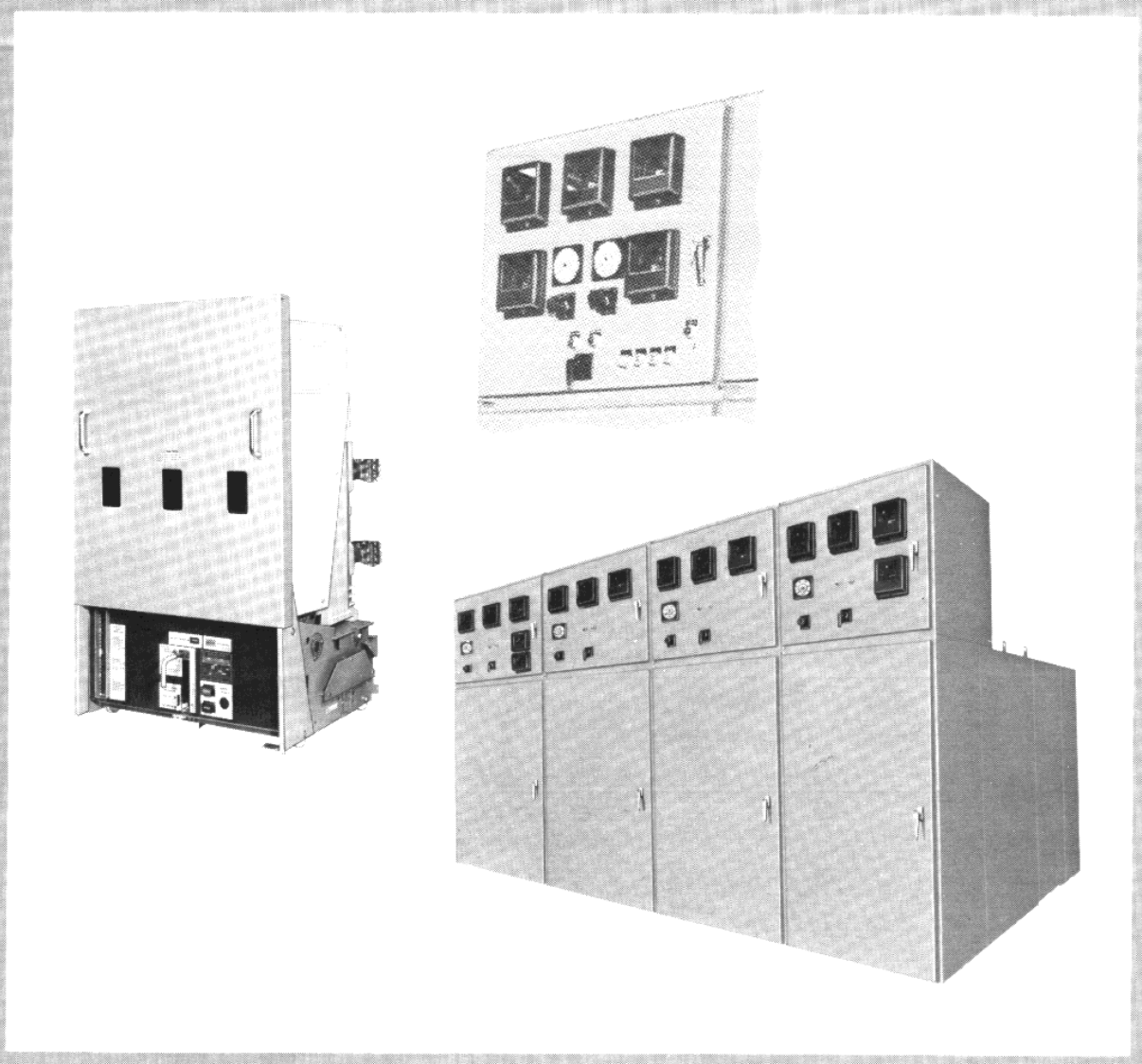
DISTRIBUTION EQUIPMENT CATALOG

SECTION 6150

NOVEMBER, 1975

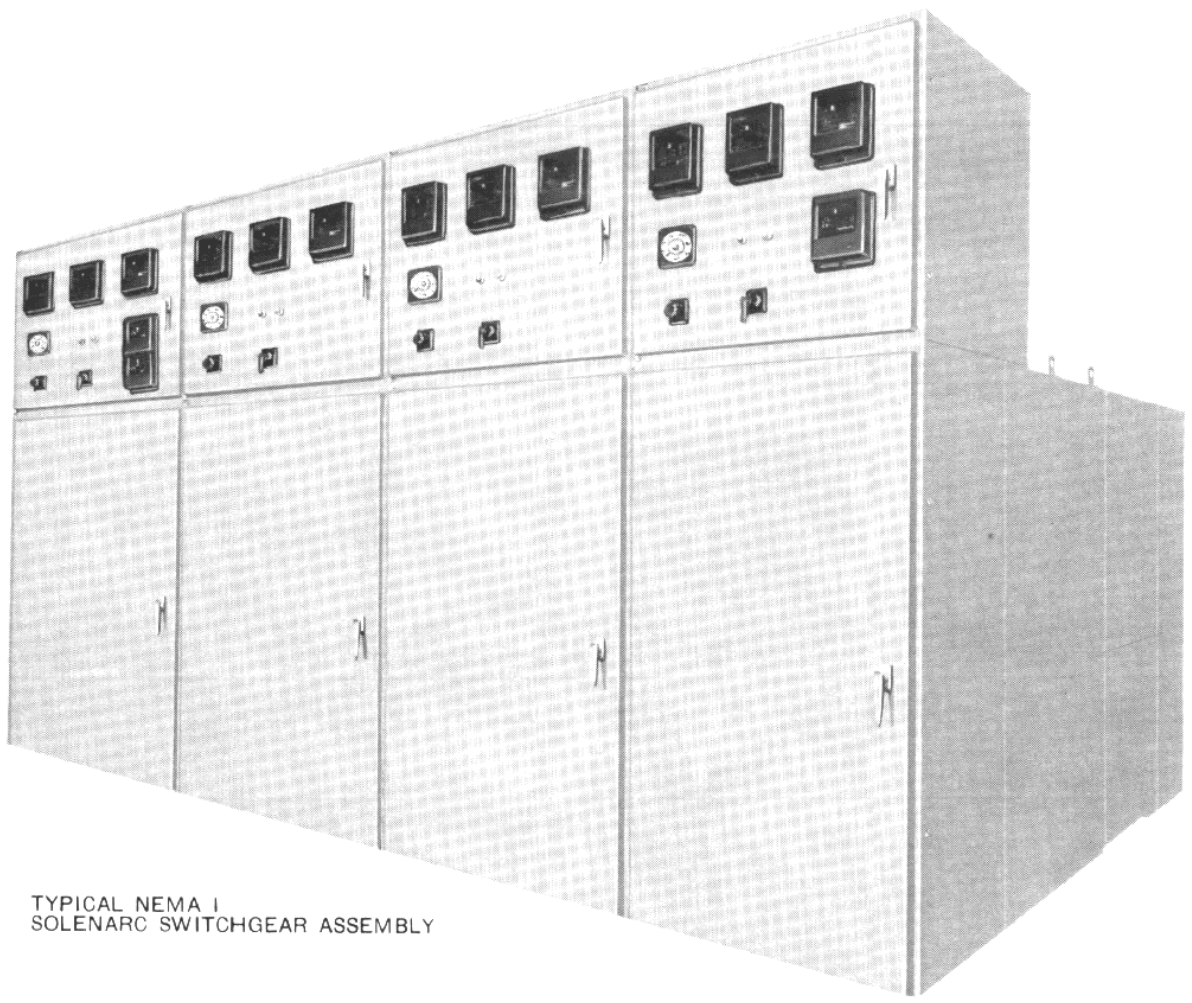


Solenarc DSE Metal-Clad Switchgear

SQUARE D COMPANY

P. O. Box 558 • Middletown, Ohio 45042

METAL-CLAD 5-15KV SWITCHGEAR
APPLICATION DATA



TYPICAL NEMA 1
SOLENARC SWITCHGEAR ASSEMBLY

RATINGS AND DESCRIPTION

- 4.16 to 13.8KV
- 1200 to 2000 ampere
- 75 to 750 MVA interrupting capacity
- Stored energy operating mechanism
- Drawout construction
- Insulated bus
- Indoor (NEMA 1) or outdoor (NEMA 3R) construction

GENERAL

Metal-clad 5-15KV Switchgear with the Solenarc DSE circuit breaker is designed for use on electrical distribution systems rated from 2400 volts to 13,800 volts. When Solenarc DSE circuit breakers are used in combination with phase current relays they offer complete overcurrent protection to most any electrical system.

This equipment is generally used in service entrance applications for system switching and isolation. Important applications of Solenarc DSE circuit breakers are for protection of transformers, motors, generators, capacitors and all types of feeder circuits.

The Solenarc DSE circuit breaker element is easily removed from its cell and when withdrawn all high voltage live parts in the structure are isolated from operating personnel by steel barriers. Major components such as main bussing, relaying and cable termination facilities are also enclosed and isolated from one another by grounded metal barriers.

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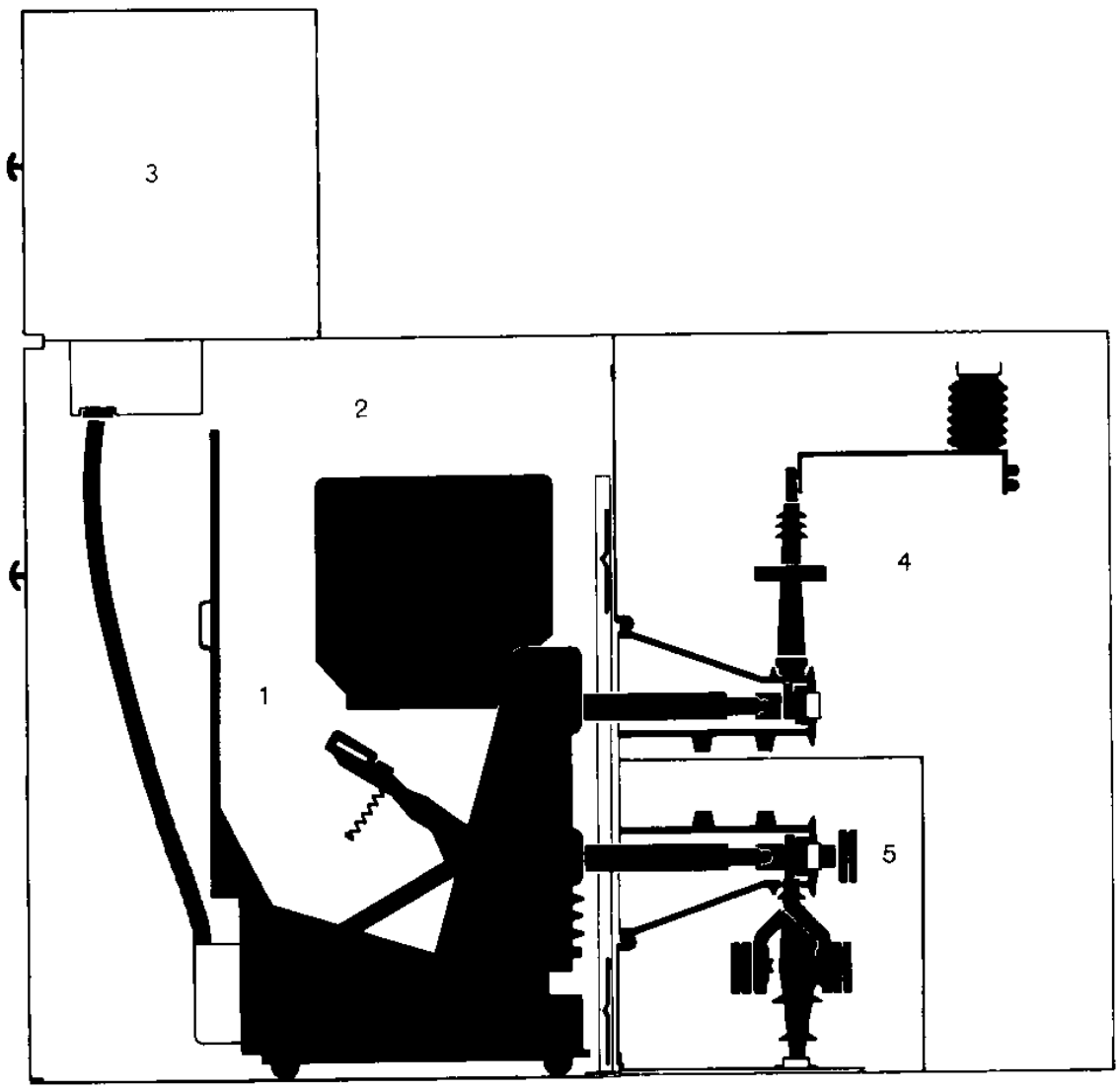
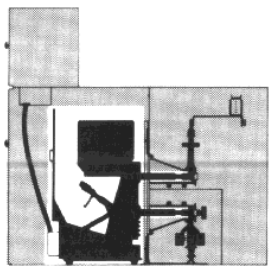
METAL-CLAD 5-15KV SWITCHGEAR
APPLICATION DATA

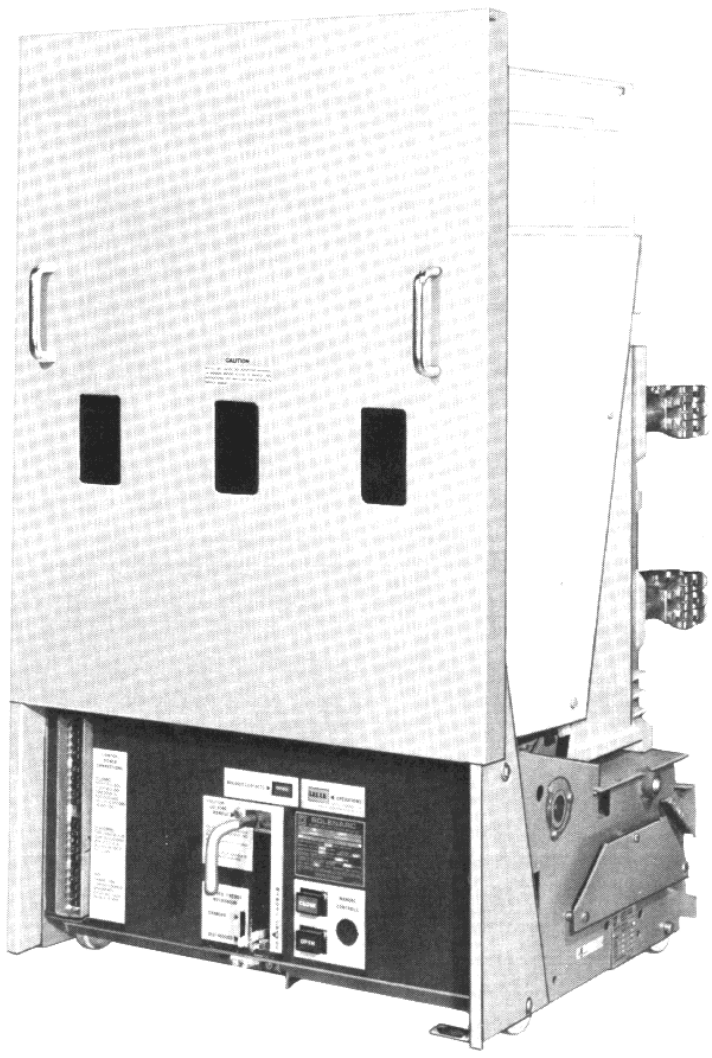


CONSISTING OF FIVE MAJOR COMPONENTS:

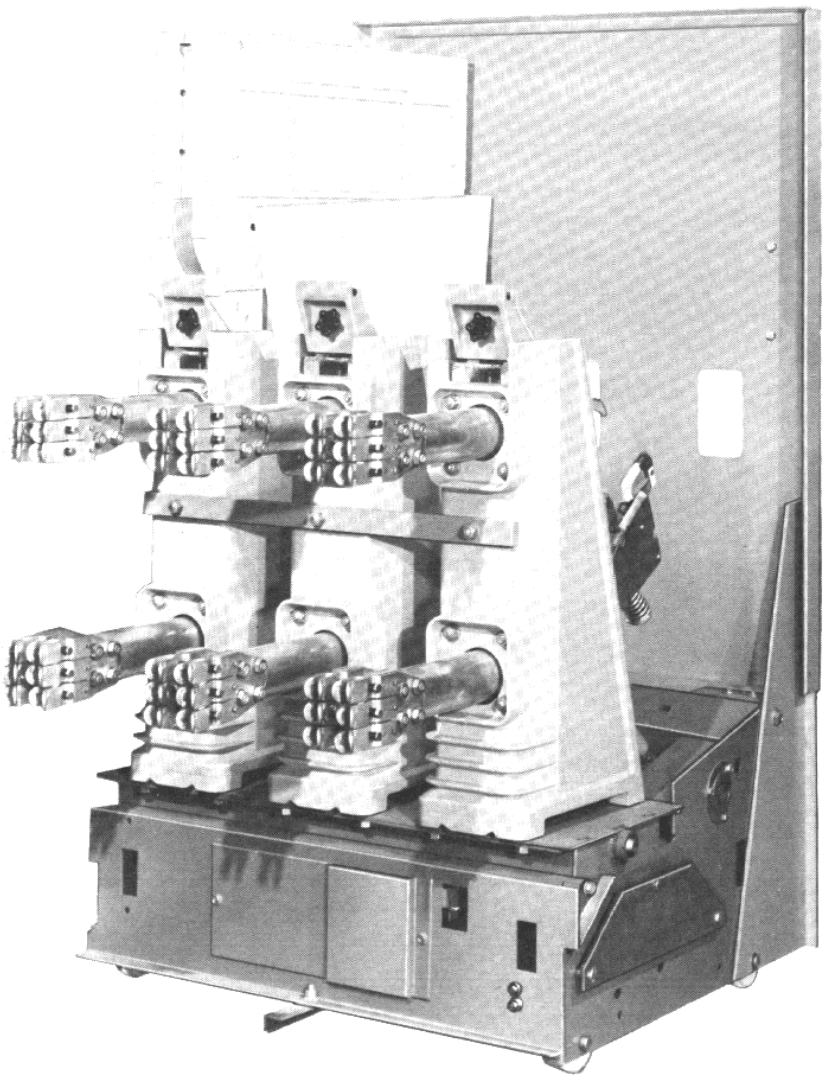
1. SOLENARC DSE CIRCUIT BREAKER ELEMENT
2. CIRCUIT BREAKER CELL
3. RELAY AND INSTRUMENT COMPARTMENT
4. CABLE TERMINATION COMPARTMENT
5. BUSSING STRUCTURE



