MOTORS — DIRECT CURRENT
1/4 HORSEPOWER OR LARGER
REQUIREMENTS AND ADJUSTING PROCEDURES

1. GENERAL

1.01 This section covers apparatus requirements and adjusting procedures for the 1/4-hp or larger dc commercial-type motors which form a part of the following sets:

KS-5006	KS-5396-01
KS-5296	KS-5396-02
KS-5296-01	KS-5397
KS-5396	KS-5419

1.02 This section is reissued to list additional sets and, in general, bring the section up to date. Since this reissue covers a general revision, the arrows ordinarily used to indicate changes have been omitted. Detailed reasons for reissue will be found at the end of the section.

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

* 1.04 Requirements are marked with an asterisk (*), when to check for them would necessitate the 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 Hunting as applied to motors may be defined as a condition in which the speed of the motor is periodically rising and falling. This condition may be present continually or intermittently.

1.06 Normal operation may be defined as a condition in which the motor is carrying any load from no load to full load with the power service within commercial limits.

1.07 Neutral marks designating the electrical neutral of a motor are found on the brush holder yoke and bearing bracket of motors except those having tubular-type (cartridge) brush holders. These marks are established by the manufacturer and when the brush holder yoke is set with both marks in line, the brushes usually will be in the position for the best commutation.

2. REQUIREMENTS

2.01 Lubrication

(a) Oil ring and waste-packed bearings shall be adequately lubricated with 220-260 S 100 oil.

Oil Ring Bearings

(b) Oil rings shall turn and deliver oil to the shaft and bearings.

(c) The oil level in the gauge shall be kept between one half and three fourths full.

Gauge by sight.

(d) If it is thought that dirt has entered the bearing chamber, it shall be flushed and the bearing relubricated.

(e) The oil shall be replaced with fresh oil every 2 years.

(f) Oil gauges shall be free from leaks.

Waste-packed Bearings

(g) Bearings shall be lubricated with six or seven drops of oil at installation and every 3 months thereafter. This interval or amount of oil may be modified if experience indicates.

(h) Every 2 years, remove the lower bearing dust cap and inspect the condition of the waste. If over lubricated, excess oil should be allowed to drain out. If waste feels dry, add one teaspoonful of oil and increase amount of quarterly application of oil one or two drops.

Ball Bearings

(i) Bearings shall be relubricated with 260-300P grease annually in service or after being dismantled. Normally, ball bearings shall not be lubricated when a motor is being put into service, but if it has been in storage for 2 or more years before being installed, they shall be lubricated.

* 2.02 Motor Speed: The speed of the motor under all operating conditions of

voltage, temperature, and load, no load to full load, as stamped on the motor nameplate, shall be within the limits defined in the section covering the generator or other apparatus with which it is associated.

Use speed indicator.

2.03 Voltage

(a) Line-driven motors shall meet the requirements of this section with the variation in the supply voltage taken as ±5 per cent of the nominal supply voltage, unless otherwise specified on the motor nameplate.

Use voltmeter.

(b) Motors intended for operation from storage batteries shall meet the requirements of this section with the voltage variation at the motor terminals taken as the following, unless otherwise specified on the motor nameplate.

Use voltmeter.

11-cell Battery	22-cell Battery	24-cell Battery
18-28 volts	36-55 volts	42-52 volts

2.04 Freedom of Rotating Parts: The motor armature shall turn freely in its bearings.

Gauge by feel.

*2.05 Airgap

(a) The airgap at all points between the armature and the pole faces shall be

Min 0.010 inch

Use feeler gauge.

Note: A motor of one of the larger sizes, having airgap approaching the minimum, should be checked frequently for noise and vibration. (See 2.08.)

*2.06 End Play: The armature shall run freely under all conditions of load from no load to full load, but there shall not be sufficient end play to permit the brushes to overhang the end of the commutator or ride upon that part of the commutator used for connection to the armature conductors.

*2.07 Bearings: The bearing linings or ball bearings shall be free from excessive wear. If the motor operates satisfactorily under all conditions of load and with requirements 2.04, 2.05, 2.08, and 2.21 met, the bearings shall be considered to be in a satisfactory condition.

2.08 Noise and Vibration: The noise and vibration of a motor under any normal operating condition shall not be excessive at any load from no load to full load.

Gauge by sound and feel.

*2.09 Commutator Surface

(a) The surface of the commutator shall be clean and free from scoring, pitting, or other deformation of the surface or structure, save that caused by normal wear.

Gauge by sight or by feel.

(b) The commutator shall have no high, low, or loose segments or flat spots. The eccentricity of the commutator shall not be enough to cause poor commutation or poor operation of the motor.

(c) The mica between the commutator segments shall be undercut not to exceed 1/32 inch.

Gauge by sight.

2.10 Commutation: Without altering the position of the brushes, the motor shall commutate successfully at any load between no load and rated load, at any voltage within the limits specified in requirement 2.03, and with the motor at any temperature within the limits specified in requirement 2.21.

Gauge by sight.

2.11 Brush Holders and Yokes

(a) The clearance between the motor commutator and the lower edge of reaction-type and tubular-type brush holders shall be

Min 1/32 inch
Max 9/64 inch

Use scale.

(b) The clearance between each speed regulator collector ring and the edge of the associated brush holder shall be

Min 1/32 inch
Max 5/64 inch

Gauge by eye.

(c) Baylis-type brush holders shall have the edges which are adjacent to the commutator

Min 1/32 inch
Max 3/16 inch

from the commutator surface.

Use scale.

An effort shall be made in readjusting to work to the minimum limit as far as possible.

(d) The angle between the slide surface of a Baylis-type brush holder and a line tangent to the commutator surface at the midpoint of the brush arc shall be as near as practicable to 60 degrees.

Use template.

(e) Brush holder yokes having a dowel-pointed setscrew shall be set with the dowel registered in its associated hole.

(f) Brush holder yokes having neutral marks on the yoke and on the bearing bracket shall be set with the marks in line.

Gauge by sight.

