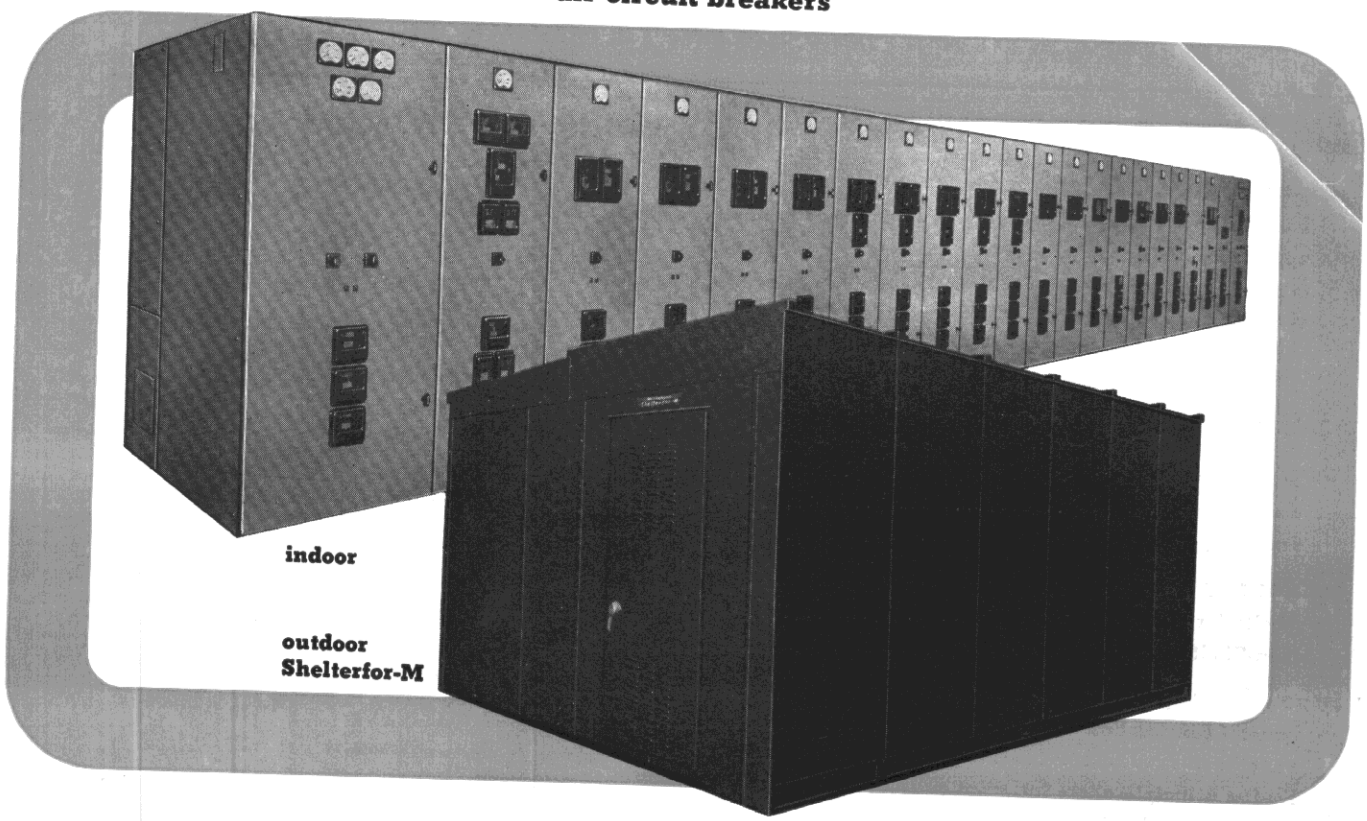
standardized metal-clad switchgear

75 to 1000 mva interrupting capacity • 4160 to 13800 volts
1200 to 3000 amps • indoor and outdoor service

with type DH magnetic De-ion® air circuit breakers



application

Westinghouse metal-clad switchgear with type DH magnetic De-ion horizontal drawout air circuit breakers provides centralized circuit control and protection for generators, motors, bus and feeders.

