

QBC®
Centrifugal
Hematology Analyzer

MAINTENANCE MANUAL
for the

 QBC® Centrifuge

Model 4207

Becton Dickinson
Primary Care Diagnostics

One Becton Drive, Franklin Lakes, New Jersey, U.S.A. 07417

BECTON
DICKINSON

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SECTION 1. GENERAL INFORMATION

1.1 SCOPE OF MANUAL

This maintenance manual provides service information and procedures for QBC Centrifuge Model 4207 (Figure 1-1), which is manufactured by Becton Dickinson Primary Care Diagnostics.

1.2 PURPOSE OF EQUIPMENT

The QBC Centrifuge is a high-speed laboratory instrument that produces packed cell volumes for the quantitative measurement of hematologic values by the QBC method.

The centrifuge is a tube-preparation accessory to the QBC Centrifugal Hematology Analyzer System (Catalog No. 4465). Special-purpose QBC blood tubes can be accommodated, which, under centrifugation, differentiate and expand the cell layers of the buffy coat. The tubes, when measured on a QBC_{II} Reader, yield a hematocrit, as well as the platelet count, total white-cell count, and counts of the granulocyte and lymphocyte/monocyte subpopulations.

1.3 EQUIPMENT SUPPLIED

The equipment supplied is QBC Centrifuge Model 4207. Step-Down Transformer Model 4477-505-000 is supplied, where applicable, to reduce a 220-240 V, 50/60 Hz main to the 120 V required at the centrifuge.

1.4 EQUIPMENT REQUIRED BUT NOT SUPPLIED

A QBC_{II} Reader Model 4477, venous blood pipetter, a workstation, and associated test accessories are required for the centrifuge to function as a preparation accessory to the QBC Centrifugal Hematology Analyzer.

1.5 TECHNICAL CHARACTERISTICS

Technical characteristics of the centrifuge are provided in Table 1-1.

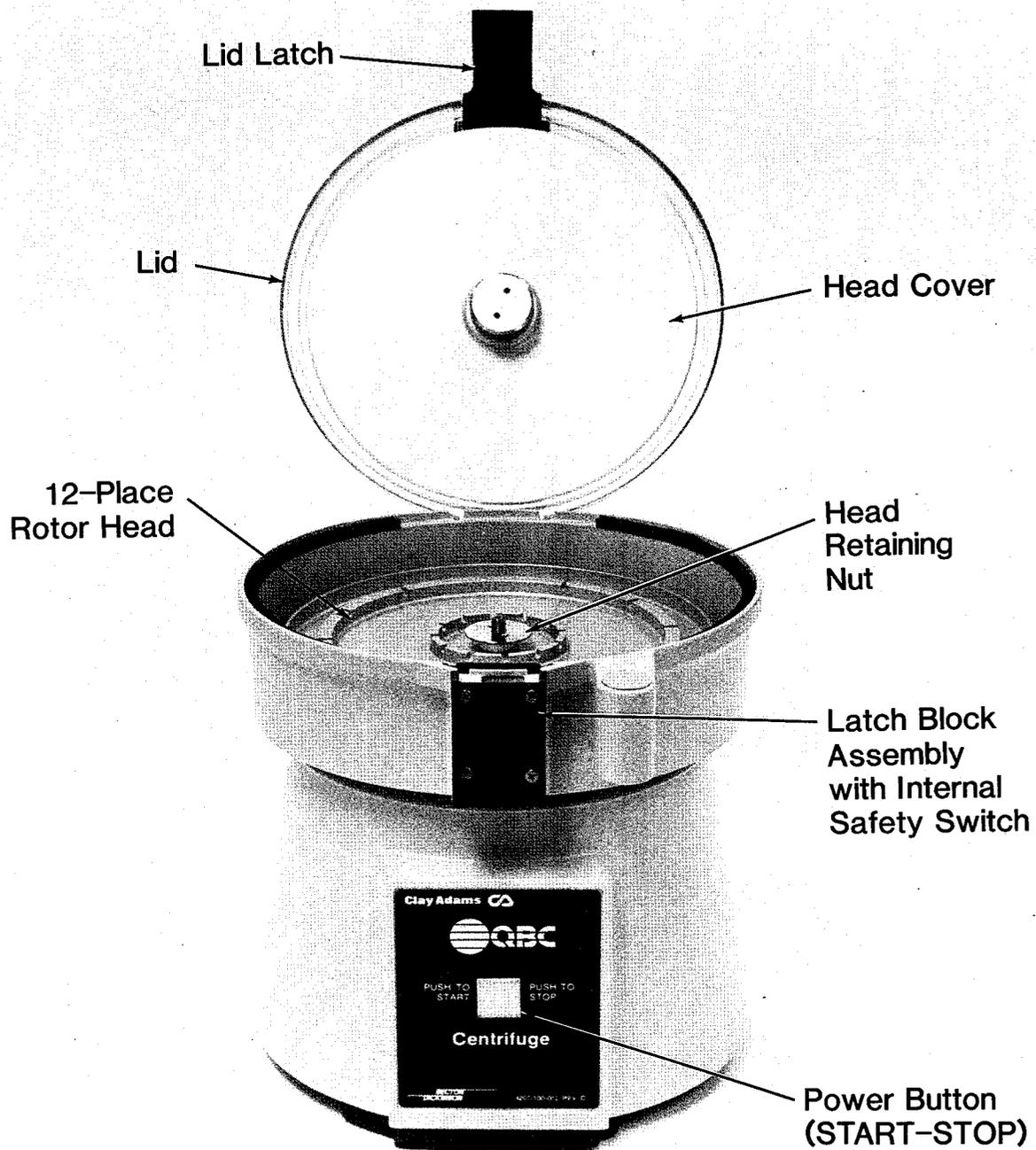


Figure 1-1. QBC Centrifuge Model 4207

TABLE 1-1. TECHNICAL CHARACTERISTICS OF CENTRIFUGE

<u>Characteristic</u>	<u>Description</u>
Rotor capacity	12 QBC blood tubes
Speed @rated voltage	Approx. 12,000 RPM.
Relative centrifugal force @rated voltage	Approx. 14,387 x g.
Timer	Electronic, fixed 5-minute cycle.
Safety interlock switch	Actuated by lid latch. Centrifuge motor is inoperable unless interlock switch is actuated (lid fully closed and latched).
Motor brake	Electric, actuated automatically by timer after completion of spin cycle. Actuated manually by pressing PUSH TO START/PUSH TO STOP switch.
Power Requirements:	
Without step-down transformer	120 V \pm 10%, 50/60 Hz, 4 amp max (avg. 180 W), typical current 1.4A, single phase.
With step-down transformer	230 V \pm 10%, 50/60 Hz, 2.3 amp max (avg. 190 W), typical current 0.9A, single phase.
Fuse, on timer circuit board	4 amp Slo-Blo (3AG)
Power cord	Two flat blades with ground pin, 2.0 m (6.5 ft) long.

1.6 PHYSICAL CHARACTERISTICS

The dimensions and weight of the centrifuge and step-down transformer, both packed and unpacked, are given in Table 1-2. The centrifuge with lid assembly raised is 42.7 cm (16.8 in.) high.

TABLE 1-2. PHYSICAL CHARACTERISTICS

<u>Characteristic</u>	<u>Weight</u> (kg/lb)	<u>Volume</u> (m ³ /ft ³)	<u>Height</u> (cm/in.)	<u>Width</u> (cm/in.)	<u>Depth</u> (cm/in.)
CENTRIFUGE:					
Packed	7.5/16.5	0.04/1.4	39.9/15.7	31.7/12.5	31.7/12.5
Unpacked	5.4/12		22/8.7	21.6/8.5	25.4/10
TRANSFORMER:					
Packed	2.3/5.1	0.02/0.06	9.3/3.6	20.5/8.1	9/3.5
Unpacked	2.2/4.75		9/3.5	7.5/2.95	11.7/4.6

1.7 ENVIRONMENTAL REQUIREMENTS

The environmental requirements of the centrifuge are given in Table 1-3.

TABLE 1-3. ENVIRONMENTAL REQUIREMENTS

<u>Characteristic</u>	<u>Operating</u> <u>Limits</u>	<u>Storage</u> <u>Limits</u>
Temperature	20° to 32°C (68° to 90°F)	-26° to 55°C (-15° to 131°F)
Relative Humidity (Non-condensing)	10% to 95%	10% to 95%

1.8 ELECTROSTATIC DISCHARGE (ESD)

The QBC Centrifuge contains a printed-circuit board on which are installed metal-oxide-semiconductor (MOS) devices. The MOS devices are subject to damage from electrostatic discharge.

Electrostatic discharge can occur at any time, but the probability of it occurring is increased when the humidity is low. The exercise of some simple precautions will minimize the likelihood of damage by ESD:

- Before handling the timer circuit board, touch a metal object, such as the centrifuge housing, to discharge electrostatic buildup from your body.

- Avoid touching, when possible, the MOS devices or their contacts.
- Stand on an anti-electrostatic mat to work on the timer circuit board. Use an anti-static work surface.
- If the timer circuit board is removed and is to be shipped, e.g., back to the factory, first place the printed-circuit board in an anti-electrostatic bag.

SECTION 2. INSTALLATION

2.1 UNPACKING

Examine the outer shipping container carefully to see if it has been damaged, e.g., punctured, dented at the corners, etc. Open the carton immediately if it is damaged, and inspect the equipment thoroughly for damage, such as dents or scratches. Notify the carrier if the equipment is damaged, and request a Damaged Equipment Report form.

The method of unpacking is shown by the exploded-view drawing in Figure 2-1. Unpack each carton as it is removed, and check its contents against the packing list, Table 2-1. Store the packing materials for possible future reuse.

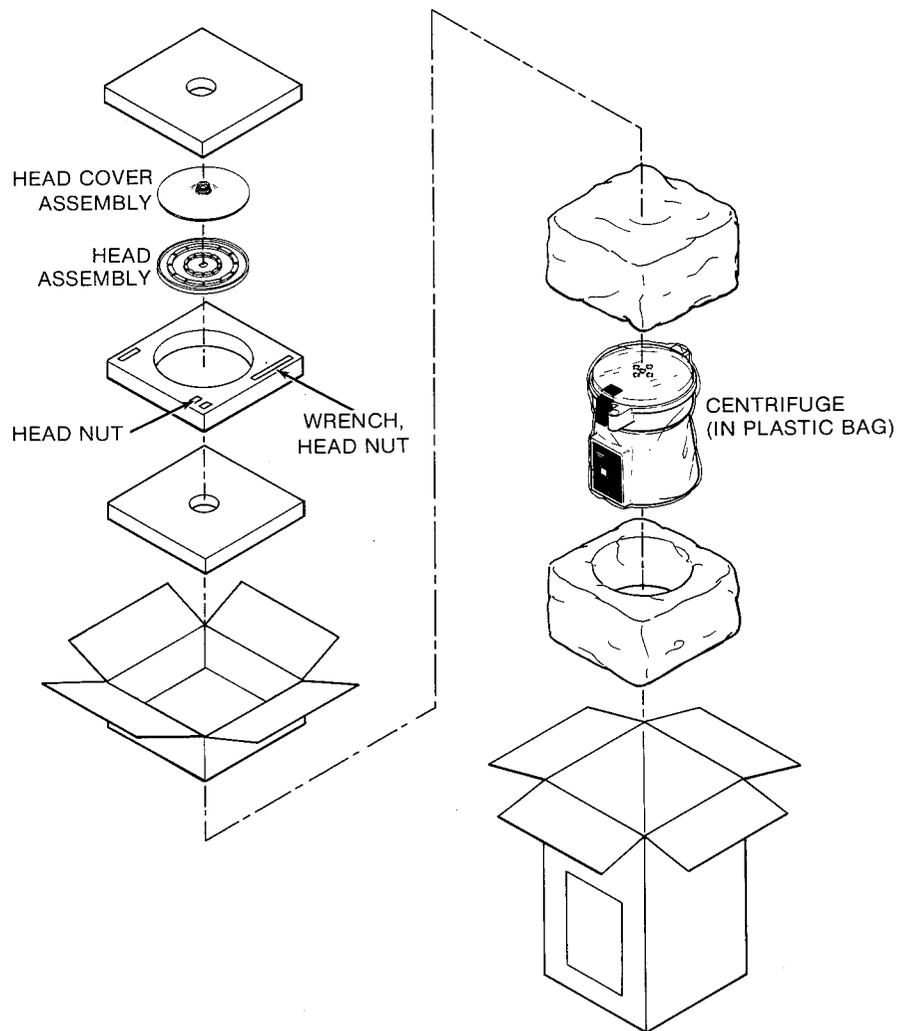


Figure 2-1. Unpacking Diagram

TABLE 2-1. PACKING LIST

<u>Item</u>	<u>Quantity</u>
Centrifuge Shipping Carton, contains:	
Carton Assembly, Head:	
Cover Assembly, Head	1
Head Assembly	1
Head Nut	1
Wrench, Head Nut	1
Centrifuge Assembly	1

