15 KV TYPE FSP LOAD INTERRUPTER SWITCH

MOTOR OPERATED-STORED ENERGY DESIGN

INSTRUCTION BOOK

I.B. 32-251-13

SWITCHGEAR DIVISION

WESTINGHOUSE ELECTRIC CORPORATION

EAST PITTSBURGH, PENNA.

MOTOR OPERATED - STORED ENERGY DESIGN

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INTRODUCTION

Throughout this instruction book, the necessary descriptive phrases such as Type FSP Switch, load interrupter switch, this switch, etc., will refer specifically to the 15 kV, motor operated, stored energy design of the Type FSP Load Interrupter Switch. These instructions cover the description, operation, and maintenance of this switch. PLEASE READ AND STUDY THESE INSTRUCTIONS BEFORE ATTEMPTING ANY OPERATIONS to avoid trouble in handling, operation, etc.

This switch is available with or without current-limiting fuses. These instructions reference both types.

The section titled GENERAL DESCRIPTION gives detailed instructions for UNPACKING, HANDLING AND STORING. If the need to get into operation is especially urgent, this section also has condensed BASIC OPERATING INSTRUCTIONS. However, this is not a recommended procedure.

NOTE: These switches are designed to operate within the current and voltage limits specified on the switch and fuse nameplates. Do not apply this switchgear to systems with currents and/or voltages outside these limits without consulting the manufacturer.

CAUTION

If a switch is used as a tie between two system voltages which are out of phase, do not leave an open switch in the connected position in the cell for long periods of time. Such a condition may cause higher than rated voltage to appear between upper and lower studs.

GENERAL DESCRIPTION

The 15 kV Type FSP Load Interrupter Switch is a coordinated 3-pole, draw-out, assembly which combines the functions of a disconnect switch having the ability to interrupt load and magnetizing currents with a co-ordinated current limiting fuse having the ability to interrupt fault current. It has a fault closing capacity which enables it to close and latch against a short circuit current without sustaining significant damage so that it remains in service as the associated fuses blow and limit the fault current. The Type FSP Interrupter Switch differs from a circuit breaker in that its fault current interrupting capacity is in the form of current limiting fuses and it does not trip open as a function of current.

This switch is designed for horizontal drawout to facilitate fuse replacement and switch inspection (See Fig. 1). It has four integral wheels that engage with guide rails in the stationary metal clad cell structure similar to that used for a circuit breaker. A coding system prevents the accidental interchange of a circuit breaker and an interrupter switch. Safety interlocks are also incorporated to prevent inserting or withdrawing the switch out of the cell unless the switch contacts are in the open position. The switch, on entering the cell, is effectively grounded before the primary contacts are engaged.

This 15 kV Type FSP Interrupter Switch is available without the protecting current limiting fuses. In this application, there must be additional back-up protection against fault currents and assurance that this switch will not be called upon to open at current values greater than its interrupting rating.

UNPACKING

The 15 kV Type FSP Interrupter Switch is packed in one crate, completely assembled except for the three (3) fuses which are packed each in its own packing box. The overall packing is such that it is easy for inspection before final assembly and placing in service.

When a shipment is first received, inspect the crate and packages for any signs of damage or rough handling. Also, after unpacking, inspect immediately for any signs of damage before further handling. If any damage is found, file a claim at once with the transportation company and notify the nearest Westinghouse Electric Corporation Sales Office.

A nail puller should be used to open the crates as this is less likely to cause damage to the apparatus than the use of crow bars, etc. There may be loose parts such as hardware packed in the crates or fastened to the larger parts. Be careful that none of these are overlooked.

To lift the switch, insert nylon straps (or equivalent) or lifting hooks and chain in the four (4) holes located at the top of the side panels. Suitable spreaders must be used to prevent chain pressure and consequent damage to the barriers and fuse cover. A simple expedient for the spreaders can be made from two (2) pieces of 2 X 4 X 33 inch lumber or equivalent. (See Fig. 2)

After the switch is out of its crate, roll it on its own wheels only if the floor is smooth. Use the handling dolly when rolling around corners (See Fig. 3).

HANDLING AND STORAGE

This apparatus is insulated for high voltages and it must be protected at all times against rough, damaging handling and from dirt and moisture. During storage, whether packed or unpacked, keep all parts in a clean dry place, warm enough and with enough clean air circulation to prevent condensation of moisture. It is desirable to keep the switch and the fuses in their packing cases until ready to install. At all times, they should be completely protected from weather, building dirt, cement dust, and the like. All dust and dirt will have to be cleaned from the interrupter chambers, contacts, insulators, and barriers before installation.

BASIC OPERATING INSTRUCTIONS

The motor operated feature of this switch plus the electrical trip feature allows operation from a remote location. This switch can also be manually closed or opened.

To Place in Cell - Push the switch into the cell along the guide rail until the disconnect position latch prevents further entry. Lift to unlatch, push gently to disengage, and lever the switch toward the rear of the cell until the crank turns freely. (See Fig. 4)

To Remove From Cell - Turn the crank counter-clockwise until the crank rotates freely. Disengage the disconnect position latch and pull the switch completely out of the cell. (See Fig. 4)

To Manually Close - (See Fig. 5), Place the operating handle through the slot in the lower front panel and simultaneously insert it into the handle casting hole. Lift the operating handle upward through an angle of 120 degrees until the spring rod snaps over toggle with a highly audible sound. When this occurs, all motion ceases and the stored energy spring is completely charged (compressed). Note that during the manual charging there will be audible "clicks" from the motor mechanism. This is normal as this is the sound of the motor mechanism pawls meshing with the ratchet teeth.

To close the switch, push upward on the trip release latch. Doing so releases the restraining linkage system keeping the spring compressed. The stored energy in the spring is released to close the switch with a loud, positive, forceful action.

To Manually Open - (see Fig. 5), Place the operating handle through the slot in the lower front panel and simultaneously insert it into the handle casting hole. Push the operating handle downward through an angle of 120 degrees until the spring rod snaps over toggle with a highly audible sound. When this occurs, all motion ceases and the stored energy spring is completely charged (compressed). Note that during this manual charging there will be audible "clicks" from the motor mechanism. This is normal as this is the sound of the motor mechanism pawls mashing with the ratchet teeth.

To open the switch, push upward on the trip release latch. Doing so releases the restraining linkage system keeping the spring compressed. The stored energy in the spring is released to open the switch with a loud, positive, forceful action.

Motor Charging and Electrical Close - (see Fig. 6). The motor mechanism charges the stored energy spring by more-or-less duplicating the action required for manual charging. The basic combination of the motor, reducing gear, driving pawl, and tooth ratchet drives a link attached to the handle casting. When power is applied to the motor the resulting stepping action of the mechanism drives this link which in turn forces the handle casting through an angle of 130 degrees until the spring rod snaps over toggle with a highly audible sound. Simultaneously, a mechanical linkage snaps over toggle the handles of two electrical limit switches. This opens the electrical circuit to the motor and all motion ceases. The limit switches also reset in preparation for remotely (electrically) closing the interrupter switch.

The stored energy spring is now completely charged (compressed). A current pulse through the trip coil results in the release of the trip latch which, in turn, releases the restraining linkage holding the stored energy spring in compression. This stored energy is released to close the interrupter switch with a loud, forceful action. When the switch closes, a trip pin mounted on the connecting shaft-mechanism linkage trips the associated limit switch over toggle which results in electrically closing the motor circuit and it immediately recharges the stored energy spring. Limit switches also reset in the trip-to-open circuit preparatory to receiving the remote signal to trip.

A properly charged spring is indicated by the audible snap over toggle of the spring rod. The (motor) limit switches snap over toggle, the motor circuit is opened and all motion ceases. The FSP switch can now be opened using the electrical trip coil circuit.

To Open - The FSP switch is opened electrically in a manner similar to that described above for closing and the same sequence of events occur. The final result is an opened switch, a recharged stored energy spring and the electrical control circ uit set-up for closing the FSP switch.

INSTALLATION

INTERRUPTER SWITCH ASSEMBLY

Each interrupter switch is completely factory adjusted and operated 25 times before shipment. No further adjustment should be necessary. However, to insure that the adjustment has not been affected in transit, unpacking or installation, it is recommended that each switch be inspected before it is put into service. A visual check can be made, as follows, through the window installed in the front panel. Detailed descriptions, operating instructions, and maintenance procedures, will be found in DETAILED SWITCH OPERATION and MAINTENANCE.

(a) The main and flicker blades should be in proper alignment with jaws and arc chute openings, respectively. (See Fig. 7)

(b) The upper brass spacer of main blades should be approximately 0.19 inches above the bottom of the depression of the angular switch jaw. (Fig. 7, View "A")

(c) Automatic and non-automatic interlocks should operate smoothly and correctly. (See Section - INTERLOCKS, Pg. 4.0)

(d) Arc chutes and insulating surfaces should be free of dust, dirt, etc.

(e) The closed position stops should be such that the shaft rod ends are slightly over toggle.

(f) The open position stops should be such that the straight-line distance between the edge of the main blade and the edge of the break jaw should be 6-5/8 ± 1/8 inches.

(g) The four barriers are shipped in place within the switch. They should be examined to insure they are located properly.

(h) If this initial inspection reveals some defects in adjustment, this should be corrected per the designated paragraph in DETAILED SWITCH OPERATION.

CAUTION

After the switch adjustment has been found (or made) satisfactory, it should be closed and opened at least three (3) times - first, by manual operation and then by motor operation and electrical trip.

(i) The two front panels are mounted at the factory using standard hardware. They are readily removed or installed but only when the switch is outside the cell. The top front panel has a window and is installed last.

If the switch is of the fused type, then the following additional checks should be made -

(j) Compare the fuse nameplate data with the switch nameplate data to assure they are identical.

CAUTION

Do not install the fuses unless the switch and fuse nameplate data are identical.

(k) Insert the three fuses solidly into the fuse clips so that the fuse ferrule is completely within the fuse clip. (See Fig. 8)

(l) Three identical barriers are installed beginning from the left. The fourth barrier is installed on the extreme right. (See Fig. 8) The barriers are properly located and aligned by guides in the switch proper and a barrier guide on the horizontal top cover.

(m) Adjust the four barriers to mesh properly with the guide mounted on the horizontal top cover (Fig. 8.)

PLACING SWITCH IN THE CELL

NOTE: This is a valuable piece of equipment. PLEASE HANDLE IT CAREFULLY. It will stand some abuse but, like any other similar equipment, it can be damaged by rough handling.

CAUTION

The pole unit parts of the cell are alive at full circuit voltages when the switch is in the fully connected position.

Before moving the switch into this position, make sure the arc chutes have been properly installed and that the four main barrier assemblies have been properly adjusted in place. Failure to do this may cause serious damage or injury.

Before levering the switch into the cell be sure and recheck that -

(a) The stored energy spring is discharged. Note CAUTION instruction on the bottom front panel. Push up on the trip latch to assure that the stored energy switch is discharged.

(b) The switch is open. A closed switch cannot be levered into the switchgear cell.

(c) The correct fuses are properly inserted in the fuse clips.

(d) The four (4) barriers are in position.

(e) The top fuse cover is in place.

(f) The front, top cover is mounted correctly.

(g) The front, bottom cover is mounted correctly.

(h) The finger clusters are properly mounted and free to mate with the cell studs.

(i) The secondary contact is properly mounted and free to mate with the cell secondary contact.

To place the switch in the first or disconnect position in the cell

(a) Examine the switch disconnecting finger clusters for any signs of damage. See that they are properly positioned and that the retaining bolts are all in place in the end of the switch studs. Clean off any dirt, grease, etc. DO NOT APPLY GREASE.

(b) Make sure that the cell is clean and clear of anything that might interfere with switch travel. Make sure levering screw in cell is clean and free from dirt or grit. However, it must be well greased.

(c) Line up the guide channel on right hand side of the switch near the floor, with the guide rail on right hand side of the cell floor. (See Fig. 9)

(d) Push switch into cell until the rail latch at front of guide channel catches in notch in guide rail and stops further movement of breaker toward rear of cell. This is the disconnect position. The switch and cell secondary contacts have not made contact, therefore, the electrical control circuit is still in the "open" condition.

To place the switch in the fully connected position.

(a) Re-read the NOTE and CAUTION paragraphs above. Push up on the trip latch to assure that the stored energy spring is discharged.

(b) The switch must be open. Mechanical interlocks will prevent the levering in of the switch into the cell if the switch is in the closed position. Damage that is difficult to repair will occur if brute force is used to overcome these interlocks. The interlock operation is detailed in - INTERLOCKS on Page 4.0.

(c) Place the portable levering-in crank within the guide tube protruding from the bottom front panel (See Fig. 10). Push the crank through the guide tube until the crank engages the levering shaft pin.

(d) Place tip of shoe under latch marked "LIFT TO UNLATCH" and tilt or lift your show to cause unlatching and push slightly on the front panel to move switch forward beyond the disconnect position. (See Fig. 4)

(e) Push switch toward rear of cell as far as it will go, about 1/4 to 3/8 inch. Be sure it is pushed until it is stopped. This should require only a few pounds of push. This push causes engagement of the levering nut on the switch with the screw in the cell.

(f) Push moderately toward the rear of the cell and turn the levering - crank clockwise. Switch should move slowly toward rear of cell. After switch starts to move it is no longer necessary to push.

(g) Continue cranking until crank turns freely and switch stops moving.

(h) Remove the levering crank as the switch is now in the fully connected position.

(i) The switch and cell secondary contact will engage before the switch is completely levered into cell. Depending on the control circuit, it is quite possible that the motor mechanism will become operational and begin to charge the stored energy spring. This is normal and cranking should continue until the levering-in crank turns freely and the switch stops moving. DO NOT PUSH UPWARD on the MANUAL TRIP LATCH. Doing so will result in the switch slamming shut.

WITHDRAWING THE SWITCH FROM THE CELL

NOTE: This is a valuable piece of equipment. PLEASE HANDLE IT CAREFULLY. It will stand some abuse but, like any other similar equipment, it can be damaged by rough handling.

(a) CAUTION - The interrupter switch must be open before it can be removed from the cell. Therefore, do not attempt to discharge the stored energy switch as this will reclose the switch. An interrupter switch with a charged stored energy switch can be removed from the cell provided the switch is open.

(b) The switch must be open. Mechanical interlocks will prevent the levering-out of the switch from within the cell if the switch is closed. Damage will occur if brute force is used to overcome these interlocks. Such damage will be very difficult and dangerous to repair. The interlock operation is detailed in - INTERLOCKS on page 4.0

(c) To withdraw the switch from the fully connected position to the disconnect position, push the levering crank through the guide tube until it engages with the levering device shaft. Turn the crank counter clockwise until the crank rotates freely. (See Fig. 10)

(d) Pull the switch toward the front of the cell until the rail latch engages the slot in the rail. The Switch is then secured in the disconnect position. The switch can be removed with a charged spring. However, once removed from the cell, the charged stored energy spring must be discharged in the interests of safety.

(e) To withdraw the switch completely from the cell place the tip of your shoe under the latch marked "LIFT TO UNLATCH" and tilt or lift your shoe to unlatch, then pull the switch slightly to move the switch out of the cell and beyond the disconnect position (See Fig. 4)

(f) Pull switch completely out of cell.

(g) Push up on the manual trip latch to assure that the spring is discharged.

SWITCH DETAILS

INTERLOCKS

The FLOOR INTERLOCK (Fig. 11) prevents the insertion of the operating handle into the handle casting during the time the switch is levered into or out of the connected position. The basic effect is to prevent manual charging of the stored energy spring during this levering in-out operation. (Won't prevent motor charging.)

In operation, the roller end of the shutter operator is forced upward by the cell floor cam when the switch is moved toward the connected position or moved out from the connected position. The resulting motion of the shutter operator arm, through the connecting linkage, lifts the shutter upward through an arc so that its red painted front surface covers the handle casting and effectively prevents the insertion of the operating handle. The floor cam and linkage holds it in this position as long as the switch is not at one of its limits of travel. When the switch is completely within the cell in its connected position or when out of the cell at its disconnect position or beyond, the shutter operator drops off the cell floor cam and the shutter drops, exposing the handle casting for insertion of the operating handle.

The SWITCH INTERLOCK (Fig. 12) prevents moving the switch into or out of the connected position if the switch contacts are in the closed position. The switch operating shaft which controls the switch position (closed or open) is interlocked with the levering-in shaft which controls the movement of the switch into or out of the connected position.

When the switch is closed, the linkage connecting these two shafts allows a spring biased locking key to firmly press on the surface of the levering-in shaft. The shaft contains a slot or keyway such that when the shaft is rotated, the slot becomes aligned with the locking key which then is spring forced into the slot and effectively prevents further turning of the shaft and the switch becomes immobile. The levering-in shaft may be left in any position so that the keyway may not line up with the key. However, since the key is pressing against the shaft, it will snap into the keyway on the first rotation of the shaft as the keyway comes into line with the key. Thus, the levering-in shaft cannot be rotated any further and no more movement of the switch can occur as long as it is in the closed position.

If you try to turn the levering-in shaft as hard as possible while the switch is closed, the spring biased locking key may distort or break.

CODING PLATES - (Fig. 13)

The Type FSP Interrupter Switch is available in many ratings and must be coordinated with a specific metal clad cell in a switchgear line-up. Consequently, the interrupter switch is keyed to assure that it is installed in its proper cell. If an attempt is made to install a switch in the wrong cell, an interference occurs between the switch code key and the cell code plate that prevents further entrance of the switch into the cell. **Coding plates are only supplied when specified by user.**

RAIL LATCH - (Fig. 4)

The purpose of the rail latch is as follows:

1. The rail latch prevents accidental damage to the cell levering-in screw or the nut on the switch. Without this rail latch, the screw and possibly the nut would be damaged if the switch were pushed into the cell so as to bump the nut hard against the end of the cell screw.
2. The rail latch holds the switch in the disconnect position.

The rail latch has two catching dogs, one on each side of the pivot, which can engage notches on the guide rail. A spring normally holds the front dog down against the rail so that as the switch is pushed into the cell, the front dog will drop into the rear notch and prevent further movement.

When it is desired to lever the switch into the connected position, the rail latch is disengaged by upward pressure of the toe against the LIFT-TO-UNLATCH lever and the switch is pushed 1/4 to 3/8 inch so as to get the levering device nut against the screw.

When levering the switch out, it should be pulled slightly forward after the nut has run off the screw, to engage the rail latch. The rail latch must be released to withdraw the switch from the cell.

HATCHET LEVER ASSEMBLY

Mounted in front of the primary main contact supports (in the cell) are molded polyester stationary barriers and a vertically moving polyester cell shutter that prevents access to the cell studs when the switch is withdrawn. A hatchet-shaped operating lever is pivoted to the right side of the cell and linked to the cell shutter. When the switch is levered toward the connected position,a roller on the switch engages against the cam surface of the hatchet lever. The associated linkage causes the shutter to rise vertically to expose the cell studs which are now ready to receive the finger clusters of the levered-in switch.

When the switch is levered out of the connected position the shutter drops by gravity and prevents access to the cell studs. The barrier and shutter (when closed) provide a physical barrier to the main contacts which may be "ALIVE".

Removing the shutter exposes the molded polyester barriers and contacts. DO NOT REMOVE OR MANUALLY LIFT THE SHUTTER UNLESS THE MAIN CONTACTS ARE DEAD.

The interrupter switch cell has a distinctively designed hatchet lever and the circuit breaker cell has its own distinctively designed hatchet lever. The interrupter switch cannot be levered into the circuit breaker cell and the circuit breaker cannot be levered into a switch cell.

DOLLY BRACKET (Fig. 3)

The combination of the dolly and dolly bracket enables the interrupter switch to be readily maneuvered and transported outside of the cell providing the floor is relatively smooth. The dolly should not be used to insert or remove the switch from the cell as interlocks may be defeated.

The switch dolly handling bracket is located in the center of the bottom, front cross-brace. When not in use, it is pushed backward within the confines of the switch and out-of-the-way. In use, pull this bracket forward as far as it will come. Place the vertical pin of the portable dolly in the hole in the dolly bracket by tilting the dolly handle sharply toward the switch. Pull the dolly handle downward until the front wheels of the switch lift off the floor. The switch can now be steered by horizontal movements of the dolly handle.

GROUND CONTACT (Fig. 1)

Connected to the rear of the switch is a heavy-duty finger type contact that clamps to the ground contact in the cell. This effectively grounds the frame and covers of the switch.

