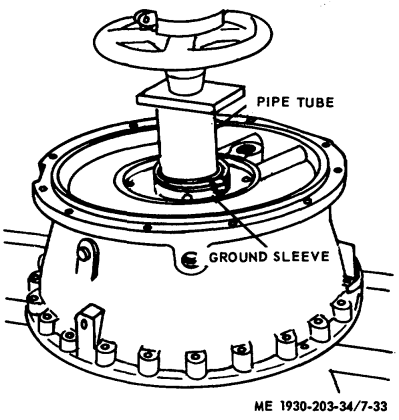


Figure 7-33. Ground sleeve installation.

(6) Reassembly.

(a) Torque converter output shaft installation.

1. Position converter housing assembly on table.

2. Install new bearing retainer gasket (9, fig. 7-23) on rear of converter housing.
3. Install output shaft and output flange assembly into ground sleeve.
4. Secure bearing retainer (10) to housing with six bolts (12) and lockwashers (11). Tighten bolts to a torque of 67 to 80 foot-pounds.

(b) Torque converter elements installation.

1. Support converter, rear end down,
2. Install hook-type seal rings on ground sleeve (fig. 7-22).
3. Install converter pump on ground sleeve, making sure tangs on pump hub are engaged with slots in pump drive gear (fig. 7-21).
4. Install one steel washer and one bronze thrust washer on converter ground sleeve (fig. 7-20). Be sure steel washer is against shoulder on ground sleeve.

NOTE

Lay both stator assemblies, flat side up, on a table. Close examination will show a difference in thickness of edges of stator blades. Stator with thin-edge blades is the first stator. Stator with thick-edge blades is the second stator.

5. Install second stator assembly flat side up on ground sleeve (fig. 7-19). Rotate stator clockwise as it is lowered to keep rollers from locking on ground sleeve. Stator assembly sleeve, part No. J4237, will be removed as stator is installed on ground sleeve.
6. Install bronze thrust washer on second stator assembly (fig. 7-18).
7. Install first stator assembly, flat side down, on ground sleeve (fig. 7-17). Rotate stator clockwise as it is lowered to keep rollers from locking on ground sleeve. Remove stator assembly sleeve, Part No. J4237.
8. Install bronze thrust washer on first stator assembly. Install steel thrust washer on bronze thrust washer (fig. 7-16).
9. Install ground sleeve snapring on ground sleeve (fig. 7-15).

CAUTION

Be sure stators can freewheel clockwise after installation and will lock up when rotated counterclockwise.

10. Install turbine locating snapring on end of output shaft (fig. 7-15).
11. Install turbine assembly on output shaft.
12. Install bearing retainer plate (7, fig. 7-8) on turbine hub (fig. 7-12).
13. Position pilot bearing (6, fig. 7-8) on end of output shaft (fig. 7-12). Place bolt (1, fig. 7-23) and bearing retainer washer (3) on pilot bearing (6, fig. 7-8) and thread bolt into output shaft (6, fig. 7-23) to seat bearing. Be careful to aline hole in washer with dowel in shaft.
14. Remove bolt from end of output shaft. Install lockwasher (2, fig. 7-23) and replace bolt. Tighten bolt to a torque of 75 to 90 foot-pounds. Bend up lip of special tabbed lockwasher to lock bolt (fig. 7-10).

(c) Flywheel assembly installation.

1. Install new seal ring (5, fig. 7-8) on converter pump flange (fig. 7-10).
2. Support flywheel above converter, using a hoist and a suitable lifting sling.
3. Keeping flywheel level, lower it on converter pump and pilot bearing.
4. Working through converter housing cover opening, install four self-locking bolts in pump. Space bolts 90 degrees apart (fig. 7-9).
5. Screw bolts in evenly to draw flywheel on pilot bearing.

CAUTION

If flywheel becomes cocked on pilot bearing, remove flywheel and repeat 3 through 5 above

6. Install remaining 32 self-locking bolts. tighten bolts to a torque of 30 to 35 foot-pounds.
7. Install seal ring (2, fig. 7-8) on each of six bolts (1) that secure bearing retainer plate (7) to flywheel. Inspect six bolt holes in flywheel, making sure chamfered seats for seal rings are smooth. Install six bolts through flywheel and into bearing retainer plate. Tighten bolts to a torque of 40 to 45 foot-pounds.
8. Install converter housing cover (6, fig. 7-6) and gasket (51 using bolts (8) and lockwashers (7).

(d) Charging oil pump assembly installation. Install charging oil pump assembly as outlined in b (5) above.

(7) Installation. Refer to paragraph 2-12.

d. Torque Converter Assembly Model TC-554 (4 Element) (fig. 2-3 and 7-2).

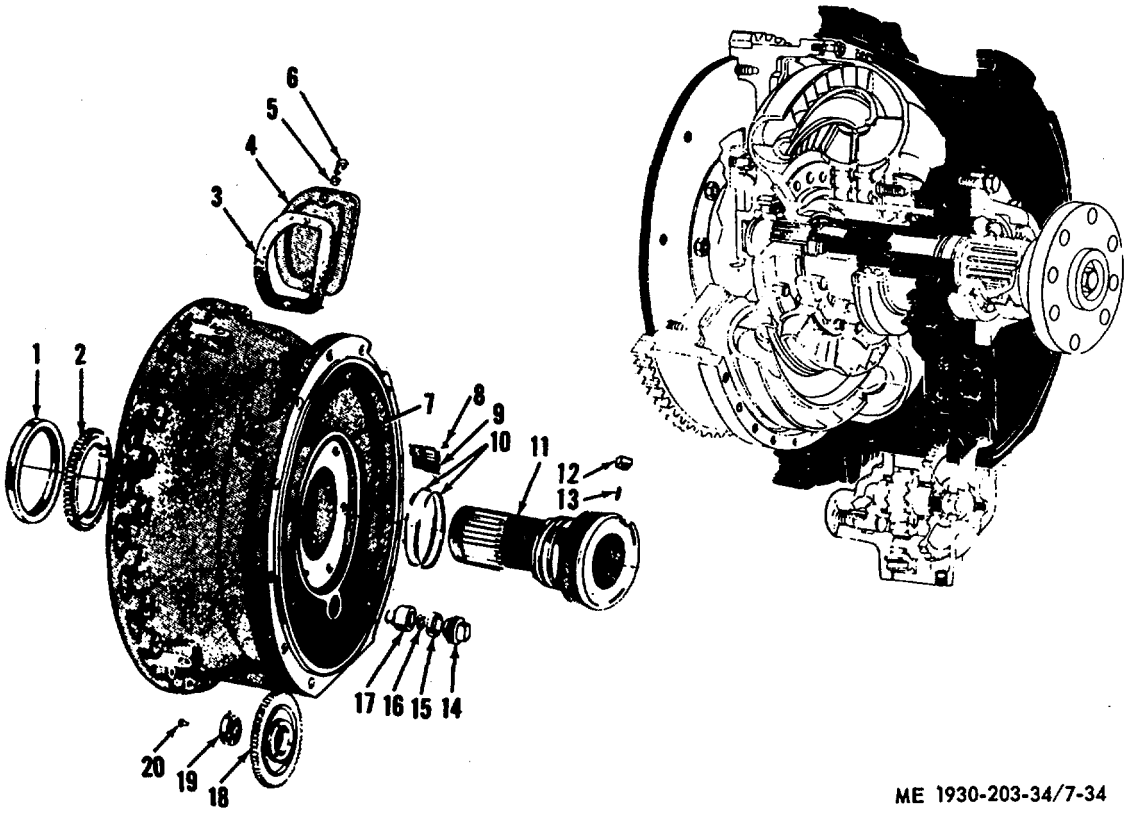
(1) Removal Remove torque converter assembly as outlined in paragraph 2-12.

(2) Disassembly.

(a) Charging oil pump assembly removal. Remove charging oil pump assembly as outlined in b(1) above.

(b) Flywheel assembly removal .

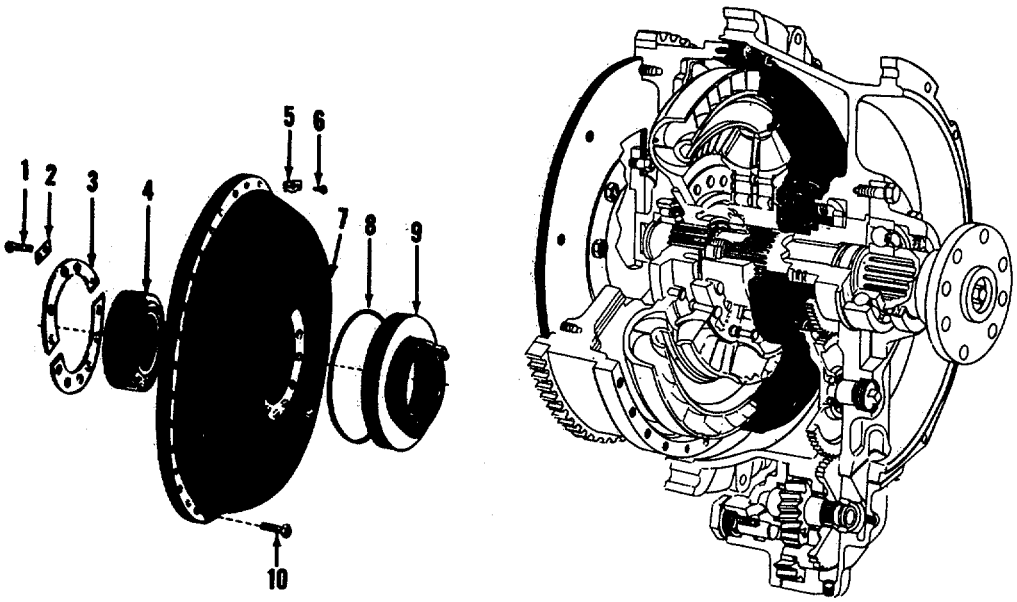
1. Place converter assembly on flywheel end.
2. Remove two bolts (6, fig. 7-34) and lockwashers (5) that secure converter housing cover (4) and remove housing cover and gasket (3).



1 Converter pump hub oil seal
2 Oil pump drive gear
3 Converter housing cover gasket
4 Converter housing cover
5 Lockwasher
6 Bolt, machine
7 Converter housing assembly
8 Screw, roundhead drive
9 Nameplate
10 Seal ring, hook-type
11 Ground sleeve
12 Ground sleeve key
13 Dowel pin
14 Plug
15 Seal ring
16 Lockwasher
17 Oil pump idler gear shaft
18 Oil pump idler gear
19 Bearing
20 Rivet

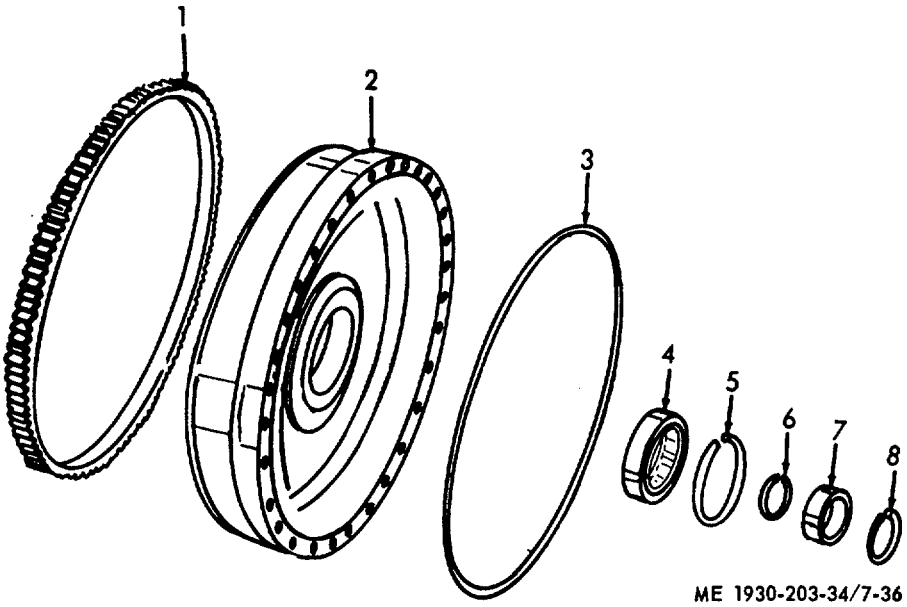
Figure 7-34. Housing assembly (model TC-554).

3. Using a 9 /16 inch socket, and working through converter housing cover opening, remove 36 bolts (10, fig. 7-35) that secure converter pump (7) to flywheel (2, fig. 7-36).



1 Bolt, machine
2 Lock strip
3 Split retainer plate
4 Bearing
5 Balance weight
6 Screw, roundhead drive
7 Converter pump
8 Seal ring
9 Converter pump hub
10 Bolt, self-locking

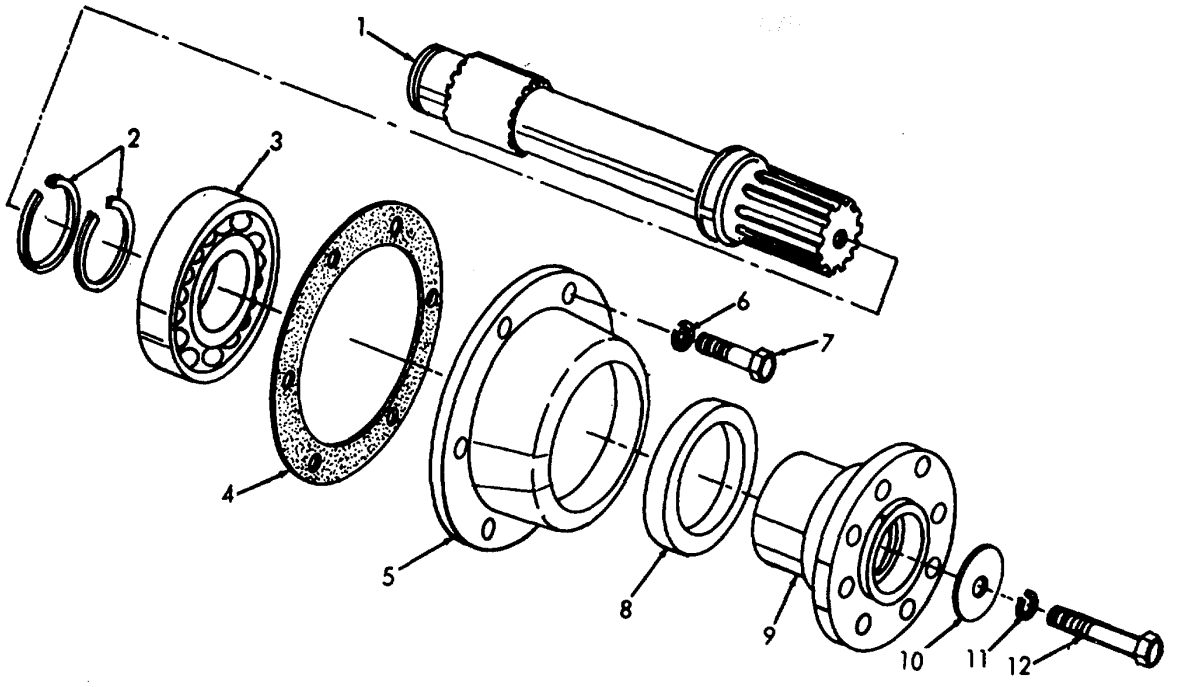
Figure 7-35. Torque converter pump and hub assembly.



1 Flywheel ring gear
2 Flywheel
3 Seal ring
4 Roller bearing
5 Snap ring, internal
6 Snap ring, external
7 Inner bearing race
8 Snap, ring, external

Figure 7-36. Flywheel assembly.

4. Remove bolt (12, fig. 7-37), lockwasher (11), washer (10), and output flange (9).



1 Output shaft
2 Hook-type seal ring
3 Bearing
4 Bearing retainer gasket
5 Bearing retainer
6 Lockwasher, plain
7 Bolt, machine
8 Output flange dual oil seal
9 Output flange
10 Output flange washer
11 Lockwasher, plain
12 Bolt, machine

Figure 7-37. Output shaft and flange assembly (model TC-554).

5. Using an eyebolt in output shaft, or sling attached to housing, lift converter up leaving flywheel on table.

6. Turn converter over and place on blocks (fig. 7-38)

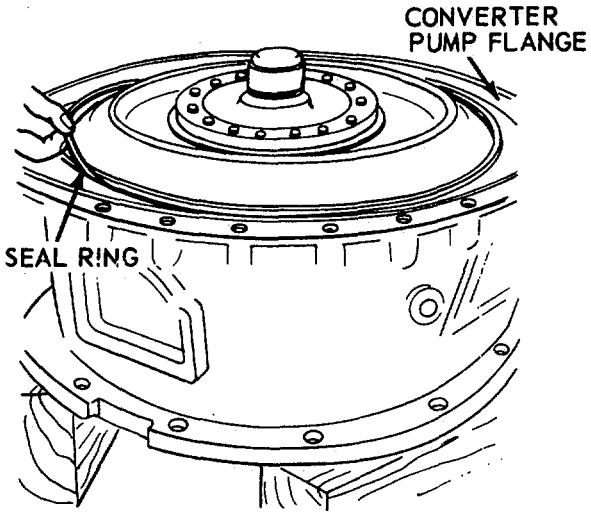


Figure 7-38. Seal ring removal and installation from converter pump flange.

7. Remove large seal ring (3, fig. 7-36) from converter pump flange (fig. 7-38).

(c) Torque converter elements removal.

1. Remove snapring from output shaft (fig. 7-39).

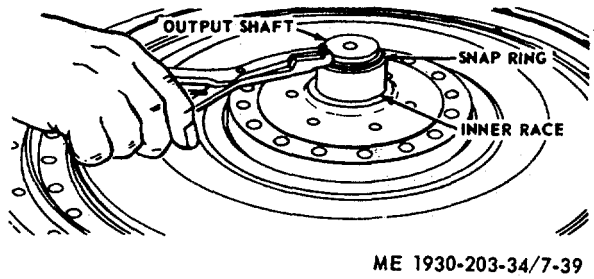


Figure 7-39. Snap ring removal and installation from output shaft.

2. Install bolts of any suitable bar-type bearing puller in tapped holes provided in turbine hub. Remove bearing inner race and turbine assembly (fig. 7-40).

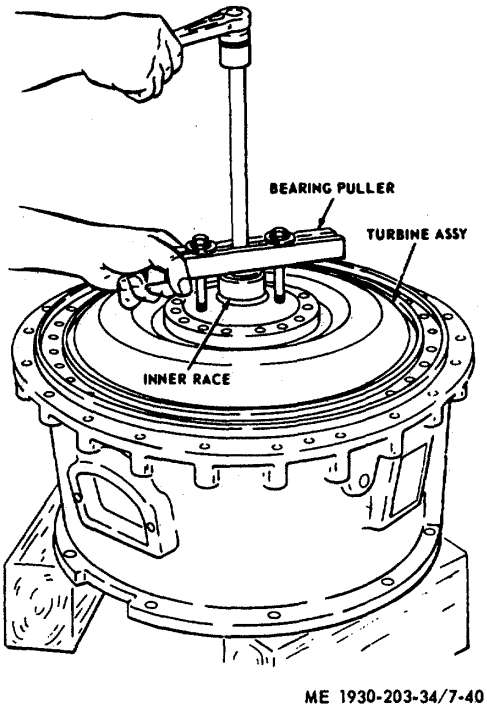


Figure 7-40. Pilot bearing inner race and turbine assembly removal and installation.

3. Remove snapring that locates turbine (fig. 7-41).

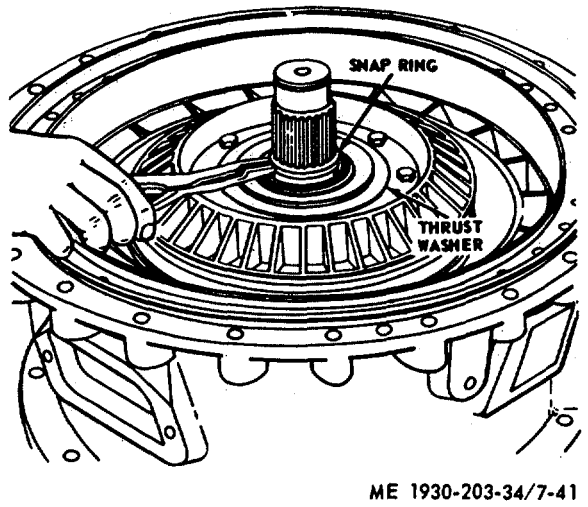


Figure 7-41. Turbine locating snapring removal and installation.

4. Remove thrust washer between turbine and first stator (fig. 7-41).
5. Remove first stator assembly (fig. 7-42)
6. Remove thrust washer between first and second stators (fig. 7-43).

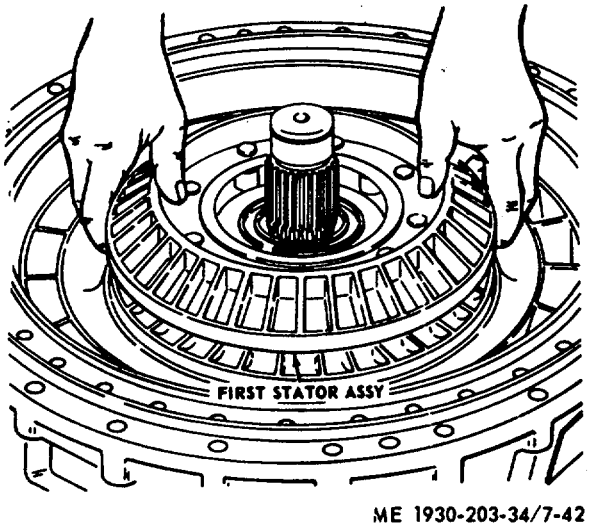


Figure 7-42. First stator assembly removal and installation (model TC-554).

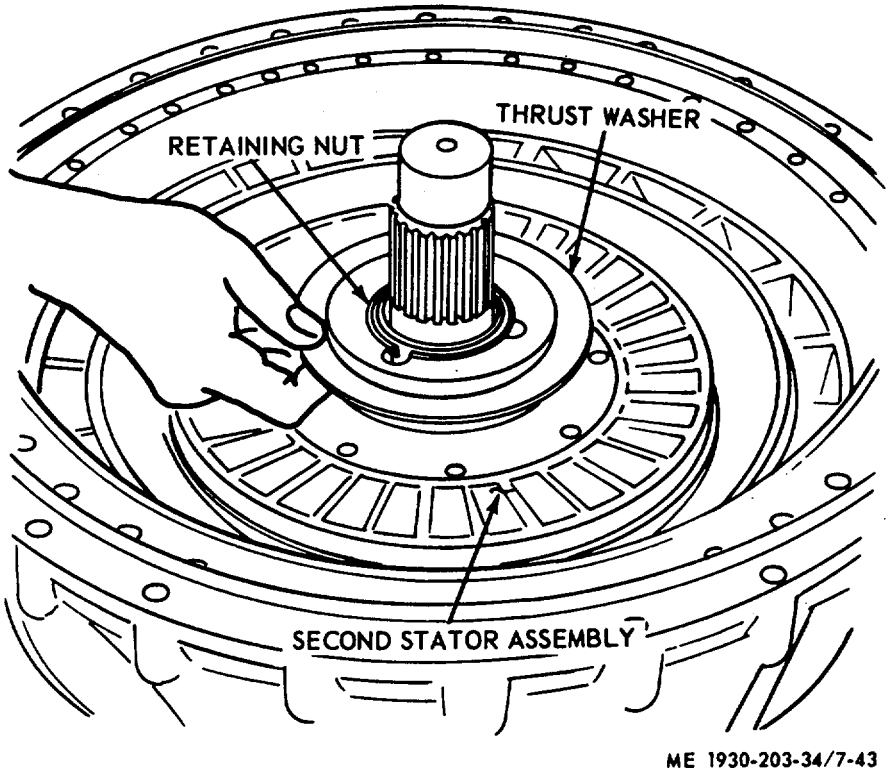


Figure 7-43. Thrust washer removal and installation.

7. Remove second stator assembly (fig. 7-43)
8. Straighten staked section of freewheel roller race retaining nut (fig 7-43).
9. Using spanner wrench, part No. J653 remove retaining nut (fig 7-44).

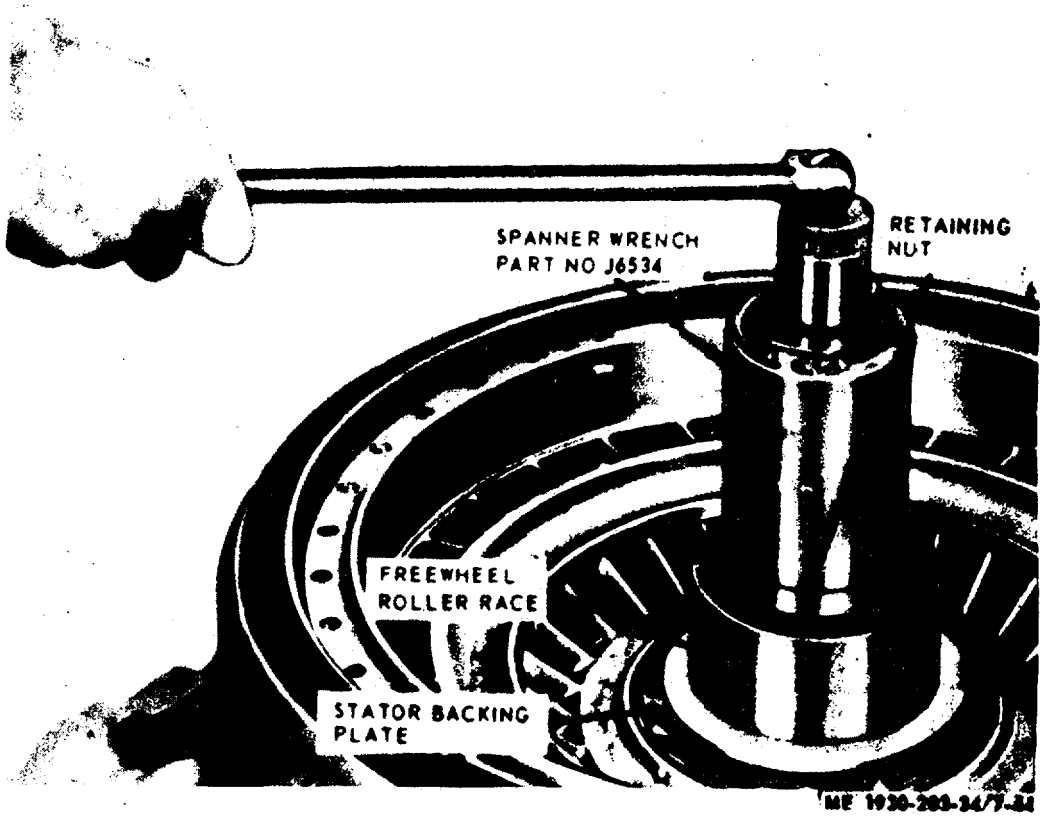


Figure 7-44. Freewheel roller race retaining nut removal and installation.

10 Removal freewheel roller race (fig. 7-45).

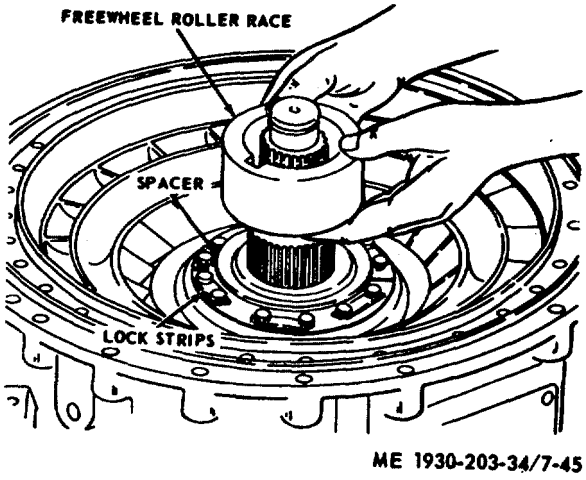


Figure 7-45. Freewheel roller race removal and installation.

11. Remove spacer (fig. 7-45).

12. Straighten bent part of lock strips and remove 12 bolts (fig. 7-45).

13. Remove two halves of retainer plate (fig. 7-46).

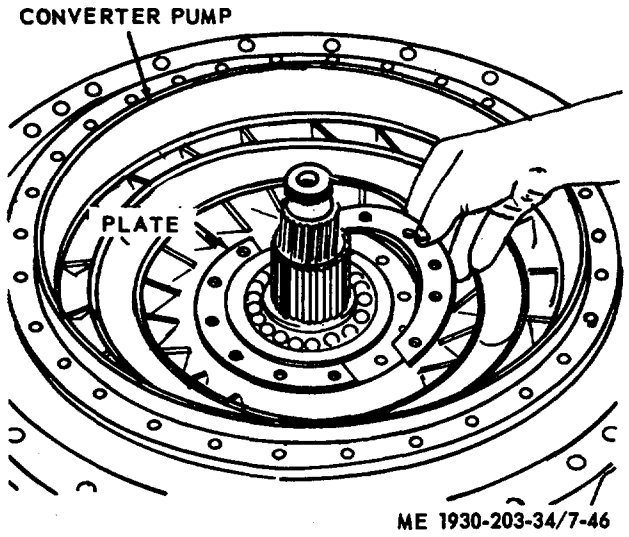


Figure 7-46. Split retainer plate removal and installation.

14. Remove converter pump (fig. 7-46).

15. Converter pump hub, seal ring, and bearing may come off with converter pump. If not, remove hub, seal ring, and bearing from ground sleeve (fig. 7-47).

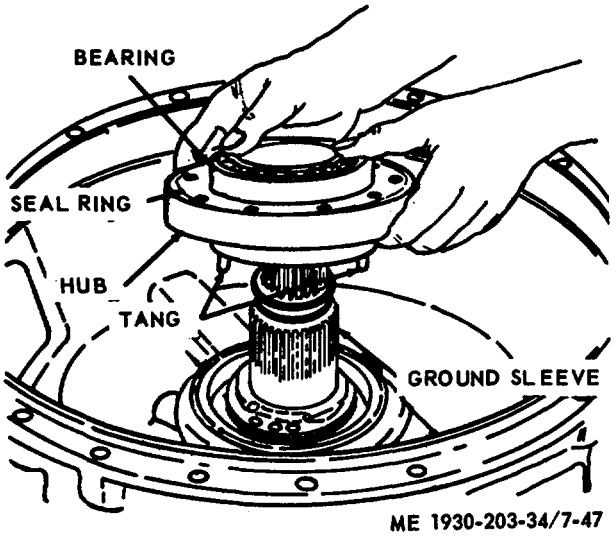


Figure 7-47. Converter pump hub, seal ring, seal ring, and bearing removal and installation.

16. Remove two seal rings from ground sleeve (fig. 7-48)

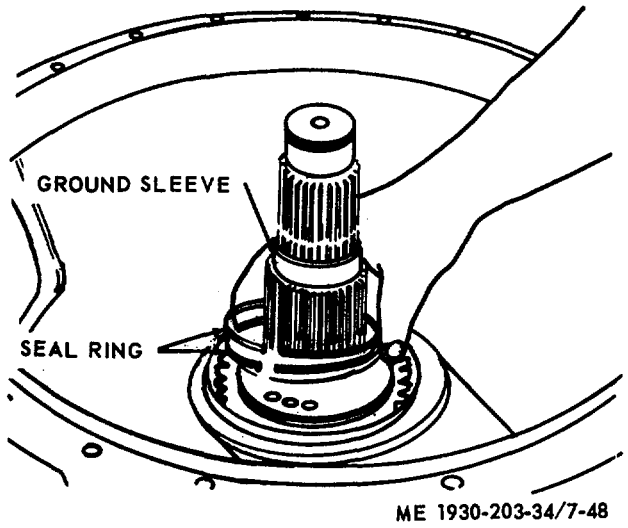


Figure 7-48. Seal ring removal and installation from ground sleeve.

(d) Torque converter output shaft removal.

1. Remove six bolts (7, fig. 7-37) and lockwashers (6) from bearing retainer (5).

2. Remove output shaft and bearing retainer (fig. 7-49).

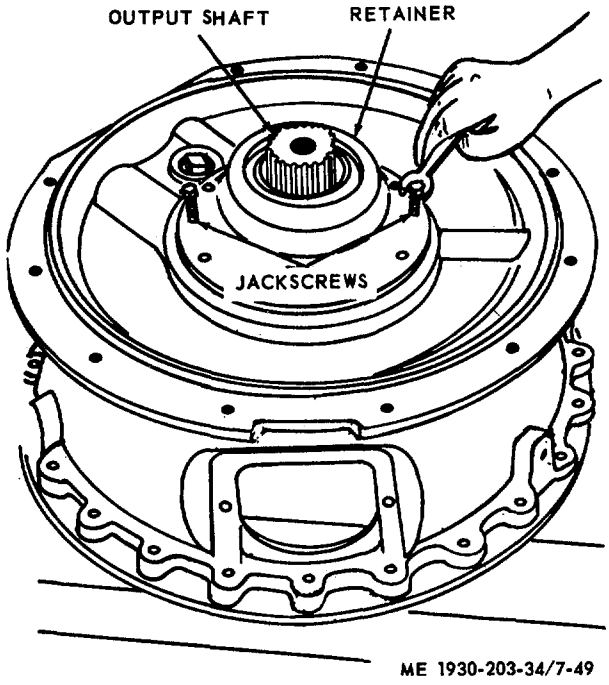


Figure 7-49. Bearing retainer removal and installation.

(3) Subassemblies disassembly.

(*a) Housing assembly disassembly.*

1. Remove plug (14, fig. 7-34), seal ring (15), and lockwasher (16) from rear of converter housing (fig. 7-24).

2. Install slide hammer remover and adapter, part No. J5901 in threaded hole in charging oil pump idler gear shaft (fig. 7-25).

3. Remove oil pump idler gear shaft (17, fig. 7-34), being careful that oil pump idler gear (18) does not drop out of housing.

4. Remove charging oil pump idler gear assembly (fig. 7-26). Do not remove bearing from gear.

5. Oil pump drive gear (2, fig. 7-34) and converter pump hub oil seal (1 generally are not removed. If either gear or seal needs replacing, collapse oil seal with drift and hammer and remove oil seal. Gear can then be removed.

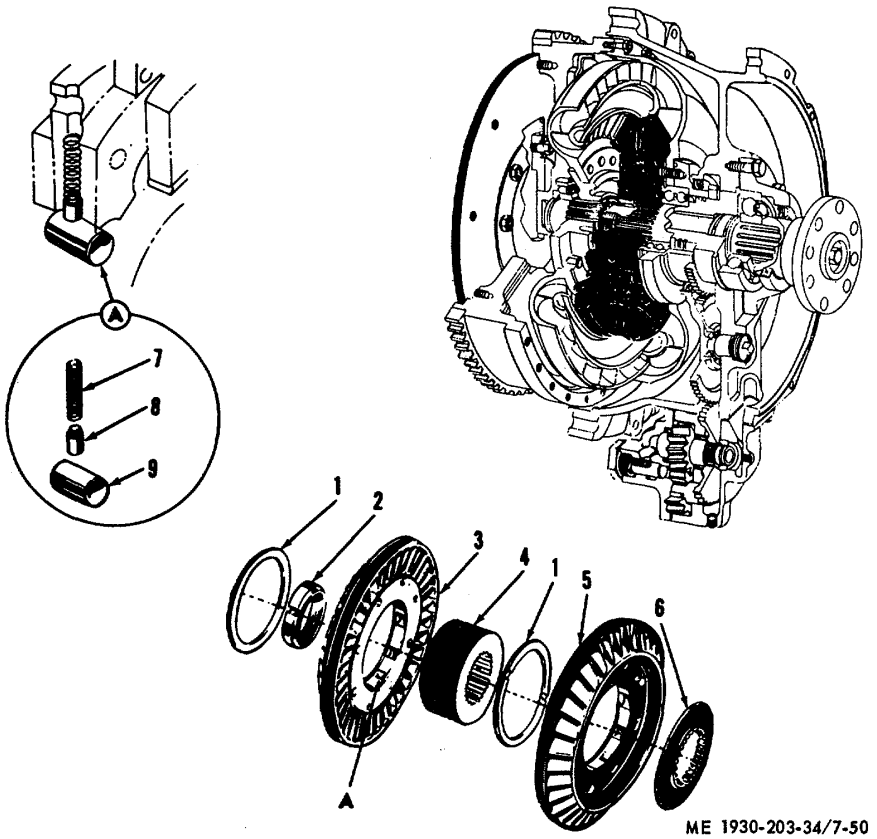
6. Ordinarily, ground sleeve (11) is not removed. If it needs replacing, position converter housing in a press, front side up, and press ground sleeve out of housing (fig. 7-28). Remove ground sleeve key (12, fig. 7-34) and dowel pin (13) from ground sleeve (11).

(b) Converter pump and hub assembly disassembly. If bearing (4, fig.7-35) requires replacement, press bearing out of converter pump hub (9).

NOTE

Do not remove balance weights (5)..

(c) Stator assembly disassembly. Remove rollers (9, fig. 7-50), springs (7), and cups (8) from stators.



1 Thrust washer
2 Retaining nut
3 First stator
4 Freewheel roller race
5 Second stator
6 Backing plate
7 Spring
8 Cup
9 Roller

Figure 7-50. Stator assembly (model TC-554).

(d) Turbine assembly disassembly. The turbine assembly is a riveted assembly consisting of a hub and turbine (3, fig. 2-3). If either is defective, replace entire assembly.

(e) Output shaft and flange assembly disassembly.

1. Use soft hammer to remove bearing retainer from output shaft assembly.

2 Remove two hook-type seal rings from output shaft.

3. To remove bearing from output shaft, support bearing and shaft assembly, rear end up, on bearing inner race. Press shaft out of bearing, using arbor press.

4. Output flange dual oil seal (8, fig. 7-37) is not ordinarily removed unless replacement is necessary. When replacing, press seal out of bearing retainer (5).

(f) Flywheel assembly disassembly.

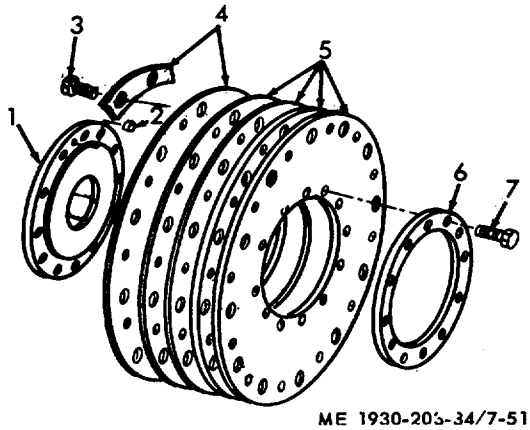
1. If roller bearing (4, fig. 7-36) requires replacement, remove snapring (5) and remove roller bearing.

2. The flywheel ring gear (1, fig. 7-36) is not ordinarily disassembled from flywheel (2). If it needs replacement, press or drive ring gear off flywheel.

NOTE

Be sure to note exact mounting position of damaged ring gear before removal. The new gear must be assembled in the same position.

(g) Flexible flywheel disk assembly disassembly. The flexible flywheel disk assembly (fig. 7-51) is not disassembled. If components (1, 4, 5, or 6) require replacement, the flexible flywheel disk assembly must be replaced as an assembly.



1 Hub
2 Pin, dowel
3 Bolt
4 Disk and washer assembly
5 Disk, flexible
6 Plate
7 Bolt

Figure 7-51. Flexible flywheel disk assembly (model TC-554)

(4) Cleaning, Inspection and Repair Procedures will be the same as outlined in c(41'above.

(5) Subassemblies reassembly.

(a) Flywheel assembly reassembly.

1. To install flywheel ring gear (1, fig. 7-36) on flywheel (2), heat ring gear and press or drive in on flywheel.

NOTE

Be careful not to drive or press on ring gear teeth when installing ring gear. Do not heat ring gear to more than 400° F.

2. Install roller bearing (4) in flywheel bore and secure with snapring (5).

(b) Output shaft and flange assembly reassembly.

1. Press bearing on output shaft, using an arbor press. Be certain to press only on bearing inner race.

NOTE

Bearing must be seated against shoulder on shaft.

2. Install two hook-type seal rings.

3. If output flange dual oil seal (8, fig. 7-37) was removed, press new seal in bearing retainer(5) from front (chamfered end) of bearing retainer bore using sealing compound, Military Specification MIL-S-7916, between seal outside diameter and bore of retainer. Spring side of seal must be toward front of retainer.

(c) Stator assembly reassembly. Install springs (7, fig. 7-50) on cups (8) and insert into bore in stator (fig. 7-52). Install rollers (9) (fig. 7-50).

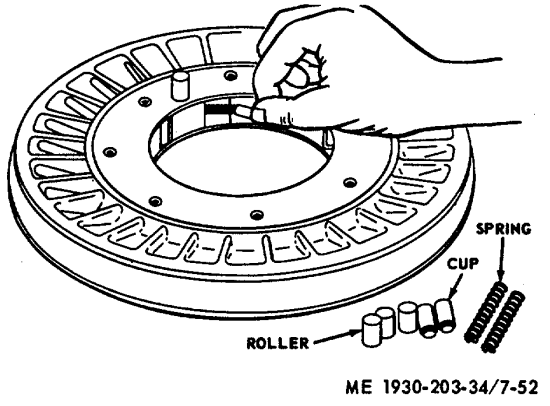


Figure 7-52. Freewheel roller, spring, and cup installation in stator.

(d) Converter pump and hub assembly reassembly. Press bearing (4, fig. 7-35) in converter pump hub (9).

(e) Housing assembly reassembly.

1. If ground sleeve (11, fig. 7-34) was removed, install dowel pin (13) in ground sleeve key (12) and install key on new ground sleeve so end of key is flush with face of ground sleeve. Notice dowel pinhole in key is off center. Press ground sleeve and key- into converter housing assembly (7).

2. If oil pump drive gear (2) and converter pump hub oil seal (1) were removed, install gear. Install oil seal with spring side toward gear using converter pump hub seal replacer, part No. J7475.

3. Position converter on table with rear end up.

4. Install charging oil pump idler gear (18) by positioning gear in housing bore and in-stalling oil pump idler gear shaft (17) in bore. Use soft drift or bolt of the proper size threaded into shaft and tap shaft in place.

5. Install lockwasher (I6), seal ring (15), and plug (14 in oil pump idler gear shaft bore. Tighten plug (14) to a torque of 80 to 100 foot-pounds (fig. 7-24).

(6) Reassembly.

(a) Torque converter output shaft installation.

1. Install new bearing retainer gasket (4, fig. 7-37) on rearof converter housing.
2. Install output shaft (1) and bearing (3) into ground sleeve.
3. Position bearing retainer on converter housing (fig. 7-49).
4. Secure bearing retainer (5,fig. 7-37) to converter housing with six bolts (7) and lock washers (6). Tighten bolts (7) to a torque of 67 to 80 foot-pounds.

(b) Torque converter elements installation.

1. Support converter, front end up.
2 Install seal rings on ground sleeve (fig. 7-48).
3. Install converter pump hub and bearing on ground sleeve, making sure tangs on pump hub are engaged with slots in pump drive gear (fig. 7-47).
4. Install new seal ring in groove of converter pump hub (fig. 7-47).
5. Install converter pump (fig. 7-46).
6. Install two halves of retainer plate (fig. 7-46).
7. Install six lock strips and 12 bolts. Bend one corner of lock strip against each bolt head (fig. 7-45).
8. Install spacer (fig. 7-45).
9. Install freewheel roller race (fig. 7-45).
10. Install freewheel roller race retaining nut using spannerwrench, part No. J6534 (fig. 7-44). Tighten nut to a torque of 275 to 325 foot-pounds.
11. Stake retaining nut (fig. 7-43).
12. Lay stator assembly, flat side up, on table. Examination will show second stator to have blades that spiral clockwise. First stator will have either straight blades or blades that spiral counterclockwise.
13. Install second stator assembly, flat side up, on ground sleeve. Rotate stator clockwise as it is lowered to keep rollers from locking on ground sleeve (fig. 7-43).
14. Install thrust washer (fig. 7-43).
15 Install first stator assembly, flat side down, on ground sleeve (fig. 7-42). Rotate stator clockwise as it is lowered to keep rollers from locking on ground sleeve.

CAUTION

Be sure stators can freewheel clockwise after installation and will lock up when rotated counterclockwise.

16. Install thrust washer (fig. 7-41).
17. Install snapring that locates turbine (fig. 7-41).
18. Install turbine assembly (fig. 7-40).
19. Install flywheel bearing inner race on output shaft (fig. 7-39).
20. Install snapring on end of output shaft (fig.7-39).

(c) Flywheel assembly installation.

1. Install new seal ring on converter pump flange (fig. 7-38).
2. Install eyebolt in end of output shaft or tie sling on converter housing and hoist converter above flywheel assembly.
3. Lower converter, guiding inner race of pilot bearing in bearing. After inner race slides in bearing, aline boltholes in converter pump with holes in flywheel. Lower converter until converter pump makes contact with flywheel.
4 Working through converter housing cover opening, install four bolts in pump. Space bolts 90 degrees apart.
5. Tighten bolts evenly to draw flywheel on pilot bearing.

CAUTION

If flywheel becomes cocked, remove flywheel and repeat 1 through 5, above.

6. Install remaining 32 self-locking bolts. Tighten bolts to a torque of 30 to 35 foot-pounds.
7. Remove eyebolt from output shaft.
8. Install output flange (9, fig. 7-37), output flange washer (10), lockwasher (11), and bolt (12) on output shaft.
9. Tighten bolt to a torque of 120 to 130 foot-pounds.

10. Install converter housing cover (4, fig. 7-34) and gasket (31 using bolts (61 and lock-washers (5).

(d) Charging oil pump assembly installation. Install charging oil pump assembly as outlined in b (5) above.

(7) Installation. Install torque converter assembly as outlined paragraph 2-12.

e. Torque Converter Assembly, Model TC-554 (3 Element) (fig. 2-4 and 7-2).

(1) Removal. Remove torque converter assembly as outlined in paragraph 2-12.

(1) Disassembly.

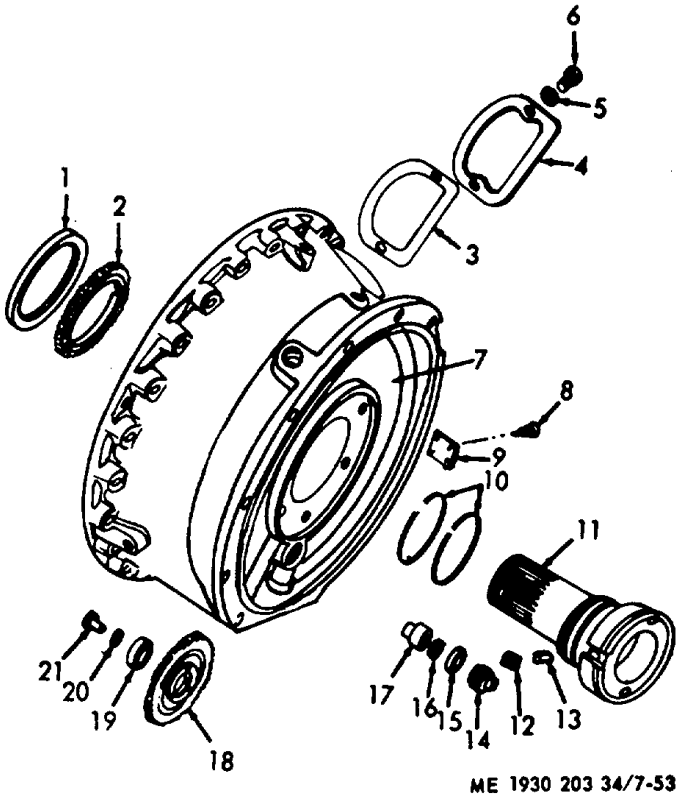
(a) Remove charging oil pump assembly as outlined in b (1) above.

(b) Output shaft flange removal.

1. Place converter assembly on flywheel end.
2. Remove bolt (12, fig. 7-37), lockwasher (11) , washer (10), and output flange (9).

(c) Flywheel, turbine. and stator removal.

1. Remove two bolts (6, fig. 7-53) and lockwashers (5) that secure converter cover (4) and remove cover and gasket (3).

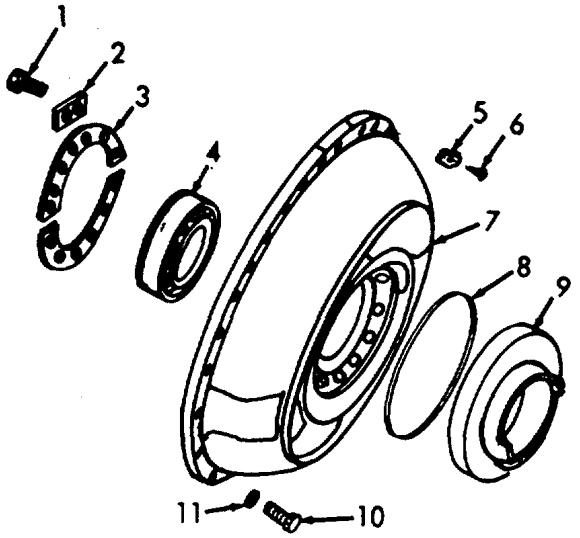


Key to figure 7-53.

1 Converter pump hub seal
2 Oil pump drive gear
3 Converter housing cover gasket
4 Converter housing cover
5 Lockwasher
6 Bolt, machine
7 Converter housing
8 Screw, round head drive
9 Nameplate
10 Seal ring, hook type
11 Ground sleeve
12 Ground sleeve key
13 Dowel pin
14 Plug
15 Seal ring
16 Lockwasher
17 Oil pump idler gear shaft
18 Oil pump idler gear
19 Bearing
20 Washer, flat
21 Rivet

Figure 7-53. Housing assembly.

2. Using a 9/16 inch socket, and working through converter housing cover opening, remove 36 bolts (10, fig. 7-54) and washers (11) that secure converter pump (7) to flywheel (2, fig. 7-36).



ME 1930-203-34/7-54

1 Bolt, machine
2 Lock strip
3 Split retainer plate
4 Bearing
5 Balance weight
6 Screw, roundhead drive
7 Converter pump
8 Seal ring
9 Converter pump hub
10 Bolt, self-locking
11 Washer, flat

Figure 7-54. Torque converter pump and hub assembly.

3. Using an eyebolt in output shaft, or sling attached to housing, lift converter up, leaving flywheel assembly, turbine assembly, thrust washer, and stator assembly on table (fig. 7-55).

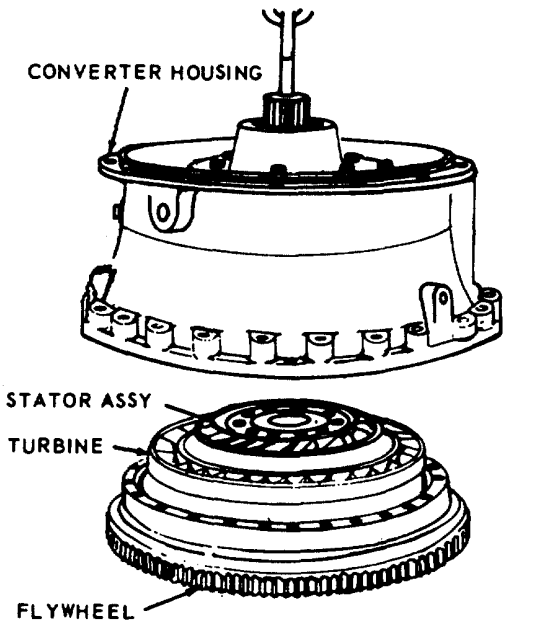


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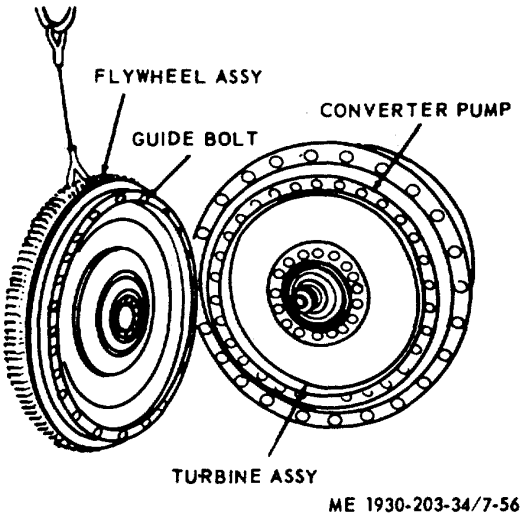
Figure 7-55. Removing flaywheel, turbine and stator assemblies from converter housing.

4. Lift stator assembly, thrust washer, and turbine assembly from flywheel (fig. 7-56).

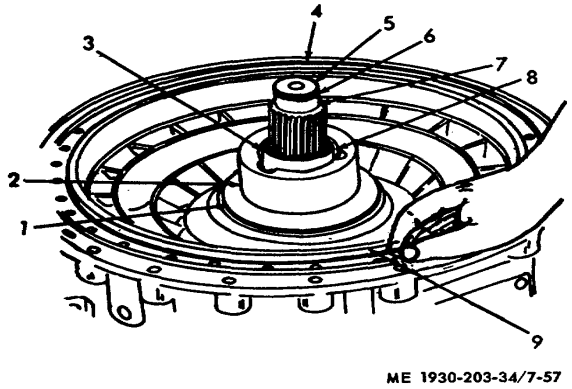


ME 1930-203-34/7-56

Figure 7-56. Installing flywheel assembly.

5. Turn converter over and place it on wooden blocks (fig. 7-57).

6. Remove seal ring from converter pump (fig. 7-57).



1 Backing plate
2 Freewheel roller race
3 Retaining nut
4 Torque
5 Output
6 Snap ring
7 Inner bearing race
8 Snap ring
9 Seal ring

Figure 7-57. Seal ring and inner race removal and installation.

(d) Converter pump and hub removal.

1. Remove snapring from end of output shaft (fig. 7-57).

2. Remove inner bearing race from output shaft (fig. 7-57).

3. Remove snapring that locates turbine (fig. 7-57).

4. Straighten staked section of freewheel roller race retaining nut (fig. 7-57).

5. Using spanner wrench, part No. J6534, remove retaining nut (fig. 7-44).

6. Remove freewheel roller race and backing plate (fig. 7-58).

7. Straighten bent part of locking strips and remove 12 bolts and locking strips (fig. 7-58).

8. Remove split retainer plates (fig. 7-46).

9. Remove converter pump (fig. 7-46).

10. Converter pump hub, seal ring, and bearing may come off with converter pump. If not, remove hub, seal ring, and bearing from ground sleeve (fig. 7-47). Remove the seal ring from the hub.

11. Remove two seal rings from ground sleeve (fig. 7-48).

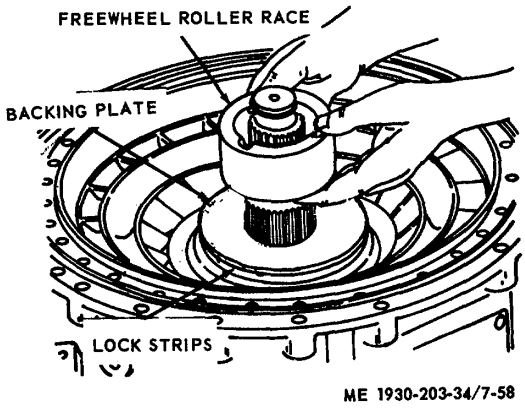


Figure 7-58. Freewheel roller race and backing plate removal.

(e) Output shaft removal.

1. Remove six bolts (7, fig. 7-37) and lockwashers (6) from bearing retainer (5).

2. Remove output shaft and bearing retainer using jackscrews in the tapped holes provided in the retainer (fig. 7-49).

(3) Subassemblies disassembly.

(a) Housing assembly disassembly.

1. Remove plug (14, fig. 7-53'), seal ring (15), and lockwasher (16) from rear of converter housing (fig. 7-24).

2. Install slide hammer remover and adapter, part No. J5901 in threaded hole in charging oil pump idler gear shaft (fig. 7-25).

3. Remove oil pump idler gear shaft (17, fig. 7-53), being careful that oil pump idler gear (18) does not drop out of housing.

4. Remove charging oil pump idler gear assembly (fig. 7-26). Do not remove bearing from gear.

5. Oil pump drive gear (2, fig. 7-53) and converter pump hub oil seal (1) generally are not removed. If either gear or seal needs replacing, collapse oil seal with drift and hammer and remove oil seal. Gear can then be removed.

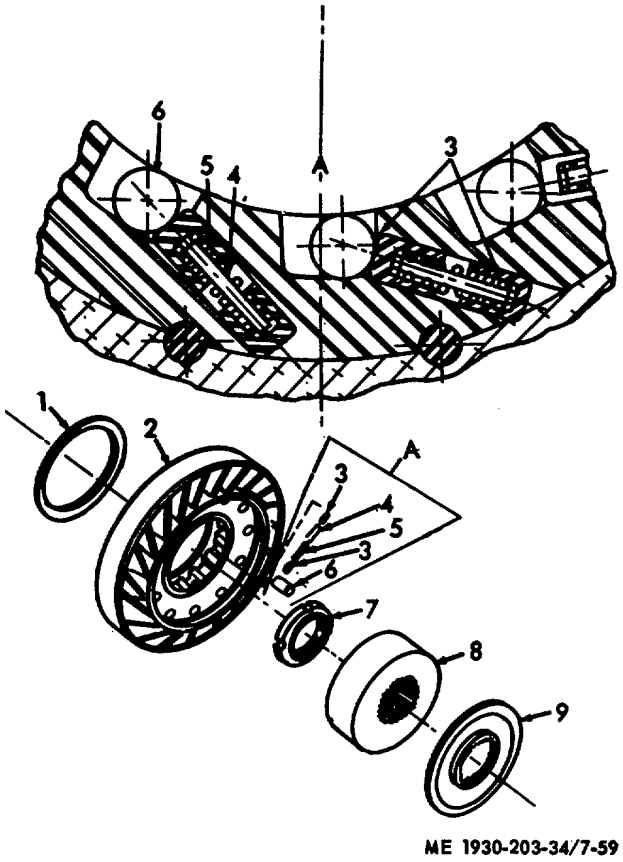
6. Ordinarily, ground sleeve (11) is not removed. If it needs replacing, position converter housing in a press, front side up, and press ground sleeve out of housing (fig. 7-28). Remove ground sleeve key (12, fig. 7-53) and dowel pin (13) from ground sleeve (11).

(b) Converter pump and hub assembly disassembly. If bearing (4, fig. 7-54) requires replacement, press bearing out of converter pump hub (9).

NOTE

Do not remove balance weights 15).

(c) Stator assembly disassembly. Remove twelve rollers (6, fig. 7-59), twelve springs (5), twelve needle rollers (4), and twenty-four cups (3).



1 Thrust washer
2 Stator assembly
3 Cup
4 Needle roller
5 Spring
6 Freewheel roller
7 Retaining nut
8 Freewheel roller race
9 Backing plate

Figure 7-59. Stator assembly.

(d) Turbine assembly disassembly. The turbine assembly is a riveted assembly consisting of a hub and turbine (3, fig. 2-4). If either part is defective, replace entire assembly.

(e) Output shaft and flange assembly disassembly.

1. Use soft hammer to remove bearing retainer from output shaft assembly.

2. Remove two hook-type seal rings from output shaft.

3. To remove bearing from output shaft, support bearing and shaft assembly, rear. end up, on bearing inner race. Press shaft out of bearing, using press.

4. Output flange dual oil seal (8, fig. 7-37) is not ordinarily removed unless replacement is necessary. When replacing, press seal out of bearing retainer (5). Flywheel assembly disassembly.

1. If roller bearing (4, fig. 7-36) requires replacement, remove snapring (5) and remove roller bearing.

2. The flywheel ring gear (1, fig. 7-36) is not ordinarily disassembled from flywheel (2). If it needs replacement, press or drive ring gear off flywheel.

NOTE

Be sure to note direction of chamfered teeth of damaged ring gear before removal. The new gear must he assembled in the same position.

(g) Flexible flywheel disk assembly disassembly. The flexible flywheel disk assembly (fig. 7-51) is not disassembled. If components (1, 4, 5, or 6) require replacement, the flexible flywheel disk assembly must be replaced as an assembly.

(4) Cleaning, inspection and repair procedures will be same as outlined in c (4) above.

(5) Subassemblies reassembly.

(a) Flywheel assembly reassembly.

1. To install flywheel ring gear (1, fig. 7-36) on flywheel (2), heat ring gear and press or drive in on flywheel.

NOTE

Chamfered teeth must face same direction as those on original gear. Be careful not to drive or press on ring gear teeth when installing ring gear. Do not heat ring gear to more than 400° F.

2. Install roller bearing (4) in flywheel bore and secure with snapring (5).

(b) Output shaft and flange assembly reassembly.

1. Press bearing on output shaft, using an arbor press. Be certain that bearing inner race is supported during pressing operation.

NOTE

Bearing must he seated against shoulder on shaft.

2. Install two hook-type seal rings.

3 If output flange dual oil seal (8, fig. 7-37) was removed, press new seal in bearing-retainer (5) from front (chamfered end) of bearing retainer bore using sealing compound, Military Specification MIL-S-7916, between seal outside diameter and bore of retainer. Spring side of seal must be toward front of retainer.

(c) Stator assembly reassembly.

1. Install twelve springs (5, fig. 7-59) on twelve needle rollers (4). Install a cup (3) at each spring end and insert the assembly into bore of stator.
2. Install rollers (6, fig. 7-59).
3. Install stator freewheel roller race (8) into stator assembly (2).

(d) Converter pump and hub assembly reassembly. Press bearing (4, fig. 7-54) in converter pump hub (9). Groove in bearing outer race must be away from hub.

(e) Housing assembly reassembly.

1. If ground sleeve (11, fig. 7-53) was removed, install dowel pin (13) in ground sleeve key (12) and install key on new ground sleeve so end of key is flush with face of ground sleeve. Notice dowel pinhole in key is off center. Press ground sleeve and key (fig. 7-33) into converter housing assembly (7, fig. 7-53).
2. If oil pump drive gear (2, fig. 7-53) and converter pump hub oil seal (1) were removed, install gear. Install oil seal with spring side toward gear using converter pump hub seal replacer, part No. J7475.
3. Position converter on table with rear end up.
4. Install charging oil pump idler gear (18) by positioning gear in housing bore and installing oil pump idler gear shaft (17) in bore. Use soft drift or bolt of the proper size threaded into shaft and tap shaft in place.

NOTE

Gear teeth are offset from the hub, toward front of converter.

5. Install lockwasher (16), seal ring (15),and plug (14) in oil pump idler gear shaft bore. Tighten plug (14) to a torque of 80 to 100 foot-pounds (fig. 7-24).

(6) Reassembly

(a) Torque converter output shaft installation.

1. Install new bearing retainer gasket (4, fig. 7-37) on rear of converter housing.
2. Install lout put shaft (1) and bearing (3) into ground sleeve.
3. Position bearing retainer on converter housing (fig 7-49).
4. Secure bearing retainer (5, fig. 7-37) to converter housing with six bolts (7) and lock-washer (6). Tighten bolts (7) to a torque of 67 to 80 foot-ponds.

(b) Converter pump and hub installation.

1. Support converter, front end up.
2. Install two seal rings on ground sleeve (fig. 7-48).
3. Install converter pump hub and bearing on ground sleeve, making sure tangs on pump hub are engaged with slots in oil pump drive gear (fig. 7-47).
4. Install new seal ring in groove of converter pump hub (fig. 7-47).
5. Install converter pump (fig. 7-46).
6. Install two split retainer plates (fig. 7-46).
7. Install six lock strips and 12 bolts. Bend one corner of lock strip against each bolt head (fig. 7-58).

(c) Stator, turbine, and flywheel installation.

1. Install new seal ring on converter pump flange (fig. 7-57).
2. Install backing plates, flat side up-ward, onto ground sleeve (fig. 7-58).
3. Position converter housing upright on assembly table (fig. 7-60).
4. Install the assembled stator assembly onto the ground sleeve (fig. 7-60).

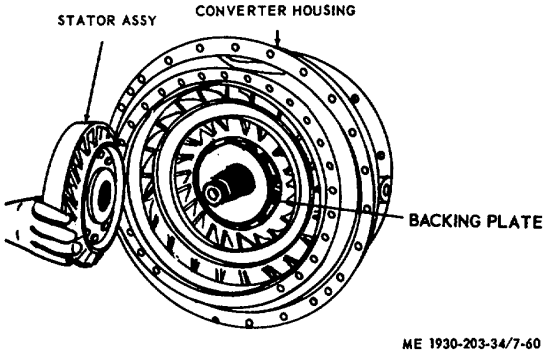


Figure 7-60. Installation converter stator assembly.

NOTE

The stator should rotate freely in a clockwise direction, and lockup when an attempt is made to turn it in the opposite direction.

5. Position converter on wooden blocks with flywheel end up (fig. 7-57).
6. Install' freewheel roller race retaining nut using spanner wrench, part No. J6534 (fig. 7-44). Tighten nut to a torque of 275 to 325 foot-pounds.
7. Stake retaining nut (fig. 7-57).
8. Install snapring that locates turbine (fig. 7-57).
9. Install flywheel bearing inner race on output shaft (fig. 7-57).

10. Install snapring on end of output shaft (fig.7-57).
11. Position converter housing upright on assembly table.
12. Install thrust washer (1, fig. 7-50) onto freewheel roller race.
13. Install turbine assembly on output shaft.
14. Using a sling and a guide bolt, install the flywheel assembly onto the torque converter (fig. 7-56). A line bolt holes in the flywheel with the bolt holes in the converter pump.
15. Working through converter housing cover opening, install four bolts and flat washers in pump. Space bolts 90 degrees apart.
16. Tighten bolts evenly to draw flywheel onto the flywheel bearing inner race on output shaft.
17. Remove guide bolt (fig. 7-56).
18. Install remaining 32 self-locking bolts and 32 flat washers. Tighten bolts to a torque of 41 to 49 foot-pounds.

(d) Output flange installation. Install output flange (9, fig. 7-37), flange washer (10),lockwasher (11), and bolt (12) on output shaft. Tighten the bolt to 120 to 140 foot-pounds.

(e) Housing cover installation. Install converter housing cover gasket (3, fig. 7-53), cover (4), two locwashers (5), and two bolts (6).

(f) Charging oil pump assembly installation. Install charging oil pump assembly as outlined in b (5) above.

(7) Installation. Install torque converter assembly as outlined in paragraph 2-12.

7-3. Torque Converter Stall Check

a. The stall check is for determining whether or not the engine and the torque converter are functioning satisfactorily as a unit.

b. Install a tee fitting at the inlet side of transmission lube manifold and install a 0 to 60 psi gage (fig. 7-61).

c. Install a 0 to 200 psi gage at inlet side of converter charging oil pump (fig.7-62).

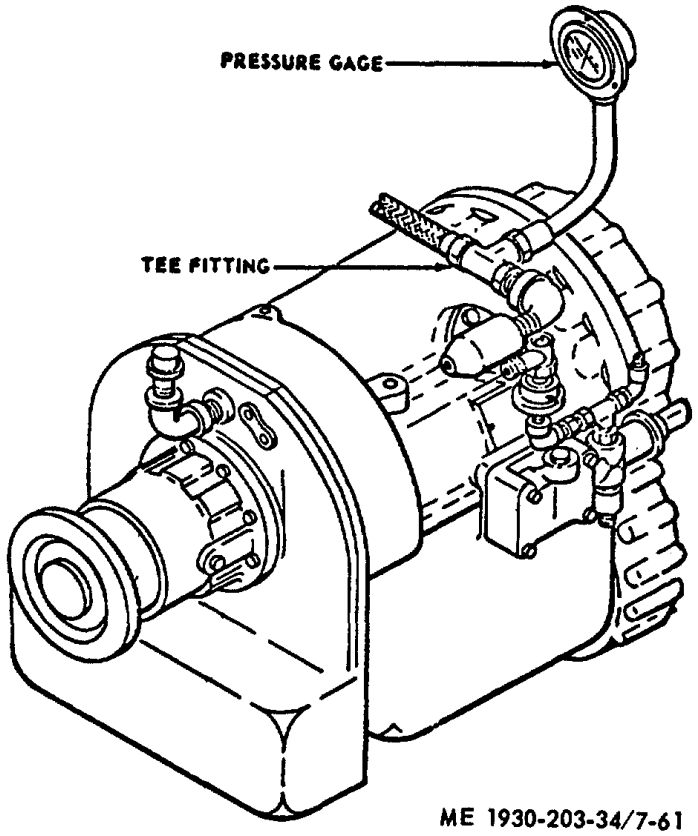


Figure 7-61. Checking transmission lube oil pressure.

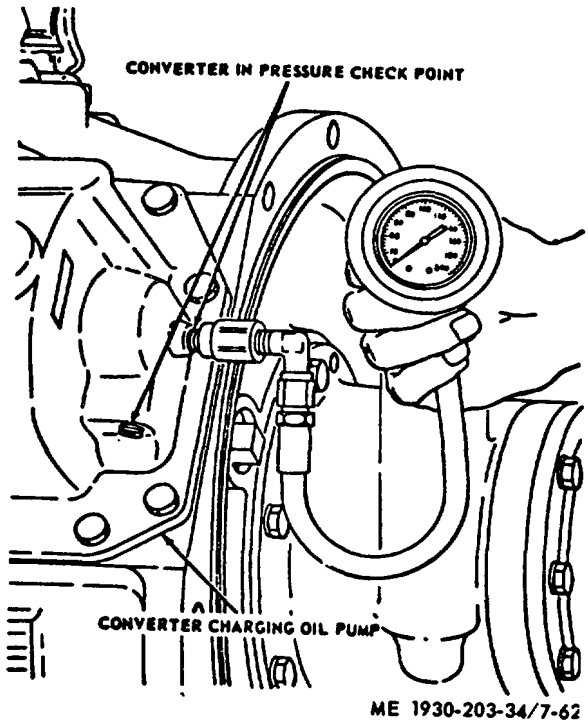


Figure 7-62. Checking converter in pressure.

NOTE

Before a stall check is performed. it is necessary to check oil level in transmission and converter system.

d. Start engine and allow temperature and pressure readings to stabilize.

NOTE

Normal operating temperature for both engine and transmission must be reached before performing stall check to evaluate true stalled speed.

e. Run engine at idling speed.

f. Apply brakes. As an added precaution the wheels can be blocked.

g. Shift transmission into high range and move engine throttle to full speed position.

CAUTION

Do not stall converter output shaft at full engine throttle over 20 seconds maximum. Do not let converter oil temperature exceed 2500 F. This temperature can be read on TOR.CONV. OIL TEMP. gage on the gage board.

h. Table 7-1 gives theoretical stall speeds on Models TC-654 and TC-554 converters. Stall speeds may vary considerably because of accessory drag. However. acceptable figures will not fall more than 100 rpm below those listed.

NOTE

Stall speeds more than 2% above thoselisted should be investigated immediately.

i. Charging oil pump IN pressure should be 500 psi minimum and 80 psi maximum at full throttle stall condition. Maximum permissible pressure at full throttle with transmission in neutral range is120 psi.

j. Transmission lube oil pressure should be 8 psi minimum and 25 psi maximum at full throttle

k. Transmission clutch pressure should be 140 psi minimum at full throttle stall as indicated on TRANS. OIL PRESS. gage on the gage board.

NOTE

Altitude must be considered in stalled readings.

l. Checking stall speed is not practical if engine tachometer is inaccurate. This should be first item checked if stall speed is above figure listed.

m. Stall speeds should be the same in all transmission ranges. If there is a variation between ranges, there is a possibility of slipping transmission clutches.

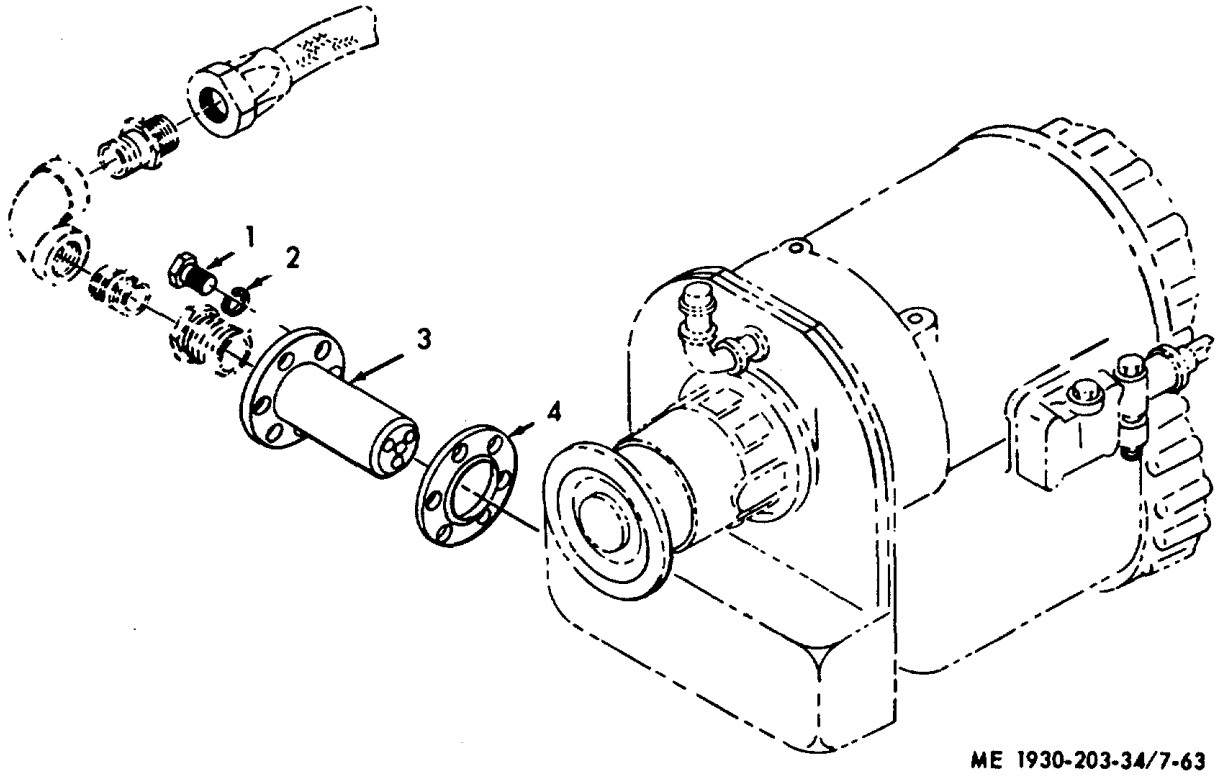
Table 7-1. Torque converter stall speed chart.

Engine governed (RPM)	Converter torque	Converter model	Stall (RPM)	Transmission lube oil pressure	Converter charging oil pressure
2100	3.6 to 1	TC-654	1710	8-25 psi	50-80 psi
2100	3.13to 1	TC-554	1840	8-25 psi	50-80 psi

7-4. Flexible Coupling, Torque Converter to Transmission
Refer to TM 55-1930-203-20 for removal. installation, disassembly. reassembly, cleaning, and inspection instructions.

7-5. Flexible Coupling, Transmission to Miter Box
Refer to TM 55-1930-203-20 for removal, installation, disassembly, reassembly, cleaning, and inspection instructions.

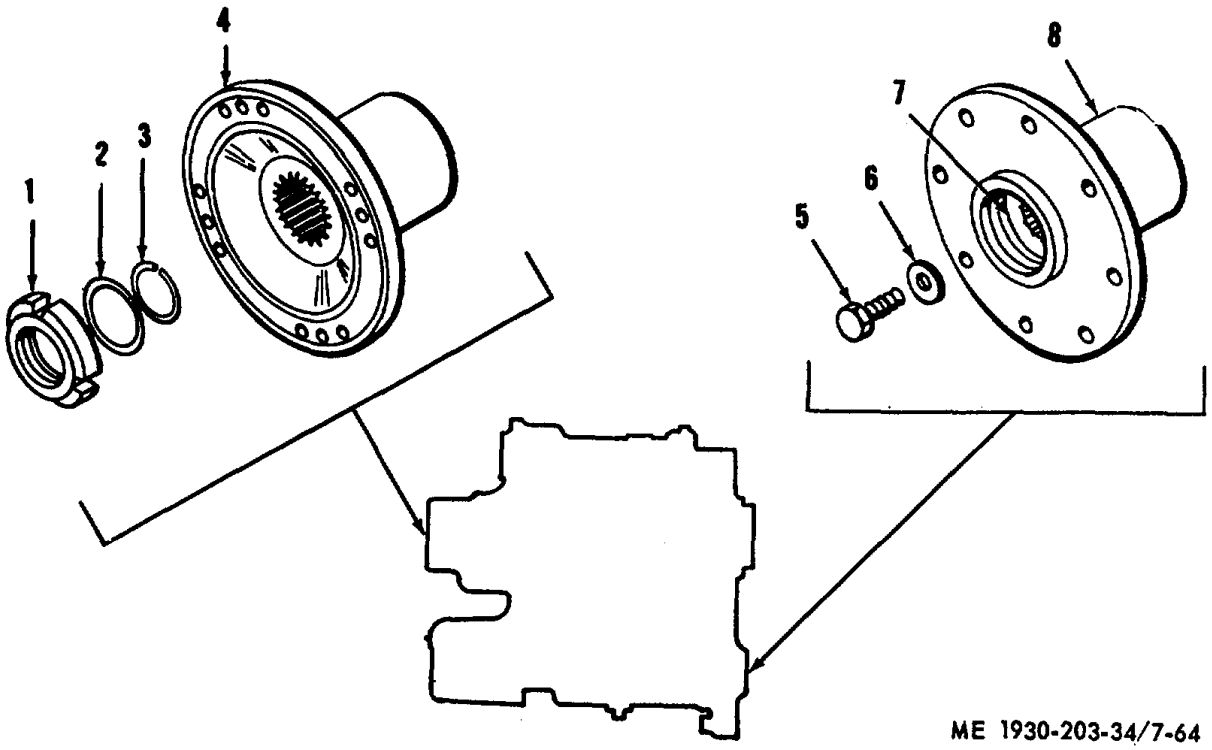
7-6. Transmission Assembly
a. Description. Refer to paragraph 2-13 for a complete description of the LARC Transmission Assembly.
b. Removal. Refer to paragraph 2-13.
c. Disassembly.
(1) Minor subassemblies removal.
(a) Place transmission. bottom side down. on worktable on wood block, or mount transmission on overhaul stand.
(b) Remove bolts (43, fig. 2-7) and lockwashers (42) and remove manifold assembly (40) and gasket (39).
(d) Remove four bolts (51) and lockwashers (52) and remove selector valve assembly (53) and gasket (54).
(d) Remove capscrews (1, fig. 7-63), lockwashers (2), and strainer (3) and gasket (4) from transmission.



1 Capscrew
2 Lockwasher
3 Oil strainer
4 Gasket

Figure 7-63. Transmission oil strainer.

(e) Straighten stake marks to unlock nut from out put shaft. Remove nut (1, fig. 7-64), seal (2), internal snapring (3), and output flange (4).



1 Nut, drive flange	5 Bolt, machine
2 Seal	6 Lockwasher
3 Internal snapring	7 Retaining washer
4 Output flange	8 Input flange

Figure 7-64. Transmission flange assembly.

(f) Remove bolt (5) and lockwasher (6) from input flange (8), and remove input flange.

NOTE

The flange is an outside diameter (tight) fit on the shaft. Proceed as outlined in (g) through (i) below.

(g) Using a suitable puller, bolt the puller to face of input flange (8).

CAUTION

A puller that pulls on the outside diameter of flange may deform the flange.

(h) Install spacer between the jackscrew and shaft.

(i) Remove input flange by tightening puller screw against spacer and shaft.

CAUTION

To avoid damage, do not hammer or pry on flange.

(2) Transmission front housing and cover removal.

(a) Remove 15 bolts (39, fig. 7-65), bolt (40), and 16 lockwashers (38 and 41).

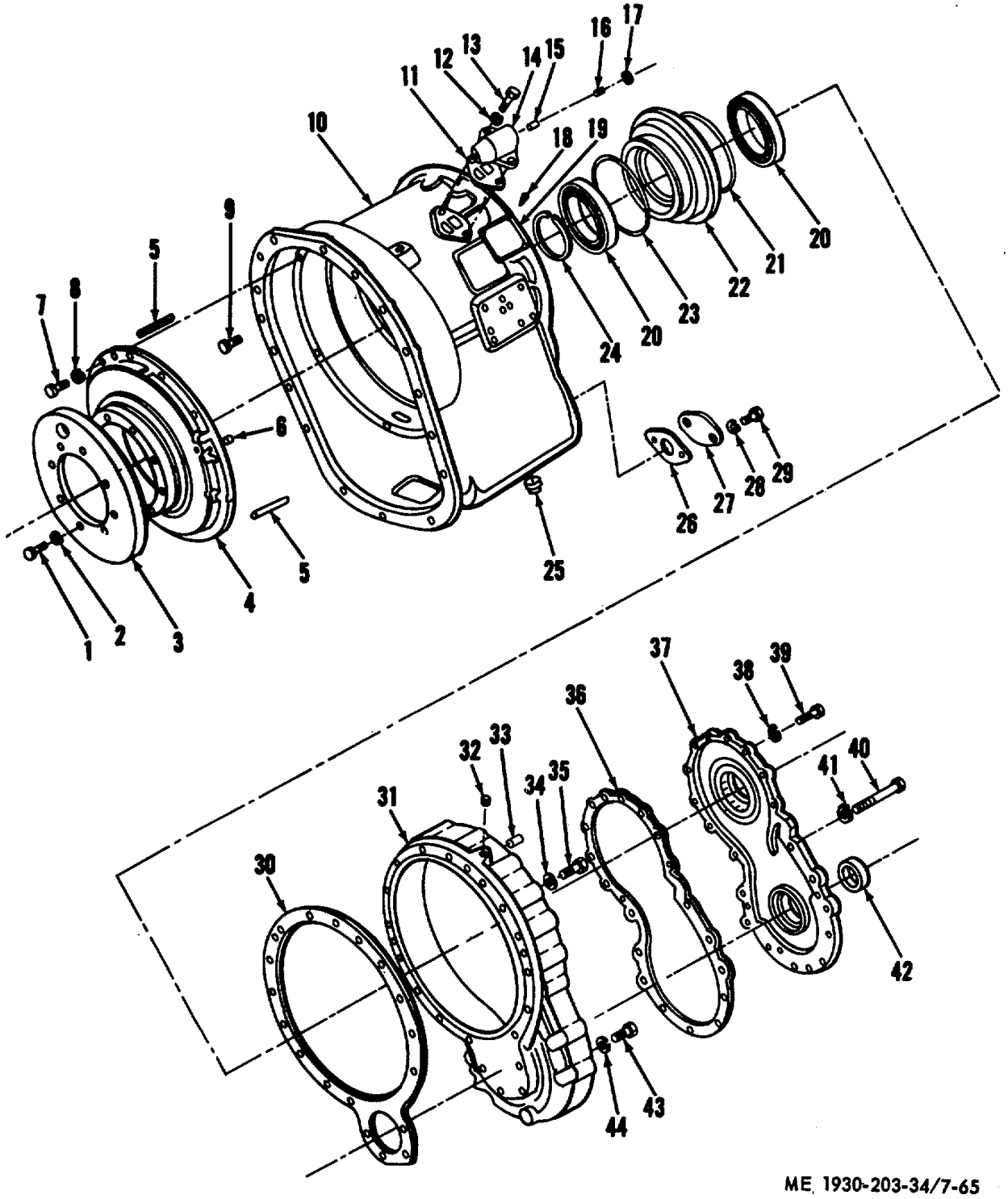
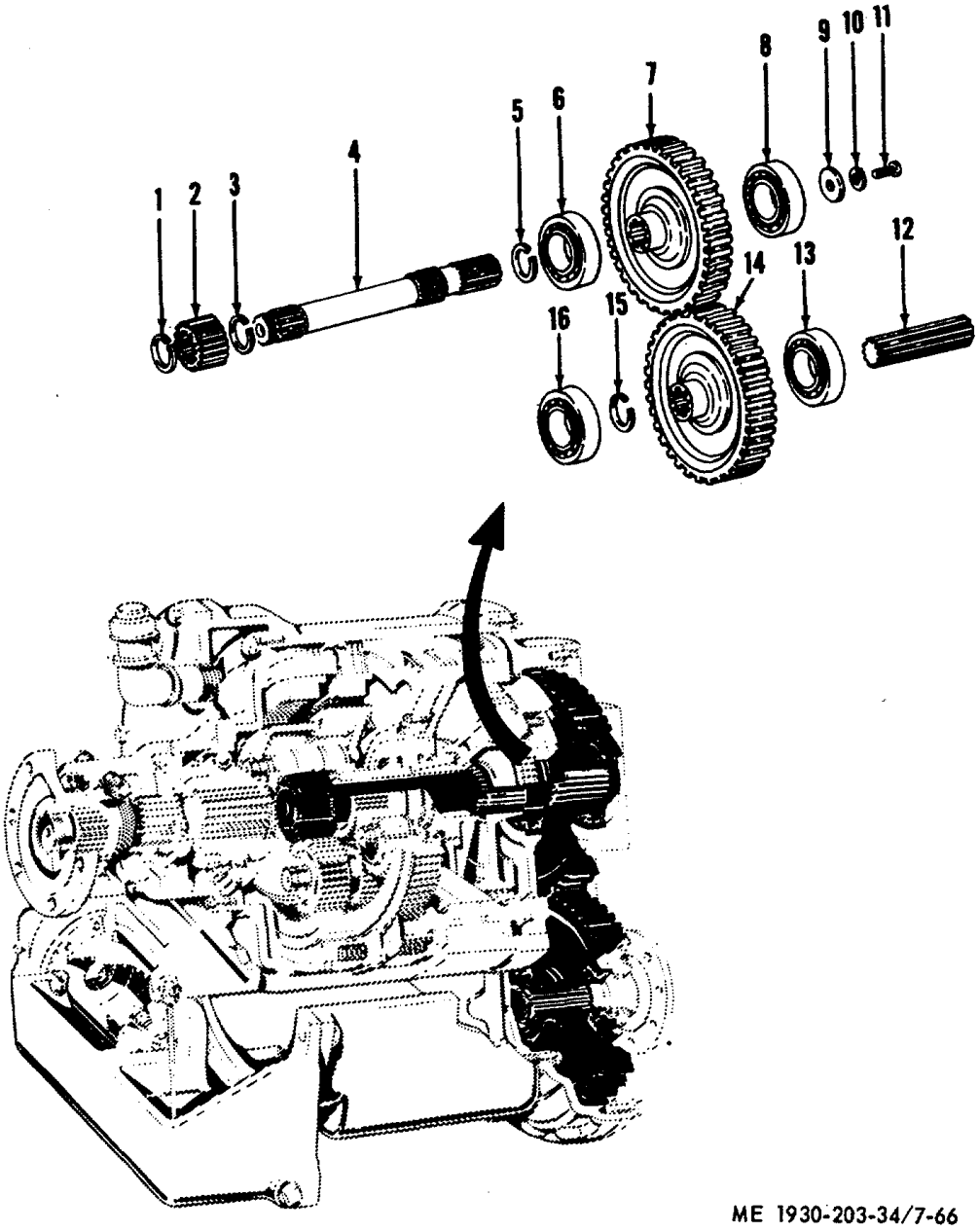


Figure 7-65. Transmission housing assembly.

Key to figure 7-65.

1 Bolt, machine
2 Lockwasher
3 Carrier, bearing retainer
4 Internal cover
5 Pin
6 Oil transfer tube
7 Bolt, machine
8 Lockwasher
9 Bolt, self4ocking
10 Transmission housing
11 Manifold gasket
12 Lockwasher
13 Bolt, machine
14 Manifold
15 Dowel pin
16 Spring
17 Valve
18 Screw
19 Nameplate
20 Bearing assembly
21 Seal ring
22 Bearing housing
23 Seal ring
24 Retaining ring
25 Plug
26 Gasket
27 Cover
28 Lockwasher
29 Bolt, machine
30 Front housing gasket
31 Front housing
32 Dowel pin
33 Plug
34 Lockwasher
35 Bolt, machine
36 Cover gasket
37 Front housing cover
38 Lockwasher
39 Bolt, machine
40 Bolt, machine
41 Lockwasher
42 Input flange oil seal
43 Bolt, machine
44 Lockwasher

(b) Remove front housing cover (37) and cover gasket (36).
(c) Remove bolt (11, fig. 7-66), lockwasher (10) and washer (9).



1 External snapring
2 Main shaft sun gear
3 External snapring
4 Transmission main shaft
5 External snapring
6 Upper transfer gear bearing
7 Upper input transfer gear
8 Upper transfer gear bearing
9 Washer
10 Lockwasher
11 Bolt, machine
12 Input shaft
13 Lower transfer gear bearing
14 Lower input transfer gear
15 External snapring
16 Lower transfer gear bearing

Figure 7-66. Transmission shaft assembly.

(d) Remove upper transfer gear bearing (8) and lower transfer gear bearing (13), upper input transfer gear (7), and lower input transfer gear (14).

NOTE

The lower input transfer gear (14) is secured to input shaft (12) by an external snapring (151 on inner side of input shaft. The input shaft must be removed with lower input transfer gear. The external snapring can then be removed and lower input transfer gear can be removed from input shaft.

(e) Remove upper transfer gear bearing (61 and lower transfer gear bearing (16).
(f) Remove 14 bolts (35, fig. 7-65), 4 bolts (43), and 16 lockwashers (34 and 44).
(g) Remove transmission front housing (31). Use jackscrews if necessary (fig. 7-67).

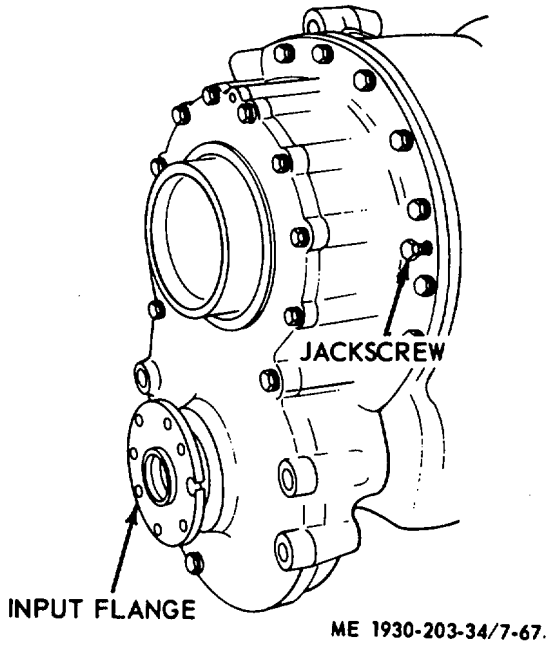


Figure 7-67. Transmission front housing

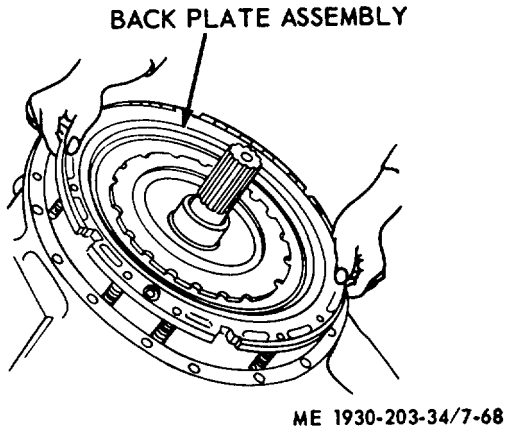


Figure 7-68. Intermediate-range clutch back plate assembly removal and installation

(3) High-range and intermediate range clutch assemblies removal.
(a) Using a suitable lifting sling, lifting eyes, and hoist, tilt transmission backward to a 45- degree angle.
(b) Remove intermediate-range clutch backplate assembly (fig. 7-68).
(c) Remove intermediate-range clutch plates (fig. 7-69).
(d) Install clutch spring compressor, part No. J7470 (fig. 7-70) to compress high-range clutch pack. Remove internal snapring from high- range clutch drum and sun gear assembly (fig. 7-70). Remove clutch spring compressor.
(e) Remove high-range clutch backplate (fig. 7-71) hub. clutch release springs, and clutch plates.

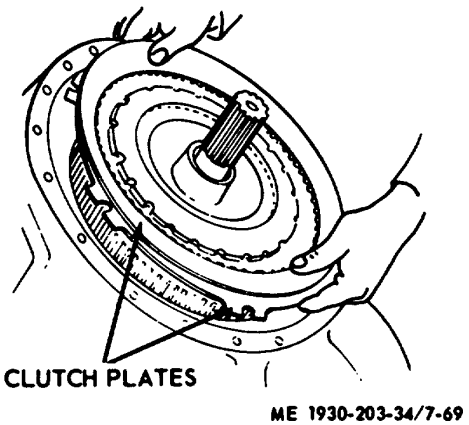


Figure 7-69. Intermediate-range clutch places removal and installation.

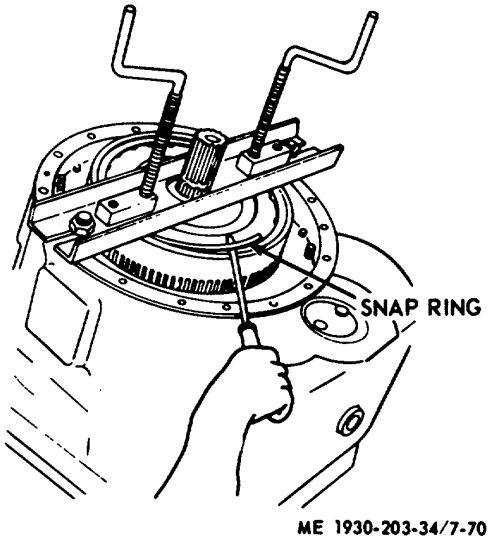


Figure 7-70. Removal of internal snapring from clutch drum and sun gear assembly with clutch spring compressor, Part No. J7470.

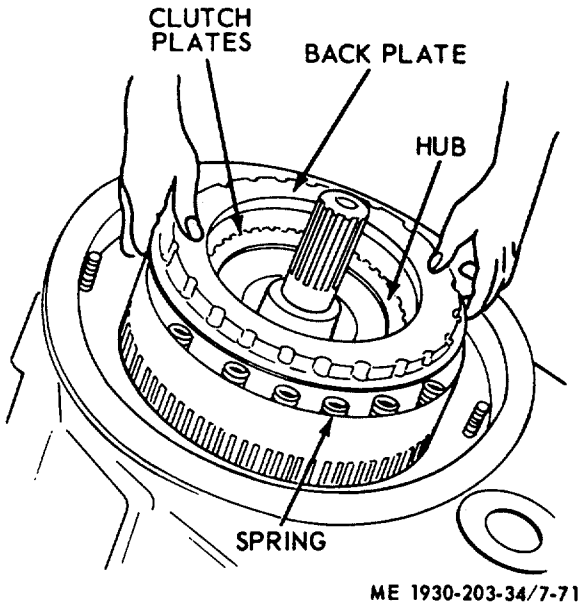


Figure 7-71. High-range clutch back plate removal and installation.

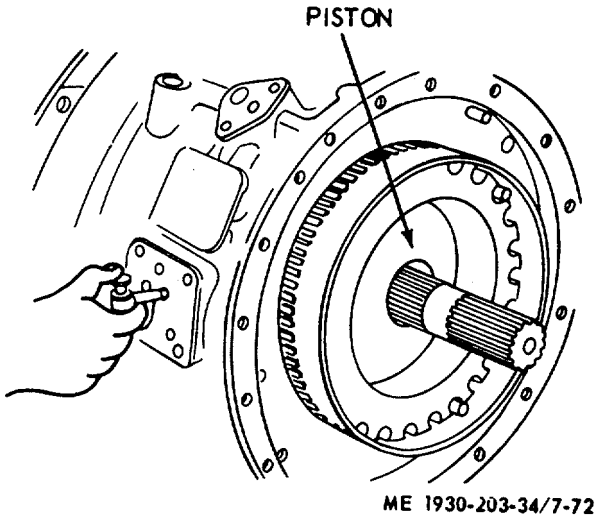


Figure 7-72. Using air pressure to remove high-range piston.

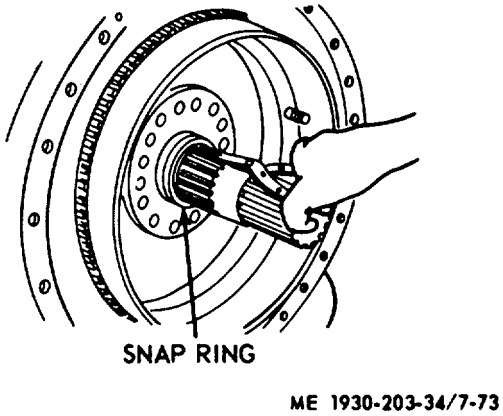


Figure 7-73. Removal and installation of snapring on transmission main shaft and sun gear.

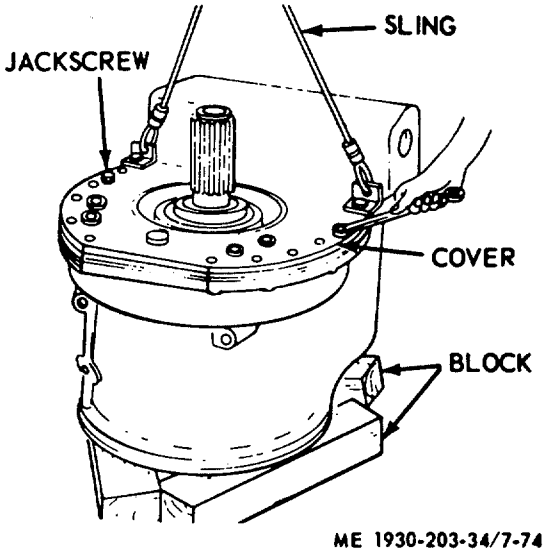


Figure 7-74. Transmission rear cover removal and installation.

(f) Using air pressure in indicated hole. force high-range piston out of its seal bore and remove (fig. 7-72).

(g) Remove snapring from transmissior main shaft and sun gear (fig. 7-73).

(4) Transmission adapter assembly removal

(a) Hoist transmission, shift its position and lower it with front end down. Use three wooden blocks to support front end (fig. 7-74).

(b) Remove bearing retainer (fig. 7-75). Use jackscrews if necessary.

(c) Remove bearing retainer seal ring (fig. 7-75).

(d) Remove 20 bolts (9, fig. 7-76), lock- washers (10) at transmission rear cover (6).

(e) Using a suitable lifting sling, remove transmission rear cover (6) and adapter gasket (7). Use jackscrews if necessary (fig. 7-74).

(5) Low-range clutch and planetary carrier assemblies removal.

(a) Using improvised tool threaded on shaft end of planetary carrier assembly, lift planetary carrier assembly and remove snapring from ball bearing assembly (fig. 7-77).

NOTE

The improvised tool can be made from a bearing locknut, part No. 179207, and a short piece of steel bar, welded together (fig. 7-77.)

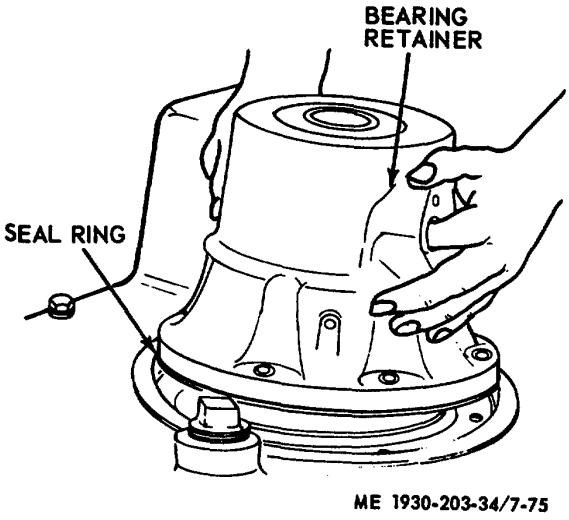
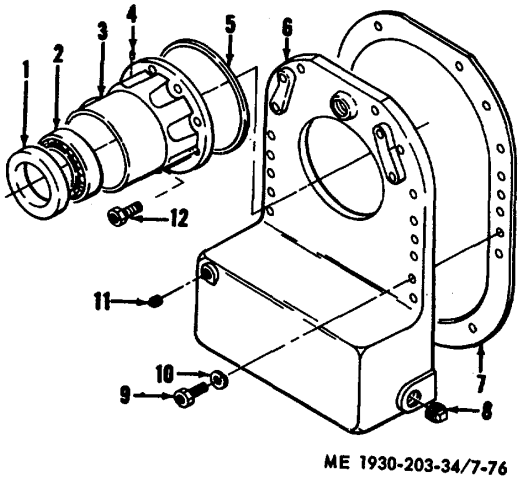


Figure 7-75. Bearing retainer removal and installation

(b) Remove improvised tool from shaft end of planetary carrier assembly.

(c) Remove 12 bolts (7, fig. 7-65) and 12 lockwashers (8) from internal cover (4, fig. 7-77).

(d) Hoist internal cover, low-range clutch plates and low-range ring gear out of transmission (fig. 7-78).



1 Oil seal
2 Ball bearing
3 Bearing retainer
4 Dowel pin
5 Seal ring
6 Transmission rear cover
7 Adapter gasket
8 Plug
9 Bolt, machine
10 Lockwasher
11 Pipe plug
12 Bolt, self-locking

Figure 7-76. Transmission adapter assembly.

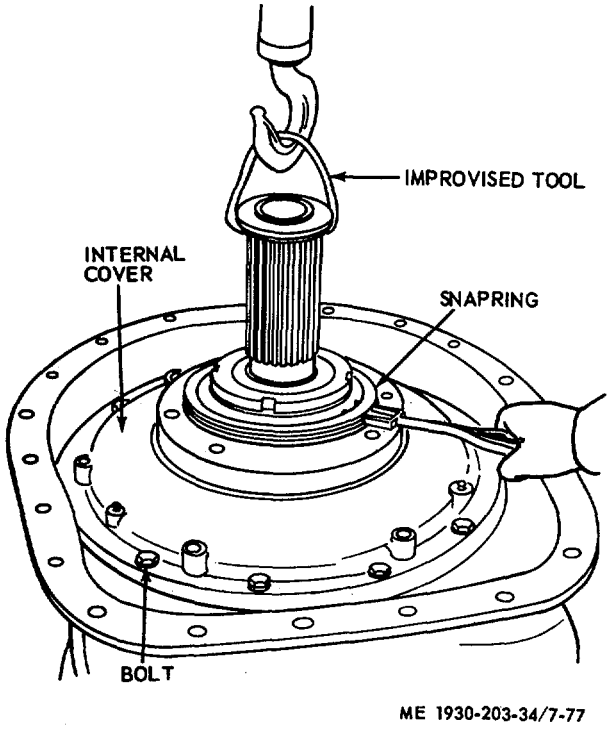


Figure 7-77. Removal and installation of snapring from ball bearing assembly.

(e) Using improvised tool, hoist planetary carrier gearing assembly out of transmission (fig. 7-79).

(6) Reverse-range clutch assembly removal.

(a) Using clutch spring compressor, part No. J7470 (fig. 7-70), compress reverse-range clutch backplate assembly and remove snapring.

(b) Remove clutch spring compressor, part No. J7470, and remove reverse-range ring gear (fig. 7-80).

(c) Remove reverse-range clutch backplate assembly (fig. 7-81).

(d) Remove reverse-range clutch plates (fig. 7-81).

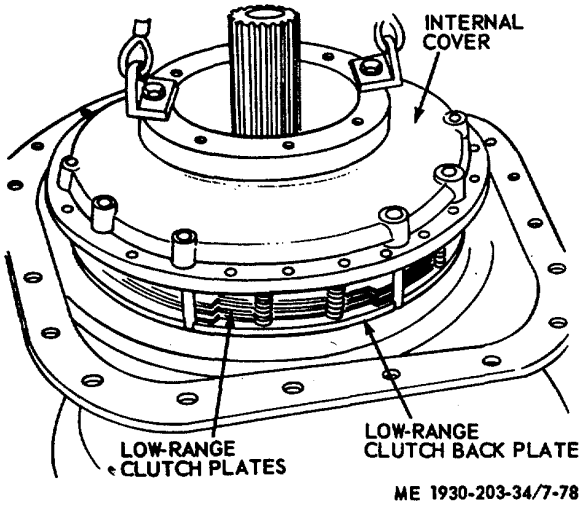


Figure 7-78. Internal cover, low range clutch, and low range ring gear removal.

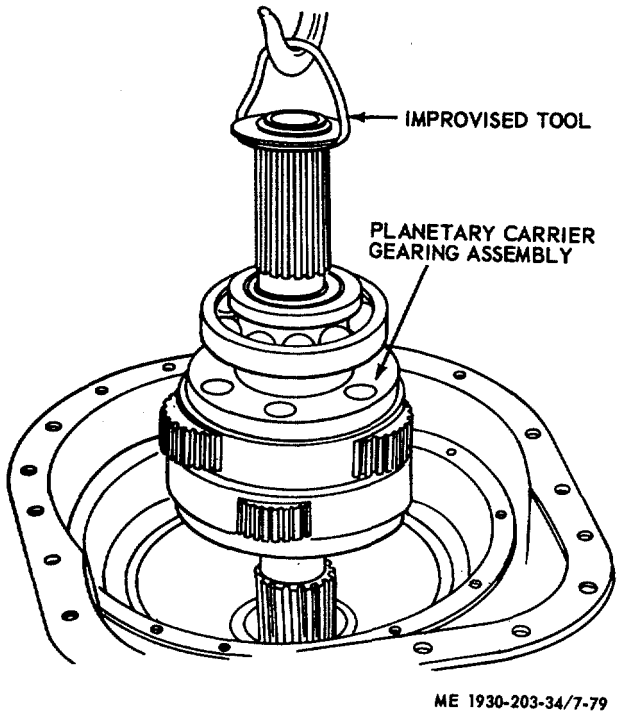


Figure 7-80. Removing snapring that retains reverse-range clutch back plate assembly with clutch spring compressor, part no. J7470.

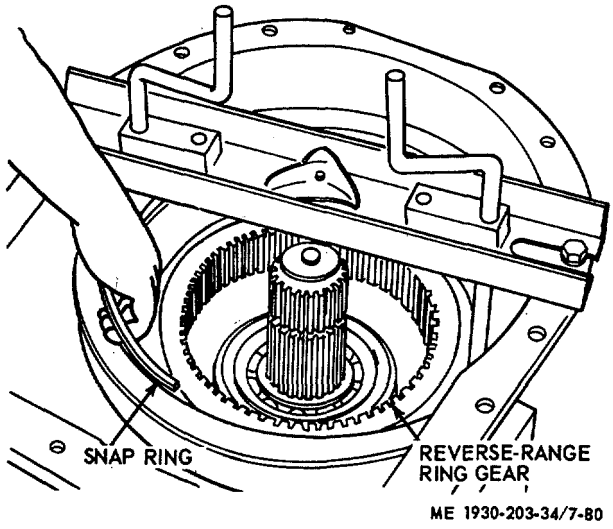


Figure 7-79. Planetary carrier assembly removal.

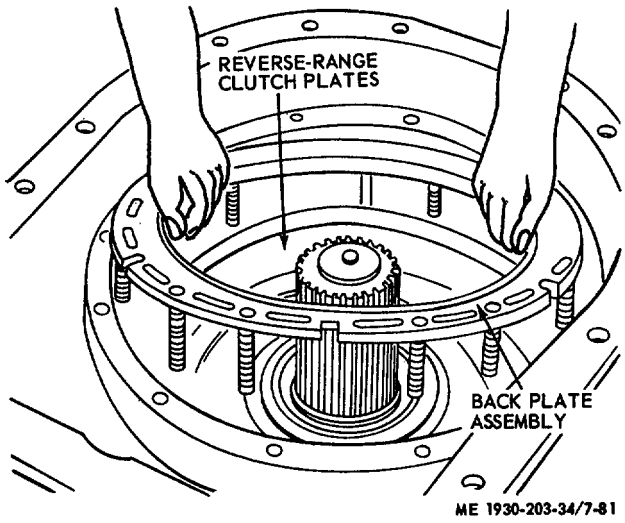


Figure 7-81. Reverse-range clutch backplate assembly removal

(e) Using air pressure in indicated hole, lift reverse-range piston out of its seal bore and remove (fig. 7-82).

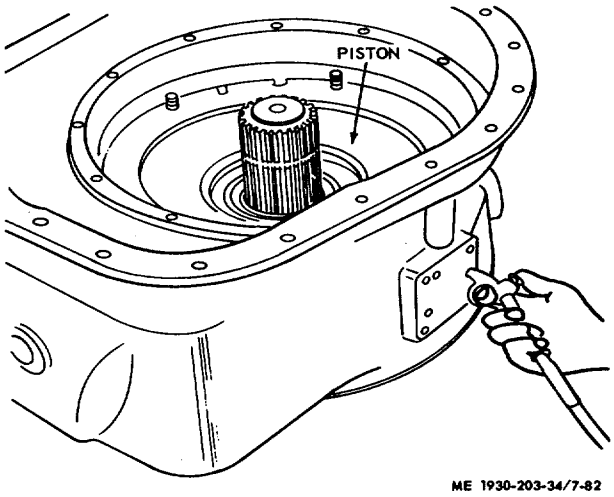


Figure 7-82. Using air pressure to remove reverse piston.

(7) Clutch drum and sun gear assembly removal

(a) If transmission main shaft and sun gear remained in transmission when planetary carrier gearing assembly was removed, remove transmission main shaft (fig. 7-83).

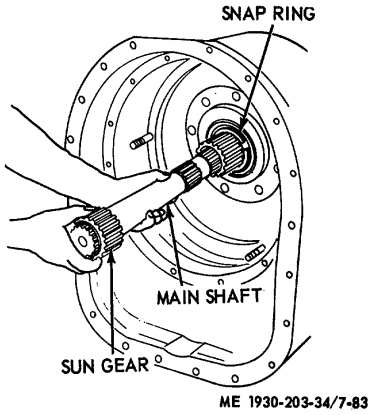


Figure 7-83. Transmission main shaft and sum gear removal

(b) From rear side of transmission, remove snapring from clutch drum and sun gear assembly (fig. 7-84).

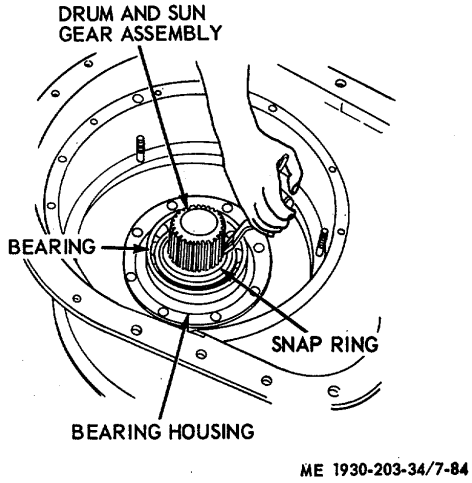


Figure 7-84. External snapring removal from clutch drum and sun gear assembly.

c) Tap clutch drum and sun gear assembly from transmission housing (fig. 7-85). (Turn transmission back over at this point).

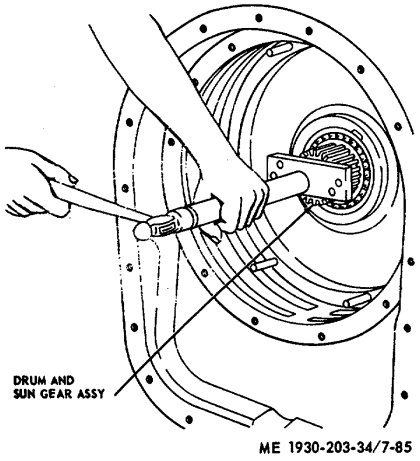


Figure 7-85. Clutch drum and gear assembly removal.

(d) Using air pressure in indicated hole, force intermediate-range piston out of its seal bore and remove (fig. 7-86).

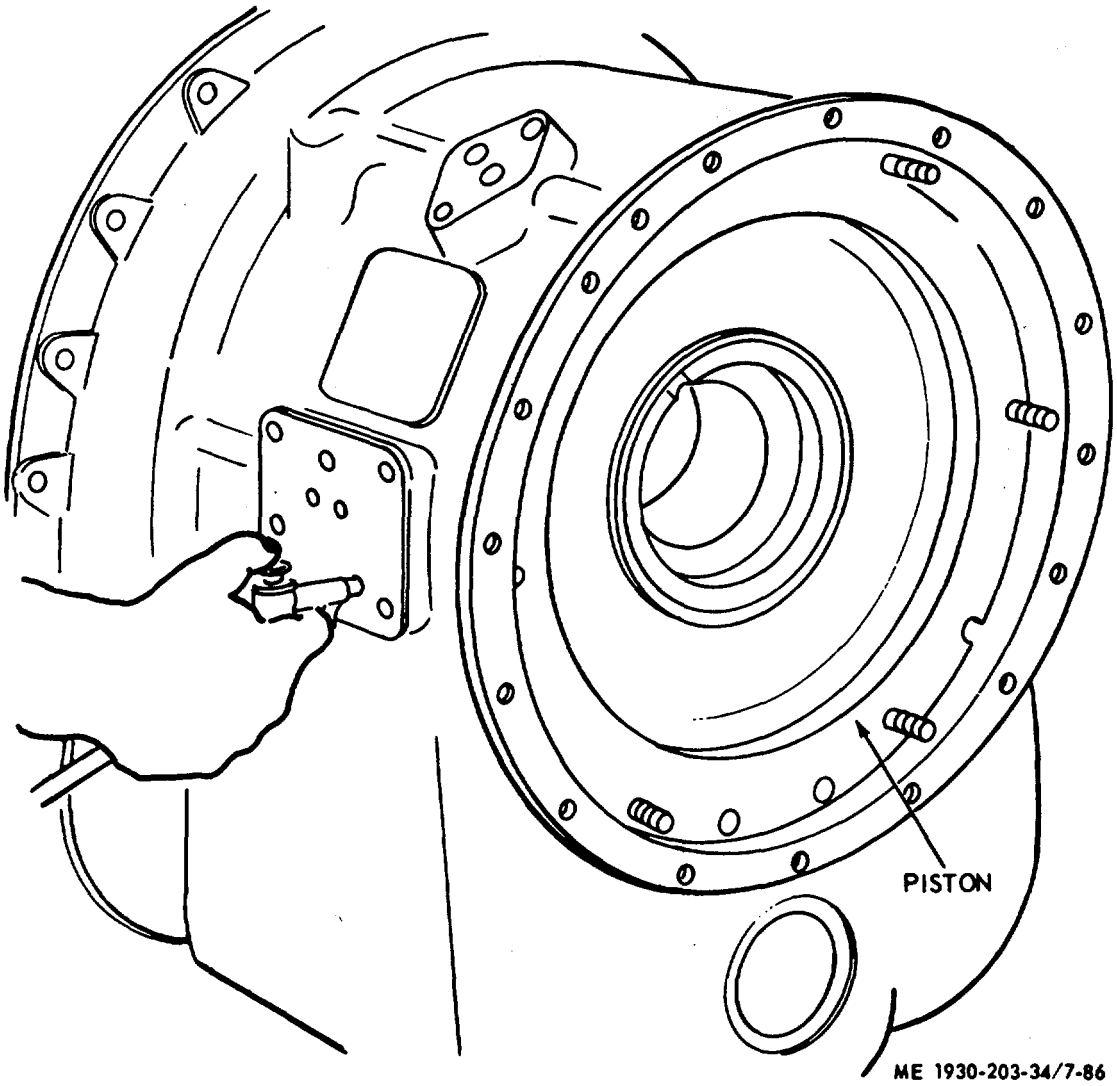


Figure 7-86. Using air pressure to remove intermediate-range piston.

(8) Transmission housing assembly and related parts disassembly.

(a) Parts that were not removed from transmission housing assembly during disassembly into subassemblies need not be removed except for replacement of parts.

(b) If bearing housing needs to be replaced, remove eight bolts (9, fig. 7-65) from bearing housing (22) using three bolts as jackscrews and remove bearing housing.

(c) If bearing assembly (20, fig. 7-65) needs to be replaced, drive bearing out of bearing housing (22).

(9) Transmission main shaft assembly disassembly.

(a) Parts in this assembly were removed from transmission during disassembly into subassemblies.

(b) Remove transmission main shaft sun gear (2. fig. 7-66) only if replacement is necessary.

(c} Remove external snaprings (I and 3) and remove transmission main shaft sun gear (2).

(10) Low-range clutch assembly disassembly.

(a) Low-range clutch assembly was removed during disassembly of transmission into subassemblies (fig. 7-78).

(b) Place the low-range clutch assembly, front side down, on worktable.

(c) Use a C-clamp to compress assemblies slightly so cotter pins can be removed. Remove cotter pins from three assembling pins (fig. 7-87). Remove assembling pins.

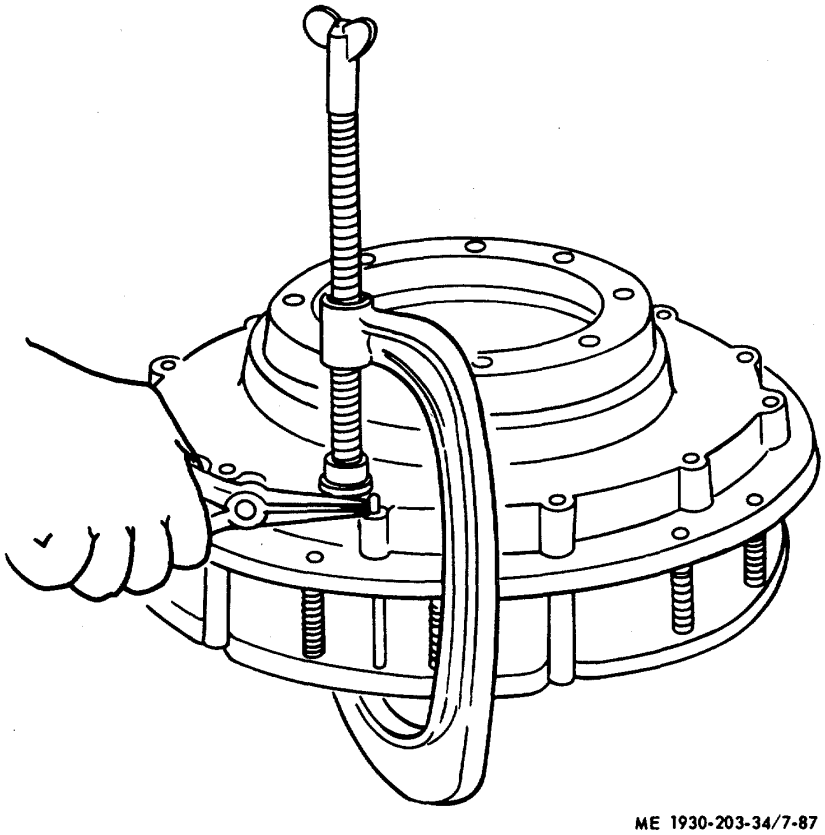


Figure 7-87. Removal and installation of cotter pins assembly pins with clutch assembly compressed.

(d) Hold clutch assembly together and turn it over.
(*e*) Remove low-range clutch backplate and springs (fig. 7-87.1).
(*f*) Remove the seven clutch plates (7 and 8, fig. 7-95).
(*g*) Remove piston plate (fig. 7-87.2)
(h) Remove ring gear (5, fig. 7-95).
(*i*) Do not remove the 12 clutch-release springs and clutch-release spring retainers from low-range clutch backplate except for replacement of parts. To aid in removing low-range clutch piston, direct compressed air through oil port in internal cover (fig. 7-87.3). Remove piston (2, fig. 7-95*).*

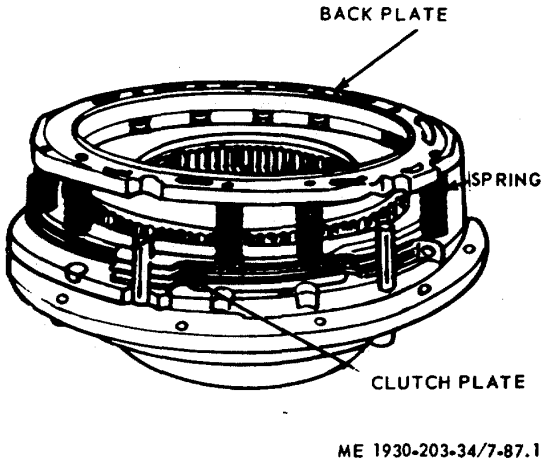


Figure 7-87.1. Low-range clutch backplate and springs removal and installation.

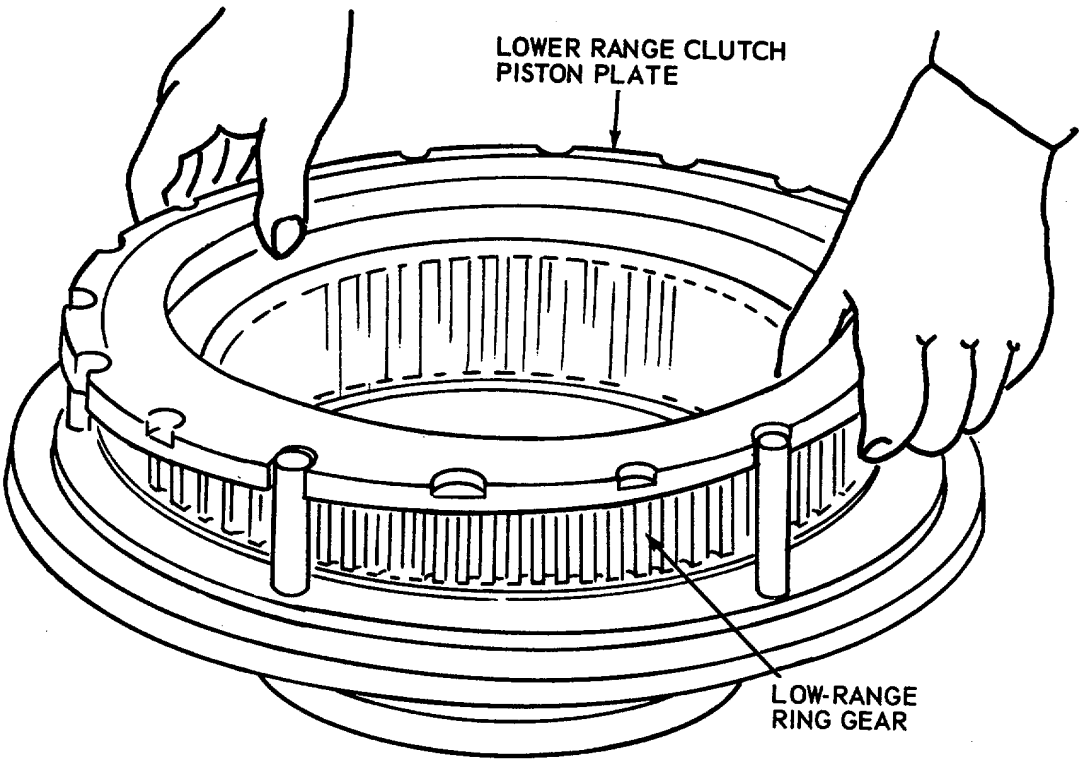


Figure 7-87.2. Low range clutch piston plate removal and installation.

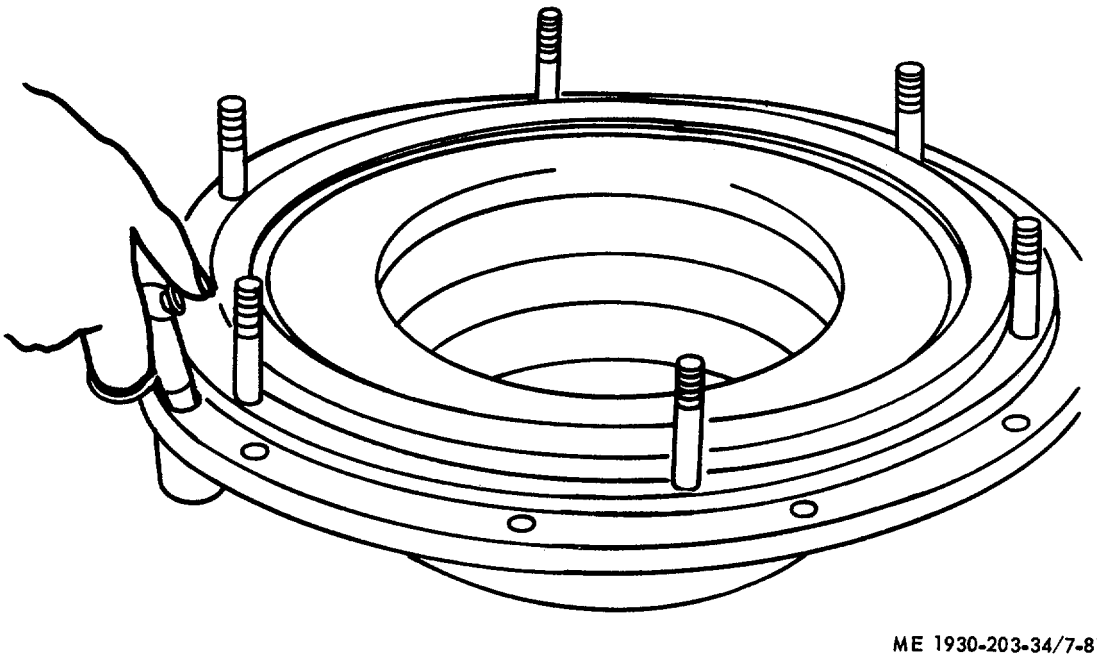


Figure 7-87.3. Loosening low-range clutch piston, using compressed air.

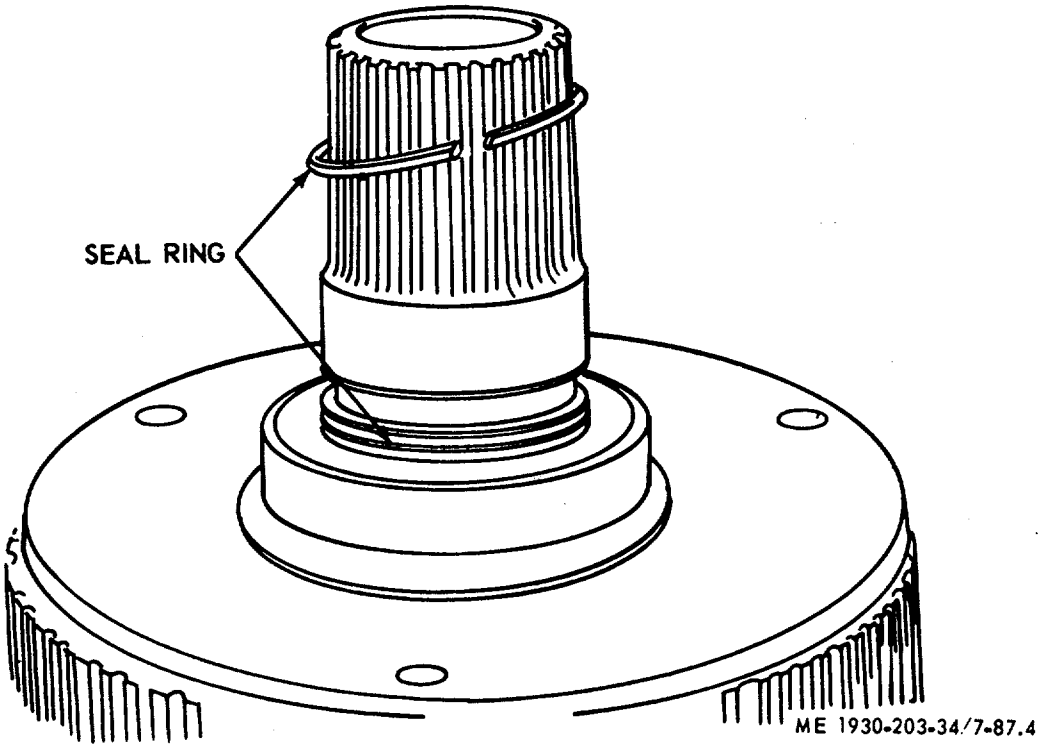


Figure 7-87.4. Seal ring removal and installation on drum and sun gear assembly.

(j) Remove seal rings (3) from piston (2).

(11) Intermediate-range clutch assembly disassembly.

(a) Remove seal ring from piston.

(b) The remaining parts in this group were removed from transmission during disassembly into subassemblies.

(12) High-range clutch assembly disassembly.

(a) Most parts in this group were removed from transmission during disassembly into subassemblies. Remove two seal rings (fig. 7-87.4) and bearing from shaft end of clutch drum and sun gear assembly. Pry bearing up with pry bars far enough to use a puller, part No. J7468.

(b) Remove remaining seal ring from small hub of drum and sun gear assembly.

(I3) Reverse-range clutch assembly disassembly.

(a) Remove seal ring from reverse-range clutch piston.

(b) Other parts in this group were removed from transmission during disassembly into subassemblies.

(14) Transmission adapter assembly disassembly.

(a) Parts in this assembly were removed from transmission during disassembly into subassemblies.

(b) The ball bearing (2, fig. 7-76) and oil seal (I) are generally not removed. If either ball bearing or oil seal needs to be replaced, collapse oil seal with drift and hammer and remove oil seal. Tap ball bearing with a drift and hammer from bearing retainer (3).

(I5) Planetary carrier assembly disassembly.

(a) The planetary gearing was removed from transmission along with transmission main shaft and planetary sun gear assembly (fig. 7-79)

(b) If main shaft and sun gear assembly remained with planetarycarrier assembly, .slide main shaft and sun gear assembly from planetary carrier (fig. 7-88).

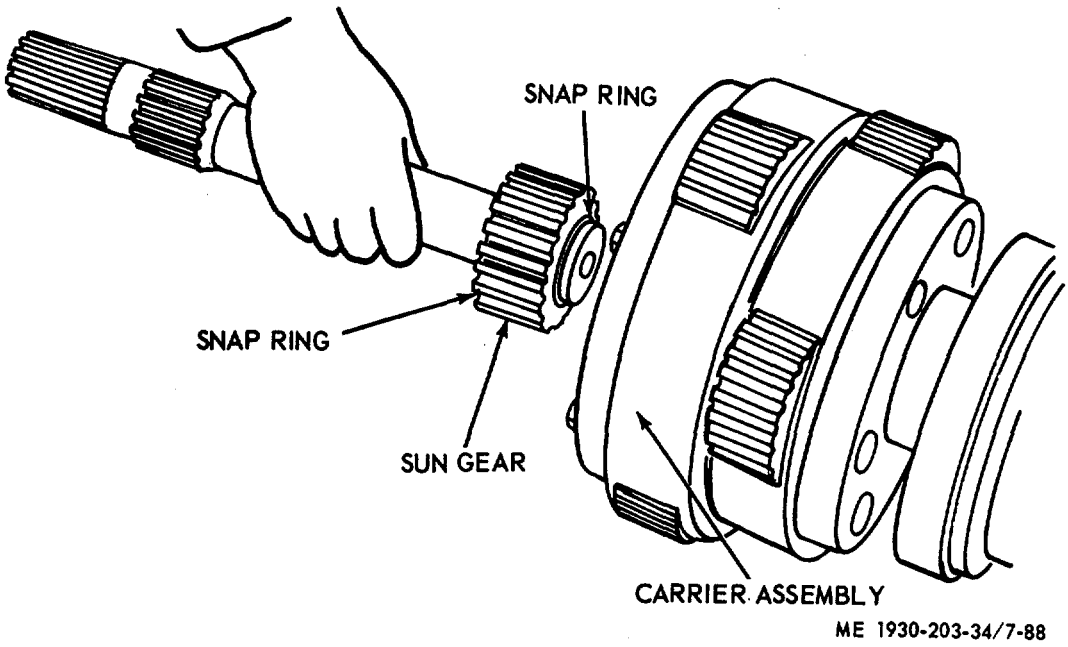
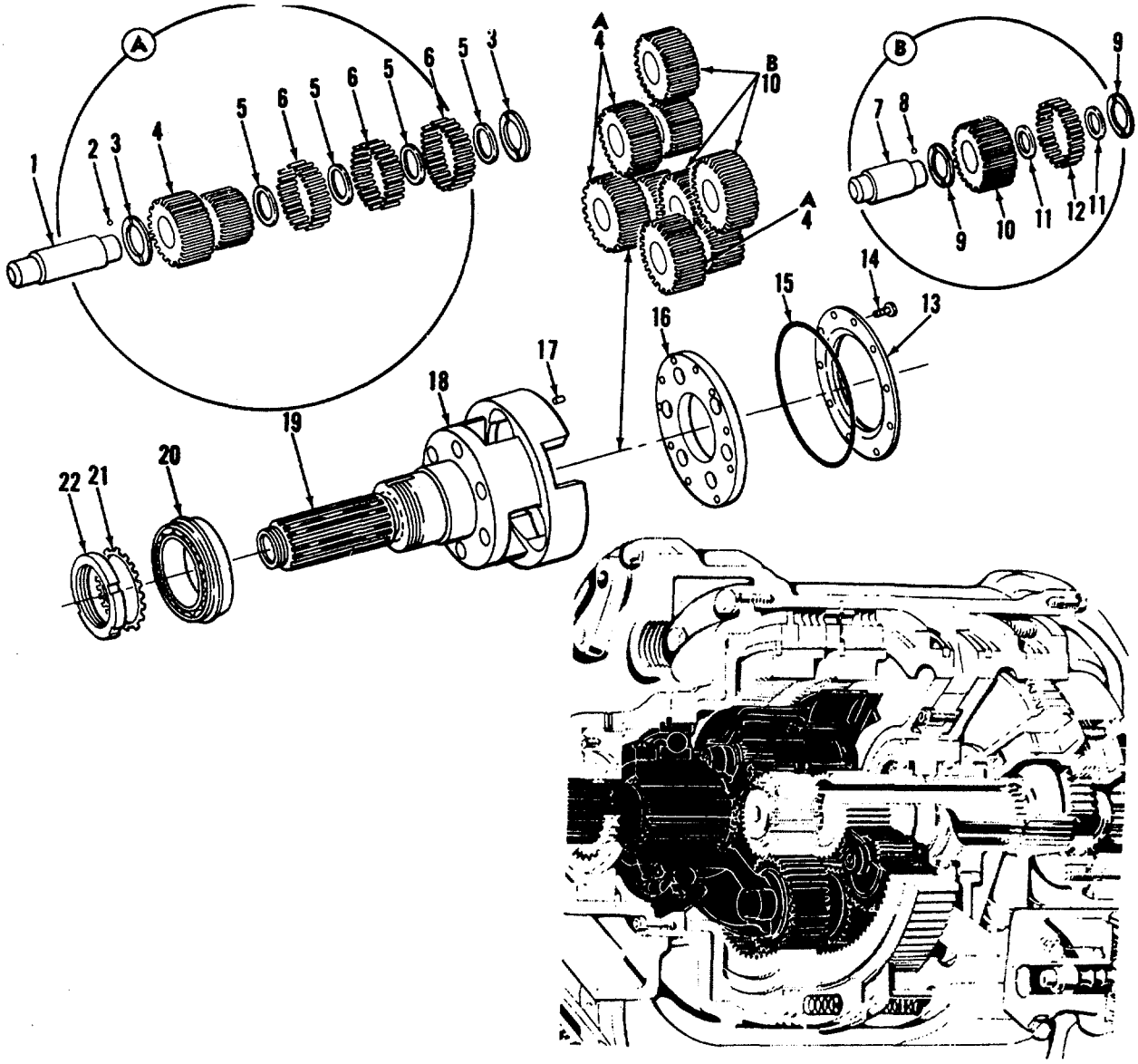


Figure 7-88. Main shaft and input sun gear removal from planetary carrier assembly

(c) Place planetary carrier assembly, small end up, on worktable.
(d) Bend down tab on bearing lockwasher (21, fig. 7-89).



