N. Davies

Westinghouse Electric Corporation
Switchgear Division
East Pittsburgh, Pa. 15112, U.S.A.

April, 1977
Supersedes DB 32-252,
dated March, 1965 and all
supplements thereto,
E,D,C/1942/DB

75 to 1000 MVA Interrupting,
4160 to 13800 Volts
1200 to 3000 Amperes,
Indoor and Outdoor

Standardized Type DHP Medium Voltage Porcel-line Metal-Clad Switchgear

In this Publication

Additional Information

Application

Westinghouse Porcel-line type DHP metal-clad switchgear with removable circuit breakers provides centralized control and protection for generators, motors, transformers, capacitors, and most feeder circuits. It is available in ratings of 4.16, 7.2 and 13.8 kV with maximum nominal interrupting capacities of 350 MVA, 500 MVA and 1000 MVA, respectively. It is available with air magnetic circuit breakers in all ratings and vacuum circuit breakers in the 13.8 kV, 500 MVA and 750 MVA nominal ratings, both Indoor and Outdoor designs are available.

Typical Applications

Electric utility systems, industrial plants, commercial buildings, municipal pumping stations, transportation systems, pipe line stations, unit substations.

Industry Standards

The following industry standards apply for the application, design, manufacture, and test of Westinghouse porcel-line medium voltage metal-clad switchgear.

ANSI Standard	American National Standards Institute
C37.010	Application guide for ac high-voltage circuit breakers rated on a symmetrical current basis
C37.100	Definitions for power switchgear
C37.04	Rating structure for ac high-voltage circuit breakers
C37.06	Preferred ratings for ac high-voltage circuit breakers rated on a symmetrical current basis
C37.07	Factors for reclosing service
C37.09	Test Procedure for ac high voltage circuit breakers
C37.11	Power circuit breaker control
C37.20	Switchgear assemblies including metal-enclosed bus
C37.24	Guide for evaluating the effect of solar radiation

NEMA Standard	National Electrical Manufacturers Association
SG-4	Power Circuit Breakers
SG-5	Power Switchgear Assemblies

Metal-Clad Switchgear

Metal-clad switchgear is an assembly of metal-enclosed units characterized by the following features:

(1) The main switching and interrupting device is of the removable type arranged with a mechanism for moving it physically between connected and disconnected positions and equipped with self-aligning and self-coupling primary and secondary disconnecting devices.

(2) Major parts of the primary circuit, that is, the circuit switching or interrupting devices, buses, potential transformers, and control power transformers, are completely enclosed by grounded metal barriers, which have no intentional openings between compartments. Specifically included is a metal barrier in front of or a part of the circuit interrupting device to ensure that when, in the connected position, no primary circuit components are exposed by the opening of a door.

(3) All live parts are enclosed within grounded metal compartments. Automatic shutters isolate the primary circuit elements when the removable element is in the disconnected, test, or removed position.

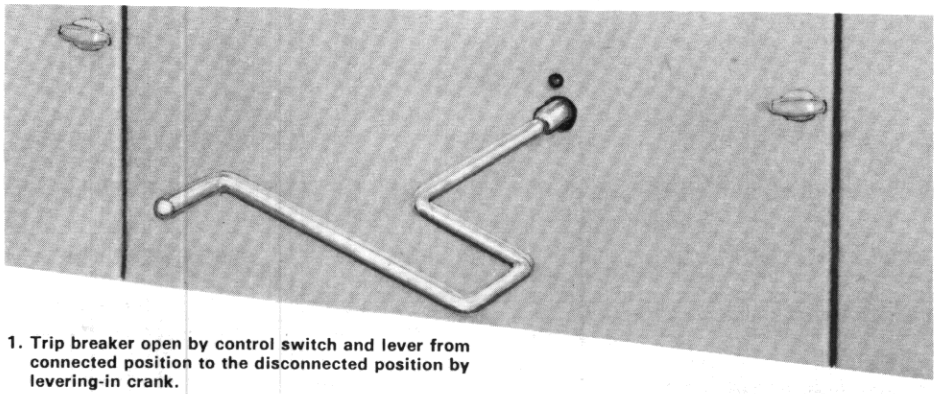
(4) Primary bus conductors and connections are covered with insulating material throughout.

(5) Mechanical interlocks are provided to maintain a proper and safe operating sequence.

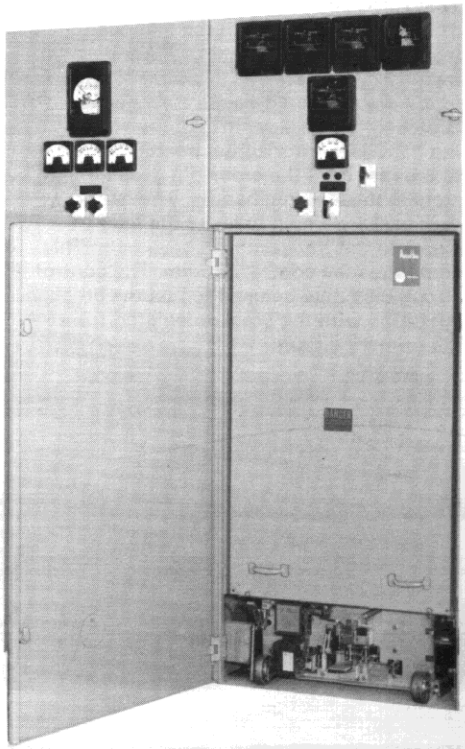
(6) Instruments, meters, relays, secondary control devices and their wiring are isolated by grounded metal barriers from all primary circuit elements with the exception of short lengths of wire such as at instrument transformer terminals.

(7) The door through which the circuit interrupting device is inserted into the housing may serve as an instrument or relay panel and may also provide access to a secondary or control compartment within the housing.

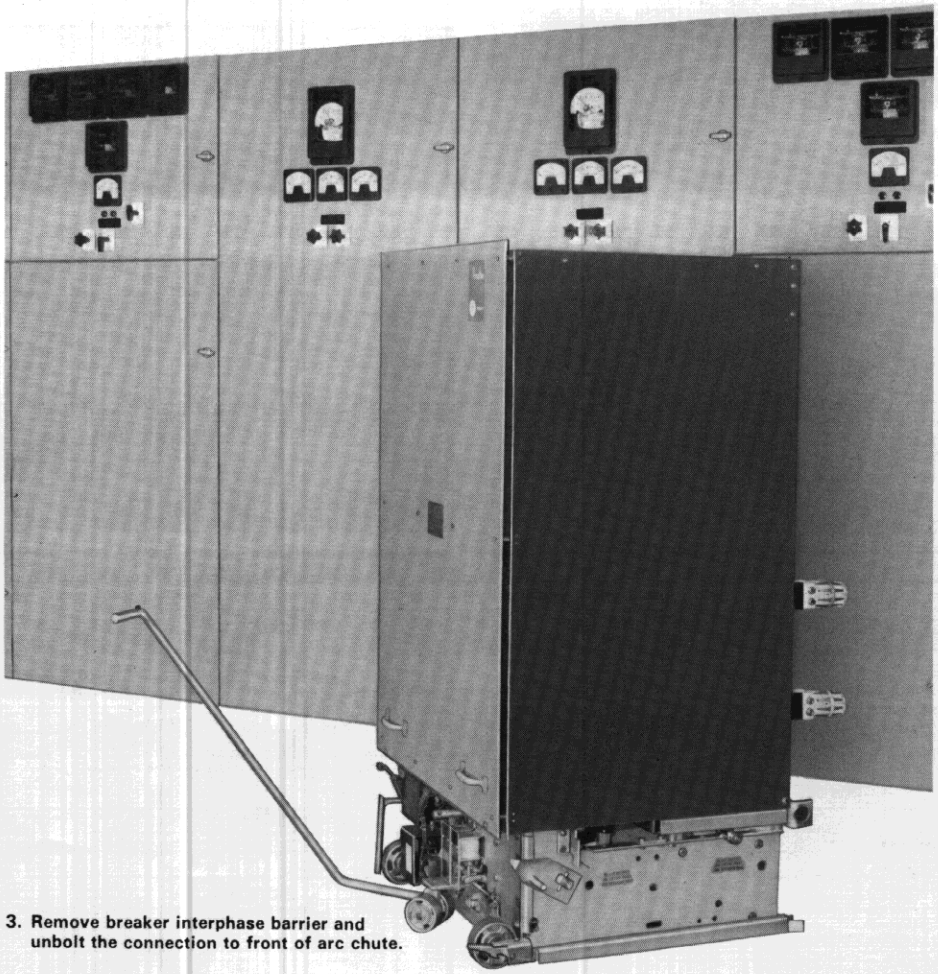
Horizontal Drawout Construction
Withdrawal and inspection of DHP breaker is accomplished by four simple procedures.



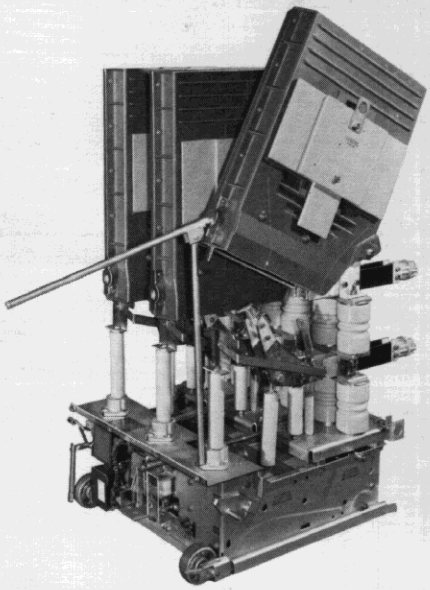
1. Trip breaker open by control switch and lever from connected position to the disconnected position by levering-in crank.



2. Unlatch breaker from disconnected position and remove from housing.



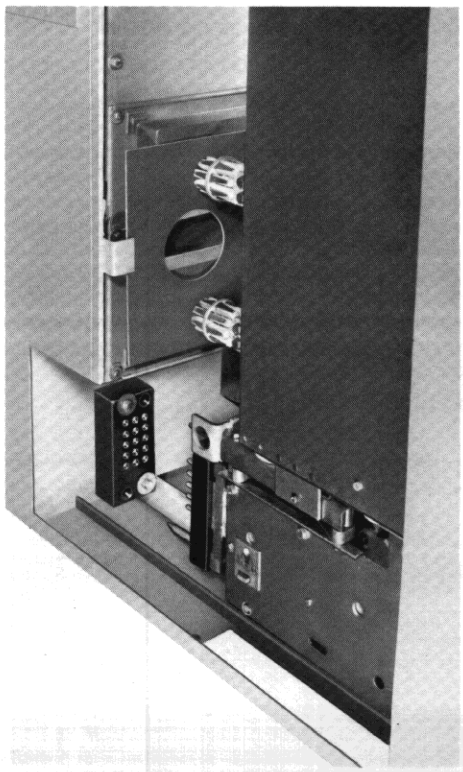
3. Remove breaker interphase barrier and unbolt the connection to front of arc chute.

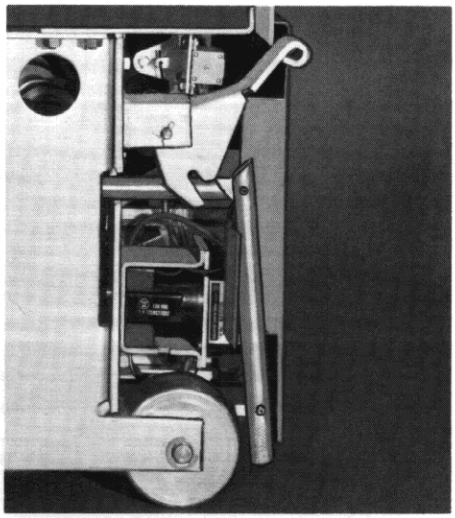


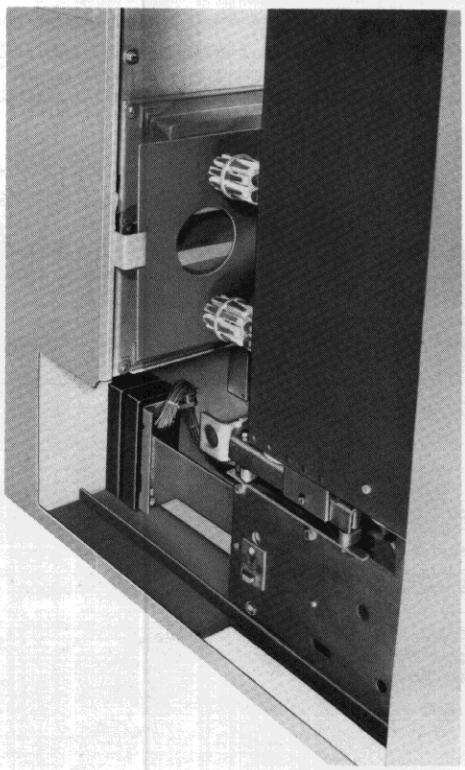
4. Tilt the hinged arc chute and inspect the breaker contacts and inside of chute.

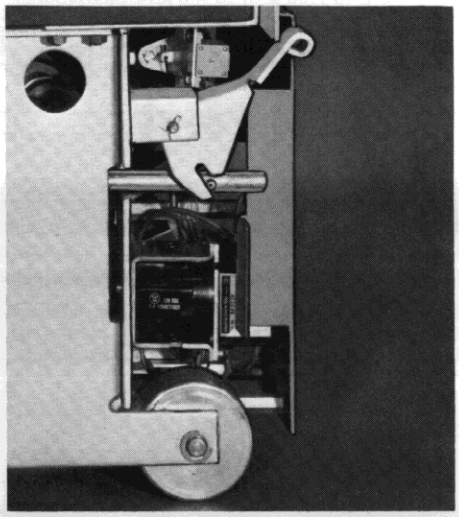
Test Position

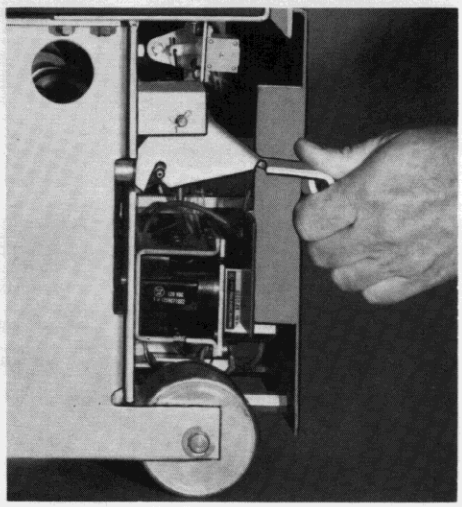
The breaker is placed in the test position by manually engaging the secondary disconnecting contacts while the breaker itself is in the disconnected position and the shutter is closed. To engage, lift the round operating handle to a horizontal position and push to the rear until the cross-pin goes into the slots in the levering handle. The handle is then pressed down to make the final engagement of the secondary contacts. This completes the control circuits. The control circuit may now be used to test the breaker operation with the breaker isolated from the primary circuit.