2.2 ASSEMBLY PROCEDURE

The unassembled rotor head and rotor cover are boxed separately from the rest of the centrifuge inside the centrifuge shipping container. This separate box includes a flanged head nut and a wrench for attaching the rotor head to the D-shaped motor shaft. Install the rotor head by referring to Figure 2-2 and performing the following procedure:

- a. Open lid of centrifuge.
- b. Remove tape from motor shaft adapter.
- c. Place D-shaped hole of rotor onto threaded D-shaped rotor shaft. Ensure that rotor is fully bottomed on motor shaft and motor shaft adapter.
- d. Thread head nut onto motor shaft, flanged side up.
- e. Place pins on head nut wrench into holes of head nut; holding rotor head with one hand, turn wrench clockwise to tighten head nut.

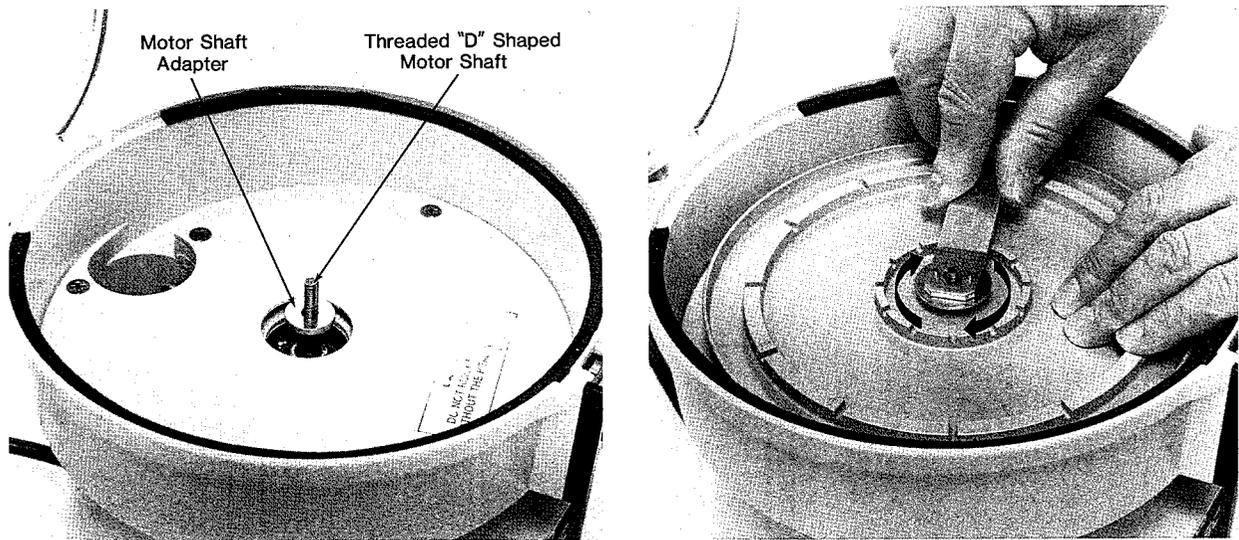


Figure 2-2. Head Assembly Details

2.3 CENTRIFUGE LOCATION REQUIREMENTS

Always place the QBC Centrifuge on a stable, level table or counter surface.

CAUTION

Locate the centrifuge where it will not be exposed to direct sunlight. Centrifugations in direct sunlight can elevate the rotor temperature and may cause adverse effects on the cell banding in QBC blood tubes.

2.4 INPUT POWER REQUIREMENTS

The input power requirements of the centrifuge are given in Table 1-1.

2.5 CABLE FABRICATION

There are no interconnecting cables between the centrifuge and other items of the system.

SECTION 3. OPERATION

The only operating control of the centrifuge is the white switch on the front panel labeled PUSH TO START/PUSH TO STOP (Figure 3-1). This switch is a push on/push off switch to control power on/off in the centrifuge.

3.1 STARTING

The centrifuge is started by pressing lightly on the white PUSH TO START/PUSH TO STOP switch on the front panel. The lens of the switch illuminates when the motor is powered. The centrifuge reaches rated speed within approximately 15 seconds. The interlock switch near the lid latch prevents the centrifuge from operating unless the latch is fully engaged.

CAUTION

Always ensure that the metal cover is installed before starting to centrifuge blood tubes. The head cover must be installed to prevent tube breakage and loss of samples.

3.2 OPERATING

3.2.1 LOADING AND BALANCING ROTOR HEAD

Blood tube positions on the rotor head are numbered counterclockwise from 1 through 12 for specimen identification. Each carrier-slot position has a number stamped next to it. Load the blood tubes as follows:

- a. Locate position 1 on rotor head.
- b. Insert open end of first blood tube under flange of head nut (Figure 3-2).
- c. Lower blood tube into position 1 tube slot.
- d. Position closure of blood tube snugly against outer rim of rotor head.



Figure 3-1. Location of PUSH TO START/PUSH TO STOP Switch

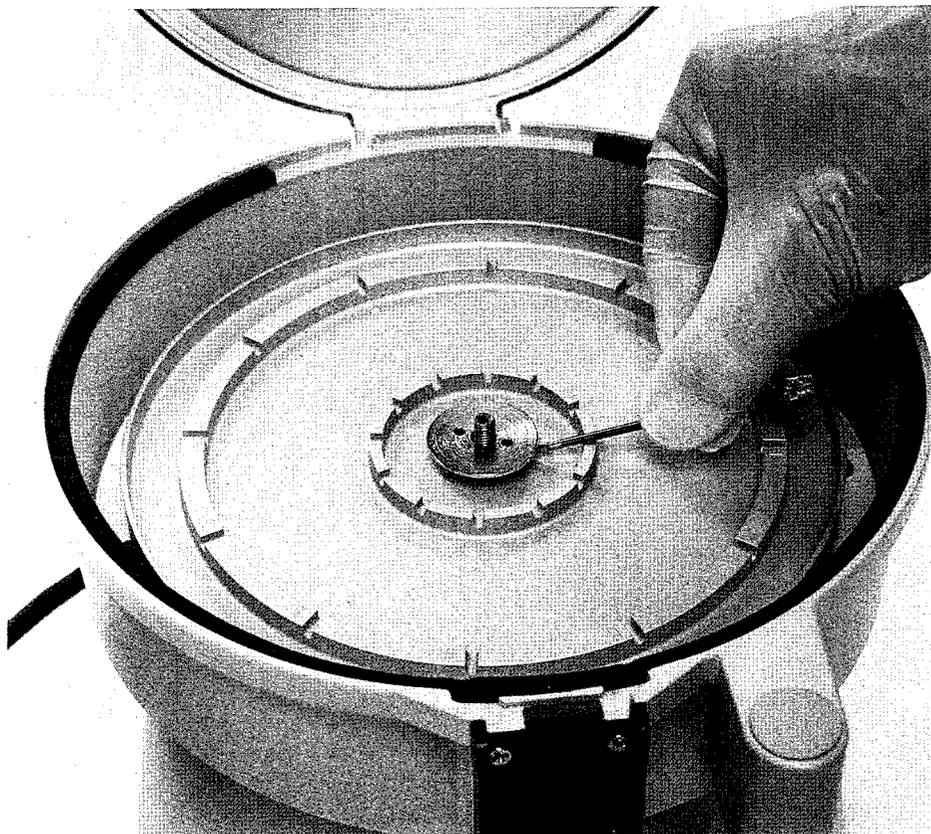


Figure 3-2. Placing QBC Blood Tubes on Rotor Head

- e. Repeat Steps a. through d. for remaining blood tubes, placing blood tubes on rotor head in a balanced array.

CAUTION

When spinning odd number of tubes, balance rotor head by placing empty QBC blood tube, fitted with closure and float, into carrier-slot position opposite odd tube. Maintain proper identification of test specimens when balancing tubes.

CAUTION

Ensure that closure of every QBC blood tube rests against outer rim of rotor head before installing head cover.

3.2.2 SECURING HEAD COVER AND LID

- a. Lower head cover onto threads of motor shaft.
- b. Turn knurled head cover knob (Figure 3-3) clockwise. Holding head cover with one hand, continue to turn head cover knob until head cover is tight on motor shaft.
- c. Close lid of centrifuge.
- d. Press down firmly until handle of lid latch (Figure 3-4) snaps into latch block on housing.

NOTE

Internal safety interlock switch will not actuate and centrifuge will not operate unless it is securely latched.

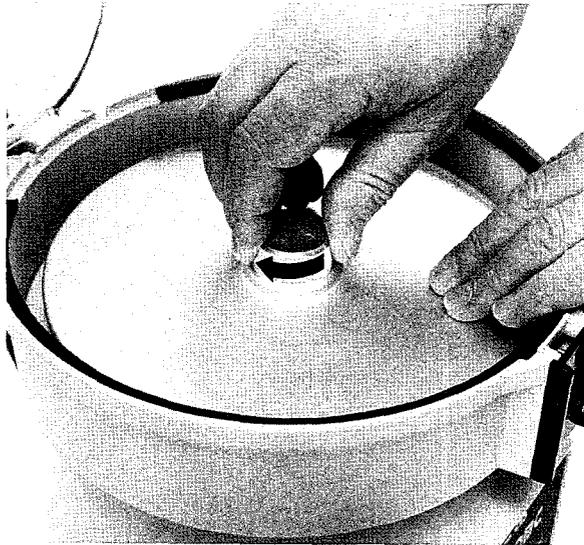


Figure 3-3. Installing Head Cover



Figure 3-4. Securing Lid Latch

3.3 STOPPING

When the 5-minute centrifugation period has elapsed, the lens of the PUSH TO START/PUSH TO STOP switch extinguishes and the electrically actuated brake causes the rotor head to decelerate. The rotor head stops within 30 to 35 seconds after the switch lens extinguishes.

NOTE

The centrifuge can be stopped at any time during the timed cycle by pressing the PUSH TO START/PUSH TO STOP switch once. The timer recycles to zero when the centrifuge is stopped before the end of the complete cycle.

SECTION 4. THEORY OF OPERATION

4.1 BLOCK DIAGRAM

The electrical circuits of the centrifuge are divided into five functional blocks. These functional blocks are designated M1 through M5 and are identified in Figure 4-1. Figure 4-1 also shows the waveforms to be expected at the identified test points.

4.2 CIRCUIT OPERATION

Refer to the block diagram, Figure 4-1 and to the schematic diagram, Figure 8-1.

4.2.1 POWER SUPPLY M1

The power supply develops a constant 12 VDC to operate the timer circuits. The power supply is controlled by a Zener diode, which clamps the output at +12 volts.