A complete line of functional units is available as standard assemblies to meet specific requirements. Each standard unit is self-contained with Westinghouse components. These components include circuit breakers, bus, instrument transformers, relays, instruments, meters and control devices, assembled into a compact, completely enclosed structure.

typical applications: Electric utilities • commercial buildings • industrial plants • municipal pumping stations • transportation and traction systems.

advantages

maximum reliability of overall design . . . Westinghouse metal-clad switchgear provides maximum design reliability for its application based on years of experience in the manufacture of all types of switchgear.

superior circuit protection with type DH magnetic air circuit breakers . . . employing the Westinghouse De-ion principle of fast, positive arc interruption.

simplified switchgear inspection and maintenance . . . provided with horizontal drawout DH breaker design and accessibility of switchgear components.

safety to personnel . . . no accidental access to live parts.

protected maintenance area for outdoor switchgear afforded with Shelterfor-M design . . . sheltered aisle provides for all-weather inspection, maintenance and breaker interchange.

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

Westinghouse metal-clad switchgear is design-proved in Westinghouse high power laboratory.

January, 1961
supersedes descriptive bulletin 32-250 dated January, 1958
mailed to: E/264/DB; C/322/DB

[redacted]

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Westinghouse metal-clad switchgear

The experience gained since Westinghouse first pioneered magnetic air circuit breakers and metal-enclosed switchgear is applied in designing metal-clad switchgear of the highest quality. Research and development are continuous in planning for metal-clad switchgear of superior quality.

compact switchgear structure

Presents attractive, safe, reliable overall construction. Compartment arrangements and all components represent most advanced designing. page 4

type DH magnetic air circuit breaker operation

provides these important features . . .

- **horizontal drawout construction**—for quick simplified withdrawal of breaker element from stationary structure for breaker inspection, maintenance or replacement page 16
- **hinged arc chutes . . .**
  permit easy inspection of contacts after horizontal withdrawal of breaker from stationary structure page 17
- **main disconnecting contact fingers . . .**
  location on breaker studs permits easy inspection and maintenance page 7
- **De-ion principle of arc interruption . . .**
  affords fast, positive action . . . important in this principle is the isolated center design of H-shaped blowout magnet and coil in the arc chute page 17

master alignment fixtures and welding jigs

utilized in manufacturing . . . assure accurate alignment of structures and interchangeability of all breakers of like rating page 5

"Limitrak" insulating system

furnishes superior, balanced protection in metal-clad switchgear bus supports, insulating barriers and type DH breakers page 25

surface treatments and finishes

provide protection from corrosion . . . are durable and pleasing in appearance page 22

Shelterfor-M metal-clad switchgear for outdoor service

represents the most advanced concept in outdoor switchgear design . . . provides sheltered aisle for inspection, maintenance and breaker interchange page 12

design proving in Westinghouse high power laboratory and production inspection-testing

Westinghouse metal-clad switchgear is design-proved in compliance with NEMA, ASA and AIEE Standards. Production inspection and testing of each assembly before shipment assure proper functioning of the component equipments. page 27

