

**AUTOMATIC ELECTRIC COS
25-AMPERE AND 80-AMPERE
COUNTER EMF CELL SWITCHES
REQUIREMENTS AND ADJUSTING PROCEDURES**

1. GENERAL

1.01 The Requirements and Adjusting Procedures specified herein, cover the Automatic Electric Company's 25 ampere and 80 ampere counter E.M.F. cell switches.

1.02 This section is reissued to incorporate material from the addendum in its proper location. In this process marginal arrows have been omitted.

1.03 The following is a list of Tools, Gauges, Test Apparatus and Materials required.

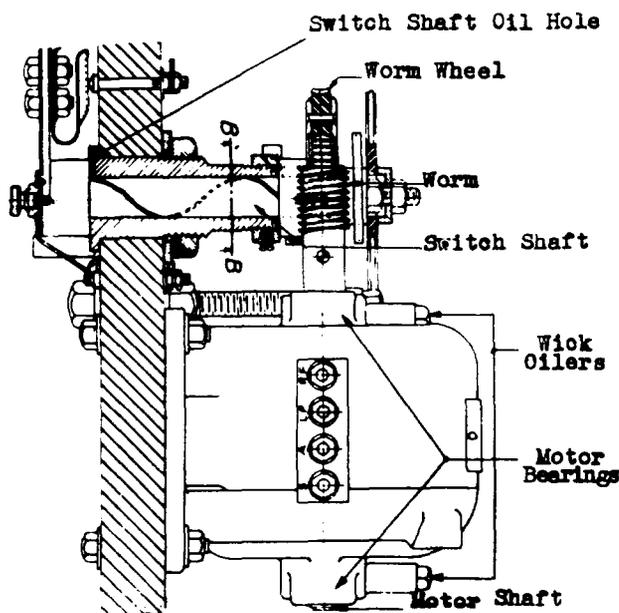
CODE OR SPEC NO.	DESCRIPTION
TOOLS	
265-B	Burnisher, Relay Contact
—	Oiler, (For oiling switch shaft bearing)
24666	Pliers, Duck-bill
46-X-57	Pliers, Side Cutting — per AT&TCo. Std Dwg.
46-X-34	Screwdriver, Cabinet, 4" — per AT&TCo. Std Dwg.
46-X-34	Screwdriver, Cabinet, 5" — per AT&TCo. Std Dwg.
46-X-40	Screwdriver, Cabinet, 3-1/2" — per AT&TCo. Std Dwg.
—	Straight Edge, 18"
—	Wrench, Open End, Flat, 7/16" Opening
—	Wrench, Open End, Flat, 2" Opening
—	Wrench, Double End, Flat, 5/16" and 3/8" Openings

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
—	Wrench, Double End, Flat, 1/2" and 9/16" Openings
—	Wrench, Double End, Flat, 5/8" and 3/4" Openings
—	Wrench, Double End, Flat, 7/8" and 1" Openings
—	Wrench, Double End, Flat, 1-1/16" and 1-1/4" Openings
GAUGES	
—	Balance, Spring (0-6 lb in 2 oz. graduations) or the Equivalent
—	Gauge, Feeler, Starrett #66 or the Equivalent
TEST APPARATUS	
—	Thermometer, 0-200°C in 5° graduations or the Equivalent
MATERIALS	
KS-7860	Petroleum Spirits
—	Cheesecloth or the Equivalent
—	Cord
—	Dynamo Oil, or any good, light or medium mineral oil
—	Sandpaper #00 and #000
—	Vaseline (Unmedicated)
—	Felt or the Equivalent

2. ADJUSTING PROCEDURES

General

2.001 Spare Parts: In general spare parts for counter e.m.f. cell switches may be obtained by describing the part fully and giving the complete nameplate data including the serial number of the regulator.



2.01 Lubrication (Reqt 3.01)

M-1 Check the motor bearings for lubrication, cleanliness and wear. To clean the bearings take down the motor as described in paragraph 2.29. Unscrew the wick oilers from the motor bearings. Clean the motor bearings and the shaft thoroughly with clean cheesecloth moistened with KS-7860 petroleum spirits. Reassemble the motor.

M-2 Fill the oil cups with vaseline and adjust the wicks as necessary to make contact with the motor shaft and replace the oilers. Wipe off any vaseline that may get on the outside of the oiler or motor frame. Oil and grease creepage along the outside of either the motor or the switch shaft is usually due to dirt or lint acting as a wick.