HANDLE STORAGE (Fig. 14)

The operating handle is required **for manual spring charging.** It is also used during the maintenance procedure. For ready access, this handle can be stored in the special mounting area located at the bottom of the front panel.

LEVERING DEVICE (Fig. 15)

The main parts of the device are:

1. The nut.
2. The guide tube.
3. The levering shaft.
4. The levering interlock.

These are part of the switch assembly. The nut is fastened securely to the guide tube and is housed in a casting fastened to the extreme rear of the switch.

The basic operation is for the nut to turn onto the screw which is mounted on the rear wall of the cell. Since the nut is securely fastened to the switch, it pulls the breaker into the fully connected position.

The levering device guide tube is slotted lengthwise for a distance about equal to the travel of the switch. The levering shaft has 2 rectangular hardened keys welded to it which slide in the guide tube slot. Thus, as the levering shaft is rotated, the guide tube and nut are also rotated. As the nut consequently moves on the screw, BY CLOCKWISE ROTATION, the screw extends farther toward the front of the switch, pushing the levering shaft with it. Consequently the levering shaft stands still relative to the screw and other cell parts, including the door. Thus, the end of the levering shaft is always the same distance behind the door, whether the switch is in the disconnect or connected position, or in between.

As the switch continues to be levered in, the keys on the levering shaft move toward the end of the guide tube slot. As the rear key comes out of the slot, the levering shaft turns freely and the switch moves no further. The end of the guide tube is shaped like a steep-pitch one-turn screw thread so that when the levering shaft is rotated counter-clockwise, the rear key will catch and enter the slot, and rotate the guide tube and nut, and the switch will be withdrawn.

AUXILIARY SWITCH (Fig. 16)

The auxiliary switch can be assembled with 1, 2 or 3 individual switches, each of which has four (4) independent contacts. The contact positions of a single auxiliary switch are as shown in Figs. 22, 23, 24, and 25. The operating arm of the switch is linked to the operating shaft. Thus, this auxiliary switch operates as a function of whether the interrupter switch is open or is closed. The auxiliary switch is optional and only supplied when specified by the user.

An operations counter is also available as optional equipment and only supplied when specified by the user. It is available as part of the auxiliary switch assembly as shown in Fig. 16 or as a separate component, i.e., without the auxiliary switches.

DETAILED SWITCH OPERATION

BASIC SWITCH DESCRIPTION

The following basic components make up the 15 kV motorized stored energy Type FSP Interrupter Switch.

FRAME - The switch is assembled as a single mobile unit having four integral wheels that engage with guide rails in the stationary metal clad cell. This frame supports porcelain post insulators which in turn support the blade assembly of each phase. The frame further supports the motor operating mechanism, the manual and electrical trip system, the interlock safety system, the fuse system with their porcelain post insulators, the levering-in device, the dolly bracket and the isolating barriers. All are integrated to provide easy access for switch inspection and fuse replacement.

OPERATING MECHANISM - Porcelain drive rods connect and insulate the main contact blades to the switch shaft. Partial rotation of this shaft imparts an equal push motion to the three porcelain drive rods to close the switch or imparts a pull motion to these rods to open the switch. The source of power to rotate the operating shaft comes from a compressed spring which acts on a driving rod connected to the spring lever which in turn is rigidly connected to the operating shaft.

MAIN BLADES AND JAWS - The switch blades, main contacts, hinges and break jaws are all constructed from hard drawn copper. To protect against erosion from the heat of the arc during possible fault closing, the stationary break jaws are provided with a copper-tungsten arcing tip and the moving blades are provided with copper-tungsten arc buttons. The contact surface areas of all current carrying components are silver plated.

LOAD INTERRUPTER - A spring-loaded moving flicker blade and engaging stationary, tungsten-tipped, contact fingers located inside a "De-ion" arc chute comprise the load interrupter function of the switch. The main blades open first and the current shunts through the still closed, spring-loaded flicker blades. Further travel of the main blades causes the flicker blades to snap out of their stationary fingers. The subsequent current arc is drawn within the confines of the "De-ion" arc chute. Positive load current arc interruption is accomplished by the de-ionizing action of the arc chutes in combination with the high speed opening of the spring loaded flicker blades.

"DE-ION" ARC QUENCHING

Fig. 17a - The flicker blade is connected to the side and parallel to the main blade. When the switch is closed, practically all the current flows through the main blade.

Fig. 17b - As the main blade separates from the main break contact, the current is transferred to the flicker blade which is restrained in the arc chute by the high pressure contacts within the arc chute. Once the maximum angular movement between the flicker blade and main blade has been reached, the flicker blade starts to move out of the arc chute contacts within the arc chute.

Fig. 17c - The combined pull of the torsional spring on the flicker blade assembly and the main blade operating mechanism snaps the blade into an open position at high speed. The heat of the arc releases a blast of deionizing gas from the gas generating material of the arc chute chambers. This combination of quick-break and De-ion action quicklly extinguishes the arc and the circuit is safely de-energized.

NOTE: The position of the switch can be viewed through the high impact safety window mounted in the top front cover. Do not observe the current arc interruption through this window.

STORED ENERGY OPERATION

INTRODUCTION

The stored energy spring mechanism stores energy by compressing, or charging, a heavy duty spring and holding this charged condition until released. When the restraining mechanism is released the stored energy in the spring is released to rapidly rotate the switch main shaft to close or open the main contacts.

MANUAL CHARGE AND TRIP - (Fig.5,18) To manually initiate the closing action, the removable handle is inserted into the handle casting and both rotated upward through an angle of 120 degrees. The handle casting presses against the spring lever which then rotates with the handle casting. The spring rod, attached to the spring lever, is thus forced in the proper direction to exert compressive pressure in the spring. Compression continues until the spring rod is snapped slightly over horizontal dead center (toggle action) with the spring fully charged. The spring rod stops with a definite audible sound because the rear teeter bar roller seats against the lip of the trip link and is held locked in this position by the resulting force vectors. At the same time, the front roller of the teeter bar presses down on the trigger latch with sufficient force to resist trip forces due to, say, shock and vibration. Consequently, the charged spring is held compressed by the mutually reacting forces of the spring release assembly linkage, teeter bar, and trip latch. (Fig. 19)

When the trip latch is lifted upward, the front roller of the teeter bar drops over and down the lip of the trip latch and the rear roller moves up the lip of the (spring) trip link. This releases the restraining linkages to the spring rod and the stored energy in the spring is released through the spring rod which pushes the spring lever, which in turn, pushes against the main lever which is solidly pinned to the shaft. Consequently, the main shaft is rapidly rotated to force the attached porcelain push rods to rapidly and forcefully close the switch.

This stored energy system has sufficient power to overcome the blowout forces which occur when the switch is closed against a fault condition. The forces from the short-circuit as well as from the mechanical forces of normal operation are not transmitted to the operating handle as the operating handle is not rigidly connected to the shaft moving contact mechanism. Therefore, it is SAFE to close the switch under short circuit conditions within its rating. When the switch is not closed against a fault, the excessive closing force of the mechanism is not transmitted to the stationary contacts and supporting insulators but is absorbed by the main lever stop adjustment.

Similar conditions prevail when initiating the opening action. The basic difference is that the operating handle and handle casting are rotated downward through an angle of 120 degrees. The spring lever and spring rod moves upward until the spring rod snaps slightly over horizontal dead center (over toggle) with the spring fully charged (compressed). The teeter bar rollers again reset and restrain the spring release linkage exactly as described before. The switch will remain "charged" until tripped to open by an upward movement of the trip release latch. (Figs. 20 and 21)

The trip release latch can be released electrically and remotely as will be described later.

Note that manual operation can be performed with the motor mechanism linked to the main shaft of the switch.

> Caution: Before manual operation is attempted, both linkage connections between the motor mechanism and the interrupter switch proper must be correctly adjusted and the respective hardware properly tightened.

MOTOR CHARGING AND ELECTRICAL TRIP - (Fig. 6)

The motor mechanism charges or compresses the main spring in a manner more-or-less duplicating the motion of the operating handle as described previously.

A drive-link connects the motor mechanisms driving-link to the handle casting on the switch shaft. The motor mechanism "steps" the driving-link through an angle of 130 degrees; the connecting drive-link, in turn, forces the handle casting through a similar angle. The final result is a charged spring restrained at slightly over toggle by the spring release linkage exactly as described for manual charging.

Details of the motor action are as follows: An eccentric cam shaft couples to the motor shaft. Floating on this eccentric cam shaft are the two driving pawls. The rotating eccentric cam imparts to the respective driving pawl a pushing forward motion, a lifting and backward motion, and a dropping-to-push-forward motion. As the eccentric cam rotates it seats the driving pawl into a tooth of the driving ratchet; further rotation of the eccentric cam causes the pawl face to push against the ratchet tooth and the ratchet advances one "notch"; further rotation of the cam lifts the pawl up and away from the tooth and then recedes preparatory to reseating into the next ratchet tooth for the next push. The toothed ratchet is kept from snapping back by the blocking action of a holding pawl which is spring loaded to remain in contact with the toothed contour of the ratchet.

A driving link is pinned to the ratchet shaft and "steps" accordingly. A drive-link connects from the driving-link to the handle casting on the switch shaft. As the driving pawl moves, its associated toothed ratchet rotates one tooth length; the ratchet shaft rotates; the driving link rotates; forcing the drive link through its restricted and somewhat linear motion that forces the handle casting to rotate with the result that the main spring is charged in a series of compressive steps.

The action continues until the spring is compressed and the spring rod snaps over toggle and is restrained by the spring release linkage system. At this time (over toggle) the driving pawl rests on the toothless portion of the ratchet and ratcheting motion ceases.

Coordinated with the above mechanical action is an electrical control circuit. The action of the electrical control circuit, consisting primarily of limit switches (toggle action), is coordinated with mechanical trip pins that operate as a function of spring charging and of switch position, i.e., open or closed. Fig. 22 represents the state of the control circuit before the switch is levered into the cell. The chevrons ^ represent the secondary contacts of the interrupter switch. Note that the motor circuit is "closed". Thus, the motor begins to charge the spring as soon as the switch is levered far enough into the cell so that electrical contact can be made between the switch - cell secondary contacts. CONTINUE TO LEVER THE SWITCH INTO THE CELL UNTIL LEVERING-IN ACTION CEASES. The motor will charge the spring as described previously.

Motor limit switch trip pins (see Fig. 6) are connected to and rotate with the ratchet shaft, i.e., these switches operate as a function of the charged or uncharged main spring. At the end of the charging cycle the following occurs:

1. The spring rod snaps over toggle and is restrained from discharging the spring. (Fig. 19)
2. The (front) driving pawl is traversing the toothless contours of the driving ratchet, essentially disengaging the ratcheting - charging action.
3. The ratchet shaft trip pin (motor trip) has rotated counter-clockwise to contact the handles of the limit switches MS1 and MS2 and snap them over toggle.

and the following action results -

4. <u>In the motor circuit</u> (Refer to Fig. 22 and 23)

   4.1 Contact MS2 opens, thus removing the electric power to the motor and motor action ceases.

   4.2 Contact MS1 closes in preparation for future action coordinated with the interrupter switch position, i.e, closed or opened.

5. <u>In the trip circuit</u> (Refer to Fig.22 and 23)

   5.1 Contact MS2 opens in the trip-to-open circuit (CST) in preparation for future action coordinated with the interrupter switch position, i.e. closed or open.

   5.2 Contact MS1 closes in the trip-to-close circuit (CSC) which can now accept a trip-to-close signal.

The state of the interrupter switch at this point is (1) the interrupter switch is open, (2) the main spring is charged and restrained, (3) the motor has ceased charging, (4) the electrical trip-to-close circuit is ready to receive the trip-to-close signal when contact CSC closes. The electrical control circuit is now as shown in Fig. 23. (Fig. 30 gives Operating Data)

When the CSC contact is closed in the trip-to-close circuit, the trip coil becomes operational and its associated tripping magnet releases the trip latch. This defeats the restrained connecting linkage and allows the stored energy of the spring to close the interrupter switch. Closing of the interrupter switch will affect the control circuit as follows: (Latch mechanism as in Fig. 20)

An operating link connects from the main switch shaft to the lever arm (walking beam) of the motor mechanism. When the switch closes, the operating link is driven downwards and pivots the lever arm in see-saw fashion. This resets the driving pawls as shown in Fig. 6 . In effect, this motion lifts the forward driving pawl away from its associated ratchet and allows the rear driving pawl to engage with the teeth in its associated ratchet. The action of the holding pawls also reverse. The net result is that the ratcheting action is reversed although the motor shaft rotation is not reversed. The driving link will rotate clockwise, the drive link will move upward when the motor begins the spring charging cycle.

Switch position limit trip pins are attached to the operating link. When the operating link is forced downward as a result of the rotation of the main shaft (closing) the top limit trip pin forces over toggle the handle of limit switch SS. The following action results -

6. <u>In the Motor Circuit</u> (Fig. 23 and Fig. 24)

   6.1 Contact SSa closes and since MS1 contact is closed the motor circuit is now connected to the electrical system. The motor begins to charge the main spring.

   6.2 Contact SSb opens in preparation for future action coordinated with the interrupter switch action.

7. <u>In the Trip Circuit</u> (Fig. 23 and Fig. 24)

   7.1 Contact SSb opens in the trip-to-close circuit. This more-or-less deactivates the circuit since closing CSC contact will have no effect on its circuit.

   7.2 Contact SSa closes in the trip-to-open circuit. At this time (spring charging) contact MS2 is open and closing CST contact will have no effect on its circuit. Thus, the interrupter switch can not be opened while the main spring is charging.

The status of the interrupter switch during this spring charging interval is (1) it is closed, (2) the main spring is charging toward its restrained position, (3) the trip-to-open circuit and the trip-to-close circuit are both "open" and (4) the trip coil SR can not be activated by closing CSC contact or CST contact. The control circuit is now as shown in Fig. 24.

The spring charging action is the same as before. However, the ratchet shaft is rotating counter clock-wise and the other motor trip pin pushes upward on the handle of the limit switch and when the handle snaps over toggle the following results.

8. <u>In the Motor Circuit</u> (Fig. 24 and Fig. 25)

   8.1 Contact MS1 opens and power is removed from the motor and motor action ceases.

   8.2 Contact MS2 closes in the motor circuit. SSb is open so motor will not re-start.

9. <u>In the Trip Circuit</u> (Fig. 24 and Fig. 25)

   9.1 Contact MS2 closes in the trip-to-open circuit (CST). Since both MS2 and SSa are closed, the interrupter switch can be tripped to open.

   9.2 Contact MS1 opens in the trip-to-close circuit (CSC).

The final interrupter switch status is (1) closed, (2) the main spring is charged over toggle and restrained (3) motor action has ceased (4) the electrical trip-to-open circuit is ready to receive the trip signal. The electrical circuit is now as shown in Fig. 25. (Latch system as in Fig. 21)

When the operator closes the CST contact in the trip-to-open circuit, the trip coil (SR) is energized resulting in the release of the tripping latch which, in turn, releases the restraint of the compressive forces in the main spring and the switch is snapped forceable open. The following results

10. The operating link is driven upward and pivots or reverses the lever arm in see-saw fashion. (Fig. 6)

11. The second driving pawl is lifted above its associated ratchet. (Fig. 6)

12. The first driving pawl drops and engages with the teeth of its associated ratchet. (Fig. 6)

The net result is that the ratcheting [illegible] reverses but the motor [illegible] does not reverse. As the [illegible] pin forces the handle of [illegible]

13. **In the Motor Circuit** [illegible]

13.1 Contact [illegible] closed [illegible] power [illegible] to the motor [illegible] paragraph [illegible]

13.2 Contact [illegible]

14. **In the Trip Circuit** [illegible]

14.1 Contact [illegible]

14.2 Contact [illegible] close [illegible]

The control circuit is [illegible] as initially described [illegible]

INTERRUPTER SWITCH MAINTENANCE

NOTE: The interrupter switch must be removed from the cell for inspection and maintenance. Access to the switch parts is prevented by the two front panels which can only be removed when the switch is outside the cell.

INSPECTION SCHEDULE

It is recommended that each switch be inspected after 24 months of service or after approximately 100 rated current interruptions, whichever occurs first. When the current interrupted is smaller than rated, the duty is proportionally lighter and more operations may be allowed before inspection. After the switch has been closed against a fault current, it should be inspected at the first opportunity at which it can be de-energized and removed from the cell.

The motor mechanism is nominally rated for 500 mechanical close-open cycles and then should be replaced or removed for overhauling. However, it should be examined at the same time the interrupter switch parts are examined. Maintenance and adjustment of the motor mechanism will be described in section 8.

> CAUTION: The two linkages inter-connecting the motor mechanism and the interrupter switch parts must be completely disconnected when adjustments are made to the interrupter switch. Such adjustments will change the connecting distance and thus the linkage lengths will change. Do not loosen and keep in place and do not remove one link and not the other. Do not make external electrical connections for the motor mechanisms during the following inspection and maintenance.

(a) Check main blade contact pieces and the edges of the flicker blades for arc erosion.

(b) Check the engagement of the flicker blades - first, close the switch. Insert the operating handle in the blade alignment (maintenance) lug (See Fig. 5) on the shaft and slowly open the switch. The flicker blades should remain engaged in their contact fingers while the main blades open. When the main blades clear the break jaws, they will hit the stop on the flicker blade support brackets and start the flicker blades out of the stationary arm contact fingers. The flicker blades will finally snap open from the forces in their charged torsional coil springs. Slowly release the pressure on the handle and the switch will return to the closed position. Do not release your hold on the handle until the switch is closed.

(c) Check barriers for carbon or metallic deposits. Replace with new barriers if deposits appear excessive.

(d) Inspect arc chute sides and replace them if they are damaged.

(e) Replace worn or damaged parts of the flicker blade assembly.

(f) Arc chute must be dismantled in order to examine condition of arc chute.

(g) After a fault closing operation it may be necessary to clean up the arcing contacts. This may be done with a few light strokes of a fine file. It is only necessary to remove sharp and high points; no attempts should be made to file out the pit marks. DO NOT USE abrasive material for cleaning.

(h) CLOSE AND OPEN THE DE-ENERGIZED SWITCH AT LEAST THREE (3) TIMES TO CHECK THE PERFORMANCE OF THE OPERATING MECHANISM

NOTE: The main current carrying contacts should not be filed. Opening and closing of the switch will clean the contacts. However, if there is evidence of excessive burning, the main blade and hinge assembly together with the break jaw should be replaced.

MAIN BLADE ALIGNMENT (See Fig. 7)

Method #1 - Loosen the four bolts holding the hinge terminal to the porcelain post insulator. Loosen the two bolts holding the jaw terminal on the insulator. Insert the operating handle in the blade alignment maintenance lug on the shaft and close the switch. For safety purposes, the switch will not fully close and will revert to the open position if the pressure on the handle is released. Do not release your hold on the handle until the switch is returned to the open position, otherwise the switch will snap open due to the partially charged spring. Hold the switch in the closed position and check that the upper spacers of the main blades are approximately 3/16 inch above the lip of the break jaw blade stop. If not, the jaw blade can be moved vertically by loosening the bolts supporting the rear of the post insulator. This insulator and jaw can be adjusted vertically to obtain this 3/16 inch distance. When obtained, tighten the four bolts. Then check that the main blade closes symmetrically and is centered on the jaw break terminal. First, move the jaw left or right until the fit is correct and tighten the jaw terminal bolts. Second, adjust the main blade parallel to the jaw break terminal by loosening the four bolts on the pedestal supporting the blade assembly (See Fig. 4) and slightly rotate the pedestal to achieve proper alignment. Recheck and realign until satisfactory.

Method #2 (See Fig. 26) - Note the two fixed arms welded to the main shaft. These arms have suitable slots that provide the necessary length adjustment to the pushrod with the switch in the closed position. Disposed between these arms is the push rod which is free to pivot on special lock-and-slip-proof spacers whose circumferential ends have a hardened contour to provide a sharp knife edge so that when the clamping hardware is tightened this special spacer is securely fixed to the shaft arms. The push rod, however, is still free to rotate about the periphery of the spacer.

