

ONE-HALF AMPERE RINGING MACHINES  
KS-5133 AND KS-5133-01  
REQUIREMENTS AND ADJUSTMENT PROCEDURES

1. GENERAL

1.01 This section covers the 1/2-ampere ringing machines per KS-5133 and KS-5133-01 with associated transformers and interrupters. The KS-5133 machine has oil ring type bearings, and the speed regulator on the d-c machine is outboard mounted. The KS-5133-01 machine has wool-packed bearings, arranged for the admission of oil through a hole in the cover plate, with an overflow below the shaft, or in earlier models, provided with a combined oil-cup and gauge on each bearing, located below the shaft. The speed regulator on the d-c machine is mounted in the coupling. The a-c machines are not equipped with speed regulators.

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 Require-

ments 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 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 or collector rings are burned or injured to the extent that abnormal maintenance is required. The presence of some visible sparking is not necessarily evidence of unsuccessful commutation.

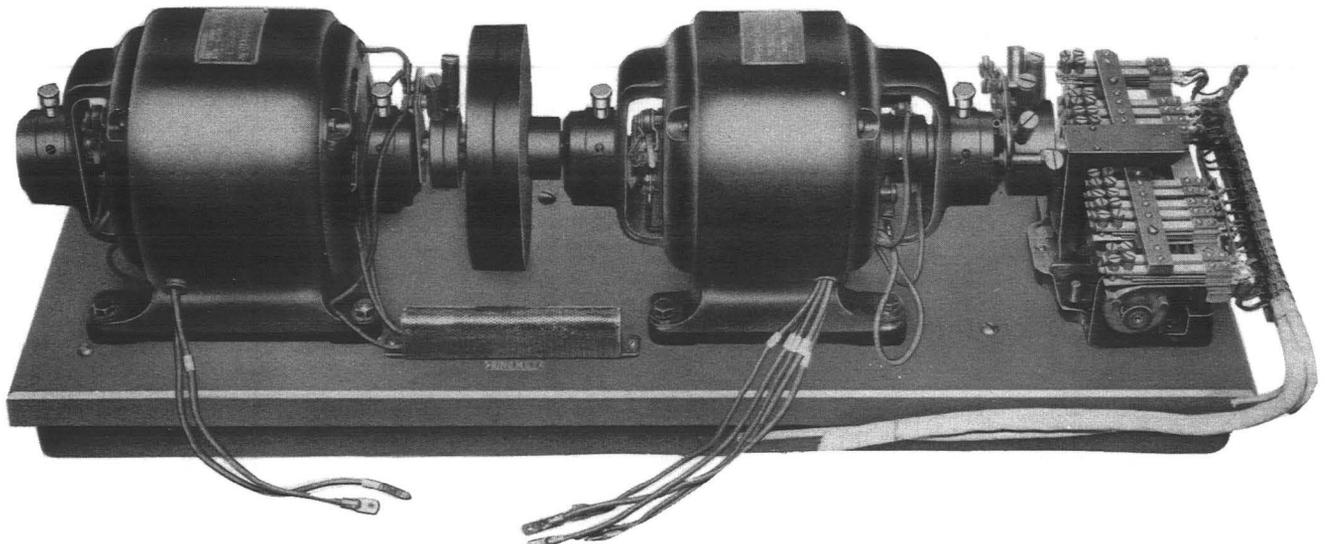


Fig. 1 - KS-5133-01 D-c Motor-driven Machine

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1.07 When making adjustments of such nature that the sudden starting of the d-c machine by automatic transfer might cause injury to the person or equipment, the d-c fuse should be removed. When so removed, it should be replaced as promptly as feasible in order that the machine may be available to take up the load in the case of an a-c power failure.

Caution: Automatic start. Remove supply fuse of d-c motor.

### 2. REQUIREMENTS

#### 2.01 Lubrication

(a) The bearings shall be adequately lubricated with oil, 130-190 S 100 except as otherwise noted.

##### 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 1/4 and 1/2 full. Gauge by sight.

#(d) The oil shall be replaced with fresh oil every two years.

(e) If it is thought that dirt has entered the bearing, it shall be flushed with regular lubricating oil and the bearing relubricated.

(f) Oil gauges and drain plugs shall be free from leaks.

##### Wool-packed Bearings

(g) A bearing having an oil-cup gauge shall have oil added at the gauge, every three months, in such quantity as to insure there being a trace left in the gauge at the time of the next oiling. However, at no time shall the gauge be more than 1/3 full. Gauge by sight.

Note: In cases where difficulty is experienced with the leakage of oil along the shaft of an old machine, the use of 50-55 S 210 oil is recommended.

(h) A bearing having an overflow hole below the shaft, with an oiler or oil hole above, shall have oil added at the top, every three months, in sufficient quantity to give a trace of oil from the overflow before the next oiling.

