assembled switchgear

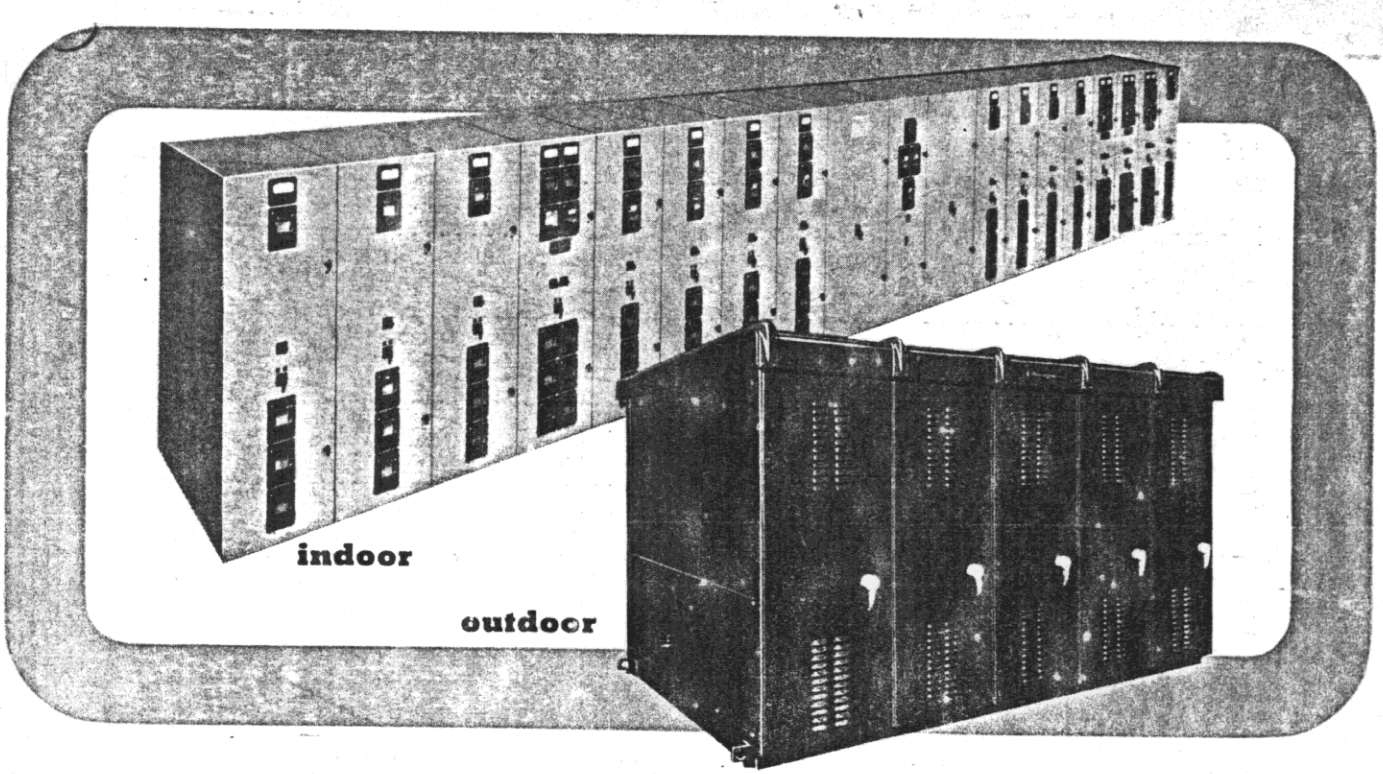
standardized metal-clad switchgear

descriptive bulletin

32-250

page 1

75 to 1000 mva interr. capacity • 4160 to 13800 v
1200 to 3000 amps • indoor and outdoor service



application

Centralized circuit control and proptection for generators, motors, bus and feeders up to 13.8 kv.

A complete line of functional units available as standardized assemblies in any combination to meet specific requirements. Each standard unit is self-contained with components assembled, wired and tested before shipment. These components include circuit breakers, bus, instrument transformers, relays, instruments, meters and control devices which form a single compact, completely enclosed structure.

typical applications:

electrical utilities • commercial buildings • industrial plants • municipal pumping stations • transportation and traction systems

major advantages

reliable overall design: Standardized metal-clad switchgear represents the most reliable overall design for its application, based on years of experience in the manufacture of all types of switchgear.

superior circuit protection with type DH air circuit breaker operation: DH magnetic De-ion air circuit breaker operation in metal-clad switchgear provides superior circuit protection. The Westinghouse De-ion principle of breaker operation accomplishes fast and positive arc interruption.

simplified planning and ordering: Use the Selector Guide of Standardized Units on pages 38 and 39 to arrange units by function. Westinghouse standard assemblies are already designed and engineered . . . no special engineering and ordering required.

Westinghouse "unit responsibility": Complete metal-clad switchgear is Westinghouse throughout, **only one manufacturer** is responsible for entire assembly, through engineering, manufacturing, ordering, shipment, installation and operation.

standardized design meets all normal requirements: Offers shorter manufacturing time, simplified installation arrangements, and minimum complete cost. It avoids time-consuming special engineering, production arrangements, and installation layouts.

January, 1958
new information
mailed to: E/264/DB; C26-ST, U

contents

outstanding features

1 Self-Contained, Horizontal Drawout type DH Air Circuit Breakers utilized in Westinghouse Metal-Clad Switchgear . . . require no vertical positioning . . .

assure quick, simplified withdrawal of breaker element for interchange, inspection or test. pages 4-6, 20

2 De-ion Principle of Fast, Positive Arc Interruption . . .

provides superior circuit protection. Type DH Air Circuit Breakers employ the Westinghouse De-ion principle of arc interruption. page 20

3 Porcelain bus supports uniquely designed . . .

are located at key positions to cover completely the bus openings, providing a non-combustible fire-wall between units. Presently available on 5 kv ratings; check Westinghouse for availability on 15 kv ratings. pages 7, 34

4 Westinghouse Redarta insulation in Metal-Clad Switchgear . . .

superior in every way, including flame-retarding ability, to any other fibrous insulation developed. page 21

5 Jig Welding and Master Alignment Fixtures . . .

utilized during manufacturing of Westinghouse Metal-Clad Switchgear. Provide accurate alignment of components and interchangeability of all breakers of like rating. page 31

6 Surface Treatments and Finishes . . .

provide protection from rust and corrosion, an ideal base of finish painting, and finish-paint protection through assembly, shipment and installation. page 37

7 Primary disconnects are full-floating . . .

with high pressure finger segments individually sprung in a single retaining ring. These segments, located on main studs of the drawout unit, permit easy inspection and maintenance. pages 22, 23, 33

8 Type DH Breaker Contacts accessible at convenient working heights . . .

Close inspection facilitated by removal of interphase barriers and lifting of arc chutes. page 6

9 Westinghouse Outdoor type Metal-Clad Switchgear utilizes rigid, self-supporting unit construction . . .

also provides undersurface coating as lasting protection from rust and corrosion. pages 12, 13

10 Shelterfor-M design of Outdoor Metal-Clad Switchgear . . .

provides sheltered area for breaker interchange or maintenance work. Includes the features of Indoor Metal-Clad Switchgear in a weatherproof enclosure. page 14

11 Westinghouse Metal-Clad Switchgear is design proved . . .

in the Westinghouse High Power Laboratory, centrally located with manufacturing and engineering at East Pittsburgh works. page 51

design features indoor

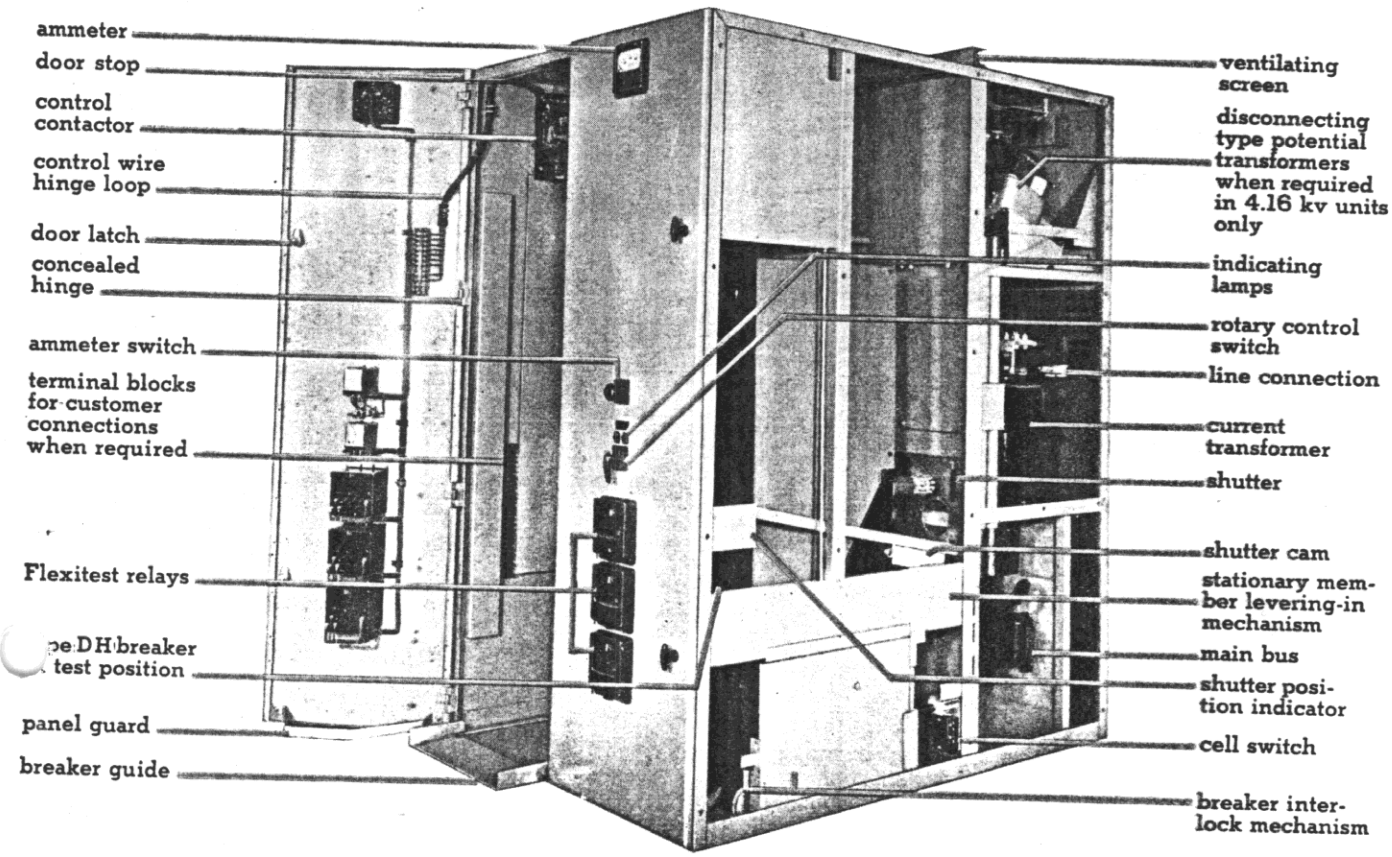


figure 1

stationary structure

The stationary structure is built of structural steel members electrically welded to form a rigid unit assembly. The unit is enclosed with sheet steel side, roof sheets bolted on rear sheet, with the necessary interior steel barriers to form bus compartment, line and current transformer compartment, and the breaker compartment. The front is provided with a steel hinged panel for mounting instruments, control switches, and protective relays.

The breaker compartment is provided with the necessary devices to give positive alignment of breaker, drive-in mechanism linkages, primary contact openings with automatic shutters, ground contact and automatic secondary control contacts.

holes and openings: All tie bolt and mounting holes, also bus openings, are accurately punched on a special 32-station punch . All punches are made against accurate stops which assure extremely close tolerances.

jig-welding: All units are jig-welded, assuring complete interchangeability. Groups of units may be disassembled, rearranged, and new groups added without additional expense of matching mounting dimensions.

insulation: Porcelain main bus supports and Westinghouse Redarta insulation is used in metal-clad switchgear. These insulations are superior in every way, including flame-retarding ability, to any other materials developed.

finishes: Surface treatments and finishes provide protection against rust and corrosion, attractive finished appearance, and plastic coating protection through assembly and installation. These surface treatments and finishes comprise Bonderizing, prime painting, finish painting and plastic coating.

breaker interchange

indoor • horizontal drawout type DH

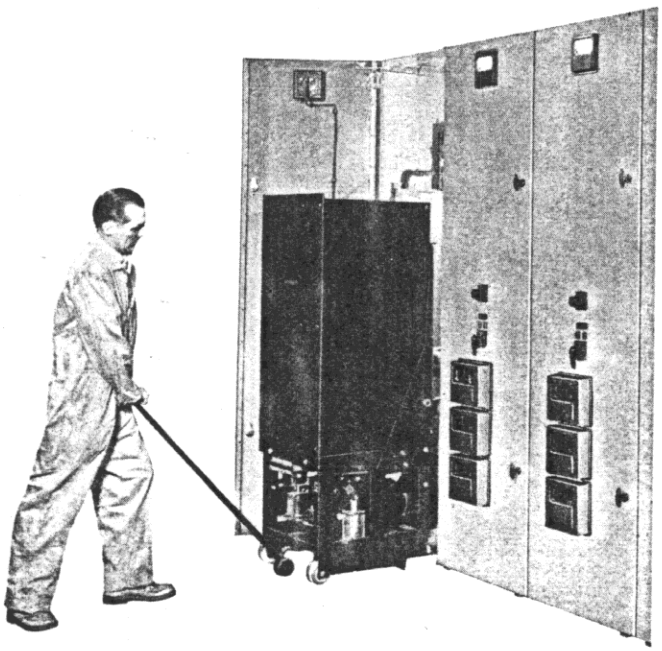


figure 2. Lining up replacement breaker with rails in stationary structure: Wheels have two rim surfaces—one for the floor; the other, of smaller diameter, for track which lines up breaker in the stationary structure.

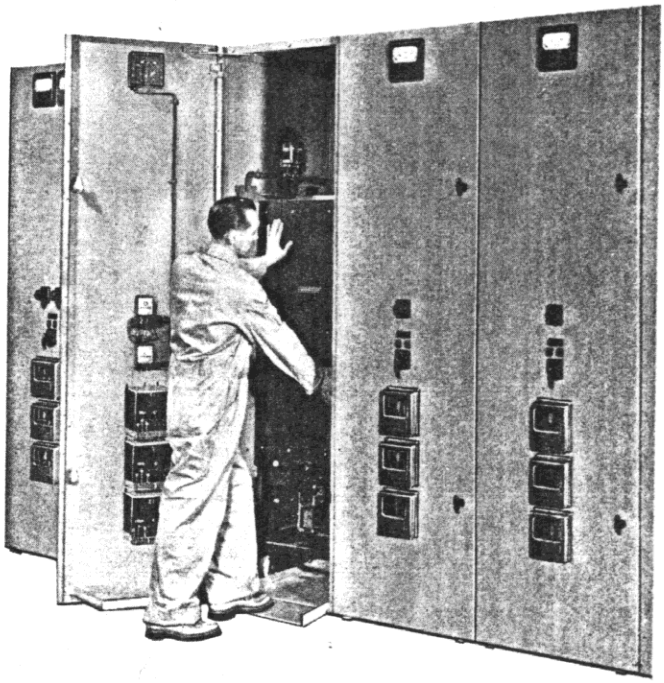


figure 3. Moving breaker to test position: Breaker is stopped at test position by drive-in device. Metal shutter for primary disconnects remains closed.

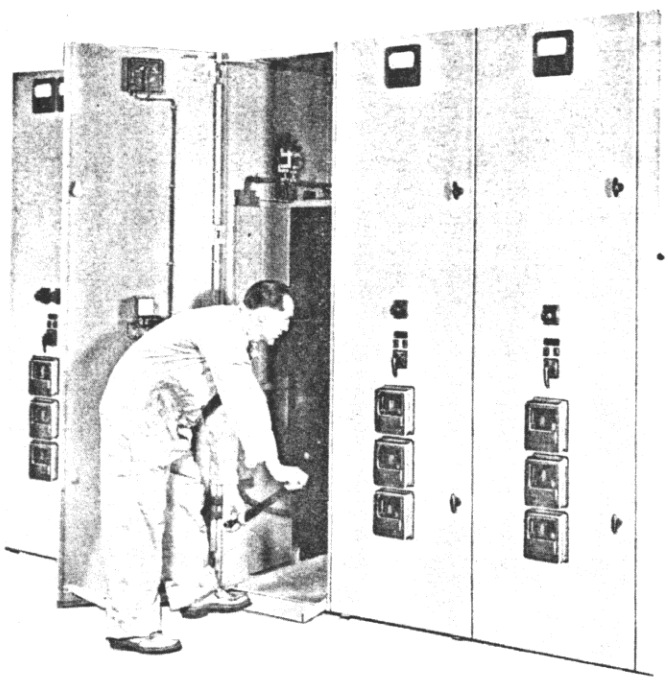


figure 4. Cranking breaker to operating position: Movement from test to operating position is accomplished by a few easy turns of the crank. Metal shutter opens automatically as breaker is advanced. An interlock prevents crank motion if breaker is in closed position.

figure 5. Turning on power with control switch: Two metal barriers are between operating and breaker when circuit is energized, providing complete safety to operator.

breaker inspection

indoor • horizontal drawout type DH

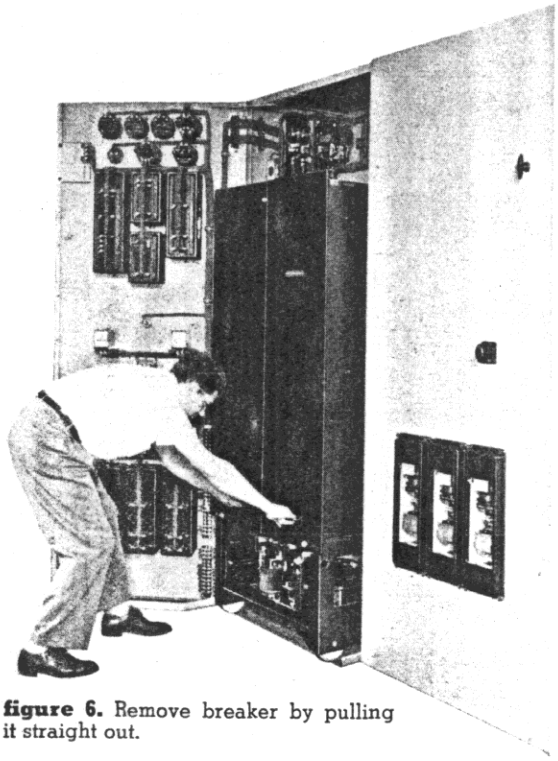


figure 6. Remove breaker by pulling it straight out.

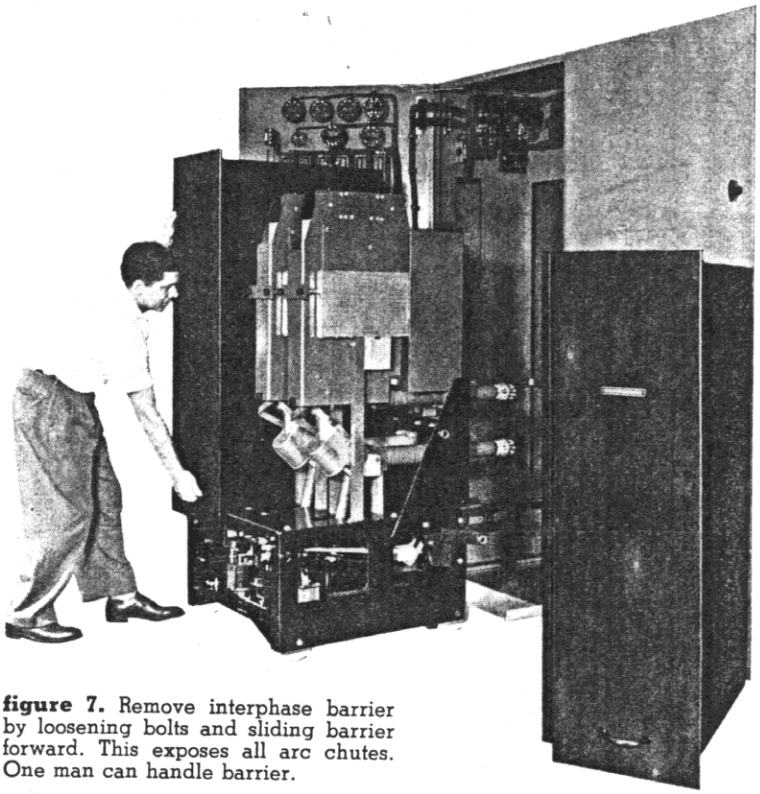


figure 7. Remove interphase barrier by loosening bolts and sliding barrier forward. This exposes all arc chutes. One man can handle barrier.

breaker contacts

Breaker contacts are accessible at a convenient working height. Close inspection is not impaired by cramped quarters. No further disassembly is necessary for inspection and minor maintenance of the contacts.

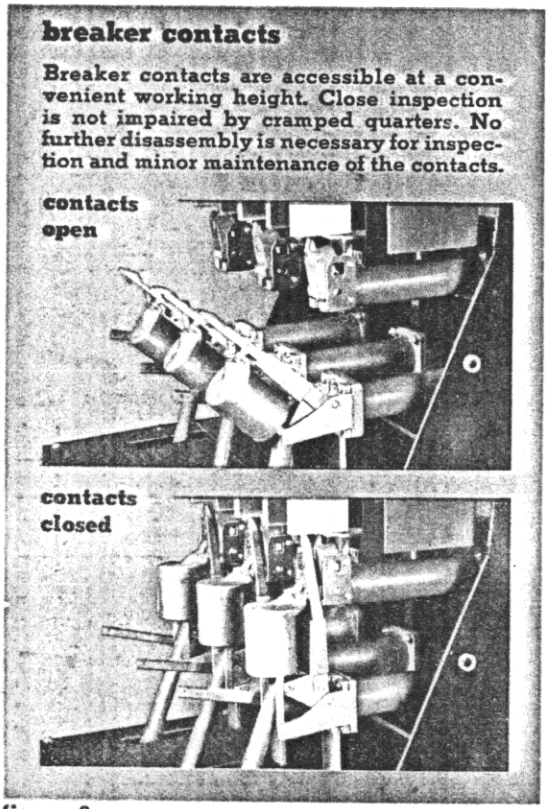
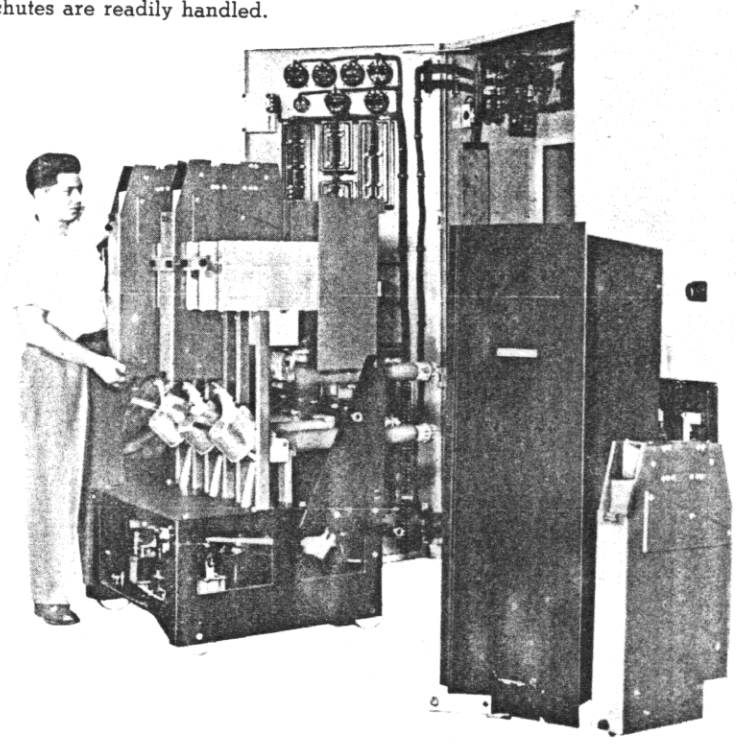


figure 8

figure 9. Remove arc chutes by removing a few accessible bolts. Arc chutes are readily handled.



components indoor

accessibility for inspection and maintenance

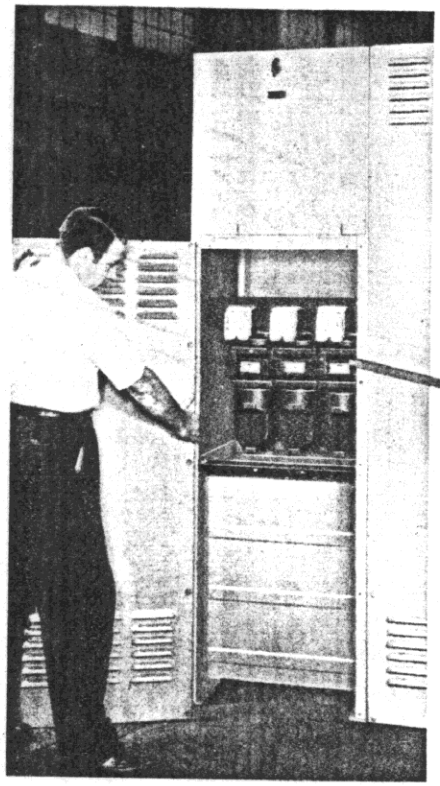
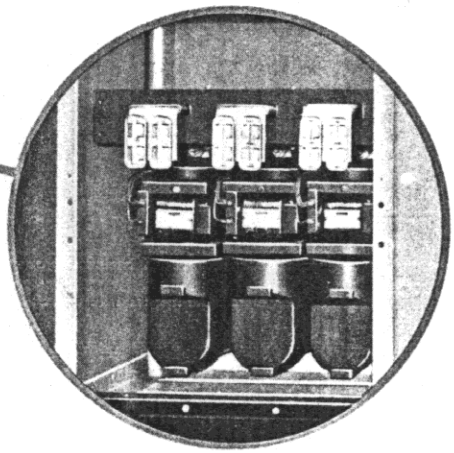


figure 10. Removing rear barrier for inspection of transformers and connections. Barrier is removed by unscrewing a few bolts.

figure 11. Current transformers are accessible from rear. View shows arrangement of transformers and cable clamps.



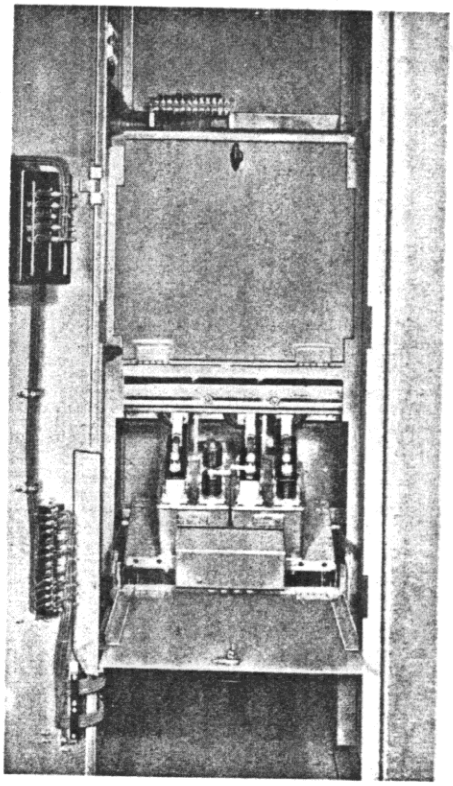


figure 12. Potential transformers in auxiliary compartment. Drawout arrangement automatically disconnects and grounds transformer when access to BAL fuses is necessary.

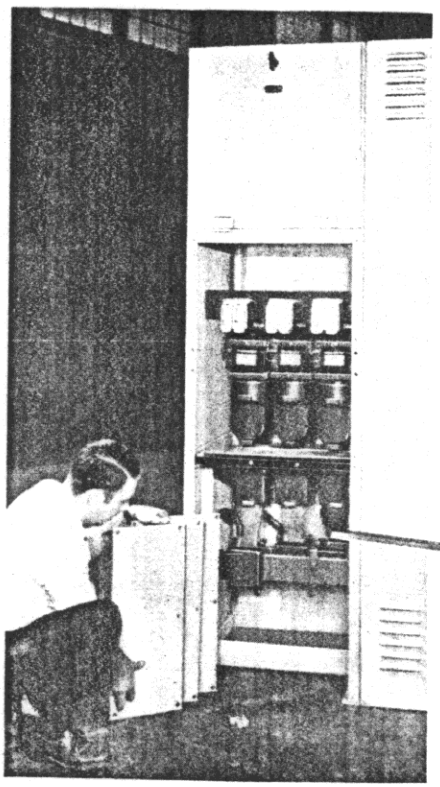
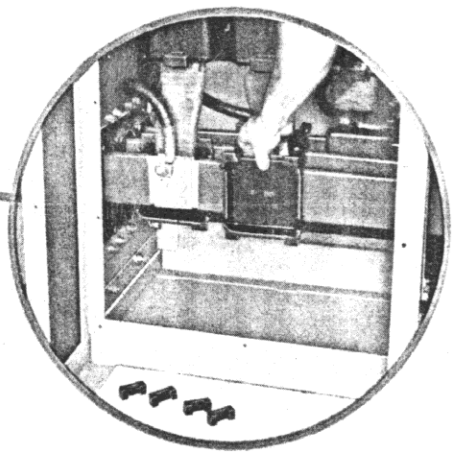
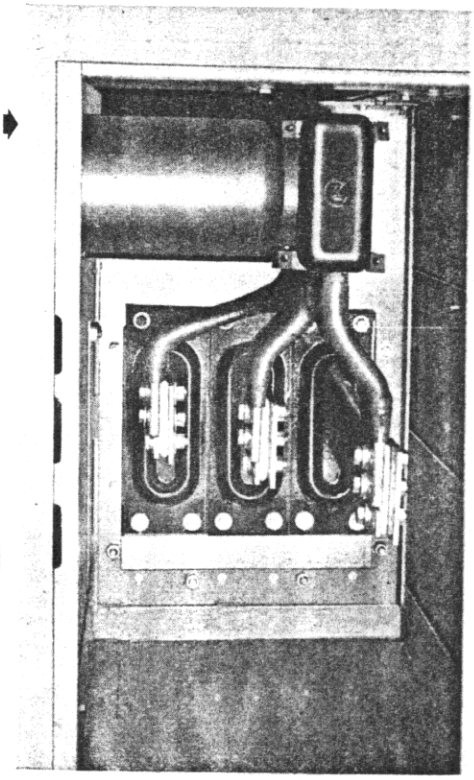


figure 13. Removing barriers of main bus compartment. Buses also accessible from breaker compartment.

figure 14. Buses easily extended when adding units. Bus ends, insulation, support and cover are removed. A porcelain support completes bus isolation between units.

figure 15. Bus taps are enclosed. Moldarta® compound box is easily installed and filled with insulating compound.





outline dimensions indoor

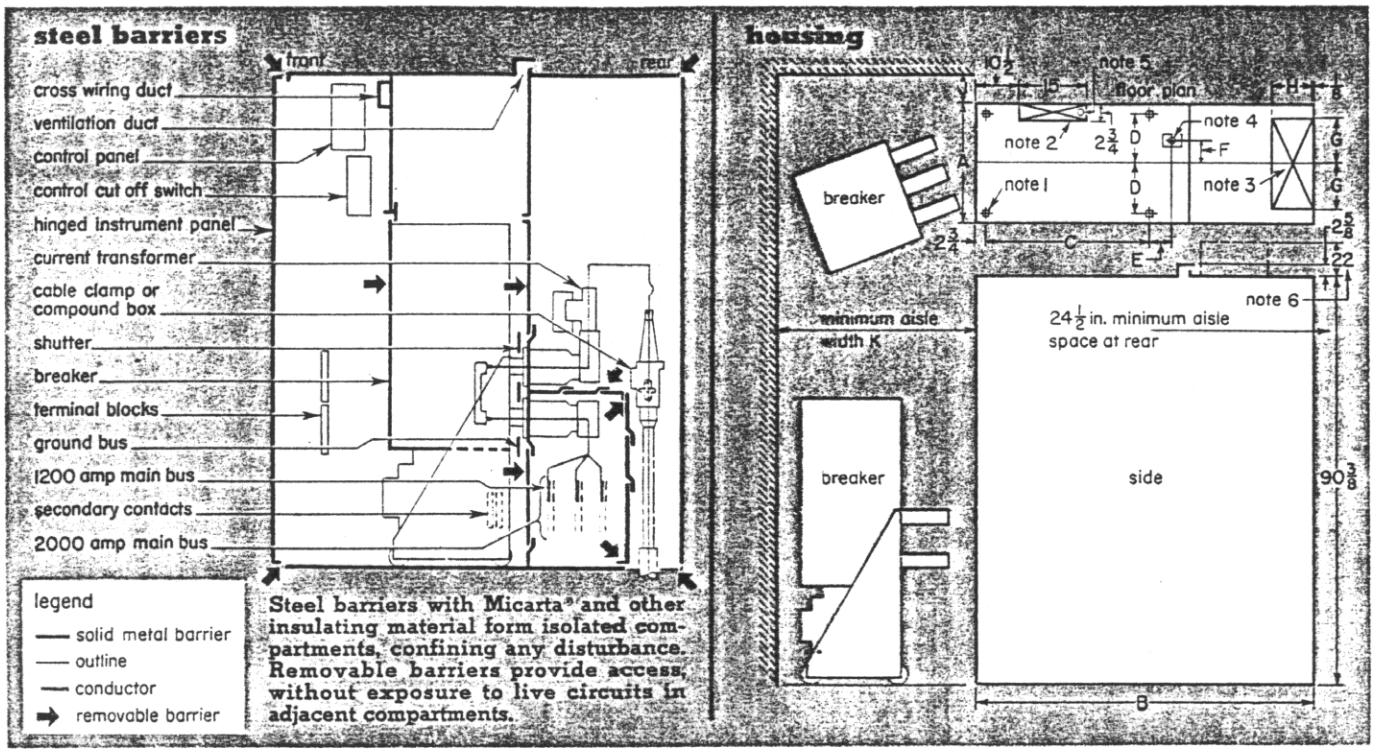


figure 16

type of unit	volts	amps	dimensions: inches A	B	C	D	E	F	G	H	J	K	approx. weight (lbs) dead weight	impact weight*
50-DH- 75 bkr	4160	1200	20	64	32	8 13/16	+	+	7 7/16	7¼	13	36	2000	2250
50-DH- 75 aux		....	26			11 13/16	.	...	10 7/16		17		1600	....
			36			16 13/16			15 7/16		23		1800	....
50-DH- 150 bkr		1200	26	74	36	11 13/16	5	0	10 7/16	9¾	17	33	2800	3350
50-DH- 250 bkr		2000	36			16 13/16			15 7/16		23	43	3300	3950
50-DH- 150 aux		....	26			11 13/16	.	...	10 7/16		17	min	2500	....
50-DH- 250 aux			36			16 13/16			15 7/16		23	36	2800	....
50-DH- 350 bkr		1200 ‡3000	36	92	41½	16 13/16	5	0	15 7/16	13	23	47	5900 6100	7050 7350
50-DH- 350 aux		....					•	...					3000	....
75-DH- 250 bkr	13800	1200	36	86	47	16 13/16	5	5½	15 7/16	9	23	49	4400	5450
75-DH- 500 bkr		2000											4800	5950
150-DH- 150 bkr		1200											4200	5150
150-DH- 250 bkr		1200											4600	5650
150-DH- 500 bkr		2000												
75-DH- 150 aux		....											3300	....
150-DH- 250 aux														
150-DH- 500 aux														
150-DH- 750 bkr		1200		92	53							55	5000	6250
		2000											5400	6750
150-DH- 750 aux		....											3600	....
150-DH-1000 bkr		1200 ‡3000		116	58					18		60	5400 6200	6050 7150
150-DH-1000 aux		....											3900	....

note: Actual weight will vary in proportion to amount and type of auxiliary equipment in units.