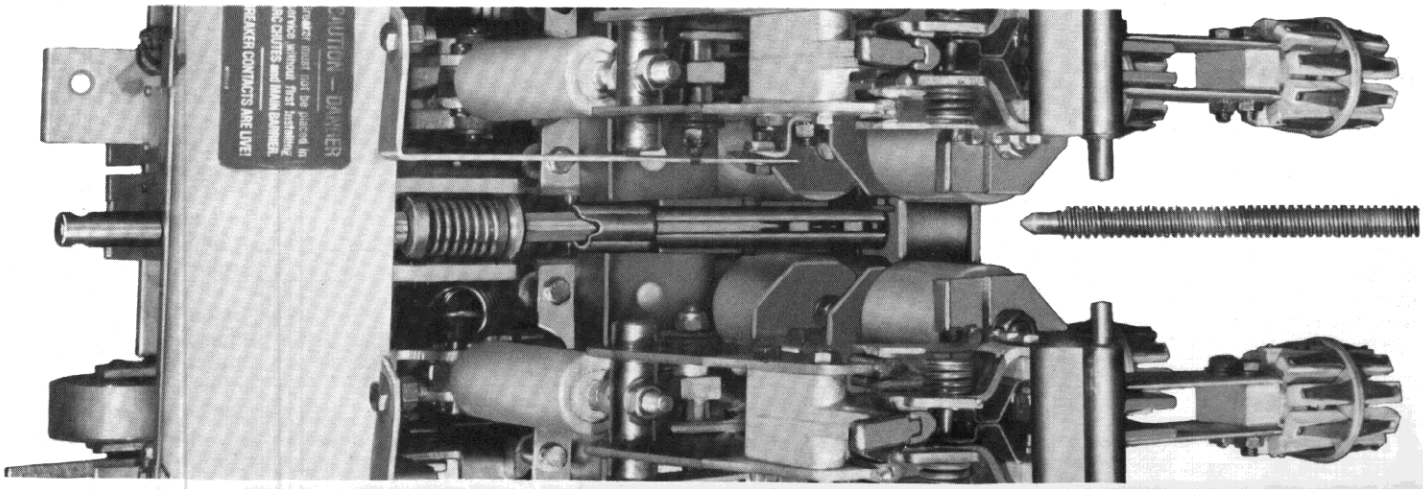






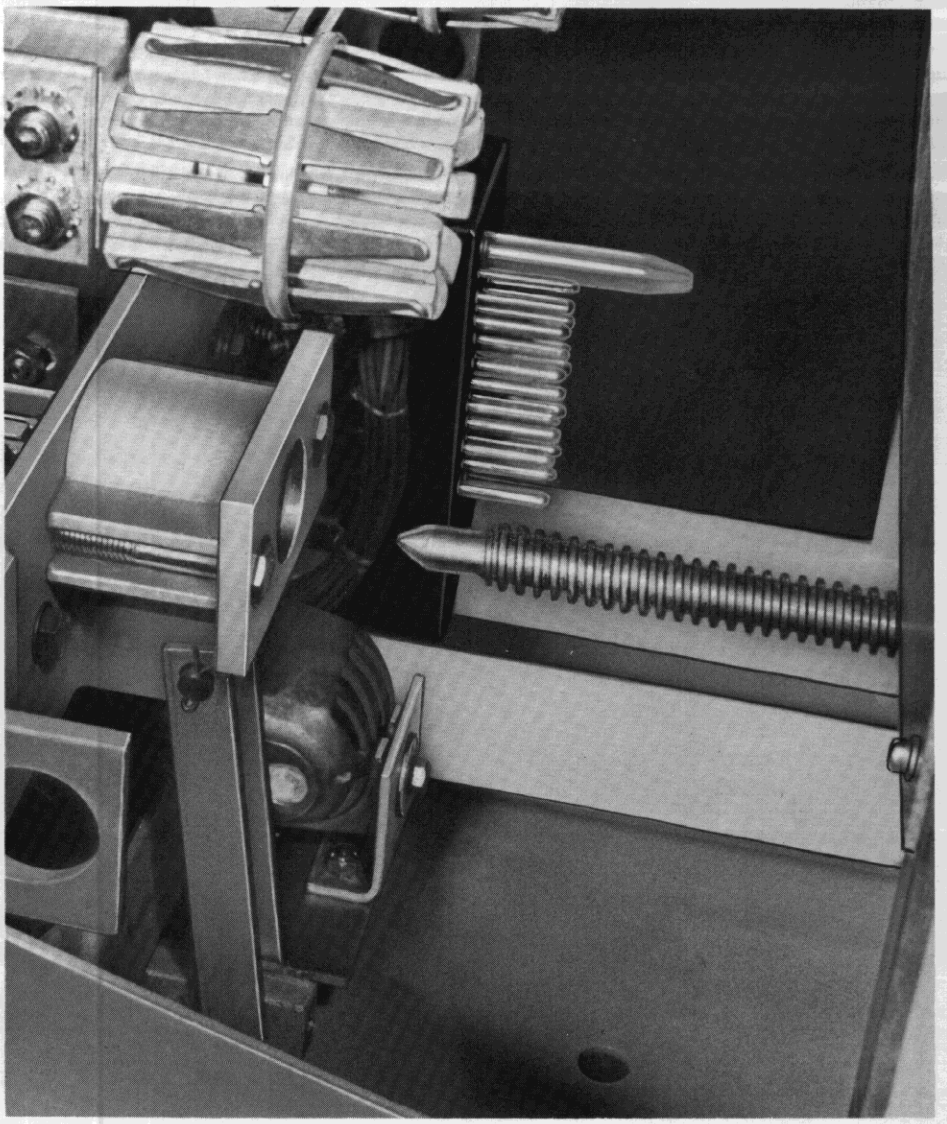


Spin-Free Levering

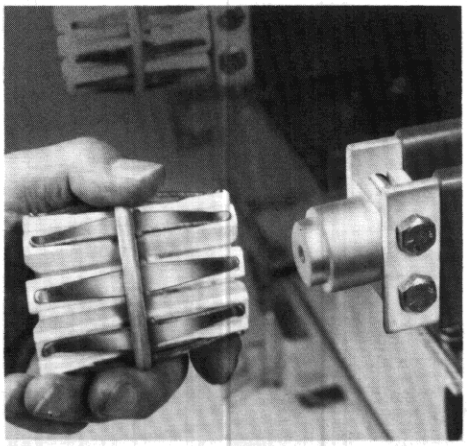


Horizontal drawout is accomplished by rotating a levering shaft on the breaker. Rotating of this shaft in turn rotates a nut which engages a stationary screw in the cell. The nut moves in along the screw pulling the breaker into the connected position. The levering shaft is interlocked with the breaker mechanism to prevent levering a closed breaker. When the split door arrangement is provided, the lower door has an access port for levering the breaker with the door closed.

The levering shaft on the breaker is spin-free at the end of breaker travel to assure proper engagement of primary disconnecting contacts and prevent overtightening.

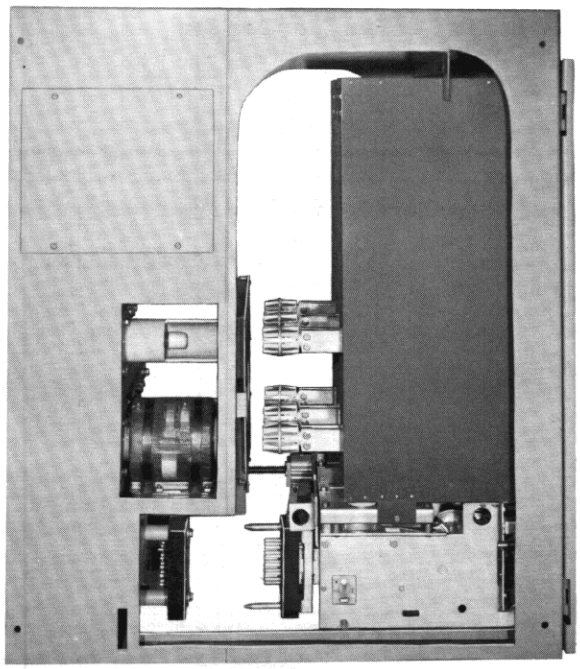


Disconnecting Contacts
The stationary primary contacts are silver-plated and recessed within procelain supports or bottles in both 5 kV and 15 kV switchgear. The disconnecting primary contact fingers are silver-plated and contact pressure is maintained by leaf springs. They are mounted on the removable breaker element for easy inspection.

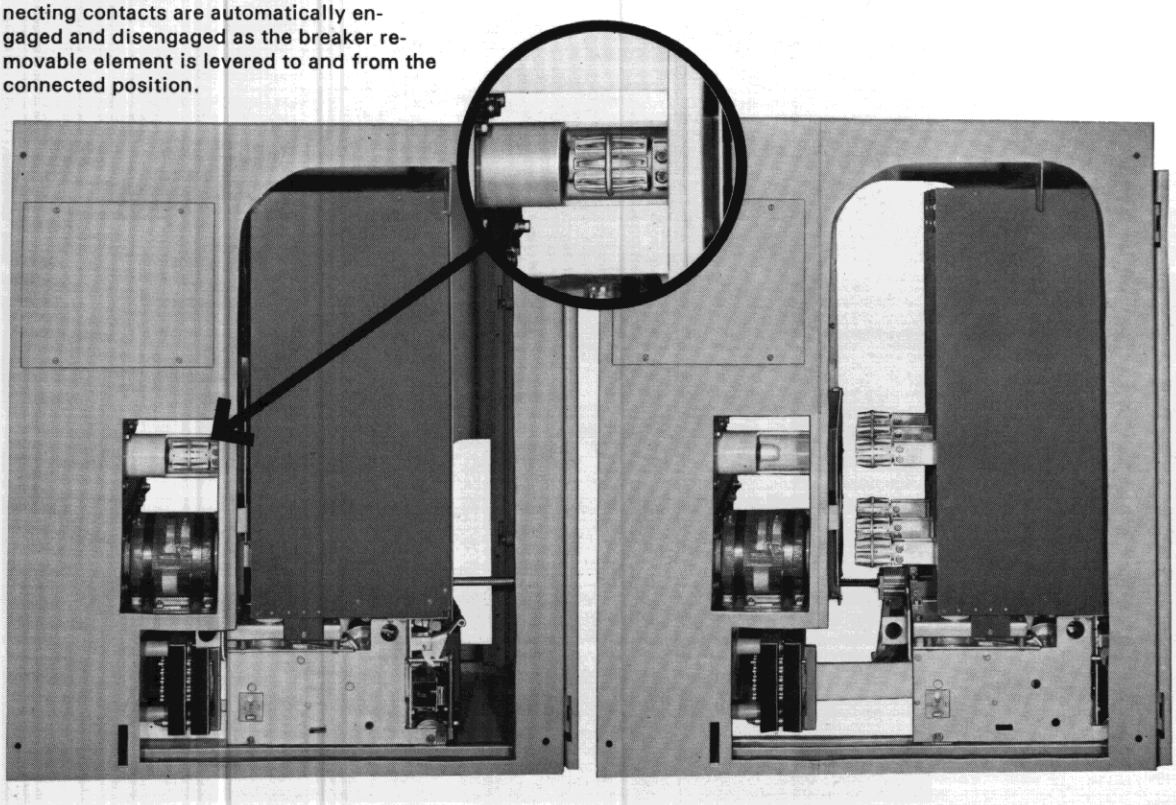


The secondary disconnecting contacts for breaker control circuits consists of multiple plug and socket contacts of the trainline coupler type.

Both the primary and secondary disconnecting contacts are automatically engaged and disengaged as the breaker removable element is levered to and from the connected position.



Disconnected Position

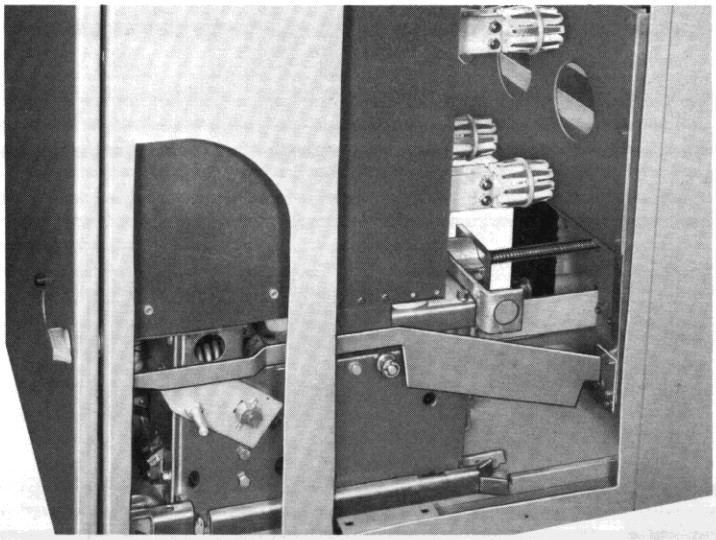


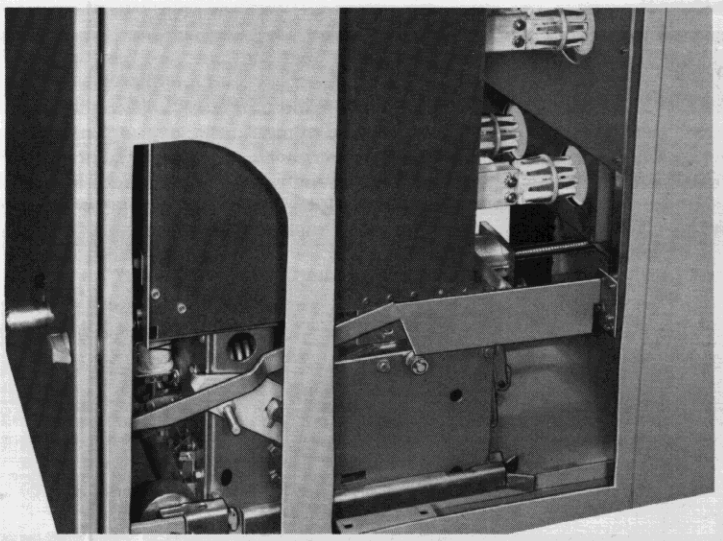
Connected Position

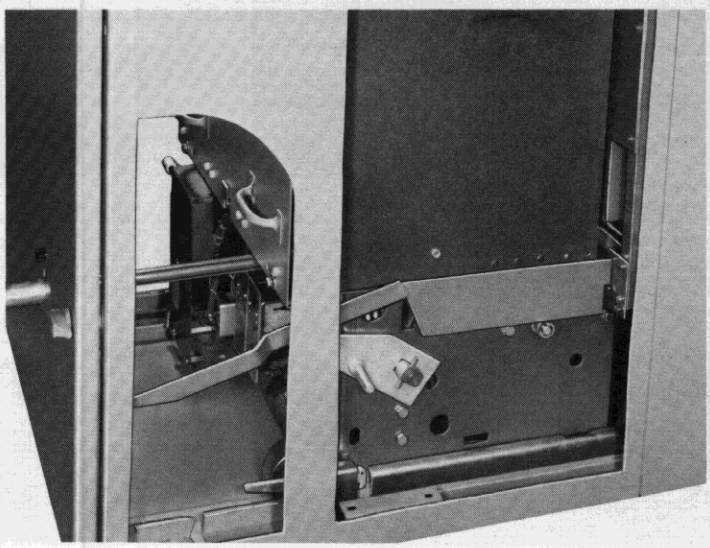
Test Position

Automatic Shutter
A glass polyester shutter covers the openings to the primary contact bottles when the removable breaker element is in the disconnected, test or removed position. The shutter is automatically raised by the action of a roller on the breaker which engages a cam surface on the shutter arm as the breaker is levered in. It drops by gravity as the breaker is levered out. At the front of the cell, the shutter arm provides a mechanical indication to show the position of the shutter at all times.