1 Planetary cluster pinion pin
2 Locking ball
3 Washer, thrust
4 Planetary cluster pinion
5 Spacer
6 Needle bearing
7 Planetary pinion pin
8 Locking ball
9 Washer, thrust
10 Planetary pinion
11 Spacer
12 Needle bearing
13 Oil collector ring
14 Bolt, machine
15 Oil seal
16 Planetary carrier cover
17 Dowel pin
18 Planetary carrier
19 Output shaft
20 Ball bearing assembly
21 Bearing lockwasher
22 Bearing locknut

Figure 7-89. Transmission planetary carrier assembly.

(e) Using special spanner wrench. part No. J7466, tap wrench and remove bearing locknut (22) from planetary carrier (18).

(f) Remove ball bearing assembly (20) from the planetary carrier (18) using puller assembly, part No. J7468, or any other suitable puller and a sleeve or piece of pipe that will fit over the output shaft (19. fig. 7-89).

(g) Place planetary carrier (18. fig. 7-89) on its side on worktable and remove nine bolts from oil collector ring (13).

(h) Remove oil collector ring (13) and oil seal II 51 from planetary carrier cover (I6). (fig. 7-90).

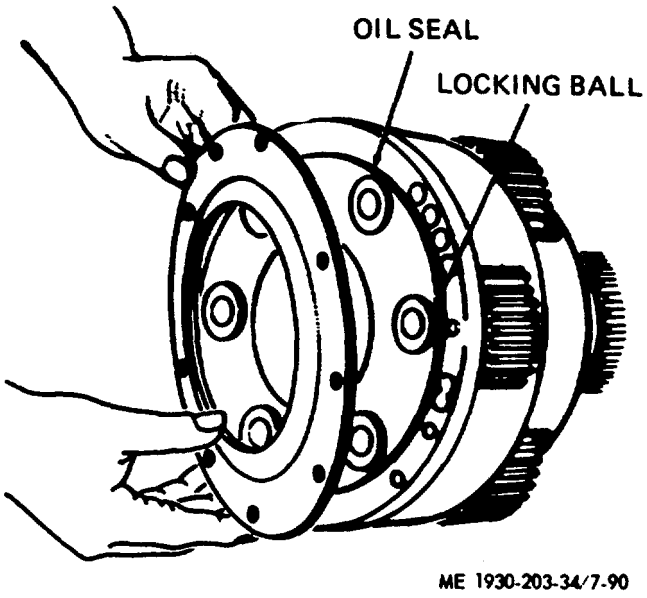


Figure 7-90. Removal and installation of oil collector ring and oil seal from planetary carrier cover.

(i) Using alinement cover {fabricated from discarded planetary carrier cover, press the six planetary pins and cover from carrier {fig. 7-91).

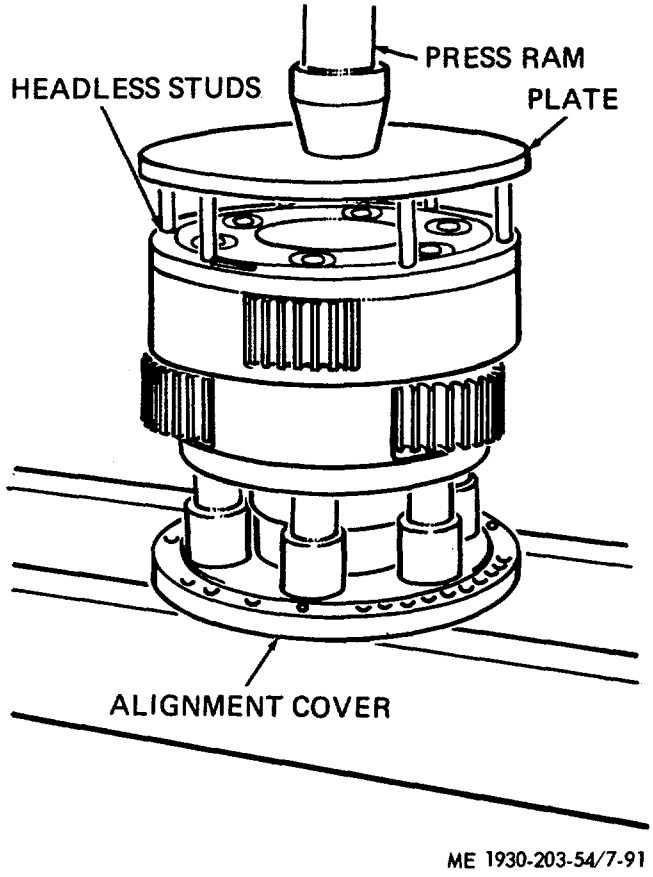


Figure 7-91. Pressing planetary pinion pins and planetary cover from planetary carrier assembly.

(j) Remove three washers (3, fig. 7-89) from rear of planetary cluster pinions (4) and three washers (9) from rear of planetary pinions (10).

(k) Press each of the planetary cluster pinion pins (1) and each of the planetary pinion pins (7) and locking balls (2 and 8) from planetary carrier cover (I6). Drive against locking ball end of each pin.

(l) Remove three planetary pinions (I0, fig. 7-89) along with washers (9), spacers (11), and needle bearings (12), (fig. 7-92).

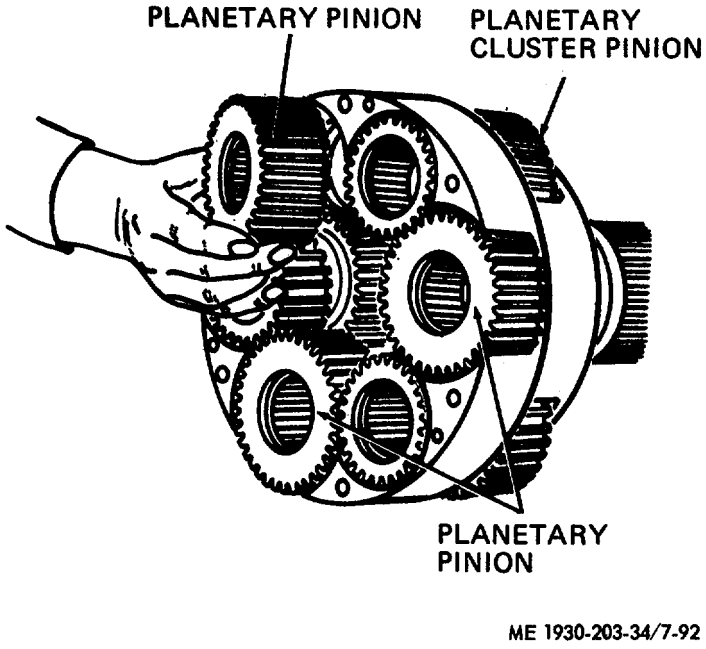


Figure 7-92. Planetary pinion removal.

(m) Remove three planetary cluster pinions (4, fig. 7-89) along with the washers (3), spacers (5), and needle bearings (6), (fig. 7-93).

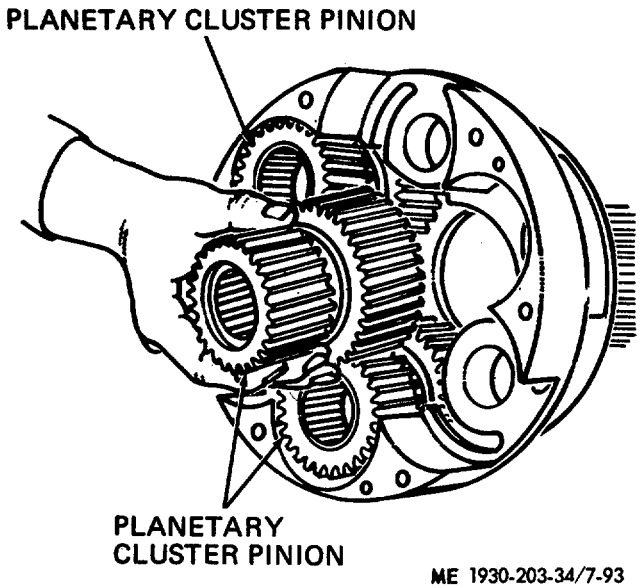


Figure 7-93. Planetary cluster pinion removal.

d. Cleaning, Inspection and Repair.

(1) Dirt and other abrasive material. Whenever the transmission contains dirt or other abrasive material, unnecessary wear will result. Inspect all parts for abrasive material any time transmission is disassembled. Metallic contamination of oil is evidence of failure of some part in either transmission or converter. When metal particles are found, both the transmission and converter must be thoroughly cleaned.

NOTE

It oil in the hydraulic system becomes contaminated with metal particles, all components of the hydraulic system-transmission, torque converter, oil lines, filters, screens, coolers, valves, ad oil pumps must be thoroughly cleaned. This usually means disassembly of the components. Metal particles in the oil are evidence of some part, either in the torque converter or in the transmission

(2) Cleaning procedures.

(a) All metallic parts of the transmission except bearings should be cleaned thoroughly with dry-cleaning solvent, Federal Specification P-D-680, or by the steam-cleaning method.

(b) Parts should be dried with compressed air. Steam-cleaned parts should be oiled immediately after drying with lubricating oil, Military Specification MIL-L-2 104.

(c) Clean oil passages by working a piece of wire back and forth through the passages and flushing them with dry-cleaning solvent, Federal Specification P-D-680. Dry passages with compressed air.

(d) After cleaning, examine parts, especially oil passages, to make certain they are entirely clean. Re-clean if necessary.

(3) Cleaning bearings.

(a) Thoroughly wash bearings that have been in service in dry-cleaning solvent, Federal Specification P-D-680.

(b) If bearings are particularly dirty or filled with hardened grease, soak in solvent before trying to clean them.

(c} Before inspection, oil bearings with same type of oil that will be used in transmission, Military Specification MIL-L-2 104.

NOTE

Never dry bearings with compressed air. Do not spin bearings while they are not lubricated.

(4) Keeping bearings clean. Since the presence of dirt or grit in ball bearings is usually responsible for bearing failures, it is important to keep bearings clean during installation and removal. Observance of the following rules will do much to insure maximum bearing lift:

(a) Do not remove wrapper from new bearings until ready to install them.

(b) Do not remove grease in which new bearings are packed.

(c) Do not lay bearings on a dirty bench; place them on clean paper.

(d) If assembly is not to be completed at once, wrap or cover exposed bearings with clean paper or cloth to keep out dust.

(5) Inspecting cast parts and machined surfaces.

(a) Inspect bores for wear, grooves, scratches, and dirt. Remove burrs and scratches with crocus cloth, Federal Specification P-C-458. Remove foreign matter. Replace parts that are deeply grooved or scratched.

(b) Inspect all oil passages for obstructions. If an obstruction is found, remove it with compressed air or by working wire back and forth through passage and flushing it out with dry-cleaning solvent, Federal Specification P-D-680.

(c) Inspect mounting faces for burrs, scratches, nicks, and foreign matter. Remove such defects with crocus cloth, Federal Specification P-C-458, or a soft stone, Military Specification MIL-S-2389. If scratches are deep, replace defective part.

(d) Inspect threaded openings for damaged threads. Chase damaged threads with the correct size tap.

(e) Replace housings or other cast parts that are cracked.

(f) Inspect all machined surfaces for damage that could cause oil leakage or other malfunction of the part. Rework or replace defective parts.

(6) Inspecting bearings. Inspect bearing for pitted, scored, or burned condition.

NOTE

When installing bearing on shaft, heat bearing to 300° F. in an oil bath. Coat mating surfaces with white lead, Federal Specification TT-W-251, and use proper size installation sleeve and an arbor press to seat bearing.

NOTE

If a bearing must be removed or installed without a sleeve, be careful to press only on the race which is adjacent to the mounting surface. If an arbor press is not available, seat bearing with a drift and hammer, driving against the supported race.

(7) Inspecting bushings and thrust washers.

(a) Inspect bushings for roundness, scores, burrs, sharp edges, and evidence of overheating. Remove scores with crocus cloth, Federal Specification P-C-458. Remove burrs and sharp edges with a scraper or knife blade. If bushing is out-of-round, deeply scored, or excessively worn, replace it using proper size replacement.

NOTE

Sometimes it is necessary to cut out a defective bushing. Be careful not to damage bore into which bushing fits.

(*b*) Inspect thrust washers for distortion, scores, burrs, and wear. Replace thrust washer if defective or worn.

(*c*) Planetary gearing thrust washer thickness is 0.050 inch minimum. Groove depth of planetary gearing thrust washer is 0.005 inch minimum.

(*8*) *Inspecting oil seals and gaskets.*

(*a*) Install new seals and gaskets.

(*b*) Inspect seal rings for cuts and hardness. Replace seal rings if these defects are found. Replace all gaskets, worn seal rings, and cotter pins. If converter has been overheated, replace all springs. Handle rubber and metal seal rings with care to prevent damage.

(*c*) When replacing lip-type seal rings, make sure spring loaded side is toward the oil to be sealed in (toward the inside of the unit). Use sealing compound, Military Specification MIL-S-7916, on the outside diameter of the seal to help prevent oil leaks.

(*d*) Replace all composition gaskets with new gaskets.

(*e*) Inspect hook-type seal rings for wear, broken hooks, and distortion.

(*f*) Install new hook-type seal ring if it is worn so much that there is no gap between the hooks of the seal ring when it is installed.

(*g*) Sides of seal ring should be smooth (0.005 inch maximum side wear). Sides of shaft groove (or bore) in which seal ring fits should be smooth (50-microinch equivalent) and square with the axis of rotation within 0.002 inch. If sides of ring grooves have to be reworked (0.020 inch maximum side wear), install new seal ring.

(9) Inspecting gears.

(*a*) Inspect gears for scuffed, nicked, burred, or broken teeth. If defect cannot be removed with a soft stone, Military Specification MIL-S-2389, replace gear.

(*b*) Inspect gear teeth for wear that may have destroyed original tooth shape. If this condition is found, replace gear.

(*c*) Inspect thrust faces of gears for scores, scratches, and burrs. Remove such defects with a soft stone, Military Specification MIL-S-2389. If scores and scratches-cannot be removed with a soft stone, replace gear.

(10) Inspecting splined parts. Inspect splined parts for stripped, twisted, chipped, or burred splines. Remove burrs with a soft stone, Military Specification MIL-S-2389. Replace part if other defects are found. Spline wear is not considered detrimental except where it affects tightness of fit of splined parts. Transmission main shaft journal diameter wear limit is 1.9684 inch minimum.

(11) Inspecting threaded parts. Inspect parts for burred or damaged threads. Chase threads or replace damaged parts.

(*12) Inspecting snaprings.* Inspect all snaprings for nicks, distortion, and excessive wear. Replace part if one of these defects is found. Snapring must snap tight in its groove for proper functioning.

(*13) Inspecting springs.*

(*a*) Inspect all springs for signs of overheating, permanent set, or wear due to rubbing adjacent parts.

(*b*) Replace spring if any defects are found.

(14) Low-range clutch assembly.

(a) In cleaning low-range clutch piston, make certain seal ring grooves are free from deposits of gum (2, fig. 7-95).

(b) Notice condition of low-range, clutch-*friction* plates (7), and clutch-reaction plates (8). These plates should not be warped, cracked, or scored deeply.

NOTE

Clutch-friction plate wear limit of 0.153 inch minimum thickness is desired with maximum cone of 0.020 inch. Clutch-reaction plate wear limit of 0.109 inch minimum thickness is desired, with maximum cone of 0 020 inch.

(c) If a low-range, clutch-release spring is removed for replacement, special attention should be given to installing new spring. Note that end of outer coil of springs should point toward center of the backplate (fig. 7-94). If springs are not properly installed, there will be interference between the springs and transmission housing. When peening spring retainer into place, place internal snapring under backplate. Use the clutch-release spring retainer installation and peening tool, part No. J7473, to install and peen the retainer.

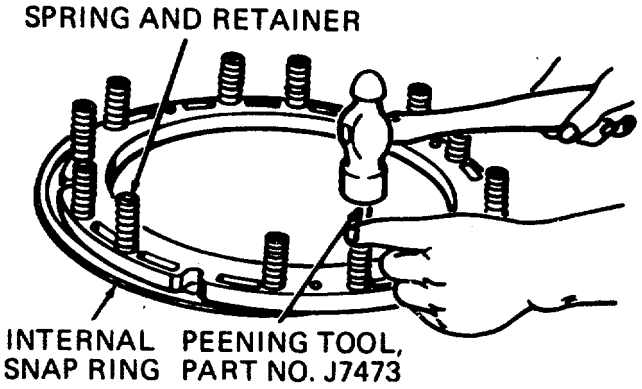


Figure 7-94. Clutch release spring and retainer installation in low-ranger clutch backplate. Using installation and penning tool, Part No. J7473.

(*15) Intermediate-range clutch assembly.*

(a) When cleaning intermediate-range clutch piston, make certain seal ring groove is free from deposits of gum.

(b) Notice condition of clutch-friction plates and reaction plates. These plates should not be warned, cracked. or scored deeply.

NOTE

Clutch-friction plate wear limit of 0.170 inch minimum thickness is desired, with maximum cone of 0.020 inch. Clutch-reaction plate wear limit of 0.113 inch minimum thickness is desired, with maximum cone of 0.020 inch.

(*c*) If an intermediate-range, clutch-release spring is removed for replacement, special attention should be given to installing new spring. Note that end of outer coil of springs should point toward center of backplate. When peening spring retainer into place, place the internal snapring under back-plate. Use the clutch-release spring retainer installation and peening tool to install and peen retainer.

(*16) High-range clutch assembly.*

(*a)* In cleaning the high-range clutch piston, made certain seal ring grooves are free from deposits of gum.

(*b)* Note that the high-range clutch-release springs are separate from the high-range clutch-backplate. The other clutches have backplates and release springs assembled together by means of spring retainers.

NOTE

Clutch-friction plate wear limit of 0.153 inch minimum thickness is desired, with maximum cone of 0.020 inch. Clutch-reaction plate wear limit of 0.190 inch minimum thickness is desired with maximum cone of 0.020 inch.

(c) See (5), (8), (10), and (13) above for cleaning and inspection procedures.

(17*) Reverse-range clutch assembly.*

(*a)* In cleaning the reverse-range clutch piston, be sure seal ring groove is free from deposits of gum.

(b) Notice condition of clutch-friction plates and reaction plates. These plates should not be warped, cracked, or scored deeply.

NOTE

Clutch-friction plate wear limit of 0.153 inch minimum thickness is desired. with maximum cone of 0.020 inch. Clutch-reaction plate wear limit of 0.109 inch minimum thickness is desired, with maximum cone 0.020 inch.

(c) If a reverse-range clutch-release spring is removed for replacement. special attention should be given to installing the new spring. Note that the end of the outer coil of the springs should point toward the center of the backplate (fig. 7-94). When peening the spring retainer into place, place the internal snapring under the backplate. Use the clutch-release spring retainer installation and peening tool, part No. J7473 to install and peen the retainer.

(18) *Oil strainer assembly.*

(*a)* If transmission has overheated during a period of malfunction. the oil strainer screen may have become clogged with a varnish-like deposit. Remove this varnish by using a suitable brush and dry-cleaning solvent, Federal Specification P-D)-680.

(b) Inspect the oil strainer screen, especially at the seam, for openings that need solder.

(19)Manifold assembly.

(*a)* Clean manifold assembly (40, fig. 2-7) in dry-cleaning solvent, Federal Specification P-D-680, and dry with low pressure air (10 psi).

(b) Apply air pressure 10 to 25 psi) to inlet of manifold assembly with port closest to inlet covered up. Air should escape from other port between 8 and 25 psi.

(c) If correct indication is not obtained in (b) above drive pin (47) from manifold body 150) and remove spring (49) and washer (48). Replace washer (48) and spring 149). Repeat *(b)* above.

e. Reassembly.

NOTE

At reassembly of carrier assembly. remember the carrier and its cover are a matched assembly. Be sure serial numbers on cover and carrier are the same and are alined. Covers and carriers of different planetaries should never be switched. Serial numbers on both pieces must be the same. New eight-pitch gears have been released to replace the formerly used ten-pitch gears.

(1) *Transmission housing assembly and related parts reassembly.*

(a) If bearing housing was removed from transmission housing. install two headless guide bolts in bearing housing (22, fig. 7-65).

(*b*) Chill bearing housing and install into front cover end of transmission housing. aligning oil passages and bolt holes in bearing housing with transmission housing.

(c) Install self-locking bolts (9, fig. 7-65) that retain bearing housing (22) through rear end of transmission housing (10). Tighten two bolts to a torque of 36 to 43 foot-pounds.

(*d*) Install two new seal rings (21 and 23) on bearing housing (22).

*(*e) If bearing assembly (20) was removed from rear end of bearing housing (22) install it with numbered side out.

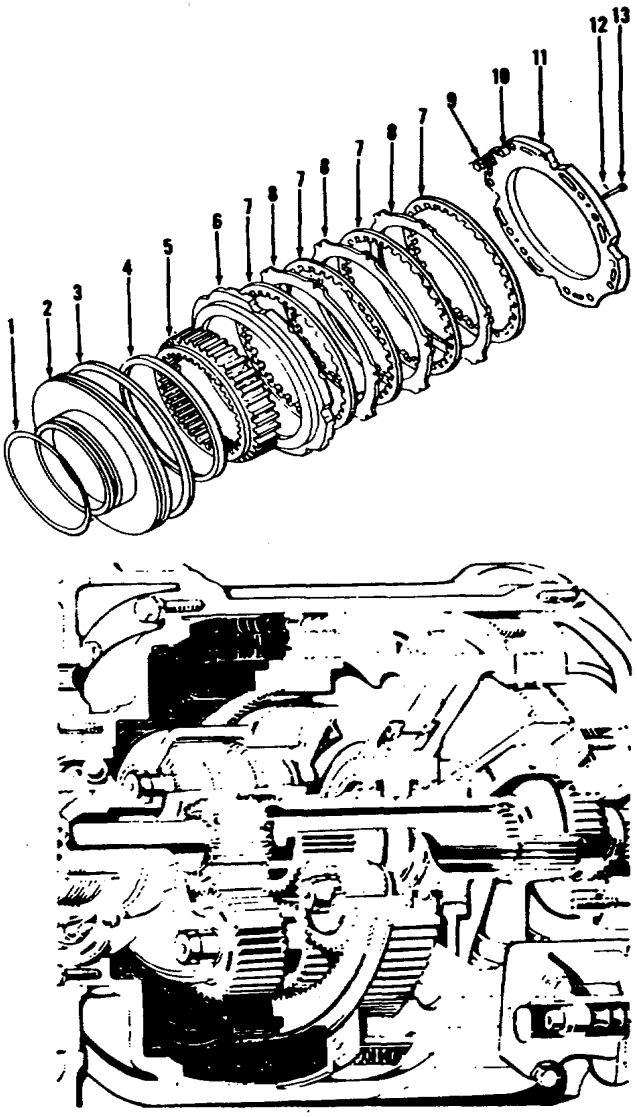
(f) Other parts in this group will be installed when transmission is assembled from subassemblies.

(2) Transmission main shaft assembly reassembly. If transmission main shaft sun gear (2, fig. 7-66) was removed, install it and install external snaprings (1 and 3). Parts in this group will be installed when transmission is assembled from subassemblies.

(3*) Low-range clutch assembly reassembly.*

(a) Place transmission internal cover (4, fig. 7-65) hub side down, on worktable.

(b) Install two seal rings (1 and 3, fig. 7-95) on low-range clutch piston (2).



1 Seal ring
2 Piston
3 Seal ring
4 External snapring
5 Low-range ring gear
6 Piston plate
7 Clutch-friction plate
8 Clutch-reaction plate
9 Clutch-release spring
10 Clutch-release spring retainer
11 Clutch backplate
12 Cotter pin
13 Assembling pin

Figure 7-95. Transmission low-range clutch assembly.

(c) Lubricate bearing surfaces of piston and corresponding surfaces in internal cover (4fig. 7-65). Install piston, hub side down, into cover.

(d) With external snapring (4, fig. 7-95) installed on low-range ring gear (5), install ring gear, snapring side down, on piston (2).

(*e)* Install piston plate (6) spring-seat side up, in internal cover.

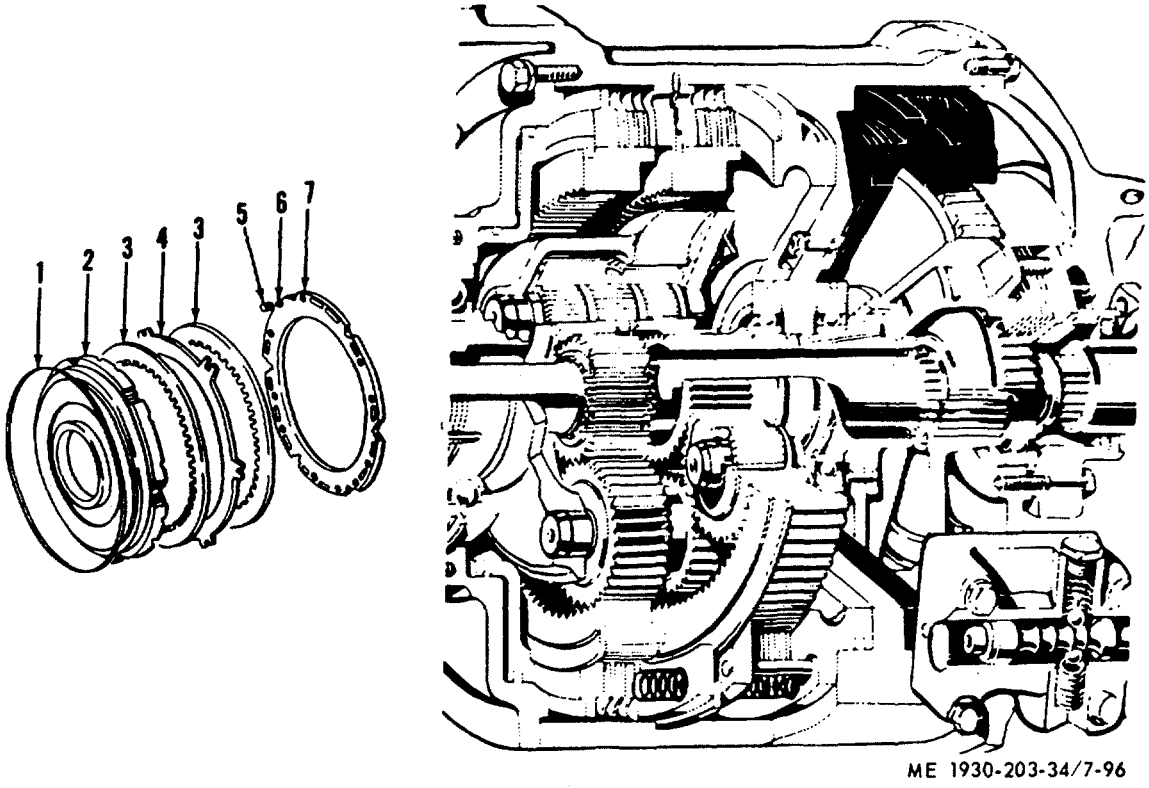
(f) Install four low-range clutch-friction plates (7) (internal splines) alternately with low-range clutch-reaction plates (8) (external splines). Begin with an internal spline plate.

(g) With clutch-release springs (9) and clutch-release spring retainers (10) installed in clutch -backplate (11), install backplate on top of clutch plates. Use a small diameter pin to make sure clutch-release springs are seated prp-erly in the counterbored seats of piston plate 161.

(h) Carefully install three assembling pins and cotter pins (fig. 7-87). Use a press or C-clamps to press down evenly on low -range clutch backplate while installing three pins and cotter pins. After three pins and cotter pins areri-stalled, again check to make sure clutch-release springs (9, fig 7-95) are seated properly in piston plate (6).

(4*) Intermediate-range clutch assembly reassernbly.*

(a) Install seal ring (1, fig. 7-96) on piston (2).



1 Seal ring
2 Piston
3 Clutch-friction plate
4 Clutch-reaction plate
5 Clutch-release spring
6 Clutch-release spring retainer
7 Clutch backplate

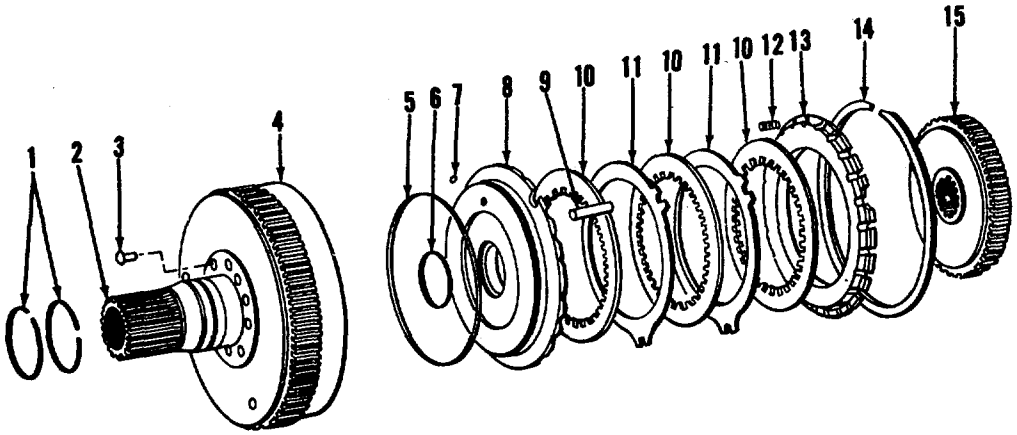
Figure 7-96. Transmission, intermediate-range clutch assembly.

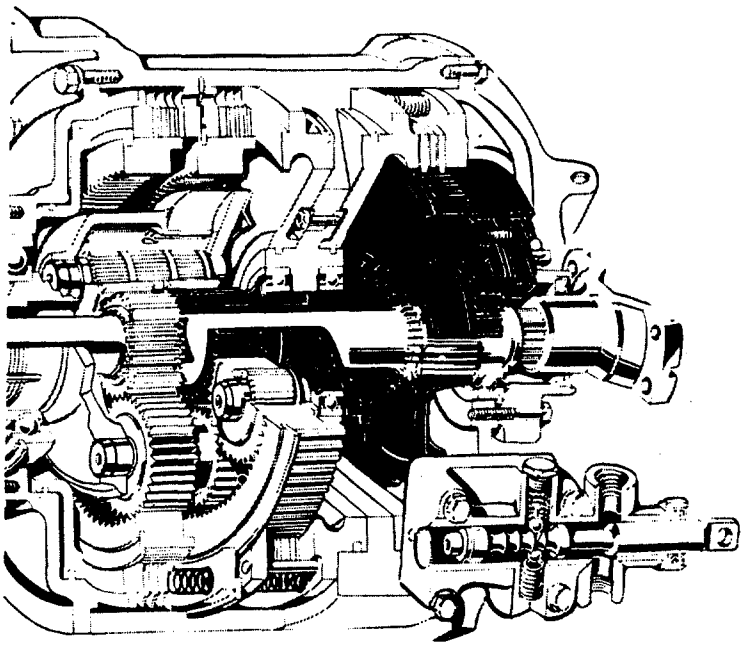
(b) Other parts in this group will be installed when transmission is assembled from subassemblies (131 below.

(5*) High-range clutch assembly reassembly.*

(a) Press ball bearing assembly on shaft end of clutch drum and sun gear assembly.

(b) Install small seal *ring (6,* fig. 7-97) on small hub of clutch drum (4) and sun gear assembly (2).





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1 Seal rings
2 Sun gear assembly
3 Rivet
4 Clutch drum
5 Large seal ring
6 Small seal ring
7 Ball
8 Piston
9 Clutch pin
10 Clutch-friction plate
11 Clutch-reaction plate
12 Clutch release spring
13 Clutch backplate
14 Internal snapring
15 Clutch hub

Figure 7-97. Transmission high-range clutch assembly.

(c) On later models, the high-range clutch-piston assembly includes two ball-type valves. The balls (7) must move freely in their passages and should be retained by staking.

(d) Install two seal rings (1) on shaft end of clutch drum (4) and sun gear assembly (2).

(e) Other parts in this group will be installed when transmission is assembled from subassemblies.

(6) *Reverse-range clutch assembly reassembly.*

(a) Install seal ring (11, fig. 7-98) on piston (9).

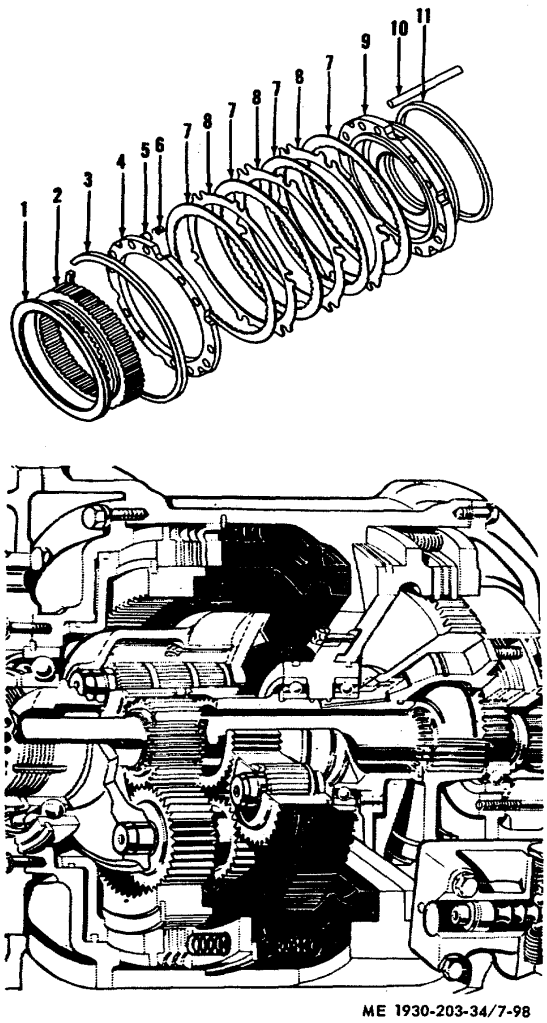

Figure 7-98. Transmission reverse-range clutch assembly.

(b) Other parts in this group will be installed when the transmission is assembled from subassemblies.

(7) *Transmission adapter assembly reassembly.*

(a) If ball bearing (2, fig. 7-76) and oil seal (1) were removed, install bearing. If necessary, press ball bearing into place. Press oil seal into position.

(b) Other parts in this group will be installed in transmission during assembly from subassemblies.

(8) *Planetary carrier assembly reassembly.*

(*a*) Place planetary carrier assembly (18, fig. 7-89) small end down, on worktable.

(b) Install a well greased thrust washer (3) in each of three cluster pinion cavities (the three deep cavities) of carrier (fig. 7-99).

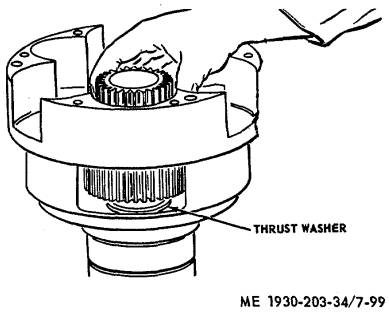

Figure 7-99. Installation of cluster pinion showing thrust washer.

(c) Place a planetary cluster pinion (4, fig. 7-89), large end down on each of three thrust washers (3).

(d) Remove pins from alinement cover fabricated from discarded planetary carrier cover. Chill planetary cluster pinion pins (1). Install one chilled planetary cluster pinion pin in alinement cover. Use headless guide bolts to guide cover. Place a steel spacer (5) under planetary cluster pinion (4) and, using a screwdriver, lift thrust washer (3) against planetary cluster pinion (fig. 7-100). Carefully press home planetary cluster pinion pin (1, fig. 7-89), making sure large diameter of pin enters thrust washer. Check by rotating thrust washer after pin is pressed home. Remove spacer from underneath planetary cluster pinion. Repeat this operation for the other two cluster pinions.

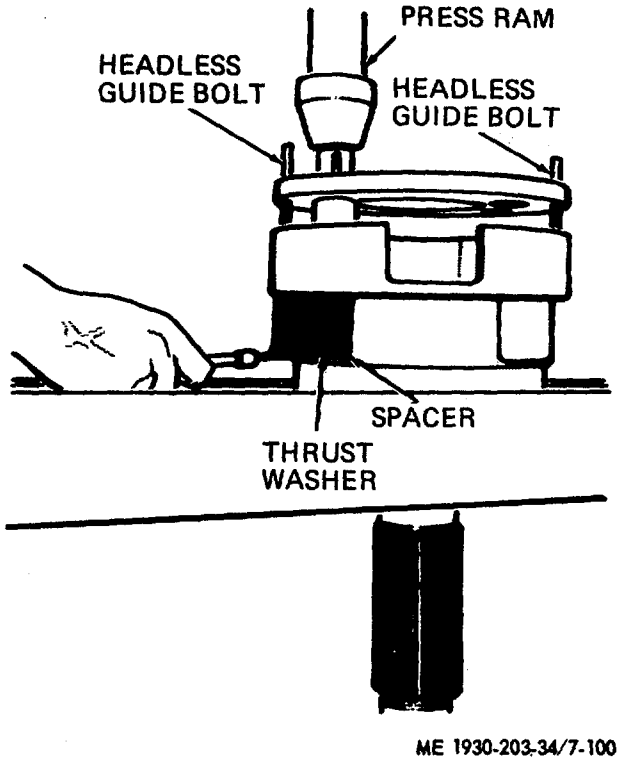

Figure 7-100. Installation of planetary cluster pinion pin in planetary carrier.

(e) Place thrust washer (3) over pins, on planetary cluster pinion (4). If shoulder at top of pin is flush with thrust washer, the pin is in proper position (fig. 7-101). If lower shoulders of pins have not entered thrust washers or thrust washers are damaged, damage can lead to malfunctioning of transmission. Remove three thrust washers from the pins.

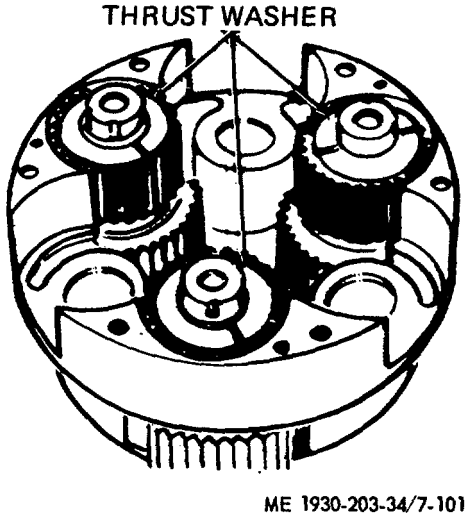

Figure 7-101. Thurst washers installed on planetary cluster pinions and pins.

(f) Fill a cluster pinion with oil soluble grease, Military Specification MIL-G-10924.

(*g*) Place a steel spacer (5, fig. 7-89) over planetary cluster pinion pin (1) and into planetary cluster pinion (4)(fig. 7-102). With two needle bearings (6, fig. 7-89) push spacer down about ½ inch inside pinion and again put grease between pinion pin and pinion.

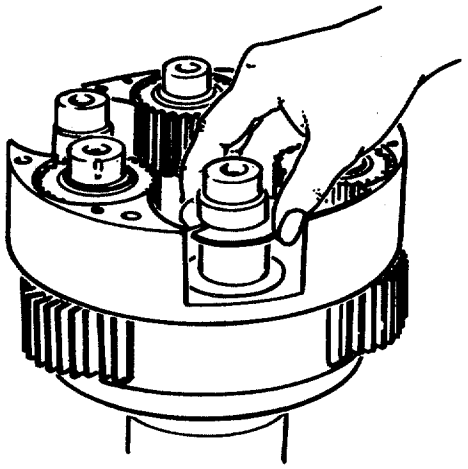

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Figure 7-102. Installation of spacer in planetary cluster pinion.

(*h)* Install needle bearings (6) in pinion to fill out row.

(*i)* Place a second steel spacer (5) on planetary clusterpinion pin (1). With two needle bearings (6), push spacers and needle bearings down so that second row of needle bearings can be installed. Again, use grease, Military Specification MIL-G-10924, to help keep needle bearings upright.

(j) Install a third steel spacer (5) and a third row of needle bearings (6).

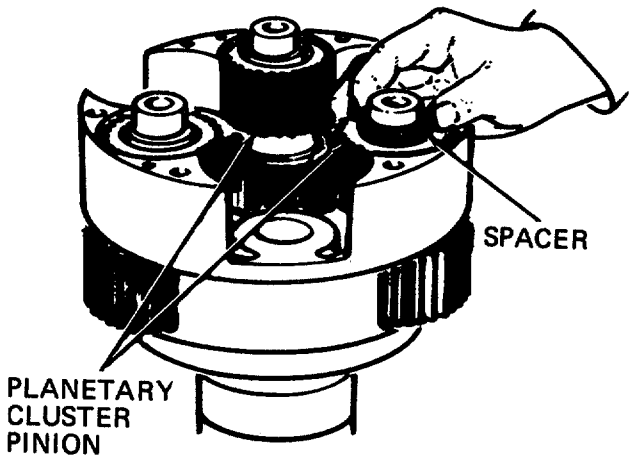
(*k)* Install a fourth steel spacer (5) and push entire group of spacers and needle bearings (6) into planetary cluster pinion (4). Note that steel spacer should be slightly less than flush with face of pinion.

(l) Repeat (f) through (k) above for the other two cluster pinions.

(*m*) Chill three planetary pinion pins (7). Place one chilled planetary pinion pin (7) in alignment cover, and using headless bolts threaded in planetary carrier (19) to guide alinement cover, press planetary pinion pin (7) in carrier. Repeat this operation for the other two planetary pinion pins.

(*n*) Install a washer (9) over each planetary pinion pin (7), (fig. 7-103).

(*o*) Install a planetary pinion (10, fig. 7-89) on each planetary pinion pin (7). Install spacer (11) over each pinion in and into the planetary pinion (fig. 7-104).



ME 1930-203-34/7-102

Figure 7-103. Installation of thrust washer on pinion pin.

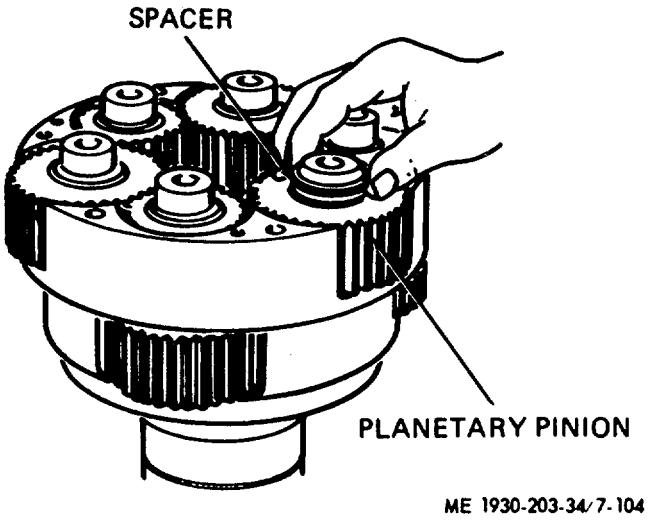


Figure 7-104. Installation of spacer in planetary pinion

(p) Install needle bearings (12, fig. 7-89) in planetary pinions (10), using grease to help keep them upright.

(q) Install second spacer (11. fig. 7-89) over planetary pinion pin (7) and into planetary pinion (10). Spacer must be slightly less than flush with face of pinion.

(r) Install second washer 191 over planetary pinion pin (7) and into planetary pinion (10).

(s) Place planetary carrier cover (16) over pins. Aline indexing marks of planetary carrier cover with indexing marks of planetary carrier (19). Check alinement of locking ball grooves. Press planetary carrier cover into position against planetary carrier.

(t) Install locking balls (2 and 8) into grooves between pins and cover (fig. 7-90).

(u) Install oil seal (15, fig. 7-89) and oil collector ring (13) on planetary carrier cover (16) as shown in figure 7-90. Secure with bolts (14, fig. 7-89). Bend metal of oil collector ring (13) up and against bolts.

(v) Press ball bearing assembly 1201. snapring groove up, on shaft end of planetary carrier. Use white lead, Federal Specification TT- W-251, to lubricate the close fit.

NOTE

When pressing bearing on shaft. be sure assembly is resting on the bolt heads and not on oil collector ring. Press or drive only on the inner race.

(w) Install bearing lockwasher (21, fig. 7-89) and bearing lock nut (22) on shaft end of planetary carrier (18). Use special spanner wrench. part No. J4558, to tighten the nut. Bend tab of bearing lockwasher into slot in bearing locknut.

(x) Planetary gear end clearance with unit assembled is 0.063 inch maximum.

(9) Clutch drum and sun gear assembly installation.

(a) Lubricate seal ring (1. fig. 7-96) on intermediate-range clutch piston (2) and seal ring (23, fig. 7-65) on bearing housing (221. Install piston.

(b) Install clutch drum (4. fig. 7-97) and sun gear assembly (2) in front cavity of transmission housing. Tap in position. Lay housing over on drum and sun gear assembly and tap other bearing (20. fig. 7-65) in place.

*(c)*Install external snapring on shaft end of clutch drum and sun gear assembly (fig. 7-84).

(10) Reverse-range clutch assembly installation.

(a) Lubricate seal ring (11, fig. 7-98) on piston (9) and seal ring (2). fig. 7-65) on bearing housing (22). Install piston (9. fig. 7-98).

(b) Install reverse-range clutch plates (fig. 7-81). Install four reverse-range clutch-friction plates (7, fig. 7-98) internal splines alternately with three reverse-range clutch-reaction plates c81 (external splines. Begin with an internal-spline plate.

(c) Install reverse-range. clutch back plate assembly fig. 7-81).

NOTE

The slots on clutch friction plate. clutch-reaction;)n plates. and clutch backplates must be aligned (on clutch pins (10. fig. 7-98). It is) that the reverse-range clutch release springs (6) be squarely seated in counterbores of reverse-range piston (9). Use a small diameter pin to seat springs.

(d) Install clutch spring compressor, part No. J7470 (fig. 7-80), to compress reverse-range clutch-back plate assembly. Install internal snapring in transmission housing.

(11) Planetary carrier and low-range clutch assemblies installation.

(a) Rotate each of the three sets of planetary pinions in planetary carrier assembly as a final check for free rotation. Place assembly on its side. Move pinions so index marks on planetary cluster pinions point toward center of carrier (fig. 7-105).

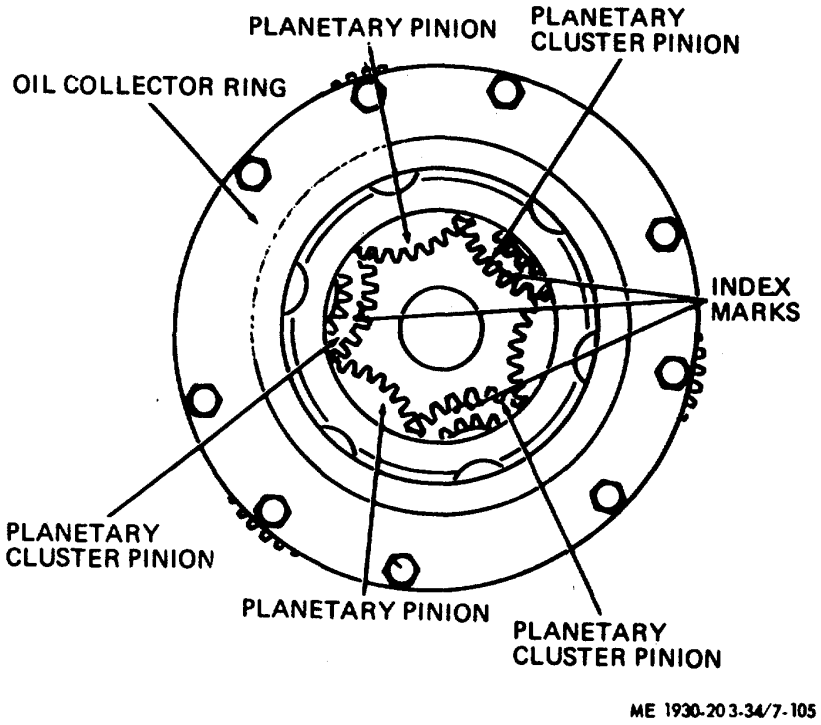


Figure 7-105. Properly aligned index marks on planetary cluster pinions

(b) If two external snaprings and main shaft sun gear were removed, install them on center most spline of main shaft (fig. 7-88). The three index marks and other etched markings on face of sun gear must face toward front end of transmission main shaft (front end is splined in two places .

NOTE

The etched T on certain sun gears indicates tapered teeth. This mark is for parts identification only.

(c) With the main shaft sun gear and two external snaprings installed on transmission main shaft, install main shaft into carrier assembly (fig. 7-88). Turn main shaft approximately 60 degrees. This will keep main shaft from sliding out of planetary gearing.

CAUTION

The main shaft sun gear must enter planetary cluster pinions so single index marks on sun gear are between 7-70 double index marks on planetary cluster pinions (fig. 7-105). Rotate main shaft several times after it is in place to make sure there is no binding between pinions and sun gear. If there is bind- ing, gears are not indexed properly. Withdraw main shaft and sun gear and reindex sun gear with planetary cluster pinions.

(d) Install reverse-range ring gear (2. fig. 7-98). Turn ring gear to pick up clutch-friction plates (7), and clutch-reaction plates (8) until external snapring (1) on reverse-range ring gear (2) is in position against reverse clutch backplate (4).

(e) Using the improvised tool threaded on shaft end of planetary carrier assembly and a hoist. lower planetary gearing into transmission housing (fig. 7-79).

NOTE

Index reverse-range planetary pinions with reverse-range sun gear and reverse-range ring gear (fig. 7-105).

(f) Install the internal cover, low-range clutch plates and low-range ring gear (fig. 7-78). Install bolts.

NOTE

Index low-range clutch housing with transmission housing so low-range oilhole is alined in both housings.

(g) Install improvised tool on threaded end of output shaft (19, fig. 7-89). Lift up on output shaft so snapring groove in ball bearing assembly 1201 is exposed. Install snapring (fig. 7-77),.

(12) Transmission adapter assembly installation.

(a) Install transmission rear cover (6, fig. 7-76), adapter gasket (7), bolts (9), and lockwashers (10).

(b) Install seal ring (5) on bearing retainer (3) and lubricate seal ring. Install bearing retainer on transmission rear cover (6), and install bolts (12).

(13) High-range and intermediate-range clutch assemblies installation.

(a) Hoist transmission and tilt it with rear end down.

(b) Install external snapring that locates high-range clutch hub on transmission main shaft (fig. 7-73). If necessary, lift main shaft out enough to install snapring in groove.

(c) Lubricate large seal ring (5, fig. 7-97), small seal ring (6), piston (8), high-range clutch drum (4), and sun gear assembly (2). Install piston, clutch-release spring seats facing out. (fig. 7-72) showing removal). Be sure balls (7, fig. 7-97) in piston move freely in their passages.

(d) Install high-range clutch hub (15) flat side down (fig. 7-106).

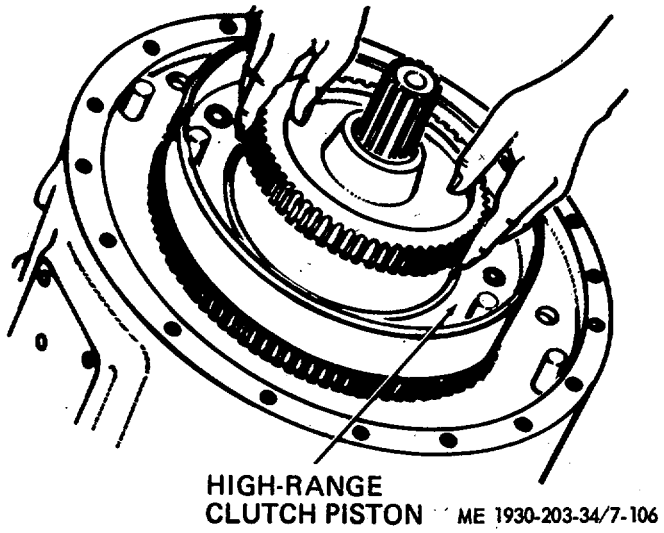


Figure 7-106. High range clutch hub installation

(e) Install three high-range clutch-friction plates (10, fig. 7-97) (internal splines) alternately with two high-range clutch-reaction plates (11) (external splines). Begin with an internal-splined plate (fig. 7-107).

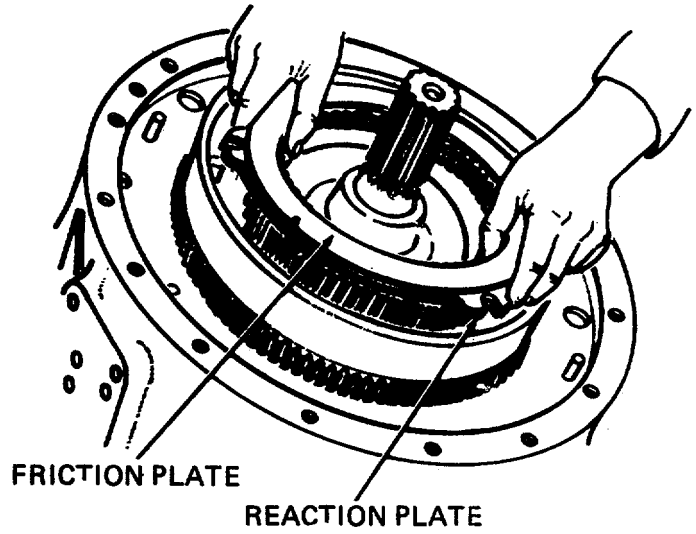


Figure 7-107. High range clutch plates installation

NOTE

The slots in clutch friction plates, clutch reaction plates, and clutch backplates must be aligned on clutch pins (10, fig. 7-98).

(f) Place high-range clutch-release springs (12, fig. 7-97)in counterbored seats of high-range piston (8). Use grease, Military Specification MIL- L-10924, on ends of springs to help keep them in place in piston.

(g) Place high-range clutch backplate (13) on clutch-release springs (12). Using a small- diameter pin, be sure springs are seated properly in high-range piston (8) and clutch backplate.

(h) Install clutch spring compressor, part No. J7470. Compress high-range clutch pack. Install internal snapring (14) in high-range clutch drum and sun gear assembly.

(i) Install two intermediate-range clutch- friction plates (3, fig. 7-96) (internal splines) alternately with one intermediate-range, clutch- reaction plate (4) (external spline) (fig. 7-69).

(j) Install intermediate-range clutch back- plate (7, fig. 7-96). Using a small diameter pin, be sure clutch-release springs (5) are seated in counterbored seats of piston (2).

(14) Transmission front housing and cover installation.

(a) Carefully place front housing (31, fig. 7-65) and front housing gasket (30) on transmission housing (10). To prevent unseating any intermediate-range clutch-release springs, draw down evenly bolts and lockwashers (35, 43, 34, and 44) that retain front housing (31) .

(b) Install *upper* and lower transfer gear bearings (6 and 16, fig. 7-66) in transmission front housing (31, fig. 7-65).

(c) Install lower input transfer gear (I 4, fig. 7-66) on input shaft (12) and install external snapring (15).

(d) Press assembled shaft and gear into lower transfer gear bearing (16) in transmission front housing (31, fig. 7-65).

(e) Install upper input transfer gear (7, fig.7-66) on transmission main shaft (4).

(f) Install upper transfer gear bearing (8) on gear (7) and install washer (9), lockwasher (10), and bolt (11) on shaft (4).

(g) Install bearing (13) on gear (14).

(h) Install cover gasket (36, fig. 7-65) and front housing cover (37) using dowel pins (32) to aline cover.

(i) Install lockwashers and bolts (38, 41, 39, and 40). Install oil seal (42) in front housing cover (37).

(j) Set transmission reasonably level on bottom of transmission housing.

(15) Minor subassemblies installation.

(a) Slide output flange (4, fig. 7-64) onto output shaft and install retainer ring (3i.

(b) Apply a coating of sealing compound, Military Specification MIL-S-7916, to retainer nut (1) face and threads and mating surface on output flange. Place seal (2) in retainer nut and install retainer nut. Stake lip of retainer nut into slots on output shaft.

(c) Coat lip of input flange oil seal (42,.fig. 7-65) and input shaft (12, fig. 7-66) splines with a

thin layer of bearing grease, Military Specification MIL-G-10924.

(d) Install input flange (8, fig. 7-64) on input shaft and secure with lockwasher (6) and bolt (5), torquing bolt to proper specifications.

CAUTION

If flange seizes to the shaft prior to its final assembled position, it is necessary to pull flange and repeat entire assembly procedure. Do not attempt to force flange with a hammer.

(c) Install oil strainer assembly (3, fig. 7- 63) and gasket (4) on transmission with capscrews (1) and lockwashers (2).

(f) Install range selector valve assembly (53, fig. 2-7) and gasket (54) on transmission with bolts (51) and lockwashers (52).

(g) Install elbow (41) in manifold assembly (40) and install manifold assembly and gasket (39) on transmission with bolts (43) and lockwashers (42).

f. Installation. Refer to paragraph 2-13.

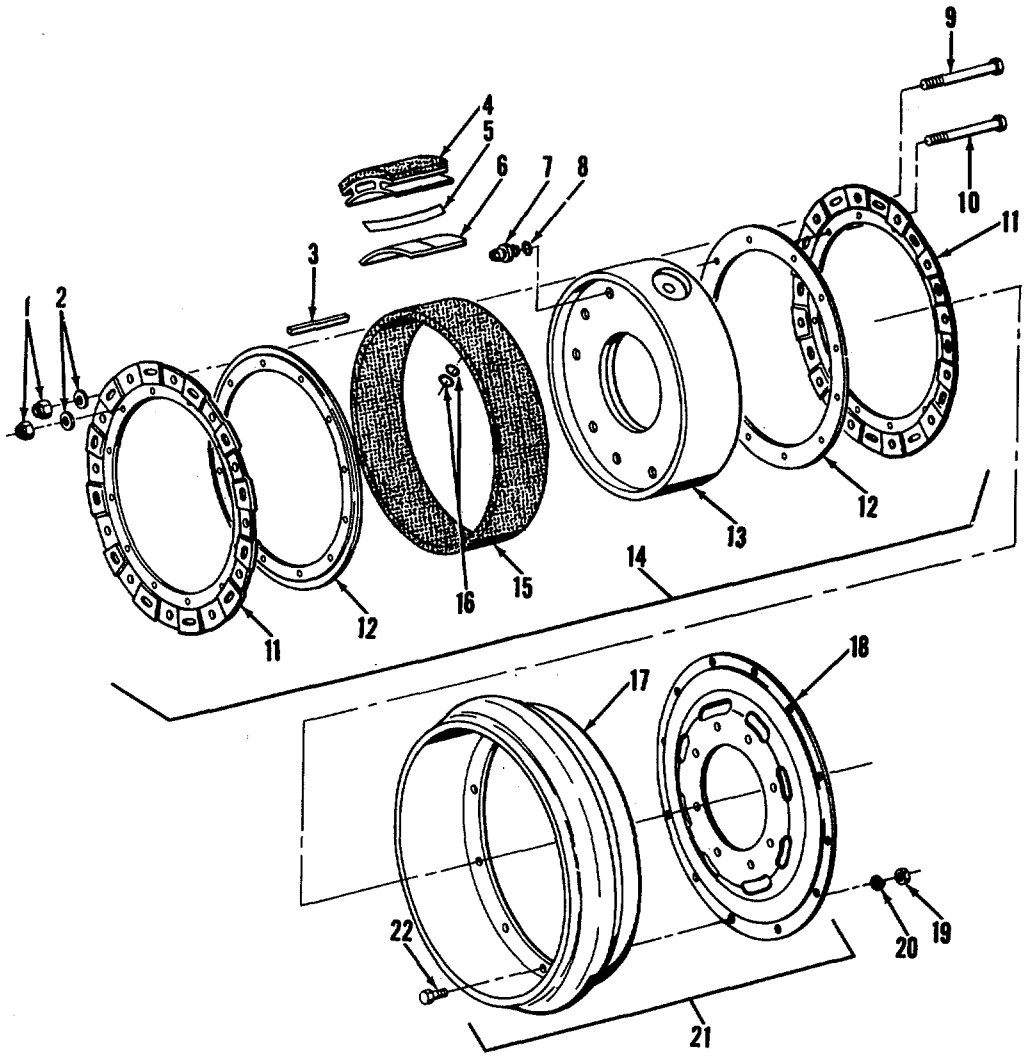
7-7. Air Brake Assembly

a. Description. The air brake assembly is of the 360° segmented, shoe type, actuated by an ex- pander tube. The brake assembly consists of an aluminum torque plate upon which the expander tube is mounted. Aluminum spacers and steel side frames are attached to each side of the torque plate and held in position by bolts. Brake linings, mounted on aluminum shoes, are inserted between torque bars bolted between the frames. The brake shoe assemblies are held in position by retractor springs which also act as a positive means of exerting a retracting force to withdraw the lining from the surface of the brake drum after air pressure has been released. The brake assembly is actuated by air which enters the expander tube through a reducer inlet. The air pressure is exerted 360° around the expander tube, forcing the brake shoe assemblies, which are bearing against the tube, to move radially against the inside diameter of the brake drum. Two air brake assemblies are used on each miter box. A torque plate, which supports the expander tube, brake shoe assemblies, and retractor springs, is mounted over each end of the miter box input shaft and is secured to the miter box mounting surface with bolts. The brake drums are mounted on each end of the miter box input shaft and are secured to the coupling flanges with bolts. When the brakes are applied, the brake assemblies restrain the miter box input shaft.

b. Removal Refer to paragraph 2-14.

c. Disassembly.

(1) To disassemble brake drum assembly (2) fig. 7-108), remove 12 capscrews (22), lockwashers (20), and nuts (19) and separate brake drum (17) from mounting plate (18).



1 Nut, self-locking
2 Washer, flat
3 Torque bar
4 Brake shoe assembly
5 Retractor spring
6 Expander tube shield
7 Reducer, expander tube inlet
8 Packing, preformed, expander tube inlet
9 Bolt, torque bar mounting
10 Bolt, frame and spacer mounting
11 Frame
12 Spacer
13 Torque plate
14 Brake assembly
15 Expander tube assembly
16 Packing, preformed, expander tube nozzle
17 Brake drum
18 Brake drum mounting plate
19 Nut
20 Lockwasher
21 Brake drum assembly
22 Capscrew

Figure 7-108. Air break assembly

(2) To remove brake shoe assemblies (4), place a screwdriver, padded with leather or heavy canvas to prevent nicking frame (11), against spring hooks of retractor springs (5) and with a sharp blow disengage springs from frame. Drive the springs through the brake assembly (14) and out of the assembly (fig. 7-109).

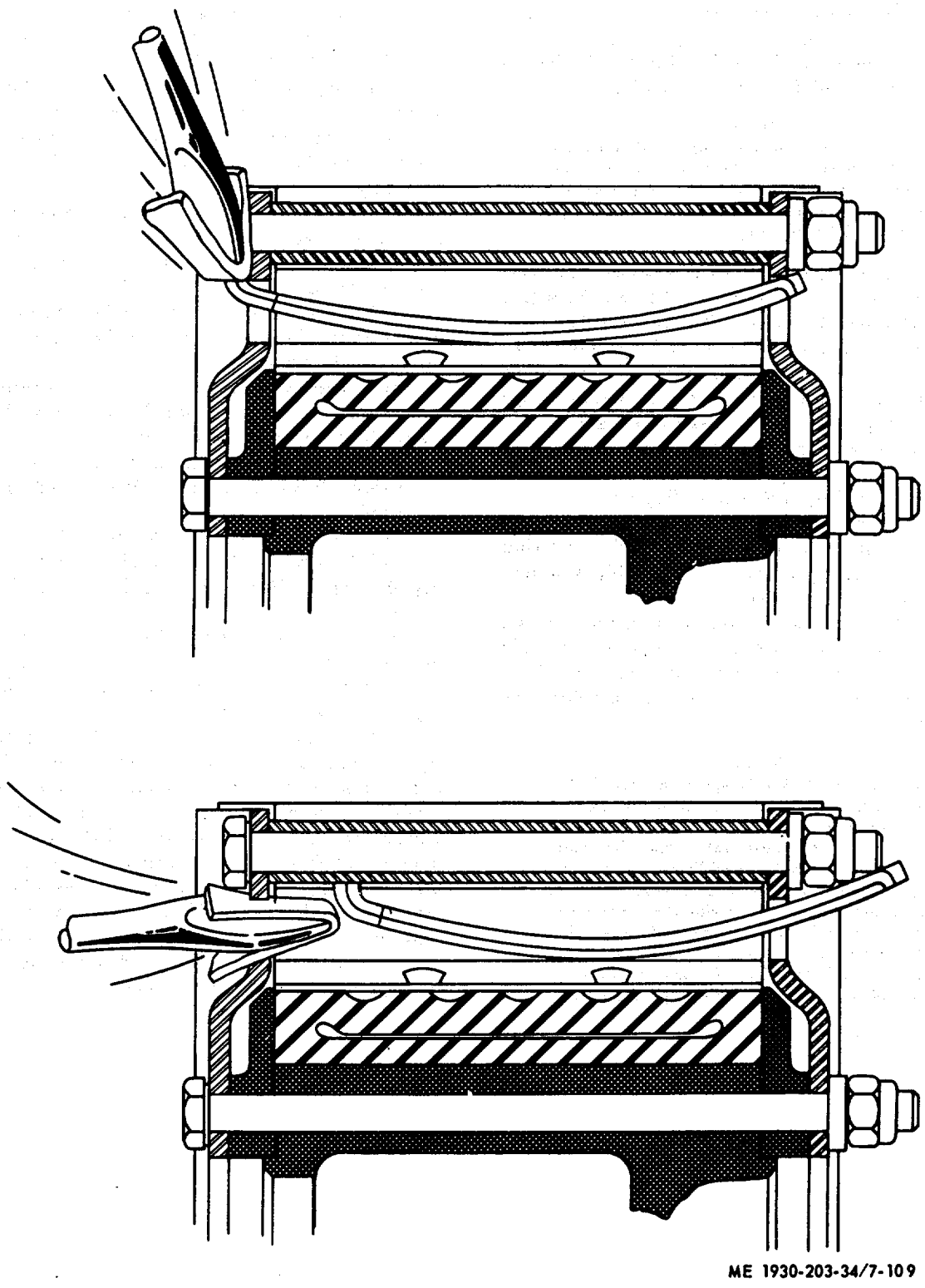


Figure 7-109. Removing retractor springs.

(3) After retractor springs (two per brake shoe assembly) have been removed, the brake shoe assemblies and expander tube shields 16, fig. 7-108) may be lifted from their position.

NOTE

If brake shoe assemblies are to be reused, keep the brake shoe assemblies in the same order as they were removed. Brakes may be relined without further disassembly. To complete disassembly, perform the following steps.

(4) Remove 12 bolts (9), washers (2), and self-locking nuts (1) and remove 12 torque bars (3).

(5) Remove 11 bolts (10), washers (2), self- locking nuts (1), frames (11), and spacers (12).

(6) Slip expander tube assembly (15) off torque plate (13). Remove two preformed packings (16) from expander tube assembly nozzle.

(7) Remove reducer (7) and preformed packing (8) from torque plate.

d. Cleaning, Inspection and Repair.

(1) Clean all parts, except preformed packings (8 and 16, fig. 7-108), in dry-cleaning solvent, Federal Specification P-D-680, and dry with low pressure air (10 psi).

(2) Check lining of brake shoe assembly (4)

The lining may be worn down to approximately 11/64 (0.172) inch minimum thickness if it is in good condition without evidence of cracking or chipping.

NOTE

When new, the lining is approximately 0.431 inches thick; but this dimension varies slightly because the brake lining is ground in assembly. The brake diameter is held rather than the lining thickness. The bonded, curved lining may tend to straighten out after considerable app6cadon of pressure and temperature, giving the appearance of bond failure between lining and shoe. The bond, however, is still intact and usefulness of the lining is unaffected. The friction or braking surface of the shoe may develop ridges and grooves and the leading edge. that which is in the direction of rotation. tends to wear slightly uneven. This situation is normal.

(3) Inspect the area of the brake shoe assembly upon which the retractor spring (5) rests. If the spring has worn to a depth greater than 1 / 16 (0.0625) inch. replace the brake shoe assembly.

(4) Check for broken or deformed retractor springs. Replace spring if broken or deformed or if permanent set reduces free spring height more than 1/16 (0.0625) inch.

(5) Inspect torque bars (3) for unusual wear or distortion. Replace torque bar if unusual wear or distortion is present.

(6) Inspect frames (11) for distortion and elongation of torque bar and frame holes. Replace frame if these conditions exist.

(7) Inspect torque plate (13) for cracks or distortion. Replace torque plate if cracked or distorted.

(8) Check expander tube assembly (15) for cracks, charring, or hardness of outer surface. If any of these conditions exist, replace expander tube assembly.

(9) Check expander tube assembly for leaks. by applying 75 psi (maximum) and immersing expander tube assembly in water. Replace a leaking expander tube assembly.

(10) Not all drums will show the conditions in figure 7-110. Some drums may show none of them. and others may have them in various combinations. The flux used to help bond the cast iron to the steel sometimes works to the surface of the drum at the junction of shell and cast iron lining, at the outer machined edge, or may appear on the braking inner diameter of the drum. When exposed to the atmosphere, it absorbs moisture and gives the appearance of corrosion. This condition is not harmful and requires no special service.

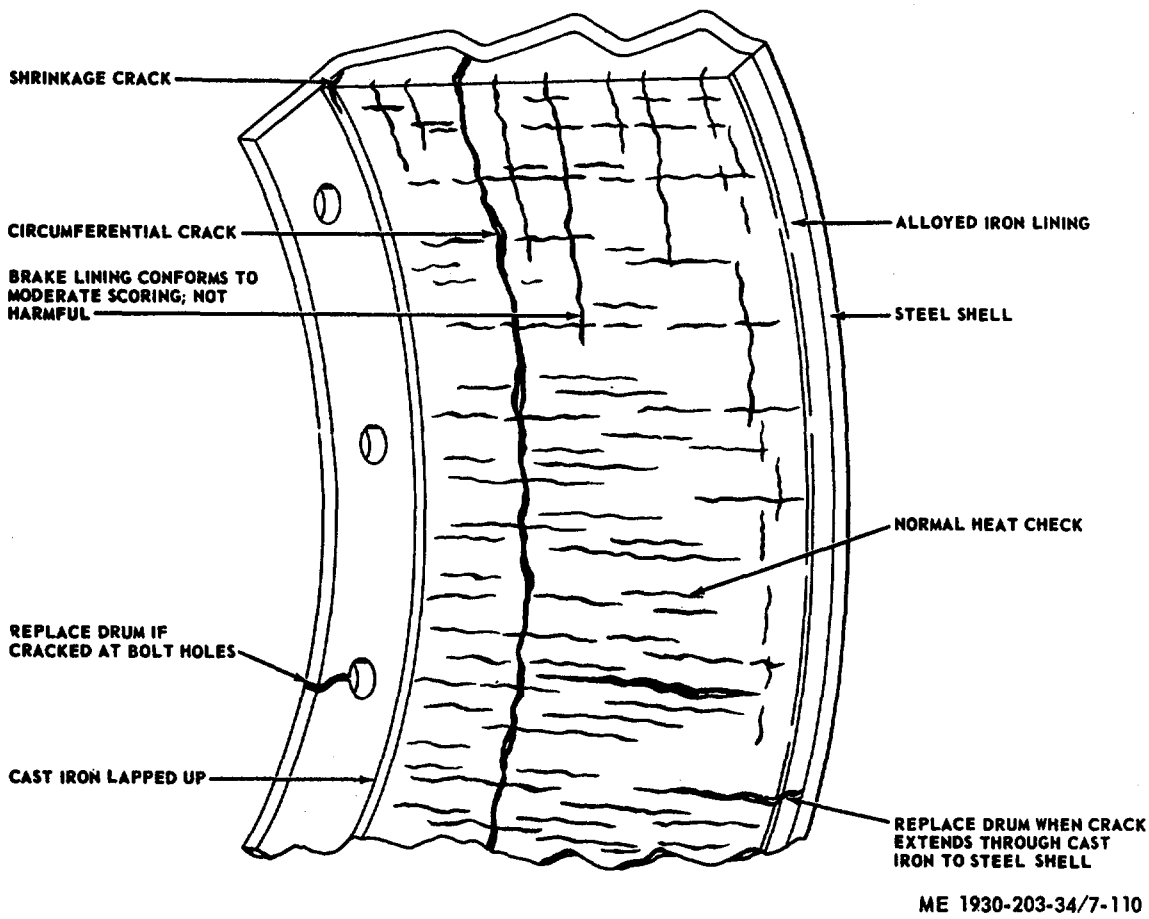


Figure 7-110. Brake drum assembly.

(11) Excessive heat at the braking surface is called a heat check. When the heat check progresses to the steel shell, remove drum from service and replace it with a new brake drum. Transverse heat checks do not aggravate lining wear, as indicated if one or two circumferential cracks appear extending around the drum and to the shell. If this condition increases the drum diameter to 15.150 inches, replace it with a new drum. The outer surface of the drum is painted with a heat resisting paint which will withstand temperatures up to 1,500° F. Because of the various high and low rises in temperature, rust will form; but this does not affect the braking and will not cause failure. The drum bolt holes are 0.333 inch diameter and can tolerate 1 / 32 inch elongation and are serviceable. If elongation is of a greater diameter, replace the brake drum.

(12) The steel reinforcing ring welded to the outside diameter of the brake drum is a safety feature to strengthen the drum. This steel ring may loosen in normal service and rattle, but this does not warrant removing the drum.

e. Reassembly.

(1) Install preformed packing (8, fig. 7-108) on reducer (7), being careful not to damage packing on threads.

(2) Install reducer in inlet port of torque plate (13). Tighten reducer until it bottoms tightly on spot faced surface.

(3) Install two preformed packings (16) on nozzle of expander tube assembly (15).

(4) Lubricate preformed packings to prevent damage to packings, then insert expander tube assembly. nozzle into cast inlet on torque plate and hold in position. Slide expander tube assembly onto torque plate 'by applying downward pressure in progressive moves around the torque plate in both directions away from nozzle.

(5) Assemble spacers (12) and frames in position and install 1I bolts (10), washers (2), and nuts (1). Tighten bolts to a torque of 80 to 100 inch-pounds.

(6) Install 12 torque bars (3), with wide portion of bar positioned so that it will be between adjacent brake shoe assemblies, using 12 bolts (9),

washers 2 1, and nuts (1). Tighten bolts to a torque of 80 to 100 inch-pounds.

(7) Place a brake shoe assembly (4) between torque bars and insert an expander tube shield 16) between brake shoe assembly and expander tube assembly.

NOTE

All brake shoe assembly linings should be approximately the same thickness. Large differences, in thickness will put undue strain on expander tube assembly.

(8) Place a second brake shoe assembly in an adjacent opening on top of the expander tube shield.

(9) Install two retractor springs (5) in the brake assembly between the two brake shoe assemblies (fig. 7-111).

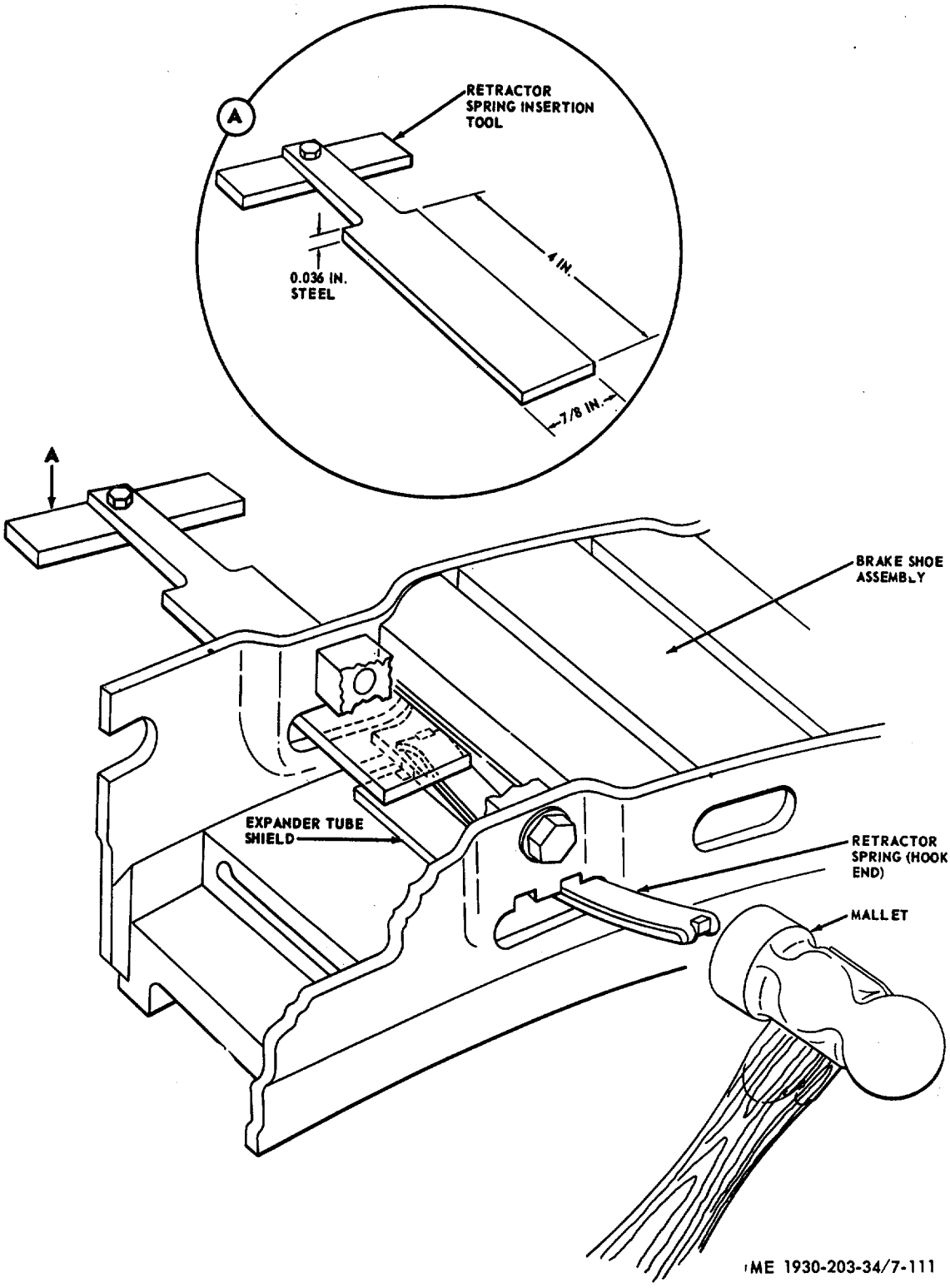


Figure 7-111. Installing retractor springs.

(10) Insert an expander tube shield under the loose end of the two previously installed brake shoe assemblies.

(11) Repeat steps (8) through (10) above until all brake shoe assemblies are installed.

(12) Check brake assembly (14, fig. 7-108) dimension to see that brake diameter does not exceed 14.965 inches. If diameter exceeds this dimension, grind brake until within limits. Maximum diameter is 14.965 inches and minimum diameter is 14.935 inches.

(13) Pressure test the completed brake assembly (14) in a brake drum assembly (21) at 100 psi for 5 minutes.

(14) Assemble brake drum (17) to brake drum mounting plate (18) using 12 capscrews (22), lockwashers (20), and nuts (19). Tighten moderately four capscrews diametrically opposite and at 90' . Stragger-tighten remaining diametrically opposite bolts.

NOTE

The brake drum flange is machined to fit on the mounting plate register with slight clearance.

f. Installation. Refer to paragraph 2-14.

7-8. Miter Box Assembly

a. Removal and Disassembly. Refer to paragraph 2-15.

NOTE

In order to remove the miter box assembly, it is necessary to disassemble the miter box assembly in place.

b. Cleaning, Inspection and Repair.

(1) Clean all parts except seals (24, 38, and 50, FO-2), preformed packings (44 and 47), and gasket (58), in dry-cleaning solvent, Federal Specification P-D-680, and dry with low pressure air (10 psi).

(2) Check coupling flange (14, fig. 2-8) for grooved condition where coupling flange mates with seal (24,FO-2). If groove depth exceeds 0.005 inch, replace coupling flange.

(3) Check coupling flange spline id between teeth. If id exceeds 2.503 inches, replace coupling flange.

(4) Check od of spline teeth on input shaft assembly (6). If od of spline teeth is less than 2.495 inches, replace input shaft (64).

(5) Inspect contact areas of gears (34 and 63) for spalling, pitting, or wear. If more than 20 units of the contact area of any face is damaged by spalling or pitting, or if more than 0.015 inch of metal is worn from any face, replace gear.

(6) Inspect bearing cups (26), bearing cones (62), bearing inner race (31), and outer race (28) for pitted, scored, or burned condition.

(7) If bearing cups (26) and cones are defective, check diameter of input shaft bearing retainer (25) in bearing cup area and od of input shaft in bearing cone area. If wear exceeds limits specified in table 2-1, replace input shaft bearing retainer and/or input shaft.

(8) If bearing inner race (31) and bearing outer race (28) is defective, check diameter of output shaft bearing yoke (29) in outer race area and od of output shaft (32) in inner race area. If wear exceeds limits specified in table 2-1, replace output shaft bearing yoke and / or output shaft.

(9) Check output shaft assembly (20) for roughness of rotation. If output shaft binds or feels rough when rotated, disassemble output shaft assembly and check bearings (37) for pitted, scored, or burned condition. If either bearing is defective, replace bearings with a new matched set.

(10) If bearings (37) are defective, check diameter of output shaft bearing carrier (39) in bearing area and od of output shaft in bearing area. If wear exceeds limits specified in table 2-1, replace bearing carrier and / or output shaft.

(11) If output shaft assembly is disassembled, replace output shaft bearing seal (38).

(12) If output shaft coupling gear (40) is removed, check spline wear on coupling gear and output shaft. If wear exceeds limits specified in table 2-1, replace coupling gear and / or output shaft. Check for a grooved condition on coupling gear where coupling gear mates with output shaft bearing seal (38). If groove depth exceeds 0.005 inch, replace coupling gear.

(13) Check gear teeth of output shaft coupling gear for wear. Chordal measurement over any five teeth should not be less than 1.716 inches. If chordal measurement is less than 1.1716 inches, replace coupling gear.

(14) If gear teeth of output shaft coupling gear are excessively worn, remove column and wheel drive and check female coupling gear (49), male coupling gear (46), intermediate shaft (48), and female coupling gear on column and wheel drive for excessive wear (table 2-1). Replace coupling gear (46 and 49) and intermediate shaft (48) if defective. If coupling gear on column and wheel drive is defective, report to fourth echelon. Replace preformed packing (47).

(15) If bearing carrier (52) is removed, inspect bearing (53) for pitted, scored, or burned condition and replace seal (50).

(16) Replace seals (24) and preformed packing (44).

(17) Inspect shim sets (5 and 8),for damage. If shim set is damaged, replace damaged shim with a new shim of same thickness.

(18) Inspect case (19) and case cover (59) for cracks, breaks, or other structural damage. Replace a damaged case or case cover.

(19) Check breather (56) for obstructions or damage. If breather cap will turn loosely, breather is satisfactory.

(20) Inspect inspection cover (57) and eye bolt (55) for good condition. If inspection cover was removed, replace gasket (58).

c. Reassembly and Insulation. Refer to paragraph 2-15.

d. Gear Mesh and Bearing Adjustment.

(1) Remove female coupling gear (49, FO-2) from intermediate shaft (48)

(2) Position shim set (8) in case (19), being careful not to damage shim set.

(3) Lower output shaft assembly (20) into case. Position bearing yoke (29) opening as shown in figure 2-9 for the particular miter box assembly installation involved.

(4) Install two capscrews (21, FO-2) and two capscrews (7) Tighten to hold yoke securely. Dc not secure with lock wire.

(5) Lightly coat several teeth on gear in output shaft assembly with gear marking compound, red lead, Federal Specification TT-R-191 B, Type 1, or equivalent.

(6) Position input shaft assembly (6) over output shaft assembly and assemble each bearing retainer assembly (4), with corresponding shim set (5) on respective end of input shaft assembly and case. Install six capscrews (22) in each bearing retainer assembly. Do not secure capscrews with lock wire.

(7) If input shaft assembly is axially loose, remove the same amount of shims from each shim set (5) until a slight amount of drag is felt in bearings when input shaft is rotated, then add 0.003 inch shim to each shim set. If input shaft is tight, add shims equally to each shim set until a slight amount of drag is felt in bearings when input shaft is rotated, then add 0.003 inch shim to each shim set.

(8) Check backlash in gear set by securing indicator rigidly to case with actuator point against and perpendicular to gear tooth face. Backlash should be 0.008 to 0.012 inch.

(9) Rotate input shaft sufficiently to mark pinion tooth contact with compound painted-on driven gear. Ideal tooth contact is slightly nearer the toe than the heel as shown in detail A. figure 7-112.

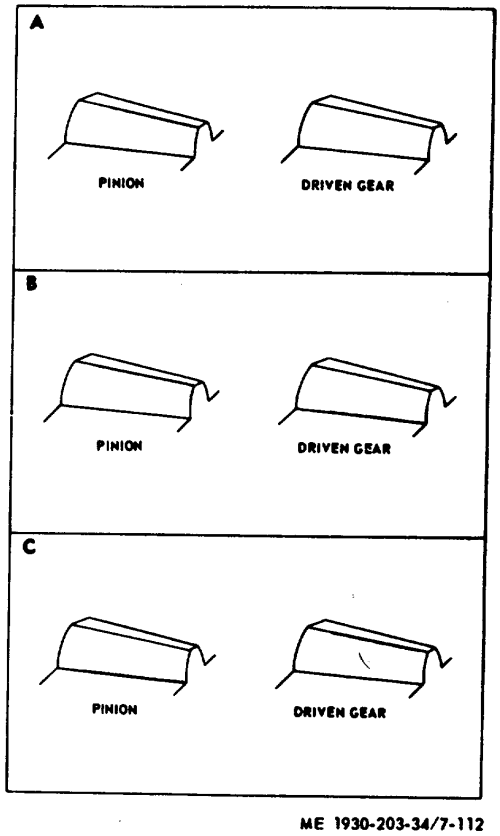


Figure 7-112. Bevel gear meshing pattern

(10) When the contact is too high on pinion and too low on driven gear. as shown in detail B. figure 7-112, the pinion is too near the center. If the backlash was too small. move pinion away from center by shimming. If the backlash was too great. shim driven gear toward pinion.

NOTE

When shimming pinion. take shims from one shim set and add to the other to maintain input shaft assembly bearing adjustment.

(11) When the contact is too low on pinion and too high on driven gear. as shown in detail B. figure 7-112, the pinion is too far from center. If the backlash was too great, shim pinion toward center. If the backlash is too small, shim driven gear away from center.

NOTE

When shimming pinion. take shims from one shim set and add to the other to maintain input shaft assembly bearing adjustment.

(12) Repeat steps (10 and 11) above until proper tooth contact and backlash are obtained.

(13) Remove capscrews (22, FO-2) and lift off bearing retainer assemblies (4). shim sets (5) and input shaft assembly 16i. Keep each shim set with its respective bearing retainer assembly.

(14) Remove capscrews 1(7 and 21) and remove output shaft assembly (20) and shim set (8).

(15) Install female coupling gear (49) on intermediate shaft (48). and reassemble miter box assembly as outlined in paragraph 2-15, *c*(1), *(e),* 3 through 10 above.

7-9. Tires

a. Tire Removal. Refer to paragraph 2-19.

b. Cleaning. Inspection and Repair.

(1) Remove all penetrating objects from tire.

(2) Inspect for cuts, ply separation is sidewall or tread. damaged beads, softened rubber due to oil or solvent soaking, and weakening due to age or exposure.

(3) Tire repair will be performed only at depot maintenance level. Unserviceable tires should be exchanged through proper channels for suitable replacement.

c. Tire Installation. Refer to paragraph 2-19.

7-10. Column and Wheel Drive Assembly

a. *Description.* The column and wheel drive assembly Fig. 3-113) transmits the output torque of the miter box assembly to the wheels. The vertical output rotation from the miter box assembly is converted to horizontal rotation by a bevel pinion and gear. The bevel gear in turn is splined to the axle, which drives a spur gear in the planetary reduction gearing. The spur gear drives three planet gears, attached to the wheel, which walk around the stationary planetary ring gear. The column and wheel drive assembly swivels to facilitate steering, thereby serving as a link in the steering system between the wheel and steering cylinders. The miter box case serves as the upper pivot support and a bracket assembly attached to the frame at the bottom of the column and wheel drive assembly serves as the lower pivot support. The bevel gear, axle, planetary gears, and associated bearings run in an oil bath; however, the bevel pinion and associated bearings are force- lubricated by an oil pump. The wheel bearings also run in the oil bath. An air tube runs through the center of the axle to provide for tire inflation and deflation. The air tube, planetary reduction gearing, and axle can be removed without removing the column and wheel drive assembly from the LARC or the tire and wheel assembly from the column and wheel drive assembly. In order to remove the column and wheel drive assembly. the tire must be removed and the miter box assembly disassembled. The wheel assembly may be removed *with the column and wheel drive assembly.

b. Removal. Refer to paragraph 2-16.

c. Disassembly.

(1) Loosen end plug (111. fig. 7-113) and remove capscrews (118) lockwashers (119). and remove air line pipe and seal assembly (110).

CAUTION

Exercise care during removal of air line pipe approximate length is 4-1/2 feet) to prevent bending or scoring surface.

(2) Remove pipe plug (111) and remove seals (112).

(3) Remove end plug (111) and preformed packing (112)

(4) Remove air line pipe (117) - and preformed packing (113).

(5) Remove preformed packing (116) and gasket (115) from air seal retainer (113).

(6) Remove check release pin assembly and gasket (82).

(7) Remove cross pin (81) and remove preformed packing (79) and check release pin 78) from check release pin bushing (80)

(8) Remove check release pin seat (83), gasket (84) preformed packing (85) gasket (86). check valve body (89). and spring (87)

(9) Remove 12 nuts (120).

(10) Remove three capscrews (92) and lockwashers (91).

(11) Install three 1 x 14 NF2 x 3 inch long jacking bolts (93) in place of capscrews (92) with suitable sling attached to jacking bolts. Remove collets (121) by driving a wedge into the opening of collet.

CAUTION

Jacking out the collets with the planet spider housing, could result in damage to the housing if a collet is frozen to a wheel stud.

(12) Using jacking bolts. disengage planet spider assembly (95) from wheel assembly (123)

(13) Remove planet spider assembly and 12 collets (121).

(14) Remove 12 capscrews (107) and retainers with seal washers (106).

(15) Remove 18 capscrews (108) and lock- washers (109) and remove end plates (105) and shim sets (104).

NOTE

Keep each shim set with its respective end plate and mark as to location on planet spider (103). Match-mark idler shafts (102) and planet spider.

(16) Successively press idler shafts out of planet spider from end plate end, then remove corresponding planet gear and bearing assembly (96).

NOTE

Mark each idler shaft and planet gear and bearing assembly as to location in planet spider (103).

(17) Remove spur pinion (101) from planet spider.

(18) Separate bearing cones (97) from bearing cups (98) and with drift, drive one bearing cup from planet gear (99). Remove snapring (100) and press out other bearing cup.

NOTE

Each bearing cone and cup must be kept together as an assembly. Do not interchange if original shim sets are to be used.

(19) Install a 1 1/4 x 7NC x 12 inch long bolt in threaded end of main axle (94) and pull the axle straight out.

CAUTION

Do not allow the axle to drop free when it clears spline in the planetary ring gear.

(20) Remove four capscrews (72) and slide reaction member and planetary ring gear assembly (73) out of spindle.

(21) Remove snapring (76) and slide planetary ring gear (74) off reaction member (75).

(22) Remove capscrew (129) and remove locknut (71).

(23) Pull wheel assembly (123) off spindle using a forklift truck or similar piece of equipment.

NOTE

Outer bearing cone (70) will come off with wheel assembly and inner bearing cone (125) should remain on spindle. Bearing cups (124) and (69) will remain in wheel assembly. It is not necessary to remove bearing cups from wheel assembly unless inspection reveals bearing cups or cones to be defective.

(24) Pull inner bearing cone (125) from spindle.

(25) Remove seals (126) from seal ring (25).

(26) Remove 12 capscrews (127) and lock-washers (128) and remove seal ring (25).

(27) Place steering post (8) in horizontal position with spindle (19) up. Remove capscrews (26) and lockwashers (27) from spindle.

(28) Remove capscrews (23), lockwashers (24), and install bolts (22) in place of cap screws (23).

(29) Loosen capscrews (21) and, using bolts (22), separate spindle (19) from steering post (8).

(30) Attach suitable sling to spindle (19), remove capscrews (21), lockwashers (20), and spindle from steering post (8).

(31) Remove retainer plate (18) from spindle (19).

(32) Install eyebolts (17) in holes provided in bearing carrier (16). Lift out bearing carrier and forward spider bearing (15) by attaching suitable sling to carrier.

(33) From opposite side of steering post (8), remove capscrews (48), lockwashers (47), capscrews (50), and retainers with seal washers (49) from bevel gear spider bearing cover (6). Remove bevel gear spider bearing cover and bevel gear shim (7).

CAUTION

Be extremely careful not to damage shim set. This shim set in conjunction with the pinion shim set adjusts the bevel gear set.

(34) Remove two capscrews (14), 180 degrees apart, from spider assembly (10). Replace with eyebolts (13).

(35) Remove cotter pin (32), nut (40), and washer (41) and pull pump gear (33) from oil pump shaft.

(36) Attach suitable sling to spider assembly (10) and lift spider assembly, gear (9), bearing housing (28), aft spider bearing (29), washer (30), and locknut (31) from steering post (8) as an assembly.

(37) Remove locknut (31), washer (30), after spider bearing (29), and bearing housing (28) from spider assembly (10).

(38) Remove capscrews (14) and bevel gear (9) from spider assembly (10).

(39) The spur gear (11) is not ordinarily removed from spider (12). If replacement is required, press or drive spur gear off spider.

(40) Remove hose (45) at elbow (44). Remove nuts (38), retainers with seal washers (37) and copper washers (36) from bolts (35). Pull oil pump assembly from steering post (8).

(41) Remove capscrews (34) and oil pump (43) from oil pump bracket (42).

(42) From inside of steering post (8), remove capscrews (62) and pull bevel pinion assembly (51) from steering post.

(43) Remove cotter pin (68), nut (67), bevel

pinion shin (52), and bevel pinion coupling 165) from bevel pinion (56).

(44) Remove capscrews (61), retainer plate (60), and bevel pinion bearing yoke 159) from bevel pinion (56). Remove retainer ring (57) from bevel pinion bearing yoke and press out bevel pinion bearing (58).

(45) Using suitable press, support assembly at lower portion of bevel pinion bearing adapter (53). Press bevel pinion (56) from bevel pinion bearing adapter.

(46) Press lower bevel pinion bearing cone (55) from bevel pinion (56). Remove upper bevel pinion bearing cone (64), upper bevel pinion bearing cup (63), and lower bevel pinion bearing cup (54) from bevel pinion bearing adapter (53) only if replacement is necessary.

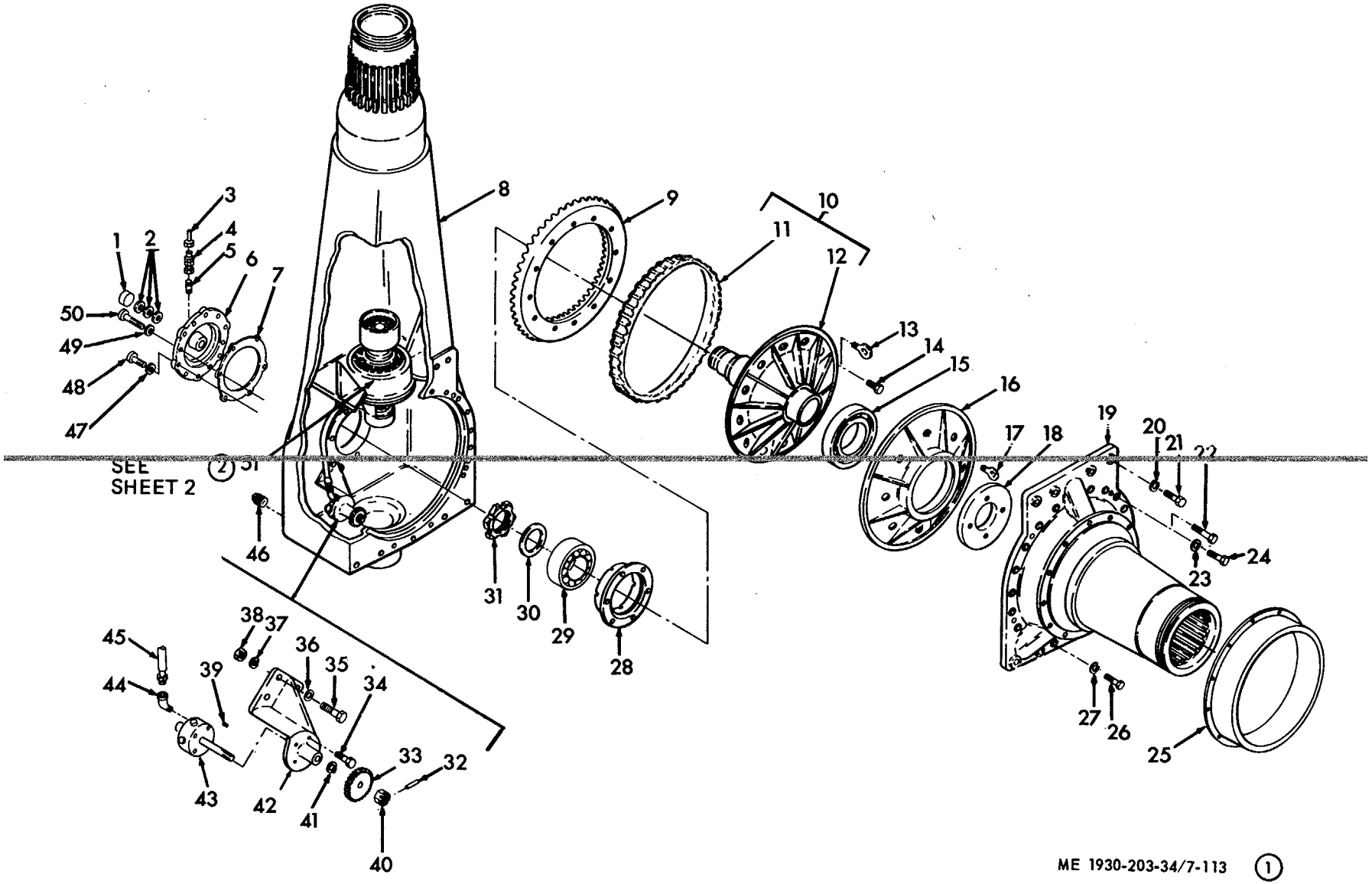


Figure 7-113. Column and wheel drive assembly (sheet 1 of 5)

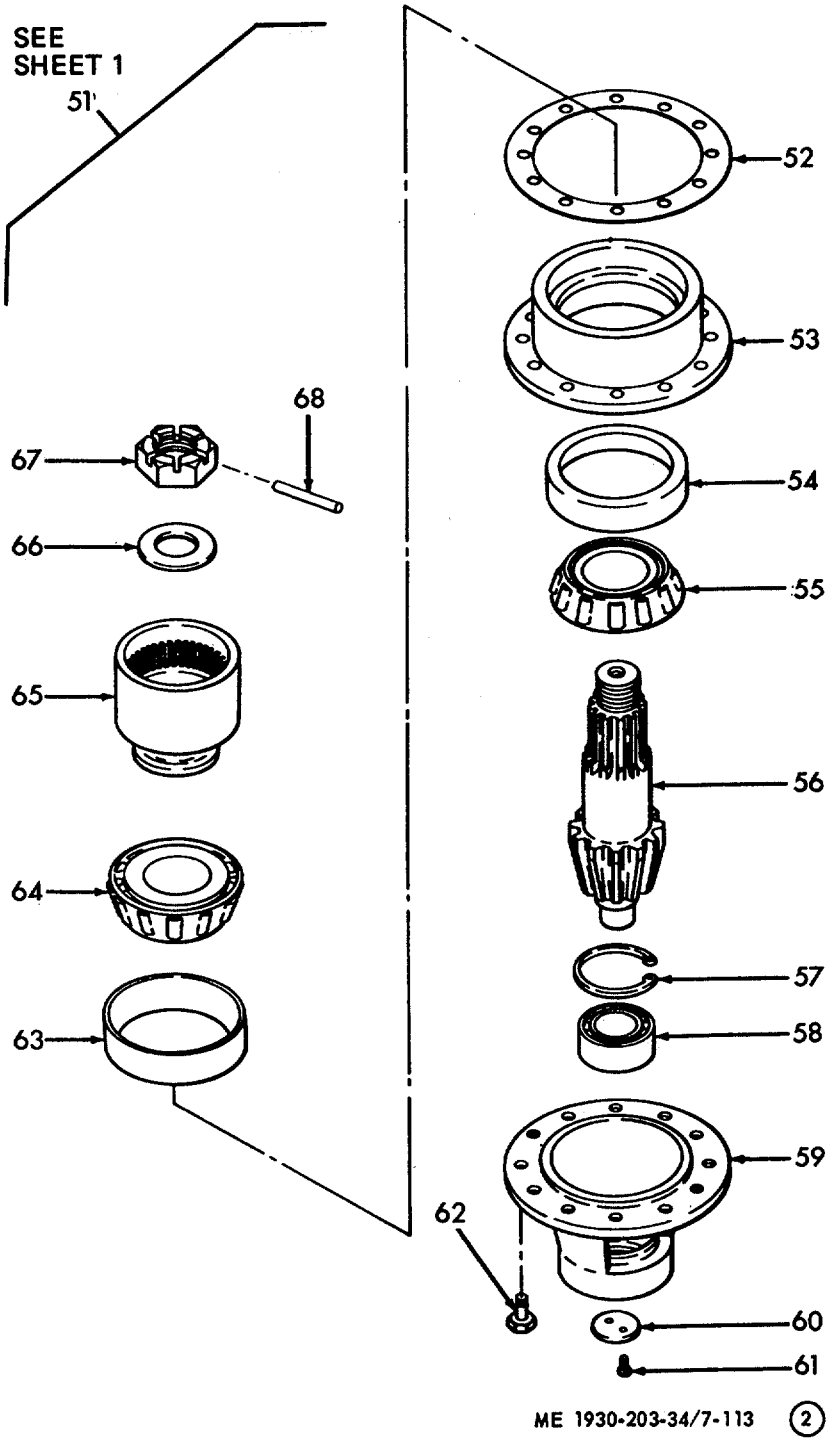


Figure 7-113. Column and wheel drive assembly (sheet 2 of 5).

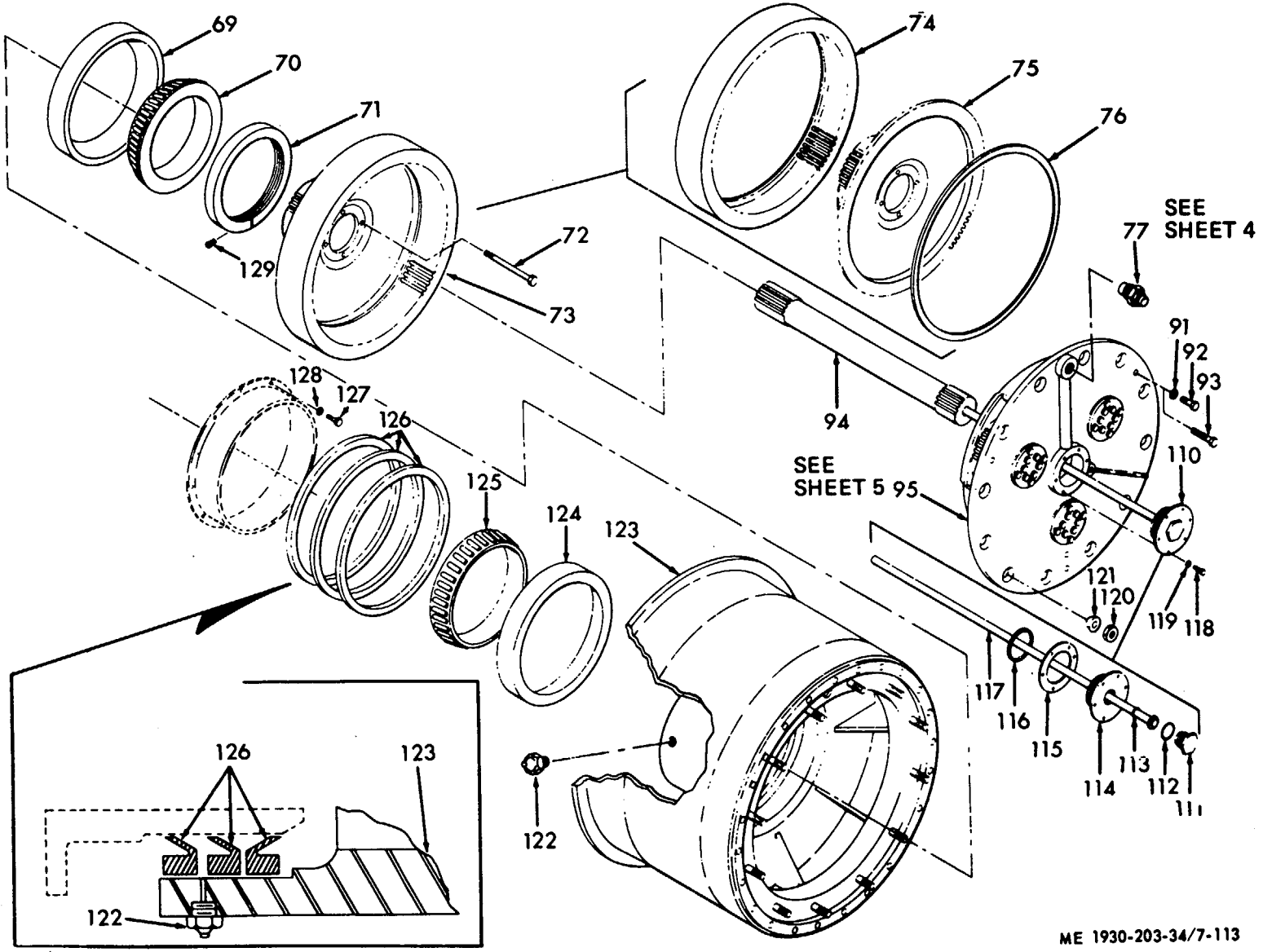


Figure 7-113. Column and wheel drive assembly (sheet 3 of 5).

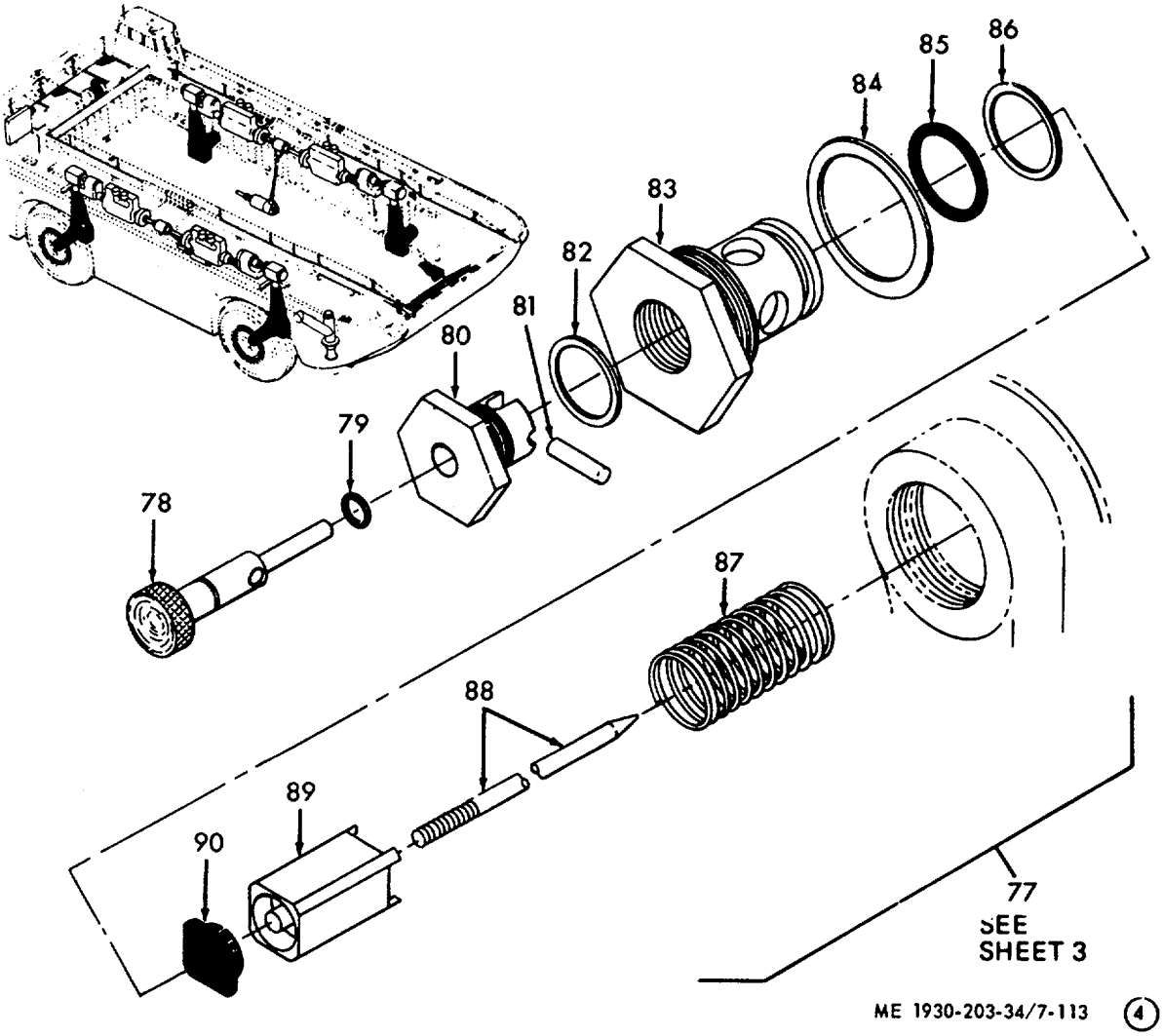


Figure 7-113. Column and wheel drive assembly (sheet 4 of 5).

Key to figure 7-13.

1 Pipe plug
2 Seal
3 Hose, flexible
4 Coupling, swivel
5 Nipple
6 Bevel gear spider bearing. cover
7 Bevel gear shim
8 Steering post
9 Bevel gear
10 Spider assembly
11 Gear, spur
12 Spider
13 Eyebolt
14 Capscrew
15 Forward spider bearing
16 Bearing carrier
17 Eyebolt
18 Retainer plate
19 Spindle
20 Lockwasher
21 Capscrew
22 Bolt, jacking
23 Capscrew
24 Lockwasher
25 Seal ring
26 Capscrew
27 Lockwasher
28 Bearing housing
29 Aft spider bearing
30 Washer, gear spider
31 Slotted nut, gear spider
32 Cotter pin
33 Pump gear
34 Capscrew
35 Bolt
36 Washer, copper
37 Retainer with seal washer
38 Nut
39 Key
40 Nut, castellated
41 Washer
42 Oil pump bracket
43 Oil pump
44 Elbow
45 Hose, oil
46 Plug
47 lockwasher
48 Capscrew
49 Retainer with seal washer
50 Capscrew
51 Bevel pinion assembly
52 Bevel pinion shim
53 Bevel pinion bearing adapter
54 Lower bevel pinion bearing cup
55 Lower bevel pinion bearing cone
56 Bevel pinion
57 Retaining ring
58 Bevel pinion bearing
59 Bevel pinion bearing yoke
60 Retaining plate
6I Capscrew
62 Capscrew
63 Upper bevel pinion bearing cup
64 Upper bevel pinion bearing cone
65 Bevel pinion coupling
66 Washer
67 Nut, castellated
68 Cotter pin
69 Cup, bearing outer
7O Cone, bearing, outer
71 Locknut
72 Capscrew
73 Gear assembly, reaction member and planetary ring
74 Planetary ring gear
75 Reaction member
76 Snap ring
77 Tire inflation valve
78 Pin, check release
79 Packing, preformed
80 Bushing, check release pin
81 Pin, cross
82 Gasket
83 Seat, check release pin
84 Gasket
85 Packing, preformed
86 Gasket
87 Spring
88 Guide rod
89 Check valve body
90 Cushion
91 Lockwasher
92 Capscrew
93 Bolt, jacking
94 Main axle
95 Planet spider assembly
96 Planet gear and bearing assembly
97 Cone, bearing
98 Cup, bearing
99 Planet gear
100 Snapring
101 Spur pinion
102 Idler shaft
103 Planet spider
104 Shim set
105 End plate
106 Retainer with seal washer
107 Capscrew
108 Capscrew
109 Lockwasher
110 Pipe and seal assembly, air line
I11 Plug, end
112 Packing, preformed, air line end plug
113 Packing, preformed, air line
114 Air seal retainer
115 Gasket
116 Packing, preformed, air seal retainer
1 1T Pipe, air line
118 Capscrew
119 Lockwasher
120 Nut
121 Collet
122 Fitting, lubrication
123 Wheel assembly
124 Cup bearing, inner
125 Cone, bearing, inner
126 Seal
12 7 Capscrew
128 Lockwasher
129 Capscrew

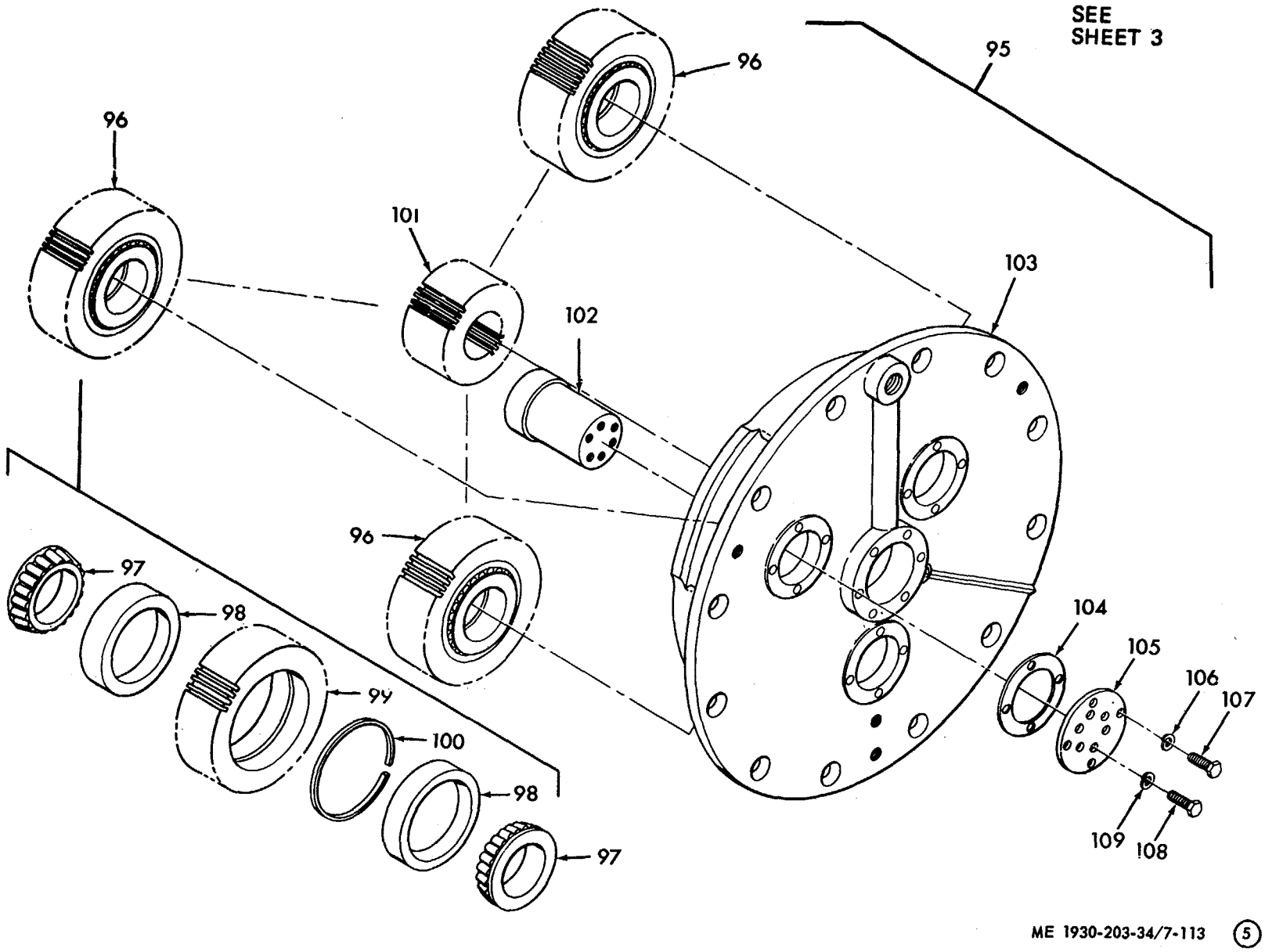


Figure 7-113. Column and wheel drive assembly (sheet 5 of 5).

d. Cleaning, Inspection and Repair.

(1) Clean all metal parts in dry-cleaning solvent, Federal Specification P-D-680. Dry with compressed air (10 psi).

(2) Inspect upper and lower bevel pinion bearing cups (54 and 63, fig. 7-113), and upper and lower bevel pinion bearing cones (55 and 64) for pitted, scored, or burned condition. Replace if defective.

(3) Inspect contact areas of bevel gear (9) and bevel pinion (56) for spalling, pitting, or wear. If more than 20 percent of contact area of any face is damaged by spalling or pitting, or if more than 0.015 inch of metal is worn from any face, replace bevel gear and bevel pinion.

(4) If inspection revealed a defective bearing cone (55 and 64), check bevel pinion (56) for signs of scoring in bearing areas. Check bearing and splined areas of bevel pinion for dimensions given in figure 7-114. If dimensions do not meet limits given in figure 7-114, replace bevel pinion.

(5) Inspect bevel pinion coupling (65, fig. 7-113) splined areas for stripped, twisted, chipped, or burred condition. Remove burrs with soft stone, Military Specification MIL-S-2389. If dimensions of bevel pinion coupling exceed limits specified in table. 1-2, replace coupling.

(6) Check bearing housing (28) and bevel pinion bearing adapter (53) for wear. If dimensions exceed limits specified in table 1-2, replace housing and / or adapter.

(7) Check bearing carrier (16) id. If id exceeds 9.8440 inches, replace bearing carrier.

(8) Inspect spider assembly (10) for structural defects such as cracks, breaks, or wear Replace damaged spider assembly. If dimensions do not meet limits given in figure 7-115, replace spider assembly.

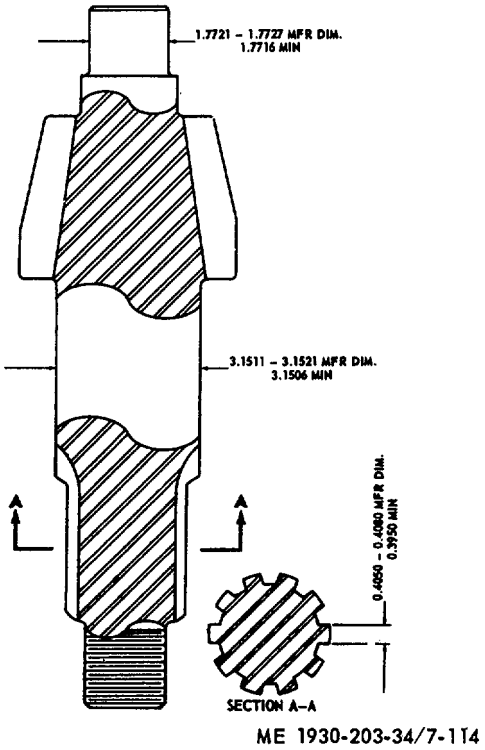


Figure 7-114. Bevel pinion dimensions and wear limits.

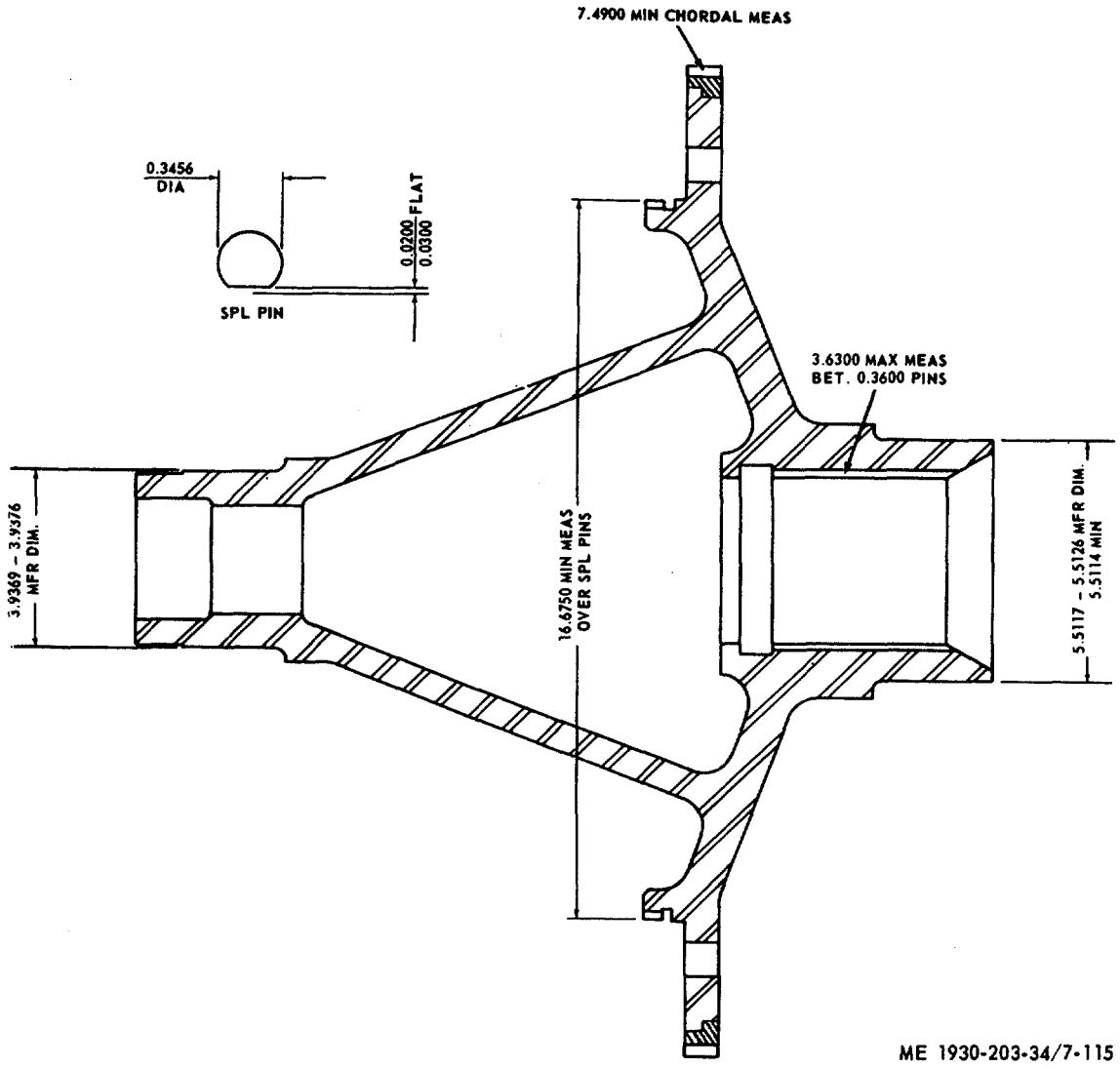


Figure 7-115. Gear spider dimensions and wear limits.

(9) Inspect pump gear (33, fig. 7-113) for chipped or broken teeth, or for wear that may have destroyed original tooth shape. Replace damaged gear. If chordal measurement over three teeth is less than 0.957 inch, replace gear.

(10) Replace air line pipe (117) if bent or scored-in seal area.

(11) Inspect spring (87) for full free length of 8 1/2 inches. If length is shorter, replace spring ,with a new one.

(12) Inspect cushion (90) for deterioration. Replace deteriorated cushion.

(13) Inspect spur pinion (101) and planet gears (99) for excessive wear (table 1-2). If more than 20 percent of the area of any gear tooth is damaged by spalling or pitting, replace gear.

(14) Inspect bearing cones (97) and cups (98) for pitted, scored, or burned condition. Replace if defective.

NOTE

If inspection revealed a frozen or damaged bearing cone, check od of idler shaft in bearing area. If od of idler shaft is less than 3.999 inches in bearing area, replace idler shaft.

(15) Check snaprings (100), end plates (105), and shim sets (104) for good condition. Replace a defective snapring, end plate, or shim.

NOTE

If a shim is defective and original bearing cups and cones, idler shaft, and gear are to be used, replace shim with a new shim of same thickness.

(16) Inspect planet spider (103) for structural

defects such as cracks or breaks. Replace a defective planet spider.

(17) Inspect main axle (94) for chipped or worn splines. If od of splines, when measured over 0.4800 inch diameter pins, is less than 4.71280 inches, replace axle.

(18) Inspect planetary ring gear (74) and reaction member (75) for excessive wear (table 1-2). If more than 20 percent of any gear tooth on planetary ring gear or reaction member is damaged by spalling or pitting, replace ring gear or reaction member. Check snapring (76) for good condition. Replace a defective ring gear, reaction member, or snapring.

(19) Replace seals (126).

(20) Inspect bearing cones (125 and 701 and cups (124 and 69) for pitted, scored, or burned condition. Replace if defective.

(21) Check wheel assembly 1123) for fractures- or cracks. Replace a defective wheel.

(22) Check studs on wheel assembly for good condition. Replace a defective stud.

(23) Check locknut (71) for good condition.

Replace a defective locknut.

e. Reassembly.

(1) Press lower bevel pinion bearing cup (54, fig. 7-113) and upper bevel pinion bearing cup (63) into bevel pinion bearing adapter.

(2) Install lower bevel pinion bearing cone (55) on bevel pinion (56).

(3) Position bevel pinion (56) in bevel pinion bearing adapter (53) and install upper bevel pinion bearing cone (64) on bevel pinion.

(4) Install bevel pinion coupling (65), washer (66), and nut (67). Tighten nut to obtain a 2½ to 3½ pound preload on the outside diameter of bevel pinion bearing adapter (53) and install cotter pin (68).

NOTE

To measure amount of preload. wrap a string around the outside of bevel pinion bearing adapter (53) and attach a spring scale to free end of string. A force of 2½ to 3½ pounds should just cause the adapter to rotate.

(5) Install bevel pinion bearing 158) and retainer ring 157) in bevel pinion bearing yoke (59).

(6) Install bevel pinion bearing yoke 1591 on bevel pinion (56) and secure with retainer plate 160) and capscrews 1611.

(7) Mount bevel pinion assembly 1511 in steering post 18) with original bevel pinion shim (52) in place. Secure with capscrews 162). Do not secure with lock wire.

NOTE

Before installing oil pump (43) in wheel column, submerge the pump in oil and rotate pump shaft several revolutions in each direction to insure that the pump %ill pump oil in both directions.

(8) Position oil pump (43) on oil pump bracket (42) and secure with capscrews (34).

(9) Mount oil pump and oil pump bracket in steering post 181 with bolts 1351, using copper washers (36) under bolt heads and sealing compound Military Specification MIL-S-7916. around bolts to prevent leakage. Secure oil pump bracket 142) to steering post (8) with seal washers (37) and nuts (38).

(10) Install elbow 1441 and hose 14.;) to oil pump 1431.

(11) If spur gear (11) was removed from spider (12). heat spur gear and press or drive on spider.

CAUTION

Be careful not to drive or press on gear teeth when installing spur gear. Do not heat spur gear to more than 400°F.

(12) Install bevel gear (9) on spider assembly (10) with capscrews (14) and secure with lock wire.

(13) Install bearing housing (28) over aft spider bearing (29).

(14) Place aft spider bearing (29) on spider assembly (10) with flange of bearing housing (28) toward bevel gear (9).

(15) Install washer (30) and slotted nut (31) on spider assembly (10) tighten locknut securely and lock by bending flange of washer into nut slot.

(16) Press forward spider bearing (15) onto forward end of spider assembly (10).

(17) Paint several teeth of bevel gear (9) with gear marking compound. red lead. Federal Specification TT-R-191 Type 1. and insert spider assembly into steering post.

(18) Install bevel gear spider bearing (over (6) with original bevel gear shim (7) in place. Secure bevel gear spider bearing cover to steering post (8) with lockwashers (47), capscrews (48). seal washers (49). and capscrews (50).

(19) Install washer (41). key (39), and pump gear (33), and secure with nut (40) and cotter pin (32). Reposition pump if necessary, for proper gear backlash (0.004 to 0.006 inch).

(20) Install bearing carrier (16) on steering post (8). Aline notch on bearing carrier with dowel pin on steering post and tap the bearing carrier with a soft mallet until it bottoms on seat.

(21) Check backlash in bevel gear set by securing an indicator rigidly to case with activator point against and perpendicular to gear face. Use value etched on gear. If backlash is not etched on gear, correct backlash should be 0.012 to 0.016 inch).

(22) Rotate pinion shaft sufficiently to mark contact of pinion teeth with compound painted on driven gear. Ideal tooth contact is slightly nearer the toe than the heel (detail A, fig. 7-112).

(23) When contact is too high on pinion and too high on driven gear, pinion is too near center (detail B) Shim pinion away from center, making adjustments with bevel pinion shim (52, fig. 7-113)

(24) When contact is too low on pinion and too high on driven gear, pinion is too far from center (detail C, fig. 7-112). Shim pinion toward center, making adjustments with bevel pinion shim (52, fig. 7-113).

(25) Repeat steps (24) and (25) above until proper tooth contact is obtained. Check backlash of gear. Adjust bevel gear shim (7) to obtain correct backlash (0.012 to 0.016 inch if value is not etched on gear).

(26) Install two guide pins (5/8 in. - 11 NC, 10 in lg., threaded on one end) into retainer plate (18) for alinement of reaction member with the retainer plate during mounting of reaction member.

(27) Place retainer plate (18) with installed guide pins into spindle (19).

(28) Apply sealing compound. Military Specification MIL-S-7916, around bolting flange of spindle (I9) and install spindle on steering post (8).

(29) Secure spindle to steering post with lock- washers (20) and capscrews (21). Tighten cap- screws to a torque of 1000 to 1200 foot-pounds.

(30) Install lockwashers (27) and capscrews (26). Tighten capscrews to torque of 600 to 700 foot-pounds.

(31)I Install lockwashers (24) and capscrews (23) to provide dust covers for jacking holes.

(32) Test steering post and spindle for leaks as follows:

(a) Blank off spindle (19) using locknut (7) 1/8 inch thick rubber gasket material, Military Specification MIL-R-1149A, Type 1, Class 2, 1/4 inch thick flat metal plate and four "C" clamps.

(b) Blank off steering post (8) using column nut (10, FO-2), I/8 inch thick rubber gasket material, Military Specification MIL-R-1149A, Type 1, Class 2, 1/4 inch thick flat metal plate and four "C" clamps.

