VOLTAGE CONTROLLERS
KS-5016, KS-5117, KS-5374 AND KS-5519
REQUIREMENTS AND ADJUSTING PROCEDURES

1. GENERAL

1.01 This section covers KS-5016, KS-5117, KS-5374, and KS-5519 voltage controllers, which control the operation of motor-driven rheostats to automatically regulate the voltage of battery charging generators.

1.02 This section is reissued to revise Table A and the List of Tools, Gauges, and Materials, to add the information covering the later type KS-5519 voltage controllers, and in general to bring the section up to date. Detailed reasons for reissue will be found at the end of the section.

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

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

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 injured in normal service to the extent that abnormal maintenance is required. The presence of some visible sparking is not necessarily evidence of unsuccessful commutation.

1.07 ***Normal voltage*** as used in this section refers to the float voltage, at the point of regulation, and shall be the value specified for the particular installation.

1.08 ***Light contact,*** when used in this section, refers to such contact as will occur between rotating contact cams and the spring contacts when operated electrically in regular service. The contact cams need not flex the spring contacts appreciably but the contact shall be sufficient to cause the associated rheostat drive motor to start.

2. REQUIREMENTS

2.01 ***Lubrication***

(a) The wick oilers for the bearings of the commutator type cam drive motor shall be inspected annually and refilled with 310-330P grease if necessary. This interval may be extended if periodic inspections indicate that local conditions are such that the bearings will be adequately lubricated during the extended interval.

(b) The wick oilers and bearings shall be thoroughly cleaned and relubricated with 310-330P grease once every 3 years in service, after 1 or more years in storage, or at any time the drive motor is dismantled for other reasons.

(c) The cam drive gear case, on other than General Electric Telechron or Warren motors, shall be relubricated with fresh 310-330P grease once every 3 years in service, after 1 or more years in storage, or at any time the gear case is dismantled for other reasons.

(d) Any exposed gears not otherwise lubricated shall be cleaned and relubricated with a small amount of 310-330P grease annually. The grease shall be smeared on the gear surfaces with a KS-14666 cloth on the end of a KS-6320 orange stick, or with the fingers, and all excess grease shall be wiped off.

(e) The voltage control coil plunger, and its associated guide pin and balanced contact arm, shall not be lubricated.