METAL-CLAD 5-15KV SWITCHGEAR
APPLICATION DATA



FRONT VIEW
OF DSE BREAKER
ELEMENT

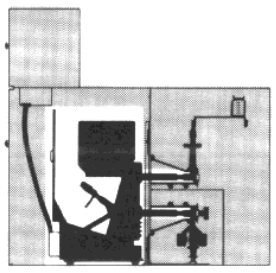


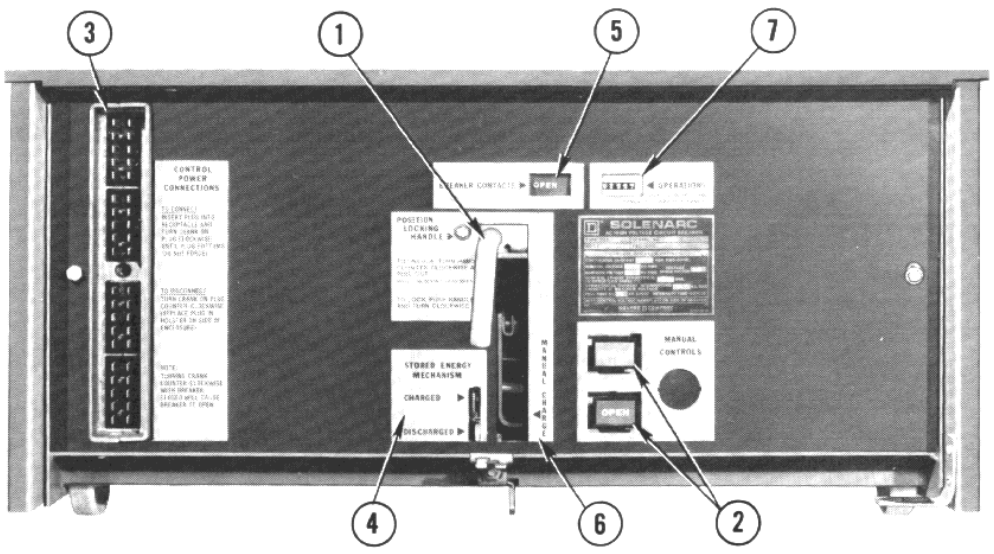
REAR VIEW
OF DSE BREAKER
ELEMENT

The Solenarc DSE circuit breaker is a stored energy air break device with self-aligning primary disconnecting contact fingers for connecting into the main power circuit. All live primary circuit components are isolated from operating personnel when it is installed in its cell by a large grounded steel barrier which is an integral part of the breaker element. Viewing windows are located in front of each pole unit to provide "visible-blades" for inspection and assurance of breaker contact position. Breaker contacts can be inspected without taking critical circuits out of service.

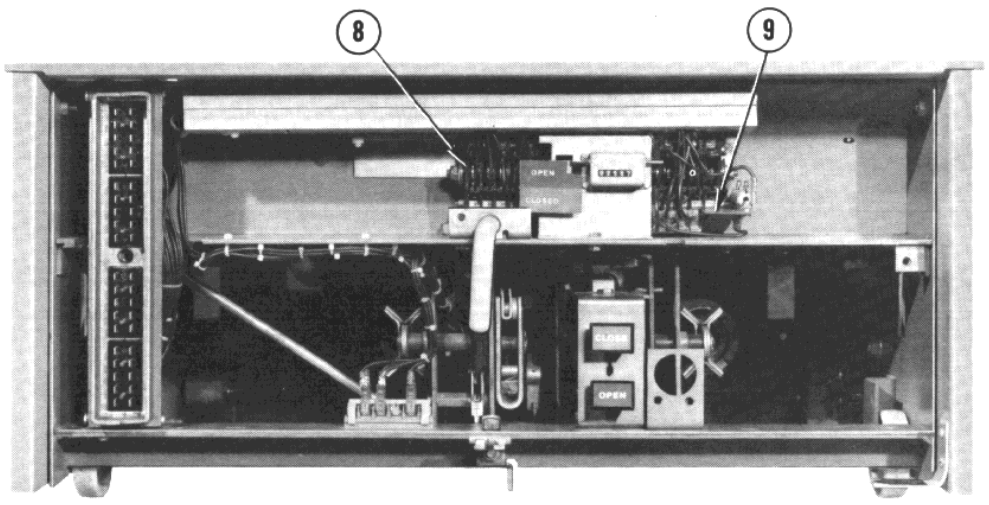
Each breaker is mounted on large wheels which permit it to be installed or removed from the switchgear structure with ease. A series of ramp type interlocks are bolted to each side of the chassis to operate cell mounted cams and levers to automatically raise the shutters as the breaker element is inserted into the structure.

METAL-CLAD 5-15KV SWITCHGEAR
APPLICATION DATA





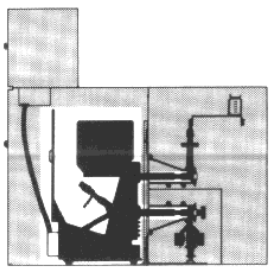
FRONT VIEW
BREAKER ESCUTCHEON



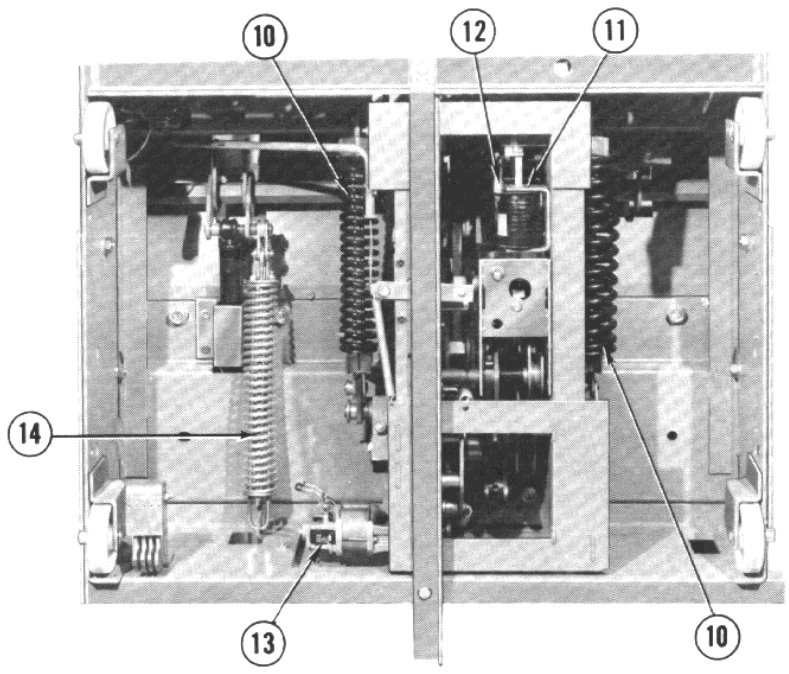
FRONT VIEW
COVER REMOVED

1. **Breaker Position Lock:** Locks breaker element into connected and test positions. Handle must be in lock position to close breaker contacts.
2. **Breaker Close and Open Controls:** Mechanically closes and opens breaker contacts by depressing the proper control button.
3. **Secondary Control Connection:** Connects control circuits to breaker element for all electrical functions. Connections are mechanically interlocked with breaker closing mechanism such that breaker contacts will open if plug is removed and will not close until plug is installed.
4. **Stored Energy Indicator:** Indicates condition of closing springs, charged or discharged.
5. **Breaker Contact Condition:** Shows position of breaker contacts, open or closed.
6. **Manual Charge Socket:** Socket for engaging manual spring charging handle.
7. **Operation Counter:** Totals number of opening and closings of breaker contacts.
8. **Auxiliary Switches:** Auxiliary contacts for control of internal breaker functions and spare contacts for control circuits.
9. **Anti-Pump Relay:** Limits breaker contacts to one closing sequence with a single operation of the control circuits.

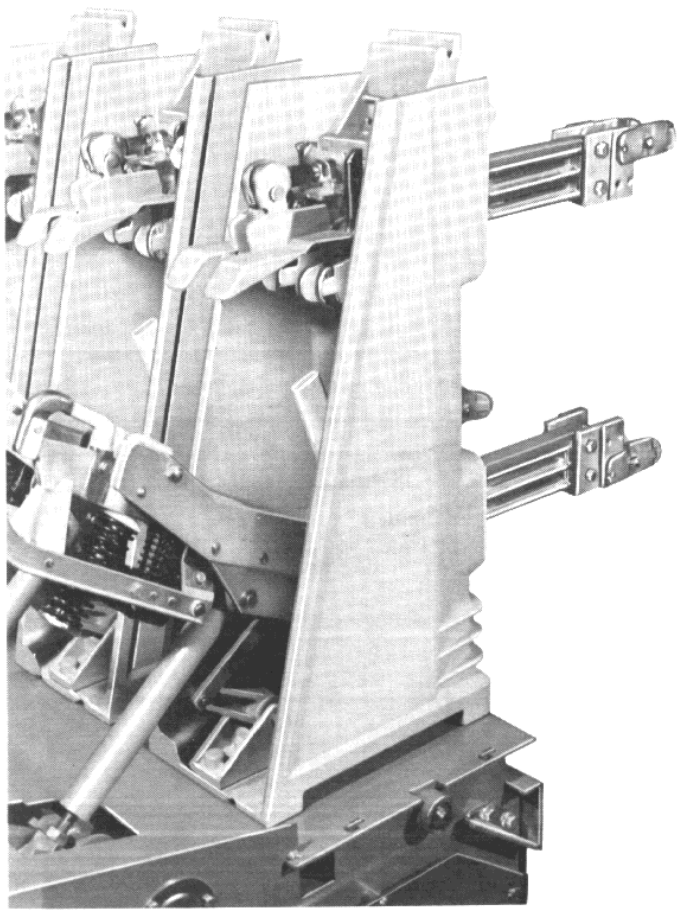
METAL-CLAD 5-15KV SWITCHGEAR
APPLICATION DATA



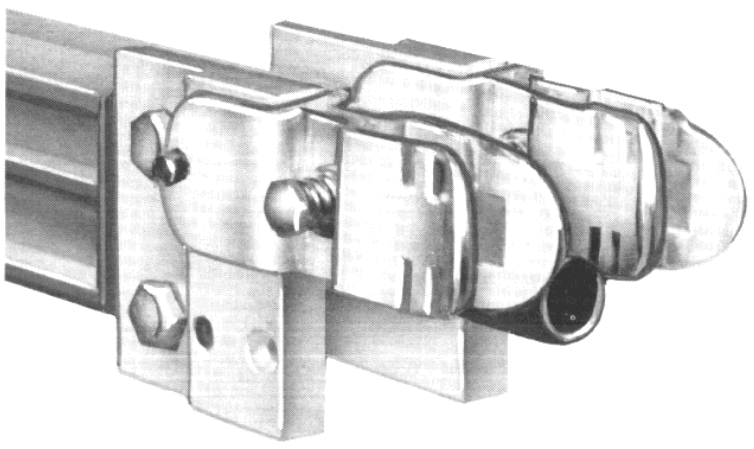
10. **Closing Springs:** Powerful main stored energy closing springs.
11. **Shunt Trip Coil:** Used to electrically trip the breaker contacts to open position.
12. **Spring Release Coil:** Electrically releases the stored energy springs to close the circuit breaker
13. **Spring Charging Motor:** Motor used to automatically charge the closing springs.
14. **Opening Springs:** Automatically charged as breaker main moving contacts close.



BOTTOM VIEW
BREAKER ELEMENT

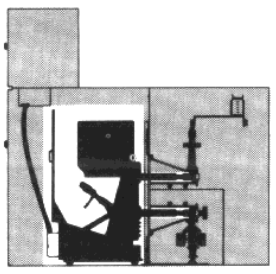


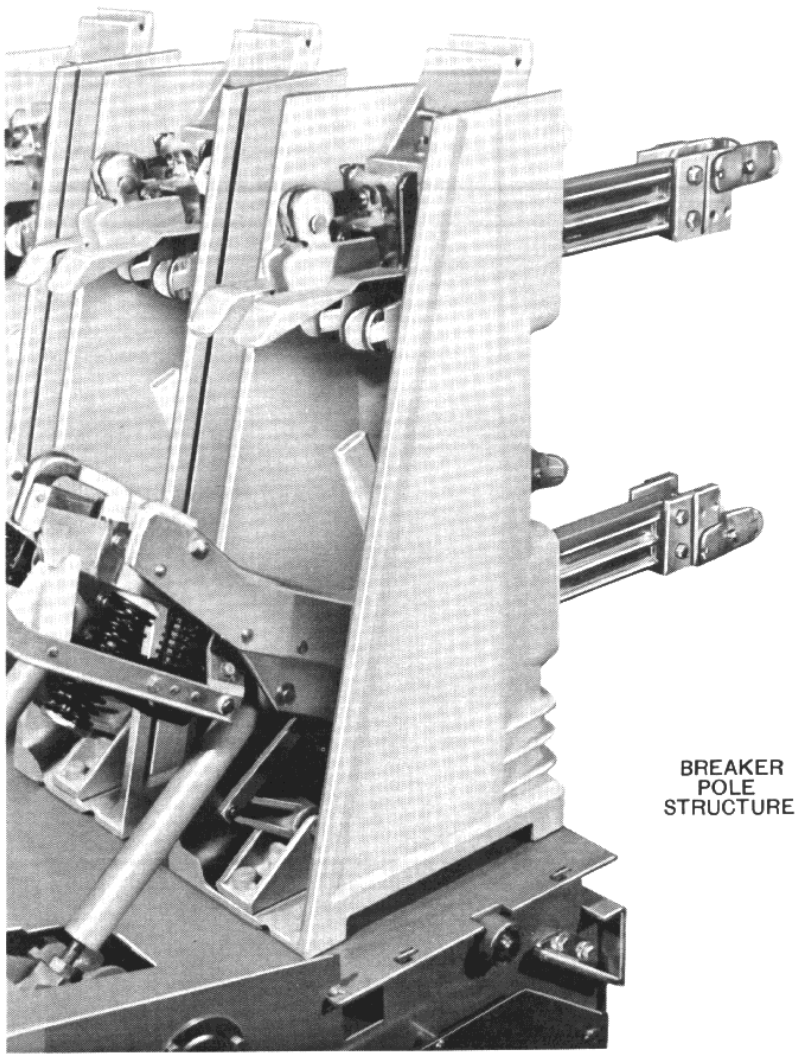
Each breaker element is provided with heavy duty self-aligning disconnect fingers which permit the breaker element to be disconnected from the main power circuit. The contacts are made of highly conductive silver plated copper. The number of contacts used on each frame size is a function of the continuous current rating of the breaker. All contacts can be removed or replaced as required by standard maintenance procedures.



PRIMARY DISCONNECT
FINGERS
(CLOSE-UP)

METAL-CLAD 5-15KV SWITCHGEAR
APPLICATION DATA





BREAKER POLE STRUCTURE

Individual pole units are held in place by a molded insulating support for all breaker sizes. The support insulates live parts from ground and from phase to phase. Interphase barriers are also added when required to individual poles to insulate and isolate them from one another and ground.

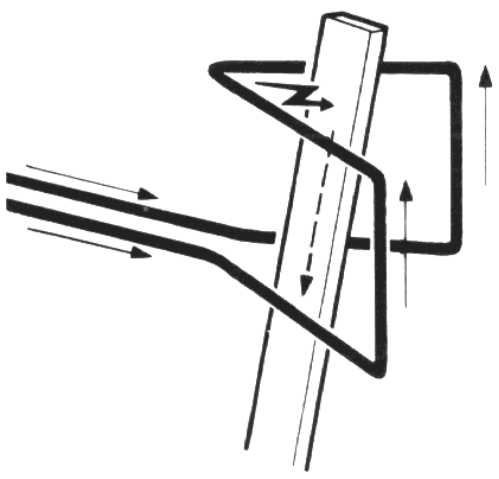
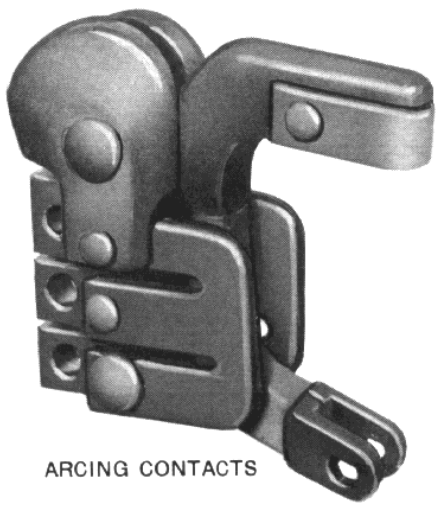


FIGURE 1



ARCING CONTACTS

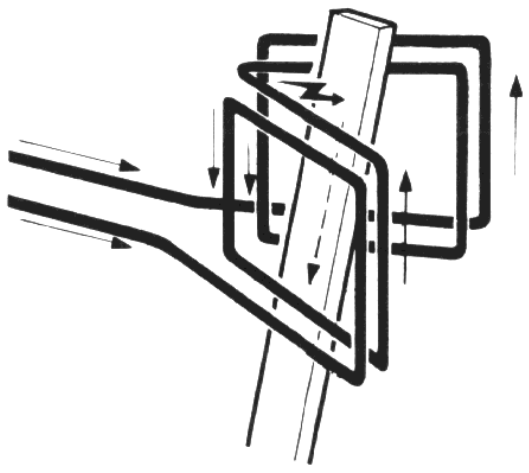
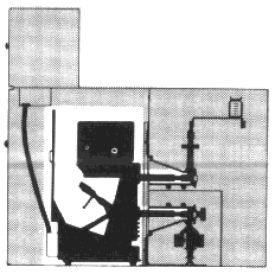
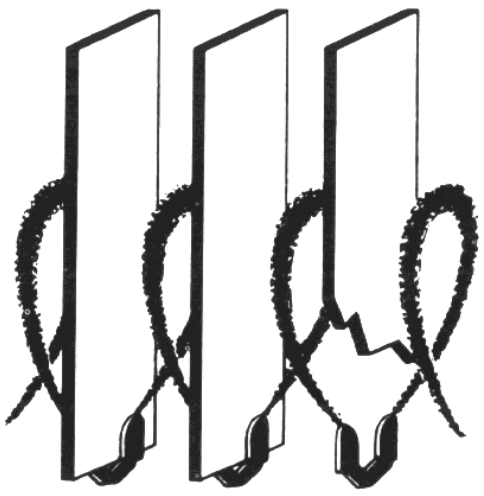