+note 5 shows location of 50-DH-75 ground connection thru floor.

* total includes dead weight.

‡ height of unit is 112 inches with 3000 amp bus.

note 1: ¾ x 1 slotted holes for ½ in. bolts or plug welding (plug welding preferred).

note 2: maximum space for secondary conduits 1½ in. max size, 3 in. max above floor.

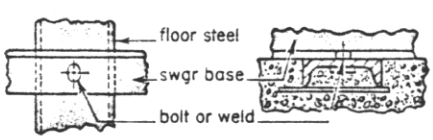
note 3: maximum space for main cables.

note 4: location for purchaser's ground connection. In groups involving six or less, this connection is made in the left hand end breaker unit; in larger groups ground connections are made in left and right hand end breaker units.

note 5: purchaser's ground connection location in 50-DH-75 breaker units.

note 6: additional height for 3000 amp bus run when required.

recommended mounting for "DH" line of switchgear units



standard units

indoor • 4.16 kv, 7.2 - 13.8 kv

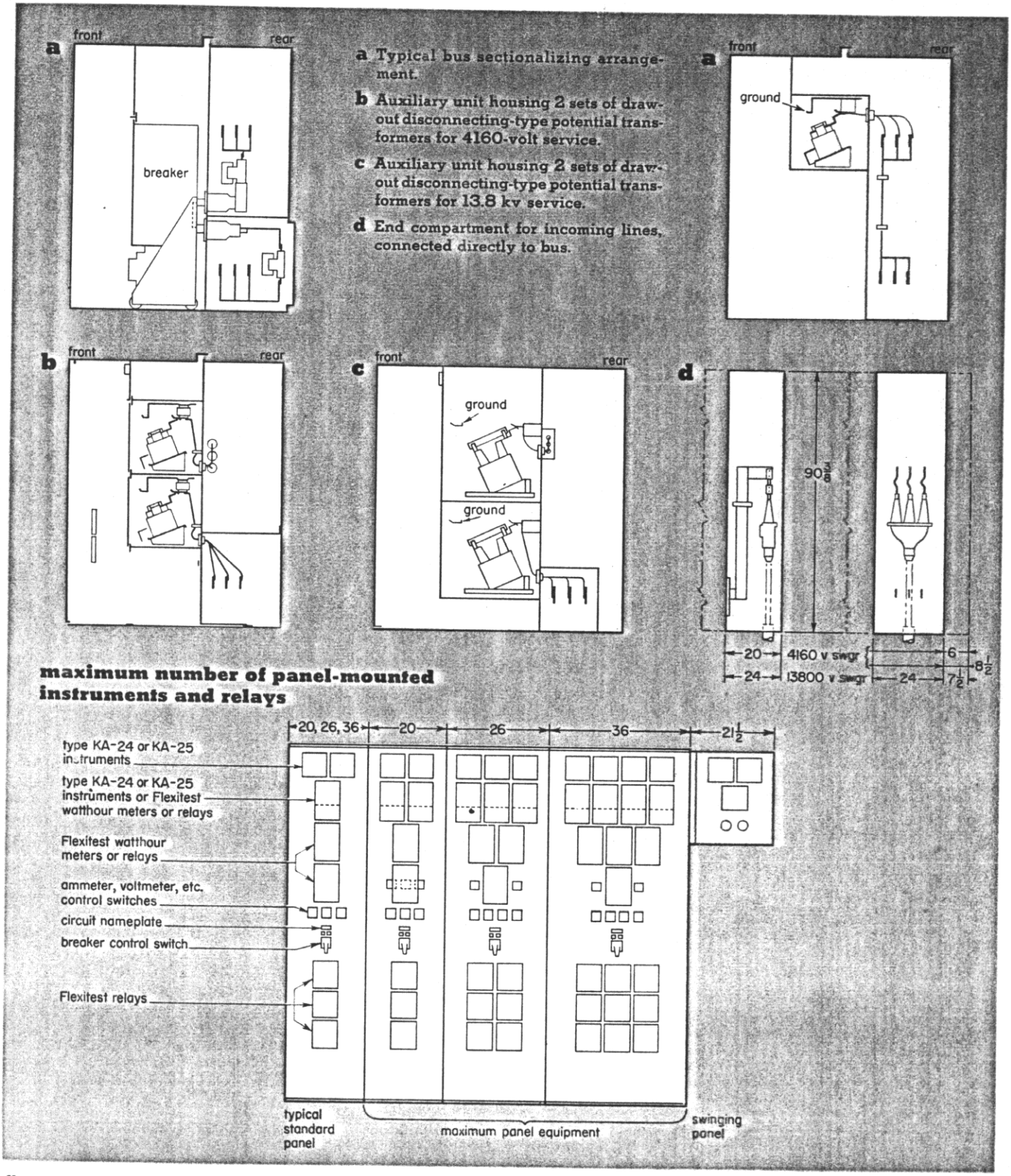
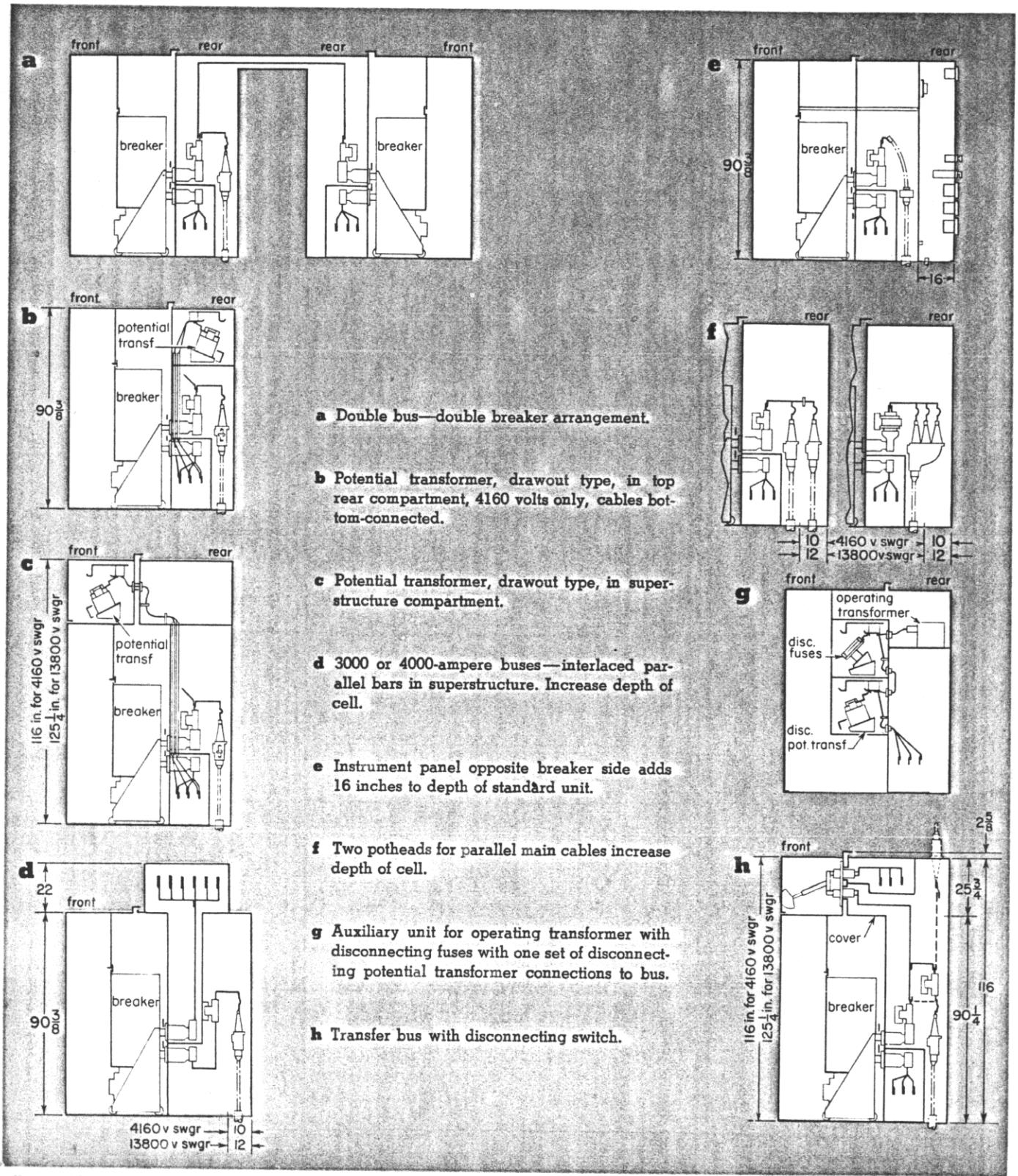


figure 17

standard units

indoor • 4.16 kv, 7.2-13.8 kv



a Double bus—double breaker arrangement.

b Potential transformer, drawout type, in top rear compartment, 4160 volts only, cables bottom-connected.

c Potential transformer, drawout type, in superstructure compartment.

d 3000 or 4000-ampere buses—interlaced parallel bars in superstructure. Increase depth of cell.

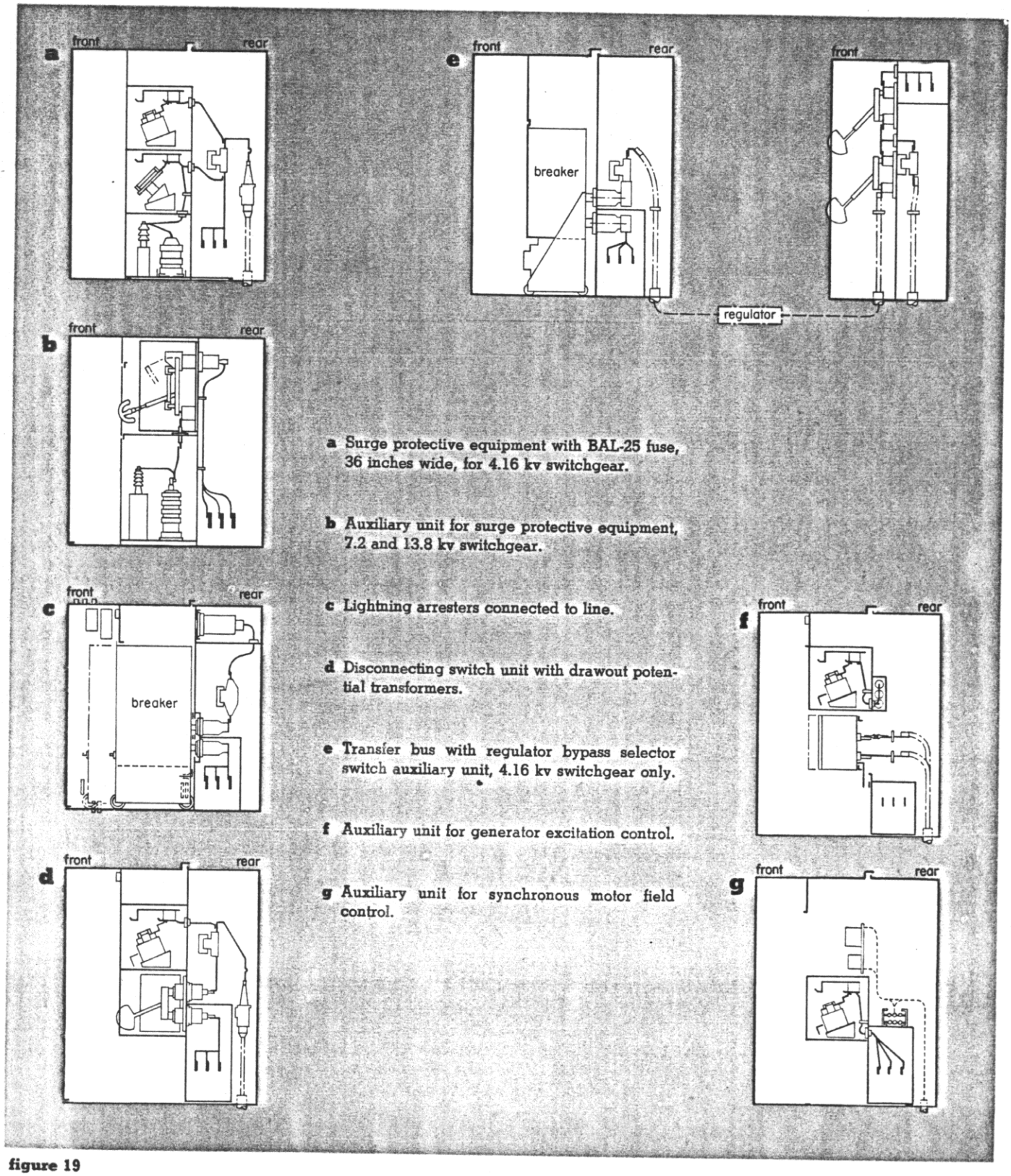
e Instrument panel opposite breaker side adds 16 inches to depth of standard unit.

f Two potheads for parallel main cables increase depth of cell.

g Auxiliary unit for operating transformer with disconnecting fuses with one set of disconnecting potential transformer connections to bus.

h Transfer bus with disconnecting switch.

figure 18



a Surge protective equipment with BAL-25 fuse, 36 inches wide, for 4.16 kv switchgear.

b Auxiliary unit for surge protective equipment, 7.2 and 13.8 kv switchgear.

c Lightning arresters connected to line.

d Disconnecting switch unit with drawout potential transformers.

e Transfer bus with regulator bypass selector switch auxiliary unit, 4.16 kv switchgear only.

f Auxiliary unit for generator excitation control.

g Auxiliary unit for synchronous motor field control.

figure 19

design features outdoor

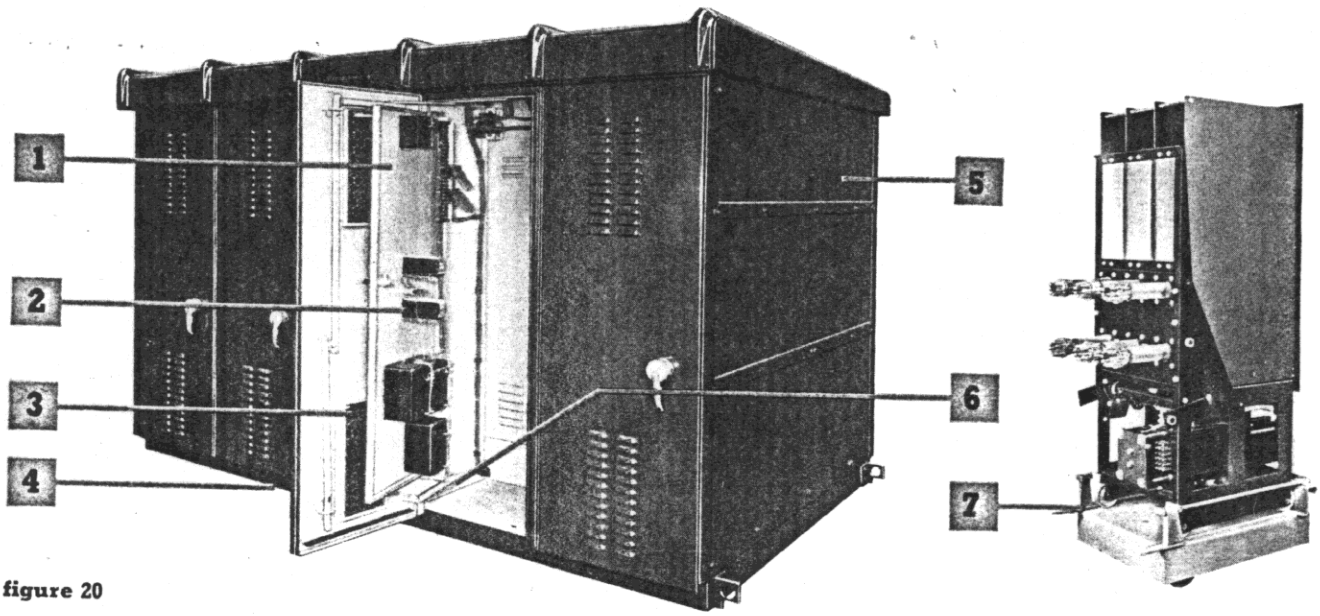


figure 20

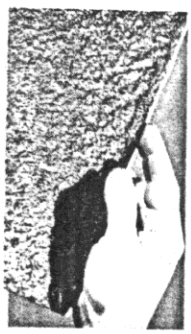
1 panel space Adequate space is available for most circuit requirements. However, large recording instrument or unusual relay applications require special attention and should be referred to the nearest Westinghouse Sales Office.

A control cable is provided to permit breaker operation in the "test" position. If it is desired, a pushbutton control station can be supplied that will provide breaker test control from the "draw-out" side of the cell.

2 control devices Electrical operations of the type DH air circuit breaker for the various circuits installed in outdoor metal-clad switchgear may be locally controlled by a Westinghouse control switch on the instrument panel . . . by a remote control switch . . . by supervisory control . . . or, the circuits may be equipped with the necessary devices for complete automatic operation.

3 ventilation Unit ventilation is provided through louvers in the doors. These louvers are backed with a disposable filter for which replacements are readily obtainable.

4 all-weather undersurface coating Westinghouse all-weather undersurface coating, applied to outdoor switch gear, provides lasting protection from rust and corrosion. It is a heavy rubberized protective sealing material. Switchgear undersurfaces are first cleaned, Bonderized and prime-painted. Then all-weather undercoating is applied by spray to insure complete, uniform coverage. The result is a thick, air-tight seal . . . lasting protection against costly undersurface deterioration.



5 stationary structure Westinghouse outdoor metal-clad switchgear utilizes the same assembled equipment as indoor metal-clad. This assures interchangeability of components for the two types of switchgear.

Weatherproofing is accomplished through the use of a heavy gauge steel floor, finished on the exposed surfaces with all-weather undercoating. The front and rear doors are double-flanged for rigidity and fitted into channel frames that assure weather resistance. The roof seams are covered to provide completely adequate weather seals.

The unit design, inherent in all metal-clad switchgear, is continued in the weatherproofing details. Base and roof sections are integral to the individual unit. This permits later additions or rearrangement of units to suit changes in operating requirements.

The type DH air circuit breakers of like ratings are mechanically interchangeable. They are also electrically interchangeable for duplicate control conditions.

6 heating elements The heating elements for outdoor metal-clad switchgear are unit-assembled, bolted in place and electrically connected at a terminal block. The combination of free-moving ventilating air and the heating elements provides outdoor units which are free from condensation.

7 breaker transport truck The type DH air circuit breaker is handled externally on a four-wheeled transport truck. The transport truck has two fixed and two swivel wheels which facilitate aligning the breaker unit with the stationary structure. The adjustable transport truck compensates for variations in the concrete mounting pad. The transport truck is securely latched to the stationary structure for inserting or removing the breaker element. The breaker element is latched to transport truck during movement outside of the stationary structure.

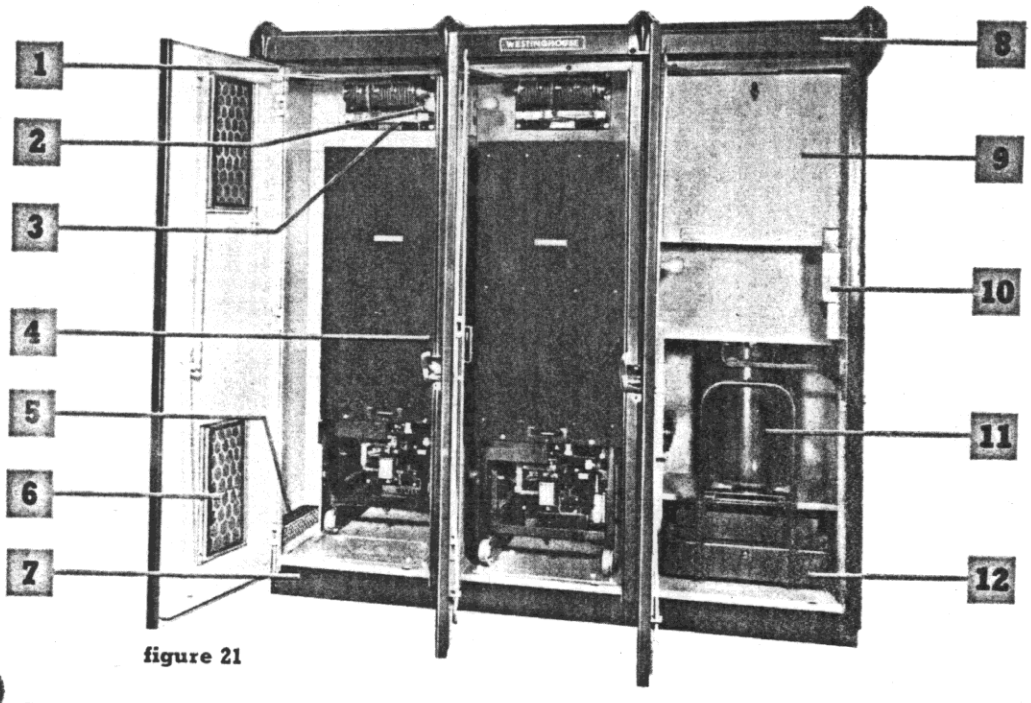


figure 21

Design planning has resulted in providing a distinctive Westinghouse family of outdoor metal-clad units for the complete range of air circuit breaker ratings with their associated auxiliary units.

1 doorstop and latching assembly

2 light

3 Rectox rectifier for closing breaker

4 shutter position indicator and convenience outlet

5 heater assembly

6 two disposable ventilating filters—top and bottom of doors

7 weatherproof, corrosion-resistant base

8 weathertight, removable roof assembly

9 door to disconnecting-type BAL fuse assembly

10 AB breaker and interlock assembly to isolate secondary load for operating transformer before making or breaking primary fuse connections

11 operating transformer

12 adjustable breaker transport truck

weatherproof assemblies

Unit construction of Westinghouse outdoor switchgear provides versatility to meet the needs of expanding electrical systems. Compartmentation is planned to provide maximum use of space, safe operating arrangements, and accessibility for inspection and maintenance.

Removable bolted-on covers give access to high-voltage circuits.

breaker unit stationary structure

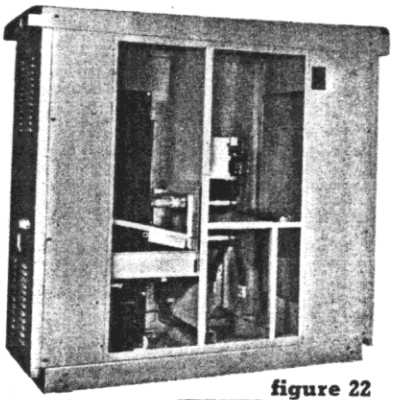


figure 22

auxiliary Unit stationary structure

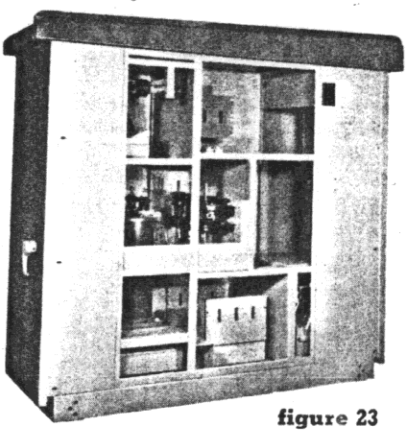


figure 23

special test jumper permits breaker unit inspection, maintenance and test at the station site.

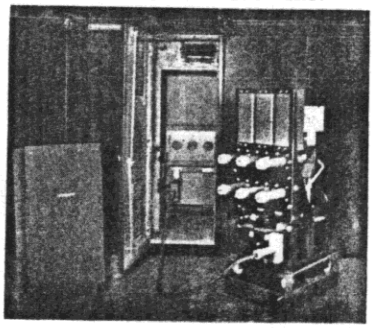


figure 24

Shelterfor-M outdoor

. . . a sheltered area for breaker interchange or maintenance

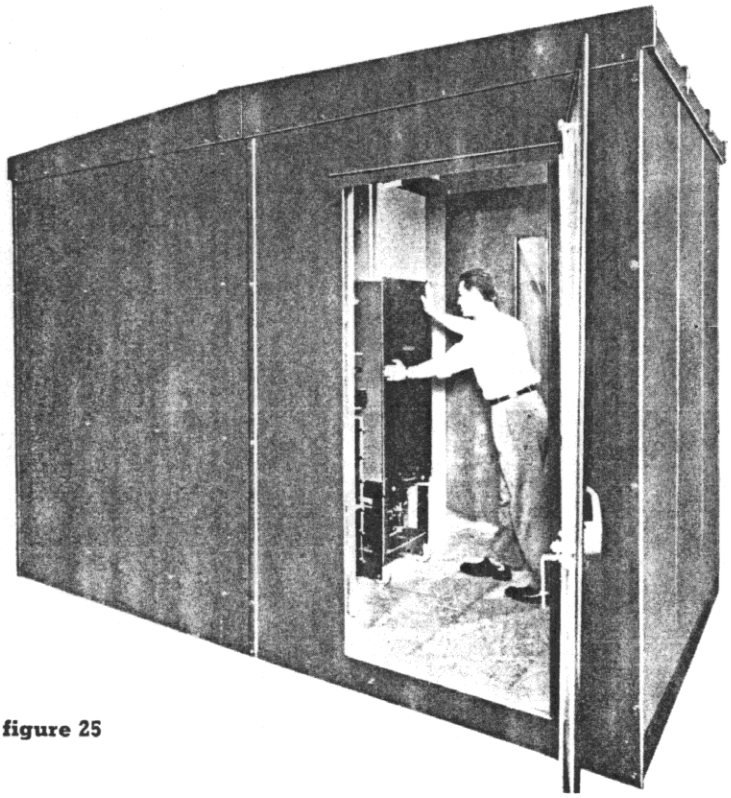


figure 25

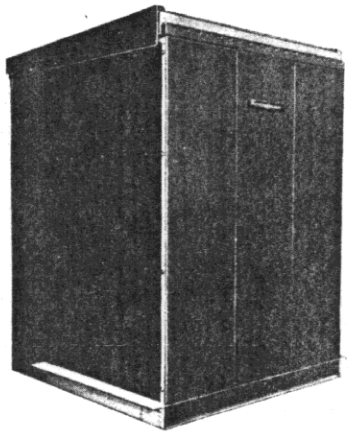


figure 26

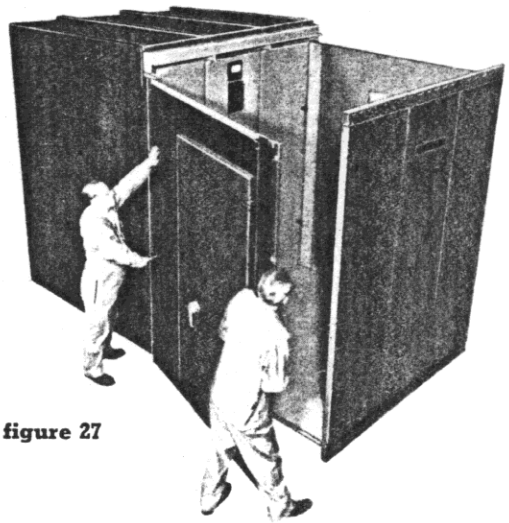


figure 27

figure 25. Adequate sheltered area for inspection or maintenance of component elements or breaker interchange.
figure 26. Shelterfor-M Switchgear as shipped with the pre-assembled aisle wall protecting the instrument panels.
figure 27. Field assembly time is kept to a minimum through use of pre-fabricated wall sections.

Westinghouse Shelterfor-M outdoor metal-clad switchgear provides a sheltered aisle for operation and maintenance. This outdoor switchgear includes the features of indoor metal-clad in a weatherproof enclosure. The aisle space, large enough to permit the free interchange of circuit breakers, is also ample for operation and maintenance without interference from the weather.

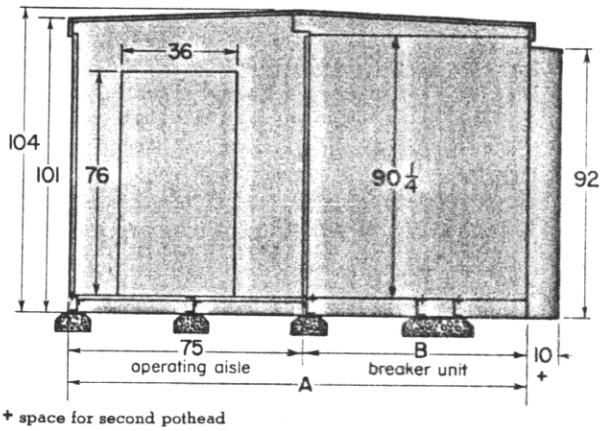
advantages

1. All-weather operation and maintenance is possible.
2. Foundation requirements are simple, no operating or breaker draw-out pad is required.
3. Space requirements are decreased. In some cases, as much as 40% less plot area is required.
4. Indoor accessories are supplied, no transport truck is required.

dimensions▪

▪ Refer to nearest Westinghouse Sales Office for 750 and 1000 mva breaker unit dimensions.

kv	A	B
5	149	74
15	161	86



+ space for second pothead

figure 28

field assembly data outdoor

1. assembly of groups . . .