2.12 Brush Length

(a) Brushes for tubular-type brush holders, having a coil spring attached, shall have a length outside the spring of

Min 1/4 inch

Use scale.

(b) Brushes which cannot pass completely through the brush holder shall have a length of

Min 1/8 inch

between the brush holder and that portion of the brush which acts as a stop.

Gauge by sight.

(c) Brushes which can pass completely through the brush holder shall have a length of

Min 1/16 inch

between the commutator surface and pigtail or rivet and washer which holds the pigtail.

Gauge by sight.

Speed Regulator Brush

(d) The length of a speed regulator brush outside of the spring shall be

Min 5/16 inch

Use scale.

2.13 Brush Fit

(a) Brushes shall not bind in their holders, neither shall they be loose enough to cause poor commutation.

(b) The contact faces of the brushes shall be fitted to the commutator so as to insure successful commutation.

2.14 Brush Pressure

(a) For motors per KS-5006, the brush pressure per square inch of contact area shall be

Brush Material	Min	Max
Metal Carbon (CM5 & CM9)	3 lbs (1360g)	4-1/2 lbs (2040g)
Carbon or Graphite	1-1/2 lbs (680g)	2-1/2 lbs (1134g)

Use spring balance or tension gauge.

(b) For motors per KS-5296 and KS-5296-01, the brush pressure per square inch of contact area shall be

Frame	Min	Max
CD 75	3 lbs (1360g)	4-1/2 lbs (2040g)
CD 103 & CD 113	1-1/2 lbs (680g)	2-1/2 lbs (1134g)

Use spring balance.

(c) For motors per KS-5396, KS-5396-01, KS-5396-02, and KS-5397, the brush pressure per square inch of contact area shall be

Min 2 lbs (907g)
Max 3 lbs (1360g)

Use spring balance or tension gauge.

(d) Pressure on individual brushes shall be set at a value within the limits given in (a), (b), and (c) which will give the best commutation.

(e) Pressure of all brushes on the same motor shall be as nearly uniform as possible.

(f) There is no requirement for brush pressures on motors per KS-5419 which are equipped with tubular-type brush holders. However, the compression on the spring shall be sufficient to give successful commutation. Brush pressure is usually satisfactory if the brush spring extends 3/16 inch or more beyond the brush holder

tube when the brush cap is removed and the brush is resting against the commutator.

*2.15 Brush Alignment

(a) The brush holders shall be so located that the brushes do not overlap the end of the commutator (or groove) or ride upon that part of the commutator used for connection to the armature conductors, under any condition of normal operation.

Gauge by sight.

(b) When possible, brushes on two adjacent studs shall cover the same portion of the commutator and the brushes on the next two studs shall cover the space between the brushes on the first two studs.

(c) The leading edges of the brushes of any one stud shall line up parallel to the segments of the commutator.

Gauge by sight.

(d) The brush alignment of motors with tubular-type brush holders is not adjustable.

2.16 Brush Spacing

(a) The variation in the spacing of the brushes around the circumference of the commutator between adjacent brush arms shall not exceed 1/16 inch. If the motor commutates in a successful manner, it will not be necessary to check this requirement.

(b) The brush spacing of motors having tubular-type brush holders is not adjustable.

*2.17 Hunting: The motor shall not hunt.

*2.18 Regulator Starting Contacts

(a) The regulator starting contact surfaces shall be clean, parallel, and free from high spots.

Gauge by eye.

(b) The regulator starting contacts shall make good contact when the machine is at rest and open before the machine reaches operating speed.

2.19 Regulator Main Contacts

(a) The clearance between the regulator main contacts with the main lever arm resting against the shoulder of the collector ring shall be as close as practicable to, but not less than

Min 0.005 inch

Use feeler gauge.

(b) The regulator main contact surfaces shall be clean, parallel, and free from high spots.

Gauge by eye.

(c) The regulator main contacts shall function to maintain the speed of the associated motor within the required limits for the particular installation.

Use speed indicator.

2.20 Regulator Collector Rings

(a) The regulator collector rings shall be clean, free from scoring, pitting, or other deformation of the surface or structure, except that caused by normal wear.

(b) The eccentricity of the collector rings shall not be enough to cause sparking or poor operation of the motor.

Gauge by eye.

2.21 Temperature

(a) When in continuous operation within normal voltage and current limits, the temperature of any part of the motor as measured by feel shall not be excessive. If the fingers can be held on the bearing bracket, frame, or part under consideration, the motor temperature may be assumed to be within the specified limits.

*(b) If the temperature is thought to be excessive, measure by thermometer. The temperature of the various parts shall not exceed the following:

	Maximum
Bearings	80C (176F)
Windings and Frame	90C (194F)

To check the temperatures, proceed as follows with the motor running. Except for bearings having oil rings, hold the bulb of the thermometer against the bearing bracket, frame, or part under consideration. Cover the part of the bulb which is not in contact with a piece of felt or the equivalent. Observe the temperatures indicated. For bearings having oil rings, place the bulb of the thermometer in the lubricating oil of the bearing for at least 5 minutes, if the oil well opening is large enough to permit this, taking care that the thermometer does not strike the shaft or interfere with the proper operation of the oil ring. Observe the temperature indicated. This method is preferred but where the bearing construction makes this method impractical, the preceding method may be used.

