MOTOR-GENERATORS
135-CYCLE SIGNALING, 10.5 AND 40 WATT
REQUIREMENTS AND ADJUSTING PROCEDURES

1. GENERAL

1.01 This section covers the 10.5- and 40-watt, 135-cycle, KS-5001, KS-5066, and KS-5362 signaling motor-generator sets.

1.02 This section is reissued to incorporate material from the addendum in its proper location. In this process marginal arrows have been omitted.

1.03 Reference shall be made to Section 020-010-711 covering General Requirements and Definitions for additional information necessary for the proper application of the requirements listed herein.

1.04 Requirements and associated procedures marked with a number sign (#) need not be checked by the installer unless it is thought that the requirement is not being met or performance indicates that such a check is advisable.

1.05 Requirements and associated procedures marked with an asterisk (*) need not be checked during maintenance unless the apparatus or part is made accessible for other reasons, or performance indicates that such a check is advisable.

1.06 Successful commutation for the purpose of this section may be said to have been obtained if neither the brushes nor the commutator is burned or injured to the extent that abnormal maintenance is required. The presence of some visible sparking is not necessarily evidence of unsuccessful commutation.

1.07 Each motor and generator field rheostat or resistor has the serial number of the associated set marked on it and should be used only with the motor or generator set having this same serial number. Rheostats or resistors for use in the motor field should not be used in the generator field and vice versa.

1.08 The Direction of Rotation when viewed from the motor end of the set is clockwise for KS-5001, KS-5066, KS-5362, Lists 1, 2, 3, 4 and 6; and counterclockwise for KS-5362, List 5.

2. REQUIREMENTS

#2.01 Lubrication: Ball bearings shall be cleaned and repacked with fresh grease once every three years.

2.02 Bearings: The condition of the bearings shall be such as to allow the machine to operate satisfactorily under all conditions of normal load. If requirements 2.03 to 2.06 inclusive are met, the bearings shall be considered to be in satisfactory condition.

2.03 Freedom of Rotation: The shaft of the rotating element shall turn freely in the bearings. Gauge by feel.

*2.04 The end play shall be taken up by the thrust spring. Gauge by feel.

2.05 The noise and vibration under any normal operating condition shall not be excessive. Gauge by sound and feel.

2.06 Speed

#(a) The motor speed shall be adjusted under office load and voltage conditions to as nearly as practicable to 2025 rpm (135 cps). Use speed indicator.

*(b) The speed, under the no load and full load conditions in 2.08, shall be:
Minimum 1985 rpm (132.3 cps)
Maximum 2065 rpm (137.7 cps)

*#(c) The motor field rheostat or tapped resistor shall be so set that with the speed regulator brush removed, and the machine cold and carrying full load (see 2.08), the speed shall be:
Minimum 2000 rpm
Maximum 2100 rpm
Use speed indicator.

Note (1): The speed values given under (c) are based on minimum nameplate motor voltages shown below. If these voltages are not readily available, the regular office voltage may be used and for each volt that it is above the minimum, these speed values should be increased for adjusting this rheostat or resistor as follows:

	KS-5001, KS-5066 and KS-5362, List 1, 3, and 6	KS-5362, List 2, 4 and 5
Minimum nameplate motor voltage	19 volts	45 volts
Increase speed for each volt above minimum	50 rpm	20 rpm

Use speed indicator and d-c voltmeter.

Note (2): This rheostat or resistor is set at the factory and ordinarily should not require readjustment unless it is replaced.