indoor metal-clad | design features

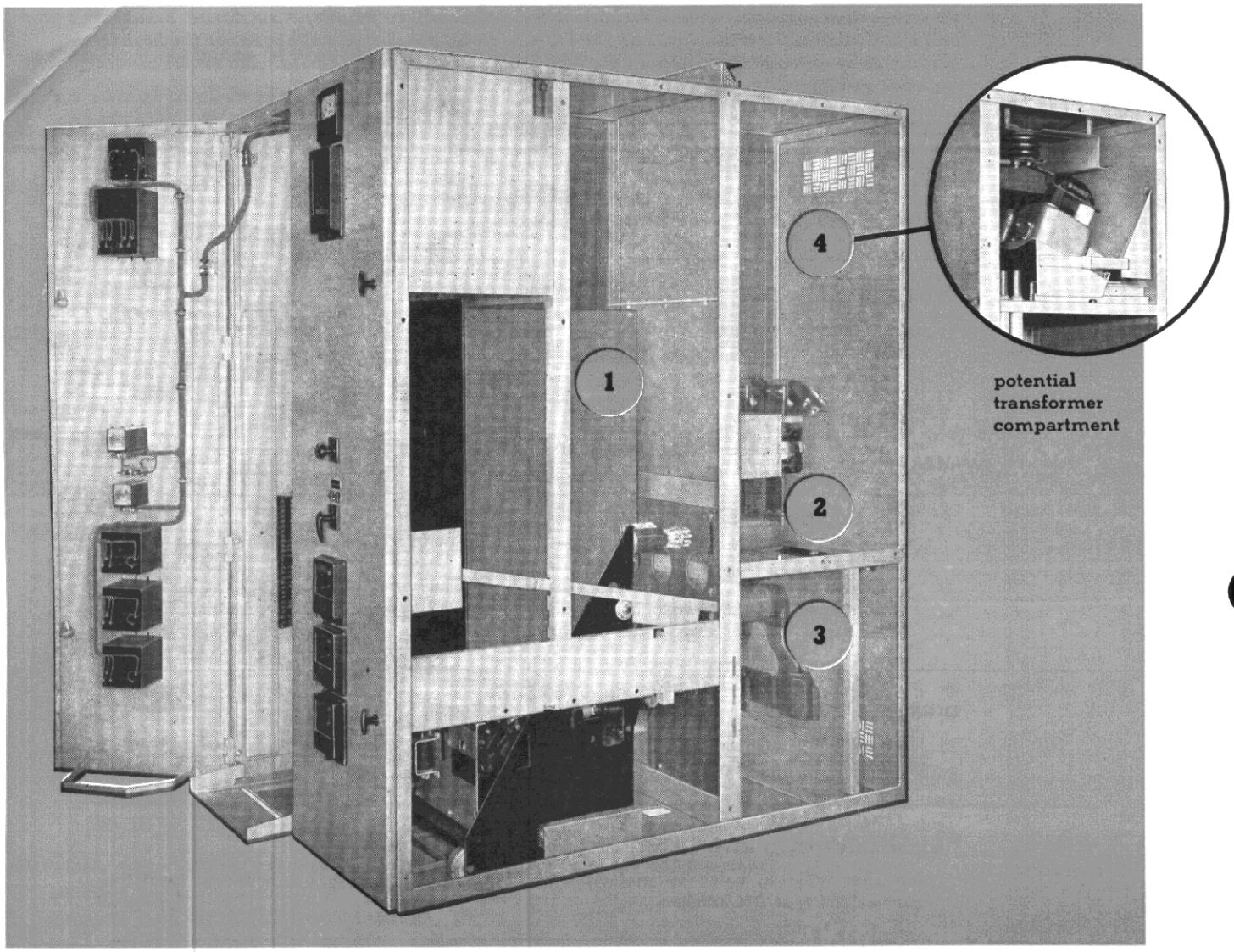


fig. 1

basic compartments and component devices

1	**breaker compartment**
2	**current transformer and cable entrance compartment**
3	**main bus compartment**
4	**potential transformer compartment▲**

application ratings

Westinghouse metal-clad switchgear is available for applications on circuits 2.4 kv through 13.8 kv, with continuous ratings from 1200 through 3000 amperes and interrupting capacities from 50 to 1000 mva. Metal-clad switchgear is coordinated and developed for the use of type DH air circuit breakers. Since the cell and breaker form one complete unit, the metal-clad unit assumes the rating of the breaker.

