INSTRUCTION BOOK

MOTOR OPERATED STORED ENERGY (SPRING) CLOSING MECHANISM

Type SE-2
for
TYPE DH AIR CIRCUIT BREAKERS

Westinghouse Electric Corporation

I.B. 32-251-9A

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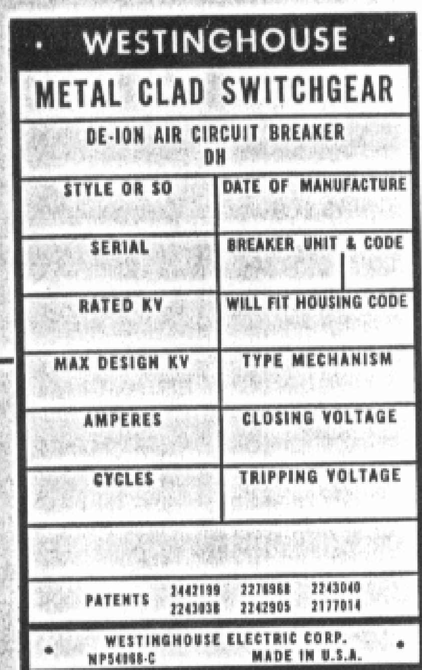

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DESCRIPTION • OPERATION • MAINTENANCE

INSTRUCTIONS

MOTOR OPERATED STORED ENERGY (SPRING) CLOSING MECHANISM

Type SE-2

for

TYPE DH AIR CIRCUIT BREAKERS

WESTINGHOUSE ELECTRIC CORPORATION
ASSEMBLED SWITCHGEAR AND DEVICES DEPARTMENT
EAST PITTSBURGH PLANT • EAST PITTSBURGH, PA.
SUPERSEDES PRELIMINARY I.B. 32-251-9
JULY, 1960
Printed in U.S.A.

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CAUTION

When handling the DH breakers with solenoid closing mechanism we have to keep in mind that the accelerating springs cause very rapid movement of the contact arms on the opening stroke (assuming that the control power is not connected, otherwise the closing stroke is equally dangerous).

However, in case of breakers with spring closing, the closing spring, if charged and accidentally released, can cause rapid close of the contact arms which is even more dangerous than their opening and for this reason, extreme care has to be exercised during both operations, opening and closing of the breaker.

NOTE: THE CLOSING SPRING IS AUTOMATICALLY CHARGED AS SOON AS CONTROL POWER IS APPLIED TO THE BREAKER.

For safety reasons, closing spring should be kept in discharged position at all times during maintenance operations (except when the breaker is to be closed by hand) and the breaker should be kept in the open position.

To put the breaker into a safe condition, the following should be done:

1. Make certain that the control power is disconnected.
2. Trip the breaker by one of the methods described on pages 31 to 33 (if the breaker is closed).
3. Close the breaker by one of the methods described on page 34.
4. Trip the breaker same as in (2).

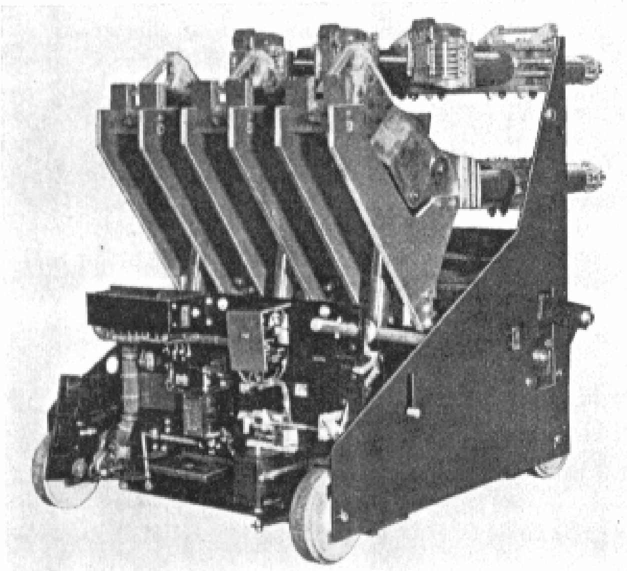


FIG. 1. Type 150-DH-1000 A.C.B. Rated at 1200 Amps. With Stored Energy (Spring) Closing Mechanism General View of Breaker Without Arc Chutes and Without Interphase Barriers

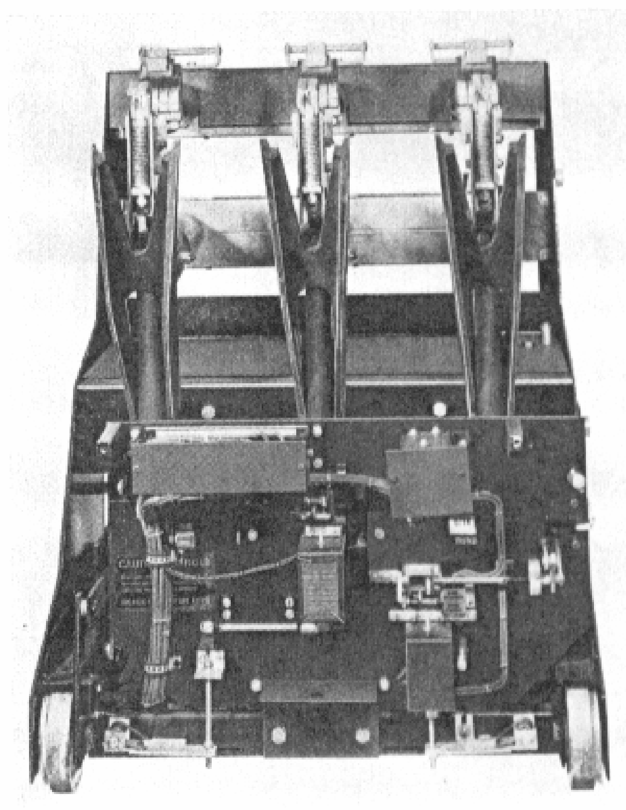


FIG. 2. General View of Type 150-DH-250 A.C.B. With Stored Energy (Spring) Closing Mechanism. Breaker is Shown Without Arc Chutes and Without Interphase Barrier

PART ONE

DESCRIPTION

GENERAL

TYPE DH AIR CIRCUIT BREAKERS provided with stored energy (spring) closing mechanism are of the same general design as the corresponding types of solenoid closed breakers. Specifically, the breaker frames are identical in both cases except that the stored energy breaker frames are, in some cases, provided with additional drilling or additional openings for easy accessibility of some parts; the lower and upper studs, contact arms, contacts, arc chutes and interphase barriers are identical.

INTERCHANGEABILITY

Mechanically, the breakers with solenoid closing are interchangeable with those with spring closing. Electrically, there is a slight difference, in that one or two points of the secondary contact blocks are connected to different circuits. Details can be found by comparing the diagrams furnished to the customer with each job.

INSTRUCTION BOOKS

Standard instruction books for DH breakers* with solenoid closing apply for the breakers with stored energy (spring) closing except where the closing mechanism is concerned.

This instruction book covers only the mechanism itself and those standard parts, common to both kinds of breakers—solenoid closed as well as spring-closed—which operate in conjunction with stored energy (spring) closing mechanism.

STORED ENERGY (SPRING) CLOSING MECHANISM SIZES AND RATINGS

The mechanism is essentially identically the same for all breaker sizes and ratings and operates in the same manner. However, some physical and dimensional differences exist between mechanisms for individual breaker types, namely the following:

1. Spring rating and length; obviously lower rated breakers employ weaker springs.

2. Spring cocking motor. Two ratings of motor are used; larger motor (higher rated) is for breakers with highest interrupting ratings and, subsequently, heaviest springs.

3. Details of mechanism frame involving mounting the mechanism in the breaker itself.

4. Front panel size and arrangement of control elements on it (see Figs. 19, 20).

5. Automatic tripping and closing devices.

6. Slight variation in dimensions of some links and the front part of the mechanism frame in case of 5 KV breakers, due to small size of these breakers.

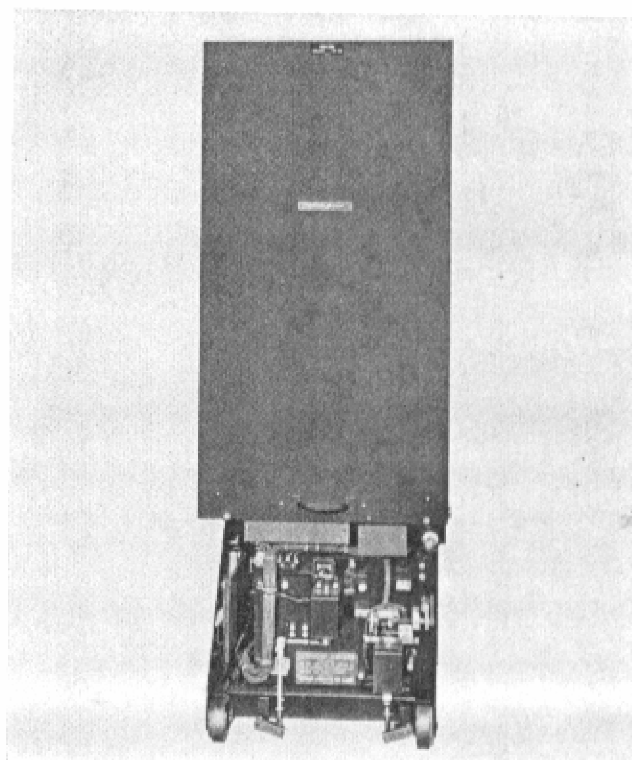


FIG. 3. Type 50-DH-150 A.C.B. With Stored Energy (Spring) Closing Mechanism. General View of Breaker With Interphase Barrier in Place.

*Standard Instruction Book references are as follows:

I.B. 32-251-3 February, 1959—50-DH-150E and 50-DH-250EE
I.B. 32-251-3 Supplement No. 1, November, 1959—75-DH-250E, 75-DH-500E, 150-DH-150E, 150-DH-250E, 150-DH-500E
I.B. 32-150-3A March, 1957 plus supplement No. 1—150-DH-750
I.B. 32-251-4 November, 1958—50-DH-350
I.B. 32-251-6 May, 1959—150-DH-1000

COMPONENT PARTS OF THE STORED ENERGY (SPRING) CLOSING MECHANISM

The mechanism involves the following parts:

1. Spring furnishing the energy for closing.
2. The breaker closing (and opening) linkage.
3. The motor and gears for winding up the spring.
4. The emergency hand winding shaft and gears.
5. The spring cocking linkage.
6. Spring latching and mechanism release system.
7. The motor control system.
8. Automatic spring discharge system.

GENERAL DISPOSITION

General disposition of the mechanism is shown in drawing in Fig. 4 and in photographs Fig. 5 and Fig. 6. The photographs and the sketch show the following main parts of the mechanism:

The mechanism frame, which consists of four bars (legs) held together by a central wall (spacer), a rectangle-like framework holding the legs in place at the front end, and a front bar or front plate serving for mounting the mechanism in the breaker frame and as a support for the dash pot (15 KV breakers only). In some cases, the central spacer serves also for mounting of mechanism in the breaker frame.

The breaker linkage, which, as already has been pointed out, is identical with that of a solenoid closed breaker and which is contained within the front part of the mechanism frame. The only exception is the slotted link corresponding to the "closing links" of the solenoid closing mechanism.

The gear housing, containing the gear drive and motor, is shown in Fig. 4 in plan view only by a dot-dash line. See photographs Figs. 5 and 6 for another view.

The spring winding up linkage is best shown in Figs. 5 and 6. It is located between the gear housing and the mechanism release housing.

The closing spring, the spring retainer, the spring rod, and the shock absorber are located at the rear of the mechanism frame. The shock absorber serves to absorb the impact of the spring and the mechanism linkage inertia at the end of spring stroke, especially should the spring operate trip-free. The shock absorber consists of a number of thin aluminum laminations sandwiched in between two steel plates.

The crank shaft is the most important single member of the mechanism since it connects the spring, the breaker linkage for closing, and the spring winding linkage actuated from the gear drive.

Closing latch is of slightly modified, otherwise conventional design and is located in approximately same place as in solenoid closed breakers.

Shaft and gear for winding up the spring by hand under emergency conditions (when power for breaker control is disconnected or in case of power failure).

Spring latching and mechanism release (to close the breaker). When spring is completely wound up, it is latched in the wound up position by means of a latch cam and a release latch very similar to tripping cam and the tripping latch. The mechanism is released to close the breaker in a manner corresponding to tripping the breaker open.

Note: The component parts of the breaker control system and the motor control system are located for the most part on the front panel with a few components of the motor control system located at various places in the mechanism itself. As the Figs. 4, 5, 6 and 7 serve only to acquaint the reader with general disposition of the mechanism, such components are not covered; they are discussed in details later on.

HOW THE MECHANISM FUNCTIONS

In the Fig. 4 the main spring is shown in the wound up (charged) position. When released, the spring expands in the direction to the right until it eventually stops against the shock absorber. The force of the spring is transmitted through the spring retainer, its pin, and the spring rod to the crankshaft, which is pulled in the clockwise direction. (The connection between the spring rod and the crankshaft is provided by another pin.)

The crankshaft carries still another pin which engages in the slot of the slotted link (see Fig. 9). Assuming the breaker open (upper right of Fig. 9), when the crankshaft moves in clockwise direction the slotted link is pulled to the right until the breaker is closed—linkage positions are then as shown in lower left part of Fig. 9. At this moment, the spring is discharged.

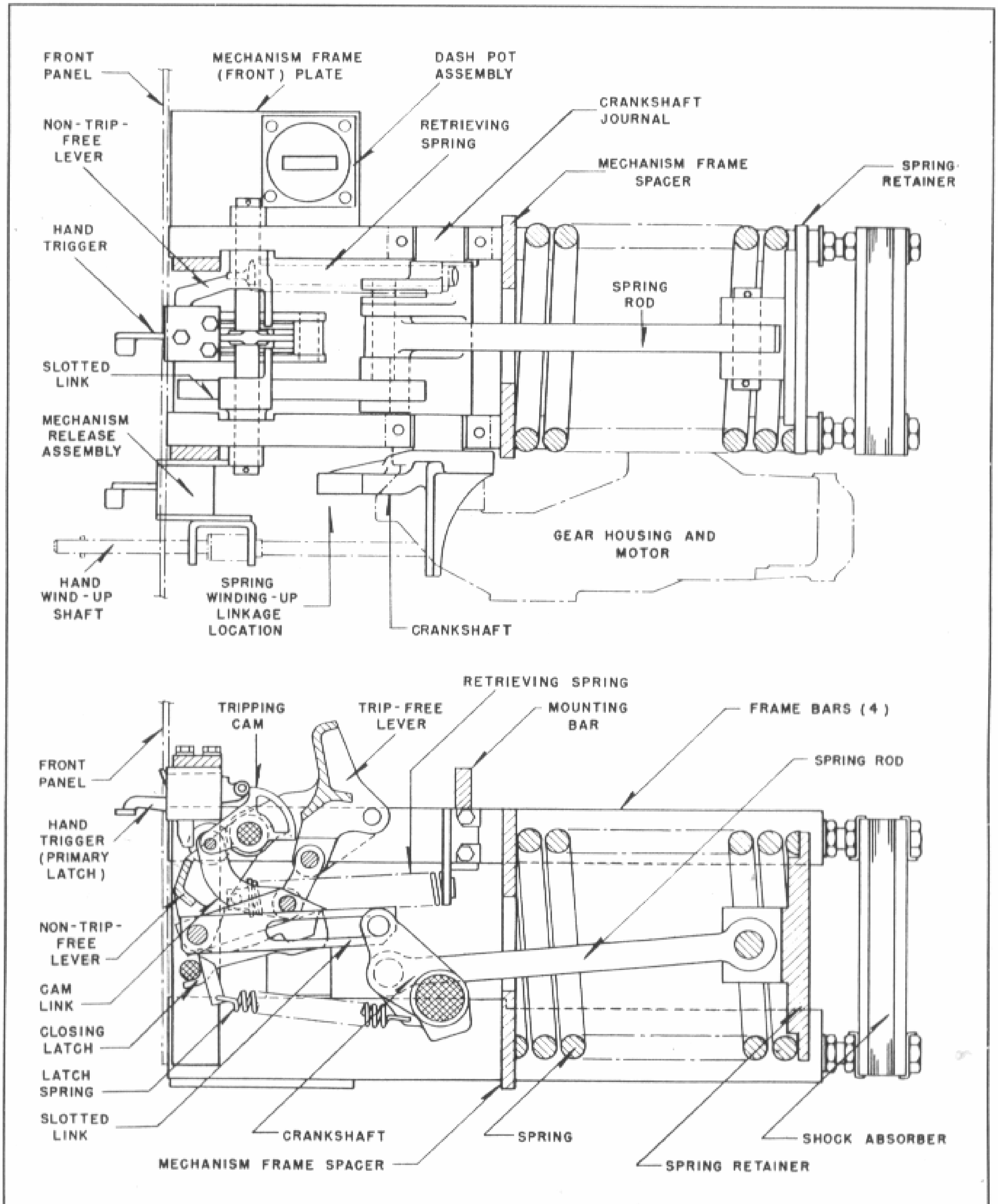


FIG. 4. General Disposition of Stored Energy (Spring) Closing Mechanism for Type DH Air Circuit Breakers (Spring Wound up, Breaker in Open Position)