The shutter provides an isolating function only and is not subject to voltage stress when the breaker is withdrawn. This is because full air clearance is maintained between the shutter and the stationary primary contact studs.

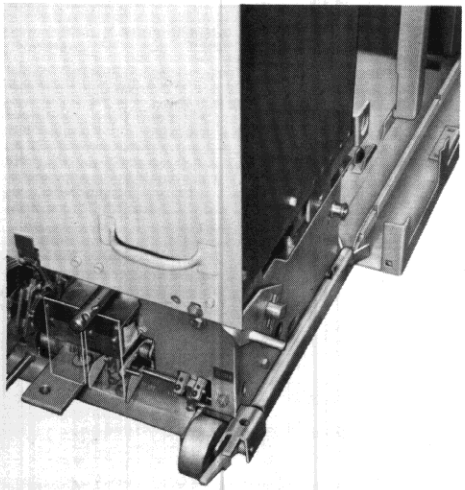






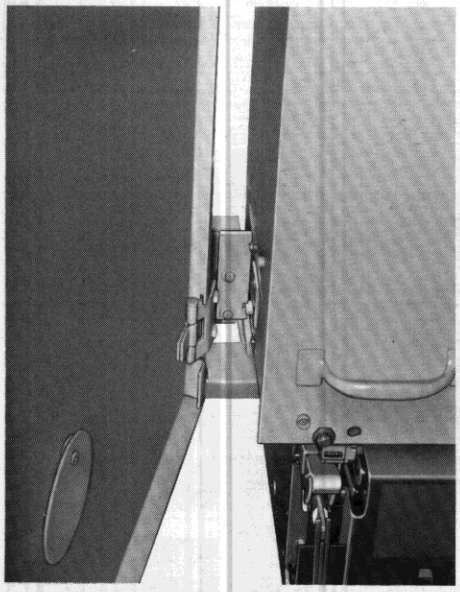
Additional Breaker Housing Features
The following features of construction are standard for the DHP breaker housing to ensure a proper and safe operating sequence.

Floor Guide



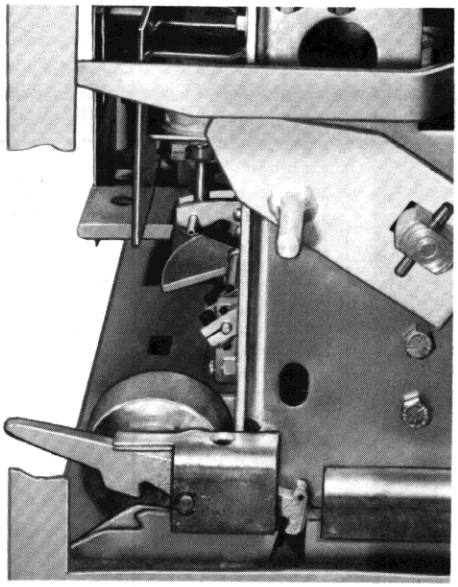
The guide channel on the right side of the breaker engages a floor guide rail in the cell providing accurate horizontal breaker movement.

Coding Plate



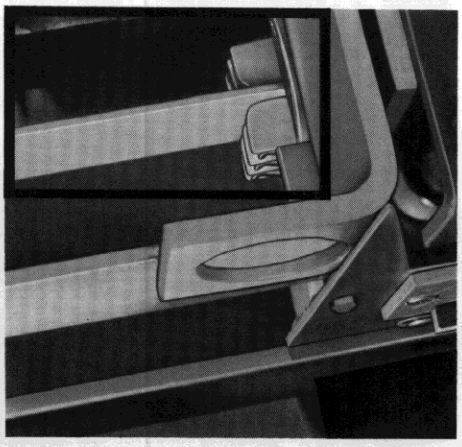
A cell coding plate prevents placing the wrong continuous current or interrupting rating breaker in the cell. A pin on the left side of the breaker will pass through a notch in the cell coding plate when the breaker and the cell are of the same rating.

Rail Latch



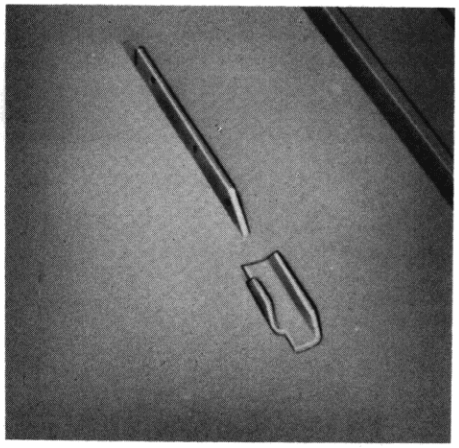
The rail latch provides a positive stop at the disconnected position. Its purpose is to prevent hard bumping the levering-in device to the screw and to secure the breaker in the disconnected or test position. Depress the rail latch lever to release when removing or installing a breaker.

Breaker Ground Bus



The breaker frame is grounded to the breaker ground bus in both the connected position and the disconnected or test position as well as all intermediate positions.

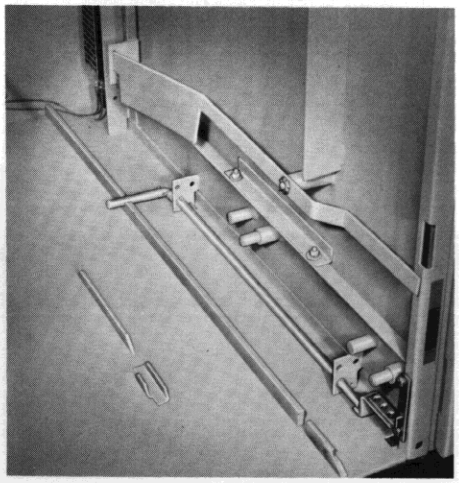
Floor Trippers



The rear floor tripper will permit operation of the breaker in the connected and disconnected positions and hold the mechanism trip-free while levering. This prevents the breaker contacts from being closed in an intermediate position.

The front floor trippers discharge all springs as breaker is removed from its cell so the breaker is in a safe condition for inspection.

Position Interlock



A breaker position interlock can be supplied which will prevent levering a breaker to the connected position. This optional feature is available with a key interlock or with provisions for padlocks as shown.

Auxiliary Switches
Optional circuit breaker and cell auxiliary switches are available where needed for interlocking or control of auxiliary devices.

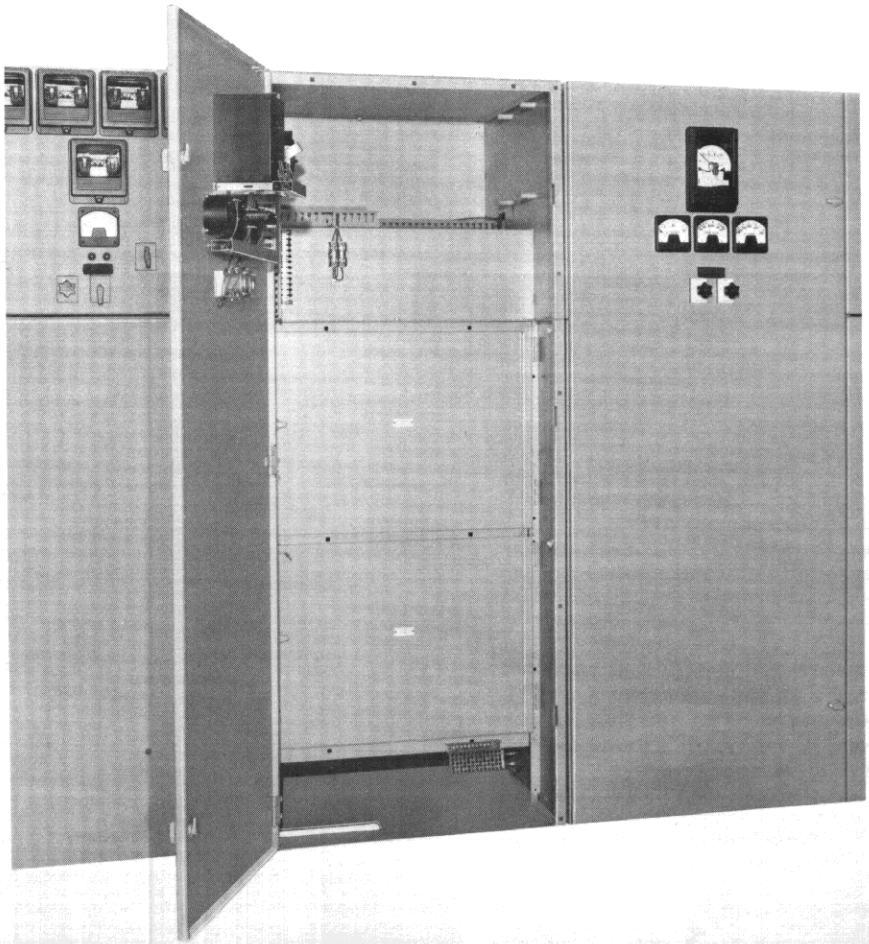
Auxiliary switch contacts on the circuit breaker mechanism are limited in number by the breaker control requirements. Usualy one 'a' and two 'b' contacts for ac control or two 'a' and two 'b' contacts for dc control are available.

When additional auxiliary contacts are needed, the optional mechanism operated cell (MOC) switch is used. The MOC switch may be applied for operation in the operating position only, or both operating and test positions of the breaker as determined by the application. A maximum of three MOC switches each with nine contacts can be supplied. One MOC switch is shown with the brackets for two additional switches. The lower end of the vertical rod is connected to a pantograph which is operated by a pin attached to the breaker mechanism.

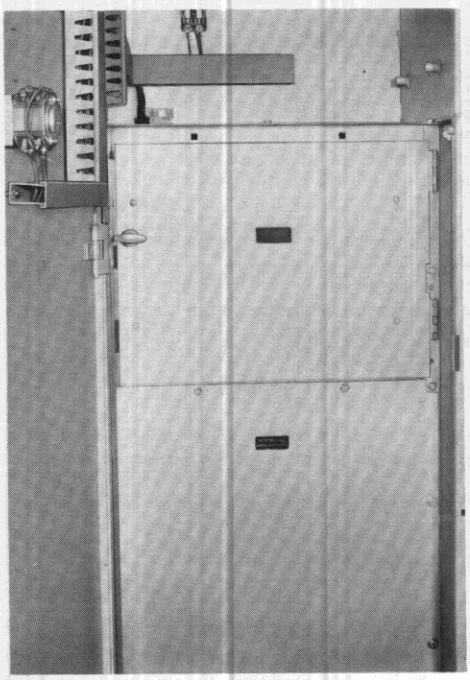
The optional truck operated cell (TOC) switch operates when the circuit breaker is levered into or out of the operating position. The TOC cell switch is shown located just below the levering screw.

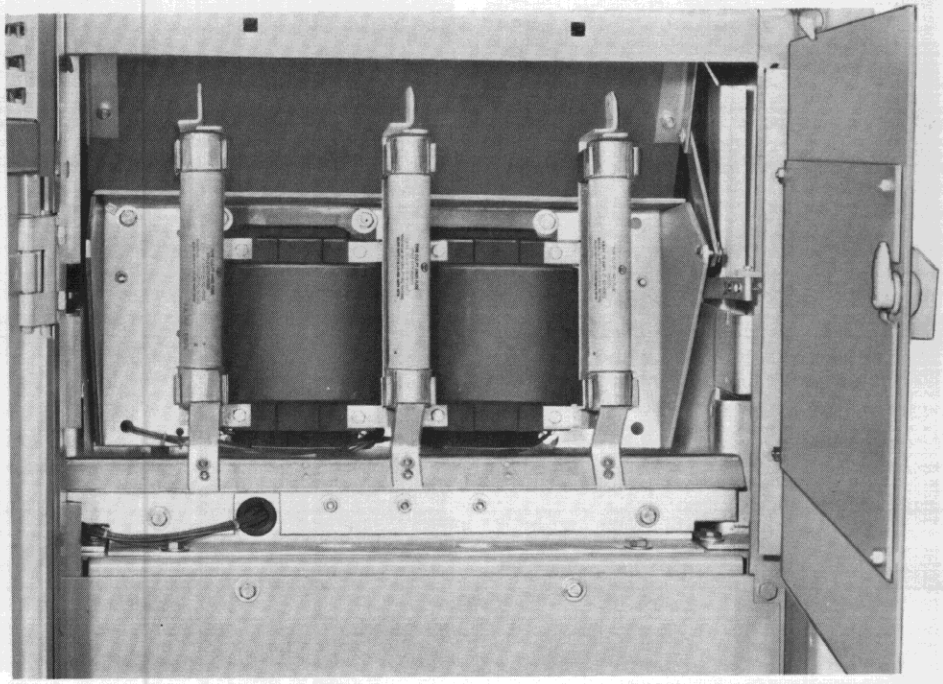
Auxiliary Housings
Auxiliary housings of Porcel-line metal-clad switchgear are arranged for maximum operating flexibility. These housings are available for equipment such as disconnecting potential transformers and fuses, control power transformers, lightning arresters, and motor or generator field equipment. The auxiliary housing door is also a full height instrument panel for mounting relays, meters or instruments.

