TM 9-4910-605-14 & P

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

OPERATOR, ORGANIZATIONAL, DIRECT SUPPORT

AND GENERAL SUPPORT MAINTENANCE

MANUAL INCLUDING REPAIR PARTS LIST

FOR

ENGINE ANALYZER

MODEL 10-516

(KING ELECTRONICS CO) (4910-00-913-9778)

HEADQUARTERS, DEPARTMENT OF THE ARMY

DECEMBER 1980

C A U T I O N

IN CLEANING THE INSTRUMENT, DO NOT CLEAN PLASTIC PANEL SCREEN OR METER COVERS WITH ANY PETROLEUM SOLVENTS. THIS WILL DAMAGE THE CLEAR PLASTIC FINISH. USE A GOOD GRADE OF DETERGENT WITH CLEAN POLISHING CLOTH AND WATER ONLY. USE FABRIC SOFTENER DETERGENT TO PREVENT STATIC ON PLASTIC CRT SCREEN OR METER FACES.

W A R N I N G

ALWAYS DISCONNECT LINE CORD PLUG FROM POWER BEFORE REMOVING REAR COVER. IN SERVICING THE UNIT, OBSERVE CAUTION WITH POWER CONNECTED AND CONSIDER ALL CONTACTS, BARE WIRES AND TERMINALS AS HAZARDOUS TO CONTACT. PERFORMANCE OF SERVICING SHOULD BE DONE BY QUALIFIED SERVICE PERSONNEL.

C A U T I O N

A KEYLESS REMOTE STARTER SWITCH IS INCLUDED WITH THIS EQUIPMENT. INSTRUCTIONS ARE PROVIDED ON THE BACK OF THE SWITCH. ON THOSE VEHICLES WHICH INCORPORATE AN IGNITION BALLAST RESISTOR THE USE OF THE IGNITION BY-PASS SECTION OF THE STARTER SWITCH CAN RESULT IN INCORRECT TEST RESULTS AND/OR POSSIBLE ELECTRICAL DAMAGE TO THE IGNITION SYSTEM.

W A R N I N G

USE INSULATED PLIERS WHEN GRIPPING CABLES TO SPARK PLUGS.

Technical Manual
No. 9-4910-605-14&P

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, 12 December 1980

OPERATOR'S ORGANIZATIONAL, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL INCLUDING REPAIR PARTS LIST FOR

ENGINE ANALYZER
MODEL 10-516
(KING ELECTRONICS CO.)
(NSN 4910-00-913-9778)

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes 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 direct to: Commander, US Army Armament Materiel Readiness Command, ATTN: DRSAR-MAS, Rock Island, IL 61299. A reply will be furnished directly to you.

NOTE

This manual is published for the purpose of identifying an authorized commercial manual for the use of the personnel to whom this analyzer is issued.

Manufactured by: KING ELECTRONICS CO.
6892 SNOWVILLE, ROAD
BRECKSVILLE, OHIO 44141

Procured under Contract No. DAAA09-75-C-6893

This technical manual is an authentication of the manufacturers' commercial literature and does not conform with the format and content specified in AR 310-3, Military Publications. This technical manual does, however, contain available information that is essential to the operation and maintenance of the equipment.

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INSTRUCTIONS FOR REQUISITIONING PARTS

NOT IDENTIFIED BY NSN

When requisitioning parts not identified by National Stock Number, it is mandatory that the following information be furnished the supply officer.

1 - Manufacturer's Federal Supply Code Number - 89737

2 - Manufacturer's Part Number exactly as listed herein.

3 - Nomenclature exactly as listed herein, including dimensions, if necessary.

4 - Manufacturer's Model Number - Model 10-516

5 - Manufacturer's Serial Number (End Item)

6 - Any other information such as Type, Frame Number, and Electrical Characteristics, if applicable.

7 - If DD Form 1348 is used, fill in all blocks except 4, 5, 6, and Remarks field in accordance with AR 725-50.

Complete Form as Follows:

(a) In blocks 4, 5, 6, list manufacturer's Federal Supply Code Number - followed by a colon and manufacturer's Part Number for the repair part.

(b) Complete Remarks field as follows:
Noun: (nomenclature of repair part)
For: NSN: 4910-00-913-9778
Manufacturer: King Electronics Co.

Model: 10-516
Serial: (of end item)

Any other pertinent information such as Frame Number, Type, Dimensions, etc.

Section I. GENERAL INFORMATION

MODEL 10-516

INTRODUCTION

The DIAL-A-TRONIC, model 10-516 series, Engine Analyzer is designed to provide the Automotive Service Technician with instrumentation, plus oscilloscope to effectively and efficiently diagnose Engine Performance problems.

The master DIAL-A-TEST selector automatically selects the proper test mode meters and vehicle connections. The DIAL-A-TEST selector also illuminates a TEST MODE INDICATOR LIGHT on the front panel which not only identifies the test being performed, but also the meter scales to be read. Meter scales are illuminated with soft fluorescent lighting for good readability.

The Scope Screen provides non-glare viewing of scope patterns.

The scope provides both primary and secondary superimposed and single cylinder patterns plus 20KV and 40 KV parade patterns.

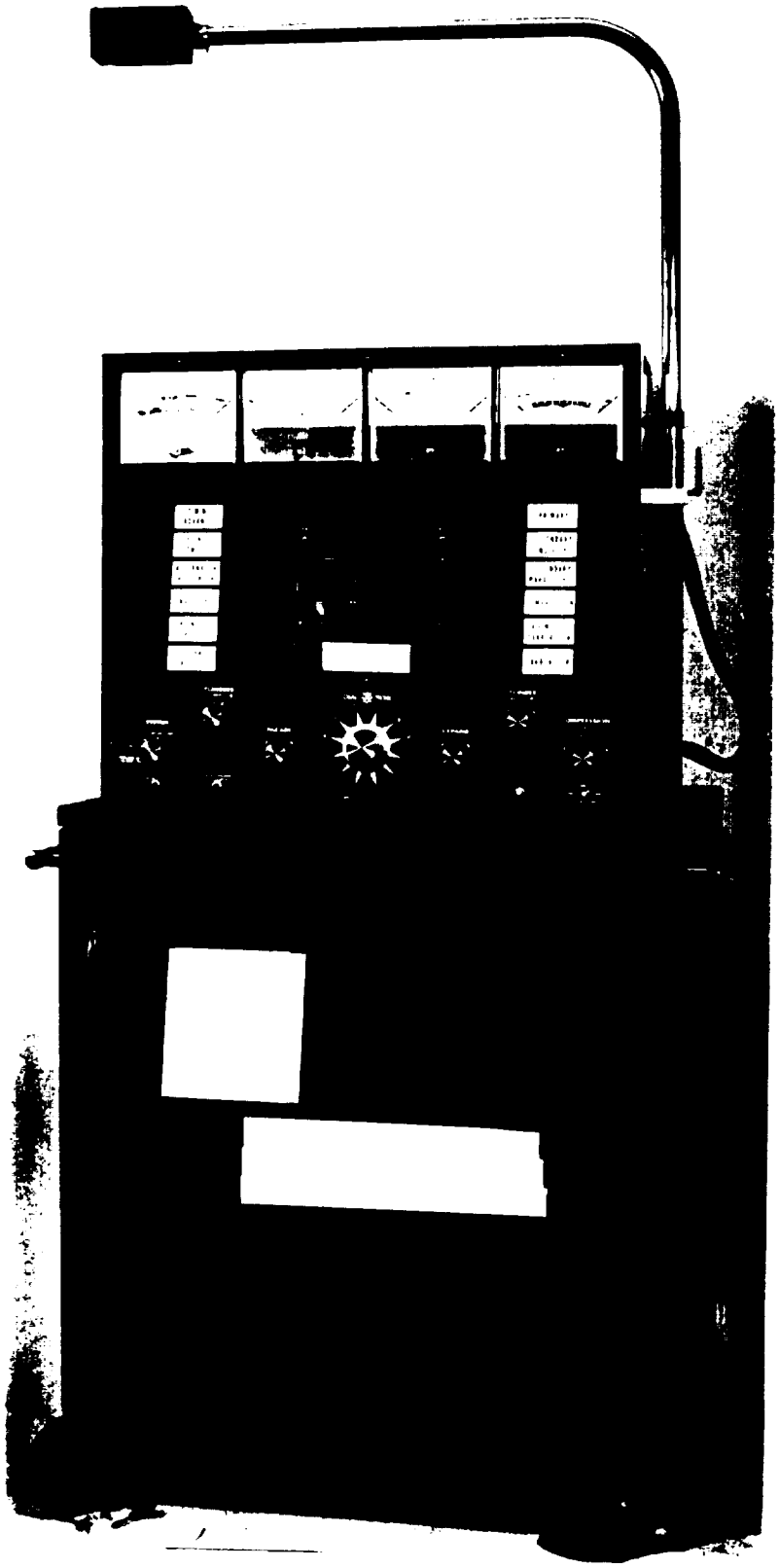
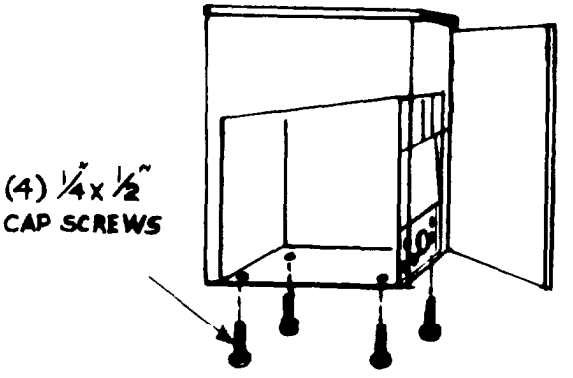


Figure 1.

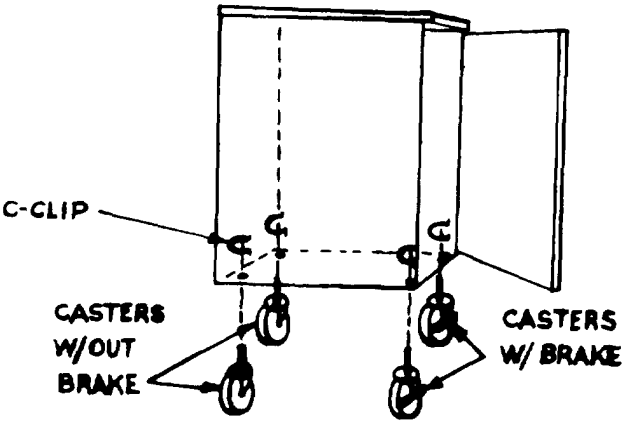
ASSEMBLY

Having removed the 10-516 Engine Analyzer and accessories from the shipping carton, assemble the unit as follows:

1. Remove 10-516 Analyzer Head from base cabinet by removing 4 - 1/4" x 1/2" cap screws from the underside of base cabinet. Remove head from cabinet.

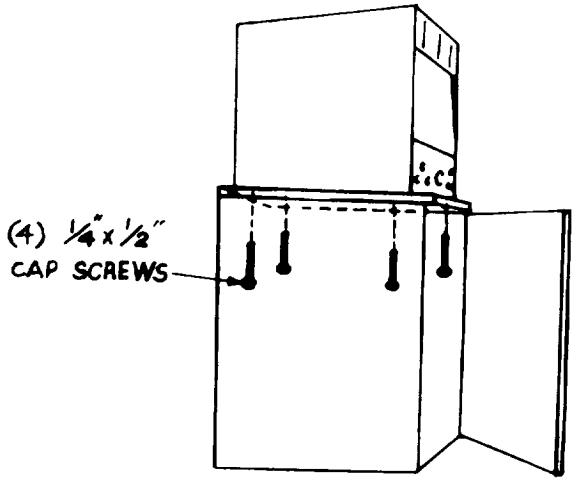


2. Install casters and secure with "C" clips provided. The Two Locking casters go to the front of cabinet.

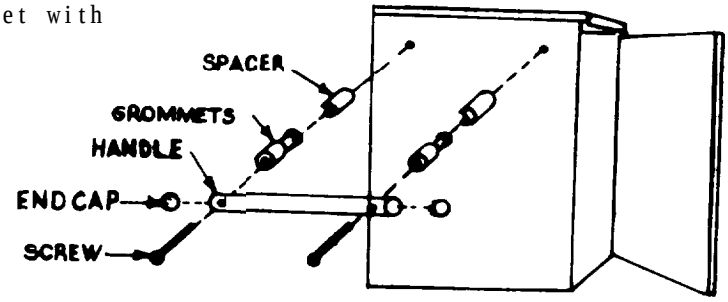


ASSEMBLY

3. Place head on base cabinet and secure with the 4 - 1/4" x 1/2" cap screws removed in step 1.

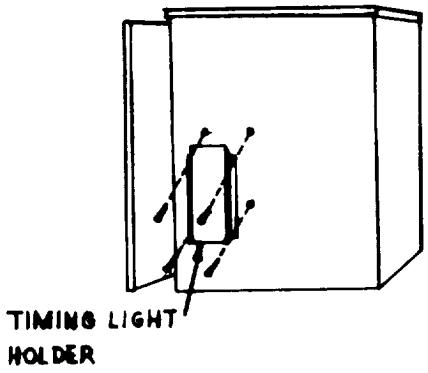


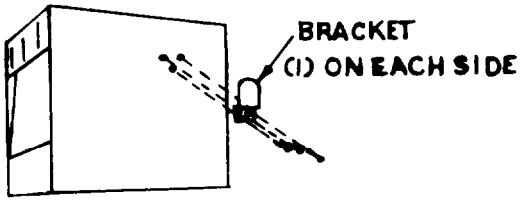
4. Install handles on base cabinet with screws and hardware provided.



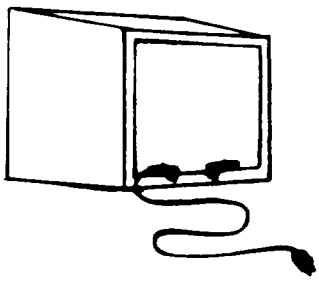
ASSEMBLY

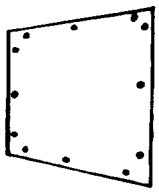
5. Mount timing light holder and brackets on side of unit with metal screws provided.





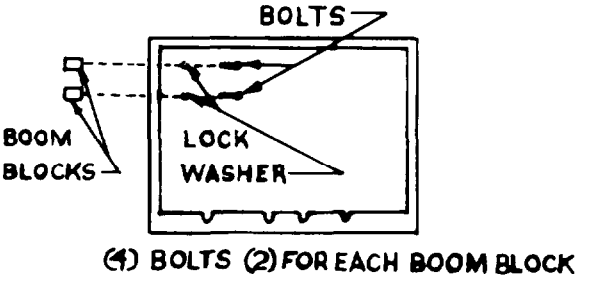
6. Remove rear panel from 10-516 head assembly and uncoil A/C cord.



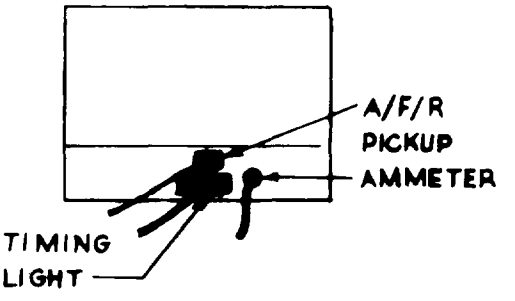


7. Mount boom blocks on side of case with 1/4" x 1/2" cap screws provided.

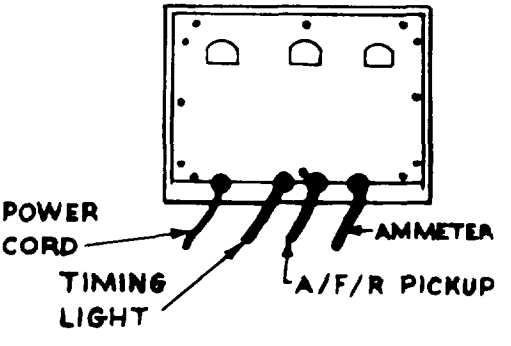
ROTE: Bore of Bottom Boom Block has a shoulder to support the boom. Install Bottom Boom Block with shoulder downward.



8. Connect Timing Light, A/F/R Pick-up and Ammeter leads to back of analyzer. Inspect inside section of scope chassis for loose tubes.

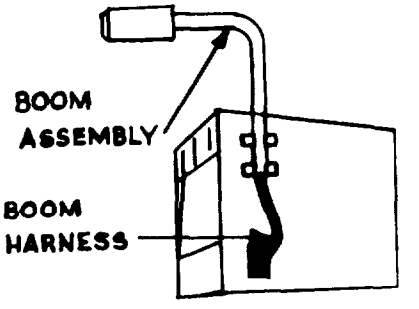


9. Insert leads and grommets into recesses in rear of case. Replace rear panel with brackets facing out.

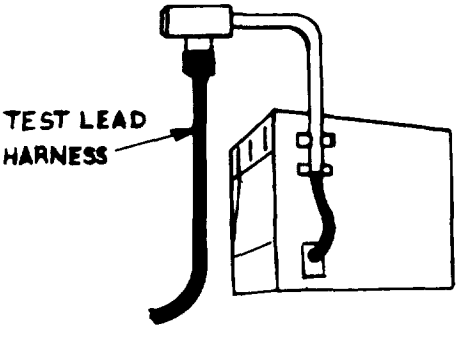


ASSEMBLY

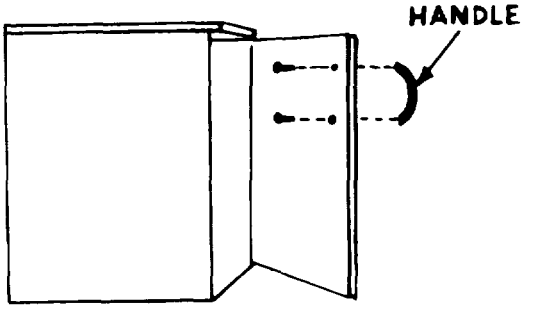
10. Mount boom assembly in boom blocks and connect boom harness to analyzer.

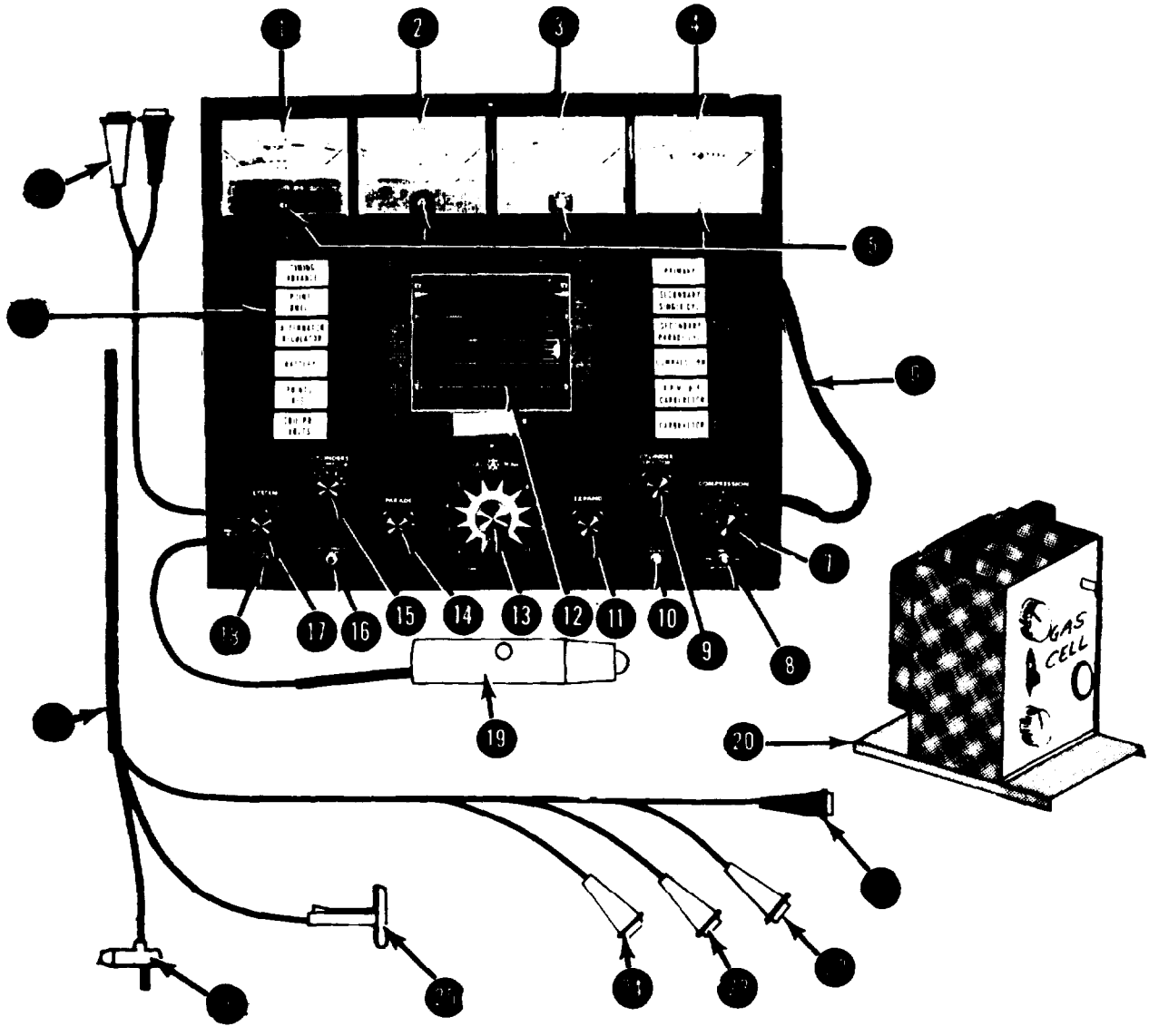


11. Connect test lead harness to boom assembly.



12. Mount cabinet door handle on door with screws provided.





1. Voltmeter
2. Advance/Amps Meter
3. Tachometer
4. Compression-A/F/R Meter
5. Zero Adjust Screws
6. Test Lead Boom Assembly
7. Compression Set/Plug Load Control
8. 40KV Scale Switch
9. Cylinder Selector Switch
10. Plug Load Switch
11. Expand Control
12. Oscilloscope Grid Screen
13. DIAL-A-TRONIC Master Test Selector Switch
14. Parade Control
15. Number of Cylinders/Polarity Switch
16. Circuit Breaker Reset
17. System Switch
18. Meter Lights Switch
19. Timing Light
20. A/F/R Gas Cell
21. Ground Lead
22. Red Voltmeter Lead
23. Yellow Primary Lead
24. Green Primary
25. Coil Pick-up
26. Spark Plug Pick-up
27. Test Lead Assembly (From Boom)
28. Test Indicator Lights
29. Ammeter Leads

Figure 2

DESCRIPTION

1. VOLTMETER - Has two voltage scales - Scales "A" and "B".

Scale "B" is read when the Test Selector is in POSITIONS 1-3-4 and has two voltage scales - O-16 volts and O-48 volts. The O-16 volts scale is the top scale on the meter. The O-48 volts scale is immediately below the O-16 volts.

The O-16 volts scale is blocked off in colored zones indicating General Specifications for Cranking and Charging Voltages in 6-12 volts systems and Coil Primary Input voltage on 12 volts system. Each division of the 9-16 volts scale equals .2 volts. This scale is used when analyzing 6-12 volts systems.

The O-48 volts scale is used for vehicles with 24-32 volts systems. Each division equals 1 volt.

Scale "A" is read when DIAL-A-TRONIC Test Selector is in POSITION 2 and is an Expanded volts scale used in making Resistance checks of the electrical system. The Green-Red-Yellow color coded band is used when checking Primary Ground circuits (POINTS) Resistance. The O-O.5 scale on the lower edge of the band is used when checking cranking or other circuit resistance.

Both Scale "A" and "B" of the voltmeter are overload protected and cannot be damaged when connected across a battery.

2. ADVANCE/AMMETER - This meter has two scales, Scales "C" and "E" and provides three readouts - DWELL - TIMING ADVANCE and CHARGING CURRENT.

Scale "C" is the ammeter scale and provides a readout of charging current when the Test Selector is in POSITION No. 4. The scale reads O-100 amps with each division equalling 5. amps.

Scale "E" includes the top 2 scales of the meter. The upper scale provides 2 readouts.
(1) Points Dwell for 6 and 8 cylinder engines when test selector is in POSITION No. 5.
(2) Timing advance for 4, 6 or 8 cylinder engines when test selector is in POSITION No. 6. This scale is calibrated to read 0-60° crankshaft degrees with each division equalling 1°.
The lower "E" Scale (middle scale of meter) reads Points Dwell for 4 cylinder engines when test selector is in POSITION No. 5. This scale reads 0°-90° with each division equalling 1°.

3. TACHOMETER - Has 3 scales - Scales "D" - "F" - "H".

Scale "D" is read during alternator, ignition and carburetion tests when test selector is in POSITIONS 4-5-6-7-8-9-12. Scale reads O-4000 RPM with each division equalling 100 RPM.

Scale "F" is read during carburetion idle test when test selector is in POSITION No. 11. Scale reads 0-10OO engine RPM with each division equalling 20 RPM.

Scale "H" is used whenever test speeds between 4000-8000 RPM are required and is selected by placing System Switch in 8000 RPM position. Scale reads from O-8000 Engine RPM with each division equalling 500 RPM.

DESCRIPTION

4. COMPRESSION - A/F/R METER - This meter has 2 scales - Scales “J” and "G".

Scale "J" is read when the test selector is in POSITION No. 10 while performing an Electronic Compression Test of the cylinders and provides an accurate cylinder power comparison test in terms of RPM loss as each cylinder is shorted out. The scale is calibrated to read from 0-400 RPM loss in divisions of 10 RPM.

Scale "G" is an Air/Fuel/Ratio scale and provides a weight ratio readout of the air fuel mixture. The A/F/R scale is read when test selector is in POSITIONS 11 or 12 to check A/F/R during IDLE, CRUISE, ACCELERATION and DECELERATION. The scale is calibrated to read from 10:1 to 16:1 air/fuel/ratio.

5. ZERO ADJUST SCREWS - A Zero Adjust Screw is located in the lower center area of each meter face. The adjust screw is used to mechanically adjust the meter pointers to ZERO should they be slightly off. The zero check and adjustment must be made with the DIAL-A-TRONIC Test Selector in POSITION No. 1 of "OFF" and before the analyzer is connected to a vehicle To adjust pointers to "ZERO", turn Zero Adjust screw slightly to left or right using a small screwdriver.

6. TEST LEAD BOOM ASSEMBLY - Provides a single plug-in connection of all electrical diagnostic test leads to the console.

7. COMPRESSION SET/PLUG LOAD CONTROL - This is a dual purpose control. When Test Selector is in POSITION No. 10 the control is used to set the compression meter to "0". When Test Selector is in POSITION 8 or 9, it provides a variable ignition load to check spark plug ignition.

8. 40 KV TEST SWITCH - When pushed, allows coil output to be read on the 40 KV scale of the scope screen in test No.9.

9. CYLINDER SELECTOR SWITCH - This rotary switch shorts out one cylinder at a time during test No. 10 "Compression Test". It is also used to raise individual cylinder patterns in test No. 8. MUST be in "OFF" position when zeroing compression meter in test No. 10.

10. PLUG LOAD TEST SWITCH - Applies plug ignition load in test 8 or 9.

11. EXPAND CONTROL - Is a rotary control used to expand scope patterns horizontally.

12. OSCILLOSCOPE SCREEN - Displays primary and secondary ignition superimposed patterns-secondary single cylinder and parade patterns. It also provides secondary KV readings on selected 20 KV or 40 KV scale. The scope screen also provides a calibrated Dwell Variation block on the 5 and 10 KV grid lines. Small Vertical Graduations on the 15 KV line are used to compare the length of the spark line of individual cylinders.

13. DIAL-A-TRONIC MASTER TEST SELECTOR SWITCH - Provides a programed test sequence for diagnosing engine performance problems. The Test Selector automatically selects meter scales, test lead connections and scope patterns related to the test being performed. It also provides an automatic "Engine Kill" in POSITIONS 1 and 3.

14. PARADE CONTROL - Positions left edge of pattern on scope screen, also moves each cylinder across the screen when parade pattern is expanded with Test Selector on POSITION No. 9.

DESCRIPTION

15. CYLINDERS SWITCH - Programs analyzer to vehicle ground polarity and number of cylinders.

16. CIRCUIT BREAKER RESET - Used to reset circuit breaker.

17. SYSTEM SWITCH - Is a 4 position rotary switch providing the selection of voltmeter scales or special analyzer functions.
(1) 16 volts scale for 6-12 volt vehicle systems.
(2) 48 volts scale for 24-32 volt vehicle systems.
(3) 8000 RPM scale for special high speed testing (DO NOT use in RPM IDLE test No. 11).
(4) H.E:I. TEST - for General Motors H.E.I. and other Electronic Ignition tests.

18. METER LIGHT SWITCH - Is a push/push switch for turning meter fluorescent lamps "ON" or "OFF". To turn lamps "ON", push switch and hold a few seconds until lamp glows, then release. To turn lamps, "OFF", push switch.

19. TIMING LIGHT - The electronically controlled strobe light checks both BASIC TIMING and TIMING ADVANCE.

20. A/F/R GAS CELL - Contains the Wheatstone Bridge used in providing an A/F/R readout on the A/F/R meter scale.

21. GROUND (black) LEAD - Is the Ground connection for all test leads and is connected to a GOOD engine ground or battery ground post.

22. RED VOLTMETER LEAD - Is the Positive voltmeter lead and is usually connected to the Battery Positive or "HOT" post to provide a volts reading for battery cranking voltage and alternator charging voltage. It may also be connected to other points in the electrical system where a voltage reading may be required.

23. YELLOW PRIMARY LEAD - Connects to distributor side of coil. The yellow lead triggers primary scope pattern and gives meter readouts for points dwell and primary ground circuit resistance.

24. GREEN PRIMARY LEAD - Connects to Battery side of coil and is used in checking voltages at the input side of the coil.

25. COIL PICKUP - Connects to Coil/Distributor high tension cable. Secondary superimposed pattern is triggered by this pickup.

26. SPARK PLUG PICKUP - Connects to spark plug of timing cylinder of the engine. (Usually No. 1 cylinder). The timing light and secondary parade pattern are triggered by this pickup.

27. TEST LEAD ASSEMBLY (FROM BOOM) - Provides a single plug-in connection of vehicle test leads to boom assembly.

28. TEST INDICATOR LIGHTS - 12 Test Indicator lights, mounted on the front panel, are numbered 1 through 12 and correspond to the numbers on the DIAL-A-TRONIC Test Selector, As the Test Selector is rotated through test positions 1 to 12, the corresponding test indicator light will come on identifying the -
(a) System or circuit being tested.
(b) The test position of the test selector.
(c) The meter scales to be read during the test.

DESCRIPTION

29. AMMETER TEST LEADS - Connect in series between the alternator and battery to provide an alternator charging current readout on the AMPS scale.

ANALYZER FUNCTIONS

The following tests are programed with the master DIAL-A-TEST selector. The test features and function of panel controls are described.

1. COIL PRIMARY - BALLAST RESISTOR TEST - OFF POSITION -- Calibrated OK zone on voltmeter scale. NOTE: When performing test 1 - 3, engines will not start. Automatic ignition loading prevents engine from starting. The secondary HT coil lead does not have to be removed. This safety feature avoids coil sparking which could cause fuel vapors to ignite.

2. POINTS RESISTANCE TEST - Expanded sensitive .5 volt range with solid state overload meter position. Calibrated points OK and replace zones on meter scale. Meter cannot be damaged by accidental connection across battery circuit. Safe for all cable and solenoid resistance tests.

3. BATTERY TEST -- Starter load. Checks battery cranking voltage and starter condition.

4. ALTERNATOR-REGULATOR TEST -- Engine is started. Voltmeter and ammeter indicate charging circuit performance. Alternator scope pattern will detect alternator defects such as shorted or open diodes and windings; positive test,no guess work on alternator troubles.

5. POINT DWELL TEST -- Solid state circuit provides accurate breaker point setting.

6. TIMING - ADVANCE -- Electronically controlled strobe light indicates distributor timing and advance performance at all speeds. Solid state advance circuit provides accuracy. Advance meter scale 0-60 degrees, calibrated for CRANKSHAFT DEGREES.

7. PRIMARY - SCOPE TEST -- Screen displays primary SUPERIMPOSED pattern with all cylinder firing patterns stacked over each other, to compare variation between cylinders. Primary circuit performance can be observed for condenser, coil and point condition.

8. SECONDARY - SINGLE CYLINDER - SCOPE TEST -- Screen displays the secondary SUPERIMPOSED or all cylinder patterns stacked for comparison of spark plug performance. Each cylinder pattern can be raised above the stacked pattern group for observation. Cylinder selector control will slowly raise each plug pattern to center of screen.

9. SECONDARY - PARADE CYLINDERS -- Screen displays the secondary parade pattern with all cylinders in firing order. Each cylinder can be expanded across the screen for more detailed observation. Spark plug and cable performance can be observed for defects.

10. COMPRESSION TEST -- Provides an accurate cylinder power comparison test. The meter indicates the power capability of each cylinder. Low power of defective cylinders easily located.

ANALYZER FUNCTIONS

11. RPM IDLE - CARBURETOR TEST -- Carburetor idle speed adjustments are made and exhaust emission performance is checked in the idle speed range.

12. CARBURETOR TEST -- Combustion efficiency and exhaust emission check at intermediate and high speed range.

PREPARING ANALYZER FOR TESTING

1. Check name plate for proper voltage and cycles before plugging analyzer A/C power cord into a 115 Volt-60 cycle A/C Service Outlet.

2. Check meter pointers for ZERO and adjust if necessary. (See Description #28)

3. Program Test Panel as follows:

METER LIGHT SWITCH - Press and hold for a few seconds until fluorescent lamp glows, then release.

SYSTEM SWITCH - Turn to 6-12V position for 6-12 volt system vehicles: 24-32V position for 24-32 volt systems.

CYLINDER SWITCH - Turn switch to correspond to number of cylinders in engine and battery polarity. NOTE: On Mazda Rotary Engines turn switch to NEG GRD, 4 cylinder.

PARADE CONTROL - Turn to "OFF" position - full right.

DIAL-A-TRONIC TEST SELECTOR SWITCH - Turn to No. 1, "OFF" position. Coil Primary Test Indicator Light should light.

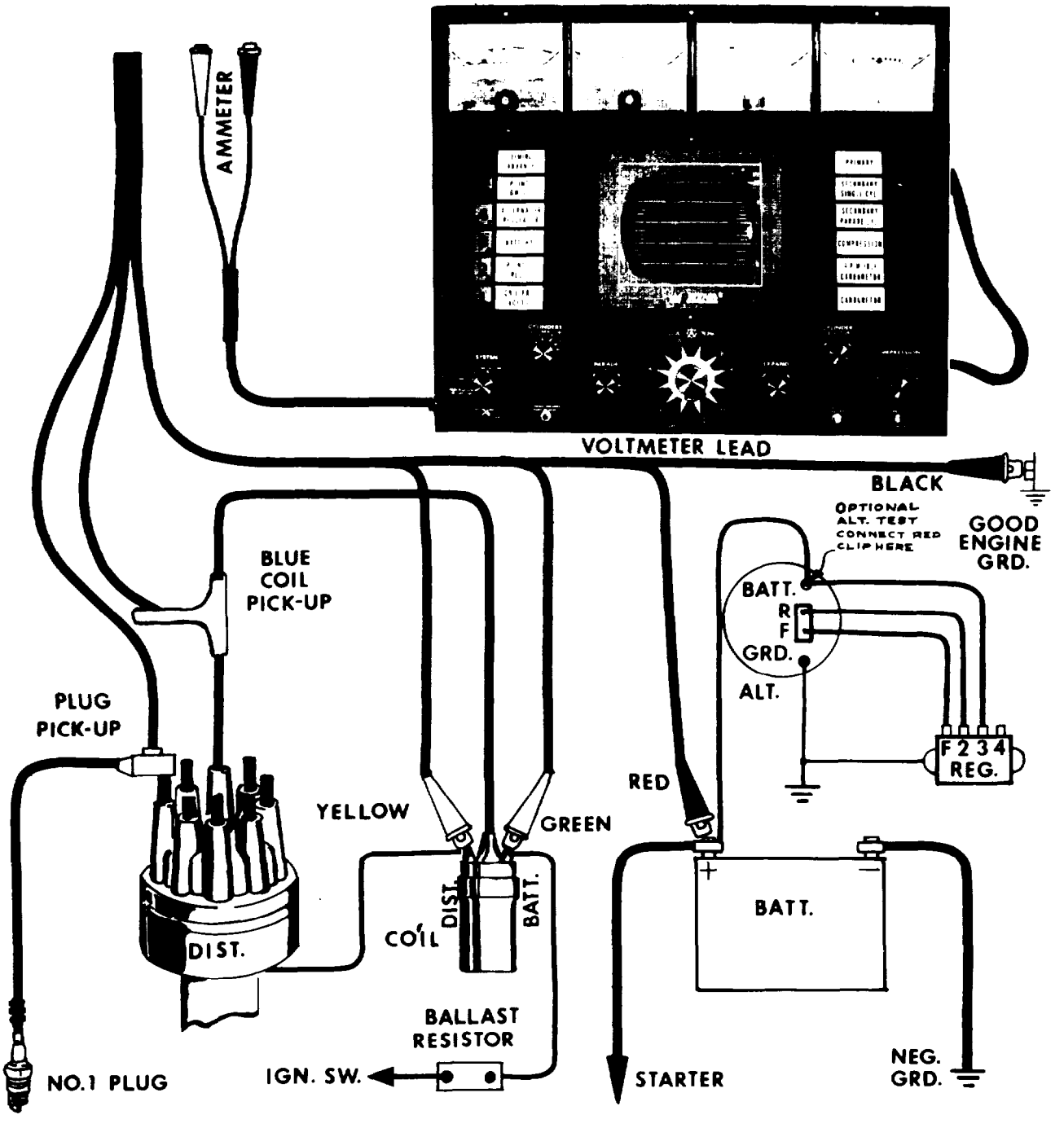
EXPAND CONTROL - Turn to "OFF" position - full left.