##### Low-Speed Interrupter

(i) The shaft bearings of the insulated cam type low-speed interrupter shall be lubricated with a drop of oil every two weeks unless local experience indicates otherwise.

#(j) The shaft bearings of the metal cam type low-speed interrupter shall be repacked with 260-300P grease after every five years of service, at such

times as the machine is being overhauled and after one or more years of storage.

(k) The worm and wheel shall be lubricated with Lubriplate No. 107 at installation and every four to six weeks thereafter until local experience indicates that another interval will be satisfactory.

(l) Metal spring operating rollers shall be lubricated with one drop of oil at each end every two weeks, unless experience indicates otherwise.

(m) The composition spring-operating rollers of the low-speed interrupter shall not be lubricated.

\*#2.02 Speed: The speed of the machine under all operating conditions of temperature, voltage, frequency (if a-c), and load, no load to full load, as stamped on the nameplate, shall be:

Min. - 1100 rpm  
Max. - 1200 rpm

Use speed indicator or other available instrument.

\*#2.03 The starting switch in the a-c motor shall function satisfactorily to start the machine. (Only the later machines have the switch. The early models have brushes.)

2.04 Freedom of Rotating Parts: All shafts shall rotate freely in their bearings but shall not be loose enough to cause objectionable noise or to permit the armature and field laminations to touch.

\*#2.05 The worm wheel and worm shall operate quietly without binding, wear, or excessive looseness.

\*#2.06 End Play: The armature shall run freely under all conditions of load, from no load to full load, but the end play shall not be enough to permit the brushes to over-ride the collector rings or the ends of the commutators.

#2.07 The bearing linings shall be free from excessive wear. If the set operates satisfactorily under all conditions of load, and with requirements 2.04, 2.05, 2.06, 2.08, and 2.18 met, the bearings shall be considered to be in a satisfactory condition.

2.08 The noise and vibration of the machine under any normal operating conditions shall not be excessive at any load from no load to full load. Gauge by sound and feel.