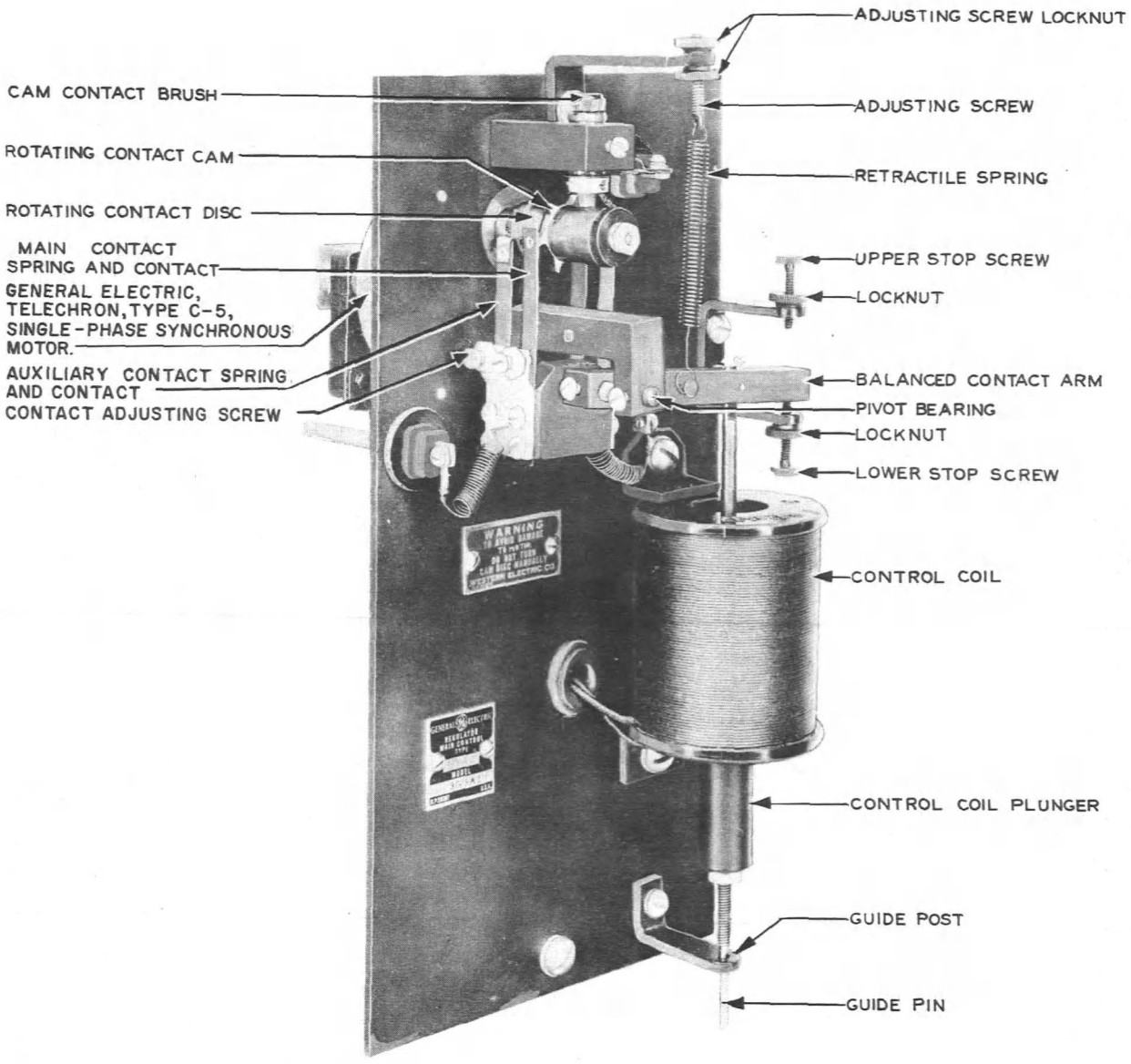

Fig. 1 – KS-5519 Voltage Controller (earlier type shown)

Voltage Relay and Contact Arm

2.02 ***Alignment***

(a) The pivot bearings shall be so adjusted horizontally that, with the contact arm in the horizontal position, the plunger attached to the arm shall hang vertically, and have its vertical axis concentric with the axis of its associated voltage coil.

Gauge by eye.

(b) With the lever arm in a horizontal position, the top of the control coil plunger shall be approximately 1/2 inch below the top of the spool flange of the magnet coil.

Gauge by eye.

2.03 ***Freedom of Contact Arm***

The contact arm shall operate freely in the pivot bearings.

Gauge by eye..

