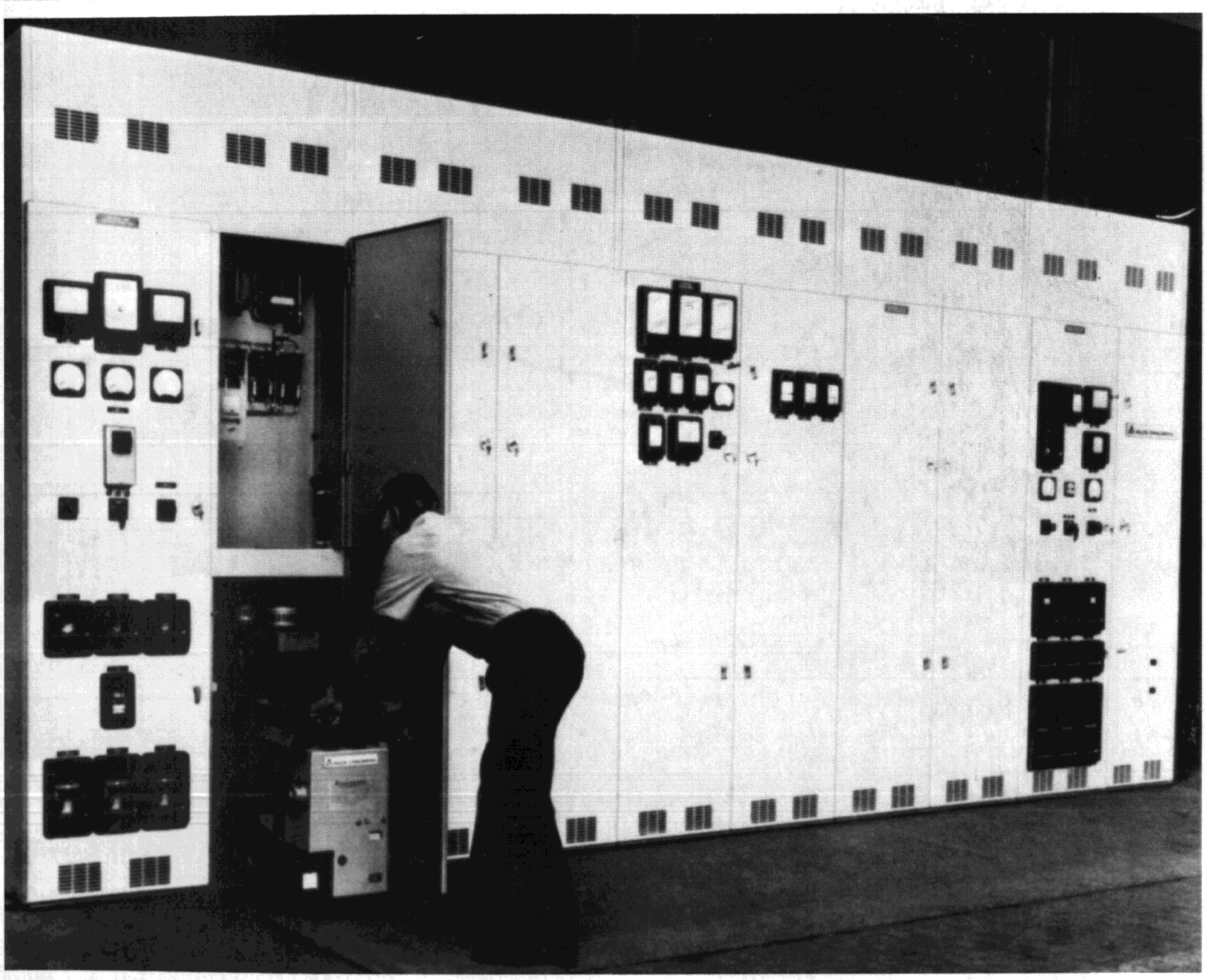
SIEMENS-ALLIS

Installation • Operation • Maintenance

Instructions



34.5 KV metal-Clad
Switchgear With
VV-1500 Circuit
Breakers
SG-3298

TAB SHEET

SECTION ONE: INSTRUCTIONS: 34.5 KV METAL CLAD SWITCHGEAR WITH VACUUM CIRCUIT BREAKERS.

SECTION TWO: INSTRUCTIONS: VV-1500 VACUUM CIRCUIT BREAKERS WITH STORED ENERGY OPERATOR NO. 515-4V

SECTION THREE: PARTS ORDERING GUIDE: VV-1500 VACUUM CIRCUIT BREAKERS WITH STORED ENERGY OPERATOR NO. 515-4V

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INTRODUCTION

THIS EQUIPMENT CONTAINS HAZARDOUS VOLTAGES. SEVERE PERSONAL INJURY OR PROPERTY DAMAGE CAN RESULT IF SAFETY INSTRUCTIONS ARE NOT FOLLOWED. ONLY QUALIFIED PERSONNEL SHOULD WORK ON OR AROUND THIS EQUIPMENT AFTER BECOMING THOROUGHLY FAMILIAR WITH ALL WARNINGS, SAFETY NOTICES, AND MAINTENANCE PROCEDURES CONTAINED HEREIN. THE SUCCESSFUL AND SAFE OPERATION OF THIS EQUIPMENT IS DEPENDENT UPON PROPER HANDLING, INSTALLATION, OPERATION AND MAINTENANCE.

QUALIFED PERSON

FOR THE PURPOSE OF THIS MANUAL AND PRODUCT LABELS, A QUALIFIED PERSON IS ONE WHO IS FAMILIAR WITH THE INSTALLATION, CONSTRUCTION AND OPERATION OF THE EQUIPMENT, AND THE HAZARDS INVOLVED. IN ADDITION, HE HAS THE FOLLOWING QUALIFICATIONS:

(a) Is qualified and authorized to energize, de-energize, clear, ground and tag circuits and equipment in accordance with established safety practices.

(b) Is trained in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc., in accordance with established safety practices.

DANGER

FOR THE PURPOSE OF THIS MANUAL AND PRODUCT LABELS, **DANGER** INDICATES DEATH, SEVERE PERSONAL INJURY OR SUBSTANTIAL PROPERTY DAMAGE WILL RESULT IF PROPER PRECAUTIONS ARE NOT TAKEN.

WARNING

FOR THE PURPOSE OF THIS MANUAL AND PRODUCT LABELS, **WARNING** INDICATES DEATH, SEVERE PERSONAL INJURY OR SUBSTANTIAL PROPERTY DAMAGE CAN RESULT IF PROPER PRECAUTIONS ARE NOT TAKEN.

CAUTION

FOR THE PURPOSE OF THIS MANUAL AND PRODUCT LABELS, **CAUTION** INDICATES MINOR PERSONAL INJURY OR PROPERTY DAMAGE CAN RESULT IF PROPER PRECAUTIONS ARE NOT TAKEN.

INTRODUCTION

General

These instructions cover the installation, operation and maintenance of Siemens-Allis vertical lift metal-clad switchgear. The equipment described in this manual consists of the indoor and *Shelter-Clad* outdoor designs in the 34.5 kV class. All diagrams, descriptions and instructions apply to all the above classes and designs unless noted otherwise. Standard construction details of the switchgear, auxiliary equipment and accessories are given in the appropriate sections. Special mechanical and electrical devices, furnished in accordance with purchase order requirements, are covered by supplementary instructions submitted with this instruction book. Ratings described in this manual are in accordance with NEMA, IEEE and ANSI standard requirements.

Warranty

Siemens-Allis warrants title to the product(s) and, except as noted below with respect to items not of Siemens-Allis's manufacturer, also warrants the product(s) on date of shipment to Purchaser, to be of the kind and quality described herein, merchantable, and free of defects in workmanship and material.

This warranty is expressly in lieu of all other warranties, including but not limited to implied warranties of merchantability and fitness, and constitutes the only warranty of Siemens-Allis with respect to the product(s).

If within one year form date of initial operation, but not more than eighteen months from date of shipment by Siemens-Allis of any item of product(s), Purchaser discovers that such item was not as warranted above and promply notifies Siemens-Allis in writing thereof, Siemens-Allis shall remedy such nonconformance by, at Siemens-Allis's option, adjustment or repair or replacement of the item and any affected part of the product(s). Purchaser shall assume all responsibility and expense for removal, reinstallation, and freight in connection with the foregoing remedies. The same obligations and conditions shall extend to replacement parts furnished by Siemens-Allis hereunder. Siemens-Allis shall have the right of disposal of parts replaced by it.

Any separately listed item of the product(s) which is not manufactured by Siemens-Allis is not warranted by Siemens-Allis, and shall be covered only by the express warranty, if any, of the manufacturer thereof.

This states purchaser's exclusive remedy against Siemens-Allis and its suppliers relating to the product(s), whether in contract or in tort or under any other legal theory, and whether arising out of warranties, representations, instructions, installations or defects from any cause. Siemens-Allis and its suppliers have no obligation as to any product which has been improperly stored or handled, or which has not been operated or maintained according to instructions in Siemens-Allis or supplier furnished manuals.

General Description

The switchgear described in this manual is the metal-clad type. All parts are completely enclosed within grounded metal barriers. Secondary control devices and primary circuits are isolated from each other by shutters or barriers. Primary circuits of different potential are also separated by barriers. All primary bus work and joints are completely encased with insulation material to suit the voltage class of the equipment.

Siemens-Allis switchgear carries a letter designation as shown in Table 1. These designations may appear on drawings and familiarity with them will simplify communications with the factory.

Table 1. Switchgear Designation

Design	34.5 kV Designation
Indoor	IV
Shelter-Clad	SIV

Indoor equipment is arranged with the circuit breaker drawout compartment behind the right-hand hinged panel. This hinged panel is opened to provide access to the circuit breaker. The left-hand hinged panel contains instruments, meters, relays, etc. and provides access to the secondary control wiring compartment. Either panel may be opened independently without disturbing the other panel.

Shelter-Clad outdoor equipment consists of indoor equipment enclosed in a weatherproof housing complete with an illuminated, walk-in aisle. Circuit breakers can be rolled out into the aisle and control devices checked without exposure to the elements.

INTRODUCTION

The cubicles described in this instruction book are for use with Siemens-Allis vacuum circuit breakers with available ratings as shown in Table 2. Installation, operation and maintenance of the vacuum breakers are covered starting on page 4.

Table 2. VV-1500 Vacuum Circuit Breaker Ratings

RATED VALUES									RELATED REQUIRED CAPABILITIES		
Voltage			Insulation Level		Current					Current Values		
Nominal Voltage Class kV, rms	Rated Max. Voltage kV, rms	Rated Voltage Range Factor k	Rated Withstand Test Voltage		Rated Continuous Current at 60 Cycles amp rms	Rated Short Circuit Current (At Rated Max. kV) kA, rms	Rated Interrupting Time Cycles	Rated Permissible Tripping Delay Y Sec.	Rated Max. Voltage Divided by k kV, rms	Max. Sym. Interrupting Capability	3 Sec. Short Time Current Carrying Capability	Closing and Latching Capability 1.6K Times Rated Short Circuit Current kA, rms
			Low Frequency kV, rms	Impulse kV, rms						k times rated short circuit current values		
										kA, rms	kA, rms	
34.5	38.0	1.65	80	150	1200 2000 3000*	21	3	2	23.0	35	35	56

*3000 amp rating achieved by use of forced air fan cooling.

Drawings And Wiring Diagrams

All drawings and wiring diagrams required during installation are furnished in advance to the customer. These include any and all changes originated by purchaser during manufacture. Any corrective changes by the supplier which are necessary to assure proper installation and operation of equipment are shown.

RECEIVING

Each group of switchgear is securely blocked and braced for shipment. It is crated, boxed, or covered as required by shipping conditions. Whatever method of shipment, every precaution is taken to insure its safe arrival. If special handling is required, it is so indicated. All moving parts are secured; however, relatively delicate instruments are included and must be handled carefully when unloading.

Identification

When shipment consists of more than one shipping group or more than one substation, each crate or package is identified by attached tag markings. The drawing number on the crate tag is also on the customer's copy of the shipping list. The shipping list describes the contents as "Unit 1-2-3." Refer to the general arrangement drawing for the location of each unit within the group line-up. Use this information to simplify the assembly operation and save unnecessary handling.

Lifting

General

Each group of switchgear has provisions for attaching lifting equipment furnished by others. Though the lift points vary in location on indoor and *Shelter-Clad* outdoor designs, all are designed for use with a crane of adequate height and capacity. To determine the required crane capacity, multiply the number of cubicles to be lifted by 5,000 pounds (2273 kg) for indoor and 7,000 pounds (3182 kg) for *Shelter-Clad* outdoor.

34.5 kV Indoor Switchgear (See Fig. 1)

34.5 kV indoor equipment has lifting channels on the top of the switchgear. These channels have spreaders between the lift points for additional strength. The load angle on the lifting cables must be at least 45°; a lesser angle could damage the equipment.

⚠ CAUTION

Do not remove lifting channels on indoor switchgear under any circumstances until the switchgear is installed in its final location. These channels insure the true alignment of the switchgear group until it is leveled and anchored.

34.5 kV Shelter-Clad Switchgear (See fig. 2)

Lift *Shelter-Clad* outdoor equipment by placing high strength pipes through holes provided in the supporting beams under the switchgear.

⚠ WARNING

All *Shelter-Clad* outdoor switchgear groups are to be lifted with 3.5" (88.9 mm) nominal xx-strong pipe. This extra heavy pipe has actual dimensions of 4.00 (101.6 mm) outside diameter with a .636 (16.2 mm) wall thickness. An alternate is 4.75 (120.7 mm) outside diameter mechanical tube with a .313 (8 mm) wall thickness.
It is extremely important that the correct size lifting pipe be used. Pipe of inadequate strength will bend, causing possible damage to the switchgear and injury to personnel.

Lift pipes, cables and spreaders are furnished by customer unless covered by contract. Cable spreaders are required above roof to protect the equipment. Wood cable spreaders, if used, must be timbers of sufficient strength to handle the compressive force of the cables and should have steel bands or studs to prevent splitting. Small groups of switchgear, up to three units, should be carefully checked for balance as distribution of equipment within the cubicles may place the center of gravity high or toward one end. If load is unbalanced, use a rope sling or other means to secure the top of the load to lifting cables to prevent tipping or rolling.

Moving Switchgear In Obstructed Areas Without A Crane

Within buildings and obstructed areas, where a crane cannot be used, move switchgear with rollers, cribbing, jacks and other such equipment as may be required to meet the situation. To prevent distortion of the cubicles, rollers and cribbing of equal height must be used in sufficient number to evenly distribute the load. DO NOT USE ROLLERS DIRECTLY ON SHIPPING SKID; ADDITIONAL CRIBBING MUST BE USED. Remove rollers and lower switchgear carefully. Leave wooden skids (when provided) in place during moving operation until final location is reached. Fork-lift trucks should be used with discretion as improper lift points could cause extreme damage to equipment. Refer to Figs. 4 and 5 for the correct jacking methods.

RECEIVING

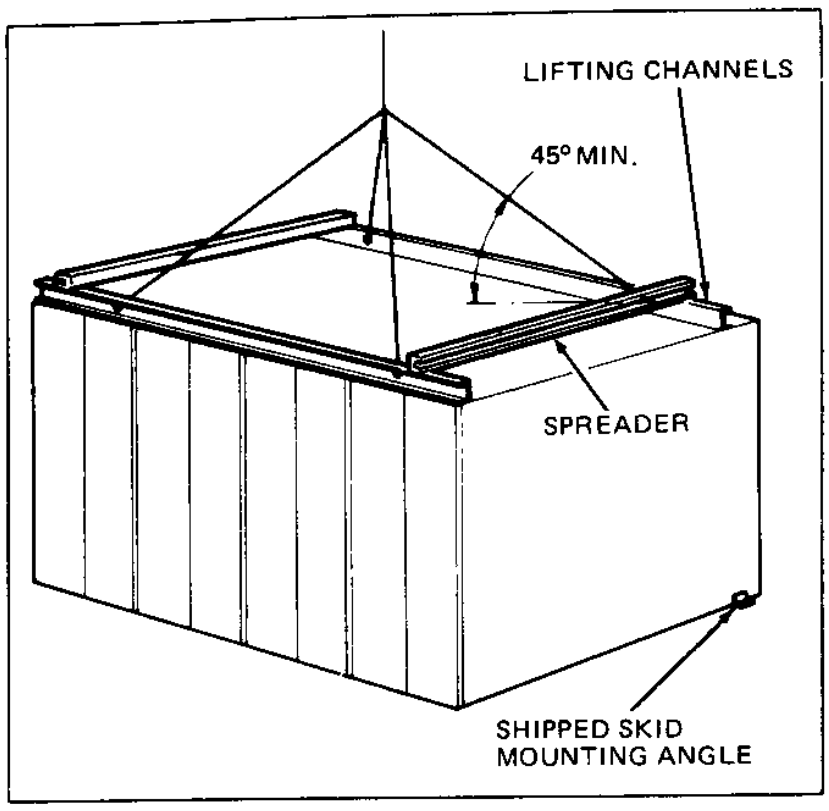


Figure 1. Lifting 34.5 kV Indoor Switchgear

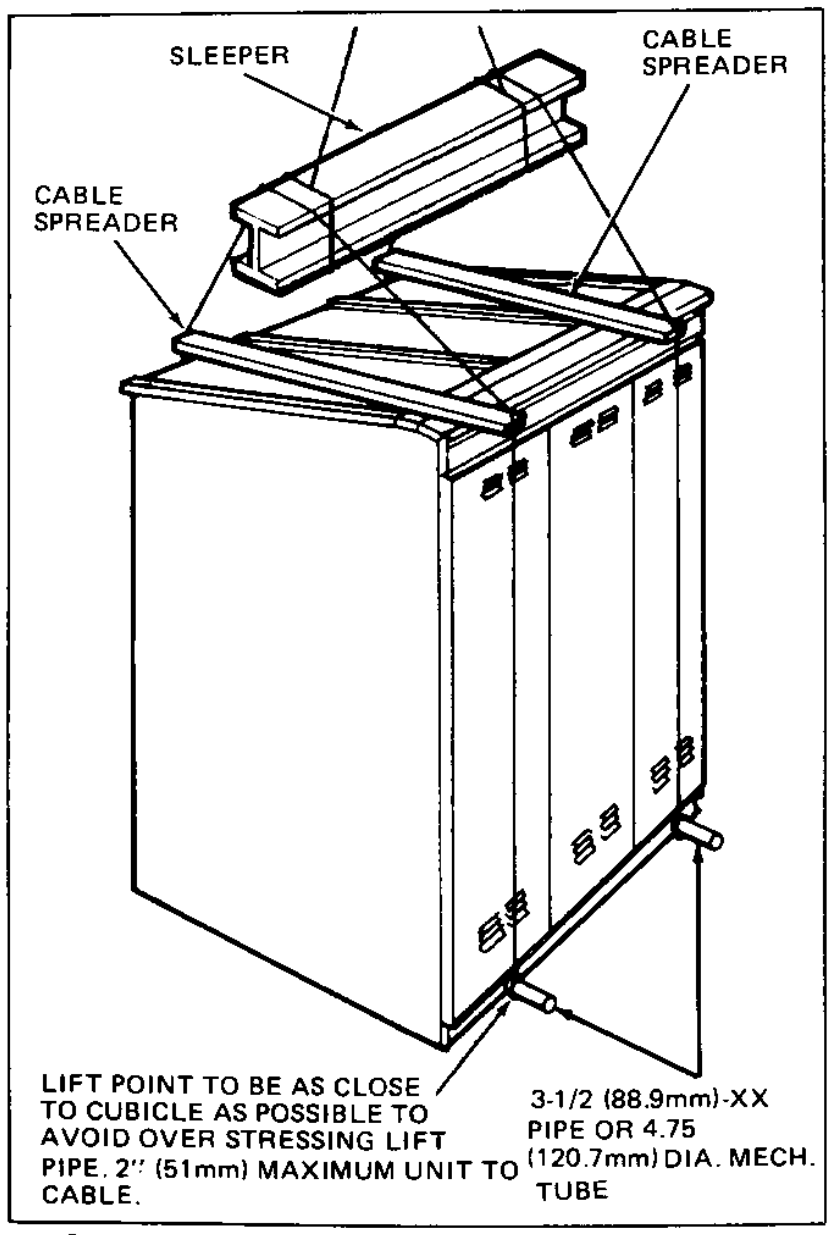


Figure 2. Lifting 34.5 kV Shelter-Clad Outdoor Switchgear

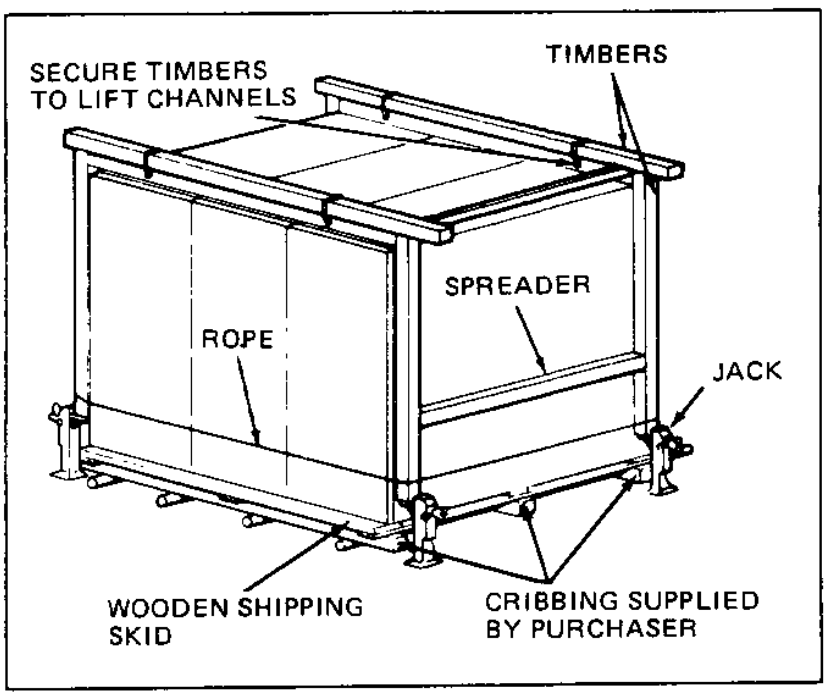


Figure 3. Jacking Indoor Switchgear

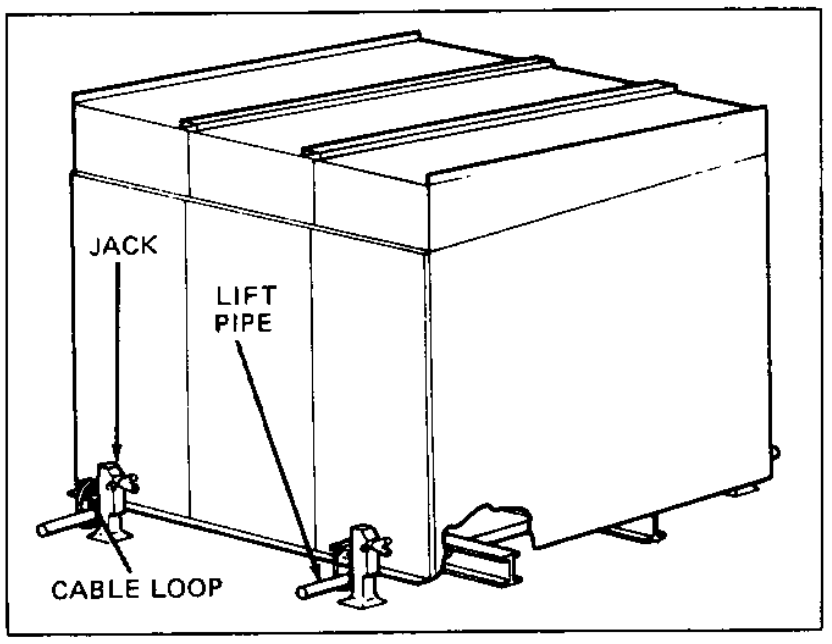


Figure 4. Jacking Shelter-Clad Outdoor Switchgear

Inspection And Uncrating

Inspect the equipment within 15 days after receiving for any damage that may have occurred in transit. Before uncrating, examine the crate itself; a splintered crate may indicate an area of damage within. Be careful when uncrating equipment. The use of sledge hammers and crowbars may damage the finish, if not the equipment itself. Use nail pullers. After uncrating, examine equipment for any possible damage. Check the shipping manifest to be certain that all items have been received. If there is a shortage, make certain it is noted on the freight bill and contact the carrier immediately. Notify the representing Siemens-Allis sales office of any shortage or damage.

Unusual circumstances may require partial shipments of switchgear. Should a case of this nature exist, provision is made for easy installation of these portions.

STORAGE

Indoor Switchgear

When switchgear is not to be erected immediately, it should be uncrated, inspected within 15 days of receipt and stored in a clean dry location. Indoor cubicles are neither weatherproof nor drip-proof; therefore, they should be stored indoors. If they must be stored outdoors, or if they are to be kept in a humid, unheated area, provide an adequate covering, and place a heat source of approximately 500 watts output within each cubicle to prevent condensation. Space heaters are not standard equipment on indoor switchgear. Lubricate any moving parts such as hinges, shutter, etc., if storage is for an extensive period of time. When batteries are supplied, connect them to a charger; never leave batteries in dead storage.

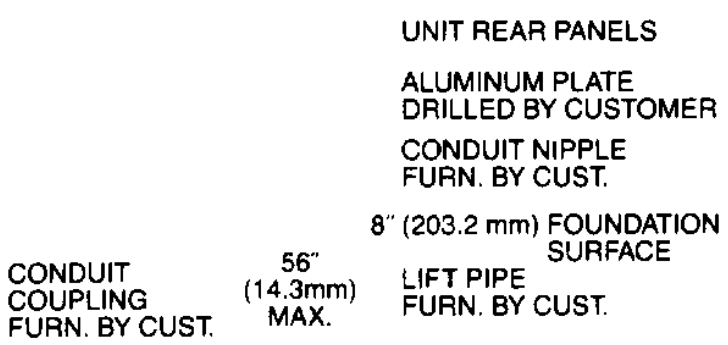
Shelter-Clad Outdoor Switchgear

When it is necessary to store *Shelter-Clad* outdoor equipment in a location exposing it to the weather or in a humid location, energize the space heaters, provided within the cubicles and make certain that louvers and vents are uncovered to allow air to circulate. If at all possible, erect the aisle section and the switchgear at the permanent location even though it may be some time before the equipment is used. Regardless of what method of storage is used, break the shipping seal and remove the aisle wall (see Page 16) from in front of instrument panels. This is required to gain access to the space heater circuit so that heaters can be energized. Reseal the front or cover it for protection from the weather. Connect batteries (if provided) to a charger. Lubricate hinges, shutters, and other moving parts.

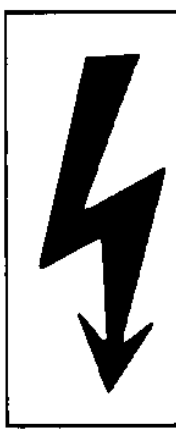
INSTALLATION

Foundation

Extreme care should be taken in layout of foundation or floor. Refer to general arrangement drawing for exact location of anchor bolts, area for secondary and primary conduits, other limitations and instruction. Should location of 3.5" (88.9 mm) nom. X-X strong lift pipe (furnished by customer) interfere with customer's primary conduit, it is suggested that a conduit coupling be installed in this location. The coupling should not project more than .56 (14.3 mm) above surface of foundation. After switchgear has been lowered to foundation and lift pipe has been removed, a conduit nipple may be screwed into coupling.



Floors, sills, piers or pilings, whichever type of foundation is used, must have a smooth level surface and be in the same plane. The surface of the foundation must not protrude above the grouted sills or bed plates at any point. Grouted sills or bed plates must be set true and level and be in the same plane to each other. Care and accuracy at this point will simplify or eliminate shimming when switchgear is installed. Foundations must be sufficiently strong to support the weight of the cubicles and breakers plus the impact loading of the circuit breakers (twice the weight of each circuit breaker). Outdoor switchgear groups which have been assembled on 4 x 8 (101.6 x 203.2 mm) beams must be supported along these beams with the maximum span between support points not exceeding eight (8) feet (2440 mm). If pilings are used, the diameter of these pilings is to be determined by the customer for proper loading. However, they must not be less than twelve (12) inches (305 mm) for sufficient contact with beam, allowing space for shipping split and space for grouting in of bed plate is used. All shipping splits must be supported and taken into consideration when foundation is constructed.



⚠ CAUTION

In the switchgear primary entrance area, steel reinforcing rods or mesh in concrete must not pass through space shown on general arrangement drawing even though cored or bored holes in concrete may miss rods or mesh. A single phase of a system may not be encircled by ferrous metals where current exceeds 600 amperes.

All sill channels, bed plates, shims and anchoring hardware are furnished by customer unless covered by contract.

Fig. 6 illustrated acceptable methods of setting sill channels for 34.5 kV indoor switchgear. Cubicles may be anchored to sills by use of nuts welded to bottom of channel. Before grouting channels in place, screws of sufficient length should be placed in anchor holes and coated with a heavy film of paraffin or other suitable coating which will allow the screws to be readily removed after the concrete has set.

Fig. 7 shows a suggested method of anchoring and leveling bed plates for outdoor switchgear of *Shelter-Clad* design. Outdoor switchgear, as received, is supported on 4" x 8" (« 18.5 lbs. (101.6 x 203.2 mm (« 27.4 kg/m) per foot beams. The maximum span between the support points on which these beams rest must not exceed eight feet. If pilings are used for foundation, their diameter may not be less than 12 inches (305 mm). Cubicles must be supported at shipping splits.

Before setting and erecting the cubicles, determine the correct locations of each shipping group and sequence of installation on the general arrangement drawing. Sweep the mounting surfaces to remove all dirt. Refer to Figs. 8 through 11 for additional installation instructions.

Secondary control conduits must be exceed 2-inch (50.8 mm) nominal pipe size (2.37 inch (60.2 mm) o.d.). If conduit extends above floor or slab to enter cubicle and exclude water, it should not exceed 1.50-inches (38 mm) on indoor equipment. On outdoor equipment, the secondary control conduit should extend to a maximum of 9.50 inches (241 mm) and a minimum of 8.75 inches (223 mm) above the slab or base plane. In cases where switchgear cannot be lowered over conduit because of headroom or other restrictions, conduit couplings can be grouted in flush with slab. Conduit nipples can then be added after switchgear is in place. Care should be taken during construction and at all times to keep conduit ends capped to prevent entry of dirt, moisture and vermin.

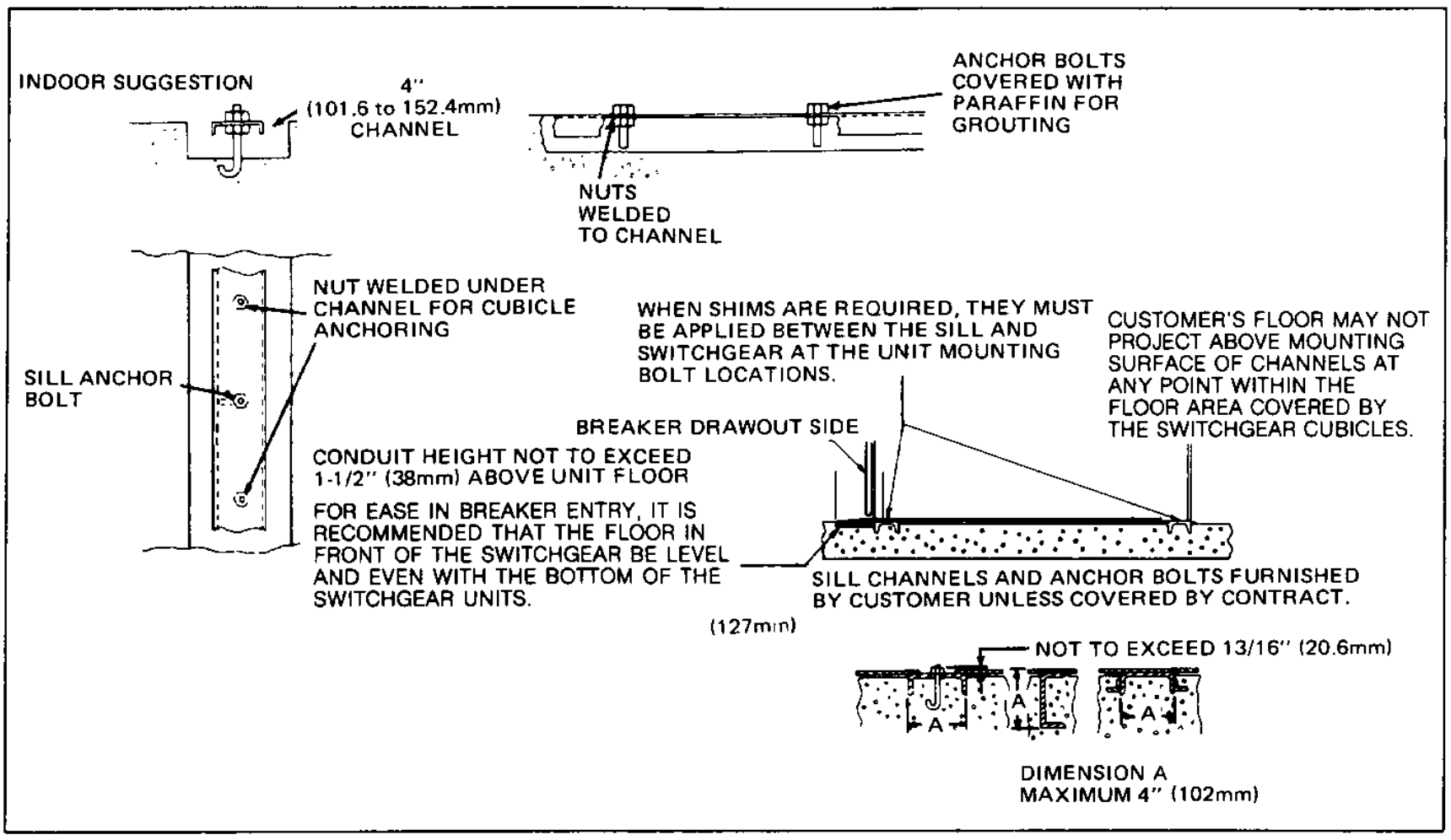


Figure 6. Setting Channel Sills for Indoor Switchgear

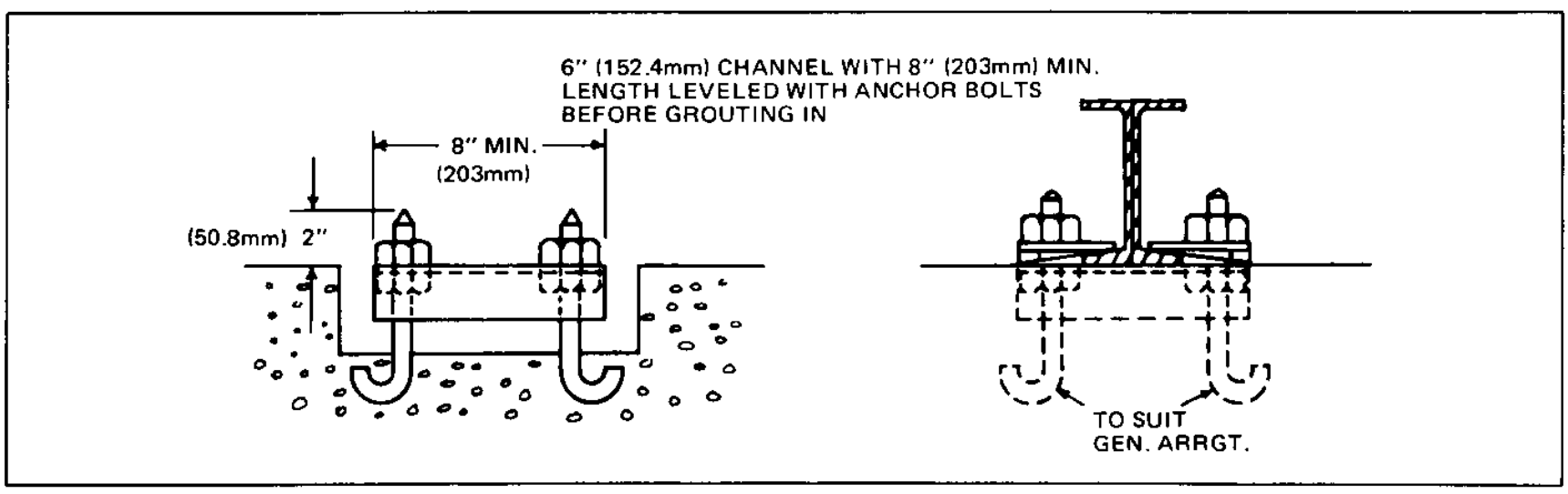


Figure 7. Securing Outdoor Cubicles

If primary power conduit is grouted into the foundation, follow instructions outlined above. (This conduit may often enter through trench or planned opening.)

Erecting Cubicles

The proper erection method depends on whether the units are shipped as one complete group or in two or more sections. In any case, the general arrangement drawing will indicate the shipping groups and their location within the lineup. Units are assembled and wired in accord with the arrangement as in the final installation.

Before setting and erecting the cubicles determine the correct locations of each shipping group on the general arrangement drawing. Sweep the mounting surfaces to remove all dirt. Refer to Figs. 8 through 11 for additional installation instructions.

INSTALLATION

Carefully check that switchgear not furnished with supporting beams is in firm contact with the sills or floor. DO NOT FORCE CUBICLE INTO FIRM CONTACT BY DRAWING DOWN MOUNTING BOLTS. THIS MAY DISTORT CUBICLE. Place 4x4 inch (100 x 100mm) shims, if necessary, in the area of the mounting.

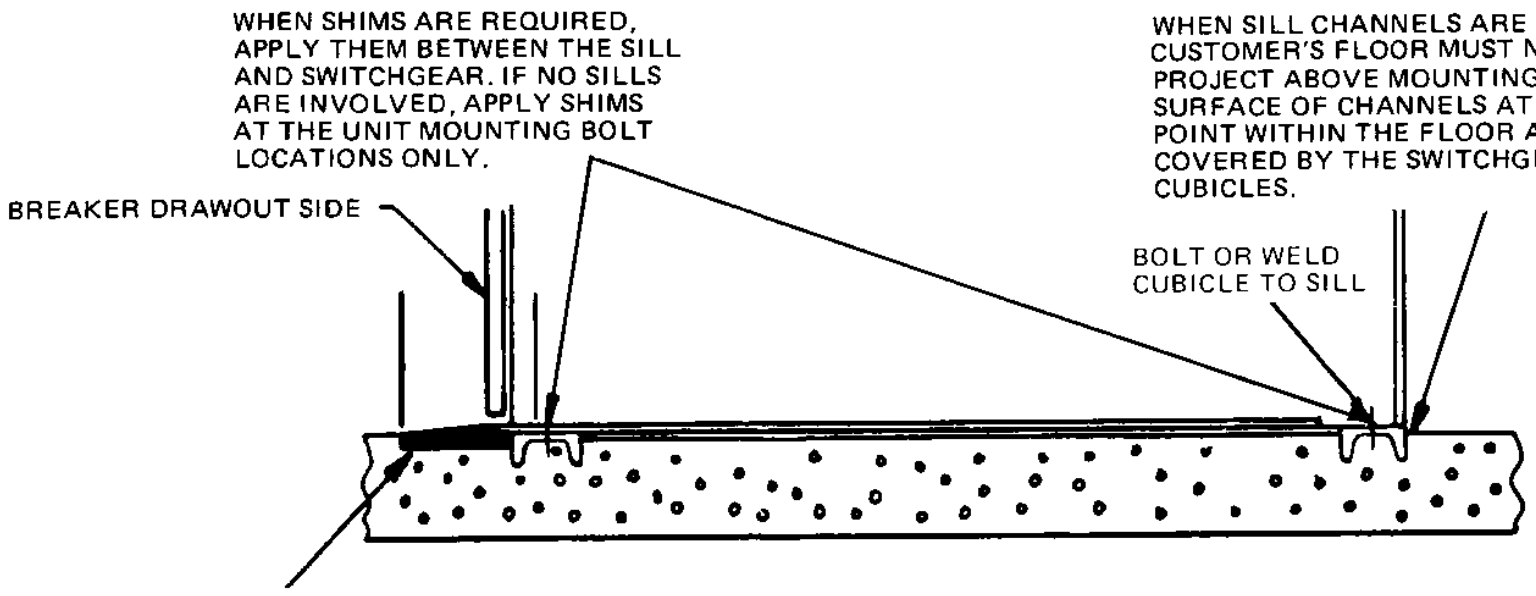


Figure 8. Setting Indoor Cubicles on Foundation

INSTALLATION

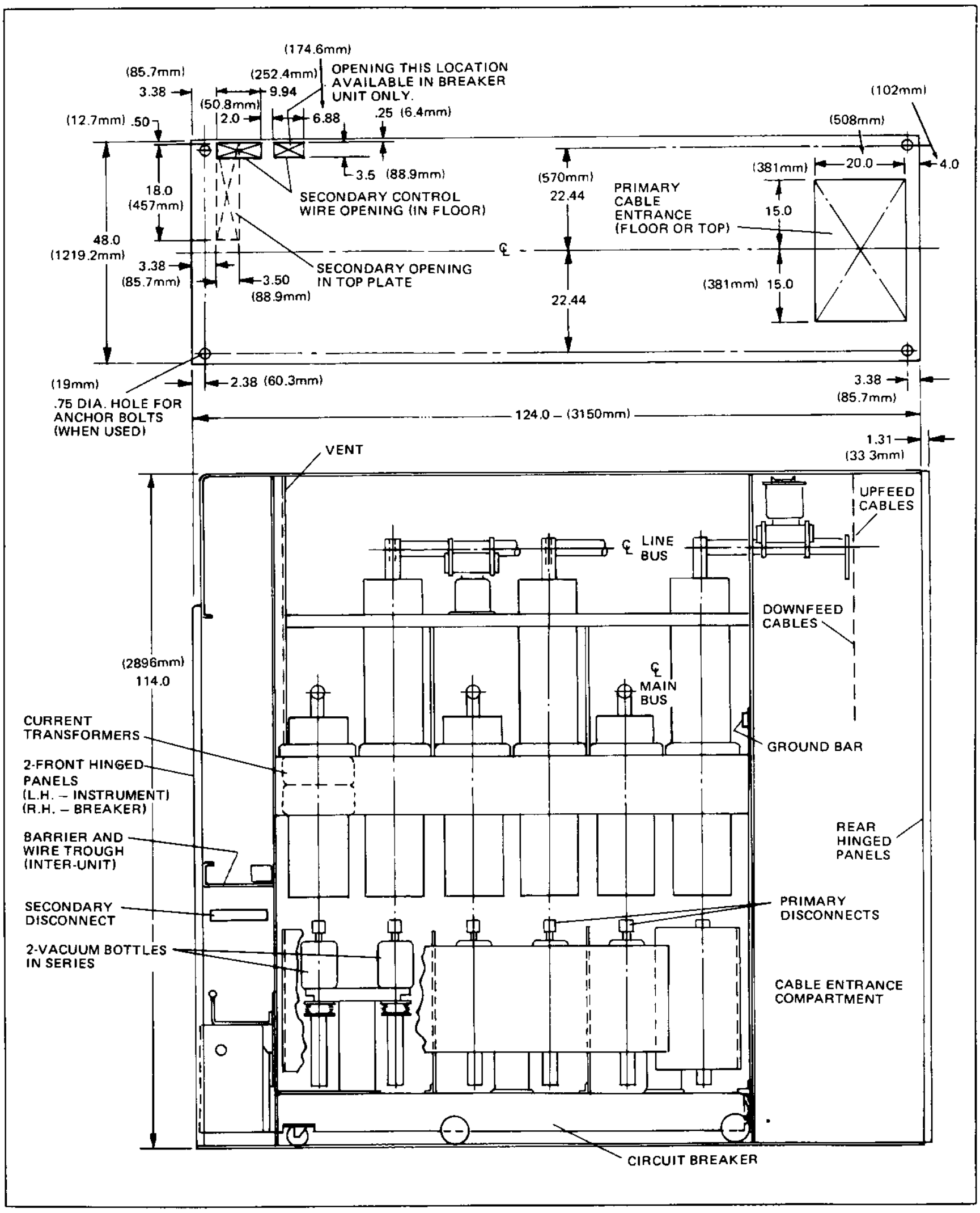


Figure 9. Floor Plan and Side View of Typical 34.5 kV Indoor Cubicle

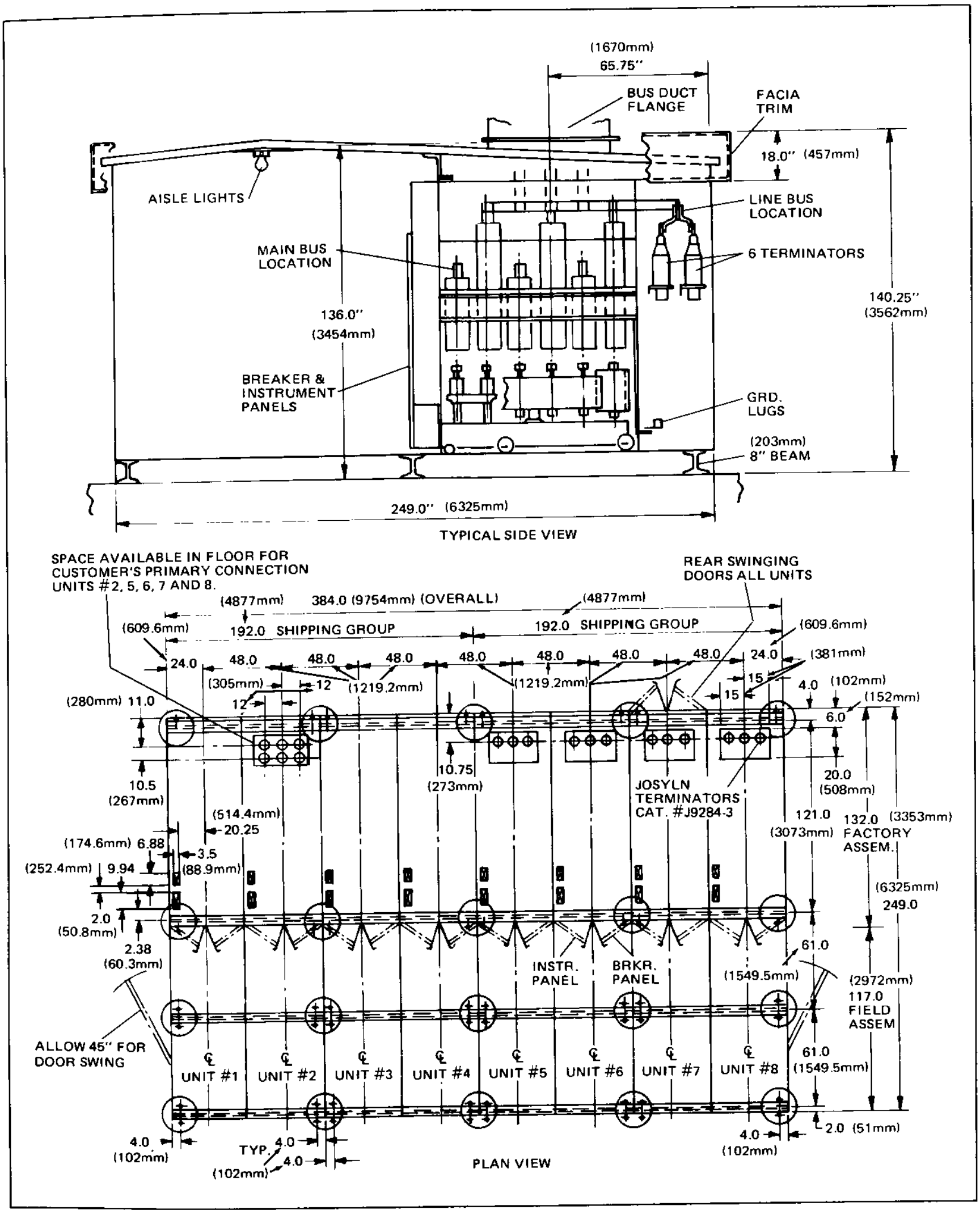


Figure 10. Floor Plan and Typical Side View of 34.5 kV Single Aisle Shelter-Clad Cubicle

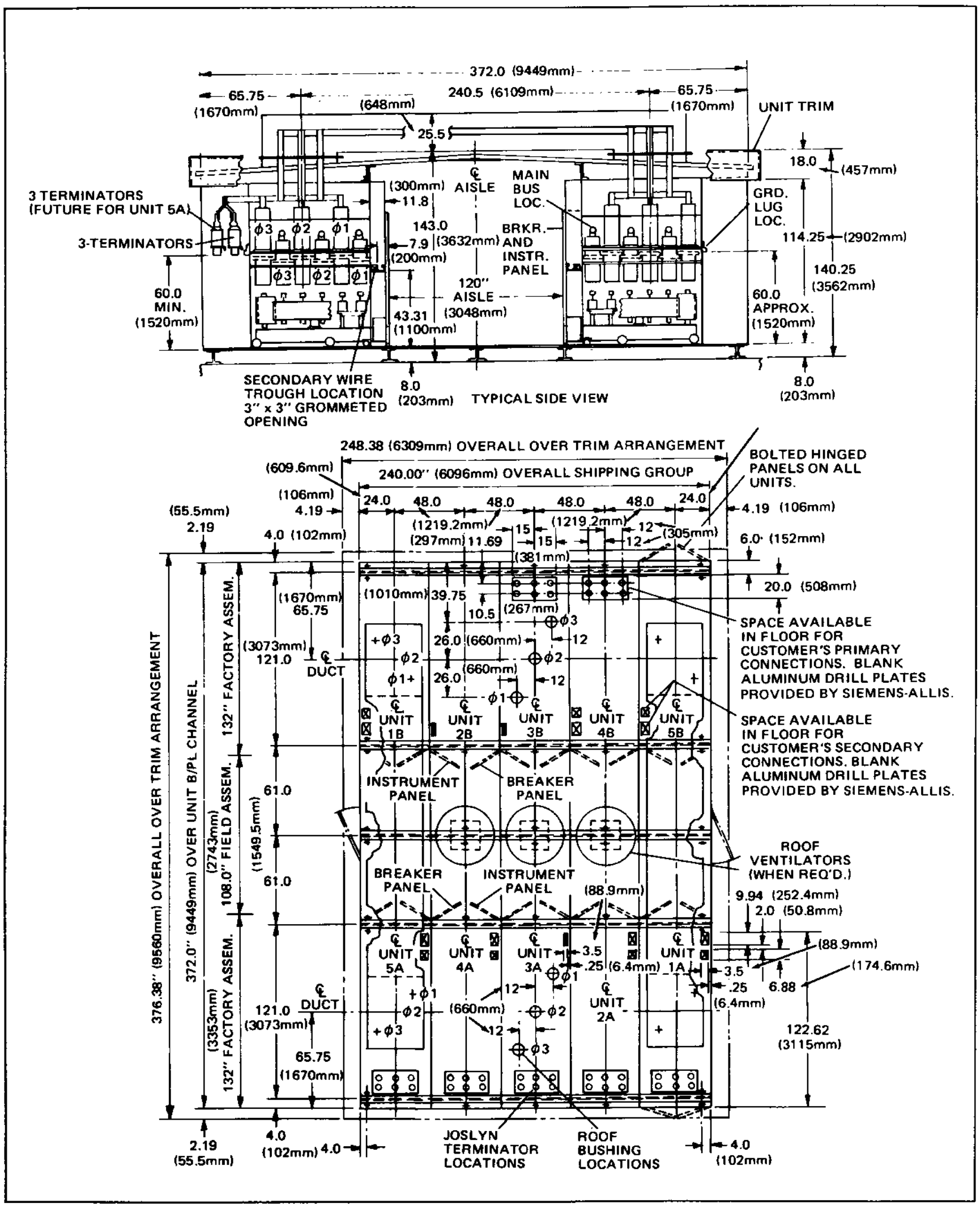


Figure 11. Floor Plan and Typical Side View of 34.5 kV Common Aisle Shelter-Clad Cubicle

INSTALLATION

Anchoring And Leveling Indoor Switchgear

Indoor switchgear shipping groups are held in true alignment by lifting channels across the top of the group and by bolts holding the cubicles to each other. The entire shipping group is to be anchored and leveled as a single element without loosening any hardware or removing lifting channel until entire shipping group is leveled and anchored.

Verify anchor bolt locations per general arrangement drawing and sweep area clean of any construction debris. Check general arrangement drawing for position of first shipping group and sequence of installation if arrangement consists of more than one shipping group.

Refer to Pages 4, 5 and 6 and move switchgear to its final location.

1. The switchgear equipment represented was accurately aligned on level steel bed plates at the factory. This care insures proper operation and fit of mating parts. Supporting surfaces for the switchgear at each mounting bolt location must be level and in the same plane. There must not be any projection above this plane within the area covered by the switchgear cubicles. If customer's floor or grouted sill channels do not meet this requirement it will be necessary to shim in the following manner. The four (4) anchor bolt locations in each cubicle must freely rest in firm contact with the mounting support surfaces. There must not be any projection or obstruction in other areas which may distort cubicle. Do not force cubicle into firm contact by drawing down mounting bolts as such drastic means will distort cubicles. Add 4 (100 mm) square shims adjacent to anchor bolts until firm contact is achieved. Check each bolt location, 4 per cubicle, and tighten bolts (see Fig. 9).
2. Tighten anchor bolts.
3. Check group for plumb. Use the first breaker cubicle in from the end of each shipping group. All plumb readings should be taken with anchor bolts tight. If it is not within .12" (3.2 mm), it could be due either to unlevel sills or the cubicles being damaged in shipment. Check first to insure that sills are level. If sills are not level, add 4" x 4" (100 x 100 mm) steel shims on top of sill, adjacent to the anchor bolts, as necessary to achieve a level floor in all cubicles and to insure that all cubicles are in form contact with the foundation at each anchor point. Tighten the anchor bolts.

   Do not loosen any hardware until *after* it has definitely been verified that floors are level and in firm contact with sills.
4. If lineup consists of multiple groups, move the next group into position, with the front of units in line and tight against the adjacent group. Do not bolt groups together at this time. Check for plumb as on previous group and bolt groups together with hardware provided. Repeat for any additional groups. Check that the cubicles are in firm contact with the foundation at each anchor point. Add 4" x 4" (100 x 100 mm) shims as necessary. Tighten the anchor bolts.

INSTALLATION

Anchoring And Leveling Of Shelter-Clad Switchgear

In *Shelter-Clad* arrangements the switchgear, as received, is true and in correct position relative to its support beams. The beams are a permanent part of the switchgear, and are not to be loosened or moved from position.

Verify anchor bolt locations in concrete as shown in Fig. 7, and at all points shown on general arrangement plan view. Sweep foundation to make certain it is free of pebbles or other debris. Check general arrangement drawing for positioning of switchgear and sequence of installation if arrangement consists of more than one shipping group.

Single aisle *Shelter-Clad* cubicles are shipped with the aisle wall covering the breaker drawout compartment. This wall may be removed before moving the switchgear into position on its foundation, if conduit clearance is in doubt, or if aisle is to be assembled immediately after leveling See Fig. 13.

1. Remove seal material at top of wall (A).
2. Remove bolts at roof gable (C).
3. Support wall (A) with crane or other means (Figure approximately 375 lb. (170 kg) per unit) and remove all the bolts (X) at each end of the group which hold the aisle wall in place. Carefully lay aisle wall aside until needed for aisle assembly.

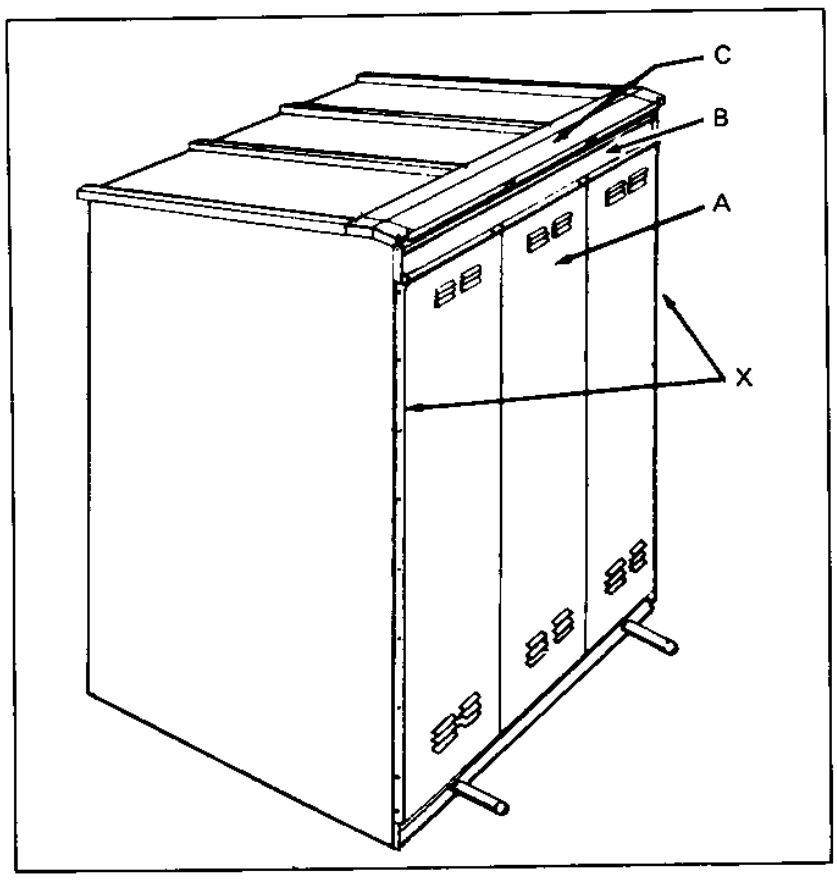


Figure 12. Aisle Wall Removal

4. Remove nuts from all anchor bolts, remove caps from all secondary conduit stubs, and remove covers from secondary openings in cubicle floor plates.

   Refer to Pages 4, 5 and 6 for Lifting and Handling *Shelter-Clad* switchgear. The arrangement may consist of a single complete shipping group, or may be broken down into a number of shipping sections as in a long line-up. Refer to general arrangement drawing for instructions as to which shipping group should be installed first, and in what sequence the remaining groups are to be installed. Using 3.50" (88.9 mm) nom. X-X strong (extra-heavy) pipe (do not substitute a member of less strength) move the first group into position as dimensioned on general arrangement drawing.

5. The switchgear equipment represented was accurately aligned on level steel bed plates at the factory. This care insures proper operation and fit of mating parts. Supporting surfaces for the switchgear's 4 x 8 (101.6 x 203.2 mm) beams must be level and in the same plane within .06" (1.6 mm). If concrete, grouted channels, pier support plates, etc. do not meet this requirement, or if there is any projection higher than the support points in line with beams, shims must be installed in the following manner to provide equivalent true surface of switchgear support. 34.5 kV outdoor switchgear groups which have been assembled on 4 x 8 (101.6 x 203.2 mm) beams must be supported along these beams with the maximum span between support points not exceeding eight (8) feet (2440 mm). If shims are required, use 4" (100 mm) square strips placed between bottom of beam and foundation, in the anchor bolt area where they will be clamped firmly in place.

6. Add clamp washers and nuts to anchor bolts and tighten securely.
7. Using the first breaker cubicle in from each end of every shipping group, check group for plumb. If the reading exceeds .12" (3.2 mm) out of plumb, does the position of the deviation in each end breaker cubicle read the same direction and approximately the same distance? If this condition exists it would normally indicate that the slab, piers or pilings, as the case may be, are not level and/or are not in the same plane. The addition of shims between foundation and the bottom of the beam should bring shipping group to level showing plumb reading within the .12" (3.2 mm) tolerance. Note all plumb readings are to be taken with anchor bolts tight.

8. A temporary plate is bolted to the end plate of each group at the shipping split. This plate was used to support the aisle wall during shipment. Remove and scrap these plates, and remove any hardware which would interfere with a tight fit when the next group is moved into position. Make sure that all anchor nuts of the first section installed are tight and have produced a true plumb reading before moving the next group into position.

9. Move the next group into position. The front edge of the cubicle floor plates should be in line with those of the previously installed group. This will insure a good fit with aisle floor plates. Make certain that the end of the group being installed is tightly against the previous installation. Repeat steps 5, 6 and 7 for each group. Replace covers for anchor bolt access at each end of line-up.

10. If there are additional groups in line-up, repeat steps 8 and then 5, 6 and 7 for each group.

Assembly Of Shelter-Clad Outdoor Switchgear

Single Aisle

Table 3 lists the standard components supplied for single aisle *Shelter-Clad* outdoor switchgear. The item numbers in the table are used in all instructions pertaining to this procedure. Assemble as follows (use hardware as indicated in Fig. 13).

1. Temporarily support the aisle wall assembly (removed from the plumb bob check) in its permanent position as shown in the exploded arrangement drawing (Fig. 13). Remove the aisle beam (B) from top of the wall assembly (A) and place the beam, with clip angles near the tip, in position as shown.

2. Put roof covers (510) in place to hold top of aisle wall in place. Do not tighten hardware. Remove and discard the buffer angles at the bottom of the unit. These angles are installed to prevent bending on the aisle wall during shipping. If not removed, they may interfere with installation of floor plates.

3. Align the ends of the aisle wall, aisle beam and switchgear. Place two sets of floor plates in position between the switchgear and the wall. Install each set next to the end position between the switchgear and the wall. (See Fig. 13 for location of floor plates.) With aisle floor plates set tightly against switchgear floor plates, check and adjust center beam and aisle wall beam location to provide a good fit with minimum size cracks between plates and a smooth surface. Check that aisle wall is square with switchgear by diagonal measurements at floor level—corner to corner distance should be equal. Tighten anchor bolts to secure beam locations.

4. With roof cover hardware loose, plumb front wall and tighten attaching hardware.

5. Install all floor plates using pattern as shown in Fig. 13. Each plate overlaps the supporting member of the next plate; therefore, determine sequence of installation accordingly. Place each set of aisle floor plates in line with cubicle floor plates to equalize the space between floor plates and prevent a wide crack at end of group.

6. Install sealant tape (310) at points "C" and "D". Place the tape so that one edge is on the vertical centerline of the holes and the other edge is toward the seam which will be exposed to the weather. See Section B-B of Fig. 13.

7. Install angles (316) to aisle beam at each end of line-up as shown in Fig. 13.

8. Install L.H. trim angle (524) and R.H. trim angle (526).

9. Set door assemblies (518) in place (Fig. 13). Bolt the doors to the aisle wall (A) and to side plate of the cubicle and to aisle beam.

10. Put all roof covers (510) in place and bolt to aisle wall assembly (A) and roof support.

11. Fasten roof covers together using bracket (310) at positions (two per joint) shown in Section A-A of Fig. 13.

12. Install trim angles (520) at each end of aisle.

13. Set roof channels (512 and 514) over roof cover points. Slide the channel toward the roof peak until the clip inside the channel engages the bracket (318).
14. Install roof hoods (516).
15. Drill primary opening cover (360 or 362) to suit conduit installation and bolt in place.
16. Mount aisle conduit, switches, receptacle and wire to junction box at each end unit. See conduit arrangement in Fig. 13.
17. If equipment consists of more than one shipping group, caulk vertical shipping split at back of switchgear with metal filler (00-519-275-001) provided.
18. Bolt corner trim bracket assemblies (610) in place as shown in A-A and C-C of Fig. 14 (three per corner).
19. Install corner trim—(612) at breaker unit corners. These are installed by raising up until clips in corner trim engage brackets (610) and then pulling down sharply while pushing trim firmly against units.
20. Install bottom covers (614) on corner trim using tamperproof screws (246). See H-H of Fig. 15.
21. Install aisle wall vertical panel braces (618) as shown in Fig. 15 aisle wall view and Section G-G.
22. Install aisle end side braces (616) as shown in side view and Section B-B of Fig. 14 (2 per end).
23. Install roof trim supports (624) to roof decks as shown in Section K-K of Fig. 15 (4 per unit).
24. Install horizontal side trim parts (628, 630, 632 and 634) as shown in Fig. 14. Use bridge trim strips (636) where shown.
25. Install horizontal front and rear trim parts (638) along with bridge trim strips (636) and corner trim (626) as shown in Figs. 14 and 15.
26. After primary cables, terminators, LA's, etc. are mounted and primary entrances are ready for closing, the rear panels should be closed and bolted shut using four (4) tamperproof screws which were provided with these units as shipped. The rear trim is then completed by installing vertical trim channels (620) in same manner as described for corners under step 19. Install bottom covers (622) using tamperproof screws (246). See Fig. 15, rear view and Sections D-D, E-E and F-F.

Table 3. Standard Components—Single Aisle Switchgear

Item	Description	Part Number	Mk.
A	Aisle Wall Assembly		
B	Aisle Beam		
218*	Wiring Hardware (#8-32)	18-194-685-	801
	(#10-32)	18-194-685-	804
238*	Rd. Hd. Screw–#10-32 x .25 (6.2 mm)	00-615-485-	214
240*	Rd. Hd. Screw–#10-32 x .50 (12.7 mm)	00-615-485-	218
242*	Lockwasher–#10	00-655-017-	022
244*	Hex Nut–#10-32	00-631-123-	210
246*	Tamperproof Screw–.25-20 x .50 (12.7 mm)	15-171-404-	001
248*	Hex Hd. Cap Screw–.25-20 x .75 (19 mm)	00-611-315-	375
250*	Round Washer–.25	00-651-007-	160
252*	Lockwasher–.25	00-655-017-	026
254*	Hex Nut–.25-20	00-631-059-	104
256*	Tamperproof Screw–.31-18 x .75 (19 mm)	15-171-404-	006
258*	Round Washer–.31	00-651-007-	905
260*	Lockwasher–.31	00-655-017-	030
262*	Hex Hd. Cap Screw–.38-16 x 1.00 (25.4 mm)	00-611-315-	466
264*	Hex Hd. Cap Screw–.38-16 x 1.25 (31.8 mm)	00-611-315-	468
266*	Hex Hd. Cap Screw–.38-16 x 1.50 (38.1 mm)	00-611-315-	470
268*	Round Washer–.38	00-651-007-	230
270*	Lockwasher–.38	00-655-017-	032
272*	Hex Nut–.38-16	00-631-059-	106
274*	Hex Hd. Cap Screw–.50-13 x 1.50 (38.1 mm)	00-611-315-	548
276*	Round Washer–.50	00-615-007-	300
278*	Lockwasher–.50	00-655-017-	036

*Use material supplied — do not use metric hardware.

Table 3. Standard Components–Single Aisle Switchgear (Cont'd.)

