INSTRUCTIONS

*Switchgear*

Types M-26 and M-36
For Magne-blast Air Circuit
Breaker Types AM-4.16 and
AM-13.8

# METAL-CLAD SWITCHGEAR

GENERAL ELECTRIC

# CONTENTS

# METAL CLAD SWITCHGEAR
# TYPES M26 AND M36
## FOR MAGNE-BLAST AIR CIRCUIT BREAKER TYPES AM-4.16 AND AM-13.8

## INTRODUCTION

Metal Clad Switchgear is equipment to control and protect various types of electrical apparatus and power circuits.

The switchgear consists of one or more units which are mounted side by side and connected mechanically and electrically together to form a complete switching equipment. Typical equipments are shown in Figures 1, 2 and 3.

The circuit breakers are easily removable to provide maximum accessibility for maintenance with minimum interruption of service. The switchgear is designed to provide maximum safety to the operator. All equipment is enclosed in grounded metal compartments.

The equipment is available in the ratings listed in the following table. For outdoor installation the same basic equipment is built into a weatherproof housing as in Figures 2 and 3.

**TYPE M26**

| CIRCUIT BREAKER | TYPE | INTERRUPT CAPACITY KVA | CURRENT | FIGURE |
|---|---|---|---|---|
| AM-4.16-150 | Magne Blast | 150,000 | 1200 - 2000 | 4 |
| AM-4.16-250 | Magne Blast | 250,000 | 1200 - 2000 | 4 |

**TYPE M36**

| CIRCUIT BREAKER | TYPE | INTERRUPT CAPACITY KVA | CURRENT | FIGURE |
|---|---|---|---|---|
| AM-13.8-150 | Magne Blast | 150,000 | 1200 - 2000 | 4 |
| AM-13.8-250 | Magne Blast | 250,000 | 1200 - 2000 | 4 |
| AM-13.8-500 | Magne Blast | 500,000 | 1200 - 2000 | 4 |
| AM-7.2-250 | Magne Blast | 250,000 | 1200 - 2000 | 4 |
| AM-7.2-500 | Magne Blast | 500,000 | 1200 - 2000 | 4 |

*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.*

AAH

Fig. 1 Typical Indoor Metal Clad Switchgear Equipment

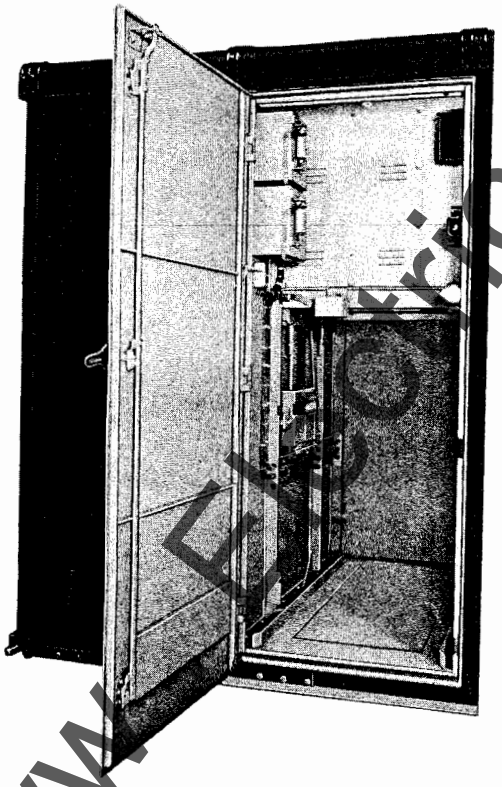


Fig. 2 Typical Outdoor Metal Clad Switchgear Equipment Front View

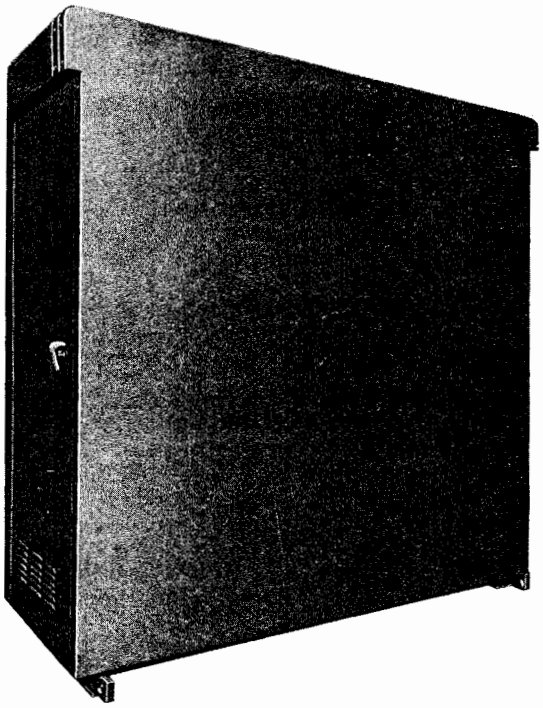


Fig. 3 Typical Outdoor Metal Clad Switchgear Equipment Side View

Fig. 1 (8012001)

Fig. 2 (8011451)

Fig. 3 (8011453)

AAH

Fig. 4 (8012851)

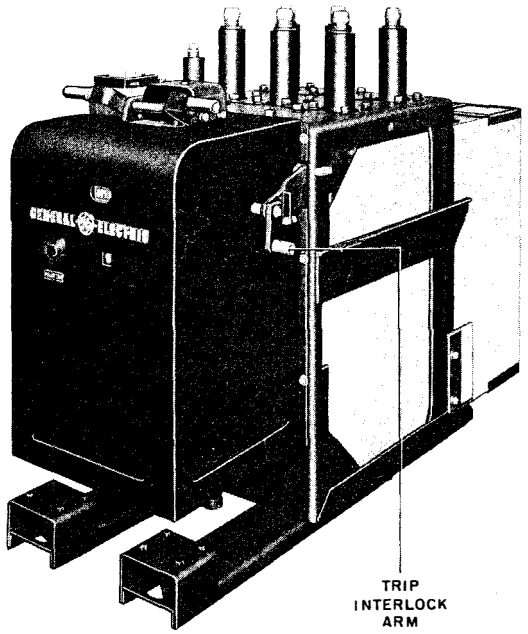



Fig. 4 Magne-Blast Breaker

Fig. 5 (8012975)

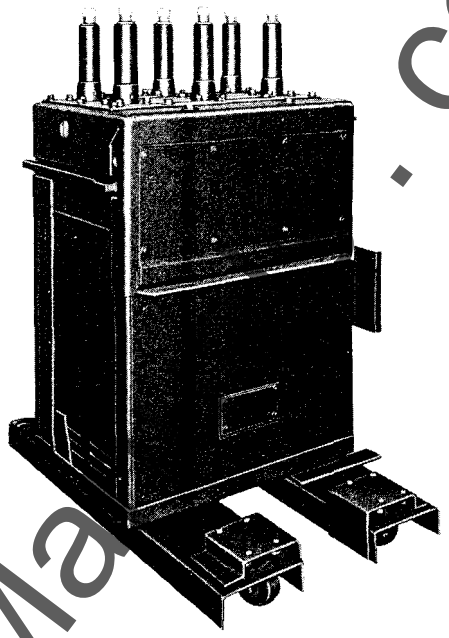


Fig. 5 Dummy Removable Element

# RECEIVING, HANDLING AND STORAGE

## RECEIVING

Every case or crate leaving the factory is plainly marked at convenient places with case number, requisition number, customer's order, front or rear, and when for size and other reasons it is necessary to divide the equipment for shipment, with the unit number of the portion of equipment enclosed in each shipping case.

The contents of each package of the shipment are listed in the Packing Details. This list is forwarded with the shipment, packed in one of the cases. The case is especially marked and its number can also be obtained from the Memorandum of Shipment. To avoid the loss of small parts when unpacking, the contents of each case should be carefully checked against the Packing Details before discarding the packing material. Notify the nearest General Electric Company representative at once if any shortage of material is discovered.

All elements before leaving the factory are carefully inspected and packed by workmen experienced in the proper handling and packing of electrical equipment. Upon receipt of any apparatus an immediate inspection should be made for any damage sustained while enroute. If injury is evident or an indication of rough handling is visible, a claim for damage should be filed at once with the transportation company and the General Electric Company notified promptly. Information as to damaged parts, part number, case number, requisition number, etc. should accompany the claim.

## HANDLING

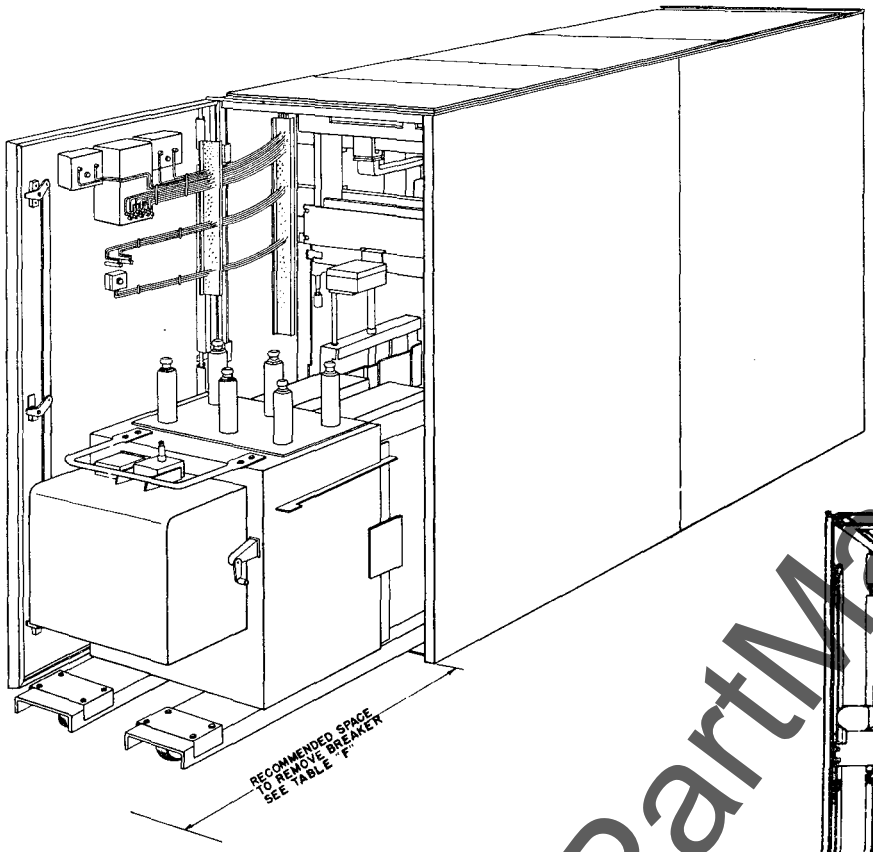
Before uncrating, indoor equipment may be moved by a crane with slings under the skids. If crane facilities are not available, rollers under the skids may be used. Fig. 6 shows suggested method of handling the switchgear after it is removed from the skids.

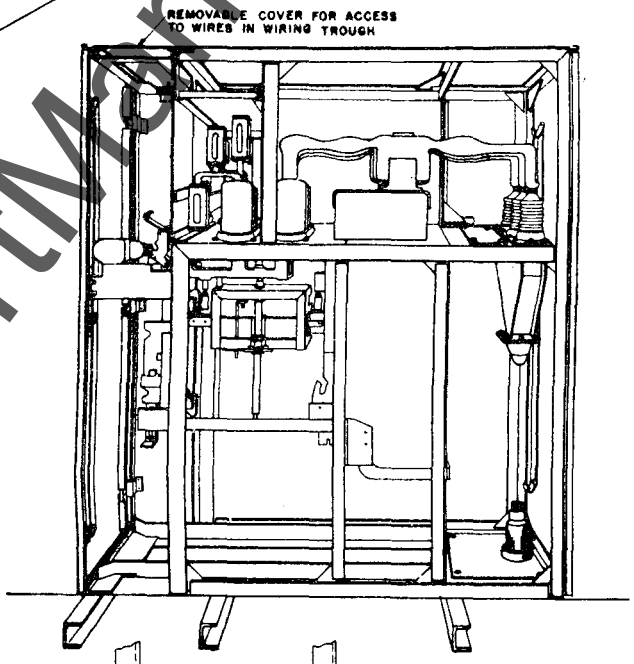
Methods of handling outdoor equipment are shown in Figure 7. After the equipment is in place the lifting plates should be removed and reassembled, "turned in" so that passageway at the ends of the equipment will not be obstructed.

## STORAGE

If it is necessary to store the equipment for any length of time, the following precautions should be taken to prevent corrosion:-

1. Uncrate the equipment.
2. Cover important parts such as jack screws, gears and chain of lifting mechanism, linkage and moving machine-finished parts with a heavy oil or grease.
3. Store in a clean, dry place with a moderate temperature and cover with a suitable canvas to prevent deposit of dirt or other foreign substances upon movable parts and electrical contact surfaces.
4. Batteries should be uncrated and put on trickle charger immediately on receipt.

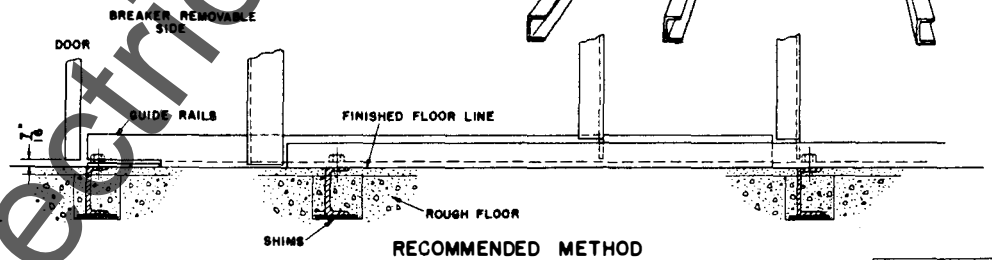



ALL FLOOR STEEL TO BE FURNISHED BY PURCHASER

CHANNELS SHOULD BE SET LEVEL WITH EACH OTHER AND SHOULD BE LEVEL OVER THEIR FULL LENGTH

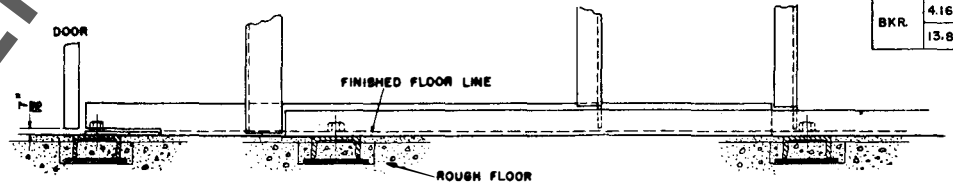
ROUGH FLOOR THICKNESS AND REINFORCING DEPENDS ON LOADING AND OTHER NORMAL FACTORS, AND SHOULD BE DESIGNED IN ACCORDANCE WITH RECOMMENDED PRACTICE




NOTE: IT IS IMPERATIVE THAT FLOOR STEEL BE EVEN WITH FINISHED FLOOR AND THAT BOTH BE LEVEL

RECOMMENDED METHOD

| TABLE "F" | | |
|---|---|---|
| BKR. | 4.16 | 5FT. 1 |
| | 13.8 | 6 FT. 3 |



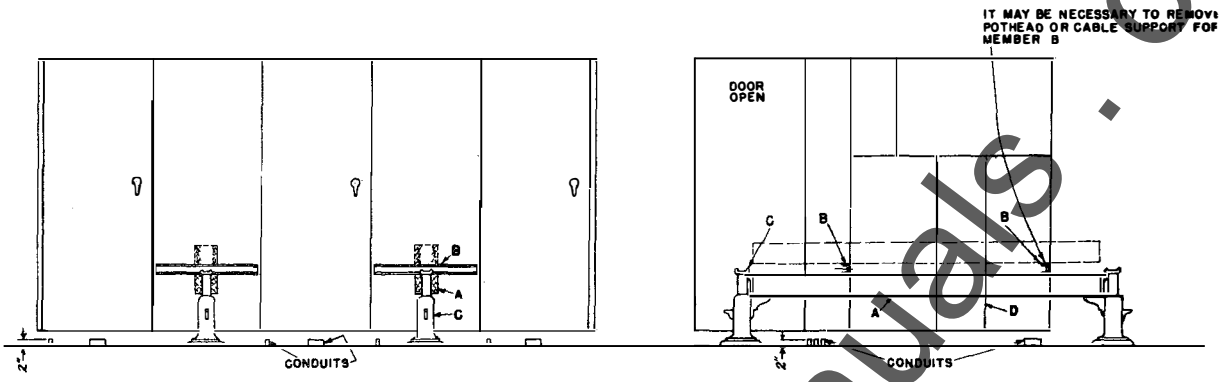

ALTERNATE METHOD

Fig. 6 (TT-6482630)

