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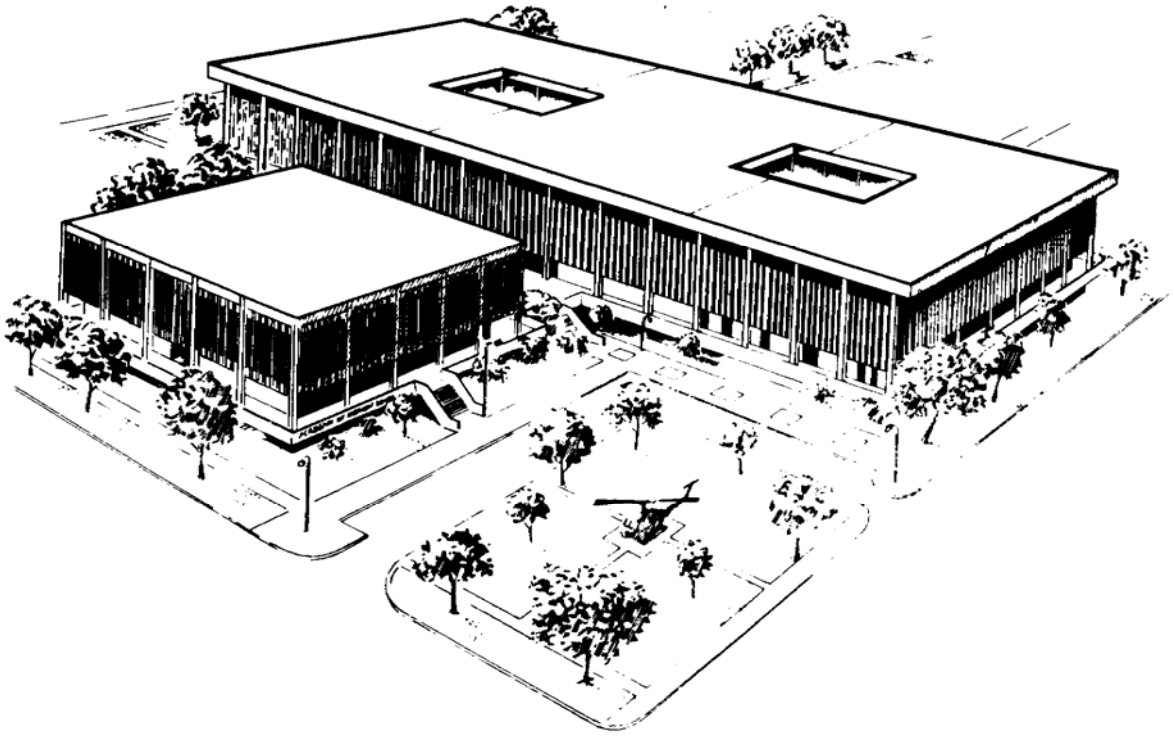

DENTAL CHAIR (JSA-R)

SUBCOURSE MD0373 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

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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.

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

SUBCOURSE MD0373

DENTAL CHAIR (JSA-R)

INTRODUCTION

The dental chair, model JSA-R, provides state-of-the-art technology to better meet the needs of modern dentistry. At the touch of one switch, this chair can raise, recline, and tilt-back to meet the dentist's working requirements. Additionally, the chair functions can be operated independently of each other. The electromechanics that make all of this possible offer a challenge to you as the medical equipment repairer. It is your job to keep the dental chair operationally efficient. The material in this subcourse covers procedures for preventive maintenance checks and services (PMCS), malfunction isolation, and removal and replacement or repair of defective components.

Subcourse Components:

This subcourse consists of three lessons and an appendix.

Lesson 1, Perform Preventive Maintenance Checks and Services on the Dental Chair.

Lesson 2, Isolate Malfunctions to the Component Level of the Dental Chair.

Lesson 3, Remove and Replace or Repair Defective Components of the Dental Chair.

Appendix, Dental Chair Troubleshooting Guideline.

Here are some suggestions that may be helpful to you in completing this subcourse:

--Read and study each lesson carefully.

--Complete the subcourse lesson by lesson. After completing each lesson, work the exercises at the end of the lesson, marking your answers in this booklet.

--After completing each set of lesson exercises, compare your answers with those on the solution sheet that follows the exercises. If you have answered an exercise incorrectly, check the reference cited after the answer on the solution sheet to determine why your response was not the correct one.

Credit Awarded:

Upon successful completion of the examination for this subcourse, you will be awarded 5 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).

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LESSON ASSIGNMENT

LESSON 1	Perform Preventive Maintenance Checks and Services on the Dental Chair.
TEXT ASSIGNMENT	Paragraphs 1-1 through 1-3.
TASKS TAUGHT	Perform Preventive Maintenance Checks and Services on the Dental Chair.
LESSON OBJECTIVES	When you have completed this lesson, you should be able to: 1-1. Identify major components of the JSA-R dental chair. 1-2. Identify procedures for performing PMCS on the JSA-R dental chair in the manual mode. 1-3. Identify procedures for performing PMCS on the JSA-R dental chair in the automatic mode. 1-4. Identify procedures for lubricating the JSA-R 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

1-1. GENERAL

The dental chair, model JSA-R, is a solid state automatic unit designed for the ideal positioning of the patient easily. It can be programmed for any operating procedure. It can also be operated manually by placing the AUTO/MANUAL mode toggle switch into the manual position. The chair features three separate motors; one for lift, one for back adjustment, and one for seat adjustment. Control switches are readily accessible on the chair or pedestal base.

1-2. DENTAL CHAIR COMPONENTS

a. **Dental Chair Component Overview.** Refer to figure 1-1. The dental chair consists 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.

(7) Chair seat assembly.

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

(9) Arm rests.

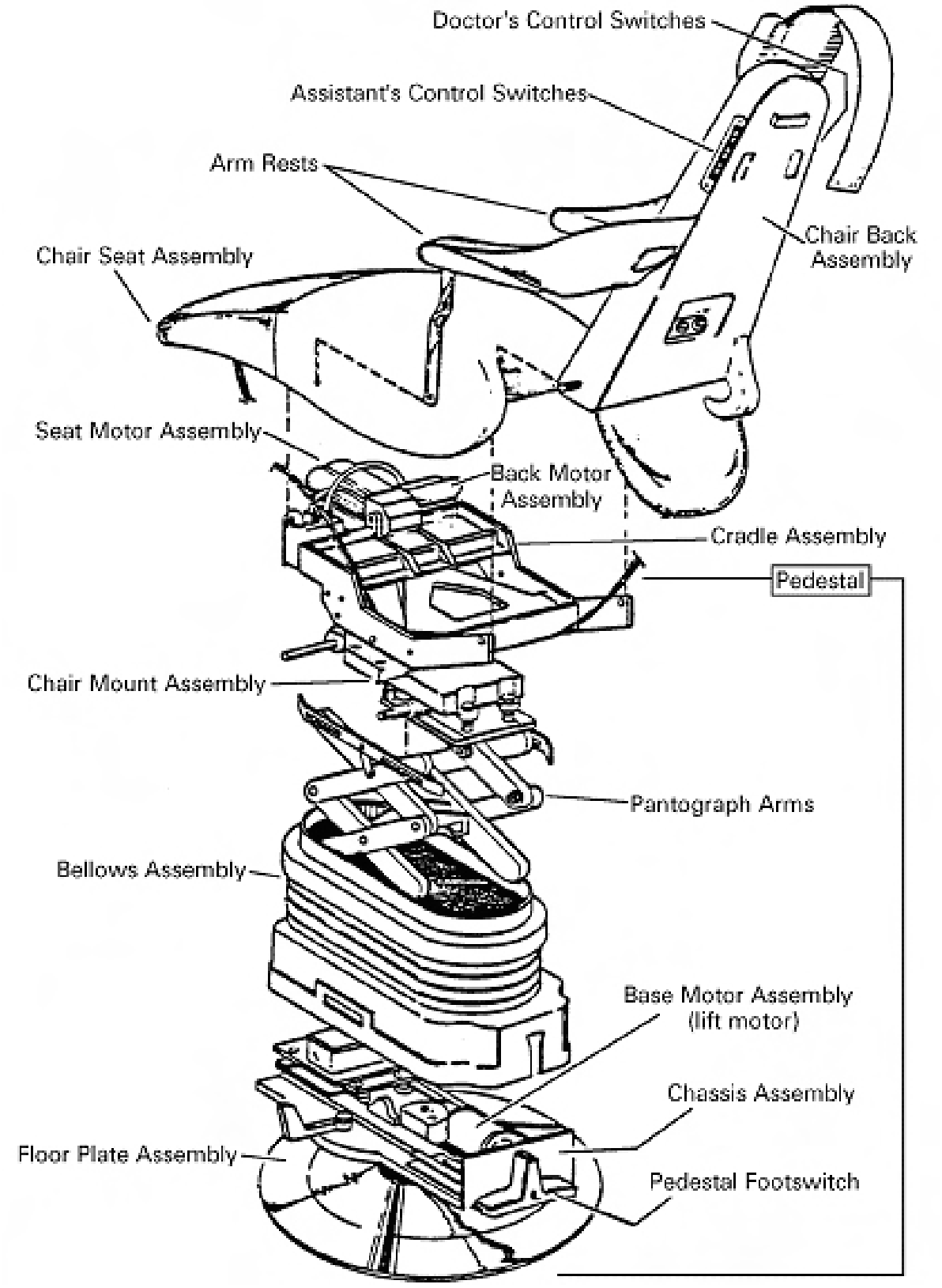

Figure 1-1. Dental chair components.

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 the following three ways.

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

(2) By using the three-position switch on the bottom of the assistant's controls (the left side of the chair as viewed from the back).

(3) By using the bottom switch on the doctor's controls (the right of the chair as viewed from the back). This switch is for automatic operation only. There are three functions: raise, tilt, and recline.

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 center switches on either side of the chair back. The seat is also positioned in the automatic mode.

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. The auto switch, lowermost on the doctor's side, will also recline or position the back upright when in the automatic mode.

e. **Doctor's Controls.** Refer to figure 1-1. The doctor's controls are located at the top of 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 automatic operation switch will recline, tilt, and raise the chair, all at the same time. This multi-directional function is referred to as operate. Depressing the switch downward will bring the chair to the upright and lowered "exit" position.

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

(1) They have the same function as the doctor's controls with the exception of the lowermost switch.

(2) The lowermost switch raises and lowers the chair.

(3) Additionally, the AUTO/MANUAL mode toggle switch is located under the chair on the assistant's side of the chair.

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. It is used in conjunction with either the manual control switches or the manual toggle switch.

(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 and the control switch is set to manual.)

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

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

(2) Check to ensure that you can raise and lower the chair from the assistant's bottom switch.

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

(a) Test the assistant's middle button.

(b) Test the doctor's middle button.

(4) 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.** Refer to figure 1-2.

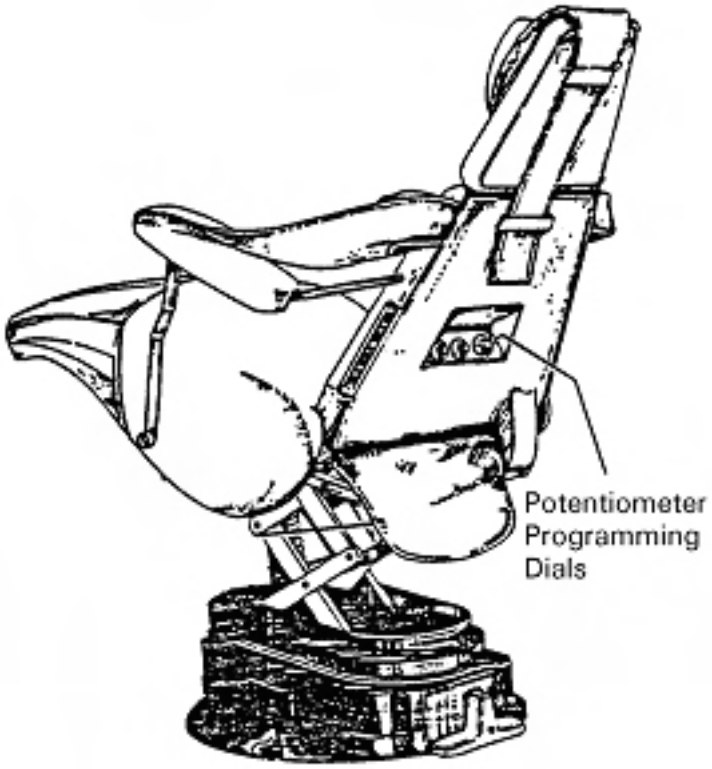

Figure 1-2. Potentiometer programming dials.

(1) Test each of the three potentiometer programming dials. For each dial use the following procedures.