4.2.2 TRIGGER INPUT CIRCUIT M2

Pressing PUSH TO START/PUSH TO STOP switch S1 turns on centrifuge power and sends a short pulse (see test point TP2) to reset flip-flop U1 in timing latch M3. Closing S1 starts the 300-second (5-minute) timing cycle of the centrifuge by applying a trigger pulse to integrated circuits U1 and U2. The waveform at TP1 normally is 1.0 volt during the period of the timing cycle.

Opening the lid closes the contacts of the lid switch. Closure of the lid switch at any time during the timing cycle causes the voltage at TP1 to become 12 volts for as long as the lid switch is closed, interrupting that cycle and resetting the trigger input circuit. This sets the flip-flop in U1: Q-not goes to logic 0, Q1 turns off, and K1 is de-energized.

4.2.3 TIMING LATCH M3

The momentary closing of switch S1 clears flip-flop U1, causing 12-volt power to be applied to timer U2 for the period of one 300-second cycle. This power output from U1 can be measured at TP4. The clock pulses generated by U2, 9.15-ms \pm 5% square waves, are available for measurement, but only during the timing cycle, at TP3.

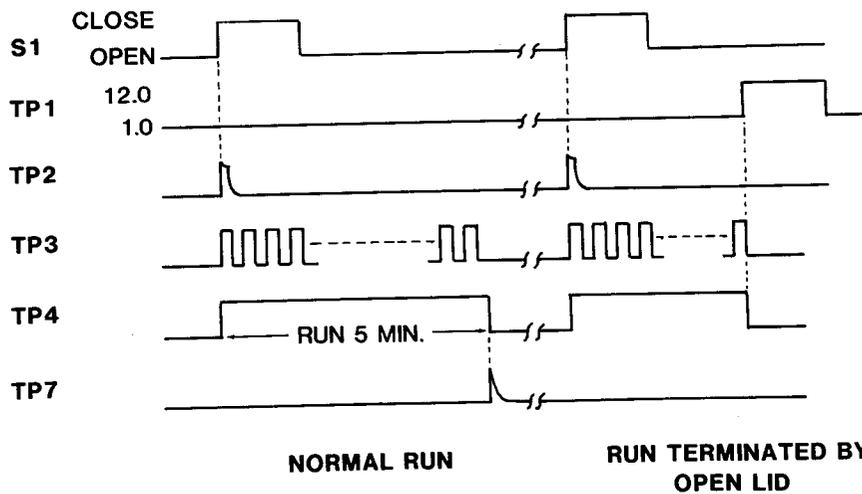
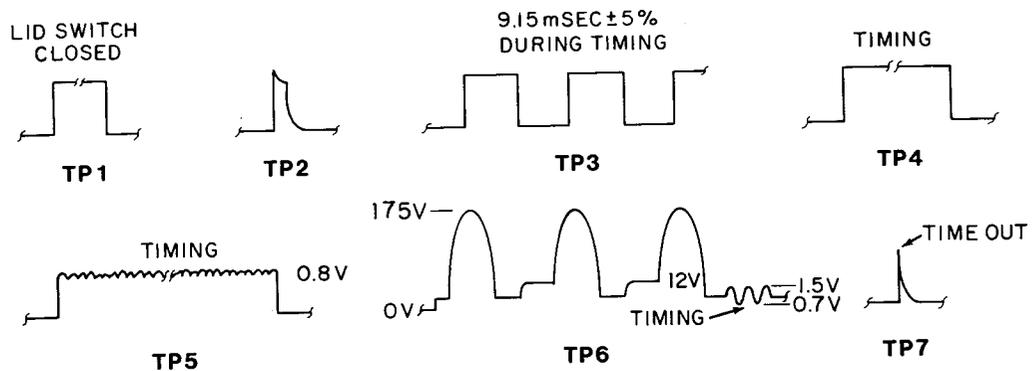
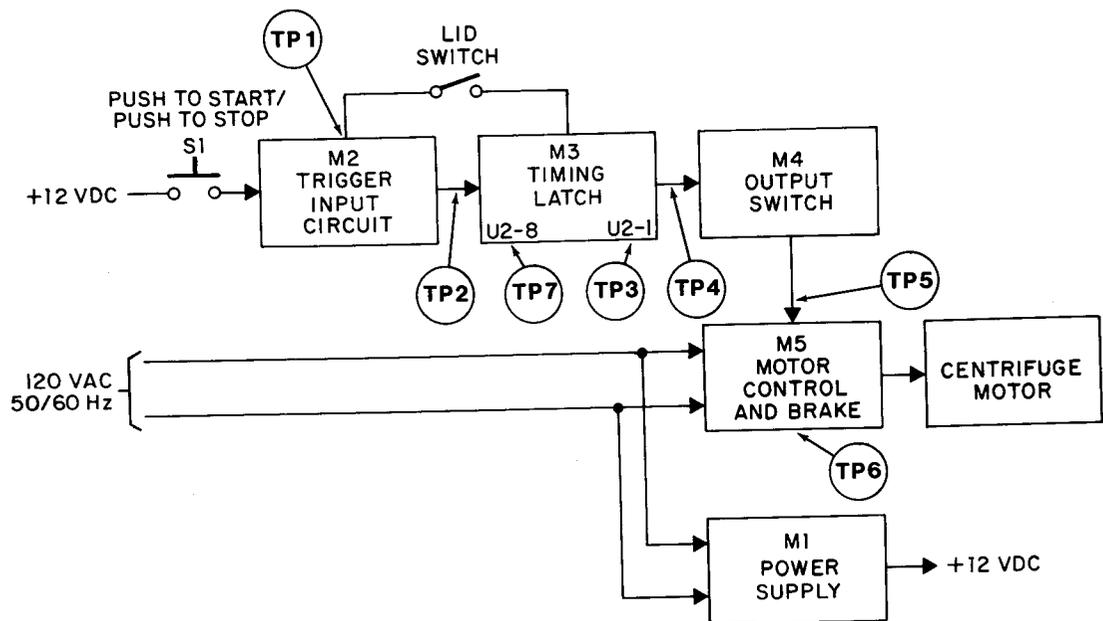


Figure 4-1. Simplified Block Diagram of Centrifuge

A time-out pulse (see TP7) is generated at pin 8 of U2 at the end of the timing cycle (after 300 seconds, or 5 minutes). This pulse triggers flip-flop U1. Triggering the flip-flop removes power from timer U2, terminating the timing cycle.

4.2.4 OUTPUT SWITCH M4

During the timing cycle, the 12-volt output from flip-flop U1 is applied across a resistive voltage divider in M4, causing 0.8 volt to be applied to the gate of silicon-controlled rectifier (SCR) Q1 (TP5). The 0.8-volt input at the gate of Q1 turns on Q1. The voltage at TP6 is the voltage across output switch M4: one-half of line voltage (half wave) during the timer off mode; or 1.5 volts AC during timer on mode. The drop from one-half of line voltage to 1.5 volts allows relay K1 to energize.

4.2.5 MOTOR CONTROL AND BRAKE M5

Energizing relay K1 causes its contacts to close, connecting the armature of the centrifuge motor to 120-volt, 50/60-Hz power and causing the motor to run. The motor is controlled, therefore, by energizing or deenergizing relay K1. The motor is protected against overspeed by its self-contained governor; when the motor speed approaches its maximum limit (13,100 RPM), the centrifugal force on the governor contacts cause the contacts to open, removing operating power from the motor until its speed again is within operating limits.

Arc suppressors on the timer circuit board protect the motor circuit during operation.

At the end of the 300-second period of timer U2 in timing latch M3, a time-out pulse at pin 8 of U2 sets flip-flop U1. Setting U1 removes the 0.8-volt input from the gate of SCR Q1 in output switch M4, turning off Q1. Turning off Q1 deenergizes relay K1 in motor control and brake M5. The contacts of K1 open, removing operating power from the motor, causing the motor to brake.

SECTION 5. MAINTENANCE

5.1 LIST OF TEST EQUIPMENT

The test equipment required, or equivalent, to maintain the QBC Centrifuge is listed in Table 5-1.

TABLE 5-1. TEST EQUIPMENT REQUIRED

<u>Equipment</u>	<u>Manufacturer</u>	<u>Use</u>
Multimeter AN/USM-303A	Western Reserve Electronics Model 300MA	General use for voltage and resistance checks
Oscilloscope OS-262(P)/U	Tektronix 7623A	Waveform measurements
Plug-in Unit, Dual Trace TD-1159/U	Tektronix 7B53	Extension of oscilloscope capabilities
Amplifier, Dual Trace AM-6785/U	Tektronix 7A26	Extension of oscilloscope capabilities
Adams Photoelectric Tachometer	Becton Dickinson 5205-000-000	Checking of centrifuge rotational speed
Stopwatch, 1-second accuracy	Any available	Checking of timer accuracy

5.2 SPECIAL TOOLS

A Head Nut Wrench, Becton Dickinson Part No. 4457-614-000, is required to maintain the QBC Centrifuge. This tool is provided in the shipping kit for each centrifuge.

5.3 PREVENTIVE MAINTENANCE

5.3.1 CLEANING

5.3.1.1 General Procedure

Use soap or a mild detergent and water to clean the lid, housing, and other parts of the centrifuge.

CAUTION

Do not use solvents or strong abrasives. They may scratch or damage surface on which they are used.

5.3.1.2 Head and Head Cover Cleaning Procedure

CAUTION

Always disassemble and remove the rotor head from the centrifuge for cleaning. The approved procedure for cleaning and disinfecting the rotor head requires the head to be immersed, rinsed, and dried.

The rotor head and cover are made of aluminum and can be damaged by chemicals and disinfecting agents.

Clean and disinfect the rotor head and cover as follows:

- a. Prepare solution containing 1:10 dilution of commercial sodium hypochlorite (%) as follows: one part household bleach (e.g., Clorox*) to nine parts of water.

CAUTION

Do not use any other cleaning and disinfecting agent, because it may corrode and damage head and cover. Do not reinstall rotor head or cover before rinsing and drying it thoroughly.

* Trademark of Clorox Company, Oakland, CA

- b. Remove rotor head from centrifuge, and soak head and cover in bleach solution for 10 minutes.

CAUTION

Remove head and cover from bleach solution promptly after 10 minutes of soaking. Prolonged exposure to bleach can corrode head and cover.

- c. Immerse parts completely in clean water. Rinse again under running water to remove all traces of bleach.
- d. Dry thoroughly both top and bottom surfaces of rotor head and cover. Oven drying may be used; however, oven temperature must not exceed 52°C (126°F).

CAUTION

Be sure that motor shaft, shaft pins, and attaching hardware are clean and dry before reassembling centrifuge.

If it is necessary to clean the rotor head without removing it from the centrifuge (not a recommended procedure), wipe it with a cloth moistened with water only. Do not use bleach solution. Avoid wetting the hub area; however, if wetted; accidentally, remove the rotor head and dry all parts. Do not wipe this area with any cleaning agent, because this area cannot be rinsed sufficiently while the rotor head is installed.

5.3.2 LUBRICATION

The centrifuge does not require lubrication. The centrifuge motor has permanently lubricated bearings.

5.3.3 VISUAL INSPECTION

Perform the inspection described in Table 5-2 every 4 months and at any time that the centrifuge is disassembled, such as after repair.

TABLE 5-2. VISUAL INSPECTIONS

<u>Item</u>	<u>Inspection</u>
Rotor Head	Top and bottom surfaces for cracks or deep scratches. (Replace rotor head if cracks are noted.)
	All surfaces for deep scratches. (Replace rotor head if deep scratches are noted.)
	All surfaces for dents (Replace rotor head if dents are noted.)
	Corrosion on surfaces, especially in region of motor shaft. (Replace rotor head if corrosion is noted in region of motor shaft.)
	Slots and all corners of top surface for dried-on residue. (Clean thoroughly if required.)
	While rotor head is off centrifuge, motor shaft, shaft adapter, and head nut for evidence of wear, corrosion, or damage. (Replace defective part, as applicable.)
Centrifuge Lid	Scratches and cracks.
Lid Seal Gasket	Cracks or other evidence of deterioration. (Replace gasket if required.)
Motor Brushes	Evidence of arcing or excessive wear (bottom cover removal required). (Replace brushes if required.)
Motor Ballmount	Ballmounts and bushings for cracks or other evidence of deterioration (bottom cover and motor removal required). (Replace ballmounts or bushings if required.)
Wiring	With bottom cover removed, motor wires and wires to timer circuit board for frayed, pinched, or broken wires (bottom cover removal required).

