

VOLTAGE REGULATORS  
KS-5016, KS-5117 AND KS-5468  
AC-DC AUTOMATIC ROTATING CAM TYPES  
REQUIREMENTS AND ADJUSTING PROCEDURES

1. GENERAL

1.01 This section together with Section 024-350-701 covers the a-c and d-c automatic rotating cam type voltage regulators KS-5016, KS-5117, and KS-5468.

1.02 This section is reissued to make changes in the requirements to express the temperature limits of the rheostat drive motor in terms of top temperature instead of temperature rise, and to add a requirement for generator field rheostat setting. It is also reissued to make changes in the adjusting procedures to provide for setting of generator field rheostat in offices having essentially constant loads and to indicate that existing adjusting procedure for setting of generator field rheostat applies to offices having variable loads; to replace kerosene throughout with petroleum spirits for cleaning purposes; to add number sign (#) to

applicable paragraphs; to add Lubriplate No. 107 grease for worm gears; to remove adjusting procedures for determining temperature of a motor commutator; and to make reference to the proper procedures for maintenance of re-oilable Telechron motors. Changes are marked with arrows.

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 Measurements called for in this section may be made by sight or by feel unless otherwise specified.

1.05 Requirements are marked with an asterisk (\*) when to check for them would necessitate the dismantling or dismounting of apparatus, would affect the adjustment involved, or other adjustments. No check