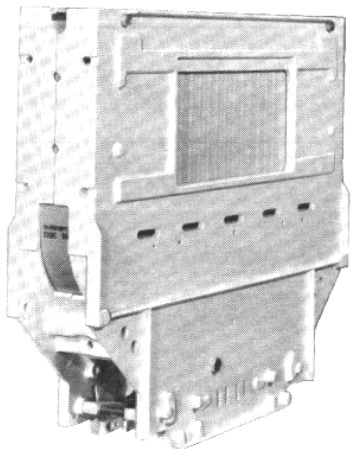
FIGURE 2

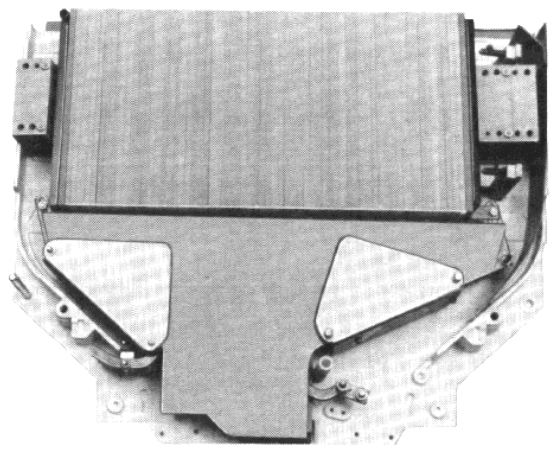
Arcing occurs only at the end of the moving arc tip assembly during opening and closing operations. A unique design for the stationary portion of this contact structure controls the current path to achieve a magnetic "blow-on" condition while closing under short-circuit conditions. For short circuits of medium capacity, the fixed contacts are arranged in a "V" form. The front legs of the "V" formation are covered with an insulating material so all pre-arcing takes place at the bottom of the "V". The current draws a half loop in each of the two legs so the current will flow parallel but in the reverse direction of the current in the moving contacts. The magnetic circuit thus set up will tend to blow the moving contact into the "V" for a solid connection (Figure 1). For short circuits of high magnitude, the fixed contacts incorporate coils with a loop on each side. The additive effect of the current flowing in these coils in the same direction are thus added to act on the moving trip to add force (Figure 2).

METAL-CLAD 5-15KV SWITCHGEAR
APPLICATION DATA









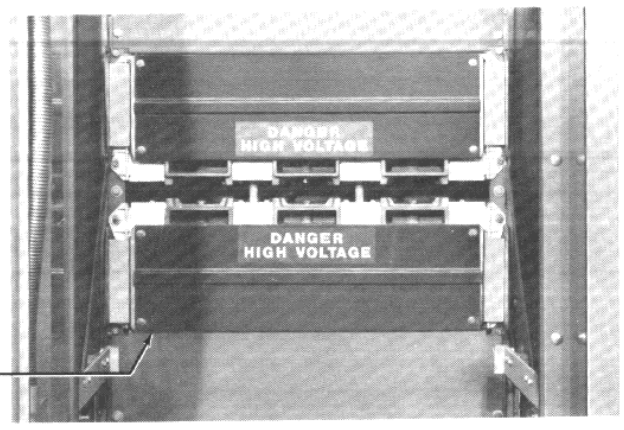
Solenarc arc chutes are designed to eliminate the need for blowout coils and magnetic circuits as required in conventional circuit breakers. As the arcing contacts begin to part, the arc is driven up into the chute by use of copper runners and in the case of low current interruptions, by a puffer. Once the arc has entered the upper portion of the chute, it is broken into many small individual arcs by the use of conducting metal plates and ceramic refractory plates. Each metal plate in combination with the refractory plate is designed to form the arc into a loop or eliptical shape which will lengthen and cool the arc without auxiliary means.

TABLE 1

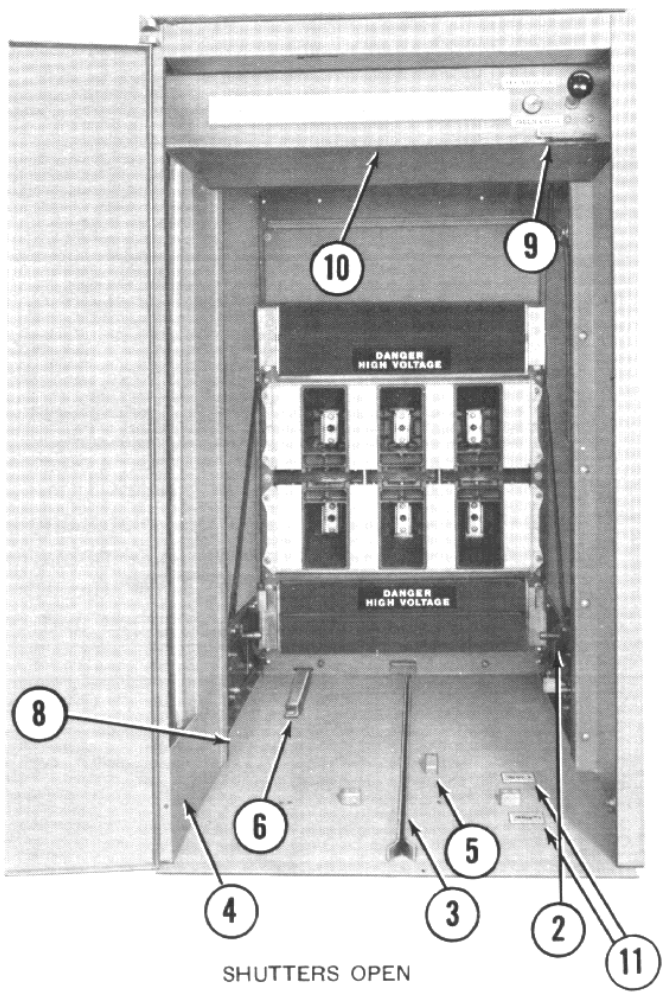
Type	Voltage Rating (KV)	Continuous Current (Amperes)	Interrupting Capacity
DSE-21	4.16	1200	75 MVA
DSE-23	4.16	1200	150 MVA
DSE-23B	4.16	1200	250 MVA
DSE-25C	4.16	1200 2000 3000	350 MVA
DSE-25BU	7.2	1200	250 MVA
DSE-25CU	7.2	1200 2000 3000	500 MVA
DSE-62	13.8	1200	250 MVA
DSE-65	13.8	1200 2000 3000	500 MVA
DSE-57	13.8	1200 2000 3000	750 MVA

Table 1 lists the types of breakers which are available along with their voltage, ampacity and interrupting capacity. Circuit breaker frames are interlocked by ampacity and interrupting capacity to prevent inter-changing within structures, however, the operating mechanisms and contact structures are all of the same basic design. This gives Solenarc DSE switchgear a homogeneous appearance and common approach to maintenance when required. It is necessary to train operating personnel for only one design.

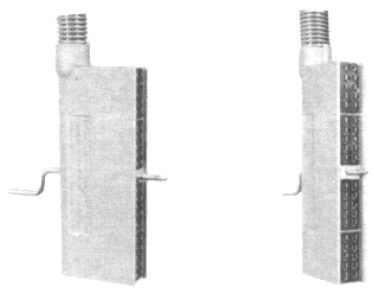
METAL-CLAD 5-15KV SWITCHGEAR
APPLICATION DATA



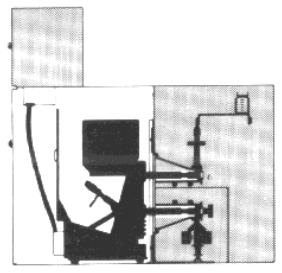
SHUTTERS CLOSED



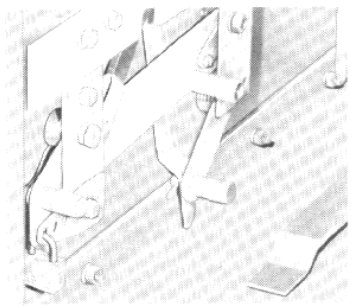
SHUTTERS OPEN



CONTROL CIRCUIT PLUG



1. GROUNDED METAL SHUTTER
2. SHUTTER ACTUATING CAMS
3. BREAKER ELEMENT GUIDE RAILS
4. CONTROL CIRCUIT PLUG HOLDER
5. SPRING DISCHARGE CAM
6. GROUND BUS
7. CELL SWITCH ACTUATING LEVER (OPTIONAL)
8. CONDUIT ENTRANCE AREA FOR CONTROL CIRCUITS
9. KIRK KEY AND POSITION PADLOCK PROVISIONS
10. INTER-SECTION CONTROL CIRCUIT WIRING TROUGH
11. BREAKER POSITION INDICATORS



Shutter Padlocking Feature

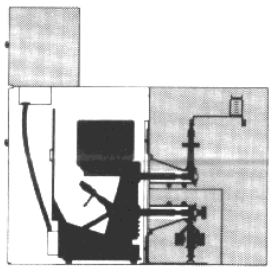
Circuit Breaker Cell

When the DSE circuit breaker is completely withdrawn from the enclosure, grounded steel shutters cover the stationary disconnecting contacts. These shutters isolate live parts and contacts to allow work to be performed with caution within the circuit breaker compartment.

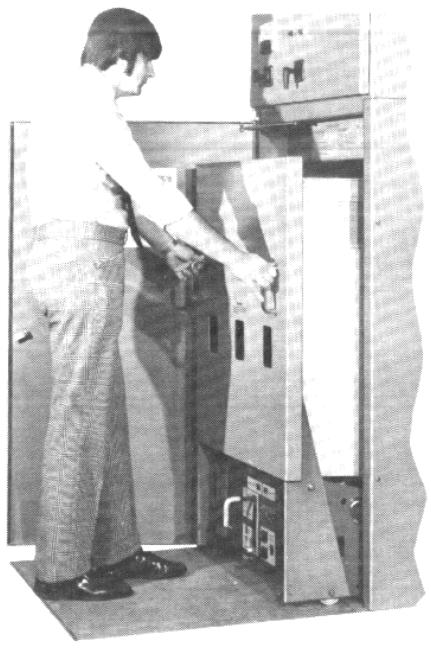
Guide rails are welded into the base of the breaker compartment to properly position the breaker element when it enters the structure. Circuit breaker elements are completely grounded by a heavy duty sliding contact in the test and connected positions. The compartment door can be closed with the circuit breaker in either connected, test, or, disconnect position.

A unique control plug offers a safe and positive means for connecting control circuits to the breaker element. Sliding contacts which can become contaminated or broken and which are generally mounted out of sight on the rear or side of the element have been eliminated. Controls are up front where thay can be inspected and are enclosed to resist contamination by dust or air-borne grease.

The control plug is mechanically interlocked with the breaker element so it can not be closed when the plug is removed and any attempt to remove the plug while the breaker is in the closed position will automatically trip it open.

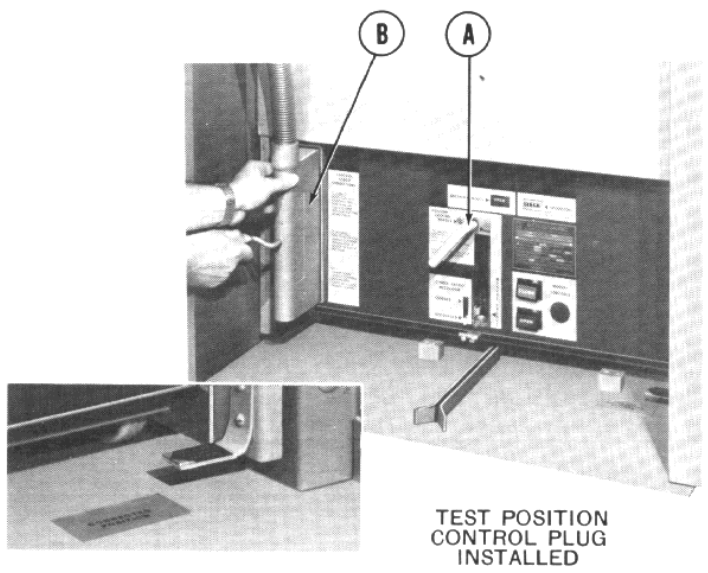


METAL-CLAD 5-15KV SWITCHGEAR
APPLICATION DATA



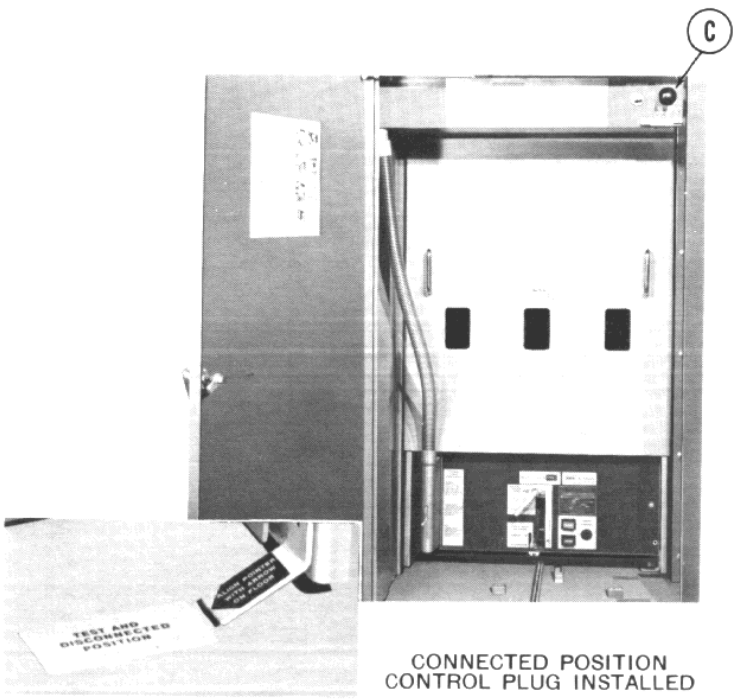
BREAKER INSTALLATION

The power circuit breaker is installed in the cubicle by simply pushing the element into the cell until it reaches the first stop position. The circuit breaker element cannot be closed while it is in this position or mode. It is possible to padlock or key interlock the cell with the breaker in this position.



TEST POSITION
CONTROL PLUG
INSTALLED

The breaker can be changed from the disconnected position to the test position by simply pushing in the position locking handle (A) and rotating it in a clockwise direction. Install the control power plug (B) on the front of the breaker element and the element is in the full test position. The breaker cannot be closed unless the control power plug is fully installed. Any attempt to remove this plug while the breaker is closed will result in tripping the breaker contacts to the open position.

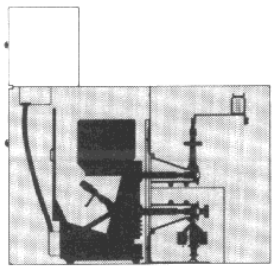


CONNECTED POSITION
CONTROL PLUG INSTALLED

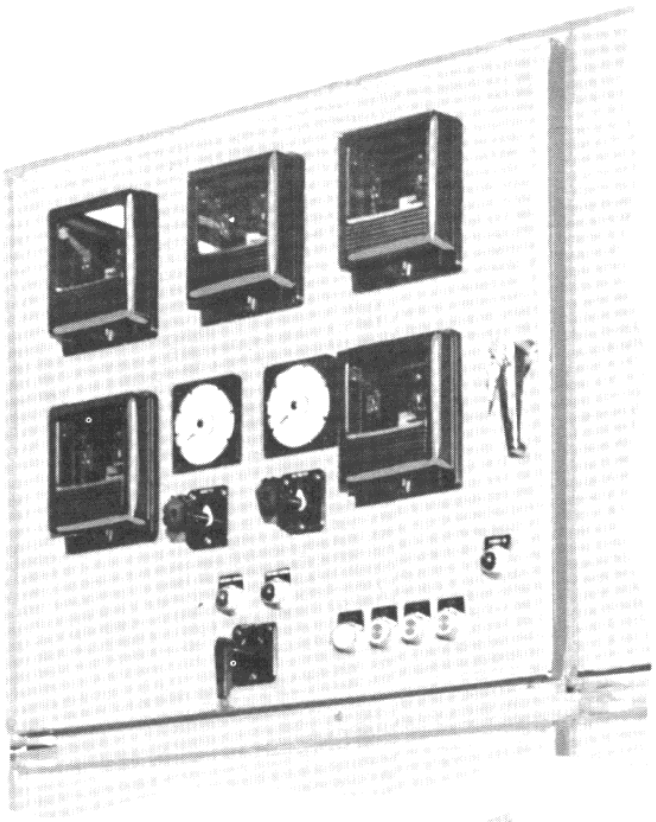
To change the breaker from the test position to the connected position it is necessary to rotate the position locking handle (A) in a counterclockwise direction and pull out. Next pull out the cell interlock handle (C) and lever the circuit breaker into the cubicle until the cell markings indicate it is in the full connected position. The position locking handle (A) can now be pushed in and rotated in a clockwise direction. The circuit breaker contacts can now be closed.

For removal of the breaker element simply reverse the above procedure.