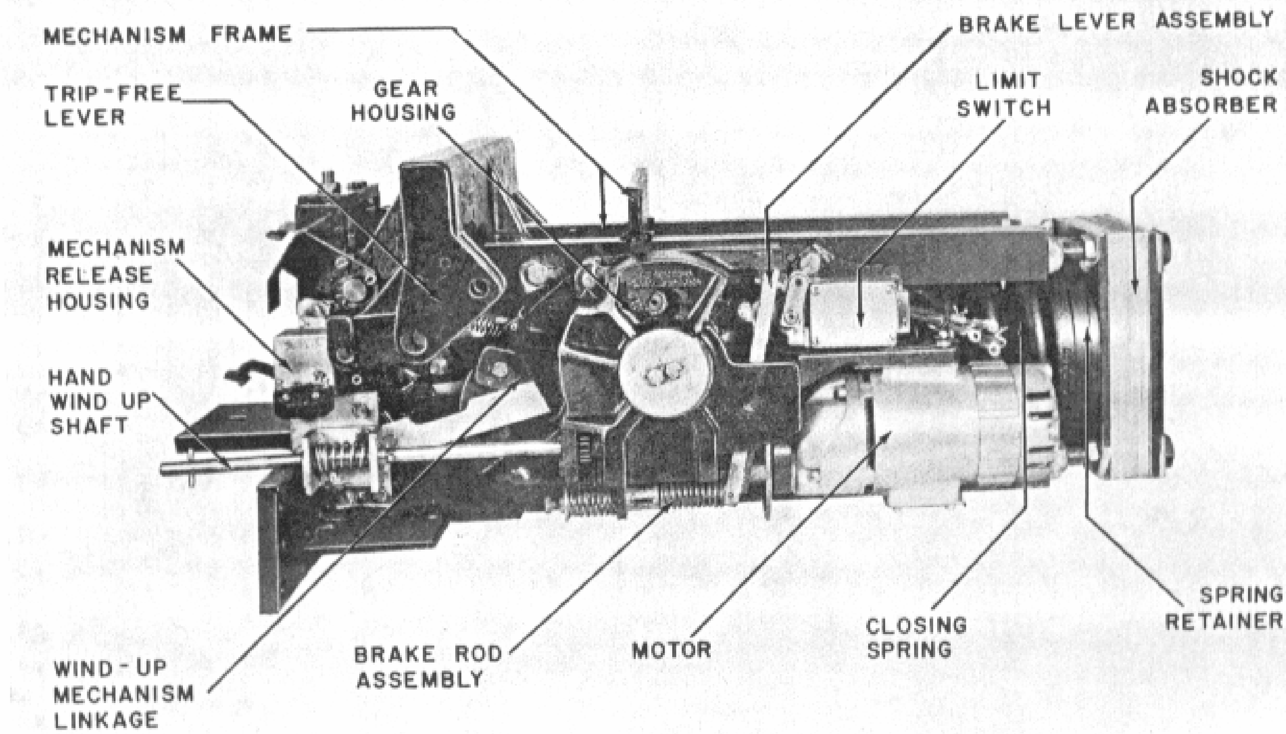


FIG. 5. Stored Energy (Spring) Closing Mechanism for Type 150-DH-1000 A.C.B. (Side View)

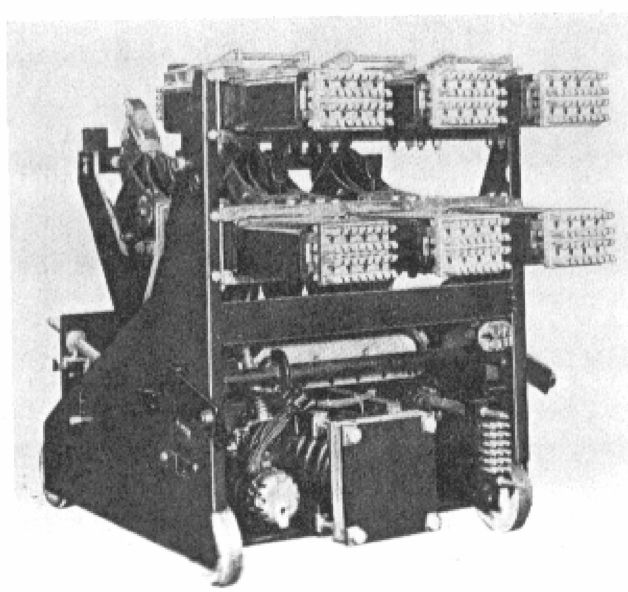


FIG. 6. Type 150-DH-1000 A.C.B. Rated at 3000 Amps.
With Stored Energy (Spring) Closing Mechanism.
Rear View Showing Main Closing Spring,
Shock Absorber, and Motor

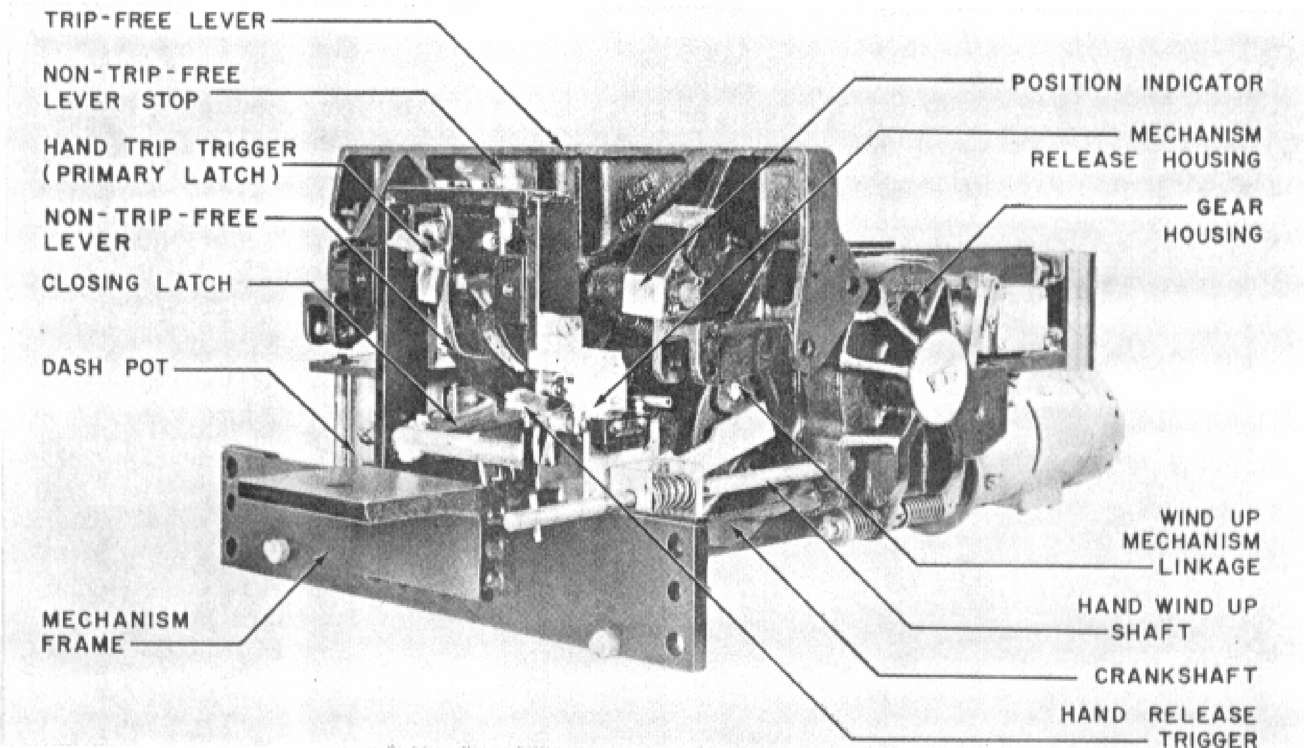


FIG. 7. Stored Energy (Spring) Closing Mechanism for Type 150-DH-1000 A.C.B. (¾ View)

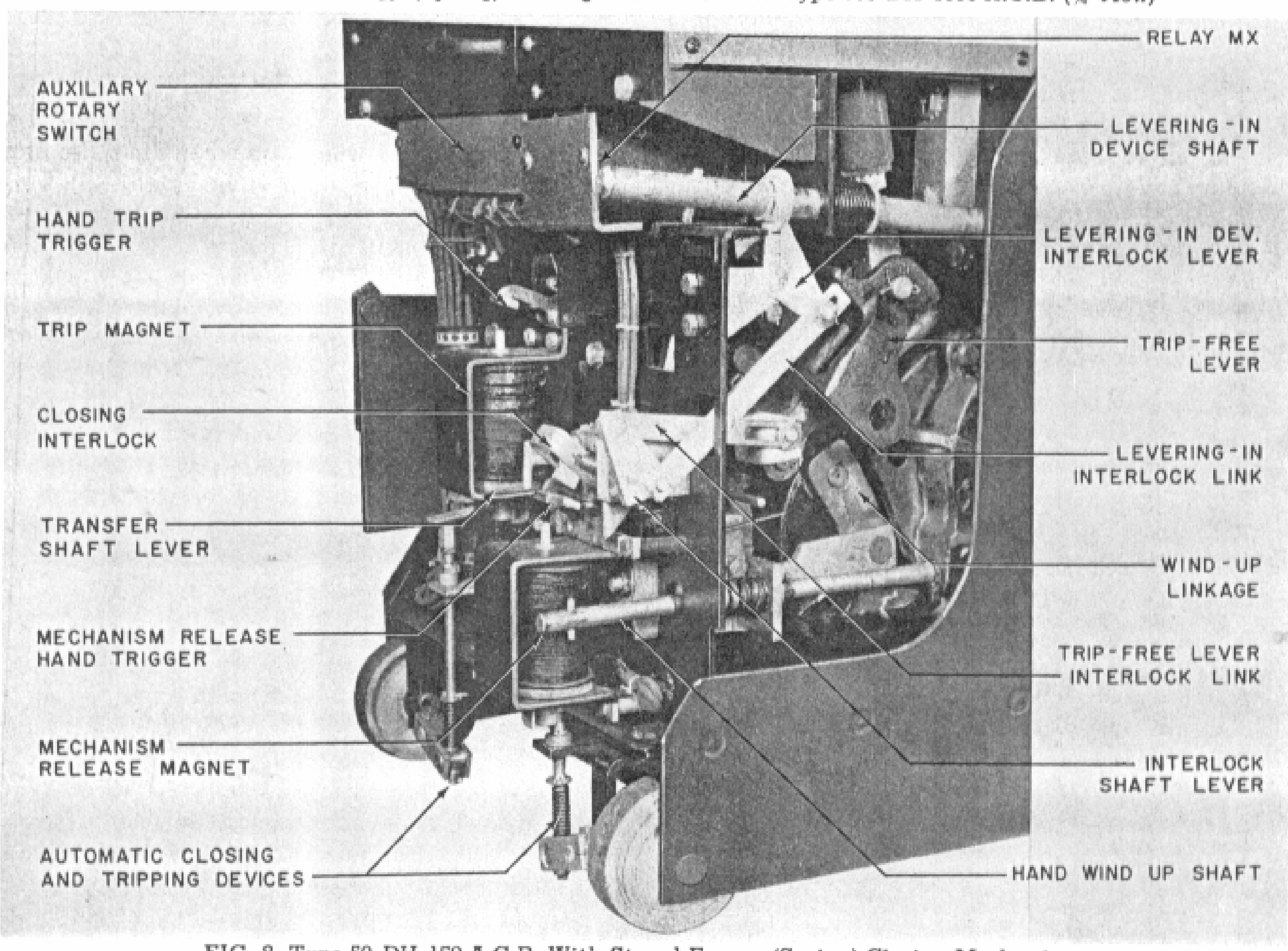


FIG. 8. Type 50-DH-150 A.C.B. With Stored Energy (Spring) Closing Mechanism.
Side View Showing Mechanism Details

However, as soon as the breaker is closed and safely latched, the motor starts running automatically and the spring is being charged. This is done by the crankshaft being moved by motor power in the counter-clockwise direction until the spring is completely charged. The linkage positions are then as shown in the lower right part of Fig. 9.

When the breaker is tripped open, the spring remains charged and the linkage assumes again the positions in upper right of Fig. 9.

Same as in case of solenoid operated breakers, the breaker linkage is trip-free and the breaker can be tripped open regardless of the conditions of the breaker closing mechanism. With the spring discharged, i.e. the breaker just having been closed, on tripping the breaker the linkage collapses as shown in upper left of Fig. 9 and breaker opens. Obviously, the same can happen at any instant during the spring wind-up and the linkage then assumes positions intermediate between those shown in upper left and upper right of Fig. 9.

MECHANISM FOR WINDING-UP THE SPRING

The mechanism consists of a motor, a worm, worm gear shown in Fig. 10, brake control and brake actuating parts, and a limit switch shown in Fig. 11, all of these mounted on or in a cast gear housing which is then bolted on the mechanism frame. In addition to the above parts, there is a trip-free linkage shown in Fig. 12 transmitting the energy from the gear to the crank shaft; this linkage is arranged outside of the gear housing. In addition to this linkage there is a linkage latch shown in Fig. 13, and a spring latching and mechanism release system shown in Fig. 14.

The motor is a universal, series wound motor for D-C or A-C operation. The motor voltage is the same as the control voltage of the breaker, usually 125V. D-C. In some cases the control voltage is 48V. D-C and then a suitable motor eventually with a series connected resistor is used. (See wiring or control diagrams Figs. 15 and 16 and description on Page 21 for details.) Otherwise, the 48V. D-C controlled breakers operate in the same manner as 125V. D-C operated breakers. It is also possible to operate the breaker from a 115V. A-C or 230V. A-C source (See diagram Fig. 17.). Furthermore, it is also possible to operate the breaker control from a separate D-C source 24V., 48., or 125V., and the motor from a 115V. A-C or 230V. A-C source.

The motor drives the worm shaft and the worm through a coupling which is at the same time designed also as a brake disc. The worm drives the worm gear which carries a driving roller on one side and a limit switch and brake operating cam on the other side (the cam has a shape of a segment). When the motor is running, the worm gear rotates clockwise and the driving roller drives in front of it a roller cam lever which is connected to spring winding linkage.

SPRING WINDING LINKAGE

This linkage (see Fig. 12) consists of a cam lever, a connecting link, clevis link, and a transfer link. The linkage is completed by cam lever retrieving spring, a linkage retrieving spring, and a linkage latch (see Fig. 13).

When the motor is running, the roller picks up the cam lever in position I (Fig. 12-A) and pushes it in clockwise direction. The connecting link and the clevis link have been pulled up by the linkage retrieving spring. The overtravel stop of the connecting link rests against the clevis link so that the two of them form a stiff rod. By the two links the crankshaft is moved in counter-clockwise direction and the spring rod is pulled to the left and the spring is winding up.

The transfer link serves to transfer the linkage movement to the spring latch cam.

The spring is fully wound-up when the roller and the cam lever are in position II (see Fig. 12-B). This is a fully wound-up position, however the motor is still running and will force the cam lever and the spring a little beyond this position to allow a little clearance to develop between the release latch and the lip of the spring latch cam. This overtravelled position corresponds to position III. When this position is reached, the motor power is cut off; the motor continues to run and the parts to move due to inertia and, to stop the motor quickly, a brake is applied (see later for description how the cut-off and stopping the motor is achieved). The roller will then stop in a position IV. (The cam lever will remain in position it occupied when the roller was in position II.)

It should be noted that, when the roller and the cam lever reach position III, there is a gap of approximately $\frac{1}{32}$ between the release latch and the lip of the spring latch cam; the lower projection of the spring latch cam just rests against the adjusting screw. When the roller and the cam lever overtravel further the cam lever returns a small distance and, subsequently, the spring latch returns so that it rests against the release latch and the clevis link and the connecting link snap over the toggle point approximately $1/8''$ (see Fig. 12-B). This will permit