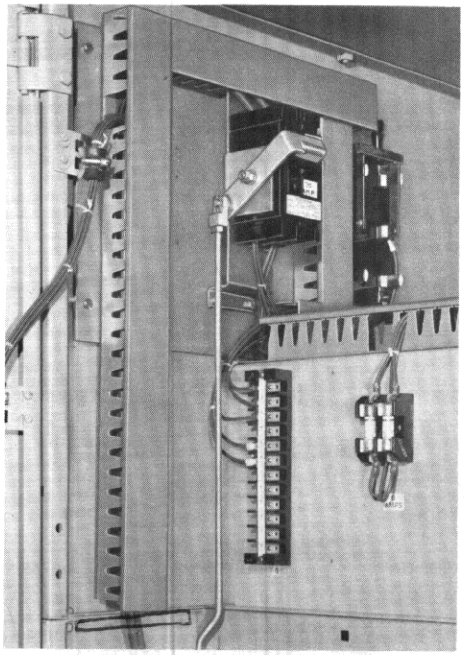
Potential transformers or control power transformers up to 15 kVA single phase are trunion mounted with current limiting fuses in enclosed compartments. They are disconnected, grounded and isolated from high voltage when the access door is open.

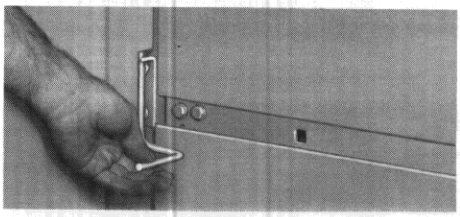


5 kV Potential Transformer

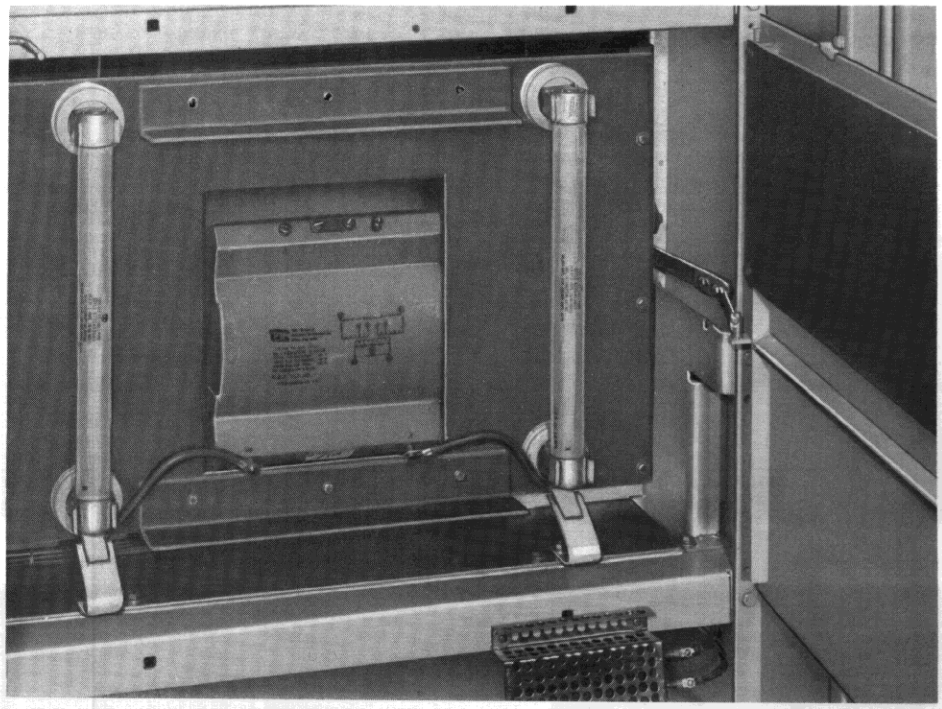




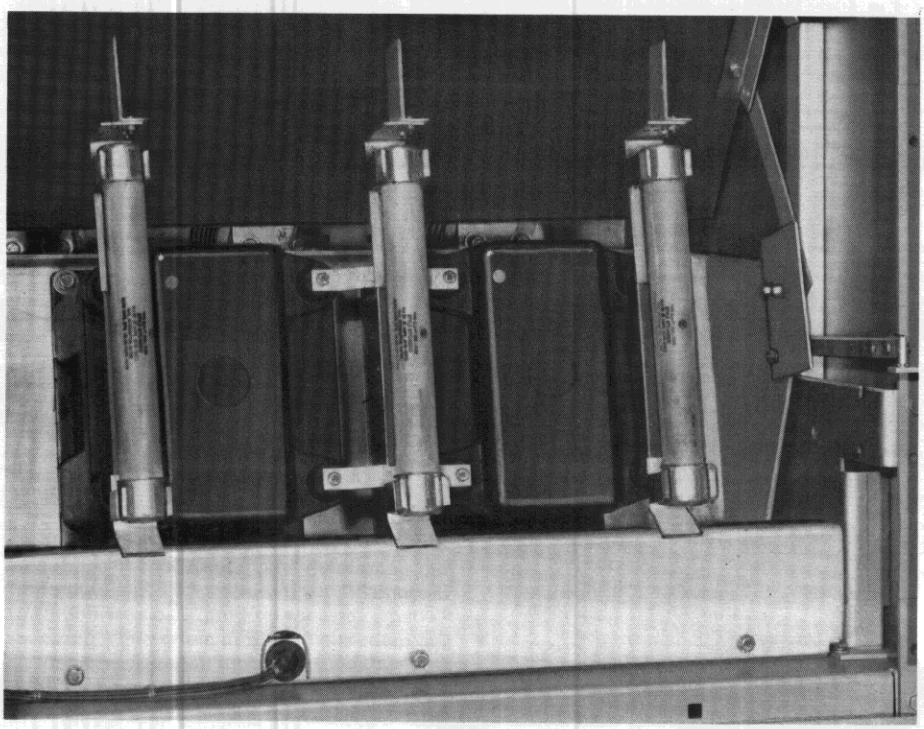




15 kV Control Power Transformer
A mechanical interlock is provided for control power transformers to require the secondary breaker to be open before the access door can be opened to disconnect the primary fuses.



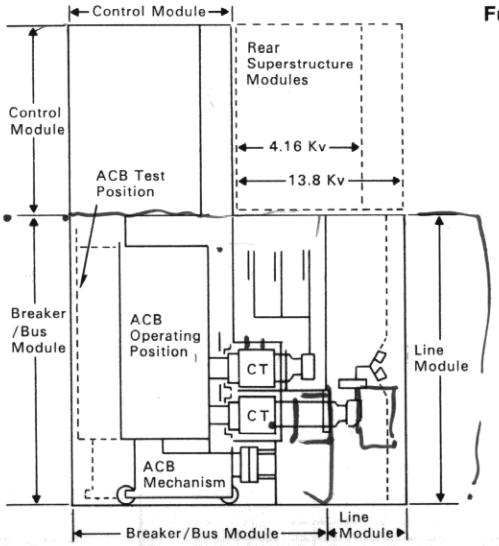
15 kV Potential Transformer



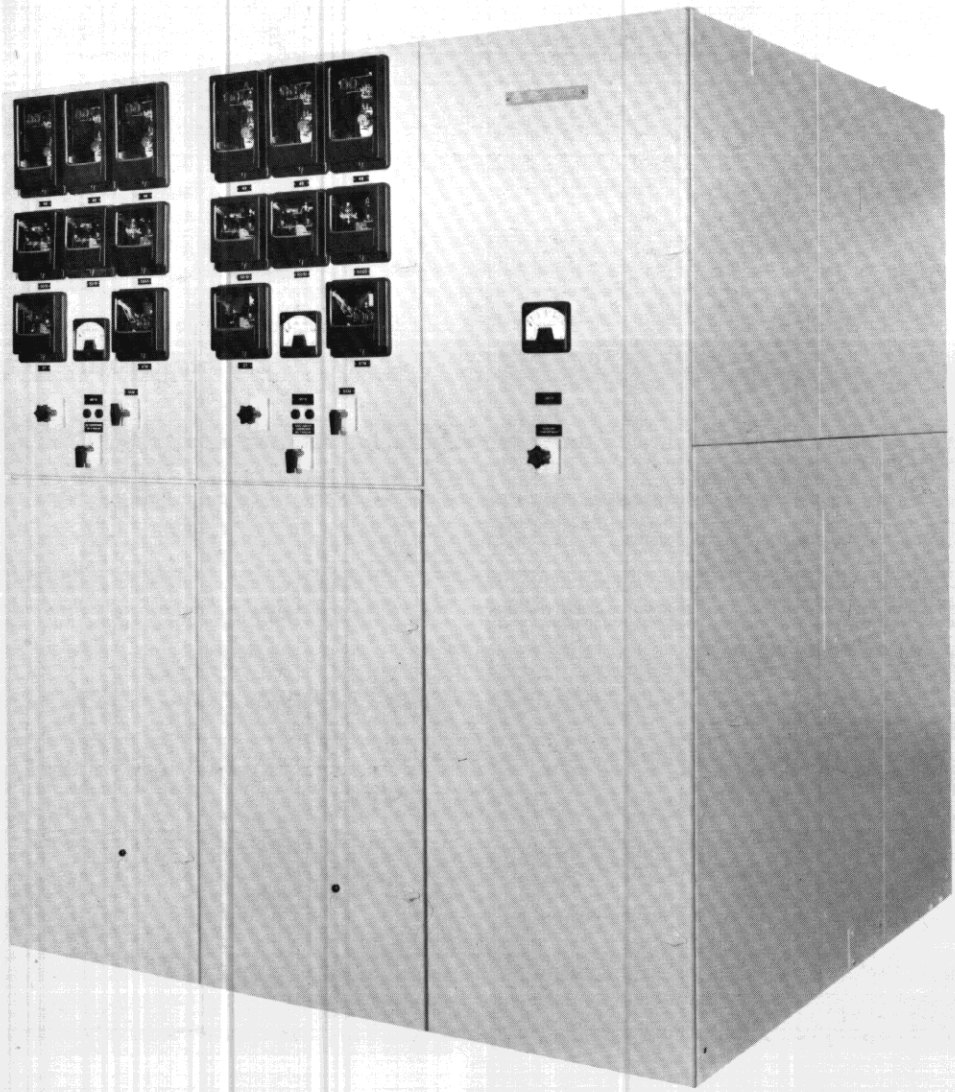
Indoor General Construction

Stationary Structure
The unit is assembled of welded functional components. Basic sub-assemblies or modules are the control, breaker/bus, and line modules. An additional rear superstructure module can be added for auxiliary equipment such as potential transformers. Complete metal barriers isolate breaker, bus, control, and line compartments.

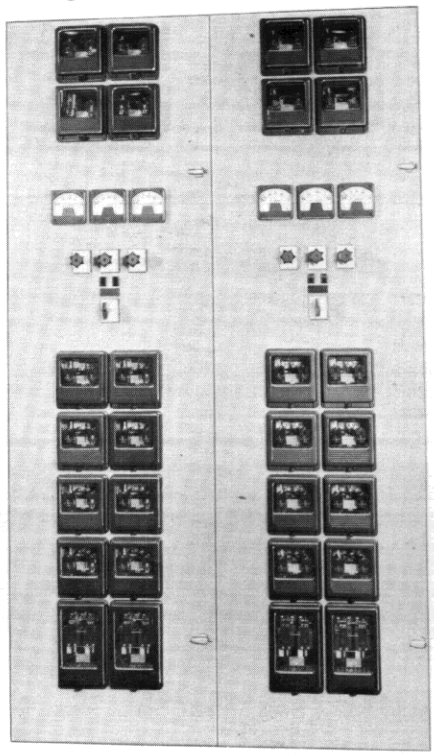
Two hinged panels enclose the front of the housing. The upper panel is used for mounting control devices, protective relays and instruments. The lower panel covers the circuit breaker portion of the unit. Each unit includes an integral panel on each side, thus providing a double thickness of steel between adjacent units. The rear of each unit is enclosed with removable bolted steel panels.



Sectional view of typical indoor circuit breaker housing

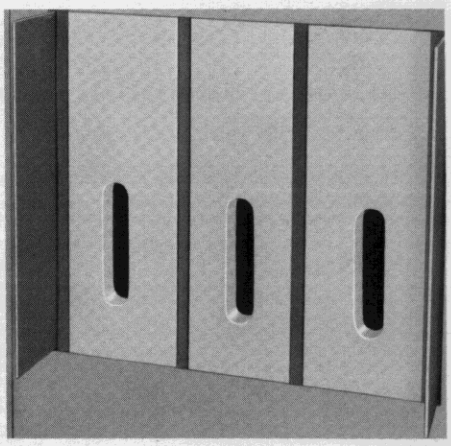


Full Height Instrument Panels



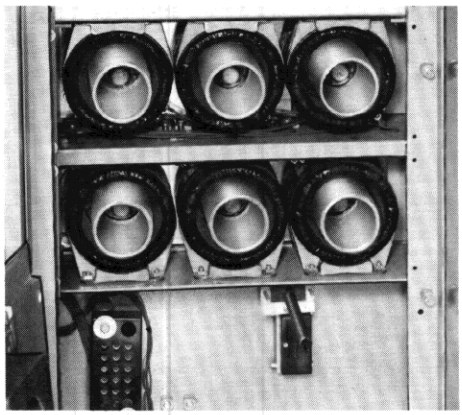
When the upper door in the standard split door arrangement provides insufficient panel space for relays, instruments or meters, a full height door can be provided as shown. This is accomplished by the addition of an eight inch deep front extension to the unit.

Main Bus and Connections



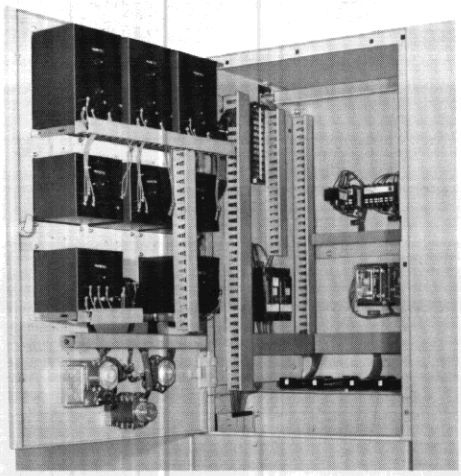
Buses and joints are made of flat aluminum bar completely insulated. Copper conductor is available as an option. The bus insulation is flame retardant tubing. Each conductor of the main bus is held in a one piece porcelain support at the wall between adjacent units. Bus structure is also front accessible by removing cover just above upper primary contact cover.

Current Transformers



Ring type current transformers are mounted around the porcelain primary contact bottles in the cell and are front accessible. Up to six current transformers can be so mounted——three on bus side and three on line side. Additional current transformers can be mounted in the line compartment.