M-3 Before applying fresh lubricant to the worm and the worm wheel wipe off any old vaseline or dirt from the edges of the gears and gear faces with cheesecloth slightly moistened with KS-7860 petroleum spirits. Apply just a sufficient amount of vaseline to the face of the gears to prevent friction or undue wear.

M-4 Clean the switch shaft with cheesecloth moistened with KS-7860 petroleum spirits before applying lubricant. Oil used to lubricate the bearing should be applied with an oil

can to the small oil hole leading to the oil groove in the switch shaft.

2.02 Mounting (Reqt 3.02)

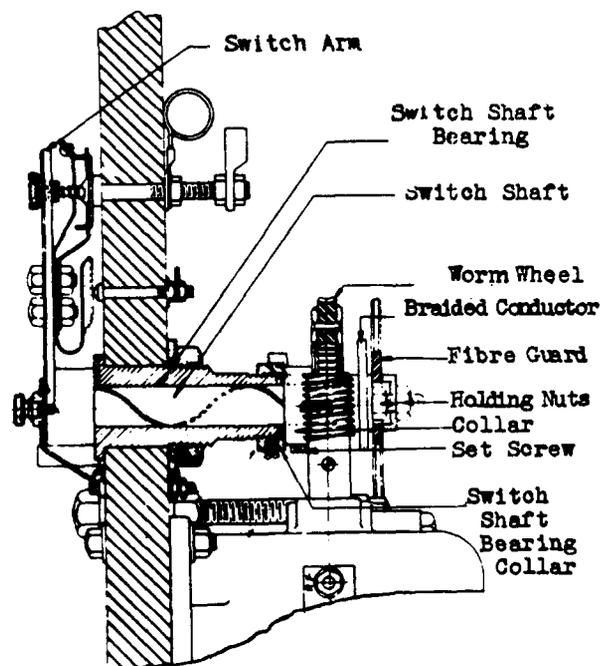
M-1 Tighten mounting screws or nuts with a wrench or screwdriver of suitable size.

Switch Shaft and Arm

2.03 Freedom of Rotation (Reqt 3.03)

M-1 Rotate the switch arm through its complete operating arc. Should the switch shaft bind in any position due to gummed oil, dirt or grit being present in the switch shaft bearing, take down and clean the switch in the following manner: Remove the braided conductor and its fibre guard from the switch shaft by unscrewing the associated holding nuts. Loosen the set screw on the worm wheel collar and remove the worm wheel and collar from the switch shaft.

M-2 **Caution:** Mark the position of the worm wheel on the switch shaft with a center punch before its removal so that it can be replaced in its original position.



M-3 Remove the switch shaft assembly from the switch shaft bearing and clean both the switch shaft bearing and the switch shaft with cheesecloth moistened with KS-7860 petroleum spirits. Dry with clean cheesecloth. Wipe the switch shaft with cheesecloth moistened with dynamo oil before replacing in the switch shaft bearing. Replace the worm wheel on the switch shaft, align with the worm, (see paragraph 2.23) and tighten the holding set screw securely. Replace the braided conductor and fibre guard and tighten the associated holding nuts.

2.04 End Play (Reqt 3.04)

M-1 Loosen the set screw in the switch shaft bearing collar and turn the collar in the proper direction until the end play is satisfactory. Tighten the set screw.

2.05 Clearance Between Switch Arm and Stop Pin (Reqt 3.05)

M-1 Loosen the nut on the stop pin stud, move the stud as required and tighten the nut.

Main Contact Brush

2.06 Contact Surface (Reqt 3.06)

M-1 Wipe the main contact brush and the main and intermediate contacts with clean cheesecloth moistened with KS-7860 petroleum spirits. Contact surfaces which are rough shall be smoothed with fine sandpaper.

2.07 Contact Pressure (Reqt 3.07)

M-1 Check the main contact brush for the correct pressure in the following manner: Loop a piece of light cord under the main contact brush of the 25 ampere switch (or between the contact shoes of the 80 ampere switch where it makes contact with the main or intermediate contacts). Measure the perpendicular pull (with a spring balance hooked into the looped cord) necessary to start moving the brush away from the contact. Adjust the thumb screws, turning to the right to increase the pressure, and to the left to decrease the pressure.