(a) Set one dial to "5," with the other two dials set at "0."

(b) Depress and release the top side of the automatic control switch (the bottom control switch on the doctor's side of the chair). The chair should move to the selected operating position.

(c) Depress and release the bottom side of the automatic control switch. The movement should stop.

(d) Depress the bottom side of the switch and release it. The chair should return to the exit position.

(e) Depress and release the top side of the switch. The movement should stop.

(2) Test all the three potentiometer dials together.

(a) Set all three dials to "5."

(b) Depress and release the top side of the automatic control switch. The chair should move to the selected operating position.

(c) Depress and release the bottom side of the automatic control switch. The chair should return 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 1-3, #2.

(2) Lubricate the lift chain. Refer to figure 1-3, #3.

(3) Lubricate the pantograph arms by extending them to their full length and applying white grease to each movable joint. Refer to figure 1-4.

(4) Lubricate the seat motor screw tube located in the cradle assembly. Refer to figure 1-5, #2.

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

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

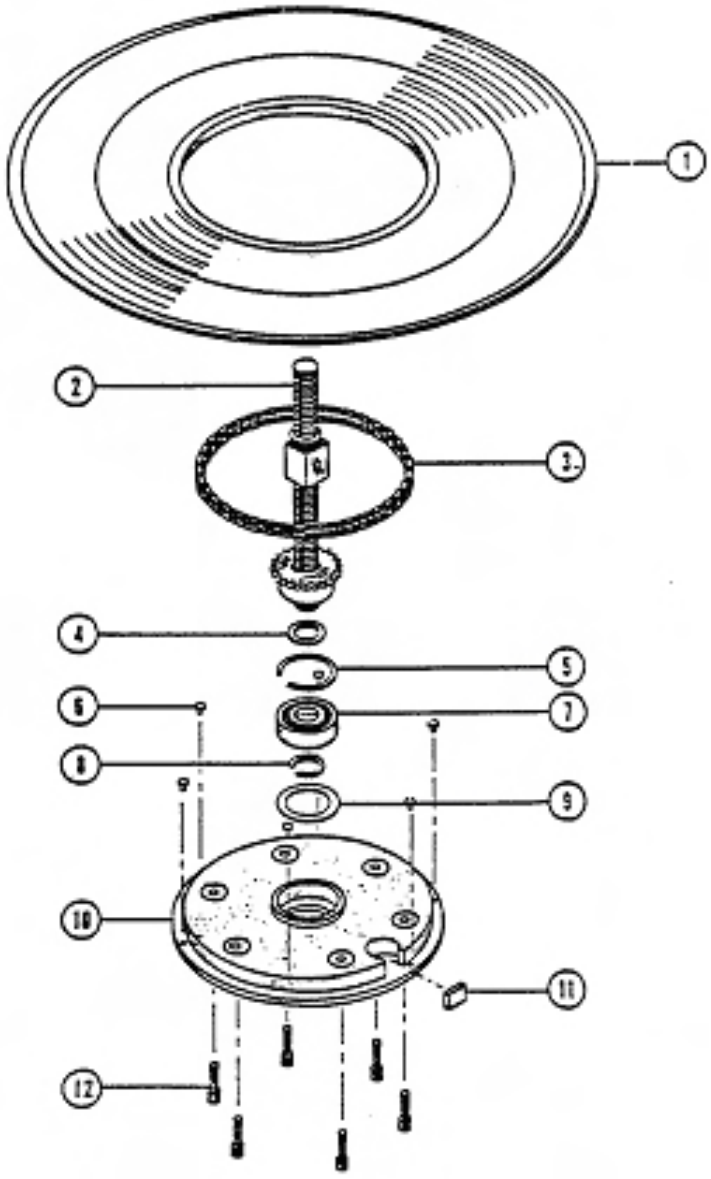

Figure 1-3. Floor plate assembly.

ITEM	DESCRIPTION
1	Bellows Hanger
2	Screw, Slotted Shoulder
3	Hex Nut, 3/4-20
4	Bushing, Nylon Flange
5	Snap Ring
6	Axle Nut, 3/4-20
7	Washer, Disk Spring
8	Cotter Pin, 1/8 x 1-1/4
9	Bushing, Steel Backed
10	Lifting Yoke
11	Hex Nut, 5/8-18
12	Washer, 7/32
13	Screw, #10-32 x 3/8

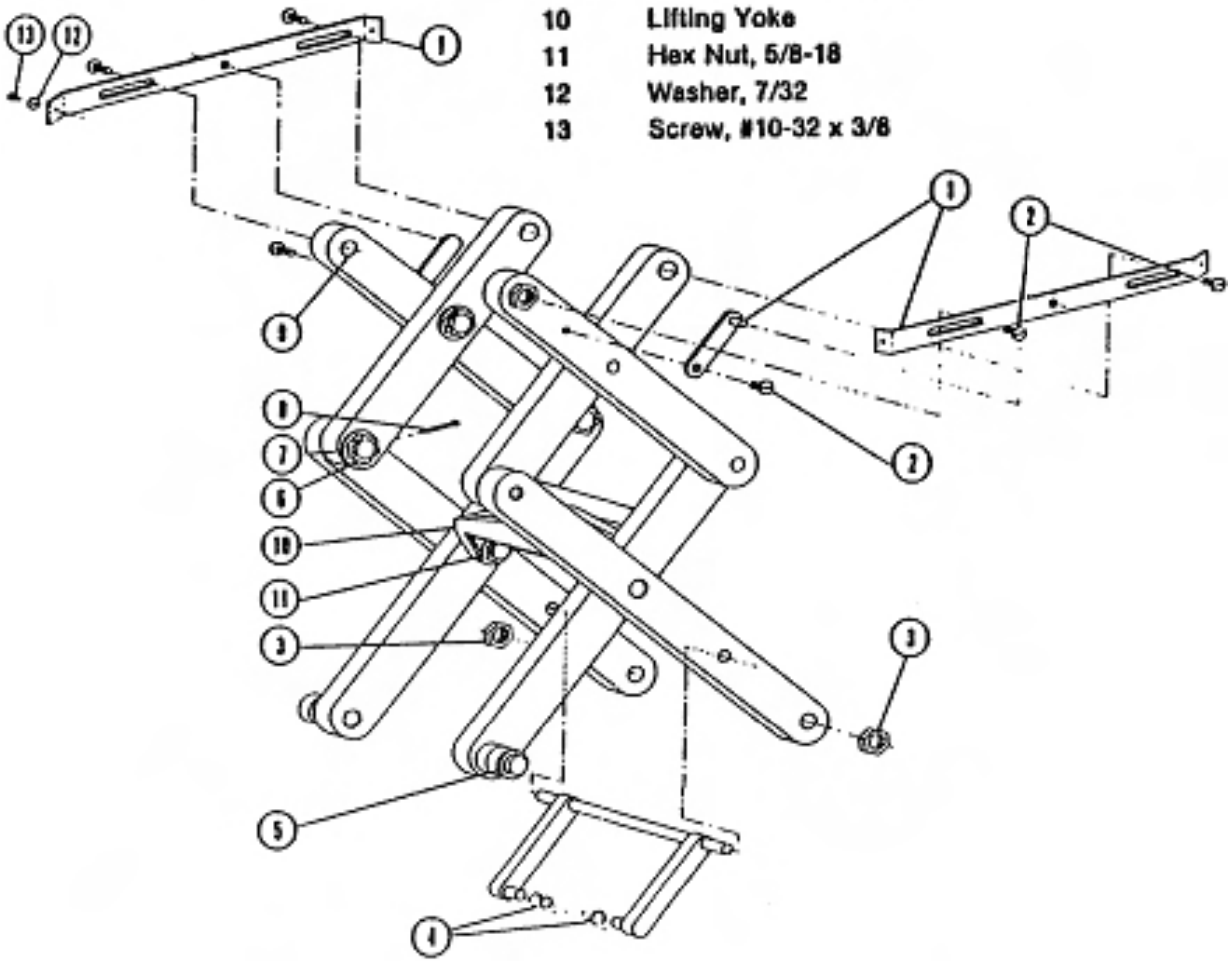

Figure 1-4. Pantograph arms.

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

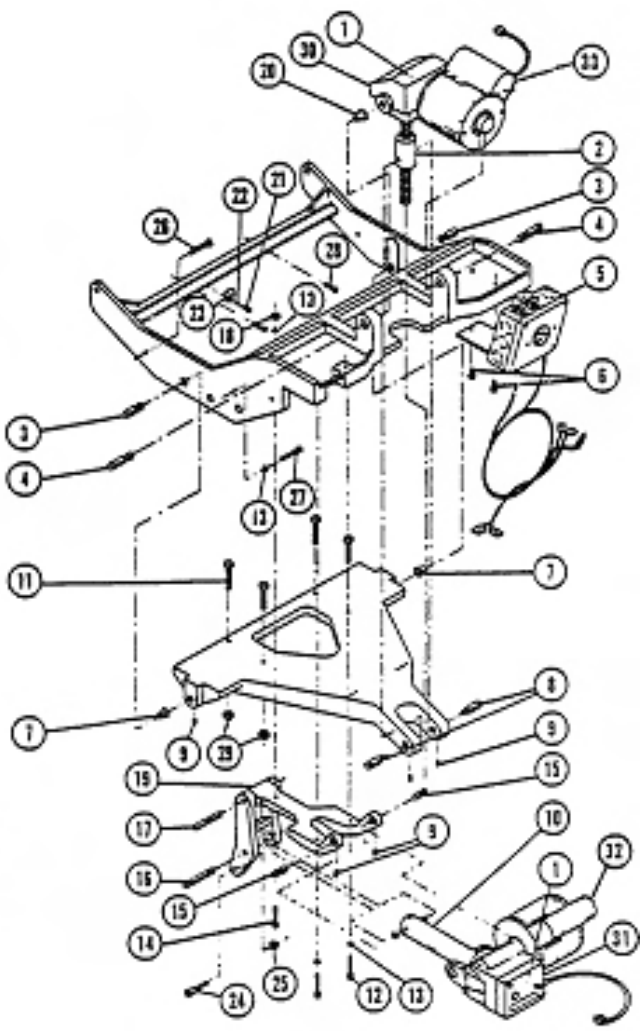

Figure 1-5. Cradle assembly.

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.

USE THE FOLLOWING ILLUSTRATION TO ANSWER EXERCISES 1 THROUGH 5.

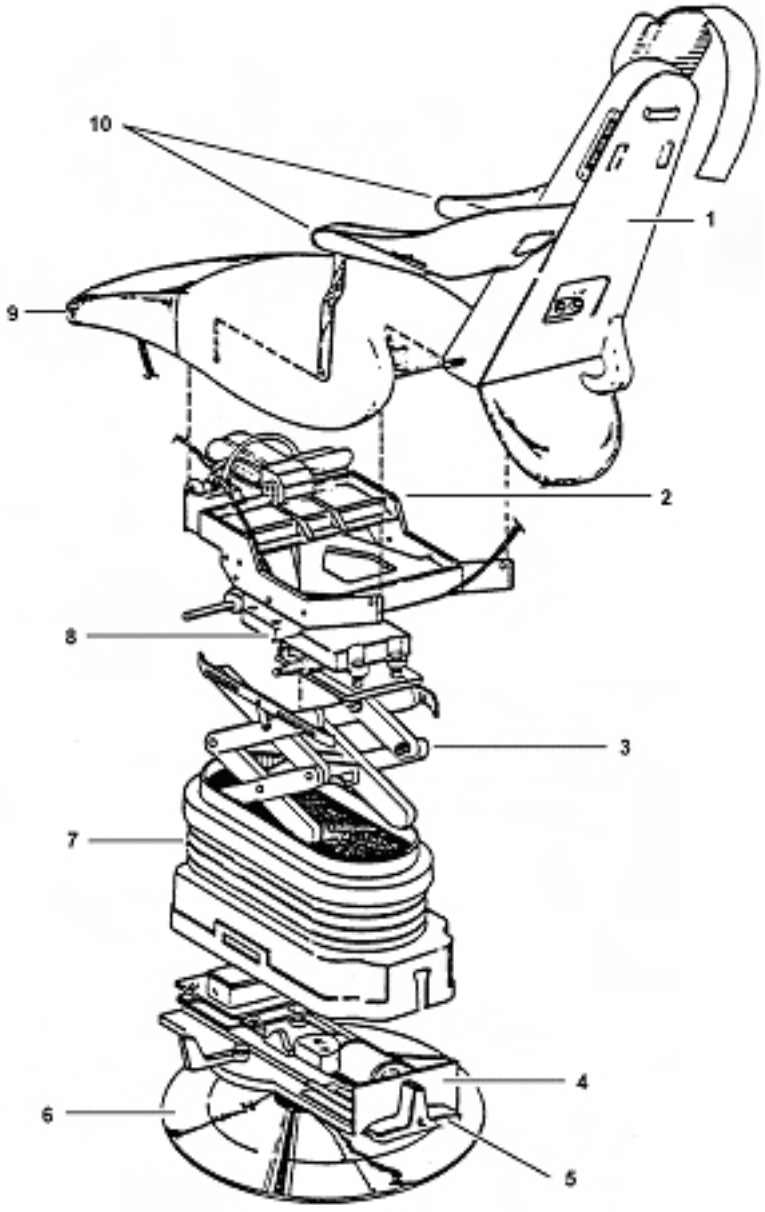

Figure 1 for exercises 1-5. Dental chair components.