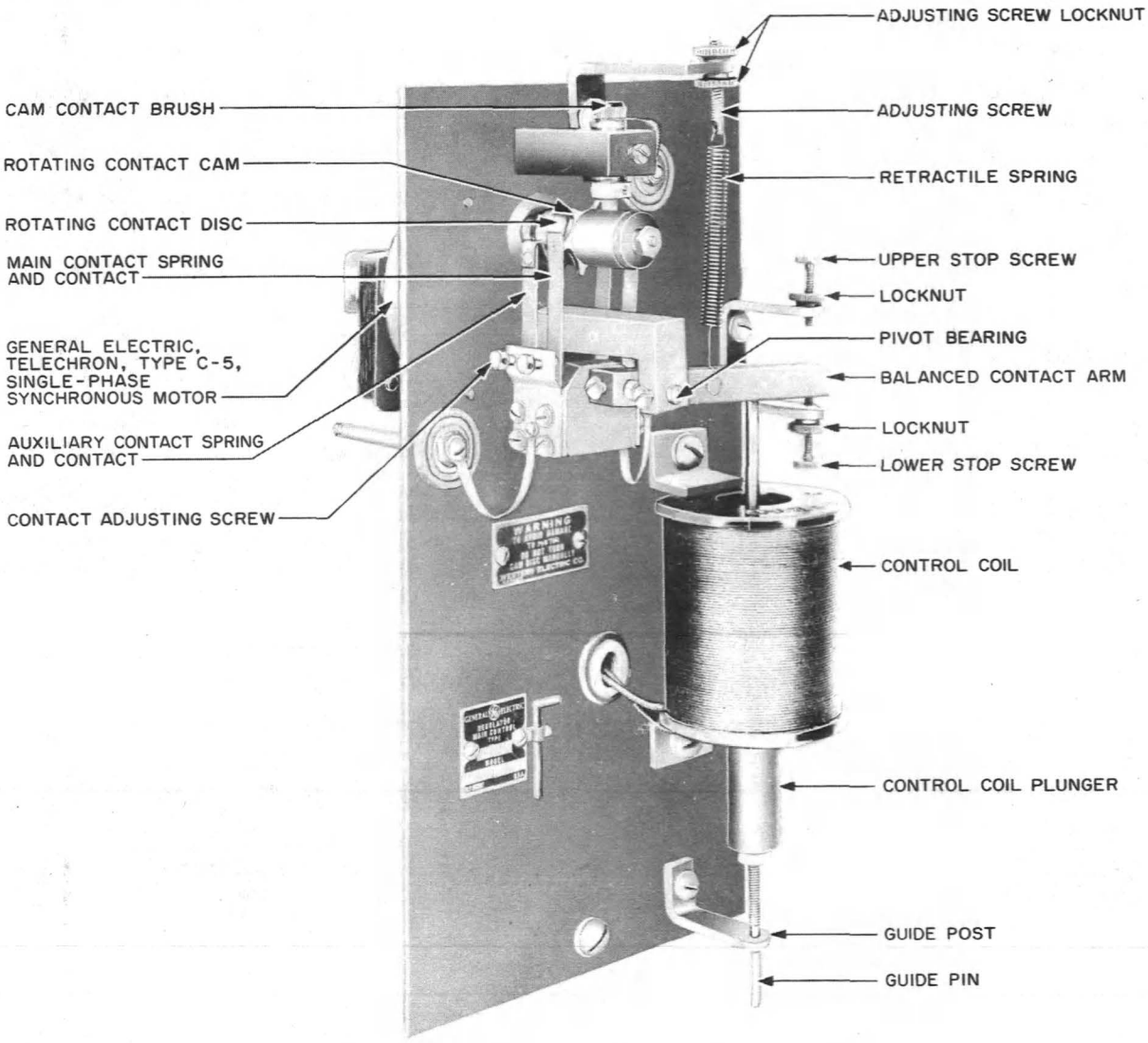

Fig. 2 – KS-5519 Voltage Controller (later type shown)

2.04 ***Freedom of Plunger***

(a) The plunger in the control coil shall not touch the coil spool, and its guide pin shall operate freely in its guide post.

Gauge by eye.

(b) Plungers with associated dashpots, installed in place of guide pins, may have their motion retarded slightly by the natural operation of the dashpot plunger.

2.05 ***Retractile Spring:*** The retractile spring for the contact arm shall not be bent or distorted appreciably.

Gauge by eye.

2.06 ***Straightness of Contact Springs:*** Contact springs shall be free from sharp bends or any other damage. A gradual bow in the spring is permissible.

Gauge by eye.

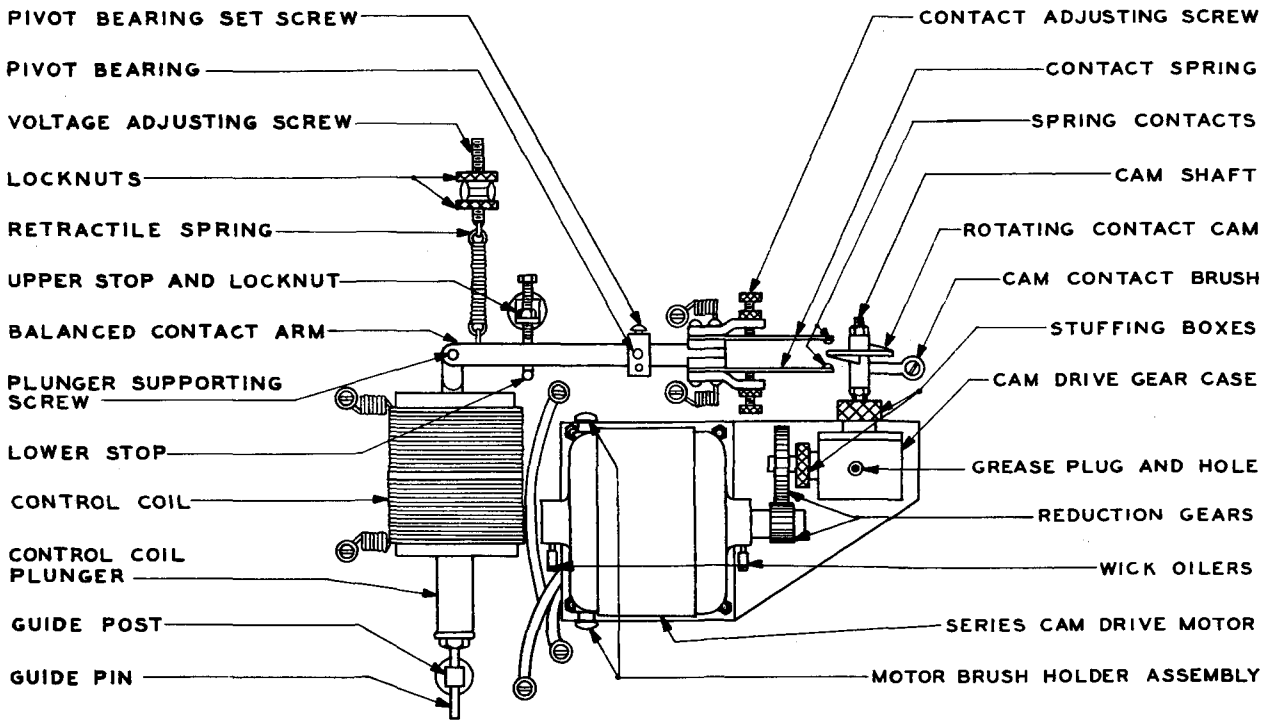

Fig. 3 – Voltage Controller — KS-5016 and KS-5117 (series motor KS-5117 shown)