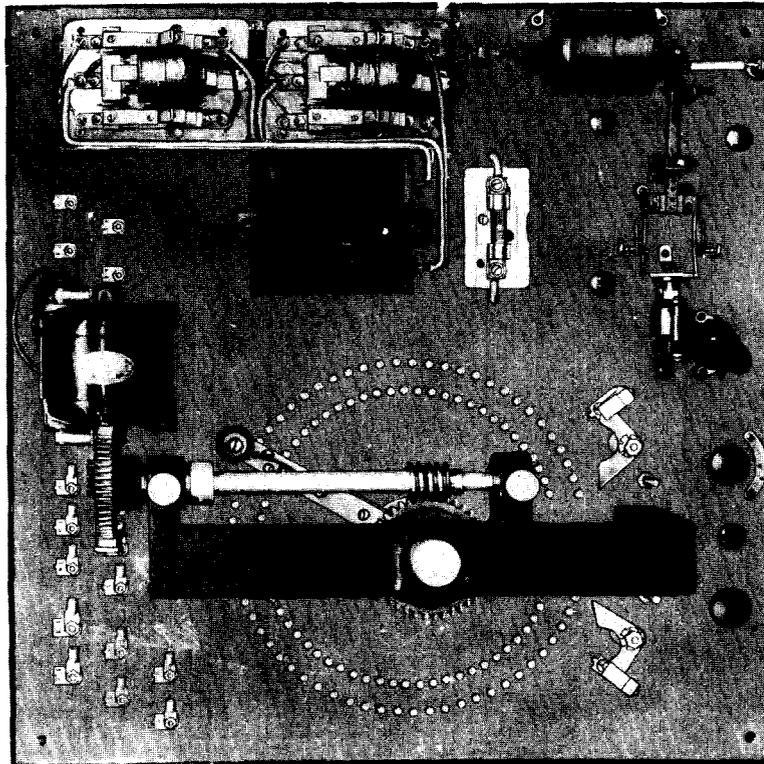


Fig. 1 - A-c Automatic Rotating Cam Type Voltage Regulator KS-5117

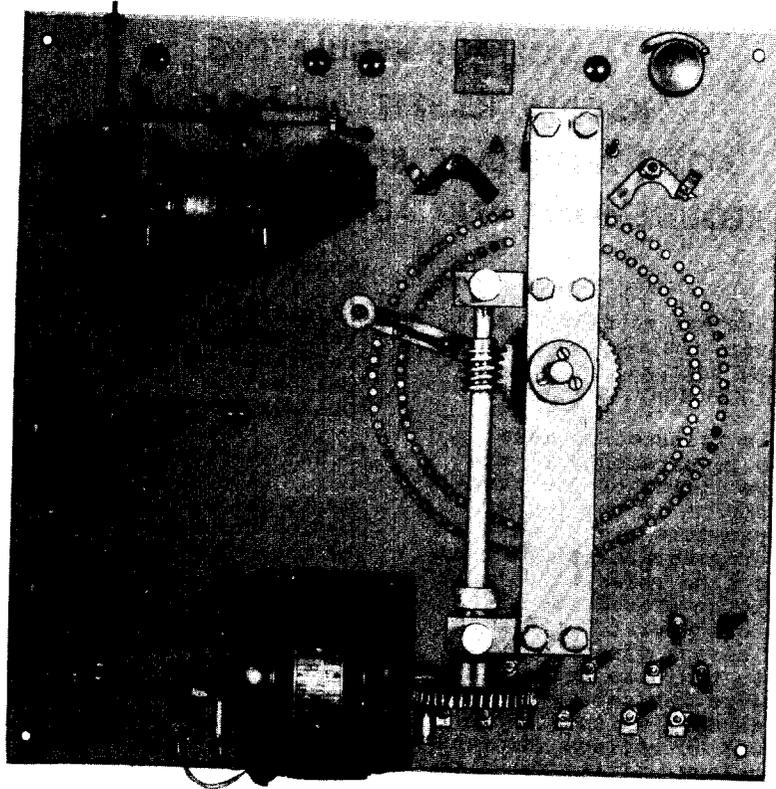


Fig. 2 - D-c Automatic Rotating Cam Type Voltage Regulator KS-5117

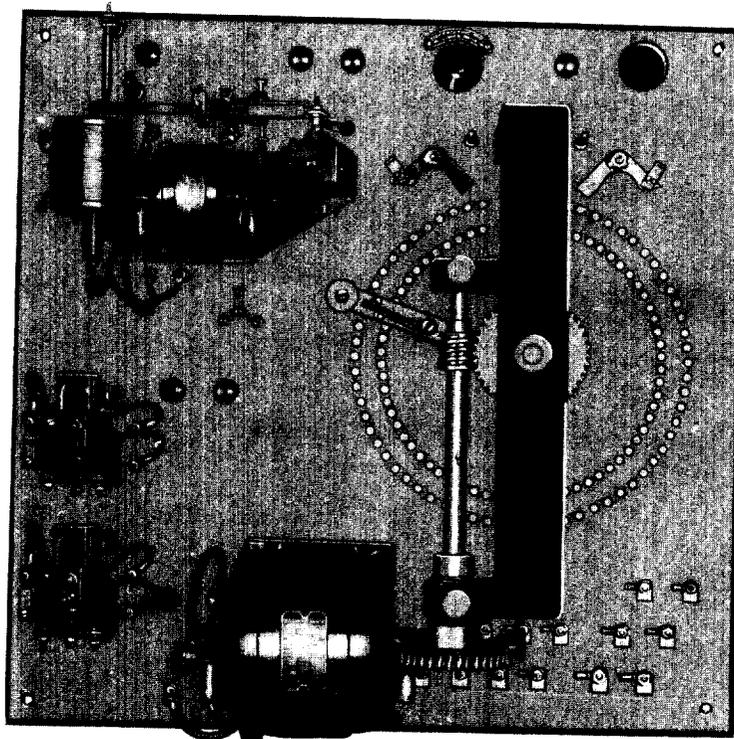


Fig. 3 - D-c Automatic Rotating Cam Type Voltage Regulator KS-5016

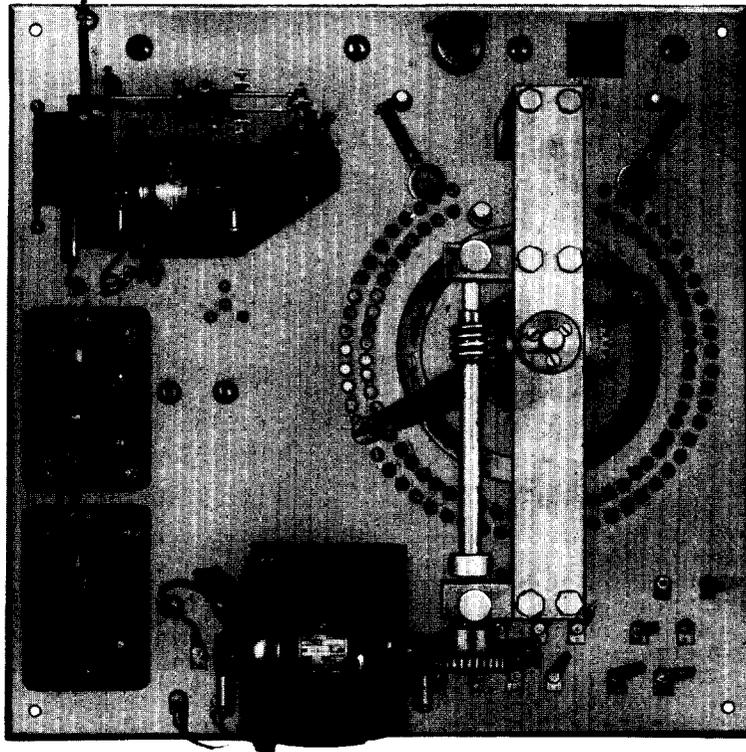


Fig. 4 - A-c Automatic Rotating Cam Type Voltage Regulator KS-5016

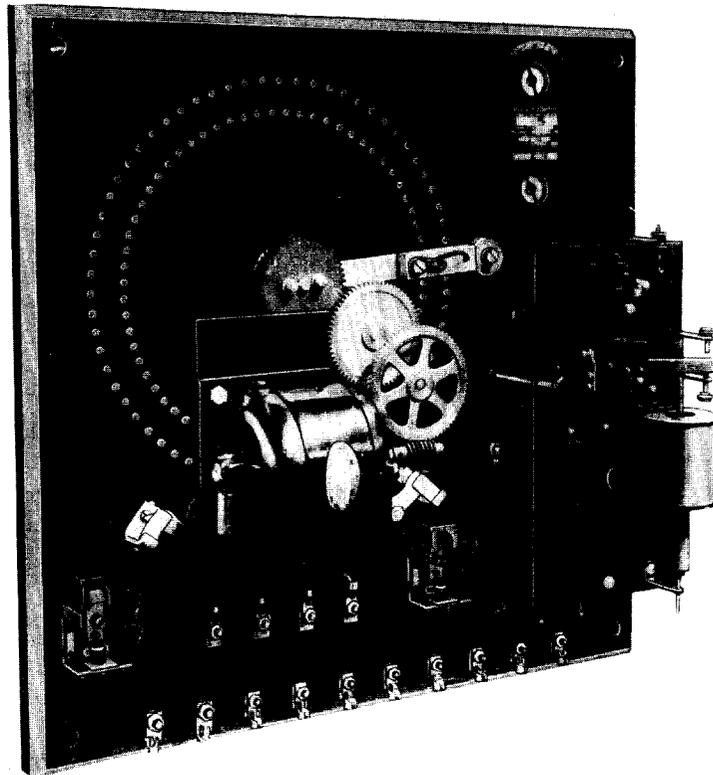


Fig. 5 - A-c Automatic Rotating Cam Type Voltage Regulator KS-5468

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.

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

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

1.08 Normal Service Voltage and Frequency as used in this section refers to the voltage and frequency of the outside service for the particular installation. The regulators are designed for operation on power or lighting circuits having a nominal voltage of 115 volts and a frequency of 60 cycles per second for alternating current. Unless otherwise specified, variations from the above voltage and frequency values for alternating current and voltage for direct current service, shall be assumed to be within the limits of

|               |      |
|---------------|------|
| A-c Volts     | ±10% |
| A-c Frequency | ±2%  |
| D-c Volts     | ±5%  |

(a) Should the voltage of the service be outside the specified limits, recommendations shall be obtained from the supervisor, as it may be necessary to order a transformer to correct the voltage applied to the regulator.