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

   a. 2.

   b. 3.

   c. 4.

   d. 8.

2. Refer to figure 1. What is the number designating the cradle assembly?

   a. 2.

   b. 4.

   c. 6.

   d. 8.

3. Refer to figure 1. What is the number designating the pantograph arms?

   a. 2.

   b. 3.

   c. 5.

   d. 10.

4. Refer to figure 1. What is the number designating the chair mount assembly?

   a. 1.

   b. 2.

   c. 8.

   d. 9.

5. Refer to figure 1. What is the number designating the bellows assembly?

    a. 2.

    b. 3.

    c. 5.

    d. 7.

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

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

    b. On the top 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.

7. 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.

8. 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.

9. Which of the following are procedures for checking the automatic mode?

   a. Test only one of the potentiometer dials at a "5" setting with the other two set at "0" to ensure all three potentiometer dials are working properly.

   b. Get the chair to move toward a desired setting but stop it along its path with all tests you perform.

   c. Make the setting "0" in the test where you set all three potentiometer dials at the same setting.

   d. Use the doctor's top and bottom switches to test the automatic mode.

10. How often do you lubricate the dental chair?

   a. Daily.

   b. Weekly.

   c. Monthly.

   d. Yearly.

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. d (figure 1-1)
6. a (para 1-2e)
7. b (para 1-2b)
8. a (para 1-2d, figure 1-1)
9. b (paras 1-3b(1)(a)-(e))
10. d (para 1-3c)

End of Lesson 1

LESSON ASSIGNMENT

LESSON 2	Isolate Malfunctions to the Component level in the Dental Chair.
TEXT ASSIGNMENT	Paragraphs 2-1 through 2-3.
TASKS TAUGHT	Isolate Malfunctions to Component Level in the Dental Chair.
LESSON OBJECTIVES	When you have completed this lesson, you should be able to: 2-1. Identify the theory of operation on the JSA-R dental chair in the manual mode. 2-2. Identify the theory of operation of the JSA-R dental chair in the automatic mode. 2-3. Identify procedures for isolating malfunctions to the component level in the JSA-R 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

2-1. GENERAL

In order to efficiently maintain the dental chair, model JSA-R, you need to understand how it operates. This lesson covers how both the manual and automatic mode circuits work. 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. This lesson covers the following malfunctions: the chair will not operate, the manual control switch fails to raise or lower the chair, and the automatic control fails to operate when the manual controls are operating.

2-2. THEORY OF OPERATION

a. **Manual Mode Circuit Description.** Refer to figures 2-1 and 2-2.

(1) Raising the chair. To raise the chair you use the bottom switch on the assistant's side of the chair or the foot switch. This applies power.

(a) When you use the foot switch, 125vac (volts alternating current) is applied from the incoming line through the black wire to the common of the mode switch. With the 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.

(b) When you use the push button switch, power is applied from the incoming line, through the mode switch. It travels to the tie point in the junction box, through the middle black wire to the common of the base switch (2). Then, it goes through the switch (3), along the red wire to the tie point to pin 2 of the terminal strip, and through the limit switch to the motor.

(c) 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.

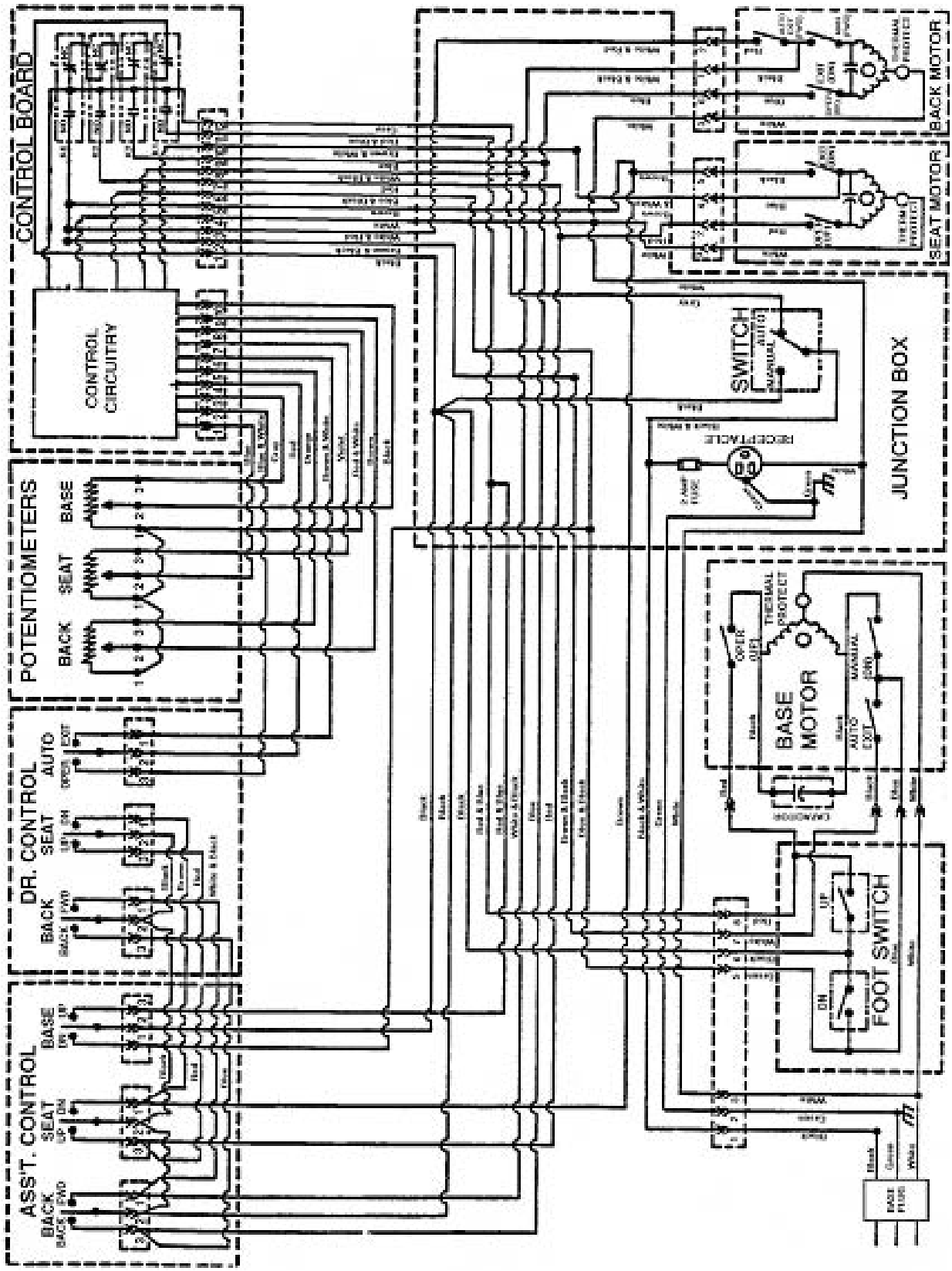

Figure 2-1. Wiring chart for the JSA-R Dental Chair.

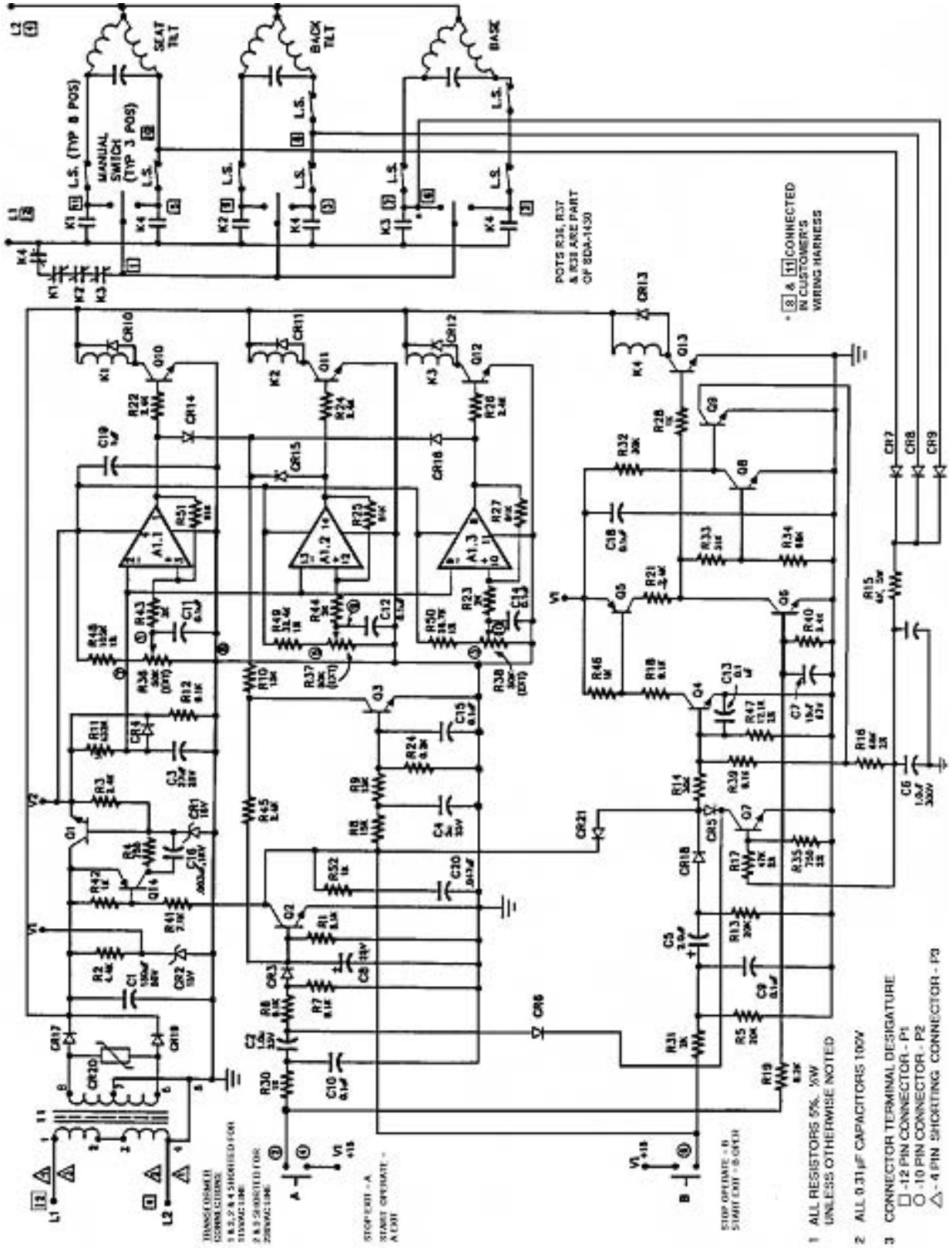

Figure 2-2. Control board schematic for the JSA-R Dental Chair.

(2) Lowering the chair.

(a) You lower the chair through much of the same circuitry as raising. Power is applied to the 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.

(b) When you use the push button switch, power from the mode switch is applied along the black wire to the tie point, along the middle black wire to the common of the base switch. It then flows through the down position (1) along the white wire to a tie point in the junction box. From there it goes along a blue wire to pin 4 of the terminal strip. It then flows to the manual down limit switch to the motor.

(3) Tilting the seat up.

(a) 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.

(b) 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.

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

(4) Tilting the seat down. 125v 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 orange 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.

(5) Reclining the back. Zero voltage is applied to the back adjust motor as it is applied to the seat adjust motor. 120v 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 terminal strip pin 4, power is applied to the back windings. It energizes the motor and reclines the back.

(6) 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 wire to the junction box to the manual up windings. It energizes the motor and brings the chair forward.

b. **Automatic Mode Circuit Description.** Refer to figures 2-1 and 2-2.

(1) The automatic control board. The control board is located underneath the footrest on the bottom of the seat itself. The board contains the control circuit consisting of transistors and three operational amplifiers driving four relays. There are (3) potentiometers used in conjunction with the control board. They are located on the back of the chair to allow access for the doctor or assistant to preset to a desired position.