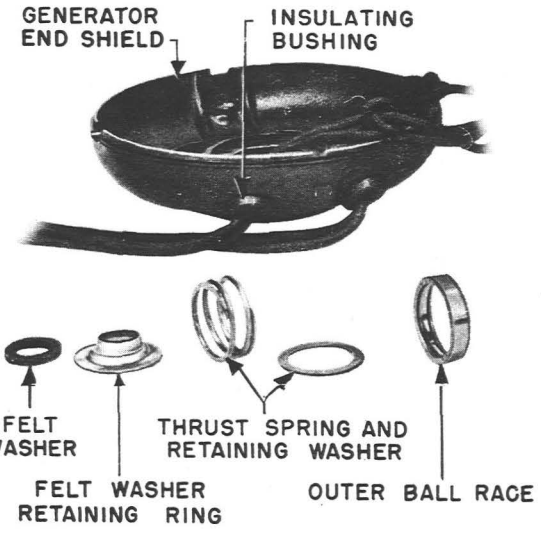


Fig. 1 - Bearing Details - Generator End

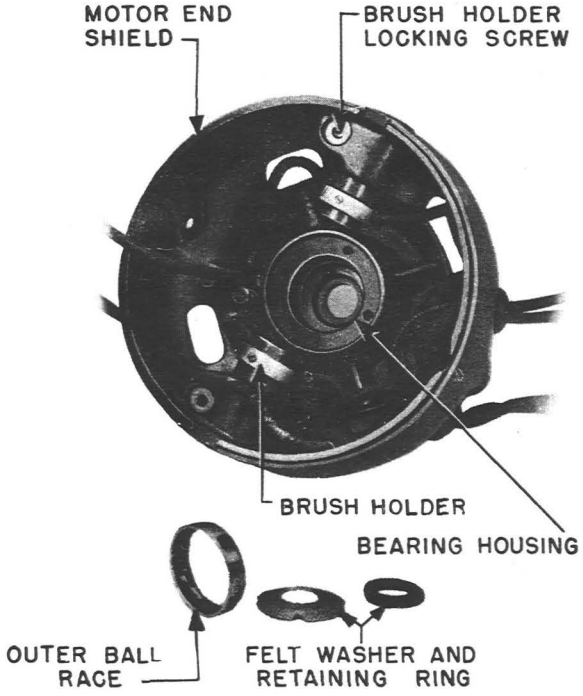


Fig. 2 - Bearing Details - Motor End

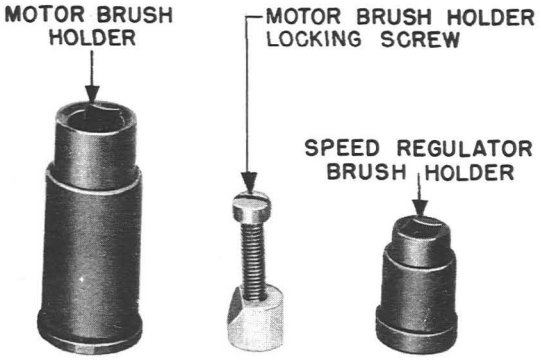


Fig. 3 - Brush Holders

*#2.07 Speed Regulator Contacts

(a) The contact surfaces shall be clean and smooth.

(b) The length of each fixed or rotating center contact metal shall be:
Minimum 0.015"
Gauge by eye.

(c) The polarity of the rotating speed regulator contact of the KS-5362, List 5 machine shall be negative to minimize contact wear. Use d-c voltmeter.

2.08 Generator Voltage: The voltage shall remain within the minimum and maximum limits under no load and full load conditions as follows:

	Generator Voltage	
	KS-5001, KS-5066 and KS-5362, Lists 1, 3 and 6	KS-5362, Lists 2, 4, and 5
Minimum	30	20
Maximum	40	30

Use a-c voltmeter.

Note (1): The voltage is ordinarily adjusted at the factory as close as possible to 25 or 35 as the mean of the above values under average conditions. The full load resistance values below are approximately on that basis.

No Load Condition on Generator

Maximum rated motor voltage if readily available
Machine cold (see note 3)
Speed 1985 to 2065 rpm

Full Load Condition on Generator

Minimum rated motor voltage if readily available
Machine hot (see note 4)

Speed 1985 to 2065 rpm
KS-5066 load 115 ohms (non-inductive) or one 50 watt lamp in parallel with two 25 watt lamps in series
KS-5362, Lists 1, 3 and 6 load 30 ohms (non-inductive) or two 100-watt and one 50-watt lamp in parallel
KS-5362, Lists 2, 4, and 5 load 15 ohms (noninductive) or four 100-watt and one 50-watt lamp in parallel

Note (2): The lamps shall be type A Mazda 110-, 115- or 120-volt rating.

