INSTRUCTIONS

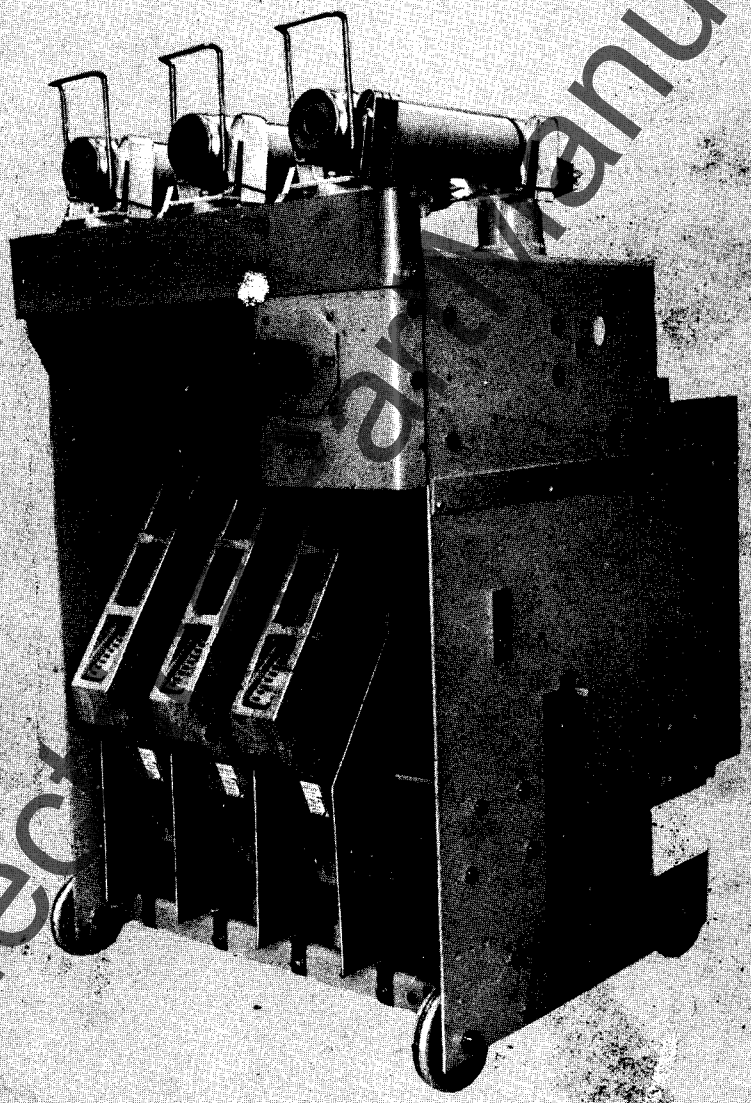
GEH-3060A

HIGH-VOLTAGE CONTACTORS

A-C AIR-BREAK TYPE

IC2814*

* Has also been designated IC2812 all forms



GENERAL ELECTRIC

CONTENTS

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

HIGH-VOLTAGE CONTACTORS

A-C AIR-BREAK TYPE

Before any adjustments, servicing, parts replacement or any other act is performed requiring physical contact with the electrical working components or wiring of this equipment, the POWER SUPPLY MUST BE DISCONNECTED.

INTRODUCTION

These instructions cover high-voltage, a-c air-break contactors as outlined in Tables 1 and 2. The contactors are designed for equipment used in starting a-c motors with a line voltage from 600 volts to a maximum of 5000 volts.

TABLE 1
CONTACTORS WITH STAB CONNECTIONS

- Without fuse shelf.

IC2814-D110	IC2814-E112
IC2814-E110	IC2814-E113
IC2814-E111	IC2814-F111
	IC2814-X111

- With fuse shelf and with a-c magnets.

IC2814-E120	IC2814-E142
IC2814-E130	IC2814-E170
IC2814-E140	IC2814-E180

- With fuse shelf and with d-c magnets.

IC2814-E121	IC2814-E133
IC2814-E131	IC2814-E141
	IC2814-E183

Stab connections are provided for power with heavy spring-backed fingers. Control-stab connections are provided with extra flexible-spring temper leaf springs.

TABLE 2
CONTACTORS WITH BOLTED CONNECTIONS*

IC2814-E150	IC2814-H151
IC2814-C151	IC2814-V151
IC2814-D151	IC2814-W151
IC2814-E151	IC2814-X151
IC2814-F151	IC2814-E191

*For further identification see the following Nomenclature Description.

These instructions are intended to apply to all listed contactors with exceptions being those unique features applicable only to a given design.

NOMENCLATURE DESCRIPTION

The contactors can be identified through the nomenclature description. A sample is below along with an explanation:

(all contactors – 400 amperes or less – and stab connections except as stated)

IC2814E110B

- Form letter or letters
  - 0 Includes an a-c magnet
  - 2 Includes a latched a-c magnet
  - 1 Includes a d-c magnet
  - 3 Includes a latched d-c magnet
- 2 Includes 4,800 volt fuse shelf
- 3 Includes 2,400 volt fuse shelf
- 7 Includes control transformer and fuses and 4800 volt fuse shelf
- 8 Includes control transformer and fuses and 2400 volt fuse shelf
- 4 Includes fuse shelf without provision for fuses
- 1 Includes contactor without fuse shelf
- 9 Includes 600 ampere contactor
- 5 Includes bolted connections
- Model or style
  - E - 3 normally open poles
  - F - 5 normally open poles
  - X - 3 normally open and 3 normally closed poles
  - D - 2 normally open poles
  - C - 1 normally open pole
  - H - 4 normally open poles
  - V - 1 normally open and 1 normally closed poles
  - W - 2 normally open and 2 normally closed poles

GENERAL

RATINGS

The contactors (see Fig. 1, 2, 3 and 4) with three normally open poles are furnished in 200-, 400- and 600-ampere continuous ratings with a maximum interrupting capacity of 50,000 kva. With 50,000 kva available, the contactor in a NEMA Class E1 starter can interrupt the fault current. The contactor can be coordinated with General Electric Co. Type EJ2 current-limiting fuses in NEMA Class E2 starters and used with systems which have up to 250,000 kva available at 5,000 volts.

Contactors with 100-ampere continuous rating are available for use in circuits having a maximum "let-through" current of 6000 amperes for one cycle or less.

DESCRIPTION

IC2814-E110, -E120, -E130, -E140, ETC., CONTACTORS

These contactors have three normally open poles with an a-c magnet and additional features per nomenclature description, page 3. All contactors have five-inch diameter roll-out wheels for moving the contactors easily in and out of enclosures. When the contactors are rolled into the enclosures, all power and control connections are automatically made. After the grounding strap (see Fig. 1) is securely bolted to the contactor frame and enclosure, the contactor is ready for operation. With forms employing the fuse-disconnect shelf, power can be completely removed from the contactor by moving

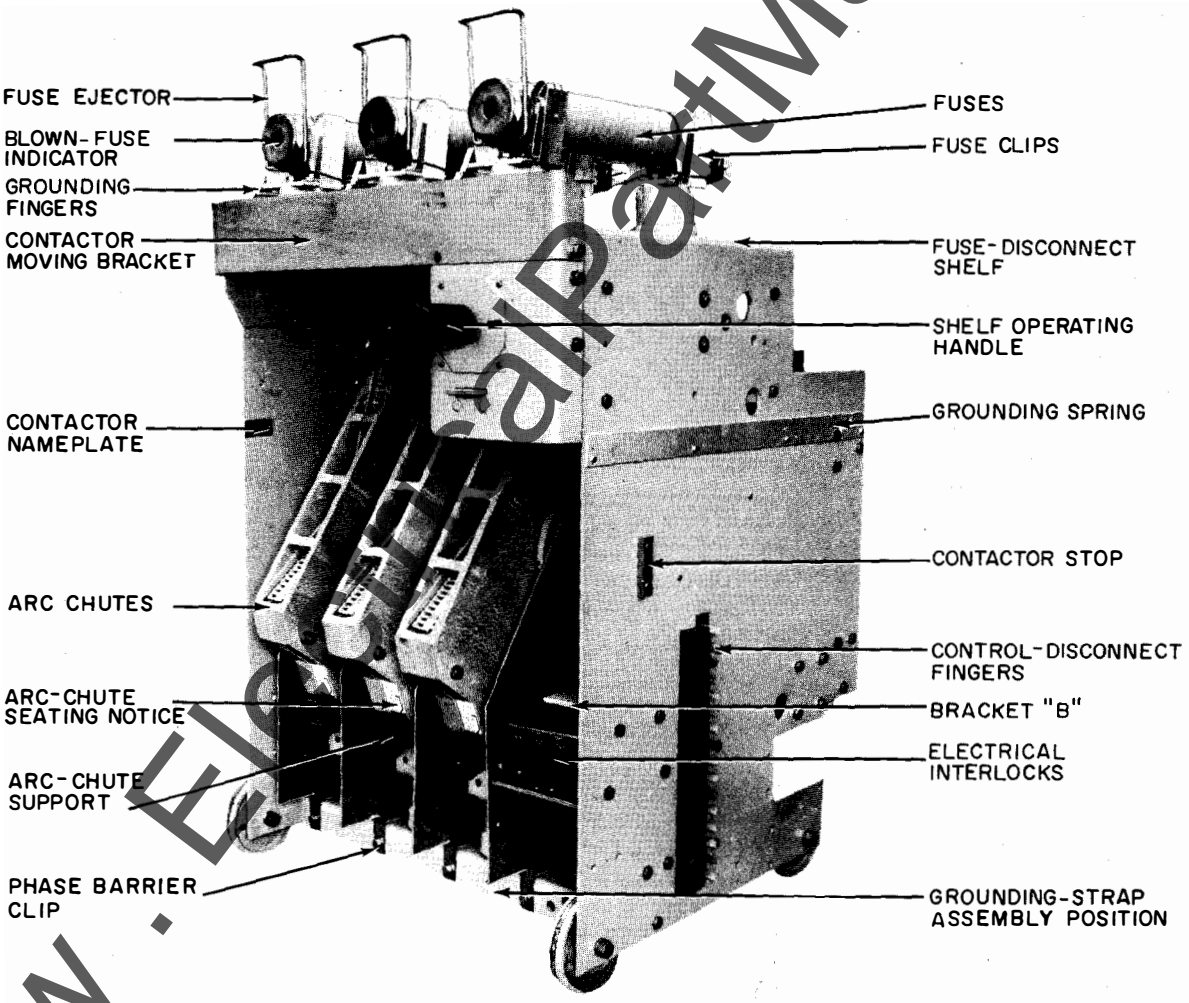


Fig. 1. Front view of IC2814-E120 high-voltage contactor with fuse-disconnect shelf

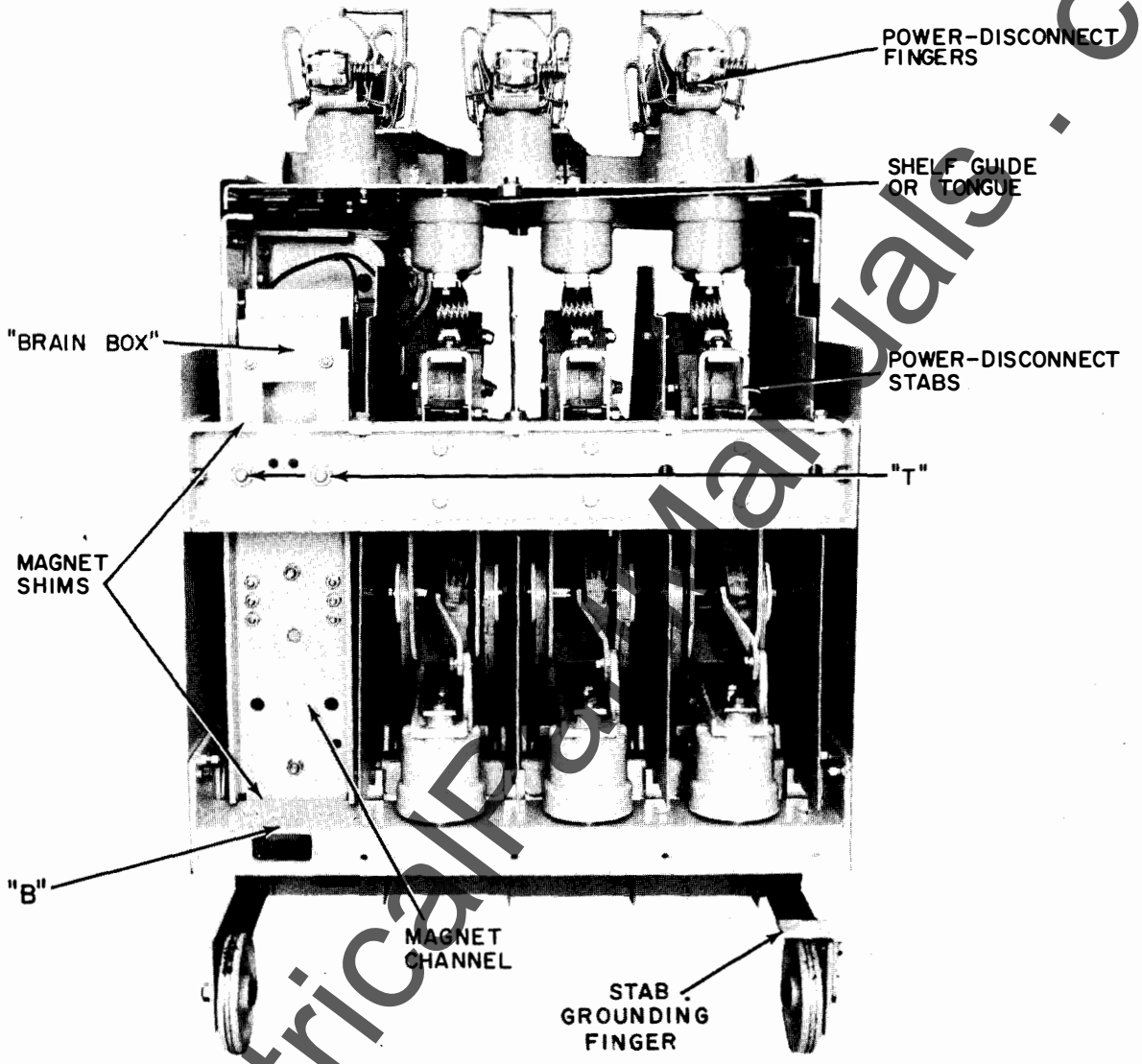


Fig. 2. Rear view of IC2814-E120 high-voltage contactor with fuse-disconnect shelf

the power-disconnect fingers of the shelf (see Fig. 2) out of engagement by rotation of the shelf operating handle if the contactor is first de-energized, so that the shelf disconnects will not interrupt the power. (See Fig. 1.) Grounding springs and fingers (see Fig. 1) are provided for additional safety.

These contactors are designed for linkage-type mechanical interlocks which operate through a brain-box. (See Fig. 19A.) Linkages connecting the contactors are supported by the enclosure.

IC2814-E111, -E121, -E131, -E141 and -F111 Contactors

These contactors are identical in construction to those described above with the exception of numbers of poles and magnet construction, which are listed in nomenclature description. To operate these contactors, d-c magnets are used with intermittently rated coils and an economy resistor. The magnet can be energized by straight dc or from dc obtained through rectifiers. Rectifiers and resistors must be mounted on the enclosure.

IC2814-E150, -E151, -F151, and -X151 Contactors

The power-pole, magnet, electrical-interlock and arc-chute assemblies of these contactors are identical to that of the IC2814-E110, -E111, -F111 and -X111 contactors, respectively. These contactors, however, have two and one-half inch diameter wheels

for providing a roll-out contactor, which will replace the IC2814-E100, -E101, -F100 and -G100 contactors of an earlier design. (See GEH-1937.) All power cables and control wires must be bolted to the contactor after it is rolled into the enclosure.

These contactors are designed for push-pull cable mechanical interlocks, which mount entirely on the contactors. The cables must be disconnected before a contactor can be rolled out of an enclosure. A door-interlock finger is extended toward the right (front view) of the contactor, when the contactor is energized, so that door interlocking can be effected.

Contactors with one normally open, two normally open, one normally open – one normally closed, and two normally open – two normally closed are also available in this type of design.

IC2814-X111 AND -X151 CONTACTOR

These contactors consist of three normally open poles which are identical to the IC2814-E111 contactor and are mechanically interlocked to three normally closed poles, so that the normally closed poles must be opened before the normally open contacts can close. The description given previously for the -E111 contactor applies to these contactors, with the following exceptions:

The normally open poles and normally closed poles each have their own d-c magnet. The normally

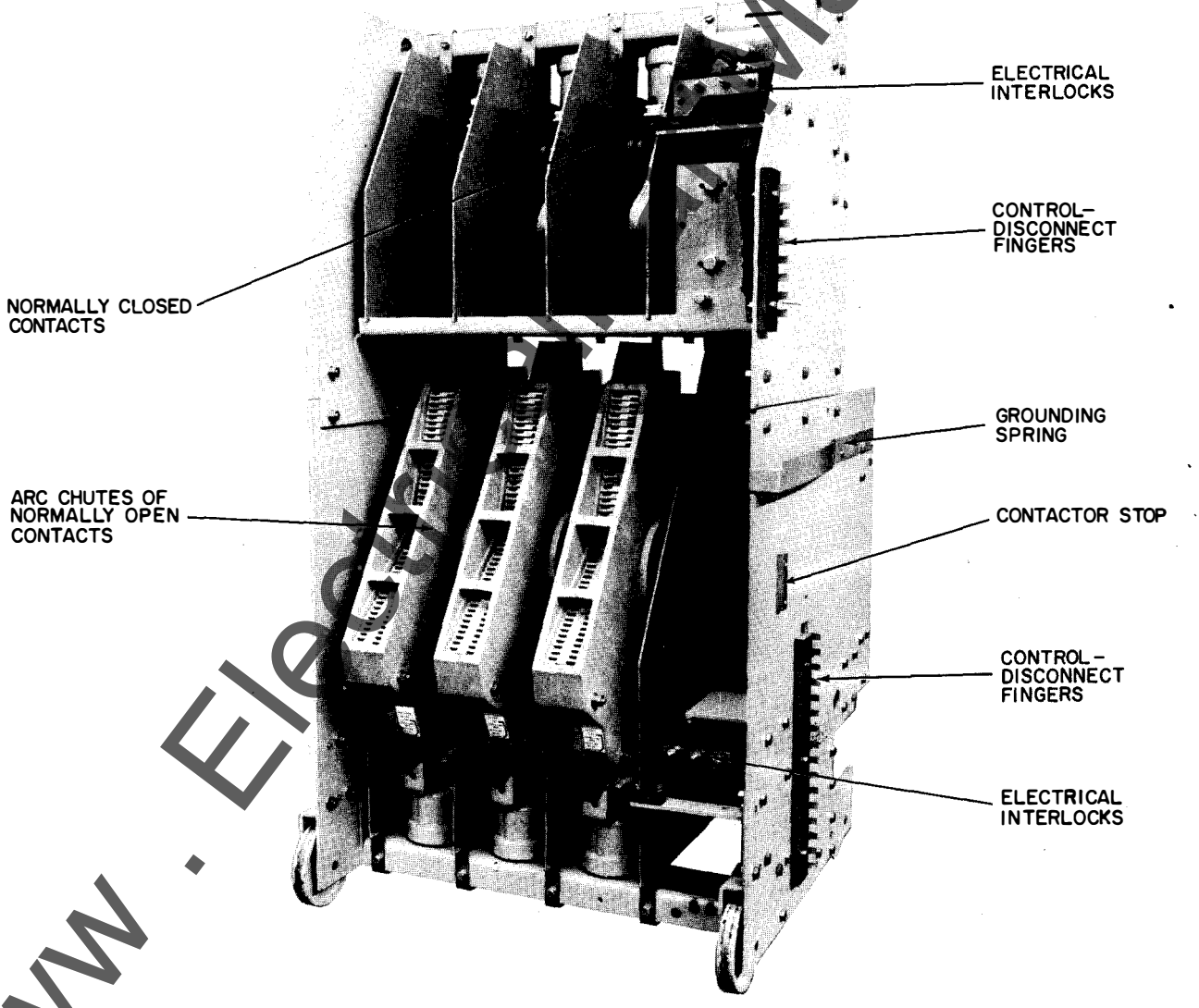


Fig. 3. IC2814-X111 high-voltage contactor with dynamic braking normally closed contacts

closed part has no blowouts or arc chutes and, therefore, has no interruption rating. These contacts establish the circuit only and should not be opened with current flowing.

The closing magnets for the normally open contacts are the same as the d-c magnets (previously described) of the -E111 contactors. The contacts are operated by intermittent-rated magnets. A resistor is added to the coil circuit after the contactor has closed, to reduce the current in the coils. The magnet of the normally closed contacts is, in general, of the same construction as that of the -E111 contactors, but operates against counterweights and a spring which close the contacts when the magnet is de-energized.

OUTLINE DIMENSIONS

Dimensions of the contactors are given in Fig. 3 through 10.

CONTACTS

The contacts are provided with a special facing which will give additional life and will assist the contactor in properly making, carrying, and interrupting electrical power. It is imperative that the contacts be replaced before part of one contact is making contact with the base material of the other contact. The special facing reduces losses of facing material during making and breaking electrical power.

BLOWOUT-COIL RATINGS

The majority of the contactors will use 400-ampere blowout coils connected in series with the contacts. 100-, 200- and 600-ampere blowout coils may be necessary for certain applications and are available. Nameplates of contactors are located on the inside of the left frame (Fig. 1) and will list the maximum ampere rating as determined by the blowout structure.