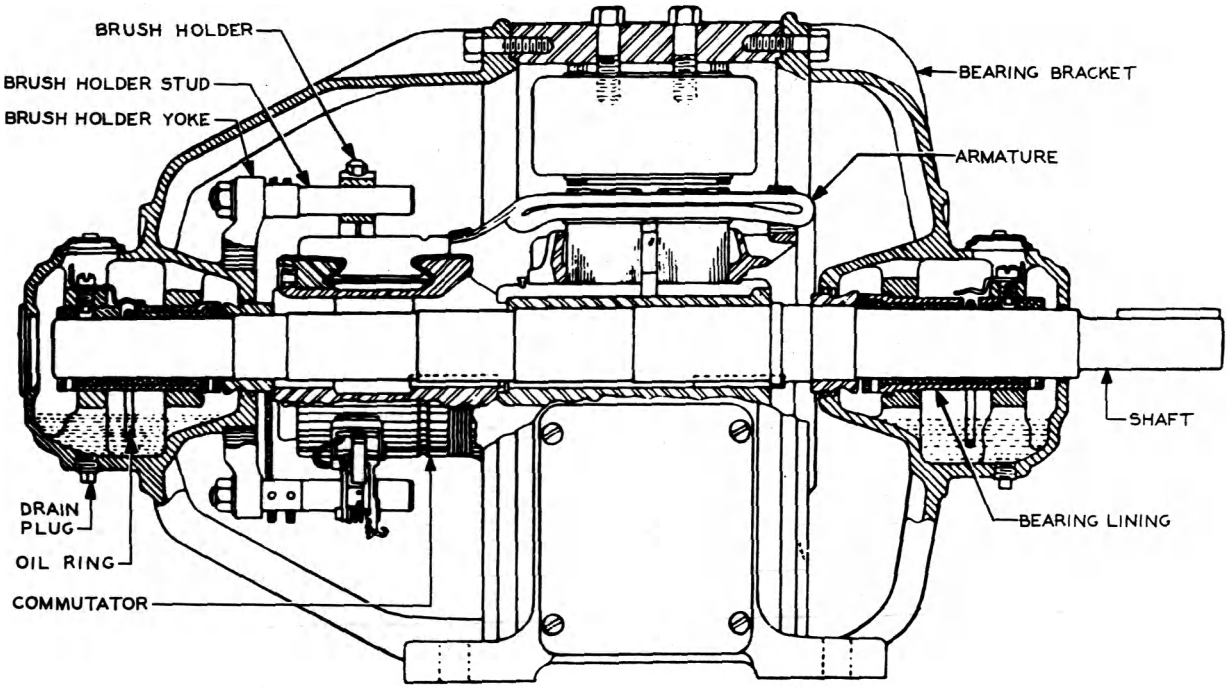


Fig. 1 - Sectional View of Motor With Oil Ring Type Bearings

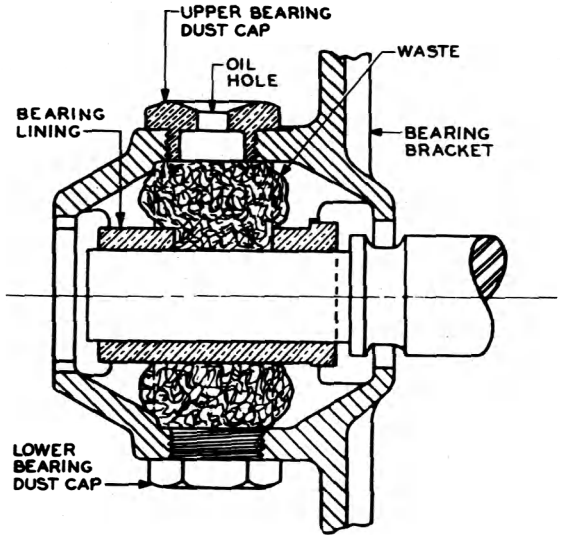


Fig. 2 - Waste-packed Bearing

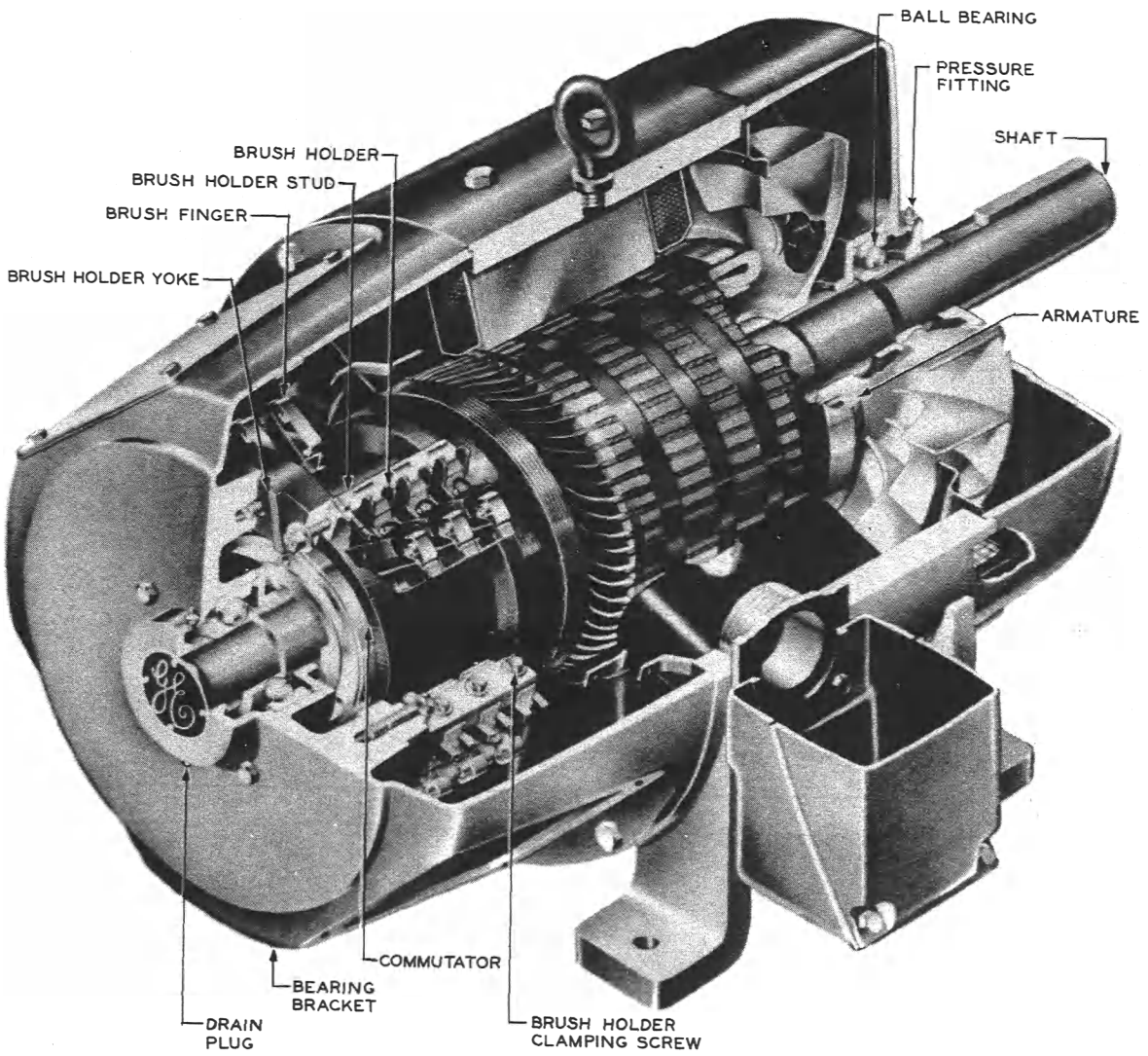


Fig. 3 - Sectional View of Motor With Ball Bearings

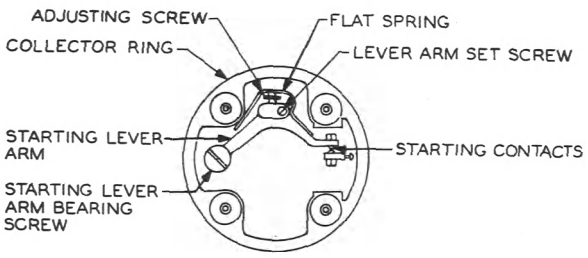