(c) Connect air hose to plug hole (46, fig. 7-113).

(d) Apply 10 psi gage air pressure and test steering post and spindle for leaks, using soap solution method. Upon completion of test, remove blanks from spindle (19). Do not remove blanks from steering post (8) at this time.

(33) Tap and thread tire air inlet-outlet hole in center of wheel rim with a 1 1/4 inch pipe tap, 3/4 inch deep. Clear cuttings from air passages in wheel with compressed air.

(34) If bearing cups (69) and 124 were removed, press bearing cups into wheel assembly (123).

(35) Install three seals (126) in -.heel hub. Install the first two seals with lips toward the exterior to exclude water. Install the last or third seal with lip toward the interior of wheel assembly (I23) to retain oil.

(36) Insert seal ring (25) into seals (126).

(37) Press inner bearing cone (125) onto spindle (19).

(38) Install wheel assembly (123) on spindle.

(39) Install outer bearing cone (70) using locknut (7) to press bearing cone (70) in place.

(40) Coat mating surfaces of seal ring (25) and spindle (19) with sealing compound. Military Specification MIL-S-7916. Secure seal ring to spindle with retaining screws (127) and lock- washers (128).

(41) Rotate wheel, and retighten locknut (71). Back off locknut slightly and install capscrew (129) in locknut.

(42) Slide planetary ring gear (72) over reaction member (75) and install snapring (76).

(43) Insert reaction member and planetary ring gear assembly (73) so that mounting holes in reaction member (75) aline with guide pins in retainer plate (18). Install capscrews (72) and remove guide pins installed in (27) above. Secure the capscrews with lock wire.

(44) Insert main axle (94) through reaction member and planetary ring gear assembly (73) into steering post assembly (8).

NOTE

Axle must be oriented so that long splines on axle enter steering post assembly.

(45) Install snapring 110(11 in planet gear

(46) Press bearing cups (98) into planet gear bore and install bearing cones (97) in bearing cups.

NOTE

Earth bearing cup and cone must be kept together as an assembly.

(47) Center spur pinion (101) in planet spider (103) and position the three planet gear and bearing assemblies (96) in planet spider.

(48) Press idler shafts 11(021 through planet gear and hearing assemblies, aline match marks on idler shafts and planet spider, and press idler shafts into planet spider.

(49) Install shim sets (104) and end plates (105) using 12 capscrews (107) and seal washers (106) and 18 capscrews (108) and lockwashers (109).

(50) Check end clearance of planet gear and

bearing assemblies. End clearance should be 0.005 inch after a slight drag is felt in bearings.

(51) If end clearance is incorrect, remove end plate and substitute shims of appropriate thickness until proper clearance is obtained.

(52) Attach a suitable sling to planet spider assembly (95) using capscrews (92) and lock- washers (91).

(53) Coat flange area of planet spider assembly, where planet spider assembly mates with wheel assembly (123) with sealing compound Military Specification MIL-S-7916.

(54) Using suitable hoisting equipment, position planet spider assembly on wheel assembly.

NOTE

Make certain tire inflation valve assembly boss on planet spider assembly alines with corresponding hole in wheel assembly. It will also be necessary to work splines of main axle (94) into splines of spur pinion (101).

(55) Install 12 collets (121) and nuts (120).

(56) Remove capscrews (92) and lockwashers (91) and remove sling, then reinstall capscrews and lockwashers.

(57) Install gasket (84) and preformed packing (85) on check release pin seat (83).

(58) Install spring (87), check valve body (89) with guide rod (88), gasket (86), and check release pin seat (83) in wheel assembly (123).

(59) Install preformed packing (79) on check release pin (78). Insert check release pin into check release pin bushing (80) and install cross pin (81).

(60) Install gasket (82) on check release pin bushing (80). Insert check release pin assembly into check release pin seat (83) and tighten securely.)

(61) Install preformed packing (113) on air line pipe (117) and insert air line pipe in air seal retainer (114).

(62) Install preformed packing (112) on end plug (111). Coat threads of end plug with sealing compound, Military Specification MIL-S-7916, and install in air seal retainer.

(63) Install gasket (115) and preformed packing (116) on air seal retainer. Use sealing compound, Military Specification MIL-S-7916, between gasket and air seal retainer.

(64) Install seals (2) in bevel gear spider bearing cover (6).

(65) Coat mating surface of air line pipe and seal assembly (110) and planet spider assembly 19S5) with sealing compound,. Military Specification MIL-S-7916, and install air line pipe and seal assembly, being careful not t9 damage seals (2).

(66) Install capscrews (118) and lockwashers (119). Tighten end plug (111).

(67) Coat threads of pipe plug (1) with sealing compound, Military Specification MIL-S-7916, and install pipe plug.

(68) Test planetary and bevel gear spider bearing cover for leaks as follows:

(a) With air hose connected to plug hole (46, fig. 7-113), apply 2 psi gage air pressure and test air seal retainer (114), end plates (105), capscrews, nuts, spider to wheel interface, and spider bearing cover (6) for leaks, using soap solution method.

(b) Upon completion of test, remove blanks from steering post (8), column nut (10, FO-2), air connection from plug hole (46, fig. 7-113) and install plug.

(69) Test tire inflation valve for leaks as follows:

(a) Close tire inflation valve (77) in wheel by releasing valve stem.

(b) Connect air hose to tire air inlet-outlet hole in center of wheel rim.

*(c)*Apply 70 psi gage air pressure and hold pressure for 15 minutes to insure no leakage in valve.

(70) Test airline pipe packings and seals for leaks as follows:

(a) Install a 1 inch pipe plug in bevel gear spider bearing cover (6) at hose connection.

(b) Open tire inflation valve (77) in wheel by depressing valve stem and locking in position.

(c) With air hose connected to tire air inlet-outlet hole in center of wheel rim, apply 70 psi air gage pressure and hole pressure for 15 minutes to insure that the air line pipe packings and seals are not leaking. Upon completion of test, remove air hose and pipe plug.

f. Installation. Refer to paragraph 2-16.

7-11. Column and Wheel Drive Lower Pivot Bearing Assembly

a. Removal and Disassembly. Refer to paragraph 2-17.

b. Cleaning, Inspection and Repair.

(1) Clean all parts, except seal (3, fig. 2-11) in dry-cleaning solvent, Federal Specification P-D- 680, and dry with low pressure air (10 psi).

(2) Replace seal (3).

(3) Inspect lower pivot bushing (4) for excessive wear. Maximum id wear is 7.525 inches. If id of bushing exceeds 7.525 inches, replace bushing.

(4) Inspect shim.(10) for damage. If shim is damaged, replace shim with- a new shim of same thickness.

(5) Check lower pivot bearing mounting bracket (6) for cracks or breaks. Replace a damaged bracket.

c. Reassembly and Installation. Refer to paragraph 2-17.

Section II. MARINE DRIVE SYSTEM

7-12. Description

For a general description of the Marine Drive System, refer to paragraph 2-20.

7-13. Flexible Coupling, Pillow Block Fluid Coupling, and Engine Adapter Flange

a. *Removal and Disassembly*. Refer to paragraph 2-21.

b. Cleaning, Inspection and Repair.

(1) Clean all parts, except seals (38, fig. 2-15) and gaskets (9, 18, and 45), in dry-cleaning solvent, Federal Specification P-D-680 and dry with low pressure air (10 psi). For cleaning, inspection, and repair of fluid coupling, refer to paragraph 7-14.

(2) Replace seals (38) and gaskets (9, 18 and 45).

(3) Inspect bearing (25 and 33) for pitted, scored, or burned condition.

(4) Inspect gear teeth in flexible coupling flange (40) and gear hub (42) for broken or chipped teeth or wear that may have destroyed original tooth shape. If a gear hub or coupling flange is damaged, replace the complete flexible coupling assembly.

(5) Inspect engine adapter flange (34) and closure plate (19) for cracks, breaks, or warpage. Replace if necessary.

(6) Inspect machine keys (36) and seal retainers (37) for good condition. Replace a damaged key or retainer.

(7) Inspect splined shaft (43) and flanged shaft (48) for damage. Replace a damaged shaft.

(8) Remove any paint and burrs from the mating surfaces of the pillow block housings (28).

NOTE

The vertical hole at the bottom of each inclosure groove in the lower half of pillow block housing (21) must be free from foreign matter.

c. Reassembly and Installation. Refer to paragraph 2-21.

7-14. Fluid Coupling

a. Removal. Remove fluid coupling as outlined in paragraph 2-21.

b. Disassembly.

(1) Remove filler plug (17, fig. 7-116), gasket (18), and dust seal (28).

(2) Remove screws (29), washers (30), and seal carrier (31). Remove seal ring (21) from rear impeller (20).

(3) Remove nuts (11), screws (33), and washers (34) securing rear impeller (20) to front impeller (10). Lift rear impeller from front impeller.

(4) Remove corprene gasket (19), carbon mating ring (1), and washer (2) from front impeller (10).

(5) Remove snapring (3) holding mating ring carrier (4) on runner hub (8). Remove oil seal packing (5) from inside diameter of mating ring carrier.

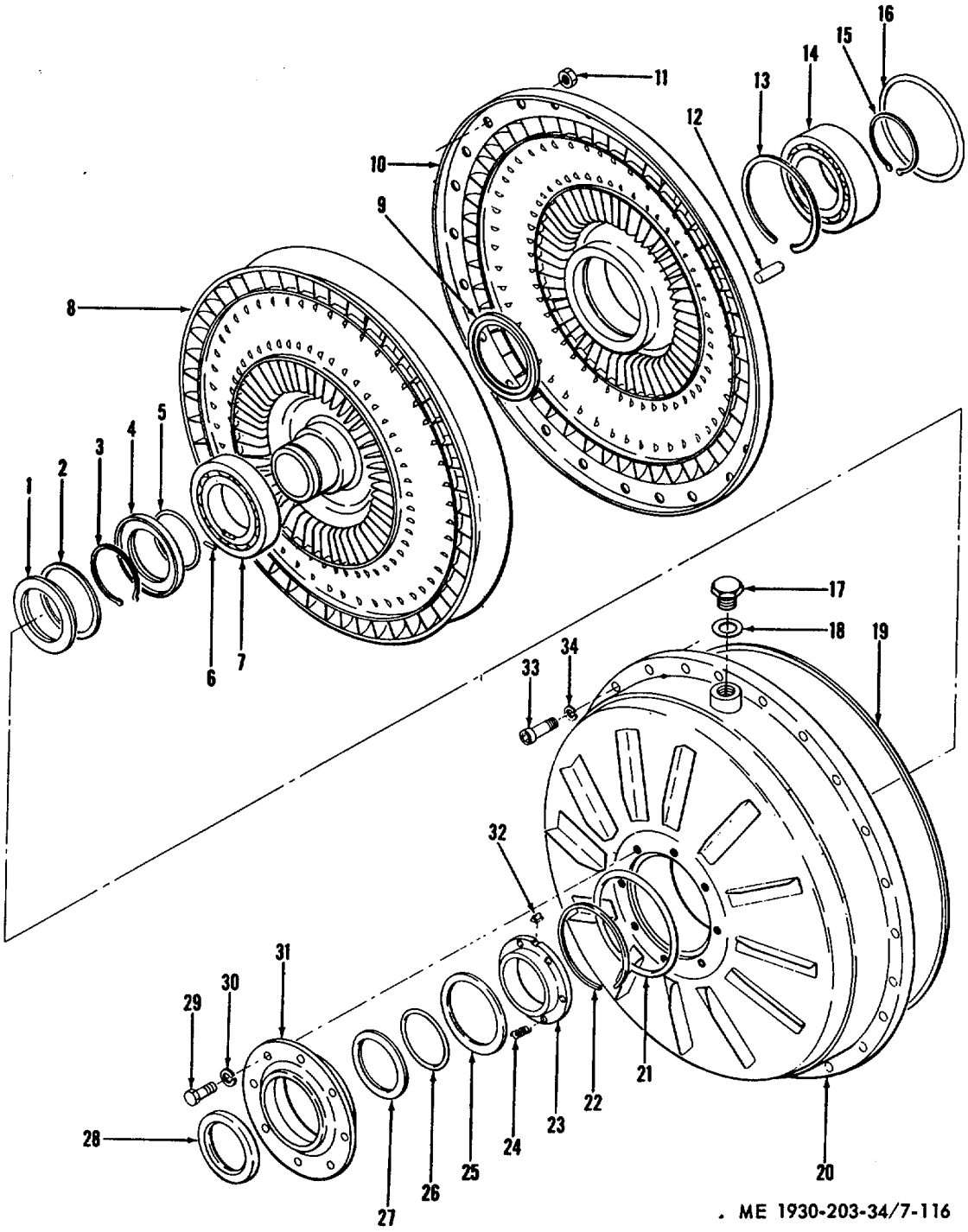
(6) Remove roll pin (6) and slide rear ball bearing (7) from runner hub (8).

(7) By using seal carrier (31) to protect the ground seal surface, depress nose piece (23) of the seal surface and remove internal retaining ring (22) holding it in seal carrier. While still depressed, remove step key (32) between nose piece and seal carrier. Gradually release pressure on nose piece until spring tension is relieved and lift nose piece from seal carrier.

(8) Remove compression springs (24), washer (25), garter spring (26), and rubber seal (27).

(9) Invert runner and front impeller. Remove front oil seal packing (16) and retaining ring (15).

(10) Remove front ball bearing (14), retaining ring (13), and baffle plate (9) from impeller hub. Lift front impeller from runner hub (8).



1 Carbon mating ring
2 Washer, mating ring
3 Snapring
4 Mating ring carrier
5 Oil seal rear packing
6 Roll pin
7 Rear ball bearing
8 Runner hub
9 Baffle plate
10 Front impeller
11 Nut
12 Dowel pin
13 Retaining ring
14 Front ball bearing
15 Retaining ring
16 Front oil seal packing
17 Filler plug
18 Gasket
19 Corprene gasket
20 Rear impeller
21 Seal ring
22 Internal retaining ring
23 Nose piece
24 Compression spring
25 Washer, retainer
26 Garter spring
27 Rubber seal
28 Dust seal
29 Screw
30 Washer
31 Seal carrier
32 Step key
33 Screw
34 Washer

Figure 7-116. Fluid coupling disassemble.

c. Cleaning, Inspection and Repair.

(1) Clean all metal parts in dry-cleaning solvent, Federal Specification P-D-680. Dry thoroughly with compressed air (10 psi).

(2) Inspect impellers for dents, nicks, burrs, or other obstacles that would hinder the smooth flow of oil through the blades, core, or cooling fins.

If there is damage to any part of impeller, replace impeller.

(3) Inspect runner for damage to blades, core rings, or steel stampings. If there is damage to any part of runner, replacement is necessary.

(4) Inspect bearings for roughness of rotation, out-of-roundness, and broken or chipped rollers. If any defects are found, replace bearings.

(5) Inspect packings and gaskets for cuts, hardness, and deterioration. Replace damaged packings and gaskets.

(6) Inspect screws, nuts, and bolts for -corroded, stripped, or damaged threads. Replace a1 damaged hardware.

(7) Check to see that springs are not broken, compressed, or stretched out of shape. Replace springs if broken and if free length is not 0.125 inch.

d. Reassembly. Reassemble fluid coupling in reverse order of disassembly.

e. Installation. Install fluid coupling as outlined in paragraph 2-21.

7-15. Gathering Box - Marine Gear Angle Drive Couplings.

a. Removal. Refer to paragraph 2-22.

b. Disassembly.

(1) Remove shaft (8, fig. 2-16) and keys (7) from flexible coupling assemblies.

(2) Remove hub gears (2 and 13). Press button (15) and thrust plate (14) from lower hub gear (13).

(3) Remove retaining rings (6) and seals (5) from flanges (3).

(4) Remove lubrication plugs (4) from flanges (3).

c. Cleaning, Inspection and Repair.

(1) Clean all metal parts in dry-cleaning solvent, Federal Specification P-D-680.

(2) Inspect retaining rings for cracked or warped condition. If damaged, replace retaining rings.

(3) Inspect each flange and gear hub for uneven wear and broken teeth. If flange and gear hub are damaged, replace angle drive coupling.

(4) Inspect button (15, fig. 2-16) and thrust plate (14) on lower coupling for broken or malformed condition. If damaged, replace button or thrust plate.

d. Reassembly. Reassemble angle drive couplings in rev---t order of disassembly.

NOTE

Replace all flexible coupling seals.

e. Installation.

(I) Pack flexible couplings with grease, Military Specification MIL-G-23549, prior to installation.

(2) Install angle drive coupling in reverse order of removal.

NOTE

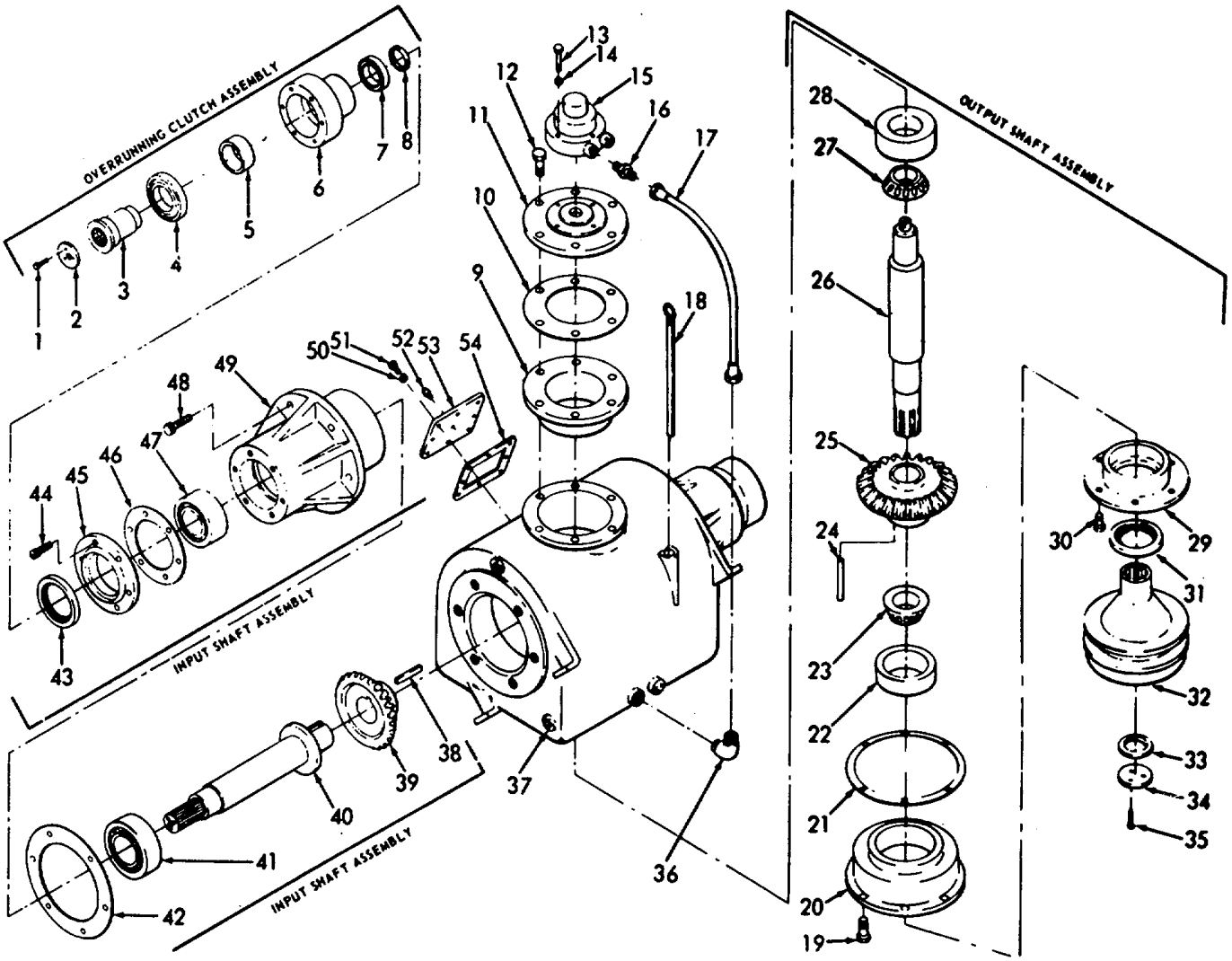
Replace all angle drive coupling mounting gaskets.

7-16. Gathering Box Assembly

a. Removal. Refer to paragraph 2-22.

b. Disassembly.

(1) *Dipstick and inspection cover removal* Remove dipstick (18, fig. 7-117), capscrews (51), lockwashers (50), inspection cover (53), and cover plate gasket (54) from housing (37).



1 Capscrew
2 Input shaft end plate
3 Inner race shaft
4 Outer clutch bearing
5 Clutch unit
6 Outer race
7 Inner clutch bearing
8 Input shaft spacer
9 Pump bearing adapter
10 Pump bearing shim set
11 Pump bearing retainer
12 Capscrew
13 Capscrew
14 Lockwasher
15 Oil pump
16 Adapter
17 Pump suction tube
18 Dipstick
19 Capscrew
20 Output shaft bearing adapter
21 Output shaft bearing shim set
22 Output shaft bearing cup
23 Output shaft bearing cone
24 Bevel gear key
25 Output bevel gear
26 Output shaft
27 Output shaft bearing cone
28 Output shaft bearing cup
29 Coupling retainer
30 Capscrew
31 Oil seal
32 Coupling
33 Gasket
34 Output shaft end plate
35 Capscrew
36 Elbow
37 Housing
38 Bevel pinion key
39 Input bevel pinion
40 Input shaft
41 Input shaft bearing
42 Input shaft bearing shim set
43 Input shaft seal
44 Capscrew
45 Bearing retainer
46 Input shaft bearing shim set
47 Input shaft ball bearing
48 Capscrew
49 Carrier
50 Lockwasher
51 Capscrew
52 Valve
53 Inspection cover
54 Cover plate gasket

Figure 7-117. Gathering box assembly disassembly.

(2) Major components removal

(a) Overrunning clutch assembly removal. Remove capscrews (t from input shaft end plate (2) and pull overrunning clutch assembly from input shaft spline. Remove input shaft spacer (8) from carrier (49).

(b) Input shaft assembly removal Remove capscrews (48) from carrier (491 and pull input shaft assembly from housing (37).

(c) Output shaft assembly removal.

1. Disconnect pump suction tube (17) from oil pump (15). Remove capscrews (13), lock- washers (14), and oil pump (15) from pump bearing retainer (11).

2. Remove capscrews (12) from pump bearing retainer (11). Remove pump bearing retainer, pump bearing shim set (10), and pump bearing adapter (9). Remove output shaft bearing cup (28) from pump bearing adapter.

3. Invert gathering box and remove capscrews (19) from output shaft bearing adapter (20). Lift output shaft assembly from housing and remove output shaft bearing shim set (21) and output shaft (26).

(3) Major components disassembly.

(a) Overrunning clutch assembly disassembly.

1. Support assembly on small end of inner race shaft (3). Press outer race (6) and inner clutch bearing (7) off shaft.

2. Remove clutch unit (5), and press outer clutch bearing (4) off of inner race shaft (3).

(b) Input shaft assembly disassembly.

1. Remove input shaft seal (43), capscrews (44), bearing retainer (45), and input shaft bearing shim set (46) from carrier (49).

2. Support assembly on bolting flange of carrier (49) and press input shaft (40) together with input bevel pinion (39) and input shaft bearing (41) from carrier.

3. Remove input shaft bearing (41), input bevel pinion (39), and bevel pinion key (38) from input shaft (40).

4. Remove input shaft ball bearing (47) from carrier (49).

(c) Output shaft assembly disassembly.

1. Remove capscrews (35), output shaft end plate (34), and gasket (33); and pull coupling (32) from output shaft (26).

2. Remove capscrews (30) and coupling retainer (29) from output shaft bearing adapter (20). Remove output shaft bearing cup (22) from output shaft bearing adapter (20) and oil seal (31) from coupling retainer (29).

3. Press output bevel gear (25), bevel gear key (24), and output shaft bearing cones (23 and 27) from output shaft (26).

c. Cleaning, Inspection and Repair.

(1) Clean all metal parts in dry cleaning solvent, Federal Specification P-D-680. Dry with compressed air (10 psi).

(2) Inspect housing (37. fig 7-117) for cracks and damage to machined surfaces that could cause oil leakage or malfunction of parts. Replace damaged housing.

(3) Inspect output shaft bearing cups (22 and 28) and bearing cones (23 and 27) for pitted, scored, or burned condition.

(4) Inspect contact areas of output bevel gear (25) and input bevel pinion (39) forspalling, pitting. or wear. If more than 20 percent of contact area of any face is damaged by spalling or pitting. or if more than 0.015 inch of metal is worn from any face, replace gear.

(5) Inspect output shaft (26) for burred and/or scored condition that would indicate the bearing has been turning on the shaft. If od of upper and/or lower bearing areas is less than 2.2508 inches, replace output shaft. If od of spline teeth is less than 2.2470 inches replace output shaft.

(6) Inspect input shaft (40) for burred and/or scored conditions that would indicate the bearing has been turning on the shaft. If od of input shaft bearing (41) area is less than 2.7560 inches and / or od of input shaft ball bearing (47) area is less than 2.3618 inches, replace shaft. Ifod of spline teeth is less than 2.1810 inches over 0.1920 inch pins. replace shaft.

(7) Check bearing areas of carrier (49) for limits specified in table 1-3. If bearing areas exceed maximum allowable wear. replace carrier.

(8) Check output shaft bearing adapter (20) and pump bearing adapter (9) for limits specified in table 1-3. If maximum allowable wear is exceeded, replace adapter.

(9) Inspect all threaded openings and inserts for damaged threads. If damage cannot be removed by chasing threads with proper size tap. replace parts. Replace damaged inserts.

(10) Replace all seals.

(11) Inspect bearings (7 and 4) for pitted, scored or burned condition.

(12) Check outer race (6) and inner race shaft (3) for wear in areas where outer bearing (4) and inner bearing (7) are located. If wear exceeds limits specified in table 1-3, replace outer race or inner race shaft.

(13) Check outer race (6) and inner race shaft (3) for a pitted or spalled condition in clutch unit area. If spalling or pitting at any point on clutch unit area exceeds 10 percent of clutch unit area width, replace outer race or inner race shaft.

(14) Check outer race (6) for grooved condition where outer race mates with input shaft seal.

(43). If groove depth exceeds 0.005 inch, replace outer race.

(15) Check that all sprags in clutch unit (5) are oriented in same direction and are free in cages.

Cage holes must be square with the flange within + I / 2°. Replace a defective clutch unit.

d. Reassembly.

(1) Major components reassembly.

(a) Output shaft assembly reassembly.

1. Press output bevel gear (25, fig. 7-117) on output shaft (26) with bevel gear key (24) in place. Make sure gear hub is against shaft shoulder.

2. Heat output shaft bearing cones (23 and 27) in oil (temperature not to exceed 250 F) and slide in place on output shaft.

3. Assemble output shaft bearing adapter (20) and coupling retainer (29), and secure with capscrews (30) and lock wire.

4. Press oil seal (31) into coupling retainer (29), and output shaft bearing cup (22) into output shaft bearing adapter (20) until cup seats against coupling retainer. Install assembly on output shaft (26).

NOTE

Place oil seal (31) with lip side toward coupling retainer (29).

5. Install coupling(32), gasket (33), and output shaft end plate (34), and secure to output shaft with capscrews (35).

(b) Input shaft assembly reassembly.

1. Press input shaft ball bearing (47) into carrier (49) and seat against shoulder of bore. Heat input shaft bearing (41) and install on input shaft (40).

2. Turn carrier on end so input shaft ball bearing (47) is down. Support bearing on inner race.

3. Lower input shaft (40), with input shaft bearing (41), into carrier until shaft starts into bearing bore. Check alinement of input shaft bearing outside diameter to bore of carrier. Tap with a soft hammer to level. Press shaft until shoulder of shaft rests against input shaft ball bearing (47). Input shaft bearing need not be flush with carrier shoulder.

4. Install input shaft bearing shim set (46), bearing retainer (45), and input shaft seal (43) on carrier (49). Install capscrews (44) and secure with lock wire.

NOTE

Place input shaft seal (43) with lip side toward carrier (49).

5. Press input bevel pinion (39) on input shaft (40) with bevel pinion key (38) in place.

(c) Overrunning clutch assembly reassembly.

1. Press outer clutch bearing (4) on inner race shaft (3).

2. Slide clutch unit (5) on inner race shaft. Clutch must freewheel when inner race shaft is rotated clockwise as viewed from small end.

3. For clutch assembly purposes only, slide large end of inner race shaft (3) on splines of input shaft (40). With a twisting action start outer race (6) onto clutch sprags. After clutch sprags start into outer race, seat outer race against outer clutch bearing (4) with a soft hammer. Insert inner clutch bearing (7) simultaneously onto inner race shaft and outer race.

4. Remove overrunning clutch assembly from input shaft (40).

(2) Major components installation.

(a) Output shaft assembly installation.

1. Install output shaft bearing shim set (21) and lower output shaft assembly into housing (37). Secure with capscrews (19).

2. Invert gathering box and install pump bearing adapter (9) in housing, making sure that bolt clearance holes are aligned with holes in housing. Press in output shaft bearing cup (28) and seat lightly on output shaft bearing cone (27).

3. Install oil pump (15) on pump bearing retainer (11) with lockwashers (14) and capscrews (13).

4. Install pump bearing shim set (10), pump assembly, and capscrews (12).

5. Adjust output shaft bearing cones (27 and 23) with pump bearing shim set (10) and output shaft bearing shim set (21) until output shaft rotates freely with no end play. After final adjustment lock wire capscrews (30, 19, and 12).

(b) Input shaft assembly installation. Install each input shaft assembly in housing with original input shaft bearing shim set (42), and secure to housing with capscrews (48).

(c) Overrunning clutch assembly. installation. Slide input shaft spacer (8) on input shaft, install clutch assembly, and lock in place with input shaft end plate (2) and capscrews (1).

Secure with lock wire.

(3) Gathering box bevel gear set adjustment.

NOTE

If bevel gear set mountings, which secure bevel gear and bevel pinion to housing, or housing has been replaced, the bevel gear set must be readjusted.

(a) Lightly coat several teeth on output bevel gear (25) with gear marking compound, red lead, Federal Specification TT-R-191, Type II.

(b) Check backlash in gear set by securing.

indicator rigidly to case with actuator point against and perpendicular to gear face. Backlash should be 0.008 to 0.012 inch.

(c) Rotate input shaft (40) sufficiently to mark pinion tooth contact with compound painted on driven gear. Ideal tooth contact is slightly nearer the toe than the heel (A, fig. 7-112).

(d) When contact is too high on pinion and too low on driven gear, pinion is too near center (B, fig. 7-112). If backlash was too small, shim pinion away from center. If backlash was too great, shim driven gear toward pinion.

(e) When contact is too low on pinion and too high on driven gear, pinion is too far from center (C, fig. 7-112). If backlash was too great, shim pinion toward center. If backlash was too small, shim driven gear away from center.

(f) Repeat (d) and (e) above until proper tooth contact is obtained; check backlash of gear.

Adjust to correct backlash (0.008 to 0.012 inch), using input shaft bearing shim set (42, fig. 7-117) for pinion adjustment and output shaft bearing shim set (21) for driven gear adjustment. Secure capscrews 119 and 48) with lockwire after proper adjustment has been made.

(4) *Inspection cover and dipstick installation.* Install cover plate gasket (54), inspection cover (53), lockwashers (50), capscrews (51), and dipstick (18).

e. Installation. Refer to paragraph 2-22.

7-17. Marine Gear Assembly

a. Removal Refer to paragraph 2-27.

b. Disassembly.

NOTE

The disassembly and reassembly procedures given are for right-hand unit. The left-hand units and right-hand units are the same except for housing. For right-hand units, bevel gearcase is on upper half housing. For left-hand units, bevel gearcase is on lower half.

(1) Remove flexible hoses (44, and 50 through 55, fig. 2-24) from marine gear.
(2) Remove elbows (45 and 46) from lube manifold (47).
(3) Remove capscrews (48) and lockwashers (49) and remove lube manifold.
(4) Remove flexible hoses (64, 68, and 71) from marine gear.
(5) Remove swivel joint (70) and elbow (69) from control valve (73).
(6) Remove capscrews (75) and lockwashers 174) and remove control valve.
(7) Remove capscrews (66) and withdraw oil pump (57) from marine gear.
(8) Remove adapter (56), elbow (67), and swivel joint (65) from oil pump.
(9) Remove staked marks around setscrew (63) and loosen setscrew.
(10) Remove oil pump drive gear (62) and key (58) from pump shaft.
(11) Remove mounting adapter (61), bearing (60), and gasket (59).
(12) *Major components removal.*

(a) Control tube assembly removal. Remove capscrews (133, FO-3 (located in back of manual)) and pull control tube assembly from housing.

(b) Pump planetary drive assembly removal. Remove capscrews (55) and washers (54); and with suitable hoist, remove pump planetary drive assembly.

(c) Bevel drive assembly removal. Remove capscrews (10) and washers (11), and lift bevel drive assembly from marine gear housing.

(d) Housing removal.

1. Remove control tube assembly, pump planetary drive assembly, and bevel drive assembly as outlined in (a) through (c) above.
2. Lay marine gear with upper housing (20) facing up.Remove capscrews (23), washers (22), and inspection covers (21).
3. Reach through inspection holes and remove three capscrews (38) fastening forward bearing adapter (43) to upper housing.
4. Remove capscrews (26) and washers (27) from aft high speed bearing adapter (28).
5. Remove three capscrews (155) and washers (154) from aft output shaft adapter (149).
6. Remove capscrews 1113) from for- ward bearing adapter (114).
7. Remove three nuts (162), three washers (161), and three bolts (24) from aft of upper housing (20). Reach through inspection holes and remove three bolts from forward flange of housing.
8. Remove nuts (164), washers (163), and bolts (25) from housing flange.
9. Lift upper housing (20) from lower housing (165) with suitable hoist.

(e) Output shaft assembly removal.

1. Remove housing as outlined in (d) above.
2. With a suitable hoist, lift output shaft assembly from lower housing (165).

(f) Input shaft assembly removal.

1. Remove output shaft assembly as outlined in (e) above.
2. Remove two capscrews (38) and lift input shaft assembly from lower housing (165).

(g) Idler shaft assembly removal.

1. Remove input shaft assembly as outlined in (f) above.
2. Remove capscrews (87), aft bearing adapter (86), and aft bearing cup (85) from lower housing (165).
3. Remove capscrews (74), idler shaft

end plate 175), and press idler shaft (82) from housing by supporting idler gear (81) on a suitable pipe or cylinder (maximum outside diameter 5 1/2 inches; minimum inside diameter 3 3/4 inches). Ram pressure should be applied from forward end of idler shaft.

4. Remove bolts (71), bearing retainer (72), forward bearing retainer gasket (73), and forward bearing adapter (78).

5. Remove forward bearing cones (76) and forward bearing cups (77) from forward bearing adapter (78).

(13) *Major components disassembly.*

(a) Control tube assembly disassembly.

1. Remove cotter pin (119), nut (118), and washer (120). Pull out washers (121 and 122), reverse oil valve (123), piston ring (124), forward oil valve (12'5), and control tube spacer (126).

2. Pull outer tube (128) from inner tube (129). If inner tube is disassembled from separator box (131), inner tube must be replaced.

3. Remove separator box cap (132) from separator box (131).

(b) Pump planetary drive assembly disassembly.

1. Remove capscrews (60) and washers (59), and pull out planetary housing adapter (58).

Remove planetary housing bearing (57) from adapter.

2. Remove capscrews (70) from aft bearing adapter (69). Pull out bearing adapter together with aft bearing cup (67) and remove aft bearing shim set (68).

3. Support planetary pinion (64), using a section of cylinder (maximum outside diameter, 3 3/8 inches; minimum inside diameter, 3 inches) through the clearance between planetary gear housing (53) and forward bearing cone (63) and through forward bearing adapter (61) and forward bearing cup (62). Press planetary pinion shaft (65) from spline end out of forward bearing cone.

4. Slide planetary pinion (64) and forward bearing cone (63) from planetary gear housing (53).

5. Remove screws (56) and forward bearing adapter (61) from housing.

(c) Bevel drive assembly disassembly.

1. Remove capscrews (3), washers (4), and bevel pinion oil seals (2). Pull out bevel pinion seal carrier (5) from bevel pinion shaft (16).

2. Remove locknuts (6) and washer (7).

3. Support bearing carrier (12) at the bolting flange and press bevel pinion shaft (16) from carrier.

4. Remove outer bevel pinion bearing cone (8), outer bevel gear bearing cup (9), and inner bevel pinion bearing cup (14).

5. Remove bevel pinion (18) and bevel pinion key (17) from bevel pinion shaft.

6. Press inner bevel pinion bearing cone (15) from bevel pinion shaft.

(d) Output shaft assembly disassembly.

1. Remove capscrews (160), packing retainer (159), and packing (158) from output shaft (102).

2. Pull off coupling half (157) using a suitable puller.

3. Remove capscrews (155), washers (154), coupling bearing retainer (153), oil seals (156), and output shaft shim set (150).

4. Remove capscrews (116) and forward retaining plate (115).

5. Use a heavy duty press, horizontal if possible, and place supports between forward output gear (105) and clutch piston (134). Press ram to push output shaft (102) from forward output gear (105), forward bearing cup (107), forward bearing cone (108), forward bearing spacer (109), and forward bearing adapter assembly. Press forward bearing cup (104) from forward output gear.

6. Remove forward retaining ring (110), forward bearing cup (111), and forward bearing cone (112) from forward bearing adapter (114).

7. Use a section of pipe (maximum outside diameter, 61/2 inches; minimum inside diameter, 5-5/8 inches) to support forward plate (92) inside clutch plate spline. Press shaft from coupling end through aft bearing cones (151), aft bearing cup (152), reverse spacer (148), reverse gear assembly, and clutch assembly.

NOTE

Each part must be handled as it comes free, and adequate support for the assembly must be maintained at all times.

8. Support assembly on forward bearing cone (103) and press output shaft free of forward bearing cone (103), and forward bearing spacer (106).

9. Remove reverse bearing cones (142 and 147), reverse bearing cups (143 and 146), and reverse bearing spacer (145) from reverse output gear (144).

10. Place clutch assembly on bench and remove forward retaining ring (99), forward backing plate (98), forward friction plates (96), forward pressure plates (97), reverse retaining ring (141), reverse backing plate (140), reverse friction plates (138), and reverse pressure plate (139) from clutch piston (134).

11. Drive out clutch dowel pins (93) and remove capscrews (94).

12. Cut three pieces of steel rods, 5/16 inch diameter by 2 inch length; and grind a 3/16

inch width plane the length of each rod. Lay these rods into inner spline of clutch piston to serve as retainment guides for forward piston rings (95). Tap out forward plate (92). Remove piston ring (91 and 95) from forward plate.

13. Switch steel rods to opposite side. Remove reverse plate (136), then remove reverse piston ring (137) from reverse plate.

14. Remove clutch compression springs (88) from both sides of piston.

NOTE

If necessary to remove clutch bushing cups (90), use a filler block slightly smaller than diameter of closed end to press out bushing. If necessary to remove clutch spring retainers (89) press from clutch pinion (134).

(e) Input shaft assembly disassembly.

1. Pull off aft high speed bearing adapter (28). Remove input shaft oil seals (29), aft retaining ring (31), and input shaft bearing (30) from adapter.

2. Remove planetary sun gear (51), and planetary sun gear key (52) from input shaft (32).

3. Remove locknuts (49) and washer (50).

4. On suitable press, disassemble forward pinion (35), forward pinion spacer (37), forward bearing retainer (39), forward bearing adapter (43), input shaft shim set (45), bevel gear (48), and bevel gear hub (46) together from shaft.

5. Remove capscrews (38) and forward bearing retainer (39) from forward bearing adapter (43). Press tapered bearing cones (40), tapered bearing cups (41), and forward pinion bearing spacer (42) from forward bearing adapter.

6. Remove capscrews (44) from bevel gear hub (46), and separate bevel gear (48) and bevel gear hub.

7. Press reverse pinion (33) from input shaft (32).

c. Cleaning, Inspection and Repair.

(1) Clean all metal parts in dry-cleaning solvent. Federal Specification P-D-680. Dry parts thoroughly with compressed air (10 psi).

(2) Inspect roller bearing for cracks, chipping, and blue-black discoloration. Bearings must rotate smoothly with no noise, binding, or excessive radial or axial play. Replace defective bearings.

(3) Inspect contact areas of bevel pinion (18, fig. FO-3) and bevel gear (48) for spalling, pitting, or wear. If more than 20 percent of contact area of any face is damaged by spalling or pitting, or if more than 0.015 inch of metal is worn from any face, replace.

(4) Inspect screws, nuts, and bolts for corroded, -tripped, or damaged threads. Replace all damaged hardware.

(5) Inspect clutch compression springs (88) for broken or distorted coils. Replace damaged springs.

(6) Inspect clutch dowel pins (93) for looseness of fit in dowel pinholes. If a dowel pinhole is worn, rebore and sleeve the hole and replace dowel pin.

(7) Inspect input shaft reverse pinion (33), input shaft forward pinion (35), planetary sun gear (51), planetary pinion (64), and idler gear (81) for scuffed, nicked, burred, or broken teeth. If gears or pinions are worn beyond limits specified in table 1- 3, replace. If scuffs, nicks, and/or burrs cannot be removed with crocus cloth, Federal Specification P- C-458, replace damaged part.

(8) Inspect forward friction plate (96) and reverse friction plate (138) for cracks, burrs, wear, and distortion. If friction plates are worn beyond limits specified in table 8-17, replace. Replace damaged friction plates.

(9) Inspect piston rings (91, 95 and 137) for scored surfaces, breaks, and wear. Check side clearance of piston rings in forward plate (92) and reverse plate (136) (piston ring (91) should be 0.008 inch to 0.012 inch and piston rings (95 and 137) should be 0.005 inch to 0.010 inch. If piston rings are damaged and / or side clearance exceeds above limits, replace piston rings.

(10) Inspect clutch forward plate (92) for scoring, pitting, and / or warpage. Replace damaged plate. If dimensions given in figure 7-118 are exceeded, replace forward plate.

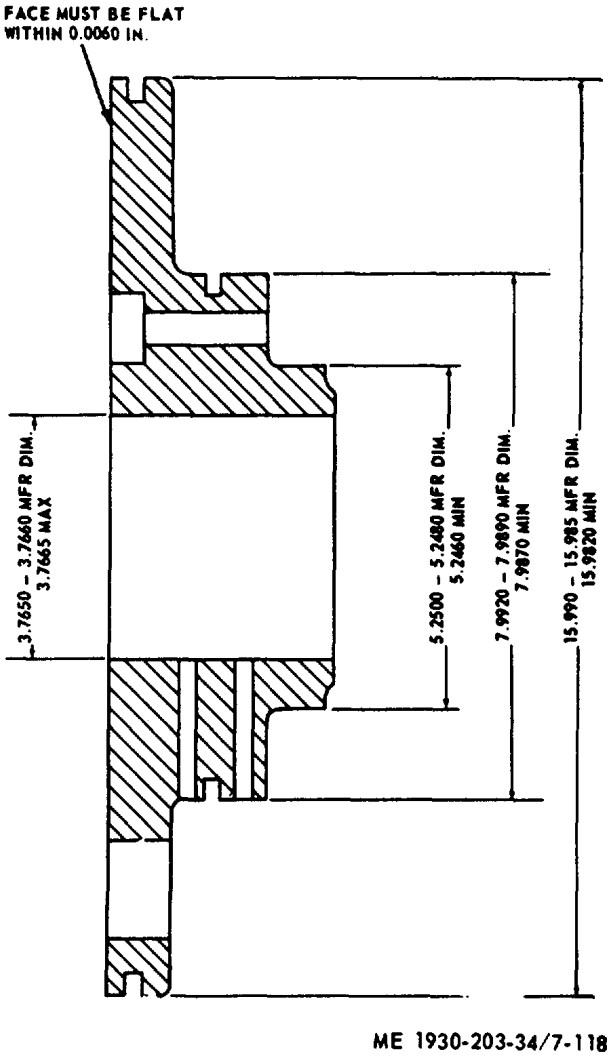


Figure 7-118. Clutch forward plate dimensions and wear limits.

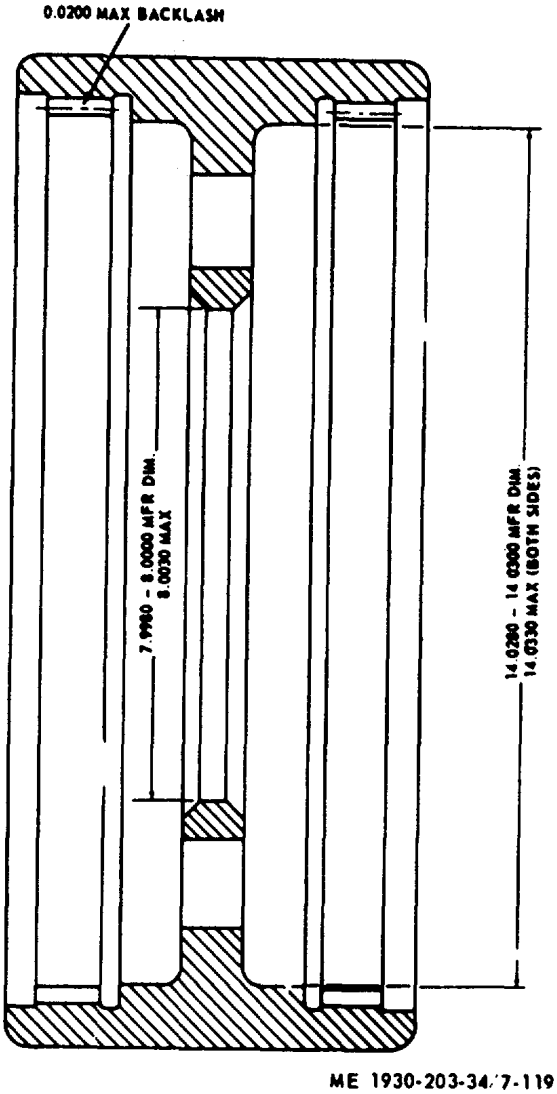


Figure 7-119. Clutch piston dimensions and wear limits.

NOTE

Clutch forward plate (92, FO-31. reverse plate (136), and clutch piston (134) are replaced as a set if either part is damaged.

(11) Inspect clutch piston (134) for scoring, pitting. or warpage. Replace damaged clutch piston. If dimensions given in figure 7-119 are exceeded, replace clutch piston.

(12) Inspect clutch reverse plate (136, FO-3) for scoring. pitting. or warpage. Replace damaged plate. If flatness of reverse plate face is worn beyond 0.0040 inch. replace plate.

(13) Inspect clutch bushing cups (90) for cracks or looseness. Replace damaged clutch bushing cup. If clutch bushing cup is worn beyond limits specified in table 1-3. replace cup.

(14) Inspect forward output gear (105) and reverse output gear (144) for scuffed, nicked. burred, or broken teeth. If gears are worn beyond dimensions given in figures 7-120 and 7-121, replace. If scuffs, nicks, and/or burrs cannot be removed with crocus cloth, Federal Specification P-C-458, replace damaged gear.

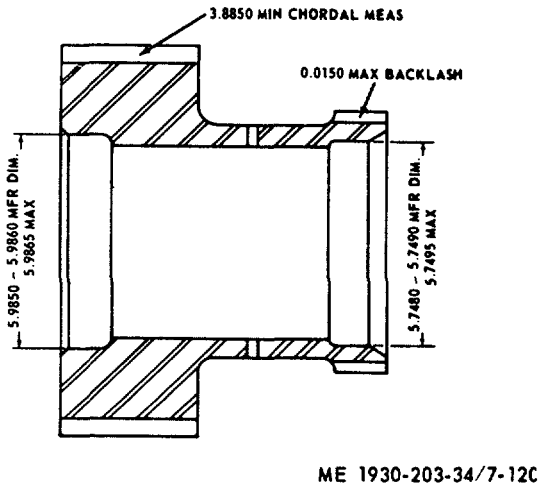


Figure 7-120. Forward output gear dimensions and wear limits

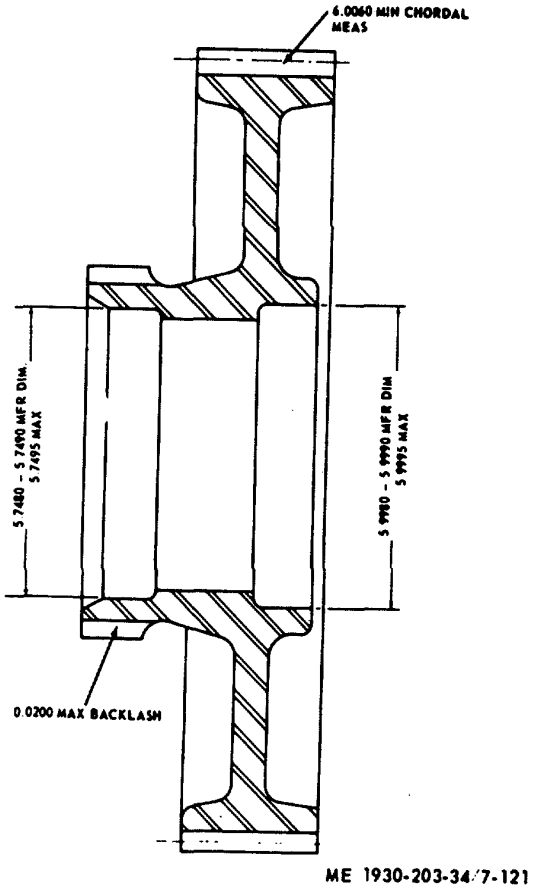


Figure 7-121. Reverse output gear dimensions and wear limits .

(15) Inspect bevel pinion shaft (16, FO-3), input shaft (32), output shaft (102), and idler shaft (82) for cracks, galling, and/or damaged splines. Replace defective shaft.

(16) Check areas of bevel pinion shaft (16) for wear. If any area of bevel pinion shaft exceeds dimensions given in figure 7-122, replace shaft.

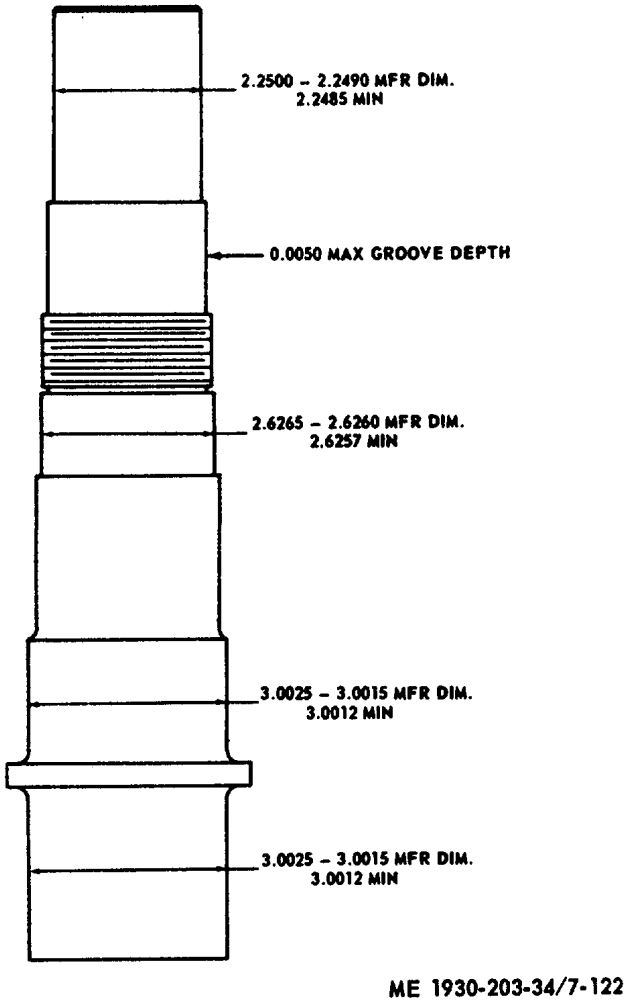


Figure 7-122. Bevel pinion shaft dimensions and wear limits

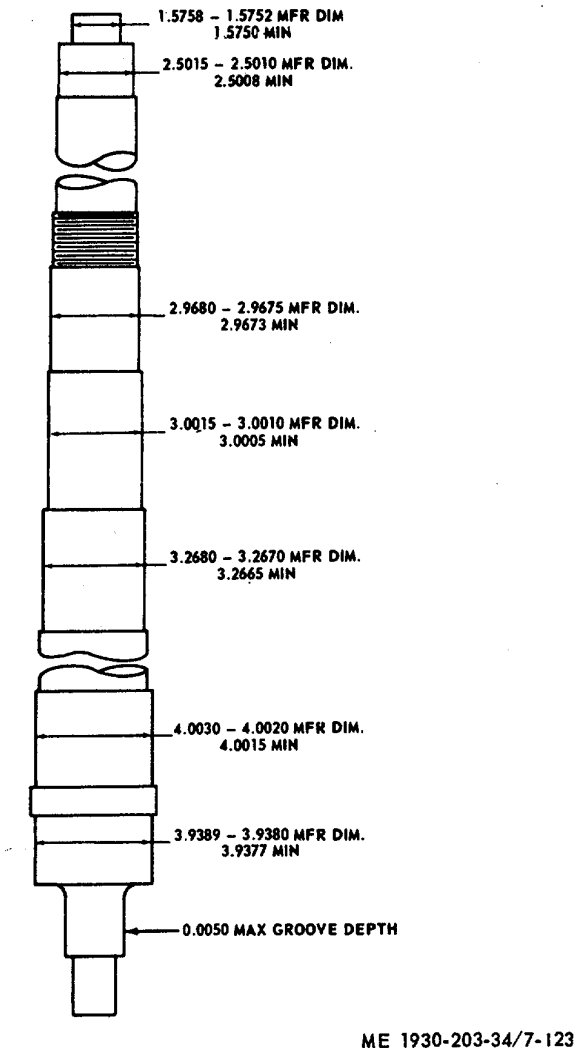


Figure 7-123. Input shaft dimensions and wear limits.

(17) Check areas of input shaft (32, FO-3) for wear. If any area of input shaft exceeds dimensions given in figure 7-123, replace shaft.

(18) Check areas of output shaft (102, FO-3) for wear. If any area of shaft exceeds dimensions given in figure 7-124, replace shaft.

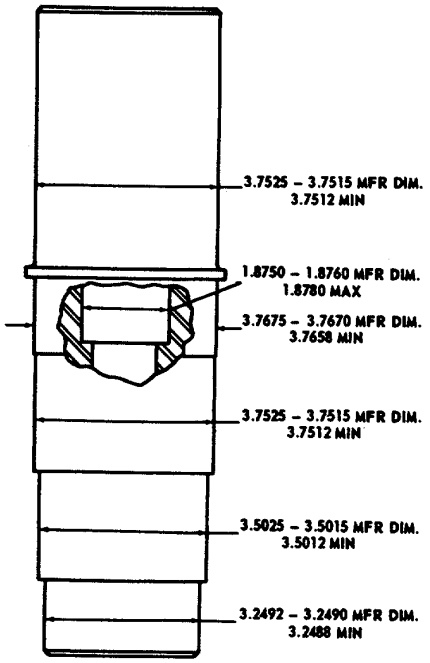


Figure 7-124. Output shaft dimension and wear limits.

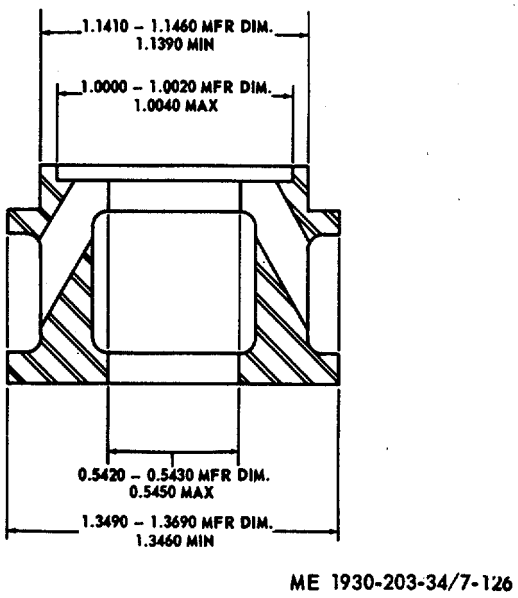


Figure 7-126. Forward oil valve dimensions and wear limits.

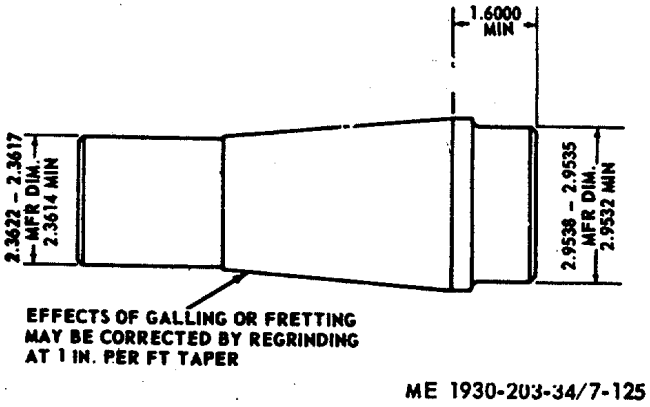


Figure 7-125. Idler shaft dimensions and wear limits.

(19) Check areas of idler shaft (82, fig. 7-118) for wear, galling, or fretting. If any area of idler shaft exceeds dimensions given in fig. 7-125, replace shaft.

(20) Inspect control tube forward oil valve (125, FO-31 !or scores, pits, and burrs. Check areas of forward oil valve as given in figure 7-126. If valve is worn beyond dimensions given, replace forward oil valve.

(21) Inspect all threaded openings for damaged threads with proper size tap. Chase damaged threads with correct size tap and e-place damaged inserts.

(22) Inspect bores for scratches, burrs, and scores. Replace damaged parts.

(23) Inspect tapered bearing cones and a-pered bearing cups for pitted, scored, or burned condition.

(24) Install new seals and gaskets.

d. Reassembly.

(1) Major components reassembly.

(a) Input shaft assembly reassembly.

1. Press reverse pinion (33, FO-3) on input shaft (32) with reverse pinion key (34) in place.
2. Press forward pinion (35) on input shaft with forward pinion key (36) in place.

NOTE

Reverse and forward pinion must be tight against shoulder.

3. Install forward pinion spacer (37) and forward bearing retainer (39) with gasket (170) on input shaft (32).
4. Press tapered bearing cups (41) and forward pinion bearing spacer (42) into forward bearing adapter (43).
5. Fasten bevel gear hub (46) to bevel gear (48) with capscrews (44) and lock wire.
6. Heat forward bearing adapter (43), tapered bearing cones (40), and bevel gear and hub .

in oil (250° to 300° F.). Install adapter assembly and input shaft shim set (45). Install heated bevel gear with bevel gear key (47) in place. These parts should rest firmly against shoulders so bearings roll freely but have no end play.

7. Secure bevel gear hub (46) on shaft with locknuts (49) and washer (50).

8. Press planetary sun gear (51) on shaft with planetary sun gear key (52) in place.

9. Press planetary housing bearing (57) on shaft.

(b) Output shaft assembly reassembly.

1. Lay forward plate (92) in press with clutch face up. Place clutch hub key (1 0 1) in center keyway of output shaft (102). Locate two drilled passages running at right angles to, and in bore of, forward plate. Locate drilled holes in output shaft and press output shaft into forward plate so drilled passages line up and keyways mate. Press forward plate to shoulder of output shaft.

2. Install piston ring (91) and forward piston ring (95) in grooves of forward plate (92), and install clutch bushing cups (90).

3. Press clutch spring retainer (89) into clutch piston (134).

NOTE

Lay clutch piston so that forward plate, piston drum assembly bushing cups, and spring retainers match. Support drum at a suitable height so that output shaft will clear the floor when assembled with piston.

4. Lightly coat piston rings (91) and forward piston ring (95) on the forward plate and their respective fits in piston drum with grease, Military Specification MIL-L-17331. Install four clutch compression springs (88) and center piston rings on forward plate.

5. Place piston ring guides at three places in piston drum splines and gently lower forward plate into place.

NOTE

Tap piston ring (91) into bore. Be sure that end of ring does not catch grooves in piston drum.

6. Lift coupling end of shaft and turn assembly upside down so assembly rests on forward end of output shaft. Install clutch hub gasket (135) on forward plate hub.

7. Install reverse piston ring (137) on reverse plate (136), using grease, Military Specification MIL-G-10924. Install four clutch compression springs (88) and grease ring bore.

8. Use piston ring guides to guide ring into place as reverse plate (136) is lowered into place. Gently tap reverse place to start ring over chamfer.

9. Install clutch dowel pins (93) and capscrews (94) securing reverse plate (136) to forward plate (92). The dowels must not stick out on either side.

10. To test clutch action, insert control tube assembly in the forward bore of the output shaft. Push tube assembly in until rings slide into valve bushing (117). Use air pressure at oil inlet fittings or passages of separator box (I 3 11. Correct positioning of tube can be obtained by sliding fore and aft until air pressure actuates the forward or reverse. Apply pressure to clutch assembly; piston drum should move without delay. Release pressure; piston drum should return to neutral position. Any drag or delay indicates faulty assembly and necessitates repair.

11. Assemble forward friction plates (96), forward pressure plate 197), and forward backing plate (98). Secure with forward retaining ring (99).

12. Install reverse friction plates (138), reverse pressure plate (139), and reverse backing plate 1140). Secure with reverse retaining ring 1141).

13. Heat forward bearing cone (103), and reverse bearing cone (142) in oil (250 to 300°F.). Install forward bearing cone (1031 and reverse bearing cone (142) to rest against shoulders of output shaft (102).

14. Press forward bearing cups (107 and 104) into forward output gear (105) to rest tightly against shoulders.

15. Install forward bearing spacer (106) tightly against forward bearing cone (103).

16. Position forward output gear (105) into inner splines of forward friction plates (96).

Heat forward bearing cone (108) in oil (250° to 300°F.). Install bearing cone against forward bearing spacer (106).

17. Heat forward bearing spacer (1091 and forward bearing cone (112) in oil (250° to 300° F.). Install spacer and bearing cone into output shaft (102). Fasten with forward retaining plate (115), capscrews (116), and lock wire.

18. Install reverse bearing spacer (145) against reverse bearing cone (142) from coupling side. Install reverse bearings cups (143 and 146) into reverse output gear (144).

19. Heat reverse bearing cone (147) and aft bearing cones (151) in oil (250 to 300°.F.).

Start reverse output gear (144 into splines of reverse friction plates (138). Install reverse bearing cone (147), reverse spacer (148), aft bearing cone (151), aft output shaft adapter (149), aft bearing cup (152), and aft bearing cone (151) on output shaft (102).

NOTE

All parts must rest against shoulders.

20. Install output shaft shim set (150), coupling bearing retainer (153), and oil seals (156). Secure with washers (154), and capscrews (155).

NOTE

Lip of outer oil seal must face outside of case and lip of inner seal must face inside of case.

21. Heat coupling half (157) in oil (250° to 300° F.), and install coupling on output shaft with coupling key (100) in place.

22. Install packing (158), packing retainer (159), and capscrews (160). Secure with lock wire.

23. Install forward bearing cup (111) in forward bearing adapter (114) and secure with forward retaining ring (110). Install forward bearing adapter on forward end of output shaft.

(c) Bevel drive assembly reassembly.

1. Press inner bevel pinion bearing cone (15) against shoulder of bevel pinion shaft (16).

2. Press bevel pinion (18) with bevel pinion key (17) on shaft tight against shoulder.

3. Press outer bevel pinion bearing cup (9) and inner bevel pinion bearing cup (14) tightly against shoulder of bearing carrier (12).

4. Position shaft and inner bevel pinion bearing cone (15) in bearing carrier (12) and press outer bevel pinion bearing cone (8) on shaft until shaft runs freely without end play.

5. Secure bearing to carrier with locknuts (6) and washer (7).

6. Pack bevel pinion oil seals (2) with grease, Military Specification MIL-G-10924, and install bevel pinion seal carrier (5) and bevel pinion oil seals (2) into position on shaft. Install washers (4) and capscrews (3) to secure bevel pinion seal carrier (5) to bearing carrier (12).

NOTE

Lip of outer oil seal must face outside of case and li) of inner seal must face inside of case.

(d) Pump planetary drive assembly reassembly.

1. Install forward bearing adapter (61) and forward bearing cup (62). Secure to planetary gear housing (53) with screws (56) from outside and stake heads of screws in position.

2. Heat forward and aft bearing cones (63 and 66) in oil (250 to 300° F.). With planetary gear housing laying flat on bench, install forward bearing cone (63) in housing. Position planetary pinion (64) in housing, and insert planetary pinion shaft (65) through inner spline of planetary pinion and forward bearing cone (63).

Position aft bearing cone (66) on planetary pinion shaft (65) against planetary pinion (64).

3. Install aft bearing cup (67) into aft bearing adapter (69). Install adapter with aft bearing shim set (68). Pinion must have no end play and no binding. Secure adapter to housing with capscrews (70) and lock wire.

(e) Control tube assembly reassembly.

1. Replace inner tube (129) and outer tube (128) into separator box (131).

2. Install washers (121 and 122), control tube spacer (126), forward oil valve (125), piston ring (124), and reverse oil valve (123), on tube assembly. Secure with nut (118), washer (120), and cotter pin (119).

(2) Major components installation.

(a) Idler shaft assembly installation.

1. Stand lower housing (165) on aft end with forward end of housing facing up, slide idler gear (81) and forward bearing spacer (79) in place with chamfer side of spacer facing forward or up.

Press aft bearing cone (84) on idler shaft (82).

2. Insert idler shaft (82) from aft through idler gear (81) and forward bearing spacer (79) with idler gear key (80) in place.

3. Install one forward bearing cone (76) by using idler shaft end plate (75) and a suitable section of pipe (maximum outside diameter 3 I inches; minimum inside diameter 21/2 inches).

Place pipe between bearing cone and retainer plate, and press bearing in place by tightening idler shaft end plate with capscrews (74). Remove capscrews and end plate after cone is installed.

NOTE

The cone must rest tightly against idler gear (81) to insure a good fit between the conical surfaces of idler gear bore and idler shaft.

4. Press forward bearing cup (77) against shoulder of forward bearing adapter (78).

5. Press forward bearing cone (76) on shaft by tightening evenly on capscrews (74) securing idler shaft end plate (75) to idler shaft and secure with lock wire.

6. Install forward bearing retainer gasket (73) and bearing retainer (72) and secure with bolts (71).

7. Install aft bearing cup (85) in aft bearing adapter (86) and secure adapter to housing with capscrews (87) and lock wire.

8. Install input shaft assembly as outlined in (b) below.

(b) Input shaft assembly installation.

NOTE

If bevel pinion (18), bevel gear (48), train of mountings locating gear and pinion to the housing, or housing has been replaced, the bevel gear set (bevel pinion and bevel gear must be replaced as a set (must be readjusted (e) below.

1. Install idler shaft assembly as outlined in (a) above.

2. Position input shaft assembly in lower housing (165). Install two socket head capscrews to secure forward bearing adapter (43) and forward bearing retainer (39) to lower housing.

3. Apply sealing compound, Military Specification MIL-S-7916, to aft high speed bearing adapter (28) to seal adapter to housing.

Install three washers (27) and three capscrews (26). Do not tighten.

4. Install two capscrews (38) on forward bearing adapter (43) in lower housing.

5. Install output shaft assembly as outlined in (c) below.

(c) Output shaft assembly installation.

1. Install input shaft assembly. as outlined in (b) above.

2. Position output shaft assembly in lower housing (165) with suitable hoist.

Lubricating hole in aft output shaft adapter (149) and coupling bearing retainer (153) must match with hole in boss of lower housing. This hole provides a passage for the return of lubricant.

3. Install three washers 1154). three capscrews (1551, and two capscrews (1131. Do not tighten.

4. Install housing as outlined in (d) below.

(d) Housing installation

1. With suitable hoist, position upper housing (20) on lower housing (165). Install three bolts (24), three washers (161), and three nuts (165). Reach through inspection holes and replace three bolts on forward flange of upper housing.

2. Install bolts (25), washers (163). nuts (164). and taper pins (19) on flange of housing.

3. Install three capscrews (38) which secure forward bearing adapter (43) to upper housing (20).

4. Install washer (27) and capscrews (26) on aft high speed bearing adapter (28).

5. Install washers (154) and capscrews (155) on aft output shaft adapter (149).

6. Install capscrews (113) on forward bearing adapter (114).

7. Install bevel drive assembly. pump planetary drive assembly, and control tube assembly as outlined in (e), (f) and (g) below.

8. Install inspection covers (21), washers (22), and capscrews (23).

(e} Bevel drive assembly installation.

NOTE

If bevel pinion (18), bevel gear (48), train of mounting securing gear and pinion to housing. or housing has been replaced. the bevel gear set (bevel pinion and bevel gear must be replaced as a set) must be readjusted as outlined in e below.

1. Install bevel drive assembly with original bevel pinion shim set (13) in upper housing (20) of right-hand unit (lower housing (165 of left-hand unit).

2. Secure bevel drive assembly to housing with washers (11) and capscrews (10).

(f) Pump planetary drive assembly installation.

l. With suitable hoist. position planetary drive assembly and start planetary sun gear (51) into planetary pinions (64). Rotate pinion to mesh with gear teeth.

2. Apply sealing compound. Military Specification MIL-S-7916 to flange and secure with washers (54) and capscrews (55).

(g) Control tube assembly installation.

1. Install separator gasket (130) and slide control tube assembly in output shaft.

2. Apply sealing compound. Military Specification MIL-S-7916 to contact surface of separator box cap (132).

3. Position cap with two pipe threads across upper and lower housing matching holes in separator box (131).

(3) Press bearing (60. fig. 2-24) into pump mounting adapter (61).

(4) Position gasket (59) on oil pump (57) and install pump mounting adapter on pump.

(5) Install key (58) and oil pump drive spur gear (62) on pump shaft with gear hub flush with end of pump shaft. Tighten setscrew (63) and stake mark around setscrew to present loosening.

(6) Install adapter (56), elbow (67) and swivel joint (65) on oil pump.

(7) Insert oil pump into marine gear, engaging gear, and install capscrews (66).

(8) Secure control valve (73) to marine gear with capscrews (75) and lockwashers (74).

(9) Install swivel joint (70) and elbow (69) on control valve.

(10) Install flexible hoses (64. 68 and 71).

(11) Secure lube manifold (47) to marine gear with capscrews (48) and lockwashers (49).

(12) Install elbows (45 and 46) on oil manifold.

(13) Install flexible hoses (44 and 50 through 55).

e. Adjustment. Adjust marine gear bevel gear set as follows:

NOTE

The bevel gear set must be readjusted if any gear set (bevel pinion (18) and bevel gear (48) must de replaced as a set) or the train of mountings securing the gear and pinion to housing, or housing has been replaced.

(1) Lay upper housing (20) with inside facing up (lower housing (165) for left-hand units). Lower input shaft assembly in upper housing with original input shaft shim set (45). Install three capscrews .

(38) to secure input shaft assembly to upper housing.

(2) Install bevel drive assembly in upper housing with original bevel pinion shim set (13). Secure with washers (11) and capscrews (1O).

(3) Lightly coat several teeth on bevel gear (48) with gear marking compound, red lead, Military Specification TT-R-191, Type 11.

(4) Check backlash in gear set by securing indicator rigidly to case with actuator point against and perpendicular to gear face. Backlash should be 0.008 to 0.012 inch.

(5) Rotate bevel pinion shaft (16) sufficiently to mark pinion tooth contact with compound painted on driven gear. Ideal tooth contact is slightly nearer toe than heel (A, fig. 7-112).

(6) When contact is too high on pinion and too low on driven gear, pinion is too near center (B, fig. 7-112). If backlash is too small, shim pinion away from center. If backlash is too great, shim driven gear toward pinion.

(7) When contact is too low on pinion and too high on driven gear, pinion is too far from center (C, fig. 7-112). If backlash is too great, shim pinion toward center. If backlash is too small, shim driven gear away from center.

(8) Repeat (6) and (7) above until proper tooth contact and backlash is obtained.

(9) Remove capscrews (10, FO-3), and washers (11), and lift bevel drive assembly from upper housing. Keep bevel pinion shim set (13) with bevel drive assembly.

(10) Remove capscrews (38) from input shaft assembly, and lift input shaft assembly from upper housing (20).

f. Installation. Refer to paragraph 2-27.

7-18. Oil Coolers

a. Description. The LARC employs four cooling systems, one for each engine, so that failure of any engine will not affect the other engines. Two oil coolers are connected in parallel in each cooling system and are used for cooling the marine gear and gathering box lubricating oil. The oil coolers function as heat exchangers. Water circulates through a tube in the center of the oil cooler and lubricating oil around the tube through passageways. One marine gear and one gathering box oil cooler are associated with each cooling system; therefore in the event of an engine failure, the lubricating oil will still be cooled. The top two oil coolers on each side are associated with the aft engine cooling system, whereas, the bottom two oil coolers are associated with the forward engine cooling system.

b. Removal and Disassembly.

(1) Determine which cooling system is associated with oil cooler (8 or 27, fig. 7-127) to be removed, and drain coolant from that system (TM .55-1930-203-20).

(2) Provide a suitable container, remove drain plugs (24), and drain lubricant from oil cooler.

(3) Loosen hose clamps 1181 and slide hoses (17) off nipples (19).

(4) Remove oil lines and fittings from oil cooler.

(5) Remove four bolts (23), lockwashers (2) nuts (1), and straps (3) and remove oil cooler.

(6) Remove nipples (19) from oil cooler.

(7) Remove capscrews (20) and remove oil cooler bonnets (21) and gaskets (22) from oil cooler core (25).

c. Cleaning, Inspection and Repair.

(1) Clean oil cooler bonnet (21, fig. 7-127) and core (25) using procedure and solution as outlined in paragraph 3-15c(1) through (3).

(2) Replace oil cooler bonnet or core if split, cracked, or otherwise rendered unserviceable. Replace gaskets (22).

(3) Inspect zinc anodes (36) and clean or replace as necessary.

d. Reassembly and Installation.

(1) Install oil cooler bonnets (21, fig. 7-127) and gaskets (22) on core (25) using capscrews (20).

(2) Install nipples (19) in oil cooler (8 or 27).

(3) Position oil cooler and work hoses (17) onto nipples (19).

(4) Secure oil cooler using straps (3), bolts (23), lockwashers (2). and nuts (1), then tighten hose clamps (18).

(5) Install drain plugs (24) and oil lines and fittings on oil cooler.

(6) Fill associated cooling system (TM 55-1930-203-20).

(7) If oil cooler (8) has been removed, fill gathering box to proper level as shown on dipstick. If oil cooler (27) has been removed. fill marine gear to proper level as shown on dipstick. Refer to LO .55-1930-203-12 for proper lubricant.

(8) Run appropriate engine for a period sufficient to allow oil to circulate through oil coolers. Shut down engine and recheck oil level. Fill as necessary.

7-19. Propeller

a. Removal. Refer to paragraph 2-28.

b. Cleaning.

(1) Apply hydrochloric acid or muriatic acid to propeller with a brush to remove all underwater corrosion.

(2) Wipe propeller clean with a damp cloth and then dry thoroughly with a dry cloth.

Key to figure 7-127.

1 Nut
2 Lockwasher
3 Strap
4 Hose, flexible, oil cooler-to-oil cooler, gathering box
5 Adapter, 90°
6 Elbow, street, 900
7 Bushing
8 Oil cooler, gathering box
9 Tubing, gathering box oil pressure
10 Nipple
11 Bushing
12 Hose, flexible, oil supply to oil cooler, gathering box
13 Bushing
14 Tee
15 Nipple, close
16 Bushing
17 Hose
18 Clamp, hose
19 Nipple
20 Capscrew
21 Oil cooler bonnet
22 Gasket, oil cooler
23 Bolt, machine
24 Drain plug
25 Oil cooler core
26 Elbow, street
27 Oil cooler, marine gear
28 Elbow, street
29 Nipple
30 Elbow, 90°
31 Adapter, straight
32 Hose, flexible, oil cooler-to-oil cooler, marine gear
33 Hose, flexible, oil supply-from oil cooler, gathering box
34 Adapter, 90°
35 Hose, flexible, oil supply-from-oil cooler, marine gear
36 Zinc anode .

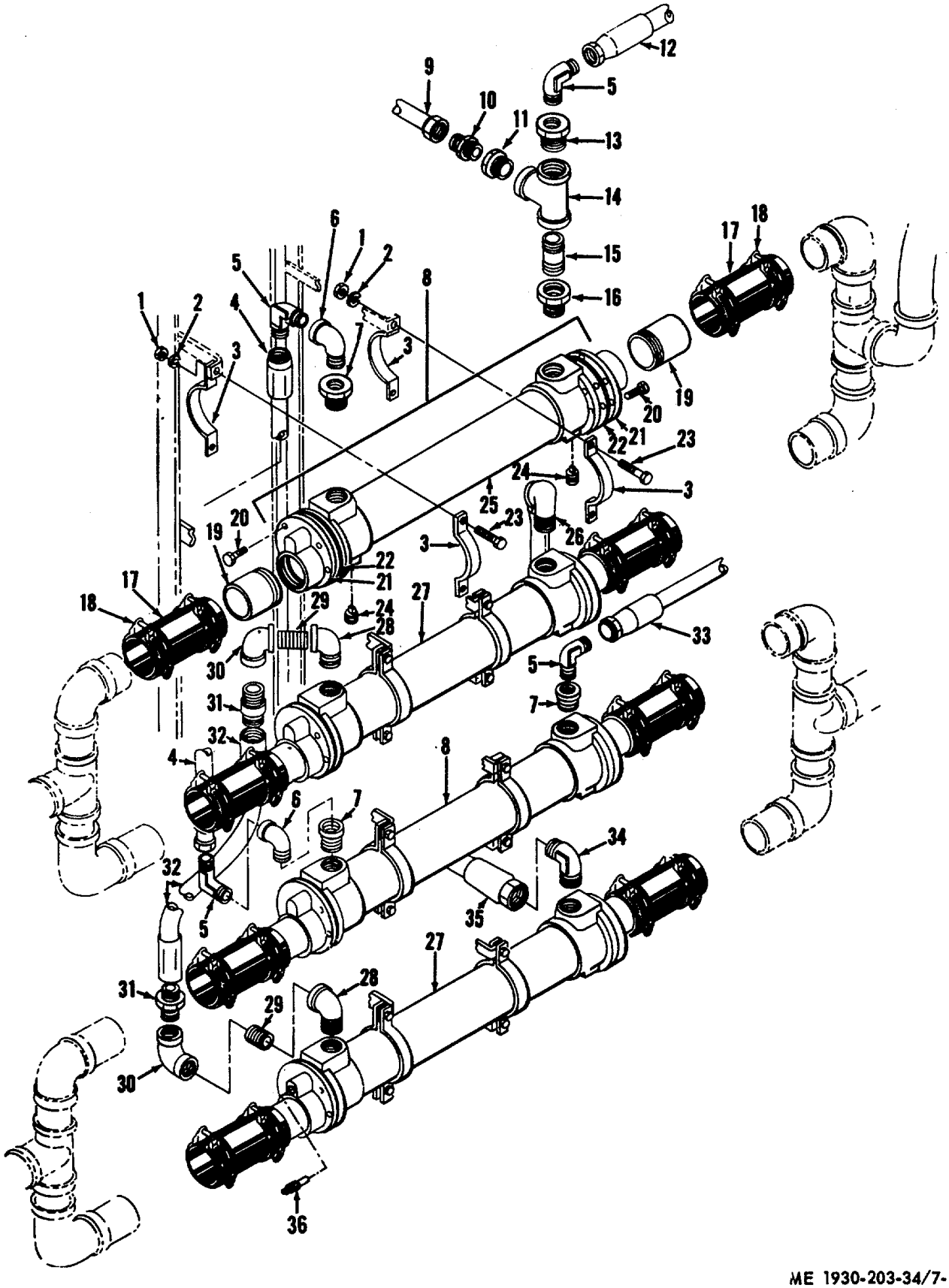


Figure 7-127. Oil coolers

(3) Rub jewelers rouge over both sides of propeller blades and polish blades with a buffing wheel.

c. Inspection and Repair.

(1) Inspect propeller for bent blades and chipped or curled edges. If propeller is badly damaged, replace it with a new one.

(2) Inspect lockbolt (1, fig. 2-25), fairwater nut (2), and machine key (4) for good condition. Replace defective part.

d. Installation. Refer to paragraph 2-28.

7-20. Propeller Shafting

a. Intermediate shaft.

(1) *Removal.* Refer to paragraph 2-28.

(2) *Cleaning, inspection and repair.*

(a) Clean all parts in dry-cleaning solvent, Federal Specification P-D-680, and dry with low pressure air (10 psi).

(b) Inspect thrust bushings (22 and 26, fig. 2-25) for elongation of holes and flexible inserts (21 and 27) for signs of chipping or cracking. Replace damaged bushings or flexible inserts.

(c) Replace a bent intermediate shaft (24).

(3) *Installation.* Refer to paragraph 2-28.

b. Propeller Shaft.

*(*1) Removal. Refer to paragraph 2-28.

(2) *Cleaning and inspection.*

*(*a) Clean all parts in dry-cleaning solvent, Federal Specification P-D-680, and dry with low pressure air (10 psi). Remove corrosion or rust from propeller shaft (5, fig. 2-25) with emery paper.

*(*b) Inspect propeller shaft sleeves for wear (table 1-3). If sleeves are worn below maximum allowable tolerance, refer to depot maintenance personnel.

NOTE

If sleeves were replaced because of worn condition, disassemble stern tube and strut tube and check bushings.

(c) Check propeller shaft hub (16, fig. 2-25), shaft nut (17), and nut lockwasher (18) for good condition. Replace a damaged hub, nut, or lockwasher.

(3) *Installation.* Refer to paragraph 2-28.

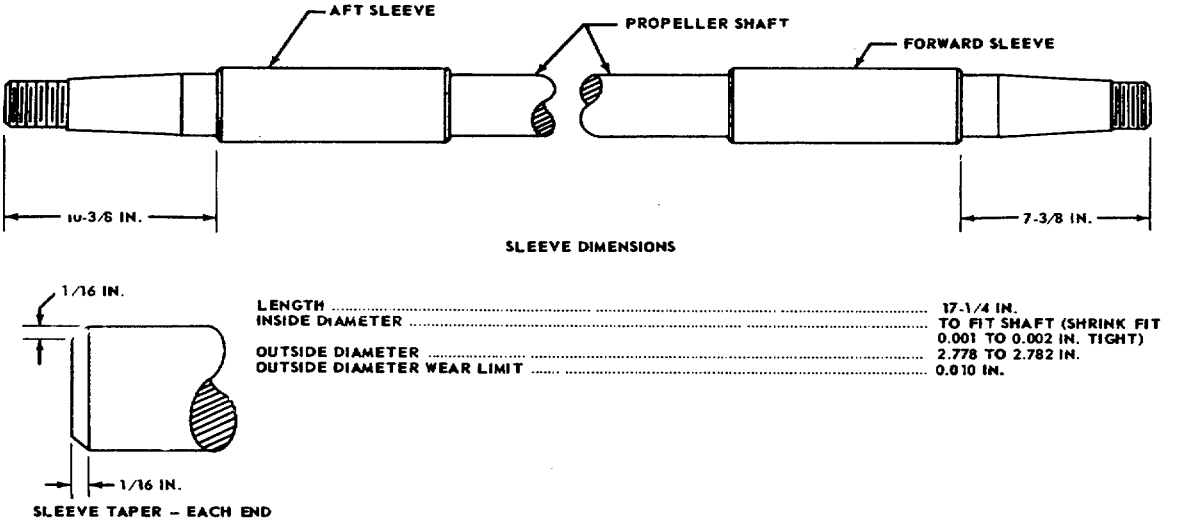


Figure 7-128. Propeller shaft sleeves.

7-21. Stern Tube

a. Disassembly, Cleaning, Inspection, Repair and Reassembly.

(1) Disassembly.

(a) Remove propeller shaft (para 2-28).

(b) Remove capscrews (15, fig. 7-129) and washers (14) which secure packing gland (13) to stuffing box (10).

(c) Slide gland out and remove packing retainer (12).

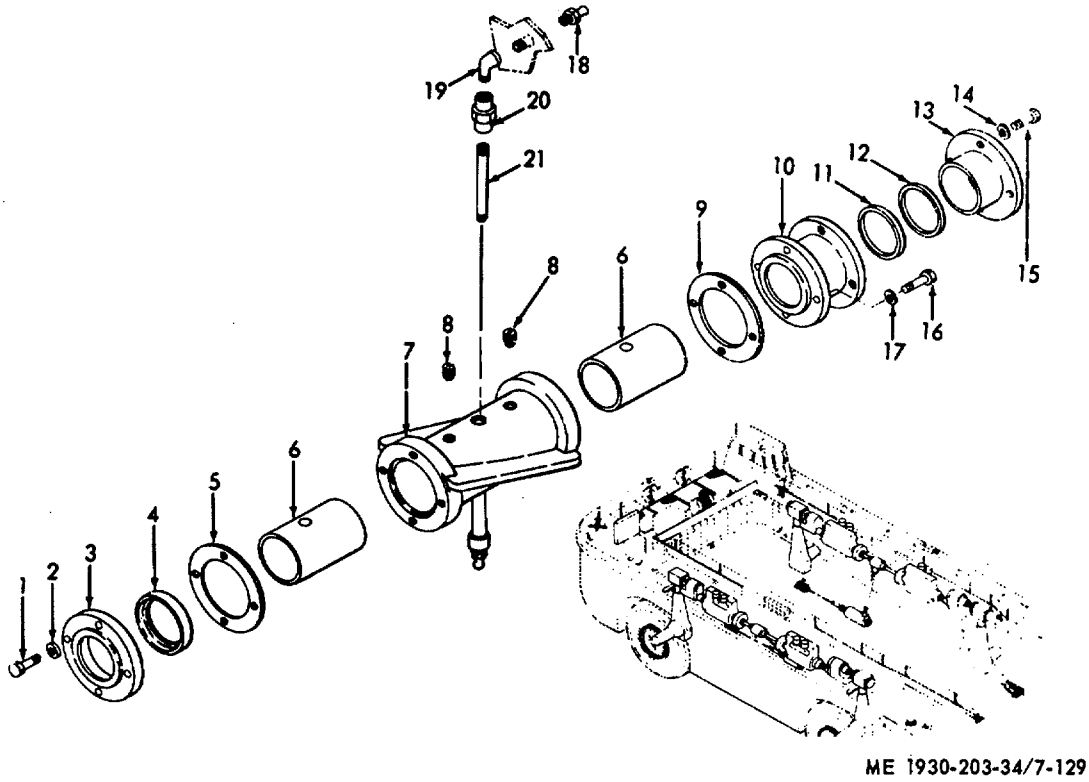
(d) Remove packing (11) from stuffing box.

(e) Remove capscrews (16) and washers

(17) which secure stuffing box to stern tube (7) and remove stuffing box and gasket (9).

(f) Remove capscrews (1 and washers (2) which secure seal retainer (3) and remove seal retainer and gasket (5).

(g) Press seal (4) out of seal retainer.



1 Capscrew
2 Washer
3 Seal retainer
4 Seal
5 Gasket
6 Bushing
7 Stern tube
8 Setscrew
9 Gasket
10 Stuffing box
11 Packing
12 Packing retainer
13 Packing gland
14 Washer
15 Capscrew
16 Capscrew
17 Washer
18 Fitting, lubrication, ⅛ in.
19 Elbow, pipe
20 Union, pipe
21 Pipe, steel

Figure 7-129. Stern tube.

(h) Remove setscrews (8) and slide bushings (6) out of stern tube.

(*2*) *Cleaning, inspection and repair.*

(a) Clean all parts, except seal (4, fig. 7-129), gaskets (5 and 9), and packing (11), in dry-cleaning solvent, Federal Specification P-D-680 and dry with low pressure air (10 psi).

(b) Replace seal (4), gaskets (5 and 9), and packing (11).

(c) Inspect bushings (6) for excessive wear (table 1-3). Replace bushing if worn beyond permissible limits.

(d) Check seal retainer (3), stuffing box (10), packing retainer (12), and packing gland (13) for good condition. Replace a damaged part.

(e) Check stern tube for damage. Replace if necessary.

(3) *Reassembly.*

(a) Slide bushings (6, fig. 7-129) into position with open end of grease grooves toward center of stern tube (7).

NOTE

If new bushings are to be installed, locate bushings so that bushing end is flush with face of stern tube and punch-nark bushing through setscrew hole. Drill a 5/16 inch hole through bushing at punch-mark. Remove burrs and filings from bushing.

(b) Install setscrews (8).

(c) Press seal (4) into seal retainer (3) and install seal retainer and gasket (5). using capscrews (1) and washers (2).

(d) Install stuffing box (10) and gasket (9) using capscrews (16) and washers (17).

(e) Install propeller shaft (para 2-28).

b. Removal and Installation. These are depot functions.

7-22. Strut Tube

a. Disassembly. Cleaning, Inspection. Repair and Reassembly.

(1) *Disassembly.*

(a) Remove propeller shaft (para 2-28).

(b) Remove capscrews (1, fig. 7-130) and washers (2) and remove seal retainers (3), gaskets (5), and rope guard (6).

(c) Press seal (4) out of seal retainer.

(d) Remove setscrews (9) and slide bushings (7) out of strut casting (8).

(2) Cleaning. inspection and repair.

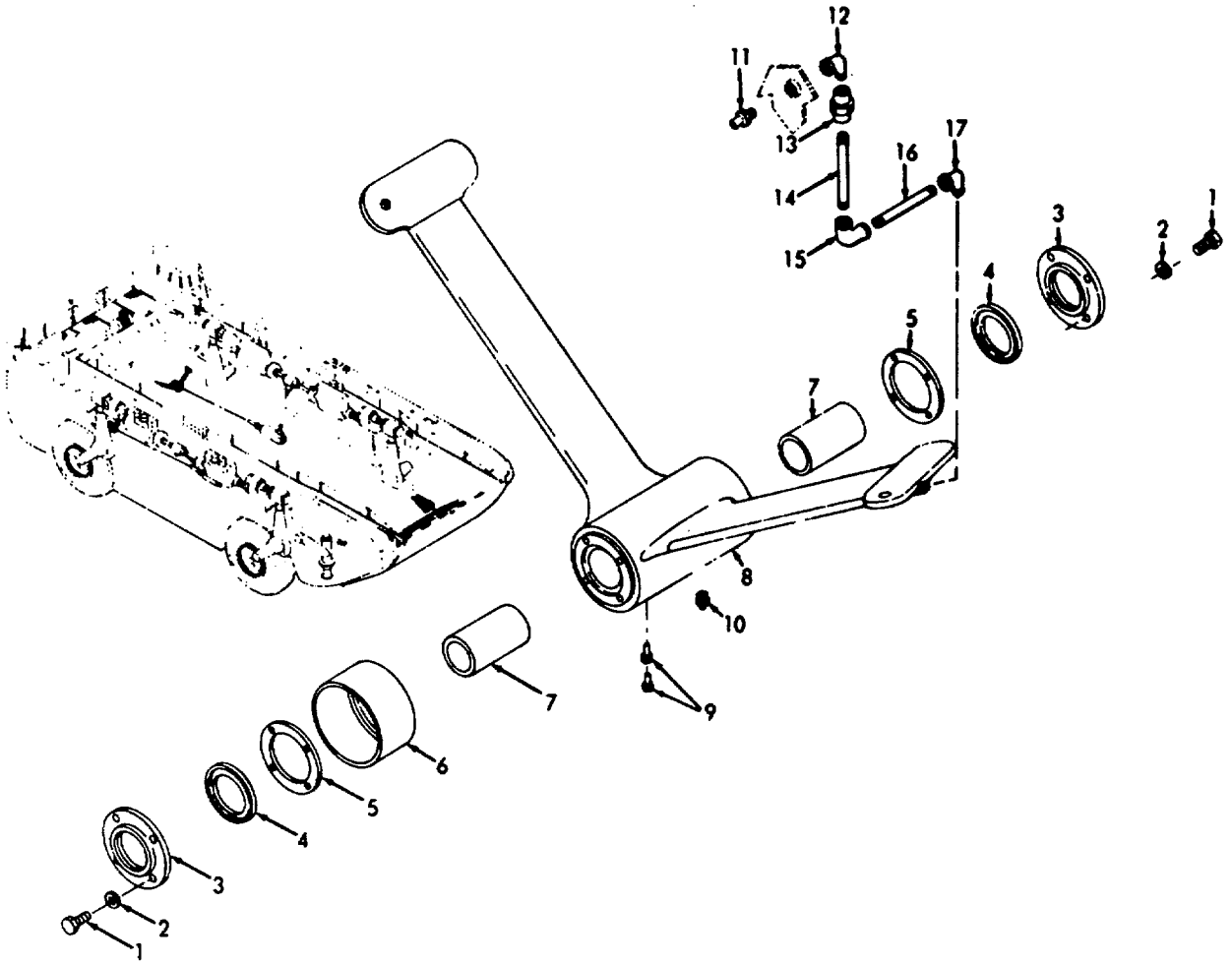
(a) Clean all parts, except seals (4, fig. 7-130) and gaskets (5), in dry-cleaning solvent, Federal Specification P-D-680,. and dry with low pressure air (10 psi).

(b) Replace seals (4) and gaskets (5).

(c) Inspect bushings (7) for excessive wear (table 1-3). Replace bushing if worn beyond permissible limits.

(d) Check seal retainer (3) and rope guard (6) for good condition. Replace a damaged seal retainer or rope guard.

(e) Check strut casting (8) for damage. Replace if necessary.



1 Capscrew
2 Washer
3 Seal retainer
4 Seal
5 Gasket
6 Rope guard
7 Bushing
8 Strut casting
9 Setscrew
10 Fitting, lubrication
11 Fitting, lubrication
12 Elbow, pipe
13 Union, pipe
14 Pipe, steel
15 Elbow, pipe
16 Pipe, steel
17 Elbow, pipe

Figure 7-130. Strut tube.

(3) *Reassembly.*

(a) Slide bushings (7, fig. 7-130) into position with open end of grease grooves toward center of strut casting (8).

NOTE

If new bushings are to be installed, locate bushings so that bushing end is flush with face of strut casting and punch-mark bushing through setscrew hole. Drill a 5/16 inch hole through bushing at punch-mark. Remove burrs and filings from bushing.

(b) Install setscrews (9).

(c) Press seal (4) out of seal retainer (3) and install seal retainers (3), gaskets (5) and rope guard (6) using capscrews (1) and washers (2).

(d) Install propeller shaft (para 2-28).

b. Removal and Installation. This is depot function.

CHAPTER 8

STEERING SYSTEM

Section I. INTRODUCTION

8-1. Description

Land steering (fig. 8-1) is accomplished by turning the column and wheel drives. Hydraulic steering cylinders are used to turn the column and wheel drives. Control of the hydraulic steering cylinders is effected by hydraulic control valves and a mechanical differential linkage. The steering levers in the cab operate their respective hydraulic control valves through jackshafts, steering rods, and bell cranks. The follow-up rods, attached to the port wheel columns, center corresponding hydraulic control valves when wheels turn to the desired direction.

NOTE

Hydraulic components of the steering system are covered in Chapter 10. The column and wheel drive assemblies are covered in paragraph 7-10.

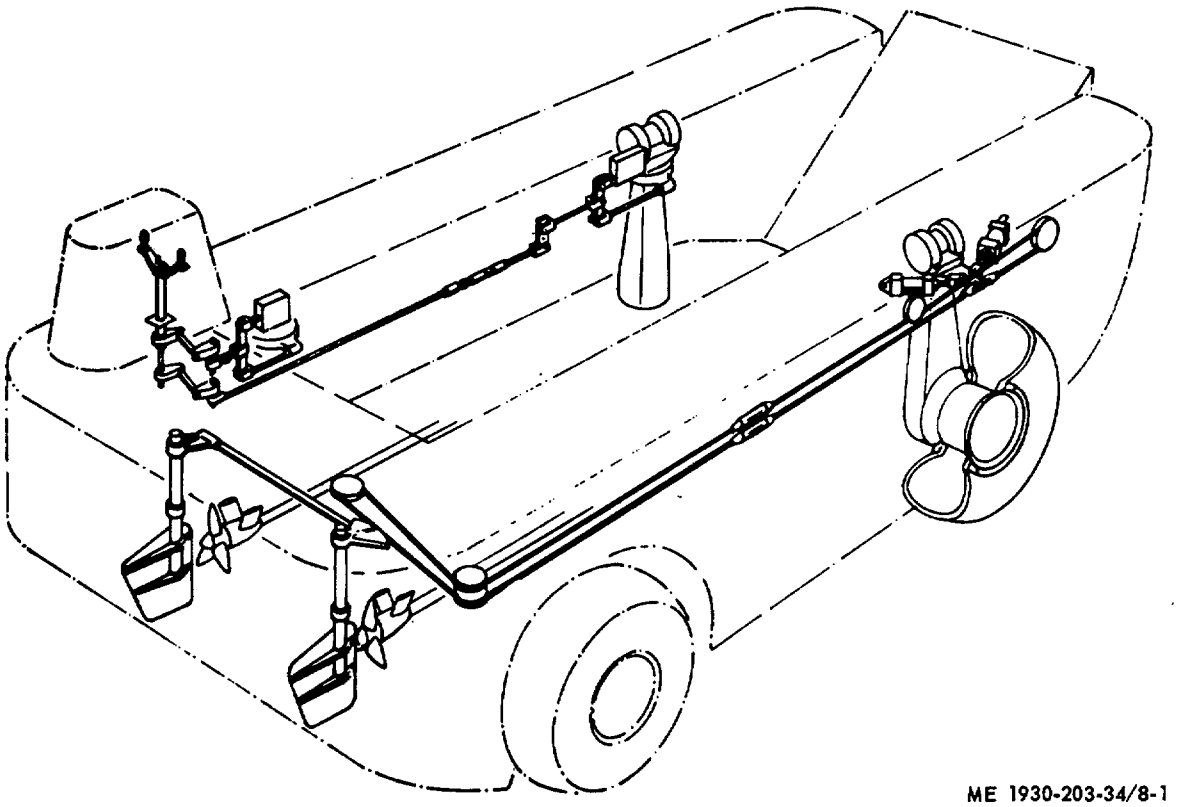


Figure 8-1. Steering schematic.

8-2. Land Steering

a. Steering Column and Jackshaft Box.

(1) *Removal and disassembly of steering column.*

(a) Disconnect tie rods (11, fig. 8-2) from bellcranks (39 and 46) by removing cotter pins (33), bolts (42), lockwashers (41), washers (32), and nuts (37).

(b) Remove cotter pin (34), nut (35), and washer (36) from lower end of inner steering column (6).

(c) Loosen setscrew (38) and slide lower steering column bellcrank (39) and key (40) off inner steering column.

(d) Remove bolts (43), lockwashers (47),

and nuts (48) and remove lower steering column bearing (44).

(e) Raise inner steering column, slide washer (8) up shaft, and remove inner needle bearings (59).

(f) Loosen setscrew (49), and slide upper steering column bellcrank (46) and key (50) off of outer steering column (9) and inner steering column.

(g) Remove bolts (51), lockwashers (53), and nuts (54) and remove upper steering column bearing (52).

(h) Remove screws (55) from bearing retainer ring (56). Slide bearing retainer down outer steering column and remove outer needle bearings (57).

(i) Unbolt upper steering column support from instrument panel and remove inner steering column (6), flat washer (58), and outer steering column (9).

(j) Loosen cap (41 holding spring (5).

(k) Remove screw (3) and pin (2).

(l) Remove cap (4) and remove spring (5).

Key to figure 8-2.

1 Hand grip
2 Pin
3 Screw, machine
4 Cap
5 Spring
6 Inner steering column
7 Lubrication fitting
8 Washer, flat
9 Outer steering column
10 Bolt, machine
11 Tie rod
12 Nut, castellated
13 Pin, cotter
14 Washer
15 Key
16 Upper jackshaft bellcrank
17 Setscrew
18 Pin, cotter
19 Bolt, machine
20 Doubler
21 Jackshaft bearing
22 Lockwasher
23 Lockwasher
24 Nut
25 Steering arm
26 Gasket
27 Jackshaft
28 Washer
29 Washer
30 Bolt, machine
31 Nut, castellated
32 Washer
33 Pin, cotter
34 Pin, cotter
35 Nut, castellated
36 Washer
37 Nut, castellated
38 Setscrew
39 Lower steering column bellcrank
40 Key
41 Lockwasher
42 Bolt, machine
43 Bolt, machine
44 Lower steering column bearing
45 Jackshaft box
46 Upper steering column bellcrank
47 Lockwasher
48 Nut
49 Setscrew
50 Key
51 Bolt, machine
52 Upper steering column bearing
53 Lockwasher
54 Nut
55 Screw, machine
56 Bearing retainer ring
57 Outer needle bearings
58 Washer, flat
59 Inner needle bearings

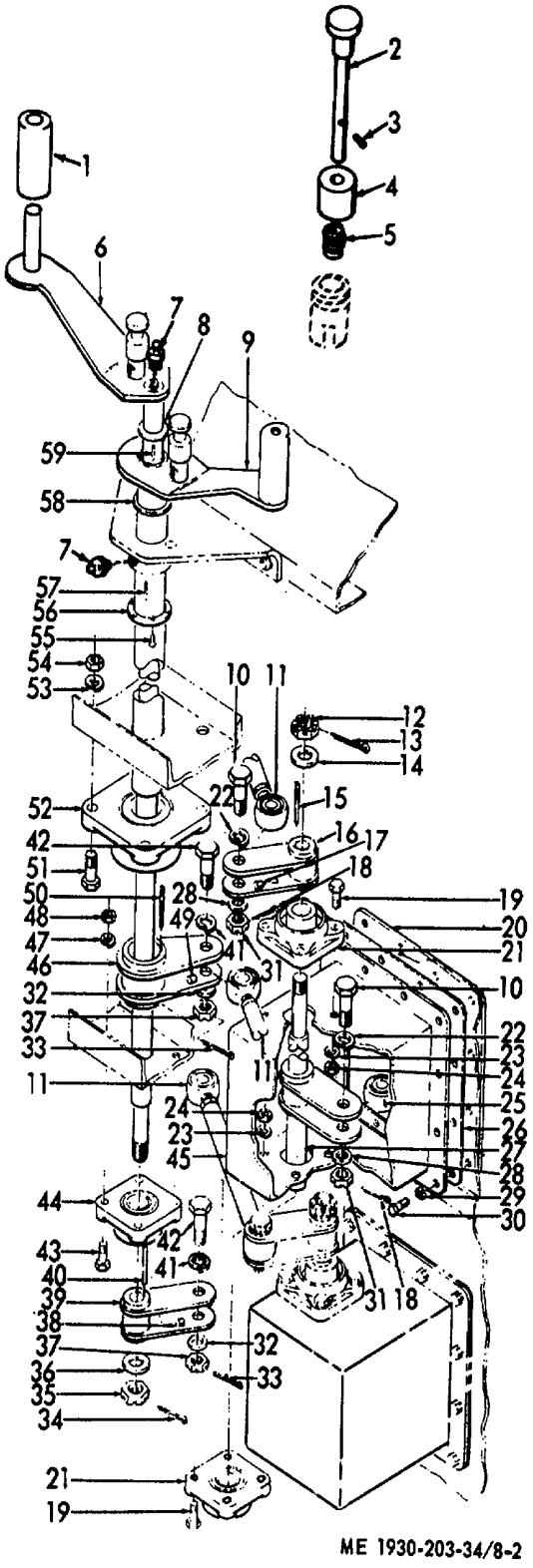


Figure 8-2. Steering column and jackshaft box.

(2) *Removal and disassembly of jackshaft box.*

(a) Remove tie rods (11, fig. 8-2) from upper jackshaft bellcrank (16) and steering arms (25) from jackshaft (27) by removing cotter pins (18), bolts (10), lockwashers (22), washers (28), and nuts (31).

(b) Remove bolts (30) and washers (29) securing jackshaft box (45) to doubler (20) and remove jackshaft box and gasket (26).

(c) Remove cotter pin (13), nut (12), and washer (14). Loosen setscrew (17) and slide upper jackshaft bellcrank (16) and key (15) off jackshaft.

(d) Remove bolts (19), lockwashers (23), and nuts (24) and remove jackshaft bearings (21).

(e) Lift jackshaft and remove from open end of jackshaft box.

(3) *Cleaning, inspection and repair.*

(a) Clean all metal parts in dry-cleaning solvent, Federal Specification P-S-661. Dry parts thoroughly with compressed air (10 psi).

(b) Inspect needle bearings for free rotation, broken or missing rollers, and tightness of fit in bore. If any defects are found, replace bearing.

(c) Inspect thrust washers for distortion, burrs, and wear. Replace damaged washers.

(d) Examine gasket for deterioration, cuts, and hardness. Replace defective gasket.

(e) Inspect bearings for scored, scratched, cracked, or chipped races and for indication of excess wear of rollers. Replace damaged bearing.

(f) Inspect bearing housing and shaft for burred, galled, and scored conditions that would indicate the bearing has been turning in its housing or on its shaft. If the damage cannot be repaired pith crocus cloth, Federal Specification P-C-458, replace defective part.

(g) Inspect columns for burrs, nicks, cracks, and warpage. If any defect is found, rework or replace column.

(h) Inspect hand grips (1, fig. 8-2) for loose, broken, or deteriorated condition. If hand grips are damaged, remove grips and clean pipes. Apply adhesive, Military Specification MIL-A-1154, to new hand grips and install hand grips. If hand grips are loose, replace adhesive.

(i) Inspect jackshaft (27) for a bent shaft and signs of scoring or loose fit in bearing area. If any of these conditions exist, replace jackshaft.

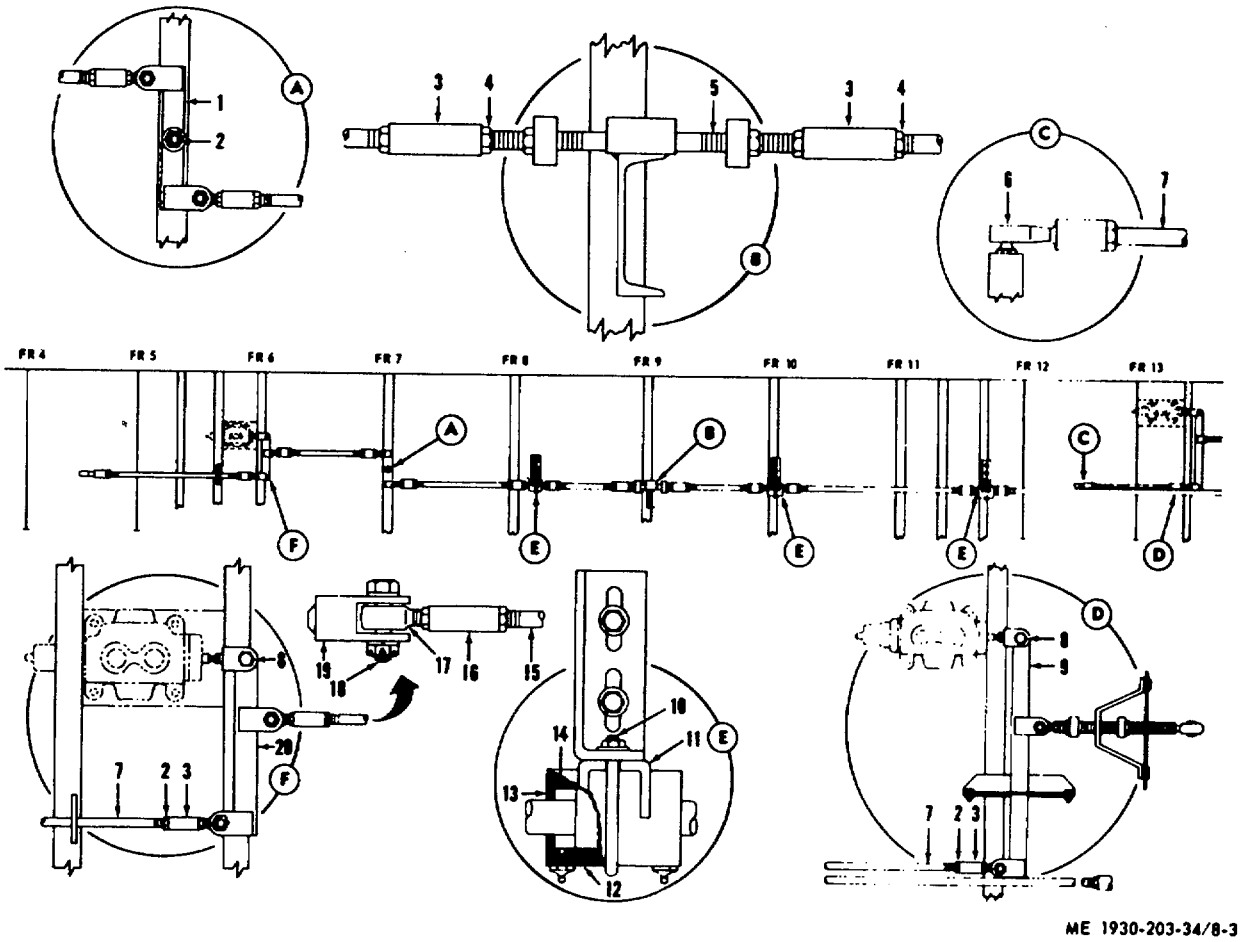
(4) *Reassembly and installation.*

(a) Reassemble and install steering column in reverse order of removal and disassembly.

(b) Reassemble and install jackshaft box in reverse order of removal and disassembly.

b. Follow-up-System.

(1) *Description.* The follow-up system is a mechanical differential linkage consisting of steering rods, follow-up rods, and differential arms which connects the steering hydraulic system to the steering column assembly. The differential arms are connected to the steering control valves, steering rods, and follow-up rods to provide a means for controlling the fluid flow to the steering cylinders (fig. 8-3).



1	Bellcrank	11	Bearing support
2	Nut	12	Steering rod bearing assembly
3	Steering rod joint	13	Seal
4	Jamnut	14	Ball bushing
5	Steering rod	15	Steering rod
6	Ball joint	16	Jamnut, control valve
7	Follow-up rod	17	Tie rod
8	Bolt, machine	18	Bolt, machine
9	Aft differential arm	19	Clevis, differential arm
10	U-bolt	20	Forward differential arm

Figure 8-3. Follow-up system diagram.

(2) *Removal and disassembly.*

(a) Disconnect steering rod-end bearing (6, fig. 8-4) nearest to steering rod to be removed by removing cotter pin (12), bolt C7), washer (8), lockwasher (10), and nut (11).

(b) Loosen jamnut 121 at nearest joint and unscrew steering rod.

(c) Disconnect steering rod at rod joint (15) on each side of steering rod bearing assembly (21).

(d) Remove nuts (18), washers (19), and

U -bolt (23) which secure steering rod bearing assembly.

(e) Remove jamnuts from steering rod and slide steering rod out of steering rod bearing assembly, being careful not to damage ball bushing (34) with threads on steering rod.

(f) Remove seals (32) and ball bushing from steering rod bearing housing (33).

(g) Remove ball joints (17) and follow-up arm connectors (16).

(h) Remove nut (28) and washer (27) and remove bellcrank (26) and washer (25).

(3) *Cleaning, inspection and repair.*

(a) Clean all parts, except seals (32, fig. 8-4). in dry-cleaning solvent, Federal Specification P-D-680, and dry with low pressure air 110 psi).

(b) Inspect steering rods (5) and steering rod joints (15) for wear and corrosion. Replace badly worn or corroded parts.

(c) Inspect bellcrank spindle (24) for scored condition. Replace a badly scored spindle.

(d) Inspect ball bushing (34) and bearings in steering rod-end bearings for pitted. scored, or burned condition.

(e) Replace seals (32).

(f) Inspect bellcrank (26) for cracks, breaks, or elongated holes. Replace bellcrank if any of these conditions are found.

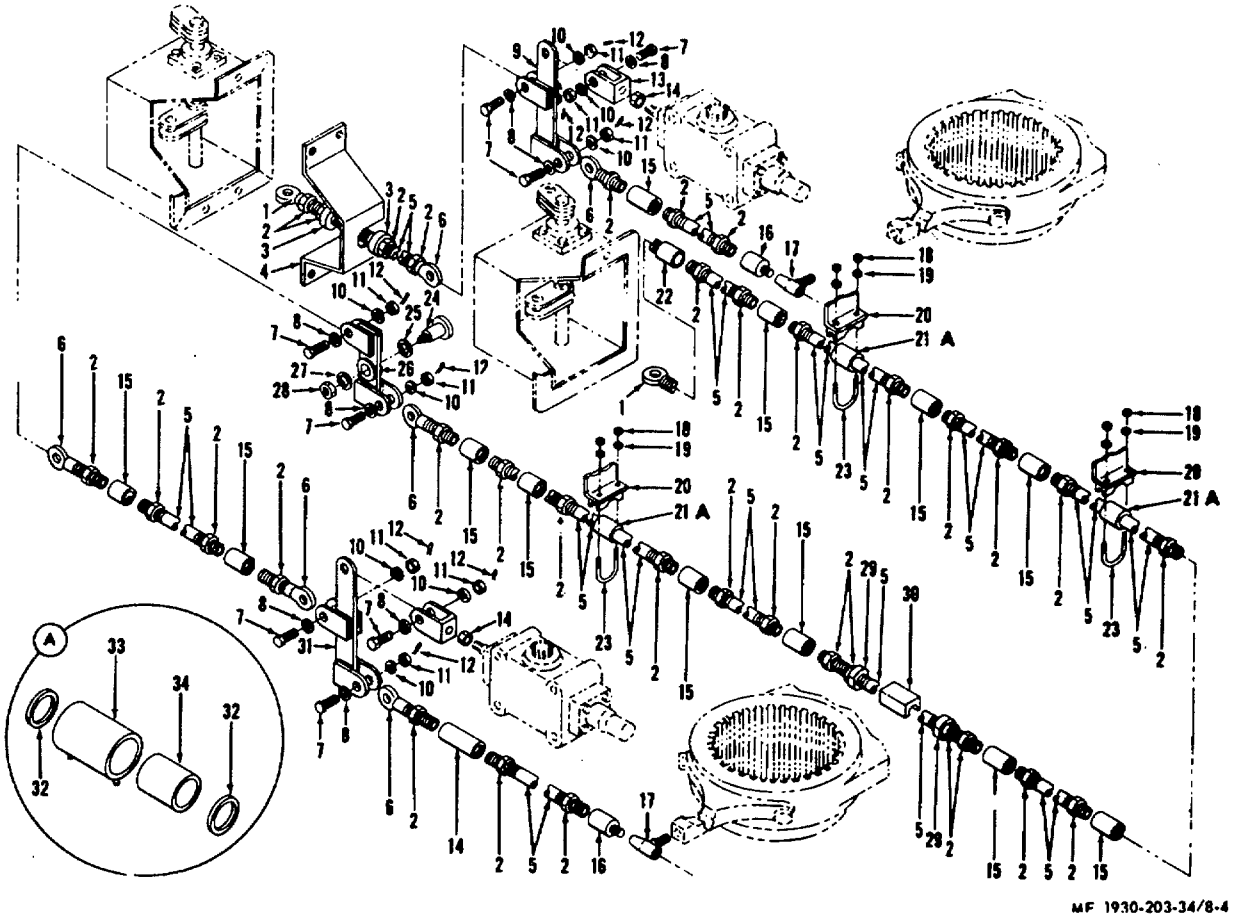


Figure 8-4. Follow-up system.

Key to figure 8-4.

1 Steering rod end bearing, jackshaft box
2 Jamnut
3 Steering stop
4 Steering limit bracket
5 Steering rod
6 Steering rod-end bearing
7 Bolt, machine
8 Washer, flat
9 Aft differential arm
10 Lockwasher
11 Nut
12 Pin, cotter
13 Control valve end shackle
14 Jamnut, control valve
15 Steering rod joint
16 Follow-up arm connector
17 Ball joint
18 Nut
19 Washer
20 Bearing support
21 Steering rod bearing assembly
22 Steering rod connector
23 U-bolt
24 Bellcrank spindle
25 Washer, flat
26 Bellcrank
27 Washer, flat
28 Nut
29 Steering stop
30 Steering limit block
31 Forward differential arm
32 Seal
33 Steering rod bearing housing
34 Ball bushing

(4) *Reassembly and installation.* Reassemble and install follow-up system in the reverse order of removal and disassembly.

(5) *Adjustment.*

NOTE

Bulkhead no. 14 access cover (21, fig. 1-2, TM55 1930-203-20) must be removed to gain access to aft steering follow-up stops.

(a) Loosen jamnuts (2, fig. 8-5) on forward steering several turns and back off steering stops (3 and 5).

(b) Push left steering lever forward and hold.

(c) After port forward steering cylinder is fully extended, screw aft steering stop (5) until stop strikes steering limit block (4).

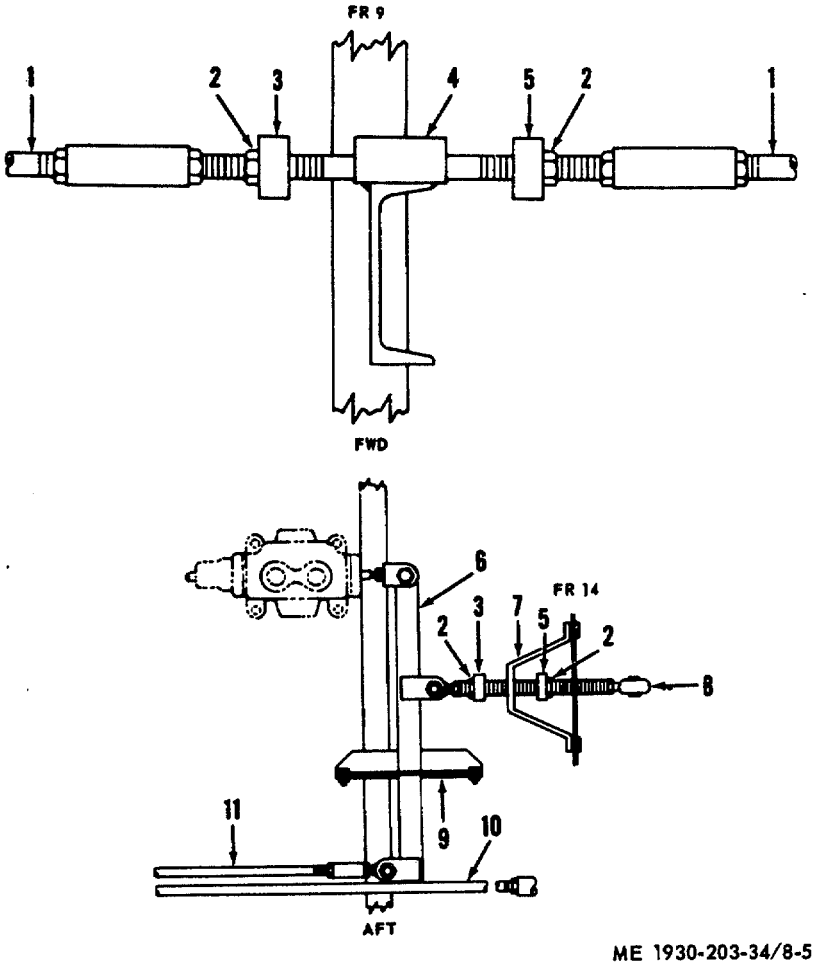
(d) Continue screwing aft steering stop (5) until steering pressure gage in cab indicates pressure drop.

(e) Lock aft steering stop with jamnut (2).

(f) Pull left steering lever aft and hold.

(g) After port forward steering cylinder is fully retracted, screw forward steering stop (3) until stop strikes steering limit block (4).

(h) Continue screwing forward steering stop (3) until steering hydraulic pressure gage in the cab indicates pressure drop.



1 Steering rod
2 Jamnut
3 Forward steering stop
4 Steering limit block
5 Aft steering stop
6 Differential arm
7 Steering limit block
8 Clevis connection to jackshaft
9 Differential arm guide
10 Front wheel steering rod
11 Rear wheel follow-up rod

Figure 8-5. Steering follow-up adjustment.

(i) Lock forward steering stop (3) with jamnut (2).

NOTE

If port front wheel steering cylinder will not travel full stroke in both directions after the steering stops (3 and 5, fig. 8-5) have been backed off, the starboard front wheel is misalined. (For alinement of the wheels, refer to paragraph 10-3).

(j) Adjust aft steering as outlined in (a) through (i) above.

c. Steering Arm Assembly.

(1) *General.* The steering arm assembly connects the steering cylinders to the column and wheel drive. Four assemblies are used on each LARC. The port, aft and 'forward steering arm assemblies consist of a steering arm, bushings, and a follow-up arm. The starboard forward assembly consists of a steering arm with a connecting arm for the wire rope from the rudders and bushings. The starboard aft assembly consists of a steering arm and bushings.

(2) *Removal.*

(a) Remove clevis pins from steering cylinder assemblies at steering arm.

(b) On port forward and aft steering arms (1, fig. 8-6) disconnect ball joint (17, fig. 8-4) from steering arm follow-up arm. To remove follow-up

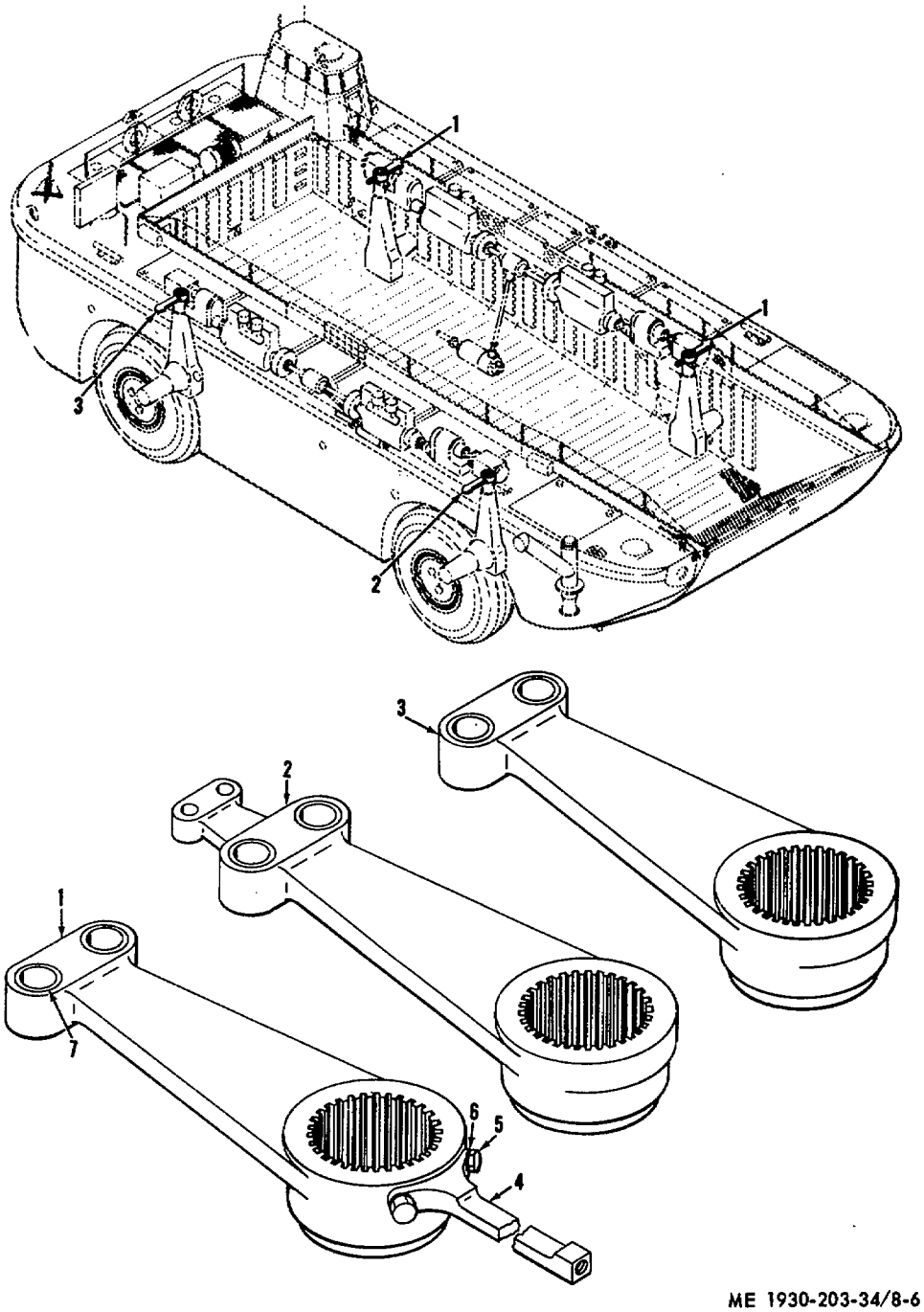
arm (4, fig. 8-6), remove capscrews 15) and lockwashers (6) and remove follow-up arm.

(c) On forward starboard steering arm (2), disconnect wire rope from steering arm.

(d) Remove column and wheel drive assembly as outlined in paragraph 2-16.

(e) Remove steering arm.

(f) If necessary, remove bushings (7) from steering arm.



1 Steering arm, port, forward and aft
2 Steering arm, starboard, forward
3 Steering arm, starboard, aft
4 Follow-up arm
5 Capscrew
6 Lockwasher
7 Bushing

Figure 8-6. Steering arm assembly.

(3) *Cleaning, inspection and repair.*

(a) Clean all parts in dry-cleaning solvent, Federal Specification P-D-680, and dry with low pressure air (10 psi).

(b) Inspect bushing (7, fig. 8-6) for scoring or elongation. If these conditions exist, replace bushings.

(c) Inspect steering rm (1, 2, or 3) for cracks, chipped or broken splines, or loose fit. Replace steering arm if any of these conditions exist.

(d) Inspect follow-up arm (4) for a bent arm, cracks, or breaks. If any of these conditions exist, replace follow-up arm.

(4) *Installation.*

(a) Perform (1) and (2) of paragraph 2-16 b.

(b) Install clevis pins in steering cylinder assemblies at steering arm.

(c) On port forward and aft steering arms (1, fig. 8-6), install follow-up arm (4) using capscrews (5) and lockwashers (6). Connect ball joint (17, fig. 8-4) to follow-up arm.

(d) On forward starboard steering arm (2, fig. 8-6), connect wire rope to steering arm.

(e) Perform (3) through (14) of paragraph 2-16b.

Section II. MARINE STEERING SYSTEM

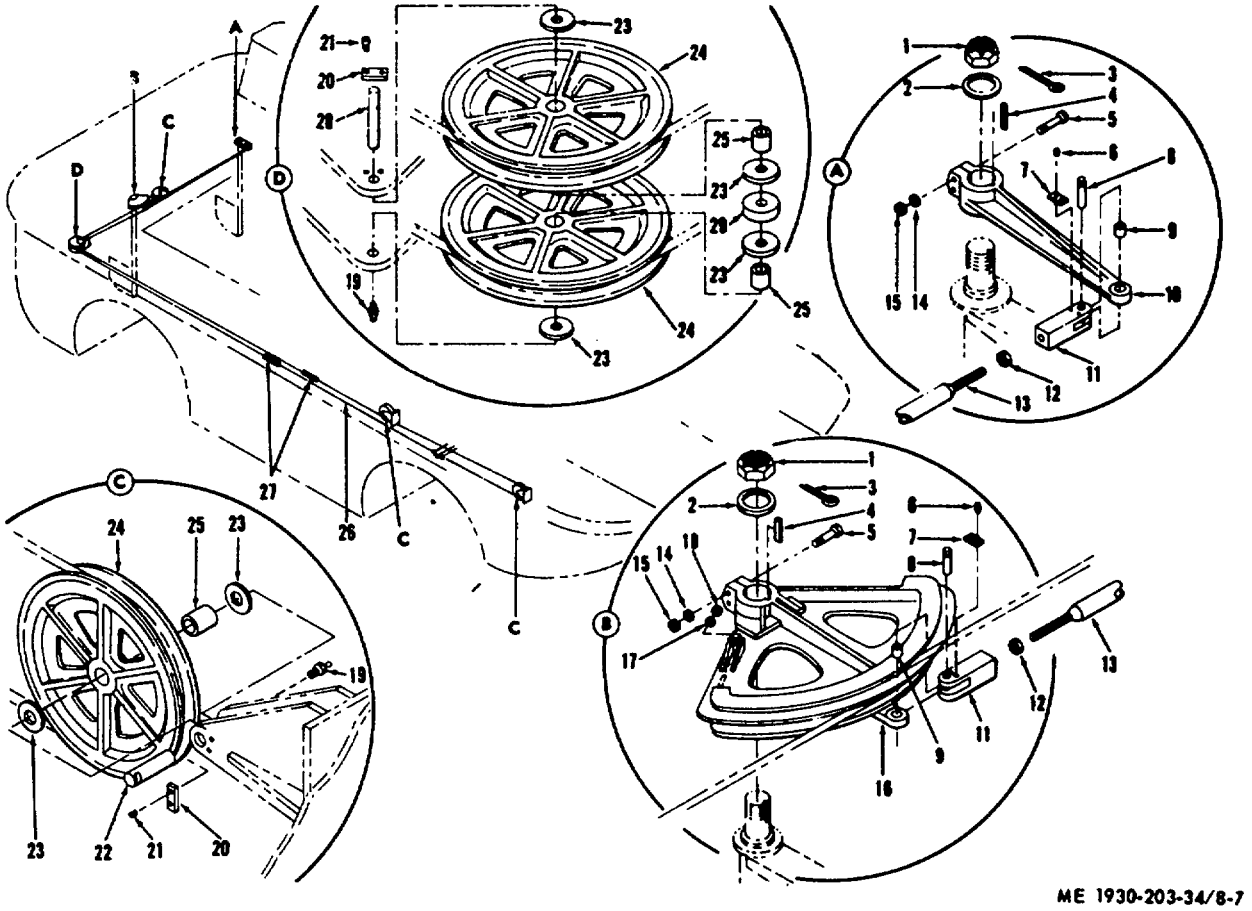
8-3. Description

Marine steering (fig. 8-1) is accomplished by two rudders located aft of the propellers. The rudders are steered with the forward wheels by a wire rope connected between the quadrant and starboard wheel column steering arm. Sheaves are provided at various bends and turns of the wire rope to insure smooth operation.

8-4. Marine Steering

a. Crossrod Assembly.

(1) Inspect crossrod (13, fig. 8-7) and clevis (11) for broken and bent condition. If damaged, repair or replace if necessary.



1	Nut	16	Quadrant
2	Washer	17	Washer
3	Pin, cotter	18	Nut
4	Key	19	Lubrication fitting
5	Bolt, machine	20	Key plate
6	Capscrew	21	Capscrew
7	Key plate	22	Pin
8	Pin	23	Spacer
9	Bushing	24	Pulley
10	Tiller arm	25	Bushing
11	Clevis	26	Wire rope
12	Jamnut	27	Turnbuckles
13	Crossrod	28	Pin
14	Washer	29	Spacer
15	Nut		

Figure 8-7. Marine steering.

(2) Replacement and adjustment.

(a) Remove capscrews (6), key plate (7), and pin (8) at either end of crossrod assembly.

(b) Loosen jamnut (12) and back jamnut off several turns.

(c) Support crossrod assembly and align rudder assemblies parallel to each other.

(d) Screw clevis (11) in or out until crossrod assembly is at correct length. secure clevis with jamnut (12).

(e) Replace crossrod assembly and install pin (8), key plate (7), and capscrews (6).

b. Tiller Arm.

(1) *Removal.*

(a) Remove capscrew (6, fig. 8-7), key plate (7), and pin (8).

(b) Remove and support crossrod assembly.

(c) Support port rudder assembly from under the LARC and remove cotter pin (3), nut (1), and washer (2) from rudder shaft.

(d) Remove nut (15), washer (14), and bolt (5) securing tiller arm to rudder shaft.

(e) Slip tiller arm (101 and key (4) from rudder shaft.

NOTE

If tiller arm bushing (9) is worn enough to allow end play of crossrod assembly, press bushing front tiller arm (10) and replace.

(2) *Cleaning, inspection and repair.*

(a) Clean all parts in dry-cleaning solvent, Federal Specification P-D-680, and dry with low air pressure (10 psi).

(b) Inspect tiller arm for broken and malformed condition. If damaged, replace tiller arm.

(3) *Installation.* Install tiller arm in reverse order of removal.

c. Quadrant.

(1) *Removal.*

(a) Loosen turnbuckles (27, fig. 8-7) and remove nuts (18), washers (17), and wire rope (26).

(b) Remove capscrews (6), key plate (7), and pin (8).

(c) Remove and support crossrod assembly.

(d) Support starboard rudder assembly from under the LARC and remove cotter pin (3), nut (1), and washer (2) from rudder shaft.

(e) Remove nut (15), washer (14), and bolt (5) securing quadrant (16) to rudder shaft.

NOTE

If quadrant bushing (9) is worn enough to allow end play of crossrod assembly, press bushing from quadrant (16) and replace.

(2) *Cleaning, inspection and repair.*

(a) Clean all parts in dry-cleaning solvent, Federal Specification P-D-680, and dry with low air pressure (10) psi).

(b) Inspect quadrant for broken or malformed condition. If damaged, replace quadrant.

(3) *Installation.* Install quadrant in reverse order of removal.

d. Wire Rope.

(1) *Removal.*

(a) Loosen locknuts at turnbuckles (27, fig. 8-7) and loosen turnbuckle.