TABLE 5-2. VISUAL INSPECTIONS (Cont)

<u>Item</u>	<u>Inspection</u>
Timer Circuit Board	Resistors for charring or other evidence of overheating. Capacitors for leakage. Relay for arcing of contacts.
Cordset	Frayed, pinched, or broken wires. (Replace cordset if required.)
Step-Down Transformer (where applicable)	Frayed, pinched, or broken wires. (Replace transformer if required.)

5.3.4 PERIODIC CHECKS

5.3.4.1 Rotor Speed

Proceed as follows to check the rotor speed of the centrifuge with an Adams Photoelectric Tachometer:

- a. Unlatch and raise centrifuge lid, and check that centrifuge contains both rotor head and head cover and that they are tightened properly.
- b. Obtain target pick-up disc supplied with tachometer, remove its adhesive backing, and attach it as close as possible to center of knurled knob on head cover. Disc is small and round with black and silver half-circles.
- c. Lower and latch centrifuge lid.
- d. Press PUSH TO START/PUSH TO STOP switch to start centrifuge. Allow centrifuge to reach operating speed.
- e. Aim probe of tachometer through clear plastic lid, perpendicular to rotating target disc. Light beam of probe should be aimed to reflect from target disc.
- f. With range selector of tachometer set at 10,000, push PRESS TO READ switch of tachometer, and read lowest steady value. Speed must not exceed range of 10,500 RPM to 13,100 RPM.

NOTE

If speed of rotation is outside of limits,
refer to Troubleshooting Table.

- g. Allow centrifuge to stop automatically, or press PUSH TO START/PUSH TO STOP switch to stop it manually.

5.3.4.2 Timer Accuracy

Check the internal timer periodically against a stopwatch as follows:

- a. Ensure that rotor head and head cover are installed, and close and latch centrifuge lid.
- b. Simultaneously press switch to start stopwatch and PUSH TO START/PUSH TO STOP switch to start centrifuge. Lens of switch on centrifuge will illuminate, indicating that motor is operating.
- c. Press switch to stop stopwatch when lens of PUSH TO START/PUSH TO STOP switch extinguishes. Lighted switch should go out within 5 minutes \pm 30 seconds (4 minutes 30 seconds to 5 minutes 30 seconds).

If the timer exceeds the limits specified, refer to the Troubleshooting Table.

5.4 CORRECTIVE MAINTENANCE

5.4.1 VOLTAGES AND RESISTANCES

Transistor and integrated circuit socket on-terminal voltage and resistance values are not applicable to the centrifuge. The timer circuit board does not contain transistors, and the integrated circuits are soldered directly to the circuit board (are not socketed).

5.4.2 WAVEFORMS

Figure 5-1 identifies significant test points on the timer circuit board and waveforms to be expected at the test points.

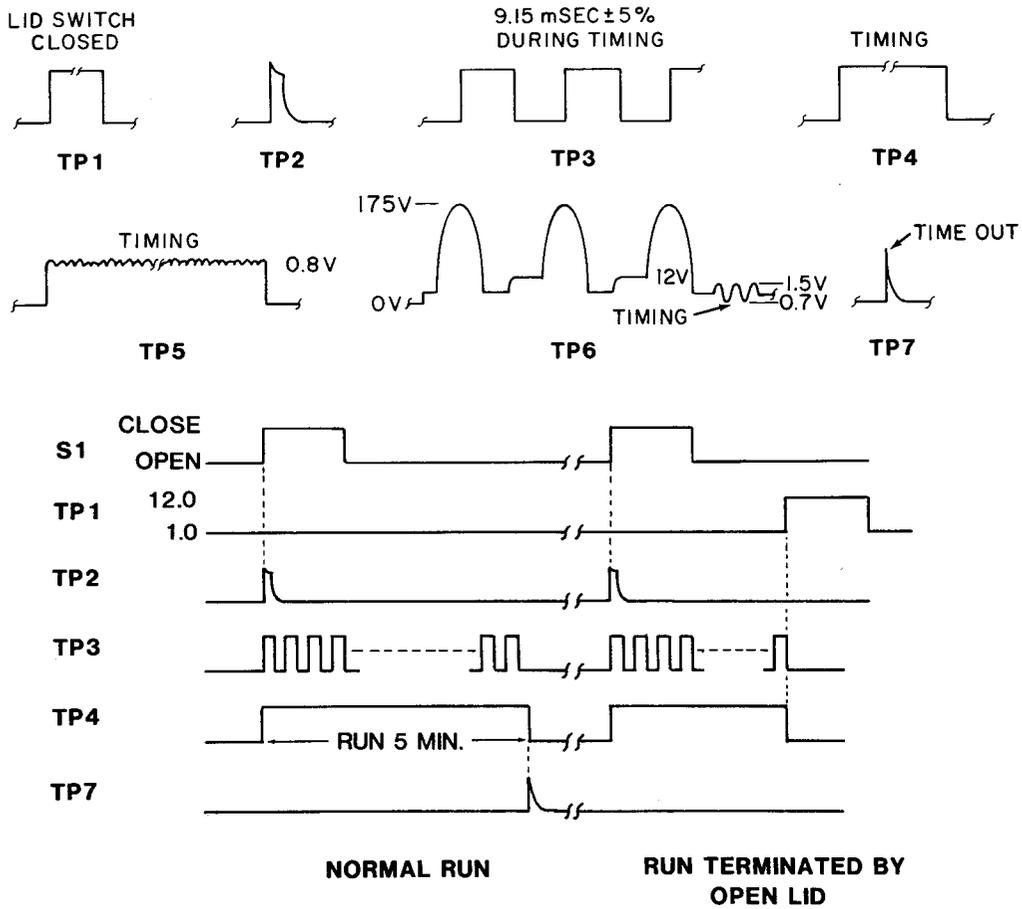
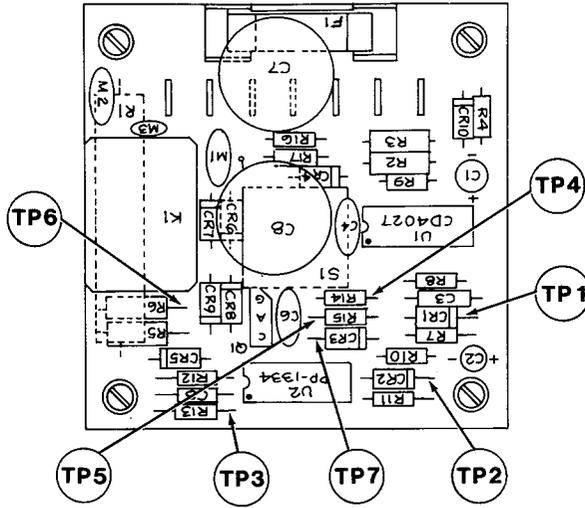


Figure 5-1. Waveform Diagram

5.4.3 TROUBLESHOOTING

Refer to the schematic diagram in Section 8 and to the troubleshooting information in Table 5-3.

TABLE 5-3. TROUBLESHOOTING TABLE

<u>Symptom</u>	<u>Probable Cause</u>	<u>Remedy</u>
Motor does not start. PUSH TO START/PUSH TO STOP switch not lighted.	Fuse blown on timer circuit board.	Replace fuse.
Motor does not start, but PUSH TO START/PUSH TO STOP switch lighted.	Motor brushes worn excessively.	Replace brushes.
	Relay K1 contacts stuck or solenoid defective.	Replace relay.
	Lid switch defective.	Replace switch.
	Timer circuit board defective.	Replace circuit board.
Motor starts, but rotor speed below 10,500 RPM.	Governor brushes in motor worn excessively.	Replace brush plate assembly.
	Governor not set correctly or failed.	Replace governor.
Motor starts, but rotor speed above 13,100 RPM	Governor not set correctly.	Replace governor.
	Motor resistor or capacitor defec- tive.	Replace resistor or capacitor.

5.4.4 DISASSEMBLY/REASSEMBLY

5.4.4.1 Line Fuse

NOTE

Do not replace line fuse without first verifying that it has blown. If PUSH TO START/PUSH TO STOP switch illuminates when centrifuge is turned on, fuse is good.

The line fuse is located internally to the centrifuge. Proceed as follows to replace the fuse:

- a. Disconnect power cord from wall/bench receptacle.
- b. Close lid, and invert centrifuge onto clean pad or soft cloth.
- c. Detach cover (Figure 5-2) by removing three attaching screws and lockwashers that secure cover to base of housing. Do not remove rubber feet from bottom cover.
- d. Remove line fuse from spring clips on timer circuit board, and snap in correct replacement. (Correct fuse is 4-ampere Slo-Blo, 3AG. Littlefuse Type 313, or approved equivalent.)

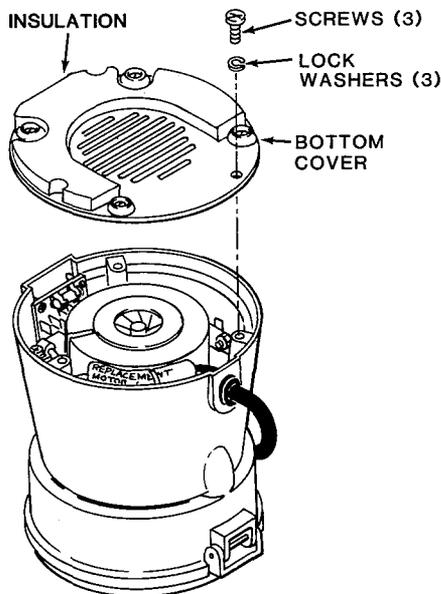


Figure 5-2. Removal of Bottom Cover

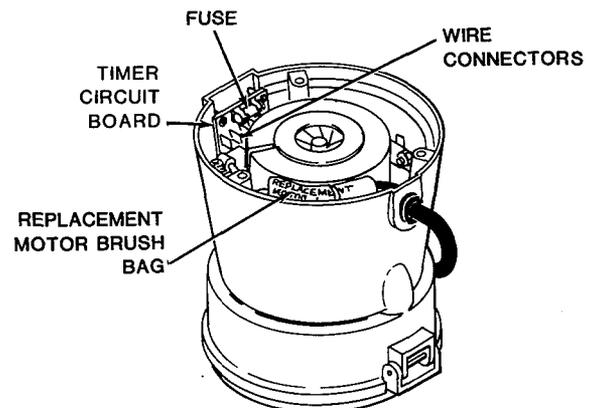


Figure 5-3. Fuse Replacement

- e. Reassemble bottom cover to base of housing, using screws and lockwashers removed in Step c.
- f. Turn centrifuge right-side up.
- g. Reconnect power cord to wall/bench receptacle, and check for correct operation of PUSH TO START/PUSH TO STOP switch and motor.

5.4.4.2 Motor

Proceed as follows to remove the centrifuge motor to gain access to other parts or to replace the complete motor:

- a. Disconnect power cord from wall/bench receptacle.
- b. Place pins on head nut wrench into holes of head nut; holding rotor head with one hand, turn wrench counterclockwise to loosen head nut.
- c. Remove head nut from motor shaft.
- d. Remove rotor head from motor shaft.
- e. Remove motor shaft adapter from motor shaft (Figure 2-2).
- f. Close lid, and invert centrifuge onto clean pad or soft cloth.
- g. Detach bottom cover (Figure 5-2) by removing three attaching screws and lockwashers that secure cover to base of housing. Do not remove rubber feet from bottom cover.
- h. Refer to Figure 5-4, and loosen three Phillips-head screws that attach motor and support bracket to housing.
- i. Raise motor (with support bracket and ballmount hardware) until it is clear of housing.