(2) Operate mode.

(a) L1-L2 power is applied across the primary of T1. T1 secondary is rectified by CR17 and CR19 to 32vdc (volts direct current). This is applied across C1 and CR2 regulates V1 output to 15vdc. This is the power supply for the control board.

(b) When switch "A" is depressed, a positive pulse is applied to the base of Q2. Its collector goes low and is applied at the base of Q14. Q14's collector goes high. This high is applied to the base of Q1. When Q14 conducts, C16 is charged to approximately 24vdc. CR1 conducts at 15v and regulates V2 to 14.3vdc V2 is the power supply for A1. It also generates a voltage for A1's non-inverting inputs.

(c) The setting of R36, R37, and R38 (located on the back of the chair) determines the reference voltages comparators A1.1, A1.2, and A1.3. Using A1.1 as an example, the voltage on the center tap of R36 is the reference or position control voltage applied on the non-inverting input (pin 3). This voltage is always positive in practice.

(d) R11, C3, CR4, and R12 form a time constant network. Before V2 is applied to this network, C3 has discharged through CR4, R11, and R12. Therefore, when V2 is first applied, pin 3 of A1.1 (from R36) is much more positive than pin 1 (from C3). The output, pin 1 of A1.1, goes high, turning Q10 on, energizing K1, causing the seat tilt motor to run. The high output at pin 1 of A1.1 also forward biases CR14 and latches Q2 on through R10 and R45.

(e) Meanwhile, C3 charges. When the voltage across C3 (applied to pin 2) exceeds the voltage at pin 3, the output at pin 1 goes low, de-energizing K1 and the seat tilt motor.

(f) Changing the setting of R36 does not change the time constant, but varies the length of time that K1 and the seat tilt motor are energized. Moving the center tap up makes the control voltage more positive. C3 takes longer to charge up enough to exceed the control voltage. The motor runs longer and the seat tilts farther back.

(g) R37 and R38 preset the control voltages for A1.2 and A1.3, controlling the back tilt and base (raising and lower) motors. The A1.2 and A1.3 circuits function exactly like the A1.1 circuit.

(h) As long as one or more of the A1 outputs is high, one or more of the diodes, CR14, CR15, and CR16 will be forward biased holding Q2 on. The last motor stops running when all the A1 outputs go low. Q2 will turn off at this time, turning off Q14 and Q1 and removing V2. C3 will discharge through CR4, R11, and R12 to ensure that the chair moves to the same position every time.

(i) While this circuit may seem very complex, it is much more reliable than a mechanical servo system.

(j) While K1, K2, and K3 are energized, their N.O. points close, applying 120vac to the motors allowing the chair to go to the operate position. 120vac is also applied from pins 10, 8, and 6 of P1 to CR7, CR8, and CR9. This is rectified and filtered to +135vdc. R15, R17, and R35 form a voltage divider network, Q7's collector goes low and is applied at the base of Q4. The low from the collector of Q2 is also applied at the base of Q4 through CR21. Q9 will also be on at this time. Its collector will also be low. These three lows ensure that Q4 stays off. Q4's collector goes high to the base of Q5. Q5 is off. Its collector goes low to the base of Q8. Q8 is off and its collector goes high. This high turns on Q9. The low on the collector of Q9 latches Q4 off. The low from the collector of Q5 is also applied to the base of Q13, keeping Q13 and K4 de-energized.

(k) Pushing the stop operate button before the chair has reached the preset position will apply a high to the base of Q3. Q3 turns on and its collector goes low. This low turns off Q2, Q14, and Q1 taking away V2. K1, K2, and K3 will de-energize.

(3) Exit mode.

(a) When you depress switch "B", a positive pulse is placed to the base of Q4. Its collector goes low and is applied to the base of Q5. Q5 turns on; its collector goes high. This high turns on Q13, energizing K4. The high from the collector of Q5 is also applied to the base of Q8. Q8 turns on, turning Q9 off. Q9's collector goes high. This high is applied back to the base of Q4, latching it on.

(b) When K4 energizes, its N.O. (normally open) points close and power is applied to the windings of the motors bringing the chair back to the exit position. When the chair reaches the exit position, the limit switches will open the current paths to the motors.

(c) If switch "A" is depressed before the chair has completed its movement, a high will be placed at the base of Q6. Its collector will go low to the base of Q13, turning it off and de-energizing K4. Power from the motors to CR7, CR8, and CR9 will be removed, turning off Q7 and Q4. Q4 and Q5 will keep Q13 off and K4 de-energized.

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 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 troubleshooting guide shows 16 probable causes from a list of all possible causes. This lesson covers the first eight of those probable causes. See the guide, "Probable Cause" column.

NOTE: "Will not operate" means that the chair does not operate at all. "Fails to function properly" means that it operates at less than manufacturer's specification.

(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 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 2-3). 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.

(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) The power cord from the electrical junction box and cord for the programming dials is not securely plugged into the automatic control board. Test by visual inspection. Refer to figure 2-4.

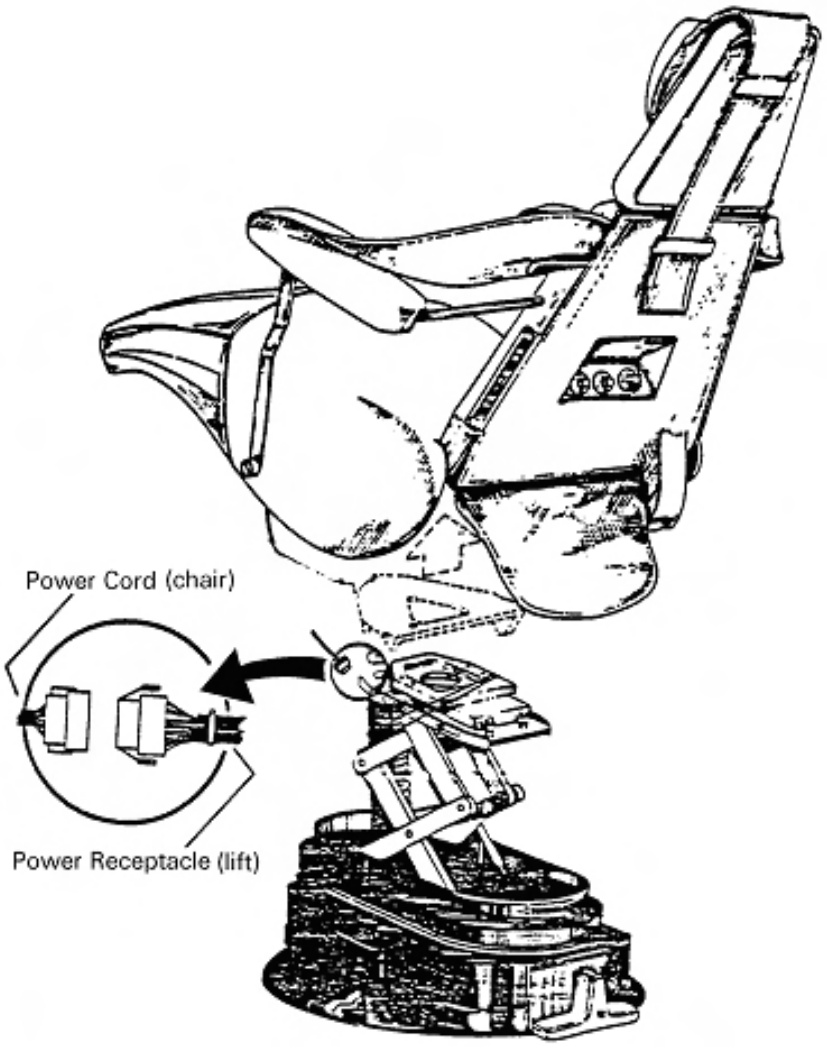

Figure 2-3. Dental chair power cord.

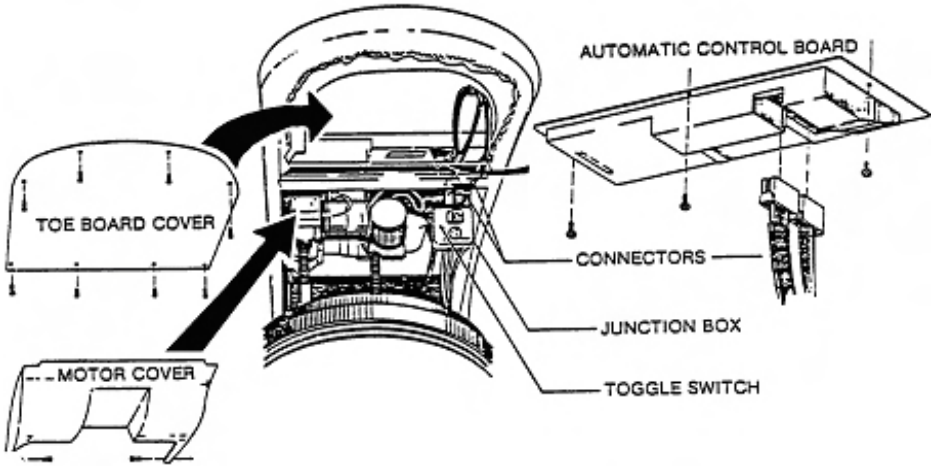

Figure 2-4. Automatic control board.

(a) Disconnect the chair power cord from the building power supply.

(b) Remove the chair plastic cover by removing the staples securing the tails of the cover to the underside of the wood seat frame. Slip cover off of the chair.

(c) Remove the 11 Phillips head screws attaching the toe board cover to the chair.

(d) If not secure, make a secure connection of each cord.

(e) If that's not the problem, continue to the next probable cause.

(7) There is a faulty solid state automatic control board. Test by using a voltmeter.

(a) Check receptacles on the chair junction box for a reading of 115v or 220v, as applicable.

(b) If there is a reading, the automatic control board is faulty.

(c) Remove and replace the automatic control board. Refer to Lesson 3, Remove and Replace or Repair Defective Components of the Dental Chair.

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

(a) Disconnect the chair power cord from the connector at front of lift.

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

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

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

(9) 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 in the troubleshooting guide. The remaining probable causes are as follows.

(a) A faulty wiring harness.

(b) The manual switches are faulty.

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

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

(e) There is a faulty motor or capacitor.

(f) The automatic controls are not functioning.

(g) The automatic exit switch is in the wrong position.

(h) There is a faulty relay.

b. If your problem is that the manual control switch for lift fails to raise or lower the chair, there are three probable causes from a list of all possible causes. See 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.

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

(a) Remove the switch bezel from the chair.

(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 top side of the control switch and between terminal 1 and the neutral line when you depress the bottom side of the switch. If there is no reading, the switch is faulty. Refer to Lesson 3, Remove and Replace or Repair Defective Components of the Dental Chair.

(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.

c. If the automatic control fails to operate the chair and the manual controls are operating, two probable causes are listed in the troubleshooting guide in the appendix.

(1) The automatic control switch is faulty. To test this, you test the automatic control switch using the procedures shown under probable cause number 14 for the chair not lifting, "automatic controls are not functioning." If any of the 14 testing procedures prove positive, you use the corresponding corrective action to fix the malfunction. Refer to figure 2-1, Control Board portion.

(2) The automatic control board is faulty. To test this, you test the automatic control board as shown under probable cause number 7, "faulty solid state automatic control board." If the test proves positive, remove and replace the automatic control board.

NOTE: If you cannot take the corrective action immediately, you place the junction box toggle switch in the manual position until you can take the corrective action.

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 statements concerning operation of the dental chair in the automatic operating mode is correct?

   a. Changing the setting of R36 changes the time constant.

   b. The length of time that K1 and the seat tilt motor are energized does not depend upon the setting at R36.

   c. Changing the setting on R36 has no effect on the length of time required for C36 to charge up enough to exceed the control voltage.

   d. Changing the setting on R36 causes the motor to run longer and the seat to tilt farther back.

4. Which of the following is a reason for using the Dental Chair 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 Troubleshooting Guide in the appendix to answer exercises 5 through 8.

5. The dental chair or lift <u>fails</u> to operate. Which of the following could be a probable cause?

   a. Faulty potentiometer wiring harness.

   b. Broken chain.

   c. Bent or broken lift control switch.

   d. Faulty relay.

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

   a. Remove the switch bezel from the chair 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 switch on the electrical junction box to the "auto" position.

7. 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. Toggle all switches to ensure they are on automatic.

   d. Make sure programming dials are not loose on the potentiometer shafts.