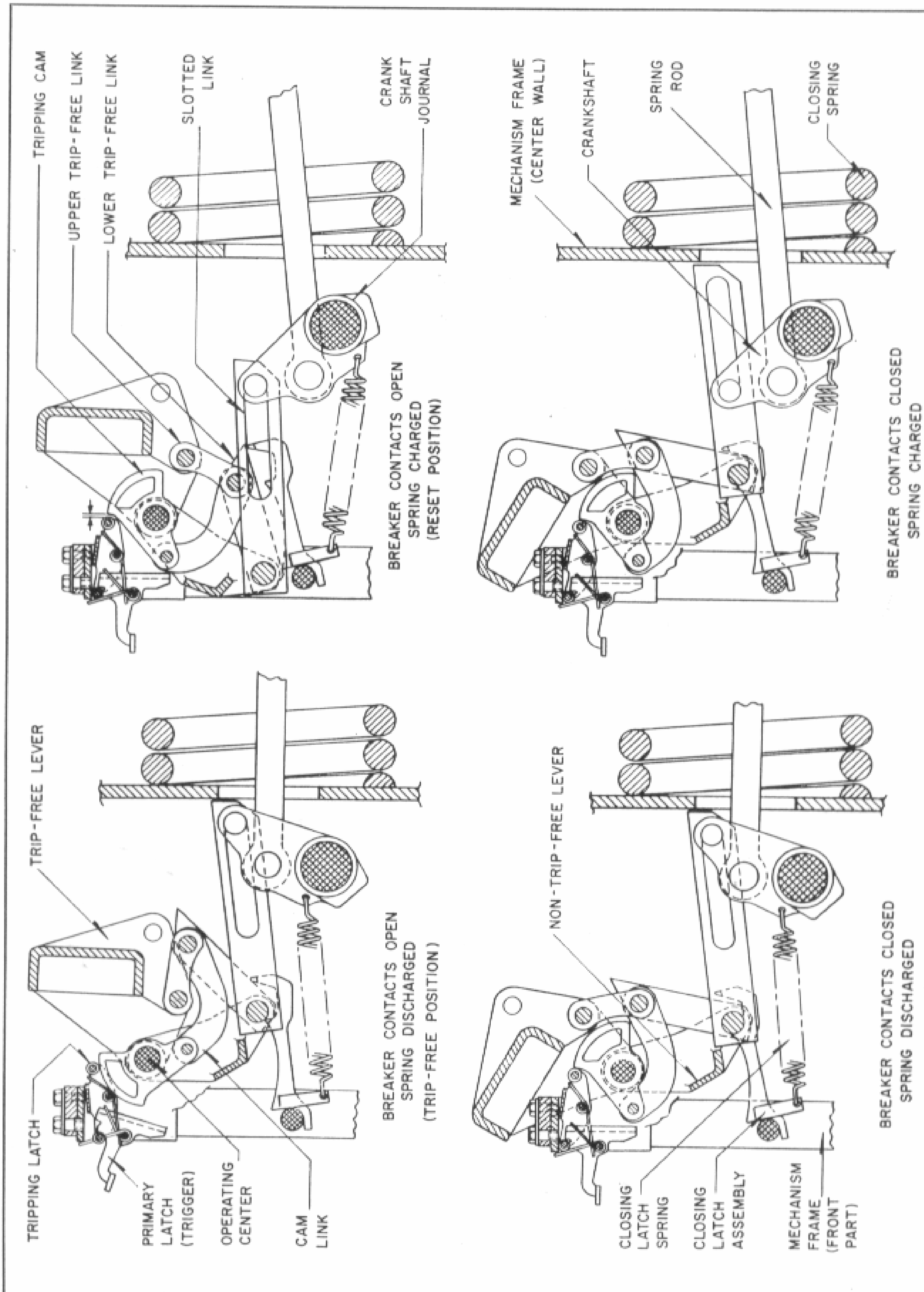


FIG. 9. Closing Spring and Breaker Linkage Positions

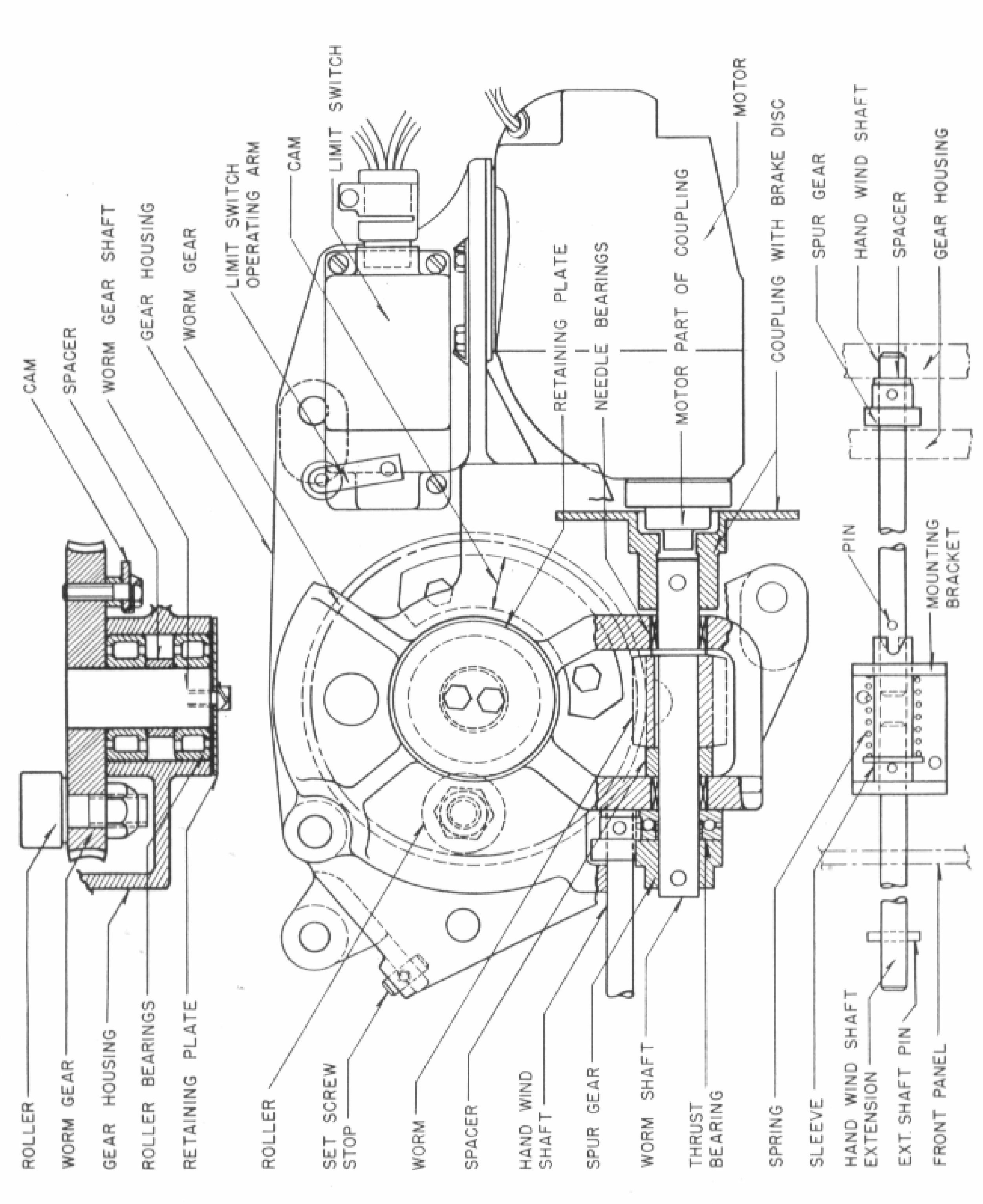


FIG. 10. General Disposition of Gear Housing and Gear Drive, of Stored Energy (Spring) Closing Mechanism

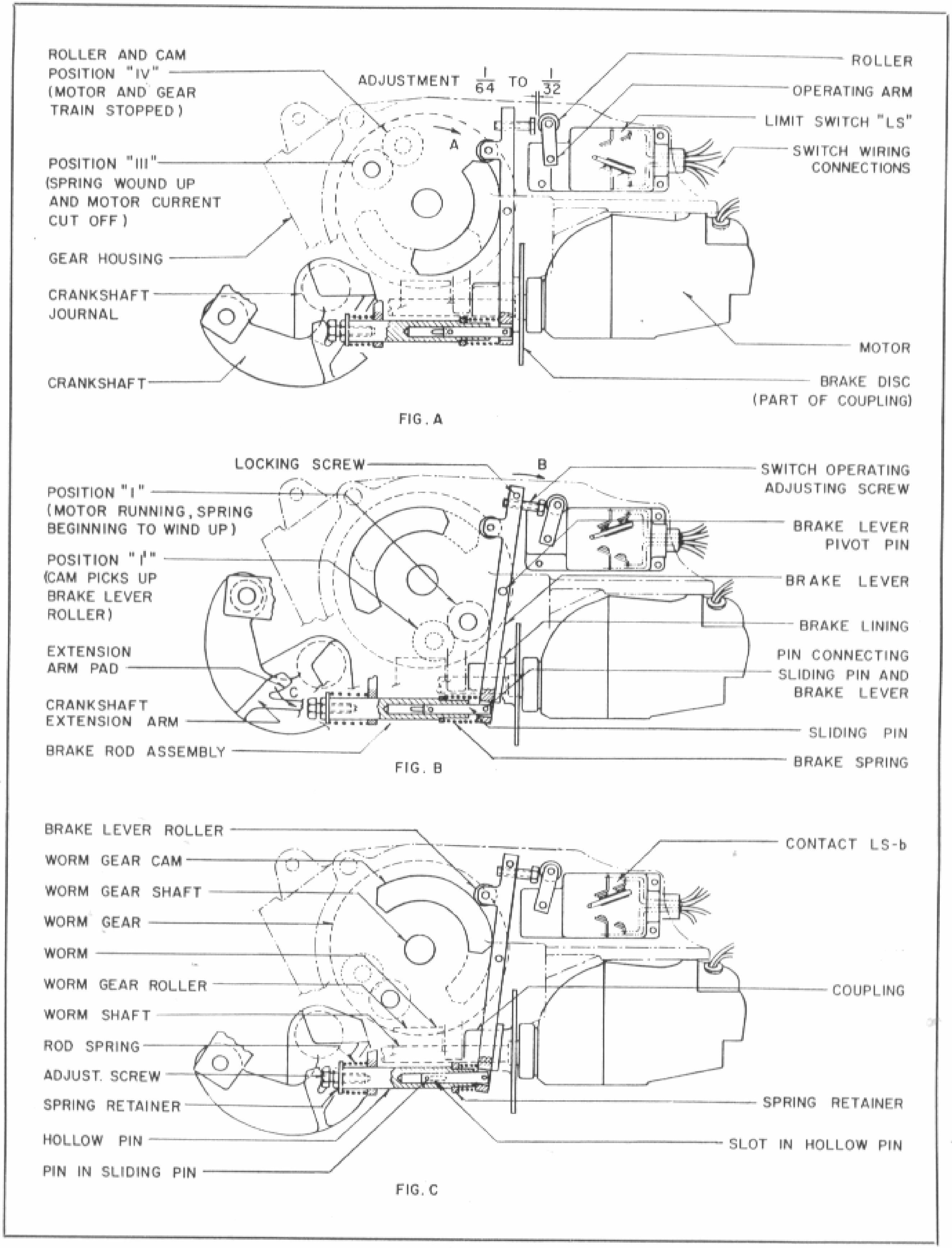


FIG. 11. Operation of Limit Switch LC and Brake

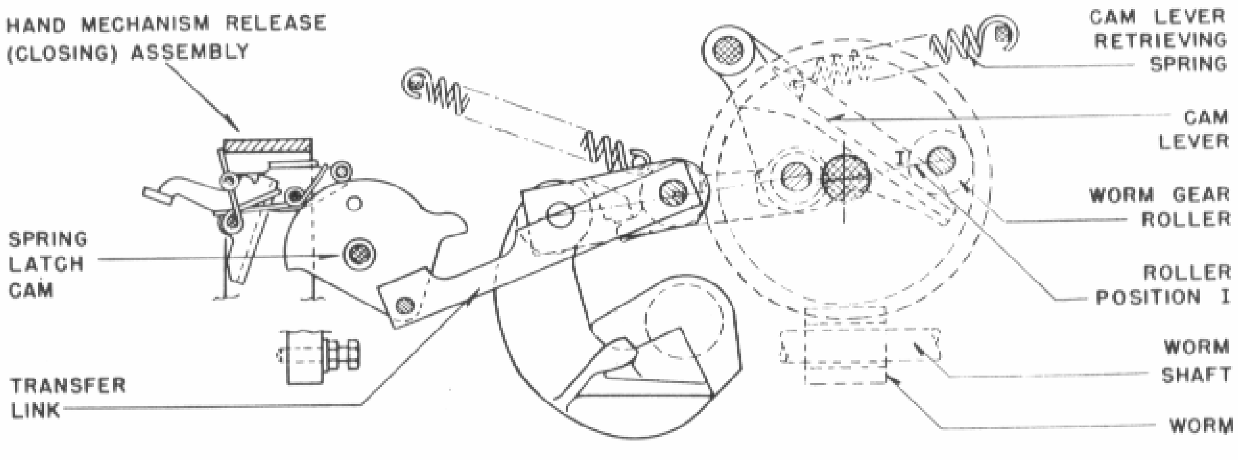


FIG. A LINKAGE POSITIONS AT THE BEGINNING OF SPRING WIND-UP

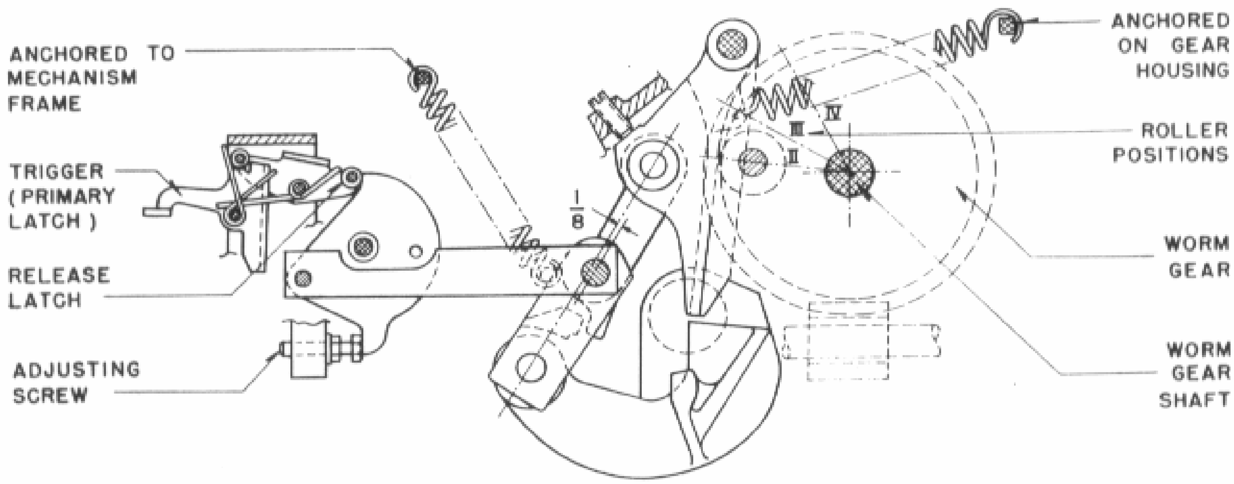


FIG. B LINKAGE POSITIONS WITH SPRING WOUND-UP AND LATCHED

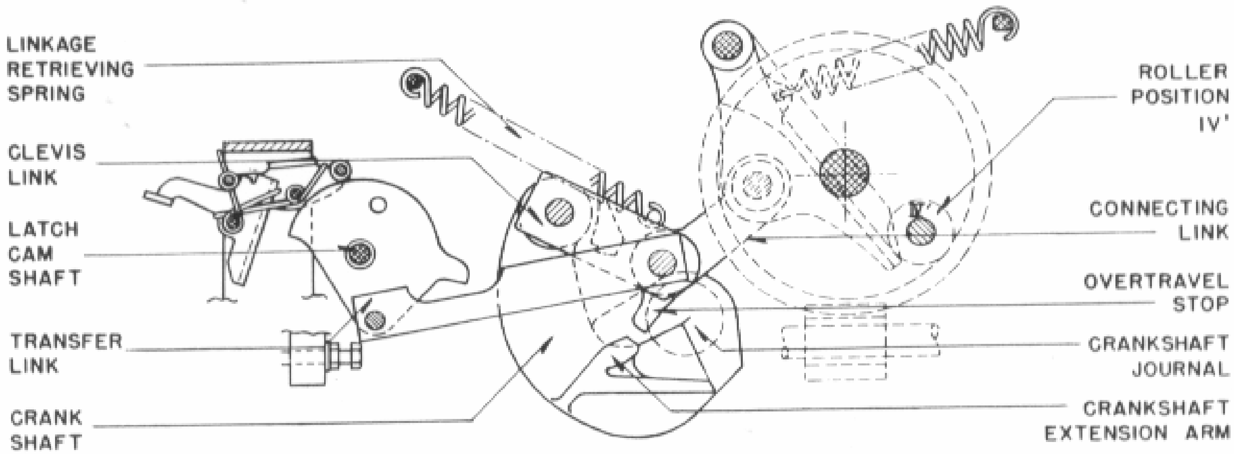


FIG. C LINKAGE POSITIONS AT ROLLER OVERTRAVEL

FIG. 12. Spring Wind-up Linkage Position (Positions) During Spring Wind-up

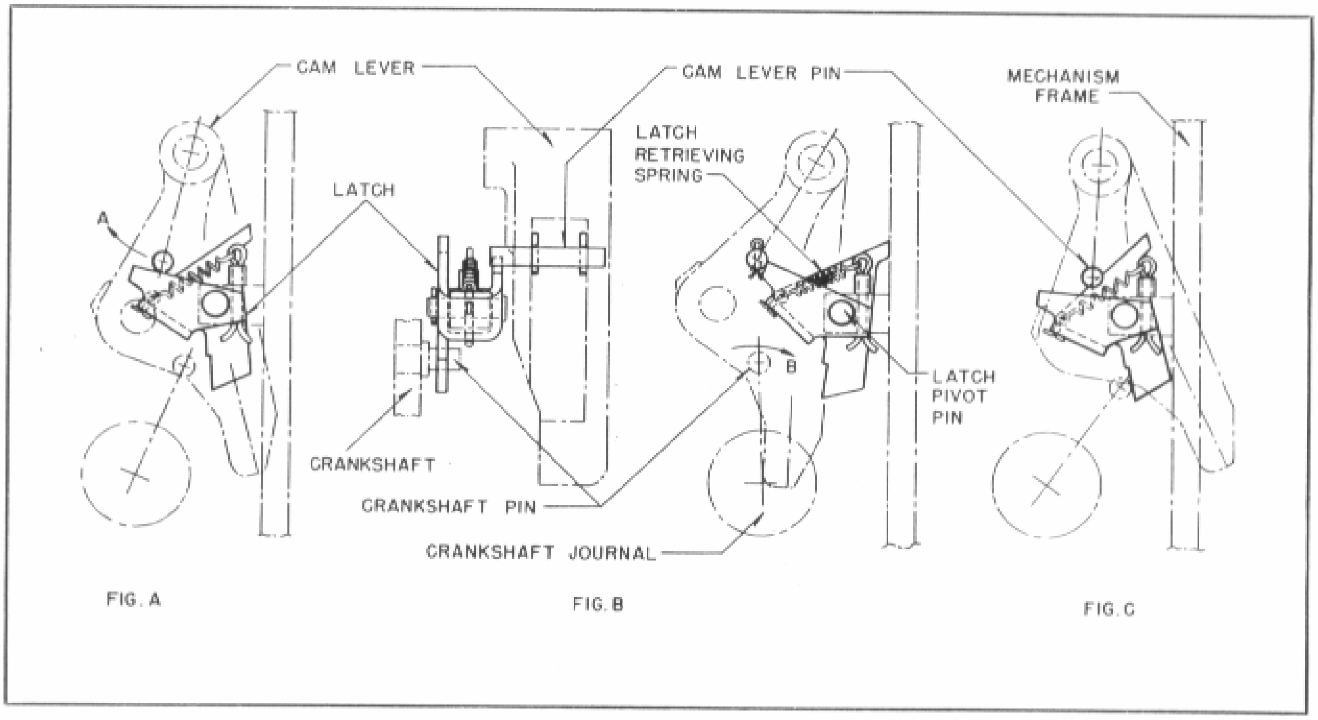


FIG. 13. Wind-up Linkage Latch Positions

the links to collapse as shown in Fig. 12-C when the spring is released.

When the spring is released, the crankshaft is returned in the clockwise direction to its original position and the cam lever is pulled by its retrieving spring in counter-clockwise direction until the clevis link and the connecting link stop it or until it stops against the roller if it stops in a position, let's say IV'. (The links will stop the cam lever for roller positions between IV and I; for all roller positions IV', i.e. all positions between I and IV—when going in clockwise direction—the cam lever will stop against the roller and links will resume the jack-knifed positions similar to the one shown in Fig. 12-C. This is why this linkage is trip-free.)

THE LINKAGE LATCH

The linkage latch shown in Fig. 13 serves the purpose of making certain that the linkage will jack-knife. Due to dynamic conditions during the closing (spring discharge) in the linkage it may happen that the linkage will "stiff-arm" instead of collapsing and the spring will be "hung" in a in-between position and breaker will not close. To prevent this, the cam lever and crankshaft are provided with suitable pins. The pin in the cam lever will be latched and will prevent the cam lever from moving until the pin in the crankshaft will knock the latch from the latched position so that the cam lever pin can move in direction opposite to arrow A. During the spring wind up the latch will permit the cam lever and pin to move in the direction of the arrow A.

On spring release the crankshaft and the crankshaft pin move in the direction of arrow B until, toward the end of stroke, the pin will knock the latch out of the latched position. By that time, the linkage is collapsed as shown in Fig. 12-C.