2.08 Freedom of Movement (Reqt 3.08)

M-1 Examine the main and intermediate contacts for uniform height and adjust according to paragraph 2.14.

Auxiliary Contact Brush

2.09 Contact Surface (Reqt 3.09)

M-1 Wipe the auxiliary contact brush and auxiliary contacts with clean cheesecloth moistened with KS-7860 petroleum spirits. Contact surfaces which are rough shall be smoothed with fine sandpaper.

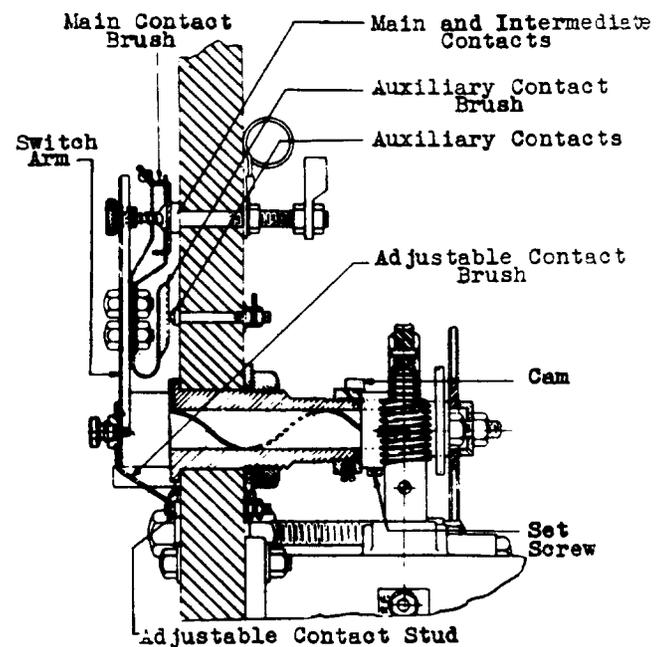
2.10 Point of Contact (Reqt 3.10)

M-1 Adjust the brush by reshaping the brush spring with a pair of duck-bill pliers.

Adjustable Contact Brush

2.11 Contact Surface (Reqt 3.11)

M-1 Wipe the adjustable contact brush and adjustable contact stud with clean cheesecloth moistened with KS-7860 petroleum



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spirits. Contact surfaces which are rough shall be smoothed with fine sandpaper.

2.12 *Point of Contact* (Reqt 3.12)

M-1 Shape the adjustable contact brush with a pair of duck-bill pliers.

Main and Intermediate Contacts

2.13 *Contact Surface* (Reqt 3.13)

M-1 Wipe the main and intermediate contacts with clean cheesecloth moistened with KS-7860 petroleum spirits. Contact surfaces which are rough shall be smoothed with fine sandpaper.

2.14 *Contact Height*. (Reqt 3.14)

M-1 Rotate the switch arm until it is at either end of its operating arc. Place a wooden straight edge across the contact surfaces of the main and intermediate contacts and note which contacts are not of uniform height. Replace badly worn contacts or any high or low contacts giving trouble.

Auxiliary Contacts

2.15 *Contact Surface* (Reqt 3.15)

M-1 Wipe the auxiliary contacts with cheesecloth moistened with KS-7860 petroleum spirits. Contact surfaces which are rough shall be smoothed with fine sandpaper.

2.16 *Contact Height* (Reqt 3.16)

M-1 Replace auxiliary contacts which have badly worn contact surfaces or are of unequal height with new contacts.

Adjustable Contact Stud

2.17 *Contact Surface* (Reqt 3.17)

M-1 Wipe the adjustable contact stud with cheesecloth moistened with KS-7860 petroleum spirits. Contact surfaces which are rough shall be smoothed with fine sandpaper.

2.18 *Cam* (Reqt 3.18)

M-1 Secure the cam to the worm wheel collar by tightening the set screw with a 3-1/2" cabinet style screwdriver.

Limit Spring Assemblies

2.19 *Contact Surface* (Reqt 3.19)

M-1 Wipe the contacts of the limit spring assemblies with cheesecloth moistened with KS-7860 petroleum spirits. Contact surfaces which are rough shall be smoothed with fine sandpaper.