\*#2.09 Commutating Surfaces

(a) The surfaces of the commutator and collector rings shall be clean and

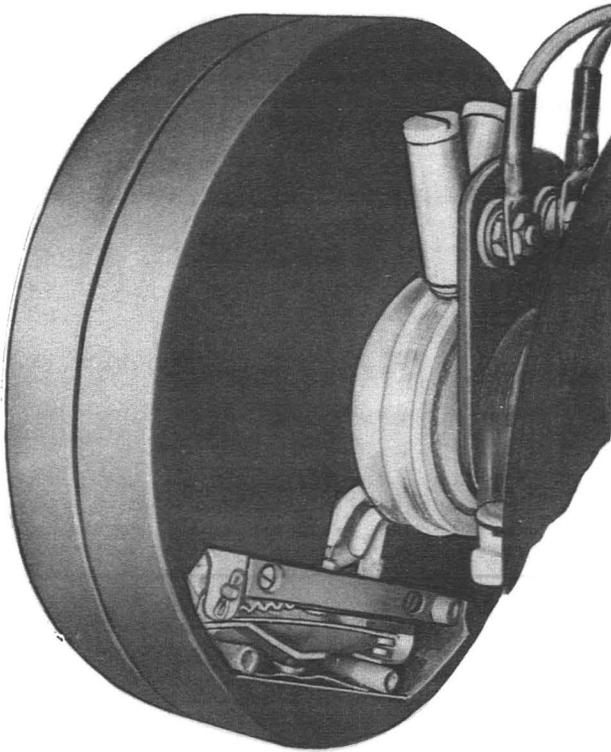


Fig. 2 - KS-5133-01 Speed Regulator

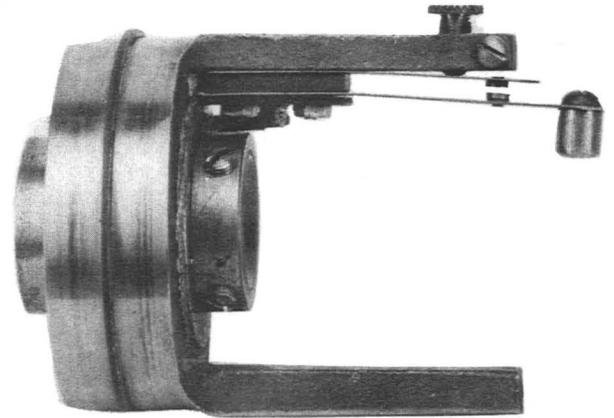


Fig. 3 - KS-5133 Speed Regulator

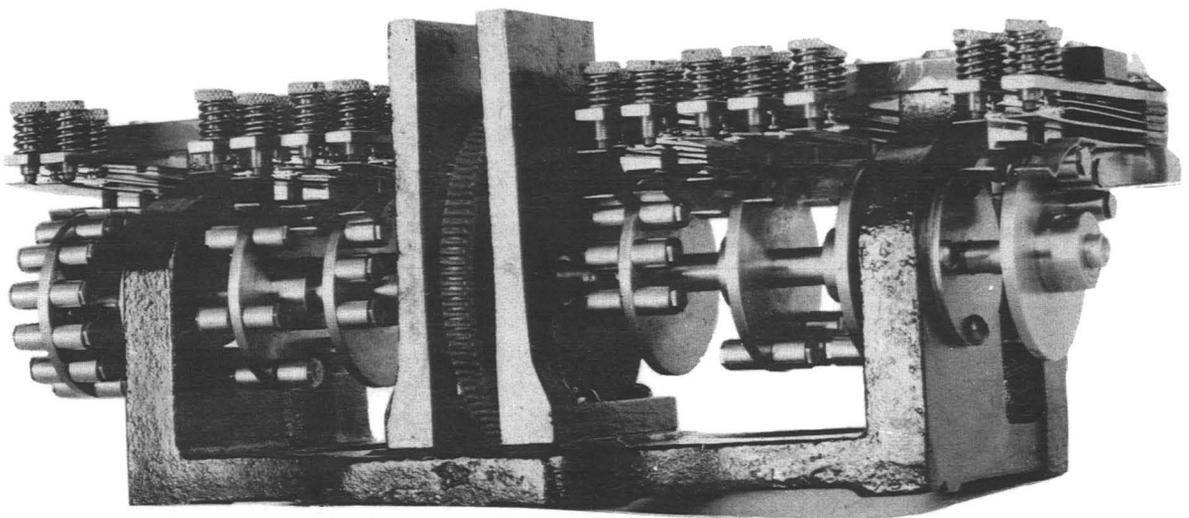


Fig. 4 - Low-speed Interrupter (Metal Cam Type)

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free from scoring, pitting, or other deformation of the surface or structure, excepting that caused by normal wear. Gauge by eye or feel.

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

	*At Turnover Min. Inches	#During Life Min. Inches
A-c motor	15/16	3/8
D-c motor	1-3/16	3/8
Generator (commutator)	1-3/16	3/8
Generator (coll.rings)	5/8	1/4
High speed interrupter	5/8	3/8
Speed regulator	5/8	1/4

Note: Later models of the a-c motor do not have brushes.

#2.10 Commutation: Without altering the position of the brushes, the motor shall commute successfully at any load between no load and full load, at any normal voltage, and with the machine at any temperature within the limits specified in requirement 2.18. Gauge by eye.

\*#2.1. Brush Holders

Note: The d-c brush holders of these machines are not adjustable for clearance.

(a) The a-c brush holders of the generator and the brush holders of the speed regulator of the KS-5133 machine shall have a clearance of approximately 1/16 inch from the associated collector ring. Gauge by eye.

(b) The a-c brush holders of the generator of the KS-5133-01 machine shall have a clearance of approximately 1/16 inch from the associated collector ring. Gauge by eye.

Note: The speed regulator brush holders of this machine are not adjustable for clearance.

(c) The brush holders of the high-speed interrupters of all machines and of the speed regulator of the KS-5133-01 machine shall be aligned radially to the drum, that is, the center line of the holder, if extended, shall pass through the axis of the shaft. Gauge by eye.

\*#2.12 Brush-holder yokes associated with d-c commutators shall be set so as to give successful commutation. The yoke associated with the generator a-c brushes shall be set as required to give satisfactory audible ringing.

#2.13 Brush Length

(a) Brushes shall have the following lengths, measured over-all, except that brushes used in tubular type holders shall be measured up to the shoulder where the spring is attached. Use scale.

#2.14 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 or collector ring so as to insure successful commutation. At least 1/2 of the area of the face shall be in contact with the commutator or collector ring. Gauge by eye.

Note: Requirement (b) does not apply to the brushes on the early model a-c motor.

\*#2.15 Brush Pressure: The brush pressure shall be sufficient to insure successful commutation.

\*#2.16 Speed Regulator Contacts

(a) The speed regulator contacts shall be clean, parallel, and free from build-ups.

(b) The regulator contacts shall be adjusted to maintain the speed of the machine within the required limits.

\*#2.17 Low-speed Interrupter

(a) The end play of the shaft of the insulated cam type, low-speed interrupter shall be: Minimum 1/64 inch. Gauge by eye.

(b) The rollers shall turn freely under the pressure of the springs as they ride under them. For lubrication of rollers see requirement 2.01.

(c) The contacts shall be clean and smooth, and the sequence of operation shall be as shown in the following charts.

