

MOTOR-GENERATOR SETS

1000-CYCLE SIGNALING

REQUIREMENTS AND ADJUSTING PROCEDURES

1. GENERAL

1.01 This section covers the following 1000-cycle signaling sets.

KS-5015 with dc motor drive, mechanical interrupter, ball bearings, and originally equipped with ring speed regulator.

KS-5051 and KS-5067 with dc motor drive, mechanical interrupter, ball bearings, and center contact speed regulator.

KS-5099 with dc motor drive, magnetic interrupter, ball bearings, and center contact speed regulator.

1.02 This section is reissued to transfer the information covering the KS-5472 and KS-5472-01 machines to a separate section (155-609-701), since these machines are not used as a source of signaling power. In addition, the list of tools and gauges is revised to specify the E screwdriver and the R-1032, detail 1, thermometer.

1.03 *Phi* (ϕ): Requirements are marked with a phi when they are not required to be checked before turnover.

1.04 *Asterisk* (*): Requirements are marked with an asterisk when to check for them would necessitate dismantling or dismounting of apparatus, or would affect the adjustment involved, or other adjustments. No check need be made for these requirements unless the apparatus or part is made accessible for other reasons, or its performance indicates that such a check is advisable.

1.05 Reference shall be made to Section 020-010-711 for additional information necessary for the proper application of the requirements listed herein.

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 field rheostat has the serial number of the associated set marked on it with paint and should be used with that set only.

2. REQUIREMENTS

2.01 *Lubrication*

Ball Bearings

ϕ (a) The ball bearings shall be lubricated with KS-7471 grease every 3 years in service.

(b) All bearings shall be lubricated when being put into service after 1 or more years of storage, or after having been dismantled for other reasons.

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 2.05 and 2.15 are met, the bearings shall be considered to be in a satisfactory condition.

2.03 *Freedom of Rotation*: The shaft shall turn freely in the bearings.

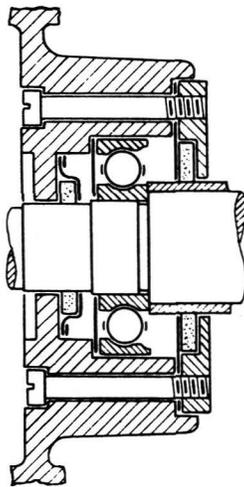
Gauge by feel.

2.04 End Play: The motor end play shall be taken up by the thrust spring.

Gauge by feel.

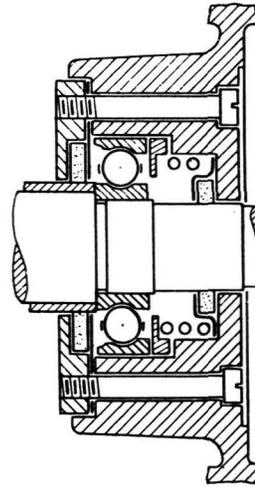
2.05 Noise and Vibration: The noise and vibration of the motor under any normal operating condition shall not be excessive.

Gauge by sound and feel.