(b) Should the frequency of the service be outside the specified limits, it will be necessary to notify the supervisor since this is usually a matter which must be taken up with the local power company for correction.

1.09 Normal Regulated Voltage as used in this section refers to the voltage of the associated generator or battery at the point of regulation and shall have the limits as specified for the particular installation.

1.10 Light Contact as 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. This contact need not move the spring contacts appreciably but shall cause the associated motor contactors to close positively, and the motor to start.

1.11 Point of Control as used in this section refers to that point at which it is desired to maintain the regulated voltage.

1.12 For Requirements and Adjusting Procedures for the voltage controller assemblies associated with these regulators → see Section 024-350-701.

## 2. REQUIREMENTS

### 2.01 Lubrication

(a) Parts of the regulator designed for lubrication shall be adequately lubricated. The amount of lubricant used at any time shall not be sufficient to cause it to run or creep along surfaces not intended to be lubricated.

#(b) The wick oilers for the bearings of the rheostat drive motors shall be filled with petrolatum once every six months.

#(c) The wick oilers shall be thoroughly cleaned and filled with fresh lubricant every two years.

#(d) The grease cups on the motor-driven rheostat shall be filled with grease as often as necessary. The cups shall be given one complete turn clockwise once every three months.

(e) All exposed gears not otherwise lubricated shall be wiped with a small amount of No. 107 Lubriplate each month. The grease should be smeared on the bearing surfaces with a cloth on the end of a stick or with the finger, and all excess grease shall be wiped off.

#(f) The regulator rheostat contacts shall be provided with a thin film of petrolatum once a month.

#(g) Telechron motors, if arranged for re-oiling, shall be flushed and re-oiled every three years of service and after one year or more of storage.

#(h) Intervals between lubrication periods may be extended where periodic inspections indicate that the equipment will be adequately lubricated over the extended period.

### Rheostat Drive Motor

#\*2.02 Brush Holder Clearance: The distance from the edge of the brush holder adjacent to the commutator shall be  
 Max. - 5/64"  
 Min. - 1/32"

#2.03 Brush Length: The length of the motor brushes outside of the spring shall be  
 Min. - 1/2" on rheostat drive motor  
 Use scale.

#2.04 Brush Fit: The brushes shall be free in their holders and shall fit so as to insure successful commutation.