8. What is the probable cause if two motors operate but only one programming dial is set?

   a. Faulty control board.

   b. Automatic control switch is faulty.

   c. Faulty potentiometer wiring harness.

   d. Limit switch is faulty.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES: LESSON 2

1. b (para 2-2a(3)(b))
2. a (para 2-2a(5))
3. d (para 2-2b(2)(f))
4. d (para 2-3)
5. a (Appendix, Problem 6)
6. c (Appendix, Problem 1, Test Procedure 12)
7. b (Appendix, Problem, Test Procedure 1-6)
8. a (Appendix, Problem 8)

End of Lesson 2

LESSON ASSIGNMENT

LESSON 3	Remove and Replace or Repair Defective Components of the Dental Chair.
TEXT ASSIGNMENT	Paragraphs 3-1 through 3-7.
TASKS TAUGHT	Remove and Replace or Repair Defective Components of the Dental Chair.
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 JSA-R Dental Chair. 3-2. Identify procedures for repairing efective components on the JSA-R 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

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. 7/16 inch open-end or box wrench.

b. 5/16 inch Allen wrench.

c. Phillips screwdriver.

d. Flat-tipped screwdriver.

e. 3/8 inch wrench.

f. 3/4 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, for example, manual control switch for chair back (one each for the doctor's and assistant's controls), manual control switch for chair seat (one each for the doctor's and assistant's controls), and a manual control switch for lift (the assistant's bottom switch). After testing per the Dental Chair 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.

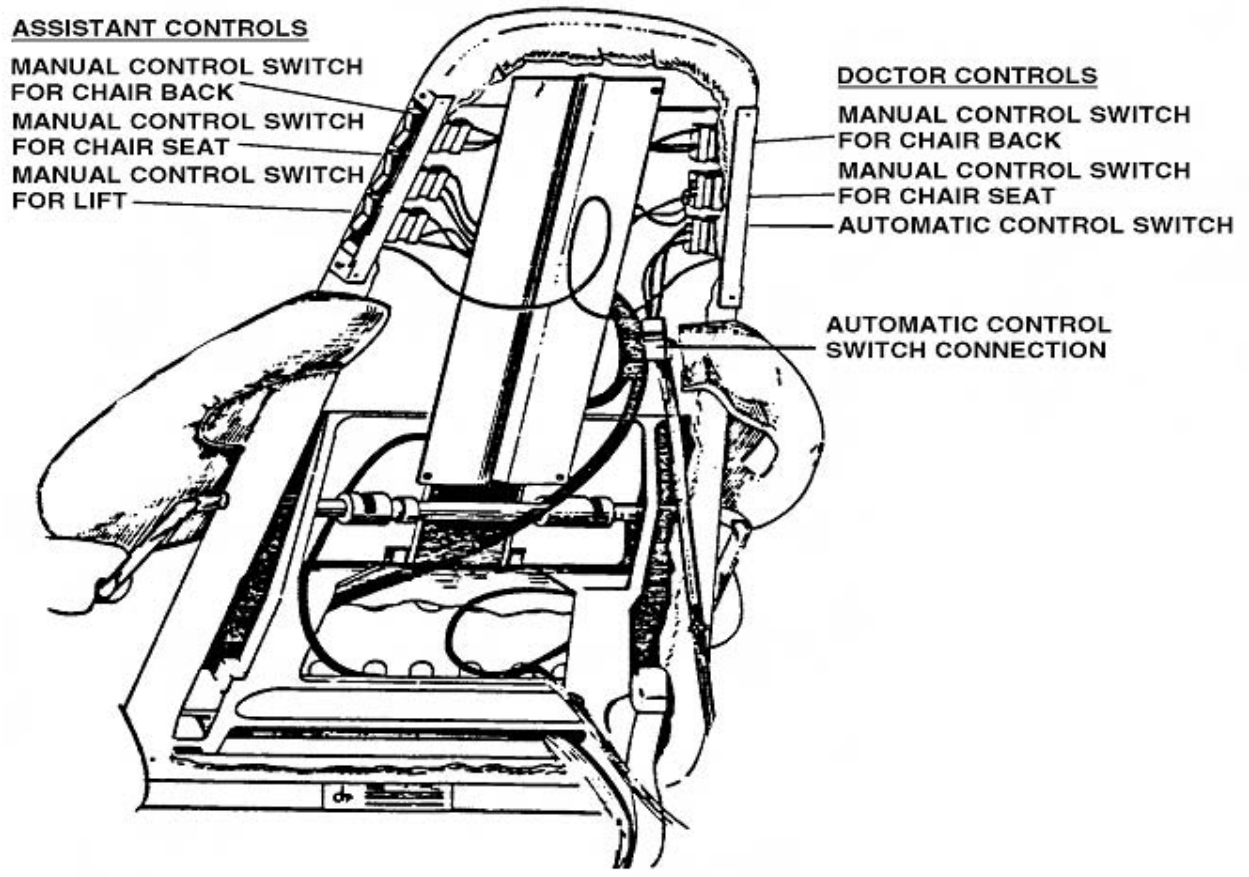

Figure 3-1. Doctor and assistant controls.

c. Pull the malfunctioning switch bezel from the chair.

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. REMOVE AND REPLACE A FAULTY SOLID STATE CONTROL BOARD.

The chair will not raise or lower. You have isolated the malfunction to a faulty solid state control board. You must remove and replace it. Refer to figure 3-2.

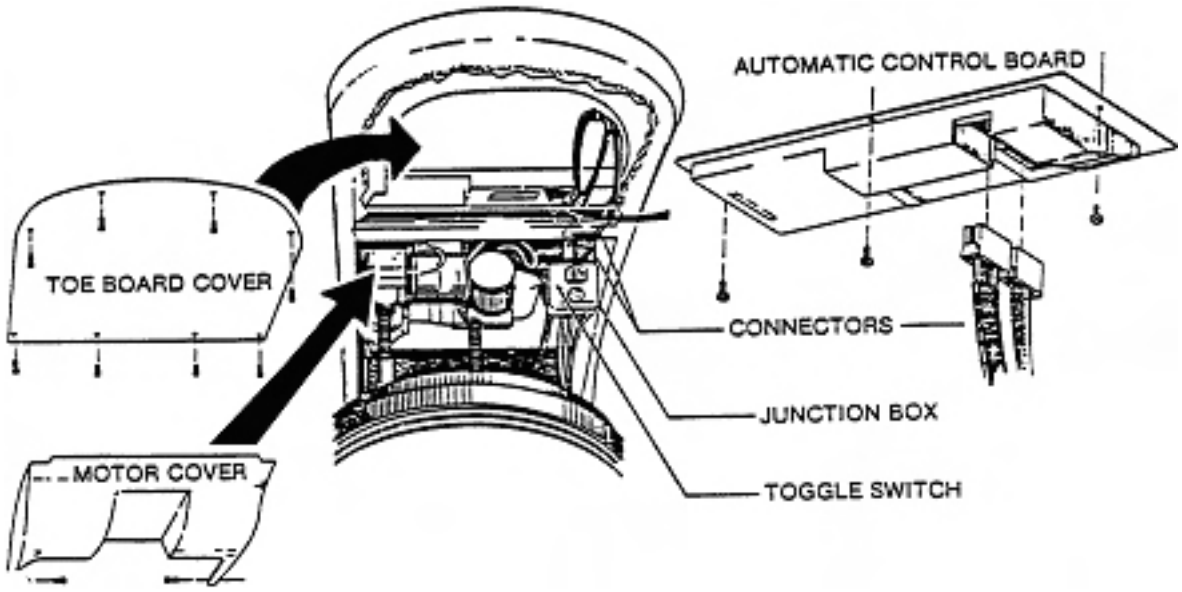

Figure 3-2. Automatic control board.

a. Disconnect the chair power cord from the building power supply.

b. Remove the chair plastic toe cover by removing the staples and securing the tails of the cover to the under side of the wood seat frame. Slip the cover off of the chair.

c. Remove the eleven Phillips head screws that attach the toe board cover to the chair.

d. Disconnect the cords from the control board by depressing the locking arms on the connectors with your thumb and the forefinger.

CAUTION: Handle the automatic control board carefully. Never flex it.

e. Remove the three screws that secure the control board to the plywood brace. Grasp the board firmly at the bottom and pull straight down parallel to the plywood brace.

f. Install the replacement control board using the screws that you removed in step e. above.

g. Push the cords into the sockets in the control board until the locking arms snap into place.

NOTE: When connected, the shielded cord should be toward the toe of the chair.

h. Ensure that the toggle switch on the junction box is in the automatic position.

i. Replace the toe board cover.

j. Replace the clear toe cover using the common tacks to secure the tails to the wood frame.

k. Connect the chair to the power supply.

l. Check the chair to ensure that it operates properly.

3-4. REPLACING BASE MOTOR (PLR-200)

The lift motor hums when you use the manual control switch, foot control switch, or the automatic switch to raise or 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 lift 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 3-3.

(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 3-4.

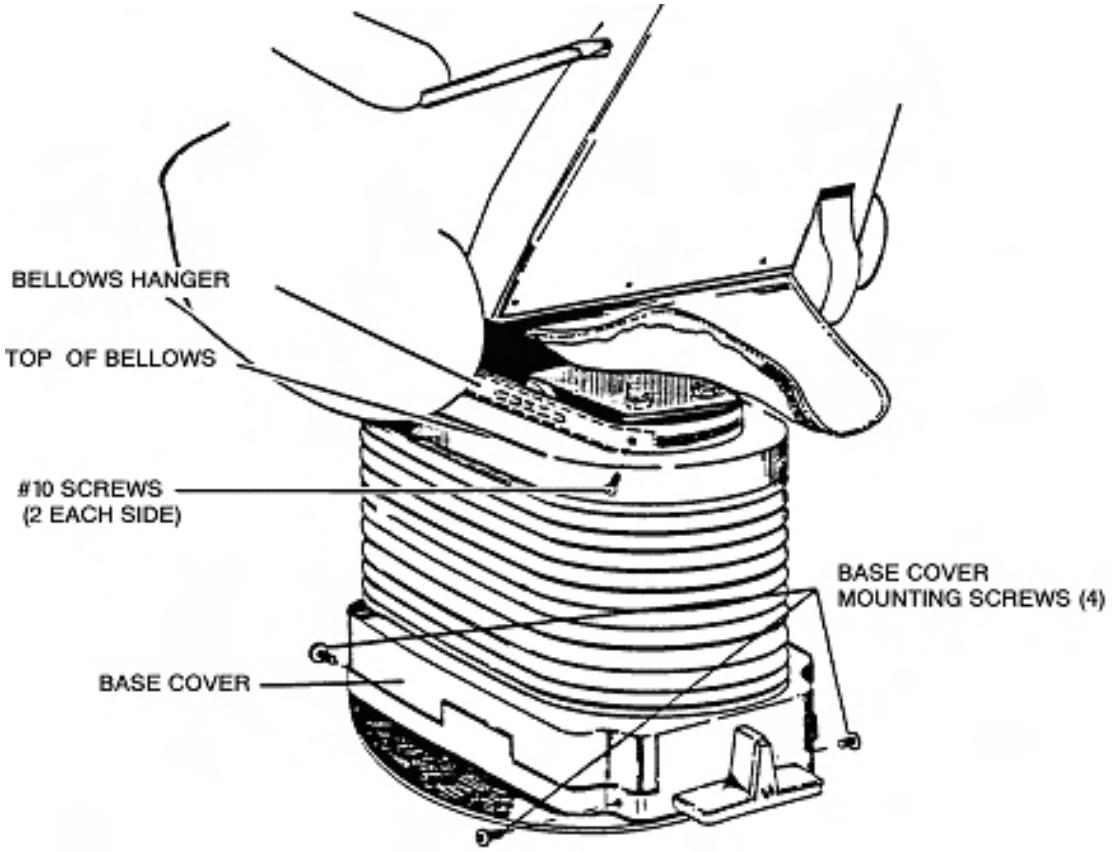

Figure 3-3. View of bellows with chair raised.