(a) Line up adjacent groups—install front, rear, and base tie bolts—draw bolts tight to get continuous close contact of all adjacent sheets.

(b) Install roof seam covers—left hand removable side sheets and right hand finishing trims.

2. assembly of new groups to group already installed . . .

(a-1) If new group is added to left hand end of old group, remove left hand side sheet from old group—place new group in position and make assembly per 1 (a and b).

(b-1) Assemble side sheet and roof seam cover from (a-1) left hand side of new group.

(c-1) If new group is added to right hand end of old group, remove right hand finishing strips from old group. Place new group in position and make assembly per 1 (a and b).

(d-1) Assemble finishing strips and roof seam cover from (c-1) on right hand side of new group.

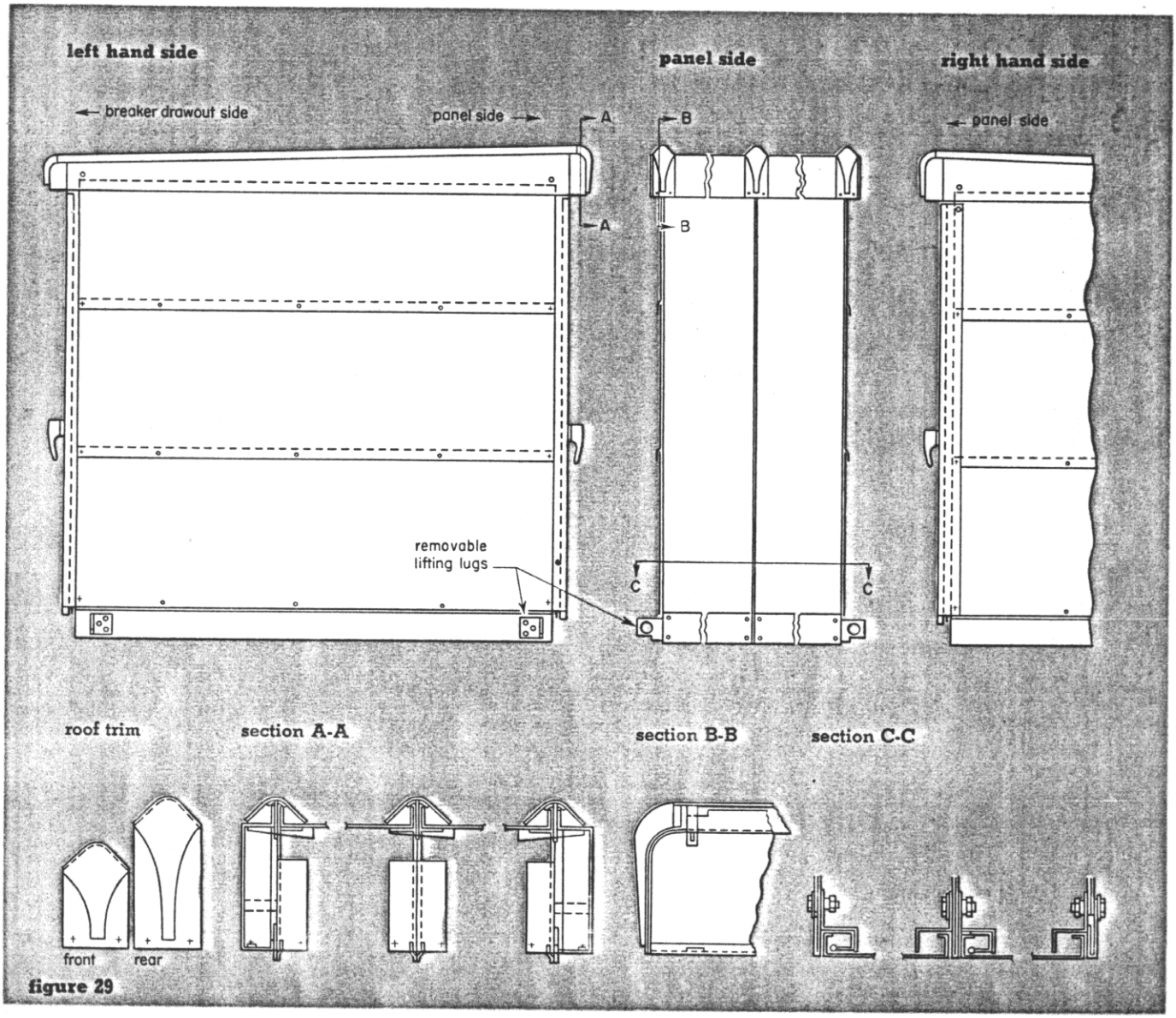
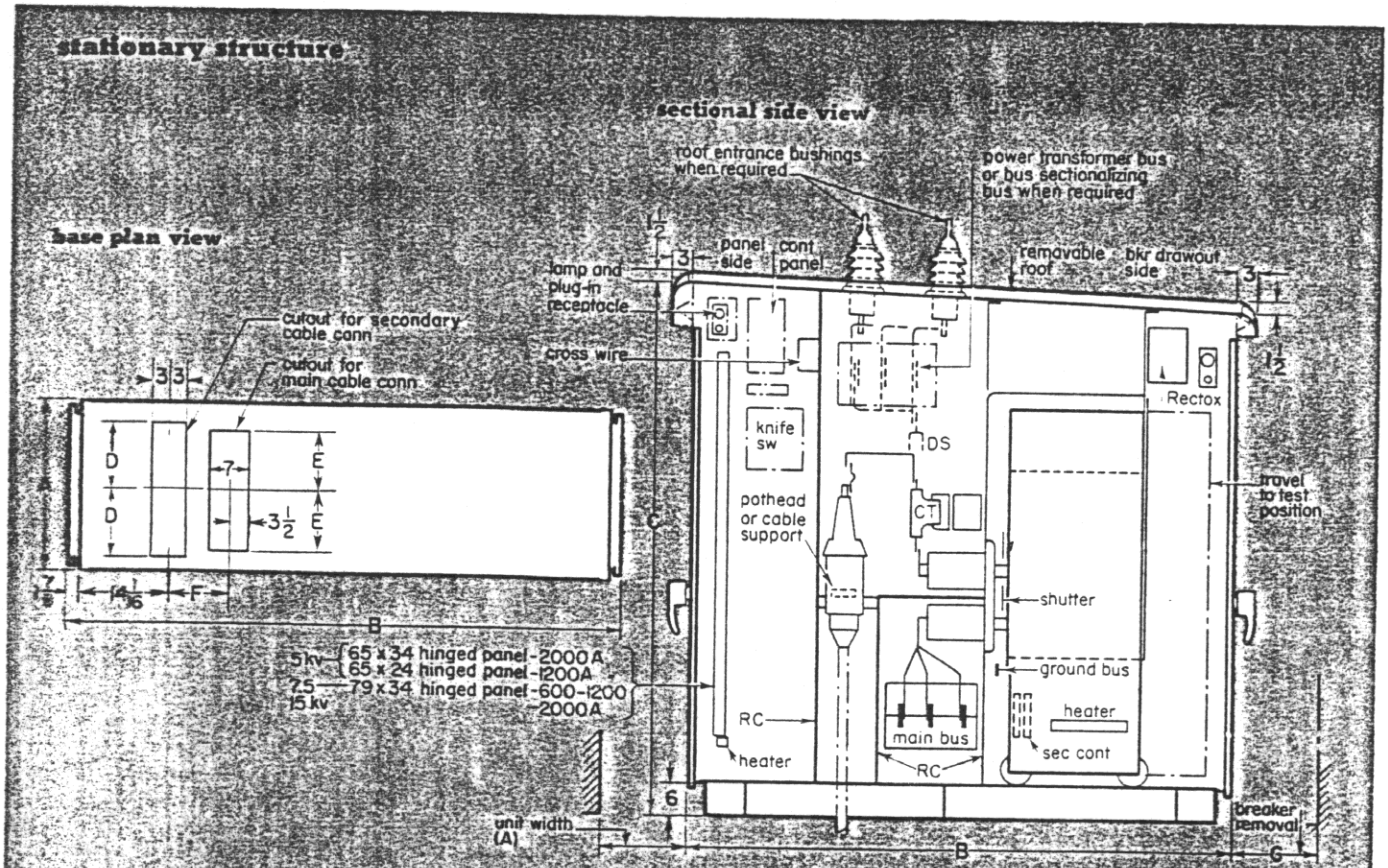


figure 29

outline dimensions outdoor



unit and type	current rating: amperes	rated kv	unit dimensions: inches A	B	C	D	E	F	G min	approx wt: lbs dead weight	impact weight
stationary structure: type DH air circuit breaker											
50-DH- 75	1200	4.16	28	90	90	11 3/8	10 1/4	10	42	3300	3550
50-DH-150	1200	4.16	28	90	90	11 3/8	10 1/4	10	42	3900	4450
50-DH-150	2000	4.16	38	90	90	16 3/8	15 1/4	10	49	4300	4950
50-DH-250	1200	4.16	28	90	90	11 3/8	10 1/4	10	42	3900	4450
50-DH-250	2000	4.16	38	90	90	16 3/8	15 1/4	10	49	4300	4950
75-DH-250	1200	7.2	38	102	104	16 3/8	15 1/4	12 1/16	49	5000	6600
75-DH-250	2000	7.2	38	102	104	16 3/8	15 1/4	12 1/16	49	5300	6950
75-DH-500	1200	7.2	38	102	104	16 3/8	15 1/4	12 1/16	49	5300	6900
75-DH-500	2000	7.2	38	102	104	16 3/8	15 1/4	12 1/16	49	5600	6250
150-DH-150	1200	13.8	38	102	104	16 3/8	15 1/4	12 1/16	49	4800	6400
150-DH-250	1200	13.8	38	102	104	16 3/8	15 1/4	12 1/16	49	4800	6400
150-DH-250	2000	13.8	38	102	104	16 3/8	15 1/4	12 1/16	49	5100	6750
150-DH-500	1200	13.8	38	102	104	16 3/8	15 1/4	12 1/16	49	5100	6700
150-DH-500	2000	13.8	38	102	104	16 3/8	15 1/4	12 1/16	49	5400	7050
150-DH-750	1200	13.8	38	108	104	16 1/8	15 1/4	12 1/16	55	6000	7750
150-DH-750	2000	13.8	38	108	104	16 1/8	15 1/4	12 1/16	55	6300	8100
stationary structure auxiliary unit											
auxiliary	....	4.16	30	90	90	....	....	....	30	3800	....
auxiliary	....	7.2	38	102	104	....	....	....	38	4200	....
auxiliary	....	13.8	38	102	104	....	....	....	38	4200	....

figure 30

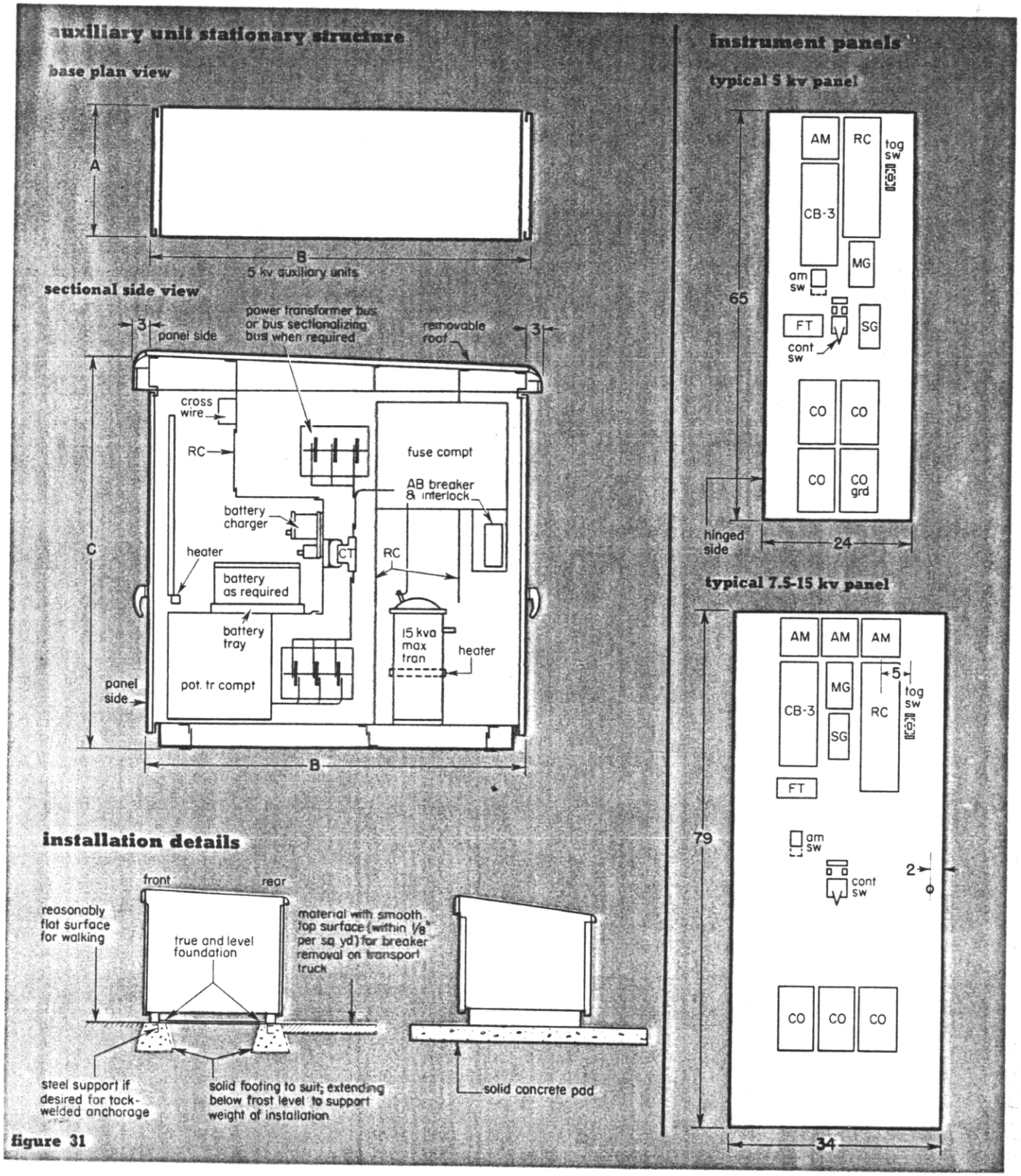
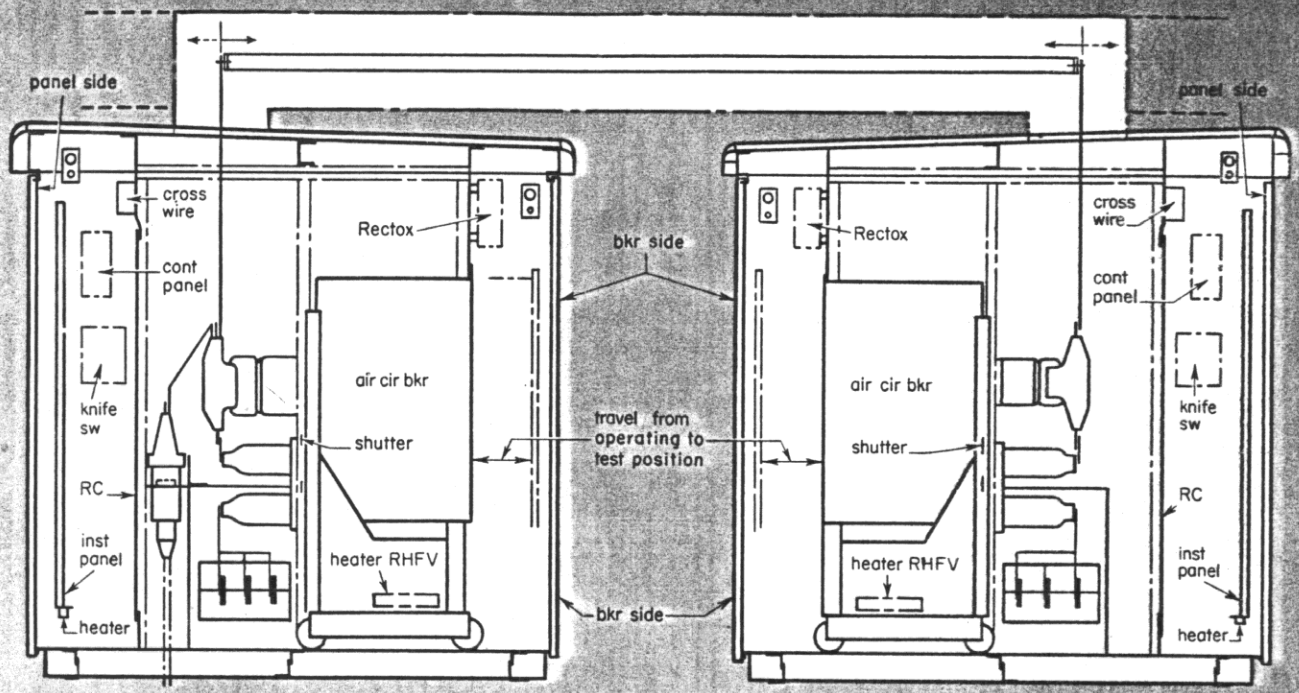

auxiliary unit stationary structure
base plan view
A
B
5 kv auxiliary units
sectional side view
3
panel side
power transformer bus or bus sectionalizing bus when required
removable roof
3
cross wire
RC
fuse compt
AB breaker & interlock
battery charger
heater
CT
RC
battery as required
battery tray
15 kva max tran
heater
panel side
pot. tr compt
C
B
installation details
front
rear
reasonably flat surface for walking
true and level foundation
material with smooth top surface (within 1/8" per sq yd) for breaker removal on transport truck
steel support if desired for tack-welded anchorage
solid footing to suit; extending below frost level to support weight of installation
solid concrete pad
instrument panels
typical 5 kv panel
AM
RC
tog sw
CB-3
MG
am sw
FT
SG
cont sw
CO
CO
CO
CO grd
65
hinged side
24
typical 7.5-15 kv panel
AM
AM
AM
CB-3
MG
SG
RC
5
tog sw
FT
am sw
cont sw
2
CO
CO
CO
79
34

figure 31

standard units outdoor

a. double bus—double breaker arrangement



b. breaker unit with lightning arresters connected to line

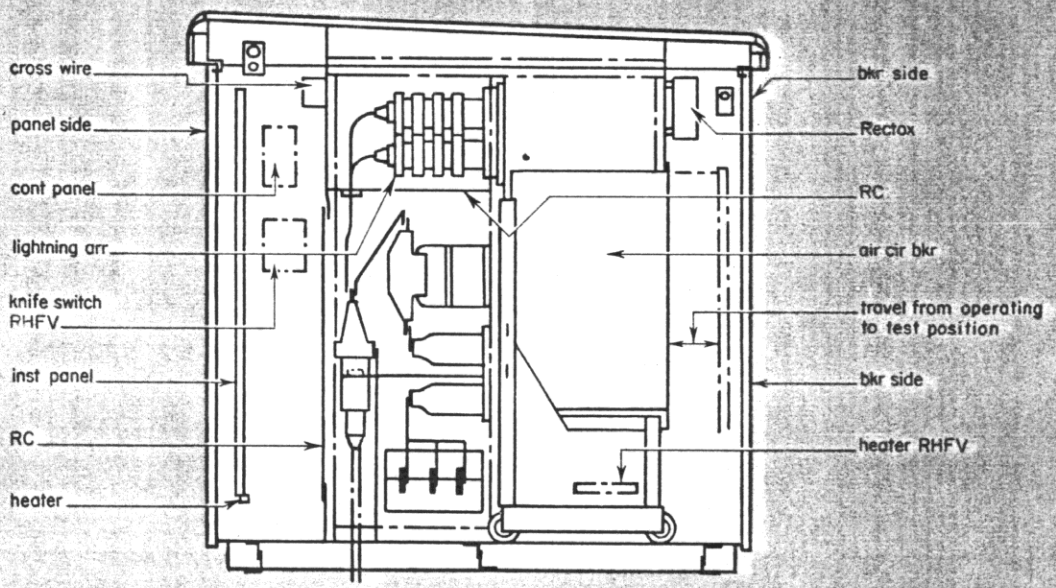
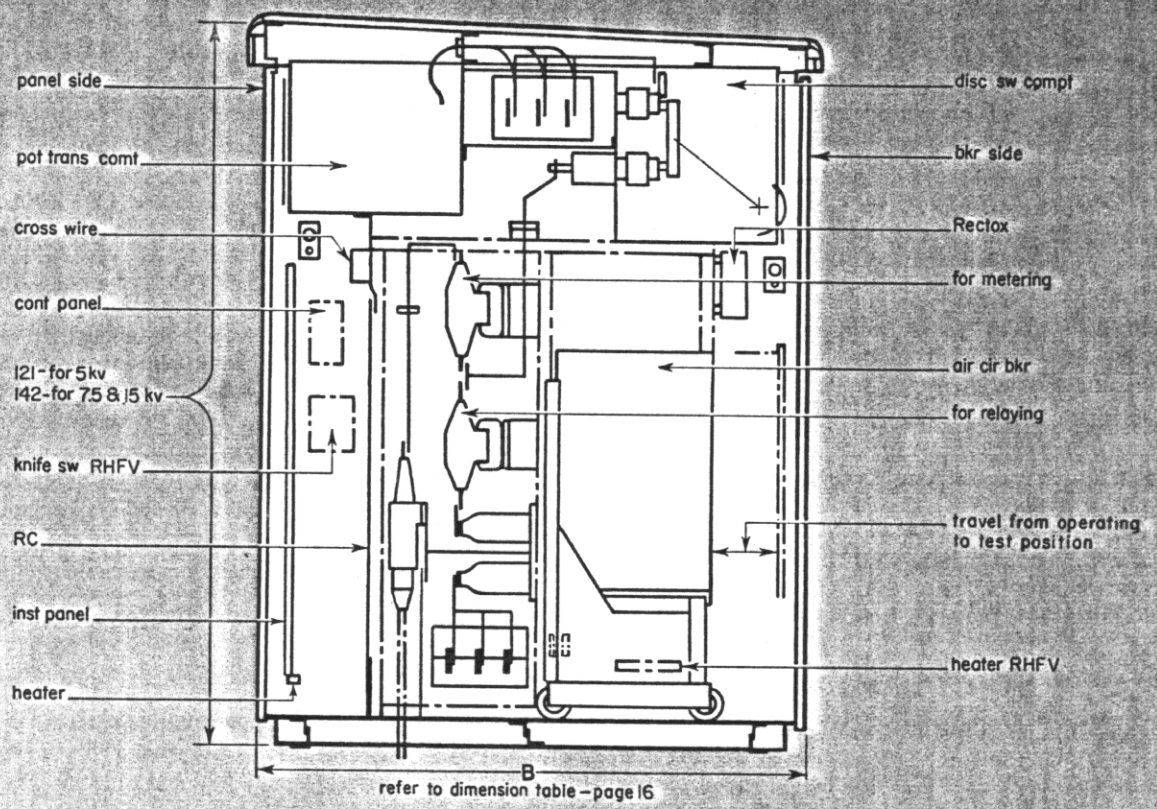


figure 32

a. breaker unit with transfer bus in superstructure



b. breaker unit with two three-conductor potheads

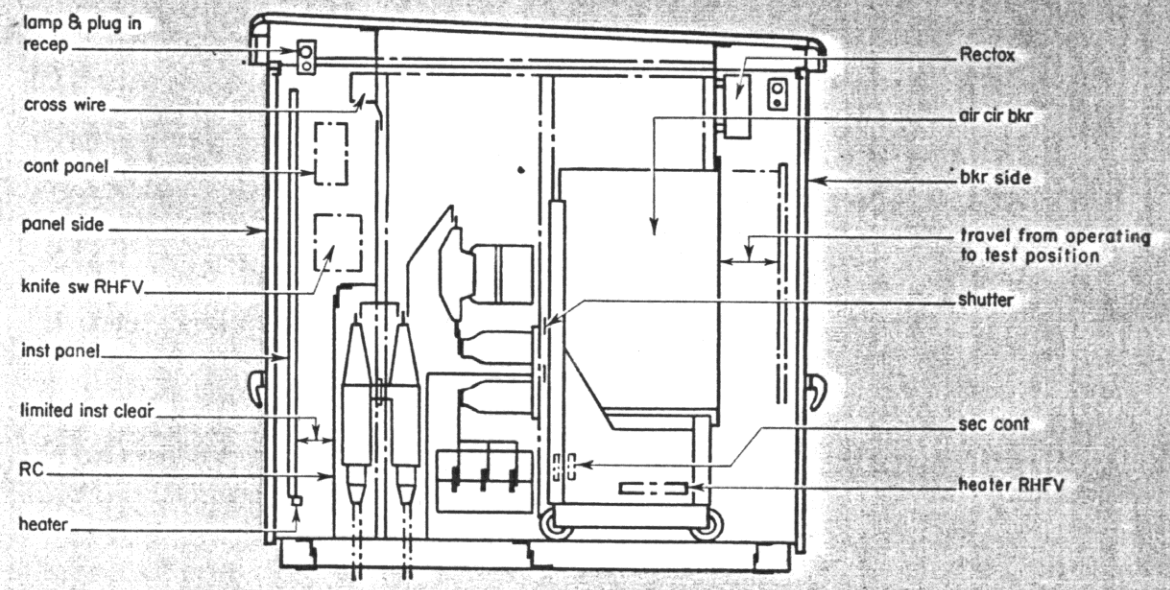


figure 33

type DH magnetic De-ion air circuit breakers

horizontal drawout
indoor and outdoor

Type DH magnetic De-ion air circuit breakers, as major components of Westinghouse metal-clad switchgear, provide superior circuit protection. The De-ion principle utilized in these breakers results in fast, positive arc interruption. In addition, the breaker replacement and maintenance procedure is the simplest possible, largely because of the horizontal drawout construction.

Type DH breakers are designed for application only in Westinghouse metal-clad switchgear . . . in all standard ratings from 50 mva at 2400 volts to 1000 mva at 13.8 kv. The type DH breaker is designed as a completely coordinated, horizontal drawout unit.

A fuller discussion of the main features of the DH breakers is desirable, followed by specific illustrations of the various DH breaker types and their interrupters . . .

the De-ion principle of arc interruption

In the 1920's, the expanding power needs of the electrical industry required circuit breakers of increasing dependability. Recognizing this need, Westinghouse directed its efforts toward a detailed study of arc interruption phenomena. Westinghouse developed the first really scientific approach to the problem of arc interruption. The name De-ion was applied to this first practical interrupter because it rendered the arc space non-conducting by quickly neutralizing or de-ionizing the intense ionization of the arc space.

In 1929 Westinghouse installed the first power air circuit breaker in the world on a commercial circuit. The rating of this breaker was 500,000 kva at 15 kv. This was a De-ion circuit breaker, and it was still operating after 27 years in its original application on a 12 kv circuit. Others of this type in industrial service have operated several hundred thousands of times and are still in service.

arc chute and blowout coil

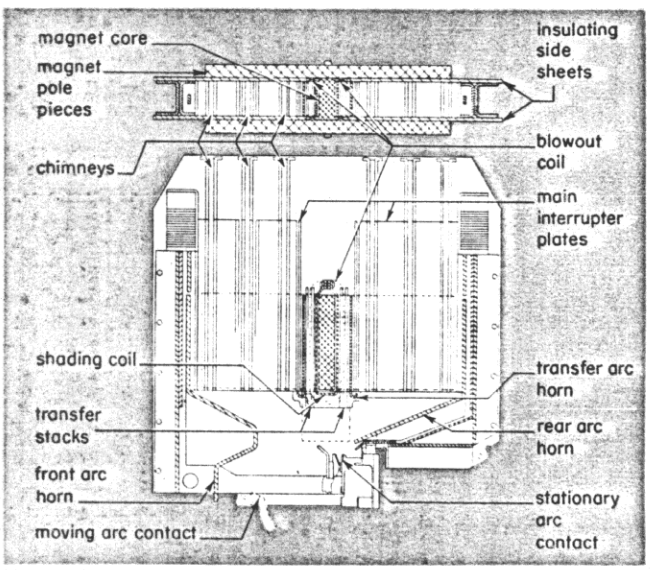


figure 34

magnetic De-ion interrupter

A further development of the De-ion principle produced the "magnetic De-ion" interrupter. It represented an important step in simplicity of construction because in it the arc is controlled and interrupted as a single long arc. This is the type of interrupter used in all DH type breakers. It consists essentially of a series of spaced insulating refractory ceramic plates having slots in the lower ends into which the arc is moved by a magnetic field. The slots, although roughly like an inverted V, have a very particular shape which is scientifically coordinated with the plate thickness, spacing and magnetic field characteristics.

In this type of interrupter, the magnetic field is of utmost importance. The magnetic fields as used are designed to give the best results for each specific type of breaker. On latest designs of interrupters such as 50-DH-75, 150-DH-750 and 150-DH-1000, the magnetic field has its energizing coil in the center of the arc chute so that in plan view the iron circuit resembles the letter "H". This gives a very strong and uniform field, and also breaks the arc into the two arcs in series. This is equivalent to two interrupters in series. In addition, the insulation strength of the arc chute assembly is approximately doubled by this construction. These new interrupters will interrupt more volts per inch of arc chute length than other designs. This means a lighter, smaller assembly to be handled in inspection and maintenance.

contacts

An additional factor of safety has been provided by placing the separating contacts, including the main contacts, inside of the arc chute.

puffers

All ratings of DH breakers are equipped with air puffers to speed the interruption of low current arcs such as in opening magnetizing or light load currents.

horizontal drawout principle and operating characteristics

Designed as the complete removable unit of metal-clad switchgear, the type DH breaker is built on the horizontal drawout principle. This means that it is simply rolled into the cell and into contact engagement with the bus and line. There is no lifting into position. The result is that the mechanism for engaging and disengaging the breaker is the simplest possible, to inspect and maintain. Also the safety interlocking is simple and positive in its direct mechanical action to prevent insertion or withdrawal if the breaker is closed, and to prevent closing unless the unit is at the full limit of travel. Pages 5 and 30 illustrate the horizontal drawout principle fully.

Other advantages result from the horizontal drawout design. The main breaker bushings are horizontal. The movable contact arm is hinged on the lower bushing and the arc chute is placed above the contacts at the upper end of the hinged movable contact arm. Thus the arc must rise from the contacts into the interrupter. The heat of the arc gives it a tendency to rise, which aids the magnetic field in moving it into the interrupter.

This arrangement of contacts and arc chute also results in greater ease of inspection of contacts, arc chute and mechanism than any other arrangement. To inspect contacts and the lower part of the arc chute quickly, it is only necessary to remove the main front barrier and use a hand light. Closer inspection and some maintenance operations can be done by merely removing or tilting the arc chutes back. Illustrated on page 27 is a 150-DH-750 with the arc chutes tilted back.

materials

Many parts of circuit breakers require highly special materials.

The material for arcing contacts is a mixture of tungsten and silver which resists the burning action of the arc and reduces the amount of metallic vapor in the arc stream, thus assuring long contact life. Westinghouse developed the first practical material of this nature, which made possible, in 1929, the first magnetic power air circuit breaker.

The refractory ceramic plates in the arc chutes are a zircon mixture made by porcelain techniques. Zircon is a superior material for this application with respect to heat shock, melting and boiling point, moisture absorption and insulating materials.

"Redarta" insulation is used in DH breakers. Redarta has superior flame-retardant characteristics and will not support combustion with the heat source removed.

ceramic arc chute construction

non-hygroscopic . . . highly resistant to heat shock

The arc chutes in DH breakers are so constructed that the arc is exposed only to ceramic material. This ceramic material, containing a high percentage of zircon, has the highest melting point of any known material and great resistance to heat shock. Its dielectric and moisture absorption properties compare favorably with high-grade porcelain.