The switch blade can be adjusted to its correct setting with the clamping hardware loose. This allows relatively easy movement of the special spacers within the arm slots. The blade should be adjusted so that it is 3.5 ± 1/16 inch from the rear of the break jaw (see Fig. 7, view A). When this distance is obtained the clamping hardware is tightened (35-40 foot pounds) and the spacers are locked in place. If found necessary, further adjustment can be made by loosening and moving the special spacer and retightening.

FLICKER BLADE AND ARC CHUTE ALIGNMENT - (See Fig. 7)

Loosen the two arc chute mounting bolts. Adjust the arc chute so that the arc chute opening is parallel to the main blade. Lightly tighten the arc chute mounting bolts. Using one of the procedures described above, slowly close the switch and check that the flicker blade is in line with the arc chute opening. If necessary, move the arc chute left or right until the flicker blade and arc chute line up. Tighten the arc chute mounting bolts and re-check the alignment. Repeat till aligned. A satisfactory adjustment is indicated when the flicker blade can be readily "flicked" or moved by hand through a small arc within the arc chute when the main blade is completely closed.

MAIN LEVER STOP ADJUSTMENT (See Fig. 5, 18 and 20)

Rotating the top stop-adjustment bolt will affect the open gap distance of the main blade. It will also affect the distance between the teeter bar roller and the lip of the trip link as shown in Fig. 18,20. For proper operation of the restraining linkage this distance should be adjusted to 1/16 ± 1/32 inch. This adjustment is made with the spring uncharged. With this adjustment, the air gap clearance between the edge of the main blade and the break jaw should be 6-5/8 ± 1/8 inch. If not, loosen the slip-and-lock proof spacers and readjust the porcelain operating rods as discussed previoulsy.

Rotating the bottom stop-adjustment bolt will affect the closed position. Again, for proper operation of the restraining linkage, the distance between the teeter bar roller and the lip of the trip link should be adjusted to 1/16 ± 1/32 inch. This adjustment is made with the spring uncharged. In this closed position the operating shaft arms should be slightly over toggle (5 degrees), i.e., the toggle position would be the straight line position of the shaft arms and porcelain operating arm.

Improper adjustment of either stop can result in:

1. The spring operating rod cannot be forced over toggle.
2. The restraining linkage can become inoperative and this results in the switch immediately closing or immediately opening when the charged spring snaps over toggle. (Quick make-quick break action)

CAUTION: ALWAYS TIGHTEN THE LOCKNUT FOLLOWING AN ADJUSTMENT BOLT CHANGE.

FLICKER BLADE REPLACEMENT

To change a flicker blade, remove the two bolts holding the flicker blade to the flicker blade bracket. The switch must be in the open position. Remove the worn blade and replace with a new blade. Replace the two bolts and tighten the nuts.

To change a complete flicker blade assembly, remove the elastic stop nut from the bolt holding the assembly to the main blade. Using a box wrench or similar tool, hook the hole in the wrench over the torsion spring end and pull slightly forward and to the left until the spring end clears the stop post. Remove the wrench and pull out the bolt. The flicker blade assembly is now free. To install a new assembly, reverse the procedure. Don't forget to reinstall the nylon spacer. Be sure the brass spacer between the two copper bars making up the main blade is still there. Tighten the stop nut only enough to eliminate any wobbling of the assembly. Before the torsion spring is placed behind the stop post, a sideward movement of 1/16" should be present. Too much tightening will decrease this movement and cause friction which will slow down the action of the flicker blade. Using the same procedure for releasing the torsion spring end, put the spring end on the other side of the stop post.

MAIN CLOSING SPRING (Fig. 27)

To dis-engage the main closing spring, located along the right side, first remove the barriers. Take a 5/16-18 threaded rod 4" long and screw it into the rear end of the spring rod. Make a spacer 1.5" long from a pipe or tube with a 1.0" I.D. Put this over the 5/16" rod. Take a washer with an O.D. as large or larger than the O.D. of the spacer and with a clearance hole for the 5/16" rod and place this on the rod. Run a 5/16-18 nut down the rod and center the spacer. Tighten the nut until the tension on the pin at the front of the spring lever is released. Remove the washers holding the pin and remove the pin. The main spring assembly is now free from the shaft. To completely remove the spring assembly, remove the two bolts holding the L-shaped bracket to the side of the frame. To re-install the assembly, or to re-engage the spring rod, reverse the procedure.

MAIN BLADE, JAW AND HINGE ASSEMBLY

Disconnect the porcelain operating drive rod from the shaft arm as instructed in MAIN BLADE ALIGNMENT. Remove the four bolts holding the hinge assembly and terminal pad to the top of the insulator. The hinge, main blade and flicker blade are now free. Remove the two bolts holding the jaw to the insulator, replace with a new jaw, and replace and finger-tighten the two bolts. If the new hinge and blade assembly is equipped with a flicker blade assembly, mount the hinge end on top of the terminal pad and install the four bolts finger tight. Remount the used flicker blade assembly if the new hinge and blade assembly is not so equipped. Tighten the lock nut on the spring washer on the jaw end of the blade. When it is tight (using standard tools) back the nut off 1/4 turn. Set the main blade to an open position of approximately 45°. The weight of the blade should let the blade fall slowly open. If the blade fails to fall open, loosen the lock nut on the hinge spring washer until the blade slowly falls open. If the blade falls too fast, tighten the lock nut. Align and adjust as per MAIN BLADE ALIGNMENT AND FLICKER BLADE AND ARC CHUTE ALIGNMENT.

NOTE: After completing any alignment, the switch should be operated thru at least three "close-open" operations to insure proper performance of the operating mechanism.

MAINTENANCE CLOSING AND OPENING

The operating handle is also the maintenance handle and fits into the maintenance lug on the shaft (See Fig. 5) for hand closing and opening the switch. The operation is sobely for the purpose of inspecting and adjusting the contacts or other working parts of the switch when slow motion is required. The maintenance handle always operates to compress the heavy duty operating spring. Consequently, there is always an opposing force on the handle. - ALWAYS RELEASE THE HANDLE SLOWLY BACK TO ITS ORIGINAL POSITION as the switch will not remain closed if it is closed with the maintenance handle nor will it remain open if it is opened with the maintenance handle.

CAUTION: THE MAINTENANCE LUG IS ACCESSIBLE ONLY WHEN THE FRONT PANELS ARE REMOVED. THE SWITCH MUST BE REMOVED FROM THE CELL. DON'T EVER ATTEMPT TO CLOSE THE SWITCH BY HAND AGAINST A LIVE CIRCUIT. PROPER CLOSING REQUIRES MORE SPEED AND POWER THAN CAN BE SUPPLIED BY HAND POWER. THE FRONT COVERS MUST BE MOUNTED PRIOR TO ENTRANCE INTO THE CELL.

AUXILIARY CLOSING SPRING (Fig. 28)

The auxiliary closing spring, located on the left side of the switch, remains charged (compressed) when the switch is open. As the switch slams closed, the stored energy of the auxiliary spring adds to that of the main spring. To disengage this auxiliary spring, close the switch and remove the pin that joins the auxiliary spring rod to the switch shaft.

SHAFT BEARING REPLACEMENT

(a) Remove barriers, front panel, operating mechanism safety pan.

(b) Disengage the main spring rod per STORED ENERGY SPRING.

(c) Disengage the operating drive rods from the shaft. Be sure to retain the lock-and-proof spacers for reuse.

(d) Disengage the interlock linkages attached to the shaft.

(e) Disengage the auxiliary spring per AUXILIARY CLOSING SPRING.

(f) Remove the four bolts on the right side panel and the two bolts on the left side panel. These bolts support the shaft.

(g) Loosen the bolts holding the reinforcing tie bars.

(h) Slide the shaft and end brackets forward and out.

(i) Remove and replace bearings.

(j) To replace the shaft, slide the shaft and end brackets back into the frame. Install the four bolts on the right side and the two bolts on the left side. Tighten all bolts. Reconnect the linkage systems, springs, and other items initially removed. Check switch alignment and operation as discussed preveiously.

NOTE: After completing any alignment, the switch should be operated through at least three "close-open" operations to insure proper performance of the operating mechanism.

MOTOR MECHANISM MAINTENANCE

The motor mechanism of the Type FSP Interrupter Switch is designed for a minimum of 500 operations. During this time it should require no lubrication or other maintenance. However, it is advisable, as part of a good maintenence procedure, to visually examine the motor mechanism at the same time the interrupter switch itself is examined as recommended in section 7 . After 500 operations the motor mechanism should be carefully examined. Any sign of wear on the pawl surfaces or any sign of wear on the teeth of the ratchet wheels is a definite indication to remove the motor mechanism and replace it with a new or overhauled device.

The mechanism is removed as follows:

1. Check to insure that the stored-energy spring is discharged. Push upward on the trip-latch.
2. The switch is out of the cell and there are no electrical connections to the secondary contacts.
3. Disconnect the drive-link.
4. Disconnect the operating shaft link
5. Remove the shutter mounting assembly.
6. Identify the electrical leads to the motor terminal block and then disconnect.
7. Remove the front dolly bracket support and the dolly bracket.
8. Remove the four (4) bolts that secure the motor mechanism to its support channel.
9. Lift the motor mechanism slightly upward and then outward.
10. The levering-in crank guide tube can be loosened if it interferes with the removal (or installation) of the motor mechanism.

If it is desired to replace the worn parts and, in general, overhaul a motor mechanism, then do as follows. The replacement of worn parts is relatively simple and does not require any special tools. The bolts, their related hardware and spacers should be removed and stored in their sequences of removal so they can be replaced in the proper sequence. This is particularly adaptable with respect to the spacers. The motor mechanism should be supported vertically and the four bolts removed. The support panel can now be removed and the pawls, ratchet, etc. are made accessible.

The following components must be replaced:

1. Drive link and X-washer
2. Driving link, two spiral pins, and the pin shaft
3. Ratchet shaft (two ratchets)
4. Driving pawls (2)
5. Holding pawls (2)
6. All toggle switches (3)

It is also advisable to replace the following, especially if there are any signs of wear:

7. Bearings (2)
8. Motor coupling pin.
9. Eccentric shaft.

Assemble in essentially the same way they were removed. Take particular care with any shims that may have been used. It is imperative that the pawls and ratchet move smoothly and freely and are not bound tight when the four assembly bolts are tightened. If they are tight first check that the spacers are assembled correctly. If so, then add shims to the respective spacer assembly until all motion is smooth and relatively friction free.

Place the motor mechanism on its mounting channel and adjust the driving link so that the driving pawl rests in the last tooth prior to the "dead" surface on the ratchet. This locates the final position of the driving link when the spring system snaps over toggle.

Align the drive links and the operating links so they are vertical and parallel and properly spaced to receive the slip-and-lock-proof washers (2 each).

TIGHTEN THE 4 BOLTS SECURING THE MOTOR MECHANISM TO ITS SUPPORT CHANNEL.

Force downward the low end of the walking beam as far as it will go, then relax and allow it to move upward 1/8 of an inch. Tighten the slip-proof washers.

NOTE - This walking beam should always be at approx. a 45 degree angle- never horizontal when the two parts of the operating link are connected. Another way of stating this is to never operate the switch or motor with the walking beam horizontal. This walking beam must always be at its 45 degree slant, otherwise, when horizontal, inadvertent operation will result in insufficient meshing of the driving pawl in the ratchet tooth. This will result in chipped teeth.

Tighten the hardware of two parts of the drive link after installing the slip-and-lock proof spacers.

Since the switch was assumed properly adjusted as explained in section it is now ready for motor operation after replacement of wires, shutter mounting assembly, dolly bracket, etc.