Note (3): "Machine Cold" refers to machine at approximately room temperature. For purposes of this section, a machine may be considered cold if operated for not more than five minutes out of each half hour or after being stopped for two or more hours after operation under any load conditions.

Note (4): "Maching Hot" refers to the maximum temperature reached at full load. For purposes of this section, hot readings may be taken after operating for at least an hour, preferably at full-rated load if available.

#2.09 Commutating Surfaces: The surface of commutator and collector ring shall be clean and free from scores, pits or other deformation of the surface or structure except that caused by normal wear. Gauge by eye.

2.10 Commutation: The motor shall commutate successfully at any voltage within nameplate rated range and at any load between no load and full rated load of the generator.

#2.11 Brush Holders

(a) Brush holder locking screws shall be tight and the clearance between a brush holder and its associated commutator or ring shall be approximately 1/16". Gauge by eye.

Note: The clearance need not be checked unless the holder is protruding so that the shoulder is not against the end shield.

(b) The brush holders shall be so adjusted that one side of the square brushes and the wide side of the rectangular brushes will be parallel to the axis of the shaft. Gauge by eye.

#2.12 Brush Length: The minimum brush length, not including the spring shall be

	Minimum
Motor	1/2"
Speed Regulator	1/4"
Interrupter	1/4"

Use Scale.

2.13 Brush Fit: Brushes shall be free in their holders but shall not be loose enough to cause binding or unsuccessful commutation. Gauge by eye or by feel.

2.14 Brush Pressure: With a brush holder screw cap removed and the brush in its holder and resting against its associated commutator, or ring, the brush spring shall extend outside of its holder at least 1/8". Gauge by eye.

*#2.15 Temperature: The temperature shall not exceed:

	Maximum
Bearings	80C (176F)
Machine frame and windings	90C (194F)

If the temperature is thought to be excessive, measure by thermometer.