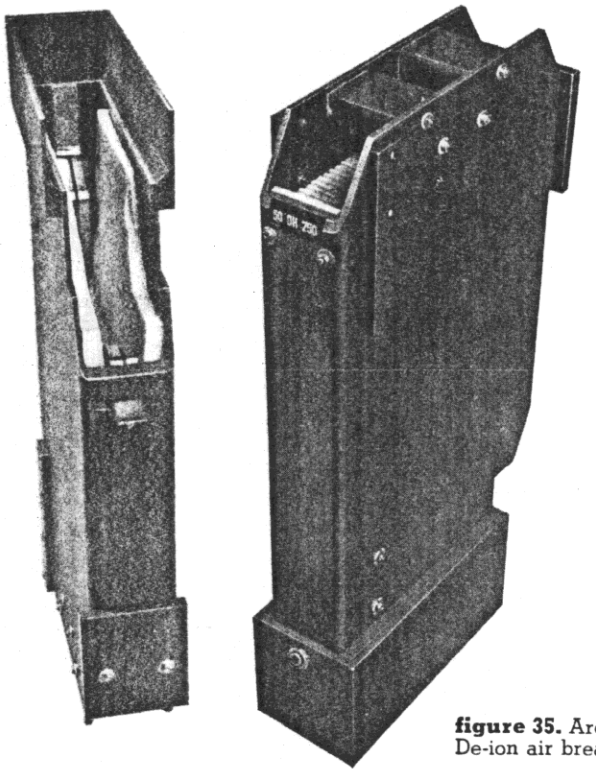


figure 35. Arc chutes for DH De-ion air breakers

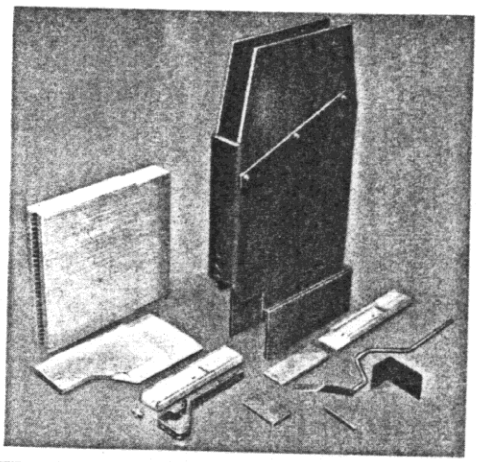


figure 36. Sub-assemblies of De-ion arc chute.

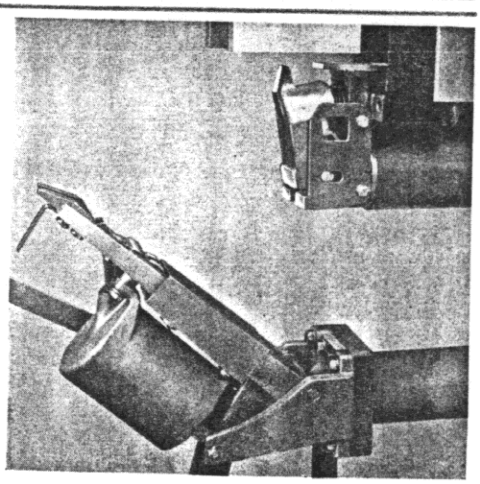


figure 37. Main and arcing contacts.

type DH magnetic De-ion air circuit breakers

horizontal drawout
indoor and outdoor • continued

type 50-DH-75 { 75 mva interrupting capacity at 4160 volts
50 mva interrupting capacity at 2300 volts
1200 amperes continuous rating

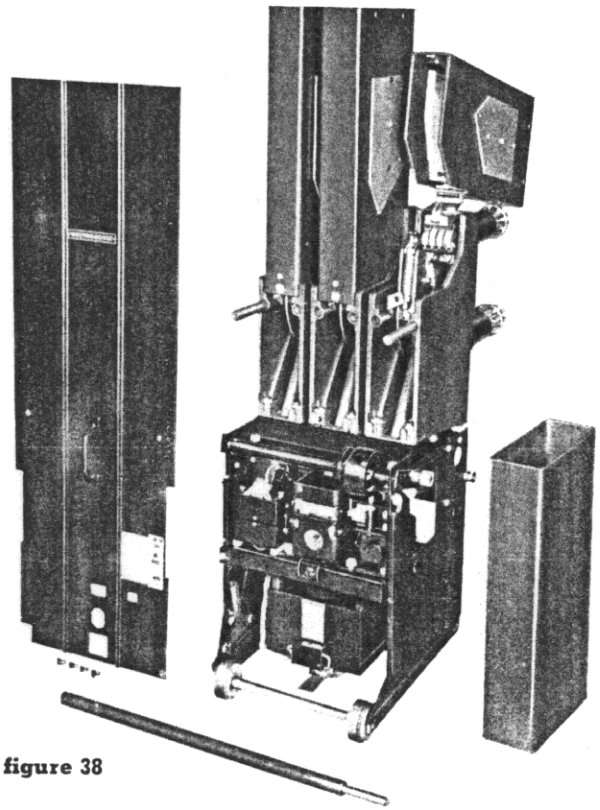


figure 38

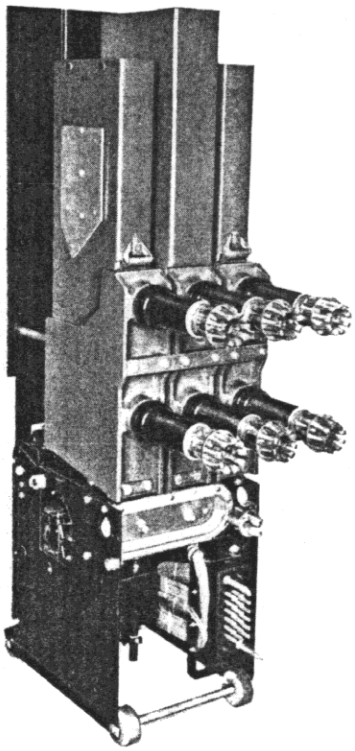


figure 39

Type 50-DH-75 magnetic De-ion air circuit breaker is three pole, electrically operated, and is complete with a mechanically and electrically trip-free solenoid closing mechanism, shunt trip coil, auxiliary switches, operation counter, and open-close indicator.

The circuit breaker frame is fabricated from formed steel plates electrically welded to form a support for the equipment. The frame has four flanged wheels which engage with the floor rails as the unit is rolled into the stationary structure. Steel barriers separate the high-voltage parts of the circuit breaker from the operating mechanism and control devices, and from the panel wiring.

magnetic De-ion circuit interruption: The interrupter plates are of zircon ceramic refractory material. The magnetic field is of the "H" type, with the blowout coil in the center. This produces a much stronger and more uniform field than other types. The field coil is put in series with the circuit by the arc itself after it is started by the arcing contacts. This field forces the arc upward into the ceramic arc chamber. Extinction occurs due to de-ionization at the zero point of the current wave. Burning of the contacts is very low because of rapid current transfer to the arcing horns.

Hinged arc chute arrangement permits easy tilting for inspection of arc chute interior and contacts. All main insulating parts of the arc chutes are made of Westinghouse Redarta.

arc chute and blowout coil

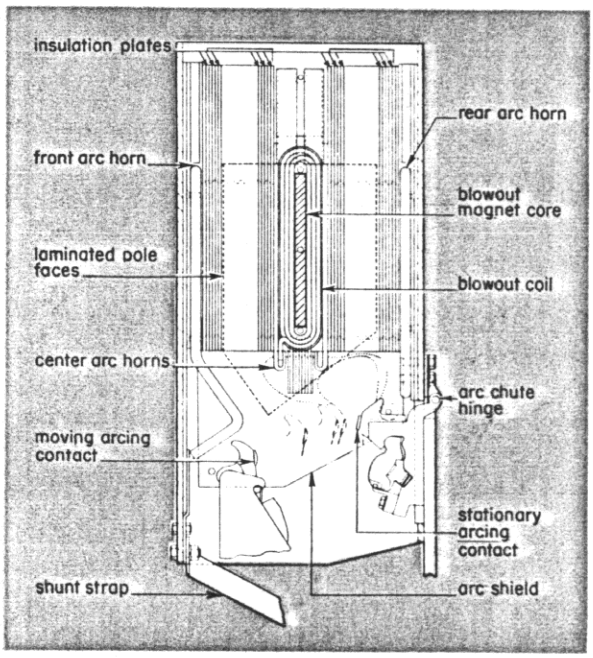


figure 40

type 50-DH-150 { 150 mva interrupting capacity at 4160 volts
100 mva interrupting capacity at 2300 volts
1200 and 2000 amperes continuous rating

type 50-DH-250 { 250 mva interrupting capacity at 4160 volts
150 mva interrupting capacity at 2300 volts
1200 and 2000 amperes continuous rating

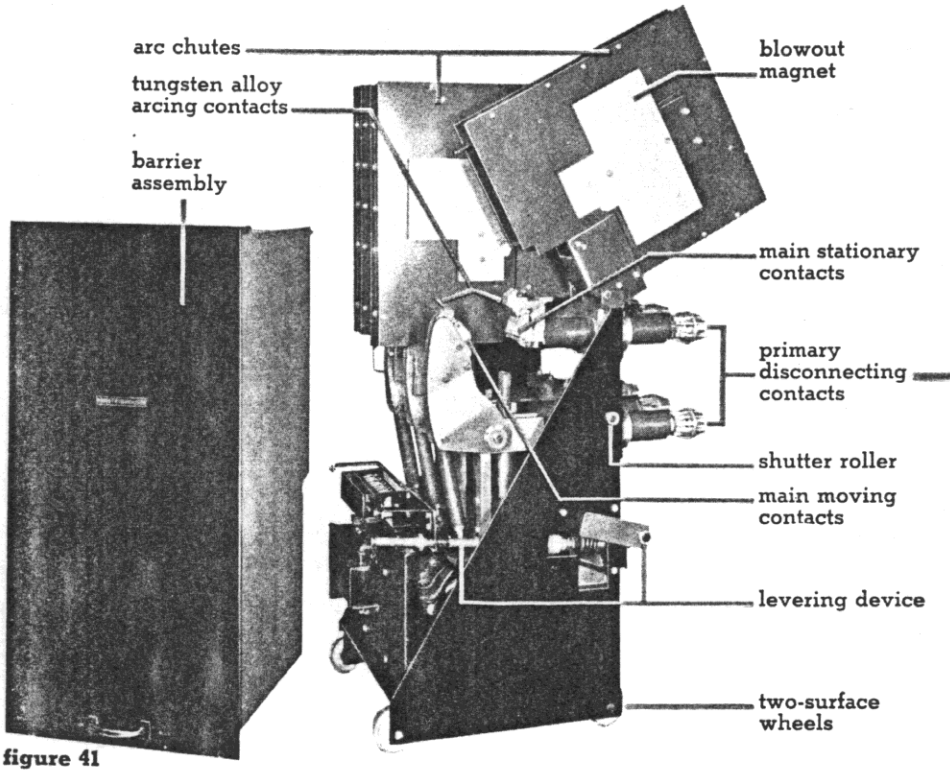


figure 41

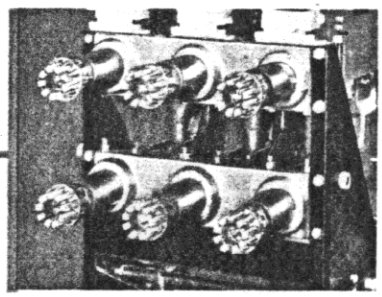


figure 42. Positive contact is obtained on primary disconnects by individual flat springs and heavily silvered, self-aligning, fingerlike segments. Segments on breaker are easy to inspect.

These DH magnetic De-ion air circuit breakers are three-pole, electrically operated, and complete with a mechanically and electrically trip-free solenoid closing mechanism, shunt trip coil, auxiliary switches, operation counter, and open-close indicator.

The circuit breaker frame is fabricated from formed steel plates electrically welded to form a support for the equipment. The frame has four wheels with needle bearings and a special flange construction which engages with the rails as the unit is rolled into the stationary structure. A horizontal steel barrier separates the high-voltage parts of the circuit breaker from the operating mechanism and control devices.

magnetic De-ion circuit interruption: The interrupter plates are of zircon ceramic refractory material. The magnetic field is of the "H" type, with the blowout coil in the center. This produces a much stronger and more uniform field than other types. The field coil is put in series with the circuit by the arc itself after it is started by the arcing contacts. This field forces the arc upward into the ceramic arc chamber. Extinction occurs due to de-ionization at the zero point of the current wave. Burning of the contacts is very low because of its rapid transfer to the arcing horns.

arc chute and blowout coil

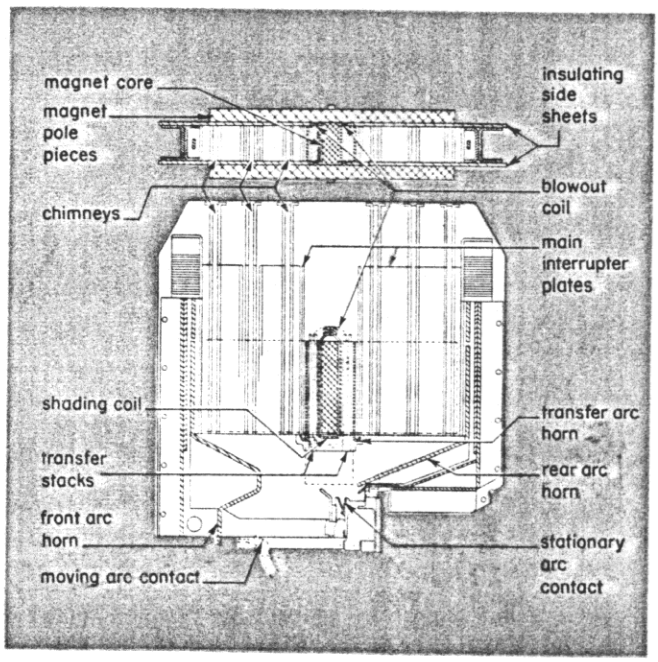


figure 43

type DH magnetic De-ion air circuit breakers

horizontal drawout
indoor and outdoor • continued

type 50-DH-350 { 350 mva interrupting capacity at 4160 volts
1200 and 3000 amperes continuous rating

The 50-DH-350 breaker in 1200 and 3000 ampere capacity was developed to meet the ever-increasing auxiliary demand in the new giant power stations. The metal-clad assembly with this breaker will also fit into the growth pattern of distribution substations.

arc interrupter

The arc interrupter is of advanced design, in which the blowout magnet and arc chute are combined in one unit. The blowout magnet is of the "H" type in which the blowout coil is in the center. Short pole faces distribute blowout flux to the ends of the arc chute. This results in a high strength, well distributed magnetic field. The shape and size of the interrupter plates is coordinated with this field for maximum interrupting ability and efficiency.

Highest quality zircon ceramic refractory is used throughout the interrupter and is the only kind of insulating material exposed directly to the arc.

This center coil "H" type magnet construction results in the most compact interrupter for its rating. It also results in maximum overall dielectric strength for its size and complies with all high potential and impulse test requirements.

The arc chutes can be tilted by a compact light-weight auxiliary device operated through the levering-in device by the regular levering-in crank, as illustrated here. This greatly facilitates inspection and is one of the features that makes Westinghouse metal-clad switchgear easy to inspect and maintain.

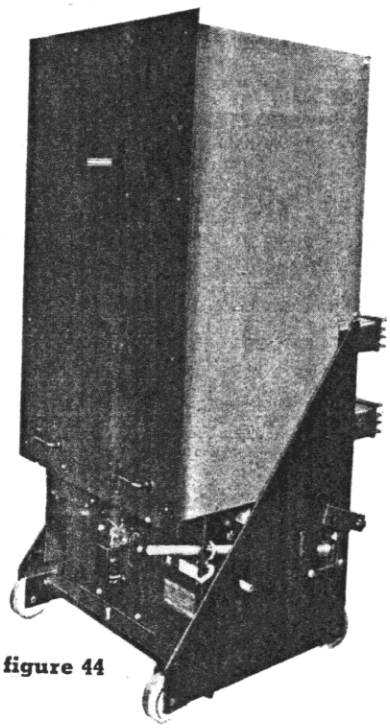


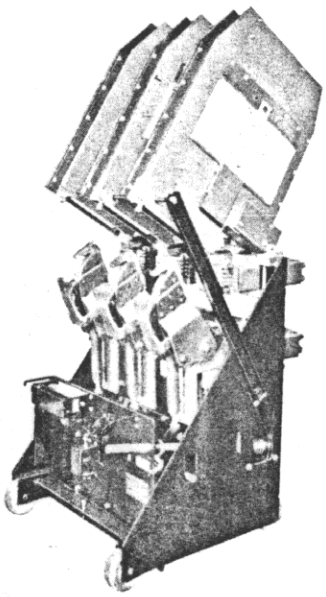
figure 44

contacts: The new breaker—types 50-DH-350 and 150-DH-1000 are both built in 1200 ampere and 3000 ampere continuous ratings, each with a momentary rating of 80,000 amperes. For this reason, the detailed design of the contacts is the same for the two breaker types.

The 3000 ampere continuous rating represents an important accomplishment in magnetic air circuit breaker contact development. This, combined with the momentary rating of 80,000 amperes places more severe duty on the contacts than those of any other magnetic air breaker ratings. These contacts are very liberally designed. Rigorous tests in the Westinghouse High Power Laboratory show that they have ample margin in closing and latching against their momentary rating.

puffer: The puffer for this breaker is of a greatly improved design. It is of the diaphragm type and consequently causes no extra friction.

front view



gure 45

rear view

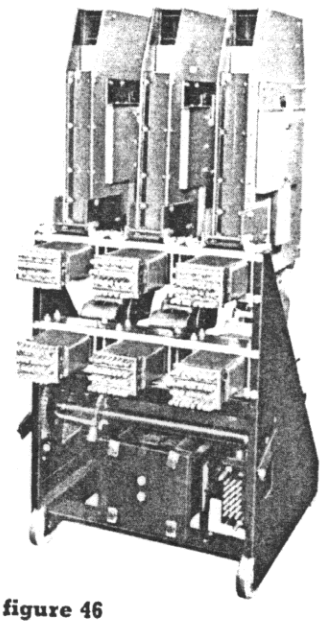


figure 46

arc chute and blowout coil

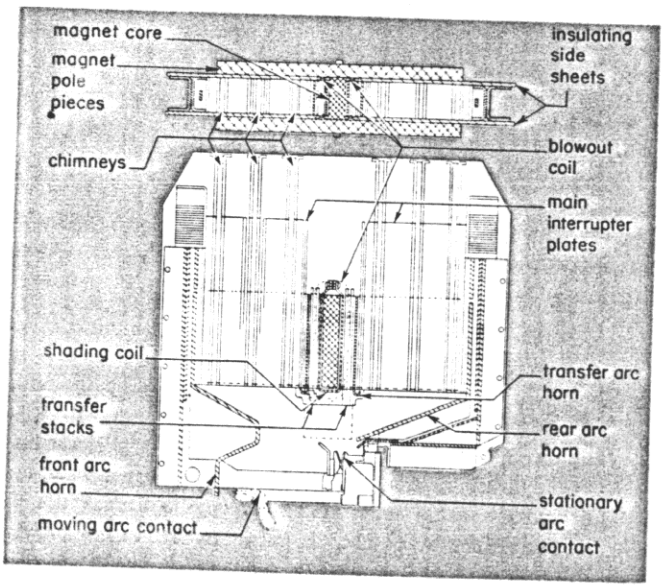


figure 47

type 75-DH-250 { 250 mva interrupting capacity at 7200 v
1200 and 2000 amperes continuous rating

with one arc chute and half of main barrier removed

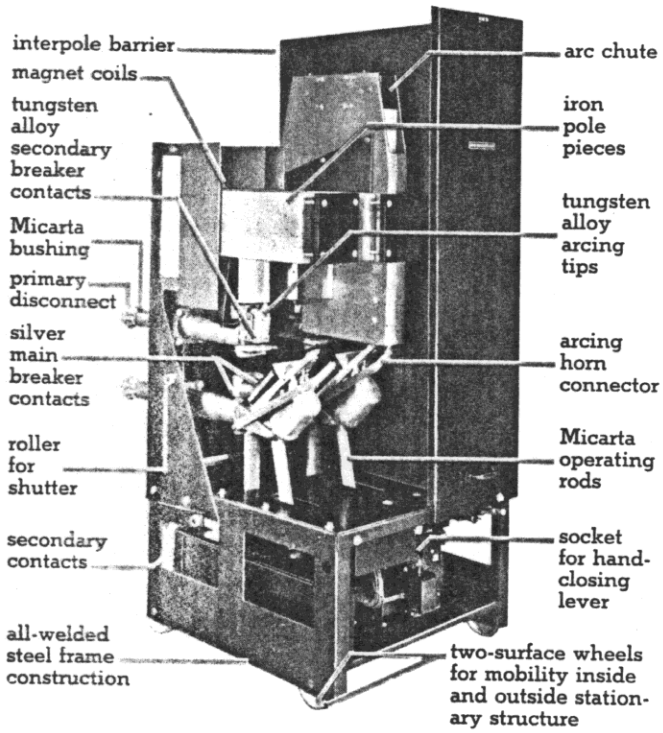


figure 48

type 75-DH-500 { 500 mva interrupting capacity at 7200 v
1200 and 2000 amperes continuous rating

with one arc chute and half of main barrier removed

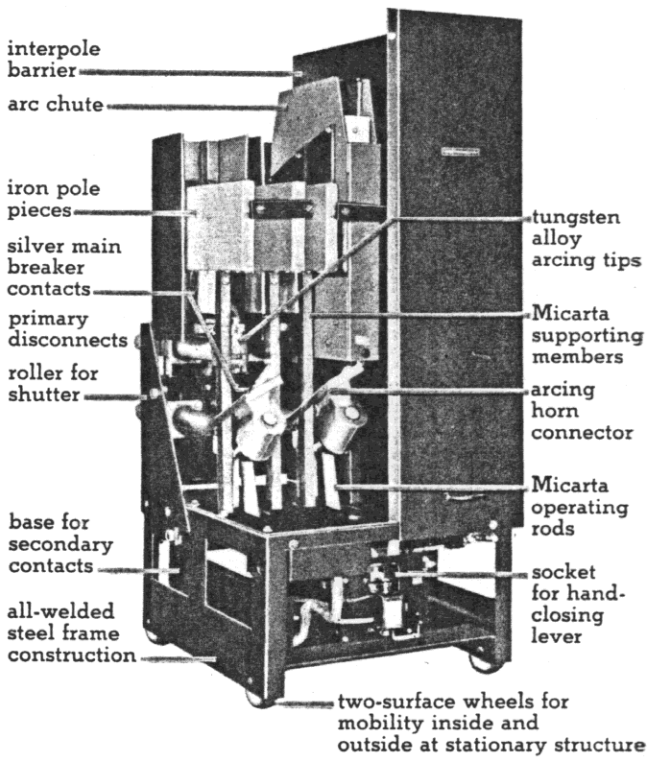


figure 49

These DH magnetic De-ion air circuit breakers are three-pole, electrically operated, and are complete with a mechanically and electrically trip-free solenoid closing mechanism, shunt trip coil, auxiliary switches, operation counter, and open-close indicator.

The circuit breaker frame is fabricated from formed steel plates electrically welded to form a support for the equipment. The frame has four wheels with needle bearings. A special flange on the wheels engages with the rails as the unit is rolled into the stationary structure. A horizontal steel barrier separates the high-voltage parts of the circuit breaker from the operating mechanism and control devices.

magnetic De-ion circuit interruption: The arc is drawn in a horizontal direction by the moving arcing contact. While the arc is being drawn it transfers from the stationary arcing contacts to an arcing horn and energizes a magnetic field between pole pieces. This field forces the arc upward into a laminated ceramic arc chamber. Extinction occurs due to de-ionization at the zero point of the current wave. Burning of the contacts is minimized during interruption of the arc because of rapid transfer from arcing contacts to arcing horns.

arc chute and blowout coil

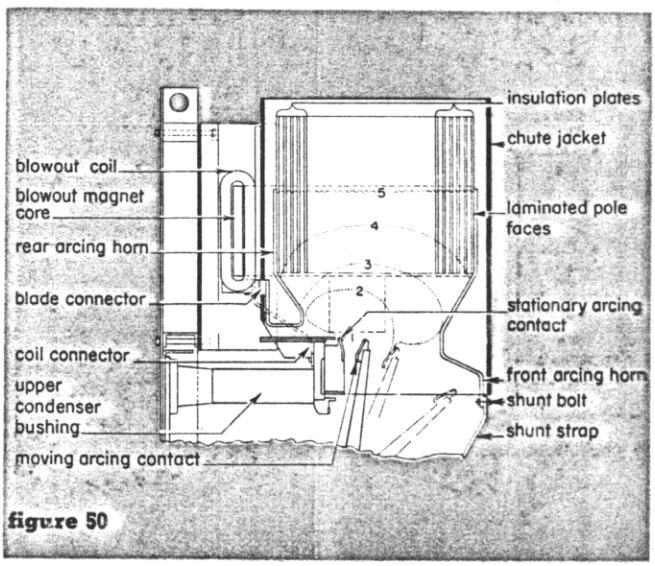


figure 50

type DH De-ion magnetic air circuit breakers

horizontal drawout
indoor and outdoor • continued

type 150-DH-150 { 150 mva interrupting capacity at 13800 volts
1200 amperes continuous rating

type 150-DH-250/500 { 250 mva interrupting capacity at 13800 volts
500 mva interrupting capacity at 13800 volts
1200 and 2000 amperes continuous rating

type 150-DH-500

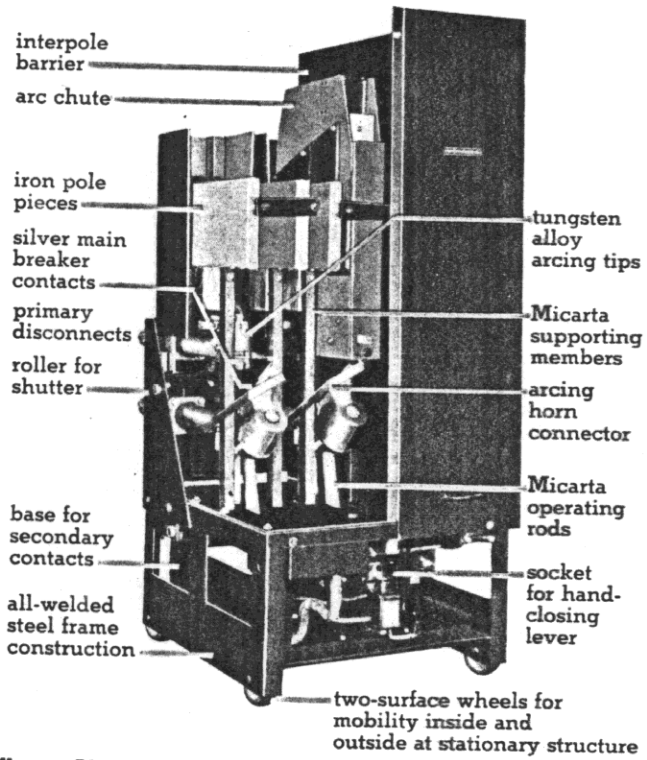


figure 51

These type DH De-ion magnetic air circuit breakers are three-pole, electrically operated, and complete with a mechanically and electrically trip-free solenoid closing mechanism, shunt trip coil, auxiliary switches, operation counter, and open-close indicator.

The circuit breaker frame is fabricated from formed steel plates electrically welded to form a support for the equipment. The frame has four wheels with needle bearings and a special flange construction which engages with the rails as the unit is rolled into the stationary structure. A horizontal steel barrier separates the high-voltage parts of the circuit breaker from the operating mechanism and control devices.

magnetic De-ion circuit interruption: The arc is drawn in a horizontal direction by the moving arcing contact. While the arc is being drawn it transfers from the stationary arcing contacts to an arcing horn and energizes a magnetic field between pole pieces. This field forces the arc upward into a laminated ceramic arc chamber. Extinction occurs due to de-ionization at the zero point of the current wave. Burning of the contacts is minimized during interruption of the arc because of rapid transfer from arcing contacts to arcing horns.

type 150-DH-150

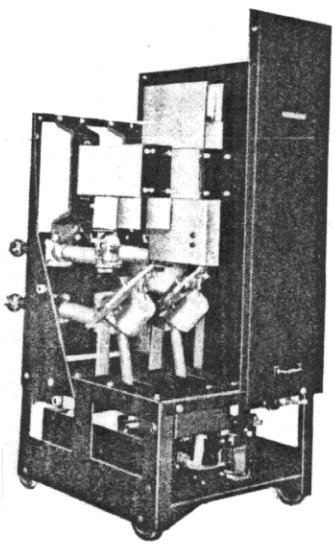


figure 52

type 150-DH-250

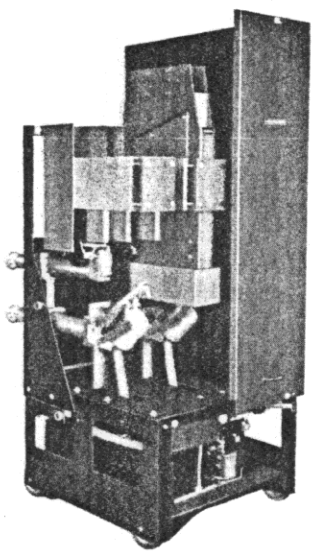


figure 53

arc chute and blowout coil

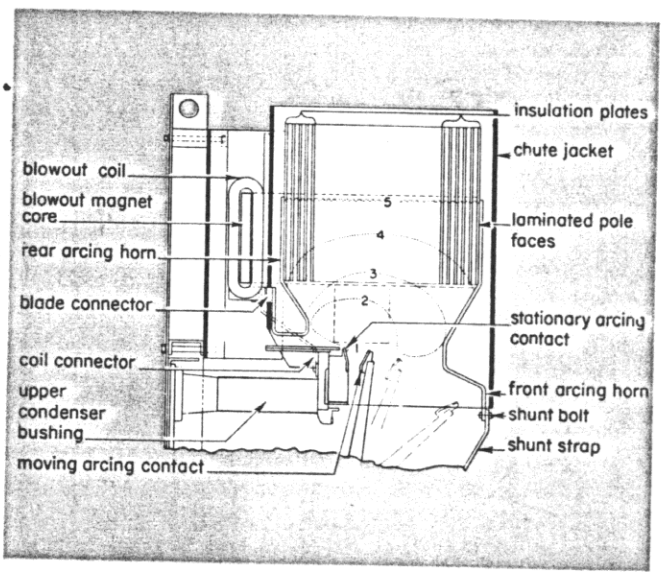


figure 54

type 150-DH-750 { 750 mva interrupting capacity at 13800 volts
1200 and 2000 amperes continuous rating

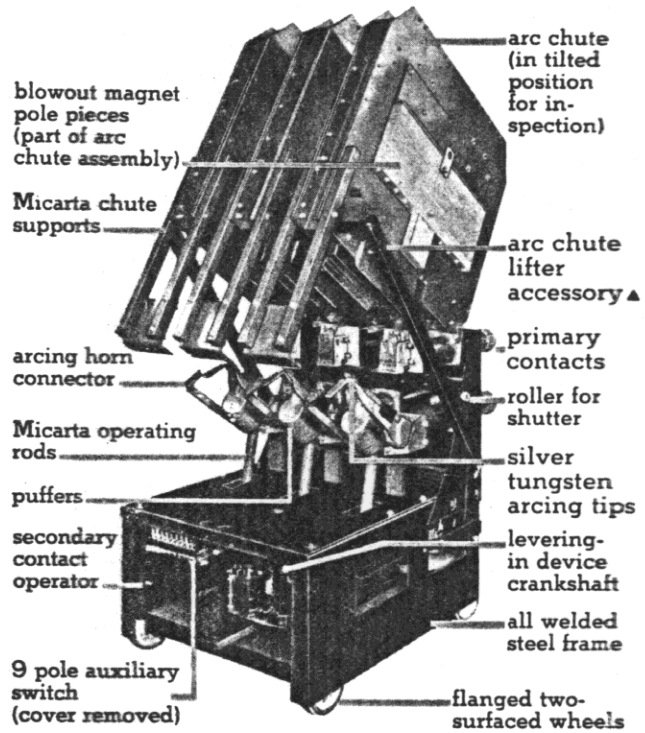
The type 150-DH-750 breaker is designed to fulfill the need in the larger metropolitan substation for a higher interrupting rating than the previous maximum of 500 mva. The increased interrupting capacity of this breaker over the previous DH standard ratings has been accomplished chiefly by new design techniques, rather than increase in size. Its ability to perform all functions within its rating has been established by complete and thorough tests.

This circuit breaker is three-pole, electrically operated, and complete with a mechanically and electrically trip-free solenoid closing mechanism, shunt trip coil, auxiliary switches, operation counter, and open-close indicator.