Fig. 6 Installation Details



AAH



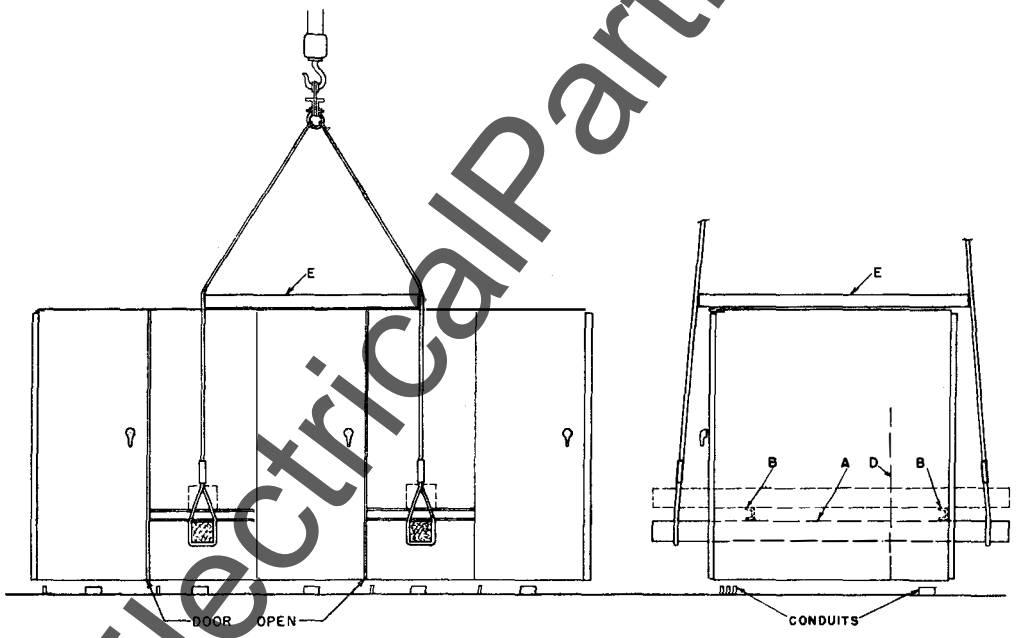

METHOD OF LIFTING

MEMBERS A-& C ——→ TO BE FURNISHED BY PURCHASER
A - RAISING MEMBER - CHANNEL OR WOOD BEAM

B - 3" CHANNEL FURNISHED WITH GEAR

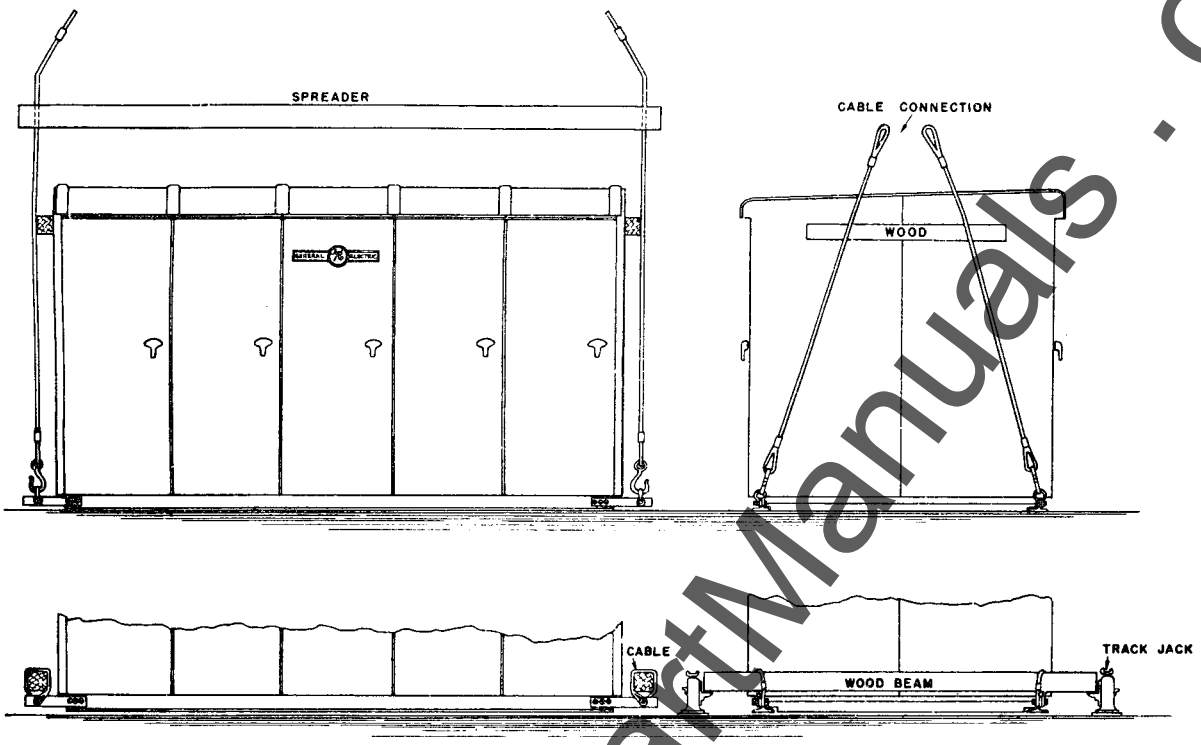
C - LIFTING JACKS
D - COVER TO BE REMOVED AND REASSEMBLED AFTER UNITS ARE IN PLACE

Fig. 6 (TT-6482630)

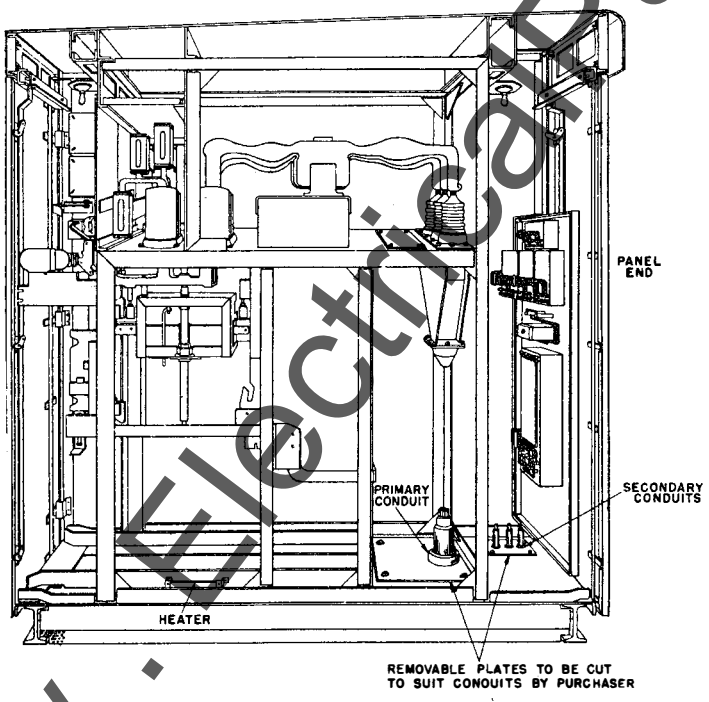


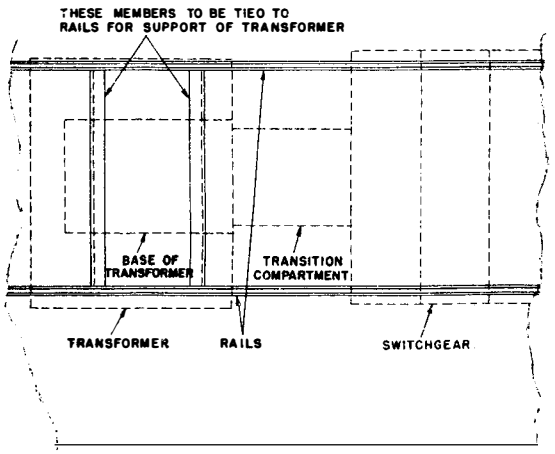

ALTERNATE METHOD OF LIFTING

MEMBERS A & E TO BE FURNISHED BY PURCHASER
B - 3" CHANNEL FURNISHED WITH GEAR
D - COVER TO BE REMOVED AND REASSEMBLED AFTER UNITS ARE IN PLACE
E - SPREADER




METHODS OF LIFTING



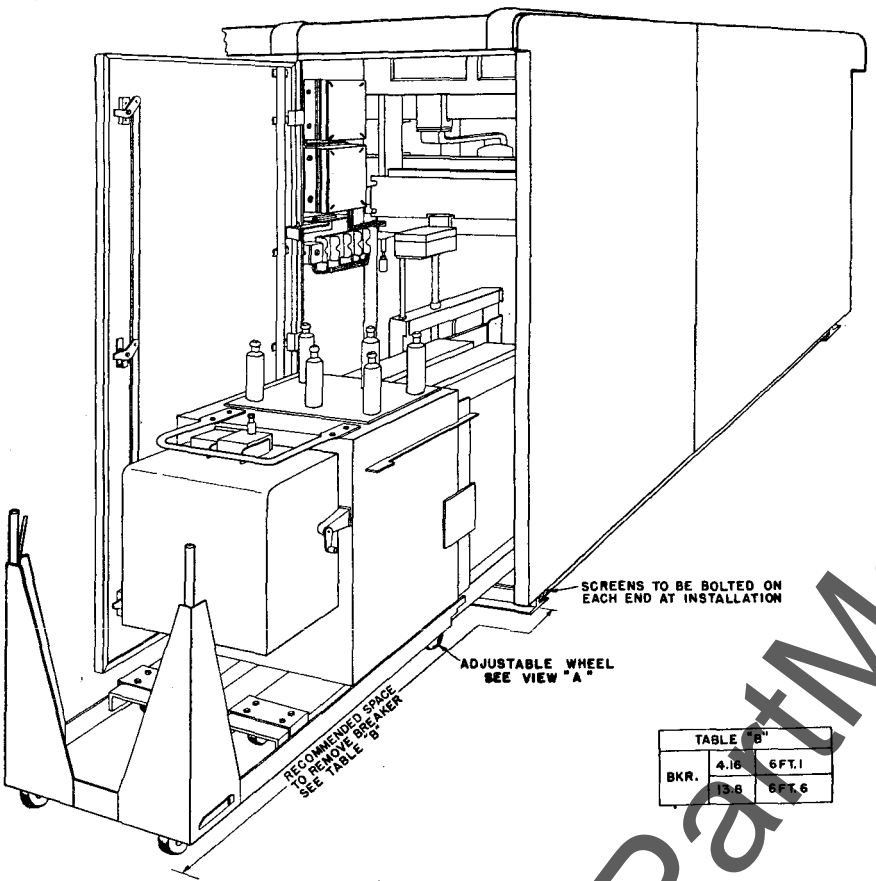

CONCRETE PAD SHOWING REINFORCEMENT

Fig. 7 Installation Details

Fig. 7 (TT-6482615)

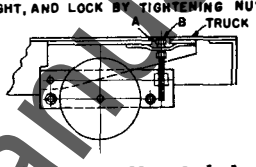


AAH



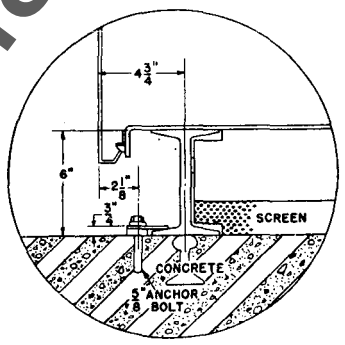

VIEW OF BREAKER END

TO CHANGE HEIGHT OF TRUCK FLOOR, LOOSEN NUT "A" THRU OPENING IN TRUCK FLOOR, ADJUST SLOTTED SCREW "B" WITH SCREW DRIVER TO GIVE DESIRED HEIGHT, AND LOCK BY TIGHTENING NUT "A".



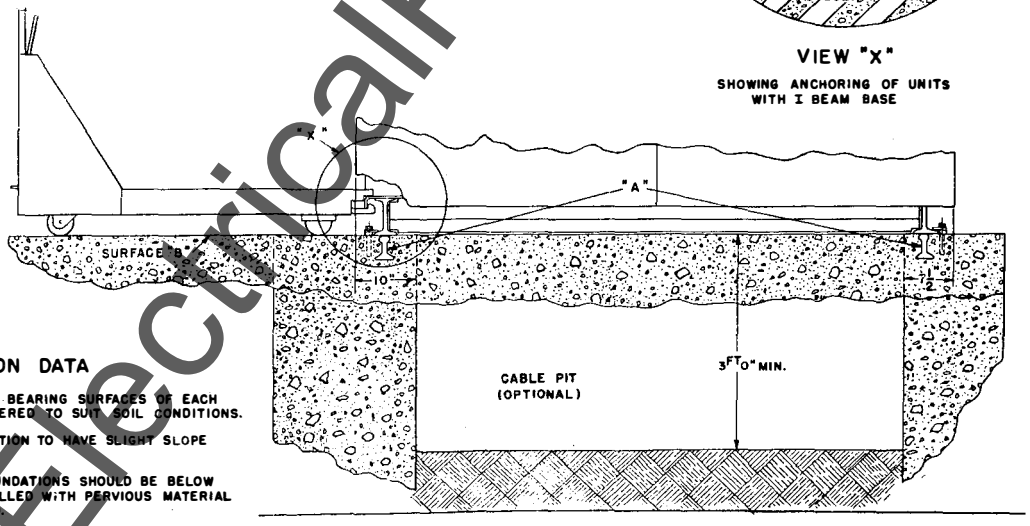

ADJUSTABLE WHEEL VIEW "A"

| TABLE "B" | | |
|---|---|---|
| BKR. | 4.16 | 6FT.1 |
| | 13.8 | 6FT.6 |




VIEW "X"

SHOWING ANCHORING OF UNITS WITH I BEAM BASE




## FOUNDATION DATA

AREA AND DEPTH OF SOIL BEARING SURFACES OF EACH FOUNDATION MUST BE ALTERED TO SUIT SOIL CONDITIONS.

TOP SURFACE OF FOUNDATION TO HAVE SLIGHT SLOPE TO FACILITATE DRAINAGE.

BOTTOM SURFACES OF FOUNDATIONS SHOULD BE BELOW FROST ACTION OR BACKFILLED WITH PERVIOUS MATERIAL AND ADEQUATELY DRAINED.

IF CABLE PIT IS USED – BOTTOM SHOULD BE BACKFILLED WITH PERVIOUS MATERIAL AND ADEQUATE DRAINAGE MUST BE PROVIDED TO PREVENT FROST ACTION AND THE ACCUMULATION OF WATER.

SUPPORTING MEMBERS "A" SHOULD BE SET LEVEL WITH EACH OTHER AND SHOULD BE LEVEL WITH THEIR FULL LENGTH. 5" RAILS RECOMMENDED.

SURFACE "B" SHOULD BE LEVEL WITH SUPPORTING MEMBERS AND LEVEL OVER ITS FULL LENGTH TO INSURE EASY HANDLING OF REMOVABLE ELEMENTS.

Fig. 7 (TT-6432615)

# DESCRIPTION

Each unit is made up of a secondary enclosure and a primary enclosure, as shown in Figure 8.

## SECONDARY ENCLOSURE

The secondary enclosure is usually located at the front or breaker withdrawal side of the unit. It consists of a compartment with a hinged door upon which are mounted the necessary instruments, control and protective devices. The terminal blocks, fuse blocks, and some control devices are mounted inside the enclosure on the side sheets and a trough is provided at the top to carry wiring between units.

## PRIMARY ENCLOSURE

The primary enclosure contains the high voltage equipment and connections arranged in compartments to confine the effects of faults and so minimize the damage.

## BREAKER REMOVABLE ELEMENT

The removable element consists of a circuit breaker with trip-free operating mechanism mounted directly on the breaker frame, interlock mechanism, the removable portion of the primary and secondary disconnecting devices, the solenoid control device and necessary control wiring. The Magne-blast Breakers are equipped with wheels for easy removal and insertion. Refer to Figure 4.

The circuit breaker unit cannot be lowered from its connected position nor raised from its disconnected position, until the breaker has been tripped by the control switch. This is accomplished by a mechanical and electrical interlock. This interlock also keeps the breaker in its tripped position until the connected position is reached (when elevating), or until the test position is reached (when lowering). With this arrangement, the circuit breaker must be tripped prior to any travel of the removable element. A positive stop prevents over-travel of the removable element when raised to its connected position. The secondary disconnecting device coupler is used for connecting outside control circuits to the circuit breaker solenoid control device, solenoid coil, trip coil and auxiliary switches. This coupler makes contact automatically when the removable element is raised to the connected position. A control test jumper is furnished which is plugged into the coupler on the stationary and removable elements when it is desired to operate the breaker in the test position.

All removable elements furnished on a particular requisition and of like design and ratings are completely interchangeable one with the other. The removable as well as the stationary elements are built with factory jigs and fixtures thus insuring interchangeability.