NOTE

If replacing part other than motor, stop disassembly at this point and proceed to appropriate disassembly/replacement procedure.

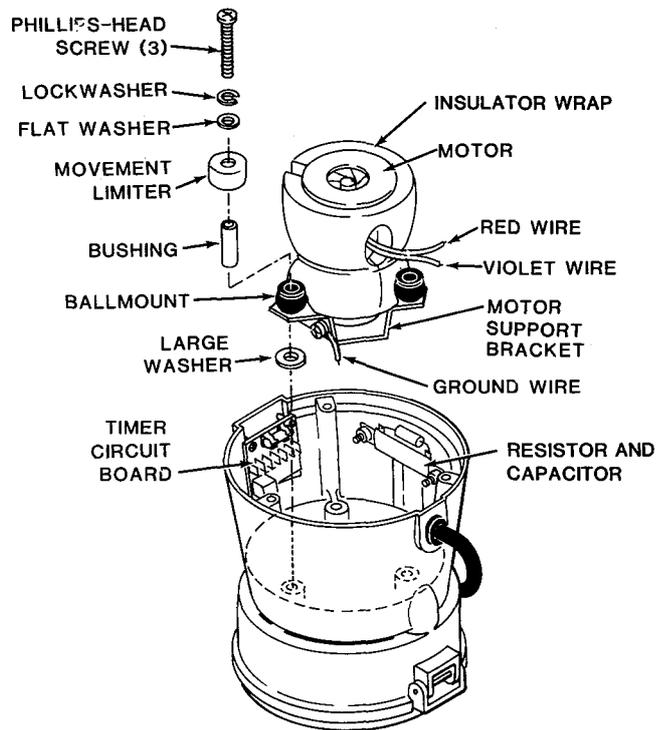


Figure 5-4. Motor Ballmount Attaching Hardware

- j. Remove attaching hardware from three ballmounts and bushings (Phillips-head screws, lockwashers, flat washers, and movement limiters). Save hardware for reuse.
- k. Refer to Figure 5-5. Hold motor in raised position, and disconnect ground wire (green with yellow stripe) from bottom of motor support bracket.
- l. Remove attaching screw and lockwasher from cable clamp at left of timer circuit board.
- m. Cut cable tie that secures yellow, pink, blue, black, and white wires.
- n. Disconnect following motor wires from their pin connectors on timer circuit board (see Figure 5-5):
 - Yellow wire (4)
 - Pink wire (2)
 - Blue wire (1) (crimped in terminal with white line cord wire)
- o. Disconnect violet wire (3) from pin connector on timer circuit board.

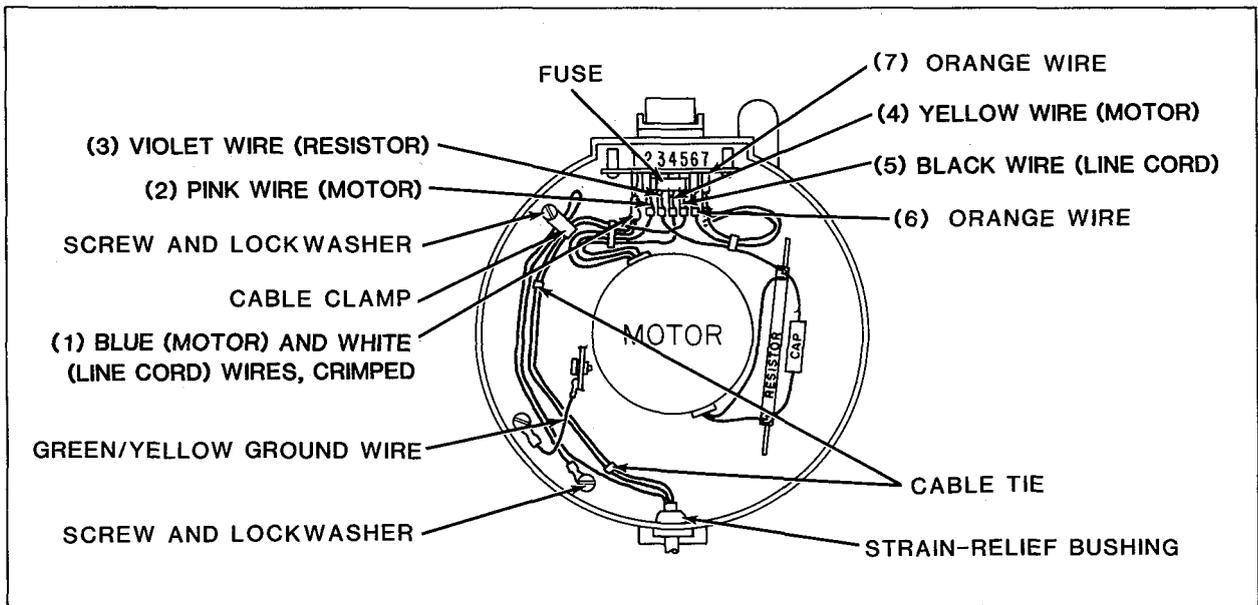


Figure 5-5. Timer Circuit Board, External Wire Connections

- p. Cut cable tie that secures violet wire to two orange wires from lid switch.
- q. Disconnect crimped violet wires and red wire from their pin connectors on motor resistor. (Motor capacitor is soldered between violet wire and red wire terminals.)
- r. Cut quick-connect terminal from blue and white wires.
- s. Carefully place motor on bench or counter.
- t. Slip sound insulation sleeve with cable tie from motor.
- u. Disconnect old motor from motor support bracket by removing four screws and lockwashers from shaft end of motor.
- v. Connect new motor to motor support bracket, using screws and lockwashers removed in Step u. Orient motor such that its ground wire (see Step k.) is on side toward motor support bracket ground. Reconnect ground wire to motor support bracket.
- w. Using new quick-connect terminal, crimp together blue and white wires.
- x. Bunch together yellow, pink, blue, black, and white wires, and use new cable tie to secure them. Reconnect motor wires to timer circuit board.

- y. Insert wires into cable clamp, and use screw and lockwasher from Step 1 to attach cable clamp at left of timer circuit board.
- z. Refer to Figure 5-9, and ensure that large washers are in position over motor mounting pads. Orient motor and support bracket correctly, and gently lower assembly onto washers. Check to see that washers remained in position over mounting pads.

CAUTION

Be sure that ballmount bushings are in place and do not slip out during reassembly. Ballmounts are unidirectional; if they are removed or they slip out, they must be reassembled correctly.

- aa. Reassemble attaching hardware of each ballmount exactly as shown in Figure 5-9; then tighten ballmount screws securely.
- ab. Bunch together violet and two orange wires, and use new cable tie to secure them.
- ac. Reconnect two violet wires and red motor wire to terminals on motor resistor. (Motor capacitor is soldered between connectors of violet and red wires.)
- ad. Slide sound insulating sleeve (removed in Step t.) around motor, and push down until seated.
- ae. Replace bottom cover by installing three attaching screws and lockwashers removed in Step g.
- af. Turn centrifuge right-side up, and lower motor shaft adapter, flange upward, such that hole in adapter slips over shaft.
- ag. Place D-shaped hole of rotor head onto threaded D-shaped rotor shaft. Ensure that rotor is fully bottomed on motor shaft and motor shaft adapter.
- ah. Thread hex nut onto motor shaft, flange side up.
- ai. Place pins on head nut wrench into holes of head nut; holding rotor head with one hand, turn wrench clockwise to tighten head nut.
- aj. Reconnect power cord to wall/bench receptacle.

CAUTION

Never operate centrifuge unless rotor head is installed. Operation without rotor head may damage motor governor.

5.4.4.3 Motor Brushes

NOTE

One set of replacement motor brushes is contained in bag taped to power cord wires, next to motor.

- a. Remove motor from centrifuge by performing Steps a. through i. of procedure in Paragraph 5.4.4.2.
- b. Slip sound insulation sleeve with attached cable tie from motor (Figure 5-6).
- c. Use blade of flat screwdriver to pry off two snap-out caps (Figure 5-6)..
- d. Refer to Figure 5-7, and unscrew slotted brush caps from inside motor enclosure. Brush contact plate should spring out when brush cap is removed; if not, use small screwdriver carefully to pry out brush assembly.
- e. Orient curved surface of each brush so that it matches curvature of motor housing as shown in Figure 5-8.
- f. Insert first brush into motor enclosure, press in spring and brush contact plate, and replace threaded brush cap.
- g. Repeat Step f. for second brush.
- h. Replace two snap-out caps on motor enclosure.
- i. Refer to Figure 5-9, and ensure that large washers are in position over motor mounting pads. Orient motor and support bracket correctly, and gently lower assembly onto washers.

CAUTION

Be sure that ballmount bushings are in place and do not slip out during reassembly.

- j. Reassemble attaching hardware of each ballmount exactly as shown in Figure 5-9; then tighten ballmount screws securely.
- k. Reassemble centrifuge by performing Steps ad. through aj. of procedure in Paragraph 5.4.4.2.