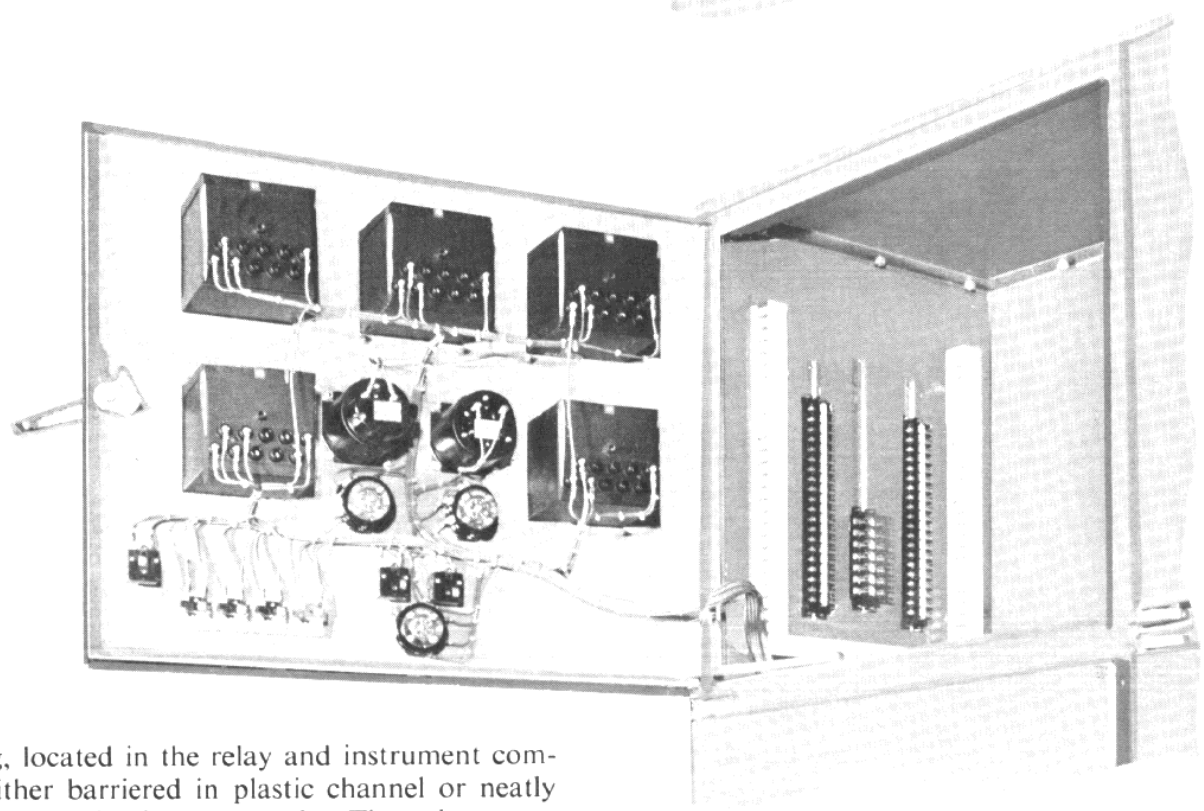
METAL-CLAD 5-15KV SWITCHGEAR
Relay and Instrument Compartment
APPLICATION DATA



The relay and instrument compartment is mounted on top of the circuit breaker cell and is entirely isolated and barriered from all other compartments in the switchgear assembly. This compartment is equipped with a circuit breaker control switch with red and green pilot lights as standard equipment. Relays and meters can be added as required by individual applications. Should additional relay space be required a full height relay panel can be provided.

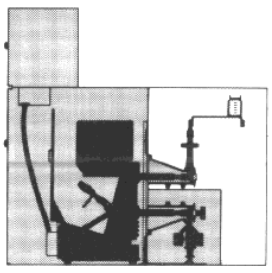


RELAY COMPARTMENT DOOR

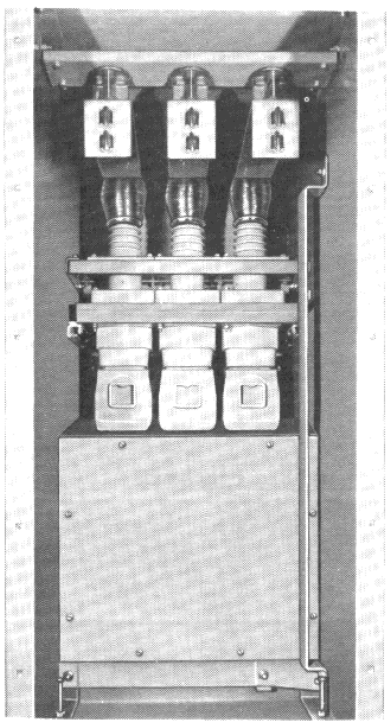


Control wiring, located in the relay and instrument compartment, is either barriered in plastic channel or neatly bundled and grouped when exposed. The wires at a hinge are installed with a relief loop to insure they are not subject to wear at the hinge side of the door. All terminal blocks are of a 600 volt class and will contain secondary control fusing when required. The relay compartment is removable for initial installation of the equipment at the job site when necessary.

CONTROL WIRING



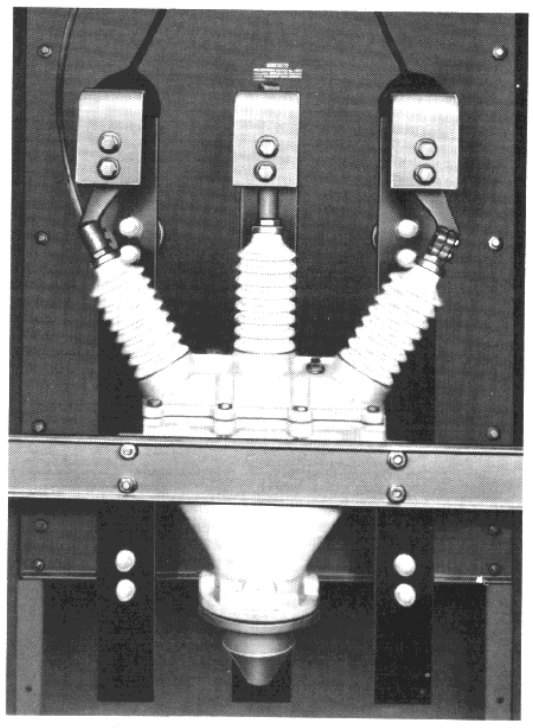
METAL-CLAD 5-15KV SWITCHGEAR
Cable Termination Compartment
APPLICATION DATA



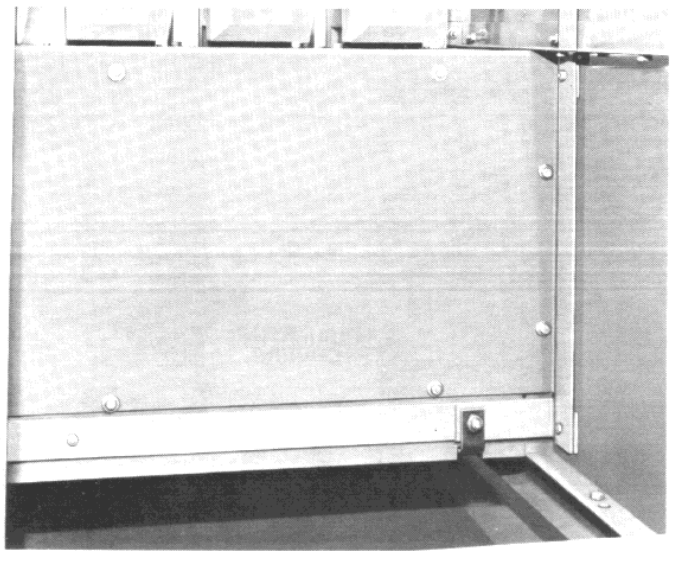
CABLE COMPARTMENT

The cable compartment, located in the rear of the switch gear assembly, is completely barriered from all other compartments. The current transformers for overcurrent sensing are located in this compartment. A three phase set of double clamp type incoming cable lugs are provided as standard in each assembly. All bussing and bussing joints are completely insulated with track resistant molded insulating materials.

Potheads or cable terminators can be installed in the cable compartment as required. When multiple incoming cable terminations are required a rear extension can be added to the switchgear assembly.



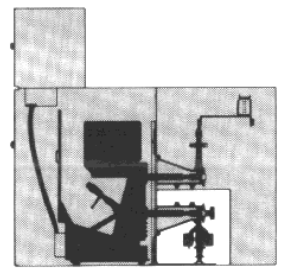
POTHEADS



GROUND BUS

A continuous ground bus is supplied with each switchgear assembly. Ground lugs are provided on each end in the switchgear assembly for connection to the station ground.

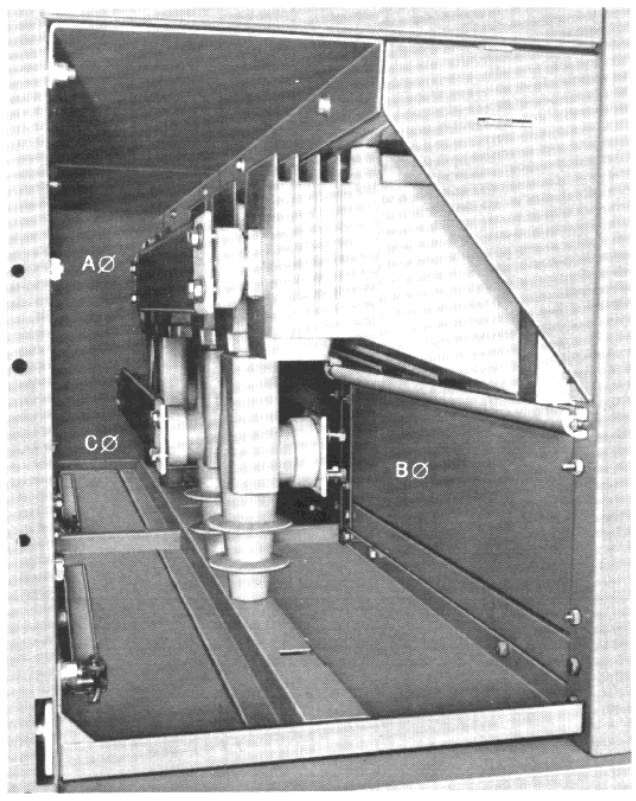
METAL-CLAD 5-15KV SWITCHGEAR
Bussing Structure
APPLICATION DATA



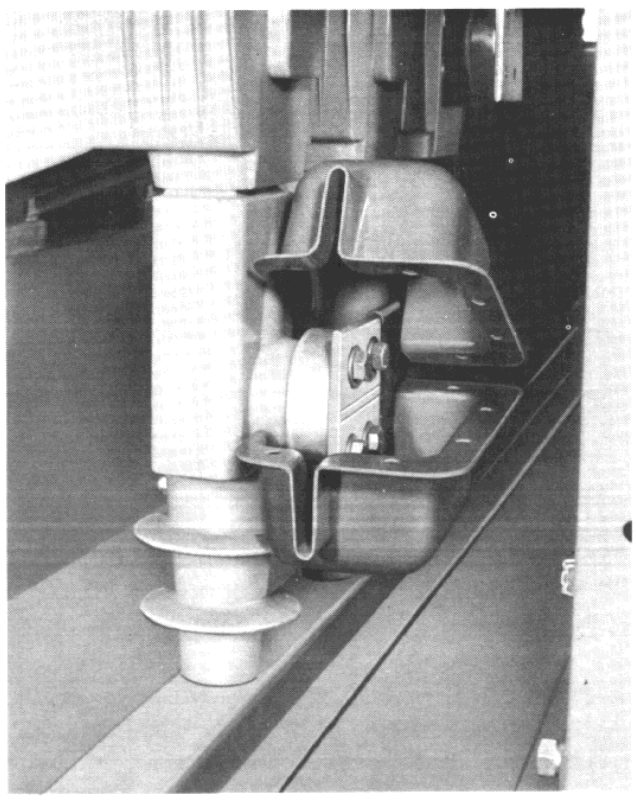
The main horizontal crossbus for connecting multiple switchgear assemblies together is located in the bottom rear of the switchgear structure. This bussing is fully insulated for its entire length and at every joint or shipping split. Additionally the bussing is isolated by steel barriers from both the cable compartment and the circuit breaker compartment.

The main crossbus in each switchgear cubicle is braced for the maximum short circuit capability of the assembly. This bracing is accomplished by use of epoxy encapsulated busbars, from the circuit breaker stationary disconnect contacts to the main crossbus, forming a unique support/insulated bussing system. Additional supports or braces at the junction of each vertical section, which may reduce the overall dielectric strength, are not required. These supports can be added as an option. However, they do not add additional protection to the user's system.

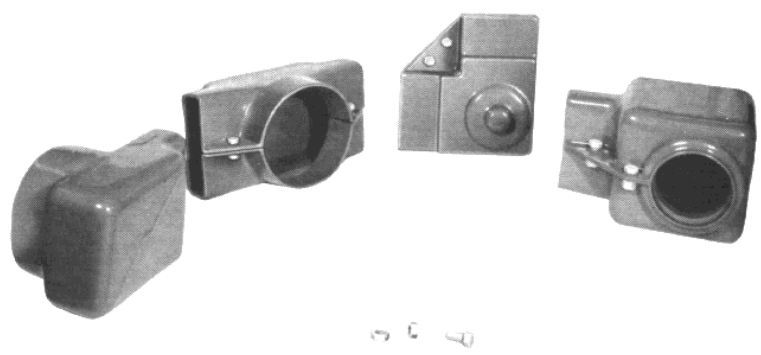
High dielectric insulation is utilized on all bussing in Solenarc DSE switchgear. Typical example of this insulation can be seen in the adjacent photographs of preformed molded bus bar insulations, special molded T or elbow covers and inter-unit isolating barriers.



MAIN CROSS BUSSING

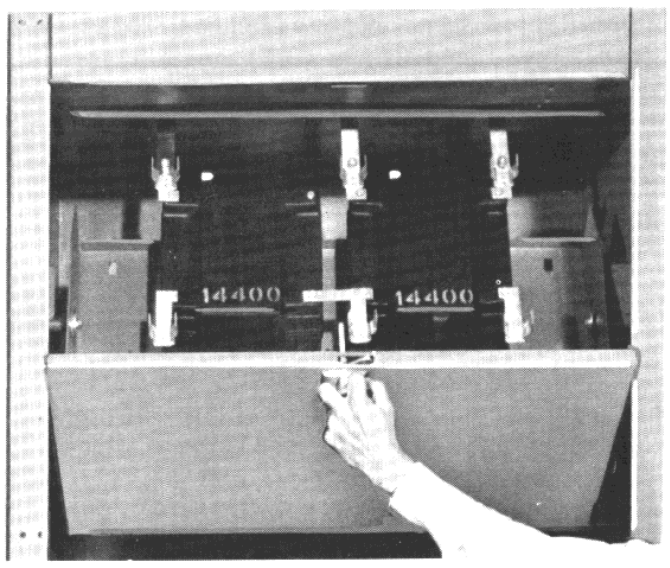


INSULATING COVERS
FOR MAIN BUS



INSULATING
COVERS

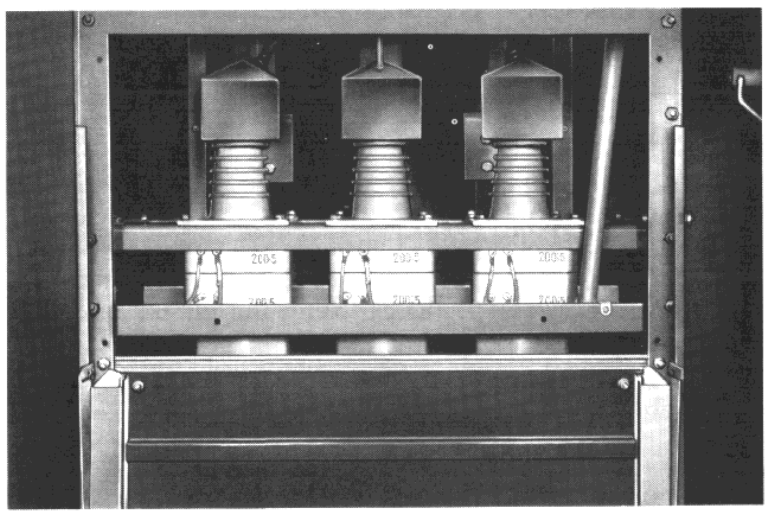
METAL-CLAD 5-15KV SWITCHGEAR
Accessories
APPLICATION DATA



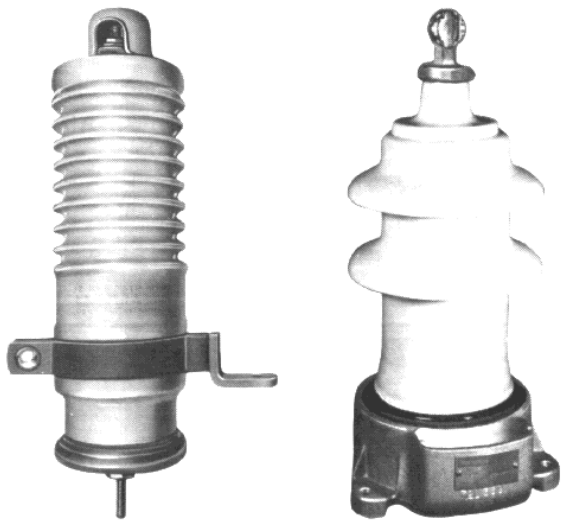
POTENTIAL TRANSFORMERS

Potential transformers are trunnion mounted and are easily drawn out for full accessibility. For safety the fuses and potential transformers are automatically grounded when disconnected.

Current transformers provided for overcurrent protection are bushing mounted and are removable. Access may be gained from the front for tap changing by simply removing a barrier to expose the terminals. In the circuit breaker compartments high voltage remains barriered during this operation.



CURRENT TRANSFORMERS



(DISTRIBUTION CLASS)

(STATION CLASS)

LIGHTING ARRESTERS

Overvoltage surge protection can be provided as specified. Station class, intermediate class and distribution class arresters are available. It is usually desirable to place a set of lighting arresters near incoming terminals of all major equipment used on high voltage systems.

METAL-CLAD 5-15KV SWITCHGEAR
Control Circuits and Operation
APPLICATION DATA

DESCRIPTION OF ELECTRICAL OPERATION

Electrical operation consists of connecting control power to an installed breaker, the automatic changing of closing springs, an external command to close the breaker, and an external command to trip the breaker. The electrical switching required to control these operations is described below.

The following sequence assumes these initial conditions: the breaker is open, all springs are discharged, and control power is not yet available.

With the breaker installed in the test or connected position, the control plug connected, interlock switch 52/IS closes when the breaker is locked in place. Limit switch 52LS/bb (2-M) is closed because the closing springs are discharged. When all of these conditions are met, the gear motor charges the closing springs when control power is supplied. This requires approximately five seconds. When the springs are charged, limit switch motor and contacts 52LS/aa(64-64X) closes to permit energization of the closing circuit. The circuit breaker is now charged and waiting for a "CLOSE" command.