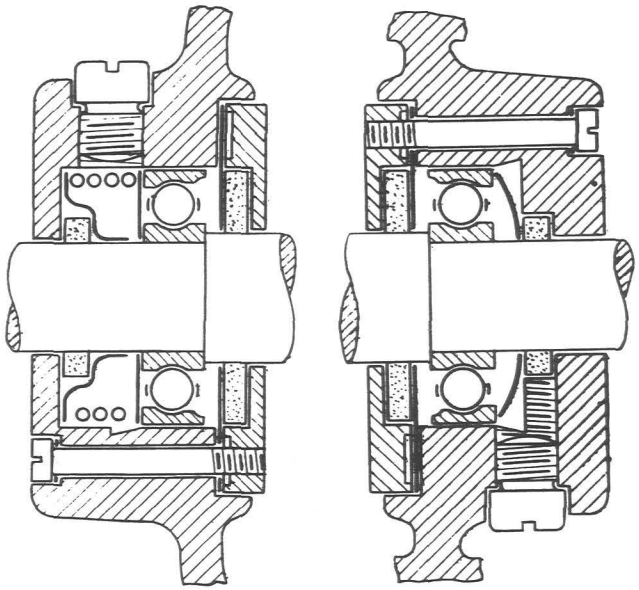


Fig. 4 - Bearing Assembly KS-5066 and KS-5362

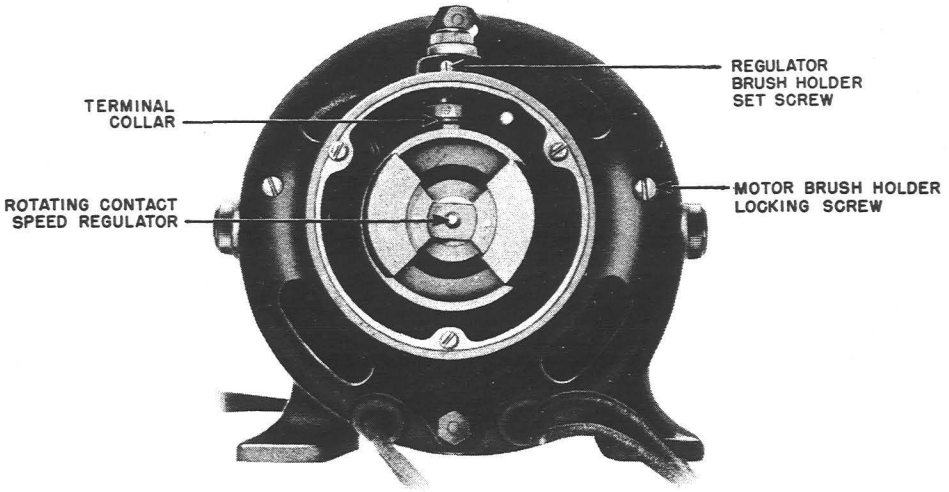


Fig. 5 - Motor End

3. ADJUSTING PROCEDURES

3.001 List of Tools, Gauges and Materials
(Equivalents may be substituted)

Tools

Bellows, Hand 10"
Brush, Typewriter, Tooth Brush Type
Pliers, P-Long-Nose, 6-1/2"
Puller, Outer Race, E13-ORP-1
Screwdriver, 4" Regular
Screwdriver, 3-1/2" KS-6854

Stud, 309 Tool
Wrench, Socket, 3/8" Hex. 46 Tool
Wrench, Hex., Open Double End, Flat, 1/4" and 3/8", R-417A Tool

Gauges

Indicator, Speed, Hasler Style A or Jones 5B
Scale, Steel, 6" R-8550
Thermometer, R-1032, Detail 1
Voltmeter, A-C/D-C Weston Model 622 (Thermocouple) Range 300-150-30-3 Volts
Voltmeter, D-C Weston Model 280, Range 150-60-3 Volts

Materials - (See 065-330-101 and 065-370-101)

Cloth, Cleaning, Twill Jean, D-98063
Grease, 260-300P
Oil, 130-190 S100
Pad, Felt
Sandpaper, 4/0
Spirits, Petroleum

3.002 Before making any tests or adjustments not requiring power, be sure to open the circuit so that the set cannot be started and cause personal injury while it is being worked on.

3.003 In removing brushes note the position of each brush in its holder and put it back in the same position and same holder to insure that the contact will be the same as before removal. In replacing a brush holder cap after fitting a brush, see that the inside of the cap is smooth and clean so that there is no possibility of the pigtail becoming twisted as the cap is screwed in place.

3.004 Whenever the machine is disassembled so that the speed regulator contacts are accessible, wipe them with a clean dry cloth to remove dirt or finger marks. Replace the cover in such a position that the contact arm will press against the contact post.

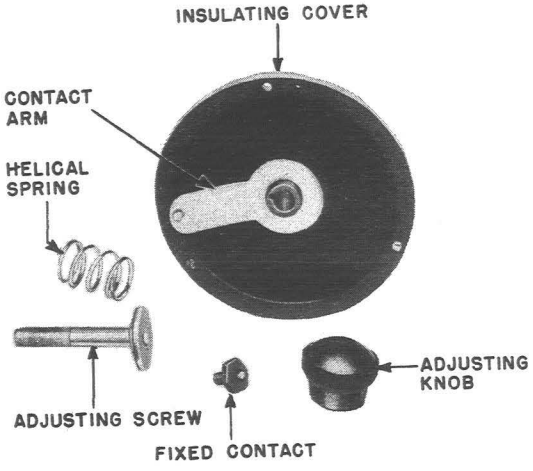
3.005 When the machine is disassembled blow out with air and wipe off the armature with a dry cloth, also wipe out the machine frame removing dust and accumulated dirt. The metal parts such as laminations of rotor or stator of some machines are protected against rusting by a thin film of anti-rust compound which is an oil that dries semi-hard. It is desirable that removal of this film be avoided as much as practicable.

#3.01 Lubrication (Rq. 2.01)

(1) To clean and repack the ball bearings, remove all brushes and insulating covers. Remove the large screw cap on the side of the motor and loosen the set screws to release the speed regulator assembly. Remove the screws from the bearing housings on both ends of the machine which secure the inside bearing retainer to the end shields as shown in Fig. 4. Remove the nuts from the end shields and pry the end shields from the frame by inserting a screwdriver in the small openings on the sides. To avoid straining the leads, when removing the end shield, support the end shields by some means other than by allowing them to hang on the leads. Remove the rotor.