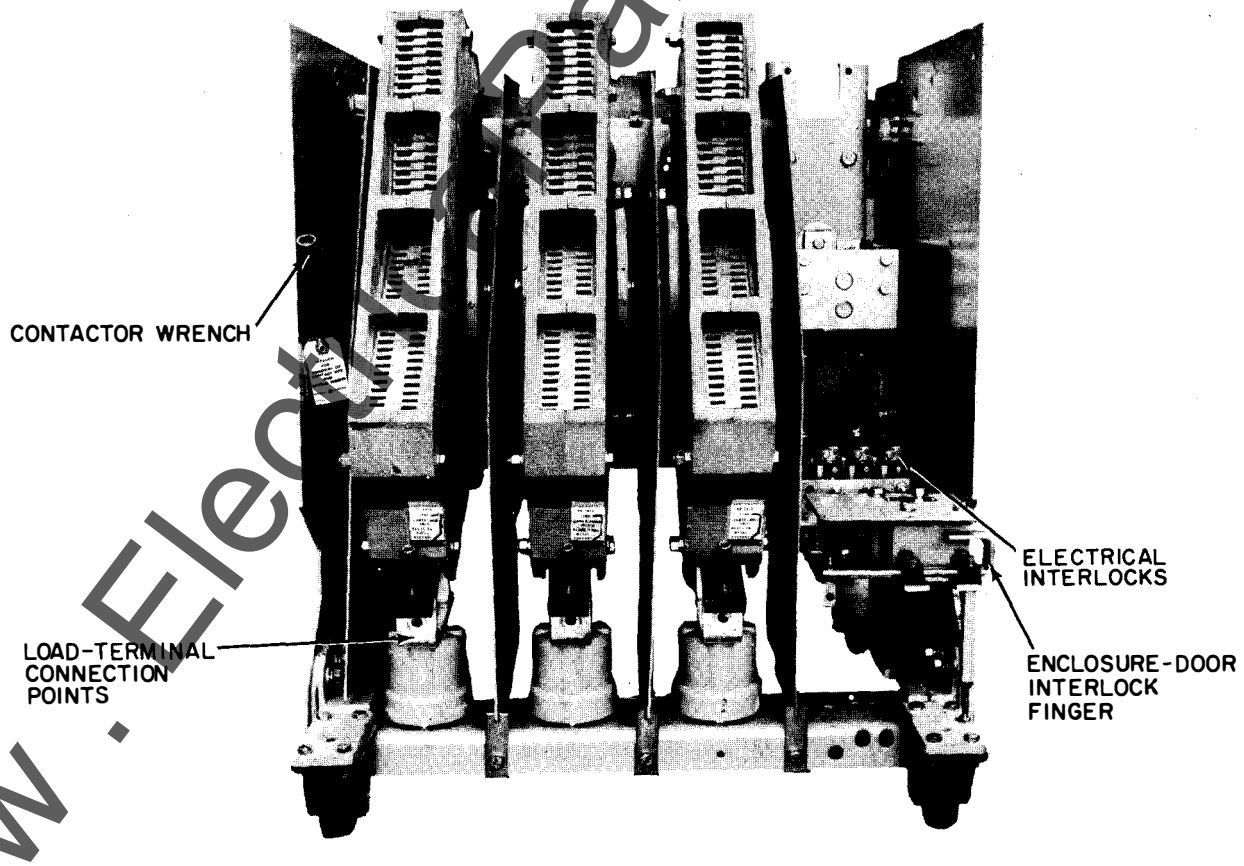
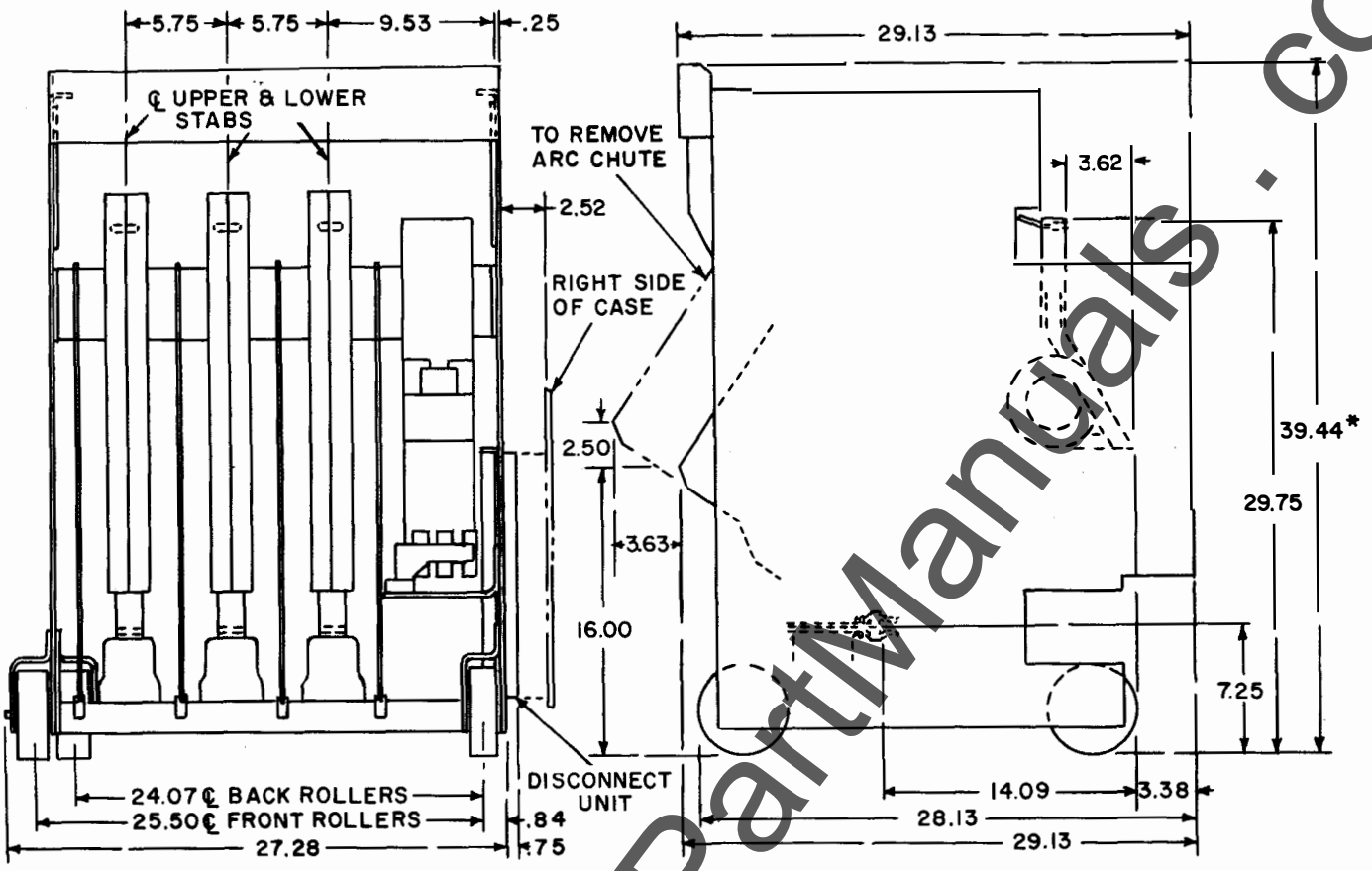
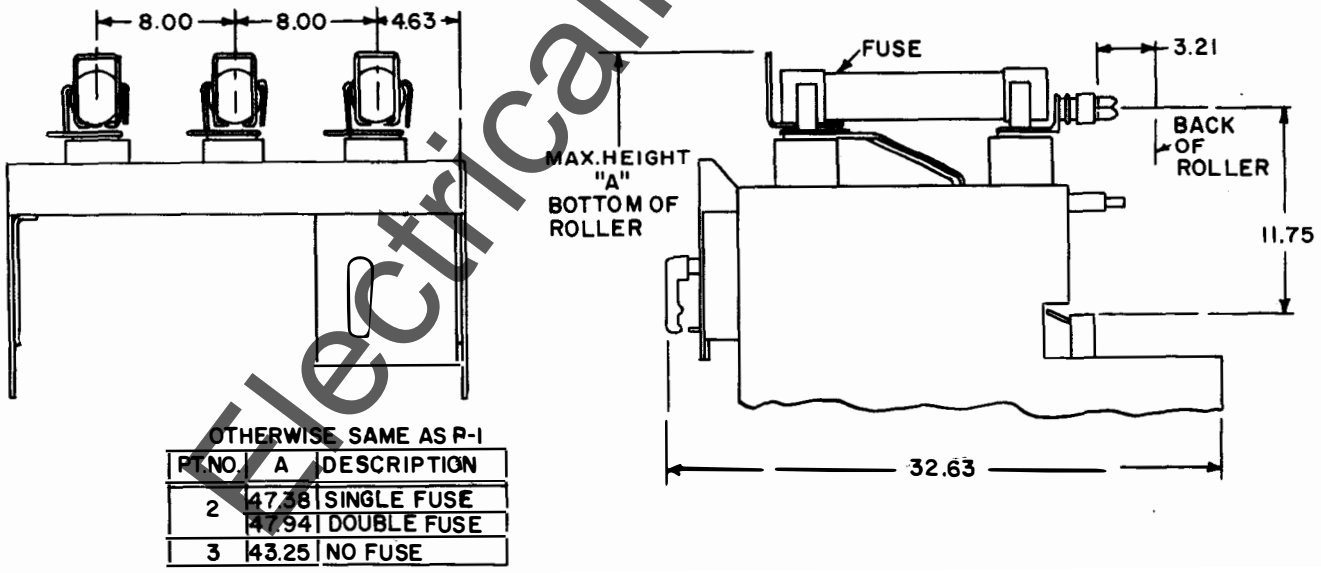


Fig. 4. IC2814-E150 high-voltage contactor





OTHERWISE SAME AS P-1

PT. NO.	A	DESCRIPTION
2	47.38	SINGLE FUSE
	47.94	DOUBLE FUSE
3	43.25	NO FUSE

Fig. 5. Dimensions, in inches, of high-voltage contactors as follows:

P1—IC2814-E110 and -E111 contactors
P2—IC2814-E120, -E121, -E130 and -E131 contactors
P3—IC2814-E140 and -E141 contactors

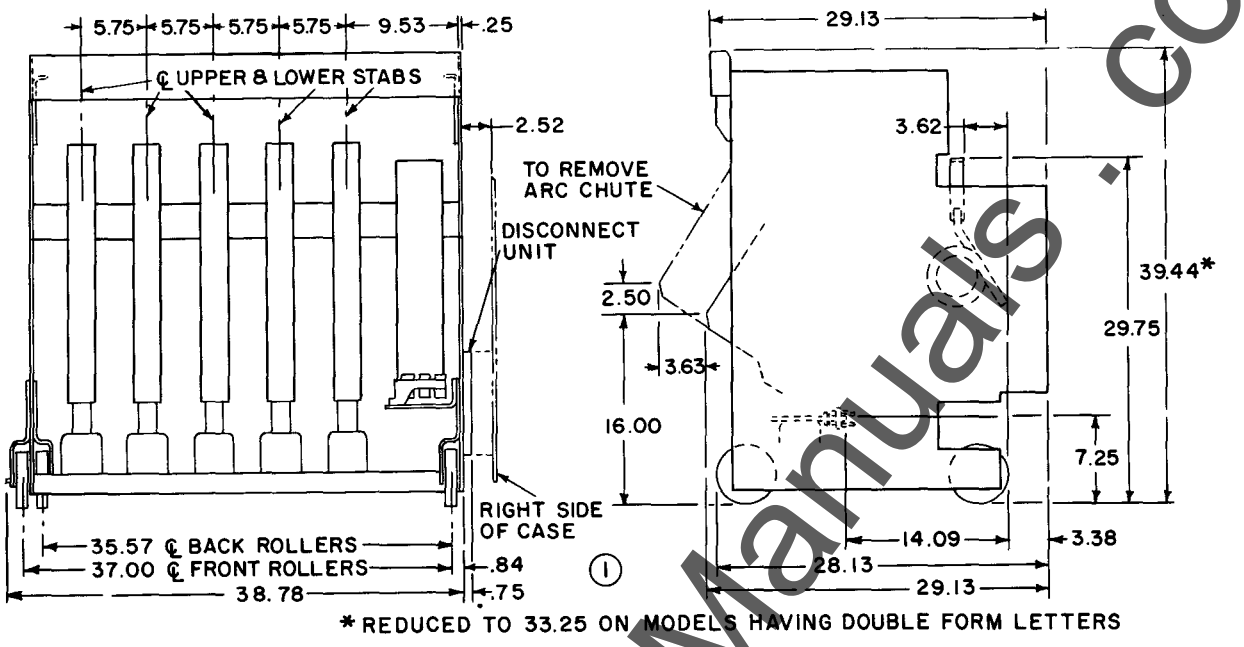


Fig. 6. Dimensions, in inches, of IC2814-F111 high-voltage contactor

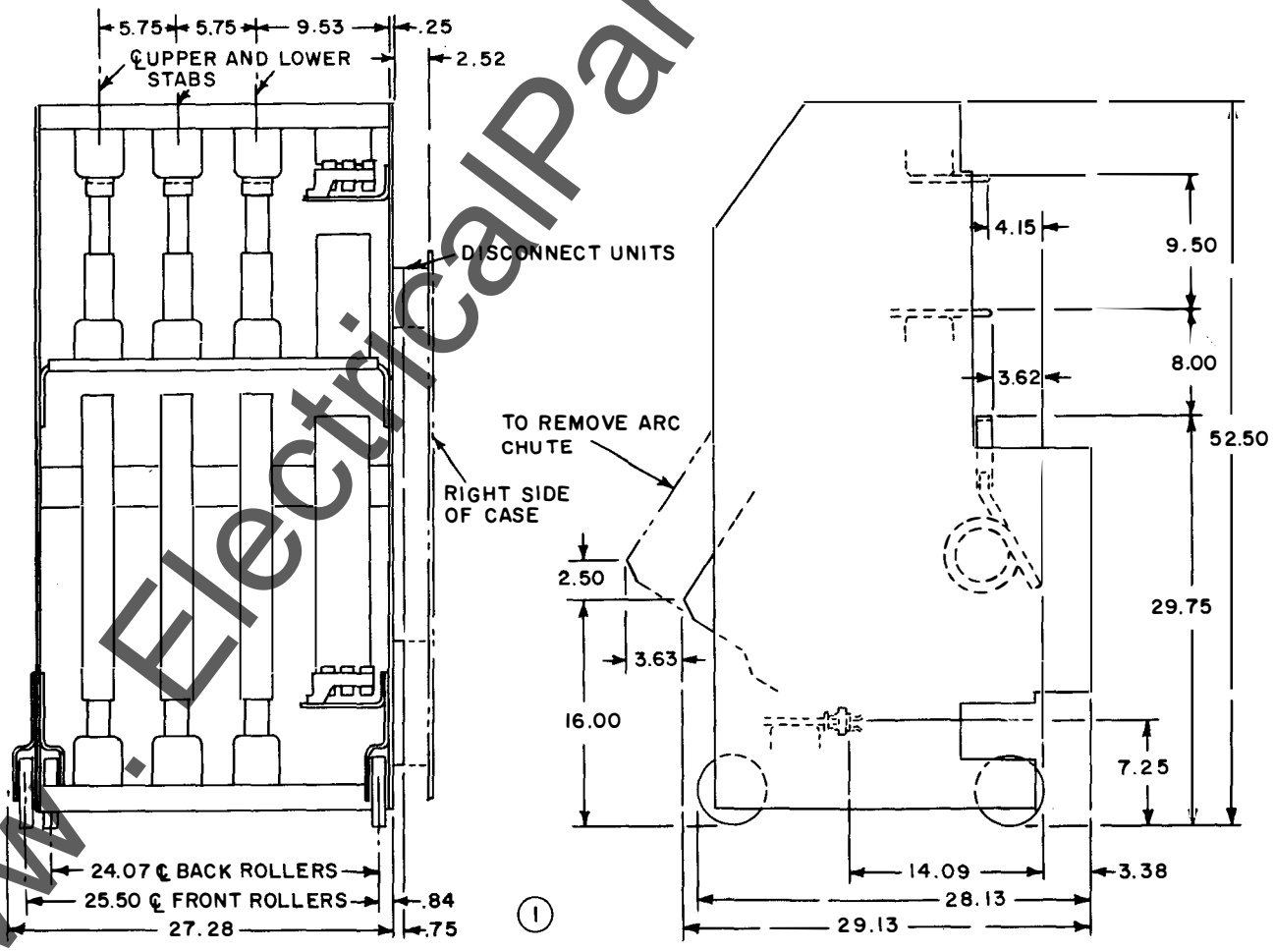
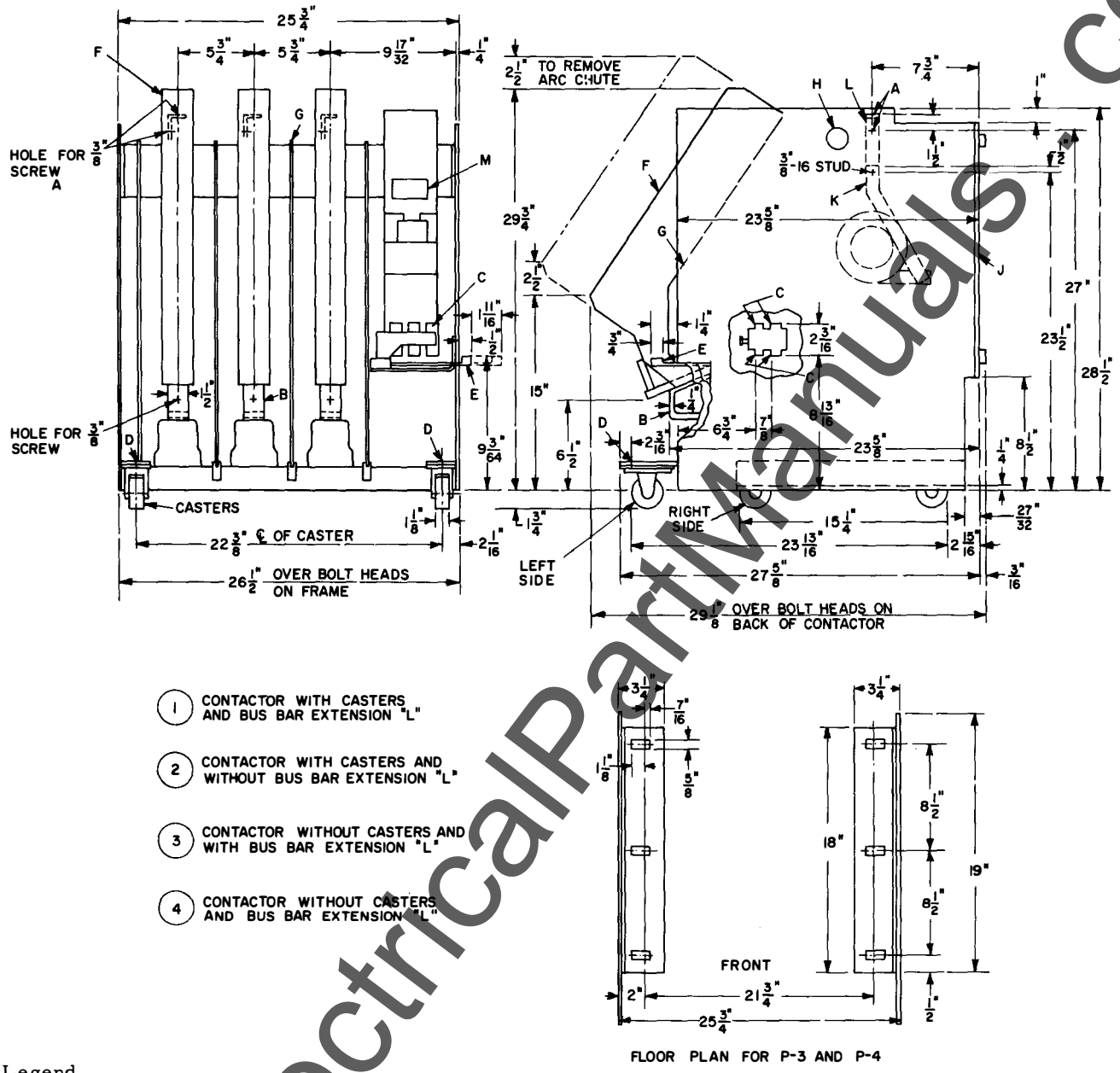


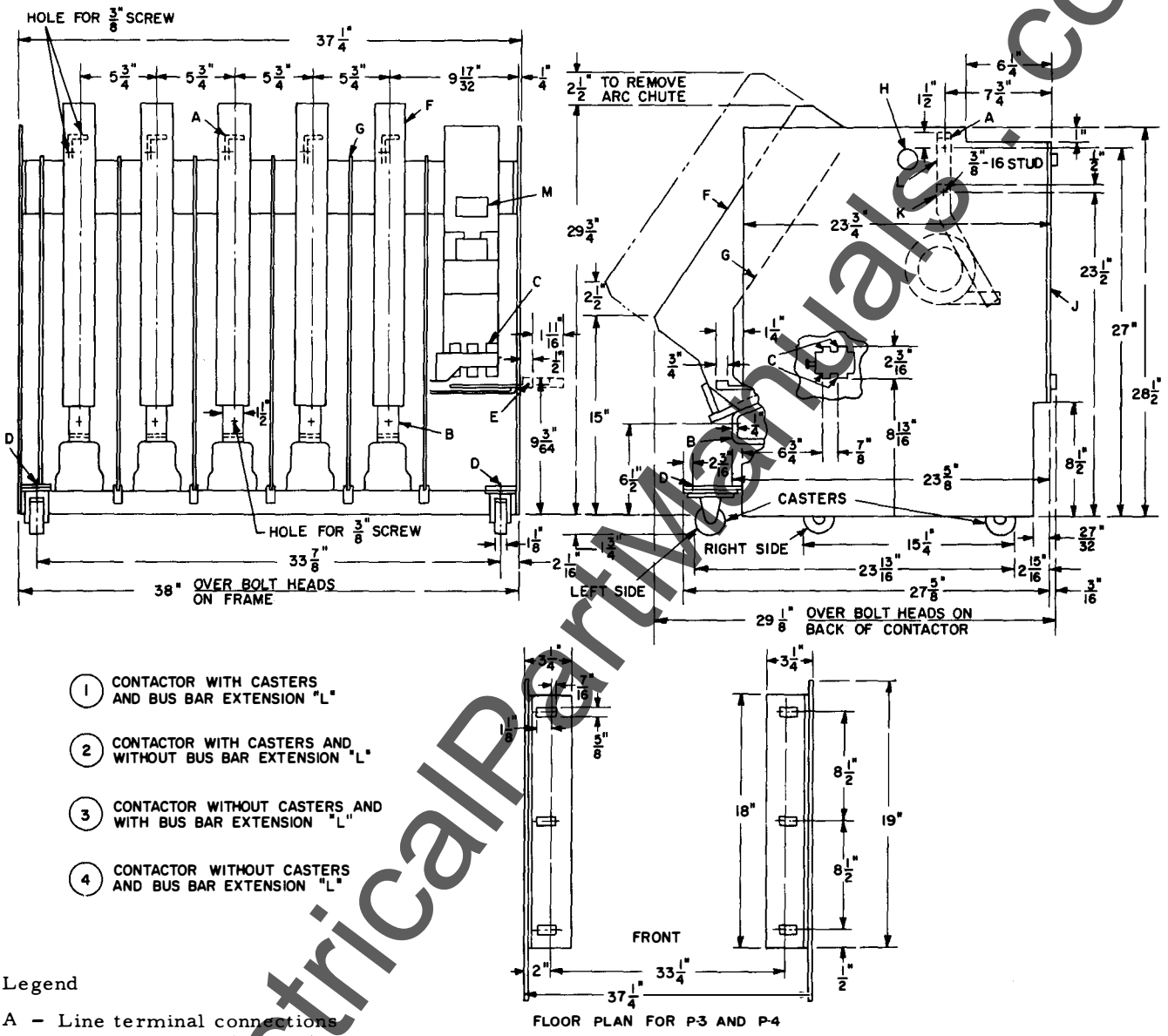
Fig. 7. Dimensions, in inches, of IC2814-X111 high-voltage contactor



Legend

A – Line terminal connections with bus bar "L"
B – Load terminal connections
C – Electrical interlock terminals
D – 3/8-16 tapped hole for connecting grounding strip
E – Door interlock (if used)
F – Arc chutes
G – Barriers
H – Lifting hole (one each side)
J – Insulation on back of contactor
K – Line terminal connection without bus bar "L"
L – Bus bar extension