2.07 ***Clearance Between Spring Contacts:*** When the contact arm is approximately horizontal:

(a) The spring contacts of KS-5016, KS-5117, and KS-5374 and the main and auxiliary contacts of KS-5519 shall clear the rotating contact cam or disc by equal amounts.

(b) Neither the spring contacts nor the main contact shall touch the contact cam.

(c) The auxiliary contact of the KS-5519 controller shall clear the rotating contact discs by at least 1/64 inch greater distance than the main contact clears the rotating contact cam.

Gauge by eye.

2.08 ***Contact Surfaces:*** All contact surfaces of both the springs and rotating cam or disc shall be smooth and free from buildups.

Gauge by eye.

2.09 ***Thickness of Contact Metal:*** The thickness of the contact metal on the spring contacts and on the rotating contact cam or disc shall be

Min 1/64 inch.

Gauge by eye.

2.10** ***Current in Control Coil Circuit: The current in the control coil circuit shall not exceed 1.2 amperes.

Use ammeter.

Contact Cam and Associated Drive Motor

2.11 ***Freedom of Rotating Parts:*** The motor armature and associated gears shall turn freely.

Gauge by eye.

Caution: Do not turn the shaft of a General Electric Telechron or Warren motor by hand as this will damage the enclosed gear.

2.12 ***Speed of Rotating Contact Cam:*** The speed of the rotating contact cam with normal voltage and frequency (if alternating current) applied to the associated motor shall be

(a) for ac and dc motors KS-5016 and dc motors KS-5117 and KS-5374

Min 5 rpm.
Max 7 rpm.

(b) for ac motors KS-5117, KS-5374, and KS-5519

Min 3 revolutions in 3 minutes 10 seconds
Max 3 revolutions in 2 minutes 51 seconds

Use watch with second hand.

2.13 ***Commutator or Collector Ring Surfaces:*** Commutator or collector ring surfaces shall be clean and free from scores, pits, or other deformations of the surface or structure, save that caused by normal wear.

Gauge by eye.

ϕ2.14 ***Brush Holder Clearance:*** The distance from the edge of the brush holder to the adjacent rotating cam disc, commutator, or slip ring shall be

	MIN.	MAX.
Cam disc brush holder	1/8 inch	1/4 inch
Motor brush holder	1/32 inch	5/64 inch

Use the R-8550 scale.

2.15 ***Brush Length:*** The brush length outside of the spring shall be

Cam disc brush	Min 11/32 inch
Cam drive motor	Min 3/8 inch

Use the R-8550 scale.

2.16 ***Brush Pressure***

(a) With the brush holder screw cap removed, and the brush in its holder and resting against the rotating cam disc, commutator, or slip ring, the spring of the brush shall extend outside of its holder

Min 1/8 inch.

Use the R-8550 scale.

(b) The pressure of the cam contact brush upon the insulated rotating contact cam of the KS-5117 voltage regulator shall be

Min 60 grams
Max 120 grams

Use the 79C gauge.

2.17 ***Brush Fit:*** Brushes shall not bind in their holders; neither shall they be loose enough to cause poor commutation.

Gauge by eye.

Operating Requirements

2.18 ***Regulation***

Note 1: Before making any check of the voltage, the voltage control coil shall be connected to the circuit for at least 1 hour with the doors of the enclosing cabinet shut.

Note 2: Nominal values in Table A are based on theoretical cell voltage averages. Mean values and corresponding adjustment values, however, are quoted in either the nearest tenths or nearest quarters of a volt due to the difficulty of reading meters to smaller divisions.

Note 3: For nominal voltage values, other than those given in the table, the same spread between maximum and minimum limits and the mean values shall apply.

(a) With a voltage within the limits as shown under Voltage Range — Nonoperate in Table A, applied to the controller circuit, the contact arm shall be approximately horizontal with no contact made between the rotating cam and any spring, main or auxiliary contact.