CYLINDER SELECTOR SWITCH - Turn to "OFF" position - full left.

COMPRESSION SET PLUG LOAD CONTROL - Turn to "O" position - full left.

ANALYZER HOOK-UP

1. Set Park Brake
2. Place transmission in "PARK" (A/T) or "NEUTRAL" (M/l
3. Place fender covers on fenders
4. Connect Analyzer Test Leads as shown below.



NOTE: On Mazda and Fiat connect Yellow Lead at distributor instead of the coil.

Figure 3

TESTING/DIAGNOSING

The TEST SELECTOR of the Engine Analyzer is programmed to provide a logical step-by-step testing procedure sequence.

The testing sequence is programed so that any specific test, except test No. 1, is related to test results of preceding test and the components related to the test being performed. Therefore, for a good diagnosis, the test sequence should be followed.

NOTE: 1. Routine tests should be made at engine R.P.M. indicated for the test being performed. If a performance problem exists at an R.P.M. other than normal test R.P.M., make additional test at R.P.M. where problem is indicated.

2. ALL TESTS should be performed with engine at OPERATING TEMPERATURE.

3. Although the Engine Analyzer is programmed to provide a logical test sequence for a complete diagnosis of the vehicle systems, it does not prevent the operator from performing any specific test out of sequence if he wishes.

The first and a very important step in any testing/diagnosing procedure is a visual inspection of the vehicle systems. Failure to perform a visual inspection often results in incorrect diagnosis. (Refer to Visual Inspection section).

VISUAL INSPECTION

The failure to perform the visual check results in incorrect diagnosis of a performance problem, and overlooks possible additional service needs.

To assist in the visual check, use the following Visual Inspection Guide.

BATTERY:

- Loose or corroded cables
- Cracked or bulged case
- Electrolyte
- Hold-down clamps
- Moisture and dirt

AIR FILTERS:

- Carburetor
- Emissions Air Pump
- Crank Case Breather

HOSES:

- Vacuum
- Fuel
- P.C.V.
- Radiator
- Heater
- Power Steering

TEMPERATURE. CONTROL VALVES:

- Heat Riser
- Distributor Vacuum Control
- Valve Connections
- Temperature Sensing Units

EXHAUST SYSTEM:

- Mufflers
- Exhaust Pipes
- Tail Pipes

ELECTRICAL:

- Loose or corroded connections
- Frayed or broken wires

BELTS:

- Fan
- Alternator/Generator
- Air Pump
- Air Conditioning
- Power Steering

FLUID LEVELS:

- Coolant
- Engine Oil
- Fuel
- Transmission
- Power Steering
- Brakes

EMMISSION CONTROL DEVICES:

- P.C.V. Valve Installation
- Air Injection System
- Temperature Controlled Air Induction Systems

RADIATOR:

- Radiator Core
- Expansion Tank
- Pressure Cap

Section II. TEST PROCEDURES

TEST NO, 1 - COIL PRIMARY BALLAST RESISTOR TEST
(12 volt systems only)

1. Test selector - No. 1 position. Read Scale (B). Turn, ignition switch on. Operate starter intermittently until the lowest meter reading is obtained, indicating points are closed.

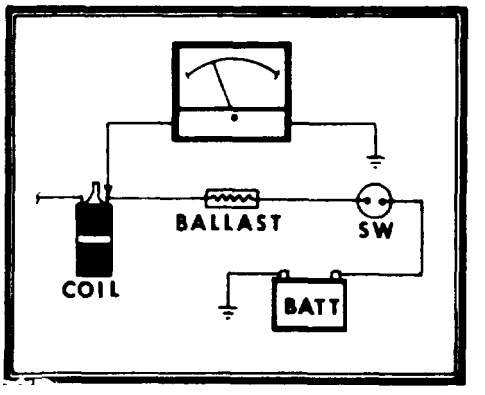


Fig. 4

2. Meter should read in. PRI. OK zone for a normal operating coil-ballast condition.

2. A HIGH reading above the OK zone may be caused by the following conditions:

A. Defective ignition switch with internal cantact shorting to cranking battery circuit.

B. Open or loose coil primary connection or points may be open.

C. Ballast resistor shorted out, due to faulty or incorrect wiring.

D. Coil may have an internal ballast resistor.

4. A LOW reading may be caused by low battery, excessive circuit resistance, defective or open resistor, loose connection between resistor and battery or coil terminal. Check battery voltage in position 3. If battery voltage is low, .3 volt or more below normal, operate engine or recharge battery.

5. Readings in the OK zone may vary slightly between 4 - 6 and 8 cylinder coil systems. Variation slightly above or below the OK zone may be obtained on heavy-duty or special coil ballast combinations. Check ballast resistor value with ohmmeter and compare to vehicle specifications, when in doubt. Refer to general test section for ballast resistor value chart.

6. Proceed to TEST NO, 2 with points closed and ignition switch on.

TEST NO. 2 - POINT RESISTANCE TEST

1. Test selector - No, 2 position. Read Scale (A). The meter indicates voltage loss in the distributor breaker point circuit.

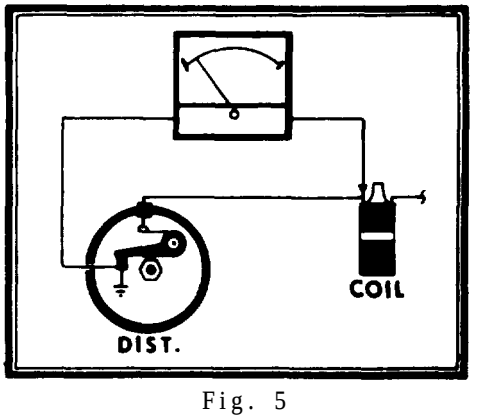


Fig. 5

2. The meter should read in the OK zone for a good breaker point condition. A reading in the REPLACE zone indicates excessive voltage loss due to burned contact surfaces, defective internal ground pigtail, loose or defective breaker point lead to coil primary,

TEST PROCEDURE

TEST NO. 3 - BATTERY CRANKING VOLTAGE

1. Test selector - No. 3 position. Read Scale (B)

2. Operate starter for 10 seconds and note cranking voltage. A STEADY reading in the normal CRK 6 or 12 volt zone indicates the battery, cables and starting system are in good operating condition. A FLUCTU - ATING reading indicates a defective starter or battery. A LOW reading indicates a discharged or defective battery condition. Recharge or replace battery.

3. Refer to general test section for detail tests in locating defects in battery starter system.

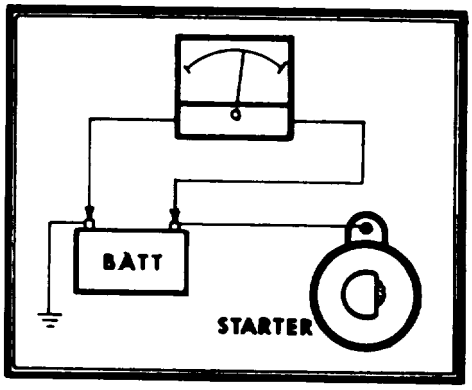


Fig. 6

TEST NO. 4 - ALTERNATOR-REGULATOR TEST

1. Test selector - No. 4 position. Read Scale (B) for regulator voltage. Rotate EXPAND control knob to full CW position for maximum pattern size.

2. Start engine and operate at 1000RPM. Turn lights and accessories on to obtain maximum charging rate,

3. ALTERNATOR TEST - Observe scope for alternator performance. A uniform wavy ripple indicates the alternator is in good condition. Disregard the ignition spikes combined with the ripple. To increase pattern size, connect red clip directly to alternator battery hot terminal.

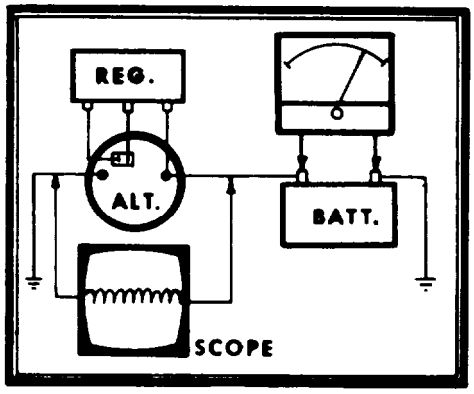


Fig. 7

4. Alternator is defective when a large size abnormal pattern is displayed. Refer to alternator patterns to identify defects. An open field circuit or defective regulator will display a flat line without the ripple. When test is completed, rotate EXPAND control CCW to panel mark.

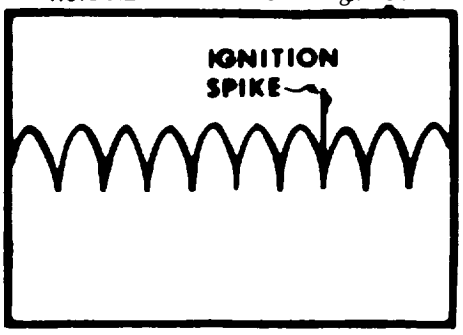
5. REGULATOR TEST - Turn off vehicle lights and accessories. Increase engine speed to 1500 RPM and operate until voltmeter slowly increases and stabilizes in the normal REG. zone indicating the charging rate and regulator is normal. If voltage does not increase, check alternator drive belt and adjust tension if necessary. If voltage increases and stabilizes above or below REG. zone, replace or adjust regulator in accordance with vehicle service instructions. Regulator must be at normal operating temperature and battery in good fully charged condition for accurate regulator test.

6. To check charging rate, connect ammeter leads in SERIES with regulator or alternator BATT. lead. Turn on vehicle lights and accessories to load battery for maximum output. Read ammeter Scale (C). If ammeter reads zero, low or erratic, test alternator for output. Refer to general test section for output test and ammeter connections diagram. Turn lights and accessories off when load test is completed.

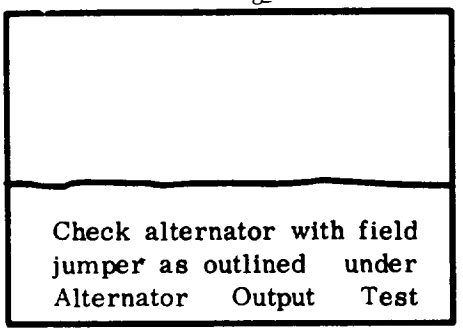
ALTERNATOR PATTERNS

The alternator patterns shown illustrate various possible alternator defects, These are basic patterns only,which will vary in vertical size and shape depending on alternator output and engine speed, which affects alternator frequency.

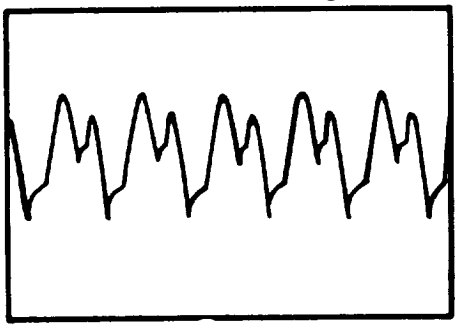
NORMAL ALTERNATOR Fig. 8.



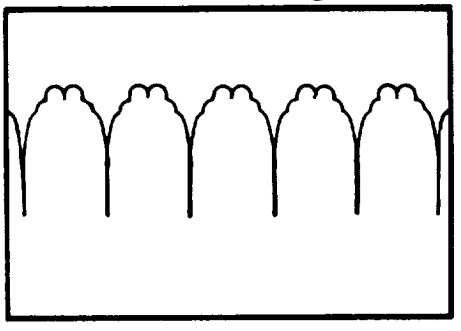
OPEN FIELD OR DEF. REG. Fig. 9.



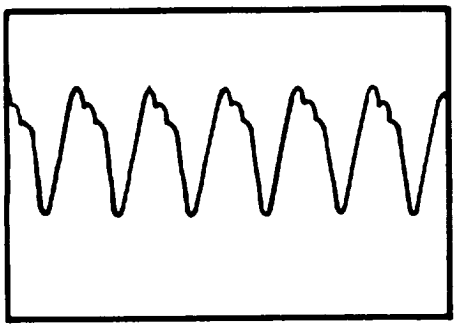
SHORTED DIODE Fig. 10



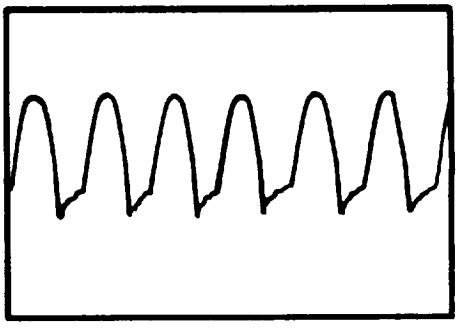
OPEN DIODE Fig. 11



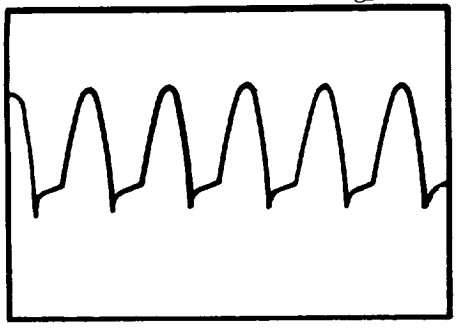
SHORTED WINDING Fig. 12



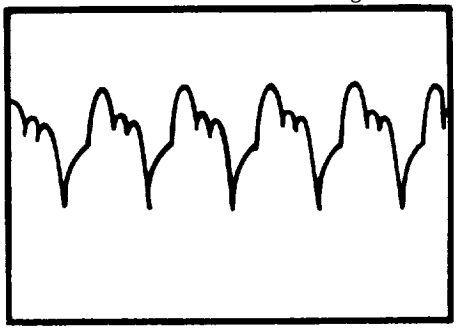
OPEN WINDING - 1 PHASE OR 2 OPEN DIODES SAME PHASE Fin. 13



1 SHORTED -1 OPEN DIODE OPPOSITE POLARITY Fig. 14



1 SHORTED - 1 OPEN DIODE SAME POLARITY Fig. 15



TEST PROCEDURE

TEST NO. 5 - POINT DWELL TEST

1. Test selector - No. 5 position. Read Scale (E)

2. The cylinder grd. switch must be in proper ground polarity and 4-6-8 cylinder position to suit vehicle.

3. Operate engine at idle and intermediate speeds. Compare point dwell reading to specifications. Variation at higher speeds should not exceed 3 degrees. Disconnect vacuum line when specified by vehicle service instructions to obtain correct dwell readings.

4. Refer to general test section on special Ford- Autolite Distributor with pivot type breaker plate assembly, which is designed to vary point dwell with vacuum control.(See Page 44)

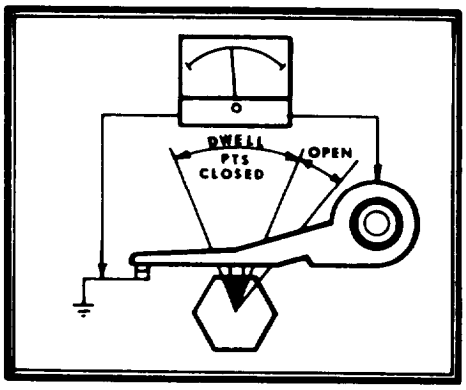


Fig. 16

TEST NO. 6 - TIMING - ADVANCE TEST

1. Test selector - No. 6 position. Read RPM on Scale (D). Read CRANKSHAFT DEGREES advance on Scale (E)

2. Operate engine at specified idle for initial basic timing. Disconnect vacuum line when specified by vehicle service instructions.

3. Rotate advance knob on timing light CCW to OFF position for initial timing test.

4. Check basic timing and compare to vehicle specifications. Adjust to specified timing when necessary. Always reset timing following any point spacing adjustments. To adjust timing, turn distributor with rotation of rotor to RETARD, or turn distributor against rotation to ADVANCE,

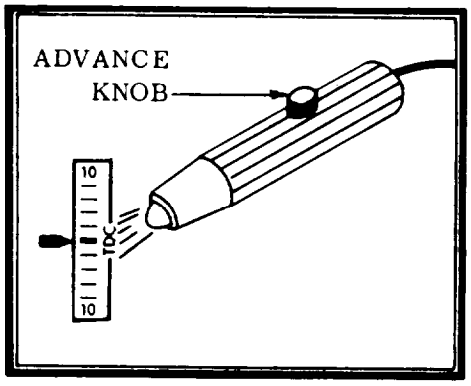


Fig. 17

5. ADVANCE TEST - Increase engine speed to 2000 RPM or as specified by vehicle service instructions to obtain full advance. Observe movement of timing mark.

6. Rotate advance knob on timing light CW until mark returns to TDC Mark. Read CRANKSHAFT DEGREES advance on meter scale (E). Compare to vehicle specifications. When using distributor advance specifications, multiply distributor degrees by 2 to obtain crankshaft degrees. The meter reads total degrees advance including initial setting.

7. When timing mark advances only one-half the specified degrees, disconnect vacuum line at distributor. If timing mark drops to initial setting and shows no advance at higher speeds, the mechanical advance mechanism is defective. If timing mark is stationary with or without vacuum line connection, the vacuum control is defective.

TEST PROCEDURE

TEST NO. 6 - TIMING - ADVANCE TEST - CONTINUED

8. Refer to vehicle service instructions on new emission control systems for timing and advance specifications.

9. TCS - Transmission controlled spark advance systems are used on late model vehicles. This system incorporates a solenoid valve to cut - off vacuum advance action at idle and low gear speeds to reduce exhaust emissions. Full vacuum advance is applied at high speeds by the transmission control switch signal or override control to open vacuum solenoid valve. To set idle and initial timing, the vacuum advance hose should be disconnected and plugged to prevent interference from temperature override controls. To check distributor vacuum advance operation, connect vacuum control directly to manifold vacuum connection. Refer to vehicle service manual for recommended test procedures on timing and advance tests.

TYPICAL
GM TRANSMISSION CONTROLLED VACUUM
SPARK ADVANCE SYSTEM

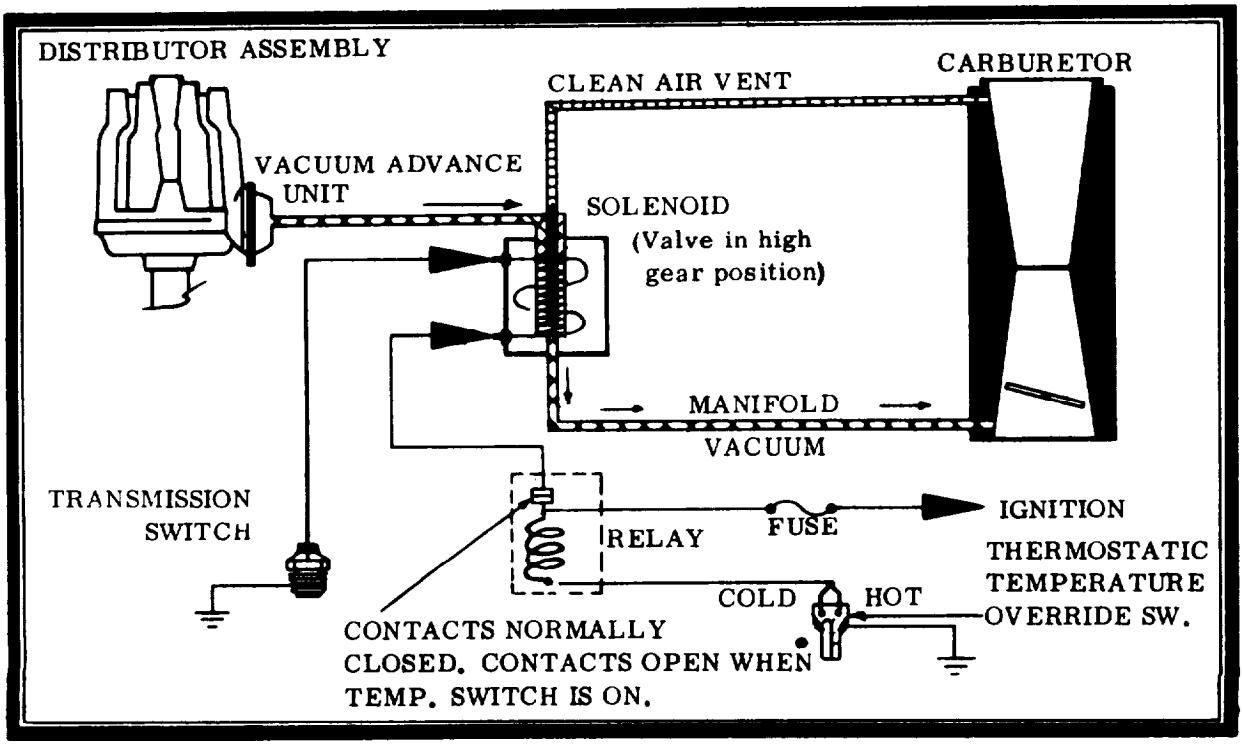


Fig. 18

TYPICAL VACUUM ADVANCE CHART FOR GM VEHICLES

	TRANSMISSION GEAR						
TRANS	PARK	NEUTRAL	REVERSE	1ST	2ND	3RD	4TH
3 SPD						V.A.	—
4 SPD (PASS)						V.A.	V.A.
4 SPD (TRUCK)							V.A.
TORQUE DR					V.A.	—	—
POWERGLIDE					V.A.	—	—
HYDRAMATIC			V.A.			V.A.	—

(V.A. - VACUUM ADVANCE)

TEST PROCEDURE
PRIMARY SUPERIMPOSED

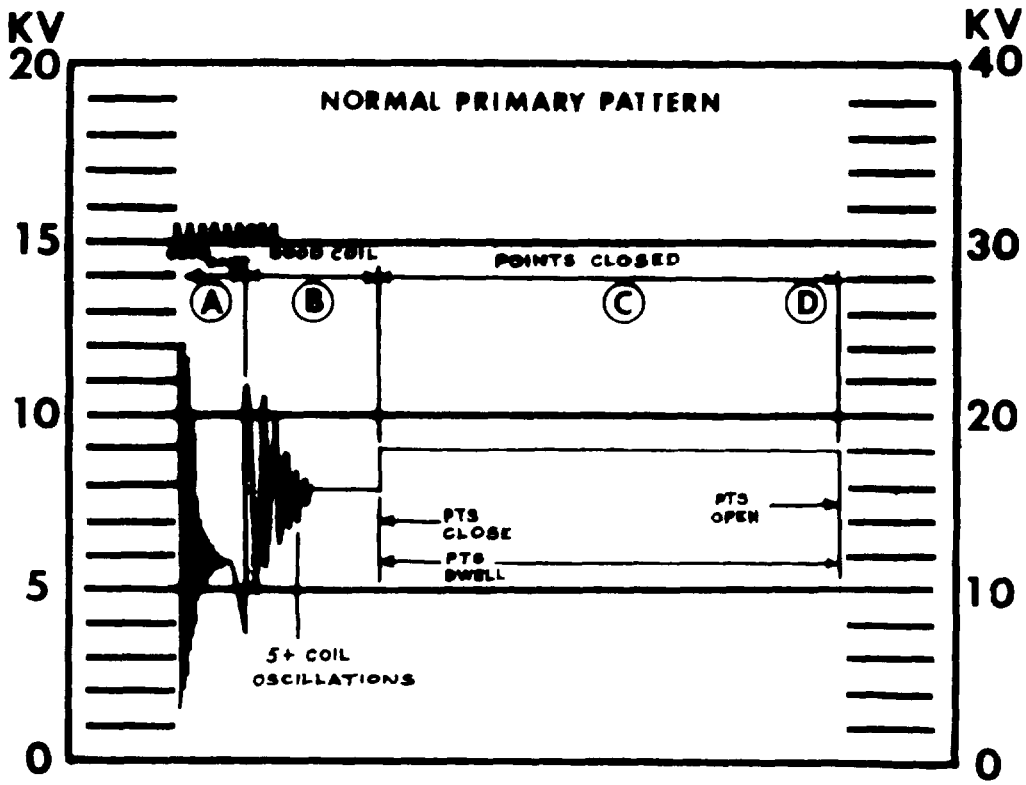


Fig. 19

TEST NO. 7 - PRIMARY

1. Test selector - No. 7 position. Read Scale (D) for RPM.

2. Sat engine speed at 1000 RPM. Adjust PARADE and EXPAND controls to center pattern on screen. Fig. 19 illustrates a NORMAL pattern for a good primary ignition system, Deviation from a normal pattern will be caused by ignition system defects.

3. Inspect the following pattern areas for defects in the primary system:

A. CONDENSER section must be a single cone shaped form. The size of oscillations will depend on coil design. Multiple groups or large oscillations may be caused by defects in the secondary circuit.

B. COIL section must have 5 or more oscillations.

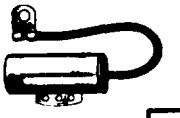
C. DWELL section should be a clear, solid line. Multiple lines at the step is due to defects in distributor. Bad points or condenser will cause flashing below the line at D.

4. Compare to following patterns illustrating GOOD and BAD parts in the primary system.

TEST PROCEDURE

PRIMARY SUPERIMPOSED

CONDENSER



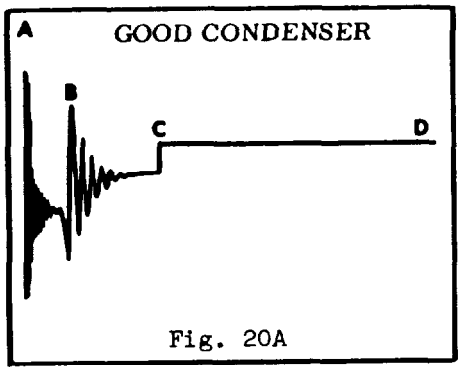


Fig. 20A

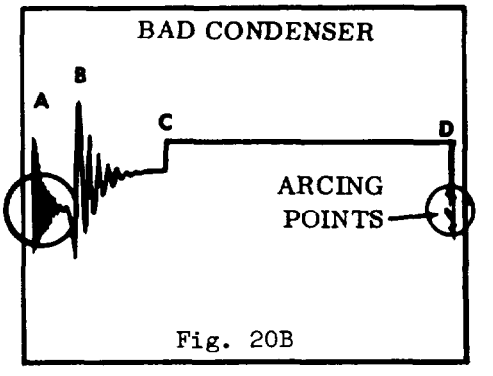


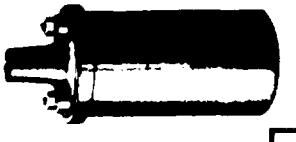
Fig. 20B

CONDENSER

A GOOD condenser will display steady oscillations in the A-B area with no flashing at D. The size of the oscillations will vary depending on ignition coil design. A new type coil, DR #1115414, produces a wavy line with small oscillations due to special coil design. This is a normal pattern for this type coil.

A DEFECTIVE condenser will cause point arcing indicated by bright flashing below line at D, and erratic oscillations in the A-B area. Erratic oscillation display may also be caused by following: loose condenser mounting or pigtail, corroded or loose connections at coil primary terminals, faulty ignition switch, wiring and series resistance in condenser.

COIL



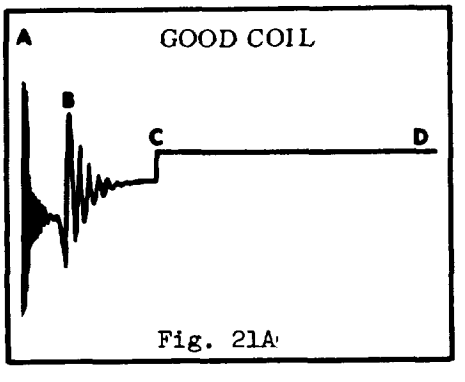


Fig. 21A

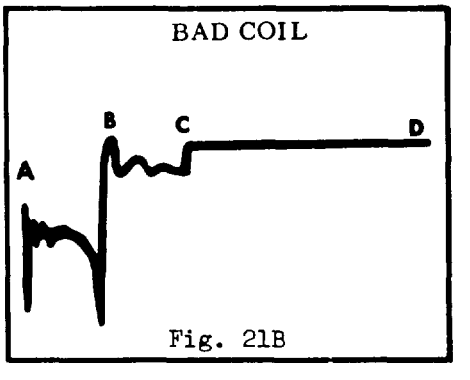


Fig. 21B

COIL

A GOOD coil must show five or more full oscillations at idle speed between Band C.

A BAD coil will show a few small size oscillations. Partial shorts or leakage will cause a reduction in coil output voltage under acceleration load. Minor shorting defect in coil will cause hard starting and misfiring during acceleration periods.

TEST PROCEDURE

PRIMARY SUPERIMPOSED

BREAKER POINTS

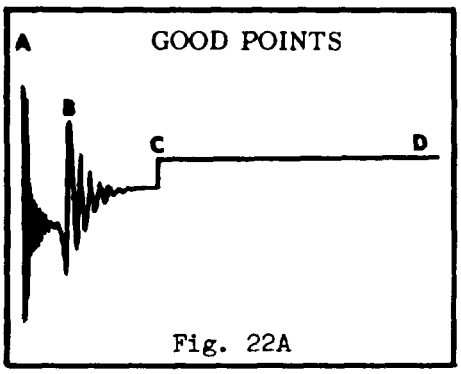


Fig. 22A

POINTS

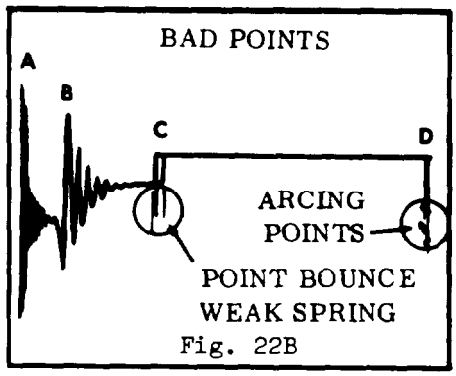


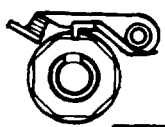
Fig. 22B

GOOD breaker point condition will produce a clean line at step C and no flashing below D.

BAD point condition will show flashing erratic spikes below step C due to weak spring tension causing point bounce when points close.

Erratic bright flashes below D indicate point arcing due to pitted or burnt condition of contact surfaces, A defective condenser or loose condenser connections will also cause point arcing.

CAM LOBE WEAR



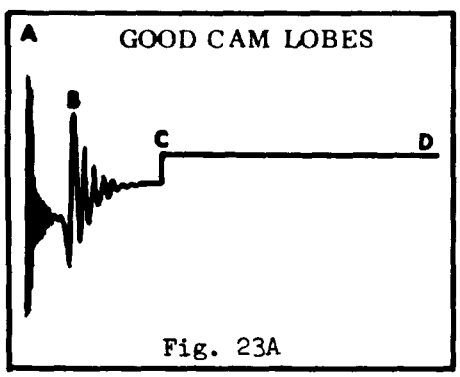


Fig. 23A

CAM LOBES

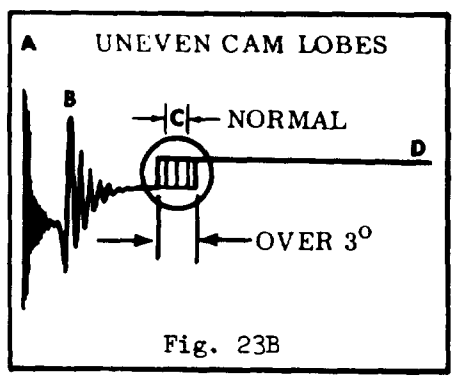


Fig. 23B

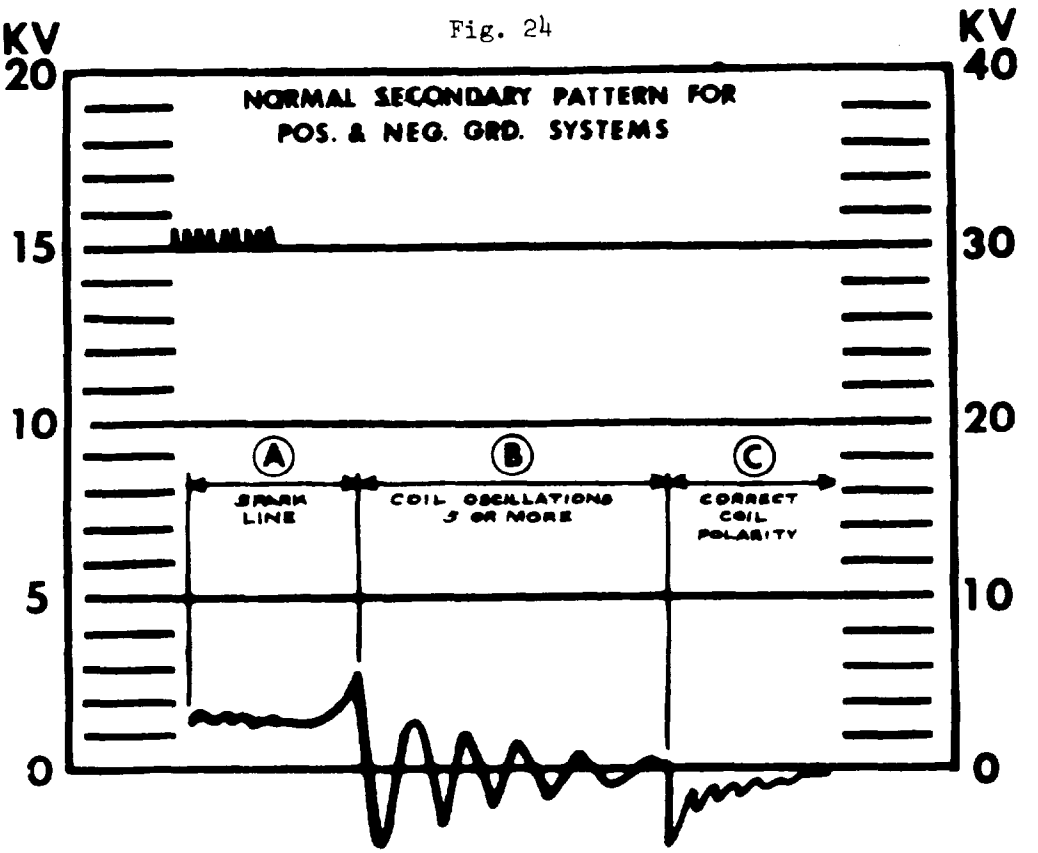
Uniform cam lobes in good condition will show a single clean solid line at step C.

Excessive cam lobe variation of more than a 3 degree spread at step C is an indication of worn distributor bushings or breaker plate, bent or worn shaft, or uneven cam lobes. This condition will cause variation in point dwell and timing for each cylinder.

NOTE: Refer to General Test Section to identify correct primary BATTERY POLARITY PATTERNS.

TEST PROCEDURE
SECONDARY SUPERIMPOSED

Fig. 24



TEST NO. 8 - SECONDARY - SINGLE CYLINDER

1. Test selector - No. 8 position. Read Scale (D) for RPM. Cylinder selector -OFF position.

2. Operate engine at 1000 RPM. fig. 24 illustrates a NORMAL pattern for a good secondary ignition system, When waveform looks different from the normal pattern, compare to test patterns illustrating various ignition defects. Refer to General Test Section.

3. Inspect following pattern areas for defects in the secondary system:

A. SPARK LINE must be a single uniform line. Variations in length, slope or multiple lines are caused by plug conditions, leakage or resistance in secondary system.