A "CLOSE" command is given by closing an external CLOSE control switch. This energizes latch release coil 52X through contacts 52/b (1-2), 52LS/aa (64-64X) and 52Y/B (3-5). The circuit breaker snaps closed under pressure from the closing springs. When the circuit breaker closes, contact 52/b (9-10) opens, turning off the green "OPEN" pilot lamp. The circuit breaker closing causes contact 52/a (7-8) to close, lighting the red "CLOSED" pilot light. Closing the circuit breaker discharged the closing springs and limit switch 52LS/bb (2-M) closes. The gear motor again charges the springs, and when they are fully charged, limit switch 52LS/bb (2-M) opens.

Anti-pump relay 52Y and resistor RES are included to limit the circuit breaker to one closing operation per "CLOSE" command. If they were not included, and the circuit breaker was tripped open, the circuit breaker would automatically re-close as soon as the springs were re-charged if the "CLOSE" command was still present. The anti-pump circuit then serves as a lockout until an operator can re-close the circuit breaker under a no-trip condition. This anti-pump circuit works as follows: When the circuit breaker closes, contact 52a (3-4) closes, energizing anti-pump relay 52Y. Relay contact 52Y/b (3-5) opens and inhibits closing latch release coil 52X from any additional re-closings. Relay contact 52Y/a (3-4) closes and holds anti-pump relay 52Y energized until the external "CLOSE" command is removed. At that time, anti-pump relay 52Y is de-energized.

A "TRIP" command is given by closing the external TRIP control switch which turns off the red "CLOSED" pilot light, and energizes shunt trip coil 52/LC (65-66). This in turn actuates a mechanical latch, tripping the circuit breaker. Contact 52/a (5-6) opens after the circuit breaker contacts open to clear coil 52/TC. With the circuit breaker open, contact 52/b (9-10) closes, causing the green "OPEN" pilot light to illuminate. The circuit breaker closing springs were charged earlier, and the circuit breaker is waiting for its next "CLOSE" command.

Refer to Table 1.1 for electrical specifications of components.

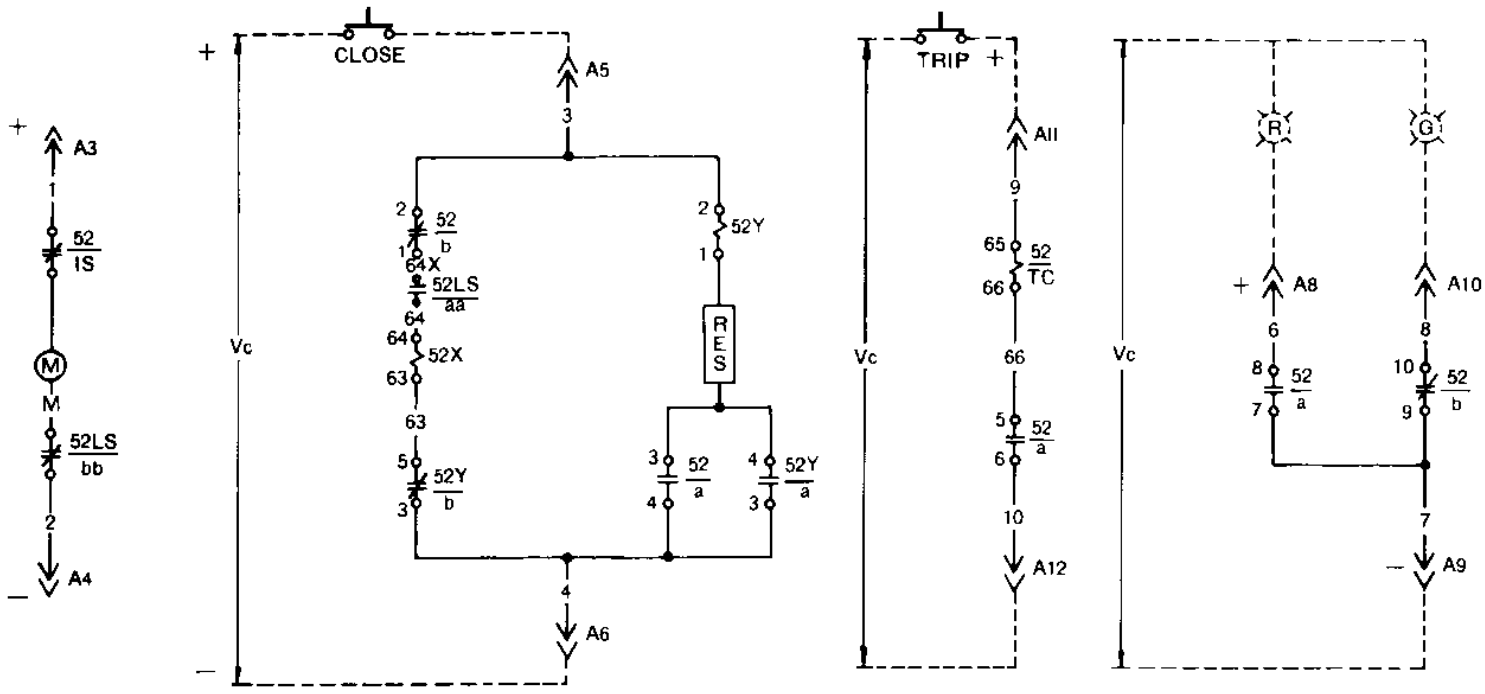
DESCRIPTION OF MECHANICAL OPERATION

Opening and closing of the breaker is performed by releasing the corresponding spring(s). The closing spring(s) are charged by an electric motor working through a series of gears. They can also be manually charged with the levering/manual charging handle. When the breaker closes it charges, then latches, the opening spring.

The three pole units are closed/opened simultaneously by their operating rods which are connected to a common drive shaft.

Releasing the close or open latch can be done mechanically with the CLOSE/OPEN push buttons located on the front of the breaker.

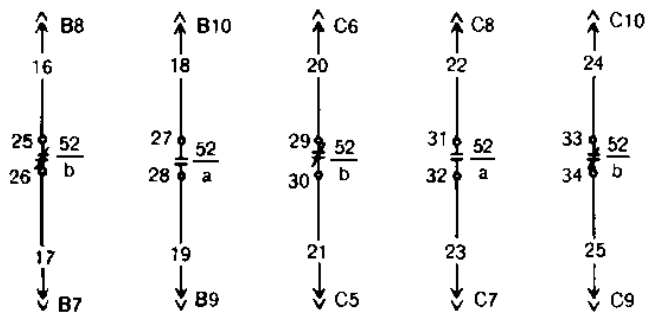
METAL-CLAD 5-15KV SWITCHGEAR
Control Circuits and Operation
APPLICATION DATA



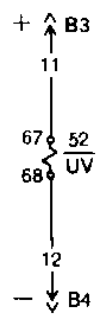
MOTOR CIRCUIT | CLOSING CIRCUIT | TRIP CIRCUIT | PILOT ACTIVATING CIRCUIT

NOTE:
THIS DIAGRAM SHOWS THE GENERAL WIRING ARRANGEMENTS.

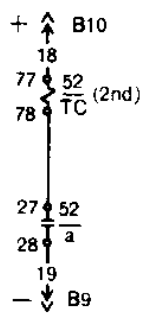
Vc—Control Voltage



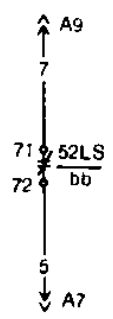
AUXILIARY CONTACTS



UNDER VOLTAGE RELEASE CIRCUIT (OPTIONAL)

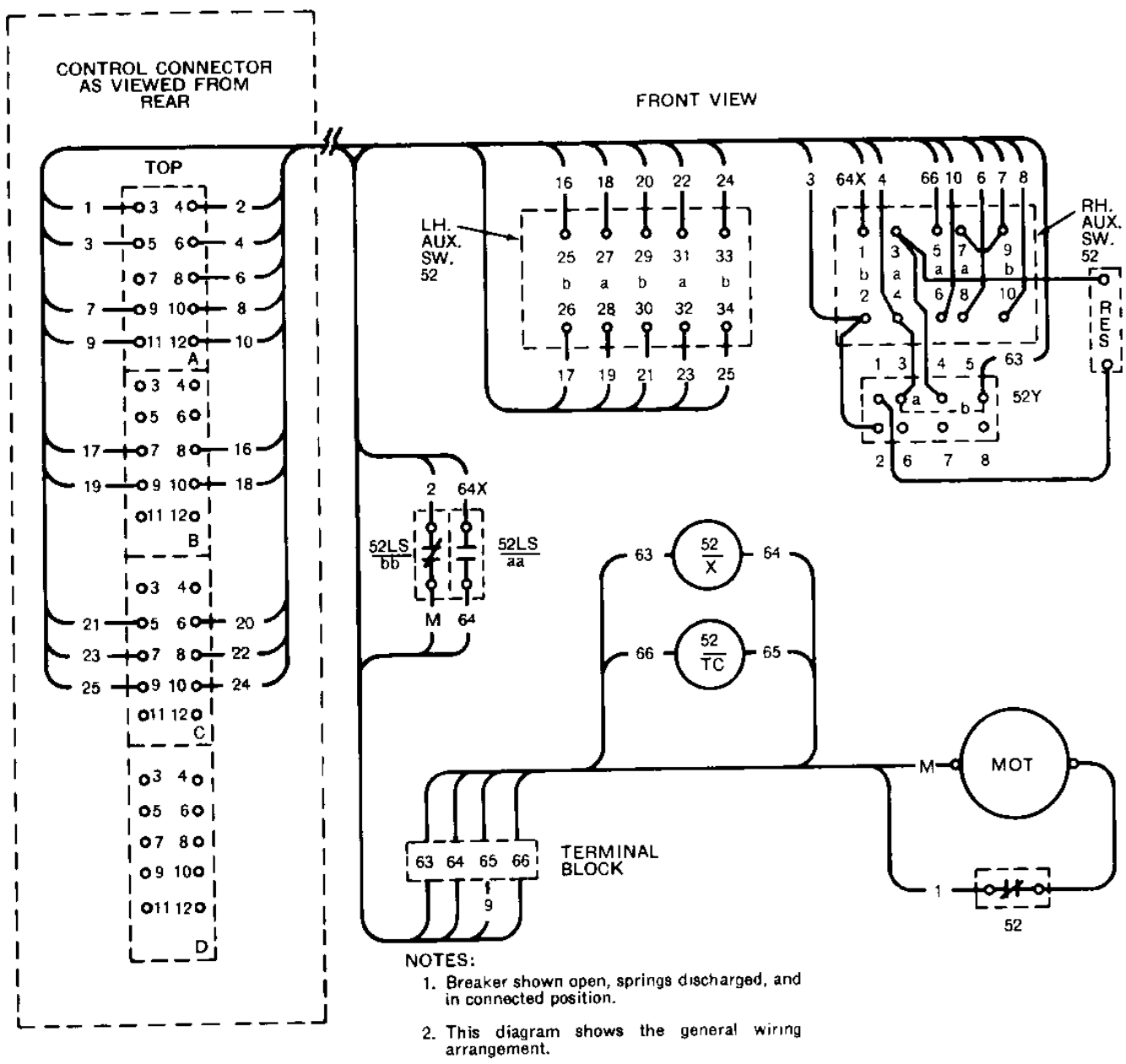


SECOND TRIP CIRCUIT (OPTIONAL)



SPARE CONTACT-END OF CHARGING SWITCH (OPTIONAL)

METAL-CLAD 5-15KV SWITCHGEAR
Control Circuit and Operation
APPLICATION DATA



NOTES:
1. Breaker shown open, springs discharged, and in connected position.
2. This diagram shows the general wiring arrangement.

LEGEND

$\frac{52}{IS}$ —Position interlock switch. Contacts are open when locking handle is unlocked contacts are closed when locking handle is in locked position.

52 —Auxiliary switches, right and left.

- $\frac{52}{a}$ Contacts are open when breaker is open
- $\frac{52}{b}$ Contacts are closed when breaker is open

52LS—End of charge limit switch

- $\frac{52LS}{aa}$ Contacts closed when springs are fully charged
- $\frac{52LS}{bb}$ Contacts open when springs are fully charged

RES —Resistor

52X —Latch release coil

$\frac{52}{TC}$ —Shunt trip coil

52Y —Anti pump relay

- $\frac{52Y}{a}$ Contacts are normally open
- $\frac{52Y}{b}$ Contacts are normally closed

METAL-CLAD 5-15KV SWITCHGEAR
Control Circuits and Operation
APPLICATION DATA

TABLE 1.1 **DSE BREAKER COIL AND MOTOR ELECTRICAL DATA**

Description	Nominal Control Voltage	Voltage•• Operate Range	Amps •••	VA	Resistance (OHMS)
Closing Solenoid	24 VDC	20-28 VDC	1.36	32.6	17.6
Closing Solenoid	48 VDC	40-55 VDC	0.68	32.6	71
Closing Solenoid	125 VDC	90-130 VDC	0.27	33.8	470
Closing Solenoid	250 VDC	180-260 VDC	0.14	35	1800
Closing Solenoid	230 VAC	190-250 VAC	0.36	83	71
Closing Solenoid	115 VAC	90-125 VAC	0 59	68	17.6
Trip Solenoid	24 VDC	14-30 VDC	1.36	32.6	17.6
Trip Solenoid	48 VDC	28-60 VDC	0 68	32.6	21
Trip Solenoid (1200A)	125 VDC	70-140 VDC	0 27	33.8	470
Trip Solenoid (2000/3000)	125 VDC	70-140 VDC	0.42	52.5	298
Trip Solenoid	250 VDC	140-280 VDC	0.14	35	1800
Trip Solenoid (1200A)	115 VAC	90-125 VAC	0.38	44	48
Trip Solenoid (2000/3000)	115 VAC	90-125 VAC	0 42	48	20.5
Trip Solenoid	230 VAC	190-250 VAC	0.2	46	118
Charging Motor	24 VDC	20-28 VDC	5.6	135	..
Charging Motor	48 VDC	40-55 VDC	2.7	130	..
Charging Motor	125 VDC	90-130 VDC	1.6	200	..
Charging Motor	250 VDC/230 VAC	180-260 VAC/VDC	0 8	200	..
Charging Motor	115 VAC	90-125 VAC	2.2	250	..
Anti Pump Relay	24 VDC	20-28 VDC	0.073	1.75	213
Anti Pump Relay	48 VDC	40-55 VDC	0.037	1.78	1210
Anti Pump Relay	125 VDC	90-130 VDC	0 02	2.5	6220
Anti Pump Relay	250 VDC	180-260 VDC	0.018	4.5	6220-6000•
Anti Pump Relay	115 VAC	90-425 VAC	0.09	10.5	160-500•
Anti Pump Relay	230 VAC	190-250 VAC	.015	3.34	3380

•6000 is external resistance in series with 6220 OHM coil.
500 is external resistance in series with 160 OHM coil.
••Per table 8, ANSI standard C37.06.
•••Inrush current is the same as the holding current for coils.

CONTROL POWER AND CONTROL CIRCUITS FOR POWER CIRCUIT BREAKERS

Control power for circuit breakers, switchgear control circuits, electrical interlocks and other general controls can be derived from several sources, three of which are as follows:

1) Control Power Transformer (AC)

2) Battery and Charger (DC)

3) Combination of Items 1 & 2 above

The user requirements will dictate which of these control power sources will be selected. If the system is small, the use of a control power transformer might be the best selection. Larger systems requiring prolonged availability of the control circuits should use a DC power source.

When a control power transformer is utilized, the secondary voltage can be 120 or 120/230 volts AC. The circuit breaker closing circuits consist of the spring charging motor and closing relays which can be operated from either voltage level. Tripping power is generally provided by a capacitor trip device which is charged by the 120 or 230 volts AC available from the control power transformer. The capacitor insures there is adequate tripping power, under short circuit conditions, to trip the power circuit breaker open. One capacitor trip unit is used with each circuit breaker. This system will insure adequate tripping power for approximately 25 seconds after removal of control power, longer times are available at slightly higher cost.

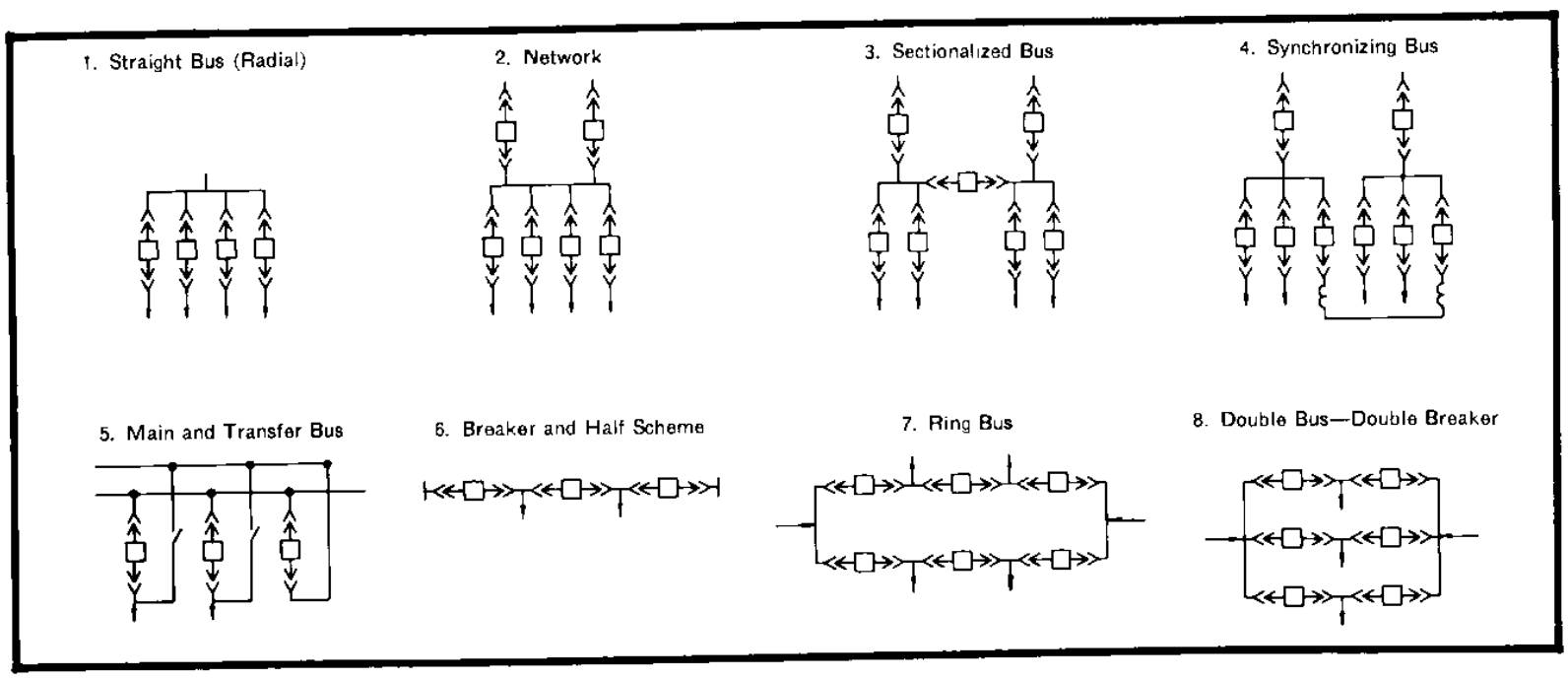
To provide prolonged control power, a battery should be considered. Depending on the power drain by auxiliary circuits tripping power would be available almost continually. A battery charger is generally included with this type of installation to maintain the charge on the batteries. Any 120 volt AC control source can be used to energize the charger, or the user can specify the control source for the charger be provided from a control power transformer in the switchgear. Installations using a battery and charger for control purposes do require routine maintenance by operating personnel.