Fig. 8. Dimensions of IC2814-E150 and -E151 high-voltage contactor

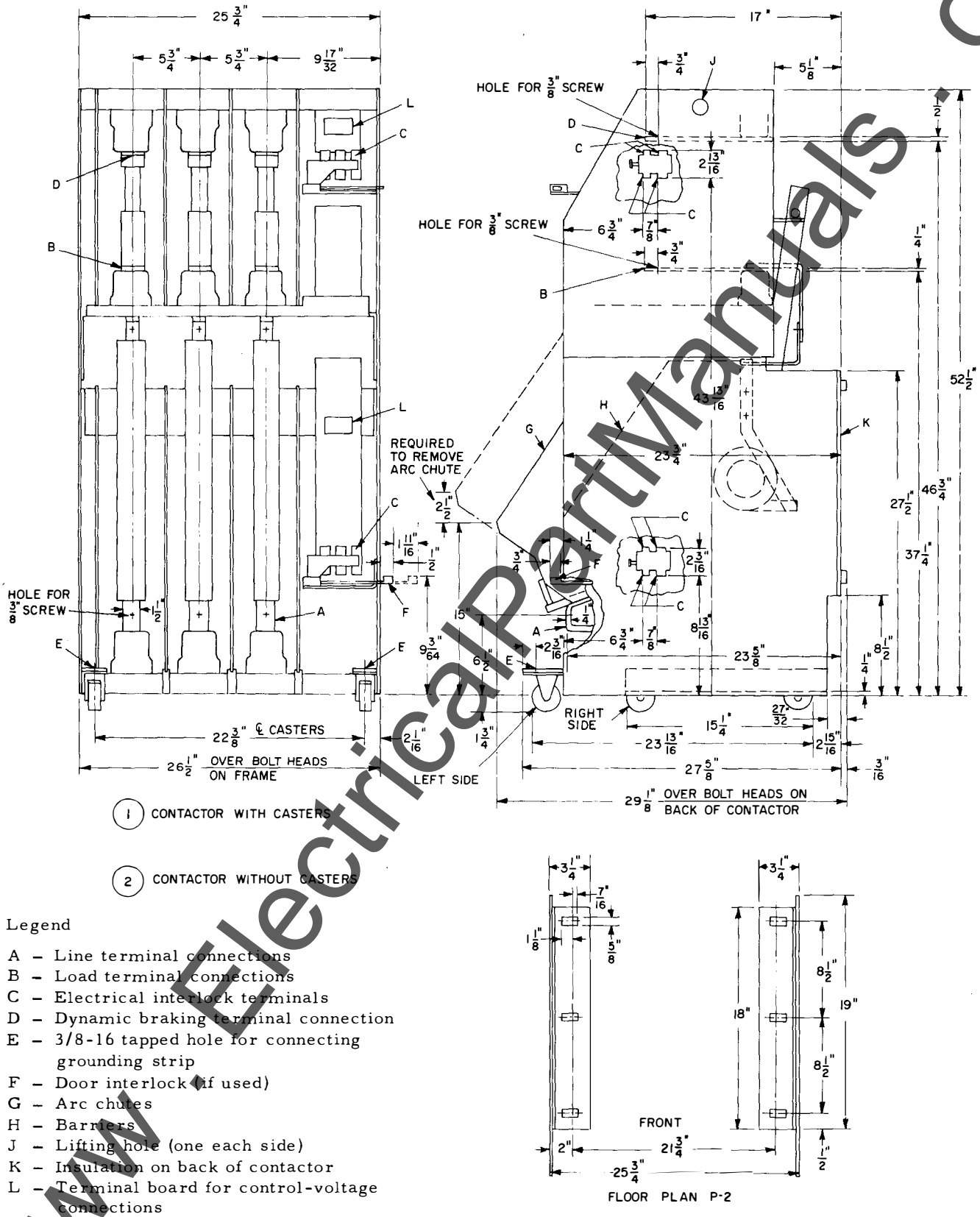


1. CONTACTOR WITH CASTERS AND BUS BAR EXTENSION "L"
2. CONTACTOR WITH CASTERS AND WITHOUT BUS BAR EXTENSION "L"
3. CONTACTOR WITHOUT CASTERS AND WITH BUS BAR EXTENSION "L"
4. CONTACTOR WITHOUT CASTERS AND BUS BAR EXTENSION "L"

Legend

A – Line terminal connections with bus bar "L"
B – Load terminal connections
C – Electrical interlock terminals
D – 3/8-16 tapped hole for connecting grounding strip
E – Door interlock (if used)
F – Arc chutes
G – Barriers
H – Lifting hole (one each side)
J – Insulation on back of contactor
K – Line terminal connection without bus bar "L"
L – Bus bar extension
M – Terminal board for control-voltage connections

Fig. 9. Dimensions of IC2814-F151 high-voltage contactor



Legend

- A – Line terminal connections
- B – Load terminal connections
- C – Electrical interlock terminals
- D – Dynamic braking terminal connection
- E – 3/8-16 tapped hole for connecting grounding strip
- F – Door interlock (if used)
- G – Arc chutes
- H – Barriers
- J – Lifting hole (one each side)
- K – Insulation on back of contactor
- L – Terminal board for control-voltage connections

Fig. 10. Dimensions of IC2814-X151 high-voltage contactor

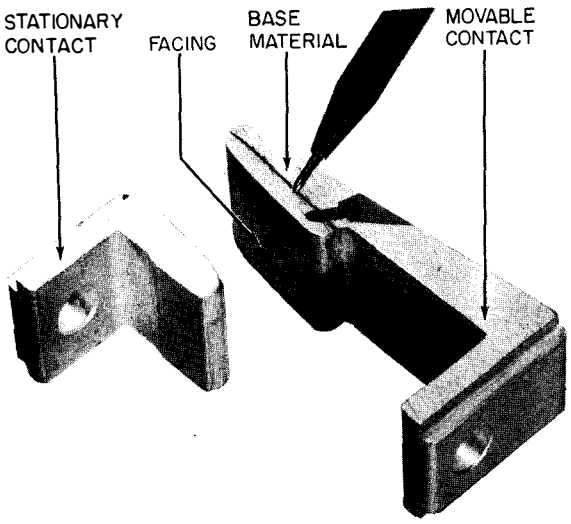


Fig. 11. Movable and stationary contacts

The blowout rating will determine the continuous rating of the contactor. Contactors cannot, therefore, be interchanged unless their nameplates have identical nameplate stampings. For example, a 100-ampere contactor cannot carry as much continuous current as a 400-ampere contactor, while a 400-ampere contactor does not have the same blowout and arc interrupting effect as a 100-ampere contactor. The 100-ampere blowout contactor is more effective on low-current loads such as magnetizing currents of transformers, etc.

OPERATING MAGNETS

These contactors are provided with magnets as listed in nomenclature description. The a-c magnets have continuously rated coils. The d-c magnets have intermittently rated coils with an economy resistor.

Control voltage for energizing the coils should be within 85 to 110 percent of the control voltage rating of a-c coils -- 80 to 110 percent of the control voltage rating of d-c coils.

Voltage less than the minimum will result in poor pickup and perhaps contact welding; voltage higher than the maximum will greatly decrease the coil life and, in the case of a-c magnets, pound the magnet severely if operated frequently. The pounding will result in misalignment, overheating, decreased contact life, etc.

Magnets and coils are designed for a 40 C ambient and coil life is greatly reduced if operated at much higher temperature. Special coils for higher voltages and temperatures can be supplied, if required.

ARC CHUTES

The arc chutes are usually shipped in their operating position on the contactors. When removing or reassembling the arc chutes, handle them carefully to prevent damage. See that there is no packing material or other foreign matter inside or around the chutes; and make certain that they are dry. Mount the chutes by easing them initially onto the upper and then over the lower arcing-horn extensions as far as they will go with the chute finally resting behind the arc-chute supports per Fig. 1. Observe the notice on the front of the chute, shown in Fig. 1 and 12. Figure 12 also shows the difference between properly and improperly seated chutes.

The weight of the arc chute itself holds the chute in place when correctly seated. The chute may be mounted with either end at the top. Seat the chute so that this top line (lower label only) rests flush with the top of the support pin or bracket. (See Fig. 12.)

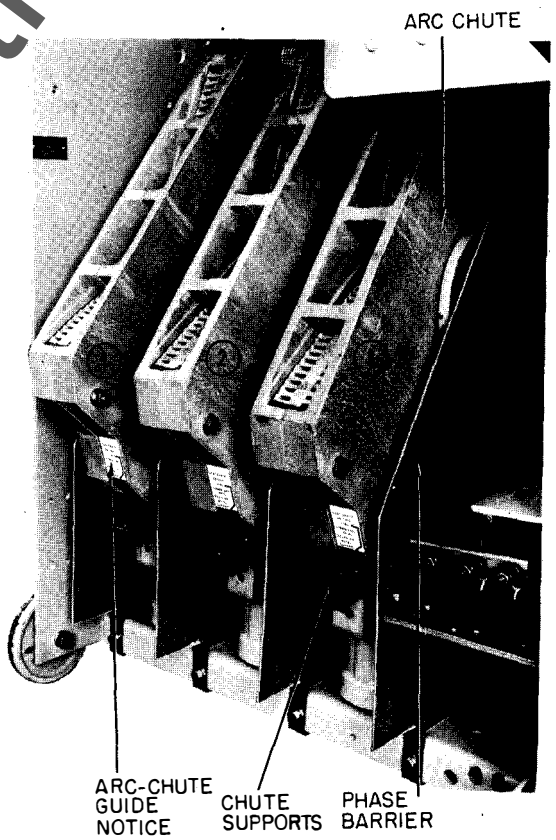


Fig. 12. View showing arc chutes 1 and 2 improperly seated with bottom of chute not pushed down into place on arcing horn and behind chute supports. View also shows arc chute 3 properly seated with the edges of the chute parallel with the phase barrier. Note the arc-chute guide notice

If the contactor is used in a humid atmosphere, or if moisture is present in its vicinity, space heaters are recommended to keep the arc chutes dry. Moisture limits the interruption ability of the arc chutes.

If the vanes inside the chute are broken, either the broken vanes or the entire chute should be replaced. Broken vanes will reduce the length of the arc between the tips and can interfere with proper interruption.

Arc chutes will have the vanes inside the chutes much closer to the contact tips at the center of the chute than at the ends of the chute. These chutes will have a 50,000-kva interrupting capacity.

These arc chutes can be used on similar contactors of the IC2812M13 and IC2812E100 variety which were built since the period 1949-1950. Chutes of these early contactors cannot be used on contactors listed in this instruction book.

ELECTRICAL INTERLOCKS

The electrical interlock (see Fig. 1) consists of three contact units, each with contacts for two circuits in various combinations of normally open and normally closed contacts. These contacts are mechanically connected to the main shaft of the contactor and move when the contactor operates. A bracket "B" (see Fig. 1) is provided above the electrical interlocks to protect them from mechanical damage. This bracket should be removed when inspection of electrical interlocks is required.

Adjustment of these interlocks is critical to the operation of the contactor. Figures 13A, 13B, and 13C should be followed in making this adjustment. Also, see Table 3.

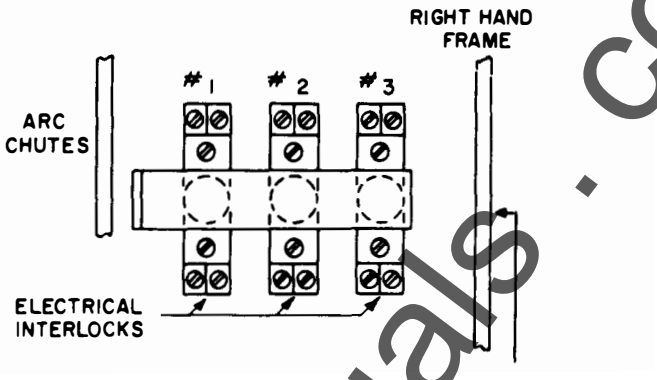


Fig. 13A. Electrical interlock arrangement viewed from front of contactor

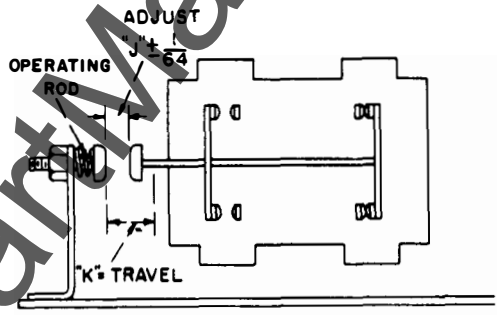


Fig. 13B. Electrical interlock with magnet energized

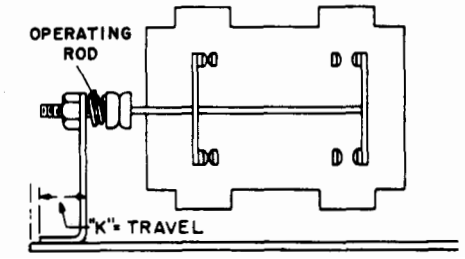


Fig. 13C. Electrical interlock with magnet deenergized

TABLE 3
ELECTRIC INTERLOCKS
(ADJUSTMENTS)

(Refer to Fig. 13A for Interlock No.)

	MAIN CONTACTS FULLY CLOSED MAGNET ENERGIZED			MAIN CONTACTS FULLY OPEN IC2814-X111 or -X151 MAGNET ENERGIZED		
	Dimension in inches Interlocks for N.O. Contacts			Dimension in inches Interlocks for N.C. Contacts		
Interlock No.	1	2	3	1	2	3
Dimension J ± 1/64	1/8	1/8	1/32	1/32	1/32	1/32
Travel "K"	17/32	17/32	17/32	13/32	13/32	13/32
N.O. Tip Wipe	1/16	1/16	1/16	1/16	1/16	1/16
N.C. Tip Gap	3/32	3/32	3/32	3/32	3/32	3/32

The electrical rating of the interlock is 10 amperes, continuous; 60 amperes, "make" current; with current interrupting values, as listed in Table 4. See Figs. 35A, 35B and 35C.

Interlock contacts should be applied in circuits consistent with the make, break, and interruption ratings of Table 4. Contacts applied outside of these ratings will have reduced life and may not operate satisfactorily. Check the adjustments of Table 3 (2814-X111 and -X151) with the magnet picked up electrically.

POWER AND CONTROL DISCONNECTS AND SHELF TONGUE

(Contactors with Stab Connections—See Table 1)

Power disconnects (see Fig. 2) are provided so that contactors so equipped can be removed or installed in enclosures without having to disconnect or connect cables. Flexible control-disconnect fingers (see Fig. 1) are also provided for the same purpose.

Figure 14 shows the location of the power stabs and fingers as well as the control-disconnect fingers with reference to the enclosure track or wheels of the contactor. These requirements with listed tolerances are necessary to allow any contactor to properly assemble into any enclosure.

TABLE 4

A-C INDUCTIVE RATINGS

Volts	Normally Open or Normally Closed One Interlock - Amperes	
	Normal	Inrush Δ
110	6	60
220	3	30
440	1.5	15
550-600	1.2	12

D-C INDUCTIVE (X) RATINGS

Volts	One Interlock Amperes	Two Interlocks in Series - Amperes
125	1.8	4.0
250	0.5	1.2
600	0.2	0.35

X Non-inductive d-c interrupting rating is 1.5 times inductive rating.

Δ Capable of interrupting inrush currents of this magnitude for a limited number of times.

No lubrication is required on any of these disconnects, but if desired, General Electric Contact Lubricant D50 H47 can be applied to the power-disconnect stabs. Do not apply this lubricant to the control-disconnect fingers.

The tongue for the fuse-disconnect shelf is located as shown in Fig. 14 so that the power fingers of the shelf will make proper contact with the power stabs on the enclosure. This guide also facilitates proper in and out operation of the fuse shelf.

Figure 14 shows the location of the top edge of the top control-disconnect finger 16 7/8 ± 1/32 in. from the track for the contactor wheels. The control-disconnect fingers are assembled to a molded block, each of which assembles four fingers. The top edges of the top finger of each block are 3.5 in. or multiples thereof apart.

FUSE-DISCONNECT SHELF

(Contactors with Stab Connections—See Table 1)

The fuse-disconnect shelf is provided to serve as an isolating switch and allow maintenance and inspection work on the contactor without removing it from the enclosure. A padlocking facility (see Fig. 15) is provided to positively lock the shelf in the "closed" or "open" position. (Fuses connected or disconnected respectively.) This is accomplished by not permitting the pushing in of the shelf operating handle (see Fig. 1). This pushing in of the handle is necessary before one can rotate the handle from "open" to "closed" position or vice versa.

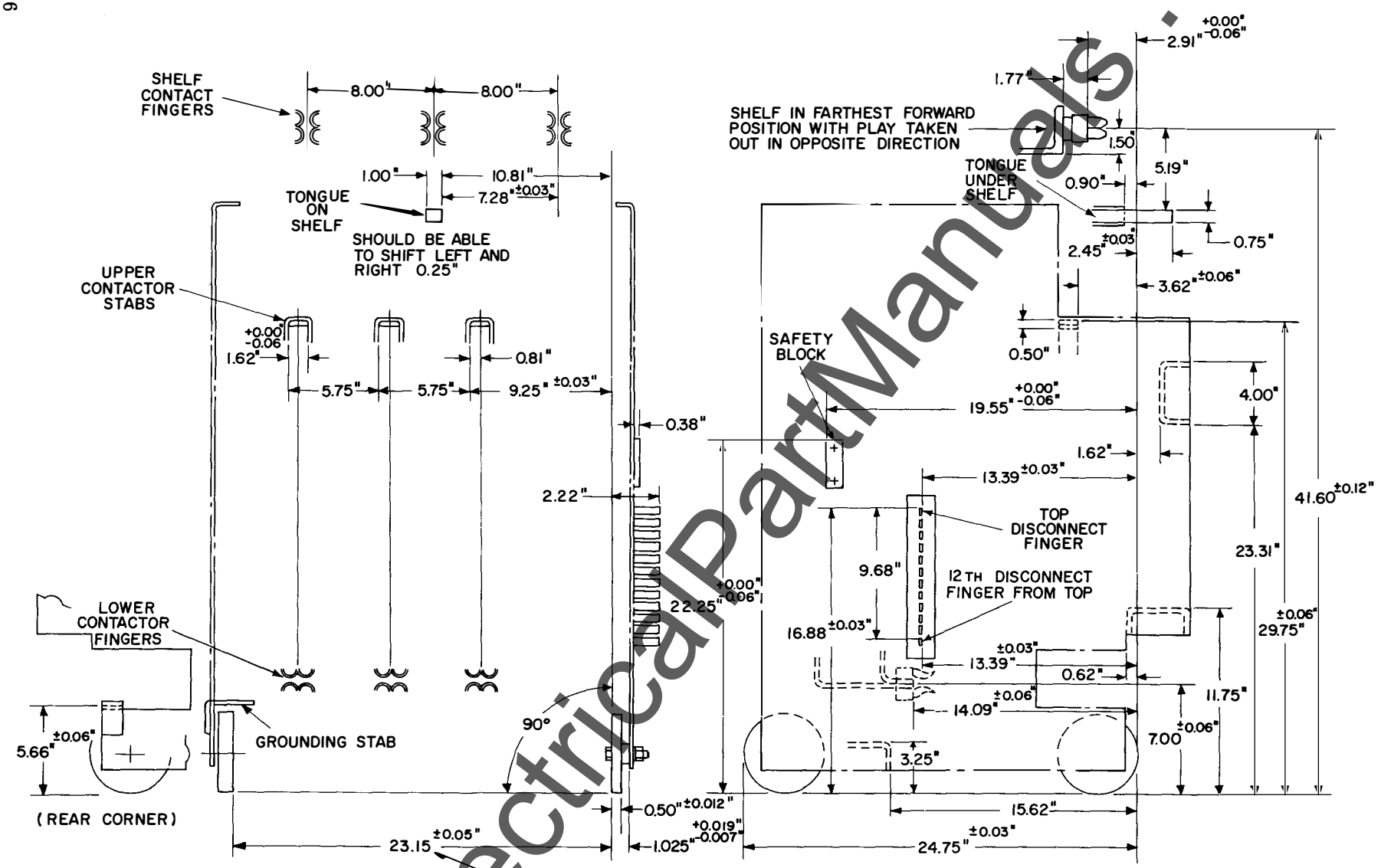
The fuse shelf disconnect should move freely on its rollers when the shelf operating handle is pushed and turned. Free action is necessary for positive connecting and disconnecting of the power fingers and will be present unless the contactor has suffered from extremely rough handling.

When the shelf operating handle (see Fig. 1) is in "open" position (shelf power fingers are disconnected) and shelf is retracted toward the back of the contactor to remove all slack in its mechanism and reduce the grounding finger flexing to a minimum, the grounding fingers are still flexed 7/64 to 9/64 in. Steel backing for the grounding finger can be bent to maintain this adjustment. See Fig. 16. The grounding fingers must also not be misaligned with the fuse mounting that contacts them (left to right) by more than 3/16 in.

When the shelf operating handle is pushed in and then turned clockwise to the "close" position, the shelf will advance toward the back of the contactor. With this handle in the "close" position, the shelf can be moved backward and forward approximately 1/8 in.

The shelf disconnects cannot make or break load power. They can break a maximum magnetizing current of the control transformer as follows:

25kva - 3Ø - 4,160-volt - 0.173-amp



NOTE: TOLERANCES REPRESENT VARIATIONS ALLOWED IN CONTACTOR AFTER ADJUSTMENT. DIMENSIONS HAVING NO TOLERANCES ARE REFERENCE DIMENSIONS.

NOTE: FOR 2-POLE DIIO THIS DIMENSION IS REDUCED TO 17.40" ±0.05" AND ONE PAIR OF STABS AND FINGERS ARE OMITTED.

Fig. 14. Outline of high-voltage contactor showing location of power stabs and control-disconnect fingers IC2814-E120, E-130, etc., contactors

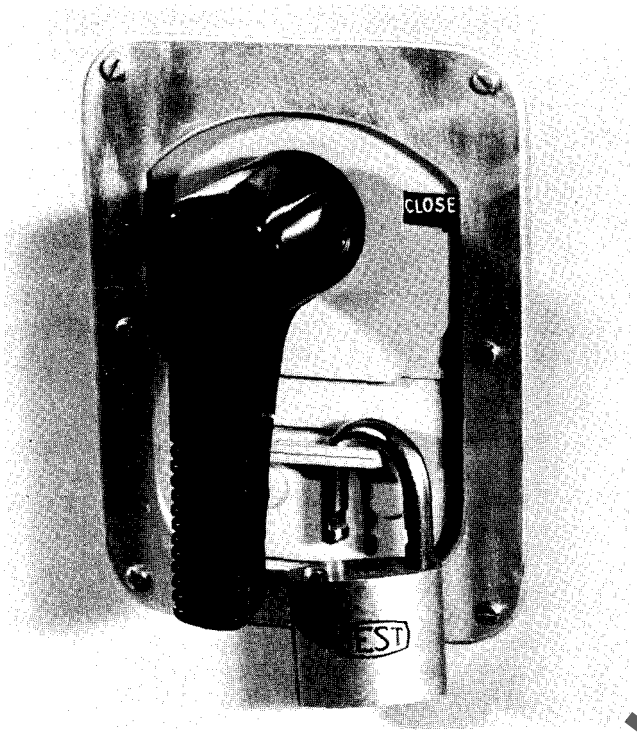


Fig. 15. Padlocking facility for locking the shelf in "closed" or "open" position

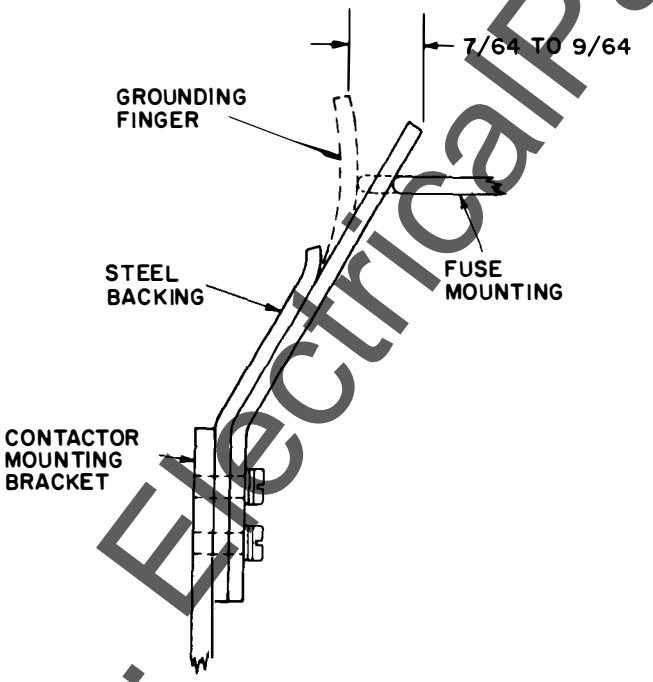
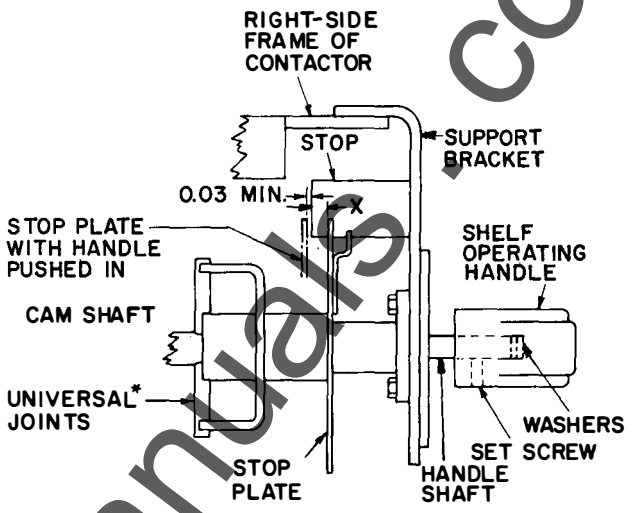


Fig. 16. Fuse-shelf grounding fingers

Models having double form letters use two concentric shafts instead of a universal joint.