Fig. 4 - Speed Regulator Starting Contacts (Motor Side or Rear View)

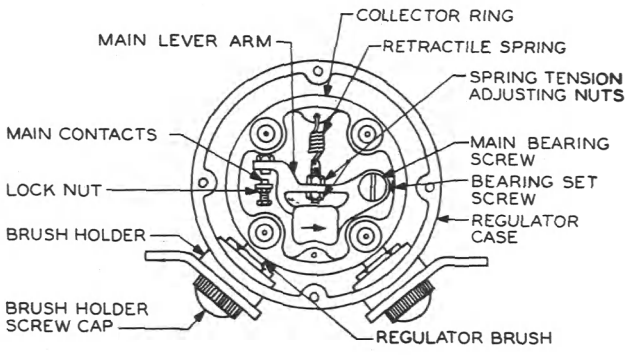


Fig. 5 - Speed Regulator Main Contacts (Front View)

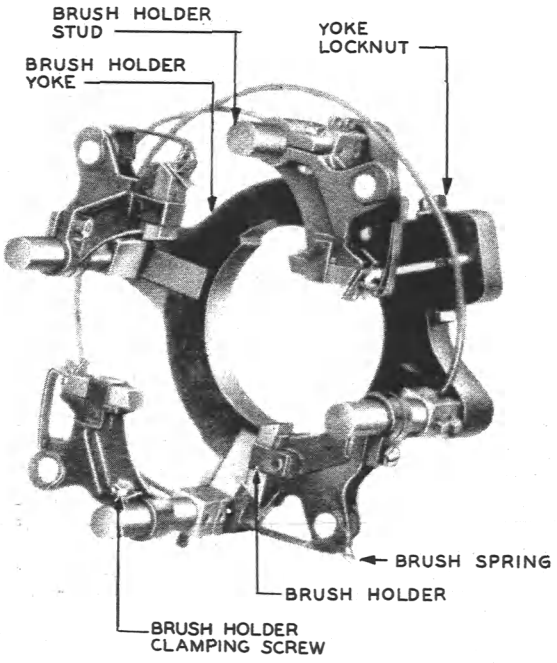


Fig. 6 - Brush Gear

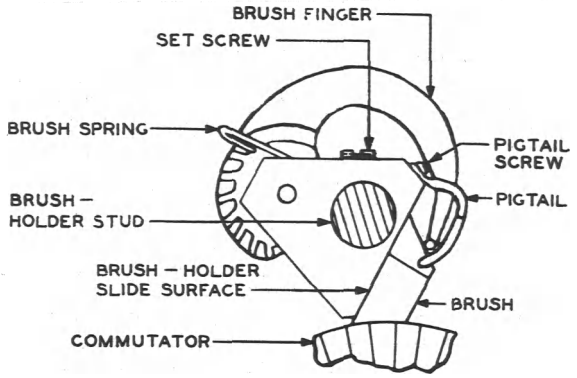
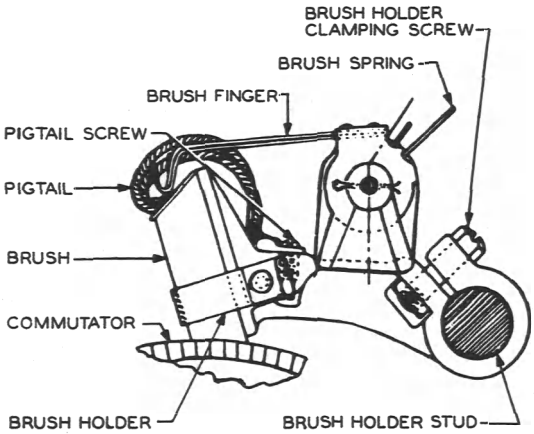


