POWER ROOM VENTILATION AND AIR DISCHARGE DUCT EQUIPMENT

1. GENERAL

1.01 This section covers apparatus requirements and adjusting procedures for the exhaust fans, shutters, shutter motors, transformers, controllers, and thermostats furnished in connection with KS-5592 and KS-5592-01 ventilation equipment, and KS-5638, KS-5704, and KS-15506 air discharge ducts for engine-set radiators.

1.02 It is reissued to add information on the T915C-type controllers, to provide replacement requirements for engine room air filters, to revise the tool list, and to eliminate most of the information on commutator maintenance. Frequent reference is now made to Sections A401.905 and A501.905.

1.03 The exhaust fans in most cases are mounted directly on their associated motors, which are ac driven or dc driven, as required, for the particular application. In a few cases, the fan is belt-connected to a motor mounted in the same supporting framework. The larger ac motors are 3 phase and the smaller, single phase. The single-phase motors of 1/4 hp and above are of the capacitor type, and those below 1/4 hp are of the split-phase type and include a starting switch.

1.04 Additional information necessary for the proper application of the requirements listed herein is covered in General Requirements and Definitions, Section A400.001.

1.05 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.

1.06 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.

1.07 For the purpose of this section, successful commutation is attained 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.

1.08 The M204A-type shutter motor (see Fig. 3) is used to operate a shutter which is intended to remain in a fully opened or a fully closed position as required. It rotates in one direction only and causes the cam follower to make a one-half revolution for each opening or closing of the associated shutter, being started as a result of the closing of a contact in the external circuit and stopped by the opening of a contact in its maintaining switch.

1.09 The M904E-type shutter motor (see Figs. 4 and 5) is used to operate a shutter which is intended to be held in any position from fully opened to fully closed as required. It is controlled by the type T915C controller.

1.10 The type T915C controller (see Fig. 6) with the type M904E shutter motor provides a means of proportioning the opening of the shutter to the temperature of the water in the radiator.

1.11 Schematic circuits applying to the M204A-type shutter motor, Fig. 2, and jointly to the T915C-type controller and the M904E-type shutter motor, Fig. 7, are included in this section for general information.

Fig. 1 - Typical Ventilation Fan

1.12 All work involving contacts or balancing potentiometers in the shutter motors or the controllers should be done with the equipment disconnected from the power supply.

1.13 The covers of shutter motors should be removed only when necessary and replaced as promptly as possible to prevent the entrance of dust.

2. REQUIREMENTS

2.01 Lubrication

(a) No lubrication is required by shutter motors, controllers, and thermostats.

(b) The bearing surfaces of the shutters shall be lubricated annually with light mineral oil.

(c) The ball bearings of fans shall be relubricated with grease after every 3 years of operating service, when being put into service after a year or more of storage, or after having been dismantled. Select the grade of grease as follows:

Motor Rating	Grade
Less than 1/10 hp	310-330 P
1/10 and larger	260-300 P

Note: It is understood that some fans have been accepted with nonstandard sleeve bearings, either waste-packed or wick type. In such cases it will be necessary to lubricate with 130-190 S 100 oil at such intervals and in such quantities as may be determined by local experience.

Fans and Fan Motors

#2.02 Bearings: The bearings shall be free from excessive wear. If the fan operates satisfactorily without excessive noise and the other requirements of this section are met, the bearings may be considered to be in a satisfactory condition.

Note: Abnormal noise from a ball bearing is an indication of damage or excessive wear.

2.03 Freedom of Rotation: The fan motor shall turn freely in its bearings and the blades of the fan shall not strike against the guard. Gauge by feel.

2.04 The noise and vibration shall not be excessive. Gauge by sound and feel.

*#2.05 Commutation: Without altering the position of the brushes, dc fan motors shall commutate successfully under all normal conditions of operation. Gauge by eye.

*#2.06 Sparking: The sparking between brushes and commutators shall be kept to a minimum. There shall be no sparking between brushes and collector rings.

*#2.07 Commutator Color: The commutator shall have a clean smooth surface which is free from any discoloration other than the dark bronze or chocolate color which indicates the best commutating condition.

*#2.08 Commutator Slots: The slots between the commutator bars shall be free of any dirt, oil, graphite, carbon dust, copper dust, copper dragging, etc. On machines now being furnished, the mica between the commutator segments is usually undercut. Gauge by eye.