Wiring



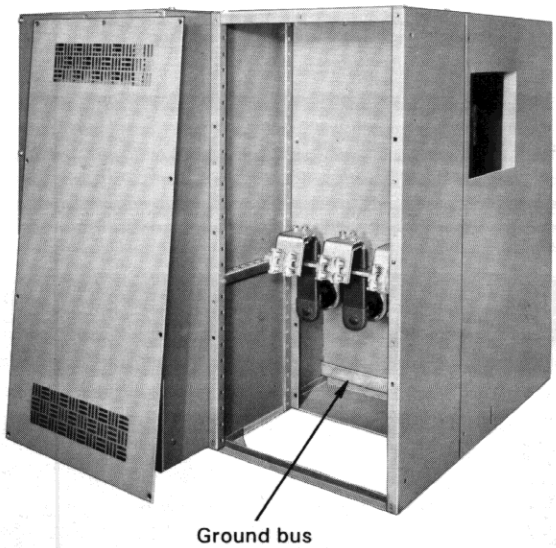
All cell and panel wiring is run in plastic wiring troughs. Leads are taken out of the trough at the approximate location through holes in the side of the trough. This wiring method facilitates field wiring revisions after initial installation.

The panel wire is carried across the hinge in a bundle without the use of terminal blocks, eliminating a source of poor connections. The bundle is arranged so that the wire twists rather than bends, prolonging wire life.

The wire is #14 stranded. Type SIS.

Ground Bus and Connections
The ground bus runs through and is bolted to each stationary structure. Both ground bus and ground cable connections are easily accessible in the cable compartment. The breaker is grounded at all times as it moves from disconnect or test position to operating position. Ground contact fingers on the breaker engage a ground bus extension in the housing.

Insulation Level
Each type DHP 4.16 kV unit is designed to withstand an impulse test of 60 kV and is given a production test of 19 kV, 60 cycles, for one minute. Each Type DHP 13.8 kV unit is designed to withstand an impulse test of 95 kV and is given a production test of 36 kV, 60 cycles, for one minute.



Cable Compartment
Rear view of 5 kV housing illustrates accessibility to cable connections. Main bus is accessible by removing upper barrier behind cable terminals.

Ground bus is directly accessible from cable compartment without removing or going through any barriers.

Preparation of Surfaces
The welded assemblies, after fabrication, are thoroughly cleaned and phosphatized. This provides an inert crystalline phosphate coating that gives excellent corrosion resistance and superior adhesion of paint finish.

Finish of Surfaces
Final indoor finish is a coat of light gray paint, ASA #61, Munsell Notation 8.3G6.10/0.54.

Standard Accessories
Standard accessories for test, inspection, maintenance, and operation, include:

1—Maintenance handle for manually closing circuit breaker when not in housing and manually charging

1—Levering crank for moving circuit breaker between test and connected positions

1—Spanner nut wrench for removing, replacing, or checking tightness of main disconnect contacts when de-energized

1—Set of test plugs for use with Flexitest relays and meters

1—Arc chute lifter to assist in tilting of arc chutes. For 50DHP350 breakers and all 7.5 and 15 kV circuit breakers.

1—Transport truck for handling circuit breaker outside housing. For Aisle-less switchgear.

1—Turning dolly for handling circuit breaker outside housing. For indoor and Shelterfor-M switchgear.

1—Test cable for electrically operating circuit breaker outside housing

1—(Optional) Test cabinet for testing electrically operated breakers outside housing

Outdoor Design Features

General Construction Features
Shelterfor-M and Aisle-less type DHP Porcel-line outdoor units have the same features as indoor DHP units and are available in the same ratings.

Both types of outdoor switchgear are constructed by assembling a weatherproof enclosure onto and around the appropriate group of indoor housings. Each shipping section is mounted on an integral base frame of welded steel channels, and pier mounting of the assembly can be employed if desired. A pad for breaker drawout is required for the Aisle-less type, however.

Insulation levels and 60 cycle dielectric tests are the same as for equivalent indoor ratings.

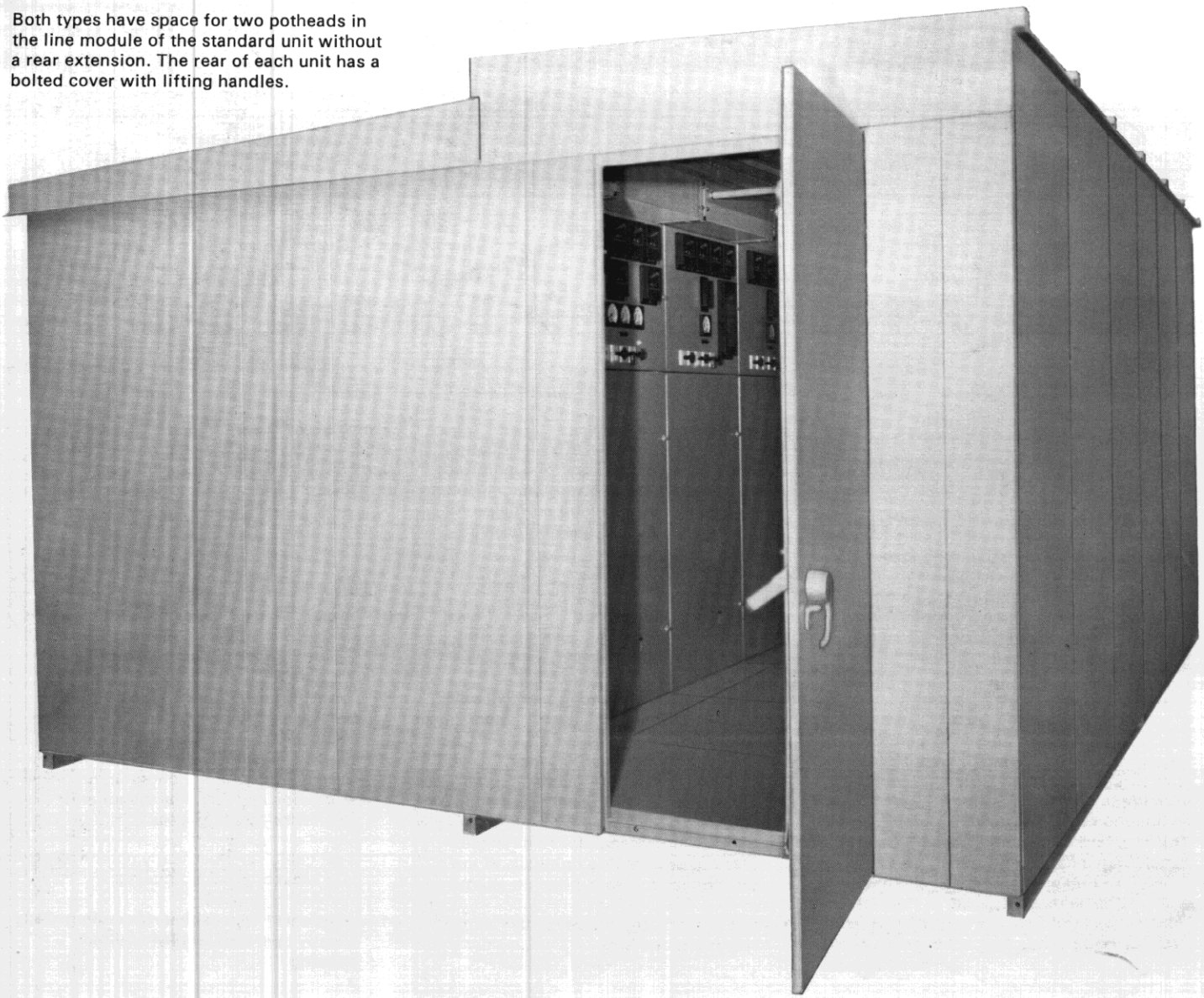
Both types have space for two potheads in the line module of the standard unit without a rear extension. The rear of each unit has a bolted cover with lifting handles.

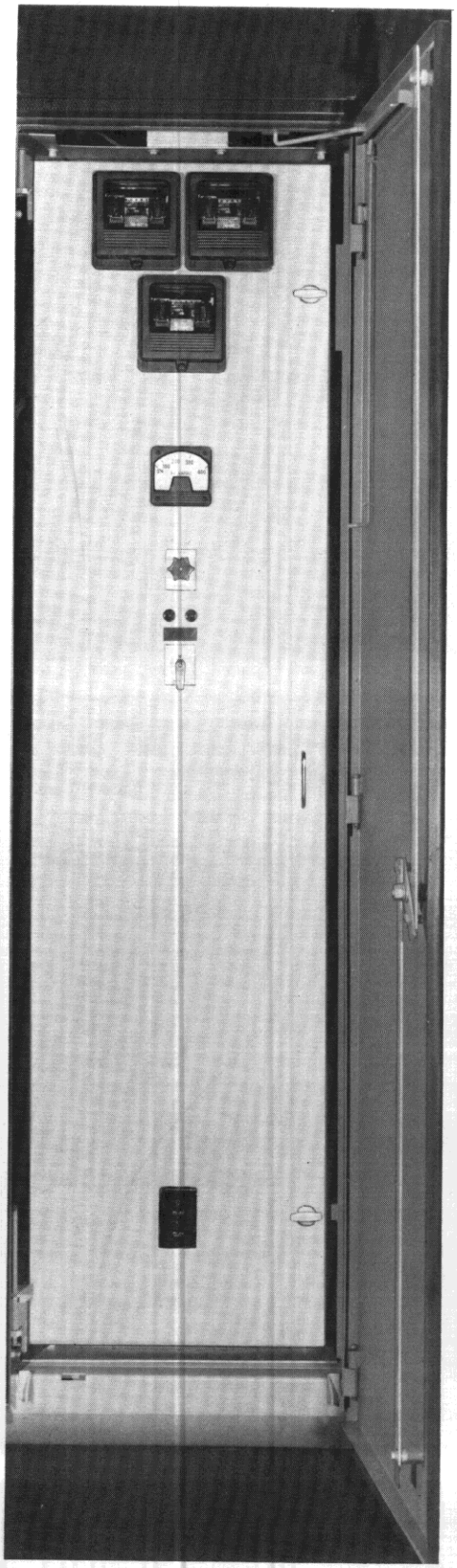
Surface Preparation and Finish
Initial surface preparation and finish of the assemblies, including a coat of light gray paint, is exactly as described for indoor units. Then a final coat of dark gray enamel, ASA #24, Munsell Notation 10B2.40/1.18, is applied to the exterior surfaces. An undercoating compound is applied to the under side of all bottom surfaces.

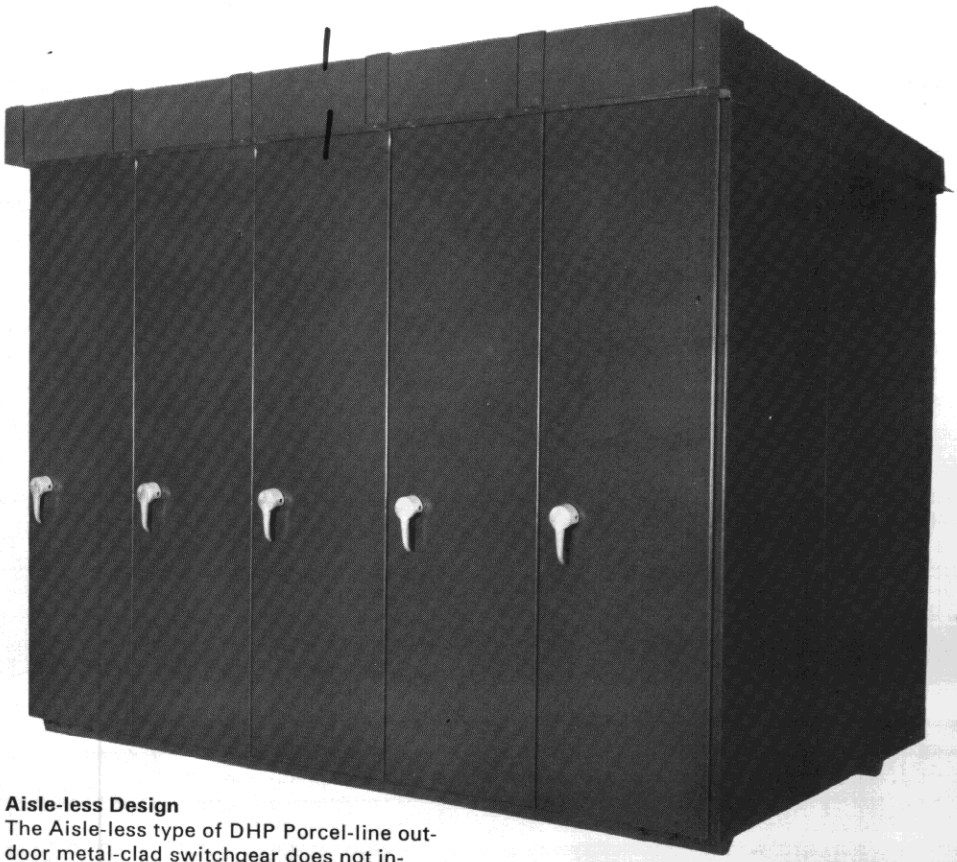
Shelterfor-M Design
This type of DHP Porcel-line outdoor metal-clad switchgear provides an operating or maintenance aisle where equipment is accessible without exposure to the weather. This area is large enough to permit interchanging breakers between cells. Doors are located at each end of the aisle, and are equipped with "crash" latch mechanisms which permit quick release from the inside even when the doors are padlocked from the outside.

Each unit has an upper and lower front hinged panel as described for indoor units. Where additional panel space is required for relays, instruments, or meters, an eight inch front extension into the aisle is provided to accommodate a full height panel. Aisle lights, switches, and service receptacles are provided.

Ventilating air enters through a screen at the bottom of each line compartment and is expelled through a screen under the rear roof overhang. Air also enters through a screen in the floor of the breaker compartment or in the aisle floor and is expelled through a labyrinth under the peak of the roof.







Aisle-less Design
The Aisle-less type of DHP Porcel-line outdoor metal-clad switchgear does not include an operating-maintenance sheltered area. A weatherproof door is located on the breaker drawout side (front) of each cell. A full height instrument and relay panel is located behind the outer weatherproof door. A light and service receptacle is provided inside the front of each unit.

Ventilating air enters through a screen at the bottom of the line compartment and is expelled through a screen under the rear roof overhang. Air also enters through a screen in the floor of the breaker compartment and is expelled through a screen under the front roof overhang.

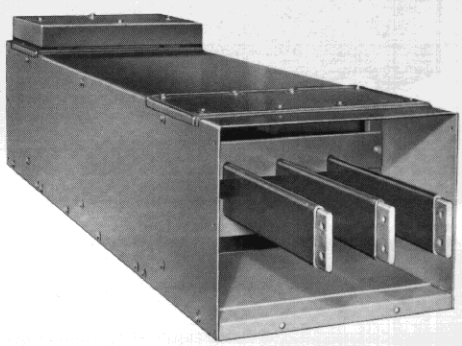
Non-segregated (Group Phase) Bus
Group phase main bus assemblies are recommended for connections between groups of metal-clad switchgear; also to connect power transformers, generators and synchronizinz buses to metal-clad switchgear. This bus can be supplied for indoor and outdoor applications.