(b) Remove nut (18) and washers (17), and remove wire rope (26) from quadrant (16).

(c) Remove turnbuckles (27) with locknuts from wire rope (26).

(d) Remove sleeves (3, fig. 8-8) from socket (5).

(e) Remove plug (4) and wire rope (1) from sleeve (3).

(f) Remove wire rope (26, fig. 8-7).

(2) *Installation.*

(a) Cut new rope to same length as rope being replaced.

(b) Thread new wire rope through sheaves.

NOTE

Use an assembled sleeve (3, fig. 8-8) and socket (5) to determine position of sleeve on the wire rope.

(c) Seize wire rope (1. fig. 8-8) just below the sleeve position to pressure lay of wire rope.

(d) Fan out strands and cut off hemp center at a point which will be just inside sleeve (3).

(e) Hold strands together and slip sleeve (3) on wire rope (3) and up against seizing (2).

(f) Fan out strands again and insert plug (4).

(g) Drive plug (4) into sleeve (3) making sure wire rope strands are laying in plug grooves.

(h) Hold strands together and slip in socket (5).

(i) Screw socket (5) onto sleeve (3) and tighten, making sure that wire rope strands are visible through inspection hole inside of socket.

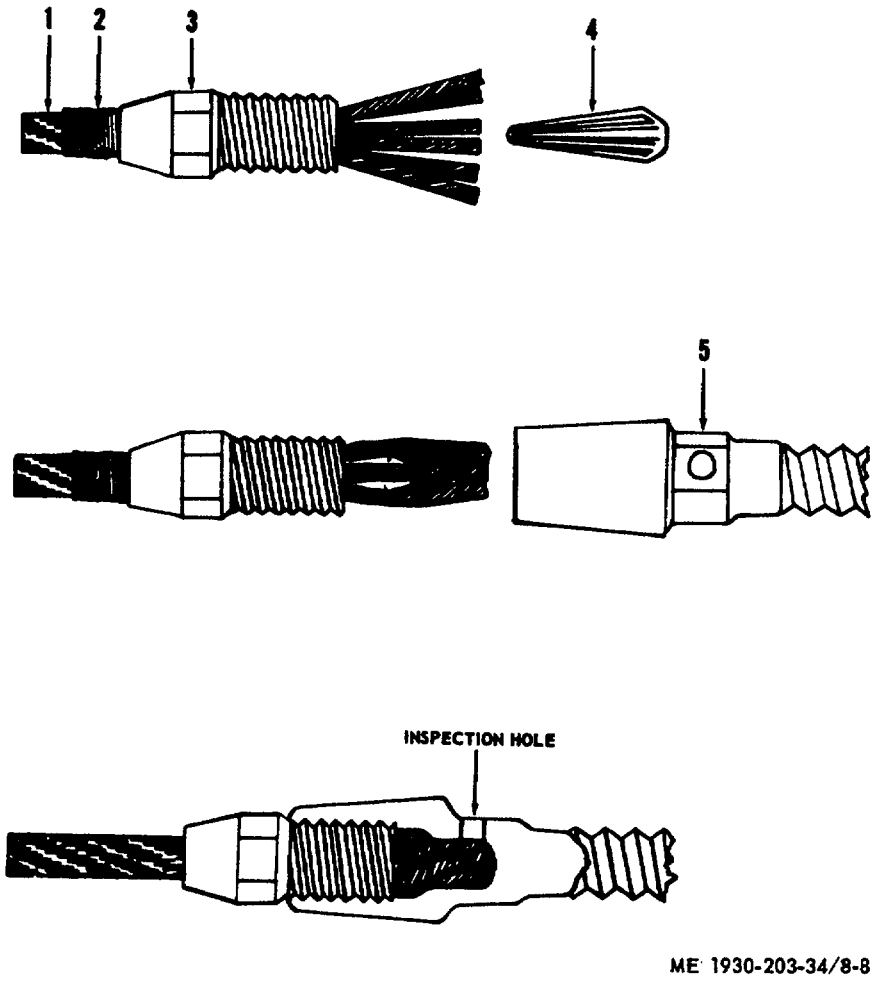
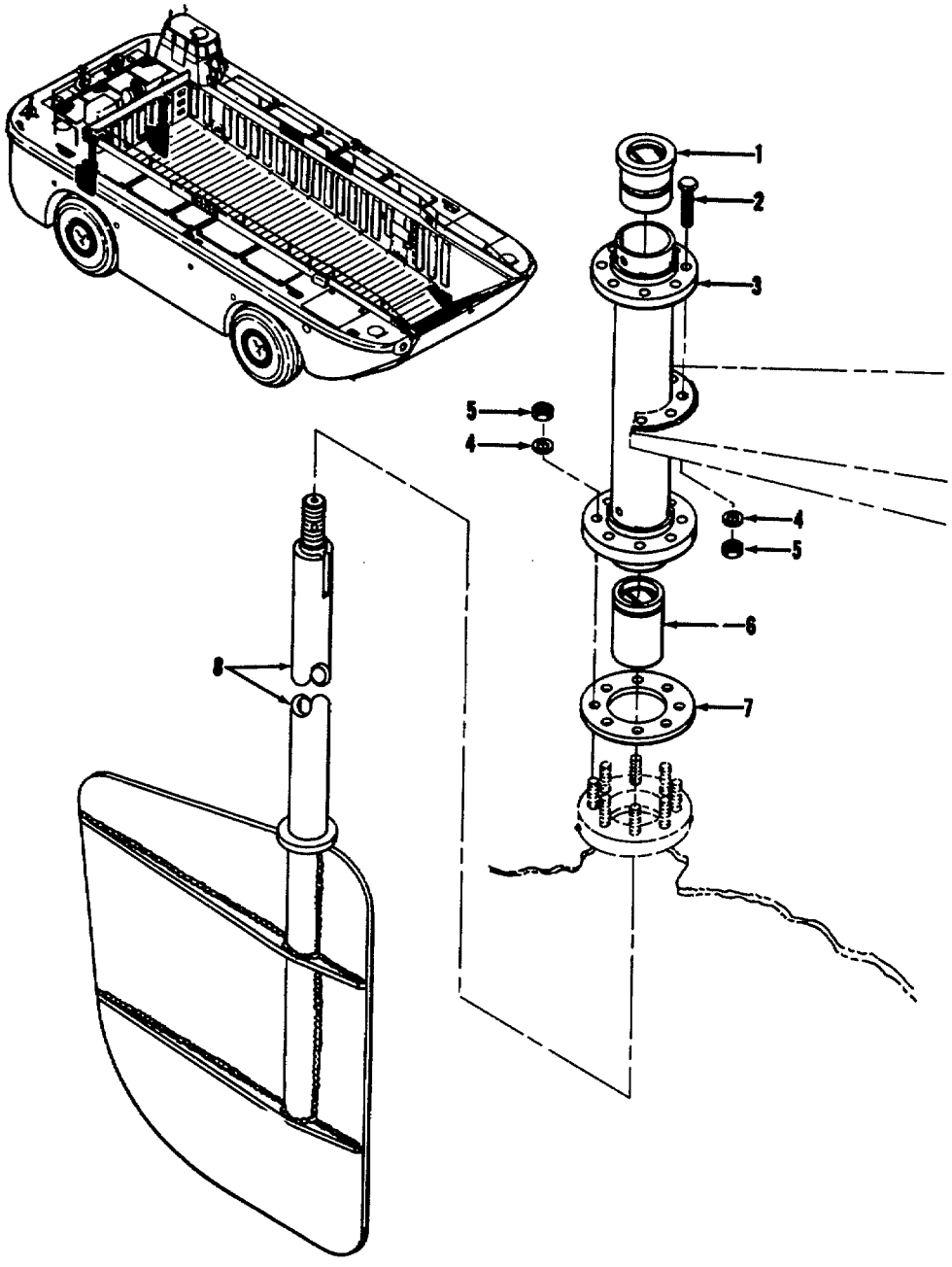


Figure 8-8. Wire rope assembly.



1 Upper bushing
2 Bolt, machine
3 Rudder sleeve assembly
4 Washer, flat
5 Nut
6 Lower bushing
7 Gasket
8 Rudder assembly

Figure 8-9. Rudder assembly

(j) Install locknuts and turnbuckles (27, fig. 8-7) on wire rope (26).

(k) Attach wire rope (26) in proper position.

(l) Adjust wire rope (26) by backing locknuts off several turns and screwing turnbuckles (27) until slack is removed. Secure turnbuckes with locknuts.

e. *Pulley.*

(1) *Removal.*

(a) Loosen wire rope at turnbuckles (27, fig. 8-7) and quadrant (16), and remove wire rope from pulleys.

(b) Remove capscrew (21), key plate (20), and pin (22) attaching pulley (24).

(c) Remove pulley (24) and spacer (23).

NOTE

If pulley bushing (25) is worn enough to allow play in the pulley, press bushing from pulley and replace.

(2) Installation. Install pulley in reverse order of removal.

f. Rudder and Rudder Sleeve Assembly.

(1) *Removal.*

(a) Remove quadrant assembly or tiller arm assembly.

(b) Lower rudder assembly (8, fig. 8-9) straight down to remove rudder assembly. If vertical clearance does not permit, it may be necessary to dig a hole in the ground to obtain clearance for the rudder assembly.

(c) Remove eight bolts (2) and sixteen washers (4) and nuts (5), and remove rudder sleeve assembly (3) and gasket (7).

(d) Remove upper bushing (1) and lower bushing (6) from rudder sleeve assembly.

(2) *Cleaning, inspection, and repair.*

(a) Clean all parts, except gasket (7, fig. 8-9) in dry-cleaning solvent, Federal Specification P-D-680, and dry with low pressure air (10 psi).

(b) Inspect bushings (1 and 6) for scored or elongated condition. Replace bushings if badly scored or elongated.

(c) Inspect rudder sleeve assembly (3) for pitting or cracks. Replace a badly pitted or cracked rudder sleeve assembly.

(d) Inspect rudder assembly (8) for a bent shaft or broken, cracked, or bent rudder. Fair up bent rudder and bent shaft. Replace rudder assembly if shaft is broken.

(e) Replace gasket (7).

(3) *Installation.* Install in reverse order of removal.

CHAPTER 9

COMPRESSED AIR SYSTEM REPAIR INSTRUCTIONS

SECTION I. INTRODUCTION

9-1. General

The compressed air system consists of an air supply system (fig. 2-19) connected to an air starting control and supply system (fig. 9-1), airbrake control and supply system (fig. 9-2), transmission shifting control and engine cutout systems (fig. 9-3), throttle control system (fig. 9-4), marine gear and radiator fan control system (fig. 9-5), tire inflation-deflation control and supply system (fig. 9-6), ramp seal control and supply system (fig. 9-7), cargo well pump and ramp control systems (fig. 9-8), windshield wiper control and supply system, and the air horn control and supply system.

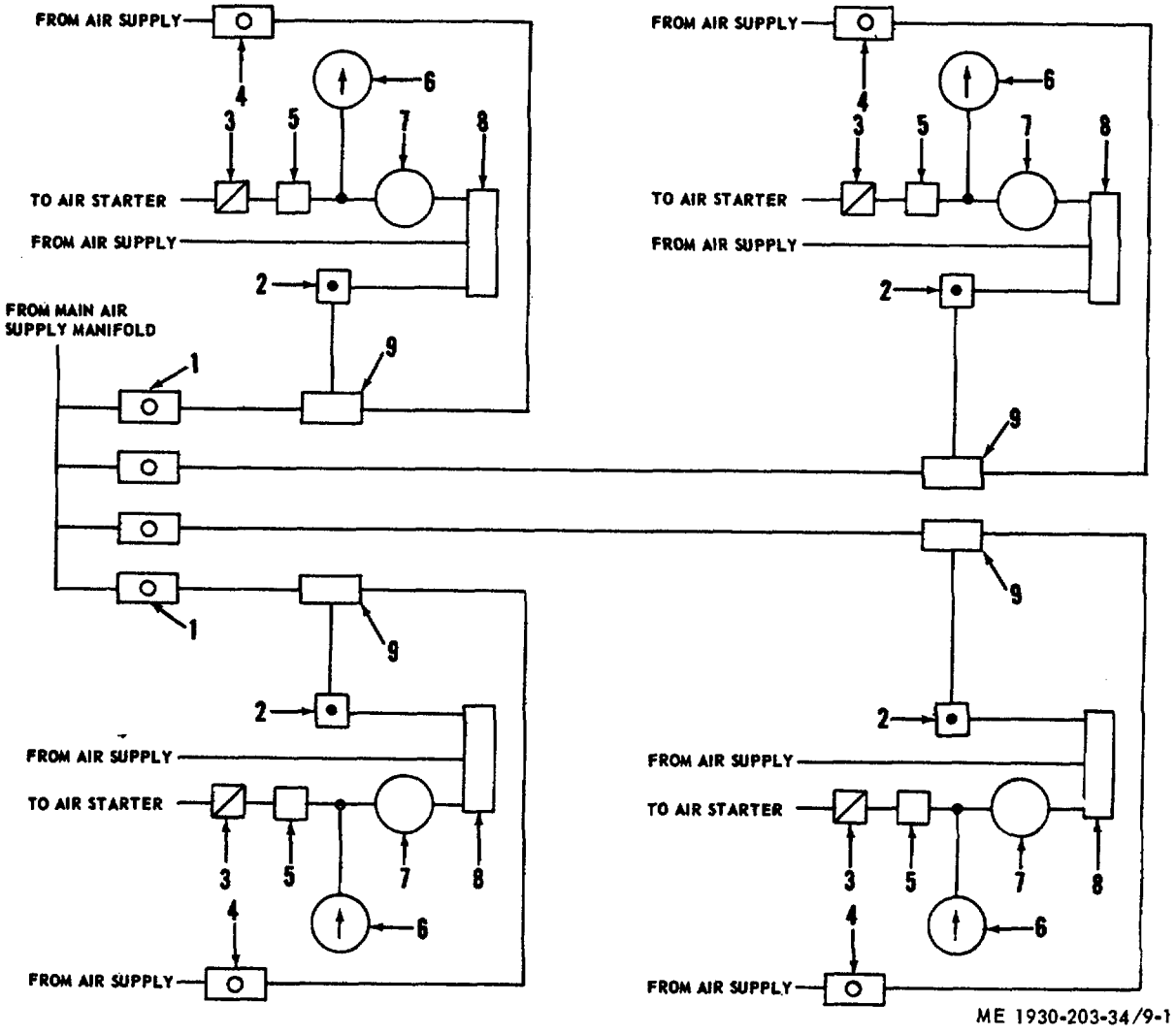
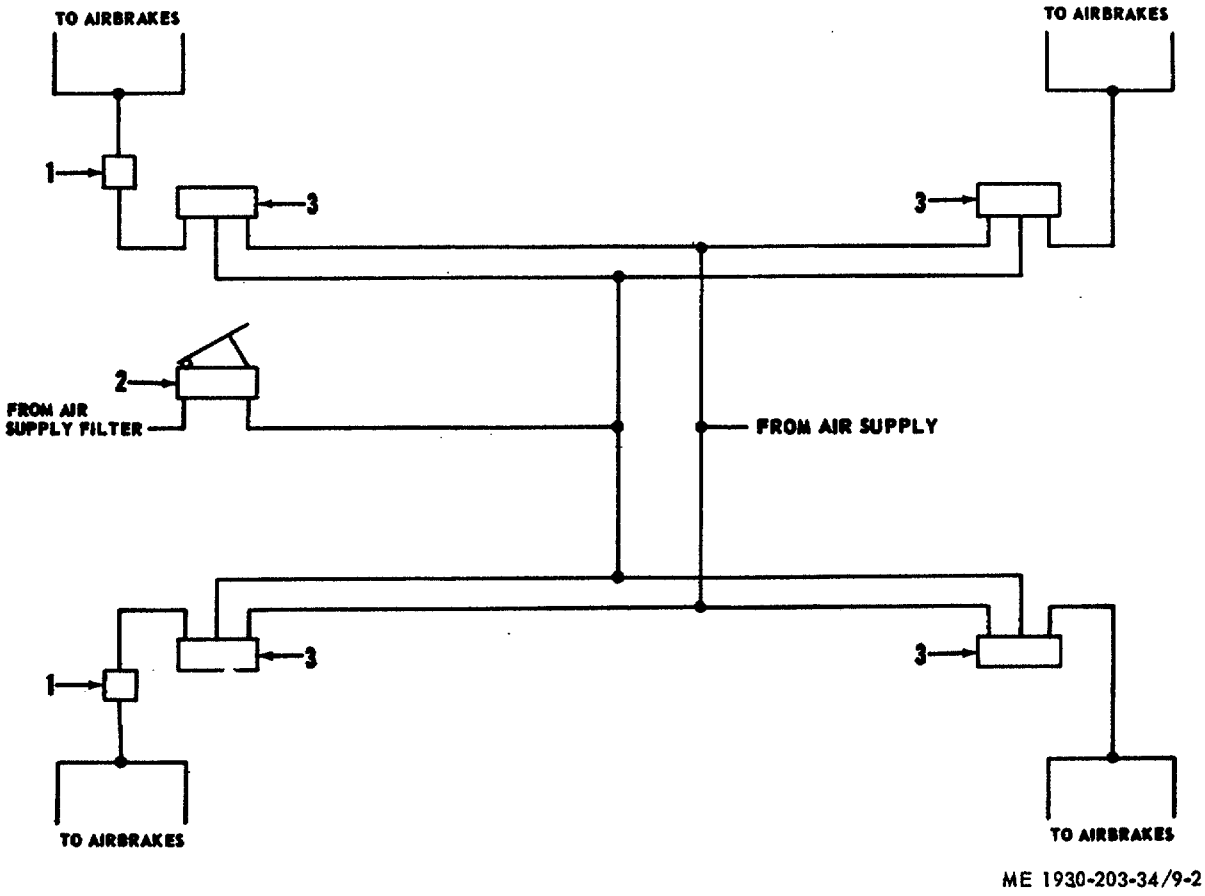


Figure 9-1. Air starting control and supply system.

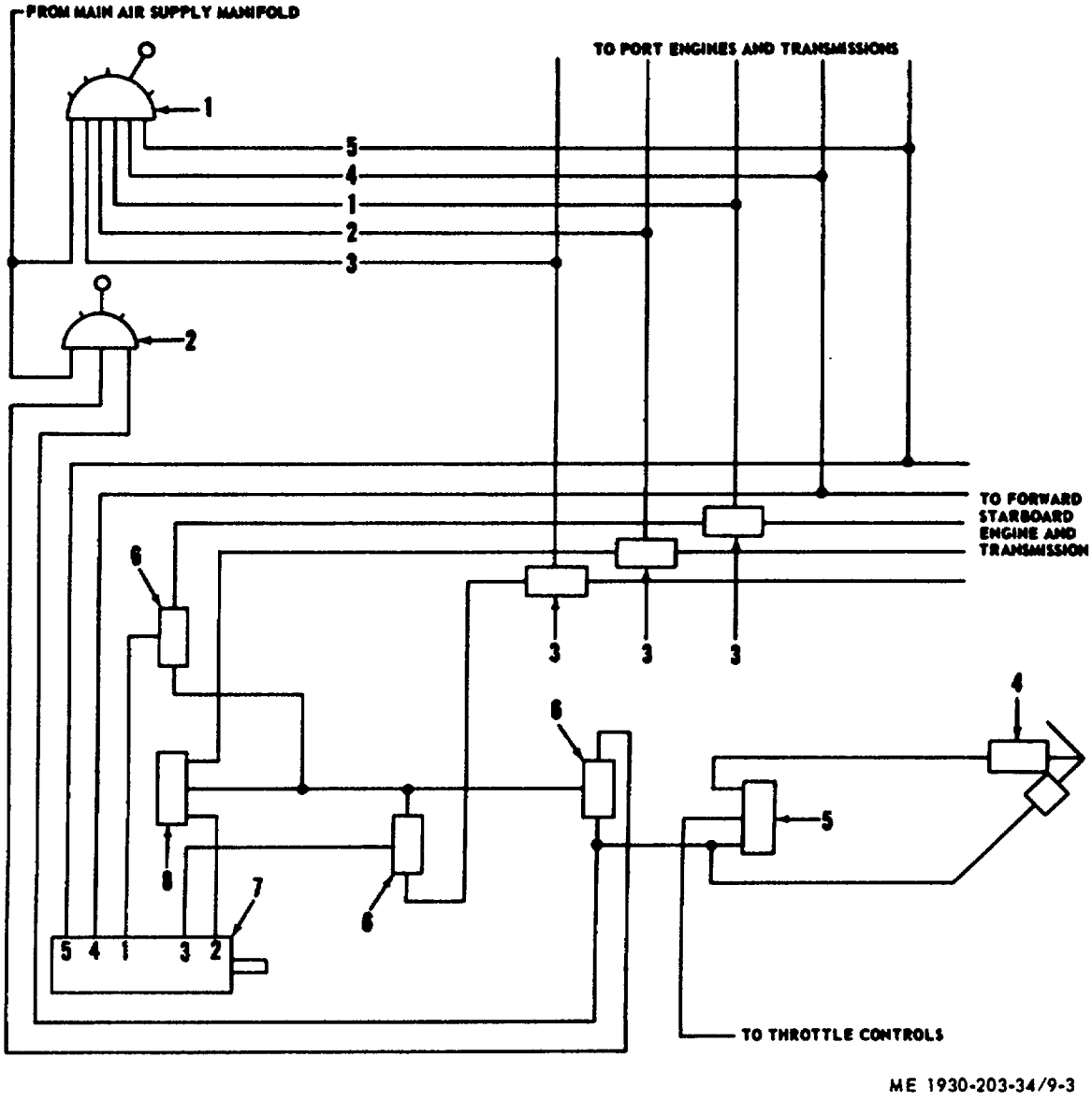
Key to figure 9-1.

1 Air starting pilot air valve
2 Quick-release valve
3 Lubricator
4 Air starting pilot air valve
5 Plug valve
6 Air starting gage
7 Air starting filter
8 Relay air valve
9 Shuttle valve



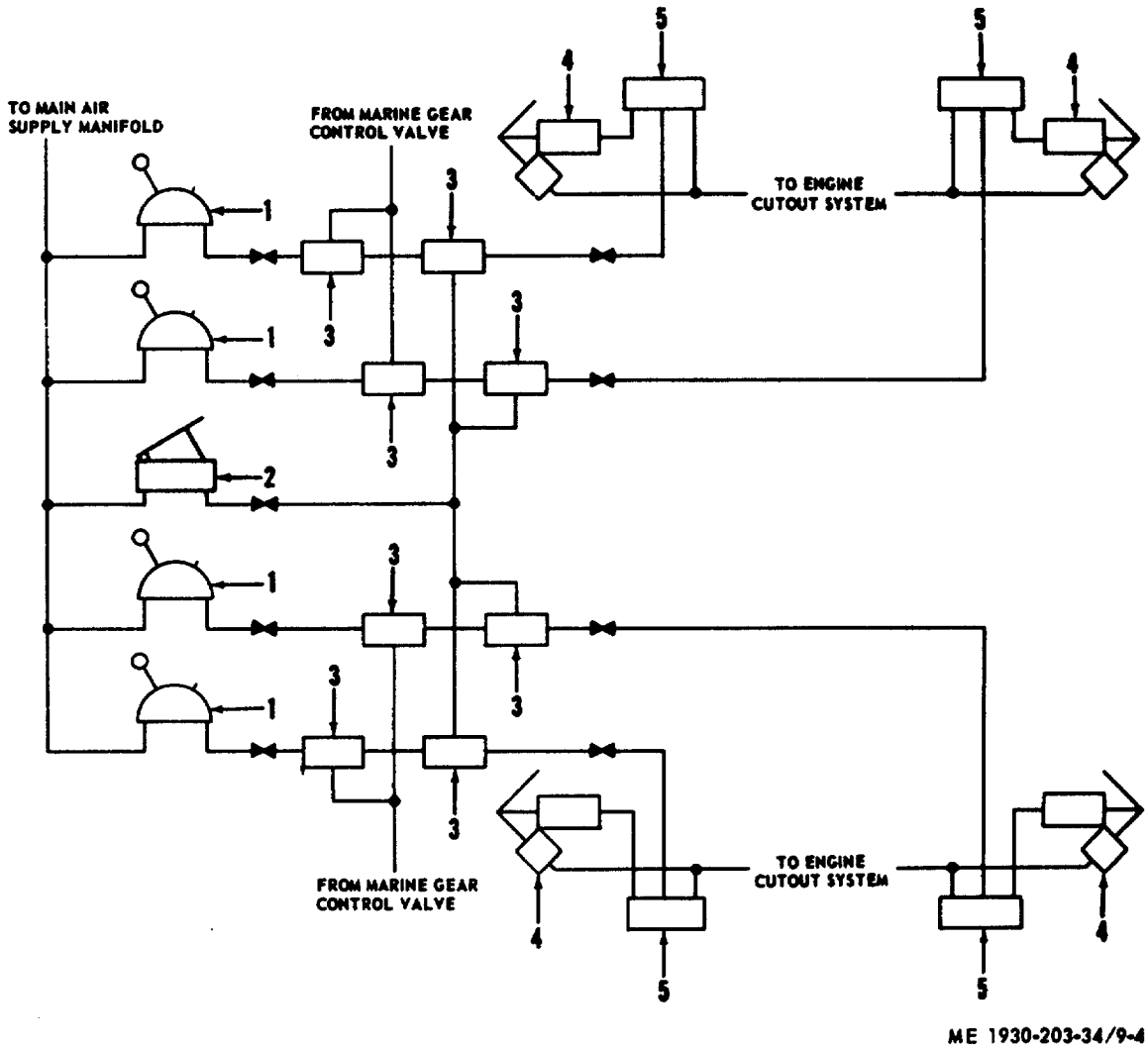
1 Globe valve
2 Foot control valve
3 Relay air valve

Figure 9-2. Airbrake control and supply system.



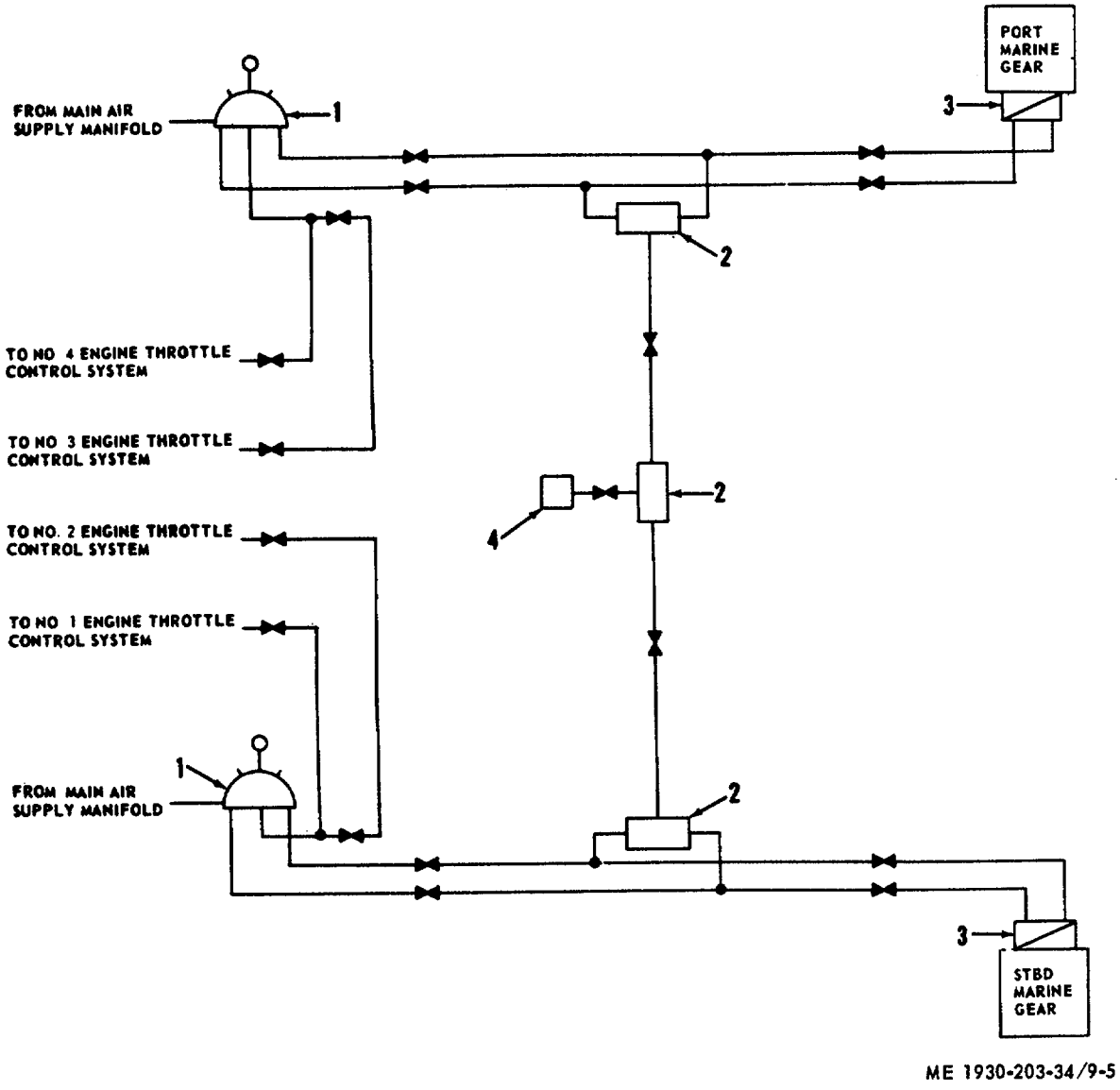
1 Transmission control valve
2 Pilot air valve
3 Quick release valve
4 Actuator positioner
5 Relay air valve
6 Shuttle valve
7 Transmission shifting control cylinder
8 Relay air valve

Figure 9-3. Transmission shifting control and engine cutout systems.



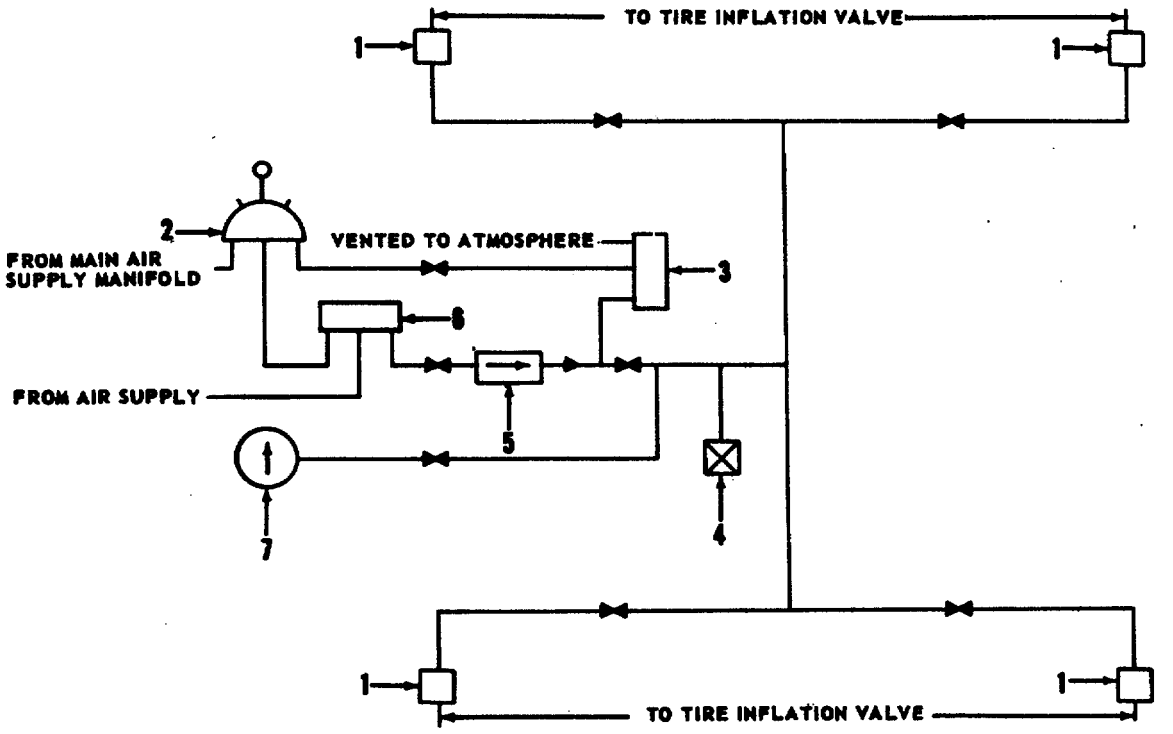
1 Hand throttle control valve
2 Foot control valve
3 Shuttle valve
4 Actuator positioner
5 Relay air valve

Figure 9-4. Throttle control system.



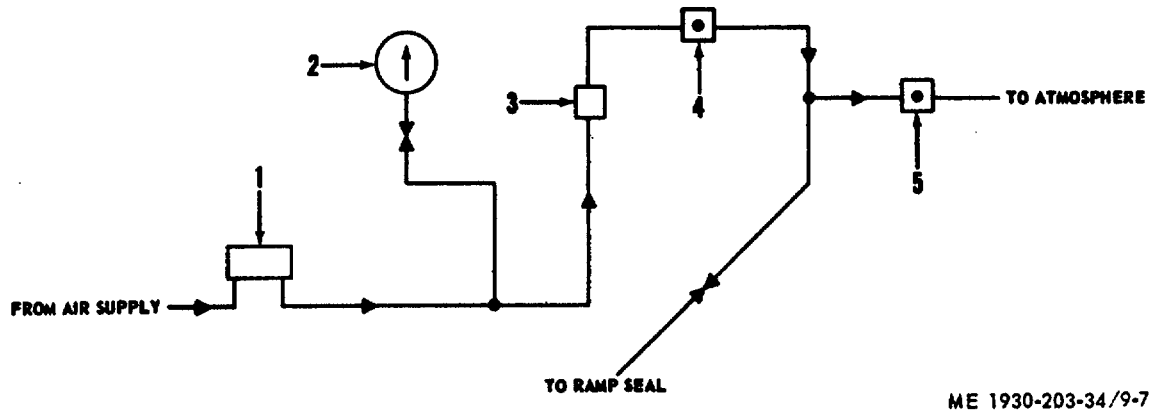
1 Marine gear shifting and throttle control valve
2 Shuttle valve
3 Logan valve
4 Single-acting cylinder

Figure 9-5. Marine gear and radiator fans control system.



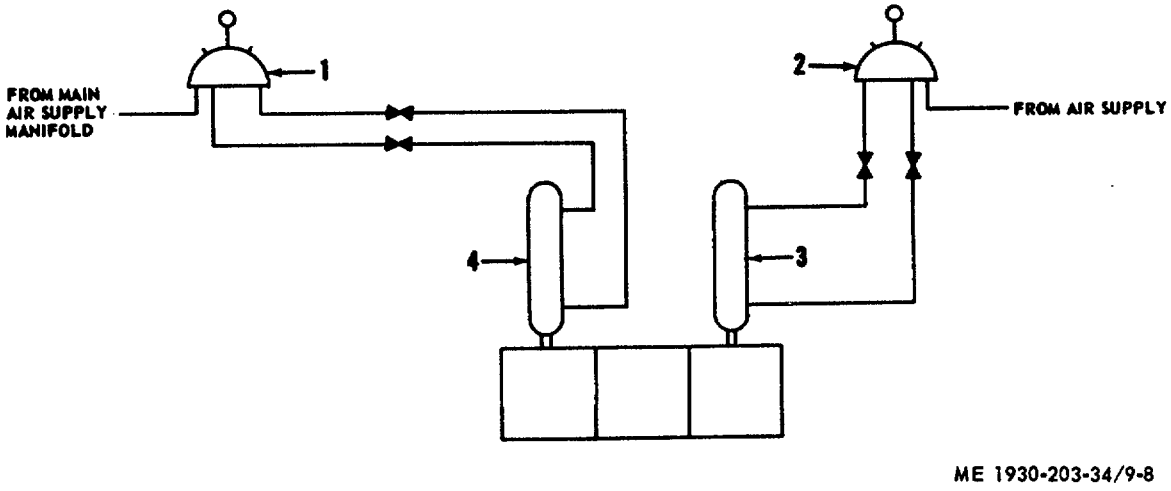
1 Angle globe valve
2 Pilot air valve
3 Deflation relay air valve
4 Safety relief valve
5 Check valve
6 Inflation relay air valve
7 Tire gage

Figure 9-6. Tire inflation-deflation control and supply system.



1 Reducing valve
2 Ramp seal gage
3 Plug valve
4 Inflation quick-opening valve
5 Deflation quick-opening valve

Figure 9-7. Ramp seal control and supply system.



1 Cargo well pump control pilot air valve
2 Ramp control pilot air valve
3 Ramp control double-acting air cylinder
4 Cargo well pump control double-acting air cylinder

Figure 9-8. Cargo well pump and ramp control systems.

Section II. COMPRESSED AIR SYSTEM

9-2. Air Compressor (Model 3YC) and Coupling Assembly

a. Removal and Installation.Refer to paragraph 2-23 to remove and install the compressor.

b. Disassembly (fig. 9-9.

(1) Cylinder heads removal.

(a) Disconnect unloader tube (1 1, between high- and low- pressure cylinder heads.

(b) Disconnect and remove vent tube (3) and unloader tube (7).

(c) Remove attaching bolts (15) and nuts (141 securing clamp (13) to intercooler.

(d)Remove bolts (IO) and nuts (11) from intercooler connections securing intercooler assembly to air compressor cylinder head.

(e)Remove gaskets (16) and unscrew safety valve (9) from intercooler assembly.

(f)Remove bolts securing cylinder heads to cylinders. Remove cylinder heads and gaskets.

(2) High-pressure cylinder head disassembly.

(a)Remove valve cap (18), from plug (17).

(b) Unscrew plug (17) from cylinder head (36).

(c) Lift discharge valve assembly (39) and gasket (35) from cylinder head (36).

(d) Unscrew tee (20) and cap nut (211, allowing unloader valve (22) to slip free.

(e)Unscrew unloader body (231 and remove from cylinder head (36).

(f) Lift out intercooler valve (24) and plunger assembly (29).

(g)Remove retainer (26), washer (27), and spring (28) from plunger (30).

(h) Remove return spring (32) from head.

(i) Remove valve plug (19) and lift out suction valve assembly (34) and gasket (35) from cylinder head.

(3) Low-pressure cylinder head disassembly.

(a)Unscrew elbow (401, from cap nut (64).

(b) Unscrew cap nut (64) and remove unloader valve (63).

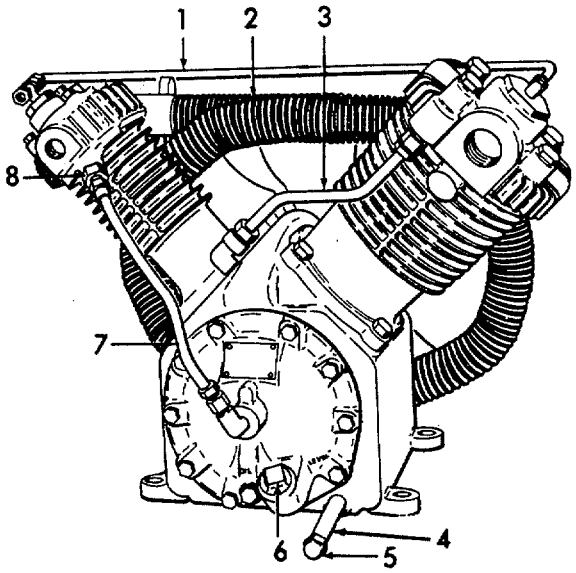


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Figure 9-9. Air compressor, Model 3YC, disassembly and reassembly (Sheet 1 of 5).

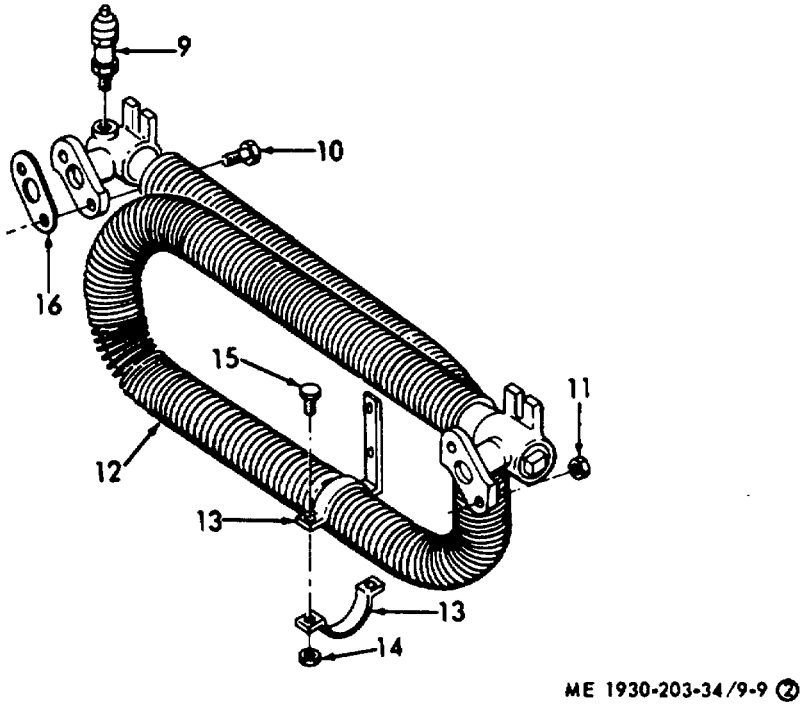


Figure 9-9. Air compressor, Model 3YC, disassembly and reassembly

(Sheet 2 of 5).

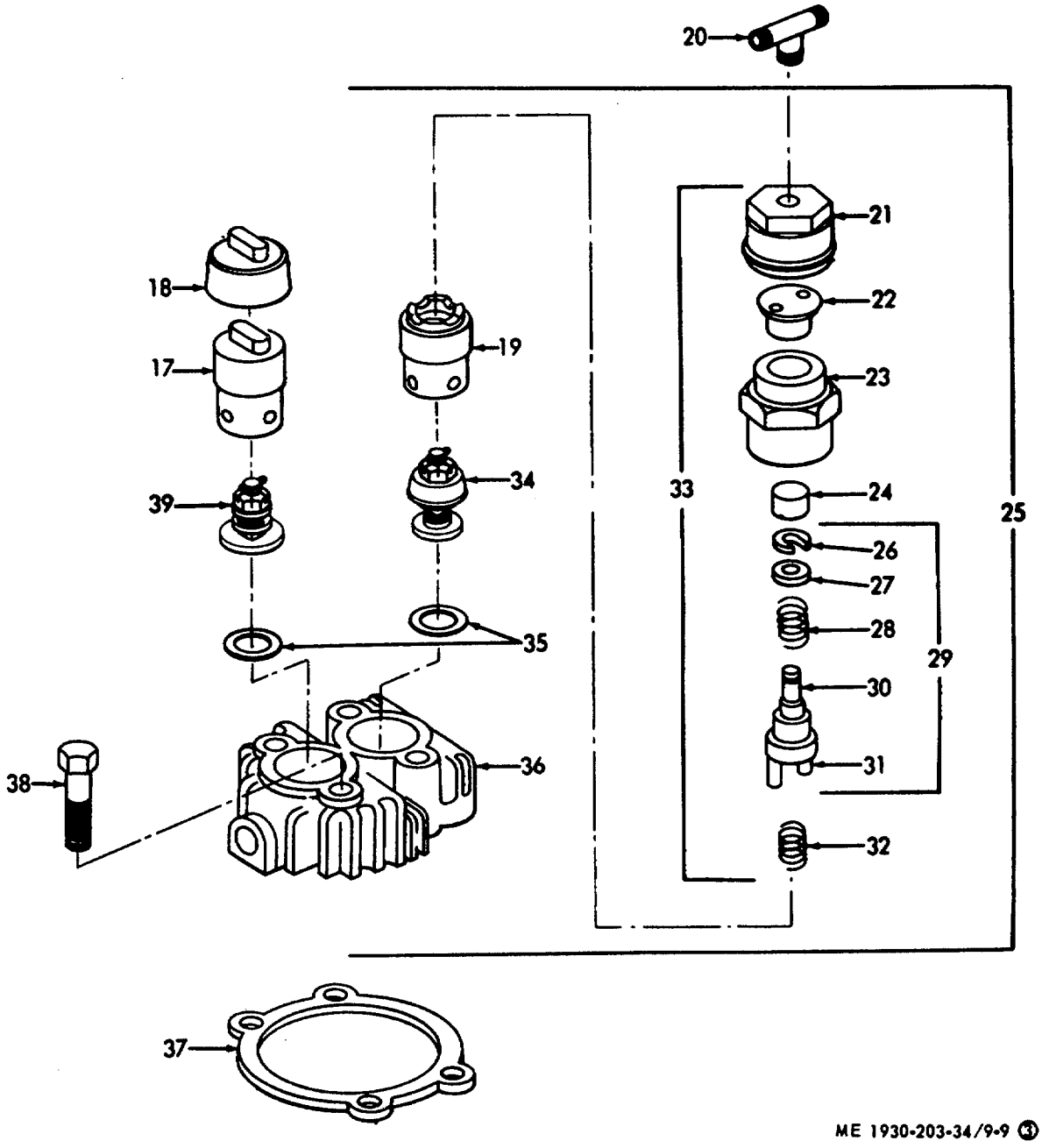


Figure 9-9. Air compressor, Model3YC, disassembly and reassembly (Sheet 3 of 5).

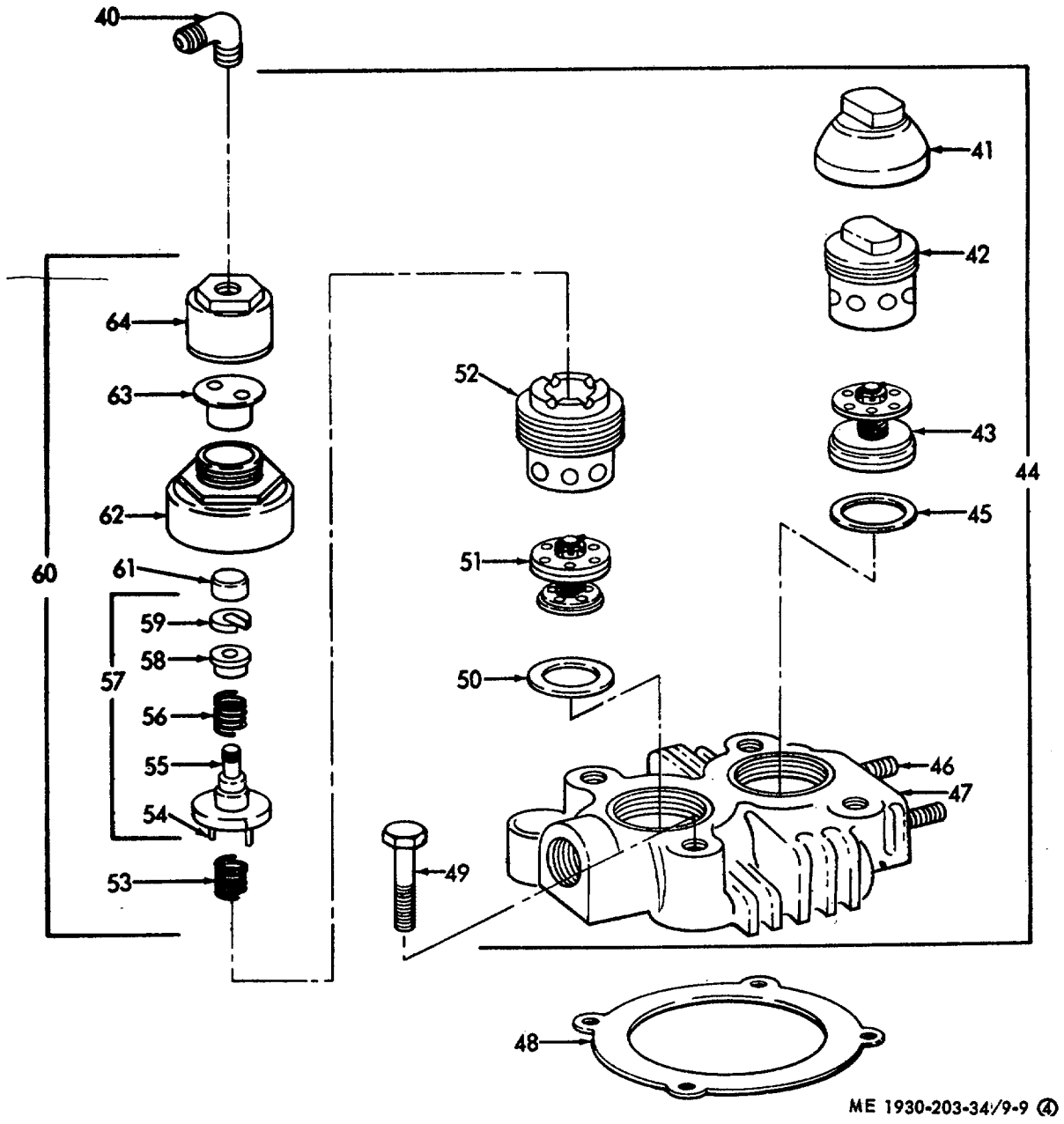


Figure 9-9. Air compressor, Model 3YC, disassembly and reassembly (Sheet 4 of 5).

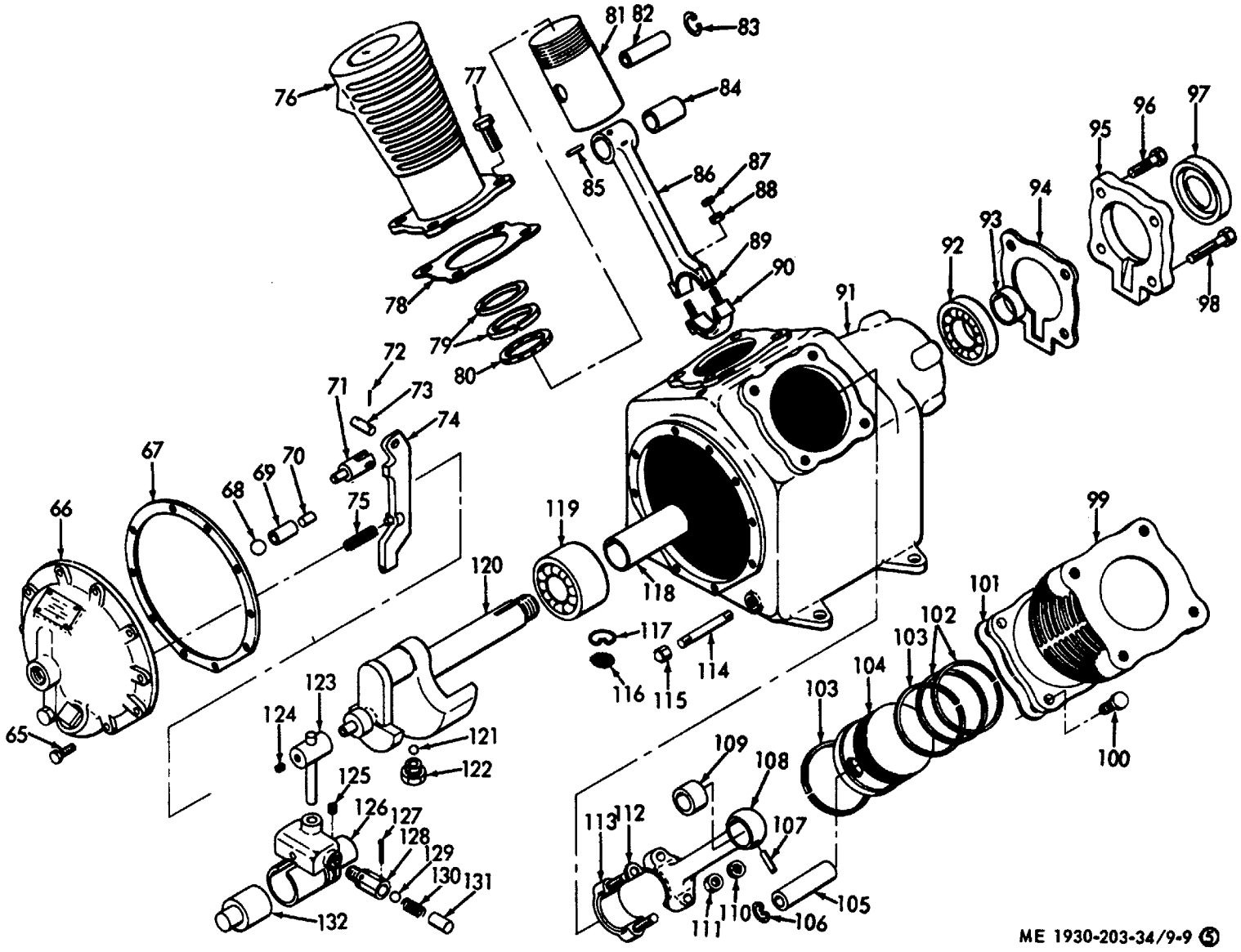


Figure 9-9. Air compressor, Model 3YC, disassembly and reassembly (Sheet 5 of 5).

Key to figure 9-9.

1 Unloader tube
2 Intercooler
3 Vent tube
4 Drain pipe
5 Cap
6 Filler plug
7 Unloader tube
8 Valve body
9 Safety valve
1O Bolt
11 Nut
12 Intercooler
13 Clamp
14 Nut
15 Bolt
16 Gasket
17 Plug
18 Valve cap
19 Valve plug
20 Tee
21 Cap nut
22 Unloader valve
23 Unloader body
24 Intercooler valve
25 Cylinder head assembly
26 Retainer
27 Washer
28 Spring
29 Plunger assembly
30 Plunger
31 Pin
32 Spring
33 Unloader assembly
34 Suction valve assembly
35 Gasket
36 Cylinder head
3 7 Gasket
38 Bolt
39 Discharge valve assembly
40 Elbow
41 Cap
42 Plug
43 Discharge valve assembly
44 Cylinder head assembly
45 Gasket
46 Stud
47 Cylinder head
48 Gasket
49 Bolt
50 Gasket
51 Suction valve assembly
52 Plug
53 Spring
54 Pin
55 Unloader plunger
56 Spring
57 Plunger assembly
58 Washer
59 Retainer
60 Compressor unloader
61 Intercooler valve
62 Cover
63 Unloader valve
64 Cap nut
65 Capscrew
66 End cover
67 Gasket
68 Unloader ball
69 Ball seat valve
70 Ball check plunger
7 1 Lever support
72 Cotter pin
73 Unloader lever oin
74 Unloader lever
75 Lever spring
76 High-pressure cylinder
77 Capscrew
78 Gasket
79 High-pressure piston rings
80 High-pressure oil piston ring
81 High-pressure piston
82 High-pressure piston pin
83 Piston pin retaining ring
84 Piston pin bushing
85 Connector rod pin
86 High pressure connector rod
87 Palnut
88 Nut
89 Shim
90 Connector rod cap
9 1 Crankcase
92 Bearing
93 Spacer
94 Gasket
95 Flange
96 Capscrew
97 Oil seal
98 Capscrew
99 Low-pressure cylinder
1 00 Capscrew
101 Gasket
102 Low-pressure piston rings
103 Low-pressure oil piston ring
104 Low-pressure piston
105 Low-pressure piston pin
106 Piston pin retaining ring
107 Low-pressure connector rod pin
108 Low-pressure connector rod
109 Piston pin bushing
110 Palnut
I11 Nut
112 Shim
113 Connector rod cap
114 Stud
115 Oil drain cap
1 16 Strainer
117 Strainer retaining ring
118 Bearing spacer
119 Bearing
120 Crankshaft
121 Ball
122 Oil control valve cap
123 Oil pump plunger
124 Plug
125 Plug
126 Oil pump body
127 Cotter pin
128 Oil relief valve body
129 Ball
130 Spring
131 Spring retainer
132 Oil pump piston

Figure 9-9. Air compressor, model 3YC, disassembly and reassembly.

(c) Remove cover (62) from inlet valve plug (52).

(d) Lift intercooler valve (61), plunger assembly (57), and return spring (53) from inlet valve plug (52) and remove retainer (59), washer (58), and unloader plunger spring (56) from unloader plunger (55).

(e) Unscrew inlet valve plug (52) and remove suction valve assembly (51) and gasket (50).

(f) Remove valve cap (41) and discharge 7alve plug (42) from cylinder head (47).

(g) Lift discharge valve assembly (43) and gasket (45) from cylinder head.

(4) Low-pressure cylinder removal.

(a) Remove low-pressure cylinder head (1) above.

(b) Remove capscrews (77), and lift high- pressure cylinder from high-pressure piston (81). Remove gasket (78) from crankcase (91).

(5) End cover removal.

(a) Remove capscrews (65), and pull end cover (66) from crankcase (91). Remove end cover gasket (67).

(b)Remove cotter pins (72), and unloader lever pin (73), freeing unloader lever (74), and lever support (71).

(c)Remove unloader lever (74), lever spring (75), ball check plunger (70), unloader ball (68), and ball seal valve (69) from end cover (66).

(6) Oil pump removal.

(a) Remove end cover ((6) above).

(b) Pull oil pump from crankcase.

(c) Remove oil pump plunger (123), oil pump piston (132), and plug (135).

(d) Remove oil relief valve body (128).

(e) Disassemble by removing cotter pin (127), spring retainer (131), spring (130), and ball (129).

(f)Remove strainer retaining ring (117) and strainer (1 16) from crankcase. t7) Low-pressure piston and connector rod removal.

(a) Remove low-pressure cylinder and oil pump ((4) and (7) above).

(b)Remove palnuts (110), and nuts (111) from studs and remove connector rod cap (113), and shims (112).

(c) Pull low-pressure piston (104) with attached low-pressure connector rod (108) from crankcase (91).

(d)Remove piston pin retaining rings (106) and press low-pressure piston pin (105) from low- pressure piston (104).

(e) Remove low-pressure piston rings (1 02) and low-pressure oil piston rings (103) from low-pressure piston (104). Remove pin (107) and press out piston pin bushing (109) from low-pressure connector rod (108).

(8) High-pressure piston and connector rod removal.

(a) Remove high-pressure cylinder and oil pump ((5) and (7) above).

(b) Remove palnuts (87), and nuts (881 from studs and remove connector rod cap (90), and shims (89).

(c) Pull high-pressure piston (81) with attached high-pressure connector rod (86) from crankcase.

(d)Remove piston pin retaining rings (83) and press high-pressure piston pin (82) from high- pressure piston (81).

(e) Remove high-pressure piston ring (79) and high-pressure oil piston ring (80) from high- pressure piston (81). Remove connector rod pin (85) and press piston pin bushing (84) from high- pressure connector rod (86).

(9) Crankshaft removal.

(a) Remove high-pressure piston and connector rod, and low-pressure piston and connector rod ((8) and (9) above).

(b) Remove capscrews (96), and (98) and remove flange (95) with oil seal (97). Remove flange gasket (94) from crankcase (91). Press oil seal (97) from flange (95).

(c) Press drive end of crankshaft from spacer (93) and bearing (92), and remove crankshaft from crankcase (91).

(d) Pull bearing spacer (I 118) and bearing (119) from crankshaft (120).

(e)Press bearing (92) from crankcase 191).

(f) Remove oil control valve cap (122) and ball (121) from crankshaft counterweight.

c. Cleaning, Inspection and Repair.

NOTE

Refer to table 1-13 to tolerances and clearances.

(1) Clean all metal parts in dry-cleaning solvent, Federal Specification P-D-680. Dry with compressed air (16 psi). Make certain oil header in crankcase is thoroughly clean and crankcase is free of metal chips and grit.

(2) Examine pistons for scores, cracks, or wear. Check each piston with a micrometer in relation to the cylinder bore diameter for clearance of 0.0020 to 0.0025 inch for high-pressure piston and 0.0040 to 0.0075 inch for low-pressure piston. Replace defective pistons.

NOTE

Clearance measurement must be made on thrust side of piston.

(3) Examine fit of piston rings in grooves of piston. The piston rings should be free in the

grooves and show an even bearing surface on the entire circumference. If rings are broken, they must be replaced.

(4) Examine fit of piston pin in piston and in connector rod. Piston pin must be a press fit in piston. If piston pin is loose in the piston, the piston, piston pin, or both must be replaced.

(5) Inspect connector rod bearing clearance on crankshaft journals. Clearance should be 0.001 to 0.002 inch. If babbitt is worn, cracked, or broken, replace the connector rod. If clearance cannot be adjusted with shims, replace the connector rod.

(6) Inspect crankshaft for scoring and overheating and wear to main bearing journal. If main bearing journal prevents roller bearings from being a tight press fit, replace bearing, crankshaft, or both. Replace damaged crankshaft.

(7) Inspect bearings for grooving, discoloration, or uneven wear. Replace defective bearings.

(8) Install new oil seals.

(9) Inspect oil pump spring and ball checks; make sure plunger works freely in the pump body. Assure ball checks are not held off their seats by dirt or foreign matter. If cleaning does not correct defective parts, replace.

(10) Inspect oil pressure relief valve for dirt, broken spring, and damaged ball or seat. Clean relief valve and replace defective parts.

(11) Examine all valve mating surfaces for smooth conditions. Replace defective parts.

NOTE

Replace all gaskets in high- and low-pressure cylinder heads.

(12) Examine safety valve 191 for corrosion and stripped threads. Replace safety valve if defective.

d. Reassembly. Reassemble compressor in the reverse order of removal.

NOTE

Refer to table 1-14 for torque specifications.

9-3. Air Compressor (Model 3VCJ and Coupling Assembly

a. Removal and Installation. Refer to paragraph 2-24 to remove and install the compressor.

b. Disassembly (fig. 9-10).

(1) Cylinder heads removal.

(a) Disconnect and remove unloader tube (1) between high and low pressure cylinder heads.

(b) Remove capscrew (16), flatwasher (17), clamp (18), and spacer (19) from air compressor.

(c) Remove screw (1) and nut (8) securing clamp (10) to intercooler.

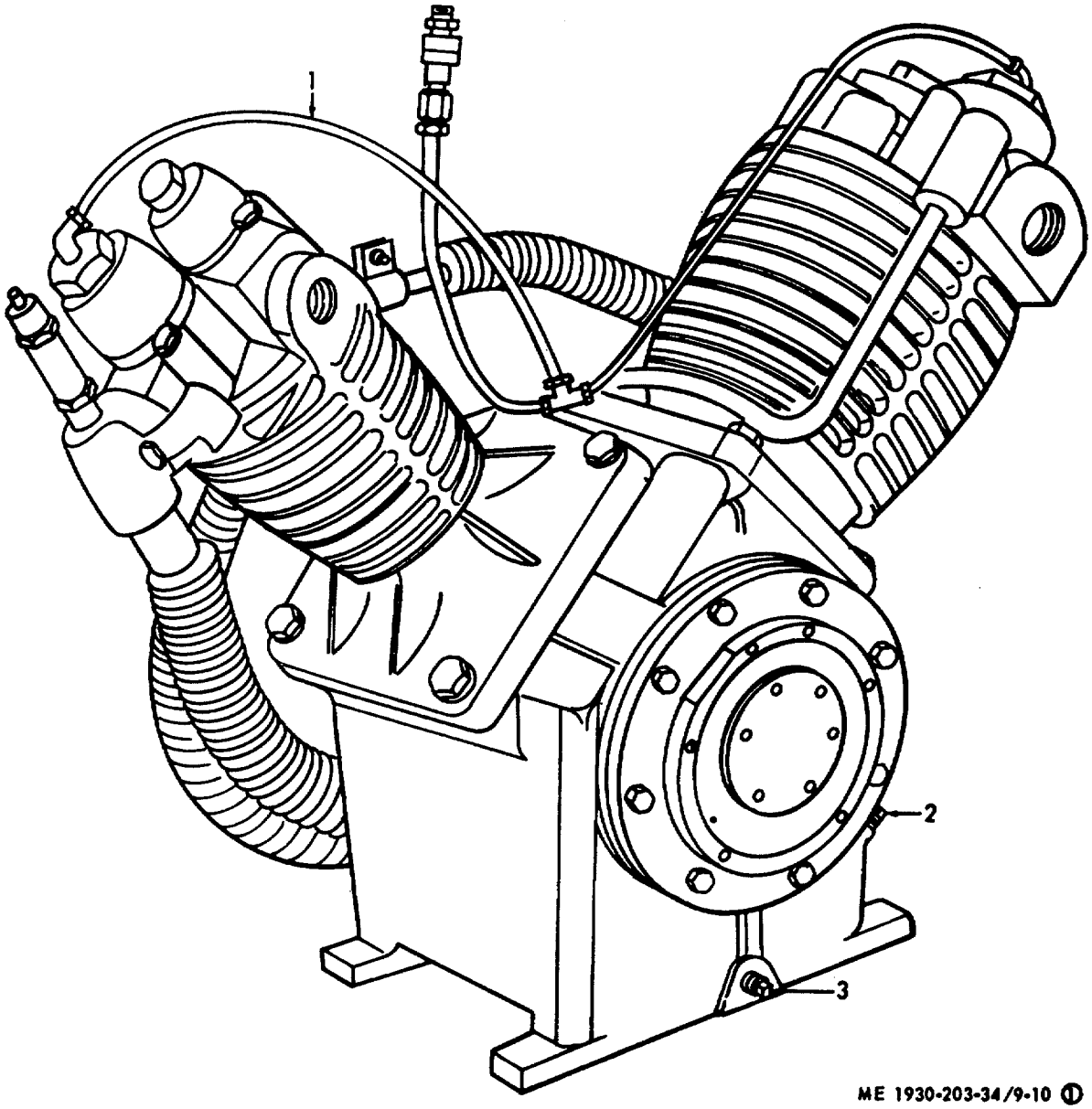


Figure 9-10. Air compressor, model 3VC, disassembly and reassembly (Sheet 1 of 6).

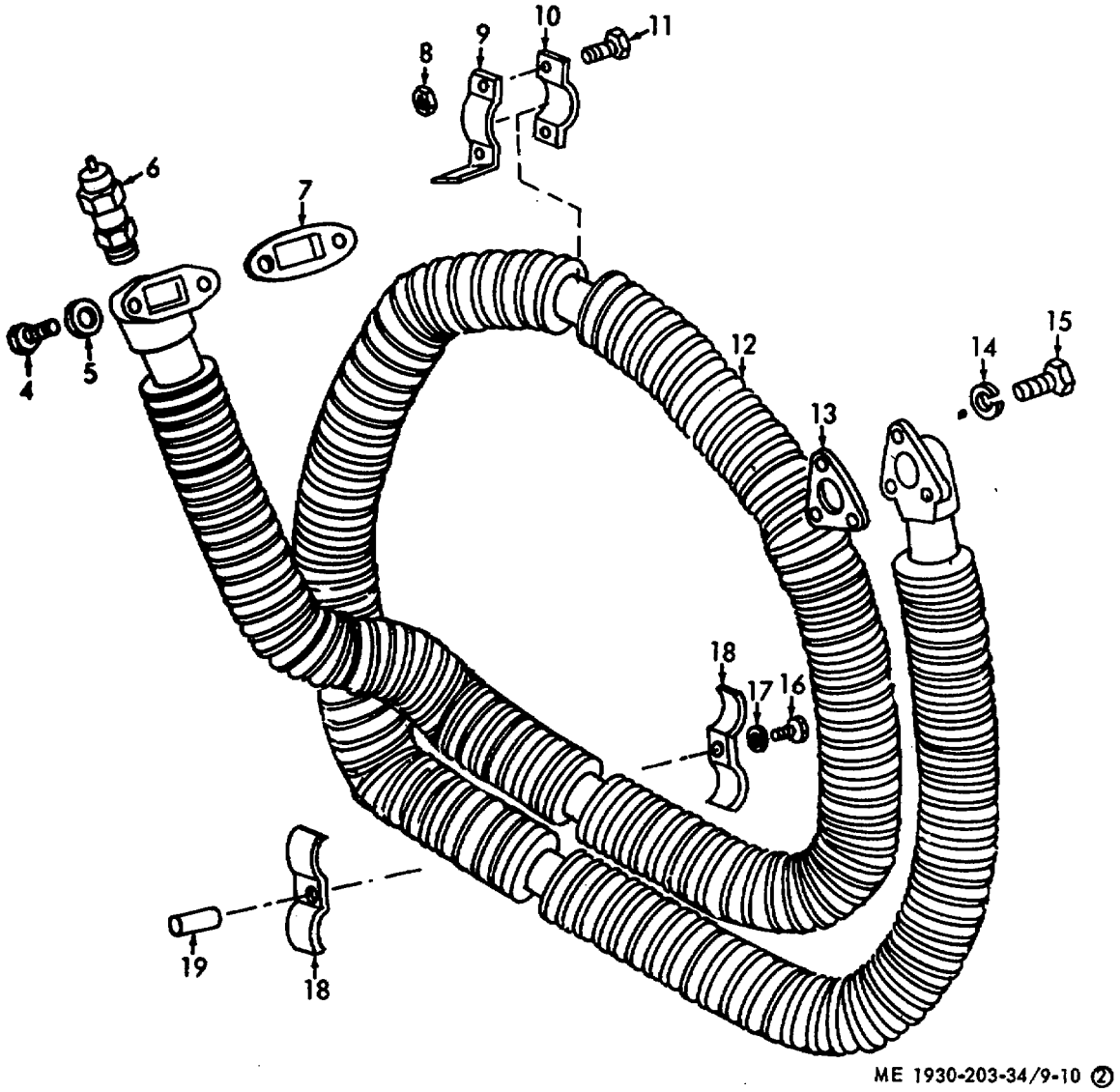


Figure 9-10. Air compressor, model 3VC, disassembly and reassembly (Sheet 2 of 6).

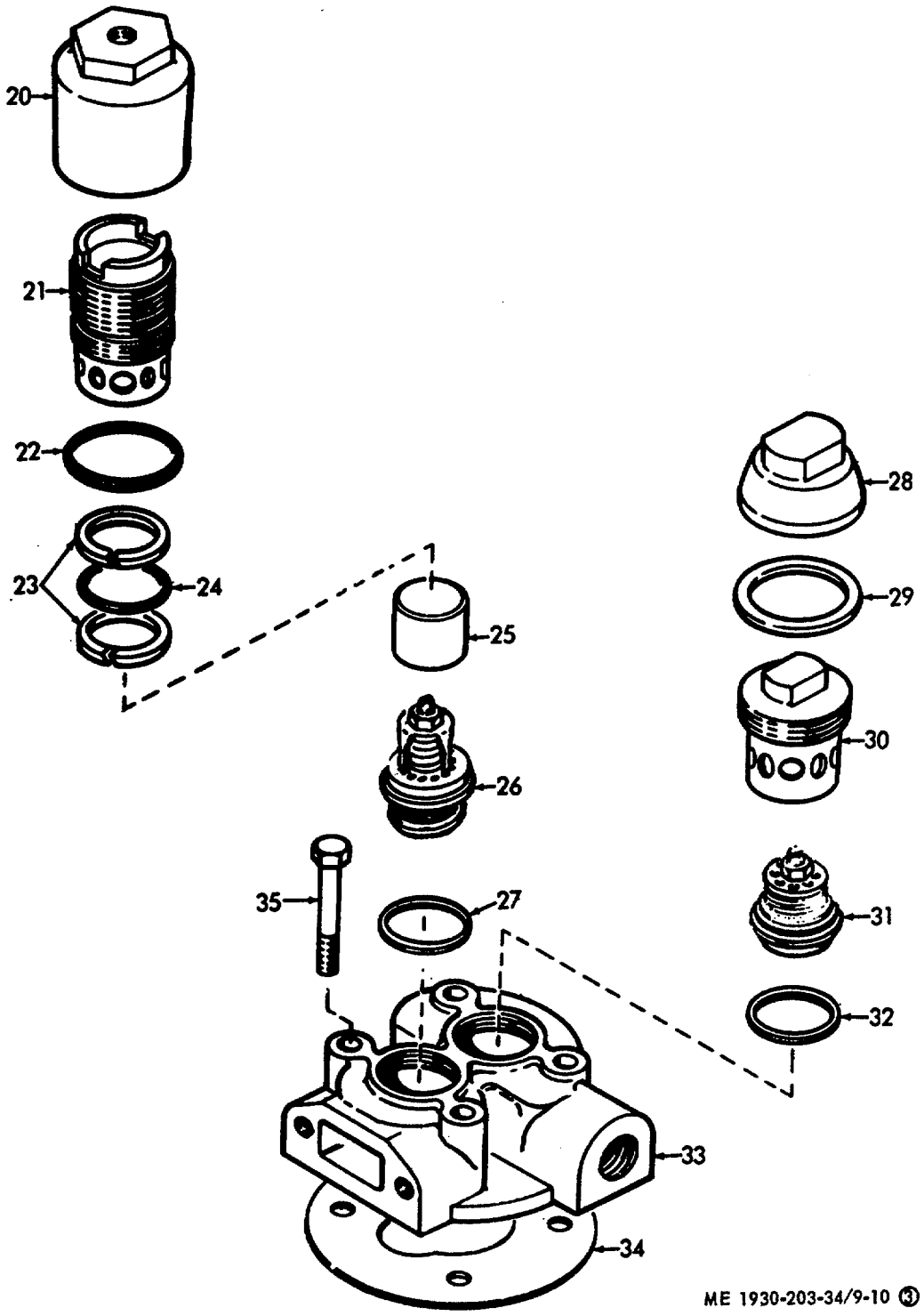


Figure 9-10. Air compressor, model 3VC, disassembly and reassembly (Sheet 3 of 6).

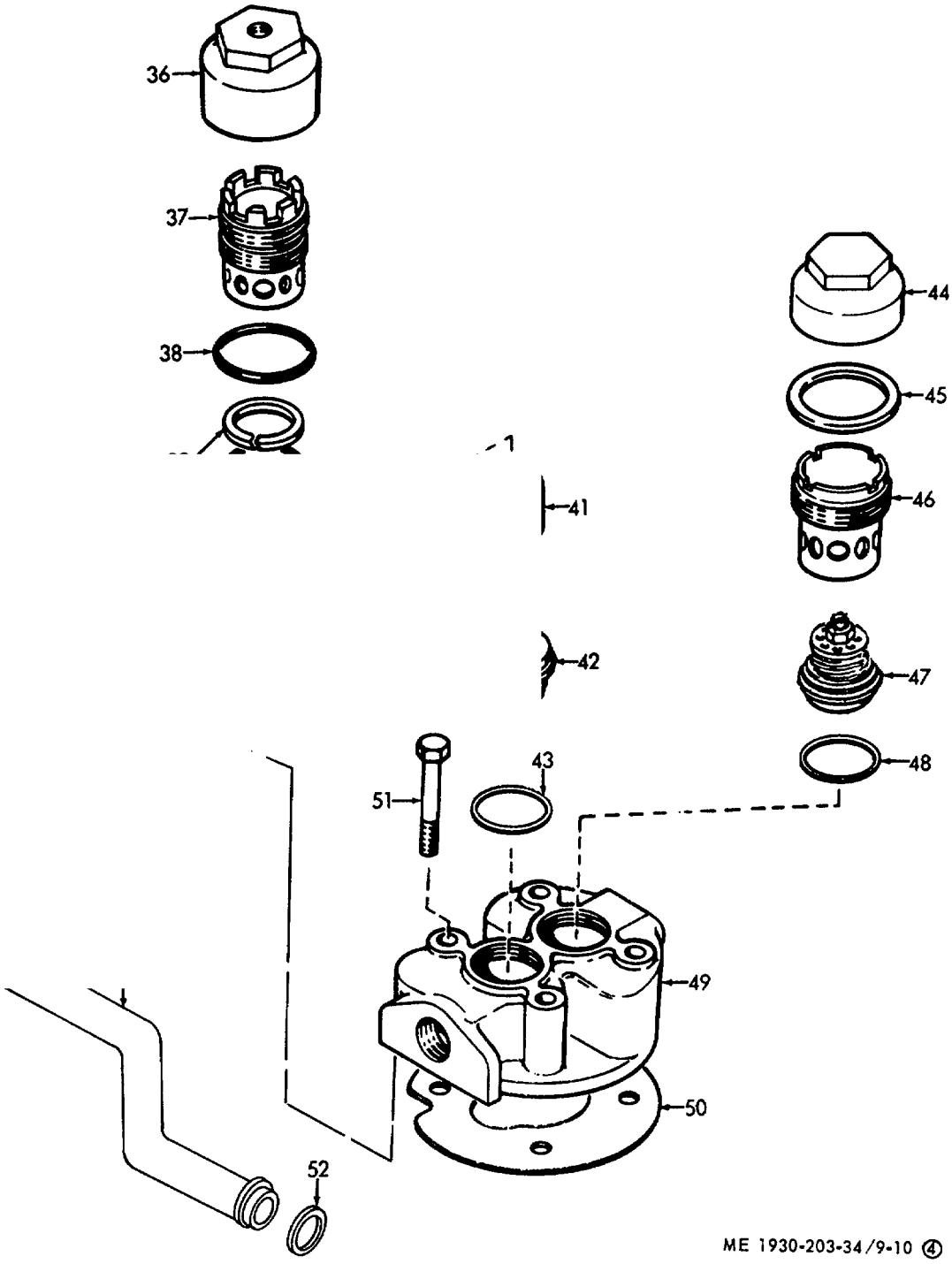


Figure 9-10. Air compressor, model 3VC, disassembly and reassembly (Sheet 4 of 6).

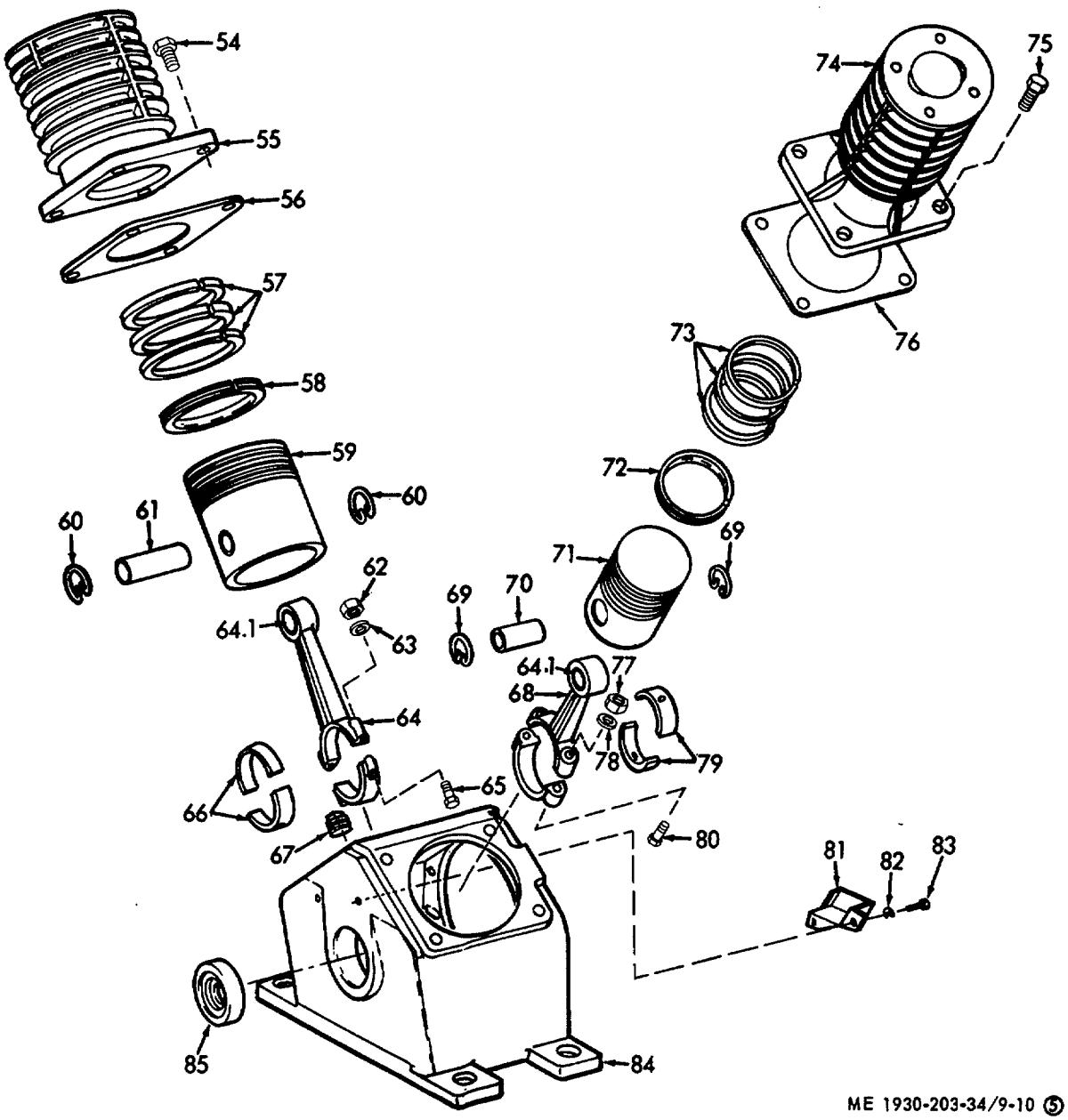


Figure 9-10. Air compressor, model 3VC, disassembly and reassembly (Sheet 5 of 6).

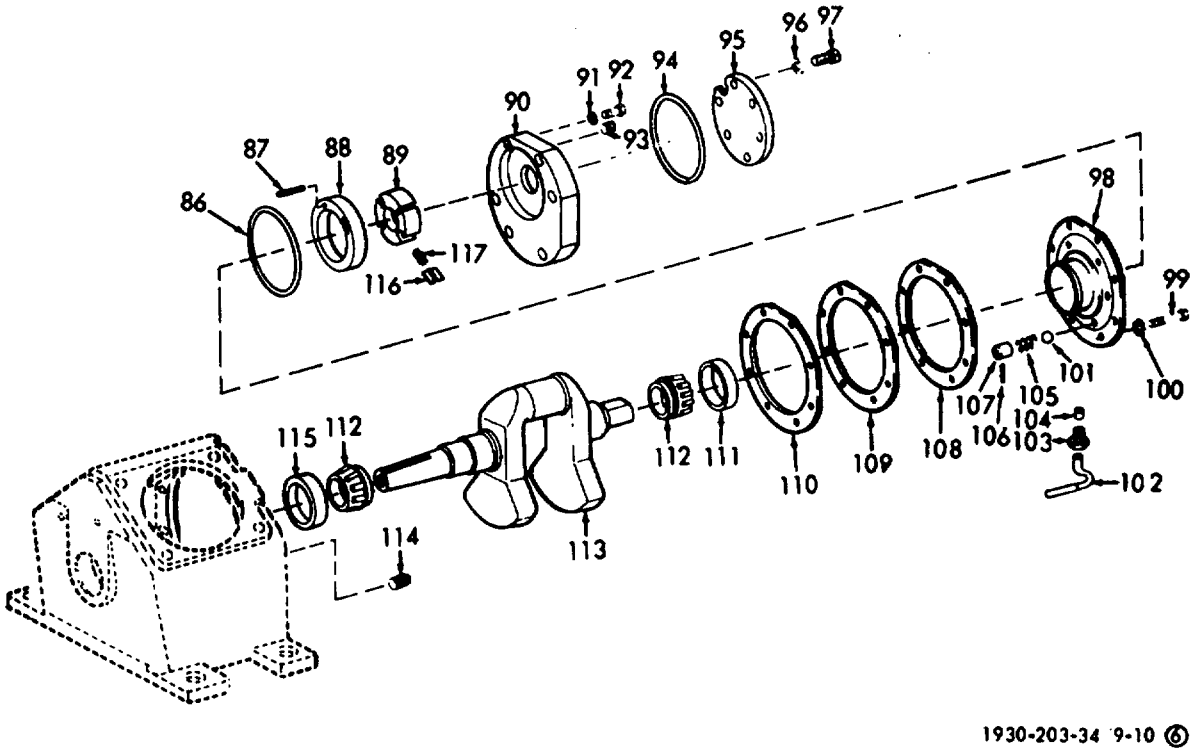


Figure 9-10. Air compressor, model 3VC, disassembly and reassembly (Sheet 6 of 6).

Key to figure 9-10.

I Unloader tube
2 Filler plug
3 Drain plug
4 Capscrew
5 Lockwasher
6 Safety} relief valve
7 Gasket
8 Nut
9 Bracket
10 Clamp
11 Screw
12 Intercooller
13 Gasket
14 Lockwasher
15 Capscrew
16 Capscrew
17 Flatwasher
18 Clamp
19 Spacer
20Cal)
21 Sleeve
22 Packing
23 Seal
24 Packing
25 Plunger
26 Valve assembly. suction
27 Gasket
28 Cap
29 Gasket
30 Plug
31 Valve assembly discharge
32 Gasket
33 Head, high-pressure
34 Gasket
35 Screw
36 Cap. valve
37 Sleeve
38 Packing
30 Seal
40 Packing
41 Plunger
42 Valve assembly. suction
43 Gasket
44 Cap
45 Gasket
46 Plug
47 Valve assembly. discharge
48 Head. low-pressure
49 Gasket
50 Screw
51 Gasket
52 Packing
53 Breather tube
54 Capscrew
55 Cylinder. low-pressure
56 Gasket
57 Ring. piston. compression
58 Ring. piston. oil
59 Piston. low-pressure
60 Retainer. piston pin
61 Piston pin. low pressure
62 Locknut
63 Washer
64 Connecting rod. Low pressure
64.1 Piston pin bushing
65 Bolt
66 Bearing insert
67 Plug
68 Connecting rod. high-pressure
69 Retainer. piston pin
70 Piston pin. high-pressure
71 Piston. high-pressure
72 Ring. piton oil
73 Ring. piston compression
74 Cylinder. high-pressure
75 Capscrew
76 Gasket
77 Locknut
78 Washer
79 Bearing insert
80 Bolt. connecting rod
81 Baffle
82 Lockwasher
83 Screw
84 Crankcase
85 Seal
86 Packing. preformed
87 Roll pin
88 Insert. oil pump
89 Rotor. oil pump
90 Cover. oil pump
91 Lockwasher
92 Screw
93 Pipe Plug
94 Packing. preformed
95 Cover
96 Lockwasher
97 Screw
98 Rear retainer assembly
99 Capscrew
100 Lockwasher
101 Ball
102 Tube. oil intake
103 Fitting. oil intake tube
104 Sleeve. rubber
105 Spring
106 Roll pin
107 Retainer. oil relief spring
108 Shim
109 Shim
110 Shim
111 Cup bearing
112 Cone and rollers
113 Crankshaft
114 Plug
115 Cup, Bearing
116 Vane
117 Spring

Figure 9-10. Air compressor, model 3VC, disassembly and reassembly

(d) Remove capscrews (4 and 15), lock-washers (5 and 14), and intercooler (12) from cylinder heads.
(e) Remove gaskets (7 and 13) and unscrew safety relief valve (6) from intercooler.
(f) Remove bolts securing cylinder heads to cylinders. Remove cylinder heads and gaskets.
(g) Remove crankcase breather tube (53) and packings (52).
(2) *High-pressure cylinder head disassembly*.
(a) Remove valve cap (28), and gasket (29).
(b) Unscrew plug (30) from cylinder head (33) and lift discharge valve assembly (31) and gasket (32) from cylinder head (33).
(c) Remove valve cap (20) and packing (22).
(d) Unscrew sleeve (21) from cylinder head and remove plunger (25), seals (23), and packing (24) from bore of sleeve.
(e) Lift suction valve assembly (26) and gasket (27) from cylinder head.
(3) *Low-pressure cylinder head disassembly*
(a) Remove valve cap (36), and packing (38).
(b) Unscrew sleeve (37) from cylinder head (49) and remove plunger (41), seals (39), and packing (40) from bore of sleeve.
(c) Lift suction valve assembly (42) and gasket (43) from cylinder head.
(d) Remove valve cap (44) and gasket (45).
(e) Unscrew plug (46) from cylinder head and lift discharge valve assembly (47) and gasket (48) from cylinder head.
(4) *High-pressure cylinder removal*.
(a) Remove high-pressure cylinder head ((1) above).
(b) Remove capscrews (75), and lift high-pressure cylinder (74) from high-pressure piston (71). Remove gasket (76) from crankcase (84).
(5) *Low-pressure cylinder removal*
(a) Remove low-pressure cylinder head ((1) above).
(b) Remove capscrews (54), and lift low-pressure cylinder (55) from low-pressure piston (59). Remove gasket (56) from crankcase (84).
(6) *Oil pump removal*.
(a) Remove screw (97), lockwashers (96), cover (95), and packing (94) from oil pump cover (90).
(b) Remove screws (92), lockwashers (91), oil pump cover (90), and packing (86) from rear retainer assembly (98).
(c) Remove oil pump rotor (89), vanes (116), and springs (117).
(d) Remove oil pump insert (88) from roll pin (87). Pu1l roll pin from rear retainer assembly (98).
(7) *High-pressure piston and connecting rod removal*.
(a) Remove high-pressure cylinder ((2) above).
(b) Remove locknuts (77), and flatwashers (78) from connecting rod bolts (80) and remove connecting rod cap and bolts.
(c) Pull high-pressure piston (71) with attached high-pressure connecting rod (68) from crankcase and remove bearing inserts (79).
(d) Remove piston rings (73 and 72) from high-pressure piston.
(e) Remove piston pin retaining rings (69) and press high-pressure piston pin (70) from high-pressure piston (71) and remove connecting rod (68).
(8) *Low-pressure piston and connecting rod removal*
(a) Remove low-pressure cylinder ((3) above).
(b) Remove locknuts (62), and flatwashers (63) from connecting rod bolts (65) and remove connecting rod cap and bolts.
(c) Pull low-pressure piston (59) with attached low-pressure connecting rod (64) from crankcase and remove bearing inserts (66).
(d) Remove piston rings (57 and 58) from low-pressure piston.
(e) Remove piston pin retaining rings (60) from low-pressure piston (59) and .heat the piston in 130° to 150°F water. Push piston pin (61) from piston (59) and remove connecting rod (64).

CAUTION

Do not drive the piston pin from the aluminum piston or use an open flame to heat the piston.

(9) *Crankshaft removal*
(a) Remove high-pressure piston and connecting rod, and low-pressure piston and connecting rod ((7) and (8) above).
(b) Remove oil pump ((6) above).
(c) Remove capscrews (99), and lockwashers (100) and remove rear retainer assembly (98). Disassemble rear retainer assembly as follows:
1. Remove oil intake tube (102) and rubber sleeve (104).
2. Remove roll pin (106), oil relief spring retainer (107), oil relief spring (105), and nylon ball (101).
3. Press bearing cup (111) from rear retainer assembly.
(d) Remove shims (108, 109 and 110) from crankcase (84).
(e) Remove crankshaft (113) from crankcase and pull cone and rollers from crankshaft.

(f) Remove screws (83), lockwashers (82), baffle (81), and oil seal (85) from crankcase. Press bearing cup (115) from crankcase.

c. *Cleaning, Inspection and Repair*.

(1) Clean all metal parts in dry-cleaning solvent, Federal Specification P-D-680. Dry with compressed air (10 psi).

NOTE

Make certain that drilled oil passages in crankshaft are thoroughly clean and crankcase is free of metal chips and grit.

(2) Examine pistons for scores, cracks, or wear. Check each piston with a micrometer in relation to the cylinder bore diameter for clearance of 0.002 to 0.0035 inch for high-pressure piston and 0.0045 to 0.0065 inch for low-pressure piston. Replace defective pistons.

NOTE

Clearance measurement must be made at piston skirt.

(3) Examine fit of piston pin in piston and connecting rod. Piston pin must be a palm push fit in piston at 70º F. If piston pin is loose in the piston, replace the piston pin and piston assembly.

(4) Check piston rings for groove and gap clearance. If clearances exceed limits specified in table 1-12, replace piston rings.

(5) Check clearance between piston pin and connecting rod bushing. Clearance should be 0.0002 to 0.0006 inch. Replace connecting rod bushing if clearance exceeds 0.0006 inch.

NOTE

Rifle drilled connecting rods, part No. AH6-96-3, are no longer manufactured and have been replaced with part No. AH7-96-4 connecting rods, which are not rifle drilled. The new connecting rod is furnished with a replaceable piston pin bushing, part No. H21-577. This bushing can be installed in the obsolete rifle drilled rods as shown in figure 9-11. when bushing replacement is required.

CAUTION

Do not substitute the bushing because the bushing material is "special".

(6) Inspect connecting rod for straightness (fig. 9-11). Connecting rod must be parallel with piston. If twisted, replace connecting rod.

(7) Inspect connecting rod bearing inserts for grooving, discoloration, or uneven wear. Replace defective bearing inserts.

(8) Inspect connecting rod bearing clearance on crankshaft journals. Clearance should be 0.0025 to 0.0044 inch. This type of bearing is not adjustable. If clearance exceeds 0.0044 inch, replace bearing inserts.

(9) Inspect crankshaft for scoring and overheating and wear to main bearing journals. If a main bearing journal prevents a roller bearing from being a tight press fit, replace bearing, crankshaft, or both. Replace a damaged crankshaft.

(10) Inspect roller bearings for grooving, discoloration, or uneven wear. Replace defective bearings.

(11) Inspect oil pump insert, rotor, springs, and vanes for damage and wear. Assure that vanes slide freely in oil pump rotor. Replace defective parts.

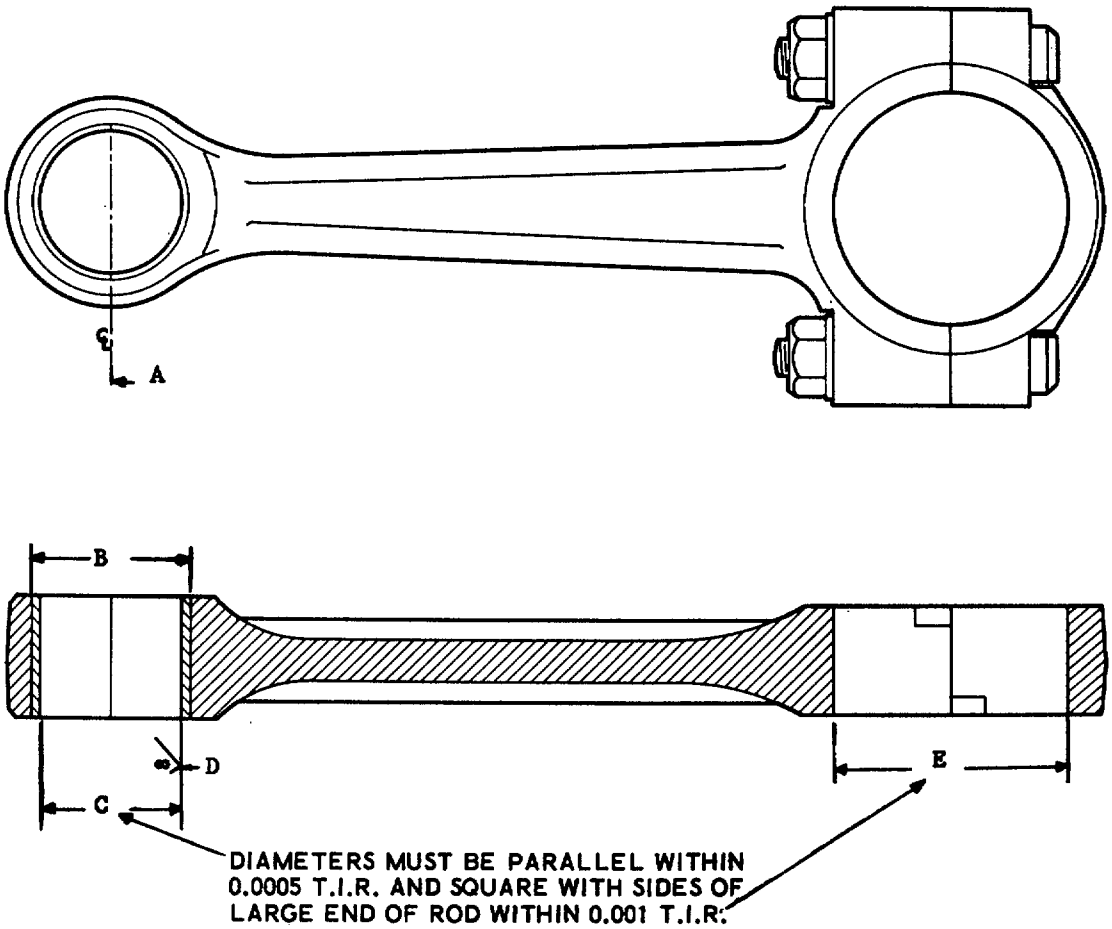
(12) Inspect oil pressure relief valve for broken spring and damaged ball or seat. Replace defective parts.

(13) Inspect suction and discharge valves for damage or wear. Replace defective valves.

(14) Check intercooler safety valve for proper operation. The valve must release at 60 psi. Replace safety valve if defective.

(15) Inspect intercooler assembly for crimping or rupture. Replace intercooler if defective.

(16) Replace all seals and gaskets.



A. Location of bushing split when pressed into rod—split ± 15º with center line.

B. Diameter of rod bore before bushing is pressed in —1.375 ± .0003.

C. Finished bore diameter of bushing-1.2501 inch minimum, 1.2503 inch maximum.

D. Surface finish requirements of bushing — 8 micro inch maximum.

E. Tolerance requirements with respect to parallelism and squareness with the large end of the rod.

ME 1930-203-34/9-11

Figure 9-11. Connecting rod.

d. *Reassembly.*

(1) Install baffle (81, fig. 9-10) in crankcase (84) with screws (83) and lockwashers (82).

NOTE

Prior to installation of screws (83), coat threads of screws with non-hardening sealing compound, Military Specification MIL-S-45180.

(2) Press bearing cup (115) into bearing counterbore of crankcase. Make sure bearing cup is' seated tightly against bottom of counterbore.

(3) Press cone and rollers (112) on crankshaft (1 13). Make sure cone and rollers are tight against the machined cheeks on counterweights of crankshaft.

(14) Insert crankshaft assembly into crank-case (84).

(5) Press bearing cup (111) into bearing counterbore of rear retainer assembly (98). Make sure the bearing cup is seated tightly against bottom of counterbore.

(6) Press roll pin (87) into hole provided in the bore of rear retainer assembly until it bottoms. The pin should not protrude more than the thickness of oil pump insert (88).

(7) Install rubber sleeve (104) on oil intake tube (102). Push the tube into tapped hole in rear retainer assembly (98) until it bottoms and hold in position while fitting (103) is firmly tightened.

NOTE

The oil intake tube must be positioned in the rear retainer assembly so that the screen will lie horizontally along the bottom of the crankcase.

(8) Start roll pin (106) in the hole provided at the relief valve bore in rear retainer assembly. Do not allow the pin to protrude into the bore. Place nylon ball (101), oil relief spring (105), and oil relief spring retainer (107) into oil relief valve bore. Push the spring retainer into the bore until it passes the roll pin hole and tap the roll pin through the relief valve bore until it is flush with the casting face.

(9) Install three shims (110) and rear retainer assembly (98) on crankcase using lockwashers (100) and capscrews (99). Tighten the capscrews evenly to a torque of 30 foot-pounds. Check crankshaft end clearance and adjust if required

((10) below).

NOTE

When installing shims and rear retainer assembly the flats on the outer diameter of the retainer and flats of the shims must be in line with the cylinder mounting faces.

NOTE

Plastic shims (108, 109, and 110, fig. 9-10) are placed between rear retainer assembly and crank-case to adjust crankshaft end clearance and are color coded to identify thickness. The blue is 0.005 inch, translucent 0.0075 inch, and the yellow 0.020 inch. The normal requirement to start the adjusting procedure should be 0.060 inch or three yellow shims between rear retainer assembly and crankcase.

(a) Check crankshaft end clearance with dial indicator. End clearance should be 0003 to 0.005 inch.

(b) Remove or add shims between retainer and crankcase until proper crankshaft end clearance is obtained.

CAUTION

Check total thickness of shims after proper crankshaft end clearance is obtained. If thickness is more than 0.068 inch or less than 0.025 inch, a complete crankshaft recheck should be made to determine whether all parts are correctly installed.

(11) Install oil seal in crankcase as follows:

(a) Turn crankshaft so that keyway is up. Coat exposed length of crankshaft with same type of oil that will be used in the crankcase, Military Specification MIL-L-2 104.

(b) Place oil seal (85), over end of crankshaft with lip of seal facing the crankcase. Lift the seal against the lower side of the shaft opposite the keyway and slide it to the crankcase bore.

(c) Coat outer diameter of the oil seal with non-hardening sealing compound, Military Specification MIL-S-45180.

(d) Using a suitable seal driving tool, drive the seal squarely into the crankcase bore until it is flush with outside of crankcase.

12) Install oil pump as follows:

(a) Slide oil pump insert (88), over guide pin (87) into counterbore of rear retainer assembly (98).

NOTE

An arrow, etched on the face of the reversible insert indicates rotation necessary for oil pump operation. The insert must be installed with the arrow pointed in direction of compressor rotation.

CAUTION

For LARC application, the insert must be installed with arrow pointed clock-wise.

(b) Place rotor (89), over crankshaft into the oil pump insert (88).

(c) Check clearance between face of rotor and oil pump cover. Correct clearance is 0.0035 to 0.0055 inch. If clearance is not within specified limits, replace oil pump rotor (89), rear retainer assembly (98), or both.

(d) Install a vane spring (117) and vane (116) in the rotor slot at the widest opening between rotor and oil pump insert. Turn the crankshaft 90º and install second spring and vane. Repeat until all four springs and vanes are installed.

NOTE

The relief provided on one side of the vane must be on the leading edge or toward the direction of rotation.

(e) Lightly grease performed packing (86) and place it in rear retainer assembly groove. Install oil pump cover (90) using lockwashers (91) and screws (92). Tighten screws to a torque of 9 foot-pounds.

(f) Lightly grease performed packing (94)

and place it in cover (95) groove. Install cover (95) using lockwashers (96) and screws (97).

(13) Heat low-pressure piston (59), in 130° to 150°F water. Place upper end of connecting rod (64) between piston pin bosses and push piston pin (61) in place. Install piston pin retainers (60).

NOTE

Lubricate piston pins with same type (of oil that will be used in the crankcase. Military Specification MIL-L-2 104. prior to installation.

CAUTION

Do not drive the piston pin into the aluminum piston or use and open flame to heat the piston.

(14) Place upper end of connecting rod (78) between piston pin bosses of high-pressure piston (71) and press piston pin (70) in place. Install piston pin retainers (69).

(15) Install oil ring (58) and compression rings (57) on low-pressure piston (59), and oil ring (72) and compression rings (73) on high-pressure piston (71).

CAUTION

An identifying mark, either the word "top" of a black dot is etched on one side of each co m-pression ring. The rings must be installed with these identifying marks toward top of piston.

(16) Wipe crankshaft journal clean and lubricate with same type of oil that will be used in crankcase, Military Spec i-fication MIL-L-2104.

(17) Install low-pressure and high-pressure piston and connecting rod assemblies as follows:

(a) Install connecting rod bearing inserts (66 or 79) in connecting rods (64 or 68).

NOTE

Before installing bearing inserts. make certain insert backs and connecting rod bore surfaces are clean and free of oil.

CAUTION

When installing bearing inserts, be sure tang of each insert is engaged in the notches pr o-vided in the connecting rod and cap bore.

(b) Lower connecting rod into place on crankshaft and secure connecting rod bearing cap to the connecting rod using bolts (65 or 80), flatwashers (63 or 78) and locknuts (62 or 77). Tighten locknuts to a torque of 350 inch-pounds.

CAUTION

When installing connecting rod bolts, be sure flats on bolt heads engage with the milled flats on the connecting rod caps. (18) Install low- and high-pressure cylinders as follows:

NOTE

Before attempting to install the cylinders over the positions and rings, support the piston so that the connecting rod is not accidentally bent or twisted. Wooden blocks should be placed between the bottom of the pistons and the cylinder mounting faces of the crankcase. The blocks should be approximately ¼" shorter than the distance between the bottom of the piston and the crank-case cylinder mounting face when the piston is at the top end of its stroke. Always use the blocks when installing the cylinders. Remove blocks after piston and piston rings have entered cylinder.

CAUTION

The cast rib running vertically through the cooling fins of the cylinders must be positioned on the same plane as the crankshaft in order to assure proper cooling and also provide proper positioning of the valve reliefs cast in the top face of the cylinder. The low pressure cylinder has a relief cast in one side of the cylinder mounting flange. This relief must be positioned to make the crankcase breather tube hole accessible.

(a) Position gasket (56 or 76). on crankcase (84) and install cylinder (55 or 74) using capscrews (54 or 75). Tighten the capscrews to a torque of 30 foot-pounds.

NOTE

Before installing the cylinders. position piston ring gaps 90° apart and apply a film of lubricating oil. Military Specification MIL-L-2104 to the pistons and rings.

(b)Check top of piston to top of cylinder clearance as follows:

1. Rotate the crankshaft to bring either piston to the top of its travel.

2.Check top of piston to top of cylinder clearance with a dial indicator. depth micrometer, or by placing a straight edge across the top face of the cylinder and then measuring the clearance with feeler gages. Clearance should be -0.007 to + 0.01, inch. If clearance is not within these limits, improper thickness cylinder mounting gasket has been installed or co n-necting rod is bent.

3. Rotate crankshaft to bring other piston to the top of its travel and repeat step 2 above.

(19) Low-pressure cylinder head reassembly and installation.

(a) Reassembly.

1. Install gasket (48), and discharge valve assembly (47) into cylinder head (49).

NOTE

Rotate valve on gasket and seat to assure proper locating.

2.Screw plug 1461 into cylinder head (49)

against discharge valve assembly (47). Tighten plug to a torque of 100 foot-pounds.

3. Install gasket (45) and valve cap (44). Tighten valve cap to a torque of 100 foot-pounds.
4. Install gasket (43) and suction valve assembly (42) into cylinder head (49).

NOTE

Rotate valve on gasket and seat to assure proper locating.

5. Install seals (39) and packing (40) in the three grooves provided in bore of sleeve (37).

CAUTION

The packing must be placed in center groove to provide a seal between the plunger and sleeve. The seals must be placed in the upper and lower grooves to facilitate lubrication.

6. Apply a light coat of grease (MIL-L-4343) to packing and seals in sleeve (37), and coat outside of plunger (41) and install the plunger into bore of sleeve.
7. Screw sleeve (37) into cylinder head (49) against suction valve assembly (42), and tighten to a torque of 100 foot-pounds.
8. Apply a light coat of grease (MIL-L-4343) to packing (38) and place it over sleeve (37) so that it rests in the undercut provided in the threaded area of the sleeve.
9. Install valve cap (36). Tighten to a torque of 100 foot-pounds.

(b) Installation. Install cylinder head in reverse order of removal (b) (1) above.

(20) *High-pressure cylinder head reassembly and installation*.

(a) Reassembly.

1. Install gasket (27), and suction valve assembly (26) into cylinder head (33).

NOTE

Rotate valve on gasket and seat to assure proper locating.

2. Install seals (24) and packing (23) in the three grooves provided in bore of sleeve (21).

CAUTION

The packing must be placed in center groove to provide a seal between the plunger and sleeve. The seals must be placed in the upper and lower grooves to facilitate lubrication.

3. Apply a light coat of grease (MIL-L-4343) to the packing and seals in sleeve (21), and coat outside of plunger (25) and install the plunger into bore of sleeve.
4. Screw sleeve (21) into cylinder head (33) against suction valve assembly (26), and tighten to a torque of 70 foot-pounds.
5. Apply a light coat of grease(MIL-L-4343) to packing (22) and place it over sleeve (21) so that it rests in the undercut provided in the threaded area of the sleeve.
6. Install valve cap (20). Tighten to a torque of 70 foot-pounds.
7. Install gasket (32) and discharge valve assembly (31) into cylinder head (33).

NOTE

Rotate valve on gaskets and seat to assure proper location

8. Screw plug (30) into cylinder head (33) against discharge valve assembly (31). Tighten plug to a torque of 70 foot-pounds.
9. Install gasket (29) and valve cap (28). Tighten valve cap to a torque of 70 foot-pounds.

(b) Installation. Install cylinder head in reverse order of removal (b)(1) above.

9-4. Actuator Positioner Governor Control

a. Description. The actuator positioner governor control is a Type AB-1 actuator positioner used to control engine speed by varying the position of the engine governor control shaft. The actuator positioner operates between 10 and 60 psi control pressure applied to its diaphragm. A rod takes specific positioning relative to the position of the speed controls in the cab. The rod end operates the governor control shaft through a linkage. The actuator positioner has a separately controlled stop cylinder. When air is admitted to the stop cylinder, the rod will be returned 2 inches in the opposite direction, regardless of the position of the rod within its 2 inch nominal stroke. Thus if the rod is in full speed position, it will be returned to idle position, or if it is in idle position, it will be returned to stop position.

b. Removal and Disassembly.

(1) *Removal*

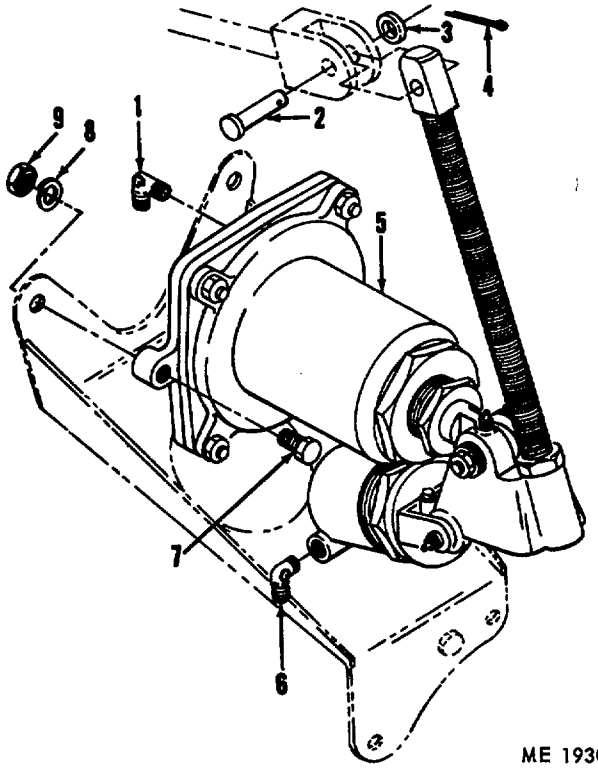
(a) Close globe valves (6 and 7, fig. 2-19) located in airlines above air supply tanks and open service connection globe valves (51 to vent compressed air from lines.

(b) Disconnect hoses from elbows (I and 6, fig. 9-12) installed in actuatorpositioner (5).

(c) Remove cotter pin (4), washers (3), and connecting pin (2) attaching control rod to governor throttle control shaft.

(d) Remove bolts (7). nuts (9), and lockwashers (8) attaching actuator positioner (5) to mounting bracket on torque converter and remove actuator positioner.

(e) Remove elbows (1 and 6) from actuator position (5).



1 Elbow
2 Connecting pin
3 Washer
4 Pin, cotter
5 Actuator positioner
6 Elbow
7 Bolt
8 Lockwasher
9 Nut

Figure 9-12. Actuator positioner removal and installation

12) Disassembly.

(a) Remove capscrews (1, fig. 9-13) and nuts (4) securing diaphragm cover (2) to actuator positioner body (7). Exercise caution as cover is under spring load.

(b) Remove cover and diaphragm (3).

(c)Remove diaphragm spring (6) and shims (8).

(d)Remove bolt (14), nut, (17), and spring washers (16).

(e) Pull out needle bearing (15).

(f) Pull out piston rod (51.

(g)Loosen locknut (9) and unscrew adjuster (1l0).

(h) Loosen jamnut (13) and unscrew rod (12).

(i)Remove cotter pin (22) and push out pin (21)

(j)Remove auxiliary body cap (26) and pull out auxiliary push piston (27) and attaching parts, including auxiliary piston spring (29).

(k) Pull out piston packing cup (31).

(l) Remove lubricator swab (30) from auxiliary push piston.

(m) Remove cotter pin (19) and press out fulcrum pin (24).

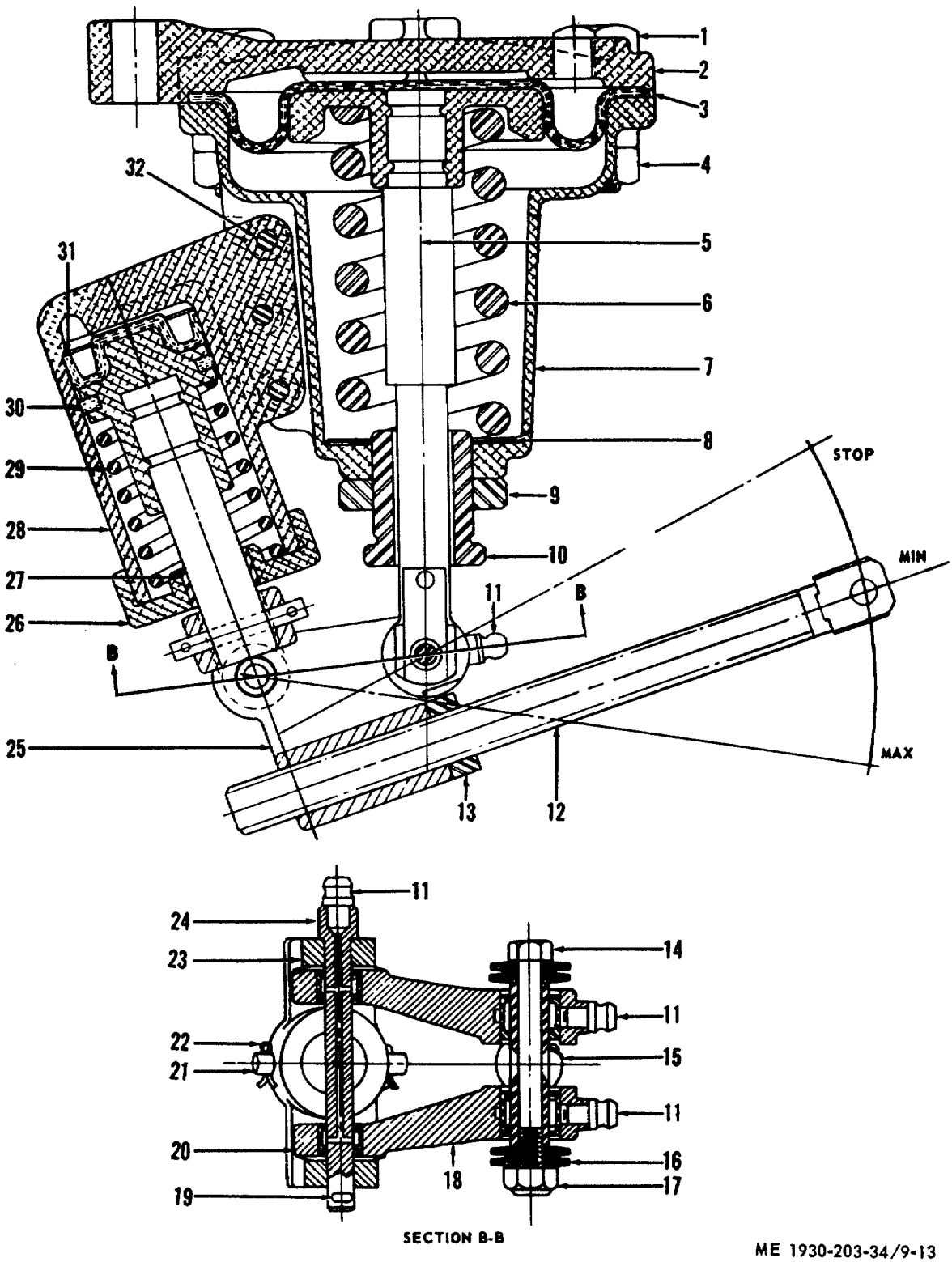


Figure 9-13. Actuator positioner governor control ,disassembly and reassembly.

Key to figure 9-13.

I Capscrew
2 Diaphragm cover
3 Diaphragm
4 Nut
5 Piston rod
6 Diaphragm spring
7Body
8 Shims
9 Locknut
10 Adjuster
11 Grease fitting
12 Rod
13 Jamnut
14 Bolt
15 Needle bearing
16 Washer
17 Nut
18 Lever arm
19 Cotter pin
20 Needle bearing
21 Pin, piston rod
22 Cotter pin
23 Washer
24 Pin, fulcrum
25 Connecting link
26 Auxiliary body cap
27 Auxiliary push piston
28 Auxiliary piston body
29 Auxiliary piston spring
30 Lubrication swab
31 Packing cup
32 Rivet

(n) Separate spring washers (23) lever arm 118), and connecting link (25).

c. Cleaning, Inspection and Repair.

(1) Clean all metal parts in dry-cleaning solvent, Federal Specification P-D-680. Wash rubber parts in soap and water and dry with a low pressure air stream.

(2) Inspect diaphragm (3), and packing cup (31) from cracks and broken sealing beads. Replace a defective diaphragm or packing cup.

(3) Check springs (6 and 29) for breaks or distortion. Replace defective springs.

(4) Check that auxiliary piston body (28) is securely mounted to actuator body (7). If piston body is loose, replace rivets (32).

(5) Inspect needle bearings (15 and 20) for scoring or roughness. Replace actuator positioner if bearings are defective.

(6) Inspect grease fittings (I1) for clogging or breaks. Replace grease fittings if clogged or broken.

d. Reassembly and Installation.

(1) Reassemble and install actuator positioner in reverse order of disassembly and removal.

(2) Lubricate actuator positioner as outlined in LO 55-1930-203-12.

e. Adjustment. Adjustments are provided for spring height. and final travel of the rod end. As assembled, these adjustable elements are so matched that lever travel starts at 10 psi control pressure and attains maximum rod end travel at about 60 psi control pressure. The rod end travel can be changed to match the operated device by backing off the jamnut (13, fig. 9-13) and moving the rod end (12) to any desired operating length and tightening the jamnut. If necessary to change the pressure at which initial travel occurs, add or remove one or more shims (8) until the rod end starts to move at the desired initial pressure. This is normally required only when the spring is replaced. The adjuster (10) is used to match total travel with smaller or higher pressure than the normal 60 psi. After loosening the locknut (9), adjuster (10) is turned in to cause maximum travel to occur at higher pressure. After installation, the distance between the connecting link (25) and the pin hole in the rod end (12) should be 6 inches. Check that the distance between the holes at each end of the link between the actuator positioner and governor is 16 19 / 32 inches. If not, loosen the jamnuts and adjust the 16 19 / 32 inches. Tighten jamnuts.

9-5. Air Compressor Governor

a. Removal and Disassembly.

(1) Removal

(a) Open globe valves on base of air tanks and vent compressed air from air supply tanks.

(b)Disconnect tubing (20 and 24, fig. 9-14) from elbows (21 and 22).

(c) Remove bolts (27), lockwashers (26), and nuts (25) securing governor to bracket and remove governor.

(2) Disassembly.

(a)Remove capscrews (23), and lift off pipe bracket (19) and gasket (18).

(b)Remove screws (28), and remove cutout seat (29) and cutout valve (30).

(c)Remove screws (13) and remove cut-in valve spring (12), cut-in tail valve seat (17), cut-in valve spring (16), cut-in tail valve (15), and cut-in valve (14).

(d) Remove nuts (6) from stems (8), and remove adjusting spring seats (11), sleeves (10), adjusting springs (9), and stems (8).

(e)Remove sediment strainer (1) from valve body (7) and disassemble as follows:

1. Remove retaining ring (5) from sediment strainer housing (2).

2.Remove strainer (4) and strainer plates(3) from sediment strainer housing (2).

b. Cleaning, Inspection and Repair.

(1) Clean all metal parts in dry-cleaning solvent, Federal Specification P-D-680. Make sure that air passages and exhaust port are free from dirt.

(2) Replace gasket (18).

NOTE

Refer to figure 9-13.1 for oil flow on model 3VC compressor.

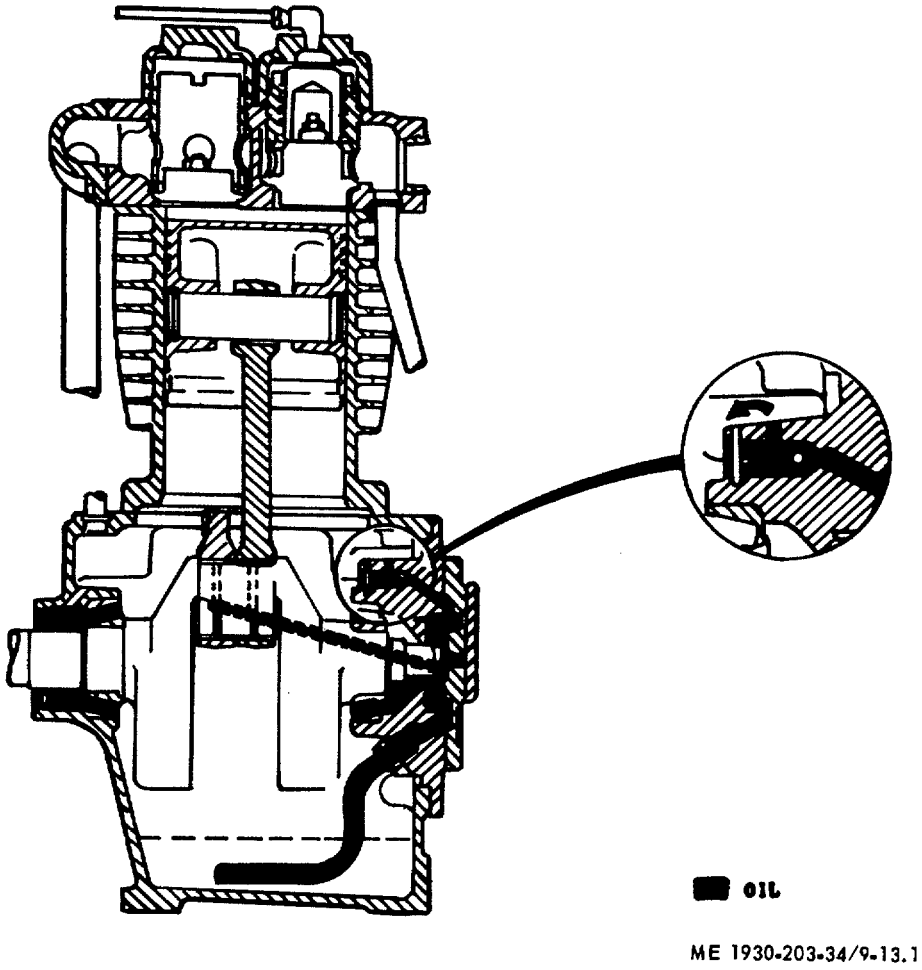


Figure 9-13.1. Oil flow model 3VC compressor

Key to figure 9-14.

1 Sediment strainer
2 Sediment strainer housing
3 Strainer plate
4 Strainer
5 Retaining ring
6 Nut
T Valve body
8 Stem
9 Adjusting spring
1O Sleeve
11 Adjusting spring seat
12 Cut-in valve spring seat
13 Screw
14 Cut-in valve
15 Cut-in tail valve
16 Cut-in tail valve spring
17 Cut-in tail valve seat
18 Gasket
19 Pipe bracket
20 Tubing
21 Elbow
22 Elbow
23 Capscrew
24 Tubing
25 Nut
26 Lockwasher
27 Bolt, machine
28 Screw
29 Cutout valve seat
30 Cutout valve

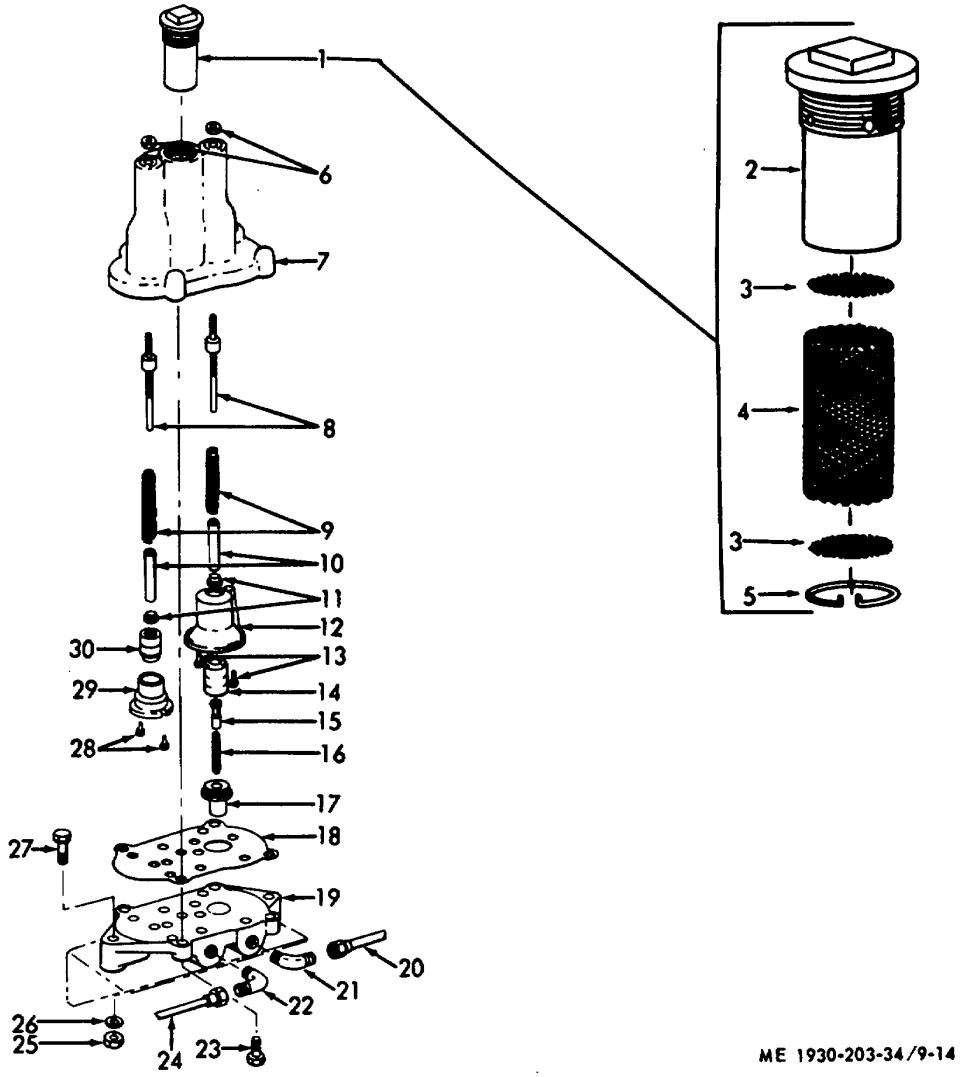


Figure 9-14. Air compressor governor removal ,disassembly reassembly and installation.

(3) Check springs C9 and 16) for breaks or distortion. Replace defective springs.

(4) Inspect seats (11, 12, 17, and 29) and valves (14, 15, and 30) for grooves, burrs, or score marks. If seats or valves are defective, replace governor.

(5) Replace strainer if ruptured or cannot be cleaned properly.

c. Reassembly and Installation. Apply a light coat of oil to surfaces of valves (14 and 30), and reassemble and install governor in reverse order of disassembly and removal.

d. Adjustment. Refer to TM 55-1930-203-20.

9-6. Air Horn

a. Removal and Disassembly.

(1) Removal.

(a) Disconnect air line from fitting installed in air horn.

(b) Remove fitting from air horn.

(c) Remove attaching bolts. nuts, and lock-washers to remove air horn.

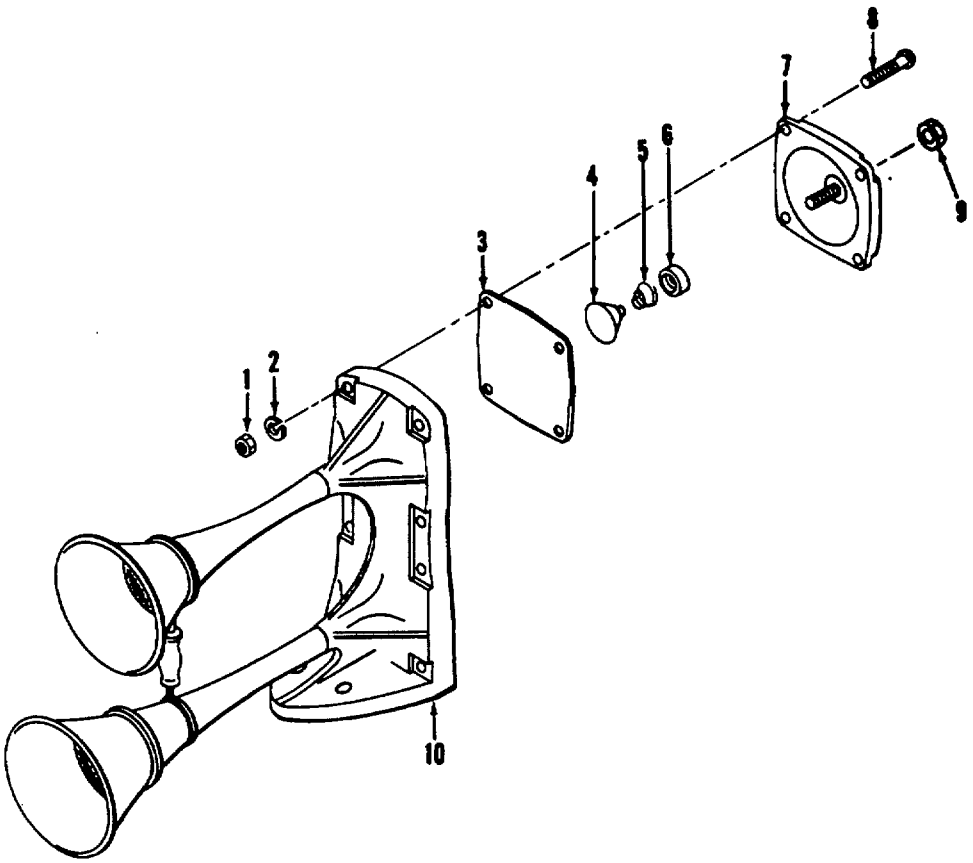
(2) Disassembly.

(a) Remove nut (1, fig. 9-15).

(b) Remove lockwasher (2).

(c) Remove screw (8).

(d) Lift off cover (7) and diaphragm (3) from body (10).



1 Nut
2 Lockwasher
3 Diaphragm
4 Spring contact
5 Spring
6 Spring seat
7 Cover
8 Screw
9 Nut
10 Body

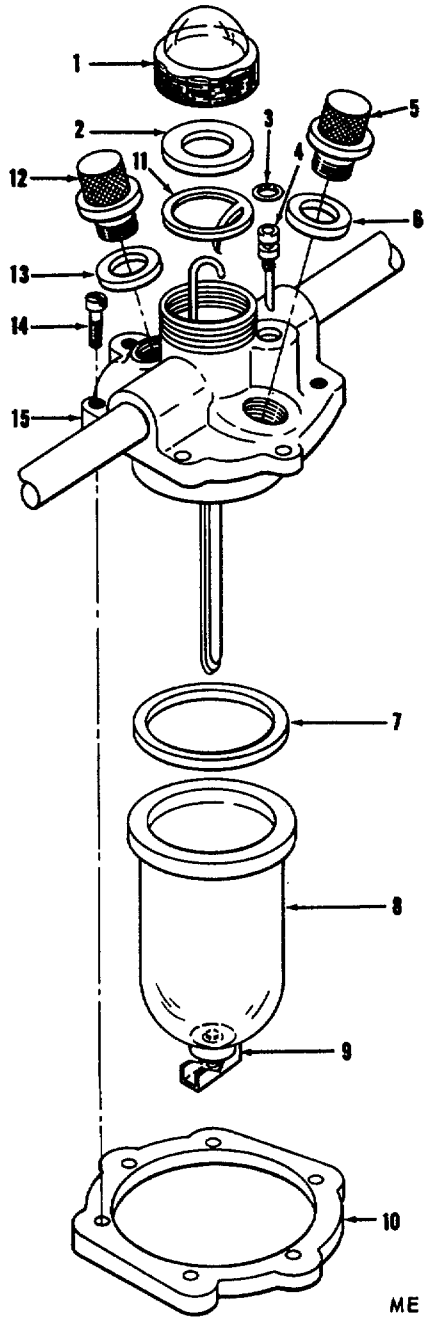
Figure 9-15. Air horn ,disassembly and reassembly

(e) Unscrew nut (91 and remove spring seat i6).
(f) Remove spring (5) and spring contact (4).
b. Cleaning, Inspection and Repair.
(1) Clean parts with lint-free cloth moistened with dry-cleaning solvent, Federal Specification P-D-680.
(2) Inspect diaphragm (3). for cracks or breaks. Replace a defective diaphragm.
(3) Inspect spring 151 for breaks and distortion. Replace a defective spring.
(4) Check spring contact 141 and spring seat (6) for good condition. Replace a defective contact or seat.
c. Reassembly and Installation. Reassemble

and install air horn in reverse order of disassembly and removal.
d. Adjustment. Refer to TM 55-1930-203-20.

9-7. Air Starting Lubricator

a. Removal and Disassembly.
(1) Removal. Disconnect tubing from air starting lubricator and remove lubricator.
(2) Disassembly.
(a) Unscrew filler plugs (5 and 12, fig. 9-16) and remove gaskets (6 and 13).
(b) Unscrew sight-feed dome (1) and remove gasket (2) and lockwasher (11).
(c) Remove adjusting screw (4) and packing (31.
(3) Remove screws (14), clamp-ring (10), lubricator bowl (8) and gasket (7).
b. Cleaning, Inspection and Repair.
(1) Clean parts in dry-cleaning solvent,, Federal Specification P-D-680.
(2) Inspect gaskets (2, 6, 7, and 13) and packing (3) for broken or deteriorated condition. Replace defective gaskets and packings.
c. Reassembly and Installation.
(11 Reassemble and install air starting lubricator in 'reverse order of disassembly and removal.
(2) Refill lubricator (LO 55-1930-203-12).
d. Adjustment. Refer to TM 55-1930-203-20.