(b) The right or top main contact shall make contact with the cam by the time the impressed voltage increases to the value under maximum; but it shall not make contact before the impressed voltage reaches the value under minimum as shown under Voltage Range — Operate in Table A.

TABLE A

NOMINAL SETTING VOLTS	MEAN SETTING VOLTS	VOLTAGE RANGE NONOPERATE		VOLTAGE RANGE — OPERATE						
				MAIN CONTACTS				AUXILIARY CONTACTS		
		MAX	MIN	MAX VARIATION FROM MEAN	MAX	MIN	CONTACTS	MAX	MIN	MAX VARIATION FROM MEAN
23.87	23.9	24	23.8	±0.3	24.20	24.00	Right or Top	24.50	24.30	±0.6
					23.80	23.60	Left or Bottom	23.50	23.30	
26.04	26	26.1	25.9	±0.3	26.30	26.10	Right or Top	26.60	26.40	±0.6
					25.90	25.70	Left or Bottom	25.60	25.40	
49.91	49.9	50.15	49.65	±0.5	50.40	50.15	Right or Top	50.90	50.65	±1.0
					49.65	49.40	Left or Bottom	49.15	48.90	
132.37	132.4	133.15	131.65	±1.25	133.65	133.15	Right or Top	135.15	134.20	±2.75
					131.65	131.15	Left or Bottom	130.40	129.65	

Example: With a nominal voltage setting of 23.87 volts, the contact arm shall be approximately horizontal with neither top nor bottom contacts making contact as long as the voltage remains between 23.8 and 24.0 volts. If the voltage increases, the right or top main contact shall make at some value between 24.0 and 24.2 volts. If the voltage continues to rise, the right or top auxiliary contact shall make at some value between 24.3 and 24.5 volts. If the voltage decreases, the left or bottom main contact shall make at some value between 23.8 and 23.6 volts. If the voltage continues to decrease, the left or bottom auxiliary contact shall make at some value between 23.5 and 23.3 volts.

(c) The left or bottom main contact shall make contact with the cam by the time the impressed voltage decreases to the value under minimum but it shall not make contact before the impressed voltage reaches the value under maximum as shown under Voltage Range — Operate in Table A.

(d) Corresponding requirements for the right or top and the left or bottom auxiliary contacts, where provided, shall be met in accordance with the values specified in Table A.

(e) Under no condition shall there be less than 0.2 volt difference for nominal 24 volt, or 0.5 volt for nominal 48-volt circuits between the make of the right or top and the make of the left or bottom main contacts.

(f) When adjustment is necessary the controller shall be set as close as possible to the minimum voltage value for the right or top contacts, both main and auxiliary, and to the maximum voltage value for the left or bottom contacts since normal operation will cause a gradual widening of the voltage limits.

*ϕ2.19 ***Temperature:*** Under normal operating conditions the temperature shall not exceed:

Bearings	80 C (176 F)
Controller Coils	105 C (221 F)
Motor Frame	90 C (194 F)
All Other Exposed Parts	80 C (176 F)

If the temperature is thought to be excessive use the R-1032 thermometer.

3. ADJUSTING PROCEDURES

3.001 ***List of Tools, Gauges, and Materials***

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
265C	Contact Burnisher Holder
KS-5000	Grease and Oil Gun
KS-6015	Duckbill Pliers
KS-6320	Orange Stick
KS-14164	Brush
R-1542	Adjustable Wrench
—	P-Long-Nose Pliers (or the replaced 6-1/2 inch P-long-nose pliers) ←
—	3-Inch C Screwdriver (or the replaced 3-inch cabinet screwdriver) ←
—	5-Inch E Screwdriver (or the replaced 5-inch regular screwdriver) ←
GAUGES	
79C	0-200 Gram Push-Pull Tension Gauge
KS-8039	Volt-Milliammeter DC
R-1032 Detail 1	Thermometer
R-8550	6-Inch Steel Scale
—	Ammeter, DC, Weston No. 281, Range 30/3/1.5 (or the replaced Weston Model No. 280) ←
MATERIALS	
KS-2423	Cloth ←
KS-7860	Petroleum Spirits
KS-14666	Cloth
—	Abrasive Paper, Flint, Extra Fine ←
—	Felt Pad
—	310-330P Grease

3.002 Before making any tests or adjustments not requiring power, be sure to open the circuit so that the cam drive motor 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 the same holder to insure that the contact will be the same as before removal. In replacing a brush holder cap screw 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 into place.