These bus assemblies are completely metal-enclosed. The main bus is insulated aluminum or copper bar mounted on supports made of track resistant, flame retardant glass polyester spaced at such intervals as to insure adequate mechanical strength to withstand forces due to fault conditions.

Condensation barriers may be installed in the bus run to provide temperature barriers between indoor and outdoor sections or fire walls between vaults or rooms.

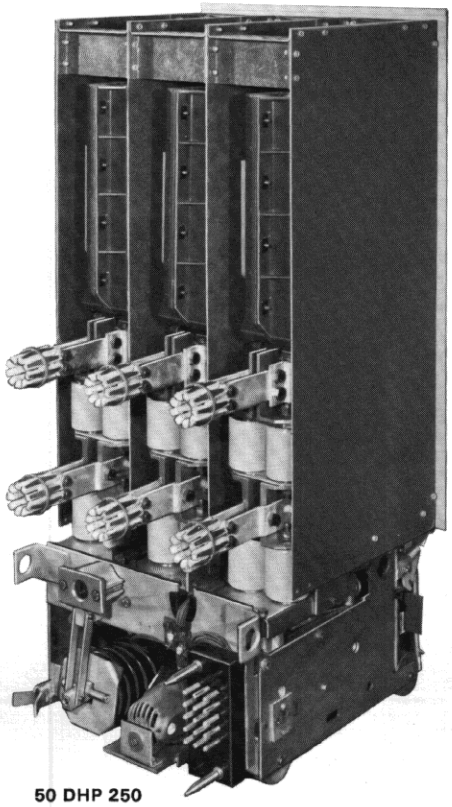
Standard group phase main bus assemblies are made in either 1200, 2000, 3000 or 4000 ampere capacity in sections not exceeding 8 feet in length, with insulation and overall dimensions as required for either 4160 or 13800 volt applications.

This bus is available for indoor and outdoor service. An outdoor section is shown below. Note the ventilator enclosure at the rear, for outdoor runs only. Space heater enclosures are also provided for outdoor runs.

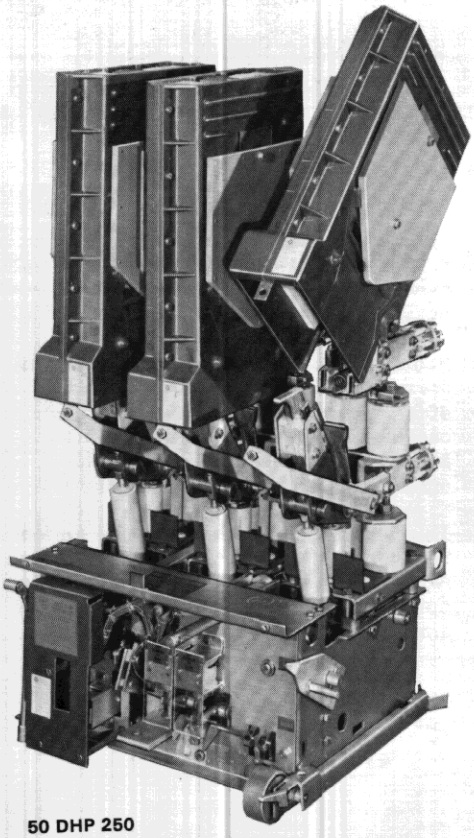


Barrier and Arc Chutes
A grounded steel-front interphase barrier for the arc chutes forms a shield from live primary breaker parts. The barrier is bolted to both the front and the rear of the breaker chassis and cannot be removed unless the breaker is removed from its housing.

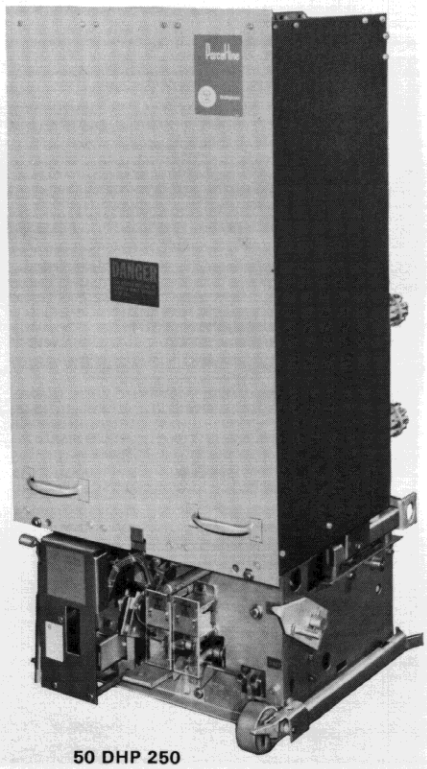
Load currents and faults are interrupted in the arc chute and the bottom or throat of the arc chute surrounds the air circuit breaker contacts. For ease of inspection the arc chute is hinged. With the breaker out of its housing and barrier removed, only one bolt, the connection to the front arcing horn, need be removed to tilt the arc chute for inspection of breaker contacts and the inside of the chute. An arc chute lifter is provided as a standard accessory for ease in lifting the larger arc chutes used on the 50DHP350 and all 7.5 kV and 15 kV breakers.



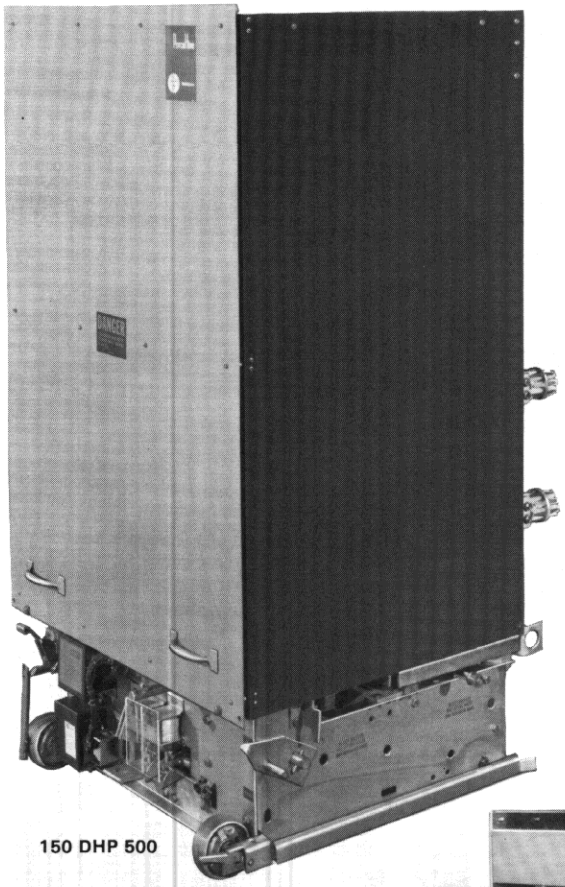
50 DHP 250



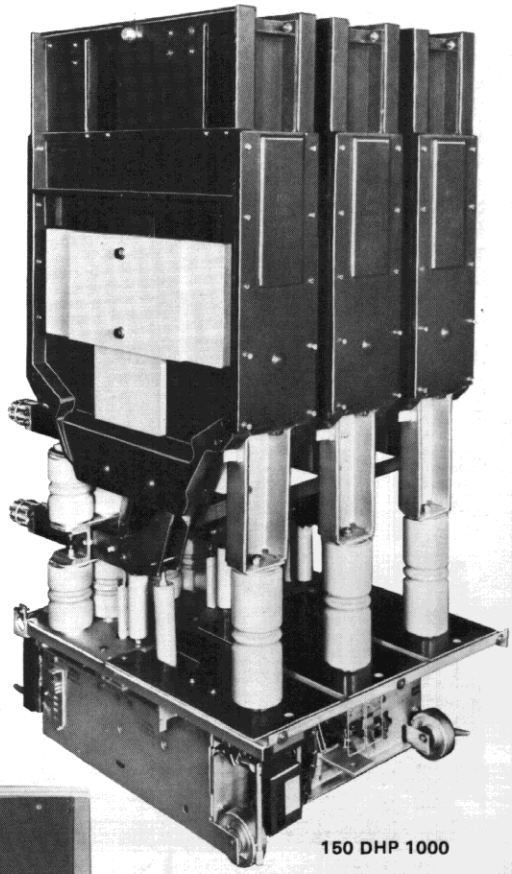
50 DHP 250



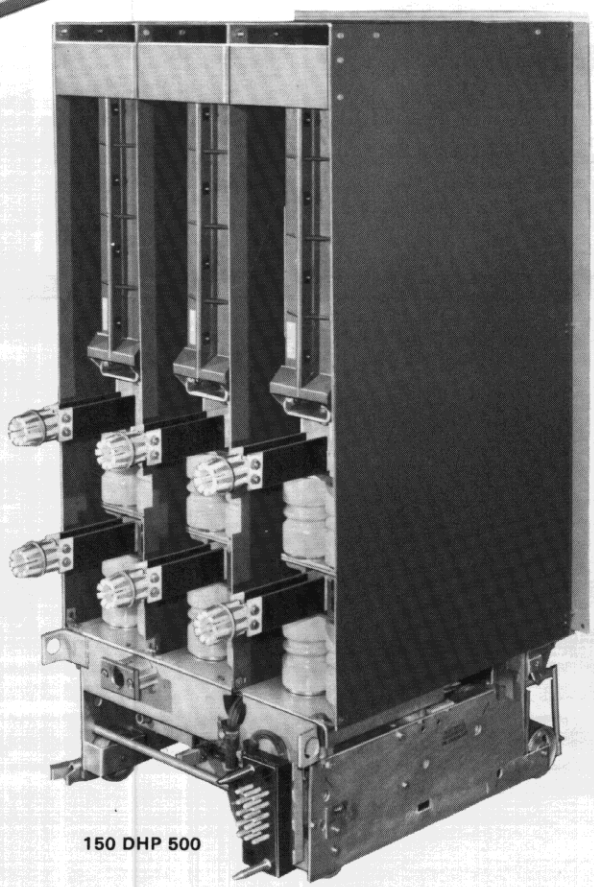
50 DHP 250



150 DHP 500

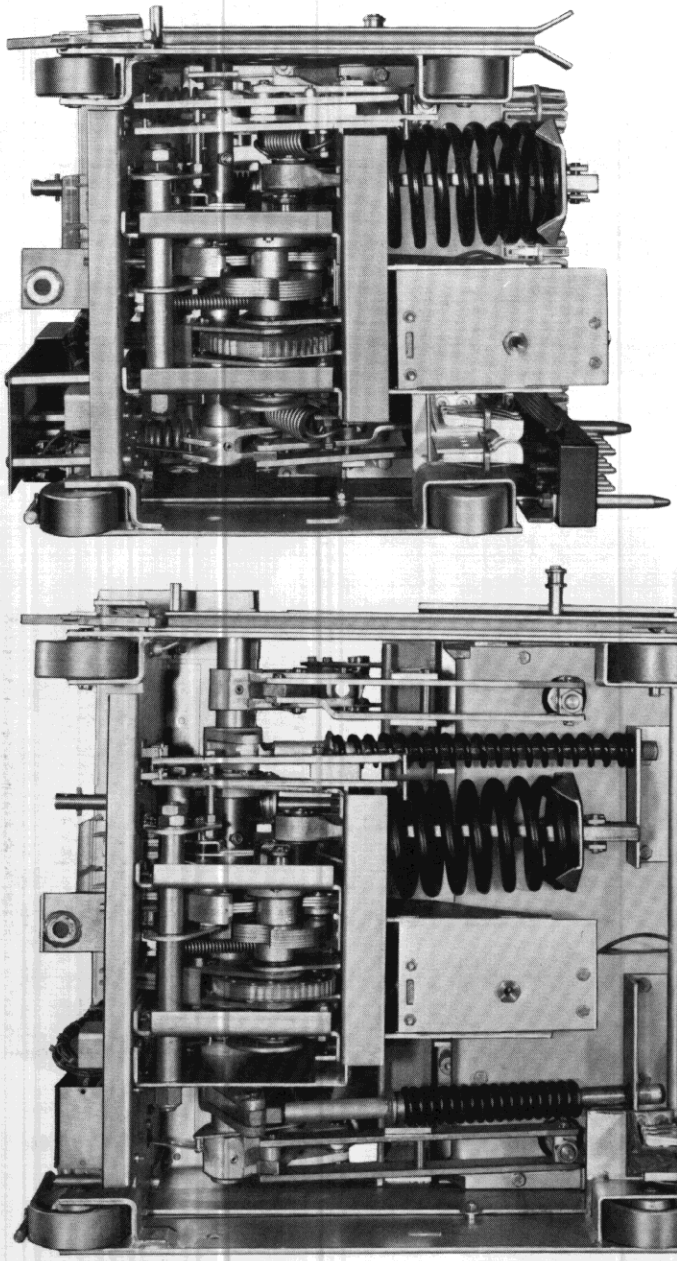


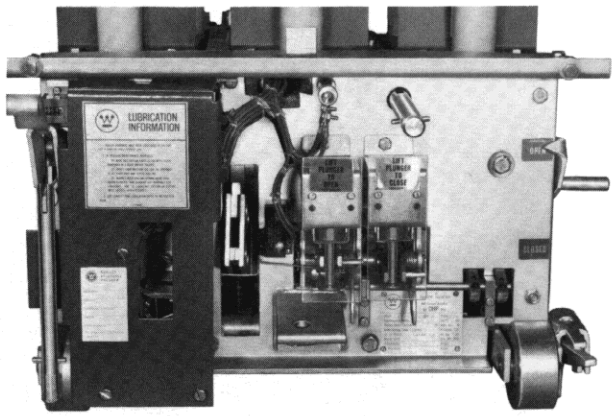
150 DHP 1000



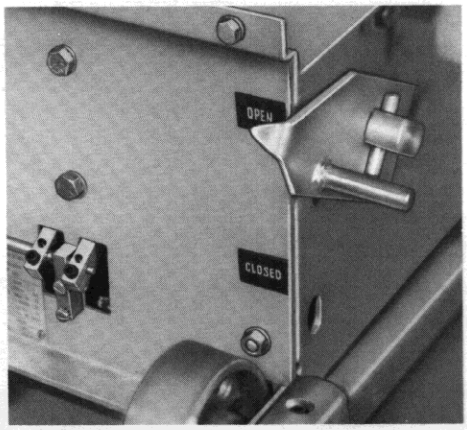
150 DHP 500

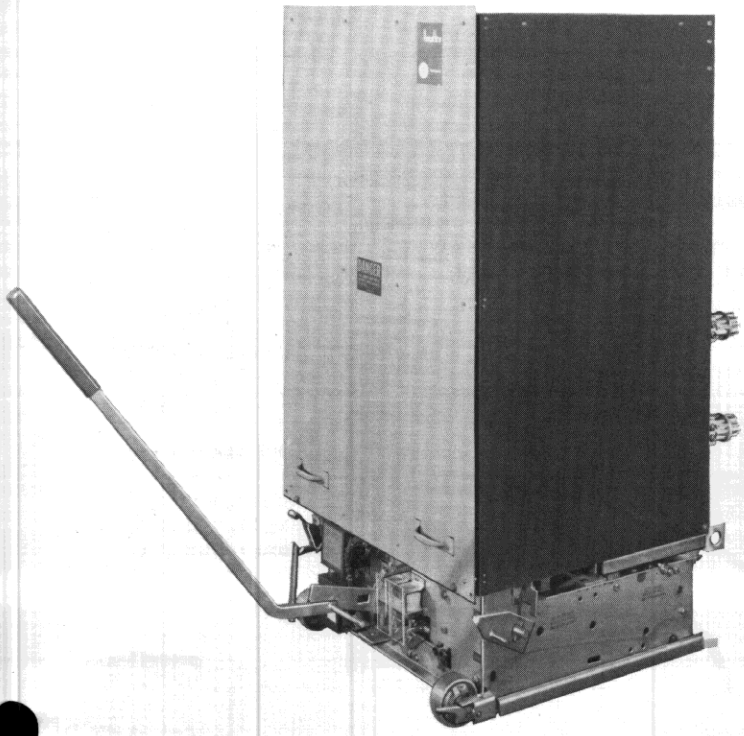
DHP Stored Energy Mechanism
The typical 5 and 15 Kv breaker mechanisms shown are motor-charged spring-type stored energy mechanisms. They are of rugged fabricated steel construction for reliable operation and long life. The spring-charge motor requires much less closing energy than the older solenoid close type breaker mechanism. This permits operation from a smaller size control power source. They are available for either a-c or d-c operation.