2.20 *Alignment of Contact Points* (Reqt 3.20)

M-1 Align the limit spring contacts by applying pressure to the end of the spring affected, exercising care not to distort or otherwise damage the spring. If in order to adjust properly the spring contacts, a considerable movement of the springs is necessary, the entire group shall be moved by loosening the screws which fasten the springs to their mounting and shifting the springs as required. Adjustment made by loosening any mounting screws will require a careful readjustment and respacing of all springs of the assembly. Tighten the spring assembly mounting screws securely after adjusting the springs.

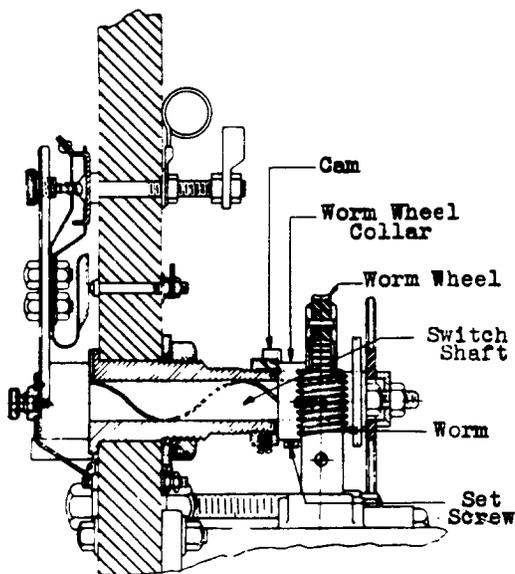
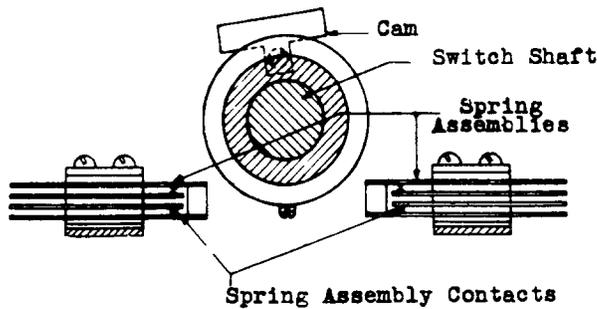
2.21 *Contact Separation* (Reqt 3.21)

M-1 Shape the individual springs with a pair of duck-bill pliers until the contact clearances for the springs of the limit spring assemblies in either their operated or unoperated position are as specified. The specified clearances between similar springs should be made as nearly uniform as possible.

2.22 *Operation* (Reqt 3.22)

M-1 Check the cam to see that the set screw holding it to the worm wheel collar is tight. Rotate the switch shaft so that the main contact brush is centered on the first main contact at the left end of the operating arc. If the cam does not operate the limit spring assembly rotate the switch arm to the main contact at the opposite end of the arc and

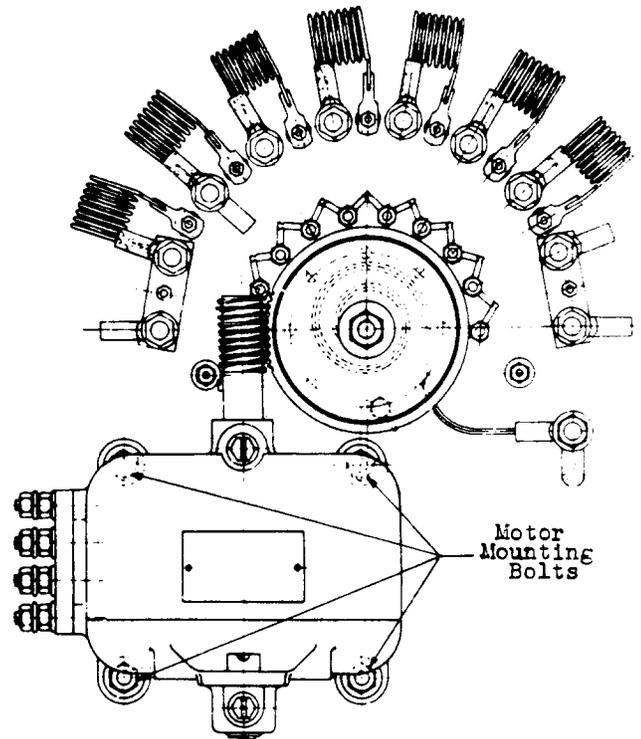
observe whether the limit spring assembly is operated. Loosen the set screw in the worm wheel collar on the switch shaft and adjust the worm wheel until the cam operates both limit spring assemblies. Tighten the set screw securely after adjusting the worm wheel.



