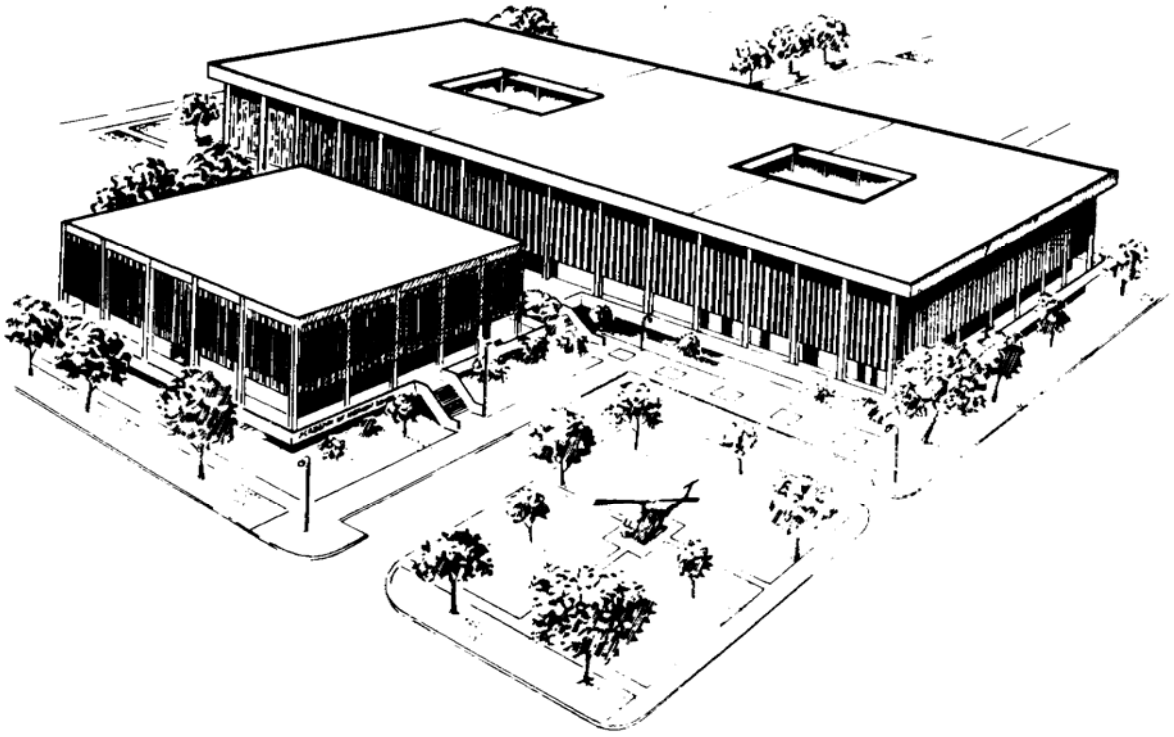
U.S. ARMY MEDICAL DEPARTMENT CENTER AND SCHOOL
FORT SAM HOUSTON, TEXAS 78234-6100



DENTAL CHAIR, STOOL, AND DENTAL OPERATING UNIT

SUBCOURSE MD0371 EDITION 100

DEVELOPMENT

This subcourse is approved for resident and correspondence course instruction. It reflects the current thought of the Academy of Health Sciences and conforms to printed Department of the Army doctrine as closely as currently possible. Development and progress render such doctrine continuously subject to change.

ADMINISTRATION

Students who desire credit hours for this correspondence subcourse must enroll in the subcourse. Application for enrollment should be made at the Internet website: http://www.atrrs.army.mil. You can access the course catalog in the upper right corner. Enter School Code 555 for medical correspondence courses. Copy down the course number and title. To apply for enrollment, return to the main ATRRS screen and scroll down the right side for ATRRS Channels. Click on SELF DEVELOPMENT to open the application; then follow the on-screen instructions.

For comments or questions regarding enrollment, student records, or examination shipments, contact the Nonresident Instruction Branch at DSN 471-5877, commercial (210) 221-5877, toll-free 1-800-344-2380; fax: 210-221-4012 or DSN 471-4012, e-mail accp@amedd.army.mil, or write to:

NONRESIDENT INSTRUCTION BRANCH
AMEDDC&S
ATTN: MCCS-HSN
2105 11TH STREET SUITE 4191
FORT SAM HOUSTON TX 78234-5064

Be sure your social security number is on all correspondence sent to the Academy of Health Sciences.

CLARIFICATION OF TERMINOLOGY

When used in this publication, words such as "he," "him," "his," and "men" 'are intended to include both the masculine and feminine genders, unless specifically stated otherwise or when obvious in context.

USE OF PROPRIETARY NAMES

The initial letters of the names of some products may be capitalized in this subcourse. Such names are proprietary names, that is, brand names or trademarks. Proprietary names have been used in this subcourse only to make it a more effective learning aid. The use of any name, proprietary or otherwise, should not be interpreted as endorsement, deprecation, or criticism of a product; nor should such use be considered to interpret the validity of proprietary rights in a name, whether it is registered or not.

TABLE OF CONTENTS

CORRESPONDENCE COURSE OF
THE U.S. ARMY MEDICAL DEPARTMENT CENTER AND SCHOOL

SUBCOURSE MD0371

DENTAL CHAIR, STOOL, AND DENTAL OPERATING UNIT

INTRODUCTION

The dental chair, model JSR, is designed and constructed for dependability. The chair features an automatic return to exit capability. It is covered with durable upholstery and has a protective plastic foot cover. The accompanying stool provides seating for the doctor during operating procedures.

The A-DEC Dental System, Model 4200, provides dentists and their assistants with the state of the art dental technology. Ease of operation and convenient instrument location are features that dental teams desire. Some of the advanced options incorporated include pre-heated water to the syringe and handpieces for patient comfort, a built-in fiber optic light system which feeds directly to the handpieces providing a lighted operating area, and a handpiece flush system designed as an infection control option. You will find this system in dental clinics throughout the Army.

As a medical equipment repairer, it is your responsibility to perform preventive maintenance checks and services (PMCS), isolate malfunctioning components, and remove and replace or repair those components. The material in this subcourse covers these procedures for the JSR dental chair, stool, and A-DEC dental operating unit.

Subcourse Components:

This subcourse consists of six lessons and an appendix. They are:

- Lesson 1, Perform Preventive Maintenance Checks and Services on the Dental Chair and Stool.
- Lesson 2, Isolate Malfunctions to Component Level in the Dental Chair and Stool.
- Lesson 3, Remove and Replace or Repair Defective Components of the Dental Chair and Stool.
- Lesson 4, Perform Preventive Maintenance Checks and Services on the Dental Chair and Stool.
- Lesson 5, Isolate Malfunctions to Component Level in the Dental Operating Unit.

- Lesson 6, Remove and Replace or Repair Defective Components of the Dental Operating Unit.

- Appendix, Dental Chair (Model JSR) Troubleshooting Guide.

Credit Awarded:

Upon successful completion of the examination for this subcourse, you will be awarded six credit hours.

To receive credit hours, you must be officially enrolled and complete an examination furnished by the Nonresident Instruction Branch at Fort Sam Houston, Texas.

You can enroll by going to the web site http://atrrs.army.mil and enrolling under "Self Development" (School Code 555).

A listing of correspondence courses and subcourses available through the Nonresident Instruction Section is found in Chapter 4 of DA Pamphlet 350-59, Army Correspondence Course Program Catalog. The DA PAM is available at the following website: http://www.usapa.army.mil/pdffiles/p350-59.pdf.

LESSON ASSIGNMENT

LESSON 1	Perform Preventive Maintenance Checks and Services on the Dental Chair and Stool.
TEXT ASSIGNMENT	Paragraphs 1-1 through 1-3.
TASKS TAUGHT	Perform Preventive Maintenance Checks and Services on the Dental Chair and Stool.
LESSON OBJECTIVES	When you have completed this lesson, you should be able to:

1-1. Identify major components of the JSR dental chair.

1-2. Identify procedures for performing PMCS on the JSR dental chair.

1-3. Identify procedures for lubricating the JSR dental chair.

SUGGESTION	Work the lesson exercises at the end of this lesson before beginning the next lesson. These exercises will help you accomplish the lesson objectives.

LESSON 1

PERFORM PREVENTIVE MAINTENANCE CHECKS AND SERVICES ON THE DENTAL CHAIR AND STOOL

1-1. GENERAL

The model JSR dental chair has control switches located on both sides of the back with exclusive arm supports to help position the patient more comfortably. The chair features the "horseshoe" headrest and is mounted on a PLR-200 base. The stool has an adjustable height swivel seat mounted on a base with casters. It is your responsibility to keep the dental chair and stool operating efficiently. This lesson covers the appropriate PMCS procedures to best accomplish this task.

1-2. DENTAL CHAIR COMPONENTS

a. **Dental Chair and Stool Component Overview.** Refer to figure 1-1. The dental chair and stool consist of the following components.

(1) Floor plate assembly.

(2) Chassis assembly that houses the base motor assembly, the foot switch, and the brake pedal.

(3) Bellows assembly.

(4) Pantograph arms.

(5) Chair mount assembly.

(6) Cradle assembly that houses the chair back motor, the chair seat motor, and the AUTO/MANUAL mode toggle switch located in the junction box.

(7) Chair seat assembly.

(8) Chair back assembly that houses the control buttons.

(9) Arm rests.

(10) Stool saddle seat.

(11) Stool post.

(12) Stool stop assembly.

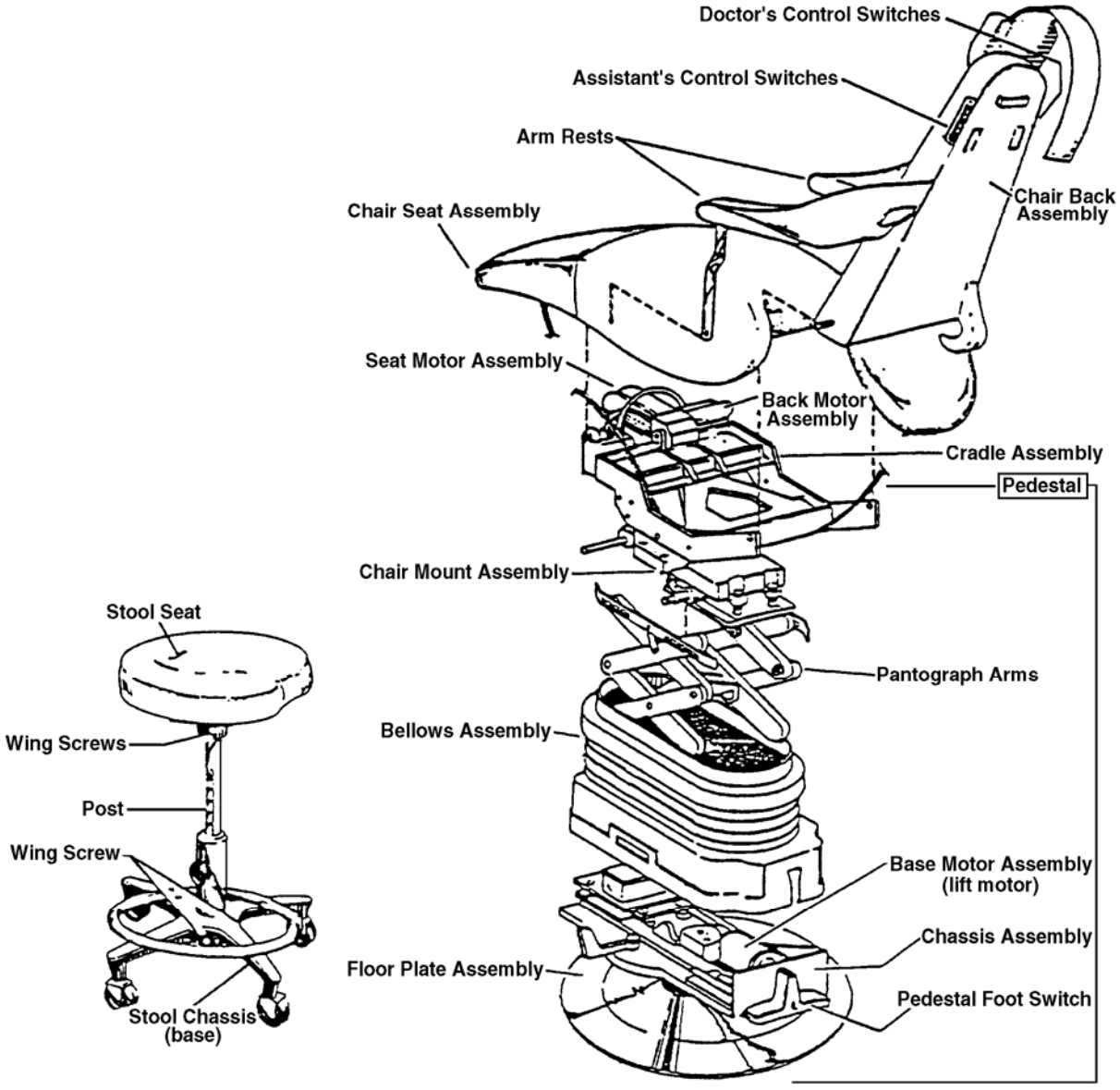


Figure 1-1. Dental chair and stool components.

b. **Pedestal and Motor Assembly.** The base motor is located on the rear of the pedestal in the chassis assembly. The pedestal can be rotated 360 degrees by releasing the manually operated lock that is located on the doctor's side of the chair at the base of the pedestal. The purpose of the base (lift) motor assembly is to raise and lower the chair. This is done in one of two ways.

(1) By using the foot switch located on the pedestal.

(2) By using the doctor's lowermost switch which lowers the chair to the exit position. You cannot raise the chair with this switch.

c. **Seat Motor Assembly.** The seat motor is used to tilt the seat of the chair up or down. It is located at the front of the chair in the center. The seat can be adjusted by the doctor's center switch or the assistant's lower switch on either side of the chair back.

d. **Back Motor Assembly.** The back motor is used to recline or tilt the back of the chair up. It is located at the front right of the cradle assembly as viewed from the rear. The back can be reclined or tilted up using the switches located at the top of either the doctor's or the assistant's side of the chair.

e. **Doctor's Controls.** Refer to figure 1-1. The doctor's controls are located on the back rest on the right side of the chair as viewed from the back.

(1) The uppermost switch is the back adjustment.

(2) The center switch is for the seat adjustment.

(3) The bottom switch is for automatic operation. Depressing the switch downward returns the chair to the "exit" position. It lowers the chair completely; it raises the back, and tilts the seat forward.

f. **Assistant's Controls.** Refer to figure 1-1. There are two switches located on the assistant's side (left) of the chair back.

(1) They have the same function as the doctor's corresponding controls with the exception of the doctor's lowermost switch, for which the assistant has no match.

(2) Additionally, the AUTO/MANUAL mode toggle switch is located under the chair on the assistant's side at the front of the chair. The doctor's lowermost switch only operates if this toggle switch is set to AUTO.

g. **Pedestal Controls.** Refer to figure 1-1. There is one foot switch at the rear of the chair that can be operated from either side.

(1) It manually raises and lowers the chair.

(2) When operated from the doctor's side, pushing the foot switch forward raises the chair.

(3) When operated from the doctor's side, pushing the foot switch to the rear lowers the chair.

1-3. PERFORM PREVENTIVE MAINTENANCE CHECKS AND SERVICES

a. **Check the Manual Mode.**

(1) Check to ensure that you can raise and lower the chair using the pedestal foot switch. (Be sure the AUTO/MANUAL mode toggle switch is set to manual).

(a) From the doctor's side of the chair, push the foot switch forward to raise the chair and rearward to lower the chair.

(b) From the assistant's side of the chair, repeat the process.

(2) Check to ensure that the seat tilts up and down.

(a) Test the assistant's bottom button.

(b) Test the doctor's middle button.

(3) Check to ensure that you can recline and bring forward the chair back.

(a) Test the assistant's top button.

(b) Test the doctor's top button.

b. **Check the Automatic Mode.**

(1) Check to ensure that you can raise and lower the chair using the pedestal foot switch. (Be sure the AUTO/MANUAL mode toggle switch is set to automatic).

(a) From the doctor's side of the chair, push the foot switch forward to raise the chair and rearward to lower the chair.

(b) From the assistant's side of the chair repeat the process.

(2) Check to ensure that the seat tilts up and down.

(a) Test the assistant's bottom button.

(b) Test the doctor's middle button.

(3) Check to ensure that you can recline and bring forward the chair back.

(a) Test the assistant's top button.

(b) Test the doctor's top button.

(4) Check to ensure that the doctor's bottom button returns the chair to the exit position.

c. **Lubricate.** Annually, lubricate the following parts with white grease by wiping off the old white grease and applying fresh white grease to each one with an acid brush.

(1) Lubricate the screw jack and nut located in the floor plate assembly. Refer to figure 1-2, number 2.

(2) Lubricate the lift chain. Refer to figures 1-2, number 3.

ITEM	DESCRIPTION
1	Floor Plate
2	Jack Screw and Nut
3	Lift Chain
4	Spacer
5	Snap Ring
6	Nylon Bumper
7	Jack Screw Bearing
8	Snap Ring
9	Shim (0.005-inch)
	Shim (0.010-inch)
10	Chassis Retaining Chassis
11	Brake Block
12	Cap Screw

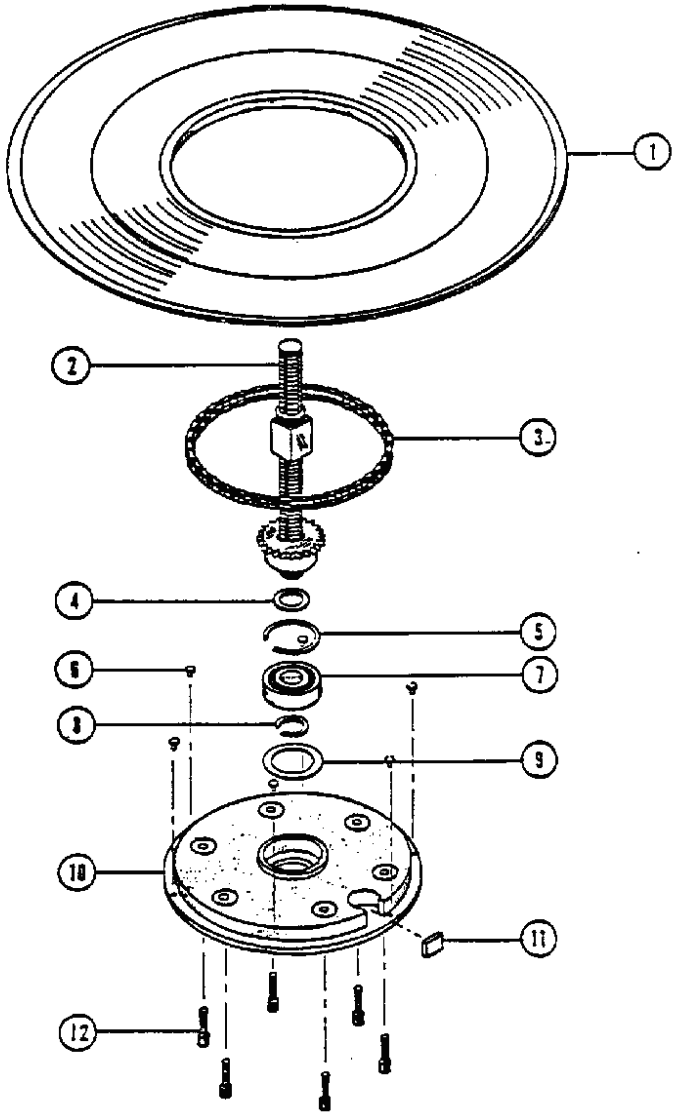


Figure 1-2. Floor plate assembly.

(3) Lubricate the pantograph arms by extending them to their full length and applying white grease to each movable joint. Refer to figure 1-3.

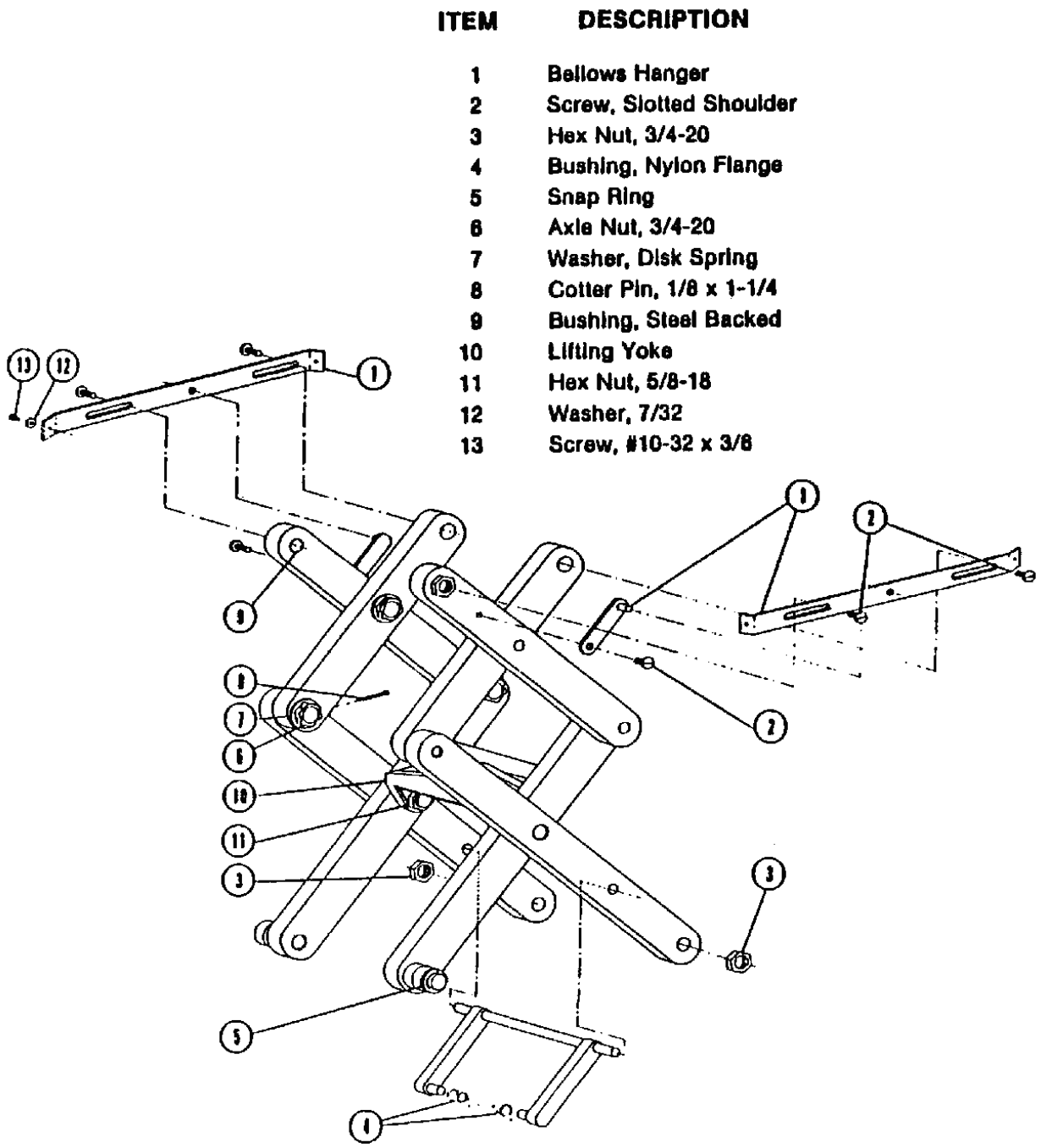


Figure 1-3. Pantograph arms.

(4) Lubricate the seat motor screw tube located in the cradle assembly. Refer to figure 1-4, number 2.

(5) Lubricate the back motor screw tube pin located in the cradle assembly. Refer to figure 1-4, number 16.

(6) Lubricate the stool using a light coat of oil.

