MANUALLY OPERATED RHEOSTATS
STEEL PLATE AND CARBON PILE TYPES
APPARATUS REQUIREMENTS AND ADJUSTING PROCEDURES

1. GENERAL

1.01 This section covers KS-5031, KS-5084, KS-5125, KS-5125-01, KS-5244, KS-5661, KS-5711, KS-5712, KS-15669, KS-15672, KS-15744, KS-15745, and similar manually operated rheostats.

1.02 This section is reissued to revise the requirements and procedures covering contact shoe pressure and cleaning and treating of contact surfaces. 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 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 In the past, field rheostats of charging generators have been tested at the factory with the associated motor-generator sets. This practice has been discontinued, and where formerly a rheostat contact arm position was marked on the rear of the plates, now the corresponding value of resistance is stamped on the generator nameplate. Information for determining any position or positions of the contact arm and for designating the corresponding position of the handwheel pointer on the front of the panel should be secured from the operating instructions, circuit drawing, or circuit description for the particular application. The resistance of a rheostat in ohms may be determined by dividing the voltage drop across it by the current in amperes flowing through it using the plant meters, where provided.

1.06 ***Caution: If practicable, disconnect power from the rheostat before starting work on it. If this is not practicable, exercise extreme care to avoid touching or shorting live parts of the rheostat.***

1.07 All rheostats covered in this section except the KS-15669 carbon pile rheostat, employ steel plates for mounting the rheostat parts. These rheostats, which are referred to as the steel plate type, differ in contact arm and contact shoe construction as described below.

1.08 ***Balanced Contact Arm Construction:*** Rheostats having this type of contact arm are shown in Fig. 1, 2, and 3. In these rheostats the contact arm is held against the contacts by a coil spring acting between the contact arm and operating arm. The operating arm is insulated from the contact arm by an insulating block or, in the rheostat shown in Fig. 2, by the use of an insulating bushing for the operating arm. Most KS-5031, KS-5125-01, KS-5244, KS-5661, KS-5711, and KS-5712 rheostats are of balanced contact arm construction.

1.09 ***Balanced Contact Shoe Construction:*** The KS-15672 rheostat shown in Fig. 4 has this type of shoe. In this rheostat the contact shoe, mounted in the contact arm, is held against the contact buttons and collector ring by a spring acting between the shoe and arm. Other rheostats using this type of shoe are the KS-5084, KS-5125-01, and KS-5711 faceplate rheostats. In the latter rheostats, the contact shoe engages only the contact buttons. A separate contact is provided for the collector ring.

1.10 ***Bent Phosphor-Bronze Ribbon Contact Arm Construction:*** Rheostats having this type of contact arm are shown in Fig. 5 and 6. In