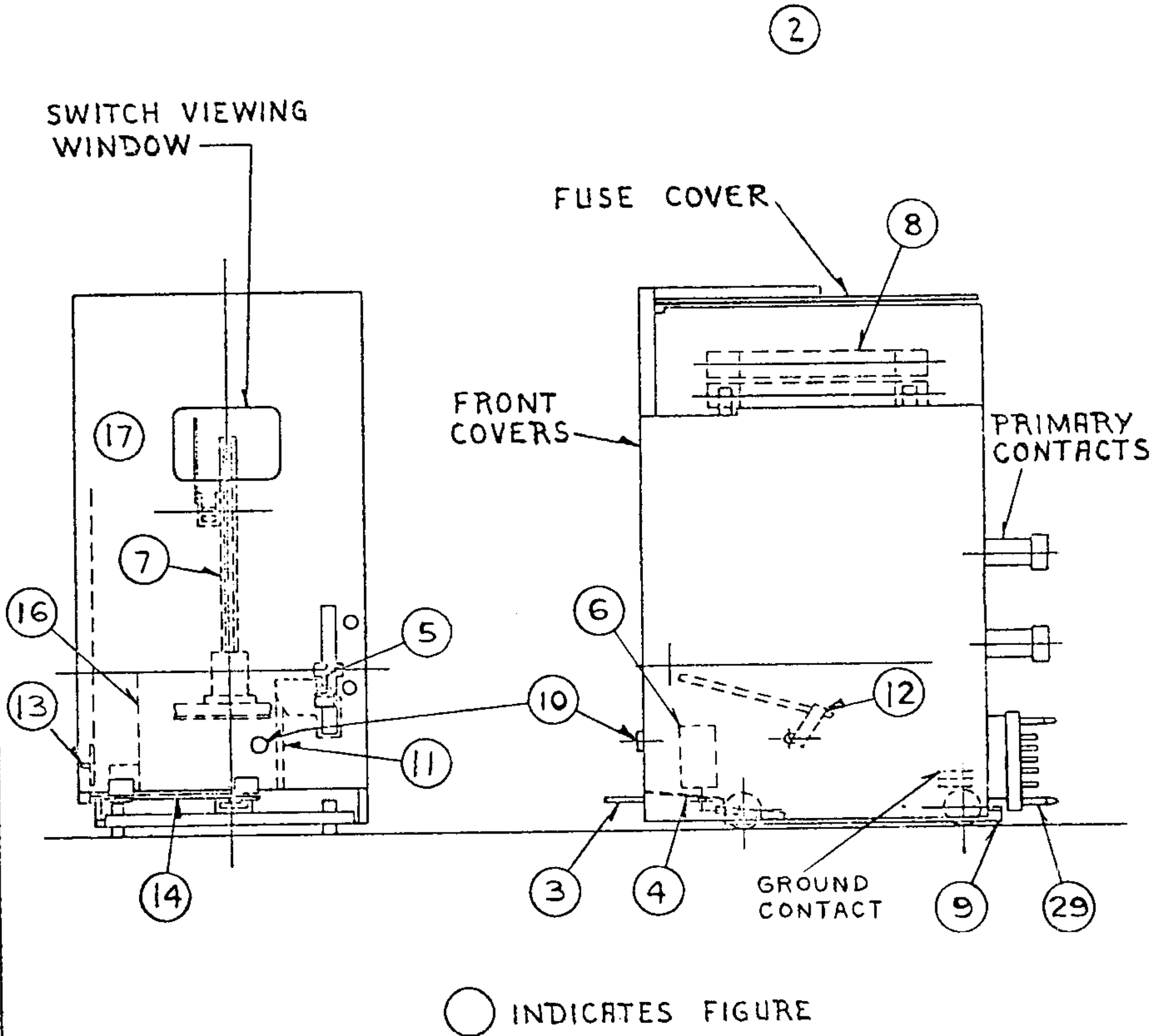


FIG. 1

WESTINGHOUSE ELECTRIC CORPORATION

TITLE OUTLINE 15 KV FSP - MOTORIZED

DIVISION DRAWOUT FUSED SWITCH

PLANT LOCATION

3714A01

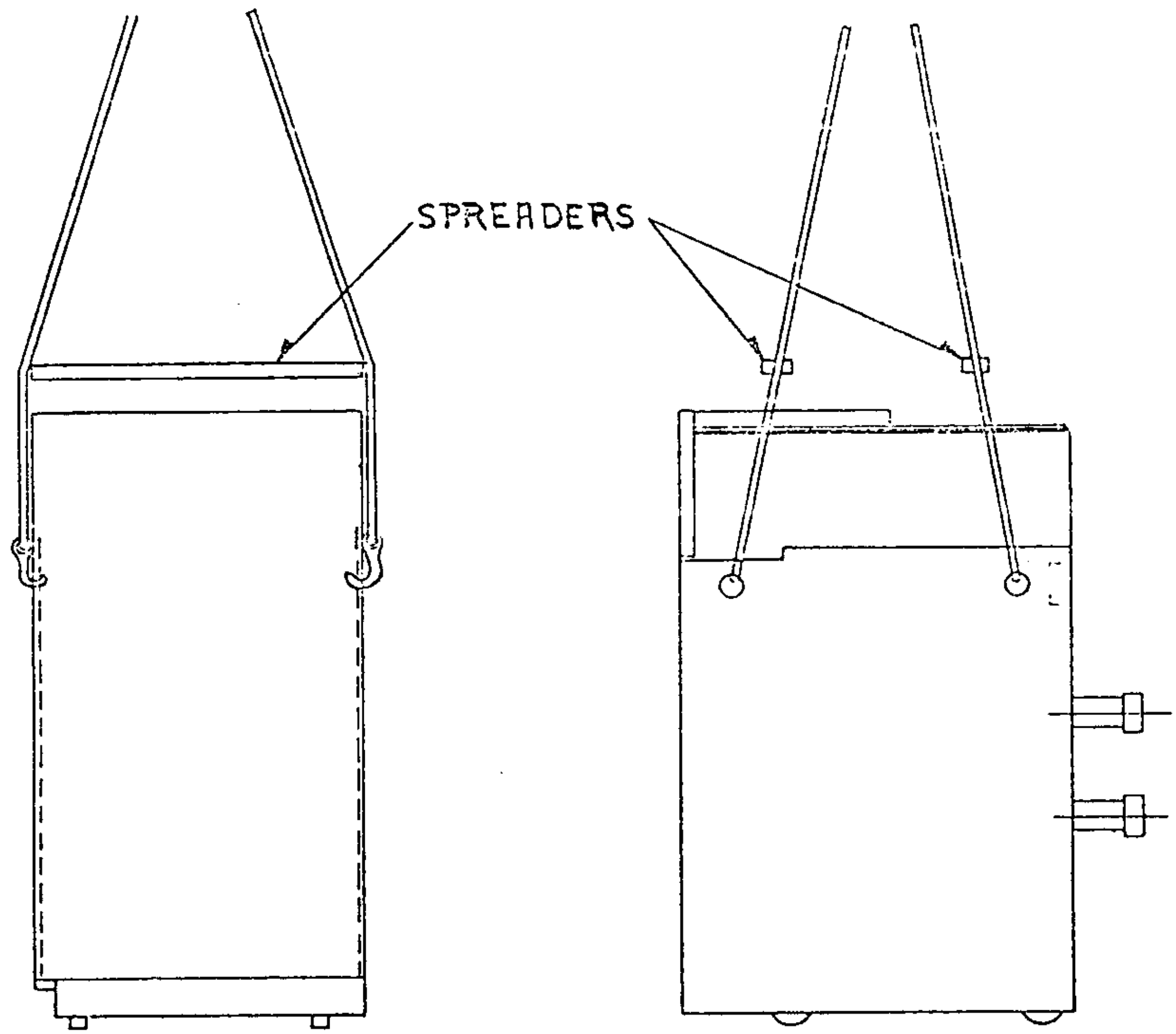


FIG. 2

WESTINGHOUSE ELECTRIC CORPORATION

TITLE LIFTING INSTRUCTIONS

3714A02

DIVISION

PLANT LOCATION

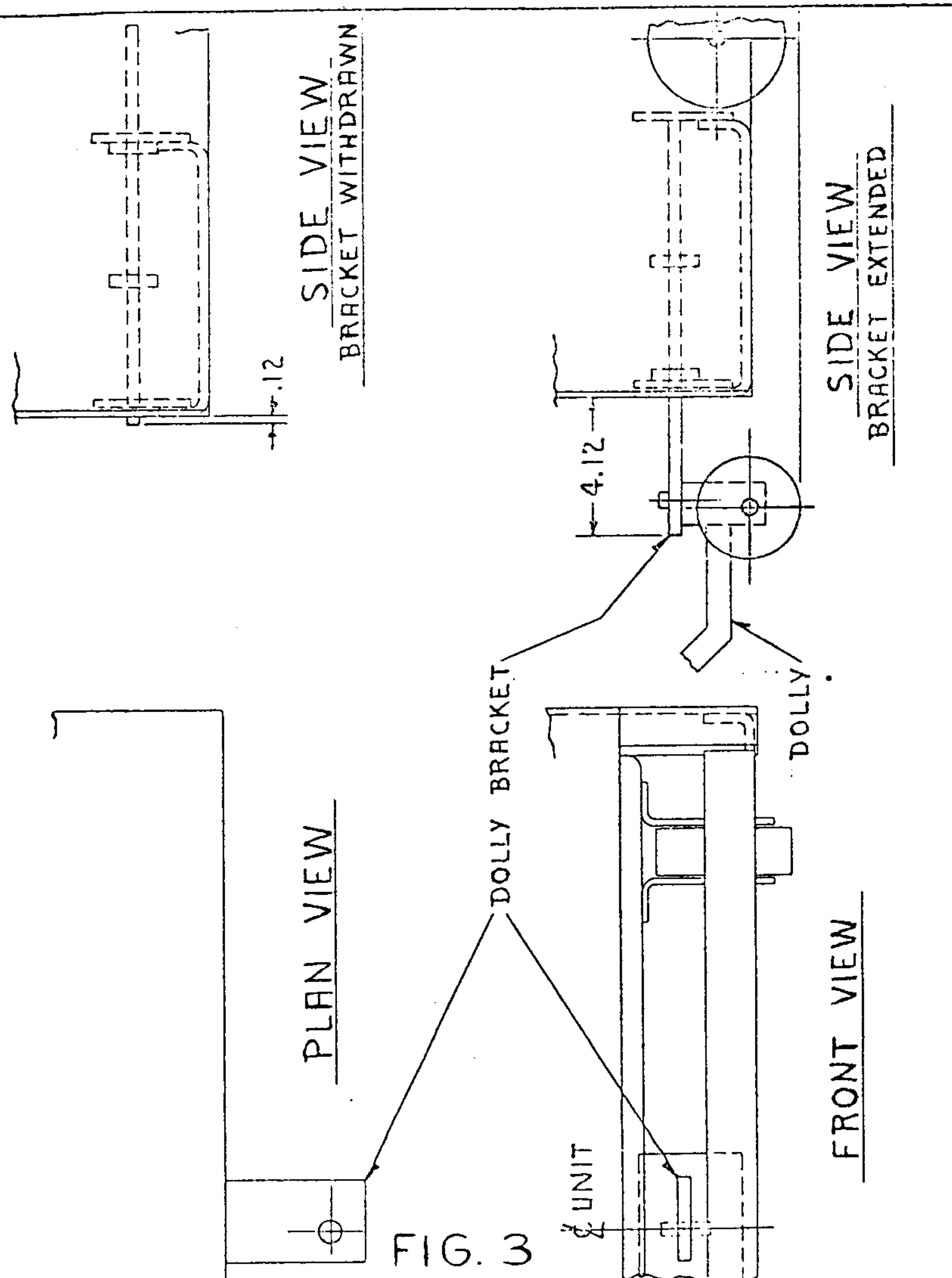


FIG. 3

WESTINGHOUSE ELECTRIC CORPORATION

TITLE DOLLY BRACKET

3714A03

DIVISION

PLANT LOCATION

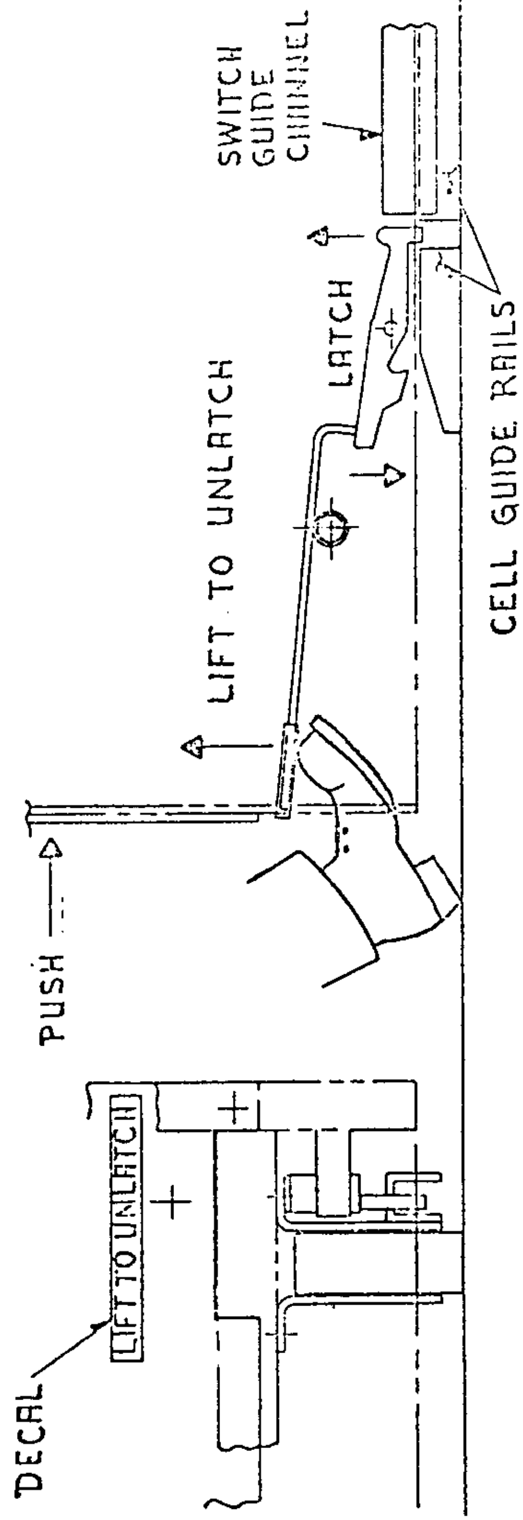


FIG. 4

WESTINGHOUSE ELECTRIC CORPORATION

TITLE DISCONNECT POSITION LATCH

3714A04

DIVISION ______ PLANT LOCATION ______

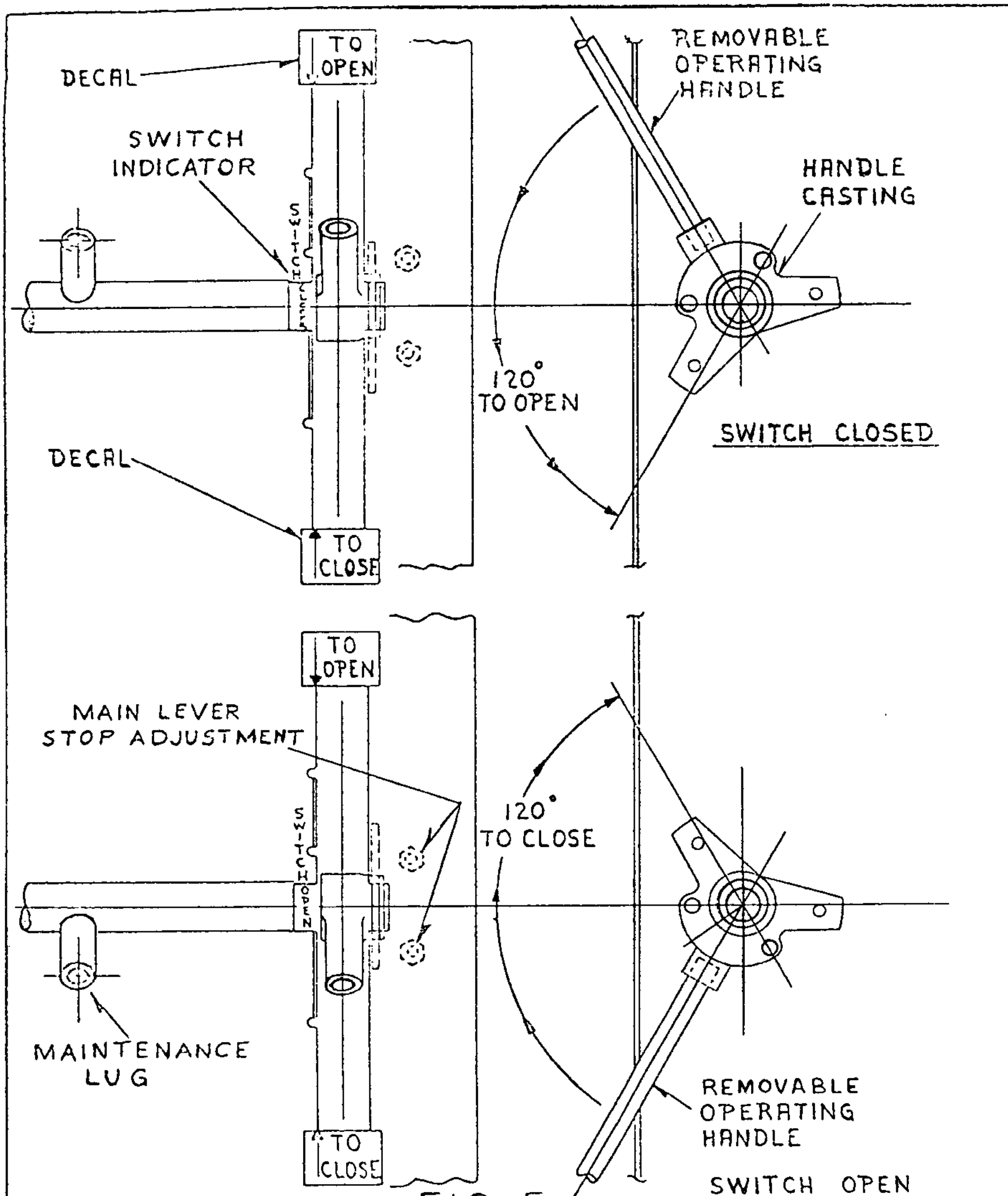


FIG. 5

WESTINGHOUSE ELECTRIC CORPORATION

TITLE SWITCH OPERATION

3714A05

DIVISION ____________

PLANT LOCATION ____________

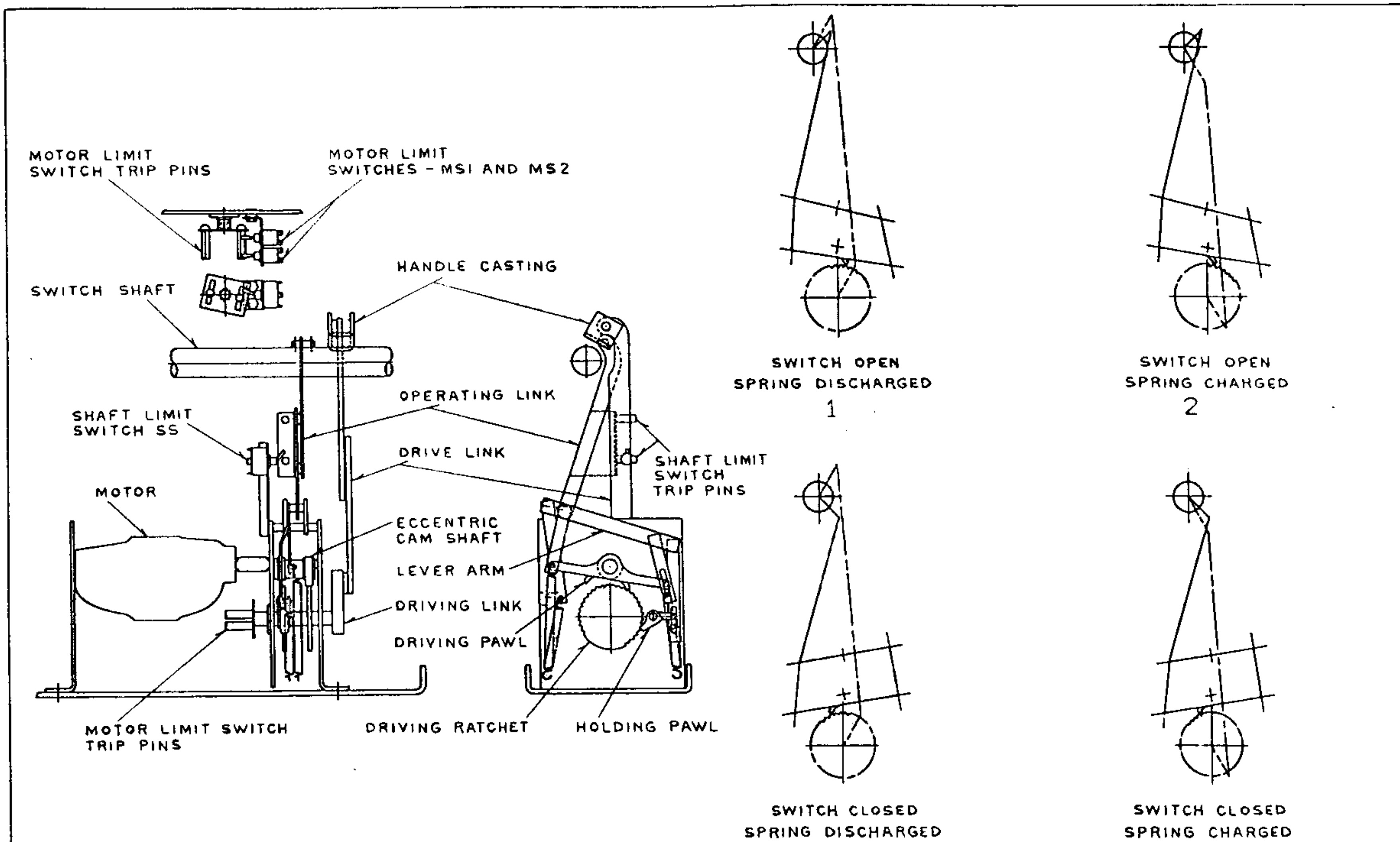


FIG. 6

MOTOR MECHANISM

507B229

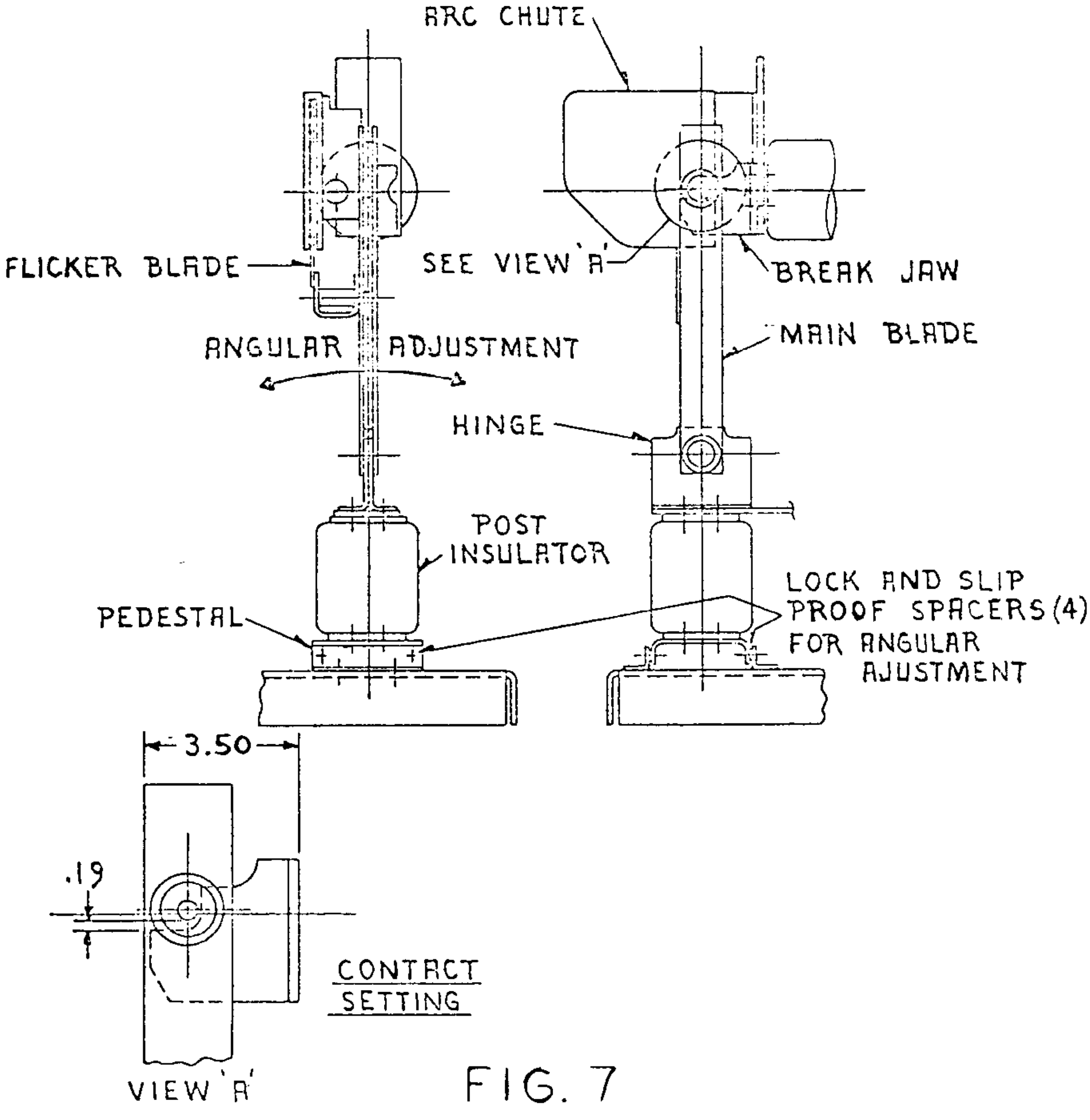