When the shelf operating handle is fully pushed in for turning, the stop plate (see Fig. 17) clears its stop by 1/32 in. minimum and the cam should turn freely without binding. The shelf operating handle must also return from the action of its spring if its support bracket has been properly adjusted to align the cam and handle shafts. "X" must be 1/4 in. to 3/8 in. with the control-power interlock operator just touching the control-power interlock plunger (see Fig. 20).



*Later models use two concentric shafts in place of universal joint.

Fig. 17. Shelf operating handle location—top view

This adjustment is obtained by locating the shelf operating handle properly on its shaft, when the handle was located along the shaft with washers on end of the shaft inside the handle. It will be important to replace all the washers in reassembling the handle to the shaft at the proper position. Early handles were attached to their shafts with two setscrews – one assembled tightly on top of the first one to lock it in position. It is, therefore, very important that the first setscrew bearing on the shaft be tightened very securely. Later handles were attached with one long setscrew and washers inside the handle were not necessary.

Fuse clips of the shelf must also hold the fuses very securely. Fuses must just enter a fuse clip with a downward force of 20 pounds. This can be assured by maintaining the setting of the "U" clip of the fuse clips to 3 9/16 in. + 1/32 in. - 1/8 in. (see Fig. 18B and 18C).

When pushing the fuses down into the clips, keep fingers clear of the end of the fuse since the ejector bracket snaps upward and would pinch the fingers.

Fuses, shipped in place in the shelf, will be cord-tied in place at the ejector end. This also keeps the

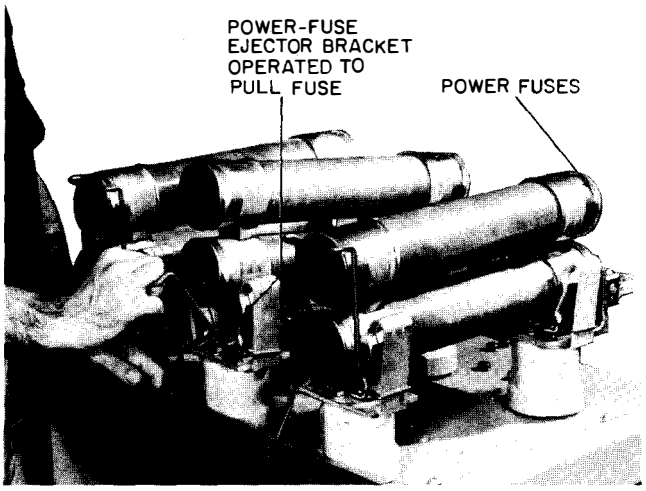


Fig. 18A. Power fuses—power-fuse ejector brackets

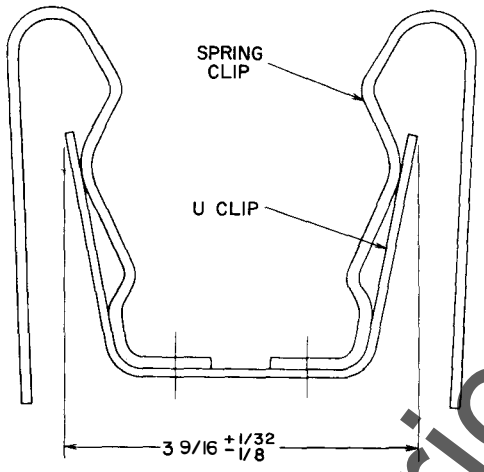


Fig. 18B. Fuse clip for fuse-disconnect shelf

ejector bracket from wearing against the underside of the fuse during shipment. Before operating, check the fuses to be sure that the fuse barrel has not been damaged by a loose ejector during shipment.

Fuse-ejector brackets (see Fig. 1 and 18A) are provided for easing the power fuses out of their brackets. This fuse pulling is accomplished by moving the fuse-puller bracket toward the front of the contactor as shown in Fig. 18A.

MECHANICAL AND ELECTRICAL INTERLOCKS AND "BRAIN BOX"

(Contactors with Stab Connections—See Table 1 and 2)

The contactor stop (see Fig. 1) on the right-hand side of contactor is provided so that, combining with the enclosure mechanical interlocks, the contactor cannot be rolled out if the shelf is in the "Close" position with its power fingers engaging the power stabs of the enclosure. This contactor stop combines with the enclosure mechanical interlocks to prevent the contactor and shelf from being pushed into the enclosure if the shelf is accidentally in the advanced or "Closed" position.

The "brain box" (see Fig. 2 and Fig. 19A) also mechanically interlocks the fuse shelf with the contactor to accomplish the following:

1. The fuse shelf cannot be moved from "Open" to "Closed" position or from "Closed" to "Open" position with the contactor picked up mechanically or electrically with its own magnet.

2. One reversing contactor is kept mechanically from picking up when the other is picked up. Any three contactors of the 3- or 5-pole varieties can also be interlocked with each other so that only one contactor can be picked up at a time or any two contactors can be picked up at the same time with the third contactor locked in open position.

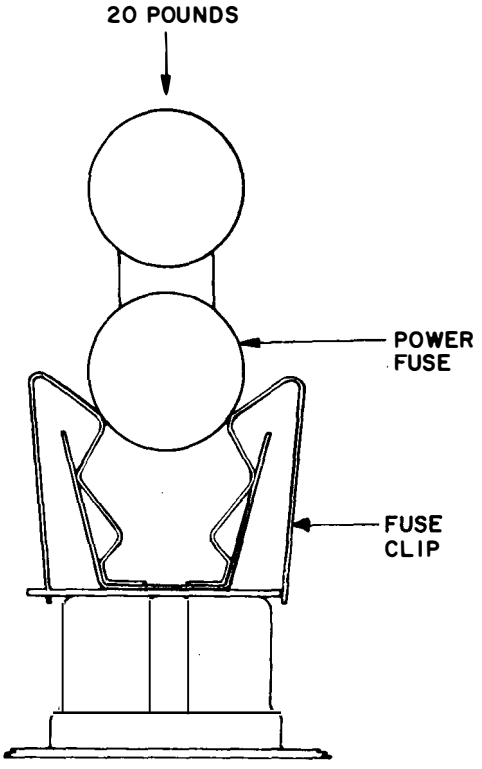


Fig. 18C. Force for inserting power fuses in fuse clips

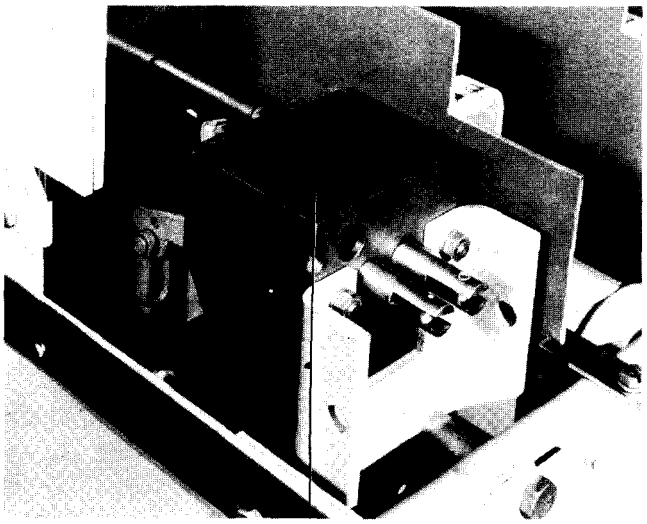


Fig. 19A. View of the "brain box"

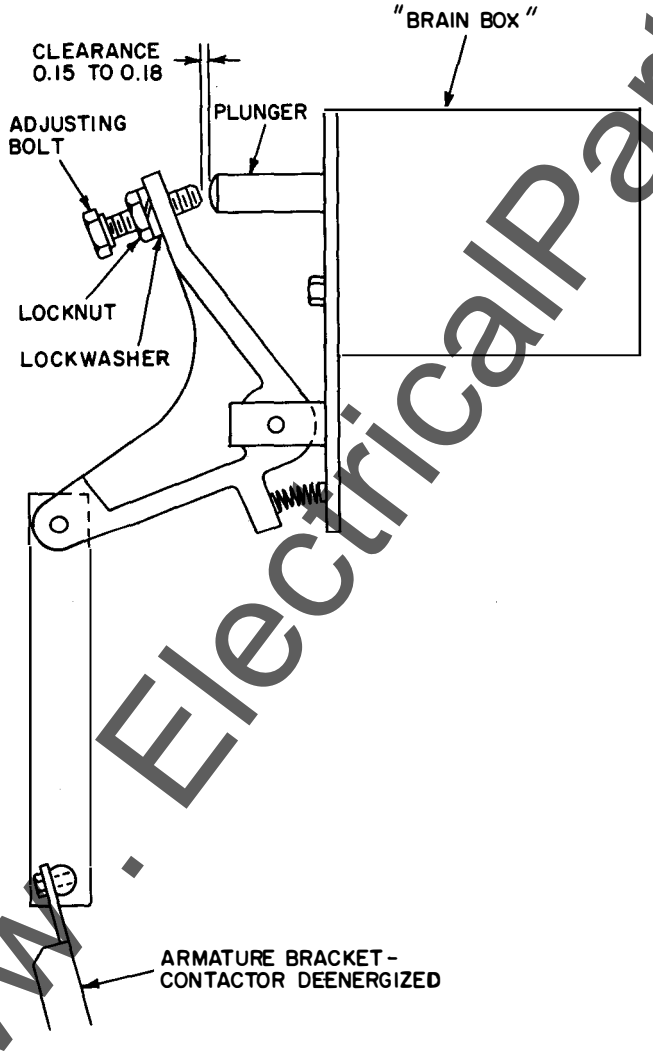
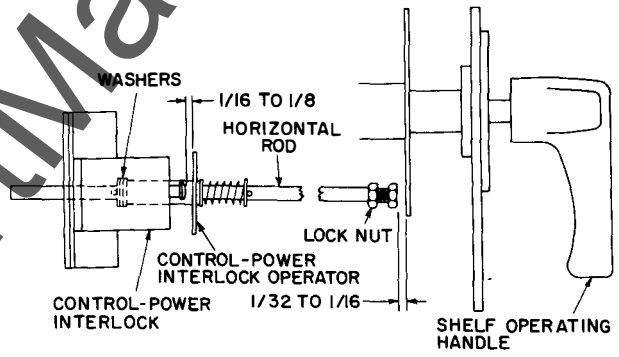


Fig. 19B. "Brain box" plus mechanical linkage

Different styles of the "brain box" are applied to offer the various special functions just mentioned. Since these operate with specific inter-contactor mechanical linkages, it is obvious that such contactors can only be interchanged between control panels which are functional duplicates, and then only in the particular panel section corresponding to that contactor function. Contactors interchanged should also have identical nameplate stamping.

3. The control-power interlock (see Fig. 20) which is operated each time the shelf operating handle is pushed in, opens the control power of the transformer secondary, when operated, so that the shelf disconnects break only the magnetizing current of the transformer.



Length of horizontal rod is adjusted and locked with lock nut so that the shelf operating handle has free travel of 1/32 to 1/16" as determined by plunger in "brain box". This adjustment is made with contactor armature fully picked up.

Fig. 20. Shelf operating handle adjustment

The adjusting bolt (see Fig. 19B) which operates the "brain box" is set and locked with a lock-nut to give a 0.15- to 0.18-in. gap between it and the "brain-box" plunger with the magnet armature fully dropped out against its backstop. When the magnet armature is fully picked up, the plunger in the "brain box" should have a minimum of 1/16 in. additional travel remaining. These adjustments assure that the magnet is free to move through its full stroke without binding. All adjustments can be accomplished with the adjusting bolt.

The control-power interlock operator (see Fig. 20) is located on this same horizontal rod with washers so that, with the magnet armature fully picked up, the clearance between the control-power interlock plunger and the dump-switch operator is 1/16 in. to 1/8 in. This adjustment allows positive operation of the dump switch, but does not allow the control-power interlock to be operated unnecessarily.

INSTALLATION

For convenience and safety in moving the contactor, use the lifting holes at the top of the steel side plates, and an equalizer bar or spreader for the cable sling. Lifting holes are located in the main side plates of the contactor below the fuse-disconnect shelf and toward the back of the contactor. See Fig. 5, 6, 7, 8, 9 and 10.

CAUTION: If the contactor is not installed in a metal enclosure, at least eight to ten feet of arcing clearance in front of the unit is advised for protection of personnel.

Observe the following precautions before applying power to the contactor for the first time.

1. Remove the shipping supports, blocks, or ties used for protecting the contactor in transit. Remove the arc chutes.

2. Carefully inspect all parts of the contactor. Operate it by hand to see that all parts work freely. Be sure that the contacts strike squarely with their sides in line within 1/32 in. Remove foreign objects or matter which may have collected in the magnet or tip gaps during transit or storage.

3. Remove any protective grease or oil which may be on the magnet face, as the grease could collect dust and dirt, thus causing a sticking of the magnet.

4. See that all parts of the contactor are clean. High-voltage equipment fails if too much dirt accumulates.

5. Check the arc chutes according to the "Arc Chute" sections of "Description" and "Maintenance" instructions before installing them on the contactor.

6. It is of the utmost importance that the arc chutes be in proper position on the contactor before applying power to the contactor, since the arc chutes are essential to confine and extinguish the arcs. Without the chutes, the arcs may cause serious damage. Refer to the section on "Arc Chutes" of "Description" instructions and to Fig. 12. Operate the contactor by hand again to see that all parts operate freely and that moving shaft parts do not rub on the arc chutes.

7. Operate the contactor electrically with the fuse-disconnect shelf in the open position. This is accomplished by connecting rated control power to the coil leads. The coil leads are connected to the third and fourth control disconnect fingers. See

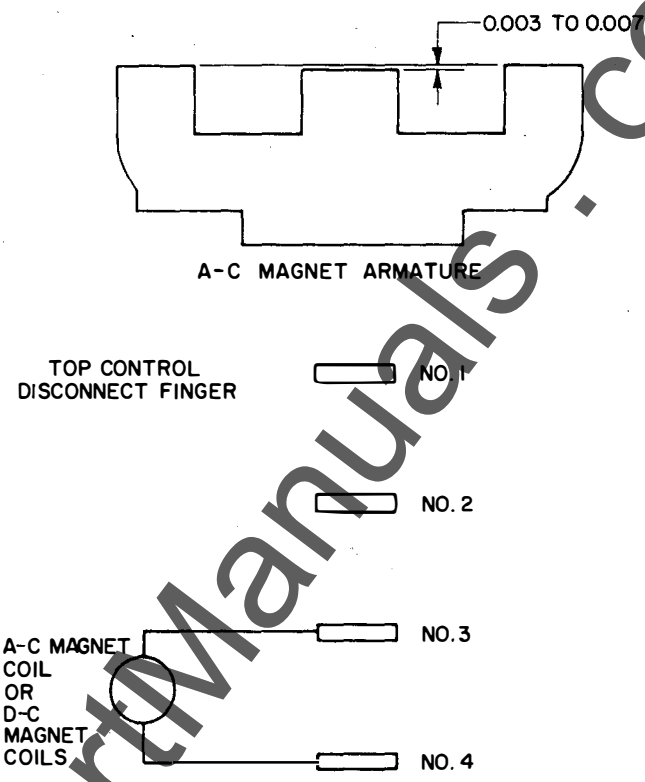


Fig. 21. Magnet-coil wiring to control-disconnect fingers

Fig. 21. The proper picking up of the contactor can thus be checked. At rated coil voltage it should pick up completely until the stationary and movable magnets hit and should be quiet. A-c magnets will have an a-c hum, but should not make an appreciable noise which would indicate magnet misalignment from rough handling. If noise is present, the magnets should be aligned according to the "Magnet Alignment" section of "Maintenance" instructions.

8. Check the fuse-disconnect shelf for free and positive operation. Adjustments according to the "Fuse Disconnect Shelf" section of "General" instructions should not have to be checked unless the contactor has received extremely rough handling.

9. Contactors without stab connections – Power cable connecting lugs must be rigidly maintained with adequate spacing between them for the voltages involved. If the spacings are inadequate, taping with proper material for the voltages involved must be applied.

MAINTENANCE

GENERAL

This electrical apparatus will provide maximum trouble-free service if given the benefit of preventive maintenance, inspection and periodic cleaning. It is important that a definite inspection schedule

be maintained. The frequency of the inspection periods will depend upon the operating conditions.

Contact life depends on the severity of service required for the device. The contactor should be thoroughly inspected after every 50,000 operations, or more often if operated very infrequently.

INSPECTIONS

In these routine inspections, check for the following per the reference instructions: (Reference instructions are in parenthesis and can be found in later pages of these instructions under the same heading.)

1. Loose screws, nuts and bolts.
2. Loose electrical interlocks – ("Electrical Interlocks")
3. Accumulation of dust and foreign material such as coal dust, cement dust or lamp black. This material must be periodically blown off the contactor if inspection shows an accumulation. The stand-off insulators must be wiped clean at regular intervals, as dust collects moisture and can cause a voltage breakdown. Dust accumulation on the arc chutes is detrimental for the same reason.
4. Contacts should be checked for general condition and replaced if necessary – ("When to Replace Contacts" and "Contact Alignment")
5. A-c Magnets (Item 1, 2, 3, 4, and 7 of "A-c Magnet Assembly" and "D-c Magnet Contactors")
6. Control disconnect finger alignment – ("Control disconnect fingers")
7. Grounding straps of fuse shelf and right side of contactor – ("Grounding Straps")
8. Loose bolted connections – hardware at connection points must be assembled securely at all times.
9. Contactors with self-aligning sleeve bearings for the main shaft should have the bearing collars set for 1/32-in. side play of main shaft. Collar set screws of all contactors must be located to align tips and magnets, then tightened securely.

If the contactor has been required to interrupt power above its rated interruption capacity, or has interrupted power without proper pertinent adjustments per these instructions, and/or the contactor has been operating for a year since the last thorough inspection, the following checks must be made:

1. Contact forces must be measured directly per Tables 5 and 6 and the springs replaced if the forces are not within limits. (Fig. 22 "Replacing Contact Springs")
2. Contacts should be inspected. ("When to replace contacts" and "Contact Alignment")

TABLE 5 ADJUSTMENTS
A-C AND D-C MAGNETS
(See Fig. 23)

Contactor IC2814 or IC2812	"A" dimension per Fig. 23 contacts fully open (inches)	"A" dimension (WIPE) per Fig. 23 Contacts just touching. *		New Contacts in open position Measurement "C" Fig. 22 (inches)	Contact Forces§	
		New Contacts (inches)	Replace when measurement "A" reaches (inches)		Initial Contacts open (pounds)	Final Contacts fully closed (pounds)
	2 5/32 ± 1/32	9/16 ± 1/16	9/32	7/8 min	9 to 11.5	12.5 to 16

* Measure per Section on "When to Replace Contacts."

§ Measure per Fig. 22 - 5/8-in. down from top of contacts. Initial force is the force in direction of arrow at "D" that will just start movable contact in motion. Final force is force in same direction at "D" that will just part contacts when contacts are fully closed. Force measurements will only be required if contact springs have been damaged physically or thermally.

One, two and three normally open poles with solid and laminated magnets (see Fig. 23).

TABLE 6 ADJUSTMENTS
D-C MAGNETS
(See Fig. 25)

Contactor IC2814 or IC2812	"B" dimension per Fig. 25 Contacts fully closed - X111 and X151 (N. C. poles) (inches)	"B" dimension per Fig. 25 Contacts fully open (inches)	"B" dimension (WIPE) per Fig. 25 Contacts just touching		New Contacts in open position measurement "C" (inches)	Contact Force	
			New Contacts (inches)	Replace when "B" reaches (inches)		Initial Contacts open (pounds)	Final Contacts fully closed (pounds)
§ (N. O. poles)		29/32 + 0.03 - 0.000	1/4 ± 1/32	1/8	7/8 min	9 to 11.5	12.5 to 16
-X111 and similar (N. C. poles)	11/16 ± 0.005		19/64 min	9/64	17/32 min*	9 to 11.5	13.5 ± 2

*Measure with magnet picked up with power.
§Contactors with magnets per Fig. 25.