3.004 When using KS-7860 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*** (Reqt 2.01)

(1) To clean, inspect and relubricate the wick oilers and the bearings, unscrew the complete oiler and remove the wick. With a clean KS-14666 cloth moistened with KS-7860 petroleum spirits placed over the KS-6320 orange stick, dig out all of the old and hardened grease from the hole under the bearing from which the oiler cup and wick were removed. Examine the wick for hardness. If hard, tap the wick all around with a screwdriver handle and then apply a small amount of light mineral oil. If the wick has lost its shape, replace it. Either add 310-330P grease to the oiler cups or, using the KS-6320 orange stick, dig out all the old grease in the oiler cup. Clean the interior of the oiler cup with KS-7860 petroleum spirits and wipe it dry with a clean cloth. Fill the oiler cup with fresh 310-330P grease and replace the cup and wick, making certain that the wick does not bind and that it presses against the shaft. Tighten the oiler cup securely to prevent it from working loose.

(2) To relubricate the cam drive gear case, on other than General Electric Telechron or Warren motors, remove the drain and filling plugs from the gear case. Insert the KS-5000 grease gun into the filling hole and force the

grease into the case until the excess being expelled from the drain plug hole, because of this forcing action, shows evidence of fresh grease. After allowing the motor to run for a few minutes, using the KS-6320 orange stick, dig out all grease that can be reasonably obtained from the filling and drain holes and then replace their respective plugs.

(3) The application of fresh grease to the exposed gears should not be undertaken until all of the old grease has been removed from the edges and faces of the gears. With a clean KS-14666 cloth moistened with KS-7860 petroleum spirits, wipe away the old grease from the gears and gear faces. Apply fresh 300-330P grease to the parts with the fingers or with a cloth dipped in the grease. Distribute the grease over the face of the gear teeth as evenly as possible and wipe off all of the excess.

Voltage Relay and Contact Arm

3.02 ***Alignment*** (Reqt 2.02)
3.03 ***Freedom of Contact Arm*** (Reqt 2.03)
3.04 ***Freedom of Plunger*** (Reqt 2.04)

(1) If the contact arm does not operate freely in its pivot bearings, or if the position of the contact arm in the pivot bearings is such that the coil plunger does not operate concentrically in its coil, move the contact arm horizontally by loosening the two pivot-bearing setscrews holding the pivot bearings and moving the bearings as necessary. The pivot bearings shall be set to give sufficient play to allow free movement of the contact arm. Tighten the pivot bearing setscrews after the required adjustment of the pivot bearings has been made.

(2) Should it be found, after adjusting the pivot bearings, that the contact arm still binds, see that the control coil plunger swings freely on the plunger supporting screw and that the guide pin is not binding in its guide post. Clean or adjust as necessary but do not lubricate.

(3) If the guide pin is bent, the control coil plunger should be removed from the coil and the guide pin straightened. To take out the plunger, loosen the setscrew holding the pin in the contact arm, remove the pin, and let the plunger down against the guide post. Unhook the retractile spring from the contact arm and disconnect the two flexible connectors from their binding posts on the panel. Hold the contact arm with one hand and loosen the pivot-bearing setscrews with a screwdriver, or the special wrench furnished with the KS-5519 controller at the time of installation, and pull the contact arm forward pushing out the pivot bearing. The contact arm may now be lifted out of position, care being taken not to bend or otherwise disturb the adjustments of the contact springs and spring contacts. The plunger and guide pin may now be removed and shaped as necessary. Before replacing the parts, clean them with the KS-14666 cloth wet with KS-7860 petroleum spirits. Replace in the reverse order.

(4) The position of the plunger in the coil may be adjusted by loosening the locknuts at the bottom and top of the plunger and screwing the plunger up or down the guide pin as required. Tighten both locknuts after an adjustment.

3.05 ***Retractile Spring*** (Reqt 2.05)

(1) If the retractile spring attached to the contact arm is considerably distorted or broken, replace it with a new spring. Adjustment of the spring, if required, may be made by loosening the locknuts and raising or lowering the spring adjusting screw as required. After an adjustment, be sure to tighten the locknuts.

(2) The retractile spring is provided to partly counterbalance the weight of the control coil plunger and is adjusted at the factory so that the balanced contact arm will float approximately horizontal when normal voltage is applied to the control coil. Unless the spring is appreciably bent or distorted, or its adjustment is known to have become upset, it is usually recommended that the factory adjustment remain undisturbed.

3.06 ***Straightness of Contact Springs*** (Reqt 2.06)
3.07 ***Clearance Between Spring Contacts*** (Reqt 2.07)
3.08 ***Contact Surfaces*** (Reqt 2.08)
3.09 ***Thickness of Contact Metal*** (Reqt 2.09)

(1) Where necessary, slight shaping of contact springs should be done with the KS-6015 duckbill pliers. Contact springs badly bent or damaged should be replaced.