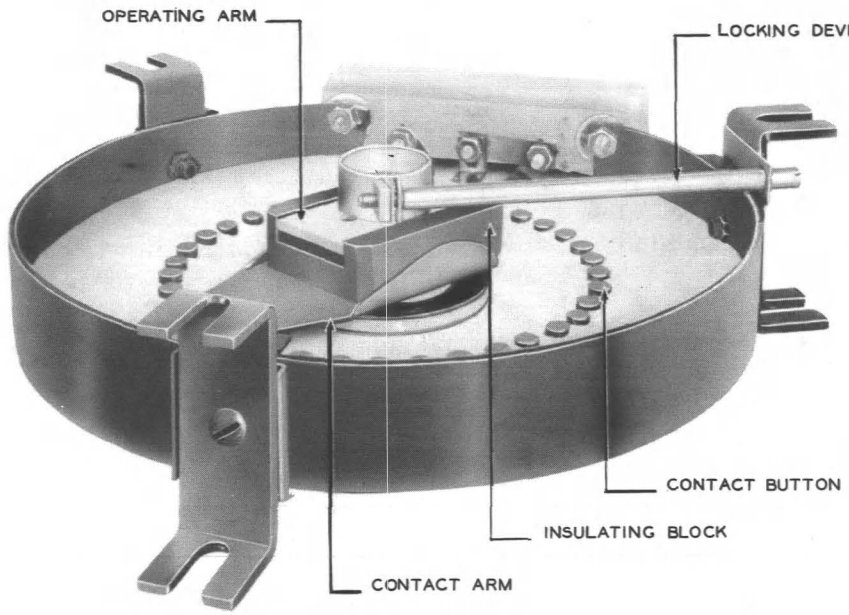

Fig. 1 – 6-, 8-, and 13-inch Rheostat — Balanced Contact Arm Construction

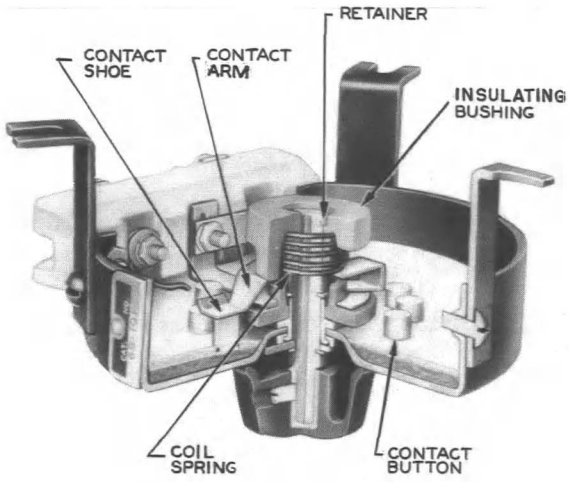

Fig. 2 – 4-inch Rheostat — Balanced Contact Arm Construction — Older Type — Cutaway Section

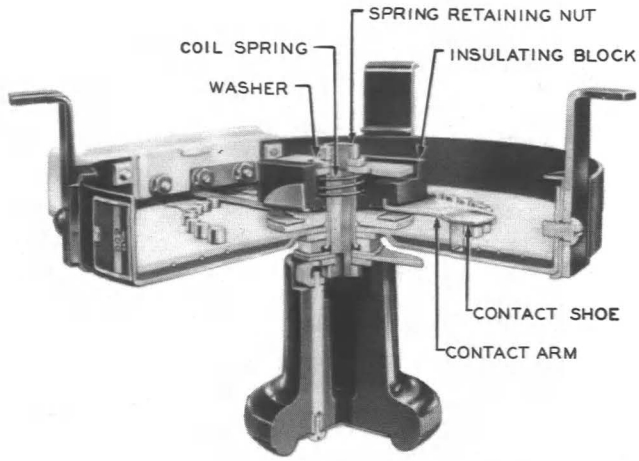

Fig. 3 – 6-, 8-, and 13-inch Rheostat — Balanced Contact Arm Construction — Cutaway Section