The breaker frame is fabricated from formed steel plates electrically welded to form a support for the equipment. The frame has four wheels with needle bearings. A special flange on the wheels engages with the rails as the unit is rolled into the stationary structure. A horizontal steel barrier separates the high-voltage parts of the circuit breaker from the operating mechanism and control devices.

magnetic De-ion circuit interruption: The interrupter plates are of zircon ceramic refractory material. The magnetic field is of the "H" type, with the blowout coil in the center. This produces a much stronger and more uniform field than other types. The field coil is put in series with the circuit by the arc itself after it is started by the arcing contacts. This field forces the arc upward into the ceramic arc chamber. Extinction occurs due to de-ionization at the zero point of the current wave. Burning of the contacts is very low because of rapid current transfer to the arcing horns.

breaker with barrier removed



▲ operated by levering-in crank

figure 55

arc chute and blowout coil

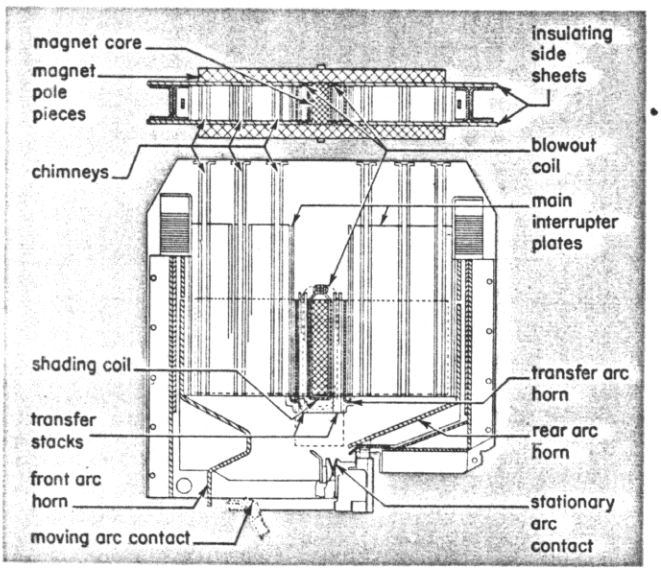


figure 56

front view—barrier in place

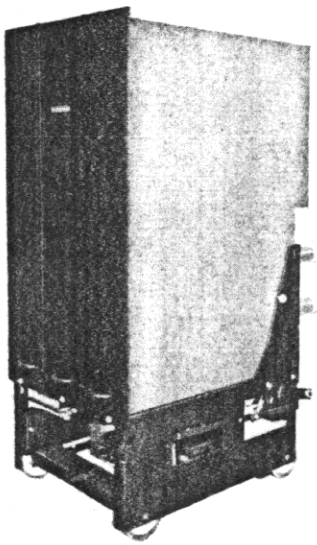


figure 57

rear view

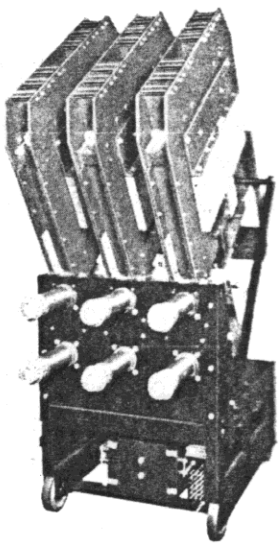


figure 58

type DH magnetic De-ion air circuit breakers

horizontal drawout
indoor and outdoor • continued

type 150-DH-1000 { 1000 mva interrupting capacity at 13800 volts
1200 and 3000 amperes continuous rating

The 1000 mva, 13.8 kv magnetic De-ion air circuit breaker is the highest rated breaker of the magnetic type breaker so far developed.

The development of the 1000 mva magnetic air circuit breaker permits the economy of metal-clad switchgear in the largest distribution substations. Its development has been justified by the factors of basic economy and desirable operating features of the magnetic type air breaker. A related condition is the continued load growth in urban cities requiring more and larger 13.8 kv primary distribution substations.

contacts: The new breaker types 150-DH-1000 and 50-DH-350 are both built in 1200 ampere and 3000 ampere continuous ratings, each with a momentary rating of 80,000 amperes. For this reason, the detailed design of the contacts is the same for the two breaker types.

The 3000 ampere continuous rating represents a most distinctive accomplishment in magnetic air circuit breaker contact development. This, combined with the momentary rating of 80,000 amperes places more severe duty on the contacts than those of any other magnetic air breaker ratings. These contacts are very liberally designed. Rigorous tests in our high power laboratory show that they have ample margin in closing and latching against their momentary rating.

puffer: The puffer for this breaker is of a greatly advanced design. It is the diaphragm type and consequently causes no extra friction.

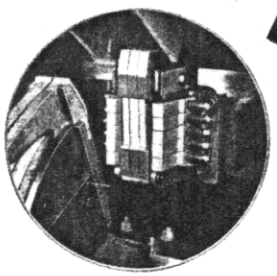


figure 59

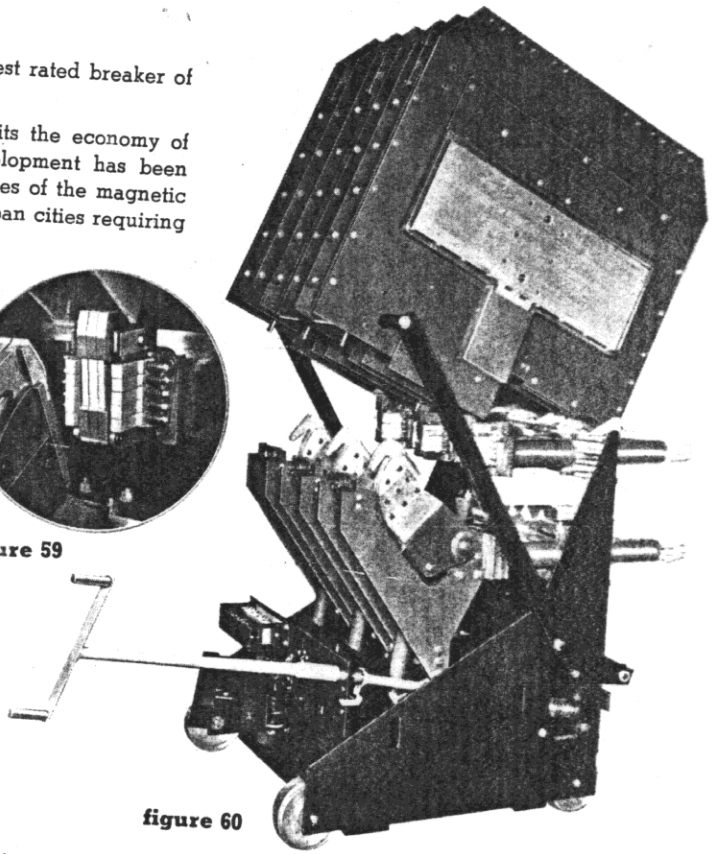


figure 60

Front view with barriers removed showing arc chutes tilted with levering device. Affords easy accessibility of contacts and other parts for inspection.
Closeup view at left shows moving and stationary contacts (fig. 59).

front view
Front view of completely assembled 150-DH-1000 breaker

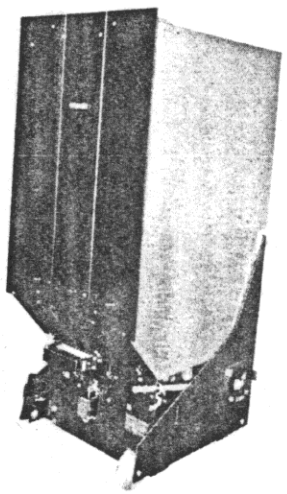


figure 61

rear view
Rear view showing 18-point secondary contact and levering-in device arrangement.

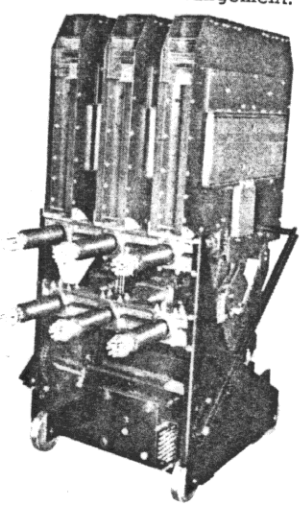


figure 62

arc chute and blowout coil

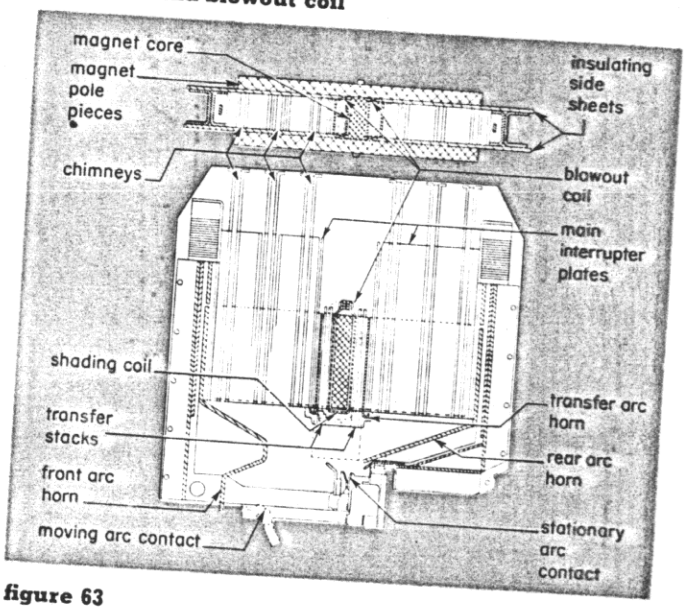


figure 63

devices and accessories indoor and outdoor

grounding and test devices

These devices are designed for insertion into the metal-clad switchgear unit housing to provide a convenient means (a) to ground the circuit for maintenance work; (b) to apply potential for cable testing; and (c) to furnish access both to bus and line circuits for "phasing-out" tests.

standard grounding and test device: The standard grounding and test device facilitates making cable connection to the primary stationary contacts by inserting the device in place of the drawout type air circuit breaker.

complete grounding and test device: The complete grounding and test device provides as many interlocks and safety features as possible for the personnel performing any of the three operations mentioned above. The solenoid closing mechanism for the grounding switch is the same as used in the type DH circuit breaker and is capable of applying the ground against a "live" circuit if operational errors have not cleared the circuit. In such case the relaying at source of power is expected to clear the circuit as this device has no interrupting ability.

stored-energy mechanism permits manual closing

The Westinghouse spring-operated mechanism for hand-closing type DH breakers makes manual operation safe. Actuated by a pushbutton, it closes the breaker with sufficient speed and force to overcome magnetic effects of short-circuit currents. The breaker can be closed and tripped with the housing door closed and the operator has a visual indication of the breaker position.

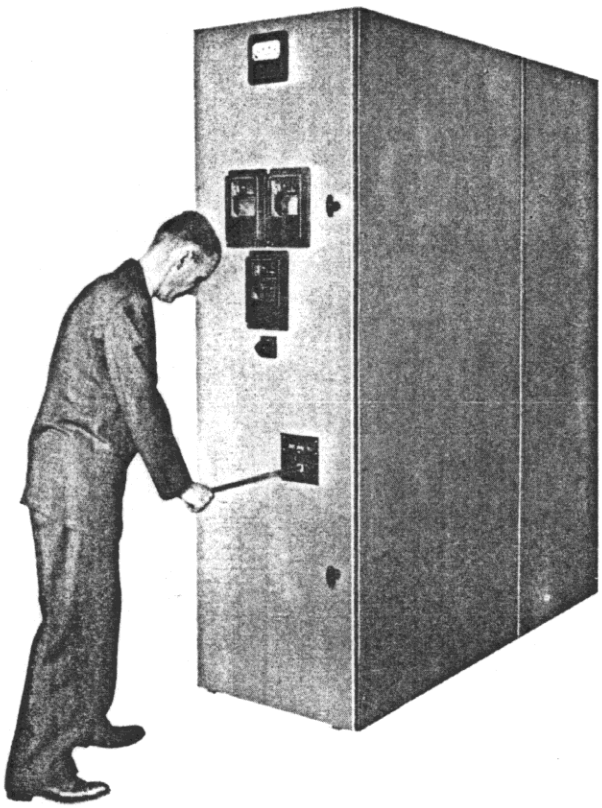
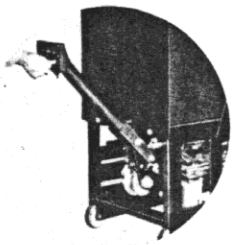
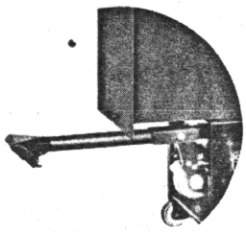


figure 64

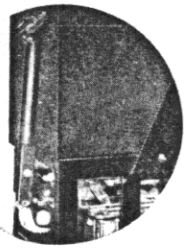
operating position



control post down



control post up



standard device

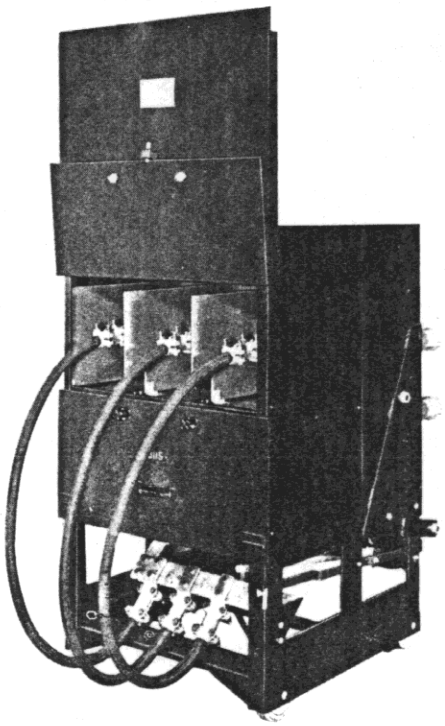


figure 65

complete device

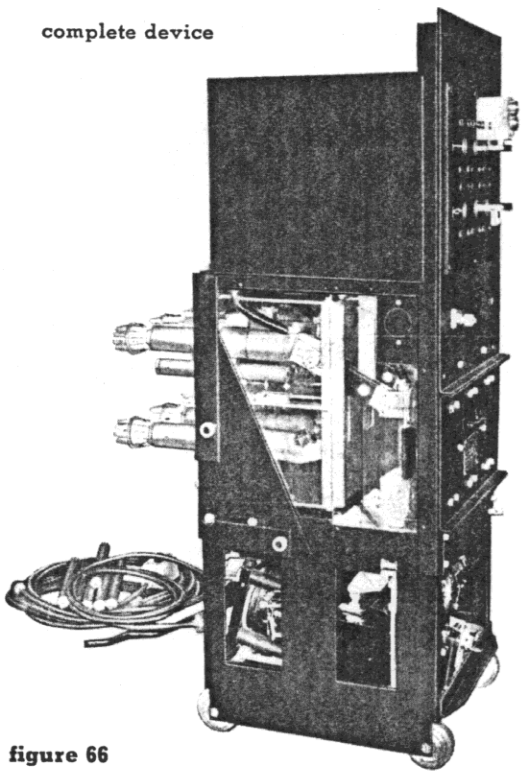


figure 66

devices and accessories indoor and outdoor

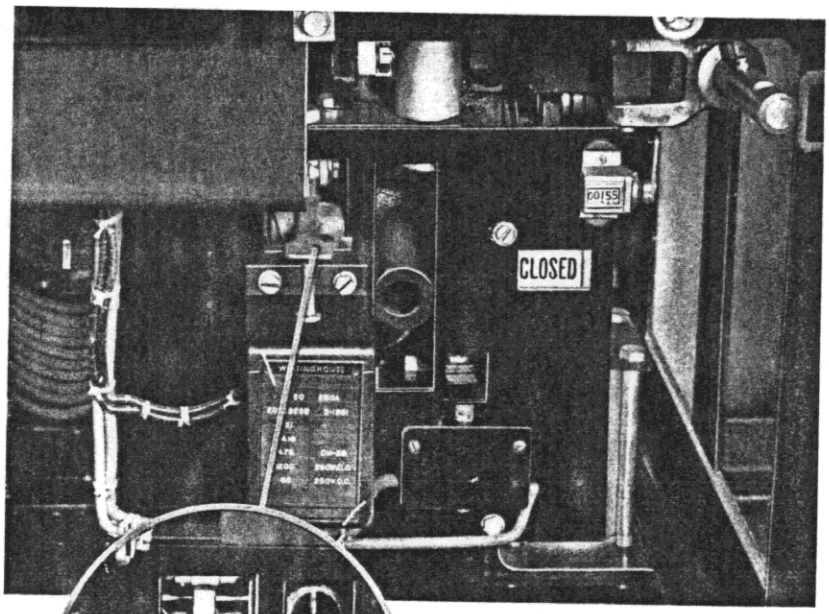
positive interlocking devices • *assure greater safety*

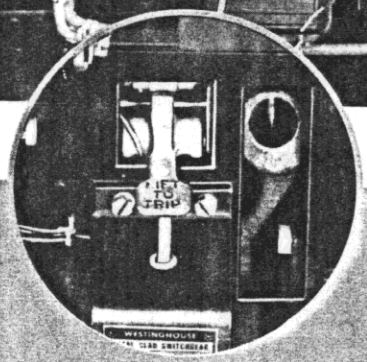
The Westinghouse standardized design makes full use of the interlocking devices developed and field-tested in all types of metal-clad installations. All interlocks are simple. A minimum of working parts assures positive trouble-free operation.

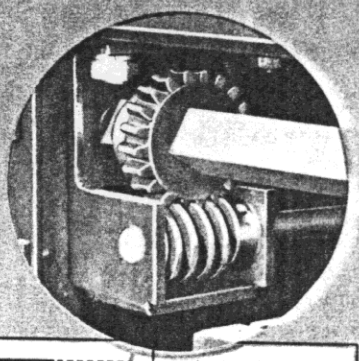
All these safety features are standard equipment in Westinghouse metal-clad switchgear.

Positive crank motion brings breaker from test to operating position. Since breaker motion is horizontal, crank is turned quickly and easily.

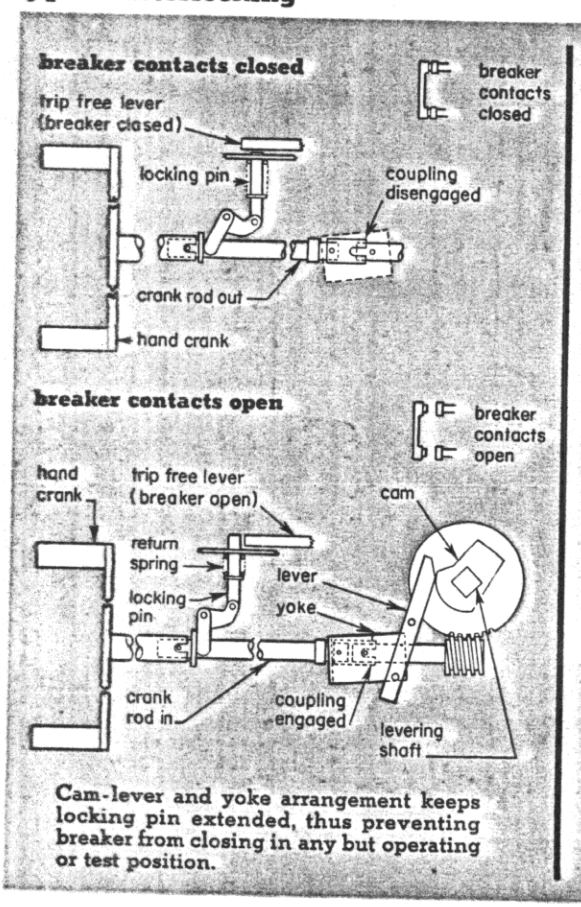
Trip lever opens breaker. Breaker must be open before it can be cranked. If breaker is closed, the trip-free linkage prevents engagement of crank linkage. When breaker is being cranked, or between test and operating positions, shear pin action with solenoid linkage prevents closing the breaker. Operation is positive.







typical interlocking



Cam-lever and yoke arrangement keeps locking pin extended, thus preventing breaker from closing in any but operating or test position.

positive crank action

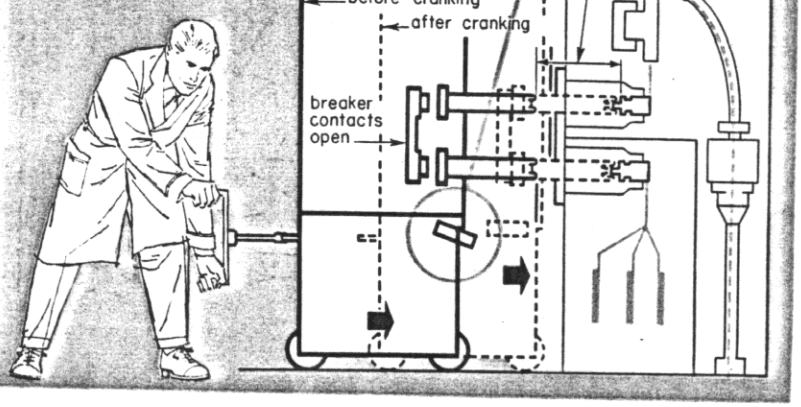


figure 67

alignment fixtures

A system of rigid double checking during the assembly of Westinghouse metal-clad switchgear assures removable elements that fit into any stationary structure of like rating.

This perfect alignment is accomplished: first, by fitting all removable elements to a master stationary structure in the assembly section; second, by matching all stationary structures to a master, precision-built, removable element in assembly operations. The result is positive alignment of rails and wheels; main, auxiliary and ground contacts; shutter and main levering-in device. It eliminates the necessity for fitting on the job . . . provides simple interchangeability of breakers when the switchgear is in service

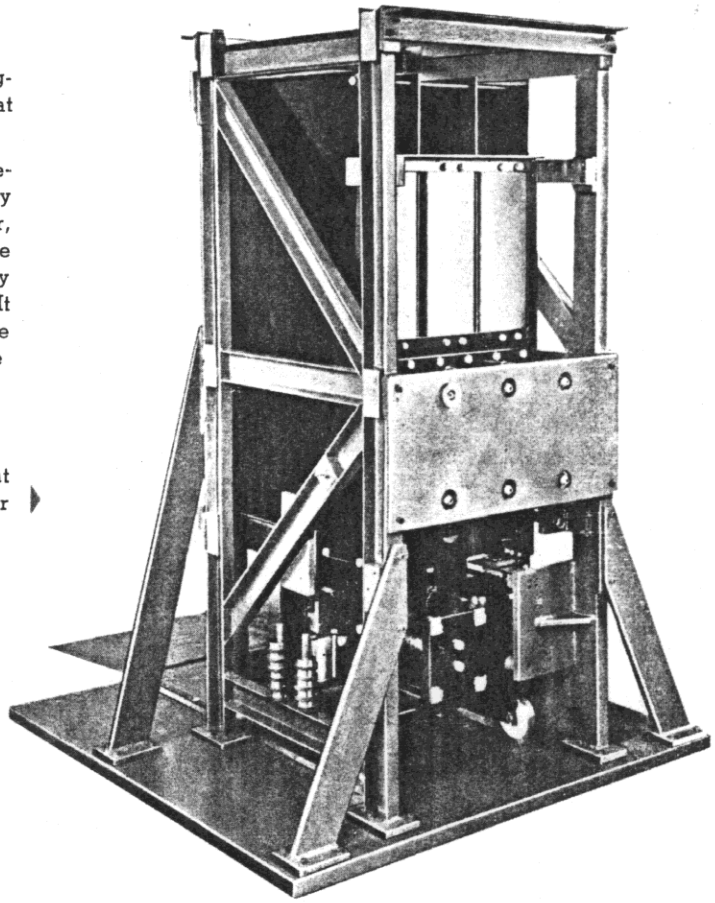


figure 68. Every removable element must fit exactly into a master switchgear stationary structure.

jig welding

Jig welding assures interchangeability of standard units. Groups of units may be disassembled, rearranged and new groups added with no additional expense incurred in matching up mounting dimensions. Outline and mounting dimensions are held to close tolerances.

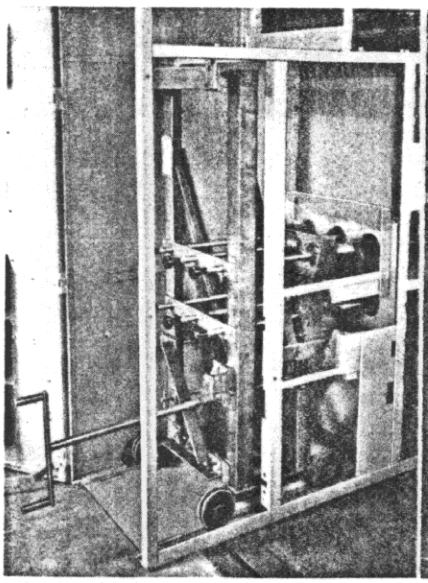


figure 69. Every stationary structure is checked for alignment with a master removable element.

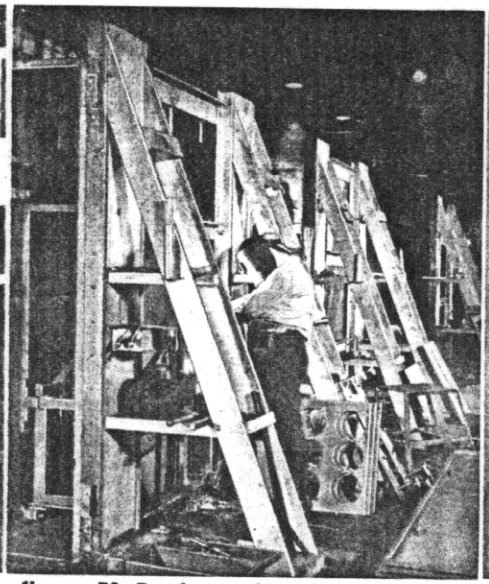


figure 70. Rigid, upright welding fixtures assure uniform, plumb and square stationary structures.

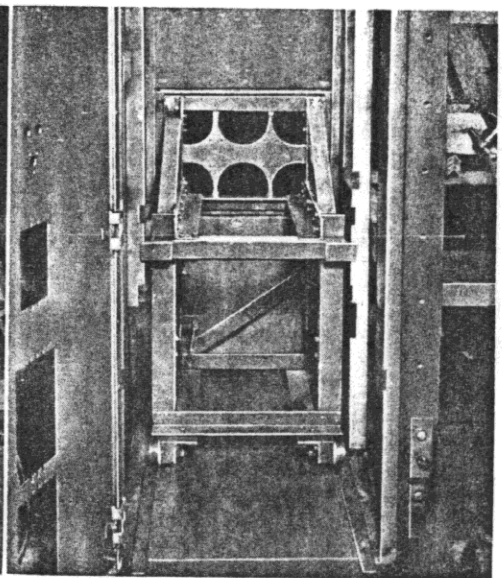


figure 71. Assembly jig fixture assures accurate location of breaker rails to main contacts, secondary contacts, ground contact, stops and levering-in mechanism for interchangeable breaker units.

positive grounding . . . safer testing

positive grounding

Ground bus connects to all breakers and stationary units. This ground bus will have a momentary rating at least equal to the highest momentary rating of any circuit breaker in the assembly. It makes positive contact with all breaker units through heavy multiple finger contacts as illustrated at the right. The breaker frame is effectively grounded before the primary contacts engage.

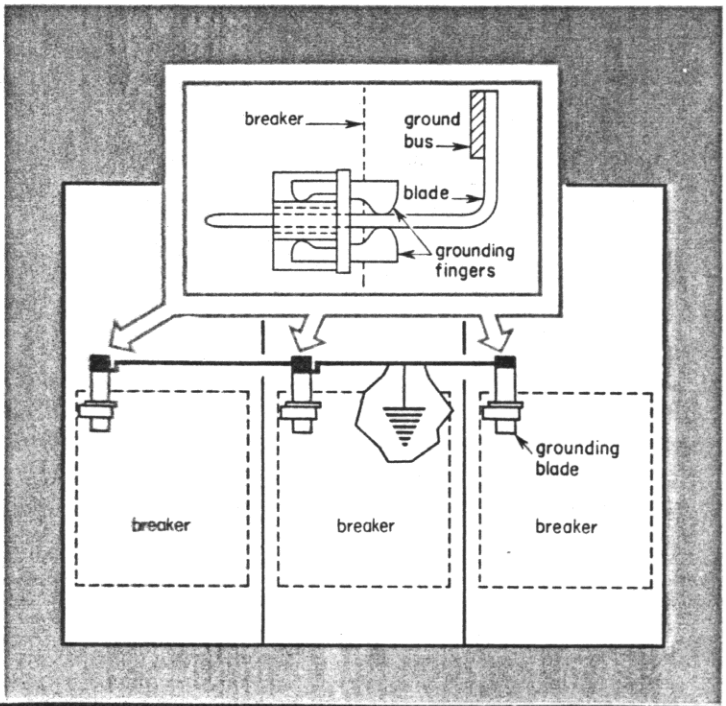
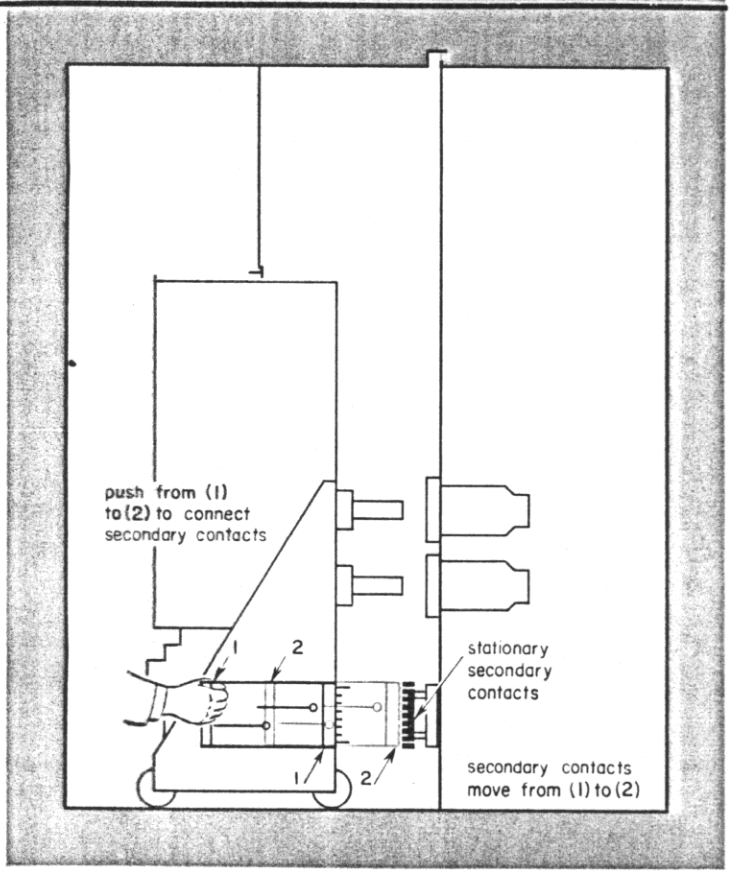


figure 72

safer testing

Breaker in "test" position . . . by engagement of secondary contacts, breaker can be tested. No jumpers are needed. Manually operated, extendable secondary contact assembly is mounted on the breaker. This assembly is normally keyed in the operating position.

figure 73



position 1

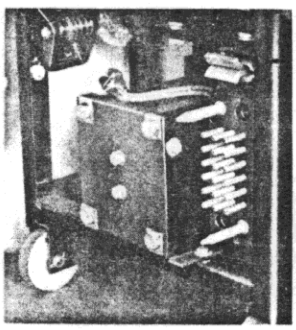


figure 74

position 2

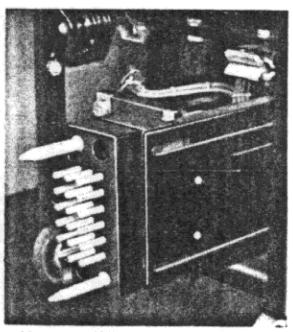


figure 75

complete isolation of live parts

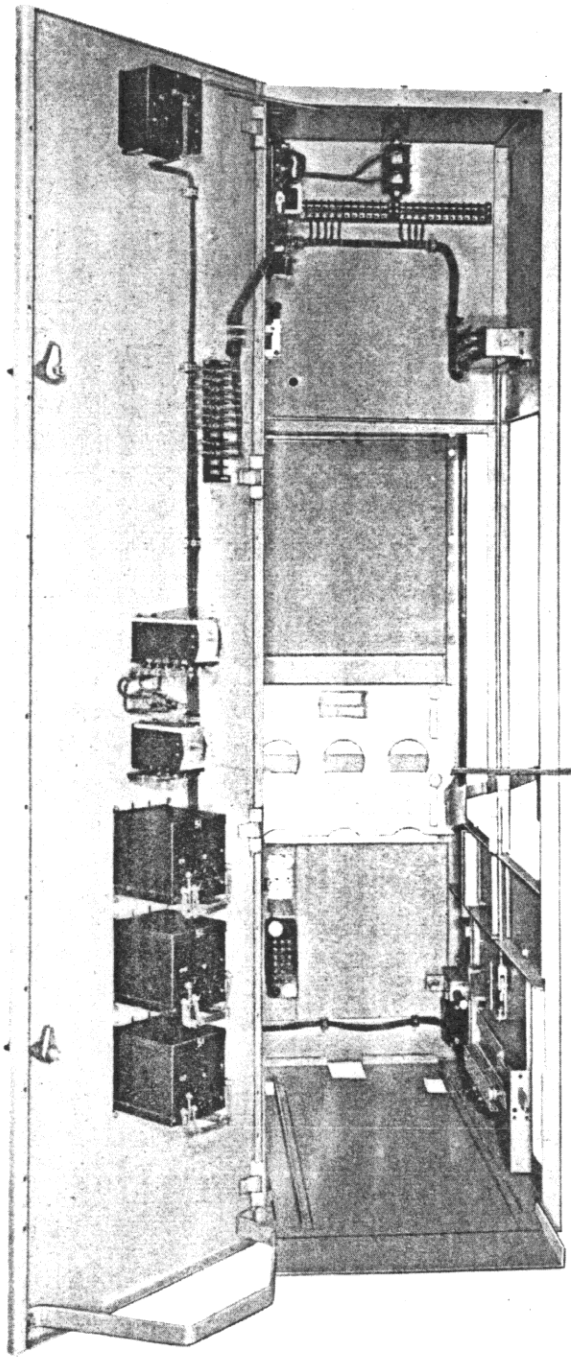


figure 76. Shutter closed—live stationary contacts in the breaker cell are covered.