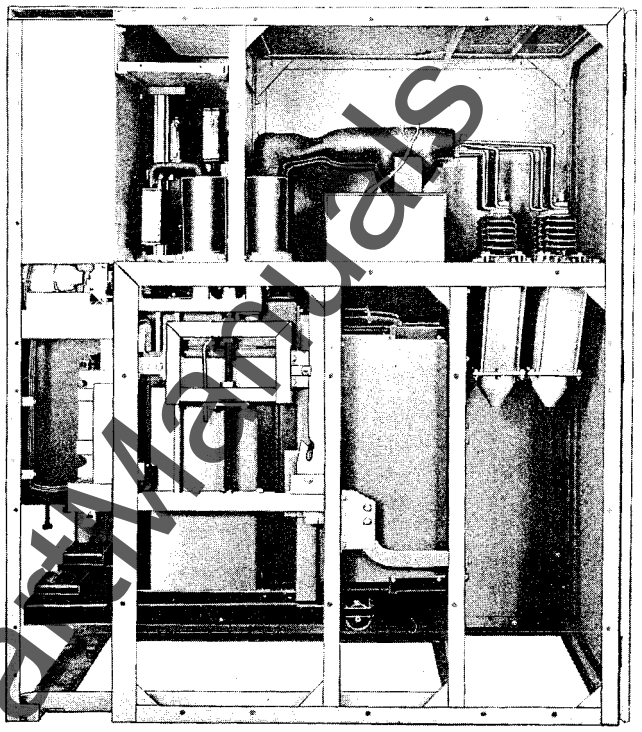


Fig. 8 (8012873)

Fig. 8 Metal Clad Switchgear

## BREAKER ELEVATING MECHANISM

The elevating mechanism for elevating or lowering the removable element to or from its connected position supports the removable element in the operating position. In the test position the breaker is lowered to the guide rails. This mechanism consists of heavy-duty steel jack screws on which are carried nuts to support the elevating carriage. The carriage is so designed that the removable element can be readily inserted or withdrawn after the carriage has been lowered to the disconnected position without necessitating the removal of any bolts, nuts or screws. The breaker cannot be lowered or raised until it has been tripped by the control switch, or if tripped by mechanical trip button, the control switch must have been turned to the trip position. The breaker cannot be closed except with the breaker in either the operating or test position.

Guide rails are built into the Metal Clad frame to guide the removable breaker element into correct position before the breaker is raised into the operating position by means of the elevating mechanism which is motor operated.

## PRIMARY DISCONNECTING DEVICE

The primary disconnecting devices utilize silver to silver contacts to insure against reduction of current carrying capacity due to oxidation of the contact surfaces. These contacts are of the high pressure line contact tube and socket design, the tube being backed up by heavy garter springs to insure contact pressure. Refer to Figure 9.

## BUS COMPARTMENT

The main buses are enclosed in a metal compartment with removable front covers to provide accessibility.

The bus is supported by an insulating material which is practically impervious to moisture, and an excellent dielectric.

The bus insulation is molded on the bars except at the joints where the insulation is completed by means of compound filled boxes.

## CURRENT TRANSFORMER AND CABLE COMPARTMENT

The current transformers are mounted in a compartment isolated from the other equipment. Provision is made in this compartment for connecting the purchaser's primary cable by means of potheads or clamp type terminals.

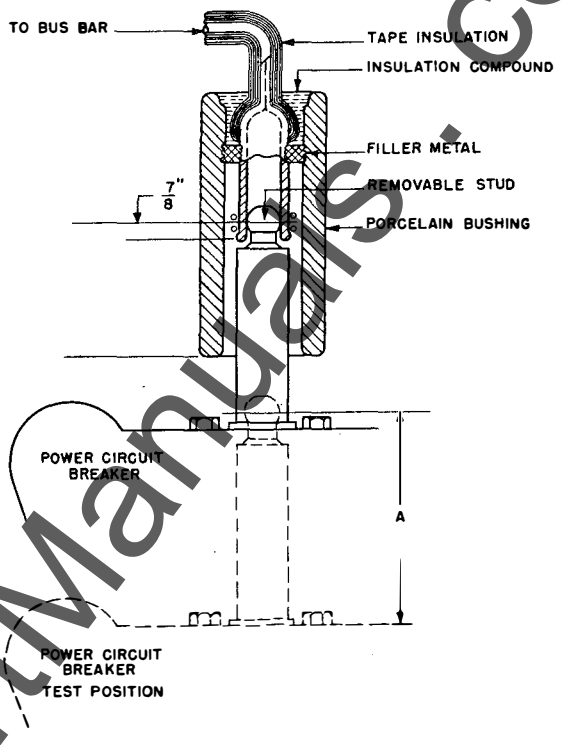



Fig. 9 Measurement of Adjustment of Primary Disconnecting Devices

Fig. 9 Refer to Fig. 34, GEI-25396

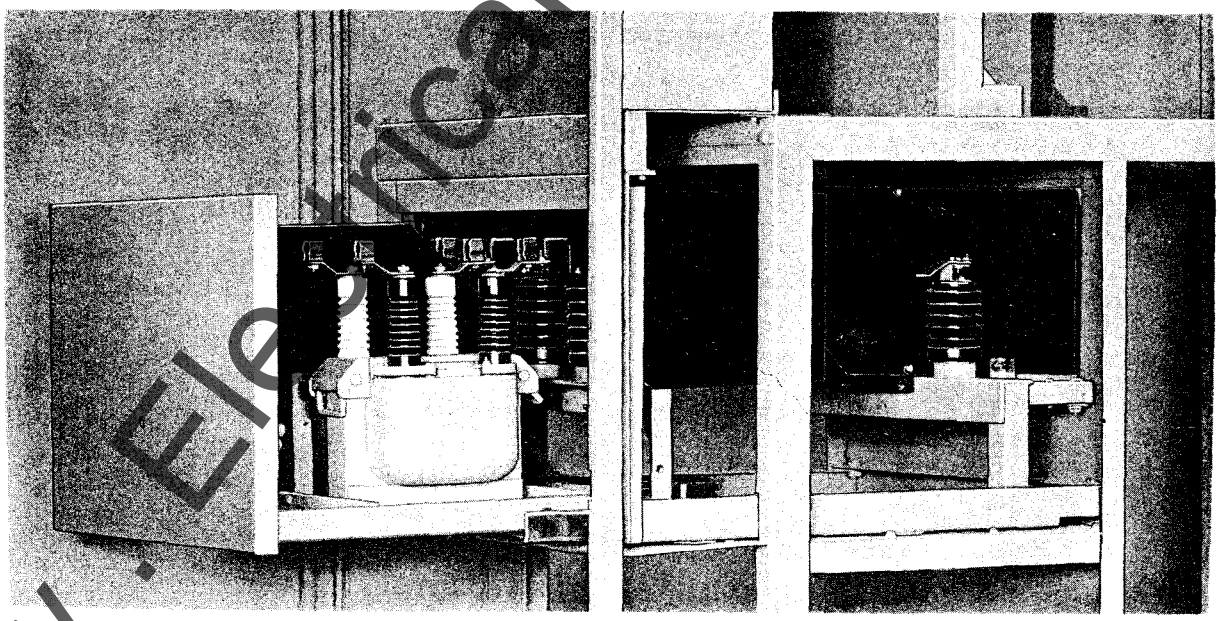
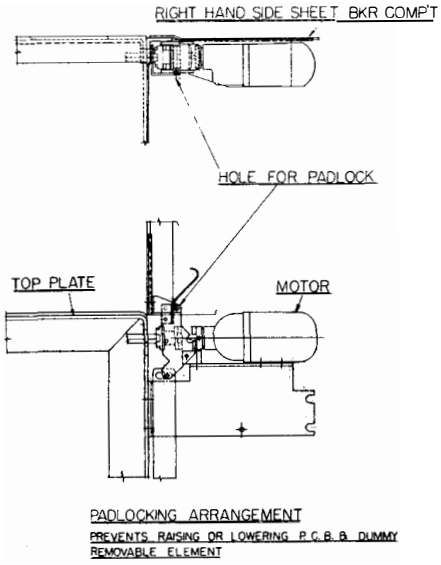
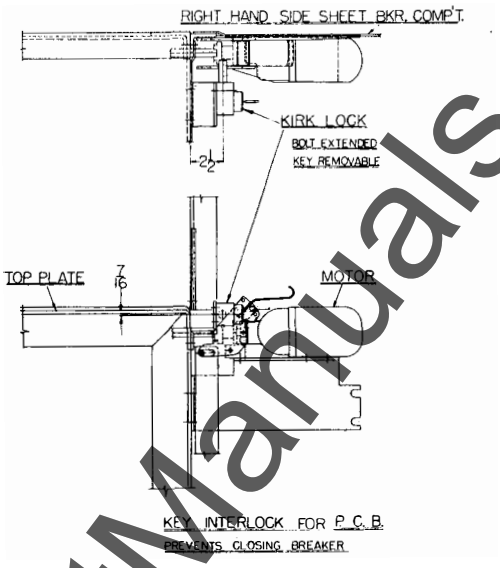
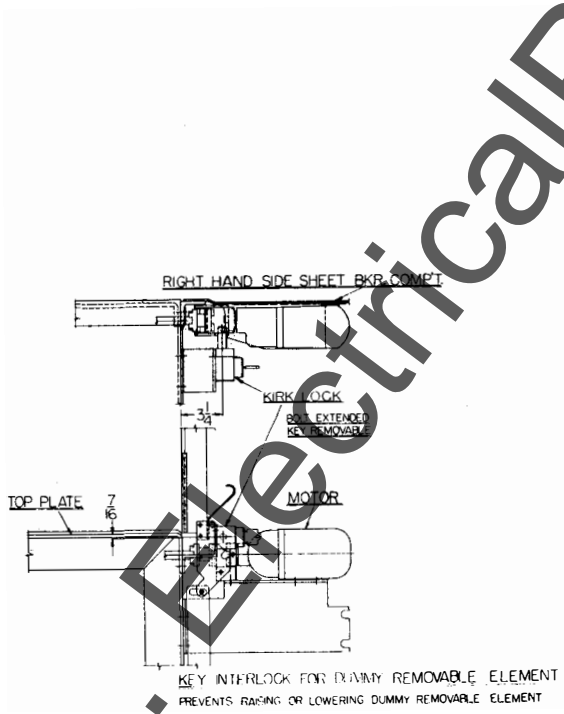


Fig. 10 (8011603)

Fig. 10 Potential Transformer Roll-out Shown In Withdrawn Position



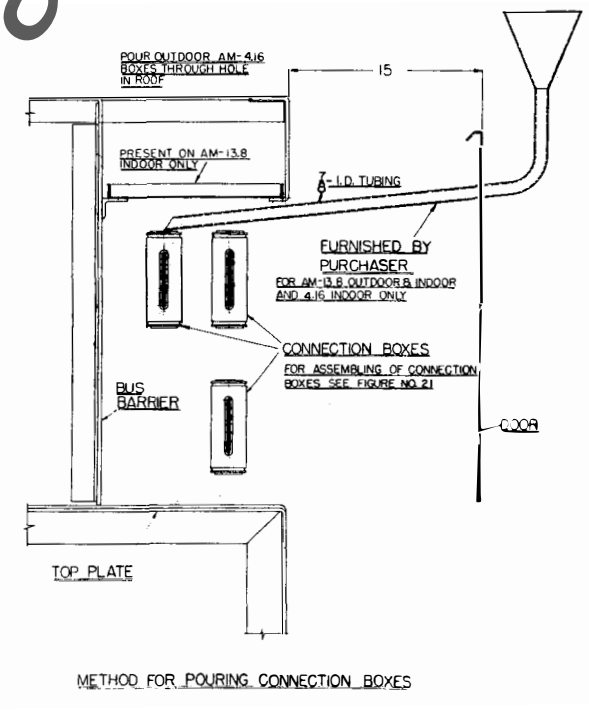




**Fig. 11** **Padlocking Arrangement, Key Interlocking, And Method For Pouring Connection Boxes**

## POTENTIAL TRANSFORMER COMPARTMENT

Potential transformers are located in a compartment above the current transformers or in a separate unit adjacent to the breaker units.

The transformers are mounted on a movable support equipped with primary and secondary disconnecting devices. When the potential transformers are disconnected they are at a safe striking distance from all live parts of the switchgear. In addition a grounding device is provided which contacts the fuses when the potential transformers are disconnected, effectively discharging the transformers. In this position the transformer fuses may be safely removed and replaced. When the carriage is drawn out it moves a barrier in front of the stationary part of the primary disconnecting device. See Figure 10.

## DUMMY REMOVABLE ELEMENT

Dummy removable elements, Fig. 5 are used as a means of isolating circuits or bus sections, where operation is infrequent and a circuit breaker cannot be economically justified. The device consists of a framework to simulate the circuit breaker removable element with a set of six studs similar to those on the metal clad breakers. The lower end of the studs are connected, front to back, by copper bars which are fully insulated and metal enclosed. The stationary structure is the same as for a circuit breaker. When the device is elevated into position it connects the front set of metal clad disconnecting devices to the rear set.

Under no conditions must the dummy element be elevated or lowered when the bus or the unit is energized. Key interlocks are applied to insure that all sources of power are disconnected before the dummy element can be operated. Refer to Figure 11.

## FUSE DISCONNECTING DEVICE

Current limiting fuses with high interrupting rating are sometimes used in metal clad switchgear to protect small transformers or circuits where circuit breakers cannot be economically or functionally justified.

The fuses are mounted on a movable support equipped with disconnecting devices. When the fuses are disconnected, they are at a safe striking distance from all live parts of the switchgear. In addition a grounding device is provided which contacts the fuses after they are disconnected, effectively removing any static charge from the fuses. In this position the fuses may be safely removed and replaced. The disconnecting devices are capable of interrupting transformer magnetizing current, but should not be used to interrupt load current. For larger transformers arc quenchers are furnished to assist the disconnecting devices in interrupting the magnetizing current. Mechanical or key interlocks are applied to prevent operating the disconnecting device while the load is connected. This is generally accomplished by interlocking so that the transformer secondary breaker must be locked in the open position before the disconnecting device can be opened or closed. Refer to Figure 12.

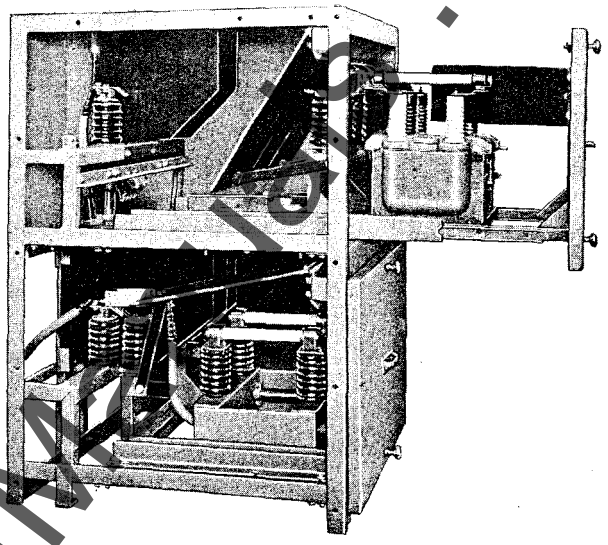


Fig. 12 Potential Transformer And Fuse Rollout Unit

## GROUNDING AND TEST DEVICE

The grounding and test device, Figure 13 provides a convenient means of grounding the cables or the bus in order to safeguard personnel who may be working on the cables or the equipment. The device can also be used for applying power for high potential tests or for fault location, to measure insulation resistance (Megger). By using potential transformers, it can also be used for phasing out cables.

The three studs of the device are similar to those of the metal clad circuit breakers. The studs are mounted on a removable plate which can be placed in either of two positions. In one position the studs will engage the front (Bus) contacts only and in the other position the studs will engage the rear (Line) contacts only of a metal clad unit.

To indicate the proper placement of the studs on the device, opposite sides of the assembly are marked "Line" and "Bus". The word corresponding to the desired position must be toward the operator.

To use, the device is rolled into the metal clad housing in place of the circuit breaker, and raised into or lowered from the connected position by means of the circuit breaker elevating mechanism.

Fig. 12 (8003W0)

AAH

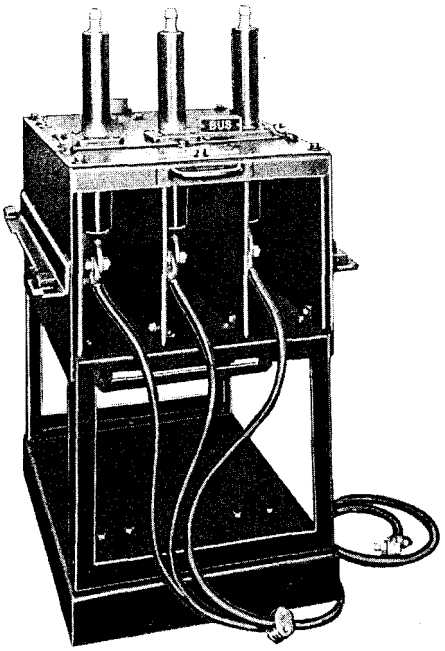



Fig. 13 Ground And Test Device
(Cable shown not furnished by G.E. Co.)