1 Sight-feed dome
2 Gasket
3 O-ring packing
4 Screw, adjusting
5 Filler plug
6 Gasket
7 Gasket
8 Lubricator bowl
9 Drain cock
10 Clamp-ring
11 Lockwasher
12 Filler plug
13 Gasket
14 Screw
15 Body

Figure 9-16. Air starting lubricator ,disassembly reassembly and installation

9-8. Air Starting Relay Air Valve

a. Removal and Disassembly.

(1) Removal.

(a) Close globe valves (6 and 7, fig. 2-19) located in air lines above air supply tanks and open service connection globe valves (5) to vent compressed air from lines.

WARNING

Failure to release pressure may result in injury to personnel removing air system components.

(b) Disconnect air lines from inlet, outlet, control, and accessory ports.

(c) Remove three mounting bolts, washers, and nuts. Remove relay air valve.

(2) Disassembly.

(a) Remove nuts (1, fig. 9-17) securing control piston cover (2) to body (4). Exercise caution as cover is under spring load.

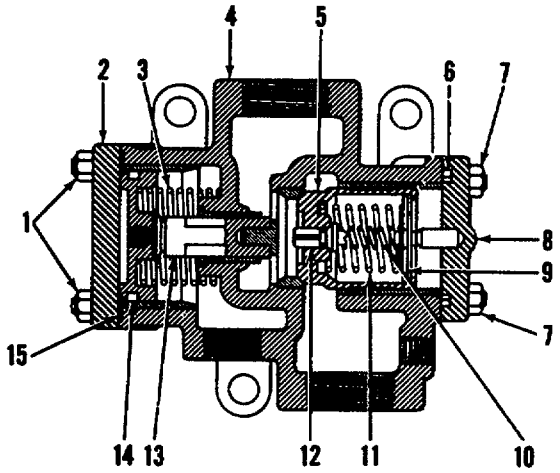
(b) Remove cover and gasket (15).

(c) Remove control piston (13) and spring (3) from body.

(d) Remove packing (141 from control piston.

(e) Remove nuts (7) and remove inlet valve cover (8) and gasket (6) from body.

(f) Slide inlet valve (5) out of body. valve.



ME 1930-203-34/9-17

1 Nut
2 Cover
3 Spring
4 Body
5 Inlet valve
6 Gasket
7 Nut
8 Cover
9 Retainer
10 Spring
11 Spring
12 Inlet pilot valve
13 Control piston
14 Packing
15 Gasket

Figure 9-17. Air starting relay air valve, ,disassembly and reassembly

b. Cleaning, Inspection and Repair.

(1) Clean all metal parts in dry-cleaning solvent, Federal Specification P-D-680, and dry with low pressure air (10 psi).

(2) Replace gaskets (6 and 15), and packing (14).

(3) Inspect springs (3, 10, and 11) for breaks or distortion. Replace a broken or deformed spring.

(4) Inspect inlet valve (5) for scores or pits on valve surface that mates with body (4) and valve surface that mates with inlet pilot valve (12). If inlet valve is defective, replace relay air valve.

(5) Inspect pilot air valve for scores or pits on valve surface that mates with inlet valve. If pilot air valve is defective, replace relay air valve.

(6) Check body for scores or pits in inlet valve seat area. If scored or pitted, replace relay air valve.

c. Reassembly and Installation.

(1) Reassembly. At reassembly, apply a light coat of approve grease to packing and all friction surfaces. Re-assemble air relay valve in the reverse order of disassembly.

(2) Installation.

(a) Mount relay air valve with three bolts, washers, and nuts.

(b) Connect air lines to inlet, outlet, control, and accessory ports.

(c) Close service connection globe valve opened in *a*(1)(a) above. Open globe valves located in air lines above air supply tank.

9-9. Air Supply Tanks

a. General. There are two air tanks, each having a capacity of 10.7 cubic feet, installed under the cargo well deck at watertight bulkhead number six. Each tank is connected to the other. Globe valves in the tank outlet lines permit shutting off either or both tanks from the remainder of the system. A flange is welded on the forward side of air tank 1 foot from aft crown of tank. The flange is welded to aft side of bulkhead number six with a continuous weld assuring a watertight integrity when installed in LARC.

b. Removal.

NOTE

Repairs should be made without removing air tank if possible.

(1) Depressurize pneumatic system, disconnect lines, and drain air tank.

(2) Remove dunnage from cargo well deck area between frames four and six.

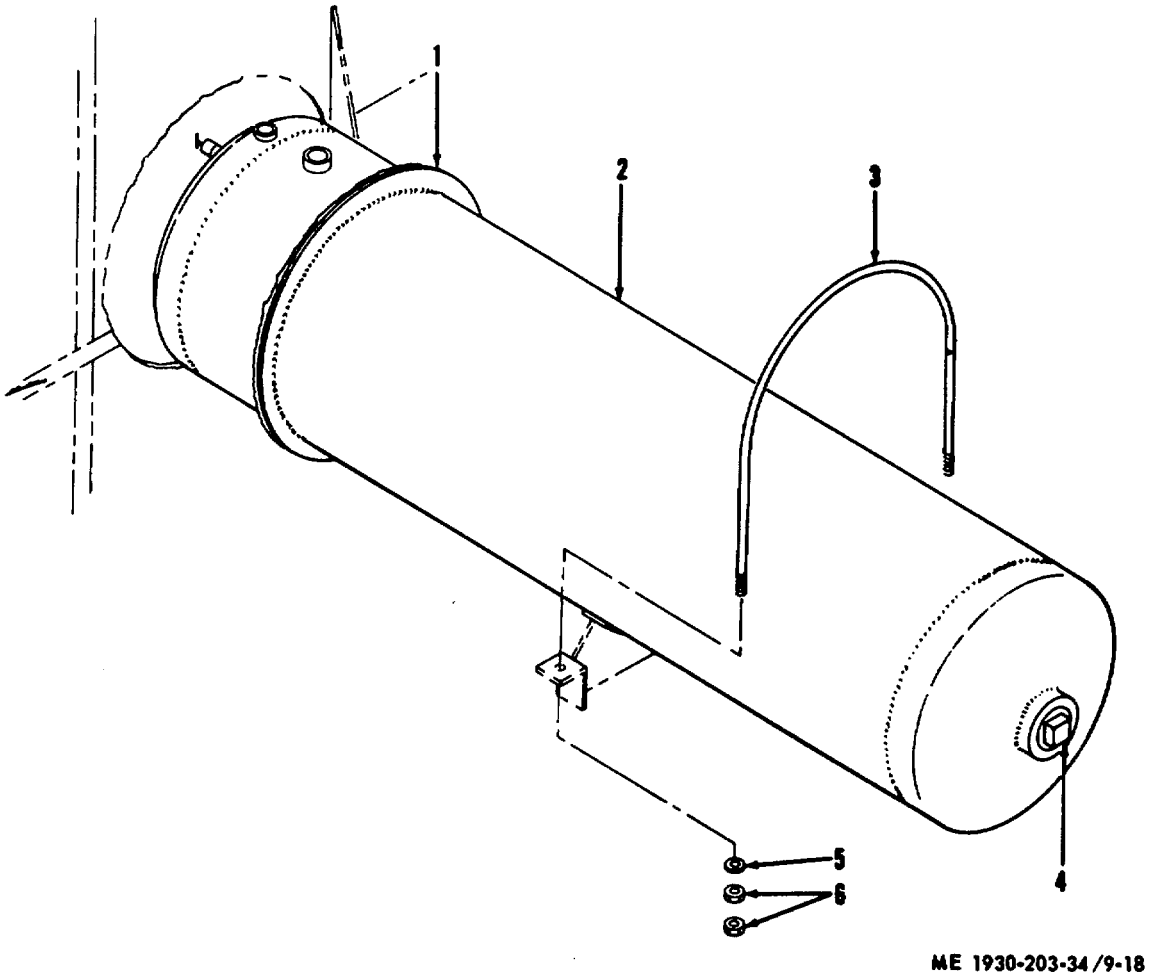
(3) With a cutting torch, cut a section of deck plating measuring 60 inches long and 20 inches wide, forward of bulkhead number six and over air tank to be removed.

(4) Remove section of deck plating to gain access to air tank for removal.

(5) With a cutting torch, cut flange (1, fig. 9-18) of air tank free of bulkhead number six.

(6) Remove nuts (6), washers (5), and tie rod (3) from air tank (2).

(7) With suitable hoisting equipment, remove air tank (2).



1 Flange
2 Air tank
3 Tie rod
4 Pipe plug
5 Washer
6 Nut

Figure 9-18. Air tank removal and installation

c. Cleaning, Inspection and Repair.

(1) Remove all rust and scale from exterior of air tanks using a wire brush.

(2) Repair damage by welding in accordance with the AWS (American Welding Society) welding handbook.

NOTE

After repairs have been made to tanks. hydrostatically test tanks with 300 psi. pressure and check for leaks. After hydrostatic test. air test tanks at 187 psi pressure and check for leaks using a soapy solution.

(3) If inside of air tank is corroded, so that wall thickness is less than 0.1875 inches. replace air tank.

d. Installation.

(1) With suitable hoisting equipment, lower air tank into LARC with ports aligned with inlet and outlet service lines from air compressor.

(2) Replace tie rod (3), washers (5), and nuts (6) used to secure air tank to LARC.

(3) Weld flange (1) to aft side of bulkhead number six to assure a watertight compartment.

(4) Replace section of cargo well deck and

weld in accordance with the AWS welding handbook.

(5) Connect lines and pressurize pneumatic system.

9-10. Brake Air Line Relay Valves

a. Removal and Disassembly.

(1) Removal.

(a) Close globe valves (6 and 7, fig. 2-19) located in air lines above air supply tanks and open service connection globe valves (5) to vent compressed air from lines.

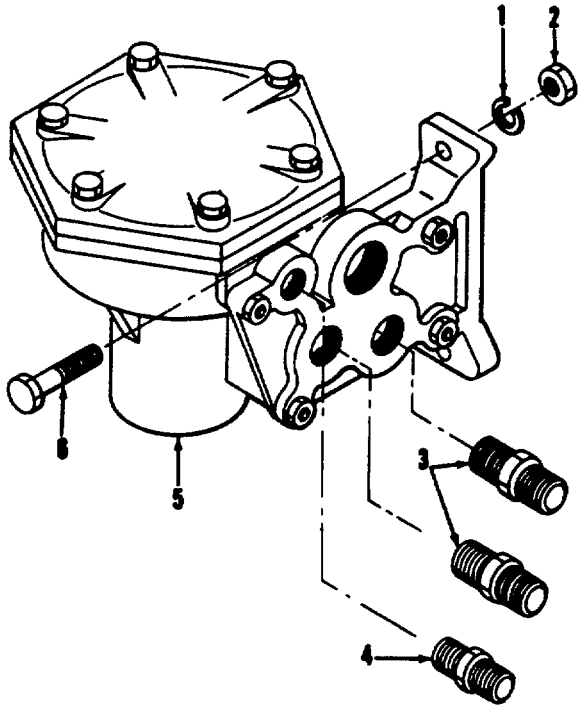
(b) Disconnect airlines from couplings (3 and 4, fig. 9-19) installed in relay air valve (5).

WARNING

Before attempting to remove any compressed air system lines or components, relieve pressure from system. Failure to do so may result in injury or death to maintenance personnel.

(c) Remove attaching bolts (6), nuts (2). and lockwashers (1) securing relay air valve (5) to bracket.

(d) Remove couplings (3 and 4) from relay air valve.



ME 1930-203-34/9-19

1 Lockwasher
2 Nut
3 Coupling
4 Coupling
5 Relay air valve
6 Bolt

Figure 9-19. Brake air line relay ,valve removal and installation

(2) Disassembly.

(a) Remove supply valve cage retaining ring (12, fig. 9-20) and remove supply valve assembly.

(b) Remove preformed packing (13).

(c) Remove bolts (7) and nuts (6) securing diaphragm cover (5) and remove cover.

(d) Lift diaphragm assembly (4) off diaphragm stem (11).

(e) Remove preformed packing (1).

(f) Remove retaining ring (9) and lift out exhaust valve assembly and diaphragm spring (10).

(g) Remove preformed packing (11).

(h) If pipe bracket (17) was removed with valve, remove nuts (2 and 3) and bolts and remove pipe bracket and gaskets.

(i) Remove sediment strainers (14) and retaining rings (15) from valve body (8).

b. Cleaning, Inspection and Repair.

(1) Clean all metal parts in dry- cleaning solvent, Federal Specification P-D-680.

(2) Check springs for breaks or distortion. Replace defective springs.

(3) Replace preformed packings.

(4) Inspect diaphragm for cracks or broken sealing beads. Replace diaphragm assembly if diaphragm is defective.

c. Reassembly and Installation. Apply a light coat of approved grease to all friction surfaces and preformed packings. Reassemble and install brake air line relay valves in reverse order of disassembly and removal.

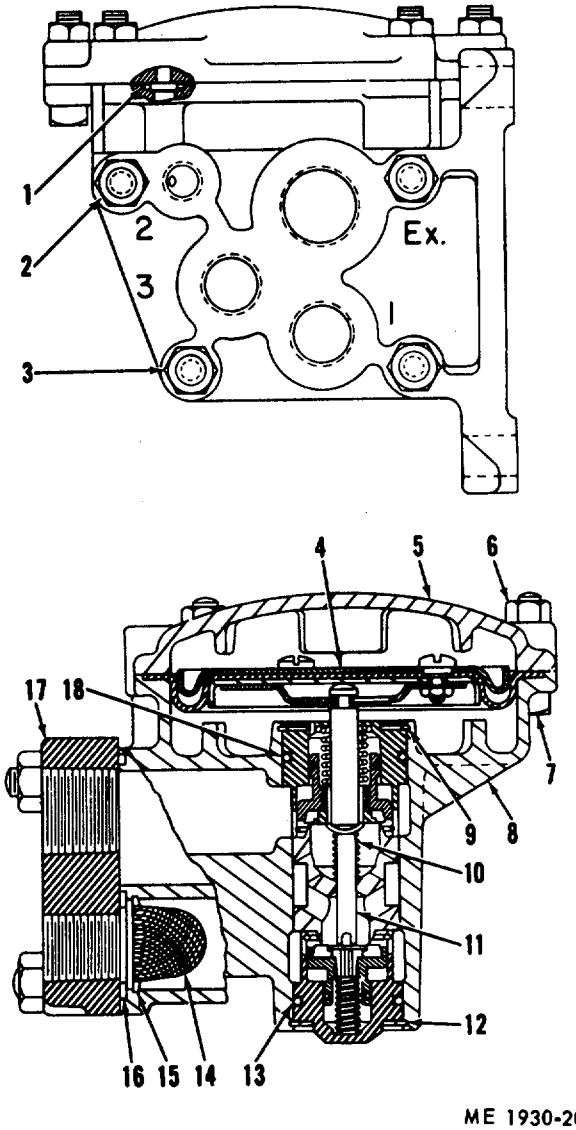


Figure 9-20. Brake air line relay valve , disassembly and reassembly.

Key to figure 9-20.

1 Preformed packing
2 Nut
3 Nut
4 Diaphragm assembly
5 Diaphragm cover
6 Nut
7 Bolt
8 Body
9 Retaining ring, exhaust valve cage
10 Diaphragm spring
11 Diaphragm stem
12 Retaining ring, supply valve cage
13 Preformed packing
14 Sediment strainer
15 Retaining ring, strainer
16 Gasket
17 Pipe bracket
18 Preformed packing

9-11. Cargo Well Pump and Ramp Cylinder Control Air Cylinder.

a. Removal and Disassembly.

(1) Removal

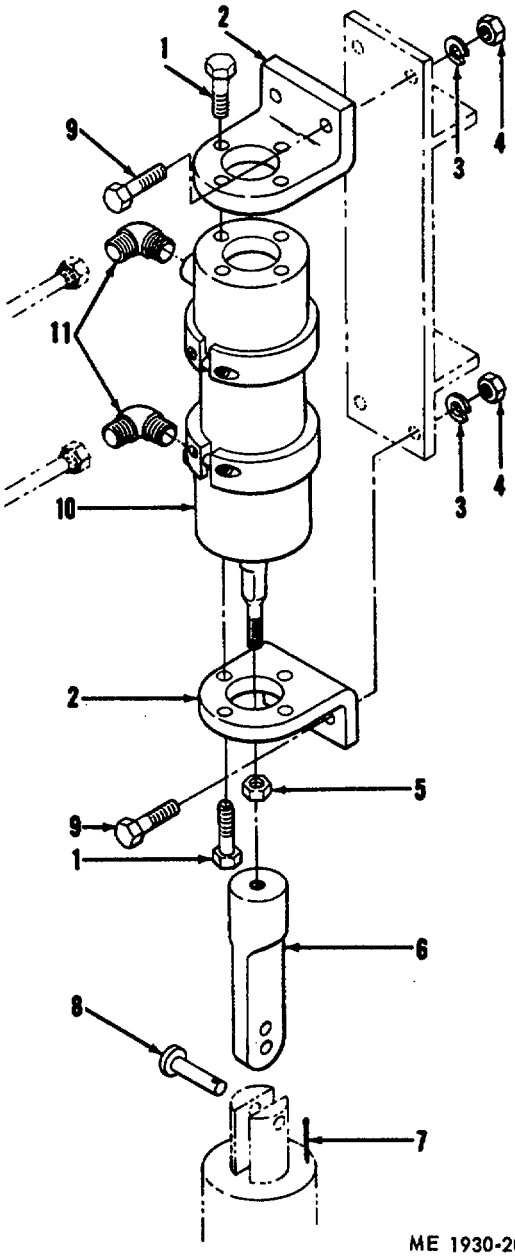
(a) Close globe valves (6 and 7, fig. 2-19) located in airlines above air supply tanks and open service connection globe valves (5) to vent air pressure from lines.

(b) Disconnect airlines from elbows (11, fig. 9-21) installed in double-acting air cylinder (10).

WARNING

Before attempting to remove any compressed air system lines or components, relieve air pressure from system. Failure to do so may result in injury or death to maintenance personnel.

(c) Remove cotter pin (7) and pin (8) attaching double-acting air cylinder (10) to multiple unit valve.
(d) Remove bolts (9), nuts (4), and lock- washers (3) attaching brackets to bulkhead bracket.
(e) Loosen jamnut (5) and unscrew piston rod (6) from cylinder shaft.
(f) Remove elbows (11) from double-acting air cylinder.
(g) Remove bolts (9) securing upper and lower mounting brackets (2) to double-acting air cylinder.



ME 1930-203-34/9-21

1 Bolt
2 Bracket
3 Lockwasher
4 Nut
5 Jamnut
6 Piston rod
7 Cotter pin
8 Pin
9 Bolt
10 Double-acting air cylinder
11 Elbow

Figure 9-21. Double- acting air cylinder , removal and installation.

(2) Disassembly.

(a) Remove screws (3, fig. 9-22) and lock-washers (4) and lift off locking clamps J2).

(b) Pull off blind end head (1) and rod end head (13) and remove preformed packings (5).

(c) Remove retaining ring (18) from rod end head and push out guide (16), packing (15), and retainer (14). Remove preformed packing (17) from guide.

(d) Remove piston rod (12) with attaching parts out of cylinder (6).

(e) Remove nut (7), followers (8), compression cups (9), and piston (10).

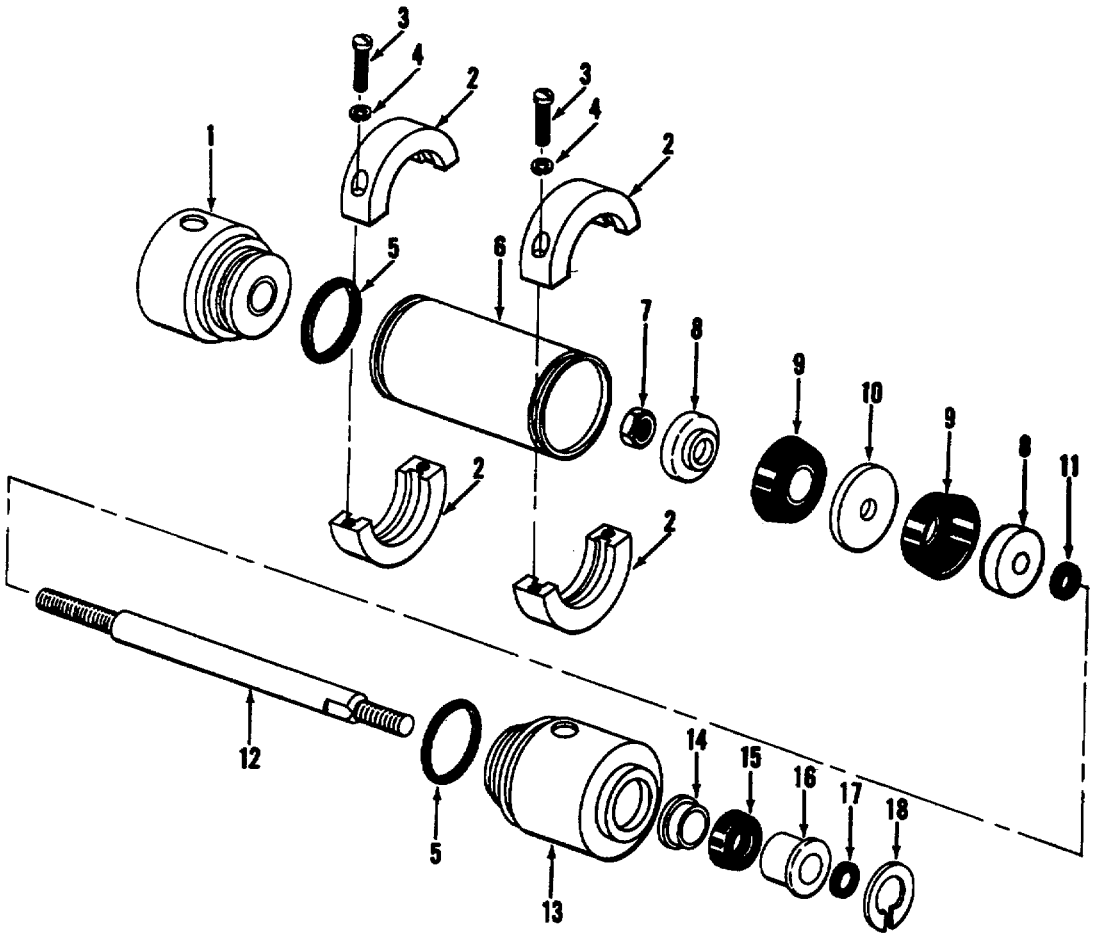
(f) Remove preformed packing (I1) from piston rod (12).

b. Cleaning, Inspection and Repair.

(1) Clean all metal parts in dry-cleaning solvent, Federal Specification P-D-680, and dry with low pressure air (10 psi).

(2) Replace preformed packings (5, 11, and 17), compression cups (9), and packing (15).

c. Reassembly and Installation. At reassembly, apply a light coat of approved grease to all friction surfaces and preformed packings. Reassemble and install control air cylinder in the reverse order of disassembly and removal.



1 Blind end head
2 Locking clamp
3 Screw
4 Lockwasher
5 Packing, preformed
6 Cylinder
7 Nut
8 Follower
9 Compression cup
10 Piston
11 Packing, preformed
12 Piston rod
13 Rod end head
14 Retainer
15 Packing
16 Guide
17 Packing, preformed
18 Retaining ring

Figure 9-22. Cargo well pump and ramp cylinder control air cylinder ,disassembly and reassembly.

9-12. Fan Control Air Cylinder

a. Removal and Disassembly.

(1) Removal

(a) Close globe valves (6 and 7, fig. 2-19) located in airlines above air supply tanks and open service connection globe valves (5) and release compressed air from lines.

(b) Disconnect and remove airlines from elbows (6, fig. 9-22) and couplings (10) installed in shuttle valves (7 and 11).

(c) Remove elbows (6) and couplings (10) from shuttle valves.

WARNING

Before attempting to remove any compressed air system lines or components, relieve pressure from system. Failure to do so may result in injury or death to maintenance personnel.

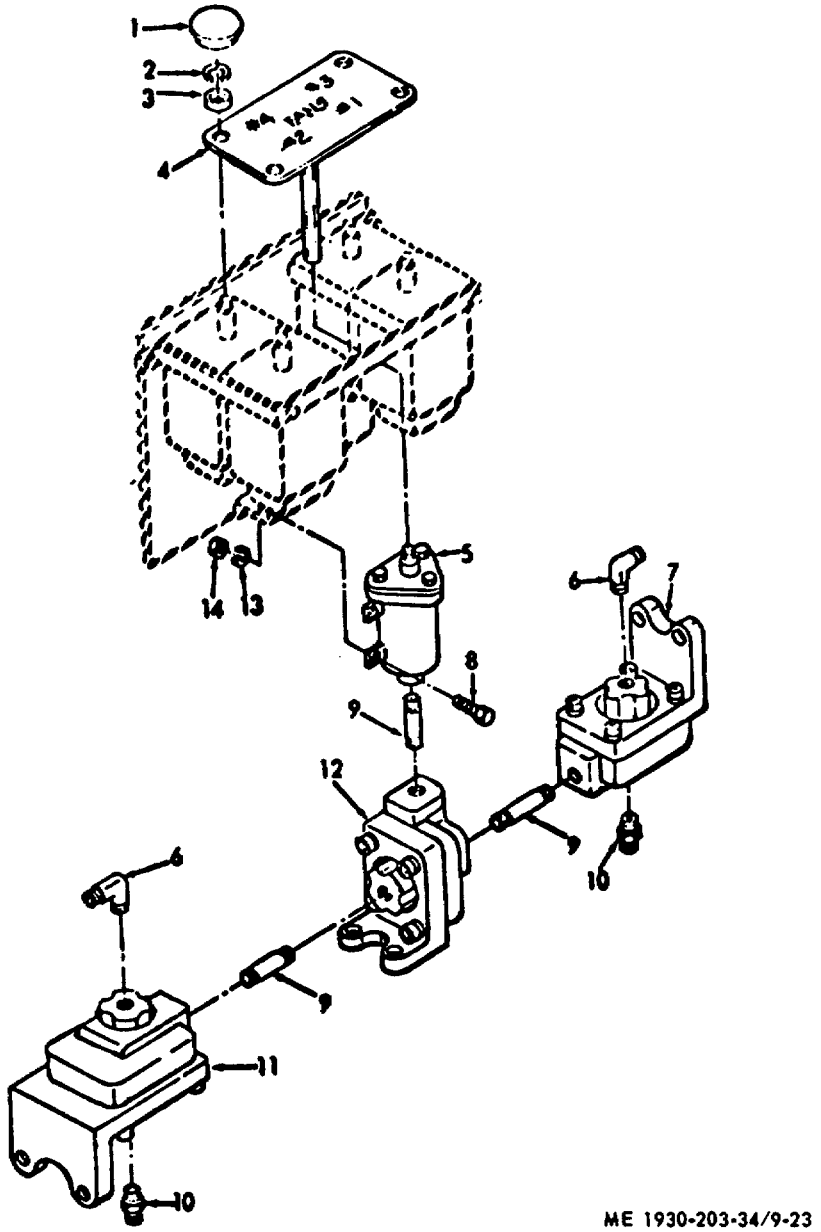
(d) Remove bolts (8). nuts (14). and lockwashers (13) securing single-acting cylinder (5) to bracket.

(e) Remove fan control knobs (1) lock washer (2). and bushing 13) from radiator fan control valves.

(f) Lift single-acting cylinder (5) up and out; remove shuttle valves (7 and 11) and nipples (9) from shuttle valve (12).

(g) Remove shuttle valve (12) and nipple (9) from base of single-acting cylinder (5).

(h) Unscrew single-acting cylinder (5) from plunger (4) and remove components.



1 Knob
2 Lockwasher
3 Bushing
4 Plunger
5 Single-acting cylinder
6 Elbow
7 Shuttle valve
8 Bolt
9 Nipple
10 Coupling
11 Shuttle valve
12 Shuttle valve
13 Lockwasher
14 Nut

Figure 9-23. Fan control air cylinder control removal and installation

(*2*) *Disassembly.*

(a) Remove capscrews (1, fig. 9-23) and lift off cover (2).

(b) Remove piston spring (4) and piston rod (10) with attaching parts from body (3).

(c) Remove cotter pin (5) and remove nut (6).

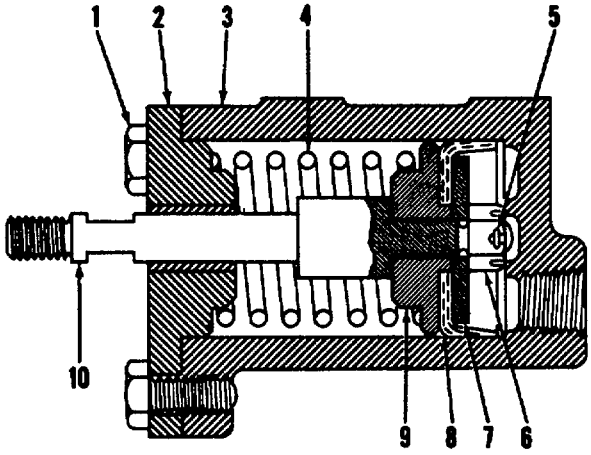
(d) Remove follower (7) packing cup (8). and piston (9) from piston rod (10).

b. Cleaning, Inspection and Repair.

(1) Clean all metal parts in dry-cleaning solvent, Federal Specification P-D-680, and dry with low pressure air (10 psi).

(2) Replace packing cup (8).
(3) Inspect piston spring (4) for breaks or distortion. Replace a broken or deformed spring.

c. Reassembly and Installation. At reassembly, apply a light coat of grease to all friction surfaces. Reassemble and install fan control air cylinder in the reverse order of disassembly and removal.



ME 1930-203-34/9-24

1 Capscrew
2 Cover
3 Body
4 Spring
5 Pin
6 Nut
7 Follower
8 Packing cup
9 Piston
10 Piston

Figure 9-24. Fan control air cylinder control disassembly and reassembly

9-13. Foot Throttle and Brake Control Valves

a. Removal and Disassembly.

(1) *Removal*.

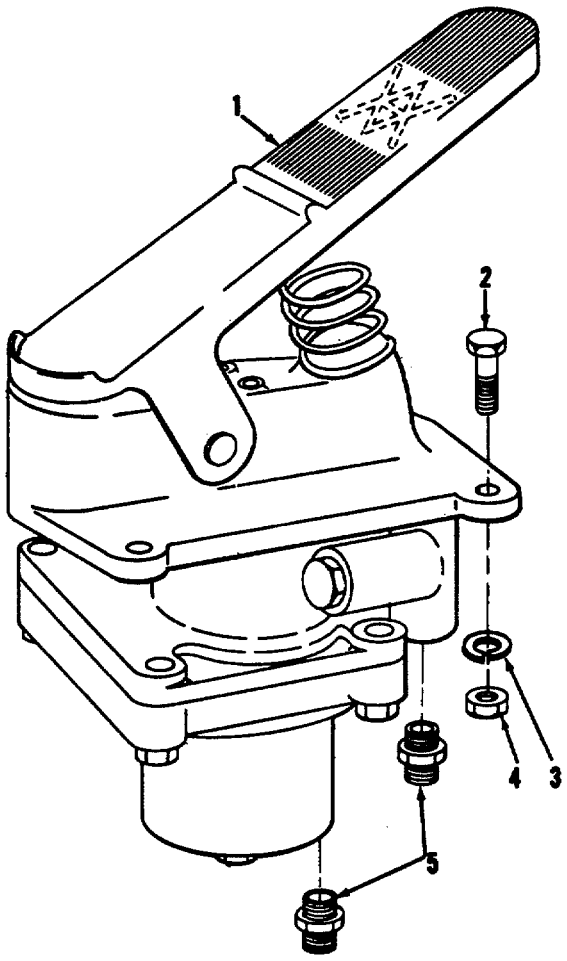
(a) Close globe valves (6 and 7, fig. 2-19) located in airlines above air supply tanks and open service connection globe valves (5) to vent compressed air from lines.

(b) Disconnect airlines from couplings (5) fig. 9-251 installed in foot control valve (1).

WARNING

Before attempting to remove any compressed air system lines or components, relieve air pressure from system. Failure to do so may result in injury or death to maintenance personnel.

(c) Remove attaching bolts (2), nuts (4), and lockwashers (3) securing foot control valve to cab floor.
(d) Remove couplings (5) from foot control valve (1).



ME 1930-203-34/9-25

1 Foot control valve
2 Bolt
3 Lockwasher
4 Nut
5 Coupling

Figure 9-25. Foot throttle and brake control valve removal and installation

(2) Disassembly.

(a) Remove bolts (30, fig. 9-26) and nuts (13); lift off spring housing (12). Exercise caution as spring housing is under spring load.

(b) Lift out exhaust valve seat (6), diaphragm (7), follower (8), and exhaust valve seat nut (9) as an assembly. Remove preformed packing (5) from exhaust valve seat (6).

(c) Remove diaphragm spring seat (11) and diaphragm spring (10).

(d) Remove retaining rings (20) and shaft (21)

(e) Remove pedal (1) and remove foot pedal spring (23).

(f) Remove capscrews (15) and lift bracket (22) from valve body (17).

(g) Remove gaskets (19) and air filters (18).

(h) Remove cotter pins (27), pin (26), and cam dog (28).

(i) Remove dirt protector (29).

(j) Push inlet and exhaust valve assembly (3) and exhaust valve spring (4) from valve body (17). Remove preformed packings (2) from inlet and exhaust valve assembly.

b. Cleaning, Inspection and Repair.

(1) Clean all metal parts in dry-cleaning solvent, Federal Specification P-D-680. Wash

rubber parts with soap and water and blow dry with low pressure air.

(2) Check springs (4, 10, and 23), for breaks or distortion. Replace defective springs.

(3) Inspect diaphragm 171 and exhaust valve seat (6) for cracks or broken sealing beads. If diaphragm or exhaust valve seat is defective, replace defective parts.

(4) Replace preformed packings (2 and 5).

(5) Inspect dirt protector (129) for cracks or deterioration. Replace a defective dirt protector.

(6) Inspect inlet and exhaust valve assembly (3) for scores, burrs, or pitting. Replace a defective inlet and exhaust valve assembly.

(7) Examine air filters (18) for broken mesh or enlarge holes. Replace defective air fillers.

c. Reassembly and Installation. At reassembly, apply a light coat of grease, Military Specification MIL-G-4343B to all rubber parts and grease, Federal Specification VV-G-632, Grade 1, Type B, to all friction surfaces. Reassemble and install foot throttle and brake control valves in reverse order of disassembly and removal.

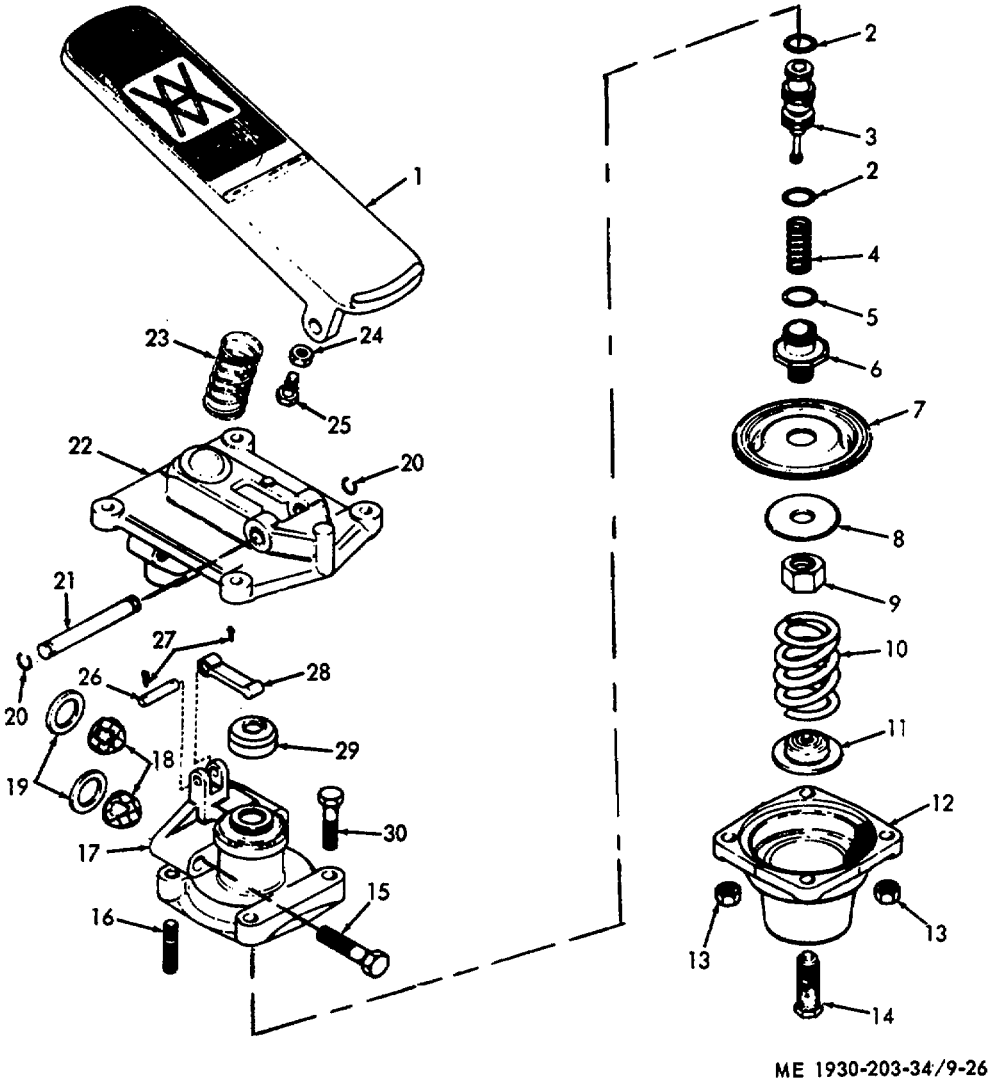


Figure 9-26. Foot throttle and brake control valve disassembly and reassembly.

Key to figure 9-26.

1 Pedal
2 Preformed packing
3 Inlet and exhaust valve assembly
4 Exhaust valve spring
5 Preformed packing
6 Exhaust valve seat
7 Diaphragm
8 Follower
9 Nut
10 Diaphragm spring
11 Diaphragm spring seat
12 Spring housing
13 Nut
14 Screw
15 Capscrew
16 Stuf
17Valve body
18 Air filter
19 Gasket
20 Retaining ring
21 Shaft
22 Bracket
23 Foot pedal spring
24 Nut
25 Screw
26 Pin
27 Cotter pin
28 Cam dog
29 Dirt protector
30 Bolt

d. Adjustment.

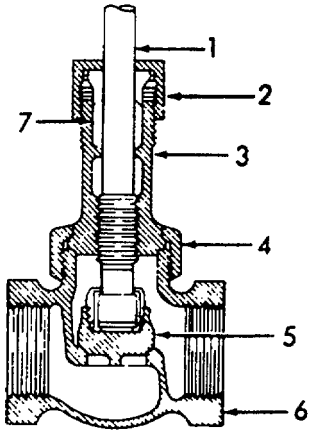
NOTE

Pedal stop screw (25, fig. 9-26) changes the angle of pedal travel and, if not compensated for by the delivery pressure adjustment, will change the maximum pressure slightly. The pedal stop screw should be set to provide minimum pedal travel to protect the valve assembly from unnecessary mechanical force.

(1) *Foot throttle control valve delivery pressure adjustment*.
(a) Start engines (TM 55-1930-203-10) and place foot control valve in the maximum rpm position.
(b) Observe the tachometers on the instruments panel for maximum engines rpm (2100 ± 50 rpm)
(c) Adjust foot control valve delivery pressure if all engines fail to reach maximum rpm as follows:
1. Turn adjusting screw (14, fig. 9-26) on base of foot control valve clockwise to increase delivery pressure and engine rpm.
2. Turn adjusting screw (14) counterclockwise- to decrease delivery pressure engine rpm.
3. Observetachometers for maximum engine rpm (21 00 5 0 rpm).
(2) *Brake control valve delivery pressure adjustment*.
(a) Start engines (TM 55-1930-203-10) and place LARC in motion.
(b) Slowly apply foot control valve and observe breaking action of LARC.
(c) If brakes do not lock all wheels at desired pedal position, adjust delivery pressure as follows:
1. Increase delivery pressure by turning adjusting screw (14), clockwise.
2. Decrease delivery pressure by turning adjusting screw (14) counterclockwise.
(d) Place LARC in motion and repeat (c) above.
(e) If foot control valve is properly adjusted, secure engines.

9-14. Globe and Angle Valves

a. Packing Removal and Installation.
(1) Packing removal.
(a) Open globe valve fully.
(b) Unscrew nut from stem and remove hand wheel.
(c) Unscrew packing retaining nut (2, fig. 9-27) and remove packing (7) from stuffing box.
(2) Packing installation. Install packing in reverse order of removal.
b. Disk Replacement.
(1) Vent or secure compressed air in line in which valve is located.
(2) Unscrew union (4) between bonnet (3) and valve body (6) and remove stem (1) and bonnet.
(3) Examine disk seat in valve body for grooves or burrs. If seat is damaged to extent that a tight seal cannot be made, replace valve.
(4) On valves with metal disk, unscrew disk (5) from stem and screw new disk on stem.
(5) On valves with composition disk, remove disk retaining nut from stem and remove disk and disk holder. Place new disk and disk holder on stem and secure with retaining nut.
(6) Position stem and bonnet on valve body and tighten union (4).



ME 1930-203-34/9-27

1 Stem
2 Nut
3 Bonnet
4 Union
5 Disk
6 Valve body
7 Packing

Figure 9-27. Globe valve packing and disk removal and installation

9-15. Hand Throttle Control Valves

a. Removal and Disassembly.

(1) Removal.

(a) Close globe valves (6 and 7, fig. 2-19) located in airlines above air supply tanks and open service connection globe valves (51 and release compressed air from lines.

(b) Disconnect airlines from couplings (8, fig. 9-28) installed in hand throttle control valve (9,).

WARNING

Before attempting to remove any compressed air system lines or compressed., relieve air pressure from system- .Failure to do so may result in injury or death to maintenance personnel.

(c) Remove attaching bolt (14), nut (1), and lockwasher (2) from control linkage.

(d) Remove attaching bolts (3), nuts (6), and lockwashers (5) securing valve to bracket.

(e) Remove all fittings from hand throttle control valve.

(2) Disassembly. Refer to figure 9-29.

(a) Remove nuts 1241, and lockwashers (25) and lift off housing (7)

(b) Remove pin (6) and pull off handle (5).

(c) Loosen nut (14) and setscrew (9).

(d) Unscrew capnut (1) and pull out camshaft 141, allowing cam (8) and brake shoe assembly (11) to drop out bottom of housing.

(e) Remove brake drum (2) and key (3)from camshaft.

(f) Remove nut (14), washer (13). And spring (12) from brake shoe assembly.

(g) Remove bolts C20t and remove bracket (19)

(h) Remove gaskets 1181 and strainers (17)

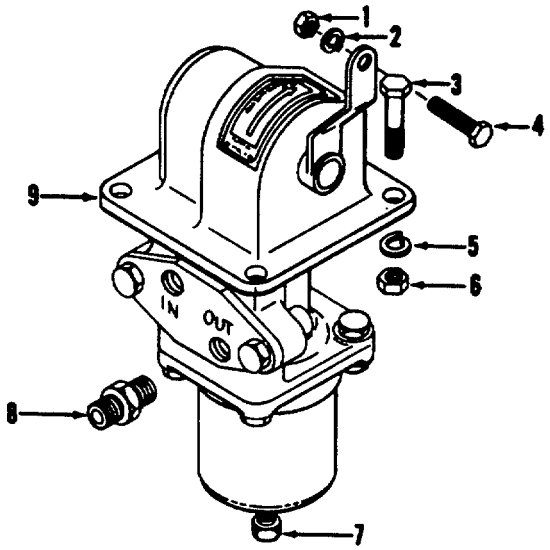
(i) Remove bolts (261 and nuts 1291 and remove spring housing (31). Exercise caution as spring housing is under spring tension.

(j) Lift out exhaust valve seat (37), diaphragm (36), follower (35) and nut (34) as an assembly. Remove exhaust compression spring (39) and preformed packing (38) from exhaust valve seat (37).

(k)Remove cotter pins (28) and remove pin (27) and cam dog (15).

(l)Push inlet and exhaust valve 122) out of body (16)

(m)Remove preformed packings 1231 from inlet and exhaust valve.



ME 1930-203-34/9-28

1 Nut
2 Lockwasher
3 Bolt
4 Bolt
5 Lockwasher
6 Nut
7 Screw
8 Coupling
9 Hand throttle control valve

Figure 9-28. Hand throttle control valve removal and installation

b. Cleaning, Inspection and Repair.

(I) Clean all metal parts in dry-cleaning solvent, Federal Specification P-D-680, and dry with low pressure air (10 psi).

(2) Replace preformed packings (23 and 38, fig. 9-29) and gaskets (181.

(3) Inspect diaphragm (36) for cracks or broken sealing beads and exhaust valve seat (37) for scores or pits in seat area. If these conditions exist, replace defective parts.

(4) Inspect inlet and exhaust valve (22) for scores or pits on valve surface that mates with exhaust valve seat (37). Replace a defective inlet and exhaust valve.

(5) Inspect springs (12, 33, and 391 for breaks or distortion. Replace a broken or deformed spring.

(6) Inspect strainers (17) for deterioration or deformation. Replace a deteriorated or deformed strainer.

c. Reassembly and Installation. At reassembly, apply a light coat of grease Military Specification MIL-G-4343B to all rubber parts and grease, Federal Specification VV-G-632, Grade 1, Type B, to all friction surfaces, except brake shoe assembly (11). Reassemble and install hand throttle control valve in reverse order of disassembly and removal.

d. Adjustment.

(11 Brake shoe assembly adjustment. The

handle force of the control valve can be varied by adjusting nut (14). This adjustment increases or decreases the manual force required to move and hold the handle in any desired position.

(2) Pressure setting adjustment.

(a)Place all hand throttle control valves in the idle position.

(b) Start engines and observe tachometers on instrument panel for proper engine idle speed (550 rpm).

(c) If engines fail to idle at 550 rpm, disconnect actuator positioner rod assembly and observe engine tachometers. Tachometers should indicate 550 rpm. If engines still fail to idle at 550 rpm, comply with paragraph 3-77, TM 55-1930-203-20.

(d) Reconnect linkage. Engines failing to idle at 550 rpm require adjustment of corresponding hand throttle control valves. Adjust delivery pressure of throttle control valves as follows:

1 .Turn adjusting screw (7, fig. 9-28) on base of hand throttle control valve clockwise to increase delivery pressure and engine rpm.

2. Turn adjusting screw (7) counterclockwise to decrease delivery pressure and engine rpm.

3. Observe tachometers for proper idle speed (550) rpm) of engines.

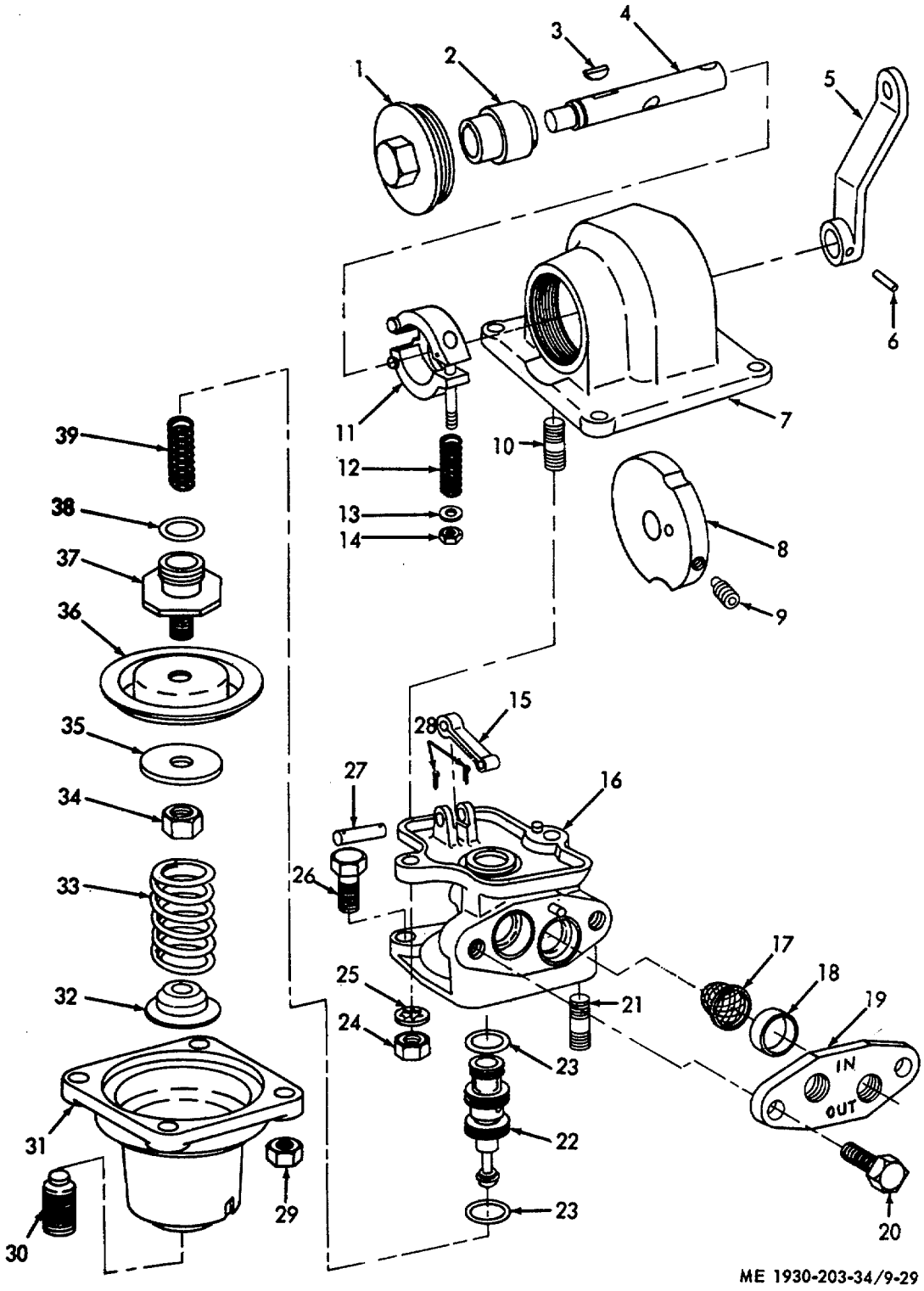


Figure 9-29. Hand throttle control valve disassembly and reassembly

Key to figure 9-29.

1 Housing capnut
2 Brake drum
3 Key
4 Camshaft
5 handle
6 Pin
7 Housing
8 Cam
9 Setscrew
10 Stud
11 Brake shoe assembly
12 Brake shoe spring
13 Washer
14 Nut
15 Cam dog
16 Body
17 Strainer
18 Gasket
19 Bracket
20 Bolt
21 Stud
22 Inlet and exhaust valve
23 Packing, preformed
24 Nut
25 Lockwasher
26 Bolt
27- Pin
28 Pin
29 Nut
30 Bolt
31 Spring housing
32 Spring seat
33 Diaphragm compression spring
34 Nut
35 Follower
36 Diaphragm
37Exhaust valve seat
38 Packing, preformed
39 Exhaust compression spring

9-16. Horn Control and Engine Starting Pilot Air Valves

a. Removal and Disassembly.

(1) *Removal*

(a) Close globe valves (6 and 7, fig. 2-19) located in airlines above air supply tanks and open a service connection globe valve (5) to vent compressed- pressed air from lines.

WARNING

Failure to release pressure may result in injury to personnel removing air system components.

(b) Disconnect pilot air valve inlet and outlet lines at valve.

(c) Remove four pilot air valve mounting bolts and remove valve.

(2) Disassembly.

(a) Remove two screws (15, fig. 9-30) and lockwashers (16) securing cover (3) to body (17)

(b) Remove pin (1), cam dog (5), and cover (3). Remove retaining ring (4) and control button (2).

(c) Remove two screws (6) and lockwashers (7) securing retaining flange (8) to body (17). Remove retaining flange (8) and packing (9).

(d) Remove plunger guide (10), plunger (12), spring (13), valve seat (14), and washer (22). Remove packing (11 and 23).

(e) Remove valve (21), spring (20), spacer(19), and filter (18).

b. Cleaning, Inspection and Repair.

(1) Clean all metal parts in dry-cleaning solvent Federal Specification P-D-680, and allow to drain dry.

(2) Inspect plunger (12, plunger guide (10), valve (21), and valve seat (14) for scoring on their mating surfaces. Replace defective parts.

(3) Inspect springs (13 and 20) for distortion and replace if defective.

(4) Inspect retaining ring (4) for distortion. Replace retaining rings that do not fit tightly in their grooves.

(5) Replace filter (18) if all foreign particles cannot be removed by cleaning.

(6) Replace all packing.

c. Reassembly and Installation.

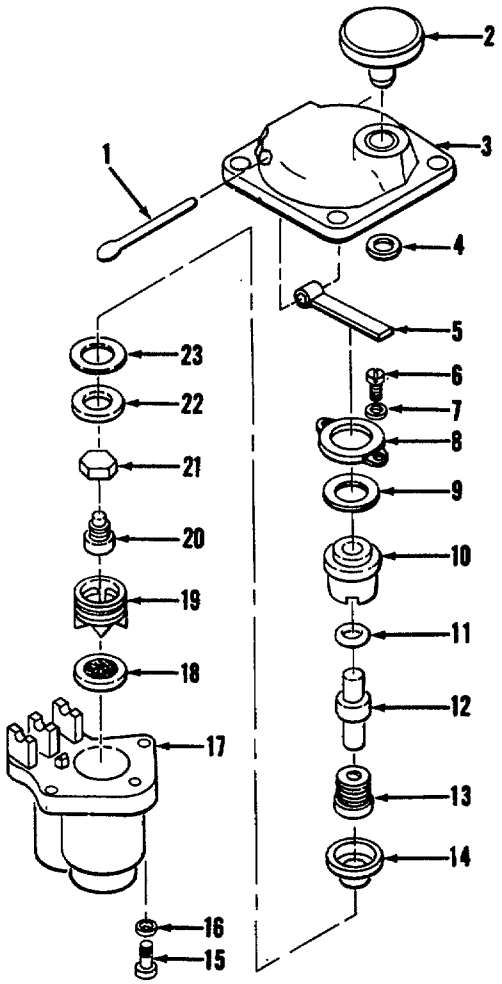
(1) Reassembly. At reassembly, apply a light coat of grease, Military Specification MIL-G-4343B to all rubber parts and grease, Federal Specification VV-G-632, Grade 1, Type B, to all friction surfaces. Reassembly pilot air valve in the reverse order of disassembly.

(2) Installation.

(a) Secure valve to mounting surface with tour mounting bolts.

(b) Connect inlet and outlet lines.

(c) Close service connection globe valve (5, fig 2-19) and open globe valves (6 and 7) located in air lines above air supply tanks.



ME 1930-203-34/9-30

1 Pin
2 Control button
3 Cover
4 Retaining ring
5 Cam dog
6 Screw
7 Lockwasher
8 Retaining flange
9 Packing
10 Plunger guide
11 Packing
12 Plunger
13 Spring
14 Valve seat
15 Screw
16 Lockwasher
17 Body
18 Filter
19 Spacer
20 Spring
21 Valve
22 Washer
23 Packing

Figure 9-30. Pilot air valve disassembly and reassembly.

9-17. Main Air Supply Filter

a. General. The main air supply filter (fig. 9-31) is located below the cab deck in the port aft storage compartment area below the service brake foot valve. The main air supply filter purifies the compressed air from the supply tank and serves to prevent water and foreign matter from entering the cab air control valves.

b. Removal and Disassembly.

(1) Removal

(a) Close globe valves (6 and 7, fig. 2-19) located in air lines above air supply tanks and open service connection globe valves (5) to vent air supply lines.

(b) Disconnect air lines from fittings installed in air supply filter.

WARNING

Before attempting to remove any compressed air system lines or components, relieve pressure from system. Failure to do so may result in injury or death to maintenance personnel.

(c) Remove attaching capscrews (1, fig. 9- 31) securing main air supply filter to bracket.

(2) Disassembly.

(a) Drain water and foreign matter accumulations from main air supply filter by removing drain plug (9).

(b)Remove capscrews (81 and remove dirt chamber (71, gasket (6X, element support (5), and element (41 from filter body (3).

(c) Remove elbow 12) and tee (101 from filter body (3).

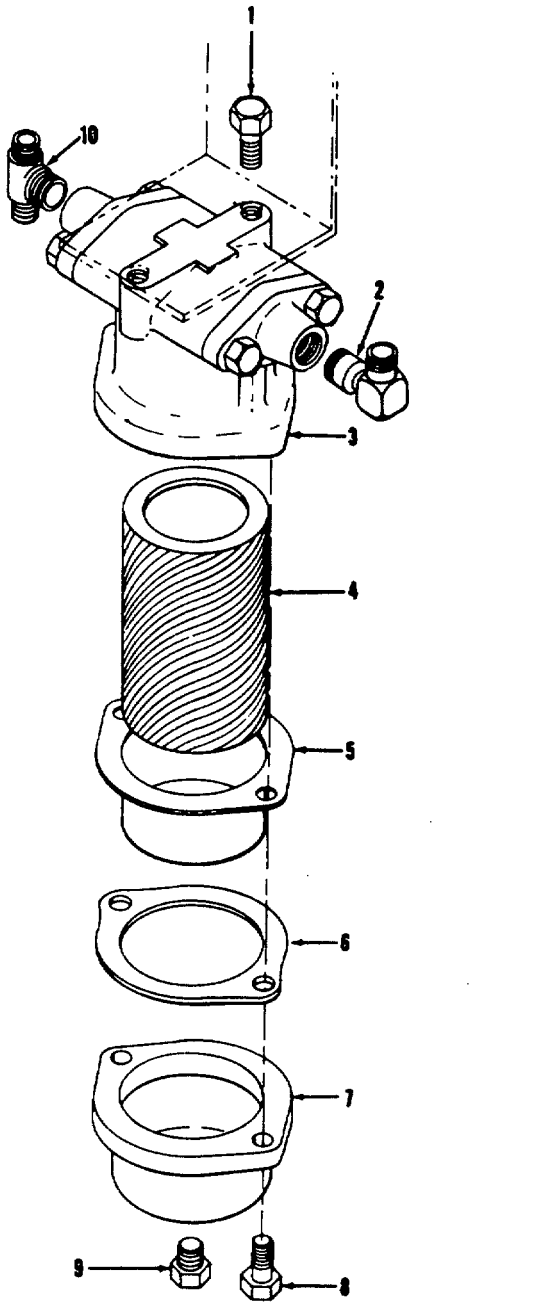
c. Cleaning, Inspection and Repair.

1 Rinse all parts except the filter element in a clean solution of dry-cleaning solvent. Federal Specification P-D-680; wipe all parts dry using a clean, lint-free cloth.

(2) Clean element (4 in a clean solution of carbon tetrachloride, Federal Specification O-C- (4). Blow filter element dry using dry compressed air not exceeding 10 psi.

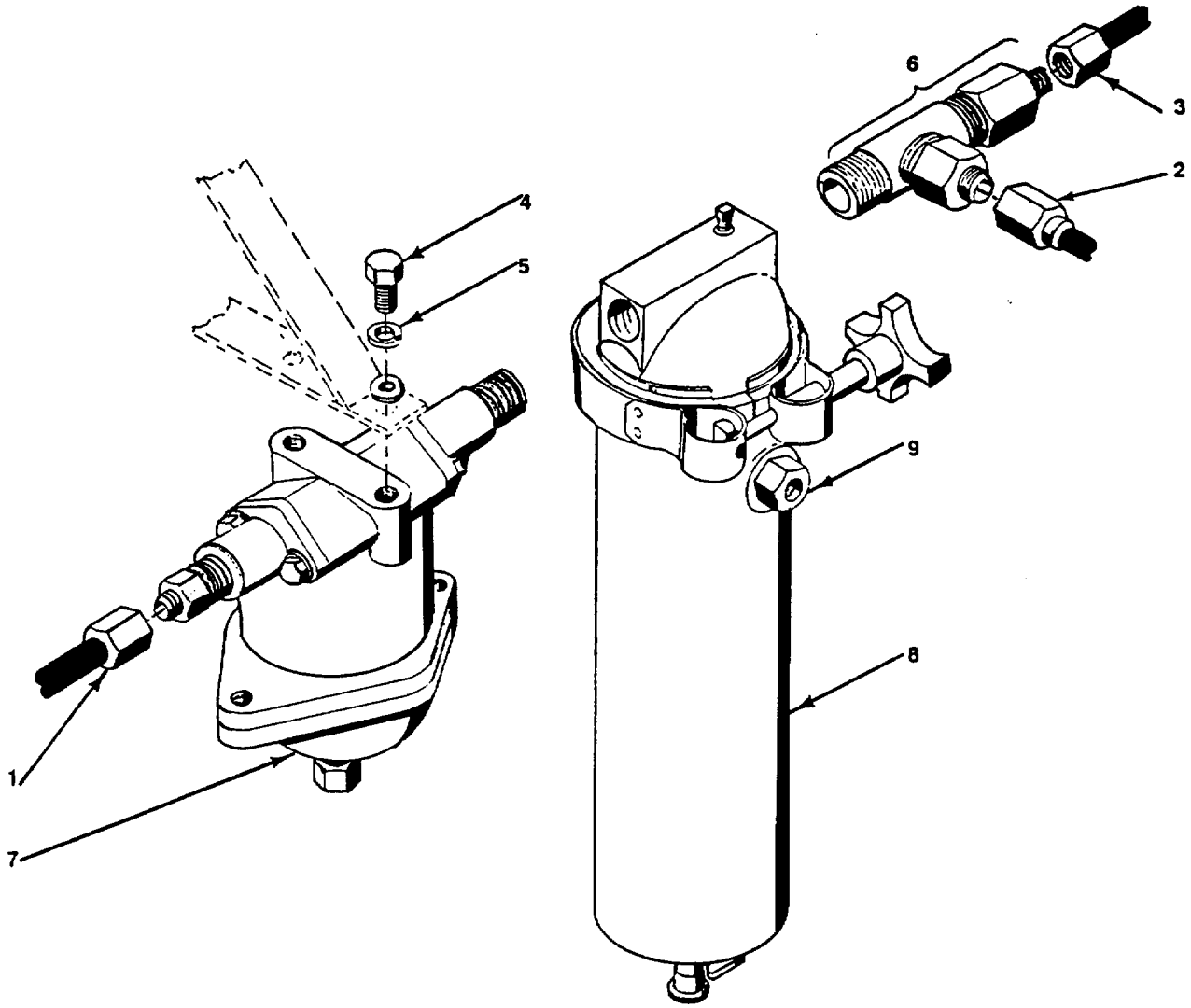
(3) Inspect element for deterioration of curled hair and felt mesh. Replace element if curled hair and felt mesh are deteriorated.

d. Reassembly and Installation. Reassemble and install main air supply filter in reverse order of disassembly and removal.



1 Capscrew
2 Elbow
3 Filter body
4 Element
5 Element support
6 Gasket
7 Dirt chamber
8 Capscrew
9 Drain plug
10 Tee

Figure 9-31. Main air supply filter removal, disassembly , reassembly and installation



1. Fitting
2. Fitting
3. Fitting
4. Capscrew
5. Lockwasher
6. Pipe nipple
7. Filter
8. Air dryer
9. Sight window

Figure 9-31.1. Air dryer, replacement

a. Removal.

(1) Disconnect tube fittings (1), (2) and (3).

(2) Remove capscrews (4) and lockwashers (5).

(3) Remove fittings and pipe nipple (6) and filter (7) from air dryer (8). Replace air dryer as required.

b. Installation

(1) Install fittings and pipe nipple (6) and filter (7) on air dryer (8). Ensure that sight window (9) is facing out when air dryer is mounted on bulkhead.

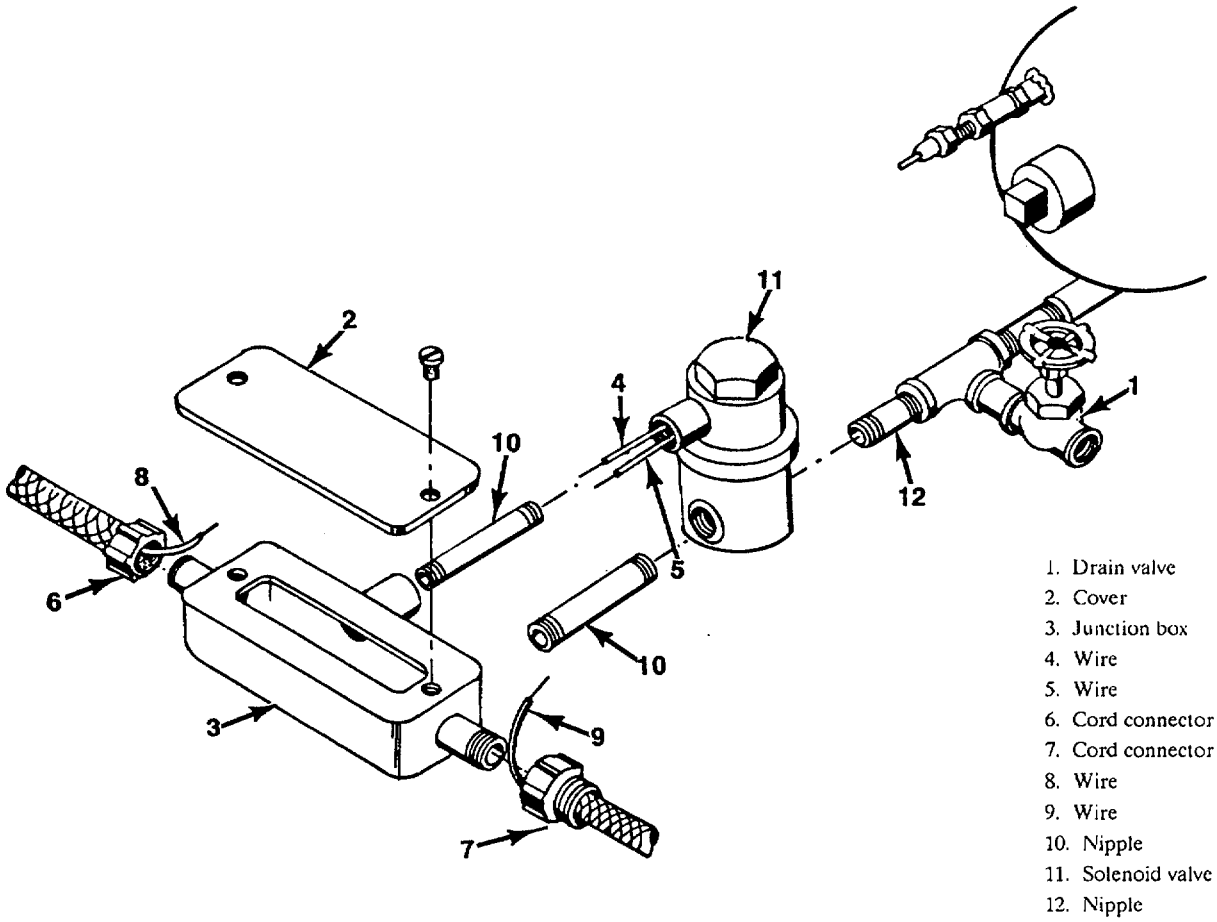


Figure 9-31.2. Solenoid valve replacement

a. Removal

(1) Open drain valve (1 figure. 9-30.2) to make sure air pressure is relieved.

(2) Remove cover (2) to wiring junction box (3).

(3) Cut wires (4) and (5) and disconnect cord connectors (6) and (7) from junction box (3) pulling wires (8) and (9) from the junction box (3).

(4) Disconnect wiring junction box (3), nipple (1O), and solenoid valve (11). Remove valve (11).

b. Installation.

(1) Screw new solenoid valve, (11) onto nipple (12) using antiseize tape around threads to ensure tightness.

(2) Feed wires (4) and (5) through nipple (10) and then screw nipple (10) into solenoid valve (11) using antiseize tape around threads.

(3) Feed wires (4) and (5) into wiring junction)ox (3) and screw box (3) onto nipple using antiseize tape around threads.

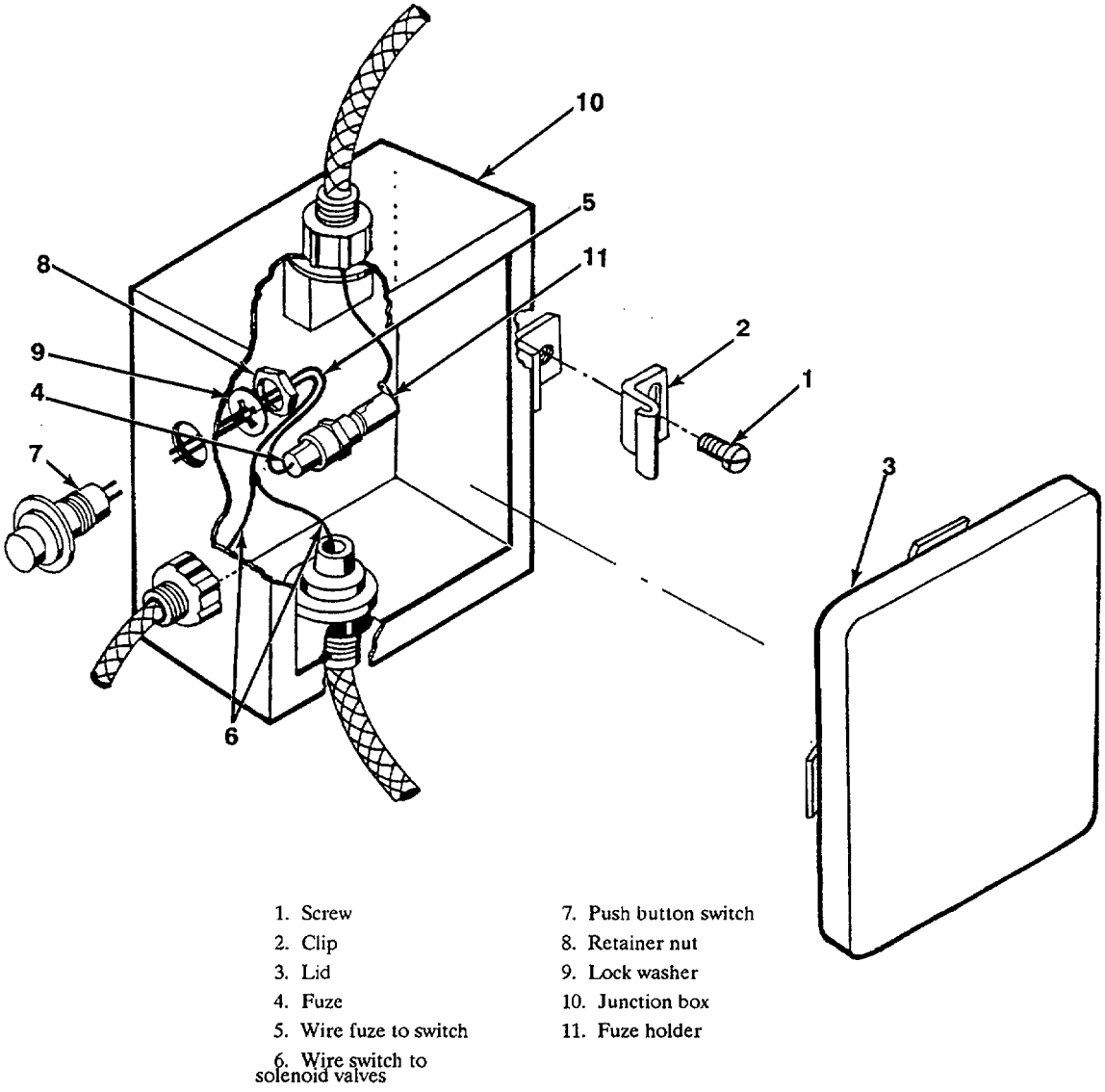
(4) Feed wires (8) and (9) into wiring junction I)ox (3). Secure wires (8) and (9) to the junction wiring t)ox (3) using cord connectors (6) and (7).

(5) Splice wires (4) and (5) to wires (8) and (9) using insulated solderless connectors. Make sure the positive lead from the solenoid is connected to the positive lead and the negative lead to the ground wire.

(6) Replace cover (2) on wiring junction box (3).

(7) Close drain valve (1).

(8) Pressurize the compressed air system and test the solenoid valve (11) by operating momentary contact switch.



1. Screw
2. Clip
3. Lid
4. Fuze
5. Wire fuze to switch
6. Wire switch to solenoid valves
7. Push button switch
8. Retainer nut
9. Lock washer
10. Junction box
11. Fuze holder

Figure 9-31.3. Push button switch momentary replacement

a. Removal.
(1) Back screws (1 fig. 9-30.3) out and move lid clips (2) aside, remove lid (3).

(2) Unsolder wires (5) and (6) from the back of push button switch (6).

(3) Remove nut (8) and lockwasher (9).

(4) Pull push button switch (7) out of junction box (10).
b. Installation.

(1) Install new push button switch (7) in junction box (10) and secure with lockwasher (9) and nut (8).

(2) Connect wires (5) and (6) to push button switch (7).

(3) Install lid (3) on junction box (10) and clamp ;shut using clips (2) and screw (1).

9-18. Marine Gear Shifting and Throttle Control Valve

a. Removal and Disassembly.

(1) *Removal.*

(a)Close globe valves (6 and 7, fig. 2-19) located in airlines above air supply tanks and open service connection globe valves (5) to vent compressed- pressed air from lines.

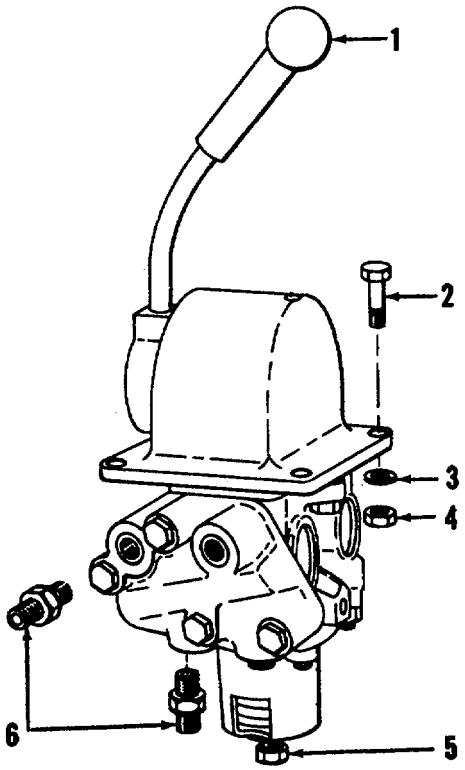
(b) Disconnect airlines from coupling (7, fig. 9-32) installed in control valve (1).

WARNING

Before attempting to remove any compressed air system lines or components, relieve pressure from system. Failure to do so may result in injury or death to maintenance personnel.

(c) Remove attaching bolts (2), nuts (4), and lockwashers (3) and remove control valve (1) from instrument panel.

(d) Remove couplings (6) from control valve.



ME 1930-203-34/9-32

1 Control valve
2 Bolt
3 Lockwasher
4 Nut
5 Adjusting screw
6 Coupling

Figure 9-32. Marine gear shifting and throttle control valve removal and installation.

(2) *Disassembly*. Disassemble the control valve in the numerical sequence as illustrated on figure 9-33.

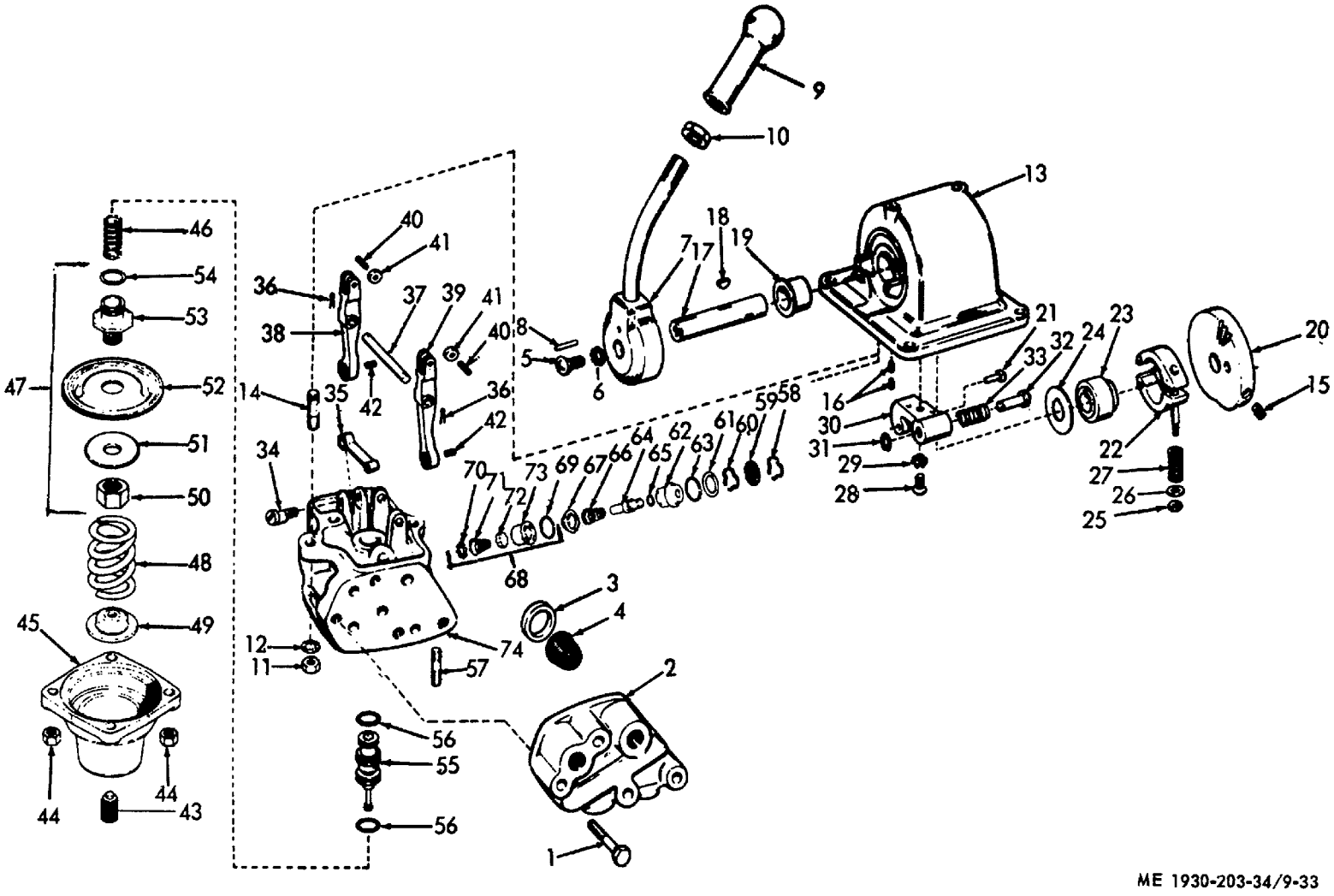


Figure 9-33. Marine gear shifting and throttle control valve disassembly and reassembly

Key to figure 9-33.

1 Capscrew
2 Bracket
3 Gasket
4 Filter
5 Screw
6 Lockwasher
7 Shaft-hub
8 Roll pin
9 Handle
10 Nut
11 Nut
12 Lockwasher
13 Housing
14 Stud
15 Setscrew
16 Setscrew
17 Camshaft
18 Key
19 Bushing
20 Cam
21 Pin
22 Brake shoe assembly
23 Brake drum
24 Disc
25 Nut
26 Washer
27 Brake spring
28 Screw
29 Lockwasher
30 Latch body
31 Retaining ring
32 Latch
33 Spring
34 Pin
35 Cam dog
36 Pin
37 Pin
38 Lever, pilot valve (RH)
39 Lever, pilot valve LH
40 Roll pin
41 Roller
42 Setscrew
43 Screw
44 Nut
45 Spring housing
46 Spring
47 Diaphragm assembly
48 Spring
49 Spring seat
50 Nut
51 Follower
52 Diaphragm
53 Seat
54 Packing, preformed
55 Inlet and exhaust valve
56 Packing, preformed
57 Stud
58 Retaining ring
59 Protector
60 Retaining ring
61 Washer
62 Guide
63 Packing, preformed
64 Plunger
65 Packing, preformed
66 Spring
67 Seat
68 Supply valve assembly
69 Packing, preformed
70 Retaining ring
71 Spring
72 Supply valve
73 Spacer
74 Body

b. Cleaning, Inspection and Repair.

(1) Clean all metal parts in dry-cleaning solvent, Federal Specification P-D-680, and dry with low pressure air (10 psi).

(2) Replace preformed packings (54, 56, 63, 65, and 69), and gaskets (3).

(3) Inspect diaphragm (52) for cracks or broken sealing beads and exhaust valve seat (53) for scores or pits in seat area. Replace defective parts.

(4) Inspect valve spacer (73) for scores or pits in seat area and supply valve (72) for scores or pits on the valve surface that mates with the valve spacer seat. Replace defective parts.

(5) Inspect inlet and exhaust valve (55) for scores or pits on valve surface that mates with exhaust valve seat (53). Replace defective inlet and exhaust valve.

(6) Inspect springs (27, 33, 46, 66, and 71) for breaks or distortion. Replace a broken or deformed spring.

(7) Inspect filters (4) and protectors (59) for deterioration or deformation. Replace a defective filter or protector.

c. Reassembly and Installation.

(1) *Reassembly*. At reassembly, apply a light coat of grease, Military Specification MIL-G- 4343B to all rubber parts and grease, Federal Specification VV-G-632, Grade 1, Type B, to all friction surfaces. Reassemble the control valve in reverse at numerical sequence as illustrated on figure 9-33.

NOTE

Adjust friction brake during reassembly as outlined in*d* (1) below.

(2) *Installation*. control valve in reverse order of removal.

d. Adjustment.

(1) *Brake shoe assembly adjustments*. The handle force of the control valve can be varied by adjusting nut (25, fig. 9-33). This adjustment increases or decreases the manual force required to move or hold the handle in any desired position.

(2) *Pilot valve lever adjustment*.

(a) Remove retaining ring (58, fig. 9-33) and protector (59).

(b)Move handle (9) back and forth on both sides of the "neutral" position, observing the action of levers (38 and 39). The corresponding pilot

valve should be fully open after the handle moves through the first 10 degrees travel arc.

(c) If the pilot valve levers need adjusting, place the handle in a maximum increasing pressure position. With a 3 / 32 inch Allen wrench, turn setscrew (42) out, just far enough to crack the exhaust valve. The gage (port 1 or port 3, fig. 9-34) will show a drop in pressure. From this point turn the setscrew in a full three turns. This will open the supply valve of the pilot valve to its maximum capacity. Move the handle to the extreme position of the opposite quadrant and repeat the adjustment for the other pilot valve lever.

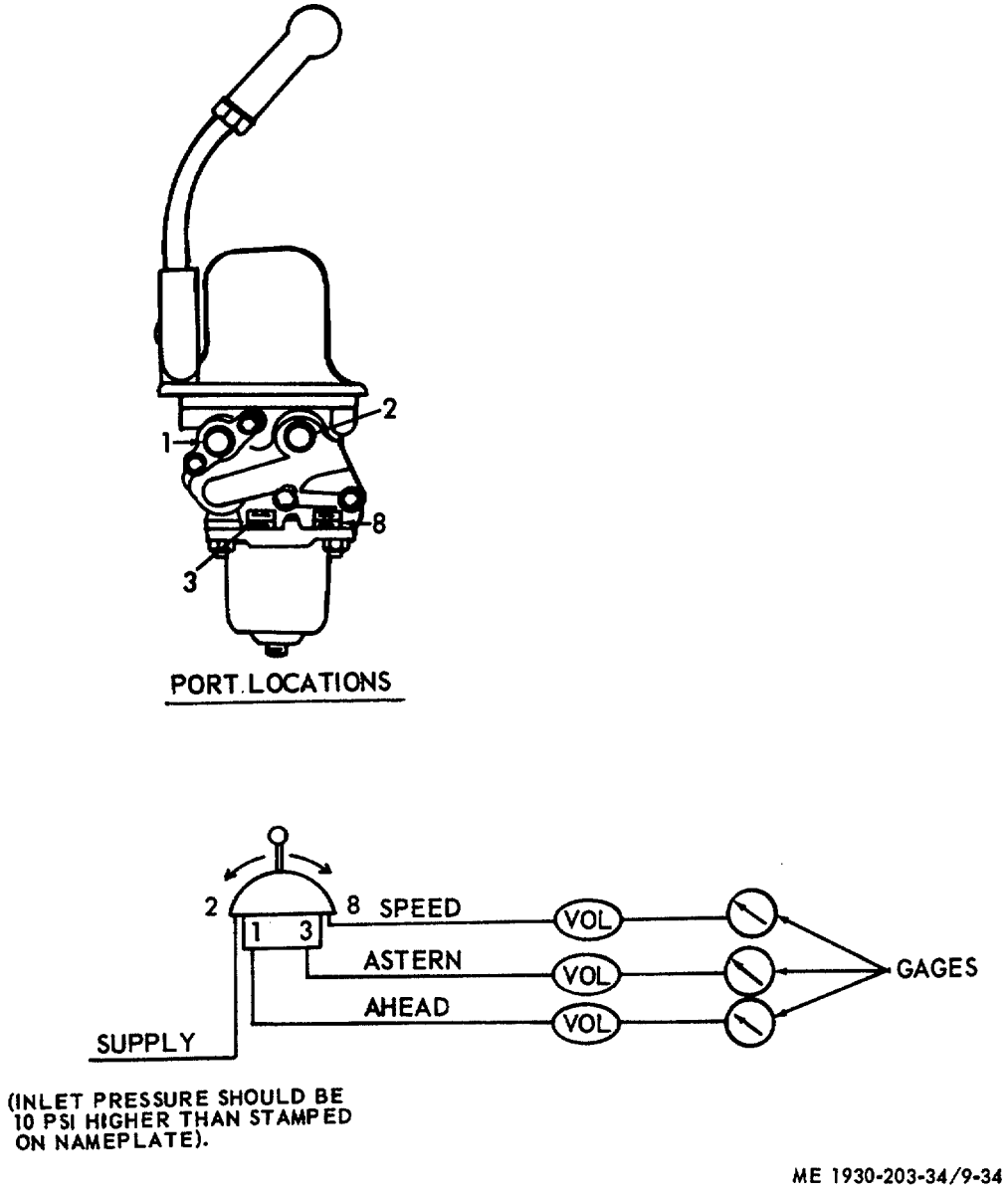


Figure 9-34. Marine gear shifting and throttle control valve adjustments.

(d) Reinstall protector (59, fig. 9-33) and retaining ring (58).

(3) *Pressure setting adjustment*. Place control valve handle (9, fig. 9-33) in the maximum increasing pressure position and turn adjusting screw (43) in or out until the gage at port 8, figure 9-34 registers 68 psi.

(4) *Cam dog adjustment*.

(a) Place control valve handle (9, fig. 9-33) in neutral position.

(b) Insert a screwdriver through hole in flange of cover (13) and turn cam dog pin (34) to position cam dog (35) in the center of cam (20) for zero delivery pressure reading on gages at ports 1 and 3, figure 9-34.

9-19. Quick Release Valve

a. Removal and Disassembly.

(1) *Removal.*

(a) Disconnect airlines from couplings (1, fig. 9-35) and remove quick release valve.

(b) Remove couplings (1) from the quick release valve.

(2) *Disassembly.*

(a) Remove screws (6) and washers (5) securing cover (7) to body (2).

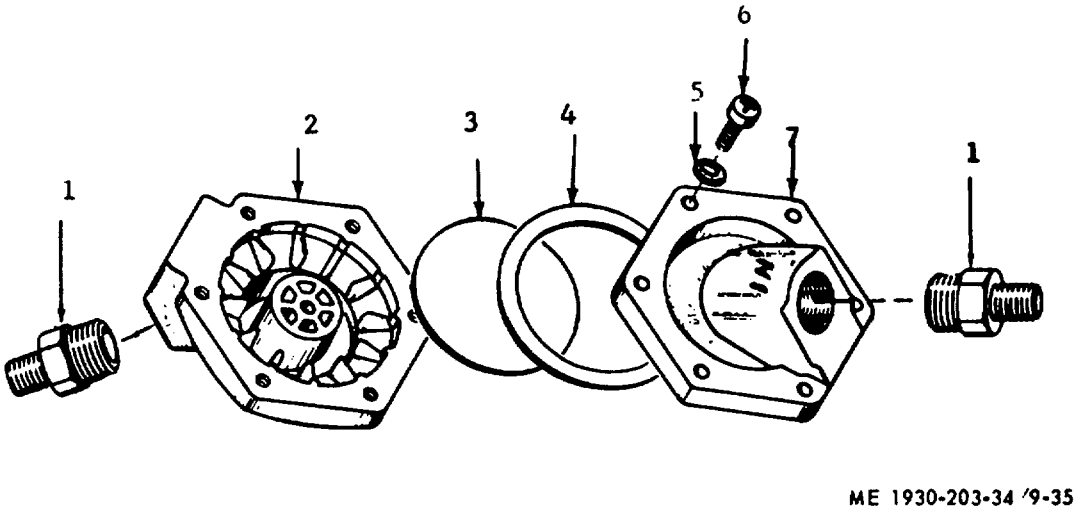
(b) Separate cover (7) from body (2) and remove gasket (4) and diaphragm (3).

b. Cleaning. Inspection and Repair.

(1) Clean all metal parts in dry-cleaning solvent, Federal Specification P-D-680. Wash all rubber parts with soap and water and rinse thoroughly. Dry parts with low pressure air (10 psi).

(2) Inspect diaphragm (3) and gasket (4) for deterioration or breaks. Replace defective parts.

c. Reassembly and Installation. Reassemble and install quick release valve in reverse order of disassembly and removal.



1 Coupling
2 Body
3 Diaphragm
4 Gasket
5 Washer
6 Screw
7 Cover

Figure 9-35. Quick release valve, removal, disassembly, reassembly, and installation.

9-20. Ramp Seal

a. Removal.

(1) Unlatch and lower ramp to deflate ramp seal (4, fig. 9-36) and gain access to seal retainers (5).

(2) Loosen union (1) and remove air pipe (2).

(3) Remove elbow (3) from ramp seal valve stem.

(4) Remove retainer bolts (6).

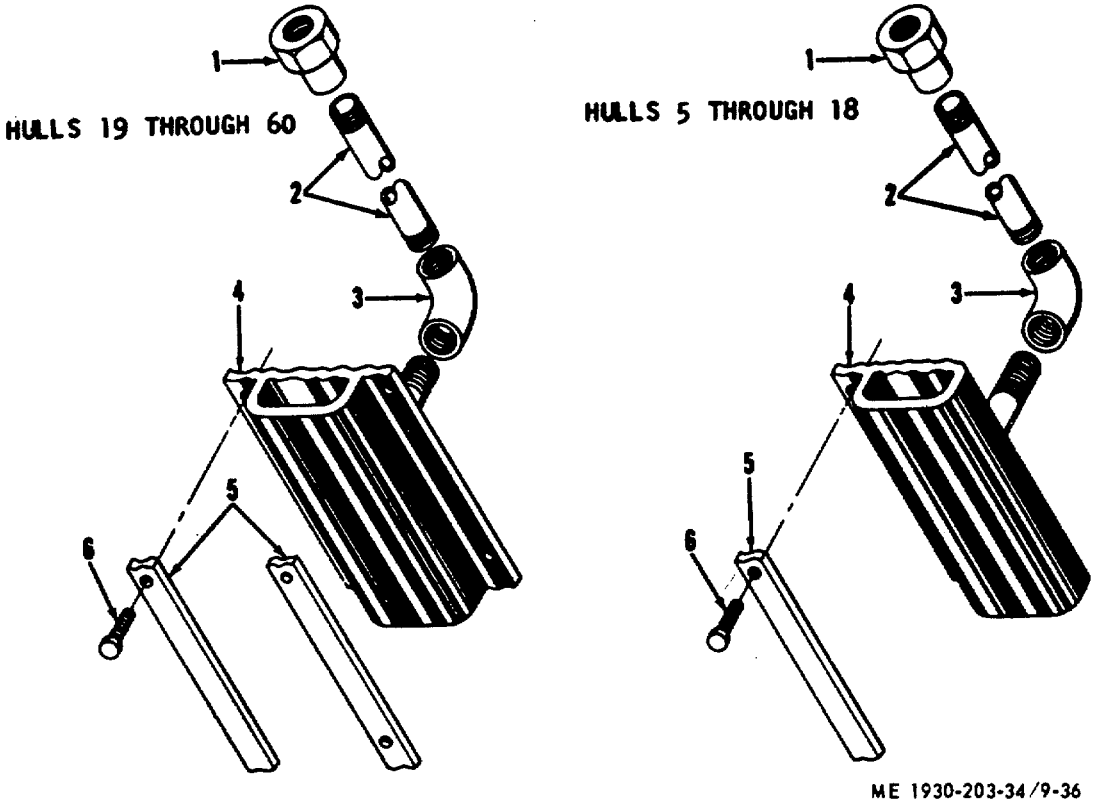
(5) Remove seal retainers (5).

(6) Remove ramp seal (4).

b. Installation. Install ramp seal in reverse order of removal.

NOTE

New ramp seals do not have mounting holes. Punch holes to correspond with existing mounting holes on hull.



1 Union
2 Pipe
3 Elbow
4 Ramp seal
5 Seal retainer
6 Bolt

Figure 9-36. Ramp seal removal and installation.

9-21. Ramp Seal Air Supply Reducing Valve

a. Removal and Disassembly.

(1) *Removal.*

(a) Close globe valves (6 and 7, fig. 2-19) located in airlines above air supply tanks and open service connection globe valves (5) to vent compressed air from lines.

(b) Disconnect air piping at pipe coupling (6, fig. 9-37).

WARNING

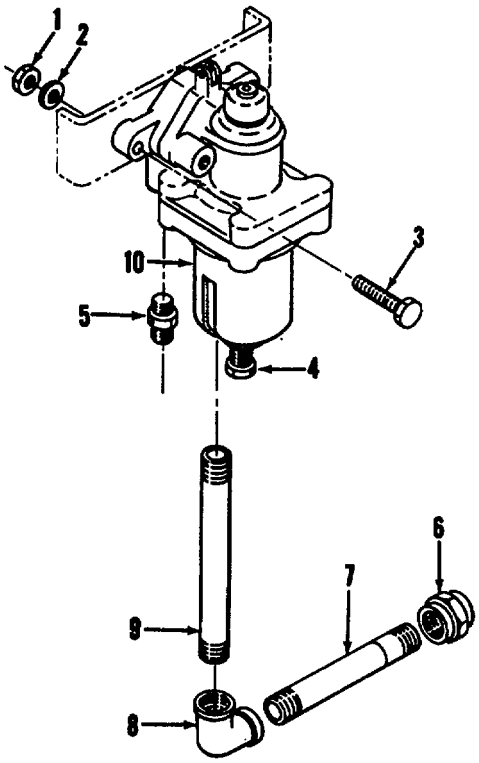
Before attempting to remove any compressed air system lines or components, relieve air pressure from system. Failure to do so may result in injury or death to maintenance personnel.

(c) Disconnect tubing from coupling (5).

(d) Remove attaching bolts (3), nuts (1), and lockwashers (2) securing valve (10) to bracket.

(e) Remove pipe coupling (6), pipe nipple (7), pipe elbow (8), and pipe nipple (9).

(f) Remove coupling (5) from reducing valve (10).



ME 1930-203-34/9-37

1 Nut
2 Lockwasher
3 Bolt
4 Adjusting bolt
5 Coupling
6 Pipe coupling
7 Pipe nipple
8 Pipe elbow
9 Pipe nipple
10 Reducing valve

Figure 9-37. Reducing valve removal and installation.

(2) *Disassembly.*

(a) Remove nuts (13, fig. 9-38) and remove bracket (6).

(b) Remove gaskets (5) and strainers (4).

(c) Remove bolts (15) and nuts (22) and remove spring housing (20). Exercise caution as spring housing is under spring tension.

(d) Lift out exhaust valve seat (11), diaphragm (12), follower (16), and nut (17) as an assembly. Remove exhaust compression spring (9) and preformed packing (10) from exhaust valve seat (11).

(e) Remove diaphragm compression spring (18) and spring seat (19) from spring housing (20).

(f) Remove protector (1) and push inlet and exhaust valve (3) out of body (14).

(g) Remove preformed packings (2) from inlet and exhaust valve.

b. Cleaning, Inspection and Repair.

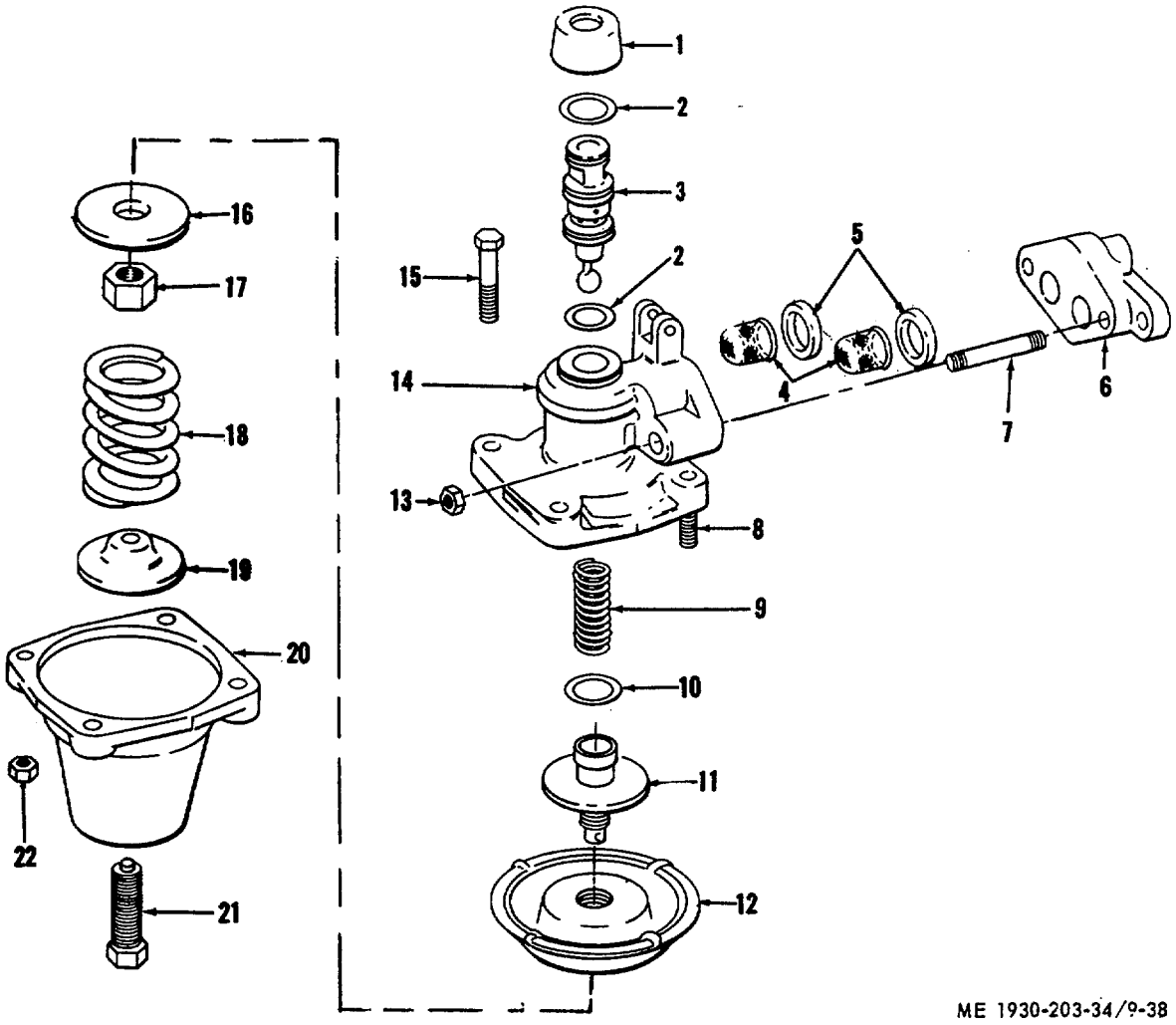
(1) Clean all metal parts in dry-cleaning solvent, Federal Specification P-D-680. Wash rubber parts with soap and water and blow dry with low pressure air.

(2) Replace preformed packings (2 and 10), and gaskets (5).

(3) Inspect diaphragm (12) for cracks or broken sealing beads and exhaust valve seat (11) for scores or pits in seat area. If these conditions exist, replace defective parts.

(4) Inspect inlet and exhaust valve (3) for scores or pits on valve surface that mates with exhaust valve seat (11). Replace a defective inlet and exhaust valve.

(5) Inspect springs (9 and 18) for breaks or distortion. Replace a broken or deformed spring.



1 Protector
2 Preformed packing
3 Inlet and exhaust valve
4 Strainer
5 Gasket
6 Bracket
7 Stud
8 Stud
9 Exhaust compression spring
10 Preformed packing
11 Exhaust valve seat
12 Diaphragm
13 Nut, bracket
14 Body
15 Bolt
16 Follower
17 Nut
18 Diaphragm compression spring
19 Spring seat
20 Spring housing
21 Screw
22 Nut

Figure 9-38. Reducing valve, disassembly and reassembly

(6) Inspect strainers (4) for deterioration or deformation. Replace a deteriorated or deformed strainer.

c. Reassembly and Installation. At reassembly, apply a light coat of grease, Military Specification MIL-G-4343B, to all rubber parts and grease, Federal Specification VV-G-632, Grade 1, Type B, to all friction surfaces. Reassembly and install reducing valve in reverse order of disassembly and removal.

CAUTION

After installation of reducing valve, check ramp seal air pressure gage (2, fig. 9-7) to insure air pressure does not exceed 15 psi with ramp raised and seal inflated.

d. Adjustment.

(1) Raise the ramp into full closed position (TM 55-1930-203-10).

(2) Turn adjusting bolt (4, fig. 9-37) on base

of reducing valve counterclockwise until adjusting screw turns freely.

(3) Turn adjusting bolt (4) slowly clockwise until air gage registers 15 psi.

9-22. Shuttle Valve

NOTE

Double check valves, type 18-A and 22-A, will be replaced with shuttle valves as they become unserviceable.

a. Removal and Disassembly.

(1) *Removal.*

(a) Disconnect air lines at shuttle valve.

(b) Remove two mounting bolls, washers, and nuts.

(2) *Disassembly.*

(a) Remove four screws (1, fig. 9-39) and lockwashers (2) securing cover (3) to body (6). Remove cover (3).

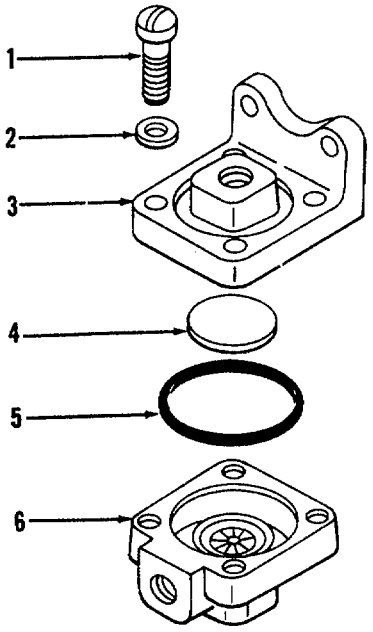
(b) Remove gasket (5) and diaphragm (4).

b. Cleaning, Inspection and Repair.

(1) Inspect diaphragm (4) and its seating surfaces for scoring. Replace defective parts.

(2) Inspect gasket (5) for deterioration or breaks and replace if defective.

c. Reassembly and Installation. Reassemble and install shuttle valve in reverse order of disassembly and removal.



ME 1930-203-34/9-39

1 Screw
2 Washer
3 Cover
4 Diaphragm
5 Gasket
6 Body

Figure 9-39. Shuttle valve disassembly and reassembly.

9-23. Throttle Cutout, Cargo Well Pump, Ramp, and Tire Control Valves

a. Removal

(1) Close globe valve (6 and 7, fig. 2-19) located in airlines above air supply tanks and open service connection globe valves (5) to vent air pressure from lines.

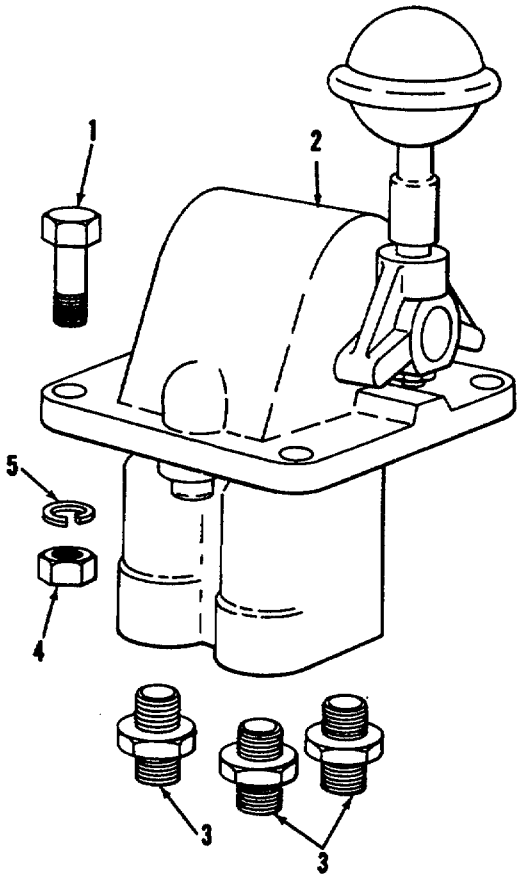
(2) Disconnect airlines from couplings installed in pilot air valve.

WARNING

Before attempting to remove any compressed air system lines or components, relieve air pressure from system. Failure to do so may result in injury or death.

(3) Remove attaching bolts (1, fig. 9-40), nuts (4), and lockwashers (5) securing pilot air valve.

(4) Remove couplings (3) from pilot air valve.



ME 1930-203-34/9-40

1 Bolt
2 Pilot air valve
3 Coupling
4 Nut
5 Lockwasher

Figure 9-40. Throttle cutout, cargo well pump, ramp, and tire control valve removal and installation.

NOTE

Two types of throttle cutout, cargo well pump, ramp. and tire control valves are used as shown in figures 9-41 and 9-42. When the valve shown in figure 9-41 cannot be repaired it will be replaced by the valve shown in figure 9-40.

b. Disassembly.

(1) Figure 9-41 (old style valve).

(a) Remove nut (2), handle shaft (4), and ball (5).

(b) Pull handle yoke (3) off camshaft (1).

(c) Remove screws (15) and lockwashers (14); lift off housing (6).

(d) Remove setscrews (7) and slide out camshaft (1). Remove cams (8).

(e) Remove cotter pins (17) from cam dog shaft (18) and remove cam dogs (19) and cam dog shaft.

(f) Remove screws (20) and clamp (23) from body (16).

(g) Lift out plunger guides (10) and remove preformed packings (9) from plunger guide.
(h) Remove valve plungers (12) and remove preformed packings (11) from plungers.
(i) Remove exhaust valve springs (13).
(j) Lift valve assemblies (21) from body (16). Remove preformed packings (22).

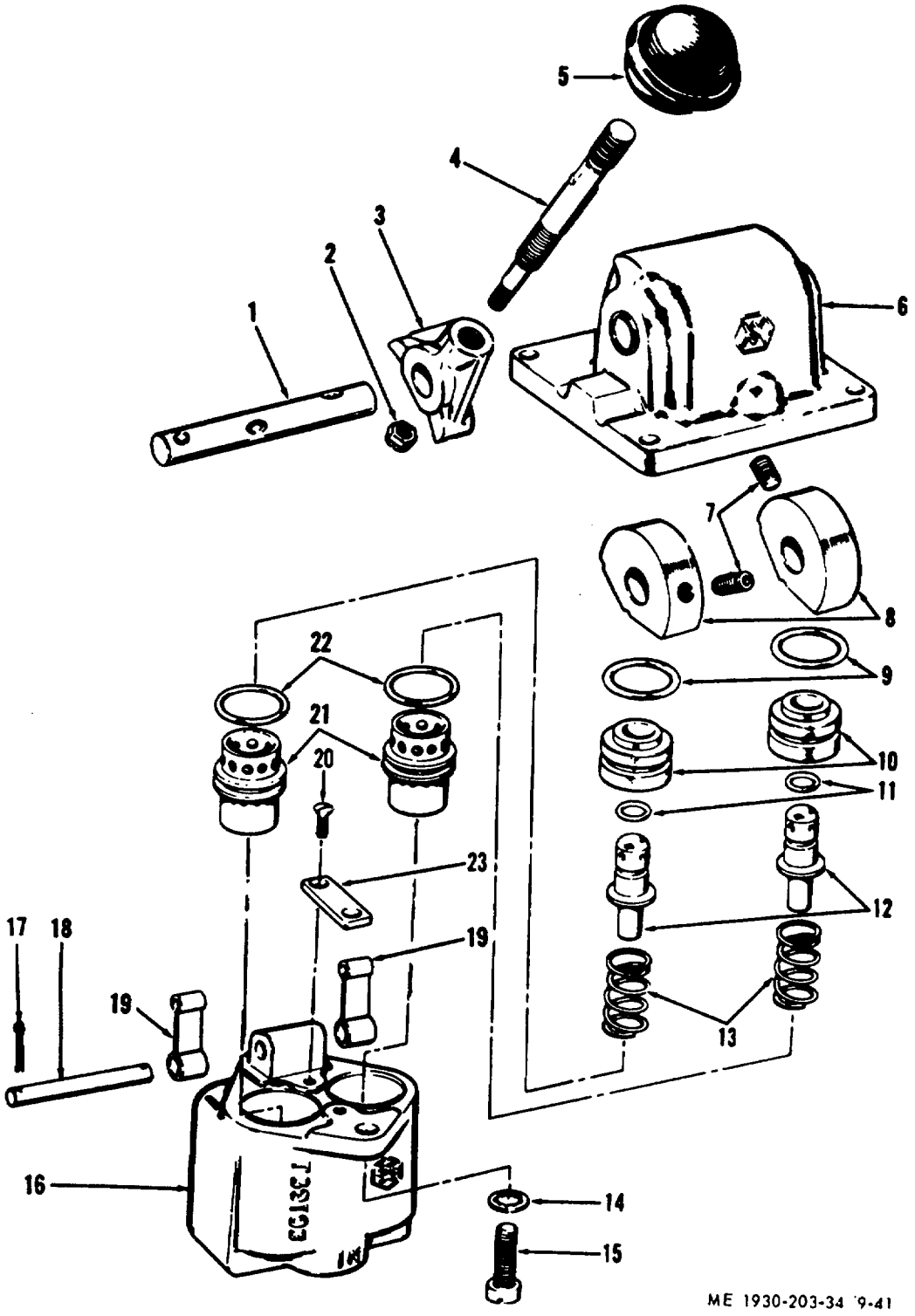


Figure 9-41. Throttle cutout, cargo well pump, ramp and tire control valve, old style, disassembly and reassembly.

Key to figure 9-41.

1 Camshaft
2 Nut
3 Handle yoke
4 Handle shaft
5 Ball
6 Housing
7 Setscrew
8 Cam
9 Preformed packing
10 Plunger guide
11 Preformed packing
12 Valve plunger
13 Exhaust valve spring
14 Lockwasher
15 Screw
16 Body
17 Cotter pin
18 Cam dog shaft
19 Cam dog
20 Screw
21 Valve assembly
22 Packing, preformed
23 Clamp

(2) *Figure 9-42 (new style valve).*

(a) Remove machine screws (1), lockwashers (2), and separate cam housing (12) from valve body (3).

(b) Remove valve cam followers (18), detent cam follower (19), and detent cam spring (20) from valve body.

(c) Loosen camshaft setscrew (15) and remove handle assembly (14).

(d) Pull capscrew (9), camshaft (10), and handle shaft (11) from cam housing (12) as an assembly. Remove valve cams (16) and detent cam (17) from the cam housing.

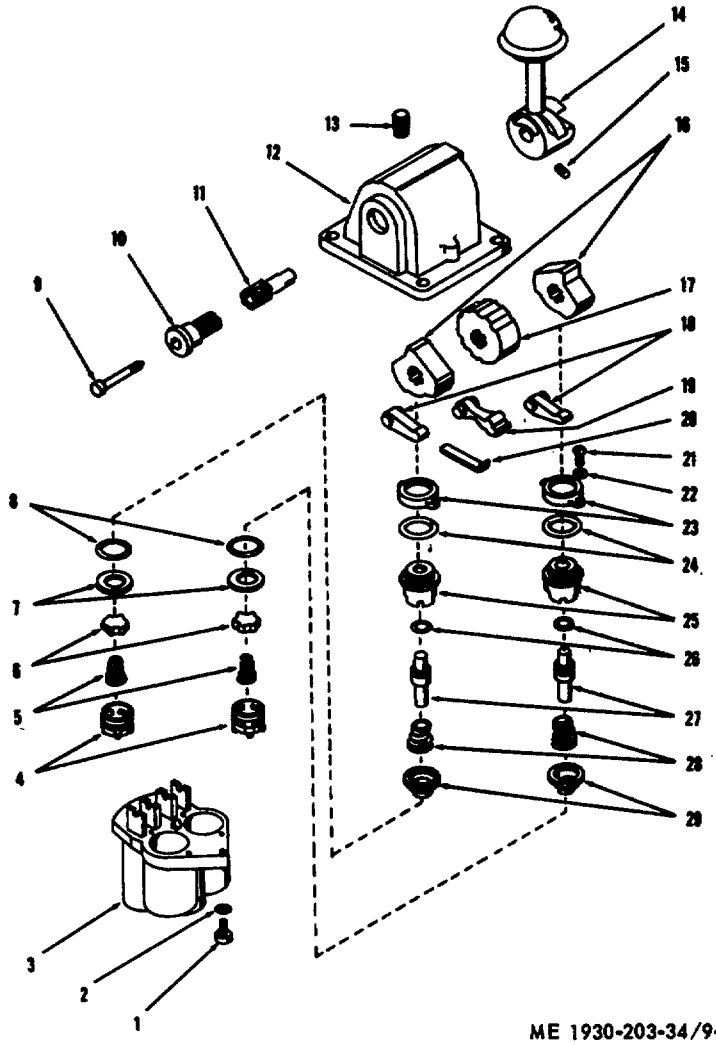
(e) Separate camshaft (10) from handle shaft (11) by removing capscrew (9).

(f) Remove screws (21), lockwashers (22), and retaining flanges (23) from valve body (3).

(g) Lift out plunger guides (25) and remove preformed packings (24) from plunger guides.

(h) Remove valve plungers (27) and remove preformed packings (26) from plungers.

(i) Remove plunger springs (28). inlet valve seats (29). preformed packings (8). flatwashers (7), supply valves (6), supply valve springs (5), and valve spacers (4) from valve body.



1 Screw
2 Washer
3 Body: valve
4 Spacer
5 Spring
6 Valve
7 Washer
8 Packing, preformed
9 Screw
10 Camshaft
11 Shaft
12 Housing
13 Setscrew
14 Handle assembly
15 Setscrew
16 Cam
17 Cam
18 Follower
19 Follower
20 Spring
21 Screw
22 Washer
23 Flange
24 Packing, preformed
25 Guide, plunger
26 Packing, preformed
27 Plunger, valve
28 Spring
29 Seat, inlet valve

Figure 9-42. Throttle cutout, cargo well pump, ramp, and tire control valve, new style, disassembly and reassembly.

c. Cleaning, Inspection and Repair.

(1) Clean all metal parts in dry-cleaning solvent, Federal Specification P-D-680. Wash rubber parts with soap and water and blow dry with low pressure air.

(2) Check springs for breaks or distortion. Replace defective springs.

(3) Inspect valves, valve spacers, valve plungers and valve guides for grooves, burrs, or cracks. Replace defective parts.

(4) Replace preformed packings.

d. Reassembly.

NOTE

During reassembly, apply a light coat of grease, Military Specification MIL-G-4343B to all rubber parts and grease. Federal Specification VV-G-632, Grade 1, Type B, to all friction surfaces.

(1) Figure 9-41 (old style valve). Reassembly control valve in reverse order of disassembly.

(2) Figure 9-42 (new style valve).

(a) Assemble handle shaft (11) to camshaft (25) with capscrew (9), and insert the assembly partially through cam housing (12), with the handle shaft in the position shown in view A-A, figure 9-43.

(b) Install valve cams (16, fig. 9-42) and detent cam (17) on the shaft assembly in the positions indicated in figure 9-43.

NOTE

The valve cams are multi-purpose cams used in various valve models. Their position on the camshaft determines the valve operation. Therefore, it is important that they be assembled correctly.

(c) Place handle assembly (14, fig. 9-42) on the shaft assembly in vertical position as shown in view A-A, figure 9-43. Secure the handle assembly to the shaft assembly with setscrew (15, fig. 9-42).

(d) Install valve spacers (4), supply valve springs (5), supply valves (6), flatwashers (7), preformed packings (8), inlet valve seats (29), and plunger springs (28) in valve body (3).

(e) Install preformed packings (26) on valve plungers (27) and insert the valve plungers in valve body (3).

(f) Install preformed packings (24) on plunger guides (25) and slide the plunger guides over ends of valve plungers (27) into the valve body.

(g) Position retaining flanges (23) on valve body and secure with screws (21) and lockwashers (22).

(h) Install detent cam spring (20), detent cam follower (19), and valve cam followers (18) on valve body.

NOTE

Position detent cam spring as shown in Section C-C, figure 9-43.

(i) Assemble the cam housing. Assemble to the valve body assembly using machine screws (1, fig. 9-42) and lockwashers (2).

(j) Adjust detent force on detent cam (17) with setscrew (13). Tighten setscrew to increase detent force; loosen to decrease force.

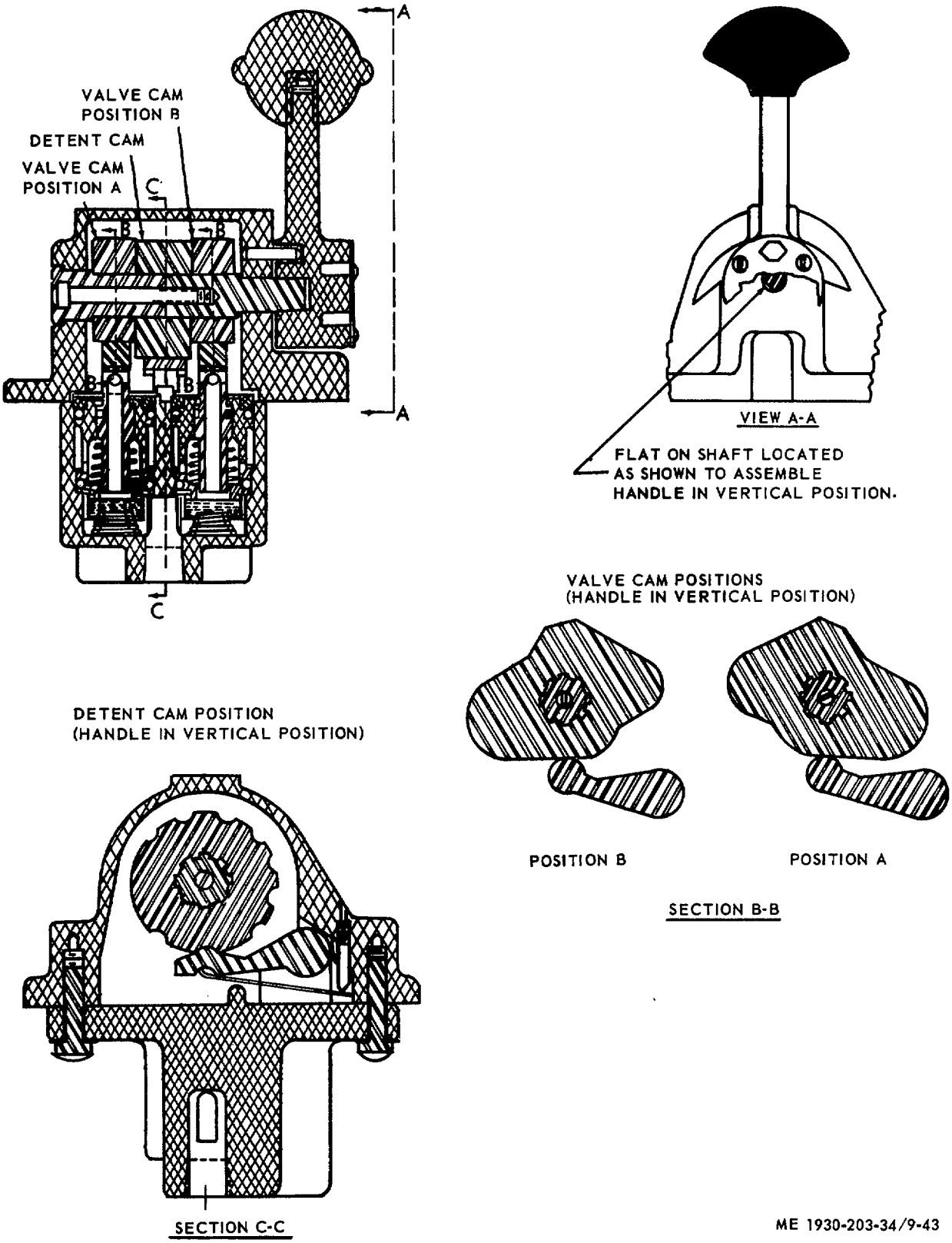


Figure 9-43. Throttle cutout, cargo well pump, ramp, and tire control valve (cut-away view).

e. Installation. Install control valve in reverse order of removal.

9-24. Throttle and Transmission Air Line Relay Valve

a. Removal and Disassembly.

(1) *Removal.*

(a) Close globe valves (6 and 7, fig. 2-19) located in airlines above air supply tanks and open service connection globe valves (5) to vent compressed air from lines.

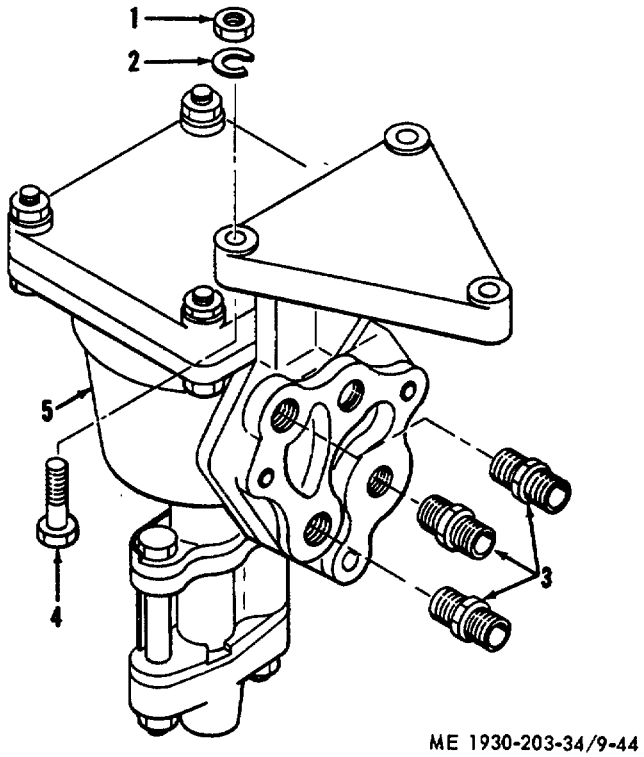
(b) Disconnect airlines from couplings (3, fig. 9-44) installed in relay air valve (5).

WARNING

Before attempting to remove any compressed air system lines or components, relieve air pressure from system. Failure to do so may result in injury or death to maintenance personnel.

(c) Remove attaching bolts (4), nuts (1), and lockwashers (2) securing relay air valve to bracket.

(d) Remove couplings (3) from relay air valve (5).



1 Nut
2 Lockwasher
3 Coupling
4 Bolt
5 Relay air valve

Figure 9-44. Throttle and transmission airline relay valve, removal and installation.

(2) *Disassembly.*

(a) Remove nuts (24, fig. 9-45) and lift off bracket (1).

(b) Remove bracket port gasket (2), strainer gasket (27), strainer (26), and retaining ring (25).

(c) Remove nuts (15) and remove check valve body cover (16), spring (17), lower check valve (18), and preformed packing (19).

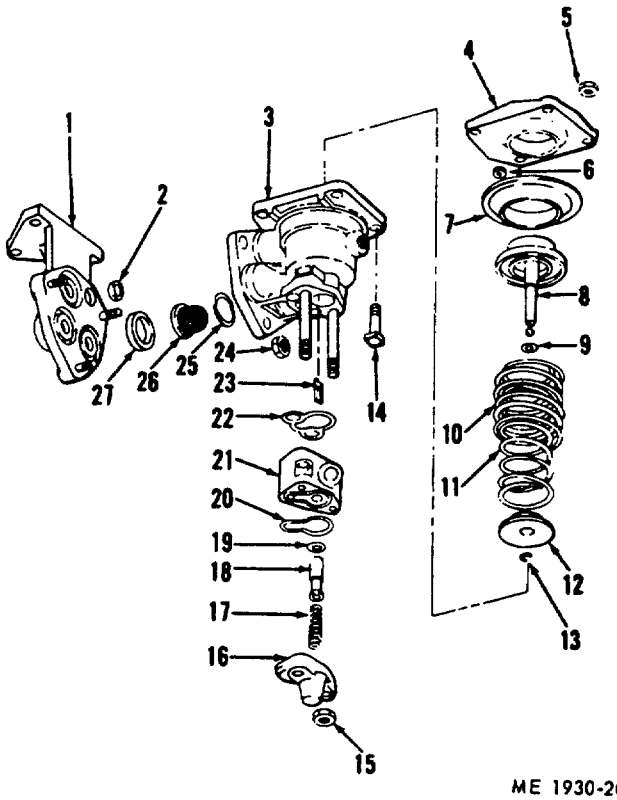
(d) Remove check valve body (21), gaskets (20 and 22), and upper check valve (23).

(e) Remove bolts (14) and nuts (5) and lift off diaphragm cover (4). Exercise caution as cover is under spring tension.

(f) Lift out diaphragm (7) and diaphragm follower (8).

(g) Remove diaphragm port gasket (6) and follower preformed packing (9).

(h) Remove spring seat retainer (13) and remove spring seat (12) and springs (10 and 11) from follower.



1 Bracket
2 Gasket
3 Body
4 Diaphragm cover
5 Nut
6 Gasket
7 Diaphragm
8 Diaphragm follower
9 Packing, preformed
10 Outer compression spring
11 Inner compression spring
12 Spring seat
13 Spring seat retainer
14 Bolt
15 Nut
16 Check valve body cover
17 Supply valve compression spring
18 Lower check valve
19 Packing, preformed
20 Gasket
21 Check valve body
22 Gasket
23 Upper check valve
24 Nut
25 Retaining ring, strainer
26 Strainer
27 Gasket

Figure 9-45. Throttle and transmission airline relay valve, disassembly and reassembly.

b. Cleaning, Inspection and Repair.

(1) Clean all metal parts in dry-cleaning solvent, Federal Specification P-D-680, and dry with low pressure air (10 psi).

(2) Replace preformed packings (9 and 19), and gaskets (2, 6, 20, 22, and 27).

(3) Inspect diaphragm (7) for cracks or broken sealing beads. Replace a defective diaphragm.

(4) Inspect springs (10, 11, and 17) for breaks or distortion. Replace a broken or deformed spring.

(5) Inspect upper and lower check valves (23 and 18) for scores or pits on valve surface that mates with seats in check valve body (21). Replace a defective upper or lower check valve.

(6) Inspect check valve body for scores or pits in seat areas. Replace a defective check valve body.

(7) Inspect strainer (26) for deterioration or deformation. Replace a deteriorated or deformed strainer.

c. Reassembly and Installation. At reassembly, apply a light coat of approved grease to all friction surfaces and preformed packings. Reassemble and install throttle and transmission airline relay valve in the reverse order of disassembly and removal.

9-25. Tire Airline Relay Valve

a. Removal and Disassembly.

(1) *Removal.*

(a) Close globe valves (6 and 7, fig. 2-19) located in the airlines above air supply tanks and open service connection globe valves (5) to vent compressed air from lines.

(b) Disconnect airlines from fittings installed in relay air valve.

WARNING

Before attempting to remove any compressed air system lines or components, relieve air pressure from system. Failure to do so may result in injury or death to maintenance personnel.

(c) Remove attaching hardware securing relay air valve.

(d) Remove fittings from relay air valve.

(2) *Disassembly.*

(a) Remove capscrews (8, fig. 9-46) and lift off valve cover (7) and gasket (6).

(b) Loosen setscrews (5) and lift cage (4) and gasket (11) out of body (3).

(c) Remove valve spring (14).

(d) Remove cotter pin (13) and nut (12) and remove small piston (1) and seal (2).

(e) Remove large piston (9) from cage.

(f) Spread piston ring (10) and remove ring from large piston.

b. Cleaning. Inspection and Repair.

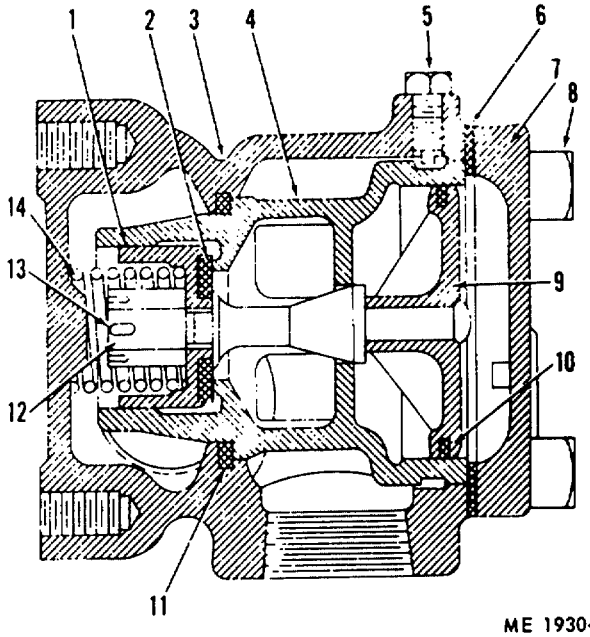
(1) Clean all metal parts in dry-cleaning solvent, Federal Specification P-D-680, and dry with low pressure air (10 psi).

(2) Replace seal (2). and gasket (11).

(3) Inspect spring (14) for breaks or distortion. Replace a broken or deformed spring.

(4) Inspect pistons (1 and 9) and piston ring (10) for cracks. scores. or pits. Replace a defective piston or ring.

c. Reassembly and Installation. At reassembly, apply a light coat of approved grease to all friction surfaces. Reassemble and install tire air line relay valve in the reverse order of disassembly and removal.



ME 1930-203-34/9-46

1 Small piston
2 Seal
3 Body
4 Cage
5 Setscrew
6 Gasket
7 Cover
8 Capscrew
9 Large piston
10 Piston ring
11 Gasket
12 Nut
13 Pin
14 Spring

Figure 9-46. Tire airline relay valve, disassembly and reassembly.

9-26. Tire Inflation Control Safety Relief Valve

a. Removal

(1) Close tire inflation valves in the wheels.

(2) Position pilot air valve (2, fig. 9-6) to deflate.

WARNING

Before attempting to remove any compressed air system lines or components, relieve pressure from system. Failure to do so may result in injury or death to maintenance personnel.

(3) Unscrew safety relief valve (4).

b. Installation. Install safety relief valve in reverse order of removal.

c. Adjustment.

(1) Close all angle globe valves (1, fig. 9-6) and while observing the tire gage (7), slowly inflate the airlines to 70 psi with the pilot air valve (2).

(2) Adjust as follows if safety relief valve (fig. 9-47) does not open at 70 psi.

(a) Remove capnut from safety relief valve.

(b) Turn regulating nut clockwise to increase release pressure or counterclockwise to decrease release pressure.

(c) Set safety relief valve to release at 70 psi.

NOTE

If safety relief valve will not release or take adjustment, replacement is required.

(d) Install and tighten capnut when proper adjustment is achieved.

(3) Open all angle globe valves.