EMERGENCY HAND WINDING

In case of emergency or during maintenance operations the spring can be wound up by hand using a hand crank which fits on hand winding shaft. (See lower part of Fig. 10.) This shaft consists of two parts, normally disengaged. The connection is made using pin in the hand winding shaft and a sleeve on shaft extension provided with a slot which engages the pin when the hand crank and shaft extension with the sleeve are pushed in. The retrieving spring disengages the extension automatically when the pressure is removed. Also, the sleeve slips off the pin in case that the motor picks-up and starts winding the spring while hand operation is in progress (safety feature).

From the hand winding shaft the power is transmitted to the worm shaft through a pair of spur gears. The transmission of power from the worm shaft on to the cam lever is the same as for the motor drive.

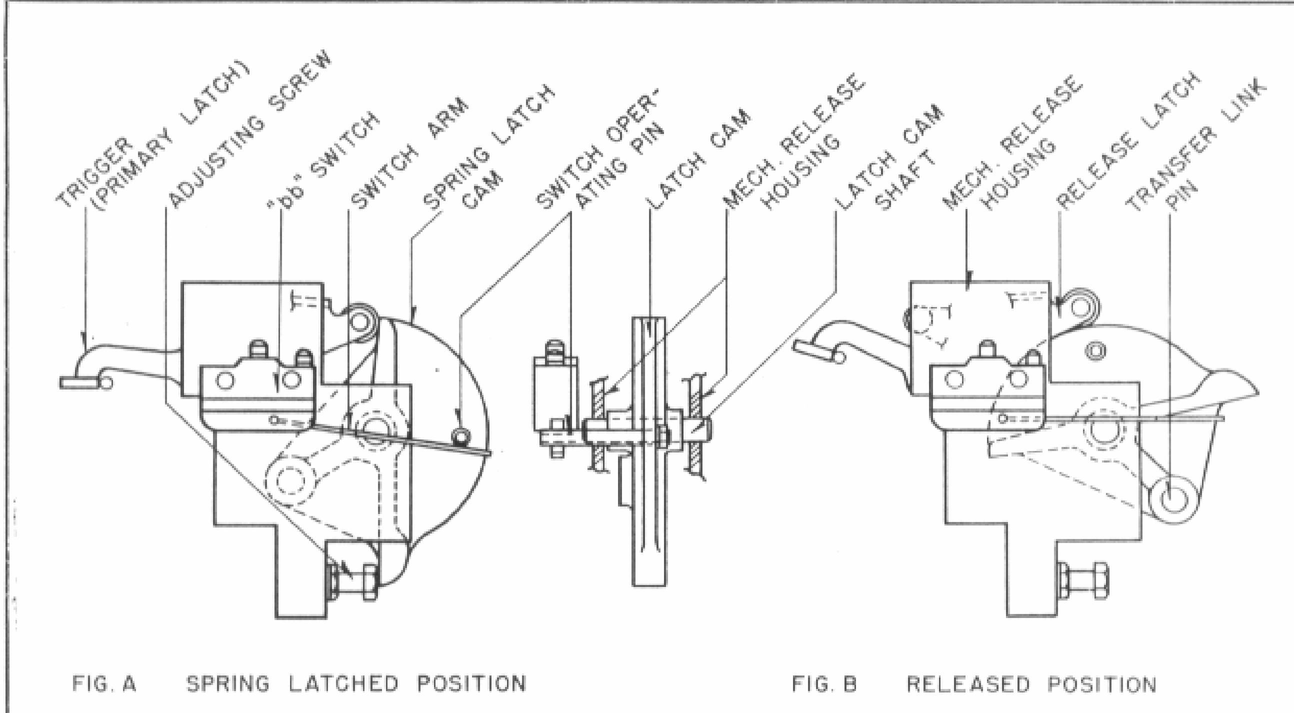


FIG. 14. Operation of Spring Latch Check Switch "bb"

FRONT PANEL AND THE CONTROL CIRCUIT COMPONENTS

As it has been already mentioned, most of the components of the control circuit, which are contained in the breaker, are located on the front panel with the following exceptions.

The limit switch LS which is mounted on the gear housing, directily above the motor (see Fig. 10).

The "bb" switch which is mounted on the mechanism release housing (see Fig. 14).

The "LCSC"switch (latch check switch on closing latch) which in some cases is mounted at the lower left front of the mechanism frame just behind the front panel. (In later designs it is also mounted on the front mechanism panel.)

The physical arrangement of the control components on the panel varies with the type (rating) of the breaker and is shown in Figs. 18, 19 and 20. These pictures show also another feature of the stored energy closing mechanism and that is, automatic discharging of the accelerating and closing springs when the breaker is being removed from the switchgear cell. Still another mechanical feature is a closing and levering-in interlock, which prevents closing the breaker while it is levered in or out of its operating position in the cell and prevents releasing of the mechanism while the breaker is closed. This eliminates "trip-free" operation of the spring which operation would result in a great shock to the mechanism and, while the mechanism is designed to take it, it is still better to avoid it, if at all possible.

Both of these mechanical features, automatic operation devices and the interlock will be discussed later in the Part III. on the opration of the breaker.

PART TWO

FUNCTIONING OF THE TYPE DH BREAKERS WITH SPRING CLOSING MECHANISM

INTRODUCTION

Please refer to typical schematic D-C control diagram and breaker wiring diagram Figs. 15 and 16.

This diagram shows the following:

a. The X-Y relay closing circuit consisting of the external and internal portions ("external" and "internal" refers to the breaker; external means outside of the breaker, i.e. in the housing cell, internal, inside of the breaker).

The external part of the circuit is the same as in case of the solenoid closed breaker.

The internal part of the X-relay circuit includes the following three points:

1. Normally closed "a" contact of the limit switch LS-a which is open when the device is in position as shown.

2. "b" contact of the auxiliary switch (usually No. 4 contact).

3. Normally open contact of the latch check switch on trip lever, LCST.

The internal part of the Y-relay circuit includes the following two points:

1. The normally closed contact of the "bb" switch.

2. Back contact (normally closed) of the relay MX.

b. The breaker tripping circuit is the same as for a standard breaker with solenoid closed. Same applies for indicating lights, etc.

Additional or different are the following circuits:

c. Mechanism release coil circuit which is analogical to the closing solenoid circuit for standard breaker, except that the closing solenoid has been replaced by mechanism release solenoid MR. (This solenoid is in most cases identically the same as the tripping solenoid and in other cases differs from it only in minor details such as, for example, drilling of mounting holes.)

d. Motor circuit includes the following:

1. Normally open contact ("b" contact) of the limit switch (LS-b)which is closed when the device is in position as shown.

2. Motor

3. Resistor (for 48V. D-C control only. Not used in all cases).

4. Two main contacts (normally open) of the relay MX.

e. Motor starting circuit includes the following points:

1. Operating coil of the relay MX.

2. Normally closed contact of the latch check switch on the trip lever, LCST-a.

3. Normally closed contact of the latch check switch on the closing latch which is open when the device is in position as shown, LCSC.

4. Normally open "a" contact of the auxiliary switch (usually No. 5 contact).

The above listed control elements are located and operated as follows:

A. The limit switch LS is mounted on the gear housing, above the motor. It is operated by a lever so that the contact LS-b is closed when the spring is discharged or not fully charged, but it opens

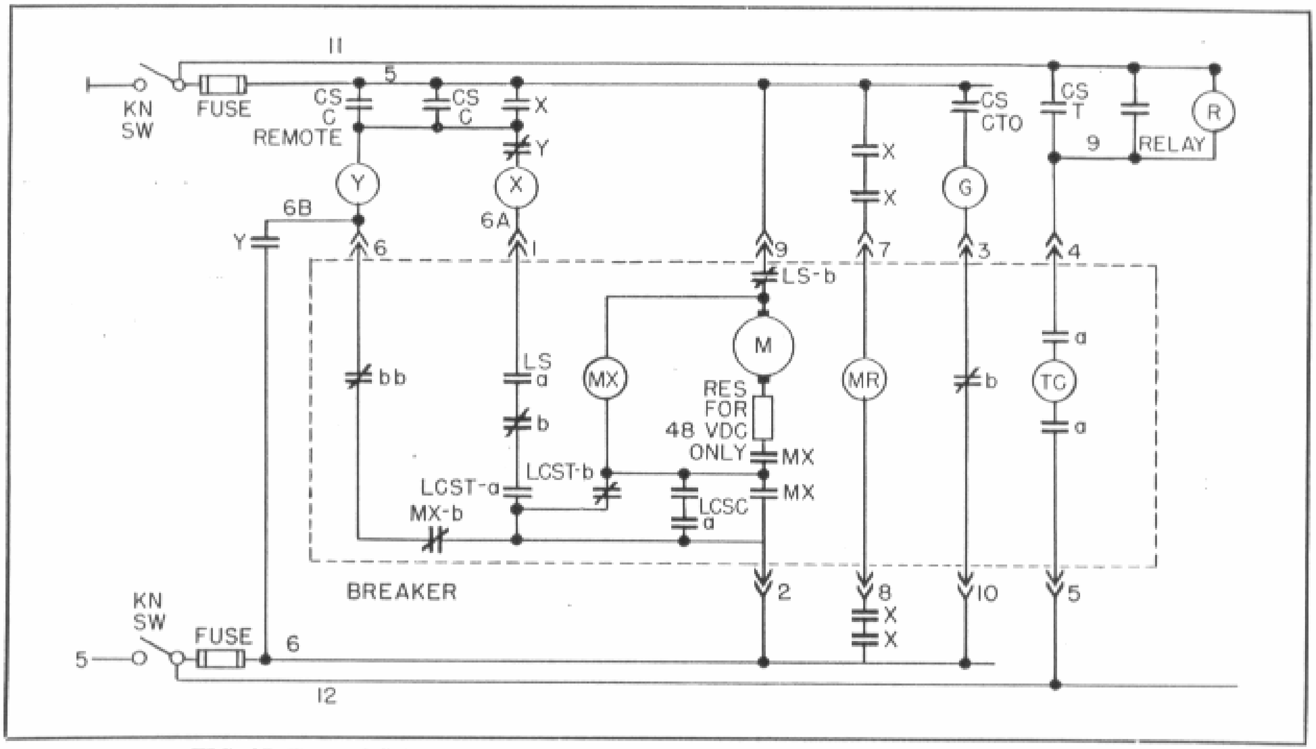


FIG. 15. Typical Schematic D-C Control Diagram for Type DH Air Circuit Breakers With Stored Energy (Spring) Closing Mechanism

LIST OF CONTROL COMPONENTS ON DIAGRAMS FIGS. 15, 16 AND 17

KN	Knife switch
CS-C	Close control switches
Y	Y-relay coil and contacts
X	X-relay coil and contacts
a or b	Auxiliary switch contacts
MX	Relay coil and contacts (on some diagrams this relay is designated as SG)
LS-a or LS-b	a-contact or b-contact of limit switch LS
bb	Microswitch operated from spring latch cam
LCST	Latch check microswitch operated from hand trip lever
LCSC	Latch check microswitch operated from closing latch shaft when breaker is closed
MR	Mechanism release (shunt) solenoid (breaker close)
TC	Trip shunt solenoid (breaker open)
R, G	Red or green signal light
CS-T	Trip control switch
CS-CTO	Lamp cut out switch

when the charging of the spring has been completed. (The description of the mechanical arrangement see later). Similarly, the "a" contact is open when spring is discharged or not fully charged and it closes as charging the spring has been completed.

B. The "a" and "b" contacts of the auxiliary switch are operated in a conventional manner from the trip free lever.

C. The "bb" switch is located near the mechanism release and is operated from spring mechanism release cam in such manner that it is closed when the spring is not wound up and latched and it opens when the spring latch falls into latched position.

D. The latch check switch on trip lever LCST is operated from the breaker trip lever. It has two contacts, one normally open (a) and one normally closed (b). The switch is in normal position when the hand trip lever is up.

E. Relay MX has three or four contacts (two main contacts and one or two back contacts, depending on type of relay used; if relay with two back contacts is employed, only one of the two back contacts is used). This relay is energized from the source of the control power and its circuit is completed automatically in one of three different ways through switches which are tied in mechanically with the spring positions and/or with position of breaker contacts.

F. The closing latch check switch LCSC is located at lower left side of the mechanism and is operated mechanically from the closing latch; it is open when the breaker is open. It closes when the closing latch falls into latched position.

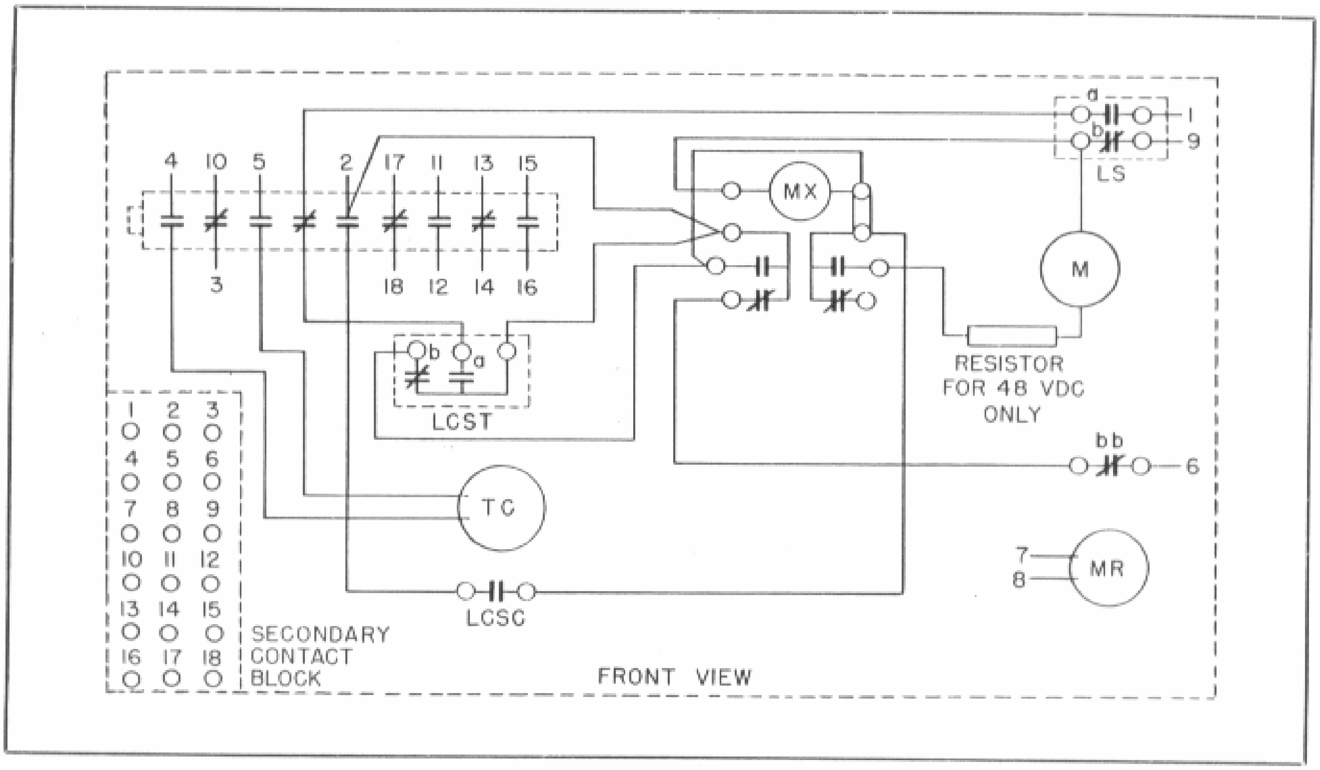


FIG. 16. Typical Breaker Wiring Diagram for D-C Control of Type DH Air Circuit Breakers With Stored Energy (Spring) Closing Mechanism

D-C CONTROL

1. Energizing the circuit. Let us start with the condition shown in the diagram Fig. 15 that is, breaker open, spring discharged, circuits de-energized.

By closing the knife switch KN, the circuits are energized. The Y-relay circuit, X-relay circuit, trip coil circuit, and mechanism release coil circuit are open.

The green light circuit is closed.

The circuit of relay MX is closed through secondary contact 9, "b" contact of the LS-switch, relay coil, "b" contact of the LCST switch, and secondary contact 2. The relay MX is energized, its main contacts close and complete the motor circuit. The motor starts running and winding up the spring. The MX relay coil circuit is now closed also through one of its own main contacts and thus is "sealed in". Simultaneously, the back contact of the MX relay opens.

During the interval in which the spring is being wound up, the X-relay circuit remains open and the breaker connot be closed ("a" contact of LS switch and "a" contact of LCST switch are open).

When the breaker is open and the spring is discharged, the breaker mechanism linkage is in the position shown in upper left, Fig. 8. As the spring is winding up, the linkage moves toward re-set position shown in upper right of Fig. 8. When the spring reaches the position when it is completely wound-up, the breaker mechanism trip latch engages with the trip cam and the hand trip lever comes down. This results in operation of the switch LCST. The contact LCST-b opens and thus interrupts one branch of the circuit of the MX coil. In the next instant the spring latch cam engages with the release latch of the spring (mechanism) release and operates the switch "bb" which opens* and also the switch LS is operated**.

The operation of the LS switch results in change of two conditions:

First, the "b" contact of this switch is interrupted and the motor current is cut off. Simultaneously, the relay MX is de-energized and opens the contacts in the motor circuit and also closes the back contact MX-b in the Y-relay circuit.

Second, the "a" contact of the LS switch closes, thus completing the X-relay circuit.

The breaker trip coil circuit and the mechanism release coil circuit are still open.

Now the spring is cocked and latched, breaker is in open position and ready to be closed.

* The mechanical operation is described on Page 23.
** The mechanical operation is described on Page 25.

2. Closing the breaker. Electrically, the breaker is closed by closing the CS-C control switch which completes the X-relay circuit. The X-relay in turn closes the circuit of the mechanism release solenoid MR which results in disengagement of the release latch (Fig. 14) with spring latch cam. Breaker closes.

By hand, the trigger (primary latch) of the mechanism release is lifted with the result that the release latch disengages with the spring latch same as in electrical operation.

When the breaker contacts close and the closing latch is in place, four things happen:

1. The LCSC switch closes*.

2. The limit switch LS operates and its b contact closes**.

3. The auxiliary switch operates and the contact a in the MX relay circuit closes.

4. The "bb" switch closes.

The operations under (1), (2), and (3) complete the circuit of the MX relay which closes the motor circuit and the motor will wind up the spring as described before.