Fig. 7 - Baylis-type Brush Holder Assembly



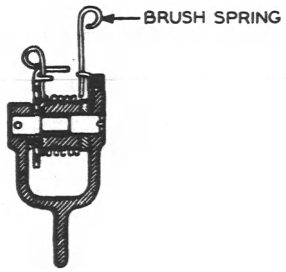


Fig. 8 - Brush Holder Assembly

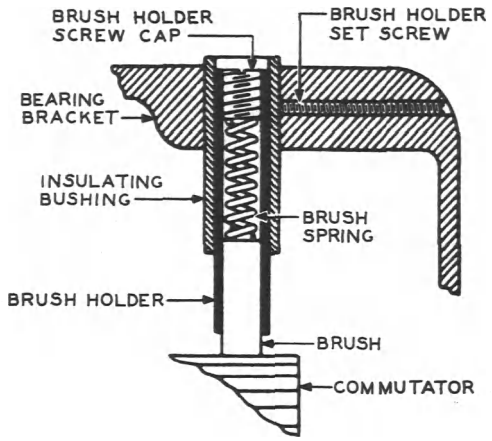


Fig. 9 - Tubular-type Brush Holder for Waste-packed Bearing Machines

3. ADJUSTING PROCEDURES

3.001 List of Tools, Gauges, and Materials

Code or Spec No.	Description
Tools	
246	1/2-inch Open Single-end Flat Wrench
247	1-1/4-inch Open Single-end Flat Wrench
KS-6320	Orange Stick
R-1255	31/32- and 1-1/16-inch Open Double-end Flat Wrench
R-1289	1-5/8-inch Open Single-end Flat Wrench
R-2512	8-inch Adjustable Wrench
-	13/32- and 19/32-inch Open Double-end Flat Wrench, J.H. Williams Co. No. 24
-	1-7/16- and 1-13/16-inch Open Double-end Flat Wrench, J.H. Williams Co. No. 42
-	Push-type Grease Gun Lincoln Engineering Co. No. 5958
-	5-inch Regular Screwdriver
Gauges	
79B	Push-pull Tension Gauge, 0-1000 grams
KS-6909	Gauge (Feeler)
R-2771	Spring Balance, 6 lbs
R-8550	6-inch Steel Scale
R-1032, Detail 1	Thermometer
-	Speed Indicator, Jones 5B, Lyons Type A or equivalent
-	DC Voltmeter, Weston Model 931, Ranges 300-150-75-30
Materials	
KS-6824	Sealing Compound
KS-14666	Cleaning Cloth
-	Felt
-	Grease, 260-300P
-	1 qt Measure (Funnel Attached) or equivalent
-	Flushing Oil
-	Oil, 220-260 S 100
-	Pail, or Equivalent Receptacle for Waste Oil
-	Sandpaper, 4/0
-	Petroleum Spirits
-	Wool Yarn Waste
-	Wooden Wedges
-	Bare Copper Wire

3.002 When using petroleum spirits for cleaning purposes in the 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 (Rq 2.01)

Oil Ring Bearings

(1) To add oil to an oil ring bearing, pour a little oil slowly into the bearing chamber, start the motor, and then shut it down while watching the rise in the gauge. This process is to be repeated until the proper level is indicated in the oil gauge. If the oil does not rise in the gauge, it is an indication that the passage to the gauge or the vent in the top of a glass gauge is blocked and should be cleaned. A small bare copper wire will be found advantageous in cleaning the passage. A quart measure with funnel attached may be found convenient for adding the oil.

(2) To replace the oil in an oil ring bearing, remove the drain plug in the bottom of the bearing chamber and drain the old oil into a pail or other receptacle. Clean the drain plug and associated threads in the casting, coat the threads on the plug with sealing compound, and replace it. In removing or replacing the drain plug, be sure to use a wrench of the proper size so as not to damage the plug and do not turn the plug in too tightly as it may break the head off. The use of sealing compound should overcome the necessity of turning the plug in too tightly.

(3) If an oil ring is bent or damaged, it should be replaced. As this will involve dismantling the motor, consult with supervision for repair schedule.

(4) If an oil gauge leaks, the oil should be drained from the bearing chamber, into a pail or other receptacle, by removing the drain plug at the bottom of the bearing chamber. If the leak occurs at the point where the gauge is screwed into the motor casting, the gauge should be removed, the screw threads on the gauge and in the casting cleaned, the threads on the gauge coated with sealing compound, and the gauge replaced. After the gauge has been replaced, replace the drain plug under the procedure in (2) above and fill the bearing chamber to the proper level with lubricating oil.

(5) To flush a bearing chamber, drain out the old oil, replace the plug, fill the chamber with lubricating oil or flushing oil, and run the motor for several minutes. Stop the motor and when it has come to rest, allow the oil to drain out. After the oil and dirt have been removed, replace the drain plug under the procedure given in (2) above and fill the chamber with lubricating oil to the proper level.

Waste-packed Bearings

(6) Before oiling a waste-packed bearing of the type equipped with upper and lower dust caps, remove the caps, observe the condition of the waste at the lower cap opening, and test the waste through the upper cap opening by pressing down on the waste with an orange stick (or screwdriver). If oil appears on the orange stick and more than a few drops run out of the bearing, the lubrication has been excessive and the amount of oil should be reduced or the interval between oilings increased. If, on the other hand, the waste at the bottom of the bearing has little or no oil in it and the orange stick shows no oil, the lubrication has been less than adequate and the amount of oil should be increased or the interval between oilings shortened. Adequate lubrication will be indicated by oil showing on the orange stick and the waste at the bottom of the bearing appearing to be well saturated. If the bearing runs dry, the waste next to the shaft may glaze. Any glazed waste should be replaced.

Ball Bearings

(7) Where the ball-bearing housing is equipped with both a pressure fitting and a drain plug proceed as follows with the machine stopped.

(a) Wipe off the pressure fitting with a clean cloth to avoid forcing dirt into the bearing chamber, and place a pail under the drain hole to catch excess grease.

(b) Remove the drain plug and scoop out as much of the old grease from the drain hole as is possible to reach with an orange stick. This should remove old coagulated grease and permit pressure relief as the new grease is forced in.

(c) While pumping new grease into the pressure fitting, watch the drain hole and the shaft adjacent to the bearing housing carefully. Stop greasing when grease appears at the drain hole or if grease oozes out along the shaft before it appears at the drain hole. If grease does ooze along the shaft before it comes out of the drain hole, remove the pressure fitting to relieve the grease pressure. With a clean cloth wipe off any grease that may have oozed along the shaft.