A ⅛-inch thick metal shutter, closed by gravity, positively prevents accidental entry to live stationary contacts. The shutter drops automatically when the breaker is removed. Shutter is closed in test position and is raised automatically as the breaker advances to operating position. The shutter is a simple mechanical device requiring no maintenance.

how shutter works

Before the breaker is removed, shutter supporting frame rests on breaker frame. As breaker is withdrawn, shutter is closed. When breaker is advanced from test to operating position, rollers passing along shutter cams raise the shutter to clear the contacts.

shutter closed

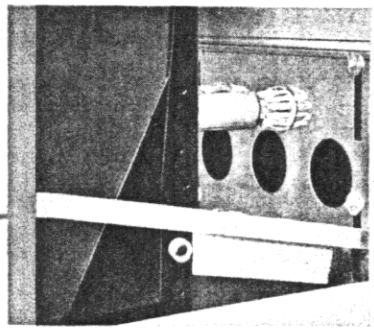


figure 77. Shutter still closed—breaker in test position, with cam about to raise shutter.

shutter open

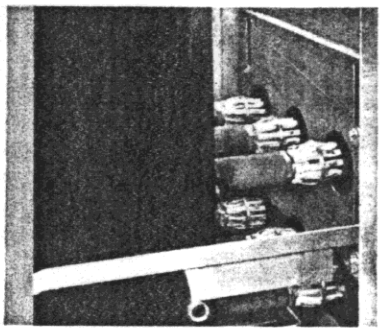


figure 78. Shutter open—stationary contacts cleared for entry of breaker contacts.

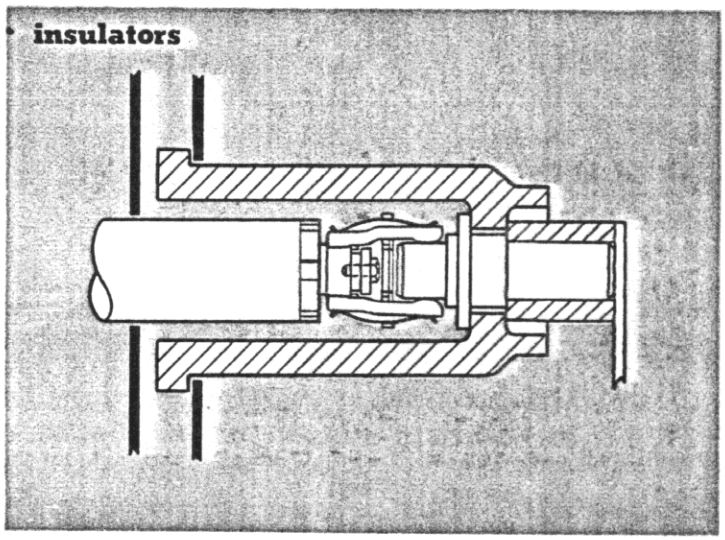


figure 79. Moldarta or porcelain insulators enclose primary disconnects and isolate them from each other.

devices and accessories indoor and outdoor

ventilation • insulation • wiring • devices • relays • instrumentation • switches

insulation

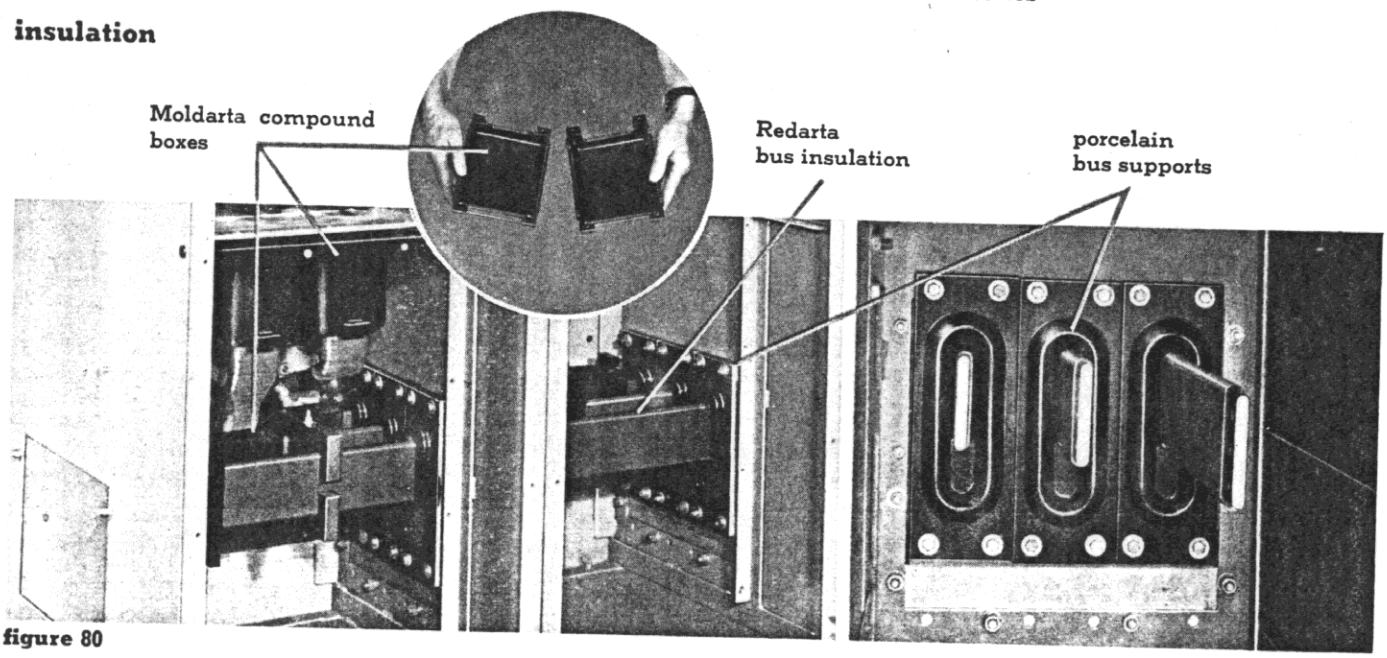


figure 80

standardized wiring

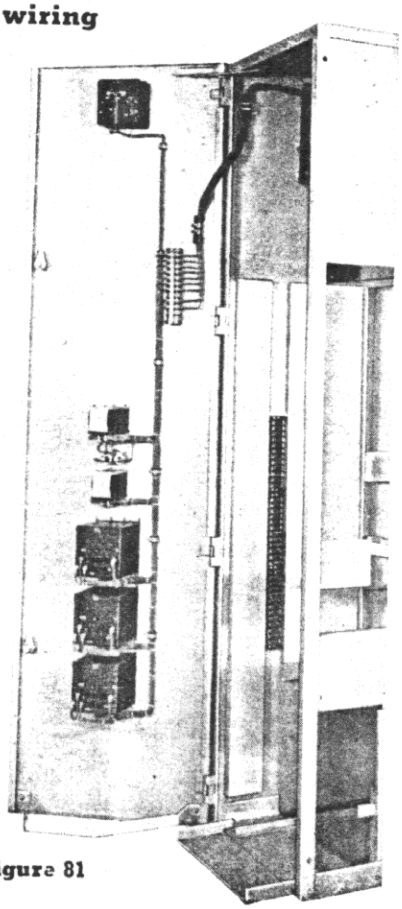


figure 81

Buses completely insulated with compound-filled Moldarta boxes at joints, preformed Micarta tubes on straight portions and varnished cambric insulating tape at bends. Buses have half rounded edges to eliminate corner voltage stress. Contact surfaces are silvered and tightly bolted.

Close-fitting porcelain bus supports prevent gas migration between compartments . . . another aid in localizing any possible disturbances. Buses are completely insulated.

Standardized wiring practice illustrated in typical panel wiring, cabled hinge loop, molded terminal blocks and rubber-lined wire cable clamp devices permit simplified, quality wiring procedures.

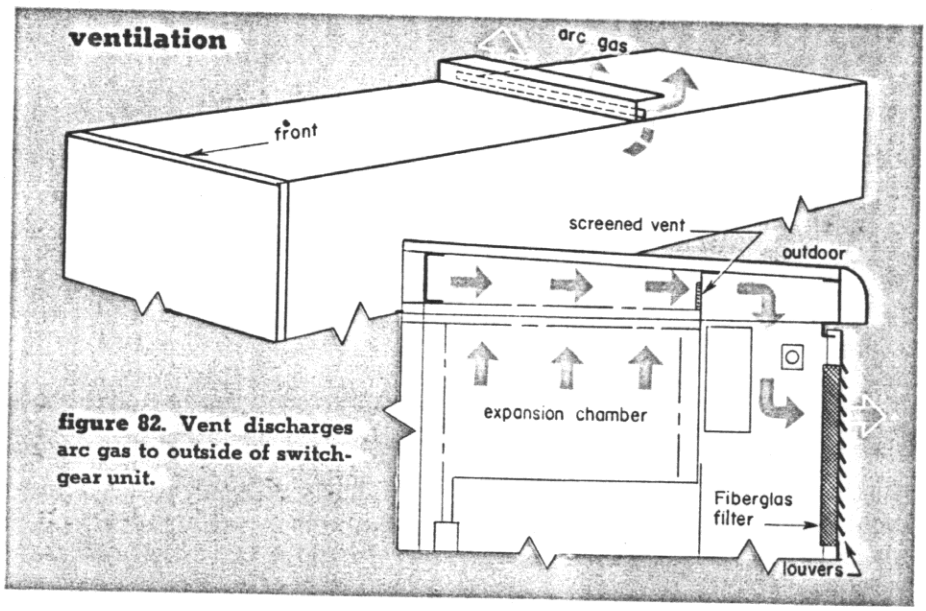


figure 82. Vent discharges arc gas to outside of switchgear unit.

devices

a-c
test cabinet

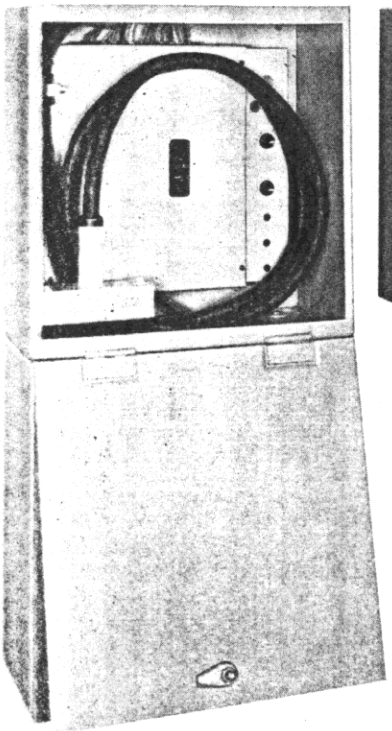


figure 83

d-c
test cabinet

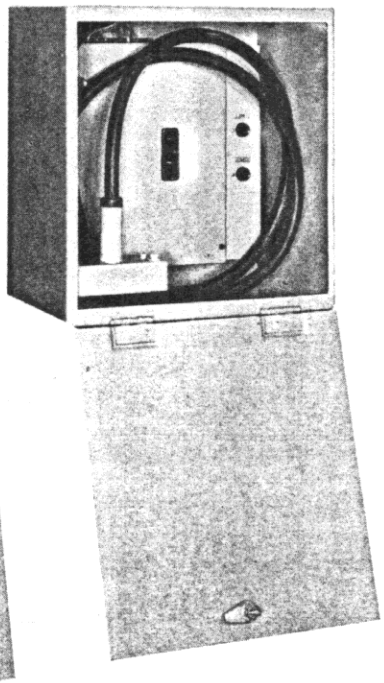


figure 84

relays • Flexitest

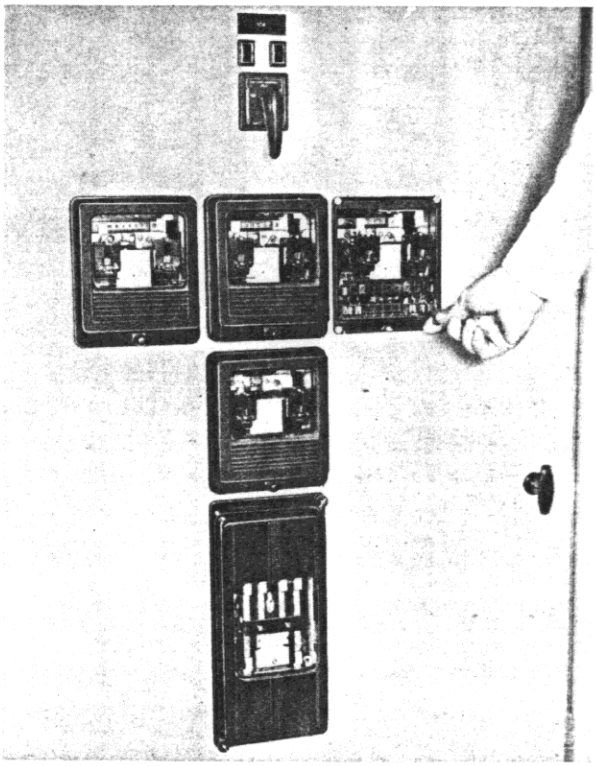


figure 85. Flexitest relays and watthour meters simplify testing, save space and improve appearance. Built-in test switches permit use of either test plug or spring clip leads.

instrumentation and switches

control switches

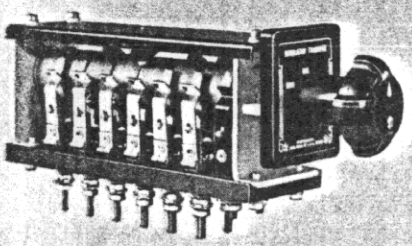
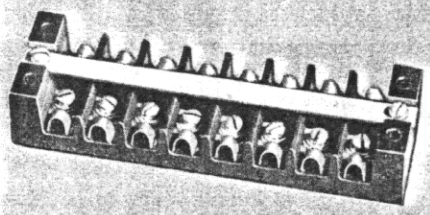


figure 86. Silver-plated contacts on instrument and control switches resist corrosion and give smooth, long-life rotary operation. Wiping action keeps contacts clean.

terminal blocks

figure 87. Sturdy terminal block has solderless connectors with reversible marking strip.



indicating lamps

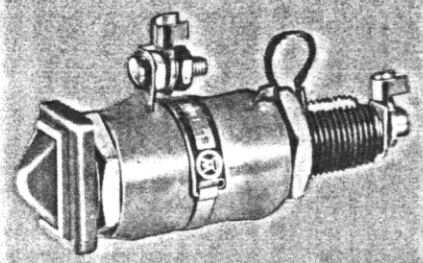


figure 88. Wide-angle indicating lamp is visible from all directions in front of switchgear. New low-drain bulb consumes minimum power, extends into lens for highest visibility.

metal-enclosed group phase bus

indoor
metal-clad type

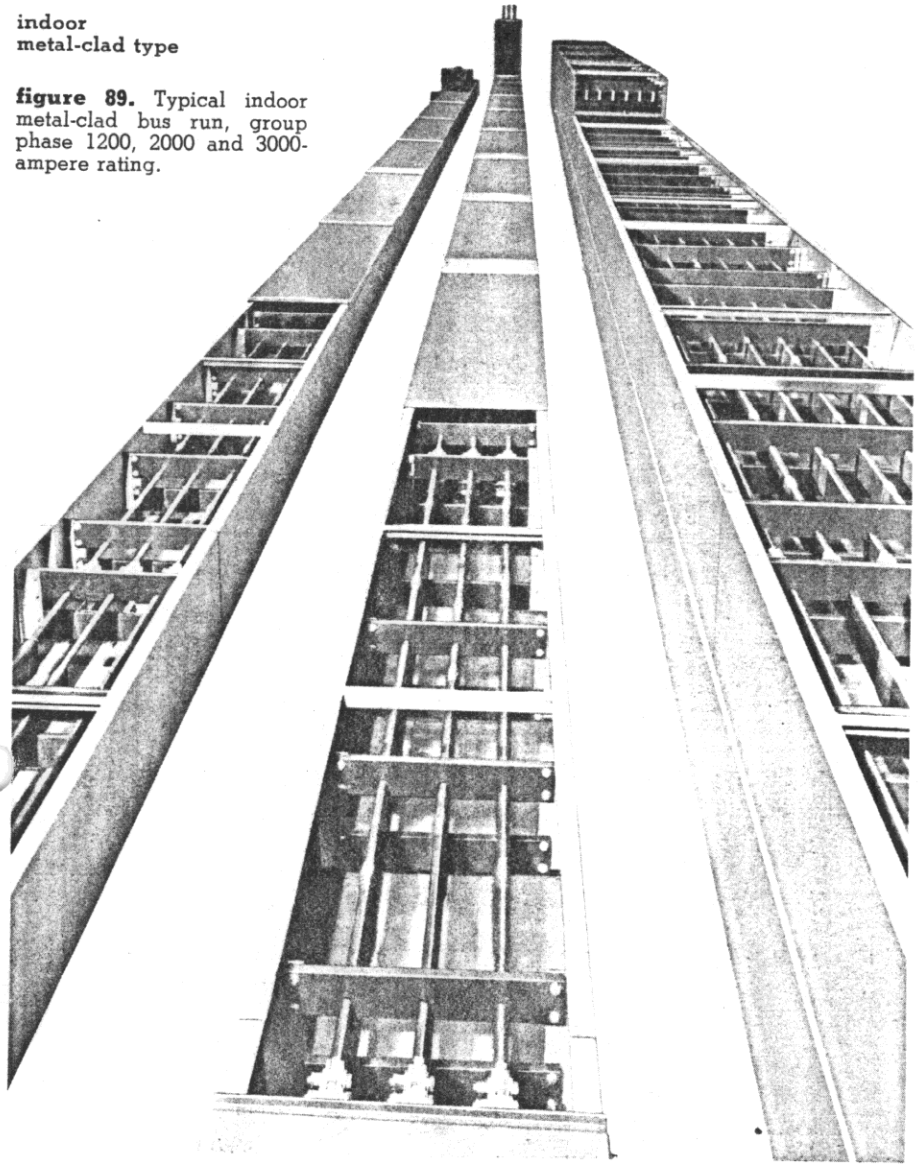


figure 89. Typical indoor metal-clad bus run, group phase 1200, 2000 and 3000-ampere rating.

Standard group phase main bus assemblies are made in either 1200, 2000 or 3000-ampere capacity with insulation and overall dimensions as required for either 4160 or 13800 volt applications.

Group phase main bus assemblies are recommended for connection ties between groups of metal-clad switchgear; also for connecting power transformers, generators and synchronizing buses to metal-clad switchgear.

These bus assemblies are completely metal-enclosed. The main bus is insulated copper or aluminum-mounted on insulated supports at such intervals to insure adequate mechanical strength to withstand forces due to fault conditions. Isolation plates may be installed in the bus run to provide temperature barriers between indoor and outdoor sections or fire walls between vaults or rooms.

bus joints

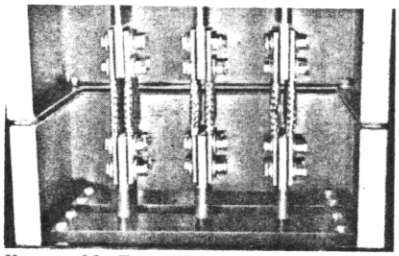


figure 90. Typical bus expansion joint construction—requires tape insulation to complete assembly.

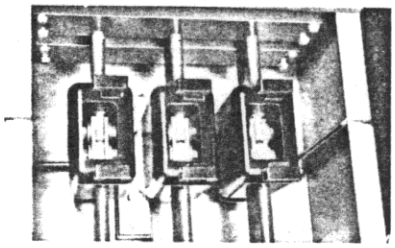


figure 91. Typical bus joint prior to filling with compound.

outdoor
metal-clad type

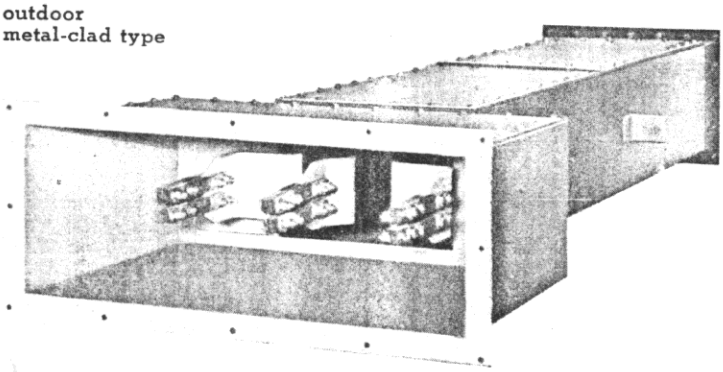


figure 92. Power transformer 2000-ampere bus connection compartment.

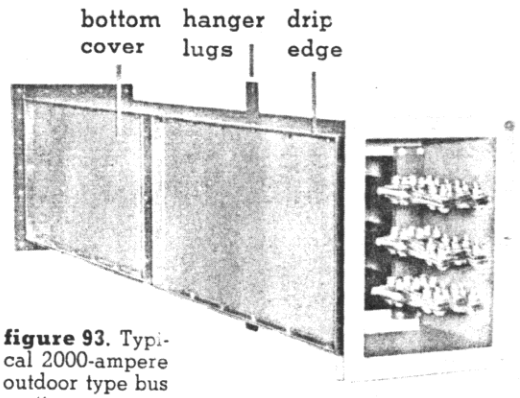


figure 93. Typical 2000-ampere outdoor type bus section.

finishes

coordination of surface treatments and plastic coating indoor and outdoor

Surface treatments and finishes for metal-clad switchgear provide protection against rust and corrosion, superior finished appearance, and surface protection during assembly, shipment and installation. Five processes bring these results . . .

1. Bonderizing

Bonderizing of switchgear metal enclosure provides a tough surface coating which protects against rust and corrosion. After welding is completed, the units are completely immersed in tanks of cleaning, Bonderizing and rinsing fluids to protect against rust and to improve the appearance of the finish.

2. prime painting

Immediately after Bonderizing, the metal structure is sprayed with a prime coat of paint to seal and preserve the full effects of the Bonderizing treatment. This provides an ideal base for final finish painting.

3. finish painting

After prime painting and drying, the units are transferred to the assembly section for finish painting in air-cleaned spray booths. This provides the finish painting with an attractive appearance and a base that affords long life under the switchgear's operating conditions.

Standard finish for indoor switchgear is light gray ASA #61 Munsell notation 8.3 G 6.1 /0.54. Outdoor switchgear is dark gray ASA #24 Munsell notation 10B 2.4/1.18.

4. plastic coating

After finish painting, the instrument panels receive a plastic coating which is sprayed onto the surface in liquid form. This protects the finished painted surface from dust, dirt and grease smudges during final assembly and through customer installation.

5. plastic coating removal after installation

After the switchgear is installed, the plastic coating is easily peeled off, as illustrated here, to present the clean, unmarred painted surface in the customer's plant.

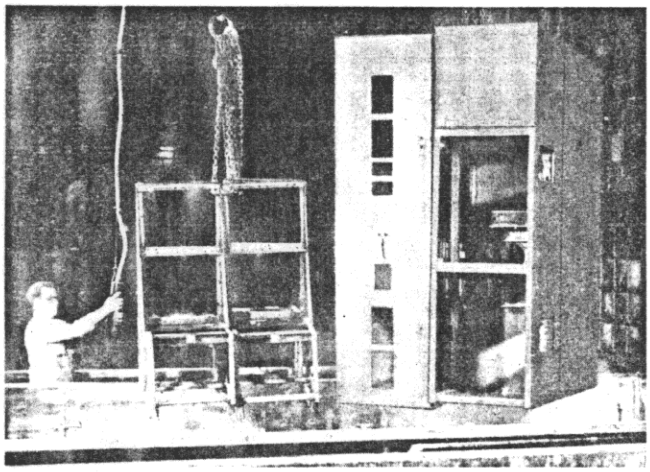


figure 94. Bonderizing.

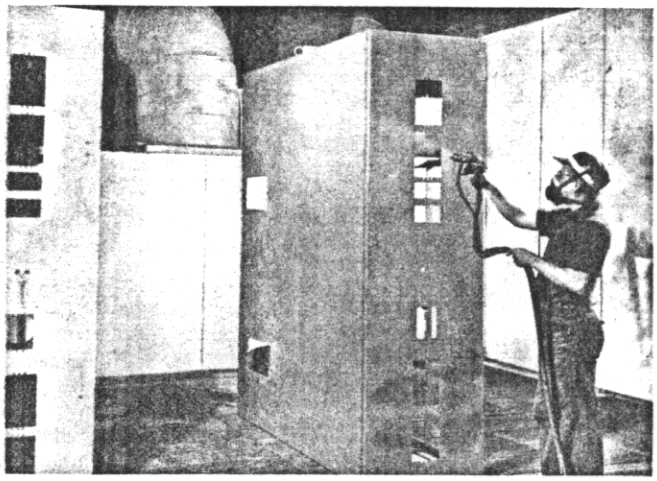


figure 95. Prime painting.

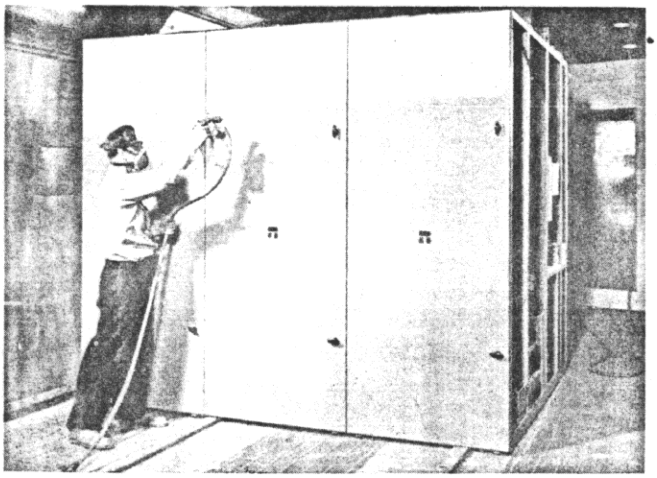


figure 96. Plastic coating being sprayed over finished painting surface.

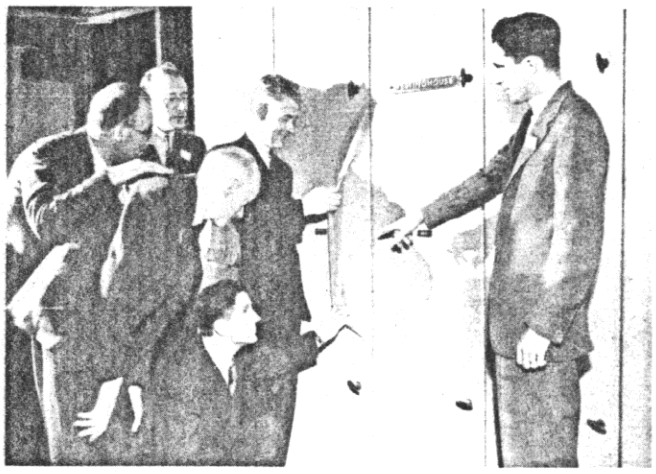
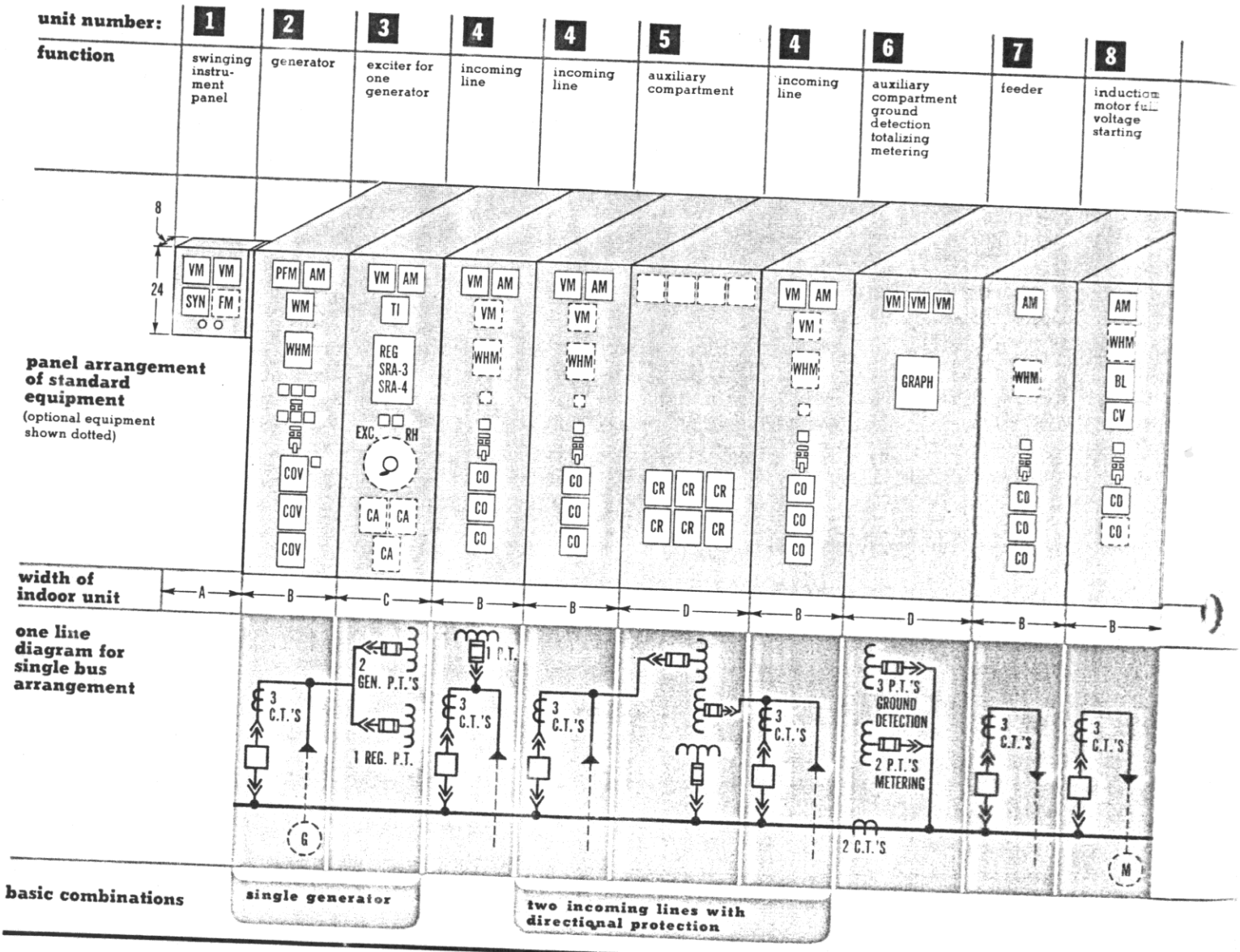


figure 97. After the switchgear installation, plastic coating is easily peeled off the clean, painted surface.

selector guide of standardized units

indoor • to meet normal requirements



typical switchgear combinations

1. required: Standardized switchgear for control of a single generator with exciter, synchronizing equipment, and three feeder circuits.