(2) If the spacing between the spring contacts and the cam is incorrect, change the adjustment of the springs by loosening the locknuts where provided and readjusting the contact adjusting screws using the C screwdriver or the special wrench furnished with the KS-5519 controller at the time of installation, as required, until the spacing between the spring contacts and rotating cam is as desired.

(3) When necessary, remove any dust or dirt from the spring contacts with the KS-14164 brush. Remove any oil or grease with a clean KS-14666 cloth moistened with KS-7860 petroleum spirits. Care shall be taken not to bend any of the parts or change any of the adjustments during this procedure.

(4) Contact surfaces of the cams and springs are of silver, and cleaning in addition to the wiping action given in normal operation should be all the maintenance required. If the contact surfaces should become rough or pitted to such an extent that uncertain operation is experienced, smoothing with the 265C contact burnisher may be resorted to. This, however, should be done only as a last resort and then remove as little of the contact metal as possible.

(5) Where the spring contacts have worn down to the specified minimum thickness, new spring contacts shall be installed. When a rotating contact cam replacement is required, a complete new contact cam disc assembly shall be installed.

3.10** ***Current in Control Coil Circuit (Reqt 2.10)

(1) If the current in the control coil circuit exceeds the amount specified, reduce by adjusting the associated compensating rheostat slightly as covered in Section 024-460-701. If this cannot be done without putting the controller out of adjustment, restore the original adjustment and increase slightly the tension of the retractile adjusting spring attached to the contact arm.

Contact Cam and Associated Drive Motor

3.11 ***Freedom of Rotating Parts*** (Reqt 2.11)

(1) On all except General Electric Telechron or Warren motors, if a motor armature or its associated gears bind, turn the armature manually and see whether or not the binding is caused by the bearings being too tight or by worn bearings or gears. If the bearings are too tight, or if the bearings or gears are badly worn, these should be adjusted or replaced. General Electric Telechron or Warren motors should not be turned by hand and, if trouble is experienced with this type motor, the motor should be replaced as a unit.

(2) In addition to the above, examine the stuffing boxes of the cam drive gear case and if the shaft binds at this point repack with new wick packing. Pack the stuffing boxes tight enough to prevent grease from leaking along the shafts, but not so tight that the speed of the cam disc will fall below the specified rpm.

(3) If it is necessary to remove the cam drive motor from the panel, remove the four nuts and lockwashers of the bolts which hold the motor to its base with a wrench, and pull the motor forward allowing the gears to roll past each other.

3.12 ***Speed of Rotating Contact Cam*** (Reqt 2.12)

(1) If, with normal power supply service, the speed of the rotating cam falls outside the specified limits, the condition should be reported to the supervisor as no speed adjustments are provided. No attempt should be made to control the speed by means of the packing in the stuffing box of dc operated controllers, or ac controllers of earlier design. Cams driven by General Electric Telechron or Warren motors should be replaced if not within the speed limit specified.

3.13 ***Commutator or Collector Ring Surfaces*** (Reqt 2.13)

(1) Wipe the commutator with a clean, dry KS-2423 cloth, inserting the cloth wrapped tightly around the end of the KS-6320 orange stick through the opening in the motor end shield. With the motor operating, hold the cloth firmly against the commutator taking care to leave no loose ends of the cloth inside the housing.

(2) Slight eccentricity in the commutator will cause no trouble. However, if trouble is encountered, and it is believed to be due to excessive eccentricity or the commutator surface is more than slightly rough or pitted, the matter should be referred to the supervisor for possible return of the motor to the factory for repair or replacement.

3.14 ***Brush Holder Clearance*** (Reqt 2.14)
3.15 ***Brush Length*** (Reqt 2.15)
3.16 ***Brush Pressure*** (Reqt 2.16)
3.17 ***Brush Fit*** (Reqt 2.17)

(1) To adjust the brush holder for clearance, loosen the associated setscrew with a screwdriver and move the brush holder closer to, or farther away from, the commutator, or cam, as required. After adjusting, tighten the setscrew firmly.

(2) Replace brushes as necessary to maintain at least the minimum length specified. Any rough brushes may be smoothed, or new brushes shaped to the curvature of the contact cam, with a strip of extra fine flint abrasive paper slid back and forth around the commutator, under the brush or cam disc surface, with the abrasive side next to the brush.

(3) The brush spring may be stretched, slightly, if required, to give the desired brush pressure. Where the desired pressure cannot be obtained, replace the brush and spring. For brush pressure measurements, see Section 171-110-701.

(4) If a brush sticks in its holder, remove the brush and clean the brush and brush holder with a clean, dry KS-14666 cloth. Slightly rough brushes should be smoothed with extra fine flint abrasive paper.