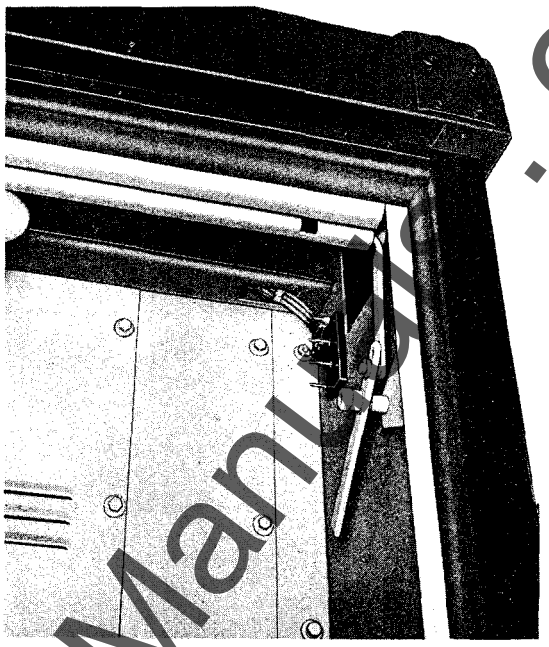


Fig. 14 Tandem Lock For Outdoor 13.8 Units

Fig. 13 (8004507)

Fig. 14 (8011450)

## TANDEM LOCK (WHEN FURNISHED) FOR OUTDOOR UNITS

Outdoor Metal Clad equipments with more than one unit may be provided with a tandem locking arrangement which makes it necessary to padlock only one door on each side. (In exceptionally long installations two or more locks may be required on each side). The unit containing the operating arm of the tandem lock is clearly marked on the drawings and also by nameplate on the equipment itself.

Before any door in the equipment can be opened it is necessary to open the padlocked door and operate the tandem locking arm to the open position. In locking the equipment the reverse procedure should be used.

Where it is desired to separately lock any particular door, the tandem lock can be disconnected in that unit by unbolting a connecting clip between the tandem bar and the locking bar, and a separate padlock used on that door. Refer to Figure 14.

The light switch, front and rear, will be located in the units with the tandem lock.

# INSTALLATION

Before any installation work is done consult and study all drawings furnished by the General Electric Company for the particular requisition.

These drawings include arrangement drawings, wiring and elementary diagrams and a summary of the equipment.

## LOCATION

The recommended aisle space required at the front and at the rear of the equipment is shown on the floor plan drawing furnished for the particular requisition. The space at the front must be sufficient to permit the insertion and withdrawal of the circuit breakers, and their transfer to other units. The space at the rear must be sufficient for installation of cables, for inspection and maintenance, and on some equipments to draw out potential transformers.

### PREPARATION OF FLOOR - ANCHORING

Indoor Equipment

The station floor must be strong enough to prevent sagging due to weight of the switchgear structure and to withstand the impact stress caused by the opening of the circuit breakers under short circuit conditions. The impact loading is approximately 1 1/2 times the static load.

Fig. 15 (8004920)

Suitable means must be provided by the purchaser for anchoring the equipment to the floor. It is essential that the floor be level to avoid distortion of the switchgear structure and the equipment be completely aligned prior to final anchoring. The recommended floor construction is shown in Figure 6. The floor channels must be level and straight with respect to each other. Steel shims should be used for final leveling of the switchgear if necessary. Care should be taken to provide a smooth, hard, and level floor under and in front of the units to facilitate installation and removal of the breaker. If the floor is not level and flush with the floor channels, it will be difficult to handle the breaker because it will not be level with respect to the stationary element.

Recommended practice is to weld the switchgear structure to the floor channels, using a tack weld at points indicated for anchoring on the drawing. If welding facilities are not available the gear should be bolted to the floor channels.

Provision should be made in the floor for conduits for primary and secondary cables, located as shown on the floor plan drawing furnished for the particular requisition. If desired, the conduits may be installed before the switchgear. Consideration should be given to conduits which might be required for future connections.

Outdoor Equipments

Recommendations for the foundations for outdoor equipment are given in Fig. 7. Primary and secondary conduits should be installed in accordance with the requisition drawings, before the equipment is put into place.

Since outdoor equipments are provided with a 6" base a transfer truck is required to place the breaker in the housing. The level adjustment on the truck is shown on Fig. 7.

When outdoor equipments are shipped in more than one section, the joint in the roof between sections must be weather-proofed. Apply G.E. #1201 Glyptal cement to the gaskets which are furnished and assemble the gasket between the roof flanges and bolt together. See Figure 16. Joints between transformer throats and the switchgear should be weatherproofed in the same manner. Refer to Figure 15.

BREAKER REMOVABLE ELEMENT

Before installing or operating the removable element consult the circuit breaker instructions for directions on installation, adjustments and inspection. The operation of the interlock device is given below.

The elevating mechanism is accurately leveled and checked at the factory and should need no adjustment. Do not install or remove the breaker or make any adjustments unless the breaker is open.

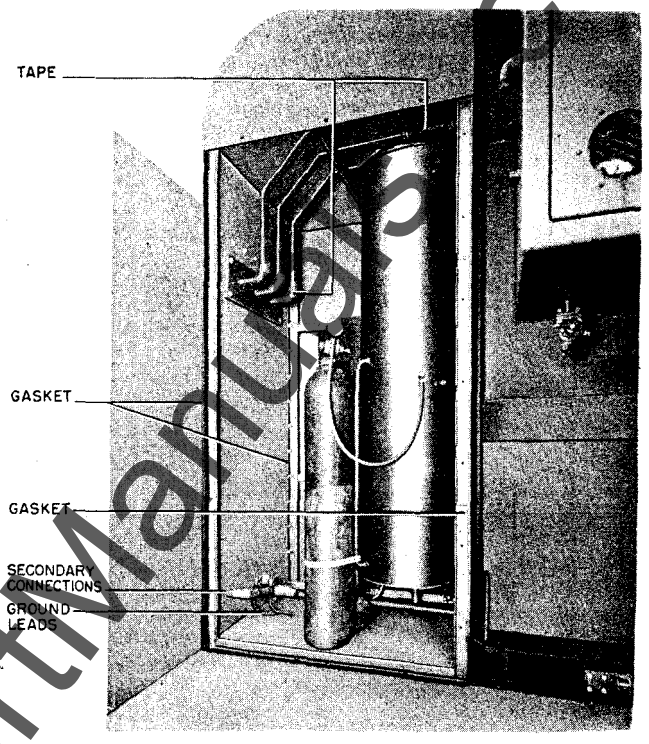



Fig. 15 Unit Substation Transition Compartment

Rub a small amount of Contact Lubricant D50H28 on the silvered portion of the breaker studs to form a thin coating for contacting purposes.

Lower the elevating mechanism lifting brackets by means of the switch until the lifting brackets are in the fully lowered or test position. The breaker should then enter the housing freely. The lower limit switch can be adjusted, if necessary, to allow the breaker to enter the housing. Push the breaker into the housing until it rests against the stop at the rear of the elevating mechanism frame. This stop has been adjusted at the factory so that the breaker will be in the correct position relative to the lifting brackets. Raise the lifting brackets until the breaker is lifted clear of the floor. Check to see that the breaker is properly seated on the lifting brackets.

Carefully raise the breaker to the connected position where the breaker plate or support solidly meets the upper stop bolts on the frame and then lower and remove it from the unit. When elevating, note that breaker studs center with respect to the stationary disconnecting device or injury to the contacts may result.

AAH

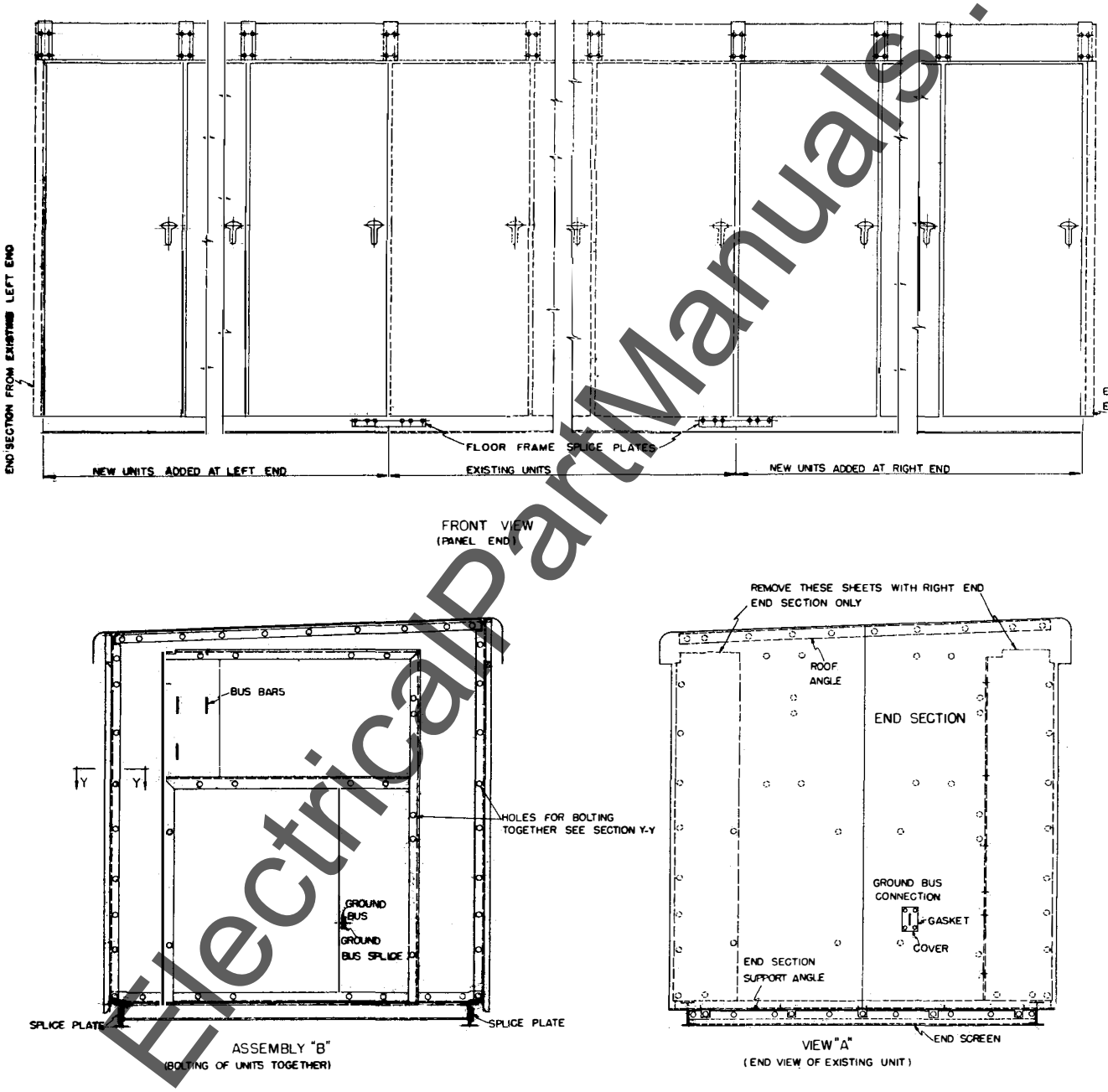
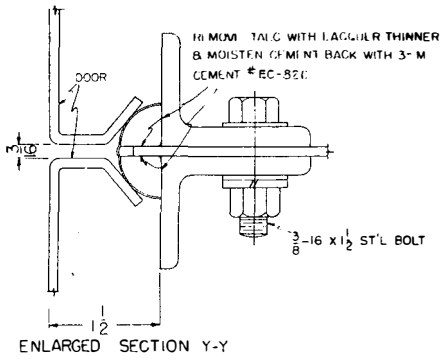



Fig. 16 (T-991295D)

**Fig. 16 Outdoor Metal Clad Switchgear**



ENLARGED SECTION Y-Y

PROCEDURE

1- REMOVE ROOF CAP, END SCREEN, GROUND BUS CONNECTION, AND END SECTION, (INCLUDING COMPARTMENT SIDE SHEETS ON RIGHT END ONLY), REMOVE END SECTION SUPPORT ANGLE, AND ROOF ANGLE – SEE VIEW "A"

2- SET NEW UNIT(S) IN PLACE AND BOLT TOGETHER AS SHOWN IN ASSEMBLY "B"

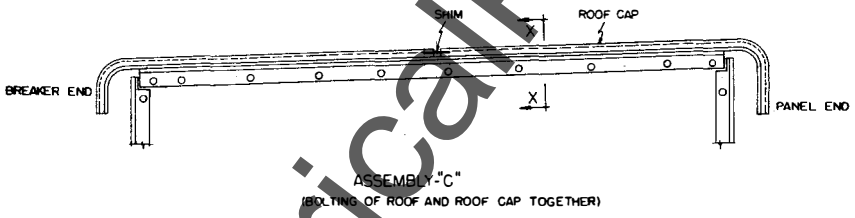
3- ASSEMBLE ITEMS LISTED IN PROCEDURE NO. 1

4- ASSEMBLE NEW ROOF CAPS AS SHOWN IN ASSEMBLY "C"

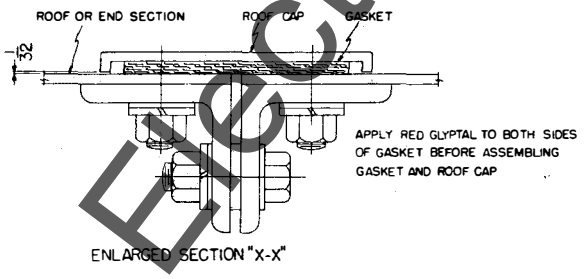
5- ASSEMBLE SPLICE PLATE FRONT AND BACK BETWEEN EXISTING AND NEW FLOOR FRAME AS SHOWN ON FRONT VIEW

6- ASSEMBLE GROUND BUS SPLICE BETWEEN EXISTING AND NEW GROUND BUS AS SHOWN IN ASSEMBLY "B"

7- ASSEMBLE BUS BARS AND CONNECTION BOXES PER INSTRUCTION BOOK FIG. 21



ASSEMBLY-"C"
(BOLTING OF ROOF AND ROOF CAP TOGETHER)



ENLARGED SECTION "X-X"

Fig. 16 (T-9912959)

- Addition Of Units To Line-up

Inspect the contact surfaces of both the breaker studs and the stationary disconnecting devices.

(a) Each segment of the stationary disconnecting device should make a heavy impression in the Contact Lubricant D50H28 on the breaker studs.

(b) The wipe of the breaker stud inside the stationary disconnecting device, as indicated by the Contact Lubricant D50H28 should be 7/8". This indicates that the breaker studs contacted at the full pressure center of the silver band on the stationary disconnecting device. The maximum permissable variation in the wipe is 3/32".

(c) Should the inspection of the contacts show that the breaker is not being raised to the proper position readjust the upper stop bolts and limit switches to raise or lower the breaker to the proper location. Lock the stop bolts in the new position.

(d) If proper contacting cannot be attained by the above methods, it is necessary to adjust the stationary disconnecting device tube. DO NOT MAKE ANY ADJUSTMENT. COMMUNICATE WITH THE NEAREST GENERAL ELECTRIC CO. OFFICE FOR ADDITIONAL INFORMATION.

The trip interlock, see Figure 4, should be checked to see that the breaker cannot be raised to or lowered from the operating position unless the breaker has been tripped and the control switch is in the "tripped" position.

The breaker is provided with an arm which is pushed forward or pulled back when the breaker is open or closed. This arm engages and holds a vertical bar when pulled back (breaker closed) and prevents the clutch being pulled forward to engage the motor, See Figure 17. When the breaker has been tripped the clutch can raise the vertical bar and engage the motor. A limit switch on the vertical bar closes the electrical circuit to the motor, if the control switch has been turned to the "trip" position and the elevating control selector switch has been turned to either "raise" or "lower". Refer to Fig. 18.