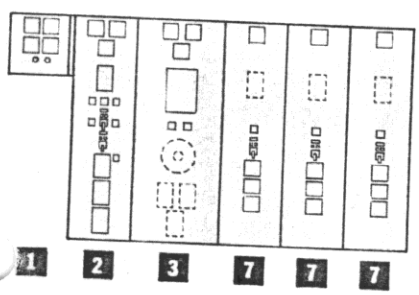
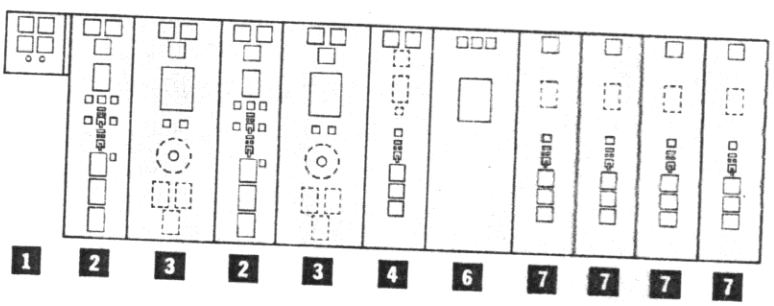


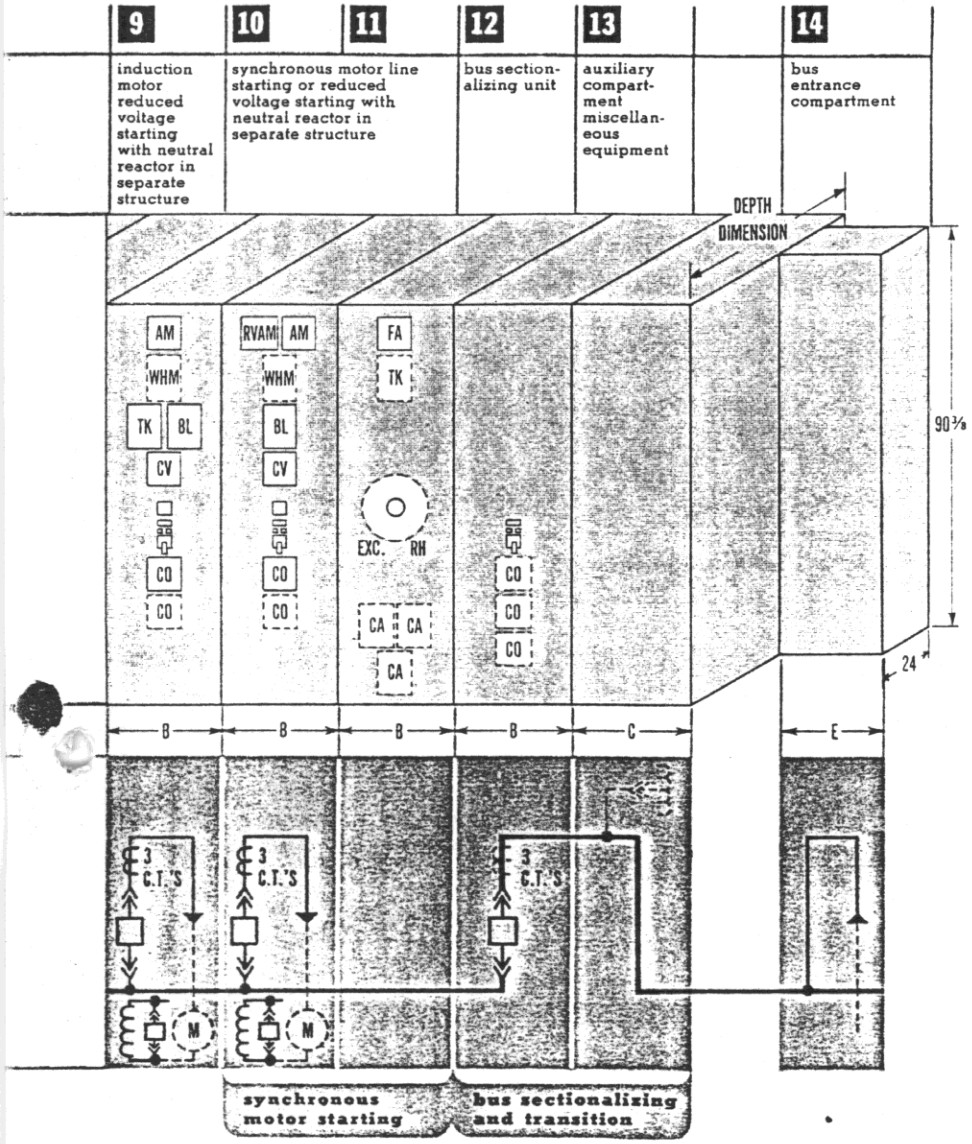
figure 98

2. required: Standardized switchgear for control of parallel generators, with exciters, ground detectors, synchronizing equipment, one incoming line, and four feeders. This becomes a group made up of the following basic units:



for outdoor metal-clad switchgear detailed dimensions, see pages 16 and 17.

From these 14 units, select the basic combinations to meet specific applications. For detailed unit arrangements, see pages 8 to 11.



symbols

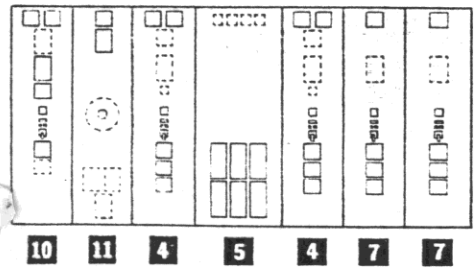
Am	ammeter
BL	thermal overload relay
CA	ratio differential relay
CO	overcurrent induction relay
CV	undervoltage induction relay
CR	reverse current relay
FA	field ammeter
FM	frequency meter
graph	graphic instruments
PFM	power factor meter
Reg	regulator
RH	rheostat
RVAM	reactive volt-ampere meter
SYN	synchroscope
TI	temperature indicator
TK	timing relay
Vm	voltmeter
Wm	wattmeter
WL	auxiliary tripping relay
WHM	watthour meter

width of indoor units: inches

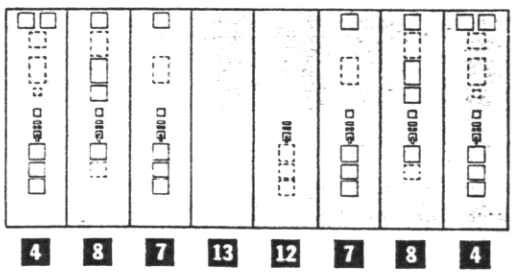
code	breaker type		
	50-DH-75 1200a	50-DH-150 50-DH-250 ♦1200-▲2000a 50-DH-350 +1200-+3000a	75-DH-250 75-DH-500 1200-2000a 150-DH-150 1200a 150-DH-250 150-DH-500 150-DH-750 1200-2000a 150-DH-1000 1200-3000a
A	21½	21½	21½
B	20	♦26 ▲36 +36	36
C	26 or 36	26 or 36	36
D	36	36	36
E	20	20	24

Depth dimension—see table on page 8.

3. required: Standardized switchgear for starting a synchronous motor, for control of two incoming lines with directional protection, and two feeders.



4. required: Standardized switchgear for a substation with two incoming lines, two induction motor circuits, two feeders and bus sectionalizing equipment.



application data indoor and outdoor

table a: available breaker types

air circuit breaker type	3-phase interrupting rating mva	voltage ratings			current ratings in amperes			interrupting rating—amperes		60 cycles test for one minute kv	impulse rating open or closed gap kv
		rated kv	max design kv	min kv for rated int mva	continuous 60 cy	short time momentary	4 second	at rated voltage	max amperes		
50-DH-75	75	4.16	4.76	3.5	1200	20,000	12,500	10,400	12,500	19	60
50-DH-150	150	4.16	4.76	3.5	1200	40,000	25,000	21,000	25,000	19	60
50-DH-150	150	4.16	4.76	3.5	2000	40,000	25,000	21,000	25,000	19	60
50-DH-250	250	4.16	4.76	3.85	1200	60,000	37,500	35,000	37,500	19	60
50-DH-250	250	4.16	4.76	3.85	2000	60,000	37,500	35,000	37,500	19	60
50-DH-350	350	4.16	4.76	4.0	1200	80,000	50,000	48,600	50,000	19	60
50-DH-350	350	4.16	4.76	4.0	3000	80,000	50,000	48,600	50,000	19	60
75-DH-250	250	7.2	8.25	4.6	1200	51,000	32,000	20,000	32,000	36	95
75-DH-250	250	7.2	8.25	4.6	2000	51,000	32,000	20,000	32,000	36	95
75-DH-500	500	7.2	8.25	6.6	1200	70,000	44,000	40,000	44,000	36	95
75-DH-500	500	7.2	8.25	6.6	2000	70,000	44,000	40,000	44,000	36	95
150-DH-150	150	13.8	15.0	6.6	1200	20,000	13,000	6,300	13,000	36	95
150-DH-250	250	13.8	15.0	6.6	1200	35,000	22,000	10,600	22,000	36	95
150-DH-250	250	13.8	15.0	6.6	2000	35,000	22,000	10,600	22,000	36	95
150-DH-500	500	13.8	15.0	11.5	1200	40,000	25,000	21,000	25,000	36	95
150-DH-500	500	13.8	15.0	11.5	2000	40,000	25,000	21,000	25,000	36	95
150-DH-750	750	13.8	15.0	11.5	1200	60,000	37,500	31,000	37,500	36	95
150-DH-750	750	13.8	15.0	11.5	2000	60,000	37,500	31,000	37,500	36	95
150-DH-1000	1000	13.8	15.0	11.5	1200	80,000	50,000	42,000	50,000	36	95
150-DH-1000	1000	13.8	15.0	11.5	3000	80,000	50,000	42,000	50,000	36	95

For application data concerning power circuit breakers, see A. D. 33-115.

table b: potential transformers • accuracy classifications • mounting limitations

Potential transformers are type PT mounted on drawout disconnect drawer assemblies which disconnect both the primary and secondary connections and ground the high-voltage winding when the door is opened. Available ratings and number of transformers per drawout drawer are indicated below.

primary voltage ratings	50/60 cycle data								max trans per drawout drawer			
	style no.	connections	impulse rating kv	55°C smbient volt-amperes thermal	accuracy classification				indoor unit width			
									60 cycle		25 cycle	
									26	36	26	36
									outdoor unit width†			
					W	X	Y	Z	30	38	30	38
2400	1629 985	Ø to Ø	60	400	0.3	0.3	0.3	0.6	3	3	2	3
4200	1483 798	Ø to grd	60	600	0.3	0.3	0.3	0.6	2	3	2	3
4800	1483 799	Ø to grd	60	600	0.3	0.3	0.3	0.6	..	3	..	3
2400	1483 803	Ø to Ø	95	600	0.3	0.3	0 3	0.6	..	3	..	2
4200	1483 804	Ø to Ø	95	600	0.3	0.3	0.3	0.6	..	3	..	2
4800	1483 805	Ø to Ø	95	600	0.3	0.3	0.3	0.6	..	3	..	2
7200	1483 800	Ø to Ø	95	600	0.3	0.3	0.3	0.6	..	3	..	2
12000	1483 801	Ø to Ø	95	750	0.3	0.3	0.3	0.3	..	3	..	2
14400	1483 802	Ø to Ø	95	750	0.3	0.3	0.3	0.3	..	3	..	2
2400	1483 794	Ø to grd	95	600	0.3	0.3	0.3	0.6	..	3	..	2
4200	1483 795	Ø to grd	95	600	0.3	0.3	0.3	0.6	..	3	..	2
4800	1483 796	Ø to grd	95	600	0.3	0.3	0.3	0.6	..	3	..	2
7200	1483 791	Ø to grd	95	600	0.3	0.3	0.3	0.6	..	3	..	2
*12000	1483 792	Ø to grd	95	450	0.3	0.3	0.3	1.2	..	3	..	2
*14400	1483 793	Ø to grd	95	450	0.3	0.3	0.3	1.2	..	3	..	2

† When outdoor Shelterfor-M equipment is applied use indoor switchgear aux unit dimensions.

* For wye connection—PT's are fluxed for line voltage. The thermal and accuracy ratings apply for operating at corresponding line to neutral voltage.

notes: 1. Listed style numbered potential transformers are for metal-clad switchgear applications.

2. When circuit breakers are type 50-DH-75, 50-DH-150 or 50-DH-250:
   Auxiliary units are— { Indoor—26″ or 36″ wide only / outdoor—30″ wide only }

3. When circuit breakers are 75-DH or 150-DH:
   Auxiliary units are— { indoor—36″ wide only / outdoor—38″ wide only }

4. Disconnecting type potential transformer assemblies can be mounted in outdoor circuit breaker units only when transfer bus type assemblies are required.

5. When three transformers are connected in wye, the neutral is grounded.

6. For technical data on potential transformers, see publication T. D. 44-060.

table c: current transformers • to be mounted in 50-DH metal-clad switchgear

50°C amb current transformer primary amperes ——/5	type	style number	50-DH-75	50-DH-150 50-DH-250	50-DH-350	accuracy classification				
						metering			relaying	
						B0.1	B0.5	B2.0	10H	2.5H
15	CT-5	1304 183	X	..	..	1.2	4.8	...	..	..
20	CT-5	1304 184	X	..	..	0.6	2.4	...	25	..
25	CT-5	1304 185	X	..	..	0.6	1.2	...	25	..
25	CT-5	1294 409	..	X	..	1.2	4.8	...	..	..
30	CT-5	1304 186	X	..	..	0.3	0.6	...	25	..
30	CT-5	1294 410	..	X	..	1.2	4.8	...	..	..
40	CT-5	1304 187	X	..	..	0.3	0.6	...	50	25
40	CT-5	1294 411	..	X	..	0.6	2.4	...	25	..
50	CT-5	1304 179	X	..	..	0.3	0.6	4.8	50	25
50	CT-5	1294 412	..	X	..	0.6	1.2	...	25	..
75	CT-5	1317 889	X	..	..	0.3	0.3	2.4	50	50
75	CT-5	1294 404	..	X	..	0.6	1.2	4.8	25	..
100	CT-5	1317 890	X	..	..	0.3	0.3	1.2	50	50
100	CT-5	1294 405	..	X	..	0.3	0.6	2.4	50	25
100	CT-5	....	..	..	X	...	...	...	..	..
150	CT-5	1590 934	X	..	..	0.3	0.3	2.4	50	50
150	CT-5	1294 406	..	X	..	0.3	0.3	1.2	50	50
150	CT-5	....	..	..	X	...	...	...	..	..
200	CT-5	1317 892	X	X	..	0.3	0.3	2.4	50	50
200	CT-5	1484 869	..	..	X	0.3	0.6	4.8	50	25
300	CT-5	1317 893	X	X	..	0.3	0.3	1.2	50	50
400	CT-5	1571 841	X	X	X	0.3	0.3	1.2	50	50
600	CT-5	1571 842	X	X	X	0.3	0.3	2.4	50	50
800	CT-5	1571 843	X	X	X	0.3	0.3	1.2	50	50
1000	UP-5	1575 633	X	X	X	0.3	0.3	0.6	100	50
1200	UP-5	1608 382	X	X	X	0.3	0.3	0.3	100	50
1500	UP-5	1608 383	X	X	X	0.3	0.3	0.3	100	50
2000	UP-5	1575 636	..	X	X	0.3	0.3	0.3	100	50

notes: 1. Secondaries are 5 amperes in all ratings.
2. The mechanical and thermal ratings of the above tabulated current transformers are coordinated with the short-circuit ratings of the circuit breakers in accordance with NEMA standards.
3. For technical data on current transformers, see publication T. D. 44-060.

table d: current transformers • to be mounted in 75-DH and 150-DH metal-clad switchgear

55°C amb current transformer primary amperes ——/5	type	style number	use with circuit breaker							accuracy classification				
			150-DH-150	150-DH-250		150-DH-500	75-DH-250		75-DH-500 150-DH-750/1000	metering			relaying	
				11.5 to 15 kv	below 11.5 kv		6 to 8.25 kv	below 6 kv		B0.1	B0.5	B2.0	10H	2.5H
20	CT-15	1304 322	X	X	..	..	..	..	..	0.6	2.4	...	25	...
25	CT-15	1304 323	X	X	..	..	..	..	..	0.6	1.2	...	25	...
30	CT-15	1304 324	X	X	..	..	..	..	..	0.6	1.2	...	50	25
30	CT-15	1317 121	..	..	X	X	X	..	..	0.6	2.4	...	25	...
40	CT-15	1304 325	X	X	..	..	..	..	..	0.3	0.6	2.4	50	50
40	CT-15	1317 122	..	..	X	X	X	..	..	0.6	1.2	...	50	...
50	CT-15	1304 259	X	X	..	..	..	..	..	0.3	0.6	4.8	50	50
50	CT-15	1317 123	..	..	X	X	X	..	..	0.3	0.6	4.8	50	...
75	CT-15	1304 260	X	X	..	..	..	..	..	0.3	0.3	2.4	50	50
75	CT-15	1317 124	..	..	X	X	X	..	..	0.3	0.3	2.4	100	50
75	CT-15	1304 636	..	..	..	..	..	X	X	0.6	1.2	...	25	..
100	CT-15	1304 261	X	X	..	..	..	..	..	0.3	0.3	1.2	100	100
100	CT-15	1309 405	..	..	X	X	X	..	..	0.3	0.6	4.8	50	50
100	CT-15	1304 637	..	..	..	..	..	X	X	0.6	1.2	4.8	50	...
150	CT-15	1309 406	X	X	X	X	X	..	..	0.3	0.3	2.4	50	50
150	CT-15	1304 638	..	..	..	..	..	X	X	0.3	0.3	2.4	100	50
200	CT-15	1309 407	X	X	X	X	X	..	..	0.3	0.3	1.2	100	100
200	CT-15	1304 639	..	..	..	..	..	X	X	0.3	0.3	1.2	100	50
300	CT-15	1309 243	X	X	X	X	X	X	X	0.3	0.3	2.4	50	50
400	CT-15	1309 244	X	X	X	X	X	X	X	0.3	0.3	1.2	100	100
600	CT-15	1571 844	X	X	X	X	X	X	X	0.3	0.3	2.4	50	50
800	CT-15	1571 845	X	X	X	X	X	X	X	0.3	0.3	1.2	100	100
1000	UP-15	1575 641	X	X	X	X	X	X	X	0.3	0.3	0.6	100	50
1200	UP-15	1608 386	X	X	X	X	X	X	X	0.3	0.3	0.3	100	50
1500	UP-15	1575 643	X	X	X	X	X	X	X	0.3	0.3	0.3	100	100
2000	UP-15	1575 644	X	X	X	X	X	X	X	0.3	0.3	0.3	200	100

notes: 1. Apply transformers marked X as noted.
2. Secondaries are 5 amperes in all ratings.
3. The mechanical and thermal ratings of the above tabulated current transformers are coordinated with the short-circuit ratings of the circuit breakers in accordance with NEMA standards.
4. For technical data on current transformers, see publication T. D. 44-060.

how to order metal-clad switchgear indoor and outdoor

information to be furnished with orders

1. Single-line diagram showing main connections and sketch showing desired order of assembly of units.
2. Name of manufacturer and complete nameplate rating of all equipment to be controlled by the switchgear. Generator information should include the field rheostat, field discharge resistor, governor motor information and exciter rating. Synchronous motor information should include exciter rating.
3. The control voltage, such as 125-250 volts d-c, for operating the solenoid closing mechanism and shunt trip coil.
4. Type of cable, number and size of conductors and diameter over lead or braid for each power circuit and where they are to enter (top or bottom).
5. How power cables are to terminate (clamp terminals or potheads).
6. Where control cables are to enter (top or bottom).
7. Maximum over-all dimensions of shipping section which can be handled and installed at destination.
8. Complete nameplate wording for each circuit identification nameplate.

standard specifications

basis of specifications

The following specifications are based on 3-phase service, with ungrounded or solidly grounded neutral. The panel equipment specified is the minimum essential for the various circuits. Additional instruments and relays may be specified within the space limitations of the panel. See pages 9 and 17.

The arrangements which are covered by these specifications are the most common for this class of switchgear. Other arrangements are also available, such as the double bus, double circuit breaker arrangement, and the main and transfer bus arrangement (pages 10, 18 and 19). All other bus arrangements or special requirements should be referred to a Westinghouse Sales Office for recommendations.

The following specifications are based on units that will accommodate 1200 or 2000-ampere bus capacities. Buses in excess of 2000 amperes will require increase in depth, as shown on pages 8 and 10.

note: The specification is based on d-c, solenoid-operated breakers, as this is the most common and desirable arrangement. A-c operation can be obtained by use of rectifier solenoid closing and capacitor tripping device or low-voltage, d-c battery trip coil. This requires the addition of operating transformers connected to the incoming circuits and bus for operating and control source. Manually operated air circuit breakers are not to be specified in any case.

general

Type DH metal-clad switchgear will consist of a stationary housing and a horizontal drawout air circuit breaker, equipped with a solenoid operating mechanism and primary and secondary disconnecting devices, assembled on a frame to form a self-contained and self-supporting mobile unit. The switchgear will be suitable for service up to (4160) (7200) (13,800) volts, as indicated in application table "A" (see page 40), and will receive dielectric tests in accordance with NEMA Standards. The switchgear will be designed, manufactured, and tested in accordance with the latest standards of the AIEE and the NEMA.

stationary structure

Unit-type construction will be used in the formation of the housing to provide a rigid, self-supporting and self-contained enclosure for each circuit breaker unit. Each stationary structure will be built of ⅛-inch thick, formed, stretcher-leveled steel sheets, and structural members, electrically welded, and will have a hinged steel panel suitable for mounting of instruments, meters, relays, and control devices. The circuit breaker unit, buses, instrument transformers, and outgoing cables will be isolated within separate compartments formed by sheet steel barriers. Porcelain bus supports completely cover the bus openings, to provide a noncombustible fire wall between units.

Each compartment will have a separate cover for individual servicing without exposing circuits in adjacent compartments.

standard specifications—*continued*

A metal shutter will automatically close the opening to the insulators for the primary disconnecting devices when the circuit breaker unit reaches the "Disconnect" position. The shutter will be a simple, one-piece unit closed by gravity and raised automatically upon insertion of the air circuit breaker.

The cable compartment in the rear of each housing will be provided with wiping sleeves or Micarta supports for the primary cables, and is adaptable for pothead entrance. Compartment will be arranged for the cables to enter from above or below the housings, as required.

Terminal blocks will be conveniently located for external connections.

The stationary structure and circuit breaker units will be constructed so that each unit is interchangeable with every other unit of similar rating.

The steel work will be Bonderized as a unit after all welding is completed, and painted with a rust-resisting primer coat, followed by a light grey interior and exterior finishing coat. The outdoor metal-clad switchgear will receive a light grey interior coat and a dark grey weather-resistant external finish coat.

The circuit identification nameplates will be engraved anodized aluminum, 1 inch high and 3 inches wide.

buses and connections

The buses will be made of flat copper or aluminum bar having round edges and will be completely insulated with preformed Micarta tubes, two-piece compound-filled Moldarta boxes and varnish cambric taping. The contact surface at each main bus joint and each tap joint will be silver-plated and tightly bolted to insure maximum conductivity.

A ground bus will extend through the stationary structure. It will have a momentary rating at least equal to the highest momentary rating of any circuit breaker in the structure assembly. Each stationary unit will be grounded directly to the ground bus. The frame of each circuit breaker unit will be grounded through heavy multiple finger contacts at all times except when the breaker primary disconnecting devices are separated a safe distance.

disconnecting devices

The primary disconnecting device for each high-voltage circuit will consist of a fixed terminal clamped within a Moldarta of porcelain tube, and a moving contact mounted on the circuit breaker stud. All live parts will be enclosed by the Moldarta tube for 5-kv and porcelain tube for 15-kv insulation class of equipment.

The moving contact will consist of a flexibly mounted, self-aligned assembly of bridging segments, formed so that each segment will make a high-pressure, two-point contact with the fixed terminal at one end and with the circuit breaker terminal at the other end. All contact surfaces will be heavily silver-plated to prevent reduction in current carrying capacity due to oxidation. The bridging segment assembly will be a part of the removable circuit breaker unit for easy accessibility and inspection.

The secondary disconnecting device will provide connections for the control circuits between the circuit breaker unit and the housing and will consist of multiple plug and socket contacts of the train-line coupler type. The secondary disconnect will automatically engage when the circuit breaker is placed in the "operating" position and can be re-engaged manually when the unit is in the "Test" position, without using a test jumper.

removable element

The circuit breaker element will be the Westinghouse type DH air circuit breaker complete with solenoid operating mechanism, auxiliary switches, and interlocks mounted on a mobile frame. The frame will be fabricated from formed steel plates electrically welded to form a rugged support for the equipment. A horizontal steel barrier will separate the high-voltage parts of the circuit breaker from the operating mechanism and control devices. The frame will have four wheels with needle bearings and a special flange construction which will engage with the rail as the unit is rolled into the housing.

The breaker unit is moved between the "test" position and "operating" position by means of a worm gear levering device that is operated by a removable hand crank. The worm gear levering device is so mechanically interlocked with the breaker closing mechanism, that a closed breaker cannot be removed from the "operating" position or inserted from the "test" position. The breaker mechanism cannot be closed when the worm gear levering device is between the "operating" position or the "test" position of the levering device.

unit 1 **swinging instrument panel**

A swinging steel instrument panel will be mounted on the (right) (left) hand end of the structure for synchronizing instruments. The panel will be 21½ inches wide and 24 inches high and will be equipped with the following:

2—Type KA-25 voltmeters, O- . . . . volt scale, 150-volt coils.

1—Type KI-25 synchroscope with two lamps.

1—(Optional) type KY-25 frequency indicator, 58-62 cycle scale, 115-volt.

standard specifications *continued*

standard units nos. 2 and 3

unit 2 **for control of one generator**

The metal-clad switchgear for the control of one generator and one exciter will consist of two housings which will provide switching, instrumentation, voltage regulation and excitation control. The metal-clad unit for the control of one 3-phase, 60-cycle generator will be .... inches wide, ... inches deep, 90⅜ inches high, and will be equipped with the following:

1—Type DH air circuit breaker, ... ampere, 3-pole, single-throw, d-c, solenoid operated.

1—Set of .... ampere insulated buses.

3—Current transformers, ... /5/5 ratio, double secondary (5 kv) (15 kv).

3—Current transformers, ... /5 single secondary (5 kv) (15 kv) for generator neutral unmounted.

mounted on the hinged instrument panel:

1—Type KY-25 power-factor meter, 50-100-50 scale.

1—Type KA-25 a-c ammeter, O-.... scale, 5-ampere coil.

1—Type KY-25 polyphase indicating wattmeter, O-.... scale, 5-ampere, 115-volt.

1—Type CB-2F Flexitest polyphase watthour meter, 2-element, 5-ampere, 120-volt, with built-in test switches.

3—Type COV Flexitest generator overcurrent voltage controlled relays, with built-in test switches.

1—Type WL auxiliary tripping relay.

1—Type W 3-phase voltmeter switch.

1—Type W 3-phase ammeter switch.

1—Type W synchronizing switch.

1—Type W rheostat control switch.

1—Type W field breaker control switch with red and green indicating lights.

1—Type W governor motor control switch.

1—Type W circuit breaker control switch with red and green indicating lamps for generator air circuit breaker.

1—Nameplate for circuit identification.

unit 3

The auxiliary compartment for the control of the exciter will be .... inches wide, ... inches deep and 90⅜ inches high, and will be equipped with the following:

note: The 26-inch auxiliary compartment is suitable for a total of two sets of three each, of 2400/120 volt potential transformers or two sets of two each, of 4200/120 volt potential transformers.

1—Set of .... ampere insulated buses.

1—Electrically operated disconnecting type DB field breaker.

2—Disconnecting type PT potential transformers ..../120 volt ratio, 60-cycle, with fuse mountings, and one set of current limiting fuses. (To be connected to the generator circuit for metering.)

1—Disconnecting type PT potential transformer, .../120 volt ratio, 60-cycle, with fuse mountings, and one set of current limiting fuses. (To be connected to the generator circuit for voltage regulator.)

mounted on the hinged instrument panel:

1—Type KX-25 d-c voltmeter, O-.... scale.

1—Type KX-25 d-c ammeter, complete with 50 mv shunt, O-.... scale.

1—Type KX-25 temperature indicator, 0-150 degrees C scale, complete with Rectox unit.

1—Type SRA-(1) (2) (3) (4), direct, quick-acting (Silverstat) generator voltage regulator with voltage adjusting rheostat, damping transformer, and provision for cross current compensation.

1—Type W temperature indicator switch.

1—Type W regulator transfer switch.

1—Type W exciter rheostat control switch, or

1—Manual mechanism for operation of exciter field rheostat and drilling only for mounting of rheostats. (2-15-inch diameter plates maximum.)

3—(Optional) Type CA Flexitest generator differential relays with built-in test switches.

unit 4 **for control of one incoming line**

The metal-clad switchgear for the control of one incoming line will consist of one housing which will provide switching, instrumentation and relaying.

note: This unit provides indicating ammeters and voltmeter. Optional equipment may include watthour meter, indicating wattmeter, synchronizing switch to synchronize between the incoming line and bus and the necessary reverse power relay protection, when required.

The metal-clad unit for the control of a 3-phase, 60-cycle incoming line will be .... inches wide, ... inches deep, and 90⅜ inches high, and will be equipped with the following:

1—Type DH air circuit breaker, ... ampere capacity, 3-pole, single-throw, d-c, solenoid operated.

1—Set of .... ampere capacity insulated buses.

3—Current transformers, .../5 ratio, single secondary (5 kv) (15 kv).

1 or 2—(Optional—mounted in superstructure) Disconnecting Type PT potential transformers ..../120 volt ratio, 60-cycle, with fuse mountings and one set current limiting fuses. (To be connected to the line).

mounted on the hinged instrument panel:

1—Type KA-25 voltmeter, O-.... scale, 150-volt coil.

1—Type KA-25 a-c ammeter, O-.... scale, 5-ampere coil.

1—Type W 3-phase voltmeter switch.

1—Type W 3-phase ammeter switch.

1—Type W circuit breaker control switch with red and green indicating lamps for incoming line air circuit breaker.

3—Type CO-6 Flexitest overcurrent induction relays, 4-12 ampere range, with built-in test switches.

1—Nameplate for circuit identification.

1—(Optional) Type KY-25 wattmeter, suitable scale.

1—(Optional) Type CB-2F Flexitest polyphase watthour meter, 2-element, 5-ampere, 120-volt, with built-in test switches.

1—(Optional) Type W synchronizing switch.

standard units nos. 4, 5, 4

unit 5 **for control of two incoming lines with directional protection**

The metal-clad unit for the control of two incoming lines will consist of three housings which will provide switchgear, instrumentation, overcurrent and directional protection.

standard unit no. 4—For specifictions, see above.

The metal-clad auxiliary unit for the two incoming lines will be 36 inches wide, ... inches deep, and 90⅜ inches high, and will contain the following equipment:

1—Set of .... ampere insulated buses.

2—Disconnecting type PT potential transformers ..../120 volt ratio, 60-cycle, with fuse mountings and current limiting fuses. (Each potential transformer will be mounted on a separate disconnect type truck connected to the incoming line side of the breaker to give potential indication and synchronizing potential for each of the two incoming lines).

2—(Optional) Disconnecting type PT potential transformers, .../120 volt ratio, 60-cycle, with fuse mountings and one set current limiting fuses. (To be connected to the bus for metering and voltage indication purposes.)

mounted on the hinged instrument panel:

6—Type CR Flexitest current relays, 4-12 ampere range, with built-in test switches. (Three of which will be connected to each incoming line circuit.)

standard unit no. 4—For specifications, see above.

unit 6 **auxiliary unit**

The auxiliary unit for the totalizing equipment will be 36 inches wide, ... inches deep, and 90⅜ inches high, with provision for the following equipment:

1—Set of .... ampere insulated buses and connections.

2—Current transformers, .../5 ratio, single secondary, (5 kv) (15 kv.)

2—Disconnecting type PT potential transformers, .../120 volt ratio, 60-cycle, with fuse mountings and one set of current limiting fuses. (To be connected to the bus.)

3—Disconnecting type PT potential transformers, .../120 volt ratio, 60-cycle, with fuse mountings and one set of current limiting fuses. (To be connected to the bus y-y for ground detector voltmeters.)

mounted on the hinged instrument panel:

3—Type RA-37 voltmeters, O-.... scale. (To be connected for ground indication.)

1—Type R-2 recording demand watthour meter, 2-element, 5-ampere, 120-volt, complete with type FT test switches. Space only for mounting other indicating or recording meters or instruments, within the limitations of the panel as shown on pages 9 and 17.

standard specifications *continued*

unit 7 for control of one feeder

The metal-clad switchgear for the control of one feeder circuit will consist of one housing which will provide switching, instrumentation and relaying.