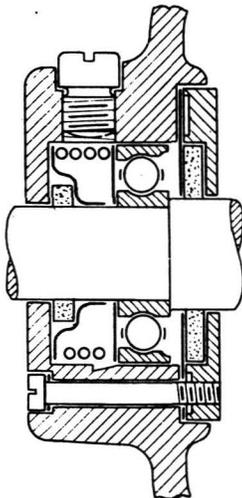


GENERATOR END

KS-5015

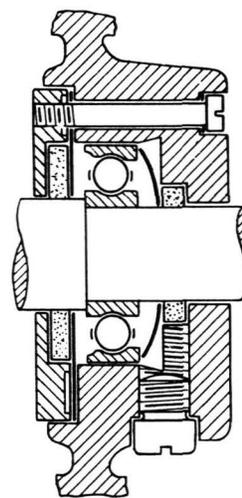


MOTOR END



GENERATOR END

KS-5067 AND KS-5099



MOTOR END

Fig. 1 – Bearing Assembly

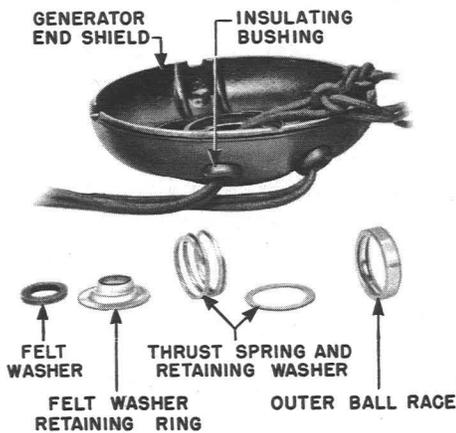


Fig. 2 - Bearing Details - Generator End - KS-5099

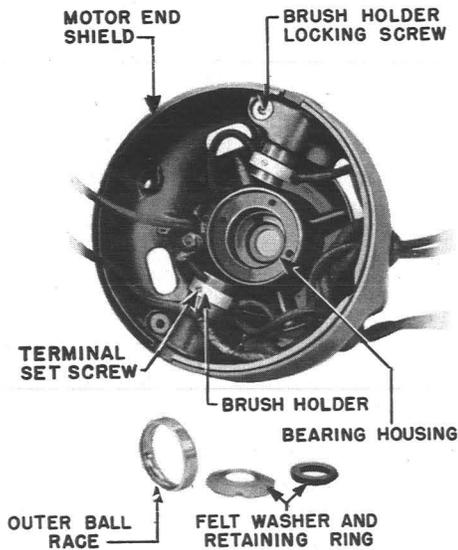


Fig. 3 - Bearing Details - Motor Ends - KS-5099

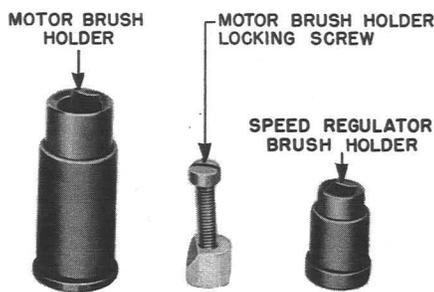


Fig. 4 - Brush Holders

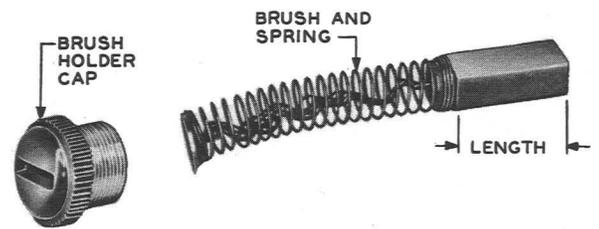


Fig. 5 - Brush Details

2.06 Adjustment of Speed Regulator and Associated Resistor (Motor Field Rheostat)

(a) The motor field rheostat of all sets shall be so adjusted that with the machine cold, carrying full load, with 19 volts on the motor and the speed regulator brush removed, the speed shall be

Min 1220 rpm
Max 1270 rpm

Use tachometer.

Note 1: For each volt above 19 volts, add 25 rpm to these values for adjustment purposes.

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

(b) The speed regulator shall be adjusted so that the motor speed under any operating conditions of voltage as stamped on the motor nameplate, motor cold or hot, and no load to full load shall be

MACHINE	MINIMUM	MAXIMUM
KS-5099	1131 rpm	1176 rpm
KS-5015	1152 rpm	1198 rpm
KS-5051	1152 rpm	1198 rpm
KS-5067	1152 rmp	1198 rpm

Note: To convert rpm to cycles per second, multiply the rpm by 0.867 for KS-5099 machines and by 0.851 for KS-5015, KS-5051, and KS-5067 machines.

Use tachometer.