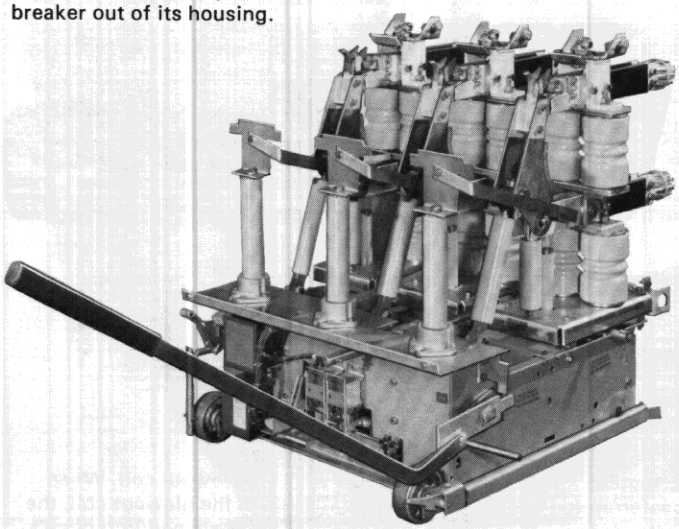


Breaker auxiliary and control devices are all mounted on the breaker front panel where they are readily accessible for inspection. Also included are positive mechanical indicators that tell whether the breaker is open or closed and if the closing spring is charged or discharged.

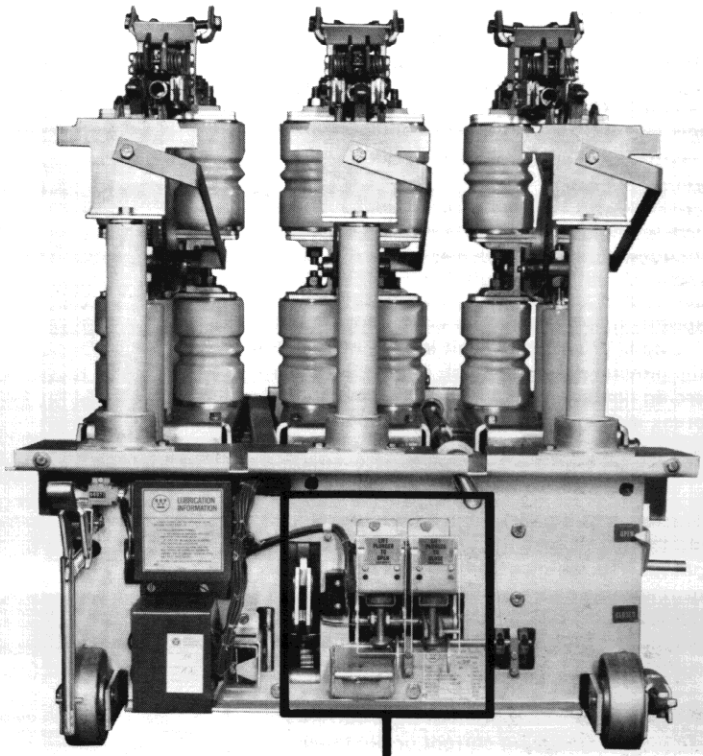


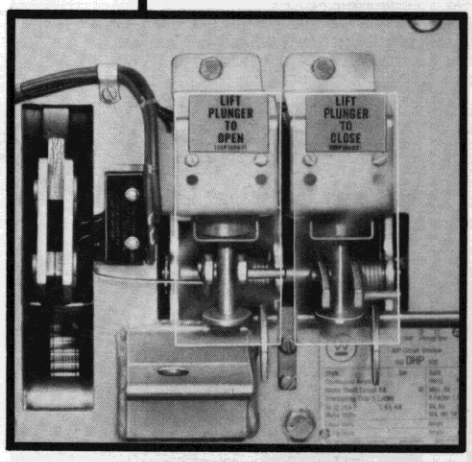


The closing spring may be easily charged manually from the front of the breaker using the maintenance handle, for manual closing with the breaker in the connected position or for test operation with the breaker out of its housing.



For maintenance test, the mechanism may be slow closed with the closing spring discharged and the breaker out of its housing. The steel rod on the maintenance handle will prevent any attempt to slow close with the breaker in its housing.





The plungers for manually opening and closing the breaker are accessible behind plexiglass guards.

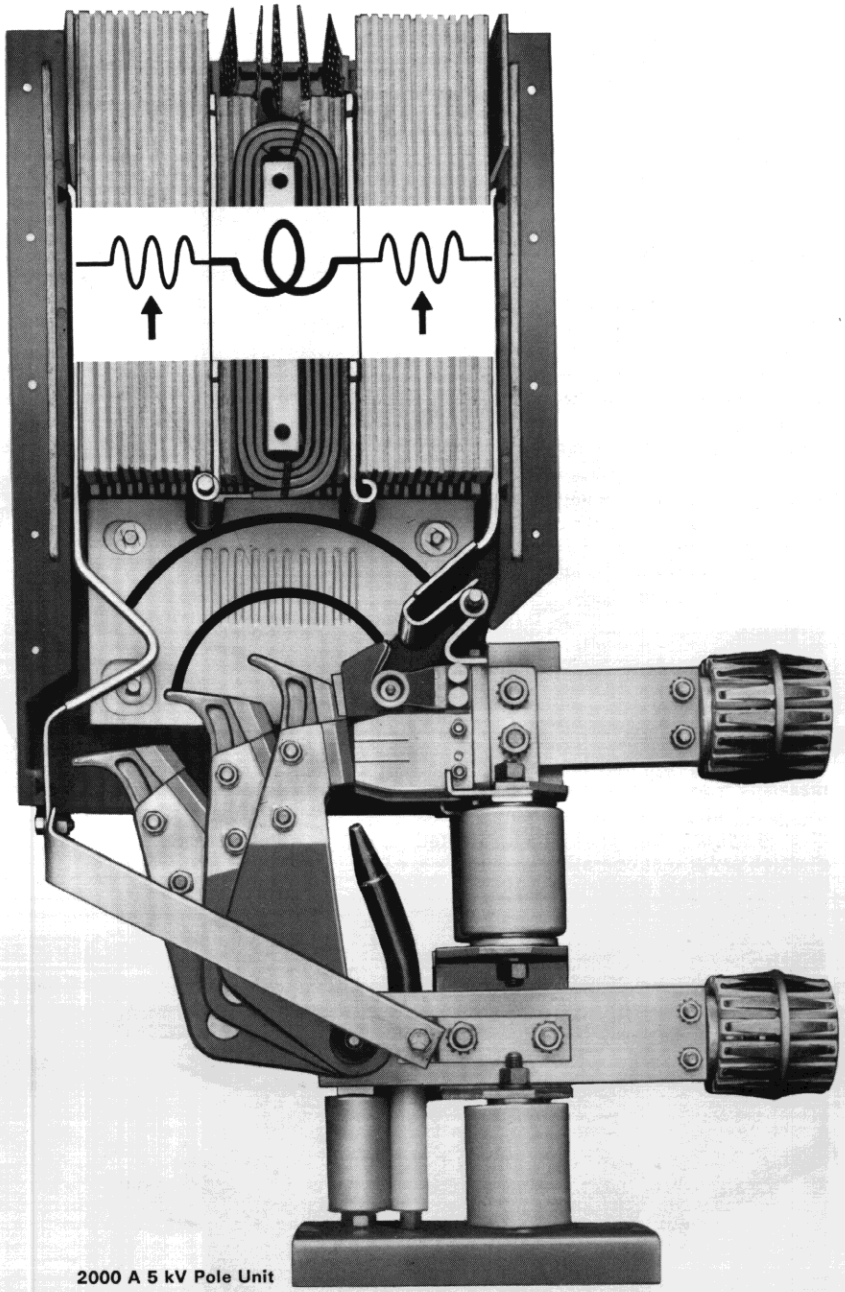
DHP Breaker Main Contacts
The wedge and finger design is used for both the arcing and main contacts for low impact and long life. Extensive closing and opening tests, interrupting both high and low currents, show that the contacts will maintain proper adjustment for long periods.

The upper arcing contacts are the same for all breaker ratings. The stationary arcing contacts can pivot slightly to align themselves and are backed by compression springs to provide proper contact pressure. A stop is provided to limit inward travel of the moving arcing contact. In operation the arcing contacts make first on closing and break last on opening and are shaped to give the arc a rapid take-off into the arc chute.

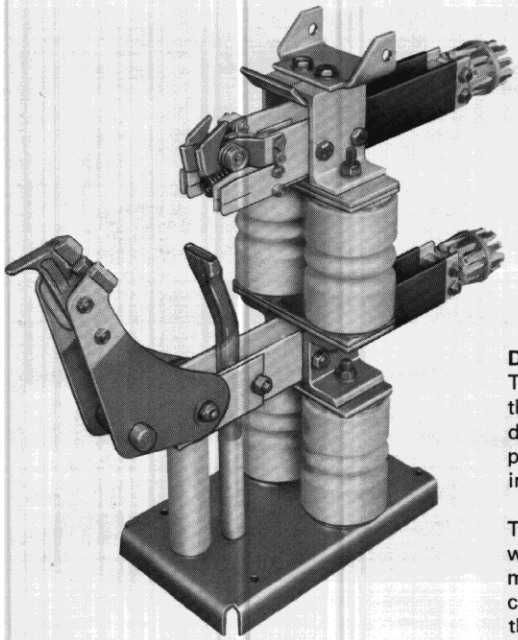
The lower stationary main contacts are slotted to increase the number of contact points. The main contact fingers act as their own springs and no other springs are required. The 1200 A, 15 kV pole unit shown is typical of the various contact assemblies supplied.

To speed the interruption of light currents such as magnetizing current or light load currents, the DHP breaker is equipped with puffers. The puffers are operated by the breaker mechanism and release a jet of air into the arc path as the breaker is tripped open. The puffer nozzle is shown just below the breaker main contacts.

All insulation to ground on the DHP breaker element is high-strength porcelain.



2000 A 5 kV Pole Unit



1200 A 15 kV Pole Unit

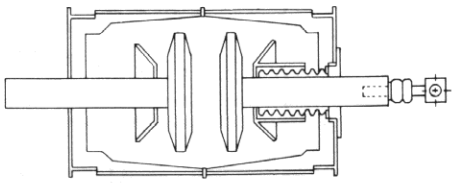
De-ion Principle of Arc Interruption
The De-ion principle of arc interruption and the magnetic De-ion interrupter are pioneer developments of Westinghouse. The De-ion principle as utilized in DHP breakers results in fast, positive arc interruption.

The arc is drawn inside the arc chute, which is the interrupter. The natural movement of the arc is upward into the arc chute. The blowout coil is in the center of the arc chute, so the arc is broken into two arcs in series with the blowout coil. When the arc current flows in the blowout coil, the magnetic effect of the H-shaped iron circuit creates a magnetic field drawing the arc further into the arc chute. As the arc progresses into the chute, it is lengthened and cooled. The cooling reduces the rate of ionization, while the longer arc path requires a higher ionization to support the arc. Thus, when the ionization drops below that required to sustain the arc, it becomes unstable and is extinguished at the next current zero.

Type DVP Vacuum Circuit Breakers
13.8 kA vacuum circuit breakers are available with 1200A or 2000A continuous current ratings and 500 MVA or 750 MVA interrupting ratings. The type 150DVP500 vacuum circuit breaker and type 150DHP500 magnetic air circuit breaker are interchangeable.

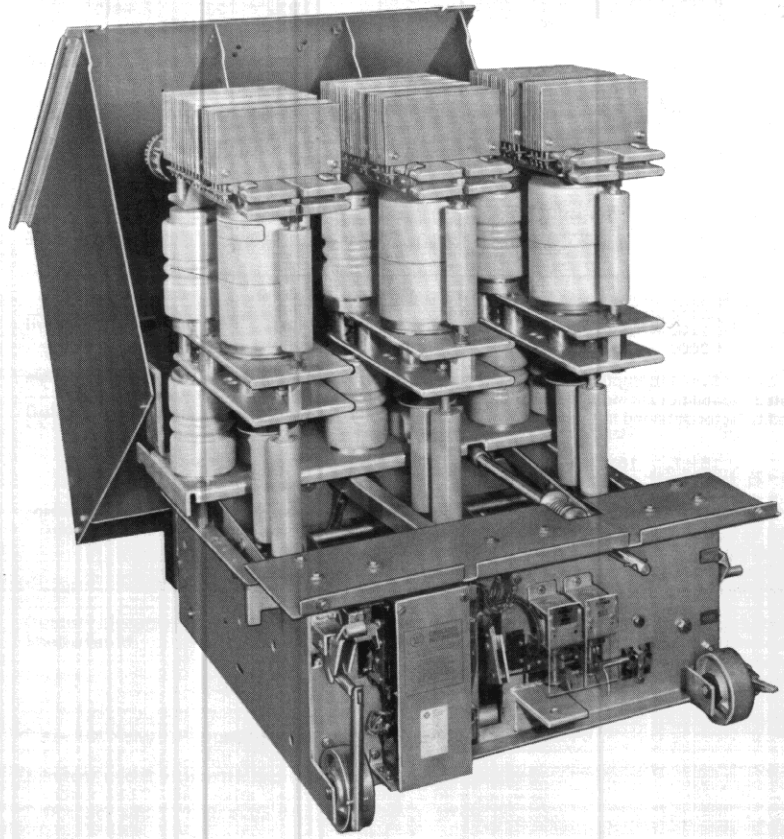
Vacuum Interrupter
The Westinghouse vacuum interrupter is processed in a deep vacuum at high temperature to increase the removal of surface absorbed gases in the contact and bottle materials and eliminate the need for a pinch off tube. The metal end plates are welded to the porcelain bottle, still in the vacuum to obtain a high integrity bond and hermetically seal the interrupter.