(2) Remove the outer ball races, springs, washers, etc., and note their positions so that they may be replaced properly. The outer race may be removed from the end shield easily with the puller. Hold the puller by the knurled end and screw the large hand nut close to that end. Turn the jack screw in the center to allow the collets to close together. Place the bridge part against the end shield and insert the puller until the points of the collets are just behind the race. Turn the jack screw to expand the collets and then turn in on the large knurled nut to remove the race. Clean the parts and housing with petroleum spirits and wipe dry. A typewriter brush will be useful for this purpose.

(3) Pack the ball races with a moderate amount of grease and assemble the various springs and washers in the end shield housings. The outer race will slide into the housing without the aid of any special tool but should have a fairly snug fit. It may be desirable to wipe the inside of the bearing chamber with a trace of grease on the end of the finger before sliding the race into place. The screws may be replaced more readily if a 309 tool is used. This tool is similar to one of the regular screws except that the head is removed and, therefore, it can be screwed into the bearing retainer and through the copper gasket and end shield from the inside before sliding the end shield into place. After the end shield is put into place, three of the screws may be put in and then the stud may be removed and the fourth screw put in place. See that the shaft turns freely. Push the shaft toward the thrust spring and release it to check that the thrust spring returns the shaft to its original position.



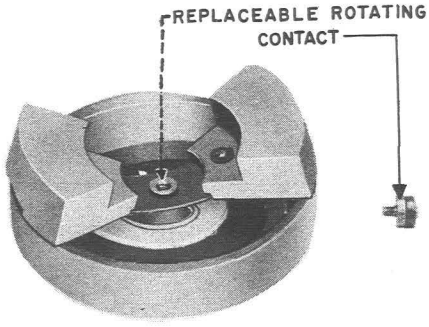


Fig. 6 - Center-contact Type - Speed Regulator Details

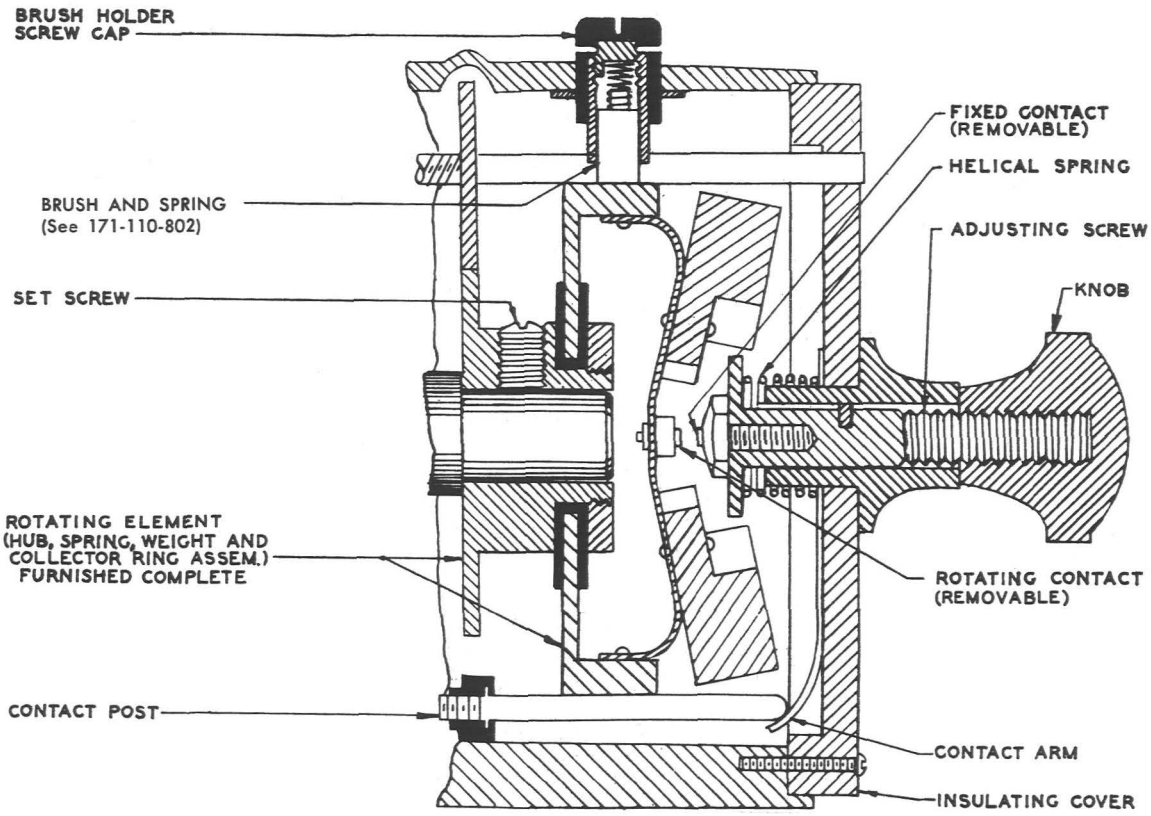


Fig. 7 - Center Contact - Speed Regulator Assembly

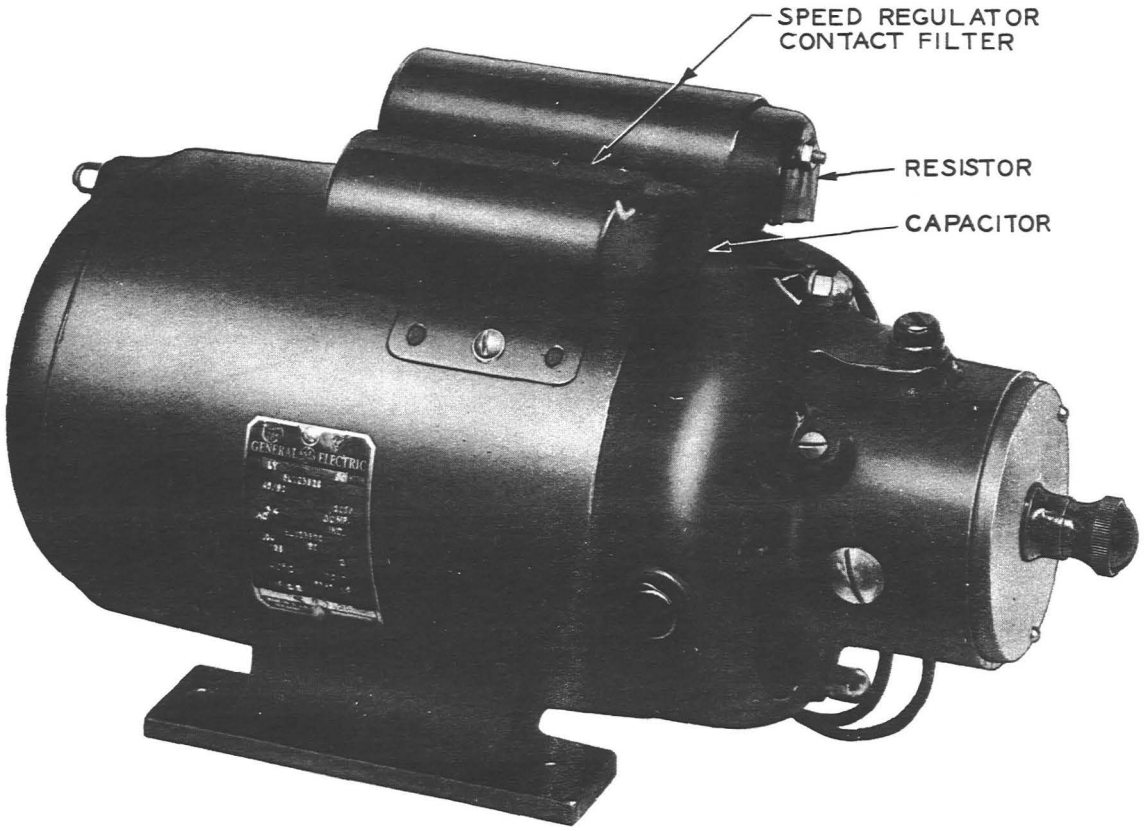


Fig. 8 - KS-5362 List 5 Machine

(4) In replacing the speed regulator rotating assembly the set screw should register on the spot on the shaft provided for that purpose. Before putting on the regulator insulating cover, wipe the speed regulator contacts with a dry cloth, avoiding touching the contacts with the bare fingers. Put on the insulating cover on the speed regulator end in such a position that the flat contact arm on the inside will press against the contact post.