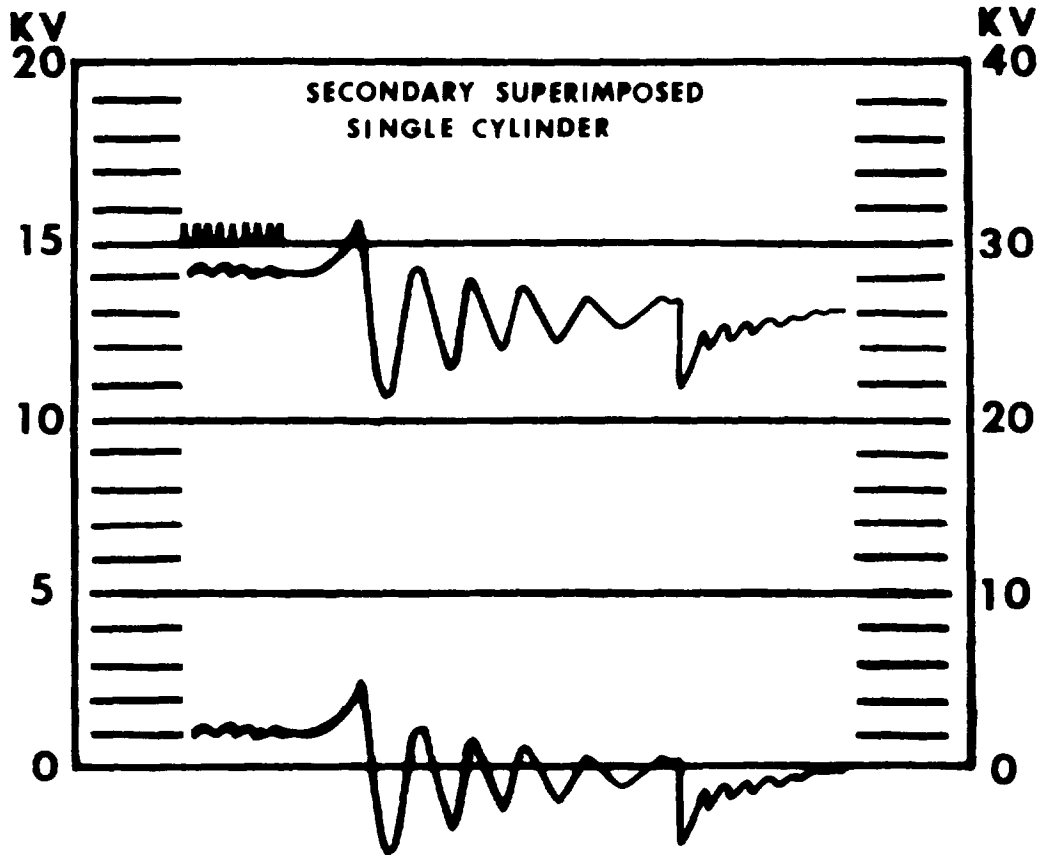
B. COIL section must have 5 or more oscillations. Open, loose or corroded HT coil lead or open coil will cause broken oscillations. Correct condition before proceeding with tests.

C. DWELL indicator must he pointing DOWN for correct coil polarity. If dwell indicator points UP, stop engine and reverse coil primary leads to correct condition before further tests are made. NOTE: When dwell indicator is off the screen on 4 or 6 cylinder engines, use PARADE control to move pattern to left, to observe dwell indicator. Use EXPAND control to EXPAND the spark line which will also move the diagonal right hand line off the screen when viewing single cylinder.

TEST PROCEDURE

SECONDARY SUPERIMPOSED
SINGLE CYLINDER

FIG. 25



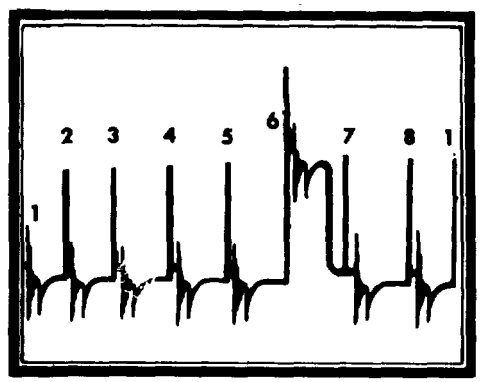
TEST NO.8 CONTINUED

SINGLE CYLINDER INSPECTION

4. To observe individual cylinder spark line variations, rotate cylinder selector CW slowly to raise each cylinder above the group. To locate the cylinder in view, switch to test No. 9 and note cylinder location. See Fig. 26. To observe No. 1 cylinder, use test No. 9. Expand pattern and parade to No. 1 cylinder,

5. When test No. 8 is completed, rotate cylinder selector to OFF position for test 9.

Fig. 26

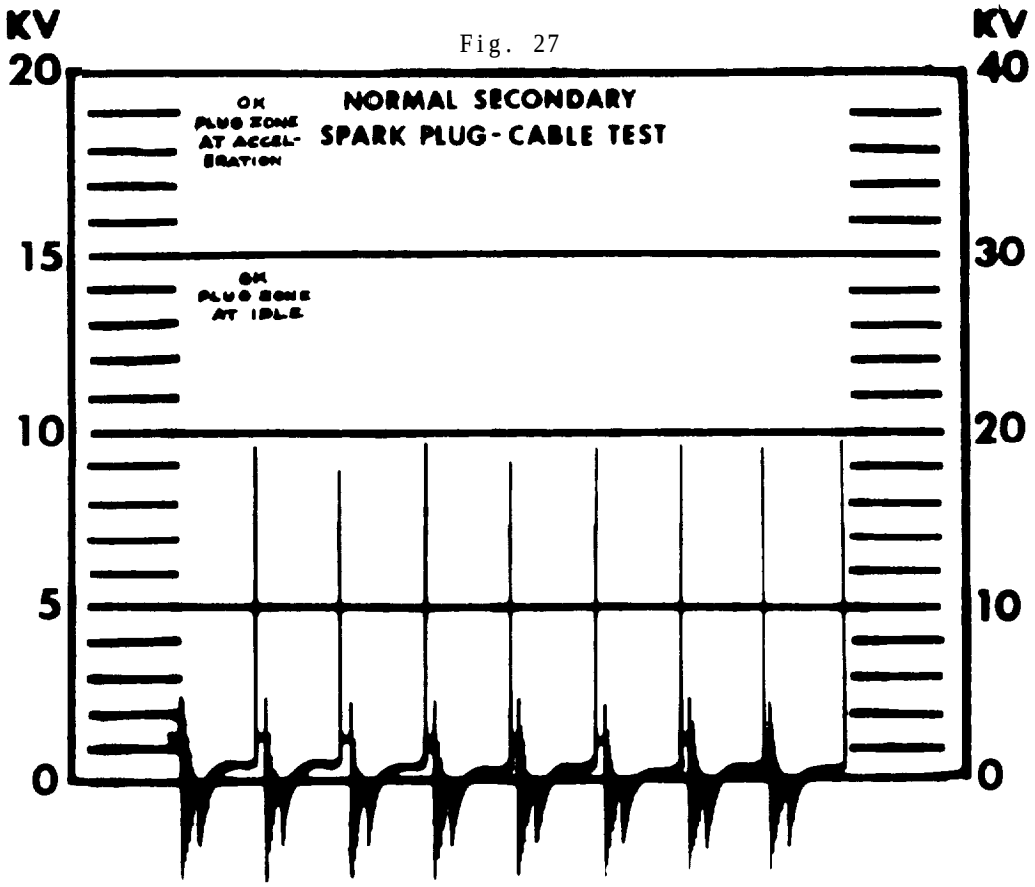


CYLINDER POSITION IN TEST 9. REFER TO FIG. 33 TO LOCATE CYLINDER ON ENGINE

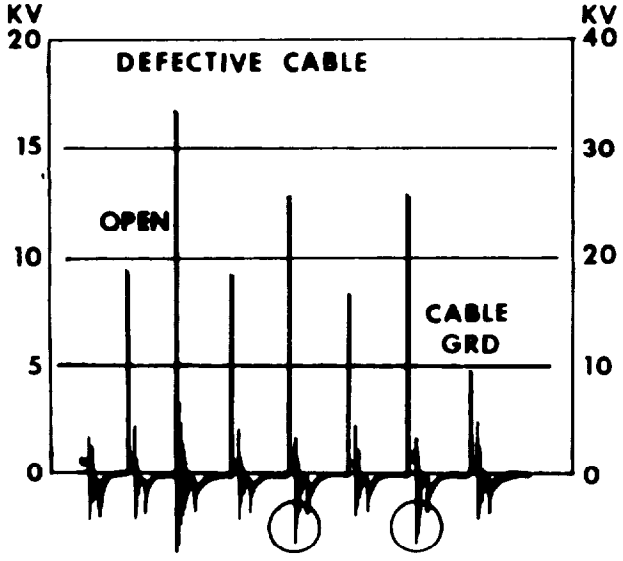
TEST PROCEDURE

SECONDARY PARADE

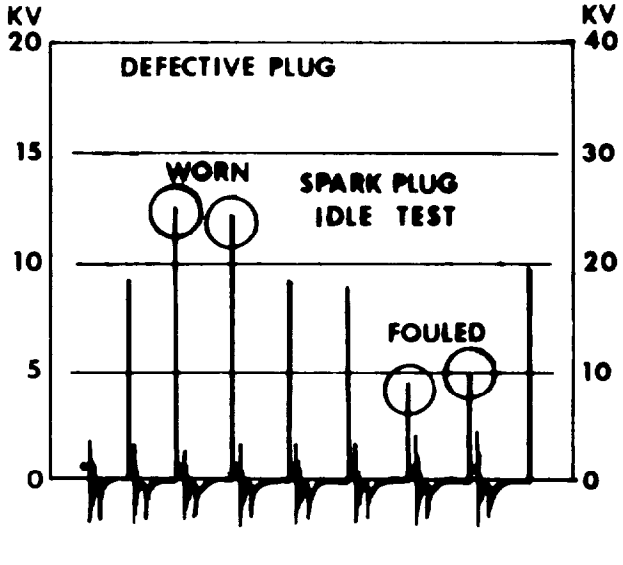
Fig. 27



DEFECTIVE CABLE Fig. 28



DEFECTIVE PLUGS Fig. 29



TEST PROCEDURE

TEST NO. 9 - SECONDARY - PARADE CYLINDERS

1. Test selector - No. 9 position. Operate engine at 1000 RPM. Read Scale (D) for RPM. Cylinder selector must be in OFF position.

2. NORMAL plug and cable conditions will show reasonably uniform KV plug spikes below 10 KV line with fairly uniform steady tail on first coil oscillation. See Fig. 27. NOTE: Spark plugs with built-in series booster gaps will have a slightly shorter and higher spark line with longer first coil oscillation. This is normal for this type of plug.

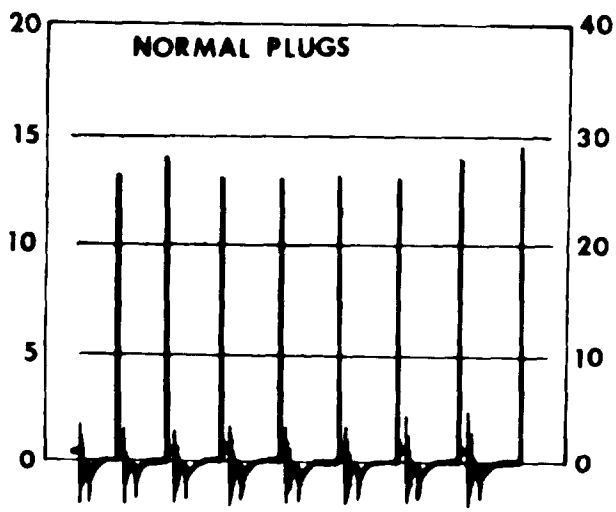
3. DEFECTIVE CABLES will cause erratic, long tail pulsations at first coil oscillation, combined with high KV plug spikes. Refer to Fig. 28. When all plugs show long tail, erratic pulsations, it is usually caused by defective rotor. Defective plug, conditions are illustrated in Fig. 29.

4. SPARK PLUG ACCELERATION TEST - Accelerate engine quickly several times and observe increase in KV firing voltage. Allow engine to stabilize between acceleration periods. WORN or WIDE GAP plugs will indicate over 15 KV line.

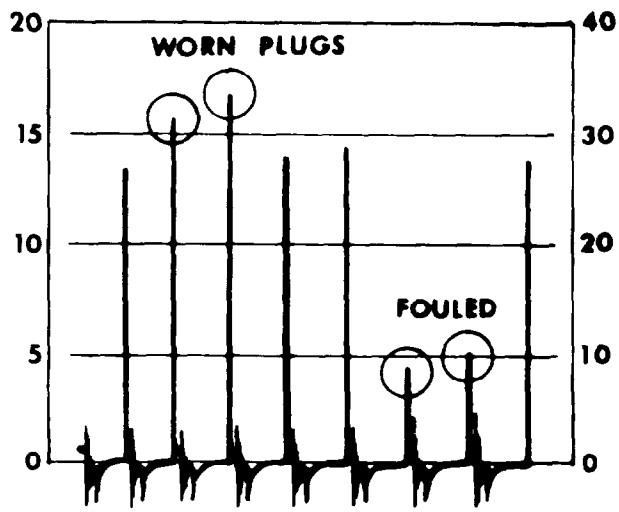
5. When KV plug spikes do not increase or show decrease under acceleration, check for close gaps, fouled plugs, cable leakage, low coil output, or low cylinder compression.

ACCELERATION TEST

NORMAL PLUGS Fig. 30



WORN PLUGS Fig. 31



6. PLUG LOAD TEST - Operate engine at 1000 RPM. Place load control knob at zero. Press plug load switch and slowly rotate load control CW to increase load. Observe plug patterns for erratic misfiring and decrease load (CCW) before engine stalls. Note load knob setting. Worn plugs, defective cables or poor ignition will cause erratic plug firing. Compare load settings before and after performing tune-up to note increase in ignition performance. Restoration of full performance with plugs and cables in good condition will withstand a higher load setting. Average load settings for each type of vehicle can be determined by experience.

TEST PROCEDURE

LOCATING A CYLINDER WITH A DEFECT

1. The last KV plug spike at the right end of the pattern sequence is the No. 1 plug pickup connection. Refer to Fig. 32.

2. Count plug spikes from left to right on pattern starting with No. 2 through No. 8.

3. Count distributor cap H. T. terminals in the direction of distributor ROTATION; starting with the pickup location as No. 1 until corresponding cylinder number is reached. See Fig. 33.

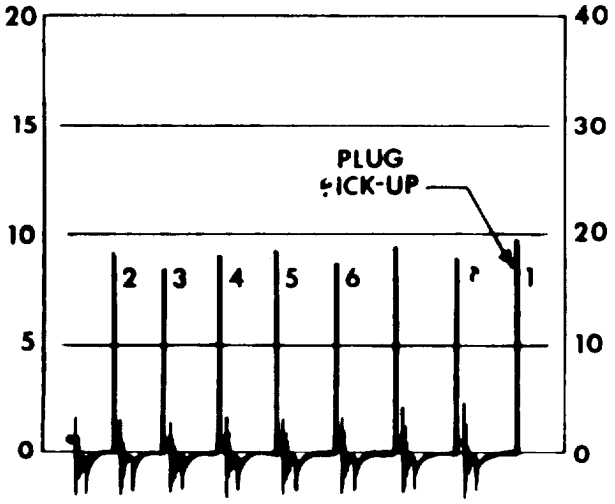


Fig. 32

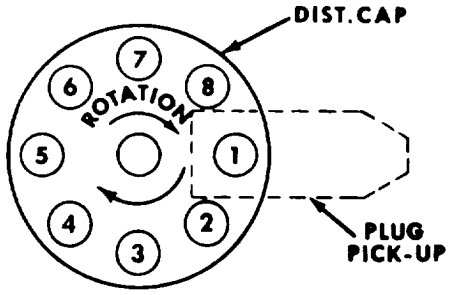


Fig. 33

COIL RESERVE TEST

1. Test selector - Test No. 9 position. Read Scale (D) for RPM.

2. Operate engine at 1000 RPM. Remove any plug cable except No. 1, which is used for scope horizontal pattern operation.

3. Push COIL 40 KV test switch. Read ignition output on 40 KV scale. A good coil must indicate over 20 KV and have 5 or more oscillations in BOTH primary and ignition tests. See Fig. 34. NOTE: Internal flashover may occur on some distributors from rotor to a high breaker screw terminal assembly where a cap terminal is located above breaker condenser screw terminal. Try removing another plug cable on opposite side of cap.

4. Low KV coil output (spikes below 20 KV line) may be caused by defective primary ballast resistor, loose or corroded primary circuit connections, defective ignition switchor condenser, improper cam angle, internal leakage, or breakdown in cable, coil, cap or rotor. Where cable leakage condition is suspected, each cable may be tested for breakdown by disconnecting and reconnecting cable at each plug. Check cap and rotor for leakage by removing each cable at cap. Use insulated pliers to remove cables.

TEST PROCEDURE

TEST NO. 9 CONTINUED

5. ROTOR GAP TEST - Before reconnecting cable, use insulated ground test prod to check rotor gap. Connect ground clip to engine block. Insert sharp prod into open cap tower. Operate engine at idle for minimum rotor gap clearance. Spark advance increases rotor gap. Plug spike should drop to 5 - 6 KV. This is voltage required to spark from rotor to cap terminal. Reading over 7 KV indicates excessive rotor gap (wrong type) or corroded tip; replace rotor. Reconnect cable into distributor. See Fig. 33. NOTE: Vehicles using a wide rotor gap of .070" to .090". Readings of 6 to 7 KV are normal.

Fig. 34

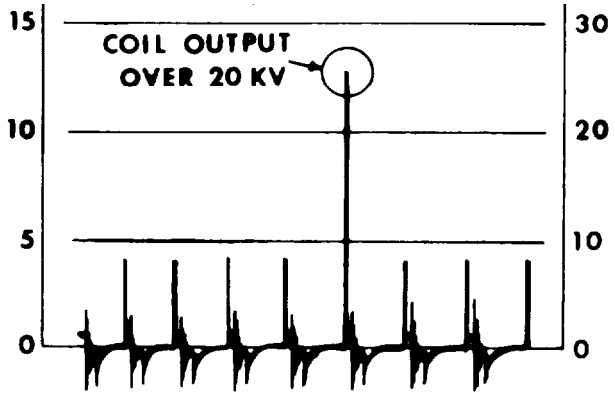


Fig. 35

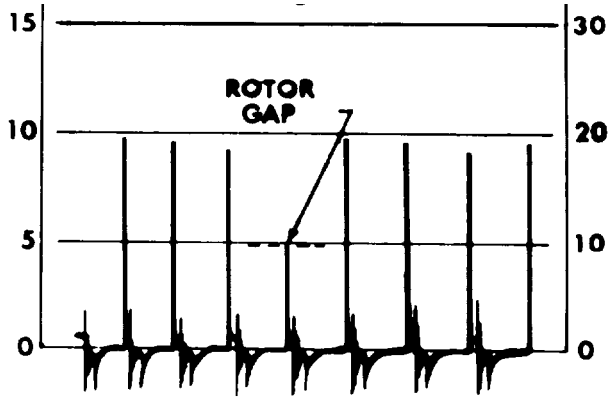
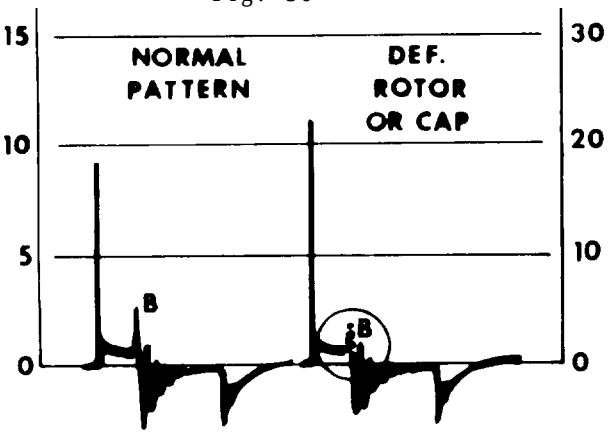
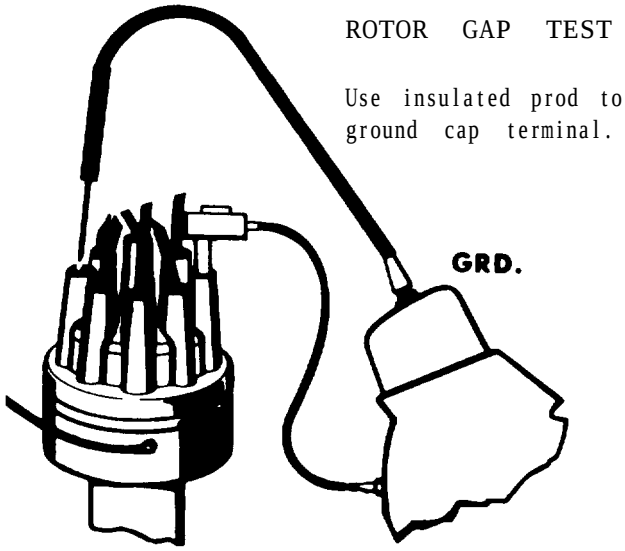


Fig. 36





ROTOR GAP TEST

Use insulated prod to ground cap terminal.

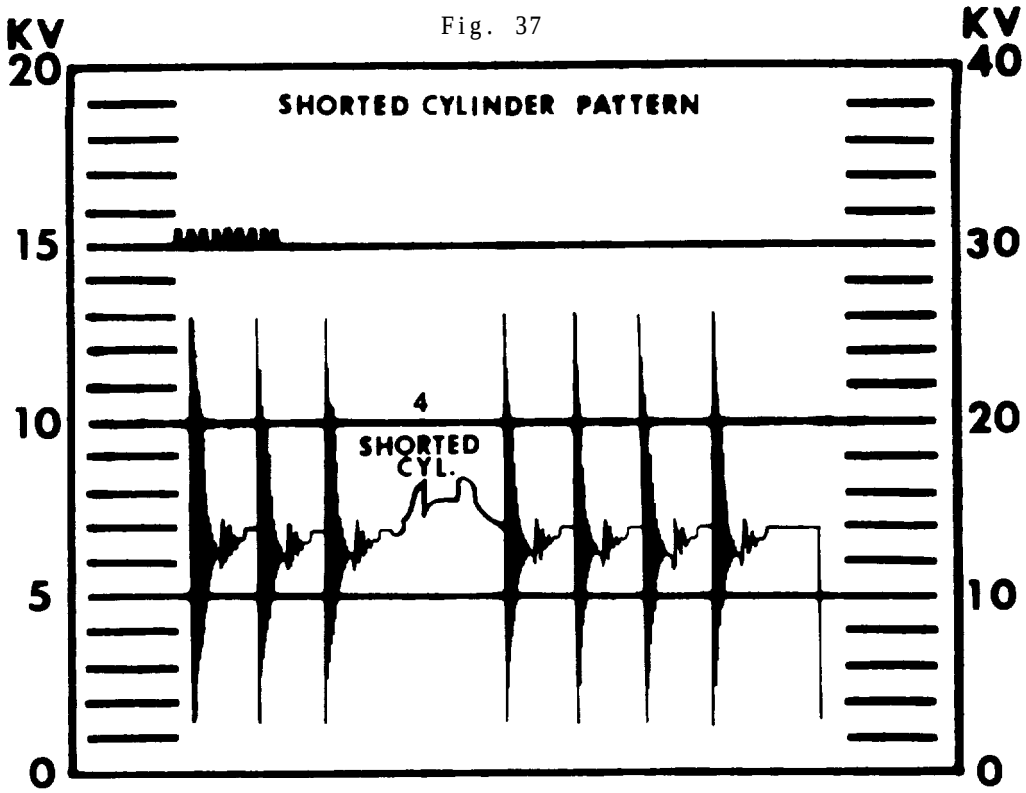
DISTRIBUTOR CAP AND ROTOR TEST

1. Operate engine at 1000 RPM. Expand pattern to obtain one firing cylinder across the screen. Parade all cylinders and observe action of first coil oscillation.

2. A good cap and rotor condition will provide a full size steady coil oscillation at (B) on ALL cylinders. A DEFECTIVE ROTOR will cause first oscillation to be erratic or broken on ALL cylinders. A DEFECTIVE CAP will cause first oscillation to be erratic on some of the cylinders, but not on all. Leakage, excessive corrosion at cable terminals, or white deposits on inside cap terminals will cause this condition. Refer to Fig. 36 for normal and defective rotor and cap condition pattern.

TEST PROCEDURE
ELECTRONIC COMPRESSION

Fig. 37



TEST NO. 10 - COMPRESSION TEST

The Electronic Compression Test provides a one - minute cylinder power test without removing spark plugs. An electronic circuit applies a momentary shorting pulse to each cylinder and the compression meter scale indicates the variation between cylinders. The cylinder selector control disables one cylinder at a time. Scope pattern indicates the shorted cylinder.

1. Test selector - No. 10 position. Read RPM on Scale (D) and compression on Scale (J).

2. Place cylinder selector control at OFF and compression set control at midpoint between 2 and 3. CYLINDER GRD. switch must be in proper ground polarity position to suit vehicle. SYSTEM switch must be in 6-12V position for all standard ignition systems, For transistorized ignition systems, refer to special section in manual.

3. Set engine speed to 1500 RPM. Balance meter pointer to zero in SET zone with compression set control. Adjust PARADE and EXPAND controls to position all cylinders on screen.

4. Rotate cylinder selector knob slowly CW, until shorting pulse locates the No. 2 cylinder on left side of pattern. Adjust cylinder control slowly on eachcylinder until maximum reading is obtained on compression meter.

TEST PROCEDURE

ELECTRONIC COMPRESSION

5. Engine RPM will drop as each cylinder is shorted. Continue clockwise rotation of cylinder control shorting out each cylinder in firing order sequence from 2 to 8. Observe shorting pulse as it moves from left to right across the screen. Record compression readings for each cylinder from 2 to 8. Recheck zero meter balance position occasionally between pulses or by rotating cylinder control to OFF. Readjust compression set control when necessary.

6. To short out No. 1 cylinder, rotate cylinder selector control to full CW rotation and then slowly back in CCW rotation until No.1 or last plug spike is located and maximum compression reading is obtained. When test is completed, always return cylinder selector control knob to OFF position.

7. The variation in compression readings between normal cylinders can be within plus or minus 5 divisions of each other. When any cylinder is dead, the pointer will remain in the ZERO SET zone.

8. Compression readings less than normal on the same engine indicates low compression due to faulty ignition, worn rings, burned or sticky valves, defective valve lifters, leaky manifold, or any other factor contributing to power loss in the cylinder. The electronic compression readings should be fairly uniform for all normal cylinders on the same engine, The actual compression readings obtained may vary from one engine to the other and are relative to engine speed change as each cylinder is disabled. On some engines the carburetor air cleaner must be in place to provide a steady meter reading.

9. To check meter balance zero position during test, observe meter zero reading between cylinder shorting pulses or rotate cylinder selector CCW to OFF position. Readjust meter to zero with compression set control when necessary.

10. To locate a defective cylinder on the engine, refer to Figure 33.

TEST PROCEDURE

TEST NO. 11 - RPM IDLE - CARBURETOR

IDLE RANGE - GAS ANALYSIS

1. Test selector - No. 11 position. Read Scale (F) for low RPM range and Scale (G) for gas analysis test. (AFR = Air Fuel Ratio).

2. Attach gas cell cable to gas cell pickup unit. ALWAYS operate cell unit in vertical position. Cell must be clear of any gas from previous test. Allow cell to stabilize for one minute before connecting sampling hose to cell nipple. Blow into opening of cell to speed ventilation.

3. GAS CELL CALIBRATION - Always calibrate cell with sampling hose DISCONNECTED from cell nipple.

   A. Push switch to No. 1 position and adjust No. 1 set control to read (1) on meter scale.

   B. Release switch to No. 2 position and adjust No. 2 set control to read (2) on meter scale. Allow cell to stabilize for one minute.

4. Clear sampling hose of any water or dirt from previous test and insert hose pipe nozzle into open end of exhaust tail pipe. Place cell unit on the floor adjacent to tail pipe. Connect rubber hose to cell nipple and proceed with gas analysis test.

5. Adjust engine to specified RPM. Adjust idle mixture screws in accordance with vehicle service instructions. On dual carburetors, adjust both idle screws the same amount for maximum steady RPM reading, unless otherwise specified by vehicle instructions. If carburetor cannot be adjusted to specifications or if idle AFR remains below specifications, replace or clean and repair carburetor.

6. IDLE SPEED TEST - Engine must be at normal operating temperature beforetesting. Refer to vehicle service instructions for recommended idle RPM and proper AFR readings. Emission control systems require special test procedures outlined by vehicle manufacturers. Ignition timing, spark advance and AFR limits are defined for proper performance for each system of emission control.

7. CARBURETOR AIR FILTER TEST - Replace air filter on carburetor. With engine operating at idle, note change in AFR meter reading with filter on and off. If meter reading indicates more than .2 toward the rich side, air filter element should be cleaned or replaced.

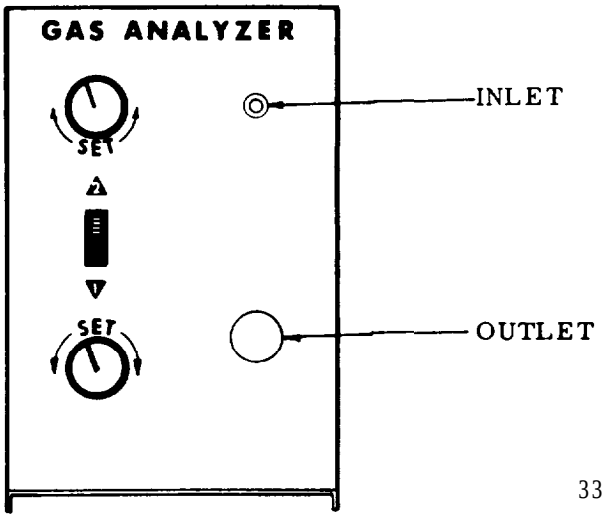


Fig. 38

TEST PROCEDURE

TEST ND. 12 - CARBURETOR TEST

INTERMEDIATE SPEED RANGE GAS ANALYSIS

1. Test selector - No. 12 position. Read Scale (D) for RPM and Scale (G) for gas analysis test.

2. Slowly increase engine speed to 2000 RPM or as specified in vehicle service instructions. Meter should indicate AFR specified for the vehicle.

3, RICH readings at higher speeds may indicate a high float setting, power jet trouble, leaking pump discharge jet, wrong size jets, or worn out carburetor.

4. LEAN or erratic readings in the lean zone may indicate low float setting, restricted jets or passages, low erratic fuel pump pressure.

5. ACCELERATOR PUMP TEST - Set engine speed at 1000 RPM. Note gas analyzer reading. Push accelerator rod quickly, release and observe meter action. The meter pointer should move to the rich zone and return to original reading if the accelerator pump is functioning properly. The pump is not satisfactory when only a slight pointer movement is obtained. This may be due to worn linkage, bad pump, or leaking check valve. These conditions will cause hesitation on acceleration.

6. Refer to vehicle service instructions for high speed emission control requirements and specifications.

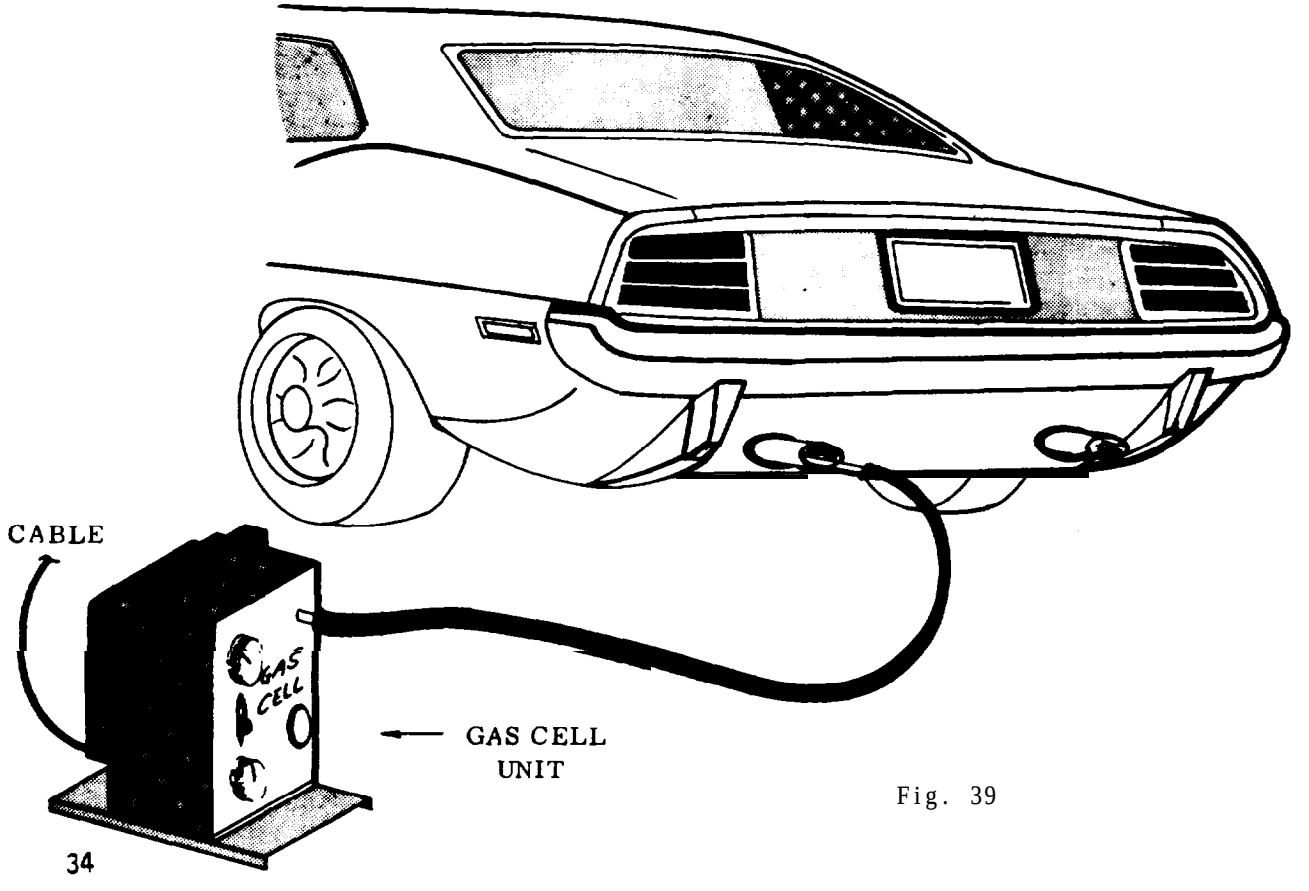


Fig. 39

TEST PROCEDURE

GAS ANALYSIS

POSITIVE CRANKCASE VENTILATION

(PCV) VALVE TEST

Inspect and service the closed crankcase ventilation system every six months and replace vent valve every twelve months.

To check PCV valve, operate engine at idle, remove ventilation valve assembly from rocker cover. If valve is functioning properly, a hissing noise will be heard as air passes through the valve and a strong vacuum should be felt when finger is placedover the valve inlet. Close the rubber hose leading to valve and a loud click should be heard when hose is opened and closed. Failure to click properly either way, indicates a defective PCV valve. If valve is plugged, do not attempt to clean it. Always replace with a new valve.

Check for deposit plugging in hose, filler cap and carburetor passages. Clean if necessary. Remove valve and check for vacuum obstruction in system hose, screen or filter.

A faulty PCV system can cause gas mileage to be cut in half, causes sludge formation and rocker arm failure. Carburetor cannot be adjusted properly with a faulty PCV system.

FUEL SYSTEM INSPECTION

Always inspect complete fuel system as a part of the gas analysis check:

1. FUEL TANK - leaks and proper vent opening in cap
2. FUEL LINES - kinks, broken or defective leaky connections
3. FUEL PUMP - loose mounting or body screws, dirt in sediment bowl; proper pressure and vacuum
4. CARBURETOR - worn linkage, loose mounting or body screws
5. MANIFOLD HEAT VALVE - frozen shaft, defective thermostat spring
6. AIR CLEANER - Replace or clean filter element

Section III. GENERAL TESTS

ALTERNATOR OUTPUT TEST

OUTPUT - Connect ammeter In series with alternator BATT. terminal. See Fig. 40. Operate starter for 15 seconds to reduce battery voltage. Start engine and turn vehicle lights ON to load battery. Operate engine at 1500 RPM and read current output on ammeter.

If no output is obtained, stop engine to connect field jumper.