Item	Description	Part Number	Mk.
280	Hex Nut–.50-13	00-631-059-	108
310	Sealant Tape	00-333-450-	005
312	Floor Plate	18-657-510-	530
316	Angle Assembly	18-657-848-	536
318	Bracket–Roof (Aisle)	18-184-206-	001
320*	conduit–EMT–.50 x 52.8 (12.7 x 1341 mm) Formed	18-657-870-	308
322*	Conduit–EMT–.75 x 67.0 (19 x 1702 mm) Formed	14-657-870-	309
324*	Conduit–EMT–.75 x 33.0 (19 x 838 mm) Straight	14-239-690-	330
326*	Conduit–EMT–.75 x 84.8 (19 x 2154 mm) Straight	14-239-692-	068
328*	Conduit–EMT–.50 x 43.0 (12.7 x 1092 mm) Straight	18-199-658-	005
330*	Box Connector–.75 (19 mm) EMT	00-855-051-	006
332*	Box Connector–.50 (12.7 mm) EMT	00-855-051-	004
334*	Clamp–.75 (19 mm) EMT	00-691-259-	101
336*	Clamp–.50 (12.7 mm) EMT	00-691-259-	100
338*	Outlet Box–4" (102 mm) Square	00-853-691-	106
340*	Cover–Blank	00-855-213-	101
342	Switch–20A–3 Way	00-871-505-	011
344	Duplex Outlet–15A	00-857-215-	003
346	Cover–Switch and Receptable	00-855-209-	375
348*	Outlet Box–4" (102 mm) Octagon	00-853-713-	004
350	Lamp Receptacle–Porcelain	00-857-353-	204
352	Lamp–Incand.–100W–120 V	00-857-283-	213
354*	Wire–#14 Black–MTW	00-557-659-	355
356*	Wire–#14, White–MTW	00-557-659-	356
358*	Terminal–#14-10	00-851-078-	070
360	Primary Opening Cover (Breaker or Auxiliary Unit Without Cpt.)	18-657-521-	130
362	Primary Opening Cover (Auxiliary Unit With Cpt.)	18-657-853-	219
510	Aisle Roof Assembly	18-729-500-	501
512	Roof Channel–(Aisle)	18-730-190-	504
514	Roof Channel–(Unit)	18-392-988-	501
516	Hood	18-726-888-	001
518	Door Mounting L.H. or R.H.	18-395-694-	508
520	Angle–Under Roof Channel (L.H. and R.H.)	18-730-190-	001
522	End Cap–Roof Channel	18-657-848-	535
524	L.H. Trim Angle	18-657-870-	282
526	R.H. Trim Angle	18-657-870	283
610	Corner Bracket Assembly	18-657-830-	575
612	Corner Trim–Vertical–Unit	18-393-251-	502
614	Corner Cover–Bottom	18-657-510-	532
616	Side Brace–Vertical–Aisle Ends	18-730-190-	510
618	Panel Brace–Vertical–Aisle	18-726-884-	501
620	Rear Channel–Vertical–Units	18-392-987-	501
622	Rear Channel Cover–Bottom	18-657-817-	544
624	Trim Support–Roof	18-657-803-	033
626	Corner Trim	18-727-106-	001
628	Side Trim–Horizontal–103" (2616 mm) Lg.	18-727-104-	501
630	Side Trim–Horizontal– 41" (1041 mm) Lg.	18-727-102-	501
632	Side Trim–Horizontal–103" (2616 mm) Lg.	18-727-103-	501
634	Side Trim–Horizontal– 41" (1041 mm) Lg.	18-727-102-	502
636	Bridge Trim Strip	18-657-804-	076
638	Front–Rear Trim–Horizontal	18-727-100-	501

*Use material supplied — do not use metric hardware.

Item Description for Figure 13.

Item	Description	Part Number	Mk.
238*	Rd. Hd. Screw–#10-32 x .25 (6.4 mm)	00-615-485	214
240*	Rd. Hd. Screw–#10-32 x .50 (12.7 mm)	00-615-485-	218
242*	Lockwasher–#10	00-655-017-	022
244*	Hex Nut–#10-32	00-631-123-	210
250*	Round Washer–.25	00-651-007-	160
252*	Lockwasher–.25	00-655-017-	026
254*	Hex Nut–.25-20	00-631-059	104
256*	Tamperproof Screw–.31-18 x .75 (19 mm)	15-171-404	006
258*	Round Washer–.31	00-651-007-	905
260*	Lockwasher–.31	00-655-017-	030
264*	Hex Hd. Cap Screw–.38-16 x 1.25 (31.8 mm)	00-611-315-	468
266*	Hex Hd. Cap Screw–.38-16 x 1.50 (38.1 mm)	00-611-315-	470
268*	Round Washer–.38	00-651-007-	230
270*	Lockwasher–.38	00-655-017-	032
272*	Hex Nut–.38-16	00-631-059-	106
274*	Hex Hd. Cap Screw–.50-13 x 1.50 (28.1 mm)	00-611-315-	548
276*	Hex Hd. Cap Screw–.50-13 x 1.50 (38.1 mm)	00-615-007-	300
278*	Lockwasher–.50	00-655-017-	036
280	Hex Nut–.50-13	00-631-059-	108
310	Sealant Tape	00-333-450-	005
312	Floor Plate	18-657-510-	530
316	Angle Assembly	18-657-848-	536
318	Bracket–Roof (Aisle)	18-184-206-	001
320*	Conduit–EMT–.50 x 52.8 (12.7 mm) Formed	18-657-870-	308
322*	Conduit–EMT–.75 x 67.0 (19 x 1702 mm) Formed	14-657-870-	309
324*	Conduit–EMT–.75 x 33.0 (19 x 838 mm) Straight	14-239-690-	330
326*	Conduit–EMT–.75 x 84.8 (19 x 2154 mm) Straight	15-239-692-	068
328*	Conduit–EMT–.50 x 43.0 (12.7 x 1092 mm) Straight	18-199-658-	005
330*	Box Connector–.75 (19 mm) EMT	00-855-051-	006
332*	Box Connector–.50 (12.7 mm) EMT	00-855-051-	004
334*	Clamp–.75 (19 mm) EMT	00-691-259-	101
336*	Clamp–.50 (12.7) EMT	00-691-259-	100
338*	Outlet Box–4" (102 mm) Square	00-853-691-	106
340*	Cover–Blank	00-855-213-	101
342	Switch–20A–3 Way	00-871-505-	011
344	Duplex Outlet–15A	00-857-215-	003
346	Cover–Switch and Receptacle	00-855-209-	375
348*	Outlet Box–4" (102 mm) Octagon	00-853-713-	004
350	Lamp Receptacle–Porcelain	00-857-353-	204
352	Lamp–Incand.–100W–120 V	00-857-283-	213
354*	Wire–#14 Black–MTW	00-557-659-	355
356*	Wire–#14, White–MTW	00-557-659-	356
358*	Terminal–#14-10	00-851-078-	070
360	Primary Opening Cover (Breaker or Auxiliary Unit Without Cpt.)	18-657-521-	130
362	Primary Opening Cover (Auxiliary Unit with Cpt.)	18-657-853-	219
510	Aisle Roof Assembly	18-729-500-	501
512	Roof Channel–(Aisle)	18-730-190-	504
514	Roof Channel–(Unit)	18-392-988-	501
516	Hood	18-726-888-	001
518	Door Mounting–L.H. or R.H.	18-395-694-	508
520	Angle–Under Roof Channel (L.H. and R.H.)	18-730-190-	001
522	End Cap–Roof Channel	18-657-848-	535
524	L.H. Trim Angle	18-657-870-	282
526	R.H. Trim Angle	18-657-870-	283

*Use material supplied — do not use metric hardware.

INSTALLATION

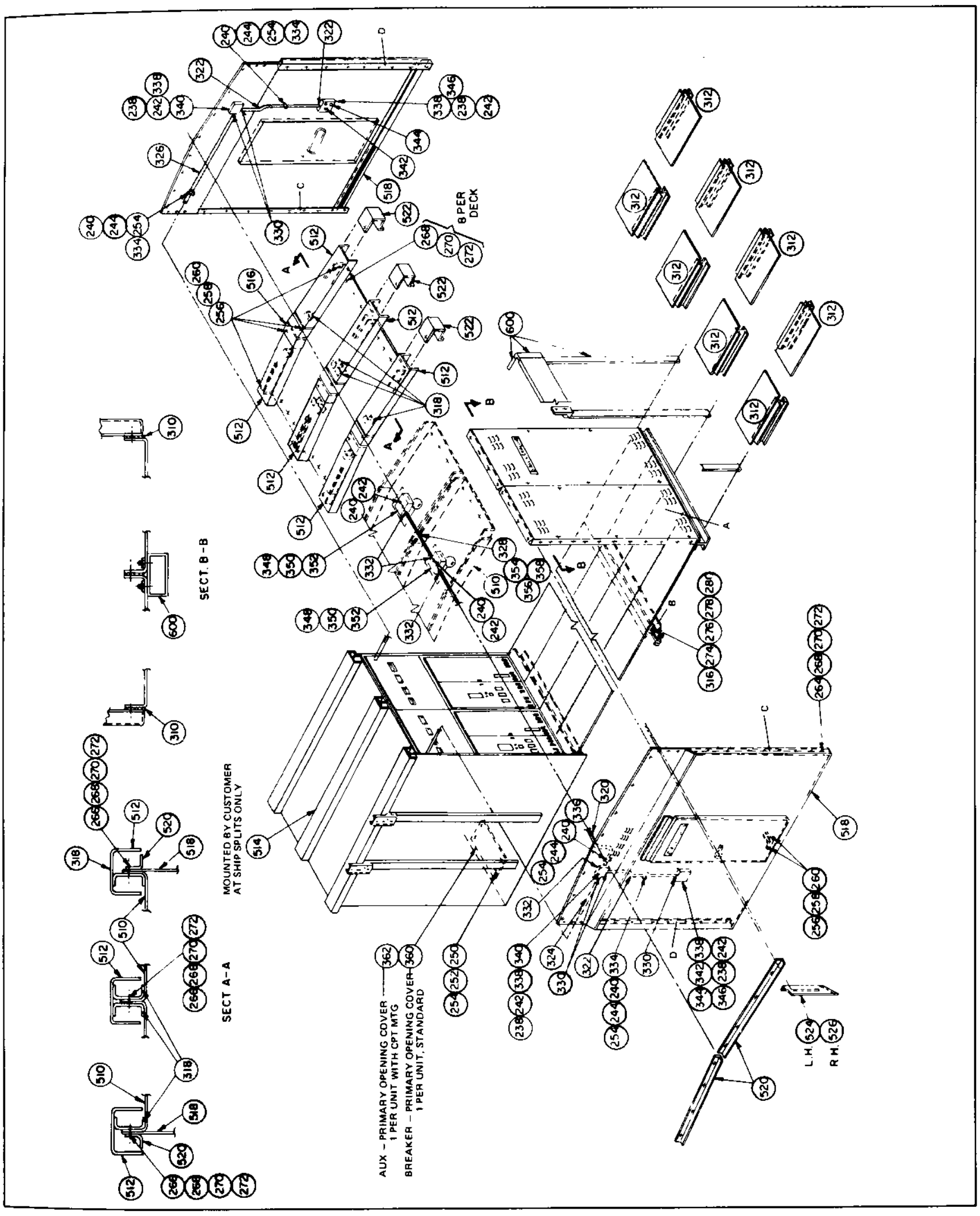


Figure 13. Aisle Assembly – Type "SIV" Single Aisle

INSTALLATION

Item Description For Figure 14

Item	Description	Part Number	Mk.
246*	Tamperproof Screw–.25 - 20 x .50 (12.7 mm)	15-171-404-	001
248*	Hex Hd. Cap Screw–.25-20 x .75 (19 mm)	00-611-315-	375
250*	Round Washer–.25	00-651-007-	160
252*	Lockwasher–.25	00-655-017-	026
268*	Round Washer–.38	00-651-007-	230
270*	Lockwasher–.38	00-655-017-	032
272*	Hex Nut–.38-16	00-631-059-	106
610	Corner Bracket Assembly	18-657-830-	575
612	Corner Trim–Vertical–Unit	18-393-251-	502
614	Corner Cover–Bottom	18-657-510-	532
616	Side Brace–Vertical–Aisle Ends	18-730-190-	510
618	Panel Brace–Vertical–Aisle	18-726-884-	501
626	Corner Trim	18-727-106-	001
628	Side Trim–Horizontal–103" (2616 mm) Lg.	18-727-104-	501
630	Side Trim–Horizontal– 41" (1041 mm) Lg.	18-727-102-	501
632	Side Trim–Horizontal–103" (2616 mm) Lg.	18-727-103-	501
634	Side Trim–Horizontal– 41" (1041 mm) Lg.	18-727-102-	502
636	Bridge Trim Strip	18-657-804-	076
638	Front–Rear Trim–Horizontal	18-727-100-	501

*Use material supplied — do not use metric hardware.

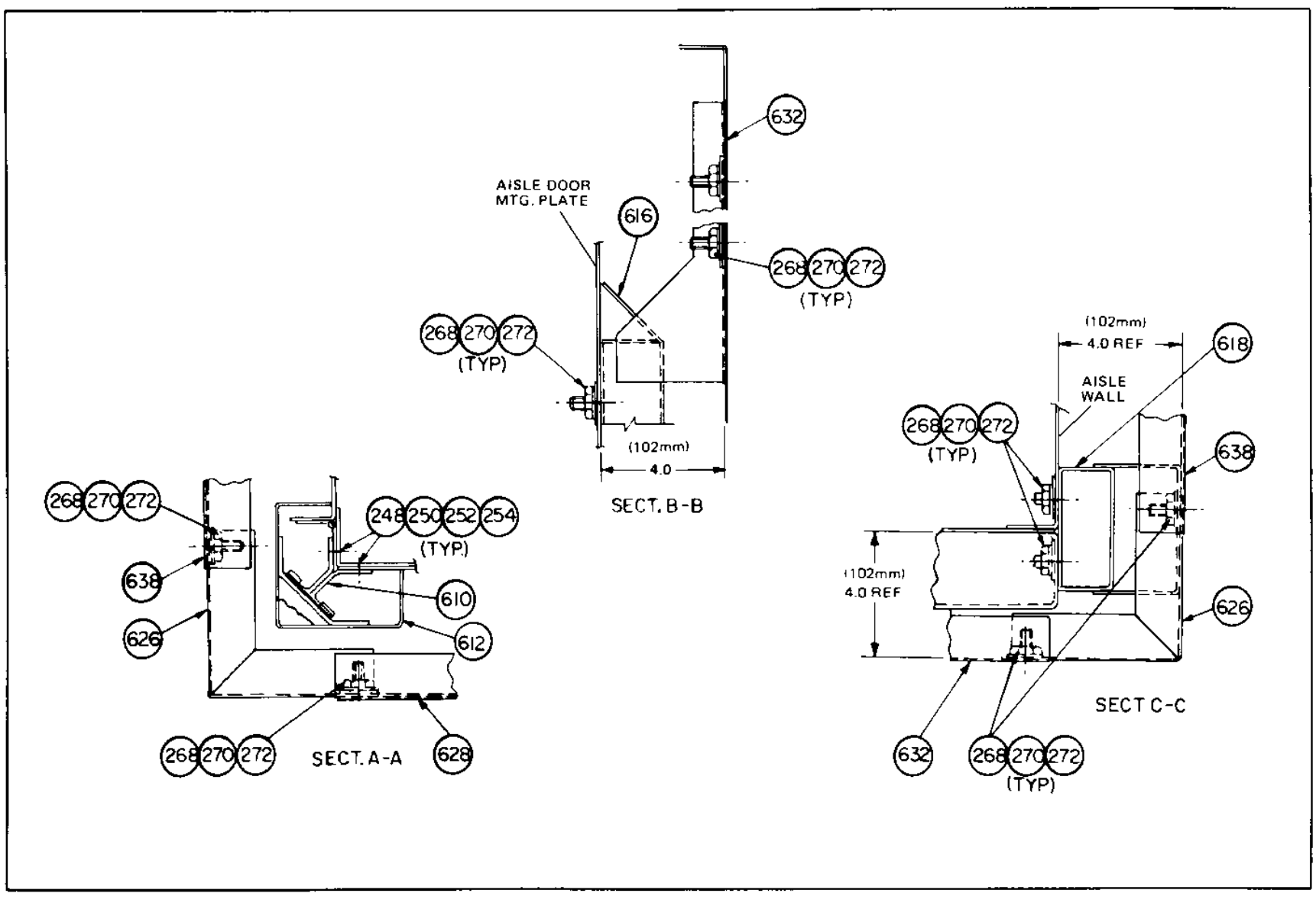


Figure 14. Trim Arrangement – Type "SIV"
Single Aisle

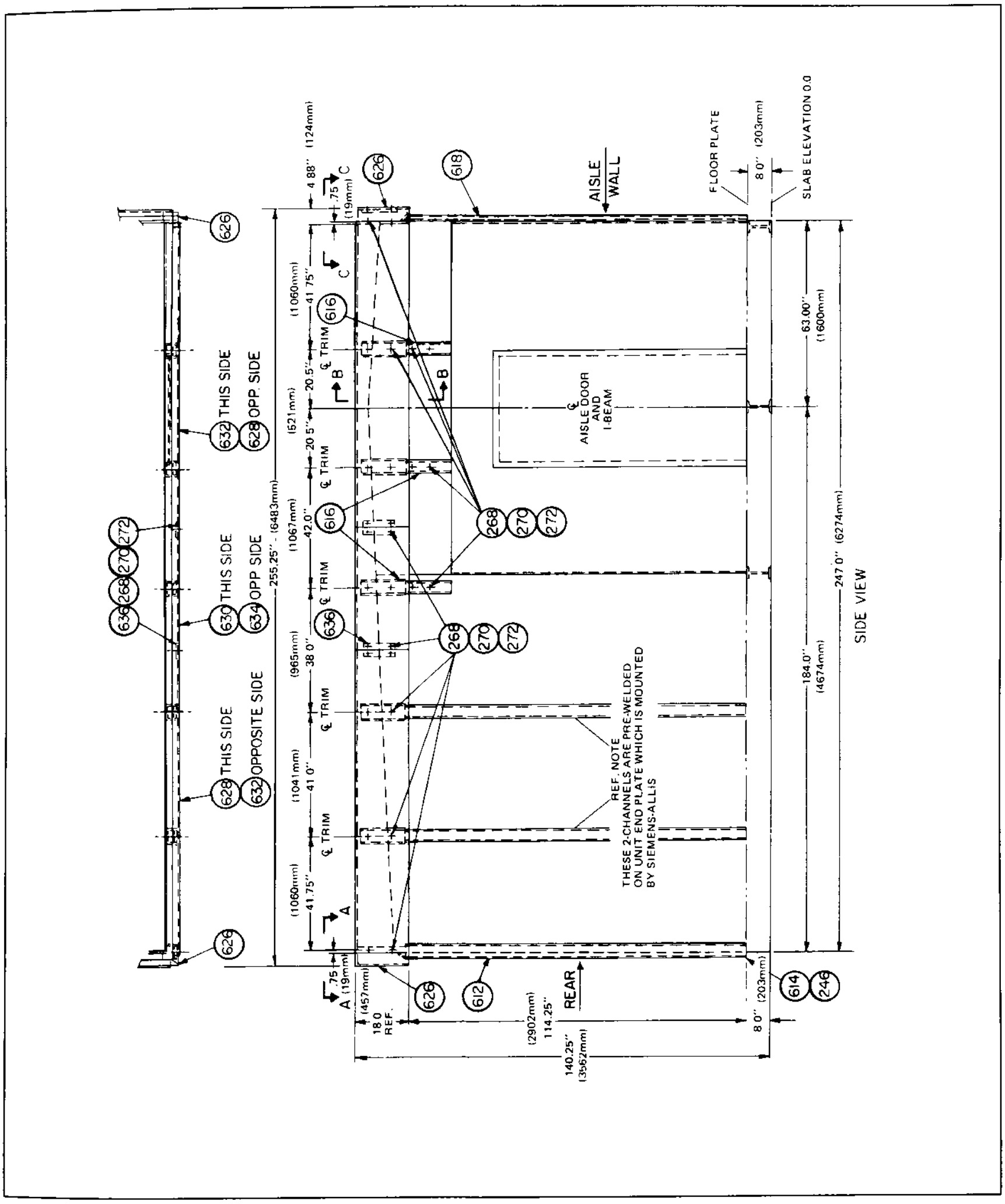


Figure 14. Trim Arrangement – Type "SIV"
Single Aisle

INSTALLATION

Item Description For Figure 15

Item	Description	Part Number	Mk.
246*	Tamperproof Screw–.25-20 x .50 (12.7 mm)	15-171-404-	001
262*	Hex Hd. Cap Screw–.38-16 x 1.00 (25.4 mm)	00-611-315-	466
268*	Round Washer–.38	00-651-007-	230
270*	Lockwasher–.38	00-655-017-	032
272*	Hex Nut–.38-16	00-631-059-	106
612	Corner Trim–Vertical–Unit	18-393-251-	502
614	Corner Cover–Bottom	18-657-510-	532
618	Panel Brace–Vertical–Aisle	18-726-884-	501
620	Rear Channel–Vertical–Units	18-392-987-	501
622	Rear Channel Cover–Bottom	18-657-817-	544
624	Trim Support–Roof	18-657-803	033
626	Corner Trim	18-727-106-	001
636	Bridge Trim Strip	18-657-804	076
638	Front–Rear Trim–Horizontal	18-727-100-	501

*Use material supplied — do not use metric hardware.

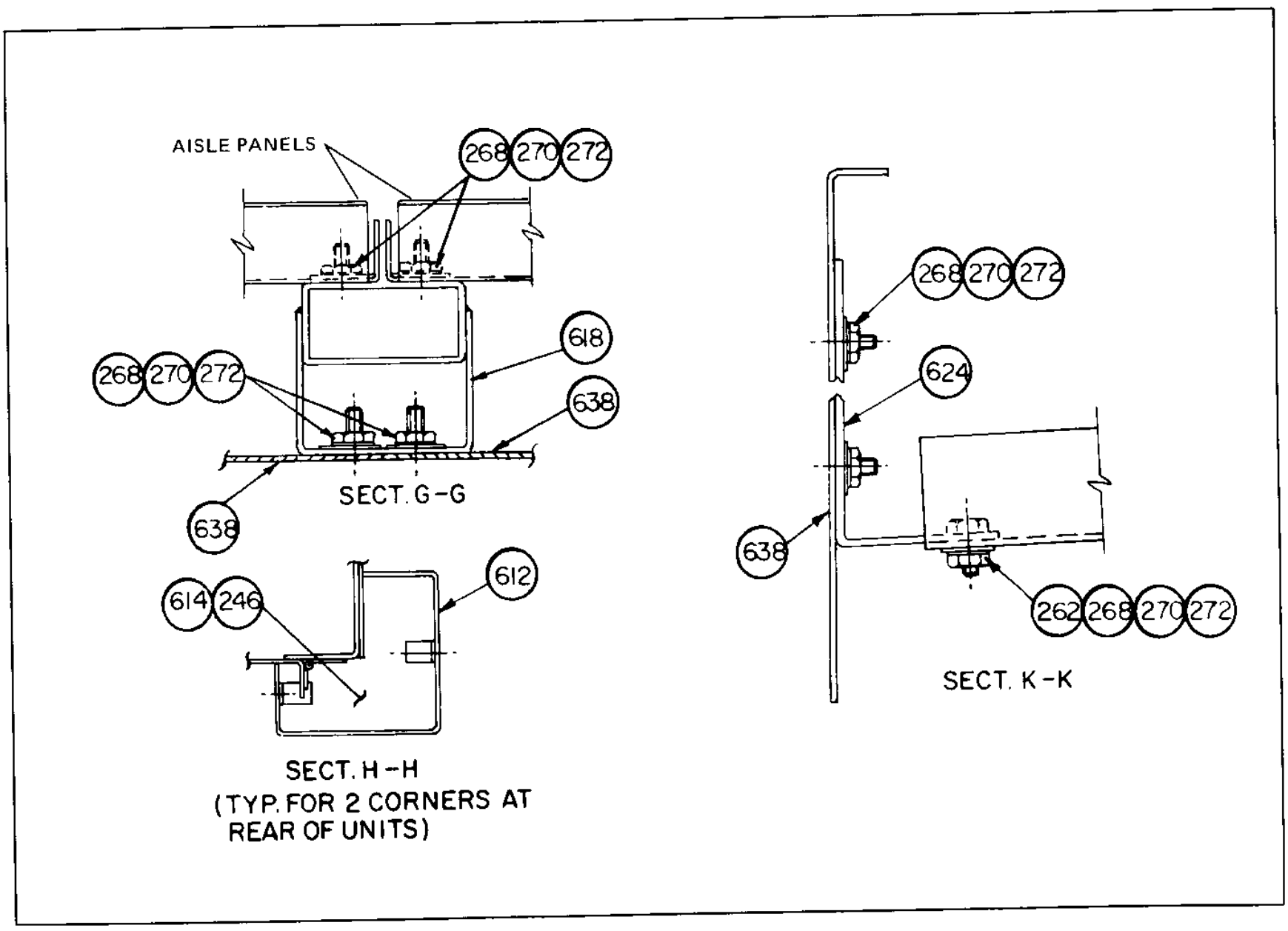


Figure 15. Trim Arrangement – Type "SIV"
Single Aisle

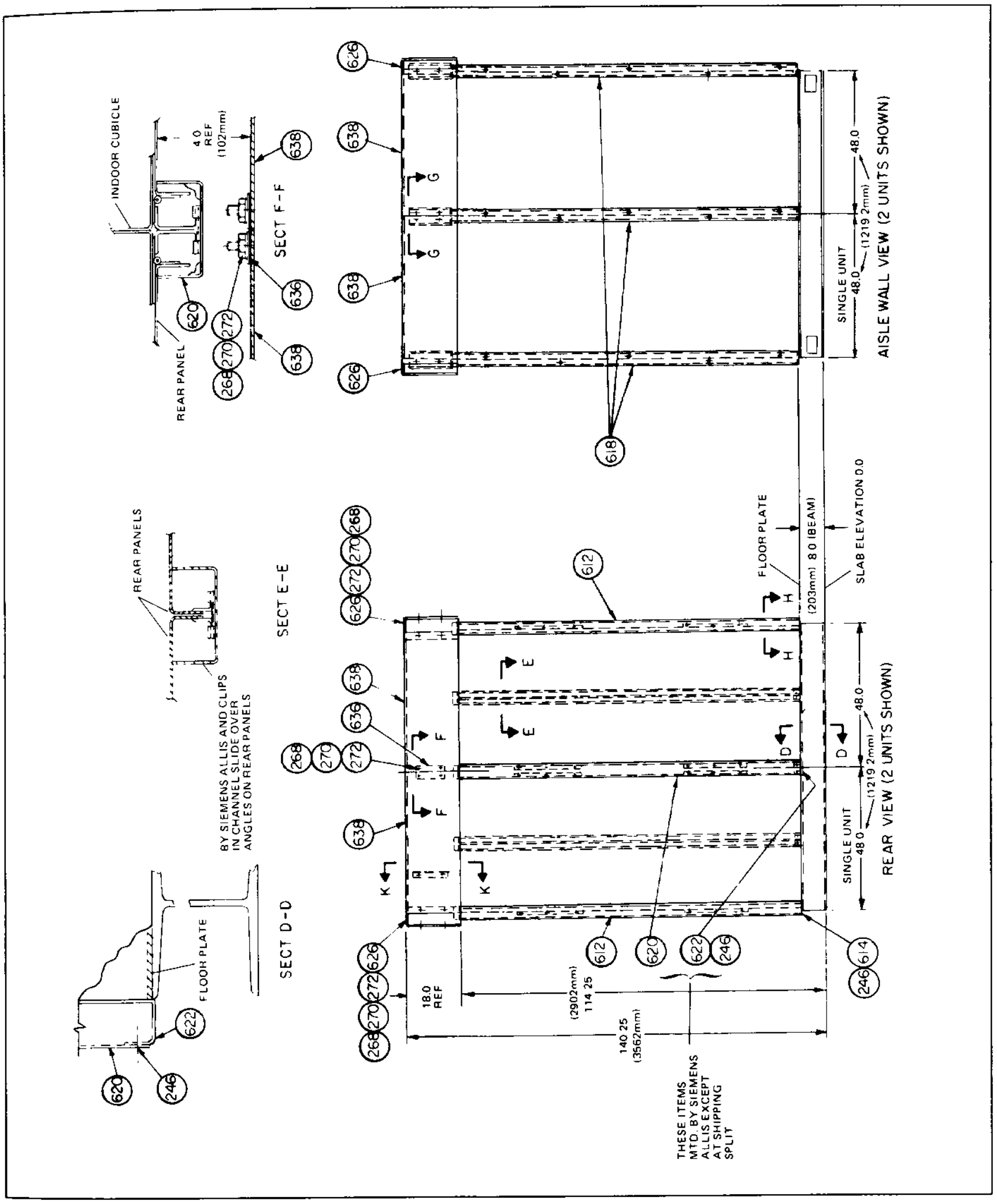


Figure 15. Trim Arrangement – Type "SIV"
Single Aisle

Item Description For Figure 16

Item	Description	Part Number	Mk.
238*	Rd. Hd. Screw–#10-32 x .25 (6.4 mm)	00-615-485-	214
240*	Rd. Hd. Screw–#10-32 x .50 (12.7 mm)	00-615-485-	218
242*	Lockwasher–#10	00-655-017-	022
244*	Hex Nut–#10-32	00-631-123-	210
250*	Round Washer–.25	00-651-007-	160
252*	Lockwasher–.25	00-655-017-	026
254*	Hex Nut–.25-20	00-631-059	104
256*	Tamperproof Screw–.31-18 x .75 (19 mm)	17-171-404	006
258*	Round Washer–.31	00-651-007-	905
260*	Lockwasher–.31	00-655-017-	030
264*	Hex Hd. Cap Screw–.38-16 x 1.25 (31.8 mm)	00-611-315-	468
266*	Hex Hd. Cap Screw–.38-16 x 1.50 (38.1 mm)	00-611-315-	470
268*	Round Washer–.38	00-651-007-	230
270*	Lockwasher–.38	00-655-017-	032
272*	Hex Nut–.38-16	00-631-059-	106
274*	Hex Hd. Cap Screw–.50-13 x 1.50 (38.1 mm)	00-611-315-	548
276*	Round Washer–.50	00-615-007-	300
278*	Lockwasher–.50	00-655-017-	036
280	Hex Nut–.50-13	00-631-059-	108
310	Sealant Tape	00-333-450-	05
312	Floor Plate	18-657-510-	530
316	Angle Assembly	18-657-848-	536
318	Bracket–Roof (Aisle)	18-184-206-	001
320*	Conduit–EMT–.50 x 52.8 (12.7 x 1341 mm) Formed	18-657-870-	308
322*	Conduit–EMT–.75 x 67.0 (19 x 1702 mm) Formed	14-657-870-	309
324*	Conduit–EMT–.75 x 33.0 (19 x 838 mm) Straight	14-239-690-	330
326*	Conduit–EMT–.75 x 84.8 (19 x 2154 mm) Straight	14-239-692-	068
328*	Conduit–EMT–.50 x 43.0 (12.7 x 1092 mm) Straight	18-199-658-	005
330*	Box Connector–.75 (19 mm) EMT	00-855-051-	006
332*	Box Connector–.50 (12.7 mm) EMT	00-855-051-	004
334*	Clamp–.75 (19 mm) EMT	00-691-259-	101
336*	Clamp–.50 (12.7 mm) EMT	00-691-259-	100
338*	Outlet Box–4" (102 mm) Square	00-853-691-	106
342	Switch–20A–3 Way	00-871-505-	011
344	Duplex Outlet–15A	00-857-215-	003
346	Cover–Switch and Receptacle	00-855-209-	375
348*	Outlet Box–4" (102 mm) Octagon	00-853-713-	004
350	Lamp Receptacle–Porcelain	00-857-353-	204
352	Lamp–Incand.–100W–120 V	00-857-283-	213
354*	Wire–#14 Black–MTW	00-557-659-	355
356*	Wire–#14, White–MTW	00-557-659-	356
358*	Terminal–#14-10	00-851-078-	070
360	Primary Opening Cover (Breaker or Auxiliary Unit without Cpt.)	18-657-521-	130
362	Primary Opening Cover (Auxiliary Unit with Cpt.)	18-657-853-	219
510	Aisle Roof Assembly	18-729-500-	501
512	Roof Channel–(Aisle)	18-730-190-	504
514	Roof Channel–(Unit)	18-392-988-	501
516	Hood	18-726-888-	001
518	Door Mounting–L.H. or R.H.	18-395-694-	508
520	Angle–Under Roof Channel (L.H. and R.H.)	18-730-190-	001
810	Aisle Beam–1 Unit 18-726-873 001	18-726-873	01
812	Aisle Beam–2 Units 18-726-873 002	18-726-873	002
814	Aisle Beam–3 Units 18-726-873 003	18-726-873	003
816	Aisle Beam–4 Units 18-726-873 004	18-726-873	004
818	Aisle Beam–5 Units 18-726-873 005	18-726-873	005

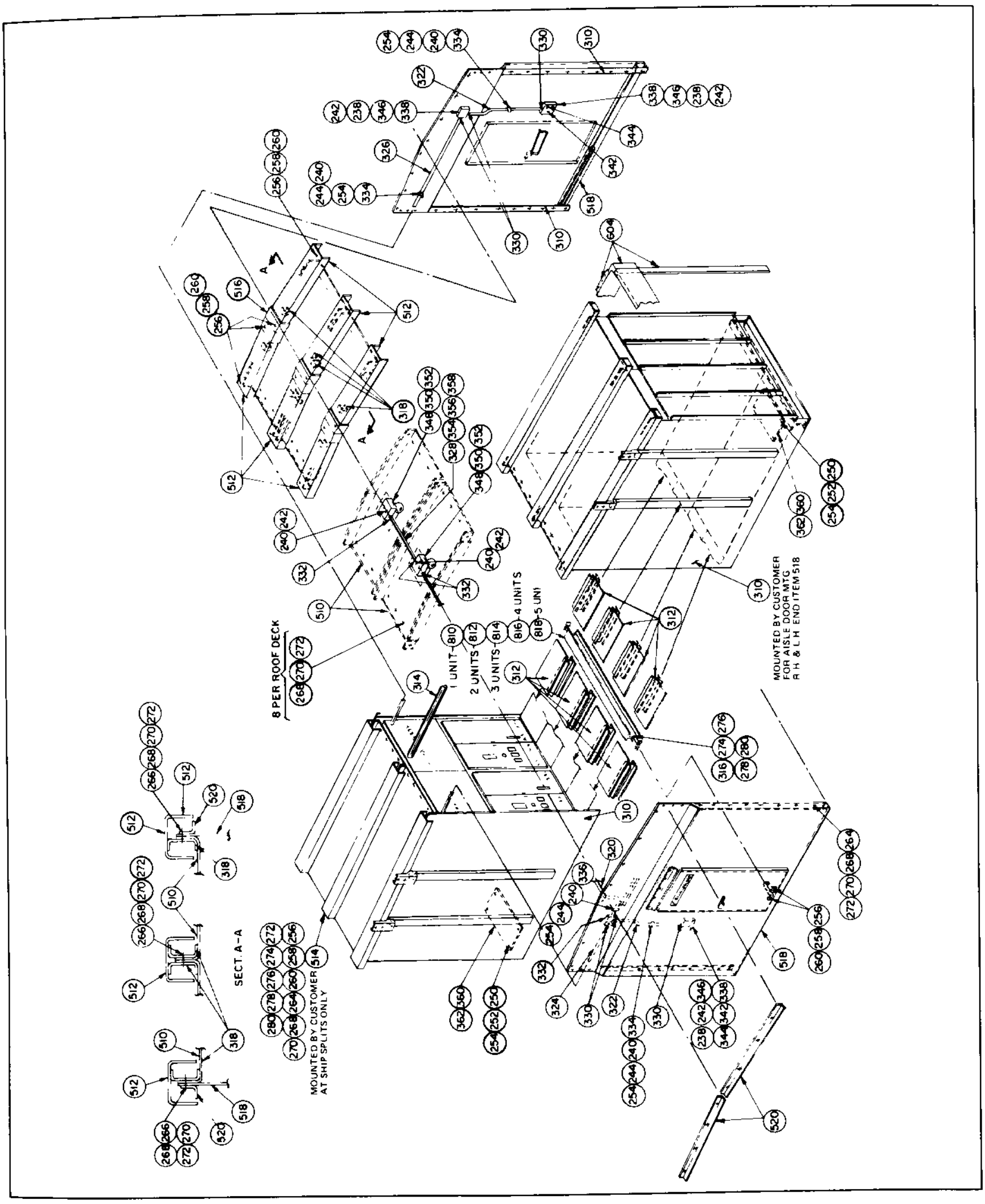


Figure 16. Aisle Assembly – Type "SIV"
Common Aisle

Item Description For Figure 17

Item	Description	Part Number	Mk.
612	Corner Trim–Vertical–Unit	18-393-251-	502
614	Corner Cover–Bottom	18-657-510-	532
616	Side Brace–Vertical–Aisle Ends	18-730-190-	510
620	Rear Channel–Vertical–Units	18-392-987-	501
622	Rear Channel Cover–Bottom	18-657-817-	544
624	Trim Support–Roof	18-657-803-	033
626	Corner Trim	18-727-106-	001
628	Side Trim–Horizontal–103" (2616 mm) Lg.	18-727-104-	501
632	Side Trim–Horizontal–103" (2616 mm) Lg.	18-727-103-	501
636	Bridge Trim Strip	18-657-804-	076
638	Front–Rear Trim–Horizontal	18-727-100-	501
246*	Tamperproof Screw–.25-20 x .50 (12.7 mm)	15-171-404-	001
262*	Hex Hd. Cap Screw–.38-16 x 1.00 (25.4 mm)	00-611-315-	466
268*	Round Washer–.38	00-651-007-	230
270*	Lockwasher–.38	00-655-017-	032
272*	Hex Nut–.38-16	00-631-059-	106
640	Side Trim–Horizontal–81" (2057 mm) Lg.	18-727-109-	501
642	Side Trim–Horizontal–81" (2057 mm) Lg.	18-727-109-	502

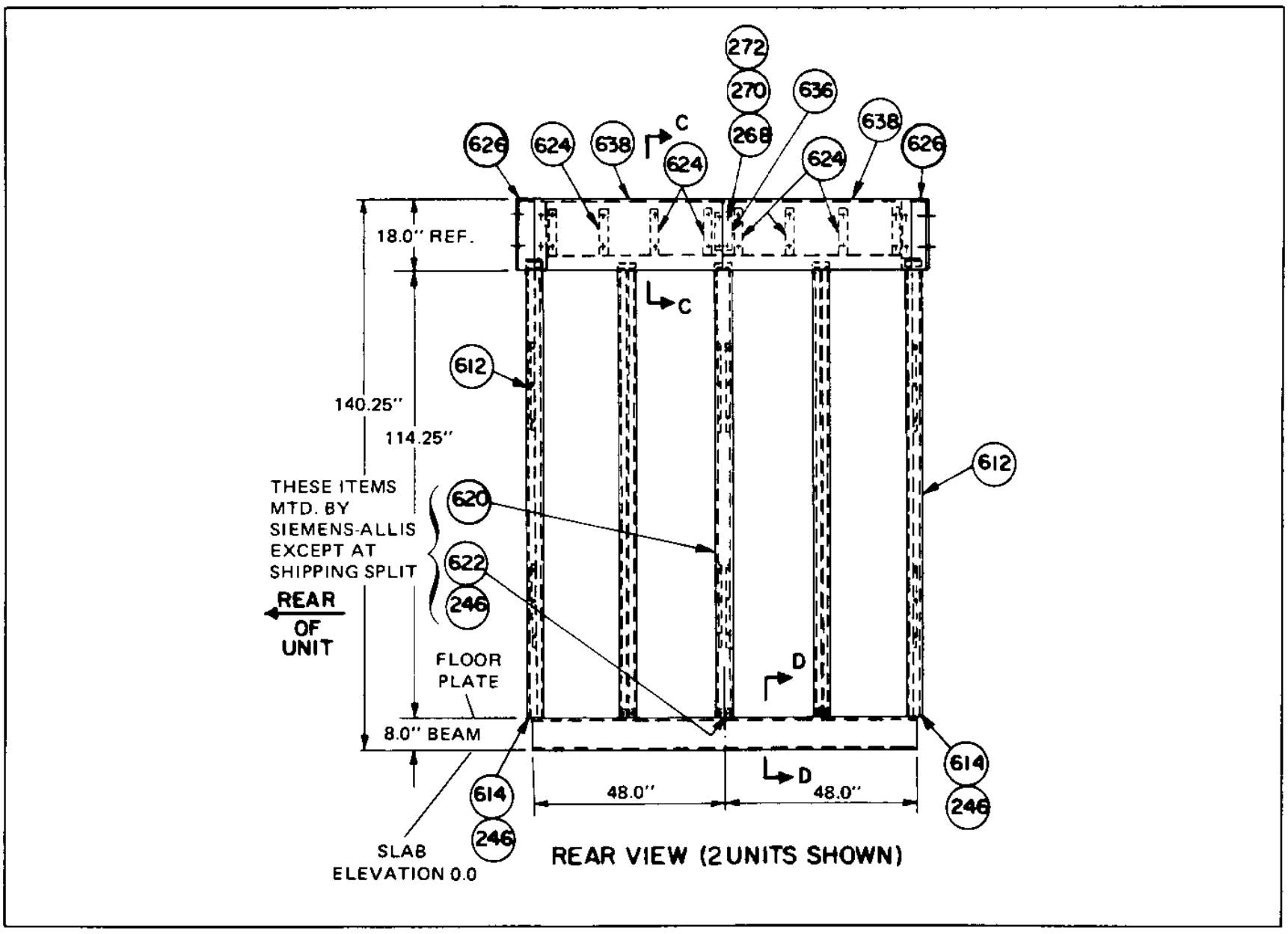


Figure 17. Trim Arrangement – Type "SIV" Common Aisle

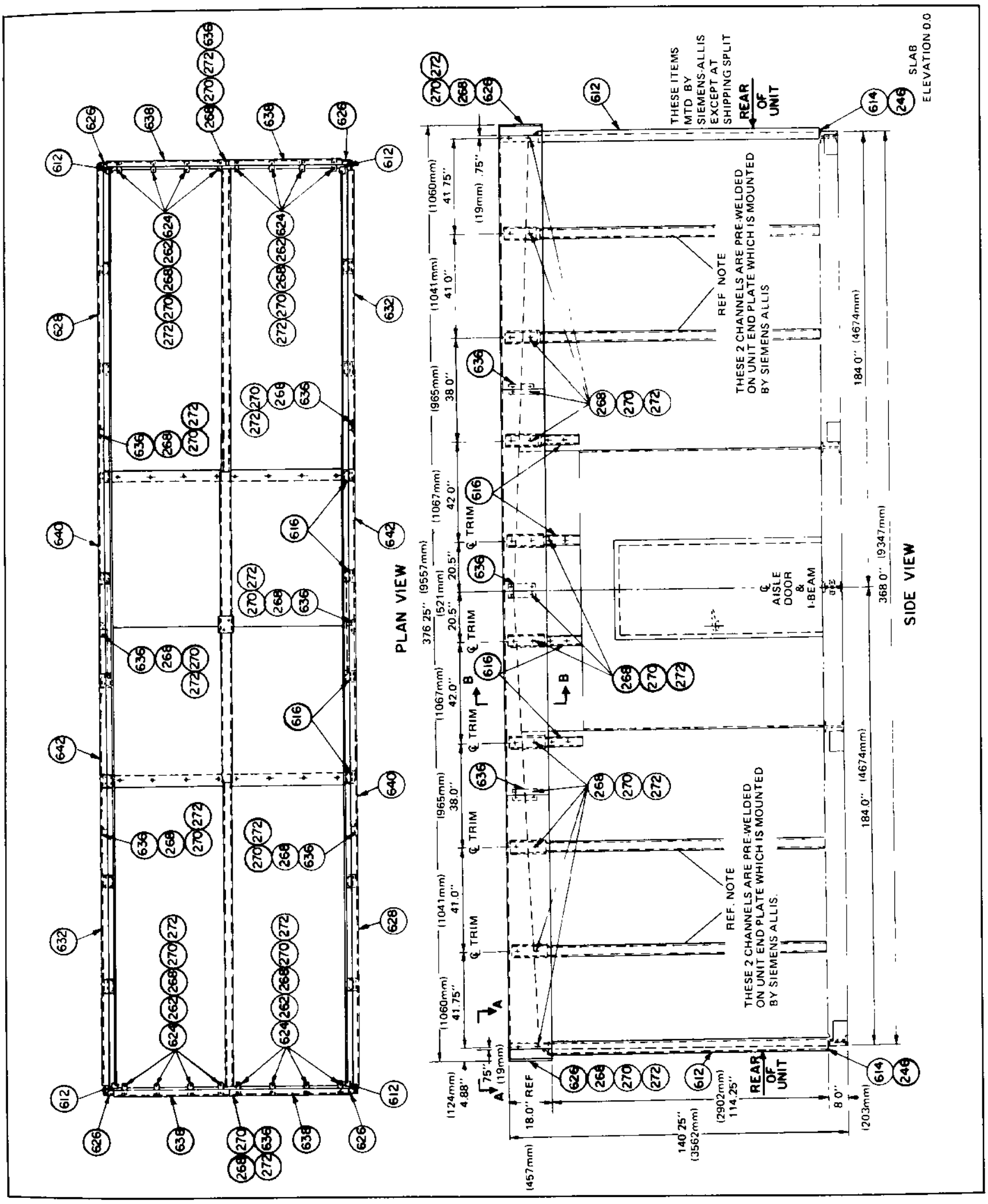
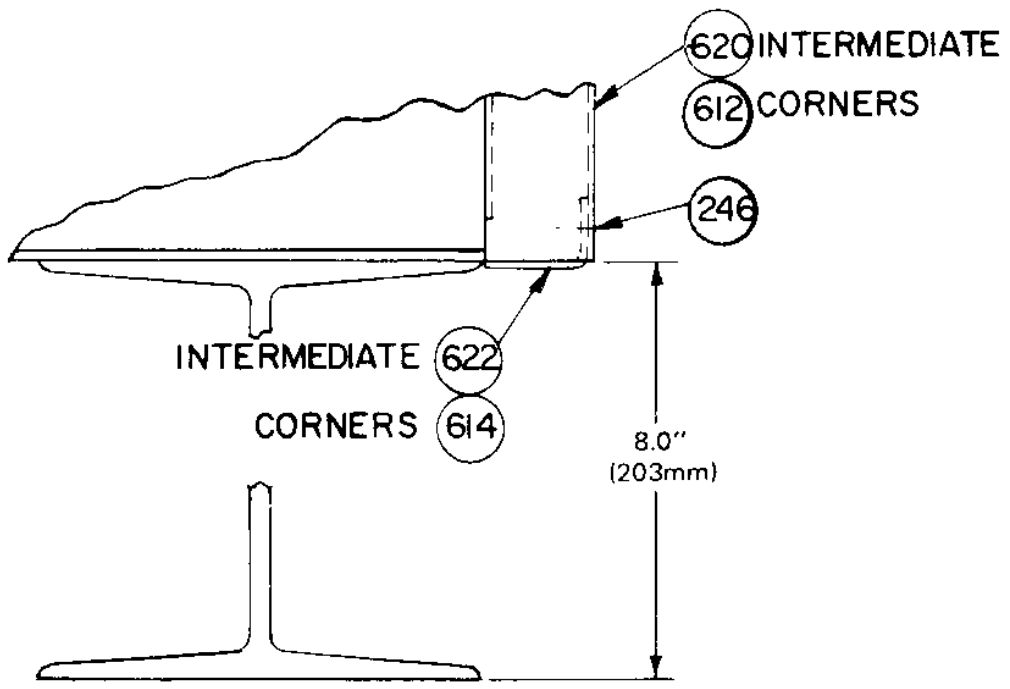


Figure 17. Trim Arrangement – Type "SIV"
Common Aisle

INSTALLATION

Item Description For Figure 18

Item	Description	Part Number	Mk.
246*	Tamperproof Screw–.25-20 x .50 (12.7 mm)	15-171-404-	001
248*	Hex Hd. Cap Screw–.25-20 x .75 (19 mm)	00-611-315-	375
250*	Round Washer–.25	00-651-007-	160
252*	Lockwasher–.25	00-655-017-	026
268*	Round Washer–.38	00-651-007-	230
270*	Lockwasher–.38	00-655-017-	032
272*	Hex Nut–.38-16	00-631-059-	106
610	Corner Bracket Assembly	18-657-830-	575
612	Corner Trim–Vertical–Unit	18-393-251-	502
614	Corner Cover–Bottom	18-657-510-	532
616	Side Brace–Vertical–Aisle Ends	18-730-190-	510
620	Rear Channel–Vertical–Units	18-392-987-	501
622	Rear Channel Cover–Bottom	18-657-817-	544
624	Trim Support–Roof	18-657-803-	033
626	Corner Trim	18-727-106-	001
636	Bridge Trim Strip	18-657-804-	076
638	Front–Rear Trim–Horizontal	18-727-100-	501



SECT. D – D

**Figure 18. Trim Arrangement – Type "SIV"
Common Aisle**

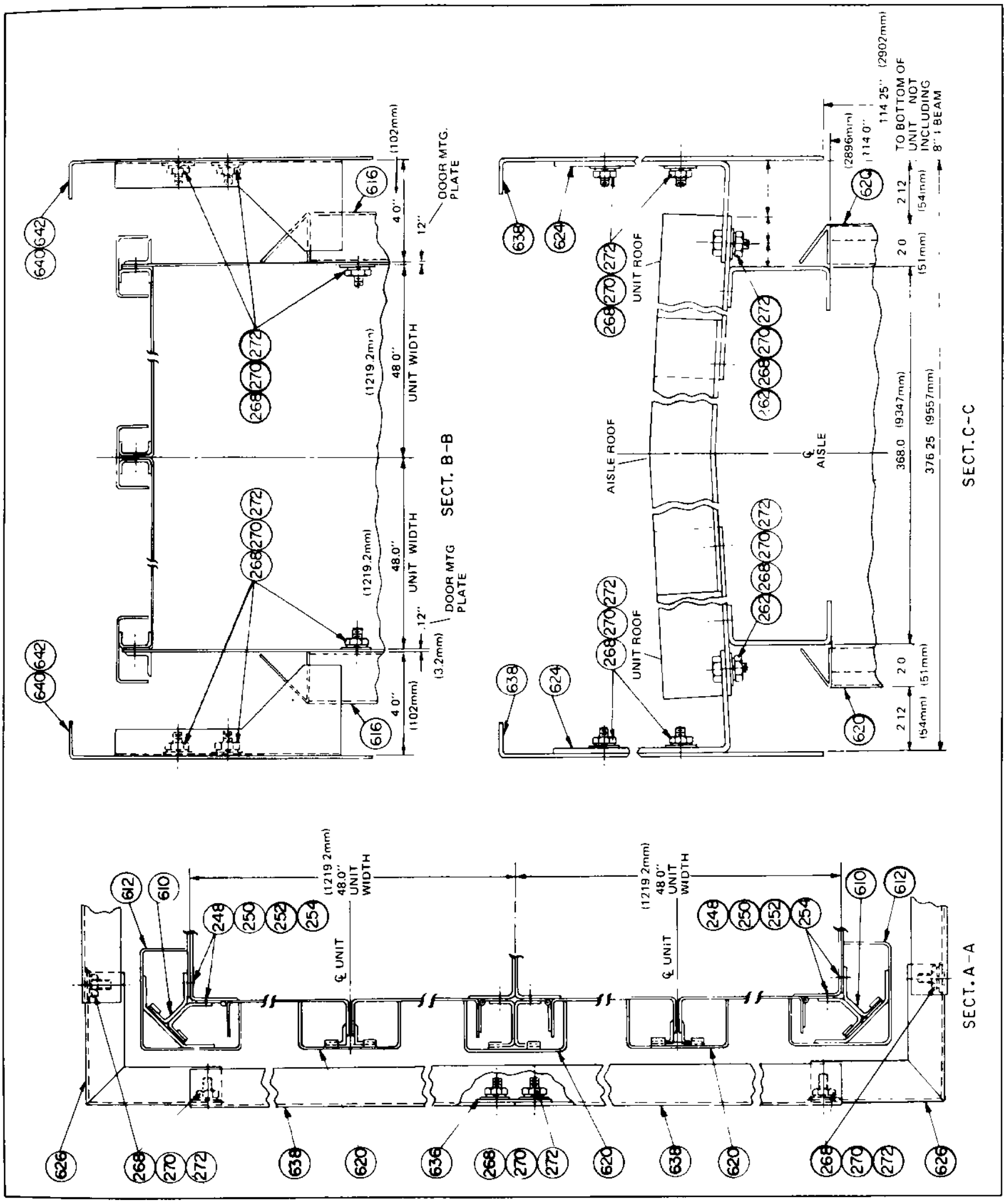


Figure 18. Trim Arrangement – Type "SIV"
Common Aisle

INSTALLATION

Common Aisle

Table 4 lists the standard components supplied for common aisle *Shelter-Clad* outdoor switchgear. The item numbers in the table are used in all instructions pertaining to his procedure. Assemble as follows:

1. Place aisle beam in position (Fig. 16) and secure with anchor bolts.
2. Attach angles (316) to ends of aisle beam as shown.
3. See Fig. 16. Install all floor plates (312) using pattern shown. Each plate overlaps the supporting member of the next plate; determine sequence of installation. Place each set of aisle floor plates in line with cubicle floor plates to equalize the space between the floor plates and prevent a wide crack at end of group.

NOTE

Leave all bolts hand tight until shelter is completely assembled.

4. Install sealant tape (310) at points "C" and "D". Place the tape so that one edge is on the vertical centerline of the holes and the other edge is toward the seam which will be exposed to the weather.
5. See Fig. 16. Raise door assemblies (518) into place. Bolt doors to side plates of cubicles. Bolt to aisle sill using angles (316).
6. Mount aisle conduit, switches, receptacle and wire to junction boxes. See conduit arrangement, Fig. 16.
7. Place roof decks (510) in position and fasten with the bolts provided.
8. Fasten roof decks together using brackets (308). See view "A", Fig. 16.
9. Add trim angles (520) at each end of group.
10. Set channel-shaped covers (512) over the joints of roof decks and slide the covers up so the clips on the inner surface (Fig. 16) engage the brackets (318).
11. Bolt hoods (516) in place.
12. Tighten all bolts to complete the assembly.
13. Drill primary opening cover (360 or 362) to suit conduit. Bolt cover in place with hardware shown.
14. If equipment consists of more than one shipping group, caulk vertical shipping split at back of switchgear with metal filler (00-519-275-001) provided.
15. Bolt corner trim bracket assemblies (610) in place as shown in Section A-A, Fig. 18 (3 per corner).
16. Install corner trim (612) by raising up until clips in trim engage brackets (610) and then pulling down sharply while pushing trim firmly against units.
17. Install bottom covers (614) on corner trim using tamperproof screws (246). See Section D-D of Fig. 18.
18. Install aisle end side braces (616) as shown in side view Fig. 17 and Section B-B, Fig. 18 (2 per end).
19. Install roof trim supports (624) to roof decks as shown in Fig. 17 Section C-C of Fig. 18 (4 per unit).
20. Install horizontal side trim parts (628, 632, 640 and 642) using bridge trim strips (636) as shown in Fig. 17.
21. Install horizontal front and rear trim parts (638) along with bridge tirm strips (636) and corner trim (612) as shown in Figs. 17 and 18.
22. After primary cables, terminators, LA's, etc. are mounted and primary entrances are ready for closing, the rear panels should be closed and bolted shut using four (4) tamperproof screws which were provided with these units as shipped. The unit rear trim is then completed by installing vertical trim channels (620) in same manner as described for corners under step 15. Install bottom covers (622) using tamperproof screws (246). See Figs. 17 and 158.

Table 4. Standard Components–Common Aisle Switchgear

Item	Description	Part Number	Mk.
218*	Wiring Hardware (#8-32)	18-194-685-	801
	(#10-32)	18-194-685-	804
238*	Rd. Hd. Screw–#10-32 x .25 (6.2 mm)	00-615-485-	214
240*	Rd. Hd. Screw–#10-32 x .50 (12.7 mm)	00-615-485-	218
242*	Lockwasher–#10	00-655-017-	022
244*	Hex Nut–#10-32	00-631-123-	210
246*	Tamperproof Screw–.25-20 x .50 (12.7 mm)	15-171-404-	001
248*	Hex Hd. Cap Screw–.25-20 x .75 (19 mm)	00-611-315-	375
250*	Round Washer–.25	00-651-007-	160
252*	Lockwasher–.25	00-655-017-	026
254*	Hex Nut–.25-20	00-631-059-	104
256*	Tamperproof Screw–.31-18 x .75 (19 mm)	15-171-404-	006
258*	Round Washer–.31	00-651-007-	905
260*	Lockwasher–.31	00-655-017-	030
262*	Hex Hd. Cap Screw–.38-16 x 1.00 (25.4 mm)	00-611-315-	466
264*	Hex Hd. Cap Screw–.38-16 x 1.25 (31.8 mm)	00-611-315-	468
266*	Hex Hd. Cap Screw–.38-16 x 1.50 (38.1 mm)	00-611-315-	470
268*	Round Washer–.38	00-651-007-	230
270*	Lockwasher–.38	00-655-017-	032
272*	Hex Nut–.38-16	00-631-059-	106
274*	Hex Hd. Cap Screw–.50-13 x 1.50 (38.1 mm)	00-611-315-	548
276*	Round Washer–.50	00-615-007-	300
278*	Lockwasher–.50	00-655-017-	036
280*	Hex. Nut–.50-13	00-631-059-	108
310	Sealant Tape	00-333-450-	005
312	Floor Plate	18-657-510-	530
316	Angle Assembly	18-657-848-	536
318	Bracket–Roof (Aisle)	18-184-206-	001
320*	Conduit–EMT–.50 x 52.8 (12.7 x 1341 mm) Formed	18-657-870-	308
322*	Conduit–EMT–.75 x 67.0 (19 x 1702 mm) Formed	14-657-870-	309
324*	Conduit–EMT–.75 x 33.0 (19 x 838 mm) Straight	14-239-690-	330
326*	Conduit–EMT–.75 x 84.8 (19 x 2154 mm) Straight	14-239-692-	068
328*	Conduit–EMT–.50 x 43.0 (12.7 x 1092 mm) Straight	18-199-658-	005
330*	Box Connector–.75 (19 mm) EMT	00-855-051-	006
332*	Box Connector–.50 (12.7 mm) EMT	00-855-051-	004
334*	Clamp–.75 (19 mm) EMT	00-691-259-	101
336*	Clamp–.50 (12.7 mm) EMT	00-691-259-	100
338*	Outlet Box–4" (102 mm) Square	00-853-691-	106
340	Cover–Blank	00-855-213-	101
342	Switch–20A–3 Way,	00-871-505-	011
344	Duplex Outlet–15A	00-857-215-	003
346	Cover–Switch and Receptacle	00-855-209-	375

*Use material supplied — do not use metric hardware.

Table 4. Standard Components–Common Aisle Switchgear (Cont'd.)

Item	Description	Part Number	Mk.
348*	Outlet Box–4" (102 mm) Octagon	00-853-713-	004
350	Lamp Receptacle–Porcelain	00-857-353-	204
352	Lamp–Incand.–100W–120 V	00-857-283-	213
354*	Wire–#14 Black–MTW	00-557-659-	355
356*	Wire–#14 White–MTW	00-557-659-	356
358*	Terminal–#14-10	00-851-078-	070
360	Primary Opening Cover (Breaker or Auxiliary Unit Without Cpt.)	18-657-521-	130
362	Primary Opening Cover (Auxiliary Unit With Cpt.)	18-657-853-	219
510	Aisle Roof Assembly	18-729-500-	501
512	Roof Channel–(Aisle)	18-730-190-	504
516	Hood	18-726-888-	001
518	Door Mounting–L.H. or R.H.	18-395-694-	508
520	Angle–Under Roof Channel (L.H. and R.H.)	18-730-190-	001
610	Corner Bracket Assembly	18-657-830-	575
612	Corner Trim–Vertical–Unit	18-393-251	502
614	Corner Cover–Bottom	18-657-510-	532
616	Side Brace–Vertical–Aisle Ends	18-730-190-	501
620	Rear Channel–Vertical–Units	18-392-987-	501
622	Rear Channel Cover–Bottom	18-657-817-	544
624	Trim Support–Roof	18-657-803-	033
626	Corner Trim	18-727-106-	001
628	Side Trim–Horizontal–103" (2616 mm) Lg.	18-727-104-	501
632	Side Trim–Horizontal–103" (2616 mm) Lg.	18-727-103-	501
636	Bridge Trim Strip	18-657-804-	076
638	Front–Rear Trim–Horizontal	18-727-100-	501
640	Side Trim–Horizontal–81" (2057 mm) Lg.	18-727-109-	501
642	Side Trim–Horizontal–81" (2057 mm) Lg.	18-727-109-	502
810	Aisle Beam–1 Unit	18-726-873-	001
812	Aisle Beam–2 Units	18-726-873-	002
814	Aisle Beam–3 Units	18-726-873-	003
816	Aisle Beam–4 Units	18-726-873-	004
818	Aisle Beam–5 Units	18-726-873-	005

Expanding Single Aisle to Common Aisle

Table 5 lists standard components supplied to extend an existing single aisle line-up to a common aisle line-up. The item numbers in the table are used in all instructions pertaining to this procedure. Assemble as follows:

1. See Figs. 14 and 15. Remove horizontal and vertical trim (items 610, 612, 618, 622, 626, 628, 630, 632, 634, 636 and 638) from ends and front of aisle area. Discard items 612, 618, 630 and 634. Save all other items and associated hardware for reuse.
2. See Fig. 13. Remove floor plates (312) adjacent to aisle wall and set aside for reuse.
3. See Fig. 13. Remove hoods (516) and roof channels (512 and 514). Discard channels (514), but save all other items for reuse.
4. See Fig. 13. Loosen, but do not remove the hardware holding aisle roof decks (510) to front of unit roof decks.
5. See Fig. 13. Remove all hardware holding roof decks (510) to aisle wall assembly (A). Save hardware for reuse.
6. Remove angles (520) from under end roof channels and set aside for reuse along with associated hardware.
7. Using wood blocking under edge of roof decks adjacent to aisle wall, jack or otherwise elevate this edge of roof decks a sufficient amount to clear weld studs on top of aisle wall assembly. Block roof decks in this elevated position.
8. Remove aisle wall assembly (A) by unbolting from door frames (518) and by removing anchor bolt hardware from around aisle wall beam. Discard this aisle wall assembly, but save hardware.

9. Move new switchgear into position as shown on the general arrangement floor plan. Secure with anchor bolts after assuring new units are plumb.
10. Lower aisle roof decks over weld studs on front of new units and fasten with hardware saved from step 5.
11. Retighten hardware at roof deck edge over existing units.
12. Reinstall angles (520) using hardware saved under step 6.
13. Install roof channels (512) saved from step 3 and supplied with new units. See Fig. 16. Also reinstall hoods (516) saved from step 3.
14. Bolt door frames (518) to new units using hardware salvaged from step 8 after installing sealant tape (302) to door frame with one edge on vertical centerline of mounting holes and other edge toward point of exposure to weather.
15. Reinstall floor plates (312) as shown in Fig. 16.
16. Drill plates (360 or 362) to suit primary conduit layout and bolt in place with hardware provided.
17. See secondary conduit arrangement and revise conduit arrangement as required.
18. If new equipment consists of more than one shipping group, caulk vertical shipping split at back of switchgear with metal filler (00-519-275-001) provided.
19. Referring to Figs. 17 and 18, install roof trim supports (624) at rear of new units.
20. Install corner trim brackets (610) saved from step 1.
21. Install corner vertical trim pieces (612) and bottom cover plates (614) which were saved from step 1.
22. Install all horizontal trim parts (628, 632, 636 and 638 saved from step 1) and (640 and 642 supplied new) as per Figs. 17 and 18.
23. When primary entrance area is ready for closing, follow procedure outlined in step 22 on Page 33.

Expanding Length of Existing Shelter-Clad Switchgear by Addition of Units

The new extended foundation–be it slab, pier or pilings–must be constructed in the same careful manner as described under "Installation".

The new foundation must be level and in the same plane as the existing foundation.

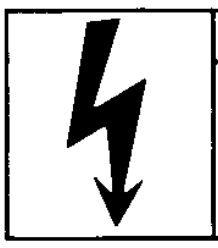
Certain items will be removed from the existing installation as described in the following instructions. Remove these items carefully and store them for remounting in the expanded set up.

Table 5. Standard Components–Expanding Single Aisle to Common Aisle

Item	Description	Part Number	Mk.
262*	Hex Hd. Cap Screw–.38-16 x 1.00 (25.4 mm)	00-611-315-	466
268*	Round Washer–.38	00-651-007-	230
270*	Lockwasher–.38	00-655-017-	032
272*	Hex Nut–.38-16	00-631-059-	106
403	Roof Channel–Open Ends	18-726-883-	501
612	Corner Trim–Vertical–Units	18-393-251	502
620	Rear Channel–Vertical–Units	18-392-987	501
624	Trim Support–Roof	18-657-803	033
636	Bridge Trim Strip	18-657-804	076
640	Side Trim–Horizontal–81" (2057 mm) Lg.	18-727-109	501
642	Side Trim–Horizontal–81" (2057 mm) Lg.	18-727-109	502
310	Sealant Tape	00-333-450	005
360	Primary Opening Cover Plate	18-657-521	130
250*	Round Washer–.25	00-651-007	160
252*	Lockwasher–.25	00-655-017	026
254*	Hex Nut–.25-20	00-631-059	104

*Use material supplied — do not use metric hardware.

INSTALLATION



⚠ CAUTION

Be certain switchgear is de-energized before removing covers to high voltage compartments.

Table 6 lists accessory items provided for addition of match and line units.

1. Referring to Fig. 14/15 or 17/18 depending upon whether switchgear is single or common aisle, remove all horizontal trim pieces (626, 628, 630, 632, 634, 640 and 642) from end to be expanded.
2. Remove vertical corner trim pieces (612 and 614) and corner brackets (610).
3. Remove hood (516) and roof channels (512 and 514) over aisle area as well as roof channels over breaker units.
4. Remove angles (520) under roof channels.
5. Disconnect aisle conduit.
6. Remove bolts located under aisle door which secure end plate to aisle beam.
7. Remove all hardware securing side plate to switchgear frame and hardware securing aisle end plate to aisle wall. It may be necessary to tap knife blade down vertical seam between aisle wall and end plate to cut sealant tape. Sealant tape is soluble in kerosene which may be used to clean surfaces after parting. Remove entire sections from both switchgear and aisle.
8. Remove aisle floor plates from in front of this end unit. These plates must be reinstalled in front of the new end unit.
9. The line-up is now ready for installation of the new unit or units. Follow the instructions outlined under "Installation", Page 7. If the foundation was carefully constructed, there should be no problems with line-up of beams or matching the level of existing equipment.
10. With new units in true alignment with existing units and properly leveled, bolt units together with .50-inch (12.7 mm) hardware provided.
11. Run aisle wiring from terminal block in existing end unit, through barrier and header to junction box area.
12. Remount all parts removed from existing equipment and caulk all external seams with metal filler. Follow instructions in previous sections for single or common aisle units.
13. Make all electrical connections as instructed on Pages 34 through 62.
14. Caulk vertical split at back of switchgear between existing equipment and new addition with metal filler. Replace bus compartment barriers.

Table 6. Standard Components–Expanding Length of Existing Shelter-Clad Switchgear

Item	Description	Single Aisle		Common Aisle	
		Part Number	Mk.	Part Number	Mk.
360	Primary Opening Cover	18-657-521	130	18-657-521	130
510	Aisle Roof Assembly	18-729-500	501	18-729-500	501
512	Roof Channel–Aisle	18-730-190	504	18-730-190	504
514	Roof Channel–Units	18-392-988	501		
516	Hood	18-726-888	001	18-726-888	001
618	Panel Brace–Vertical–Aisle	18-726-884	501		
620	Rear Channel–Vertical–Unit	18-392-987	501	18-392-987	501
622	Rear Channel Cover–Bottom	18-657-817	544	18-657-817	544
624	Roof Trim Support	18-657-803	033	18-657-803	033
636	Bridge Trim Strip	18-657-804	076	18-657-804	076
638	Front/Rear Horizontal Trim	18-727-100	501	18-727-100	501
810	Aisle Beam–1 Unit	18-726-873	001	18-726-873	001
812	Aisle Beam–2 Units	18-726-873	002	18-726-873	002
814	Aisle Beam–3 Units	18-726-873	003	18-726-873	003
816	Aisle Beam–4 Units	18-726-873	004	18-726-873	004
818	Aisle Beam–5 Units	18-726-873	005	18-726-873	005

ELECTRICAL CONNECTIONS

Bus Bars

Siemens-Allis 34.5 kV vacuum switchgear utilizes all welded aluminum construction for main bus and line bus runbacks. Ground bus connections, however, are of bolted construction with either aluminum or copper conductors depending upon specific job requirements.