ITEM	DESCRIPTION
1	Limit Switch
	Limit Switch (Micro)
2	Seat Motor Screw Tube
	Metal Screw Tube
3	Pivot Yoke Pin
4	Seat Motor Trunnion Pin
5	Auto Chair Wiring Harness
	Manual Chair Wiring Harness
6	Screw, 1/4-20 x 3/4
7	Bushing, Nylon Flange
8	Seat Motor Screw Tube Pin
9	Set Screw, 1/4-20 x 3/8 Soc. Hd.
10	Metal Screw Tube
	Back Motor Screw Tube
11	Cap Screw, 3/8-16 x 1-3/4
12	Cap Screw, 1/4-20 x 1-3/4
13	Lock Washer 1/4
14	Cap Screw, 1/4-20 x 1-1/4 Soc. Hd.
15	Back Motor Bracket Trunnion Pin
16	Back Motor Screw Tube Pin
17	Back Motor Crank Pin
18	Hex Nut, 1/4-20
19	Back Motor Bracket
20	Bushing, Nylon Flange
21	Screw, #8-32 x 1/2
22	Lock Washer
23	Clamp, 9/16
24	Screw, 1/2 x 3/8-16 x 13/32 x 9/16 Shoulder
25	Hex Nut, 3/8-16
26	Cap Screw, 1/4-20 x 1-1/2 Hex Hd.
27	Cap Screw, 1/4-20 x 1-1/2 Hex Washer Hd.
28	Screw, #12 x 1
29	Hex Nut, 3/8-16
30	Seat Motor Gear
31	Back Motor Gear
32	Back Motor
33	Seat Motor

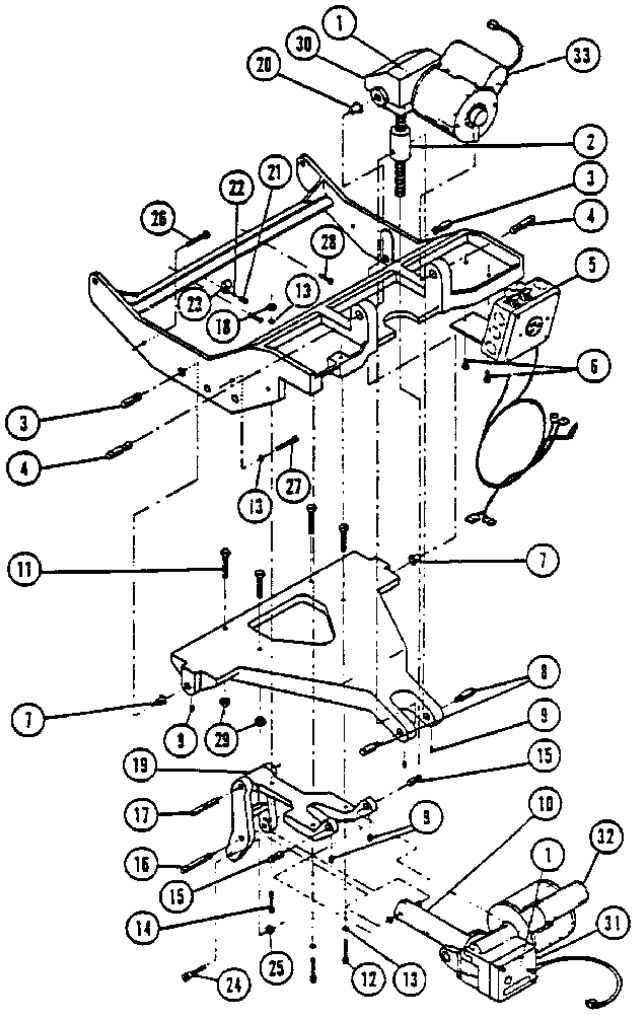


Figure 1-4. Cradle assembly.

Continue with Exercises

EXERCISES, LESSON 1

INSTRUCTIONS: Answer the following exercises by circling the lettered response that best answers the question.

After you have answered all of the exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers. For each exercise answered incorrectly, reread the lesson material referenced after the solution.

Refer to the following illustration for exercises 1 through 4.

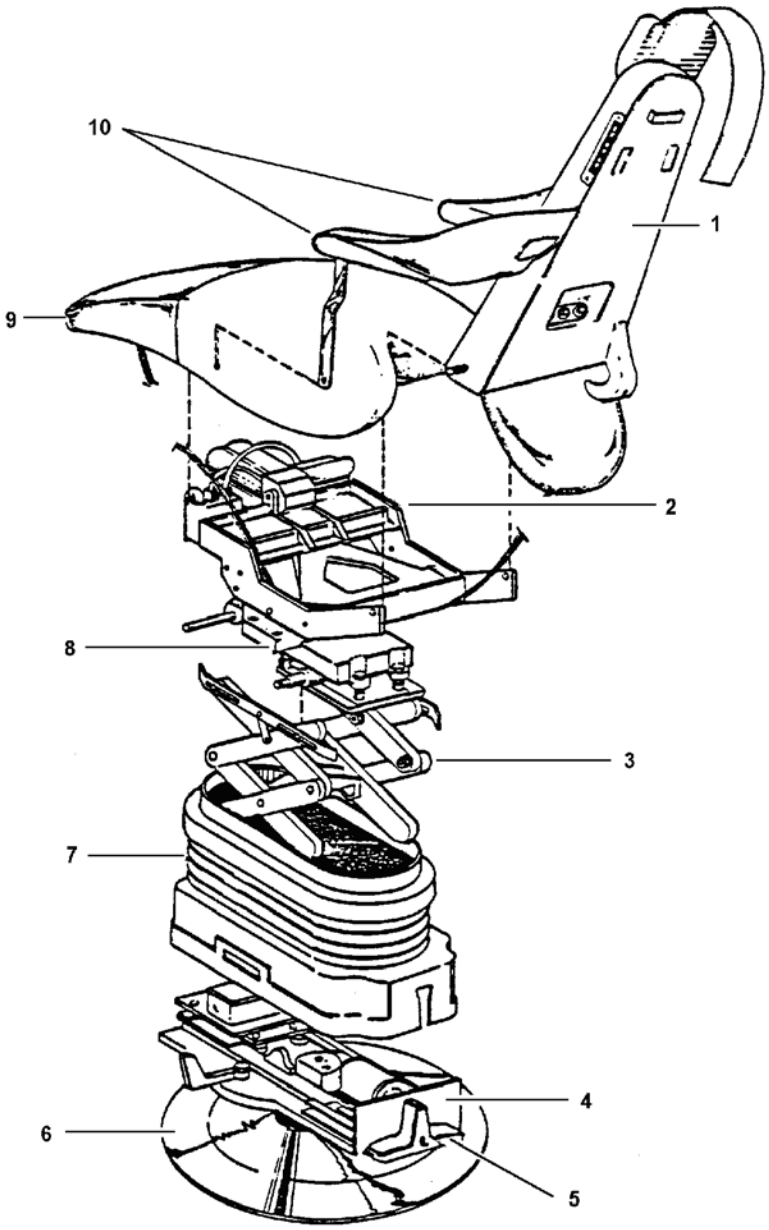


Figure for exercises 1-4. Dental chair components.

1. Refer to the figure on the previous page. What is the number designating the chassis assembly?

   a. 2.

   b. 3.

   c. 4.

   d. 8.

2. Refer to the figure on the previous page. What is the number designating the cradle assembly?

   a. 2.

   b. 4.

   c. 6.

   d. 8.

3. Refer to the figure on the previous page. What is the number designating the pantograph arms?

   a. 2.

   b. 3.

   c. 5.

   d. 10.

4. Refer to the figure on the previous page. What is the number designating the chair mount assembly?

   a. 1.

   b. 2.

   c. 8.

   d. 9.

5. Where do you find the base motor assembly?

    a. In the cradle assembly.

    b. In the chassis assembly.

    c. In the chair back assembly.

    d. In the floor plate assembly.

6. Where do you find the back motor assembly?

    a. In the cradle assembly.

    b. In the chassis assembly.

    c. In the chair mount assembly.

    d. In the chair back assembly.

7. Where are the doctor's controls on the dental chair?

    a. On the right side of the chair back when viewing the chair from the rear.

    b. On the left side of the chair when viewing the chair from the rear.

    c. Underneath the chair right arm rest, recessed to ensure the patient won't accidentally depress them.

    d. On the lower back of the dental chair back.

8. How often do you lubricate the dental chair?

    a. Daily.

    b. Weekly.

    c. Monthly.

    d. Annually.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES: LESSON 1

1. c (figure 1-1)
2. a (figure 1-1)
3. b (figure 1-1)
4. c (figure 1-1)
5. b (para 1-2b)
6. a (para 1-2d)
7. a (para 1-2e)
8. d (para 1-3c)

End of Lesson 1

LESSON ASSIGNMENT

LESSON 2	Isolate Malfunctions to Component Level in the Dental Chair and Stool.
TEXT ASSIGNMENT	Paragraphs 2-1 through 2-3.
TASKS TAUGHT	Isolate Malfunctions to Component Level in the Dental Chair and Stool.
LESSON OBJECTIVES	When you have completed this lesson, you should be able to: 2-1. Identify the theory of operation on the JSR dental chair. 2-2. Identify procedures for isolating malfunctions to the component level in the JSR dental chair.
SUGGESTION	Work the lesson exercises at the end of this lesson before beginning the next lesson. These exercises will help you accomplish the lesson objectives.

LESSON 2

ISOLATE MALFUNCTIONS TO COMPONENT LEVEL IN THE DENTAL CHAIR AND STOOL

2-1. GENERAL

In order to efficiently maintain the dental chair, model JSR, you need to understand how it operates. This lesson covers how the circuit works. It also covers how to use a troubleshooting chart to isolate certain malfunctions. The malfunctions chosen are examples of the methods to use to isolate common malfunctions.

2-2. THEORY OF OPERATION

Refer to figure 2-1.

a. **Raising the Chair.** To raise the chair you use the foot switch. This applies power.

(1) When you use the foot switch, 125 volts alternating current (vac) is applied from the incoming line through the black wire to the common of the mode switch. With the AUTO/MANUAL mode switch in the manual position, continuity is maintained to a tie point in the junction box, then out the junction box along the lower black wire to the common of the foot switch. With the foot switch in the up position, potential is applied through the switch, along the red wire, through the limit switch to the motor. The other side of the motor is tied to the incoming neutral line.

(2) You raise the chair by the use of a scissors jack assembly. As the motor runs, worm gears turn a sprocket. The sprocket connects to a chain which turns a screw shaft running through the center of the scissors jack. The jack is mounted to the base plate and the seat base. Clockwise movement of the shaft raises the chair. Counterclockwise movement lowers the chair.

b. **Lowering the Chair.** You lower the chair through much of the same circuitry as raising. Power is applied to the AUTO/MANUAL mode switch (still in manual) to the tie point in the junction. From there it flows along the lower black wire to the foot switch. With the foot switch closed to the "lower" position, power is applied through the switch, out of the blue wire to the manual "lower" limit switch. It then goes to the motor and out the neutral white wire.

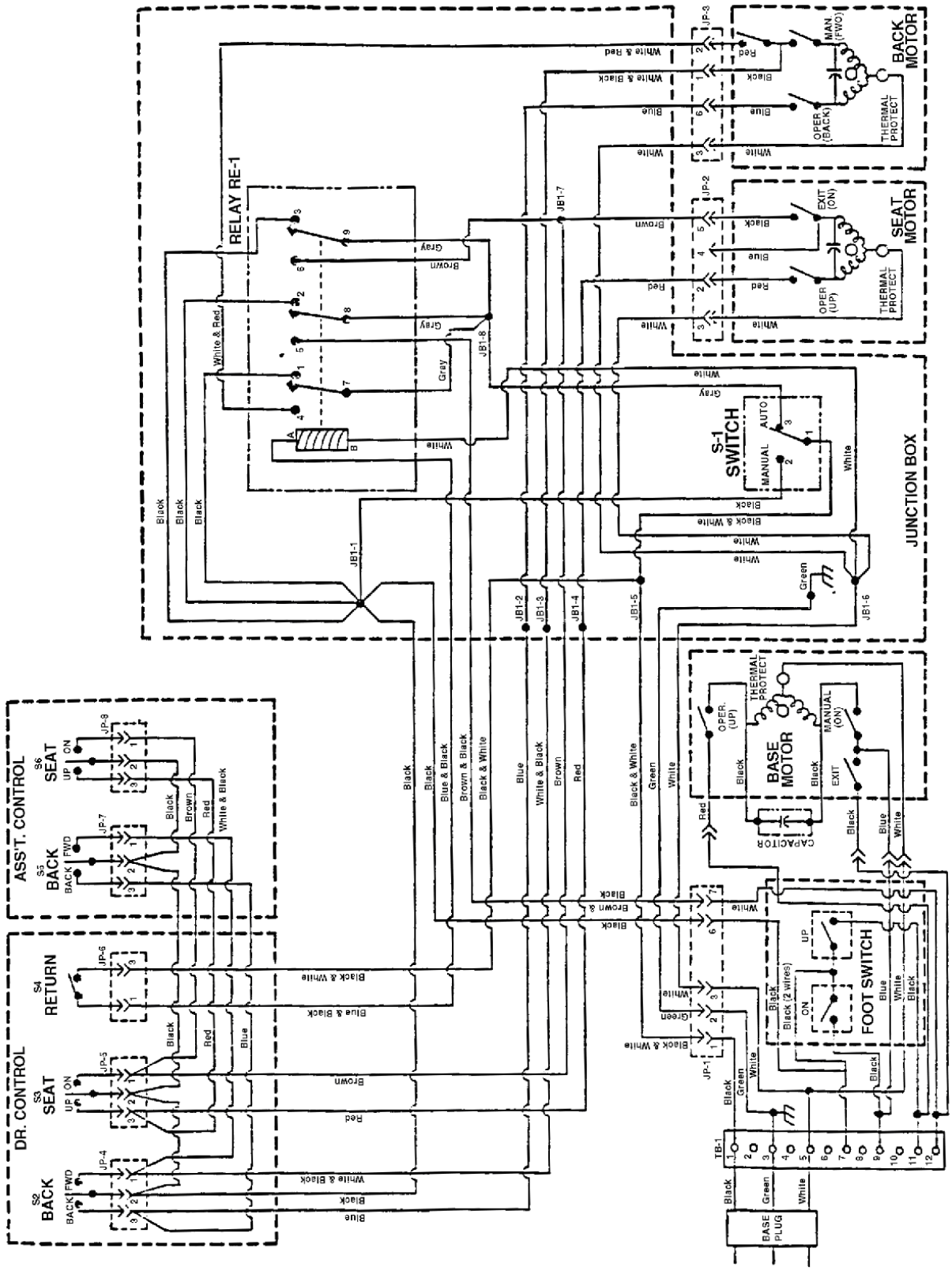


Figure 2-1. Schematic for the JSR Dental Chair.

c. **Tilting the Seat Up.**

(1) You can tilt the seat up from either the doctor's or the assistant's side of the chair. Zero voltage is applied from the incoming neutral wire to a tie point in the junction box to one side of the motor. 125v is brought to the other side of the motor through the black wire to the mode switch. With the switch in the manual position, power is applied to the tie point in the junction box, along the top wire to the common of the back adjust switch.

(2) The assistant's and the doctor's seat adjust switches are parallel to each other. The commons of all four switches are tied together. From the common of the seat adjust switch, continuity is maintained through the switch to the red wire, pin 3 of the switch to the junction box. From the tie point in the junction box, power is applied along the red wire to the “operate up” windings of the seat motor, energizing the motor and tilting the seat. A screw shaft protrudes from the bottom of the motor. As the motor turns, the shaft tilts the seat back by turning inside a plastic sleeve.

(3) This mechanical action tilts the seat up or down, depending on the direction of travel.

d. **Tilting the Seat Down.** One hundred twenty five voltage is applied to the junction box, through the mode switch to the common of the seat adjust switch. When you select down, power is applied out the brown wire from switch pin (1) to the junction box, along the brown wire to the exit down windings. It energizes the motor and lowers the seat.

e. **Reclining the Back.** Zero voltage is applied to the back adjust motor as it is applied to the seat adjust motor. One hundred twenty voltabe is applied through the mode switch to the common of the back adjust switch, pin (2). The switch is pushed to the back position bringing 120v through switch, pin 3, out the blue wire to the junction box. Out of the junction box at JP-3 pin 6, power is applied to the back windings. It energizes the motor and reclines the back.

f. **Tilting the Back Up.** Power is applied to the common of the back adjust switch through the junction box and the mode switch. When the switch is depressed to the forward position, power is applied through switch pin (1), out the white and black wire to the junction box to the manual up windings. It energizes the motor and brings the chair forward.

2-3. ISOLATE MALFUNCTIONS TO THE COMPONENT LEVEL

Troubleshooting is a systematic method of isolating malfunctions by means of tests based on symptoms. It is intended to reduce the amount of time normally required to locate maladjustments and defective components. It is also intended to restore equipment to a serviceable condition. When you isolate dental chair malfunctions you use a troubleshooting guide. Refer to the Dental Chair Model JSR Troubleshooting Guide in the appendix. Based on the observed problem, the guide tells you a probable cause, how to test for that cause, and if the test is positive, the corrective action to take. If the test shown is negative, check for other chair problems and troubleshoot them. The troubleshooting guide supplements your experience as the repairer. As you gain experience isolating malfunctions in the chair, you will rely less and less on it. To perform some of the appropriate tests, you need a digital multimeter.

a. If the chair will not operate (lift), the Dental Chair Model JSR Troubleshooting Guide shows 13 probable causes from a list of all possible causes. This lesson covers the first six of those probable causes. See the guide, "Probable Cause" column.

(1) The power cord is not plugged in to the supply receptacle or that the circuit breaker is off. The testing procedure for this probable cause is to visually inspect the power cord and the circuit breaker. See the guide, "Testing Procedure" column.

(a) If the power cord is not plugged in or the circuit breaker is off, the action to take to correct the problem, according to the "Corrective Action" column, is to plug in the cord or turn on the circuit breaker.

(b) If the visual inspection shows the power cord is not unplugged and the circuit breaker box is on, you continue to the next probable cause.

(2) The building power supply is faulty.

(a) Use a voltmeter to check for a reading of 115v or 220v, as applicable, at the power supply receptacle.

(b) If there is no reading, the problem is with the building power supply. The corrective action is to notify the proper personnel.

(c) If there is a reading, and the chair still won't operate, you go on to the next probable cause.

(3) The chair power cord is not plugged into the gray cord at the rear of the lift. Visually inspect the chair power cord.

(a) If the chair power cord is disconnected, connect it.

(b) If the chair power cord is not disconnected and the chair still doesn't operate, continue down the "Probable Cause" column.

(4) The four conductor plug on the chair is not securely plugged into the black coil cord at the rear of the lift. On newer models, the chair-base connector is mounted on the front of the chair. Refer to figure 2-2. Test by visually inspecting the four conductor plug.

(a) If not securely plugged into the black coil cord, make a secure connection.

(b) If securely plugged, continue to the next probable cause.

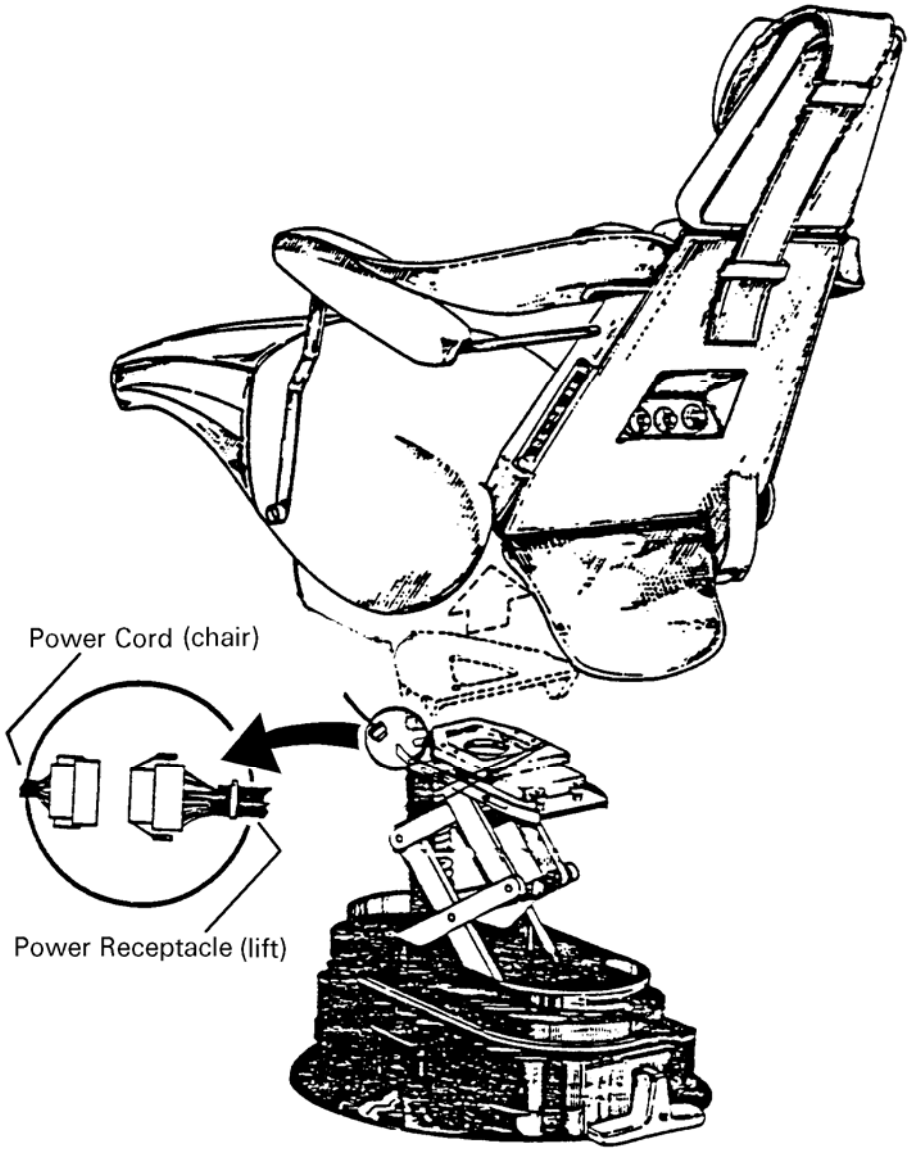


Figure 2-2. Dental chair power cord.

(5) The motors are not plugged into the chair electrical junction box. Test by visually inspecting the chair electrical junction box to see if the three motors are plugged in.

(a) If the motors are not plugged in, plug in each one.

(b) If they are plugged in, continue to the next probable cause.

(6) There is a loose connection in the lift electrical junction box.

(a) Use a voltmeter to check receptacles on the chair electrical junction box for a reading of 115v or 220v, as applicable.

(b) If there is no reading at the chair receptacle on the electrical junction box, disconnect the chair power cord from the connector at front of lift.

(c) Check terminal 1 (lift connector) for a reading of 115v or 220v, as applicable.

(d) If there is no reading, remove the lift motor cover and check for a loose connection in the lift electrical junction box.

(e) If you find a loose connection, the correct action is to make a secure connection.

(7) If none of the aforementioned tests proved a probable cause as the reason for the malfunction, you continue down the list of probable causes using the testing procedures and corrective actions shown on the troubleshooting guide. The remaining probable causes are shown below.

(a) A faulty wiring harness.

(b) The assistant or the doctor's manual seal and back switches are faulty.

(c) There is a broken chair or sheared pin in the motor sprocket.

(d) There is a bent or broken foot control switch.

(e) There is a faulty motor or capacitor.

(f) The automatic control is not functioning.

(g) There is a faulty relay.

b. If your problem is that the foot switch fails to raise or lower the chair, there are three probable causes from a list of all possible causes. Refer to the appendix.

(1) The chain could be broken. You test this by visually inspecting. If broken, you replace it.

(2) The pin on the motor sprocket could be sheared. Test by visually inspecting. If sheared, replace the motor. Refer to Lesson 3, Remove and Replace or Repair Defective Components of the Dental Chair and Stool.

(3) You could have a faulty foot switch or wiring harness. Test by using the following procedures.

(a) Remove the foot switch from the pedestal.

(b) Use a voltmeter to check for a reading of 115v or 220v, as applicable, between terminal 2 and the neutral line. If there is no reading, the wiring harness is faulty. Replace the wiring harness.

(c) If there is a reading in (b) above, check for a reading of 115v or 220v as applicable between terminal 3 and the neutral line when you depress the left side of the foot switch. Also check for the same reading between terminal 1 and the neutral line when you depress the right side of the foot switch. If there is no reading, the foot switch is faulty. Refer to Lesson 3, Remove and Replace or Repair Defective Components of the Dental Chair and Stool.

(d) If there is a reading on both switch legs, the motor is faulty. Refer to Lesson 3, Remove and Replace or Repair Defective Components of the Dental Chair and Stool.

Continue with Exercises

EXERCISES, LESSON 2

INSTRUCTIONS: Answer the following exercises by circling the lettered response that best answers the question.

After you have answered all of the exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers. For each exercise answered incorrectly, reread the lesson material referenced after the solution.

1. Which of the following statements concerning tilting the seat up in the manual mode is correct?

   a. Power is applied out of the orange wire, pin 1 of the switch to the junction box.

   b. Power is applied out of the red wire, pin 3 of the switch to the junction box.

   c. Power is applied out of the red wire, pin 1 of the switch to the junction box.

   d. Power is applied out of the orange wire, pin 3 of the switch to the junction box.

2. Which of the following statements concerning reclining the seat back in the manual mode is correct?

   a. Power is applied out of the blue wire, pin 3 of the switch to the junction box.

   b. Power is applied out of the blue wire, pin 1 of the switch to the junction box.

   c. Power is applied out of the white wire, pin 3 of the switch to the junction box.

   d. Power is applied out of the white wire, pin 1 of the switch to the junction box.

3. Which of the following is a reason for using the Dental Chair Model JSR Troubleshooting Guide when isolating a malfunction?

   a. It ensures you will find the cause for the malfunction, maladjustment, or defective component.

   b. It provides a detailed listing of all possible causes for a malfunction.

   c. It replaces a need for the repairer to have experience isolating malfunctions on the dental chair.

   d. It reduces the amount of time normally required to locate the cause of a malfunction.

SITUATION: You are troubleshooting malfunctioning components in the dental chair. Refer to the Dental Chair Model JSR Troubleshooting Guide in the appendix to answer exercises 4 through 6.