1. Disconnect REG. FIELD lead from Alternator F terminal and insulate from ground.
2. Connect jumper from alternator FIELD terminal to alternator hot BATT. terminal. See Fig. 41. CAUTION: Do not operate engine at high RPM with regulator disconnected. Tills will cause high voltage and may damage diodes.

If the ammeter reads zero or a discharge to left is indicated, the alternator is defective and must be replaced.

VOLTAGE REGULATOR TEST (GENERATOR SYSTEM)

CURRENT REGULATOR - Operate engine at 1500 RPM. Remove cover and close VOLTAGE regulator contacts by hand. Read current regulator setting on ammeter.

VOLTAGE REGULATOR - Operate engine at 1500 RPM until output drops below 20 amperes. Read voltage regulator setting on voltmeter scale. Cycle engine a few times to stabilize regulator at final setting.

CUTOUT Operate engine at idle speed to open cutout relay. Slowly increase speed and note closing voltage at instant voltmeter pointer drops or kicks lightly, indicating contact closure. Final regulator settings should be checked withcover in place and regulator stabilized at operating temperature. Refer to vehicle service instructions for adjustment procedure.

GENERATOR OUTPUT TEST

OUTPUT - Operate starter for 15 seconds to reduce battery voltage. Start engine and turn vehicle lights ON to load battery. Operate engine at 1500 RPM and read output on ammeter. If no output is obtained, stop engine to connect field jumper.

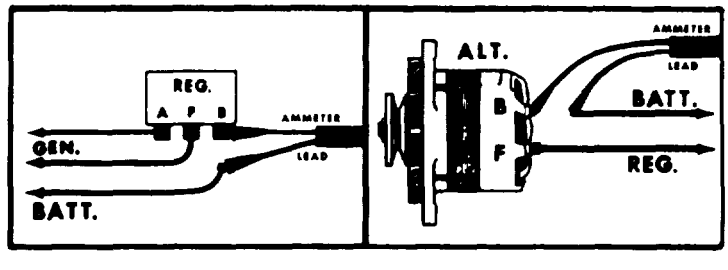
1. Disconnect REG. FIELD lead at generator.
2. Connect a jumper lead from generator FIELD terminal to ground on externally grounded field systems. ("A" circuit - Autolite, Delco). See Fig. 43.

On Ford products, "B" circuit systems, connect jumper lead from generator FIELD terminal to ARM terminal. See Fig. 42.

If the above test fails to produce any charging current, replace generator.

AMMETER CONNECTIONS

Fig. 40



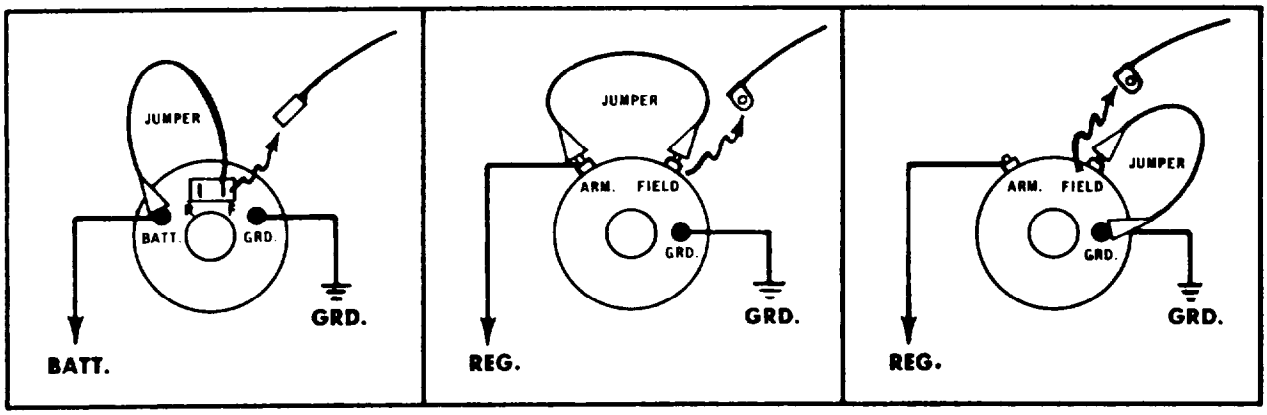
GENERAL TEST SECTION

ALTERNATOR - GENERATOR OUTPUT TEST
FIELD JUMPER CONNECTIONS

Fig. 41
ALTERNATOR

Fig. 42
GENERATOR
FORD "B" TYPE

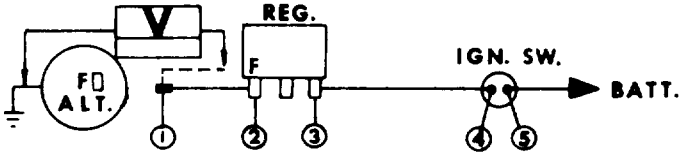
Fig. 43
GENERATOR
"A" TYPE



ALTERNATOR SYSTEM TESTS

OPEN FIELD CIRCUIT TEST PROCEDURE - Remove field lead from Alternator terminal. Turn ignition key ON. Use voltmeter lead for a voltage continuity check. Place master selector in TEST NO. 4 to use voltmeter. Connect BLK. clip to ground and use red clip with test prod to check voltage of each point starting from the alternator.

1. Field lead terminal
2. Input voltage to regulator



3. Field relay terminal, etc. to battery source until open circuit is located.

Refer to vehicle wiring diagram to follow field circuit to battery. Replace any section of field circuit found open. Check each terminal for loose connections. CAUTION: Do not ground field circuit with key ON or engine running, as this will cause damage to voltage regulator, wiring or ignition switch.

FLARING LIGHTS - Alternator systems with flaring lights from dim to very bright intensity on acceleration is a sure indication of open or high resistance in battery circuit. Inspect for loose or corroded connection on battery or alternator output terminal.

CHARGE INDICATOR GLOWS - When scope alternator test indicates normal alternator and voltmeter reading shows normal voltage regulator function, inspect indicator circuit for defect. This may be caused by the following--defective indicator relay voltage regulator, break in printed circuit dash wiring on certain C. M. products, blown fuses in dash light or stop light circuit or poor ground on bulb. Correction can be made on some Ford productsby addition of resistor in field circuit. Always refer to vehicle service bulletins or manual for complete troubleshooting details.

GENERAL TEST SECTION

CRANKING CIRCUIT TESTS

BATTERY

1. Check specific gravity with a temperature compensated hydrometer.

   A. Variation of over 25 points in electrolyte reading (compensated) indicates defective cell.

   B. One dry, or very low, cell usually indicates cracked case or shorted cell.

2. If cell readings are within 25 points, charge test battery as follows:

   A. Connect fast charger and tester red and black voltmeter leads to battery.

   B. Charge battery for three minutes at 40 amps. Excessive gassing indicates a "sulphated" battery condition.

   C. Following three minute period, with charger connected, check battery voltage. Reading should be under 15.5 volts for a twelve volt battery. Higher reading indicates battery is not taking high rate and must be slow charged for much longer period to break down sulphated condition.

3. After charge test

   A. Use a Battery Load Tester, and follow directions for testing battery capacity and condition.

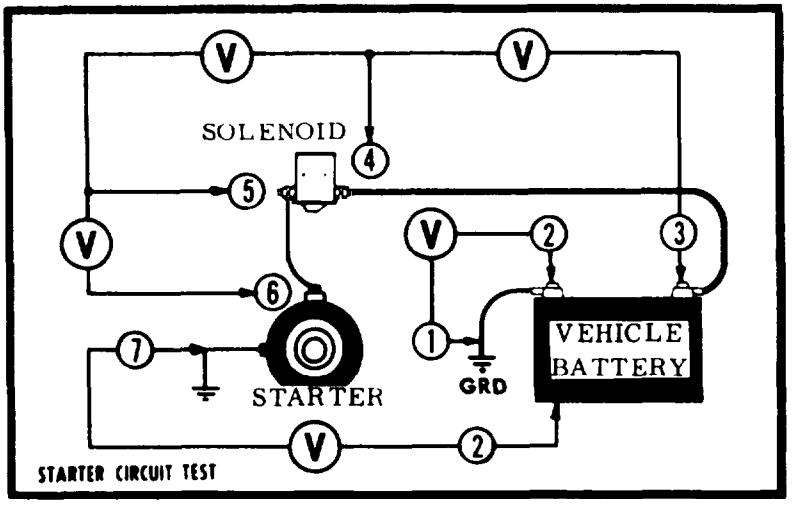
BATTERY CABLES- STARTER SOLENOID

1. Place selector switch in the No. 1 position. Read Scale (A)

2. Connect YELLOW and BLACK clip ACROSS any CURRENT carrying cable or starter switch contacts to check for resistance or voltage loss.

3. Crank engine and note meter readings on each cable and solenoid in order. Readings in REPLACE zone on Scale (A) indicates excessive resistance. See Fig. 44. for connections. Readings should be .1 volt or less for 12 volt systems, 6 volt systems - allow .2 volt, with starter operating. Excessive voltage drop between any two points can be corrected by cleaning or tightening connections. Replace cables or starter solenoid switch when necessary.

Fig. 44



BATT. STARTER CIRCUIT

GENERAL TEST SECTION

DEAD ENGINE TEST

The following fast check procedure is outlined for vehicles that won't start.

1. Connect analyzer scope test leads to engine.

2. Turn ignition switch ON and make points resistance test.

3. Remove air cleaner, check for gas discharge into carburetor venturiby operating accelerator. If no gas discharge is obtained, check carburetor and fuel system.

4. Place test selector in DWELL position. Operate starter and check point dwell for breaker point operation which should be approximately within proper limits. If dwell is erratic or no reading, check points, primary lead and ground pigtail for defects.

5. Place test selector in TIMING-ADVANCE position. Observe timing mark, this should be at least within 15 degrees of correct setting. If not, possible troubles may be in timing chain, distributor gear, loose distributor, plug cables improperly installed. No flash in timing light can be caused by bad coil, coil cable, defective rotor or cracked cap.

6. Place test selector in SEC. PARADE position. Remove one plug wire at distributor cap, Crank engine and observe scope. Small KV plug spikes indicate plugs are firing. One high KV spike verifies coil output is okay with sufficient reserve to fire plugs.

7. When above requirements have been checked, the problem is narroweddown to following areas:

   A. Plugs are fouled and will not fire.

   B. Compression is so low engine will not fire.

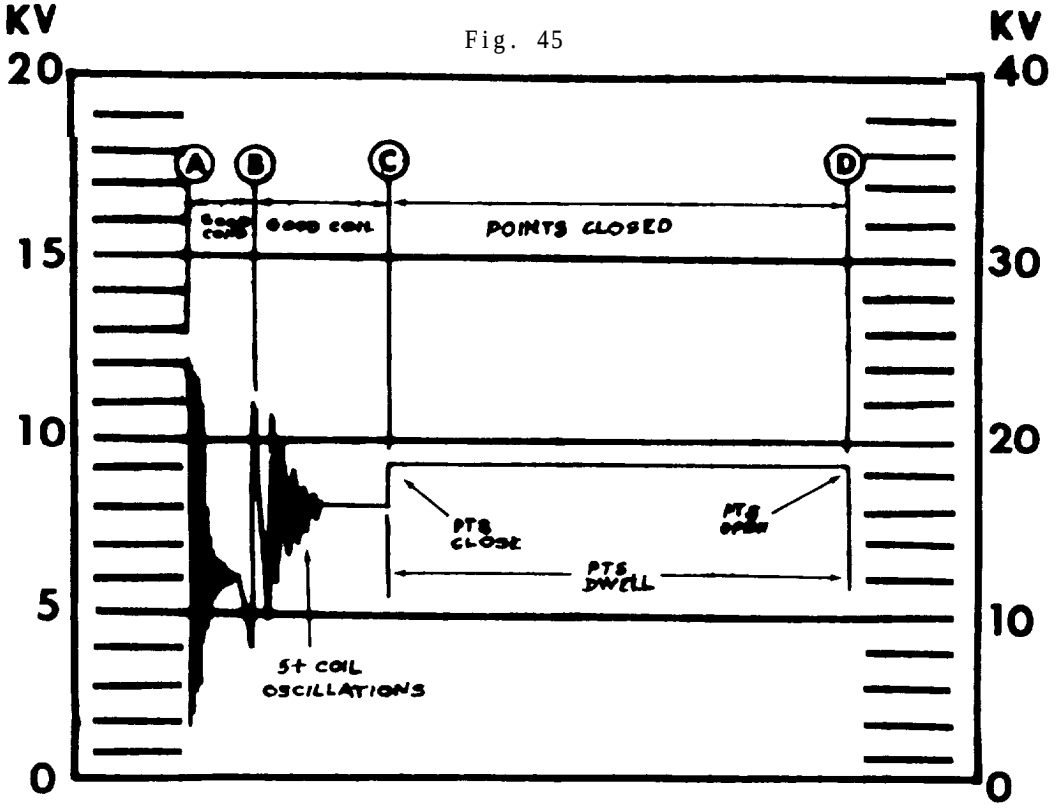
   C. Remove and inspect any plug. If plug is not fouled, check compression in one plug hole. Reading should exceed 70% of rated compression.

NOTE: It is recommended that a fast charger be connected to vehicle battery for above tests to provide steady starter operation and full battery voltage.

On some vehicles equipped with Electronic Ignition it is not recommended that a battery charger be connected to the vehicle battery. This can damage the Electronic module.

GENERAL TEST SECTION
PRIMARY SUPERIMPOSED PATTERN
TEST NO. 7

Fig. 45



Primary pattern analysis - - Breaker points open at A, starting the CONDENSER oscillation section. This is the condenser charging voltage for duration of spark. When spark stops at B, the COIL oscillation section shows the gradual discharge of coil energy in primary winding. Breaker points close at vertical step C which is the dwell indicator. Section C to D is the point dwell duration. 'The points open at D to start the next cycle of condenser oscillations at A.

GENERATOR SYSTEM - BATTERY POLARITY PATTERNS

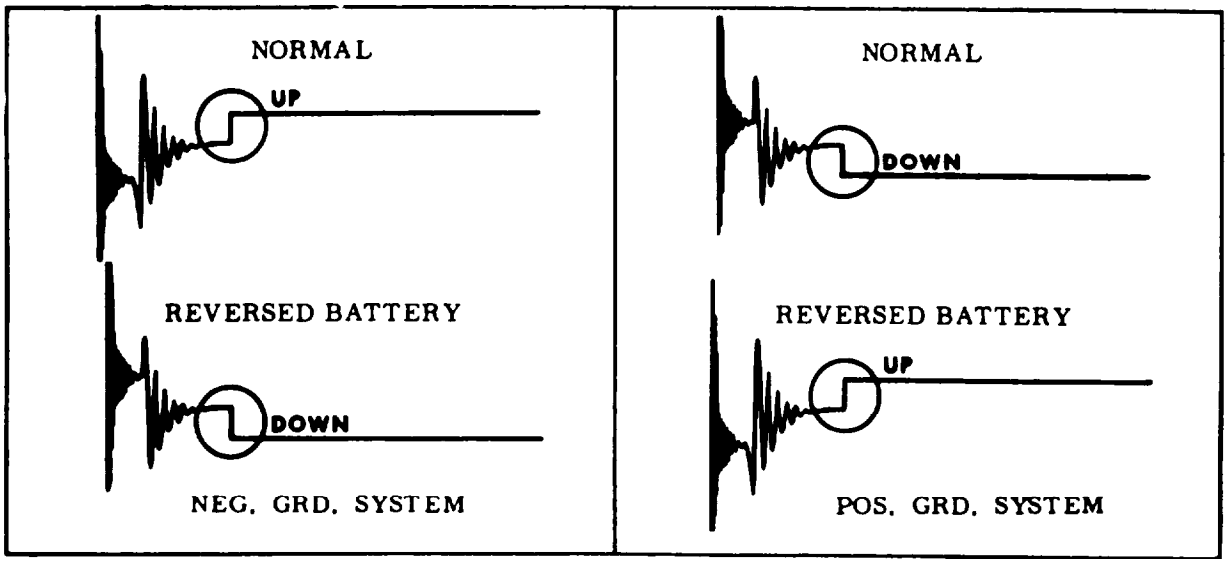
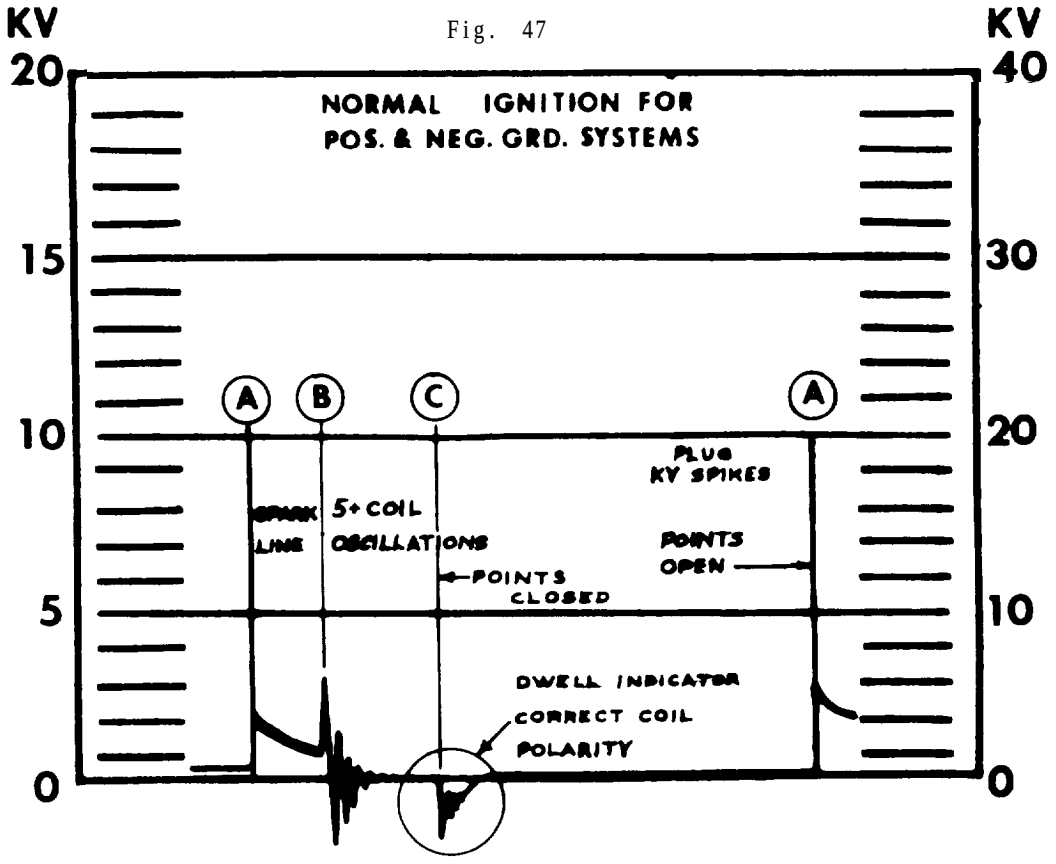


Fig. 46

GENERAL TEST SECTION
SECONDARY PATTERN
TEST NO. 8

Fig. 47



Pattern Analysis - - Test No. 8 is the secondary SUPERIMPOSED pattern display of all cylinders stacked one on top of another for a comparison of each cylinder performance. Test No. 9 is the secondary PARADE pattern display of all cylinders in firing order sequence. The following pattern analysis describes a complete firing cycle of one plug.

1. When breaker points open at (A), the KV plug spike is the ignition voltage required to fire plug gap. Ignition voltage is measured in kilovolts or KV (1,000 volts). The coil secondary voltage increases until the plug gap fires. The voltage required depends on plug and cable condition. Section (A) to (B) is the SPARK LINE which is the durationof the spark at plug gap.

2. The spark stops at (B) and is followed by the COIL OSCILLATION section (B) to (C). A good coil must show five or more oscillations at idle speed. As the speed is increased, the oscillations decrease. The coil oscillation voltage is gradually dissipated by charging and discharging condenser into primary while the points are open.

3. The points close at DWELL INDICATOR point (C), producing a few downward oscillations. This is generated by a surge of current in the coil primary when points close. The primary current slowly decreases and the line gradually slopes upward and levels off as a solid line to (A) where points open again to fire the next plug.

GENERAL TEST SECTION
SUPERIMPOSED SECONDARY PARADE
TEST NO. 8

COIL POLARITY

Coil polarity is REVERSED when dwell indicator points UP and plug spikes are downward. To correct this condition, reverse coil primary leads at terminals. Always be sure to check vehicle battery polarity first.

SPARK LINE

A GOOD ignition system will show a single UNIFORM spark line. Variations in length, slope or multiple spark lines are caused by system defects.

A LONG LOW spark line combined with a low plug spike is caused by leaky, shorted or grounded plug or cable.

A NARROW spark line sloping downward with a high plug spike is due to high secondary resistance such as burned or corroded rotor tip, breaks in cable or terminal connections, or corrosion in distributor cap terminals.

An OPEN plug cable will show a large oscillation in the spark line area.

Fig. 48

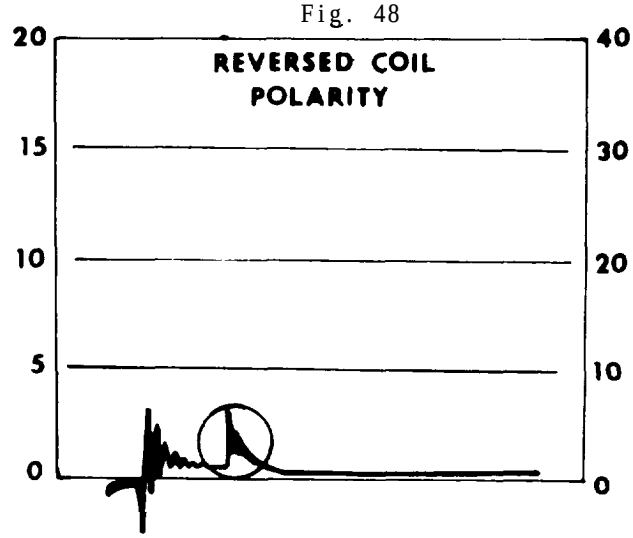


Fig. 49

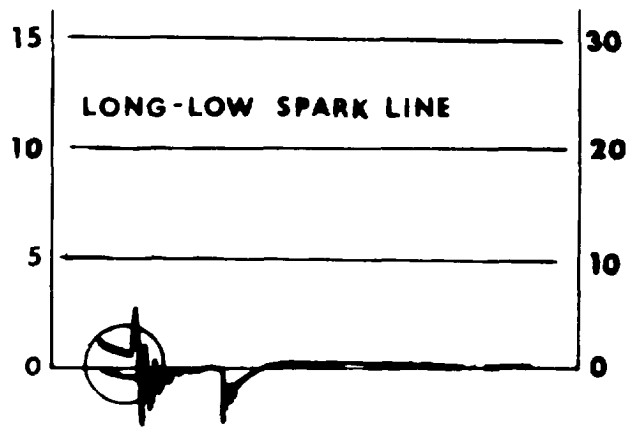


Fig. 50

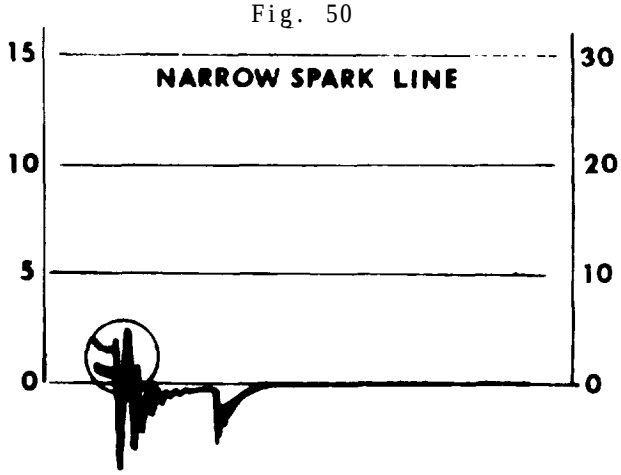
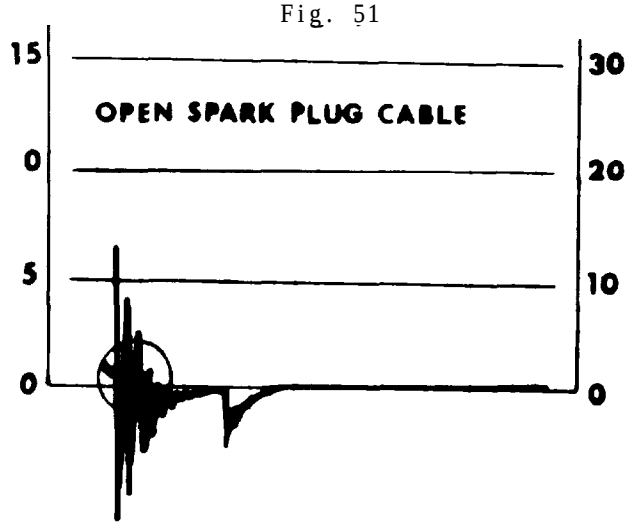


Fig. 51



GENERAL TEST SECTION
EXPANDED SECONDARY PARADE PATTERNS
TEST NO. 9

Fig. 52.

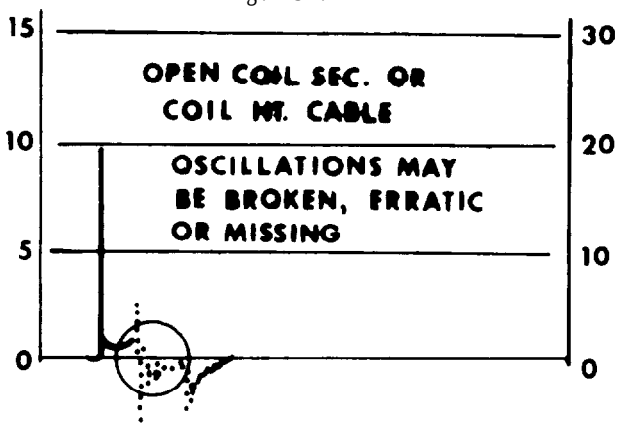


Fig. 53

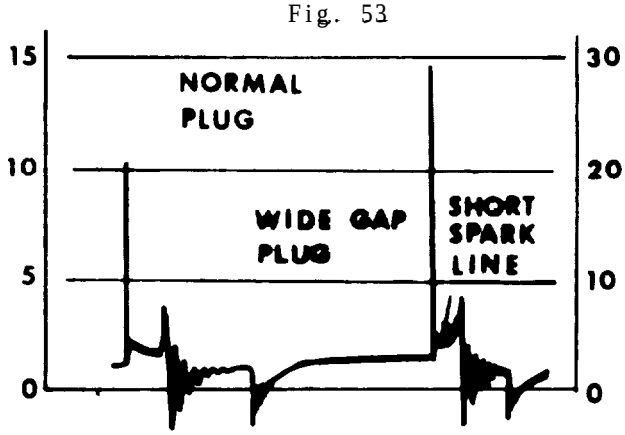


Fig. 54

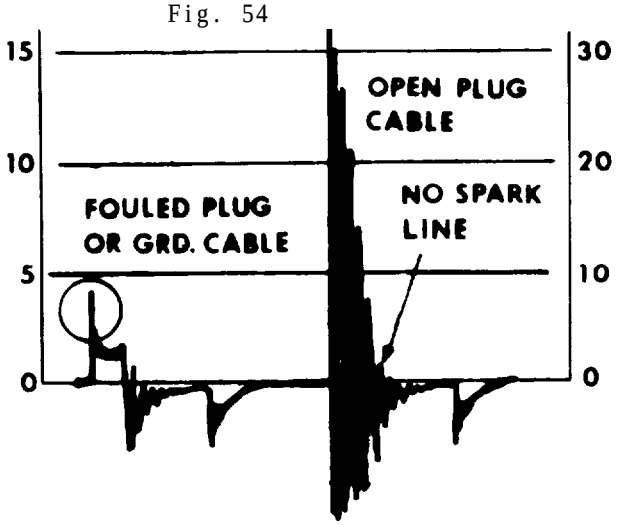


Fig. 55

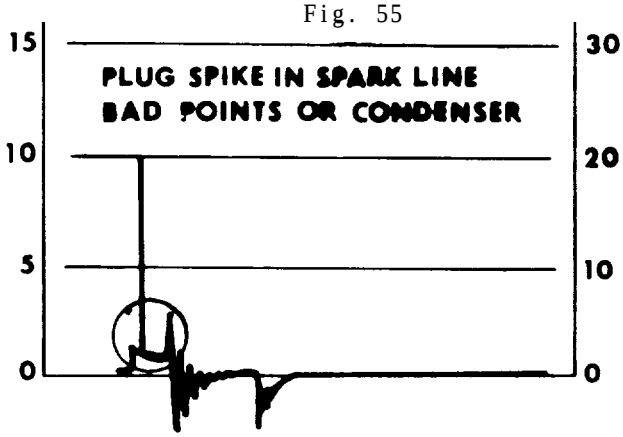


Fig. 56

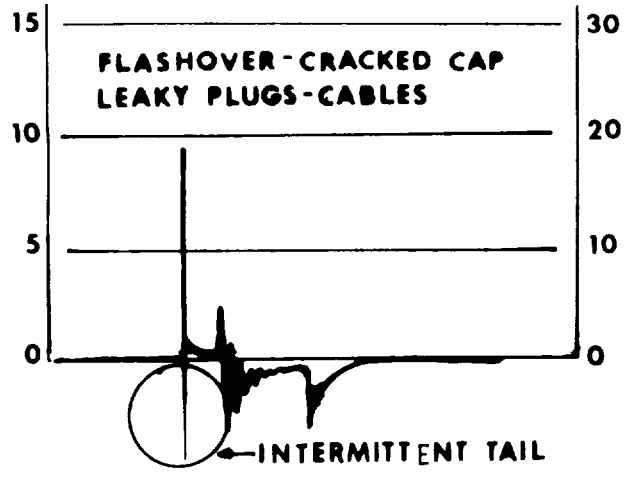


Fig. 57

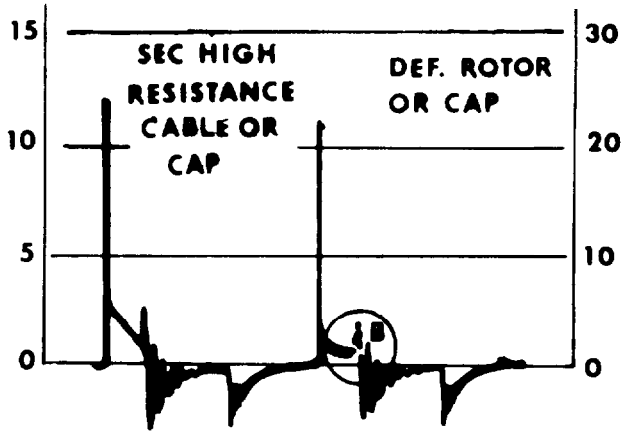
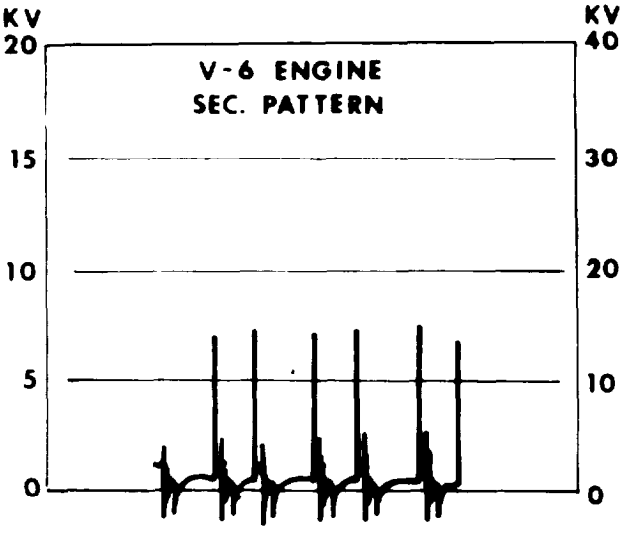


Fig. 58

V-6 ENGINE SCOPE PATTERN

There are some special V-6 distributors with special cam lobe spacing of 75-45-75-45 degrees. This will produce alternately narrow and wide-spaced secondary plug patterns. The primary will show two separate step positions.



CAM ANGLE VARIATION
Special FORD-AUTOLITE Distributors

Changes in point dwell when engine speed is increased may be caused by distributor defects or it may be a special type designed to vary the point spacing. Certain models of Ford and Auto-lite distributors use a special pivot type breaker plate assembly designed to vary point opening up to 10 degrees. This is normal for this special type distributor only. Failure to obtain proper dwell change is caused by a sticky or defective breaker plate or vacuum advance unit.

General rule to follow when vehicle specifications are not available is - - Ford products drop 3 to 5 degrees, Chrysler products drop 5 to 10 degrees, with normal vacuum advance.

Standard type distributors should not have more than a 3 degree variation between idle and 2000 RPM. Variations over 3 degrees indicate replacement or overhaul of distributor.

When in doubt on this type distributor, remove cap to verifyfollowing special mechanical features as follows - -breaker plate assembly is roughly triangular in shape and pivots at one corner, also the opening around distributor shaft would be an oblong hole. This type of plate pivots in an arc with vacuum advance action, instead of a circular rotation. The plate pivot action brings the rubbing block on movable points closer to cam, thusopening the points and changing the timing for “economy”.

GENERAL TEST SECTION
TRANSISTOR TYPE IGNITION SYSTEMS

Transistor type ignition primary and secondary patterns will deviate from the conventional standard ignition. Magnetic impulse and capacitor discharge systems show a long ON period and short OFF period.

Connect test leads for BREAKER TYPE transistor and CD systems, except - - Do not connect GREEN clip to the transistor type primary coil terminal. This lead is used for ballast voltage test only. All ballast resistors used in any transistor type system should be checked with an ohmmeter for resistance value and compared to specifications. Place system switch in H.E.I. position. Refer to list below for deviations in test procedure.

DO NOT USE - - - Test 1. Pts. Res., Test 2. Coil Primary
O. K. - - - Test 3. Batt. Volts, Test 4. Alternator-Reg., Test 5. Point Dwell, Test 6. Timing Advance.
O. K. - - - Test 7. Scope Primary - - patterns vary for each system - normal coil-condenser oscillation patterns do not apply to transistor systems.
O. K. - - - Test 8. Secondary Superimposed Patterns.
O. K. - - - Test 9. Secondary Parade Patterns.
O. K. - - - Test 10. Compression Test - O. K. on all cylinders except #l. Move # 1 pickup to adjacent plug to check #1 cylinder.
O. K. - - - Test 11. Test 12. Carburetor Gas Analysis Test.
DO NOT USE - - - Spark Plug Load Test.

CD SYSTEM - A new type capacitor discharge ignition incorporates a unique feature which fires the plug twice in rapid succession to ignite the fuel mixture. This causes slightly higher RPM readings and secondary patterns will show a different spark line with two KV spikes in the spark line. When using the superimposed pattern position, the separated patterns will overlap due to large pattern. Use 40 KV switch to reduce pattern size. NOTE: Connect yellow clip to distributor BREAKER point lead, which may be a bolted connection on this system.

The RPM meter indications on the dual sparkCD system will read higher and the following conversion chart can be used for actual engine RPM settings.

1000 Scale		4000 Scale	
Engine RPM	Meter reads	Engine RPM	Meter reads
500	600	500	900
600	715	* 1000	1600
700	825	* 1500	2250
800	990	2000	2900
		2500	3500
		2700 & up	O. K.

* Adjust engine speed to read1600 on meter for scope test and 2200 for compression test.

GENERAL TEST SECTION

HIGH ENERGY IGNITION SYSTEM

GENERAL INFORMATION

The General Motors High Energy Ignition System (H.E.I.) was introduced in 1973 production of 1974 Cadillacs and its application extended in 1974 as an option on various other GM passenger cars. Beginning with the 1975 model year, the H.E.I. system is standard on all General Motors vehicles including trucks as well as 4 and 6 cylinder engines.

DESCRIPTION--High Energy Ignition System (H.E.I.)

The H.E.I. system is a complete single unit ignition assembly featuring a built-in ignition coil, electronic module, and magnetic pickup assembly. The entire unit incorporates all the parts that make a complete ignition system with the exception of the spark plugs. It combines the distributor, coil, electronic module, magnetic pickup, rotor, cap and secondary harness. With the H.E.I. system installed, a single lead from the ignition switch supplies the required battery voltage. The only remaining connections are the attachment of the cables to the spark plugs.

1. The H.E.I. system minus the ignition harness is shown in Fig.59. On some models (V-8s) the attachment of the plug wires to the distributor cap is accomplished by an additional retainer ring which helps to hold down the plug cable harness.