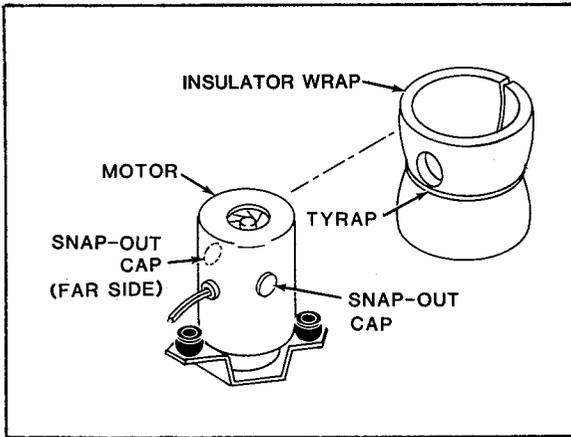


Figure 5-6. Motor Enclosure Snap-Out Caps

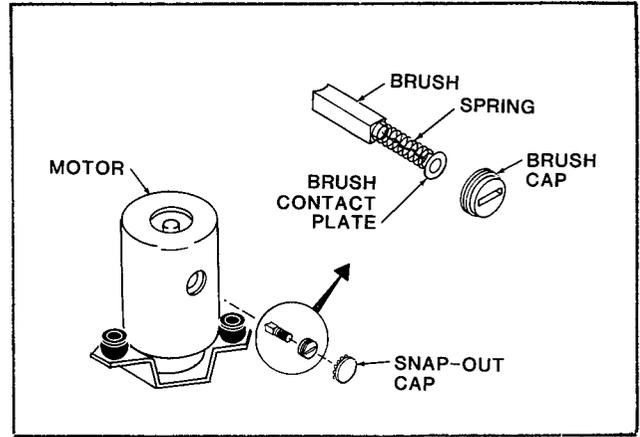


Figure 5-7. Brush Assembly Removal

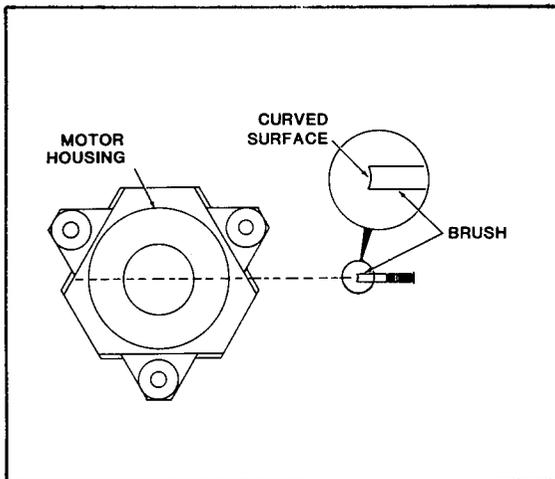


Figure 5-8. Motor Brush Orientation

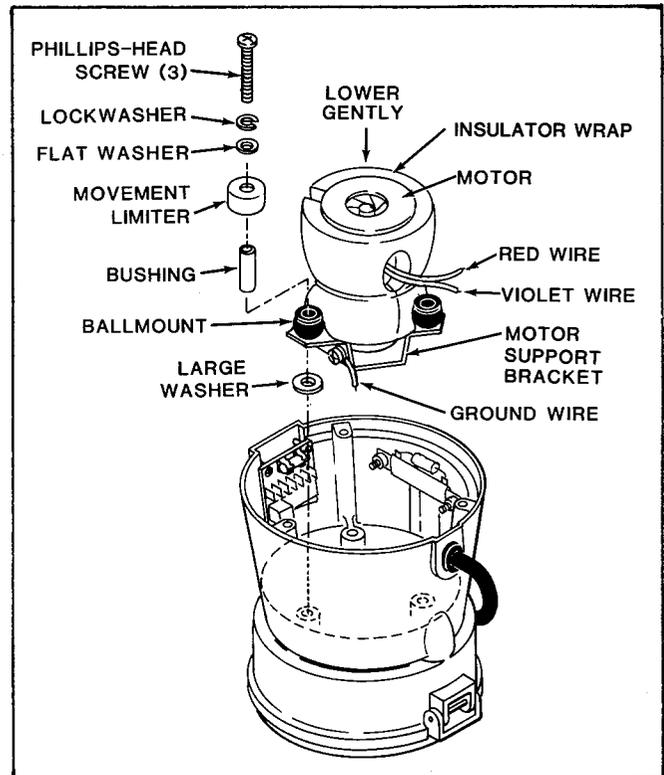


Figure 5-9. Motor and Ballmount Installation

5.4.4.4 Governor Brushes

Proceed as follows to replace worn governor brush plate assembly:

- a. Remove motor from centrifuge by performing Steps a. through t. of procedure in Paragraph 5.4.4.2.
- b. Remove two slotted screws and lockwashers from each side of motor (Figure 5-10).
- c. Pull up motor housing, slipping motor wires through rubber grommets on sides of housing, until fan and governor are accessible.

NOTE

Mark locations of fan and governor to maintain circumferential locations for balance.

- d. Loosen single set screw on hub of fan (Figure 5-10), using 5/64" Allen wrench, and remove fan from motor shaft.
- e. Loosen two set screws on hub of governor assembly (Figure 5-11), and remove assembly.
- f. On brush plate assembly, pry off spring contacts of violet and red wires from brass brush holders.
- g. Remove four screws and lockwashers from governor brush plate assembly, and remove assembly.
- h. On replacement brush plate assembly, insert spring contacts of violet and red wires through plastic grommet.
- i. Turn brush plate assembly so that outer and inner brushes are oriented as shown in Figure 5-12.
- j. Attach brush plate assembly to motor using four screws and lockwashers removed in Step g.
- k. Snap spring contacts of wire leads onto brass brush holders as follows:
 - Violet wire onto inner brush holder.
 - Red wire onto outer brush holder.
- l. Slide governor assembly partially onto motor shaft.

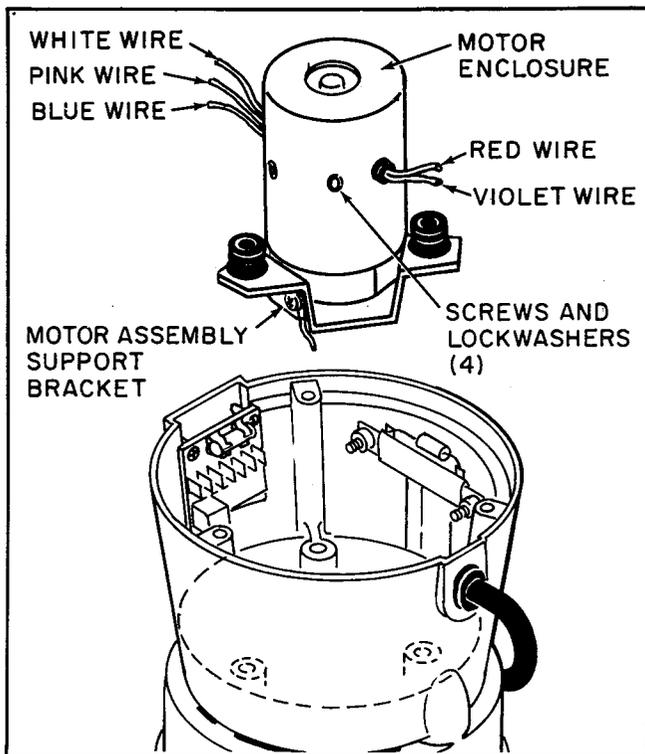


Figure 5-10. Removal of Motor Enclosure

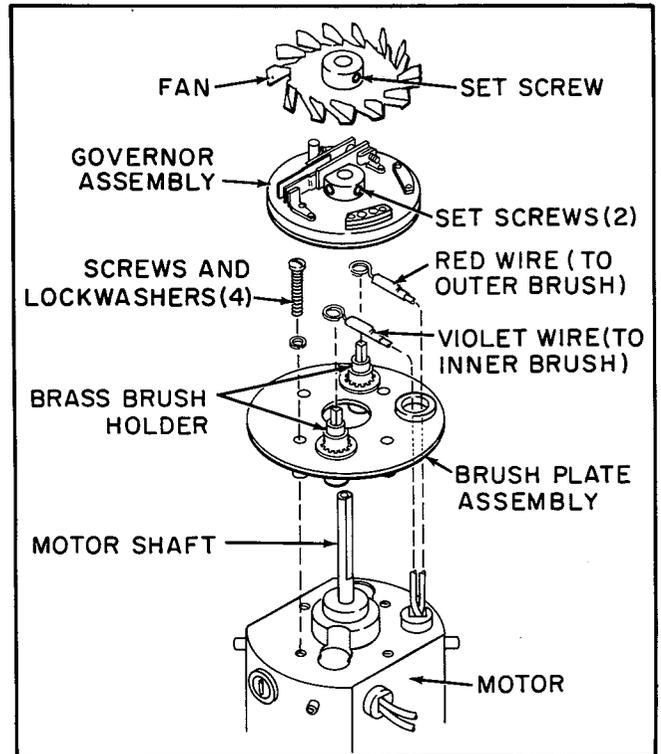
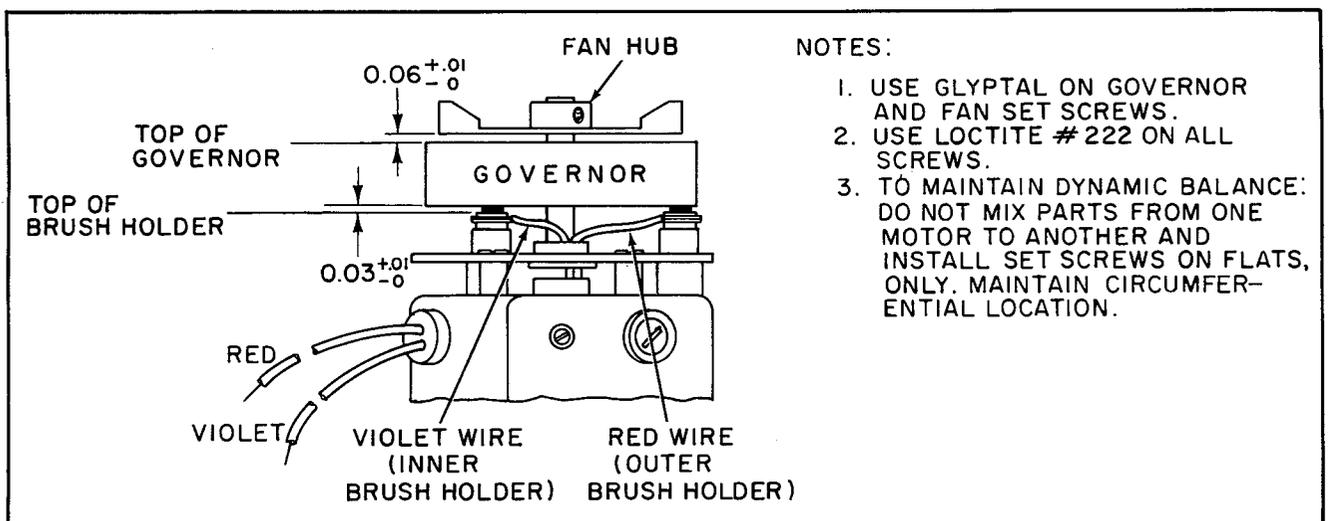


Figure 5-11. Fan and Governor Assembly Details



NOTES:

1. USE GLYPTAL ON GOVERNOR AND FAN SET SCREWS.
2. USE LOCTITE # 222 ON ALL SCREWS.
3. TO MAINTAIN DYNAMIC BALANCE: DO NOT MIX PARTS FROM ONE MOTOR TO ANOTHER AND INSTALL SET SCREWS ON FLATS, ONLY. MAINTAIN CIRCUMFERENTIAL LOCATION.

Figure 5-12. Governor Brush Assembly Details

- m. Use 0.03-inch (+0.01, -0.0 inch) shim to adjust clearance between bottom of governor assembly and top of brass brush holders. Tighten two set screws, and use LOCTITE #222 on both set screws.
- n. Reinstall fan on motor shaft. Use 0.06 (+0.01, -0.0) inch shim to adjust clearance between fan and governor. Tighten set screw, and use LOCTITE #222 on set screw. Re-form fan blades if bent.
- o. Reassemble centrifuge by performing Steps a. through c. of this procedure and Steps a. through q. of Paragraph 5.4.4.2 in reverse order.

5.4.4.5 Lid-Seal Gasket

Proceed as follows to replace the lid-seal gasket:

- a. Remove old gasket by peeling it from groove in housing.
- b. Scrape or rub off any residual adhesive remaining in gasket groove.
- c. Apply thin bead of PERMABOND White Label Gasket Seal (or equivalent adhesive for bonding rubber material) around bottom of gasket groove.

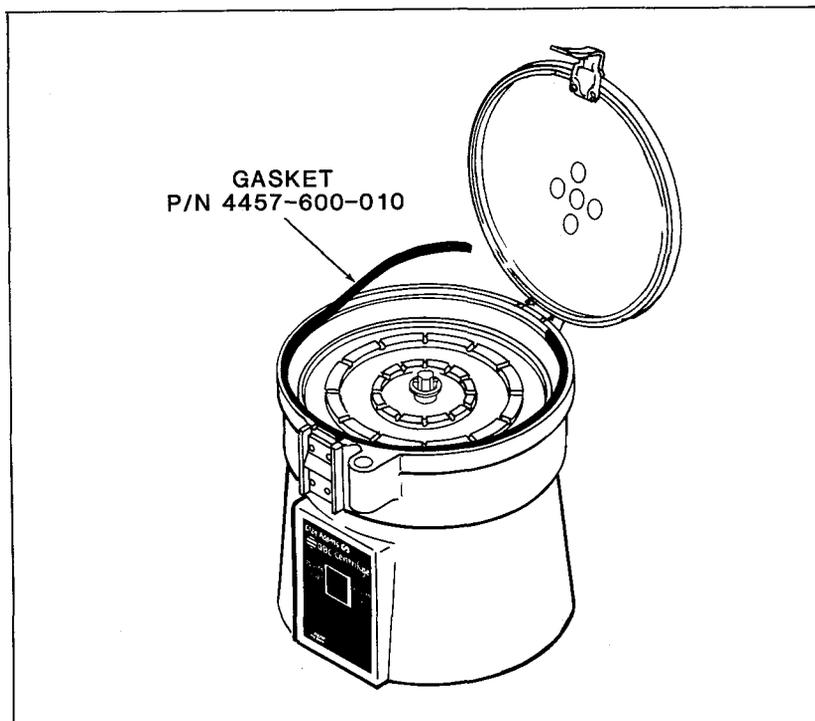


Figure 5-13. Lid-Seal Gasket Installation

- d. Orient new gasket as shown in Figure 5-13, and press firmly around circumference of groove. Make sure that open space between ends of gasket is at rear of centrifuge.
- e. Allow adhesive to dry before closing lid.