Worm and Worm Wheel

2.23 Alignment (Req't 3.23)

M-1 Loosen the set screw in the worm wheel collar and shift the position of the worm wheel along the shaft as necessary. Tighten the set screw.



2.24 Freedom of Movement (Req't 3.24)

M-1 Loosen the hexagon nuts of the motor mounting bolts and adjust the position of the motor on the panel until the worm and worm wheel mesh securely. Rotate the motor shaft to see if there is any tendency for the worm and worm wheel to bind. If the motor shaft does not turn freely, it indicates that the worm and worm wheel are binding. Re-adjust the position of the motor until there is no indication of binding and tighten the nuts of motor mounting bolts.

Motor

2.25 Brush Length (Req't 3.25)

M-1 Brushes which are too short shall be replaced by new brushes.

2.26 Brush Fit (Req't 3.26)

M-1 Remove brushes found to be sticking in their holders, and wipe with a cloth (or smooth with a piece of #00 or finer sandpaper,

if there are any irregularities on the brush surfaces). Clean out the holders with cheesecloth moistened with KS-7860 petroleum spirits. Never use oil on the brushes and always replace brushes in the same holders from which they were removed and in the same position in the holder. If the brushes are sticking because they are broken or otherwise defective, replace with new brushes.

2.27 Brush Pressure (Reqt 3.27)

M-1 Brushes which after having had time to "wear in" do not insure good commutation should be replaced by new brushes.

2.28 Commutator Surface (Reqt 3.28)

M-1 On first signs of unusual deterioration, usually shown by bright scratches or roughness of the commutator surface, the brushes should be taken out and cleaned with a cheesecloth moistened with KS-7860 petroleum spirits and if necessary replaced with new brushes. Commutators may be reached through openings in the motor end shields and cleaned by wiping with clean dry cheesecloth. If the commutators become smutted clean with cheesecloth slightly moistened with KS-7860 petroleum spirits. *Never use a file, emery cloth, vaseline or paste on the commutator.* Use #00 or finer sandpaper if it is necessary to remove any slight roughness. If the commutator is more than slightly roughened the armature shall be removed and the commutator refaced.

2.29 Noise and Vibration (Reqt 3.29) (See Fig. 1 and Fig. 2)

M-1 Check the motor bearings for lubrication, cleanliness and wear. Should the motor require cleaning and lubrication refer to paragraph 2.01.

M-2 Caution: *When removing the end plate observe the position of the brush holder plate and mark so that in reassembling the motor the brushes will be replaced in their original position.*

M-3 Take down the motor and replace the bearings or armature assembly as follows: Disconnect the motor leads from the motor terminal strip, loosen the motor mounting bolts and remove the motor from the panel. Remove the worm and the three screws that secure the end plate to the motor frame. Remove the motor end plate, the brush holder plate and the brushes. The armature may now be removed and the shaft examined for wear. In case the shaft is worn replace the armature. The sleeve bearings are secured in place with a set screw and may be removed, after first removing the wick oiler tube and the associated set screw, with a pair of pliers and screwdriver. Replace the sleeve bearings if necessary and reassemble the motor in the reverse order.

Operation

2.30 Temperature Limits (Reqt 3.30)

M-1 Place the bulb of the thermometer as near as possible to the hottest spot of the part of which it is desired to take a temperature reading, covering that part of the bulb not in contact with the metal with felt or equivalent and read the highest temperature indicated.

3. REQUIREMENTS

Definitions and General Information

3.001 Requirements which cannot be checked due to the location of the apparatus, or when the application of the requirement would affect other adjustments, are marked with an asterisk (*). These requirements need not be checked unless the apparatus is made accessible for other reasons or if its performance indicates that such a check is advisable.

3.002 "Follow" may be defined as the distance traveled with the two contacts closed during the opening or closing of the contacts.

Requirements

3.01 Lubrication: The counter EMF cell switch shall be adequately lubricated as follows:

(a) *Vaseline — Unmedicated*

(1) The wick oilers for the motor bearings shall be filled with vaseline (unmedicated) once every six months.