(5) In replacing the brushes, see that they are put back in the same holder and in the same position in which they were originally. Tighten the brush holder screw cap firmly. Brushes which are too loose in their holders shall be replaced. New brushes are supplied with their bearing surfaces curved approximately to the curvature of the commutator. Any further shaping of the brush shall be acquired in actual service.

Operating Requirements

3.18 ***Regulation*** (Reqt 2.18)

(1) Check the voltage being applied to the control coil by means of the powerboard voltmeter or a portable voltmeter, such as the KS-8039, connected across the controller circuit.

(2) If the powerboard voltmeter is used, leave all connections normal and slowly increase (or decrease) the circuit voltage by operating the RAISE (or LOWER) button, on the switch marked MANUAL, which is located on the associated regulator control panel. Continue to raise (or lower) the impressed voltage until the rotating contact cam and the right (top), or left (bottom), contact makes connection. Observe these voltages on the powerboard voltmeter. If the observed voltages are within the specified limits, no adjustment is necessary. If the observed voltage is less than the low value for the right (top) contact, or above the high value for the left (bottom) contact, the spacing of the contact springs is too close and will result in too frequent operation of the regulator. If the observed voltage is above the high value for the right (top) contact, or below the low value for the left (bottom) contact, the spacing is too great and in either case the contact springs should be adjusted.

(3) If the portable voltmeter is used, it should be connected across the coil and the associated series resistance as shown in Fig. 4. In most offices, the office battery voltage is sufficiently stable to use as test voltage supply but in No. 5 crossbar offices, due to large load changes, the office battery voltage may not be stable enough for this purpose. ***With stable office battery,*** the battery voltage may be raised and lowered as covered in (2), or if such action would result in voltages outside circuit voltage limits, the office battery plus a group of emergency cells may be used as the test voltage shown in Fig. 4. In this latter case, a rheostat (about 2 amperes, 4 ohms) is required to vary the test voltage over the range shown in Table A. ***With unstable office battery,*** the test voltage (see Fig. 4) may be arranged with temporary wiring from an idle charger or from No. 6 dry cells in series with a rheostat. The current required by the KS-5519 controller is approximately 1 ampere.

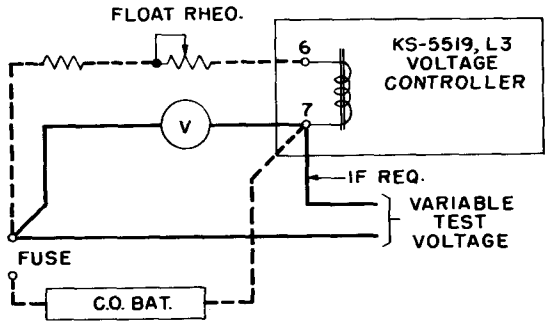

Fig. 4 – Typical Test Connections

(4) Adjust the contact springs by means of the associated contact adjusting screws until the spacing of the spring contacts is such that the difference in voltage between the terminals, when the cams make contact with the right (top) and left (bottom) contact springs, is within the specified limits. Tighten the locknuts where provided on the adjusting screws when the adjustments are completed.

(5) If the right (top) and left (bottom) contacts fail to make, at equal values on each side of the desired normal operating voltage, the operating range of the regulator can be shifted in position to a higher or lower voltage by adjusting one of the compensating rheostats located elsewhere in the circuit, as covered in Section 024-460-701, until the mean value corresponds to that desired. Slight final adjustment may be made with the retractile spring of the controller itself but, with the plunger in the required position in the coil, only slight changes in the adjustment of the retractile spring should be tolerated.

(6) The stop pins for the contact arm should be adjusted so as not to interfere with positive make of both main and auxiliary contacts with their respective cam or disc, but should be set to prevent excessive bowing of the contact springs after positive contact has been made. Adjust the stop pins by loosening the locknuts and raising or lowering the pins as required. After an adjustment, tighten the locknuts firmly.

3.19 *Temperature* (Reqt 2.19)

(1) The temperature of any part may be measured by placing the bulb of the R-1032 thermometer on the part, the temperature of which is desired, covering the exposed portion of the bulb with a piece of felt, and observing the highest temperature reading.

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

REASONS FOR REISSUE

1. To revise the information covering the use of the asterisk (1.04).
2. To revise the information covering the use of the phi. (1.05)
3. To add Fig. 2.
4. To revise Table A.
5. To revise the List of Tools, Gauges, and Materials (3.001).
6. To revise the method of adjusting contact springs to include the later type KS-5519 controllers. [3.06 through 3.09 (2) and 3.18 (4)]