\*#2.18 Temperature

(a) When in continuous operation within normal voltage and current limits, the temperature of any part of the machine, as measured by feel, shall not be excessive. If the fingers can be

ITEM #1 - FOUR PARTY SUPERIMPOSED MACHINE RINGING - MANUAL AND STEP-BY-STEP OFFICES

Spring Assemblies		Revolutions of Motor Shaft						
		20	40	60	80	100	120	
1	Upper	40(+0-4)						Ringing
	Lower				80(+0-4)			Trip.Batt.
2	Upper	40(+0-4)						Ringing
	Lower				80(+0-4)			Trip.Batt.
3	Upper			40(+0-4)				Pick-up
	Lower					80(+0-4)		Alarm
4	Upper			40(+0-4)				Ringing
	Lower					80(+0-4)		Trip.Batt.
5	Upper			40(+0-4)				Ringing
	Lower					80(+0-4)		Trip.Batt.
6	Upper					40(+0-4)		Pick-up
	Lower		80(+0-4)					Alarm
7	Upper					40(+0-4)		Ringing
	Lower		80(+0-4)					Trip.Batt.
8	Upper					40(+0-4)		Ringing
	Lower		80(+0-4)					Trip.Batt.
9	Upper	40(+0-4)						Pick-up
	Lower				80(+0-4)			Alarm
10	Upper	Double Decked Springs 10 and 11 Close						60 I.P.M.
	Lower	10(±1) and Open 10(±1) Revolutions						60 I.P.M.
11	Upper	10(±1) and Open 10(±1) Revolutions						60 I.P.M.
	Lower							60 I.P.M.
12	Upper	Double Decked Springs 12 and 13 Close						120 I.P.M.
	Lower	5(±1) and Open 5(±1) Revolutions						120 I.P.M.
13	Upper	5(±1) and Open 5(±1) Revolutions						120 I.P.M.
	Lower							120 I.P.M.

ITEM #2 - FOUR PARTY SEMI-SELECTIVE MACHINE RINGING - MANUAL OFFICES

Spring Assemblies		Revolutions of Motor Shaft						
		20	40	60	80	100	120	
1	Upper	20(+0-4)		20(+0-4)				Ringing
	Lower		20(+0-4)			60(+0-4)		Trip.Batt.
2	Upper	40(+0-4)						Ringing
	Lower				80(+0-4)			Trip.Batt.
3	Upper			20(+0-4)				Pick-up
	Lower					100(+0-4)		Alarm
4	Upper		20(+0-4)		20(+0-4)			Ringing
	Lower	60(+0-4)			20(+0-4)			Trip.Batt.
5	Upper			40(+0-4)				Ringing
	Lower					80(+0-4)		Trip.Batt.
6	Upper					20(+0-4)		Pick-up
	Lower		100(+0-4)					Alarm
7	Upper	20(+0-4)			20(+0-4)			Ringing
	Lower		60(+0-4)				20(+0-4)	Trip.Batt.
8	Upper					40(+0-4)		Ringing
	Lower		80(+0-4)					Trip.Batt.
9	Upper	20(+0-4)						Pick-up
	Lower				100(+0-4)			Alarm
10	Upper	Double Decked Springs 10 and 11 Close						60 I.P.M.
	Lower	10(±1) and Open 10(±1) Revolutions						60 I.P.M.
11	Upper	10(±1) and Open 10(±1) Revolutions						60 I.P.M.
	Lower							60 I.P.M.
12	Upper	Double Decked Springs 12 and 13 Close						120 I.P.M.
	Lower	5(±1) and Open 5(±1) Revolutions						120 I.P.M.
13	Upper	5(±1) and Open 5(±1) Revolutions						120 I.P.M.
	Lower							120 I.P.M.

## ITEM #3 - FOUR PARTY SEMI-SELECTIVE MACHINE RINGING - STEP-BY-STEP OFFICES

Spring Assemblies		Revolutions of Motor Shaft						
		20	40	60	80	100	120	
1	Upper	20(+0-4)		20(+0-4)				Ringing
	Lower		20(+0-4)			60(+0-4)		Trip.Batt.
2	Upper	40(+0-4)						Ringing
	Lower				80(+0-4)			Trip.Batt.
3	Upper					60(+0-4)		Pick-up
	Lower		60(+0-4)					Alarm
4	Upper		20(+0-4)		20(+0-4)			Ringing
	Lower	60(+0-4)		20(+0-4)				Trip.Batt.
5	Upper			40(+0-4)				Ringing
	Lower					80(+0-4)		Trip.Batt.
6	Upper	60(+0-4)						Pick-up
	Lower			60(+0-4)				Alarm
7	Upper	20(+0-4)				20(+0-4)		Ringing
	Lower			60(+0-4)			20(+0-4)	Trip.Batt.
8	Upper					40(+0-4)		Ringing
	Lower		80(+0-4)					Trip.Batt.
9	Upper			60(+0-4)				Pick-up
	Lower					60(+0-4)		Alarm
10	Upper							60 I.P.M.
	Lower	Double Decked Springs 10 and 11 Close						60 I.P.M.
11	Upper	10(±1) and Open 10(±1) Revolutions						60 I.P.M.
	Lower							60 I.P.M.
12	Upper							120 I.P.M.
	Lower	Double Decked Springs 12 and 13 Close						120 I.P.M.
13	Upper	5(±1) and Open 5(±1) Revolutions						120 I.P.M.
	Lower							120 I.P.M.