The metal-clad unit for the control of a 3-phase, 60-cycle feeder circuit will be .... inches wide, ... inches deep, 90⅜ inches high, and will be equipped with the following:

1—Type DH air circuit breaker, ... ampere, 3-pole, single-throw, d-c, solenoid operated.

1—Set of .... ampere insulated buses.

3—Current transformers, .../5 ampere ratio, single secondary (5 kv) (15 kv).

2—(Optional—mounted in superstructure) Disconnect, type PT potential transformers, .../120 volt ratio, 60-cycle, with fuse mountings, and one set current limiting fuses.

mounted on the hinged instrument panel:

1—Type KA-25 ammeter, O-.... scale, 5-ampere coil.

3—Type CO-6 Flexitest overcurrent induction relays, 4-12 ampere range, with built-in test switches and 20-80• ampere instantaneous trip attachment.

1—Type W 3-phase ammeter switch.

1—Type W circuit breaker control switch with red and green indicating lamps.

1—Nameplate for circuit identification.

1—(Optional) Type CB-2F Flexitest polyphase watthour meter, 2-element, 5-ampere, 120-volt, with built-in test switches.

• except feeders to transformers usually require 40-160 ampere instantaneous trip range.

unit 8 for control of induction motor (full voltage starting)

The metal-clad switchgear for the control of one across-the-line starting circuit will consist of one housing which will provide switching, instrumentation and relaying.

The metal-clad unit for the control of a 3-phase, 60-cycle induction motor circuit will be .... inches wide, ... inches deep and 90⅜ inches high, and will be equipped with the following:

1—Type DH air circuit breaker, ... ampere, 3-pole, single-throw, d-c, solenoid operated.

1—Set of .... ampere insulated buses.

3—Current transformers, .../5 ampere ratio, single secondary (5 kv) (15 kv).

2—(Optional—mounted in superstructure) Disconnecting type PT potential transformers, .../120 volt ratio, 60-cycle, with fuse mountings, and one set current limiting fuses.

mounted on the hinged instrument panel:

1—Type KA-25 a-c ammeter, 0-.... scale, 5-ampere coil.

1—Type CV Flexitest a-c undervoltage relay, with built-in test switches.

1—Type BL-1 two element Flexitest thermal relay, with instantaneous trip attachments, and built-in test switches.

1—Type CO-5 Flexitest overcurrent induction relays, 4-12 ampere range, long time, with built-in test switches and 10-40 ampere instantaneous trip attachment.

1—Type W 3-phase ammeter switch.

1—Type W circuit breaker control switch with red and green indicating lamps.

1—Nameplate for circuit identification.

1—(Optional) Type CB-2F polyphase watthour meter, 2-element, 5-ampere, 120-volt, complete with test switches.

1—(Optional) Type CO-8 overcurrent relay for ground fault protection.

unit 9 for control of induction motor (reduced voltage starting)

The metal-clad switchgear, for the control of one induction motor reduced voltage starting unit, will consist of one housing which will provide switching, instrumentation, and relaying.

The metal-clad unit for the control of a 3-phase, reduced voltage starting unit will be .... inches wide, ... inches deep, and 90⅜ inches high and will be equipped with the following:

1—Type DH air circuit breaker, ... ampere, 3-pole, single-throw, d-c, solenoid operated.

1—Set of .... ampere insulated buses.

3—Current transformers, .../5 ampere ratio, single secondary (5 kv) (15 kv).

2—(Optional—mounted in superstructure) Disconnecting Type PT potential transformers, .../120 volt ratio, 60-cycle, with fuse mountings, and one set current limiting fuses.

mounted on the hinged instrument panel:

1—Type KA-25 a-c ammeter 0-.... scale, 5-ampere coil.

1—Type CV Flexitest undervoltage relay, with built-in test switches.

1—Type BL-1 two element Flexitest thermal relay, with instantaneous trip attachments, and built-in test switches.

1—Type TK Flexitest timing relay, with built-in test switches, for automatic operation of the shunting breaker for the starting reactors.

1—Type CO-5 Flexitest overcurrent long-time induction relays, 4-12 ampere range, with built-in test switches and 10-40 ampere instantaneous trip attachment.

1—Type W 3-phase ammeter switch.

1—Type W circuit breaker control switch with red and green indicating lamps.

1—Nameplate for circuit identification.

1—(Optional) Type CB-2F Flexitest polyphase watthour meter, 2-element, 5-ampere, 120-volt, with built-in test switches.

1—(Optional) Type CO-8 overcurrent relay for ground fault protection.

unit 9-a: for separate location

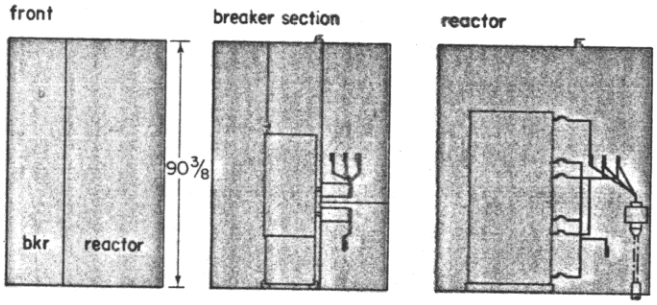


figure 99. Neutral reactor starting auxiliary compartment for shielded air core reactor. Space shown suitable up to approximately 2500 hp motor.

The auxiliary structure for the starting reactor and starting reactor shunting breaker will be .... inches wide, ... inches deep, 90⅜ inches high, and will be equipped with the following:

1—Type DH air circuit breaker, ... ampere, 3-pole, single-throw, d-c, solenoid operated.

1—Space for starting reactor, 3-phase, ... ampere, ... kv.

1—Set of .... ampere insulated connections.

1—Set of cable clamps and terminals.

standard units nos. 10 and 11

unit 10 — for control of synchronous motor

The metal-clad switchgear for full voltage or reduced voltage starting of one synchronous motor will consist of two housings which will provide switching, automatic field application, instrumentation, and shutdown upon occurrence of overcurrent, thermal overload, undervoltage, synchronous speed pullout, field failure, and incomplete starting sequence.

The metal-clad unit containing the circuit breaker for the control of a 3-phase, 60-cycle, full voltage or reduced voltage starting synchronous motor will be .... inches wide, ... inches deep, and 90⅜ inches high, and will be equipped with the following:

1—Type DH air circuit breaker, ... ampere, 3-pole, single-throw, d-c, solenoid operated.

1—Set of .... ampere insulated buses.

3—Current transformers, .../5 ratio, single secondary (5 kv) (15 kv).

2—(Optional—mounted in superstructure) Disconnecting type PT potential transformers ..../120 volt ratio, 60-cycle, with fuse mountings and one set current limiting fuses.

mounted on the hinged instrument panel:

1—Type KY-25 polyphase, reactive volt-ampere indicator, 0-.... scale, 5-ampere, 120-volt.

1—Type KA-25 a-c ammeter, 0-.... scale, 5-ampere coil.

1—Type CV Flexitest undervoltage induction relay, 120 volts, with built-in test switches.

1—Type BL-1 two element Flexitest thermal overload relays, with instantaneous trip attachments, and built-in test switches.

1—Type CO-5 Flexitest overcurrent, long time, induction relay, 4-12 ampere range, with built-in test switches and 10-40 ampere instantaneous trip attachment.

1—Type W 3-phase ammeter switch.

1—Type W circuit breaker control switch, with red and green indicating lamps.

1—Nameplate for circuit identification.

1—(Optional) Type CB-2F Flexitest polyphase watthour meter, 2-element, 5-ampere, 120-volt, with built-in test switches.

1—(Optional) Type W rheostat control switch.

1—(Optional) Type CO-8 overcurrent relay for ground fault protection.

unit 11

This compartment can be located in the main structure lineup as shown, or arranged for separate mounting adjacent to the motor.

When supplied for remote mounting for reduced voltage starting application, the field equipment will be mounted on the reduced voltage starting structure, unit 11-A. When compartment is removed from main structure, field rheostat, when required, must be electrically operated and rheostat control switch added to main panel unit no. 10.

The auxiliary unit for the control of the motor field circuit will be .... inches wide, ... inches deep, and 90⅜ inches high and will be equipped with the following:

1—Set of .... ampere insulated buses.

1—Synchronous motor field panel, consisting of the following:
- 1—Type AV field failure relay.
- 1—Shunt for field ammeter.
- 1—Type M field contactor for field current of approximately 200 amperes or less.

or 1—Electrically operated type DB field breaker for field currents greater than 200 amperes.

standard specifications *continued*

unit 11 *continued*

1—Field discharge and starting resistor.

1—Field application relay.

2—(Optional) Disconnecting type PT potential transformers, .../120 volt ratio, 60-cycle, with fuse mountings and one set of current limiting fuses.

mounted on the hinged instrument panel:

1—Type KX-25 ammeter, 0-.... scale for motor field.

1—Type TK Flexitest timing relay, with built-in test switches, for field application over-all sequence checking.

1—Manual mechanism for operation of exciter field rheostat and drilling only for mounting of rheostats, maximum size, 2-15-inch diameter plates, or one type W switch for electrically operated rheostats when size exceeds two 15-inch diameter plates.

3—(Optional) Type "CA" Flexitest ratio differential relays, with built-in test switches.

unit 11-a: for separate location

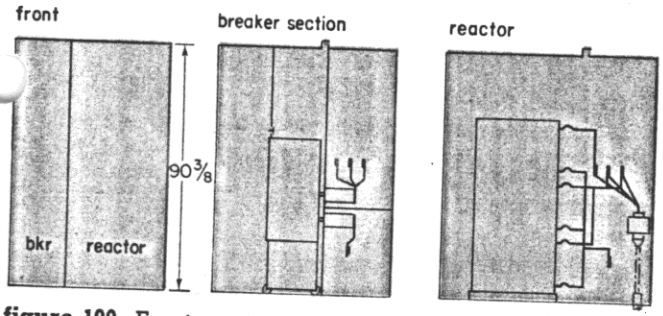


figure 100. Front reactor starting auxiliary compartment for shielded air core reactor. Space shown suitable up to approximately 2500 hp motor.

The auxiliary structure for the starting reactor and starting reactor shunting breaker will be .... inches wide, ... inches deep, 90⅜ inches high, and will be equipped with the following:

1—Type DH air circuit breaker, ... ampere, 3-pole, single-throw, d-c, solenoid operated.

1—Space for shielded air core starting reactor, 3-phase, ... ampere, ... kv.

1—Set of .... ampere insulated connections.

1—Set of cable clamps and terminals.

1—Type TK Flexitest timing relay, with built-in test switches, for closing running breaker.

3—(Optional) Type CA Flexitest ratio differential relays, with built-in test switches.

unit 12 control for bus sectionalizing

The metal-clad unit for the control of the bus sectionalizing circuits will be .... inches wide, ... inches deep, and 90⅜ inches high, and will be equipped with the following:

1—Type DH air circuit breaker, ... ampere, 3-pole, single-throw, d-c, solenoid operated.

1—Set of .... ampere insulated buses and transition bus connections.

3—(Optional) Current transformers, .../5 ratio, single secondary (5 kv) (15 kv).

2—(Optional—mounted in superstructure) Disconnecting type PT potential transformers, .../120 volt ratio, 60-cycle, with fuse mountings and one set current limiting fuses.

mounted on the hinged instrument panel:

1—Type W circuit breaker control switch, with red and green indicating lamps.

1—Nameplate for circuit identification.

3—(Optional) Type CO-6 Flexitest overcurrent induction relays, 4-12 ampere range with built-in test switches.

1—(Optional) Type W synchronizing switch.

note: An auxiliary unit is required for the bus transition connections of the bus sectionalizing unit. When an auxiliary unit is not included in the switchgear assembly that can be used for bus transition connections, auxiliary unit no. 13 must be added.

unit 13 auxiliary unit

The auxiliary unit will enclose one set of insulated primary transition bus connections associated with the bus sectionalizing breaker unit and one set of insulated main bus and connections. Space will be available when required for mounting current transformers in the transition connections, a disconnecting type potential transformer assembly or an operating transformer for control power with its associated disconnecting type "BAL" fuse assembly, surge protective equipment or other equipment associated with the metal-clad switchgear.

The housing for an auxiliary compartment will be .... inches wide, ... inches deep, and 90⅜ inches high.

unit 14 bus entrance compartment

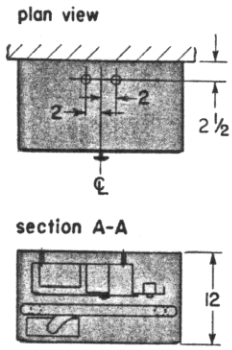
The bus entrance compartment will be mounted on the (right) (left) hand end of the switchgear structure and will provide an enclosure for incoming cables which are to connect directly to the main bus.

accessories indoor and outdoor

One set of accessories for the operation, test and inspection of the circuit breakers, which will include the following:

equipment identification

1. 1 or 1¼ conduit may enter top or bottom
2. terminal block (8 or 12 pt)
3. 4⅝ dia. holes for mtg. cabinet to wall
4. T-handle latch
5. pushbuttons (close and trip)
6. control relay
7. sec. cont. jumper for conn. to cir. bkr. 10 ft. lg.
8. AB breaker
9. door hinged af bottom (has 180° travel)
10. removable cover
11. Rectox
12. capacitor or inst. trip device } for a-c control
13. terminal block (4 pt) } for a-c control
14. Rectox and bkr. attachment cabinet } for a-c control



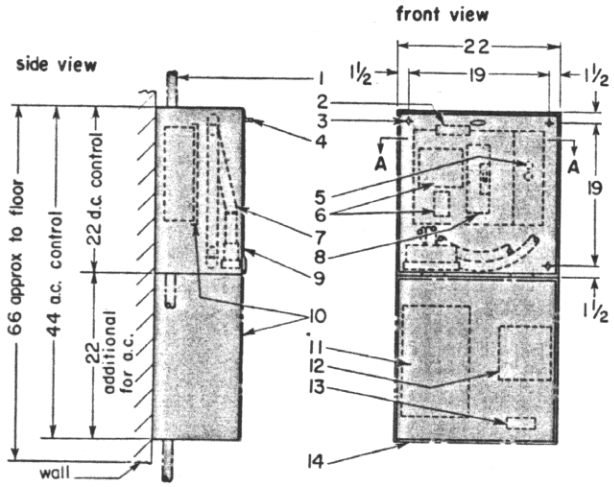


figure 101. test cabinet

1—Test cabinet, complete with secondary contacts, control relay and pushbuttons for electrically-operated breakers (see above).

1—Closing lever for manually closing the circuit breaker.

1—Removable hand crank for operation of the levering-in-device.

1—Set of special wrenches, for the primary disconnecting devices.

1—Set test plugs for Flexitest meters and relays.

1—Adjustable transport truck for outdoor metal-clad switchgear installations only, or

1—Transport dolly for indoor installations.

note: For outdoor installations, a 10-foot test jumper is usually substituted for the test cabinet.

standard grounding device
complete grounding device
emergency stored energy closing device } see page 29

125-volt control battery

The control battery will provide power for operation of electrical operating mechanism and may be used for all indicating lamps and any alarm circuits.

1—60-cell storage battery, acid type with pasted plate assembly in sealed glass jars. Discharge rate will not be less than .... amperes for one minute or .... amperes for 8 hours to 1.75 volts per cell. There will also be furnished electrolyte, inter-connectors, two-step rack, cell numbers, portable hydrometer and vent hole thermometer.

24-volt tripping battery

The tripping battery will provide power for operation of the shunt trip coils of metal-clad switchgear installations when a-c rectifier solenoid operating mechanisms are supplied.

1—12-cell storage battery, acid-type, with pasted plate assembly in sealed glass jars. The discharge rate will not be less than .... amperes for one minute or .... amperes for 8 hours to 1.75 volts per cell. There will also be furnished the electrolyte and inter-connectors.

a-c tripping

A 24-volt tripping battery is recommended as the most reliable method for a-c rectifier operated breakers. Where local conditions make the tripping battery undesirable, specify a capacitor trip device for each breaker. In addition, a potential transformer or operating transformer must be available on the line side of each incoming line and generator unit, and on each bus section, to insure a-c supply to the capacitor trip device before its respective breaker is closed.

battery charger for 125-volt control battery

nonautomatic chargers

1—Static battery charger, 115-volt, 60-cycle, a-c and 0.1 to 3.0-ampere, d-c, complete with dial switch voltmeter and ammeter suitable for wall mounting.

1—Static battery charger, 115-volt, 60-cycle, a-c and 0.2 to 6.0-ampere, d-c, complete with dial switch, ammeter, voltmeter and suitable for floor mounting.

Rectomatic self-regulating battery charger

1—Rectomatic battery charger 115-volt, 60-cycle, a-c and 0.3 to 3.0-ampere, d-c, complete with indicating and control devices. Floor mounting.

1—Rectomatic battery charger 115-volt, 60-cycle, a-c and 0.6 to 6.0-ampere, d-c, complete with indicating and control devices. Floor mounting.

a-c closing

A full-wave rectifier for each breaker will provide the necessary d-c power for operating the solenoid closing mechanism. One ——/250/120 volt, operating transformer is required for each incoming line and generator unit and each bus section.

battery charger for 24-volt tripping battery

1—Static battery charger, 115-volt, 60-cycle, a-c and 0.1 to 1.0-ampere, d-c, complete with ammeter, voltmeter, rheostat and suitable for wall mounting.

surge and lightning protection

Where there are exposed lines, it is recommended that the purchaser provide adequate surge and lightning protection. If desired, this protective equipment can be supplied in the metal-clad gear.

manufacturing and development testing — metal-clad switchgear

Three general assembly aisles—with flanking, fabricating, and machining sections—are utilized in East Pittsburgh Division for the manufacture of metal-clad switchgear.

S and CS aisles are the general assembly areas for indoor and outdoor metal-clad switchgear, respectively. Among the facilities employed are master alignment fixtures for precise checking of type DH air circuit breakers and stationary housings to insure complete breaker interchangeability . . . preformed wiring jigs . . . production test equipment . . . modern finish paint and plastic coating arrangements . . . floor-operated cranes to expedite assembly and shipment procedures. To these aisles, the type DH breakers are delivered from their complete production point in T aisle and are fitted into the metal-clad switchgear stationary structure. Various other components and accessories are also fitted here into the stationary structure.

indoor metal-clad switchgear assembly in S aisle

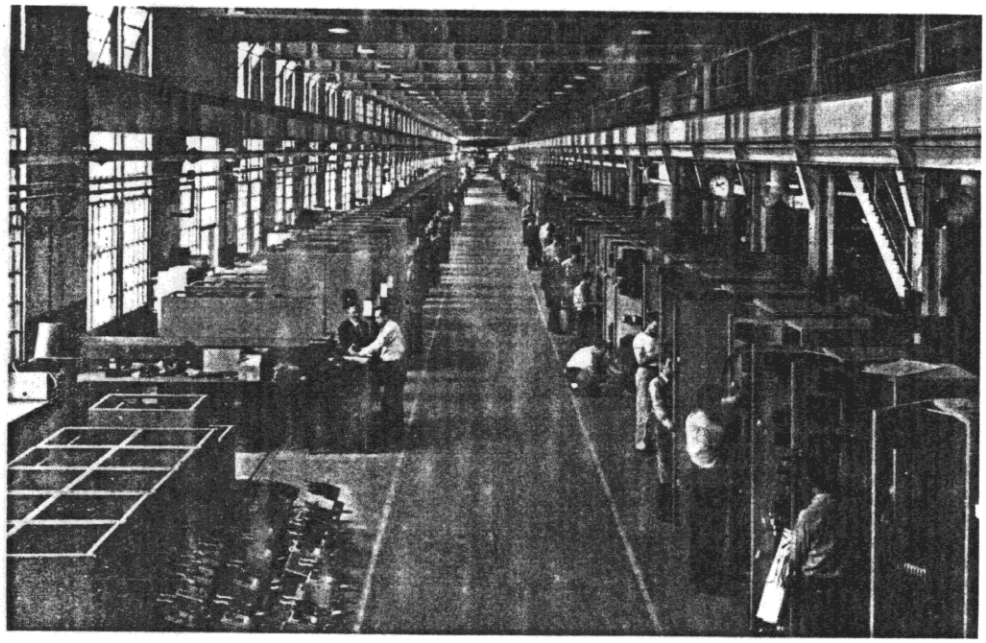


figure 102

outdoor metal-clad switchgear assembly in CS aisle

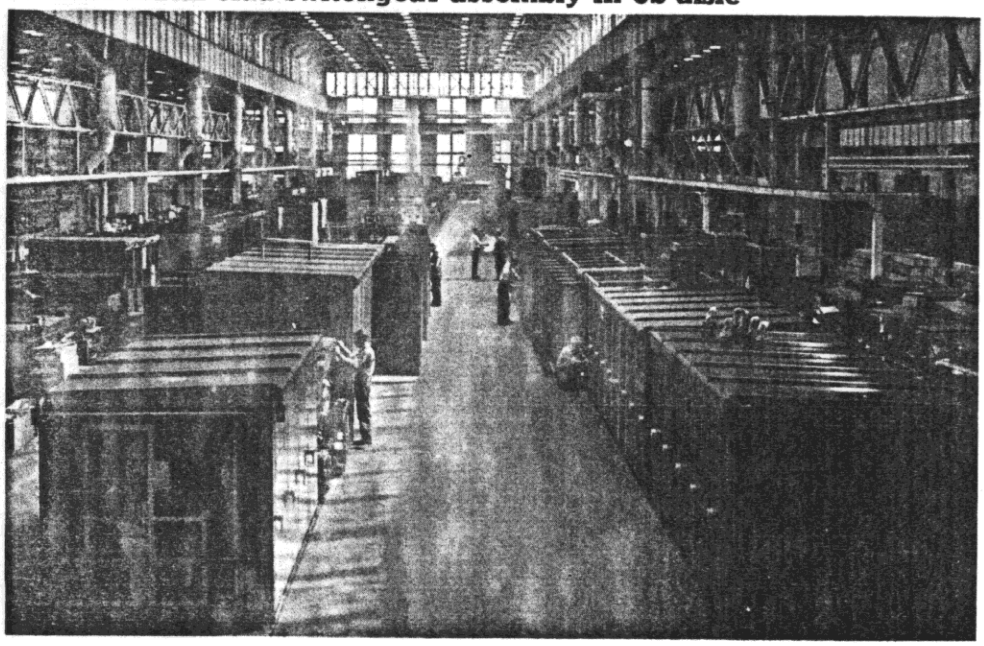
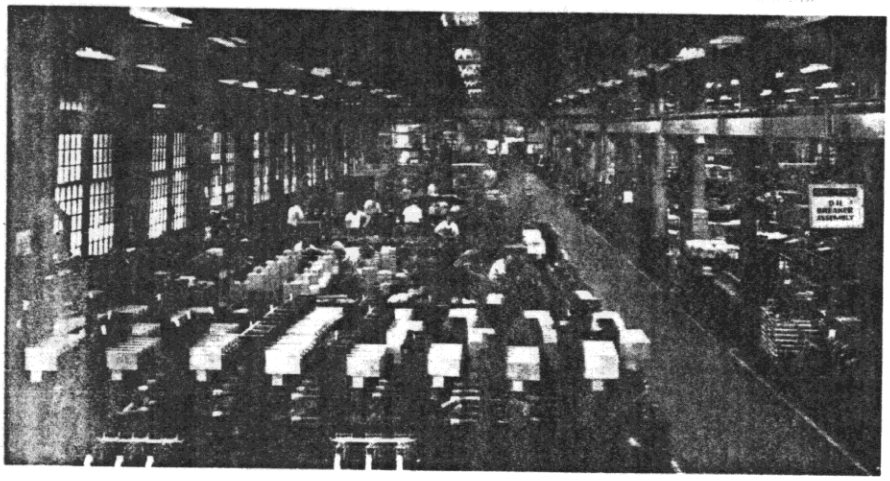


figure 103

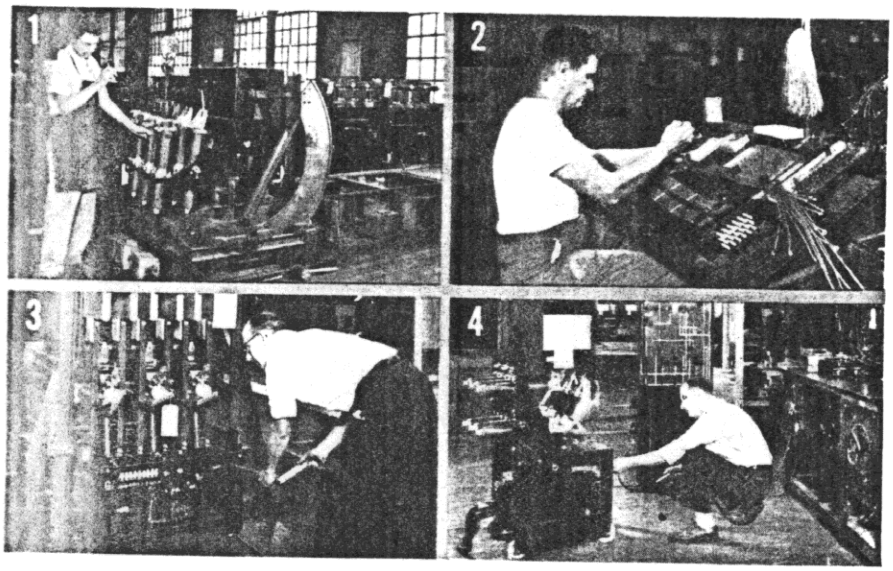
manufacturing of type DH magnetic De-ion air circuit breakers in T aisle



T aisle is the general assembly area for type DH air circuit breakers, which are utilized in metal-clad switchgear. Here are handled the fitting of breaker sub-assemblies and assembly of component parts as the complete DH breaker, including inspection and testing. DH breakers are built in progressive assembly line procedure, starting with the basic metal frame and adding various pre-assembled components such as mechanism, pole units and contacts by means of accurate assembly fixtures at work stations along the line.

figure 104

close-ups of some DH breaker assembly line procedures



1. Contact sub-assembly is added to breaker frame in progressive assembly procedure. DH breaker sub-assemblies are built in section T.
2. Wiring in preforming fixture.
3. Master gauge fixture checks breaker alignment.
4. Testing the assembled breaker.

figure 105

development testing at Westinghouse high power laboratory

Over 30 years of design, manufacturing and application experience are represented in type DH magnetic De-ion air circuit breakers utilized in metal-clad switchgear.

DH breakers and all metal-clad switchgear are design-proved in the Westinghouse high power laboratory under full-scale conditions comparable to actual field service requirements. The high power laboratory is centrally located with the switchgear manufacturing areas for ideal coordination of engineering and manufacturing phases involved in the design-planning and proving of the DH breakers and other components of metal-clad switchgear.

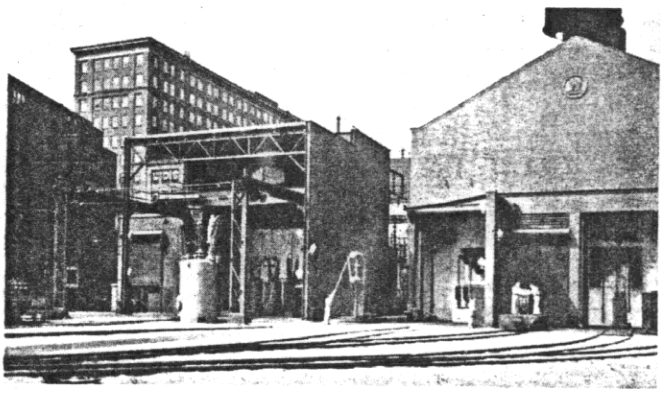


figure 106

typical installations

Westinghouse metal-clad switchgear

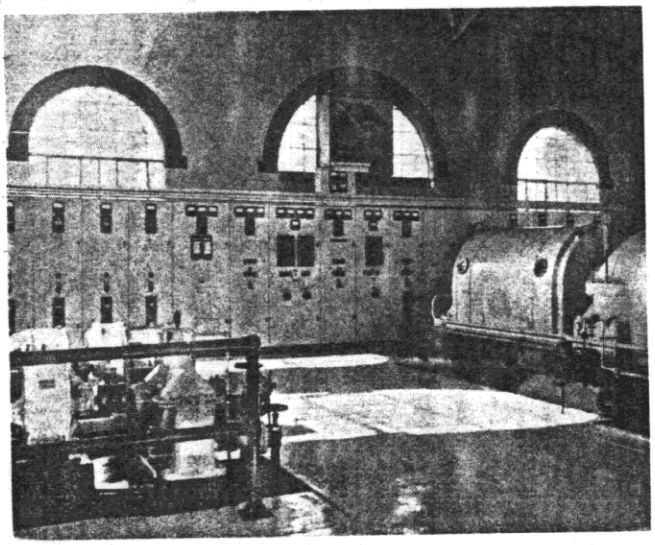


figure 107. indoor metal-clad switchgear for generating stations

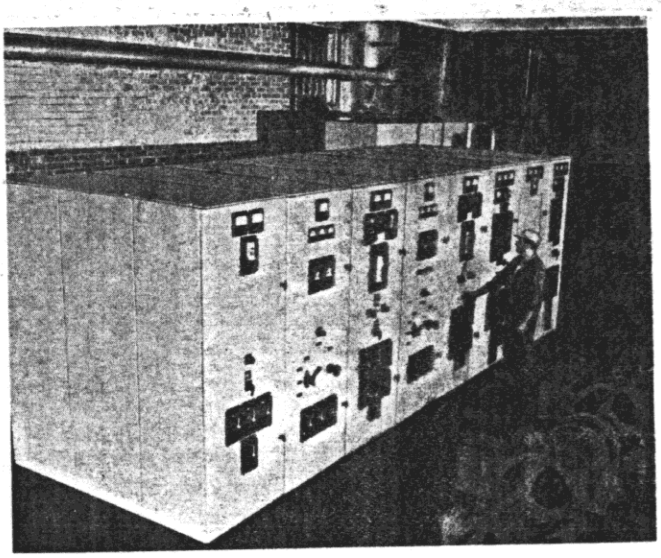


figure 108. indoor metal-clad switchgear for industrial plants

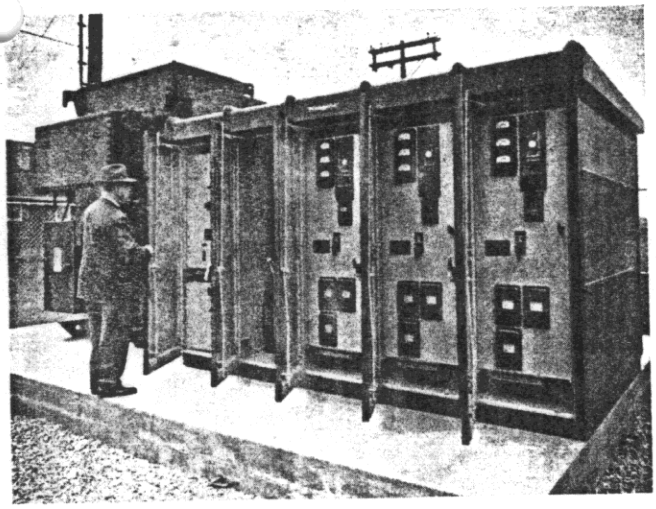


figure 109. outdoor metal-clad switchgear for substation service—
electric utility, industrial or municipal

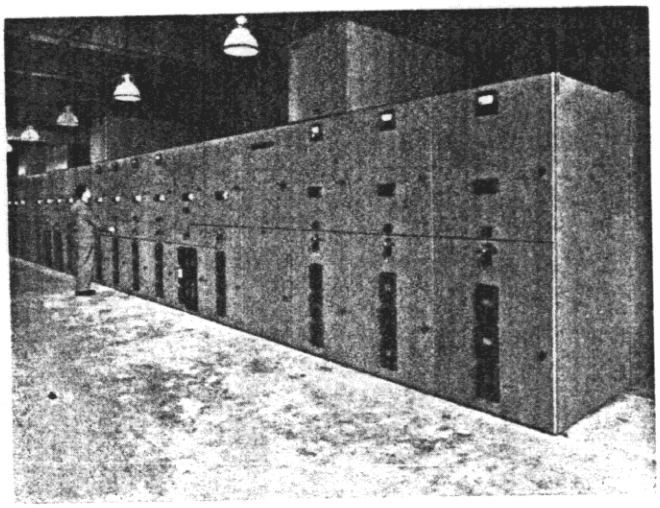


figure 110. indoor metal-clad switchgear for commercial and institutional buildings

further information

prices: price list 32-220

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