4. The dental chair or lift will not operate. Which of the following could be a probable cause?

   a. Faulty wiring harness.

   b. AUTO/MANUAL mode switch is set to AUTO.

   c. AUTO/MANUAL mode switch is set to MANUAL.

   d. Brake fails to release.

5. The dental chair or lift will not operate. You are testing for the probable cause of a bent or broken foot control switch. What testing procedure do you use?

   a. Remove the foot switch from the pedestal and use a voltmeter to check for appropriate voltage between terminal 2 and the neutral line.

   b. Test automatic control board using a voltmeter. Check receptacles of chair electrical junction box for appropriate readings, 115v or 220v.

   c. Visually inspect the component. Ensure contacts of the switch are intact and properly engaging.

   d. Toggle the AUTO/MANUAL mode switch on the electrical junction box to the AUTO position.

6. If the chair or lift will not operate which of the following is the first level of testing?

   a. Check receptacles on the chair electrical junction box for appropriate voltage readings using a voltmeter.

   b. Make visual inspection of all electrical plugs and power sources.

   c. Ensure the AUTO/MANUAL mode toggle switch is set to AUTO.

   d. Make a visual inspection of all switches and motors.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES: LESSON 2

1. b (para 2-2c(2))
2. a (para 2-2e)
3. d (para 2-3)
4. a (Appendix, PROBLEM I, PROBABLE CAUSE 7)
5. c (Appendix, PROBLEM I, TEST PROCEDURE 10)
6. b (Appendix, PROBLEM I, TEST PROCEDURE 1)

End of Lesson 2

LESSON ASSIGNMENT

LESSON 3	Remove and Replace or Repair Defective Components of the Dental Chair and Stool.
TEXT ASSIGNMENT	Paragraphs 3-1 through 3-5.
TASKS TAUGHT	Remove and Replace or Repair Defective Components of the Dental Chair and Stool.
LESSON OBJECTIVES	When you have completed this lesson, you should be able to: 3-1. Identify procedures for removing and replacing defective components on the JSR Dental Chair. 3-2. Identify procedures for repairing defective components on the JSR Dental Chair.
SUGGESTION	Work the lesson exercises at the end of this lesson before beginning the next lesson. These exercises will help you accomplish the lesson objectives.

LESSON 3

REMOVE AND REPLACE OR REPAIR DEFECTIVE COMPONENTS OF THE DENTAL CHAIR AND STOOL

3-1. GENERAL

After you have isolated a malfunction, you must remove and replace or repair the component that is malfunctioning. The components covered in this lesson represent only a portion of the total number of components that could malfunction. However, the skills required to correct the malfunctioning components are transferable to correcting all malfunctioning components. You need a medical equipment repairer's tool kit including at least the following equipment:

a. Seven-sixteenths inch open-end or box wrench.

b. Five-sixteenths inch Allen wrench.

c. Phillips screwdriver.

d. Flat-tipped screwdriver.

e. Three-eights inch wrench.

f. Three-fourths inch open-end wrench.

g. Digital multimeter.

3-2. REPLACING A FAULTY MANUAL CONTROL SWITCH

The dental chair does not function properly. You have isolated a malfunction to a faulty manual control switch, e.g., manual control switch for chair back (one each for the doctor's and assistant's controls), or the manual control switch for the chair seat (one each for the doctor's and assistant's controls). After testing per the Dental Chair Model JSR Troubleshooting Guide, you have no readings. Therefore, the corrective action you must take is to remove and replace the switch assembly. Refer to figure 3-1.

a. Disconnect the external power source.

b. Remove the two screws that secure the malfunctioning switch bezel to the chair top.

c. Pull the malfunctioning switch bezel from the chair.

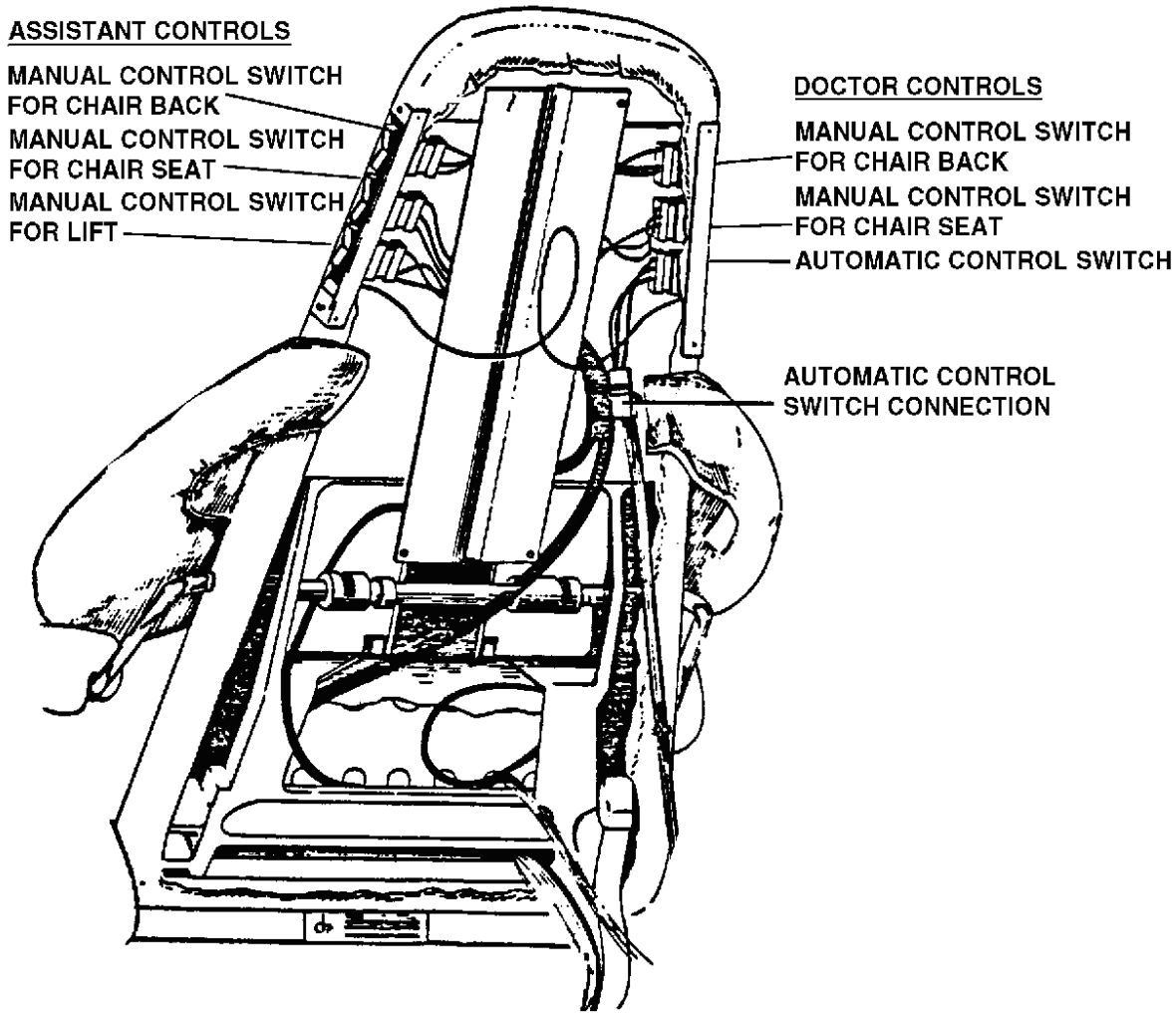


Figure 3-1. Doctor and assistant controls.

CAUTION: Do not pull the switch bezel and the wiring harness too far out of the chair as you may damage the wiring harness or the other switch assembly.

d. Disconnect the switch assembly from the wiring harness.

NOTE: Disconnect the switch assembly socket terminals from the wiring harness one at a time. Connect the replacement switch socket terminal as you disconnect each individual terminal. This prevents making a wrong connection.

e. After you connect the new switch assembly, push the wiring harness back into the chair.

f. Install the new switch assembly bezel to the chair using the two screws removed in step b. above.

g. Reconnect the external power source.

h. Depress each switch and operate the chair and the base motors through their full travel.

3-3. REPLACING BASE MOTOR (PLR-200)

The lift motor hums when you use the foot control switch to raise or lower the chair, or the doctor's automatic switch to lower the chair. You have isolated the malfunction to a faulty base motor. You must remove and replace it. There are different procedures for the chair in the UP position and DOWN position. If you can raise the chair with the foot control switch to the “UP” position, use procedure a. If the chair is in the “DOWN” position and you cannot raise it, use procedure b.

a. **Chair Is in “UP” Position.** Refer to figure 3-2.

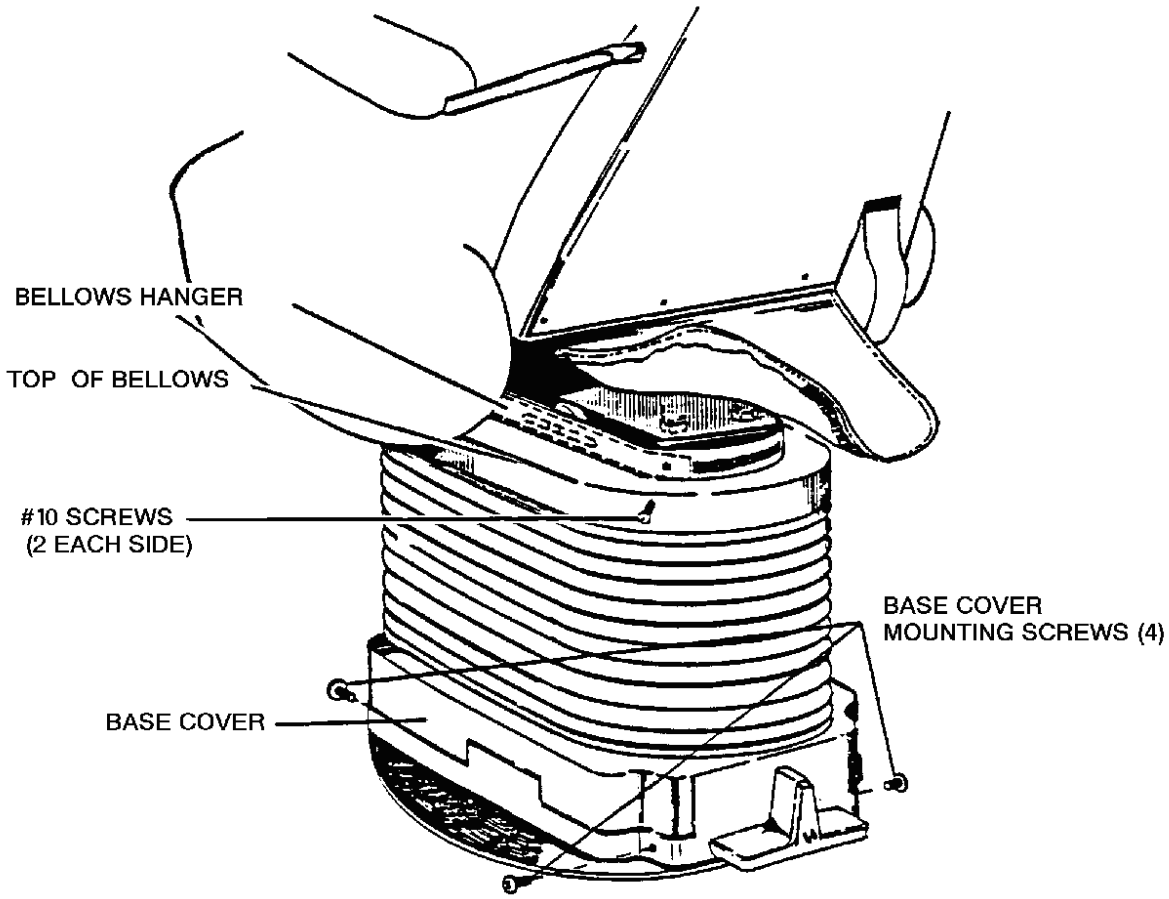


Figure 3-2. View of bellows with chair raised.

(1) Detach the top bellows by removing the four #10 screws that secure the bellows to the bellows hanger.

(2) Lower the bellows to the base cover exposing the pantograph.

CAUTION: Place a block of wood, five inches long, between the pantograph arms on one side and lower the pantograph slightly to grip the block of wood securely. Refer to figure 3-3.

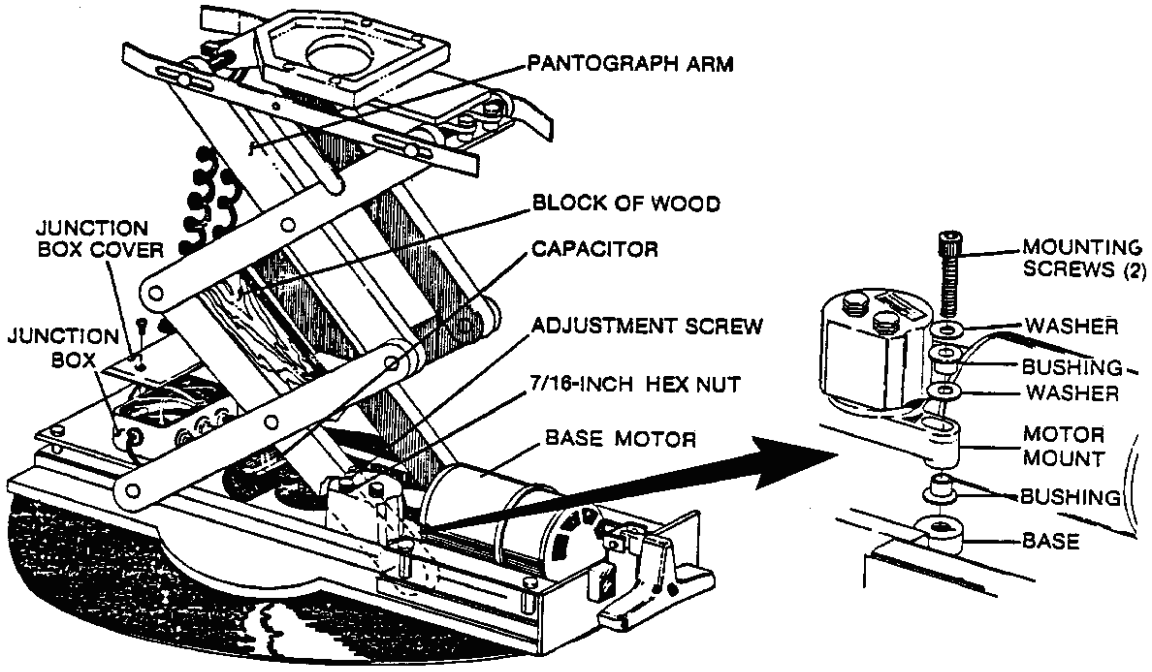


Figure 3-3. PLA-R-200 lift.

(3) Disconnect the external power source and disconnect the chair power cord from the receptacle in the lift.

(4) Remove the four nuts, lock washers, and the mounting screws that secure the chair to the lift. Remove the chair.

(5) Remove the four mounting screws that secure the base cover. Refer to figure 3-2.

(6) Loosen the nut that secures the rotation lock pedal.

(7) Lift the main cover off over the top of the lift.

CAUTION: Be sure you have disconnected the external power cord.

(8) Remove the gear motor and the capacitor.

(a) Remove the junction box cover, disconnect the motor wires, and remove the motor leads from the box. Refer to figure 3-4.

(b) Remove the three motor mounting screws and slide the motor forward to disengage from the chain. Lift the motor and the capacitor out.

(c) Repair or replace the chain as necessary.

(9) Install the new gear motor and the capacitor.

(10) Reconnect all of the electrical leads in the junction box so that the motor is ready to operate.

(11) Reconnect the external power source.

(12) Run the motor counterclockwise until it stops to correspond to the raised condition of the lift.

NOTE: On the PLR-200, the lift will not operate without the jumper cord originally shipped with the lift. If the jumper cord is not available, you must connect the receptacle to the chair cord. Refer to figure 3-5.

(13) Check the lift to ensure that it is blocked to its highest position. Make adjustments as required.

(14) Engage the chain drive upon the sprockets and replace the three mounting screws. Pull the motor to tighten the drive chain while tightening the mounting screws. Refer to figure 3-2.

(15) Remove the wood block from the pantograph arms.

CAUTION: The lift must not over travel to the point where the pantograph arms close up under power. Otherwise serious damage will occur. There should be at least 5/8 inch of space remaining between the parallel pantograph arms when the motor stops at the low lift position.

(16) Run the lift down to check the lower extreme position.

(17) Adjust the height of the lift using a 7/16 inch open-end or box wrench. Loosen the locknut on the adjusting screw (Switch "A" on PLR-200) (refer to figure 3-6) and turn clockwise (refer to figure 3-3) to raise the lower limit of the lift. Turn counterclockwise to decrease the lower limit of the lift. Each full turn of the adjusting screw changes the lift height 9/16 inch.

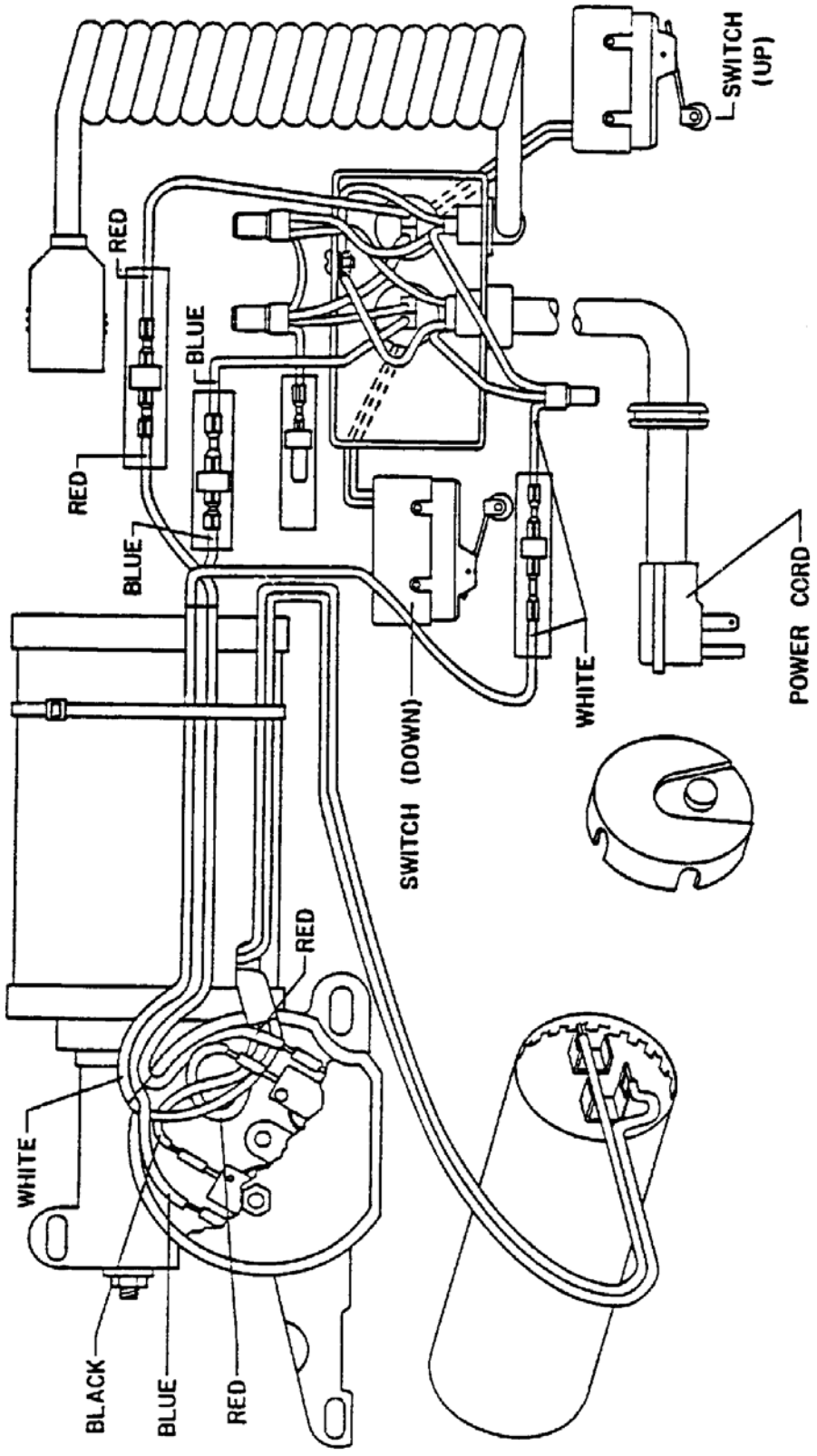


Figure 3-4. PL-200 wiring diagram.

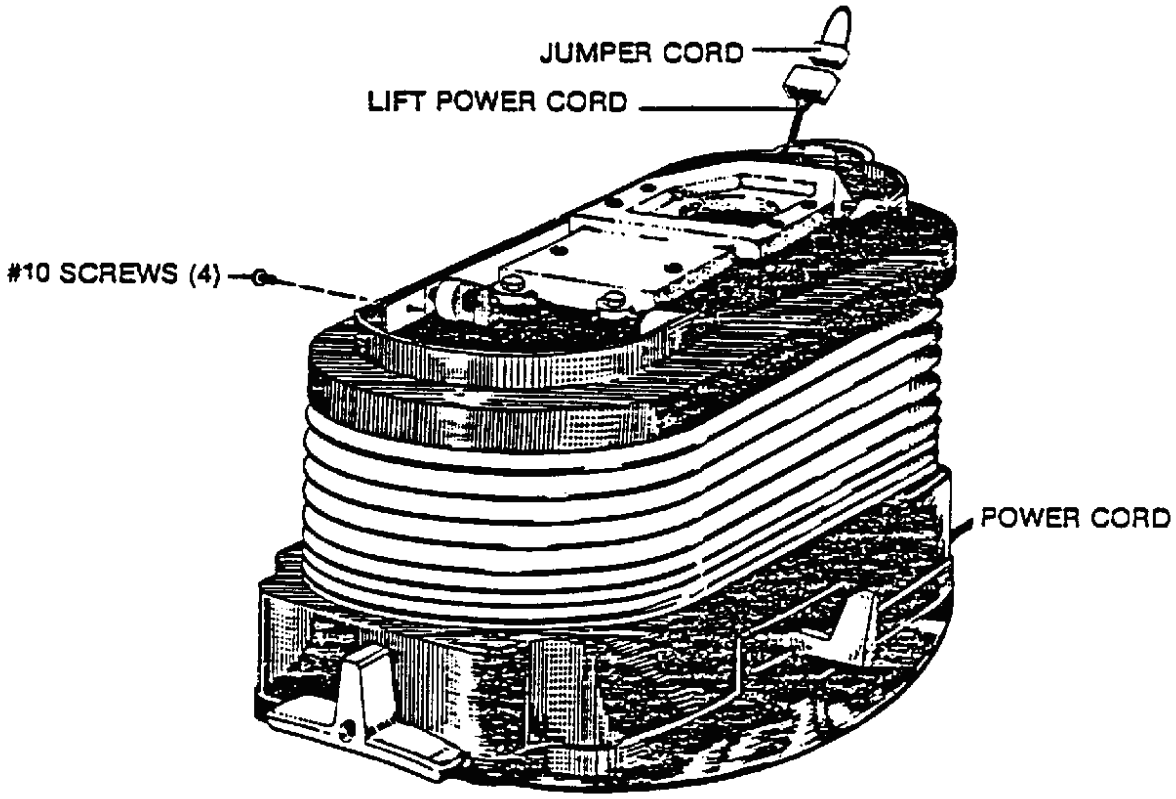


Figure 3-5. PLA-200 precision lift.

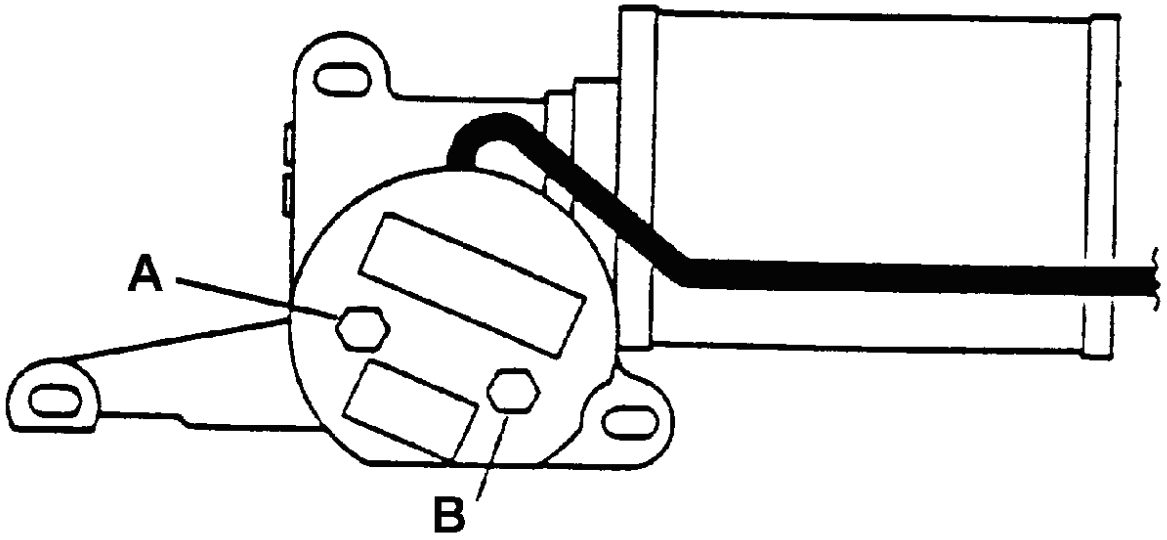


Figure 3-6. Switches "A" and "B" on PLR-200.