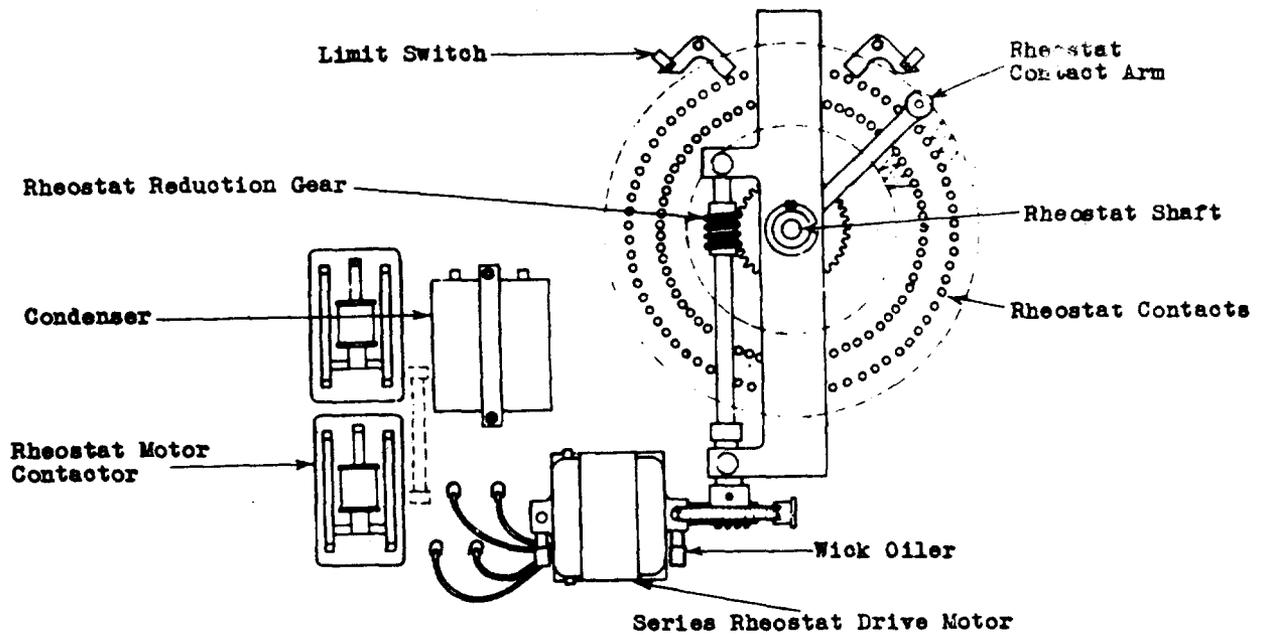


Fig. 6 - Motor-driven Rheostat Assembly

**#2.05 Commutator Surfaces** shall be clean and free from scores, pits or other deformations of the surface or structure, except that caused by normal wear.

**2.06 Freedom of Rotating Parts:** The motor armatures and associated gears shall turn freely.

#### Rheostat Motor Contactors

**2.07 The Rheostat Motor Contactor Contact Surfaces** shall be clean, smooth, and free from pits.

**2.08 The Contactor Closure** of the rheostat motor contactors shall be firm and positive when normal service voltage is applied.

**2.09 Freedom of Contactors:** The rheostat motor contactors shall operate freely.

#### Rheostat

**2.10 Rheostat Contact Surfaces** shall be clean, smooth, and free from pits.

**2.11 Rheostat Contact Height** shall be uniform so that the contact brush will not bind during operation.

**2.12 The Rheostat Contact Arm** shall move smoothly through the complete operating arc without binding.

#### **2.13 Backlash in Rheostat Gearing and Contact Arm**

(a) At time of turnover, the backlash in the gearing of the motor-operated rheostat shall not exceed the amount which shall permit the contact end of the rheostat arm to be moved manually 1/4" along the circumference of the outer ring of contact buttons.

(b) After turnover, the backlash in the gearing of the motor-operated rheostat shall not exceed the amount which shall permit the contact end of the rheostat arm to be moved manually 1/2" along the circumference of the outer ring of contact buttons.

**2.14 The Rheostat Limit Switch Closure** shall be firm and positive but shall not be stiff enough to interfere with successful operation of the rheostat contact arm.

#### Operating Requirements

##### **2.15 Operating Sequence**

(a) Closure between one spring contact and the rotating contact cams shall cause the associated motor contactor to close and the rheostat arm to turn in a clockwise direction facing the regulator panel. This will lower the voltage.

(b) Closure between the other spring contact and the rotating contact cams shall cause the associated motor contactor to close and the rheostat arm to turn in a counterclockwise direction facing the regulator panel. This will raise the voltage.

(c) The associated motor shall move the rheostat contact arm from one extreme position to the other extreme position in either direction in

Max. - 100 operations of the motor contactor ("main" contacts only of controller operating)

Min. - 30 operations of the motor contactor ("main" contacts only of controller operating)

Note: See that one or more operations of the associated motor contactor shall be caused by an equal number of light contacts between the rotating contact cams and the "main" spring contacts of the contacts of the controller.

### 2.16 Temperature Limits

(a) When in continuous operation, the temperature as measured by feel of the various parts shall not be excessive.