3.02 Bearings (Rq. 2.02)

(1) Replace worn ball bearings.

3.03 Freedom of Rotation (Rq. 2.03)

(1) If binding is present examine the machine and remove any foreign matter. Also check to see that all bolts and screws are firm. Tighten if necessary. See that the brushes are free in their holders. Binding may be due to short brushes, pitted or dirty speed regulator collector ring or commutator surfaces; damaged bearings; gummed or caked grease in the bearings; or the fixed regulator contact being screwed in too far counterclockwise against the rotating regulator contact. Roughened or pitted commutator, speed regulator collector ring surfaces should be removed as outlined in 3.01 and turned down or smoothed with sandpaper. Gummed or caked grease in the bearings should be thoroughly removed, the bearings cleaned or replaced. Place new grease in the bearings. Reassemble the rotor and speed regulator in the reverse order.

*3.04 End Play (Rq. 2.04)

(1) Press the shaft inward against the thrust spring which is usually in the end opposite the regulator but may be in either end of the machine. See that the thrust spring (or thrust washer) works freely and returns the rotor to its original position when the pressure is released. If the spring does not return the rotor, examine for binding. The spring is accessible after removing its end shield as covered under 3.01.

3.05 Noise and Vibration (Rq. 2.05)

(1) See that all bolts, nuts and screws are firm. Examine for chattering brushes. If excessive noise and vibration continues, the trouble is probably due to worn bearings which should be replaced, or the matter referred to the supervisor.

3.06 Speed (Rq. 2.06)

#(1) With the speed adjusted to the mean of 2025 rpm and the generator voltage at the mean for the regular office conditions, they should ordinarily remain within limits for no load to full load condition. At no load they would have a tendency to increase and at full load to decrease.

*(2) If the speed is not within the limits for no-load and full-load conditions, readjust the regulator as required. If this cannot be done, examine the regulator parts and the motor rheostat or resistor for defects. If the trouble is not found, check the motor rheostat or resistor in accordance with 2.06(c).

*#(3) In case it is necessary to readjust the motor field rheostat or resistor, remove the regulator brush, apply full load and adjust the rheostat or the taps on the resistor until the speed is within limits of 2.06(c), preferably nearer the lower limit. When adjusting the external regulator resistor, turn the speed regulator adjusting knob to its maximum clockwise position to separate the regulator contacts during the adjustment. Then replace the brush and adjust the speed with the regulator under the full-load and no-load test conditions of 2.08. When the speed is satisfactory, mark the rheostat setting and remove old marking.

#3.#(4) On machines equipped with filters, a shorted capacitor would give an immediate drop in generator frequency to a value approximating the full shunt-field speed of the motor. If this occurs, the capacitor should be replaced and the speed checked and readjusted where necessary.

*#3.07 Speed Regulator Contacts (Rq. 2.07)

(1) Replace short or badly roughened contacts.

Note: New rotating elements ordered for the older machines, and rotating elements on machines of later design, are equipped with replaceable rotating contacts (see 155-605-801).

(3) The polarity of the rotating contact may be checked by connecting the negative terminal of a d/c voltmeter to the brush holder of the regulator, under the brush holder cap, after backing off the cap one or two turns; and connecting the positive terminal of the voltmeter to the end of the motor regulating tapped tube resistor which gives a deflection on the voltmeter. A positive reading on the voltmeter indicates the proper polarity. This check should be made with the regulator contacts open.

(4) Machines of more recent design are equipped with a filter consisting of a resistor and a capacitor, connected across the contacts, to reduce the peak voltage and the regulator contact duty as much as practicable. There is little danger of the electrolytic capacitor short circuiting; but any failure will probably be a loss in capacity, which in turn will result in the gradual burning of the contacts indicating the capacitor should be replaced.