When making bus bar connections in the field, it is important to review and fully understand the configuration to be used; this is shown on the bus arrangement drawing provided with each contract.

For bolted bus bar joints (ground bars or external primary cable areas), the following procedure should be followed:

1. All surfaces must be free of dust, dirt or other foreign material.
2. Assemble all joints as shown in Fig. 19.

NOTE

All hardware furnished is plated high-strength, steel. Cap screws are .50-13 SAE Grade 5. Hexagon nuts are SAE Grade 2. Do not substitute with smaller or lower grade hardware than supplied.

3. Torque .50-13 steel hardware to 50 to 75-lb ft. (68 to 102 N·m)

Notice in Fig. 19 heavy washers are used on both sides of the bus bar joint—under the cap screw head as well as under the nut and lockwasher. These washers insure an evenly distributed force around each screw, producing a low resistance joint. The torque value of approximately 75-lb. ft. (102 N·m) produces a joint of adequate pressure without cold flow.

Bus Joints

When a switchgear group is split for shipping purposes, the primary bus and ground bus connections must be made when installing the switchgear.

For the ground bus, bolted connections as previously covered above are required.

For the primary bus, welding of aluminum conductors is required and this must be done with extreme care to obtain an adequate and trouble-free joint.

An ideal joint in a bus conductor would continue the cross sectional area of the parts joined in addition to providing mechanical strength.

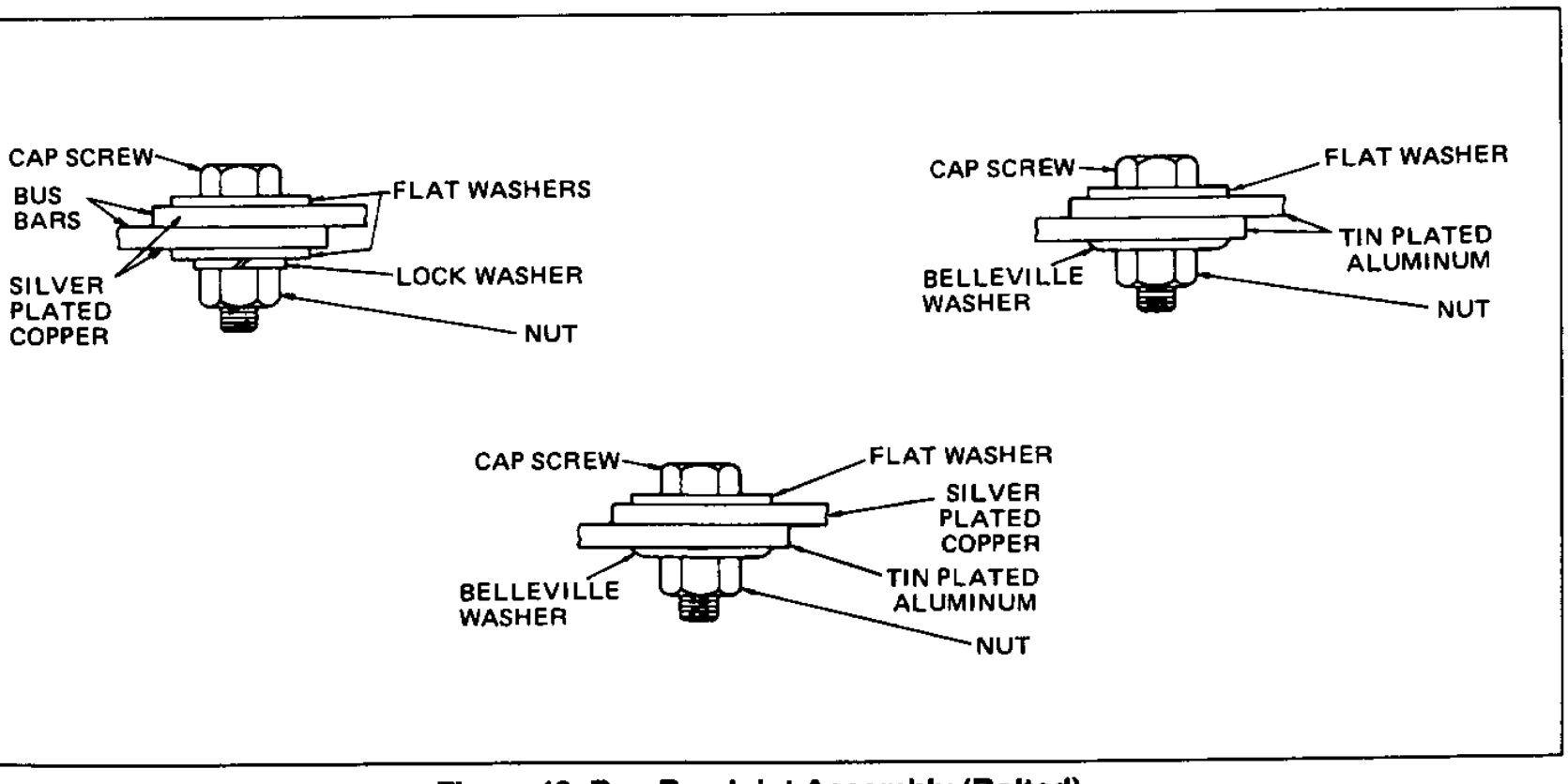


Figure 19. Bus Bar Joint Assembly (Bolted)

FIED WELDING PROCEDURE FOR ALUMINUM BUS

1.0 Scope

This welding procedure specification covers the welding of aluminum conductor components for 1200 ampere and 2000/3000 ampere rated designs of Siemens-Allis 34.5 kV switchgear.

2.0 Process

All welding shall be accomplished by the Gas Metal Arc Welding Process (GMAW) using #4043 aluminum alloy welding wire (AWS A5. 10-69, classification ER-4043) or equivalent.

NOTE: A typical wire feeding system is shown in figure #20.

3.0 Joint Preparation

3.1 All joint edges and at least one inch of the adjacent base metal surfaces shall be degreased prior to welding using clean rags or paper towels and an acetone or alcohol solvent.

CAUTION: After cleaning, all solvents, rags and papers should be removed from the weld area to prevent fires.

3.2 After cleaning, all joint edges and at least one inch of the adjacent base metal surface shall be wire brushed prior to welding. Stainless steel brushes shall be used.

3.3 To prevent excessive heating of the bus insulation, dampened asbestos cloth or equivalent shall be used over the insulation adjacent to the joint to be welded. This protection should extend a minimum of 12 inches (305 mm) from the joint.

3.4 Precautions must be taken to prevent weld spatter or other foreign materials from entering the vertical connector porcelains when welding the main bus joints, metal, asbestos or foil barriers shall be formed over the opening in the porcelain while welding, and carefully removed after welding. Shields shall also be used to protect all adjacent porcelain insulators.

4.0 Preheat and Interpass Temperature

4.1 Preheating of base metals is not required and shall not be done.

4.2 The joint area shall be allowed to cool to below 150° F (65° C) between multiple weld passes and prior to welding opposite sides of conductors. A 150° F (65° C) crayon should be used for temperature indication.

NOTE: The above is necessary to prevent damage to the molded insulation.

5.0 Welding Parameters

5.1 Current type: DCRP (Electrode Positive)

5.2 Filler material: AWS A5. 10-69. Class ER-4043

5.3 Shielding gas: Argon @ 30-40 CFM (.014-.019 m^3/sec.

FIED WELDING PROCEDURE FOR ALUMINUM BUS

5.4 Welding technique

5.4.1 The welding sizes, types of joint, welding conditions and typical number of passes are given in figure 22.

5.4.2 Weld metal shall be deposited using a stringer bead technique.

5.4.3 The gun shall be tilted in the forehand direction approximately 10° (from the vertical) for flat groove and flat and horizontal fillet welding. For horizontal and vertical groove or vertical fillet welding, the gun shall be tilted upward 5-10°.

5.4.4 The weld crater shall be filled by momentarily reversing the direction of the gun travel at the end of each pass.

5.4.5 Each weld pass must be wire brushed prior to the next pass in multiple-pass weld joints. All joints shall be wire brushed when welding is completed.

6.0 Workmanship & Cleanup

6.1 The cross-sectional area of the applied weld shall be as shown in figures (21 & 22).

6.2 Where the contour of parts being joined produces a deep crevice, small voids at the bottom of these crevices are acceptable, however, the dimensional thickness of the weld as shown on the weld symbol must be maintained.

6.3 The finished weld shall be carefully examined to make certain there are no sharp projections of spatter,
"bee-bees" or pieces of electrode which would reduce the insulation integrity.

6.4 All molded insulation surfaces and other adjacent insulation materials shall be carefully examined for evidence of soot and other surface contamination. This shall be removed from insulating materials prior to installation of final insulating materials.

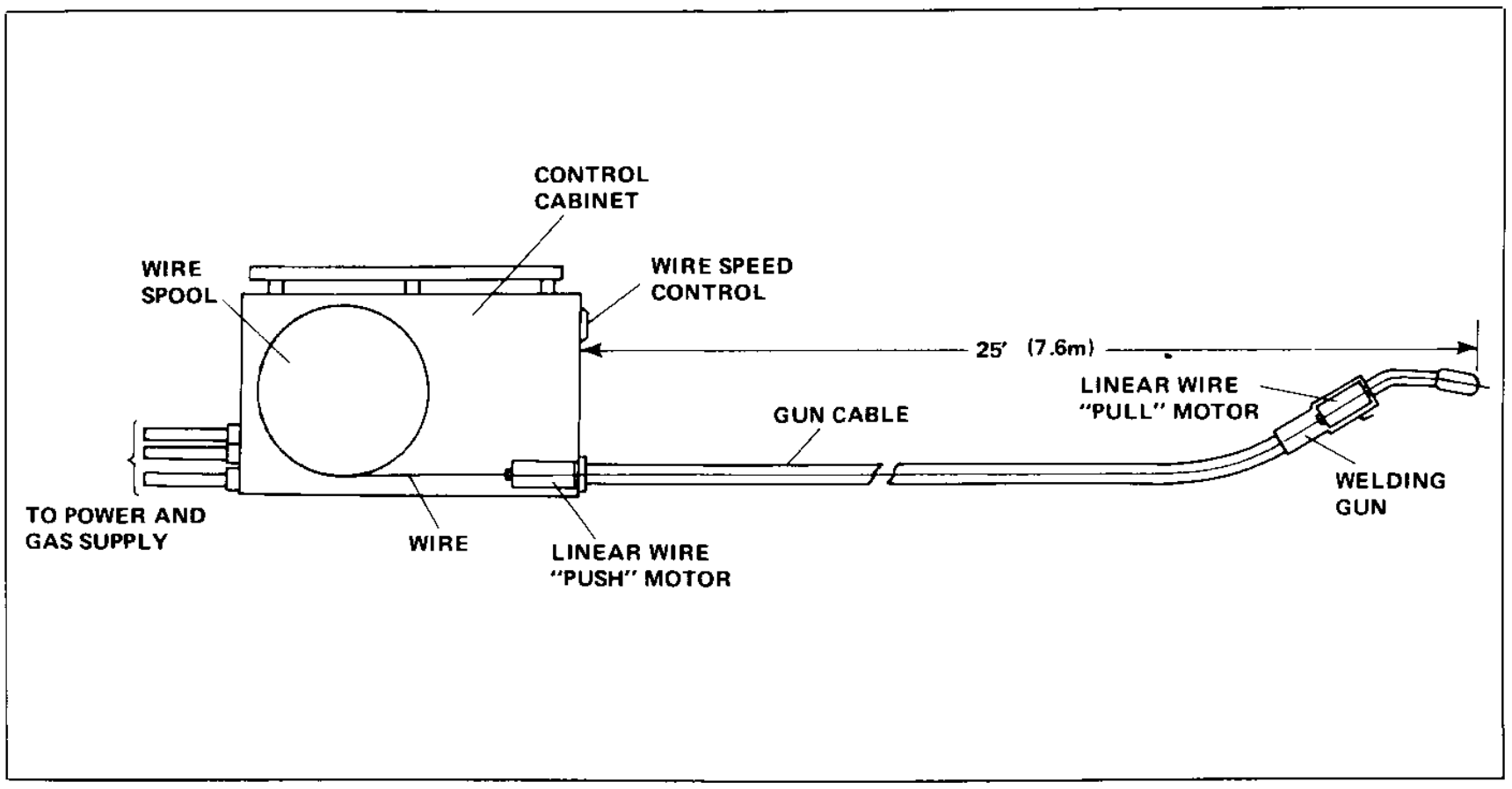
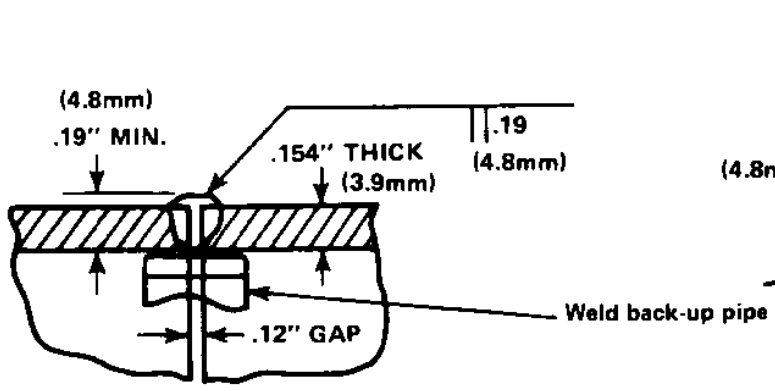


Figure 20. Schematic of Typical Wire Feeding System

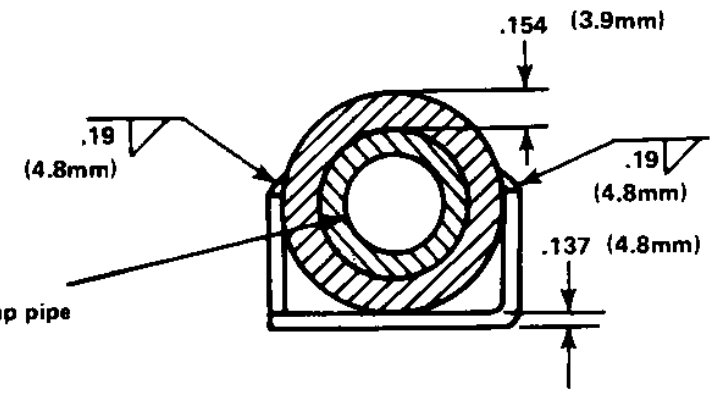
FIED WELDING PROCEDURE FOR ALUMINUM BUS

WELD JOINT DESCRIPTION	FIGURE NO.	FILLET LEG OR WELD SIZE	BASE METAL THICKNESS	WELD PARAMETERS (DCRP)* AMPS	WELD PARAMETERS (DCRP)* VOLTS	NUMBER* OF PASSES
B-6	3-1 (Plan) & 4	.19 (4.8 mm)	.154 to .154 w/plug (3.9 to 3.9 mm)	125/155	20.5/23.5	1
B-9	3-1 (Side) & 4	.19 (4.8 mm)	.187 to .154 (4.8 to 3.9 mm)	125/155	20.5/23.5	1 (AER side)
B-5B	3-2 (Side) & 4	.50 (12.7 mm)	.50 to .50 (12.7 to 12.7 mm)	190/230	21.5/24.5	3
B-4A	3-2 (Plan) & 4	.50 (12.7 mm)	50 to 50 (12.7 to 12.7 mm)	190/230	21.5/24.5	2

*Parameters shown are typical for 3/64 inch (1.19 mm) diameter weld wire.

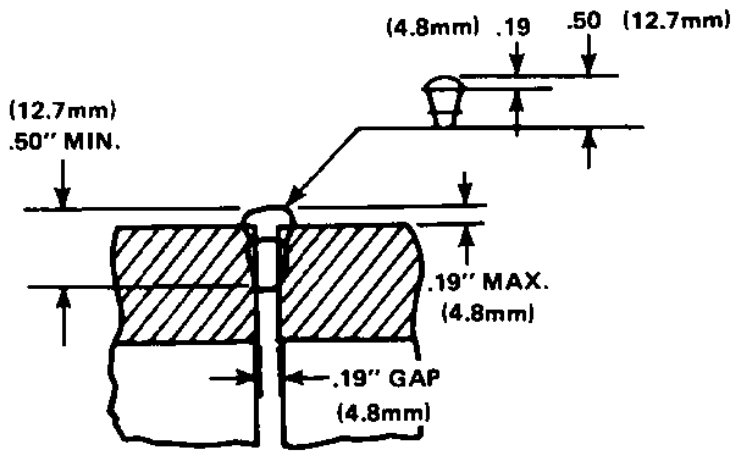


Joint B-6. 1200 Amp Round Conductor Butt Joint

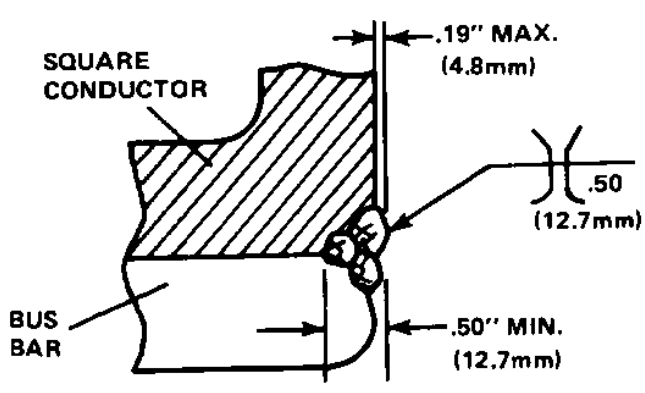


Joint B-9. 1200A Saddle Connection

1200A Main Bus Splice



Joint B-4A. 2000/3000 Amp Square Conductor Butt Joint



Joint B-5B. 2000/3000 Amp Conductor To Bus Bar

2000/3000A Main Bus Splice

Figure 21. GMAW Welding Parameters for Flat, Horizontal, Vertical Fillet and Partial Penetration Groove Welds

FIED WELDING PROCEDURE FOR ALUMINUM BUS

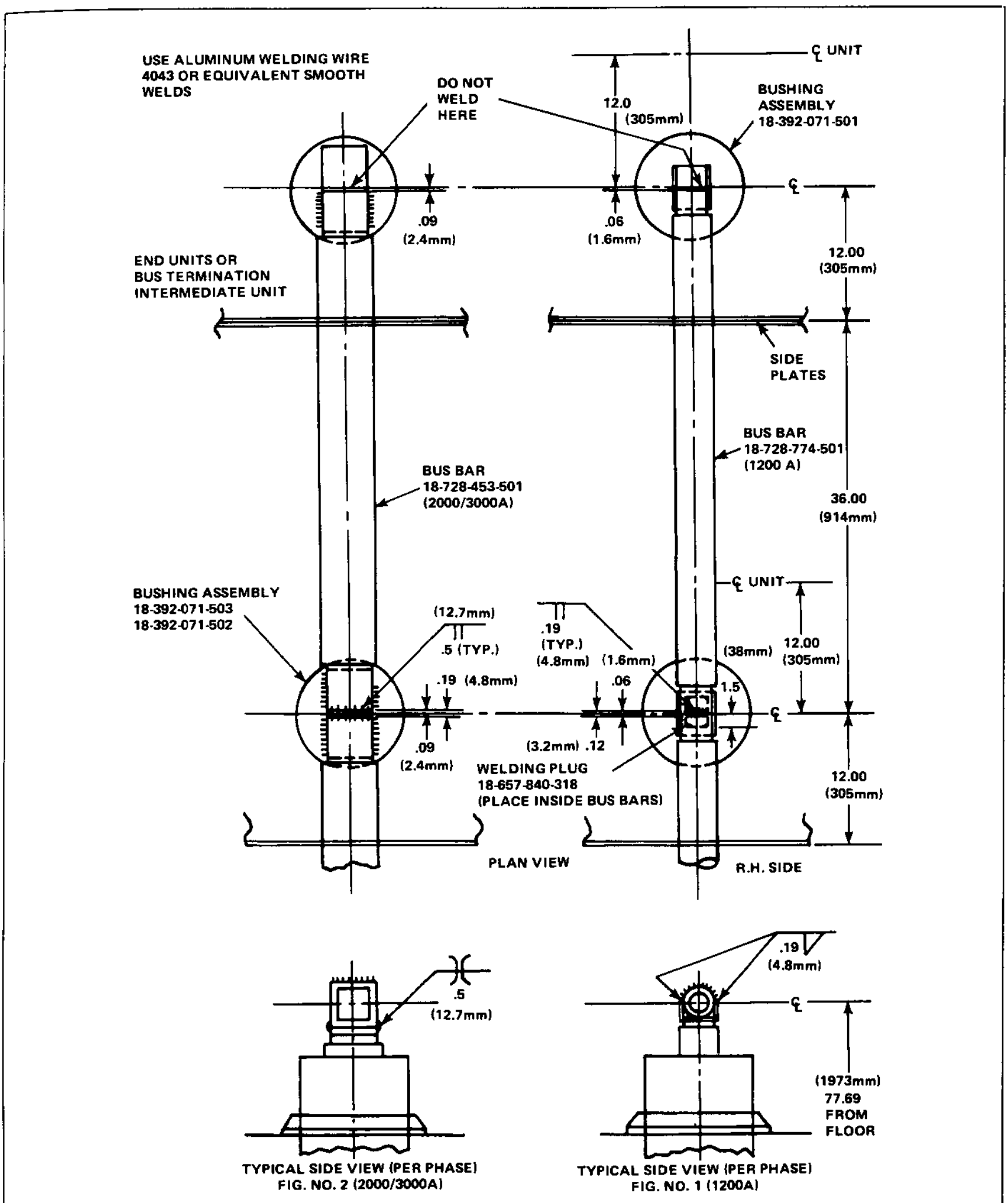


Figure 22. Shipping Split Drawing (Main Bus Welding)

FIED WELDING PROCEDURE FOR ALUMINUM BUS

Field Welding Procedure For Conductors In Rear EXTENSIONS

B1.0 All details of "Field Welding Procedure for Aluminum Bus" on the preceding pages are to be followed except as noted below. This will insure that no damage is done to the factory applied molded or taped insulation or to the tin plating on bolted contact surfaces.

B2.0 Wire Brushing. It is not necessary to wire brush the tin plated connectors prior to the first weld pass as mentioned in 3.2 of referenced supplement; however, where joints require multiple passes to achieve the required weld depth, wire brushing per 5.4.5 of supplement shall be done.

B3.0 Surface Protection. In addition to protecting the insulation as specified in 3.3 and 3.4 of supplement, the bolted contact areas shall also be shielded to potect the tin plating from weld spatter.

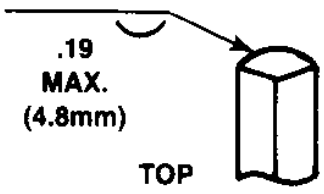
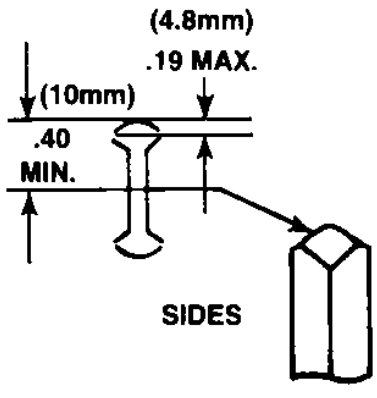
B4.0 Welding Parameters. Field weld requirements are shown on drawings supplied with the contract. The following parameters are typical for "GMAW" welding using a 3/64 inch (1.19 mm) diameter weld wire:

A shipping split drawing (18-728-937-401) provided on each contract gives specific details of joint welding (Fig. 23).

Access to the main bus joints for welding is through two hinged barriers in the left-hand side of the unit. To gain access to the hinged barriers, the lower left-hand front cover must be removed. Hinged barriers are then released and lowered against the side plates. This gives full access to the main bus compartment.

For 3000A fan-cooled units, the three-phase fan assembly must be removed before hinged barriers can be lowered. This is accomplished as follows (Figs. 23A and B).

a. Remove front barrier assembly.
b. Remove wires from right-hand side of block on front of fan assembly.
c. Remove top plate by removing four (4) bolts and washers in the corners.
d. Remove two (2) bolts and washers holding fan assembly to front barrier.
e. Slide assembly to the left so that fan baffle will clear opening and remove assembly by pulling straight out of unit.

JOINT	WELD SIZE	BASE METAL THICKNESS	AMPS	VOLTS	NUMBER OF PASSES
	1.0" x .19 Max. (25.4 x 4.8mm)	.50 to .50 (12.7 to 12.7mm)	190/230	21.5/24.5	1
	.40 Min. (10mm)	.50 to .50 (12.7 to 12.7mm)	190/230	21.5/24.5	2 or 3

FIED WELDING PROCEDURE FOR ALUMINUM BUS

BUS JOINT INSULATION-TAPING

Insulation covers are provided for repetitive or standard bus joint conditions, however, where covers are not provided, the bus joints must be carefully taped to the required insulation level.

The bus arrangement drawing will indicate the insulation required for field joints and also the taping specification applicable for taped joints.

Fig. 24 illustrates various bus joint configurations which are completely insulated with insulation covers.

Fig. 25 illustrates various bus joints which are either a combination of taping and insulation covers or fully taped.

Fig. 23 details the steps for taping various joint or connector configurations. These steps must be followed to the letter to assure high integrity of the insulation system.

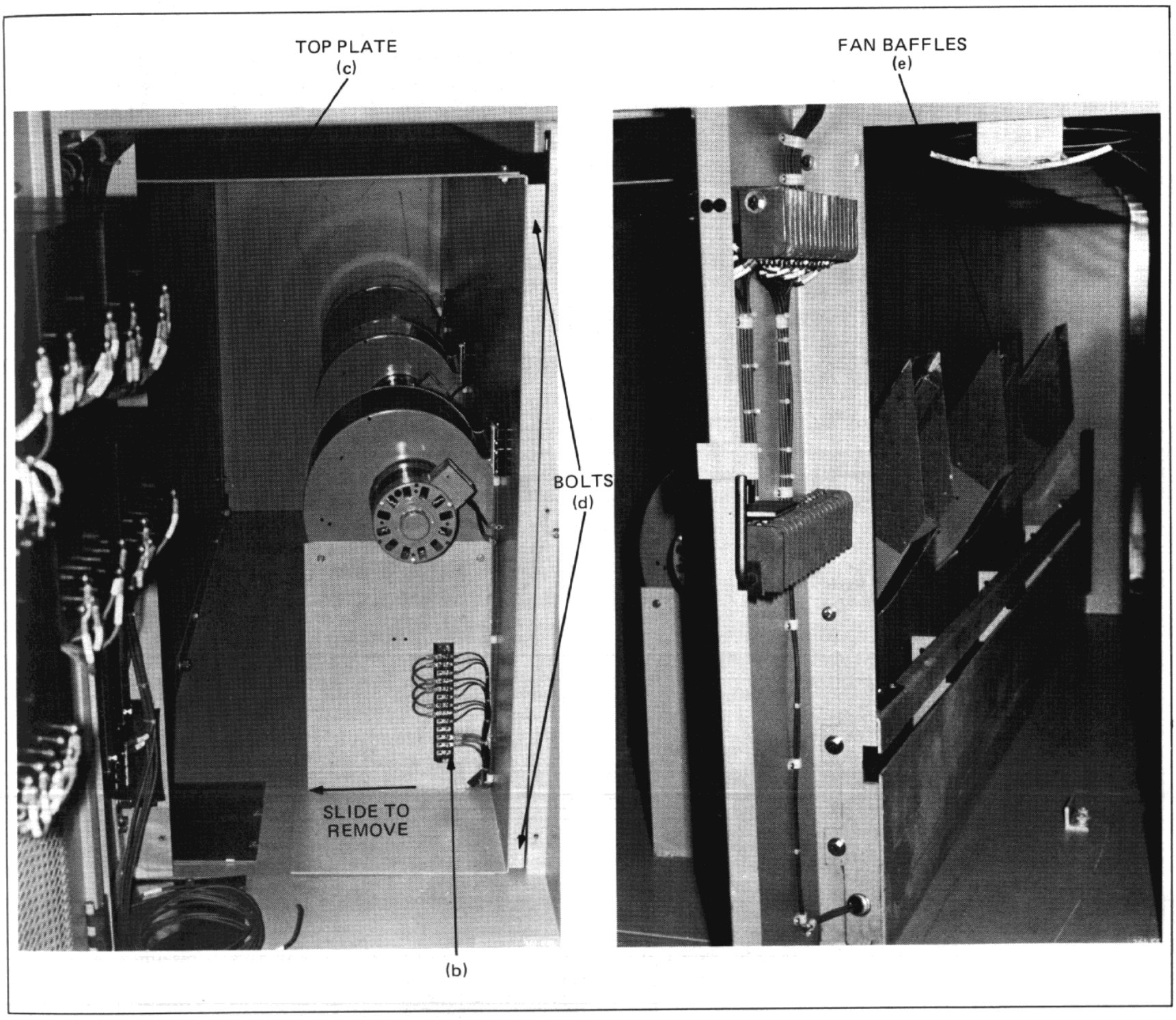


Figure 22A – Fan Duct Assembly Showing Blowers and Blower Outlets

ELECTRICAL CONNECTIONS

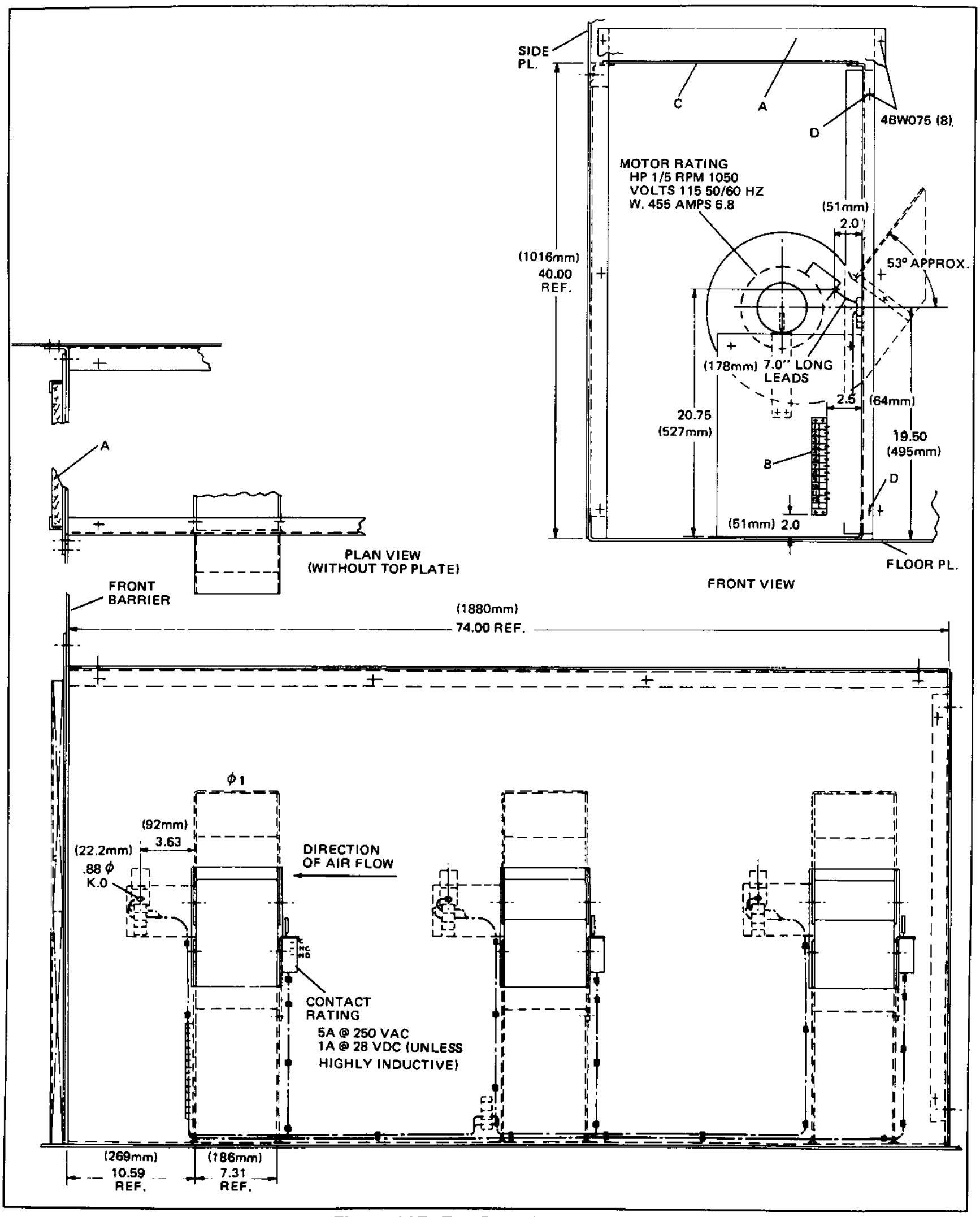


Figure 22B. Fan Duct Arrangement

Figure 23. Insulation Specification

INSULATION SPECIFICATION FOR BOLTED, WELDED OR BOLTED/WELDED JOINTS USED IN 34.5 kV (IV/SIV) METAL-CLAD SWITCHGEAR

Step No. 1: Inspect all welded joints to assure no sharp projections exist.

Step No. 2: Inspect all bolted joints to assure they are clamped tight without causing undue strain on component parts. Draw up all bolts and nuts tightly (25-40 ft-lb (34-54 N·m) for .38 (9.5 mm) hardware and 50-75 ft.-lb. (68-102 N·m) for .50 (12.7 mm) hardware).

Step No. 3: Wrap joints with filler tape (15-171-164-001) using only as much as necessary to form a regular surface (not necessarily a straight surface) over bolts and/or welds. Air pockets under this tape need not be filled.

Step No. 4: Wrap joints with eight (8) layers of .010 x 18.0 (.25 x 457mm) wide black polyester cloth (15-171-467-005) so that edges overlap adjoining insulation by 4.0 - 4.25 inches (102 - 108mm) and long enough so that ends overlap by 4.0 - 4.25 inches (102 - 108mm). Stagger the overlapping as much as possible and tie the layers firmly with yellow bias tape .010 x .75 (.25 x 19 mm) wire (00-413-431-100) wrap tightly so as to exclude as much air as possible between layers of cloth and between cloth and adjoining insulation.

Step No. 5: Repeat step no. 4 using a minimum of seven (7) layers of black polyester cloth.

Step No. 6: Complete by applying one layer of .010 x 75 (.25 x 19 mm) wide red flame retardant tape (00-479-441-107) half lapped and pulled tight. This tape to extend a minimum of 1.0 inch (25.4 mm) beyond black cloth.

Material: For joints having an open end 4". (102 mm) sq. tube—18-657-834-856.

All other joints—18-657-834-857, 18-471-852-805 T or 18-395-154-806 T as applicable.

General Clarification

The taping specification detailed on page 40 and the materials supplied by Siemens-Allis (Fig. 26 or job drawings for special configurations) are identical to these used on the design tests and for all factory taped joints; they are recommended for all new tapped joints also.

For some joint configurations, it may be difficult to use the 18" wire polyester cloth. In such cases, it will be permissible to cut the cloth to a narrower, more manageable width for ease of taping. When this is done, it will be necessary to use a lesser number of layers than indicated in Steps 3 & 4 and repeat these steps a sufficient number of times to produce a minimum of 15 layers at any point along the insulation system. The overlap of these layers must be maintained at 4" to 4.25" (102 - 108 mm) whenever possible.

It is also permissable to use other insulation systems (such as 3M Electro-Products Division #E-2047B-76 "Method of Insulating Bus-Bar Connections").

Note that the taped insulation system has two basic requirements:

1) 60 Hz 1 minute withstand and impulse withstand values per ANSI C37.20 Table 1.

2) 38 kV foil test are ANSI C37.30 Para. 5.2.1.4.

As a minimum, any alternate taping system must be tested for 60 kV a-c (85 kV d-c) for 1 minute. If assurance that the alternate system will withstand the 38 kV foil test is desired, this test should be conducted per ANSI C37.20 Para. 5.2.1.4 as follows:

1. Make a sample joint external to the switchgear with identical to the switchgear joint in question.
2. Tape sample joint with the proposed alternate system.
3. Wrap sample taped joint with aluminum foil.
4. Apply 38 kV a-c (54 kV d-c) between bus bar and foil (start at zero and raise gradually to final test value).

5. Joint must withstand voltage of Step 4 for 1 minute.

Siemens-Allis will not supply any materials for these alternate insulation systems.

Primary Connections To Switchgear

All primary connections to 34.5 kV switchgear must be fully insulated. Because of considerable variations in customer requirements and available cables and potheads or terminators, Siemens-Allis will normally furnish double-bolt, double-clamp terminal lugs only unless contract specifically calls for other termination facilities. All insulating and terminating materials other than lugs and cable supports are also to be furnished by the customer unless otherwise specified in the contract.

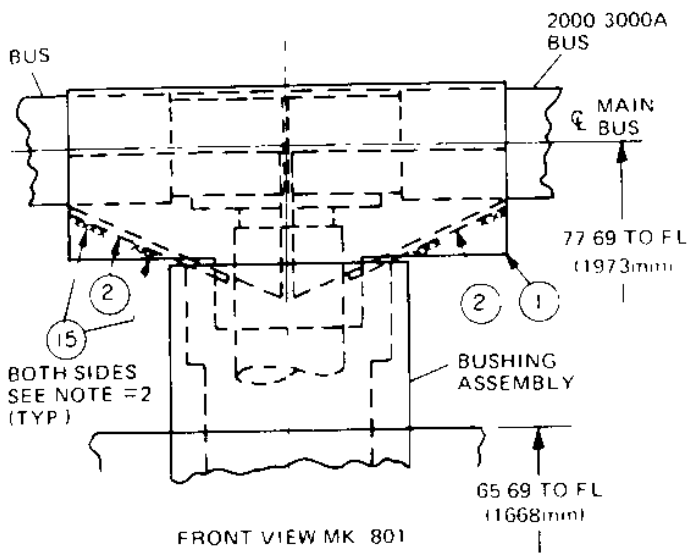
Phase rotation must be considered before primary cable connections are made. Standard phasing (1-2-3 left to right, top to bottom and front to back viewed from breaker drawout side) will be furnished unless otherwise marked on installation drawings prior to shipment of switchgear.

When termination primary cables, instruction data supplied by the cable manufacturer and cable terminating device manufacturer should be followed. If cable terminators are supplied by Siemens-Allis, the instructions will be furnished with the devices when shipped.

Fig. 26 illustrates field insulation arrangements for connections to single or double terminators, roof bushing or bus duct. This figure together with the taping specification (Fig. 23) should be followed to insure insulation integrity.

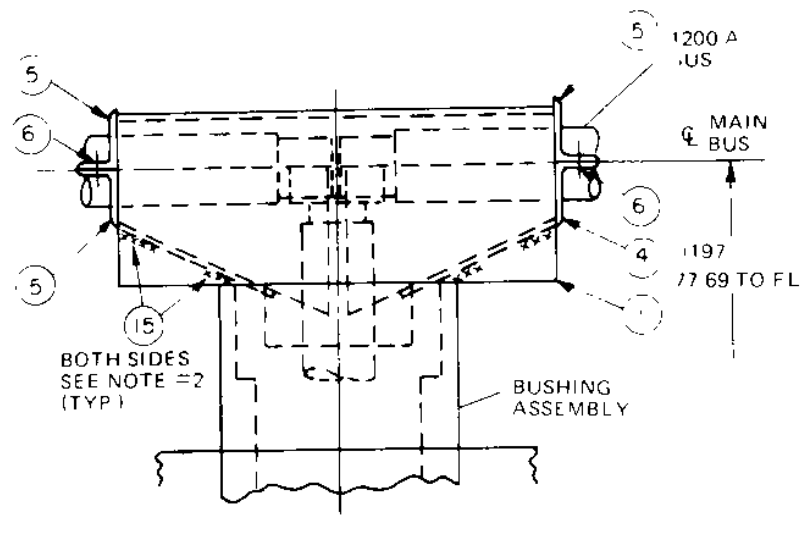
When lightning arresters are mounted in the same compartment as cable terminators, they must be porcelain top design and will be located as shown in Fig. 27. In this case, the connection from the line bus to the LA and terminators will be a flexible connection and will remain untaped. Insulation of these connections is achieved by a system of glass polyester barriers to assure adequate phase-phase and phase to ground clearance. A removable insulating barrier is also provided to prevent access to live connections when rear panels are opened. The barriers between phases 1 and 2 and phases 2 and 3 are removable to provide adequate working space for field installations of LA's and terminators.

If metal top arresters are required (above 27 kV), they require the entire 30" (762 mm) rear entrance section to maintain adequate electrical clearances. A typical mounting of metal top arresters in shown in Figure 28.



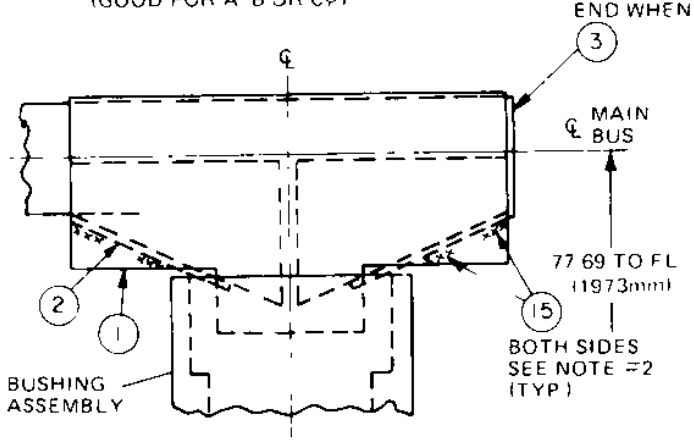
FRONT VIEW MK 801

TYPICAL 2000 3000A INTERMEDIATE UNIT BUS INSULATION COVERS (GOOD FOR A B OR C0)



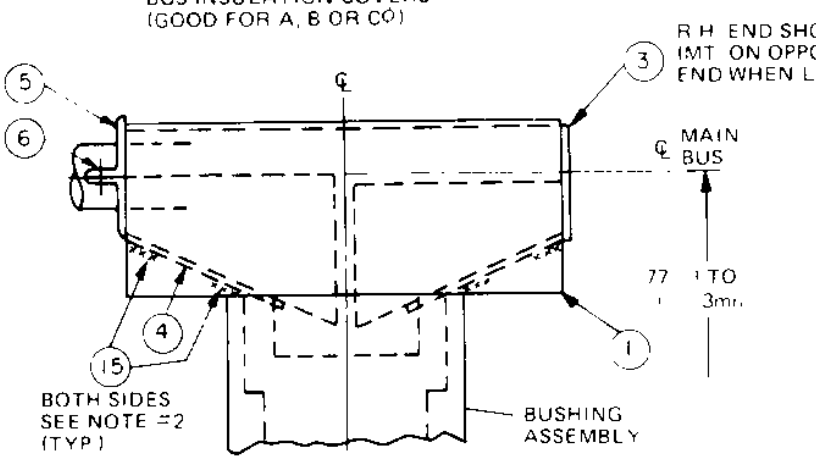
FRONT VIEW MK 803

TYPICAL 1200A INTERMEDIATE UNIT BUS INSULATION COVERS (GOOD FOR A, B OR C0)



FRONT VIEW MK 802

TYPICAL 2000/3000A END UNIT BUS INSULATION COVERS L H END OR R H END (GOOD FOR A, B OR C0)

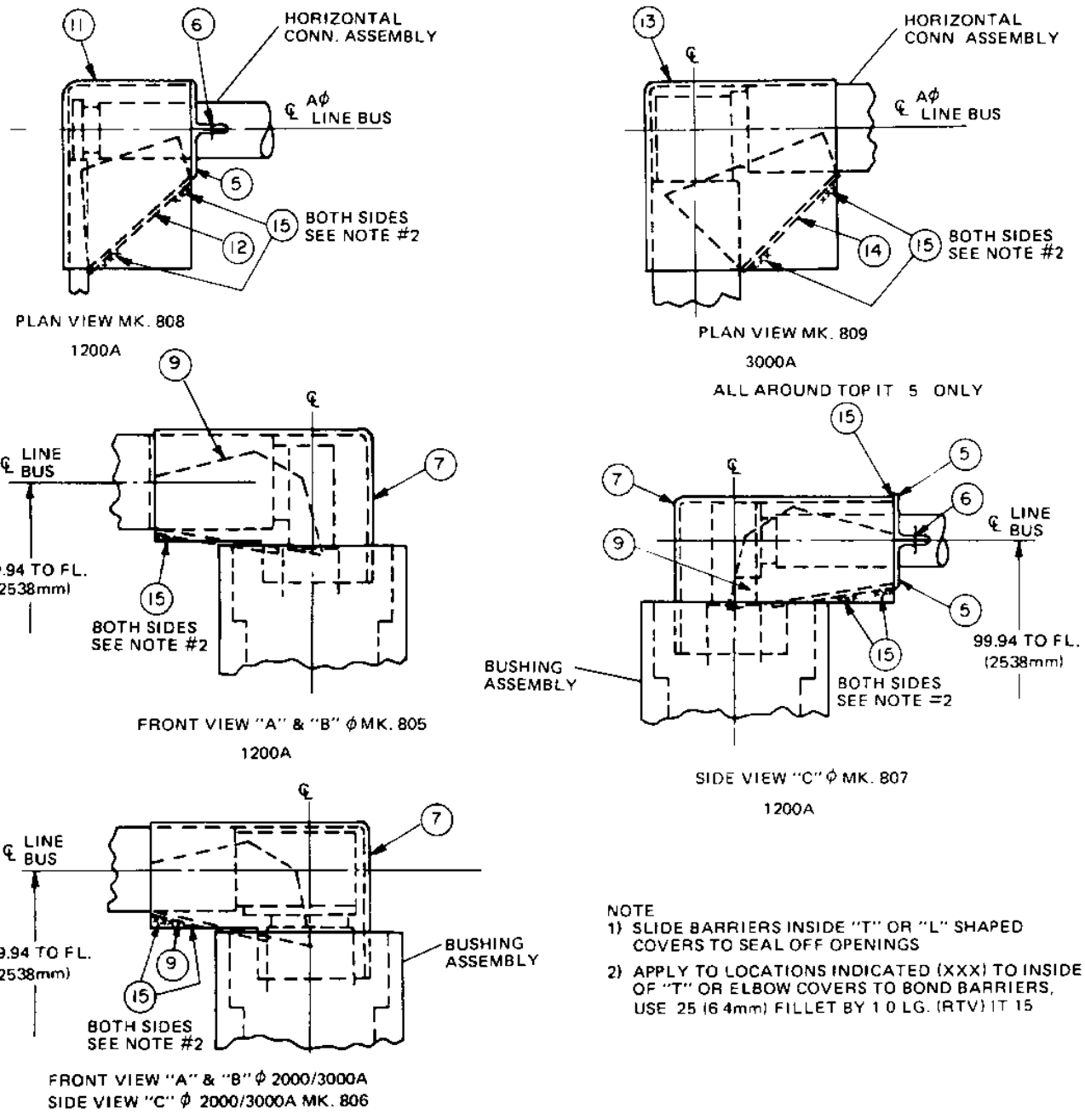


FRONT VIEW MK 804

TYPICAL 1200A END UNIT BUS INSULATION COVERS L H END OR R H END (GOOD FOR A, B OR C0)

Mk. 809 Req.	Mk. 808 Req.	Mk. 807 Req.	Mk. 806 Req.	Mk. 805 Req.	Mk. 804 Req.	Mk. 803 Req.	Mk. 802 Req.	Mk. 801 Req.	Item	Description	Drawing No.	Mk. No.
–	–	–	–	–	1	1	1	1	001	"T" Insulation	18-728-164	001
–	–	–	–	–	–	–	1	2	002	Barrier	18-728-164	005
–	–	–	–	–	1	–	1	–	003	End Barrier Assembly	18-729-009	501
–	–	–	–	–	1	2	–	–	004	Barrier Assembly	18-729-011	501
–	1	2	–	–	1	2	–	–	005	Angle Barrier	18-657-840	092
–	2	2	–	–	2	4	–	–	006	Rivet (Plastic .25)	00-671-501	070
–	–	1	1	1	–	–	–	–	007	Cut Elbow Insulation	18-728-164	003
–	–	–	–	–	–	–	–	–	008	Barrier Assembly	18-729-012	501
–	–	1	1	1	–	–	–	–	009	Barrier	18-728-164	007
–	–	–	–	–	–	–	–	–	010	Barrier Assembly	18-729-010	501
–	1	–	–	–	–	–	–	–	011	Barrier Assembly	18-729-008	501
–	1	–	–	–	–	–	–	–	012	Barrier Assembly	18-728-164	008
1	–	–	–	–	–	–	–	–	013	Elbow Insulation	18-728-164	002
1	–	–	–	–	–	–	–	–	014	Barrier	18-728-164	006
.1	.1	.1	.1	.1	.1	.1	.1	.1	015	RTV Silicone Rubber	00-333-031	025

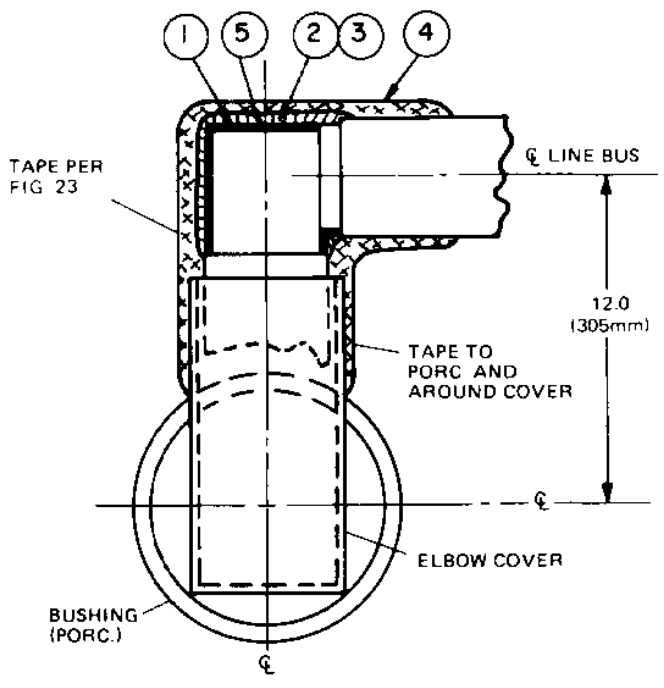
Figure 24. Factory Insulation Arrangement



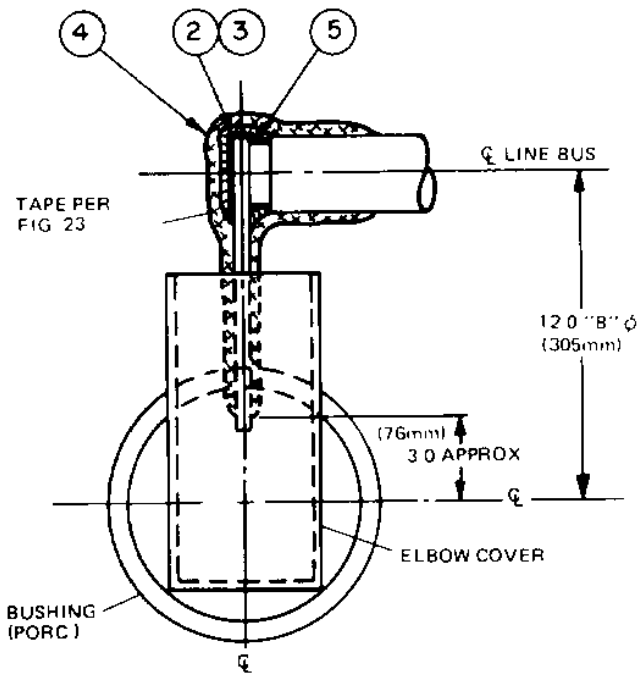
NOTE
1) SLIDE BARRIERS INSIDE "T" OR "L" SHAPED COVERS TO SEAL OFF OPENINGS
2) APPLY TO LOCATIONS INDICATED (XXX) TO INSIDE OF "T" OR ELBOW COVERS TO BOND BARRIERS, USE .25 (6.4mm) FILLET BY 1.0 LG. (RTV) IT 15

Mk. 809 Req.	Mk. 808 Req.	Mk. 807 Req.	Mk. 806 Req.	Mk. 805 Req.	Mk. 804 Req.	Mk. 803 Req.	Mk. 802 Req.	Mk. 801 Req.	Item	Description	Drawing No.	Mk. No.
–	–	–	–	–	1	1	1	1	001	"T" Insulation	18-728-164	001
–	–	–	–	–	–	–	1	2	002	Barrier	18-728-164	005
–	–	–	–	–	1	–	1	–	003	End Barrier Assembly	18-729-009	501
–	–	–	–	–	1	2	–	–	004	Barrier Assembly	18-729-011	501
–	1	2	–	–	1	2	–	–	005	Angle Barrier	18-657-840	092
–	2	2	–	–	2	4	–	–	006	Rivet (Plastic .25)	00-671-501	070
–	–	1	1.	1	–	–	–	–	007	Cut Elbow Insulation	18-728-164	003
–	–	–	–	–	–	–	–	–	008	Barrier Assembly	18-729-012	501
–	–	1	1	1	–	–	–	–	009	Barrier	18-728-164	007
–	–	–	–	–	–	–	–	–	010	Barrier Assembly	18-729-010	501
–	1	–	–	–	–	–	–	–	011	Barrier Assembly	18-729-008	501
–	1	–	–	–	–	–	–	–	012	Barrier Assembly	18-728-164	008
1	–	–	–	–	–	–	–	–	013	Elbow Insulation	18-728-164	002
1	–	–	–	–	–	–	–	–	014	Barrier	18-728-164	006
.1	.1	.1	.1	.1	.1	.1	.1	.1	015	RTV Silicone Rubber	00-333-031	025

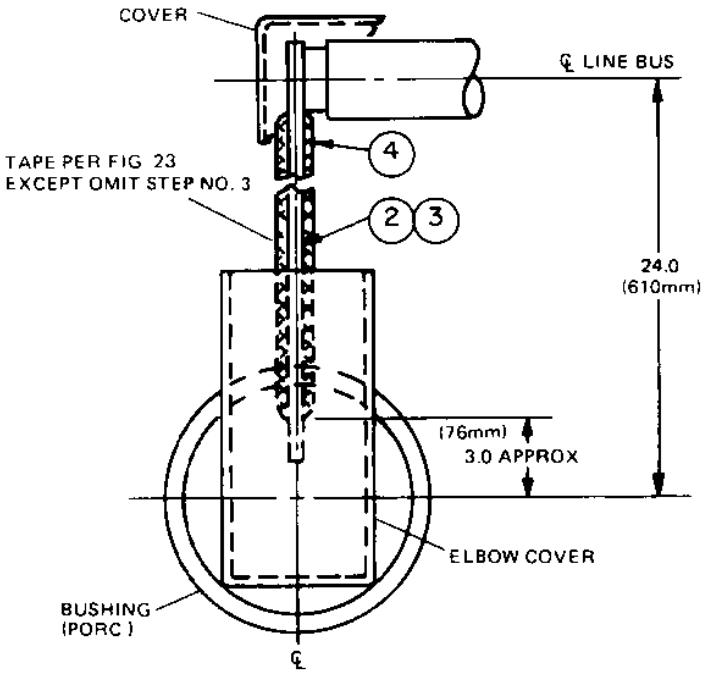
Figure 24. Factory Insulation Arrangement



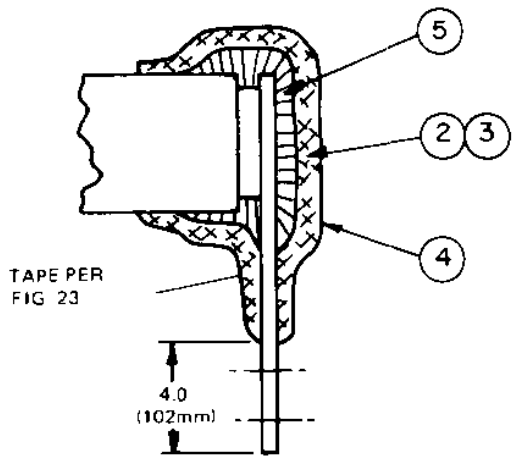
PLAN VIEW – ϕ2 2000/3000A
MK 801



PLAN VIEW – ϕ2 1200A
MK 802



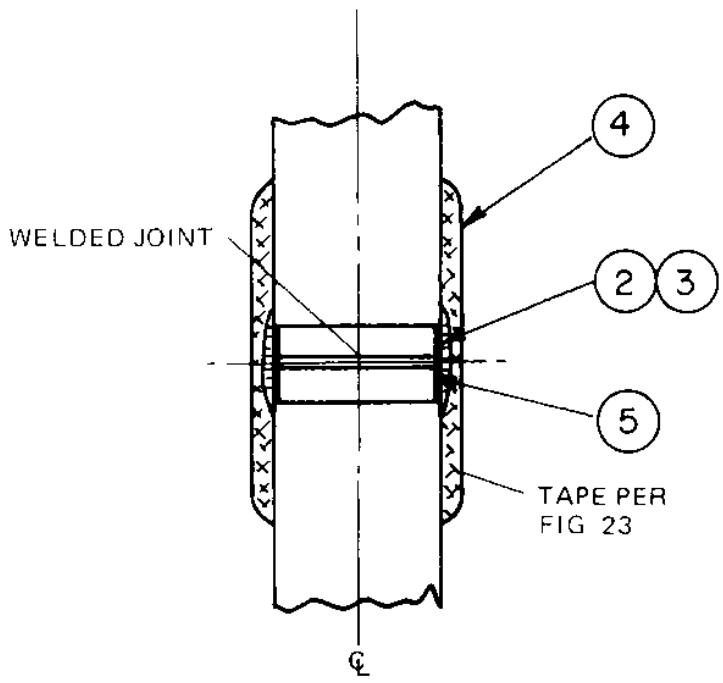
PLAN VIEW – ϕ1 - 1200A
MK 805



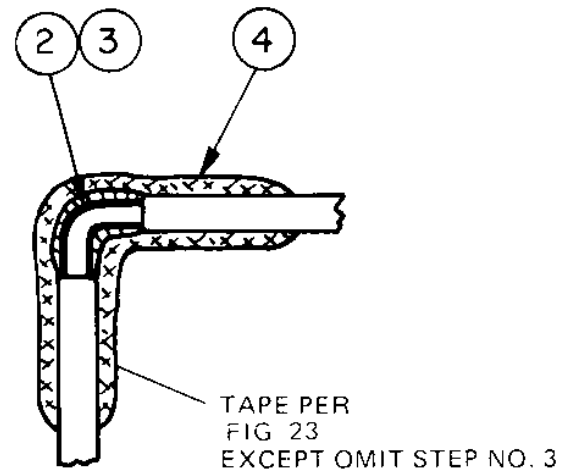
LINE BUS INSULATION
MARK 806
1200/2000/3000

Mk. 807 Req.	Mk. 806 Req.	Mk. 805 Req.	Mk. 804 Req.	Mk. 803 Req.	Mk. 802 Req.	Mk. 801 Req.	Item	Description	Drawing No.	Mk. No.
–	–	–	–	–	–	1	1	Insulation Cover	18-657-840	317
.25 Roll	.25 Roll	.2 Roll	.1 Roll	.1 Roll	.2 Roll	.3 Roll	2	.010 x 18.0 (.25 x 457mm) Black Polyester Cloth	15-171-467	005
.5 Roll	.5 Roll	.5 Roll	.3 Roll	.3 Roll	.5 Roll	.5 Roll	3	.010 x .75 (.25 x 19mm) Yellow Bias Tape	00-413-431	100
.5 Roll	.5 Roll	.5 Roll	.3 Roll	.3 Roll	.5 Roll	.5 Roll	4	.010 x .75 (.25 x 19mm) Fl. Ret. Tape (Red)	00-479-441	107
.5 Lb.	.5 Lb.	–	–	.3 Lb.	.3 Lb.	.5 Lb.	5	Filler Tape (Alum.)	15-171-164	001

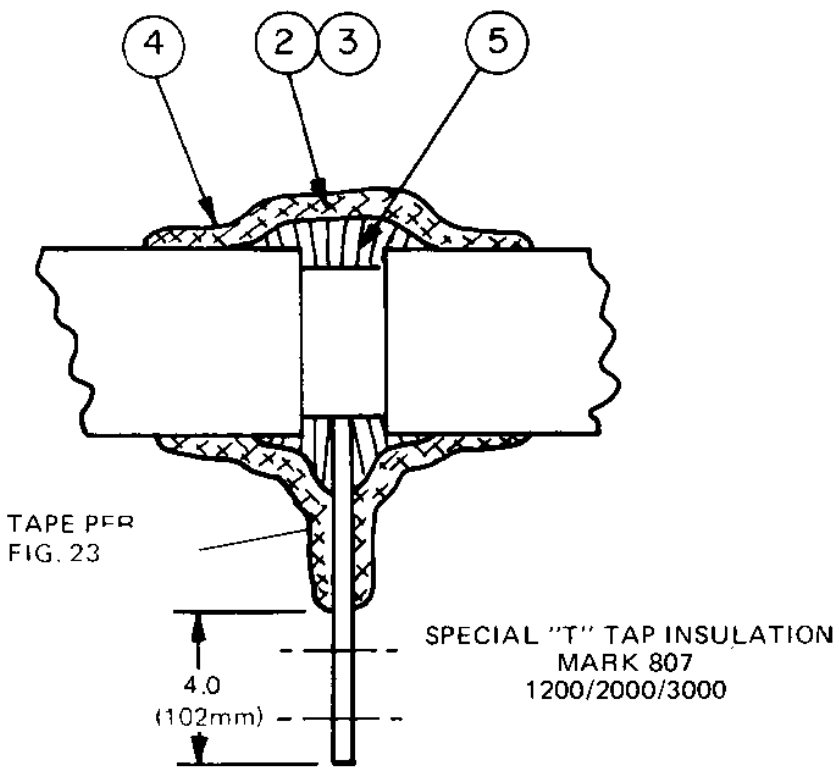
Figure 25. Insulation Material



PLAN VIEW – $\phi 1, \phi 2, \phi 3$ 1200/3000A
(STRAIGHT THRU WELDED BUS JOINT)
MK. 803



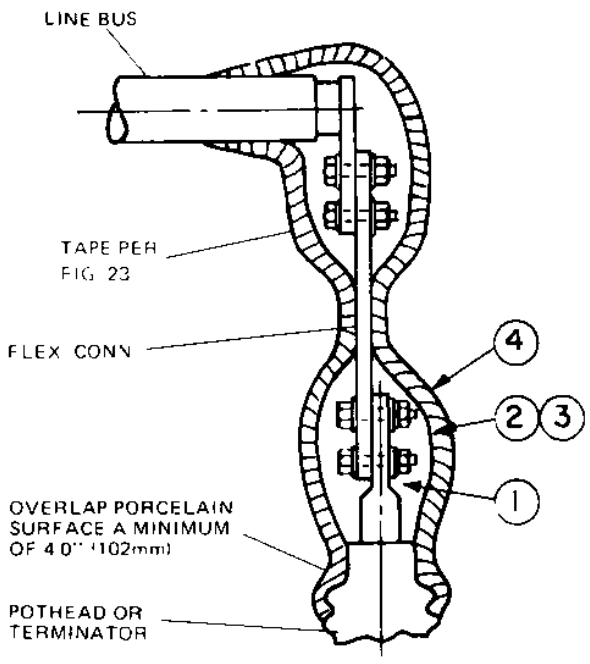
AUX. UNIT CONN. – $\phi 1, \phi 2, \phi 3$
MK. 804



Mk. 807 Req.	Mk. 806 Req.	Mk. 805 Req.	Mk. 804 Req.	Mk. 803 Req.	Mk. 802 Req.	Mk. 801 Req.	Item	Description	Drawing No.	Mk. No.
–	–	–	–	–	–	1	1	Insulation Cover	18-657-840	317
.25 Roll	.25 Roll	.2 Roll	.1 Roll	.1 Roll	.2 Roll	.3 Roll	2	.010 x 18.0 (.25 x 457mm) Black Polyester Cloth	15-171-467	005
.5 Roll	.5 Roll	.5 Roll	.3 Roll	.3 Roll	.5 Roll	.5 Roll	3	.010 x .75 (.25 x 19mm) Yellow Bias Tape	00-413-431	100
.5 Roll	.5 Roll	.5 Roll	.3 Roll	.3 Roll	.5 Roll	.5 Roll	4	.010 x .75 (.25 x 19mm) Fl. Ret. Tape (Red)	00-479-441	107
.5 Lb.	.5 Lb.	–	–	.3 Lb.	.3 Lb.	.5 Lb.	5	Filler Tape (Alum.)	15-171-164	001

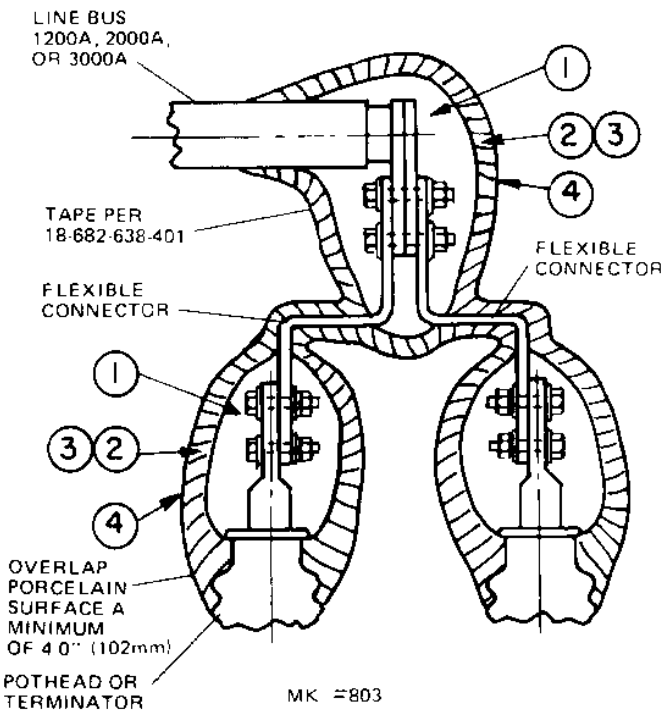
Figure 25. Insulation Material

ELECTRICAL CONNECTIONS



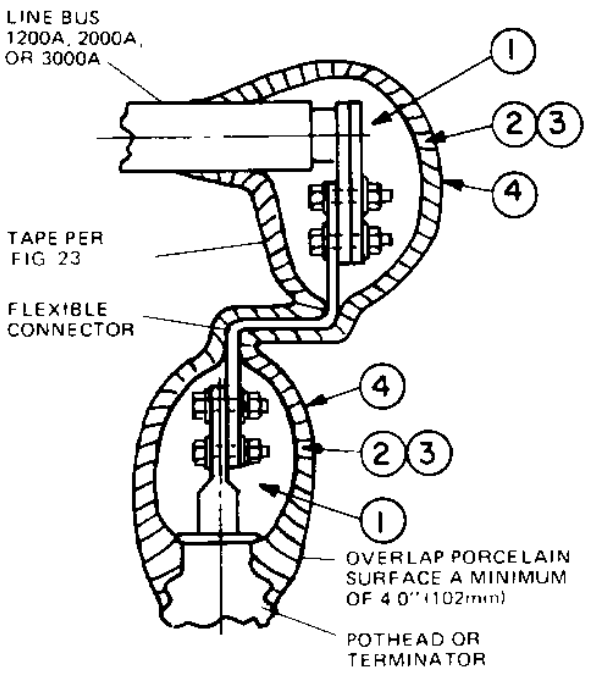
MK =801

CONNECTION FROM 1200A LINE BUS TO ONE POTHEAD OR TERMINATOR BUSHING



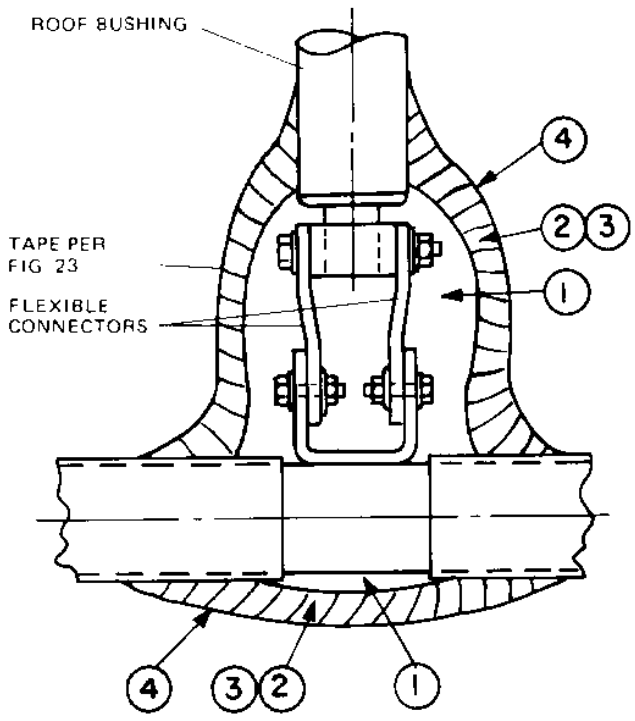
MK =803

CONNECTION FROM 1200A, 2000A OR 3000A LINE BUS TO TWO POTHEAD OR TERMINATOR BUSHINGS



MK =802

CONNECTION FROM 1200, 2000 OR 3000A LINE BUS TO ONE POTHEAD OR TERMINATOR BUSHING



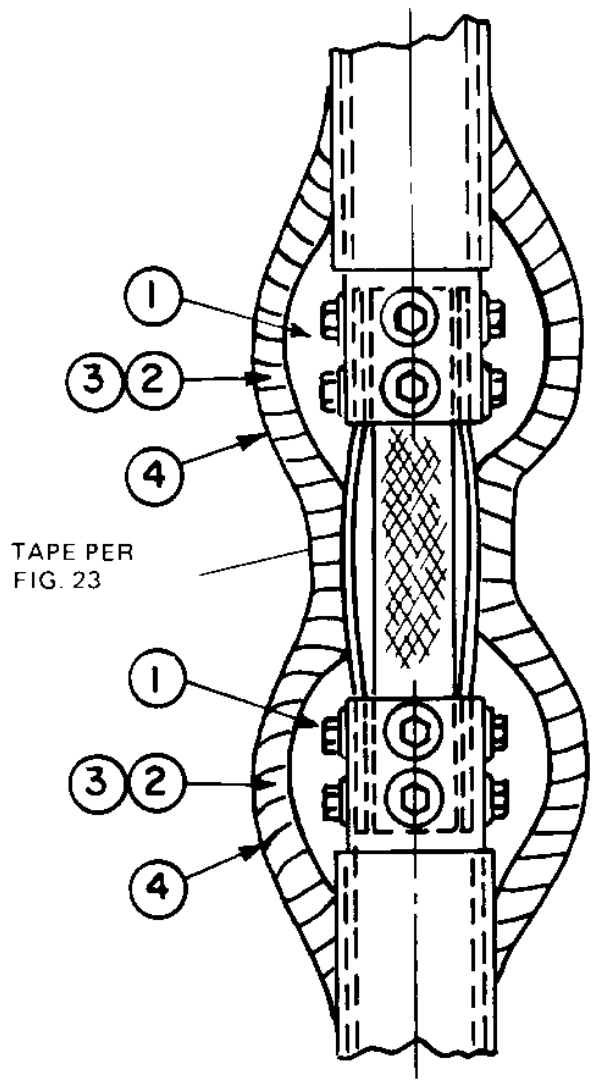
MK =804

CONNECTION FROM 2000A OR 3000A LINE BUS TO ONE ROOF BUSHING

Mk. 806 Req.	Mk. 805 Req.	Mk. 804 Req.	Mk. 803 Req.	Mk. 802 Req.	Mk. 801 Req.	U/M	Item	Part Name	Part Number
1.5	2.0	2.0	1.5	1.0	1.0	lbs	001	Filler Tape (Alum.)	15-171-164-001
.5	.8	.8	.8	.5	.5	rol	002	.010 x 18.0 (.25 x 457mm) Black Polyester Cloth	15-171-467-005
2.0	2.0	2.0	2.0	1.0	1.0	rol	003	.010 x .75 (.25 x 19mm) Yellow Bias Tape	00-413-431-100
2.0	2.0	2.0	2.0	1.0	1.0	rol	004	Red Flame Ret. Tape (.010 x .75 Wide) (.25 x 19mm)	00-479-441-107

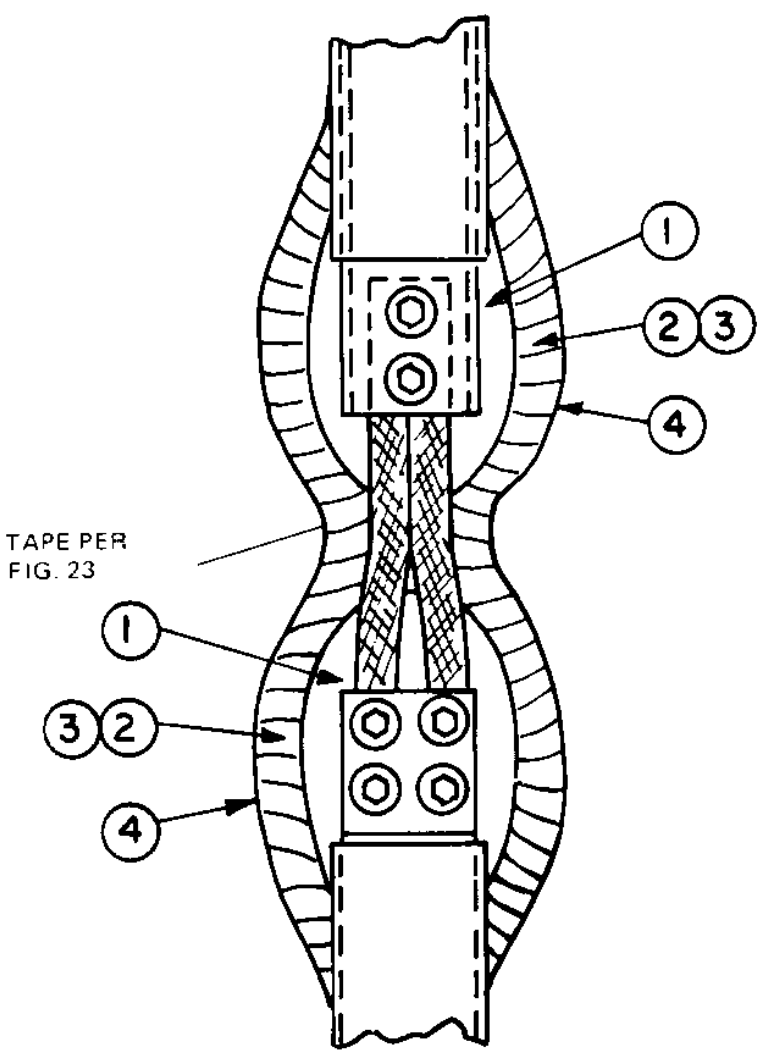
Figure 26. Field Insulation Arrangement

ELECTRICAL CONNECTIONS



MK. #805

CONNECTION FROM 2000A OR 3000A.
RISER BAR TO 2000A OR 3000A BUS DUCT.