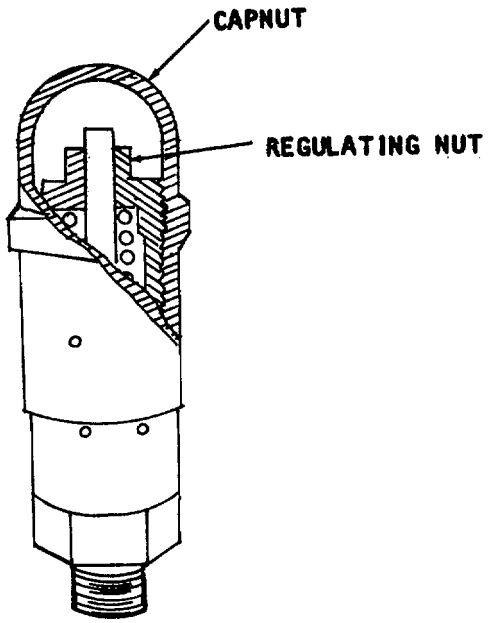
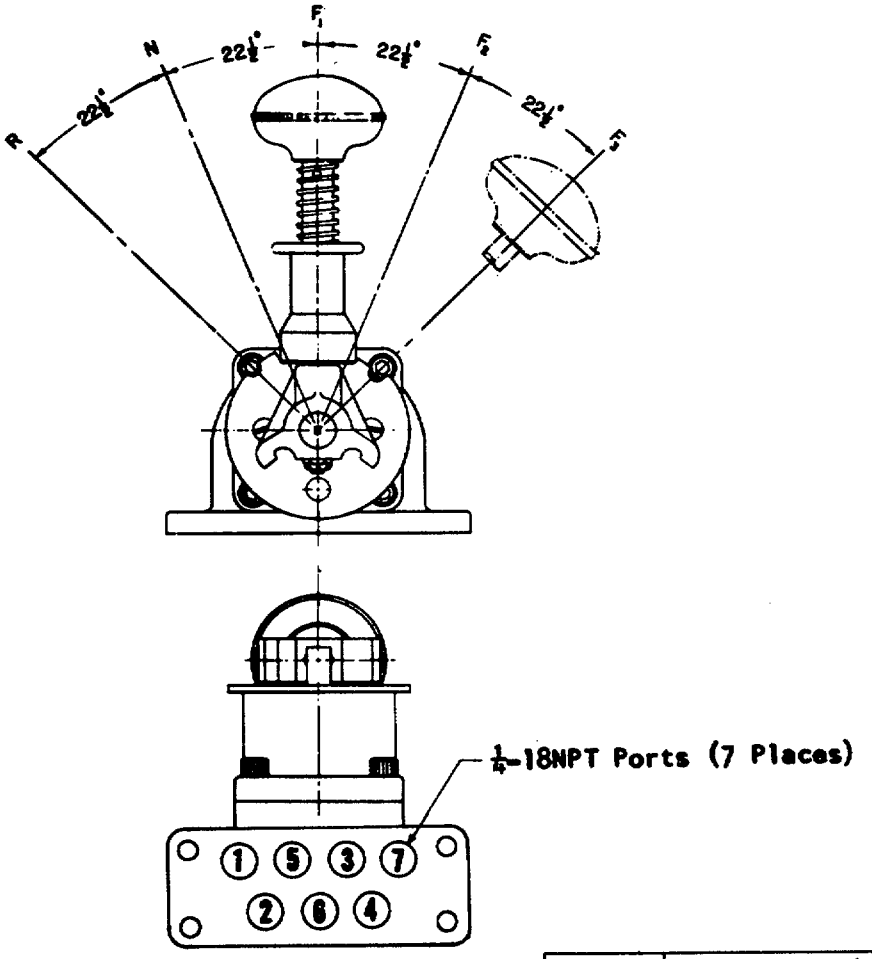


Figure 9-47. Tire inflation control safety relief valve.

9-27. Transmission Control Valve

a. Description. The transmission control valve (Type 5-P-1B) is a five-position multi-way valve used to control the four transmission shifting control air cylinders (five-position cylinders). The control valve contains five delivery ports, a supply port, and an exhaust port. To prevent unintentional operation of the control valve, the hand lever has a latch which requires a manual release before the hand lever position may be changed. The control valve ports are connected to corresponding ports in the shifting control air cylinders. When the hand lever is moved to the positions indicated in figure 9-48, supply pressure is discharged from ports indicated through internal passageways in the control valve.



Handle Position	Ports to Which Pressure is Supplied				
	1	2	3	4	5
R			X		X
N	X		X		X
F_1	X	X			X
F_2	X	X		X	X
F_3	X	X			

NOTE: Port No. 6 - SUPPLY

Port No. 7 - EXHAUST

ME 1930-203-34/9-48

Figure 9-48. Transmission control valve operation and port location.

b. Removal and Disassembly.

(1) *Removal*

(a) Close globe valves (6 and 7, fig. 2-19) located in airlines above air supply tanks and open service connection globe valves (5) to vent compressed air from lines.

(b) Disconnect airlines from couplings (5, fig. 9-49) installed in control valve (1).

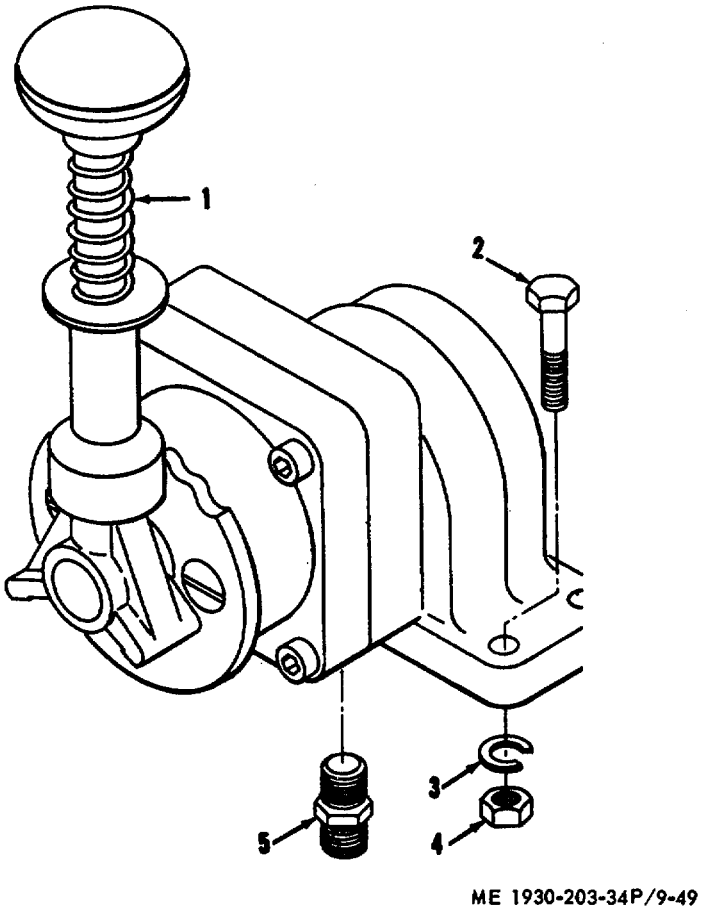
WARNING

Before attempting to remove any compressed air system lines or components, relieve air pressure from

system. Failure to do so may result in injury or death to maintenance personnel.

(c) Remove bolts (2), nuts (4), and lockwashers (3) securing control valve to bracket.

(d) Remove couplings (5) from base of control valve (1).



1 Control valve
2 Bolt
3 Washer
4 Nut
5 Coupling

Figure 9-49. Transmission control valve, removal and installation.

(2) *Disassembly.*

(a) Remove nut (7, fig. 9-50) and unscrew handle assembly (1).

(b) Slide plunger (4), plunger spring (3), and stud tube (2) off handle assembly.

(c) Pull off yoke (5).

(d) Remove two screws (8) and lift off index plate (9) and shim (17).

(e) Remove four screws (11) and remove body (10) and gasket (12) from valve seat (13).

(f) Lift out rotary (15) and rotary spring (14).

(g) Push key (6) out of body.

(h) Remove preformed packing (16) from key.

c. Cleaning, Inspection and Repair.

(1) Clean all metal parts in dry-cleaning solvent, Federal Specification P-D-680, and dry with low pressure air (10 psi).

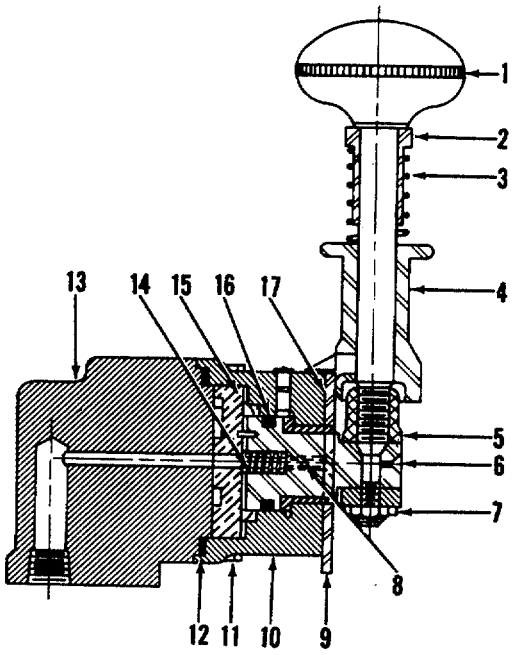
(2) Replace preformed packing (16) and gasket (12).

(3) Inspect springs (3 and 14) for breaks or distortion. Replace a broken or deformed spring.

(4) Inspect rotary (15) and mating surface on

valve seat (13) for dents, pitting, or scoring. If any of these conditions are found, replace valve.

d. Reassembly and Installation. At reassembly apply a light coat of approved grease to friction surfaces and preformed packing. Reassemble and install transmission control valve in reverse order of disassembly and removal.



ME 1930-203-34/9-50

1 Handle assembly
2 Stud tube
3 Plunger spring
4 Plunger
5 Yoke
6 Key
7 Nut
8 Screw
9 Index plate
10 Body
11 Screw
12 Gasket
13 Valve seat
14 Rotary spring
15 Rotary
16 Packing, preformed
17 Shim

Figure 9-50. Transmission control valve, disassembly and reassembly.

9-28. Transmission Shifting Control Air Cylinder

a. Removal and Disassembly.

(1) *Removal.*

(a) Close globe valves (6 and 7, fig. 2-19) located in airlines above air supply tanks and open service connection globe valves (5) to vent compressed air from lines:

(b) Remove cotter pin (6, fig. 9-51) and pin (5) from piston rod (7).

(c) Disconnect air hoses from the transmission shifting control cylinder.

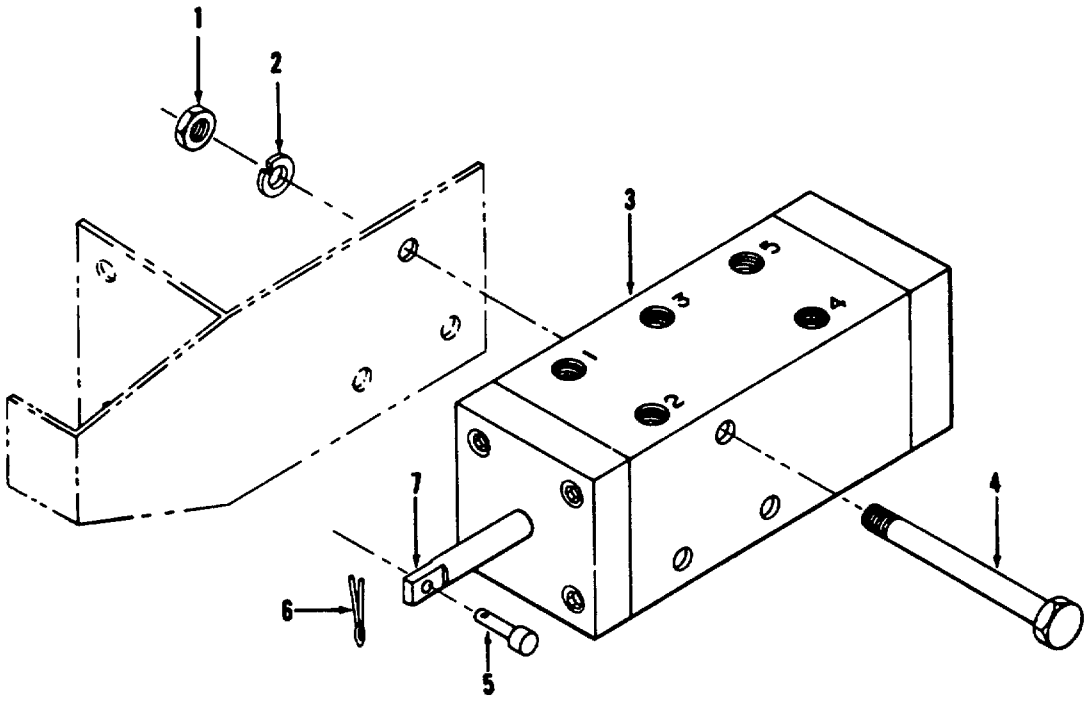
WARNING

Before attempting to remove any compressed air system lines or components, relieve air pressure from system. Failure to do so may result in injury or death to maintenance personnel.

NOTE

Tag air hoses on transmission control cylinder before disconnecting hoses so hoses may be easily installed in the correct ports when replacing the transmission shifting control cylinder.

(d) Remove attaching bolts (4), nuts (1), and lockwashers (2) securing transmission shifting control cylinder (3) to bracket.



1 Nut
2 Washer
3 Transmission shifting control cylinder
4 Bolt
5 Pin
6 Pin
7 Piston rod

Figure 9-51. Transmission shifting control cylinder removal and installation.

(2) *Disassembly.*

(a) Remove capscrews (2, fig. 9-52) and remove rod-end head (3) and blind-end head (15).

(b) Push piston rod (7) and stop rod (12) with attached parts out blind-end head end of body (17).

(c) Push rod-end free piston (6) out rod-end head end of body.

(d) Remove nut (10) and slide operating piston (9) off piston rod (7).

(e) Slide blind-end free piston (11) off stop rod (12).

*(f)*Remove nut (14) and slide stop piston (13) off stop rod.

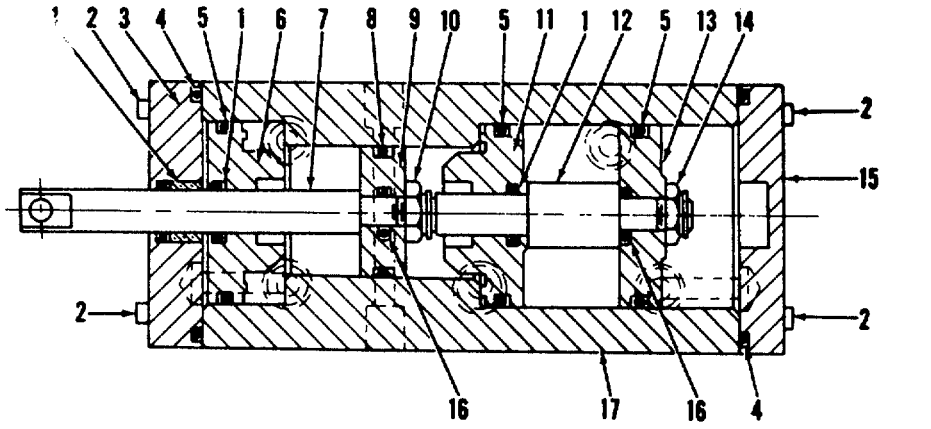
(g) Remove preformed packings (1, 4, 5, 8, and 16).

b. Cleaning , Inspection, and Repair.

(1) Clean all metal parts in dry-cleaning solvent, Federal Specification P-D-680, and dry with low pressure air (10 psi).

(2) Replace preformed packings (1,4, 5, 8, and 16).

c. Reassembly and Installation. At reassembly, apply a light coat of approved grease to all friction surfaces and preformed packings. Reassemble and install transmission shifting control air cylinder in the reverse order of disassembly and removal.



ME 1930-203-34/9-52

1 Packing, preformed
2 Capscrew
3 Rod-end head
4 Packing, preformed
5 Packing, preformed
6 Rod-end free piston
7 Piston rod
8 Packing, preformed
9 Operating piston
10 Nut
11 Blind-end free piston
12 Stop rod
13 Stop piston
14 Nut
15 Blind-end head
16 Packing, preformed
17 Body

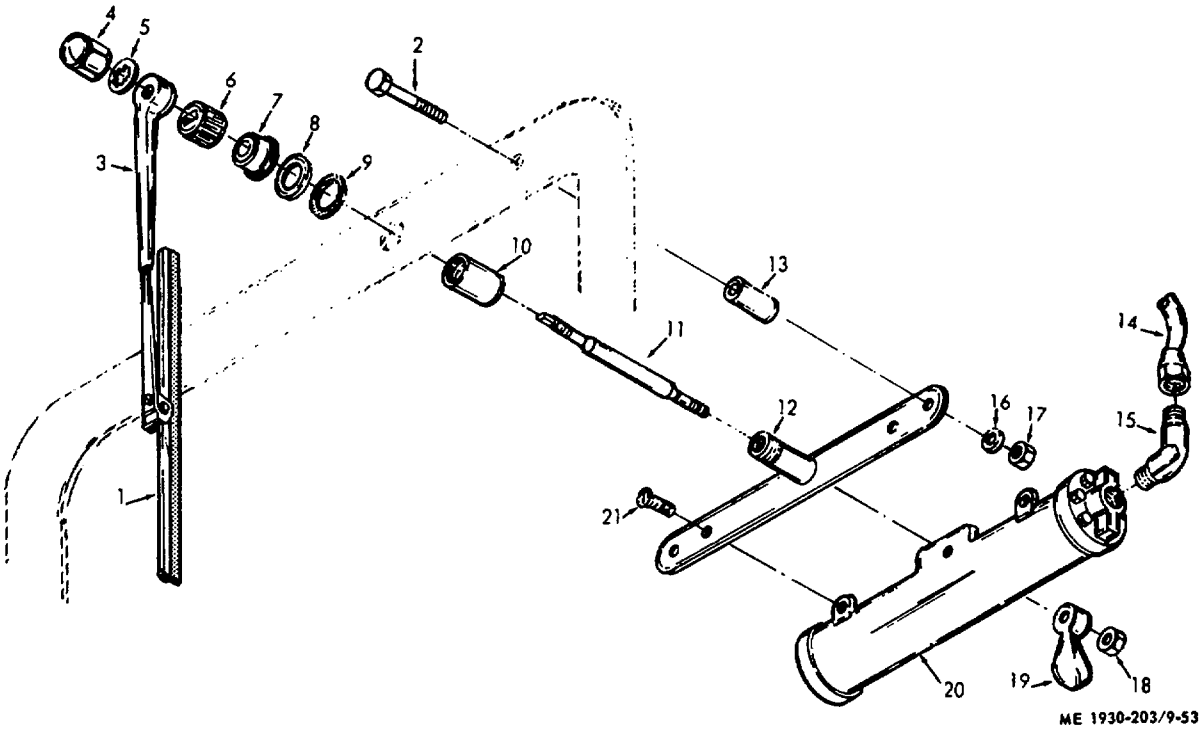
Figure 9-52. Transmission shifting control air cylinder, disassembly and reassembly.

9-29. Windshield Wiper Motor

a. Removal.

(1) Remove nut (4, fig. 9-53) and lockwasher (5), and pull wiper arm and blade assembly from adapter (6).
(2) Remove adapter (6), shield (7), flat washer (8), and gasket (9).
(3) Remove mounting bolts (2), nuts (17), and lockwashers (16).
(4) Pull wiper motor from window frame and remove spacers (10 and 13).
(5) Remove hose (14) from elbow (15) and remove elbow from wiper motor.

b. Installation. Install windshield wiper motor in reverse order of removal. Check that wiper arm is positioned properly before tightening the retaining nut.



1 Bolt
2 Capscrew
3 Wiper arm and blade assy
4 Cap
5 Spacer
6 Spacer
7 Elbow
8 Washer
9 Nut
10 Motor

Figure 9-53. Windshield wiper assembly.

CHAPTER 10

HYDRAULIC SYSTEM REPAIR INSTRUCTIONS

Section I. GENERAL

10-1. Description

For a complete description of the hydraulic system refer to TM 55-1930-203-20.

10-2. General Repairs

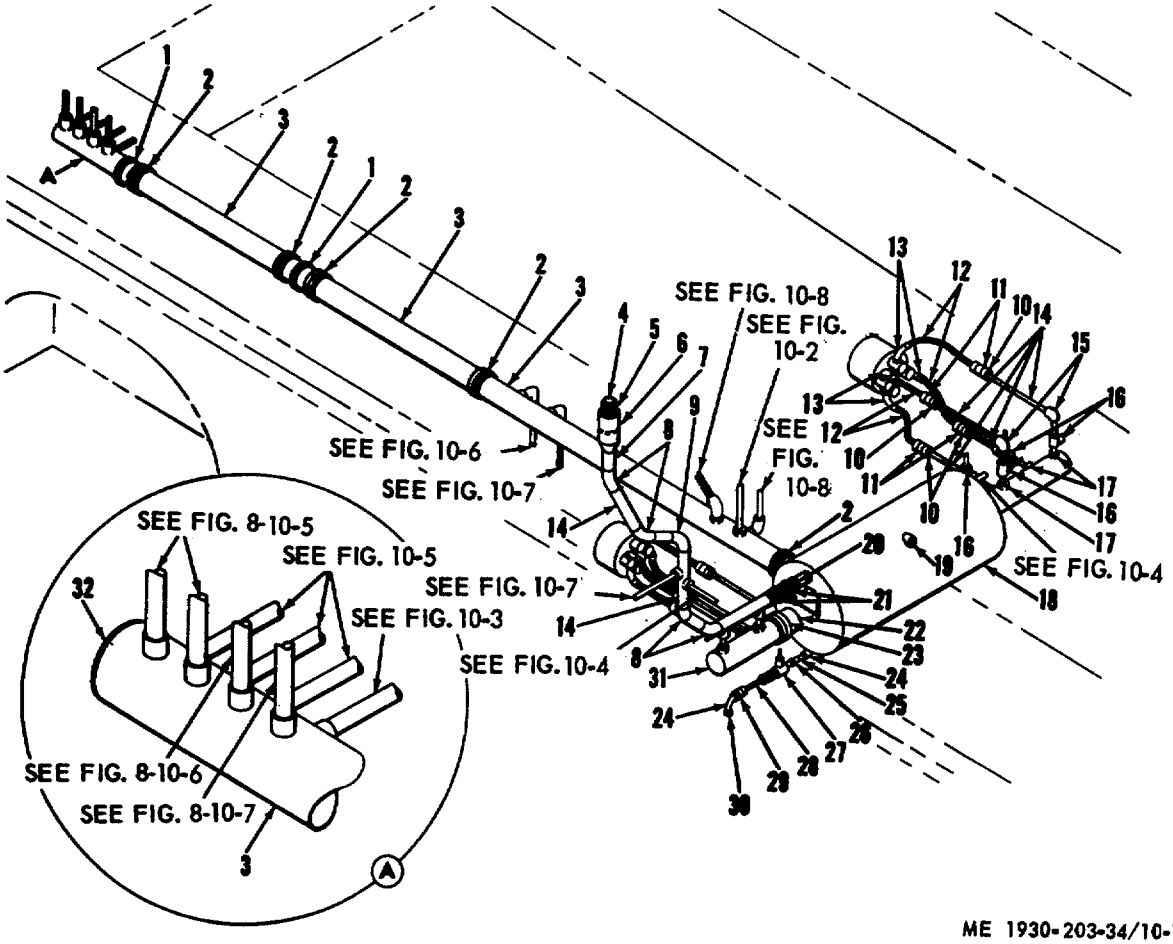
a. All hoses, pipes, fittings, tubing, and gaskets in the hydraulic system are designed to withstand a continuous pressure equal to that supplied in the system (fig. 10-1 thru 10-8). Refer to TM 55-1930- 203-35P for replacement parts.

b. Hangers and straps, strong enough to take all shocks required of the vehicle, are located so that piping vibrations are at a minimum. These items will be replaced when damaged or worn to the extent that functional ability is affected.

c. Piping passing through watertight bulkheads is welded at these points to maintain watertight integrity of the vehicle. Any time the piping is removed the welding must be replaced.

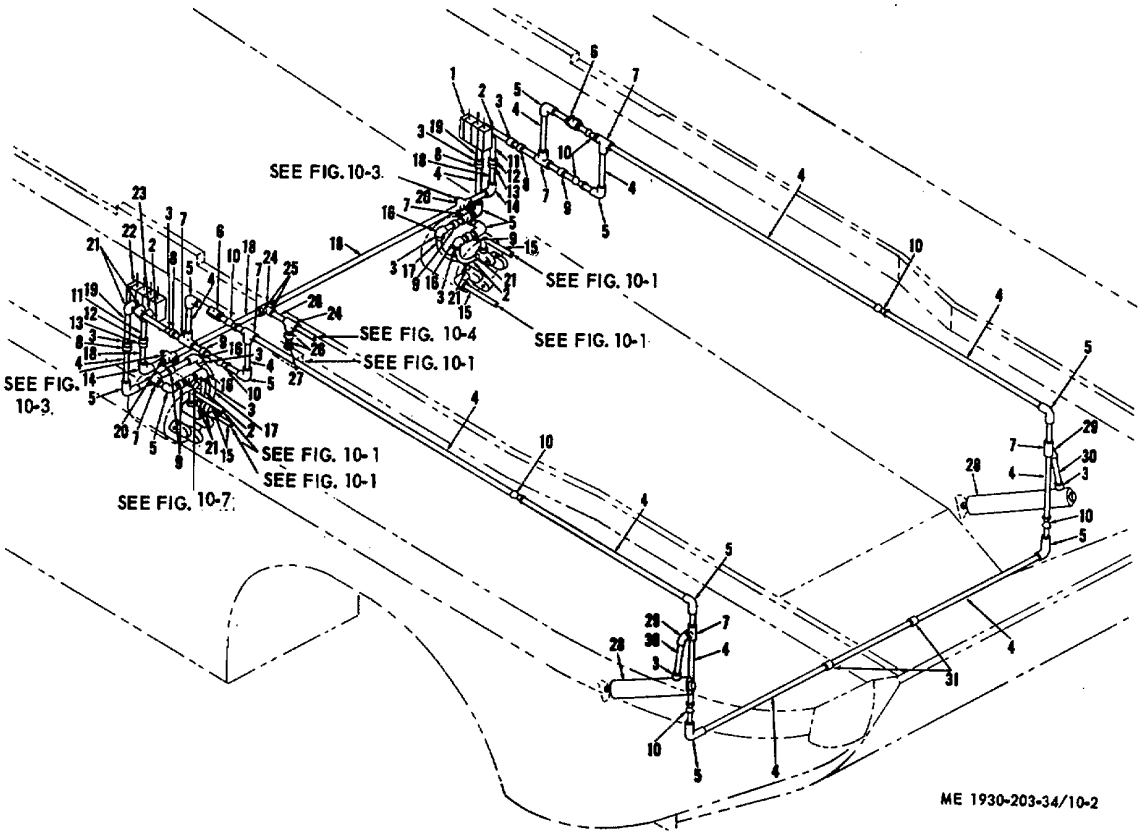
d. Two fluid indicators (43, fig. 10-7) are located in the steering alinement circuit and are used to detect the presence of air in the circuit. To replace these indicators, proceed as follows:

(1) Disconnect each end of indicator (43) at coupling (45). Remove indicator.
(2) Remove valve connectors (44).
(3) Install valve connectors on new indicator.
(4) Install new indicator in line with couplings (45).



1 Plate
2 Flange
3 Pipe
4 Filler and vent cap
5 Ring
6 Pipe
7 Reducer
8 Elbow
9 Elbow
10 Coupling
11 Adapter
12 Hose
13 Adapter
14 Pipe
15 Elbow
16 Gate valve
17 Outlet
18 Hydraulic oil supply tank
19 Coupling
20 Hose
21 Clamp
22 Pipe
23 Flange
24 Elbow
25 Nipple
26 Union
27 Gate valve
28 Hose
29 Adapter
30 Coupling
31 Plate
32 Plate

Figure 10-1. Hydraulic supply and return system.



1 Port multiple unit valve
2 Hose
3 Adapter
4 Pipe
5 Elbow
6 Fluid flow restrictor
7 Tee
8 Coupling
9 Check valve
10 Union
11 Hose
12 Adapter
13 Coupling
14 Elbow
15 Hose
16 Elbow
17 Hose
18 Pipe
19 Hose
20 Cross
21 Adapter
22 Starboard multiple unit valve
23 Adapter
24 Tee
25 Reducer
26 Pipe
27 Union
28 Ramp hydraulic cylinder
29 Adapter
30 Hose
31 Coupling

Figure 10-2. Ramp hydraulic system.

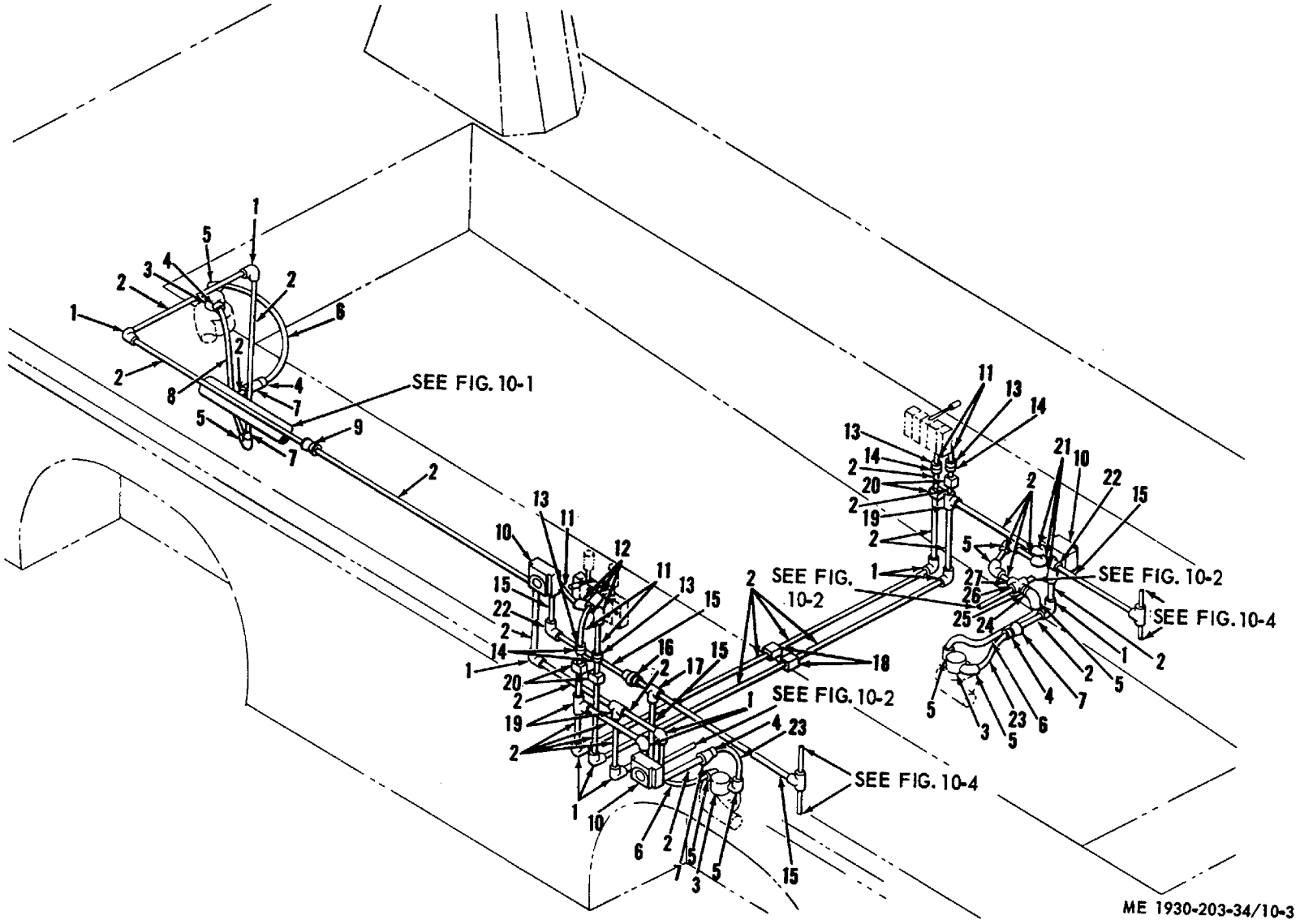


Figure 10-3. Bilge pump hydraulic system.

Key to figure 10-3.

1 Elbow
2 Pipe
3 Bilge pump hydraulic motor
4 Adapter
5 Adapter
6 Hose
7 Reducer
8 Hose
9 Union
10 Flow control valve
11 Hose
12 Adapter
13 Coupling
14 Adapter
15 Pipe
16 Union
17 Tee
18 Coupling
19 Tee
20 Check valve
21 Elbow
22 Elbow
23 Hose
24 Reducer
25 Nipple
26 Cross
27 Reducer

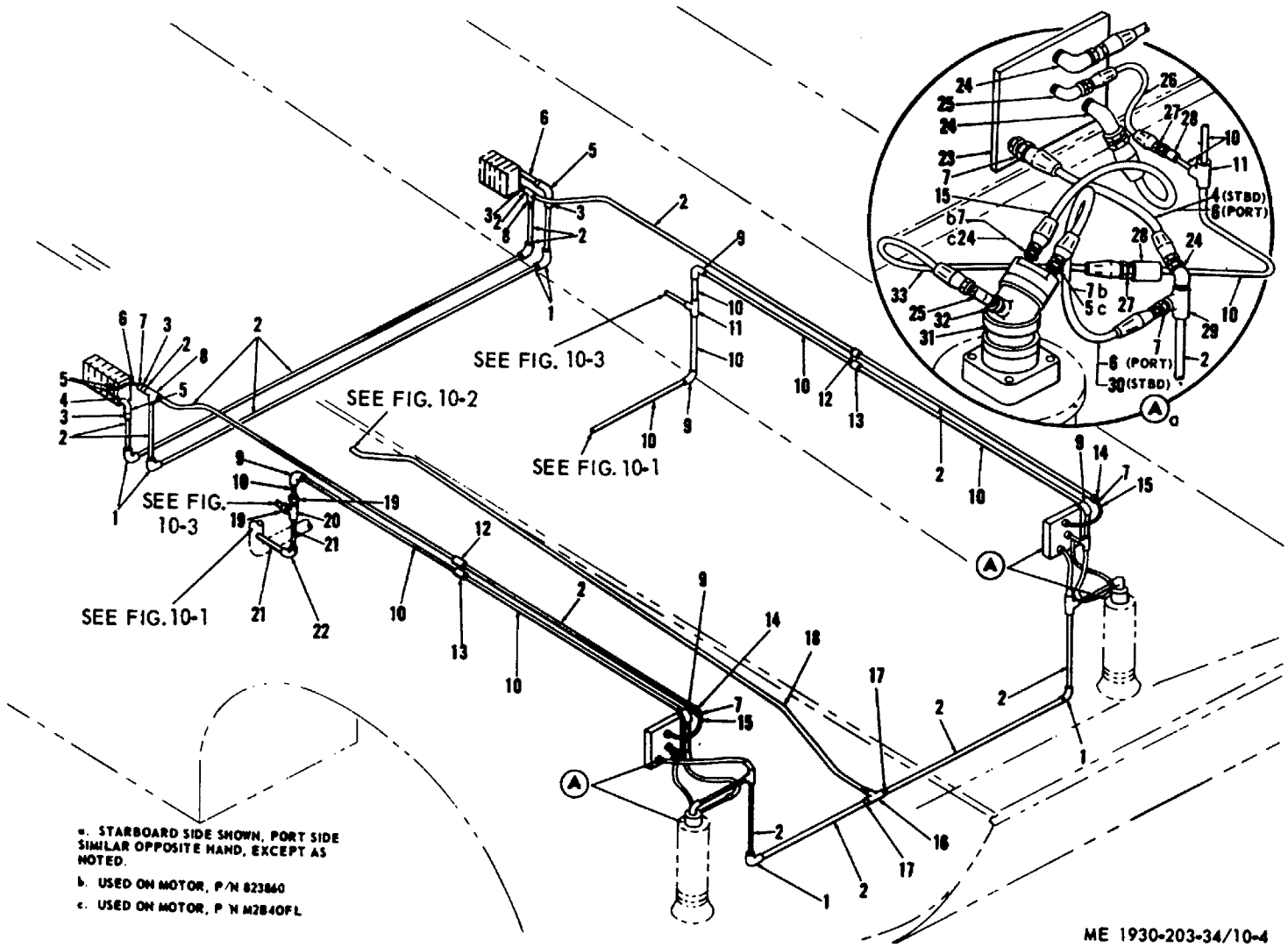


Figure 10-4. Cargo well pump hydraulic system.

Key to figure 10-4.

1 Elbow
2 Pipe
3 Check valve
4 Hose
5 Adapter
6 Hose
7 Adapter
8 Tee
9 Elbow
10 Pipe
11 Tee
12 Coupling
13 Coupling
14 Coupling
15 Hose
16 Tee
17 Reducer
18 Pipe
19 Reducer
20 Tee
21 Pipe
22 Elbow
23 Flow control valve
24 Adapter
25 Adapter
26 Hose
27 Adapter
28 Coupling
29 Tee
30 Hose
31 Cargo well pump hydraulic motor
32 Reducer
33 Hose

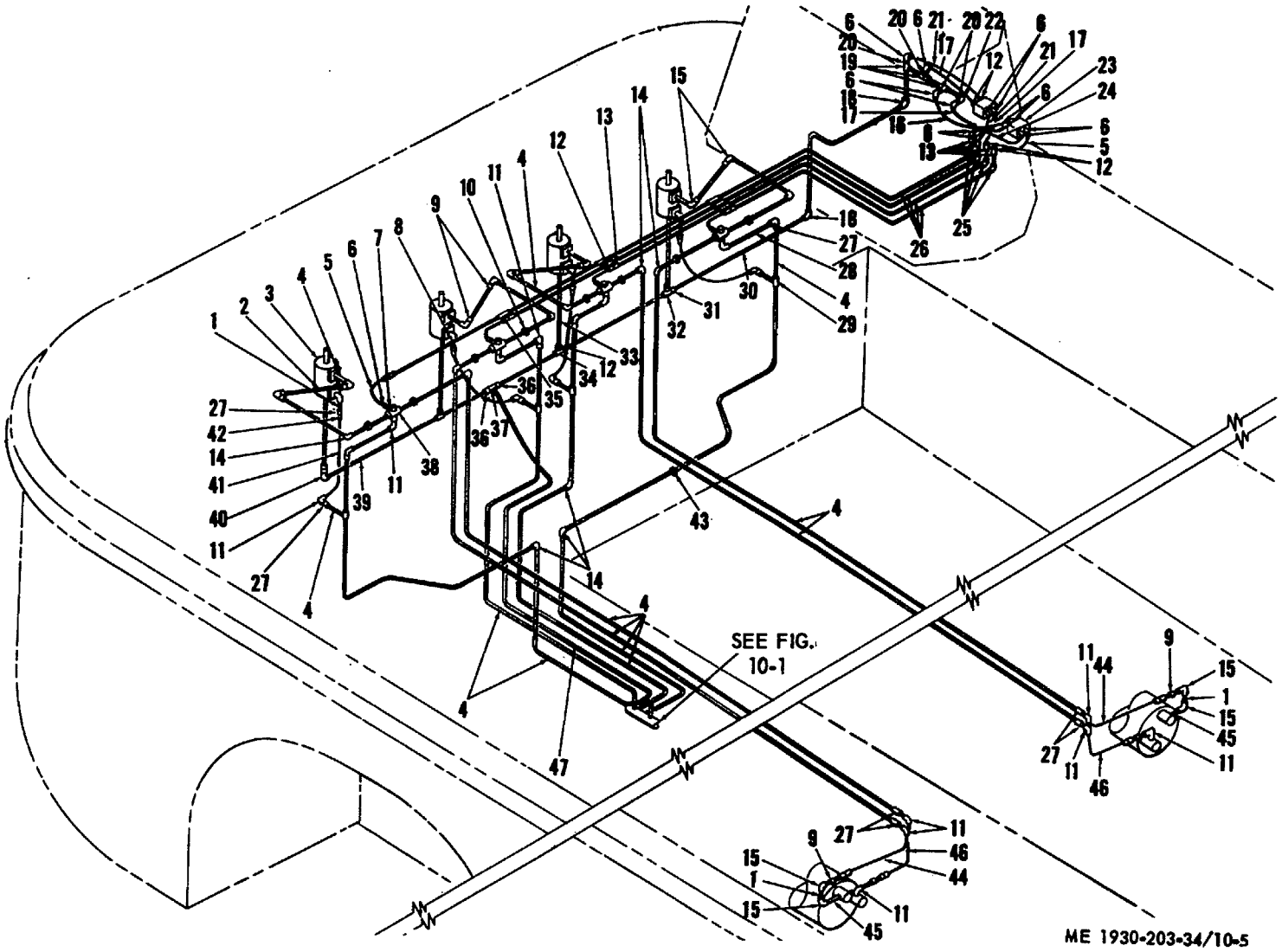
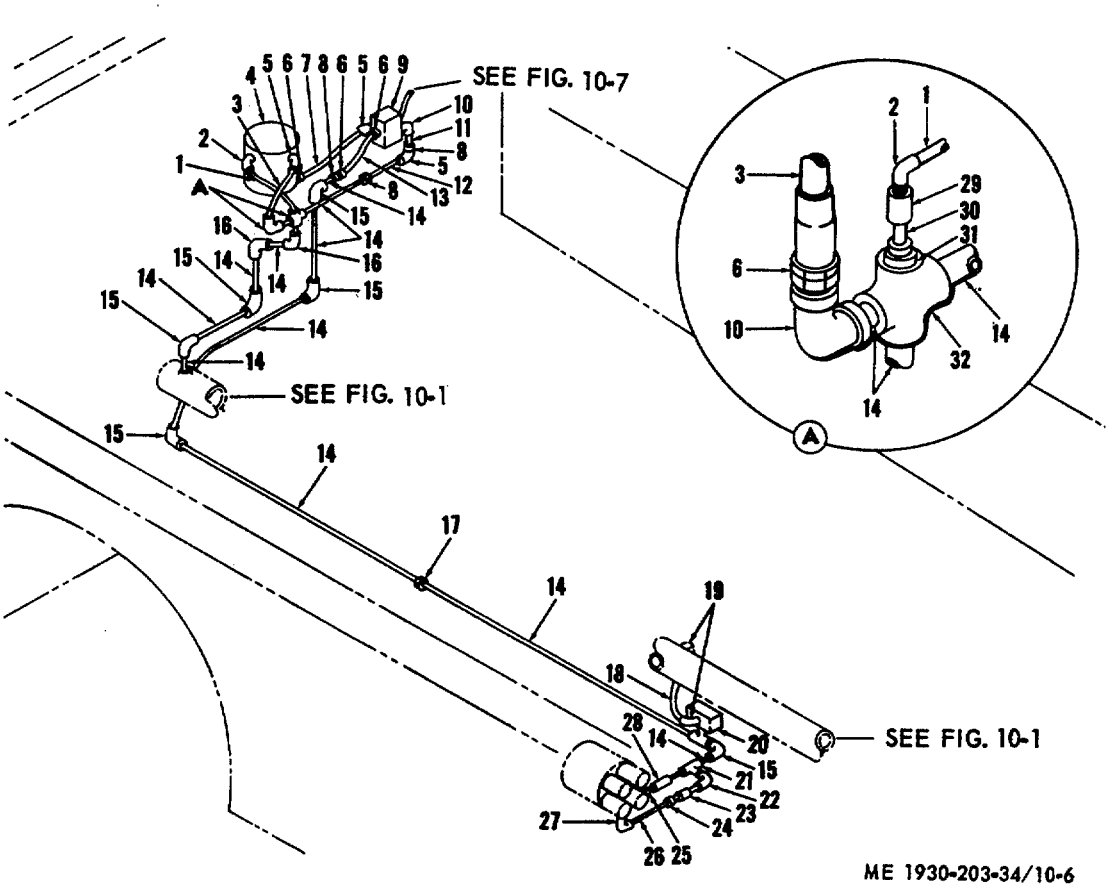


Figure 10-5. Radiator fan hydraulic system.

Key to figure 10-5.

1 Nipple
2 Hose
3 Hydraulic motor
4 Pipe
5 Hose
6 Adapter
7 Bushing
8 Elbow
9 Adapter
10 Union
11 Adapter
12 Adapter
13 Coupling
14 Elbow
15 Elbow
16 Hose
17 Hose
18 Elbow
19 Tee
20 Bushing
21 Hose
22 Elbow
23 Control valve
24 Hose
25 Elbow
26 Pipe
27 Coupling
28 Hose
29 Tee
30 Pipe
31 Bushing
32 Bushing
33 Hose
34 Tee
35 Coupling
36 Reducer
37 Tee
38 Relief valve
39 Pipe
40 Elbow
41 Hose
42 Adapter
43 Coupling
44 Hose
45 Nipple
46 Hose
47 Pipe



1 Hose
2 Adapter
3 Hose
4 Cargo winch hydraulic motor
5 Adapter
6 Adapter
7 Hose
8 Coupling
9 Cargo winch control valve
10 Elbow
11 Nipple
12 Hose
13 Hose
14 Pipe
15 Elbow
16 Elbow
17 Coupling
18 Hose
19 Adapter
20 Relief valve
21 Tee
22 Elbow
23 Check valve
24 Adapter
25 Adapter
26 Hose
27 Adapter
28 Check valve
29 Coupling
30 Pipe
31 Reducer
32 Cross

Figure 10-6. Cargo winch hydraulic system.

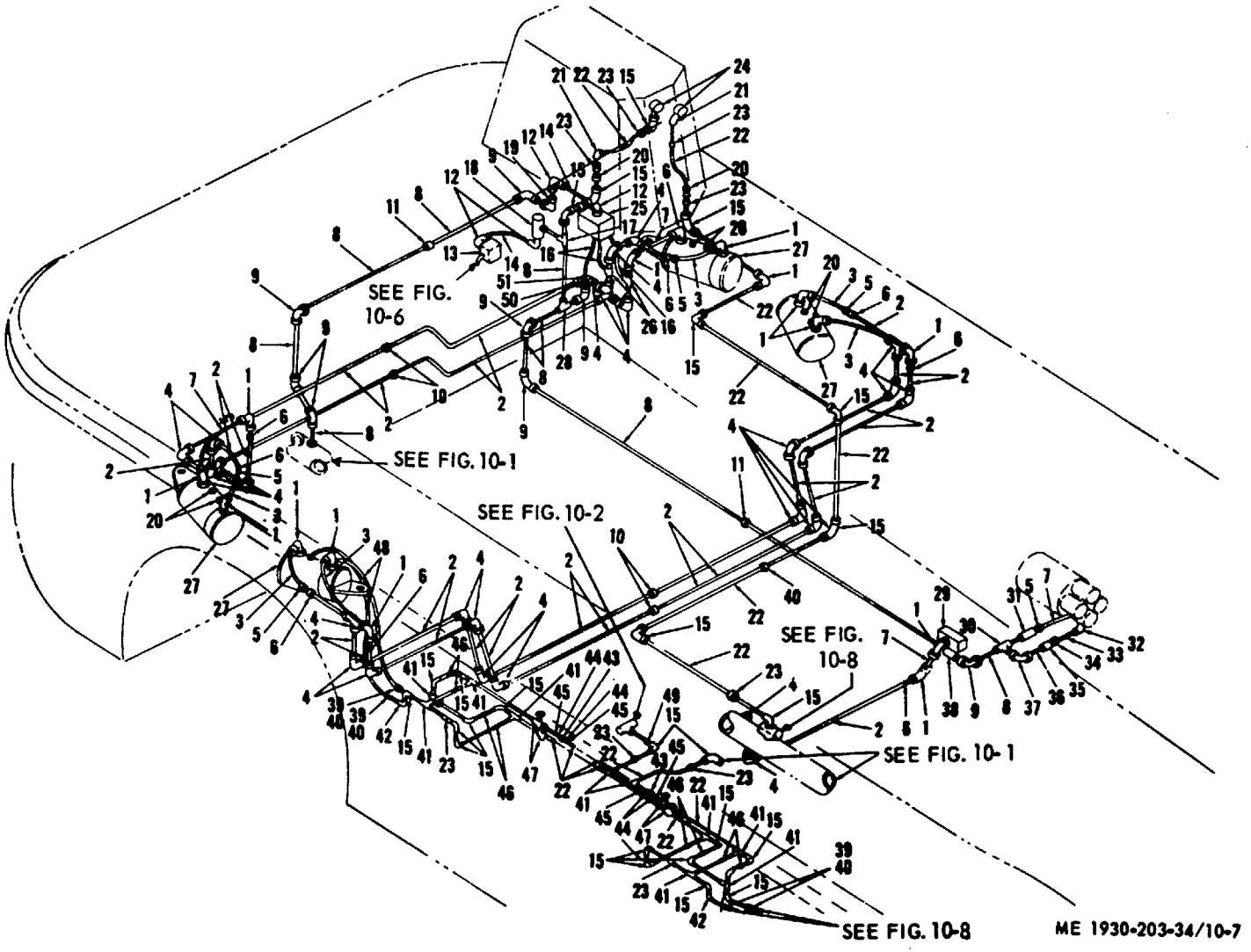


Figure 10-7. Aft steering hydraulic system.

Key to figure 10-7.

1 Adapter
2 Pipe
3 Hose
4 Elbow
5 Adapter
6 Coupling
7 Hose
8 Pipe
9 Elbow
10 Coupling
11 Coupling
12 Adapter
13 Cargo winch control valve
14 Hose
15 Elbow
16 Hose
17 Tee
18 Right angle check valve
19 Elbow
20 Needle valve
21 Elbow
22 Pipe
23 Union
24 Pressure gage
25 Aft steering control valve
26 Tee
27 Steering cylinder
28 Tee
29 Relief valve
30 Tee
31 Check valve
32 Adapter
33 Hose
34 Adapter
35 Check valve
36 Pipe
37 Elbow
38 Tee
39 Adapter
40 Coupling
41 Tee
42 Street elbow
43 Fluid indicator
44 Valve connector
45 Coupling
46 Check valve
47 Needle valve
48 Hose
49 Reducer
50 Coupling
51 Adapter

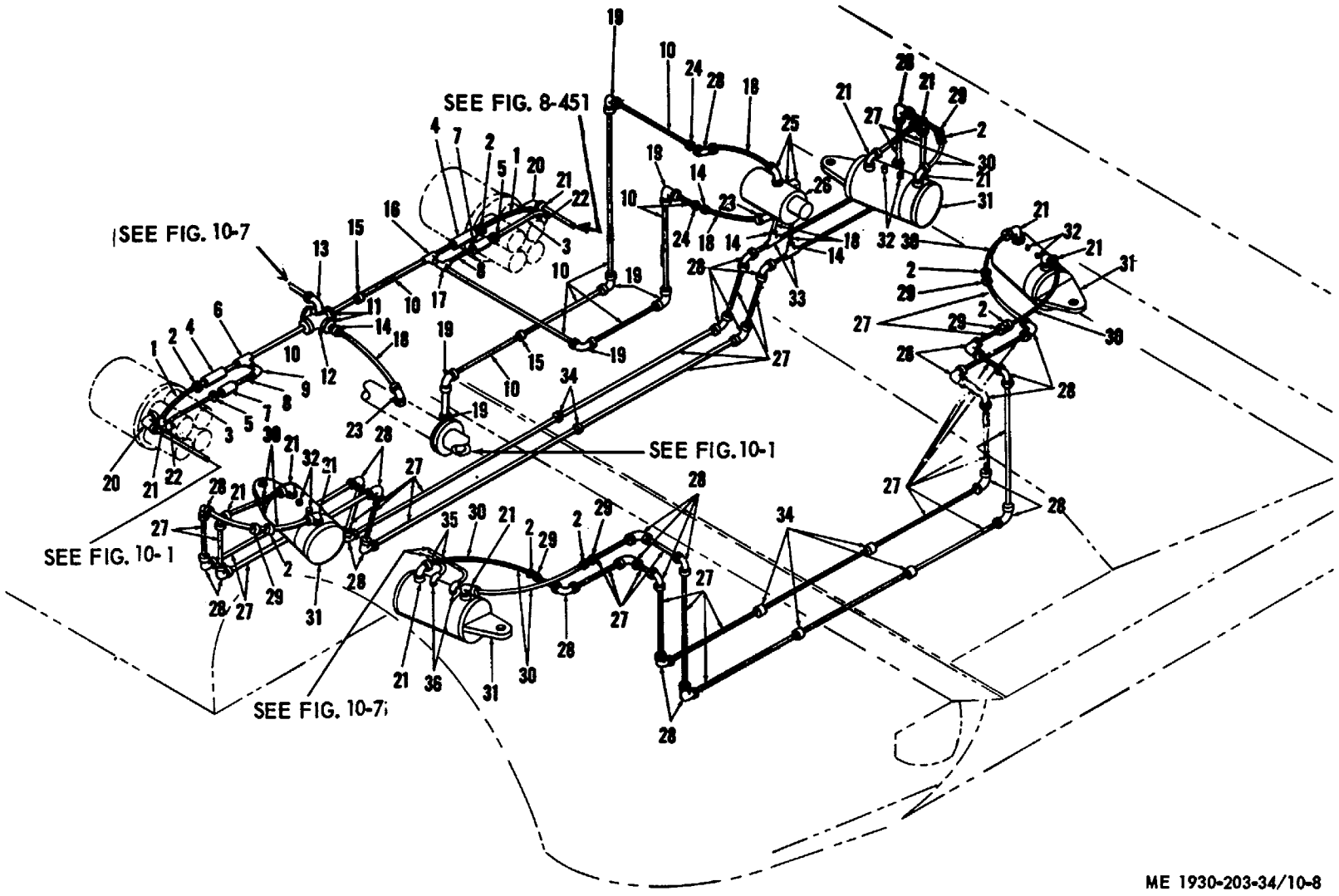


Figure 10-8. Forward steering hydraulic system.

Key to figure 10-8.

1 Hose
2 Adapter
3 Hose
4 Check valve
5 Adapter
6 Tee
7 Check valve
8 Pipe
9 Elbow
10 Pipe
11 Flange
12 Relief valve
13 Elbow
14 Adapter
15 Coupling
16 Tee
17 Tee
18 Hose
19 Elbow
20 Adapter
21 Adapter
22 Adapter
23 Adapter
24 Coupling
25 Adapter
26 Forward steering control valve
27 Pipe
28 Elbow
29 Coupling
30 Hose
31 Steering cylinder
32 Needle valve
33 Tee
34 Coupling
35 Hose
36 Adapter

Section II. REPAIR INSTRUCTIONS

10-3. Hydraulic Wheel Alinement

a. To check wheel alinement, open steering pressure gage needle valves, located in the cab beneath the instrument panel. Start engines and put LARC in motion (TM 55-1930-203-10). Turn steering levers sharply in both directions, observing that pressure builds up and then drops off. If pressure does not drop off, steering is misalined.

b. To realine the hydraulic wheel alinement cylinders refer to TM 55-1930-203-20.

10-4. Bilge Pump Assembly

a. Removal and Installation. Refer to paragraph 2-34 to remove and install the bilge pump assembly.

b. Disassembly.

(1) *Pump motor.*

(a) Cut lock wire and remove bolts (6, fig. 10-9) and washers (5) securing body (7) to cover (14). Separate body and cover and remove gasket (12).

NOTE

Separate body and cover if necessary with a soft-faced hammer.

(b) Pull idler gear (11) and drive gear (15) out of cover.

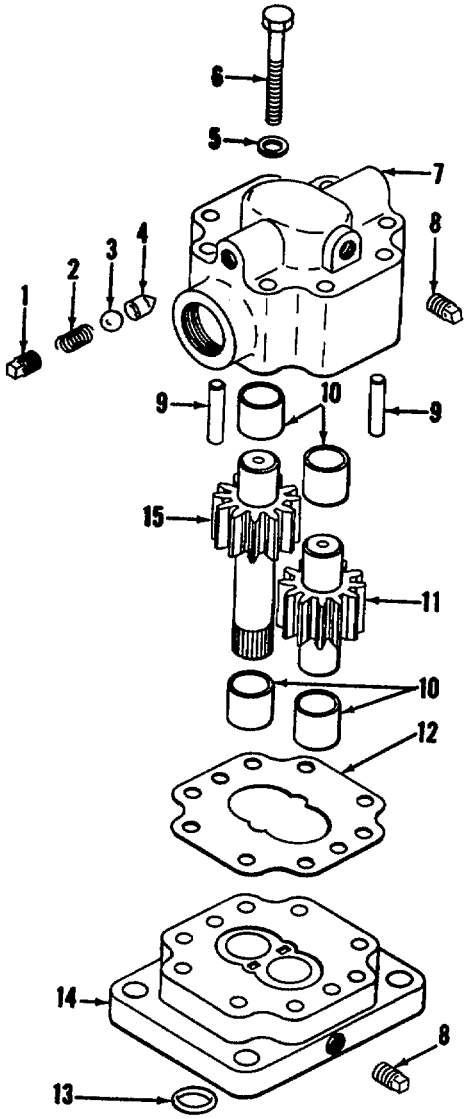
(c) Remove O-ring seal (13) from groove in drive gear bore.

(d) Remove two plugs (8) from cover flange and body and dowel pins (9) from cover, if necessary.

(e) Pull two needle bearings (10) from cover (14) and body (7) only if they are to be replaced with new parts.

(f) Remove two plugs (1), two valve springs (2), and two balls (3) from body.

(g) Pull two valve seats (4) from body only if they are to be replaced with new parts.



1 Plug
2 Valve spring
3 Ball
4 Valve seat
5 Washer
6 Bolt
7 Body
8 Plug
9 Dowel pin
10 Needle bearing
11 Gear
12 Gasket
13 O-ring
14 Cover
15 Gear

Figure 10-9. Bilge pump hydraulic motor disassembly and reassembly.

(2) *Pump.*

(a) Remove three screws (16, fig. 10-10) and lockwashers (15) from case (13) and remove strainer (14).

(b) Remove eight bolts (6) and remove housing (7) and gasket (12) from case (13).

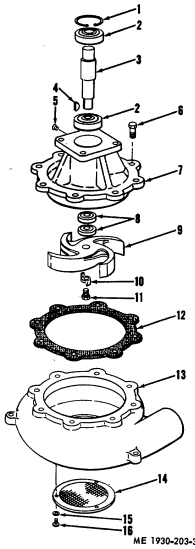
(c) Pry up tab of key-lockwasher (10) and remove bolt (11) and key-lockwasher.

(d) Using a puller, remove impeller (9).

(e) Remove key (4) and retaining ring (1) from shaft (3). Place housing in a universal press and pressing down on impeller end of shaft, press shaft assembly out of housing (7).

(f) Pull two bearings (2) from shaft (3).

(g) Push two oil seals (8) from housing (7).



1	Retaining ring	9	Impeller
2	Bearing	10	Key-lockwasher
3	Shaft	11	Bolt
4	Key	12	Gasket
5	Plug (for shipping only)	13	Case
6	Bolt	14	Strainer
7	Housing	15	Washer
8	Seals	16	Screw

Figure 10-10. Bilge pump disassembly and reassembly.

c. Cleaning, Inspection and Repair.

(1) *Pump motor.*

(a) Wash all metal parts thoroughly in kerosene, Federal Specification VV-K-211, or mineral spirits, and dry with compressed air.

(b) Pressure flush all bores in body and cover with dry-cleaning solvent, Federal Specification P-D-680, and blow out with compressed air.

(c) Inspect all threaded parts for stripped or crossed threads and replace as necessary.

(d) Inspect body and cover for cracks and all bores for scratches, scores, and burrs. Repair or notify supporting higher echelon maintenance.

(e) Inspect needle bearings. Be sure they are free to turn and have not rough or sticky spots. Replace as necessary.

(f) Inspect gears and shafts for wear, cracks, burrs, and scores. Repair or replace as necessary.

(g) Inspect check valve ball seats in body. If there is evidence of improper seating, install new parts.

(2) *Pump.*

(a) Wash all parts with dry cleaning solvent, Federal Specification P-D-680, and dry with compressed air. Remove rust and scale. If badly pitted, replace with new part.

(b) Inspect case and housing for damage or cracks. Discard oil seals and gasket. Check bearings for scoring or excessive wear. Inspect splines for wear or burrs. Inspect impeller blades for damage or distortion. Inspect strainer for holes or damage. Replace defective parts with serviceable parts.

d. Reassembly.

(1) *Pump motor.*

(a) Install two needle bearings (10, fig. 10-9) to cover (14) and body (7) if they have been removed from bores of body.

(b) Install two valves seats (4) to ports in body if they are to be replaced with new parts.

(c) Install two balls (3), two valve springs (2), and two plugs (1) in body.

(d) Install two plugs (8) in body and cover flange.

(e) Install new O-ring seal (13) in groove in drive gear bore.

(f) Install dowel pins (9) in cover, if they have been removed.

(g) Press idler gear (11) and drive gear (15) into cover through needle bearings.

(h) Install new gasket (21) of the same thickness as the original gasket in place on the cover.

(i) Press body (7) onto cover (14) and secure with bolts (6) and washers (5).

(j) Secure bolts with lock wire.

(2) *Pump*

(a) Press two bearings (2, fig. 10-10) on shaft (3).

(b) Press two oil seals (8) into housing (7).

NOTE

Both oil seals must be installed with lips facing the impeller.

(c) Press shaft assembly into housing (7) and install key (4) on shaft.

(d) Install retaining ring (1). Press impeller (9) on key and shaft.

(e) Install key-lockwasher (10) on impeller end of shaft, and install and tighten bolt (11). Lock bolt with tab on key-lockwasher (10).

(f) Replace gasket (12) and install housing on case (13), in position required, with eight bolts (6).

(g) Install strainer (14) on case (13) with three screws (16) and lockwasher (15).

10-5. Cargo Well Pump, Motor, Model M2B-40-FL-S15

a. Removal and Installation. Refer to paragraph 2-35 to remove and install the cargo well pump motor.

b. Disassembly (fig. 10-11).

(1) Fasten motor snugly in a bench vise, or other suitable fixture, in a vertical position with shaft end up.

(2) Remove key (7), screws (16), flange (15), and dowel pin (17).

(3) Using a small punch drive out dowel pins (4 and 23).

(4) Remove and discard seal rings (3).

(5) Remove screws (13) and reposition motor with shaft end down. Be careful that body (10) and covers (2 and 11) do not separate in the process.

(6) To disengage cover (2), insert a small punch in drain hole and tap lightly until shaft (5) clears cover bore.

(7) Remove cover (2) and spacer (25).

(8) Using a bearing puller, remove bearing (24) from shaft (22).

(9) Lift off body (10), gear (8), and gear (9).

(10) Remove key (6).

(11) Using a soft hammer, lightly tap shaft (5) through bore of cover (11) dislodging plug (12) in the process.

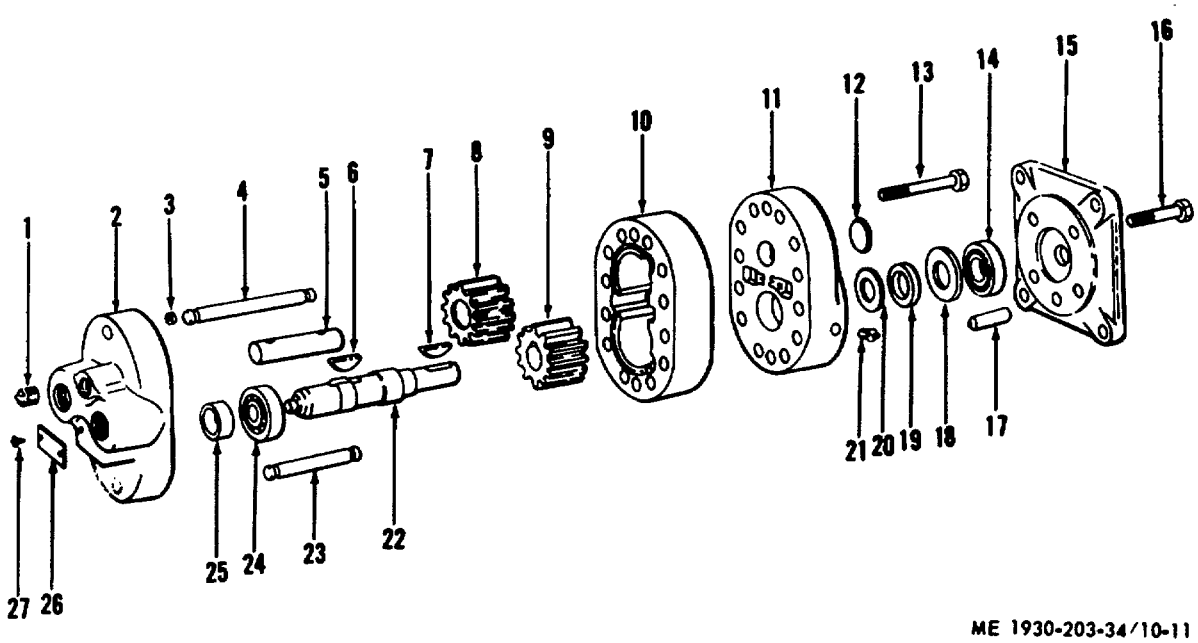
(12) Tap cover end of shaft (22) lightly to dislodge shaft and bearing (14) from cover (11) and remove spacer (18).

NOTE

If necessary to remove bearing (14) from shaft (22), support inner race in an arbor press while pressing shaft out.

(13) Remove seal (19) and washer (20) by tapping on edge of washer with a punch inserted in bore of cover (11).

(14) Remove screws (27) and nameplate (26) only when it is necessary to repaint motor.



1 Plug
2 Cover
3 Seal ring
4. Dowel pin
5 Shaft
6 Key
7 Key
8 Gear
9 Gear
10 Body
11 Cover
12 Plug
13 Screw
14 Bearing
15 Flange
16 Screw
17 Dowel pin
18 Spacer
19 Seal
20 Washer
21 Grease fitting
22 Shaft
23 Dowel pin
24 Bearing
25 Spacer
26 Name plate
27 Screw

Figure 10-11. Cargo well pump hydraulic motor, model M2-40-FL-S15 disassembly and reassembly.

c. Cleaning, Inspection and Repair.

(1) Discard used oil seal and seal rings. Clean all parts in dry cleaning solvent, Federal Specification P-D-680, and place them on a clean, protected surface for inspection.

(2) Check inner and mating surfaces of body and mating surfaces of covers for score marks or excessive wear. Light scratches may be removed by careful lapping of mating surfaces and by polishing inner surface of body with crocus cloth, Federal Specification P-C-458.

(3) Check dowel pinholes and shaft bores in covers for out-of-roundness, oversize, or burrs caused by a shearing action. Presence of any of these defects is cause for rejection.

NOTE

Covers and body are machined in matched sets. If defective, replace the model M2B-40-FLS15 motor with model MF-2008-30-38-21 motor.

(4) Check gears for chipped or worn teeth, shaft bore and bushing for out-of-roundness, or other excessive wear. If gears are defective, replace the model M2B-40-FL-S15 motor with model MF 2008-30-38-21 motor.

(5) Check bearings for wear and looseness. Rotate bearings, applying pressure to outer race, to check for pitted or cracked races.

(6) Inspect oil seal journal on shaft for scoring or wear. Replace shaft if marks cannot be removed by lapping with crocus cloth, Federal Specification P-C-458.

d. Reassembly (fig. 10-11).

(1)Coat all parts with clean engine oil, OE-10, to facilitate assembly and provide initial lubrication.

(2) To install seal (19), place cover (11) in an arbor press with mating surface down. Insert washer (20). Press seal (19) into cover with sealing lip facing in. Use a driver which will apply force near seal outer edge only. Be sure seal is firmly in place and is not cocked or sheared.

(3) To install bearing (14) on shaft (22), place spacer (18) and bearing in 'an arbor press and press shaft down until inner race of bearing bottoms evenly on drive shaft shoulder.

(4) To install shaft (5), place cover (11) in an arbor press with shaft end down. Place gear (8) subassembly in position over cover bore to act as a guide, since the shaft must be held perpendicular to prevent shearing of cover bore during installation. Press shaft down with an even steady force until the center of the cross-drilled drain holes in shaft are alined with sides of gear teeth.

NOTE

Measure depth from flange mounting surface of cover (11) to end of shaft (5) through expansion plug hole with a depth gage. Make note of dimension and check measurement after motor is assembled to be sure shaft did not change position during installation of cover (2).

(5) Install key (6) in shaft (22), and install gear (9) on shaft. Slide body (10) carefully over the assembled shafts and gears.

(6) To install bearing (24), place assembled shaft (22) in an arbor press with shaft end down. Apply an even steady force on inner race of bearing until it bottoms on shaft shoulder. Be sure inner race of bearing (14) is supported during the process.

(7) Install spacer (25) in cover (2) and install cover. Be careful that body (10) and covers (2 and 11) do not separate in the process.

(8) Install screws (13) finger tight.

(9) Place new seal rings (3) in grooves in dowel pins (4 and 23) and lightly tap dowel pins into the assembled motor.

NOTE

Lubricate dowel pins with clean engine oil, OE-10, before installation to prevent binding and damage to seal rings.

(10) Install dowel pin (17) in flange (15).

(11) Install flange (15) on motor and secure with screws (16).

(12) Install key (7) in shaft (22).

(13) Rotate drive shaft several times by hand to determine freedom of movement.

(14) Check shaft bore depth as outlined in note. If shaft did not change position, insert plug (12) in cover (11).

e. Testing.

(1) Mount motor on a suitable test stand. Connect a relief valve set at 1 100 psi and a pressure gage into pressure line of a 4-way valve. Provide for 15 psi back pressure at drain port.

(2) With motor loaded to produce 1000 psi, intermittently stall motor and check drain port and outlet port leakage. Stall leakage should not exceed values given in table 10-1.

Table 10-1. Model M2B-40-FL-S15, Cargo well pump hydraulic motor test data.

RPM (MAX)	Stall Leakage		Volume (GPM)		Approximate running torque (in. lb)
	Outlet port (GPM)	Drain port (cu. in. per min)	Motor un-loaded inlet pressure 0	Motor loaded inlet pressure 1000 psi	
1800	4.5	50	19.1 to 20.6	21.1 to 23.6	360

(3) With motor unloaded and running at 1800 rpm, check for volume in both directions as given in table 10-1.

(4) With motor loaded to produce 1000 psi inlet pressure and running at 1800 rpm, check for volume and approximate running torque in both directions as given in table 10-1.

NOTE

Both loaded and unloaded, the motor should respond instantly when direction of rotation is reversed with 4-way value, and should operate without excessive noise.

10-6. Cargo Well Pump Motor, Model MF-2008-30-38-21

a. Removal and Installation. Refer to paragraph 2-35 to remove and install the cargo well pump motor.

b. Disassembly. Refer to figure 10-12.

NOTE

Prepare a clean, lint-free surface on which to place parts as they are disassembled.

(1) Remove cotter pin (1), nut (2), washer (3), spring (50), and retainer (49) from pin (14).

(2) Remove valve block mounting screws (4 and 5) from block (6) and lift block off angle housing (9). Be sure plate (8) does not adhere to block.

(3) Remove gasket (7).

NOTE

Do not remove pin (48) unless damaged or worn.

(4) Fasten motor snugly in a bench vise or other suitable fixture in a vertical position with the shaft end down.

(5) Remove six screws (34).

NOTE

These screws extend through the retainer (35) and housing (38) and are threaded into the angle housing (9).

CAUTION

Be careful to prevent components from separating when removing screws.

(6) Remove key (32) from drive shaft and piston subassembly (31).

(7) While exerting an even downward pressure on plate (8), ease angle housing (9) off housing (38).

(8) Remove plate (8) and gasket (10).

(9) Press down on housing (38) and lift block (12), drive shaft and piston subassembly (31), and bearings (41, 44, and 46) out of housing as an assembly.

CAUTION

Be careful not to allow block (12) to separate from the drive shaft and piston subassembly (31).

(10) Separate retainer (35) from housing (38) and disassemble gasket (37), ring (40), and pins (39).

(11) Press oil seal (36) out of retainer (35).

(12) Separate block (12) from drive shaft and piston subassembly (31) slowly so that pistons do not strike against each other.

(13) Remove bearing (24) from retainer (23).

(14) Using long-nose pliers, compress ears of snap ring (22) and extract snap ring and retainer (23) from bore of block (12).

(15) Remove snap ring (11), pin (14), and seal (13) from block (12).

(16) Remove screw (21) and washer (20) from pin (14).

(17) Remove bearing (19), spacer (18), bearing (17), and thrust washer (16).

(18) Extract universal link (26) from drive shaft and piston subassembly (31) and remove knuckles (25) from universal link.

(19) Remove bearing (27), spring (28), retainer (29), and key (30) from drive shaft and piston subassembly (31).

NOTE

It is not recommended that bearings and retainers be removed from drive shaft and piston subassembly unless they require thorough cleaning or replacement.

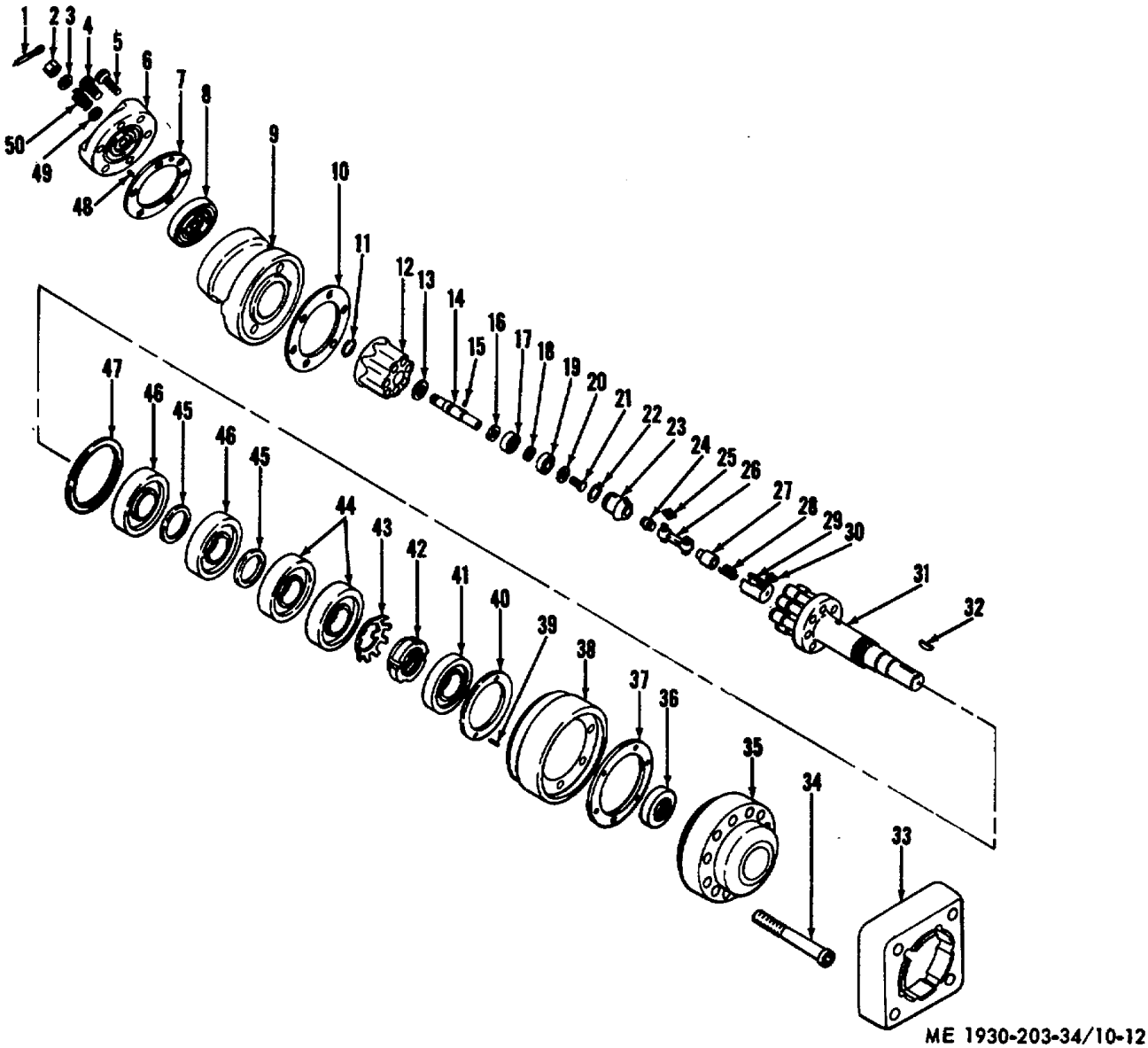
(20) To remove bearings (41, 44, or 46), place drive shaft and piston subassembly (31) in an arbor press and support bearing to be removed with two steel straps. Press bearing off shaft by exerting force on shaft, using a length of steel rod.

NOTE

Bearings to be removed must be pressed off individually and only after any retaining rings, spacers, or nuts have been removed.

CAUTION

Do not attempt to disassemble pistons from shaft assembly.



1	Cotter pin	18	Spacer	35	Retainer
2	Nut	19	Bearing	36	Oil seal
3	Washer	20	Washer	37	Gasket
4	Screw	21	Screw	38	Housing
5	Screw	22	Snapring	39	Pin
6	Block	23	Retainer	40	Ring
7	Gasket	24	Bearing	41	Bearing
8	Plate	25	Knuckle	42	Locknut
9	Angle housing	26	Universal link	43	Lockwasher
10	Gasket	27	Bearing	44	Bearings
11	Snapring	28	Spring	45	Spacer
12	Block	29	Retainer	46	Bearing
13	Seal	30	Key	47	Retainer
14	Pin	31	Drive shaft and piston subassembly	48	Pin, valve plate locating spring
15	Key	32	Key	49	Retainer
16	Thrust washer	33	Flange	50	Spring
17	Bearing	34	Screw		

Figure 10-12. Cargo well pump hydraulic motor, model MF-2008-30-38-21, disassembly and reassembly.

c. Cleaning, Inspection and Repair.

(1) Clean all parts except seals and gaskets in dry-cleaning solvent, Federal Specification P-D- 680.

(2) Place all bearings, which have been removed for closer inspection in a wire basket and immerse in dry-cleaning solvent. Agitate basket frequently to allow solvent to reach all parts of bearings and to loosen dirt and sludge.

(3) Using a spray gun equipped with an air filter, flush bearings with clean solvent. Turn bearing races slowly during this operation to assure thorough cleaning.

(4) Visually inspect bearings for rusted balls or raceways caused by oxidation or water in system.

(5) Check for fractured rings caused by too heavy a press fit, excessive loading, or by forcing a cocked bearing on or off shaft.

(6) Inspect bearings for worn, galled, or rough surfaces caused by dirt locking and bearing while shaft continued to turn.

(7) Check bearings for broken or bent separators.

NOTE

Do not attempt to repair damaged bearings. Always replace them with new ones.

(8) Inspect bearings for discolored balls or races.

NOTE

Moderate discoloration of balls, rollers, or ball track does not necessarily mean replacement is required.

(9) If none of the above defects are found and the cleaning and flushing operation restores bearings to their original smooth working condition, rinse bearings in clean engine oil, OE-10, and wrap in a clean piece of paper barrier material, Military Specification MIL-B-121, and lay bearings aside until reassembly.

(10) Inspect housing (38, fig. 10-12) and angle housing (9) for damage or excessive wear, obstructions of internal passages, stripped threads of tapped holes, burrs and nicks in bearing bores, and out-of-round or burred locating pinholes. Remove burrs and nicks with crocus cloth, Federal Specification P-C-458. Repair threads using proper size tap. Clean passages by working a piece of wire back and forth through the passages and flushing them with dry-cleaning solvent, Federal Specification P-D-680. Dry passages with compressed air. (

(11) Inspect block (6) for deep nicks or scratches on valving surface, stripped threads in connection ports, and nicks and burrs on edges of mating surfaces. Remove nicks and scratches with crocus cloth, Federal Specification P-C-458. Repair threads with proper size tap.

(12) Inspect drive shaft and piston subassembly (31) for deep scratches, scores or nicks on pistons, binding rod bearings in flange and piston ends, grooves or deep scratches of drive shaft oil seal journal. Remove scratches, scores, or nicks from pistons with crocus cloth, Federal Specification P-C-458. If grooves and scratches cannot be removed from shaft oil seal journal, replace entire assembly.

(13) Inspect plate (8) for grooves or deep 3cratches and nicks or burrs on contacting surfaces. Check for flatness of contracting surfaces and excessive wear or burrs in kidney slots and pressure holes. Remove scratches, nicks, and burrs with crocus cloth, Federal Specification P-C-458.

NOTE

The plate (8) and block (12) are precision parts and valving action of motor is entirely dependent upon flatness of their contacting surfaces. These parts should be lapped in accordance with procedures outlined in step (17) below.

(14) Inspect block (12) for out-of-round or scored cylinder bores or grooved, burred, or nicked valving surface. Check retainer positioning ears of the block for excessive wear and retainer bore for out-of-round condition. Remove burrs and nicks with crocus cloth, Federal Specification P-C-458 (See note above).

(15) Inspect universal link subassembly as follows:

(a) Check link pins of universal link (26) for wear or flatness on one side, bent pins, or twisted link.

(b) Check knuckles (25) for enlarged or out-of-round link pinholes, excessive wear, and burrs. Remove burrs with crocus *cl*oth, Federal Specification P-C-458.

(c) Inspect bearings (24) for feathered edges or other indications of excessive wear.

(d) Inspect retainer (23) for burrs, nicks, or worn key slot. Remove burrs and nicks with crocus cloth, Federal Specification P-C-458.

(16) Check springs, nuts, washers, and pins for signs of severe wear or distortion. Replace as required.

(17) Inspect parts for roughness and scored areas. If parts are rough or scored to the extent that would impair proper function of motor, perform lapping procedures as follows: (a) On bronze parts use abrasive paper, Federal Specification P-P-101, on a surface plate to remove imperfections. Clean thoroughly with clean dry-cleaning solvent, Federal Specification P-D- 680.

(b) Use abrasive paper, Federal Specification P-P-101, on a surface plate to polish parts. Clean thoroughly with clean dry-cleaning solvent.

NOTE

Never use polishing paper on a bronze part after using it on a steel part. Particles of steel will cut into bronze part. Use a new polishing paper for each part to be lapped.

(c) For steel parts. use lapping compound. Military Specification MIL-L-17862, on a grooved lapping plate. After lapping. clean thoroughly with clean dry-cleaning solvent.

(d) Polish parts with abrasive paper. Federal Specification P-P-IOI, on a surface plate. Clean thoroughly with clean dry-cleaning solvent.

(e) Check surface and flatness of lapped parts on a checking plate with a thin film of oil. Press lapped part firmly into film of oil and twist part approximately one-eighth turn.

(f) Lift part clear of checking plate. Impression of part on oil film should be nearly perfect.

(18) After all parts have been thoroughly cleaned, inspected and repaired or replaced. rinse parts in clean engine oil, OE-10, prior to reassembly. This protects and lubricates parts and aids reassembly.

d. Reassembly.

NOTE

If bearings (41, 44, or 46, fig. 10-12) were not removed during disassembly, omit steps (1) through (5).

(1) Mount drive shaft and piston subassembly (31) in an arbor press with pistons down, but not resting on them. Use a piece of steel tubing slightly larger than diameter of drive shaft for bearing installation.

CAUTION

When installing bearings, tubing must press on inner race only.

NOTE

Install bearings individually.

(2) Install retainer (47), bearing (46) and spacer (45) followed by second bearing (46) and spacer (45).

(3) Install bearings (44).

(4) Install tab lockwasher (43) and locknut (42). Tightenlocknut securely and position slots in locknut to match tabs of lockwasher. Bend tabs of lockwasher down into slots to prevent locknut from loosening. (5) Install bearing (41) on drive shaft.

NOTE

Rotate each bearing by hand to determine freedom ofrotation.

(6) Install key (30). retainer (29). spring (28), and bearing (27), in central bore of shaft.

(7) Install knuckles (25) on link pins with the grooved end up. Hold universal link (26) and pins at an angle and slide one knuckle in retainer slot.

CAUTION

Do not permit pistons to strike each other.

(8) Install thrust washer (16). bearing (17)spacer (18). bearing (19). and snapring(11) on pin (14).

(9) Install washer (20) and screw (21) on pin (14).

(10) Install seal (13) and cylinder bearing pin assembly in block (12).

(11) Place snapring (22) around recess in retainer (23). Compress ears of snapring with long- nose pliers and install retainer with snapring in block (12) 90 degrees from final position. Seat retainer with a twisting downward motion.

(12) Install bearing 1241 in retainer 1231 with a small amount of petrolatum. Federal Specification 'VV-P-236. to hold it in place.

(13) To install block (12) on pistons. match pistons t(o their respective cylinder bores. position one (cylinder bore in line with retainer slots.

NOTE

This is No.1 cylinder bore while the piston in line with its retainer slots is No.1 piston.

(14) Insert No.1 piston in No. I cylinder bore. Be sure piston is not cocked.

(15) Insert remaining pistons alternately on each side of No. I piston in their respective 1)ores. When only two pistons remain to be inserted. tilt block (12) back and slip first knuckle (25) in retainer slot. 'Tilt block forward and slide remaining knuckle in opposite retainer slot.

(16) Install two remaining pistons and test assembly by quickly pushing block (12) straight down. This action should he smooth and springy.

(17) Rotate block (12) to test for erratic action or binding.

(18) Press oil seal (30) in retainer (35) with sealing lip facing inside.

(19) Support the assembled block (12) and drive shaft and piston subassembly (13), making sure parts do not separate, and carefully press housing (38) over bearings from shaft end.

(20) Install pins (39) and ring (40) in retainer (35).

(21) Install gasket (37) and install retainer (35) over shaft and down against housing (38).

(22) Install plate (8) and gasket (10).

(23) Install angle housing (9) carefully over plate (8) and block (12) and press angle housing firmly against housing (38).

(24) If pin (48) was removed from block (6). press a new pin in place.

(25) Install new gasket (7)on angle housing (9).

(26) Position block (6)over pin (14) and over plate (8) so pin (48) enters hole in plate. If necessary. rotate plate, pin (14). and block C61 so screw holes in block are aligned with holes in angle housing (9).

NOTE

Arrangement o)f holes limits assembly to two positions either of which is correct.

(27) Install valve block mounting screws C4 and 51 securing block 161 to angle housing 191. Tighten only finger tight at this time.

CAUTION

Until screws (34) are installed to secure retainer (35), housing (38), and angle housing (9), extreme care must be taken to prevent motor components from separating.

(28) Lift assembled motor from support and install six screws C34). Tighten screws tight enough to secure motor components.

(29) Tighten the valve block mounting screws (4 and 51.

(30) Install retainer (491, spring C50I. washer (3). and nut 121. To obtain proper clearance of 0Ol0 to 0.015 inch, tighten nut so block 161. plate C81. and block (12) are clamped snugly together. Then back nut off from 90 to 120 degrees to align the cotter pin slot in nut with whole in pin C 141.

(31) Insert and secure cotter pin (1) to maintain adjustment.

(32) Insert key (32) in drive shaft slot.

e. Testing.

NOTE

Before mounting motor (on test stand. check shaft for free rotation without bind in both directions when rotated by hand.

(1) Mount motor on suitable test stand. Fill motor case with engine oil, OE-1O.

(2) Install a 5 psi check valve in drain port.

(3) Install a needle valve in inlet and outlet ports.

(4) Connect inlet port to a 2000 psi maximum pressure source.

(5) With outlet needle valve fully open. gradually open inlet needle valve permitting motor to accelerate until discharge oil is free of air.

(6) With inlet valve fully open, gradually close off outlet needle valve until motor stops.

(7) With 2000 psi inlet pressure, case drain leakage must not exceed 30 cubic inches per minute.

(8) With 5 psi applied to case through 5 psi check valve, there must not be any external leakage.

10-7. Cargo Well Pump

a. Removal and Installation. Refer to paragraph 2-35 to remove and install the cargo well pump.

b. Disassembly.

(1) Remove cargo well pump hydraulic motor front pump (para 2-35).

(2) Knock out pin (2. fig. 10-13) and remove coupling (1) from pump shaft.

(3) Close oiler metering valve (7) and disconnect oiler line (6) from packing ring (4).

(4) Remove tension nut (3) from pump upper column sleeve bearing and remove packing ring (4).

(5) Remove preformed packing (5).

(6) Remove bolts (19), lockwashers (11), and nuts (12) securing discharge elbow (8) to stator case (10).

(7) Separate stator case (10) from discharge elbow (8) and withdraw inner column (17) together with sleeve bearing (18), and pump shaft (13) with stator case.

(8) Withdraw pump shaft (13) with impeller (15) from stator case.

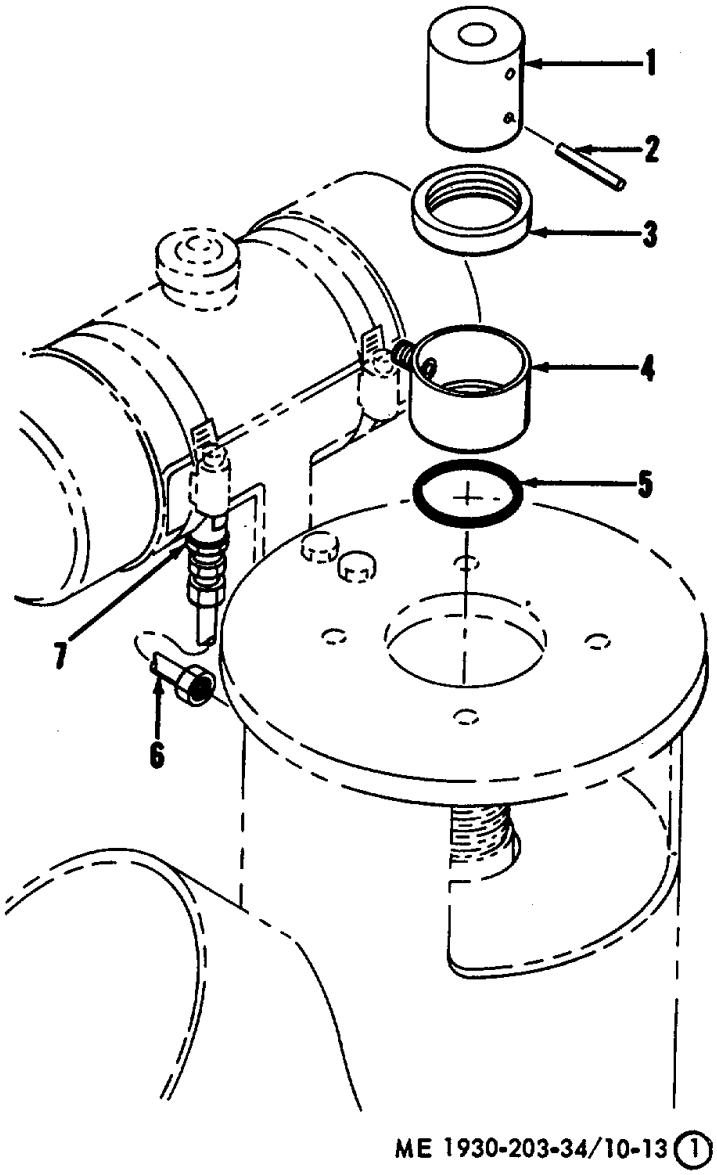
(9) Remove upper column sleeve bearing (!8) from inner column (17).

(10) Unscrew inner column (17) from stator case upper sleeve bearing (9).

(11) Remove stator case upper sleeve bearing (9).

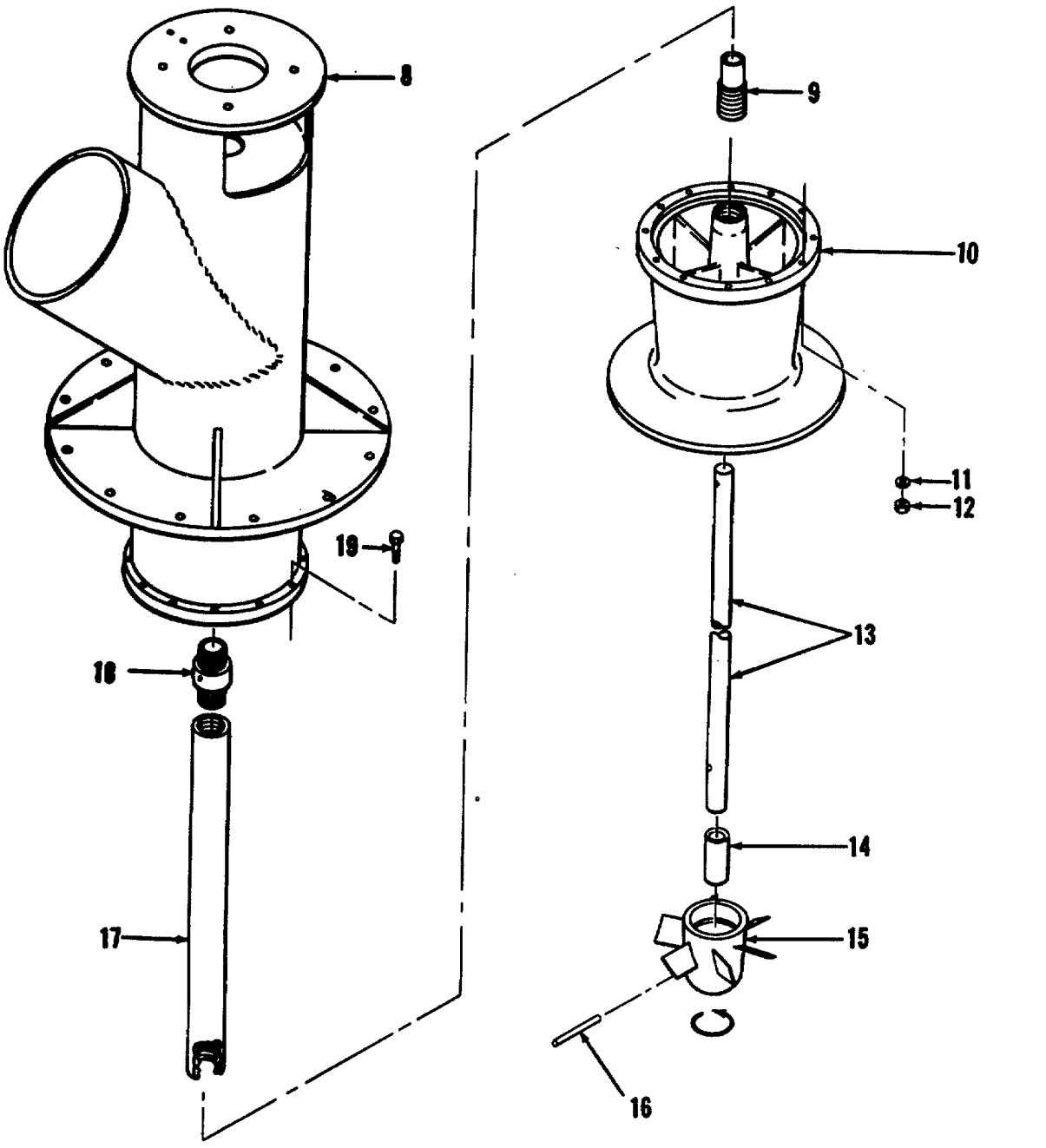
(12) Remove lower sleeve bearing (14), from stator case (10), if replacement is necessary.

(13) Drive pin (16) from impeller (15) and remove impeller.



1 Coupling
2 Pin
3 Nut
4 Packing ring
5 Preformed packing
6 Oiler line
7 Oiler metering valve

Figure 10-13. Cargo well pump, disassembly and reassembly. (Sheet 1 of 2).



8 Discharge elbow
9 Sleeve bearing
10 Case
11 Washer
12 Nut
13 Shaft
14 Sleeve bearing
15 Impeller
16 Pin
17 Column
18 Sleeve bearing
19 Bolt

Figure 10-13. Cargo well pump, disassembly and reassembly. (Sheet 2 of 2).

c. Cleaning, Inspection and Repair.

(1) Clean all metal parts with dry-cleaning solvent, Federal Specification P-D-680, and dry with compressed air.

(2) Inspect impeller blades for burrs, scratches, nicks, and distorted blades. Remove burrs with a fine file. Remove scratches and nicks with crocus cloth, Federal Specification P-C-458.

NOTE

If impeller is cracked or any blades are distorted or cracked, replace impeller.

(3) Inspect threaded parts for burred or damaged threads. Replace damaged parts.

(4) Inspect stator case upper sleeve bearing (9), stator case lower sleeve bearing (14), and upper column sleeve bearing (18) for scores, burrs, sharp edges, and evidence of overheating. Remove. scores with crocus cloth, Federal Specification P-C-458. Remove burrs and sharp edges with a scraper or knife blade. Replace bearings that are out-of- round, deeply scored, or excessively worn.

(5) Inspect pump shaft (13) for grooves or deep scratches at bearing surface contact at upper and lower end of shaft. Remove grooves and scratches with crocus cloth, Federal Specification P-S-458. If defects cannot be removed, replace shaft.

(6) Inspect stator case (10) for cracks at stator case bearing and sleeve bearing support.

NOTE

If stator case is cracked or damaged in any way, replace it.

(7) Inspect mounting faces on discharge elbow (1) for burrs, scratches, and nicks. Remove burrs with a fine file. Remove scratches and nicks with crocus cloth, Federal Specification P-C-458.

d. Reassembly.

(1) Install stator case lower sleeve bearing (14) in stator case (10), if bearing was removed during disassembly.

(2) Install stator case upper sleeve bearing (9) in stator case.

CAUTION

Tighten stator case upper sleeve bearing carefully. Damage to bearing or stator case will result if bearing is forced.

(3) Install impeller (15) on pump shaft (13) and insert pin (16).

(4) Install assembled pump shaft and impeller in stator case (10).

(5) Slide inner column (17) over pump shaft and screw onto stator case upper sleeve bearing (9).

(6) Screw upper column sleeve bearing (18) into inner column (17).

(7) Attach stator case with assembled parts to discharge elbow (8), with bolts (19), lockwasher (11), and nuts (12).

(8) Place new preformed packing (5) around pump inner column and install packing ring (4) and tension nut (3).

(9) Place coupling (1) on pump shaft and install pin (2).

(10) Install hydraulic motor in reverse order of removal as outlined in paragraph 10-5.

(11) Connect oiler line (6) to packing ring (4).

10-8. Cargo Winch Brake Assembly

a. Removal and Disassembly.

(1) Remove wire rope guard (2, fig. 2-30) by removing bolts (1), lockwashers (6), and nuts (7).

(2) Remove capscrews (39) and lockwashers (40); loosen capscrews (38).

(3) Remove capscrews (3) and remove brake cover (4).

CAUTION

Care should be used when removing brake cover (4) to avoid damaging pins (43).

(4) Remove pins (43).

(5) Remove capscrews (15, fig. 10-14) and lockwashers (14). Remove brake cover plate (13).

(6) Loosen brake band (7) by turning brake adjustment bolt (16) clockwise.

(7) Remove retaining rings (6) and pins (5). Remove adjustment link assembly.

(8) Remove pins (11 and 12) and differential lever (10).

(9) Remove brake band (7) by pulling straight to the rear over brake drum.

(10) Remove brake cable locknut (2) and lift out lever (4). Remove pin (1) and universal block (3).

(11) Remove setscrews (37, fig. 2-30) and pull brake cable (22, fig. 10-14) from winch. Remove brake cable jamnut (23).

(12) Disassemble adjustment link assembly by removing adjustment bolt (16).

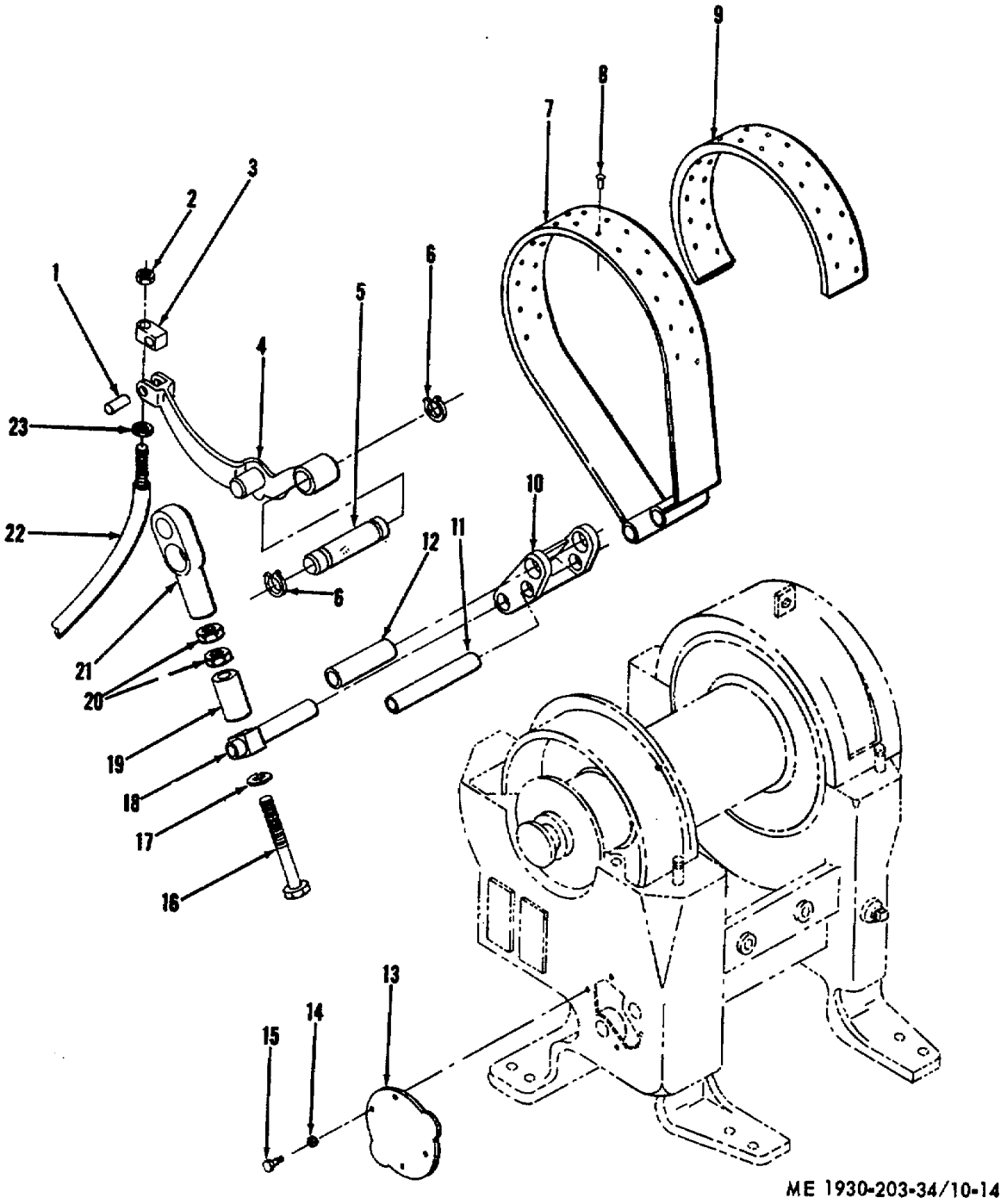
b. Cleaning, Inspection and Repair.

(1) Clean all metal parts in dry-cleaning solvent, Federal Specification P-D-680.

(2) Inspect brake lining (9, fig. 10-14) for wear and condition. Replace lining if worn to the point where rivets (8) are contacting drum or if lining has become oil-soaked.

(3) Inspect all threaded parts for stripped or damaged threads and replace if defective.

(4) Inspect pins (1, 5, 11, 12, and 18) and their mating parts for cracks and replace if defective.



1 Roll pin
2 Locknut
3 Universal block
4 Brake lever
5 Brake lever pin
6 Retaining ring
7 Brake band
8 Rivet
9 Brake lining
10 Differential lever
11 Pivot pin
12 Differential pin
13 Cover plate
14 Lockwasher
15 Capscrew
16 Adjustment bolt
17 Lockwasher
18 Adjustment pin
19 Spacer
20 Adjustment nut
21 Adjustment link
22 Brake cable
23 Jamnut

Figure 10-14. Cargo winch brake accessory.

c. Reassembly and Installation. Reassemble and install winch brake assembly in reverse order of disassembly and removal.

d. Brake Adjustment.

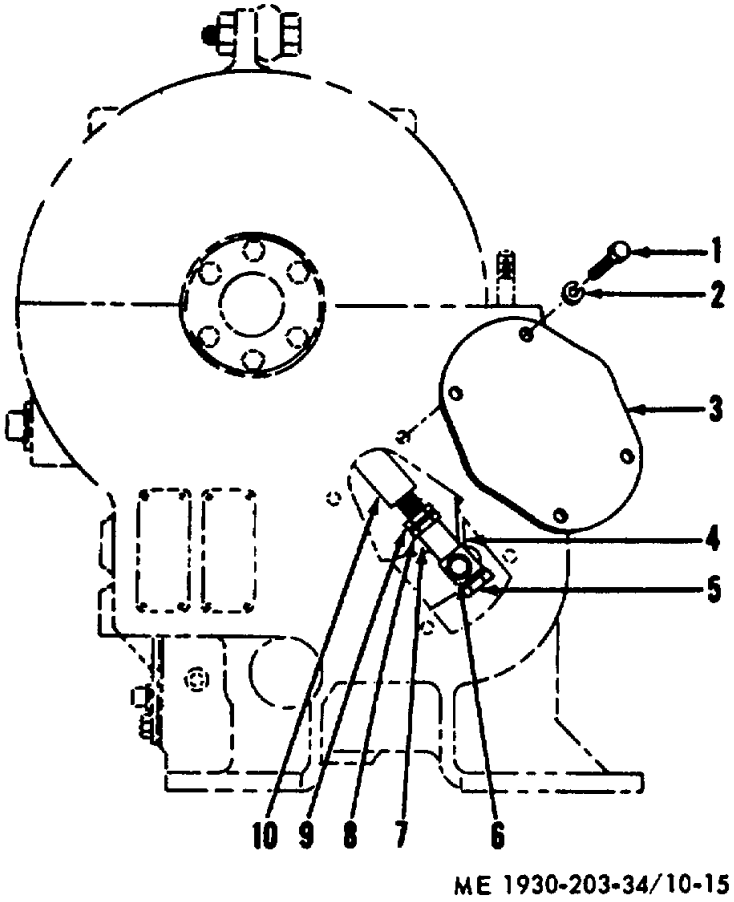
(1) Remove brake cover (3, fig. 10-15) by removing four capscrews (1) and lockwashers (2).

(2) Loosen locknuts (9) and jamnut (8) turn brake adjusting bolt (5) clockwise until cable drum can be turned freely by hand.

(3) Tighten brake band (4)by turning brake adjusting bolt (5) counterclockwise until a slight drag is felt on cable drum.

(4) Tighten jamnut (8) and locknut (9).

(5) Replace brake cover (3).



1 Capscrew
2 Lockwasher
3 Brake cover
4 Brake band
5 Bolt, brake adjusting
6 Pin, brake adjusting
7 Spacer
8 Jamnut
9 Locknut
10 Brake adjusting link

Figure 10-15. Winch brake adjustment.

10-9. Cargo Winch Wire Rope

a. Removal.

(1) Unwind wire rope from cable drum.

(2) Slide ferrule end of wires out of slot in cable drum..

b. Installation.

NOTE:

If ferrule is assembled in to wire rope, install wire rope in reverse order of removal. The following instructions apply to installation of new wire rope that does not have a ferrule.

(1) Apply whipping (1, fig. 10-16) to new wire rope approximately 3 inches from end of wire rope, using heavy safety wire.

(2) Place wire rope upright in a vise; unwind strands and broom out wire in each strand.

(3) Remove wire rope from wise and carefully clean wires back to whipping (1) with dry-cleaning solvent. Federal Specification P-D-680.

(4) Replace wire rope in vise; hold wire ends together and temporarily whip with three or four turns of light wire.

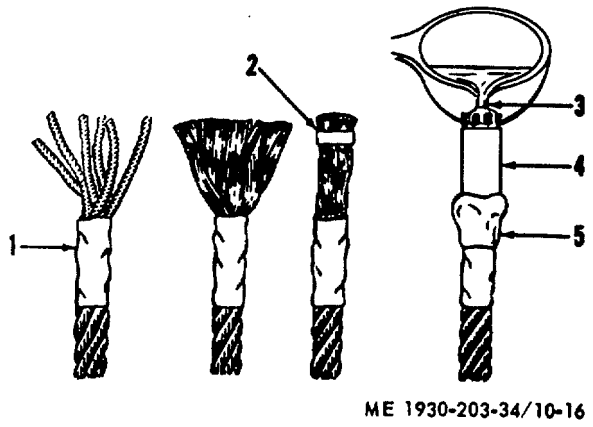
(5) Install ferrule (4) on temporarily whipped end of wire rope and remove temporary whipping (2).

(6) Place molder's putty (5) around outside base of ferrule (4) to prevent molten zinc from running our ferrule end next to whipping (1).

(7) Fill ferrule (4) with molten zinc (3). When zinc has returned to its solid form, place end of wire rope with ferrule (4) into water to cool.

(8) Remove solder's putty (5) and trim protruding strands flush with end of ferrule (4).

(9) Install wire rope ferrule (4) in cable drum ferrule slot and underwind wire rope on cable drum.



1 Whipping
2 Temporary whipping
3 Molten zinc
4 Ferrule
5 Molder's putty

Figure 10-16. Pouring wire rope ferrule.

10-10. Cargo Winch Assembly

a. Removal and Installation. Refer to paragraph 2-33 to remove and install the cargo winch assembly.

b. Disassembly.

(1) Remove wire rope (para 10-91.

(2) Remove packing nut 173, fig. 10-17) and packing rings (721 from stuffing box 1711. Remove stuffing box.

(3) Remove brake assembly (para IQ-8).

(4) Remove bull gear end cover (3, fig. 10-17) and drum shaft shim set 14i from winch housing (221 by removing bolts (1) and lockwashers (2).

(5) Remove gear cover C 1i, and gasket 1101 by removing capscrews 112. Shift clutch shaft to free-spooling and remove bull gear 17) and gear hub assembly.

(6) Remove spacer (9) from bore of annular ball bearing (5). Remove annular ball bearings, snapring (6), and gear hub (8) from bull gear (7).

(7) Remove clutch shaft cover (19) and clutch shaft shim set (18) by removing capscrews (21) and lockwashers (20). Remove drum (13) and clutch shaft assembly from housing.

(8) Pull clutch shaft (14) from brake end of drum. taking care to recover bearing (15) and clutch shaft spring (11). Remove annular ball bearing (17) from drum.

(9) Remove capscrew (31). washer (30). and reduction gear plate (29). Drive reduction gear shaft (23) from outside toward center of winch assembly until spacer (28) and reduction gear (27) are free. Remove spacer. reduction gear assembly. and reduction gear shaft from winch housing (22).

(10) Remove spacers (24) reduction gear bearings (25) and reduction gear snaprings (20) from reduction gear (27).

(11) Remove compartment cover (56) and gasket (55) by removing capscrews (58) and washers (57).

(12) Remove capscrews (68). washer (67). and back gear plate (66). Drive back gear shaft (60) from outside toward center of winch until spacer (65) and back gear (64) are free. Remove shaft, -;pacer. and gear from winch housing (22).

(13) Remove spacers (61). back gear roller bearings (62). and back gear snaprings (63) from back gear (64).

(14) Loosen nut (45) a shifter shaft (44). Unscrew control rod (46) from shifter shaft. Remove nut and pull control rod from winch housing (22).

(15) Remove capscrew (43). washer (42). and pull shifter shaft (44) toward brake side of case until shifter fork (47) is free. Remove shifter fork, shifter shaft, bearing (41) and spring (48).

(16) Remove bevel gear snaprings (50) from bevel gear shaft (49).

(17) Remove capscrews (32). washers (33). and bearing retainer plate (34).

(18) Pry bearing housing (38) and shaft assembly from winch, taking care not to damage bevel gear shim (39).

(19) Remove bevel gear shaft (49), bevel gear (54), spacer (53) and sliding pinion (40) from winch.

(20) Remove nut (35), washer (36), bearing housing (38), and bevel gear shaft outer bearing (37).

(21) Drive bevel gear shaft inner bearings (52) from winch housing and remove bearing adapter (51) from bearings.

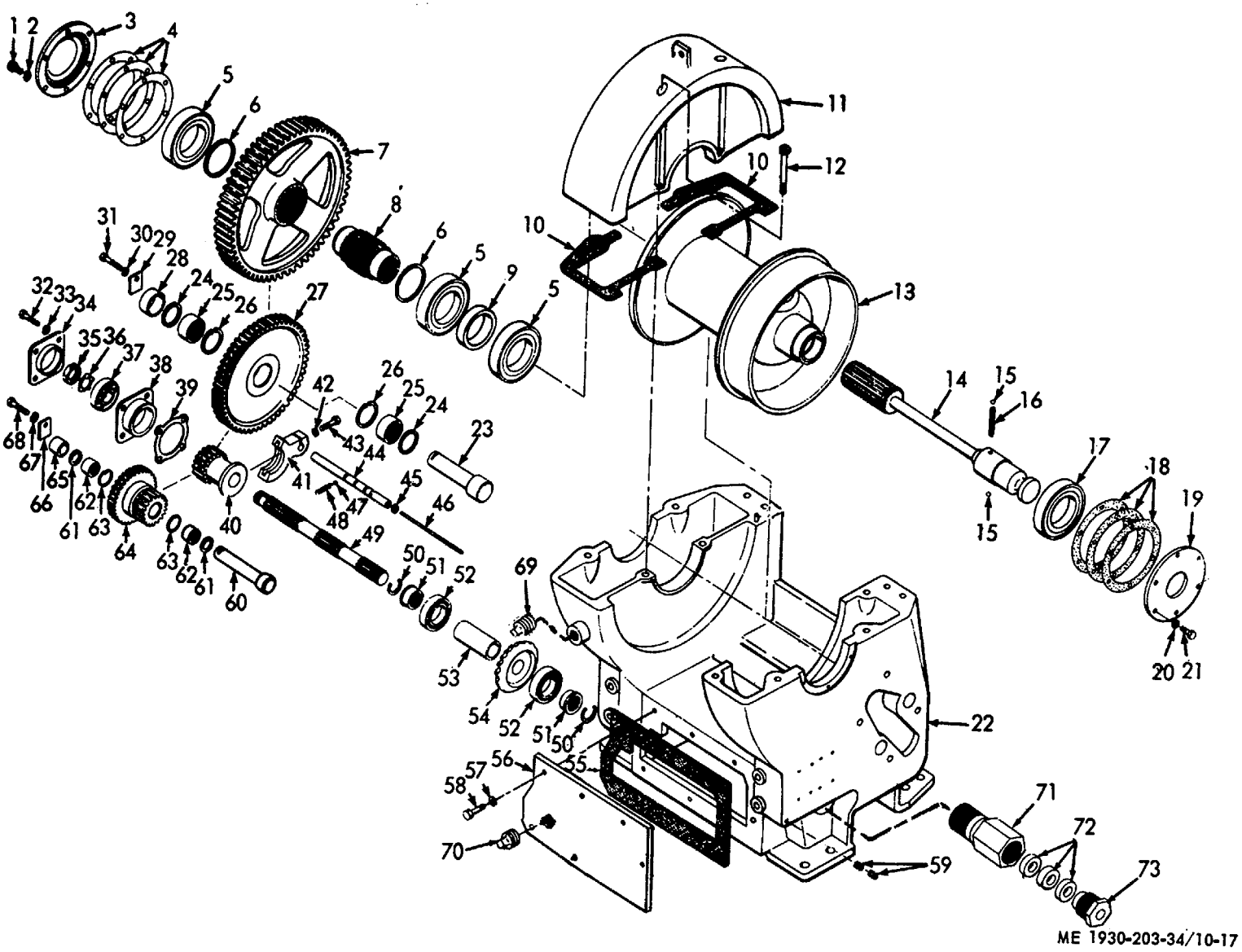


Figure 10-17. Cargo winch disassembly.

Key to figure 10-17.

1 Capscrew
2 Lockwasher
3 Bull gear end cover
4 Drum shaft shim set
5 Annular ball bearing
6 Snapring
7 Bull gear
8 Gear hub
9 Spacer, hub gear bearing
10 Gasket
11 Gear cover
12 Capscrew
13 Drum
14 Clutch shaft
15 Bearing
16 Clutch shaft spring
17 Annular ball bearing
18 Clutch shaft shin set
19 Clutch shaft cover
20 Lockwasher
21 Capscrew
22 Winch housing
23 Reduction gear shaft
24 Spacer, reduction gear bearing
25 Reduction gear bearing
26 Reduction gear snapring
27 Reduction gear
28 Spacer, reduction gear
29 Reduction gear plate
30 Washer
31 Capscrew
32 Capscrew
33 Washer
34 Bearing retainer plate
35 Nut, plain
36 Washer, key
37 Bevel gear shaft outer bearing
38 Bearing housing
39 Bevel gear shim
40 Sliding pinion
41 Shifter fork
42 Washer, shifter fork
43 Capscrew
44 Shifter shaft
45 Nut
46 Control rod
47 Bearing
48 Spring
49 Bevel gear shaft
50 Bevel gear snapring
51 Bearing adapter
52 Bevel gear shaft inner bearing
53 Spacer, bevel gear
54 Bevel gear
55 Gasket
56 Compartment cover
57 Washer
58 Capscrew
59 Setscrew
60 Back gear shaft
61 Spacer, back gear bearing
62 Back gear roller bearing
63 Back gear snapring
64 Back gear
65 Spacer, back gear
66 Back gear plate
67 Washer
68 Capscrew
69 Plug, pipe
70 Plug, pipe
71 Stuffing box
72 Packing ring
73 Packing nut

c. Cleaning, Inspection and Repair

(1) Clean all parts in dry-cleaning solvent, Federal Specification P-D-680, and dry with compressed air (10 psi).

(2) Inspect all parts for abrasive material while disassembled. Reclean if necessary.

(3) Inspect bores for grooves, scratches, and burrs. Remove burrs and scratches with crocus cloth, Federal Specification P-C-458. Replace deeply grooved or scratched parts.

(4) Inspect mounting surfaces for burrs, scratches, and nicks. Remove defects with crocus cloth, Federal Specification P-C-458. If defects cannot he removed without disfiguring the surface, replace part.

(5) Inspect all threaded openings and inserts for damaged threads and chase threads as necessary. Replace damaged part.

(6) Inspect bearings for pitted, scored, or burned condition. Replace as necessary.

(7) Inspect gears for scuffed, nicked, burred, or broken teeth. Remove defects with crocus cloth, Federal Specification P-C-458. If defects cannot be removed without changing teeth profile, replace gear.

(8) Inspect snaprings for proper fit. Snaprings must snap tight in their grooves for proper functioning.

(9) Inspect splined parts for stripped, twisted, chipped, or burred splines. Remove burrs with crocus cloth, Federal Specification P-C-458. Replace stripped or twisted splined parts.

(10) Inspect stuffing box (71, fig. 10-17) and packing nut (73) for damaged threads and replace as necessary.

(11) Replace packing rings (72).

d. Reassembly (fig. 10-17).

(1) Place bevel gear shaft inner bearings (52), and bearing adapters (5 1) into winch housing (22) with adapters shoulders to outside of winch.

(2) Install bevel gear shaft outer bearing (37), bearing housing (38), washer (36), nut (35), and shim (39) on bevel gear shaft (49).

(3) While sliding bevel gear shaft (49) into winch housing (22) position sliding pinion (40), spacer (53), and bevel gear (54) on bevel gear shaft (49).

(4) Install bearing retainer plate (34), washers (33), and capscrews (32) to secure bevel gear assembly in housing.

(5) Install bevel gear snaprings (50) on bevel gear shaft (49).

(6) Install shifter fork (41) and shifter shaft (44) with bearing (47) and spring (48) into winch housing (22). Secure shifter fork (41) with washer (42) and capscrew (43).

(7) Install control rod (46) into shifter shaft (44) and tighten nut (45) securing control rod to shifter shaft.

(8) Install back gear snaprings (63) and back gear roller bearings (62) into bore of back gear (64).

(9) Slide one spacer (61) on back gear shaft (60) to rest against shoulder of shaft.

(10) Position back gear (64) in winch housing (22) and slide back gear shaft (60) into back gear. Position spacers (61 and 65) into place and slide back gear shaft into position in housing.

(11) Install back gear plate (66) into slot of back gear shaft (60) and secure with washer (67), and capscrew (68).

(12) Install reduction gear snaprings (26) and reduction gear bearings (25) into bore of reduction gear (27).

(13) Slide one spacer (24) on reduction gear shaft (23). Position reduction gear (27) in winch housing (22), slide reduction gear shaft into reduction gear. Position spacers (24 and 28) into place and slide reduction gear shaft into position in winch housing (22).

(14) Install reduction gear plate in slot of reduction gear shaft (23) and secure with washer (30), and capscrew (31).

(15) Install gear hub (8) in bull gear (7) and secure with snaprings (6). Replace annual ball bearings (5) on hub.

(16) Install clutch shaft (14) into brake end of drum (13) with clutch shaft spring (16) and bearing (15).

(17) Install annular ball bearings (5 and 17) on drum and place drum and shaft in winch housing (22). Install clutch shaft shim set (18) and clutch shaft cover (19), and secure with lock- washers (20) and capscrews (21).

(18) Install spacer (9) into bore of bearing (5) on drum. Install bull gear and hub assembly into housing.

(19) Install gasket (10) and gear cover (II), and secure with capscrews (12).

(20) Install drum shaft shim set (4) and bull gear end cover (3), and secure to housing with lock- washers (2) and capscrews (1).

NOTE

Drum shaft shim set (41 and clutch shaft shim set (18) are provided to bring bull gear into correct alinement with face of bull pinion. Sufficient shims must be used to take up the space between the winch housing and cover, with an additional 0.01 O inch of shims to avoid preload on the drum line bearings.

(21) Replace gasket (55) and compartment cover (56), and secure with washers (57) and capscrews (58).

(22) Install and adjust brake assembly (para 10-8).

(23) Install stuffing box (71, fig. 10-17). packing rings (72), and packing nut (73).

10-11. Cargo Winch Hydraulic Motor

a. *RemovaL* Remove cargo winch and motor as outlined in paragraph 2-33.

b. Disassembly (fig. 10-18).

(1) Drain fluid from motor.

(2) Remove bolts (1), and washers (2) and lift off cover (3) and packing (7).

(3) Remove washer (8), pressure plate assembly (9), and packing (10).

(4) Remove vanes (14) from rotor (13) and slide the rotor from shaft (19).

(5) Remove rotor ring (11), pins (12), and packing (15) from body (16).

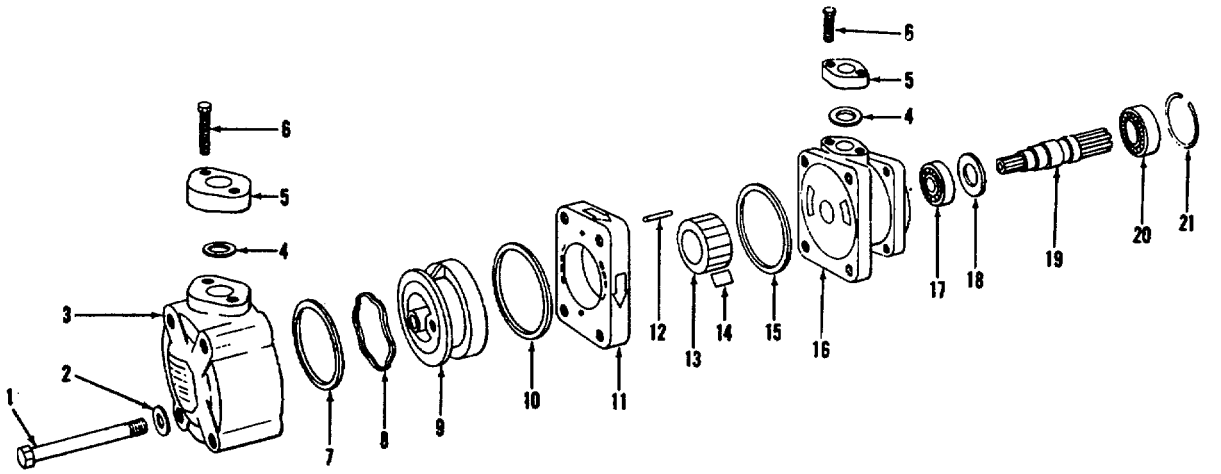
(6) Remove snapring (21) and press shaft (19) and bearing (20) out of body (16).

NOTE

Do not remove bearing (17) from the body unless bearing is defective.

(7) Remove seal (18) from body (16).

(8) Remove capscrews (6), flanges (5), and packings (4).



1 Bolt, machine
2 Washer, flat
3 Cover
4 Packing, flange-to-body and cover
5 Flange
6 Capscrew
7 Packing, cover-to-pressure plate
8 Washer, spring tension
9 Pressure plate assembly
10 Packing, rotor ring-to-pressure plate
11 Rotor ring
12 Pin
13 Rotor
14 Vane
15 Packing, rotor ring-to-body
16 Body
17 Small bearing
18 Seal
19 Shaft
20 Large bearing
21 Snapring

Figure 10-18. Cargo winch hydraulic motor.

c. Cleaning, Inspection and Repair.

(1) Clean all parts except packings in dry- cleaning solvent, Federal Specification P-D-680, and allow to drain dry.

(2) Inspect all mating surfaces for signs of scoring or roughness. Slight scoring may be removed by lapping.

CAUTION

Sides of rotor (13, fig. 10-18) and lapped face of pressure plate (9) must be parallel and flat within 0.0002 inch. If any burrs result in rotor slots from lapping, these must be removed. (3) Inspect all vanes (14) for wear defects. Replace defective vanes.

(4) Check fit of vanes in all rotor slots. Vane must move freely in slot without any angular motion. Replace a rotor with enlarged slots.

(5) After thorough cleaning, check bearings for cracked races or roughness of rotation. Replace defective bearings.

(6) Inspect bevel gear (16, fig. 2-30) for cracks or damage. If damage cannot be repaired without altering profile of gear, replace part.

(7) Replace all packings and seal (18, fig. 10-18).

d. Reassembly (fig. 10-18).

(1) Coat all mating surfaces with clean engine oil, OE-10, prior to reassembly.

(2) If bearing (17), was removed, press bearing into body (16).

(3) Press new seal (18) into body (16).

NOTE

Seal (18) must be installed with its sealing lip pointing toward the rotor end of the body.

(4) Press bearing (20) onto shaft (19) and insert shaft in body (16). Install snapring (21).

(5) Insert new packing (15) in groove on body (16).

(6) Install pins (12) and rotor ring (11).

NOTE

Be sure arrow on rotor ring (11) points in counterclockwise direction, as viewed from shaft end of motor. Inverting the ring will reverse direction of rotation.

(7) Install rotor (13) and vanes (14).

NOTE

Each vane (14) must be installed in the rotor with its radius edge toward rotor ring (11).

(8) Place pressure plate assembly (9) on pins (12) with lapped face against rotor (13). Install washer (8).

(9) Place packing (7) in cover (3) and secure cover in place with bolts (1) and washers (2). Tighten the bolts to a torque of 250 foot-pounds.

(10) Install packings (4) and flange (5) and secure with capscrews (6).

e. Installation. Refer to paragraph 2-33 to install the motor and winch assembly.

10-12. Cargo Winch Controls

a. Control Stand.

(1) Removal (fig. 10-19).

(a) Loosen jamnuts 1274 and 28). and remove cotter pins (24 and 29) and yoke pins (22 and 25).

(b)Remove yokes (23 and 261 and jamnuts (27 and 281 from control rod and brake cable.

(c) Loosen jamnuts (30) and remove set screws (31).

(d)Remove control stand (33) by removing attaching capscrews (20 and 32) and lockwashers (21).

Key to figure 10-19.

I Grip latch
2 Nut, plain
3 Washer, plain
4 Spring
5 Screw, machine
6 Rod end
7 Pawl and rod
8 Pawl and rod
9 Brake lever
10 Shift lever
11 Screw, pawl and rod retaining
12 Nut
13 Lockwasher
14 Spacer
15 Sector
16 Stud, plain
11 Spacer
18 Ratchet
19 Spacer
20 Capscrew
21 Lockwasher
22 Pin, yoke
23 Yoke
24 Pin, cotter
25 Pin, yoke
26 Yoke
27 Jamnut
28 Jamnut
29 Pin, cotter
30 Jamnut
31 Setscrew
32 Capscrew
33 Control stand
34 Rod
35 Universal joint
36 Pin
37 Brake cable

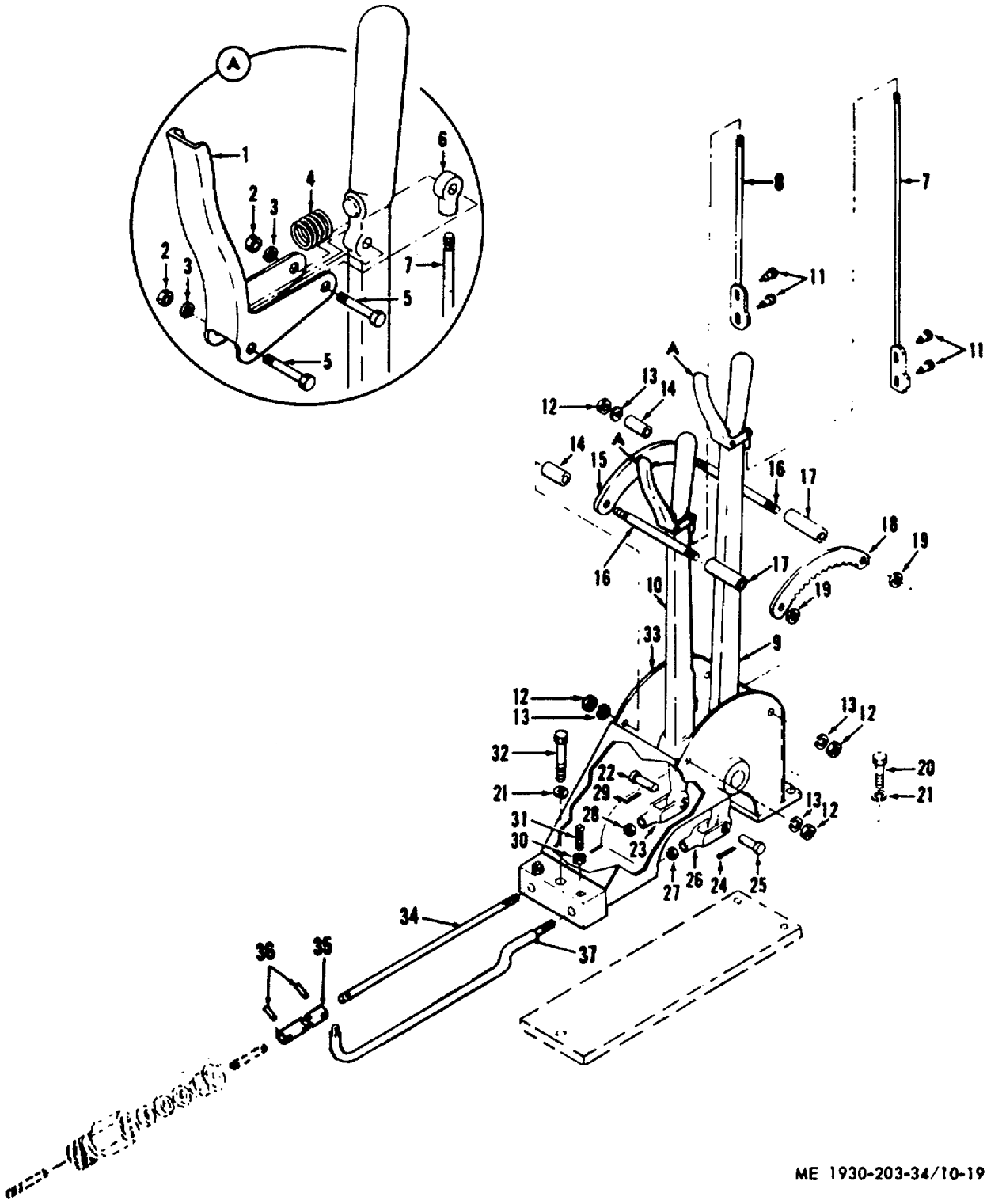


Figure 10-19. Cargo winch control stand and linkage.

(2) Disassembly.

(a) Remove pawl screws (11) and remove pawl and rods (7 and 8) from rod ends (6).

(b) Remove screws (5), nuts (2), and washers (3) and remove rod end (6) and grip latch (1) with spring (4).

(c) Remove spacers (14, 17, and 19), sector (15), and ratchet (18) by removing nuts (12), lock- washers (13), and stud (16).

NOTE

Notches are not required in the shift [ever sector (15) for forward or reverse positions because detents in winch assembly shift fork hold the shifter in place.

(3) Cleaning, Inspection and Repair.

(a) Clean all parts in dry-cleaning solvent, Federal Specification P-D-680. Dry with compressed air (10 psi).

(b) Inspect for broken or bent levers (9 and 10) and damaged control stand (33). Repair or replace defective items.

(c) Inspect grip latches (1), pawl and rods (7 and 8), sector (15), and ratchet (18) for broken or bent condition. Replace parts if damaged.

(4) Reassembly. Reassemble control stand in reverse order of disassembly.

(5) Installation. With exception of yoke (23) and jamnut (28), install control stand in reverse order of removal. Install and adjust shifting yoke (23) as follows:

(a) Install jamnut (28) and yoke (23) on control rod.

(b) Pull knob on port center side of the winch assembly to disengage internal-external gear type clutch.

(c) Move shift lever (10) to vertical position and allow pawl and rod (8) to drop into notch on shift sector (15).

(d) Move control rod in or out until winch assembly is in neutral position.

NOTE

The control rod must shift the winch assembly to neutral before the winch assembly will free spool.

(e) Hold control rod down and turn yoke (23) until yoke holes aline with hole in bottom of shift lever (10).

(f) nstall yoke pin (22) and cotter pin (29).

(g) Lock yoke (23) to control rod with jamnut (28).

b. Speed Control Linkage.

(1) Removal (fig. 10-20).

(a) Remove connecting bars (15) by removing cotter pins (16) and clevis pins (3).