The operation of bb switch at breaker closing completes the Y-relay circuit resulting in conventional anti-pumping protection.

3. Tripping the breaker. The breaker is tripped open in conventional manner and its opening does not affect the spring winding-up in any way even if it occurs during the wind-up in any stage of it.

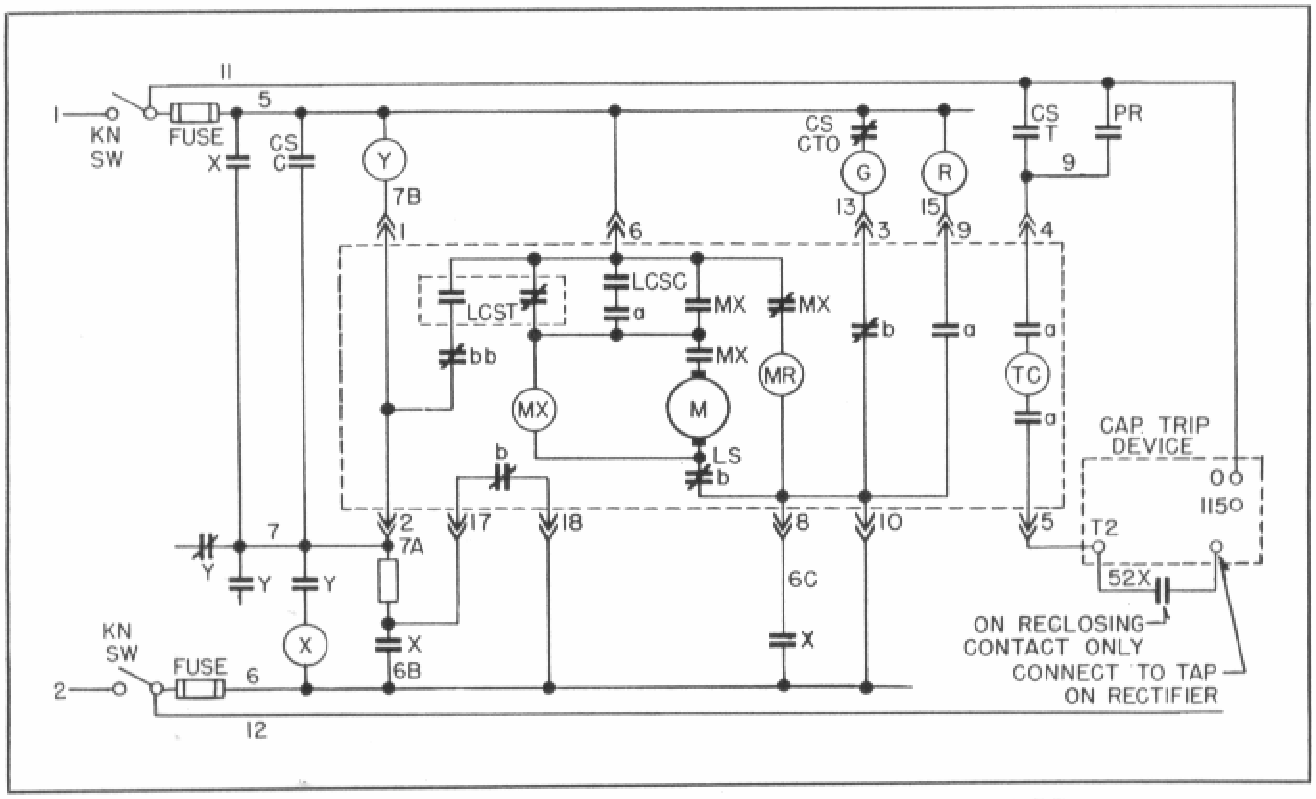


FIG. 17. Typical Schematic A-C Control Diagram for Type DH A.C.B. With Stored Energy (Spring) Closing Mechanism

A-C CONTROL

Typical control schematic diagram is shown in Fig. 17. The same elements are used and they function in the same manner as described above; therefore, no discussion or description seems to be necessary.

Note: The diagrams shown in Figs. 15, 16, and 17 are "typical" wiring diagrams or "basic" diagrams. In case of specific orders, always refer to diagrams furnished with that order.

* For description of mechanical arrangement of this operation see Page 25.
** For description of mechanical arrangement of this operation see Page 25.

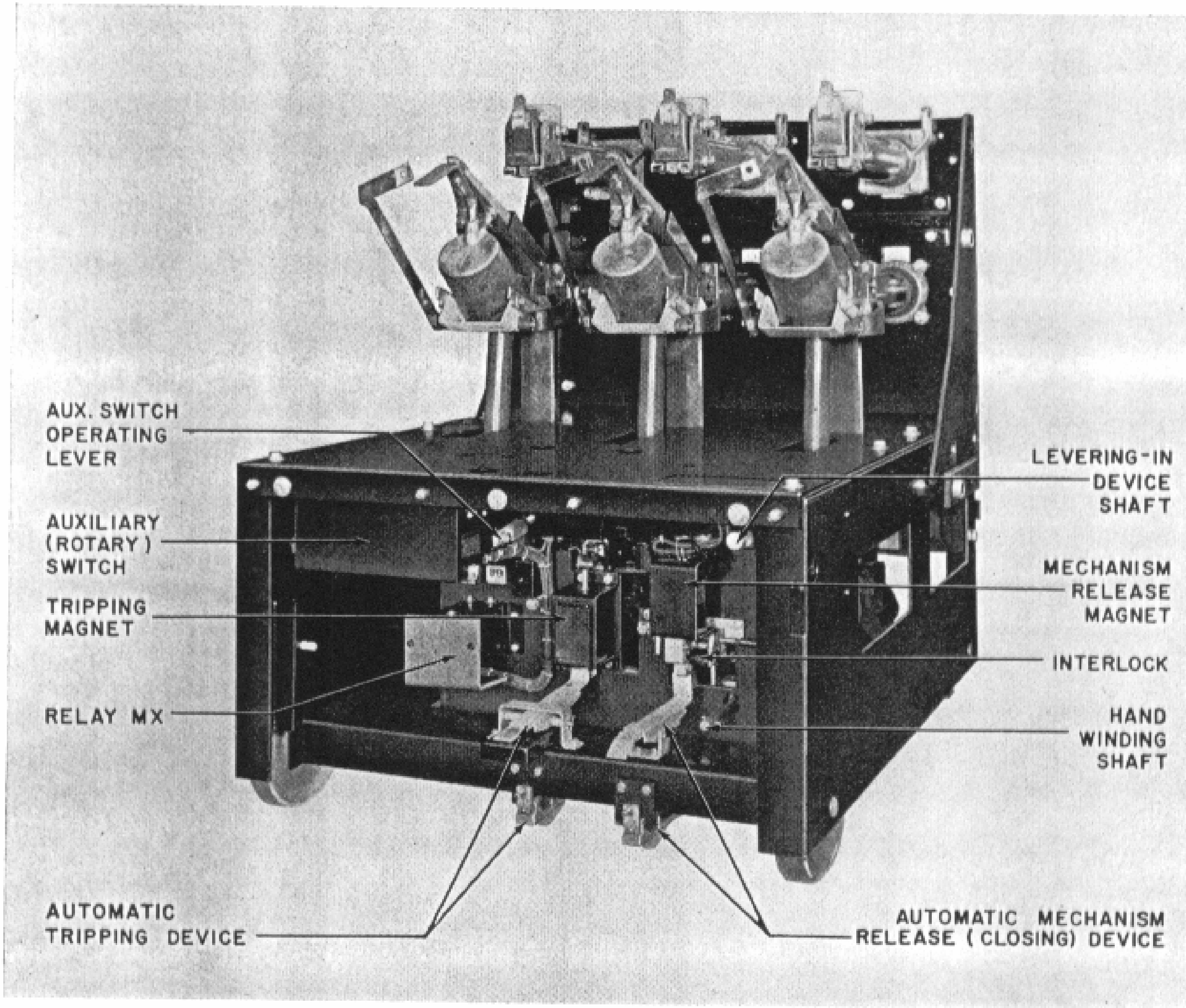


FIG. 18. Type 150-DH-750 A.C.B. With Stored Energy (Spring) Closing Mechanism. General View (Without Arc Chutes and Interphase Barrier)

MECHANICAL ARRANGEMENTS OF THE CONTROLS

1. Operation of the "bb" switch is shown in Fig. 14. The switch is mounted on the side of the mechanism release housing and it is operated by a pin fastened in the spring latch cam. The switch is in its normal position when mechanism is released, i.e. spring discharged or only partially charged. As the winding-up of the spring progresses, the transfer link (see Fig. 12-A) moves to the left and rotates the spring latch cam in the clockwise direction. Referring again to Fig. 14, in this manner the switch operating pin moves toward the operating arm of the switch until it operates the switch at the instant the release latch falls into the place.

Upon the mechanism release, i.e. spring discharge, the process is reversed. The "bb" switch is operated practically immediately upon the beginning of the movement of the spring and, obviously, the linkage and the spring latch cam.

2a. The arrangement of closing latch check switch is shown in Fig. 21. The switch is in its normal position (closed) when the breaker is closed and when, and only when, the closing latch is safely in latched position. If the breaker closes, but the latch does not fall into latched position, the switch does not close. This is an important safety feature because if the motor proceeded to wind-up the spring while the breaker is not latched, the breaker contacts

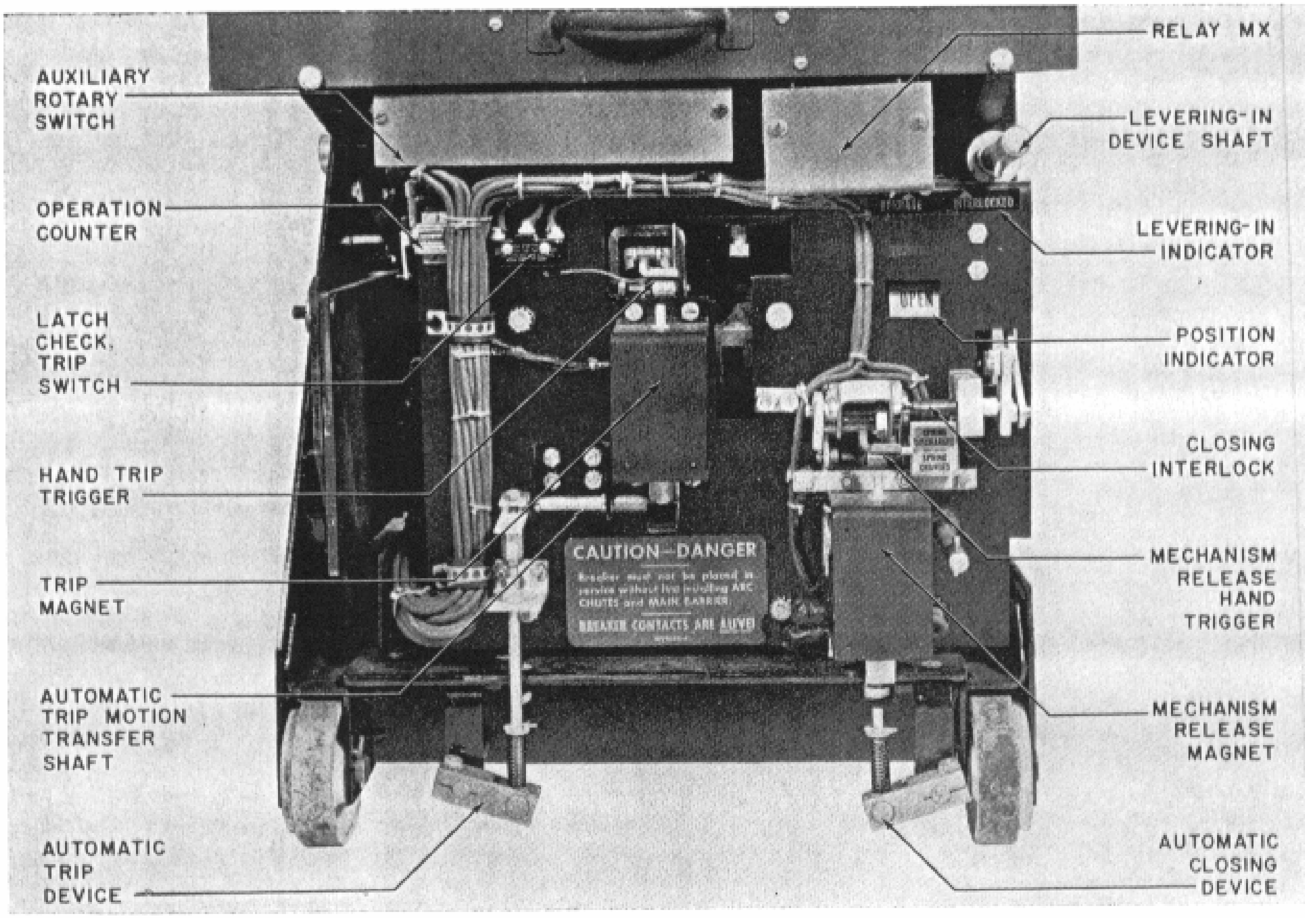


FIG. 19. Type 50-DH-150 A.C.B., 1200 Amps, With Stored Energy (Spring) Closing Details of Front Panel

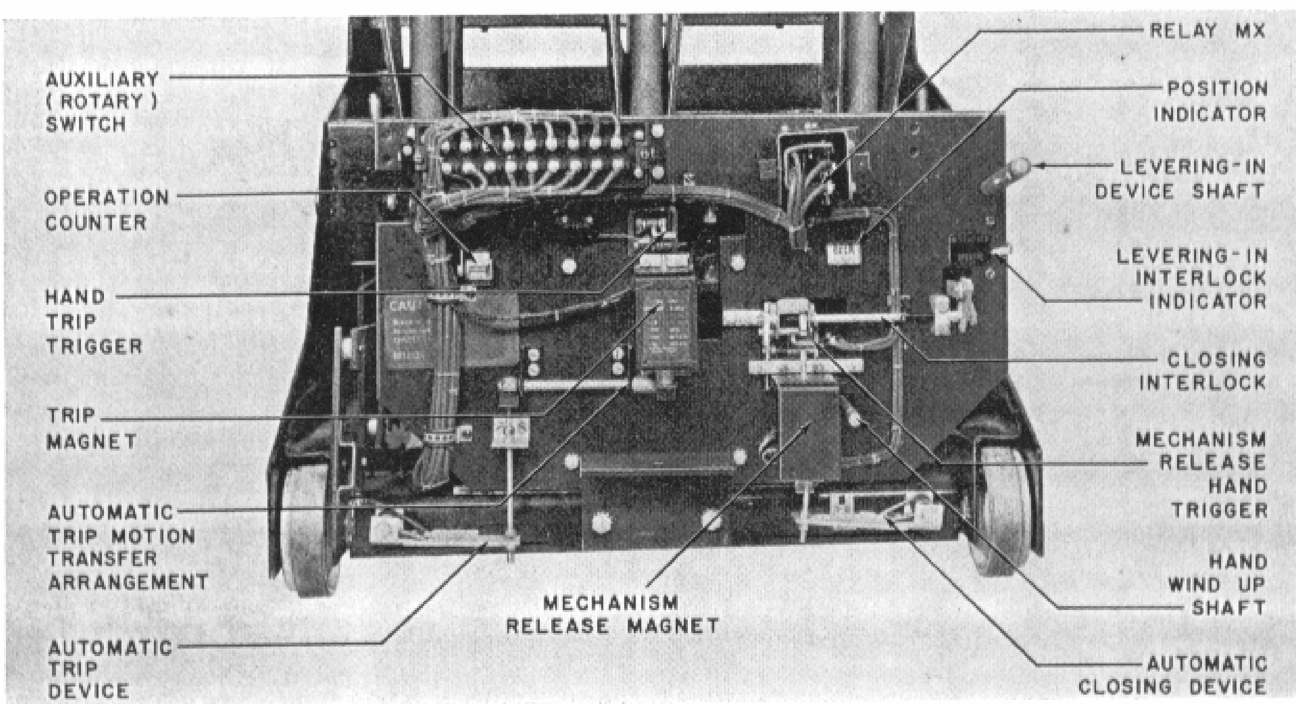


FIG. 20. Type 150-DH-250 A.C.B. With Stored Energy (Spring) Closing Mechanism. Details on Front Panel. (Note: Covers have been Removed from Relay MX and from Auxiliary Switch—Automatic Closing Device is in Operated Position)

would open slowly and an arc would be drawn between them.

It should be noted, though, that for the purpose of proper timing (with respect to "reaction" times), the switch is set to operate when the latch is in a position 1/16" before the final, fully engaged position is reached. At this instant, the point "a" on the non-trip-free lever pin is past the lip "b" of the latch. The switch is set to "click" when a 1/16" thick spacer is inserted between the latch and the non-trip-free lever pin.

The switch is mounted on a bracket on the left lower bar of the mechanism frame.

2b. Alternative arrangement of the closing latch check switch is shown in Fig. 22. In this case, the LCSC switch is mounted on the front panel and in its normal position (breaker open or closing latch not in latched position) is open. It operates and closes when the latch is in position 1/16" away from the fully latched position same as before. Note the over-travel stop arranged in this case.

The latched position of the closing latch is coincidental with spring discharged, i.e. it needs to be wound up. Assuming that the LS-b contact is closed, the circuit of the MX relay is completed, the relay picks-up and seals itself in.

3. Starting The Motor. As it has been described in discussion of the electrical functions of the breaker control, the starting of the motor is dependent on positions of the following components.

Closing latch check switch LCSC; mechanical control of this switch has been described above.

Limit switch contact LS-b; this contact is always closed when the spring is discharged; the mechanical arrangement and the manner in which it works is best described in the next part.

The contact "a" is part of the auxiliary switch and it works in the conventional manner. It is closed when the breaker closes, i.e. when the spring is discharged and even if the breaker trips open ("a" opens) instantly upon closing, it is the last of the switches to open and permits the relay MX to pick up and seal itself in.

4. Stopping The Motor. The stopping of the motor is effected by opening the contact LS-b of the limit switch. This switch and the mechanical parts of the arrangement for stopping the motor are shown in Fig. 11.

The limit switch LS is a two pole switch with snap action. The pole arrangement is such that one pole is normally closed and the other normally open; because of the snap action, when operated, the closed contact opens and—for all practical purposes simultaneously—the open contact closes. The switch is mounted at the upper left of the gear housing immediately above the motor. It is operated from a brake lever by means of an adjusting screw.