(2) The worm and worm wheel shall be lubricated with vaseline (unmedicated) once every two weeks.

(b) *Dynamo Oil*

(1) The switch shaft bearing shall be lubricated with dynamo oil once every week.

(c) Periodic inspection shall be made to determine whether local conditions will necessitate decreasing the intervals between lubrication periods.

3.02 Mounting: The switch and motor shall be securely mounted on the panel.

Gauge by eye.

Switch Shaft and Arm

***3.03 Freedom of Rotation:** The switch shaft and arm shall turn through the complete operating arc without binding.

Gauge by eye.

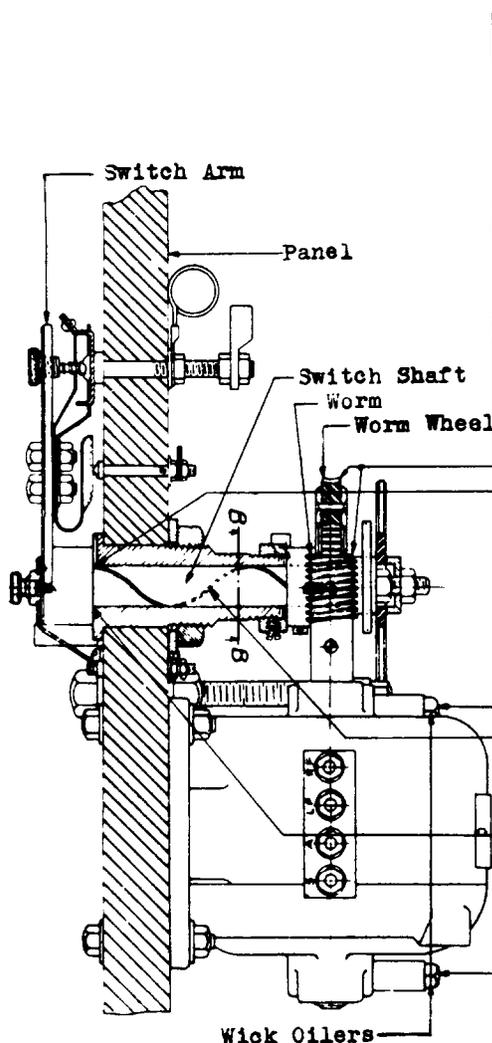
3.04 End Play: The switch shaft shall have appreciable end play (approximately .008" but not more than .010").

Use feeler gauge.

3.05 Clearance Between Switch Arm and Stop Pin:

There shall be a minimum of .020" and a maximum of .040" clearance between the switch arm and the associated stop pin when the main contact brush comes to rest on the last main contact at either end of the operating arc when operated electrically.

Use feeler gauge.



Main Contact Brush

3.06 **Contact Surface:** The contact surface of the main contact brush shall be clean and smooth. Gauge by eye.

3.07 **Contact Pressure:** The pressure of the main contact brush on the main and intermediate contacts shall be a minimum of 18 ounces (500 grams) and a maximum of 50 ounces (1500 grams). Use spring balance.

3.08 **Freedom of Movement:** The main contact brush shall pass over the main contacts (from one end to the other end of the operating arc) smoothly and without binding. Gauge by eye.

Auxiliary Contact Brush

3.09 **Contact Surface:** The contact surface of the auxiliary contact brush shall be clean and smooth. Gauge by eye.

3.10 **Point of Contact:** The auxiliary contact brush shall engage the auxiliary contacts within the lower half of the sloping part of the contact. Gauge by eye.

Adjustable Contact Brush

3.11 **Contact Surface:** The contact surface of the adjustable contact brush shall be clean and smooth. Gauge by eye.

3.12 **Point of Contact:** The adjustable contact brush shall engage the associated contact stud within the lower half of the sloping part of the contact. Gauge by eye.

Main and Intermediate Contacts

3.13 **Contact Surface:** The main and intermediate contacts shall be clean and smooth. Gauge by eye.

3.14 **Contact Height:** The main and intermediate contacts shall be of uniform height so that the contact brush will not bind during operation. Use straight edge.