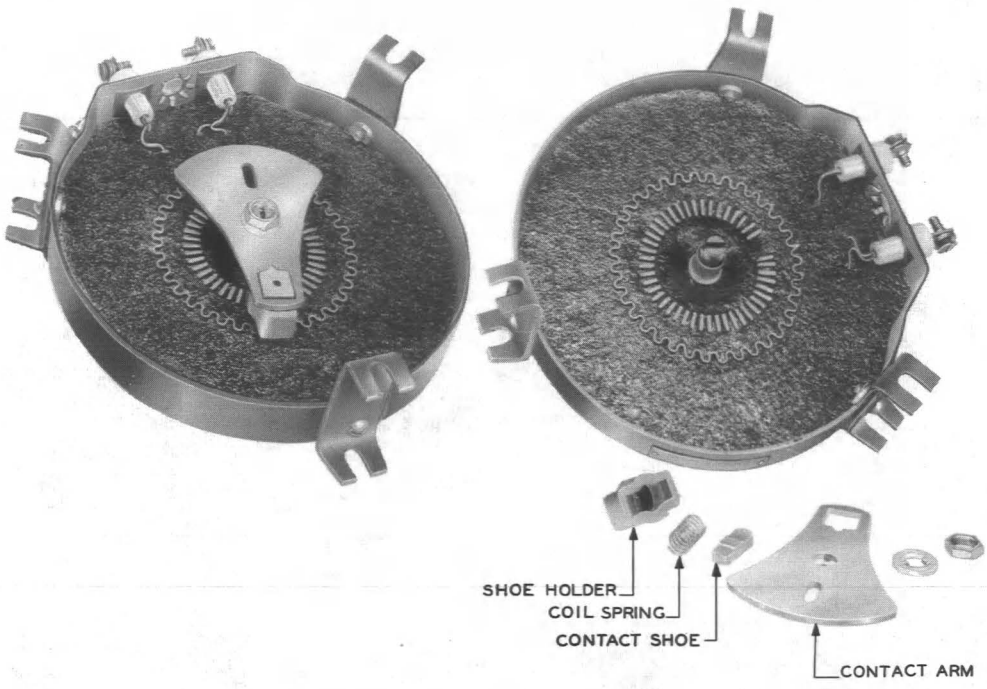

Fig. 4 – KS-15672 Rheostat —Balanced Contact Shoe Construction

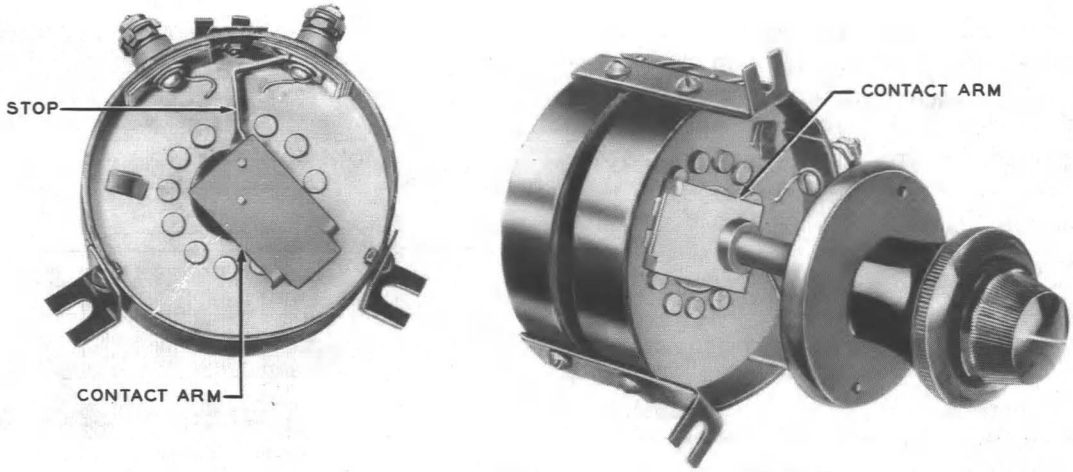

Fig. 5 – 4-inch Rheostat — Bent Phosphor-bronze Ribbon Contact Arm Construction

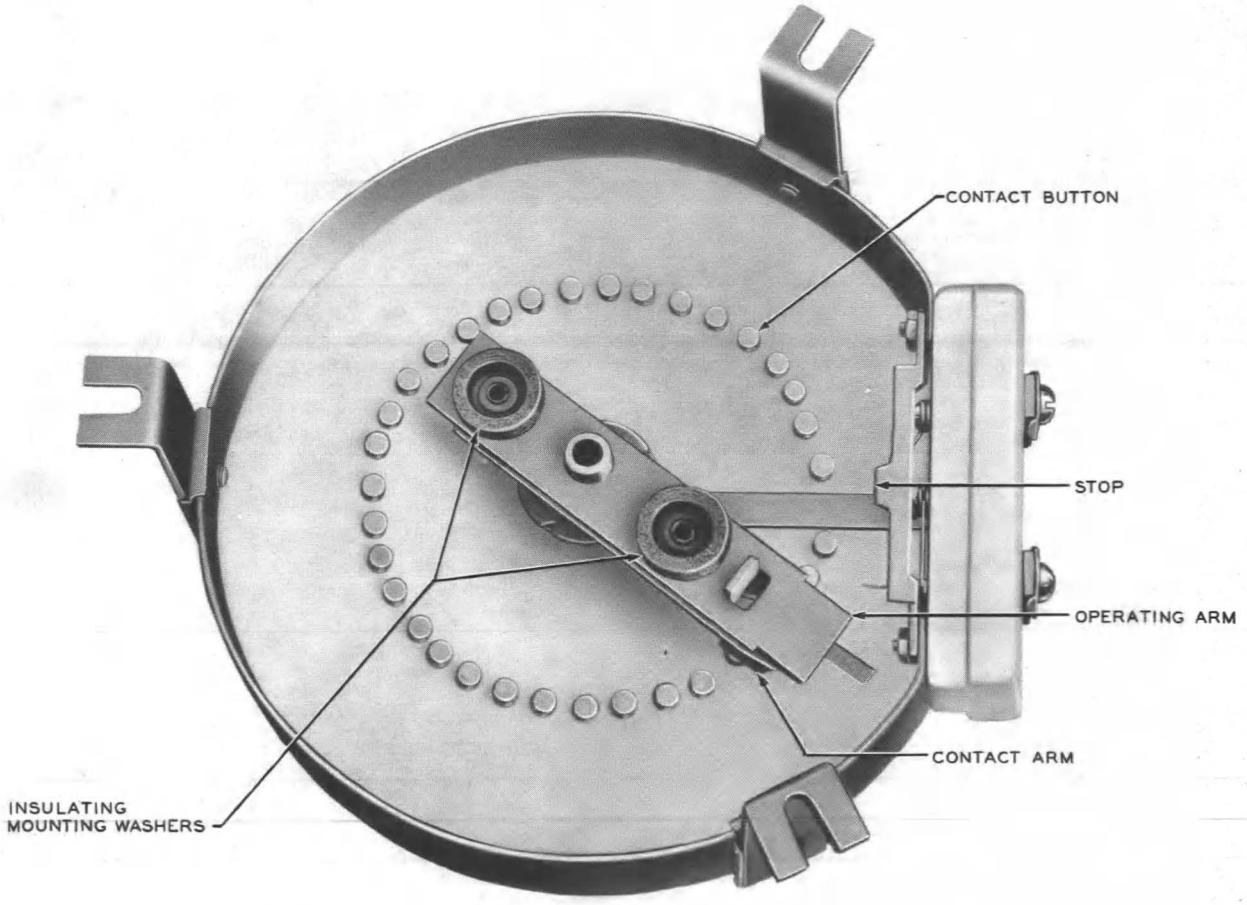

Fig. 6 – 6-, 8-, and 13-inch Rheostat — Bent Phosphor-bronze Ribbon Contact Arm Construction

these rheostats the contact arm consists of a flat phosphor-bronze spring one end of which is bent back 180 degrees to make contact with the contact buttons. The pressure against the buttons is provided by the spring characteristics of the phosphor-bronze. Some KS-5031, KS-5125, KS-5125-01, and KS-5244 rheostats have this construction.

1.11 *Carbon Pile Construction:* A rheostat of this type is shown in Fig. 7. This rheostat consists of graphite discs mounted on an insulated shaft which extends through holes in