The 1975 4 and 6 cylinder version of the H.E.I. are different in that an external coil is used but the basic operating features are like that of the 8 cylinder systems.

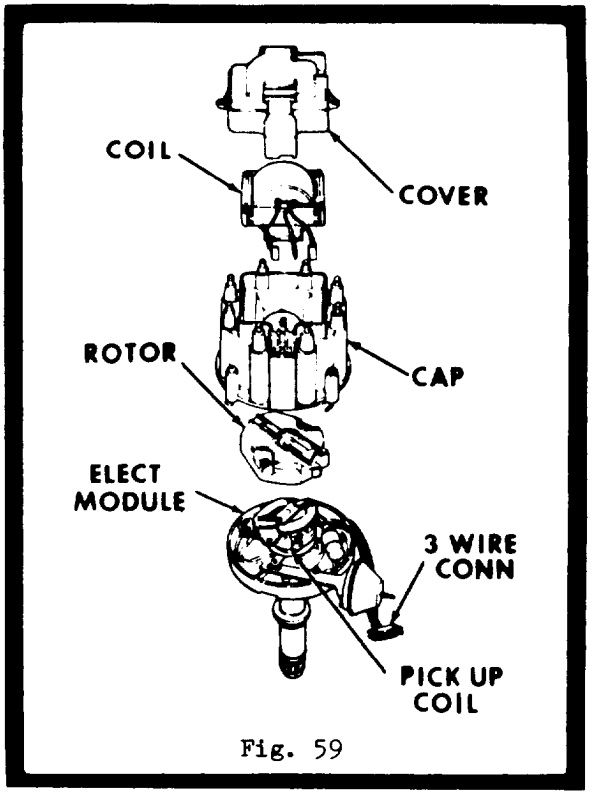


Fig. 59

CAUTION

A KEYLESS REMOTE STARTER SWITCH IS INCLUDED WITH THIS EQUIPMENT. INSTRUCTIONS ARE PROVIDED ON THE BACK OF THE SWITCH. ON THOSE VEHICLES WHICH INCORPORATE AN IGNITION BALLAST RESISTOR THE USE OF THE IGNITION BY-PASS SECTION OF THE STARTER SWITCH CAN RESULT IN INCORRECT TEST RESULT-R POSSIBLE ELECTRICAL DAMAGE TO THE IGNITION SYSTEM.

2. Ignition Coil - Fig. 2

Fig.60 illustrates the coil as viewed underneath. Currently (1974) there are two different coils being used on V-8 model

Part No. 1875894 - Cadillac, Chevrolet and Oldsmobile Toronado.
Primary - Yellow and Red Leads.
Secondary - Yellow and Output terminal

Part No. 1876209 - Buick, Pontiac and Oldsmobile (except Toronado).
Primary - White and Red Leads.
Secondary - White and Output terminal.

Resistance Checks are:
Primary resistance reading should be less than 1 ohm but not 0.
Secondary resistance should be between 6,000 and 30,000 ohms.

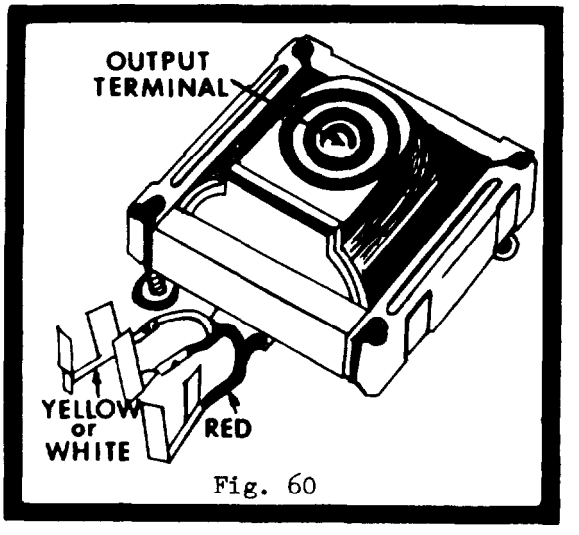


Fig. 60

3. Magnetic Pickup Assembly - Fig. 61.

The magnetic pickup assembly has a permanent magnet and pickup coil both sandwiched between a pole piece with internal teeth and a bottom plate held together with three screws. As the timer core teeth (external teeth) line up with the pole piece internal teeth, a strong magnetic field from the permanent magnet is established through the center of the pickup coil. This induces a voltage in the pickup coil which is then directed to the electronic module.

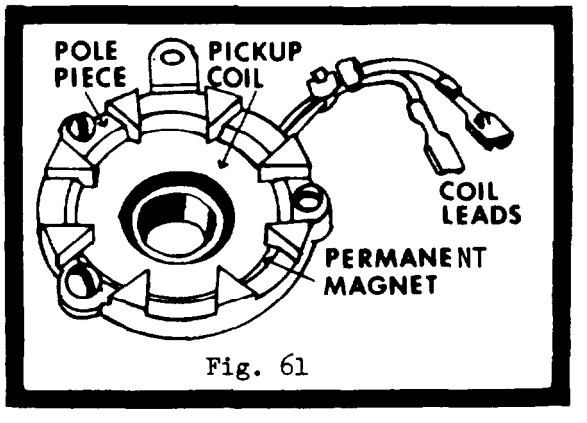


Fig. 61

4. Electronic Module - .Fig. 62.

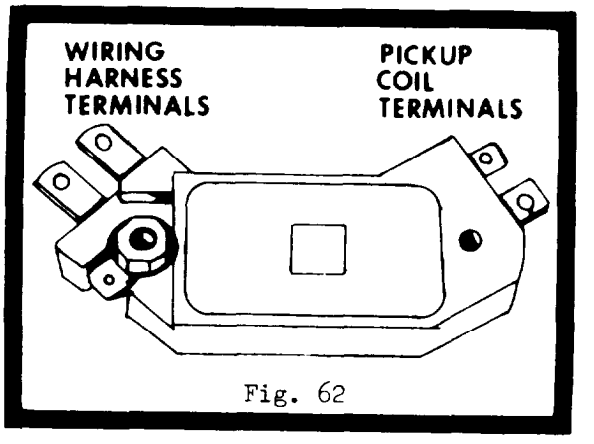


Fig. 62

The electronic module receives a voltage signal from the pickup coil and then allows ignition coil primary current to - flow. Primary current flows when the timer core teeth aporoach alignment with the pole piece teeth. Primary current decreases when the teeth start to separate. It is at this time that the voltage is induced in the ignition coil secondary to fire the spark pluq. The time (dwell) between increasing and decreasing primary current flow changes with engine RPM. This time is dependent on the electronic module. Note that the electronic module is serviced by complete replacement only.

HOOKUP PROCEDURES - 10-516 ENGINE ANALYZER

To permit testing of the H.E.I., a kit of adapters is provided on current Model 10-516's to make the necessary test lead connections to this system.

The 529 adapter kit is available for those equipment owners of older Model 10-516's on which the test lead has a secondary Pickup which normally clamps over the coil high tension lead.

The 530 adapter kit is available for those equipment owners of older Model 10-516's on which the test lead has a secondary pickup which normally is placed in series with the coil high tension lead.

Contents of Kit: Fig. 63.

1 Secondary adapter
1 Primary adapter
2 #1 Red pickup adapter cables
1 Red spark plug boot
*1 Voltage protector
**1 Secondary clamp and tubing (530 only)

*To protect the engine analyzer from any arcing which may occur, the voltage protector must be installed according to the instructions of SB-62. This modification is not required on equipment purchased in which the adapters are furnished as shipped from the factory.

**Installed according to instructions of SB-55, the secondary clamp provided in the 530 adapter permits modification of older style test lead secondary pickup to the current type required for the H.E.I.

GENERAL TEST SECTION

Referring to Fig.63. the test lead and adapter hookup procedure is as follows:

- The chrome plated SECONDARY ADAPTER is simply snapped over the coil cover. The contour of the chrome plate matches the coil cover and the 2 clips snap over the fins of the coil cover.

- The test lead BLUE coil PICKUP is clamped over the 2 studs or screws extending up from the adapter plate. Insure that the Blue Pickup does not exert any pressure on the adapter plate which will cause the plate to move away from the coil cover.

- The quick connect terminal of the PRIMARY ADAPTER is connected to the TACH terminal on the side of the distributor. This terminal is identified by a stamping on the coil cover and is a normally unused connection. As the terminal is recessed and pointing down, experience will enable you to make this connection.

- Connect the test lead YELLOW clip to the yellow clip of the PRIMARY ADAPTER. Insure that the yellow clip connections do not come in contact with any engine ground.

- 2 short adapter cables are provided to connect the test lead #1 Red Pickup to the distributor. Remove #1 spark plug cable at the distributor. The adapter cable with the Red boot is connected to the #1 terminal on the distributor. Insert the male end of the Red Pickup into the Red boot. The remaining adapter cable is connected between the female end of the Red Pickup and the #1 spark plug cable.

NOTE: On those vehicles where a retainer ring is used and is not easily removable, the ring latches can be snapped open and the ring can be lifted just high enough to remove the #1 spark plug cable. The #1 adapter cable can then be connected and the ring pressed back down.

- Connect the test lead BLACK CLIP to a good engine ground.

- Connect the test lead RED CLIP to the positive side of the battery.

- The GREEN CLIP is not used. As the H.E.I. system does not use a ballast resistor, there is no primary volts reading.

- The Red Spark Plug boot is used in performing the coil reserve test.

- Refer-to Figure 64 for the test lead hookup procedure on 6 cylinder engines.

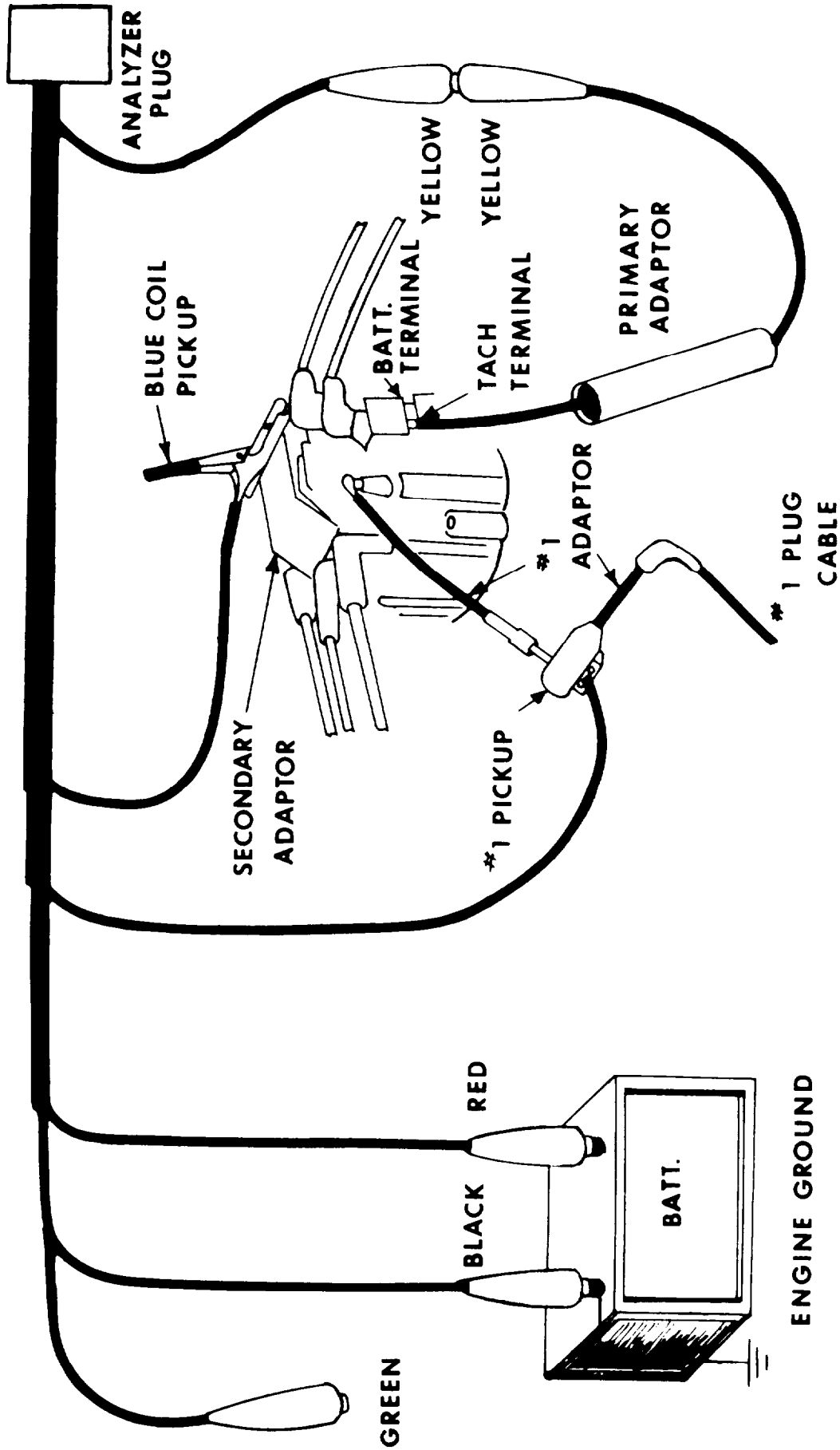

ANALYZER PLUG
BLUE COIL PICK UP
BATT. TERMINAL
YELLOW
YELLOW
TACH TERMINAL
PRIMARY ADAPTOR
#1 ADAPTOR
#1 PLUG CABLE
SECONDARY ADAPTOR
#1 PICKUP
RED
BLACK
GREEN
BATT.
ENGINE GROUND

Fig. 63

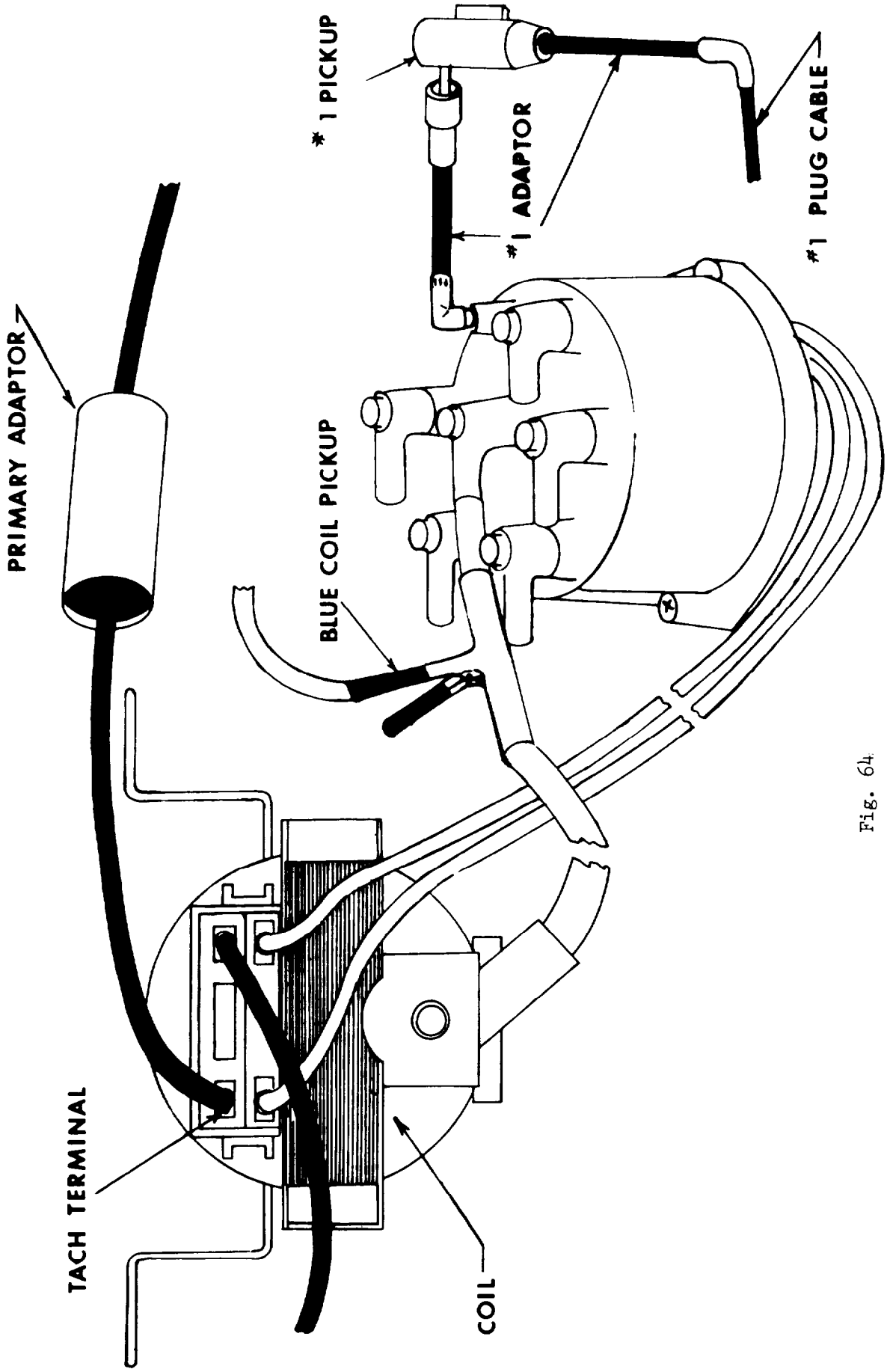


Fig. 64 TYPICAL SIX CYL TEST LEAD HOOK-UP

GENERAL TEST SECTION

TEST PROCEDURE ON THE H.E.I. SYSTEM - 10-515 SCOPE ANALYZER

All usual test procedures may be performed according to the Instruction Manual by turning System Switch to H.E.I. position and noting the following differences.

TEST 1 PRIMARY COIL VOLTS
As one side of the ignition coil is connected directly to the battery (through the ignition switch) there is no ballast resistor and therefore no primary coil volt measurement.

TEST 2 POINT RES
This system does not use points and the up scale meter reading obtained is meaningless for this system.

TEST 3 & 4
All tests performed in a normal manner. Note that on test $4 10-516 scope analyzers with serial numbers 740201 and above have a special pattern for checking ignition failure on dead engines. This pattern appears in test #4 when the system switch is set to "Electronic iqnition".

TEST 5 DWELL
Unique to the H.E.I. System is the large Dwell change from low to high RPM as read on the Dwell scale. Although no specifications are published typical dwell variations are 5-8 ^{0} at idle up to 30 ^{0} at 3,000 RPM. This dwell change is determined by the electronic module and cannot be changed or adjusted. We can conclude that as engine RPM is varied and no dwell change is observed the electronic module should be suspected as faulty.

TEST 6 TIMING ADVANCE - - - OK

TEST 7 PRIMARY SUPERIMPOSED
A normal H.E.I. primary pattern should appear as illustrated in Fig. 65.

SECTION A SPARK ZONE - The conventional coil/condenser oscillations are not present on this system as there is no ignition condenser. The condenser that is in the distributor is for radio noise suppression.

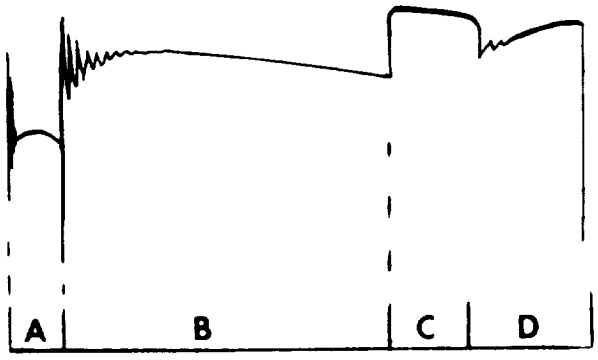
SECTION B COIL ZONE - At the start of Section B the plug ARC stops and the remaining energy is dissipated in the coil oscillations.

SECTION C DWELL ZONE - At this time the electronic module is on and primary current is flowing. This dwell zone changes with RPM, becoming wider with increasing RPM.

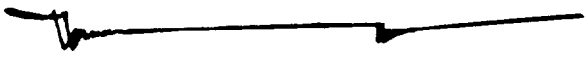
SECTION D At this time primary current begins to decrease with the firing of the spark plug occurring at the end of Section D or beginning of Section A.

Note that Section C (Dwell Zone) moves to the left on the screen with increasing RPM. The exact change of dwell can be read on the dwell scale in test #5. If the dwell does not change the electronic module is defective.

Figures 68, 69, 70 and illustrate ignition defects which can be diagnosed on the primary superimposed pattern.



PRIMARY SUPERIMPOSED- Fig. 65



SECONDARY SUPERIMPOSED- Fig. 66

SECONDARY PARADE- Fig. 67

GENERAL TEST SECTION

TEST 8 SECONDARY SUPERIMPOSED

The pattern illustrated in Fig.66 is quite conventional. Compared to point contact ignition systems the H.E.I. spark duration may be longer due to the higher amount of energy stored in the coil primary. Coil defects will appear as a reduced number of oscillations (less than 4) but are analyzed by viewing the primary pattern. Figures 72 and 73 illustrate the effects of secondary resistance on the spark line.

TEST 9 SECONDARY PARADE

Again the pattern as illustrated in Fig. 67 is quite similar to the conventional ignition patterns we are used to seeing. More important than the actual KV voltages required to fire each plug is the differences between plugs. Providing your 10-516 analyzer is in a good state of calibration and the adapter plate is properly fitted snug against the coil cover, we can make the following two tests with a good degree of confidence and accuracy.

1. PLUG FIRING ZONE: The normal plug firing zone for the H.E.I. System is read on the O-40KV scale. All plug spikes should be within 2 divisions of each other.

2. COIL OUTPUT: An available coil voltage test can be obtained by disconnecting any spark plug wire (except #l) at the distributor. With the wire disconnected, slip the RED SPARK PLUG BOOT provided in the adapter kit over the exposed terminal on the distributor. Operate the engine at approximately 1500 RPM and note the maximum height of the KV spike of the cylinder disconnected. A good coil will indicate 35KV or more as read on the O-40 KV scale. (Do not depress the 40KV test button). To confirm a suspected faulty coil, additional diagnosis would be:

   -perform test on another cylinder or two to rule out a leakage condition.
   -check primary pattern for 4 or more coil oscillations.
   -measure both the primary and secondary coil resistance.

Test 10. 11 and 12 - All tests performed in the normal manner. Note that in performing the electronic compression test (#10) the E.G.R. valve vacuum hose should be disconnected and plugged to prevent false readings.

GENERAL TEST SECTION

PRIMARY SUPERIMPOSED

GOOD COIL

Fig. 68

GOOD COIL SHOWS.4 OR MORE OSCILLATIONS AT SECTION B

DEFECTIVE COIL

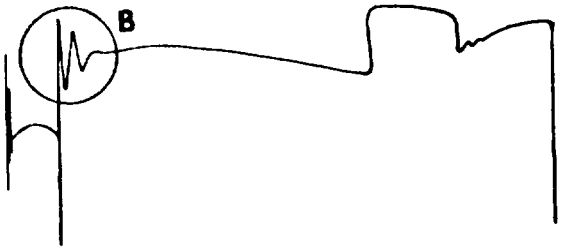


Fig. 69

DEFECTIVE COIL WILL SHOW LESS THAN 4 OSCILLATIONS AT SECTION B.

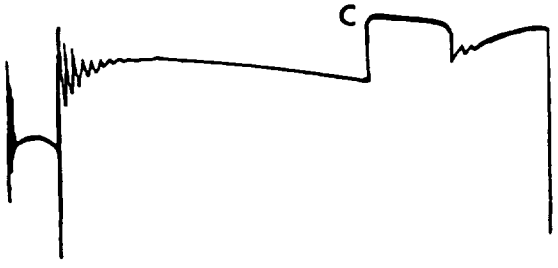


Fig. 70

A DISTRIBUTOR IN GOOD MECHANICAL CONDITION WILL SHOW A SINGLE CLEAN SOLID LINE AT SECTION C

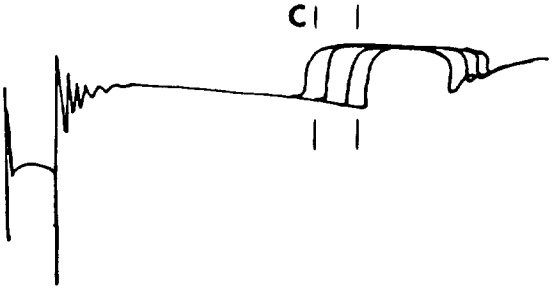


Fig. 71

EXCESSIVE VARIATION OF MORE THAN 3 DEGREES. INDICATION OF WORN DISTRIBUTOR PLATE, BENT OR WORN DISTRIBUTOR SHAFT.

SECONDARY SUPERIMPOSED

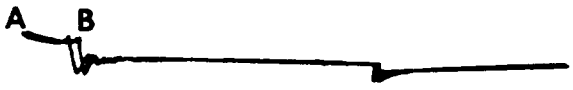


Fig. 72

NORMAL PATTERN - ALL SPARK LINES (A-B) SHOULD BE THE SAME APPROXIMATE LENGTH

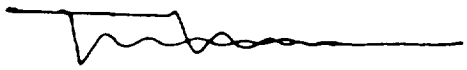


Fig. 73

SHOWS ONE SHORT SPARK LINE. INDICATES EXCESSIVE SECONDARY RESISTANCE - WORN OR WIDE GAPPED PLUG OR DEFECTIVE PLUG WIRE

SECONDARY PARADE

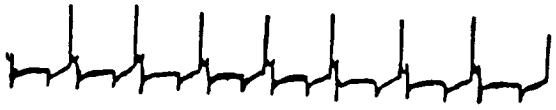


Fig. 74

NORMAL PATTERN - ALL PLUG SPIKES ARE UNIFORM

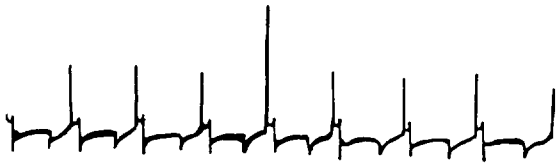


Fig. 75

SHOWS ONE HIGH KV PLUG SPIKE. INDICATES A DEFECTIVE PLUG WIRE

GENERAL TEST SECTION

TEST 8 & 9 SPARK PLUG LOAD TEST

The spark plug load test has demonstrated to be a very effective test to check the over all condition of the spark plugs and ignition wires. The objective of the test is to determine if all the spark plugs and ignition cables will endure the same amount of load.

TEST PROCEDURE - Fig. 74 & 75

1. Operate engine at 1500 RPM. SCOPE SET TO SECONDARY PARADE.
2. Depress the Load Control button.
3. Slowly rotate the Load Control C.W. to increase the load.
4. Observe the spark line of each spark plug and look for erratic misfiring Or breakdown as shown in Fig. 77. The misfiring or breakdown will be the spark line disappearing while under load.

The results of this test are:

IF ONE OR MORE PLUGS BREAKDOWN PREMATURELY, AS SHOWN IN Fig. 75, WE CAN SUSPECT DEFECTIVE PLUGS OR DEFECTIVE PLUG WIRES.

To determine whether it's a plug or wire problem observe the pattern in test 8 with no plug load applied.

the problem is most likely a plug if the test 8 pattern appears as Fig. 72.
the problem is most likely a wire of the test 8 pattern appears as Fig. 73.

NORMAL SECONDARY PARADE PATTERN - NO LOAD APPLIED

Fig. 76

SECONDARY PARADE PATTERN LOAD APPLIED - BREAKDOWN ON #4 CYLINDER

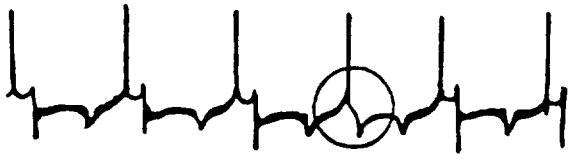


Fig. 77

TESTING A DEAD ENGINE WITH H.E.I. SYSTEM - 10-516

The following procedure can be used to check a dead engine for ignition system failure. This procedure isolates the problem area and is accomplished with the aid of the 10-516 oscilloscope patterns and ohmmeter. Checks should be made in the sequence indicated.

1. PRELIMINARY TEST LEAD HOOK-UP AND CHECKS:
   A. Confirm dead ignition by holding one spark plug lead with insulating piiers about l/4" from engine block while cranking engine. Dead ignition will not produce any spark.

   B. Connect test lead GREEN and BLACK clips to battery - Green to positive, Black to negative.

   C. Connect H.E.I. Primary Adapter to TACH terminal and test lead RED clip to yellow clip of Primary Adapter.

2. VOLTAGE CHECKS: (Ignition on)
   A. Set 10-516 test selector to positive #l, read and record voltmeter reading (reading is the battery voltage).

   8. Set 10-516 test selector to position #4, read and record voltmeter reading (reading is the voltage supplied through the primary to the module).

   RESULTS: Reading obtained in B must be within 1 volt of the reading obtained in A. If B reads 0 volts, coil primary is open or no voltage is being supplied to the BATT terminal of the distributor.

   Check for open primary with ohmmeter.

   Check for no supply voltage by disconnecting ignition switch connector at distributor and connect Green clip to feed wire. Should read battery voltage (test selector at 1).

   If B reads less than 1 volt below the battery but not 0, the electroni: module could have a shorted or leakage condition.

3. ELECTRONIC MODULE CHECK - STEP 2 OK:
   A. 10-516 test selector set to position #4. 10-516 system switch set to H.E.I. test position - test lead Red clip connected to H.E.I. primary adapter.

   B. Crank the engine and observe the pattern.

   RESULTS: As the engine is cranked, a large vertical pattern should appear which would indicate the module is switching on and off.

If a large vertical pattern appears, primary current is being switched on and off indicating the module should be operating satisfactorily enough to produce high voltage.

If only a straight horizontal line remains on the scope, the electronic module is defective or the magnetic pickup assembly is bad. Proceed with Step 4.

4. MAGNETIC PICKUP ASSEMBLY CHECKS:
   A. Remove cap and ignition coil. Position the assembly out of the way and remove the rotor.

   B. Disconnect the two pickup coil leads from the electronic module and carefully connect the Red and Black test clips to these leads.

   C. Insuring that the connections are free from the rotating part of the distributor again crank the engine and observe the pattern.

   RESULTS: As the engine is cranked a vertical pattern should appear which would indicate the magnetic pickup assembly is generating a signal to the electronic module.

   If only a straight horizontal line remains on the scope, the pickup assembly is defective.

   If a vertical pattern does appear, the pickup assembly is ok. Additionally the pickup coil should be checked with an ohmmeter. Resistance should be between 500 and 1500 ohms.

5. TEST CONCLUSIONS:
   A. If Step 4 checks ok and Step 3 did not produce a large vertical pattern, the electronic module is defective.

   B. If Steps 1, 2 and 3 check ok the problem is reduced to secondary side of the system.

   Coil secondary/check for resistance reading of between 6,000 and 30,000 ohms.

   Inspect cap, coil assembly and rotor for spark arc over or if defective.

CHRYSLER ELECTRONIC IGNITION SYSTEM

DESCRIPTION: Electronic Ignition
The system consists of the Dual Ballast Resistor, Electronic Control Unit, Distributor, and the Ignition coil.

1. Dual Ballast Resistor - Fig. 78
Two resistors are mounted in the ballast unit. The compensating resistor (.5 to .6 ohms) is in series with the ignition coil and serves the same function as a ballast in a conventional ignition system. The auxiliary resistor (4.75 to 5.75 ohms) controls the voltage to the Electronic Control Unit.

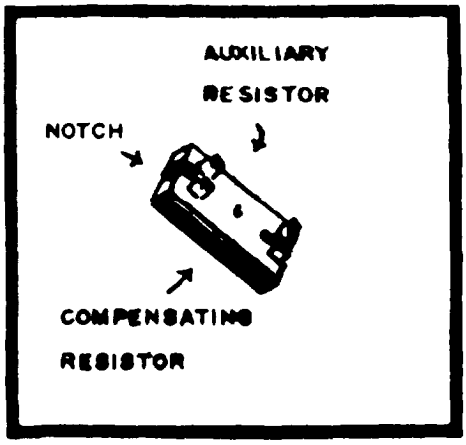


Fig. 78

2. Electronic Control Unit - Fig. 79.
The transistorized control unit interrupts the coil primary circuit to produce the required spark whenever a pulse comes from the distributor. The unit is connected to the rest of the system by a 5 pin plug. (Fig. 3) Pins 4 and 5 receive the pulse signal from the distributor causing the power transistor within the unit to interrupt the primary current from Pin 2 to the minus side of the Ignition coil. Pin 3 is connected through the auxiliary ballast resistor and ignition switch to the battery. Pin 1 is connected directly to the battery through the ignition switch. Note that the length of time that the power transistor controls the flow of current in the primary circuit is determined by electronic circuitryin the control unit. Dwell is not adjustable.

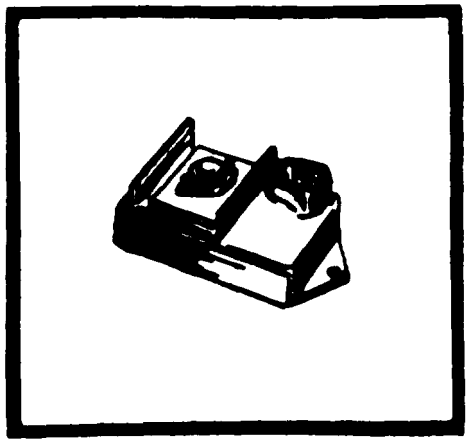


Fig. 79

GENERAL TEST SECTION

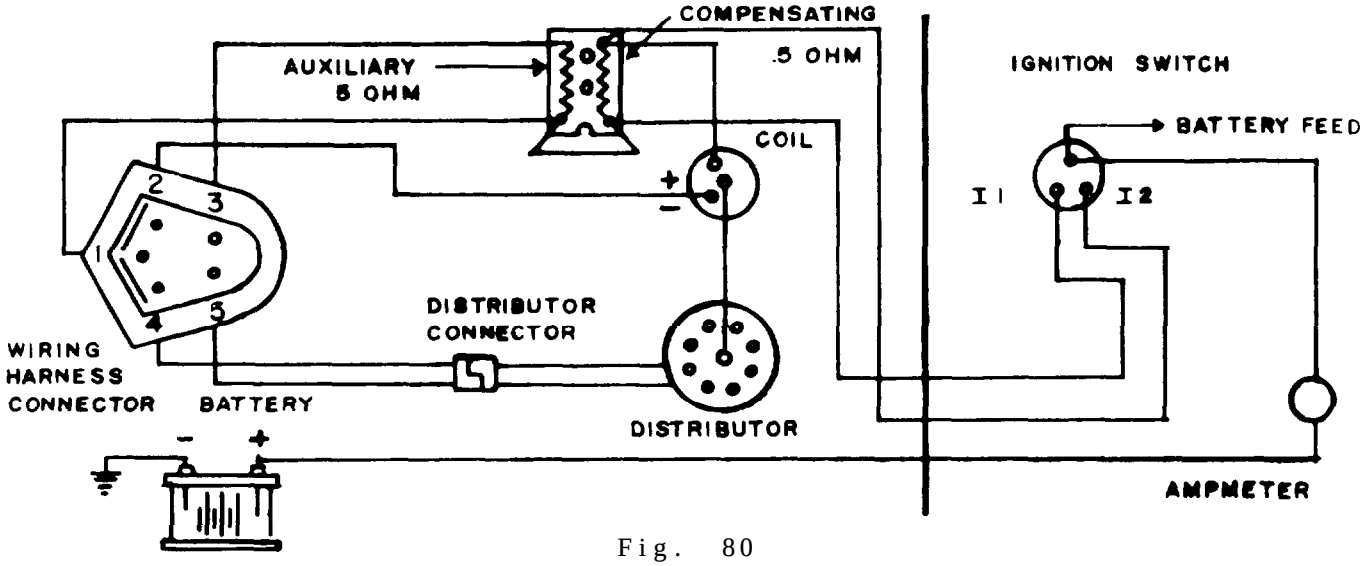


Fig. 80

3. Distributor - Fig. 81.
The two-wire lead is the only change in the distributor outside appearance. Inside, the conventional cam lobe is replaced by an 8 or 6 tooth reluctor and the contact points are replaced by the pick-up coil and permanent magnet. The reluctor rotating with the distributor shaft produces a voltage pulse in the magnetic pick-up. The pulse is transmitted through the pick-up coil to the power transistor in the electronic control unit. The gap between the pick-up and reluctor is adjustable to a specification of .008 in. with a non-magnetic feeler gauge. This gap does not affect dwell. Timing and advance mechanisms are identical to the conventional ignition system.