MK. #806

CONNECTION FROM 1200A RISER BAR
TO 1200A BUS DUCT

Mk. 806 Req.	Mk. 805 Req.	Mk. 804 Req.	Mk. 803 Req.	Mk. 802 Req.	Mk. 801 Req.	U/M	Item	Part Name	Part Number
1.5	2.0	2.0	1.5	1.0	1.0	lbs	001	Filler Tape (Alum.)	15-171-164-001
.5	.8	.8	.8	.5	.5	rol	002	.010 x 18.0 (.25 x 457mm) Black Polyester Cloth	15-171-467-005
2.0	2.0	2.0	2.0	1.0	1.0	rol	003	.010 x .75 (.25 x 19mm) Yellow Bias Tape	00-413-431-100
2.0	2.0	2.0	2.0	1.0	1.0	rol	004	Red Flame Ret. Tape (.010 x .75 Wide) (.25 x 19mm)	00-479-441-107

Figure 26. Field Insulation Arrangement

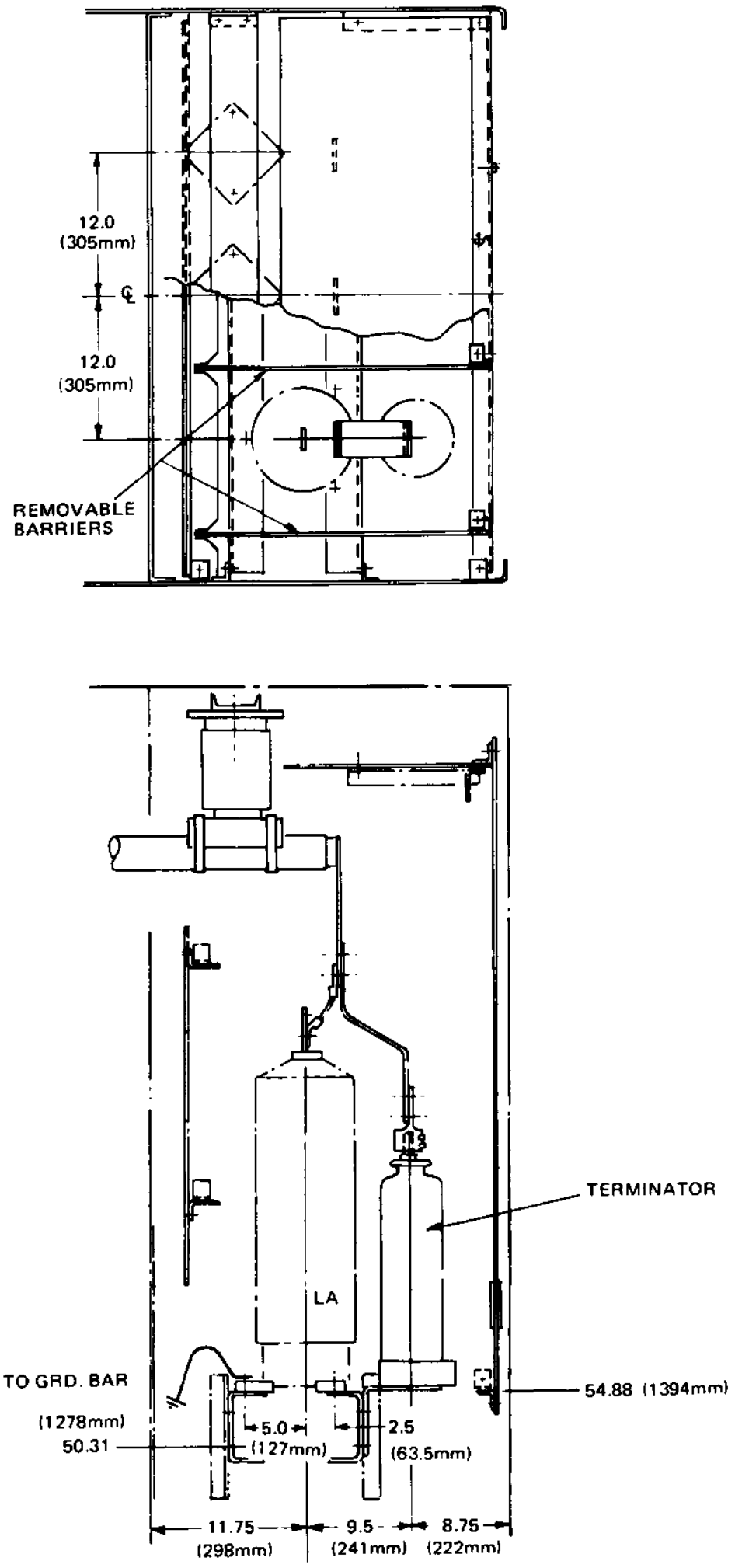


Figure 27. Porcelain Top Lightning Arrester and Terminator Mounting

ELECTRICAL CONNECTIONS

Panel Wire Chart

Wire No.	
C31	TC10-F6
C32	TC11-F12
C33	TC12-F18
C41	TB1-M3
C42	TB2-M9
C43	TB3-M15
C1	TB4-M2
C2	TB5-M8
C3	TB6-M14
CO	TB7-M4-M10-M16
IC1	TB8-L4
IC2	TB9-L6
IC3	TB10-L8
IC0	TB11-L2
C11	D1-M1
C12	D3-M7
C13	D5-M13
C21	D2-F4
C22	D4-F10
C23	D6-F16
AM2	E1-F8-F20
AM1	E2-F2-F14
IC21	G5-N4
IC22	H5-N6
IC23	J5-N8
IC20	J6-H6-G6-K5
IC11	L5-N3
IC12	L7-N5
IC13	L9-N7
IC10	L3-K6
SC1	TC1-A6
SC2	TC2-A5
ST1	TC3-C6
ST2	TC4-C5
V11	TC6-M6
V12	TC7-M12
V13	TC8-M18
V0	TC9-M20
5	TA1-A4-CS1
5A	TA2-A8-CS2
9	TA4-C8-CS4-G2-G3 -H2-H3-J2-J3-K2-K3 -L10-N2
9	CS4-LR2
11	TA5-C4-LR1-LG1-CS3 -G1-H1-J1-K1-N1
12	TA6-B8
13	TA7-LG2
21	TA8-B10
21A	TA9-B1-B7
9A	B9-L1
62-3	TA10-B8
62-4	TA11-B4
RP	TD10-P1
RN	TD11-P3
GB	TD12-P3

ELECTRICAL CONNECTIONS

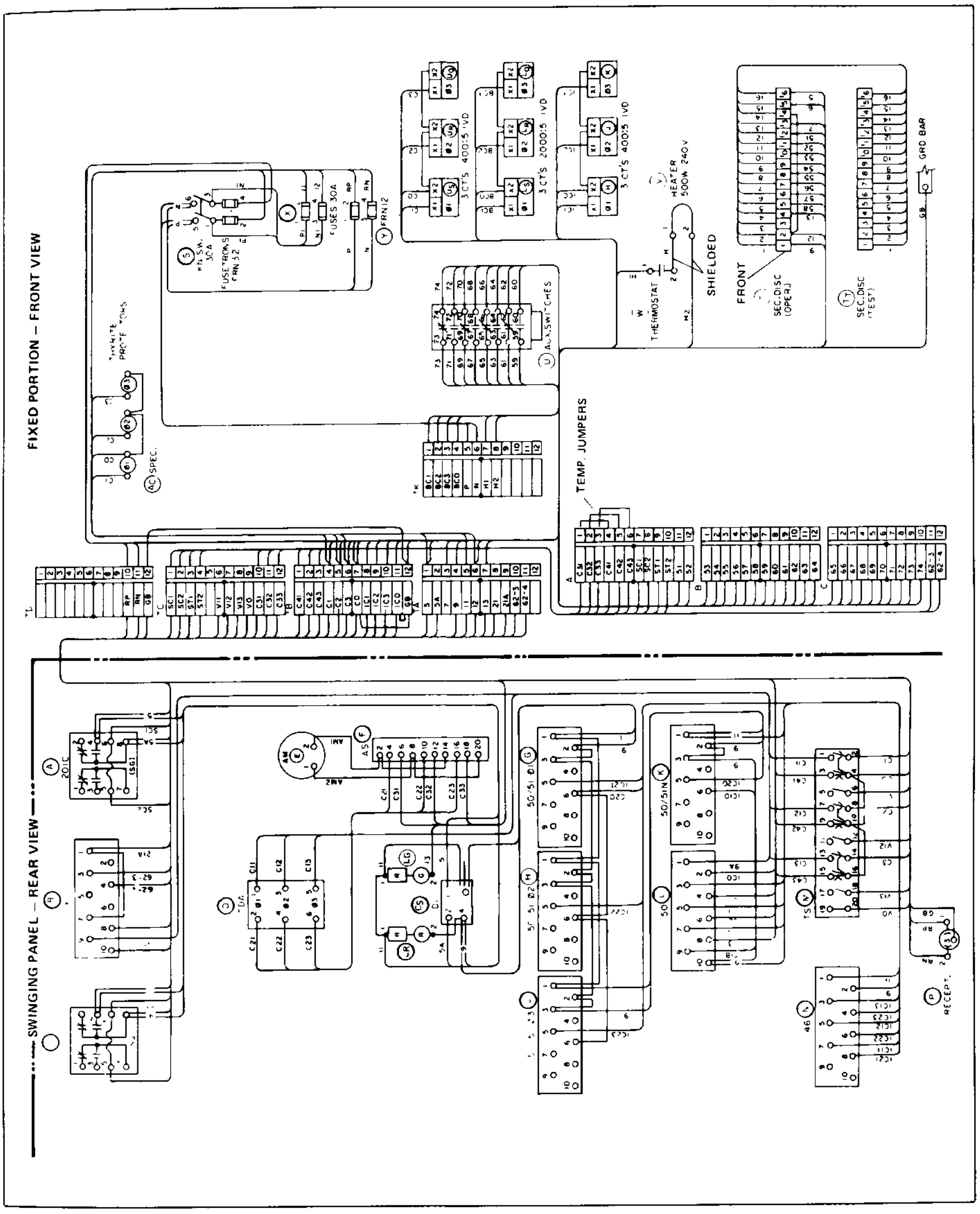


Figure 28. Typical Wiring Diagram

ELECTRICAL CONNECTIONS

Secondary Control Wiring

Secondary control wiring is carefully installed and tested at the Factory. Inter-group wiring at shipping splits can be readily connected by referring to wire markings. All wiring charts needed for installation are furnished in advance. These charts show both the changes originated by purchaser during manufacture and the changes made by the supplier to incorporate the purchaser's changes.

Wires can be traced easily on a wire chart similar to those shown in Figure 28. Each device is illustrated and identified with a letter. Each terminal on each device is identified by a number. The table on the chart indicates the device and terminal number to which each wire is connected and the next connection point. For example, the designations TC10-F6 appear opposite wire No. C31 in the table in Fig. 28. This indicates that wire No. C31 is connected to terminal 10 of TC, a terminal block and to terminal 6 of F, the ammeter switch.

Wires may be connected to a series of devices. For example, wire No. CO is connected to terminal 7 on TB, the terminal block; then to terminals 4, 10 and 16 on M, the test switch.

All secondary control wiring installed by the Factory is neatly bundled and cleated to the cubicle side plate. Make all field connections in a similar manner. Check that the circuit breaker, its components and panel clear any additional wiring installed. Fig. 29 shows a typical secondary control cable installation. Fig. 30 shows the physical location of maximum number of terminal blocks located above secondary cable entrance to guide customer in designing conduit entrance layouts or control cable locations.

Ground Connection

A common ground bus is incorporated in all units for properly grounding the equipment after installation. The ground bus is accessible in the primary cable area.

Provision for connecting this ground bus must be made in such a manner that a reliable ground connection is obtained. Consult latest National Electrical Code for ground connection standards.

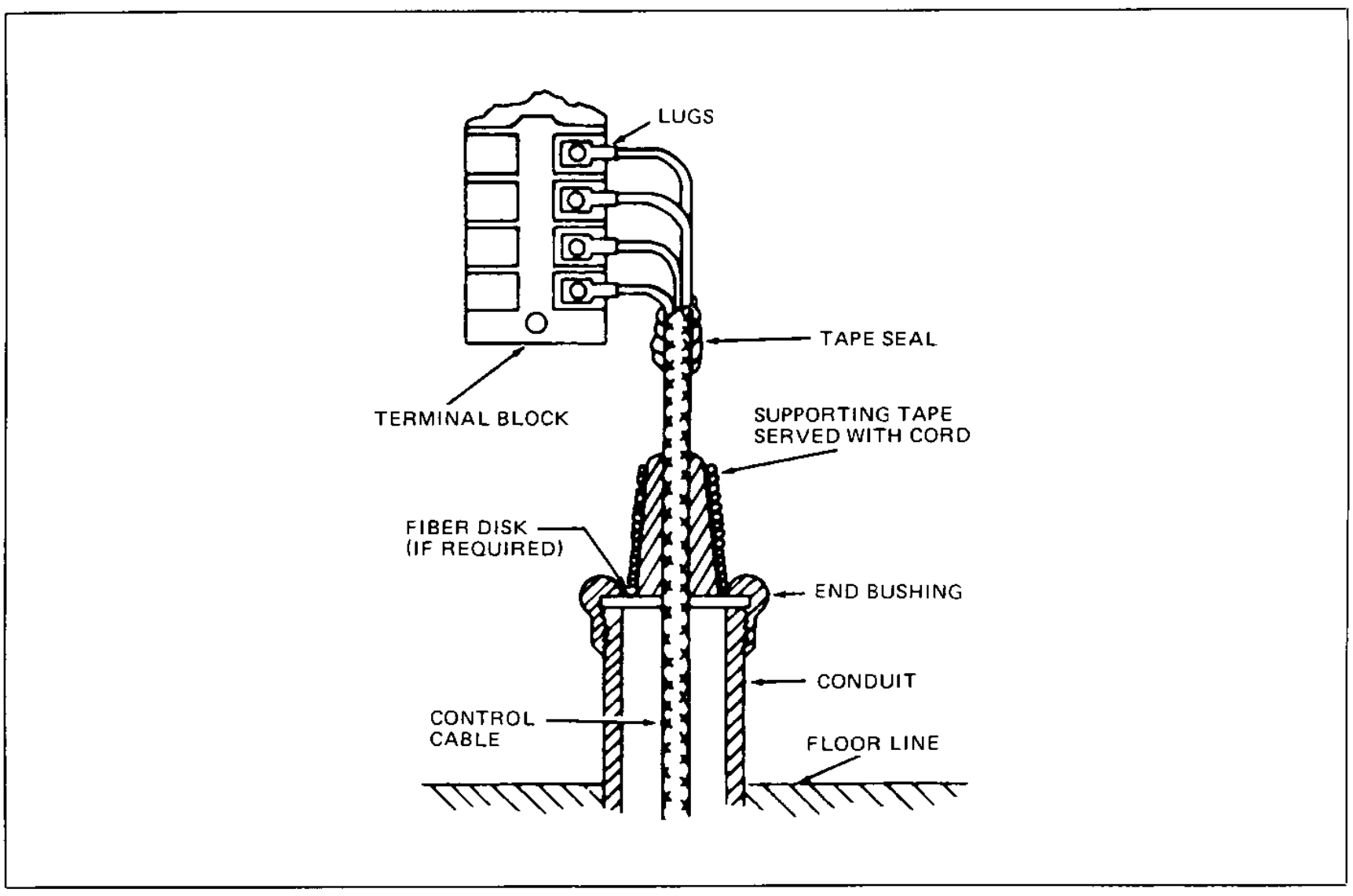


Figure 29. Secondary Control Cable Connections

ELECTRICAL CONNECTIONS

Temporary Ground Connections

It is recommended that no work be done on current carrying parts until these parts have been disconnected from the system and solidly grounded. One method of solidly grounding the high voltage circuit is by use of a grounding device. This device is placed in a cubicle in the same manner as a breaker and provides a path to ground. It is furnished only when specified in the contract.

Potential And Control Power Transformers

Potential and control power transformers are mounted in auxiliary units in a fixed position; the primary fuses are mounted on a removable fuse truck. Fig. 31 illustrates the location of these devices—note that one auxiliary unit can accommodate up to three (3) potential transformers or one (1) control power transformer. PT's are of molded type; CPT is non-inflammable liquid-filled type. When the fuse truck is moved from the connected to the disconnected position, spring loaded grounding fingers automatically ground the PT or CPT primary to remove any charge from the transformers. Truck operated shutters provide a protective barrier between the stationary primary contacts and the operator when the fuse truck is withdrawn from the cubicle.

To remove and replace PT fuses, proceed as follows:

1. Rotate front panel latches 1/4 turn and open panels.
2. Lift cubicle interlock rod (located at lower front of truck) to release truck.
3. Using the two handles near top of truck, pull truck out of unit. This disconnects and grounds transformers. Fuses are now accessible for removal and replacement.

	⚠ CAUTION
↯	When opening or closing any type of disconnect always perform the action in one complete, continuous motion.

For CPT applications, an interlock circuit breaker is furnished on the secondary side of the control power transformer to prevent disconnecting the transformer unless the circuit breaker is open. This breaker is located in the center of the front barrier directly over the fuse truck. Only when this breaker is opened (disconnecting the load from the transformer) can the fuse truck be moved from the connected position (Fig. 31).

To remove and replact CPT fuses, proceed as follows:

1. Open cubicle doors.
2. Open secondary breaker.
3. Follow steps 2 and 3 under PT instructions.

Current Transformers

Current transformers are of the torodial type and are mounted in the circuit breaker compartment between the channels which support the high voltage disconnects (Fig. 32).

The primary bushings of the circuit breaker serve as the primary bar of the current transformer. Therefore, removing the circuit breaker actually removes the primary bar. It is possible to test the current transformers without removing them from the unit while maintaining maximum operator safety.

This testing should be done at the terminal blocks located in the secondary control compartment accessible through the left-hand front door of the unit.

Current transformers are built to NEMA and IEEE standards. Each current transformer has a nameplate with the following information: type, serial number and rating. When contacting the Factory about transformers, include the nameplate information and identify the cubicle in which the transformer is mounted.

	⚠ CAUTION
↯	Do not operate any current transformer with secondaries open-circuited.

ELECTRICAL CONNECTIONS

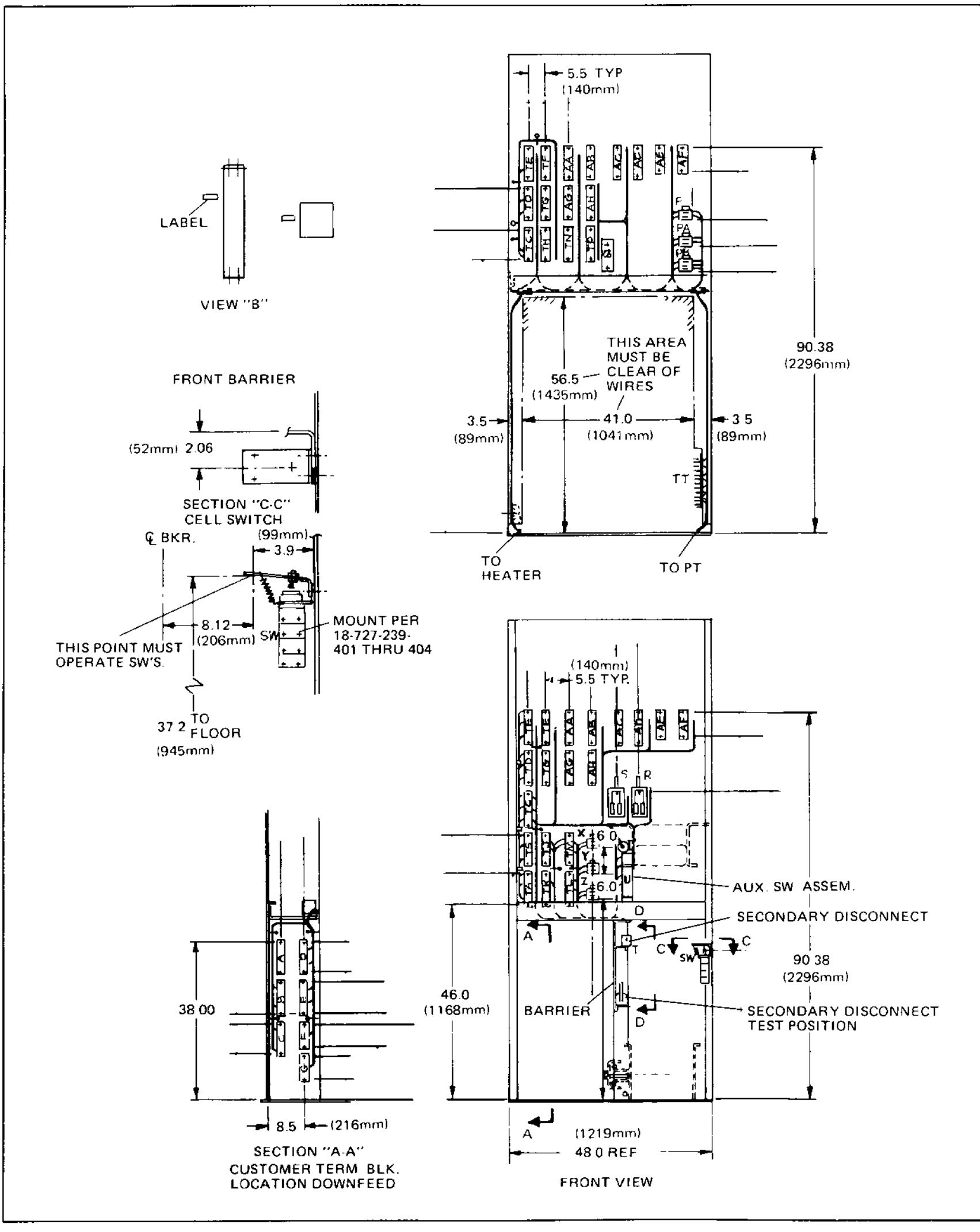
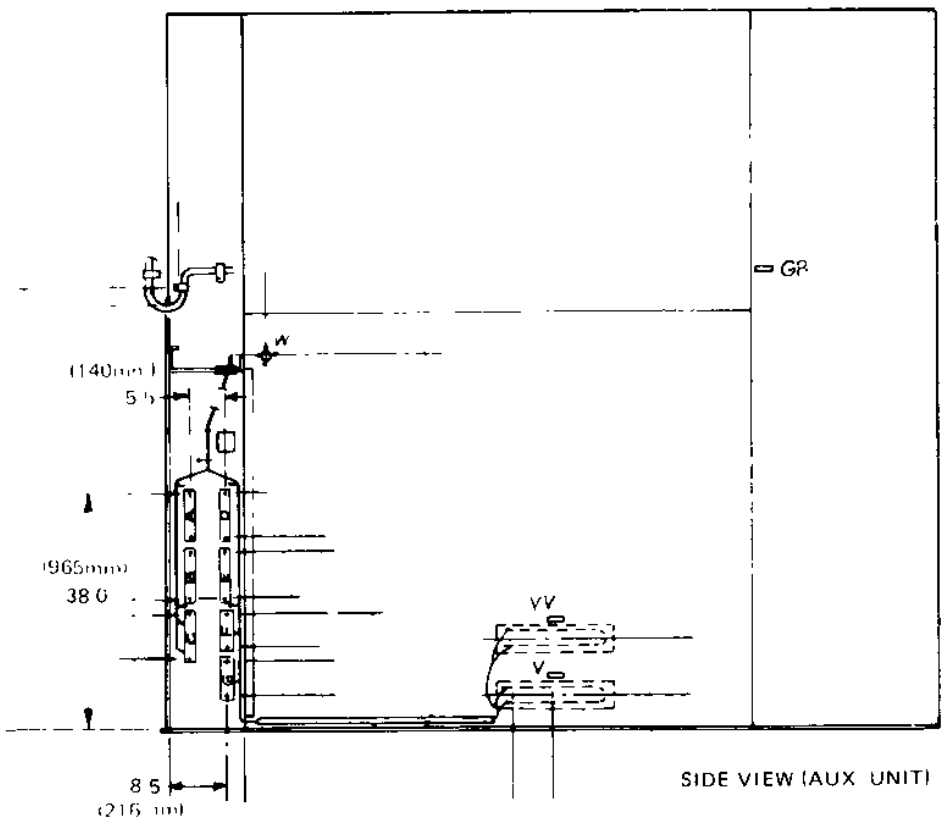
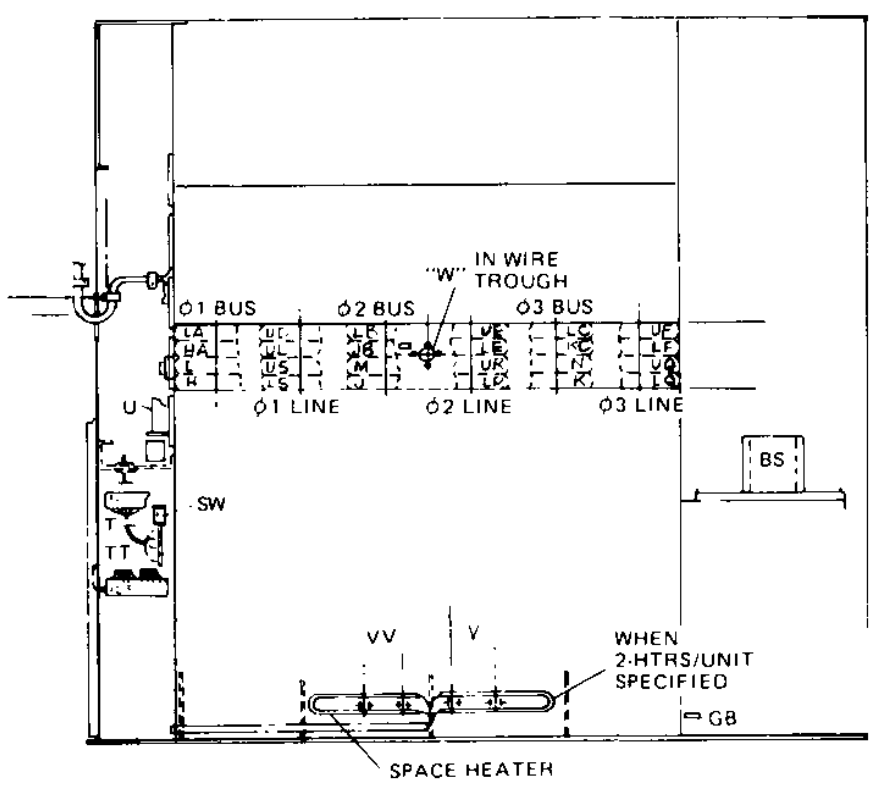


Figure 30. Miscellaneous Auxiliary Equipment

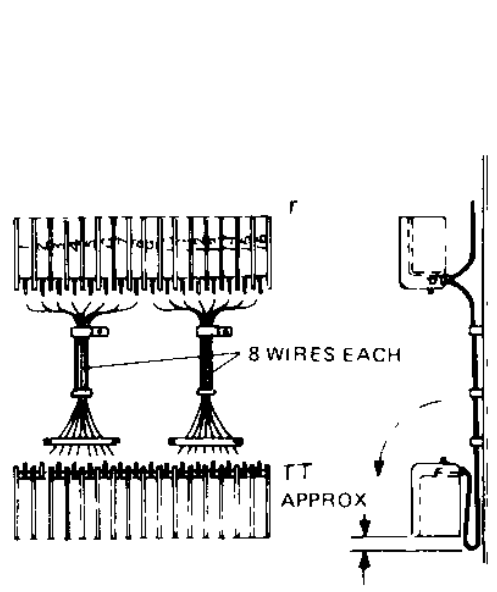
ELECTRICAL CONNECTIONS



SIDE VIEW (AUX UNIT)



SIDE VIEW (BRK UNIT)



SECTION "D-D"

Figure 30. Miscellaneous Auxiliary Equipment

ELECTRICAL CONNECTIONS

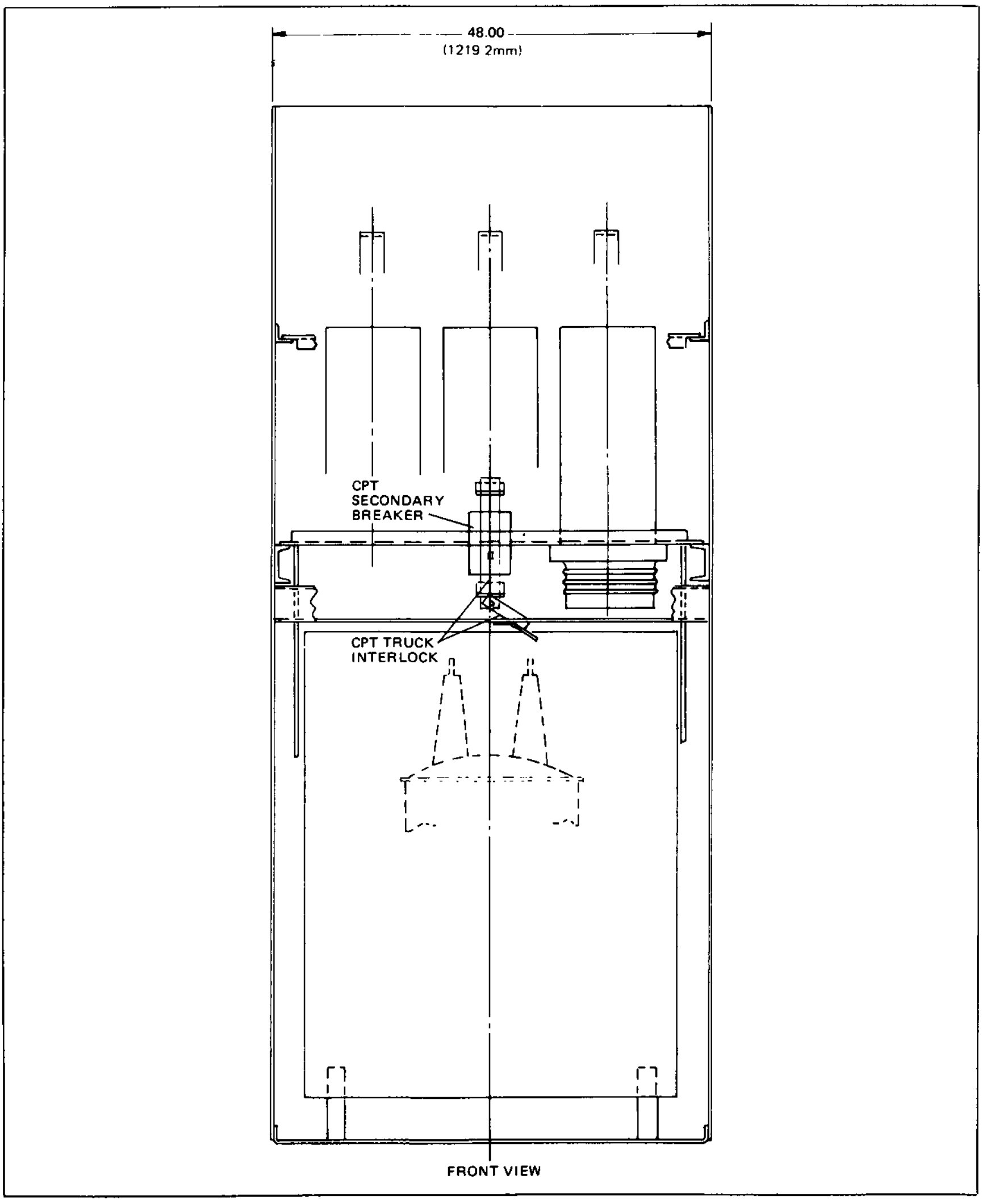


Figure 31. Auxiliary Unit Assembly (Typ.)

ELECTRICAL CONNECTIONS

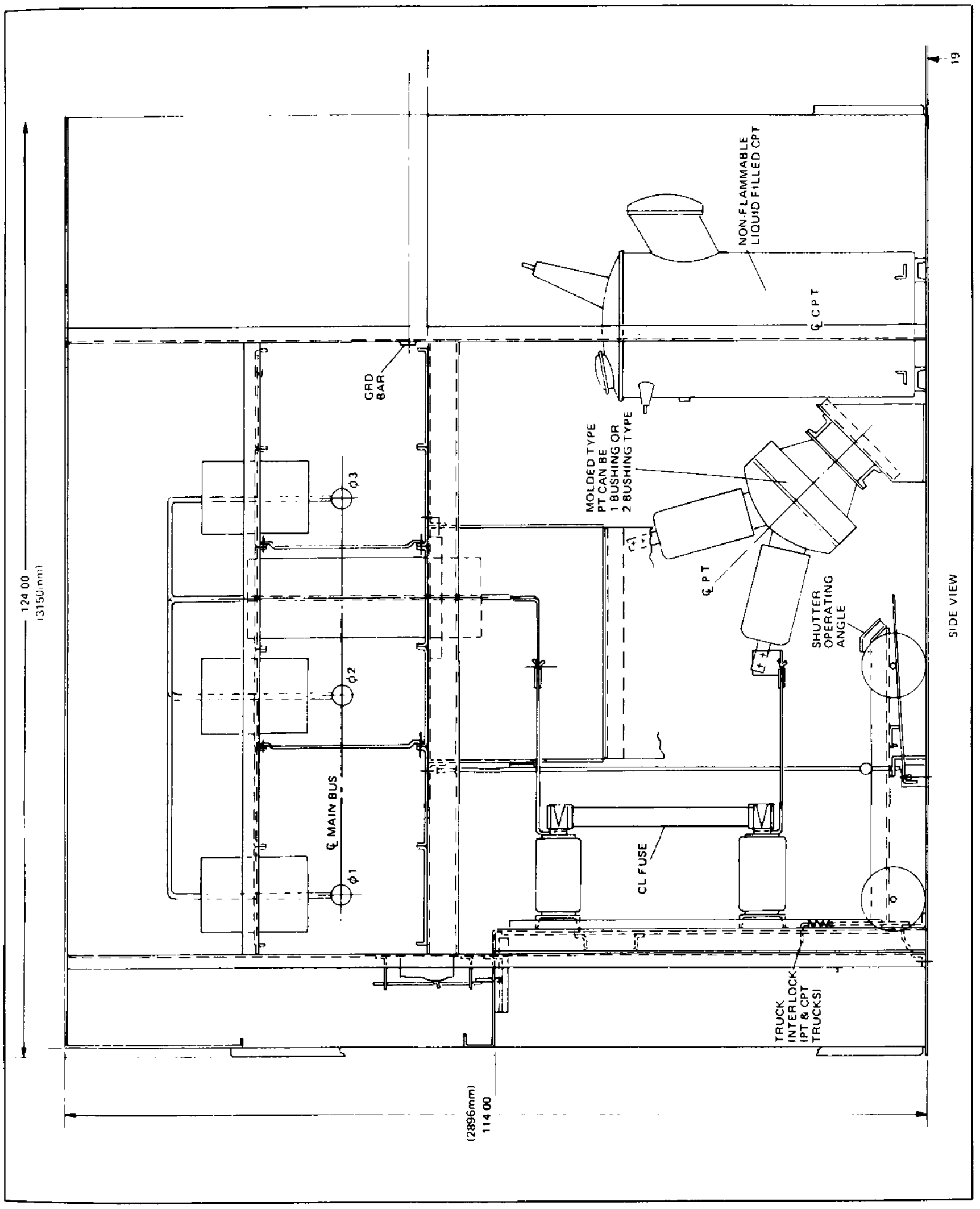


Figure 31. Auxiliary Unit Assembly (Typ.)

ELECTRICAL CONNECTIONS

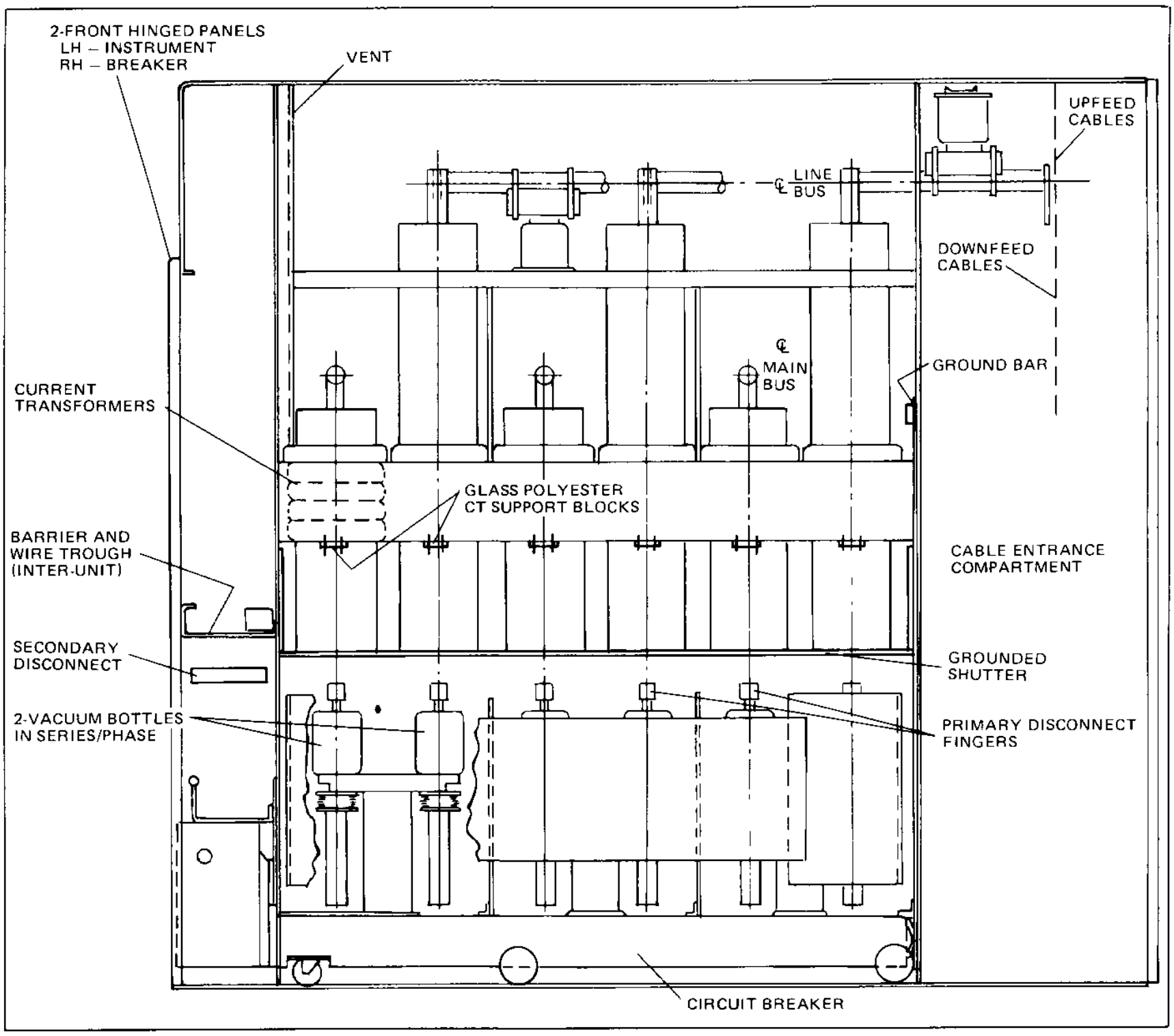


Figure 32. Side View Typical 1200A Breaker Cubicle Showing CT Location

The toroidal current transformers shown in Fig. 33 are the type used in 34.5 kV switchgear equipment. The circuit breaker primary bushings pass through the transformers when in the connected position. Nameplates are located on the outer diameter of the transformer. These CT's are supplied in either single ratio or multi-ratio design.

An elliptical shaped toroidal current transformer, Fig. 34, is furnished for ground sensing circuits. This transformer is mounted in the primary cable area at a convenient height for receiving customer's cables. If shielded cables are used it is important that the ground lead be brought back down through the ground sensing CT and grounded ahead of this CT to insure proper relay operation.

CIRCUIT BREAKER INSTALLATION

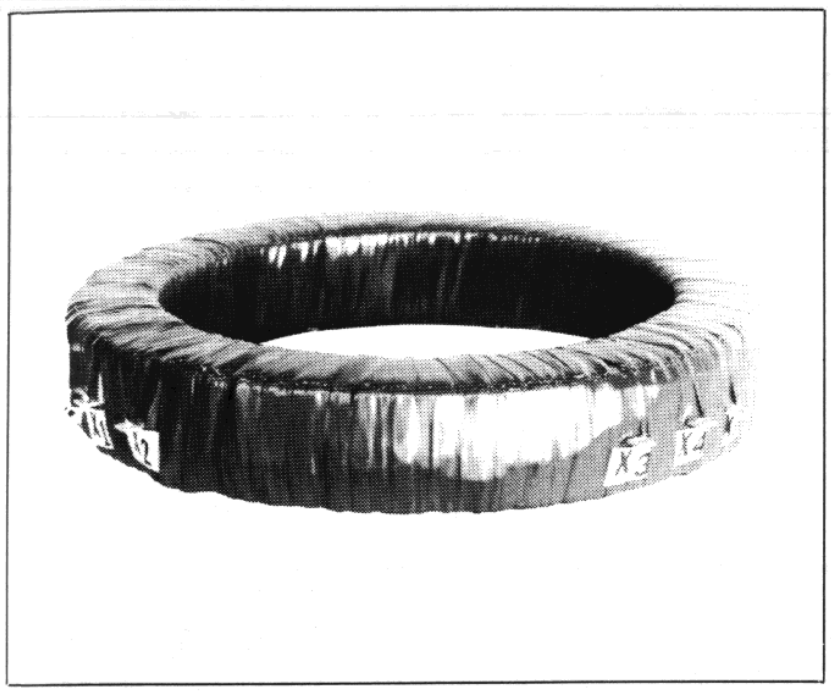


Figure 33. Typical IVD Current Transformer

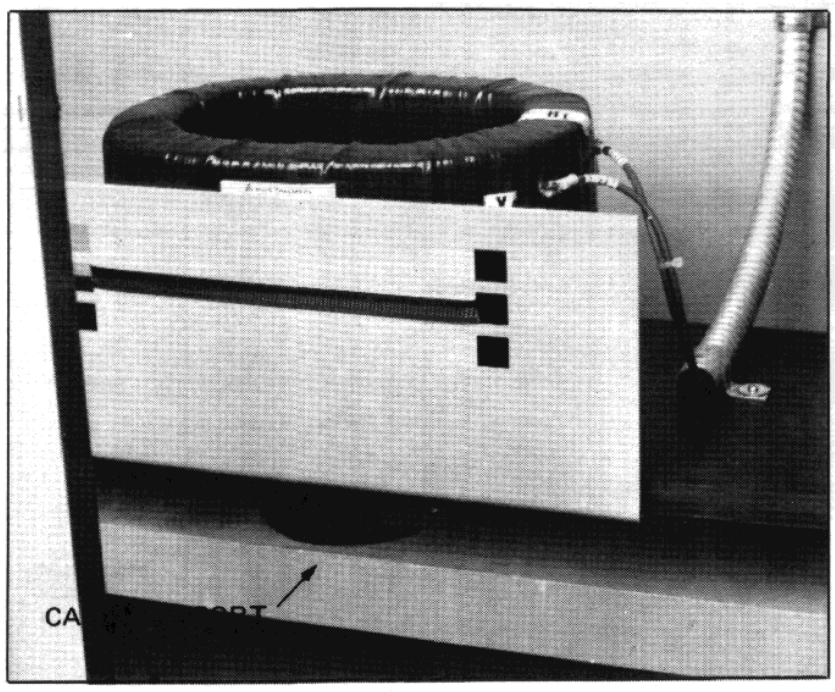


Figure 34. Elliptical Toroidal Current Transformer (Ground Sensor)

Cubicle Preparation

The cubicle contains the positioning, interlocking and operating devices described below and shown in Figure 35. These devices must be checked for placement and freedom of operation.

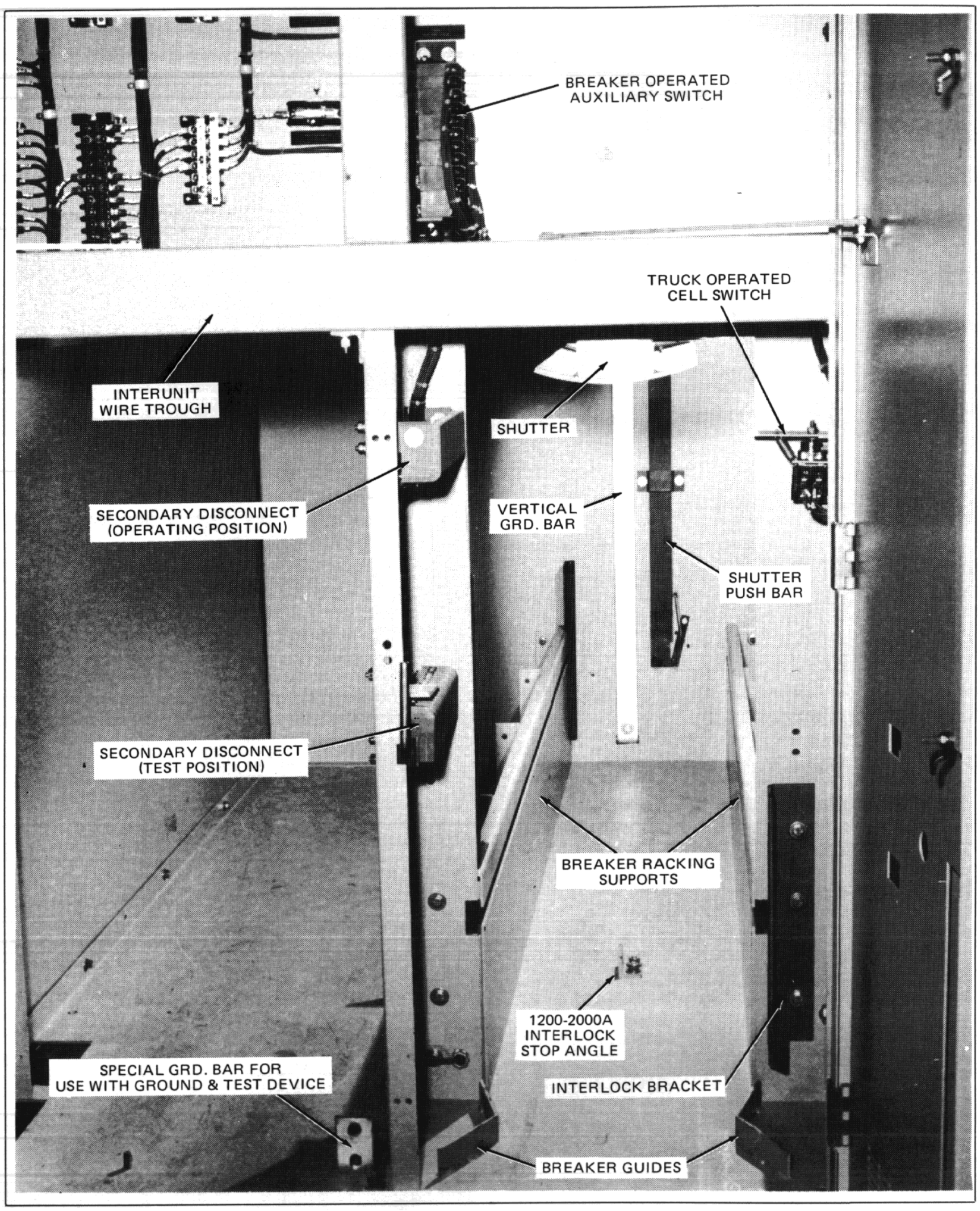
Guide Rails, Racking Supports And Main Interlock Bracket

The funnel-shaped guide rails on the cubicle floor together with slots in the L.H. and R.H. racking supports will align the breaker and assure proper entry into the cubicle. The main interlock bracket is located at the lower right front of the cubicle and contains notches at top and bottom plus an offset angle in front of the bottom notch; These, in conjunction with interlock bars on the breaker, latch the breaker in one of two definite positions. These two positions are disconnect/test (breaker lowered to floor) and operate (breaker raised to full elevation). The circuit breaker is made trip-free (main contacts cannot be held closed, electrically or mechanically) at all times except when the interlock bar on the circuit breaker engages either the disconnect test or operate position as shown in Figure 36.

The main interlock bracker (Figs. 35 and 36) provides three types of interlocking functions.

1. The lower notch which also has a cam face prevents a closed breaker from being rolled into the test position. The racking interlock on the breaker is a sliding bar which extends outward to the right of the breaker. If the breaker is in the open mode, the racking interlock bar will be allowed to slide to the left as it rides up over the cam face of the interlock bracket. This permits rolling the breaker to the test position after which the racking interlock bar springs into the notch behind the cam face. If the breaker is in the closed mode, the racking interlock on the breaker cannot slide to the left, therefore it cannot ride up over the cam face and breaker is held outside of cubicle.
2. The lower notch prevents a closed breaker from being withdrawn from the cubicle in much the same manner as in #1 above. In place of a cam face on the interlock bracket on withdrawal, the front edge of the racking interlock on the breaker is beveled.

CIRCUIT BREAKER INSTALLATION



CIRCUIT BREAKER INSTALLATION

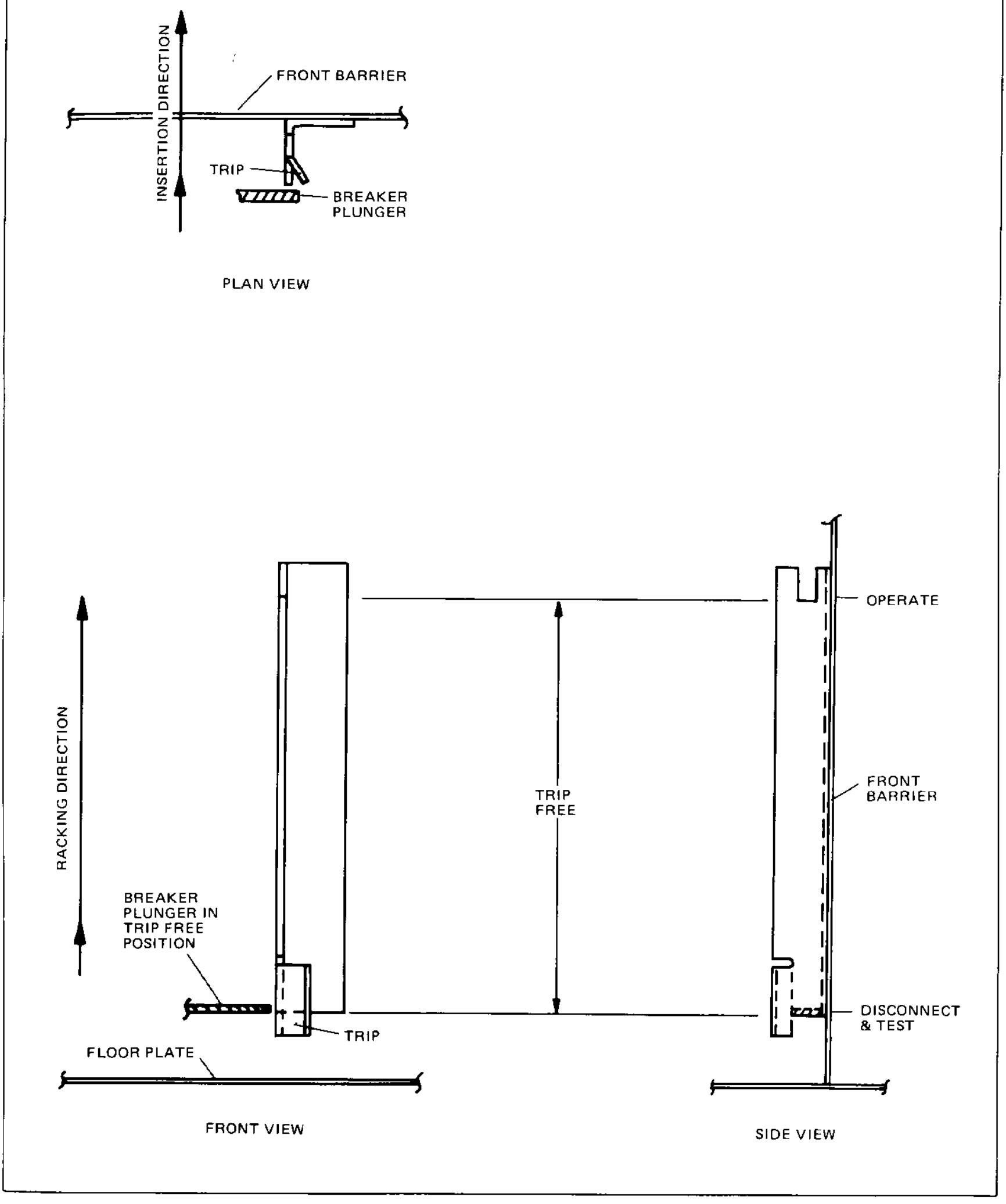


Figure 36. Circuit Breaker Interlock Bracket

CIRCUIT BREAKER INSTALLATION

3. The upper notch in the interlock bracket allows the closing springs to be charged while the breaker is in the disconnect/test position. The face of the interlock bracket depresses the spring release interlock on the breaker as it is being rolled into the cubicle. This unloads the springs if they were charged and springs cannot be recharged until the spring release interlock either drops into the upper notch or breaker has been withdrawn beyond the interlock bracket. To withdraw the breaker from the cubicle the spring release lever on the breaker must be moved to the right, which will then cause the spring release interlock to withdraw from the notch in the interlock bracket. This will discharge the springs if they were charged and it will also close the breaker. The breaker must now be tripped to the open mode, hold the spring release lever to the right and withdraw the breaker.

   The face of the interlock bracket also serves to keep the breaker in a trip free state during racking as it holds the racking interlock in a depressed position (Fig. 36.).

Interlock Stop Angle

The angle is mounted on the cubicle floor so as to allow only a 1200-ampere circuit breaker to enter a 1200-ampere cubicle and a 2000-ampere circuit breaker to enter a 2000-ampere cubicle. When other special devices restrict a circuit breaker to a specific cubicle, it will be indicated on the circuit breaker rating plate. Normally cubicle and circuit breaker rating plates will be identical. Figure 36 illustrates the placement of the interlock stop angle for a 1200-ampere breaker.

Secondary Disconnect

The secondary disconnect contains all the electrical control circuit connections for the circuit breaker. It mates with the secondary disconnect block on the circuit breaker. The sliding fingers of the secondary disconnect block on the circuit breaker engage the contact strips on the secondary disconnects in both the test and connected (operate) positions. In the test position, the secondary disconnect is engaged by rotating the lower stationary contacts 90° with the handle provided.

Auxiliary Switch

This switch is operated by a cam bar on the circuit breaker. The breaker engages the auxiliary switch in the connected (operating) position and test position. Switch contacts should be lubricated regularly with Siemens-Allis electrical contact lubricant supplied by Siemens-Allis.

Circuit Breaker Ground Connection

A sliding contact finger for grounding the circuit breaker frame is mounted at rear of the breaker. This finger engages a vertical ground bar mounted at rear of the cubicle and maintains a solid ground contact with a continuous wipe through the test and connected positions. The contact is broken when the breaker is being removed from the cubicle.

Shutter Operation

Through the engagement of a cam on the shutter push bar with a cam follower on the breaker, the shutter opens as the circuit breaker is raised into the connected (operate) position, and closes as the breaker is lowered. Shutter is fully closed with the breaker at the test position and is opened when the breaker is just above the test position.

Circuit Breaker Preparation

⚠ CAUTION

Remove Packaging. Breakers are shipped in closed position. Do not trip breaker open until reading the breaker instruction manual 18X5763.

Refer to the circuit breaker manual 18x5763 for instructions on handling and preparing the circuit breaker.

Circuit Breaker Insertion

After the circuit breaker has been prepared in accordance with instructions in the breaker manual, check to see that control power is off and primary system is de-energized. Visually inspect the cubicles and remove any foreign material that might hinder or prevent smooth insertion of the breaker. Proceed as follows:

1. Line up the circuit breakers in front of their respective cubicles.
2. Check that circuit breaker interlock will pass interlock stop angle on floor of cubicle.
3. Apply a .03 to .06 (1 to 2 mm) layer of electrical contact grease inside primary finger clusters at contact point area. Siemens-Allis electrical contact lubricant, No. 15-171-370-002.)

CIRCUIT BREAKER INSTALLATION

NOTE

The finger clusters are lubricated in preparation for the check of the primary contact engagement which is made when circuit breaker is removed, (see step 6) and also to protect contact surfaces (see step 7).

4. Move breaker into disconnect/test position. See Racking Instruction (page 61). The funnel-shaped guide rails on the cubicle floor and guide slots on the racking supports will align the breaker with the cubicle on entry. When the disconnect position is reached, the interlocks on the circuit breaker will drop into the interlock bracket notches. In this position, check the following items:

   a. That secondary contacts have good contact alignment. This can be done by rotating the test position secondary block (lower of two blocks) see Fig. 25, Book 18X5763, until it engages the secondary fingers on the breaker; leave in test position for steps e, f, g and h.

   b. That ground contact is made (rear of breaker)

   c. That shutter operating pin has engaged mating hole on circuit breaker and shutter interlock latch has released.

   d. If manual charging crank has been used, remove it. Then energize control power and proceed with the checks outlined in steps f, g and h.

NOTE

Breaker is a stored-energy type: spring-charging motor will start immediately. Wait until springs are completely charged (motor stops) before proceeding.

   f. Close and trip breaker electrically two or three times using panel-mounted control switch.

   g. Close breaker mechanically by pulling the manual close pull rod and tripping mechanically by operating trip button.

   h. Close breaker and attempt to rack. Racking handle cannot be turned while breaker is closed.

Manually trip the breaker and again attempt to rack. One or two clockwise turns of the racking handle will cam out the racking interlock if the circuit breaker is open and will allow the breaker to move toward the connected position. Note that the shutter moves away from the disconnects with the first few turns of the crank.

It is normal for the first one or two turns of the racking crank (in either direction) to require higher than normal torque to cam out the interlock; if the high resistance to turning is encountered after two turns, check to see that the breaker is in the open position.

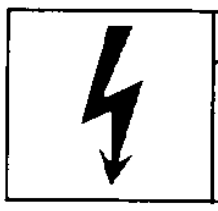
5. Raise the breaker to the connected position. (See Racking Instructions, below). The breaker will travel 15 inches (381 mm) to reach this locaiton at which time the interlock bar will drop into the connected position notch.

   If the springs are discharged, the charging motor will start immediately upon reaching this position. However, with control power on, if breaker stopped in test position, the mechanism would have charged and retained its charge between positions. Perform the following checks in this position:

   a. Electrically close and trip breaker to check operation in the connected position.

   b. Check ground contact.

6. Lower breaker and remove it from cubicle to check the length of engagement of the primary contact fingers over the straight portion of the stationary contact surface. The contact point of the fingers must have a minimum wipe of .12 inch over this portion. This can be observed by opening the shutter and with a flashlight noting the polish marks on the stationary contact surface. Remove excess grease form the contact fingers.



⚠ WARNING

STATIONARY PRIMARY DISCONNECTS MUST NOT BE ENERGIZED WHEN OPENING SHUTTERS.

CIRCUIT BREAKER INSTALLATION

7. Before final installation of circuit breakers, check that all primary disconnect studs and contact fingers and secondary disconnect strips and fingers are lubricated with a film of the Siemens-Allis electrical contact lubricant provided. This lubricant will insure a long service life for the contacts and will protect them against corrosion. Lubricant Siemens-Allis No. 15-171-370-002.

Racking Instructions

A crank for raising or lowering the breakers is provided as a standard accessory. Racking can be accomplished with the circuit breaker front panel open or through a small door in the front panel, with this panel closed. (See Figure 37).

Insert crank into opening at front of breaker operator panel until it engages the end of the racking screw.

Rotate crank clockwise to raise breaker or counter-clockwise to lower breaker.

As an optional extra, an electrical racking package can be supplied for operation from a 120 VAC source. It consists of a motor on the breaker plus a control package and limit switches installed on the fixed portion. A portable electrical racking device is also availabe for operation from either a 120 VAC source or a 125 VDC source.