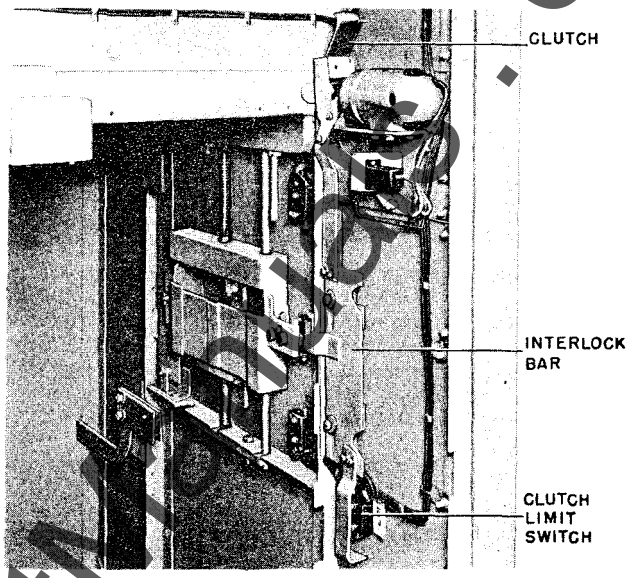



Fig. 17 View Showing Positive Interlock, Elevating Motor and Elevating Mechanism

Fig. 17 (8012855)

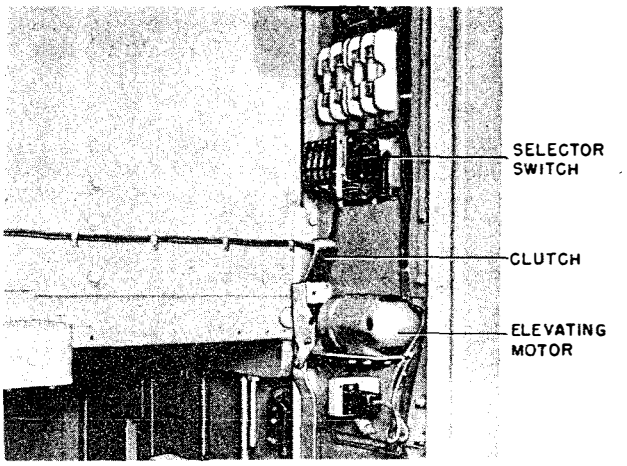



Fig. 18 View Showing Elevating Mechanism Motor and Control Unit

Fig. 18 (8012855)

## TESTING CABINET

The testing cabinet, Figure 19, should be installed on the wall at a location where maintenance and testing of the breaker can be conveniently done. Conduits must be installed to carry cables to supply control power for testing.

## ADDITION OF UNITS TO EXISTING EQUIPMENT

Figure 16 indicates the special procedures involved to add new metal clad units to an existing equipment. Otherwise the installation procedure is the same as described above.

# CONNECTIONS

## BUS BARS

Where bus bar connections are made to join groups or separate units together, proceed as follows:

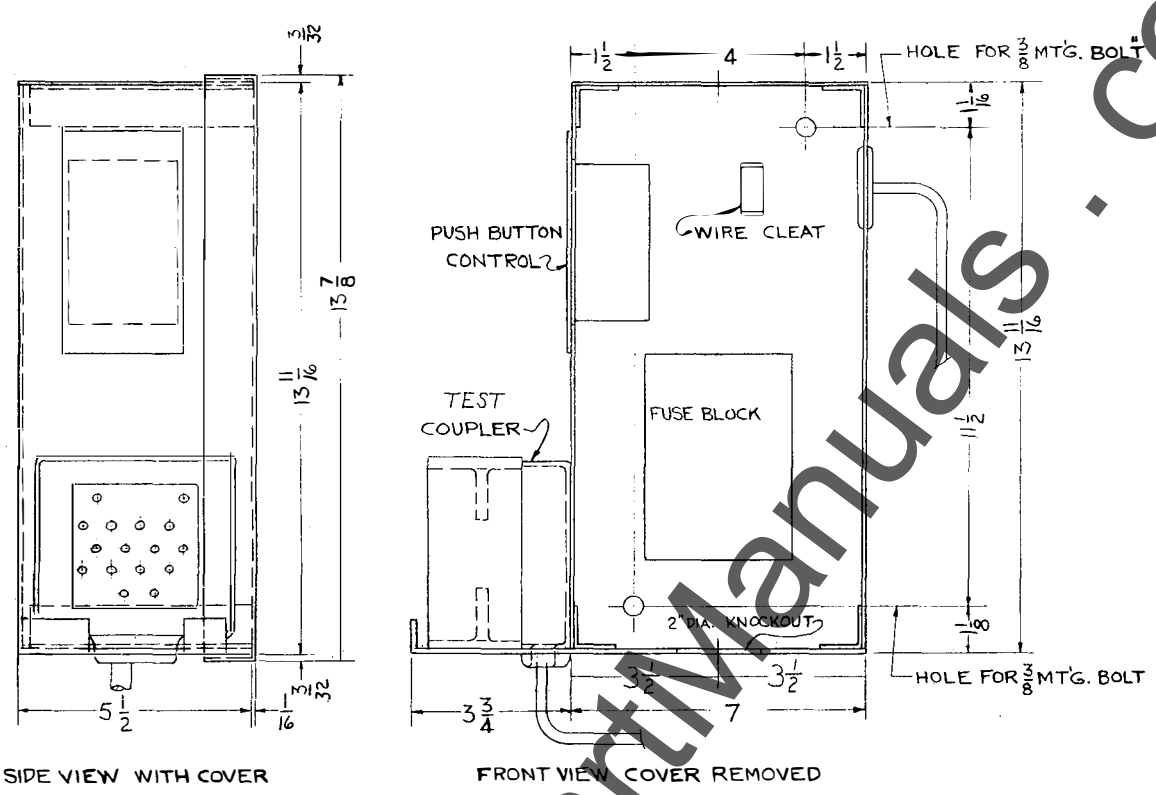



Fig. 19 (K-6515226)

**Fig. 19 Inspection Box For 13.8KV Metal Clad Switchgear**
**(Dimensions Are For Box For D.C. Control Power)**

(a) Remove compartment covers.

(b) Bolt splice plates and bus bars together, see Figure 20. Clean silvered contacts with silver polish. Be sure all polish is removed. Do not use sand paper.

(c) Complete the taping of the vertical riser bars using varnished cambric tape (2/3 lap) stopping the tape at the bus bar. If the riser bars connect to the bus from below, sufficient tape should be added to prevent compound leakage when filling. Apply a layer of cotton tape (1/2 lap) over the varnished cambric tape, stopping the cotton tape just inside molded splice cover.

(d) Place molded covers around the bolted splice joints. Note that compound filling space is at top of joint, and add filler pieces furnished for the purpose to the bottom of box and around bus bar laminations (Fig. 20) to prevent compound leakage while filling. Duxseal should be placed over the joints to make the box free of leaks while filling. The duxseal should be removed after the compound has set. G. E. #860 cord should be used to hold the molded parts securely in place.

(e) Heat G.E. #1347 compound (furnished) to minimum 200°C and maximum of 220°C. Avoid overheating the compound for the dielectric strength may be seriously affected. Pour the compound into the molded covers intermittently, allowing an interval of cooling to prevent formation of gas or air pockets.

Fig. 20 (K-6503903)

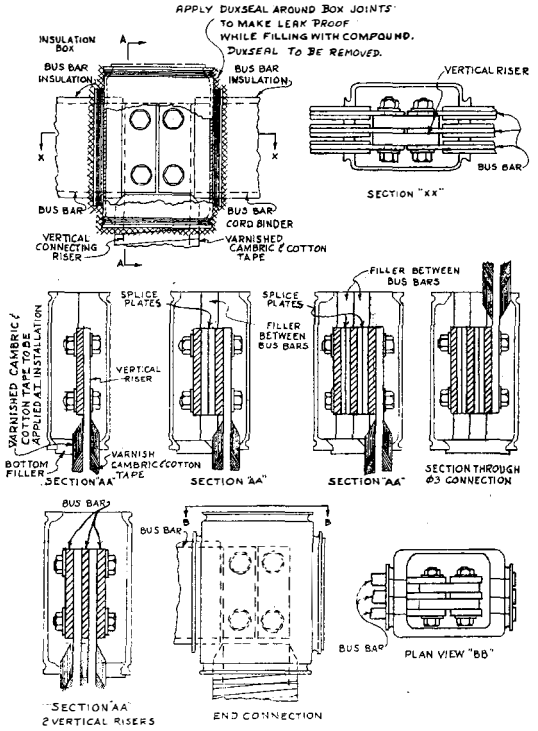



**Fig. 20 Method of Making Bus Bar Connections**

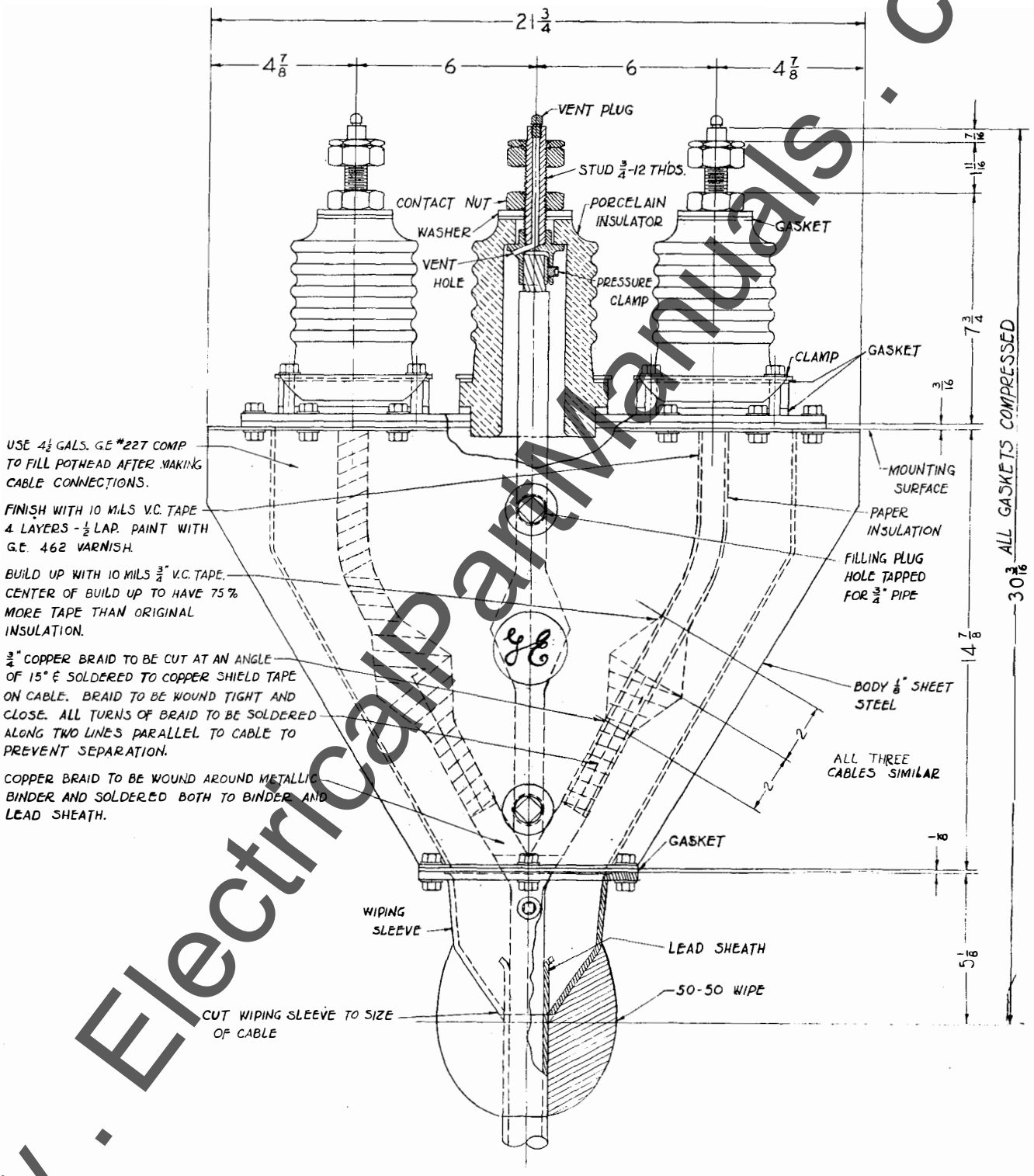



Fig. 21 Pothead

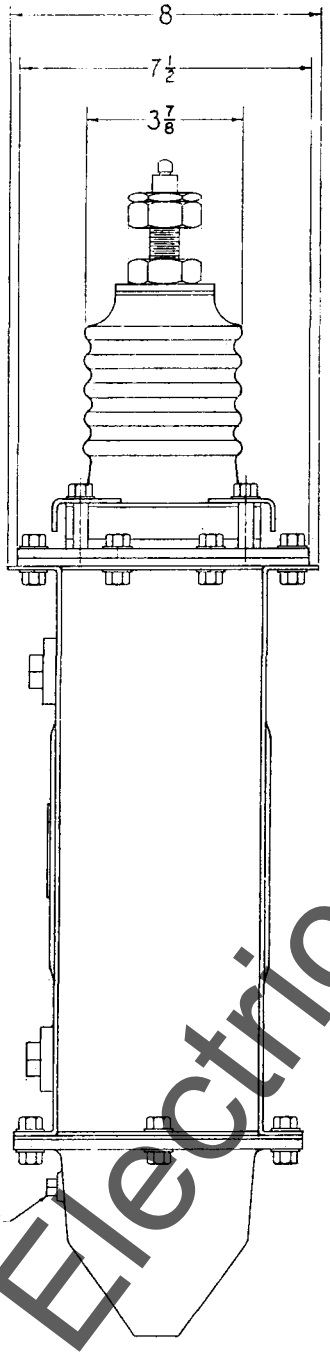
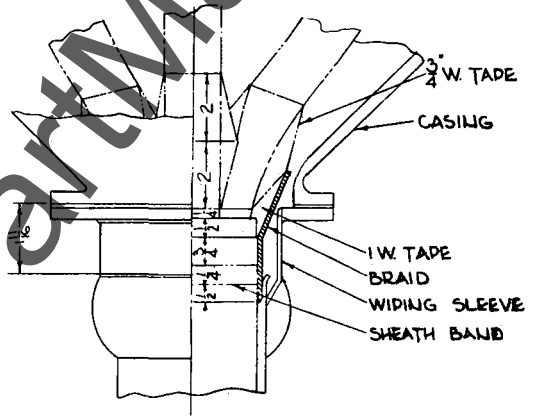



Fig. 21 (T-659322)

FOR "BELTED" CABLE

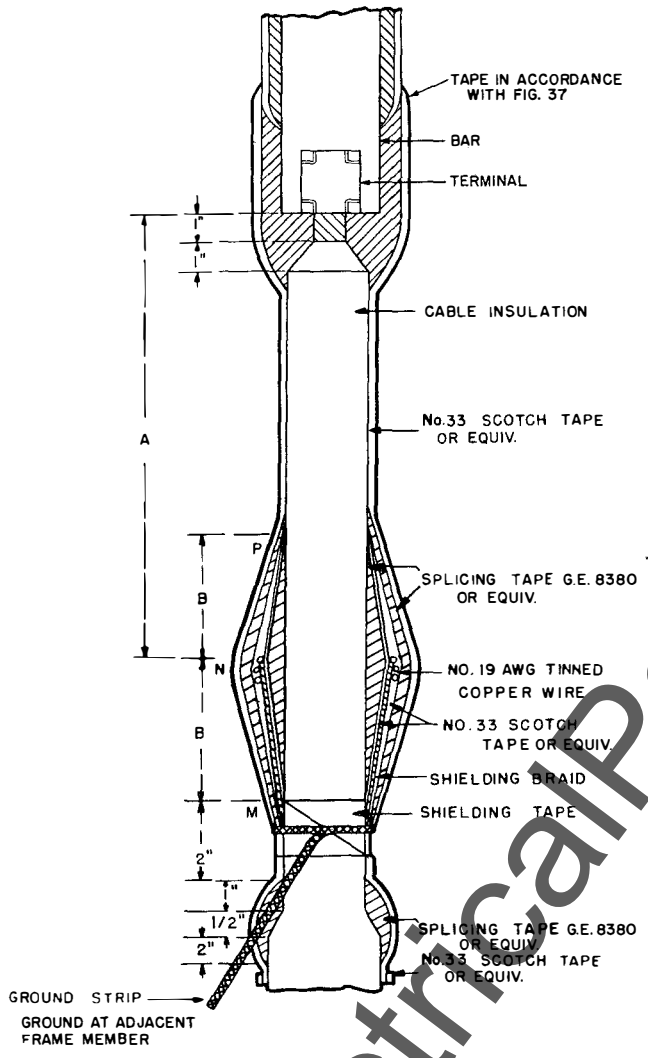
APPLY $\frac{3}{4}$" TAPE IN FIRMLY DRAWN WRAPPINGS ON EACH CONDUCTOR IN THE REGION OF THE CABLE-CROTCH, AS INDICATED ON THE DRAWING. THE AXIAL DIMENSIONS FOR THE REINFORCEMENT ARE INDICATED. THE MAXIMUM THICKNESS OF THE APPLIED TAPE SHOULD EQUAL APPROXIMATELY THAT OF THE ORIGINAL CONDUCTOR-INSULATION. AFTER COMPLETION OF THE INDIVIDUAL REINFORCEMENTS, APPLY 1" WIDTH TAPE OVER THE THREE CONDUCTORS FORCED TOGETHER IN THE CROTCH REGION.

SHIELD A PORTION OF THE OVERALL REINFORCEMENT AS INDICATED. TRIM ONE END OF THE COPPER-BRAID TO AN ANGLE APPROXIMATELY 15 DEG., AND LAY IT ON THE SHEATH-BAND WITH THE CUT EDGE TOWARD THE SHEATH. SOLDER-ATTACH IT TO THE SHEATH. THEN COVER THE SHEATH-BAND, EXPOSED BELT-INSULATION, AND THE ADJACENTLY TAPERED SURFACE OF OVERALL REINFORCEMENT, WITH A SINGLE LAYER OF TIGHTLY DRAWN BUTT WRAPPINGS OF BRAID AS SHOWN. SOLDER TOGETHER ALL TURNS ON OPPOSITE SIDES OF THE CABLE, AND TERMINATE THE BRAID BY CUTTING $\frac{1}{2}$" BEYOND A SOLDERED POINT. THE LOOSE END OF THE BRAID SHOULD BE TURNED BACK AND SOLDERED TO THE PRECEDING TURNS SO THAT NO FRAYED ENDS OF COPPER EXTEND OVER THE VARNISHED CLOTH.