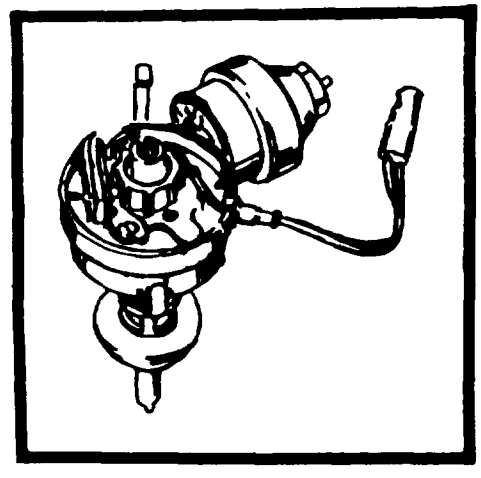


Fig. 81

4. Ignition Coil -Fig. 82.
Resistances of the coil are similar to conventional coils:

Chrysler Prestolite - Primary 1.6 - 1.79 ohms
Secondary 9400 - 11,700 ohms

Chrysler Essex - Primary 1.41 - 1.55 ohms
Secondary 8000 - 10,200 ohms

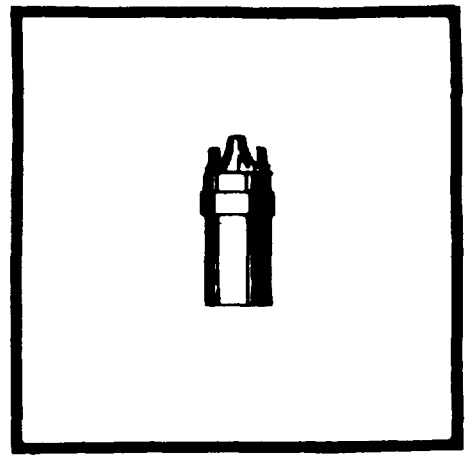


Fig. 82

GENERAL TEST SECTION

TESTING - 10-516 ENGINE ANALYZERS

The Electronic Ignition system can be completely tested on engine analyze basic test lead hook-up of this system is the same as for conventi Fig. 83.

- Connect BLACK clip to a good engine ground.
- Connect YELLOW clip to the - (minus) side of the ignition coil. (Coil is marked with a + and -).
- Connect RED clip to battery Positive post.
- Connect GREEN clip to the + (plus) side of the ignition coil.
- Remove No. 1 spark plug cable at distributor cap and insert No. 1 SPARK PLUG PICK-UP into cap terminal. Insert No.1 plug cable into end of pick-up.
- The secondary BLUE coil PICK-UP is simply clipped over the COIL H.T. lead. (On older engine analyzers the BLUE COIL PICK-UP is inserted in series with the cap and insert the male end of BLUE PICK-UP into center terminal of the cap. Insert H.T. coil lead into female end of BLUE PICK-UP).

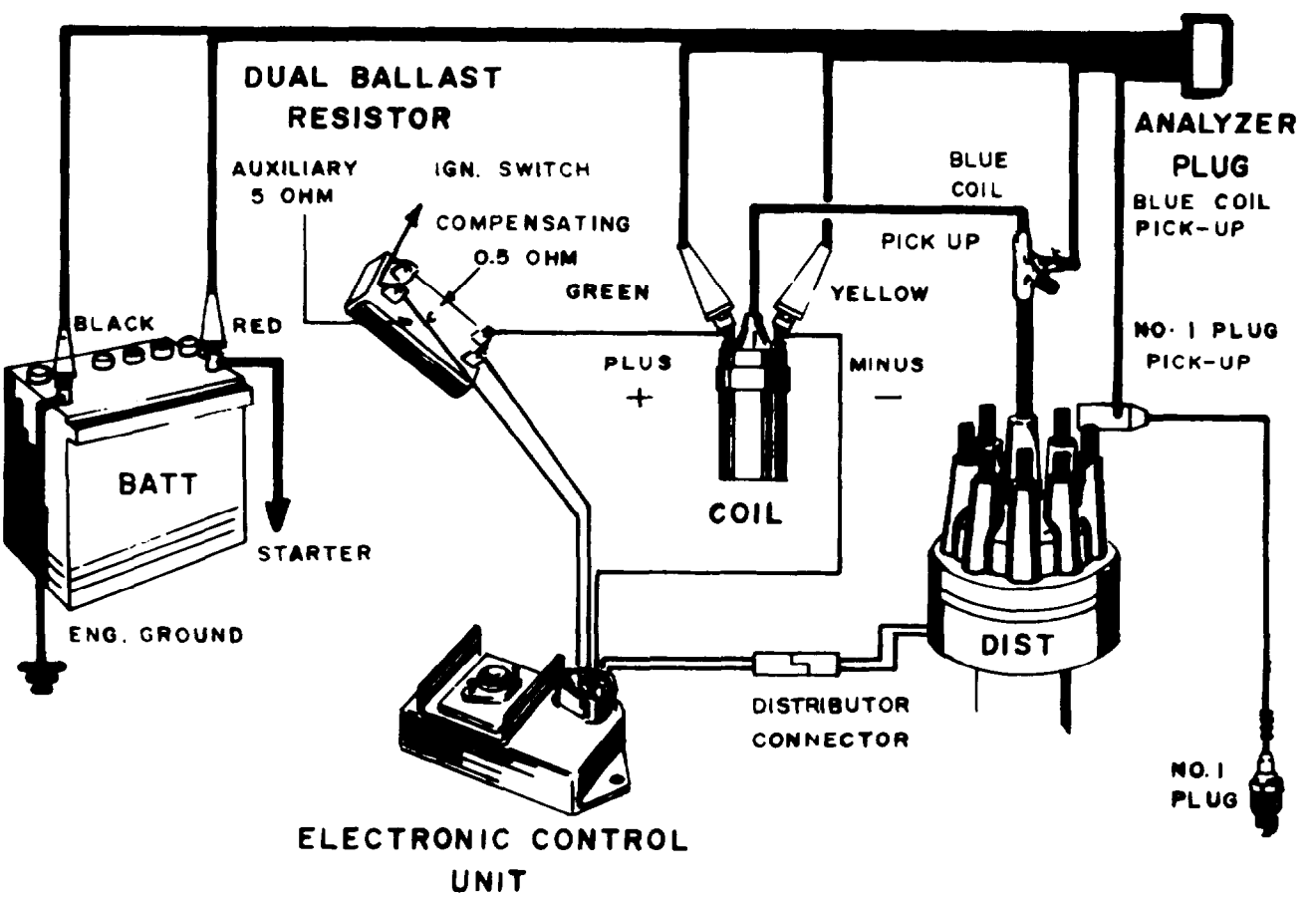


Fig. 83

GENERAL TEST SECTION

10-516 TESTING - EXPLANATORY NOTES

All usual test procedures may be performed noting the following differences:

10-516 Test 2 POINTS RES. - A reading up scale will be obtained but is meaningless for this ignition system.

10-516 Test 5 DWELL - The dwell meter should indicate a reading of 40-43° (8 cyl.) or 53-57° (6 cyl.). It is important to remember that the dwell is determined by the electronic circuitryof the Electronic Control Unit. It cannot be changed or adjusted, unless the Electronic Control Unit is replaced.

10-516 OHMMETER TESTS - The following ohmmeter test can be made with the separate ohmmeter of the 13-516:
- coil, as specified in Fig. 82.
- ballast, compensating @ .50-.60 ohms and auxiliary 0 4.75 - 5.75 ohms
- distributor pick-up coil @ 350-550 ohms

10-516 PRIMARY SCOPE PATTERN - A Chrysler Electronic Ignition primary pattern appears as shown in Fig.84. The condenser oscillations (as called on a conventional system) are replaced by a set of oscillations that occur during the firing time of the spark plugs. These oscillations are immediately followed by the long dwell line. These oscillations are affected by both the ignition coil and electronic control unit.

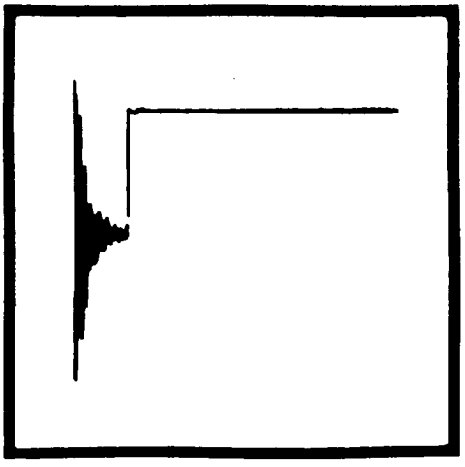


Fig. 84

10-516 SECONDARY SCOPE PATTERN - Fig 85. Illustrates a Chrysler Electronic Ignition secondary superimposed pattern. The pattern is similar to that of a conventional system except for the absence of the point closing oscillations. Ignition pattern defect will be identical to those illustrated in the 10-516 instruction manual.

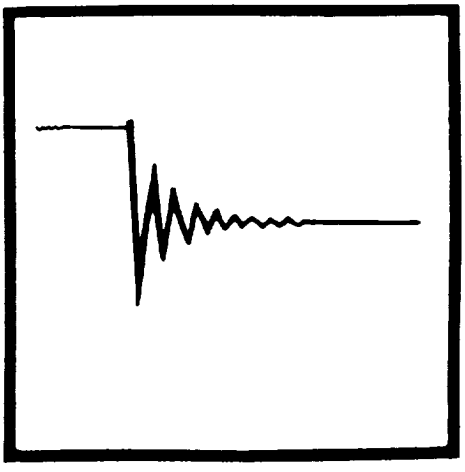


Fig. 85

GENERAL TEST SECTION

TESTING A DEAD ENGINE WITH CHRYSLER ELECTRONIC IGNITION

The following procedure can be used to quickly check a dead engine for ignition failure. This procedure indicates (1) whether or not the distributor is sending a pulse to the Electronic Control Unit and (2) whether or not the Electronic Control Unit is operating. These tests are applicable to all 10-516 scope analyzers manufactured after February 1, 1974.

1. To check the distributor pulse. -Fig. 86.
   - -Disconnect the 2 pin plug between the distributor and control unit.
   - -Using the small jumper, connect the test lead RED clip to the recessed terminal of the plug.
   - -Connect the BLACK clip to the exposed pin of the plug.
   - -Set the 10-516 Test Selector to Test Position #4 (Alternator/Regulator) and set the 10-516 SYSTEM switch to the H.E.I. position.
   - -Crank the engine while observing the scope screen.
   - -A wave pattern will appear on screen if the distributor pick-up coil is delivering a pulse.
   - -If no pulse is being delivered a straight horizontal line will appear on the screen.

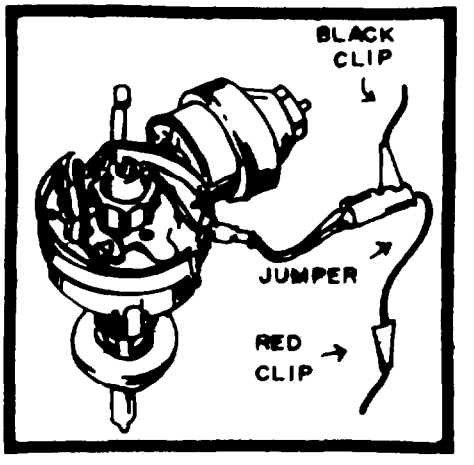


Fig. 86

2. Verifying operation of the Electronic Control Unit - Fig. 87.
   - -With 10-516 Test Selector in Test Position #4 reconnect the 2 pin connector (Distributor lead).
   - -Connect RED clip to one of the threaded studs on the Electronic Control Unit.
   - -Crank the engine while observing the scope screen.
   - -A straight horizontal line will appear on the scope screen if:
     - (a) Control Unit is defective
     - (b) There is no voltage to Control Unit
   - -Voltage to the Control Unit Fig. 80 can be checked at pins, 1, 2 and 3. With the plug disconnected all pins should read within 1 volt of the battery voltage.

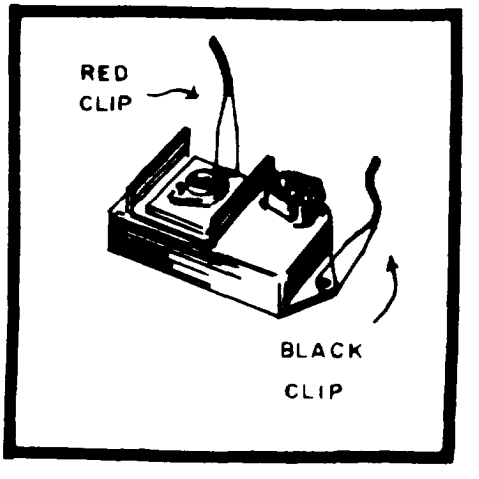


Fig. 87

NOTE: The 10-516 System switch should be returned to the 6-12 V position for conventional testing.

Section IV. SERVICE INFORMATION

The Ignition Scope Analyzer has been carefully tested, calibrated and adjusted at the factory. The equipment does not require special adjustments when properly assembled and installed. In some areas a slight pattern positioning may be required.

The following basic scope pattern adjustment controls are located at rear of cabinet.

1. INTENSITY - - Controls overall brilliance of pattern. Adjust for best focus below maximum intensity. It may be necessary to readjust FOCUS control when changing intensity.

2. FOCUS - - Controls spot size in vertical direction. Adjust for sharp horizontal lines.

3. VERTICAL CENTER - - Control is used to raise or lower pattern on front screen. Base line of pattern is positioned on scope KV zero line. Adjust in Test No. 9 Secondary Parade position only.

4. ASTIGMATISM - - Controls spot size in horizontal direction. Adjust for sharp vertical lines.

5. All other internal adjustments are outlined under Test and Procedure.

C A U T I O N

IN CLEANING THE INSTRUMENT, DO NOT CLEAN PLASTIC PANEL SCREEN OR METER COVERS WITH ANY PETROLEUM SOLVENTS. THIS WILL DAMAGE THE CLEAR PLASTIC FINISH. USE A GOOD GRADE OF DETERGENT WITH CLEAN POLISHING CLOTH AND WATER ONLY. USE FABRIC SOFTENER DETERGENT TO PREVENT STATIC ON PLASTIC CRT SCREEN OR METER FACES.

W A R N I N G

ALWAYS DISCONNECT LINE CORD PLUG FROM POWER BEFORE REMOVING REAR COVER. IN SERVICING THE UNIT, AS OUTLINED IN THE FOLLOWING PAGES, OBSERVE CAUTION WITH POWER CONNECTED AND CONSIDER ALL CONTACTS, BARE WIRES AND TERMINALS AS HAZARDOUS TO CONTACT. PERFORMANCE OF SERVICING SHOULD BE DONE BY QUALIFIED SERVICE PERSONNEL.

Should Scope Analyzer fail to operate, always check power line connections. The tester circuit breaker is located inside of scope cabinet. Check test lead plug connection and individual test leads at clips for breaks or open. When writing factory for information always specify equipment model and serial number. Supply full information on tests which function as well as tests which do not.

Always recheck test lead connections to vehicle system. When No. 1 Pickup is connected in a fouled plug or bad cable circuit, it may cause unstable pattern operation. Check scope operation on another plug circuit on a vehicle known to have a system in good condition.

W A R N I N G

USE INSULATED PLIERS WHEN GRIPPING CABLES TO SPARK PLUGS.

SERVICE INFORMATION

GENERAL SERVICE TECHNIQUES

The following trouble charts and service information are provided in a simple form to aid in field repair with minimum of test equipment or knowledge of the electroniccircuitry. In all cases, the scope itself is used to determine a faulty area. The following spare parts are necessary to troubleshoot a scope. All circuit boards with tubes, timing light and test lead assembly must be in good working condition and known to be normal.

XP-100-086. . . . . HORIZONTAL PC BOARD
XP-100-087. . . . . RPM PC BOARD
XP-100-088. . . . . DWELL - POINTS - VOLTS PC BOARD
XP-100-140. . . . . VERTICAL PC BOARD
XP-100-090. . . . . COMPRESSION PC BOARD
XL-016-114. . . . . TEST LEAD
XL-000-033. . . . . ADVANCE TIMING LIGHT

Further benefit can be derived through the use of an AC-DC Volt-Ohm-Meter. No attempt is made to locate specific faulty components, wires or switches. Unless they are quite obvious, a qualified service technician should service problems of-this nature.

Always check the following obvious problems first

AC power to scope
Tube filaments must be on
Test leads in good condition
Test leads connected properly to vehicle
Correct position of switches and controls

When possible, substitute test leads, PC boards, tubes, etc. In all cases use the trouble charts in justifying the change of substitution. DO NOT adjust any internal control without understanding the correct procedure for setting that particular control.

DEAD SCOPE TROUBLES

I. No scope patterns or intensity in any scope position - no meter lights or position indicators - tube filaments not glowing.

A. Check AC Cord for condition and proper connection.

B. Check Circuit Breaker. Press to reset. If scope operates for a short time and the circuit breaker trips again, check under II.

C. If resetting Circuit Breaker provides normal operation, everything can be assumed normal. Line surges at high line voltages may cause Circuit Breaker to trip occasionally.

II. Circuit Breaker Trips

A. Disconnect HV Transformer black primary leads. Reset Circuit Breaker.

SERVICE INFORMATION

If it remains set, check and replace defective HV components.

B. If Circuit Breaker continues to trip, check for defect on Low Voltage power supply section or wiring harness. The PC Boards, can be removed to isolate the individual board, which may cause the circuit breaker to trip.

III. No scope pattern or intensity in any scope position - Lights and filaments O.K.

A. Check for glowing of OA2's. If one, or more, is not glowing, trouble is indicated on low voltage Power Supply or scope circuits.

B. Check for +2600 to +2800 VDC at CRT anode connection; meter probe can be slipped under rubber suction cap without removal. Check for -2600 to -2800 VD at white lead located at High Voltage circuit. Note: Insure that meter is set for proper High Voltage range and polarity. If either voltage is low, check High Voltage Circuit.

C. If High Voltage is correct, check CRT socket or test with new CRT tube.

TEST LEAD TROUBLES

For all symptoms listed below all leads including the Red and Blue pickups must be properly connected.

I. Open Yellow Lead

A. No Point Res. reading
B. Incorrect Dwell reading when connected to operating ignition system
C (reads 45° or 90° on meter)
No Primary pattern
D: No Horizontal sweep in single secondary pattern
E. No Vertical pattern on Compression Test

II. Open Black Lead

A. No Point reading
B. No Dwell reading
C. Defective Vertical pattern in Primary
D. Defective Vertical pattern in Compression
E. Defective Alternator pattern
F. No voltmeter reading

Note: Symptoms shown may not be present when scope chassis contacts the vehicle frame ground.

III. Defective #1 Pick-up (Red Pickup)

A. No Horizontal sweep in Alternator-Regulator Test
B. Inoperative Timing Light
C. No RPM reading
D. No Horizontal sweep in Secondary Parade
E. No Horizontal sweep in Compression

SERVICE INFORMATION

TEST LEAD TROUBLES

IV. Open or Shorted Blue Pick-up Unit

A. No Secondary Single Vertical Pattern
B. No Secondary Parade Vertical Pattern

V. Open Green Lead

No Coil Primary voltage reading.

VI. Open Red Lead

A. No Alternator Vertical Pattern
B. No Battery Voltage Reading

METER INDICATION TROUBLES

When a defective meter is suspected, check by substitution with another meter:

1. Remove (2) leads from suspected meter and remove, if any, the capacitor connected to that meter. Note which lead goes to the +lug, as stamped on the meter studs.

2. Repeat above for any other meter on scope which is not working properly.

3. Connect (2) jumper leads from the suspected meter leads to the good meter. Observe correct polarity. Also, connect the capacitor associated with the suspected meter.

Symptoms listed below assume the test lead is good and properly connected to an operating vehicle or simulator.

I. No Point Reading

A. Points - Dwell - Volts PC Board
B. Meter (O.K., if reading is obtained in Battery or Alternator)
C. Other

II. No Coil Primary Reading

A. Points - Dwell - Volts PC Board (O.K., if reading obtained in Battery or Alternator)

B. Meter (O.K., if reading obtained in Points, Battery or Alternator)
C. Other

III. No Battery Reading in Battery Alternator

A. Points - Dwell - Volts PC Board (O.K., if reading is obtained in Coil Primary)
B. Meter (O.K., if reading is obtained in Coil Primary of Points)
C. Other

SERVICE INFORMATION

IV. No Dwell Reading

A. Meter (OK., if meter reads 45°, 90° or reads in Timing Advance or Amps.
B. Points - Dwell Volts PC Board
C. Other

V. No RPM Reading

A. RPM PC BOARD
B. Meter
C. Other

VI. No Timing Advance Reading

A. Timing Light (Substitute)
B. RPM PC Board
C. Meter (O.K., if reading is obtained in Dwell or
D. Other

VII. No Compression PC Reading or Incorrect Reading

A. Compression PC Board
B. Meter (O.K., if reading is obtained in carburetor)
C. Other

VIII. No Carburetor Reading

A. Meter (O.K., if reading is obtained in Compression)
B. Gas Analyzer Unit Substitute
C. Other

SCOPE PATTERN TROUBLES

General:

Scope troubles fall under one or both of two areas, Horizontal Sweep and Vertical deflection.

A Horizontal Sweep is a pattern from left to right across the CRT face. If a line or pattern moves slowly or not at all, when connected to an operating vehicle or simulator, a Horizontal Sweep problem is indicated.

A vertical deflection is a pattern, up and down the CRT face. If a steady horizontal line appears but with no vertical deflection, a vertical problem is indicated.

The CRT Presentation can be only one of five displays:

1. Normal Horizontal Sweep and Vertical Pattern
2. Normal Horizontal Sweep but no Vertical Pattern
3. Vertical Pattern but no Horizontal Sweep (or slow and/or erratic)
4. No Horizontal Sweep and No Vertical Pattern
5. Normal Horizontal Sweep and defective or distorted Vertical Pattern

SERVICE INFORMATION

HORIZONTAL SWEEP TROUBLES

I. No Sweep in any scope position

A. One or more OA2's not glowing (Indicates internal scope troubles)
B. Horizontal PC Board or tubes defective
C. Horizontal controls not set properly
D. Other

II. No Sweep in Primary or Secondary Single Pattern

A. Black or Yellow Leads open (no Vertical Pattern).
B. Vertical PC Board
C. Other

III. No Sweep in Alternator, Secondary Parade or Compression - RPM Meter reads O.K.

A. RPM PC Board
0. Horizontal PC Board
C. Other

IV. No Sweep in Alternator, Secondary Parade or Compression - RPM Meter does not read

A. #1 Pick-up or lead defective
B. RPM PC Board
C. Check for Sweep with Compression Board out. If Sweep is then normal, replace Compression PC Board
D. Horizontal PC Board (indicated by right side of sweep pulling in)
E. Other

V. No upper Sweep in Secondary Single Pattern

A. Compression PC Board
B. Other

VERTICAL PATTERN TROUBLES

I. No or defective Vertical Pattern in any position - Horizontal Sweep O.K.

A. Vertical PC Board
B. LV Power Supply
C. Other

II. Defective Vertical Pattern in Primary and Compression - Horizontal Sweep O.K.

A. Black Lead Open
B. Vertical PC Board
C. Other

III. No Vertical Pattern in Secondary Single or Secondary Parade - Horizontal Sweep O.K.

SERVICE INFORMATION

A. Blue Pick-up or Lead
B. Vertical PC Board
C. Other

IV. No Vertical Pattern in Alternator - Horizontal Sweep O.K.

A. Open Red Clip or Lead
B. Vertical PC Board
C. Other

V. Defective or No Vertical Pattern in Comp.- O.K. In Primary

A. Compression PC Board
B. Other

VI. No Vertical raised pattern in Secondary Sweep when, Cylinder Selector is operated - All other patterns O.K.

A. Compression Board
B. Other

VII. Compression Check troubles - substitute Compression Board when any of the following problems occur.

A. Stalls engine in Compression position
B. Compression meter does not indicate
C. Unable to short-out cylinders
D. Unable to select single cylinders in Secondary single position

TIMING LIGHT TROUBLES

I. Advance Meter does not indicate - Strobe Lamp Flashes

A. Meter (O.K., if Dwell reading is obtained)
B. Trouble in Timing Light
C. Other

II. Strobe Lamp does not flash - Meter indicates

A. Check for 400V, ±50V at Pin 7 of Timing Light socket
B. Trouble in light or cable if +400V reads at Pin 7
C. Trouble in Scope if No Reading at Pin 7
D. Other

III. Advance Meter does not indicate - Strobe Lamp does not flash

A. Check for RPM meter reading
B. Check for +15 to +20V at Pin 8 of Timing light socket.
C. Trouble in Scope if RPM meter does not read or no voltage measured at Pin 8 - Substitute RPM PC Board
D. Trouble in Timing Light or cable, if A & B are O.K.

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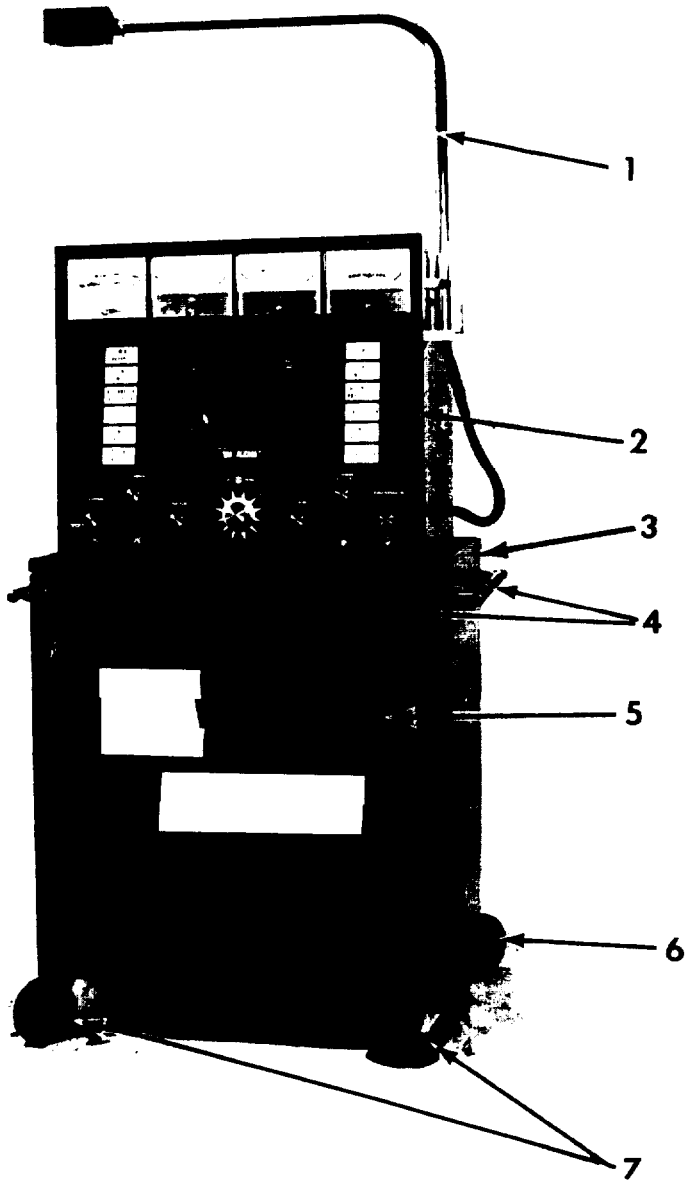
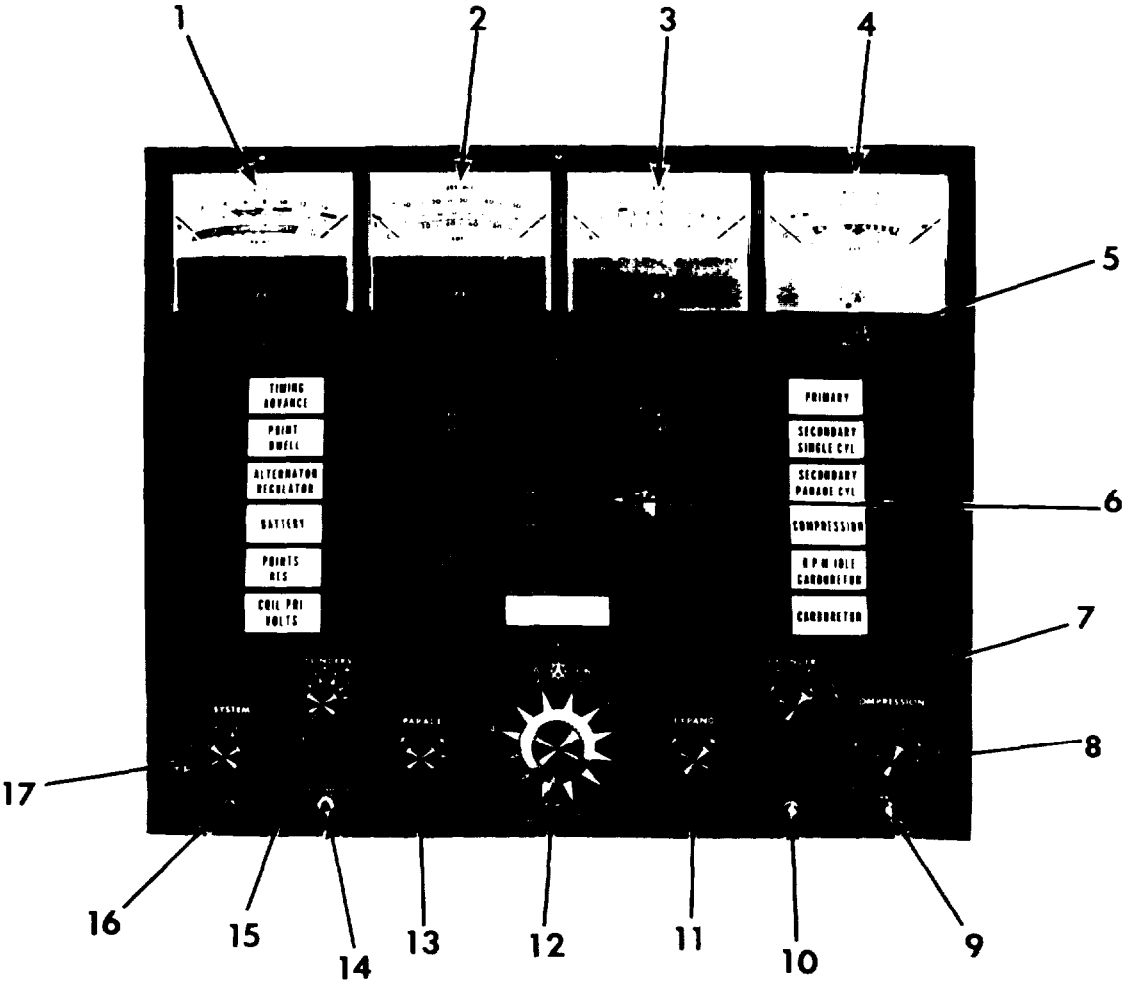


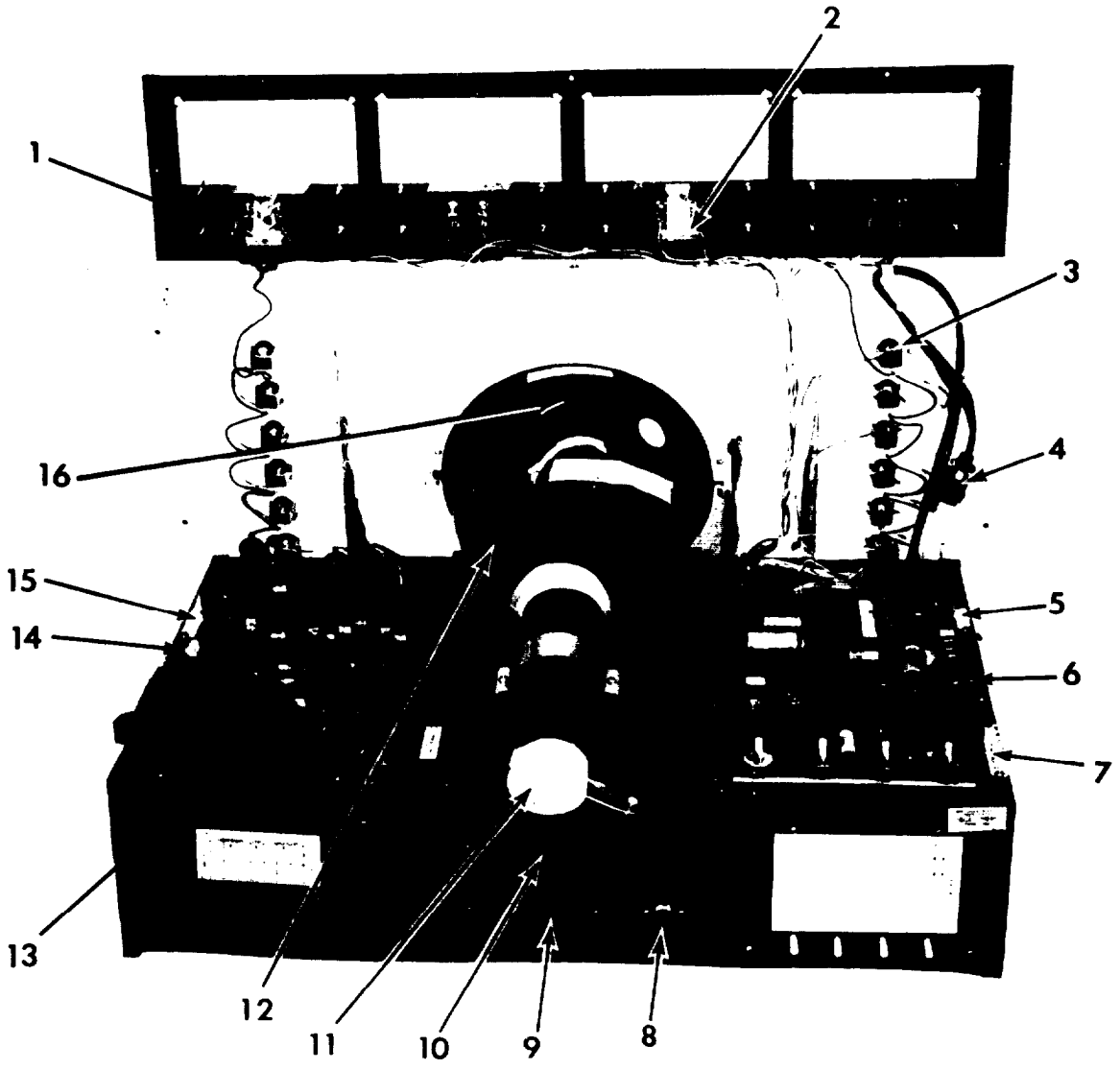
1. 11-521. . . . . .TEST LEAD BOOM
2. AC-026-167. . . . . .CASE, SCOPE SECTION
3. 12-518 . . . . . BASE CABINET, Assembly
4. AP-197 . . . . . HANDLE, Side
5. BD-24 . . . . . DECAL, Door
2: AC-192-i . . . . . CASTER, Plain
7. AC-193-B . . . . . CASTER, With Brake