(18) Retighten the lock nut after you complete adjusting the adjusting screws.

(19) Reinstall the junction box cover.

(20) Place the main cover over, reinstall the rotation lock pedal, and tighten the 3/4 inch nut.

(21) Replace the four screws securing the base cover to the lift.

(22) Reinstall the chair and secure it to the lift with the screws, lock washers, and the nuts removed in step (4) above.

(23) Run the lift up to its two extreme positions with one person in the chair.

CAUTION: Take care when running the lift down so that it does not crush the bellows cover. Recheck the clearance between the pantograph arms in the lower position. There should be at least 5/8 inch clearance. Readjust as required.

(24) Adjust the automatic exit position (Switch "B" in figure 3-6) to the desired position as described in step (17) above.

(25) Run the lift one-half way down and secure the bellows cover to the bellows hanger with the screws removed in step (1). Refer to figure 3-2.

b. **Chair Is in “DOWN” Position and Will Not Raise.**

(1) Remove the chair and cover as stated in procedure a. above, steps (1)-(7).

(2) Remove the screw and the cord clamp which secures the chair power coil cord.

(3) Remove the four 5/16 inch hex-head bolts which secure the upper roller guide to the chair mount casting. While removing each bolt, be very careful not to get the four adjustment nuts and the sleeves mixed up or change the adjustment. You must place these back in the same order in which you removed them.

(4) Remove the upper roller guide from the lift assembly and the lift chair mount casting and swing it over and out of the way for removal of the gear motor.

(5) Use a 5/16 inch Allen wrench to remove the three motor mounting screws.

(6) Remove the screw which secures the limit switch cover and lift the cover out.

(7) Ensure that the limit switch cover is off, then slide the gear motor forward and lift up to disengage the chain from the sprocket.

(8) Ensure that the chain is disengaged from the sprocket and lift up on the lift assembly to its full extended up position (a helper will be required).

(9) Remove the faulty motor by removing the junction box cover and disconnecting the three motor wires inside the box and removing the motor lead from the box.

(10) Install the new motor as explained in procedure a. above, steps (9)-(22).

(11) Replace the chair mount casting back into place and assemble the upper guide to the chair mount casting in the same manner that it was removed. Be careful not to get the four adjustment nuts and the sleeves mixed up or change the adjustment.

(12) Test using the procedures explained in a. above, steps (23)-(25).

3-4. REPLACING THE BACK MOTOR ASSEMBLY

The dental chair back continues to move after motor has stopped running. You have isolated the malfunction to insufficient friction in the back motor and the screw tube. You must replace the back motor assembly.

a. Raise the chair to its maximum height with the back to the full upright and the seat to the full uptilt.

b. Disconnect the power.

c. Detach the back skirt from the bellows cover.

d. Remove and retain the four #10 screws that secure the bellows cover to the bellows hangers and lower the bellows.

CAUTION: When you remove the pivot pins in the next step, e., the section will drop. Support the chair toe when you are removing the pivot pins.

e. Loosen the set screws on the seat motor screw tube pivot pins. Support the toe section of the chair and pry the pivot pins out of the pivot castings.

f. Raise the toe section of the chair and place a wood block between the pivot casting and the chair mount casting. See figure 3-7.

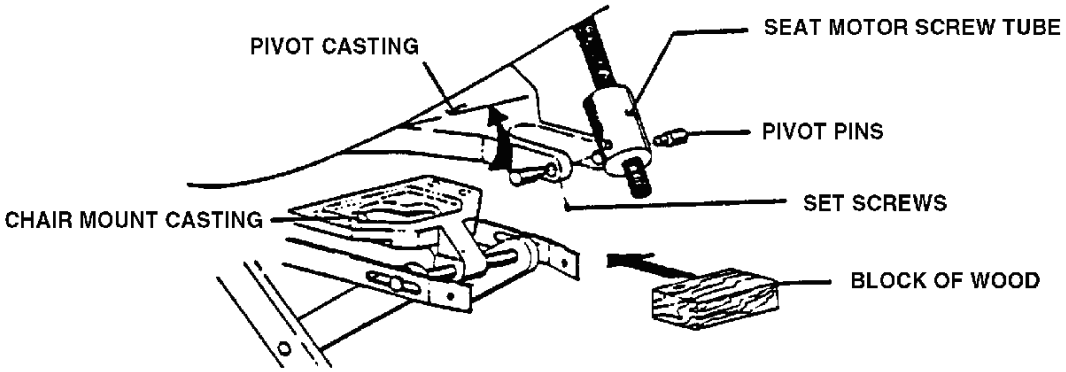


Figure 3-7. Wood block installation.

g. Disconnect the back motor from the chair junction box.

h. Remove the "C" rings and the pivot pins that hold the screw tube in the back motor crank.

i. Remove the set screws and the trunnion pins securing the back motor to the back motor bracket and remove the motor.

NOTE: If you are replacing the back motor bracket, continue with steps j. through m. If you are not replacing the back motor bracket, go to step n. to replace the back motor. Refer to figure 3-8.

j. Remove the round head screw connecting the back link to the crank.

k. Loosen the set screw and remove the crank pin.

l. Using a 3/8 inch wrench, remove the hex nut and washer from the back motor bracket. Do not remove the socket head cap screw.

m. Remove the two hex washer head screws from the bracket and lower the bracket out of the chair frame.

n. Attach the back motor bracket to the motor assembly with the trunnion pins removed in step i. Tighten the set screws.

o. Install the crank with the crank pin removed in step k. Tighten the set screws.

p. Secure the motor and the bracket assembly to the chair casting with the two hex washer head screws removed in step m. Install the nut and the lock washer removed in step l.

NOTE: Place a drop of Locktite on the screws and nuts.

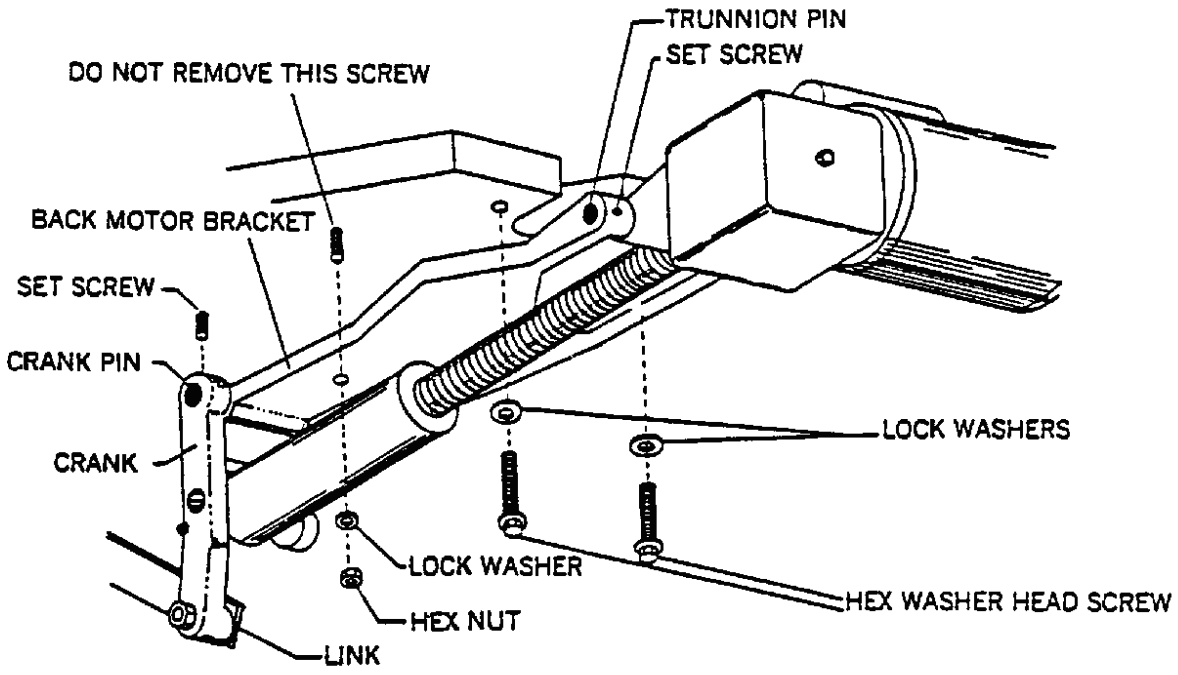


Figure 3-8. Back motor bracket installation.

q. Attach the back link to the bracket crank with the round head shoulder screw removed in step j.

r. Connect the back motor to the chair junction box.

s. Lift the chair and remove the wood block. Replace the seat motor pivot pins and the set screws removed in step e.

t. Install the retainer bracket onto the back motor bracket.

u. Replace the motor skirt and secure the bellows cover to the bellows hangers with the screws removed in step d.

v. Connect the chair to the power supply.

w. Ensure that the chair operates properly.

NOTE: The screw tube is factory set with a distance of 3/16 inch minimum plus 1/4 turn between the screw tube and gear housing. This is set with the motor in the DOWN position. Check the dimensions to see that they are correct.

3-5. REPLACING THE SEAT MOTOR

The dental chair travels beyond the exit position. You have isolated the malfunction to a faulty limit switch. You must remove and replace the seat motor. Refer to figure 3-9.

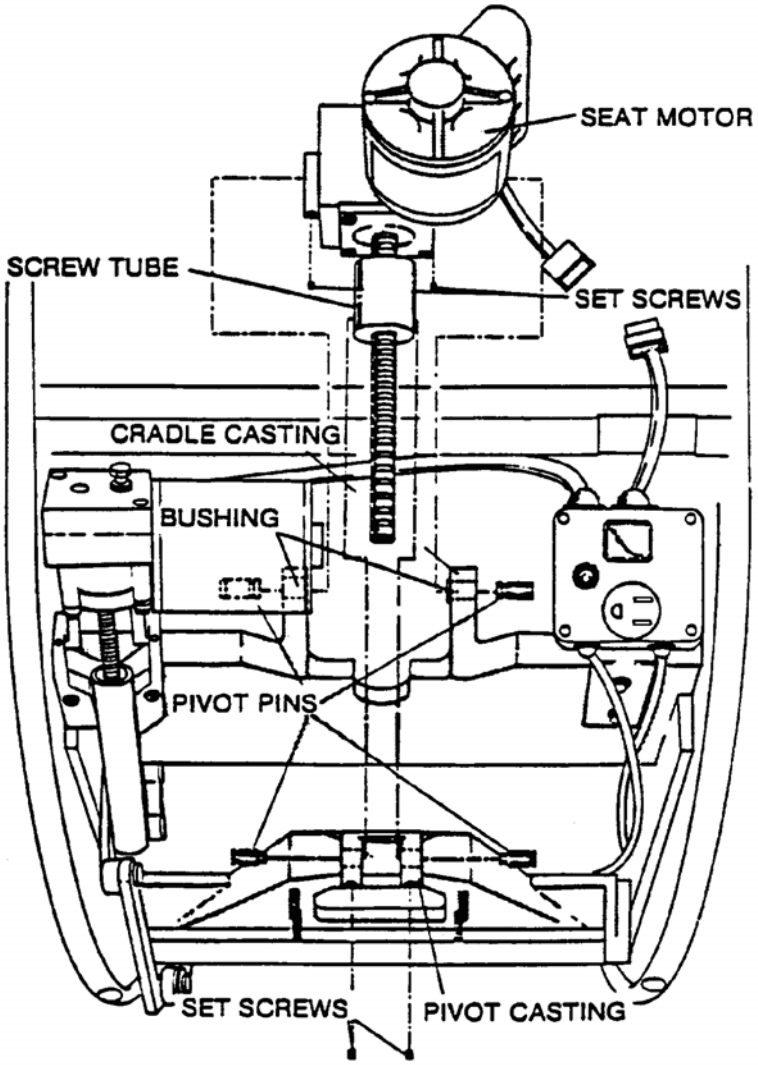


Figure 3-9. Seat motor removal.

a. Run the chair up to its full height.

b. Disconnect the external power source.

c. Disconnect the chair electrical cords from the lift.

d. Remove the four screws and nuts securing the chair to the lift.

e. Lift the chair free and place it on its side on the floor.

f. Disconnect the seat motor power cord.

g. Loosen the two set screws securing the pivot pins in the screw tube and remove the pivot pins.

h. Loosen the set screws securing the pivot pins in the seat motor gear housing and pry the pivot pins free.

i. Lift the seat motor from the casting.

j. Connect the following:

(1) The new seat motor plug to the proper connector from the junction box.

(2) The chair power cord to the lift.

(3) The lift to the external power source.

k. Depress the seat control switch and operate the motor to the TOE DOWN limit.

NOTE: Let the screw tube turn free. The screw tube will rotate counterclockwise as the motor runs toward the TOE DOWN position. The seat motor assembly has been factory set at the TOE DOWN position.

l. Disconnect the chair power cord and the external power cord.

m. Secure the seat motor gear housing to the cradle casting with the pivot pin and set screws you removed in step h. above, taking care not to rotate screw tube more than 1/2 turn.

NOTE: The pivot pins must be driven into the housing.

n. Secure the screw tube with the pivot pins and set screws you removed in step g above.

o. Install the chair to lift using the screws and nuts you removed in step d. above.

p. Connect all the power cords.

q. Operate the controls to check the new seat motor.

Continue with Exercises

EXERCISES, LESSON 3

INSTRUCTIONS: Answer the following exercises by circling the lettered response that best answers the question.

After you have answered all of the exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers. For each exercise answered incorrectly, reread the lesson material referenced after the solution.

1. Which of the following procedures applies to removing and replacing a faulty manual control switch?

   a. Keep the external power source connected so you can test the switch as you make each connection.

   b. Pull the wiring harness completely away from the chair in order reach the switch bezel.

   c. Disconnect and connect replacement switch assembly socket terminals one at a time rather than disconnecting all at once and then replacing.

   d. Replace the wiring harness as well whenever replacing the switch bezel.

2. Which of the following procedures applies to removing and replacing a faulty base motor when the chair is in the “UP” position?

   a. Place a block of wood between the pantograph arms on one side and lower the pantograph slightly to grip the block of wood securely.

   b. After you have reconnected all of the electrical leads in the junction box and reconnected the power source, run the motor clockwise until it stops to correspond with the raised condition of the lift.

   c. Leave at least one inch of space remaining between the parallel pantograph arms when the motor stops at the low lift position because the lift must not over travel when the pantograph arms close up under power.

   d. Once the lift is at the lower extreme position, adjust the height of the lift. Loosen the locknut on the adjusting screw and turn clockwise to lower the lower limit of the lift.

3. Which of the following is a true statement about changing a base motor when the dental chair is in the “DOWN” position?

   a. You do not need to remove the chair as you do when the chair is in the UP position.

   b. You must always replace the chain when you replace the motor.

   c. You must be sure the limit switch cover is secure before you slide the gear motor forward.

   d. You will need a helper to lift up on the lift assembly while you remove the faulty motor.

4. Which of the following applies to replacing the back motor?

   a. Lower the chair to its minimum height, place the back in full recline, and put seat in full downtilt.

   b. Support the back of the chair when you loosen the set screws on the seat motor screw tube pivot pins.

   c. Pry the pivot pins out of the pivot castings, raise the toe section of the chair, and place a wood block between pivot casting and chair mount casting.

   d. Always replace the back motor bracket as well as the back motor by removing the set screws and the trunnion pins securing the two together.

5. Which of the following applies to replacing the seat motor?

   a. You can replace the limit switch without replacing the seat motor.

   b. You can remove the seat motor without removing the chair from the pedestal.

   c. You must not rotate the screw tube more than 1/2 turn when you secure the seat motor gear housing to the cradle casting.

   d. You must take care not to drive the pins into the housing when you are securing the seat motor gear housing to the cradle housing.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES: LESSON 3

1. c (para 3-2d NOTE)
2. a (para 3-3a(2) CAUTION)
3. d (para 3-3b(8))
4. c (paras 3-4e, f)
5. c (para 3-5m)

End of Lesson 3

LESSON ASSIGNMENT

LESSON 4	Perform Preventive Maintenance Checks and Services on the Dental Operating Unit.
TEXT ASSIGNMENT	Paragraphs 4-1 through 4-5.
TASKS TAUGHT	Perform Preventive Maintenance Checks and Services on the Dental Operating Unit.
LESSON OBJECTIVES	When you have completed this lesson, you should be able to: 4-1. Identify the water and air circuits in the dental operating unit. 4-2. Identify the components of the dental operating unit. 4-3. Identify the frequency and steps in performing PMCS on the dental operating unit.
SUGGESTION	Work the lesson exercises at the end of this lesson before beginning the next lesson. These exercises will help you accomplish the lesson objectives.

LESSON 4

PERFORM PREVENTIVE MAINTENANCE CHECKS AND SERVICES ON THE DENTAL OPERATING UNIT

4-1. GENERAL

The A-DEC Dental System consists of two main subsystems. These are the dental chair and the dental operating unit. The A-DEC chair incorporates electronic circuitry to provide for control of the hydraulic motor/pump assembly. Two small circuit boards with cable connections and chair mounted control switches provide for chair control. The A-DEC dental operating unit utilizes the Century II Automatic Control System in conjunction with the foot control for handpiece operation. This lesson covers PMCS procedures on the dental operating unit for which you, as the medical equipment repairer, are responsible.

4-2. OVERVIEW OF SYSTEM DESIGN

Refer to figure 4-1 for a schematic of the flow of water and air throughout the dental operating unit.

a. Unregulated air and water enter the unit from a floor mounted service box through the air and water closet valves. Air is supplied through line #1 to the air and water utility module. Two sources of air are then distinguished at this point; continuous filtered regulated air and continuous filtered unregulated air.

(1) The filtered unregulated air is supplied to the master control block through line number 2. Switching the master control toggle ON creates a holdback air source to control the handpiece hanger valves. It also creates a pilot air source which enables other functions of the dental operating unit.

(2) From the control block, pilot air, enabled (regulated) by the master toggle, is supplied to the air and water pre-regulators through line number 3. The air preregulator accomplishes three tasks.

(a) Air is supplied to the water heater (if so equipped).

(b) Air is then supplied to the pilot air valve (water relay valve) on the main incoming water line through line number 4. This enables an air actuated diaphragm thus allowing water to enter the utility module through line number 5.

(c) Pilot air is also supplied to the air regulators and the air and water utility module through line number 6. This signal is applied to another air actuated diaphragm. The air pre-regulator is adjusted thus changing the regulated air delivery pressure.

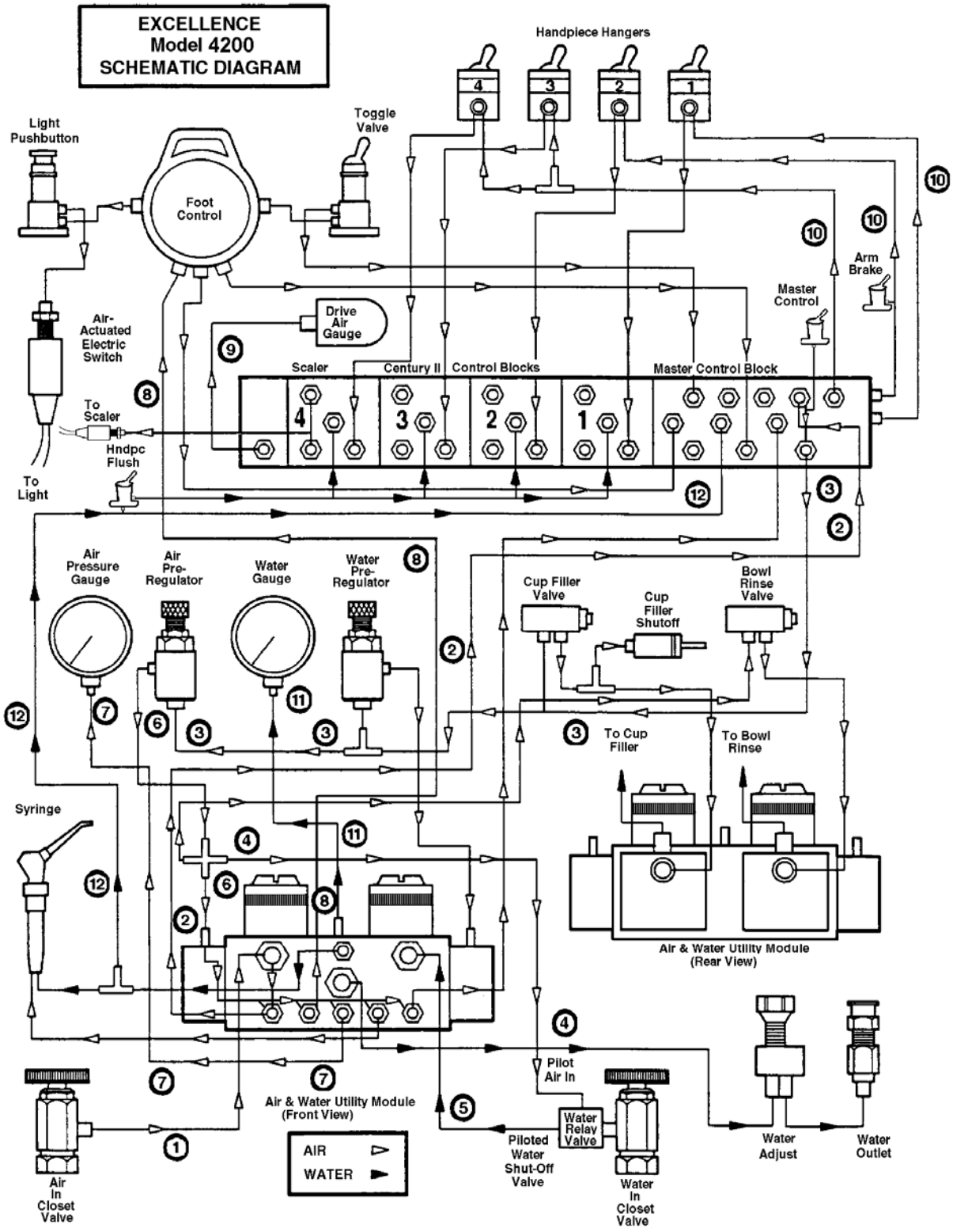


Figure 4-1. A-DEC dental operating unit schematic diagram.

(3) Line number 7 from the air and water utility module feeds a regulated air signal to the system air pressure gauge located in the utility module.

(4) Another regulated air line, number 8, from the utility module feeds the foot switch. The foot switch becomes the source for air for the following systems.

(a) System drive air.

(b) Coolant air.

(c) Chip air.

(d) Water coolant signal air.

(5) A line, number 9, from the control block feeds the drive air pressure gauge. Coolant air and drive air are supplied through the master block to the control blocks for the individual handpieces. Regulated air is supplied through the master block to the individual handpiece hangers number 10.

b. Water is supplied to the unit in the same fashion that air is processed. A pilot air signal, located near the water closet valve, opens the air actuated diaphragm in the water relay valve enabling unregulated water to enter the air and water utility module through line number 5.

(1) An air operated diaphragm, within the water pre-regulator, adjusts the system water pressure which can be read on the water pressure gauge number 11.

(2) Water is supplied from the air and water utility module to the water heater tank (if supplied). From the tank, heated water flows to the master control block, number 12, and is distributed to the individual handpieces and the accessories.

4-3. DENTAL OPERATING UNIT COMPONENTS

a. **Master Block Assembly.** Refer to figure 4-2. The master block houses the master ON-OFF valve, the ON-OFF indicator, the air coolant flow control, the water coolant ON-OFF valve, and the syringe flow controls. All the working components are accessible from the front of the unit and are of the "cartridge" design, so they can be serviced without disconnecting any tubing.