## NOTES

- 120 revolutions of motor shaft is equivalent to 1 revolution of interrupter cam shaft.
- Timing based on 1200 R.P.M. for motor. White areas indicate the motor revolutions during which contacts are closed. For example Spring Assembly #1, Item #2, the upper contacts are closed during the first 20 revolutions of the motor shaft, the lower contacts then close for the next 20 revolutions of the motor shaft, the upper contacts close for the next 20 revolutions of the motor shaft, and the lower contacts close for the remaining 60 revolutions of the motor shaft.
- The periods during which upper and lower contacts of the same spring assembly remain closed shall not overlap and the intervals between these periods shall not exceed 4 revolutions of the motor shaft.
- The periods on separate spring assemblies which are shown as coincident in commencing shall commence within ± 2 revolutions of each other.

held on the bearing housing, frame, or part under consideration, the machine temperatures may be assumed to be within 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:

	<u>Maximum</u>
Bearings	80C (176F)
Windings and frame	90C (194F)
Transformer	95C (203F)

### 3. ADJUSTING PROCEDURE

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

##### Tools

Bellows, hand, 10"  
Brush, typewriter, toothbrush  
Burnisher, contact, 265C  
File, Pillar, 6" R1051  
Screwdriver, 3" cabinet  
Screwdriver, 4" regular  
Screwdriver, offset, No. 40 tool

##### Gauges

Buzzer test set, or flashlight equipped with KS-7742 bottom cap  
Indicator, speed, Jones 5B, Hasler, or equivalent  
Scale, steel, 6" R-8550  
Thermometer, R-1032, Detail 1

##### Materials

Cloth, cleaning, Twill Jean (D98063)  
Compound, sealing, KS-6824  
Felt  
Grease, 260-300P  
Grease, Fiske Lubriplate No. 107  
Oil 130-190 S 100  
Oil 50-55 S 210  
Pail  
Sandpaper, 4/0  
Spirits, petroleum

#### 3.01 Lubrication (Rq.2.01)

- (1) In lubricating a bearing having an oil cup gauge below the shaft, whether of the oil-ring or wool-packed type, add the oil slowly with the machine stopped to permit the oil to rise in the bearing chamber at the same rate as in the gauge.

##### Oil-ring Bearings

- (2) If an oil ring is bent or damaged, it should be replaced.  
(3) To replace the oil in a bearing, remove the drain plug in the

bottom of the bearing chamber and drain the old oil into a pail or other receptacle. Scrape the old sealing compound away from around the drain hole and clear all threads of particles which might interfere with obtaining a perfect seal. Wipe away all trace of oil, using petroleum spirits on a cloth. Allow it to evaporate before applying the sealing compound to the threads of the plug and the tapped hole. Replace the plug.

- (4) To flush a bearing chamber, stop the machine, remove the drain plug, drain out the old oil and replace the plug. Fill the bearing chamber with regular lubricating oil and bring the machine up to speed. Stop the machine and again drain out the oil. After the dripping has stopped, replace the drain plug as outlined in (3) and fill the bearing chamber to the proper level with fresh lubricating oil.

- (5) If an oil gauge leaks, the oil should be drained from the bearing chamber. If the leak occurs at the point where the gauge is screwed into the machine casting, the gauge should be removed, cleaned, and replaced under the procedure given in (3) above. Treat a leaking drain plug in a similar manner.

##### Wool-packed Bearings

- (6) In following requirement 2.01(g), it is suggested that ten drops of oil be added initially. During the following month, note whether the oil entirely disappears from the cup. If there is no trace of oil at the end of the month, the amount should be increased, and on the other hand, if oil remains in the cup, the amount to be added should be reduced. Avoid over-oiling.

- (7) If following requirement 2.01(g) results in excessive lubrication, to the extent that oil leads out of the bearings along the shaft, the machine may be modified by drilling a 3/16-inch hole in the center of the plate over the bearing for admitting the oil, and removing the oil gauge, letting its mounting hole serve as an overflow. The felt and canvas under the cover plate should be cut away from around the oil hole so that oil will be delivered to the waste and not to the felt. Since there is danger of wick action in the felt, the relative size of the holes through the felt and the canvas should be such that the canvas protects the felt from contact with the waste.