Note: In any case, do not pump more than one full gun (approximately 5 ounces) into the bearing chamber even if grease does not appear at the drain hole or shaft.

(d) Start and run the motor until hot (this may take several hours). This will expand the grease and force the excess grease out of the drain hole (or pressure fitting hole if this fitting was removed). After the grease has expanded fully and stopped coming out, stop the motor and scoop out as much grease from the drain hole (or pressure fitting hole) as is possible to reach with an orange stick. Replace the drain plug (and pressure fitting if removed).

(8) To relubricate a ball bearing not equipped with a pressure fitting, or in a motor which has been in storage or not operated for 2 or more years, dismantle as required for access and proceed in accordance with (9) below.

(9) To relubricate a ball bearing in a motor which has been dismantled, remove all grease from the accessible side with a clean cloth and an orange stick. Apply a few drops of 220-260 S 100 oil and rotate the bearing a few times, if feasible, to assist the oil in working past the ball retainer. Apply fresh grease, filling the space between the ball rings. Fill the bearing chamber one third full of grease.

3.02 Motor Speed (Rq 2.02)

(1) Where the motor is equipped with a shaft-mounted speed regulator, which prevents access to the shaft, apply the

speed indicator to the shaft of the driven equipment. Where the motor drives a commercial ringing generator, remove the flat plate from the end of the mercury interrupter speed reduction unit, in order to expose the end of the shaft. With a pencil or equivalent, hold the bearing in the gear case in place against the end thrust and take the reading with a speed indicator. If no mercury interrupter is present, the end of the shaft will be accessible.

(2) If a frequency meter is available, the speed of a motor which is directly connected to an alternator or a ringing generator, can be determined from the output frequency of the driven machine. The frequency and speed are proportional and the following table should be used for reference.

KS-5396, KS-5396-01, KS-5396-02, and KS-5397

Cycles	RPM
18	1080
19	1140
20	1200
21	1260
22	1320

KS-5296 and KS-5296-01

Cycles	L1 & L4 RPM	L2,L3,L5, & L6 RPM
54	1620	1080
57	1710	1140
60	1800	1200
63	1890	1260
66	1980	1320

(3) The speed of a motor may also be obtained by the use of a Strobotac if one is available.

(4) If the motor speed is not within the required limits, check 3.19(3), the supply voltage to the motor, the condition of the brushes, the temperature, and test for freedom of rotation. If these conditions meet the requirements, and the motor speed is still outside the specified limits, the matter should be referred to the supervisor or the motor replaced.

3.03 Voltage (Rq 2.03)

(1) To determine the voltage, use may be made of the switchboard voltmeter if one is available. If not available, use a portable voltmeter. If the voltage is not within the proper limits, refer the matter to the supervisor.

3.04 Freedom of Rotating Parts (Rq 2.04)

(1) Examine the motor and driven equipment and remove any foreign objects which might interfere with rotation. Also check to see that all mounting bolts are firm and tighten if necessary. Check for brushes binding or for worn bearings and adjust or replace if necessary.

3.05 Airgap (Rq 2.05)

(1) With the armature in any position, measure the airgap between the armature and each pole face with a thickness gauge. Particular care should be taken in measuring the airgap between the armature and the pole face mounted in the lower half of the motor frame, as this is where the bearing wear will be most noticeable. Rotate the armature approximately a quarter of a turn and repeat the above. Checks should be made with the armature in at least four different positions.

(2) If the airgap is too small, new bearings should be installed, in which case the matter should be referred to the supervisor.

3.06 End Play (Rq 2.06)

(1) If there is too much end play, it may be necessary to replace the bearings. (See 3.07.)

3.07 Bearings (Rq 2.07)

(1) Replace any worn bearings. To do this, it will be necessary to dismantle the set in which case the matter should be referred to the supervisor.

3.08 Noise and Vibration (Rq 2.08)

(1) Where excessive noise and vibration are present, see that all holding down bolts and coupling bolts are drawn up firmly. If this does not clear the trouble, check the alignment of the set.

(2) If the noise and vibration continue to be excessive after the above adjustments have been made, the trouble may be caused by worn bearings. If this is found to be the case, the bearings should be replaced.

3.09 Commutator Surface (Rq 2.09)

(1) See Section 171-110-701 for commutator care and Section 171-110-801 for commutator resurfacing.

3.10 Commutation (Rq 2.10)

(1) If the commutation is not satisfactory, see that requirements 2.06, 2.09, 2.11 through 2.17, and 2.21 are met. With the above conditions met, the commutation should be satisfactory. (See Section 171-110-701.)

3.11 Brush Holders and Yokes (Rq 2.11)

(1) To adjust the clearance between the lower edge of a box-type brush holder and the commutator, where the brush holder yoke is not slotted, loosen the brush holder clamping screw and rotate the brush holder on its stud as required. After an adjustment, be sure the clamping screw is tightened firmly. If the brush holder yoke is slotted, proceed in accordance with (2) below, except that with box-type brush holders the brush angle is not so critical. After adjusting a brush holder, check the brush for fit and send in, if necessary, in accordance with 3.13.

(2) To adjust the distance between a Baylis-type brush holder and commutator, loosen the hexagonal nuts holding the brush stud in place in the brush holder yoke. Slide the stud in the slotted holes of the yoke as found necessary. Inasmuch as the brush angle is very critical, any adjustment of distance of the brush holder from the commutator should be made by sliding the brush stud up or down in the slots without turning the brush holders on the studs or the studs themselves. Check the angle after adjusting the clearance.

Note: Some motors equipped with Baylis-type brush holders have crank-type (offset) brush holder studs which are rotated to adjust the clearance between brush holder and commutator. Reset the angle after adjusting clearance and recheck the spacing. (See requirement 2.16)

(3) In adjusting the clearance, it is desirable to work toward the minimum limit. Where the commutator is worn to such an extent that the clearance, with all possible adjustment made, exceeds the maximum limit, the armature should be replaced. However, if the commutation is satisfactory and the brushes do not chatter or are not forced off the brush holder slide surface, no harm will come if the maximum limit is exceeded slightly. Brush pressures should not be exceeded however, in an endeavor to overcome the brushes jumping off their slide surfaces or to stop their chattering.