FIG. 7

WESTINGHOUSE ELECTRIC CORPORATION

TITLE SWITCH ADJUSTMENT

3714A07

DIVISION

PLANT LOCATION

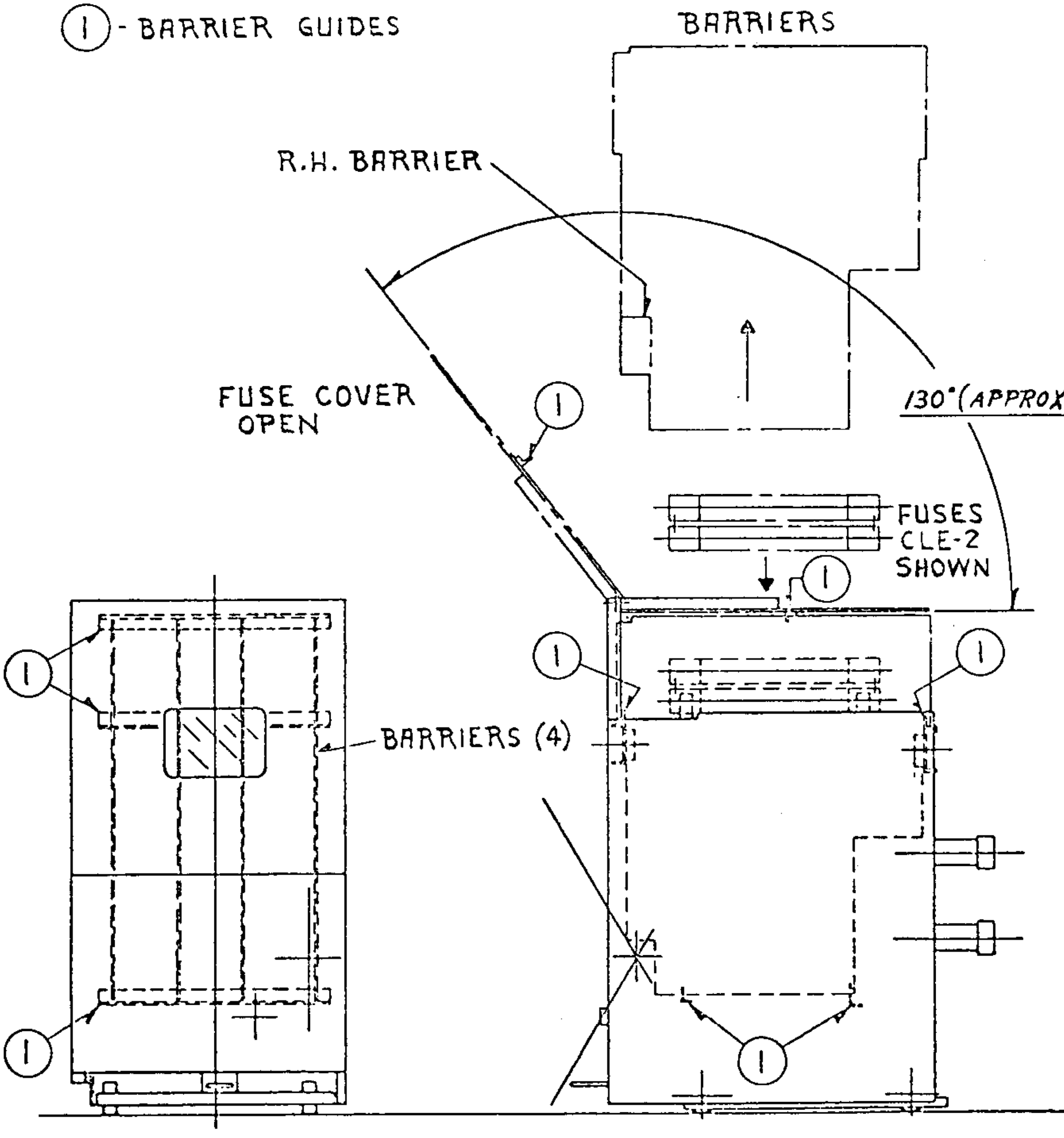


FIG. 8

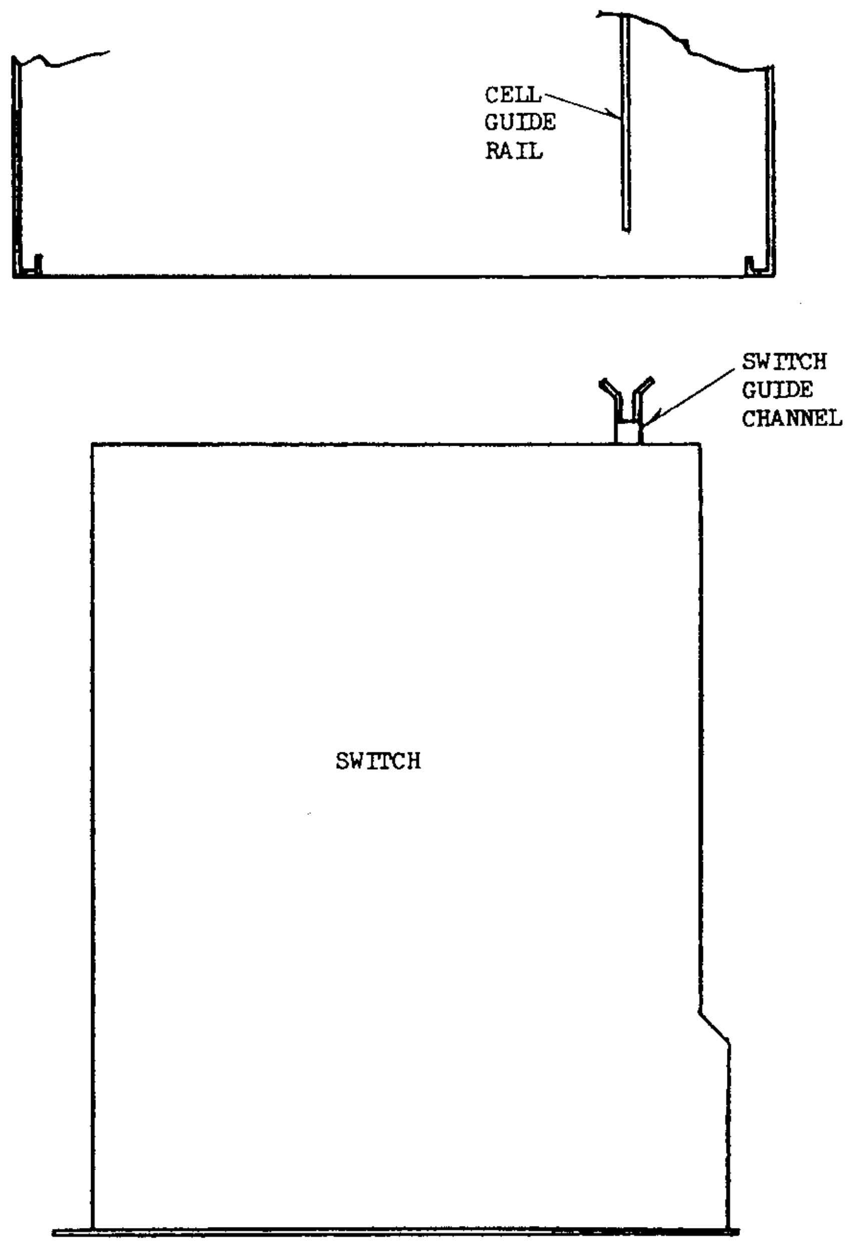
WESTINGHOUSE ELECTRIC CORPORATION

TITLE REMOVAL OF BARRIERS & FUSES

3714A08

DIVISION

PLANT LOCATION



PLAN VIEW

FIG. 9

WESTINGHOUSE ELECTRIC CORPORATION

3714A09

TITLE SWITCH CELL LINEUP FOR LEVERING IN

DIVISION ____ PLANT LOCATION ____

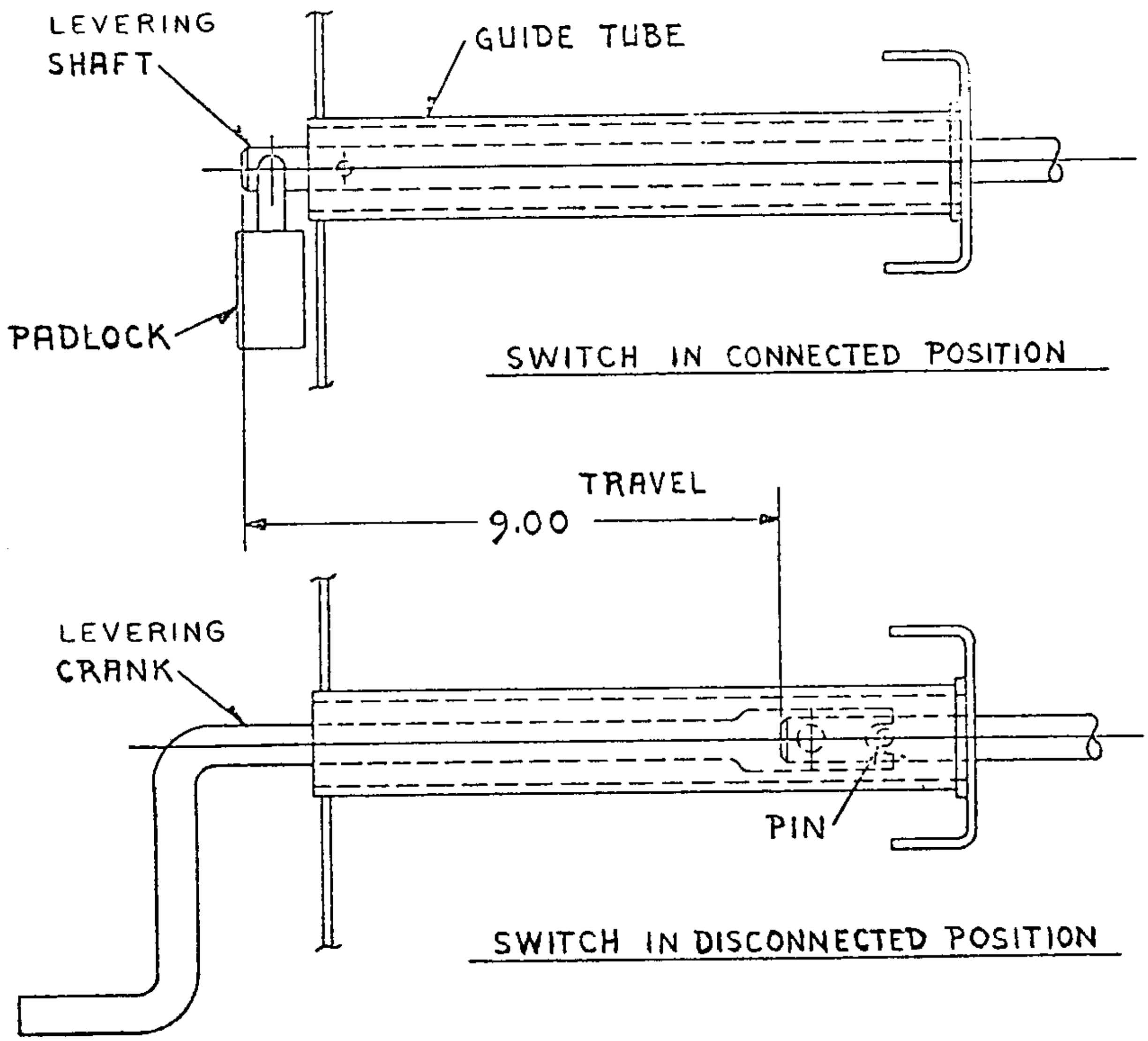


FIG. 10

WESTINGHOUSE ELECTRIC CORPORATION

TITLE LEVERING DEVICE

3714A10

DIVISION

PLANT LOCATION

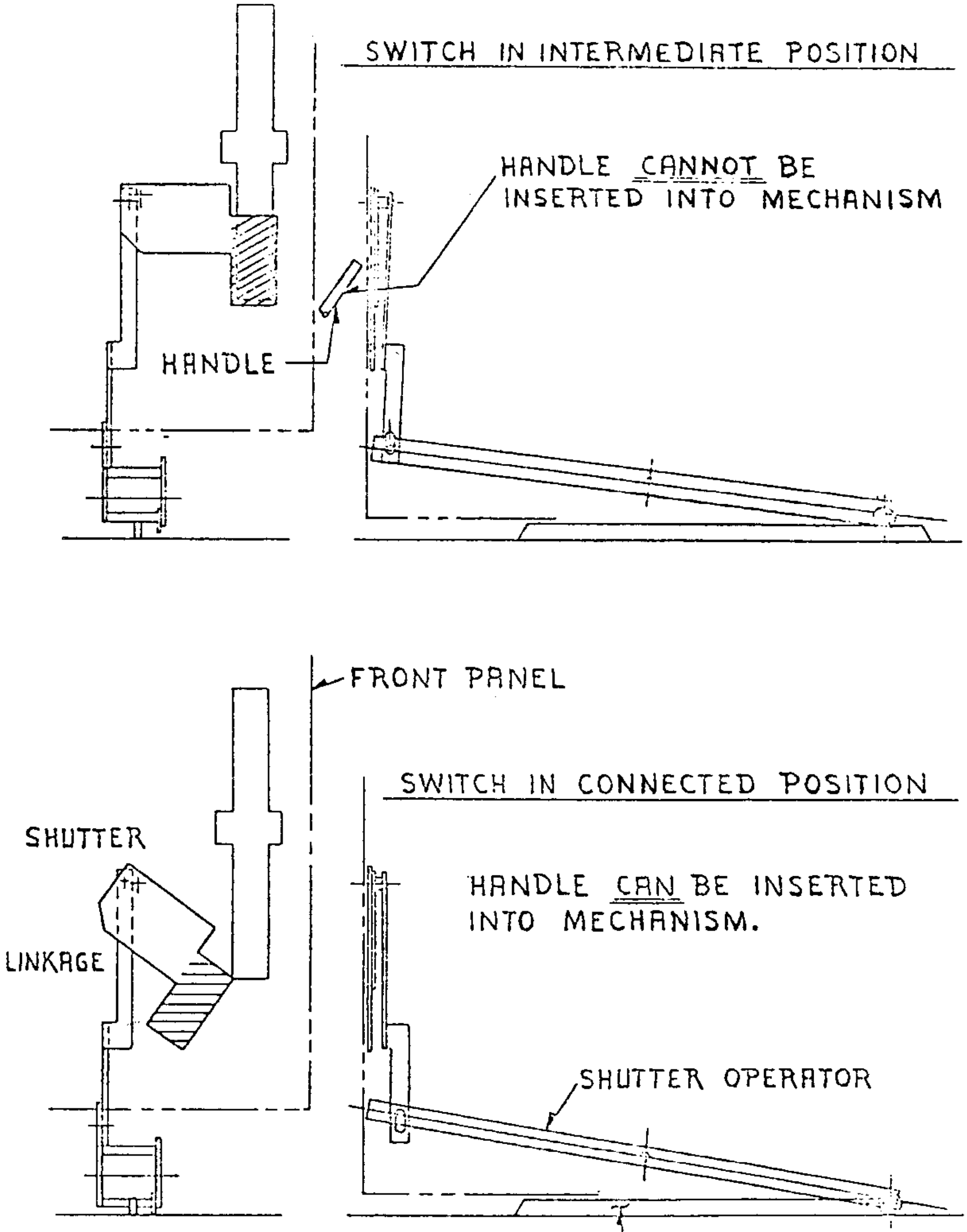


FIG. 11

WESTINGHOUSE ELECTRIC CORPORATION

TITLE FLOOR INTERLOCK

3714A11

DIVISION

PLANT LOCATION

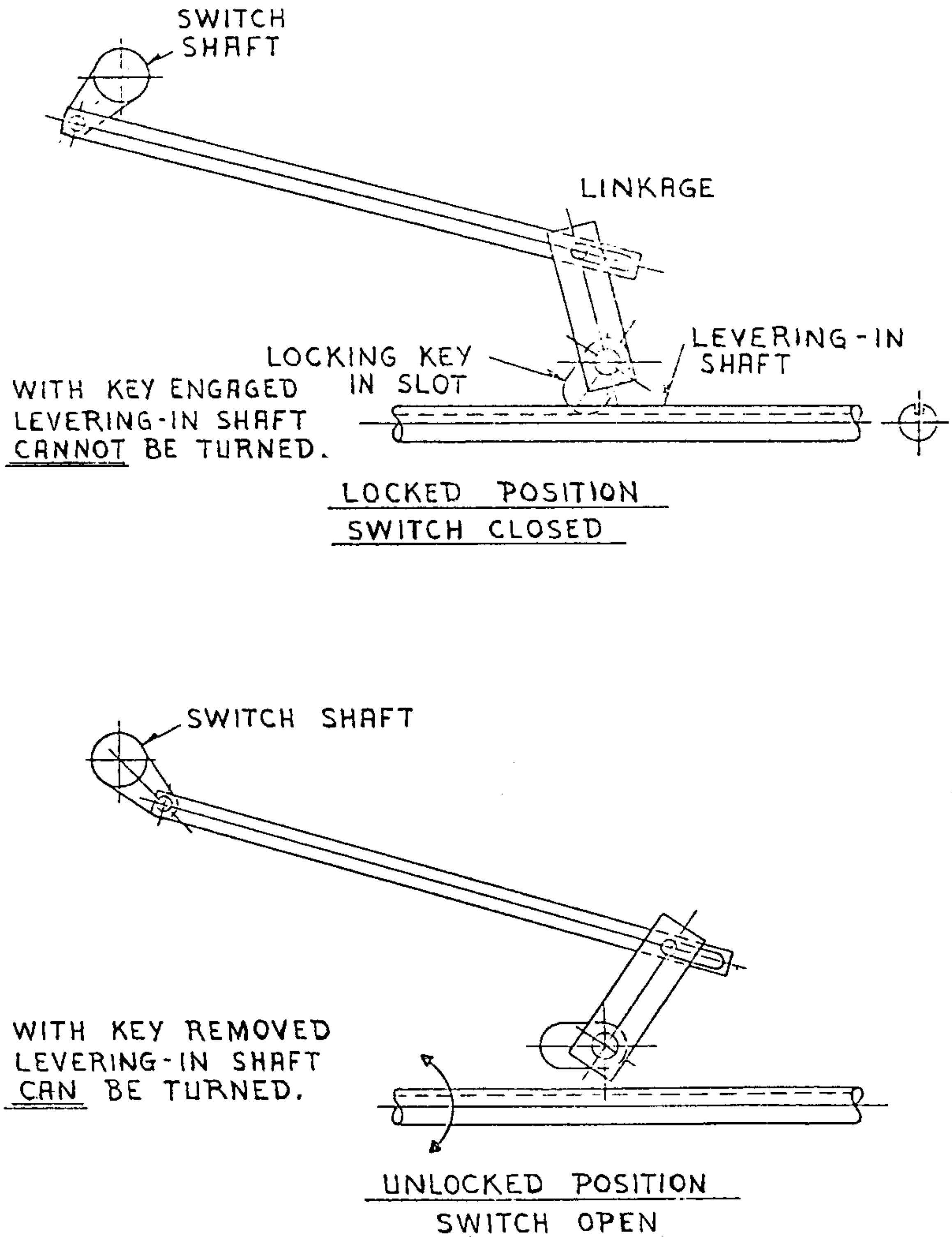


FIG. 12

WESTINGHOUSE ELECTRIC CORPORATION

TITLE SWITCH INTERLOCK

3714A12

DIVISION

PLANT LOCATION

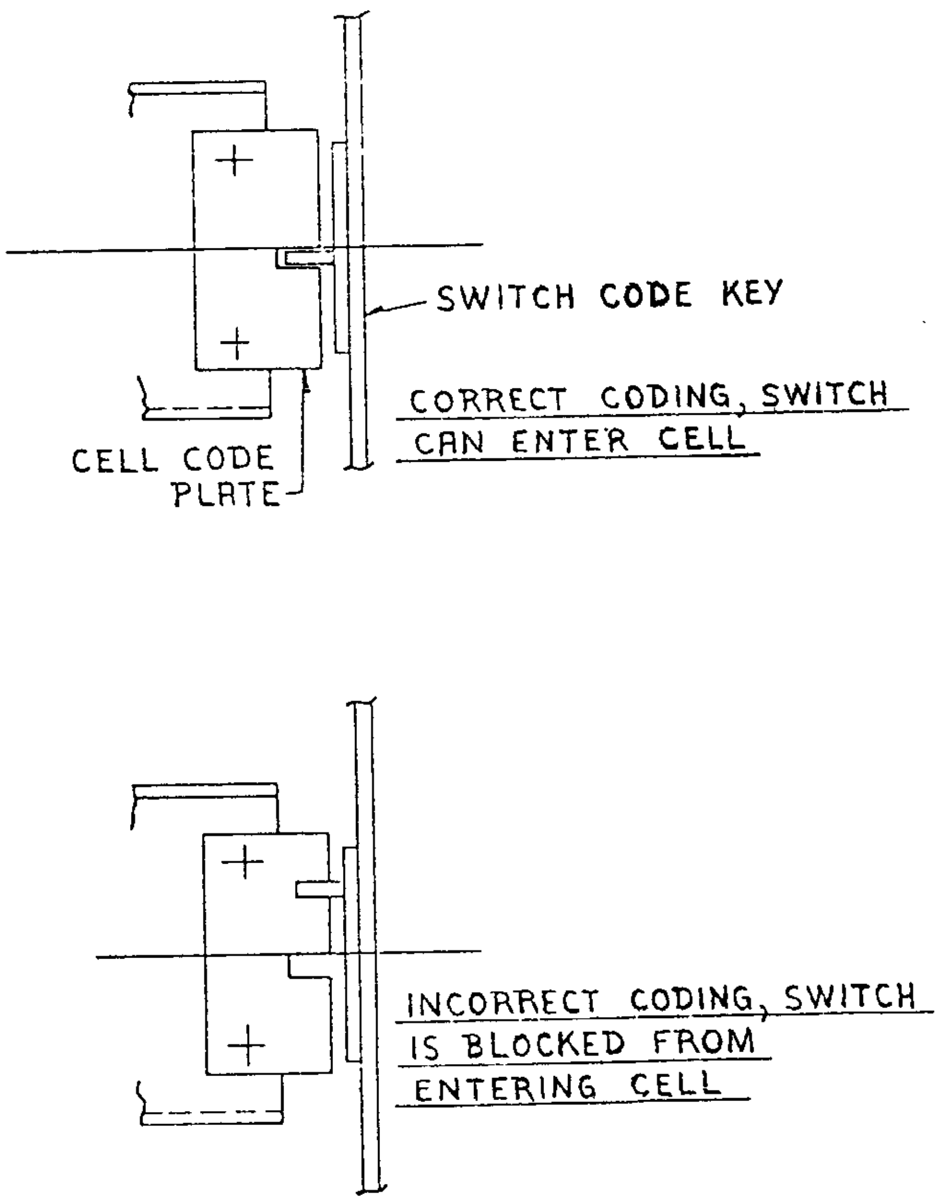