(c) When readjusted under office load and average office voltage, the motor speed shall be approximately

MACHINE	MEAN
KS-5099	1155 rpm
KS-5015	1175 rpm
KS-5051	1175 rpm
KS-5067	1175 rpm

Use tachometer.

Note: On systems equipped with frequency alarm the speed can be disregarded if the alarm does not operate.

***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

Min 0.015 inch

Gauge by eye.

(c) The polarity of the rotating contact shall be negative.

Use voltmeter.

***2.08 Capacity**

Motor

(a) The motor shall be capable of driving its generator at full load continuously at the line voltage as stamped on the motor nameplate.

Generator

(b) **Full-load Test:** With the speed of the generator between the limits specified in 2.06 and with a power factor of unity, the generator shall deliver its full rated load. For the purpose of this section, full load may be said to have been obtained when 400 ohms noninductive resistance is placed across the uninterrupted output terminals (A-1)—(A-2), and simultaneously 170 ohms across each inter-

rupted output terminal (IC-1)—(IC-2) and (IC-3)—(IC-4) of the KS-5099 machine with 4.25 ± 0.25 volts across each of these latter terminals.

Use thermocouple-type voltmeter.

On KS-5015, KS-5051, and KS-5067 machines, full load may be said to have been obtained when 170 ohms noninductive resistance is placed across the uninterrupted output terminals (A-1)—(A-2) with 6 ± 0.5 volts across these terminals.

Use thermocouple-type voltmeter.

(c) **No-Load Test:** With the speed of the generator between the limits specified in requirement 2.06 with no load on the generator and with a fixed setting of the generator field rheostat (not necessarily the same setting as at full load), the following requirements shall be met.

(1) The voltage of each interrupted output circuit shall be 4.25 ± 0.25 volts. On the KS-5099 machine these voltages shall not differ from each other by more than 0.25 volt.

Use thermocouple-type voltmeter only on these small capacity machines.

(2) The ac voltage of the uninterrupted output circuit with the same setting of the field rheostat used under (1) shall be 6 ± 0.50 volts on the KS-5099 machine and 6 ± 1.0 volts on the KS-5015, KS-5051, or KS-5067 machine.

Use thermocouple-type voltmeter.

Note: Some KS-5015 and KS-5067 machines build up high-contact drop at the regulator when under light load and cause a low-voltage alarm. A 300-ohm artificial load is suggested in such cases.

***2.09 Commutator, Speed Regulator Collector Ring, and Interrupter Ring Surfaces:**

The surface of the commutator collector ring and interrupter rings 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.

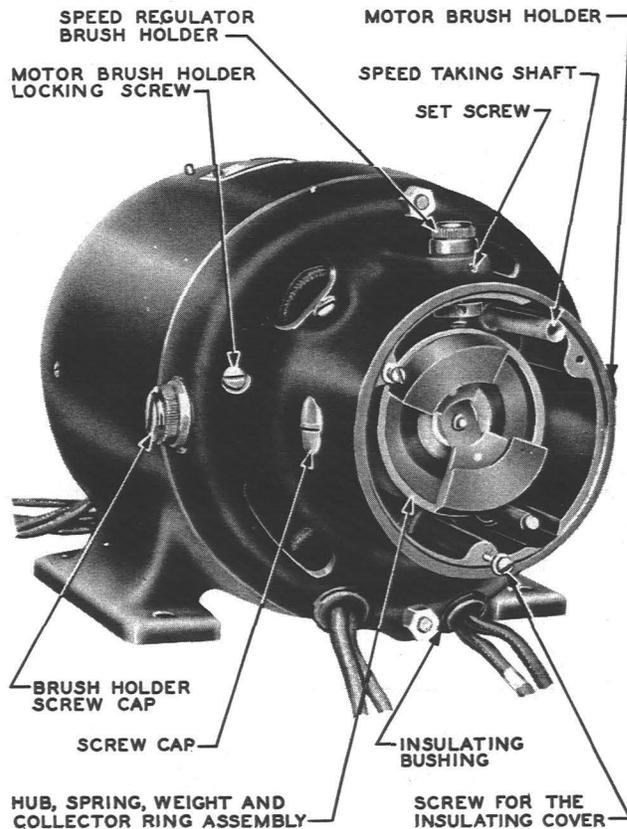


Fig. 6 - Motor End - KS-5099

2.10 Commutation: The motor shall commute 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 inch.

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 Brushes	1/2 inch
Speed Regulator	1/4 inch
Interrupter	1/4 inch

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 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

Min 1/8 inch

Gauge by eye.