Figure 37. Breaker Racking, Manual

INSPECTION AND TESTING

Installation, Inspection And Testing

Before the equipment is put in service, it must be thoroughly inspected and tested. Correct any defects immediately.

Check the following points:

1. High voltage connections properly insulated.
2. Electrical disconnecting contacts, machine parts, shutter, etc., checked for lubrication and operation.
3. Blockings, supports and other temporary ties removed from breakers, instruments, relays, etc.
4. Proper fuses correctly placed.
5. Temporary wiring jumpers (used on the secondaries of current transformers tied to external devices, as shown on wiring diagrams) removed.
6. Ground connections properly made.
7. Incoming primary and secondary connections properly made and checked for shorts or undesired grounds as well as proper phasing.
8. All equipment, removed during assembly, replaced.
9. Relays coordinated with other relays, etc., on the system. Refer to relay instruction book before making any adjustments. Consult local power company before making any connections to the power supply.
10. Storage battery fully charged and provided with recharging facilities.
11. Interlocks performing properly.
12. Circuit breakers checked and prepared per instruction books.
13. All filters in vent areas are clean and free of shipping or construction material.

Final Testing

1. A megger test is made on the high voltage circuit to be sure that all connections made in the field are properly insulated. A megger test is also advisable on the control circuit.
2. A dielectric test, if possible, should be made on the high voltage circuit for one minute at one of the following voltages. (Potential transformers, control transformers, lightning arresters, surge capacitors must be disconnected during this test.)

Rated kV	Test kV	
	AC	DC
34.5	60.0	85.0

A dielectric test on secondary and control circuits should be made at 1200 volts.

Note: Caution "certain control devices (motors, motor circuits, etc.) 75% of 900 volts or 675 volts."

The above voltages are in accord with NEMA Standards.

3. With breaker in the test position make the following tests on each unit.
   a. Trip and close the circuit breaker with the control switch.
   b. Trip the breaker by passing sufficient amps (or volts) through the coils of protective relays.
   c. Trip and close the breaker from any remote control positions.
   d. Operate auxiliary devices.
   e. Test the phase sequence of polyphase high voltage circuits, particularly those used for motor starting.

MAINTENANCE

To place equipment in service for the first time proceed as follows:

1. Check that all circuit breakers are open and all control circuits energized.
2. Connect primary incoming power source to equipment.

NOTE

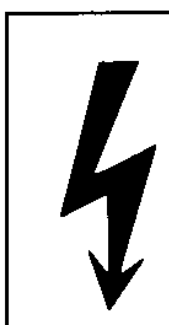
The primary incoming power source should be at the lowest voltage possible and gradually brought up to normal.

3. Check all instruments, relays, meters, etc., during this time.
4. Connect as small a load as possible and observe instruments.

NOTE

Allow several minutes before connecting additional load.

5. Gradually connect more load to the equipment while observing instruments until full load is connected.
6. Check for overheating of primary and secondary circuits and satisfactory operation of all instruments during the first week of operation.



⚠ WARNING

Before any maintenance work is performed within primary compartments, make certain that the equipment is completely de-energized, tested, grounded, tagged or properly identified, and released for work in an authorized manner.

Thorough inspections at periodic intervals are important for satisfactory operation. The frequency of inspection depends on installation conditions and is determined by experience and practice. Make inspections at least once a year—more frequently if local conditions require. Conditions affecting inspection and maintenance scheduling are weather and atmosphere, unusual number of operations, experience of operating and maintenance personnel and special operating requirements.

After the frequency of inspection has bene established, include the following items in your inspection procedure.

1. Inspect switchgear interior for accumulation of dust, dirt or any foreign matter. Remove dust from all insulators.
2. Clean air filters by washing in any mild household detergent.
3. Check instrument and control switches and inspect their contacts.
4. Examine indicating lamps and replace as required.
5. Check terminal block contacts for loose connections.
6. Inspect bus bars and connections for proper condition. If bus bars are overheating, check for poor or loose connections or for overload.
7. Check for proper condition of instrument transformers. Replace burned out fuses, if any. Check primary and secondary connections.
8. Examine automatic shutters for proper operation.
9. Examine all safety interlocks.
10. Perform maintenance of circuit breakers as outlined in circuit breaker instruction manual.
11. Check space heaters and thermostat (if equipped) for proper operation.

Cubicle Lubrication

It is essential that switchgear be lubricated carefully and properly to guard against corrosion and to insure that all operating parts work freely.

A tube of Siemens-Allis electrical contact lubricant is furnished by Siemens-Allis packed with accessories, for this purpose. Old grease should be removed annually and current carrying parts relubricated. Relubricate at more frequent intervals if required. Lubricant Part No. 15-171-370-002.

MAINTENANCE

Electrical Contacts

Lubricate stationary silver-surfaced contacts and auxiliary switch contacts with contact lubricant furnished by Siemens-Allis, prior to use, as follows:

1. Wipe contacts clean.
2. Apply lubricant to contact surfaces.
3. Wipe off excess lubricant, leaving a film.

	⚠ CAUTION
↯	Avoid getting lubricant on insulation.

Do not use Siemens-Allis electrical contact lubricant on non-current carrying parts. Non-current carrying parts which may require lubrication are to be lubricated with Beacon P-290 grease.

Corrosive Atmospheres

This switchgear is designed to give top performance when installed in normal indoor or outdoor locations. Where abnormal conditions, such as corrosive atmospheres, are encountered, special precautions must be taken to minimize their effect. Exposed metallic surfaces—non-insulated bus bars, disconnect switches, primary and secondary disconnecting contacts, wire ends, instrument terminals, etc.,—must be protected. At each maintenance inspection all of the old grease should be wiped off of the contacts and new lubricant applied to all sliding surfaces. Apply the material in a layer between .03″ and .06″ (1 - 2mm) thick. Use only Siemens-Allis Electrical Contact Lubricant, part no. 15-171-370-002, available in 8 oz. (.23 kg) tubes. Other exposed members can be protected with a coat of glyptol lacquer or any other corrosion-resisting paint.

When old grease becomes dirty, wipe the parts clean and apply new grease immediately.

Relays And Instruments

To insure satisfactory operation of relays and instruments do not leave device covers off longer than necessary. When a cover has been broken, cover the device temporarily and replace broken glass as soon as possible.

Equipment Surfaces

Matching paint, one pint per three units, thinned and ready for use, is supplied with each order for touching up any scratches, etc., made during installation. Inspect the surface and retouch when necessary. Paint is furnished in one pint spray cans.

Inspect the cubicle surfaces and touch up scratches as necessary. Use the paint furnished with the unit. This paint matches the cubicle, is thinned and ready for use in spray-on pint cans.

ACCESSORIES

Key Interlock

When specified, a key interlock can be supplied to prohibit closing a breaker. The interlock bar is attached to the guide bar. In the locked position, the lock bolt is extended, locking the breaker in the trip-free position. Then the key can be removed to release disconnects or associated equipment for operation.

This interlock is cleared for normal breaker operation by returning disconnects, etc., to normal operating position and inserting the key into its lock, permitting withdrawal of the bolt and releasing of the cam follower bar.

Testing Device

When specified, a plug jumper is supplied so that a breaker can be operated (tested) outside its compartment with the control switches on the instrument panel. This plug jumper is used to bridge—with a flexible cable—the secondary disconnects so that the breaker can be electrically closed and tripped, see Figures 38 and 39. Refer to Figures 40 and 41 for plug jumper connection instructions.

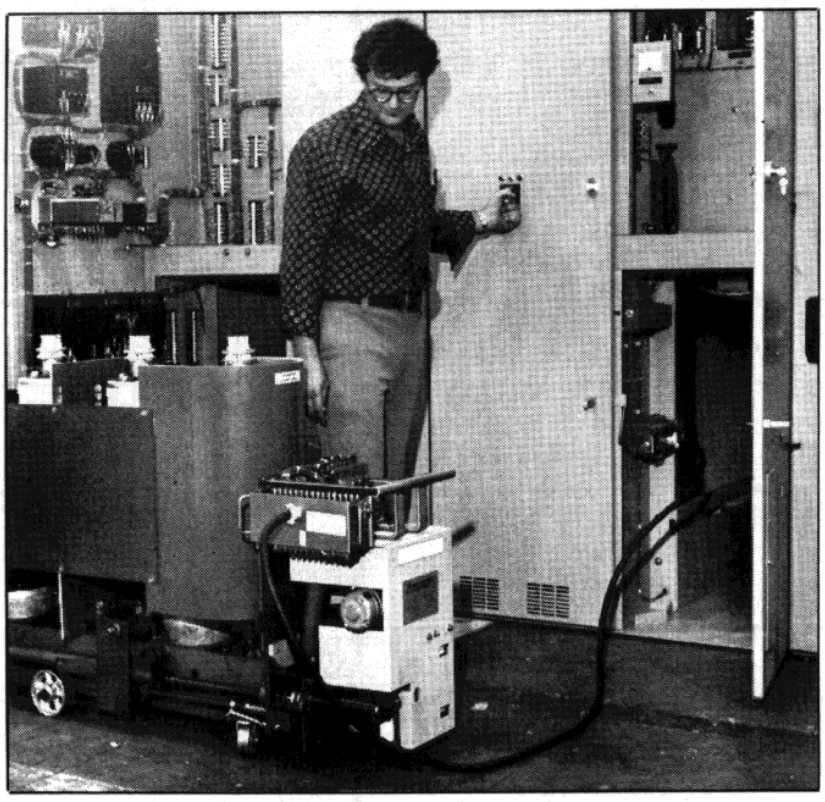


Figure 38. Test Device for Testing Breaker Outside Unit with Switchgear Control Power

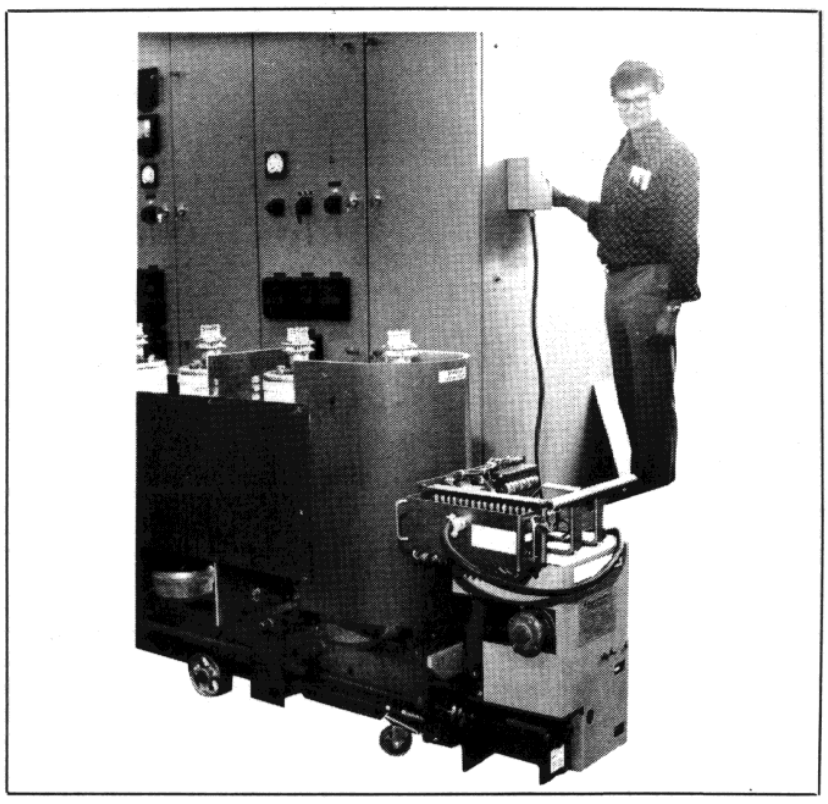


Figure 39. Testing Breaker Outside Unit with Test Cabinet

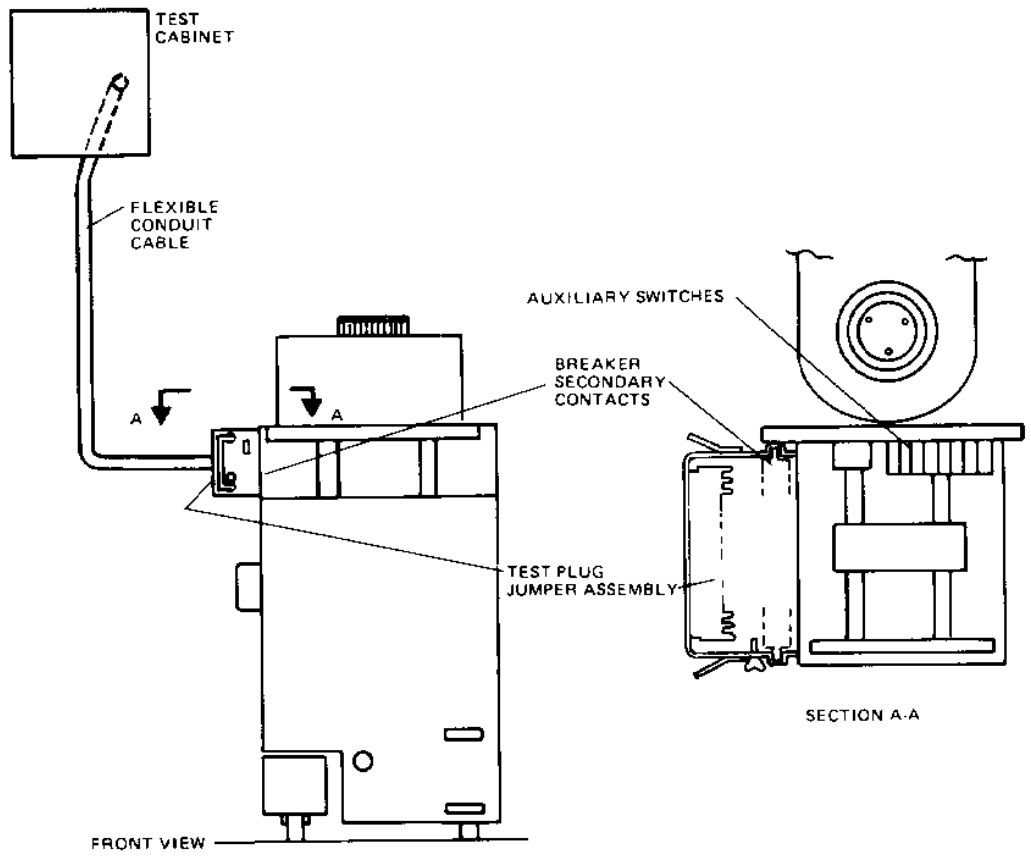


Figure 40. Connecting Breaker Secondary to Test Control Cabinet

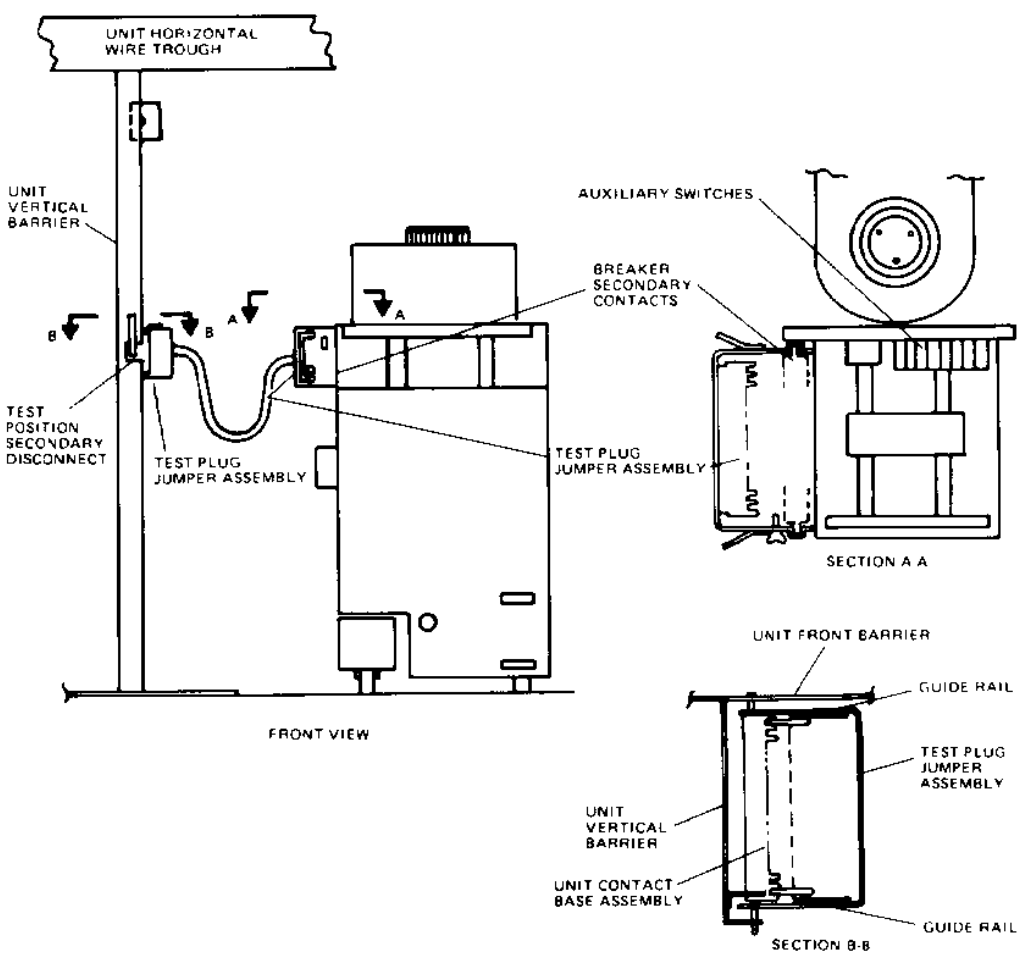


Figure 41. Connecting Breaker Secondary to Cubicle

ACCESSORIES

Ground And Test Device

A ground and test device (Fig. 42) is available for use in phasing out and potential testing of line and bus circuits. The device is furnished with six studs which terminate within the unit. Access to stud terminals is through insulating doors which are clearly marked to indicate stud position.

When this device is furnished, a special ground bar (see Fig. 35) is provided in the breaker cubicle to allow connection of ground ties for grounding dead bus of feeder circuits for maintenance protection.

Fig. 44 shows a ground and test device in the disconnected position while Fig. 45 shows the device in the connected position within a breaker cubicle.

Portable Racking Motor

A portable racking motor for elevating or lowering a breaker in its unit is also available. This motor can be supplied for either 120 VAC or 125 VDC operation at customer's option

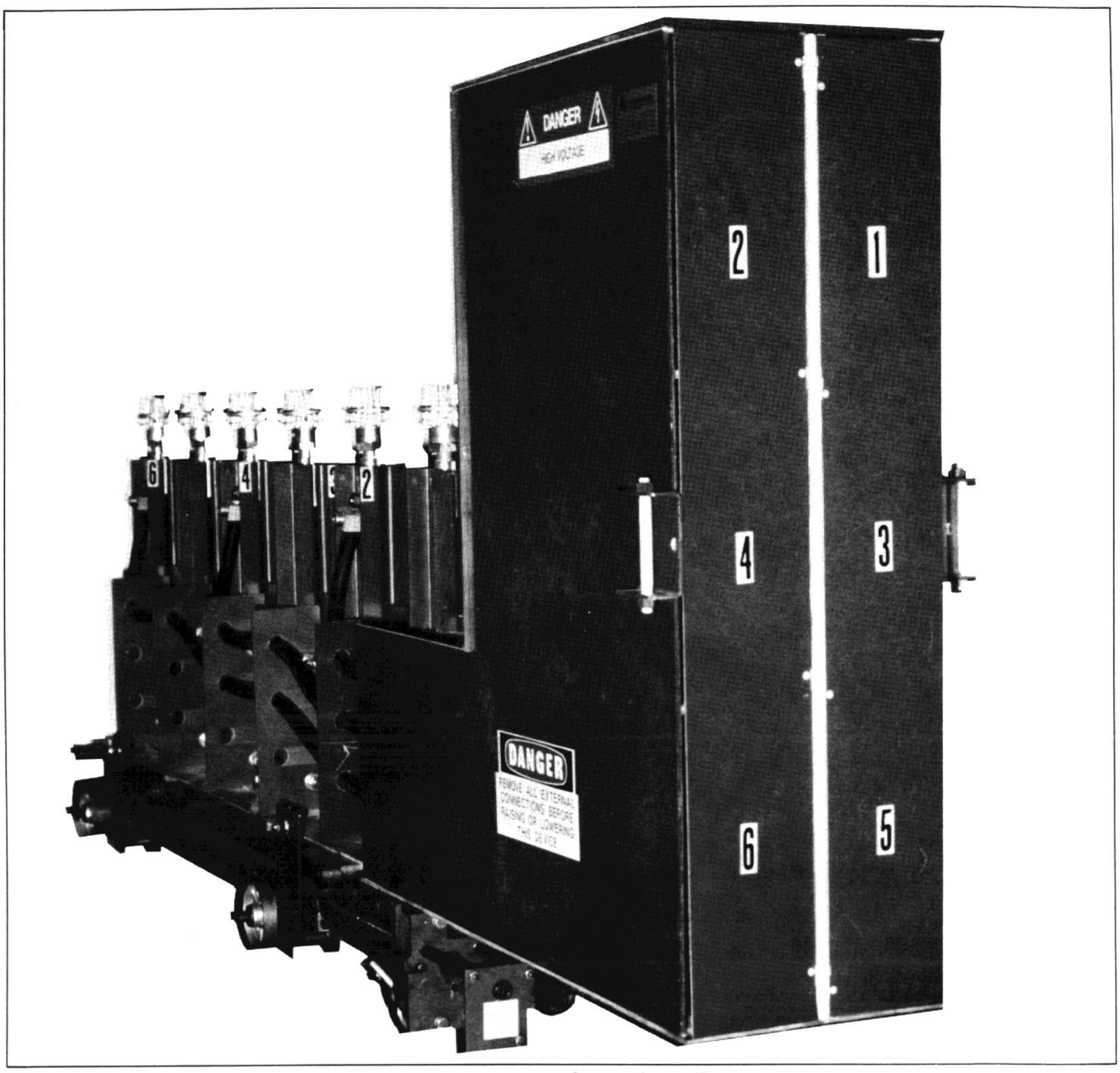


Figure 42. Typical 34.5 kV Ground and Test Device

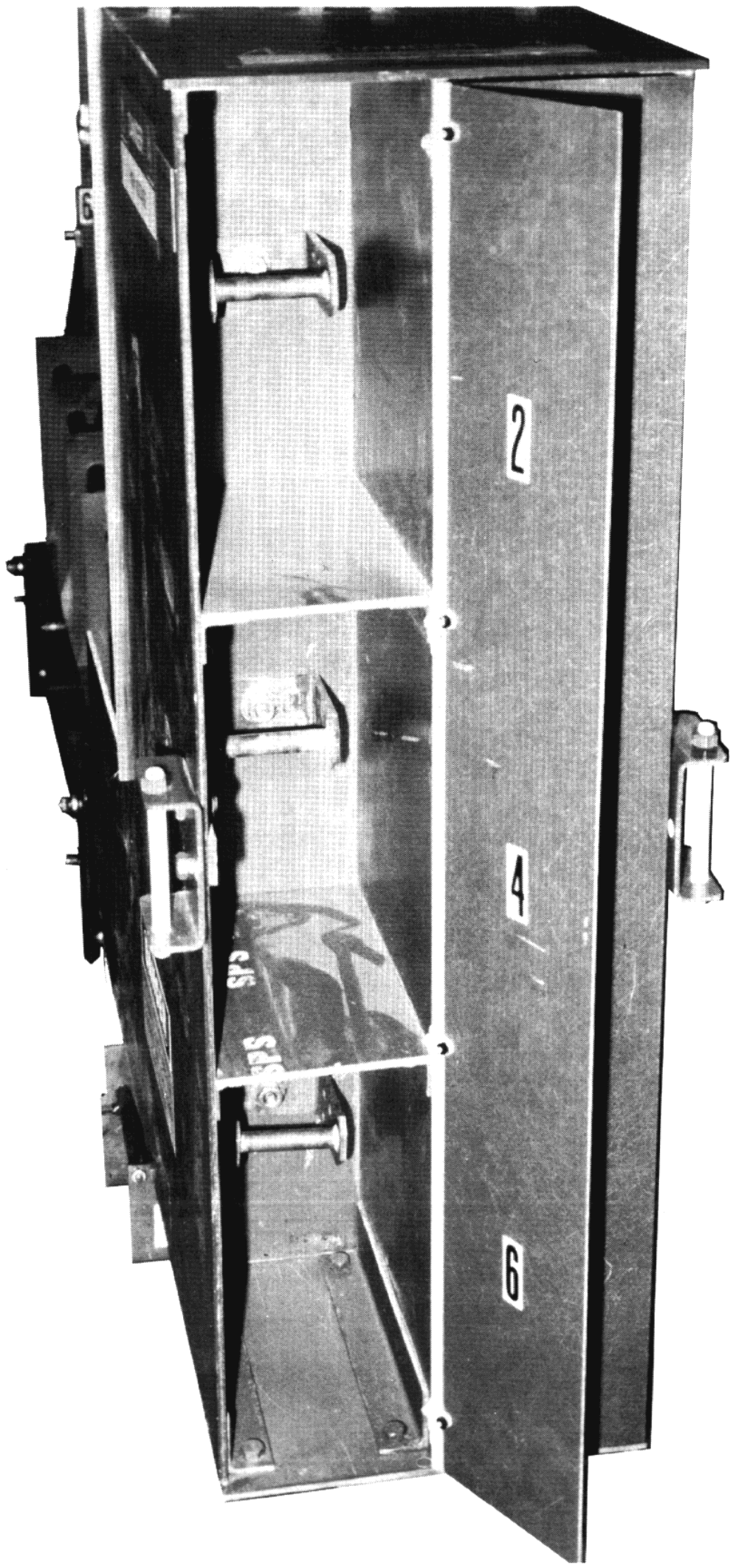


Figure 43. 34.5 kV Ground and Test Device with One Door Open to Show Ground Stirrups

ACCESSORIES

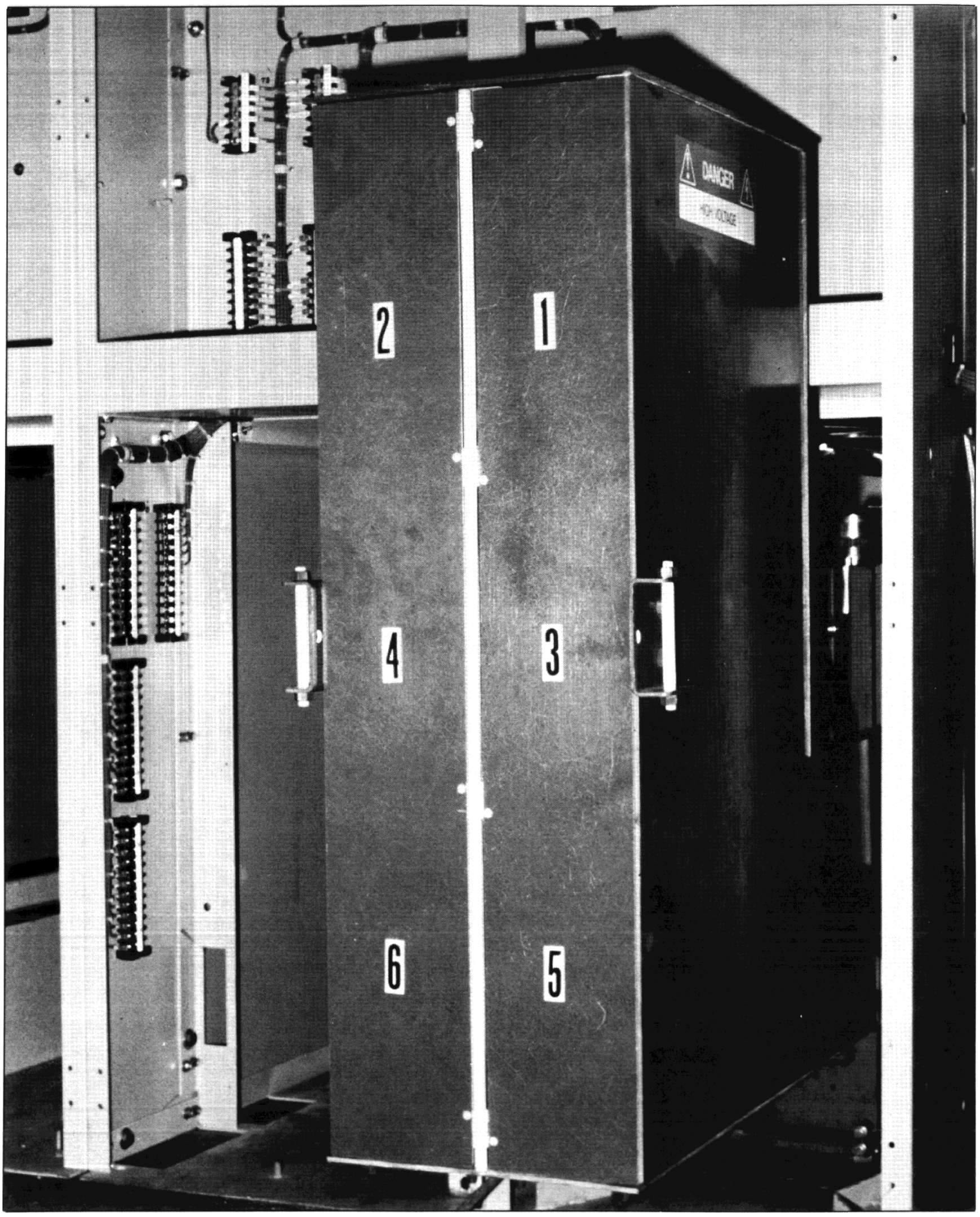


Figure 44. Ground and Test Device in Disconnect Position

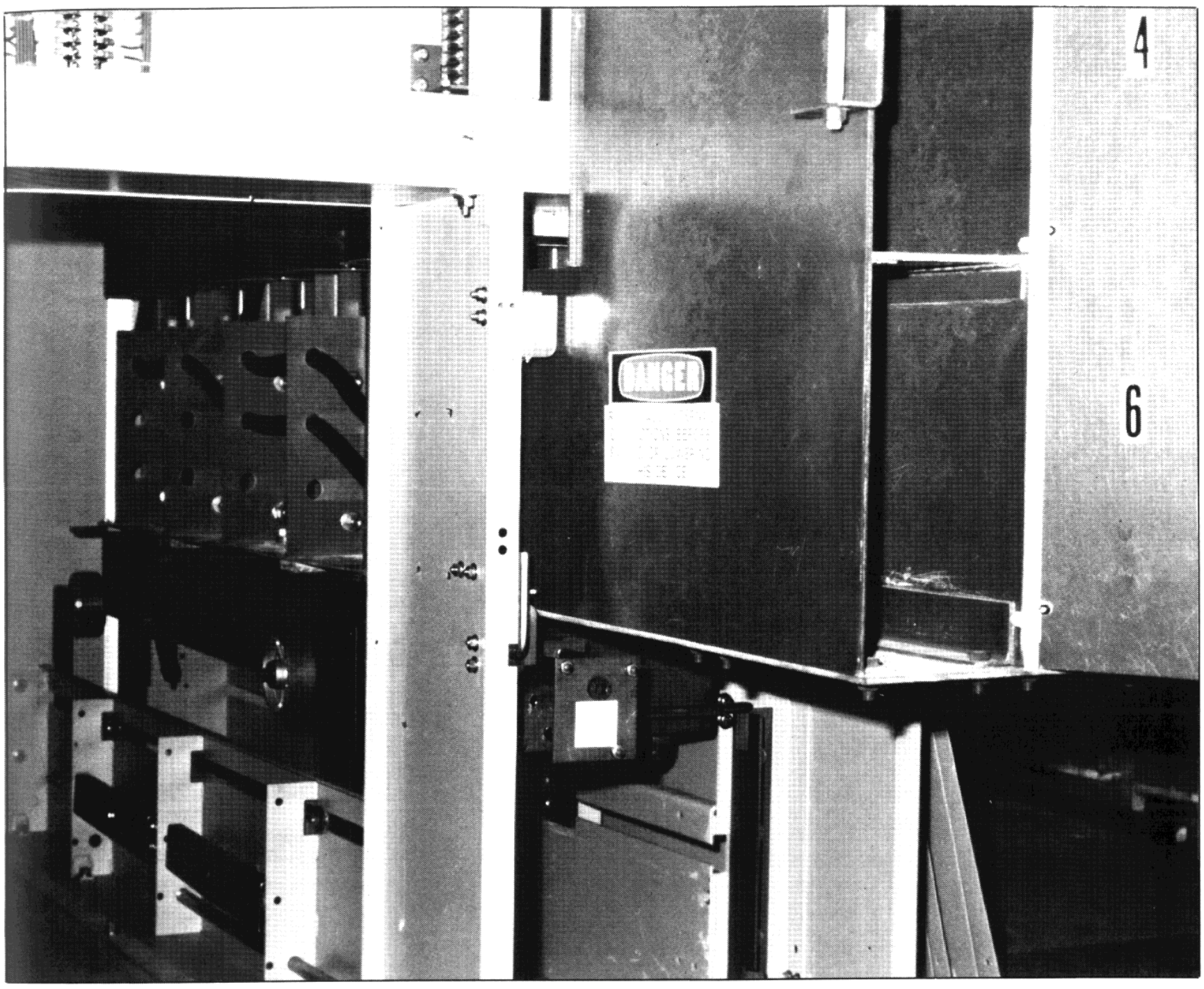


Figure 45. Ground and Test Device in Connected Position

SELECTED SWITCHGEAR BACKUP PARTS
HORIZONTAL DRAWOUT SWITCHGEAR
CUBICLES – 23 kV AND 34.5 kV

Description	Drawing Number	Quantity 1-4	Quantity 5+
Fuses - cont crt frn 2 1/4 125 V	00-871-145-00-231	04	08
Fuses - cont crt frn 6 1/4	00-871-145-00-249	04	08
Fuses - cont crt frn 8 230 V	00-871-145-00-253	04	08
Fuses - cont crt frn 3 2/10 125 V	00-871-145-00-237	04	08
Fuses - cont crt frn 12	00-871-145-00-259	04	08
Fuses - cont crt frn 20	00-871-145-00-265	04	08
Fuses - cont crt frn 5	00-871-145-00-245	04	08
Fuses - cont transf or pt 23 kV 0.5E	00-871-181-01-199	04	08
Fuses - cont transf or pt 23 kV 1E	00-871-181-01-201	04	08
Fuses - cont transf or pt 23 kV 2E	00-871-181-01-203	04	08
Fuses - cont transf or pt 23 kV 3E	00-871-181-01-205	04	08
Fuses - cont transf or pt 23 kV 5E	00-871-181-01-207	04	08
Fuses - cont transf or pt 23 kV 7E	00-871-181-01-209	04	08
Fuses - cont transf or pt 23 kV 10E	00-871-181-01-211	04	08
Fuses - cont transf or pt 23 kV 15E	00-871-181-01-213	04	08
Fuses - cont transf or pt 34.5 kV 1E	00-871-181-01-016	04	08
Fuses - cont transf or pt 34.5 kV 2E	00-871-181-01-018	04	08
Fuses - cont transf or pt 34.5 kV 3E	00-871-181-01-019	04	08
Fuses - cont transf or pt 34.5 kV 5E	00-871-181-01-020	04	08
Fuses - cont transf or pt 34.5 kV 7E	00-871-181-01-021	04	08
Fuses - cont transf or pt 34.5 kV 10E	00-871-181-01-022	04	08
Fuses - cont transf or pt 34.5 kV 15E	00-871-181-01-023	04	08
Fuses - secondary 3A 250 V	00-871-129-00-003	02	04
Fuses - secondary 6A 250 V	00-871-129-00-006	02	04
Fuses - secondary 30A 250 V	00-871-129-00-030	02	04
Indicating light assy - red	00-871-091-00-281	02	04
Indicating light assy - green	00-871-091-00-282	02	04
Indicating light assy - blue	00-871-091-00-283	02	04
Indicating light assy - clear	00-871-091-00-284	02	04
Indicating ligth assy - amber	00-871-091-00-285	02	04
Indicating light assy - white	00-871-091-00-286	02	04
Indicating light mtg assy w/resistor 240 V AC	18-393-217-501	02	04
Indicating light mtg assy w/resistor 125 V AC & DC	18-393-217-502	02	04
Indicating light mtg assy w/resistor 48 V DC	18-383-217-503	02	04
Space heater - 500 watt 240 V	18-193-359-00-501	02	04
Space heater - 500 watt 120 V	18-193-359-00-502	02	04
Space heater - 1000 watt 240 V	18-193-359-00-503	02	04
Thermo disk	00-873-827-00-105	02	04
Switchboard wire SIS No. 14	00-557-286-00-341	99 ft.	99 ft
Switchboard wire SIS No. 12	00-557-286-00-363	99 ft.	99 ft
Terminal block - 13 point	00-857-024-00-013	02	04
Touch-up spray paint lt gray ASA 61 (pint (470 mm) can)	18-168-000-00-001	01	02
Touch-up spray paint dk gray ASA 24 (pint (470 mm) can)	18-168-000-00-002	01	02
Touch-up spray paint sky gray ASA 70 (pint (470 mm) can)	18-168-000-00-003	01	02
Contact lube 8 oz. (.23 kg) tube	15-171-370-00-002	01	02
Spray lube for latches, etc. 16 oz. (.45 kg)	15-171-270-00-001	01	02

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ILLUSTRATION

INTRODUCTION

This instruction manual contains installation, operation and maintenance information for Type VV-1500 vacuum circuit breaker of the 34.5 kV class, with Type 515-4 V stored energy operator.

Warranty

The sales contract carries all information on warranty coverage.

Receiving

Circuit breakers are shipped from the factory completely assembled. Observe weight markings on crates and ensure that capable handling equipment is used.

Remove crating carefully with the correct tools. Check each item with the shipping manifest. If any shortage or damage is found, immediately call it to the attention of the local freight agent handling the shipment. Proper notation should be made by him on the freight bill. This prevents any controversy when claim is made, and facilitates adjustment.

When handling breaker (Fig. 1) with a crane or hoist, secure one sling around handle on front of breaker and other sling under bottom of truck frame at rear of breaker. Use a spreader to prevent truck frame distortion and/or damage to interrupters. Do not attach lifting hooks, rope, etc., to bushings, insulating parts, fittings, etc. Do not attempt to roll breaker off of shipping skid without using ramps provided for this purpose.

Storage

Indoor—The circuit breaker should be installed as soon as possible. If storage is necessary, breaker should be kept in a clean dry place where it will not be exposed to dirt, corrosive atmospheres or mechanical abuse.

Outdoor—Outdoor stoage of circuit breakers is not recommended. If breakers must be stored outdoors, they must be covered completely and a heat source provided to prevent condensation and subsequent corrosion.

Circuit Breaker Preparation

Prepare the circuit breaker for insertion into its cubicle as follows:

1. Remove crate and hardware securing breaker to shipping skid. Secure the unloading ramps provided to the skid and roll breaker off skid.

NOTE

Breaker is shipped in the closed position. DO NOT TRIP OPEN UNTIL STEP 5.

2. Remove the four bolts at the breaker frame which attach the glass polyester barrier assembly. Lift the barrier assembly vertically to clear the vacuum interrupter assemblies. See Fig. 47 & 47A.
3. Examine the vacuum interrupter tubes and supporting structure for any obvious evidence of shipping damage.
4. With breaker still in closed position observe the distances marked "A1" & "A2" in Figure 48. An average between "A1" & "A2" will produce distance "A" which represents the additional compression imparted to the contact pressure springs from the point where the interruptor contacts make, to the point where closing linkage has completely toggled. Distances "A1" & "A2" should be approximately 1/8 inch and should not require adjustment. Do not attempt to adjust these dimensions to be exactly 1/8 inch on each side as it is not required and could disturb other settings.

   Distance "A" also represents the maximum allowable erosion of approximately 1/8 inch of the interrupter contacts. As the contacts erode during the service life of the circuit breaker, distance "A" will become less. When distance "A" measures within .030 to .015 inches, the vacuum interrupter should be replaced. This distance should be checked at periods of routine maintenance and after periods of high short-circuit interruptions. The rate of erosion will vary with the service conditions. See "CONTACT EROSION," page 88.
5. Push manual trip button to open breaker (Fig. 60).
6. Wipe the outside of the interrupters and supporting insulating parts with a clean, dry cloth.

7. Hi-pot each individual vacuum interrupter while in the open position, to verify that damage has not occurred during shipment. The voltage should be raised gradually, and the contact gap should sustain 30 kV, 60 Hz ac for 1 minute, or 42 kV dc for 1 minute. If it does not, the interrupter is faulty and must be replaced. **Test each interrupter individually, not two in series.**

⚠ CAUTION

OBSERVE THE FOLLOWING ITEMS WHEN HI-POTTING THE VACUUM INTERRUPTERS.

- With respect to X-radiation: (No hazardous X-radiation is produced with closed contacts or with open contacts or with open contacts with rated operating voltage applied to them).
- Do not hi-pot the interrupters at voltages higher than listed.
- Test personnel should remain at least six feet away from the interrupter being tested.
- The circuit breaker current carrying parts on the interrupter may retain a static charge after the hi-pot test, so discharge with a grounded probe before handling.

8. Install plus jumper and energize control. (Spring charging motor will run to compress closing springs.) Refer to Switchgear Instruction Book 18X5847 for plug jumper installation instructions.
9. Close the circuit breaker electrically by using the control switch on the switchgear cubicle panel. Note that the motor will immediately run again, charging the closing springs.
10. Verify that the circuit breaker is closed and remains closed by checking the mechanical position indicator.
11. Trip the circuit breaker with the control switch.
12. Close the breaker by pulling on the manual close loop (72, Fig. 51).
13. Repeat the close and opening operations several times either manually or electrically observing that the following items are functioning properly:
    Operation Counter (6, Fig. 67)
    Open-Close Indicator (40, Fig. 60)
    Charge-Discharge Indicator (25, Fig. 60)
14. It is suggested that the opening and closing times be established for the breaker when new and periodically when routine maintenance is performed. The closing time should be within the range of .036 to .056 seconds, and the tripping time within .015 to .023 seconds.
15. De-energize control power and remove plug jumper. Close and trip breaker manually to discharge springs.
16. Coat movable primary and secondary disconnects with a film of S-A contact lubricant, 15-171-370-002.
17. Replace barrier assembly, centering with respect to interrupter assemblies. Note: Barrier assembly mounts on the side of the angles farthest from the operating mechanism (Fig. 47).

⚠ CAUTION

PUSH MANUAL TRIP BUTTON TO MAKE SURE BREAKER IS OPEN BEFORE ATTEMPTING TO INSERT BREAKER INTO CUBICLE.

18. Insert breaker into cubicle. Breaker must be aligned with cubicle rails by maneuvering in the aisle. It is recommended that a reference pivot point for the center wheels of the breaker be located on the aisle floor to facilitate alignment. The breaker cubicle has floor-mounted guide angles to funnel the front wheels into proper position and the front of the breaker has a fender plate to protect the barrier assembly while inserting.
19. Should interference occur as the breaker starts into the cubicle, check that the continuous current ratings of the breaker and cubicle are the same. An angle on the floor of the cubicle will interfere with insertion if the ratings are not the same.
20. The breaker must be pushed into the cubicle (see caution above) until the latch bar (LB, Fig. 71) engages the slot in the cubicle angle (CA, Fig. 71). Should the breaker stop before latch bar (LG, Fig. 71) engages, check to see that the breaker is in the open position. If not, manually trip open and push the breaker in.
21. Swing test block (TB, Fig. 70) clockwise until it maintains its position against the secondary disconnect (SD, Fig. 70).
22. Energize the control and test the close-open operation of the breaker. Observe the operation of the stationary mounted auxiliary switch (if one is provided). See Fig. 67.

23. Leave the breaker in the closed position. De-energize the control and disconnect the test block.

24. With the breaker closed, attempt to raise the breaker by inserting the racking crank (Fig. 70) and turn clockwise. It should not be possible to turn the crank, nor should the cranking effort trip the breaker.

25. Manually trip the breaker, and again turn the crank clockwise. This time the cranking effort will turn against the resistance of the racking screw clutch (Fig. 52) until the racking interlock is cammed out. Then the screw will turn and the breaker will start to rise.

    Note that the first one or two turns require extra torque to cam out the interlock.

26. Observe that the shutter moves and that the breaker disconnects clear the shutter.

27. After several turns in the clockwise direction, return the breaker to the disconnect position by turning the crank counterclockwise. When the breaker has reached the disconnect position, the trip free interlock bar snaps to the right and the cranking should be stopped.

28. Place a padlock hasp in hole shown in Fig. 57. Attempt to crank the breaker. It should not be possible.

29. Remove the padlock and slowly turn the racking crank clockwise until the trip free interlock has cammed to the left. Then place the padlock hasp in hole shown in Fig. 57. This will maintain the breaker in the trip free position. Check by repeating steps 21 and 22 above.

30. Remove the padlock, open the breaker, turn control power off, and with the line and bus de-energized, rack breaker into fully connected position. IF BUS OR LINE ARE ENERGIZED, GET CLEARANCE BEFORE BEGINNING THIS STEP.

31. Repeat Step 22.

32. Lock out kirk interlock (if provided) and check that the breaker remains trip-free.

33. Open the breaker and turn the racking crank counterclockwise to lower the breaker. At about the half way position, the breaker should **not** lower itself (negative crank effort). If the breaker tends to fall, the brake band spring (BBS, Fig. 50) should be tightened when the breaker has been removed from the cubicle. To make this adjustment see view "A" Fig. 50 and tighten cap screw 65, stopnut 59, spring 74 as required.

34. To remove the breaker from the cubicle, check that the control power is off, the test block disconnected and that the breaker has been manually closed and opened to remove any residual spring energy. If spring energy is not removed, operation of the breaker release lever will close the breaker. Push manual trip button to open breaker before attempting to pull breaker out of cubicle. Push breaker release lever (Fig. 54), to the right and pull on the breaker handle. If the breaker moves outward only a few inches, and seems to jam, push it in a short distance and again attempt to pull it outward. The swivel wheels at the operator end of the breaker may wedge on the guide funnel, but can be cleared by the above action.

CIRCUIT BREAKER DESCRIPTION

A typical circuit breaker consists of primary disconnects, vacuum interrupters, and operator sections (Fig. 47a). The primary disconnect section contains the main contacts which supply power to the load. The vacuum interrupters open and close the electrical system during normal and/or fault conditions. The operator section contains the mechanism which operates the drive bar used to close and open the main contacts. This mechanism consists of a stored energy operator with its associated linkages and control circuitry.

Tripping

The vacuum circuit breaker is tripped due to operation of the manual trip button (Fig. 60) or the trip solenoid (59, Fig. 51).

Interruption

When the circuit breaker is tripped while carrying current, the contacts within the vacuum interrupters part, and an arc is established. Due to the efficiency of the vacuum interrupter, the arc is normally interrupted at the first current zero.

Closing

The breaker is closed by the stored energy operator straightening a toggle in the four-bar linkage which forces the drive bar (36, Fig. 49) back, rotating the bell cranks (37, Fig. 49) upward, closing the breaker.

Stored Energy Operator

The stored energy operator (Fig. 51) uses charged springs to power the closing operation. A stored energy operator consists of three systems: spring charging drive, cam and ratchet assembly, and four bar toggle linkage (Fig. 63). These systems are disengaged from each other except while performing their specific functions. For example—the spring charging drive and cam-ratchet assembly are disengaged except when the cam-ratchet arrangement is being charged. Similarly, the cam-ratchet and four bar linkage are free of each other except during closing.

Stored energy operated breakers normally require a single commercial relay for control. This relay is furnished to match the control voltage.

Reclosing Control (Optional—For Reclosing Applications Only)

The trip latch check system provides the necessary control to perform the reclosing function when the switchgear is equipped with reclosing relays.

The system is comprised of three elements: a magnetic actuator (2, Fig. 64) a non-contacting magnetically operated hall effect switch (sensor) (1, Fig. 64), and a time (delay) module (Fig. 64). The system performs two distinct functions prior to enabling the reclosing operation.

1. It senses that the trip latch has returned to its reset position, and is ready to receive a reclosing operation.
2. Imposes a delay following latch reset to insure the linkage assembly has fully reset and then applies power to the spring release coil.

The non-contacting magnetically operated Hall Effect switch and magnet actuator combine to perform proximity detection of the trip latch tail. The speed of operation and life expectancy of this proximity sensor system is not limited by mechanical actuation as no physical contact between the actuating magnet and hall switch exists. The switch consists of a hall sensor, trigger, and amplifier integrated on a silicon chip. Its complete encapsulation isolates the device from environmental effects.

Auxiliary Switch

Mounted on the breaker, the auxiliary switch is normally used to open the trip circuit when the circuit breaker is opened. As this multi-stage switch operates from the breaker drive bar, circuitry dependent on the position of the breaker, such as indicator lights, etc., is wired through this switch. The individual stages are easily converted to "a" or "b" without disassembling the switch (Fig. 62).

Trip Solenoid

Normal electrical tripping (opening) is caused by the trip solenoid (59, Fig. 51) which is designated 52 TC on the schematic of Fig. 61. The trip solenoid is energized by operation of the circuit breaker control switch or the protective relays which are mounted on the switchgear.

CIRCUIT BREAKER OPERATION

Normal—Normal circuit breaker operation is controlled by cubicle mounted controls or other control devices. The closing springs of the stored energy operator will charge as soon as the breaker control is energized. Check the motor cutoff adjustment (Page 81) if springs do not charge.

Opening Breaker—Stored energy operated breakers can be tripped manually by depressing the trip button (Fig. 60) or electrically by energizing the trip circuit. This rotates the latch that allows the closing linkage to collapse and reset.

Closing Breaker—When the springs of the stored energy operator are fully charged, the breaker can be closed manually by pulling the manual close pull rod (72, Fig. 51), or electrically by energizing the closing circuit. This rotates the latch (15, Fig. 6) that allows the springs to close the breaker.

Stored Energy Operator—Description Of Operation

Spring Charging Cycle

Energization of the Breaker Control Circuit will cause the spring charging motor (20, Fig. 51) to start charging the closing springs (94, Fig. 51). The spring charging motor (20) will drive the driving pawl (DP, Fig. 51) through an eccentric drive shaft (14, Fig. 51). The driving pawl (DP) will turn the ratchet wheel (51, Fig. 51) counterclockwise one tooth at a time. The holding pawl (HP, Fig. 51) will hold the ratchet in position between driving strokes of the driving pawl (DP). This charging operation will continue turning the ratchet wheel (51) counterclockwise a tooth at a time until the closing springs (94) are fully charged (compressed) and dead center. The motor will drive the ratchet wheel past this dead center position and the closing springs (94) will aid rotation of the ratchet wheel and cams counterclockwise until spring release rollers (SRR, Fig. 51) on the inside surfaces of cams (52 & 53, Fig. 51) engage the closing latch (15, Fig. 51). This arrests the motion of the ratchet wheel (51) and the cams (52 & 53) and holds the operator in the fully charged position. As the cams and ratchet wheel go over center, the motor cutoff switch (10, Fig. 65) is actuated to de-energize the spring charging motor (20). The spring charging motor then coasts to a stop and driving pawl (DP) oscillates freely in the smooth toothless section of the ratchet wheel.

The motor cutoff switch (10, Fig. 65) has four functions:

1. It de-energizes the spring charging motor (20, Fig. 51).
2. It opens a contact in the anti-pump relay circuit.
3. It sets up the closing coil circuit.
4. It can be used to energize an indicating light to indicate that the closing springs (94, Fig. 51) are fully charged.

NOTE

The close latch check switch (CLCS, Fig. 51) is in the motor circuit. The close latch check switch monitors the position of the close latch (15) and will prevent charging of the closing springs (94) electrically unless the close latch (15) is in the correct position.

As energy is stored in the closing springs, the four bar linkage (54, Fig. 51) will be positioned by the linkage reset spring (LRS, Fig. 51) which acts to cause cam follower rollers (CFR, Fig. 51) to follow the surface of cams (52 & 53, Fig. 51) until the links are in a reset position, and allowing latch rollers (LR, Fig. 51) to be positioned in front of trip latch (16, Fig. 51).

The charging position of the operator is shown by an indicator (25, Fig. 59).

Reclosing Control (Optional—For Reclosing Applications Only)

The electronic solid state time delay module works in concert with the trip latch sensor system. The time delay module consists of an electronic timer and an electromagnetic relay. The diagram (Fig. 61) shows the timer module receiving power between terminals 1 and 3. Terminal 3 is connected to the common side of the closing control source. Terminal 1 is connected to the high side of the closing control source through auxiliary contact (52B) and the closing source contact "01/C".

The trip latch sensor system consists of the magnetic actuator (2, Fig. 64) and the Hall Effect switch (1, Fig. 64).

The time delay module is not energized until the closing springs are charged, the breaker is open and the closing source switch "01/C" is closed. When the latch resets at the instant "01/C" closes, the timer module's internal relay with normally open contact operates with no intentional delay (40 ms electro-mechanical delay) to connect the spring release solenoid through timer module terminal 2 to the high side of the closing source initiating the breakers closing sequence.

CIRCUIT BREAKER OPERATION

If the trip latch is not reset at the time the closing source is applied, the timer module will assume a delaying mode of operation. Upon latch reset a predetermined delay will be imposed before the timer's relay closes energizing the spring release solenoid. The complete trip latch check system is not affected by broad variation of closing source voltage. The time delay error caused by temperature extremes of – 40° C to 65° C is a minus 3% to plus 5%.

Breaker Closing Cycle

Energizing the closing solenoid (63, Fig. 51) will drive the close latch (15, Fig. 51) away from the spring release rollers (SRR, Fig. 51) on the cams (52 & 53, Fig. 51) releasing the stored energy in the closing springs (94, Fig. 51). The closing springs will drive the ratchet wheel (51, Fig. 51) and the cams counterclockwise at a high rate of speed. The cams will engage the cam follower rollers (CFR, Fig. 51) of the four bar linkage (54, Fig. 51) and drive them forward, causing the four bar linkage to become straight. As the four bar linkage becomes straight, it forces the drive bar (36, Fig. 49) back, causing the bell cranks (37, Fig. 49) to rotate while causing the breaker contacts to close and the opening springs

(16, Fig. 50) to be charged. The cams (52 & 53, Fig. 51) drive the four bar linkage (54) over toggle and against the frame, thereby latching the breaker contacts in the closed position.

Spring Recharge After Closing

When the closing cycle has been initiated and the cams (52 & 53, Fig. 51) begin to turn, the motor cutoff switch (MCS, Fig. 56) resets itself. A "b" auxiliary switch of the breaker opens, de-energizing the closing solenoid (63, Fig. 51). The close latch (15, Fig. 51) returns to its reset position and the close latch check switch (CLCS, Fig. 51) closes and energizes the spring charging motor (20). The closing springs (94) are then recharged as described earlier.

Tripping Cycle

Energizing the trip solenoid (59, Fig. 51) will drive the trip latch (16, Fig. 51) away from latch roller (LR, Fig. 51) on the four bar linkage (54, Fig. 51). This allows the four bar linkage to collapse and the breaker contacts will open. If the closing springs (94) are in the charged position, the linkage reset spring (LRS, Fig. 51) will immediately reset the four bar linkage (54). If the closing springs (94) are not charged, the linkage reset spring (LRS) will not reset the four bar linkage (54) until just before the closing springs (94) are completely charged.

Electrical Control

Schematic (Fig. 61)

The normal control for this operator is contained in a control panel (CP, Fig. 56) mounted on the right hand side of the operator. It consists of the motor cutoff switch (MCO, Fig. 56), anti-pumping relay (APR, Fig. 56), and the close latch check switch (CLCS, Fig. 56). The control arrangement schematic diagram is shown in Fig. 61.

Spring Charging

The spring charging motor power is supplied through circuits 3 and 4, Fig. 61. The close latch check switch is closed when the close latch (15, Fig. 51) is in the reset position. The MCO switch contacts are shown with the closing springs discharged. When the control is energized, the motor starts to charge the springs. The MCO switch is operated by roll pin striker (RPS, Fig. 51) mounted in the ratchet wheel. As the ratchet wheel and drive blocks (RW & DB, Fig. 56) charge the springs, the ratchet wheel revolves to the position of full compression, dead center. Beyond dead center position, the springs aid rotation and cause the roll pin striker (37, Fig. 65) to depress the actuator (35, Fig. 65) of the MCO switch, opening the motor circuit and the MCO contact in the anti-pumping relay circuit. The spring charging motor coasts to a stop with the driving pawl (DP, Fig. 51) oscillating freely on the smooth portion of the ratchet wheel.

CIRCUIT BREAKER OPERATION

Closing

The standard control schematic for the stored energy operator is shown in Fig. 61. When the close control switch is closed, the circuit from wire 7 through MCO and 52/ to 52b to wire 6 energizes the closing coil, closing the breaker. When reclosing relays are used, the circuit is from wire 7 through MCO and 52Y to 52b through trip latch delay module (timer-TLT) energizing the closing coil, closing the breaker.

As soon as the closing springs are discharged, the MCO switch contact closes to energize the 52Y relay. If the close control switch remains closed, the 52Y relay remains picked up through contact 52Y. The control switch must be released to reset control for another closing operation. This forms the anti-pumping relay circuit which prevents the circuit breaker from reclosing immediately after a trip free operation. If control power is momentarily lost during closing, upon re-energization, the 52Y relay picks up instantaneously through contact MCO maintaining the anti-pumping relay circuit prior to complete spring charging.

Close Latch—Mechanical and Electrical Interlocks

The close latch (15, Fig. 51) must be fully reset to receive the cam mounted spring release rollers at the end of the charging cycle. To insure the close latch is in this fully reset position, an electrical and mechanical interlock is provided.

The close latch check switch (CLCS, Fig. 51) consists of a snap-action type switch mounted in close proximity to the close latch. A striker plate at the tail of the close latch engages the switch's actuator slightly before the fully reset position is achieved and actuates the switch prior to the latch's reaching the fully reset position. At the time of actuation, a contact closes, initiating the charging sequence. The switch operates with very small differential. This sensitivity, coupled with the close latch biased engagement of the spring release rollers, provides a positive sensitive interlock.

The mechanical interlock (Fig. 68) prevents charging of the closing springs if the close latch is not adequately reset. A linkage attached by a clevis to the close latch, extends across the upper portion of the operator on right hand side to the driving pawl mechanism. An extension of the interlock linkage passes above the driving pawl constant force return spring. If the close latch fails to return to a fully reset position, the linkage extension thrusts the driving pawl's return spring outward, preventing the driving pawl's engagement of the ratchet wheel, thus mechanically inhibiting either manual or electrical spring charging.

Racking interlock: (Fig. 57 & 58) Prevents racking the breaker up or down and removal or full insertion into cubicle if breaker is closed. The racking interlock is actuated by the cubicle angle (Fig. 71) or by a cam (Fig. 53) on the clutch assembly which cams against the cam roller on the interlock. When the breaker is open the drive bar (Fig. 56) is in the raised position and the racking interlock is permitted to slide from right to left without interference. When the breaker is closed the drive bar is in the down position and the racking interlock is prevented from sliding from right to left by the stop block (Fig. 57) which cannot pass under the drive bar (Fig. 56). When the stop block hits the drive bar preventing the interlock from sliding the breaker cannot be racked up or down because the cam on the clutch assembly cannot push the cam roller on the interlock out to clear the cam. Since the interlock cannot slide it also prevents the breaker from going into the cubicle past the cubicle angle (Fig. 71): If it is possible to turn the racking crank far enough to trip a closed breaker, the stud (Fig. 67a) is out of adjustment. Check the dimension .38 ± 1/32 inch (Fig. 67a) and adjust if required. Also, check the roll pin (Fig. 67a) to make sure it is set at .50 ± 1/32 inch as shown.

Spring discharge interlock: (Fig. 57) Prevents breaker from going fully into the cubicle or from being withdrawn from the cubicle with the closing springs charged. This interlock is actuated by spring release lever (Fig. 54) or by cubicle mounted angle. (Fig. 71). When the interlock is actuated it pushes close latch (Fig. 51, item 15) away from spring release roller (Fig. 6, item SRR) allowing springs to discharge.

ADJUSTMENTS

Adjustments are factory set and checked before and after numerous mechanical operations on every breaker to insure correctness. No adjustment checking should be necessary on new breakers. If a malfunction occurs, check for hidden shipping damage.

The following will help make proper installation and adjustment when replacing a broken or worn part.

Circuit Breaker Timing

A comparison of circuit breaker timing at any period of maintenance with that taken when the breaker was new will indicate the operational condition of the breaker mechanism. The normal closing and tripping tolerances are given in item 14 on page 80. If operation exceeds these tolerances, investigation to determine the cause should be initiated.

Auxiliary Switch (Cubicle Mounted—Optional Equipment)

The auxiliary switch actuating rod on breaker (Fig. 67) operates the cubicle mounted auxiliary switch (when furnished) by rotating the drive tubes (Fig. 67). Actuating rod adjustment is covered in Fig. 67.

Auxiliary Switch (Breaker Mounted)

The Type Q-10 auxiliary switch (Fig. 62) is designed so that the individual contacts may be positioned in fifteen degree steps without disassembling the switch.

Using long-nosed pliers, move the rotor contact (16) in the slot of the shell (14), compressing spring (15). This will free the rotor from the retainer (17). Rotate the rotor to the desired position and release. Be sure the rotor springs solidly back against the retainer to fully engage the rotor and retainer teeth.

Racking Interlock Adjustment (Fig. 72)

In down position (view #1, Fig. 72) adjust collar "A" so that point "B" is flush with back plate when roll pin is 0.12 to 0.19 inches from positive stop angle (item 18).

In up position (view #2, Fig. 72) adjust collar "C" so that point "D" is 0.31 inches beyond backplate when ball nut is 0.12 to 0.19 inches from clamp collar. Adjust collar "E" to compress spring 0.25 to 0.38 inches.

TRIP LATCH ADJUSTMENTS

Trip Latch Clearance—To change clearance between trip latch and trip latch rollers, see Fig. 63. Breaker must be open with springs discharged, then loosen "Lower Link Stop" (Fig. 63) and rotate to permit maximum "Lower Trip Link" movement. Adjust all locknuts (20, Fig. 48) on new interrupters only until a 0.030 to 0.060 inch gap appears between the trip latch and latch roller. Rotate lower link stop until it touches lower link and lock in place.

Any adjustment to locknuts (20, Fig. 48) will affect the "B" dimension (Fig. 48).

Important: On new interrupters only (not interrupters which have been in service) the "B" dimension must be 0.675 ± 0.030 inches which should automatically produce a trip latch clearance of 0.030 to 0.060 inches (Fig. 63).

DO NOT ADJUST LOCKNUTS (20, Fig. 48) **on any interrupter which has been in service.**

Trip Latch Bite—Trip latch bite is established by setting the latch tail top surface 0.531 inches below bottom surface of solenoid mounting plate (Fig. 64). Lock securely with jam nut. One turn of adjusting screw will alter the gap
0.062 inches. This setting will produce a latch bite of approximately 1/8–1/4 inch as shown in Fig. 64.

Trip Latch Check Sensor Adjustments (Fig. 64)

This adjustment is to be completed only after establishing the "bite" adjustment described above.

The magnetically operated hall effect switch (sensor) and actuating magnet are to be assembled to the operator. After installation, the unit is to be adjusted by advancing the threaded bushing (1, Fig. 64) through the tapped hole in mounting plate until a gap of .040–.000 + .015 inches is achieved between the surface of the switch and the top of the shrink tubing, holding the magnet actuator (2, Fig. 64) assembly to the trip latch tail. With this gap achieved, the sensor may be locked in place. **Important:** Torque limit on item 1, Fig. 64 is 60 in. lb.

Functional electrical test on breaker may be made to confirm sensor's operation. The timing module's nameplate and rated voltage should be checked to insure it matches breaker closing control voltage. The timer's delay adjustment has been previously set and **should not be altered.** Remove wire from terminal 2 on timer module and insulate. Open breaker and charge closing springs.

Apply closing voltage and observe light emitting diode (led) adjacent to delay adjustment. The led should be brightly illuminated when the trip latch is fully reset. Depress latch with manual trip lever and observe the led goes out. Release trip lever and the led should come on. This sequence confirms sensor's operation. Do not apply closing control voltage for longer than two minutes while performing this test.

Manual Charging Of Closing Springs

To charge the closing springs manually, disconnect control power before inserting the manual charging crank in the socket located on R.H. side of operator cover (Fig. 58). Turn the crank in a counterclockwise direction to charge the springs.

⚠ CAUTION

MAINTAIN A FIRM GRIP ON CRANK
The closing springs are charged through the driving pawl and ratchet wheel and are thereby indexed by the holding pawl. Some springback can occur between tooth positions on the ratchet wheel.

The effort to charge the closing springs will fluctuate and will increase to a peak and then decrease. At the point of least effort an audible click will be heard and the effort to turn the crank will drop to near zero. The mechanism is now fully charged. Remove manual charging crank. The breaker may be closed by pulling the manual close pull rod
(72, Fig. 51).

Removal Of Closing Springs

The closing springs may be quickly and safely removed from the breaker. Remove two of the four bolts holding the spring bearing block at the top of the operator (Fig. 54). These bolts should be removed diagonally opposite each other. Insert studs approximately six inches long in place of bolts. Remove the remaining two bolts by shifting the spring load to the six inch long studs. The spring bearing block can then be backed off the studs. To install the closing springs, the reverse procedure should be used. The spring bearing block top surface should be even with the bracket of the frame. The four bolts should be torqued to 50 ft. lbs. **IMPORTANT: Be sure to maintain alignment of backplate (Fig. 54) vertically when replacing spring bearing block. It is also important that the spring release lever mounting bracket be squared with backplate to avoid having release lever hit the closing spring tube.**

If the charging ratchet and cams are to be revolved with springs removed, it is advisable to remove two **aluminum spring drive blocks** (DB, Fig. 56) secured to the ratchet and cam crankpins by retaining rings. If not removed or held essentially in a vertical position, these drive blocks may jam while revolving the cam and ratchet assembly.

MAINTENANCE

General

Thorough, periodic inspection is important to satisfactory operation. Inspection and maintenance frequency depends on installation, site, weather and atmospheric conditions, experience of operating personnel and special operation requirements. Because of this, a well-planned and effective maintenance program depends largely on experience and practice.

Prior to performing any maintenace work, make certain all control circuits are open, and that the braker has been completely withdrawn from the metal-clad unit.

⚠ SAFETY WARNING

BEFORE ANY MAINTENANCE WORK IS PERFORMED, MAKE CERTAIN THAT ALL CONTROL CIRCUITS ARE OPENED AND THAT THE BREAKER IS REMOVED FROM THE SWITCHGEAR UNIT. DO NOT WORK ON THE BREAKER OR MECHANISM WHILE IN THE CLOSED POSITION UNLESS THE BREAKER HAS BEEN LOCKED CLOSED PER FIG. 50, NOTE = 1 TO PREVENT ACCIDENTAL TRIPPING. DO NOT WORK ON THE BREAKER OR MECHANISM WHILE THE CLOSING SPRINGS ARE CHARGED.

Always inspect a breaker which has interrupted heavy fault current.

All current carrying joints should be inspected to be sure all contact surfaces are free of protrusions or sharp plane changes.

Contact Erosion ("A" = Average Between "A1" & "A2")

A visual check of distances "A1" & "A2" (Fig. 48) with breaker closed will indicate the contact erosion. When distance "A" approaches .030 to .015 inches, the interrupter assembly should be replaced. This distance should be established by measuring both "A1" & "A2" then take an average. This will compensate for any minor tilt in the retaining plate (It. 5). The best measure of erosion rates is to look at the change in the "A" dimension over a series of time-separated intervals. Note: If at any given point the "A" dimension seems to have grown, it may be due to an irregular contact surface. An open-close operation and remeasurement will probably give a different dimension. **Intermediate adjustment is not recommended.**

INTERRUPTER-VACUUM

⚠ CAUTION

OBSERVE THE FOLLOWING ITEMS WHEN HI-POTTING THE VACUUM INTERRUPTERS.