(b) Remove speed control handle (1) by removing cotter pin (19) and clevis pin (2).

(c) Loosen jamnut (6) and unscrew stuffing box nut (17).

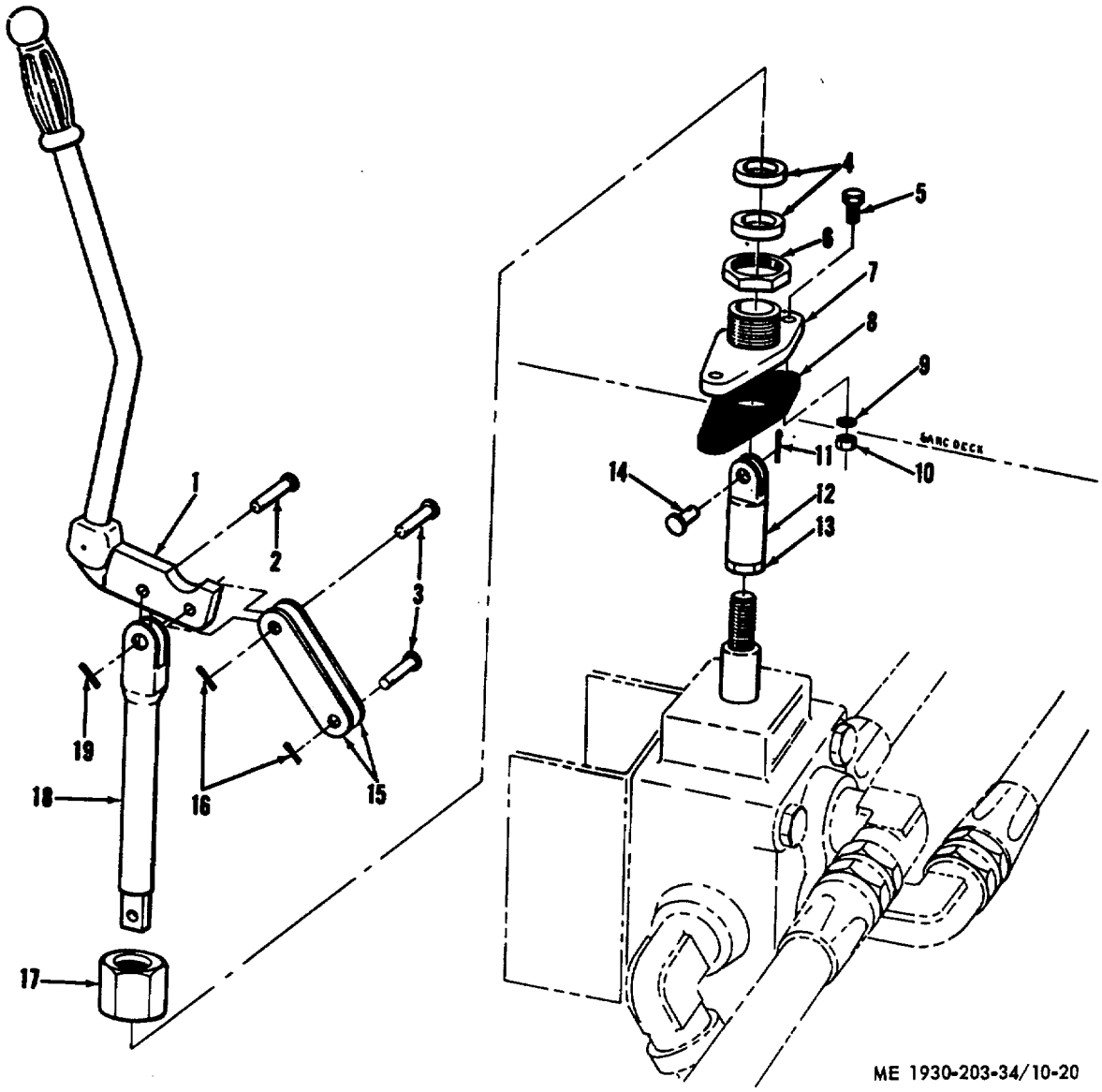
(d) Remove cotter pin (11) and clevis pin (14) and remove shaft (18) and stuffing box nut (17).

(e) Remove jamnut (6) and packing rings (4) from stuffing box (7).

(f) Remove stuffing box (7) and gasket (8) by removing bolts (5), nuts (10), and lockwashers (9).

(g) Loosen jamnut (13) and remove clevis (12).

(h) Remove jamnut (13).



1 Handle
2 Pin, clevis
3 Pin, clevis
4 Packing rings
5 Bolt, machine,
6 Jamnut
7 Stuffing box
8 Gasket
9 Lockwasher
10 Nut, plain
11 Pin, cotter
12 Clevis
13 Jamnut
14 Pin, clevis
15 Connecting bar
16 Pin, cotter
17 Nut, stuffing box
18 Shaft
19 Pin, cotter

Figure 10-20. Speed control linkage.

(*2) Cleaning, inspection and repair.*
(a) Wash all parts in dry-cleaning solvent, Federal Specification P-D-680. Dry with compressed air (10 psi).
(b) Inspect speed control handle, connecting bars, and shaft for bent or broken condition.
Replace handle, connecting bars, and shaft if bent or broken.
(c) Insure all attaching hardware is in good operating condition.
(3) Installation. Install speed control linkage in reverse order of removal.

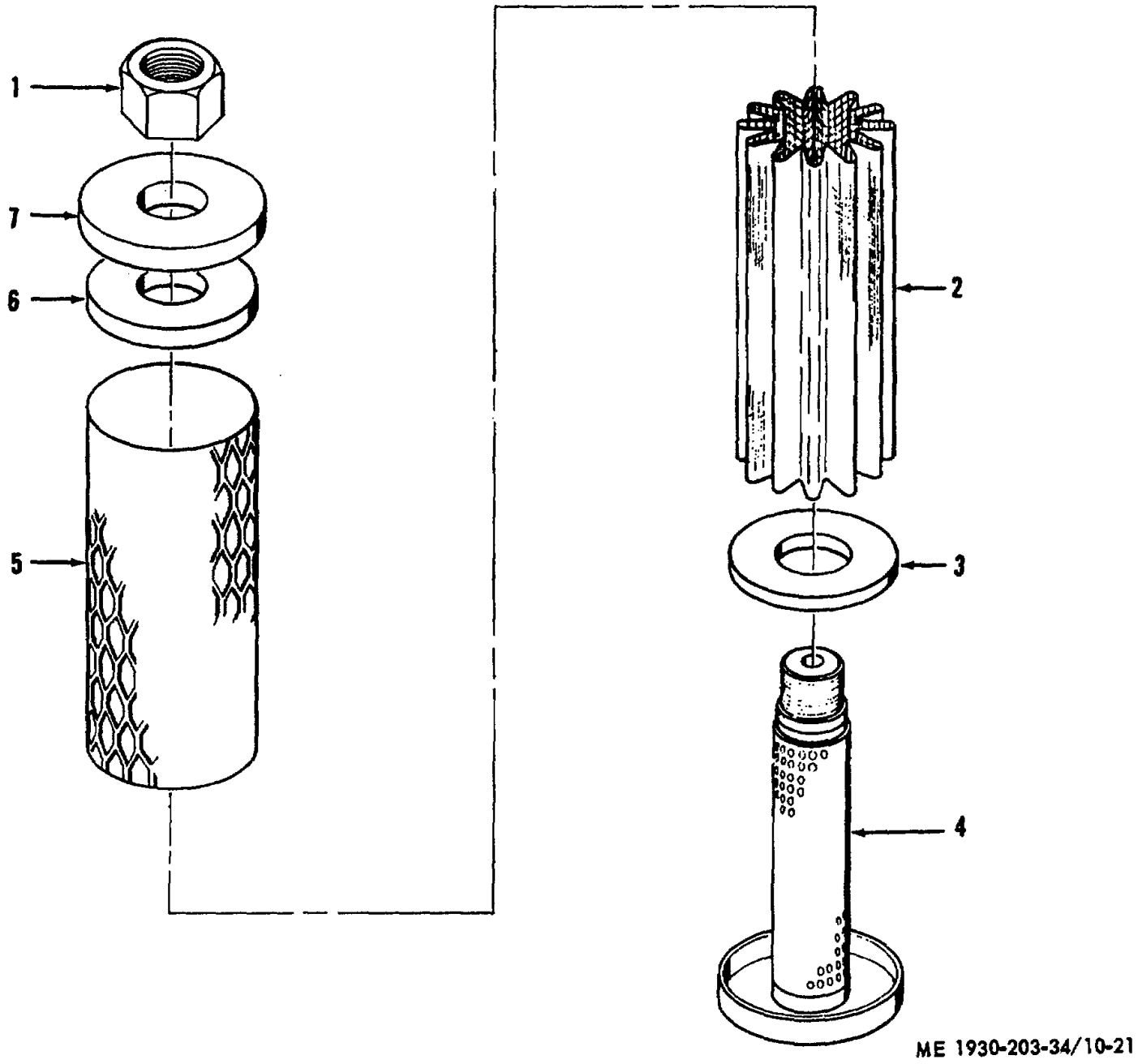
10-13. Hydraulic Oil Supply Tank Filters

a. Removal.
(1) Drain hydraulic oil supply tank (para 10- 14a(1)).
(2) Remove access covers from both ends of tank by removing attaching bolts and washers.
Remove access cover gaskets.
(3) Remove filters by unthreading from supply line.

WARNING

While working inside the hydraulic oil supply tank, a portable-type circulating blower should be used to prevent vapor accumulation. For extended work periods inside the tank, an air line type respirator should be worn. Station an observer outside tank in case worker is overcome by fumes.

b. Disassembly (fig. 10-21).
(1) Remove coupling (1) and lift off cover (7) and washer (6).
(2) Slide housing (5), insert (2), and washer (3) off centering tube (4).
c. Cleaning, Inspection and Repair.
(1) Immerse insert (2) in dry-cleaning solvent, Federal Specification P-D-680, until all residue is loosened. Shake off excess solvent and blow dry from inside with compressed air. Replace insert if all impurities cannot be removed.
(2) Clean coupling (1), cover (7), housing (5), and centering tube (4) in dry-cleaning solvent, Federal Specification P-D-680, and allow to drain dry on a clean, lint-free cloth.
(3) Inspect washer (3 and 6) for deterioration and replace as necessary. Replace washers damaged in removal.
(4) Inspect coupling (1) and centering tube (4) for damaged threads. Replace defective parts.
(5) Replace access cover gaskets if torn or deteriorated.



1 Coupling
2 Insert
3 Washer, bottom
4 Centering tube
5 Housing
6 Washer, top
7 Cover

Figure 10-21. Hydraulic oil supply tank filter.

d. Reassembly. Reassemble filters in the reverse order of disassembly.

e. *Installation.*

(1) Connect filters to supply line.

WARNING

While working inside the hydraulic oil supply tank, a portable-type circulating blower should be used to prevent vapor accumulation. For extended work periods inside the tank, an air line type respirator should be worn. Station an observer outside tank in case worker is overcome by fumes.

(2) Install access covers and gaskets.

(3) Fill hydraulic oil supply tank (LO 55- 1930-203-12).

10-14. Hydraulic Oil Supply Tank

a. Disassembly.

(1) Drain hydraulic fluid from tank as follows:

(a) Provide suitable containers and remove pipe plug located under the LARC in supply tank drain line.

(b) Open supply tank gate valve and drain fluid from tank (TM 55-1930-203-20).

NOTE

All repairs and replacement of parts can be accomplished without removal of the hydraulic tank. Component parts can be disassembled while the tank is in place.

(2) Remove access covers from both ends of tank.

(3) Remove filters from tank (para 10-13a).

(4) Remove low level warning switch from tank (para 6-4e(1).

b. Cleaning, Inspection and Repair.

(1) Clean interior of tank with dry-cleaning solvent, Federal Specification P-D-680. Apply solvent to tank interior by spraying or swabbing. Allow solvent to drain from tank.

WARNING

While performing cleaning operations or repairs inside the tank, a portable- type, air-circulating blower must be used to prevent vapor accumulation.

WARNING

For extended work periods inside the tank, an airline-type respirator should be worn. Personnel should not work alone while cleaning the tank interior. Explosion-proof lighting fixtures must be used inside the tank during cleaning operations.

(2) If sludge deposits do not flush off readily, use a soft cloth or brush to remove deposits.

CAUTION

Under no circumstances will a wire brush, metal wool, or abrasive be applied.

(3) Examine interior of tank for evidence of pitting or corrosion. Remove surface corrosion with a clean, lint-free cloth or brush using dry-cleaning solvent, Federal Specification P-D-680. Remove excess solvent and wipe dry with clean cloth.

CAUTION

Do not use wire brush, metal wook, or abrasive for cleaning tank interior.

(4) Examine all metal parts for cracks, corrosion, and wear. Cracks in inspection covers may be repaired by welding. Repairs to plating around stud holes will be smoothed with a file to insure adequate sealing of cover gasket.

(5) Repairs on tank may be accomplished by welding. Refer to paragraph 11-1b for welding instructions.

WARNING

Before welding hydraulic tank, remove residual hydraulic fluid by steam cleaning tank interior. Refill tank with water. Provide a vent for release of pressure generated in tank by heat of the welding process.

NOTE

Before steam cleaning tank, inlet line and supply line filter mounting outlets be capped or plugged to prevent water from entering hydraulic system.

(6) Accomplish repairs as soon as possible after tank has been drained and cleaned.

(7) Remove all flammable material from immediate vicinity of welding operation. If removal is impractical, provide a suitable fire-resistant shield.

WARNING

Forced ventilation must be provided when natural ventilation is inadequate to keep concentration of injurious fumes in the cleaning or welding operation below harmful levels. Suitable respiratory equipment must be worn when fumes cannot be kept to a minimum.

(8) Inspect surrounding area upon completion of welding operations to determine any potential fire hazard.

(9) Drain water from hydraulic tank as soon as repairs are completed and dry tank interior.

(10) Clean repaired area with abrasive paper, Federal Specification P-P-101, and repaint as necessary.

c. Reassembly.
(1) Install low level warning switch on tank (para 6-4e(2)).
(2) Install filters in tank para 10-13e).
(3) Install access covers and gaskets.

NOTE

Before refilling tank with fluid, reinstall supply lines if they have been disconnected.

(4) Fill hydraulic oil supply tank (LO 55-1930-203-12).

10-15. Hydraulic Master Pressure Pumps

a. Removal and Installation. Refer to paragraph 2-26 to remove and install the hydraulic master pressure pumps.
b. Disassembly (fig. 10-22).
(1) Drain excess oil from pump before beginning disassembly by turning shaft and allowing oil to drain from ports. Position pump vertically with shaft end down for convenience of disassembly.

NOTE

Prepare a clean, lint-free place for disassembled parts.

(2) Remove capscrews (30) and washers (29). Remove pump cover 128) from large rotor ring (l0).
(3) Remove pump cover packing 1271, spring washer (26), spacer 125), sleeve 1241, and sleeve packings (22) from rotor drive shaft (5).
(4) Remove screws (23) from rotor cover (21). Remove small rotor plate spring washer (20), small rotor pressure plate (19), and pull small rotor pins (18) from small rotor ring (15).
15) Remove small rotor ring (15). small rotor (17)., and small rotor vanes (16) from rotor drive shaft (5).

CAUTION

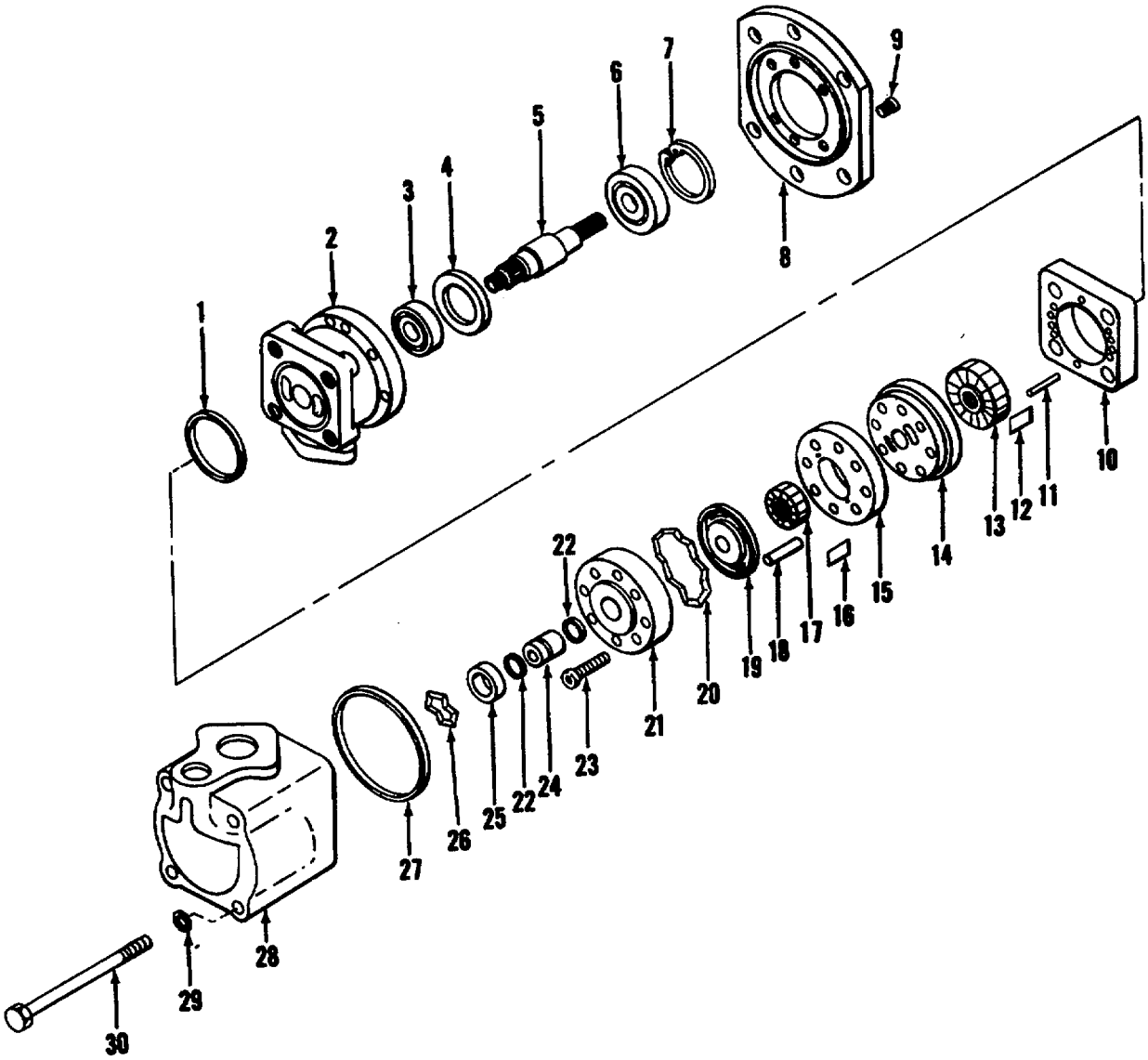
Remove small rotor (17) and small rotor vanes (16) carefully to protect their finished surfaces.

(6) Remove large rotor pressure plate (14). Remove large rotor pins (11), large rotor ring (10), large rotor (13), and large rotor vanes (12) from rotor drive shaft (5). Remove pump body packing

CAUTION

Remove large rotor (13) and large rotor vanes (12) carefully to protect their finished surfaces.

(7) Remove screws (9) and mounting bracket (8) from pump body (2).
(8) Remove retaining ring (7) which secures rotor drive shaft (5), bearings (3 and 6) and oil seal (4) to pump body.
(9) Using arbor press, press rotor drive shaft (5) from pump body (2). Press bearing (6) from rotor drive shaft.
(10) Press oil seal (4) and bearing (3) from pump body.



1 Pump body packing
2 Pump body
3 Bearing, shaft, driven end
4 Oil seal
5 Rotor drive shaft
6 Bearing, shaft, drive end
7 Retaining ring
8 Mounting bracket
9 Screw, mounting bracket
10 Large rotor ring
11 Large rotor pin
12 Large rotor vane
13 Large rotor
14 Large rotor pressure plate
15 Small rotor ring
16 Small rotor vane
17 Small rotor
18 Small rotor pin
19 Small rotor pressure plate
20 Spring washer, small rotor plate
21 Rotor cover
22 Sleeve packing
23 Screw, rotor cover
24 Sleeve
25 Spacer
26 Spring washer, shaft
27 Pump cover packing
28 Pump cover
29 Washer
30 Capscrew, pump cover

Figure 10-22. Master pressure pump.

d. Cleaning, Inspection and Repair.

(1) Wash all metal parts, except seals, in dry- cleaning solvent, Federal Specification P-D-680, and let parts drain dry.

(2) Clean bearings thoroughly by repeated washing with dry-cleaning solvent, Federal Specification P-D-680, and shake off excess solvent.

WARNING

Use dry-cleaning solvent in a well- ventilated area. Avoid breathing fumes. Keep away from flame or extremely high temperatures.

CAUTION

Do not use compressed air for drying pump parts. Moisture and small particles of dirt in airstream will damage polished surfaces.

(3) Inspect large rotor ring and small rotor ring for wear, grooves, burrs, and scratches. Remove burrs and scratches with crocus cloth, Federal Specification P-C-458. Replace deeply grooved or scratched parts.

(4) Check all threaded openings for damaged threads. Replace parts as necessary.

(5) Check all slots of large rotor and small rotor for sticking vanes or loose, worn slots. Inspect all vanes on flat sides and ends for wear and defects. Defective vanes and rotors with enlarged slots must be replaced. Slight scratches on parallel sides of rotors may be removed by light lapping on a flat, smooth surface using crocus cloth, Federal Specification P-C-458. Any slight burrs in slots resulting from lapping must be removed.

NOTE

Sides of rotors must be parallel and flat within 0.0002 inch.

(6) Check sides of small rotor pressure plate and large rotor pressure plate. Scratches may be removed by light lapping using crocus cloth, Federal Specification P-C-458.

NOTE

Faces of pressure plates must be flat within 0.0002 inch.

(7) Inspect bearings by exerting pressure on inner race while turning slowly. Any scored, pitted, cracked, or chipped races require replacement of bearing.

(8) Discard pump body packing, pump cover packing, sleeve packing, and oil seal and replace with new parts.

(9) Inspect bearing housing in pump body and mounting bracket for grooved, burred, or galled condition. If damage cannot be repaired with crocus cloth, Federal Specification P-C-458, replace defective parts.

(10) Check rotor drive shaft for twisted, chipped, or burred splines and bearing surfaces for grooves. Remove burrs with crocus cloth, Federal Specification P-C-458. Replace shaft when damage cannot be repaired.

(11) Inspect retaining ring for nicks and distortion. Retaining ring must snap tight in groove. Replace defective ring.

(12) Examine spring washers for signs of overheating or wear caused by rubbing adjacent parts. Replace washers where any defect is noted.

e. Reassembly (fig. 10-22).

(1) Place pump body packing (1), oil seal (4), pump cover packing (27), and sleeve packings (22) in clean engine oil, OE-10, and allow to soak before reassembly.

(2) Press bearing (3) and oil seal (4) into pump body (2).

NOTE

Apply grease, Military Specification MIL-G- *3545,* to pockets of oil seal (4). (fig. 10-23).

NOTE

The oil seal must be inserted with solid flat side against bearing (3, fig. 10-22).

(3) Press bearing (6) on rotor drive shaft (5) and push shaft carefully through oil seal (4) and bearing (3).

(4) Install retaining ring (7) against outer race of bearing (6) and into groove of pump body (2).

(5) Position mounting bracket (8) on pump body (2) and secure with screws (9).

(6) Stand pump body (2) up vertically with drive end of rotor drive shaft (5) down. Insert pump body packing (1) into recessed groove in pump body (2).

NOTE

Apply a thin coat of clean engine oil, OE-1O, to all mating surfaces.

*(*7) Install large rotor ring (10) on pump body (2). Insert large rotor pins (11) into locating holes of large rotor ring and pump body.

CAUTION

The correct direction of rotation is indicated by the arrow stamped on large rotor ring (10). The correct rotation is counterclockwise as viewed from drive shaft end. Reverse rotation will result if large rotor ring is inverted.

(8) Install large rotor (13) on rotor drive shaft (5) and insert large rotor vanes (12) with radius edges toward large rotor ring (10).

(9) Install large rotor pressure plate (14) on rotor drive shaft (5) with large face against large rotor (13).

(10) Install small rotor ring (15) on large rotor pressure plate (14). Insert small rotor pins (18) in locating holes of small rotor ring.

CAUTION

Direction of rotation as indicated by the arrow on the small rotor ring (15) must be the same as the arrow in the large rotor ring (10).

(11) Install small rotor (17) on rotor drive shaft (5) and insert small rotor vanes (16) with radius toward small rotor ring (15).

(12) Place small rotor pressure plate (19) on shaft (5) with lapped face against small rotor (17).

(13) Place spring washer (20) on small rotor pressure plate (19). Replace rotor cover (21) and secure to large rotor pressure plate (14) with screws (23). Tighten screws to a torque of 10 foot-pounds.

(14) Install sleeve packings (22) on sleeve (24) and insert one end of sleeve into rotor cover (21).

(15) Install spacer (25) and spring washer (26).

(16) Place pump cover packing (27) in pump cover (28). Install pump cover on large rotor ring (10) and secure with washers (29), and capscrews (30). Tighten capscrews to a torque of 140 to 160 foot-pounds.

10-16. Radiator Fan Assembly

a. Removal and Installation. Refer to paragraph 2-32 to remove and install the radiator fan assembly.

b. Disassembly

(1) Remove radiator fan motor (para 10-17a).

(2) Remove seal retainer (10, fig. 2-29) and seal (9) from casing (22).

(3) Separate nose piece (28) and rotor assembly (26) by removing screws (30) and washers (29). Remove spacer (27).

(4) Separate inlet adapter (6) and casing (22) by removing bolts (31), washers (11), and nuts (20).

c. Cleaning, Inspection and Repair.

(1) Clean all metal parts in dry-cleaning solvent, Federal Specification P-D-680, and allow to drain dry.

(2) Inspect inlet adapter (6), nose piece (28), rotor assembly (26), and casing (22) for cracks or dents caused by foreign objects being drawn into fan. Minor damage to inlet adapter (6) and casing (22) can be repaired by straightening or welding.

CAUTION

Nose piece (28) and rotor assembly (26) should be replaced if damaged since repair could create an unbalanced condition.

(3) Inspect key (19) for cracks or chips and replace if damaged.

(4) Inspect seal retainer (10) for cracks or distortion and replace if damaged.

(5) Replace seal (9).

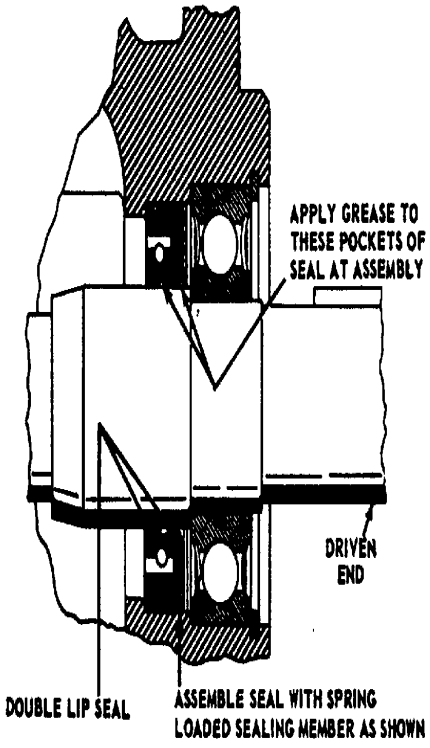


Figure 10-23. Master pressure pump oil seal installation.

d. Reassembly.

(1) Insert spacer (27) and secure nose piece (28) to rotor assembly (26) with screws (30) and washers (29). Secure screws (30) with lock wire.

(2) Secure inlet adapter (6) to casing (22) with bolts (31) ,washers (11),and nuts (20).

(3) Press seal (9) into seal retainer (10), then press seal and retainer in casing with lip of seal facing outward (towards rotor assembly). Install radiator fan motor as outlined in steps (1) through (4) of paragraph 10-17 e.

10-17. Radiator Fan Motor

a. Removal.

(1) Remove radiator fan assembly as outlined in paragraph 10-16a.

(2) Remove bolts (21, fig. 2-29), washers (17), and nuts (16) securing vane assembly (18) to casing (22).

(3) Remove pipe (12), elbow (13), and adapter (14).

(4) Remove nut (7) and lockwasher (8) from motor shaft. Lift off nose piece (28) and rotor assembly (26).

(5) Remove key (19).

(6) Remove cotter pins (25), nuts (24), and washers (23) securing hydraulic motor (15) to casing (22). Remove motor (15).

b. Disassembly. Refer to figure 10-24.

NOTE

Clean exterior of motor thoroughly before beginning disassembly. Prepare a clean, lint-free place for disassembled parts.

(1) Remove four screws (1) which secure flange mounting adapter (3) to front housing (32) and remove adapter.

(2) Remove shaft (5) with bearing (6). Remove retaining ring (7) and press bearing from shaft.

(3) Remove front housing O-ring packing (8) and seal (9) from front housing (32).

(4) Turn motor on end and support in vertical position with rear housing (40) facing upward.

(5) Remove two screws (36) and eight screws (37) from rear housing (40) and remove rear housing.

CAUTION

Do not use tools to pry off housing. If housing sticks, tap lightly with rawhide mallet.

(6) Remove sequence check plate assembly consisting of check plate (14) and segment (15). Disassemble sequence check plate assembly by loosening nut (27) and removing two segments (15), check plate (14), large spring (30), and small spring (28) from screw (29).

(7) Remove rear port plate (34) and rear bushing (33). Disassemble rear port plate by removing piston ring (16) and port plate O-ring (17). Remove port plate plug (18), ball (19), and spring (20).

NOTE

Place parts in separate container with port plate to prevent loss or mixing with other port plate.

(8) Remove vanes (26) and rotor (23).

(9) Remove housing O-ring seal (35) and dowel pin (25).

(10) Remove cam ring (24).

(11) Remove front port plate (21) and front bushing (22). Disassemble front port plate by removing piston ring (16) and port plate O-ring (17). Remove port plate plug (18), ball (19), and spring (20).

NOTE

Place parts in separate container with port plate to prevent loss of mixing with other port plate.

(12) Remove front sequence check plate assembly consisting of check plate (14) and segments (15). Disassemble sequence plate assembly by removing nut (27) and removing two segments (15), check plate (14), large spring (30), and small spring (28) from screw (29).

(13) Remove screws (13) from pipe flange (12) and remove pipe flange. Remove small and large pipe flange O-rings (10 and 11).

(14) Disassemble front housing (32) by removing screws (13) from pipe flange (12) and remove pipe flange. Remove small and large pipe flange O-rings (10 and 11). Remove front housing plug (31)

Key to figure 10-24.

1	Screw, socket head	21	Front port plate
2	Nut, slotted	22	Front bushing
3	Flange mounting adapter	23	Rotor
4	Bolt, machine	24	Cam ring
5	Shaft	25	Dowel pin
6	Bearing	26	Vane
7	Retaining ring	27	Nut, check plate
8	Front housing O-ring packing	28	Small spring
9	Seal	29	Screw, check plate
10	Small pipe flange O-ring	30	Large spring
11	Large pipe flange O-ring	31	Front housing plug
12	Pipe flange	32	Front housing
13	Screw, socket head	33	Rear bushing
14	Check plate	34	Rear port plate
15	Segments	35	Housing O-ring seal
16	Piston ring	36	Screw, socket head
17	Port plate O-ring	37	Screw, socket head
18	Port plate plug	38	Screw, nameplate
19	Ball	39	Nameplate
20	Spring	40	Rear housing

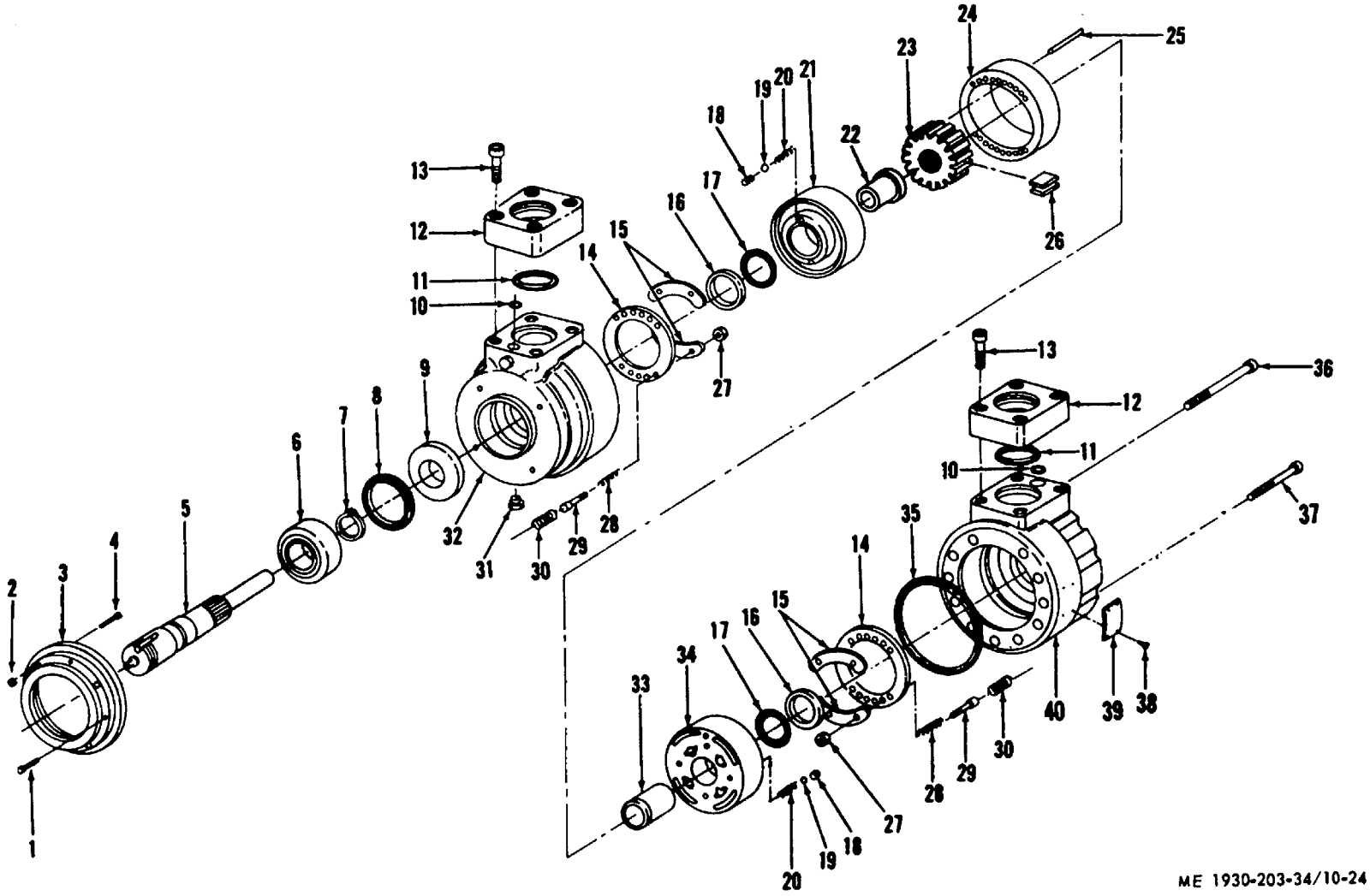


Figure 10-24. Radiator fan hydraulic motor disassembly.

c. Cleaning, Inspection and Repair.

(1) Wash all metal parts in dry-cleaning solvent, Federal Specification P-D-680, and let parts drain dry.

(2) Clean bearing by repeated washing with dry-cleaning solvent, Federal Specification P-D-680, and shake off excess solvent.

WARNING

Use dry-cleaning solvent in a well ventilated area. Avoid breathing fumes. Keep away from flame or extremely high temperatures.

CAUTION

Do not use compressed air to dry motor parts. Moisture and small particles of dirt in air stream will damage polished surfaces.

(3) Inspect cam ring for wear and damaged inner surface. Remove minor burrs and scratches with crocus cloth, Federal Specification P-C-458. Inner surface of cam ring should be smooth. Replace defective cam ring.

(4) Examine all slots of rotor for sticking vanes or loose, worn slots. Rotor slots must be square and parallel and 0.004 to 0.006 inch wider than combined width of two vanes. Measure clearance with a feeler gage.

(5) Inspect all vanes for wear and defects. Slight imperfections, such as scratches and burrs in the vane surface can be removed with crocus cloth, Federal Specification P-C-458. Vanes showing excessive wear, deep grooves, or scratches should be replaced.

(6) Check bore of front bushing and rear bushing for wear. Replace bushings if badly worn plate

(7) Check port assemblies for wear on vane side. Wear in vane patch should not exceed 0.004 inch. Port plates can be reground or polished with a sheet of crocus cloth, Federal Specification P-C-458, on a smooth flat surface. A maximum of 0.005 inch can be removed from face of port plates. After polishing, faces of port plates must be flat within 0.0005 inch. Measure both inner and outer edges of port plates.

(8) Check port plate plugs, balls, and springs for serviceability. Ball should be smooth and free from grooves or scratches. Replace defective balls and broken springs.

(9) Examine mating surfaces of check plate and segment. Surfaces should be smooth and free from nicks, burrs, or scratches. Minor defects can be removed with crocus cloth, Federal Specification P-C-458. Replace defective plates and segments.

(10) Inspect threads in pipe flanges for damage. Repair minor damage with a fine file. Replace flanges if repair results in a loose fit or misalignment of parts.

(11) Inspect bearing for scored, pitted, or cracked races. Any defect requires replacement of bearing.

(12) Check shaft for twisted or burred splines and bearing surfaces for grooves. Remove burrs with crocus cloth. Federal Specification P-C-458. Replace shaft if damage cannot be repaired.

d. Reassembly (fig. *10-24).*

NOTE

Before reassembly, coat all parts with clean engine oil, OE-10

(1) Place front housing (32), on bench with internal portion facing upward.

(2) Place small spring (28) and large spring (30) over each screw (29), and install screws and springs in check plate. Place segments (15) in correct position on check plate (14) and tighten each nut (27).

NOTE

Vanes must be assembled so a groove is formed between the two vanes.

CAUTION

Improper assembly of vanes will cause motor noise and wear port plates. Install vanes carefully.

(3) Install one sequence cheek plate assembly in front housing (32) with segments 15) facing upward.

(4) Install spring (20), ball (19), and port plate plug (I8) in front port plate (21). Install new port plate 0-ring (I7) and replace piston ring (16) in front port plate.

NOTE

Surface of piston ring must be smooth to seat properly on housing hub.

(5) Install front port plate (21) in front housing (32).

(6) Install front bushing (22) in front port plate (21). Shoulder of front bushing (22) will fit in recess of port plate.

(7) Install cam ring (24) in front housing (32). Line up dowel hole in cam ring with dowel hole in front port plate (21) and install dowel pin (25).

(8) Install rotor (23) inside cam ring (24) and install vanes (26) in rotor slots.

(9) Place new housing O-ring seal (35) around cam ring (24).

(10) Install spring (20), ball (19), and port plate plug (18) in rear port plate (34). Install new port plate O-ring (17) and replace piston ring (16) in rear port plate (34).

NOTE

Surface of piston ring must be smooth to seat properly on housing hub.

(11) Install rear bushing (33) in rear port plate (34). Bushing shoulder should fit in recess in port plate.

(12) Install rear port plate (34) and align dowel hde with dowel pin (25).

(13) Install other sequence check plate assembly on top of rear port plate (34) with screws (29) facing upward.

(14) Place rear housing (40) over assembled parts.

NOTE

It may be necessary to tap the housing lightly with a rawhide mallet until it slips down all the way.

(15) Insert two screws (36) and eight screws (37) and tighten fingertight.

(16) Turn motor over and install seal (9) and front housing O-ring packing (8).

(17) Install bearing (6) on shaft (5) and install retaining ring 17).

(18) Install shaft assembly in motor.

(19) Place flange mounting adapter (3) over shaft (5) and tighten four screws (1).

(20) Turn motor on its side and tighten housing screws (36 and 37) alternately around circumference of housing.

NOTE

Rotate shaft while tightening screws to detect any binding or high spots which would prevent shaft from turning.

(21) Install new small and large pipe flange O-rings (11 and 11) and install pipe flanges (12) on front and rear housing sections. Install four socket head screws in each pipe flange and tighten. Install front housing plug (31).

(22) Pour a small amount of clean engine oil, OE-10, into pipe flange ports and turn motor shaft by hand several times in direction of rotation to determine that motor turns freely without binding. Drain hydraulic fluid from motor.

e. Installation.

(1) Position motor (15, fig. 2-29) in casing (22) and secure with washers (23), nuts (24), and cotter pins (25).

(2) Install key (19), rotor assembly (26), and nose piece (28) on motor shaft and secure with lockwasher (8) and nut (7).

(3) Install pipe (12), elbow (13), and adapter (14) in motor inlet opening. Position elbow (13) so it will align with flexible hose (2, fig. 10-5) when installed on LARC.

(4) Secure vane assembly (18, fig. 2-29) to casing (22) with bolts (21), washers (17), and nuts (16).

(5) Install radiator fan assembly as outlined in paragraph 10-16c.

10-18. Ramp Cylinder

a. Removal and Installation. Refer to paragraph 2-29 to remove and install the ramp cylinder.

b. Disassembly.

CAUTION

If ramp cylinder is placed in a vise, wooden blocks contoured to fit cylinder should be used to prevent distortion of cylinder walls.

(1) Loosen locknut (6, fig. 2-26) and remove clevis (5). Remove locknut (6).

(2) Unscrew rod end cover assembly (1, fig. 10-25) and pull piston rod assembly (2) out of cylinder body (16).

NOTE

When necessary to hold cylinder in a vise to remove the cylinder rod end cover, two wooden blocks should be cut to the same diameter as the outside diameter of the cylinder barrel to prevent the barrel from being damaged.

NOTE

It may be necessary to hold cylinder barrel with a strap wrench to prevent it from turning when loosening cylinder rod end cover.

(3) Remove rod end cover (8) from piston rod (10).

(4) Unscrew retainer (4) from rod end cover (8) and remove wiper (3).

(5) Remove rod packing (5), adapter (6), and rod end packing (9).

CAUTION

Use extreme care in removing packings from packing grooves not to scratch grooves with sharp edged tools. Remove packings by inserting a blunt instrument under edge of packing and lifting it outward.

(6) Remove piston packing (13) from piston (12).

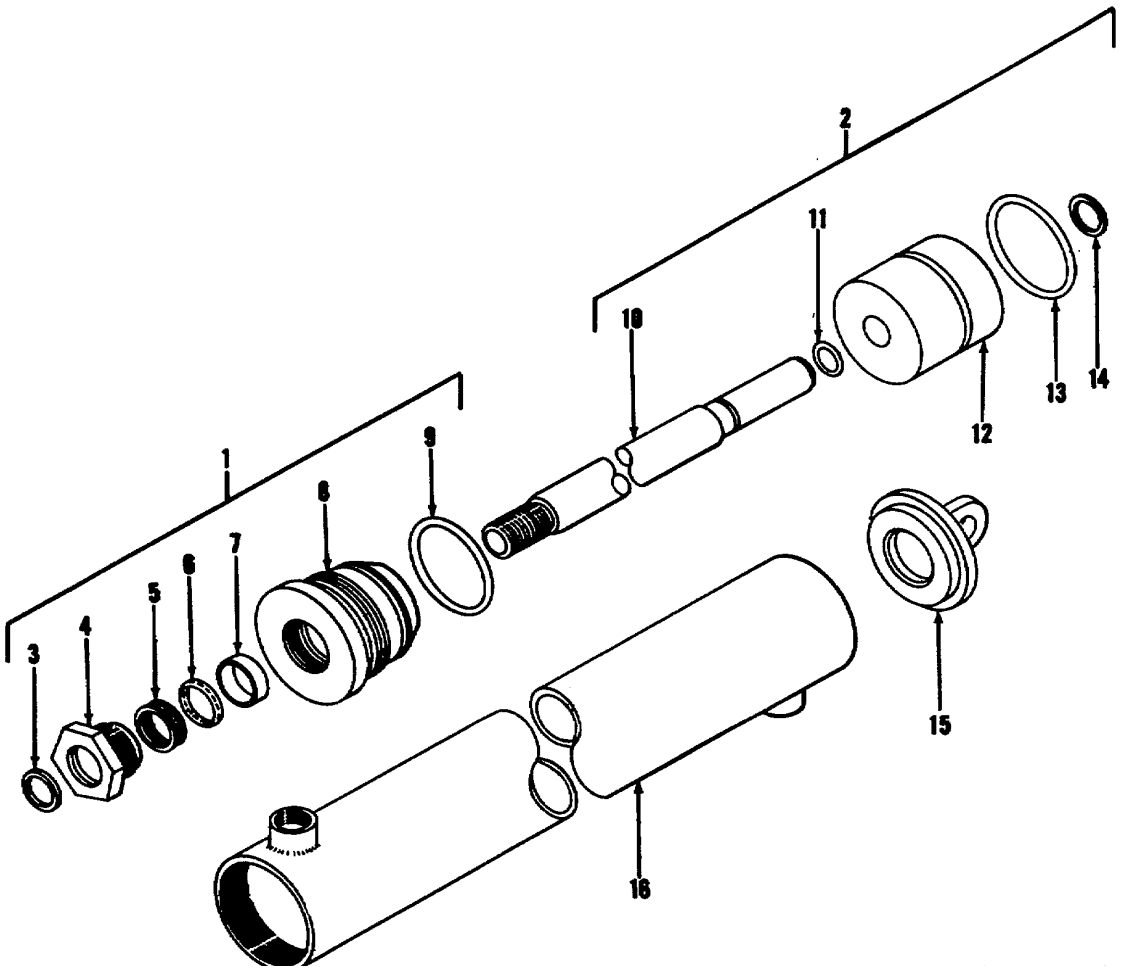
(7) Press bushing (7) out of rod end cover (8).

(8) Place assembled piston (12) and piston rod (10) on a machine lathe,, and remove fillet weld between washer (14) and piston rod (10) with suitable cutting tool.

(9) Remove washer (14) and press piston rod (10) out of piston (12). Remove piston rod packing (11).

NOTE

Discard used packing seals and install new packing at reassembly.



1	Rod end cover assembly	9	Rod end packing
2	Piston rod assembly	10	Piston rod
3	Wiper, thrust	11	Piston rod packing
4	Retainer	12	Piston
5	Rod packing	13	Piston packing
6	Adapter	14	Washer, plain
7	Bushing	15	Cylinder head end cover
8	Rod end cover	16	Cylinder body

Figure 10-25. Ramp cylinder disassembly.

c. Cleaning, Inspection and Repair.

(1) Wash all metal parts in dry-cleaning solvent, Federal Specification P-D-680. Dry with filtered, low-pressure compressed air.

WARNING

Use dry-cleaning solvent, Federal Specification P-D-680, in a well-ventilated area. Avoid breathing fumes. Keep away from open flame or where very high temperatures prevail.

CAUTION

Do not use wire brush or metal tool for scraping cylinder working surfaces. Take every precaution to prevent foreign material from entering or adhering to cylinder.

(2) Inspect inside of cylinder body for evidence of scoring or scratches which might cause leakage. If barrel is scored to such an extent to cause leakage, it may be honed to the following

dimensions: minimum diameter 4.002 inches, maximum diameter 4.004 inches.

(3) Examine piston and piston rod for scratches, nicks, and grooves. Remove any defects with crocus cloth, Federal Specification P-C-458. Surface defects can be removed from a maximum diameter of 3.996 inches to a minimum diameter of 3.994 inches. If defects cannot be removed, replace part.

(4) Inspect threaded parts for damaged threads. Repair minor thread damage with a fine file. If repair results in loose fit or misalignment parts, replace damaged parts.

CAUTION

If threaded portion of cylinder pipe ports are repaired, make sure all foreign material is cleaned from cylinder barrel.

(5) Inspect all machined surfaces for damage that could cause leakage or other malfunction. Repair or replace defective parts if necessary.

d. Reassembly.

NOTE

Be sure work area is clean before beginning assembly of ramp cylinder.

(1) Place piston packing (13, fig. 10-25), piston rod packing (11), rod end packing (9), rod packing (5), and wiper (3) in clean engine oil, OE- 10, and allow to soak before installation.

(2) Install piston rod packing (11) on piston rod (10) and press piston (12) on piston rod.

(3) Install washer (14) on piston rod (10) and make a fillet weld (1, fig. 10-26) between washer (2) and piston rod (6).

NOTE

Electric arc-type welding method will be used for this operation.

(4) Install bushing (7, fig. 10-25) in rod end cover (8).

(5) Place adapter (6) and rod packing (5) in rod end cover (8) and install rod end packing (9)

NOTE

Narrow edge of adapter (6) and packing (5) should face outward.

(6) Install wiper (3) in retainer (4) and screw retainer into rod end cover (8).

(7) Apply a thin coat of engine oil, OE-10, to piston rod (10) and place assembled rod end cover assembly (1) on piston rod.

(8) Install piston packing (13) on piston (12),and apply engine oil, OE-10, to surface of piston.

(9) Apply engine oil, OE-10, to barrel of cylinder body (16) and slide assembled piston rod assembly (2) with rod end cover (8) into cylinder body (16).

CAUTION

Use extreme care when installing piston and rod in cylinder to prevent entrance of foreign material.

(10) Screw rod end cover assembly (1) onto cylinder body (16).

(11) Install locknut (6, fig. 2-26) and clevis (5).

10-19. Steering Cylinder

a. Removal and Installation. Refer to paragraph 2-30 to remove and install the steering cylinder.

b. Disassembly (fig. 10-27).

(1) Loosen nut (11), and remove needle valve (12) from rod end and blind end covers (14 and 20).

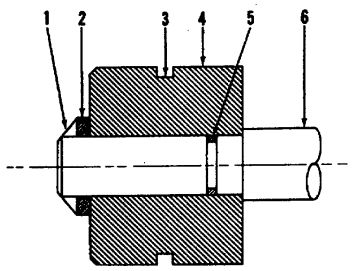
(2) Remove spring retaining plug (8), ball check spring (9), and ball bearing (10) from rod end and blind end covers (14 and 20).

(3) Remove nut (26) and bolt (24), and unscrew rod end clevis (25) from piston rod (16).

(4) Remove nuts (1) and washers (2) from tie rods (17). Slide bushing retainer (3) from piston rod (16).

(5) Remove piston rod bushing (6) and rod end cover (14) from piston rod (16). Remove packings (5, 7 and 15) and wiper ring (4) from bushing and cover.

(6) Slide blind end cover (20) and tie rods (17) from cylinder body (23) and unscrew tie rods from cover. Remove packing (21) from cover.

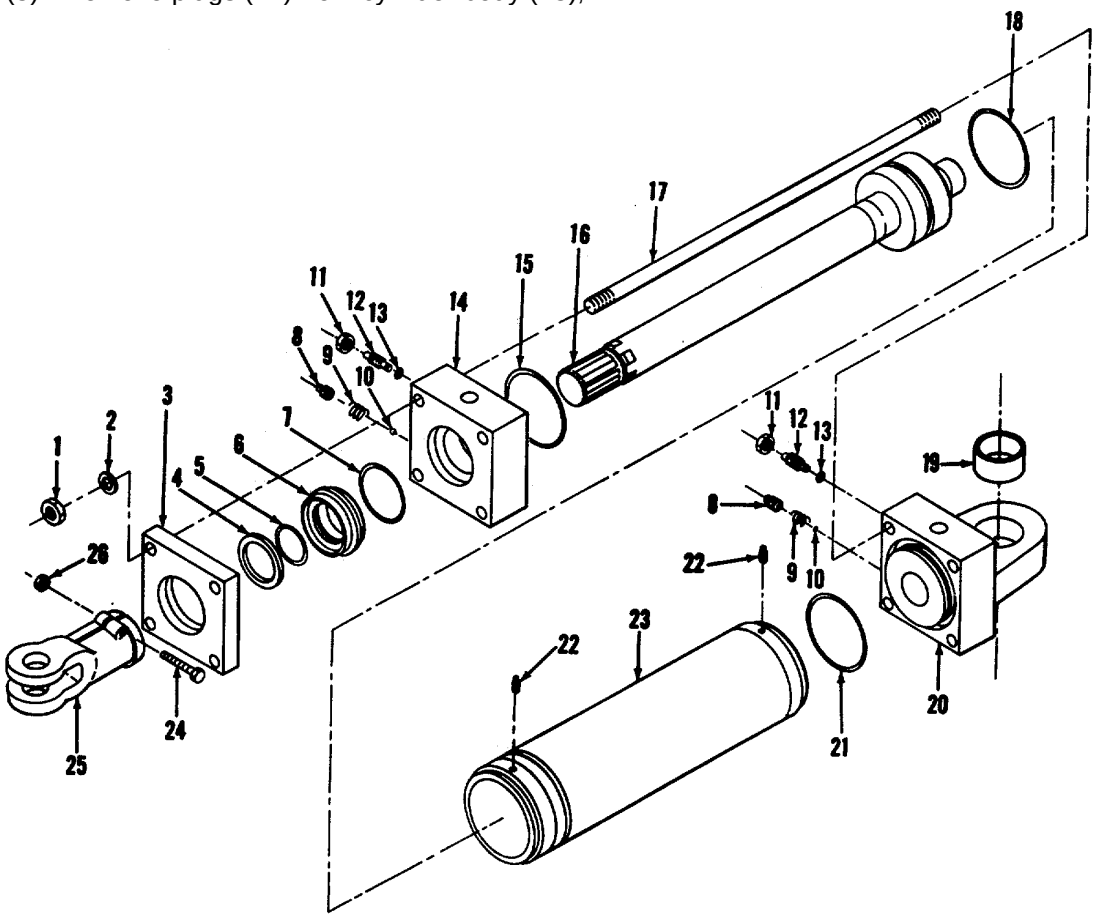


1 Fillet weld
2 Washer
3 Piston packing groove
4 Piston
5 Piston rod packing
6 Piston rod

ME 1930-203-34/10-26

Figure 10-26. Piston installation and welding.

(7) Remove piston rod (16) from cylinder body (23). Remove packing (18) from piston rod.
(8) Remove plugs (22) from cylinder body (23),



ME 1930-203-34/10-27

1 Nut
2 Washer
3 Bushing retainer
4 Wiper ring
5 Packing preformed
6 Piston rod bushing
7 Packing, preformed
8 Spring retaining plug
9 Ball check spring
10 Ball bearing
11 Nut
12 Needle valve
13 Packing, preformed
14 Rod end cover
15 Packing, preformed
16 Piston rod
17 Tie rod
18 Packing, preformed
19 Blind end cover bushing
20 Blind end cover
21 Packing preformed
22 Plug
23 Cylinder body
24 Bolt, machine
25 Rod end clevis
26 Nut

Figure 10-27. Steering cylinder assembly.

c. Cleaning, Inspection and Repair.

(1) Clean all metal parts in dry-cleaning solvent, Federal Specification P-D-680. Dry thoroughly with compressed air (10 psi).

(2) Inspect cylinder bore for scratches, scoring, and excessive wear. Remove slight scratches with crocus cloth, Federal Specification P-C-458. Replace cylinder body if bore exceeds 6.005 inch diameter.

(3) Inspect bushing for scratches, scoring,and wear. Remove scratches with crocus cloth, Federal

Specification P-C-458. Replace bushing if inside diameter exceeds 3.007 inches.

(4) Inspect piston for excessive wear, scratches, and imperfections. Remove scratches and minute imperfections with crocus cloth, Federal Specification P-C-458. Replace piston if outside diameter is less than 5.994 inches.

(5) Inspect piston rod for excessive wear, scratches, and imperfections. Remove scratches and minute imperfections with crocus cloth, Federal Specification P-C-458. Replace piston rod if diameter is less than 2.745 inches.

(6) Install new seals and packings.

(7) Inspect threaded parts for damage. Repair minor damage by chasing threads. If repair results in a loose fit or misalignment of parts, replace damaged parts.

(8) Inspect all machined surfaces for damage that could cause leakage or other malfunctions. Replace defective part.

(9) Inspect ball check valves for nicks or scratches that could keep the ball from seating properly. If any nicks or scratches are found, replace valve.

d. Reassembly. Reassemble steering cylinder in reverse order of disassembly.

NOTE

Prior to reassembly of hydraulic cylinder. immerse packings and wiper rings in engine oil, OE-10. Avoid using excessive amounts of lubricant.

10-20. Cargo Winch Control Valve

a. Removal and Disassembly.

(1) *Removal.*

*(*a) Close gate valve (3, fig. 3-30, TM 55i-1930-203-20) to master pressure pump supplying cargo winch system.

(b) Disconnect inlet, outlet, and return lines at valve. Tag lines for installation.

(c) Disconnect valve control rod.

(d) Remove four mounting bolts, washers, and nuts securing valve to mounting bracket. Remove valve.

(2) *Disassembly (fig. 10-28).*

(a) Remove drain plug (8) and drain fluid from valve.

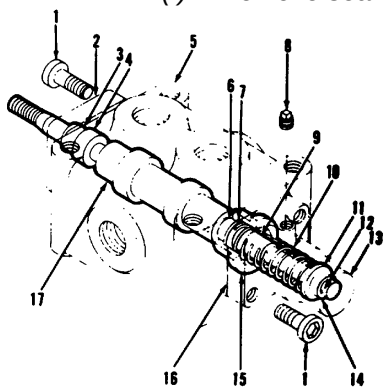
(b) Remove screws (1) securing end covers (2 and 13) to body (5). Remove end covers (2 and 13) and gaskets (16).

(c) Remove spool (17) with parts attached.

(d) Remove pin (12) and slide off spacers (6, 9, and 14), washers (7 and 11), and spring (10).

(e) Remove sleeve (15) from valve body.

(f) Remove seal (4) and bushing (3) from control end cover (2).



ME 1930-203-34/10-28

1	Screw	10	Spring
2	Control end cover	11	Washer, outer
3	Bushing	12	Pin
4	Seal	13	Spring end cover
5	Body	14	Spacer, outer
6	Spacer, inner	15	Sleeve
7	Washer, inner	16	Gasket
8	Drain plug	17	Spool
9	Spacer, middle		

Figure 10-28. Cargo winch control valve.

b. Cleaning. Inspection and Repair.

(1) Clean all metal parts in dry-cleaning solvent. Federal Specification P-D-680, and allow to drain dry.

(2) Inspect all parts for corrosion resulting from impurities in system and replace as necessary.

(3) Inspect spring (10) for distortion and proper tension. Approximately 75 pounds should be required to compress spring. Replace spring if defective.

(4) Inspect pin (12) for wear that would prevent a tight fit in spool.

(5) Inspect gaskets (16) and seal (4) for damage or deterioration and replace as necessary.

(6) Inspect bushing (3) and sleeve (15) for scoring, scratches, or grooves and replace if defective.

c. Reassembly and Installation.

(1) Reassembly. Reassemble the cargo winch control valve in the reverse order of disassembly.

NOTE

All new seals and gaskets should be soaked in clean engine oil, OE-10, before installation to provide a more efficient seal.

(*2*) *Installation.*

(a) Secure valve to mounting bracket with four bolts, washers, and nuts.

(b) Connect valve control rod.

*(*c) Connect all hydraulic lines.

(d) Open gate valve C3, fig. 3-30, TM 55- 1930-203-20) to master pressure pump supplying cargo winch system.

10-21. Fan Control Valve

a. *Removal and Disassembly*.

(1) *Removal*

(a) Close gate valves (3, fig. 3-30, TM 55-1930-203-20) in radiator fan hydraulic system.

(b) Remove valve control knobs.

(c) Disconnect and tag hydraulic lines to all fan control valves.

(d) Remove bolts, washers, and nuts securing valves and valve mounting bracket to cab wall. Remove valve.

(2) Disassembly (fig. 10-29).

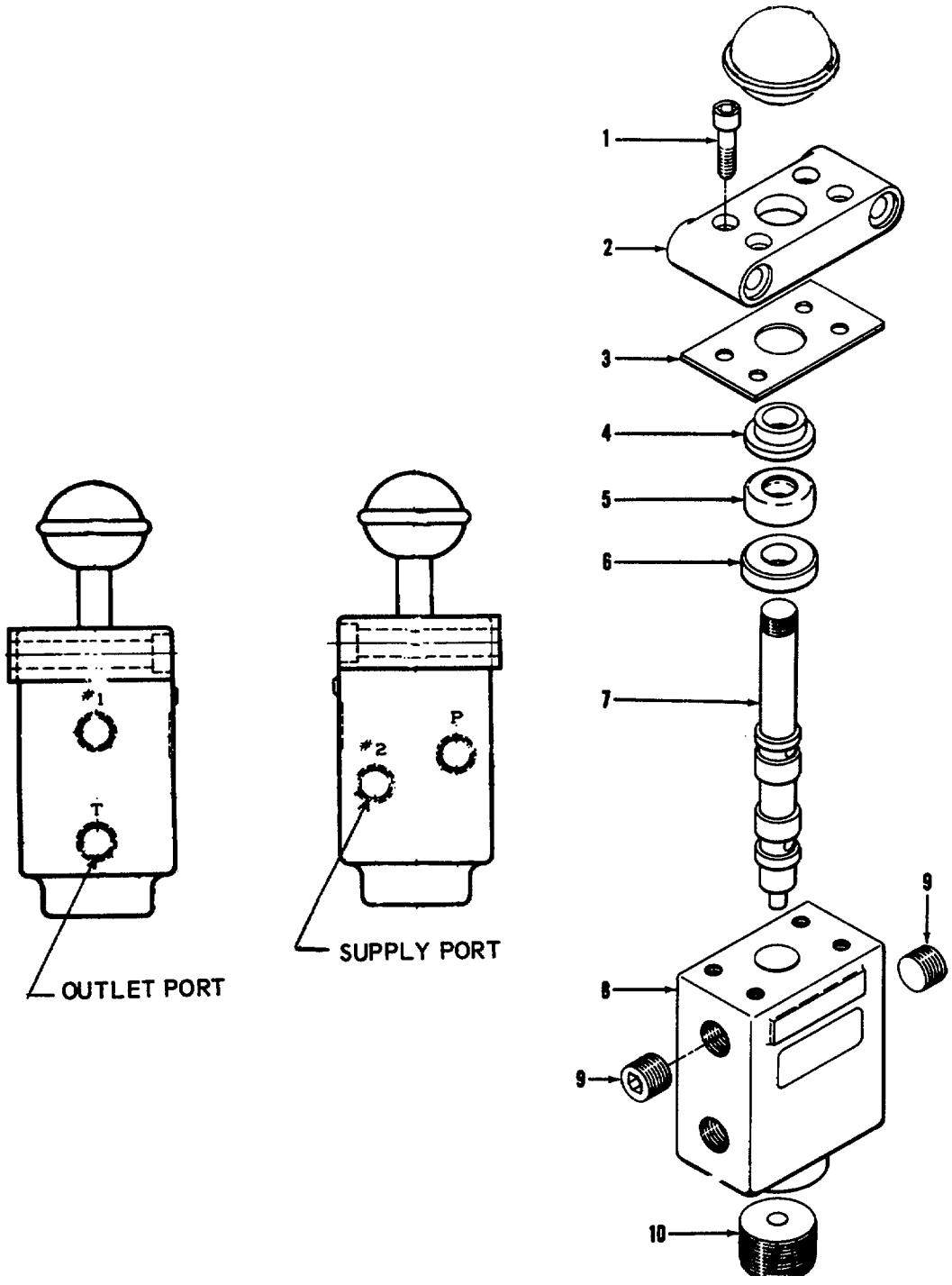
(a) Remove drain plug 110J and allow trapped fluid to drain from valve.

(b) Remove outlet plugs 19J.

(c) Remove four screws (1) securing cover (2) to body (8). Remove cover (2) and gasket (3).

(d) Press spool (7) from body (8) and remove bushing (4), seal (5), and washer (6).

b. Cleaning, Inspection and Repair.



ME 1930-203-34/10-29

1	Screw	6	Washer
2	Cover	7	Spool
3	Gasket	8	Body
4	Bushing	9	Outlet plug
5	Seal	10	Drain plug

Figure 10-29. Fan control valve.

(1) Clean all metal parts in dry-cleaning solvent. Federal Specification P-D-680, and allow to drain dry.
(2) Inspect all parts for corrosion resulting from impurities in hydraulic fluid and replace as necessary.
(3) Inspect gasket (3) and seal (5) for damage or deterioration and replace if defective.
(4) Inspect bushing (4) and spool (7) for scoring, scratches, or grooves and replace if defective.

c. Reassembly and Installation.

(1) *Reassembly*. Reassemble valve in the reverse order of disassembly.

NOTE

Plugs (9) are installed in inlet P and outlet No. 1.

NOTE

All new seals and gaskets should be soaked in clean engine oil, 0E-10, before installation to provide a more efficient seal.

(2) *Installation.* Install valve in the reverse order of removal.

10-32. Flow Control Valves

NOTE

The Model FRG-06-20-10 Cargo Well Pump flow control valves originally installed in the LARC s are obsolete. When the obsolete valve cannot be repaired, it will be replaced with the Model FRG- 06-24-12 valve illustrated in figure 10-31.

a. Description. Two Model FRG-06-20-10 or Model FRG-06-24-12 flow control valves (23, fig. 10-4) are used in the cargo well pump hydraulic system and three Model FRG-06-15-10 flow control valves (10, fig. 10-3) are used in the bilge pump hydraulic system. These valves provide a manual adjustment for rate of flow and system pressure. A mounting plate enable valves to be removed without disconnecting hydraulic lines. A pressure gage connection is provided for adjusting system pressure.

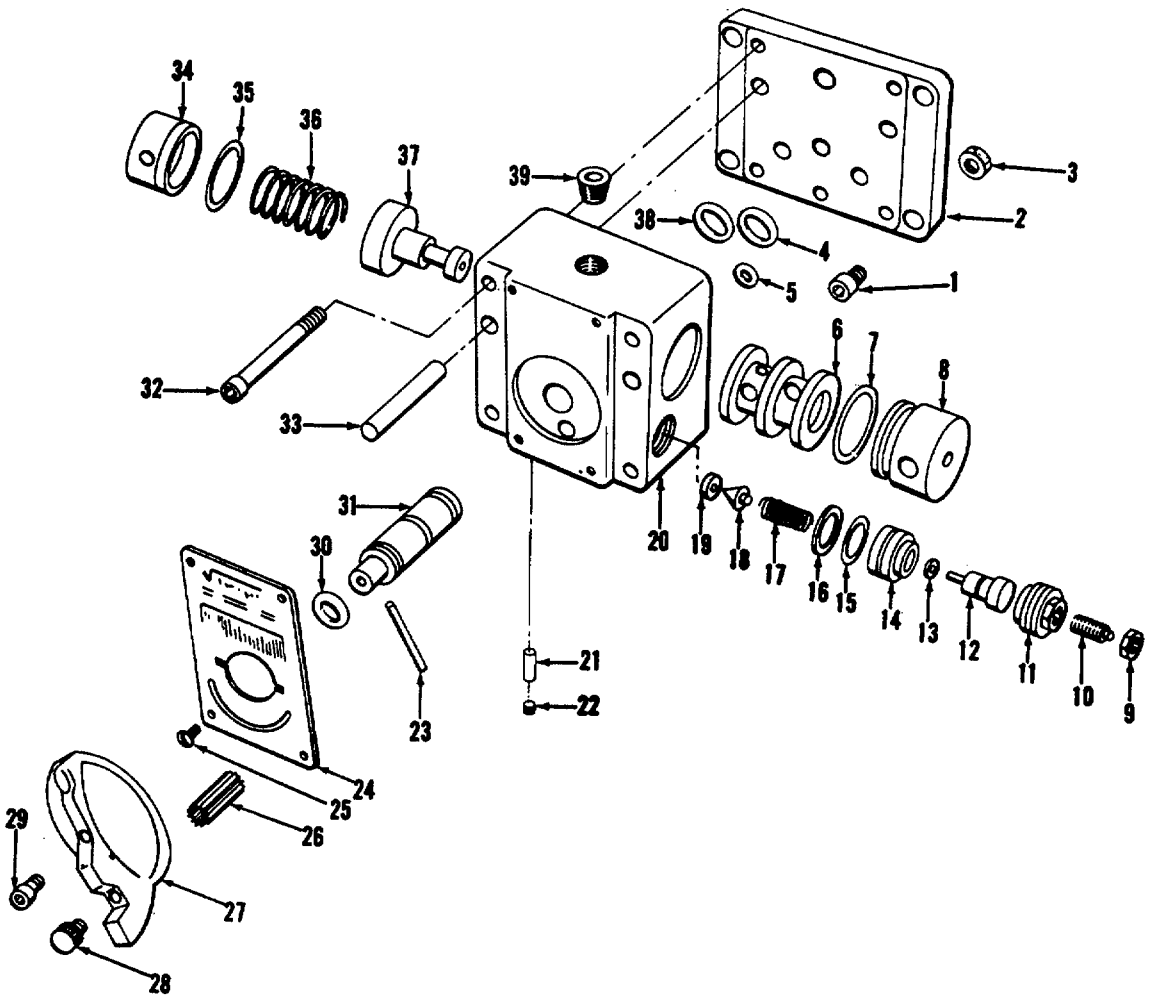
b. Removal.

(1) Close gate valve (3, fig. 3-30, TM 55-1930-203-20) in hydraulic system containing valve to be removed.

(2) Provide a suitable container for spillage and remove four screws (32, fig. 10-30, or 31, fig. 10-31) securing valve to subplate (2). Remove valve.

NOTE

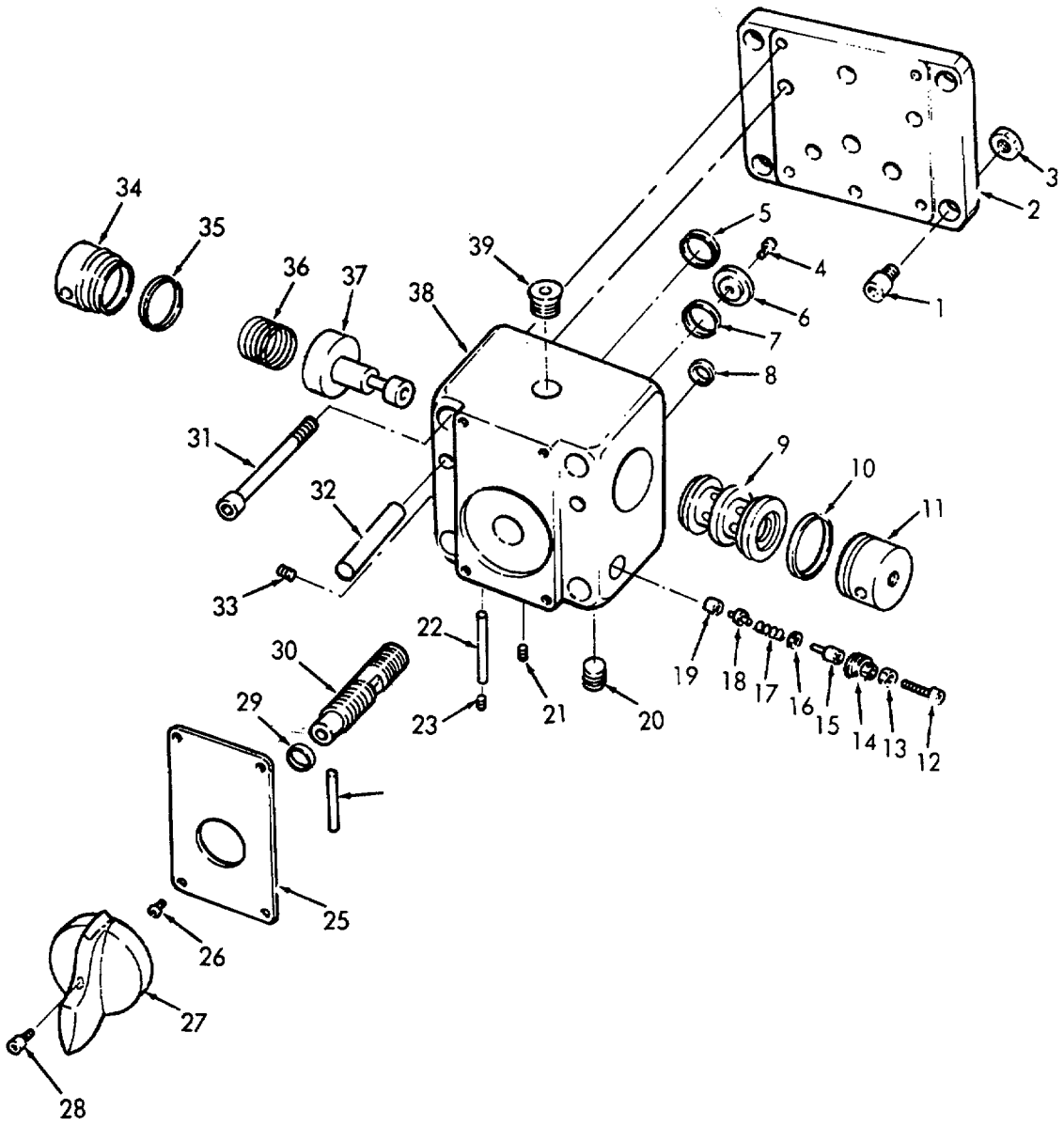
Removing valve without removing subplate (2) does not necessitate disconnecting hydraulic lines. To remove subplate, disconnect all hydraulic lines and remove four screws (1) and nuts (3).



ME 1930-203-34/10-30

1 Screw
2 Subplate
3 Nut
4 Packing, medium
5 Packing, small
6 Sleeve
7 Packing lh plug
8 Plug, lh
9 Locknut
1 Screw
11 Plunger retainer
12 Plunger
13 Packing, plunger
14 Packing retainer
15 Packing, retainer
16 Washer
17 Piston spring
18 Piston
19 Seat
20 Body
21 Pin
22 Plug
23 Pin
24 Nameplate
25 Screw
26 Pinion
27 Dial
28 Knob
29 Screw
30 Packing
31 Throttle
32 Screw
33 Pin
34 Plug, lh
35 Packing, rh plug
36 Valve spring
37 Valve
38 Packing, large
39 Plug

Figure 10-30. Flow control valve (Model FRG-06-15-10 and FRG-06-20-10).



1	Screw	14	Retainer, plunger	27	Dial
2	Subplate	15	Plunger	28	Screw
3	Nut	16	Packing plunger	29	Packing
4	Screw	17	Spring	30	Throttle
5	Packing	18	Piston	31	Screw
6	Retainer	19	Seat	32	Pin
7	Packing, medium	20	Plug	33	Plug
8	Packing, small	21	Plug	34	Plug, 1h
9	Sleeve	22	Pin	35	Packing, 1h
10	Packing, rh plug	23	Plug	36	Valve spring
11	Plug, rh	24	Pin	37	Valve
12	Screw	25	Name plate	38	Body
13	Locknut	26	Screw	39	Plug

Figure 10-31. Flow control valve (Model FRG- -24-12).

c. Disassembly .

(1) Models FRG-06-15-10 and FRG-06-20- 10 .

(a) Remove pins (33, fig. 10-30) securing plugs (8 and 34) .

(b) Remove plug (34), packing (35), spring 136), and valve (37) from right side of body (20) . Remove plug (8), packing (7), and sleeve (6) from opposite side .

(c) Remove screw (29) and lift off dial (27), pinion (26), and knob (28) .

(d) Remove four screws (25) and lift off nameplate (24) .

(e) Remove packing (4, 5, and 38) from rear of body .

(f) Remove pin (23) securing throttle (31) . Remove throttle (31) and packing (30) .

(g) Remove locknut (9), screw (10), and retainer (11) allowing plunger (12), packing (13 and 15), retainer (14), washer (16), spring (17), and piston (18) to fall free .

(h) Remove plug (22) and pin (21) securing seat (19). Remove seat .

(2) Model FRG-06.24-12 .

(a) Remove pins (32, fig. 10-31) securing plugs (11 and 34) .

(b) Remove plug (34), packing (351, spring 1361, and valve (37), from body (38). Remove plug (11), packing (101, and sleeve (9) from opposite side of body .

(c) Remove screw (28) and lift off dial (27) .

(d) Remove four screws (26) and lift off nameplate (25) .

(e) Remove packing (5, 7, and 8i from rear of body .

(f) Remove screw 14), retainer (6) and pin (24) securing throttle (30). Remove throttle (30) and packing (29) .

(g) Loosen locknut (13) and remove adjusting screw (12) .

(h) Remove retainer (14), plunger (15), packing (16), spring (17) and piston (18) .

(i) Remove plug (23) and pin (22) securing seat (19). Remove seat .

d. Cleaning, Inspection and Repair .

(1) Clean all metal parts in dry-cleaning solvent, Federal Specification P-D-680, and allow to drain dry .

(2) Inspect springs (17 and 36) for distortion and replace as necessary .

(3) Inspect hydrostatic valve, sleeve, piston, seat, and throttle for corrosion caused by impurities in the system. Replace defective parts .

(4) Inspect all plugs, screws, and threaded openings for damaged threads. Tap opening or replace part as necessary .

(5) Replace all packings .

e. Reassembly. Reassemble valve in the reverse order of disassembly .

NOTE

All new packing should be soaked in clean engine oil, OE-10, before installation to provide a more efficient seal .

f. Installation .

(1) If subplate (2, fig. 10-30, or 2, fig. 10-31) has been removed, secure subplate with screws (1) and nuts (3) and connect hydraulic lines .

(2) Secure valve to subplate (2) with four screws (32, fig. 10-30. or 31, fig. 10-31).

g. Adjustment .

(1) Remove gage outlet plug (39, fig. 10-30 or 10-31) and install a suitable pressure gage .

(2) Open gate valve closed in step b (1) above.

(3) Start engine necessary to pressurize system containing valve being installed (TM 55- 1930-203-10) .

(4) Loosen locknut (9, fig. 10-30. or 13, fig. 10-31) and dial locking screw (20, fig. 10-30, or 28, fig. 10-31). Using adjusting screw (10, fig. 10-30 or 12, fig. 10-31) to control pressure and dial (27) to control rate of flow, adjust valve as follows:

*(*a) On Model FRG-06-20-10 or Model FRG-06-24-12 flow control valves, adjust pressure to 1000 psi and set flow control dial between 7 and 8.

*(*b) On Model FRG-06-l5-10 flow control valves, adjust pressure to 550 psi and set flow control dial at 4 .

(5) Tighten locknut (19, fig. 10-30, or 13, fig. 10-31) and dial locking screw (29, fig. 10-30, or 28, fig. 10-31).

(6) Secure adjusting knob (28, fig. 10-30) and dial (27) with lock wire.

(7) Shut down engine.

(8) Remove pressure gage and install gage outlet plug (39).

10-33. Steering Control Valve

a. Description. Four-way control valves (2.5, fig. 10-7 and 26, fig. 10-8) are used to transmit steering control from the follow-up system to the steering hydraulic system. Each valve contains a spring that causes it to return to a neutral position when pressure is released at the control. When the valves are in a neutral position. fluid is routed to the hydraulic oil supply tank return line .

b. Removal and Disassembly .

(1) *Removal .*

*(*a) Close gate valves (3, fig. 3-30, TM 5.3-1930-203-20) in system containing valve to be removed.

*(*b) Disconnect inlet, outlet, and return lines and tag for installation .

*(*c) Disconnect valve control linkage .

*(*d) Remove four bolts, washers, and nuts securing valve to mounting plate. Remove valve .

(2) Disassembly (fig. 10-32).

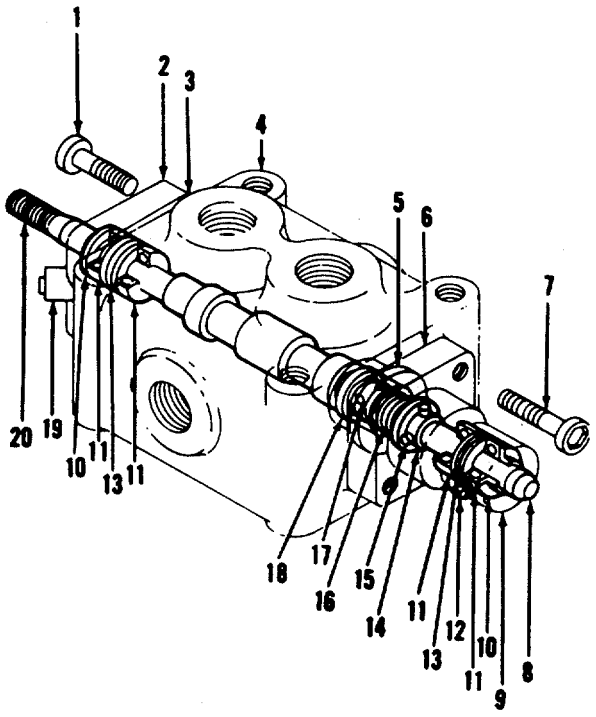
(a) Remove drain plugs (12 and 19) and allow valve to drain.

(b) Remove four screws (1), securing control end cover (2) to body (4). Remove cover (2) and gasket (3).

(c) Remove four screws (7) securing stem end cover (9) to body (4). Remove cover (9) and gasket (6).

(d) Slide stem (8) from body (4). Remove pin (15) and washer (14). Remove pin (17) and slide off spring (16) and washer (18).

(e) Press bushings(10), seals, (11), and spacers (13) fromcontrol end cover (2) and stem end cover (9).



ME 1930-203-34/10-32

1	Screw	11	Seal
2	Control end cover	12	Stem end cover drain plug
3	Gasket	13	Spacer
4	Body	14	Washer, outer
5	Sleeve	15	Pin, outer
6	Gasket	16	Spring
7	Screw	17	Pin
8	Stem	18	Washer
9	Stem end cover	19	Control end cover drain plug
10	Bushing	20	Control rod

Figure 10-32. Steering control valve.

c. Cleaning. Inspection and Repair.

(1) Clean all metal parts in dry-cleaning solvent, Federal Specification P-D-680, and allow to drain dry.

(2) Inspect all parts for corrosion resulting from impurities in hydraulic system and replace as necessary.

(3) Inspect spring (16) for distortion and proper tension. Approximately 30 pounds should be required to compress spring. Replace spring if defective.

(4) Inspect pins (15 and 17) for wear that would prevent a tight fit in spool. Replace worn pins.

(5) Inspect gaskets (3 and 6) and seals (11) for damage or deterioration and replace as necessary.

(6) Inspect bushings (10) and sleeve (5) for scoring, scratches, or grooves and replace if defective.

d. Reassembly and Installation.

(1) Reassembly. Reassemble the steering control valve in the reverse order of disassembly.

NOTE

AR new seals and gaskets should be soaked in dean engine oil, OE-10, before installation to provide a more efficient seal.

(*2*) *Installation.*

(a) Secure valve to mounting plate with four bolts, washers andnuts.

(b) Connect control linkage.

(c) Connect all hydraulic lines.

(d) Open gate valves closed in step *b* (1) *(a)* above.

10-34. Gate Valves

a. General Gate valves (16 and 27, fig. 10-1) are used in the lines between the hydraulic oil supply tank and each master pressure pump and in the hydraulic oil supply tank drain line.

b. Removal and Disassembly.

(1) *Removal.*

(a) Drain hydraulic oil supply tank (para 10-14a (1).

(b) Disconnect inlet and outlet lines and remove valve.

(*2*) *Disassembly (fig. 10-33).*

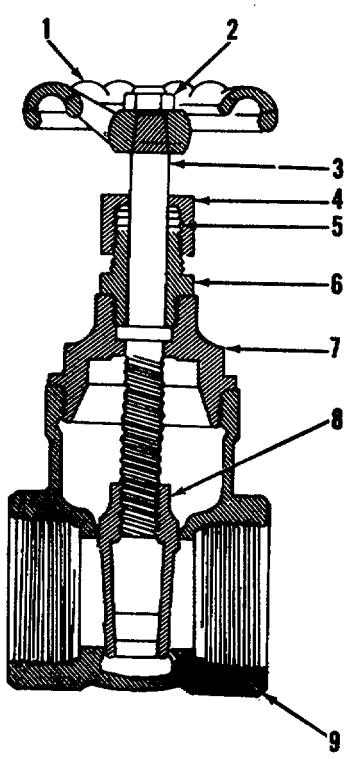
(a) Remove nut (2) and lift off handle (1) if installed.

(b) Remove packing nut (4) and packing 15).

(c) Remove stuffing box (6).

(d) Turn stem (3) toward closed position until valve is fully closed; then, continue turning until stem (3) is free from disk (8). Remove stem (3).

(e) Remove bonnet (7) and disk 8).



ME 1930-203-34/10-33

1 Handle
2 Nut
3 Stem
4 Packing nut
5 Packing
6 Stuffing box
7 Bonnet
8 Disk
9 Body

Figure 10-33. Gate Valve.

c. Cleaning, Inspection and Repair.

(1) Clean all parts with dry-cleaning solvent, Federal Specification P-D-680. Thoroughly clean old packing material from stem (3), packing nut (4), and stuffing box (6).

(2) Inspect disk (8) for grooves for damage that would cause leakage. Replace disk if defective.

(3) Replace packing.

d. Reassembly and Installation.

(1) *Reassembly.*

(a) Insert stem (3) through bonnet (7) and atach disk (8).

(b) Install bonnet (7) on body (9).

(c) Install stuffing box (6), new packing (5), and packing nut (4).

(d) Install handle (1) and nut (2).

(2) *Installation.*

(a) Connect valve to inlet and outlet lines.

(b) If valve is being installed in line between hydraulic oil supply tank and master pressure pump, turn valve to fully open position and remove and destroy handle (1).

(c) Fill hydraulic oil supply tank (LO 55-1930-203-12).

10-35. Inline Check Valves

a. Description. The inline check valves used on the LARC are of the spring closing type. Inline check valves in the ramp system and in the master pressure pump discharge line supplying the steering alignment system have a cracking pressure of 65 psi. Check valves in other master pressure pump discharge lines and in the steering alignment system have a cracking pressure of 5 psi.

b. Replacement.

(1) If check valve is in pump discharge line, close gate valve in that circuit.

(2) Provide a suitable container for spillage and disconnect hydraulic lines.

(3) Install new check valve.

CAUTION

Be sure check valve is positioned to give correct direction of fluid flow.

(4) Open gate valve closed in step (1) above.

10-36. Right Angle Check Valve

a. Description. A right angle check valve (18, fig. 10-7) is located in the line between the cargo winch control valve and the aft steering system. The valve has a 5 psi cracking pressure and uses a spring closing action to check a high velocity reverse flow of fluid.

b. Removal and Disassembly.

(1) *Removal.*

(a) Position cargo winch control valve to route fluid to hydraulic oil supply tank return line by moving [ever to starboard position. Provide a means for holding lever in this position.

(b) Provide a suitable container for spillage and disconnect inlet and outlet lines. Remove right angle check valve.

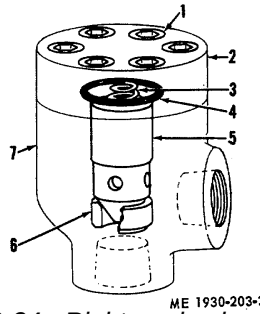
(2) *Disassembly (fig. 10-34).*

(a) Remove six capscrews 1) securing cover (2) to body (7). Remove cover (2).

(b) Remove packing (4), spring (3), and valve (5).

NOTE

Seat (6) should not be removed unless it is found to be damaged or defective.



1 Capscrew
2 Cover
3 Spring
4 Packing
5 Valve
6 Seat
7 Body

Figure 10-34. Right angle check valve.

c. Cleaning, Inspection and Repair.

(1) Clean all metal parts in dry-cleaning solvent, Federal Specification P-D-680, and allow to drain dry.

(2) Inspect valve (5) and seat (6) for scratches or grooves caused by impurities in the system and replace if damaged. If valve (5) requires replacement, seat (6) should be pulled and replaced also.

(3) Inspect spring (3) for distortion and proper tension. A pressure of 5 psi should be required to compress spring. Replace spring if defective.

(4) Replace packing (4).

d. Reassembly and Installation.

(1) *Reassembly*. Reassemble check valve in the reverse order of disassembly.

(2) *Installation.*

(a) Connect valve inlet and outlet lines.

(b) Position cargo winch control valve to neutral.

10-37. Female Needle Valves

a. Description. Four needle valves (47, fig. 10-7) are located in the forward and aft steering alignment systems. These manual shutoff type valves are normally in the closed position, being opened only when adjusting wheel alignment.

b. Replacement.

(1) Close gate valve (3, fig. 3-30, TM 55- 1930-203-20) to master pressure pump supplying steering alignment system.

(2) Relieve pressure from system containing valve to be removed by opening neede valve in line connecting that system to the hydraulic oil supply tank vent line (fig. 10-7).

(3) Provide a suitable container for spillage and disconnect valve at both ends.

(4) Install new needle valve.

(5) Open gate valve closed in step (1) above.

(6) Bleed all air from system and check wheel alignment as outlined in paragraph 10-3 a.

10-38. Male-Female Needle Valves

Description. Needle valves (20, fig. 10-7 and 32, fig. 10-8) having one male and one female outlet are installed on all steering cylinders, port alignment cylinders, and in the lines to the steering system pressure gages. This valve is a manual shutoff type valve.

b. Steering Cylinder Needle Valve Replacement. Remove valve from steering cylinder and install new valve. Place new valve in closed position.

c. Alignment Cylinder Needle Valve Replacement.

(1) Relieve pressure from system containing valve to be removed by opening needle valve in line connecting that system to the hydraulic oil supply tank vent line (fig. 10-7).

(2) Remove valve from alignment cylinder and install new valve.

(3) Bleed all air from system and check wheel alignment as outlined in paragraph 10-3 a.

d. Pressure Gage Needle Valve Replacement.

(1) Close gate valves (3, fig. 3-30, TM 55-1930-203-20) to master pressure pumps supplying steering system.

(2) Provide a suitable container for spillage and remove valve.

(3) Install new valve.

(4) Open gate valves closed in step (1) above.

(5) Disconnect line at pressure gage. Start one engine (TM 55-1930-203-10) and bleed all air from pressure gage line. Reconnect line.

(6) Shut down engine.

10-39. Multiple Unit Valves

a. Description. The multiple unit valve is an assembly of directional control valves flanked by inlet and outlet units. A relief valve is incorporated in the inlet unit. Each control unit is equipped with a centering spring which returns the spool to a neutral position when actuating pressure is released. The port multiple unit valve (1, fig. 10-2) contains one T and two D type control units and controls fluid flow to the ramp cylinders, port bilge pump, and port cargo well pump. The starboard multiple unit valve (22) contains two T and two D type control units and controls fluid flow to the ramp cylinders, starboard cargo well pump, and star- board and aft bilge pumps. The control unit bodies of the T and D type control units are identical, only the spools are different. The spools used in the T units have two lands. Spools used in the D units have three lands.

b. Removal and Disassembly.

(1) *Removal.*

(a) Close gate valves in system containing valve to be removed.

(b) Disconnect all hydraulic lines and tag for installation.

(c) Remove cotter pins (6, fig. 10-35) and fulcrum rod (7).

(d) Disconnect controls by removing cotter pins (3) and clevis pins (2). Remove control handles.

(e) Remove eight bolts (9), washers (4), and nuts (5) securing valve (1) to mounting plate. Remove valve (1).

(2) *Disassembly.*

(a) Unit removal

NOTE

Replacement of a control unit spool should be accomplished with multiple unit valve assembled to obtain proper spool fit.

1. Remove five bolts (10) and nuts (8) and remove mounting brackets.

2. Separate units.

CAUTION

Use care when separating units to avoid damage to spacers and packing.

(b) Inlet unit disassembly.

1. Remove sleeve (1, fig. 10-36) and gasket (2).

2. Remove spring (5), piston (17), and washers (3, 4, and 6).

3. Remove plug (10) securing spring (9) and valve (8). Remove spring and valve.

4. Remove plug (13) and pin (15) securing seat (16). Remove seat.

5. Remove packing (11 and 14).

(c) Control unit disassembly.

1. Remove four screws (14, fig. 10-37) securing cover (1) to control unit body (5). Remove cover.

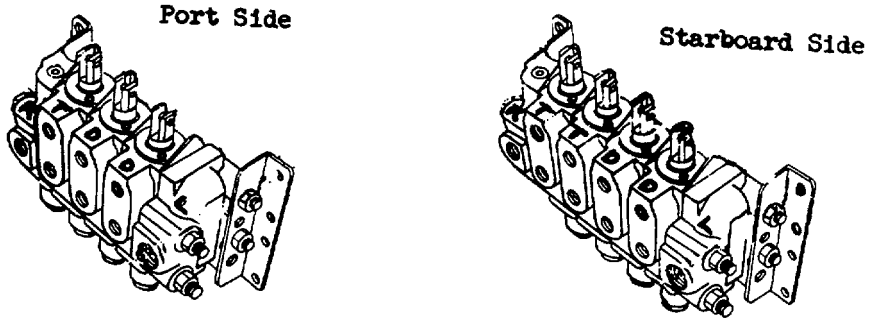
2. Remove washers (2) and spring (3). Slide spool (7) out of body (5).

NOTE

Keep each spool together with its respective control unit body and tag the body as to the unit for proper reassembly.

3. Remove two screws (10) securing wiper ring plate (9). Remove wiper ring plate (9) and wiper ring (8).

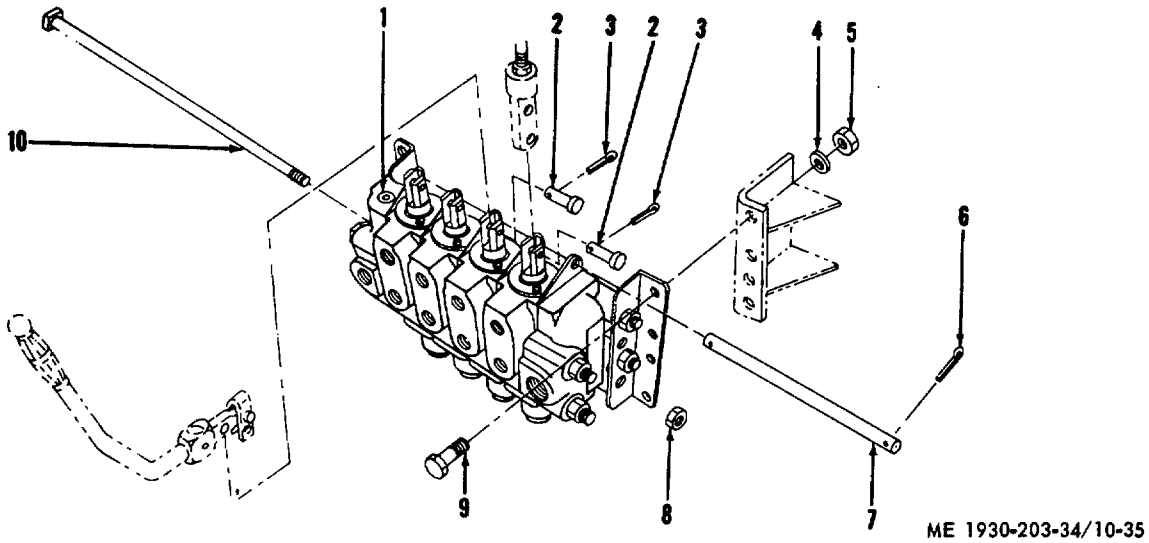
4. Remove packing (4). If control unit has been removed from assembly, remove packing (11 and 13).



LEGEND

R - Valve inlet unit
T - Valve control unit
D - Valve control unit
L - Valve outlet unit

VALVE UNIT LOCATIONS



1	Multiple unit valve	6	Cotter pin
2	Clevis pin	7	Rod, fulcrum
3	Cotter pin, control retaining	8	Nut, valve assembly
4	Washer	9	Bolt, valve mounting
5	Nut, valve mounting	10	Bolt, valve assembly

Figure 10-35. Multiple unit valve removal.

c. *Cleaning, Inspection and Repair.*

(1) *Inlet unit.*

(a) Clean all metal parts in dry-cleaning solvent, Federal Specification P-D-680, and allow to drain dry.

(b) Inspect all parts for corrosion resulting from impurities in hydraulic system and replace as necessary.

(c) Inspect springs for distortion and replace if defective.

(d) Inspect all threaded parts and openings for stripped or damaged threads. Replace defective parts.

(e) Inspect sleeve (1, fig. 10-36), valve (8), seat (16), and piston (17) for grooves or scratches. Replace defective parts.

(f) Replace gasket (2) and packing (11 and 14).

(2) *Control unit.*

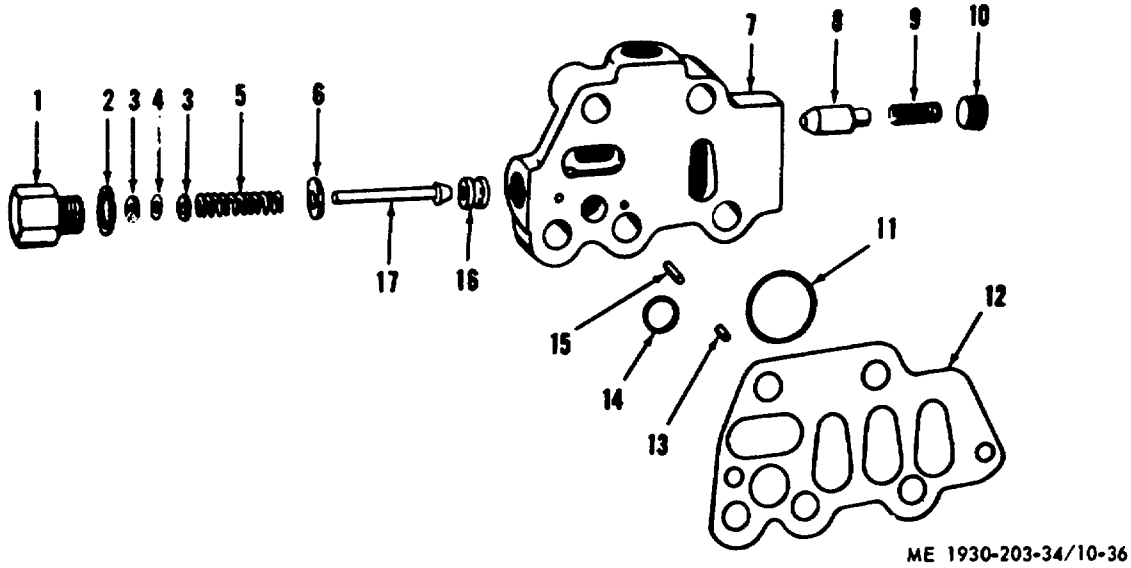
(a) Perform steps (1) (a) through (1) (d) above.

(b) Inspect spool (7, fig. 10-37) for grooves or scratches. If spool is scored considerably, the body bore will be also and complete control unit should be replaced. If spool has been leaking excessively and is not grooved or scored, leakage can be contributed to normal wear. In this case, spool should be replaced with one of larger diameter.

NOTE

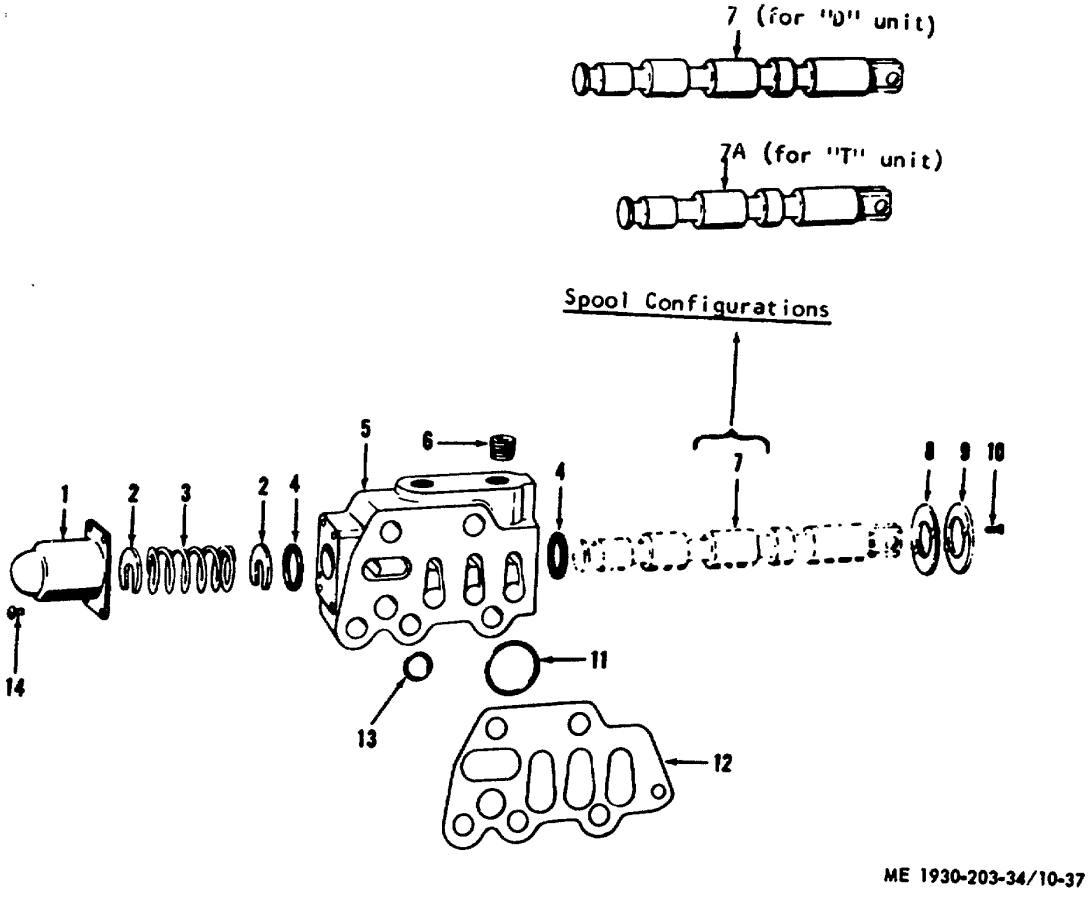
Spool diameter is indicated by a number etched on the stem. For example, a spool having a 0.9997 inch diameter will be etched with the number 7 and a spool having a 0.9998 inch diameter will have the number 8.

(c) Replace all packings (4, 11, and 13).



1 Sleeve
2 Gasket
3 Washer, piston spring, inner and outer
4 Washer, piston spring, center
5 Spring, piston
6 Washer, piston compensating
7 Inlet unit body
8 Valve
9 Spring valve
10 Plug, valve spring retaining
11 Packing, large
12 Spacer
13 Plug, pin retaining
14 Packing, small
15 Pin
16 Seat
17 Piston

Figure 10-36. Multiple unit valve inlet unit.



1	Cover	8	Wiper ring
2	Washer, spring retaining	9	Wiper ring plate
3	Spring	10	Screw, wiper ring plate retaining
4	Packing, spool to body	11	Packing, large
5	Control unit body	12	Spacer
6	Plug, outlet	13	Packing, small
7	Spool	14	Screw, cover retaining

Figure 10-37. Multiple unit valve control unit.

d. Reassembly and Installation.

(1) *Reassembly.*

(*a*) *Control unit reassembly.*

NOTE

Control unit body (5, fig. 10-37) should be in stalled with remaining units of multiple unit valve and bolts (10, fig. 10-35) tightened to proper torque before reassembling internal components. See step *(c)* below for unit installation.

1. Lubricate packing (4, fig. 10-37) with clean engine oil, OE-10, and install in body (5).
2. Install wiper ring (8) and wiper ring plate (9). Secure with two screws (10).
3. Slide spool (7) into body (5).

CAUTION

Packing (4) must be lubricated. Do not attempt to slide spool through dry packing.

NOTE

Be sure to install the proper spools in each of the two different type control units. Spools used in the T type control units have two lands. The D type control units have three lands. Improper installation will result in the incorrect direction of oil flow.

4. Install spring (3) and washers (2).
5. Secure cover (1) to body (5) with screws (14).

(b) Inlet unit reassembly.

1. Install seal (16, fig. 10-36) and secure with pin (15) and plug (13).
2. Install valve (8) and spring 19). Secure with plug (10).
3. Place spring (5) and washers (3, 4, and 6) on piston (17) and install in body (7). Secure with sleeve (1) and gasket (2).

(c) Unit installation.

1. Mount one mounting bracket and inlet unit on five bolts (10, fig. 10-35).
2. Lubricate packings (11 and 14, fig. 10-36) with petrolatum, Federal Specification VV-P-236, and install on inlet unit. Install spacer (12).
3. Install one control unit.
4. Lubricate packings (11 and 13, fig. 10-37) with petrolatum, Federal Specification VV-P-236, and install on control unit. Install spacer (12).
5. Repeat steps 3 and 4 above for remaining control units.
6. Install outlet unit and mounting bracket. Install nuts (8, fig. 10-35) and tighten to 250 to 300 inch-pounds.

(2) *Installation.*

(a) Fasten valve to mounting plate with eight bolts (9, fig. 10-35), washers (4), and nuts (5).
(b) Connect controls with clevis pins (2) and cotter pins (3).
(c) Install fulcrum rod (7) and secure with cotter pins (6).
(d) Connect all hydraulic lines.
(e) Open gate valves closed in step b(1) (a) above.

10-40. Series CT10 Relief Valve

a. Description. The series CT10 is a manually adjustable, balanced piston-type pressure control valve. These valves are used in the radiator fan, cargo winch, and aft steering hydraulic systems to provide a maximum limit for pressure in the system (38, fig. 10-5; 20, fig. 10-6; and 29, fig. 10-7. A pressure gage connection is provided on each valve to facilitate adjustment.

b. Removal and Disassembly.

(1) *Removal.*

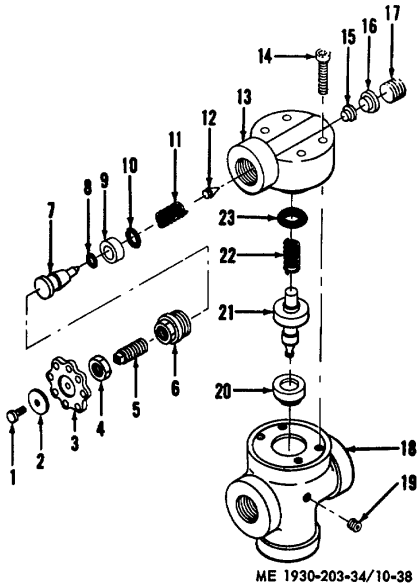
(a) Close gate valve (3, fig. 3-30, TM 55-1930-203-20) in system containing valve to be removed.
(b) Provide a suitable container for spillage. Disconnect and tag lines. Remove valve.

(2) Disassembly (fig. 10-38).

(a) Remove four screws (14) securing cover assembly to valve body (18). Remove cover assembly and packing (23).

(b) Remove spring (22), piston (21), and seat (20) from body (18).

(c) Remove locknut (4), screw (5), and retainer (6) allowing plunger (7), packing (8 and 10), spacer (9), spring (11), and piston (12) to fall free. Remove vent plugs (17 and 16) and remove seat (15).



1	Screw	13	Cover
2	Washer	14	Screw, cover mounting
3	Handle	15	Cover assembly seat
4	Locknut	16	Inner vent plug
5	Screw, adjusting	17	Outer vent plug
6	Retainer	18	Body
7	Plunger	19	Gage plug
8	Packing, plunger	20	Valve seat
9	Spacer	21	Valve piston
10	Packing, spacer	22	Valve spring
11	Cover assembly spring	23	Packing, cover-to-body
12	Cover assembly piston		

Figure 10-38. Series CT10 relief valve.

c. Cleaning, Inspection and Repair.

(1) Clean all metal parts in dry-cleaning solvent, Federal Specification P.D-680, and allow to drain dry.
(2) Inspect springs (11 and 22) for distortion and replace as necessary.

(3) Inspect pistons (12 and 21) and seats (15 and 20) for grooves or scratches caused by impurities in the system. Replace defective parts.

(4) Inspect all plugs, screws, and threaded openings for damaged threads. Tap opening or replace part as necessary.

(5) Replace all packing.

d. Reassembly and Installation.

(1) Reassembly. Reassemble relief valve in the reverse order of disassembly.

NOTE

All packing should be soaked in clean engine oil, OE-10, before installation to provide a more efficient seal.

(2) *Installation.*

(a) Connect inlet and outlet lines.

(b) Open gage valve closed in step b (1) (a) above.

(c) Loosen locknut (4) and turn adjusting screw (5) to full counterclockwise.

(d) Remove gage plug (19) and install a suitable pressure gage.

(e) Start engines necessary to activate system containing valve (TM 55-1930-203-10).

(f) Turn adjusting screw (5) clockwise to obtain desired system pressure. System pressures are radiator fan 1000 psi; cargo winch, 1300 psi; and aft steering 1300 psi.

(g) Tighten locknut (4).

(h) Shut down engines.

(i) Remove pressure gage and install gage plug (19).

(j) If a new valve has been installed, remove screw (1), washer (2), and handle (3), then destroy handle.

10-41. Series CF16 Relief Valve

a. Description. The series CF16 relief valve is similar to the series CT10 described in paragraph 10-40a. Mounting flanges have been added to facilitate removing valve without removing lines. This valve is used in the forward-steer steering hydraulic system (12, fig. 10-8).

b. Removal and Disassembly.

(1) *Removal.*

(a) Close gate valves (3, fig. 3-30, TM 55-1930-203-20) to master pressure pumps supplying forward steering system.

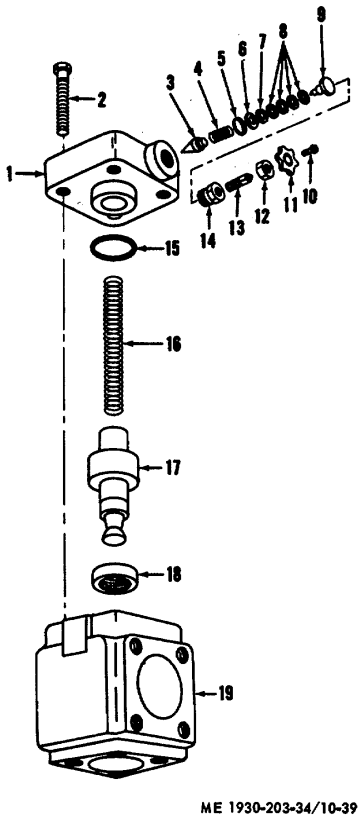
(b) Provide a suitable container for spillage. Disconnect pressure page line. Disconnect inlet, outlet, and return lines by removing screws securing mounting flanges to valve body.

(2) *Disassembly (fig. 10-39).*

(a) Remove four screws (2), securing cover (1) to body (19). Remove cover.

(b) Remove packing (15), spring (16), and piston (17). Pull seat (18) from body (19).

(c) Remove locknut (12), screw (13), and retainer (14) allowing plunger (9), spacers (8), packings (7 and 5), bushing (6), spring (4), and piston (3) to fall free.



1	Cover	10	Screw, handle retaining
2	Screw, cover retaining	11	Handle
3	Cover valve piston	12	Locknut
4	Cover valve spring	13	Screw, adjustment
5	Packing, adjustment spacer seal	14	Retainer
		15	Packing, body to cover
6	Bushing	16	Vertical valve spring
7	Packing, adjustment plunger	17	Vertical valve piston
8	Spacer	18	Vertical valve seat
9	Plunger	19	Body

Figure 10-39. Series CF16 relief valve.

c. Cleaning, Inspection and Repair.

(1) Clean all metal parts in dry-cleaning solvent. Federal Specification P-D-680, and allow to drain dry.

(2) Inspect springs (4 and 16) for distortion and replace as necessary.

(3) Inspect pistons (3 and 17) and seat (18) for grooves or scratches caused by impurities in the system. Replace defective parts.

(4) Inspect all plugs, screws, and threaded openings for damaged threads. Tap opening or replace part as necessary.

(5) Replace all packing.

d. Reassembly and Installation.

(1) Reassembly. Reassemble relief valve in the reverse order of disassembly.

NOTE

All packing should be soaked in clean engine oil. (OE-10), before installation to provide a more efficient seal.

(2) *Installation.*

(a) Connect inlet, outlet, and return lines by securing flanges to valve body with flange mounting screws.

(b) Turn adjustment screw (13) to full counter-clockwise position.

(c) Open gate valves closed in step *b* (1) *(a)* above.

(d) Install a suitable pressure gage at valve gage port.

(e) Start one port and one starboard engine (TM 55-1930-203-10).

(f) Turn adjustment screw clockwise until a reading of 1300 psi is obtained on pressure gage. Tighten locknut (12).

(g) Shut down engines.

(h) Remove pressure gage and connect pressure gage line.

(i) If a new valve is being installed, remove and destroy handle (11).

CHAPTER 11

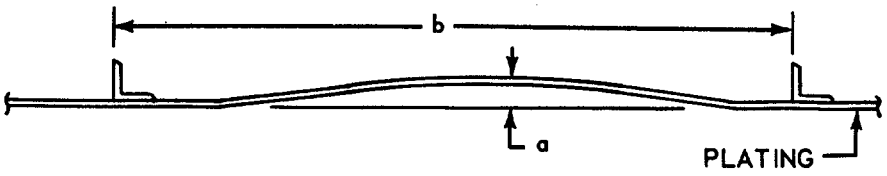
CAB AND HULL REPAIR INSTRUCTIONS

Section I. GENERAL PROCEDURES FOR REPAIR

11-1. Cabin and Hull Distortion Limits

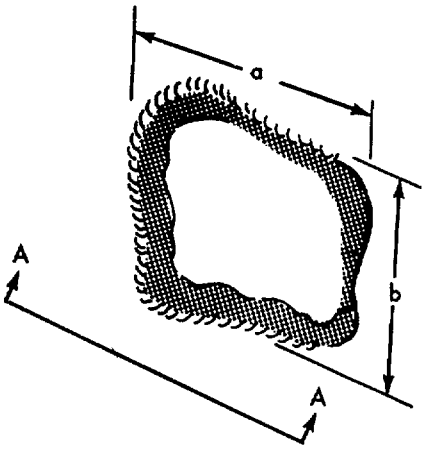
a. Existing sheet meta1 distortion in the form of waves, sags, or bulges will not exceed 0.017 inch per inch between frame members (fig. 11 -1A). The plating buckles and fairness deviation for installation of new sheet metal shall not exceed 0.007 inch per inch between framing members.

b. Dents not over ¾ inch in depth covering an area not more than one square foot are acceptable (fig. 11-1B). Rust pitting which does not reduce the metal thickness more than 50 percent in any area prior to rework is acceptable. Welded patches are acceptable, providing the weld is ground smooth and overall contour is maintained. All cracks or breaks will be welded and ground smooth. Normal distortion caused by forming or welding operations is acceptable. Any distorted or twisted frame stiffener or gusset plate will be straightened to within ½ inch in 5 feet of its original configuration (fig. 11-1C) or replaced.

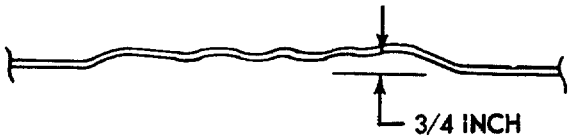


b= DISTANCE BETWEEN FRAMING MEMBERS (INCHES)
a= .007 X b (FOR NEW PLATING)
.017 X b (FOR EXISTING PLATING)

A. WAVES, SAGS OR BULGES IN PLATING.

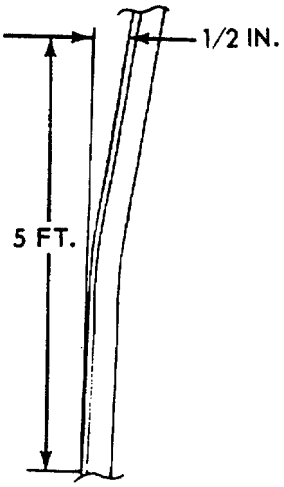


a X b = 1 SQUARE FOOT



VIEW A -A

B. DENTS IN PLATING.



C. BENT OR TWISTED STIFFNERS AND GUSSET PLATES.

ME 1930-203-34/1 1.1

Figure 11-1. Cab and hull metal distortion limits.

11-2. Materials

a. All guage steel shall he in the as-rolled condition and shall be "COR-TEN" manufactured by U.S. Steel Corporation, "MAYARI R" manufactured by Bethlehem Steel Co., or "REPUBLIC 50" manufactured by Republic Steel Co.

b. All plate steel shall conform to ASTM

(American Society for Testing Materials) Specification A131, in the following grades:

(1) Grade A, 3/16 inch to 1/2 inch.

(2) Grade B. 1/2 inch to 1 inch. Structural shapes shall conform to ASTM specification A36.

11-3. Welding

a. Welding of guage steel used on this equipment shall be by the shielded metal-arc method. This is a welding process wherein the welding heat is produced by an electric arc between the covered metal electrode and the work. Shielding is obtained from gases caused by the decomposition of the electrode covering. Pressure tis not used and filler metal is obtained from the electrode. Electrodes used in welding COR-TEN steel must be absolutely dry. Low alloy steel electrodes (ASTM tentative specification for iron and steel arc-welding electrodes. serial designation A316 type E.018 iron powder low hydrogen) are to be used for welding COR-TEN steel. If type E7018 rods are not available, types E7015 or E7016 may be used. Welds made with these electrodes will have yield points in excess of those of the base metal.

b. Welding shall be in accordance with the AWS (American Welding Society) welding handbook and TM9-237. For types and sizes of welds to be used, refer to table 1-3.

11.4. Marine Gear Access Covers (Refer to FO-4)

a. Removal. The marine gear access covers are located amidship on the port and starboard sides of the cargo well. To remove them, proceed as follows:

(1) Remove eight nuts (7) and bolts (6), which secure the access cover and spacing blocks (14) to the center girder.

(2) Remove the thirty-six bolts (12) and lockwashers (14) which secure the access cover to the deck.

(3) Remove the four plug bolts (12) and lock-washers (14) from lifting eye blocks (18) and insert four lifting eyes (19) in their places.

(4) With suitable hoisting equipment, lift and remove access cover.

b. Installation. Install marine gear access cover in the reverse order of removal.

NOTE

If the gasket (10) was replaced. seal gasket joint with sealing compound before installing access cover.

11-5. Cab Top Half

a. Removal.

(1) Remove bow light, range light, and searchlight from top of cab (para 6-13. 6-14, and 6-16).

(2) Remove radio antenna and disconnect coaxial feeder cable.

(3) Remove windshield wiper piping.

(4) If equipped with a compass, remove the compass.

(5) Disconnect all electrical wires that run from cab top to cab body structure by uncoupling each connector plug and pulling out top half. Tag and number each connector jack and its respective connector plug for reassembly.

(6) Following demarcation flange in interior of cab. make sure that all wires and piping have been disconnected.

(7) Remove brackets holding defroster piping to cab top, just aft of forward windows.

(8) Remove hinge pins and lift off cab door.

(9) Remove all nuts, bolts, and washers from demarcation flange.

CAUTION

Before proceeding, make a final inspection of both inside and outside of cab to ascertain that obstructions that could interfere with the lifting operation or could damage the equipment have been removed.

(10) Position crane boom directly over cab top.

(11) Secure cables to cab top.

(12) Raise cab top and position in predetermined area.

CAUTION

The cab top should be guided by hand until it is clear of the lower cab structure, to prevent any damage to equipment in the lower portion of the cab.

NOTE

If conditions warrant, suitable weather protection must be provided for area vacated by cab top removal.

b. Installation. Install cab top in reverse order of removal.

11-6. Cab Scuttle Cover (Refer to TM 55-1930-203-20, figure 3-29)

a. General. On hulls 19 through 60, the opening in the top of the cab is sealed with a scuttle cover. A

dog handle is installed on the bottom side of the scuttle cover to lock the scuttle cover in the closed position.

b. Dog Handle Removal and Installation. Refer to TM 55-1930-203-20 to remove and install the dog handle.

c. Scuttle Cover Removal. Refer to TM 55-1930-203-20, figure 3-29 and remove the scuttle cover as follows:

(1) Unlatch dog handle (13).

(2) Remove two cotter pins (61, nuts (5), bolts (2), and washers (3) and (4) securing scuttle cover.

(3) Remove scuttle cover (1).

(4) Inspect cover for cracks. Repair all cracked scuttle covers by welding.

d. Installation. Install scuttle cover in the reverse order of removal.

11-7. Window Glass and Seals

a. Removal. Refer to figure 11-2 and remove as follows:

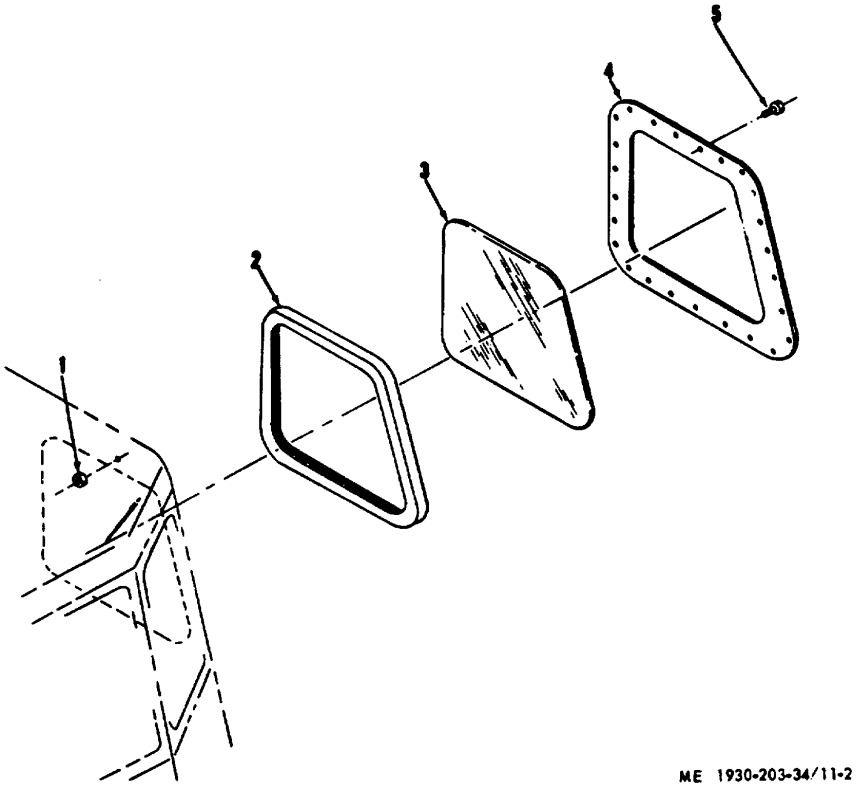
(1) Remove bolts (5) and nuts (1) from window retainer (4). Support glass (3) to prevent its falling out and remove window retainer (4).

NOTE

On hulls 19 through 60 the windshield wiper motor must be removed prior to removing the front glass retainer. Refer to paragraph 9-29 for removal of the windshield wiper motor.

(2) Press out glass (3) and window seal (2) from inside of cab.

(3) Clean all remaining pieces of window seal and adhesive from window frames and retainers with a wire brush.



1 Nut. plain
2 Window seal
3 Glass
4 Window retainer
5 Bolt, machine

Figure 11-2. Cab window.

b. Installation.

(1) Notch window seal (2) at corners to obtain a smooth surface when seal is installed.
(2) Coat circumference of window frame and window seal (2) with rubber cement.
(3) Apply second coat of rubber cement to outer surface of window seal (2).
(4) Insert glass (3) in window seal (2).
(5) Install window retainer (4) and secure to window frame with bolts (5) and nuts (1).

Section II. REPAIR INSTRUCTIONS

11-4. Operator's Seat

a. Removal.

(1) Remove four bolts and lockwashers at base of seat.
(2) Lift seat from mount.

b. Cleaning, Inspection and Repair.

(1) Clean seat assembly, except backrest and seat cushion, with lint-free cloth dampened in dry-cleaning solvent, Federal Specification P-D-680.

(2) Clean seat backrest and seat cushion with mild soap and water. Apply leather preservative, Military Specification MIL-L-10095.

(3) Examine for torn cushion cover or broken springs. Repair seat if damaged.
(4) Inspect frame for bends or breaks. Repair by straightening, or replace if necessary.
(5) Inspect back support of seat frame for breaks or wear in metal or fabric. Repair or replace if necessary.
(6) Examine the carriage assembly, spring, sector, and retainer. Replace any defective or damaged parts.
(7) Lubricate all moving parts of carriage assembly with grease, Military Specification MIL-G-10924.

c. Installation. Install operator's seat in reverse order of removal.

11-9. Cargo Well Dunnage

a. Removal.

(1) Remove two lag screws from lower dunnage board bracket.
(2) Lift dunnage board up and remove from bulkhead.

b. Disassembly. Remove three wood screws securing hanger to dunnage board and remove hanger.

c. Repair.

(1) Use 2-by-12 inch timber when replacing damaged dunnage boards.
(2) Cut length to suit location in cargo well.
(3) Lay dunnage board being replaced beside new dunnage board and mark hanger location on new dunnage board.
(4) Notch out dunnage board to fit hanger.
(5) Use hanger as a template and drill holes 1 inch deep for number 14 wood screws.
(6) Trim and notch bottom of dunnage board to fit lower bracket.

d. Reassembly. Reassemble in the reverse order of disassembly.

e. Installation. Install cargo well dunnage in reverse order of removal.

11-10. Compartment Scuttle Covers

a. Removal. Refer to TM 55-1930-203-20, figure 3-20 and remove as follows:

(1) Unlatch dog bolt and wing nut (9).
(2) Remove cotter pins (3), nut (4), bolts (6), and washers (5).
(3) Remove scuttle cover (1).

b. Inspection and Repair.

(1) Inspect scuttle covers for security of hinges.
(2) Inspect covers for cracks. Repair all scuttle cover cracks by welding.
(3) Inspect dog bolt and wing nut (9) for broken or bent condition. Replace damaged dog bolts and wing nuts.

c. Installation. Install scuttle cover in reverse order of removal.

11-11. Corrosion Preventive Anodes

a. General. There are 12 corrosion preventive zinc anodes located on the LARC. One anode is welded to the outboard side of each rudder, one to the port and starboard side of each tunnel, and three in each aft wheel well.

b. Replacement.

(1) Remove galvanized coating from the steel straps of zinc anodes.

(2) Apply zinc oxide paste, Federal Specification TT-Z-301, to zinc surfaces of anodes to be in contact with mounting surfaces, prior to installation.

(3) Weld steel straps of anodes into place.
(4) Paint steel straps same color as surrounding surfaces.

NOTE

Do not paint zinc portion of anodes.

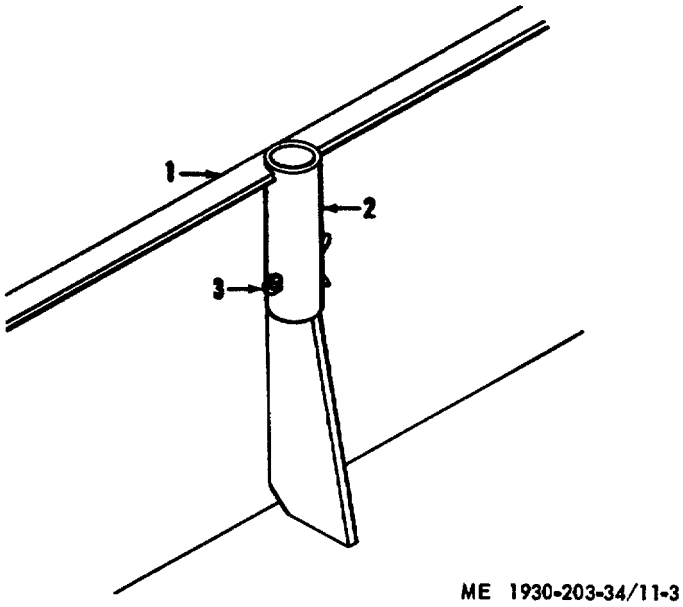
11-12. Stanchion Sockets

a. Removal.

(1) Remove lifelines and stanchion from LARC (TM 55-1930-203-20).
(2) Cut existing stanchion socket (2, fig. 11-3, loose from bulwark (1).

b. Installation.

(1) Align and weld stanchion socket (2) to bulwark (1). Refer to paragraph 11-3 for welding procedures.
(2) Install lifeline and stanchion on LARC (TM 55-1903-203-20).



1 Bulwark
2 Stanchion socket
3 Cotter pin

Figure 11-3. Stanchion socket removal and installation.

11-13. Machinery Hatch Covers

a. Brace Assembly (fig. 11-4).

(1) *Removal*.

(a) Raise hatch cover to fully open position.

(b) Support cover in open position before removing brace.

(c) Remove brace (6) by removing bolts (1), nuts (5), and washers (2,3,and 4).

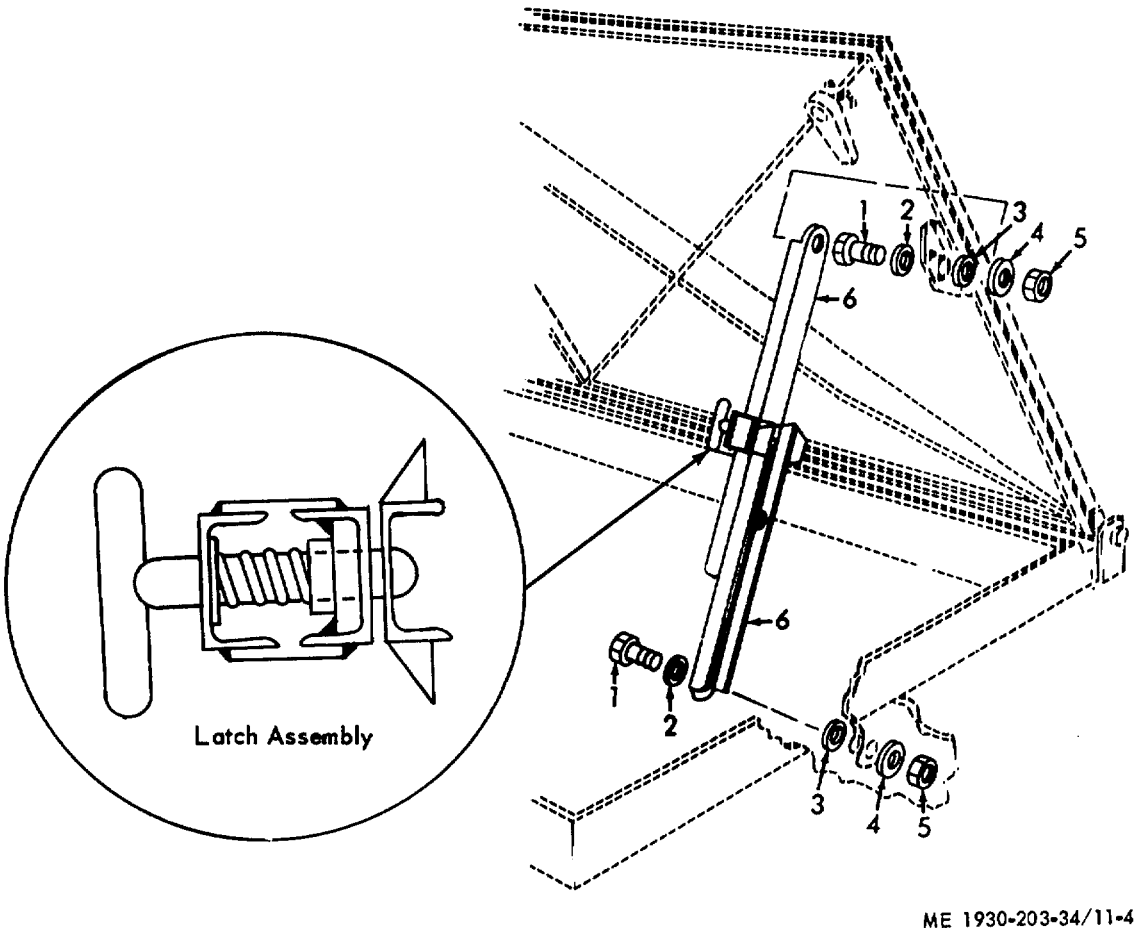
(2) *Inspection and repair.*

(a) Inspect brace for bent or broken condition. If bent or broken, replace brace.

(b) Inspect brace for freedom of movement and operation. Lubricate brace if necessary. If brace binds after lubrication, replace brace.

(c) Inspect brace latch assembly for proper operation. If necessary, replace as follows:

1. Cut off the latch assembly at the 1/8 inch thick plates on both sides.
2. Cut latch handle off the latch pin.
3. Remove pin, springs, and washers.
4. Replace new latch assembly using old latch assembly as a model.



1 Bolt
2 Washer
3 Washer
4 Washer
5 Nut
6 Brace

Figure 11-4. Brace assembly, removal and installation.

(3) *Installation*. Install brace assembly in reverse order of removal.

b. Hatch Cover Assembly.

(1) *Removal.*

(a) Raise hatch cover to fully open position.

(b) Support cover in open position.

(c) Remove nuts, bolts, spacers, and washers from upper end of brace assemblies (fig. 11-4).

(d) Remove cotter pin (9, fig. 11-5) and hinge pins (8) from both hinges.

(e) Lift hatch cover assembly from LARC with suitable hoisting equipment.

(2) *Cleaning, inspection and repair.*

(a) Inspect hatch cover for security of hinges and condition of painted surfaces.