the discs, an operating handwheel, and a frame for supporting the assembly. The resistance is varied by turning the handwheel to vary the pressure with which the graphite discs are held together.

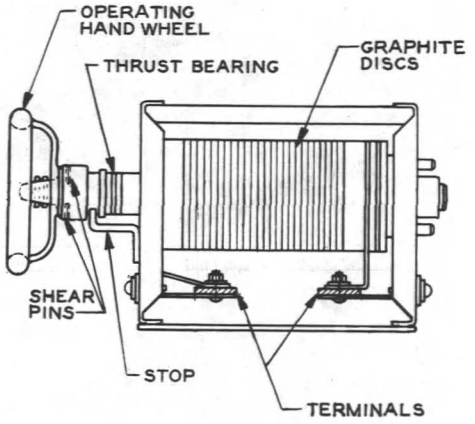

Fig. 7 – KS-15669 Rheostat — Carbon Pile Type

2. REQUIREMENTS

Requirements for All Rheostats Except Carbon Pile Type

2.01 ***Cleaning and Treating of Contacts and Contact Shoes***

(a) ***Rheostats Having Impregnated Graphite-type Contact Shoes*** (KS-5661, KS-5711, KS-5712, KS-15672, KS-15744, and KS-15745 Rheostats): Contacts and contact shoes shall be cleaned when necessary, but shall not be treated.

(b) ***Rheostats Having Other Than Impregnated Graphite-type Contact Shoes*** (See 3.002): Contacts and contact shoes shall be cleaned and treated when necessary in accordance with the section covering cleaning of this apparatus.