The brake lever is actuated from two points, one of them being a cam mounted on the worm gear, second one being a brake rod assembly. The brake rod assembly consists of a sliding pin, the hollow pin and two springs, brake spring and pin spring, of an adjusting screw with respective locknut, washers serving as spring retainers, and similar small details. The brake rod assembly is in turn actuated from an extension arm on the outside of the crank shaft. This arm is provided with a pad, which pushes against the adjusting screw in the hollow pin.

To explain how the motor current is cut-off and motor stopped, let us assume that the spring has been wound-up and the motor stopped. The worm gear stopped with the roller as shown in Fig. 11-A, which corresponds to position IV in Fig. 12-B. The crankshaft extension arm has pushed the brake rod assembly to the right so that the brake lever is in its extreme counter-clockwise position and the brake shoe pushes against the brake disc. The pressure on the switch operating arm has been relieved and the switch contact LS-b has opened.

Next, the spring is discharged. The crankshaft and its extension arm move clockwise to a position shown in Fig. 11-B. Because the pin spring is stronger than the brake spring, the brake rod assembly is pulled to the left and with it the brake lever is rotated clockwise to the extreme position in that direction. Switch LS is operated and contact LS-b closes, motor circuit is to be completed as described previously.

After the motor started, the worm gear moves in clockwise direction until the roller (see Fig. 12-A) reaches position I. This position of the roller is shown also in Fig. 11-B, together with position of the cam, which in this particular instant engages with the brake arm roller; from this moment on, the brake arm is held in the extreme clockwise position by the cam. As explained at another place, while the spring is being wound-up, the crankshaft is moving counter-clockwise and the gap between the pad at the end of the extension arm and the adjusting screw of the

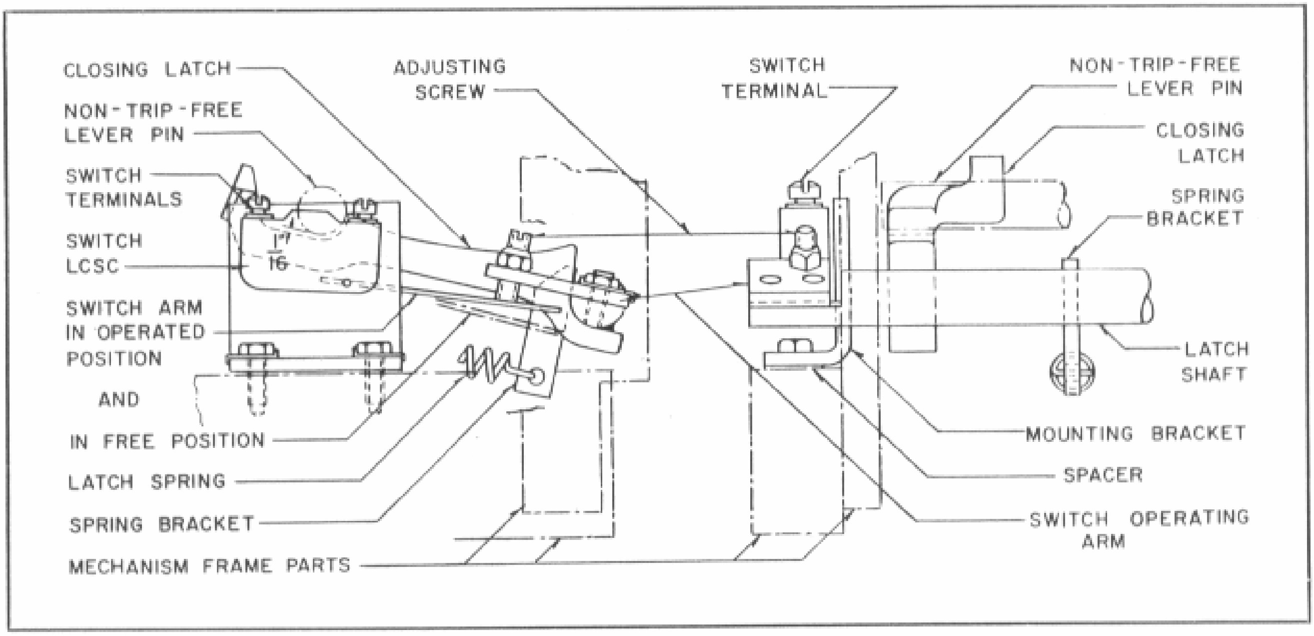


FIG. 21. Operation of Closing Latch and Closing Latch Check Switch LCSC

brake rod assembly is closing up. Shortly before spring is wound-up, the brake rod is being pushed to the right, and the pin spring is being compressed. However, the cam on the worm gear is keeping the brake lever from counter-clockwise movement resulting in telescoping of the hollow pin over the sliding pin, until the position shown in Fig. 11-C is reached. This position is then maintained while the worm gear roller is moving around and the spring continues to wind-up. When the position III (Fig. 12-B) is reached, i.e. spring is completely wound-up and latched, the cam releases the brake lever (see

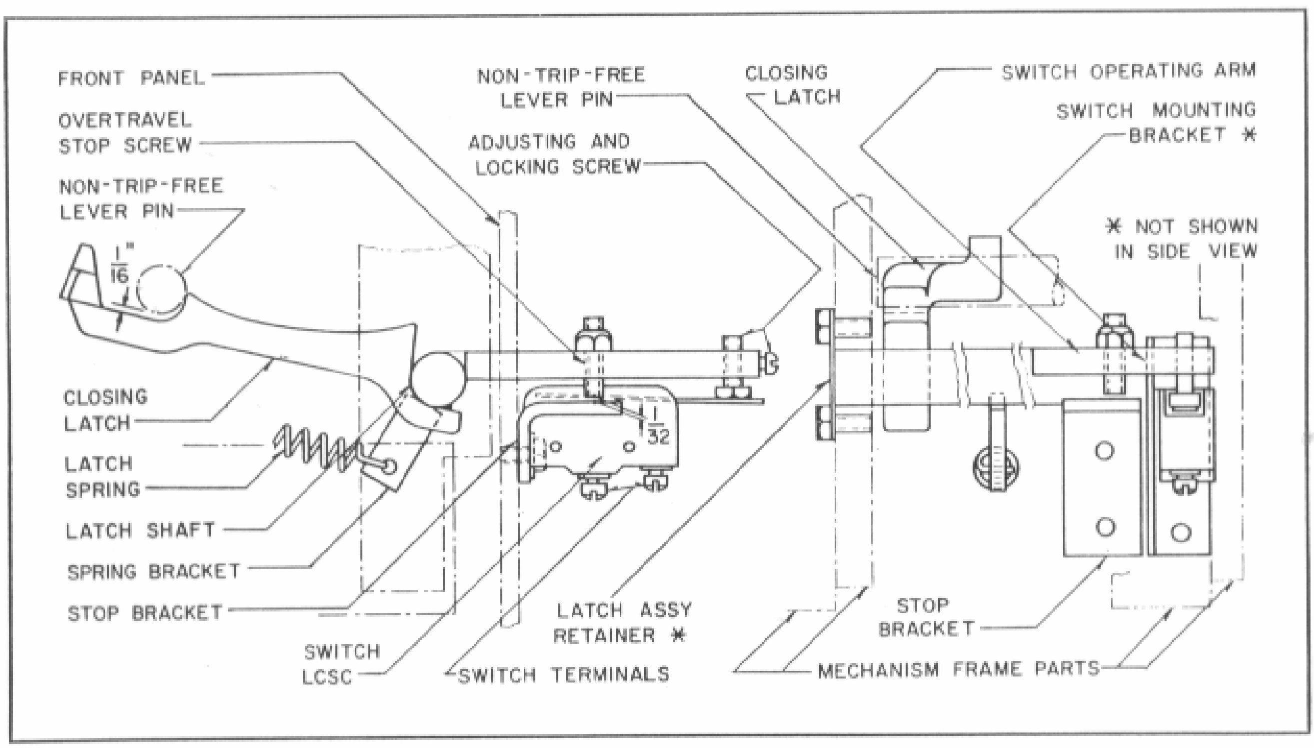


FIG. 22. Alternate Design of Closing Latch and Closing Latch Check Switch LCSC

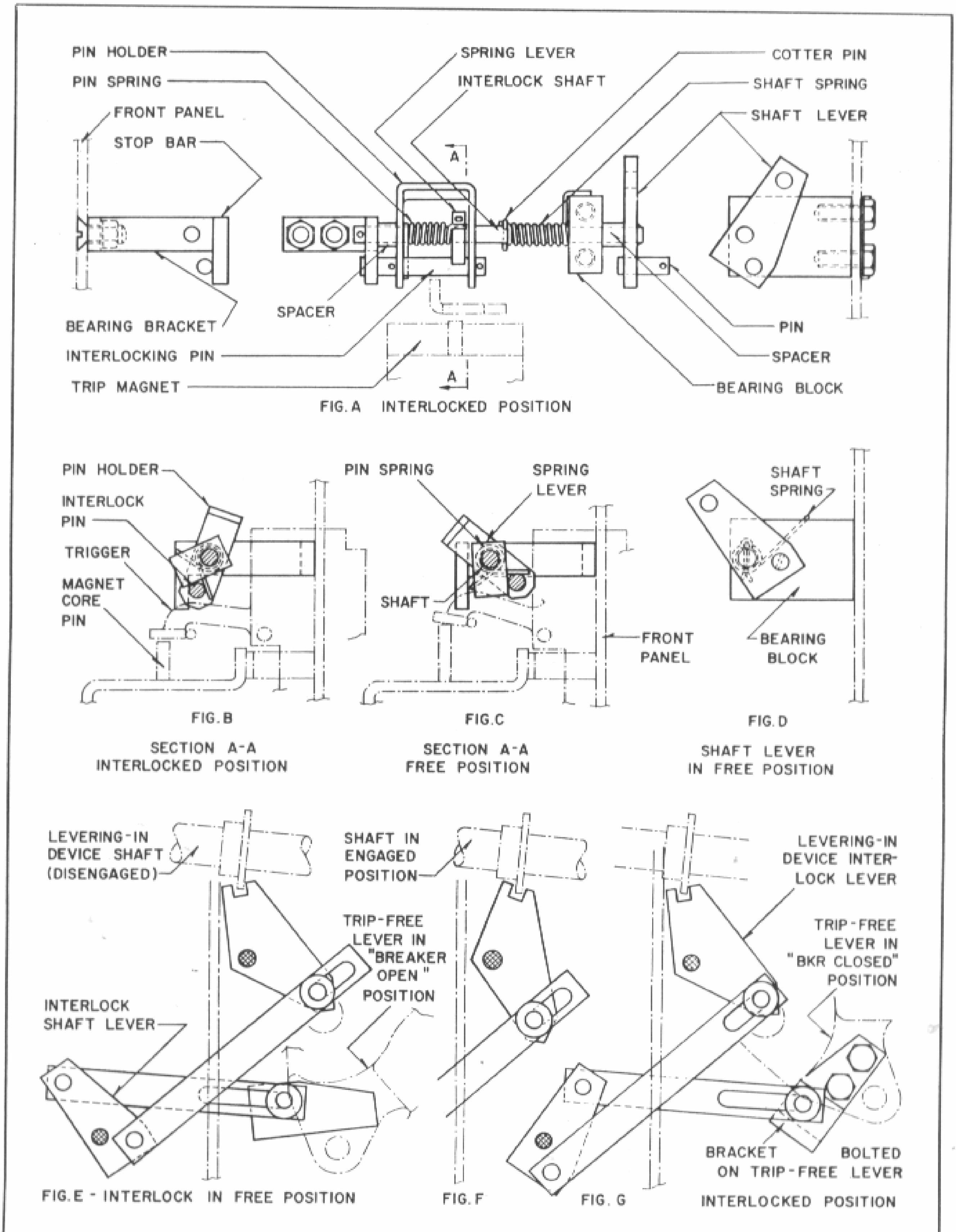


FIG. 23. Mechanical Interlock

Fig. 11-A) which moves under the pressure of the brake spring in position as shown, two things happen:

a. Switch LS is operated so that contact LC-b opens and motor current is cut-off.

b. Brake is applied to the brake disc and the motor is brought quickly to a stop so that the roller stops in position IV (Fig. 12-B).

MECHANICAL INTERLOCK

The mechanical interlock covers two undesirable contingencies.

a. Closing the breaker while the breaker is in process of levering in or out of the breaker cell.

b. Releasing the mechanism while the breaker is in closed position (trip-free operation of the main spring).

The interlock and the respective operating links, etc., is shown in Fig. 23.

The interlock acts upon the primary latch (trigger) of the mechanism release in such a way that it prevents the trigger from being lifted when it is desirable to keep the breaker from closing.

The essential part of the interlock is the interlock pin. The pin is mounted in a U-shaped holder which can oscillate between two end positions on interlock shaft. In one position (Fig. 23-B) the holder and pin are almost vertically above the trigger—interlocked position. In the other position the holder is inclined at approximately 45° so that the pin is removed from the vicinity of the trigger thus permitting the trigger to be lifted—free position, Fig. 23-C.

The movement of the holder and pin is controlled by a interlock shaft and the proper position of the holder and pin on the shaft is maintained by the pin spring. This connection is flexible for the following reason:

When the spring is not wound up, the trigger is in the "up" position, (see, for example, Fig. 12-C or Fig. 14). If the levering device is operated under this condition, the pin would assume position as in Fig. 23-B. This would lead to interference and damage to the device. The pin spring permits the holder and pin to assume position as in Fig. 23-C while the shaft is pulled by the shaft spring into the position shown in Fig. 23-A. The pin spring is then flexed but as soon as the main spring is wound up, the pin spring will pull the holder and pin into interlocked position Fig. 23-B.

The shaft spring always tends to pull the shaft into interlocked position; the levering-in device interlock lever, when the shaft is disengaged (levering-in device not in operation) will pull the interlock shaft out of interlocked position; a bracket mounted on the trip free lever, will pull the interlock shaft out of the interlocked position when the breaker is open. In both cases, the controlling links are provided with slots so that one link does not interfere with operation of the other one.

Note: The trip-free lever brackets and the shape and dimensions of the links vary with the type and rating of the breaker, but in principle it remains as shown in Fig. 23.

THE AUTOMATIC TRIPPING DEVICES

1. General. As a safety measure for protection of the operating personnel it is required that the breaker, when it is rolled out of the breaker cell, is in a safe condition, specifically, open and with opening and closing springs discharged.

To obtain a condition like that, the provisions have been made to operate the breaker automatically after the control power has been disconnected, that is, after the breaker has been moved a short distance out of the test positions.

The automatic operation of the breakers is obtained by means of tripping bars welded on the floor of the breaker cell and corresponding devices mounted on the breaker and operating hand trigger either of the trip assembly or of the mechanism release.

2. Automatic Tripping Device for Type 150-DH-750 Breaker. An example of such device is shown in Figs. 18 and 24. This design is used on Type 150-DH-750 air circuit breakers.

The top picture in Fig. 24 shows the device in normal position; the main part of the device is an operating bar provided with a trip cam, a block, and a stop plate (all welded together). The bar pivots on a pin, held in a mounting bracket bolted to the breaker frame. When the breaker travels in the direction to the left, the trip cam is pulled over the trip bar and tilts the trip bar as shown in the bottom part of the picture. This movement is transferred by the transfer pin assembly to the trigger lever which acts on the core extension or directly on the core of the tripping magnet and in this way trips the breaker open. The operated position is shown in bottom part of Fig. 24.

Same arrangement is used on the other side of the breaker for mechanism release (closing the breaker).

The transfer pin assembly incorporates a spring which is stiff enough to transmit the force needed for tripping, but which would give in case of jamming, etc., so that no damage occurs.

There are three trip bars welded to the floor plate of the cell; two for tripping the breaker open and one for tripping the breaker closed. Bars are arranged so that the sequence of operations when the breaker is being pulled out from the cell, is as follows:

Breaker is assumed to be in test position when moving the breaker starts.

First, secondary contacts are disengaged (control power is disconnected).

Second, the breaker passes over the trip bar No. 1 and opens (if it happens to be closed).

Third, the breaker passes over the trip bar No. 2 and closes; as the power is disconnected, the closing spring remains discharged.

Fourth, the breaker passes over the trip bar No. 3 and opens (the accelerating springs are discharged).

Breaker is then in a "safe condition" as recommended on Page 1 of this book.

Adjustment of the Device. A 1/4" dimension is to be maintained between the trip cam and the floor. This is obtained by means of the stop screw.

A gap of max. 1/32" is to be maintained between the trigger lever and the magnet core or core extension. This is obtained by using a suitable number of washers on the transfer pin.