3.08 Generator Voltage (Rq. 2.08)

(1) To check the generator voltage range, set up the no-load and full-load test conditions of 2.08. If the voltage on the motor is not at the high or the low value as desired, it will be satisfactory to use the voltage available. The switchboard voltmeter or a portable instrument of the thermocouple type may be used to read the generator voltage. Do not use ordinary voltmeters on small capacity machines. The resistance or lamp load indicated should draw suitable full load. However, if a portable ammeter of the thermocouple type is available, the load could be built up on the basis of the current. In this case the full-load current is the wattage rating of the machine (10.5 or 40) divided by the generator voltage while full load is being delivered.

(2) If, with the speed within limits, the voltage is outside the limits, look for loose connections on the generator rheostat or resistor and readjust the rheostat or refer the matter to the supervisor.

#3.09 Commutating Surfaces (Rq. 2.09)

(1) The commutator may be cleaned of dust with air blown through the brush holder or end shield openings. Turn the armature slowly by hand while blowing out the dirt. If necessary, dismantle the machines as outlined under 3.01 and clean the commutator with a cloth moistened with petroleum spirits and then wipe dry. If the commutator surface becomes sufficiently rough or pitted to cause poor commutation, it will be necessary to reface it.

(2) The collector ring may be cleaned by blowing out the dust or wiping with a clean cloth moistened with petroleum spirits. Wipe dry after cleaning. If necessary, remove the rings and smooth with 4/0 sandpaper.

3.10 Commutation (Rq. 2.10)

(1) If the commutation is not satisfactory, see that requirements 2.11 to 2.15 inclusive are met. If the above conditions are met and the commutation is still unsatisfactory, replace the parts involved.

#3.11 Brush Holders (Rq. 2.11)

(1) In case the brush holder locking screw loosens, there is a tendency for the brush spring to force the brush holder outward. In general, the clearance is within limits when the shoulder of the holder rests against the end shield. The clearance may be checked by removing the brush and sighting down through the opening, by removing the insulating covers on the end shields or, in the case of the motor brush holders, by sighting through the openings in the end shield. If the brush holders are once set so that the flat sides of the brushes line up with the shaft, there is little likelihood of their rotating from this position. Slight misalignment might not be worthwhile correcting since any change would require reseating the brush.

(2) If any change in the position of a holder is necessary, first loosen the locking screw. In the case of the motor brush holder, tap the screw inward gently after loosening, to free the wedge nut. The wire connection to each brush holder is terminated in a collar around the holder on the inside of the end shield. The collar is secured by a small set screw. Consequently, the brush holders cannot be completely removed or turned appreciably without first loosening these collars from within the housings. Do not attempt to turn the holders, other than for slight adjustments, unless collars are first loosened as this would strain the connections. Check that the set screws and lock screws are tightened firmly after adjustments are completed.

#3.12 Brush Length (Rq. 2.12)

(1) Replace loose brushes. Brushes which are too tight can usually be fitted by cleaning the brush and brush

3.13 Brush Fit (Rq. 2.13)

(1) Replace loose brushes. Brushes which are too tight can usually be fitted by cleaning the brush and brush

holder. Remove any burrs or rough places in the brush holders. If binding is caused by a deformed brush spring, relace the brush.

(2) Brushes are generally furnished with their faces curved to the approximate curvature of the commutator or ring. After inserting new brushes run the machine without load for a few hours.

3.14 Brush Pressure (Rq. 2.14)

(1) The brush spring should be stretched if required to give the desired spring extension. Usually a shortened spring is the result of a twisted pigtail and the desired spring extension may be obtained by untwisting the copper pigtail. If this does not give the desired length stretch the spring slightly.

*#3.15 Temperature (Rq. 2.15)

(1) The temperature of any part may be measured by placing the bulb of the thermometer on the part, the temperature of which is desired, covering the exposed portion of the bulb with a piece of felt, and observing the highest temperature reading.

(2) If the temperature exceeds the specified limits, refer the matter to the supervisor.