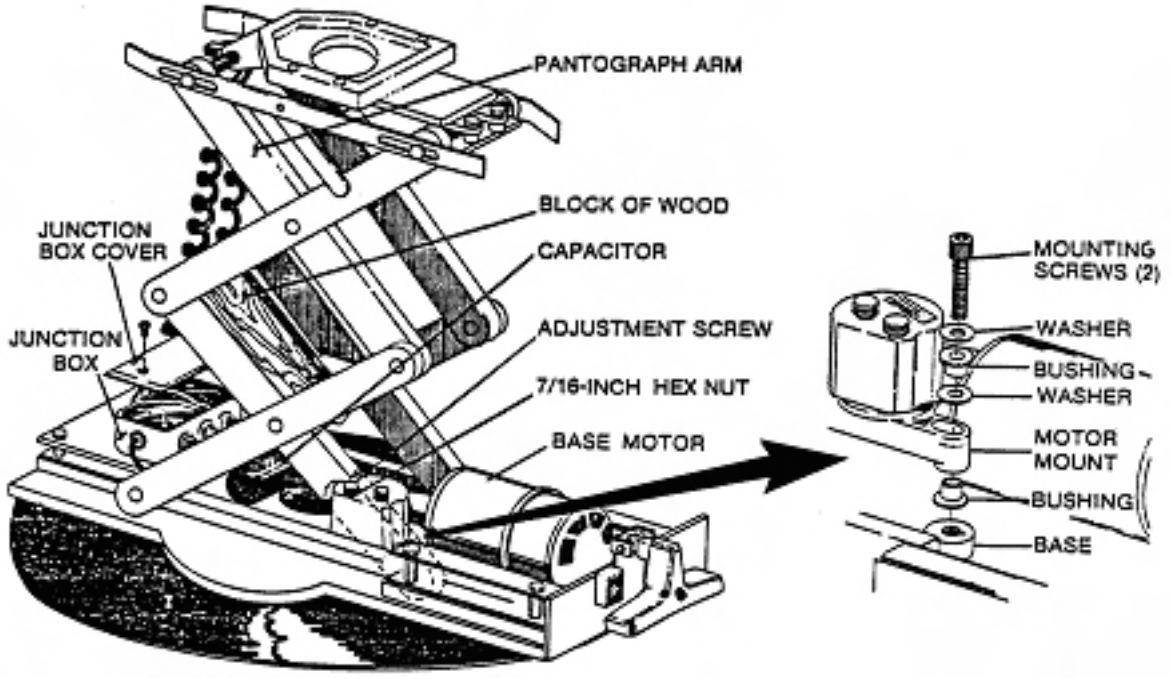

Figure 3-4. PLA-R-200 lift.

(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 3-3.

(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 3-5.

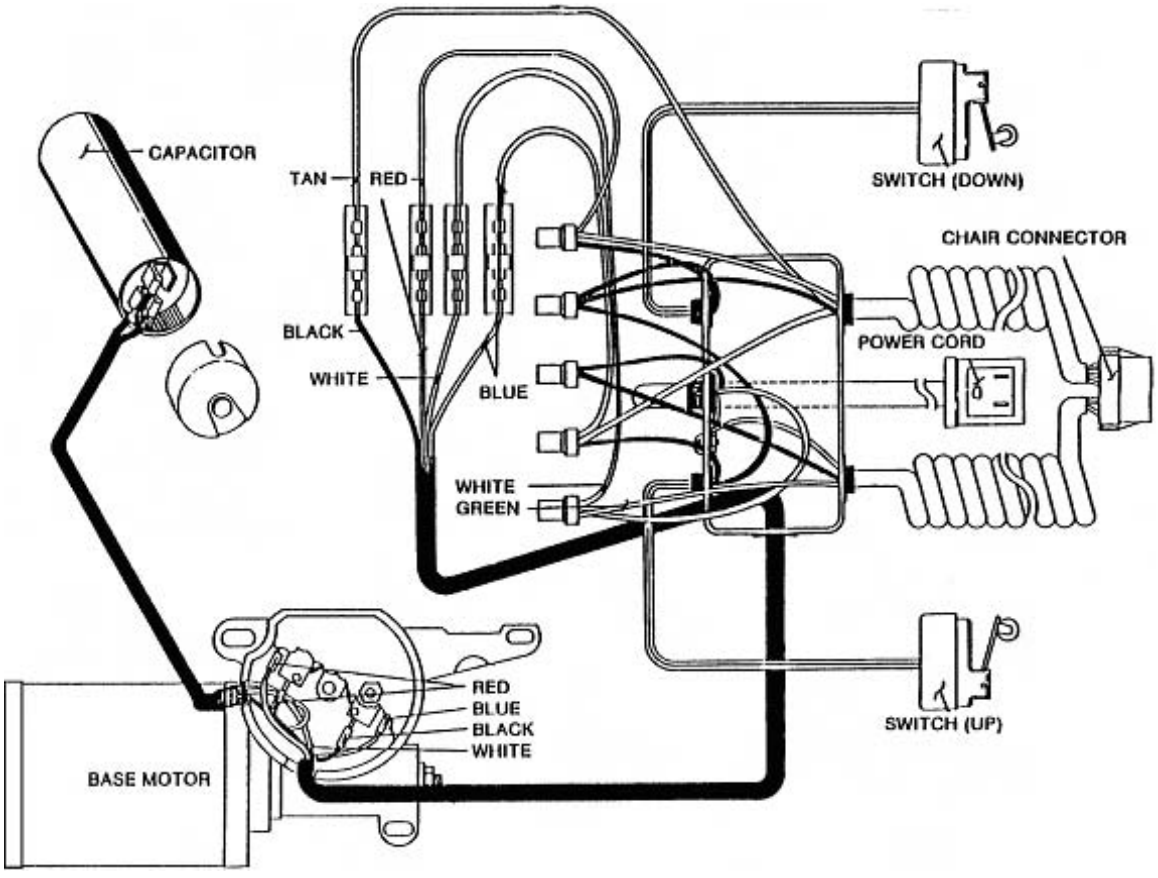

Figure 3-5. PLR-200 wiring diagram.

(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 3-6.

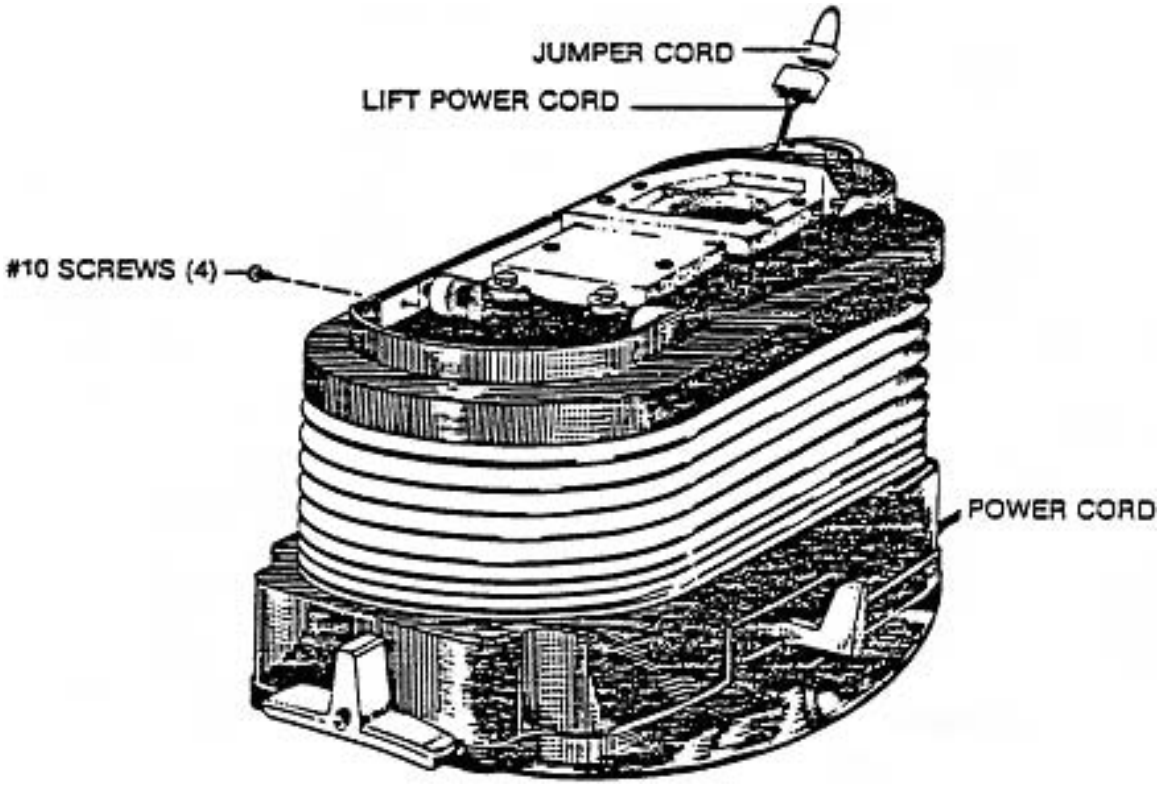

Figure 3-6. The PLA-200 precision lift.

(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 3-4.

(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 3-7) and turn clockwise (refer to figure 3-4) 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.

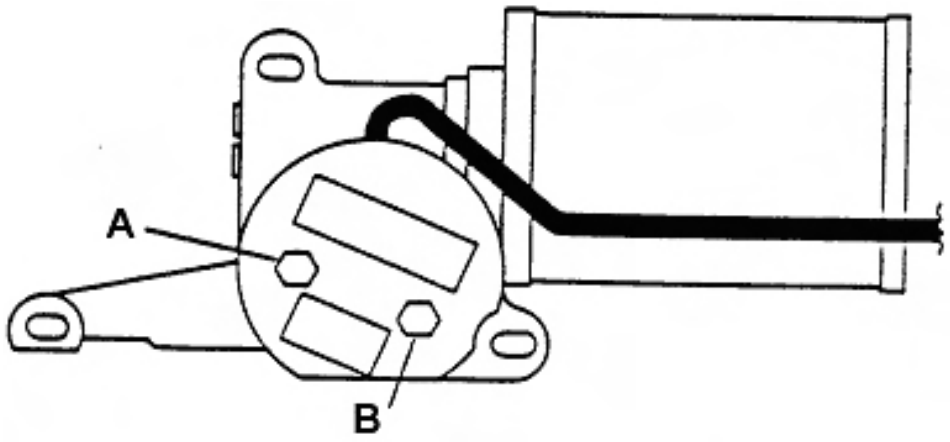

Figure 3-7. Switches "A" and "B" on PLR-200.

(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 3-7) 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 3-3.

b. **Chair Is In DOWN Position and Will Not Raise.**

(1) Remove the chair and cover as stated in procedure a. above, steps (1) through (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 (a helper will be required). The lift can then be raised to its full extended up position.

(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).

3-5. 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 number ten 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 3-8.

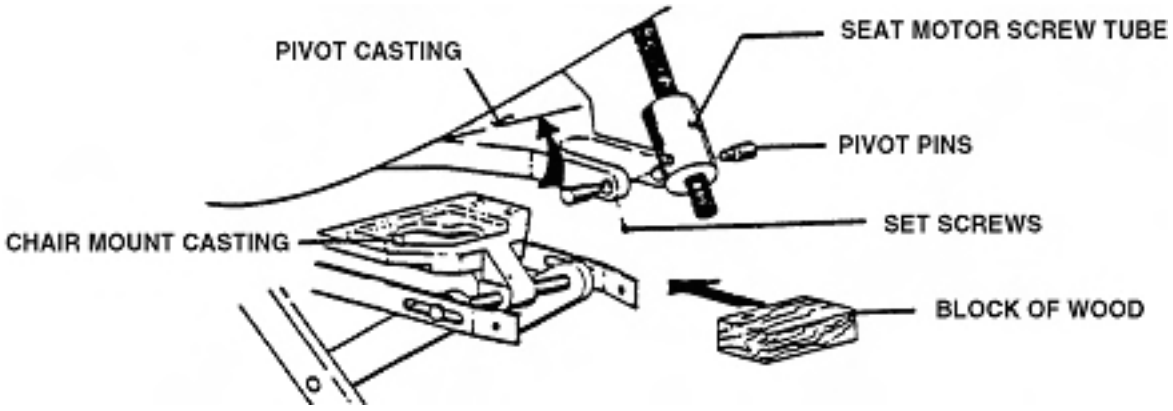

Figure 3-8. Installing wood block.

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 3-9.

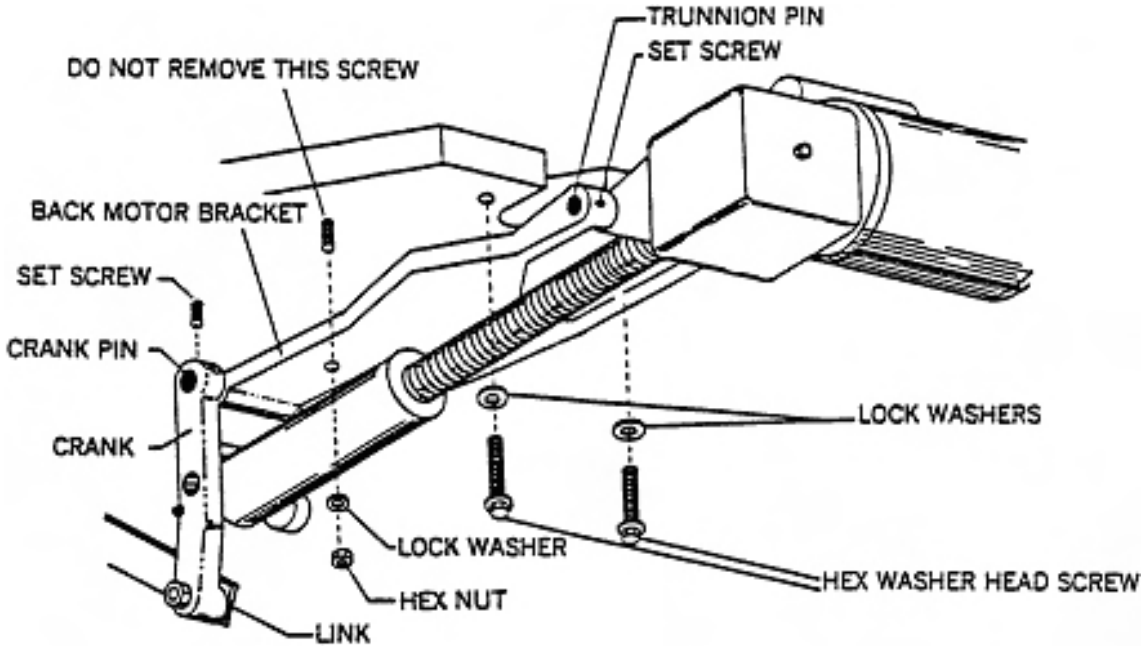

Figure 3-9. Installing back motor bracket.