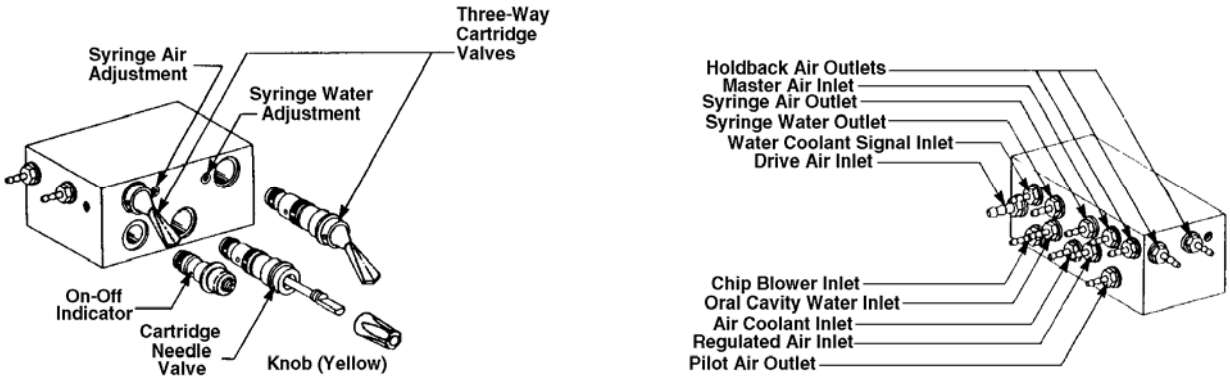


Figure 4-2. Master block assembly.

b. **Control Blocks.** The control block, in both the automatic and manual systems, controls the routing of air and water coolant and drive air to the handpieces. The control blocks are used in conjunction with the master block and either a manual selector valve or a set of automatic handpiece hangers, to make a complete control system. Refer to figure 4-3.

(1) Each of the control blocks has laterally drilled passages for drive air, water coolant, air coolant/chip blower, and signal air. These passages line up with the outlet passages in the end of the master block.

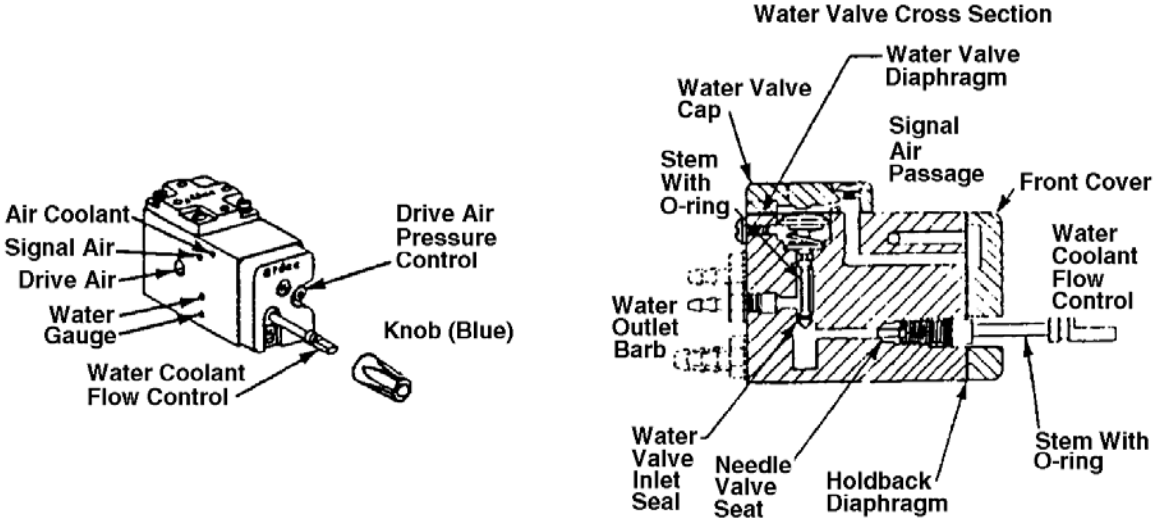


Figure 4-3. Control blocks.

(2) In each block, the following processes occur,

(a) The lateral passages for the drive air, air coolant, and signal air intersect with longitudinal passages that lead to the front surface of the block.

(b) Parallel to these, other longitudinal passages lead to the handpiece drive air barb, the handpiece pressure gauge, the handpiece air coolant barb, and the cap for the water valve.

(c) It is here, at the surface of the block, that air from the foot control is either held back or allowed to flow through and run the handpiece.

(3) The front cover of the control block has three cavities in the inner surface. These cavities in the cover correspond in location to the three groups of passages drilled in the front of the block. When the block is assembled, with the diaphragm in place between the block and the cover, the cavities allow the diaphragm to deflect away from the surface of the block, so air can flow between the grouped passages.

(4) However, the flow between the grouped passages can occur only if the diaphragm is allowed to deflect into the cavities in the cover. Air pressure from the handpiece hanger valve or the handpiece selector valve, applied into the cavities, presses and holds the diaphragm against the block. This prevents any flow between the passages, so the handpiece cannot operate.

(5) In automatic control systems, placing a handpiece in its hanger actuates the hanger valve to supply the "holdback signal" that pressurizes the cavities in the cover and shuts off the control block. Lifting the handpiece out of its hanger releases the holdback signal allowing air to pass through the control block. In manual control systems, the manually-operated selector valve accomplishes this task.

(6) Water coolant for the handpiece is controlled by an integral water valve in the control block. The water is supplied through a passage from the master block. This passage intersects with the water coolant flow control needle valve bore. After passing the needle valve seat, the water flows to the inlet seal at the bottom of the water valve stem. Unless the water valve is actuated, the flow of water is blocked at this point.

(7) Actuation of the water valve occurs when air pressure is applied above the water valve diaphragm in the water valve cap. The signal air reaches the water valve cap after passing the holdback diaphragm at the front of the control block. When the signal air reaches the water valve cap, it deflects the diaphragm downward. This, in turn, pushes the stem downward and unseats the inlet seat, allowing water to flow through the valve to the outlet barb.

(8) Releasing the signal air pressure allows the spring to push the stem and diaphragm back up to close the valve.

c. **Foot Control.** The foot control is actuated by foot pressure on the cover, which depresses the stem assembly in the valve bore. This moves the fluted surfaces of the stem below the inlet O-ring seal, allowing air to flow to the outlet. When foot pressure is released, the stem returns, sealing the inlet at the O-ring. Any pressure from the outlet side of the valve is then exhausted as the fluted surfaces move above the outlet O-ring seal. Refer to figure 4-4.

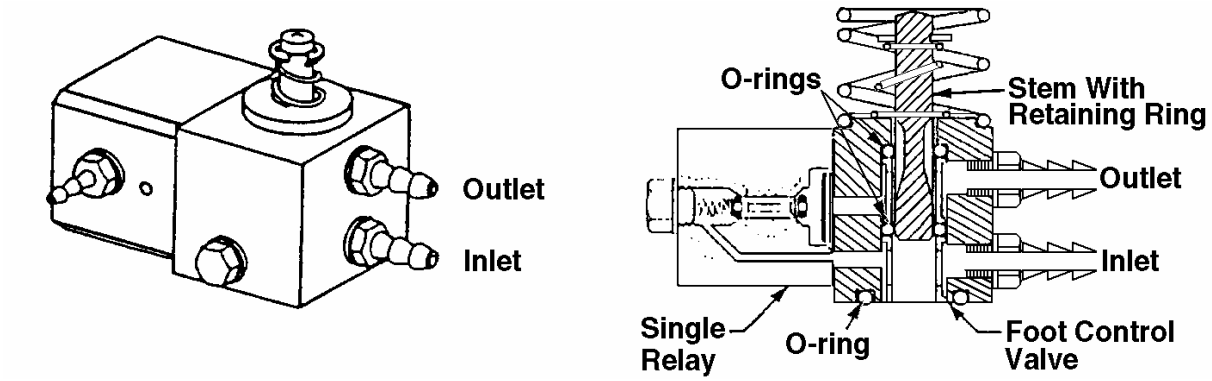


Figure 4-4. Foot control.

4-4. UNIT OPERATION AND CHECK OUT PROCEDURE

Prior to operating the dental operating unit, perform the following check out procedures.

a. Turn the dental operating unit ON.

(1) Turn the alternating current (ac) power ON.

(2) Turn the air closet valve ON.

(3) Turn the water closet valve ON.

(4) Turn the vacuum system ON.

b. Verify that there are adequate delivery pressures in the dental unit. Check the filters monthly to ensure there are adequate delivery pressures in the dental unit. If necessary, clean the filters at the air and the water utility module. The optimum system pressures for all A-DEC units are as follows.

(1) 80 pounds per square inch (psi) for air.

(2) 40psi for water.

c. Adjust the delivery pressures at the air and the water pre-regulators, if required.

(1) In systems that use dual pre-regulators, you must adjust the air pressure before the water pressure since that adjustment affects both the air and water pressures.

(2) In systems that use a single pre-regulator, the air and water pressures are both controlled by the same regulator whose outlet pressure is always one-half that of the air regulator. Thus, by adjusting the system air pressure to 80psi, the water pressure is automatically regulated to 40psi.

(3) In systems that use two of these pre-regulators, the air and water pressures are independently adjustable.

(4) With all systems, adjust the pre-regulator by using the following procedures.

(a) Turn the knob clockwise to increase pressure.

(b) Turn the knob counterclockwise to decrease pressure.

NOTE: The pilot-operated regulators are not self-relieving. When adjusting to decrease the pressure, relieve the pressure in the system before reading the gauge. Do this by running a handpiece or depressing the syringe buttons. Refer to figure 4-5.

d. Turn the master ON-OFF toggle to the ON position; the ON-OFF indicator should change colors.

NOTE: This step cannot be accomplished unless the foot pedal is depressed, and the handpieces are attached.

CAUTION: Do not run handpieces without a burr in the chuck, or before properly oiling the turbine as damage to the unit can occur. Use only sterile test burrs.

CAUTION: Do not exceed recommended operating pressures as specified by the manufacturer's literature.

e. Adjust the coolant air pressure for all handpieces simultaneously using the coolant air flow control valve.

f. Reposition the control head, if necessary, using the arm brake toggle switch located on the right side of the control head.

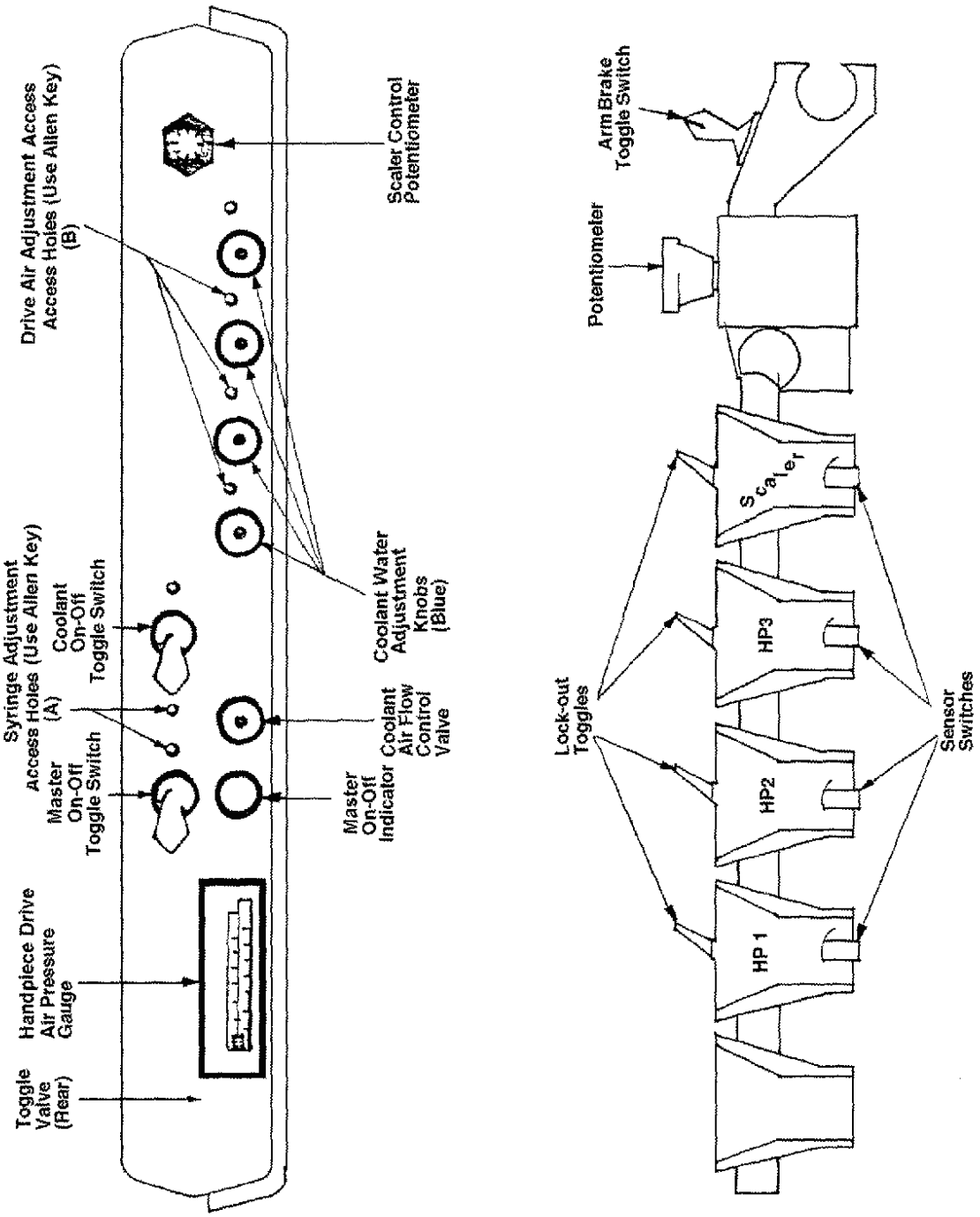


Figure 4-5. Control panel and handpiece hangers.

g. Verify that the vacuum system works properly.

(1) Turn the water supply to the pumps ON.

(2) Turn the vacuum system ON.

(a) Verify that high volume suction is present.

(b) Verify that suction from the saliva ejector is present.

h. Push the master ON-OFF toggle to the right. This supplies water to the entire unit. Verify that the following items operate properly. These items are located on the cuspidor arm assembly.

(1) The cup filler.

(2) The weight actuated shut-off feature.

(3) The bowl rinse.

i. Verify that the syringe on the assistant's chair arm operates properly.

(1) Verify that there is a misting effect when both valves are pushed simultaneously.

(2) Adjust the valves to achieve a misting effect as necessary.

(a) Locate the countersunk Allen key access holes (A) that are to the right of the master control toggle.

(b) Adjust the adjusting points for the air and the water syringe outputs. The left adjusting points adjust the air output. The right adjusting point adjusts the syringe water output.

j. Verify that each handpiece operates properly.

CAUTION: Never run a handpiece without a burr installed as damage will occur to the unit. Never run a handpiece until it has been properly lubricated. Do not exceed handpiece manufacturer's recommended operating pressures.

(1) Depress the foot switch toggle to the WATER ON position.

(2) Verify that each handpiece expels drive air, coolant air, and coolant water.

(a) Verify that drive air pressure is reflected on the drive air pressure gauge.

(b) Adjust the air pressure, as necessary, by using the countersunk Allen key access holes (B) which correspond to handpiece (HP) #1 through HP #3 (left to right).

(c) Adjust the water volume, as necessary, by using the blue control knobs that correspond to the HP numbers 1-3.

NOTE: The foot switch toggle must be in the WATER ON position.

k. Verify that the high speed handpiece is installed in HP num ber 3 hanger position.

l. Verify that the optical light source illuminates when you select HP number 3 and depress the foot switch.

m. Verify that you can vary the intensity of the lamp using the potentiometer on the right side of the control head.

n. Verify that the handpieces are placed in their proper hangers. Each of the handpieces and the scaler device has its own hanger. Each automatic hanger consists of the following.

(1) A lock-out toggle which when turned on or off enables or disables the corresponding handpiece.

(2) A sensor switch in the back. These switches are positioned such that the weight of the handpiece enables the air supply thereby disabling the handpiece.

o. Verify that the scaler (ultrasonic prophylaxis) unit, in the control head, operates properly:

(1) Remove the scaler from the HP number 4 hanger and depress the foot switch. Water should drip out of the insert sleeve.

CAUTION: Water must run into the ultrasonic scaler (handpiece) sleeve, if not the sleeve can get very hot and possible burn out.

(2) Place an ultrasonic probe into the sleeve, and verify that there is water and high frequency output at the probe tip.

(a) Adjust the water flow by using the corresponding number 4 flow control valve, as necessary.

(b) Adjust the amplitude of the ultrasonic output by using the scaler control potentiometer that is located on the right hand side of the control head.

p. Verify that adequate water simultaneously flushes all handpieces when you depress the toggle valve on the rear of the control head.

4-5. ROUTINE PREVENTIVE MAINTENANCE CHECKS AND SERVICES

You must perform routine PMCS at least semi-annually to ensure continued reliable operation of the dental operating system. Preventive maintenance checks and services must also be performed each time a defective component is removed, replaced, or repaired.

a. **Inspect Parts.** Inspect parts whenever you remove and replace or repair defective components of the dental operating system.

NOTE: Air and water filters must be inspected monthly to ensure adequate delivery pressures in the dental unit.

(1) Replace all rubber gaskets or diaphragms of the defective components during reassembly.

(2) If the old gasket is re-used, inspect the gasket or diaphragm for pin holes or cracks.

(a) Use a magnifier to detect flaws that are too small to see otherwise.

(b) Inspect all sealing parts and surfaces of the seal area (the seal itself, the bore or seat in the valve body, and the O-ring groove in the valve stem or piston). Defects in any of these may result in a seal leakage.

b. **Lubricate Parts.** Lubricate parts whenever you remove the O-rings and are ready to replace them.

(1) Apply a light coat of silicone grease before installing the O-rings.

(2) Lightly lubricate the seal bores before inserting the stems and pistons.

(3) Lubricate the internal moving parts, the oral evacuator valves, and the bushings in the moveable arm systems whenever they require repair or replacement, or as otherwise necessary to ensure that they remain pliant.

c. **Clean and Inspect the Internal Parts.** Whenever you service the dental operating system you should clean and inspect the internal parts.

(1) Clean the disassembled internal parts of the dental operating system with a hot detergent solution whenever you service it.

(a) Wipe the parts with a soft, lint-free cloth.

(b) Flush all parts with clear, hot water, and rinse them in isopropyl alcohol.

(2) Inspect the disassembled internal parts for defects whenever you are reassembling the components of the dental operating system after you have serviced it.

Continue with Exercises

EXERCISES, LESSON 4

INSTRUCTIONS: Answer the following exercises by circling the lettered response that best answers the question.

After you have answered all of the exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers. For each exercise answered incorrectly, reread the lesson material referenced after the solution.

1. Which of the following statements concerning the system design for the A-DEC dental operating unit is correct?

   a. One of the functions of the air pre-regulator is to supply the air that allows water to enter the utility module.

   b. Another regulated air line from the utility module feeds water to activate the foot switch.

   c. The foot switch becomes the source of water for the cup filler valve and bowl rinse valve.

   d. A water actuated diaphragm, controlled by the water pre-regulator, adjusts the system delivery water pressure gauge.

2. Which of the following is the purpose of the control blocks?

   a. To house the air coolant flow control and the syringe flow controls.

   b. To control the flow of air to the foot control switch.

   c. To control the routing of air and water coolant and drive air to the handpieces.

   d. To provide air to an air actuated diaphragm that adjusts the system delivery water pressure gauge.

3. How often do you check the water and air pre-regulators?

   a. Daily.

   b. Weekly.

   c. Monthly.

   d. Quarterly.

4. Which of the following procedures do you follow prior to each operation of the dental operating unit?

   a. Adjust the syringe valves to achieve a steady stream of water when you push both valves simultaneously.

   b. Verify that each handpiece expels drive air, coolant air, and coolant water.

   c. Adjust the water pressure to 80psi and the air pressure to 40psi.

   d. Remove the scaler from its hanger and depress the switch verifying that water is <u>not</u> dripping out of insert sleeve.

5. Which of the following procedures do you follow as a part of routine PMCS?

   a. Always replace all rubber gaskets and diaphragms, never re-use them.

   b. Clean the dental operating unit by running a hot detergent solution through it.

   c. Never lubricate the O-rings or oral evacuator valves because the silicone grease can contaminate the system.

   d. After flushing all parts with clear, hot water, rinse them in isopropyl alcohol.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES: LESSON 4

1. a (para 4-2a(2)(b))
2. c (para 4-3b)
3. c (para 4-4b)
4. b (para 4-4j(2))
5. d (para 4-5c(1)(b))

End of Lesson 4

LESSON ASSIGNMENT

LESSON 5	Isolate Malfunctions to Component Level in the Dental Operating Unit.
TEXT ASSIGNMENT	Paragraphs 5-1 through 5-8.
TASKS TAUGHT	Isolate malfunctions to component level in the dental operating unit.
LESSON OBJECTIVES	When you have completed this lesson, you should be able to:

5-1. Identify procedures for troubleshooting a water subsystem malfunction.

5-2. Identify procedures for troubleshooting an air subsystem malfunction.

5-3. Identify procedures for troubleshooting a handpiece holdback system malfunction.

5-4. Identify procedures for troubleshooting a master block assembly malfunction.

5-5. Identify procedures for troubleshooting the pilot-operated regulators.

5-6. Identify procedures for troubleshooting the pre-regulators.

5-7. Identify procedures for troubleshooting the automatic bowl rinse system.

SUGGESTION	Work the lesson exercises at the end of this lesson before beginning the next lesson. These exercises will help you accomplish the lesson objectives.

LESSON 5

ISOLATE MALFUNCTIONS TO THE COMPONENT LEVEL IN THE DENTAL OPERATING UNIT

5-1. GENERAL

Whenever the dental operating unit malfunctions, you must troubleshoot to determine the cause. In this lesson, you learn how to isolate the cause of a variety of malfunctions in the A-DEC Model 4200 Dental System dental operating unit. As a medical equipment repairer, you perform this task whenever the dental operating unit malfunctions. The following procedures for isolating defective components are examples of the methods used to isolate all common malfunctions. You must correct malfunctions before returning the dental operating unit to service. For further information on isolating malfunctioning components of the A-DEC Model 4200 Dental System dental operating unit, refer to the manufacturer's service literature or the manufacturer's service representative.

5-2. TROUBLESHOOT A WATER SUBSYSTEM MALFUNCTION

If you find there are air bubbles in the water system, you could find the cause in several areas. Use the following procedures to isolate the actual malfunction.

a. **Air Bubbles in the Water System at the Water Regulator.**

(1) Determine if there is a defective O-ring on the connection tube at the syringe terminal (head). Refer to figure 5-1.

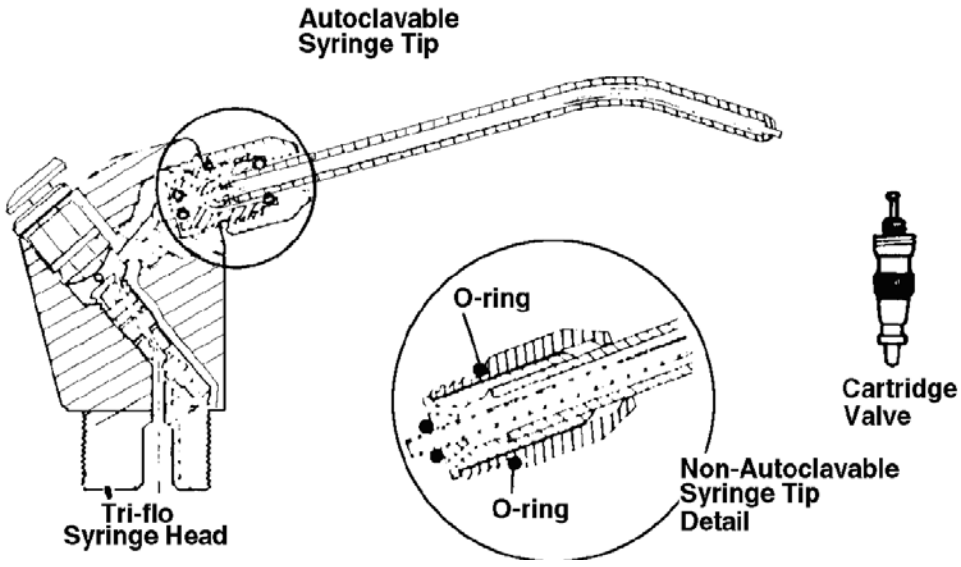


Figure 5-1. Syringe head.

(a) Use hemostats or similar tool to clamp the syringe tubing below the syringe handle.

(b) Retest the water flow from a handpiece or another water outlet.

(c) If you do not see air bubbles, unscrew the syringe handle and replace the connector tube O-rings.

(d) If air bubbles still appear in the water system, refer to (2) below.

(2) Determine if there is a hole in the water regulator diaphragm. Refer to figure 5-2.