2.02 ***Contact Surface Alignment***

(a) The contact surface of the contact shoe or contact arm shall be approximately parallel to the surface of the contact buttons.

Gauge by eye.

2.03 ***Contact Shoe Pressure:*** The contact shoe shall press firmly against the surface on which it makes contact.

Gauge by feel.

2.04** ***Resistance of Rheostat and Associated External Resistors: The resistance of each rheostat and associated external resistor, if provided, shall be within the following percentage of the value specified on the nameplate.

RHEOSTAT AND EXTERNAL RESISTOR	ALLOWABLE VARIATION FROM NAMEPLATE VALUE
Rheostat	±10 Per Cent
External Resistor	
Total Resistance	±10 Per Cent
Resistance of Taps	±20 Per Cent

Use the KS-14510, List 1, Volt-Ohm-Milliammeter.

Before checking a rheostat, set the rheostat to the all-resistance-in position.

2.05 ***Temperature of Rheostat and Associated External Resistors:*** The temperature of each rheostat and associated external resistor, if provided, shall be within the following values.

RHEOSTAT AND EXTERNAL RESISTORS	MAX TEMP	LOCATION FOR MEASUREMENT
KS-5244 (Aluminum or Gray Enamel Fin.)	200C (392F)	Hottest Exposed Part
KS-5084	140C (284F)	Top of Cover
Other Rheostats and External Resistors	290C (554F)	Hottest Exposed Part

Use the Fisher Scientific Co., No. 14-985 thermometer.

To check this requirement, hold the thermometer bulb against the part and cover the portion of the bulb not in contact with the part with a small asbestos pad or equivalent. Observe the maximum temperature reading.

2.06 ***Freedom of Operation:*** The rheostat handwheel shall turn smoothly and without excessive bind.

Gauge by feel.

To check the requirement, slowly turn the handwheel.

2.07 ***Contact Arm Travel:*** The contact surface of the contact shoe or contact arm shall travel onto, but not beyond, the extreme contact buttons at each end.

Gauge by eye.

2.08 ***Contact Arm Locking Device*** (KS-5031, KS-5244, and KS-5125-01 Rheostats): When tightened, the contact arm locking device shall prevent movement of the contact arm.

Gauge by feel.

Requirements for Carbon Pile Rheostats

2.09 ***Lubrication:*** The shaft thread and thrust bearing shall be lubricated sparingly with KS-6232 light mineral oil.

Lubrication shall be applied annually.

2.10 ***Tightness of Terminal Bar Connections:*** The connections between the terminal bars and resistance element shall be tight.

This requirement shall be checked annually.

Use the R-1542 adjustable wrench.

2.11 ***Rheostat Resistance:*** The rheostat shall provide resistance values within the resistance range specified on the nameplate.

Use the KS-14510, List 1, Volt-Ohm-Milliammeter.

Before measuring the rheostat resistance, allow sufficient warm-up time for the rheostat to reach a stable condition.

2.12 ***Temperature:*** Under operating conditions, the temperature of the rheostat shall not exceed 350C (662F) measured at the hottest exposed part.

Use the Fisher Scientific Co., No. 14-985 thermometer.

To check this requirement, hold the thermometer bulb against the part and cover the portion of the bulb not in contact with the part with a small asbestos pad or equivalent. Observe the maximum temperature reading.

2.13 ***Freedom of Operation:*** The handwheel shall turn smoothly and without excessive bind over the range required to provide the specified resistance values.

Gauge by feel.

To check the requirement, slowly turn the handwheel. Take care to avoid breaking the shear pins in the handwheel.

3. ADJUSTING PROCEDURES

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

CODE OR SPEC. NO.	DESCRIPTION
TOOLS	
KS-6320	Orange Stick
R-1542	Adjustable Wrench
—	P-Long-nose Pliers
GAUGES	
—	Thermometer, −10° to +400°C, Fisher Scientific Co, No. 14-985
TEST APPARATUS	
KS-14510, List 1	Volt-Ohm-Milliammeter
MATERIALS	
KS-2423	Cleaning Cloth
KS-6232	Light Mineral Oil
KS-8372	Stabilized Trichloroethylene
KS-13148, List 1	Abrasive Paper

3.002 Care should be exercised when using petroleum spirits in the power room where there are dc machines, since commutation may be adversely affected by softening of the commutator films by the fumes. To avoid the need for burnishing the commutators of the dc machines after doing any cleaning operations called for in this section, use the absolute minimum amount of petroleum spirits required for the cleaning operation and keep the container closed when not in use.