- (8) As an alternative to the above procedure, set up a local routine based

on experience with the particular machine, taking into account operating time and the tendency of the particular machine to leak around the shaft.

(9) To lubricate a wool-packed bearing having an overflow hole in the lower part of the bearing housing, add sufficient oil in the top of the bearing once a month so that a trace of oil will come from the overflow hole some time before the next monthly oiling. Any excess will probably appear within a day after oiling. Since the amount of oil necessary to accomplish this result varies with local conditions, such as the length of time a machine is in operation, temperature, etc., it is necessary to determine by experience the amount of lubricant required in each case. As a trial, it is suggested that about ten drops be added initially. During the following month, note whether oil comes from the overflow. If no oil appears, increase the amount at the next lubrication. If several drops come out, the amount may be decreased until only a drop or two shows.

#### Low-speed Interrupter

(10) To lubricate the shaft bearings of the insulated cam type, low-speed interrupter, apply the oil on the upper side of each bearing.

(11) To lubricate the shaft bearings of the metal cam type, low-speed interrupter, remove the two end cams from the low-speed interrupter shaft (one from each end) and the three cap screws which hold each bearing in place. Loosen the nut on the remaining screw, remove the bearing sideplate and the felt washer. Move the bearing container in and out on the shaft to separate the outer ball race from the ball-bearing container. Clean out the old grease with a brush wet with petroleum spirits and then wipe the parts with a dry cloth. Repack the bearing with ball-bearing grease and re-assemble in the reverse order.

(12) To clean and lubricate the worm and wheel at installation and as often thereafter as necessary, clean both worm and worm wheel with petroleum spirits and allow to dry. A clean, hard, nonlinting cloth may be used both in applying the petroleum spirits and in removing excess to speed up drying. A brush is also convenient to use when applying the petroleum spirits to the worm and in removing excess.

(13) At periodic relubrication as well as after cleaning, apply Lubriplate No. 107 grease to the worm over all the area where it meshes and to the teeth of the bronze wheel. The machine

should be disconnected from the supply and turned by hand. The fingers may be used when applying the grease, and after the machine has run for a few minutes, the oil dampened cloth may be used to remove excess grease.

(14) Apply a drop of oil to the top side, at each end, of each metal spring-operating roller; and turn the roller manually a few turns to allow the oil to work along the pin shaft. Use the oil sparingly on the metal rollers and wipe away any excess with a dry cloth.

#### \*#3.02 Speed (Rq.2.02)

(1) In taking readings of speed with a speed indicator, first wipe the end of the shaft, including the outer bore. Hold the indicator so that its shaft is, as nearly as possible, in line with the shaft of the machine and apply sufficient pressure to insure against slipping.

(2) If a frequency meter is available, the speed of the machine can be determined from the output frequency. Frequency and speed are proportional, and the following table should be used for reference.

<u>Cycles</u>	<u>RPM</u>
18	1080
19	1140
20	1200
21	1260
22	1320

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

(4) If the speed is not within the required limits, adjust the speed regulator contacts in accordance with procedure 3.16, check the supply voltage to the motor and the condition of its brushes and the temperature, and test for freedom of rotation. If these conditions meet the requirements and the speed is still outside the specified limits, the matter should be referred to the supervisor.

#### \*#3.03 Starting Switch on A-c Motor (Rq.2.03)

(1) If the machine fails to start or does not come up to speed, check the line voltage and if correct, examine the starting switch. This switch is mounted in the motor end shield and is designed to close and connect the starting winding when the machine is stopped. When voltage is applied, the machine should start and when nearly full speed is reached, the switch should open by centrifugal action and disconnect the starting winding. Failure to start, accompanied by a slight

hum, indicates that the starting switch contacts are stuck in the open position. Clean or replace defective parts as required.

### 3.04 Freedom of Rotating Parts (Rq.2.04)

- (1) Make sure that no foreign objects interfere with the operation of any rotating parts. Check the bearings, lubrication, etc., and correct as necessary.
- (2) Metal spring-operating rollers that are flat, or composition rollers that are oil soaked, should be replaced. If the composition rollers are sticking but have not been oiled, they should be removed and the pin cleaned with sandpaper and petroleum spirits. The pin should be allowed to dry before replacing the roller, as both petroleum spirits and oil are detrimental to composition rollers.