METHOD OF STRESS RELIEF FOR BELTED LEADED CABLE

NOTE:
PHASE ROTATION TO BE CHECKED BEFORE CONNECTING TO POTHEAD TERMINALS.
ALL GASKETS AND GASKETED SURFACES TO BE COATED WITH GLYPTAL BEFORE MOUNTING AND CLAMPING IN PLACE




| +Rated kv Phase to Phase | Dimensions in Inches | |
|---|---|---|
| | A | |
| | Indoors Dry Locations | B |
| 2 to 5 | 5 | 2 |
| 6 to 10 | 9 | 3 |
| 11 to 15 | 13 | 4 |

+ For ungrounded neutral use 1.33 times phase-to-phase voltage in selecting distance A.

1. Cut cable to proper length.

2. Remove jacket and cable tape for distance of A plus B plus 3 inches, plus length to be inserted into terminal lug.

3. Unwrap shielding tape to point M, cut and solder it in place avoiding excessive heat on insulation. Remove outer semi-conducting tape for same distance. Thoroughly clean surface from which the semi-conducting tape was removed.

4. Remove insulation and inner semi-conducting tape to expose conductor for distance of one inch plus length to be inserted into terminal lug.

5. Attach terminal lug to conductor.

6. Taper insulation for one inch as shown.

7. Apply end seal. Clean surface over which splicing tape is to be applied and coat with G-E No. A50P68 adhesive cement or equivalent. When solvent evaporates, build up with splicing tape GE8380 or equivalent, as shown.

8. Build stress cone. Clean cable surface and coat with G-E No. A50P68 adhesive cement or equivalent. When solvent evaporates build up cone with splicing tape GE8380 or equivalent, for length B plus B. Between points M and P, tape is applied so that wrapped thickness at N is equal to 75% of the original insulation thickness - and so that the cone tapers to zero thickness at points M and P. Apply one layer No. 33 Scotch tape or equivalent, half lapped. Obtain a smooth wrapping but do not stretch tape more than necessary.

9. Pass a turn of tightly drawn braid around exposed portion of shielding tape at point M and solder in place. Then apply shielding braid in tightly drawn 1/16 inch lamp wrappings to point N and spot solder. Terminate the braid by cutting 1/2 inch beyond soldering point. Turn down and solder loose ends to preceding turns. Wrap four to six turns of No. 19 Awg tinned copper wire around shielding braid and solder. Solder all turns of braid together along three lengthwise lines equally spaced around braided surface.

10. Solder-attach ground strip over shielding tape near cable covering. Cover stress cone with one layer No. 33 Scotch tape, half lapped. Obtain a smooth wrapping but do not stretch tape more than necessary. Add two layers of splicing tape.

11. Pencil jacket for 1/2 inch as shown. Clean surface. Take particular care in cleaning outside jacket surface in order to entirely remove black wax finish. Coat with G-E No. A50P68 adhesive cement or equivalent. When solvent evaporates, apply splicing tape, GE8380 or equivalent and make sheath seal as shown on drawing. Apply one layer No. 33 Scotch tape or equivalent, half lapped. Obtain a smooth wrapping but do not stretch tape more than necessary.

12. Over entire termination apply two layers of No. 33 Scotch tape or equivalent, half lapped, in manner to shed water. Obtain a smooth wrapping but do not stretch tape more than necessary.

Fig. 22 (B-2300-C)

Fig. 22 Termination Non-Leaded Cable Single Conductor

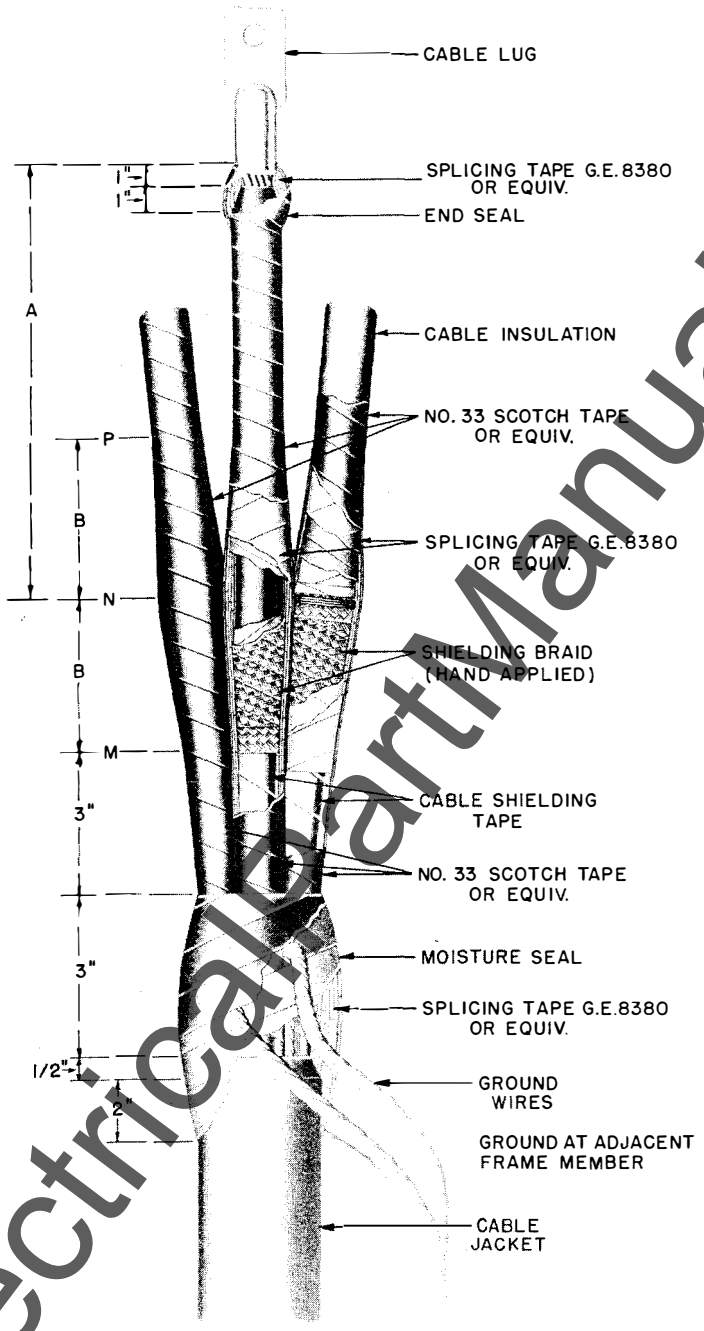



Fig. 23 (B-23204-C)

Make termination as indicated for single conductor except - substitute the following for paragraphs 10, 11 & 12.

Pencil Geoprene jacket 1/2 inch. Clean surface over which sheath moisture seal is to be applied. Take particular care in cleaning outside jacket surface in order to entirely remove black wax finish. Coat with G-E No. A50P68 adhesive cement or equivalent. Allow to dry. Apply splicing tape, GE8380 or equivalent, to make moisture seal as shown. This is done by starting wrapping tape near end of jacket and wrapping over ground wires for 1-1/2 inches. Bend ground wires out and back over taping just applied and continue applying lapped layers of tape to completion of moisture seal including a complete tape seal in crotch formed between the three conductors. Bond and ground the ground wires.

For a multi-conductor cable not having ground wires, the individual terminations should have grounding strips applied as for a single conductor termination. These grounding strips are to be joined together to a common ground. This common ground must then be grounded.

Fig. 23 Termination Non-Leaded Cable Multi Conductor

The final pouring, should be level with the top of the box and should be done only after due allowance for shrinkage is made. Refer to Figure 11.

(f) Paint the exposed cotton tape on vertical riser bars with G. E. #1201 varnish.

(g) In unit substations, the connection bars should be assembled in the Transition Compartment (Fig. 15) and the connections at the transformer terminals taped and painted as indicated above. The conduit for secondary circuits should also be assembled in the Transition Compartment.

PRIMARY CABLES

Before any primary cable connections are made, the cables should be identified to indicate their phase relationship with the switchgear connections. This is necessary to insure that motors will rotate in the proper direction, and that the phase rotation is the same when interconnecting two different sources of power.

There are two common methods of making primary cable connections:

(a) Potheads, see Figure 21, are used when it is desired to hermetically seal the end of the cable to make a moisture proof connection between the cable and the switchgear copper. A pothead also prevents seeping of oil from the end of oil impregnated varnish cambric or paper insulated cable.

(b) Clamp type terminals and wiping sleeve or cable clamp. In all cases carefully follow the cable manufacturer's recommendations for installation of the type of cable being used, as well as the instructions contained herein, see Figs. 22 and 23.

POTHEADS

Potheads are mounted on an adapter plate extending across the width of the metal clad unit as shown in Figure 8. The adapter plate is split into two parts to facilitate the installation of the potheads. The potheads will usually be shipped arranged for cables to enter from below, however the steel and copper is entirely interchangeable for the potheads arranged for cable entrance from above.

Three Conductor Potheads

The following description applies to the installation of a three conductor lead sheathed cable with a wiping sleeve cable entrance fitting on the pothead. This is the type most generally used. Instructions for installation of other types are included in the text following.

(a) Remove the wiping sleeve from the pothead and cut the tapered end at a point where the cable will enter it freely, and file off sharp edges. Tin the sleeve by applying flux and dipping in hot solder. Temporarily assemble the wiping sleeve and gasket on the pothead.

(b) Train the cable in front of the pothead allowing it to extend about two inches above the top of the porcelain bushings. When training the cable handle with care and avoid sharp bending which might damage the insulation. Mark a point on the lead sheath of the cable about 1 1/2 inches above the bottom of the wiping sleeve.

(c) Remove the pothead from the unit, and slip the wiping sleeve and its gasket over the cable as shown in Figure 24.

(d) Remove the lead sheath from the cable to the point marked in operation "b" as shown in Figures 25 and 26 proceeding as follows:

First make a cut around the cable half through the sheath at the reference point. Second, split the sheath lengthwise between the cut and the cable, holding the cutting tool at an angle to the cable radius to avoid damaging the insulation. Third, remove the sheath by catching the split edge with pliers and pulling directly away from the cable axis.

Clean and tin the outside of the lead sheath for about 3 inches and bell out the end of the lead sheath.

(e) Remove the belt and interphase insulation down to within 1 1/2 inches of the lead sheath as shown in Figure 27. The last few layers should be torn off to avoid damaging the individual conductor insulation. To reinforce and protect the conductor insulation, wrap two layers of half lapped varnished cambric tape over the factory insulation.

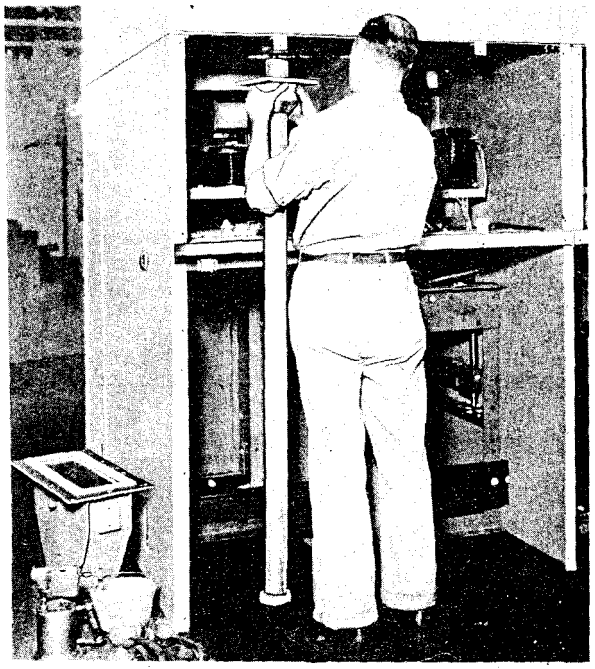


Fig. 24 Slipping Wiping Sleeve and Gasket Over Cable

Fig. 25 (857622)

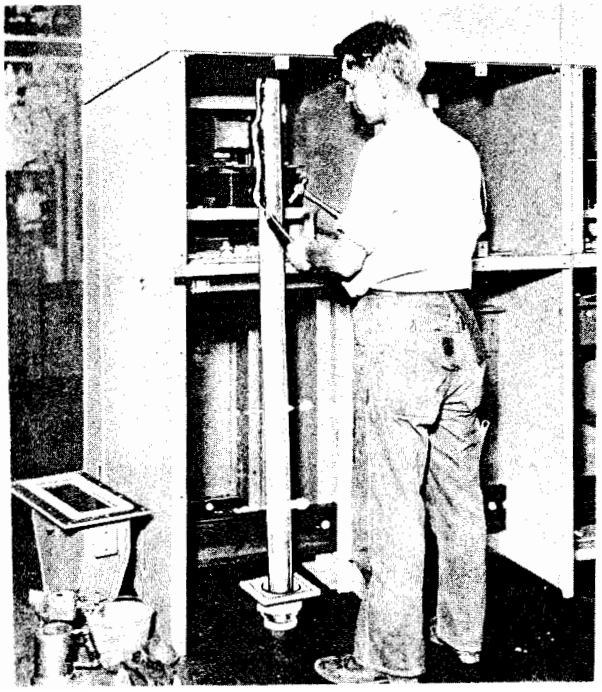


Fig. 25 Second Step In Removing Lead Sheath

Fig. 26 (857621)

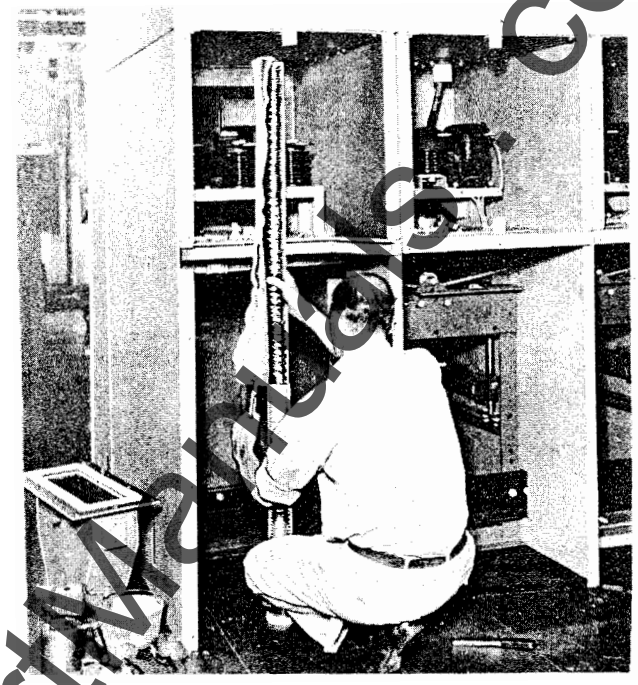


Fig. 26 Third Step In Removing Lead Sheath

Fig. 27 (857613)

Fig. 27 Removing Belt and Interphase Insulation

Fig. 28 (857611)

Fig. 28 Approximating Final Position

(f) Place pothead body over cable and then fan out the conductors into approximately the final position, as shown in Figs. 28 and 29. The middle conductor shouldbe bowed slightly for final adjustment of length. Avoid sharp bends and damage to the nsulation, particularly at the crotch.

(g) For system voltage above 7500 volts it is recommended that stress relief cones be built up when single conductor or three conductor shielded cable is used. Construct stress relief cones in accordance with the recommendations of the cable manufacturer. See Figure 21 for one recommended method. On lower voltage cables, belling out the endof the lead sheath, ordinarily provides sufficient stress relief. (Stress cone material will not be furnished with pothead).

(h) Bolt pothead body to metal clad adapter plate. Shape conductor into final position then cut off each conductor to fit its terminal.

(i) Remove 2 inches of insulation from the end of each conductor and assemble pothead terminals as shown in Fig. 30. Potheads are furnished with standard cable solderless lugs.