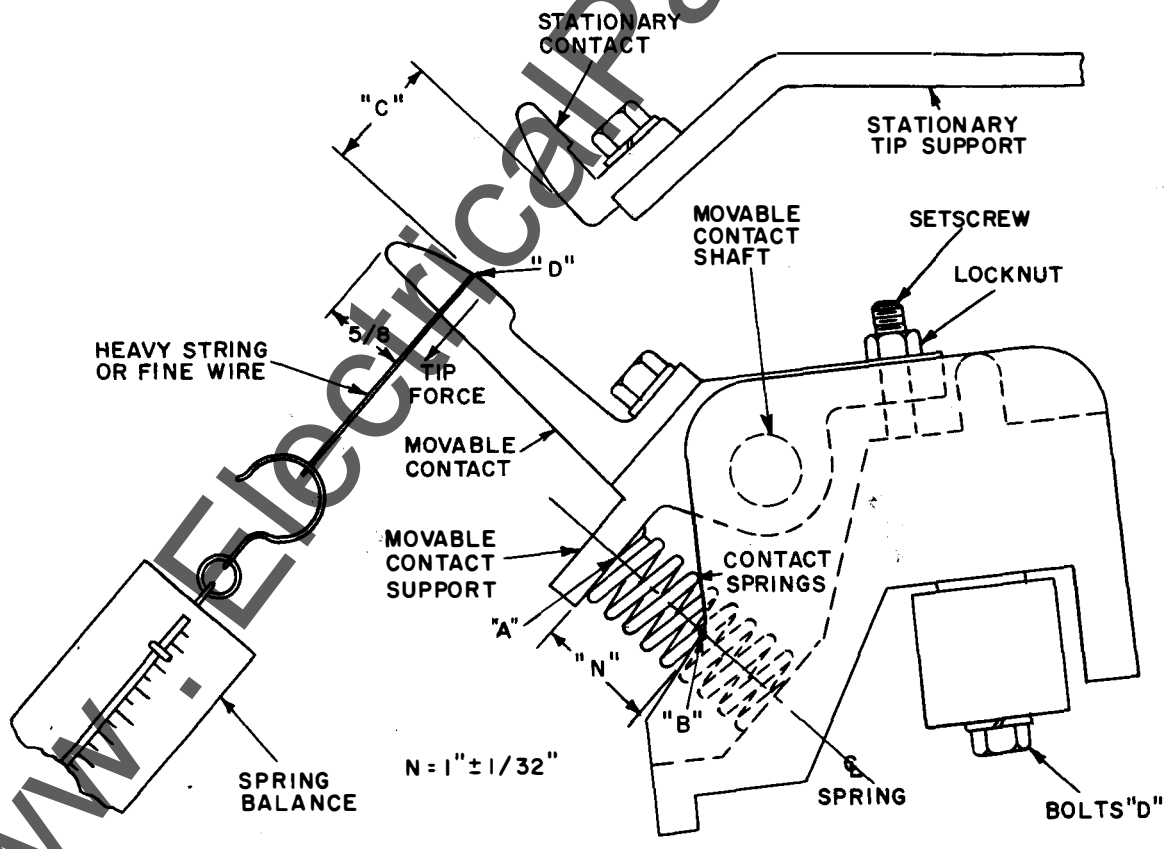


Fig. 22. Movable and stationary contact structure

3. Arcing-horn assemblies – ("Arcing horn assemblies and pole pieces on normally open poles")
4. Arc chutes – ("Arc Chutes")
5. D-c Magnets – ("D-c Magnet")
6. Electrical interlocks – ("Electrical Interlocks")
7. Power disconnects – ("Power Disconnects")
8. Fuse Clips – ("Fuse Clips")
9. Brain Box – ("Brain Box")
10. Shaft bearings (with grease fittings) – lubricate bearings once a year with a good grade of ball-bearing lubricant. Check for loosened ball-bearing screws at this same time. These setscrews keep the shaft positioned laterally and therefore maintain contacts in alignment. See Fig. 26. Bearings of later contactors do not require more lubricant during the life of the contactor. Sleeve bearings are lubricated for life of contactor.
11. Shelf adjustments – ("Fuse-disconnect Shelf")

WHEN TO REPLACE CONTACTS

The contacts will be pitted and show various shades of black after considerable usage. The pitted contact surfaces are characteristic of a-c applications and will not interfere with proper operation as long as proper contact pressures are maintained per Tables 5 and 6. If the contacts are wearing away with the contacts misaligned more than 1/16 in. the contacts should be replaced, as the misaligned condition can only get worse and accentuate the wear of the bearing hole in the bronze movable-contact support.

Outlined below is the proper method for determining when it is necessary to replace contacts:

1. See Fig. 22 and Fig. 23. With the contacts in the "kiss" (just touching) position, measure the magnet gap "A" per Fig. 23. If the gap is less than 9/32 in., replace both the movable and stationary contacts. Contacts not replaced at this time may overheat or weld together. Wedge the top of the armature away from its supporting bracket as far as it will go per Fig. 23, when measuring the "A" dimension. Use similar procedure for Fig. 25, and Table 6.
2. The contacts must also be replaced if misalignment as mentioned above exists.

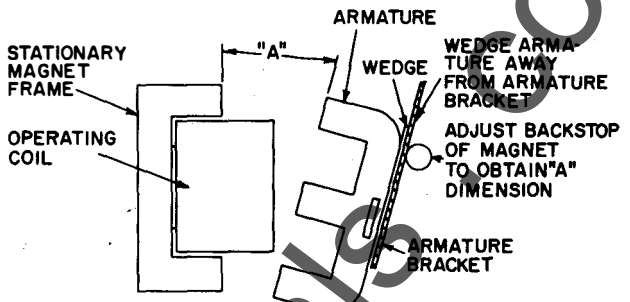


Fig. 23. A-c and d-c magnet structure

CONTACT ALIGNMENT

The contacts are adjusted to make at the same time within 1/64 in. When replacing the contacts, check this adjustment by picking up the contactor mechanically until the contacts of the first pole to touch are just touching each other. The maximum gap between the contacts of any other pole of a contactor must not exceed 1/64 in. Adjust the movable contact position to obtain this requirement as well as the wipe per Tables 5 and 6 by means of the setscrew in each movable tip support. The setscrews should be locked in their final position by means of their locknuts. (See Fig. 22.)

The angular position of one contact with reference to the other, when they first touch each other and with the contactor fully closed, is not critical as the special facing for each contact substantially assists the contacts in making, carrying, and interrupting electrical power. Their relative positions with reference to each other may also change considerably during the life of the contacts. Alignments per Fig. 24A and 24B, however, must be maintained to obtain maximum life of the contact facing material.

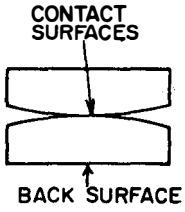


Fig. 24A. Contacts with their back surfaces parallel

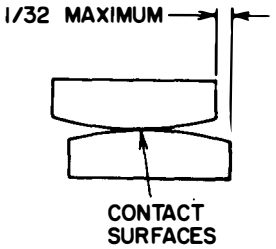


Fig. 24B. Maximum sidewise misalignment of contact surfaces

The angular positions of the contacts were properly set at the factory through accurate tooling of the parts and assembly. Side frames are precision tooled and can be used effectively in the field for complete reassembly. Shaft bearings must be centered over the holes in the side frames. The channel supporting the stationary contacts must be assembled centered over the holes in the side frames. Supports for the stationary contacts should then be assembled to align the contacts left to right and to obtain the above-mentioned requirements.

The contacts of a pole must also make with the back surfaces approximately parallel per Fig. 24A. The contacts must also be aligned from left to right within 1/32-in. maximum per Fig. 24B. These requirements must be met to increase the life of the contacts and movable-contact supports. These requirements will be present also with replacement contacts unless the alignment of the pole assembly has been disturbed. The movable- and stationary-contact supports can be moved slightly, if necessary, to obtain these requirements. The movable-contact support can be moved slightly with reference to the shaft by loosening bolts "D" and turning the shaft insulator and retightening bolts "D" (see Fig. 22).

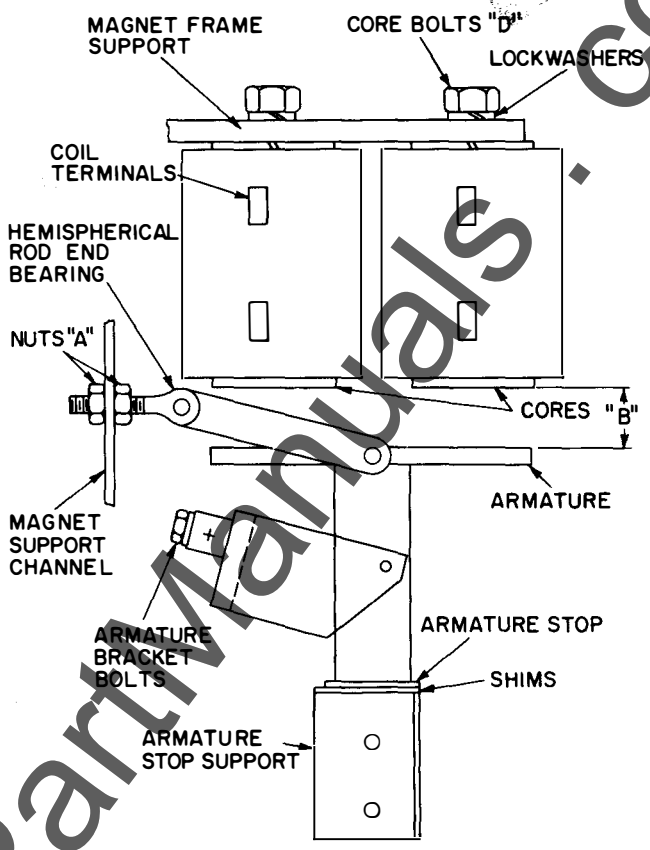


Fig. 25. D-c magnet structure (left side view)

MEASURING CONTACT FORCES AND CONTACT ADJUSTMENTS

One lower horn assembly can be removed at a time after removing the shunt and carefully recording the stab position left to right and front to back. The stand-off insulator should be removed along with the whole lower horn assembly. After the contact pressures of one set of contacts have been measured, the lower horn assembly should be again secured accurately and tightly in its exact previous position by again assembling the bolts from the support channel to the stand-off insulator. Other stab locations will assist in relocating the lower horn assembly at its previous position. The horn spacings with reference to the movable contact and upper horn must also be maintained per Fig. 29. Forces of other poles can be measured in the same manner.

Initial contact force will be maintained if the "N" dimension between "A" and "B" on the spring's centerline is 1 in. ± 1/32. Final forces will be maintained if the "A" dimensions of Table 5 are maintained. This "N" dimension applies to all d-c and a-c magnets. See Fig. 22.

The hardware for assembling the stationary tip support (see Fig. 22) to the stand-off insulators can be loosened and the assembly rotated, and then the hardware should be tightened securely.

Contact gap "C" (see Fig. 22) must be 7/8-in. minimum. The phase-barrier clip (see Fig. 1) can be used as a gage for "C" contact gap, as it is 7/8-in. wide. "C" dimension can be obtained by moving the back-stop slightly, if necessary – (magnets through the sliding backstop (see Fig. 23); d-c magnets through shimming the armature stop (see Fig. 25). When the A and B dimensions with the contacts fully open are set per Table 5 and Table 6 respectively, "C" contact gap should be available without further adjustment.

If the A and B dimensions are maintained with the contacts just touching (N.O. contacts), initial and final contact forces should be properly set without further adjustment. Similar "B" dimensions for the N.C. contacts of the IC2814-X111 set the contact gaps and pressures properly. These adjustments will set the contact forces properly unless the contactor's contact supports have been misaligned through rough handling. The initial and final contact forces or a contact spring compression of 3/16 in. between the initial and final positions of each spring must be maintained after final adjustments following rough handling.

REPLACING NORMALLY OPEN CONTACTS

In replacing the normally open contacts, work from the front of the contactor following the steps described below:

1. Remove the arc chute by lifting gently from the upper and lower arcing-horn extensions. Exercise care in handling the chutes so that they will not be damaged by tipping or accidental blows.

2. See Fig. 26. Using the socket wrench provided, remove the upper arcing horn along with its insulation backing. The socket of the wrench contains a permanent magnet for picking up the hardware after it has been completely loosened.

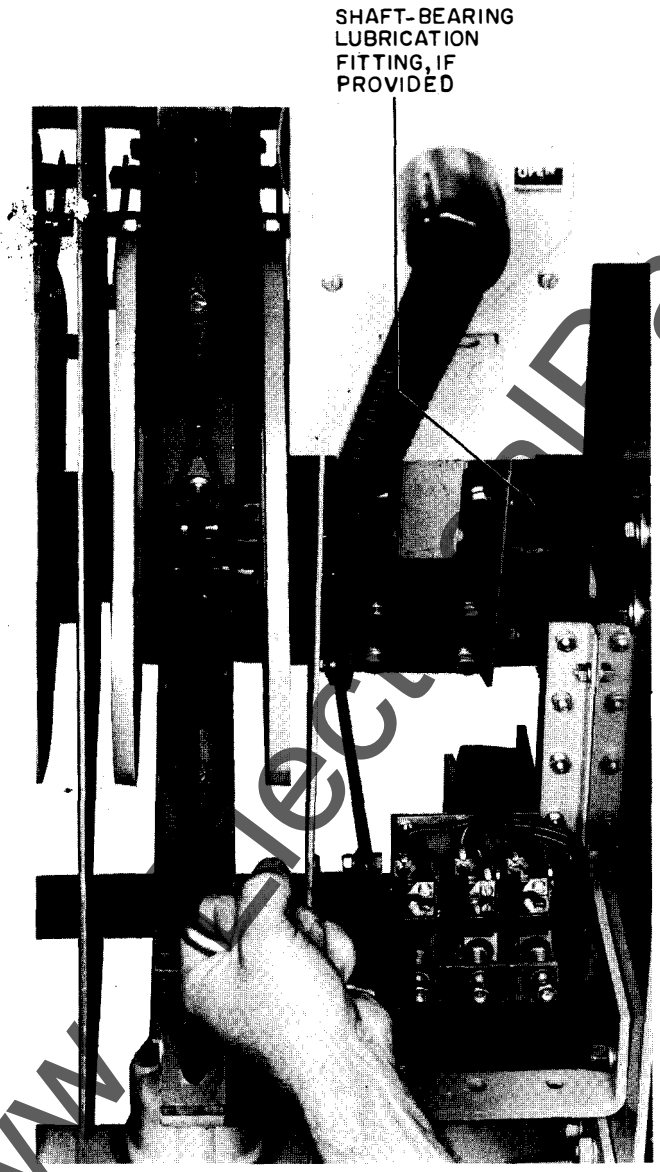


Fig. 26. Method of replacing contacts

3. The stationary contact can then be removed after removing its assembly hardware with the wrench mentioned in item 2 above.

4. The new stationary contact should then be placed in its proper position with its machined projection seated in the machined groove of its support. The arcing horn should then be reassembled maintaining its position per the section on "Arcing-horn assemblies and pole pieces on normally open poles".

5. The movable contacts can be removed with the same wrench without removing the lower arcing horn. The wrench can be inserted between the stationary and movable contacts for removing hardware for movable contacts. New movable contacts must be installed in the same manner as the new stationary contacts, as they also have similar machined projections in their bases.

6. It is recommended that both contacts of a pole be replaced at one time. If only one contact (movable or stationary) is replaced, the electrical current make and carry ability of the pair of contacts will be impaired.

REPLACING NORMALLY CLOSED CONTACTS

Contacts for the normally closed contacts of the IC2814-X111 contactor can be replaced by blocking its magnet (upper magnet) in the closed position and proceeding as outlined for "Replacing Normally Open Contacts". This operation is simplified, as the contacts do not have arc chutes or arcinghorns.

REPLACING CONTACT SPRINGS

(See Fig. 22)

The contact springs must be replaced if they have been overheated from interruptions above the contactor ratings or damaged from rough handling. Contactors having contact springs with a grayish-black color should have the contact pressures checked per Table 5 and 6 as they have probably been overheated. Any initial and final contact forces outside of those of Table 5 or 6 will require that the springs be replaced. These spring forces are necessary to allow the contactor to properly make, carry, and interrupt electric power.

To replace the contact springs, first remove the interphase barriers by removing the bolts in the front of the contactor and sliding the barrier forward. Reach under the lower arcing-horn assembly with a screw driver as shown in Fig. 27 and pry the spring forward, out of its lower seat.

Thread a length of heavy cord around the top of the spring and drop the cord down to the bottom. Pull

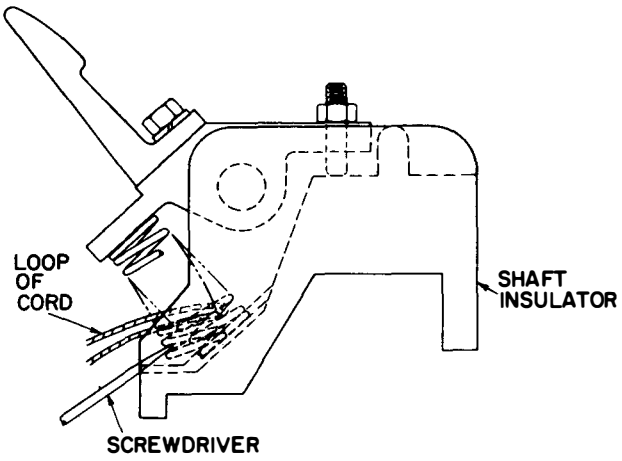


Fig. 27. Method of replacing contact spring

the spring out with the cord (refer to Fig. 27). To replace the spring, slide one end of the spring into the recess formed by the shaft insulator and the contact holder. Compress the spring with the thumbs and insert the spring in the top seat. The bottom then can be seated by prying with a screw driver. Replace the barriers.

ARCING-HORN ASSEMBLIES AND POLE PIECES ON NORMALLY OPEN POLES

(See Fig. 28 and 29)

Arcing-horn assemblies should never have to be replaced except for mechanical damage from rough handling. Spatter of arcing-horn material on its insulation strip should be removed after every 50,000 operations or more often if the contactor is frequently interrupting high currents. Spatter can be effectively removed from insulation material with a chisel.

The clearance between the arcing-horn insulation strip and the pole pieces should be balanced to provide room for inserting the arc chute. "X" dimension of Fig. 28 should be 1/2-in. minimum. "Y" dimension should be 3 1/16 ± 1/8 in. These dimensions will allow the arc chute to be moved into position without forcing. Adjustments will not be necessary in replacing the arcing-horn assemblies unless the pole pieces are changed in position.

The arc chutes can be properly assembled and the contactor can be assisted in proper operation by maintaining the arcing horn spacings with reference to each other and the contacts per Fig. 29. These adjustments will be maintained even when the arcing horn assemblies are replaced unless the main structural members of the contactor are disturbed in position from extremely rough handling or major disassembly and reassembly operations. Spacings between the arcing horns must be maintained per Fig. 29 to allow proper assembly of the arc chute and proper interruption of electrical current. The spacings between the horns and contacts per Fig. 29 are also necessary to assure proper physical operation (keep the movable contact from catching on the lower arc horn) and proper electrical functioning of the contactor.

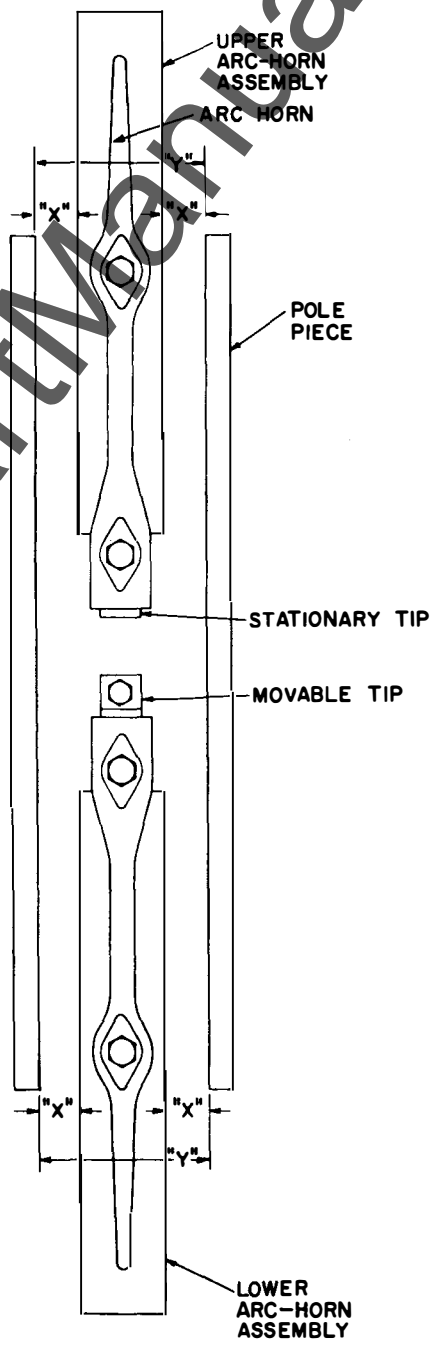
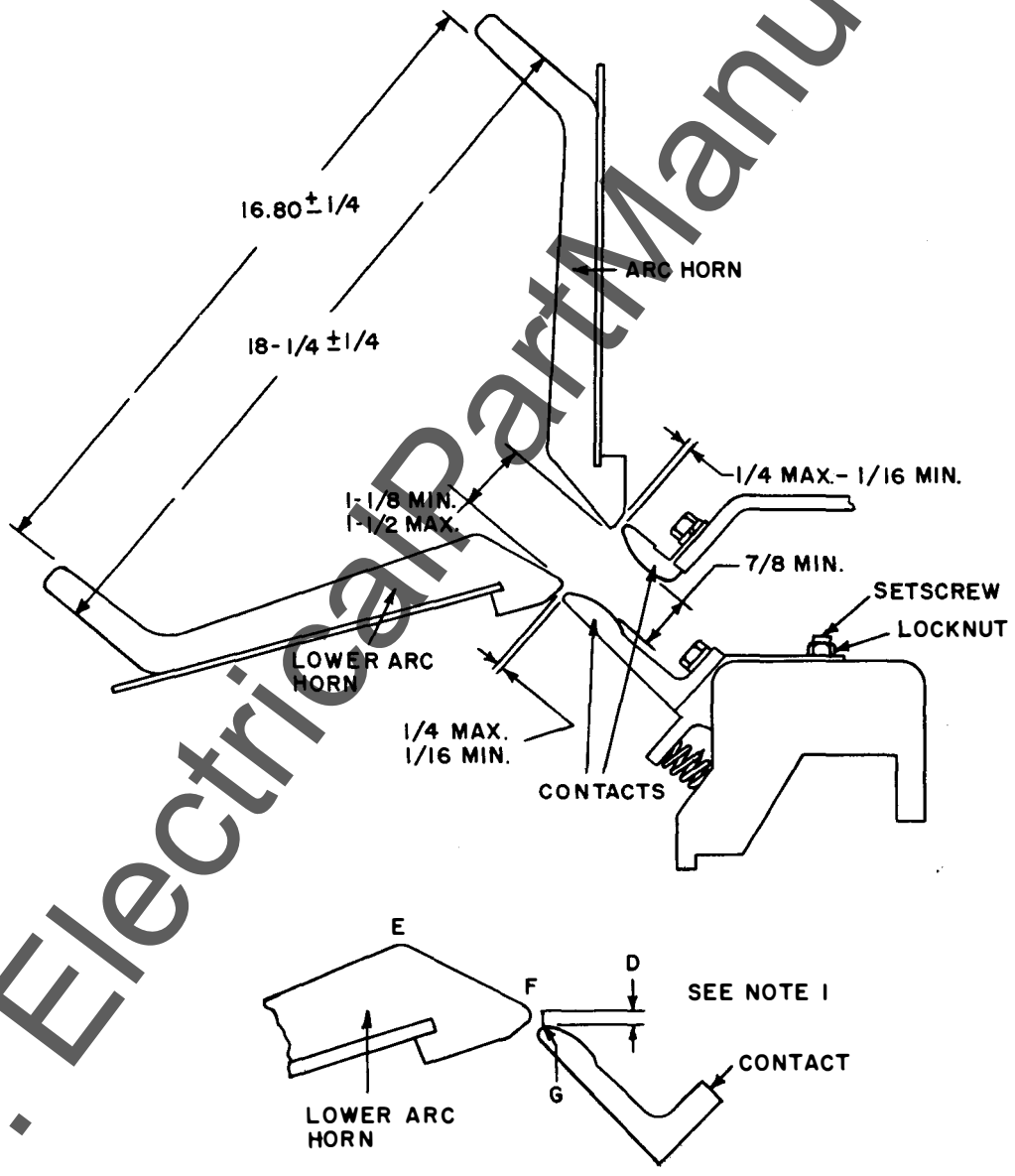


Fig. 28. Arcing-horn and pole-piece assembly

Any spatter on the ends of the arc horns near the contacts must be removed to maintain the 1/16-in. minimum spacing between the contacts and arc horns. A chisel or file is a satisfactory tool for this cleaning operation. Salient points formed on the arc-horn ends near the contacts are also objectionable from the standpoint of allowing electrical charge build-ups which can cause objectionable voltage breakdowns across the horns and should be removed.