***2.15 Temperature:** The temperature of any machine shall not exceed

	MAXIMUM
Bearing	80 C (176 F)
Machine Frame	90 C (194 F)

Use thermometer.

Caution: Under trouble conditions the unit temperature may exceed that shown above. Do not use fingers to estimate temperature.

If the temperature is thought to be excessive, measure by thermometer. To check the temperature, proceed as follows. Hold the bulb of the thermometer against the frame or part under consideration. Cover the part of the bulb which is not in contact with the part with a piece of felt or the equivalent. Observe the temperature indicated after it has stabilized.

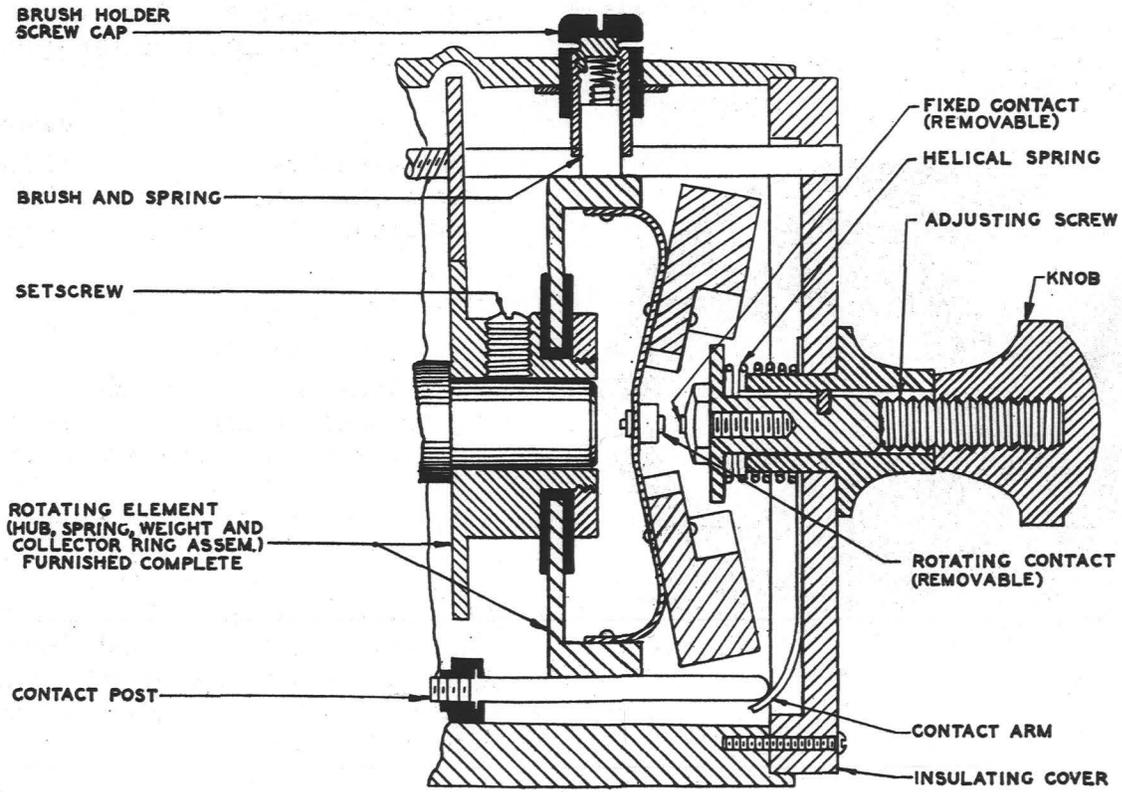


Fig. 7 - Speed Regulator Assembly — KS-5099

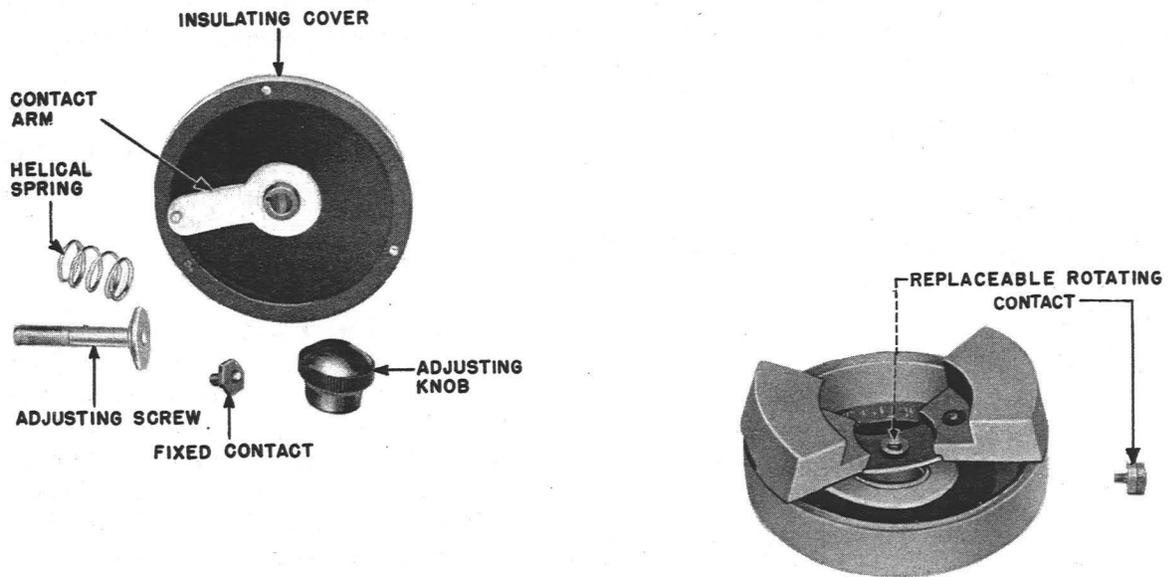


Fig. 8 - Center-contact-type Speed Regulator Details

3. ADJUSTING PROCEDURES**3.001 List of Tools, Gauges, and Materials**CODE OR
SPEC NO.**TOOLS**

46	3/8-inch Hex. Single-end Socket Wrench	
63	3/8-inch Open-end Hex. Wrench	
309	Threaded Stud	
KS-6320	Orange Stick	
KS-6854	3-1/2 inch Screwdriver	
R-1005	Jeweler's Screwdriver	
R-2969	Typewriter Brush	
—	10-inch Hand Bellows	
—	6-1/2 inch P-Long-nose Pliers	
—	4-inch E Screwdriver (or replaced 4-inch Regular Screwdriver)	←

GAUGES

R-1032, Detail 1	Thermometer -5 C to +150 C (or replaced Kimble Co, No. 43732 Thermometer -20 C to +151 C)	↕
R-8550	6-inch Steel Scale	
—	Tachometer, Type A or No. 5, Boulin Instrument Corp	
—	Voltmeter, AC/DC Weston Model 622 (Thermocouple) Range 300/150/30/3 volts	

MATERIALS

KS-7471	Ball Bearing Grease
KS-7860	Petroleum Spirits
KS-14666	Cleaning Cloth
—	Felt Pad
—	Abrasive Paper, Extra Fine Flint Paper or 4/0 Garnet Paper

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. 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 antirust compound which is an oil that dries semihard. It is desirable that removal of this film be avoided as much as practicable.