5.4.4.6 Timer Circuit Board

Proceed as follows to replace the timer circuit board:

CAUTION

The timer circuit board contains MOS devices, which are subject to damage from electrostatic discharge (ESD). Refer to Paragraph 1.8 for information pertaining to proper handling.

- a. Detach bottom cover (Figure 5-2) by removing three attaching screws and lockwashers that secure cover to base of housing. Do not remove rubber feet from bottom cover.
- b. Remove quick-connect terminals from pin connectors on timer circuit board.
- c. Peel off front panel to access screws that attach timer circuit board to frame of centrifuge.
- d. Remove four attaching screws from front of centrifuge, and move board toward center of centrifuge so that POWER switch slides evenly out of front panel. Press in POWER switch to gain clearance.
- e. Install new timer circuit board by performing Steps a. (Figure 5-5) through c. in reverse order. Circuit board replacement includes new front panel with adhesive back.
- f. Replace bottom cover by installing three attaching screws and lockwashers removed in Step a.

5.4.4.7 Cordset

Proceed as follows to replace the cordset:

- a. Detach bottom cover (Figure 5-2) by removing three attaching screws and lockwashers that secure cover to base of housing. Do not remove rubber feet from bottom cover.
- b. Remove attaching screw and lockwasher from cable clamp at left of timer circuit board.
- c. Remove screw and external-tooth lockwasher from ground near cordset entrance.
- d. Cut cable tie that secures yellow, pink, blue, black, and white wires.
- e. Cut two cable ties that secure black and white wires. If bag holding spare motor brushes still is wrapped around cordset wires, cut cable tie and remove and set aside bag.
- f. Disconnect white wire (crimped with blue line cord wire) from its pin connector on timer circuit board.
- g. Cut quick-connect terminal from blue and white wires.
- h. Compress rear of strain-relief bushing (grommet), and pop out bushing from outside of centrifuge.
- i. Install new cordset by performing Steps a. through h. in reverse order. Use new cable ties where old ones were cut.
- f. Replace bottom cover by installing three attaching screws and lockwashers removed in Step a.

SECTION 6. STORAGE

6.1 INDOOR STORAGE

Prepare the centrifuge for indoor storage as follows:

- a. Remove rotor cover, head nut, and rotor head.
- b. Package rotor components in their original packing materials.
- c. Place centrifuge in plastic bag, seal bag with tape, and return all parts to their original shipping carton as shown in Figure 2-1.

Specialized heating or cooling equipment is not required, provided the environmental conditions in the storage area do not exceed the following limits:

Temperature: -26° to 55°C (-15° to 131°F)

Relative Humidity: 10% to 95%, non-condensing

The external packaging container should be inspected visually on a routine basis. Internal inspection of the centrifuge is not required.

If the centrifuge has been in storage for 2 years or more and will be placed into operation, it should be referred to a qualified serviced technician for inspection and performance evaluation before centrifuging blood for medical diagnostic purposes. Particular attention should be paid to visual inspection of the foam lid-seal gasket for signs of deterioration and the rubber ballmounts for the motor for signs of cracks. Estimated storage life of these components, under the specified environmental conditions, is approximately 5 years.

. The technician should inspect the centrifuge and evaluate its performance before using it to centrifuge blood for medical diagnostic purposes.

6.2 OUTDOOR STORAGE

The QBC Centrifuge is not recommended for outdoor storage unless the environmental conditions specified in Paragraph 6.1 can be maintained and the complete system has been packaged in a waterproof container. Refer the centrifuge to a qualified service technician if the container shows evidence of exposure to water or moisture.

SECTION 7. PARTS LIST

This section identifies replacement parts on the QBC Centrifuge.

The left column of parts lists that are primarily mechanical refers to the illustration on which the part is shown (i.e., 1- refers to Figure 1. The exact location of the part on the illustration is identified by an index number on the referenced illustration (e.g., -6). The full identification of the part location for the example given, therefore, would be "1-6."

The left column of parts lists that are primarily electrical refers to the illustration on which the part is shown (i.e., 2- refers to Figure 2. The exact location of the part on the illustration is identified by the reference designation of the part, which is silk-screened on the circuit board (e.g., -R1). The full identification of the part location for the example given, therefore, would be "2-R1."

The "Part/Reorder No." column identifies the number that should be used to order a replacement part from Becton Dickinson.

The "Description" column provides a brief listing of what the part is and how it may be distinguished from another part with a similar name. The numbers at the top of the column (1 2 3 4 5) are used to designate generation levels for mechanical items, "1" being the highest level. The description of each item is indented to show the degree of subordination to the assembly being broken down. Dots are used to fill the spaces for the higher level(s). Item 1-14 (BRUSH AND CAP SET), for example, is identified by two dots to show that it is part of Item 1-13 (MOTOR , with capacitor), the next prior one dot).

The "Quantity per Assembly" column identifies the total quantity used for of that part. Where a part is shown on more than one illustration, the quantity is given only for the first listing of the part; subsequent listings contain "REF" (reference) as the quantity.

Figure & Index No.	Part/Reorder No.	Description	Quantity					
			1	2	3	4	5	per Assembly
1-	Model 4207	CENTRIFUGE						REF
-1	4457-600-011	. LID						1
-2	0591-603-001	. LATCH, lid						1
-3	4457-601-000	. COVER ASSY, head						1
-4	4457-600-034	. NUT, head						1
-5	4207-601-000	. HEAD ASSY, rotor						1
-6	4457-600-010	. SEAL, lid						1
-7	4457-600-002	. CATCH PLATE						1
-8	4457-605-000	. SWITCH ASSY, lid						1
-9	4457-600-035	. CUSHION, switch						1
-10	4457-600-013	. GASKET, foam						1
-11	4457-600-019	. ADAPTER, motor shaft						1
-12	4457-600-031	. INSULATION, sound, motor						1
-13	4457-603-001	. MOTOR, with capacitor						1
-14	4457-616-002	. . BRUSH AND CAP SET						1
-15	4457-603-004	. . GOVERNOR BRUSHES ASSY, motor						1
-16	4457-618-510	. . CAPACITOR, 0.22 UF, 200 WVDC						1
-17	4457-616-015	. . RESISTOR, 20 ohms $\pm 5\%$, 55 W						1
-18	0558-600-004	. BALLMOUNT KIT, motor, in- cludes:						1
		. . BALLMOUNT						3
		. . BUSHING						3
		. . WASHER, ballmount						3
		. . WASHER, flat, #10						3
		. . LOCKWASHER, split, #10						3
		. . SCREW, pan hd, Phillips, #10-32 x 1-1/2 in.						3
		. . LIMITER, movement						3
-19	4457-600-006	. CIRCUIT BOARD, timer (see Fig. 2)						1
	4207-100-002	. . NAMEPLATE, front panel, provided w/ckt board						1
-20	4200-600-004	. FOOT						4
-21	4457-607-000	. CORDSET ASSY						1
-22	2510-623-819	. FUSE, 4 amp, Slo-Blo, (Littlefuse 3AG-4A-313) (see Fig. 2)						1
-23	4207-513-128	. FUSE CLIP: timer board						2
-24	4207-513-127	. STANDOFF: timer board						4
-25	4457-614-000	WRENCH, head nut						1