Procedures for All Rheostats Except Carbon Pile Type

3.01 ***Cleaning and Treating of Contacts and Contact Shoes*** (Reqt 2.01)

(1) ***Rheostats Having Impregnated Graphite-type Contact Shoes***

(a) ***Contacts (Buttons, Segments, or Ring):*** Wrap the KS-13148, List 1 abrasive paper around a block of wood of convenient size. Clean the contact surfaces by wiping the abrasive paper over them while holding the paper squarely and firmly against the contacts. Then, wipe the surfaces with a

clean KS-2423 cloth moistened with KS-8372 trichloroethylene followed by wiping with a dry cloth.

(b) ***Contact Shoes:*** Using the KS-6320 orange stick, raise the shoe and insert a strip of KS-13148, List 1 abrasive paper between the shoe and associated contact surfaces with the abrasive side of the paper toward the shoe. Release the shoe. Then, without applying additional pressure to the shoe, withdraw the paper. Repeat this procedure if necessary. Remove particles which may have been deposited on the contact surfaces using a clean KS-2423 cloth.

(2) ***Rheostats Having Other Than Impregnated Graphite-type Contact Shoes***

(a) ***Contacts and Contact Shoes:*** Clean and treat contacts and contact shoes as covered in the section covering cleaning of this apparatus.

3.02 ***Contact Surface Alignment*** (Reqt 2.02)

Balanced Contact Arm Construction (See 1.08)

(1) If the requirement is not met, refer the matter to the supervisor for consideration of replacing the contact arm or contact shoe.

Balanced Contact Shoe Construction (See 1.09)

(2) If the requirement is not met, refer the matter to the supervisor for consideration of replacing the contact shoe.

Bent Phosphor-Bronze Ribbon Contact Arm Construction (See 1.10)

(3) If the requirement is not met, adjust the contacting portion of the contact arm with the pliers or fingers. In most cases, it will be necessary to relieve the contact pressure before making the adjustment. On KS-5031, KS-5125, and KS-5125-01 rheostats of this type, relieve the pressure by loosening the setscrew in the shaft collar on the side of the plate opposite the contact buttons. On KS-5244 one-plate rheostats or on the outer plate of 2-plate rheostats, remove the cotter pin and move the plate or shaft. On the inner plate of KS-5244 2-plate rheostats, remove the handwheels and horseshoe washer and remove the outer shaft and plate. After aligning the contact surfaces, remount the parts in the reverse order of removal.

3.03 ***Contact Shoe Pressure*** (Reqt 2.03)

(1) If the requirement is not met, proceed as follows depending on the type of construction.

(2) ***Balanced Contact Arm Construction*** (See 1.08): Adjust the coil spring acting between the contact and operating arms as follows. Remove the spring retaining nut, washer, and operating arm, using the adjustable wrench. Remove the spring. On rheostats of the type shown in Fig. 2, press down on the insulating bushing and remove the retainer from its slot near the end of the shaft to gain access to the coil spring. Extend or compress the spring to adjust its tension as required. If the spring cannot be adjusted to meet the requirement, replace it. Remount the parts in the reverse order of removal.

(3) ***Balanced Contact Shoe Construction*** (See 1.09): Adjust the contact shoe spring as follows. Remove the nut holding the contact arm to the operating shaft, using the adjustable wrench, and remove the contact arm. Remove the contact shoe and spring from the shoe holder. Adjust the tension of the spring as required. If the spring cannot be adjusted to meet the requirement, replace the spring or the spring and shoe. Remount the parts in the reverse order of removal.