3.006 When using petroleum spirits for cleaning purposes in a power room, provide as much ventilation as practicable. After using the petroleum spirits, the commutators of all dc machines in the power room should be burnished in accordance with approved procedures for the machines involved, since the fumes from the petroleum spirits may soften commutator film and thus adversely affect commutation.

3.01 Lubrication (Reqt 2.01)**Ball Bearings**

(1) To clean and repack the ball bearings on the dc sets, 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 and interrupter drum. It will be noted that the interrupter drum is held in place by two set-screws and the speed regulator has one set-screw. 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. 1. 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. Clean the parts and housing with petroleum spirits and wipe dry. A typewriter brush will be useful for this purpose.

Note: The thrust spring is in the motor end of KS-5015 machines and in the generator end of the other machines.

(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 No. 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 inward on the speed regulator end of the KS-5051, KS-5067, and KS-5099 machines and release it to check that the thrust spring returns the shaft to its original position. On the KS-5015 machine, push the shaft inward on the generator end.

(4) In replacing the speed regulator rotating assembly, the setscrew should register on the spot on the shaft provided for that purpose. This also applies to the interrupter ring setscrews if spots are provided for them. 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 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 as shown in Fig. 7.

3.02 *Bearings* (Reqt 2.02)

(1) Replace worn ball bearings as covered in Section 155-608-801.

3.03 *Freedom of Rotation* (Reqt 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, interrupter rings, 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, or interrupter ring surfaces should be removed as outlined in 3.01 and turned down or smoothed with abrasive paper. 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* (Reqt 2.04)

(1) On KS-5051, KS-5067, and KS-5099 sets, remove the insulating cover and press against the end of the shaft. On the KS-5015 set, press in on the exposed shaft at the generator end. 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 in 3.01.

3.05 *Noise and Vibration* (Reqt 2.05)

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

3.06 Adjustment of Speed Regulator and Associated Resistor (Motor Field Rheostat)
(Reqt 2.06)

(1) In case it is necessary to readjust the regulator rheostat, remove the machine from service and connect full load on the generator as covered in 3.08. Remove the speed regulator brush and read the office voltage. Calculate the range of speed for adjustment as covered in 2.06(a). Start the set and adjust the rheostat to give a speed within the calculated range. Remove the artificial load and replace the brush. Mark the new position of the contact arm near the button. Adjust the speed regulator as covered below.

(2) The normal wear of the contacts causes a gradual increase in the speed of the motor. When the speed reaches the upper limit of the specified range in 2.06(b) under any of the specified conditions, the speed regulator should be readjusted to the calculated mean value in 2.06(c). With the ring-type speed regulator, loosen the locknut before adjusting and retighten before checking the speed. In adjusting the speed, the knob should be turned in a counterclockwise direction facing the regulator to lower the speed or in a clockwise direction to increase the speed. In making adjustments, the knob should be turned only 10 or 15 degrees at a time and the speed checked before proceeding further.

Note: 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.

3.07 Speed Regulator Contacts
(Reqt 2.07)

(1) Replace short or badly pitted contacts.

Note: New rotating elements ordered for existing machines, and on machines of later design, will be equipped with replaceable rotating contacts. (See Section 155-608-801.)

(2) To check polarity, connect the voltmeter negative lead to the brush holder of the speed regulator under the brush holder cap. Connect the voltmeter positive lead to the R2

end of the motor regulating rheostat. With the machine running and the speed regulator contacts open, a positive voltmeter indication should be obtained.

3.08 Capacity (Reqt 2.08)

(1) If fixed or variable 400- and 170-ohm resistor units are not available, a lamp bank may be used. To obtain full load with a lamp bank on the KS-5099 machine, connect four 25-watt lamps in series across terminals (A-1) — (A-2) and connect one 25-watt lamp across each pair of terminals (IC-1) — (IC-2) and (IC-3) — (IC-4). For the KS-5015, KS-5051, or KS-5067 machine, connect two 25-watt lamps in series across terminals (A-1) — (A-2). Start the set and adjust the voltage across the interrupter terminals to the specified value by operating the associated generator field rheostat.