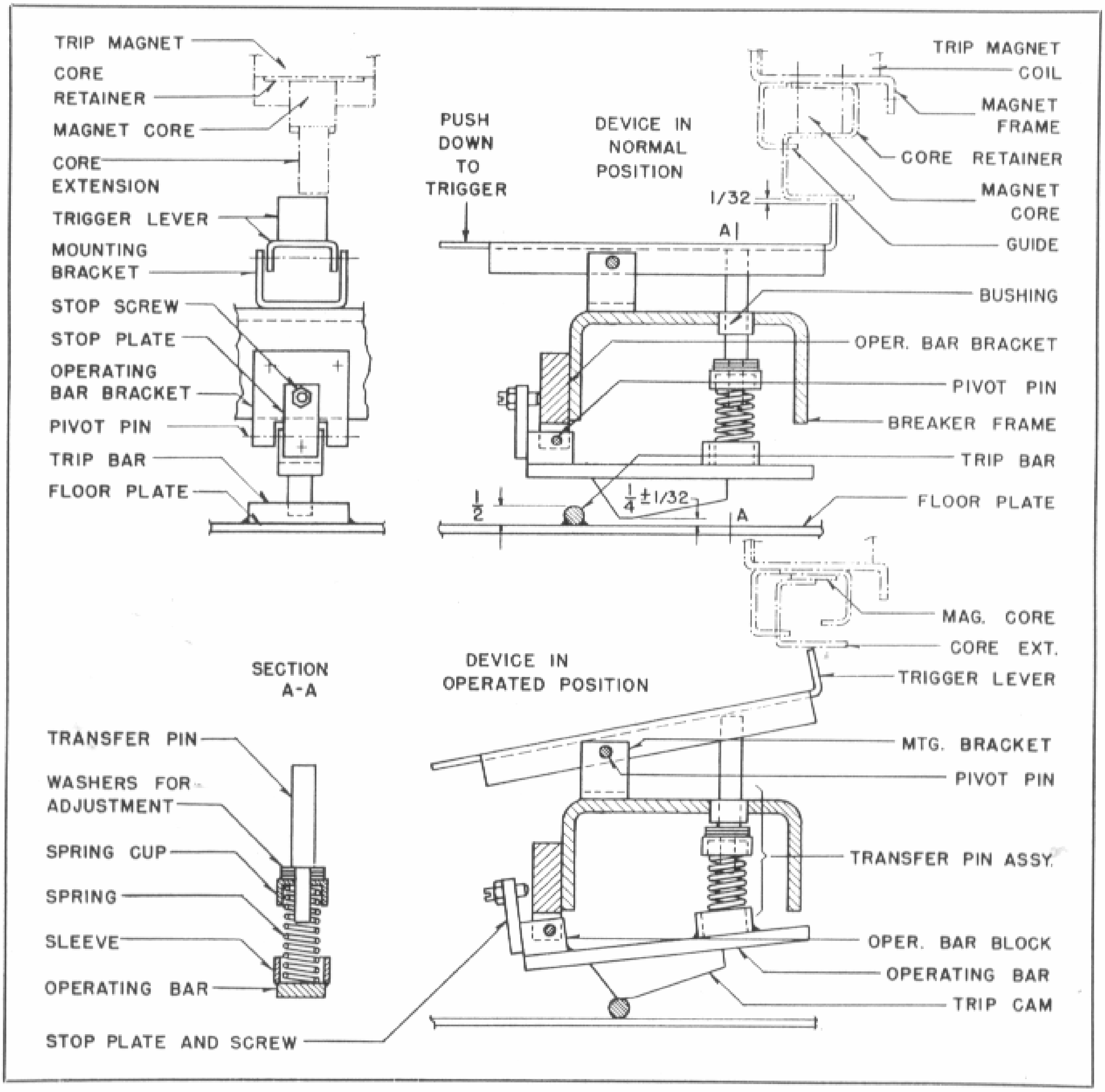


FIG 24. Automatic Tripping Devices for Type 150-DH-750 Air Circuit Breakers With Stored Energy (Spring) Closing Mechanism

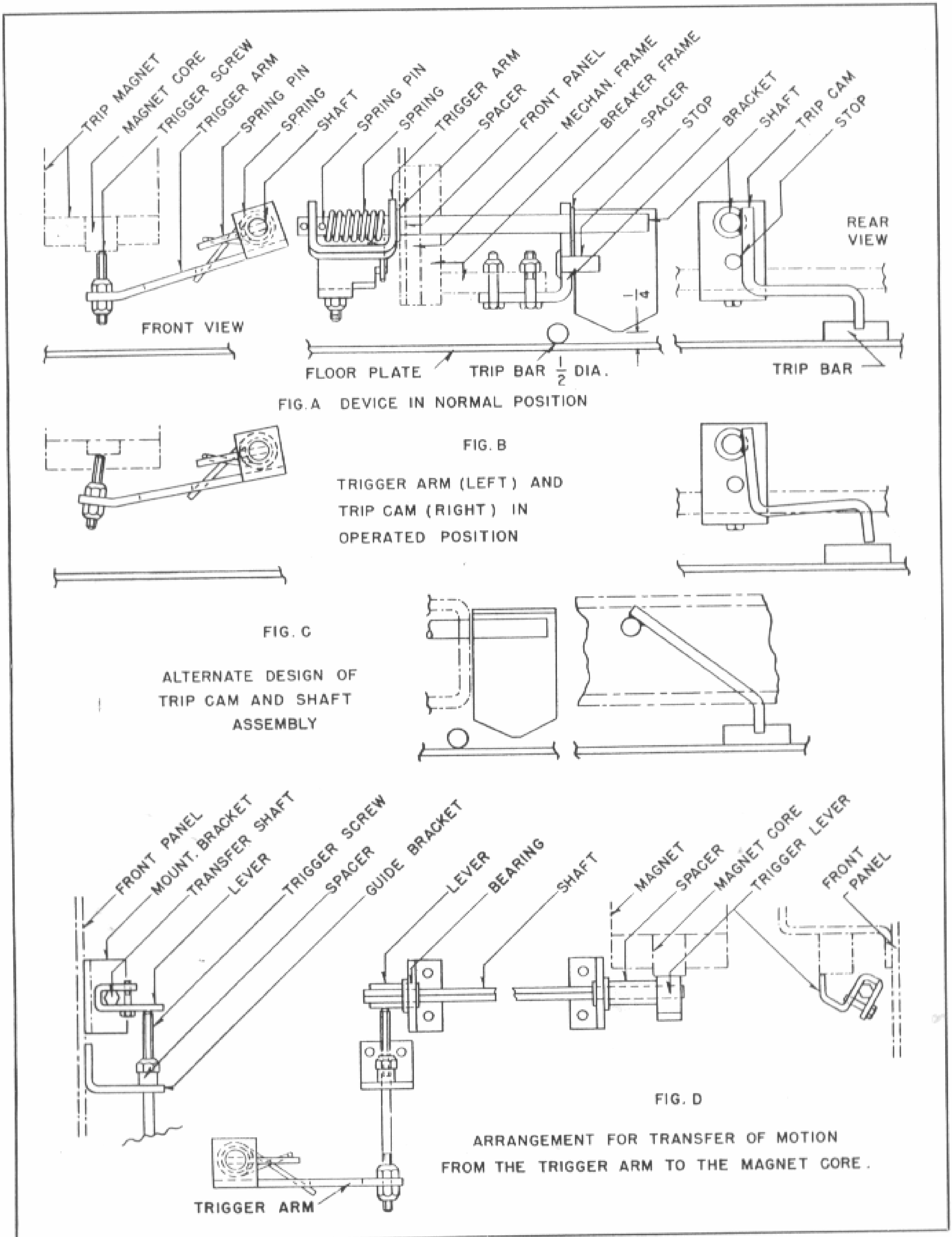


FIG. 25. Automatic Tripping Devices for 15 KV Type DH Air Circuit Breakers Except Type 150-DH-750

3. Automatic Trip Devices For Other 15 KV Breakers. This design is shown in Fig. 25 (for pictures see Figs. 2 and 19). In principle, this design works in the same way as the design shown in Fig. 24; the main difference is in the fact that the axis around which the trip cam moves is parallel to the front-to-back direction in case of Fig. 25 while in case of Fig. 24 it is perpendicular to that direction.

Same as in previous design, a spring is included in the arrangement to absorb extraordinary forces resulting from jamming or from breaker running accidentally over objects of larger dimensions than those of the trip bar, etc.

In some of the breaker ratings the trip cam has a shape as shown in Fig. 25-C instead of the shape shown in Fig. 25-A and 25-B; also, the physical dimensions of other parts may vary.

Because of the different location of the trip magnet, it is necessary to have a transfer arrangement shown in Fig.25-D on the left side of the breaker front panel.

The adjustment of the 1/4" dimension under the trip cam is obtained in two different ways:

For the device operating the mechanism release, there is a little bracket bolted on the front panel under the "trigger arm"; this bracket is adjustable and limits the movement of the trigger arm in the downward direction. By moving this bracket up or down, the 1/4" adjustment is obtained. (The bracket is not shown in Fig. 25 but it can be seen in Fig. 19.) Second adjustment is obtained by moving the two elastic stop nuts on the trigger screw until a gap of max. 1/32" is obtained between the trigger screw and the bottom surface of the mechanism release magnet core.

For the device operating the trip, (see Fig. 25-D), first the adjustment at the top of the trigger screw is made so that the gap between the trigger lever and the bottom of the trip magnet core is max. 1/32".

Second, the adjustment is made to obtain the 1/4" dimension between the floor plate and the trip cam; this is done by moving the two elastic stop nuts at the bottom of the trigger screw holding the trigger arm in position.

4. Automatic Tripping Devices For 5 KV Breakers. The picture of the front part of this device is seen in Fig. 3 or, better in Fig. 18. The trip cam of this design is similar to trip cam shown in Fig. 25; the trigger arms are in shape of a bar and is not difficult to understand the arrangement.

The device works in the same way as described above.

The adjustment of the gap between the trigger screw or trigger lever and the magnet core is made on the trip device same as in the case of Fig. 25-D and on the mechanism release device by using suitable number of washers. The adjustment of 1/4" dimension is made by rotating the trip cam shaft in the trigger arm and then tightening the locking screw.

PART THREE

OPERATION OF A BREAKER WITH STORED ENERGY (SPRING) CLOSING MECHANISM

GENERAL

Operation of such breaker is the same as operation of the breaker with solenoid closing mechanism except the closing and opening operations themselves.

Therefore, refer to standard books for respective instructions and this book will cover only these two details.

OPENING OR CLOSING THE BREAKER ELECTRICALLY

This is done in the same manner as in case of solenoid operated breaker by using the control switch or other device acting in the same way.

Normally, the breaker will be in a condition with a spring wound up, i.e. ready to close, and will be either opened or closed.

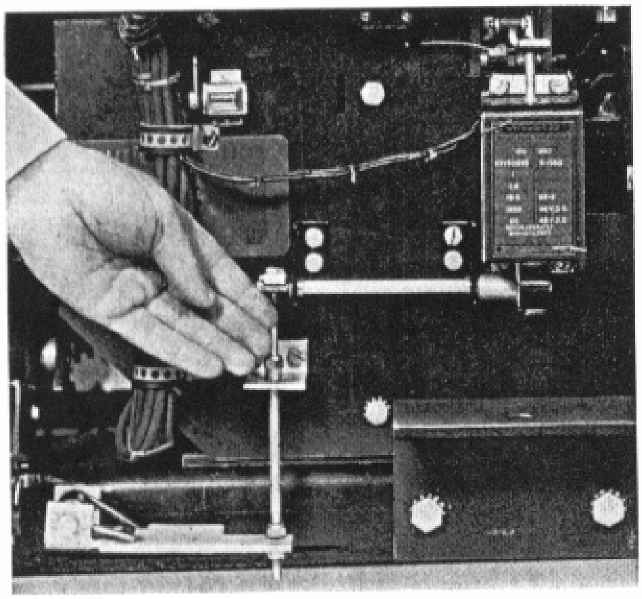


FIG. 26-A. Tripping

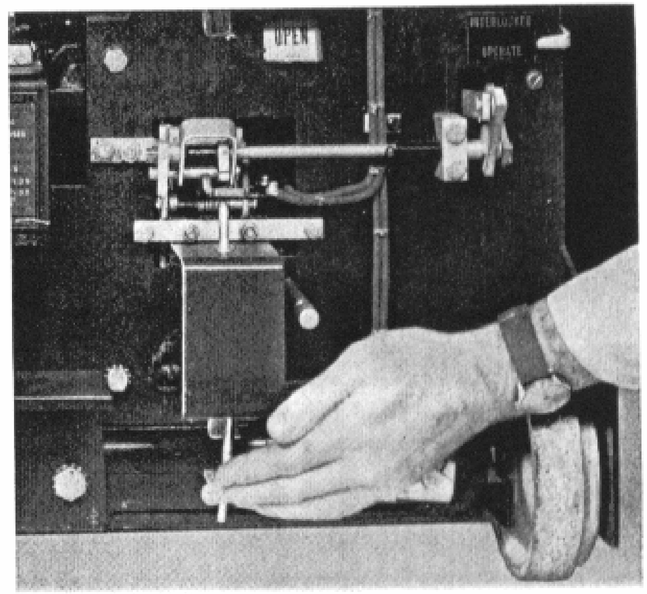


FIG. 26-C. Closing

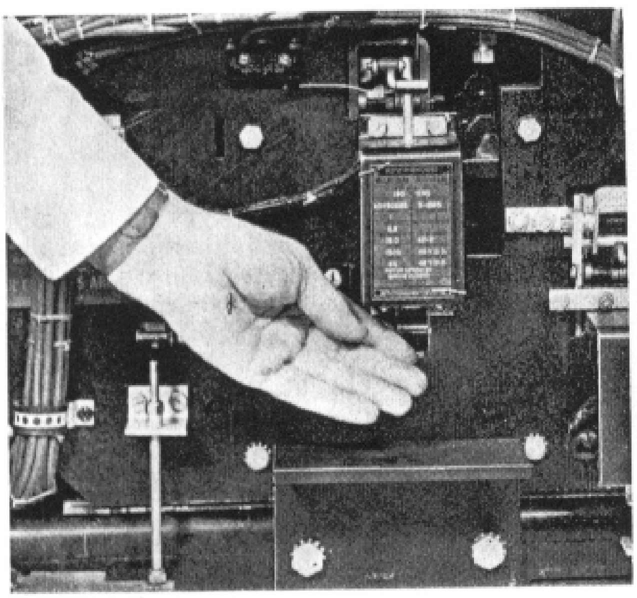


FIG. 26-B. Tripping

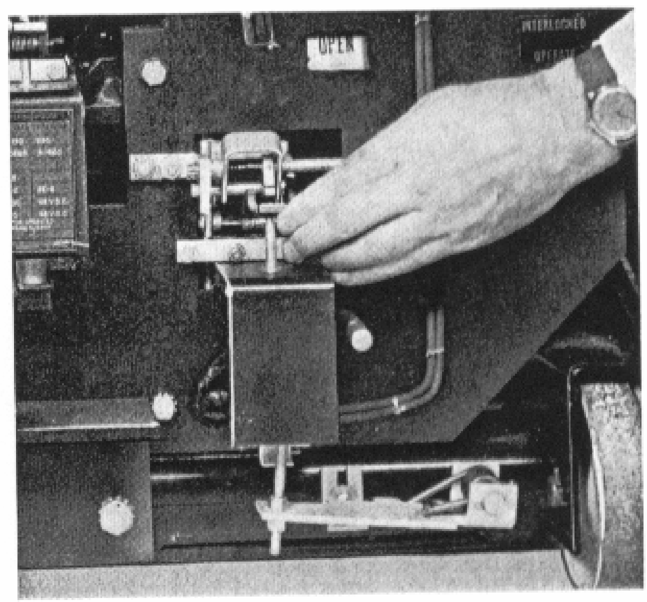


FIG. 26-D. Closing

FIG. 26. Hand Operation of Circuit Breakers With StoredEnergy (Spring) Closing Mechanism (Except Type 150-DH-750)—A and B Tripping—C and D Closing

If opened, then it can be closed and immediately opened, but then at least the spring wind-up time should be allowed before attempting to close again.

When closed, obviously can be opened, immediately closed again, and immediately opened. The spring wind-up time must elapse before another closing operation is attempted.

The wind-up time varies slightly from one type and rating of breaker to another, but in general it lasts in the neighborhood of 10 seconds for the complete wind-up cycle.

This condition will permit first reclose instantaneously and second reclose in 15 seconds or more.

When operating the breaker in test position for testing its operation, it should be borne in mind that the motor rating has been selected for intermittent service and that repeated closing of the breaker, i.e. winding up the spring, one after another will

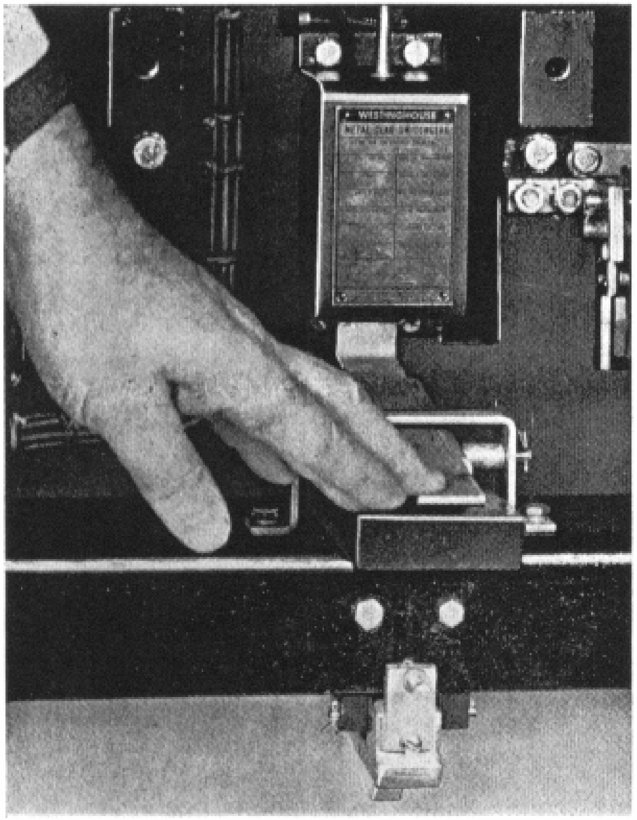


FIG. 27-A. Tripping

lead to overheating of the motor and, eventually to burning it up. Therefore, do not close the breaker more than 20-times in 10 min. and no more than 30-times in 1 hour. (This condition is the same as required by the NEMA Standards.)

TRIPPING BY HAND

There are no restrictions on this operation other than those of safety of the operating personnel.

The tripping by hand is done by any one of several methods indicated as follows:

Most common method is to lift the trigger (primary latch) in the same manner as shown in Fig. 27-B.

Fig. 26-A shows tripping by lifting the lever at the left end of the transfer shaft (refer also to Fig. 25-D).

Fig. 26-B shows tripping by lifting the trigger lever at the right end of the transfer shaft.

Fig. 27-A applies only to 150-DH-750 breakers and consists of pushing down on the trigger lever (refer to Fig. 24) of the automatic trip device.

Method in Fig. 26-C is shown for hand operation of mechanism release, however, it can be applied equally well to tripping.