(4) ***Bent Phosphor-Bronze Ribbon Contact Arm Construction*** (See 1.10): Relieve the contact pressure as covered in 3.02(3). Then, bend the contact arm as required, using the P-long-nose pliers or the fingers and making the adjustment as far back on the contact arm as possible. If the contact arm cannot be adjusted to meet the requirement, replace it. Remount the parts in the reverse order of removal.

3.04 ***Resistance of Rheostat and Associated External Resistors*** (Reqt 2.04)

(1) If the requirement is not met, refer the matter to the supervisor for consideration of replacing the resistance plate or associated external resistor.

3.05 ***Temperature of Rheostat and Associated External Resistors*** (Reqt 2.05)

(1) If the temperature exceeds the specified limits and all other requirements are met, refer the matter to the supervisor.

3.06 ***Freedom of Operation*** (Reqt 2.06)

(1) Remove any foreign matter which may have lodged between moving and fixed parts using the KS-6320 orange stick.

(2) If the handwheel binds and requirements 2.02 and 2.03 are met, refer the matter to the supervisor.

3.07 ***Contact Arm Travel*** (Reqt 2.07)

(1) If the stop is bent or improperly positioned, adjust or reposition the stop if practicable. If the stop is damaged or cannot be adjusted, replace it.

3.08 ***Contact Arm Locking Device*** (Reqt 2.08)

(1) If the locking device is defective, replace it. Make sure the locking device is positioned on the rheostat so that it is accessible for adjustment.

Procedures for Carbon Pile Rheostats

3.09 ***Lubrication*** (Reqt 2.09)

(1) Turn the handwheel to expose the shaft thread and apply a few drops of KS-6232 oil to the thread and to the thrust bearing. Wipe off excess oil with a KS-2423 cloth. Take care to keep oil away from the graphite discs.

3.10 ***Tightness of Terminal Bar Connections*** (Reqt 2.10)

(1) Tighten loose nuts with the 6-inch adjustable wrench.

3.11 ***Rheostat Resistance*** (Reqt 2.11)

(1) If the requirement is not met, refer the matter to the supervisor for consideration of replacing the graphite discs.

3.12 ***Temperature*** (Reqt 2.12)

(1) If the temperature exceeds the specified limits and all other requirements are met, refer the matter to the supervisor.

3.13 ***Freedom of Operation*** (Reqt 2.13)

(1) Remove dirt or foreign matter from the screw thread using the KS-6320 orange stick and a KS-2423 cloth. Lubricate the thread as covered in 3.09. If this does not correct the trouble, refer the matter to the supervisor.

(2) If the shear pins in the handwheel are broken, replace the shear pins.

REASONS FOR REISSUE

1. To omit the paragraph covering the number sign (1.04 of previous issue).
2. To revise the paragraph covering the asterisk (1.04).
3. To add a caution against touching live parts (1.06).
4. To add a paragraph covering balanced contact arm rheostat construction (1.08).
5. To add a paragraph covering balanced contact shoe rheostat construction (1.09).
6. To add a paragraph covering bent phosphor-bronze ribbon contact arm rheostat construction (1.10).

7. To add a paragraph covering carbon pile rheostat construction (1.11).

8. To revise the requirement covering cleaning and treating of contacts and contact shoes (2.01).

9. To revise the requirement covering contact shoe pressure (2.03).

10. To revise the requirement covering temperature of rheostat and associated external resistors (2.05).

11. To add a requirement covering contact arm travel (2.07).

12. To revise the list of tools, gauges, and materials (3.001).

13. To add a paragraph covering use of petroleum spirits (3.002).

14. To revise the procedure covering cleaning and treating of contacts and contact shoes (3.01).

15. To revise the procedure covering resistance of rheostat and associated external resistors (3.04).

16. To revise the procedure covering temperature of rheostat and associated external resistors (3.05).

17. To revise the procedure covering freedom of operation (3.06).

18. To add a procedure covering contact arm travel (3.07).

19. To add a procedure covering lubrication of carbon pile rheostats (3.09).

20. To add a procedure covering tightness of terminal bar connections (3.10).

21. To add a procedure covering carbon pile rheostat resistance (3.11).

22. To revise the procedure covering temperature of carbon pile rheostat (3.12).

23. To add a procedure covering freedom of operation for carbon pile rheostat (3.13).

24. To revise Fig. 2, 3, and 4.