FIG. 13

WESTINGHOUSE ELECTRIC CORPORATION

3714A13

TITLE CODING PLATES

DIVISION

PLANT LOCATION

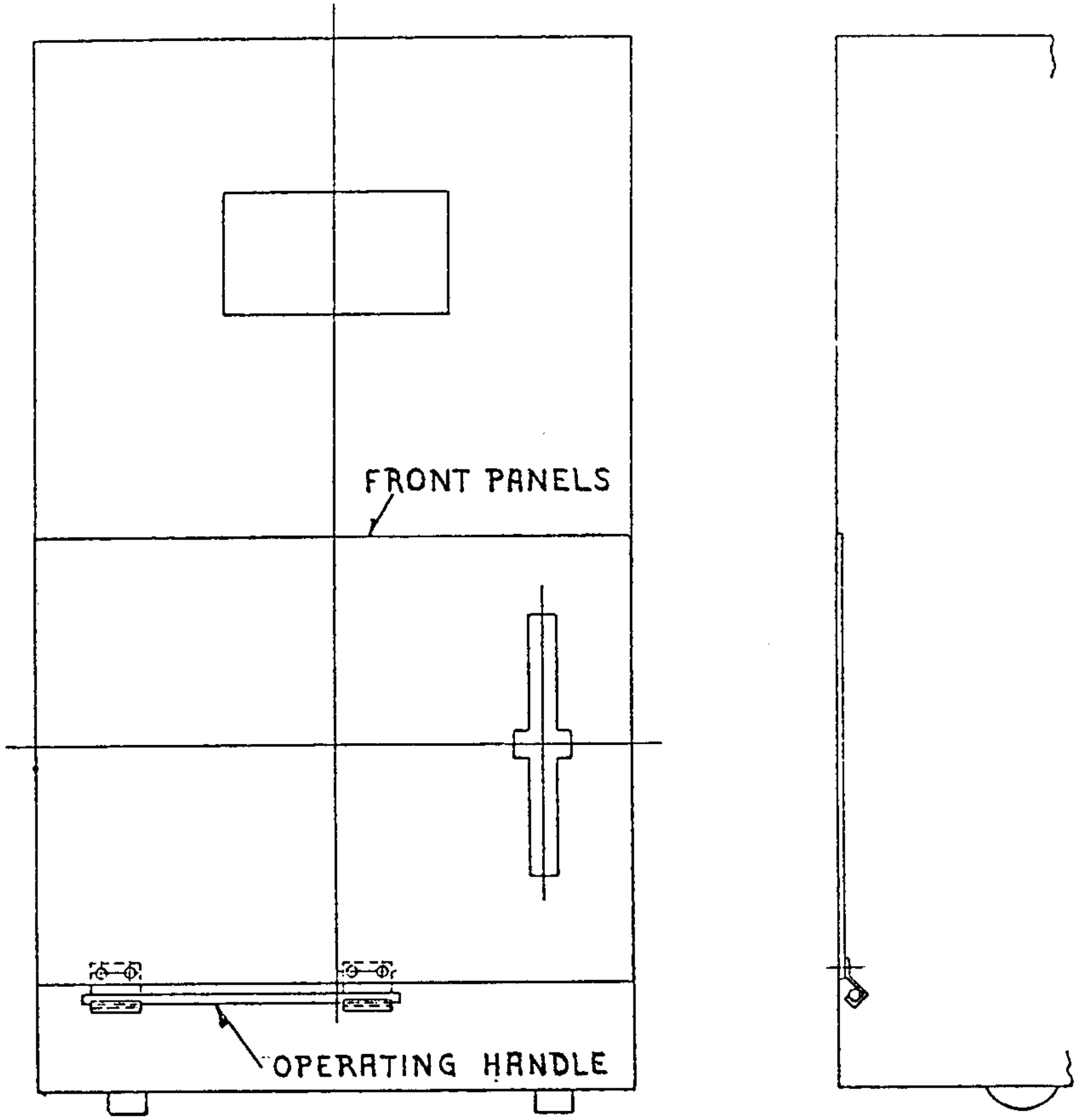


FIG. 14

WESTINGHOUSE ELECTRIC CORPORATION

TITLE STORAGE OF OPERATING HANDLE

3714A14

DIVISION

PLANT LOCATION

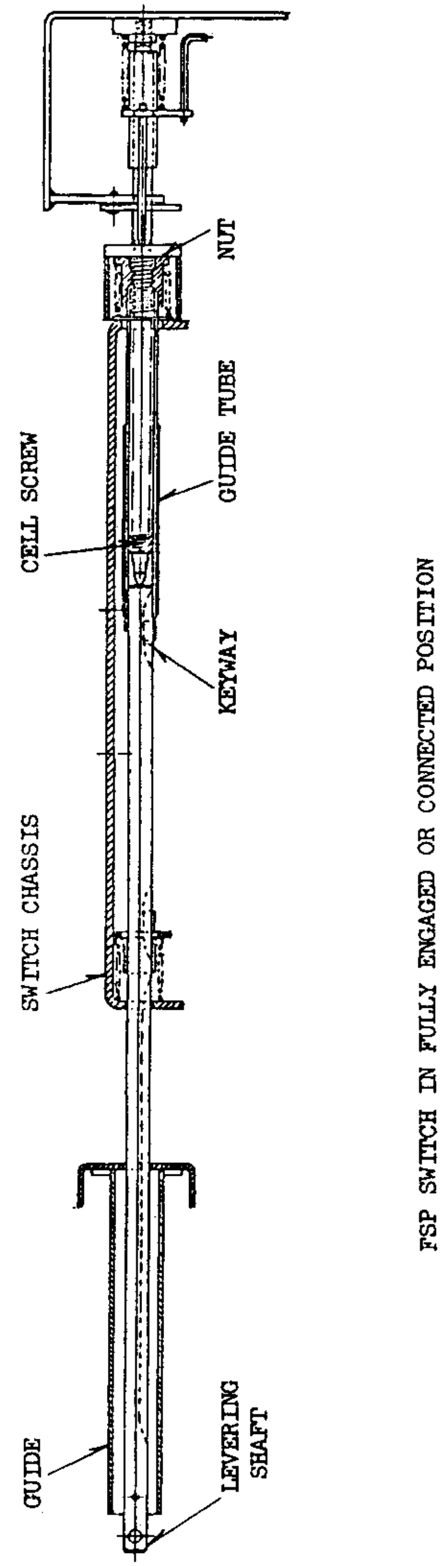


FIG. 15

WESTINGHOUSE ELECTRIC CORPORATION

3714A15

TITLE LEVERING DEVICE - DETAILS

DIVISION

PLANT LOCATION

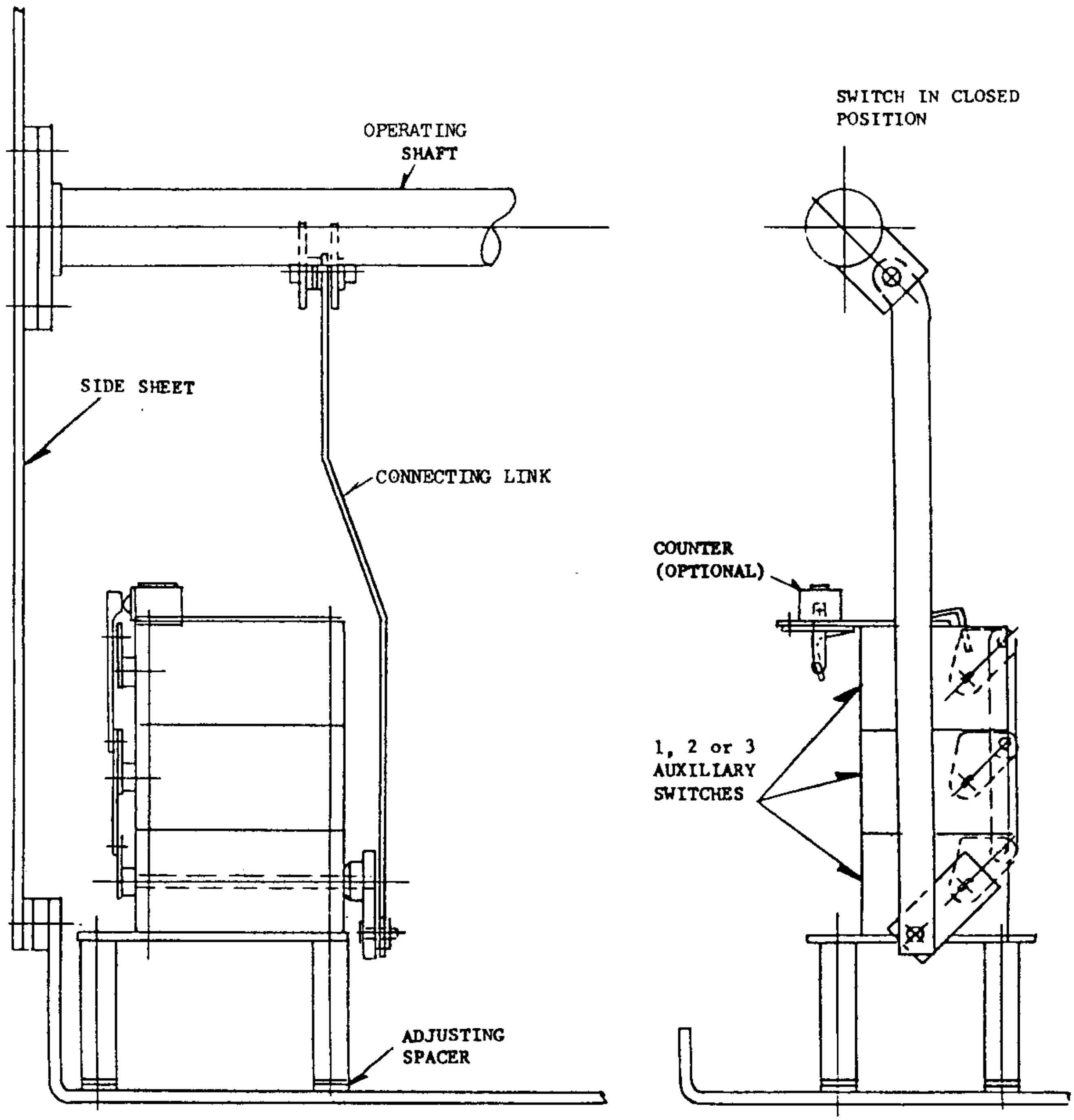


FIG. 16

WESTINGHOUSE ELECTRIC CORPORATION

TITLE AUXILIARY SWITCH AND COUNTER

3714A16

DIVISION ______ PLANT LOCATION ______

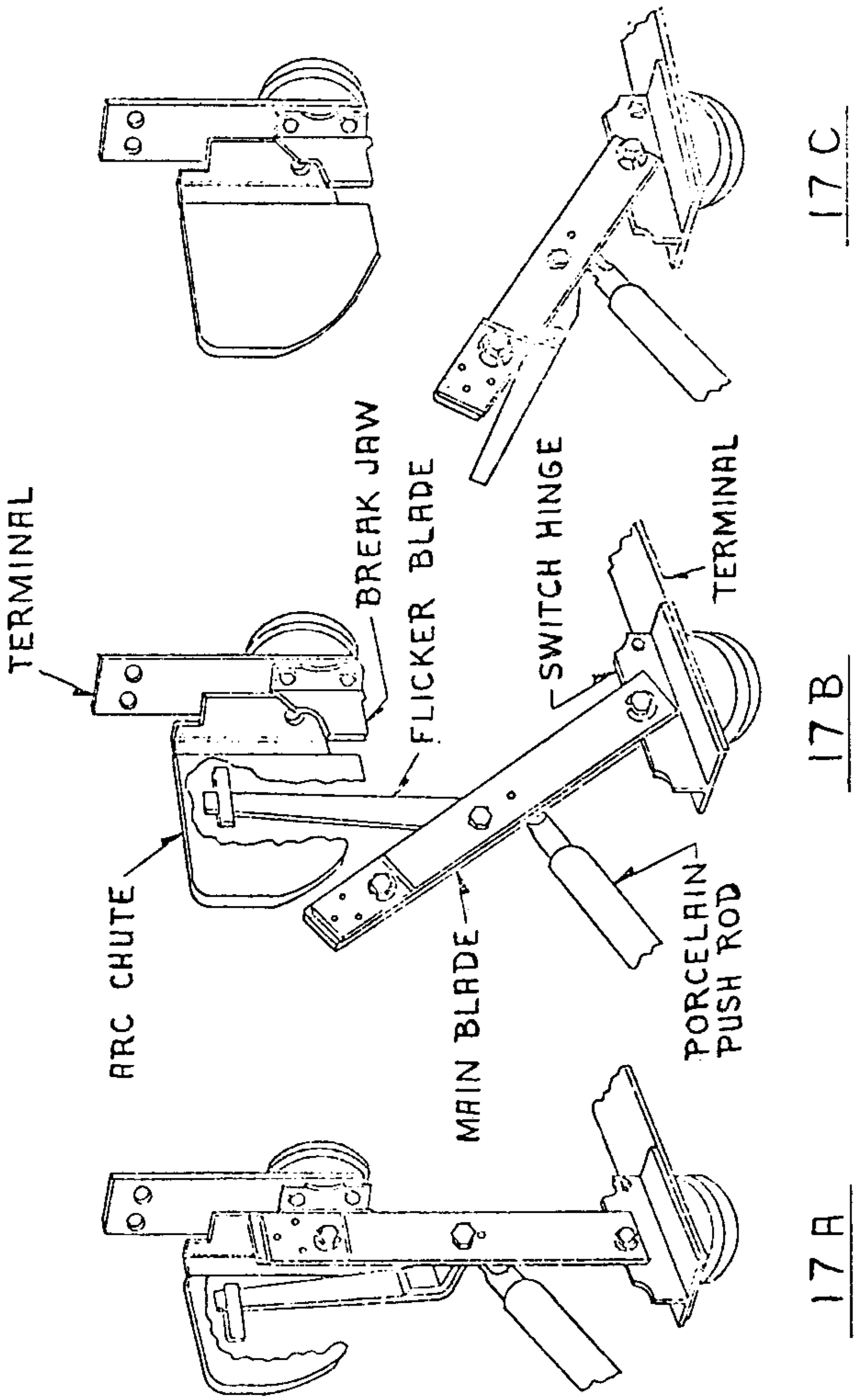


FIG. 17

WESTINGHOUSE ELECTRIC CORPORATION

TITLE 'DE-ION' QUICK BREAK OPERATION

3714A17

DIVISION ____________ PLANT LOCATION ____________

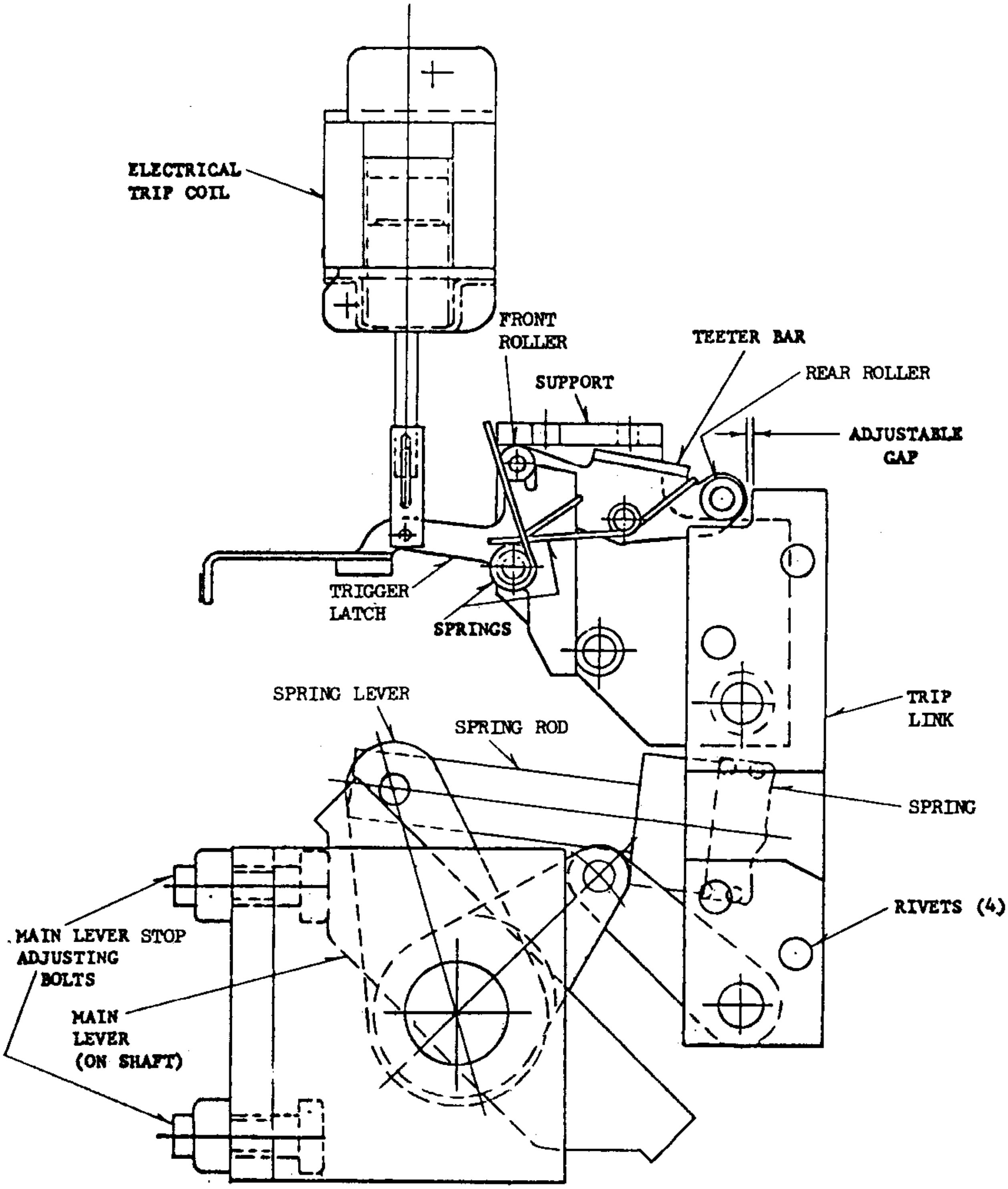


FIG. 18

WESTINGHOUSE ELECTRIC CORPORATION

TITLE SWITCH OPEN, SPRING NOT CHARGED

3714A18

DIVISION

PLANT LOCATION