ARC-CHUTE ASSEMBLY

The contactor should be checked periodically to be sure that all personnel, in reassembling arc chutes, have maintained their position per "Arc chutes" section of "General" instructions. Arc chutes should also be inspected periodically in accordance with this same section.



NOTE 1. VERTICAL CLEARANCE (D) OF HIGHEST POINT (G) OF MOVABLE TIP BELOW PLANE (E-F) OF LOWER ARCING HORN SHOULD BE 1/16 TO 1/4 IN.

Fig. 29. Arcing-horn and contact assembly

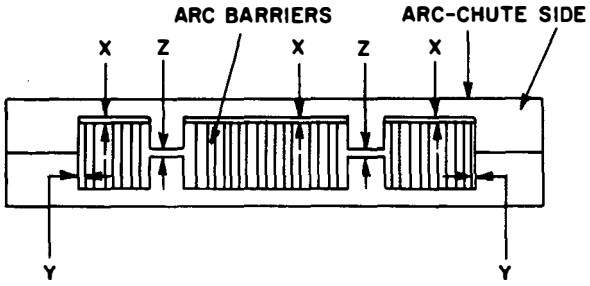


Fig. 30A. Arc-chute assembly

After the contactor has been required to interrupt power above its rated interruption capacity, or has interrupted power without proper pertinent adjustments in accordance with these instructions, the following checks must be made:

1. The arc barriers or vanes inside the arc chutes must be checked for excessive gutting from the arcing at the "V" notches. Excessively gutted vanes must be replaced. Those having enlargements 1/4-in. or greater, must be replaced.

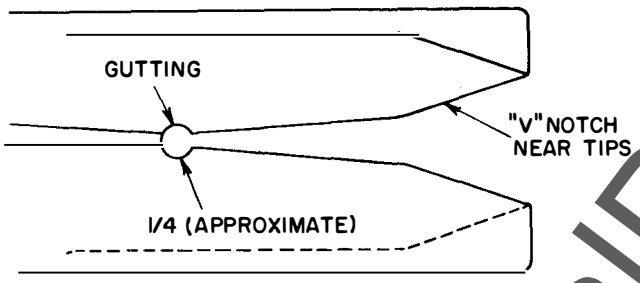


Fig. 30B. Arc barrier with excessive gutting at "V" notch

2. The vanes should be checked for continuous beads resulting from the gutting which makes a continuous path across more than a few vanes (5) of the arc chute. (See Fig. 30C.) These beads offer a current-conducting path which reduces the length of the interrupting arc. Any vanes with the continuous bead between them must be replaced.

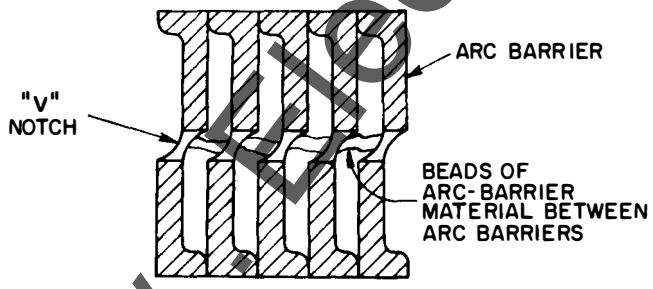


Fig. 30C. Arc barriers with connecting beads

Vanes inside the arc chute have been given special treatment to allow the proper interruption of all power within its ratings. These vanes will, therefore, vary considerably in over-all width. The first six vanes assembled near the bolted sides of the arc chute must sometimes, therefore, be selected so that the bolting together of the arc chute will not crush the end vanes. This condition is a rare occurrence. Vanes other than these six vanes on either side of the arc chute can be assembled at random. A thick fiber spacer which looks like an arc barrier must be assembled on each end of the arc chute before the remainder of the inside of the arc chute is filled with regular arc barriers as shown in Fig. 30A.

Spacings "(Z)" between the arc chute sides (see Fig. 30A) must not exceed 1/16 in. Side play of the arc barriers must not exceed "X" dimension of 1/32 in. for more than four adjacent arc barriers. Clearance at "Y" must also not exceed 1/32 in. These dimensions will be held on arc-chute assemblies shipped from the factory, but can be exceeded if the contactor interrupts current above the limits or without proper adjustments. "Z" and "X" dimensions outside the requirements can only be corrected with new arc-chute sides and/or new arc barriers or by replacing the complete chutes. "Y" dimension can be maintained by adding fiber spacers as mentioned above. If the limits of these dimensions are exceeded, hot gases at high power interruptions will bypass the arc barriers and limit the arc extinguishing ability.

A-C LAMINATED MAGNET ASSEMBLY

1. The top and side surfaces of the armature and stationary-magnet (see Fig. 32) frame must be aligned within 1/32 in. More misalignment will allow the magnets to wear unevenly and must be corrected to give the proper alignment if quiet operation is to be achieved. If the magnet contact surfaces are worn and misaligned more than 1/16 in. and the magnet is noisy, both the armature and stationary-magnet frame must be replaced. Magnets operating with excessive noise will reduce the life of their operating coils because the picked-up magnet will eventually draw excessive magnetizing current.

2. The contact faces of the armature and magnet frame (see Fig. 31) must seat flush against each other without any rolling action or the magnet will be noisy in operation. Magnet shims between the magnet channel and contactor frame at "T" or "B" (see Fig. 2) can be changed to obtain proper seating of the magnets. Usually a noisy magnet can be made to operate quietly by not shimming equally at left and right at "T". This unequal shimming removes any twisting of the magnet channel in assembly. Shims at "S" at the top or bottom of the magnet frame between the magnet frame and magnet channel (see Fig. 31) can be varied as a last resort to obtain proper magnet seating.

3. The armature in picked-up position must have a minimum of 1/64-in. spacing between it and its

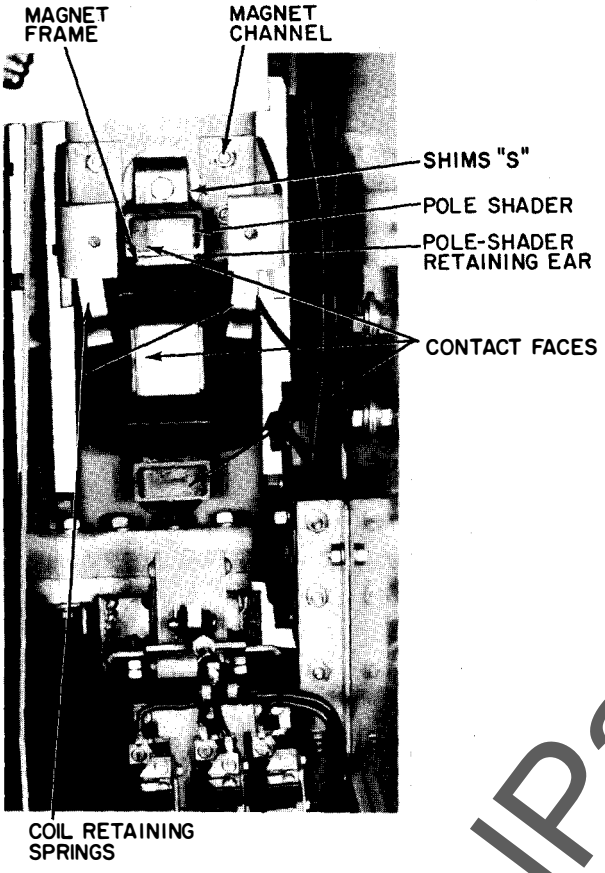


Fig. 31. A-c magnet assembly

armature bracket. (See Fig. 32.) The fulcrum plate must always be assembled with its emboss toward its armature bracket per Fig. 32.

4. The armature bracket must be assembled to its shaft supporting bracket in such a manner that the armature has a vertical end play in its armature support of 1/32-in. minimum. (See Fig. 32.) The armature width is such that side play of 1/32 in. exists. This freedom of the armature in all directions is necessary to allow it to seat properly against the magnet frame. The armature bracket legs "L" must be assembled toward the armature and straddling the shaft supporting bracket per Fig. 32.

5. The pole shaders must be assembled tightly to the magnet frame so that the pole-shader retaining ears and the pole shader itself are appreciably below the machined faces making contact with the armature. Bend the pole-shader retaining ears down over the pole shader to hold it tightly and keep it from rattling. The machined faces of the armature and magnet frame must be free of all foreign material including grease. (See Fig. 31.) The curved pole shaders must be snapped into position on the magnet frames without retaining ears and with an extra notch at top and bottom of the magnets. Do not use any tool that will nick or change the shape of the pole shader. It must not be squeezed to tighten it in the magnet slots. In its end position it must not have enough freedom to rise above the machined faces of the magnet.

6. All three contact faces (see Fig. 31) of the magnet frame are machined in the same plane. The outside contact faces of the armature are machined in the same plane. All of these contact faces are machined very accurately with a good finish to allow satisfactory operation. The armature's middle leg is machined 0.003 to 0.007 in. below the plane of the outside leg. This machining was done to give magnet life without magnet operating noise. (See Fig. 21.)

7. Both magnets should be replaced when the armature legs are worn so that the center leg hits on the center leg of the magnet frame. Both magnets which are worn at all with the misalignment present of item 1 must also be replaced, as magnets when realigned will have some rolling action present and will be very noisy.

8. Check to see if one side of the top and bottom of the movable magnet armature is worn more than the other side. This shows that it doesn't have correct clearances per Item 3 and 4 and must be readjusted.

9. Check to be sure that the armature doesn't hit on the coil and that the coil leads and retaining springs haven't been left in the way so that armature hits them when it closes.

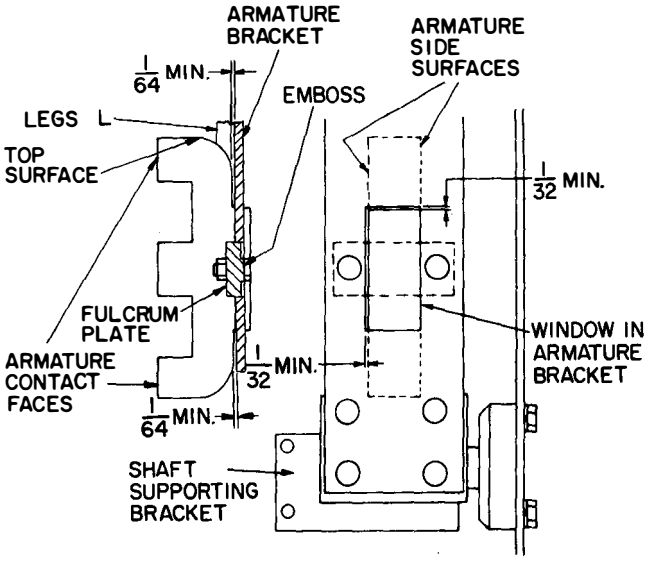


Fig. 32. A-c magnet assembly shown with contactor closed

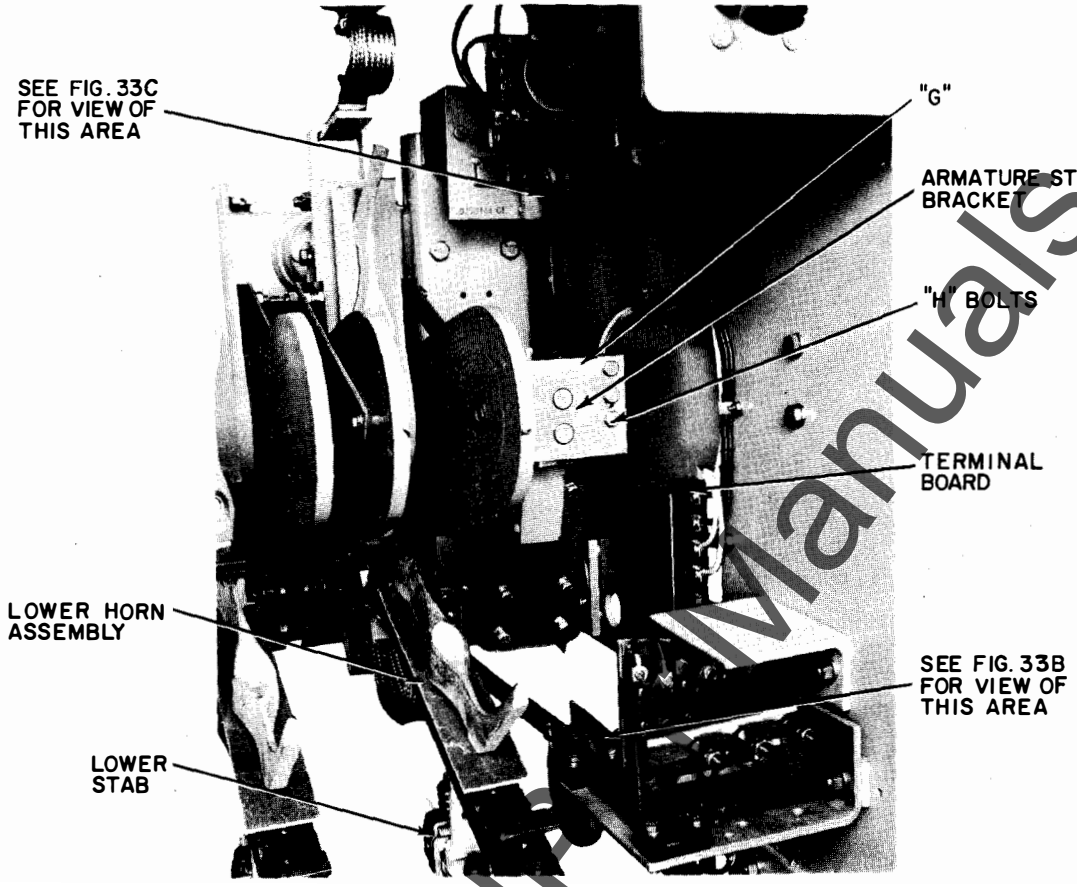


Fig. 33A. IC2814-E120 high-voltage contactor with arc-chute removed

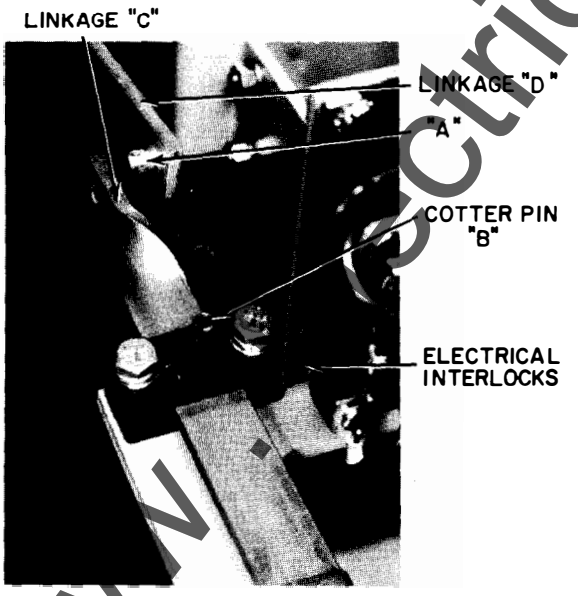


Fig. 33B. See Fig. 33A. for location of this closeup view

REPLACING MAGNET COILS (See Fig. 23)

In replacing these coils, refer to Figs. 33A, -B, and -C and follow the steps outlined below:

1. Remove cotter pin "B" in the pin at "A" of Fig. 33B and 33A with a screwdriver or similar tool; remove the pin from linkage "C" by prying linkage "D" and linkage "C" apart to allow linkage "D" to drop down out of the way.

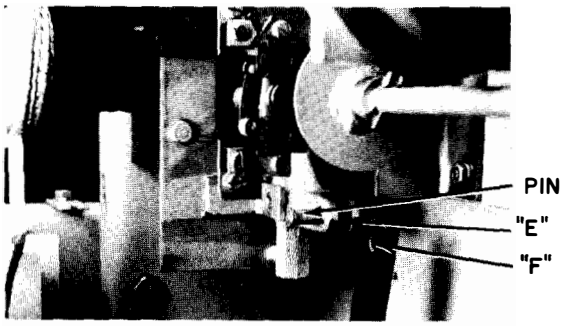


Fig. 33C. See Fig. 33A. for location of this closeup view

2. Remove the cotter pin and the pin at "E" of Fig. 33C and allow the linkage "F" to be rotated down against the armature stop bracket at "G" of Fig. 33A.

3. Remove the armature stop bracket by removing the six bolts "H" per Fig. 33A with the wrench provided with the contactors and ease the armature assembly down until it is supported only by the movable tip shunts.

4. Loosen the hardware for the two coil retaining springs with the contactor wrench (except on early contactors) and rotate them up out of the way of the operating coil. (See Fig. 31.)

5. Remove the coil leads from the terminal board (see Fig. 33A) and let them hang free.

6. Remove the coil, threading the leads by the brackets supporting the coil retaining springs and through the wire clamps.

7. Replace the coil being sure to connect the leads to the terminal board in the same positions as the first coil was connected. (See Fig. 21.)

8. Return the coil retaining springs to their former positions being careful to keep them well away from the hole in the coil. The coil can be assembled either side up as long as the leads are toward terminal board. (See Fig. 33A.) This assembly keeps the leads off mating surfaces of the armature and magnet frame.

9. Reassemble the armature stop bracket with bolts "H" high on the armature stop assembly, taking care to keep linkage "F" in such a position that it can be reassembled to the pin at "E".

10. Reassemble linkage "D" to linkage "C" and linkage "F" to the "brain-box" assembly.

11. All the hardware removed in the above operations should be tightened securely.

12. The movable contact shunts must again assume their approximate original shape with the shunts extending straight from their terminals without sharp bends at edge of their terminals.

D-C MAGNET ASSEMBLY (See Fig. 25)
(Magnets for Normally Open Contacts)

The armature of the d-c magnet must be aligned so that it will touch both cores. (See Fig. 25.) The armature can have a maximum clearance at other points with cores of 1/64 in.

Alignment with the cores parallel to the shaft can be obtained by loosening the armature bracket bolts which assemble the armature assembly to the shaft, shifting the armature and then reassembling the bolts to full tightness. Alignment from front to back can be obtained by adjusting the bolt of the hemispherical-rod end bearing that attaches the armature through a linkage to the magnet-support channel. The nuts "A" of Fig. 25 assembling this adjusting means should be thoroughly tightened to lock the adjustment in its final position.

Alignment of the d-c magnet as mentioned above is necessary to give an appreciable spread between the pick-up and drop-out voltages of the contactor. This is necessary to prevent the contactors from dropping out from slight dips in control voltage. Realignment of the magnet will only be necessary if the contactor was mishandled or dropped.

The helper springs shown in Fig. 34C were included only on a few early contactors. These springs have since been removed, since the help of these springs is not required. These springs are adjusted to give 63-percent pickup with cold coils but should not be so strong that the contactor rebounds on dropping out.

Coarse alignment of the magnet can be obtained by leaving the armature-stop and magnet-frame support bolts loose and rotating the shaft to close the armature completely. The magnet frame will then rotate slightly and align itself with the armature. The loosened bolts should then be tightened securely. The armature-stop and magnet-frame support shims can be varied to obtain the "C" and "B" dimensional requirements of Table 6 of "Maintenance" instructions.

REPLACING D-C COILS (See Fig. 25)
(D-C Magnet Assembly)

The coils of these contactors can be replaced by the following procedure:

1. For easier replacement, remove the phase-barrier clip (see Fig. 34A) and remove the barrier closest to the magnet.

2. Referring to Fig. 34A, disconnect the control wiring and jumpers from the coil terminals after marking the wires so that they can be connected to the same terminals of the new coil.

3. Disassemble the core bolts "D" completely from the coil cores, being careful to allow the coil assemblies to settle gently down on the magnet armature (see Fig. 34C).

4. The core assembly, including the coil, can then be removed. The Kantlink lockwasher should be saved for the new coil (see Fig. 34D).

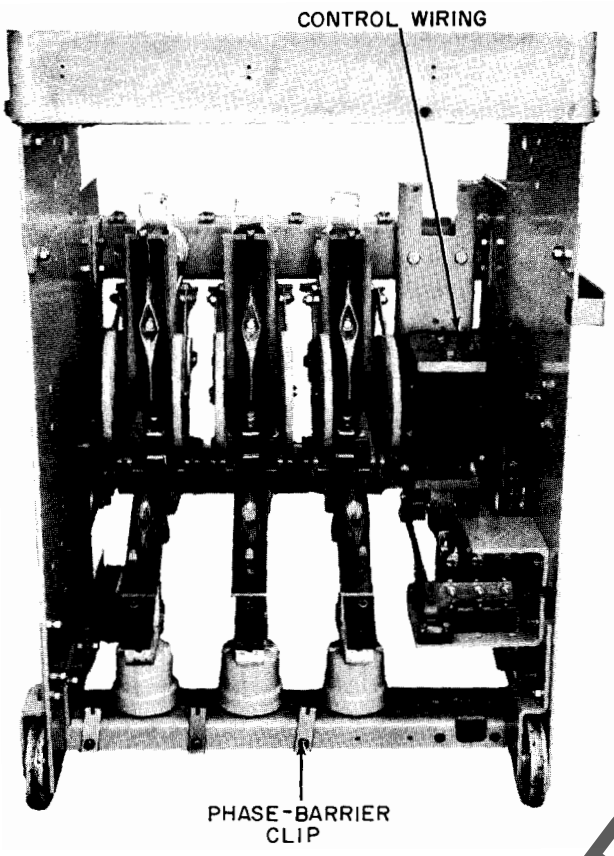


Fig. 34A. IC2814-E111 high-voltage contactor with d-c operating magnet. See Fig. 34B, C, D, E and F for closeup views

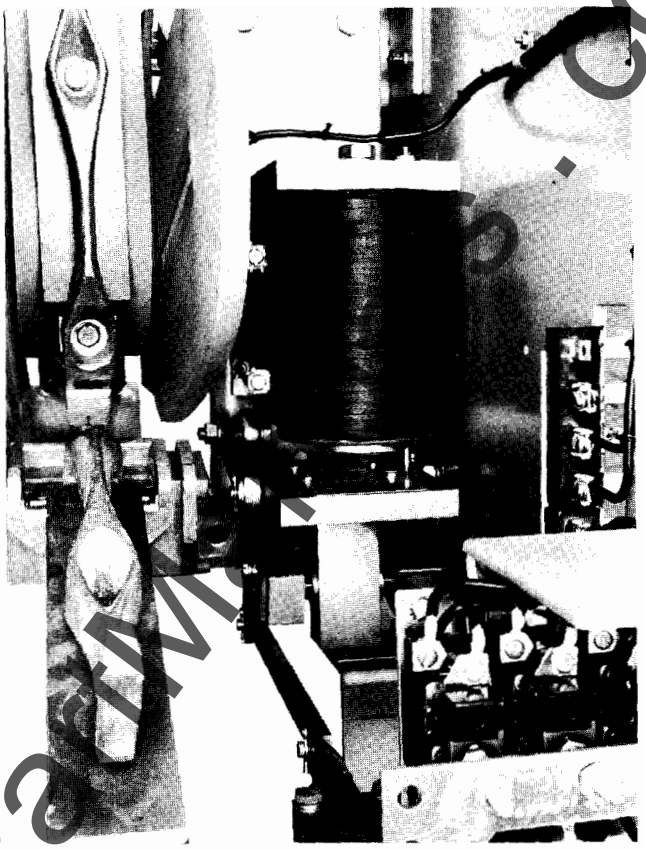


Fig. 34B. D-c magnet structure

Assemble the New Coil as Follows:

1. Assemble the large Kantlink lockwasher on the core per Fig. 34E.

2. Place the new coil over the core, with the coil-end washer with its flat side on the inside diameter near the core end containing the groove pin. (See Fig. 34E.) The coil should be pushed on gently with the milled flat of the core aligned with the flat of the coil inside hole. This procedure will prevent breakage of the coil end washer.