(4) To set a Baylis-type brush holder at the correct angle, cut a guide template as described below. Reproduce Fig. 10 on a piece of stiff cardboard, making the radius of the arc equal to the radius of the commutator. The radius is one half of the diameter, which may be obtained by measurement. Draw a radius and where it crosses the arc (point A) draw a line AC at a right angle to it. This will be tangent to the arc. From point A measure 2 inches along this line and draw another line BD at a right angle. Measure along this line 3-1/2 inches from line AC and mark the point B. Draw the line AB. This line will be at an angle of 60 degrees to the tangent. Draw another line EF parallel to, and to the left of, the line AB, at a distance from it equal to one half the thickness of the brush. Cut the template as shown, first loosen the setscrew which holds the brush holder to its stud, place the template against the commutator surface and the slide surface of the brush holder, rotating the holder to obtain the required angle. Tighten the setscrew firmly.

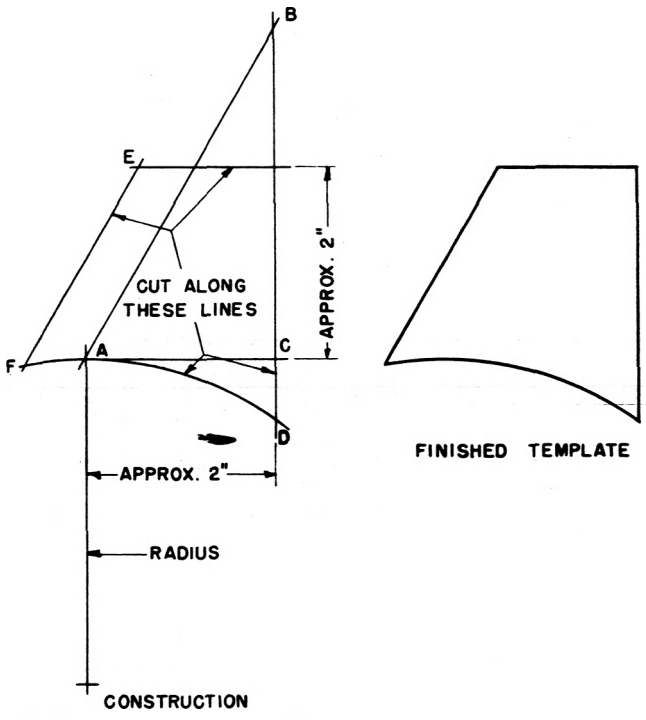


Fig. 10 - Template for Setting Baylis-type Brush Holder

(5) To adjust the clearance between a speed-regulator brush holder and the collector ring, remove the brush holder caps, withdrawing the spring and brush in each case. See that the brushes are marked so that they can be replaced in the same holders they occupied before removal. Mark and remove the regulator leads and remove the speed regulator housing from the frame. Unscrew the locknut which holds the brush holder in place and remove the insulating washers from the outside of the housing. Place sufficient insulating washers on the brush holder to meet the requirement. Be sure to have at least one insulating washer on the outside of the housing under the locknut. Replace the brush holder in the housing. Check the brush for fit and sand in, if necessary, in accordance with Section 171-110-701.

(6) To adjust a brush holder yoke (see note), loosen the locknut or clamping screws, shift the yoke as necessary, and retighten. If the yoke is held in position on the housing by a setscrew or dowel, this locking device should be loosened before shifting the yoke position and then tightened firmly at the close of the adjustment.

Note: The factory marking for the setting of the brush holder yoke will usually give the best commutation over the complete load range and this setting should be changed only as a last recourse.

(7) Solderless connectors may eventually loosen, because of the conductor contracting and expanding with temperature variations and vibrations. With the motor shutdown, periodically tighten the connector until no further take-up is obtained. If this fails to clear the trouble, it may be necessary to remove the bearing bracket of some types of motors in order to obtain easy access to the connector. Before removing the bearing bracket, it will be necessary to support the armature by inserting wooden wedges between it and each of the lower main field poles. These wedges should be of hard wood and should be approximately 0.2 inch thick at the thick end and 1/2 inch or more wide, and of convenient length. Insert a wedge at the edge of the pole, parallel to the shaft, and move it toward the center until it fits snugly.

3.12 Brush Length (Rq 2.12)

(1) Replace any short brushes.

3.13 Brush Fit (Rq 2.13)

(1) **See Section 171-110-701.**

3.14 Brush Pressure (Rq 2.14)

(1) The brush pressure may be determined by looping a piece of cord under the brush finger as near the point where it touches the brush as possible. Exert a radial pull on this finger by means of the push-pull tension gauge hooked into a looped cord. The reading of the gauge, just as the finger starts to move away from the brush, gives the total brush pressure. When the No. 79B push-pull tension gauge is used, this must be corrected to take into account the fact that the gauge is calibrated for use in a horizontal position only, and when in any other position, allowance must be made for the weight of the movable plunger.

(2) The following table gives the total brush pressures (contact area times pressure per square inch) in accordance with the requirements of 2.14. It applies to KS-5006 motors in frames CD55 and CD65 having metal carbon brushes such as grade CM5 and CM9, and to motors per KS-5296, KS-5296-01, KS-5396, KS-5396-01, KS-5396-02, and KS-5397.

Note: On KS-5006 motors, if the brush grade is not specified on the brush, it may usually be determined from the existing brush pressure. If the pressure is approximately one half of that shown below, the brushes are probably carbon or graphite.

Frame	Min	Max
CD 55	14 oz (400g)	1 lb, 4 oz (570g)
CD 65	1 lb, 0 oz (450g)	1 lb, 8 oz (680g)
CD 75	2 lb, 13 oz (1280g)	4 lb, 4 oz (1920g)
CD 103	1 lb, 14 oz (850g)	3 lb, 2 oz (1420g)
CD 113	2 lb, 2 oz (960g)	3 lb, 8 oz (1600g)
B 254	1 lb, 7 oz (650g)	2 lb, 2 oz (960g)
B 284	1 lb, 7 oz (650g)	2 lb, 2 oz (960g)

Note: For motors having requirements not exceeding 1000 grams, use the No. 79B tension gauge in preference to the spring balance.