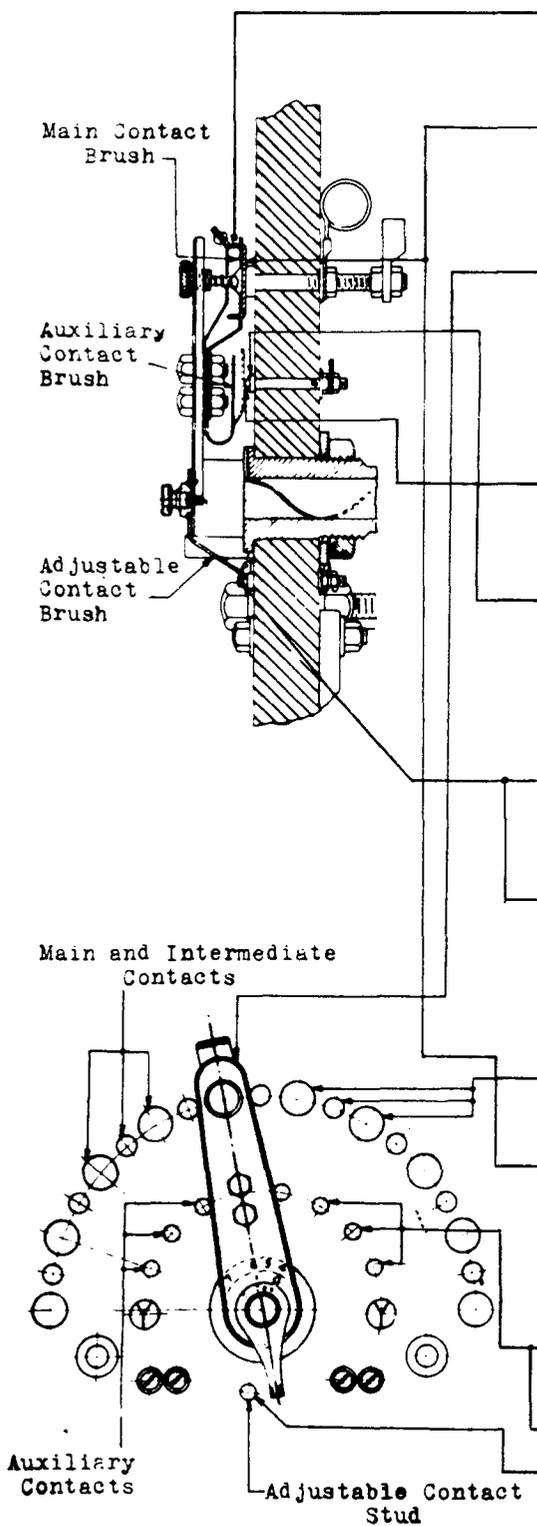
Auxiliary Contacts

3.15 **Contact Surface:** The auxiliary contacts shall be clean and smooth. Gauge by eye.

3.16 **Contact Height:** The auxiliary contacts shall be of uniform height. Use straight edge.

Adjustable Contact Stud

3.17 **Contact Surface:** The contact surface of the adjustable contact stud shall be clean and smooth. Gauge by eye.



Cam

3.18 **Cam:** The cam shall be securely attached to the worm wheel collar. Gauge by eye.

Limit Spring Assemblies

3.19 **Contact Surface:** All contact surfaces shall be clean and smooth. Gauge by eye.

3.20 **Alignment of Contact Points:** The point of contact shall fall wholly within the circumference of the opposing contact disc except for opposing contacts having the same diameter in which case their centers shall not be out of alignment more than 25% of the diameter of the contact points. Gauge by eye.

3.21 Contact Separation

(a) The contact separation for springs that are not operated shall be $.015'' \pm .005''$. Use feeler gauge.

(b) With the cam operated electrically, contact separation for springs having normally closed contacts in the open position shall be at least $.010''$.

Use feeler gauge.

(c) Make and break contacts shall "follow" at least $.010''$ when making or breaking contact.

Gauge by eye.