- With respect to X-radiation: (No hazardous X-radiation is produced with closed contacts or with open contacts or with open contacts with rated operating voltage applied to them).
- Do not hi-pot the interrupters at voltages higher than listed.
- Test personnel should remain at least six feet away from the interrupter being tested.
- The circuit breaker current carrying parts on the interrupter may retain a static charge after the hi-pot test, so discharge with a grounded probe before handling.

"A Hi-Pot Test should be applied to the open interrupter contacts of each individual interrupter on each phase. The voltage should be raised gradually, and the contact gap should sustain 30KV 60 Hz A.C. for one minute. Each interrupter in each phase should be so tested and sustain this voltage. Testing with D.C. potentials is not recommended. However, if only D.C. equipment is available the test may be conducted to a level of 42KV provided no attempt is made to compare the condition of one vacuum interrupter to another on the basis of differing D.C. currents. These currents are primarily caused by emission from the tubes internal contacts and do not indicate a loss of dielectric integrity."

Opening and Closing Time:

Closing time range .036 to .056 seconds
Opening time range .015 to .023 seconds

Mounting and adjusting hardware should be checked for tightness. Elastic stop nuts (15, Fig. 48) should not be turned, as indicated by the "Note".

Interrupter Replacement

Replacement interrupters are furnished only as complete assemblies as shown in Fig. 48. This eliminates the need for special field assembly fixtures and avoids the risk of inadvertent damage to the vacuum interrupter bellows by field assembly.

IMPORTANT

Remove only one complete phase assembly at a time. This leaves the two remaining phases intact and they will serve as the reference required to realign the one phase being replaced. See Fig. 49.

This procedure will also help to minimize chances of damaging interrupter assemblies by accidentally bumping them together.

Following is a step-by-step procedure for removing and replacing the interrupter assembly.

1. Move breaker to a level floor area.
2. Remove barrier assembly to expose the interrupter assemblies. Refer to item 2 page 79 also Fig. 47a.
3. With breaker in the open state, insert racking crank and rotate clockwise. This will drive the racking arms (8, Fig. 50) to the full vertical position. The breaker has now been elevated off the wheels and will be more stable when working on the breaker.
4. Close the breaker. When closed insert a 3/8"–16 x 12" long threaded rod through opening spring as shown for Note #1, Fig. 50. Screw the threaded rod into opening spring guide (34, Fig. 50) tightly. Run locknut up tight against opening spring holder (35, Fig. 50). **Breaker is now locked firmly in the closed position so that it cannot be accidentally tripped open.**
5. Loosen locknuts (23 R.H. & 24 L.H., Fig. 48).
6. Loosen the four hex head cap screws (99, Fig. 49) alternating diagonally so as to relax spring pressure evenly as screws are loosened.

NOTE

It is recommended that a second person hold the interrupter assembly when these cap screws are removed.

7. With second person holding the interrupter assembly steady, back out both adjusting screws (9, Fig. 48) simultaneously by turning clockwise as viewed from top of breaker. This will release adjusting screws from base of connecting rod (Fig. 48) and pivot block (38, Fig. 49). The complete interrupter assembly is now free and can be carefully set aside. Replace the adjusting screws in the pivot block (fine thread end) about two or three turns counterclockwise.
8. To replace this assembly, have second person hold the assembly in position so that adjusting screw (9, Fig. 48) can be started into the base of the insulator simultaneously by turning counterclockwise. The adjusting screws should be turned evenly so as to maintain approximately the same penetration into both pivot blocks as well as into the insulators. This will aid in making final gap adjustment, "A", Fig. 48.
9. When adjusting screws have been well started into pivot blocks and insulators, replace the four cap screws and lockwashers (99 & 103, Fig. 49). Making sure that assembly is located on 13 inch center line (Fig. 49) and in line with the other disconnects (Fig. 49). Tighten to 96–136 foot pounds.
10. Turn adjusting screw counterclockwise until either the "A1" or "A2" dimension (Fig. 48) is approximately 1/8 inch. It is not necessary to measure this dimension on both sides of a single tube assembly as there may be a slight difference between them. Do not change the factory settings of the elastic stop nuts (15, Fig. 48). All adjusting to get the 1/8 inch dimension on either side of a single interrupter tube must be done with adjusting screw (9, Fig. 48) only. Now repeat this procedure on the other interrupter of this phase. After the 1/8 inch dimension is obtained, hold adjusting screw tight and secure firmly with the upper and lower locknuts (23 & 24, Fig. 48).
11. Mount adapters for primary contact finger assemblies. For 2000 amp and 3000 amp contact adapters, loosen the socket head locking screw on side of adapter before threading onto the stud on top of interrupters. Coat stud with copper plate grease Part #15-171-455-001. Thread adapter onto stud and run down to base of stud without forcing. Refer to Note #1, Fig. 4 for adapter height adjustment. Be sure to lock firmly in place after adjustment.

    For adapter assembly on 1200 amp unit, coat stud with copper plate grease Part #15-1171-455-001 (Kopr-Shield, Thomas & Betts Cat. No. CP-16). Torque requirements (90 to 110 ft. pounds).

When spanner wrench 15-171-797-001 and adapter wrench 18-657-902-313 are furnished, the customer is expected to provide a torque wrench (1/2 inch drive with foot pound scale). He will have to modify his dial to accommodate the increased extension of the adapter wrench. The modified dial reading may be calculated using the following expression:

$$D_M = 100 \frac{L}{6+L} \text{ foot pounds}$$

D_M = modified dial reading (foot pounds).

L = active extension of customers torque wrench (inches).

12. Remove the 3/8 inch rod installed in Step 42. Trip breaker to open. Insert racking crank and turn counterclockwise to lower breaker to its wheels. Continue cranking until racking arms return to position for inserting into cubicle.
13. Hi-pot the vacuum interrupters.

	⚠ CAUTION
	Do not hi-pot interrupters with open gaps adjusted to values less than 0.05 inch.

14. Verify the opening and closing times.
15. Replace barrier assembly and bolt in place.

	⚠ CAUTION
	Be sure primary disconnect fingers have been installed before inserting into cubicle.

Mechanism—Stored Energy Operator

The circuit breaker mechanism should be inspected and lubricated at 1000 operation intervals. This inspection should check for loose hardware and any broken parts. The control wiring should be checked for loose connections and frayed or damaged insulation. The "close latch check switch" should be checked for mounting tightness. The satisfactory operation of the switch should be assured with a continuity meter and manual manipulation of the switch, and adjusted if necessary.

After 5,000 operations, the operating mechanism should be given a general overhaul and all worn parts replaced. Excessive wear will usually be indicated when adjustments can no longer be satisfactorily made. The general overhaul will require disassembly of the operating mechanism. All bearings and surfaces receiving wear should be examined carefully and relubricated in accordance with lubrication instructions, Figs. 73 and 75.

Closing Spring Removal

The removal of closing springs will be necessary in order to permit general overhaul of the breaker. These springs may be removed as described on Page 86.

Lubrication

NOTE

The contact lubricant supplied with the accessories is intended to be used exclusively on the exposed contacts and must not be used on any part of the circuit breaker mechanism.

Recommended circuit breaker lubrication points are shown in Fig. 73 and 74. The chart (Fig. 75) outlines two methods of lubrication. Refer to this chart for recommended lubricant and points of application. The first method requires no disassembly and is suggested for the prevention of problems which could be created by severe environmental or operating conditions.

The second method follows procedure similar to that performed on the breaker at the factory. Follow this procedure only in case of a general overhaul or disassembly.

It is important that auxiliary switch contacts (16, Fig. 62) are cleaned and lubricated with S-A electrical contact lubricant every 1000 operations.

Method For Cleaning Bearings

Needle and roller bearings are factory lubricated for life and should not require attention. However, the best of greases are affected by time and atmospheric conditions and may require service.

To lubricate these bearings when parts are disassembled, the following procedure is recommended. Clean in solvent, wash in alcohol, spin in light machine oil, drain and repack with Beacon P-325 grease.

DO NOT REMOVE NEEDLE BEARINGS FROM THE RETAINING PART

NOTE

Ball screw of racking mechanism must not be removed from ball nut. Brake-bearing must have Torrington name visible away from backplate.

HANDLING INSTRUCTIONS

- Move breaker to installation location with fork lift or crane.
- Carefully remove protective plastic cover and crate.
- Remove ramp pieces nailed to the pallet.
- Remove hold down bolts located on each side of breaker.
- Place ramp pieces in front of the pallet in line with breaker wheels and nail to pallet as shown.
- Slowly roll breaker off pallet.

	⚠ CAUTION
	BREAKERS ARE SHIPPED IN CLOSED POSITION.

HANDLING INSTRUCTIONS

- Move breaker to installation location with fork lift or crane.
- Carefully remove protective plastic cover and crate.
- Remove ramp pieces nailed to the pallet.
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- Slowly roll breaker off pallet.

	⚠ CAUTION
	BREAKERS ARE SHIPPED IN CLOSED POSITION.

CAUTION—BREAKERS ARE SHIPPED IN CLOSED POSITION.

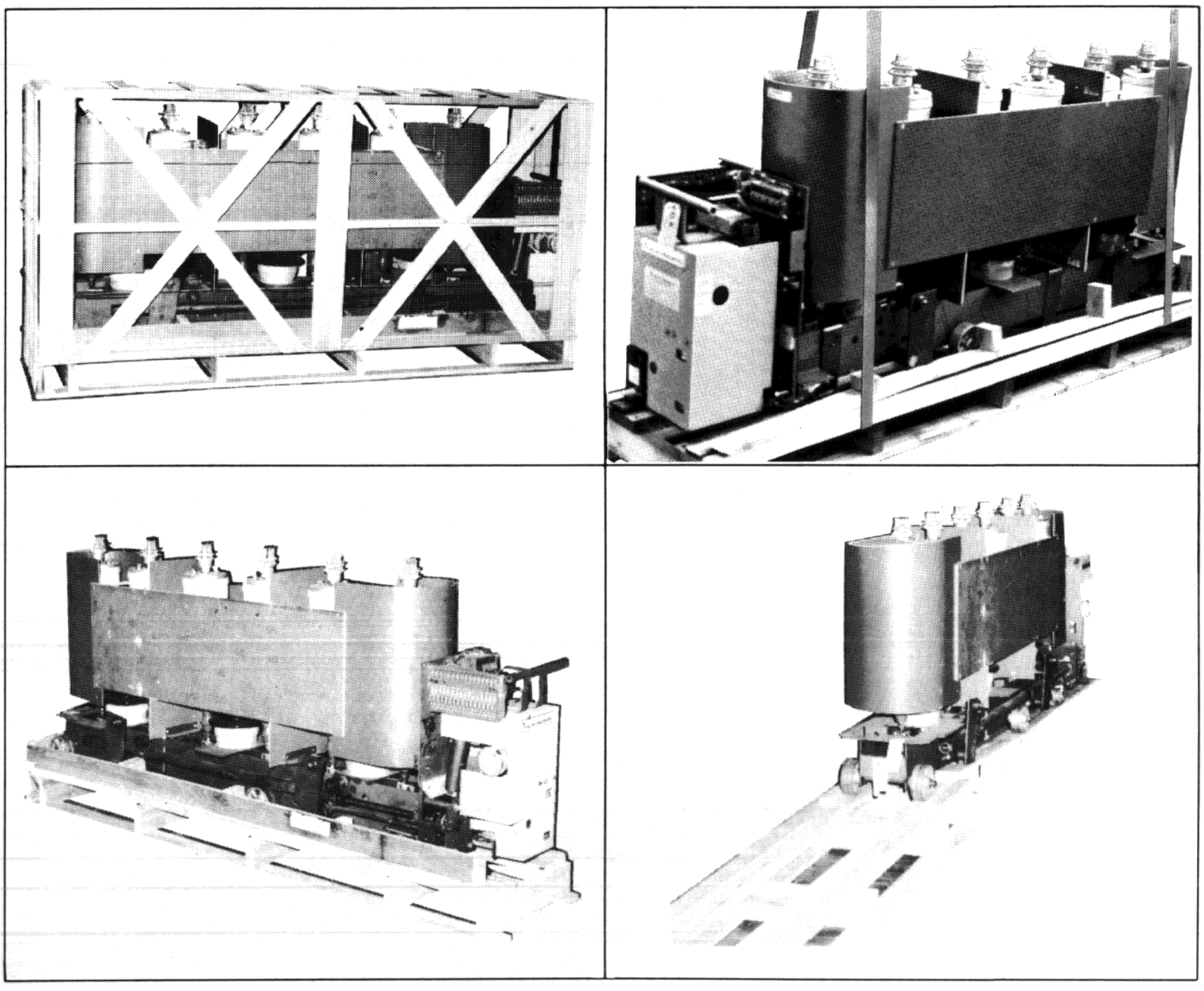


Figure 46.–Handling Instructions

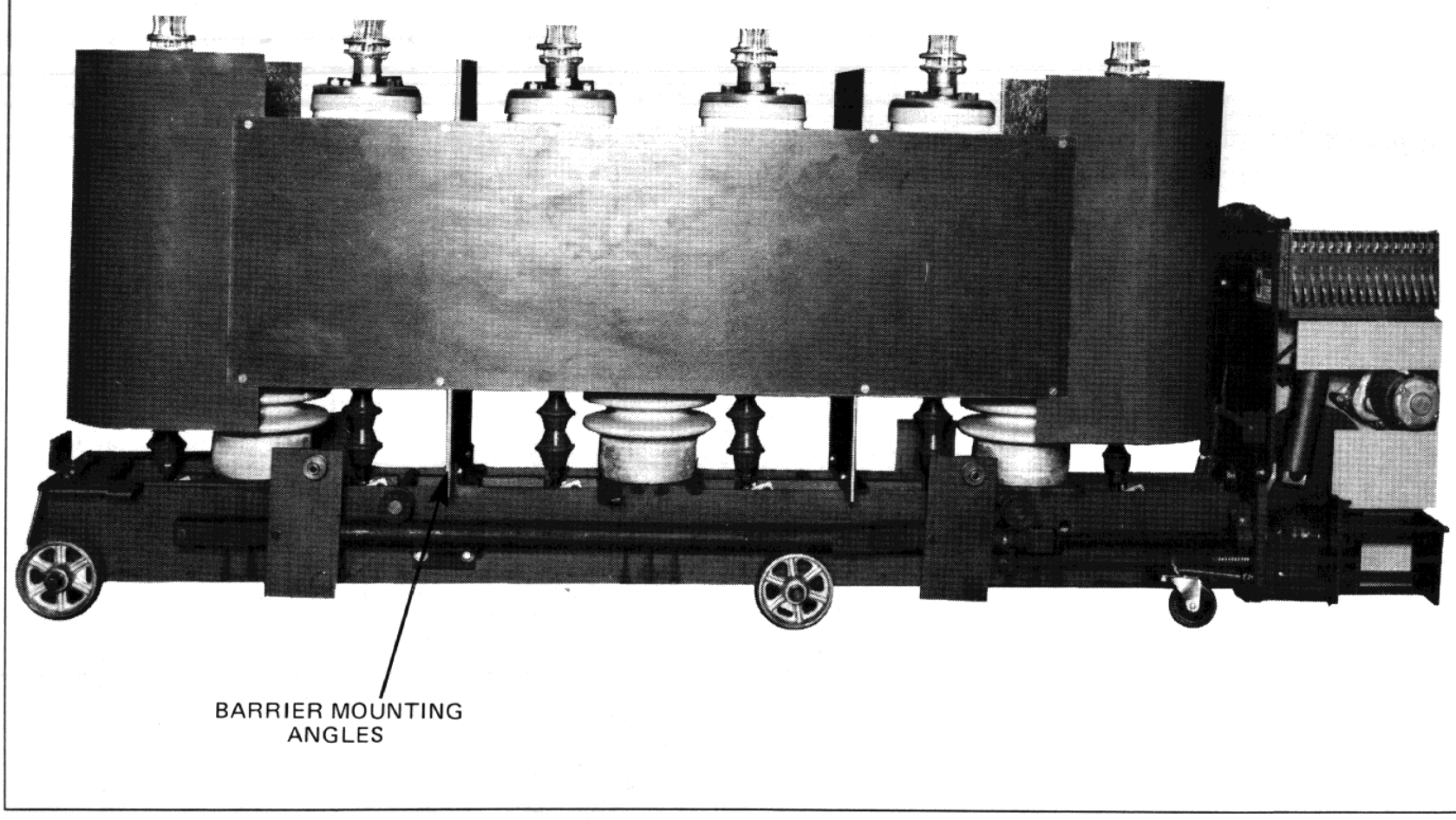


Figure 47–VV1500 Vacuum Circuit Breaker

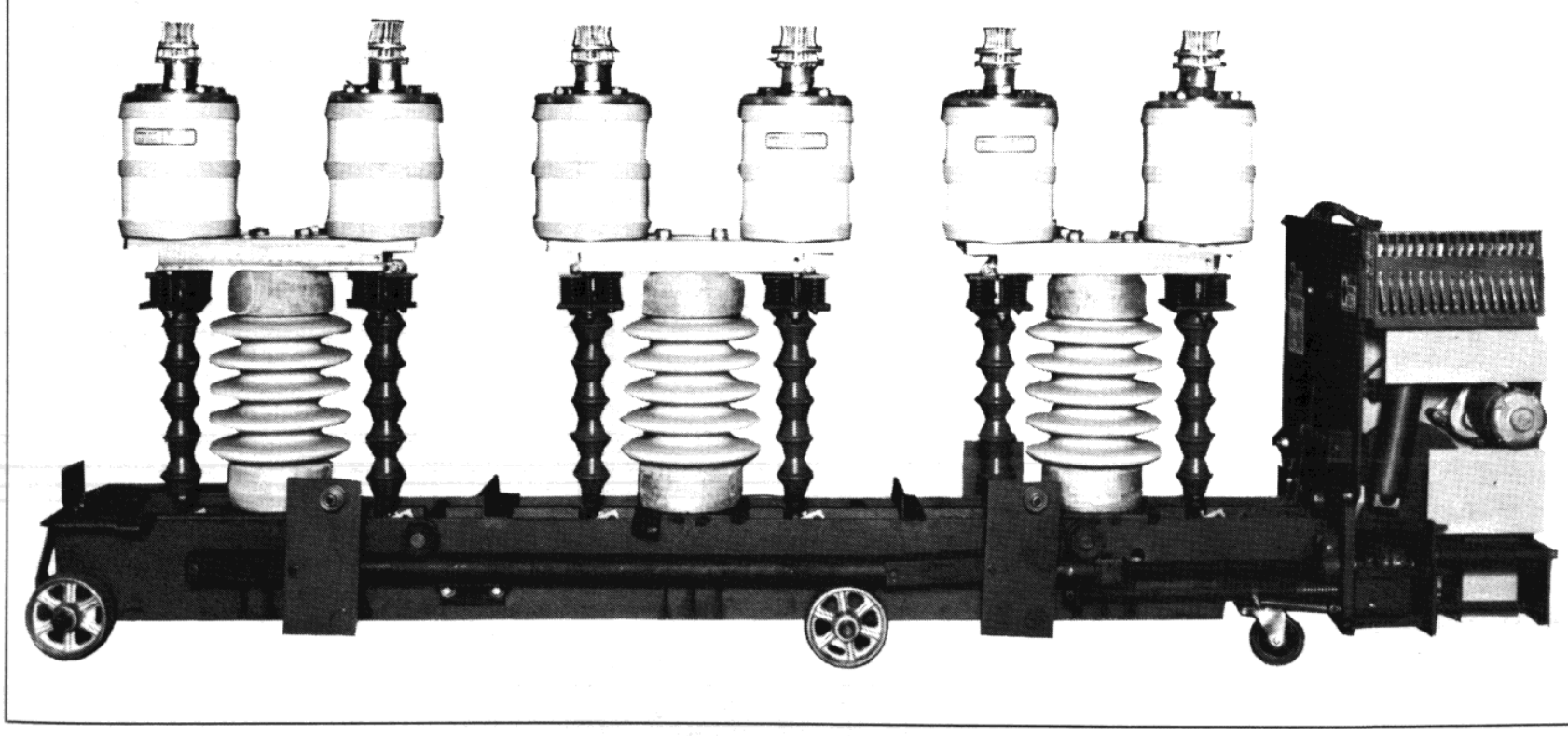


**Figure 47A–VV1500 Vacuum Circuit Breaker
Barrier Assembly Removed**

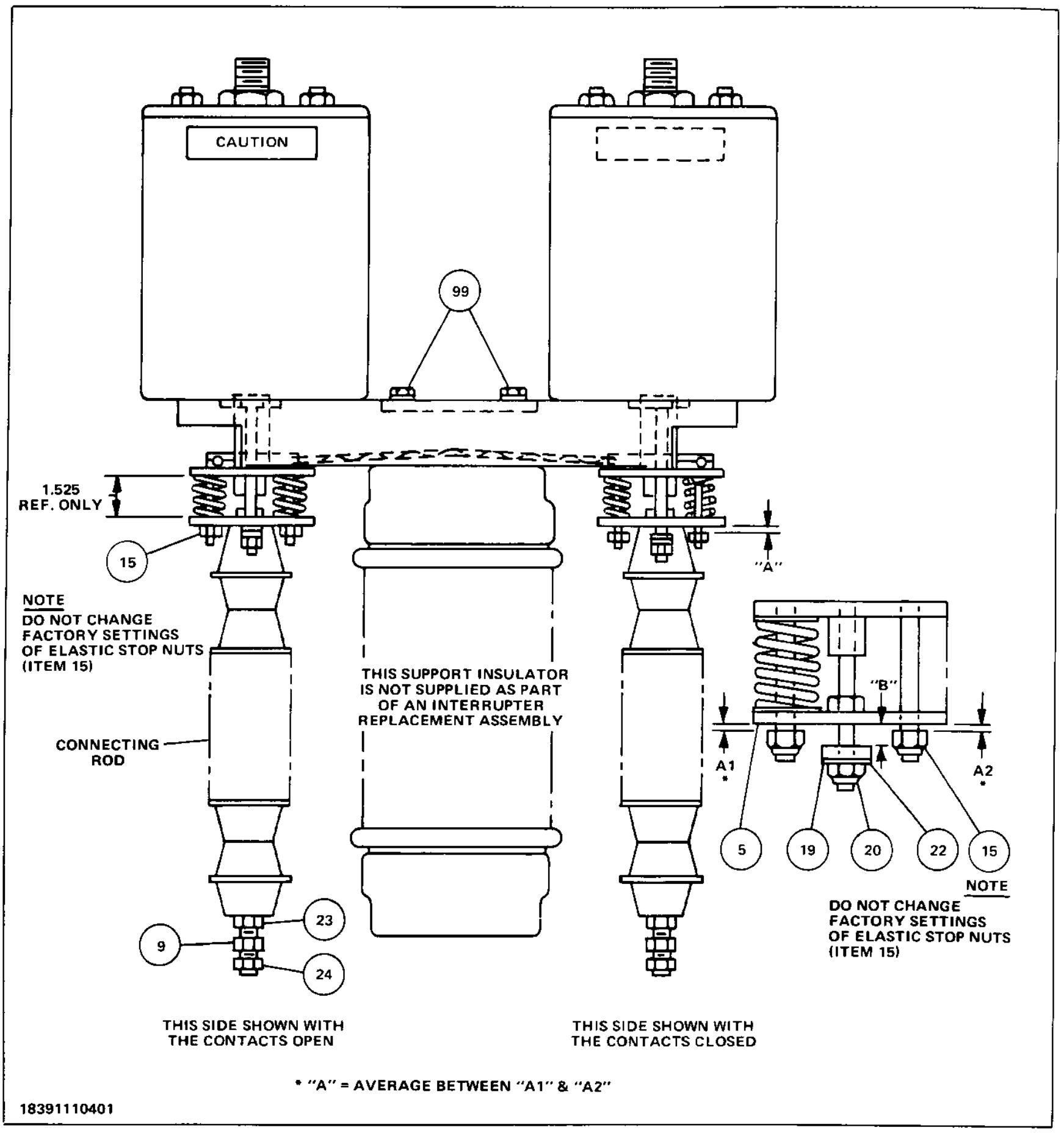


Figure 48—Vacuum Interrupter Assembly–One pole (1200 Amp Shown)

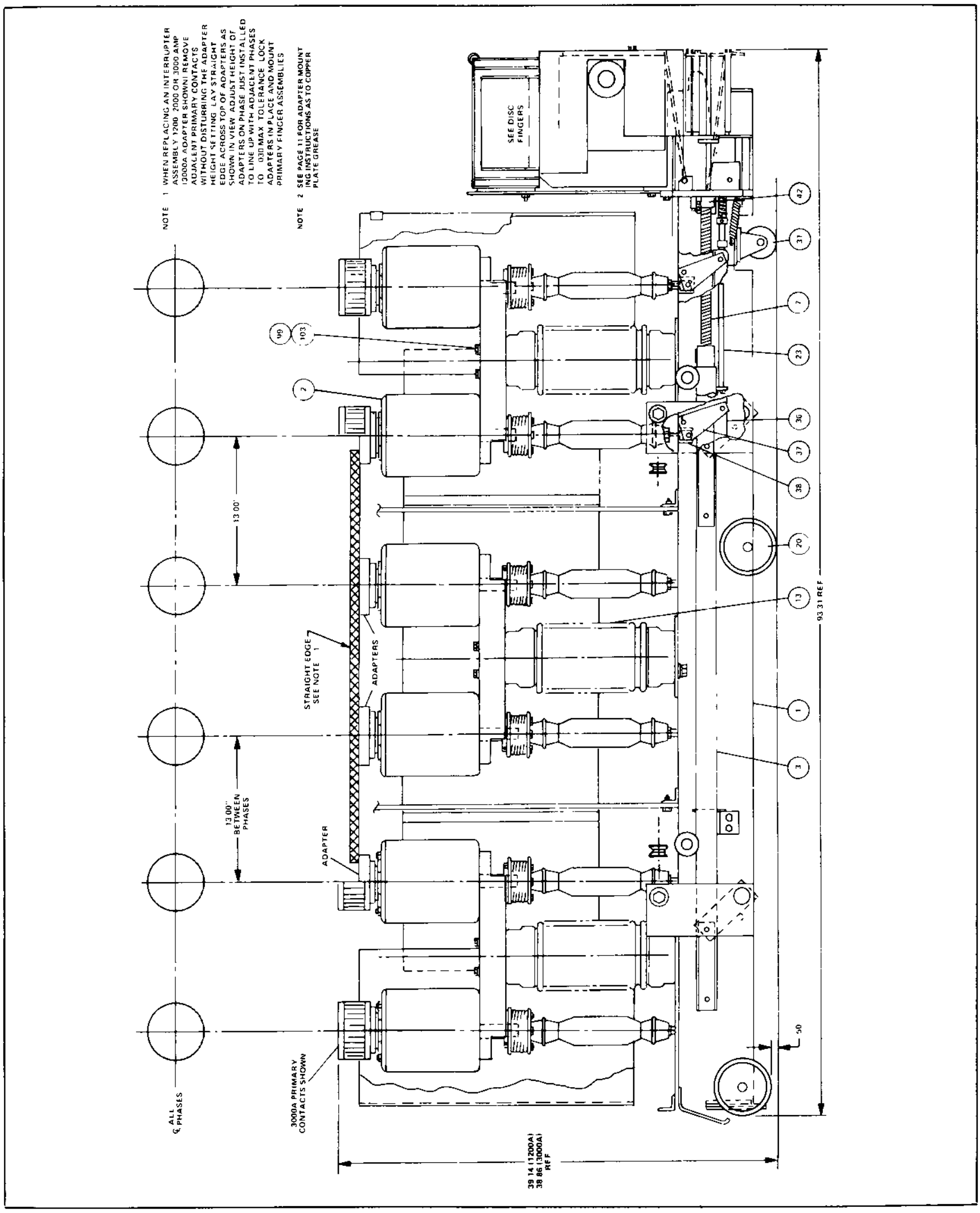


Figure 49–Side View–34.5 kV Vacuum Breaker (Shown with Contacts Open)

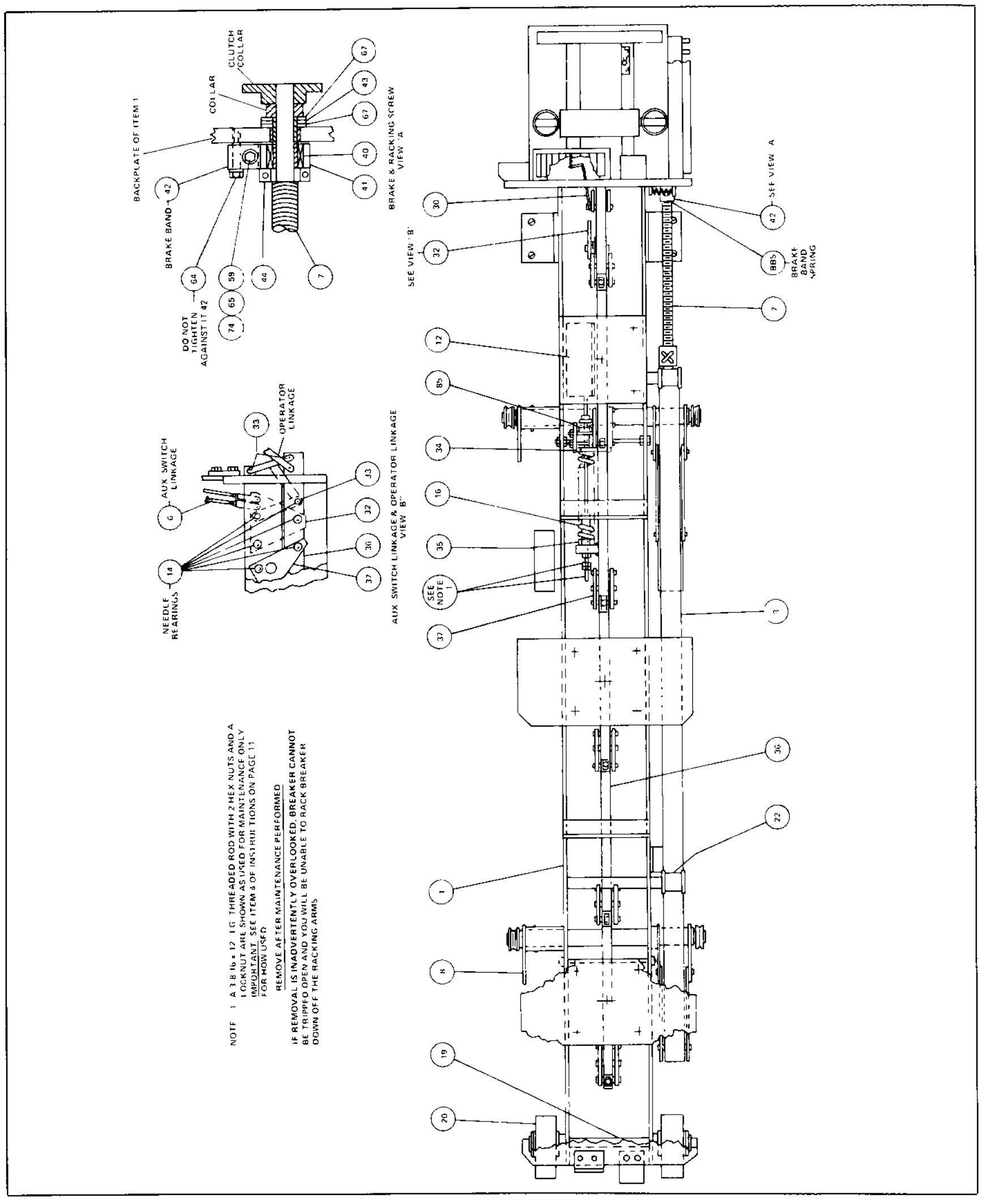


Figure 50–Truck Frame Assembly (Plan View)

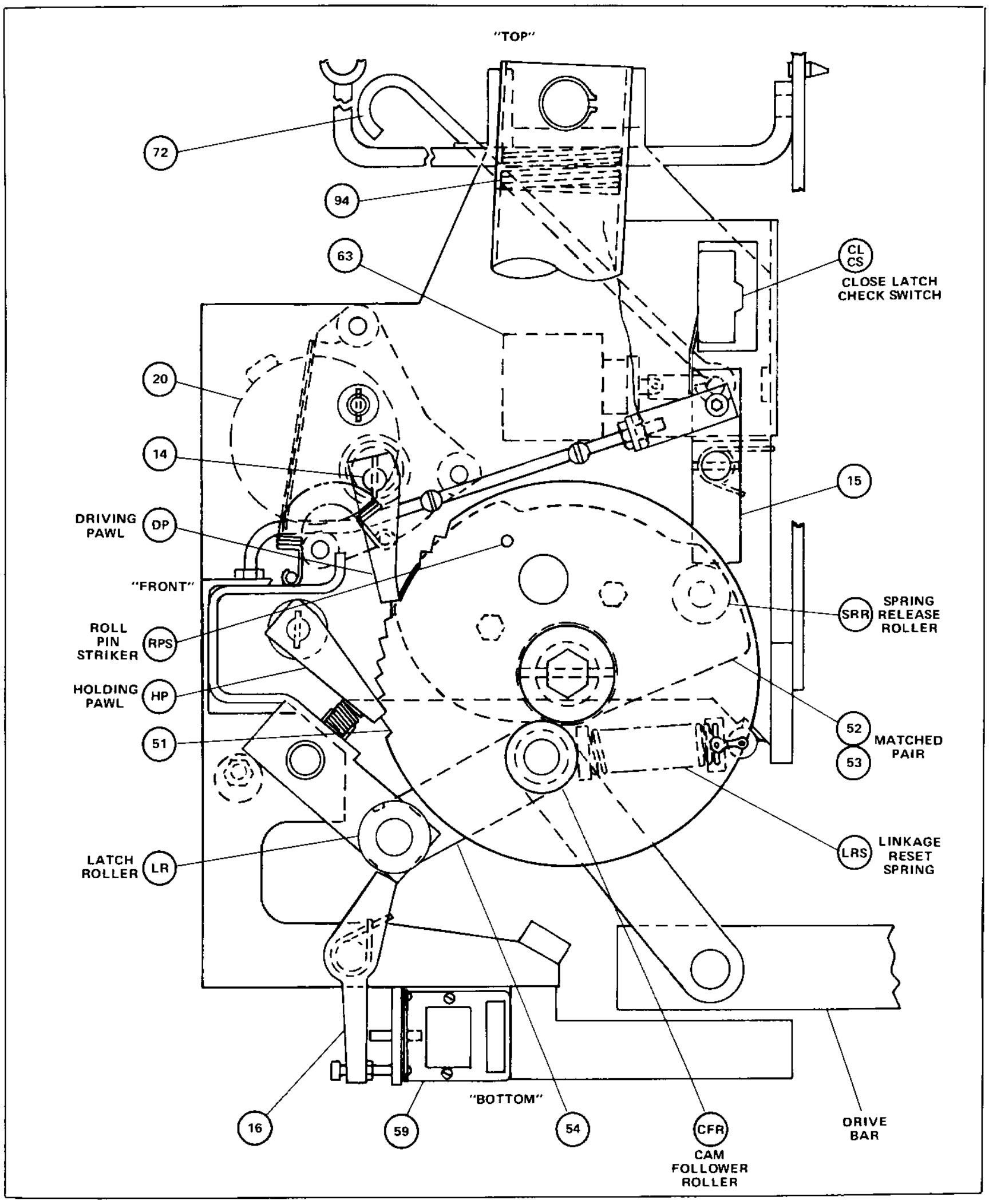
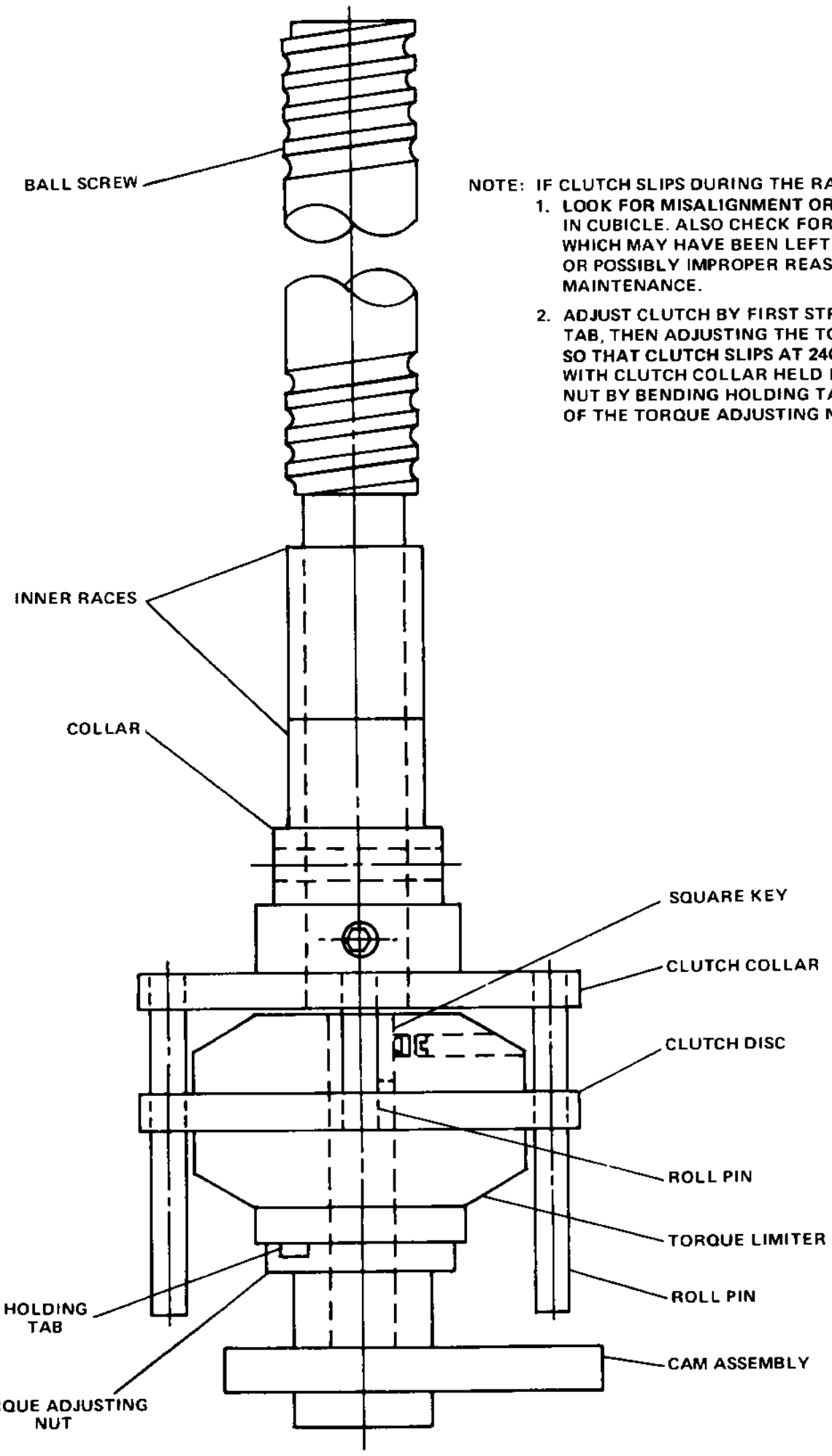


Figure 51–515-4V Operator



NOTE: IF CLUTCH SLIPS DURING THE RACKING OPERATION

1. LOOK FOR MISALIGNMENT OR BINDING OF BREAKER IN CUBICLE. ALSO CHECK FOR ANY FOREIGN OBJECT WHICH MAY HAVE BEEN LEFT IN OR ON EQUIPMENT OR POSSIBLY IMPROPER REASSEMBLY AFTER MAINTENANCE.
2. ADJUST CLUTCH BY FIRST STRAIGHTENING HOLDING TAB, THEN ADJUSTING THE TORQUE ADJUSTING NUT SO THAT CLUTCH SLIPS AT 240 TO 260 INCH POUNDS WITH CLUTCH COLLAR HELD FIXED. LOCK ADJUSTING NUT BY BENDING HOLDING TAB BACK OVER THE TOP OF THE TORQUE ADJUSTING NUT.

Figure 52–Clutch and Screw Assembly

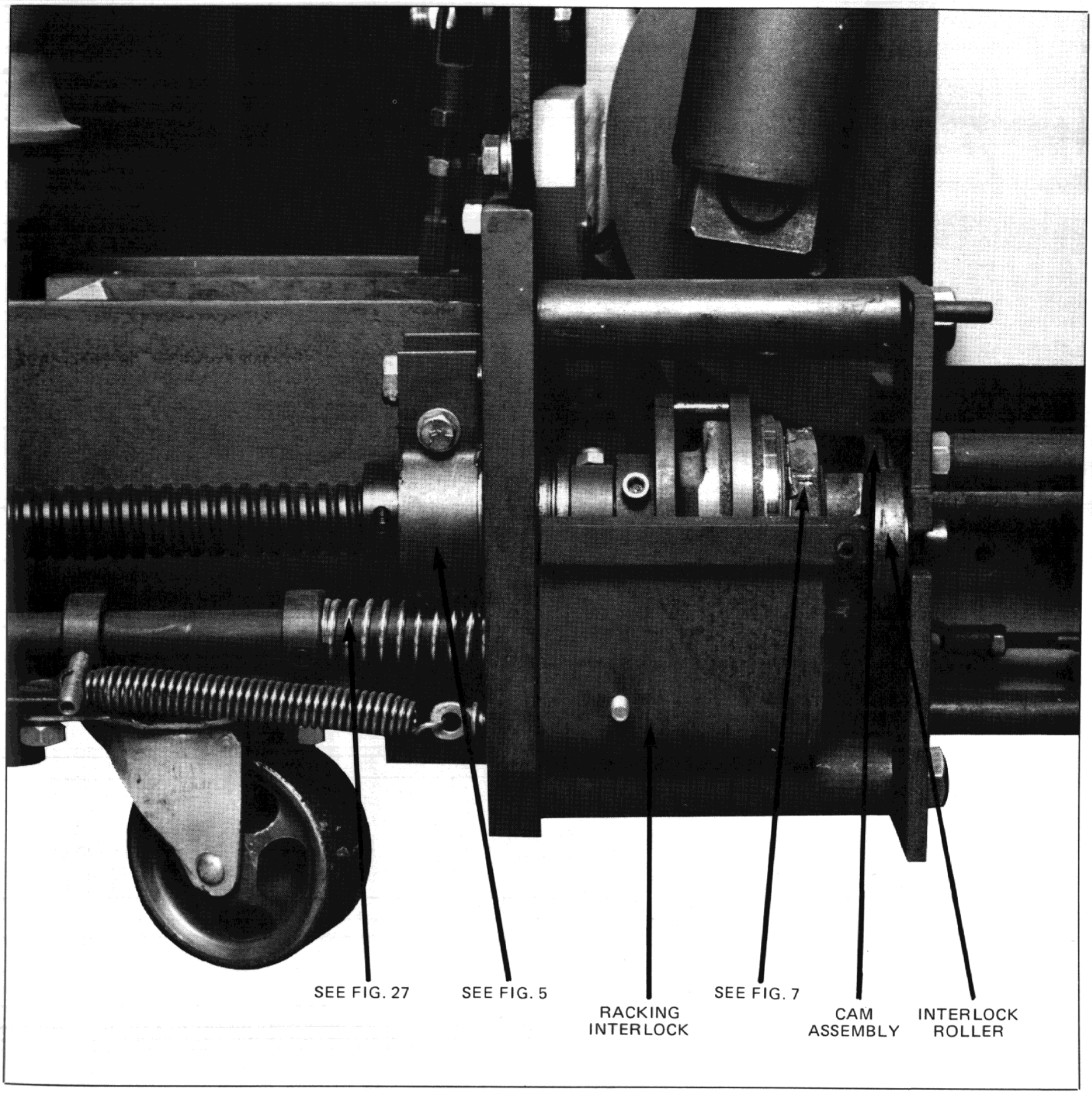


Figure 53–Clutch and Brake Assembly

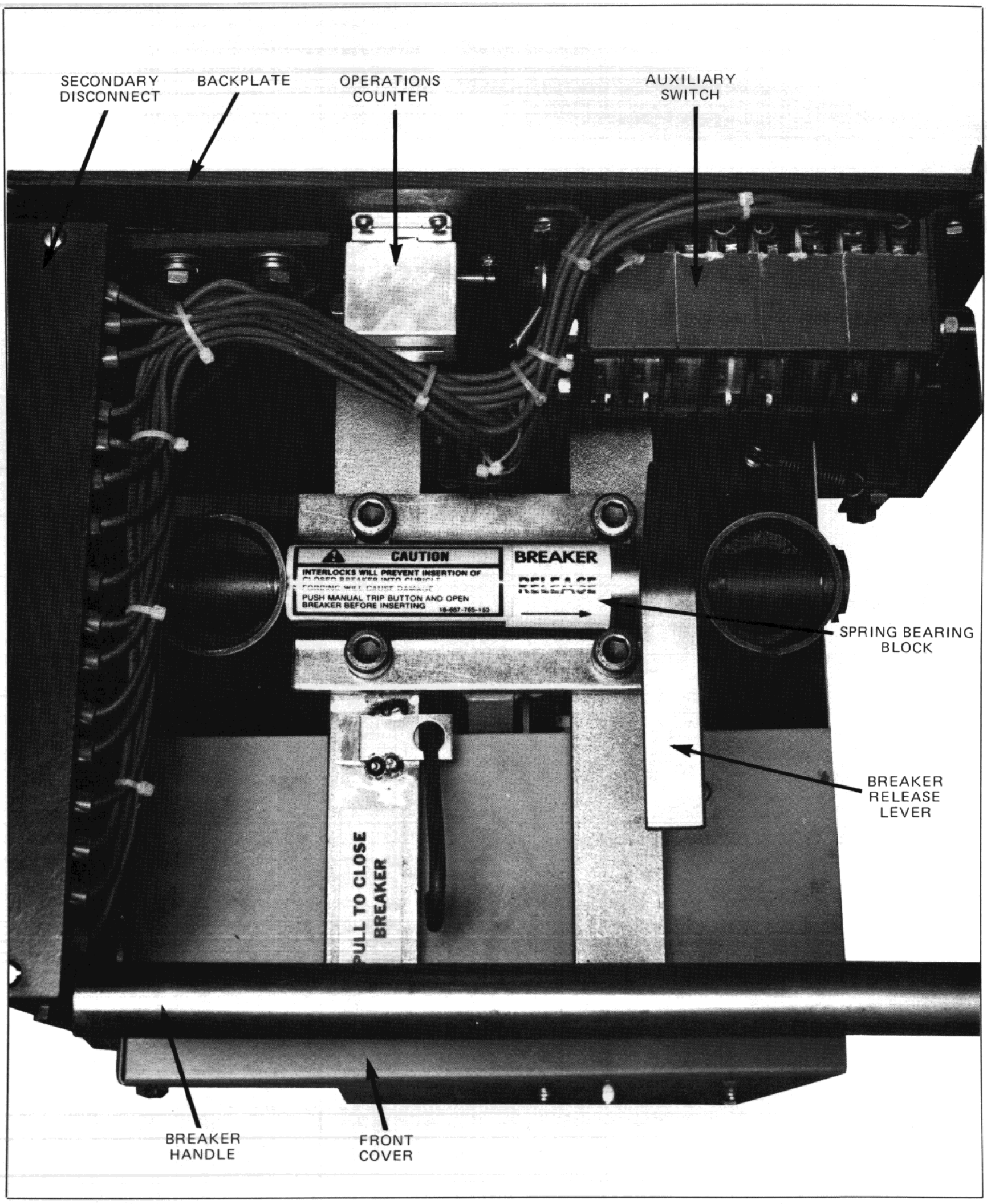


Figure 54–515-4V Operator–Top View

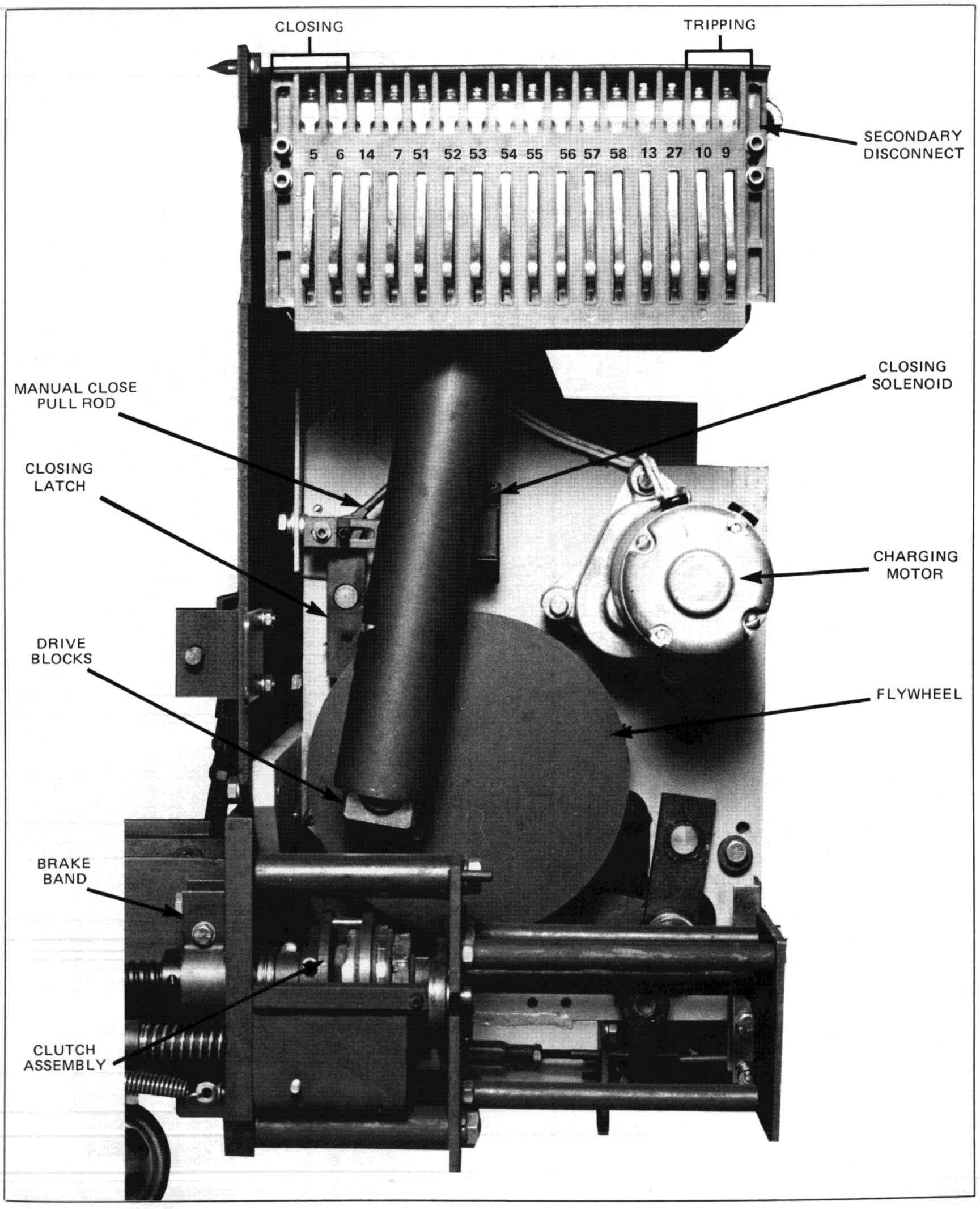


Figure 55–515-4V Operator–L.H. View

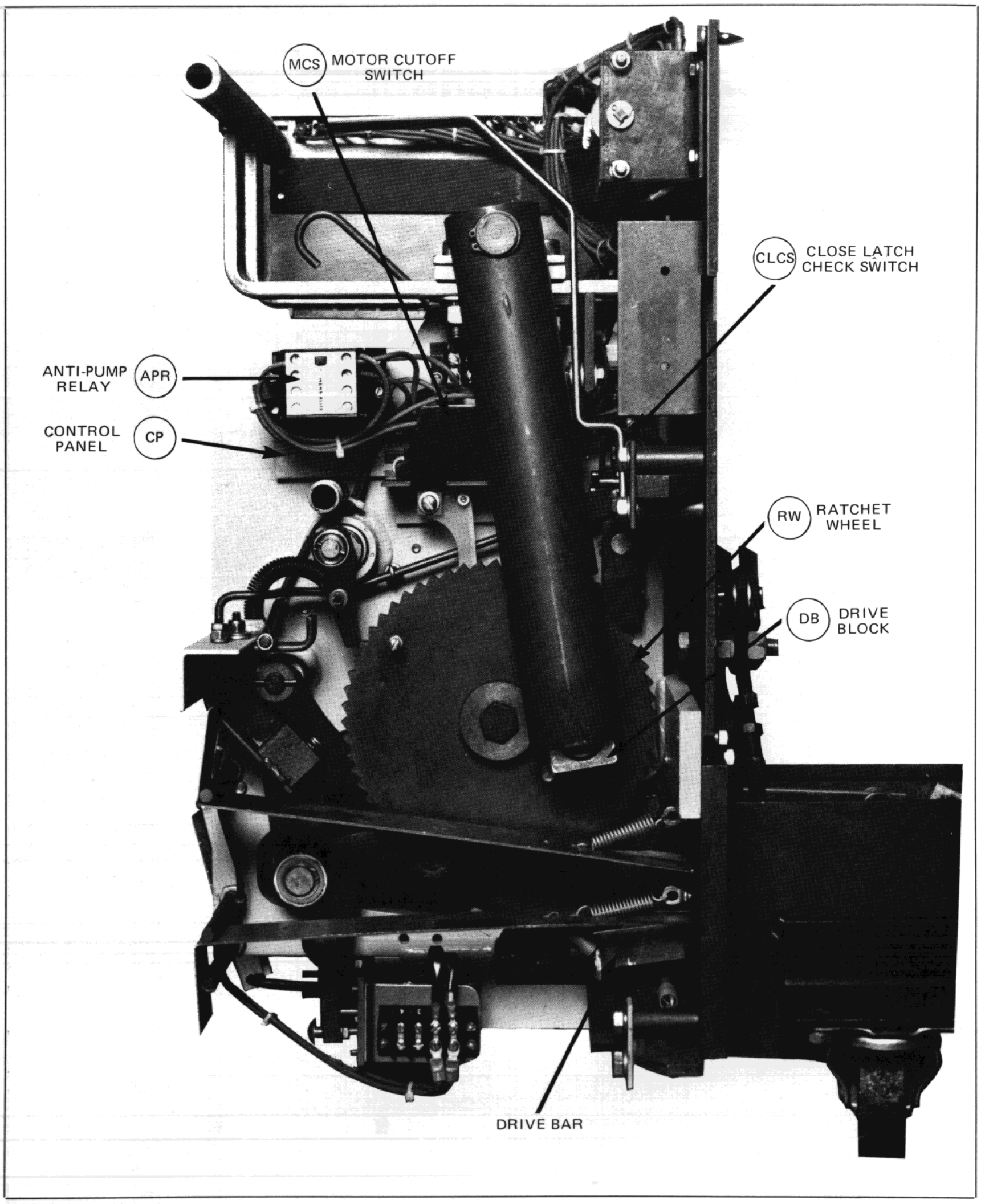


Figure 56–515-4V Operator–R.H. View

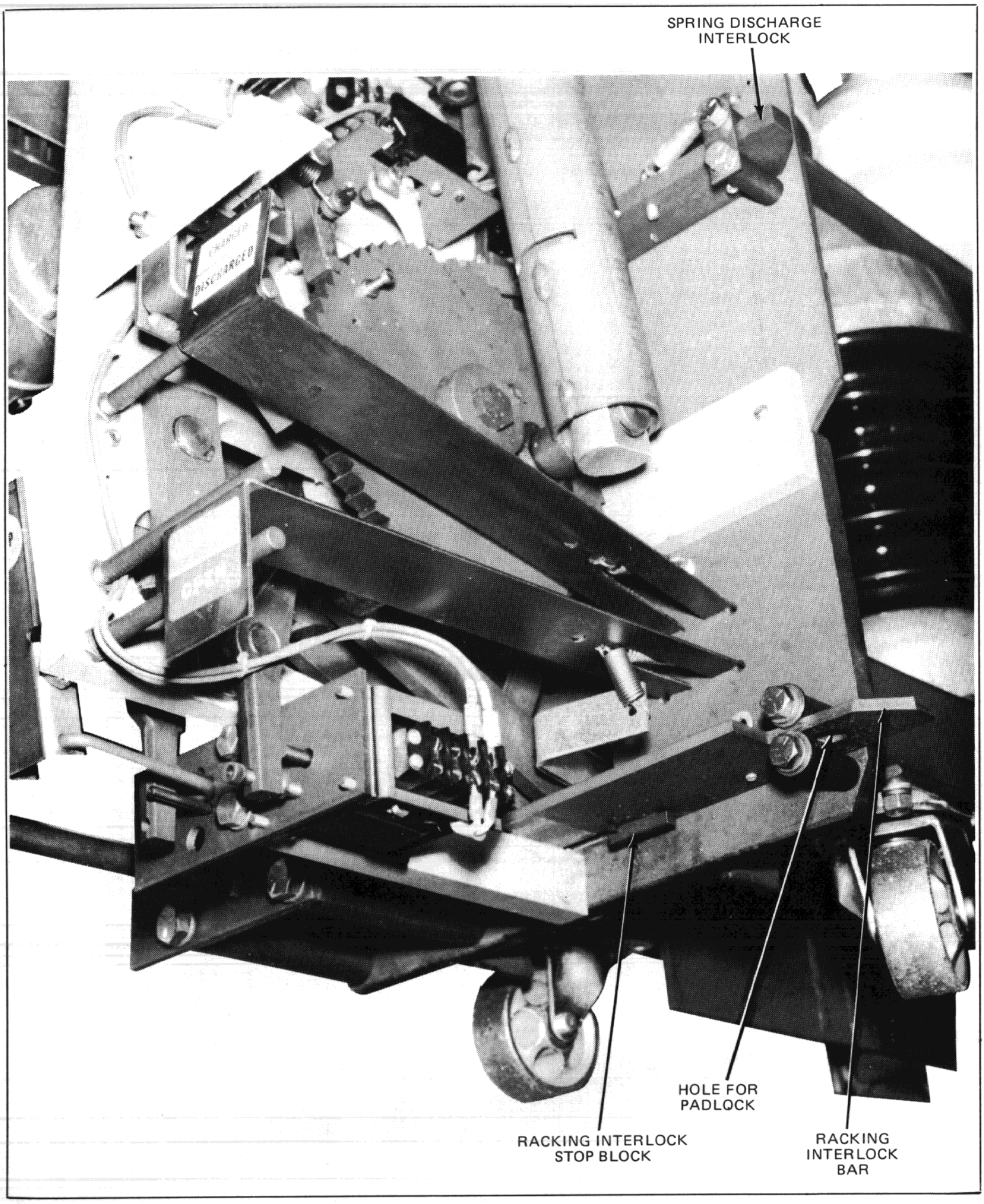


Figure 57–515-4V Operator–R.H. View (From Below)

Figure 58–515-4V Operator–R.H. Side View with Cover and Opening for Manual Charge Crank

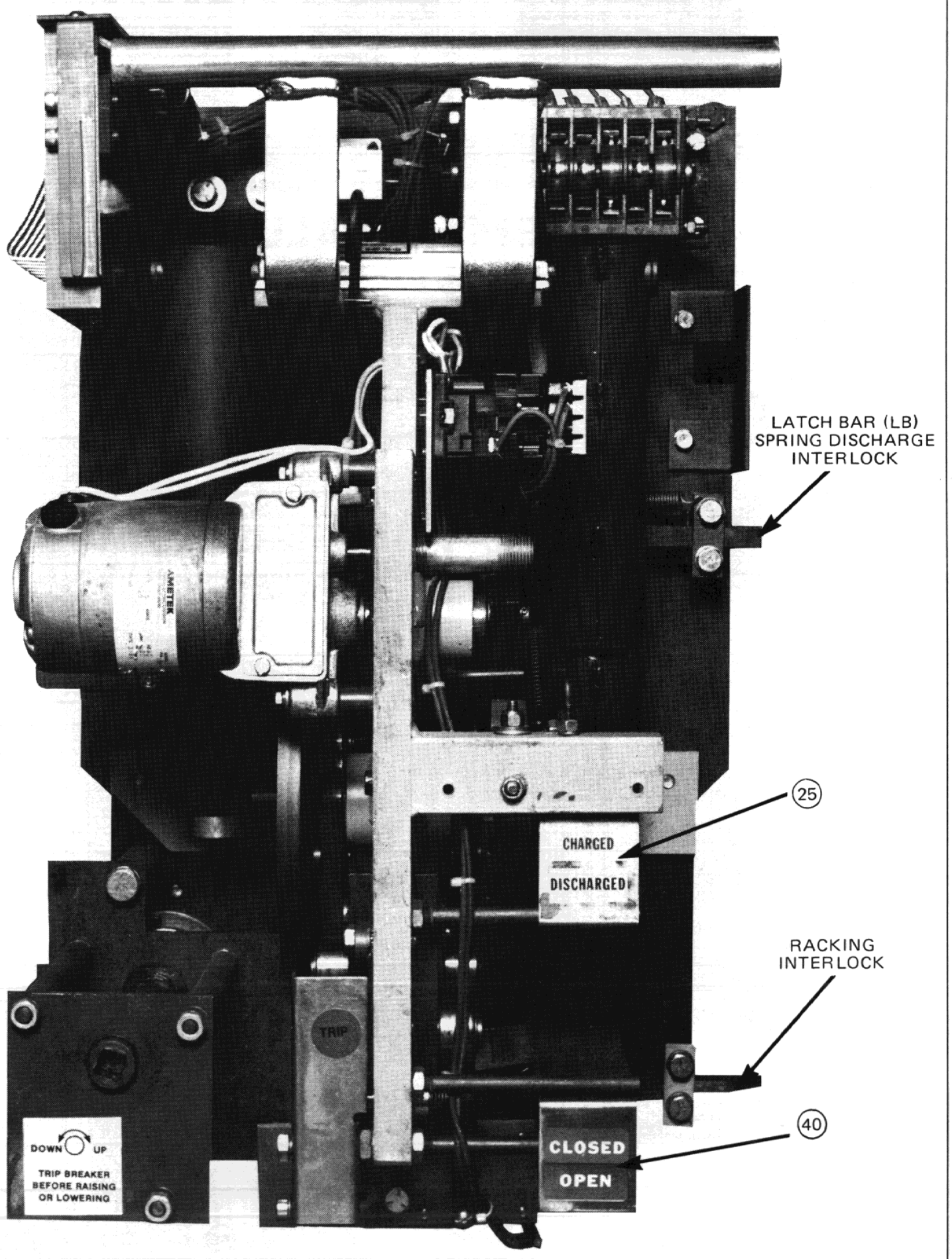


Figure 59–515-4V Operator–Front View

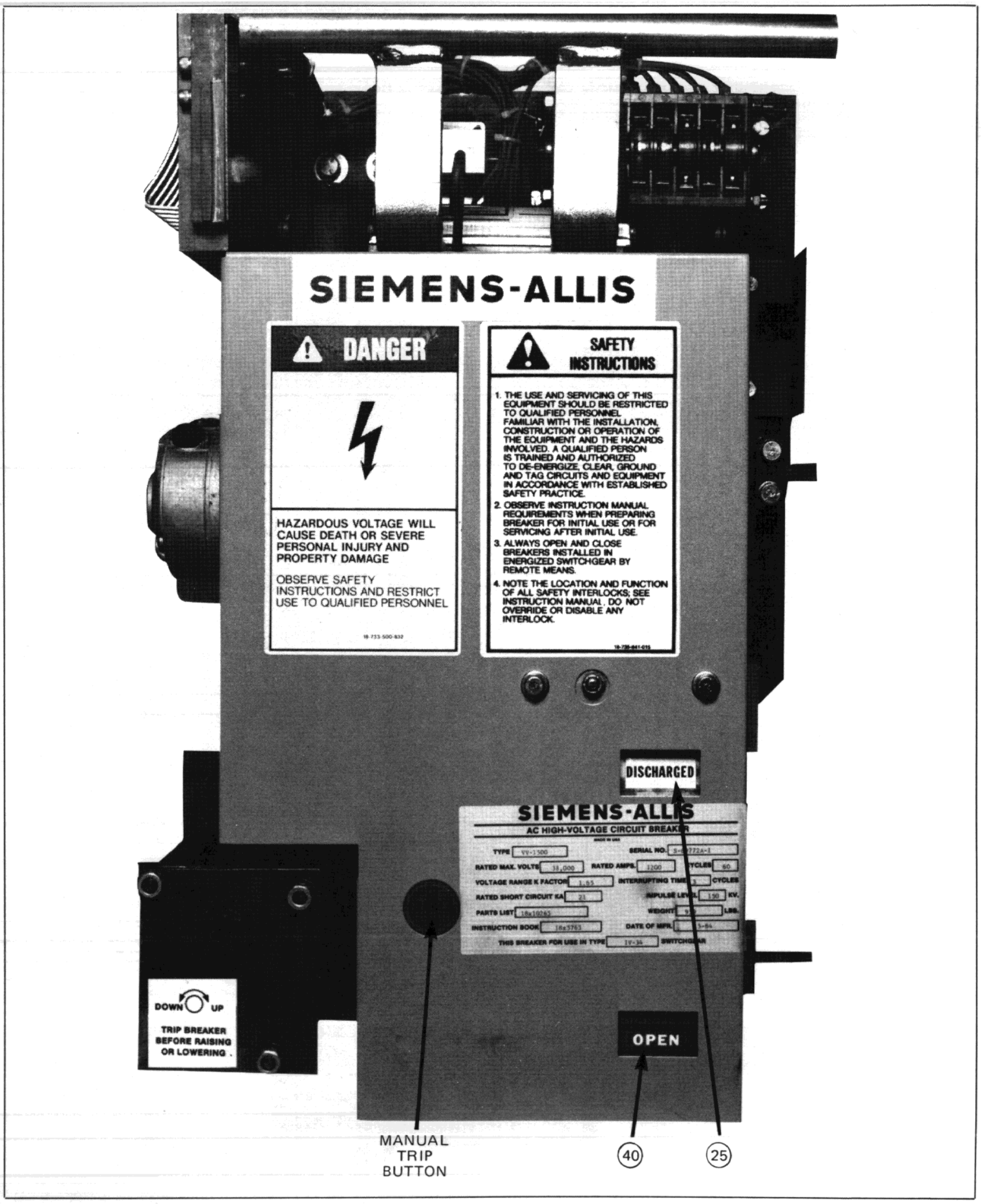
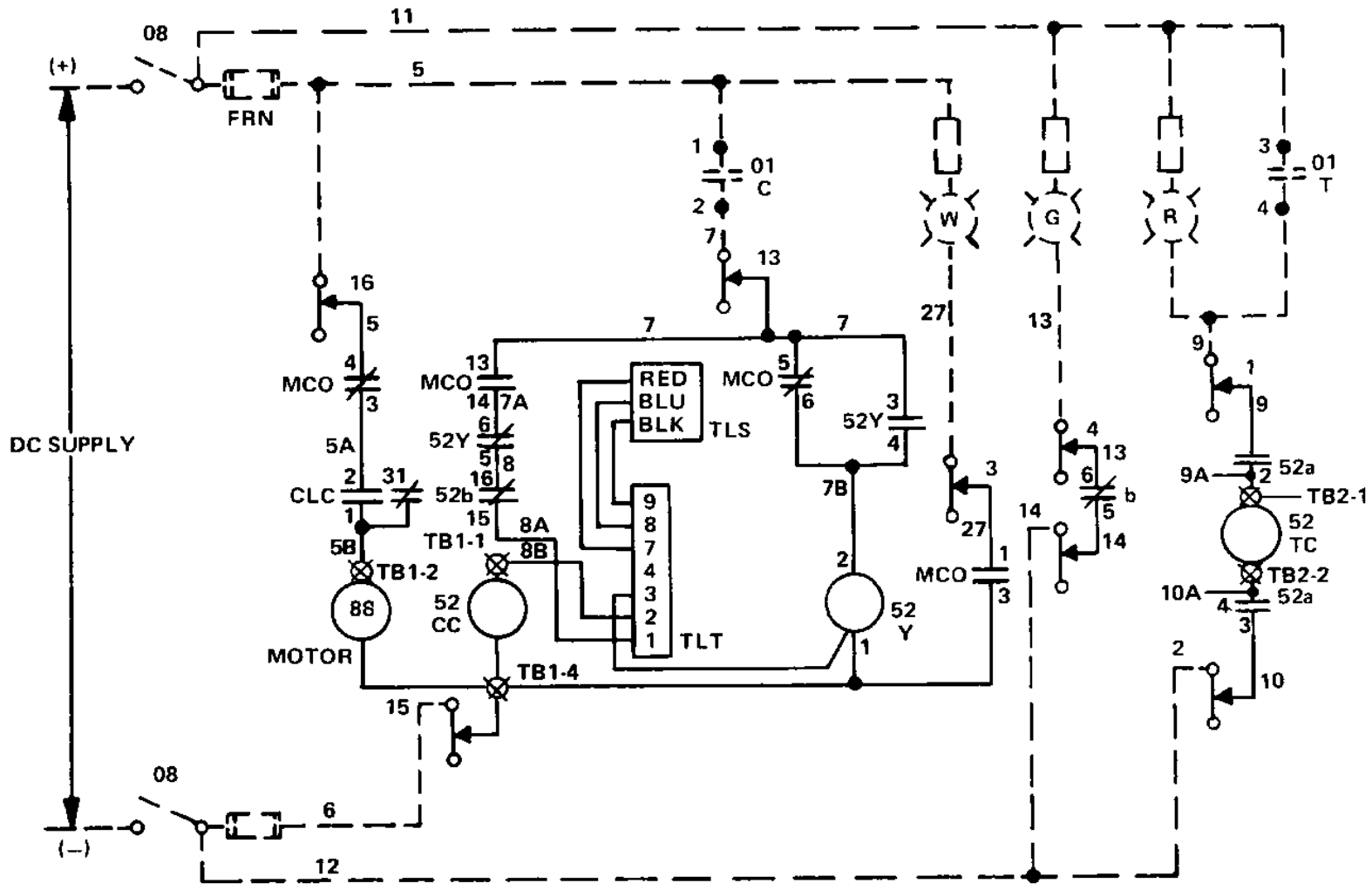


Figure 60–515-4V Operator–Front View with Cover



NOTE: SEE FIG. 10 FOR TERMINAL NUMBERS.