(3) The pressure may be adjusted by increasing or decreasing the tension of the brush spring.

(4) On small motors having the brushes and brush-coil springs in tubular holders beneath screw caps, it is impractical to measure the brush pressure. In the latter instance, the brush-coil spring should be stretched, if required, to increase spring pressure. Usually a shortened spring is the result of a twisted pigtail and the desired spring extension may be obtained by untwisting the copper pigtail and the spring will then follow up and give the desired length in the brush holder.

3.15 Brush Alignment (Rq 2.15)

(1) To realign a brush, loosen the clamping screw and shift the brush holder along the brush holder stud. Tighten the clamping screw. After changing the position of a brush holder, check to see that the brush holder has the proper clearance from the commutator and the brush fits properly. Check a Baylis-type brush holder for angle as well as clearance.

(2) To align brushes parallel to the commutator segments, either align the stud in the yoke or rotate, slightly, the

holders around the stud, as required. In any case, see that other requirements continue to be met.

3.16 Brush Spacing (Rq 2.16)

(1) To check the spacing of the brushes, place a piece of paper around the commutator and mark the points where the toes of the brushes make contact with the paper. Remove the paper from the commutator and measure the distance between the marks.

(2) To adjust the brush spacing, loosen the brush holder clamping screw and turn the brush holder on its stud. Tighten the brush holder clamping screw.

Note: On motors with waste-packed bearings and the larger type equipped with the Textolite brush holder yoke, no further adjustment of the brush spacing is possible.

If this does not give the correct spacing, loosen the brush holder stud nut holding the brush holder stud in the brush holder yoke and raise or lower the brush holder stud, as required. Tighten the brush holder stud, readjust the brush holder in accordance with requirement 2.11, and refit the brushes in accordance with Section 171-110-701.

3.17 Hunting (Rq 2.17)

(1) If the motor tends to hunt, check the contact clearance specified in requirement 2.19. Check the brush setting on the motor and see that the commutator is in good condition with no excessive sparking at the brushes. See that the collector rings on the regulator are clean, that the brushes are not stuck in their holders and are making good contact, and that the main lever arm is working freely.

Note: On 2-motor ringing sets, when the load transfers from the ac motor to the dc motor, there will be a momentary increase of speed. The speed will immediately fall off and should not be confused with hunting which may be experienced periodically or continually.

3.18 Regulator Starting Contacts (Rq 2.18)

(1) If necessary, the contacts should be smoothed with No. 4/0 sandpaper and then wiped with a clean cloth to remove all particles of dust or dirt.

(2) To check the speed at which the starting contacts open, disconnect the leads from the regulator brushes, connecting them together to short-circuit the field rheostat, and connect a buzzer test set or equivalent to these brushes. The buzzer will operate to indicate good contact of the starting contacts. Start the motor in the usual manner. As its speed increases, the buzzer should cease to operate before the motor comes to its final speed. Stop the motor. Be sure that the lever arm moves freely on its bearing screw before attempting to make any adjustments. To adjust the speed at which the starting contacts open, loosen the setscrew in the lever arm and turn the associated adjusting screw out to increase or in to decrease the tension of the flat spring, which in turn increases or decreases the speed at which the contacts will open. Tighten the setscrew and retest, repeating this procedure until the adjustment is satisfactory. Disconnect the buzzer test set and reconnect the original leads.

3.19 Regulator Main Contacts (Rq 2.19)

(1) To adjust the regulator main contacts, remove the cover which is secured to the regulator case. Loosen the locknut and screw the contact, which is adjustable, in or out, as necessary, until the specified clearance is obtained. Tighten the locknut and again check the clearance.

(2) If necessary, the regulator main contacts should be smoothed with No. 4/0 sandpaper and then wiped with a clean cloth to remove all particles of dust or dirt.

(3) Be sure that the lever arm moves freely on its bearing screw before attempting to make any adjustments to the retractile spring which controls the main lever arm. To adjust the motor speed, adjust the tension of the retractile spring by means of the spring tension adjusting nuts. The speed at which the motor operates is increased by increasing the tension of the spring. The spring tension adjusting nuts should be tightened after each adjustment. Remount the cover on the regulator case.

3.20 Regulator Collector Rings (Rq 2.20)

(1) The collector rings may be cleaned by removing the regulator brushes and the regulator housing or coverplate and wiping the surface of the rings with a clean, hard, nonlinting cloth moistened with petroleum spirits, when the machine is stopped. If the surfaces show scratches or roughness, the collector rings should be smoothed with No. 4/0 sandpaper. If the surfaces are very rough or if the eccentricity is sufficient to cause poor electrical contact, the collector ring assembly should be removed from the shaft and the rings refaced in a lathe. To remove the collector ring assembly, mark and remove the leads and brushes. Remove the regulator case which is secured to the regulator plate. Then remove the regulator which is screwed into the end of the motor shaft. Reassemble in the reverse order from taking down.

3.21 Temperature (Rq 2.21)

(1) If the temperature exceeds the specified limits, see that requirements 2.02 through 2.07 and 2.09 through 2.16 are met. If these requirements are met and the temperature is still outside the specified limits, refer the matter to the supervisor as the motor may have to be replaced.

REASONS FOR REISSUE

1. To add the following sets (1.01): KS-5296-01, KS-5396-01, KS-5396-02, and KS-5397.
2. To revise the requirements for brush pressure [2.14(c)].
3. To revise Fig. 1, 4, 5, 8, and 9, omit old Fig. 10, and add Fig. 3, 7, and 10.
4. To revise the list of tools, gauges, and materials (3.001).
5. To add information regarding the use of petroleum spirits (3.002).
6. To revise numerous procedures.