▲The potential transformer compartment may be included as an integral part of the 5 kv breaker unit, space permitting. For 15 kv, or in 5 kv units where space is not available, the potential transformer compartment will be located in a superstructure, or in an available auxiliary compartment in the assembly.

general construction

stationary structure: The stationary structure is built of structural steel members electrically welded to form a rigid assembly. The units are enclosed with sheet steel sides, roof sheets, bolted-on rear sheets and interior steel barriers to form the separate compartments for breaker, bus, current transformers and potential transformers. The front is provided with a steel hinged panel for mounting instruments, control switches and protective relays.

panel wiring: Advances in wiring are shown in fig. 2. All wire, including the front panel wiring, is stranded and flexible, possessing extremely long life. The panel wire is carried across the hinge in a bundle without the use of terminal blocks, eliminating a possible source of poor connections. This bundle is not subjected to sharp bends, thus eliminating the possibility of wire breakage. The inherent durability of stranded wire over solid wire further reduces the possibility of wire breakage from vibration during shipment. Terminal blocks for connection of external or off-panel wires are conveniently located in the control voltage compartment in a vertical column. They are exposed with the circuit breaker in the test position and are suitable for off-panel wiring connections entering through either the roof or the floor.

jig welding: Cell units are welded in jigs to assure accurate cell construction, which is important to assure complete interchangeability of standard breaker units of the same rating. The panels are accurately punched to very close tolerances on a special punch press.

master alignment fixtures: In metal-clad switchgear the alignment of the cell and the air circuit breaker is of utmost importance.

Positive alignment is assured in Westinghouse metal-clad switchgear by accurate manufacturing techniques and rigid double-checking procedure followed during assembly. These procedures are as follows:

1. All cells and breaker frames are jig-welded to assure uniform and square structures.
2. Assembly jig fixtures assure accurate location of cell rails, breaker wheels, stationary and moving contacts, and other devices.
3. Every stationary structure is checked for alignment with a master removable element.
4. Each air circuit breaker removable element is checked in a master stationary jig to assure that the breaker is properly aligned.

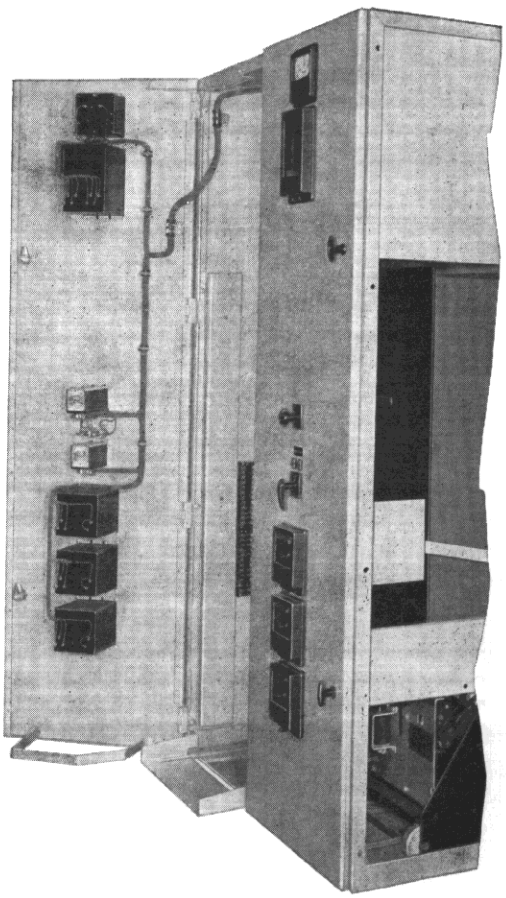


fig. 2: **Typical panel wiring.**

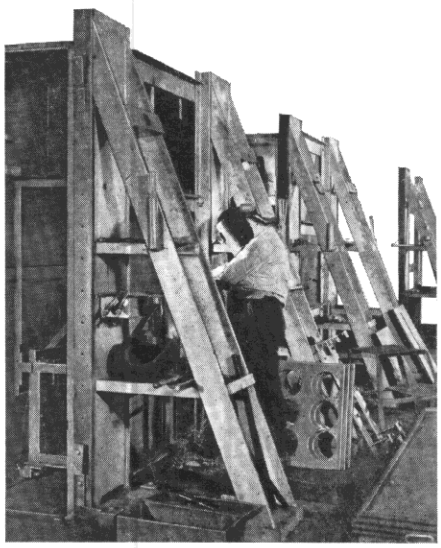


fig. 3: **Rigid upright welding fixtures assure uniform, plumb and square stationary structures.**