*#2.09 Commutator Surface: The commutator shall be free from scoring, pitting, streaking, grooving, cutting, etching, burning, copper dragging, or other deformation of the surface or structure except that caused by normal wear. Gauge by eye or feel.

*#2.10 Commutator Cleaning and Care: If necessary, the commutator shall be cleaned and otherwise cared for whenever the motor is dismantled for any other reason.

*#2.11 Physical Defects: The commutator shall have no high, low, or loose segments or flat spots. Eccentricity of the commutator shall not be enough to cause poor commutation or poor operation of the machine. Gauge by eye.

*#2.12 Brush Condition: The brushes shall be free of dirt, dust, grease, oil, carbon particles, and copper picking.

*#2.13 Brush Length

(a) Brushes, which have a coil spring attached and which are mounted in tubular-type holders, shall have a length, measured between the commutator and the spring, of

Min - 1/4 inch

Use scale.

(b) Brushes, other than those in tubular holders, having pigtails secured by riveted assemblies shall have a length, measured between the commutator surface and the nearest metal part of the assembly, of

Min - 1/16 inch

Gauge by eye.

(c) Brushes, other than those in tubular holders, having pigtails secured without rivets or those without pigtails shall have a length over-all of

Min - 1/2 inch

Gauge by eye.

*#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 so as to insure successful commutation.

*#2.15 Brush Pressure

(a) For brushes in tubular holders, no specific pressure is required but the compression of the spring shall be sufficient to provide successful commutation. Brush pressure is usually satisfactory if the brush spring extends 1/4 inch or more beyond the brush holder tube when the brush cap is removed and the brush is resting against the commutator. Gauge by eye.

(b) For brushes not in tubular holders, the pressure shall be

	Lbs per Sq In.	Grams per Sq In.
Min	2-1/2	1134
Max	3-1/2	1588

Use 79B push-pull tension gauge.

2.16 The starting switch, if provided on an ac motor, shall disconnect the starting winding after starting and reconnect it on stopping. The contact surfaces shall be clean and smooth. Gauge by eye or sound.

2.17 The shutters and their associated linkage shall be clean and shall operate without binding. Gauge by eye.

*#2.18 M204A-type Shutter Motors

(a) The motor shall operate to open or close its associated shutter, without stopping at intermediate points, under control of the external circuit and its internal maintaining switch. Gauge by eye.

(b) The contact surfaces of the maintaining switch shall be clean and free from build-ups which might interfere with reliable contact. Gauge by eye.

(c) The contact pressure of the contacts of the maintaining switch shall be

Min - 25 grams
Max - 45 grams

Use 70D gauge.

Caution: When working on shutter motors connected to power supply, avoid contact with the top terminal of the capacitor.

*#2.19 M904E-type Shutter Motors

(a) The motor shall operate to close its shutter or to hold it partially or fully open under the control of its associated controller. There shall be no objectionable hunting. Refer to the circuit description and gauge by eye.