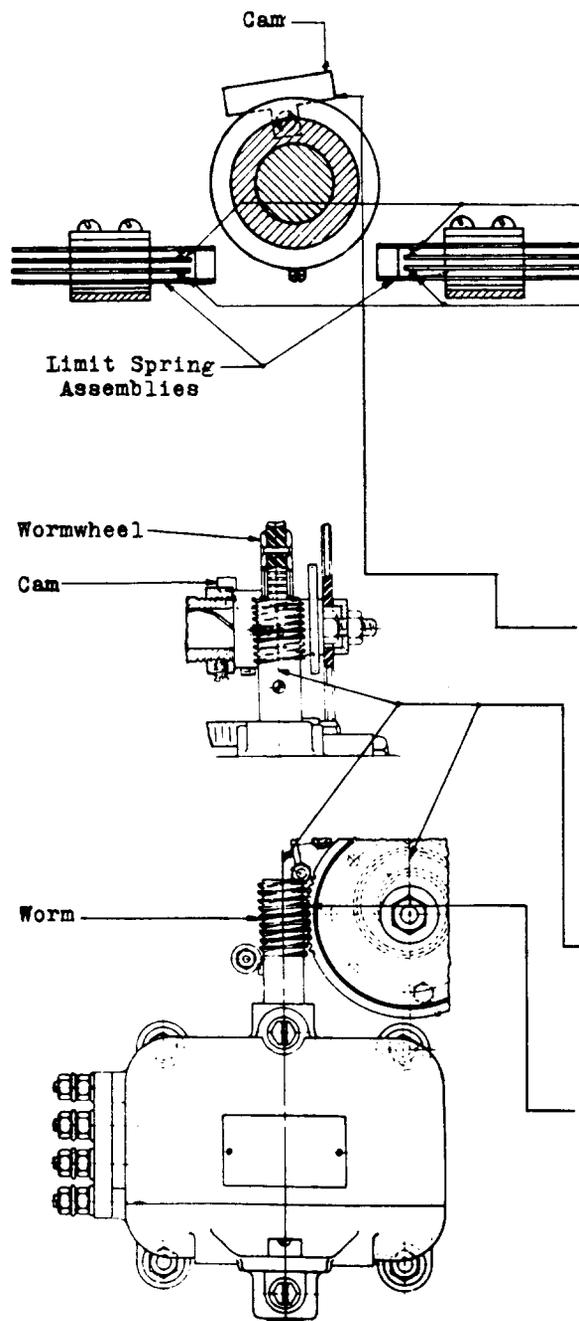
3.22 **Operation:** The cam when operated electrically shall open and close the associated limit spring assemblies as the main contact brush makes contact with the last main contact at either end of the operating arc.

Gauge by eye.

Worm and Worm Wheel

3.23 **Alignment:** The vertical center line through the worm shall be parallel with and in the same plane as the vertical center line through the worm wheel on the switch shaft. Gauge by eye.

3.24 **Freedom of Movement:** The worm and worm wheel shall turn freely and mesh with just a perceptible amount of play between the worm and wormwheel teeth. Gauge by eye.



Motor

3.25 Brush Length

- (a) At time of turnover the motor brushes shall be at least $15/16''$ in length.

Gauge by eye.

- (b) In service the motor brushes shall be at least $5/8''$ in length.

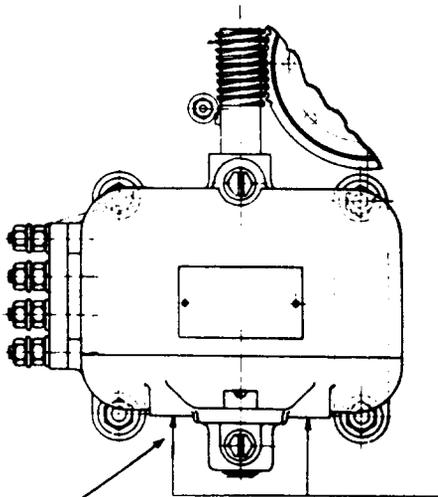
Gauge by eye.

3.26 Brush Fit: Brushes shall be free in their holders and shall fit so as to insure good commutation.

Gauge by eye.

3.27 Brush Pressure: The brushes shall be under sufficient compression to insure good commutation.

Gauge by eye.



← Commutator End of Motor

3.28 Commutator Surface: The surface of the commutator shall be clean and free from scoring, pits or other deformation of the surface or structure other than that caused by normal wear.

Gauge by eye.

3.29 Noise and Vibration: The noise and vibration of the motor armature under any normal operating condition shall not be excessive.

Gauge by feel or ear.

Operation

3.30 Temperature Limits: The temperature of the various parts of the counter E.M.F. cell switch in service as measured by the thermometer shall not rise more than 30°C above the room temperature.

Use thermometer.