Fig. 88 Analyzer Test Set



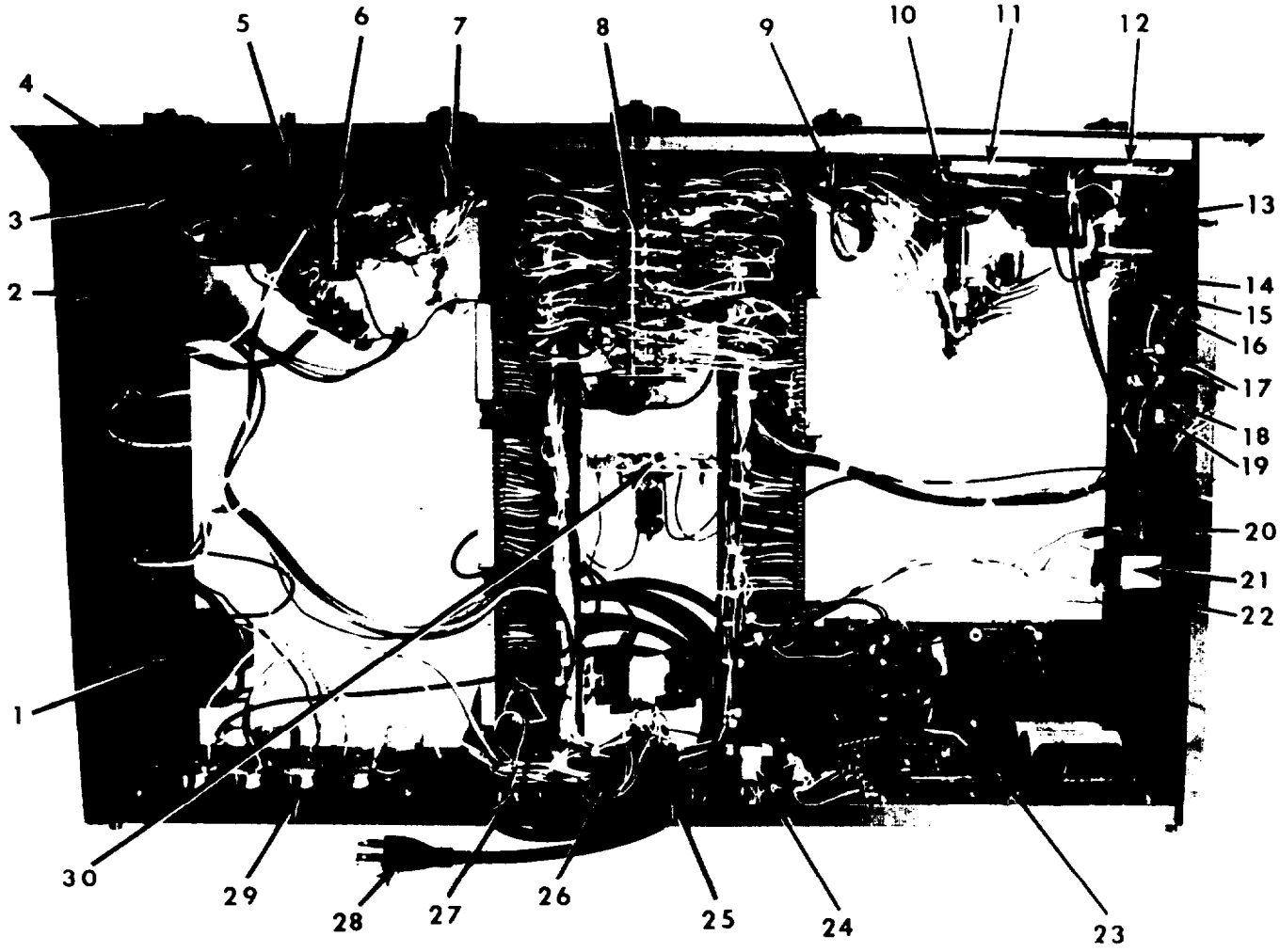
1.	AM-315	. . . . .	METER, Volts, points, l/2 ma.
2.	AM-316	. . . . .	METER, Advance, CA, Amps. 1/2ma., 90mv
3.	AM-317	. . . . .	METER, RPM, 1/2ma.
4.	AM-318	. . . . .	METER, G.A., Comp. 1/2ma., 90mv.
5.	AP-126-283B	. . . . .	PANEL, plastic, front
6.	AS-206-014	. . . . .	FILTER, CRT, blue
7.	XR-077-109A	. . . . .	CONTROL-SWITCH Assembly, Cyl., Comp. (AK-46 Knob)
8.	AR-077-122	. . . . .	CONTROL, plug load, 100 ohm, 25W (AK-46 Knob)
9.	AS-009-052	. . . . .	SWITCH, push, KV.
10.	AS-009-052	. . . . .	SWITCH, push, Plug Load
11.	AR-79MC-500K	. . . . .	CONTROL, Expand, 500K, 2W, (AK-46 Knob)
12.	AS-008-063D	. . . . .	SWITCH, master (AK-45 Knob)
13.	AR-79MC-25K	. . . . .	CONTROL, Parade, 25K, 2W (AK46 Knob)
14.	AS-183-011	. . . . .	CIRCUIT BREAKER, A.C. Line, 1.5A.
15.	AS-008-061F	. . . . .	SWITCH, Cyl.-Grd.
16.	AS-009-055	. . . . .	SWITCH, Lamp, Fluorescent
17.	AS-008-056	. . . . .	SWITCH, System (AK-46 Knob)

Fig. 89 Front Panel & Controls



1.	AC-017-022	CAPACITOR, electrolytic, 1000mfd, 15wv.
2.	AC-017-021	CAPACITOR, electrolytic, 2200mfd, 6.3wv.
3.	AS-025-012S	SOCKET, pilot lamp, bayonet
4.	AS-025-036	SOCKET. meter lamp cable
5.	XP-100-088	PC MODULE, Pts., Volts, Dwell
6.	XP-100-087	PC MODULE, RPM
7.	XP-100-086	PC MODULE, Hor. Amp.
8.	AS-025-037	SOCKET, Chassis, 2 pin, Ammeter lead
9.	AS-025-038	SOCKET, Chassis, 6 pin female
10.	AP-106-015	PLUG, Chassis, 4 pin male
11.	AS-025-013	SOCKET, CRT
12.	AT-006-8E11B1	TURE, CRT
13.	XP-100-091	CKT. MODULE, Low voltage power supply
14.	XP-100-090	PC MODULE, Compression
15.	XP-100-140	PC MODULE, vert. Amp.
16.	AC-262-036	CONNECTOR, CRT anode

Fig. 90 Top View, Chassis Components

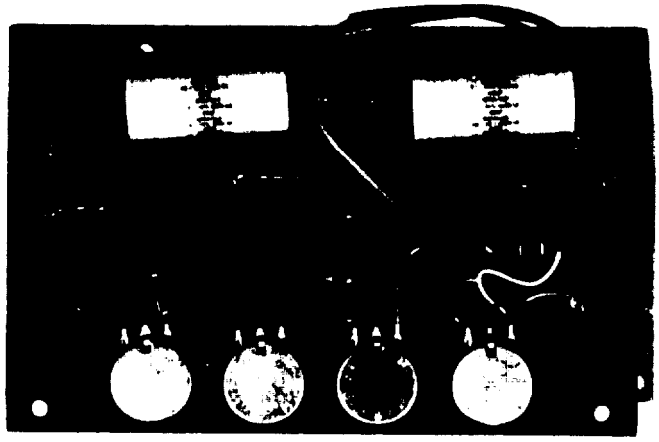


INDEX

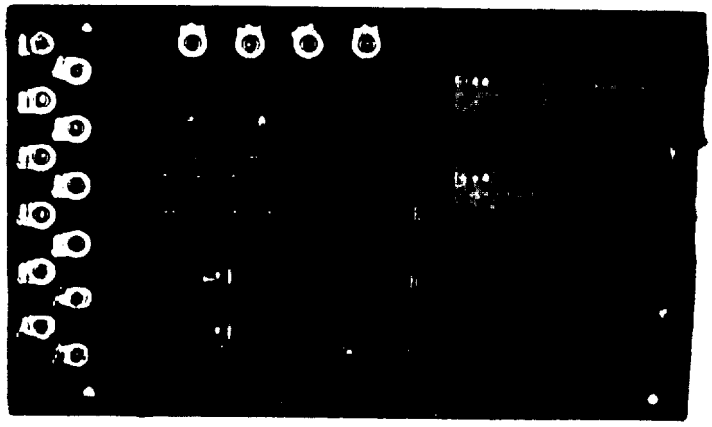
1.	XT-017-129 . . . TRANSFORMER, H.V.	16.	AR-063-037 . . . RECTIFIER silicon
2.	AC-015-070 . . . CAPACITOR, .01 mmf.	17.	AS-183-012 . . . CKT BKR, GND
3.	AS-008-056 . . . SWITCH, system	18.	AP-106-016 . . . PLUG, 8 pin
4.	AS-009-055 . . . SWITCH, lamp	19.	AP-128-001 . . . VOLTAGE PROT.
5.	AS-183-011 . . . CKT BKR, AC line	20.	AR-168-330) . . . RESISTOR, 330 ohm
6.	AS-008-061F . . SWITCH, cyl-gnd	21.	XT-017-135 . . . XFMR, pulse
7.	AR-79MC-25K . . CONTROL, parade	22.	AR-168-0.51 . . RESISTOR, .5 ohm
8.	AS-008-063D . . SWITCH, master	23.	XP-100-091 . . . CKT. mod., LVPS
9.	AR-79MC-500K . . CONTROL, expand	24.	XT-017-133 . . . XFMR, fil.
10.	XR-077-109A . . CONTROL assy.	25.	AS-025-038 . . . SOCKET, 6 pin
11.	AS-009-052 . . . CONTROL, plug load	26.	AP-106-015 . . . PLUG, 4 pin
12.	AS-009-52 SWITCH, KV	27.	AS-025-037 . . . SOCKET, 2 pin
13.	AR-077-122. CONTROL, plug load, 100ohm	28.	XL-016-073 . . . LINE CORD
14.	AR-79MC-25K . . CONTROL, comp.	29.	XP-100-075 . . . CKT. mod., HVPS.
15.	AR-077-076 . . . RESISTOR 2 ohm 2OW	30.	XP-10O-110 . . . P.C. mod, int. amp.

Fig. 91 Bottom View, Chassis Components

PC MODULE, Intensifier Amp....XP-100-110

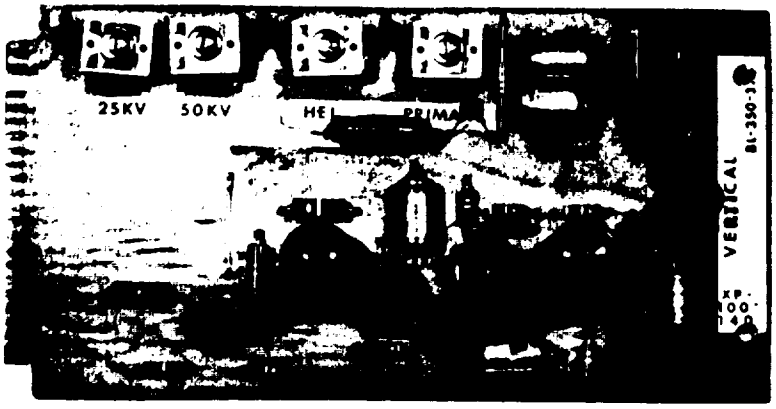


CIRCUIT MODULE HVPS....XP-100-075

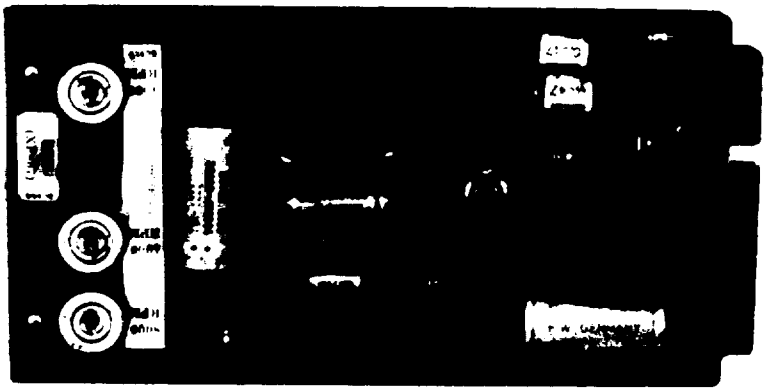


CIRCUIT MODULE, LVPS....XP-100-91

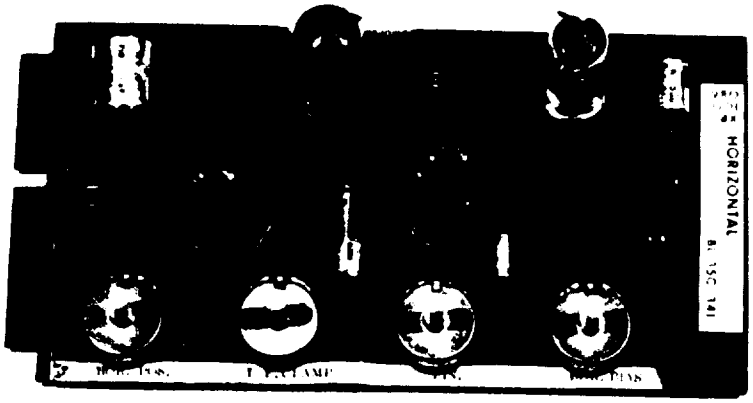
Fig. 92



PC MODULE, Vertical Amp....XP-100-140

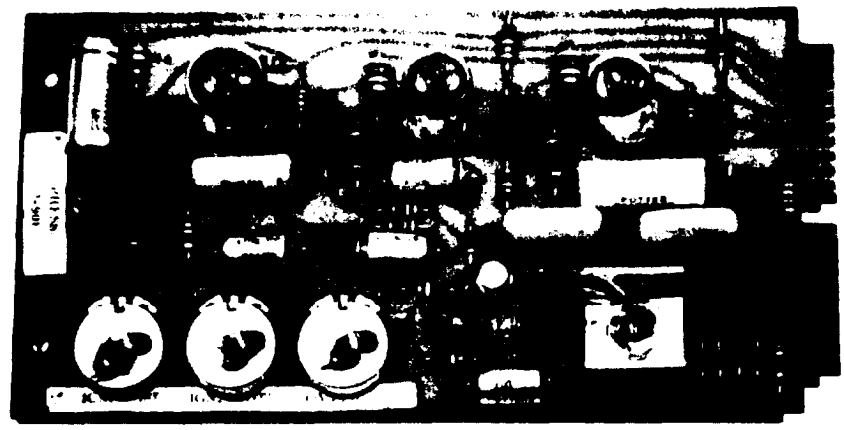


PC MODULE, RPM....XP-100-087

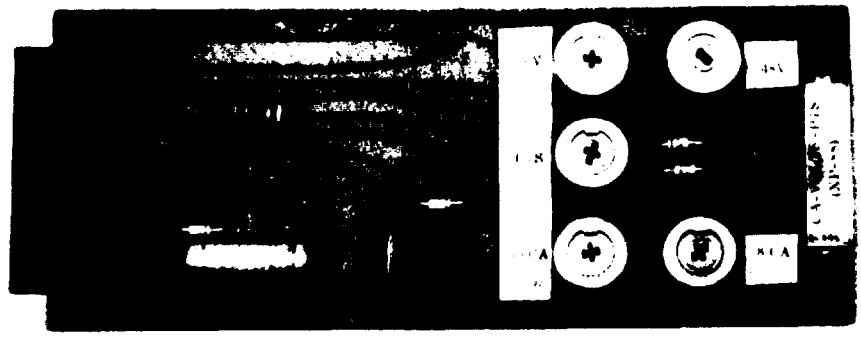


PC MODULE, Horizontal Amp....XP-100-086

Fig. 93

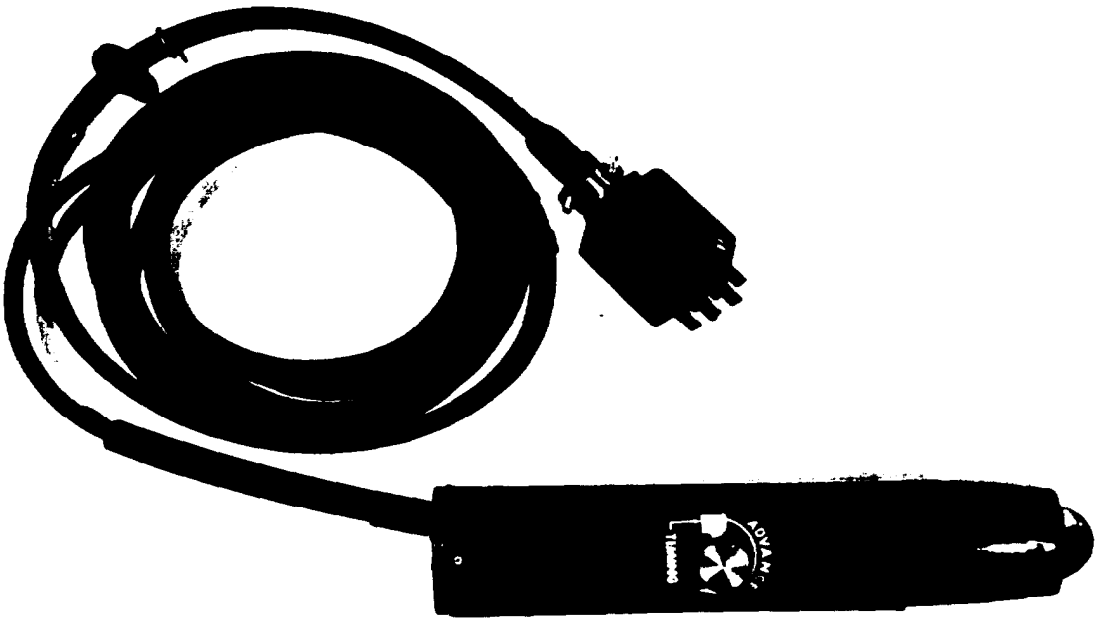


PC MODULE, Compression....XP-lOO-090



PC MODULE, Points, Volts, Dwell....XP-100-088

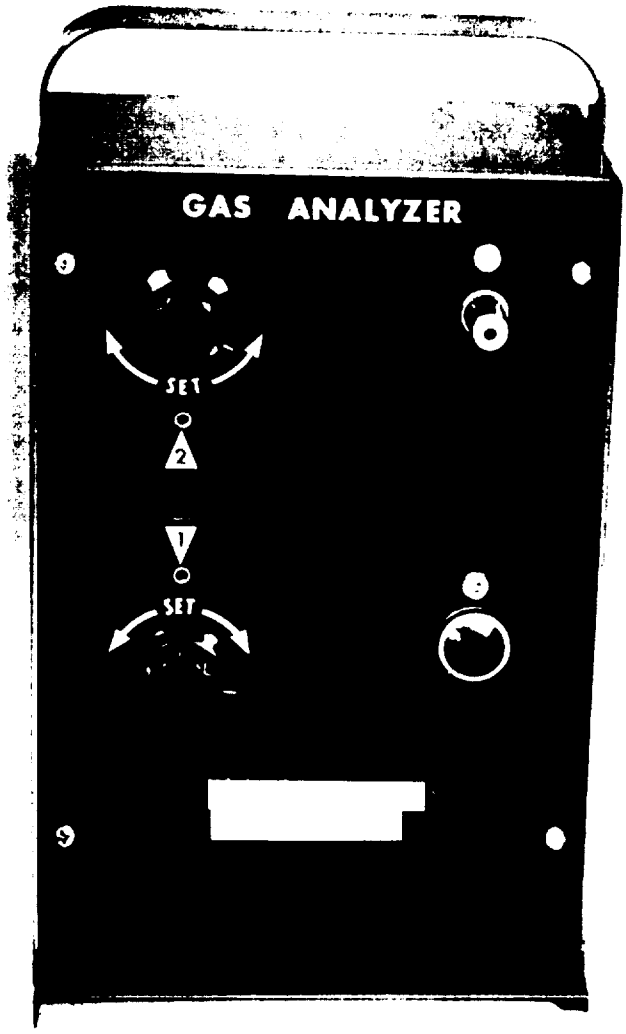
Fig. 94



ADVANCE TIMING LIGHT....XL-33

CIRCUIT MODULE, Advance Timing Light....XP-100-092

Fig. 95.



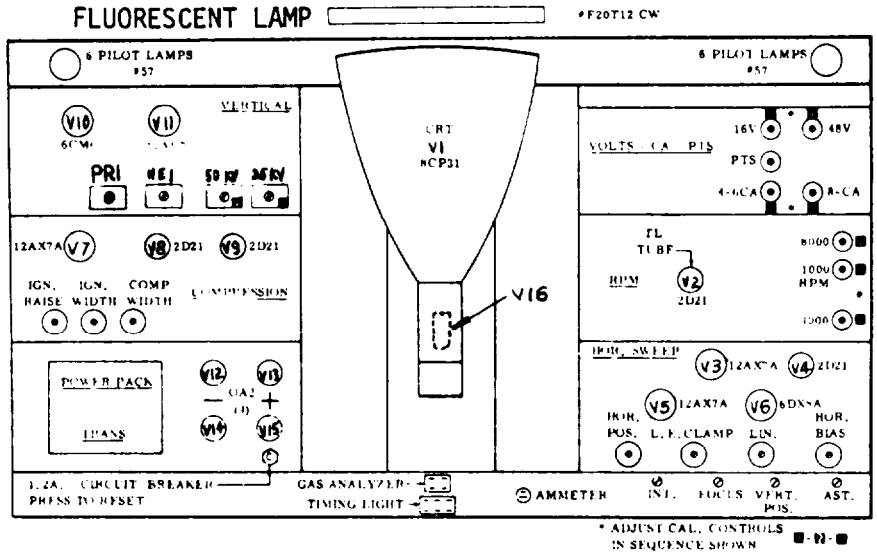
MODEL 11-516 GAS ANALYZER

Fig. 96

SERVICE INFORMATION

TUBE LOCATION DIAGRAM

TESTER MODEL 10-516



IDENT.	FUNCTION	PART NO.	TYPE
Vl	CRT	AT-6-8E11P31	8CP31
v2	TRIGGER INTEGRATOR	AT-6-2D21	2D21
v3	HORIZ. INPUT	AT-6-12AX7A	12AX7A
v4	TRIGGER TUBE	AT-6-2D21	2D21
v5	HORIZ. OUTPUT	AT-6-12AX7A	12AX7A
V6	SWEEP TUBE	AT-6-6DX8	6DX8
v7	PULSE SHAPER	AT-6-12AX7A	12AX7A
V8	PULSE GEN.	AT-6-2D21	2D21
v9	PULSE GEN.	AT-6-2D21	2D21
V1O	VERT. AMP.	AT-6-6CM6	6CM6
Vll	VERT. OUTPUT	AT-6-12AU7	12AU7
v12	-150V. REG.	AT-6-OA2	OA2
v13	+15OV. REG.	AT-6-OA2	OA2
v14	-300V. REG.	AT-6-OA2	OA2
v15	+3OOV. REG.	AT-6-OA2	OA2
V16	INTENSIFIER AMP.	AT-6-12AU7	12AU7

Fig. 97

SERVICE INFORMATION

LIST OF SCHEMATICS

		Page No.
1.	Test Selector Switch	84
2.	Low Voltage Power Supply	85
3.	High Voltage Power Supply	86
4.	XP-100-088 Points, Volts, Dwell	87
5.	XP-100-086 Horizontal Amplifier	88
6.	XP-100-140 Vertical Amplifier	89
7.	XP-100-087 RPM	90
8.	XP-lO0-90 Compression	91
9.	XP-100-110 Intensifier Amp	92
10.	XP-100-092 Advance Timing Light	93
11.	11-516 Gas Analyzer	94
12.	Test Leads	95