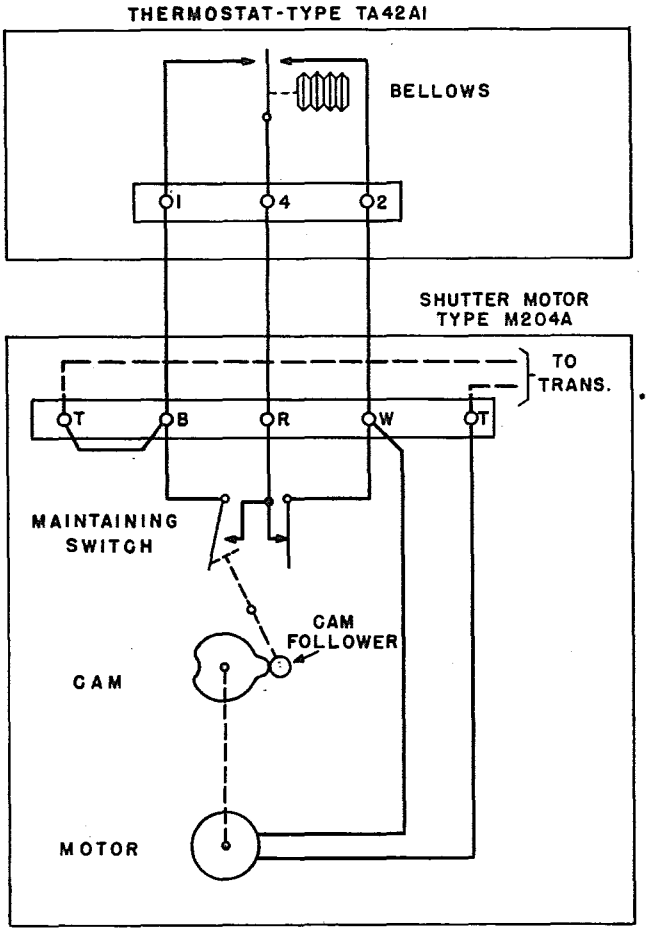

Fig. 2 - Schematic - M204A-type Shutter Motor

(b) The contact surfaces of the limit switches and of the balancing relay shall be clean and free from build-ups which might interfere with reliable contact. Gauge by eye.

(c) The contact pressure of the contacts of the limit switches shall be

Min - 25 grams
Max - 45 grams

Use No. 70D gauge.

(d) The limit switches shall limit the rotation of the motor to

Min - 72 degrees
Max - 77 degrees

in each direction from the midposition.

Gauge by eye.

(e) The contact surfaces of the balancing potentiometer and its wiper arm shall be clean and shall make reliable contact. Gauge by eye.

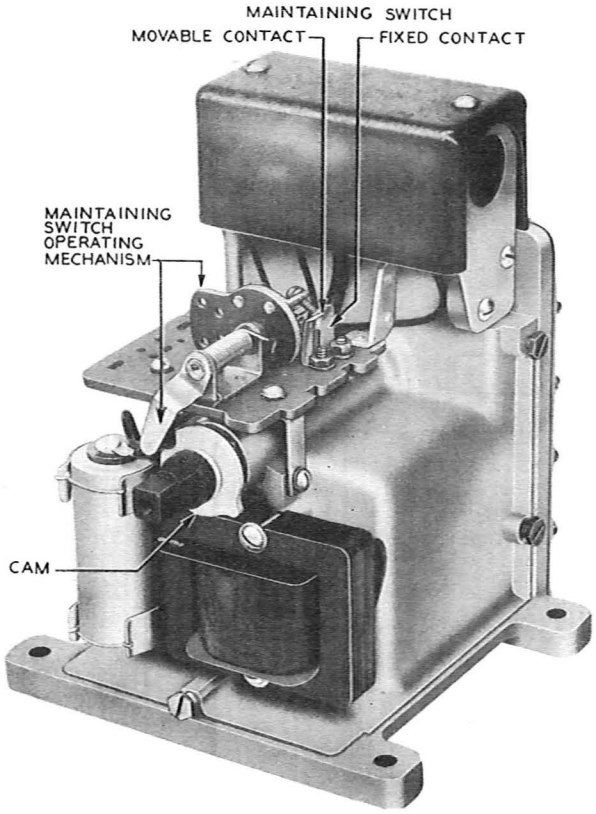

Fig. 3 - M204A-type Shutter Motor - Cover Removed

(f) The contact pressure of the wiper arm, measured at the tip, shall be

Min - 15 grams
Max - 20 grams

Use 70D gauge.

(g) With the circuit disconnected, the movable contact shall rest against the right-hand stationary contact.

(h) The contact separation between movable and stationary contacts of the relay, measured with the relay in either operated position, shall be

Min - 0.020 inch
Max - 0.030 inch

Use KS-6909 thickness gauge nest.

Caution: When working on shutter motors connected to power supply, avoid contact with the top terminal of the capacitor

*#2.20 Controllers - T915C Type

(a) The wiper arm shall be at the right end of the active part of the balancing potentiometer (Fig. 6 shows this condition) when the water in the radiator is cold, and shall move to the left as the temperature of the water rises above the value specified in the circuit description (usually 135 to 140F) at which the shutter shall begin to open. When the water temperature reaches the specified value for the shutter to be fully open (usually 170F), the wiper arm shall be at the left end of the potentiometer. Gauge by eye and use the temperature indicator installed on the engine. After the linkage for operating the M904E-type shutter motor is connected, it may be neces-