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.

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.

3-6. 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 3-10.

a. Run the chair up to its full height.

b. Disconnect the external power source.

c. Disconnect the chair electrical cords from the lift.

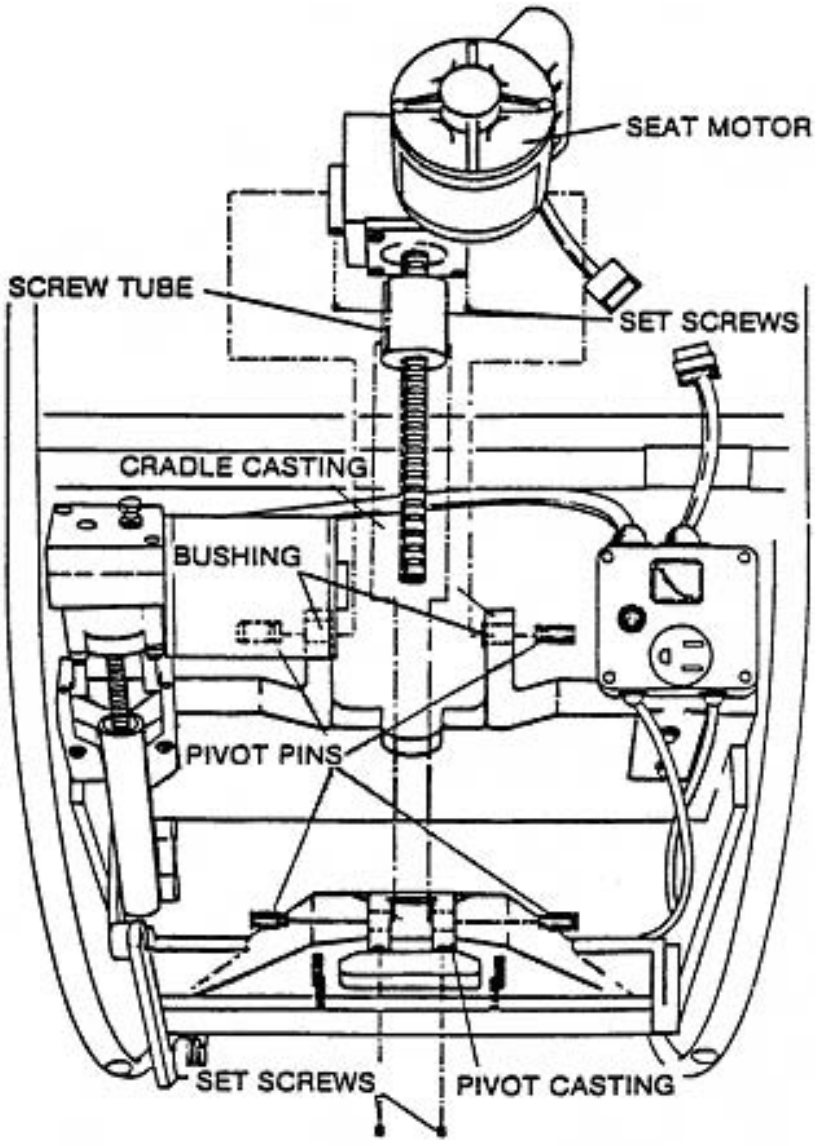

Figure 3-10. Removal of seat motor.

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 components as indicated below.

(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.

3-7. REPLACING THE POTENTIOMETER WIRING HARNESS

The dental chair fails to operate. You have isolated the problem to a faulty potentiometer wiring harness. You must replace it. Refer to figure 3-11.

a. Use the foot switch to raise chair to its maximum height.

b. Disconnect the chair from the building power supply.

c. Disconnect the chair power cord from the base cords.

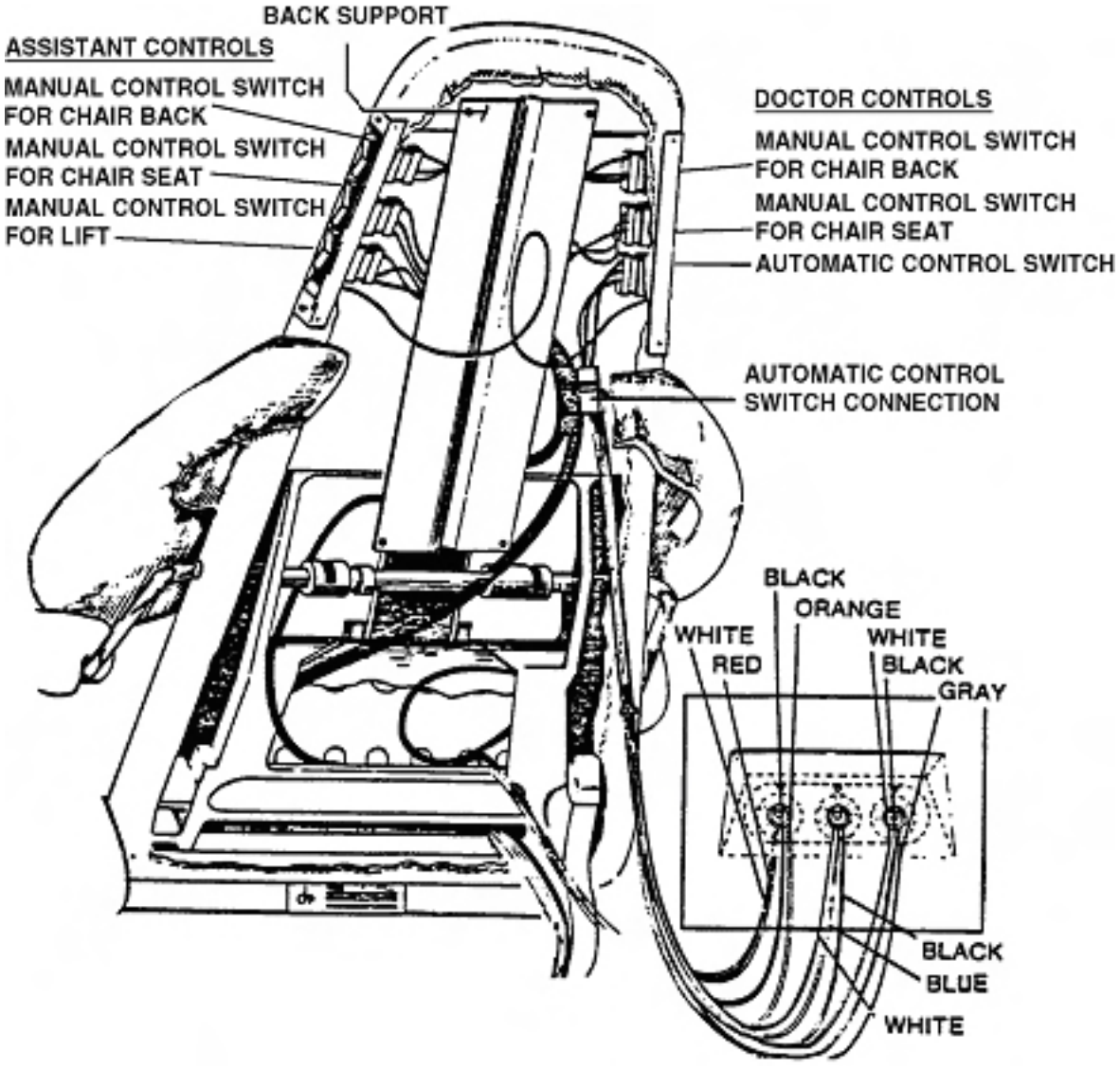

Figure 3-11. Potentiometer wiring harness installation.

d. Remove the four number ten screws securing the bellows top cover to the bellows hanger and let the bellows fall free.

e. Remove and retain the four bolts, nuts, and washers securing the chair to the lift and remove the chair from the lift.

f. Place the chair on its side on a carpet or other protective covering so that it will not get scratched or damaged.

g. Set the potentiometer dials at "9" and loosen the set screws in each knob. Remove the knobs/dials and the 3/8 inch hex nuts on the potentiometer shafts.

h. Remove the screws from the back cover and remove the cover.

i. Remove the plastic toe cover, motor cover, and toe board cover.

j. Disconnect the potentiometer wiring harness from the automatic switch.

NOTE: It may be necessary to loosen or remove the top screws securing the back support in order to gain access to the connections of the wiring harness and the switch.

k. Disconnect the potentiometer wiring harness from the solid state control board by depressing the locking arms of the connector, using the thumb and forefinger, and pulling outward.

l. Remove the screws and clamps securing the potentiometer wiring harness to the chair, and remove the harness.

m. Install the new wiring harness connector to the control board by pushing down until the locking arms of the connector catch.

n. Install the new potentiometer wiring harness onto the frame of the chair using the clamps and screws you removed in step l. above.

o. Connect the wiring harness to the automatic switch.

p. Replace the potentiometers in the back cover and secure with the 3/8 inch hex nuts you removed in step g. above.

q. Replace the back cover.

r. Install the potentiometer dials in the "9" position and tighten the set screws in each knob.

s. Replace the toe board cover, motor cover, and plastic toe cover.

t. Install the chair on the lift using the bolts, washers, and nuts you removed in step e. above.

u. Connect the chair power cord to the connector at the front of the lift.

v. Raise the bellows cover and attach to the bellows hanger with the number ten screws you removed in step d. above.

w. Connect to the external power supply.

x. Using the foot control, lower the chair.

y. Check the automatic controls as follows.

NOTE: Make sure the toggle switch on the junction box located under the chair is in the AUTO position. Refer to figure 3-12.

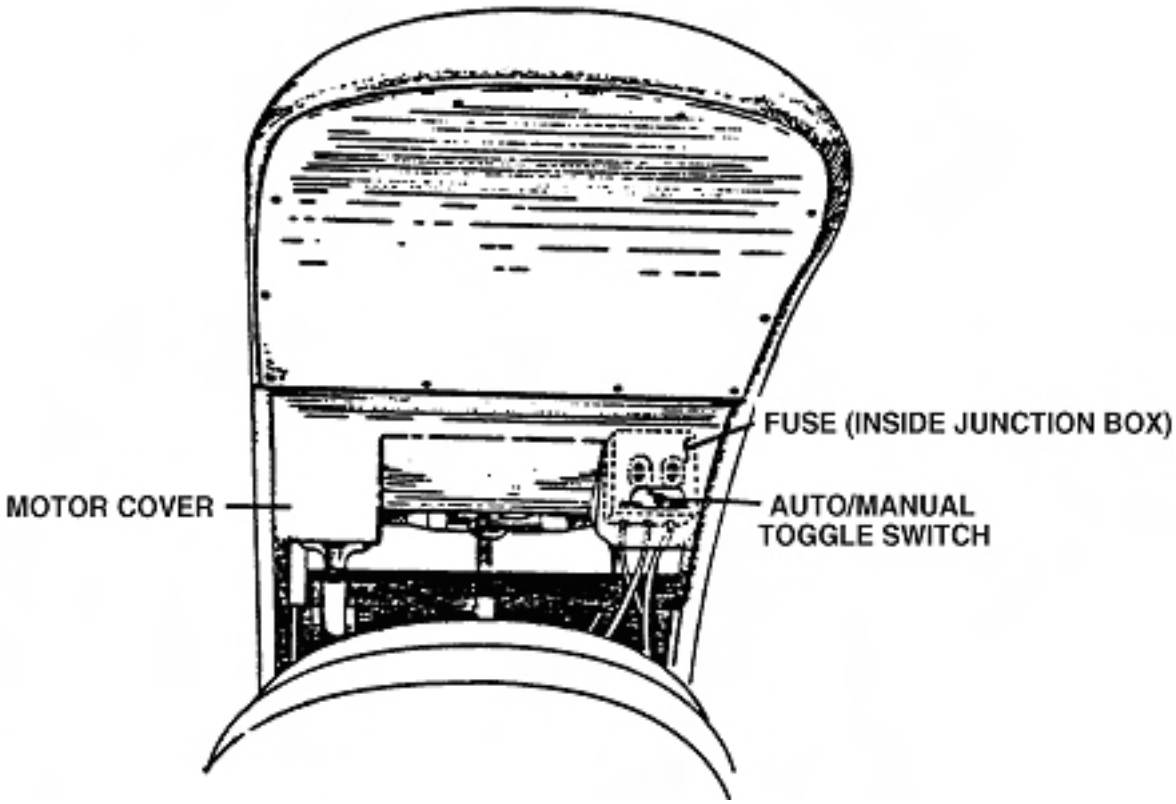

Figure 3-12. View of toggle switch on junction box.