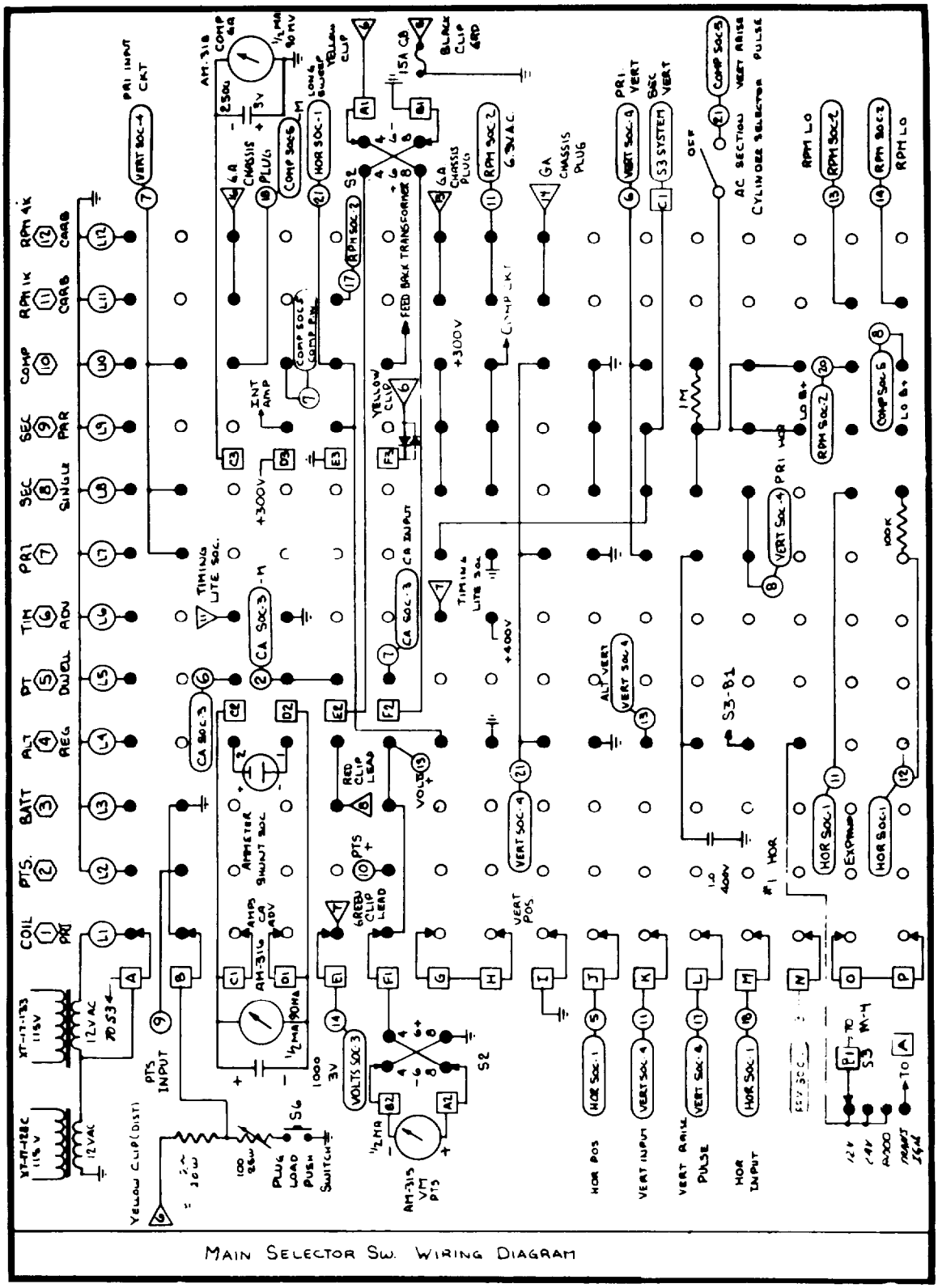


Fig. 98 TEST SELECTOR SWITCH

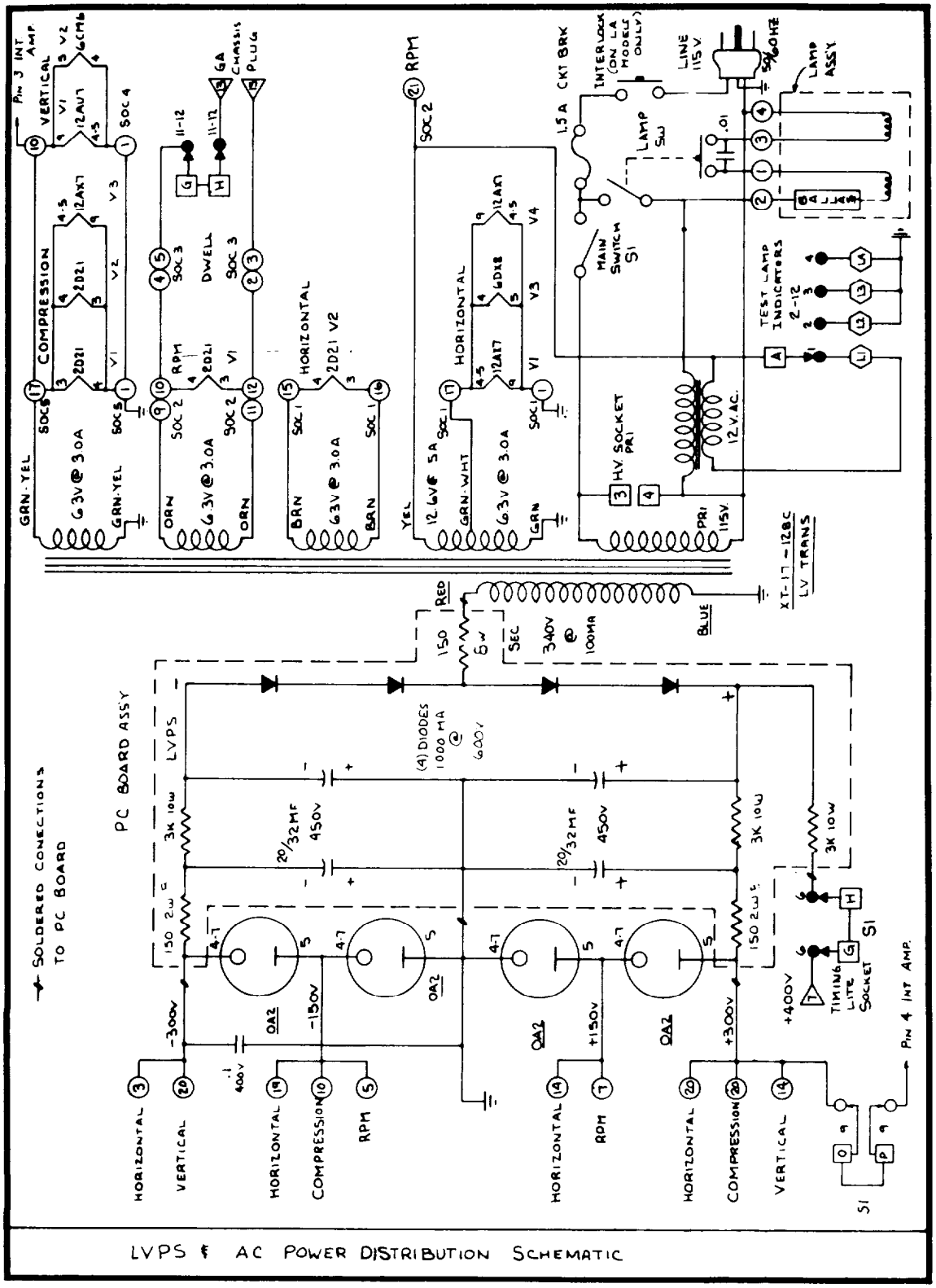


Fig. 99 LOW VOLTAGE POWER SUPPLY

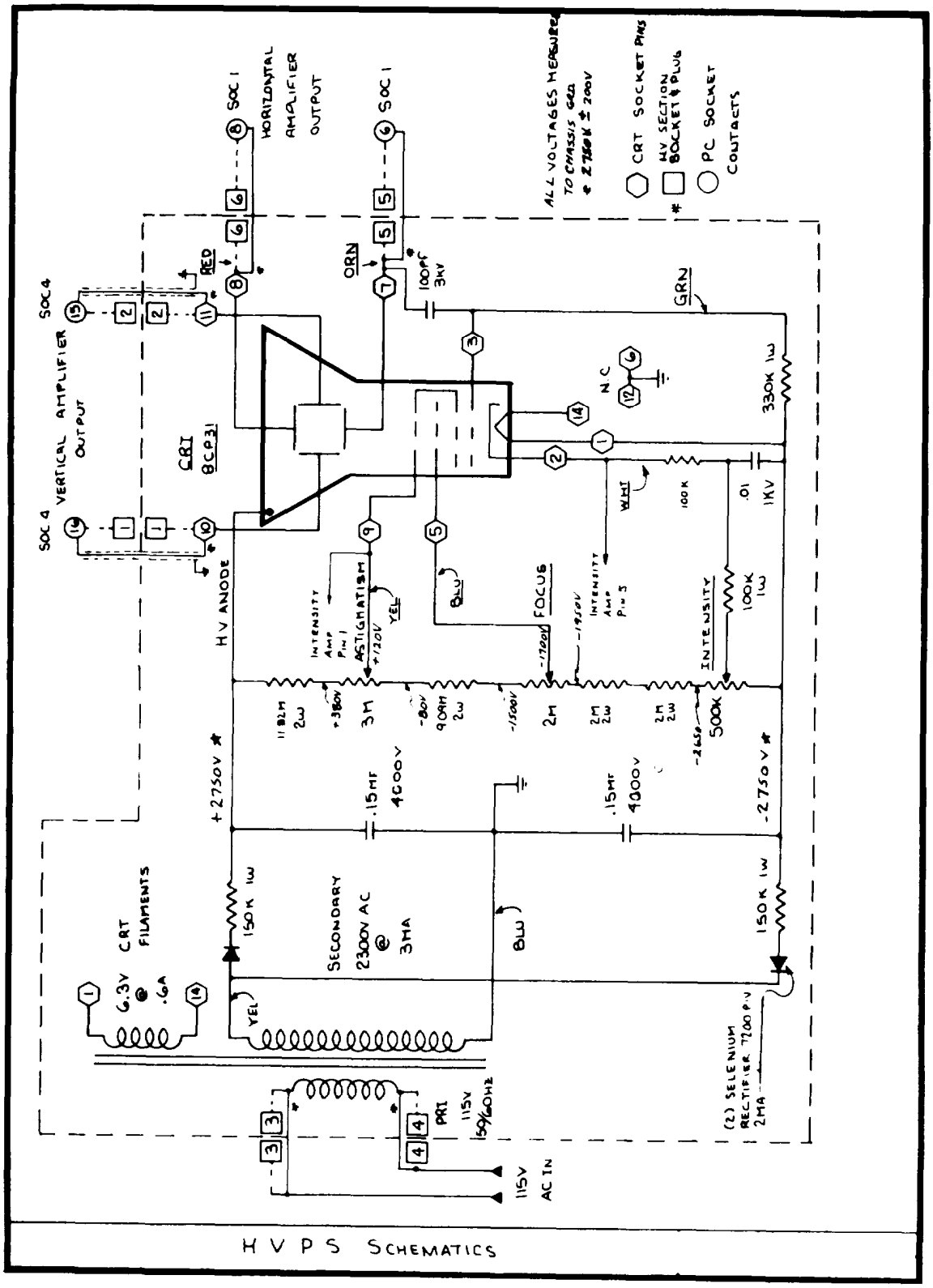


Fig. 100 HIGH VOLTAGE POWER SUPPLY

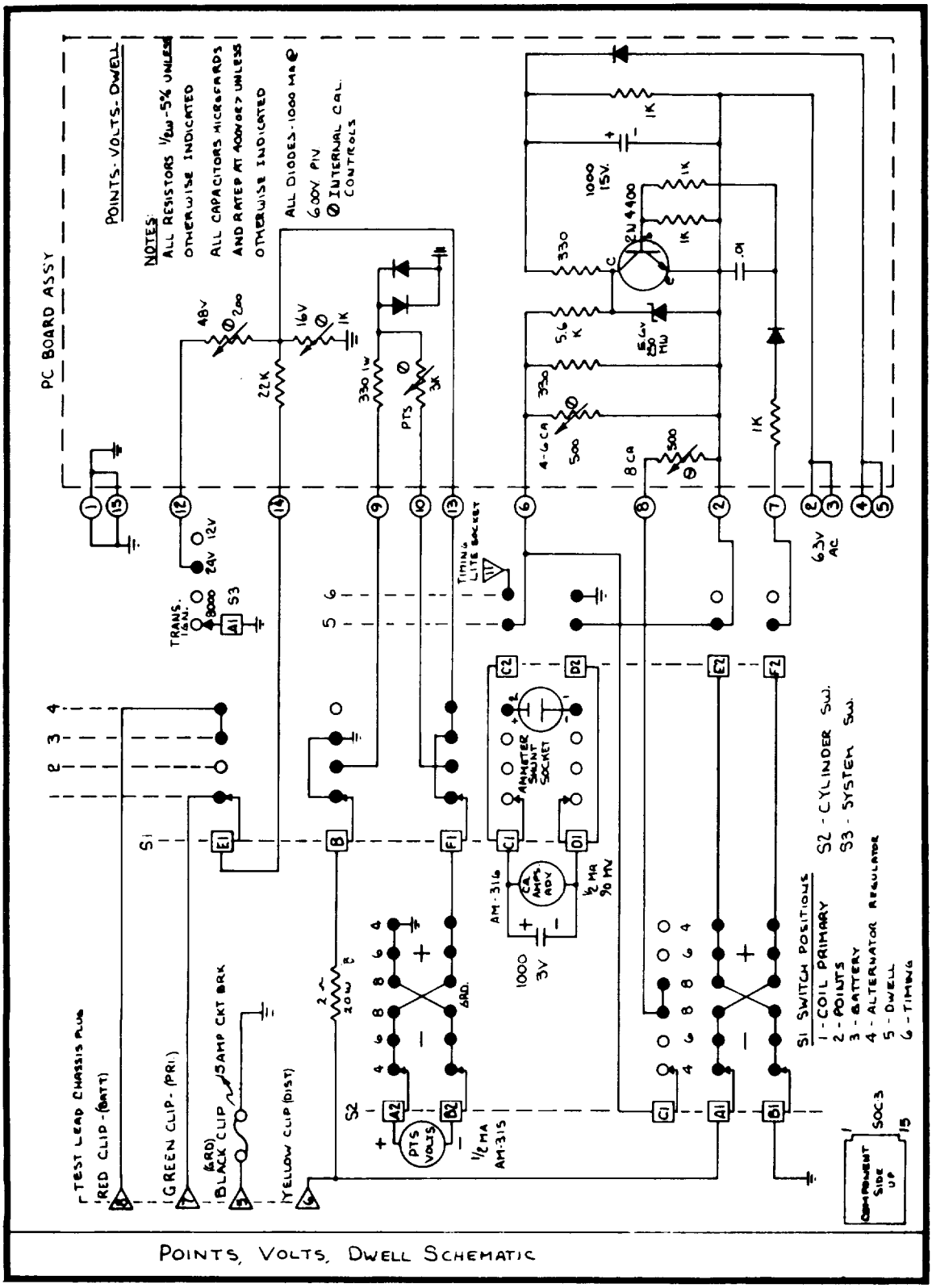


Fig. 101 POINTS, VOLTS, DWELL

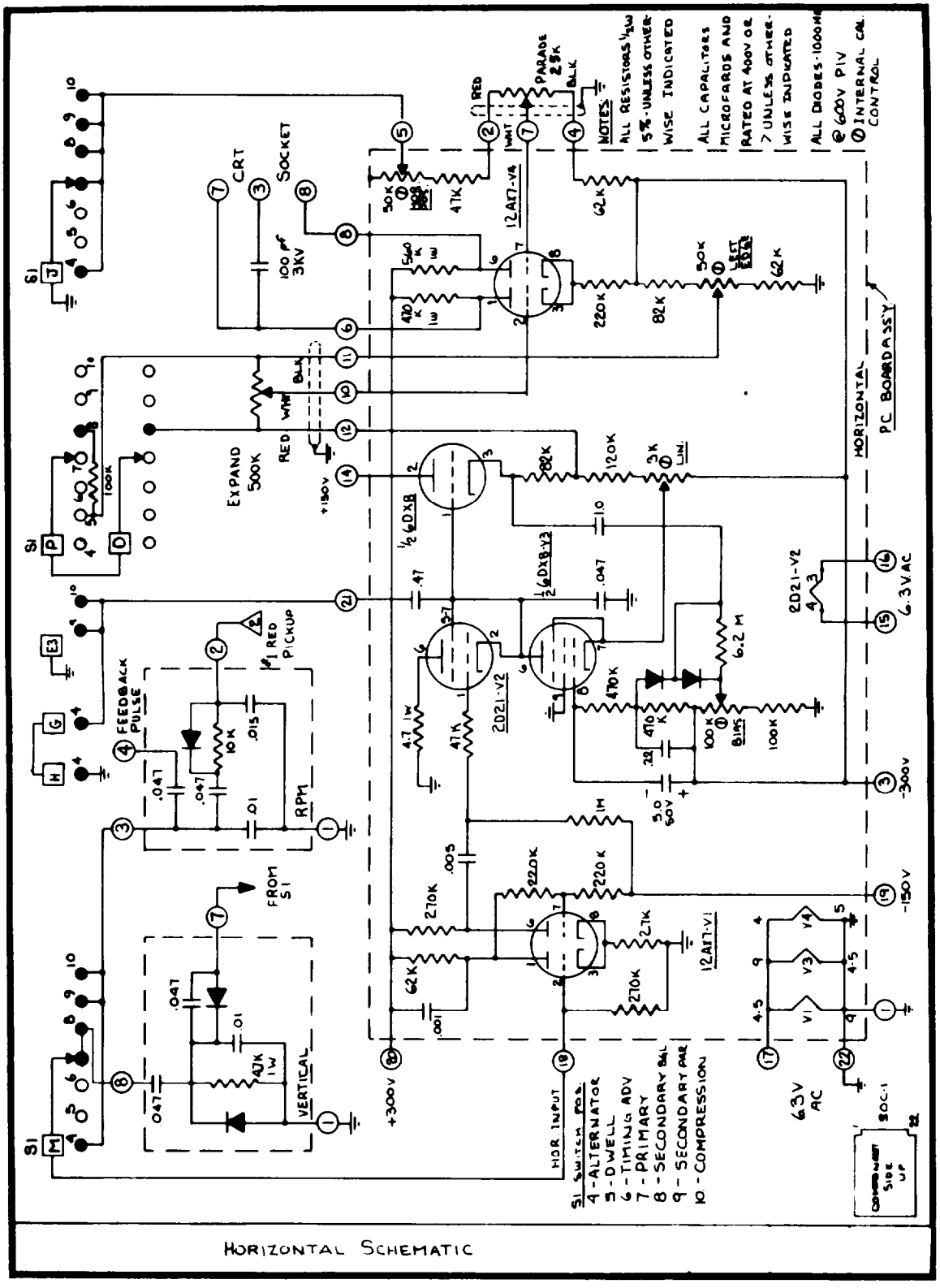


Fig. 102 HORIZONTAL AMPLIFIER

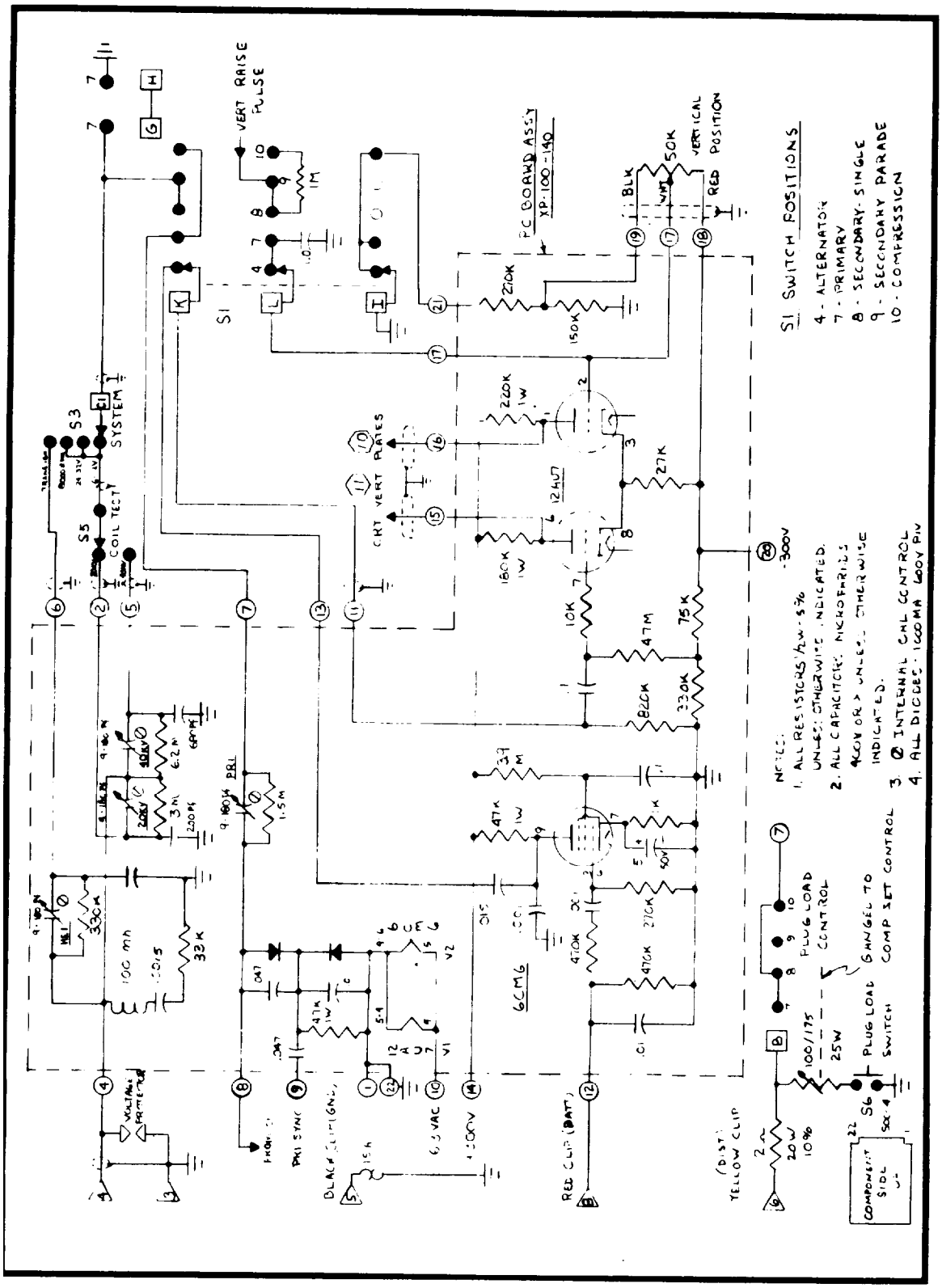
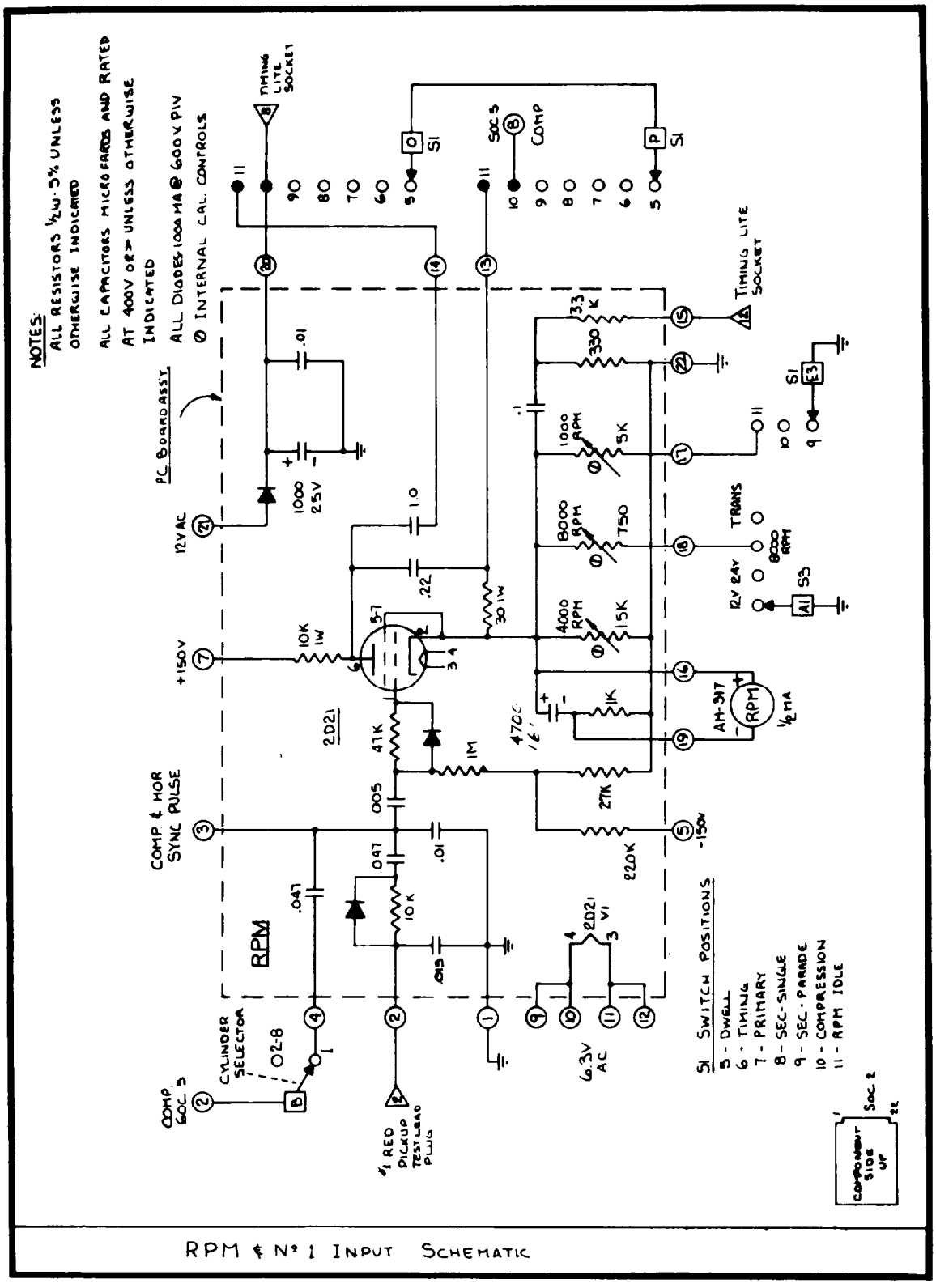
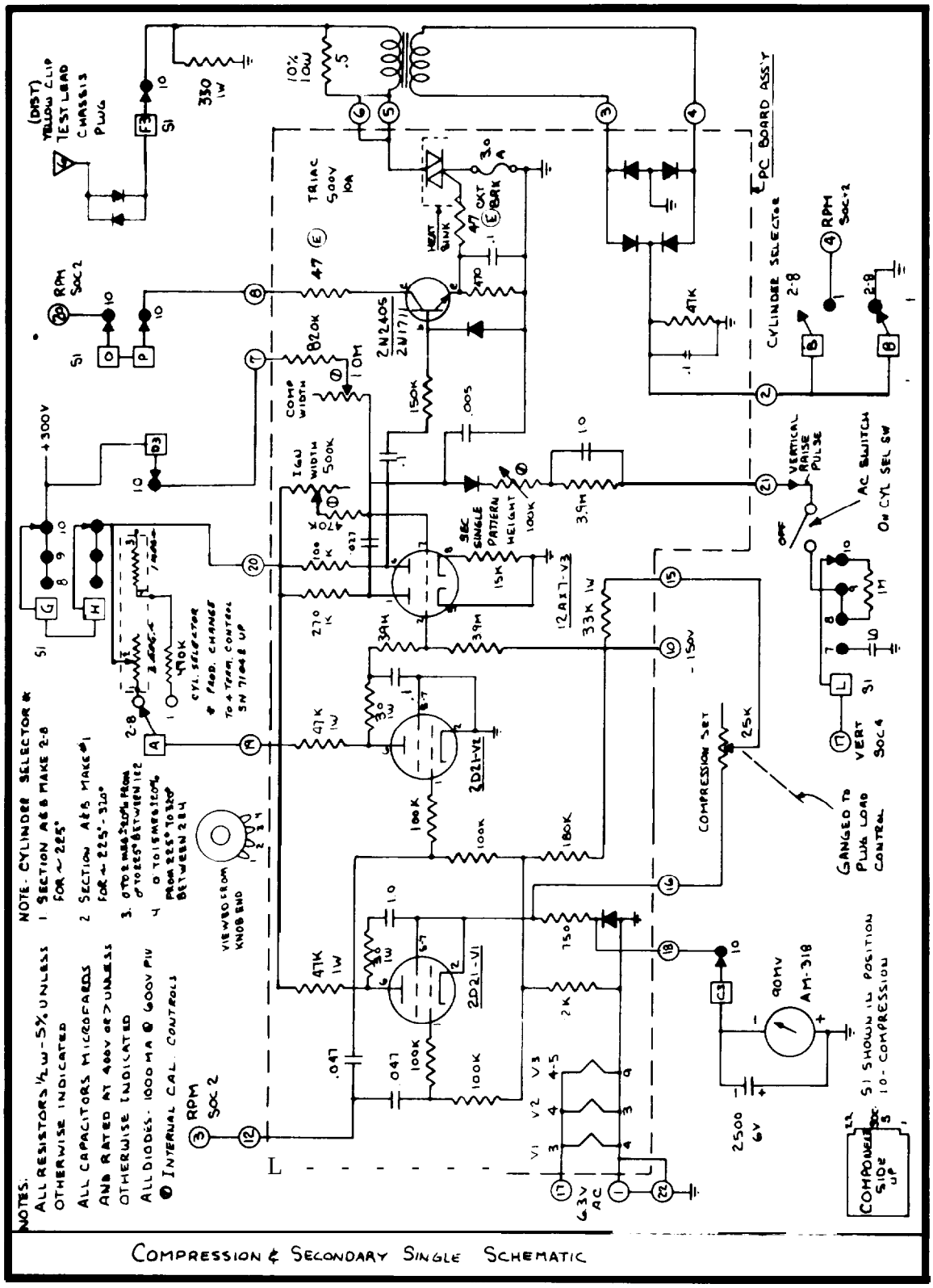


Fig. 103 VERTICAL AMPLIFIER



RPM & N° 1 INPUT SCHEMATIC

Fig. 104 RPM BOARD



COMPRESSION & SECONDARY SINGLE SCHEMATIC

Fig. 105 COMPRESSION CIRCUIT

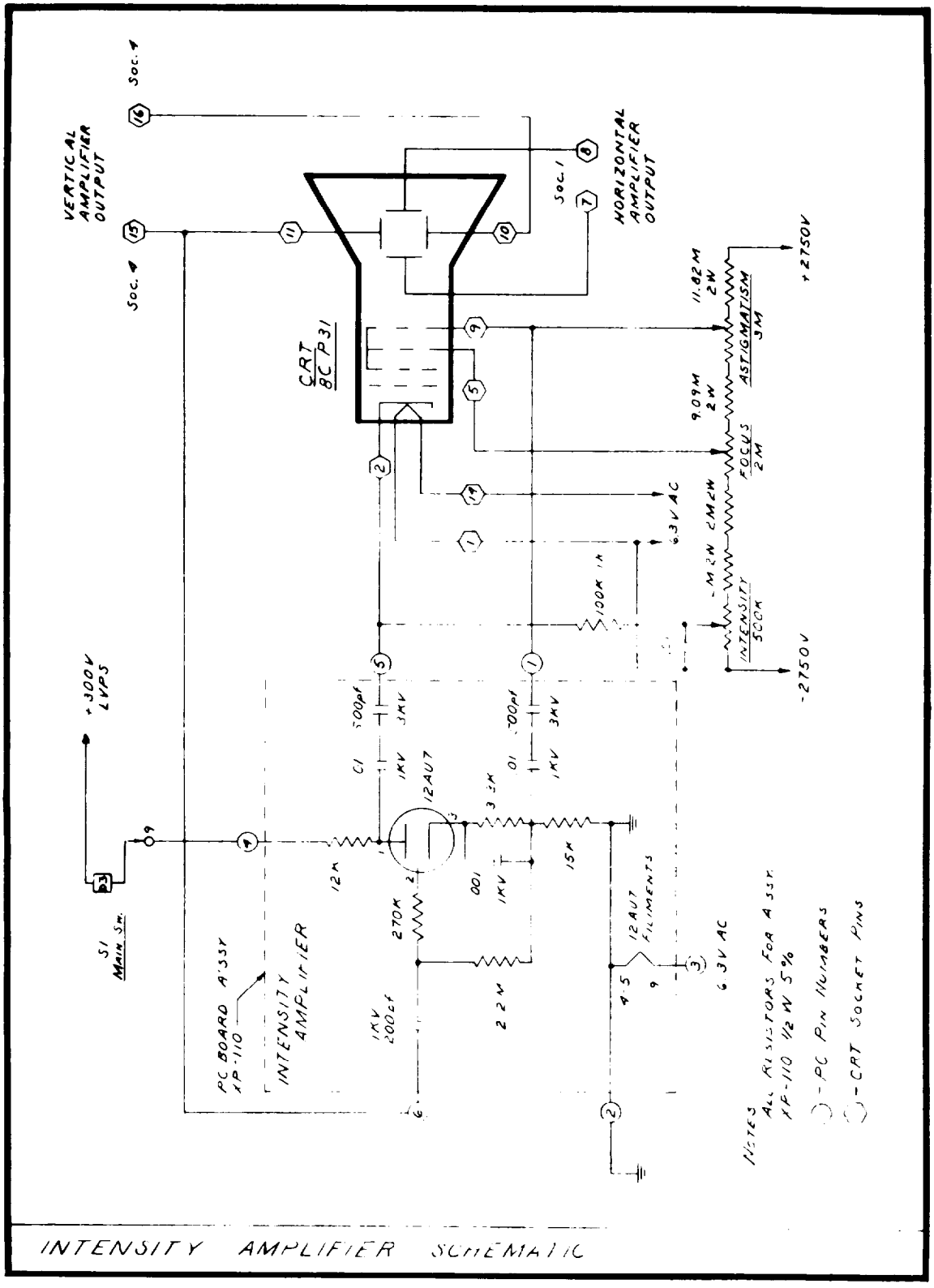


Fig. 106 INTENSIFIER AMP

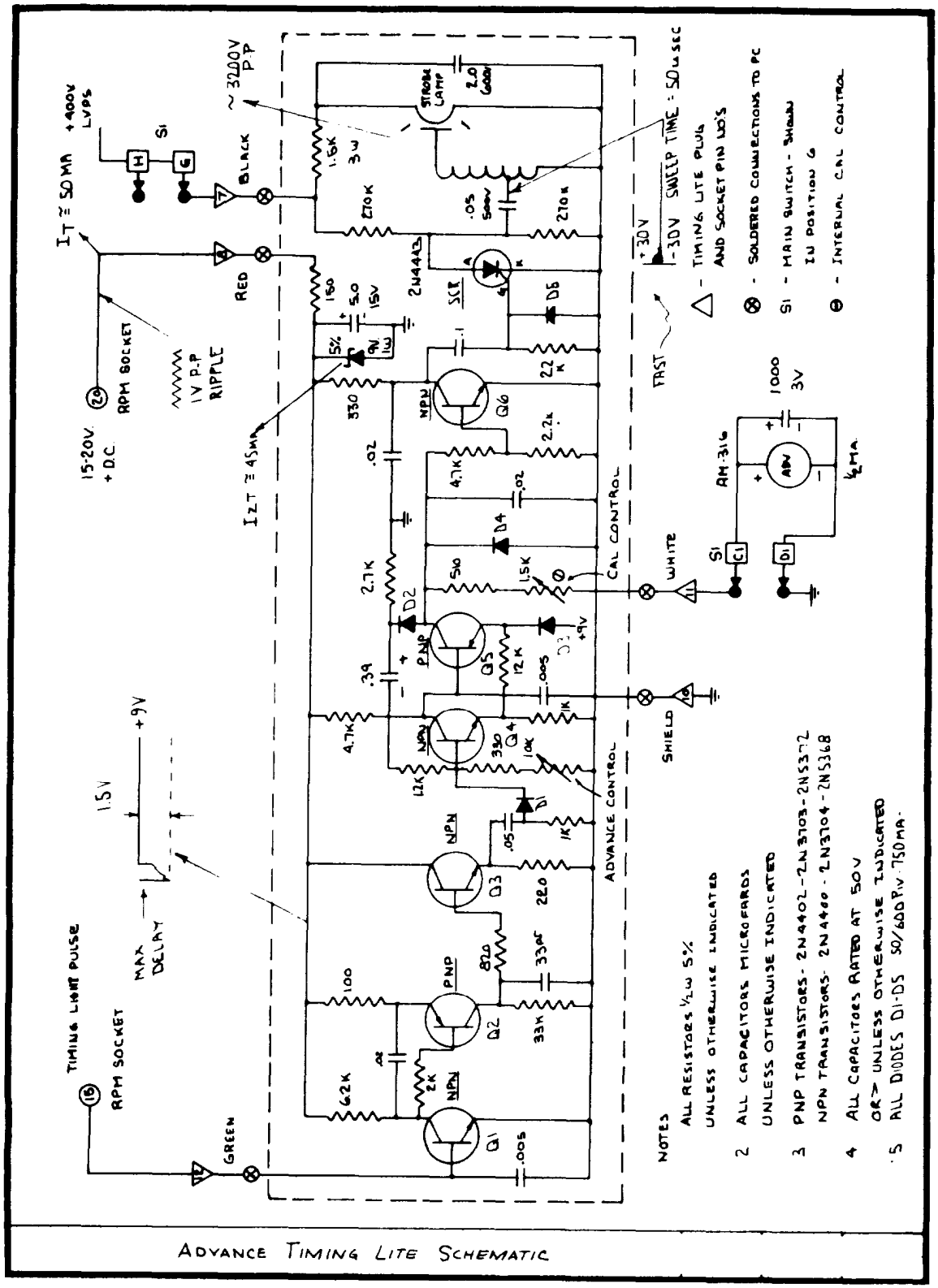


Fig. 107 ADVANCE TIMING LIGHT

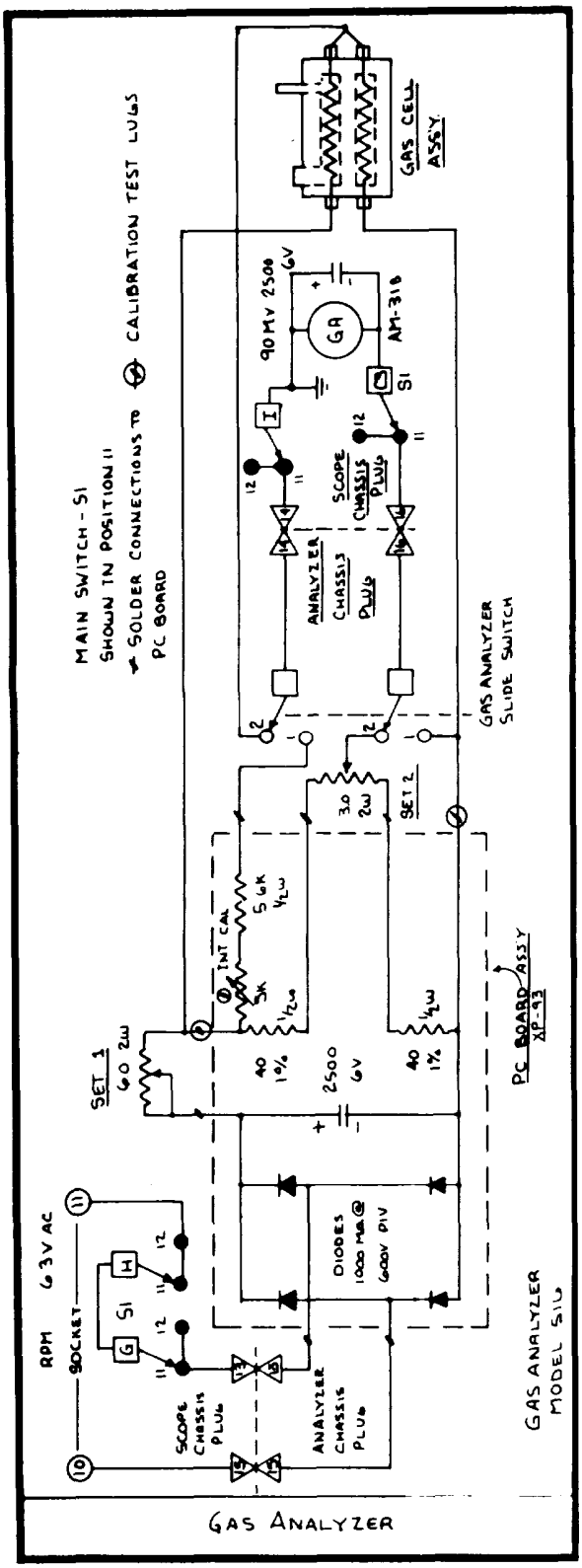


Fig. 108 GAS ANALYZER SCHEMATIC

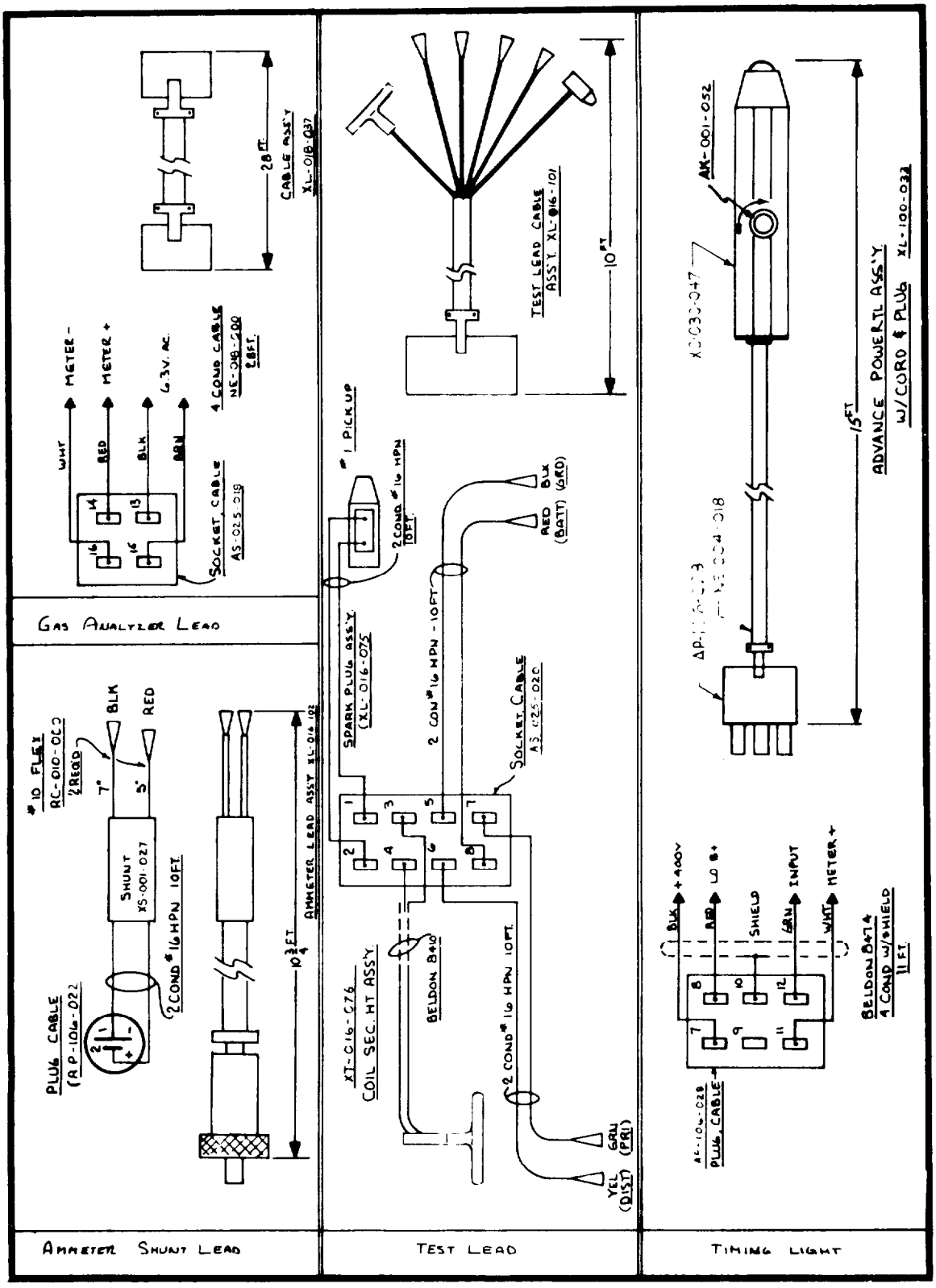


Fig. 109 TEST LEADS

SERVICE INFORMATION

MODEL 10-516

NSN 4910-913-9778

REPLACEMENT PARTS LIST

PART	PART NO.	ILLUSTRATED ITEM NO.
BASE, cabinet, complete assembly	12-518	fig 88-3
CASTER, plain	AC-192-B	fig 88-6
CASTER, with brake	AC-193-B	fig 88-7
DECAL, door	BD-24	fig 88-5
HANDLE, side	AP-197	fig 88-4
BOOM, test lead	11-521	fig 88-1
BRACKET, timing light storage	AB-028-206	*
BALLAST, fluorescent lamp, 20W	AB-169	*
CASE, scope section	AC-026-167	fig 88
CAPACITOR, electrolytic, 2200 mfd., 6.3wv	AC-017-021	fig 90-2
CAPACITOR, electrolytic, 1000 mfd., 15wv.	AC-017-022	fig 90-1
CAPACITOR, ceramic, .01 mfd., 1 kv	AC-015-070	fig 91-2
CKT. module, HVPS	XP-100-075	fig 92
CKT. module, LVPS	XP-100-091	fig 90-13
CKT. module, pwr. XFMR. assy.	XP-100-098	fig 98
CKT. module, adv. timing light	XP-100-092	fig 95
CONNECTOR, CRT anode	AC-262-036	fig 90-16
CONTROL, parade, 25K ohm, 2W	AR-79MC-25K	fig 89-13
CONTROL, expand, 500K ohm, 2W	AR-79MC-500K	fig 89-11
CONTROL, Comp., Zero, 25K ohm, 2W	AR-79MC-25K	fig 91-9
CONTROL, Sw. assy., Cyl. Comp.	XR-077-109A	fig 89-7
CONTROL, plug load, 100 ohm, 25 watt	AR-077-122	fig 89-8
CIRCUIT breaker, AC line 1.5A	AS-183-011	fig 89-14
CIRCUIT breaker, gnd., 15A	AS-183-012	fig 98
CIRCUIT breaker, comp., 3A	AS-183-009	*
GAS analyzer assy.	11-516	fig 96
CABLE assy., 4 wire, 28 ft.	XL-018-037	fig 109-1
KNOB, master switch	AK-045	fig 89
KNOB, control	AK-046	fig 89
LAMP, pilot, G.E. #57 15 v bay.	AL-068-016	fig 97
LAMP, fluorescent, G.E. #FT2OT12CW	AL-068-024	*
MANUAL, instruction	BI-001-278	*
METER, Volts, points, 1/2ma.	AM-315	fig 89-1
METER, ADV., CA., Amps, 1/2ma. 90mv.	AM-316	fig 89-2
METER, RPM, 1/2ma.	AM-317	fig 89-3
METER, GA. Comp., 1/2ma. 90mv.	AM-318	fig 89-4
METER cover, 6" plastic	AC-157-010	fig 97
PANEL, plastic, front	AP-126-283B	fig-5
FILTER, blue CRT	AS-206-014	fig 89-6
PC module, hor. amp.	XP-100-086	fig 90-7
PC module, vert. amp.	XP-100-140	fig 90-15
PC module, RPM	XP-100-087	fig 90-6
PC module, PTS., Volts., dwell	XP-100-088	fig 90-5
PC module, compression	XP-100-090	fig 90-14
PC module, intensifier amp.	XP-100-110	fig 92
PLIERS, insulated	AP-171	*

*PARTS NOT ILLUSTRATED

SERVICE INFORMATION

REPLACEMENT PARTS LIST

PART	PART NO.	ILLUSTRATED ITEM NO.
PLUG, chassis, 4 pin male	AP-106-015	fig 90-10
PLUG, chassis, 8 pin male	AP-106-016	fig 98
POWER TIMING LIGHT	XL-033	fig 95
CASE, with lens	XC-046	fig 109
KNOB, advance	AK-052	fig 109-2
DECAL	BD-018	fig 109
PC assy.	XP-100-092	fig 109
PLUG, cable 6 pin male	AP-106-028	fig 169
CABLE, 4 wire sh., 15ft.	NE4S-18F-000	fig 109
RECTIFIER, silicon 50 piv. 2A	AR-063-037	fig 98
RESISTOR, .5 ohm. 1w	AR-168-0.51	fig 98
RESISTOR, 2 ohm, 20w	AR-077-076	fig 91-15
RESISTOR, 330 ohm, 1w	AR-168-330	fig 98
SOCKET, CRT	AS-025-013	fig 90-11
SOCKET, meter lamp cable	AS-025-036	fig 90-4
SOCKET, chassis, ammeter lead 2 pin	AS-025-037	fig 90-8
SOCKET, chassis, timing light, 6 pin	AS-025-038	fig 90-9
SOCKET, pilot lamp, bayonet	AS-025-12S	fig 90-3
SWITCH, master	AS-008-63D	fig 89-12
SWITCH, cyl. -gnd	AS-008-61F	fig 89-15
SWITCH, push, KV and plug load	AS-009-052	fig 89-9
SWITCH, system	AS-008-056	fig 89-17
SWITCH, fluorescent lamp	AS-009-055	fig 89-16
TEST lead adapter, HT	XL-018-034	*
TEST lead, jumper, w/clips	XL-018-089	*
TEST lead, jumper, w/QC terminals	XL-018-090	*
THROTTLE control	11-459	*
TEST lead, ammeter	XL-016-102	fig 109
TEST lead, ground prod	XL-016-081	*
TEST, lead assy., 8 pin	XL-016-114	*
TRANSFORMER, HV power, 115v	XT-017-129	fig 91-1
TRANSFORMER, fil., pilot, 117v, 12v. sec.	XT-017-133	fig 98
TRANSFORMER, pulse	XT-017-135	fig 98
TUBE, CRT	AT-006-8E11P31	fig 90-12
TUBE, thyratron	AT-006-2D21	fig 97-2
TUBE, twin triode	AT-006-12AU7	fig 97-11
TUBE, twin triode	AT-006-12AX7	fig 97
TUBE, triode pentode	AT-006-6DX8	fig 97-6
TUBE, voltage regulator	AT-006-OA2	fig 97-12
TUBE, power	AT-006-6CM6	fig 97-10
VOLTAGE protector	AP-128-001	fig 98

* PARTS NOT ILLUSTRATED

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E. C. MEYER
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