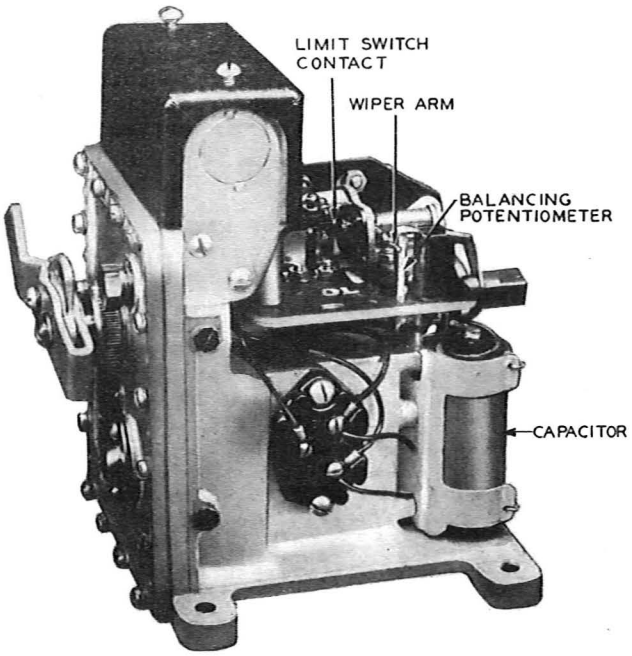

Fig. 4 - M904E-type Shutter Motor - Cover Removed

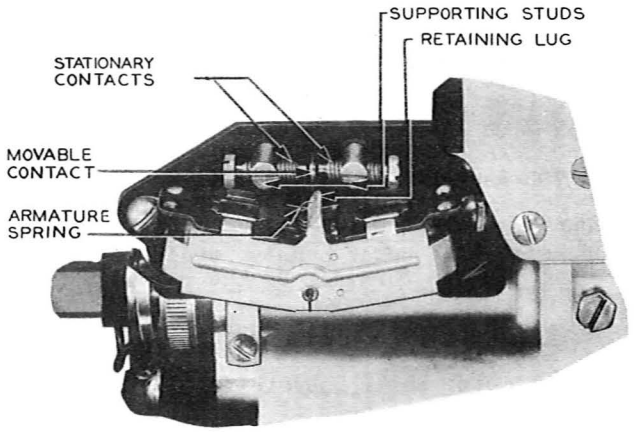

Fig. 5 - Balancing Relay - Shown in Neutral Position

sary to interchange the blue and white connections at the motor terminals to obtain the proper action of the damper. If the shutters of the damper close when the temperature rises or if the shutter opens when the temperature is low, the connections to the motor are wrong and must be reversed.

(b) The contact surfaces of the balancing potentiometer and its wiper arm shall be clean and shall make reliable contact.

Gauge by eye.

(c) The contact pressure of the wiper arm measured at the tip, shall be

Min - 15 grams
Max - 20 grams

Use 79C push-pull tension gauge.

*#2.21 Thermostat

(a) The room thermostat, through its associated shutter motor, shall open and close the recirculating shutter.

#2.22 Air Filter: The condition of the filter cells may be determined by measuring the air velocity through the cells or by measuring the pressure drop across the cells. For single thickness KS-7406 filter cells (that is only one filter cell in the path of the air flow), the air flow or pressure drop for each cell shall be

Air Velocity	Min - 220 feet per minute
Pressure Drop	Max - 0.22 inch of water

Use anemometer or draft gauge.

*#2.23 Temperature

(a) The temperature shall not exceed the following value

	Max
Motors and Transformers	85C (185F)

If the temperature is thought to be excessive, measure by thermometer.