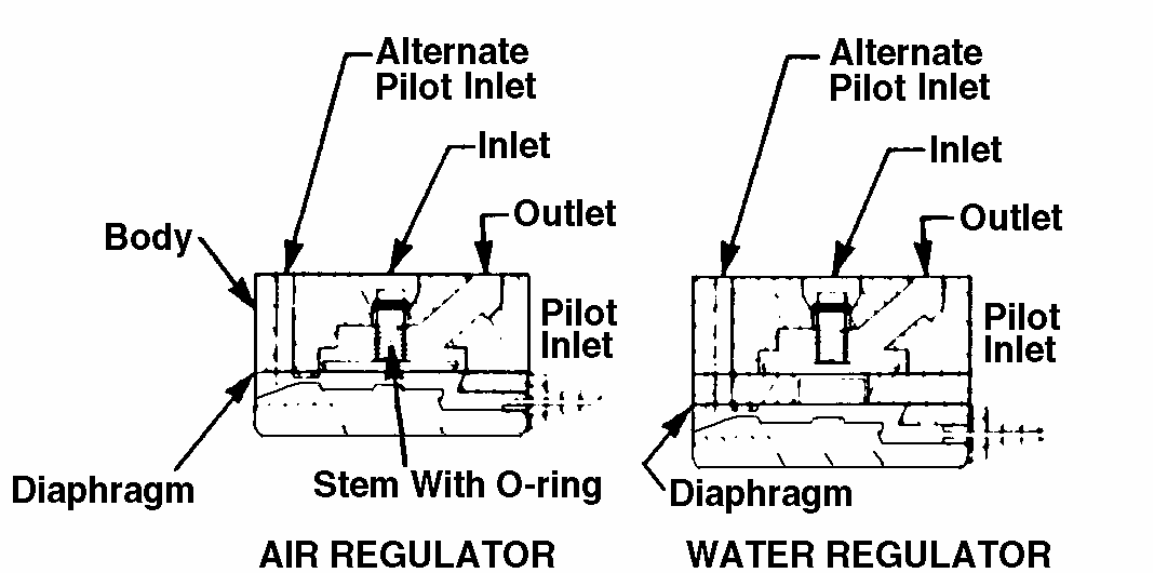


Figure 5-2. Pilot-operated regulators.

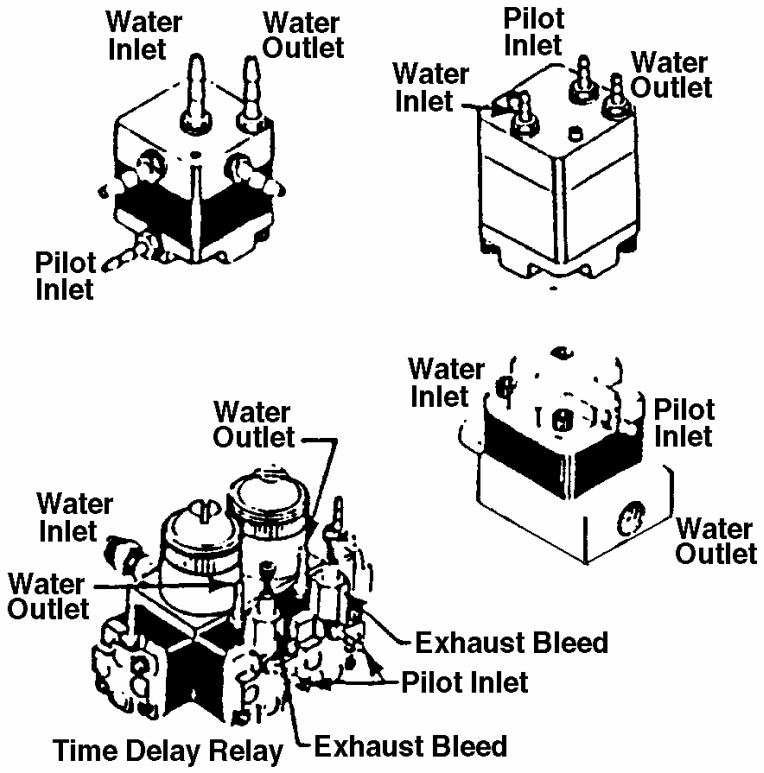
(a) Disconnect the pilot air tube from the regulator.

(b) Use a valve test syringe to pressurize the pilot air inlet on the regulator. You should be able to inject only a limited amount of air into the regulator. The plunger should spring back out by itself when released.

(c) If no defect is noted, check for air in the water supply to the unit.

(d) If you can push the plunger all the way in and it stays there when you release it, the diaphragm is defective. Install a new one and re-test the unit.

b. **Air Bubbles Causing Sputtering.** Determine if there is a leaking diaphragm in the water relay valve. Refer to figure 5-3.



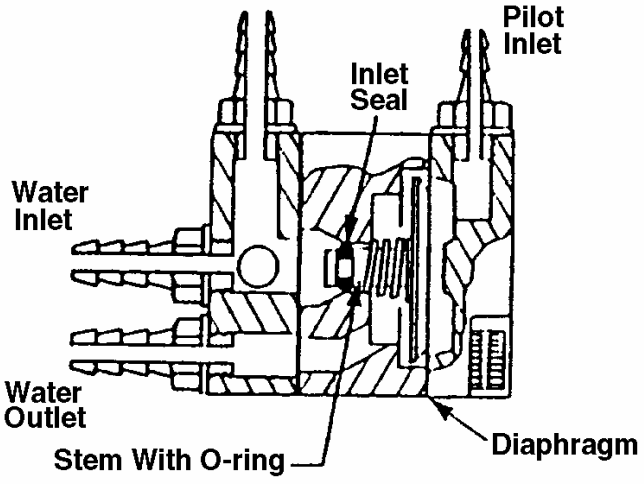


Figure 5-3. Water relays.

(1) Turn the master On-Off valve OFF.

(2) Remove the cover from the water relay valve.

(3) Remove and inspect the water relay diaphragm.

(a) If there is no defect in the diaphragm, reassemble and test the valve.

(b) If it is defective, replace the water relay diaphragm. Reassemble and test the valve.

c. **Air Bubbles in the Coolant Water.** Refer to figure 5-4.

(1) Determine if there is a defective O-ring on the connector tube at the syringe terminal. Refer to 5-2a(1) above.

(2) Determine if there is a defective water regulator. Refer to 5-2a(2) above.

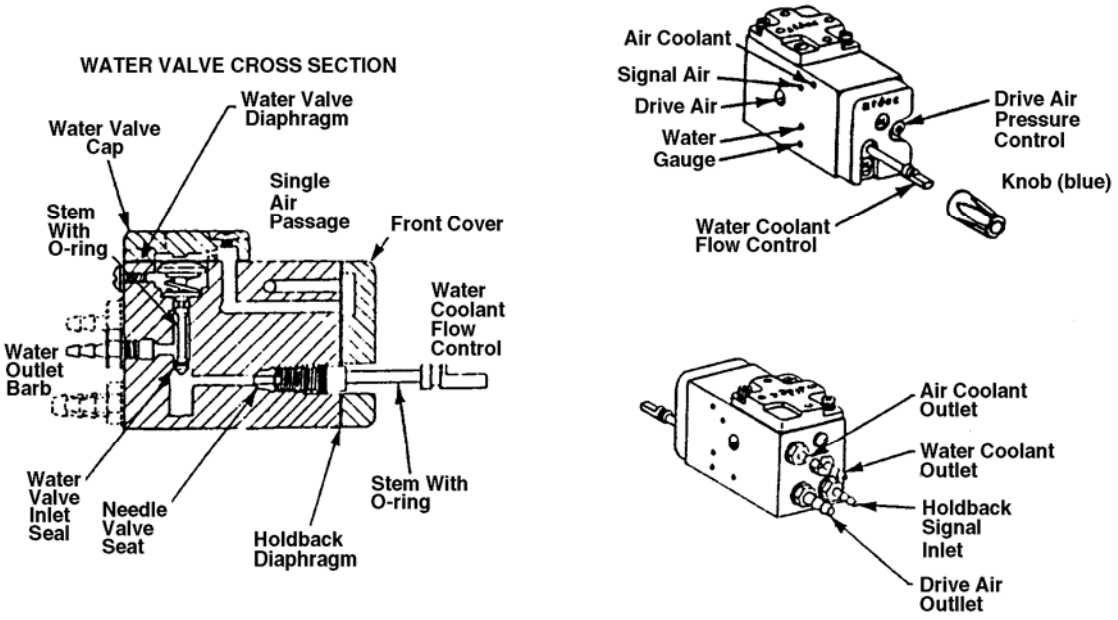


Figure 5-4. Water valve cross section.

(3) Determine if there are loose fasteners.

(a) Tighten the screws that secure the water valve cap to the control block.

(b) Tighten the tie bolt that secures the blocks together.

(c) If this corrects the problem, no further action is required.

(d) If there is still air in the water, proceed to (4) below.

(4) Determine if there is cross-leakage under the water valve diaphragm.

(a) Remove the cap from the top of the control block.

(b) Inspect the diaphragm and surfaces of the block and cap carefully.

(c) If you observe no defects, install a new water valve diaphragm. Reassemble and test the valve.

(d) If the test is abnormal, replace any defective parts. Reassemble and test the unit.

5-3. TROUBLESHOOT AN AIR SUBSYSTEM MALFUNCTION

When you have an audible leak when no one is using the foot control, the air subsystem is probably malfunctioning. After verifying that all tubing is properly connected, use the following procedures to find the cause of the malfunction, if necessary. Refer to figure 5-5.

a. Determine if the mounting screws are loose.

(1) Turn the foot control face down.

(2) Tighten the two Phillips-head screws at the center of the baseplate.

(3) If the leakage stops, no further action is required.

(4) If the leakage does not stop, proceed with the next step.

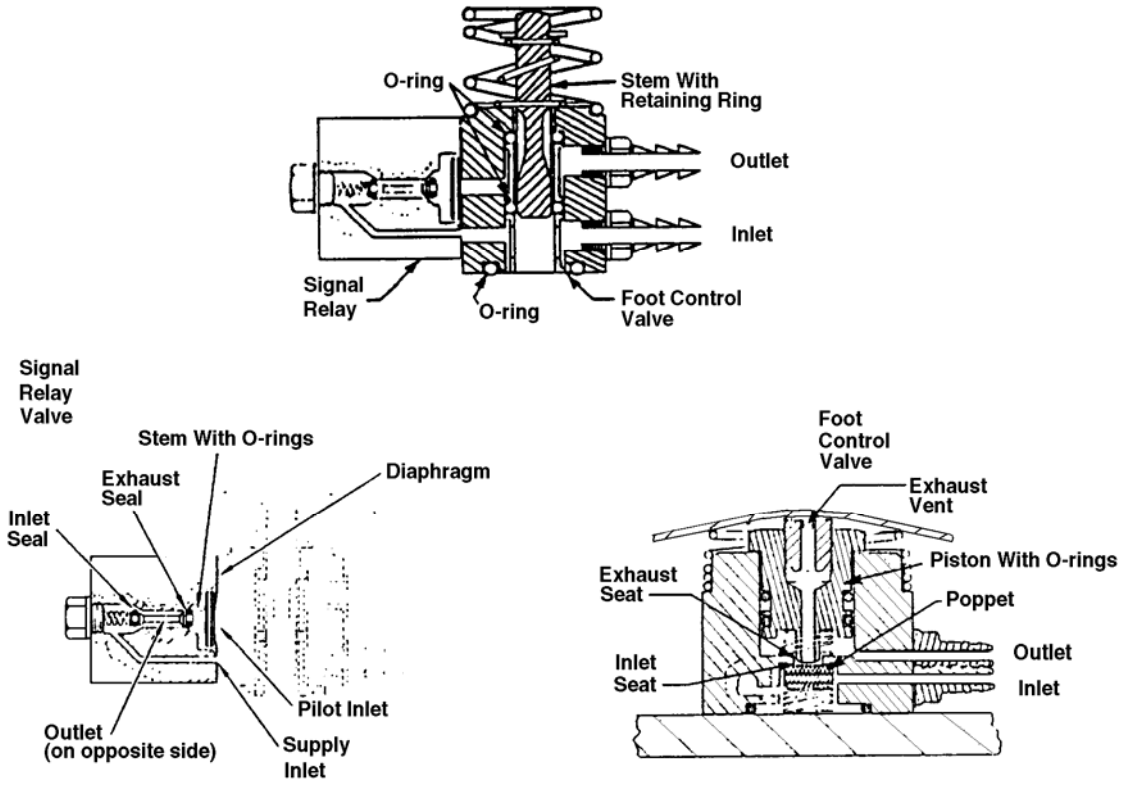


Figure 5-5. Foot control and foot control valve.

b. Determine if you have a loose connection.

WARNING

Before removing the foot control cover, turn the air supply OFF and bleed all pressure from the system. If this is not done, the stem assembly may be ejected from the foot control valve. Never turn the air supply to the foot control ON when the cover is off of the foot control, unless appropriate steps have been taken to ensure that the stem assembly cannot be ejected.

(1) Remove the foot control cover.

(2) Use a soap solution, if necessary, to locate the source of the leakage. The leak will bubble when you coat the area where the leak is occurring with a heavy soap-water solution.

(3) For leakage from the signal relay, use the following procedures. Refer to figure 5-5.

(a) Test for improper seating of the diaphragm with a soap solution. If the leakage is from the exhaust holes on the sides of the signal relay, proceed with (b). If the leakage is at the diaphragm line, tighten the signal relay mounting screws. If the leakage persists, replace the diaphragm.

(b) Test to see if the signal relay inlet seal does not fully close. Shut the unit OFF. Remove the signal relay from the foot control, inspect the stem, O-rings, and seats for debris or defects. If you see no defects, carefully clean and lubricate the parts, reassemble, and test the valve. If the test is abnormal, replace any defective parts. Clean and lubricate the parts, reassemble, and test the valve.

(4) If the air is leaking around a barb connection, tighten the barb and re-test the valve.

(5) If the air is leaking from the exhaust vent or around the bottom of the valve body, proceed with the next step.

c. Determine if there is a defective O-ring or sealing surface, poppet or inlet seal.

(1) Turn the unit to OFF and bleed the air pressure.

(2) Disassemble the foot control.

(3) Inspect the O-rings and sealing surfaces for defects or debris.

(4) If you have leakage from the exhaust vent, inspect the poppet and inlet seal for defects or debris.

(5) If no defects are noted, carefully clean and lubricate the parts. Reassemble and test the valve.

(6) If the test is abnormal, replace any defective parts. Carefully clean and lubricate the parts. Reassemble and test the valve.

5-4. TROUBLESHOOT A HANDPIECE HOLDBACK SYSTEM MALFUNCTION

Sometimes the handpieces on the dental operating unit will continue to run while in their holders. You isolate the malfunction based on how the holdback system is malfunctioning. Refer to figure 5-6.

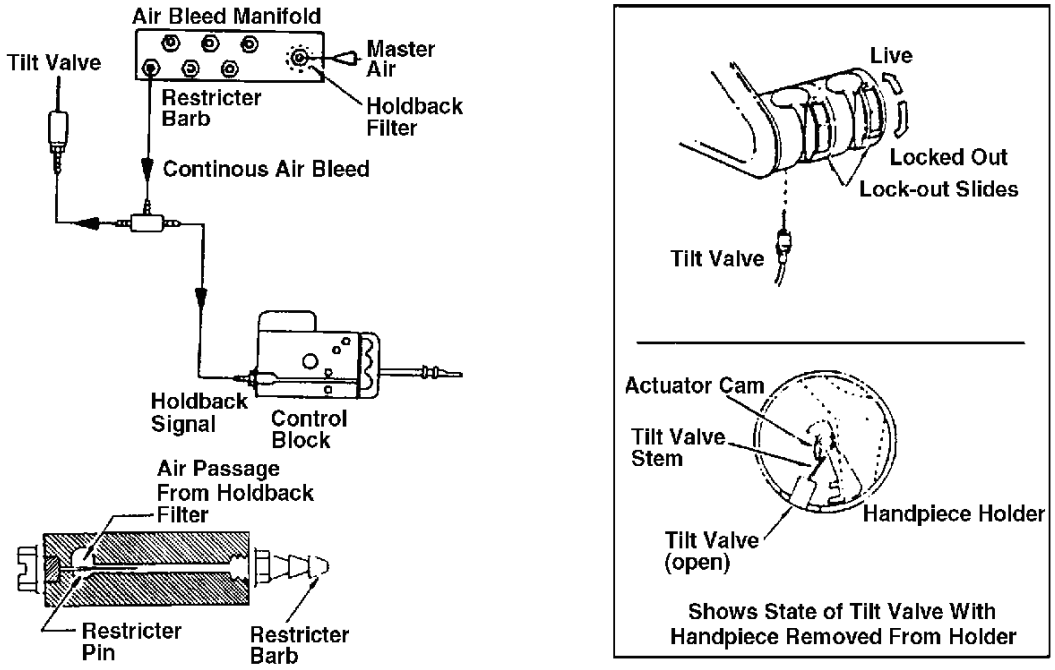


Figure 5-6. Handpiece holdback system.

a. **All the Handpieces Run While in Their Holders.** A possible cause is that the holdback filter is clogged. Use the following procedures to isolate the actual cause of this malfunction.

(1) Remove and inspect the holdback filter. The filter can most easily be removed using the system's internal air pressure.

(a) Turn the system off.

(b) Remove the cap over the filter.

(c) Cup your hand over the filter opening.

(d) Turn the system back on momentarily to eject the filter out of its seat. Then, inspect the filter.

(2) If you do not need to replace the filter.

(a) Check for a loose connection.

(b) Check leakage between the holdback outlet of the master block and the filter inlet of the air bleed manifold.

(3) If the filter is damp or discolored, replace it.

b. **One Handpiece Runs While in Its Holder.** There are multiple possible causes for this malfunction. Use the following procedures to isolate the actual cause.

(1) Verify that the handpiece is in the correct holder.

(a) If it is in the correct holder and is still running, go to (2) below.

(b) If it isn't in the correct holder, move it to the correct one.

(2) Verify that the restricter pin is clean and installed correctly.

(a) Remove and clean the restricter pin associated with the faulty handpiece.

(b) If this solves the problem, no further action is required.

(c) If the handpiece continues to run, proceed to (3) below.

(3) Verify that there is no loose connection or leaky tubing.

(a) Check for loose connections or leakage between the air bleed manifold, the control block, and the tilt valve.

(b) Use soapy water to detect a slight seepage.

(c) Repair the leaks and tighten loose connections.

(d) If none can be found, proceed to (4) below.

(4) Verify that there are no defective tilt valves.

(a) Use hemostats to clamp off the holdback tubing to the tilt valve.

(b) If the handpiece stops running, replace the tilt valve.

(c) If the handpiece continues to run, proceed to (5) below.

(5) Verify that the restricter barb is not clogged.

(a) Pull the tilt valve out of the handpiece holder.

(b) Manually tilt the system.

(c) Check for air flow around the tilt valve stem using soapy water, if necessary.

(d) If there is no air flow, replace the restricter barb.

(e) If there is air flow, proceed to (6).

(6) Verify that the diaphragm on the control block is not defective and that the holder is not defective. Refer to figure 5-4.

(a) Check for a defective holdback diaphragm in the control block.

(b) Replace the holdback diaphragm if necessary.

(c) If the control block holdback diaphragm is not defective, the actuator mechanism in the handpiece holder is defective. Replace the holder.

5-5. TROUBLESHOOT A MASTER BLOCK ASSEMBLY MALFUNCTION

You may see malfunctions that originate in the master block assembly. If the unit does not come on when the master ON-OFF valve is turned ON, use one of the following procedures based on the ON-OFF indicator showing either ON or OFF. Refer to figure 5-7.

a. **ON-OFF Indicator Shows OFF.** A possible cause is that there is no air pressure at the inlet to the master ON-OFF valve.

(1) Verify that you have turned on the compressor and that you have fully opened the manual shut-off valve.

(2) If so, turn the master ON-OFF valve ON and OFF while listening for a "puff" of air from around the toggle each time you turn the valve OFF.

(3) If you can hear a "puff," the outlet is plugged, either in the cartridge valve body or the master block.

(a) Remove the master ON-OFF valve.

(b) Clean the passages.

(4) If you cannot hear air, check for a clogged filter. If the filter is clogged, replace it. If the filter is okay, continue with the following procedures.

(a) Check for a pinched master air tube (solid yellow) between the filter-regulator and the master block.

(b) Check also for an obstructed barb on the master block.

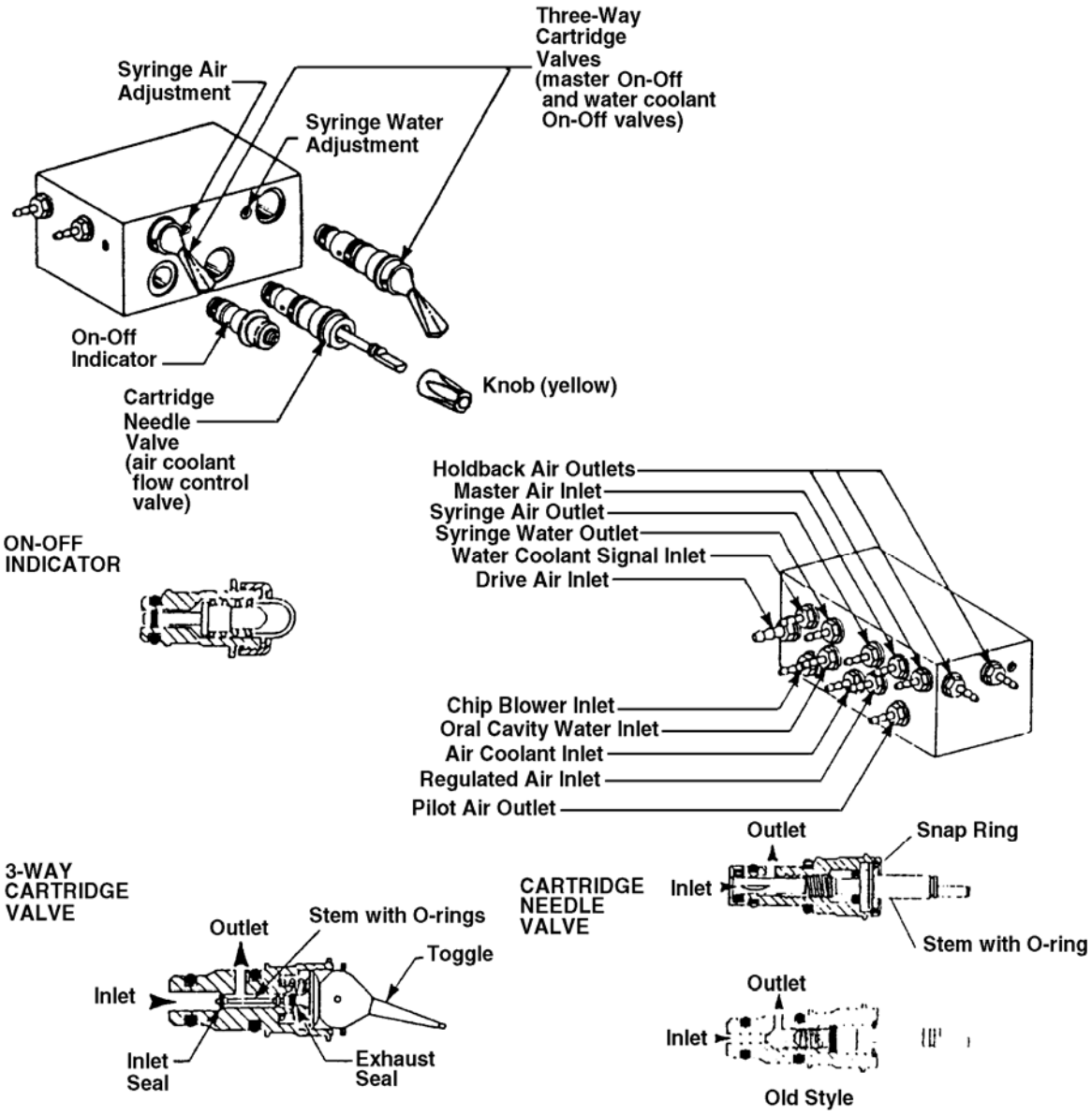


Figure 5-7. Master control block assembly.

b. **The ON-OFF Indicator Shows ON.** A possible cause is that there is no pressure at the air regulator outlet. Check the system air pressure gauge. It should indicate 80psi.

(1) If the system pressure is adequate, there is an obstruction between the regulator and the foot control.

(a) Check for crimped tubing.

(b) Check for plugged barbs.

(2) If there is little or no pressure indicated on the gauge, troubleshoot the pilot-operated regulators and pre-regulators, below.

5-6. TROUBLESHOOT THE PILOT-OPERATED REGULATORS

If the dental operating unit will not come on due to a lack of pressure either at the regulator outlet, or from leakage around the gasket or diaphragm, use the following procedures to troubleshoot the malfunction. Refer to figure 5-2.

a. **No Pressure at the Regulator Outlet.** There are at least three possible causes of no pressure at the regulator outlet.

(1) Supply is shut off ahead of the regulator.

(a) Turn the master ON-OFF valve OFF and bleed the system.

(b) Turn the manual shut-off valve OFF.

(c) Open the line on the outlet side ahead of the regulator.

(d) Cover the opening with a towel and briefly open the manual shut-off valve.

(e) If there is a good strong flow, proceed with to (2) below.

(f) If there is little or no flow, check the supply at its source.

(2) No pilot pressure to the regulator.

(a) Disconnect the signal air tube from the regulator.

(b) Turn the master ON-OFF valve ON.

(c) Check for air coming from the tube.

(d) If a flow of air is present, proceed with paragraph (3) below.

(e) If the test is abnormal with no air flow, it means that the problem is upstream from the regulator. Refer to the troubleshooting instructions for pre-regulators paragraph 5-7, below.

(3) Improperly assembled regulator.

(a) Disassemble the regulator and inspect all parts.

(b) Look for a diaphragm installed where the gasket belongs. The two parts are identical except that the gasket has a 9/16-inch hole in the center.

(c) If no problem is found, assemble and re-test the unit.