### \*#3.05 Worm Wheel and Worm (Rq.2.05)

- (1) To change the alignment of the worm wheel and worm on the insulated cam type, low-speed interrupter shaft, loosen the associated set screws and rotate the shaft bearing bushings until the worm wheel and the worm are fully meshed but do not "bottom", that is, the tips of the teeth on the worm-wheel do not strike or rub the bottom of the threads on the worm, or vice versa. The bearing bushing at each end of the shaft shall have approximately the same relative position in the frame. Tighten the set screws. Where it is impossible to adjust the clearances between the worm wheel and worm in this manner, the low-speed interrupter shall be taken down and new bearing bushings installed. Realign the worm wheel and worm. Firmly tighten the associated bearing set screws and make certain that the low-speed shaft rotates throughout several revolutions without binding.
- (2) On the metal cam type, low-speed interrupter, the interrupter shaft bearings are aligned at the factory and no adjustment is provided for changing the alignment of the worm wheel and worm. Replace any defective or worn parts if necessary.

### \*#3.06 End Play (Rq.2.06)

- (1) If there is too much end play, it will be necessary to replace the bearing linings. (See 3.07)

### #3.07 Bearings (Rq.2.07)

- (1) Replace any worn bearing linings. To do this, it will be necessary to dismantle the machine, in which

case the matter should be referred to the supervisor.

### 3.08 Noise and Vibration (Rq.2.08)

- (1) Where excessive noise or vibration is present, see that all bolts, nuts, and screws are tight. Check for loose or worn parts, including bearings, and replace parts as necessary. Check the alignment of the machine.

### \*#3.09 Commutating Surfaces (Rq.2.09)

- (1) A bronze colored, highly polished commutator is very desirable and it should not be mistaken for a burned commutator. If a commutator presents this condition, is smooth, and the commutation satisfactory, it should be left alone.
- (2) If oily, the commutator or collector rings should be cleaned by rubbing with a clean hard, nonlinting, cloth, moistened with petroleum spirits followed by a dry cloth. After being so cleaned, they may be polished, with the machine running, by the use of a commutator polisher such as shown below.

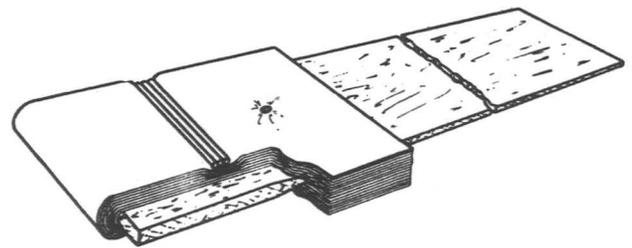


Fig. 5 - Typical Commutator Polisher

The polisher should be made up locally, and consists of a hardwood stick of the following approximate dimensions which should be varied as required to meet local conditions; length 15", width 1", thickness 3/16". It is covered at one end, for approximately 6" with several layers (6 or 8 are suggested) of hard woven canvas or duck (8 ounce), suitably secured. It is applied "end on" to the commutator or slip rings with heavy pressure to remove surface deposits and to produce a polish on the surface of the metal. When the outer layers of canvas become too dirty for effective use, they can be cut away successively, near the cord binding and removed.

- (3) If the commutator or collector rings show tarnished spots after cleaning and polishing, they should be sanded.

(4) Never allow a commutator or collector ring to become more than slightly rough before endeavoring to correct with fine sandpaper. If a commutator or ring becomes excessively rough or develops flat spots, 4/0 sandpaper, folded sanded side out on a wooden block shaped to fit the commutator surface, may be used for smoothing. Before smoothing, mark and remove the brushes.

(5) After smoothing the commutator or collector rings, the surfaces and coils shall be cleaned with air or wiped with a clean cloth, and the commutator or rings polished. In replacing the brushes, see that they are clean and put back in the same holders and in the same position in which they were originally.

(6) If loose, high, or low commutator segments appear on the commutator, or serious eccentricity appears on the commutator or rings, it will be necessary to remove the armature for repairs or replacement, in which case the matter should be referred to the supervisor. For turning and resurfacing information see Section 171-110-801.

#### #3.10 Commutation (Rq. 2.10)

(1) If the commutator is not satisfactory, see that requirements 2.09 and 2.11 to 2.16, inclusive, are met. With these conditions met, the commutation should be satisfactory.

(2) Slight visible sparking is not necessarily an indication of unsatisfactory commutation.

#### \*#3.11 Brush Holders (Rq.2.11)

(1) The clearance of a-c brush holders may be adjusted after loosening the clamping screws. After adjustment, be sure the clamping screws are tightened firmly.

(2) The clearance of the speed regulator brushes in the KS-5133 machines may be adjusted after loosening the set screws.

(3) If a brush holder is only slightly off alignment, this will usually not interfere with commutation, and re-adjustment would not be justified, since any change in the position of the holder necessitates refitting the brush. If the holder is realigned, tighten the securing nuts firmly and reseal the brush.