\*(b) If the temperature, as measured by feel, is thought to be excessive, measure by means of a thermometer. The maximum temperature of the parts shall not exceed the values listed below. Use thermometer

|                  |              |
|------------------|--------------|
| Bearings         | - 80C (176F) |
| Contactors Coils | - 80C (176F) |
| Motor Windings   | - 90C (194F) |
| Motor Frame      | - 90C (194F) |

### 2.17 Generator Field Rheostat Setting:

Satisfactory operation of the generator under automatic regulation must be possible within the limits of the regulator rheostat for all changes in generator temperature, for line voltage changes in input to its drive motor, and for changes in generator loads from no load to full load. Therefore, to insure that the regulator will accomplish this and still be at all times within the specified limits of the office, it is required that the generator field rheostat be varied during the set-up and warm-up period until this condition obtains, after which the final position or setting is required to be marked as an established position to which the pointer of the generator field rheostat is to be turned when the regulator is to be put in operation.

## 3. ADJUSTING PROCEDURES

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

#### Tools

→ Bellows, hand, 10"  
 Brush, Artist's Show Card, No. 4 - R-1575  
 File, Pillar, 6", R-1051  
 Gun, Grease, KS-5000  
 Pliers, Duck Bill, 6", KS-6015 or 5"  
 No. 50620 Tool  
 → Screwdriver, Cabinet, 3"  
 Tool for adjusting compensating rheostats (older models only) furnished by manufacturer  
 Wrench, Adjustable, Single End, 6", R-1542

#### Gauges

Scale, Steel, 6", R-8550  
 Thermometer, R-1032 - Detail 1  
 Watch, Pocket

#### Materials

Bare Copper Wire #18 gauge or smaller, short length  
 → Cloth, Abrasive, or Paper 150 grade or 4/0 Sandpaper  
 Cloth, Cleaning, Twill Jean, D-98063  
 Pad, Felt (For temperature measurements)  
 → Grease, 280-300P  
 → Grease, Fiske Lubriplate No. 107  
 Petrolatum  
 → Spirits, Petroleum

3.002 Always open the voltage control coil and motor switches on the control panel associated with the automatic rotating cam type voltage regulator when cleaning, lubricating, or making adjustments on the voltage regulator, unless the contrary is specified. When one regulator is associated with only one generator, the double-pole regulator REG RHEO switch shall be thrown to the HAND REG position, and where associated with two generators the double-pole REG RHEO switch shall be placed in the open-circuit position.

### 3.01 Lubrication (Rq.2.01)

\*(1) Wick Oilers: To fill the wick oilers, unscrew the complete oiler from the bearing and adjust the wick as necessary to make contact with the motor shaft. Unscrew the oil cup. Put in sufficient petrolatum to fill the cup when it is screwed back into place with the wick. Replace the oil cup and wipe off any excess petrolatum.

→ \*(2) To clean a wick oiler, remove the oiler, wash the wick, the reservoir, and the surrounding bearing housing with petroleum spirits and dry with cloth. Repack with petrolatum as described in paragraph (1).

(3) Gears: Before applying fresh grease to the gears, wipe off any old grease from the edges of the gears and gear faces with cloth wet with petroleum spirits. Lubriplate grease may be applied to the face of the gears in small amounts by using a cloth dipped in the Lubriplate grease or with the finger. Smear the grease over the face of the gear teeth and wipe off all excess.

#(4) Grease Cup: To fill a grease cup remove the grease cup cap, fill with fresh 260-300P grease and replace the cap. Screw the cap down only far enough to pack the grease firmly in the cup and wipe off any excess grease.

#(5) To clean a grease cup, remove the cup, wash the cup and cap and surrounding bearing housing with petroleum spirits and dry with a clean cloth. If necessary, clean out the hole in the grease cup stem with a piece of bare copper wire. Repack as described in paragraph (4).

#(6) Rheostat Contacts: Before applying petrolatum to the contacts, wipe the contacts with cleaning cloth moistened with petroleum spirits. Apply a thin film of petrolatum on the rheostat contacts with cloth dipped in petrolatum to prevent cutting of the rheostat contacts by the brush on the rheostat contact arm. Remove any excess petrolatum with a clean cloth.

#(7) Re-oilable Telechron motors should be flushed and re-oiled in accordance with the section on lubrication and replacement of telechron motors.