(d) If the regulator was improperly assembled, reassemble it with all parts in their proper positions. Re-test the unit.

b. **Leakage from the Gasket or Diaphragm Area.** Improper assembly or loose screws is the possible cause for this type of leakage.

(1) Tighten the screws.

(2) If the leaking still persists, use the following procedures.

(a) Disassemble the regulator.

(b) Inspect the gasket, diaphragm, and sealing surfaces on the block and cap.

(3) If all parts are in good condition, assemble and re-test the unit.

(4) If the test is abnormal, replace any parts that are defective, then assemble and re-test the unit.

5-7. TROUBLESHOOT THE PRE-REGULATORS

If the dental operating unit will not come on due to a lack of pressure at the pre-regulators, there are two additional symptoms you may see; either air leaking from a vent hole or no pressure from the outlet. Use the following procedures to isolate the malfunction. Refer to figure 5-8.

a. **Air Leaking from a Vent Hole.** Two possible causes for this symptom are leakage past the piston seal or exhaust seat, or that the inlet seal does not fully close.

(1) Leakage past the piston seal or exhaust seat.

(a) Test procedures for early design pre-regulators (pre-1979) are to remove the adjusting screw, spring, and piston from the pre-regulator and inspect the exhaust seat, stem, piston O-ring, and bore for defects or foreign matter.

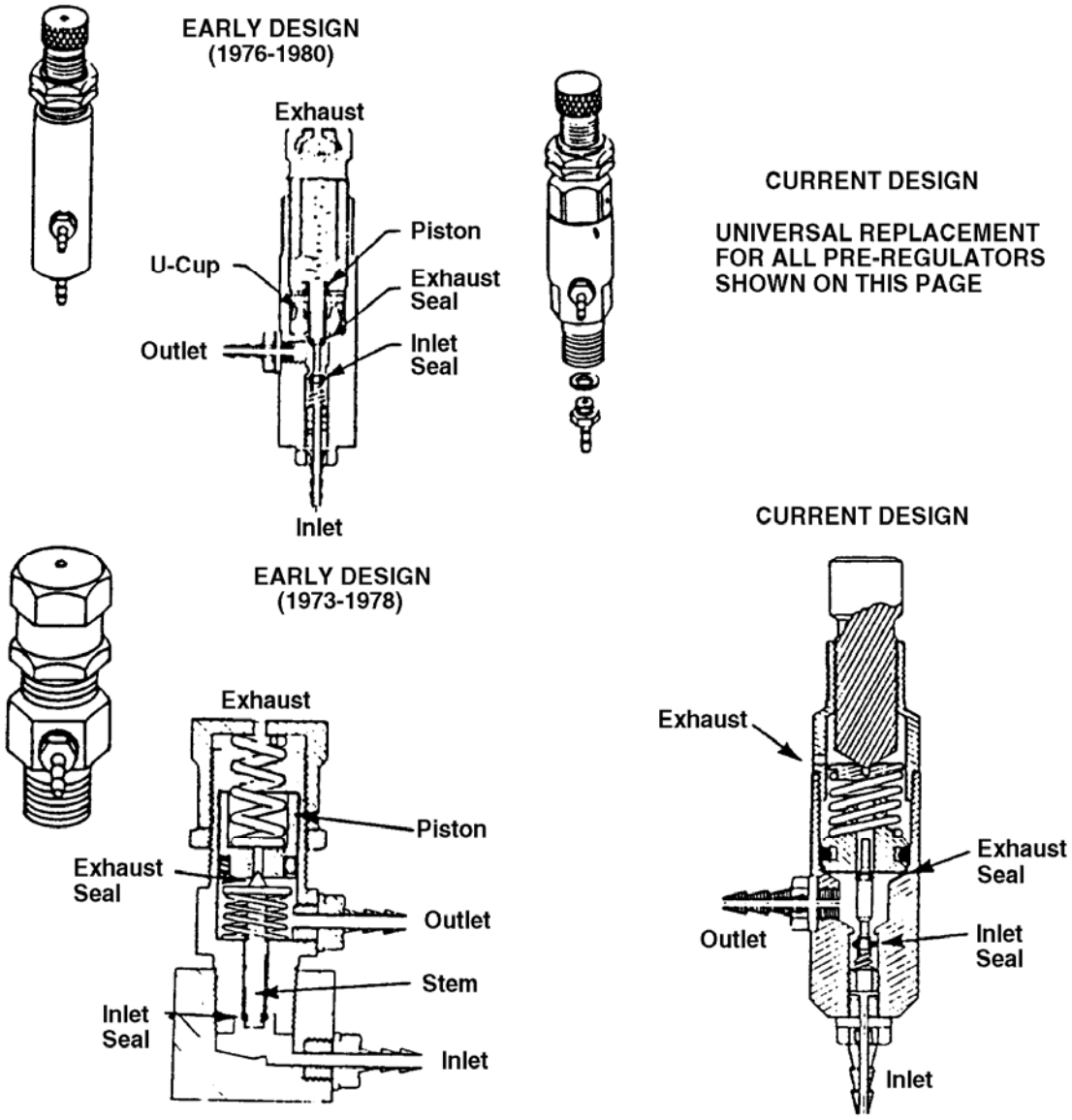


Figure 5-8. Pre-regulators.

(b) Test procedures for current design pre-regulators are to install a new pre-regulator and re-test the unit.

(c) If there are no defects, proceed with (2) below.

(d) If any parts are defective, replace the pre-regulator with one of the new design and re-test the unit.

(2) Inlet seal does not fully close.

(a) Test procedures for early design pre-regulators are (with the adjusting screw, spring, and piston still removed) to apply pressure at the inlet and verify that there is no air leakage from the pre-regulator.

(b) Test procedures for current design pre-regulators are to install a new pre-regulator and re-test the unit.

(c) If there is no leakage, clean and lubricate all parts and reassemble. Re-test the unit.

(d) If there is any leakage, clean and inspect the inlet seal area. If any parts are defective, replace the pre-regulator with one of the new design. Re-test the unit.

b. **No Pressure from the Outlet.** A possible cause for this is that the pre-regulator is improperly adjusted. The test procedure is to try adjusting the pre-regulator by turning the knob clockwise.

(1) If this results in pressure at the outlet, adjust the pressure.

(a) Turn the knob clockwise to increase pressure.

(b) Turn the knob counterclockwise to decrease pressure.

NOTE: When adjusting to decrease pressure, you must relieve the pressure in the system before reading the gauge because the pilot-operated regulators are not self-relieving. Do this by running a handpiece or depressing the syringe buttons.

(2) If adjustment does not result in pressure at the outlet, check for air pressure at the supply.

5-8. TROUBLESHOOT THE AUTOMATIC BOWL RINSE SYSTEM

The automatic bowl rinse system consists of an air-actuated water relay valve, a momentary two-way valve, and a needle valve. A single touch of the two-way valve provides a steady stream of water for rinsing the cuspidor bowl. There are two types of systems with which you may work: an automatic bowl rinse system used with the filter-regulator utilities system, shown in figure 5-9, and the automatic bowl rinse used with the utility module system, shown in figure 5-10. Flipping the two-way valve applies air pressure to the signal inlet on the water relay, thus opening the relay and allowing water to flow from the nozzle. The signal air pressure begins to bleed down as air exhausts through the time control valve. The setting of the time control valve determines the speed with which the pressure bleeds down. When the signal air pressure drops sufficiently, the water relay closes and the cycle ends. The bowl rinse time is factory pre-set at 25-30 seconds. If the bowl rinse does not shut off automatically, you must troubleshoot the malfunction using the following procedures.

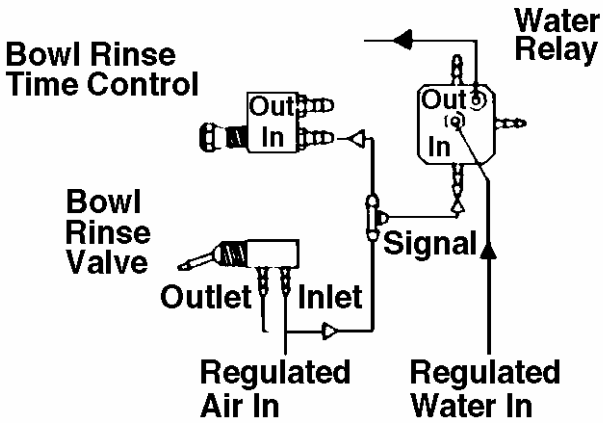


Figure 5-9. Filter-regulator utilities system.

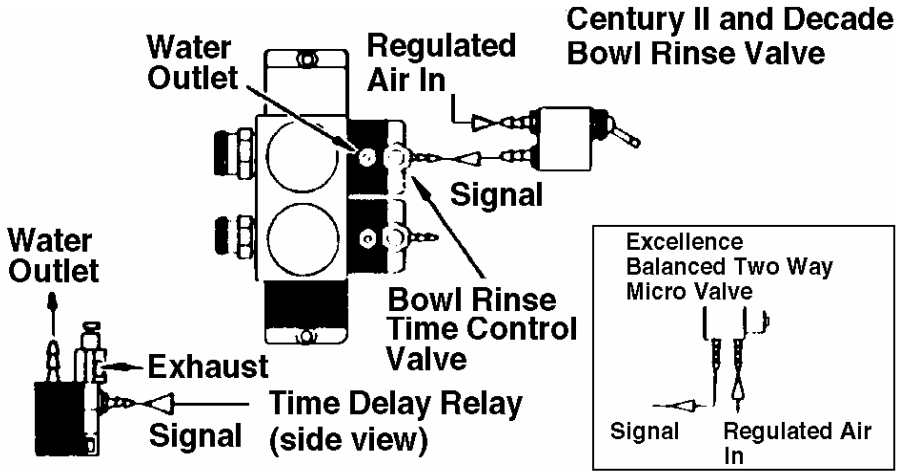


Figure 5-10. Utility module system.

a. **Improper Adjustment of the Bowl Rinse Time Control.** Improper adjustment of the bowl rinse time control is one possible cause for the bowl rinse to not shut off automatically. To test this, use the following procedures.

(1) Turn the bowl rinse time control counterclockwise while the rinse is activated.

(2) If the bowl rinse stops, set the rinse time control for the desired rinse time.

(a) Turn the control valve clockwise to increase rinse time.

(b) Turn the control valve counterclockwise to decrease rinse time.

(3) If the rinse does not shut off when the bowl rinse time control is fully counterclockwise, go to procedure b. below.

b. **Defective Time Control Valve.** If you have tested the bowl rinse time control and it has not solved the problem, use the following procedures to test for a defective time control valve.

(1) Remove the time control valve (or the tubing going to the time control valve for systems as in figure 5-9). The water should shut off immediately.

(2) If the water shuts off, there is an obstruction in the time control valve. For systems as in figure 5-9, refer to the instructions for needle valves below (refer to figure 5-11). For systems as in figure 5-10, clean the valve inlet.

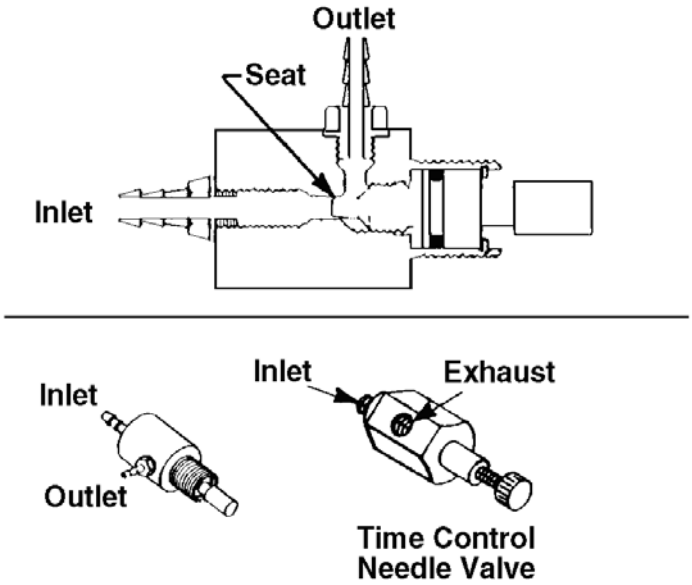


Figure 5-11. Time control needle valve.

(a) To test for an obstruction in the barb or valve body, verify that there is a flow at the valve inlet, then turn the control knob counterclockwise to open the valve.

(b) If the valve begins to work, adjust it for the desired rate of flow.

(c) If the valve remains blocked, clamp the inlet tube, then disassemble the valve. Carefully clean and lubricate the parts, then reassemble and test the valve.

(3) If the water stays on, refer to the instructions for the water relay valve below. Refer to figure 5-3.

(a) If the water relay valve does not completely shut off, you may have a defective O-ring seal on the end of the system. Disassemble the water relay valve and inspect the O-ring, stem, and seat for defects or debris.

(b) If there are no defects or debris, check to see if the signal to the water relay valve shuts off fully.

(c) If the test is abnormal, replace any defective parts. Reassemble and test the valve.

Continue with Exercises

EXERCISES, LESSON 5

INSTRUCTIONS: Answer the following exercises by circling the lettered response that best answers the question.

After you have answered all of the exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers. For each exercise answered incorrectly, reread the lesson material referenced after the solution.

1. Which of the following is a potential cause for air bubbles in the water system?

   a. Foot control mounting screws are loose.

   b. Debris is clogging the holdback filter.

   c. The water relay valve has a leaking diaphragm.

   d. There is no air at the air regulator outlet.

2. You are testing for an audible leakage in the foot control. Which of the following procedures would you use if you think the signal relay is leaking air?

   a. Remove, inspect, and if necessary, replace the holdback filter

   b. Tighten the two Phillips-head screws at the center of the foot control baseplate.

   c. Check the air flow around the tilt valve stem using soapy water.

   d. Remove the signal relay and inspect the stem, O-rings, and seats for debris or defects.

3. The dental operating unit will not come on, and the ON-OFF indicator shows ON. Which of the following procedures might you use to isolate the malfunction?

   a. Troubleshoot the time control valve.

   b. Troubleshoot the pre-regulators.

   c. Troubleshoot the foot control.

   d. Troubleshoot a syringe or handpiece holder.

4. Which of the following procedures would you use to isolate the malfunction of all the handpieces running while in their holders?

   a. Remove, clean, and reinstall the restricter pin.

   b. Check for leakage between the holdback outlet of the master block and the filter inlet of the air bleed manifold.

   c. Replace the diaphragm on the control block and all actuator mechanisms in the handpiece holders.

   d. Using hemostats, clamp off the holdback tubing and replace all tilt valves.

5. The dental operating unit will not come on, and the ON-OFF indicator shows OFF. Which of the following procedures do you use to isolate the malfunction?

   a. Verify you have turned on the compressor and fully opened the manual shut-off valve.

   b. Listen for a "puff" of air from each handpiece holder when you remove the handpiece.

   c. Check for an obstruction between the regulator and the foot control.

   d. Check for a pinched pilot air tube between the pre-regulator and the utility module.

6. The bowl rinse does not shut off automatically. Which of the following procedures do you use to troubleshoot the malfunction?

   a. Test the master ON-OFF valve.

   b. Test for improper adjustment of the bowl rinse time control.

   c. Test the pre-regulator to ensure that there is sufficient air pressure in the system.

   d. Test the handpiece holdback system to verify there is sufficient water in the system.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES: LESSON 5

1. c (para 5-2b)
2. d (para 5-3b(3)(b))
3. b (para 5-5b(2))
4. b (para 5-4a(2)(b))
5. a (para 5-5a(1))
6. b (para 5-8a)

End of Lesson 5

LESSON ASSIGNMENT

LESSON 6	Remove and Replace or Repair Defective Components of the Dental Operating Unit.
TEXT ASSIGNMENT	Paragraphs 6-1 through 6-6.
TASKS TAUGHT	Remove and Replace or Repair Defective Components of the Dental Operating Unit.
LESSON OBJECTIVES	When you have completed this lesson, you should be able to: 6-1. Identify the special equipment required to remove and replace or repair defective components of the dental operating unit. 6-2. Identify the procedures to remove and replace defective components in the air, water, and mechanical subsystems.
SUGGESTION	Work the lesson exercises at the end of this lesson before beginning the next lesson. These exercises will help you accomplish the lesson objectives.

LESSON 6

REMOVE AND REPLACE OR REPAIR DEFECTIVE COMPONENTS OF THE DENTAL OPERATING UNIT

6-1. GENERAL

Once you have isolated a malfunction in the A-DEC dental operating unit, you must remove and replace or repair the defective component. You can service most A-DEC valves and components in the field with the aid of certain special tools described in this lesson. This may be particularly necessary when you need to get a doctor's equipment back into operation quickly. The procedures covered in this lesson are examples of the methods to use to correct common malfunctions.

6-2. MEDICAL REPAIRER'S EQUIPMENT

The following is a description of the types of tools, beyond the medical equipment repairer's tool kit and volt-ohm meter (multimeter) that may be required in removing and replacing or repairing components of the A-DEC dental operating unit.

a. **Hemostats.** These are useful for temporarily stopping air or water flow through the tubing while troubleshooting or repairing the unit. Refer to figure 6-1.

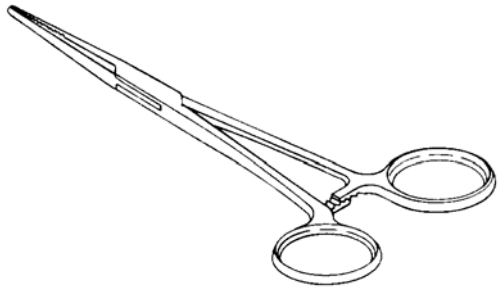


Figure 6-1. Hemostats.

b. **Valve Test Syringe.** Use the syringe for making quick tests of the pilot-operated valves. It can apply a static pressure of 5 to 75psi. Refer to figure 6-2.

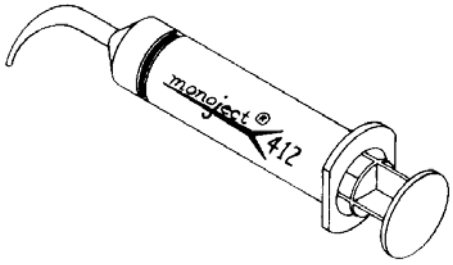


Figure 6-2. Valve test syringe.

c. **Test Gauge.** Use an A-DEC air pressure gauge with a 0-100psi range for checking air pressure at various points while troubleshooting the system. You also require the following to use this gauge: barbed fitting, washer and sleeve clamp kit, tee barb and sleeve clamp kit, and a two-foot length of 1/8-inch tubing. Refer to figure 6-3.

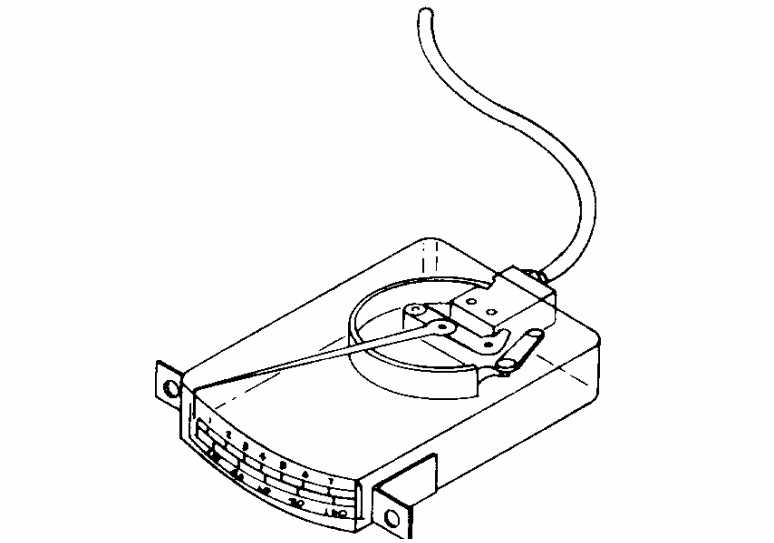


Figure 6-3. Test gauge.

d. **Syringe Tool.** This tool incorporates a valve core tool, a 3/32-inch hex wrench for adjusting the syringe flow, and a 5/32-inch hex wrench for removing and installing the syringe tip insert. Refer to figure 6-4.

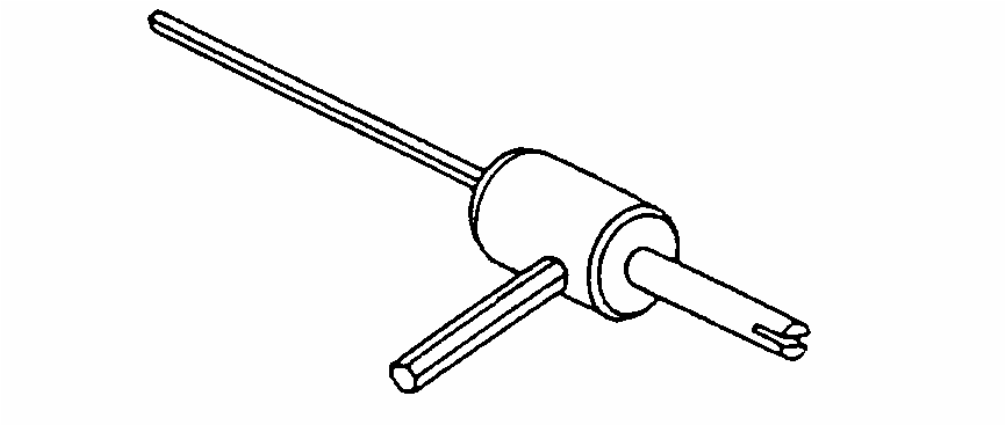


Figure 6-4. Syringe tool.

e. **Sleeve Tool.** Use this for pressing the 1/4 and 1/8-inch tubing sleeves in place when installing the tubing on the barb fittings. Refer to figure 6-5.

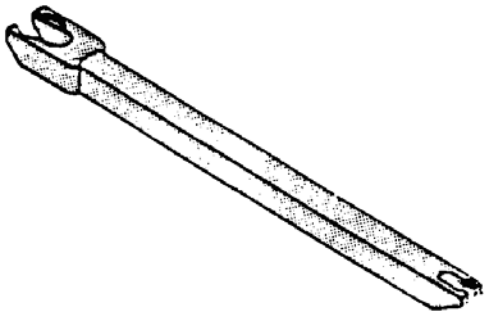


Figure 6-5. Sleeve tool.

f. **Tubing Pliers.** Use these modified pliers for pushing 1/8-inch tubing onto the barbed fittings. Refer to figure 6-6.

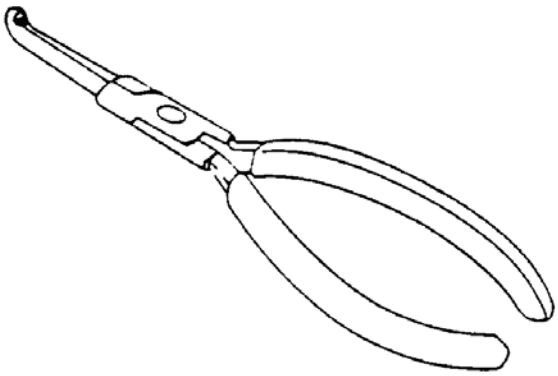


Figure 6-6. Tubing pliers.

g. **Snap Ring Pliers.** These snap ring pliers are for both inside and outside the snap rings and fit all the sizes used in A-DEC equipment. Refer to figure 6-7.

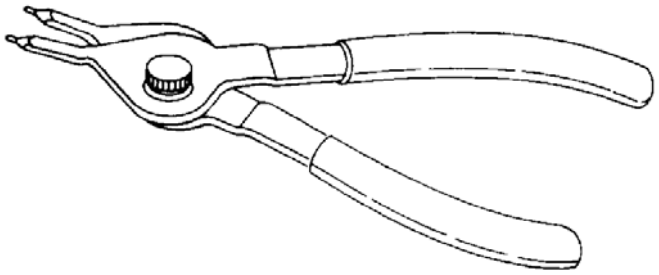


Figure 6-7. Snap ring pliers.

h. **Umbilical Tubing Stringer.** This tool provides an easy way to string new or additional tubing into an existing umbilical assembly. Refer to figure 6-8.

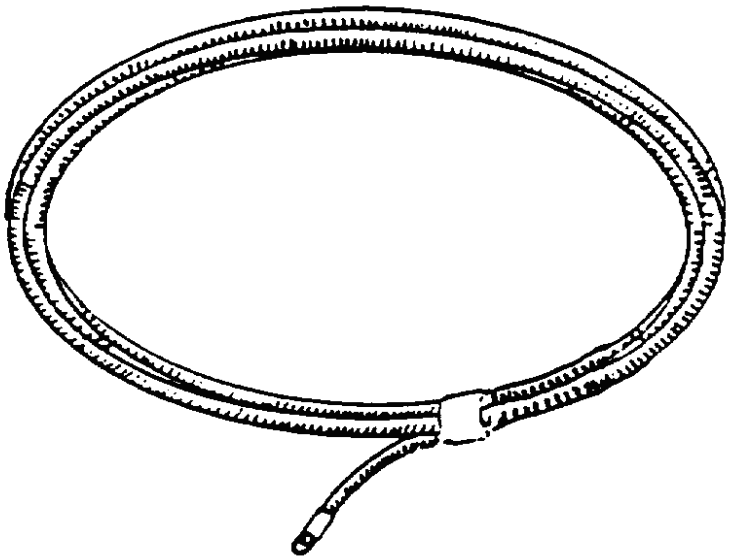


Figure 6-8. Umbilical tubing stringer.

i. **Pocket Magnifier.** This 10X magnifier is for inspecting defects in miniature valve parts. Refer to figure 6-9.