Note: The lamps shall be standard 25-watt, 110-, 115-, or 120-volt type.

(2) In the case of the KS-5099 machine, the two interrupted voltages may be balanced by adjusting the air gaps between the alternator pole faces and the rotor, and reading the voltages across each of the interrupted circuits. This adjustment is made by slightly loosening one of the two setscrews which hold the alternator field core in position and tightening the other, which shifts the entire stator winding assembly with respect to the rotor. These setscrews are located on each side of the frame at the alternator end just above the feet. The correct direction for shifting the stator is conveniently determined by trial. By varying the pressure on both setscrews, the balanced interrupted voltages may be adjusted to a limited extent if necessary to meet the specified readings. Screwing in on both setscrews raises the voltages and loosening slightly decreases the voltages. The screws should not be loosened to such an extent that they fail to press securely against the field core laminations, and, in general, this method need be used only when the proper relations cannot be secured by field rheostat adjustment.

(3) Machines which do not meet the requirements of 2.08 when driven at the proper speed after meeting other requirements of this section should have the associated field rheostat examined for open circuit or poor connections. Repair or replace a defective rheostat. If the machine still fails to meet the capacity requirements of this section, the machine shall be replaced or the matter referred to the supervisor.

(4) The switchboard voltmeter where available may be used in reading the voltage. Where a switchboard instrument is not available, a portable instrument of the thermocouple type may be used. In actual installations, the switchboard meter is usually connected across the uninterrupted or 6-volt winding. In such a case, the regular wires should be temporarily disconnected from the meter and a pair of testing leads with picks or clips on the free ends substituted. Read the voltages of the interrupted windings alternately, connecting to the soldering lugs on the rear of the panel, then adjust the rheostat as necessary to get the voltages as near as practicable to the value specified in 2.08(c). Read the voltage across the uninterrupted winding, restore the regular meter wires, and thereafter operate the machine at this voltage in order to obtain the correct voltage on the interrupted windings.

Example: IC1-IC2 = 4.30 volts
 IC3-IC4 = 4.22 volts
 A1-A2 = 6.35 volts

Operate machine regularly at 6.35 volts as read on voltmeter.

3.09 *Commutator, Speed Regulator, Collector Ring, and Interrupter Ring Surfaces* (Reqt 2.09)

(1) The commutator may be cleaned of dust with compressed air blown through the brush holder or end shield openings. Turn the armature slowly by hand while bowing out the dirt. If necessary, dismantle the machine as outlined in 3.01, clean the commutator with a cloth moistened with petroleum spirits, and then wipe dry. If the commutator be-

comes sufficiently rough or pitted to cause poor commutation, it will be necessary to re-surface it.

(2) The collector rings 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 abrasive paper.

3.10 *Commutation* (Reqt 2.10)

(1) If the commutation is not satisfactory, see that requirements 2.02, 2.03 and 2.11 to 2.15, inclusive, are met. If the conditions are met, and the commutation is still unsatisfactory, replace the parts involved.

3.11 *Brush Holders* (Reqt 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 shields. 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 justify 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 setscrews and lockscrews are tightened firmly after adjustments are completed.

3.12 Brush Length (Reqt 2.12)

- (1) Replace brushes as necessary to maintain at least the minimum length specified.

3.13 Brush Fit (Reqt 2.13)

- (1) Replace loose brushes. Brushes which are too tight can usually be fitted by cleaning the brush and brush holder. Remove any build-ups or rough places in the brush holders.
- (2) Brushes are generally furnished with their faces curved to the approximate curvature of the commutator or ring. After in-

serting new brushes, run the machine without load for a few hours, if possible.

3.14 Brush Pressure (Reqt 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 (Reqt 2.15)

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