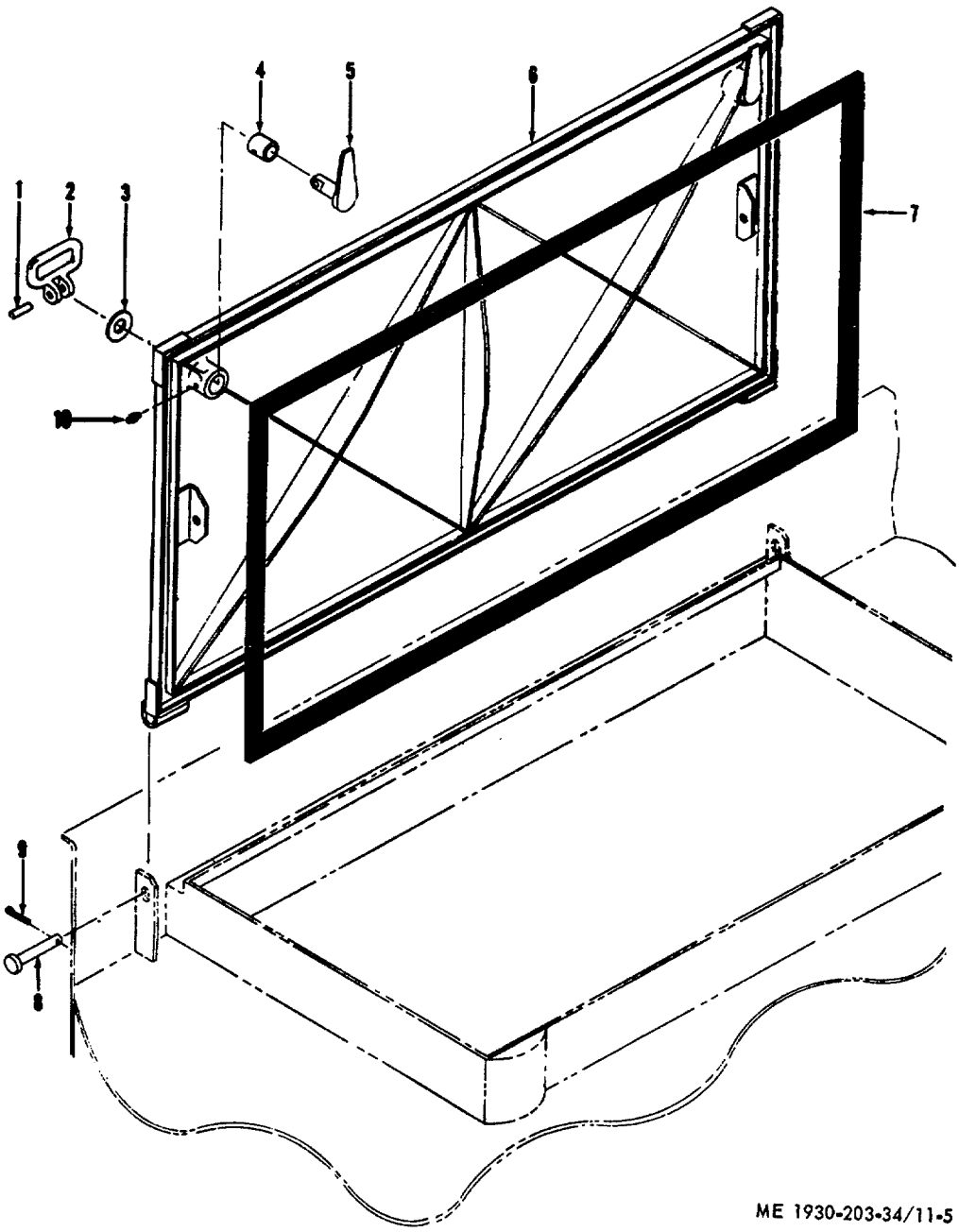
(b) Inspect covers for cracks. Repair all cracks by welding.

(c) Inspect hatch cover gasket (7) for presence of grease, rust, or paint spots on sealing surfaces. Remove paint, grease or rust spots from gasket.

(d) Inspect hatch cover gasket for looseness. If gasket has become loose, secure gasket to hatch cover with rubber cement.

(e) Inspect hatch cover gasket for breakage or deterioration. If gasket is broken or deteriorated, remove gasket and clean gasket seat on hatch cover. Secure gasket to hatch cover with rubber cement.

(3) *Installation*. Install hatch cover assembly in reverse order of removal.



1 Pin
2 Latch handle
3 Washer
4 Bushing
5 Latch
6 Hatch cover
7 Gasket
8 Hinge pin
9 Cotter pin
10 Lubrication fitting

Figure 11-5. Hatch cover assembly removal and installation.

11-14. Manually Operated Drainage System

a. General. There are 11 bilge drain valves located at different points in the bilge area (fig. 11-6). These valves provide a means of draining water from the bilge areas while the LARC is on land. The valves are operated by hand-wheels connected to the valves by flexible shafts.

b. Bilge Drain Valves.

(1) *Removal and installation*. Refer to TM 55-1930-203-20 to remove and install the bilge drain valves.

(2) *Disassembly*. Refer to TM 55-1930-203-20 to disassemble the bilge drain valves.

(3) *Cleaning*. *Inspection, and repair*. Refer to TM 55-1930-203-20 to clean, inspect and repair the bilge drain valves.

(4) *Reassembly*. Refer to TM 55-1930-203-20 to reassemble the bilge drain valves.

c. Drain Valve Seal Replacement.

(1) Remove bilge drain valve (TM 55-1930-203-20).

(2) Remove drain valve foundation.

(3) To remove valve seat, cut through seat from inside to outside diameter in four places, 90° apart. Melt silver braze from each quarter section of valve seat and remove seat.

(4) Clean valve seat opening of all traces of brazing material.

(5) Insert new valve seat and silver braze in place as shown in figure 11-7.

(6) Replace drain valve foundation as shown in figure 11-7.

(7) Replace drain valve (TM 55-1930-203-20).

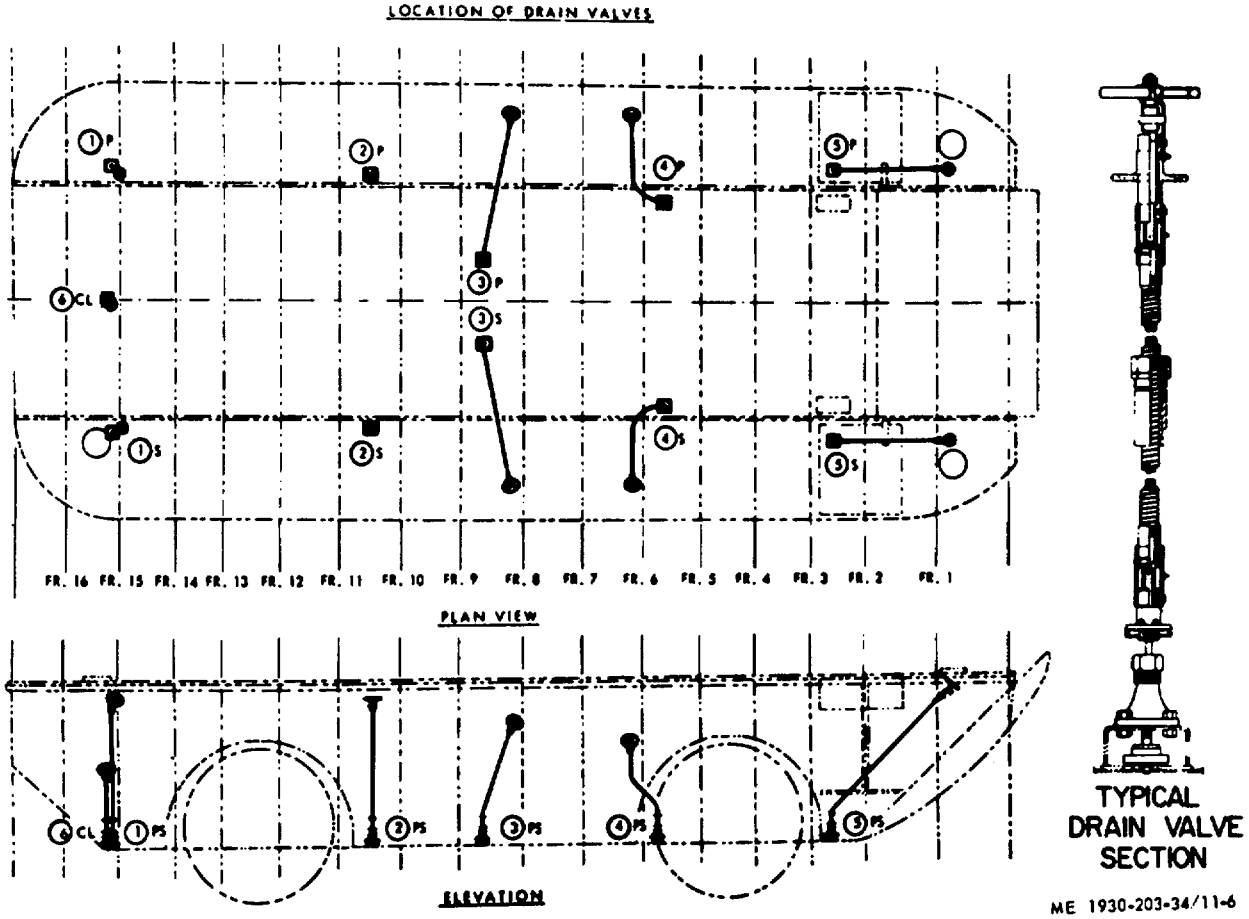


Figure 11-6. Bilge drain valve locations.

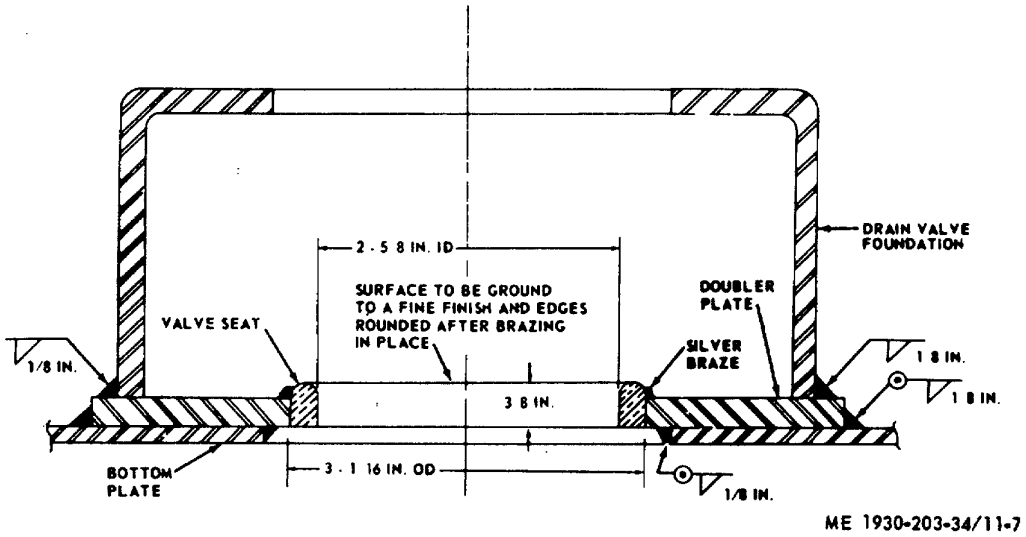


Figure 11-7. Valve seat installation.

11-15. Ramp Hinge Pins

a. Removal.

(1) Lower ramp (TM 55-1930-203-10), so that it rests firmly and evenly on the ground or other surface.

WARNING

Hinge pins must be replaced one at a time allowing three remaining hinge pins to support ramp. Removal of two or more hinge pins may result in the weight of the ramp misalining the remaining hinges, causing damage to ramp and possible injury or death to personnel.

(2) Remove cotter pin, castellated nut, and washer from one end of hinge pin.
(3) Punch or press hinge pin out of hinge fitting.
(4) Remove lubrication fitting, nut, and washer from hinge pin.
(5) Remove spacers from joints of hinge.

NOTE

If spacers are worn down to 1/16 inch thick, replace worn spacers with new spacers.

b. Installation. Install spacers and hinge pin in reverse order of removal and lubricate pin (LO 55-1930-203-12).

NOTE

Apply a light film of grease on hinge pin before attempting to install hinge pin into hinge.

11-16. Rubber Fenders

a. Removal. Refer to figure 11-8 and proceed as follows:

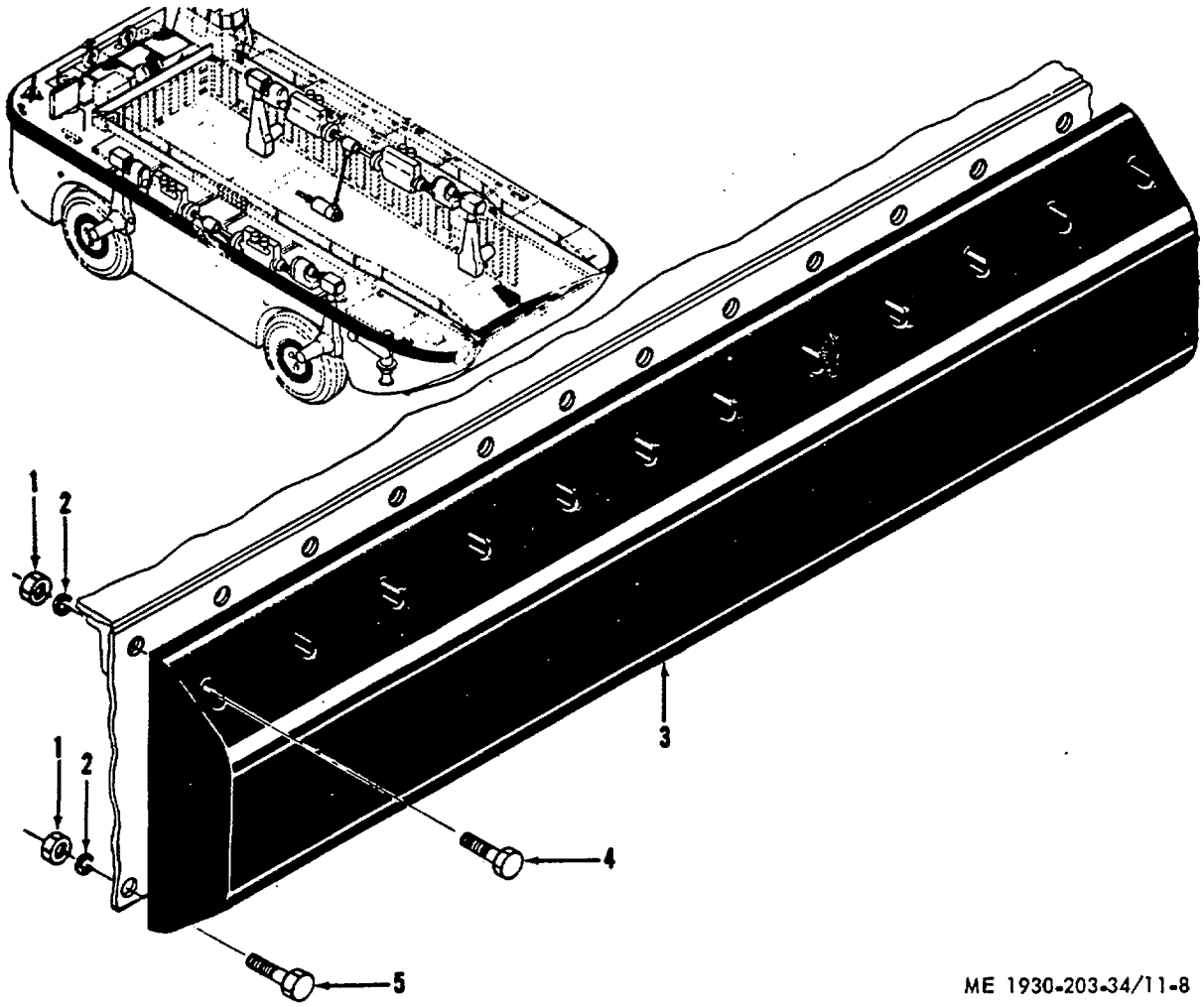
(1) Remove rubber cement from fender mounting bolt holes.
(2) Remove bolts (4), lockwashers (2), nuts (1), and capscrews (5), which secure fender (3) to shell plating.
(3) Pry fender section loose from shell plating by using a thin blade.
(4) Lift off fender (3).

WARNING

Support the fender while removing bolts and capscrews. (Otherwise it may fall free and injure personnel.

b. Installation.

(1) Scrape old adhesive cement off of shell plate and see that it is clean.
(2) To insure water tight joints, fender must be fitted in place before installation.
(3) Trim fender ends so that a tight joint between it and the next fender is obtained.
(4) On bends, bevel the ends of the fender for a tight fit.
(5) Apply adhesive cement to fraying surfaces of the fender and its ends.
(6) Position fender in place, and secure with bolts, capscrews, lockwasher and nuts.
(7) Fill gaps between fenders with additional cement.
(8) Fill mounting bolt holes in fender with Minnesota Mining and Manufacturing Company No. 612 cement, or equal, after installation.



1 Nut
2 Lockwasher
3 Rubber fender
4 Bolt
5 Capscrew

Figure 11-8. Rubber fender removal and installation.

11-17. RAMP SEAL PROTECTOR

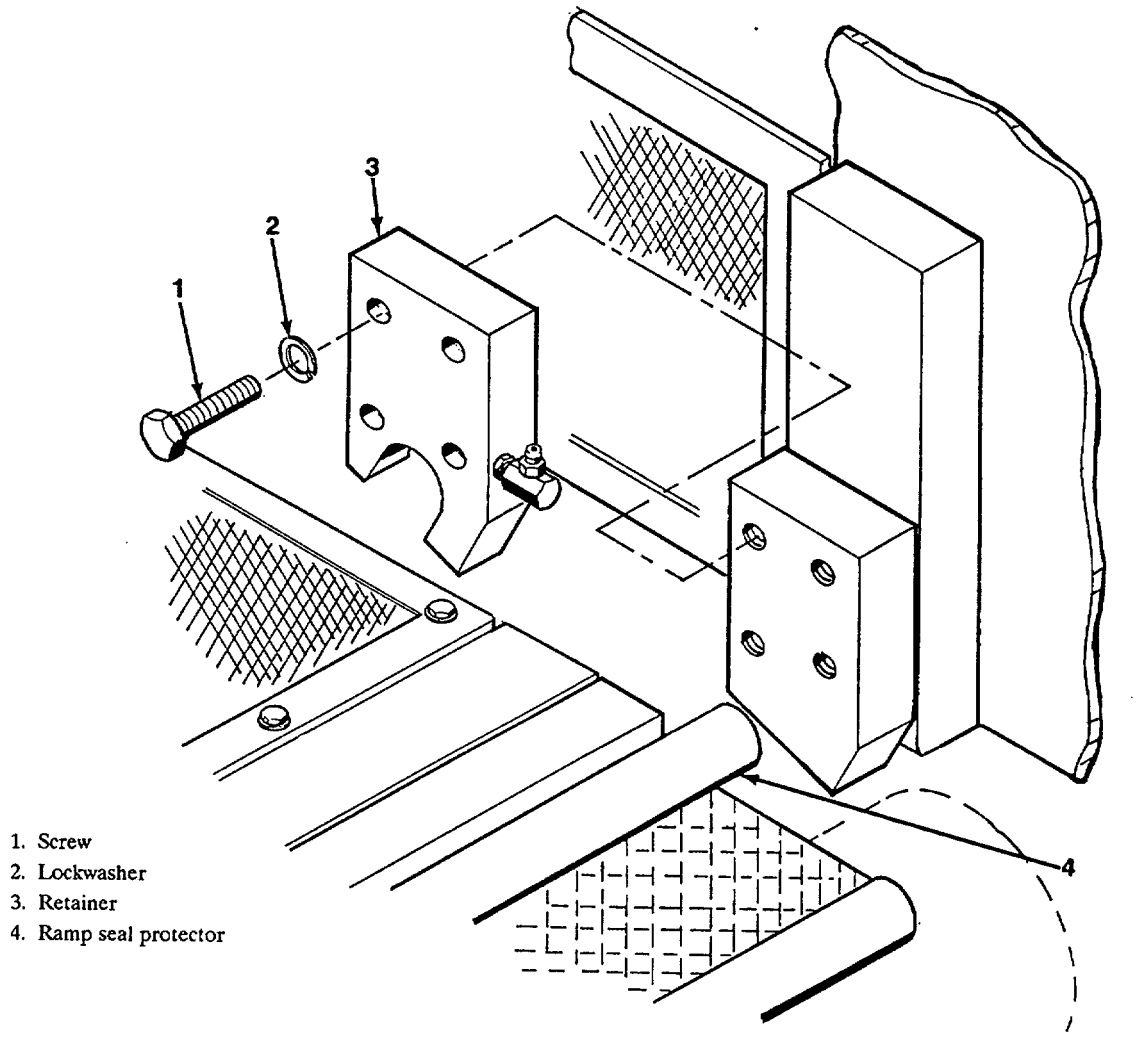


Figure 11-9. Ramp seal protector, removal and installation.

a. Removal

(1) Remove screws (1,fig. 11-9) and lockwashers (2) freeing retainers (3).
(2) Remove retainers (3) at each end of ramp seal protector (4).
(3) Lift and remove protector (4).

b. Installation.

(1) Place new ramp seal protector (4) in position over ramp seal.
(2) Install retainers (3) at each end of protector (4) andsecure using screws (1) and lockwashers (2).

CHAPTER 12

GAGES AND INSTRUMENTS

12-1. Temperature Gages

a. General. The temperature gages located on the gage boards are provided for the engines, transmissions, marine gears, and gathering boxes.

b. Removal and Installation (Hulls 5 through 18).

(1) Remove capscrews (1, fig. 12-1) and lock-washers (2) securing gage board guard (23) and remove gage board guard.

(2) Remove screws (24), frames (22, 25, and 26) and gaskets (20 and 21)securing glass (18 and 19). Remove glass and gasket (17).

(3) Disconnect tubing to all gages at base of gage board in upper machinery area.

(4) Remove screws (3) and lockwashers (4) securing panel (16) to LARC and slide panel from its mount to remove gages.

(5) Remove screws (5) securing temperature gage and remove gage.

(6) Drain fluid from related components in which temperature gage bulb is installed.

(7) Unscrew coupling and remove temperature sensing bulb with capillary tubing.

NOTE

Do not attempt to remove capillary tubing from the gage or bulb. Do not cut or crimp the capillary tubing.

(8) Remove attaching spacers (7) and mounting ring (27).

(9) Install temperature gage in reverse order of removal.

NOTE

Be careful when installing capillary tubing, that the tubing does not break or become damaged

c. Removal and Installation (Hull 19 through 60).

(1) Remove gage board cover (3) by removing screws (32).

(2) Remove screws (39) securing gage board guard (40) and remove guard.

(3) Remove screws (38) and frames (36 and 37) securing gage board glass (34). Remove glass and gasket (35).

(4) Drain fluid from related component in which temperature sensing bulb is installed.

(5) Unscrew coupling and remove temperature sensing bulb.

NOTE

Do not attempt to remove capillary tubing from the gage or bulb. Do not cut or crimp the tubing.

(6) Remove screws (5) securing temperature gage and remove gage with capillary tubing and bulb.

(7) Repeat steps (8) and (9) above.

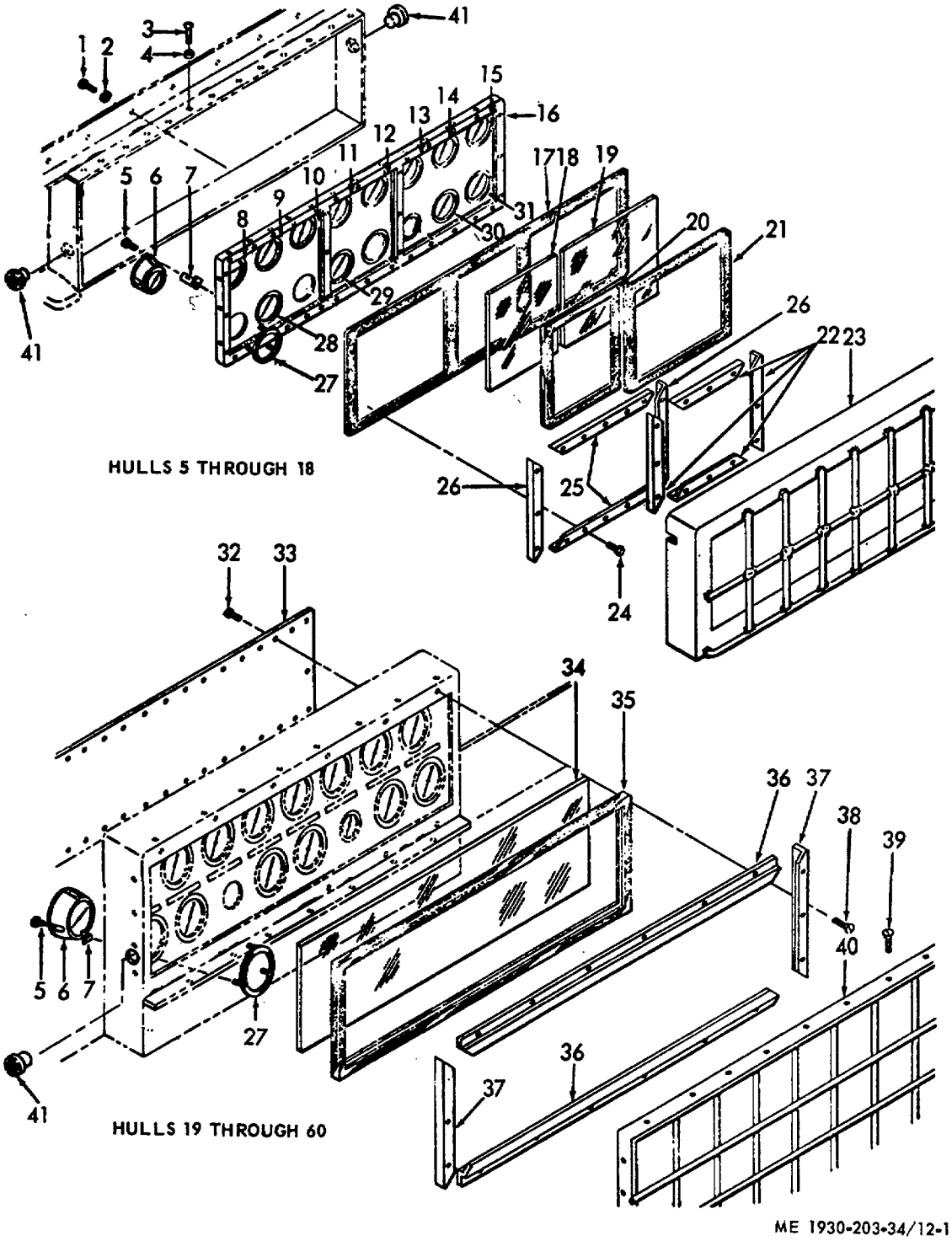


Figure 12-1. Gage board.

Key to figure 12-1.

1 Capscrew
2 Lockwasher
3 Screw
4 Lockwasher
5 Screw
6 Engine oil pressure gage
7 Spacer
8 Engine water temperature gage
9 Engine oil temperature gage
10 Torque converter oil temperature gage
11 Gathering box oil temperature gage
12 Maring gear oil temperature gage
13 Torque converter oil temperature gage
14 Engine oil temperature gage
15 Engine water temperature gage
16 Panel
17 Gasket
18 Glass
19 Glass
20 Gasket
21 Gasket
22 Frame
23 Guard
24 Screw
25 Frame
26 Frame
27 Mounting ring
28 Transmission oil pressure gage
29 Gathering box oil pressure gage
30 Transmission oil pressure gage
31 Engine oil pressure gage
32 Screw, machine
33 Cover
34 Glass
35 Gasket
36 Frame
37 Frame
38 Screw
39 Screw
40 Guard
41 Vent

12-2. Oil Pressure Gages

a. General. Oil pressure gages for the engines, transmissions, and gathering boxes are located on the gage boards.

b. Removal and Installation (Hulls 5 through 18).

(1) Repeat steps (1) and (2) of paragraph 12-1*b*.

(2) Insure that there is no oil pressure in tubing connected to gage board oil pressure gages. Tab controls in cab: **CAUTION: DO NOT OPERATE ENGINES, OIL LINES OPEN.**

(3) Disconnect tubing to all gages at base of gage board in upper machinery area.

(4) Remove screws (3) and lockwashers (4) securing panel (16) to LARC and slide panel from its mount.

(5) Remove screws (5) securing oil pressure gage and remove gage.

(6) Remove attaching spacers (7) and remove mounting ring (27).

(7) Install oil pressure gages in reverse order of removal.

c. Removal and Installation (Hulls 19 through 60).

(1) Repeat steps (1), (2), and (3) of paragraph 12-1*c*.

(2) Insure that there is not oil pressure in tubing connected to applicable oil pressure gage. Tag controls in cab: **CAUTION: DO NOT OPERATE ENGINES, OIL LINE OPEN.**

(3) Disconnect tubing from applicable oil pressure gage.

(4) Remove screws (5) securing oil pressure gage and remove gage.

(5) Remove attaching spacers (7) and remove mounting ring (27).

(6) Install oil pressure gages in reverse order of removal.

d. Instrument Panel Mounted Marine Gear Oil Pressure Gage, Removal and Installation.

(1) Insure that there is no oil pressure in tubing connected to applicable marine gear oil pressure gage.

(2) Disconnect tubing from marine gear oil pressure gage to be removed.

(3) On hulls 5 through 18, remove nuts and bracket attaching marine gear oil pressure gage to the instrument panel and remove gage. On hulls 19 through 60, remove screws (1, fig. 12-2) attaching marine gear oil pressure gage (2) and remove gage.

(4) Install marine gear oil pressure gage in reverse order of removal.

12-3. Steering Pressure Gage

a. General. Two steering pressure gages are located on the cab instrument panel. One steering pressure gage is installed in the forward hydraulic steering system, and the other gage is installed in the aft hydraulic steering system. The steering pressure gages, used only when aligning the wheels, are calibrated from 0 to 2000 psi.

b. Removal.

(1) Insure that there is no oil pressure in tubing connected to applicable steering pressure gage (fig. 12-2).

(2) Disconnect tubing from steering pressure gage to be removed.

(3) Remove four machine screws (3) and remove steering pressure gage.

c. Installation. Install steering gage in reverse order of removal.

NOTE

Make sure steering pressure gage tubing is filled before connecting to gage.

12-4. Main Air and Tire Air Pressure Gages

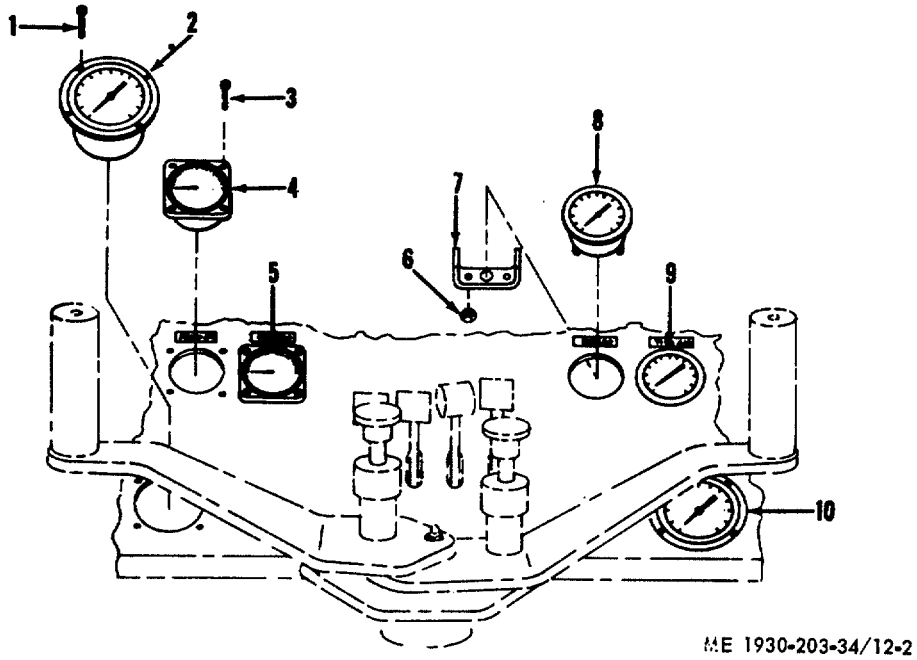
a. Removal.

(1) Close globe valves (6 and 7, fig. 2-19) located in airlines above air supply tanks (11) and open service connection globe valves (5) to vent compressed air from lines. When removing tire air pressure gage, also close tire inflation valves in wheel columns and position pilot air valve (2, fig. 9-6) to deflate.

(2) Disconnect tubing from air pressure gage to be removed.

(3) Remove nuts (6, fig. 12-2) and U-clamp (7); remove main air pressure gage (8).

b. Installation. Install main air or tire air pressure gage in reverse order of removal.



1 Screw
2 Marine gear oil pressure gage
3 Screw
4 Aft steering pressure gage
5 Forward steering pressure gage
6 Nut
7 U-clamp
8 Main air pressure gage
9 Tire pressure gage
10 Marine gear oil pressure gage

Figure 12-2. Instrument panel gages.

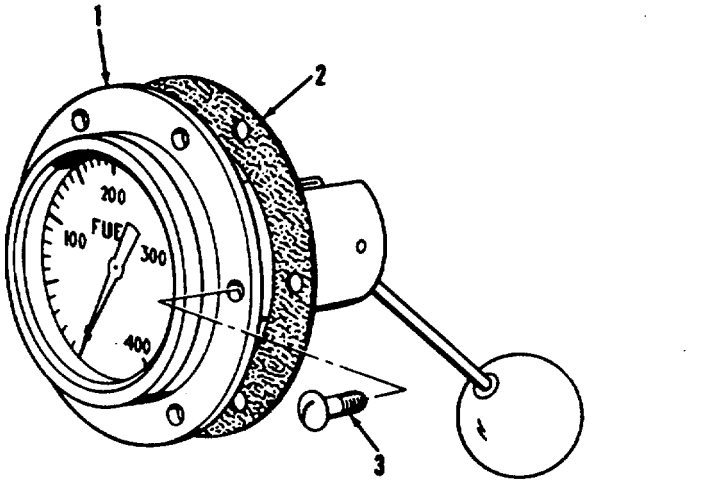
12-5. Fuel Quantity Gages

a. Removal.

(1) Check to see that fuel level in tank is below level of fuel quantity gage to be removed. If not, lower fuel level in the tank below fuel quantity gage by siphoning fuel into a suitable container.

(2) Remove six screws (3, fig. 12-3) securing fuel quantity gage (1) to tank and remove gage and gasket (2).

b. Installation. Install fuel quantity gage in reverse order of removal.



ME 1930-203-34/12-3

1 Fuel quantity gage
2 Gasket
3 Screw

Figure 12-3. Fuel quantity gage.

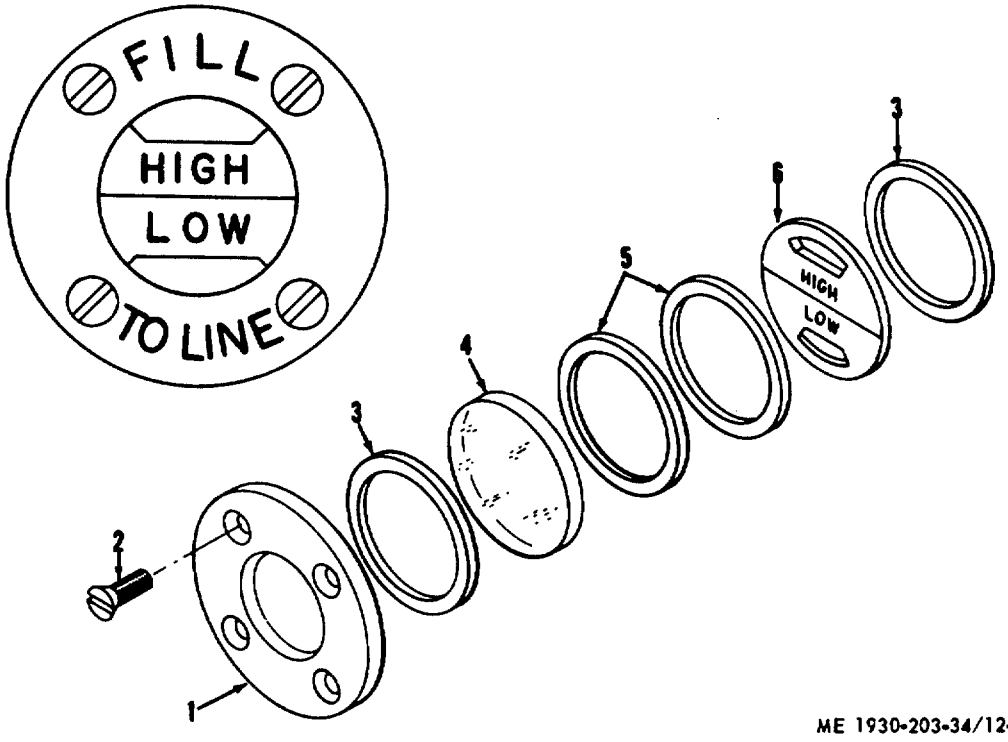
12-6. Sight Level Quantity Gage

a. Removal.

(1) Insure that hydraulic fluid in tank is below the level of the sight level quantity gage (para 10-14).

(2) Remove four screws (2, fig. 12-4) to free cover (1), gaskets (3), glass (4), gaskets (5), and plate (6).

b. Installation. Install in the reverse order of removal.



1 Cover
2 Screw
3 Gasket
4 Glass
5 Gasket
6 Plate

Figure 12-4. Sight level quantity gage.

12-7. Ramp Seal Air Pressure Gage

a. Removal.

(1) Close globe valve (6 and 7, fig. 2-19) located in airlines above air supply tank (11) and open service connection globe valve (5) to vent compressed air from lines.

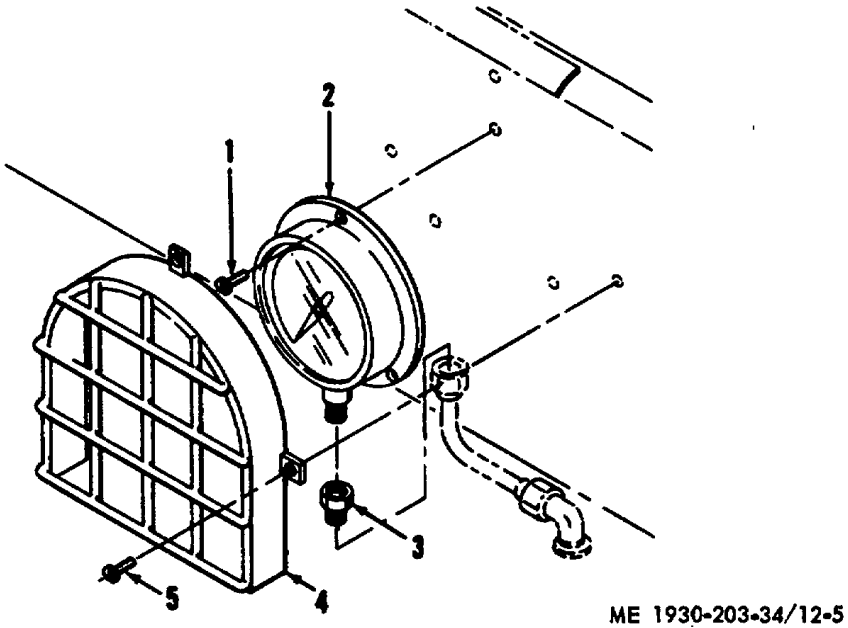
(2) Remove three machine screws (5, fig. 12- 5) attaching guard (4) and remove guard.

(3) Disconnect tubing from adapter (3).

(4) Remove screws (1) attaching ramp seal air pressure gage (2) and remove gage.

(5) Remove adapter (3) from ramp seal air pressure gage (2).

b. Installation. Install ramp seal air pressure gage in reverse order of removal.



1 Screw
2 Gage
3 Adapter
4 Guard
5 Screw

Figure 12-5. Ramp seal air pressure gage.

CHAPTER 13

HYDRAULIC START AND WHEEL ALIGNMENT SYSTEM

REPAIR INSTRUCTIONS

Section I. GENERAL

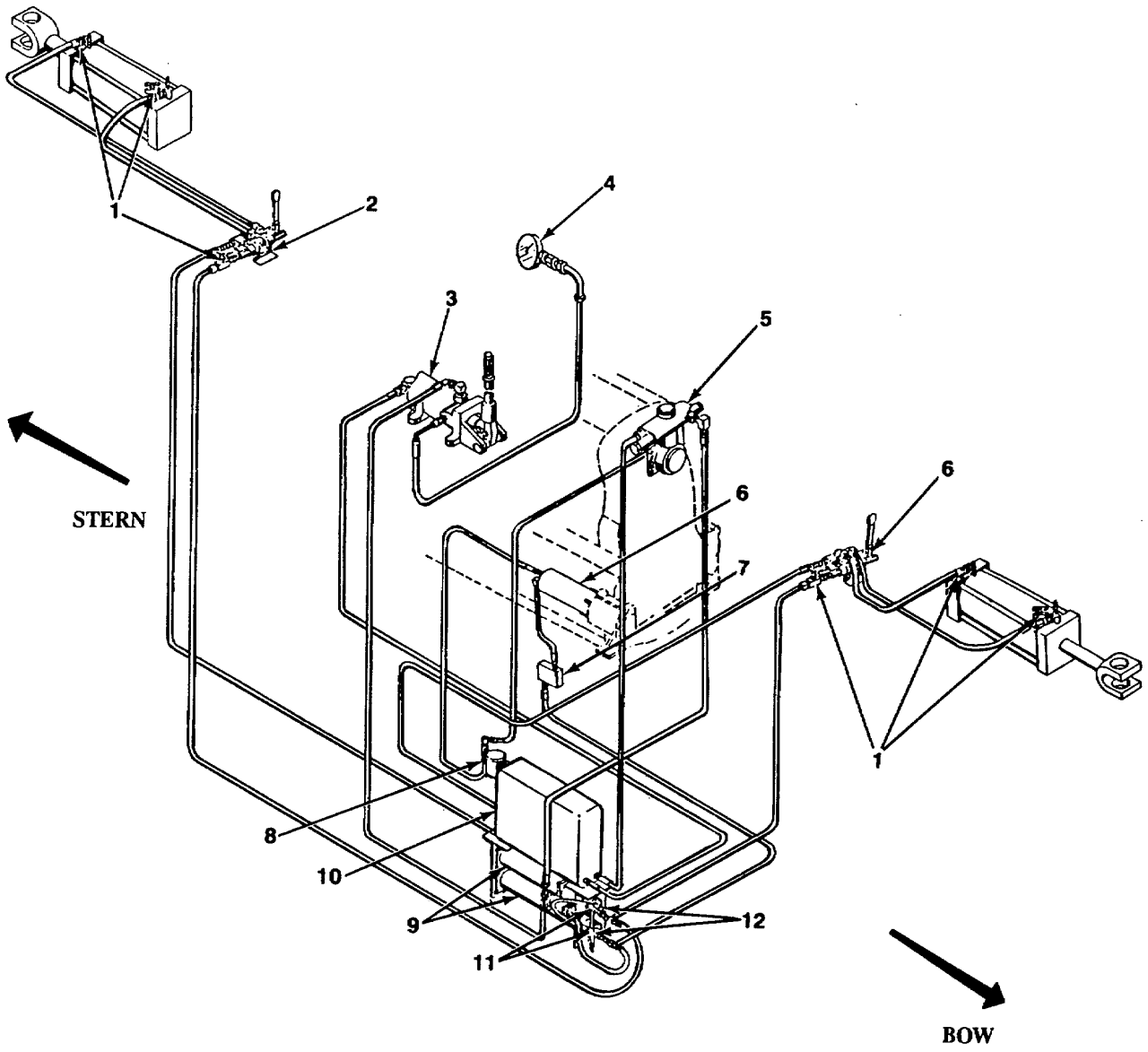
13-1. DESCRIPTION.

For a complete description of the hydraulic start and wheel alignment system refer to TM 55-1930-203-10. 13-

13-2. GENERAL REPAIRS.

a. All hose lines, fittings, valves and components are inspected under PMCS for leaks.

b. Faulty hose lines, fittings and valves are repaired or replaced in accordance with Section II. Repair instructions. Refer to TM 55-1930-203-34P for replacement parts.



Major Components

1. Needle Valve
2. Spool valve
3. Hand pump
4. Pressure gauge
5. Pump
6. Starter motor
7. Start control valve
8. Filter
9. Filter
10. Reservoir
11. Accumulator
12. Ball valve

Figure 13-1. Hydraulic Start and Wheel Alignment System.

SECTION II. REPAIR INSTRUCTIONS

13-3. REPLACE HYDRAULIC STARTER

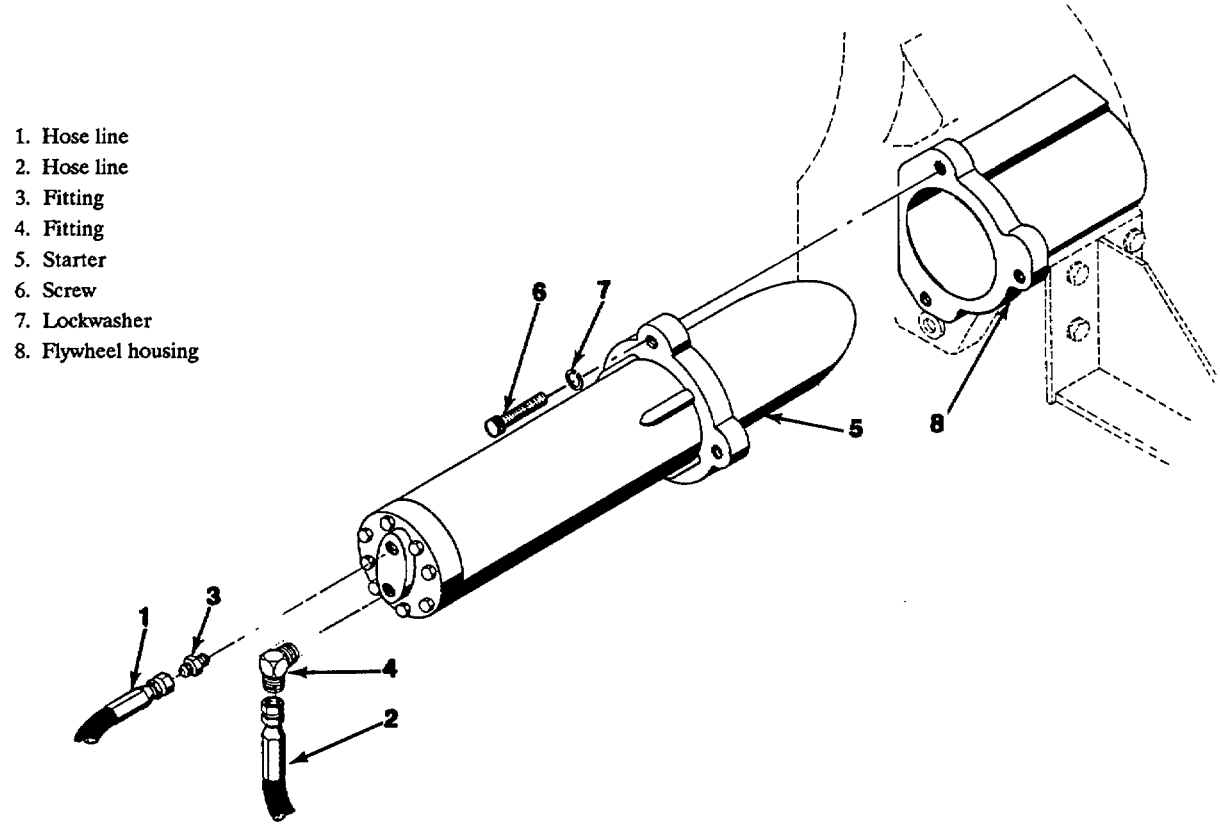


Figure 13-2. Hydraulic Starter, Replacement

a. Remove.

(1) Disconnect hose lines (1, fig. 13-2) and (2) and remove fittings (3) and (4) from hydraulic starter (5).

(2) Remove screws (6) and lockwashers (7) and remove hydraulic starter (5) from flywheel housing (8).

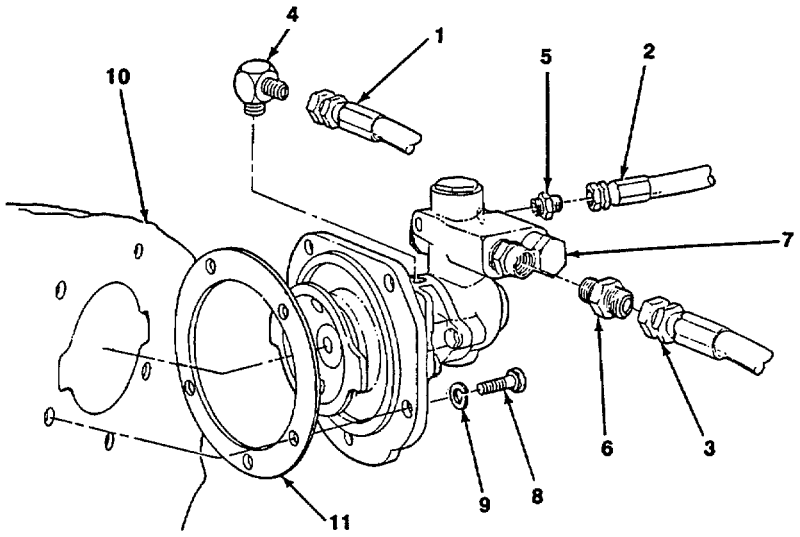
b. Install.

(1) Install hydraulic starter (5) in flywheel housing (8) and secure using lockwashers (7) and screws (6).

(2) Install elbow fittings (4) in "out" port and straight fitting (3) in "in" port of hydraulic starter (5).

(3) Connect hose lines (1) and (2) to fittings (3) and (4).

13-4. REPLACE HYDRAULIC PUMP



1.	Hose line	7.	Pump
2.	Hose line	8.	Screw
3.	Hose line	9.	Lockwasher
4.	Adapter	10.	Flywheel housing
5.	Adapter	11.	Gasket
6.	Adapter		

Figure 13-3. Hydraulic Pump, Replacement

a. Remove

WARNING

Hydraulic hose lines are under pressure. Relieve pressure in lines by operating spool valve. Loosen fittings on hose lines slowly. Allow oil to run around threads of fitting releasing pressure before disconnecting fitting. Releasing pressurized oil suddenly may cause personal injury.

(1) Close valves at the accumulators and then open wheel alignment spool valve by placing spool valve level all the way to one side or the other rapidly. This will relieve the pressure in the hydraulic system.

(2) Disconnect hose lines (1, fig. 13-3) (2) and (3) and remove adapter fittings (4), (5) and (6) from hydraulic pump (7).

(3) Remove screws (8) and lockwashers (9).

(4) Pull hydraulic pump (7) away from flywheel housing (10) disengaging intermediate drive flywheel auxiliary drive gear.

(5) Remove gasket (11).

b. Install.

(1) Mount new gasket (11) on hydraulic pump (7).

(2) Mount hydraulic pump (7) to flywheel housing (10) engaging intermediate drive on pump with flywheel auxiliary drive gear.

(3) Secure pump (7) to housing (10) using screws (8) and lockwashers (9).

(4) Install adapter fittings (4), (5) and (6) in hydraulic pump (7) ports and connect hose lines (1), (2) and (3) to the fittings.

13-5. REPLACE ACCUMULATOR.

1. Valve
2. Accumulator
3. Hose line
4. Hose line
5. Hose line
6. Tee
7 all valve
8. Nipple
9. Accumulator
10. Nut
11. Clamp
12. Frame

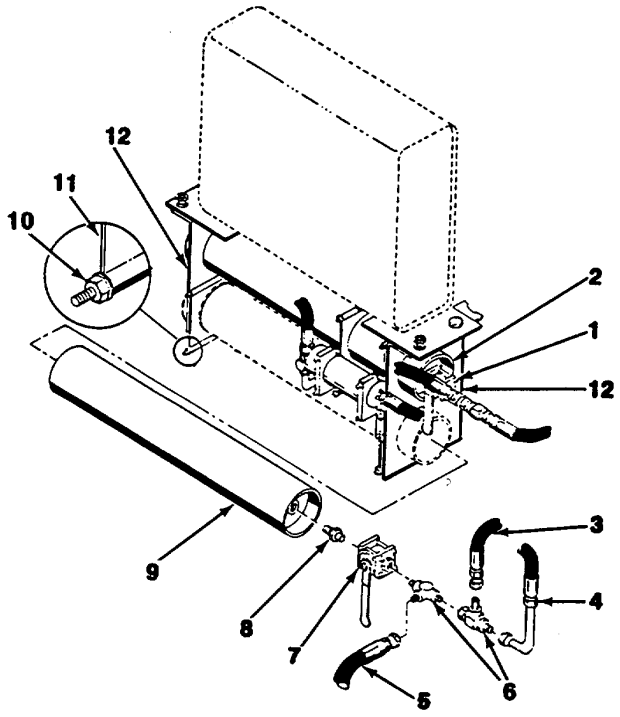


Figure 13-4. Accumulator, Replacement.

WARNING

Hydraulic hose lines are under pressure. Relieve pressure in lines by operating spool valve. Loosen fittings on hose lines slowly. Allow oil to run around threads of fitting releasing pressure before disconnecting fitting. Releasing pressurized oil suddenly may cause personal injury.

a. Remove.

(1) Close valve (1, fig. 13-4) on accumulator (2) not being removed.

(2) Open a wheel alignment spool valve rapidly bleeding hydraulic pressure.

(3) Disconnect three hose lines (3), (4) and (5) from tees (6).

(4) Disconnect tees (6), attached ball valve (7) and pipe nipple (8) from end of accumulator (9).

(5) Loosen nuts (10) on clamps (11) holding accumulator (9).

(6) Slide accumulator (9) out of frames (12) and clamps (11).

b. Install.

(1) Insert accumulator (9) through frames (12) and clamps (11). Tighten clamps (11) securing accumulator (9) in place.

(2) Thread pipe nipple (8) into end of accumulator (9). Thread ball valve (7) and tees (6) onto nipple (8).

(3) Connect hose lines (3), (4) and (5) to tees (6).

(4) Open ball valves (1) and pressurize hydraulic system to 3000PSI using hand pump.

13-6. REPLACE HYDRACULIC HAND PUMP.

1. Hose line
2. Hose line
3. Hose line
4. Elbow fitting
5. Elbow fitting
6. Straight fitting
7. Capscrew
8. Washer
9. Net
10. Hand pump

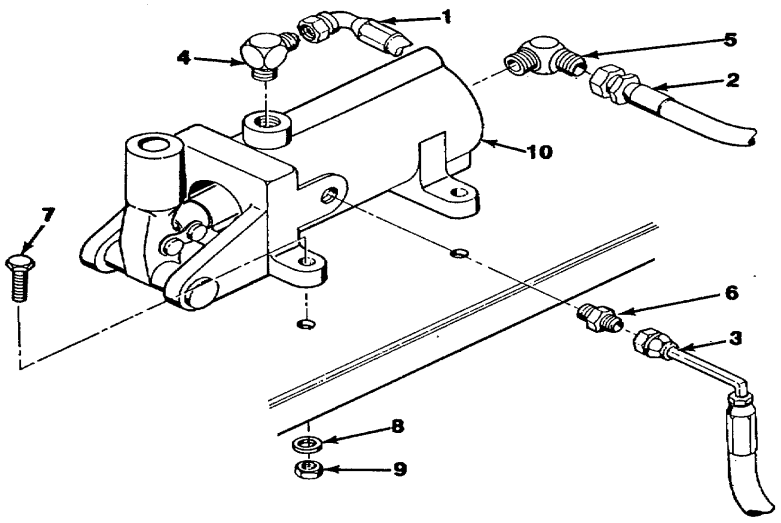


Figure 13-5. Hydraulic Hand Pump, Replacement

WARNING

Hydraulic hose lines are under pressure. Relieve pressure in lines by operating spool valve. Loosen fittings on hose lines slowly. Allow oil to run around threads of fitting releasing pressure before disconnecting fitting. Releasing pressurized oil suddenly may cause personal injury.

(1) Close valves at the accumulators and then open wheel alignment spool valve by placing spool valve level all the way to one side or the other rapidly. This will relieve the pressure in the hydraulic system.
(2) Disconnect hose fittings (1, fig. 13-5) (2) and (3).
(3) Remove elbow fittings (4) and (5), and straight fitting (6).
(4) Remove capscrew (7), washer (8) and nuts (9) and remove hand pump (10).

b. Install.

(1) Secure hand pump (10) to mounting using capscrews (7), washer (8) and nuts (9).
(2) Install fittings (6), (5) and (4) in hand pump (10) and then connect hose fittings (1), (2) and (3).

13-7 REPLACE PRESSURE GAGE.

1. Gage
2. Bulkhead connector

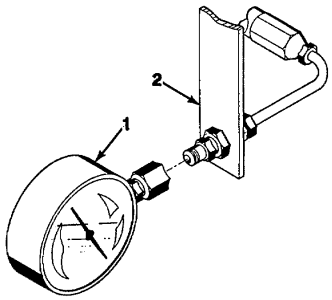


Figure 13-6. Pressure Gage, Replacement.

WARNING

Hydraulic hose lines are under pressure. Relieve pressure in lines by operating spool valve. Loosen FITTING on hose lines slowly. Allow oil to run around threads of fitting releasing pressure before disconnecting fitting. Releasing pressurized oil suddenly may cause personal injury.

a. Remove.

(1) Close valves at the accumulators and then open wheel alignment spool valve by placing spool valve level

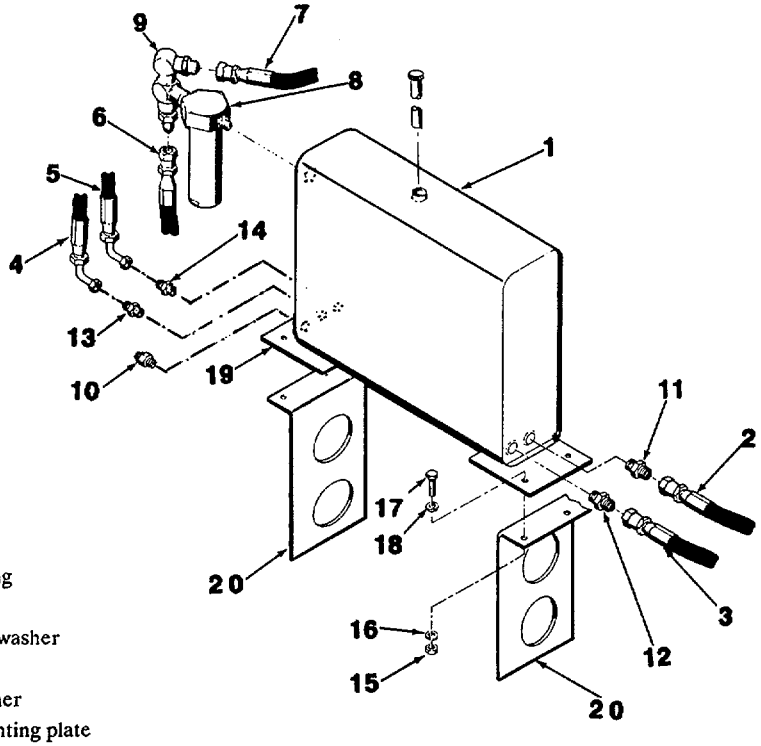
all the way to one side or the other rapidly. This will relieve the pressure in the hydraulic system.

(2) Remove pressure gage (1) from bulkhead connector (2).

b. Installation.

(1) Connect new pressure gage (1) to bulkhead connector (2).

13-8. REPLACE HYDRAULIC OIL RESERVOIR



1. Reservoir
2. Hose line
3. Hose line
4. Hose line
5. Hose line
6. Hose line
7. Hose line
8. Filter
9. Tee assembly
10. Plug
11. Fitting
12. Fitting
13. Fitting
14. Fitting
15. Nut
16. Lockwasher
17. Bolt
18. Washer
19. Mounting plate
20. Mounting bracket

Figure 13-7. Hydraulic Oil Reservoir, Replacement

a. Removal.

(1) Drain reservoir (1, fig. 13-8)..
(2) Disconnect hose lines (2), (3), (4), (5), (6) and (7).
(3) Remove high pressure filter (8) with attached tee fitting assembly (9).
(4) Remove pipe plug (10).
(5) Remove fittings (11), (12), (13), and (14).
(6) Remove nuts (15), lockwashers (16), bolts (17) and washers (18).
(7) Lift reservoir (1) free and remove.

b. Installation.

(1) Fabricate new mounting plates (19) and weld to reservoir (1).
(2) Position reservoir (1) on mounting brackets (2), mark mounting plates (19) with holes for mounting bolts. Remove reservoir and drill holes.
(3) Position reservoir (1) on mounting brackets (2()) and secure using washers (18), bolts (17),lockwashers (16) and nuts (15).
(4) Install fittings (11), (12), (13) and (14) in reservoir (1).
(5) Install pipe plug (10) in reservoir (]).
(6) Install filter (8) with attach tee fitting ,assembly (9) in reservoir (1).
(7) Connect hose lines (2), (3), (4), (5), (6) and (7) to their respective fittings.

13-9. SERVICE HIGH PRESSURE FILTER (RESERVOIR)

1. Housing assembly
2. Cap
3. "O" ring
4. Fitter element
5. Guide seat
6. Spring

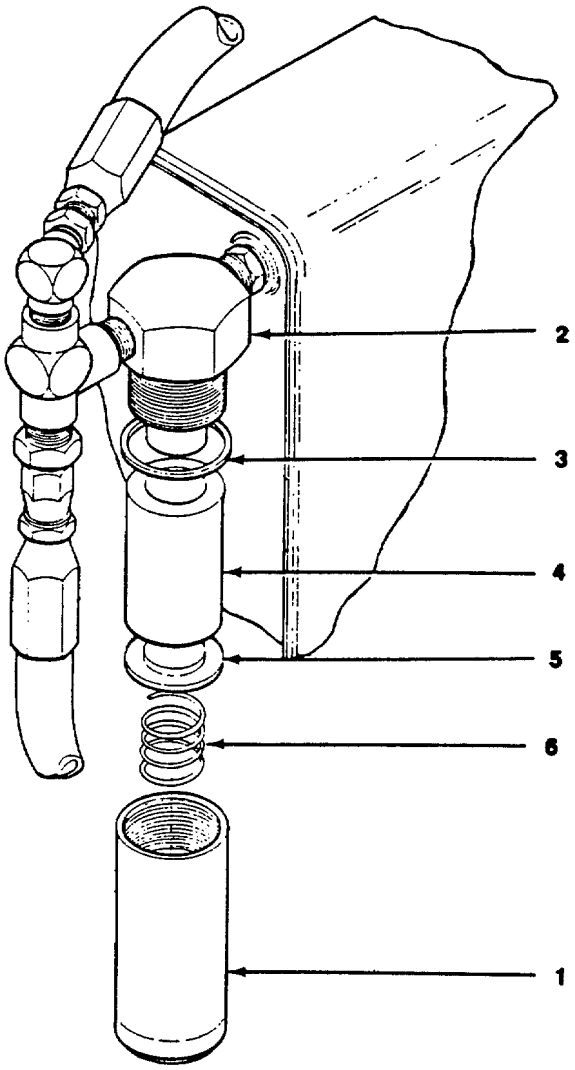


Figure 13-8. High Pressure Filter (Reservoir), Service.

a. Disassemble.

(1) Unscrew housing assembly (1, fig. 13-8) from cap (2). Remove "O" ring (3) from cap (2).

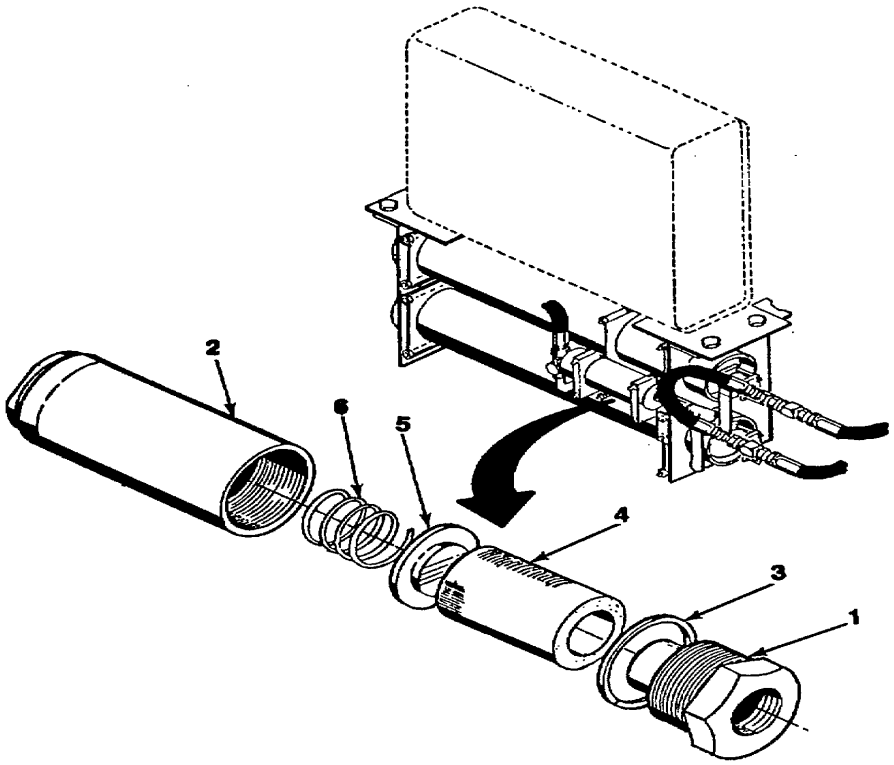
(2) Remove filter element (4), guide-seat (5) and spring (6) from housing assembly (1). Replace guideseat (5) as required.

b. Assemble.

(1) Insert spring (6), new guide-seat (5) and new filter element (4) in housing assembly (1) being sure to seat element (4) on guide-seat (5) correctly.

(2) Place new “O" ring (3) over cap (2) and screw housing assembly (1) onto cap (2). Torque to 80-90 ft. lbs.

13-10. SERVICE HIGH PRESSURE FILTER (ACCUMULATOR).



1. End cap
2. Filter body
3. "O ring
4. Filter element
5. Spring seat
6. Spring

Figure 13-9. High Pressure Filter (Accumulator), Service

WARNING

Hydraulic hose lines are under pressure. Relieve pressure in lines by operating spool valve. Loosen fittings on hose lines slowly. Allow oil to run around threads of fitting releasing pressure before disconnecting fitting. Releasing pressurized oil suddenly may cause personal injury.

a. Disassemble.

(1) Close valves at the accumulators and then open wheel alignment spool valve by placing spool valve level all the way to one side or the other rapidly. This will relieve the pressure in the hydraulic system.
(2) Unscrew end cap (1, fig. 13-9) from filter body (2) and remove.
(3) Remove "O" ring (3) from end cap (1).
(4) Remove filter element (4), spring seat (5) and spring (6) from filter body (2).

b. Assemble.
(1) Place spring (6), new spring seat (5) and new filter element (4) in filter body (2).
(2) Place new "O" ring (3) on end cap (1).
(3) Screw end cap (1) onto filter body (2).

13-11. REPLACE HIGH PRESSURE FILTER (RESERVOIR).

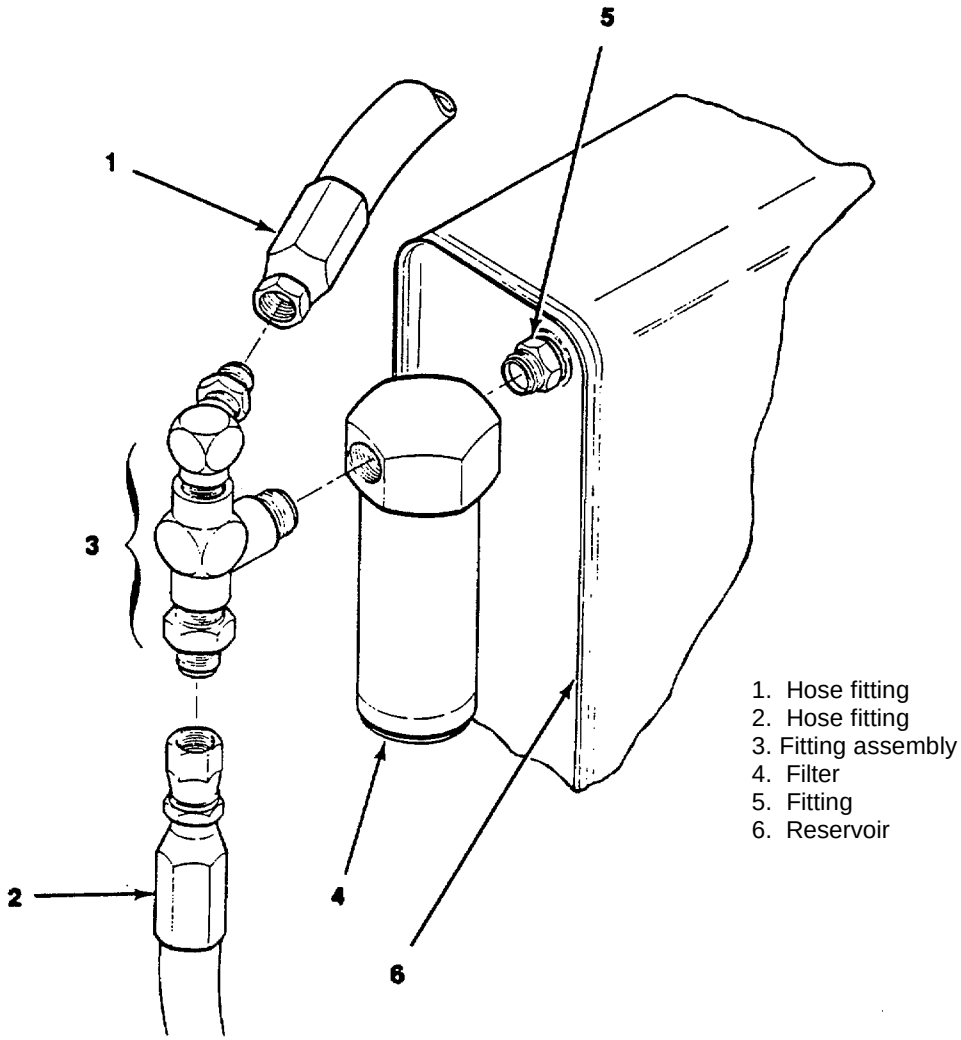
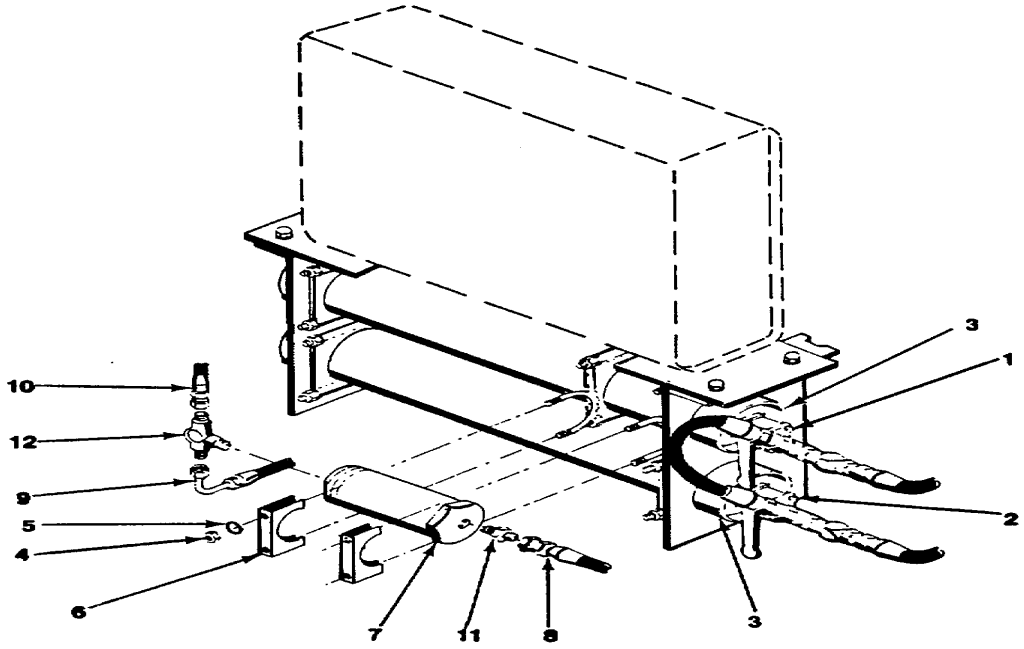


Figure 13-10. High Pressure Filter (Reservoir), Replacement

a. Remove.
(1) Disconnect hose fittings (1, fig. 13-10) and (2).
(2) Disconnect fitting assembly (3) from filter (4).
(3) Disconnect filter (4) from fitting (5) on reservoir (6) and remove. Replace filter as required.

b. Install.
(1) Install filter (4) on fitting (5).
(2) Install filter assembly (3) on filter (4).
(3) Connect hose fittings (1) and (2) to fitting assembly (3).

13-12. REPLACE HIGH PRESSURE FILTER (ACCUMULATOR).



1. Valve
2. Valve
3. Accumulator
4. Nut
5. Washer
6. Bracket
7. Filter
8. Hose line
9. Hose line
10. Hose line
11. Adapter
12. Adapter

Figure 13-11. High Pressure Filter (Accumulator), Replacement.

WARNING

Hydraulic hose lines are under pressure. Relieve pressure in lines by operating spool valve. Loosen fittings on hose lines slowly. Allow oil to run around threads of fitting releasing pressure before disconnecting fitting. Releasing pressurized oil suddenly may cause personal injury.

a. Remove.

(1) Close valves (1, fig. 13-11) and (2) at accumulator tanks (3).
(2) Relieve hydraulic pressure in system by moving level on wheel alignment spool valve all the way to either left or right position.
(3) Remove nuts (4), washers (5) and brackets (6) freeing filter (7).
(4) Disconnect hose lines (8), (9) and (10) and remove adapter fittings (11) and (12) from filter (7).
(5) Remove filter (7).

b. Install.

(1) Install adapter fittings (11) and (12) in filter (7).
(2) Secure filter (7) to accumulator brackets using brackets (6), nuts (4) and washers (5).
(3) Connect hose lines (8), (9) and (10) to adapter fittings (11) and (12).
(4) Open valves (1) and (2).

13-13. REPLACE NEEDLE VALVE.

1. Lever
2. Hose line
3. Adapter
4. Needle valve
5. Adapter

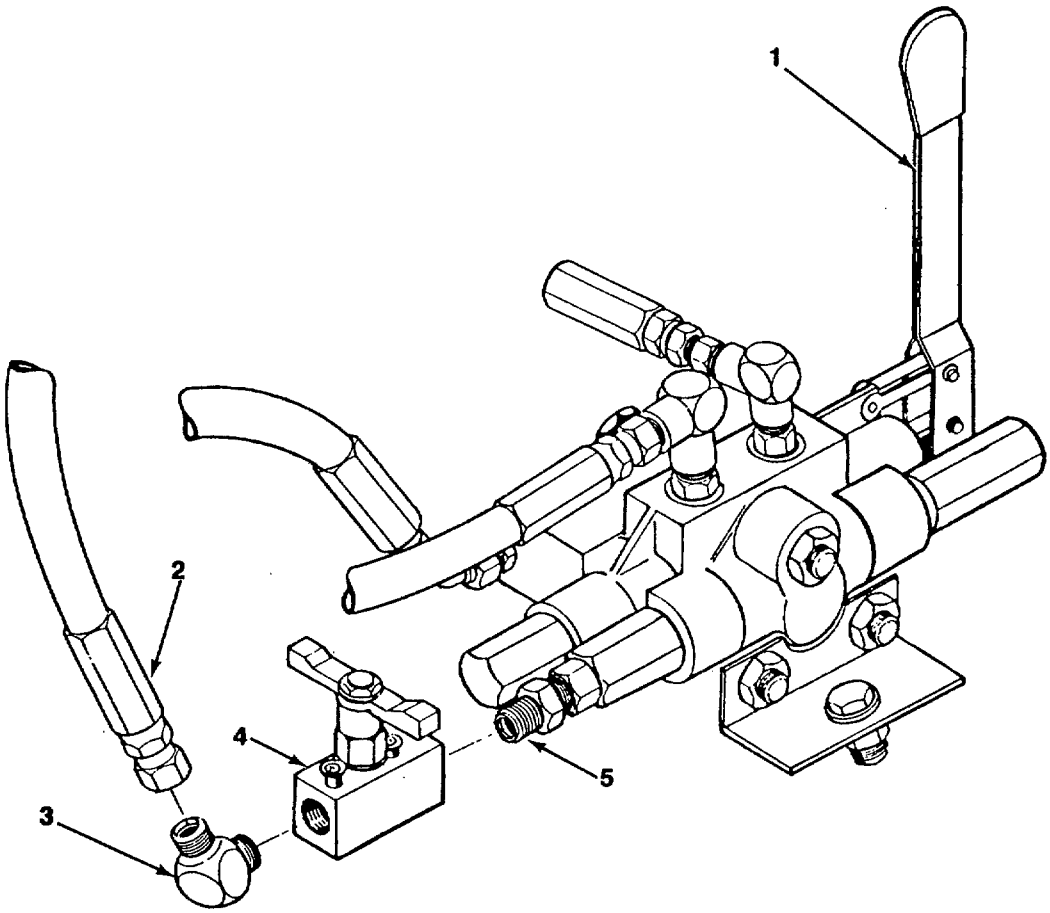


Figure 13-12. Needle Valve, Replacement

WARNING

Hydraulic hose lines are under pressure. Relieve pressure in lines by operating spool valve. Loosen fittings on hose lines slowly. Allow oil to run around threads of fitting releasing pressure before disconnecting fitting. Releasing pressurized oil suddenly may cause personal injury.

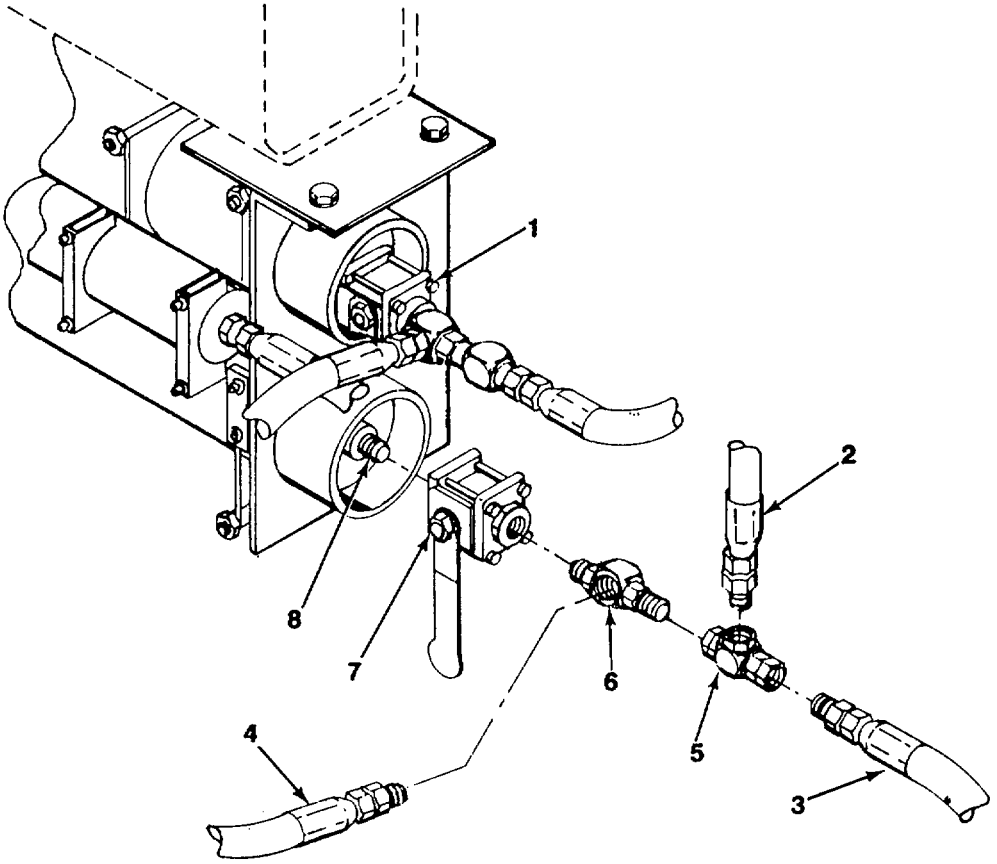
a. Removal.

(1) Close valves at accumulators and then release hydraulic pressure in lines by rapidly moving spool valve lever (1, fig. 13-12) to one side or the other.
(2) Disconnect hose line (2).
(3) Remove adapter (3).
(4) Remove needle valve (4).

b. Installation.

(1) Install new needle valve (4) onto adapter (5).
(2) Install adapter (3) in needle valve (4).
(3) Connect hose line (2) to adapter (3).

13-14. REPLACE BALL VALVE.



1. Ball valve
2. Hose line
3. Hose line
4. Hose line
5. Tee
6. Tee
7. Ball valve
8. Pipe nipple

Figure 13-13. Ball Valve, Replacement

WARNING

Hydraulic hose lines are under pressure. Relieve pressure in lines by operating spool valve. Loosen fittings on hose lines slowly. Allow oil to run around threads of fitting releasing pressure before disconnecting fitting. Releasing pressurized oil suddenly may cause personal injury.

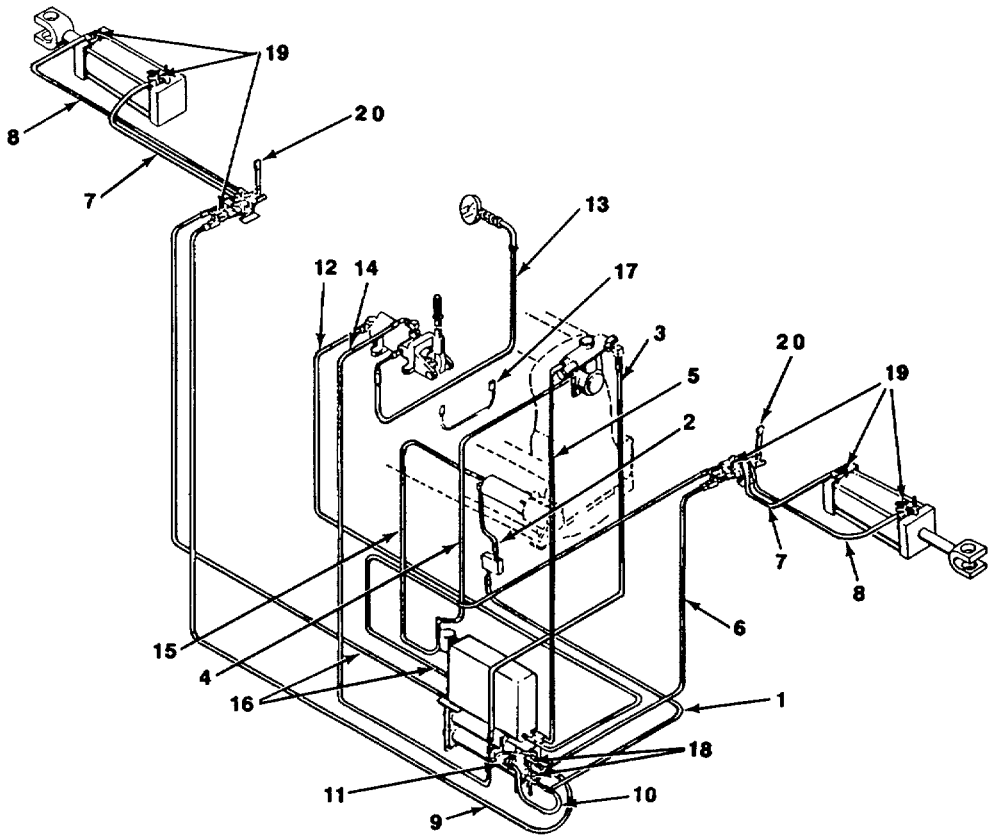
a. Removal.

(1) Close ball valve (1, fig. 13-13) which is not being replaced.
(2) Open a wheel alignment spool valve rapidly to bleed hydraulic pressure.
(3) Disconnect hose lines (2), (3) and (4).
(4) Remove tees (5) and (6).
(5) Remove ball valve (7).

b. Installation.

(1) Install new ball valve (7) on pipe nipple (8).
(2) Install tees (S) and (6).
(3) Connect hose lines (2), (3) and (4) to tees (5) and (6).
(4) Open ball valve (1) and run engine with hydraulic pump to pressurize system.

13-15. REPLACE HYDRAULIC HOSE LINES.



1.	Control valve to accumulator	8.	Spool valve to steering cyl.	15.	Filter to starter
2.	Control valve to starter	9.	Spool valve to accumulator	16.	Reservoir to spool valve
3.	Pump to filter	10.	Accumulator to filter	17.	Engine oil pressure chamber to oil pressure sending unit
4.	Pump to filter	11.	Accumulator to accumulator	18.	Ball valve
5.	Pump to reservoir	12.	Hand pump to reservoir	19.	Needle valve
6.	Spool valve to accumulator	13.	Hand pump to pressure gauge	20.	Spool valve handle
7.	Spool valve to steering cyl.	14.	Hand pump to filter		

Figure 13-14. Hydraulic Hose Line, Replacement

WARNING

Hydraulic hose lines are under pressure. Relieve pressure in lines by operating spool valve. Loosen fittings on hose lines slowly. Allow oil to run around threads of fitting releasing pressure before disconnecting fitting. Releasing pressurized oil suddenly may cause personal injury.

a. Removal.

(1) Make sure engine No. 3 is stopped. Tag operator control for engine No. 3 to warn "DO NOT START ENGINE" while maintenance in progress.

(2) Close ball valve (18, fig. 13-14) at the accumulators.

(3) Open all needle valves (19) and then move spool valve handles (20) rapidly to either side allowing pressure in hydraulic hose lines to be relieved.

(4) Clean connections at both ends of faulty hose to prevent dirt from gettinginto hydraulic system. Place dip pans under connections to collect any spilled hydraulic fluid.

(5) Open couplings just enough to relieve any hydraulic pressure.

(6) Disconnect hose line.
(7) Cap or plug open connections to keep dirt out of hydraulic system.
(8) Tag connections to identify which end of hose line connects to which opening.
(9) Remove brackets and/or hose ties as required.
(10) Remove faulty hose line.

b. Obtain Replacement Hose Line.

(1) Determine the find number for the faulty hose line in figure 13-14 above.

(2) Go to Appendix E Illustrated List of Manufactured Items. Enter the table of hydraulic hose lines for the Hydraulic Start and Wheel Alignment System using the find number from figure 13-14. Determine the end fittings, hose, and hose length required to fabricate a replacement hose line.

(3) Fabricate a replacement hose assembly using procedures in TM 9-4940-468-14.

c. Pressure Proof Test.

(1) Precharge the cleaned hose assembly by filling with clean hydraulic oilWhen filing hose, make sure there are no loops or turns in hose to trap air.

(2) Plug one end of the hose and connect the other end to the pressure pump mounted on the HSTRU.

WARNING

Be sure no one is at or near rear of the HSTRU while hose assembly is pressurized. Do not approach, look at, or touch pressurized hose assembly. Personal injury can occur if hose assembly fails.

(3) Determine proof pressure for the hose assembly from Section III, Appendix E.

(4) Raise pressure in the fabricated hose assembly to the designated proof pressure using the pressure pump. Hold this pressure for 1/2 minute (minimum) to 3 minutes (maximum).

(5) Read pressure gauge on pump at beginning, during, and at end of test. A loss of 200 psi or more indicates a leak in the hose assembly.

(6) Release pressure at pump.

(7) Inspect hose assembly for signs of leaks. If any droplets of oil are found, wipe hose assembly clean and repeat pressure test. If oil droplets appear on the retest, correct cause of leaks or fabricate another replacement hose assembly.

(8) If hose assembly is free of leaks, disconnect from pressure pump.

d. Installation.

WARNING

Cleaning solvent, Fed Spec P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100°F138°F (38°C-59°C).

(1) Flush new hose with solvent and drain.

(2) Blow hose dry using compressed air, if available.' If compressed air is not available, hang hose assembly to allow drip-drying.

(3) Plug ends of hose assembly after drying to keep clean while installing.

(4) Note tags on connections to determine which end of the replacement hose assembly connects to which fittings (this is important where one or both fittings are angled elbows).

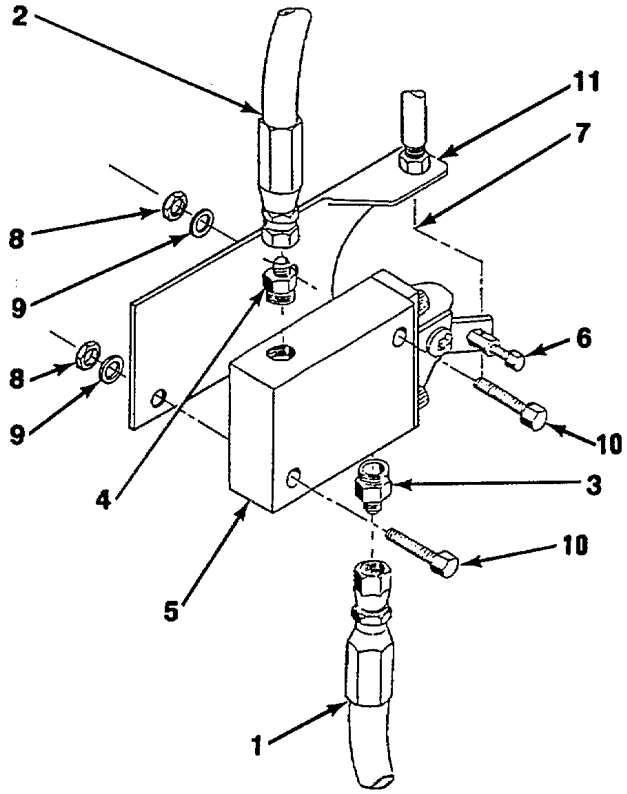
(5) Connect hose assembly to adapter fittings one end at a time.

(6) Determine correct torque Valve for hose fittings from table. Torque each fitting to correct torque Valve.

NOTE

When connecting a hose assembly to an adapter fitting, always connect a hose end that has an elbow fitting first. This allows you to align the elbow fitting correctly with the adapter fitting on the LARC-60. When the opposite end from the elbow fitting end is connected first, the hose may be twisted (rotated) causing a misalignment between the hose fitting (elbow) and the adapter.

13-16. REPLACE EMERGENCY START CONTROL VALVE.



1. Hose fitting
2. Hose fitting
3. Fitting
4. Fitting
5. Control valve
6. Wire pin
7. Valve cable
8. Nuts
9. Washer
10. Bolt
11. Cable bracket

Figure 13-15. Emergency Start Control Valve, Replacement

WARNING

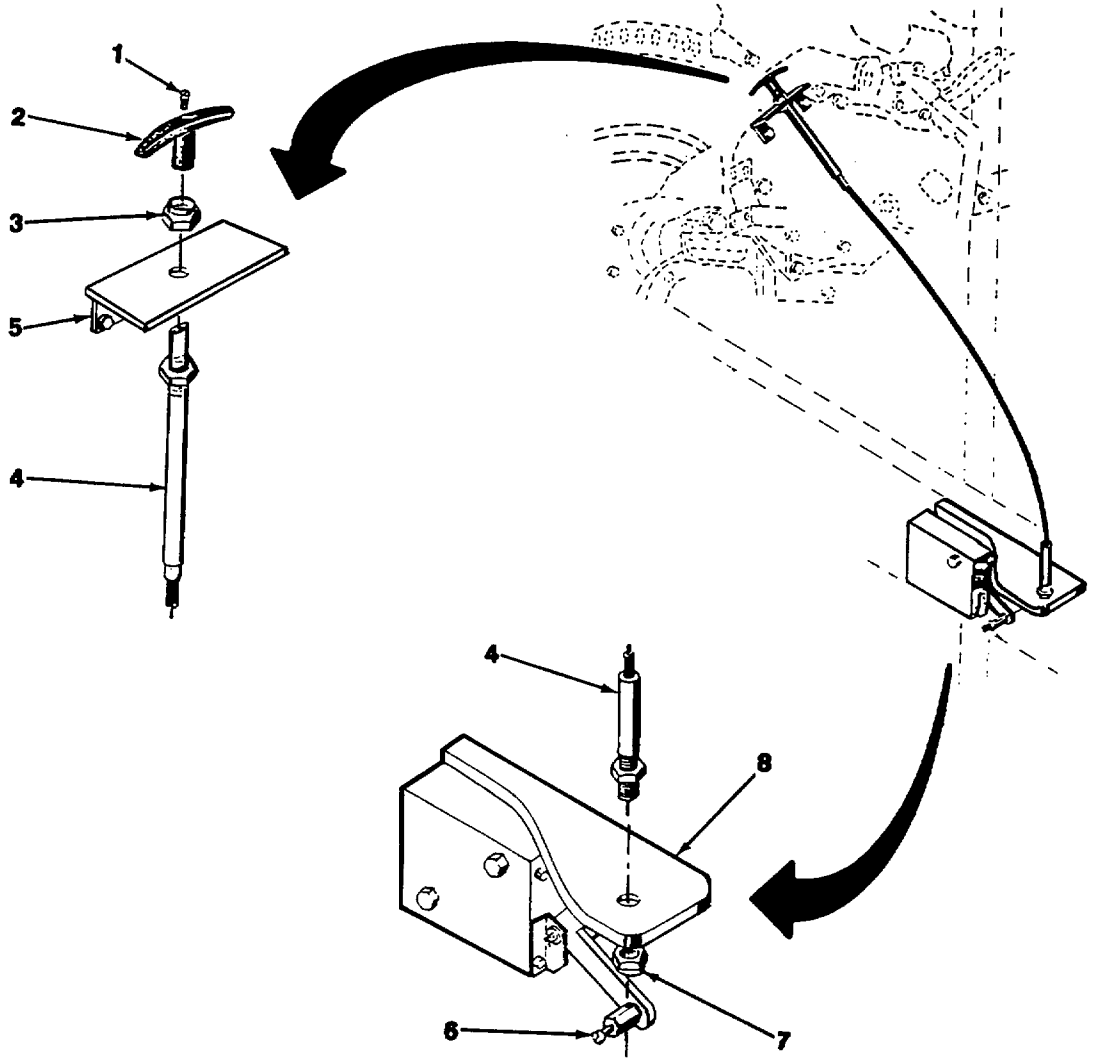
Hydraulic hose lines are under pressure. Relieve pressure in lines by operating spool valve. Loosen fittings on hose lines slowly. Allow oil to run around threads of fitting releasing pressure before disconnecting fitting. Releasing pressurized oil suddenly may cause personal injury.

(1) Close valves at the accumulators and then open wheel alignment spool valve by placing spool valve level all the way to one side or the other rapidly. This will relieve the pressure in the hydraulic system.
(2) Make sure valves at accumulators are closed.
(3) Relieve pressure in hydraulic hose lines by rapidly opening emergency steering spool valve.
(4) Loosen hose fitting (1, fig. 13-15) allowing hydraulic oil to leak out around fitting and releasing pressure on line.
(5) Disconnect hose fittings (1) and (2) and remove fittings (3) and (4).
(6) Loosen wire pin (6) and pull start valve cable (7) loose from wire pin (6).
(7) Remove nuts (8), washers (9) and bolts (10) and remove control valve (5).

b. Install.

(1) Mount control valve (5) and start valve cable bracket (11) on to bulkhead frame using nuts (8), washers (9) and bolts (10).
(2) Insert pull start valve cable (7) into wire pin (6) and tighten to hold wire.
(3) Install fittings (3) and (4) in control valve (5) and connect hose fittings (1) and (2) to fittings.

13-17. REPLACE START VALVE CABLE.



1. Screw
2. Pull handle
3. Nut
4. Cable
5. Bracket
6. Screw
7. Nut
8. Bracket

Figure 13-16. Start Valve Cable, Replacement

a. Remove.

(1) Remove Screw (1, fig. 13-16) and pull handle (2).
(2) Remove nut (3) and free start cable (4) from bracket (5) which is mounted on end of engine No. 3.
(3) Loosen screw (6) freeing start cable (4).
(4) Remove nut (7) and pull start cable (4) free of start control valve bracket (8) and remove cable.

b. Install.

(1) Insert start valve cable (4) into start control valve bracket (8) and secure using nut (7).
(2) Connect start cable (4) and tighten screw (6) to secure.
(3) Insert start valve cable (4) into bracket (5) and secure using nut (3).
(4) Install pull handle (2) on end of start cable (4) and secure to cable using screw (1).

13-18. REPLACE WHEEL ALIGNMENT SPOOL VALVE

1. Lever
2. Hose line
3. Hose line
4. Hose line
5. Hose line
6. Valve assembly
7. Straight adapter
8. Tee adapter
9. Spool valve
10. Nut
11. Washer
12. Bolt

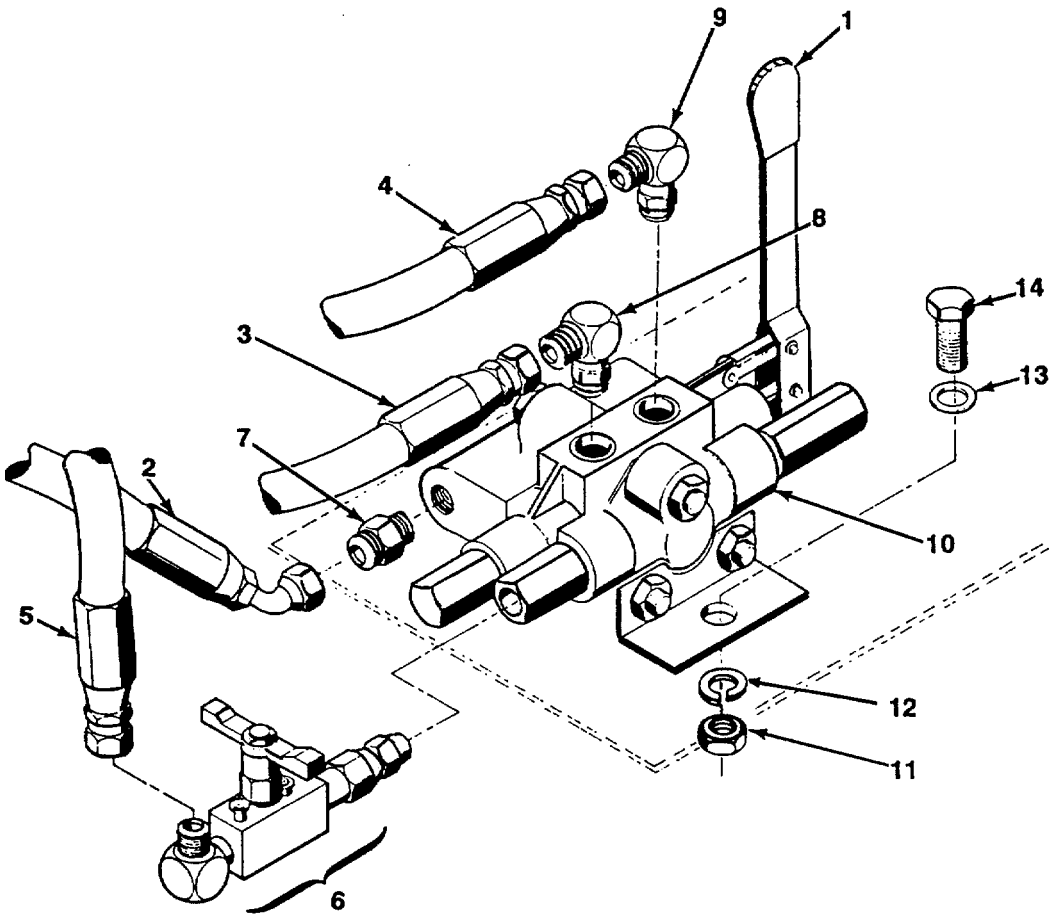


Figure 13-17. Wheel Alignment Spool Valve, Replacement

WARNING

Hydraulic hose lines are under pressure. Relieve pressure in lines by operating spool valve. Loosen fittings on hose lines slowly. Allow oil to run around threads of fitting releasing pressure before disconnecting fitting. Releasing pressurized oil suddenly may cause personal injury.

a. Removal

(1) Close valves at accumulators and then release hydraulic pressure in lines by moving spool valve lever (l,4fig. 13-17) rapidly to one side or the other.
(2) Disconnect hose lines (2), (3), (4) and (5).
(3) Remove valve assembly (6), straight adapter (7), and tee adapters (8) and (9) from spool valve (10) and keep for reuse.
(4) Remove nuts (11), lockwashers (12), washers (13) and bolts (14) freeing spool valve (10).
(5) Remove spool valve (10).

b. Installation.

(1) Place spool valve (10) on support and secure using washers (13), bolts (14), lockwashers (12) and nuts (11).
(2) Install valve assembly (6), straight adapter (7) and tee adapters (8) and (9) on spool valve (10).
(3) Connect hose lines (2), (3), (4) and (5) to their respective fittings.
(4) Open ball valves at accumulators to pressurize hose lines.

APPENDIX A

REFERENCES

A-1. Fire Protection

TB 5-4200-200-10	Hand Portable Fire Extinguishers for Army use

A-2. Maintenance

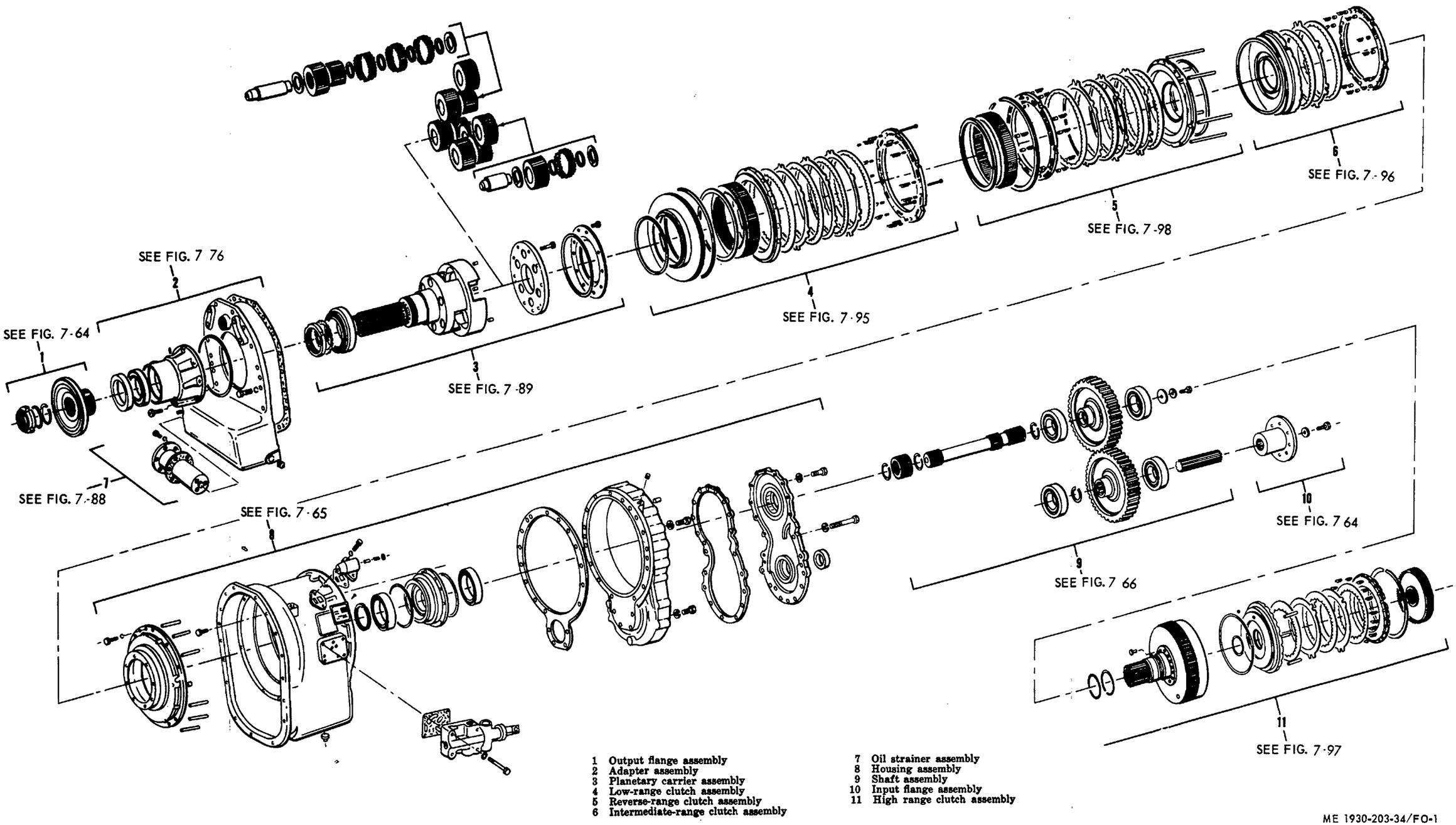
TM 5-764	Electric Motor and Generator Repair
TM 9-214	Inspection, Care and Maintenance of Antifriction Bearings
TM 9-237	Welding: Theory and Application
DA Pam 738-750	The Army Maintenance Management System (TAMMS)
TM 55-1930-203-10	Operator's Manual
TM 55-1930-203-20	Organizational Maintenance Manual
TM 55-1930-203-35P	Direct and General Support and Depot Maintenance Repair Parts and Special Tools List

APPENDIX B

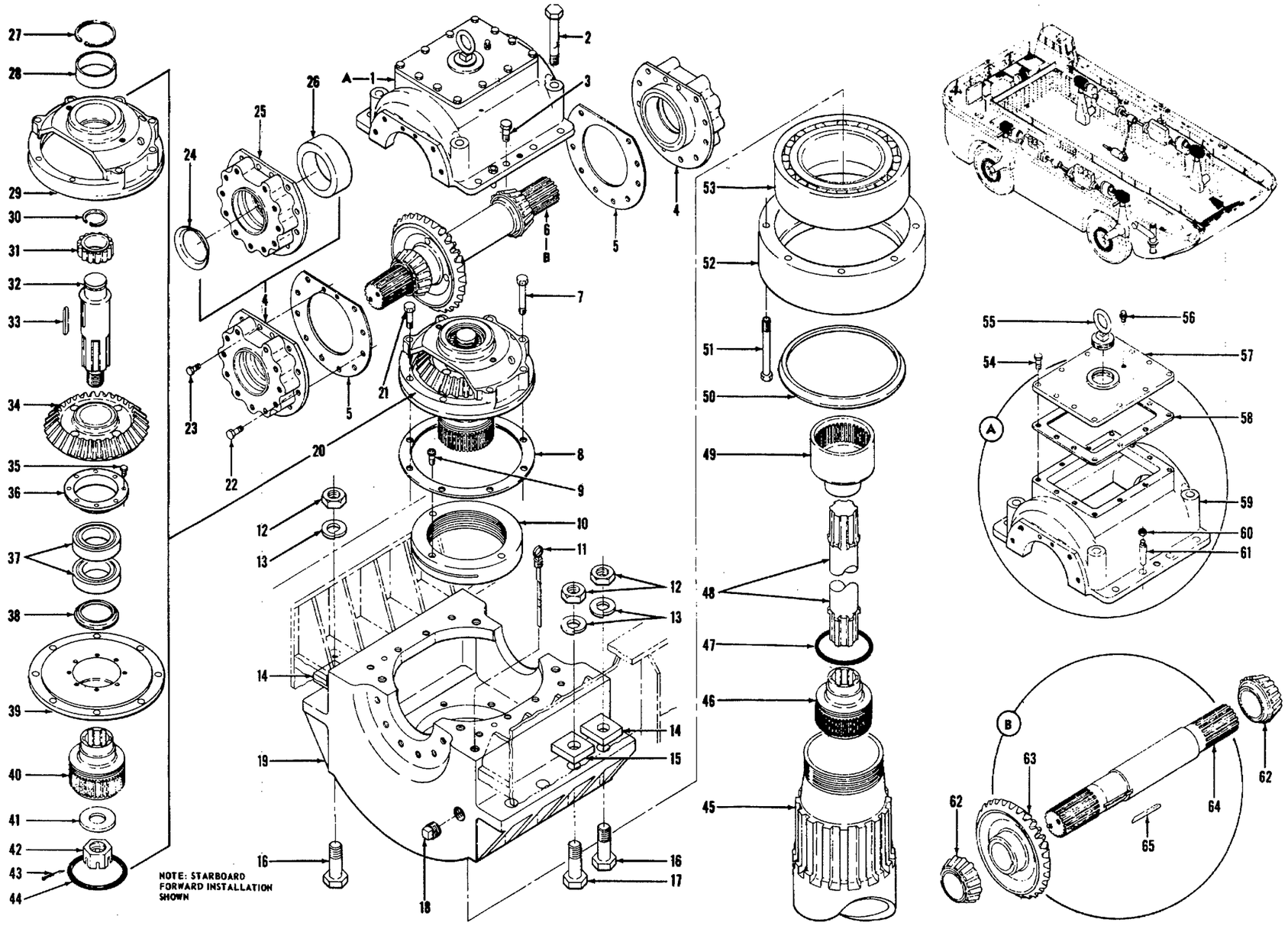
ILLUSTRATED LIST OF MANUFACTURED ITEMS

Refer to FO-5 for illustrated list of manufactured items.

INDEX



FO-1. Transmission assembly, exploded view.

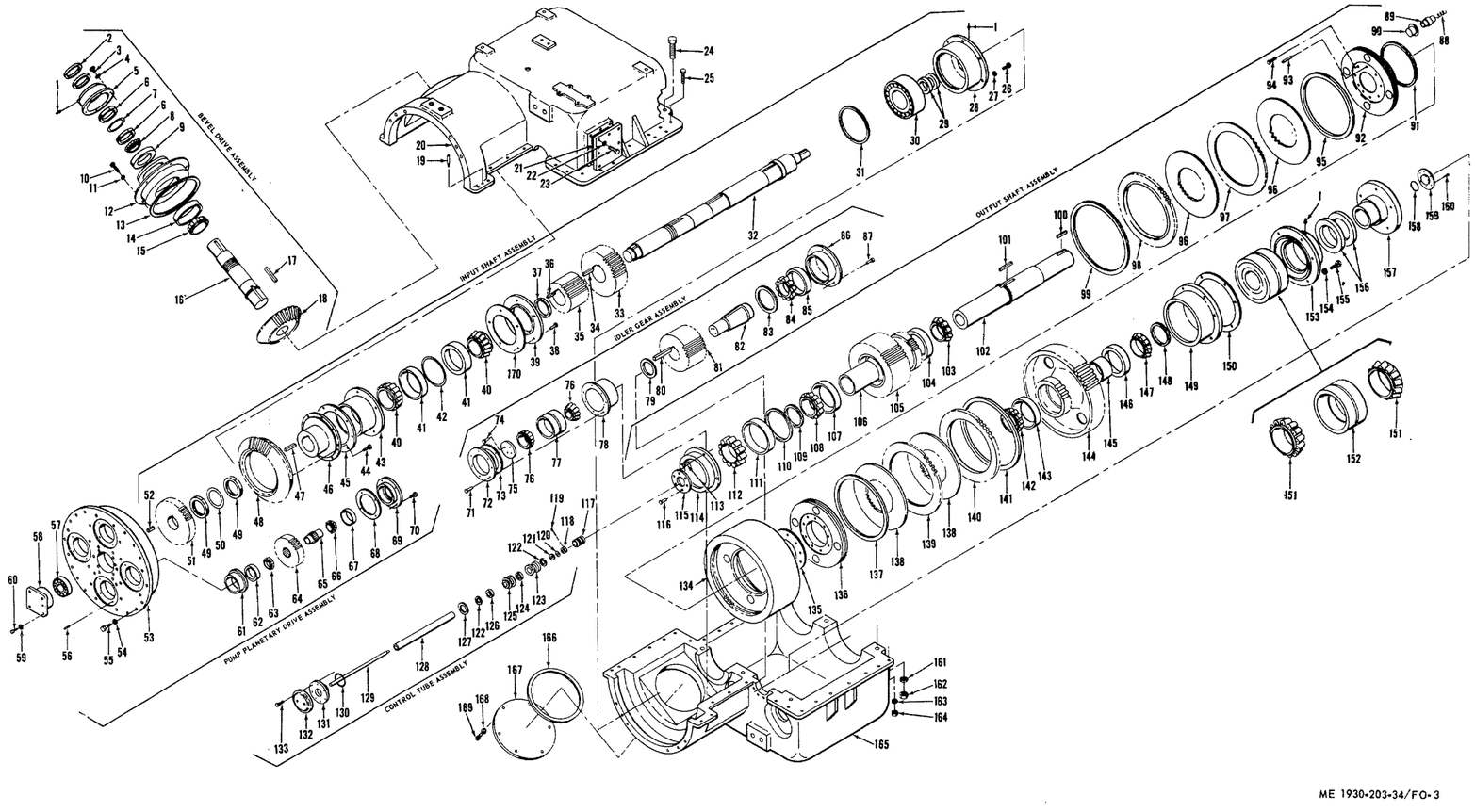


1 CASE COVER ASSEMBLY
2 CAPSCREW
3 CAPSCREW
4 BEARING RETAINER ASSEMBLY
5 SHIM SET
6 INPUT SHAFT ASSEMBLY
7 CAPSCREW
8 SHIM SET
9 CAPSCREW
10 NUT
11 OIL GAGE
12 NUT
13 LOCKWASHER
14 SHIM
15 SHIM
16 BOLT
17 BOLT
18 PLUG
19 CASE
20 OUTPUT SHAFT ASSEMBLY
21 CAPSCREW
22 CAPSCREW
23 CAPSCREW
24 SEAL
25 BEARING RETAINER
26 BEARING CUP
27 SNAP RING
28 BEARING OUTER RACE
29 BEARING YOKE
30 SNAP RING
31 BEARING INNER RACE
32 OUTPUT SHAFT
33 KEY
34 GEAR
35 CAPSCREW
36 BEARING STOP
37 BEARING, ANNULAR (MATCHED SET)
38 SEAL
39 BEARING CARRIER
40 COUPLING GEAR
41 WASHER
42 NUT
43 PIN, COTTER
44 PACKING, PREFORMED
45 COLUMN AND WHEEL DRIVE
46 COUPLING GEAR
47 PACKING, PREFORMED
48 INTERMEDIATE SHAFT
49 COUPLING GEAR
50 SEAL
51 CAPSCREW
52 BEARING CARRIER
53 BEARING
54 CAPSCREW
55 EYE BOLT
56 BREATHER
57 INSPECTION COVER
58 GASKET
59 CASE COVER
60 NUT
61 PIN, TAPER
62 BEARING CONE
63 GEAR
64 INPUT SHAFT
65 KEY

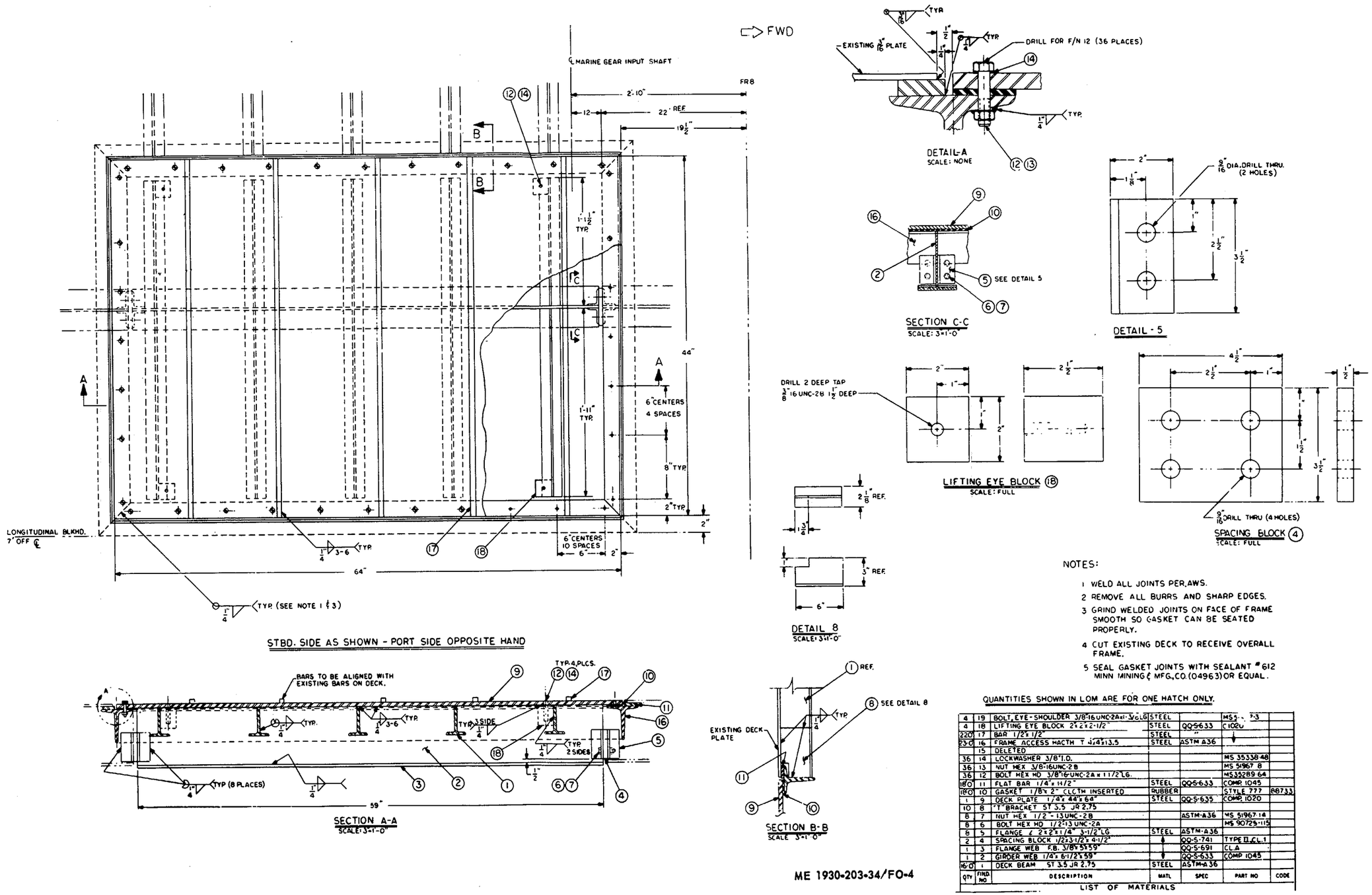
ME 1930-203-34/FO-2

FO-2. Removal and disassembly of miter box assembly.

1 Lubrication fitting
2 Bevel pinion oil seal
3 Capscrew, 3.5 x 1 in.
4 Washer, 3.8 in.
5 Bevel pinion seal carrier
6 Locknut, 2.933 in.
7 Washer, bevel drive key
8 Outer bevel pinion bearing cone
9 Outer bevel pinion bearing cup
10 Capscrew, ⅜ x 1 in.
11 Washer, ⅜ in.
12 Bearing carrier
13 Bevel pinion shim set
14 Inner bevel pinion bearing cup
15 Inner bevel pinion bearing cone
16 Bevel pinion shaft
17 Bevel pinion key
18 Bevel pinion
19 Taper pin
20 Upper housing
21 Inspection cover
22 Washer, ⅜ in.
23 Capscrew, ⅜ x 1 in.
24 Bolt, machine, ⅝ x 7¼ in.
25 Bolt, machine, ⅝ x 2⅝ in.
26 Capscrew, ½ x 1¼ in.
27 Washer, ½ in.
28 Aft high speed bearing adapter
29 Input shaft oil seal
30 Input shaft bearing
31 Aft retaining ring
32 Input shaft
33 Reverse pinion
34 Reverse pinion key
35 Forward pinion
36 Forward pinion key
37 Forward pinion spacer
38 Capscrew, ⅝ x 1½ in.
39 Forward bearing retainer
40 Tapered bearing cone
41 Tapered bearing cup
42 Forward pinion bearing spacer
43 Forward bearing adapter
44 Capscrew, ½ x 1 in.
45 Input shaft shim set
46 Bevel gear hub
47 Bevel gear key
48 Bevel gear
49 Locknut, 2.548 in.
50 Washer, input shaft key
51 Planetary sun gear
52 Planetary sun gear key
53 Planetary gear housing
54 Washer, ⅛ in.
55 Capscrew, ½ x 1½ in.
56 Screw, ¼ x 1 in.
57 Planetary housing bearing
58 Planetary housing adapter
59 Washer
60 Capscrew, ⅜ x 1 in.
61 Forward bearing adapter
62 Forward bearing cup
63 Forward bearing cone
64 Planetary pinion
65 Planetary pinion shaft
66 Aft bearing cone
67 Aft bearing cup
68 Aft bearing shim set
69 Aft bearing adapter
70 Capscrew, ⅜ x ⅝ in.
71 Bolt, 5/16 x ⅞ in.
72 Bearing retainer
73 Forward bearing retainer gasket
74 Capscrew, ⅜ x 1 in.
75 Idler shaft end plate
76 Forward bearing cone
77 Forward bearing cup
78 Forward bearing adapter
79 Forward bearing spacer
80 Idler gear key
81 Idler gear
82 Idler shaft
83 Retaining ring
84 Aft bearing cone
85 Aft bearing cup
86 Aft bearing adapter
87 Capscrew, ½ x ⅝ in.
88 Clutch compression spring
89 Clutch spring retainer
90 Clutch bushing cup
91 Piston ring
92 Forward plate
93 Clutch dowel pin
94 Capscrew, ⅜ x 2½ in.
95 Forward piston ring
96 Forward friction plate
97 Forward pressure plate
98 Forward backing plate
99 Forward retaining ring
100 Coupling key
101 Clutch hub key
102 Output shaft
103 Forward bearing cone
104 Forward bearing cup
105 Forward output gear
106 Forward bearing spacer
107 Forward bearing cup
108 Forward bearing cone
109 Forward bearing spacer
110 Forward retaining ring
111 Forward bearing cup
112 Forward bearing cone
113 Capscrew, ⅜ x 3¼ in.
114 Forward bearing adapter
115 Forward retaining plate
116 Capscrew, ½ x 1 in.
117 Valve bushing
118 Nut, castellated, ⅝ in.
119 Cotter pin
120 Washer, control tube
121 Washer, control tube beveled
122 Washer, control tube inner
123 Reverse oil valve
124 Piston ring
125 Forward oil valve
126 Control tube spacer
127 Valve retaining ring
128 Outer tube
129 Inner tube
130 Separator gasket
131 Separator box
132 Separator box cap
133 Capscrew, ⅜ x 1½ in.
134 Clutch piston
135 Clutch hub gasket
136 Reverse plate
137 Reverse piston ring
138 Reverse friction plate
139 Reverse pressure plate
140 Reverse backing plate
141 Reverse retaining ring
142 Reverse bearing cone
143 Reverse bearing cup
144 Reverse output gear
145 Reverse bearing spacer
146 Reverse bearing cup
147 Reverse bearing cone
148 Reverse spacer
149 Aft output shaft adapter
150 Output shaft shim set
151 Aft bearing cone
152 Aft bearing cup
153 Coupling bearing retainer
154 Washer
155 Capscrew
156 Oil seal
157 Coupling half
158 Packing, 1¾ x 2 in.
159 Packing retainer
160 Capscrew, ⅜ x 1 in.
161 Washer, 15/16 x 2 in.
162 Nut, ¾ in.
163 Washer, ⅜ x ¾ in.
164 Nut, ⅜ in.
165 Lower housing
166 Gasket, bevel drive cover
167 Bevel drive cover
168 Washer, bevel drive cover
169 Screw, ⅜ x 1½ in.
170 Gasket



FO-3. Marine gear assembly (right-hand unit) exploded view.



ME 1930-203-34/FO-4

NOTES:

1. WELD ALL JOINTS PER AWS.
2. REMOVE ALL BURRS AND SHARP EDGES.
3. GRIND WELDED JOINTS ON FACE OF FRAME SMOOTH SO GASKET CAN BE SEATED PROPERLY.
4. CUT EXISTING DECK TO RECEIVE OVERALL FRAME.
5. SEAL GASKET JOINTS WITH SEALANT #612 MINN MINING & MFG. CO. (04963) OR EQUAL.

QUANTITIES SHOWN IN LOM ARE FOR ONE HATCH ONLY.

QTY	FIND NO	DESCRIPTION	MATL	SPEC	PART NO	CODE
4	19	BOLT, EYE-SHOULDER 3/8"-16UNC-2A x 1-3/4 LG	STEEL		MS 3-3	
4	18	LIFTING EYE BLOCK 2"x2"x2-1/2"	STEEL	QQ-S-633	C102U	
220	17	BAR 1/2"x 1/2"	STEEL	"	↓	
23'-0	16	FRAME ACCESS MACTH T 3/4"x13.5	STEEL	ASTM A36		
	15	DELETED				
36	14	LOCKWASHER 3/8" I.D.			MS 35338-48	
36	13	NUT HEX 3/8-16UNC-2B			MS 51967 8	
36	12	BOLT HEX HD 3/8"-16-UNC-2A x 1 1/2" LG.			MS35289-64	
180	11	FLAT BAR 1/4"x 1½"	STEEL	QQ-S-633	COMP 1045	
180	10	GASKET 1/8"x 2" CLOTH INSERTED	RUBBER		STYLE 777	88733
1	9	DECK PLATE 1/4"x 44"x 64"	STEEL	QQ-S-635	COMP 1020	
10	8	"T" BRACKET ST 3.5 JR 2.75				
8	7	NUT HEX 1/2"-13UNC-2B		ASTM-A36	MS 51967-14	
8	6	BOLT HEX HD 1/2"-13 UNC-2A			MS 90725-115	
8	5	FLANGE ∠ 2"x2"x1/4" 3-1/2" LG.	STEEL	ASTM-A36		
2	4	SPACING BLOCK 1/2"x3-1/2"x 4-1/2"	↓	QQ-S-741	TYPE II CL.1	
1	3	FLANGE WEB F.B. 3/8"x 5"x 59"		QQ-S-691	CL.A	
1	2	GIRDER WEB 1/4"x 6-1/2"x 59"		QQ-S-633	COMP 1045	
16'-0	1	DECK BEAM ST 3.5 JR 2.75	STEEL	ASTM-A36		

LIST OF MATERIALS

FO-4. Marine gear access cover.

ILLUSTRATED LIST OF MANUFACTURED ITEMS

HYDRAULIC START AND WHEEL ALIGNMENT SYSTEM HOSE ASSEMBLIES

SECTION I. INTRODUCTION

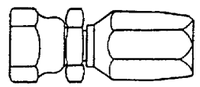
a. This appendix contains a tabulated list of components for each hose assembly used in the HYDRAULIC START AND WHEEL ALIGNMENT SYSTEM and illustrated views of each component.

b. Fabrication instructions for the hose assemblies are contained in TM for the HYDRAULIC SYSTEM TEST AND REPAIR UNIT (HYSTRU).

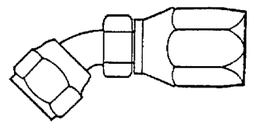
SECTION II. ILLUSTRATED VIEWS

HOSE, SYNTHETIC RUBBER, 2 WIRE BRAID REINFORCEMENT AND SYNTHETIC RUBBER COVER
4720-00-722-4722 (1/4")
4720-00-722-4723 (3/4")
4720-00-797-2488 (1/2")

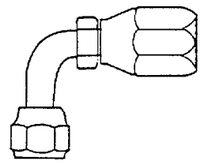
HOSE, ELASTOMER TUBE, BRASS PLATED STEEL WIRE REINFORCED, BRAIDED REFRACTORY INSULATION
4720-01-244-3576 (3/8")
FC234-8(01276) (1/2")
FC234-10(01276) (5/8")
FC234-12(01276) (1")



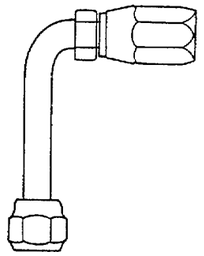
FITTING, WIRE REINFORCED HYDRAULIC HOSE (REUSABLE), SCREW-ON TO 37° FLARE FEMALE SWIVEL, STRAIGHT
4730-00-931-2458 (1/4")
4730-00-051-4709 (3/8")
4730-00-455-8650 (3/8")
4730-00-869-3757 (3/8")
4730-00-897-6271 (1/2")
4730-00-952-0038 (1/2")
4730-01-189-8570 (5/8")
4730-00-881-5536 (1")



FITTING, WIRE REINFORCED HYDRAULIC HOSE, (REUSABLE), SCREW-ON TO 37° FLARE FEMALE SWIVEL, 45° BENT TUBE
4730-00-103-8256 (1/4")



FITTING, WIRE REINFORCED HYRAULIC HOSE (REUSABLE), SCREW-ON TO 37° FLARE FEMALE SWIVEL, 90° BENT TUBE, SHORT DROP
4730-00-937-0239 (1/4")
4730-00-852-4310 (3/8")
4730-01-077-0302 (3/8")
4330-00-913-7405 (3/8")



FITTING, WIRE REINFORCED HYDRAULIC HOSE (REUSABLE), SCREW-ON TO 37° FLARE FEMALE SWIVEL, 90° BENT TUBE, LONG DROP
4730-00-226-8077 (1/4")
190263-62(01276) (3/8")

SECTION III. COMPONENTS OF REPLACEMENT HOSE ASSEMBLIES, HYDRAULIC START AND WHEEL ALIGNMENT SYSTEM

FIND NO. ✳	HOSE				FITTING FIRST END				FITTING SECOND END				HOSE ASSEMBLY
	NSN	LENGTH	CAGE	PART NO.	NSN	CAGE	PART NO.	TORQUE IN LBS	NSN	CAGE	PART NO.	TORQUE IN LBS.	PROOF PRESSURE PSI
1	4720-00-797-2488	2FT	01276	FC195-8	4730-00-952-0038	01276	4721-8-8	430-470	4730-00-952-0038	01276	4721-8-8	430-470	8500
2	4720-00-797-2488	10FT	01276	FC195-8	4730-00-952-0038	01276	4721-8-8	430-470	4730-00-952-0038	01276	4721-8-8	430-470	8500
3	4720-00-722-4723	12FT	01276	FC195-6	4730-00-913-7405	01276	190264-6-5	215-245	4730-00-051-4709	01276	4721-6-6	215-245	10000
4	4720-01-244-3576	13FT 7in	01276	FC234-6	4730-00-869-3757	01276	4411-6-6	215-245	4730-00-869-3757	01276	4411-6-6	215-245	3000
5		10FT	01276	FC234-10	4730-01-189-8570	01276	4411-8-10	430-470	4730-01-189-8570	01276	4411-8-10	430-470	2500
6	4720-00-722-4722	20FT	01276	FC195-4	4730-00-931-2458	01276	4721-4-4	135-145	4730-00-931-2458	01276	4721-4-4	135-145	11500
7	4720-00-722-4722	4FT 8in	01276	FC195-4	4730-00-937-9239	01276	190264-4-4	135-145	4730-00-931-2458	01276	4721-4-4	135-145	11500
8	4720-00-722-4722	6FT 8in	01276	FC195-4	4730-00-931-2458	01276	4721-4-4	135-145	4730-00-931-2458	01276	4721-4-4	135-145	11500
9	4720-00-722-4722	30FT	01276	FC195-4	4730-00-931-2458	01276	4721-4-4	135-145	4730-00-931-2458	01276	4721-4-4	135-145	11500
10	4720-00-722-4723	2FT	01276	FC195-6	4730-00-051-4709	01276	4721-6-6	215-245	4730-01-077-0302	01276	190264-8-6S	215-247	10000
11	4720-00-797-2488	1FT 8in	01276	FC195-8	4730-00-952-0038	01276	4721-8-8	430-470	4730-00-952-0038	01276	4721-8-8	430-470	8500
12		3FT	01276	FC234-8	4730-00-897-6271	01276	4411-8S	430-470	4730-00-897-6271	01276	4411-8S	430-470	2500
13	4720-00-722-4722	5FT 7in	01276	FC195-4	4730-00-226-8077	01276	190263-4S	135-145	4730-00-226-8077	01276	190263-4S	135-145	11500
14	4720-00-722-4723	3FT 11in	01276	FC195-6	4730-00-455-8650	01276	4721-6	215-245		01276	190263-6S	215-245	1000
15		10FT	01276	FC234-12	4730-00-881-5536	01276	4411-12	855-945	4730-00-881-5536	01276	4411-12,	855-945	1500
16	4720-00-722-4722	25FT	01276	FC195-4	4730-00-103-8256	01276	190287-4S	135-145	4730-00-937-0239	01276	190264-4-4	135-145	11500
17	4720-01-244-3576	3FT 6in	01276	FC234-6	4630-00-852-4310	01276	190261-6S	215-245	4730-00-852-4310	01276	190261-6S		3000

✳ SEE FIGURE 13-15 FOR FIND NUMBERS

FO-5. Illustrated List of Manufactured Items

By Order of the Secretary of the Army:

CARL E. VUONO
General, United States Army
Chief of Staff

Official:

R. L. DILWORTH
Brigadier General, United States Army
the Adjutant General

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* U.S.GOVERNMENT PRINTING OFFICE : 1993 - 342-421 (62893)

The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigram = .035 ounce
1 dekagram = 10 grams = .35 ounce
1 hectogram = 10 dekagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	*To*	*Multiply by*	*To change*	*To*	*Multiply by*
inches	centimeters	2.540	ounce-inches	newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29,573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	newton-meters	1.356	metric tons	short tons	1.102
pound-inches	newton-meters	.11296			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

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