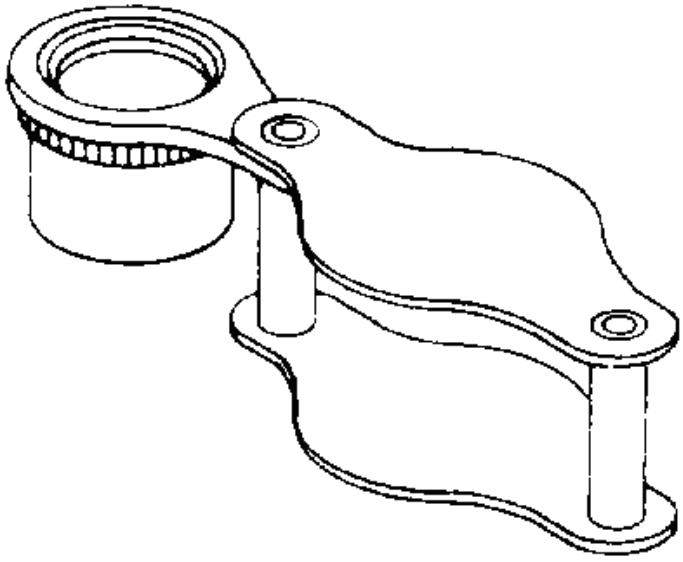


Figure 6-9. Pocket magnifier.

j. **O-Ring Installation Tools.** These tools enable you to make quick repairs in the field on most A-DEC miniature components. The three tools in this set fit the four smallest O-ring sizes in A-DEC equipment. Refer to figure 6-10.

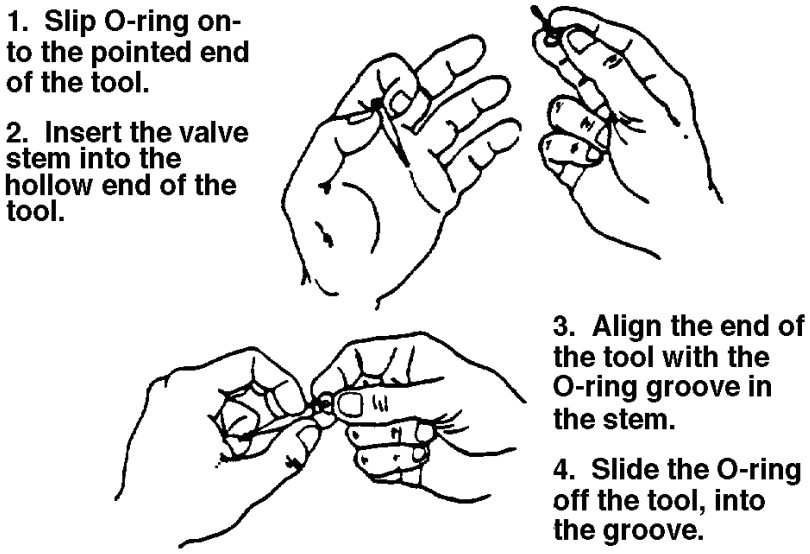


Figure 6-10. O-ring installation tools.

k. **Hex Wrench Set With Holder.** This complete hex wrench set includes all hex wrenches that might be required to service the A-DEC equipment. The plastic holder keeps the hex wrenches together and makes them easy to identify. Refer to figure 6-11.

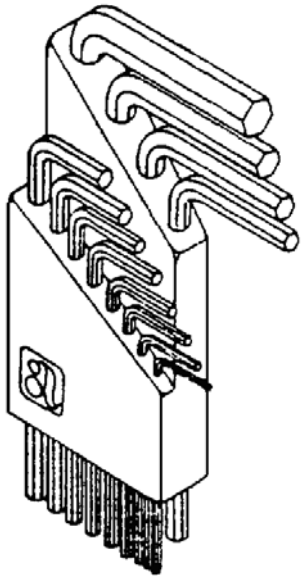


Figure 6-11. Hex wrench set with holder.

6-3. REMOVE AND REPLACE PILOT-OPERATED REGULATOR DIAPHRAGM

After troubleshooting for air bubbles in the water system, you isolate the fault to a hole in the pilot-operated water regulator diaphragm. To correct the fault, you must remove and replace the defective diaphragm. Refer to figure 6-12.

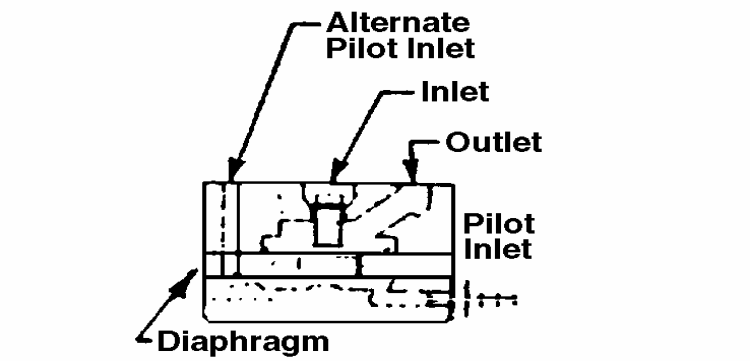


Figure 6-12. Pilot-operated water regulator.

a. Turn the water to the unit off at the floor utility box, bleed any water left in the system, and remove the water regulator from the control box.

b. Turn the regulator face up (the word "A-DEC" should be right-side-up).

c. Remove the two Allen screws that are diagonally opposed to each other, and loosen the third screw in the bottom right corner.

d. Separate the top from the bottom of the regulator. The white spacer will remain attached to the top of the regulator.

e. Remove and replace the diaphragm.

(1) Do not overtighten the screws as deformation of the diaphragm will occur.

(2) Tighten evenly to ensure that the diaphragm is not wrinkled causing air leaks.

NOTE: The top cover is made of a relatively soft brass and overtightening will permanently distort it and cause it to leak.

f. Reverse steps a. through d. above to reassemble the diaphragm.

6-4. REMOVE AND REPLACE FOOT CONTROL SIGNAL RELAY VALVE O-RINGS

After troubleshooting for an audible leakage when you are not using the foot control, you isolate the fault to defective O-rings in the foot control signal relay valve. To correct the fault, you must remove and replace the O-rings. Refer to figure 6-13.

No.	Description
1	Housing, Accessory, Plastic, 2-hole, Gray
2	Actuator, Button, Valve
3	Toggle Valve Lever, Gray
4	Spring, Helical Comp, .300 OD x 40
5	Cap, Spring, Wet/Dry Valve Assy
6	O-ring, AS568-014, .489 ID x .070 W
7	Set Screw, Cup Pt, 6-32 x 3/16
8	Pin, Dowel, .125 Dia x .625 Lg, Stl
9	Holder, Valve, Gray
10	Valve, Micro, Two-way
11	Valve, Micro, Three-way
-	Valve Assy, Chip Blower (includes items 2, 4, 6, 7, 8, 9, & 11)
-	Valve Assy, Wet/Dry (includes items 3, 4, 5, 6, 7, 8, 9 & 10)
12	Base Assy, Foot Control, Gray
-	Bumper Pad, Rubber, 1/2 Dia, Gray (not shown)
13	Screw Pan Hd Phil, ff x 1/2, Stl, Zinc
14	Screw, Pan Hd Phil, #6 x 1/2, Mtl, Zinc
15	Cover, Foot Control
16	Retaining Ring, Internal, 5" OD
17	Spring, Helical Comp, .760 OD x .47
18	Stem Assy, Foot Control
18A	Retaining Ring, External, .167" ID
19	Spring, Conical Comp, .265 x .485 OD
20	Valve Body, Foot Control
21	Diaphragm, 3/4 Square x .013 Thk
22	Body, Valve, Signal Relay
23	Screw, Pan Hd Phil, 4-40 x 7/8 Zinc
24	Spring, Compression, .93 OD x .250
25	Stem w/O-rings Valve, Signal Relay
25A	O-ring AS568-001, .029 ID x .040 W
26	O-ring, AS568-008, .176 ID x .070 W
27	Spacer, .307 OD x .223 ID
28	O-ring, AS568-012, .364 ID x .070 W
29	Screw, Soc Hd, 4-40 x 1/4, Zinc

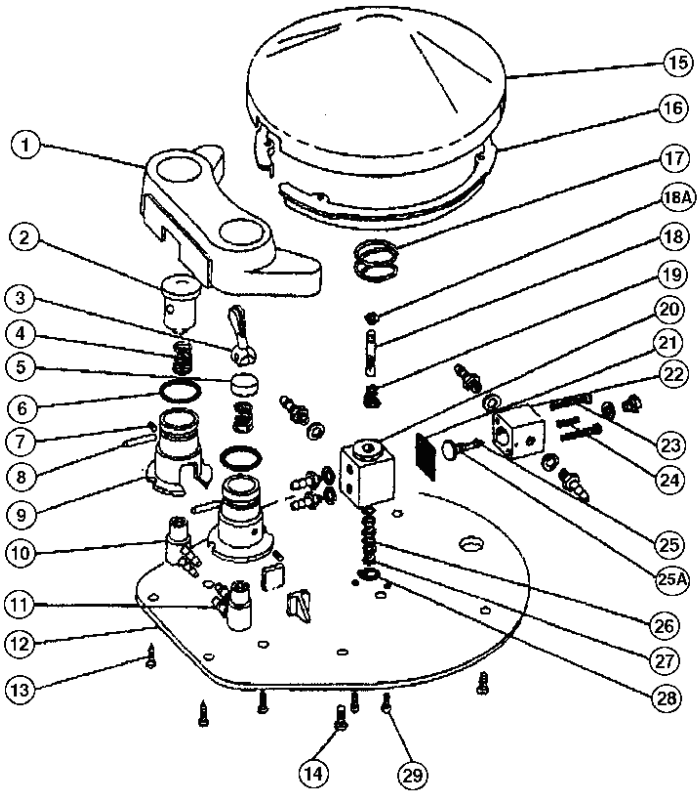


Figure 6-13. Foot control.

WARNING

Before removing the foot control cover, turn the air supply off and bleed all of the pressure from the system. If this is not done, the stem assembly may be ejected from the foot control valve. Never turn the air supply to the foot control on when the cover is off of the foot control, unless appropriate steps have been taken to ensure that the stem assembly cannot be ejected.

a. Position the foot control so that the silver top is face down.

b. Remove the four Phillips screws from the base. This will release the silver top.

c. On the bottom of the foot control, remove the two Allen screws that are in the center of the black base.

d. Separate the top of the foot control from the base.

e. Remove the stem with the retaining ring by sliding the stem up.

f. Turn the assembly over.

g. Remove the visible O-ring and slide the spacer out.

h. Remove the three O-rings and two spacers from inside the valve.

i. Grease the new O-rings lightly with A-DEC Silicone Lubricant prior to inserting them into the grooves.

j. Reverse steps a. through h. to reassemble the valve.

NOTE: Before installing O-rings, always apply a light coating of silicone grease. This makes installation easier and will prevent the O-rings from being damaged. The seal bores should also be lightly lubricated before inserting the stems or pistons.

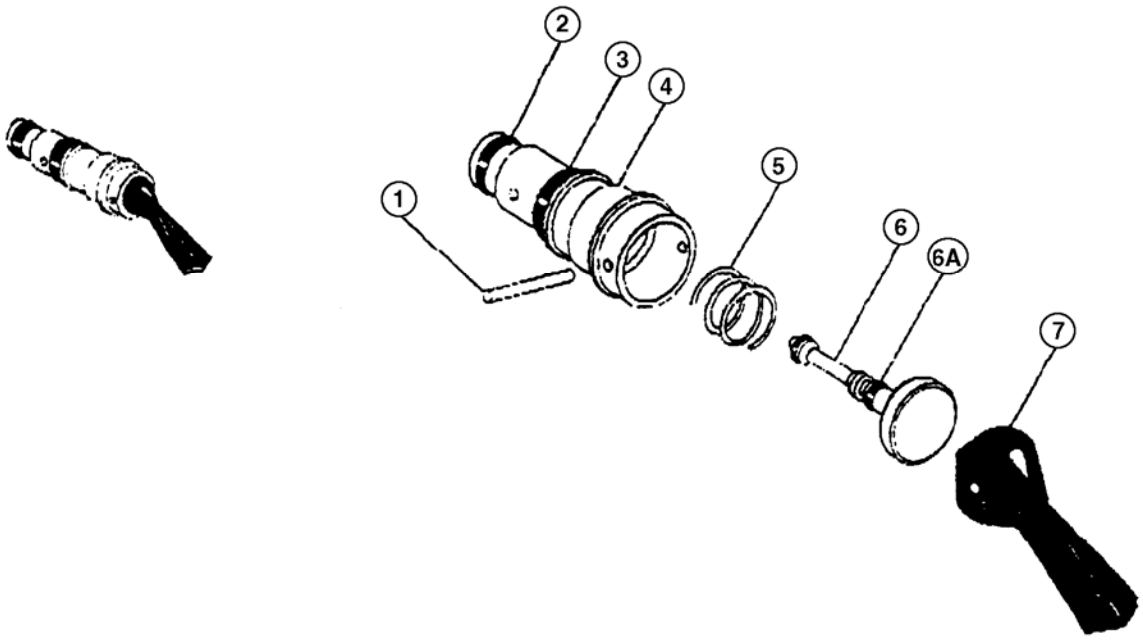
6-5. REMOVE AND REPLACE MASTER BLOCK 3-WAY CARTRIDGE VALVE STEM O-RING

After troubleshooting an air leak on the master block to a cartridge toggle valve that is turned ON, you isolate the problem to a defective O-ring on the stem. You must remove and replace the defective O-ring. Refer to figure 6-14, number 6A.

a. Pull the knobs off of the air and water coolant flow controls. The cartridge valves are flanged so that they cannot be removed through the faceplate.

b. Remove the two screws that secure the master block to the faceplate, then move the block assembly away from the faceplate.

c. Turn the air to the unit off at the floor utility box and bleed all air pressure left in the system.



No.	Description
1	Pin, Straight, .062 Dia x .450 Lg. SST
2	O-ring, AS568-008, .176 ID x .070 W
3	O-ring, AS568-010, .239 ID x .070 W
4	Body, Valve, Toggle, Cartridge

No.	Description
5	Spring, Helical Comp, .300 OD x .40
6	Stem w/O-rings, Three-way
6A	O-ring, AS568-001, .029 ID x .040 W
7	Lever, Plastic, Toggle Valve, Gray

Figure 6-14. Cartridge valve, 3-way.

d. Loosen the set screw that secures the valve in the block. The set screws are on the bottom of the master block.

e. Pull the cartridge valve out of the master block. If the valve can not be pulled out by hand, use pliers on the toggle or stem.

f. Lightly coat the replacement valve O-rings with silicone lubricant, then push the replacement valve in until it is fully seated. For toggle valves, be sure that the ON/OFF position is properly oriented. Firmly tighten the set screw.

g. Reinstall the block assembly to the faceplate, then turn the air on at the floor utility box.

6-6. REMOVE AND REPLACE WEAK SPRING IN FOOT CONTROL

After troubleshooting the foot control for a sluggish response, you isolate the malfunction to a weak spring in the foot control. You must remove and replace the defective spring. Refer to figure 6-13, number 17.

NOTE: Before removing the foot control cover, turn off the air supply and bleed all \ pressure from the system. If this is not done, the stem assembly may be ejected from the foot control valve. Never turn on the air supply to the foot control when the cover is off of the foot control, unless you have taken appropriate steps to ensure that the stem assembly cannot be ejected.

a. Position the foot control so the silver top is face down.

b. Remove the four Phillips screws from the base. This releases the silver top.

c. On the bottom of the foot control, remove the two Allen screws that are in the center of the black base.

d. Separate the top portion of the foot control from the base.

e. Remove the stem with the retaining ring by sliding the stem up.

f. Holding the stem firmly, remove the retaining ring which is holding the spring in place.

g. Place a replacement spring over the stem and replace the retaining ring.

h. Reverse steps a. through f. above to reassemble the unit.

Continue with Exercises

EXERCISES, LESSON 6

INSTRUCTIONS: Answer the following exercises by circling the lettered response that best answers the question.

After you have answered all of the exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers. For each exercise answered incorrectly, reread the lesson material referenced after the solution.

1. What tool should you use to temporarily stop air or water flow through tubing while repairing the unit?

   a. Sleeve tool.

   b. Snap ring pliers.

   c. Tubing pliers.

   d. Hemostats.

2. When you replace the pilot-operated regulator diaphragm, which of the following procedures should you use?

   a. Unplug the dental operating unit from the power source.

   b. Turn the regulator face up with the word "A-DEC" right-side-up.

   c. Remove the two Allen screws that are diagonally opposed to each other and remove the screw in the bottom right corner.

   d. Separate the top from the bottom or the regulator and remove the white spacer from the top.

3. When you replace the foot control signal relay valve O-rings, which of the following procedures should you use?

   a. Position the foot control so that the top is face up.

   b. After separating the top of the foot control from the base, remove the stem by sliding it down.

   c. Turn the assembly over and remove the O-ring and slide the spacer out.

   d. Wash off, with a hot soapy solution, all grease that may have dripped onto the O-rings.

4. When you replace a master block 3-way cartridge valve stem O-ring, which of the following procedures should you use?

   a. Pull the knobs off the air and water coolant flow control and remove the cartridge valves through the faceplate.

   b. Turn the air off to the unit and bleed all air pressure left in the system.

   c. If the valve cannot be pulled out by hand, place the master block in a silicone solution until you can pry it loose with a wrench.

   d. Turn the water off at the floor utility box and bleed all water from the system.

5. When you remove and replace a defective spring in the foot control, you should use which of the following procedures?

   a. Position the foot control so the silver top is face down.

   b. On the bottom of the foot control, remove the four phillips head screws from the center of the black base.

   c. Remove the stem with the retaining ring by forcing air pressure through the foot control valve.

   d. Lubricate the replacement spring before placing over the stem, and secure with Locktite.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES: LESSON 6

1. d (para 6-2a)
2. b (para 6-3b)
3. c (paras 6-4f and g)
4. b (para 6-5c)
5. a (para 6-6a)

End of Lesson 6

APPENDIX

DENTAL CHAIR (MODEL JSR) TROUBLESHOOTING GUIDE

PROBLEM I. Chair or lift will not operate.

PROBABLE CAUSE	TESTING PROCEDURE	CORRECTIVE ACTION
1. Power cord not plugged in to supply receptacle or circuit breaker is off.	1. Visual inspection.	1. Plug in power cord or turn circuit breaker on.
2. Building power supply fault.	2. Use voltmeter to check for reading of 115v or 220v as applicable at power supply receptacle. If there is no reading, the problem is with building power supply.	2. Notify proper personnel.
3. Chair power cord not plugged into gray cord at rear of lift.	3. Visual inspection.	3. Connect.
4. Four conductor plug on chair not securely plugged into black coil cord at rear of lift. NOTE: On newer model chairs the chair-base connector is mounted in front of the chair (figure 2-2).	4. Visual inspection.	4. Make a secure connection.
5. Motors not plugged into chair electrical junction box.	5. Visual inspection.	5. Plug in each motor.

PROBLEM I. Chair or lift will not operate (continued).

PROBABLE CAUSE	TESTING PROCEDURE	CORRECTIVE ACTION
6. Loose connection in lift electrical junction box (figure 3-3).	6. Using a voltmeter, check receptacles on chair electrical junction box for a reading of 115v or 220v as applicable. If there is no reading at chair receptacle on electrical junction box, disconnect chair power cord from connector at front of lift. Check terminal 1 (lift connector) for reading of 115v or 220v as applicable. If there is no reading, remove lift motor cover and check for loose connection in lift electrical junction box.	6. Make a secure connection
7. Faulty wiring harness.	7. Remove screws securing electrical junction box cover and check wiring for reading of 115v or 220v as applicable. If there is no reading, wiring harness is faulty.	7. Remove and replace wiring harness.
8. Assistant and Doctor's manual seat and back switches are faulty.	8a. Remove screws securing switch bezel to chair and pull switch bezel out from the chair. Check for a reading of 115v or 220v as applicable between terminal 2 and ground (figure 3-1). If there is no reading, wiring harness is faulty.	8a. Remove and replace chair wiring harness.
	8b. Check for a reading of 115v or 220v as applicable between terminal 3 and neutral line when top side of control switch is depressed; between terminal 1 and neutral line (figure 2-1) when bottom side of control switch is depressed. If there is no reading, switch is faulty.	8b. Remove and replace switch.
	8c. If there is a reading on both switch legs in 8b above, the motor is faulty.	8c. Remove and replace applicable motor.

PROBLEM I. Chair or lift will not operate (continued).

PROBABLE CAUSE	TESTING PROCEDURE	CORRECTIVE ACTION
9. Broken chain or sheared pin in motor sprocket.	9. If foot control is activated and motor runs but lift does not raise, failure is due to either a broken chair or pin on motor sprocket sheared. Visual inspection.	9. Replace chain. Remove and replace pin on motor sprocket.
10. Bent or broken foot control switch.	10. Visual inspection.	10. Remove and replace foot control switch.
11. Faulty motor or capacitor.	11. If motor hums when foot control is used to operate lift, capacitor or motor is faulty.	11. Remove and replace motor and/or capacitor.
12. Automatic control not functioning.	12a. Toggle switch on electrical junction box should be in the AUTO position. NOTE: If there is no action, check AUTO/MANUAL mode toggle switch as follows: 12b. Disconnect lift power cord from supply receptacle. 12c. Using an ohmmeter, check across terminals 1 and 3 on S-1 for a reading of "0" ohms when switch is in the AUTO position. 12d. If there is no movement of ohmmeter indicator, the AUTO/MANUAL mode switch is faulty.	12a. Place in AUTO position. 12d. Replace the AUTO/MANUAL mode switch.

PROBLEM I. Chair or lift will not operate (continued).

PROBABLE CAUSE	TESTING PROCEDURE	CORRECTIVE ACTION
13. Faulty relay.	13a. Place the chair in full operating condition (back down and toe up); actuate the doctor's bottom switch and listen for a clicking noise. If noise is heard, the relay is faulty.	13a. Replace the relay.
	13b. Remove the relay from the junction box. Using an ohmmeter, check for continuity across terminal A and B. If the reading approaches infinity, the relay is bad.	13b. Replace the relay.

PROBLEM II. Foot switch fails to raise or lower the chair.

PROBABLE CAUSE	TESTING PROCEDURE	CORRECTIVE ACTION
1. Bent or broken foot switch.	1. Visual inspection.	1. Replace foot switch.
2. Broken chain.	2. Visual inspection.	2. Replace broken chain.
3. Sheared pin on motor sprocket.	3. Visual inspection.	3. Replace motor.
4. Faulty foot switch or wiring harness.	4a. Remove foot switch from pedestal. 4b. Use a voltmeter to check for reading of 115v or 220v as applicable between terminal 2 and neutral line. If there is no reading, the wiring harness is faulty. 4c. If there is a reading in 4b above, check for a reading of 115v or 220v as applicable between terminal 3 and neutral line when left side of foot switch is depressed; between terminal 1 and neutral when right side of switch is depressed. If there is no reading, the switch is faulty. 4d. If there is a reading on both switch legs, the motor is faulty.	 4b. Replace wiring harness. 4c. Replace foot switch. 4d. Replace motor.

PROBLEM III. Lift motor hums when foot switch is used to raise or lower the chair, or when the automatic switch is used to lower the chair.

PROBABLE CAUSE	TESTING PROCEDURE	CORRECTIVE ACTION
1. Motor or capacitor is faulty.	1. Audible test.	1. Replace motor and/or capacitor.

PROBLEM IV. Automatic control fails to operate (manual controls are operating.

PROBABLE CAUSE	TESTING PROCEDURE	CORRECTIVE ACTION
1. Test AUTO/MANUAL mode switch is faulty.	1. Test AUTO/MANUAL mode switch as in I. 12b-d above.	1. Remove and replace the AUTO/MANUAL mode switch. NOTE: If corrective action cannot be accomplished immediately, place junction box toggle switch in manual position until corrective action can be accomplished.

PROBLEM V. Chair or lift travels beyond exit position.

PROBABLE CAUSE	TESTING PROCEDURE	CORRECTIVE ACTION
1. Limit switch is faulty.	1. Visual inspection.	1. Remove and replace lift motor.

PROBLEM VI. Arm will not hold position.

PROBABLE CAUSE	TESTING PROCEDURE	CORRECTIVE ACTION
1. Arm screw or arm rod broken.	1. Visual inspection.	1. Repair or replace.

PROBLEM VII. Back continues to move; motor has stopped running.

PROBABLE CAUSE	TESTING PROCEDURE	CORRECTIVE ACTION
1. Insufficient friction in back motor and screw tube.		1. Replace back motor assembly.

End of Appendix