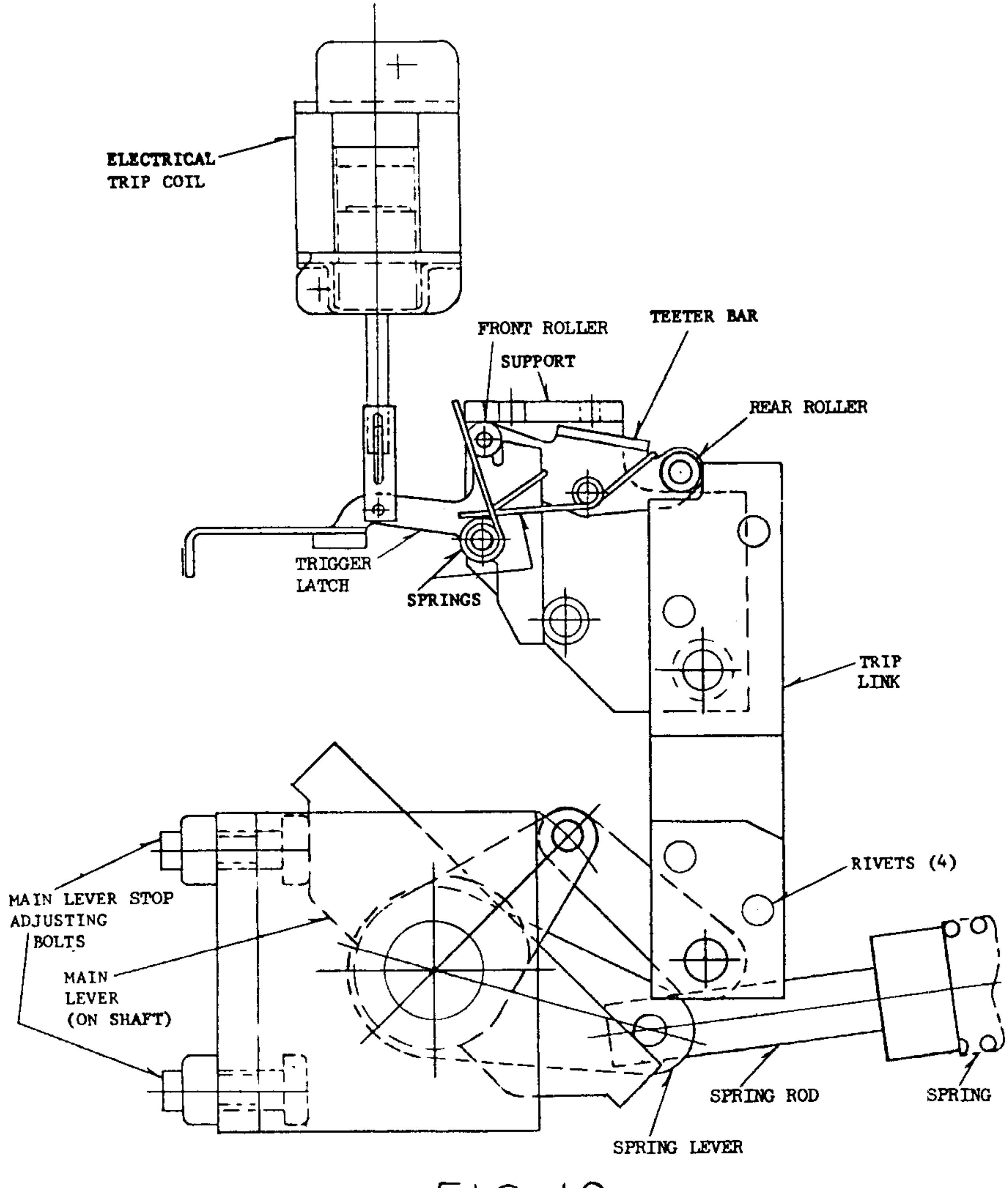


FIG. 19

WESTINGHOUSE ELECTRIC CORPORATION

3714A19

TITLE SWITCH OPEN, SPRING CHARGED

DIVISION

PLANT LOCATION

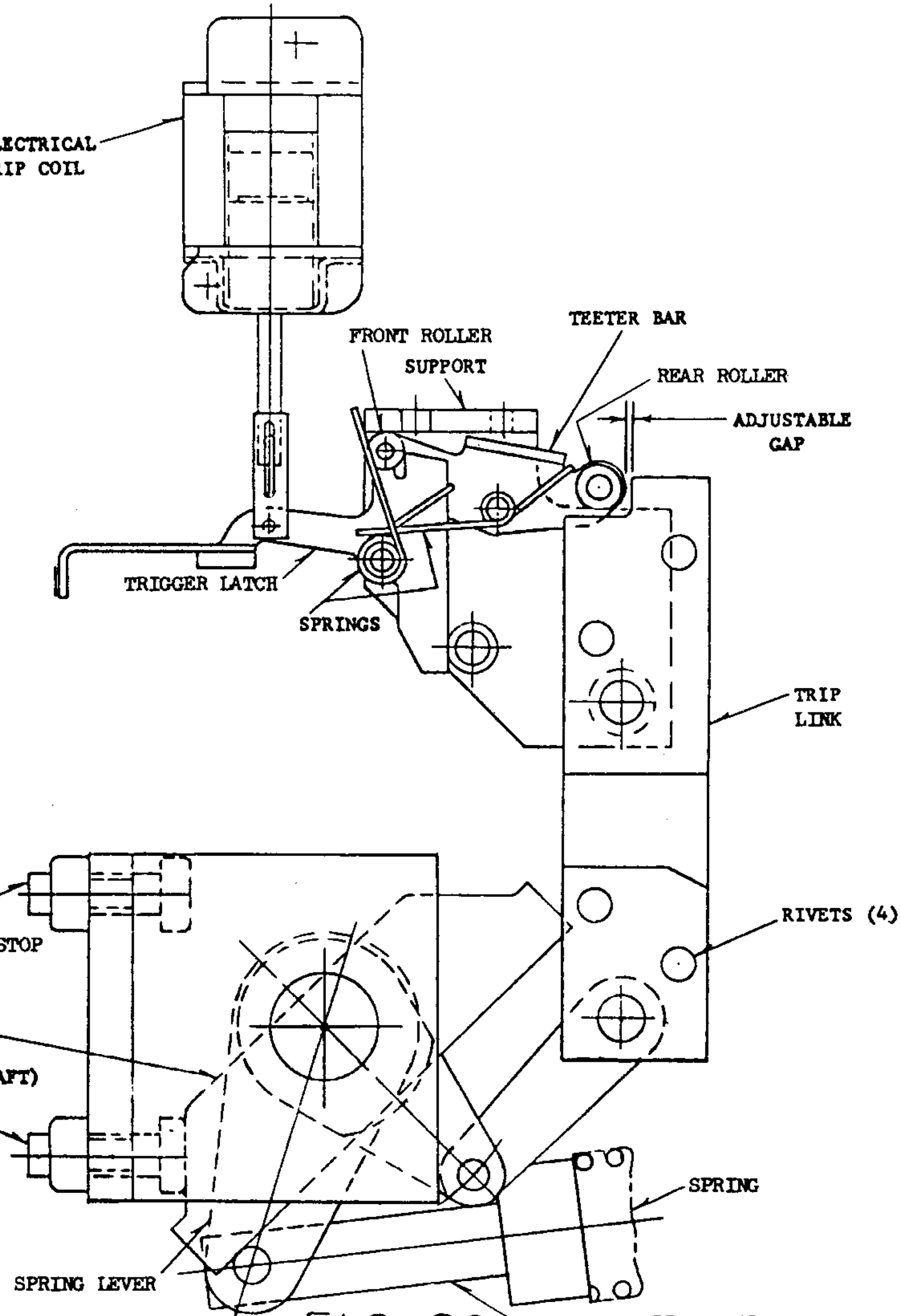


FIG. 20

WESTINGHOUSE ELECTRIC CORPORATION

TITLE SWITCH CLOSED, SPRING NOT CHARGED

3714A20

DIVISION ______ PLANT LOCATION ______

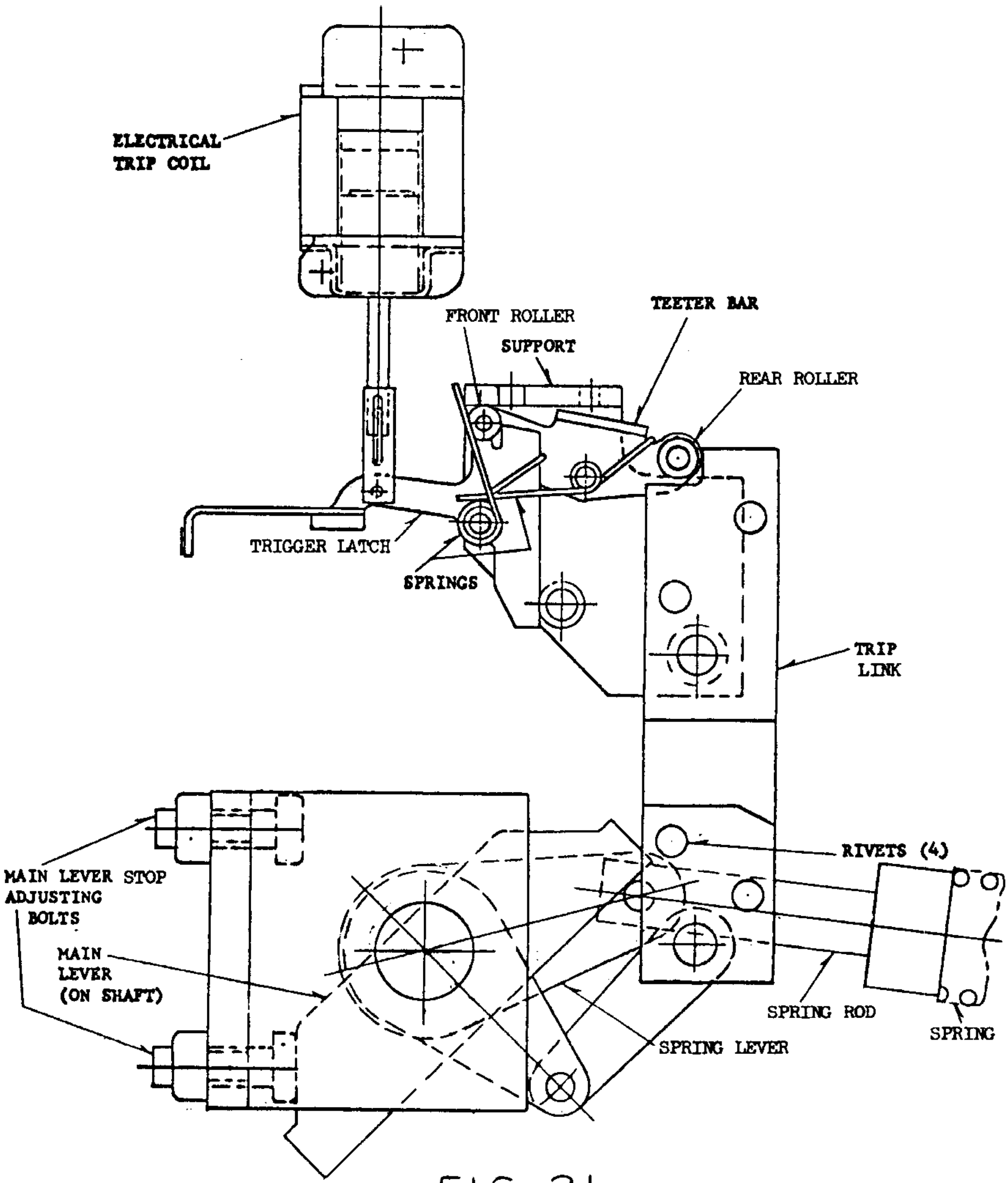


FIG. 21

WESTINGHOUSE ELECTRIC CORPORATION

3714A21

TITLE SWITCH CLOSED, SPRING CHARGED

DIVISION ______

PLANT LOCATION ______

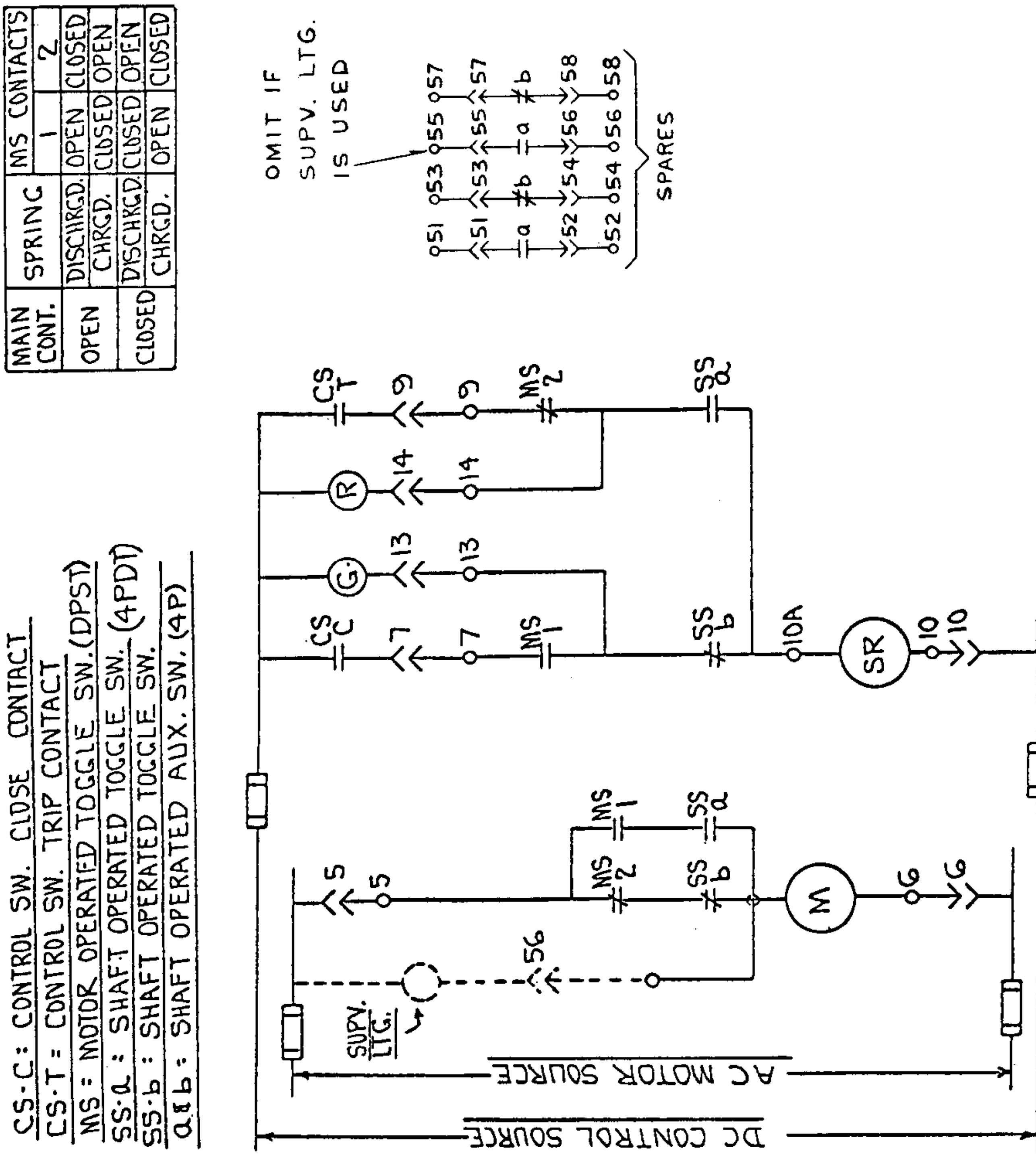


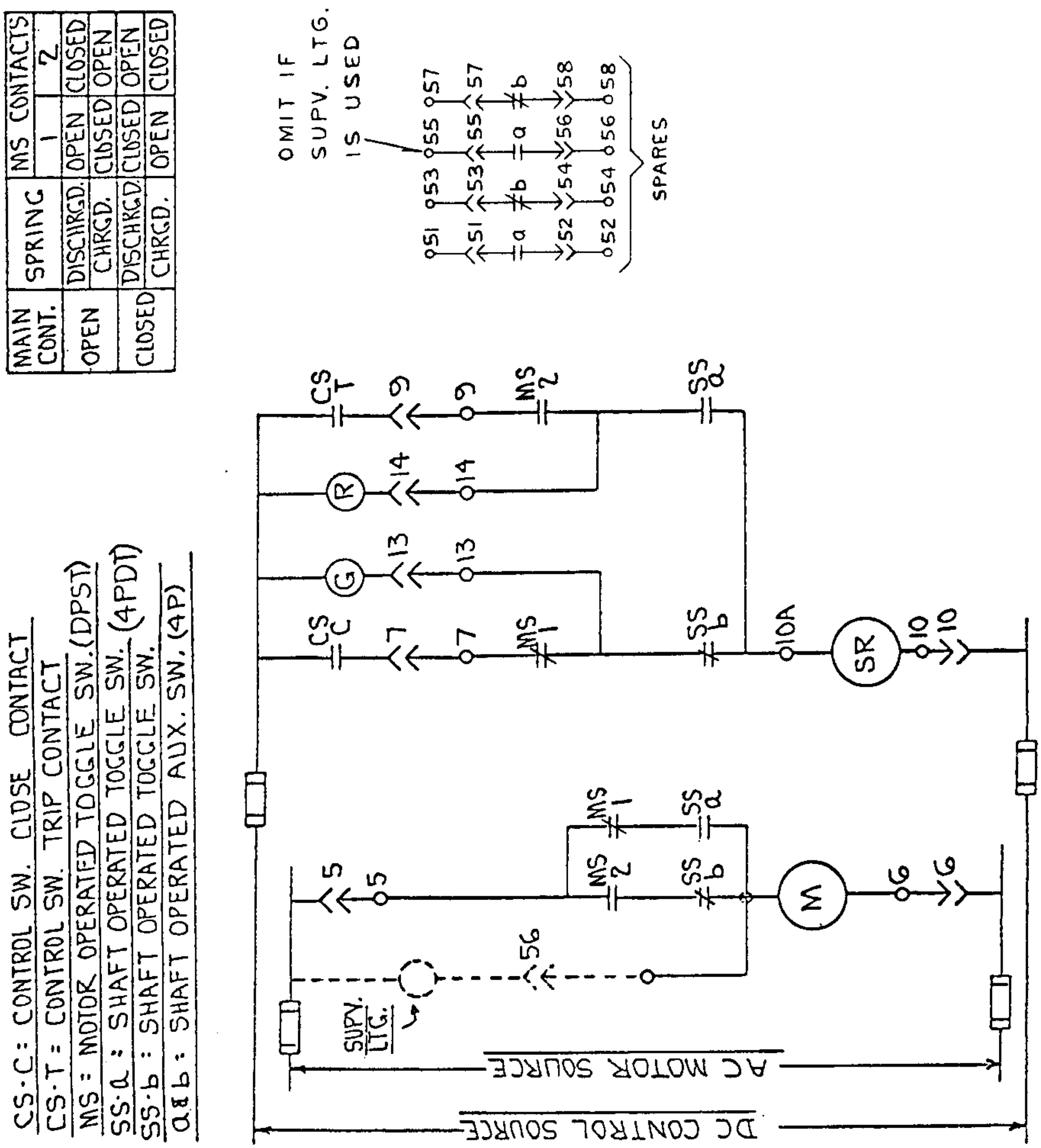
FIG. 22

WESTINGHOUSE ELECTRIC CORPORATION

TITLE SWITCH OUTSIDE CELL

3714A22

DIVISION ____________ PLANT LOCATION ____________



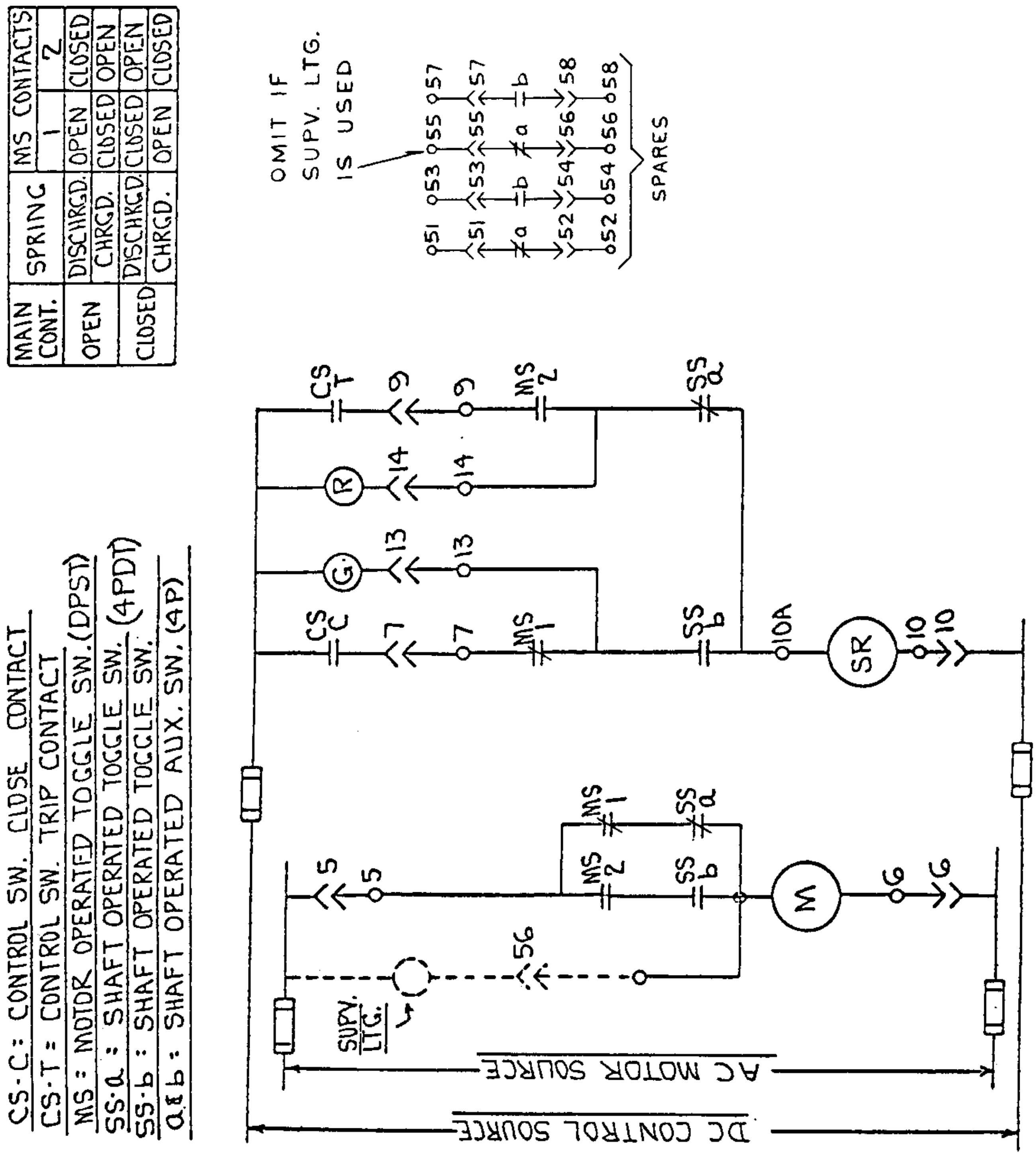
MAIN CONT.	SPRING	MS CONTACTS 1	MS CONTACTS 2
OPEN	DISCHRGD.	OPEN	CLOSED
OPEN	CHRGD.	CLOSED	OPEN
CLOSED	DISCHRGD.	CLOSED	OPEN
CLOSED	CHRGD.	OPEN	CLOSED