The high-strength porcelain used is of high density to prevent gas diffusion and permit high temperature processing well above the melting point of glass with extremely high mechanical strength.



The vacuum interrupter contacts are butt type with helical arcing tip. An external wear gap is provided for checking contact wear.

Contacts will maintain proper adjustment for long periods since anti-bounce springs adjust for contact wear as well as maintain contact pressure. The contact material "CLR" is a high purity copper alloy which is weld resistant and minimizes current chopping.

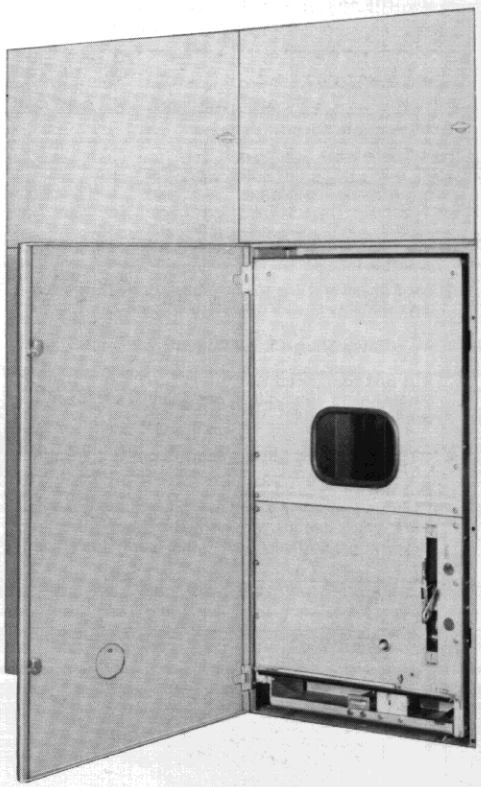


Type 150 FSP Load Interrupter Switch
The 150 FSP load interrupter switch with current limiting fuses is applied in 500, 750 or 1000 MVA class switchgear for protection of transformer loads where economics does not require circuit breaker protection. The ratings listed are for the unfused switch which may be applied only with 37 kA or 58 kA close and latch capability switchgear.

Ratings

Nominal Voltage Class	13.8 kV
Rated Maximum Voltage	15 kV
Rated Continuous Current at 60 Hz	1200 A
Load Break Rating	600 A
No. of Load Break Operations	
600 Ampere 80% P.F.	100
1200 Ampere 80% P.F.	10
Magnetizing Current Break	Yes
Momentary 10 Cycle	61 kA rms Asym.
3-Second Short-time Carrying Capability	38 kA rms Sym.
Fault Closing Capability	61 kA rms Asym.

Operating Mechanism
The standard manual operating mechanism is quick-make, quick-break. Optional stored energy manually operated mechanism and optional stored energy electrically operated mechanisms are also available.



Available Breaker Types Rated on Symmetrical Current Rating Basis

Identification	Rated Values											Related Required Capabilities③		
	Nominal Voltage Class	Nominal 3-Phase MVA Class	Voltage: Rated Maximum Voltage	Voltage: Rated Voltage Range Factor	Insulation Level: Rated Withstand Test Voltage: Low Frequency	Insulation Level: Rated Withstand Test Voltage: Impulse	Current: Rated Continuous Current at 60 Hz	Current: Rated Short Circuit Current (at rated Max. kV)	Rated Interrupting Time	Rated Permissible Tripping Delay	Rated Max. Voltage Divided By K	Current Values: Maximum Sym. Interrupting Capability	Current Values: 3 Sec. Short-Time Current Carrying Capability	Current Values: Closing and Latching Capability (Momentary)
				②				②		④		K Times Rated Short-Circuit Current②		1.6 K Times Rated Short-Circuit Current
Circuit Breaker Type	kV Class	MVA Class	E kV rms	K	kV rms	kV Crest	Amperes	I kV rms	Cycles	Y Sec.	E/K kA rms	KI kA rms	KI kA rms	kA rms
DHP Air Circuit Breaker														
50 DHP 75	4.16	75	4.76	1.36	19	60	1200	8.8	5	2	3.5	12	12	19
50 DHP 250		250		1.24			1200 2000	29			3.85	36	36	58
H 50 DHP 250①							1200 2000							78①
50 DHP 350		350		1.19			1200 2000 3000	41			4.0	49	49	78
75 DHP 500	7.2	500	8.25	1.25	36	95	1200 2000 3000	33	5	2	6.6	41	41	66
150 DHP 500	13.8	500	15	1.30	36	95	1200 2000 3000	18	5	2	11.5	23	23	37
H 150 DHP 500①							1200 2000 3000							58①
150 DHP 750		750					1200 2000 3000	28				36	36	58
H 150 DHP 750①							1200 2000 3000							77①
150 DHP 1000		1000					1200 2000 3000	37				48	48	77
DVP Vacuum Circuit Breaker														
150 DVP 500	13.8	500	15	1.30	36	95	1200 2000	18	3	2	11.5	23	23	37
150 DVP 750		750					1200 2000	28				36	36	58

① Non-Standard Breaker with High Momentary Rating available for Special Applications.

② For 3 phase and line to line faults, the sym. interrupting capability at a kV operating voltage

$$= \frac{E}{kV} \text{(Rated Short-Circuit Current)}$$

But not to exceed KI. E

Single line to ground fault capability at a kV operating voltage

$$= 1.15 \frac{E}{kV} \text{ (Rated Short-Circuit Current)}$$

But not to exceed KI.

The above apply on predominately inductive or resistive 3-phase circuits with normal-frequency line to line recovery voltage equal to the operating voltage.

③ For Reclosing Service, the Sym. Interrupting Capability and other related capabilities are modified by the reclosing capability factor obtained from the following formula:

$$R\,(\%) = 100 - \frac{C}{6}\left[(n-2) + \frac{15-T_1}{15} + \frac{15-T_2}{15} + \ldots\right]$$

Where C = kA Sym. Interrupting Capability at the Operating Voltage but not less than 18

n = Total No. of Openings

T_1, T_2, etc. = Time interval in seconds except use 15 for time intervals longer than 15 sec.

Note: Reclosing Service with the standard duty cycle 0+15s+CO Does not require breaker Capabilities modified since the reclosing capability factor R = 100%.

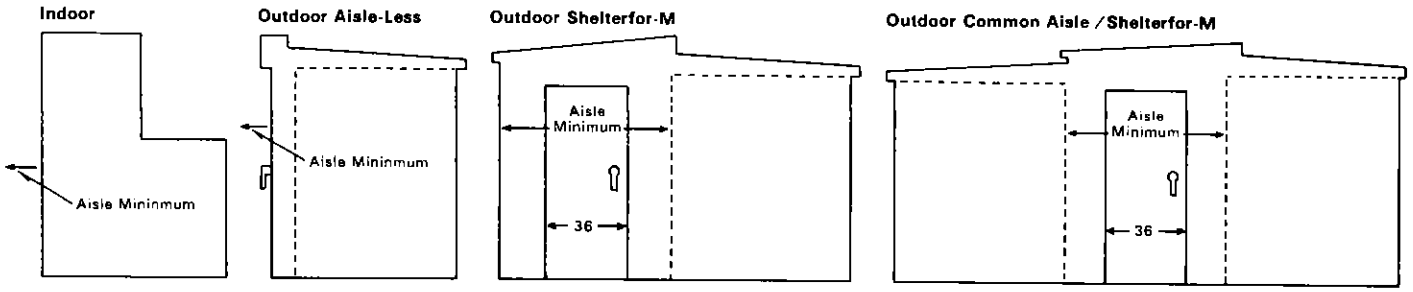
④ Tripping may be delayed beyond the rated permissible tripping delay at lower values of current in accordance with the following formula:

T (seconds) =

$$Y\left[\frac{KI\ (K \text{ Times Rated Short-Circuit Current})}{\text{Short-Circuit Current Through Breaker}}\right]^2$$

The aggregate tripping delay on all operations within any 30 minute period must not exceed the time obtained from the above formula.

Approximate Dimensions in Inches



4.16 kV

Type 50 DHP 250 or 50 DHP 75

	Ampere Rating	Width of Unit	Depth	Height	Aisle Minimum
Indoor	Aux. 1200 2000	26	62 ① ③	90.38	36
Outdoor Aisle-Less	End Panel Aux. 1200 2000	1.5 26	82.62 ⑤	107	59
Outdoor Shelterfor-M	End Panel Aux. 1200 2000	1.5 26	151.5 ⑤	111.75	73.5
Outdoor Common Aisle Shelterfor-M	End Panel Aux. 1200 2000	1.5 26	228 ⑤	111.75	72

Type 50 DHP 350

	Ampere Rating	Width of Unit	Depth	Height	Aisle Minimum
Indoor	Aux. 1200 2000 3000	26 36	70 ① ③	90.38	46
Outdoor Aisle-Less	End Panel Aux. 1200 2000 3000	1.5 26 36	90.62 ⑤	107	68 80
Outdoor Shelterfor-M	End Panel Aux. 1200 2000 3000	1.5 26 36	159.9 ⑤	111.75	73.5
Outdoor Common Aisle Shelterfor-M	End Panel Aux. 1200 2000 3000	1.5 26 36	244 ⑤	111.75	72

13.8 kV or 7.2 kV

Type 150 DHP 500 or 75 DHP 500
Type 150 DVP 500 or 150 DVP 750

	Ampere Rating	Width of Unit	Depth	Height	Aisle Minimum
Indoor	Aux. 1200 2000 3000	36	78 ① ④	90.38	49
Outdoor Aisle-Less	End Panel Aux. 1200 2000 3000	1.5 36	100.62 ⑤	107	80
Outdoor Shelterfor-M	End Panel Aux. 1200 2000 3000	1.5 36	169.5 ⑤	111.75	73.5
Outdoor Common Aisle Shelterfor-M	End Panel Aux. 1200 2000 3000	1.5 36	264 ⑤	111.75	72

Type 150 DHP 750 or 150 DHP 1000

	Ampere Rating	Width of Unit	Depth	Height	Aisle Minimum
Indoor	Aux. 1200 2000 3000	36	94 ② ④	90.38	55
Outdoor Aisle-Less	End Panel Aux. 1200 2000 3000	1.5 36	108.62 ⑤	107	85
Outdoor Shelterfor-M	End Panel Aux. 1200 2000 3000	1.5 36	185.5 ⑤	111.75	81.5
Outdoor Common Aisle Shelterfor-M	End Panel Aux. 1200 2000 3000	1.5 36	288 ⑤	111.75	80

① For full height instrument panel on all units add 8 inches.
② Full height instrument panel on all units.
③ Indoor add 8 inch extra depth line compt. where required.
④ Indoor add 10 inch extra depth line compt. where required.
⑤ Outdoor add 12 inch extra depth line compt. where required.

Porcelain Insulation System
Porcelain, in additon to its excellent dielectric characteristics, is non-tracking, non-combustible, non-hygroscopic, won't age, and is easy to clean. It is the near ultimate in insulation.

The use of porcelain insulation for all live parts to ground on the DHP and DVP breaker elements remains an industry exclusive. The breaker pole units are a high strength porcelain post insulator design mounted on a flat chassis. The operating rods, lower contact supports, and lower portions of the puffer tubes are also of high strength porcelain. Arc chute supports on 350 MVA and larger breakers are high strength porcelain. Thus, there is no organic insulation between live parts and ground.

In addition, the metal-clad switchgear housings utilize porcelain bus supports and porcelain contact bottles on all 5 kV and 15 kV ratings.

The porcelain insulation system is the key to the superior performance of Porcel-line Metal-clad switchgear, under the widest range of operating conditions.

Quality Assurance
The Switchgear Quality Assurance Program is an integral part of our modern production facilities at East Pittsburgh. The objective of the program is to insure delivery to the customer of the finest metal clad switchgear that modern technology can produce. The success of the program is demonstrated by the excellent performance record of our equipment in all types of service applications. DHP metal clad switchgear provides many years of safe, trouble free operation.

Quality control begins with the receipt of material from our many suppliers, continues through the manufacturing and assembly process and culminates in a thorough inspection of the finished product to insure customer satisfaction. On those rare occasions when the equipment requires adjustment at the job site, Westinghouse Field Service engineers are available locally.

An assembly can only be as good as the sum total of its parts. That's why we spend so much time being sure of the quality of every component. For example, every current transformer is electrically tested by computer and the test results are provided by a printer terminal.

Type DHP breakers are a major component of our metal clad assemblies. All critical parts for every breaker are quality monitored for compliance with specifications including dimensions, finish and heat treat hardness before being approved for use. Each breaker must pass an electrical performance test on a semi-automatic test device.

Corrosion protection as well as a good appearance are assured by our finishing process. Each part receives a chemical degreasing and phosphatizing bath to properly prepare the surfaces. Drying ovens prepare the parts for a baked-on enamel paint. All solutions are continuously monitored by chemical analysis.

The final assembly process is constantly monitored for such details as main bus alignment, circuit breaker fit and alignment in each cell, tightness of each bus joint, current and/or potential transformer installation, shutter operation, switch settings, control wiring connections, electrical clearances and a host of other quality checks. A functional electrical test is performed on each assembly to verify electrical operation followed by 60 hertz dielectric withstand tests to check the insulation of primary conductors and control circuitry. The assemblies are then completely finished to customer requirements. Each assembly is thoroughly inspected prior to release for delivery to the customer.

Our Quality Assurance Program recognizes that quality can not be inspected into a product. What we can do is see that the inherent quality designed and built into every DHP assembly comes through to our customers. And that's the way it will always be with Westinghouse Metal Clad Switchgear.

Printed in U.S.A.

Westinghouse Electric Corporation
Switchgear Division
East Pittsburgh, Pa. 15112, U.S.A.