*OPTIONAL ITEMS FURNISHED FOR RECLOSING APPLICATIONS ONLY.

52TC – CIRCUIT BREAKER TRIP COIL
52CC – CIRCUIT BREAKER CLOSING COIL
52Y – AUX. CLOSING RELAY (ANTI-PUMP)
MCO – MOTOR CUTOFF SWITCH
CLC – CLOSE LATCH CHECK SWITCH
*TLS – TRIP LATCH SENSOR
*TLT – TRIP LATCH TIMER
01/C – CONTROL SWITCH – CLOSE CONTACT
01/T – CONTROL SWITCH – TRIP CONTACT
R – RED INDICATING LAMP
G – GREEN INDICATING LAMP
W – WHITE INDICATING LAMP
88 – MOTOR
52a – AUX. SWITCH – OPEN WHEN BREAKER IS OPEN
52b – AUX. SWITCH – CLOSED WHEN BREAKER IS OPEN

Figure 61–Control Scheme (Typical)

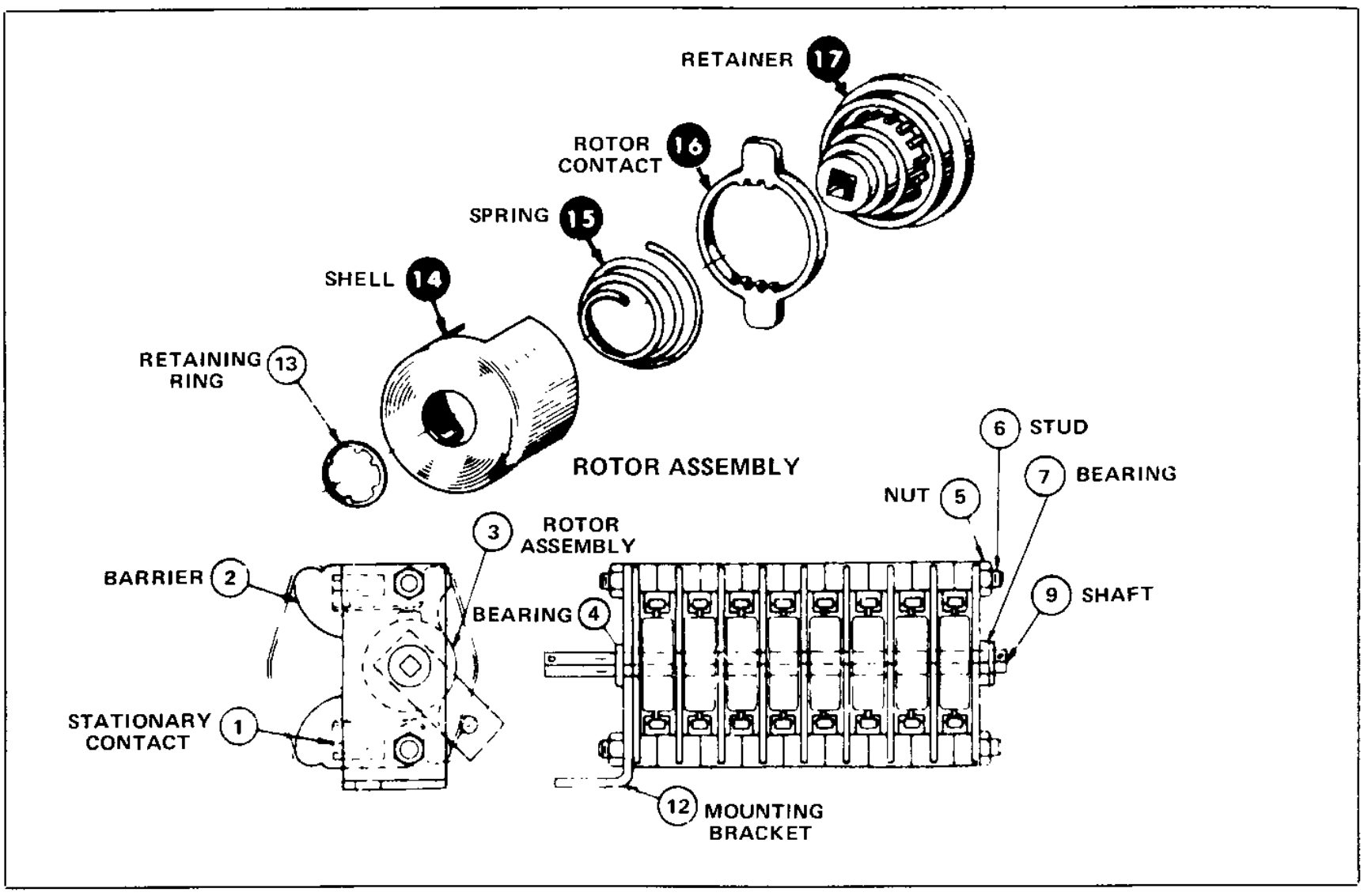


Figure 62–Type Q-10 Auxiliary Switch

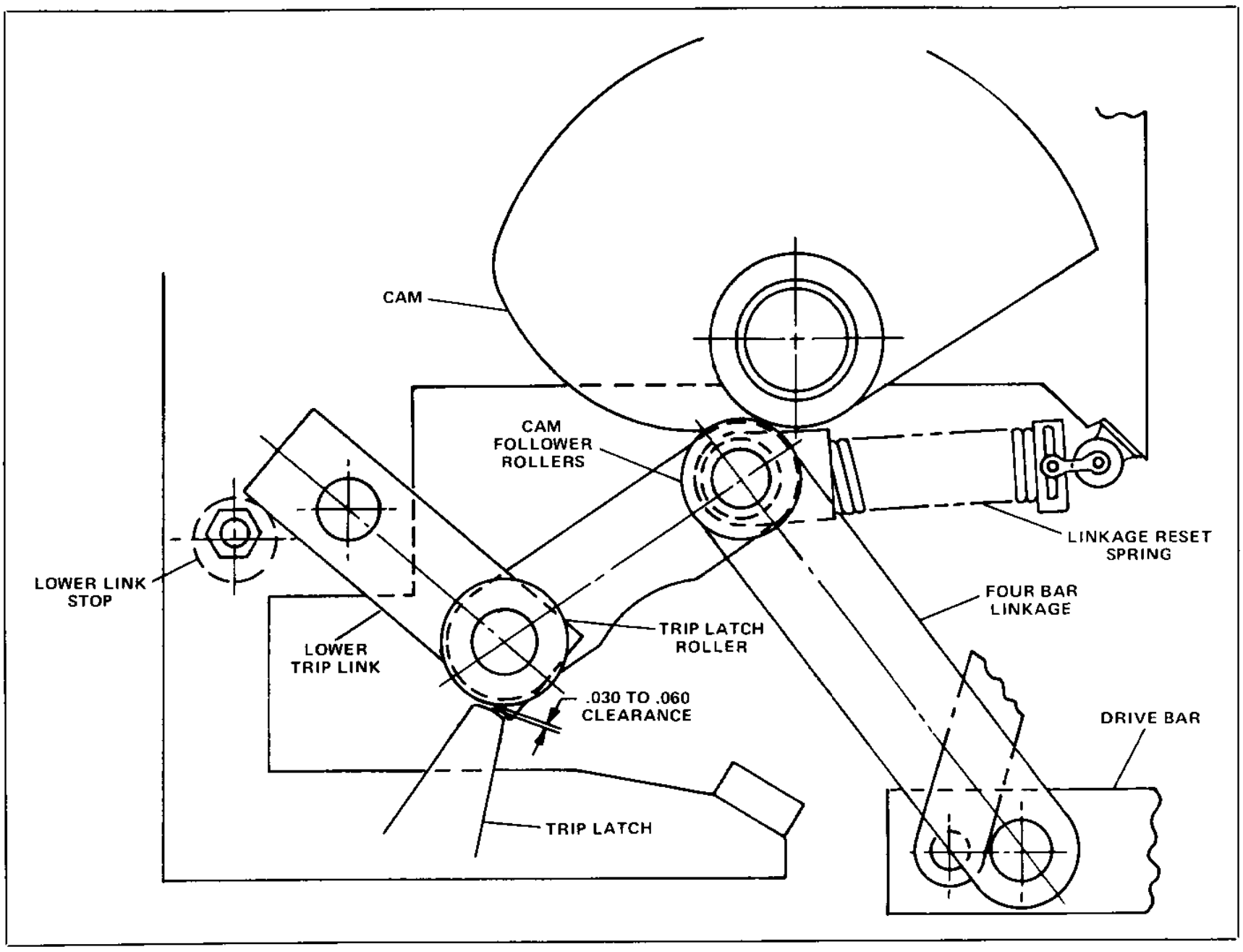


Figure 63–Trip Latch Clearance Adjustment

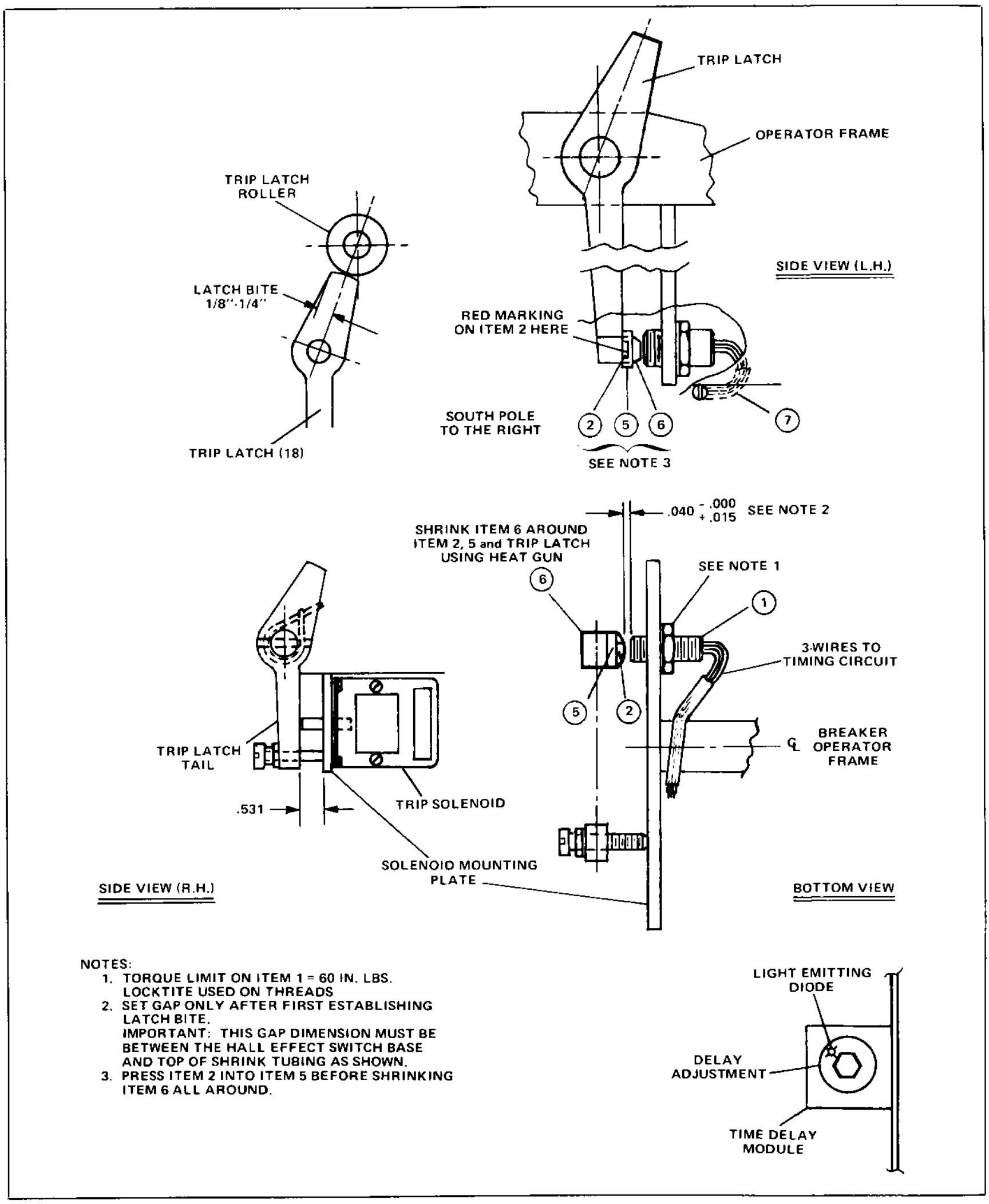


Figure 64–Trip Latch Bite and Latch Check Switch

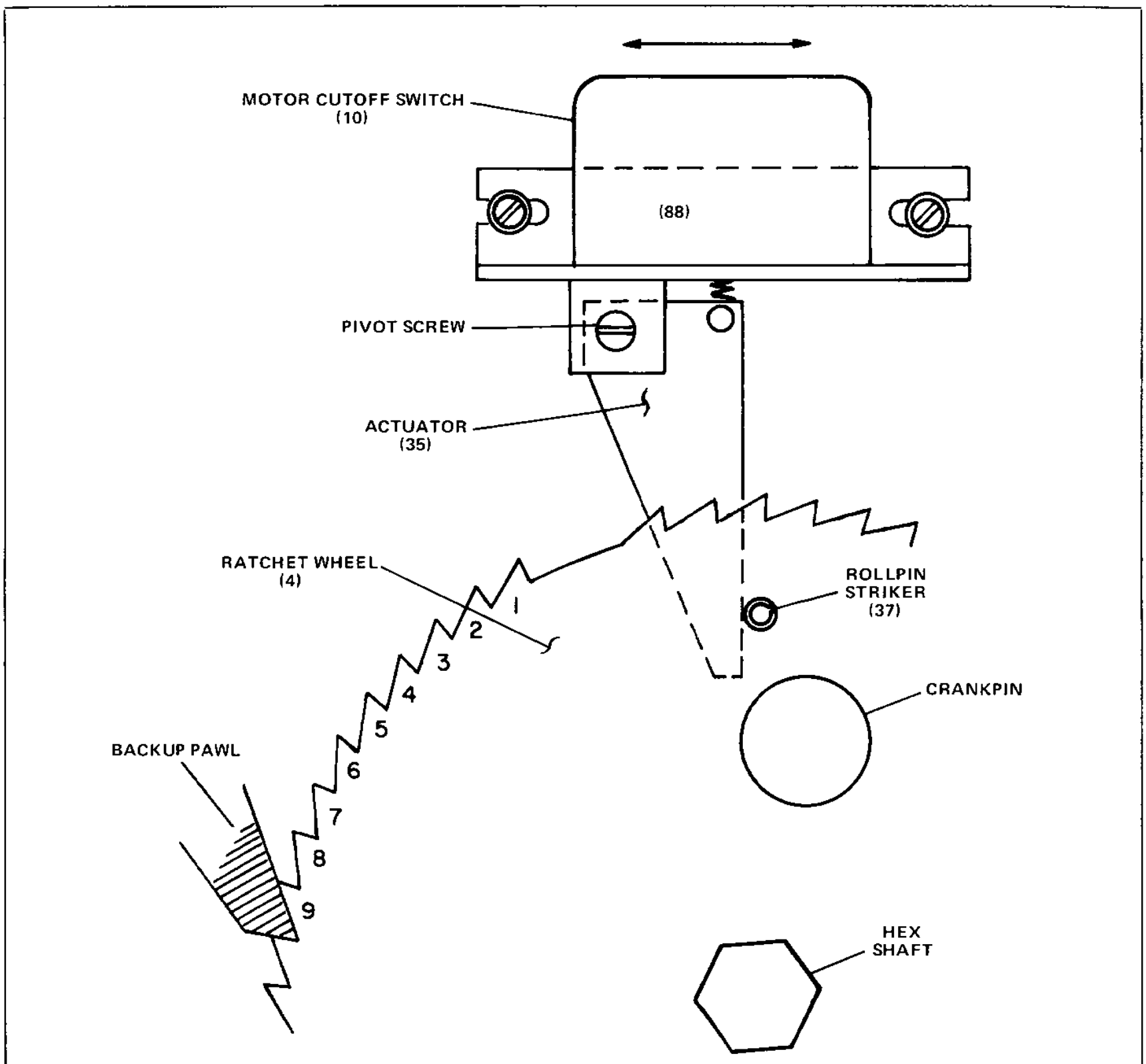


Figure 65–Motor Cutoff Switch

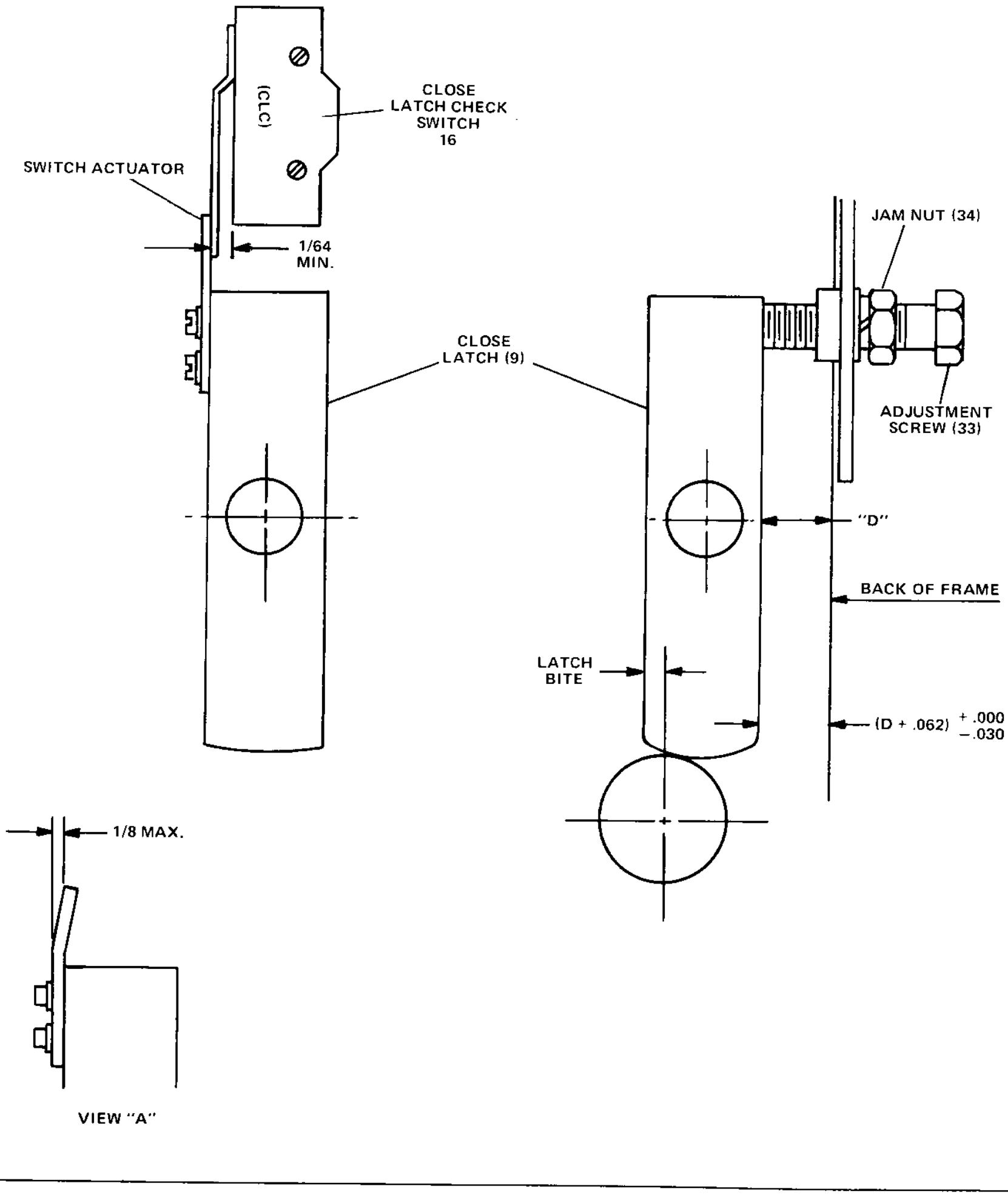


Figure 66–Close Latch Bite and Check Switch Adjustments

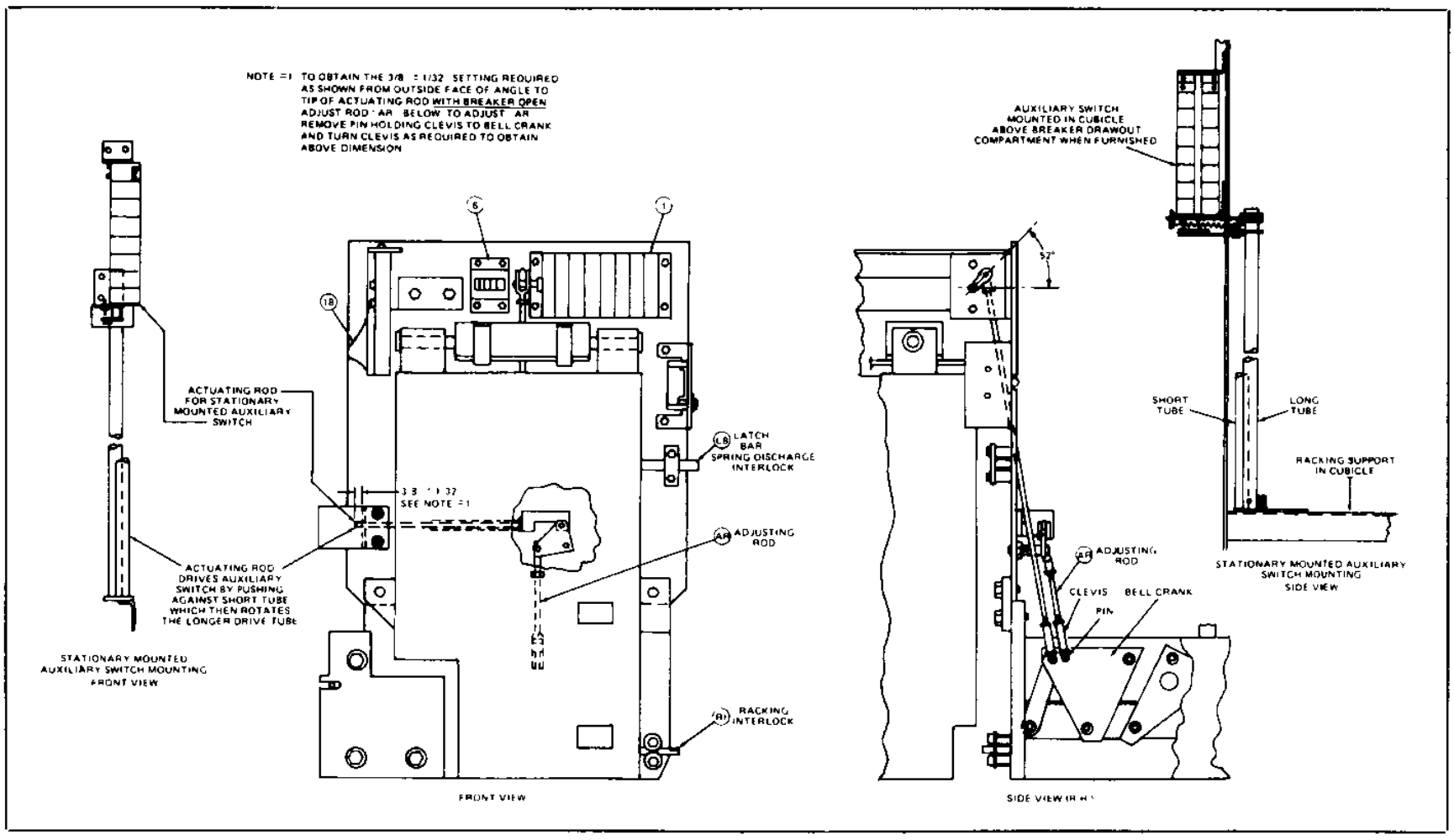


Figure 67–Auxiliary Switch and Secondary Disconnect Mounting

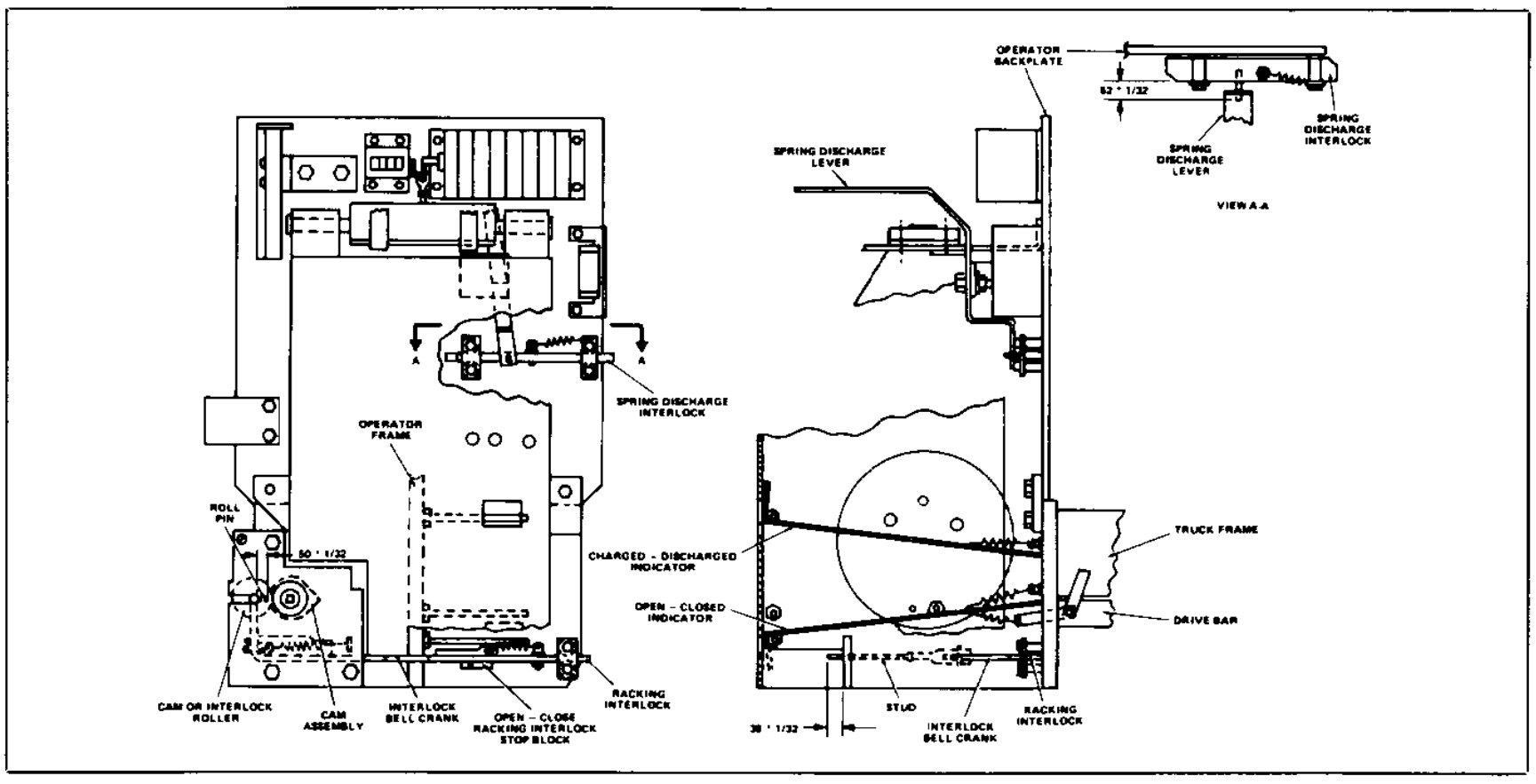


Figure 67a–Interlock and Indicator Assemblies

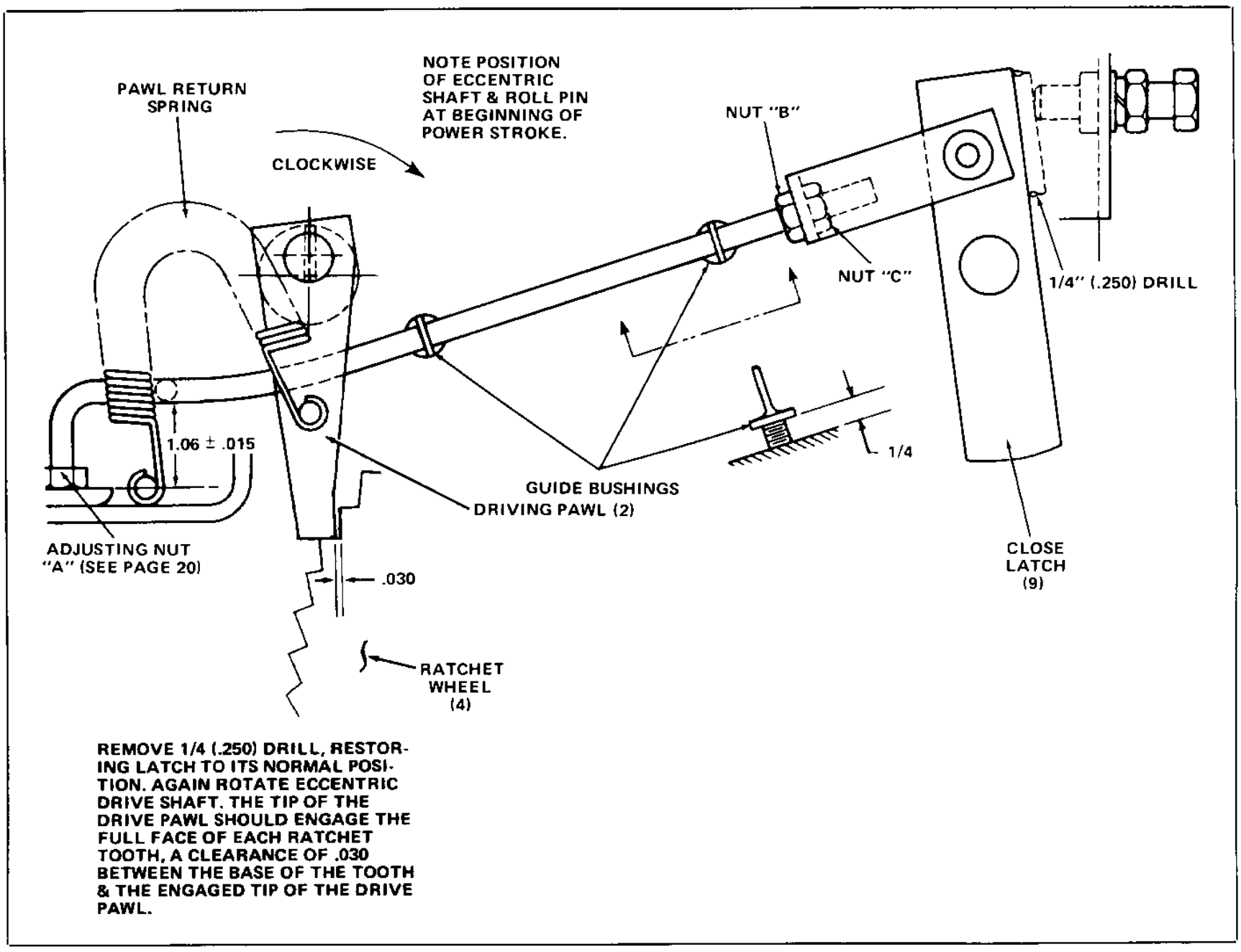
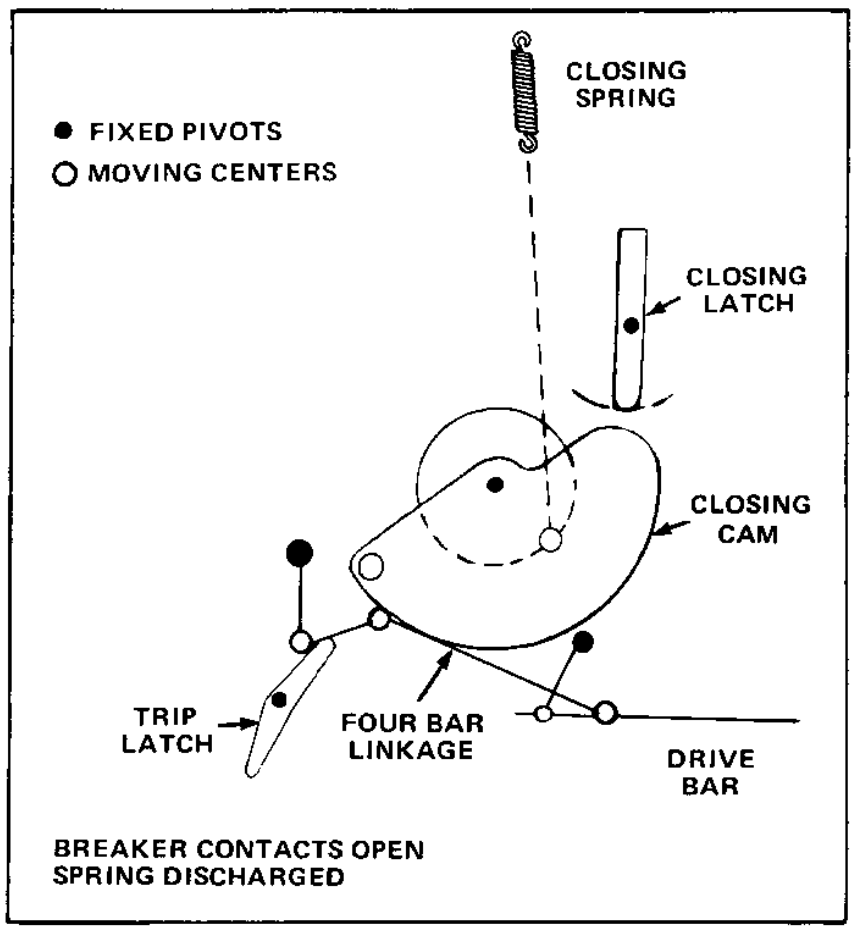
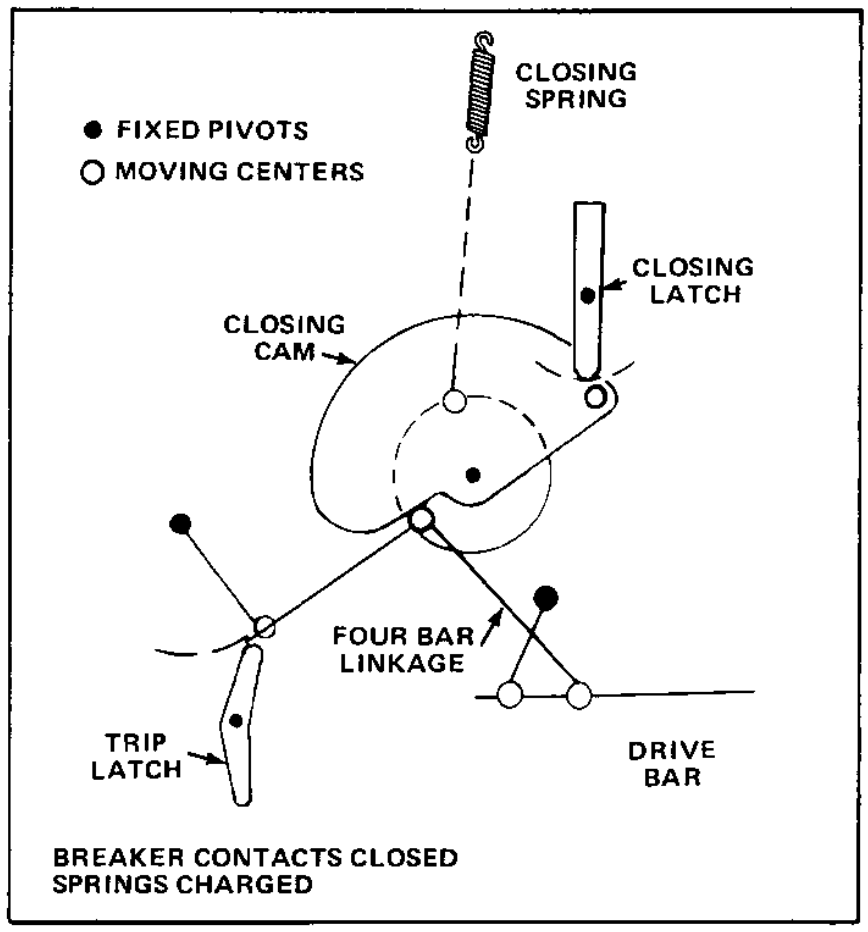


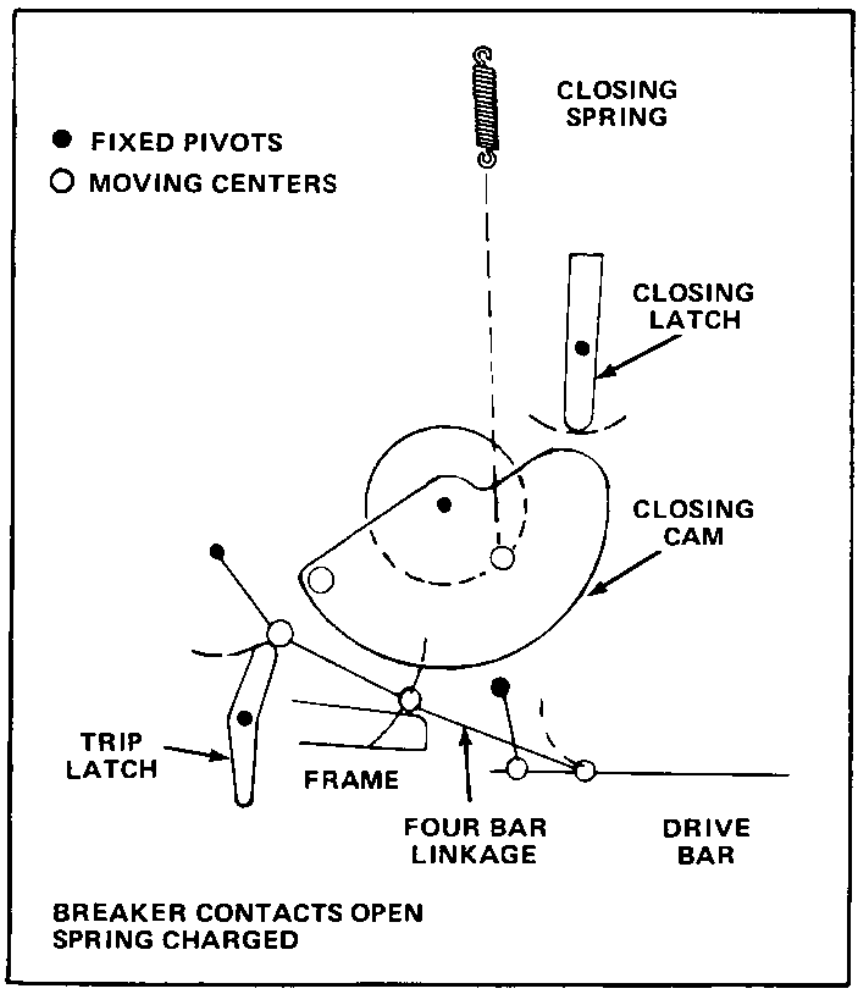
Figure 68–Close Latch Mechanical Interlock



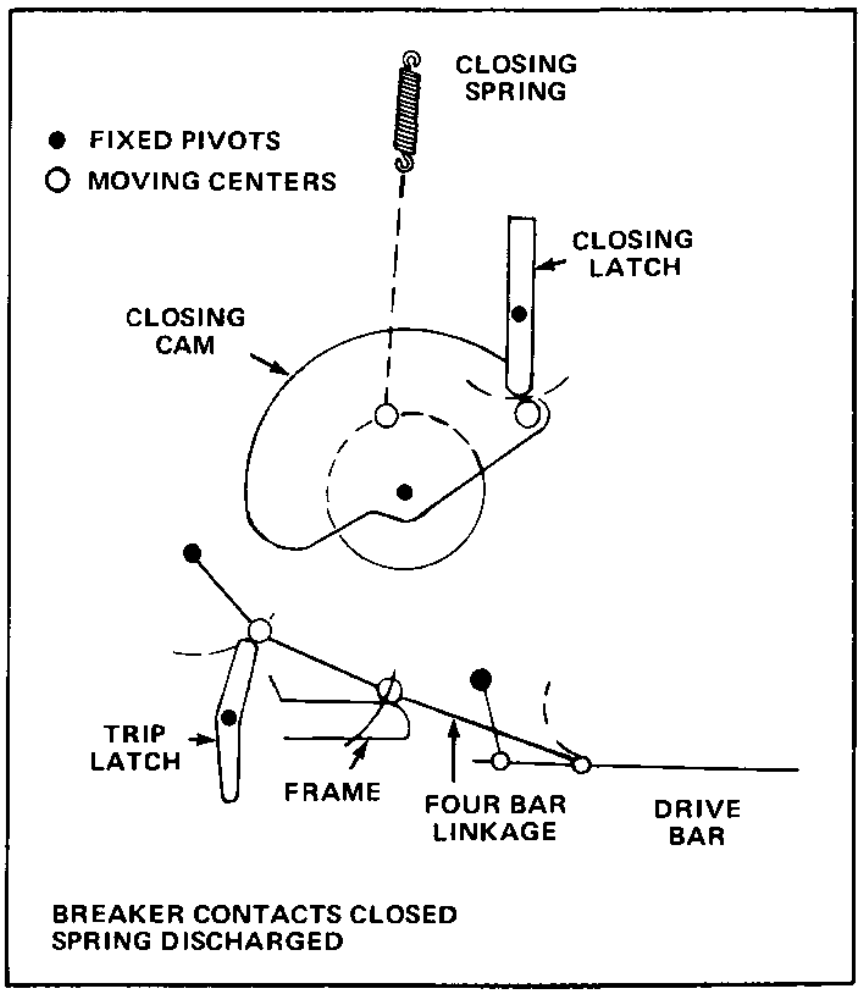
(A)



(B)

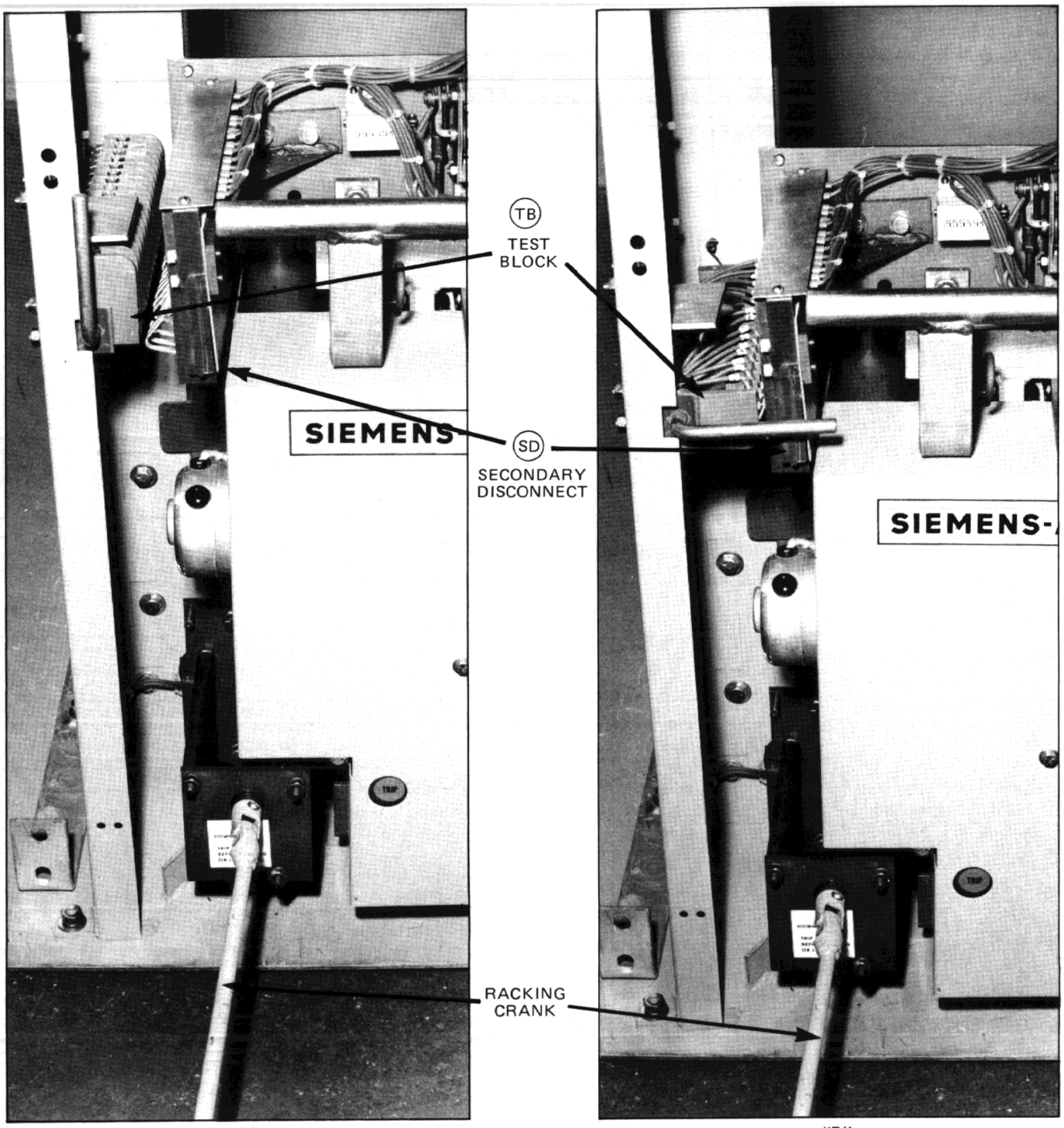


(C)



(D)

Figure 69–Sequence of Operation



"A"
TEST BLOCK IN DISCONNECT POSITION

"B"
TEST BLOCK IN CONNECT POSITION

Figure 70–Breaker is Shown Racked into Cubicle and in Disconnect/Test Position

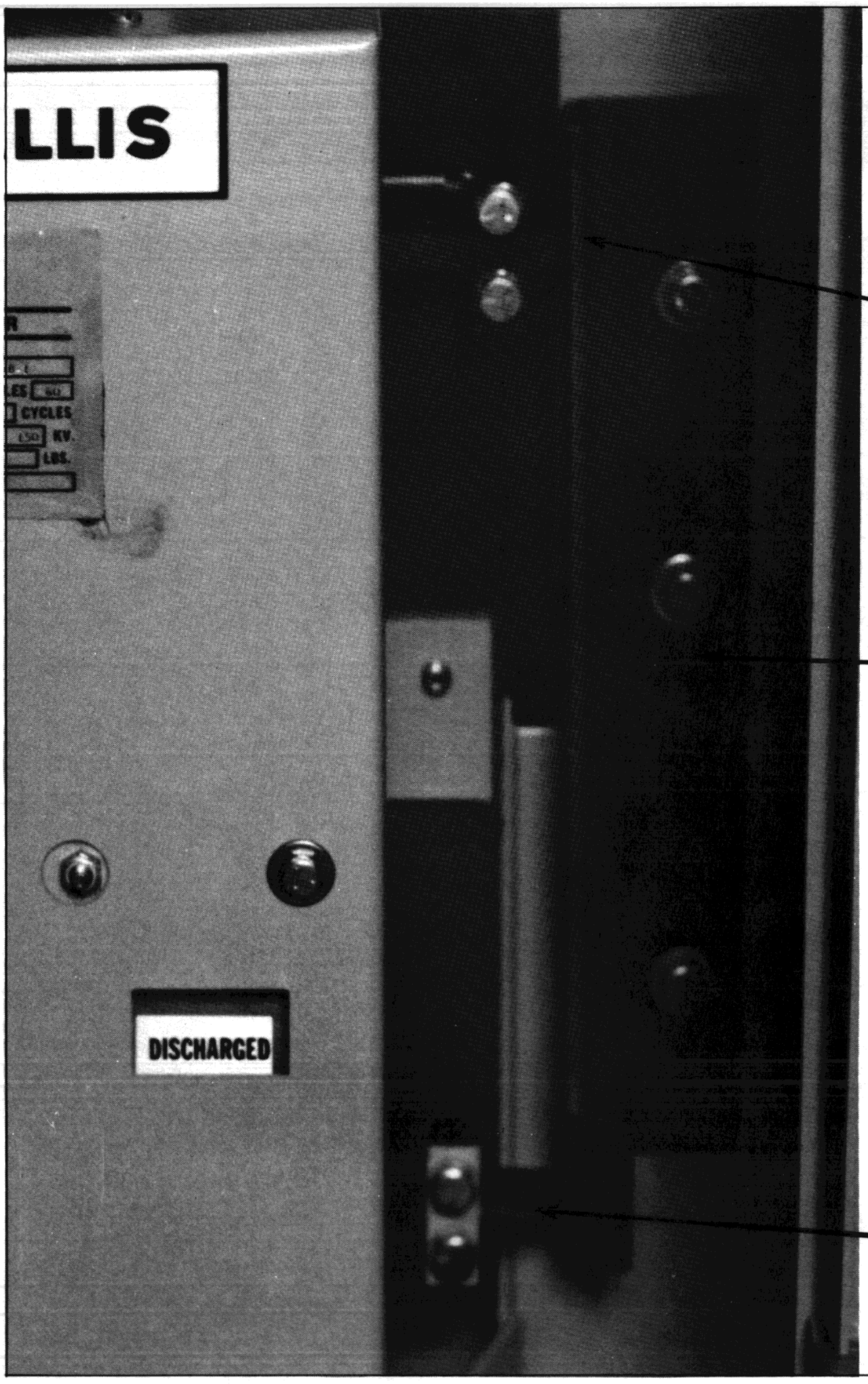
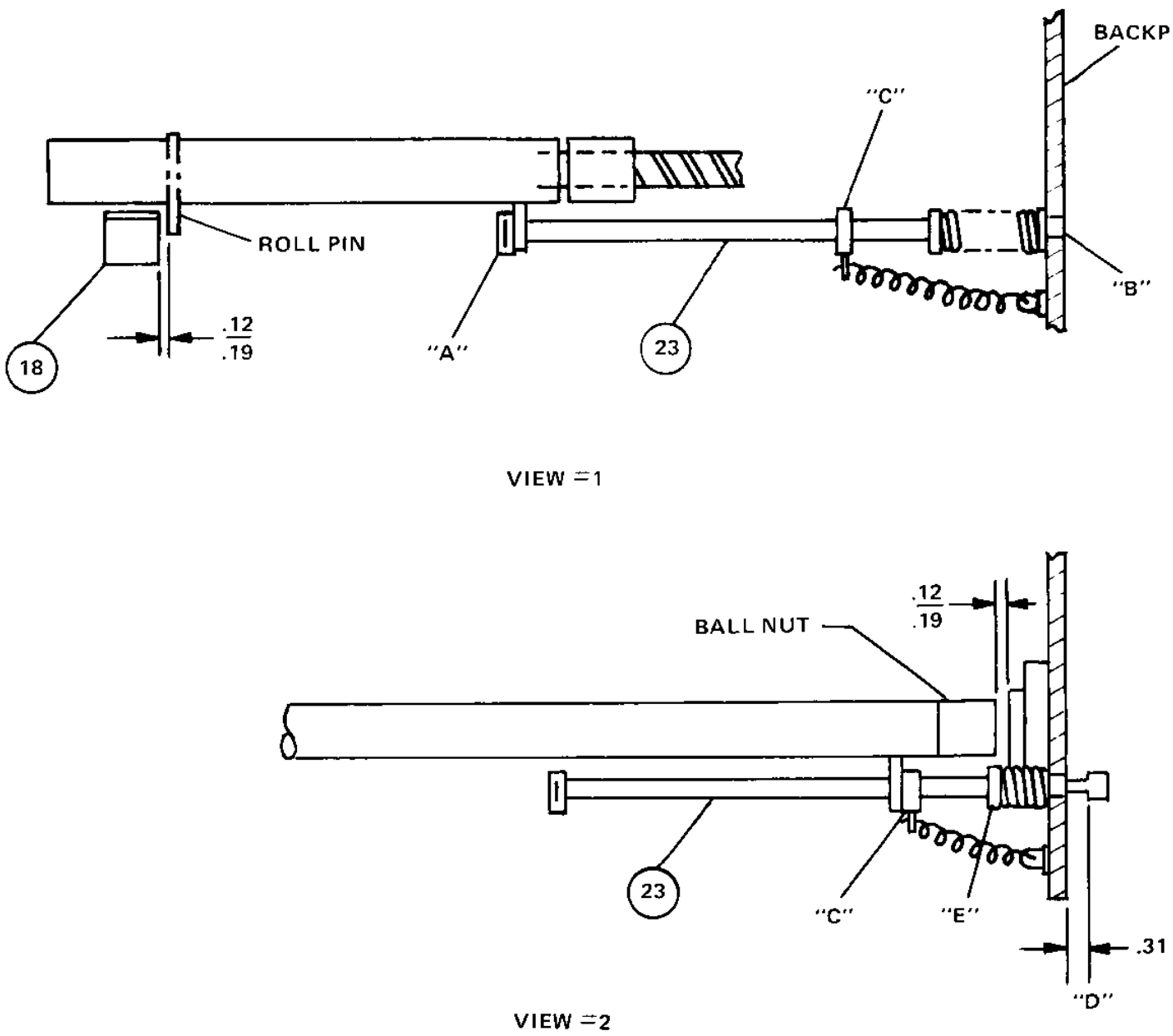


Figure 71–Mechanical Interlocks



VIEW =1 SHOWS INTERLOCK ROD ASSEMBLY FOR BREAKER IN RACKED DOWN POSITION.

VIEW =2 SHOWS INTERLOCK ROD ASSEMBLY FOR BREAKER IN RACKED UP POSITION.

SEE ADJUSTMENT PROCEDURE PAGE 85.

Figure 72. Racking Interlock Rod Assembly

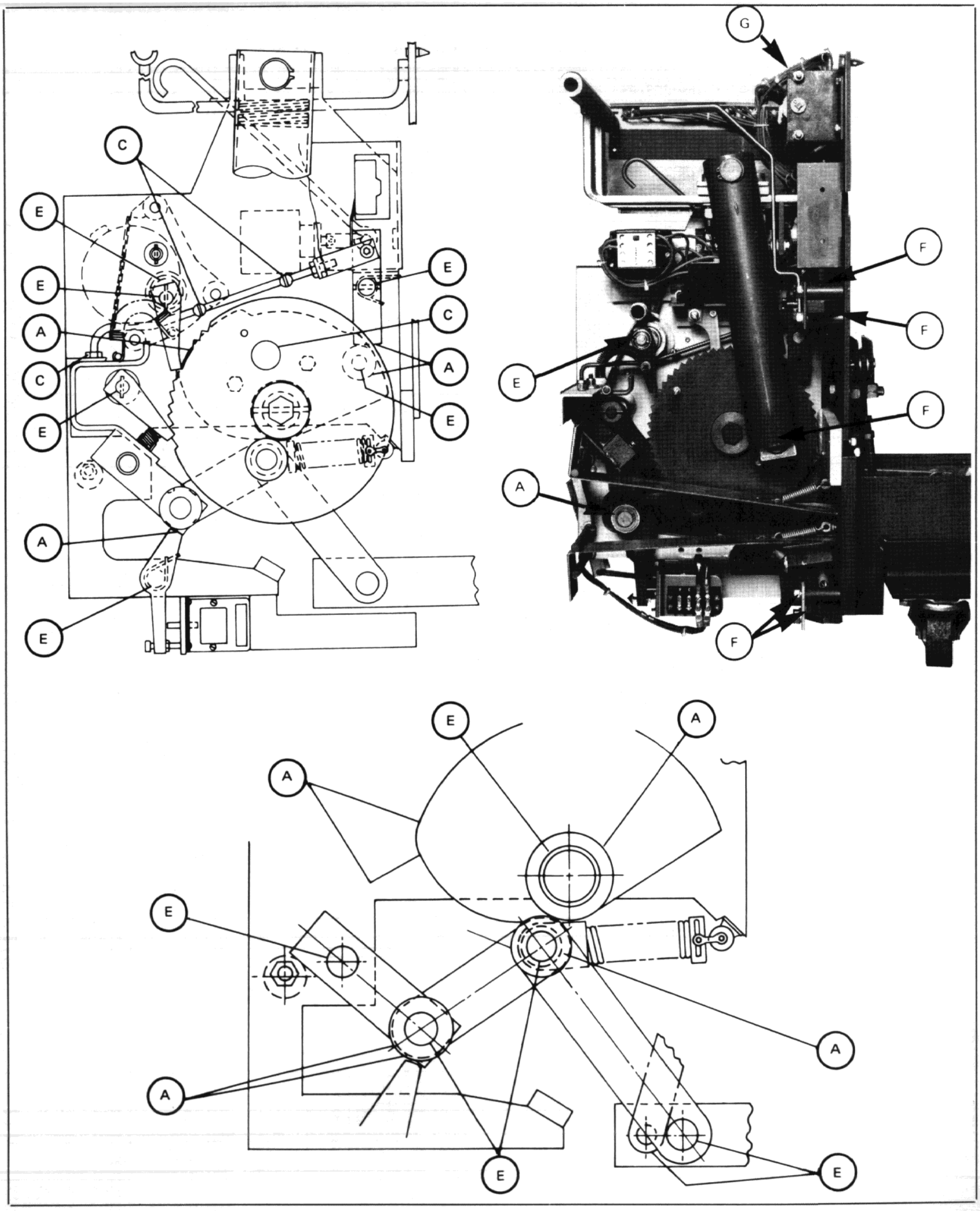


Figure 73–Lubrication Points

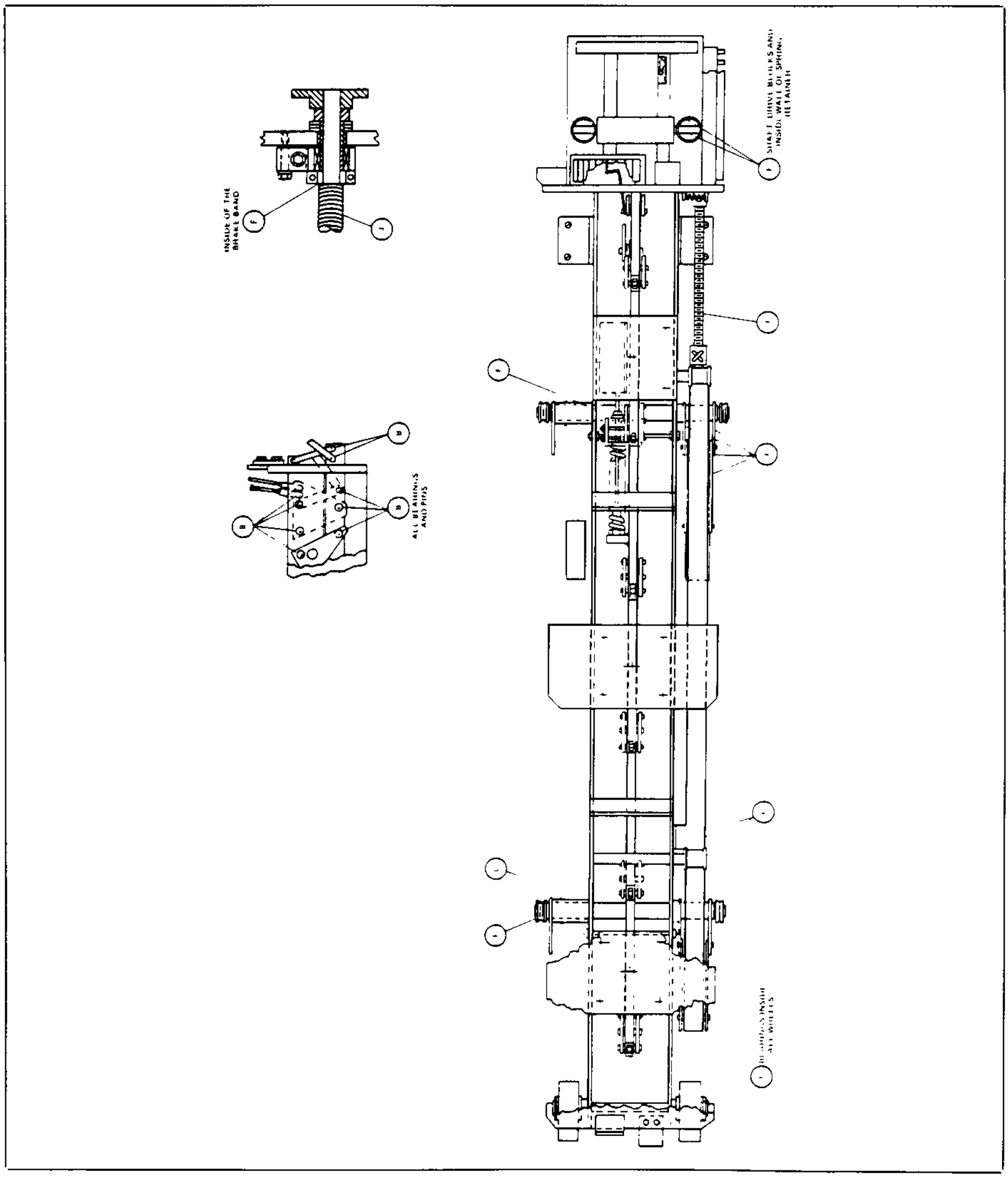
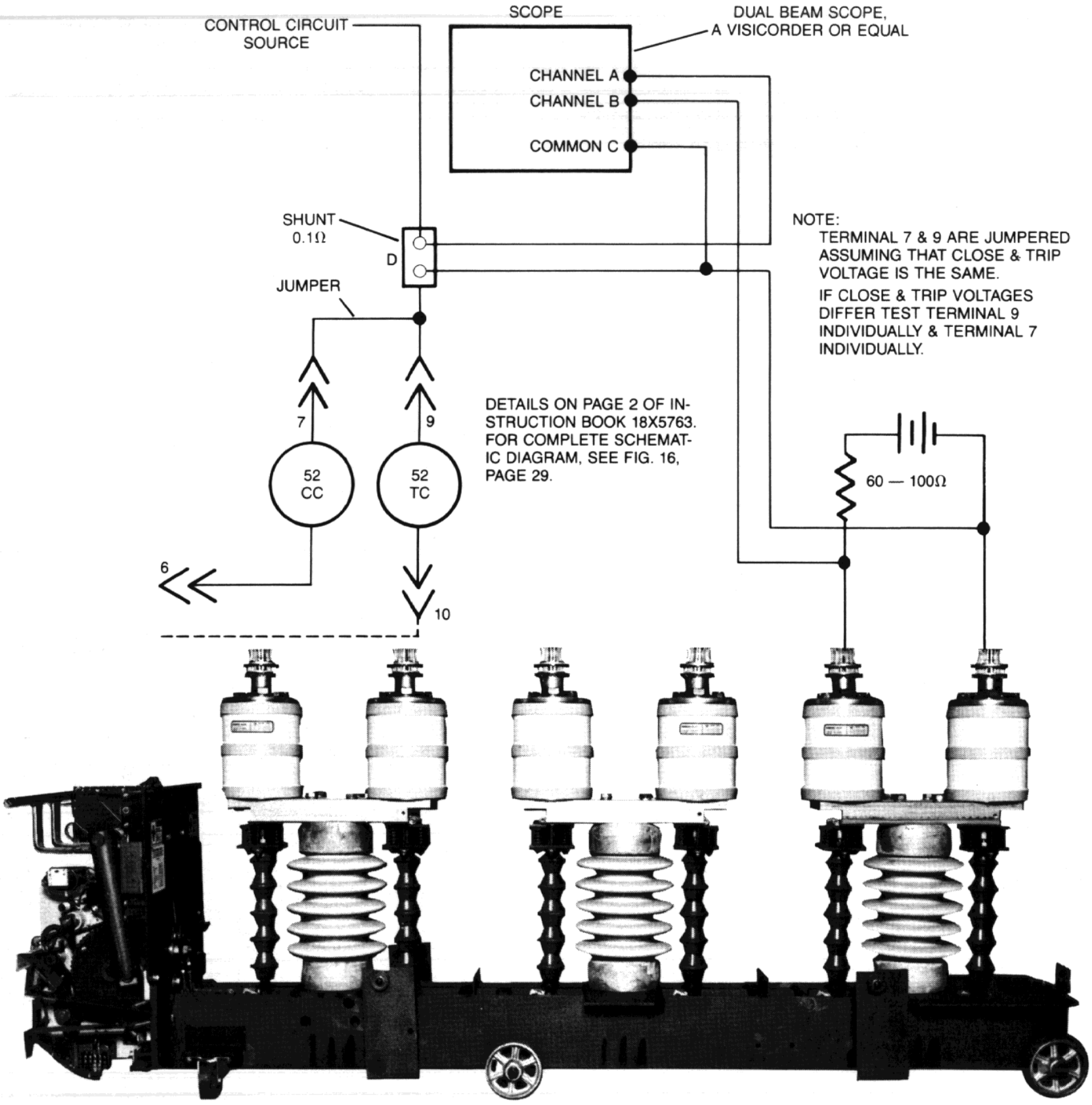


Figure 74–Lubrication Points on Truck Frame Assembly (Plan View)

LUBRICATION KEY	PART DESCRIPTION	SUGGESTED LUBRICATION AT EVERY 1,000 OPERATIONS OR ONCE EVERY YEAR	ALTERNATE LUBRICATION (REQUIRES DISASSEMBLY) RECOMMENDED AFTER EVERY 5,000 OPER.
A	GROUND SURFACES SUCH AS LATCHES, ROLLERS, PROPS, ETC.	WIPE CLEAN AND SPRAY WITH *MOLYCOTE 557* 15-171-270-001.	WASH CLEAN AND SPRAY WITH *MOLYCOTE 557* 15-171-270-001.
B	SLEEVE BEARINGS AND PIVOT PINS, ROTATING PARTS SUCH AS BELL CRANKS, DRIVE BAR.	LIGHT APPLICATION OF *MOLYCOTE PENELUBE* 15-171-270-002.	REMOVE PINS OR BEARINGS, CLEAN PER INSTRUCTIONS AND APPLY *BEACON P-290* 00-337-131-001.
C	SLIDING SURFACES.	LIGHT APPLICATION OF *MOLYCOTE 557*.	WIPE CLEAN AND APPLY *MOLYCOTE 557* LIBERALLY.
D (Fig. 3)	SLIDING PARTS AT VACUUM INTERRUPTER.	LIGHT APPLICATION OF *BEACON P-325*.	LIGHT APPLICATION OF *BEACON P-325*.
E	ROLLER AND NEEDLE BEARINGS.	NO LUBRICATION REQUIRED.	CLEAN PER INSTRUCTIONS AND REPACK WITH *BEACON P-325*.
F	WHEELS, SHAFTS, DRIVE BLOCKS, SPRING RETAINER.	BEACON P-290.	BEACON P-290.
G	PRIMARY AND SECONDARY DISCONNECT FINGERS. GROUNDING CONTACT AND AUXILIARY SWITCH CONTACTS.	WIPE CLEAN AND APPLY A THIN FILM OF SIEMENS-ALLIS CONTACT LUBRICANT 15-171-370-002.	
H	CHARGING SPRINGS AND SPRING RETAINERS.	NO LUBRICATION REQUIRED.	WIPE CLEAN AND COAT WITH *BEACON P-325*.
J	RACKING SCREW.	COAT OF LIGHT GRADE OIL. #5 HYDRAULIC FLUID.	