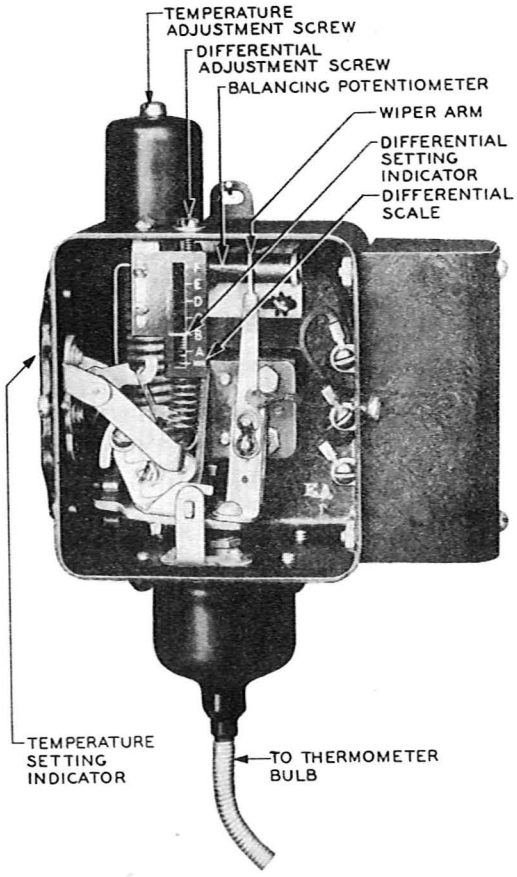

Fig. 6 - T915C-type Controller

3. ADJUSTING PROCEDURES

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

Tools

Adjuster, No. 507A tool
Brush, typewriter, toothbrush type
Burnisher, contact, No. 265C Tool
Gun, grease, push type, Lincoln No. 5958
Oiler, Gem 1704, 1/2 pint
Pliers, duck bill, KS-6015
Screwdriver, 3-1/2 inches, KS-6854
Wrench, adjustable, 8 inches, (R-2512)
Wrench, open, double end, 3/16 and 1/4 inch, No. 388A Tool

Gauges

Anemometer, Eugene Dietzgen Co., No. 6994DI
(or Taylor Instrument Co., No. 3132)
Gauge, push-pull tension, No. 79B, 0-1000 grams
Gauge, push-pull tension No. 79C, 0-200 grams
Gauge, gram, No. 70D, 50-0-50 grams
Gauge nest, thickness, KS-6909
Scale, steel, 6 inches, R-8550
Thermometer, 0°C-200C, R-1032

Materials (See Sections A710.011 and A710.012)

Block, wooden
Cloth, cleaning, KS-14666
Felt,
Grease, 310-330P or 260-300P, as required
Oil, 130-190 S 100 or 220-260 S 100
Oil, mineral, light
Sandpaper, 4/0
Spirits, petroleum, KS-7860

3.01 Lubrication (Rq 2.01)

(1) With the oiler, apply one drop of oil to each of the bearings at the ends of the shutter vanes and to each trunnion by means of which the operating rods are attached to the vanes.