#### \*#3.12 Brush-holder Yoke (Rq.2.12)

(1) To adjust a brush-holder yoke, loosen the associated set or

clamping screws, shift the yoke, and tighten the screws. The factory marking will usually give the best results over the range of operation.

#### #3.13 Brush Length (Rq.2.13)

(1) Replace any short brushes.

#### #3.14 Brush Fit (Rq.2.14)

Note: When removing brushes, note their position in the holder and mark them, if necessary, to insure replacement in the same holder and in the same position in the holder.

(1) Replace any brushes that are too loose in their holders.

(2) If brushes bind, remove them from their holders and wipe them with a clean, dry cloth. If there are rough projections, the edges of the brush may be smoothed with abrasive cloth or sandpaper before wiping with a cloth.

(3) If the contact face of a brush requires fitting, cut a strip of sandpaper slightly wider than the width of the brush and at least as long as the circumference of the commutator or collector ring. Place the strip of sandpaper under the brush with the sanded side next to the brush and hold the sandpaper so that it will bear on approximately 180 degrees of the commutator or collector ring surface. Draw the sandpaper back and forth under the brush until the brush has the same curvature as the commutator or collector ring. The final cut should be made in the direction of rotation. After sanding, blow the dirt away and wipe with a dry cloth.

#### \*#3.15 Brush Pressure (Rq.2.15)

(1) Brushes in box type holders may be checked for pressure by partly withdrawing the brush and seeing that it returns to good contact with the commutator under the influence of its spring.

(2) Brushes in tubular type holders will, in general, have satisfactory pressure if the spring extends 3/16 inch or more beyond the brush holder when the brush-holder cap is removed and the brush is resting against the commutator or collector ring.

#### \*#3.16 Speed Regulator Contacts (Rq.2.16)

(1) Any necessary work on the contacts should be done before checking the speed. The contacts may be smoothed with a fine file and burnisher and then cleaned with air or wiped with a clean cloth.

(2) To adjust the speed on the KS-5133 machine, stop the machine, remove the regulator cover, and loosen the clamping screw. Should it be desired to raise the speed range, screw out the adjusting screw away from the shaft. To lower the speed range, screw in the adjusting screw toward the shaft. Move the adjusting screw in or out only a small amount, say 1/8 of a turn at a time, until the motor speed stays within the specified limits.

(3) To adjust the speed on a KS-8133-01 machine, stop it and turn the set screw located at the periphery of the coupling in or out a small amount at a time as required.

\*#3.17 Low-speed Interrupters (Rq.2.17)

(1) Where necessary, the end play of the low-speed shaft for the insulated cam type interrupter may be adjusted by loosening the associated set screws and shifting the eccentric bushings in or out of their frames, being careful not to alter the shaft alignment. Be sure to tighten the set screws after each adjustment. Where it is impossible to adjust the end play in the above manner, replacing bushings should be installed.

Note: For the metal cam type interrupter, the end play is automatically taken care of by a spring in one bearing container and is not adjustable.

(2) The contacts may be smoothed by using a contact burnisher and then wiping with a clean cloth. If the contacts are in bad condition, or if the contact springs are badly bent, they shall be replaced.

(3) The springs may be adjusted by turning the associated thumb screw in or out as necessary. This adjustment may be determined by using a buzzer test set, or equivalent, such as a tester's receiver or indicating lamp connected across the contacts, and then timing of the interval noted by counting the number of revolutions of the motor shaft while turning the

tone interrupter drum by hand. It is suggested that a pencil mark be made on the drum to facilitate counting the turns.

\*#3.18 Temperature (Rq.2.18)

(1) The temperature of oil ring bearings should be taken in one of two ways with the machine running. One method is to place the bulb of the thermometer in the lubricating oil of the bearing for at least five minutes, taking care that the thermometer does not strike the shaft or interfere with the proper operation of the oil ring in the bearing. This method is to be preferred. Where the bearing construction makes this method impracticable, the following method which may also be used for ball bearings and wool-packed bearings is recommended.

(2) Hold the bulb of the thermometer against the hottest spot on the outside of the bearing housing as near as possible to where the bearing is located, covering that part of the bulb which is not in contact with the housing by a piece of felt, or the equivalent, and observe the highest temperature indicated.

(3) If a wool-packed bearing heats excessively and the wool contains oil, check to see if the wool is glazed where it is in contact with the shaft. Glazed wool should be removed or replaced as necessary.

(4) The winding, frame, and transformer may be measured for temperature in a similar manner, but with the machine stopped if necessary for safety. If in any case the temperature exceeds the specified limits, see that requirements 2.02 to 2.07 and 2.09 to 2.15 are met. If these requirements are met and the temperature is still outside the specified limits, the matter should be referred to the supervisor, as replacement may be required.