3. Raise each core assembly into position with the groove pin inserted in the small hole "H" in the magnet frame. The core bolts "D" then can be assembled and tightened completely. The d-c magnet alignment requirements of these "Maintenance" instructions, "D-c Magnet Assembly" also should be maintained.

D-C MAGNET ASSEMBLY (See Fig. 23)

1. Top surfaces of armature and stationary magnet (see Fig. 32) frame must be aligned within 1/16-inch. Alignment is not so important as with a-c magnets as noise problems are not encountered. Armature must be approximately centered laterally over stationary magnet frame.

2. Contact faces of magnet can be made to seat flush against each other in same manner as for a-c magnets. Alignment is again not so important for reasons mentioned in Item 1 above.

3. The armature in picked-up position must have a minimum of 1/64-inch spacing between it and the armature bracket. (See Fig. 32.) The fulcrum plate must always be assembled with its emboss toward its armature bracket. (See Fig. 32.)

4. The armature bracket must be assembled to its shaft supporting bracket in such a manner that the armature has a vertical end play in its armature support of 1/32-inch minimum. (See Fig. 32.) The armature width is made so that a side play of 1/32-inch exists. This freedom of the armature in all directions is necessary to allow it to seat properly against the magnet frames. The armature bracket legs "L" must be assembled toward armature and straddling shaft supporting bracket. (See Fig. 32.)

5. Check also to be sure armature doesn't hit on coil and that the coil leads and retaining springs

haven't been left in the way so that the armature hits them when it closes.

6. Magnet coils can be replaced per "Replacing a-c Manget Coils" section of these instructions.

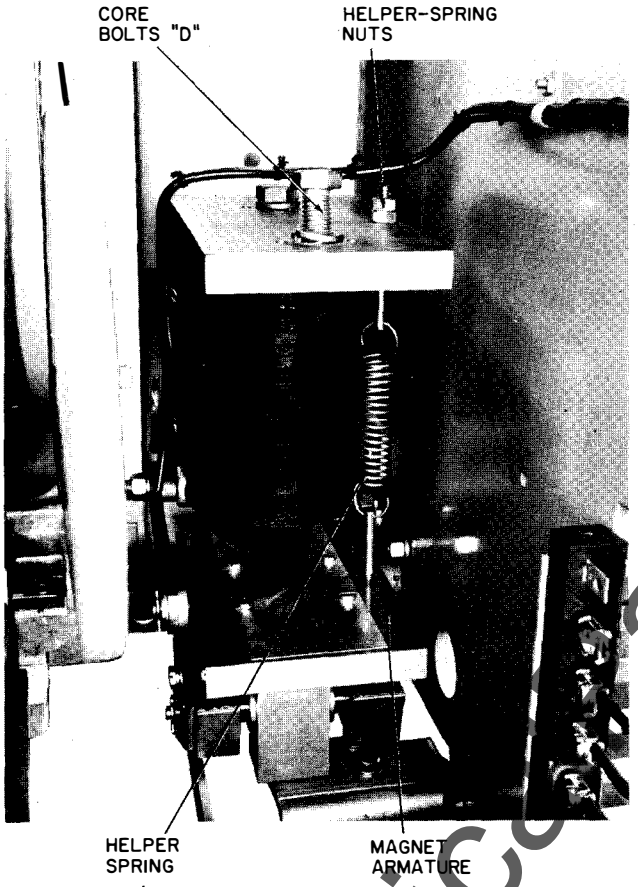


Fig. 34C. One coil removed

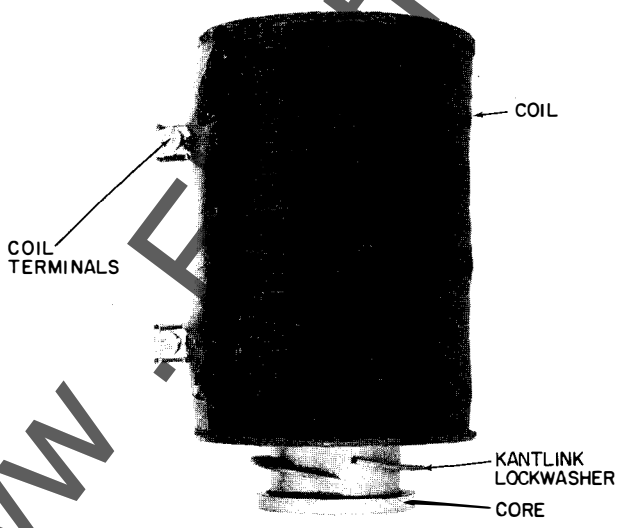


Fig. 34D. Core plus coil assembly

Magnets must be replaced when air gap between their center legs reaches 1/64-inch to insure proper drop out. This air gap with new magnets is 1/32-inch.

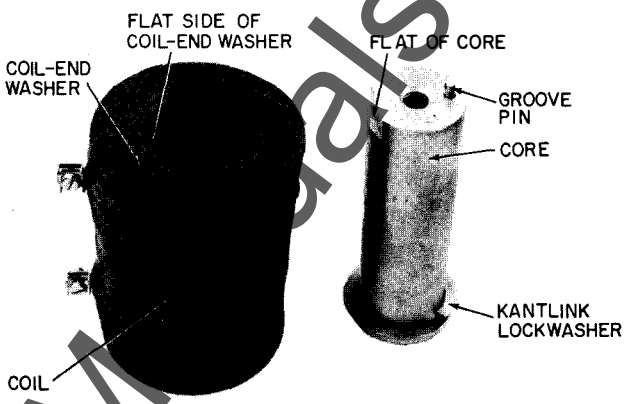


Fig. 34E. D-c magnet core and coil

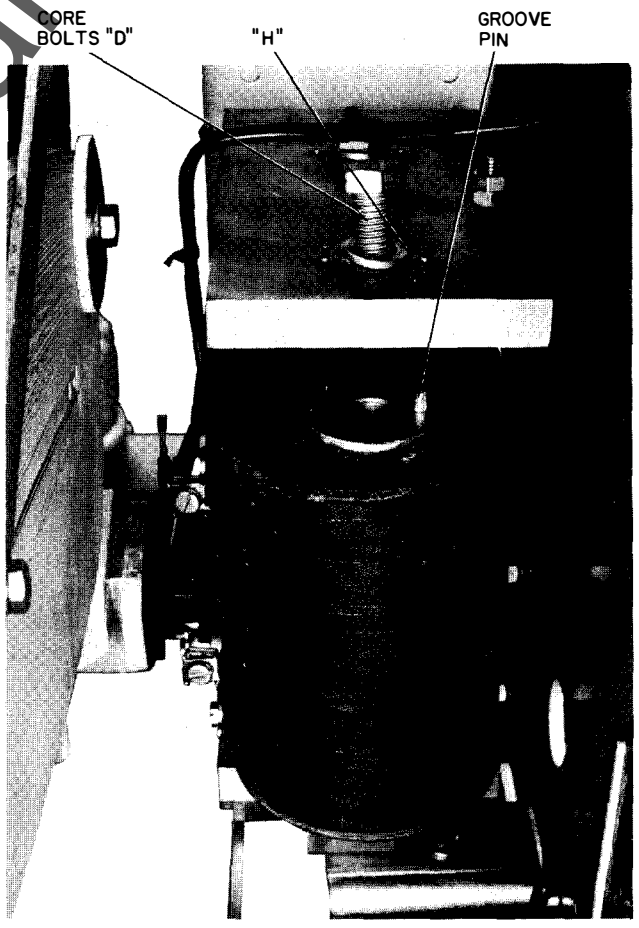


Fig. 34F. D-c magnet—top view

ELECTRICAL INTERLOCKS

The location of the electrical interlocks with reference to the assembly which operates them must be maintained in accordance with the "Electrical Interlocks" section of "General" instructions. If the hardware has not loosened due to abnormal handling, these adjustments will be maintained.

In the de-energized position of the contactors, the electrical interlocks have their operating arms (see Fig. 35B and 35C) fully operated and bottomed in the molded housing of the interlock. Gaps and wipes of the interlocks in the de-energized position will, therefore, not have to be checked during periodic inspections unless the hardware has loosened or parts have been damaged.

In the energized position of the contactor, the operating rods for the electrical interlocks must not touch the operating arms of the electrical interlocks and be positioned per Fig. 13B and Table 3 of "Electrical Interlocks" section of "General" instructions. In this position the tip gaps and wipes must be as follows:

Tip gap – 5/64-in. minimum (see Fig. 35B)

Tip wipe – 3/64-in. minimum (see Fig. 35A)

Replacing or Rearranging Movable and Stationary Contacts of Electrical Interlocks

This interlock has been designed so that the movable or stationary contacts can be replaced or rearranged to change an individual assembly to give a different number of normally open or closed contacts. When these operations are performed, the parts must be reassembled in accordance with Fig. 35A, 35B, and 35C, the previous instructions and the following requirements:

> **NOTE:** If the contacts in an electrical-interlock housing are changed from normally open to normally closed or vice versa, the contactor involved will not agree with its nameplate and will not be identical with another contactor with the same nameplate stamping.

1. The spring ends must not protrude into the holes (A), slots (B), or keys (C), which serve as guides for the operating rod. (See Fig. 35A.)

2. The stationary-contact assemblies must be driven down over the molded brass inserts in the molded housings in such a manner that they lay flat against the housing.

3. The normally open and closed contacts of an assembly must be located as shown in Fig. 35C to maintain proper electrical clearances between the sets of contacts.

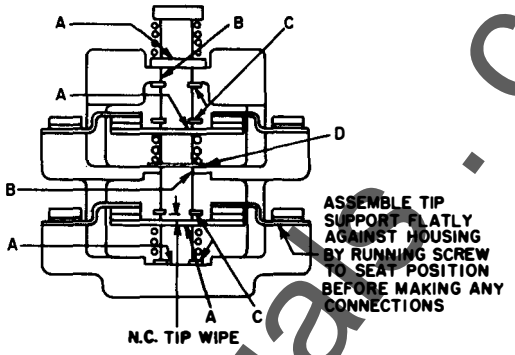


Fig. 35A. Electrical interlock—contactor energized—two normally open contacts

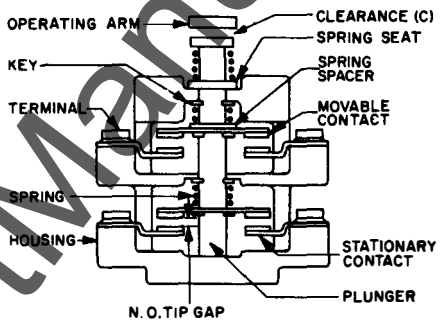


Fig. 35B. Electrical interlock—contactor energized—two normally closed contacts

4. On the completed interlock, the operating rod must operate freely without excessive binding or scraping which would indicate improper assembly.

5. The contacts of a movable-contact assembly must also make with their corresponding stationary contacts at the same time within 1/64 in. Bend the stationary-contact support up or down with the fingers to obtain this requirement.

When to Replace or Service Electrical Interlocks

Contact assemblies or preferably the whole interlock assembly (one assembly includes contacts for two circuits) should be replaced when the following conditions exist:

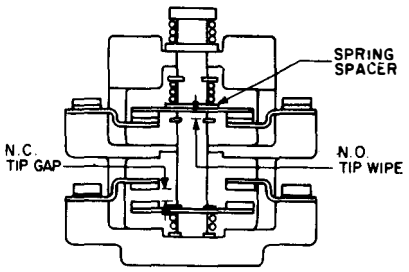


Fig. 35C. Electrical interlock—contactor deenergized—one normally open and one normally closed set of contacts

1. The contacts are badly pitted to the point where the bottoms of the pits are close to touching the steel backing of the silver facings of the contacts. The top of the steel backing is obvious from looking at the side of the contact. The bad build-ups on the one contact opposite the pitts of the mating contact can be removed and thus extend the life of the contacts through forcing the contacts to make on other areas.

NOTE: Tarnish on the silver facings does not have to be removed, as with power the the tarnish breaks down into products which are conducting.

2. If the contacts are worn so that they are thrown very badly out of alignment, the contact assemblies should be replaced to reduce friction between the movable parts of the interlock.

3. When the wipe is reduced to one half of the minimum values shown in the "Electrical Interlocks" section, the contact assemblies should be replaced to obtain proper pressures to allow the interlock to operate satisfactorily. The wipe is the compression in inches of movable contact spring between the energized and de-energized positions of contactor. See Fig. 35A, 35B, and 35C.

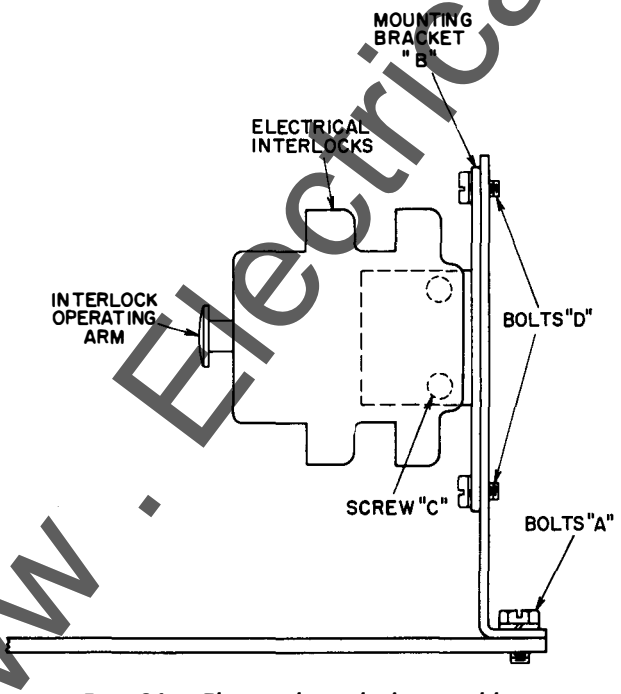


Fig. 36. Electrical-interlock assembly

Replacing Complete Electrical Interlock Assembly

An electrical interlock can be replaced by following the steps outlined below (see Fig. 36):

1. Sufficient slack is available in the wiring to the electrical interlocks so that bolts "A" can be removed and the whole interlock assembly raised up.

2. Tag the wires and then disassemble the wires of the interlock to be replaced.

3. Each interlock, plus its mounting bracket "B", can then be removed through loosening bolts "D".

4. Each interlock assembly can then be removed from its bracket "B" by removing self-tapping screws "C".

5. The interlock can be replaced by following the reverse of the steps outlined above.

6. Interlocks should be adjusted in accordance with Fig. 13B and Table 3 as mentioned previously.

POWER-STAB FINGERS

Power-stab fingers must be maintained in location per "Power and Control Disconnects and Shelf Tongue" section of "General" instructions so that the proper power connections will be made at all times. Only very rough handling would cause these fingers to change in location. They should be free to rock 1/8 in. in each direction.

A pressure of 45 to 55 pounds on a stationary, or male, stab must be maintained to make proper connections. These pressures were properly set at the factory and should not change unless the assemblies have loosened through rough handling or the power finger springs have been damaged.

These pressures can be set on the power fingers with the following procedure (see Fig. 37):

1. Select, for a finger spacer, a piece of metal that is 1/2 ± 0.002-in. thick. Cold-rolled steel of this thickness would be very satisfactory as its tolerance is within this range.

2. With the adjusting nut located for weak spring pressure, insert the finger spacer between the pairs of fingers.

3. Tighten the adjusting nut until there is a very slight drag on the finger spacer when trying to pull it out of engagement.

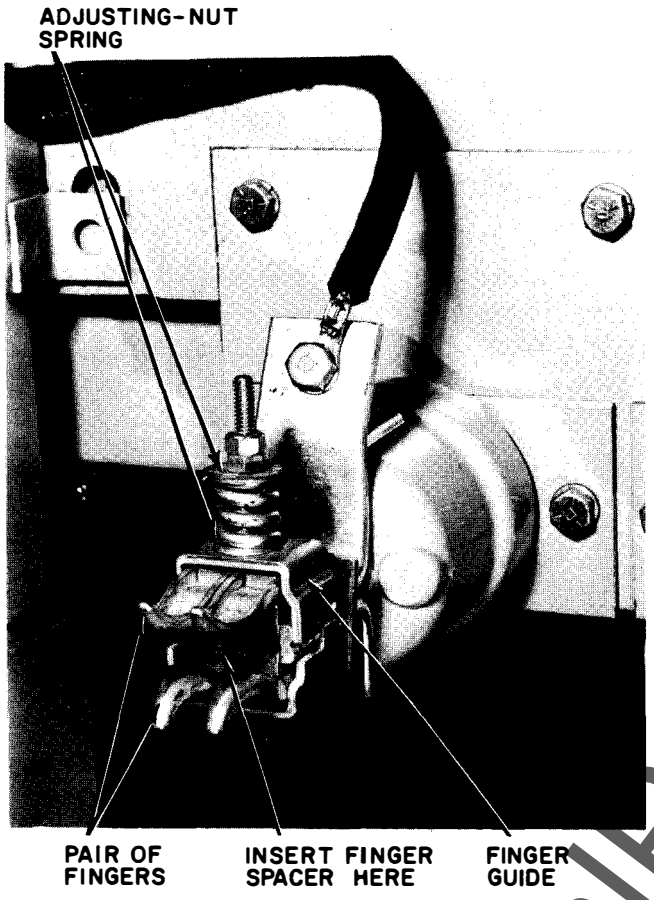


Fig. 37. Power-stab fingers

4. Record the position of the nut by placing pencil marks on the nut and finger guide opposite each other. Set proper pressure by turning the adjusting nut through exactly two full turns in a direction to increase the spring pressure. The nut will remain in position as it is a self-locking nut. Earlier contactors used two regular nuts which were thoroughly tightened against each other.

The power fingers and control-disconnect fingers do not need lubrication, but grease (Nebula No. 1 of Esso or equal) can be added to the power-finger surfaces mating with the stabs, if desired. All fingers have been tested in contaminants such as cement, metal, dust and paper-mill atmospheres and have been found to function satisfactorily without grease. If foreign matter collects on the stabs or power fingers (condition is worse with grease as it holds dust, etc.), it must be removed by blowing or brushing as it will interfere with the ease of operation of the fuse shelf and stabbing in general.

CONTROL-DISCONNECT FINGERS

The control-disconnect fingers must be maintained in position per "Power and control disconnects and shelf tongue" section of "General" instructions. Vertical alignment with the mating stationary fingers of the enclosure is set at the factory and must be maintained within 1/16 in. Contact will be made with the edge of the stationary finger with the contactor finger flexed considerably if both sets of fingers are maintained in position per the above instructions. The control-disconnect fingers should not be lubricated as it is not necessary and they will only collect dirt, which will interfere with proper contact between the enclosure and contactor fingers.

FUSE CLIPS AND GROUNDING STRAPS

Fuse clips and grounding fingers must be maintained in adjustment per "Fuse-Disconnect Shelf" section of "General" instructions. The grounding fingers (see Fig. 1 and 16) of one fuse assembly must also stay together and align with the fuse mounting sufficiently to make a good contact. The grounding strap (see Fig. 1) must also be free to spring the maximum distance away from the contactor side frame. A hook in its front near the shelf operating handle will keep it from springing too far away from contactor side frame on earlier models. Late models have a grounding stab located on the left rear corner, (see Fig. 2 and 14) and have a nonspring grounding strap on the side of the contactor.

"BRAIN BOX"

The "brain box" (see Fig. 19A) does not require lubrication or adjustment during the life of the contactor. The precision plungers and permanently lubricated molded housing are designed into the unit for positive trouble-free operation. It is appropriate, however, to check the mechanical interlocking in general to be sure that it is performing its functions properly. The parts could be damaged from severe handling and would not permit proper operation.

FUSE-SHELF ADJUSTMENTS

Check the following of "Mechanical and electrical interlocks and brain box" section of "General" instructions:

1. The adjusting-bolt adjustment for operating the "brain box".

2. The horizontal-rod adjustment.

3. The control-power interlock adjustment.

These adjustments will have been maintained unless the parts have been damaged by severe handling.

Adjustments of the fuse-shelf must be maintained so that the following requirements will be met:

1. The shelf should move without excessive friction.

2. The grounding fingers (see Fig. 16) must be aligned with the fuse supports.

3. The power stabs of the shelf must have considerable horizontal side play so that they can seek and find the female receptacles on the enclosure.

Requirements of item 1 above are maintained by allowing 1/32-in. minimum of vertical freedom of the shelf per Fig. 38A. This adjustment is maintained by proper assembly of the parts.

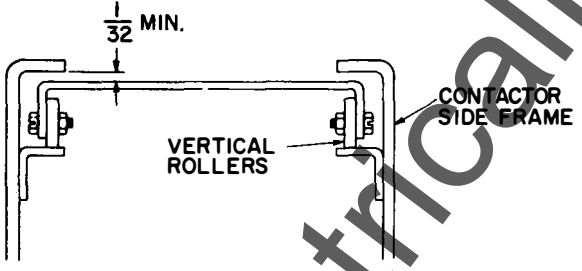


Fig. 38A. Fuse-shelf vertical play

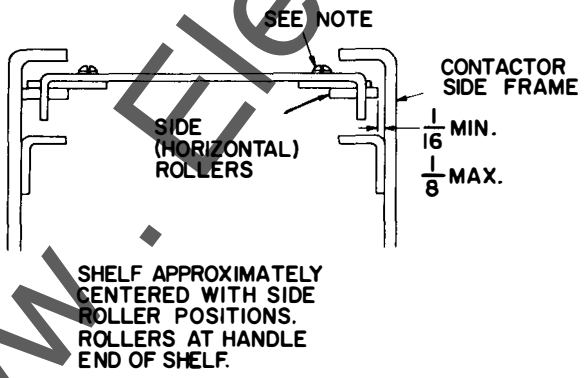


Fig. 38B. Fuse-shelf horizontal (side) play. Shelf driven fully by cam toward handles

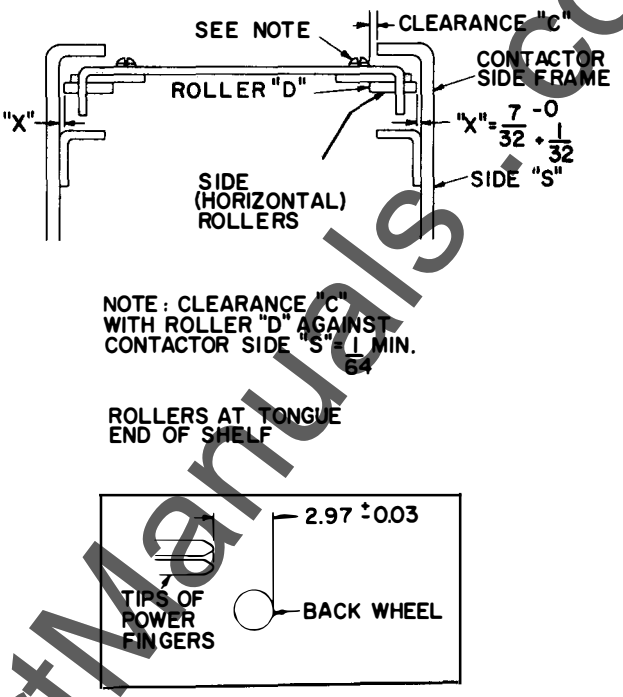


Fig. 38C. Fuse-shelf horizontal (side) play. Shelf driven by cam away from handle until the power-finger ends are 2.97 ±0.03 in. from the back of the back wheels. See inset

Requirements of item 2 above will be maintained if the side-horizontal rollers at the front or handle end of the shelf are always adjusted to keep the shelf approximately centered and to set a total side play of 1/16 to 1/8 in. per Fig. 38B. Clearance "C" of Fig. 38C must also be 1/64-in. minimum so that the bolt heads will not hit the side frames. This adjustment should be made with the shelf fully retracted toward the handle or front end of the contactor.