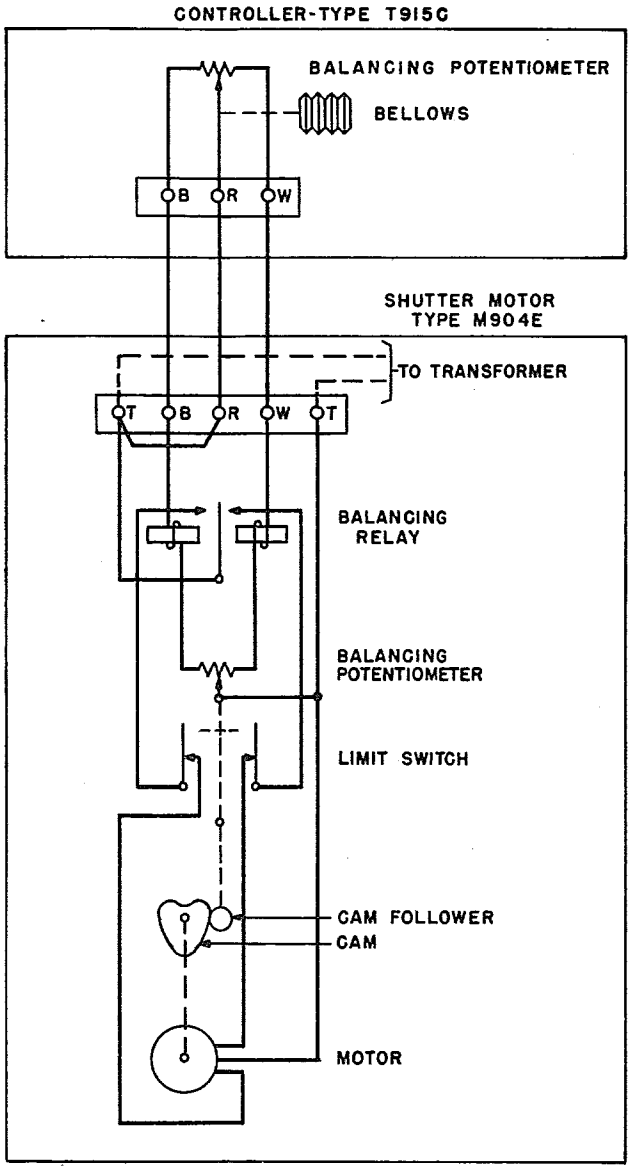

Fig. 7 - Schematic - T915C-type Controller and M904E-type Shutter Motor

(2) To lubricate a ball bearing equipped with a drain plug and pressure fitting, clean the area around the plug and the pressure fitting. Remove the plug and, with a screwdriver, free the opening of hardened grease and remove whatever grease may be reached by this means. With the motor running, add grease with the Lincoln gun until soft grease comes from the drain hole. Allow the motor to continue running until all excess grease has been expelled. Stop the motor, remove enough grease from the drain hole to clear the space to be occupied by the plug, and replace the plug. If desired, procedure (4) may be substituted.

(3) Where the bearing is equipped with a grease cup and drain plug instead of a pressure fitting and drain plug proceed as above, but add new grease by filling the cap and screwing it down on the cup, repeating until soft grease appears at the drain hole. Leave the cap screwed down on the cup and allow all excess grease to be expelled. Proceed to clear space for the plug and replace it. If desired, procedure (4) may be substituted.

(4) To relubricate a ball bearing which is not equipped with a drain hole, dismantle the motor to the extent required to obtain access to the bearing and wipe away excess grease with a new cleaning cloth. Clear away hard grease with a stiff bristle brush dipped in petroleum spirits. Remove the excess of petroleum spirits and apply a small amount of light mineral oil and, in turn, remove it. For this purpose it will be found convenient to blot up the spirits or oil with a cleaning cloth. Then apply the grease around the balls making no attempt to force grease into the spaces between them. Fill the bearing chamber, if any, about one-third full of grease and reassemble.

Fans and Fan Motors

#3.02 Bearings (Rq 2.02)

(1) Replace any worn bearings.

3.03 Freedom of Rotation (Rq 2.03)

(1) Examine the fan and remove any foreign objects which might interfere with rotation. Check that all bolts are firm and tighten if necessary. Look for brushes which may be binding and for damaged bearings. If the fan blades strike the guard, look for misalignment in the mounting and correct as required.

3.04 Noise and Vibration (Rq 2.04)

(1) Where excessive noise and vibration are present, see that all bolts, including mounting bolts, are drawn up firmly. Check for damaged bearings.

*#3.05 Commutation (Rq 2.05)
*#3.06 Sparking (Rq 2.06)
*#3.07 Commutator Color (Rq 2.07)
*#3.08 Commutator Slots (Rq 2.08)
*#3.09 Commutator Surface (Rq 2.09)
*#3.10 Commutator Cleaning and Care (Rq 2.10)
*#3.11 Physical Defects (Rq 2.11)
*#3.12 Brush Condition (Rq 2.12)
*#3.13 Brush Length (Rq 2.13)
*#3.14 Brush Fit (Rq 2.14)
*#3.15 Brush Pressure (Rq 2.15)
See Sections A401.905 and A501.905 for information on these topics.

3.16 Starting Switch (Rq 2.16)

(1) Operation of the switch can be checked by observing the click produced as the motor approaches full speed after starting,

and again shortly before it comes to rest after being disconnected from the supply.

(2) Failure of the motor to start, accompanied by a humming sound, may be due to sticking of the starting switch mechanism, failure of the contacts to close the circuit, or a broken lead. Remove the end shield and examine the mechanism, clearing any binding. The contacts will be open when the end shield is removed. Clean and burnish them as required. Look for broken leads and repair.

(3) If any part of the mechanism is worn or bent, the entire switch should be replaced.

3.17 Shutters (Rq 2.17)

(1) Remove dust from the shutters with air or wipe with a cleaning cloth.

(2) Observe the operation of the shutters for irregular action indicative of binding. Check for and remove foreign objects and adjust parts which have become bent out of alignment.

*#3.18 M204A-type Shutter Motors (Rq 2.18)

(1) If the motor does not operate as required, see that the contacts of the maintaining switch make reliably when in the nonoperated position. See that the operating mechanism of the switch follows the cam and opens the contacts as required to stop the motor at the end of each half-revolution. If necessary, loosen the locknut and adjust the screw which opens the contact. Tighten the locknut when the adjustment is completed. Use KS-6854 screwdriver and No. 388A tool. See Fig. 3.

(2) The purpose of cleaning contacts is to remove any gummy or dirty substance that would interfere with reliable contact. It is not necessary or desirable to keep contacts polished or shining. Clean contacts by wiping with a cleaning cloth moistened with petroleum spirits, followed by a dry cloth.