#### Rheostat Drive Motor

##### #\*3.02 Brush Holder Clearance (Rq.2.02)

(1) To adjust the brush holder clearance, loosen the associated set screws with a screwdriver and adjust the clearance, moving the holder closer to or further away from the commutator as required. Tighten the set screws after an adjustment has been made.

##### #3.03 Brush Length (Rq.2.03)

(1) Replace with new brushes all brushes which do not meet the specified requirements.

##### #3.04 Brush Fit (Rq.2.04)

(1) If a brush sticks in its holder, remove the brush and clean the brush and brush holder with a cleaning cloth moistened with petroleum spirits. Then wipe dry with a dry cloth. Care shall be taken to mark each brush so that it may be replaced in the same position and in the same holder from which it was removed. If slightly rough, the

brushes may be smoothed with fine sandpaper.

(2) 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.

##### #3.05 Commutator Surfaces (Rq.2.05)

(1) Wipe the commutator with a small piece of cloth moistened with petroleum spirits, and insert the cloth wrapped tightly around the end of a small stick through the opening in the motor end shield. With the motor operating, hold the cloth firmly against the commutator, and take care to have no loose ends of 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, it will be necessary to remove the armature and have the commutator refaced. See the section on lubrication and replacement of telechron motors. After refacing the commutator, reassemble and lubricate the motor.

##### 3.06 Freedom of Rotating Parts (Rq.2.06)

(1) 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.

(2) If it is necessary to remove the rheostat drive motor of KS-5016 regulators, first remove the four cap screws (two on each end) which hold the motor and remove the motor from the panel. On KS-5117 regulators the motor may be removed without disturbing the associated gears and shafts by the removal of the cap screws which hold the motor to the associated spacers.

(3) Replace any defective gear shaft or gear of the reduction gear with a new shaft or gear.

Rheostat Motor Contactors3.07 Contactors Contact Surfaces (Rq.2.07)3.08 Contactors Closure (Rq.2.08)3.09 Freedom of Contactors (Rq.2.09)

(1) If the contact surfaces are dirty or rough, clean them with cloth wet with petroleum spirits and smooth with abrasive cloth or paper, or fine sandpaper. Wipe with dry cloth.

(2) If a fuse has blown replace the fuse. If a coil is open-circuited, replace the contactor which has the open-circuited coil.

(3) If the main or interlocking contacts are bent out of shape, they shall be reshaped or replaced. Where the parts are badly distorted, worn, or burned they shall be replaced by new parts.

(4) The air gap between the armature and magnet core in the open position may be too great. Adjustments of the armature stop shall be made to shorten the air gap until reliable closing consistent with positive contact break is obtained.

(5) Contactors operated from a-c circuits are provided with brass stops to limit the travel of the contactor armature. This stop may be shaped with duck-bill pliers to give the proper adjustment of the air gap. Contactors operated from d-c circuits are provided with an adjusting screw for controlling the armature back tension.

(6) Remove the dust or dirt from the hinge joint with a hand bellows or by compressed air.

(7) In the KB-5117 regulator if the one ampere fuse on the front of the regulator panel blows when the spring contact closes, examine the associated condensers to see that they are not short-circuited. If defective, replace.

Rheostat3.10 Rheostat Contact Surfaces (Rq.2.10)

(1) If the surfaces of the rheostat contacts and brush are dirty or rough, clean them with cloth moistened with petroleum spirits and smooth with abrasive cloth or fine sandpaper. Wipe with a dry cloth after smoothing with sandpaper and cover contacts with a thin film of petrolatum as described in paragraph 6 of procedure 3.01.

3.11 Rheostat Contact Height (Rq.2.11)3.12 Rheostat Contact Arm (Rq.2.12)

(1) Failure of the rheostat drive to meet the specified requirements may

be due to worn gears, sticking of limit switches, or contacts of uneven height. Repair or replace any damaged parts as necessary.