When sizing a control power source for a switchgear assembly, allow for indicating lights, space heaters, emergency lighting and external control circuit requirements. After considering these requirements it should be relatively easy to select which type of control power source is required for any switchgear installation.

METAL-CLAD 5-15KV SWITCHGEAR
System Selection
APPLICATION DATA

While some system applications for metal-clad switchgear are complex most switchgear layouts are relatively simple and straightforward. For complex schemes Square D Company application engineers are available for consultation purposes. The following minimum information is required whether the system is complex or relatively simple:

1. Select a system one line diagram which adequately meets the needs for the primary distribution system of the project.
2. Select the continuous current rating of all devices in the switchgear assembly and determine the short circuit capacity of the system.
3. Size the ampacity of the main bus.
4. Select current transformers for over current protection.
5. Select potential transformers.
6. Select closing, tripping and power requirements of auxiliary circuits.
7. Special considerations and applications.



BUS ARRANGEMENT

A bus is the junction of three or more incoming and outgoing circuits. The most common bus arrangements utilized with metal-clad switchgear are detailed in this section. They range from the simplest system to the most complex. Each system should be evaluated for the users application, investment cost and operating procedure. A decision must be made on which arrangement most ideally suits the needs of each user before specifying the system.

METAL-CLAD 5-15KV SWITCHGEAR
APPLICATION DATA

CIRCUIT BREAKER SELECTION

Circuit breakers must be properly selected for each application. Criteria to be considered is interrupting capacity, continuous current, duty cycle and unusual service conditions. Table 1.2 gives the electrical characteristics for the DSE Power Circuit Breaker complete with all conversion factors to adjust the ratings to a particular system voltage and/or fault availability. For unusual applications consult the latest NEMA and ANSI Standards for derating factors.

TABLE 1.2

Type of Breaker	Nominal Rating		Rated Cont. Current 60 Hertz Amps.—RMS	Rated Voltages			Insulation Level Rated With Stand		Interrupting Ratings † Amps.—Symmetrical			Asymmetrical Rating Factor*	Short Time Rating 3 Sec. Amps.—RMS	Close & Latch Rating Amps.—RMS	Interrupting Time Cycles
	Three Phase MVA	Voltage KV—RMS		Maximum Voltage KV—RMS	K—Factor Max. KV Min. KV	Minimum Voltage KV—RMS	Low Frequency KV—RMS	△Impulse 1.2x50MS KV—CREST	Maximum KV Amps.—RMS	Nominal KV Amps.—RMS	Minimum KV Amps.—RMS				
DSE-21	75	4.16	1200	4.76	1.36	3.50	19	60	8,800	10,000	12,000	1.1	12,000	19,000	5
DSE-23	150	4.16	1200	4.76	1.36	3.50	19	60	18,000	20,600	24,000	1.1	24,000	39,000	5
DSE-23B	250	4.16	1200	4.76	1.24	3.85	19	60	29,000	33,200	36,000	1.1	36,000	58,000	5
DSE-23B	250	4.16	2000	4.76	1.24	3.85	19	60	29,000	33,200	36,000	1.1	36,000	58,000	5
DSE-25C	350	4.16	1200	4.76	1.19	4.0	19	60	41,000	46,900	49,000	1.1	49,000	78,000	5
DSE-25C	350	4.16	2000	4.76	1.19	4.0	19	60	41,000	46,900	49,000	1.1	49,000	78,000	5
DSE-23BU	250	7.20	1200	8.25	1.79	4.6	36	95	17,000	19,500	30,000	1.1	30,000	49,000	5
DSE-25CU	500	7.20	1200	8.25	1.25	6.6	36	95	33,000	37,800	41,000	1.1	41,000	66,000	5
DSE-25CU	500	7.20	2000	8.25	1.25	6.6	36	95	33,000	37,800	41,000	1.1	41,000	66,000	5
DSE-25CU	500	7.20	3000	8.25	1.25	6.6	36	95	33,000	37,800	41,000	1.1	41,000	66,000	5
DSE-62	250	13.8	1200	15.0	2.27	6.6	36	95	9,300	10,100	21,000	1.1	21,000	34,000	5
DSE-65	500	13.8	1200	15.0	1.30	11.5	36	95	18,000	19,500	23,000	1.1	23,000	37,000	5
DSE-65	500	13.8	2000	15.0	1.30	11.5	36	95	18,000	19,500	23,000	1.1	23,000	37,000	5
DSE-65	500	13.8	3000	15.0	1.30	11.5	36	95	18,000	19,500	23,000	1.1	23,000	37,000	5
DSE-57	750	13.8	1200	15.0	1.30	11.5	36	95	28,000	30,400	36,000	1.1	36,000	58,000	5
DSE-57	750	13.8	2000	15.0	1.30	11.5	36	95	28,000	30,400	36,000	1.1	36,000	58,000	5
DSE-57	750	13.8	3000	15.0	1.30	11.5	36	95	28,000	30,400	36,000	1.1	36,000	58,000	5

NOTES:

†—For converting voltages other than those listed the interrupting current = Amps at max. KV $\frac{\text{Max. KV}}{\text{operating KV}}$ but in no case this current exceed the interrupting current at minimum KV.

•—Rating factor is based on breaker speed from initiation to contact parting with ½ cycle relay time. Multiply factor X symmetrical current to obtain asymmetrical current interrupting capability of breaker.

△—These values apply with circuit breaker in or out of enclosure.

METAL-CLAD 5-15KV SWITCHGEAR
Control Circuits and Operation
APPLICATION DATA

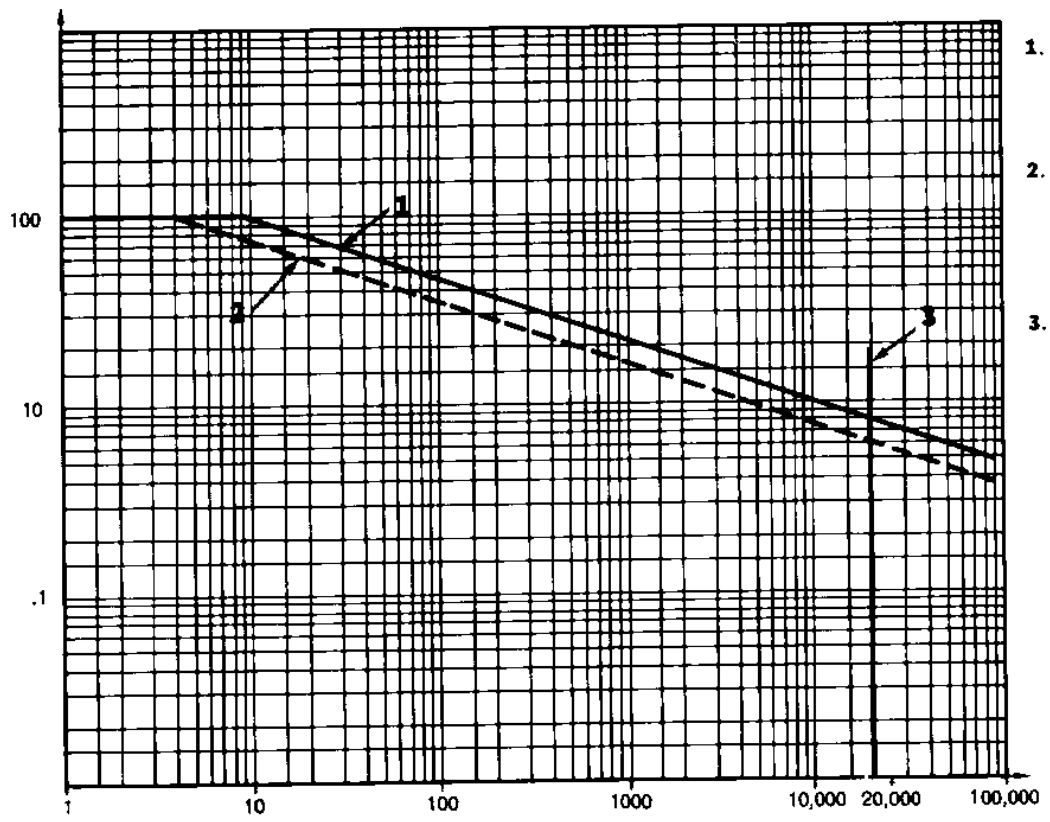
OPERATING LIFE

Many industrial installations demand metal-clad switchgear with a high endurance duty cycle in the power circuits. The standard Solenarc DSE circuit breaker can be operated for three years without parts replacement when the switching frequency is ten operations per day or less.

Long operating life on the Solenarc DSE power circuit breaker can be attributed to the arc chute design, heavy duty arcing contacts and rugged construction of the stored energy operating mechanism. The thermal capacity of the arc chute in the Solenarc circuit breaker is very high and is capable of absorbing the energy in the arc rapidly because of the ceramic refractory plate construction. The electrical endurance of an arc chute used at normal current compares favorably with the mechanical endurance on the breaker. For example, a Solenarc circuit breaker when used to control and protect a motor with a 50 ampere rated current has interrupted 40,000,000 amperes as a whole without renewal of the arc chutes.

The endurance of the electrical contacts of the breaker at the arcing tips is very high because of the speed in which the arc is transferred to the arc chute. Erosion at the arcing contacts is kept to the absolute minimum. The main contacts of the breaker never carry the arc. The high electrical endurance combined with excellent mechanical endurance makes the Solenarc DSE circuit breaker well suited for use in high duty cycle switching installations.

INTERRUPTING LIFE OF SOLENARC DSE
POWER CIRCUIT BREAKERS



METAL-CLAD 5-15KV SWITCHGEAR
SUGGESTED SPECIFICATIONS

I. General

The (indoor) (outdoor non-walk-in) (outdoor walk-in) Metal-Clad switchgear described in this specification is intended for use on a (2400) (4160) (4800) (7200) (13,800) ( ) volt 3-phase (3) (4) wire (grounded) (ungrounded) 60 Hertz system. The switchgear shall be rated (4160) (7200) (13,800) volts and have horizontal drawout circuit breakers. The switchgear and circuit breaker either individually or as a unit shall have an impulse rating of (60) (95) KV. The entire switchgear assembly including circuit breakers, meters, relays, etc., shall be completely factory tested and the circuit breakers of like ratings shall be interchangeable.

II. Applicable Standards

The switchgear covered by these specifications shall be designed, tested and assembled in accordance with the latest applicable standards of ANSI and NEMA.

III. Stationary Structure

The switchgear shall consist of_____breaker units and_____auxiliary units assembled to form a rigid self-supporting completely metal-enclosed structure providing two thicknesses of painted steel between units. Each breaker unit structure shall be segregated by metal barriers into the following separate compartments:

1) Circuit breaker
2) Main bus
3) Instrument
4) Auxiliary device
5) Cable

IV. Circuit Breaker Compartment

Each circuit breaker compartment shall be designed to house a horizontal drawout (4160) (7200) (13,800) volt Solenarc DSE air circuit breaker. The stationary primary disconnecting contacts are to be silvered copper and field replaceable. The movable contacts and springs shall be mounted on the circuit breaker element for ease of inspection.

Entrance to the stationary primary disconnecting contacts shall be automatically covered by bright red grounded steel shutters when the circuit breaker is withdrawn to the test or disconnected positions or removed from the circuit breaker compartment. The shutter mechanism design is to latch the shutters closed, and which can be only defeated by two distinct operations, so only operating personnel familiar with the switchgear design can gain access to the stationary contacts. Provide means for padlocking the shutters in the closed position for safety purposes when the breaker element is removed from the compartment for long periods of time. Extend a ground bus into the circuit breaker compartment to automatically ground the breaker frame with a high current spring type grounding clip located on the breaker chasis when in the test and connected positions. Welded guide rails for positioning the circuit breaker and all other necessary hardware are to be an integral part of the circuit breaker compartment. Blocking devices shall interlock breaker frame sizes to prevent installation of lower ampacity or interrupting capacity element into a compartment designed for one of a higher rating.

V. Cable Compartment

The upper primary disconnecting contacts shall be extended into the cable compartment by means of compensated epoxy bushings which are vacuum cast from cycloaliphatic resins. The current transformers for overcurrent protection and other relaying functions are to mount on these bushings and be accessible from the front or rear of the structure by removing bolted plates. (Clamp type cable lugs) (Potheads) (Cable Terminators) will be furnished as shown on plans. The ground bus shall extend through this compartment for the full length of the switchgear.

VI. Main Bus Compartment

The lower primary disconnecting contacts shall be extended into the bus compartment by means of polyester or epoxy bushings. The main bus is to be rated (1200) (2000) amperes and be fully insulated for its entire length with Lexan, PVC tube or epoxy encapsulated. The conductors are to be (tin plated aluminum) (silver plated copper) and be of a bolted (not welded) design. Access to this compartment is gained form the rear of the structure by removing an 11 gauge steel barrier.

VII. Doors and Panels—Indoors

Relays, meters, instruments, control switches, etc. shall be mounted on a formed front hinged panel. The breaker compartment shall have a formed hinged panel separate from that for the relays and meters. In the event the quantity of relays and meters become excessive a full front hinged panel is to be provided to allow for mounting the additional devices.

The cable compartment shall have a bolted rear panel.

Continued on page 22

METAL-CLAD 5-15KV SWITCHGEAR
SUGGESTED SPECIFICATIONS

VIII. Circuit Breakers

The circuit breakers shall be rated (4160) (7200) (13,800) volts, 60 Hertz, having a continuous current rating of (1200) (2000) (3000) amperes and an interrupting rating of (75) (150) (250) (350) (500) (750) MVA. All breakers of equal rating shall be completely interchangeable (breakers of higher ratings may be placed in cubicles of lower ratings).

The circuit breaker shall be operated by means of a stored energy mechanism which is normally charged by a universal motor, but can also be charged by a manual handle for manual emergency closing or testing. The closing speed of the moving contacts is to be independent of both the control voltage and the operator. Breaker main contracts shall be arranged such that under fault conditions, magnetic forces tend to blow the contacts closed rather than open.

The circuit breaker shall have three independent arc chutes, which do not depend on magnetic blow-out coils for interrupting the circuit and which are light weight in design for ease of removal.

Provide a full front shield on the breaker element designed to barrier operating personnel from live primary bus when the breaker is installed in the circuit breaker compartment. This barrier is to contain three windows or portals to allow the main moving and stationary contacts to be visually inspected while the breaker is in service. The windows are to be of high quality insulation and shock proof in design so as to withstand any pressures within the enclosures during short circuit interruptions. Designs which might allow blow-out of the windows will not be acceptable.

Secondary control circuits are to be of a plug-in design such that all control terminals are up front on the breaker element and completely accessible while the breaker is installed in the circuit breaker compartment. The secondary control plug shall be permanently connected to structure by a flexible control harness which encloses and protects the individual control circuit wires. This plug is to be grounded to the structure with no less than a number 12 wire and shall seal the control contacts against dirt, dust and other contaminents when installed on the breaker. Installation of the control plug on to the front of the breaker element shall defeat a mechanical interlocking system which will allow the circuit breaker to close by use of the electrical controls or manually.

Provide a circuit breaker position locking handle to lock the circuit breaker into the test and connected positions. Removal of the control plug or unlocking position locking handle shall automatically trip the circuit breaker to the open position. The interlocking system is to make it impossible to rack a closed circuit breaker to or from any position. An additional interlock shall automatically discharge the stored-energy operating mechanism closing spring upon removal or insertion into or out of the compartment.

The circuit breaker control voltage shall be (48) (115) (125) (250) (AC) (DC).

IX. Instrument Transformers

Current transformers—The current transformer shall have ratios as indicated in the details of each switchgear unit. The transformer shall have mechanical rating equal to the momentary rating of the circuit breakers. The current transformer shall be insulated for full voltage of the switchgear assembly by use of compensated type bushings. Relay and metering accuracy shall be as indicated in the details for each switchgear unit.

X. Control Wiring

The switchgear shall be wired with Type SIS #14 AWG, except where larger is specified. The switchgear shall be provided with terminal blocks for outgoing control connections.

XI. Drawings

Upon award of the contract, the manufacturer shall furnish for (approval) (record) showing the general arrangement and schematic diagrams. These drawings shall supply all installation and coordination data required by the purchaser for the preparation of electrical and mechanical details necessary to the installation of the switchgear by the purchaser.

METAL-CLAD 5-15KV SWITCHGEAR
SUGGESTED SPECIFICATIONS

XII. Details of Overall Switchgear Assembly

The Solenarc DSE Metal-Clad Switchgear assembly shall be complete with structure and three phase_____ampere (aluminum) (copper) interconnecting bus and consisting of:

1— DSE Main Circuit Breaker (#52) rated_____amperes,_____KV with_____MVA interrupting capacity. With_____Volts (DC) (AC) close and_____volts (DC) (AC) (capacitor) trip.

1 —Circuit breaker control switch with red and green pilot lights.