FIG. 23

WESTINGHOUSE ELECTRIC CORPORATION — 3714A23

TITLE SWITCH OPEN, SPRING CHARGED AND RESTRAINED

DIVISION ______ PLANT LOCATION ______



MAIN CONT.	SPRING	MS CONTACTS 1	MS CONTACTS 2
OPEN	DISCHRGD.	OPEN	CLOSED
	CHRGD.	CLOSED	OPEN
CLOSED	DISCHRGD.	CLOSED	OPEN
	CHRGD.	OPEN	CLOSED

FIG. 24

WESTINGHOUSE ELECTRIC CORPORATION

TITLE SWITCH CLOSED, SPRING CHARGING

3714A24

DIVISION ________

PLANT LOCATION ________

MAIN CONT.	SPRING	MS CONTACTS 1	MS CONTACTS 2
OPEN	DISCHRGD.	OPEN	CLOSED
	CHRGD.	CLOSED	OPEN
CLOSED	DISCHRGD.	CLOSED	OPEN
	CHRGD.	OPEN	CLOSED

CS·C: CONTROL SW. CLOSE CONTACT
CS·T: CONTROL SW. TRIP CONTACT
MS: MOTOR OPERATED TOGGLE SW. (DPST)
SS·a: SHAFT OPERATED TOGGLE SW. (4PDT)
SS·b: SHAFT OPERATED TOGGLE SW.
a & b: SHAFT OPERATED AUX. SW. (4P)

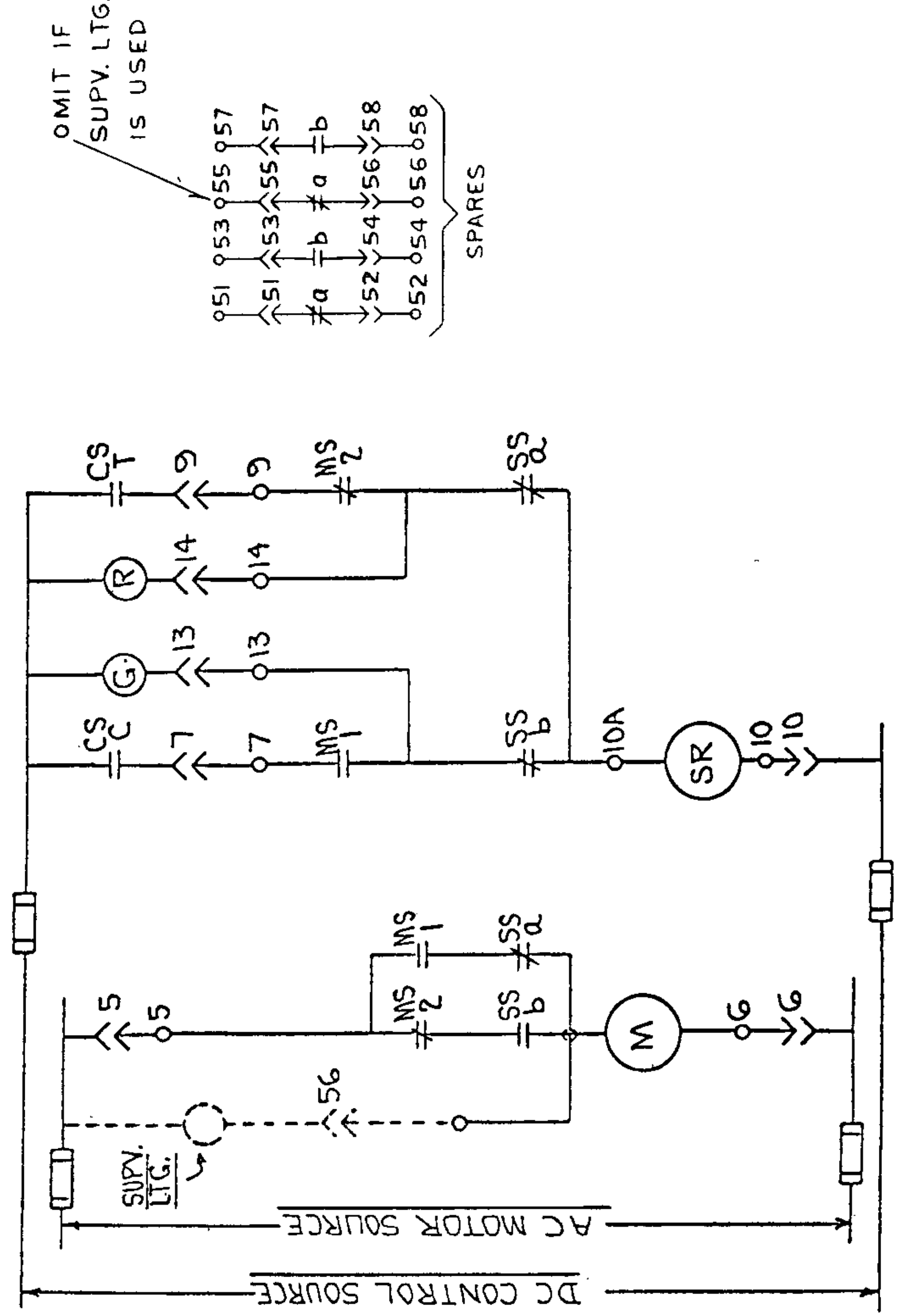


FIG. 25

WESTINGHOUSE ELECTRIC CORPORATION

3714A25

TITLE SWITCH CLOSED, SPRING CHARGED AND RESTRAINED

DIVISION

PLANT LOCATION

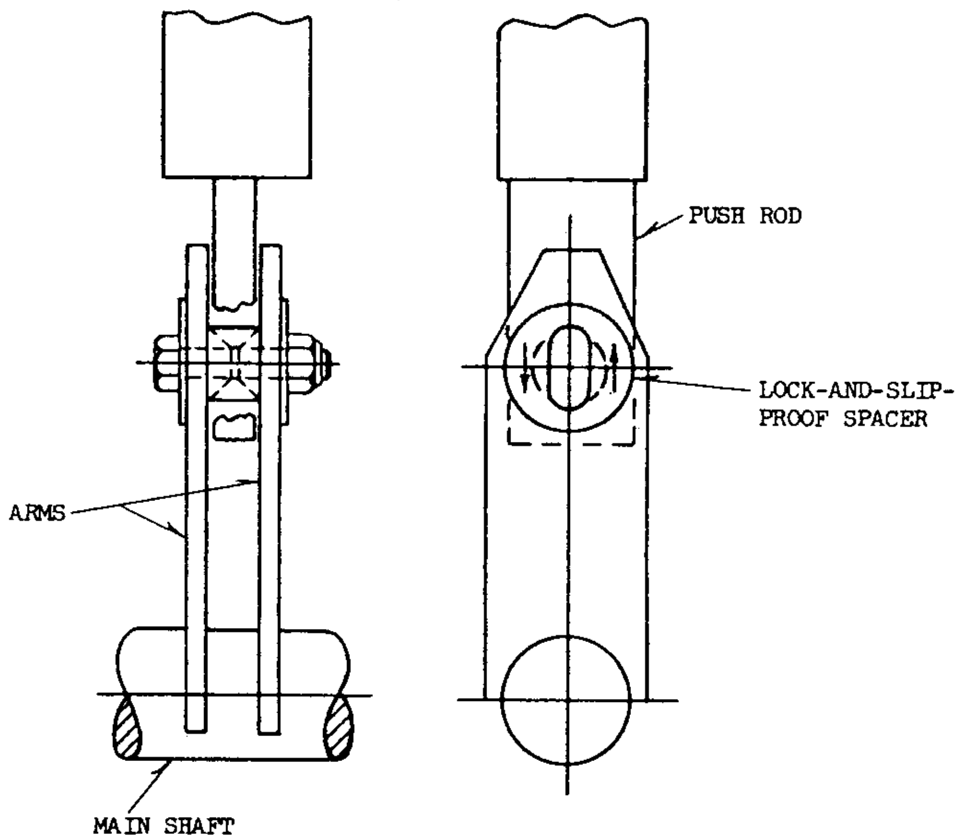


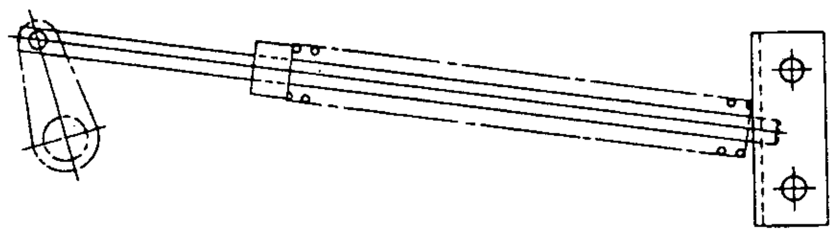
FIG. 26

WESTINGHOUSE ELECTRIC CORPORATION

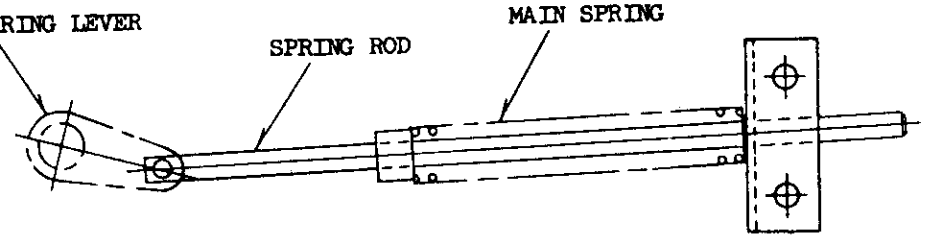
TITLE BLADE ALIGNMENT

3714A26

DIVISION ______ PLANT LOCATION ______



SPRING DISCHARGED - SWITCH OPEN



SPRING CHARGED - SWITCH OPEN

FIG. 27

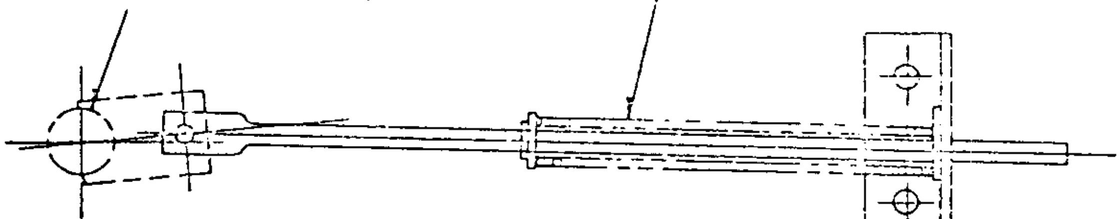
WESTINGHOUSE ELECTRIC CORPORATION

3714A27

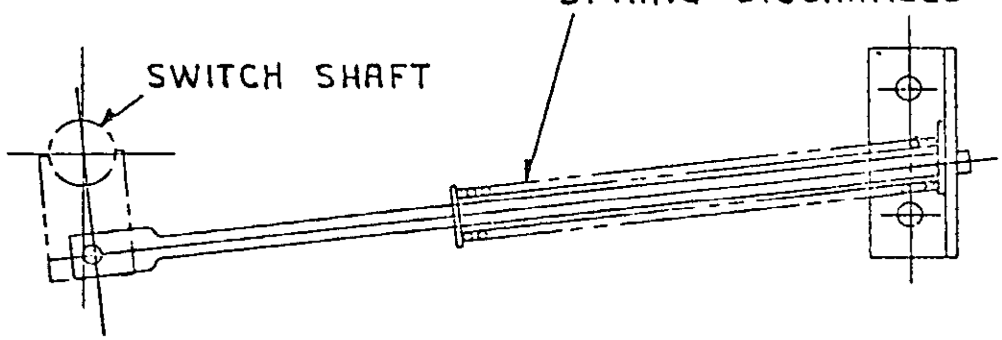
TITLE MAIN CLOSING SPRING

DIVISION

PLANT LOCATION



SWITCH OPEN



SWITCH CLOSED

FIG. 28

WESTINGHOUSE ELECTRIC CORPORATION

TITLE AUX. SPRING L.H. SIDE

3714A28

DIVISION

PLANT LOCATION

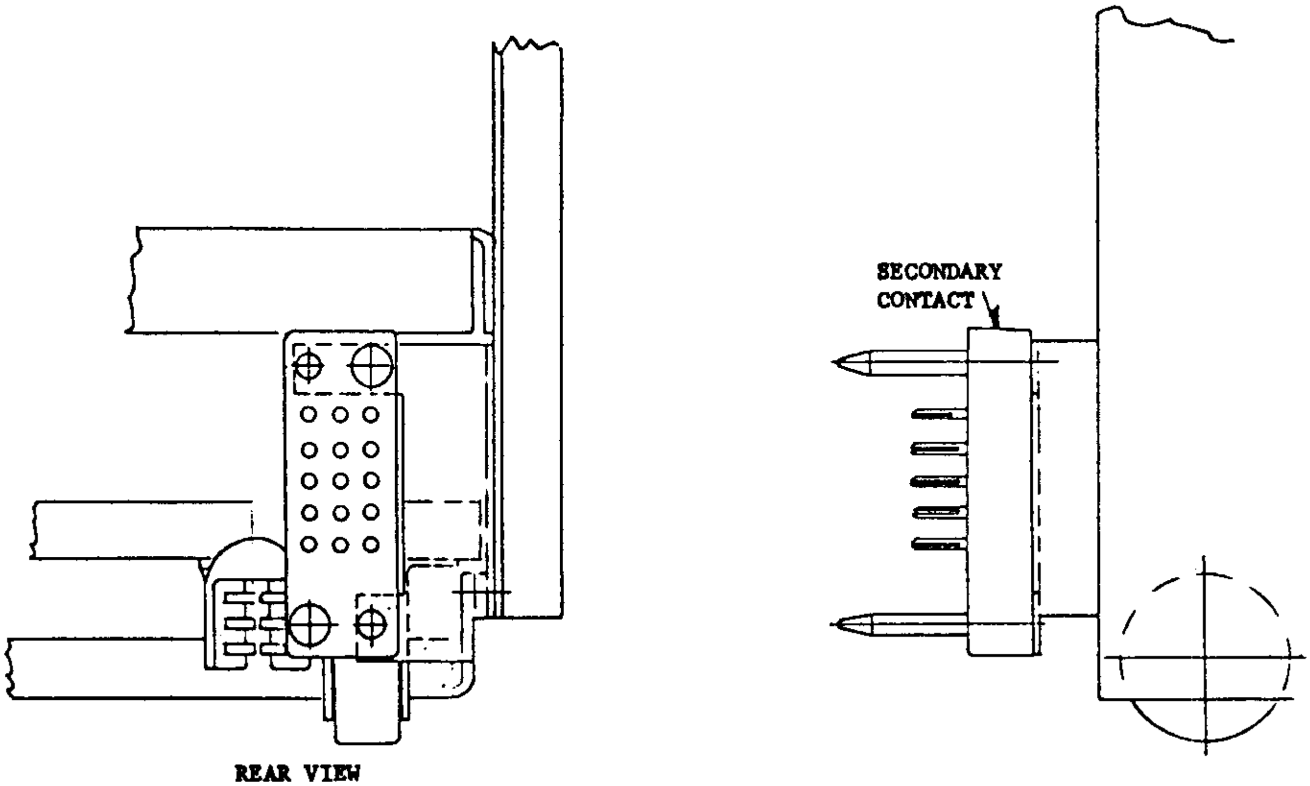


FIG. 29

WESTINGHOUSE ELECTRIC CORPORATION

3714A29

TITLE SECONDARY CONTACT

DIVISION

PLANT LOCATION

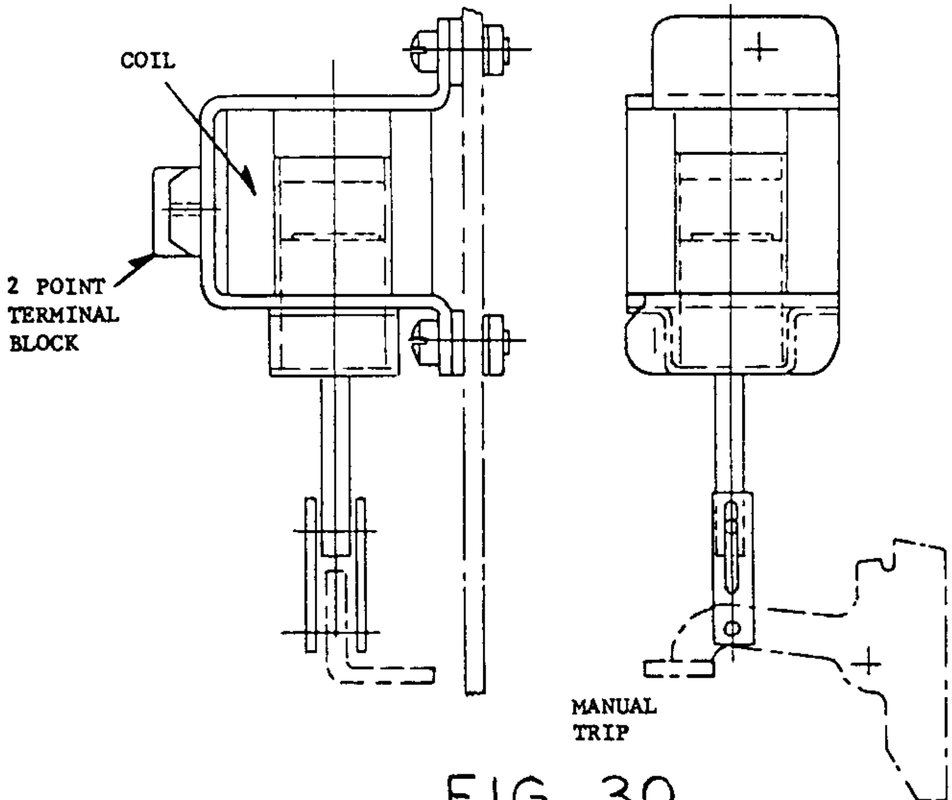


FIG. 30

TRIP COIL OPERATING DATA			
COIL RATING	APPLIED VOLTAGE	INRUSH CURRENT	STEADY STATE CURRENT
S#1574584 115V AC	115V AC RMS 125V AC RMS 95V AC RMS	17.9A RMS 18.7A RMS 15.1A RMS	9.6A RMS 11.2A RMS 7.6A RMS
S#1574583 220V AC	220V AC RMS 250V AC RMS 190V AC RMS	12.0A RMS 13.4A RMS 9.6A RMS	6.0A RMS 7.4A RMS 4.6A RMS
S#1491401 48V DC	48V DC 60V DC 28V DC	-- -- --	5.3A DC 7.4A DC 3.7A DC
S#1491991 125V DC	125V DC 140V DC 70V DC	-- -- --	4.2A DC 4.8A DC 2.3A DC
S#1640660 250V DC	250V DC 280V DC 140V DC	-- -- --	1.6A DC 1.8A DC .89A DC

WESTINGHOUSE ELECTRIC CORPORATION

3714A30

TITLE TRIP COIL AND OPERATING DATA

DIVISION

PLANT LOCATION