(j) Bolt insulators and support and wiping sleeve to the pothead body. Thoroughly clean all gaskets and gasket surfaces. Cement all gaskets with G. E. Glyptal #1201. Compress gaskets by a part al turn on each bolt successively until the

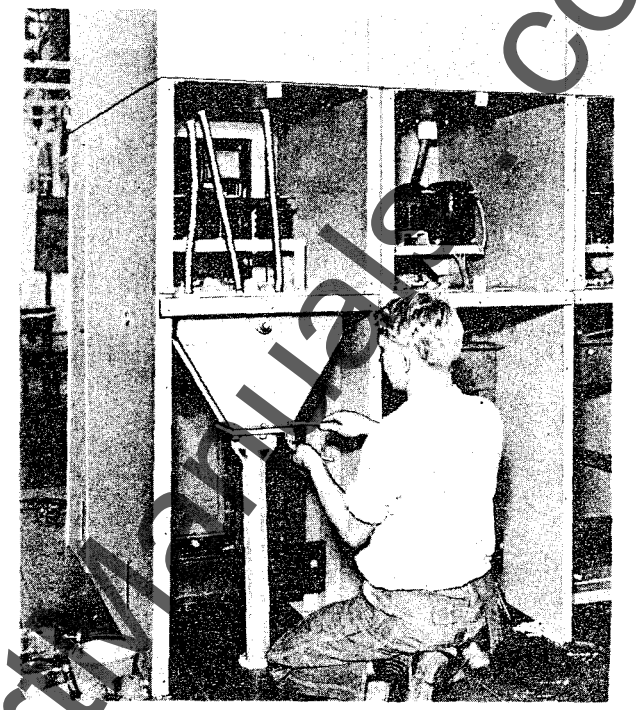


Fig. 29 Bolt Wiping Sleeve To Pothead Body

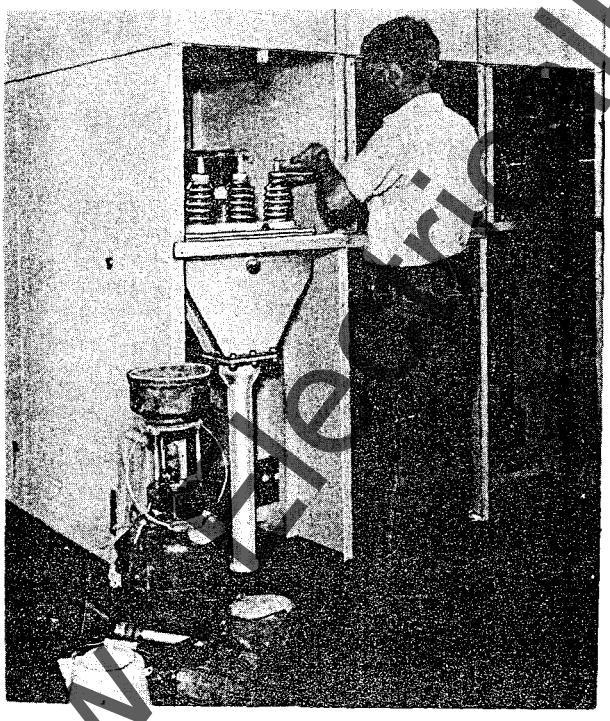


Fig. 30 Tightening Contact Nut

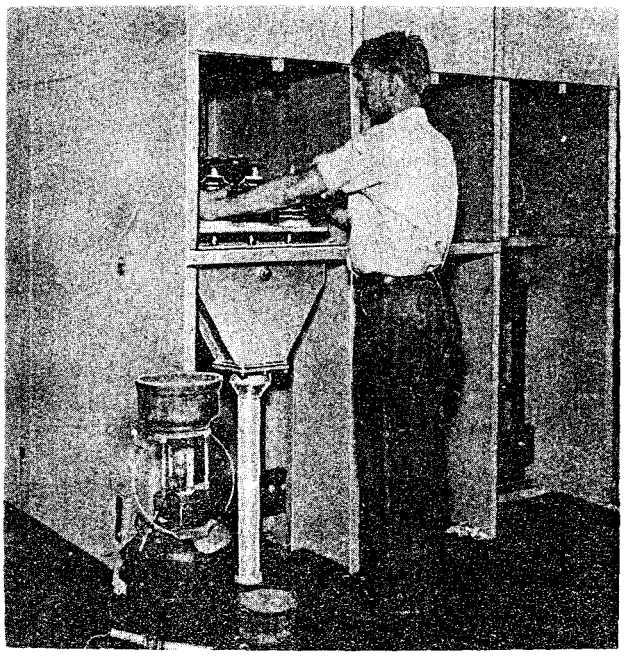


Fig. 31 Checking Terminal Stud Seating

Fig. 29 (857606)

Fig. 30 (857610)

Fig. 31 (857619)



AAH

Fig. 32 (857609)

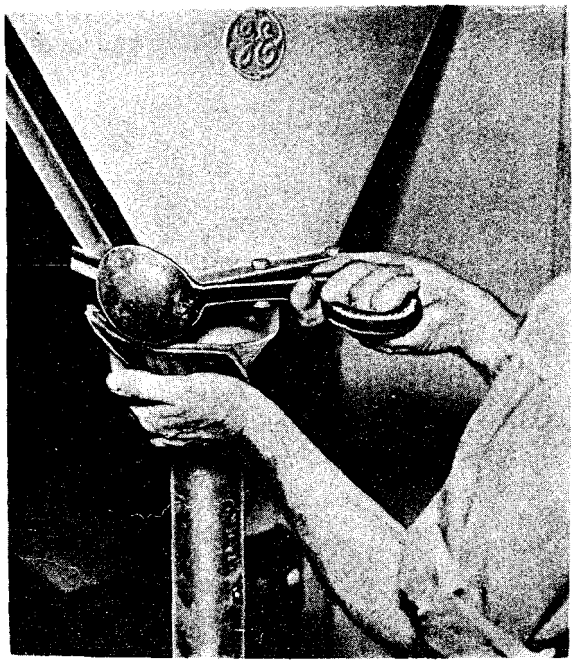


Fig. 32 Pouring Wiped Joint

Fig. 33 (857604)

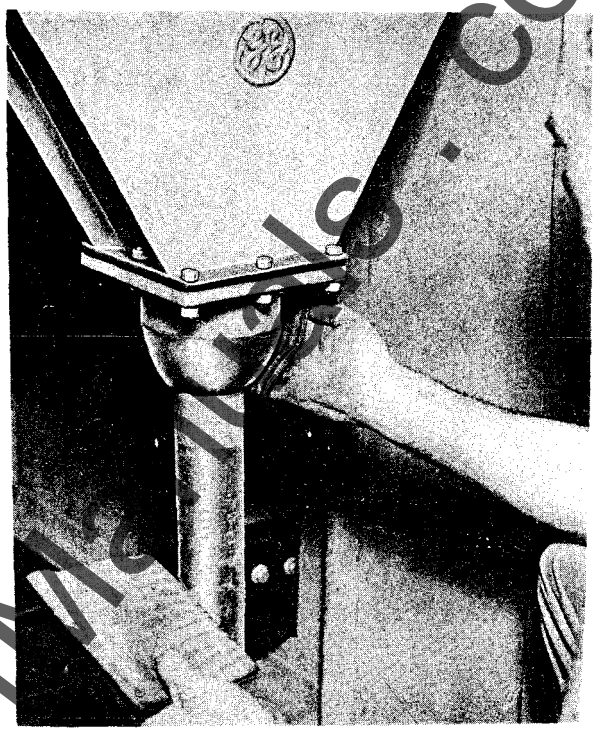


Fig. 33 Wiping Bell To Lead Covered Cable

gasket is uniformly compressed forming a tight joint. Check to be sure the terminal studs are seated properly on their gaskets then screw contact nut in place. See Figures 30 and 31.

(k) Make a plumber's wiped joint between the wiping sleeve and the lead sheath of the cable, as shown in Figures 32 and 33. Use a suitable flux to facilitate the wiping operation.

(l) Remove the 3/4" filling plug in the pothead body and the pipe plugs in the top of the studs. Insert a stand pipe and funnel in the filling hole, of sufficient height to extend above the top of the studs as shown in Figure 34.

Heat #227 compound to the pouring temperature, 165 C. Do not overheat compound as higher temperatures may injure cable insulation and also result in excessive shrinkage of the compound while cooling. Before filling, warm pothead body to prevent sudden chilling of compound which may result in the formation of air voids. The pothead may be warmed by playing a blowtorch over the pothead body, taking care that no direct heat reaches the porcelains.

Pour compound through the filling pipe until the compound appears at the top of the pothead studs. While filling, play a blowtorch on the pothead body and on the filling pipe to prevent air voids and clogging. When full, insert pipe plugs in the top of the studs to trap compound in the porcelain insulators. Continue pouring compound while the pothead

Fig. 34 (857607)

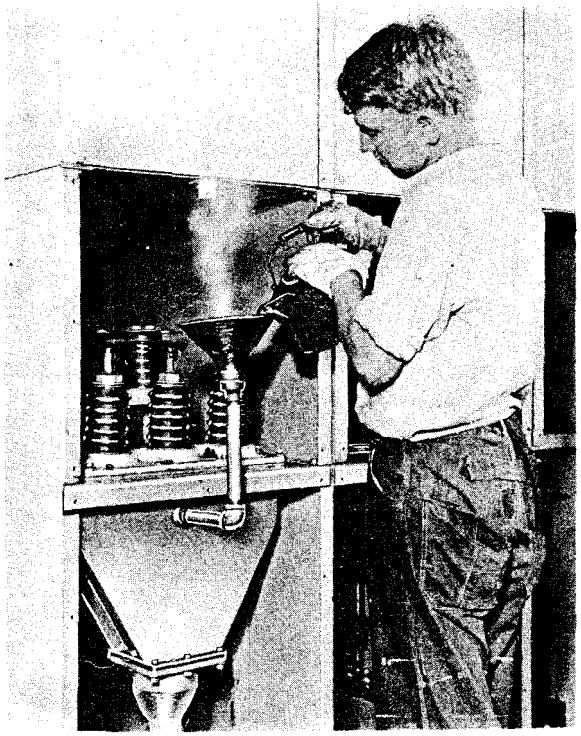


Fig. 34 Filling Pothead With Insulating Compound

AAH

is cooling to fill air voids which might form while the compound is cooling.

When the pothead has cooled, remove filling pipe and insert plug. Clean off compound which might have overflowed on the outside of the porcelains. Retighten all bolts to be sure that all joints are tight.

(m) Assemble pothead connection bars, see Figure 35, and insulate connections as follows:

(1) Fill all cavities around bolts and nuts with "Duxseal" compound to form smooth surface for taping, thus preventing air voids. This compound is not an insulating medium and should not be used for that purpose.

(2) Wrap with varnished cambric tape, G. E. #992, as shown in Figure 37, the number of layers depending on the voltage rating of the equipment. Where there are sharp angles apply additional layers to obtain the equivalent of the insulation of the flat surfaces.

(3) Over the varnished cambric tape apply one layer of white cotton tape, half lap, as a binder.

(4) Over the white cotton tape, brush a good coat of G.E. Glyptal. (#1201 Red for 15KV. and #462 Black for 5KV.)

Single Conductor Potheads

The procedure for installation of single conductor potheads is in general the same and described for three conductor potheads.

Cable Entrances Other Than Wiping Sleeve

Stuffing box cable entrance fittings, Figure 36, are used for nonlead covered cable, and are installed as follows. Assemble stuffing box in pothead. Wrap graphite cord packing around the cable and compress by screwing the gland nut into the stuffing box.

A combination clamping ring and stuffing box, is sometimes furnished instead of a wiping sleeve for lead covered cables. This fitting is installed as follows. Wrap graphite cord packing around cable and compress by screwing gland nut into stuffing box. Bell over lead sheath and notch the edges to expose screw holes. (Note the openings in the fitting below the notches, which permit compound to reach the sheath and seal any splits which might occur while belling over and notching).

Clamp lead sheath with ring and trim off sheath smoothly. Leave about 1 1/2 inch of belt insulation above the clamping ring.

CONTROL CABLES

When control conduits enter the unit from below the conduit should not extend more than 4 inches above the floor. The control cables may be pulled through the conduits before or after the switchgear is installed, whichever is more convenient.

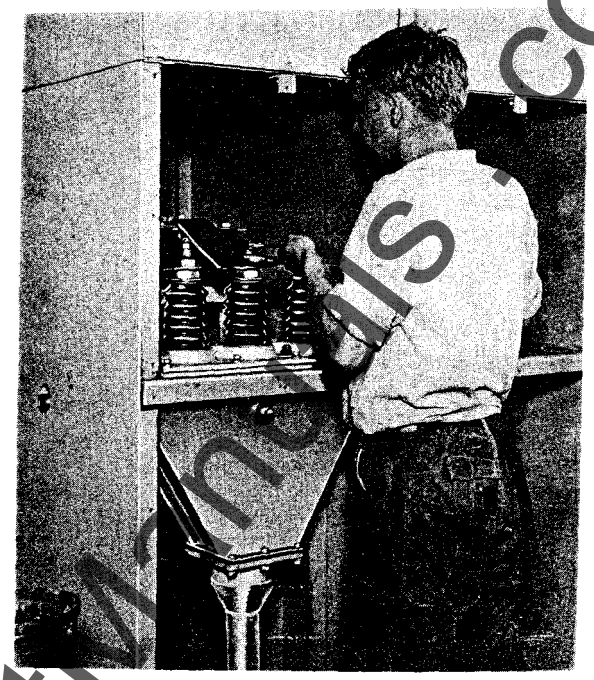


Fig. 35 Assembling Pothead Connection Bars

Fig. 35 (857608)

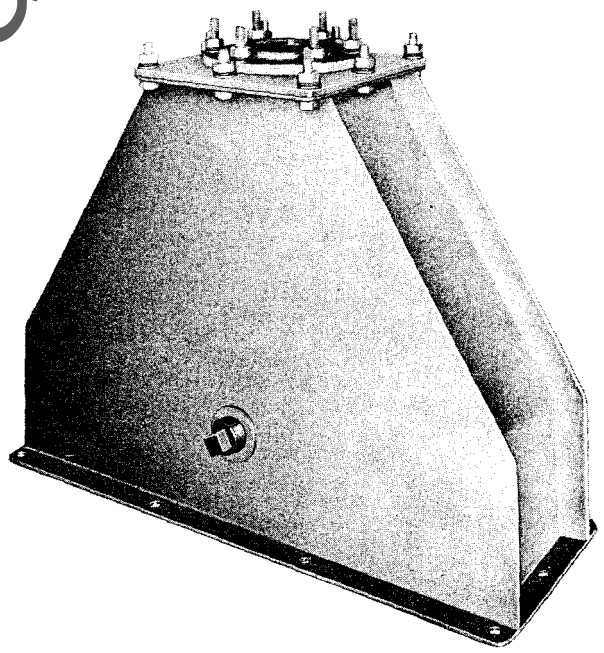


Fig. 36 G-E Pothead With Stuffing Box

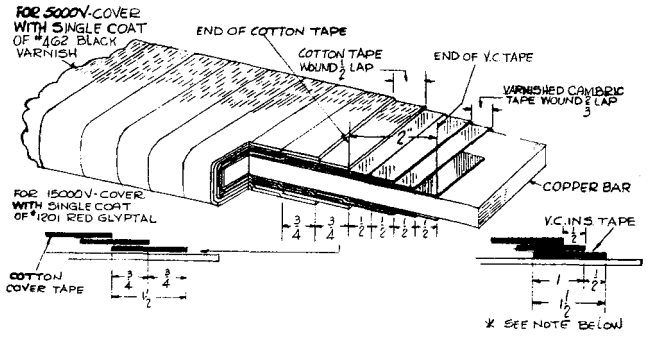
Fig. 36 (8004733)

Connect the cables to the terminal blocks in accordance with the wiring diagrams furnished for the requisition.



AAH

Fig. 37 (K-6500514)




| INSULATION LEVEL | INSULATION LAYERS | |
|---|---|---|
| | V.C. | COTTON TAPE |
| 5000 V. | 4 | 1 |
| 15000 V. | 7 | 1 |

V.C. IS BLACK VARNISHED CLOTH (CAMBRIC) TAPE #992 WIDTH 1½" THICKNESS 0.012 COTTON TAPE IS WHITE G.E. 650-116 WIDTH 1 1/2"

*ONE LAYER (WOUND 2/3 LAP) REQUIRES 3 TURNS AROUND BAR IN ONE WIDTH OF TAPE. THE THICKNESS OF ONE LAYER IS 3 TIMES THE THICKNESS OF THE TAPE.

Fig. 37 Insulation of Connection Bars

If the control conduits enter from above, drill the top and bottom covers of the front enclosure wiring trough to suit the conduits. Fasten the conduits to the bottom cover with locknuts.

The cables from the control power source to the switchgear should be large enough to avoid excessive voltage drop when the circuit breakers are operated. See testing instructions.

Check over all screws and nuts connecting the control wiring to make sure that none have been loosened in shipment.

Where units have been split for shipment, any control or other secondary leads which must connect across the split will be arranged with terminal blocks in the cross trough or convenient side sheet so that the wires can be reconnected. The wires will be cut to length and formed before being folded back so that a minimum of time will be required for reconnecting them.

GROUND BUS

The ground bus is bolted to the rear of the frame near the bottom. It is arranged so that connections to the station ground can be made in any unit. Where the equipment is shipped in more than one group, the sections of ground bus, must be connected by using the splice plates furnished with the equipment. Ground bus connections are made in the lower portion of the cable entrance compartment. The switchgear ground bus must be connected to the station ground bus by a conductor having a current carrying capacity equal to that of the switchgear ground bus. It is very important that the equipment be adequately grounded, to protect the operator from injury when short circuits or other abnormal occurrences take place, and to insure that all parts of the equipment, other than live parts, are at ground potential.