3.13 Backlash in Rheostat Gearing and Contact Arm (Rq.2.13)

(1) Excessive backlash may be due to some of the gears of the rheostat contact arm being loose on their respective shafts or to worn or damaged gears. Inspect all gears to see that they are tight on their shafts, and if necessary, drive in the pins which hold them to the shafts using care not to spring or bend the motor or gear shafts. Tighten the set screw which holds the rheostat contact arm to its shaft if this is loose.

3.14 Rheostat Limit Switch Closure (Rq.2.14)

(1) Adjust the limit switches as necessary to give satisfactory operation, or if damaged, repair or replace the damaged parts.

Operating Requirements3.15 Operating Sequence (Rq.2.15)

(1) If the rheostat contact arm is driven in the reverse direction from that specified, check the connections of the motor leads as indicated on the metal tags on the leads with the terminal post markings on the regulator panel. Change any connections necessary to give the required operation.

(2) Failure of the rheostat drive motor to meet the specified requirements may be due to improper voltage, dirty or worn commutator, worn brushes, worn bearings or gears. If after a check of the above, the requirements are not met, the motor shall be reported as defective since no speed adjustment is provided for use in the field.

(3) If the right (top) and left (bottom) "main" contacts fail to "make" at approximately 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 a lower voltage by means of the compensating rheostat, till the mean value corresponds to that desired. Adjustment of the compensating rheostat, on early models, is made with the tool furnished for that purpose by the manufacturer and supplied with each regulator. On later models, a screwdriver is used. Where a concentric locking bushing is provided, this should be loosened before making the rheostat adjustment and tightened after the adjustment is completed.

**#3.16 Temperature Limits (Rq.2.16)**

- (1) If the temperature as observed by feel is thought to be excessive, and such that the fingers cannot be held on the part, it may be measured with a thermometer.
- (2) To measure the temperature of a motor bearing, hold the bulb of a thermometer against the outside of the bearing housing with the motor running until a maximum reading is obtained. The bulb shall be held in place by means of a piece of felt or equivalent, covering that part of the bulb which does not touch the bearing housing.
- (3) The temperature rise of windings and motor frame shall be measured in a similar manner by holding a thermometer against the surface as outlined above.

**3.17 Generator Field Rheostat Setting (Rq.2.17)**

- (1) For Offices Having Variable Loads: With the controller coil hot and the generator cold (disconnected from the battery and load), close the motor switch on the regulator control panel and gradually out in all the resistance of the automatic regulator rheostat by operating the manual switch. Connect the generator to the battery in the usual manner. With the generator to be regulated delivering a current not in excess of the minimum current drain expected on the machine if only one machine is used, or from 0 to 10 per cent of its rating if more than one machine is used in the office, vary the manually operated generator field rheostat (in some instances consisting of main and interpolating plates) until the suppressed zero voltmeter reads the lower limit of the regulated voltage specified for the particular office. In cases where the entire regulated generator field rheostat can be out

out before the generator voltage is raised sufficiently to reach this lower limit, it is best to leave at least one step of the field rheostat in the circuit and let the automatic operation of the regulator rheostat take care of cutting out the additional resistance required to give the desired voltage regulation.

- (2) For Offices Having Essentially Constant Loads: With the controller coil hot and the generator cold (disconnected from the battery and load), close the motor switch on the regulator control panel and gradually out all the resistance of the automatic regulator rheostat by operating the manual switch. Connect the generator to the battery in the usual manner. With the generator to be regulated delivering a current not in excess of the maximum current drain expected on the machine, vary its manually operated generator field rheostat (in some instances consisting of main and interpolating plates) until the suppressed zero voltmeter reads the upper limit of the regulated voltage specified for the particular office.
- (3) Warm-up Period for All Offices: Operate under automatic regulation for approximately two hours or until the generator becomes thoroughly warmed up. If the regulation is not within the specified limits of the office, vary the generator field rheostat as required. When the equipment operates under automatic regulation within the specified voltages of the office for one-half hour after making final setting, a mark shall be stamped on the index plate of the regulated generator field rheostat to indicate the position to which the pointer is to be turned to put the regulator in operation. For interpolating rheostats, marks also shall be placed on the two handwheels in line with the mark on the index plate.

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