(2) (3)—Overcurrent relay # (50) (50/51).

1 —Ground overcurrent relay #51N.

1 —Indicating ammeter and instrument control switch with OFF position.

1 —Indicating voltmeter and instrument control switch with OFF position.

3 —Current transformers, single (multi) ration type.

(2) (3)—Potential transformer ration_____/120 volts, trunnion mounted with primary and secondary fuses.

(1) (2)—Three phase (set) (clamp) (compression) (pothead) (type cable lugs).

(1) (2)—(Incoming line) Auxiliary section each consisting of:

(1) (2)—(Rigid mounted) (Drawout mounted) (single) (three) phase control power transformer rated_____KVA, 150°C rise, no taps, with_____(delta) primary and_____(Wye) secondary.

(1)—Three phase set of (distribution) (intermediate) (station) class lightning arresters.

(1) (2)—(3/C) (Three—1/C) potheads

(1) (2)—Three phase set (clamp) (compression) type cable lugs.

(1)(2) (3) ( )—DSE feeder circuit breakers #52 rated_____amperes,_____KV with_____MVA interrupting capacity. With_____volts (DC) (AC) close and_____(DC) (AC) (Capacitor) trip.

1 —Circuit breaker control switch with red and green pilot lights.

(2) (3)—Overcurrent relay # (50) (50/51).

1 —Ground overcurrent relay #51N.

1 —Indicating ammeter and instrument control switch with OFF position.

1 —Indicating voltmeter and instrument control switch with OFF position.

3 —Current transformers, single (multi) ratio type.

(2) (3)—Potential transformer ratio_____/120 volts, trunnion mounted with primary and secondary fuses.

(1) (2)—Three phase set (clamp) (compression) type cable lugs.

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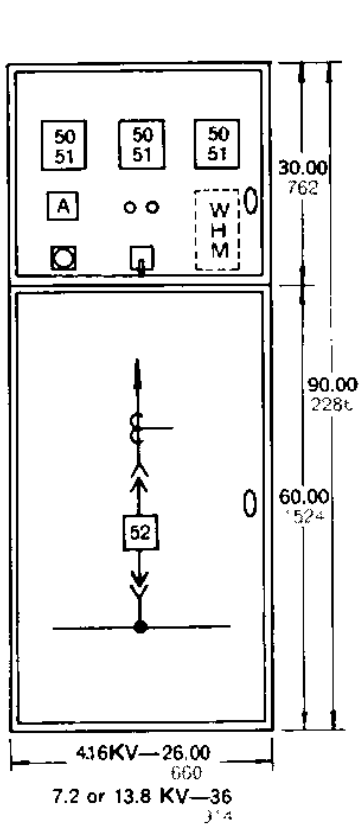
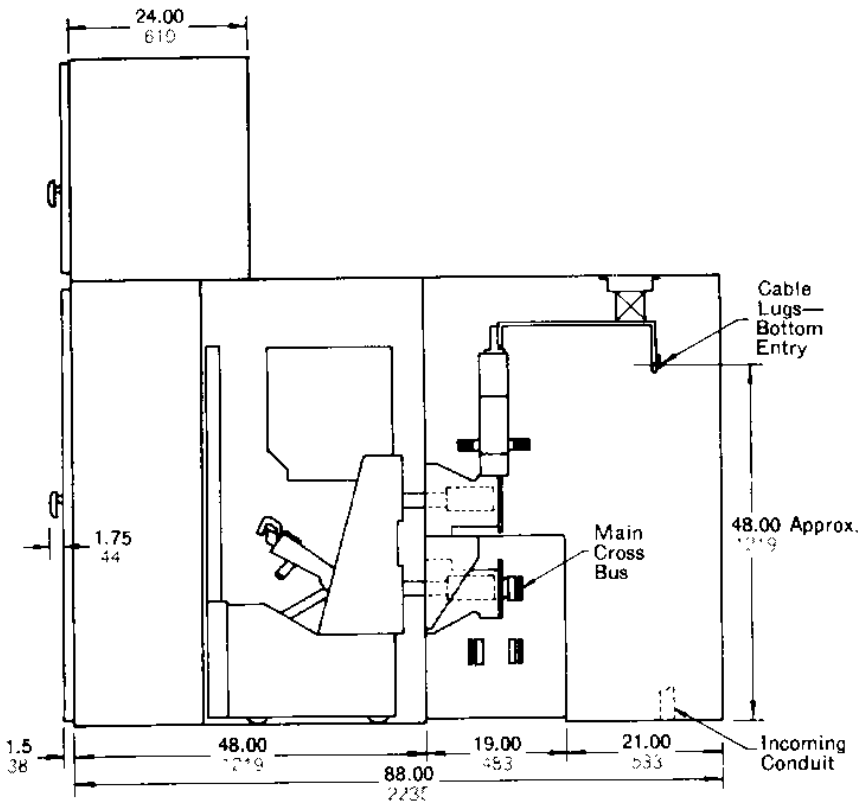
METAL-CLAD 5-15KV SWITCHGEAR
DIMENSIONS
APPROXIMATE DIMENSIONS—NOT FOR CONSTRUCTION

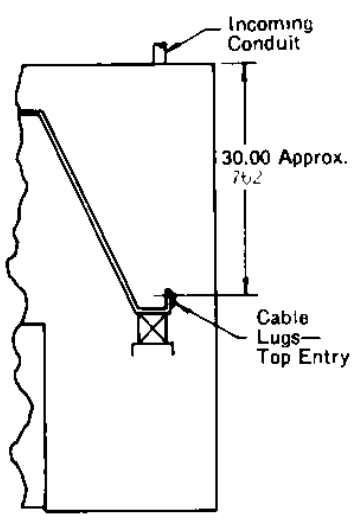


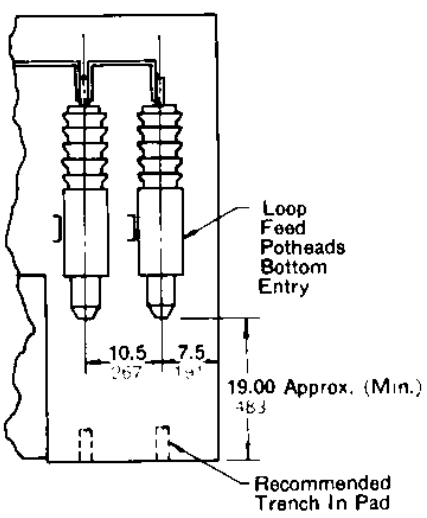
FRONT VIEW

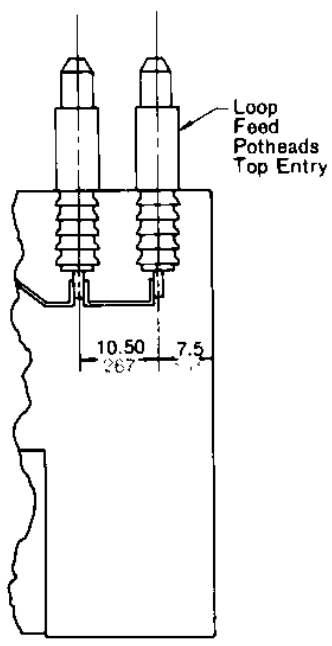


PARTIAL
SECTION VIEW
(RIGHT HAND SIDE)

TYPICAL MAIN INCOMING LINE OR FEEDER METAL-CLAD SWITCHGEAR SECTION



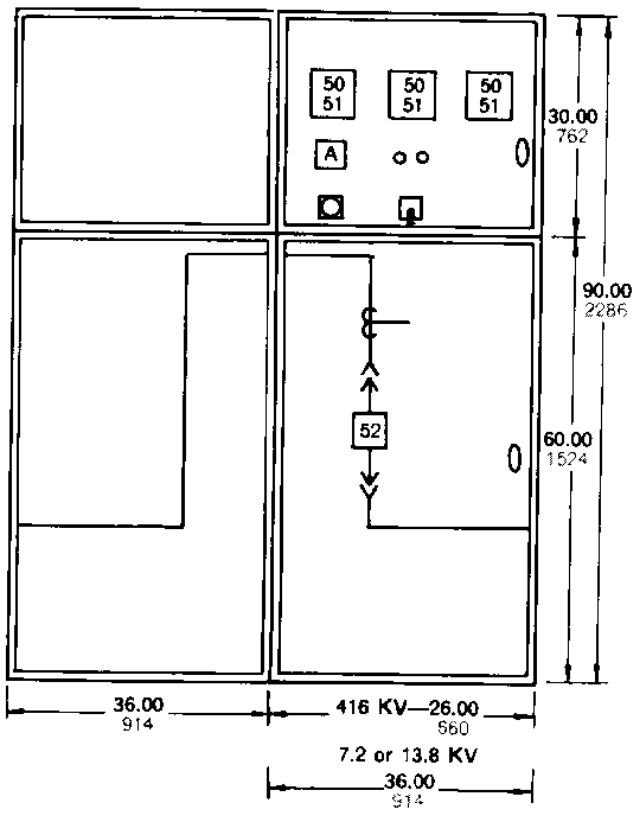




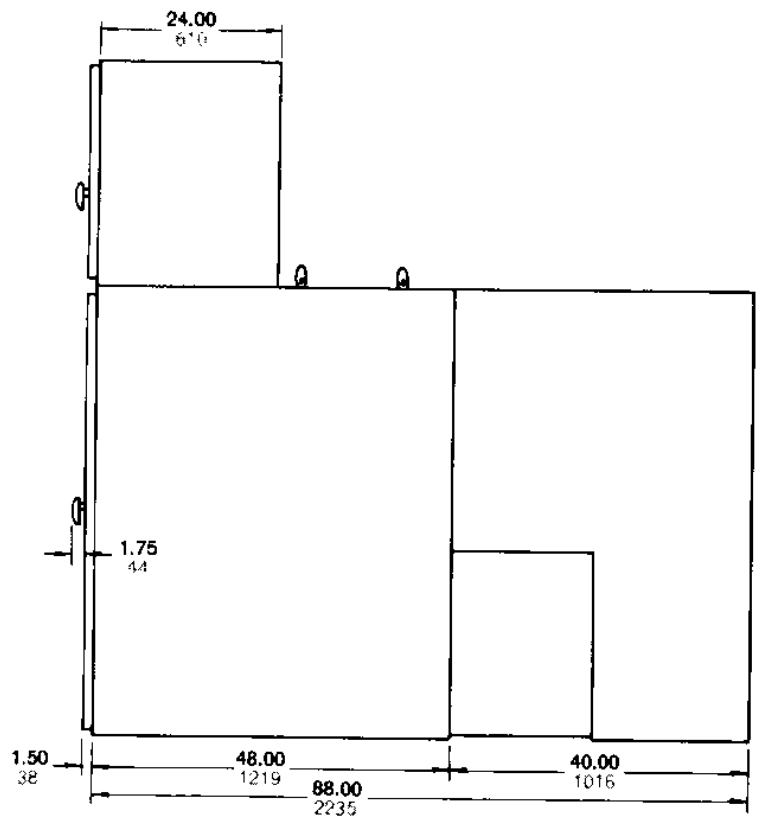
METAL-CLAD 5-15KV SWITCHGEAR

DIMENSIONS

APPROXIMATE DIMENSIONS—NOT FOR CONSTRUCTION

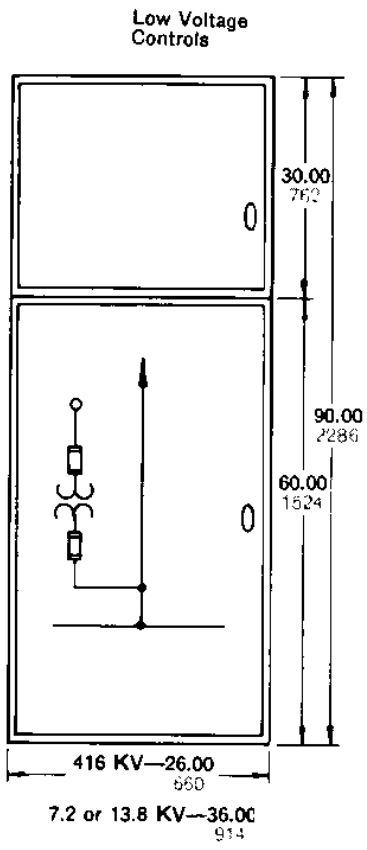


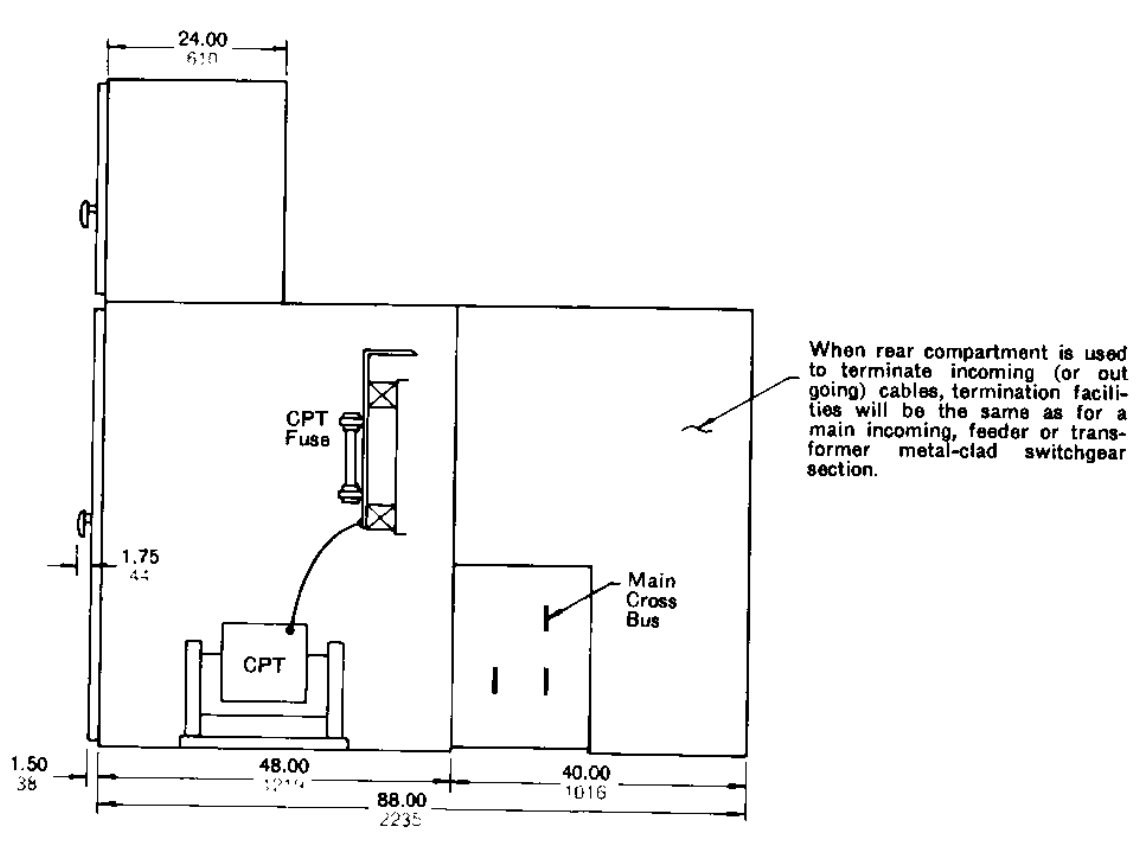
FRONT VIEW



SIDE VIEW

BUS TIE OR BUS SECTIONALIZING METAL-CLAD SWITCHGEAR SECTION

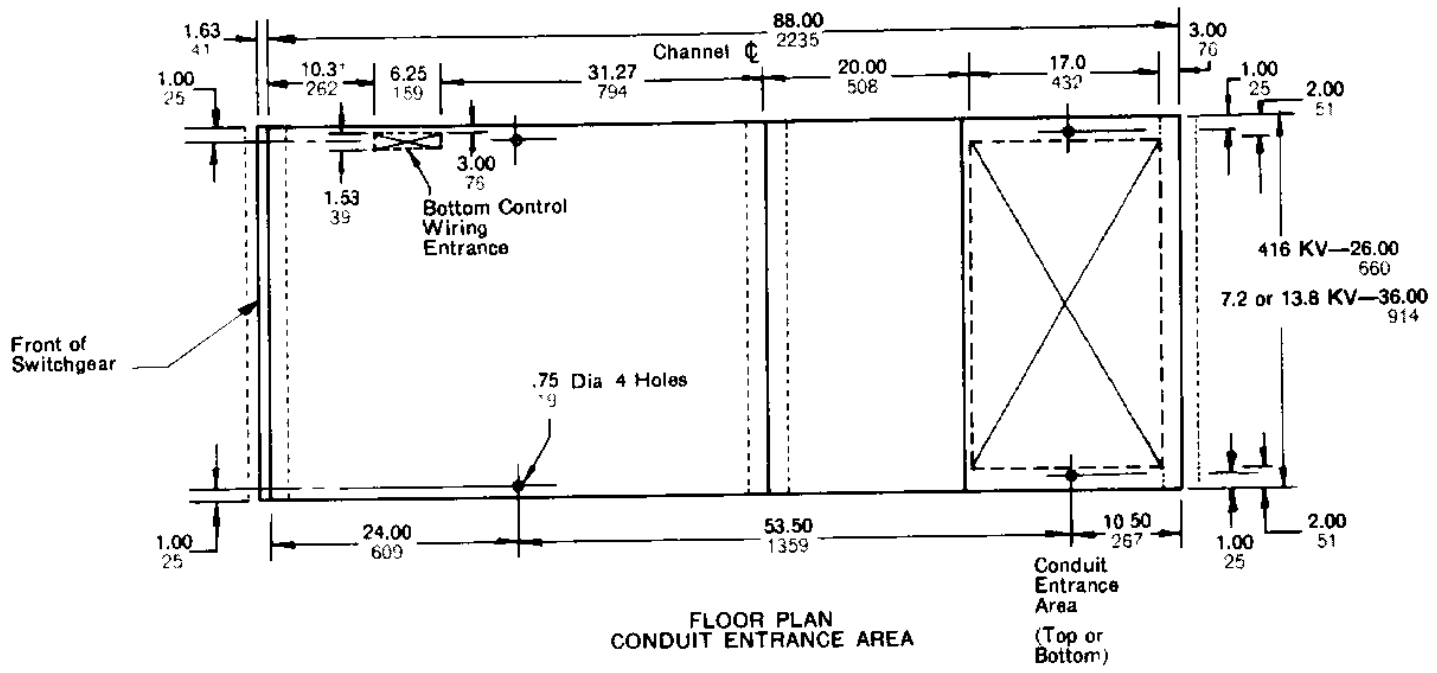




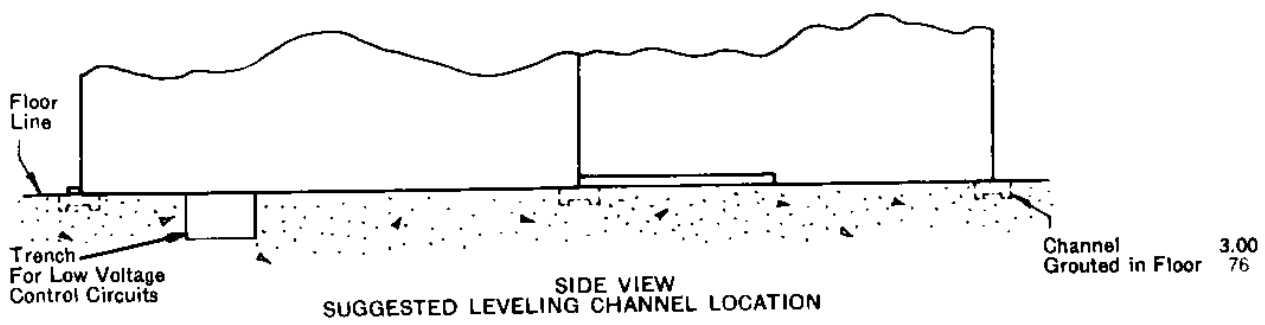
TYPICAL AUXILIARY OR MAIN INCOMING LINE* SECTION

*Not suitable for installation of a power breaker.