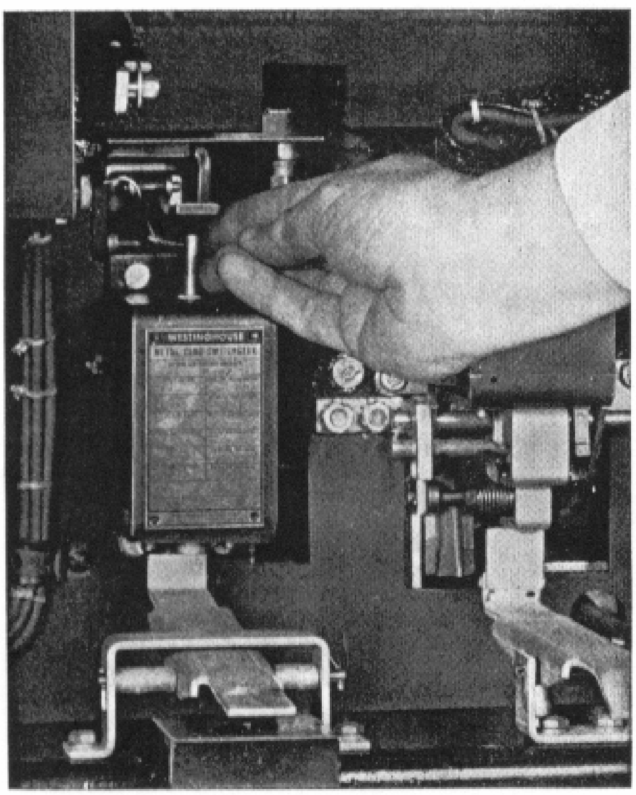


FIG. 27-B. Tripping

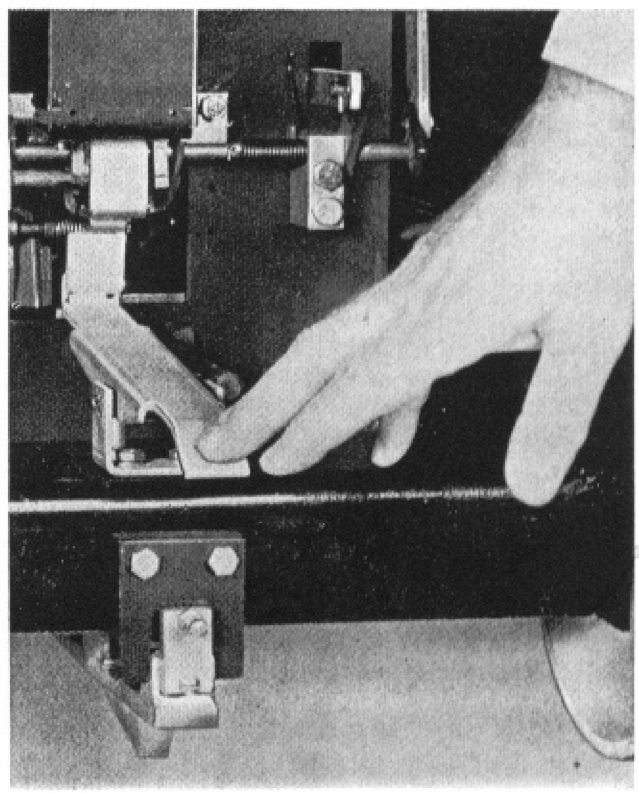


FIG. 27-C. Closing

FIG. 27. Hand Operation of Type 150-DH-750 A.C.B. With Stored Energy (Spring) Closing Mechanism.
A and B Tripping—C Closing

CLOSING BY RELEASING THE MECHANISM BY HAND

This operation should be clearly distinguished from closing by hand closing lever for maintenance.

The breakers with stored energy (spring) closing may be "hand" closed by spring same as in electrical operation except that the mechanism release is actuated by hand instead by solenoid.

This is a distinctive advantage over the solenoid operated breakers because in case of absence of control power, the stored energy (spring) closing breaker can be closed on live circuit by releasing the spring. In case the spring is discharged, it can be first wound up by hand and then the breaker can be closed by hand-releasing the mechanism.

The release of the mechanism can be done by any of the methods illustrated by Figs. 26 and 27 analogically as hand tripping.

There are no restrictions on this method of closing other than those of safety of the operating personnel.

CLOSING THE BREAKER BY HAND CLOSING LEVER

This method must not be used under any circumstances for closing the breaker on the live circuit.

However, during maintenance operations it might be desirable to close the breaker by hand to check the contact adjustments or to "rock" the mechanism linkage to locate points of resistance, distribute the lubricants, check the freedom of movement, etc.

It is inherent in the design of the mechanism, that the breaker cannot be closed by maintenance handle unless the spring is wound up. If this condition does not exist in the breaker at hand, the spring must be wound up first, either by hand or by power.

WINDING UP THE SPRING BY HAND

This operation is performed using the levering-in crank with special adapter which fits on the mechanism hand winding shaft. For winding up the crank is pushed in to engage the sleeve (see Fig. 10, bottom) and rotated in the clockwise direction.

The hand winding should continue until the roller is in position IV (Fig. 12-A). As explained before, the spring is wound up and latched when the trigger (primary latch) of the mechanism release comes down into latched position. However, the winding should continue for approximately 10 revolutions beyond that point to get the roller in position IV.

At the beginning of the wind-up both triggers (primary latches), the one of the hand trip as well as the one of the mechanism release, are in the "up" positions. As the wind-up progresses and nears it end, first the hand trip trigger will come down and fall in its latched position and then, second, the mechanism release trigger comes down into the latched position. Also, toward the end on the wind-up two "clicks" will be heard. One is due to the linkage latch Fig. 13 falling into place and the other one due to connecting link, and clevis link (Fig.12) going over the toggle.

PART FOUR

MAINTENANCE

There are no special requirements on the stored energy (spring) closing mechanism maintenance other than those specified for solenoid closing mechanism.

Exception is the lubrication. The spring closing mechanism includes a number of needle, ball and roller bearings which are lubricated for life and under normal conditions will not require re-lubrication. The mechanism should be lubricated in the same manner as prescribed for solenoid operated mechanism and same lubricant should be used.

The pins and bearing surfaces of the cam link, main pin through the trip free and non-trip free levers, slotted link, upper and lower trip free links, crankshaft journals and all pins, and all spring wind-up linkage are lubricated with lubricant (W) No. 9921-4.

Special lubricant must be used for best results on the worm and the worm gears. Contact factory for this lubricant.

ADJUSTMENTS

The mechanism is completely adjusted at the factory and under normal circumstances, no adjustment in field should be necessary.

It is strongly recommended, that the factory adjustments should not be tampered with unless need for re-adjustment occurs for some reason, such as, for example, during periodic maintenance revisions.

The following adjustments are covered.

a. The adjustment of the shock absorber The shock absorber assembly (refer to Fig. 4) can be adjusted by means of its four retaining bolts. For making the adjustment, the breaker should be closed and spring discharged. The spring then rests against the shock absorber. By moving the shock absorber to the right, the gap between the lip of the closing latch and the pin of the non-trip-free lever is increased; naturally, by moving the shock absorber to the left, it is decreased. The position of the shock absorber should be adjusted so, that the gap is minimum 1/32" and maximum 1/16".

Note: When the spring is charged and breaker is closed, the gap between the lip of the closing latch and the pin is zero; the pin rests against the latch.

b. The adjustment of the closing latch check switch LCSC. This switch is adjusted so, that it will just operate (click) when the gap between the non-trip-free lever pin and the bottom of latch hook is 1/16" as shown in Figs. 21 and 22.

The adjustment is made by means of an adjusting screw which is then locked in its position by either a lock-nut (Fig. 24) or by a locking screw (Fig. 22).

Fig. 22 shows also an overtravel stop arrangement where an adjustment of approximately 1/32" recommended.

c. Tripping cam adjustment. This adjustment covers the gap between the tripping latch and the tripping cam (see upper right of Fig. 9). It is made the same way as in case of solenoid operated breaker, therefore, please refer to instruction book for the respective breaker.

d. Latch check switch LCST. For instructions how to make this adjustment, please refer to instruction book for the respective breaker.

e. Adjustment of spring latch switch "bb". This adjustment is made by bending the switch arm so, that the switch operates no sooner than when the pin is in a position 1/4" before the position in Fig. 14-A is reached and, naturally, not later than in the latched position.

f. Adjustments of switch LS operating screw. The switch operating adjusting screw is set so that in the extreme counter-clockwise position of the brake lever there is a gap between the screw and switch operating arm between 1/16" and 1/32".

The brake rod assembly is adjusted so that the travel of the hollow pin between its extreme positions is approximately 1/2".

g. Adjustment for cam lever. This adjustment is made by means of set screw stop (see Fig. 10). Rotate the hand wind shaft until the roller on the worm gear is in a position tangent to cam lever and the cam lever is in maximum clockwise position. Adjust the set screw stop so that a .020" thick feeler gage can be inserted between the screw and the lever. Lock the screw stop by tightening the small set screw on the side.

h. Adjustment on mechanism release assembly. The adjusting screw (see Fig. 14) is set so, that the gap between the release latch and the lip of the spring latch cam is minimum 1/32" and maximum 1/16". This is done by turning the screw (bolt) in one direction or the other, as needed. The bolt is locked in position by the lock-nut.

i. Adjustment of spring wind-up linkage. After the adjustment g and h have been made, the entire mechanism release assembly is moved until the connecting link and the clevis link are in a position which is usually called "over the toggle position". The center of the pin which is common to both links is then 1/8" distant from the centerline connecting the other two pins (see Fig. 12-B).

When the adjustment is obtained, the mechanism release housing is dowelled on the mechanism frame.

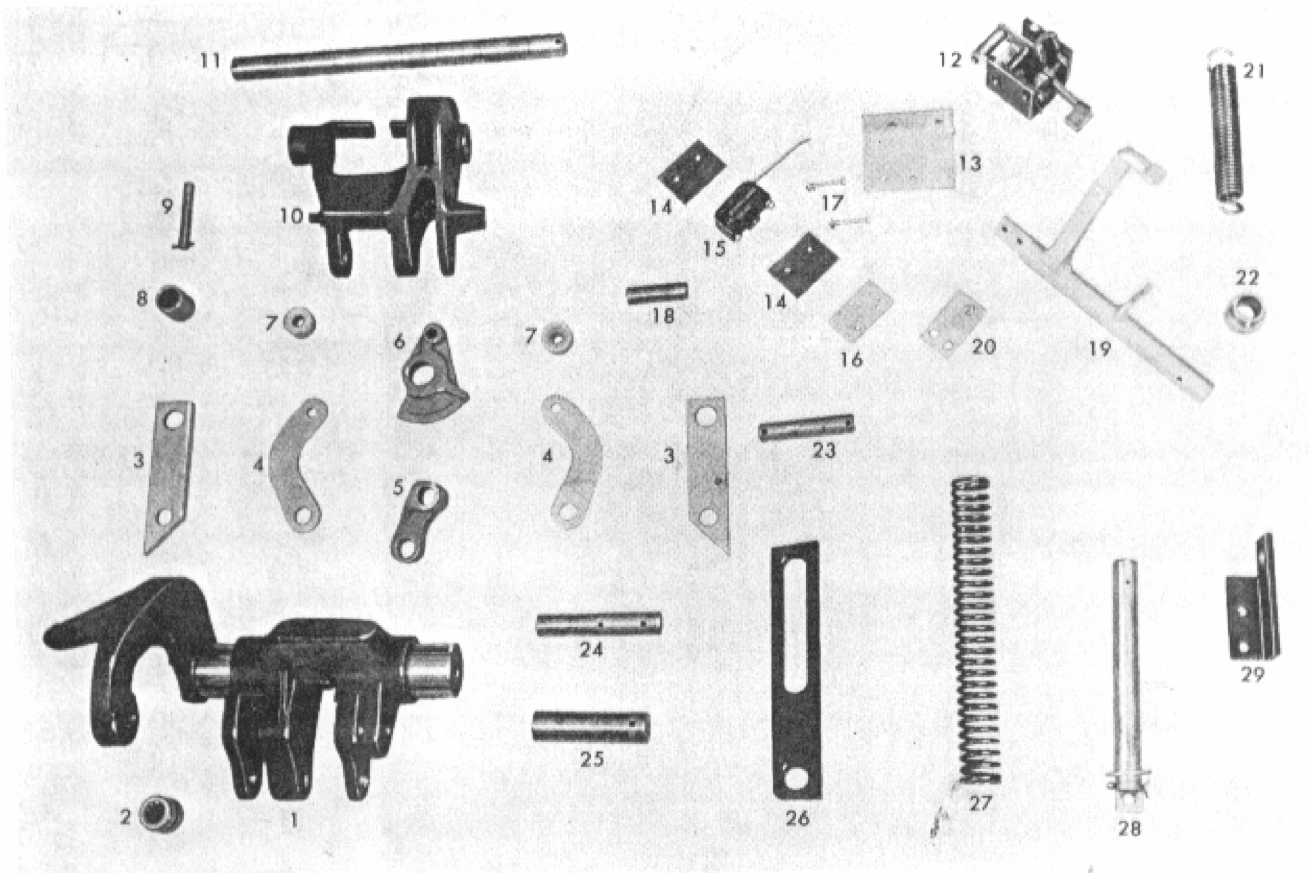
j. Adjustment of the brake rod assembly. This is made by adjusting the adjusting screw of the brake rod assembly (see Fig. 11-C). The procedure is as follows:

Charge spring by hand and after the spring has been wound up, keep on turning the hand winding shaft until the roller on the brake lever drops off cam segment on the worm gear and the brake lining bears on the brake disc (approximate position in Fig. 11-A). When this position has been obtained, turn the adjusting screw at the left end of the brake rod assembly against the pad on the crankshaft until stop pin in sliding pin clears the rear end of the slot in hollow pin by 1/32" to 1/8". When this is obtained, lock the adjusting screw with the lock-nut.

PART SIX

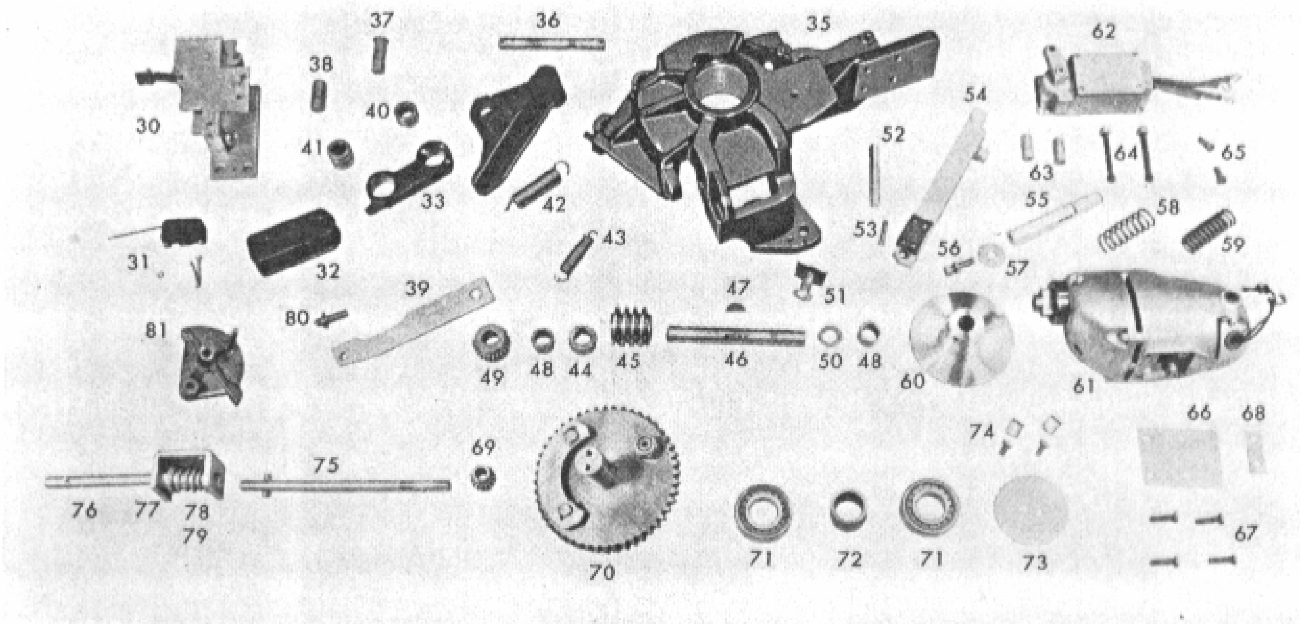
PARTS IDENTIFICATION

The photographs in Figs. 28 and 29 are showing the more interesting parts of the mechanism. The ist of parts carries no suggestion of renewal parts and is intended more or less as a supplement to the figures in text.



1. Crankshaft
2. Roller bearing for crankshaft arm
3. Lower trip-free link
4. Cam link
5. Upper trip-free link
6. Tripping cam
7. Roller
8. Spacer between cam link and lower trip-free link
9. Cam and cam link pin
10. Non-trip-free lever
11. Main pin (mechanism center pin)
12. Hand trip assembly
13. Mounting bracket for LCSC switch
14. Resilient plate for switch
15. Micro-switch LCSC
16. Mounting plate for switch
17. Mounting bolts for switch
18. Pin for upper and lower trip-free pin junction
19. Closing latch
20. Switch operating arm
21. Closing latch spring
22. Closing latch sleeve (bearing)
23. Pin for non-trip-free lever and lower trip-free link junction
24. Crankshaft and slotted link pin
25. Crankshaft and spring rod pin
26. Slotted link
27. Non-trip-free lever retrieving spring
28. Retrieving spring guide
29. Spring guide bracket

FIG. 28. Parts Identification



30. Mechanism release housing
31. Switch "bb"
32. Clevis link
33. Connecting link
34. Cam lever
35. Gear housing
36. Cam lever pin
37. Clevis link and connecting link pin
38. Crankshaft and clevis link pin
39. Transfer link
40. Roller bearing for connecting link (cam lever end)
41. Roller bearing for connecting link (clevis link end)
42. Cam lever retrieving spring
43. Linkage retrieving spring
44. Spacer
45. Worm
46. Worm shaft
47. Worm key
48. Needle bearing for worm shaft
49. Spur gear on worm shaft
50. Thrust washer
51. Gear housing mounting bolt with locking clip
52. Brake rod sliding pin
53. Pin for brake lever and sliding pin junction
54. Brake lever assembly
55. Brake rod hollow pin
56. Brake rod adjusting screw
57. Spring retaining washer
58. Rod spring
59. Brake spring
60. Brake disc and coupling
61. Motor
62. Limit switch LS
63. Spacers
64. Mounting bolts for limit switch (long)
65. Mounting bolts for limit switch (short)
66. Motor shim
67. Motor mounting bolts
68. Locking clip
69. Spur gear
70. Worm gear with shaft, cam and roller
71. Roller bearings for worm gear shaft
72. Spacer
73. Retaining plate
74. Mounting screws for bracket It. 77
75. Hand winding shaft
76. Hand winding shaft extension
77. Bracket
78. Sleeve
79. Spring
80. Spring latch and transfer link pin
81. Spring latch

FIG. 29. Parts Identification