Requirements of item 3 above will be maintained if the shelf is always adjusted per Fig. 38C. With the shelf operated to 2.97 ± 0.03 in. from the back wheels (wheels closest to shelf power fingers), horizontal rollers at back or the tongue end of the shelf should be adjusted to approximately center the shelf and give a horizontal side play on each side of 7/32 to 1/4 in.

These adjustments will be maintained unless the contactor has received extremely rough treatment. After such treatment, these adjustments should be checked and readjusted if necessary.

A good grade of heavy oil should be added to the horizontal and vertical rollers of the fuse shelf dur-

ing each routine inspection. This lubrication will keep the fuse shelf operating satisfactorily and will prevent corrosion of the rollers. The pins through which the shelf is driven, the stop plate and stop, and handle shaft (Fig. 17) and the cam mechanism shaft should also be greased during the same routine inspections with a good grade of heavy grease.

D-C MAGNET ASSEMBLY (NORMALLY CLOSED POLES IC2814-X111 AND -X151 CONTACTORS)

This section of the contactor can be treated as a completely separate contactor to be assembled and placed on top of its normally open poles and then slid to proper location. See Fig. 7 or Fig. 10. Assembly and adjustments in general are as follows:

Shaft

The shaft should be centered with reference to holes in side frames.

Top Cross Channel

The Top Cross Channel should be approximately centered over the mounting holes in the side frames and 7-3/8 inch above top flat of shaft with shaft in its final position with the contacts closed and magnet de-energized. The top flat of the shaft should be horizontal in this position, in all directions. This channel should be parallel to shaft left to right and parallel to this same top flat of shaft and pan support front to back. See Fig. 39.

Contacts

With the contacts open the "N" dimension of Fig. 22 should be 1 in. ± 1/32 in. The setscrew can be changed slightly to make contacts make at the same time within 1/64 inch. "N" spring space with contacts open minus "N" dimension with contacts fully wiped (closed) must 3/16 in. ± 1/32 in.

Armature Backstop Assembly

All pins of armature stop assembly, Fig. 40, must be parallel to each other and all linkages must operate freely. This assembly should be assembled with shims between it and the shelf support if necessary to maintain "X" equaling "X" at top approximately and a minimum of 1/32 in. on either side. Special shims are often necessary to tilt the assembly to maintain the "X" dimension. The shaft block should be approximately parallel and flush with the top flat of shaft (magnet de-energized). Slight changes from parallel may be necessary to make mechanism operate freely. All pins must also be in a straight line in this position with Pin D-D approximately 1/2 in. in front of A-A Pin. (Direction away from shaft.) Lock adjusting screw "S" (Fig. 39) in final position to give the adjustments. The shaft block should also be parallel with shaft in its free position before it is bolted to shaft (Fig. 41). With assembly in the fully de-energized position, the assembly must hold position when it is lightly pounded in the direction of picking up armature magnetically without the return spring installed.

Magnet Frame Location

The magnet frame should be assembled to shelf support so that a contact gap of 0.660 in. to 0.690 in. is maintained with magnet picked up manually. The armature gap will be approximately 23/32 in. A 0.530 in. minimum contact gap must be maintained with magnet fully picked up electrically. The magnet frame adjusting screw "T" should be adjusted to, and locked, to hold magnet frame in position. See Fig. 39.

Mechanical Interlock Between N.O. and N.C.C. Contacts

This mechanical interlock is necessary to prevent the upper-normally closed contacts from touching when the contacts of the lower-normally open section are touching.

When the lower contacts are just touching, the upper contacts must have a minimum contact gap of 3/16 inch. See Fig. 42. When lower magnet is sealed in closed position, the upper contacts should have approximately 1/2-inch contact gap.

Return-Spring Adjustment

When the upper magnet is moved to the sealed or closed position and slowly released, the return spring should be adjusted to just close and wipe completely the contacts and then given one additional turn of the spring adjusting screw in the direction to tighten the spring. Initial position of spring should be determined as a minimum setting from several trials. See Fig. 39.

Mechanical Interlock Between 2814-X111 and Other Contactors

The top block should be adjusted in height location to maintain 1/32-inch to 1/16-inch clearance

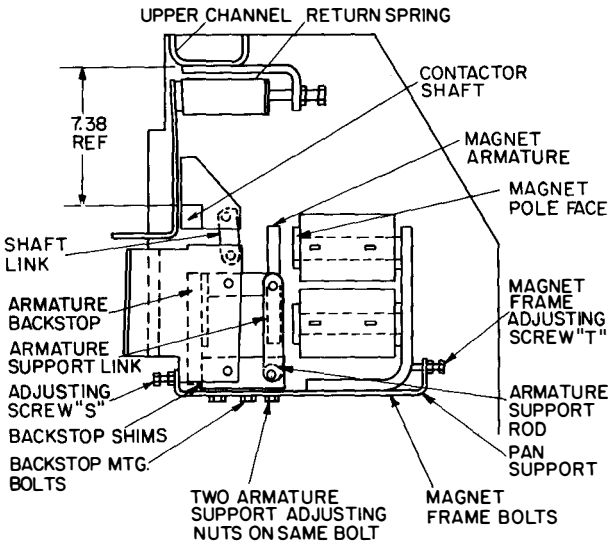


Fig. 39. Magnet assembly

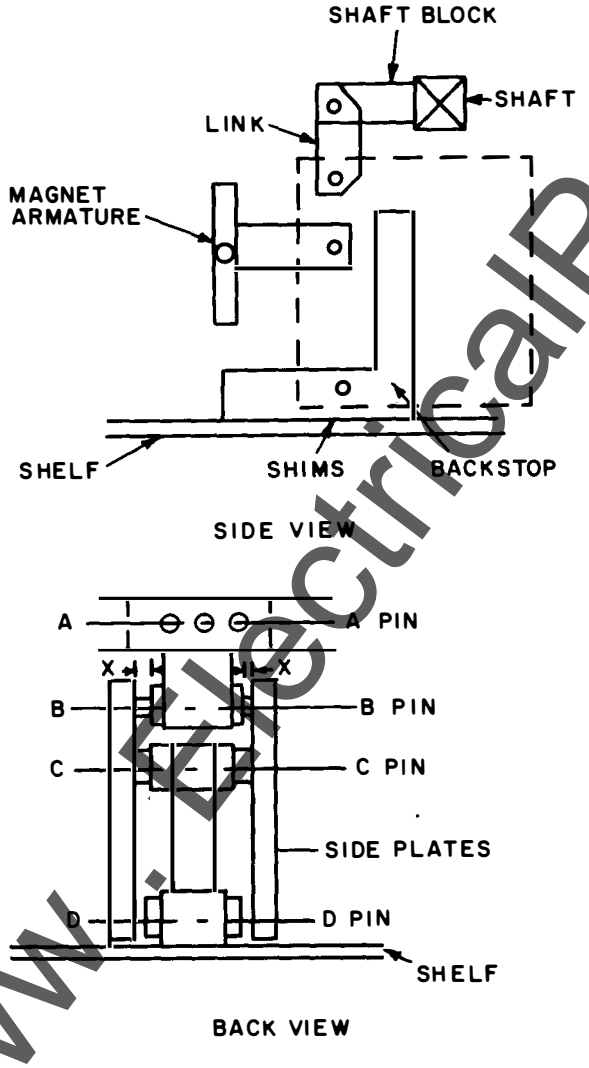


Fig. 40. Magnet armature stop assembly

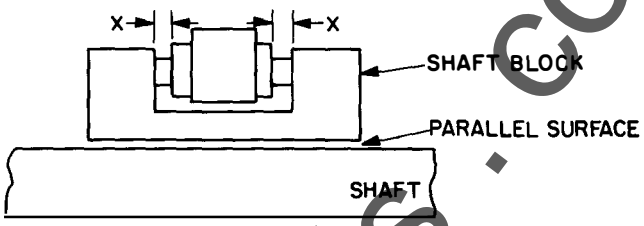


Fig. 41. Shaft block assembly—top view

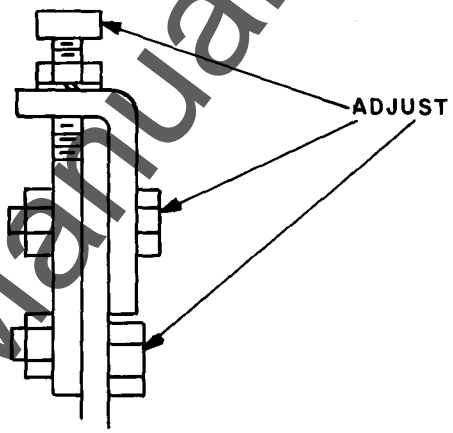


Fig. 42. Mechanical interlock

"C," see Fig. 43. The bell crank should rest on channel cutout per this same figure. The lower vertical rod should be adjusted to give the height of its lower end. See Fig. 44 and 45. This height is measured above track on which contactor rolls.

Magnet Alignment

Locate magnet frame to also make armature hit both cores at one time. The armature will probably make only a point or line contact with each core. Maximum gap between rest of armature and rest of cores with armature held touching both cores should not exceed 0.010-inch as measured by eye.

MECHANICAL INTERLOCK STAB-TYPE CONTACTORS

The mechanical interlock assemblies for the stab-type contactors should be adjusted as follows with contactors de-energized:

1. Clearance between fully extended brain box plungers and bell crank adjusting screws at rear of contactor must be 0.00-in. to 0.020-inch. See Fig. 44. The bell crank must rest on upper channel for making this adjustment.

2. Vertical rods of all contactors that are connected to these bell cranks must have 8-7/8-in. ± 1/32-in. clearance to bottom of contactor

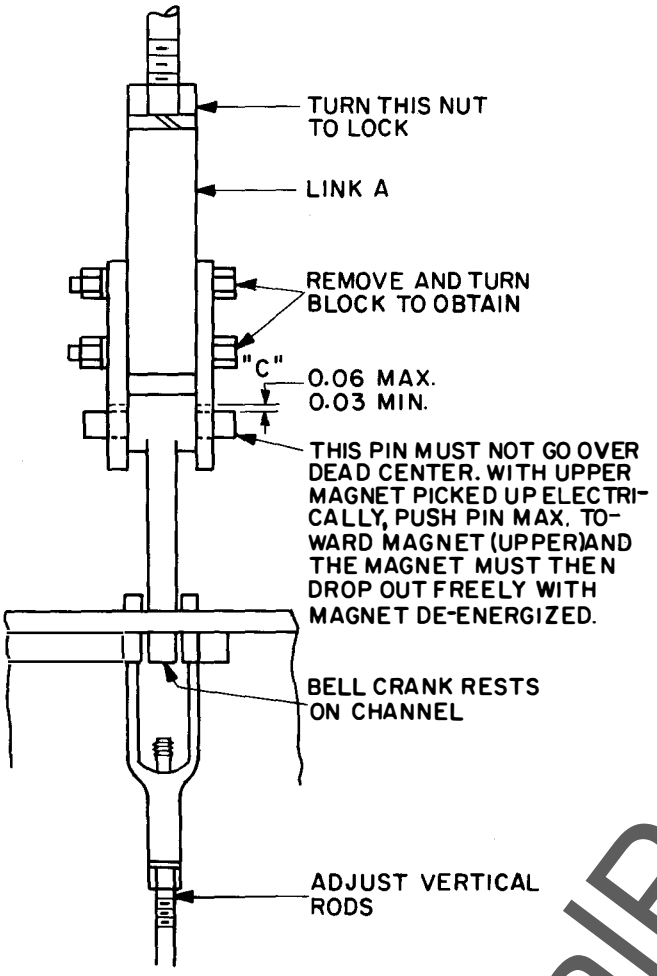


Fig. 43. Mechanical interlock IC2814-X111 contactor

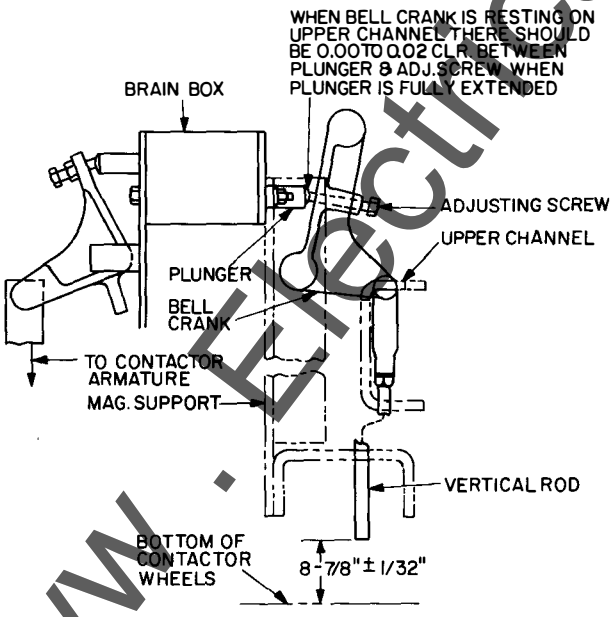


Fig. 44. Mechanical interlock through brain box—contactor de-energized

wheels. See Fig. 44. The bell crank vertical rods can be present on any of the contactors and perhaps along with a vertical rod operated directly from link not connected to brain box.

3. Vertical rods connected through links to contactor armature (see Fig. 45) must have clearance to bottom of contactor wheels of 9-3/4-in. ± 1/32-in. Helper spring must be set to an operating length of 3/4-in. ± 1/8-in. through changing numbers of washers after setting 9-3/4-in. dimension.

IC2814 LATCHED CONTACTORS

The latched in forms of the high voltage contactors are the same as the non-latched in forms with the addition of a latch that holds the contactor closed. Once it is closed it can be opened by pulling on the manual trip or by energizing the magnetic trip solenoid. The closing coil and magnets are the same as the non-latched in forms so that these instructions apply to the contactor except for the latching mechanism itself.

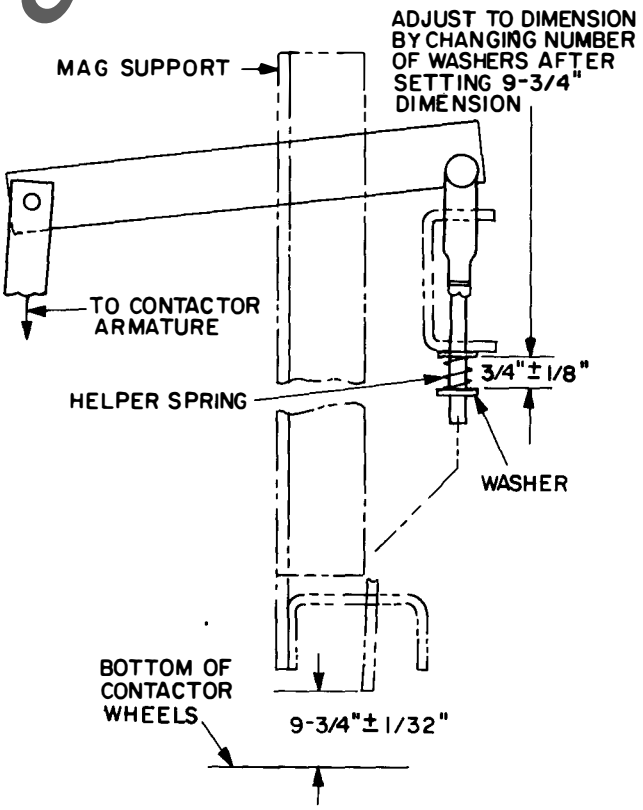


Fig. 45. Mechanical interlock through brain box—contactor de-energized

Adjustments

As received the contactor is preadjusted in the factory and ready for use after all shipping braces and blocking have been removed.

For servicing and maintenance all checks and adjustments for the standard IC2814 should be made. In addition to these instructions the following adjustments should be made:

With the contactor latched closed and the closing coil de-energized, make the following checks and adjustments:

1. The gap between the tops of the armature and magnet as measured at A in Fig. 46 must be 0.035-in. to 0.045-in. "A" dimension must be measured with armature wedged fully away from its armature bracket. See Fig. 23.

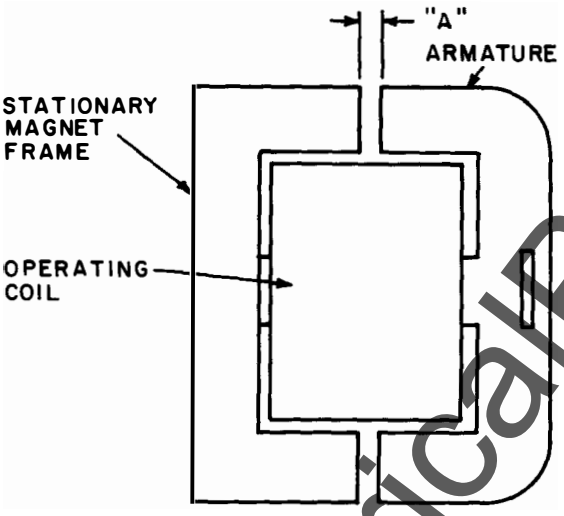


Fig. 46. A-c and d-c magnet structure

2. The trip solenoid armature gap must be 1/4-in. plus or minus 1/32-in. as measured in Fig. 47.

3. The hand release mechanism must have free travel of approximately 3/64-in. as measured in Fig. 48 at the "E" retaining ring before engaging the latch.

4. The plunger on the trip electrical contact block must not bottom in its housing and should have an additional travel of 1/32-in. remaining as shown in Fig. 49.

5. The spring space on the main contactor tips must be 13/16-in. as measured at "N" in Fig. 22.

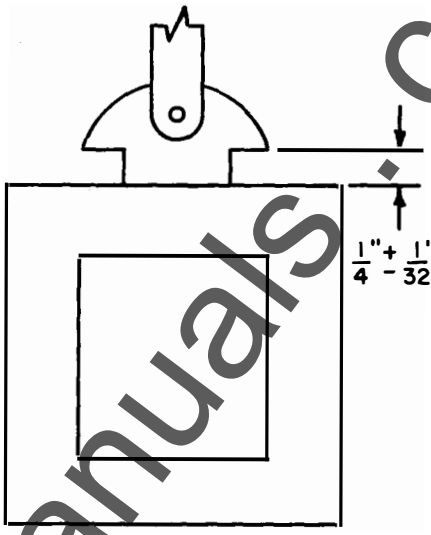


Fig. 47. Solenoid armature

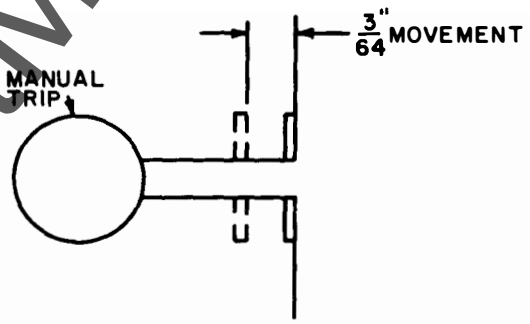


Fig. 48. Hand release mechanism

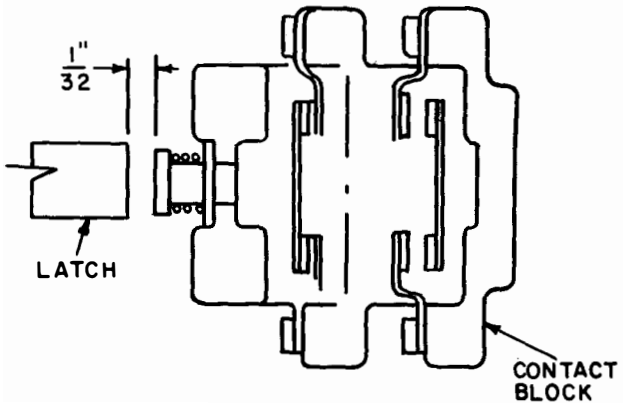


Fig. 49. Electrical contact block

With the contactor in the open, de-energized and unlatched position, make the following checks and adjustments:

1. The compressed length of the trip arm spring should be 2-3/64-in., measured as shown in

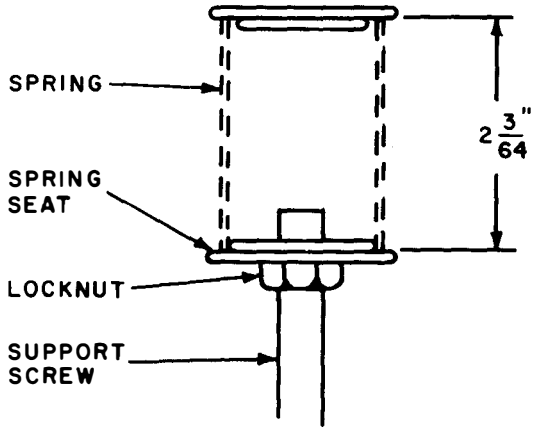


Fig. 50. Trip arm spring

Fig. 50. Trip solenoid is in the fully closed position for this measurement.

2. The spring seat is threaded on the support screw and can be adjusted by loosening the locknut and turning the spring seat until the desired 2-3/64-in. is obtained. Lock in position with the locknut after adjustments have been made. This spring length can be increased slightly to allow positive latching action.

3. The latch bar must clear roller support attached to the armature bracket by 1/16-in. and should be centered on the roller as determined by sight.

4. Latching mechanism must operate freely and not having binding at any position.

When contactor is picked up and latch is held manually, it must latch when gradually released.

600-AMPERE CONTACTORS

STAB-TYPE, NORMALLY OPEN POLES

Additional stabs are provided to carry the additional current. In each pair of power stabs, the pressure is set in the same manner as those for the 400-ampere contactors.

Control and power stabs are accurately located in our factory in the same general manner as those for the lower current contactors. Care should be taken to never lose track of the exact position of each of these stabs. Dimension drawing 135C7698 gives details.

Shelf alignment of rollers, tongue, and horizontal guides are maintained in the same manner.

These fuses are mounted vertically because of space limitations. They must be maintained approximately on the vertical with each fuse clip finger working freely without interference of other fingers and making good contact with the fuse surfaces.

Tip pressures measured per Fig. 22 are as follows:

Initial – 13.5 to 17.5 pounds
Final – 21.5 to 27.5 pounds

Otherwise, instructions for the lower current contactors can be followed by all servicing operations.

RENEWAL PARTS

When ordering renewal parts, address your request to the nearest General Electric Company sales office, specify the quantity required, and give the catalog number or describe the required parts in detail. Give the complete nameplate rating of the equipment. Renewal part bulletin GEF-4164 will give catalog numbers for renewal part items.

INDUSTRY CONTROL DEPARTMENT

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