(1) Set programming dials one at a time at "5," the other two dials at "0."

(2) Depress the top side of the automatic control switch and release. The chair should move to the selected operating position.

(3) Depress the bottom side of the automatic control switch and release. The chair should return to the exit position.

(4) Set all three programming dials at "5" and depress the top side of the automatic control switch and release. The chair should move to the selected operating position.

(5) Depress the bottom side of the automatic control switch and release. The chair should return to the exit position.

(6) Change the dial settings and repeat the procedure.

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 solid state control board?

   a. Because the control board is on the underneath portion of the chair seat, you do not need to remove the chair toe cover.

   b. Once you remove the three screws securing the control board, you grasp it firmly and flex it until it comes loose from the plywood brace.

   c. When connected, the shielded cord should be away from the toe of the chair.

   d. Always push the cords into the sockets in the control board until the locking arms snap into place.

3. 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.

4. 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 <u>not</u> 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.

5. 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.

6. 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.

7. Which of the following applies to replacing the potentiometer wiring harness?

   a. Use the foot switch to raise the chair to its maximum height.

   b. Use the doctor's manual control switch to raise the chair to its maximum height.

   c. Set the potentiometer dials on "0" and loosen the set screws in each knob.

   d. Also replace the automatic control board whenever you replace the potentiometer wiring harness.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES: LESSON 3

1. c (para 3-2d NOTE)
2. d (para 3-3g)
3. a (para 3-4a(2) CAUTION)
4. d (para 3-4b(8))
5. c (paras 3-5e, f)
6. c (para 3-6m)
7. a (para 3-7a)

End of Lesson 3

APPENDIX

DENTAL CHAIR TROUBLESHOOTING GUIDE

PROBLEM #1

1. 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 coil at rear of lift	4. Visual inspection.	4. Make a secure connection.

NOTE: On newer model chairs the chair-base connector is mounted in front of the chair. (See figure 2-3.)

PROBLEM #1 (continued)

1. Chair or lift will not operate (continued).

PROBABLE CAUSE	TESTING PROCEDURE	CORRECTIVE ACTION
5. Motors not plugged into chair electrical junction box.	5. Visual inspection.	5. Plug in each motor.
6. Power cord from electrical junction box and cord from programming dials not securely plugged into automatic control board.	6. Visual inspection. Remove plastic cover, motor, and toe board covers following instructions.	6. Make a secure connection of each cord.
7. Faulty solid state automatic control board.	7. Using a voltmeter, check receptacles on chair electrical junction box for a reading of 115v or 220v as applicable. If there is a reading, the automatic control board is faulty.	7. Remove and replace the automatic control board.

PROBLEM #1 (continued)

1. Chair or lift will not operate (continued).

PROBABLE CAUSE	TESTING PROCEDURE	CORRECTIVE ACTION
8. Loose connection in lift electrical junction box. (See figure 3-4.)	8. If there is no reading at chair receptacle on electrical junction box, (Step 7 above) 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.	8. Make a secure connection.
9. Faulty wiring harness.	9. Remove screws securing elec-trical junction box cover and check wiring for reading of 115v or 220v as applicable. If there is no reading, wiring harness is faulty.	9. Remove and replace replace wiring harness.

PROBLEM #1 (continued)

1. Chair or lift will not operate (continued).

PROBABLE CAUSE	TESTING PROCEDURE	CORRECTIVE ACTION
10. Assistant and Doctor's manual switches are faulty.	10a. 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. (See figure 3-11) If there is no reading, wiring harness is faulty.	10a. Remove and replace chair wiring harness.
	10b. 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 (see figure 2-1, [Control Board portion]) when bottom side of control switch is depressed. If there is no reading, switch is faulty.	10b. Remove and replace switch.

PROBLEM #1 (continued)

1. Chair or lift will not operate (continued).

PROBABLE CAUSE	TESTING PROCEDURE	CORRECTIVE ACTION
	10c. If there is a eading on both switch legs in l0b above, the motor is faulty.	10c. Remove and replace applicable motor.
11. Broken chain or sheared pin in motor sprocket.	11. If manual control for lift or foot control is activated and motor runs but lift does not raise, failure is due to either a broken chain or pin on motor sprocket sheared. Visual inspection.	11. Replace chain. Remove and replace pin on motor sprocket.
12. Bent or broken lift control switch.	12. Visual inspection.	12. Remove and replace lift control switch.
13. Faulty motor for capacitor.	13. If motor hums when manual control or foot control is used to operate lift, capacitor or motor is faulty.	13. Remove and replace motor and/or capacitor.

PROBLEM #1 (continued)

1. Chair or lift will not operate (continued).

PROBABLE CAUSE	TESTING PROCEDURE	CORRECTIVE ACTION
14. Automatic controls not functioning.	14a. Toggle switch on electrical junction box should be in the "Auto" position.	14a. Place in "Auto" position.
	14b. Make sure programming dials are not loose on the potentiometer shafts.	14b. If dials are loose, tighten.
	14c. Remove clear plastic cover, motor. and toe board covers.	
	14d. Power cord from electrical junction box and cord from programming dials should be securely plugged into automatic control board.	14d. Plug power cords in securely.
	14e. Set programming dials one at a time at "5," other two at "0." Use automatic control switch to check each motor.	
	NOTE: If there is no action, check automatic control switch as follows:	

PROBLEM #1 (continued)

1. Chair or lift will not operate (continued).

PROBABLE CAUSE	TESTING PROCEDURE	CORRECTIVE ACTION
(14. continued)	14f. Disconnect lift power cord from supply receptacle. 14g. Disconnect programming dials cord from automatic control board. 14h. Using an ohmmeter, check across the following terminals on programming dials and for a reading from "infinite" to "0." (Refer to figure 2-1 [Control Board portion].) (a) Terminals 4 and 6 when bottom side of automatic control switch is depressed. (b) Terminals 4 and 2 when top side of switch is depressed.	

PROBLEM #1 (continued)

1. Chair or lift will not operate (continued).

PROBABLE CAUSE	TESTING PROCEDURE	CORRECTIVE ACTION
(14. continued)	14i. If there is no movement of ohmmeter indicator, the automatic control switch is faulty.	14i. Replace the automatic control switch.
	14j. If there is movement of ohmmeter indicator, the automatic control board is faulty.	14j. Replace the the automatic control board.
	NOTE: If the chair or lift fails to proceed to the position in which it was programmed, check potentiometer wiring harness as follows:	
	14k. Disconnect lift power cord from supply receptacle.	
	14l. Disconnect potentiometer cord from automatic control board.	

PROBLEM #1 (continued)

1. Chair or lift will not operate (continued).

PROBABLE CAUSE	TESTING PROCEDURE	CORRECTIVE ACTION
(14. continued)	14m. Using an ohmmeter, check for a reading of "50k" across the following terminals on potentiometer cord. (Refer to figure 2-1 [Control Board portion].) (a) Terminals 8 and 5 to check back motor potentiometer. (b) Terminals 8 and 7 to check seat motor potentiometer. (c) Terminals 8 and 3 to check lift motor potentiometer.	

PROBLEM #1 (continued)

1. Chair or lift will not operate (continued).

PROBABLE CAUSE	TESTING PROCEDURE	CORRECTIVE ACTION
(14. continued)	**NOTE:** If the reading is 10 percent, proceed to Step 4 below. If the ohmmeter indicates "infinite" on any of the potentiometers, an open circuit is indicated. If the ohmmeter indicates "0" on any of the potentiometers, a short circuit is indicated. 14n. Using an ohmmeter, checkacross the following terminals for a variable reading from "0" to "50k," while turning programming dials clockwise and counter-clockwise. (a) Terminals 8 and 9 to check back motor potentiometer. (b) Terminal 8 and 1 to check seat motor potentiometer. (c) Terminals 8 and 10 to check lift motor potentiometer.	If the open or short circuit cannot be located and repaired, it may be internal to the potenti-ometers. Replace automatic wiring harness.

PROBLEM #1 (continued)

1. Chair or lift will not operate (continued).

PROBABLE CAUSE	TESTING PROCEDURE	CORRECTIVE ACTION
(14. continued)	**NOTE:** If the reading on the ohmmeter varies from "0" to "50k" + 10 percent as the dials are rotated, the automatic control is faulty. If the ohmmeter reads "0" on any of the potenti-ometers and does not change when rotating the dials, a short circuit is indicated. If the ohmmeter indicates "infinite" on any of the potentiometers and does not change as the dials are rotated, an open circuit is indicated.	Replace the automatic control board. Replace the programming dials wiring harness.
15. Automatic exit switch in wrong position.	15. Visual inspection.	15. Change switch position.

PROBLEM #1 (continued)

1. Chair or lift will not operate (continued).

PROBABLE CAUSE	TESTING PROCEDURE	CORRECTIVE ACTION
16. Faulty relay.	16a. Place the chair in full operating condition (back down and toe up); actuate the auto return switch and listen for a clicking noise. If noise is heard, the relay is faulty.	16a. Replace the relay.
	16b. 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.	16b. Replace the relay.

PROBLEM #2

2. Manual control switch for lift fails to raise or lower the chair.

PROBABLE CAUSE	TESTING PROCEDURE	CORRECTIVE ACTION
1. Broken chain.	1. Visible inspection.	1. Replace broken.
2. Sheared pin on motor sprocket.	2. Visible inspection.	2. Replace motor.
3. Faulty switch or wiring harness.	3a. Remove switch bezel from chair.	
	3b. 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.	3b. Replace wiring harness.
	3c. If there is a reading in 3b above, check for a reading of 115v or 220v as applicable between terminal 3 and neutral ine when top side of control switch is depressed; between terminal 1 and neutral when bottom side of switch is depressed. If there is no reading, the switch is faulty.	3c. Replace switch.

PROBLEM#2 (continued)

2. Manual control switch for lift fails to raise or lower the chair. (continured)

PROBABLE CAUSE	TESTING PROCEDURE	CORRECTIVE ACTION
(3. continued)	3d. If there is a reading on both switch legs, the motor is faulty.	3d. Replace motor.

PROBLEM #3

3. Foot control pedal fails to raise or lower chair.

PROBABLE CAUSE	TESTING PROCEDURE	CORRECTIVE ACTION
1. Bent or broken lift control switch.	1. Visible inspection.	1. Replace control switch.

PROBLEM #4

4. Lift motor hums when manual control switch, foot control, or automatic switch is used to raise or 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 #5

5. Automatic control fails to operate (manual controls are operating.

PROBABLE CAUSE	TESTING PROCEDURE	CORRECTIVE ACTION
1. Automatic control switch is faulty.	1. Test automatic control switch as in 14 above.	1. Remove and replace the automatic control switch.
2. Auto control board is faulty.	2. Test automatic control board as in 7 above.	2. Remove and replace the automatic control board.

NOTE: If corrective action cannot be accomplished immediately, place junction box toggle switch in manual position until corrective action can be accomplished.

PROBLEM #6

6. Chair or lift fails to function properly.

PROBABLE CAUSE	TESTING PROCEDURE	CORRECTIVE ACTION
1. Faulty potentiometer wiring harness.	1. Test potentiometer wiring harness as in 14n above. harness.	1. Remove and replace the potentiometer.

PROBLEM #7

7. 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 #8

8. Two motors operate when only one programming dial is set.

PROBABLE CAUSE	TESTING PROCEDURE	CORRECTIVE ACTION
1. Faulty control board.		1. Replace the control board.

PROBLEM #9

9. Chair reverses or automatic movement does not stop when canceling automatic operate or automatic exit.

PROBABLE CAUSE	TESTING PROCEDURE	CORRECTIVE ACTION
1. Faulty control board.		1. Replace the control board.

PROBLEM #10

10. Arm will not hold position.

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

PROBLEM #11

11. 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