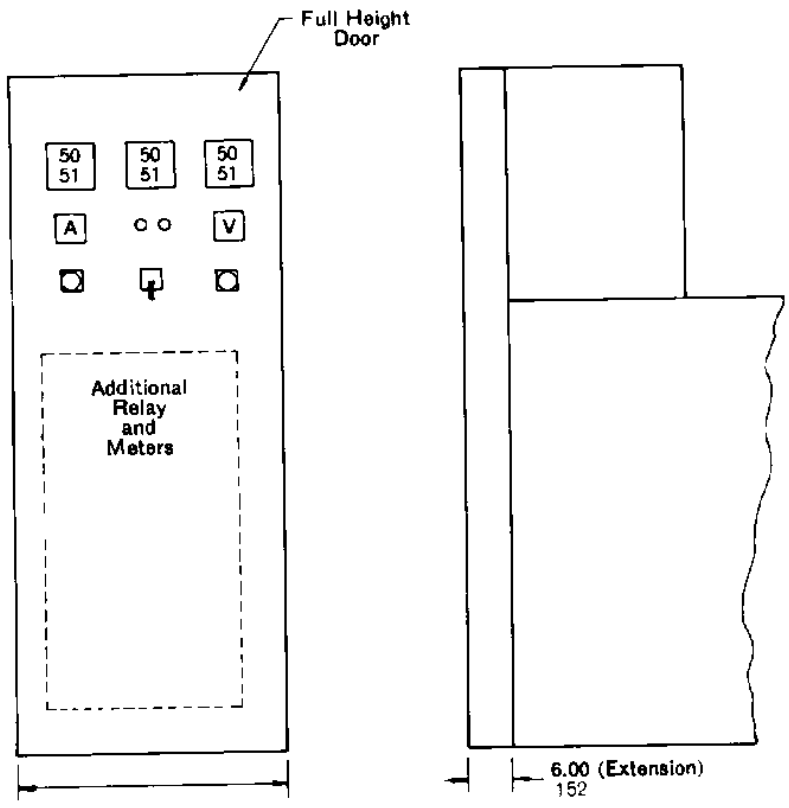
METAL-CLAD 5-15KV SWITCHGEAR
DIMENSIONS
APPROXIMATE DIMENSIONS—NOT FOR CONSTRUCTION



FLOOR PLAN
CONDUIT ENTRANCE AREA



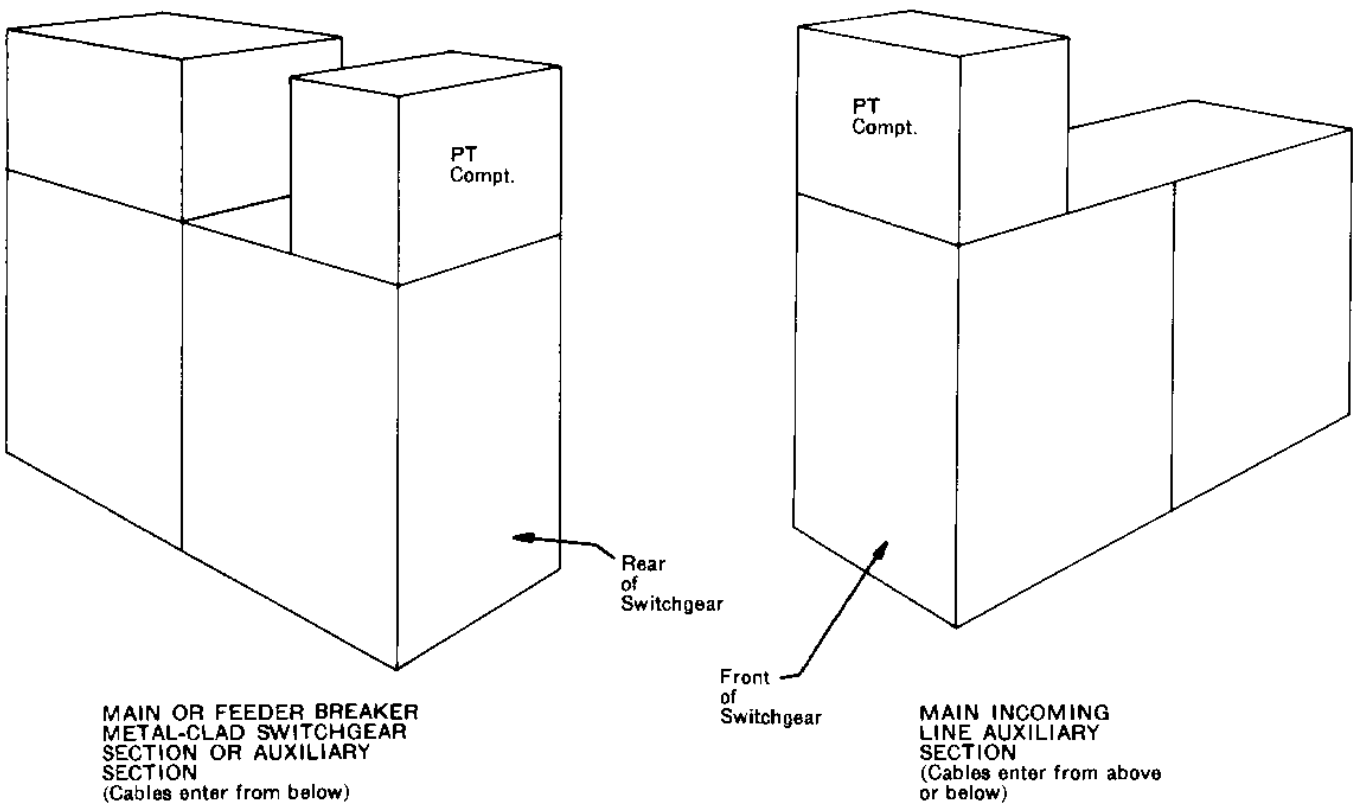
SIDE VIEW
SUGGESTED LEVELING CHANNEL LOCATION



FRONT EXTENSION FOR ADDITIONAL RELAY MOUNTING SPACE

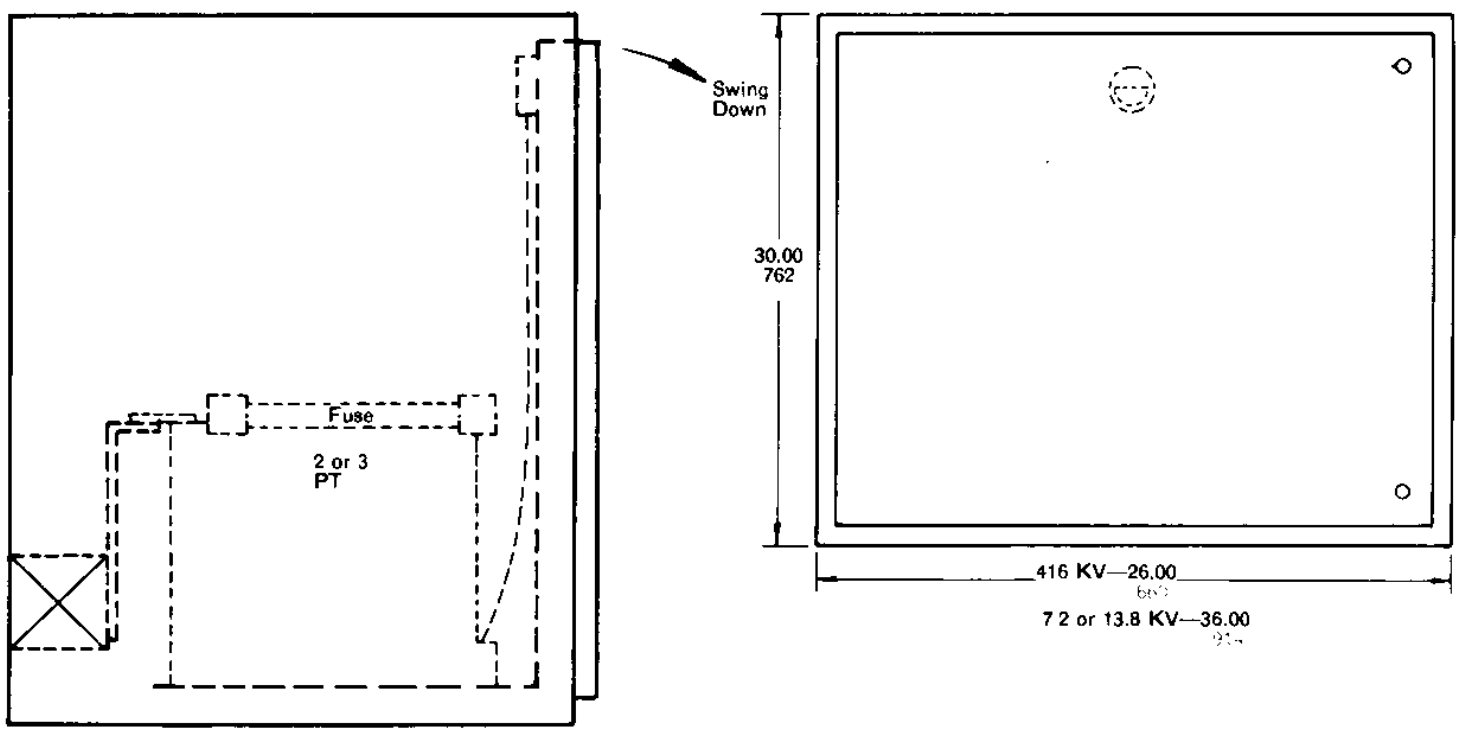
METAL-CLAD 5-15KV SWITCHGEAR
DIMENSIONS
APPROXIMATE DIMENSIONS—NOT FOR CONSTRUCTION

TYPICAL POTENTIAL TRANSFORMER COMPARTMENT MOUNTINGS



MAIN OR FEEDER BREAKER METAL-CLAD SWITCHGEAR SECTION OR AUXILIARY SECTION
(Cables enter from below)

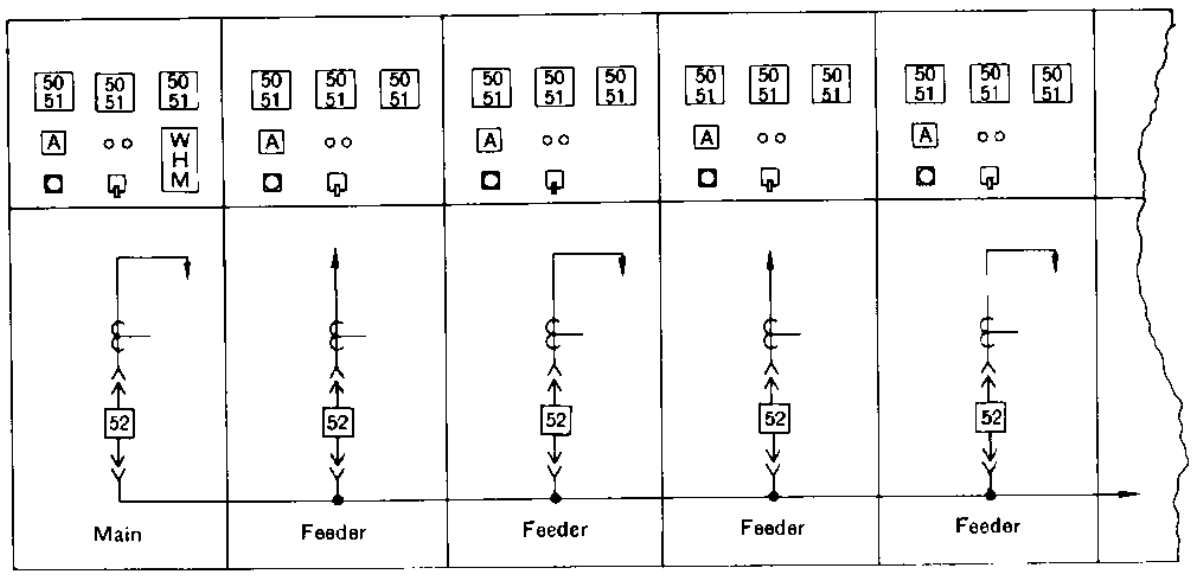
MAIN INCOMING LINE AUXILIARY SECTION
(Cables enter from above or below)

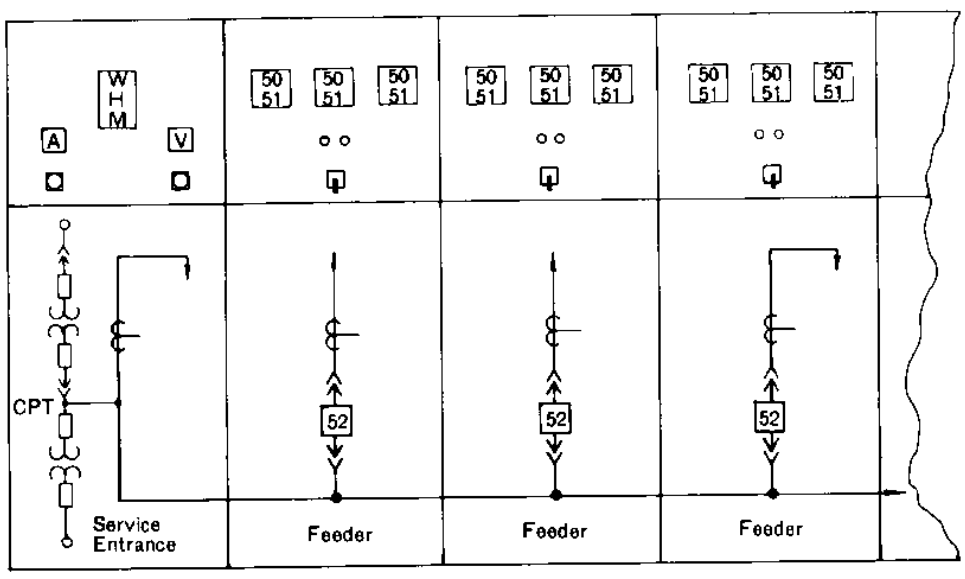


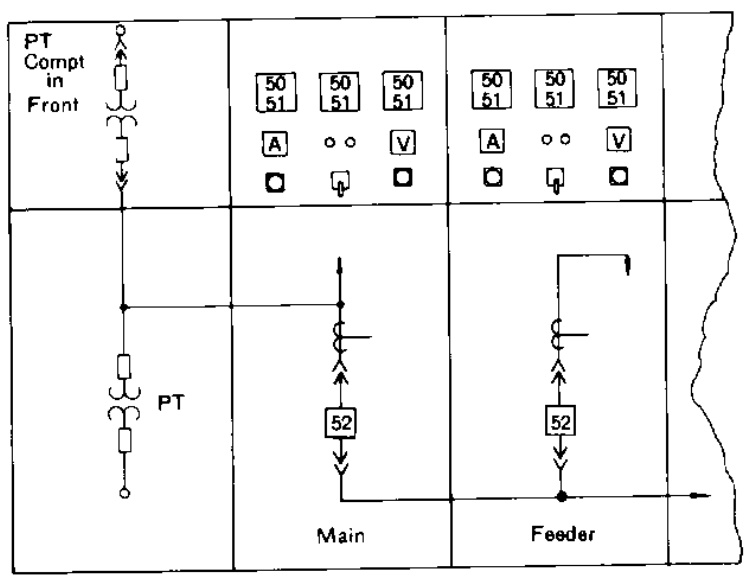
COMPARTMENT FOR TRUNNION MOUNTED POTENTIAL TRANSFORMERS

METAL-CLAD 5-15KV SWITCHGEAR
DIMENSIONS

TYPICAL METAL-CLAD SWITCHGEAR LAYOUTS

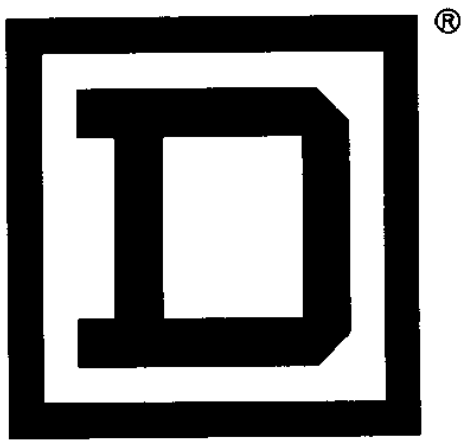






APPROXIMATE BREAKER WT.
5 KV-700 Lbs./318 Kg
15 KV-750 Lbs./340 Kg

APPROXIMATE CUBICLE WT.
5 KV-1600 Lbs./726 Kg
15 KV-1800 Lbs./816 Kg



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