(3) There shall be as little smoothing of contacts as is consistent with satisfactory operation. Contacts should be smoothed while closed. Disconnect the power supply and insert a burnishing tool between the contacts to be cleaned and draw it back and forth until the build-ups are reduced enough to insure satisfactory operation. Then clean the contacts as outlined in (2) above.

(4) When measuring the contact pressure, hold the gauge vertically over the motor and apply the end of reed as close to the contact as possible. If necessary, to correct the pressure, adjust the contact spring with the No. 507A tool.

*#3.19 M904E-type Shutter Motors (Rq 2.19)

(1) If the motor fails to open or close its shutter, as required, look for open leads, short circuits, or poor contacts in the motor and controller. If the operation in intermediate positions of the shutter is erratic, look for poor contact of the wiper arms of the balancing potentiometer in the motor or controller. See Fig. 4. If hunting is experienced, see that the balancing relay in the motor is meeting its requirement. See Fig. 5.

(2) Maintain the contacts of the limit switches in accordance with 3.18 which applies to the maintaining switch of the M204A-type motor.

(3) Clean the contact surfaces of the balancing potentiometer and its wiper arm with a cleaning cloth moistened with petroleum spirits, followed by a dry cloth.

(4) Adjust the contact pressure of the wiper arm by forming the flat part of the arm, as required. Use the KS-6015 duck-bill pliers.

(5) Clean the contacts of the balancing relay with a cleaning cloth moistened with petroleum spirits, followed by a dry cloth. With the burnishing tool, reduce build-ups as required to insure satisfactory operation.

(6) If necessary, bring the movable contact to its required position by adjusting the retaining lug with the duck-bill pliers. Avoid changing the tension of the armature spring.

(7) To measure the contact separation, operate the relay by hand and apply the gauge between the open contacts. Adjust by using the No. 388A tool to turn the contact supporting screws as required. See that they project equally from the supporting studs.

*#3.20 Controllers - T915C Type (Rq 2.20)

(1) By means of the temperature adjustment screw, bring the temperature setting indicator to the specified value on its scale. See Fig. 6. Start the engine and, as the water temperature rises, observe the action of the wiper arm. Adjust the temperature setting indicator further to secure the required operation. As the temperature continues to rise, observe the wiper and adjust the differential setting indicator, by means of the differential adjusting screw, to bring the wiper to the left end of the potentiometer when the temperature reaches the upper specified value.

Note: In normal operation, the wiper arm associated with the balancing potentiometer in the motor will assume a position corresponding to that of the wiper arm in

the controller as the motor comes to rest. This provides the balancing action which causes the relay to assume its neutral position with both contacts open, thus stopping the rotation of the motor.

(2) Clean the contact surfaces of the balancing potentiometer and its wiper arm with a cleaning cloth moistened with petroleum spirits, followed by a dry cloth.

(3) Adjust the contact pressure of the wiper arm by forming the flat part of the arm as required. Use the KS-6015 duck-bill pliers.

*#3.21 Thermostat (Rq 2.21)

(1) Look for mechanical trouble. A defective switch should be replaced.

#3.22 Air Filter (Rq 2.22)

(1) Where a draft gauge has been permanently installed, the condition of the air filter cells can be determined by reading the gauge directly. If a draft gauge has not been installed, it will be necessary to determine the air velocity as described in (2) below. Replace cell if pressure is more than the specified maximum value when the associated fans or engines are operating.

(2) To check the air delivery through the filter cells, set the indicator reading on the anemometer to zero. Hold the anemometer so that the scale is toward the observer and the fan of the anemometer is approximately 3 inches away from the outside surface and directly in front of the filter cell. Then release the stop on the scale so that readings may be taken and note the time on a watch. Move the anemometer slowly over the entire outer surface of the cell for one minute and secure the stop mentioned above in order to prevent the indicator from registering further. Note the reading on the anemometer which will be in linear feet per minute. Replace cell if air velocity is less than the specified minimum value when the associated fans or engines are operating.

*#3.23 Temperature (Rq 2.23)

(1) To measure the temperature of a motor or transformer, hold the bulb of the thermometer against the hottest spot, covering that part of the bulb which is not in contact with the apparatus with a piece of felt or the equivalent, and observe the highest temperature indicated. Stop the motor, if necessary, for safety.