# OPERATION

The operation of metal clad switchgear is similar to that of other types except that it provides maximum safety to the operator and the feature of easy removal and replacement of the circuit breaker.

All circuit breaker removable elements of the same type and rating which have duplicate wiring may be interchanged.

## BREAKER POSITIONING

To place the circuit breaker in operating position, proceed as given below.

Clean contacts and cover with a very thin coating of Contact Lubricant D50H28.

Push the breaker into the unit until it rests against the stop.

To raise the breaker, operate the control switch located on the door of the unit, to the "Trip" position. A set of contacts of this switch are in the elevating control circuit. Next, turn the elevating control selector switch just inside the door on the right hand side to "Raise". A clutch handle just above the elevating motor is then pulled until it engages the motor, at which time it closes the clutch limit switch to start the motor, and raise the breaker in the housing. At the end of the upward travel, a limit switch on the structure opens to stop the motor. See Figures 17 and 18.

To lower the breaker proceed the same as for raising except turn selector switch to "Lower".

The clutch must be held in the engaged position otherwise a spring will return it to its normal position opening the electrical circuit to the motor.

The breaker may be raised and lowered by an emergency hand wrench which can be inserted after removing the motor. The motor is removed by taking out four mounting screws in the base of the motor and disconnecting the four motor leads.

After removing the motor, pull the clutch forward and insert the wrench over the end of the clutch shaft. The breaker must be tripped before the clutch can be engaged with the wrench.

## SPACE HEATERS

Space heaters are provided in all outdoor equipment in order to keep the inside temperature several degrees higher than that outside. This helps prevent condensation and the resultant corrosion which might occur. The heaters should be turned on at all times. Heaters are also furnished for indoor equipments when it is known that abnormal atmospheric conditions exist at the installation.

# TESTING AND INSPECTION

After the equipment has been installed and all connections made it should be tested and inspected before putting in service. Although the equipment and devices have been completely tested at the factory, a final field test should be made to be sure that the equipment has been properly installed and that all connections are correct and have not become loose in transportation. The primary equipment should be completely de-energized while the tests are in progress.

Directions for testing devices such as relays, instruments and meters are given in the instruction book furnished for each device. The settings of the protective relays must be coordinated with the other relays on the system and therefore these relays must be set by the purchaser. General instructions on setting the relays are given in the relay instruction books. Special instruction books are furnished for complicated automatic equipments, describing the sequence of operation of the devices required to perform the desired function.

The extent of the tests on the equipment as a whole will depend on the type and function of the equipment.

When transformers are furnished to supply the control power, the primary taps should be selected so that the control voltage indicated on the wiring diagram is obtained on the secondary of the transformer. When a battery is used to supply the control power, the cables from the battery to the switchgear should be large enough to avoid excessive voltage drop. The voltage at the terminals of the breaker closing coils, when the breaker is being closed should not be less than 112.5 volts for 125 volt coils and 225 volts for 250 coils.

The operation of the breaker with its associated devices may be tested in the unit while the equipment is energized by use of the test coupler which is furnished. Lower the breaker to the test or down position. Attach the test coupler to connect the breaker secondary disconnecting device to that on the structure.

High potential tests to check the integrity of the insulation are not necessary if the installation instructions in this book are carefully followed. If the purchaser wishes to make high potential tests the voltage should not exceed 75% of the AIEE factory test voltages.

Potential transformers must be disconnected during high voltage testing.

# MAINTENANCE

A regular maintenance schedule should be established to obtain the best service and reliability from the switchgear. Plant, operating and local conditions will dictate the frequency of inspection required. For specific information regarding the maintenance of devices, such as circuit breakers, relays, meters, etc., refer to the separate instruction book furnished for each device. The inspection cabinet, which is furnished, provides a convenient means for maintaining the circuit breakers. Under normal conditions the protective relays do not operate, therefore it is important to check the operation of these devices regularly.

A permanent record of all maintenance work should be kept, the degree of detail depending on the operating conditions. In any event it will be a valuable reference for subsequent maintenance work and for station operation. It is recommended that the record include reports of tests made, the condition of equipment and repairs and adjustments that were made.

The switchgear structure and connections should be given the following overall maintenance at least annually.

1. De-energize the equipment and thoroughly clean removing all dust and other accumulations. Wipe clean the buses and supports. Inspect the buses and connections carefully for evidence of overheating or weakening of the insulation.

2. Measure the resistance to ground and between phases of the insulation of buses and connections. Since definite limits cannot be given for satisfactory insulation resistance values, a record must be kept of the readings. Weakening of the insulation from one maintenance period to the next can be recognized from the recorded readings. The readings should be taken under similar conditions each time if possible, and the record should include the temperature and humidity.

High potential tests are not required, but if it seems advisable, based on the insulation resistance tests or after repairs, the test voltage should not exceed 75% of the AIEE factory test voltage. The potential transformers must be disconnected during the high voltage testing.

3. Clean elevating mechanism and lubricate jack screws and gears with General Electric Com-

pany Lubricant #D50H15 (Atlantic Refining Company #52 or equal).

4. Check primary disconnecting device contacts for signs of abnormal wear or overheating. Clean contacts with silver polish. Discoloration of the silvered surfaces is not ordinarily harmful unless atmospheric conditions cause deposits such as sulphides on the contacts. If necessary the deposits can be removed with a good grade of silver polish.

Before replacing breaker, apply a thin coat of Contact Lubricant D50H28 to breaker studs for lubrication.

5. Check to see that all anchor bolts and bolts in the structure are tight. Check tightness and continuity of all control connections and wiring.

# WHEN YOU NEED SERVICE

GEZ-85R

IF YOU NEED TO REPAIR, recondition, or rebuild any electric apparatus, a G-E service shop near you is available day and night, seven days a week, for work in the shops or on your premises. Latest factory methods and genuine G-E renewal parts are used to maintain the original performance of your G-E equipment. For full information about these services, contact the nearest service shop or sales office listed below:

## APPARATUS SERVICE SHOPS

Atlanta—Chamblee, Ga.....4639 Peachtree Indus. Blvd.
Baltimore 30, Md.....920 E. Fort Ave.
Boston—Medford 55, Mass.....Mystic Valley Pkwy.
Buffalo 11, N. Y.....318 Urban St.
Charleston 28, W.Va..306 MacCorkle Ave., S.E.
Charlotte, N. C.....2328 Thrift Road
Chicago 80, Ill.....849 S. Clinton St.
Cincinnati 2, Ohio.....444 W. Third St.
Cleveland 4, Ohio.....4966 Woodland Ave.
Columbus 15, Ohio.....213 Cozzens St.
Dallas 9, Texas.....3202 Manor Way
Denver 5, Colo.....3353 Larimer St.
Detroit 2, Mich.....5950 Third Ave.
Houston 20, Texas..5534 Harvey Wilson Drive
Johnstown, Pa.....841 Oak St.
Kansas City 8, Mo.....819 E. 19th St.
Los Angeles 1, Calif.....6900 Stanford Ave.
Milwaukee 3, Wisc.....940 W. St. Paul Ave.
Minneapolis 12, Minn.....2025 49th Ave., N.
New York 14, N. Y.....416 W. 13th St.
Philadelphia 23, Pa.....429 N. Seventh St.
Pittsburgh 6, Pa.....6519 Penn Ave.
Portland 18, Oregon....2727 N.W. 29th Ave.
Richmond 24, Va.....1403 Ingram Ave.
St. Louis 10, Mo.....1115 East Road
San Francisco 3, Calif.....1098 Harrison St.


For service outside the United States, Canada, and Hawaii, consult the nearest office of the International General Electric Company.

Salt Lake City 4, Utah..301 S. Seventh West St.
Seattle 4, Wash.....3422 First Ave., S.
Spokane 3, Wash.....S. 155 Sherman St.
Toledo 4, Ohio.....1 So. St. Clair St.
York, Pa.....54 N. Harrison St.
Youngstown 5, Ohio....272 E. Indianola Ave.

## APPARATUS SALES OFFICES

Abilene, Texas.....442 Cedar St.
Akron 8, Ohio.....335 S. Main St.
Albany 7, N. Y.....90 State St.
Albuquerque, N. Mex.....323 Third St., S.W.
Alexandria, La.....720 Murray St.
Allentown, Pa.....1014 Hamilton St.
Amarillo, Texas.....719 Amarillo Bldg.
Appleton, Wisc.....531 W. College Ave.
Atlanta 3, Ga..Peachtree Rd. at 28th St., N.W.
Augusta, Ga.....423 Masonic Bldg.
Augusta, Me.....15 Grove St.
Bakersfield, Calif.....211 E. 18th St.
Baltimore 1, Md.....111 Park Ave.
Bangor, Maine.....77 Central St.
Battle Creek, Mich.....25 W. Michigan Ave.
Beaumont, Texas.....1385 Calder Ave.
Binghamton, N. Y.....19 Chenango St.
Birmingham 3, Ala.....1804 Seventh Ave., N.
Bismarck, N. Dak.....117½ Fifth St.
Bluefield, W.Va. P.O. Box 447, Appalachian Bldg.
Boston 1, Mass.....140 Federal St.
Buffalo 3, N. Y.....535 Washington St.
Butte, Mont. P.O. Box 836, 103 N. Wyoming St.
Canton 2, Ohio.....700 Tuscarawas St., W.
Cedar Rapids, Iowa.....210 Second St., S.E.
Charleston 28, W.Va..306 MacCorkle Ave., S.E.
Charlotte 1, N. C.....112 S. Tryon St.
Charlottesville, Va.....123 E. Main St.
Chattanooga 2, Tenn.....832 Georgia Ave.
Chicago 80, Ill. P.O. Box 5970A, 840 S. Canal St.
Cincinnati 2, Ohio.....215 W. Third St.
Cleveland 4, Ohio.....4966 Woodland Ave.
Columbia 1, S.C. P.O. Box 1434, 1420 Lady St.
Columbus 15, Ohio.....40 S. Third St.
Corpus Christi, Texas.....205 N. Chaparral
Dallas 2, Texas.....1801 N. Lamar St.
Davenport, Iowa.....511 Pershing Ave.
Dayton 2, Ohio.....118 W. First St.
Denver 2, Colo.....650 Seventeenth St.
Des Moines 9, Iowa.....505 W. Fifth Ave.
Detroit 2, Mich.....700 Antoinette St.
Duluth 8, Minn.....14 W. Superior St.
Elmira, N. Y.....Main and Woodlawn Aves.
El Paso, Texas.....109 N. Oregon St.
Erie, Pa.....1001 State St.
Eugene, Ore.....29 W. Eleventh St.
Evansville 19, Ind.....123 N.W. Fourth St.
Fairmont, W. Va.....310 Jacobs Bldg., P.O. Box 1626
Fergus Falls, Minn.....108 N. Court Ave. P.O. Box 197
Flint 3, Mich.....653 S. Saginaw St.
Fort Wayne 2, Ind.....127 W. Berry St.
Fort Worth 2, Texas.....408 W. Seventh St.
Fresno 1, Calif.....407 Patterson Bldg. Tulare and Fulton St.
Grand Rapids 2, Mich..148 Monroe Ave., N.W.
Greensboro, N. C.....301 S. Elm St.
Greenville, S. C.....108 W. Washington St.
Hagerstown, Md.....Professional Arts Bldg.
Harrisburg, Pa.....300 N. Second St.
Hartford 3, Conn.....410 Asylum St.
Houston 1, Texas.....1312 Live Oak St.
Huntsville, Ala.....1107 Times Bldg.
Indianapolis 4, Ind.....110 N. Illinois St.
Jackson, Mich.....120 W. Michigan Ave.
Jackson 1, Miss.....203 W. Capitol St.
Jacksonville 2, Fla.....700 E. Union St.
Jamestown, N. Y. P.O. Box 548, 2 Second St.
Johnson City, Tenn....321-323 W. Walnut St.
Johnstown, Pa.....841 Oak St.
Joplin, Mo. P.O. Box 931, 220½ W. Fourth St.
Kansas City 6, Mo.....106 W. Fourteenth St.
Knoxville 08, Tenn.....602 S. Gay St.
Lansing 8, Mich.....106 W. Allegan St.
Lexington, Ky.....First National Bank Bldg.
Lincoln 8, Nebr.....1001 "O" St.
Little Rock, Ark.....103 W. Capitol Ave.
Los Angeles 54, Calif.....212 N. Vignes St.
Louisville 2, Ky.....455 S. Fourth St.
Macon, Ga.....682 Cherry St.
Madison 3, Wisc.....16 N. Carroll St.
Manchester, N. H.....875 Elm St.
Medford, Ore., P.O. Box 1349, 205 W. Main St.
Memphis 3, Tenn.....8 N. Third St.
Miami 32, Fla.....25 S.E. Second Ave.
Milwaukee 3, Wisc.....940 W. St. Paul Ave.
Minneapolis 3, Minn.....12 S. Sixth St.
Mobile 13, Ala.....54 St. Joseph St.
Montgomery 4, Ala.....205 Montgomery St.
Nashville 3, Tenn.....234 Third Ave., N.
Newark 2, N. J.....744 Broad St.
New Haven 6, Conn.....129 Church St.
New Orleans 12, La.....837 Gravier St.
New York 22, N. Y.....570 Lexington Ave.
Niagara Falls, N. Y.....253 Second St.
Norfolk 10, Va.....229 W. Bute St.
Oakland 12, Calif.....409 Thirteenth St.
Oklahoma City 2, Okla....119 N. Robinson St.
Omaha 2, Nebr.....409 S. Seventeenth St.
Paducah, Ky...P.O. Box 1001, 231 S. Fourth St.
Pasco, Wash.....421 W. Clark St.
Peoria 2, Ill.....309 Jefferson Bldg.
Philadelphia 2, Pa.....1405 Locust St.
Phoenix, Ariz..P.O. Box 4037, 303 Luhrs Tower
Pittsburgh 22, Pa.....535 Smithfield St.
Portland 3, Maine.....477 Congress St.
Portland 7, Ore.....920 S.W. Sixth Ave.
Portsmouth, Ohio..P.O. Box 37, 721 Sixth St.
Providence 3, R. I.....Industrial Trust Bldg.
Raleigh, N. C.....336 Fayetteville St.
Reading, Pa.....31 N. Sixth St.
Richmond 17, Va.....700 E. Franklin St.
Riverside, Calif.....3808 Main St.
Roanoke 16, Va....920-924 S. Jefferson St.
Rochester 4, N. Y.....89 E. Ave.
Rockford, Ill.....110 S. First St.
Rutland, Vt.....38½ Center St.
Sacramento 14, Calif.....626 Forum Bldg.
Saginaw, Mich.....501 Beoringer Bldg.
St. Louis 2, Mo.....112 N. Fourth St.
Salt Lake City 9, Utah.....200 S. Main St.
San Antonio 5, Texas....310 S. St. Mary's St.
San Diego 1, Calif.....1240 Seventh Ave.
San Francisco 6, Calif....235 Montgomery St.
San Jose 10, Calif.....460 Park Ave.
Savannah, Ga.....4 E. Bryan St.
Seattle 4, Wash.....710 Second Ave.
Shreveport, La.....910 Shelby Bldg.
Sioux City 13, Iowa. 572 Orpheum Electric Bldg.
Sioux Falls, S. D.....306 South Phillips Ave.
South Bend 1, Ind.....112 W. Jefferson Blvd.
Spokane 8, Wash.....S. 162 Post St.
Springfield, Ill.....607 E. Adams St.
Springfield 3, Mass.....1387 Main St.
Stockton, Calif.....11 So. San Joaquin St.
Syracuse 2, N. Y.....113 S. Salina St.
Tacoma 1, Wash.....1202 Washington Bldg.
Tampa 6, Fla.....1206 North A St.
Toledo 4, Ohio.....420 Madison Ave.
Trenton 8, N. J.....214 E. Hanover St.
Tulsa 3, Okla.....320 S. Boston Ave.
Tucson, Ariz..P.O. Box 710, 650 N. Sixth Ave.
Utica 2, N. Y.....258 Genesee St.
Washington 5, D.C.....777–14th St., N.W.
Waterbury 89, Conn.....111 W. Main St.
Waterloo, Iowa.....206 W. 4th St.
Wenatchee, Wash...328 N. Wenatchee Ave.
Wheeling, W. Va.....40 Fourteenth St.
Wichita 2, Kan.....200 E. First St.
Williamston, N. C.....115 E. Main St.
Wilmington 98, Del.....1326 N. Market St.
Worcester 8, Mass.....507 Main St.
York, Pa.....56 N. Harrison St.
Youngstown 5, Ohio....272 E. Indianola Ave.

**Hawaii: American Factors, Ltd., P. O. Box 3230, Honolulu 1** **Canada: Canadian General Electric Company, Ltd., Toronto**

17

# GENERAL ELECTRIC

PRINTED IN U.S.A.

3-54

*Handbook Reference No. 6818 Supersedes GEI-1802A*