Figure 75–Lubrication Chart



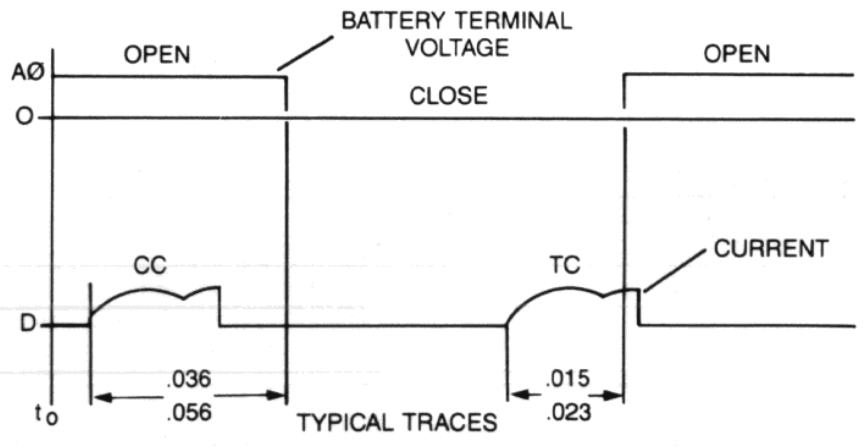


Figure 76–Method for Checking Opening and Closing Times

HOW TO USE YOUR PARTS ORDERING GUIDE

1. Locate the part or parts to be replaced in one of the drawings on this manual.
2. Identify each part by number, description and part number. Give drawing figure number in which part is shown.
3. Include breaker type, rating and breaker serial number with your order.
4. Place order with your Siemens-Allis representative.
5. When ordering relays or other electrical parts, include control voltage (see recommended spare parts list for part numbers).

ORDERING EXAMPLE

Type VV-1500 Rated Amps 1200 Serial Number H-76679A-4

Parts Ordering Guide 18X10265

Fig	Item	Description	Part Number	Quantity
17	5	Lock Washer	00-655-017-018	1
	44	Nut	00-633-025-120	2
	11	Connector	71-141-786-001	1

If required part is not identified in this manual —

1. Make a copy of the drawing figure in which the part would appear.
2. Indicate with arrows or other markings locations of part.
3. Describe or sketch required part.
4. Include breaker type, rating and breaker serial number and control voltage with your order.
5. Place order with your Siemens-Allis representative.

Record your breaker serial numbers here for ready reference.

_____ _____

_____ _____

_____ _____

_____ _____

TABLE OF CONTENTS

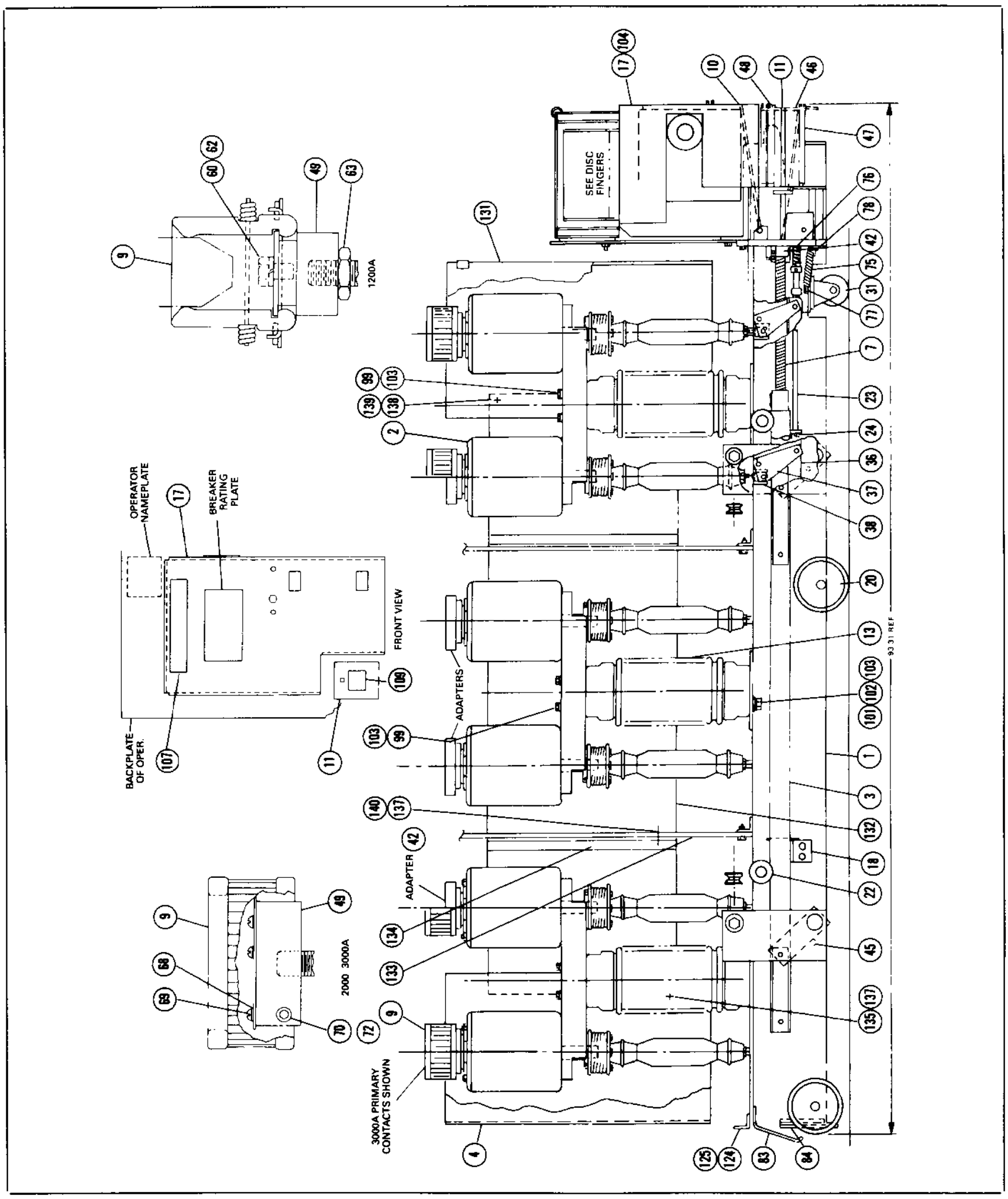


Figure 77 Side View–34.5 kV Vacuum Breaker (Shown with Contacts Open)

Items Description For Figure 77

Item	Description	Part Number	Usage
1	Truck Frame Ass'y	18-469-468-501	
2	Vacuum Tube Ass'y.	18-391-110-502	1200A
		18-391-110-503	2000
			3000A
			See Fig. 3
3	Racking Tube Ass'y.	18-391-111-501	See Fig. 8
4	Barrier Ass'y. (See Items 131 thru 140)	18-391-109-501	1200/2000
		18-394-054-501	3000
7	Clutch & Screw Ass'y	18-724-682-501	See Fig. 7
9	Contact finger Ass'y.	18-657-456-579	1200
		18-657-511-579	2000/3000
10	Interlock & Ind. Mtg.	18-391-113-801	
11	Extension Assembly	18-657-770-517	
13	Insulator (Lapp Cat No. 34247)	18-657-854-042	
17	Cover	18-391-108-001	
18	Rack Tube Support	18-657-521-102	
20	Wheel	15-171-424-007	
22	Support Roller	18-657-521-073	
23	Interlock Lock	18-657-780-188	
24	Collar (With Set Screw)	00-833-681-062	
31	Truck Caster (Bassick 3611 3" Dia. Wheel)	15-171-424-004	
36	Drive Bar	18-390-878-002	
37	Bell Crank	18-657-521-135	
38	Pivot	18-657-521-148	
42	Brake Band	18-724-684-001	
45	Stud	18-724-451-009	
46	Adapter Plate	18-657-780-189	
47	Spacer	18-657-780-190	
48	Stud	18-724-451-011	
49	Pri Disc. Adaptor	18-657-521-081	1200A
		18-657-825-295	2000
			3000A
60	Screw	00-611-315-461	
62	Lockwasher	00-655-017-032	
63	Nut	00-631-087-218	
68	Lockwasher	00-655-047-140	
69	Screw	00-615-015-375	
70	Screw	00-615-114-470	
72	Lockwasher	00-655-025-032	
75	Spring	71-113-503-001	
76	Spring	15-171-431-001	
77	Set Screw 312-18 x 1.25	00-617-025-424	
78	Adj Screw	18-657-765-390	
83	Ground Finger	18-657-521-198	
84	Stop	71-113-478-001	
99	.625-11 x 2.75 Lg. Hex Hd Cap Screw	00-611-289-618	
101	.625-11 x 1.25 Lg. Hex Hd. Cap Screw	00-611-315-609	
102	.625 Rd. Washer	00-651-007-372	
103	625 Lockwasher	00-655-017-040	
104	Shield	18-657-782-265	
107	Siemens-Allis Decal	00-891-105-002	
109	Label (Racking)	18-657-800-339	
124	Angle-Shutter Oper	18-657-521-066	
125	Shim .06 x 2.0 x 3.38	18-657-765-150	
131	End Barrier	18-469-124-001	
132	Side Barrier	18-657-521-069	
133	Vertical Barrier	18-657-521-068	
134	Clip Angle	18-657-521-087	
135	Fl. Hd. Mach. Screw .25-.20 x 750 Lg.	00-615-331-375	
137	Hex Nut (Stover) .25- 20	15-171-063-004	
138	Spreader Rod	18-657-780-184	
139	Fl. Hd. Mach Screw .25-.20 x 1.00	00-615-331-378	
140	Hex Hd. Screw .25-20 x .75 Lg	00-611-315-375	

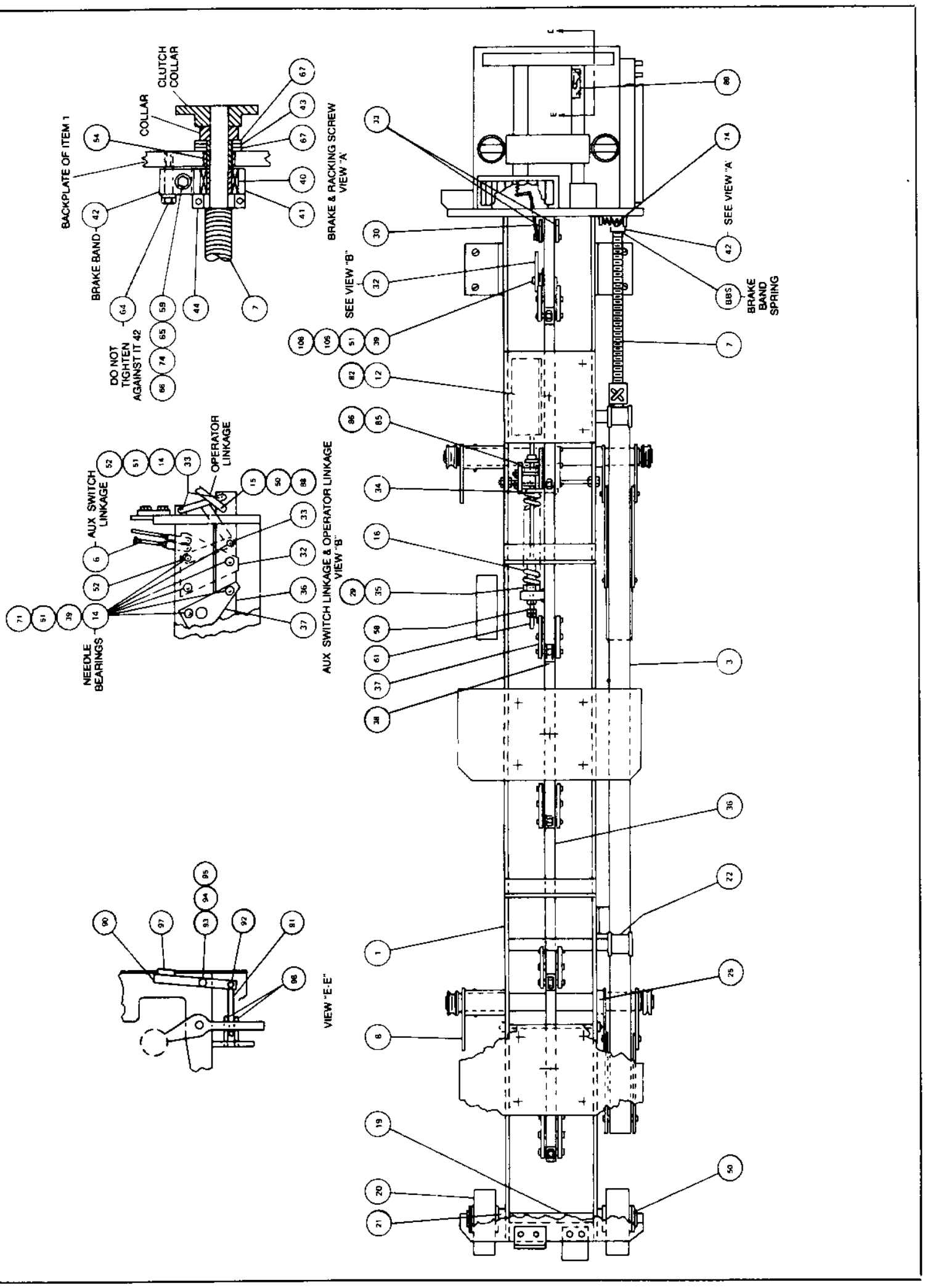


Figure 78 Truck Frame Assembly (Plan View)

PARTS

Items Description For Figure 78

Item	Description	Part Number	Usage
1	Truck Frame Ass'y	18-469-468-501	
3	Racking Tube Ass y.	18-391-111-501	See Fig 8
6	Aux. Sw. & Sec Disc Mtg	18-391-112-801	See Fig 22
7	Clutch & Screw Ass'y.	18-724-682-501	See Fig 7
12	Shock Absorber	15-171-424-001	
14	Needle Bearing	00-813-119-806	
15	Needle Bearing	00-813-119-814	
16	Spring	15-171-331-010	
19	Axle	18-657-521-075	
20	Wheel	15-171-424-007	
21	Collar (With Set Screw)	00-833-681-075	
22	Support Roller	18-657-521-073	
25	Spacer	18-657-521-101	
29	Washer	00-651-027-480	
30	Ind. Link	18-657-783-136	
32	Bell Crank	18-657-521-169	
33	Link	18-724-683-001	
34	Op. Sp. Guide	18-657-521-151	
35	Op. Sp. Spacer	18-657-769-077	
36	Drive Bar	18-390-878-002	
37	Bell Crank	18-657-521-135	
38	Pivot	18-657-521-148	
39	Pin	18-657-521-150	
40	Roller Clutch (RCB162117)	15-171-422-001	
41	Brake Collar	18-657-521-103	
42	Brake Band	18-724-684-001	
43	Thrust Bearing NTA1625	15-171-425-001	
44	Clamp	15-171-424-002	
50	Retaining Ring	00-673-165-075	
51	Retaining Ring	00-673-165-050	
52	Pin	18-657-782-269	
54	Sleeve Bearing	15-171-424-008	
58	Nut (Jam) (.50-13)	00-631-171-108	
59	Elastic Stop Nut (25-20)	00-633-025-116	
61	Hex Hd. Cap Screw .500-13 x 1.75 Lg.	00-611-357-550	
64	Screw (.375-16 x 1.75 Lg.)	00-611-315-472	
65	Screw (.250-20 x 2.50 Lg.)	00-611-315-390	
66	Washer	00-651-007-123	
67	Washer TRE1625	15-171-425-002	
71	Washer .531 I.D x 1.00 O.D. x .062 T	00-651-027-286	
74	Spring	14-139-411-001	
82	Hex Soc. Hd. Cap Screw (.375-16 x 1.75)	00-615-114-472	
85	Bumper	18-657-800-331	
86	Angle	18-657-800-330	
88	Pin	18-657-781-275	
89	Label (Pull to Close)	71-114-294-001	
90	Trip lever	18-657-782-276	
91	Trip Link	18-657-783-135	
92	Push Nut (.25)	00-639-047-004	
93	.375-16 x 2.00 Lg. Hex Hd. Cap Screw	00-611-315-474	
94	.375-16 Hex Jam Nut	00-631-185-106	
95	.375 Shakeproof Lockwasher	00-655-047-200	
97	Trip Button Decal	18-657-783-359	
98	.188 x 2.50 Lg Roll Pin	00-671-176-327	
105	Spacer	18-194-796-001	
106	Washer .531 I.D.	71-152-809-024	
130	Washer 1.00 I.D.	15-171-949-045	

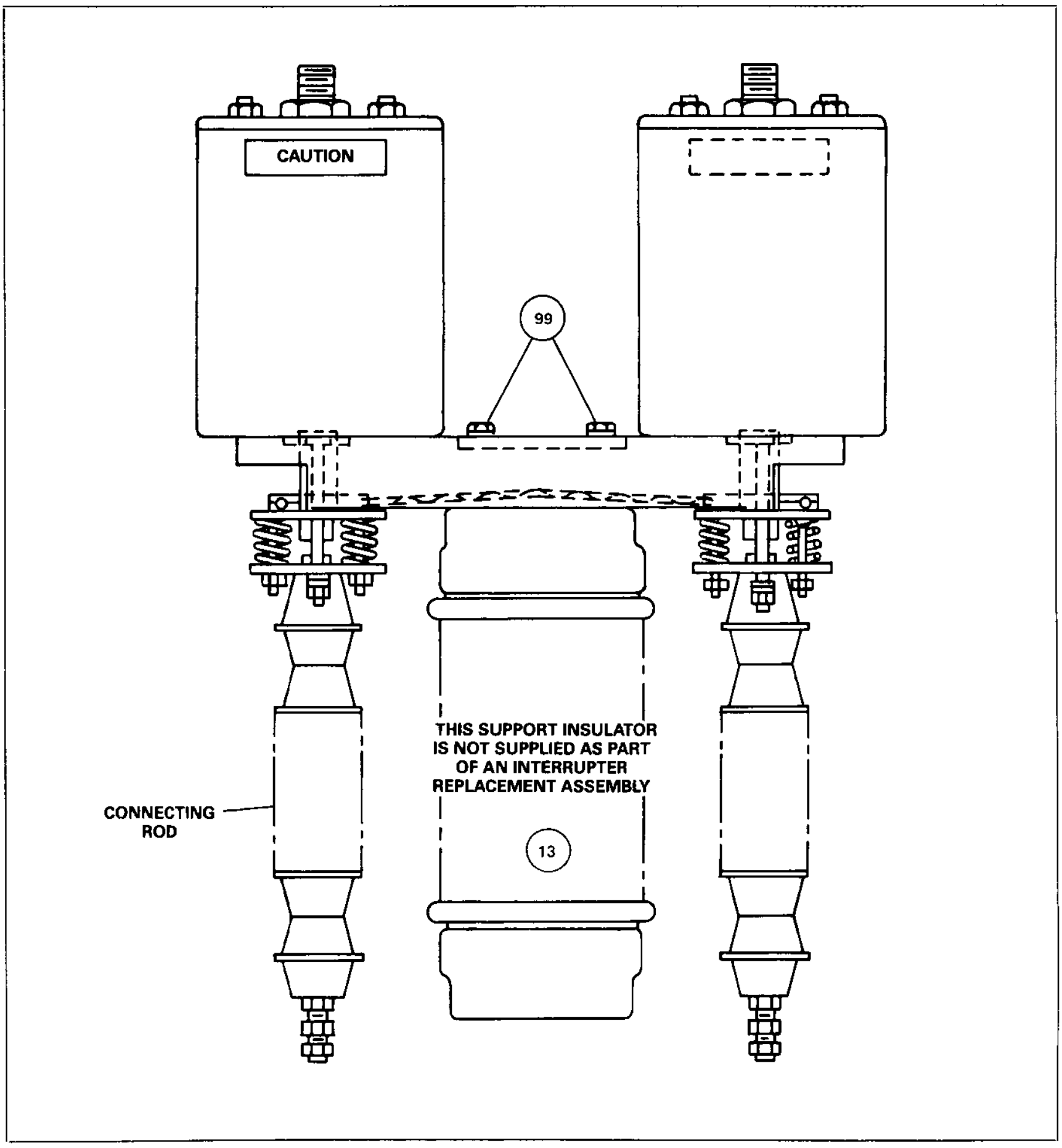
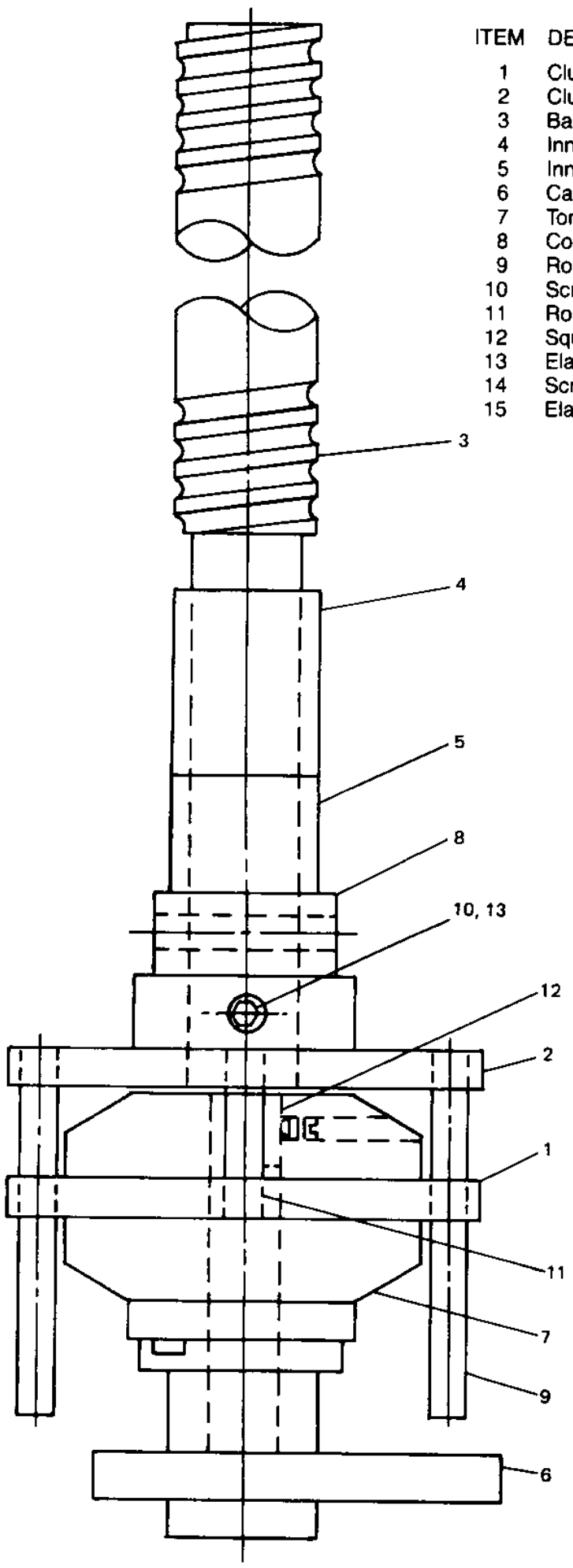


Figure 79 Vacuum Interrupter Assembly–One Pole (1200 Amp Shown)



ITEM	DESCRIPTION	PART NUMBER	USAGE
1	Clutch Disc	18-657-521-109	
2	Clutch Collar	18-657-521-099	
3	Ball Screw & Nut	18-722-287-801	
4	Inner Race	15-813-119-023	
5	Inner Race	15-813-119-022	
6	Cam Assembly	18-657-510-522	
7	Torque Limiter	15-171-402-001	
8	Collar	18-657-780-186	
9	Roll Pin	00-671-176-389	
10	Screw	00-615-114-386	
11	Roll Pin	00-671-176-381	
12	Square Key	00-677-101-013	
13	Elastic Stop Nut	00-633-083-104	
14	Screw	00-617-849-254	
15	Elastic Stop Nut	00-633-039-110	

Figure 80 Clutch and Screw Assembly

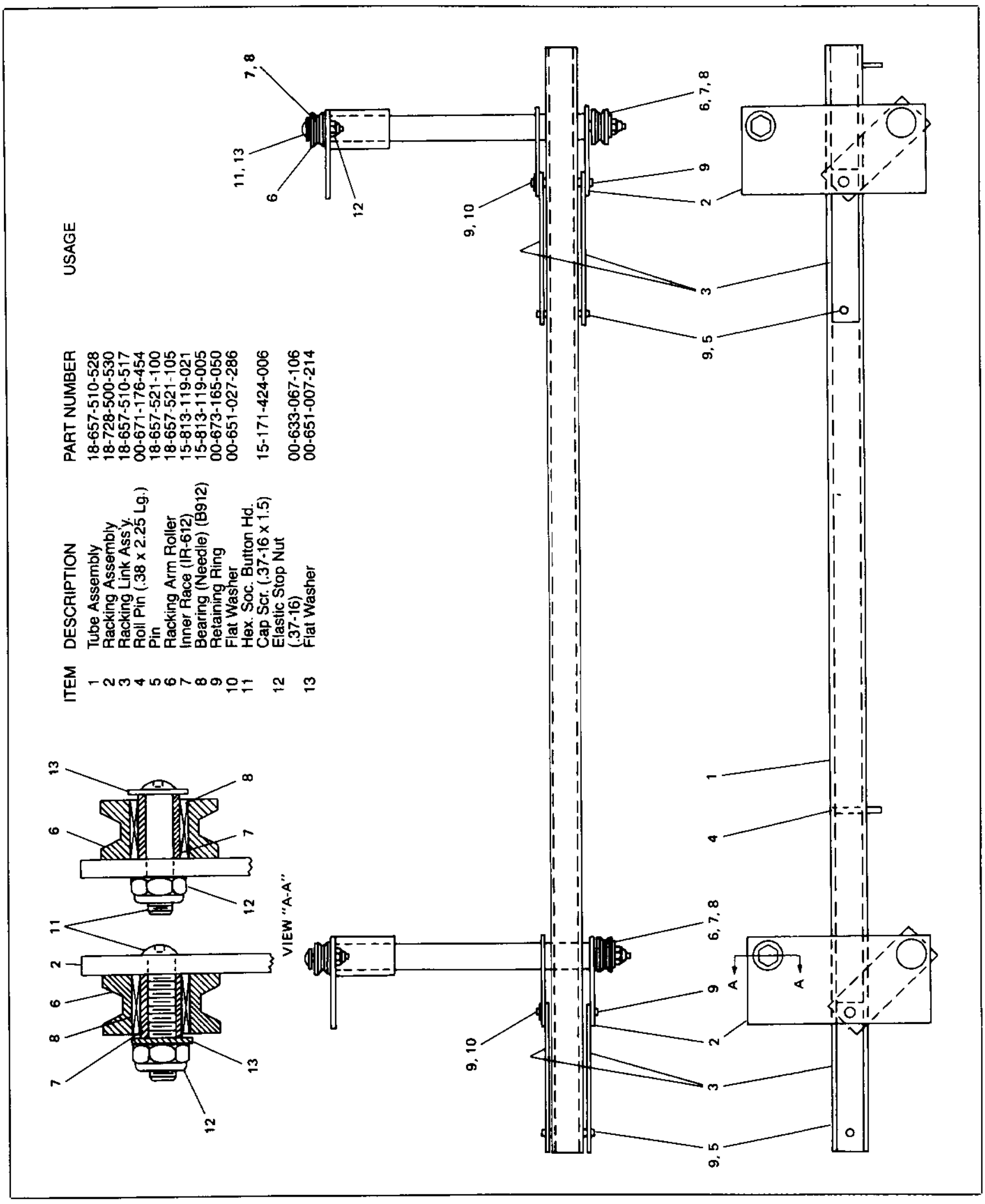
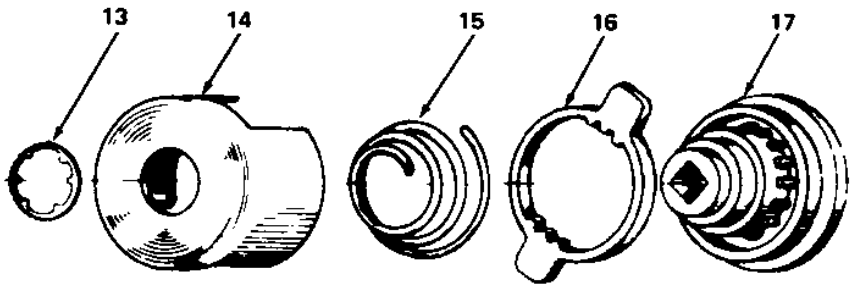
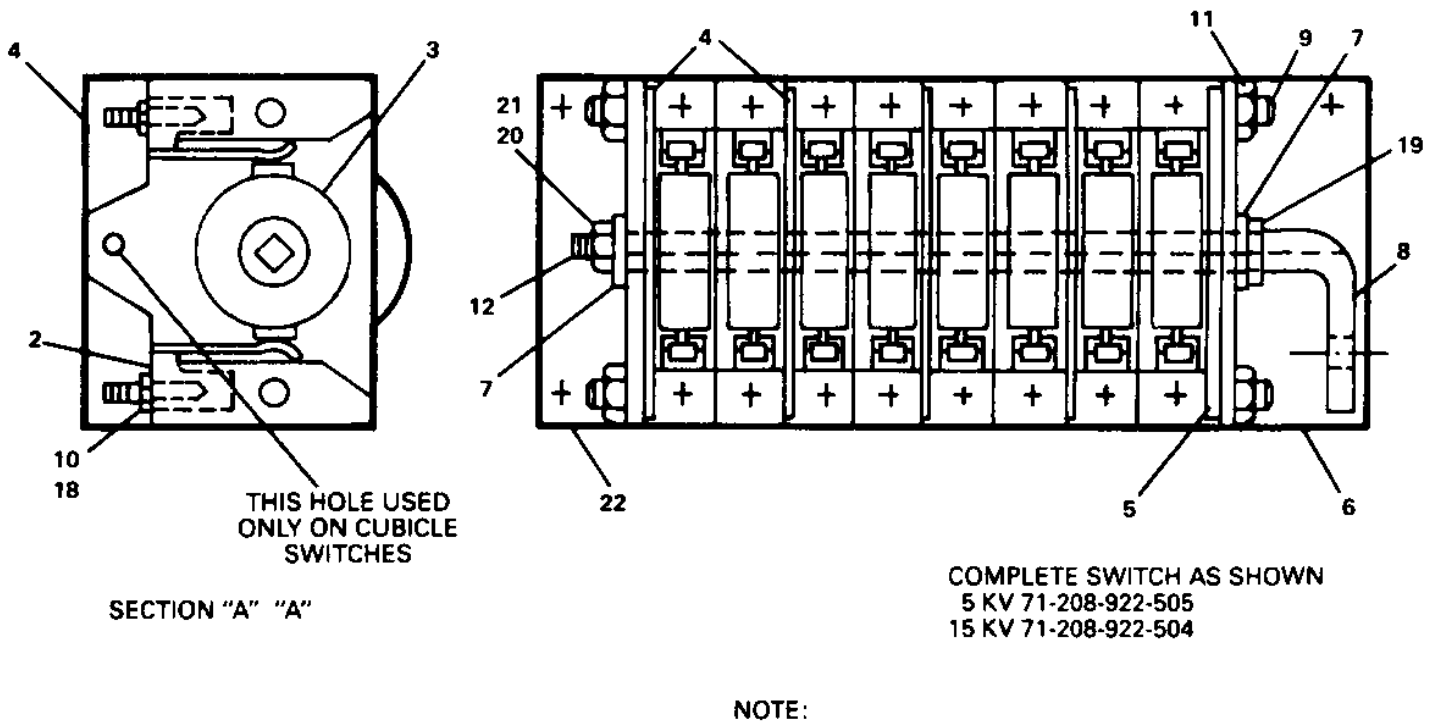


Figure 81 Racking Bar Assembly



2	Contact Finger	18-657-524	224
3	Rotor Assembly	71-109-293	501
4	Barrier	18-723-775	001
5	Barrier	18-657-523	003
6	Bracket	71-208-921	003
7	Bushing	71-109-282	001
8	Shaft	71-114-838	001
9	Stud	18-292-228	029
10	Hex Nut (10-32) Brass	00-631-133	030
11	Stv. Locknut	15-171-063	003
12	Cotter Pin	00-671-195	049
13	Retaining Ring	Rotor 71-109-293-501	
14	Shell		
15	Spring		
16	Rotor		
17	Retainer		
18	#10 Lockwasher	00-655-059	100
19	Washer	71-110-035	001
20	Hex Nut (.250)	00-631-059	204
21	.25 Lockwasher	00-655-017	026
22	Bracket	71-208-921	004



NOTE:
ITEMS 2, 3, 4, 5, 7, 10, 11, 12, 18, 19, 20 & 21 ARE ALSO USED ON CUBICLE AUXILIARY SWITCH.

Figure 82 Auxiliary Switch

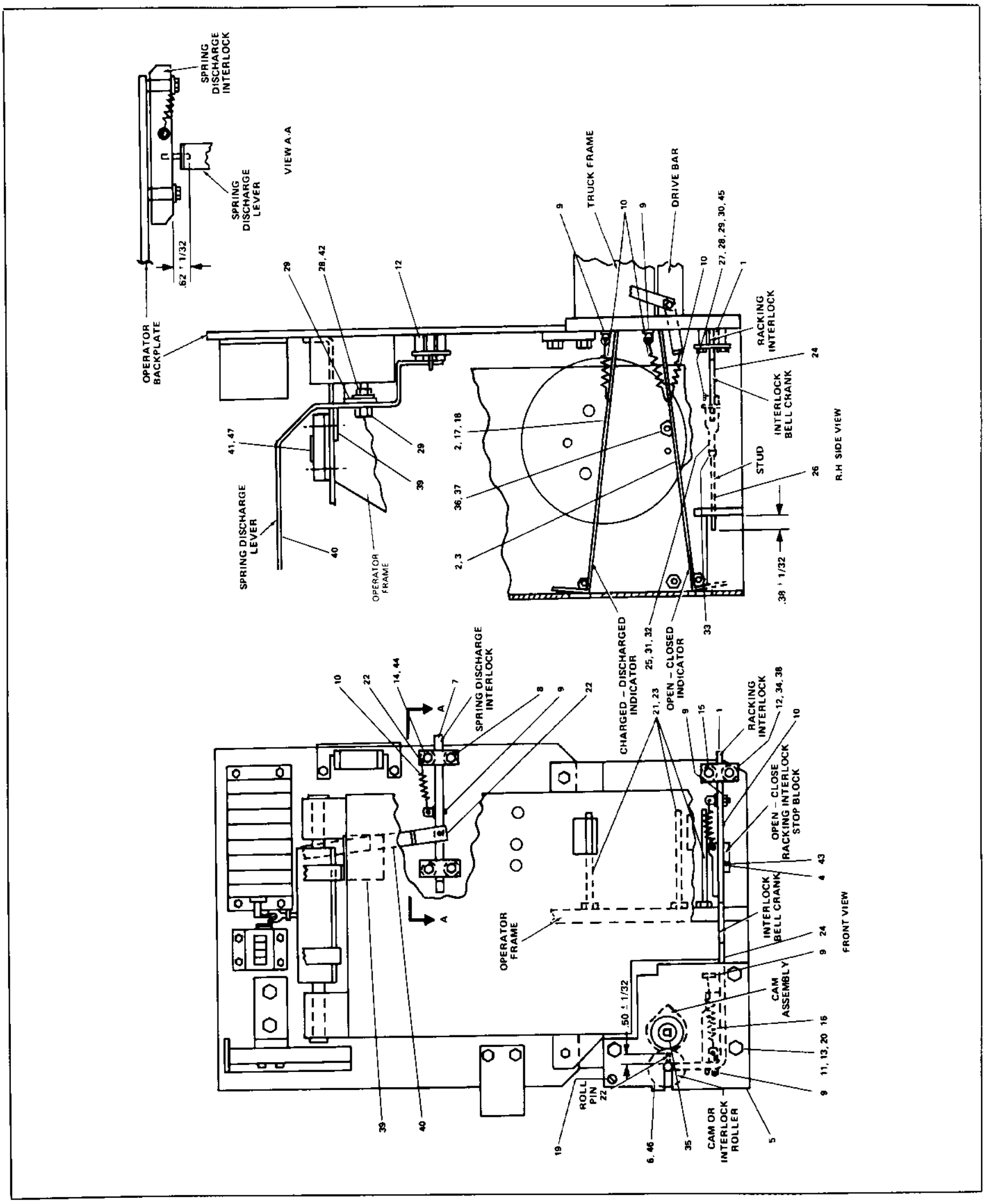


Figure 83 Interlock and Indicator Arrangement

Items Description for Figure 83

Item	Description	Part Number	Usage
1	Interlock Assembly	18-390-876-501	
2	Flag	18-724-455-001	
3	Indicator	71-141-817-001	
4	Op-Cl Interlock	18-657-521-138	
5	Motor Mt.	18-657-521-132	
6	Interlock Roller	18-657-521-136	
7	Sp. Dump Bar	18-657-521-157	
8	Dump Bar Retainer	18-657-521-159	
9	Adj. Screw	18-657-765-390	
10	Ext. Spring	18-199-881-001	
11	Spacer	18-657-521-147	
12	Spacer	18-657-853-028	
13	Screw	00-611-315-570	
14	Screw	00-611-315-474	
15	Interlock Bar Retainer	18-657-765-242	
16	Ext. Spring	00-837-455-078	
17	Indicator	71-141-815-003	
18	Indicator	71-141-815-004	
19	Roll Pin	00-671-176-379	
20	Lockwasher	00-655-017-036	
21	Stud	18-724-451-013	
22	Roll Pin	00-671-176-381	
23	Nut, Jam	00-631-143-106	
24	Interlk. Bell Cr.	18-657-521-134	
25	Yoke End	00-691-701-901	
26	Stud	18-724-451-004	
27	Bushing	18-160-855-001	
28	Screw	00-611-315-378	
29	Washer	00-651-007-160	
30	Lockwasher	00-655-017-026	
31	Clevis Pin	00-957-211-901	
32	Cotter Pin	00-671-155-049	
33	Nut	00-631-003-204	
34	Lockwasher	00-655-017-032	
35	Bushing	18-657-521-142	
36	Screw	00-615-245-225	
37	Nut	00-631-109-210	
38	Screw	00-611-315-478	
39	Lever Support	18-657-800-337	
40	Spring Dump Lever	18-657-800-338	
41	Indicator (Breaker Release)	71-111-259-001	
42	Elastic Stop Nut	00-633-025-116	
43	Roll Pin	00-671-176-187	
44	Washer	00-655-047-200	
45	Washer	00-651-017-922	
46	Washer	00-651-027-286	
47	Caution Label	18-657-765-153	

PARTS

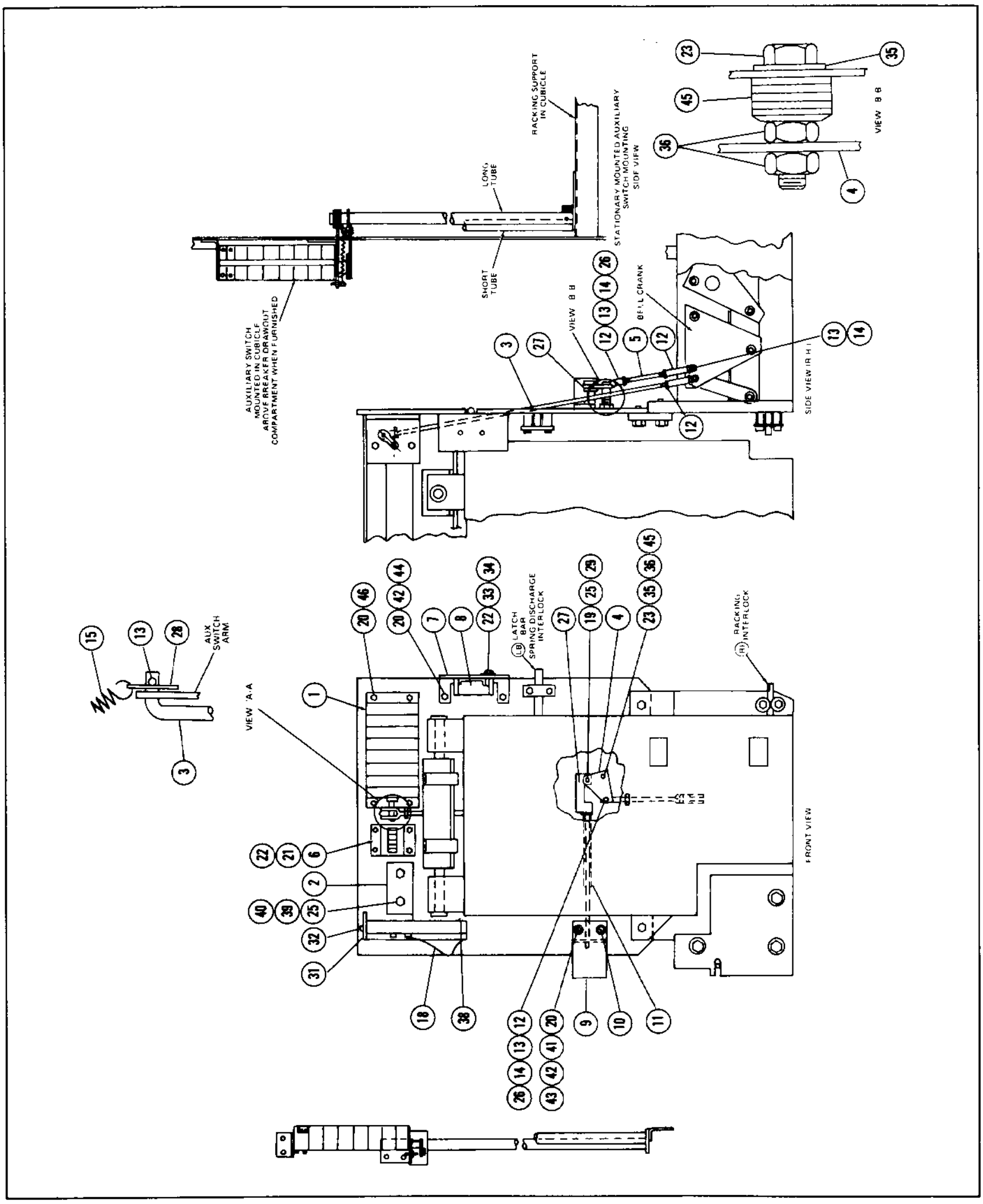


Figure 84 Auxiliary Switch and Secondary Disconnect Mounting

Items Description for Figure 84

Item	Description	Part Number	Usage
1	Aux. Switch Q10	18-724-460-501	
2	Support Assembly	18-724-525-501	
3	Stud	18-657-870-196	
4	Bell Crank	18-657-521-168	
5	Stud	18-724-451-018	
6	Operation Counter	15-171-424-005	
7	Switch Mtg. Angle	18-657-521-158	
8	Switch	00-871-282-403	AD
		00-871-383-402	DC
9	Shield	18-657-769-370	
10	Guide	18-657-521-170	
11	Rod	18-657-765-108	
12	Yoke End	18-657-870-197	
13	Cotter Pin	00-671-195-049	
14	Clevis Pin	00-957-211-901	
15	Extension Spring	71-141-266-001	
18	Sec. Disc. Assembly	72-120-237-501	
19	Cotter Pin	00-671-195-119	
20	Lockwasher	00-655-017-026	
21	Mach. Screw	00-615-471-120	
22	Lockwasher	00-655-017-018	
23	Capscrew	00-611-315-554	
25	Pl Rd. Washer	00-651-007-230	
26	Nut	00-631-003-205	
27	Bracket Assembly	18-657-775-533	
28	Washer	18-657-784-009	
29	Clevis Pin	00-957-211-903	
31	Sec. Shield	18-657-769-374	
32	Screw Tapping	00-615-581-218	
33	Mach. Screw	00-615-471-122	
34	Nut	00-631-109-106	
35	Pl. Rd. Washer	00-651-007-300	
36	Hex Nut	15-171-063-012	
38	Barrier	18-657-765-061	
39	Capscrew Hex Hd.	00-611-315-463	
40	Lockwasher	00-655-017-032	
41	Capscrew Hex Hd.	00-611-315-378	
42	Washer, Plain	00-651-007-160	
43	Nut, Hex	00-631-059-104	
44	Capscrew Hex Hd.	00-611-315-371	
45	Capscrew Hex Hd.	15-171-001-005	
46	Capscrew	00-611-315-369	

PARTS

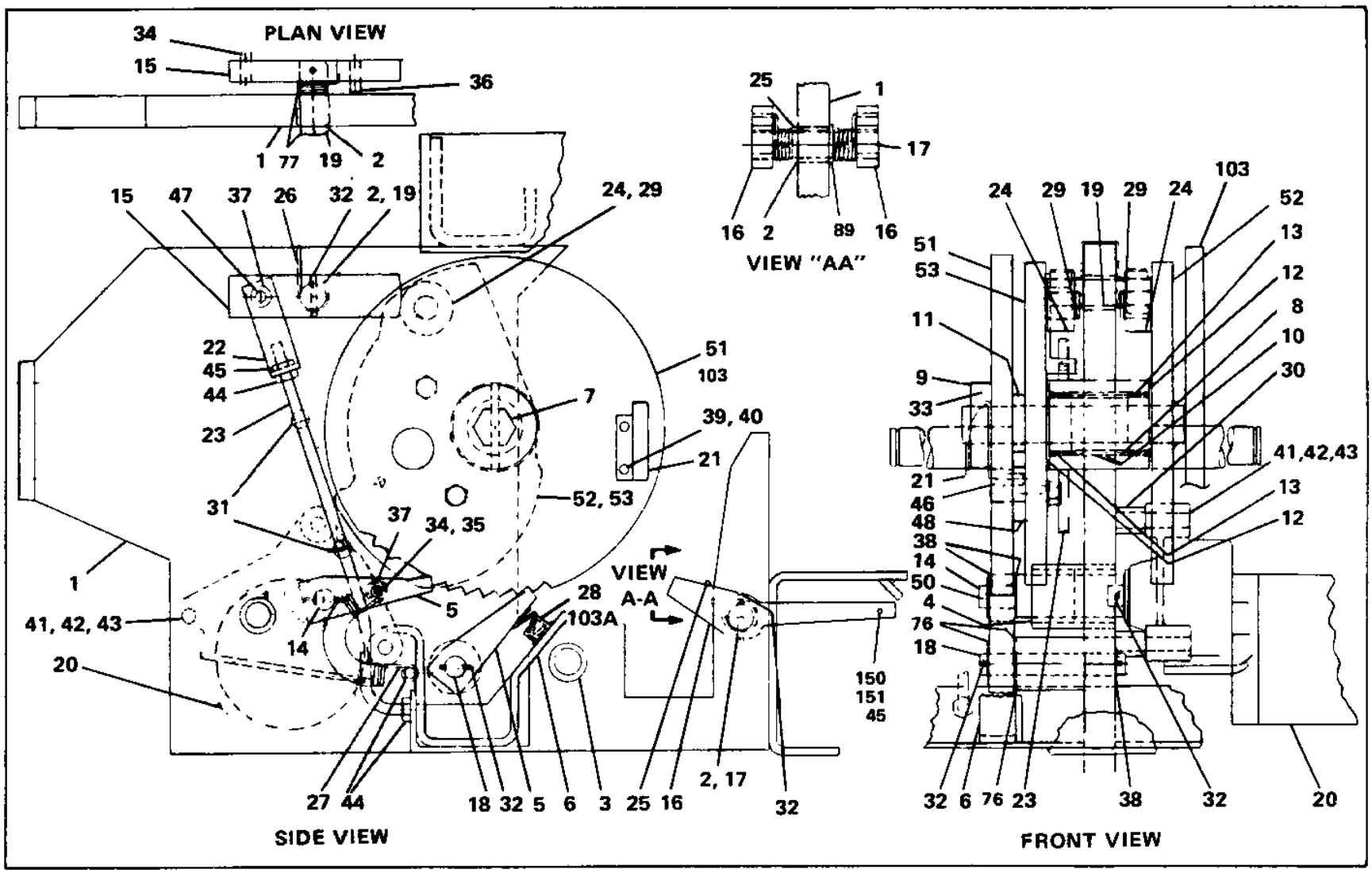


Figure 85 Frame and Drive Assembly

Items Description for Figure 85

Item	Description	Part Number	Usage
1	Frame Assembly	18-469-404-501	
2	Needle Bearing	00-813-119-810	
3	Needle Bearing	00-813-119-814	
4	Needle Bearing	00-813-119-821	
5	Pawl Assembly	18-657-485-536	
6	Stop Bracket Ass'y.	18-657-852-582	
8	Slit Spacer	18-657-800-113	
9	Collar	18-657-467-290	
10	Inner Race**	18-657-467-335	
11	Spacer	18-158-935-009	
12	Thrust Washer	00-815-225-131	
13	Needle Bearing	15-813-119-003	
14	Pin	18-657-463-368	
15	Stop Latch	18-657-463-388	
16	Trip Latch	18-657-521-179	
17	Pin	18-657-464-012	
18	Pin	18-657-523-064	
19	Shaft	18-657-463-389	
20	Motor*	18-469-223-001	48V DC
	C. W. Rotation	18-469-223-002	115 AC 125V DC
		18-469-223-003	230AC
21	Charge Disc Actuator	18-657-522-305	
22	Bracket	18-657-800-114	
23	Interlock Rod	18-657-522-269	
24	Roller Bearing	15-813-073-003	
25	Torsion Spring	18-657-466-081	
26	Torsion Spring	18-657-466-080	
27	Pawl Return Spring	18-657-229-240	
28	Comp. Spring	15-837-321-008	
29	Retaining Ring	00-673-165-062	
30	Spacer	18-158-935-011	
31	Adj. Screw	15-657-765-390	
32	Roll Pin	00-671-176-194	
33	Roll Pin	00-671-165-325	
34	Roll Pin	00-671-176-383	
35	Roll Pin	15-671-173-002	
36	Roll Pin	00-671-171-375	
37	Washer	18-657-522-303	
38	Washer, Thrust Race	15-171-091-005	
39	Screw	00-615-245-218	
40	Lockwasher	00-655-017-022	
41	Screw	00-611-315-392	
42	Washer	00-651-007-160	
43	Lockwasher	00-655-017-026	
44	Elastic Stop Nut	00-633-025-116	
45	Jam Nut	00-631-143-104	
46	Roll Pin	00-671-176-373	
47	Roll Pin	00-671-171-379	
48	Spacer	18-657-523-278	
50	Roll Pin	00-671-176-189	
51	Ratchet Assembly	18-390-202-501	
52	Cam Assembly	18-390-882-501	
53	Cam Assembly***	18-391-882-502	
76	Washer	71-163-273-001	
77	Washer	71-140-443-001	
89	Washer	00-651-017-357	
103	Flywheel	18-392-067-001	
103A	Bumper	18-657-822-286	
150	Screw	00-615-114-380	
151	Lockwasher	00-655-047-140	

PARTS

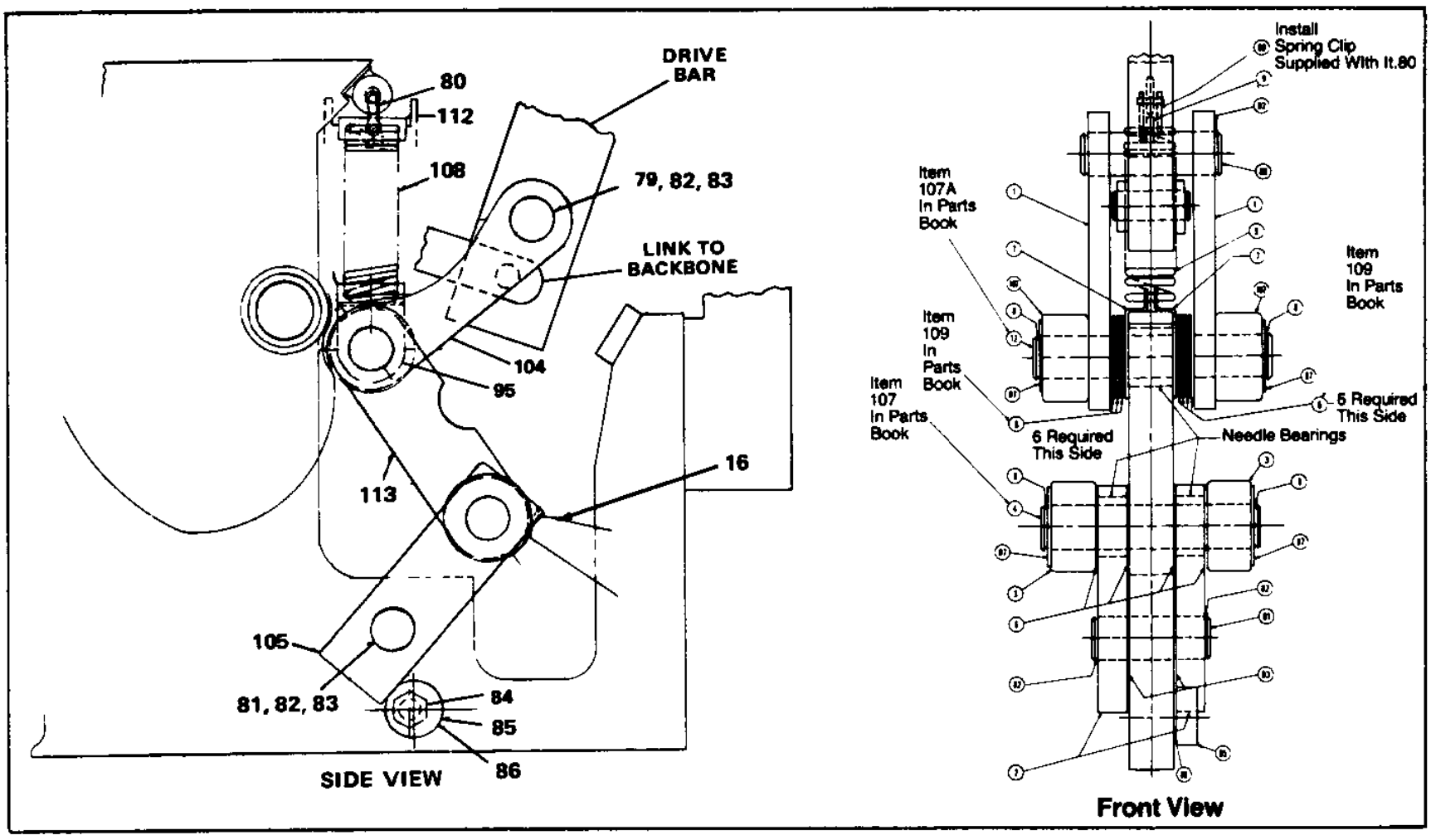


Figure 86 Operator Assembly

Items Description for Figure 86

Item	Description	Part Number	Usage
79	Pin	18-657-781-275	
80	Chain Link	00-831-349-065	
81	Pin	18-657-464-105	
82	Retaining Ring	00-673-165-075	
83	Washer	71-152-809-026	
84	Cap Screw	15-171-059-005	
85	Stop	18-657-464-118	
86	Washer	00-655-067-200	
87	Washer	00-651-027-087	
104	Link	18-657-521-145	
105	Link w/Bearing	18-657-510-524	
106	Roller	15-813-073-001	
107	Pin	18-657-464-104	
108	Spring	18-657-523-331	
109	Washer	71-152-809-026	
110	Spring Holder	18-657-523-332	
111	Retaining Ring	00-673-465-075	
112	Spring Anchor	18-657-523-333	
113	Link	18-657-775-534	
114	Needle Bearing	00-813-119-813	

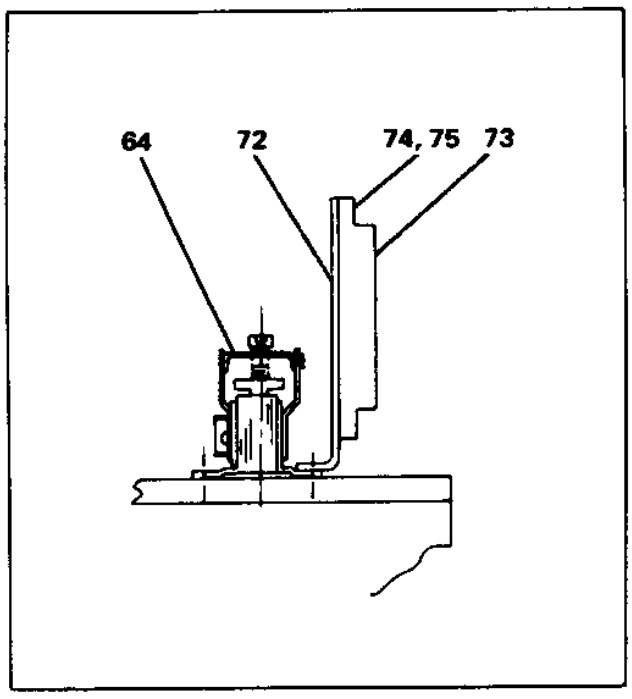


Figure 87 Type 515-2 Stored Energy Operator Assembly

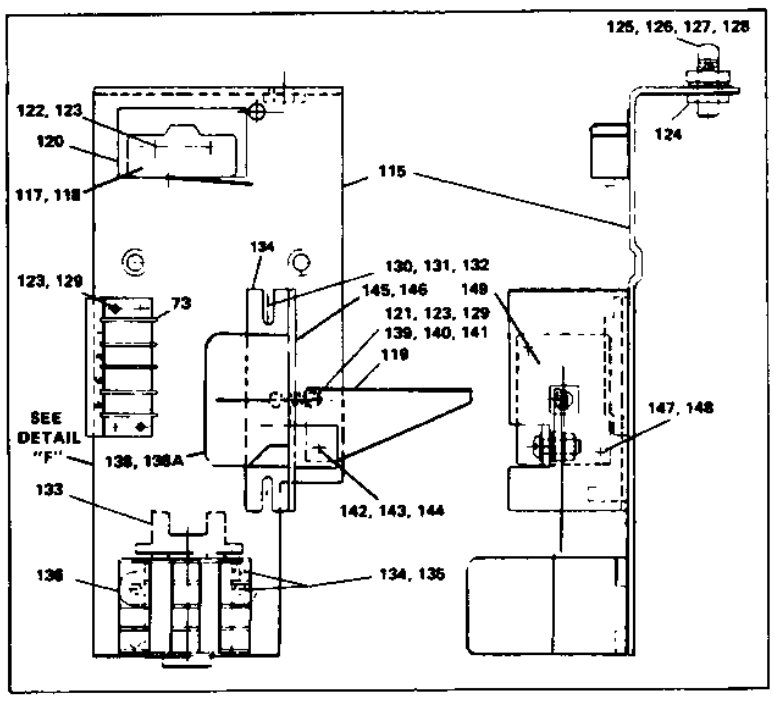


Figure 88

Items Description for Figure 87 & 88

Item	Description	Part Number	Usage
72	Term. Block Supp. Bracket	18-657-524-111	
73	Term. Block with Hardware	00-857-036-012	
74	Screw	00-615-471-124	
75	Lockwasher	00-655-047-060	
115	Plate	18-723-641-001	
117	Closing Latch Check Switch	15-171-323-001	AC
118	Closing Latch Check Switch	15-171-323-002	DC
119	Actuator Arm	18-657-769-376	
120	Shield	18-657-468-090	
121	Extension Spring	18-657-523-061	
122	Screw	00-615-471-130	
123	Washer	00-655-047-060	
124	Nut	14-147-052-002	
125	Screw	00-617-247-470	
126	Nut	00-631-171-106	
127	Washer	00-655-017-032	
128	Washer	00-651-007-230	
129	Screw	00-615-471-124	
130	Screw	00-615-485-216	
131	Washer	00-655-017-022	
132	Washer	00-651-007-907	
133E	Relay, Anti-Pump	15-171-405-001	230V AC
134	Bracket	18-657-522-356	
135	Screw	00-615-291-171	
138	Motor Cutoff Switch	18-736-827-501	
	All Except 150 DC	NC-NO-NO-NO	
138A	Motor Cuttoff Switch 250V DC Only	18-394-426-544	
		NO-NO-NO-NC	
139	Washer	00-651-007-059	
140	Nut	00-631-109-106	
141	Eyelet	00-691-651-003	
142	Washer Rd.	00-651-007-123	
143	Screw	00-615-245-375	
144	Elastic Nut	00-633-103-216	
145	Screw	00-615-471-170	
146	Lockwasher	00-655-047-080	
147	Screw	18-657-780-193	
148	Lockwasher	00-655-017-018	
149	Spring	15-171-366-007	
642	Closing Coil	17-171-339-017	

PARTS

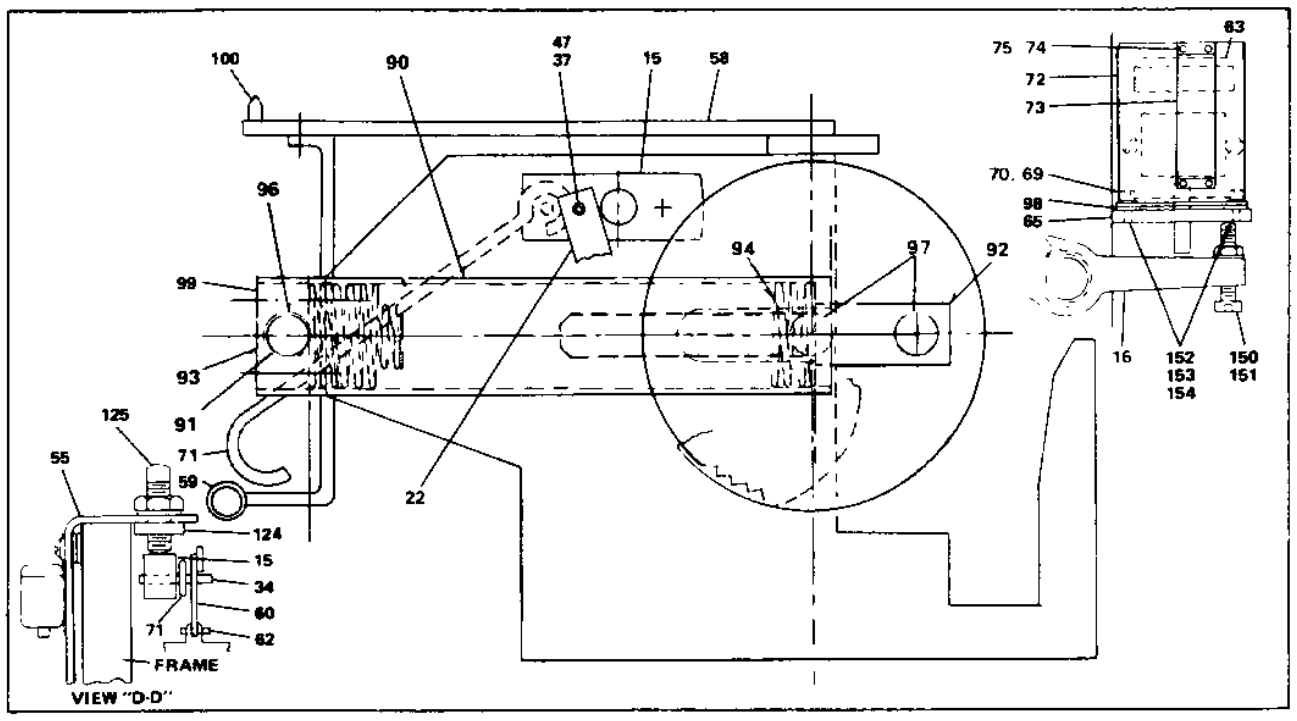


Figure 89

Items Description for Figure 89

Item	Description	Part Number	Usage
15	Stop Latch	18-657-463-388	
16	Trip Latch	18-657-521-179	
34	Roll Pin	00-671-176-383	
37	Washer	18-657-522-303	
47	Roll Pin	00-671-171-379	
55	Motor & Closing Control (Consist of 115 to 149)	18-390-246-501	
58	Back Plate	18-390-977-001	
60	Solenoid Trip Link Assembly	18-657-770-518	
62	Clevis Pin	15-171-751-002	
63	Closing Coil	15-171-339-001	48V DC
64D		17-171-339-017	120C AC
65	Mounting Plate	18-724-476-001	
69	Screw	00-615-124-220	
70	Lockwasher	00-655-017-022	
71	Manual Close Rod	18-657-521-160	
72	Term Block Supp. Bracket	18-657-524-111	
73	Term Block with Hardware	00-857-036-012	
74	Screw	00-615-471-124	
75	Lockwasher	00-655-047-060	
90	Spring Retainer	18-657-523-038	
91	Shaft	18-657-463-369	
92	Drive Block	18-657-465-170	
93	Bearing Block	18-657-942-303	
94	Spring	15-171-833-661	
96	Retaining Ring	00-673-165-087	
97	Retaining Ring	00-673-165-087	
98	Shim	18-657-784-007	
99	Screw	00-615-114-552	
100	Guide Pin	18-657-902-312	
115	Plate	18-723-641-001	
117	Closing Latch Check Switch	15-171-323-001	AC
118	Closing Latch Check Switch	15-171-323-002	DC
124	Nut	14-147-052-002	
125	Screw	00-617-247-470	
133E	Relay, Anti-Pump	15-171-405-001	230V AC
134	Bracket	18-657-522-356	
150	Screw	00-615-114-380	
151	Lockwasher	00-655-047-140	
152	Washer	00-615-017-032	
153	Washer	00-651-007-230	
154	Screw	00-611-315-463	

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