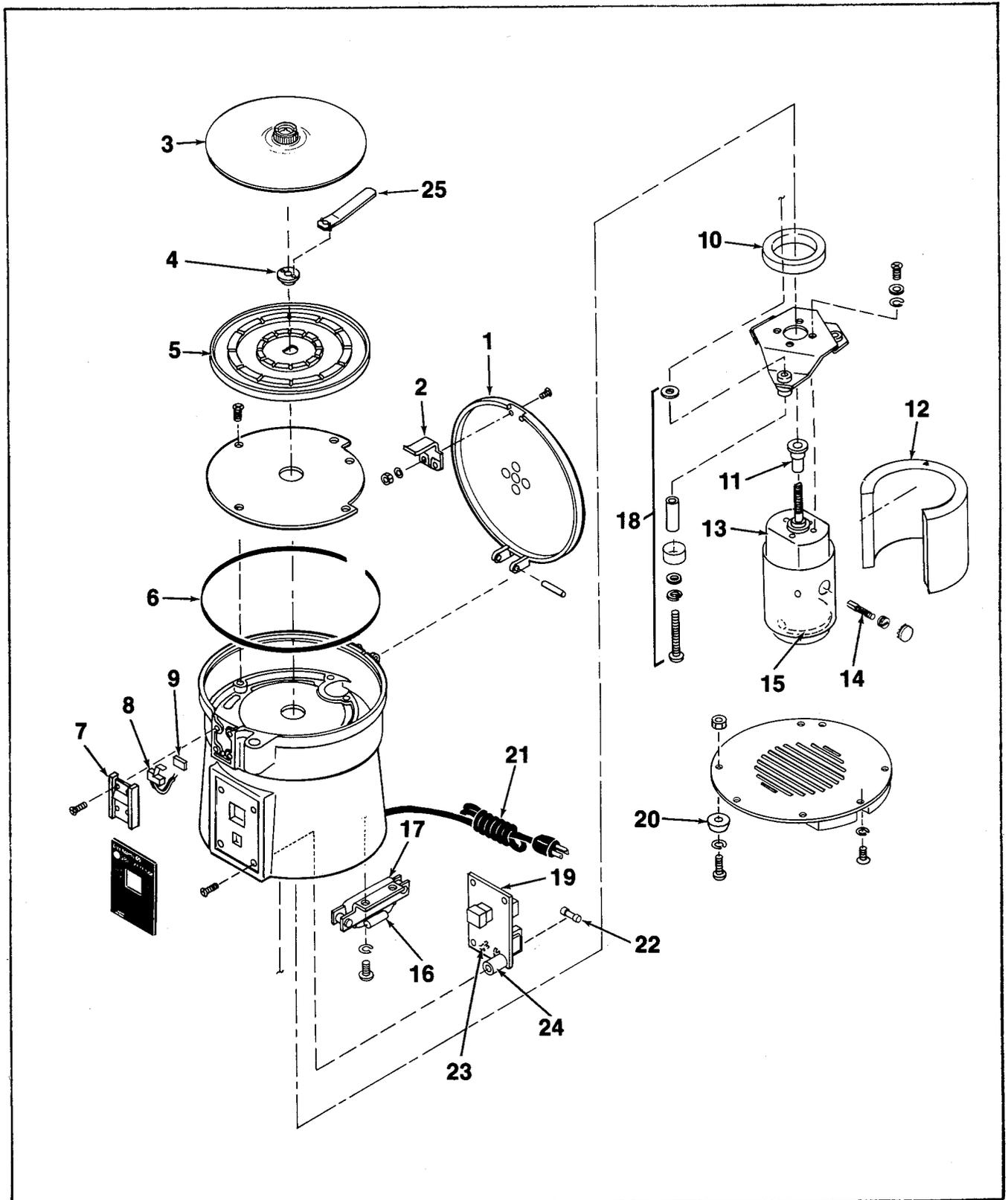


Figure 1. Centrifuge Model 4207, Exploded View Drawing

<u>Figure & Ref. Desig.</u>	<u>Part/Reorder No.</u>	<u>Description</u>	<u>Quantity per Assembly</u>
2-	4457-600-006 (4457-100-006)	CIRCUIT BOARD, timer	REF
-C1	4207-513-209	CAPACITOR, alum elect: 47 UF, 16WVDC, radial leads	1
-C2	4207-513-210	CAPACITOR, alum elect: 4.7 UF, 16WVDC, radial leads	1
-C3	4207-513-211	CAPACITOR, disc: 0.1 UF, 25 WVDC	2
-C4	4207-513-211	CAPACITOR, disc: same as C3	REF
-C5	4207-513-212	CAPACITOR, ceramic: 0.012 UF, +5% 25 WVDC	1
-C6	4207-513-213	CAPACITOR, disc: 5000 pF, 500 WVDC	1
-C7	4207-513-214	CAPACITOR, arc suppressor, Centralab 0.02 UF, 1,000 WVDC, 2-3 kV arc	2
-C8	4207-513-214	CAPACITOR, same as C7	REF
-CR1	4207-513-215	DIODE, silicon rectifier, 1 A, 1,000 PIV, 1N4007	9
-CR2	4207-513-215	DIODE: same as CR1	REF
-CR3	4207-513-215	DIODE: same as CR1	REF
-CR4	4207-513-215	DIODE: same as CR1	REF
-CR5	4207-513-215	DIODE: same as CR1	REF
-CR6	4207-513-215	DIODE: same as CR1	REF
-CR7	4207-513-215	DIODE: same as CR1	REF
-CR8	4207-513-215	DIODE: same as CR1	REF
-CR9	4207-513-215	DIODE: same as CR1	REF
-CR10	4207-513-216	DIODE, Zener: 12 V, 1 W	1
-DS1	4207-511-004	LAMP (p/o S1) #7839	1
-F1	2510-623-819	FUSE, 4 amp, Slo-Blo, (Littlefuse 3AG-4A-313) (see Fig. 1)	REF
-K1	4207-513-203	RELAY (Aromat HC2-P-AC115V)	1
-M1	4207-513-208	ARC SUPPRESSOR, MOV type, (Maida Dev. Co. D73ZOV301RA25)	2
-M2	4207-513-206	ARC SUPPRESSOR, MOV type, (GE V150LA2)	1
-M3	4207-513-208	ARC SUPPRESSOR: same as M1	REF
-Q1	4207-513-204	SILICON CONTROLLED RECTIFIER, Artisan Controls 1136	1
-R1	4207-513-218	RESISTOR: 2 ohms, 10, W (Dale CP-10-2)	1
-R2	4207-513-219	RESISTOR: 20 kilohms, 1/2 W,	2
-R3	4207-513-219	RESISTOR: same as R2	REF
-R4	4207-513-220	RESISTOR: 10 kilohms, 1/4 W	3
-R5	4207-513-221	RESISTOR: 5100 ohms, 1 W	2

<u>Ref. Desig.</u>	<u>Part/Reorder No.</u>	<u>Description</u>	<u>per Assembly</u>
-R6	4207-513-221	RESISTOR: same as R5	REF
-R7	4207-513-222	RESISTOR: 100 kilohms, 1/4 W	1
-R8	4207-513-220	RESISTOR: same as R4	REF
-R9	4207-513-223	RESISTOR: 1 megohm, 1/4 W	2
-R10	4207-513-224	RESISTOR: 10 ohms, 1/4 W	3
-R11	4207-513-220	RESISTOR: same as R4	REF
-R12	4207-513-207	RESISTOR: same as R9	REF
-R13	4207-513-225	RESISTOR: 330 kilohms, 1/4W	1
-R14	4207-513-226	RESISTOR: 6800 ohms, 1/4 W	1
-R15	4207-513-217	RESISTOR: 1000 ohms, 1/4 W	1
-R16	4207-513-224	RESISTOR: same as R10	REF
-R17	4207-513-224	RESISTOR: same as R10	REF
-S1	2510-625-334	SWITCH (EAO 99-450)	1
	2510-625-336	CAP ASSY, Lens (p/o S1) (EAO 99-901.9)	1
-U1	4207-513-201	INTEGRATED CIRCUIT, MOS, dual J-K flip-flop (RCA CD4027BE)	1
-U2	4207-513-202	INTEGRATED CIRCUIT, MOS (Artisan Controls 1334)	1

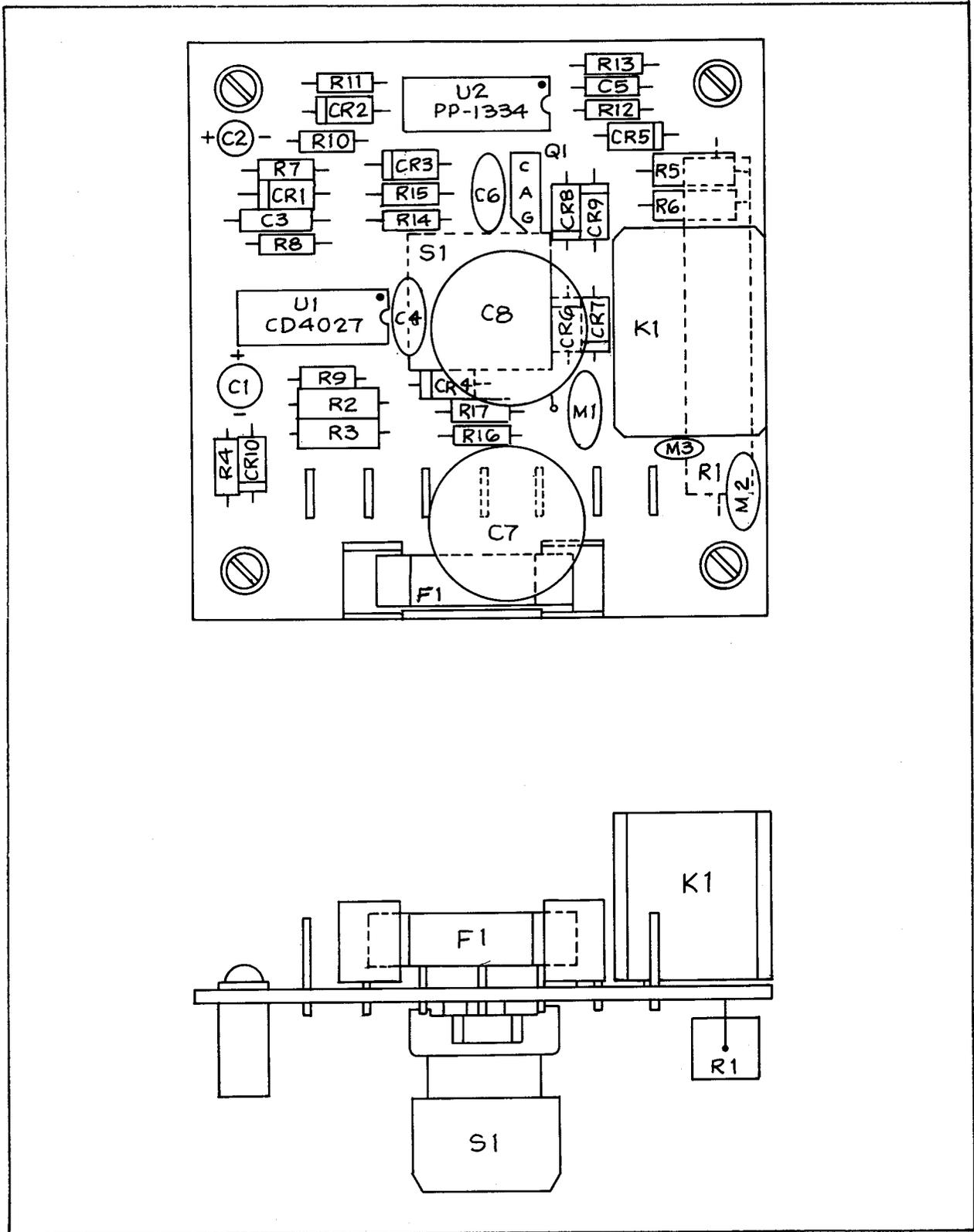


Figure 2. Timer Circuit Board

SECTION 8. DRAWINGS

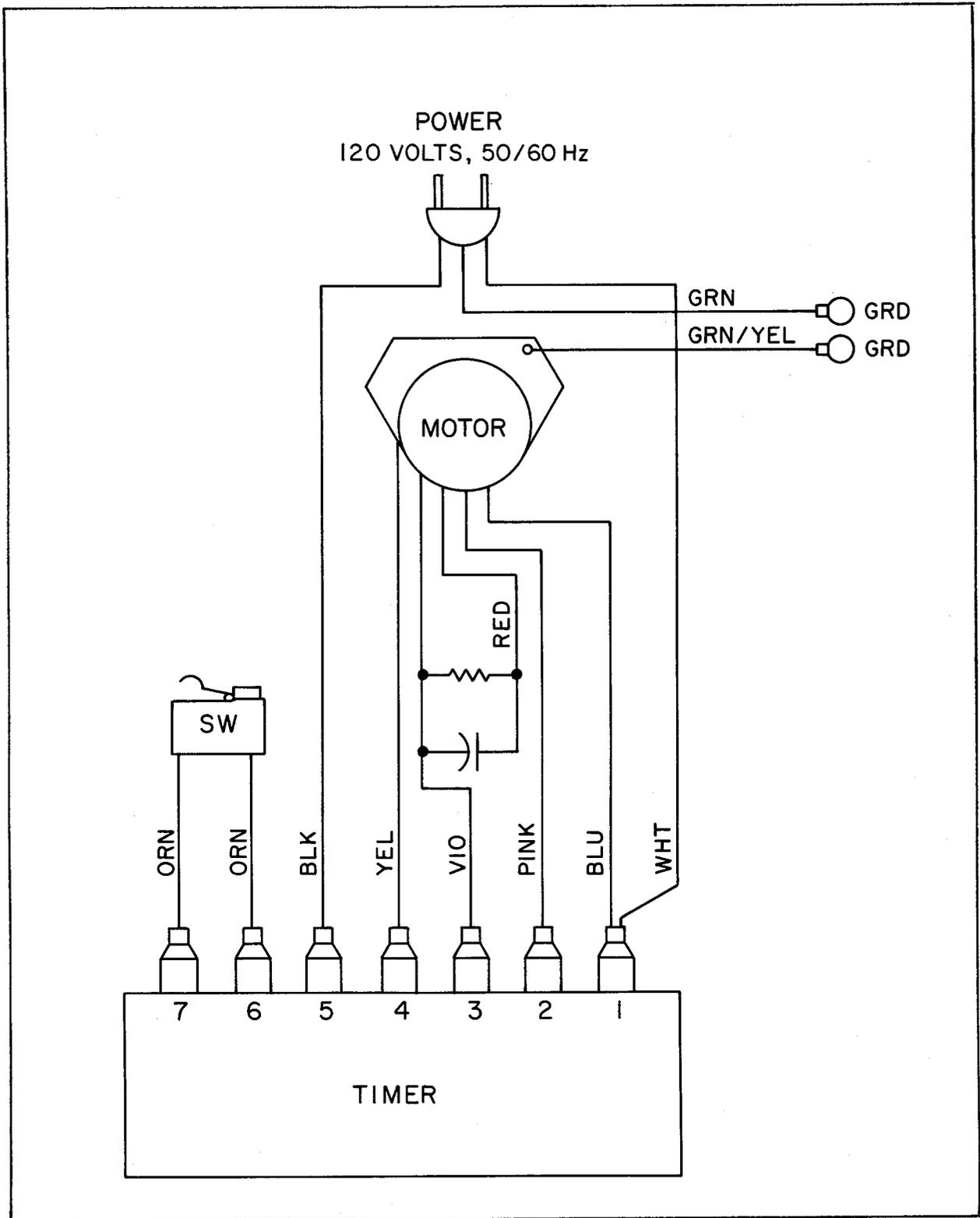


Figure 8-2. Centrifuge, Internal Wiring

**Becton Dickinson
Primary Care Diagnostics**

One Becton Drive, Franklin Lakes, New Jersey, U.S.A. 07417

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