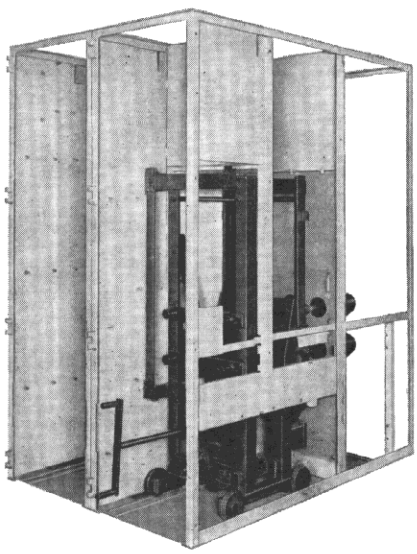


fig. 4: **Every stationary structure is checked for alignment with master removable element.**

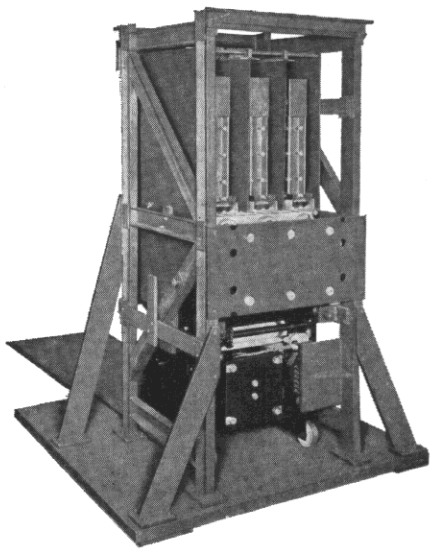


fig. 5: **Every breaker element is checked for alignment with a master stationary jig.**

indoor metal-clad *continued*

1 circuit breaker compartment

breaker movement into cell

Figure 6 shows the interior of a metal-clad breaker cell. With the breaker withdrawn, a shutter drops by gravity to prevent accidental contact with the stationary main contacts. As the breaker is inserted into the cell, a roller on the breaker engages the shutter lifting arm when the breaker reaches the test position. Then, as the breaker levering-in mechanism is cranked, the breaker moves deeper into the cell and automatically raises the shutter, allowing the breaker to continue its travel until fully engaging the main contacts. As the breaker is withdrawn to the test position the shutter drops, thus isolating the stationary studs.

To assist in properly aligning the horizontal drawout DH breaker wheels with the cell rails, a breaker guide is supplied. This breaker guide can be seen in figure 6. As the breaker is inserted into the cell, the guide automatically aligns the breaker wheels with the cell rails.

positive grounding

A full momentary ground bus extends through all stationary units. The breaker frame is effectively grounded before the primary contacts engage, through a heavy multiple finger ground contact, as illustrated in figure 7.

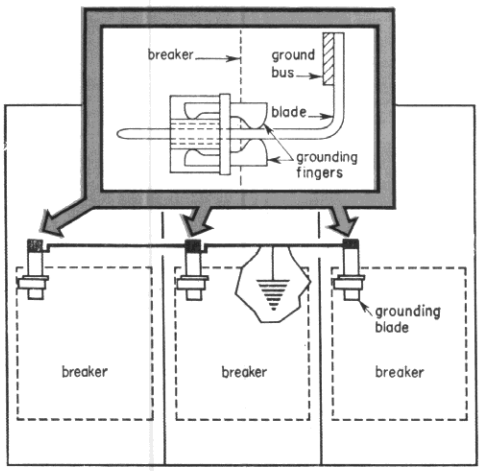
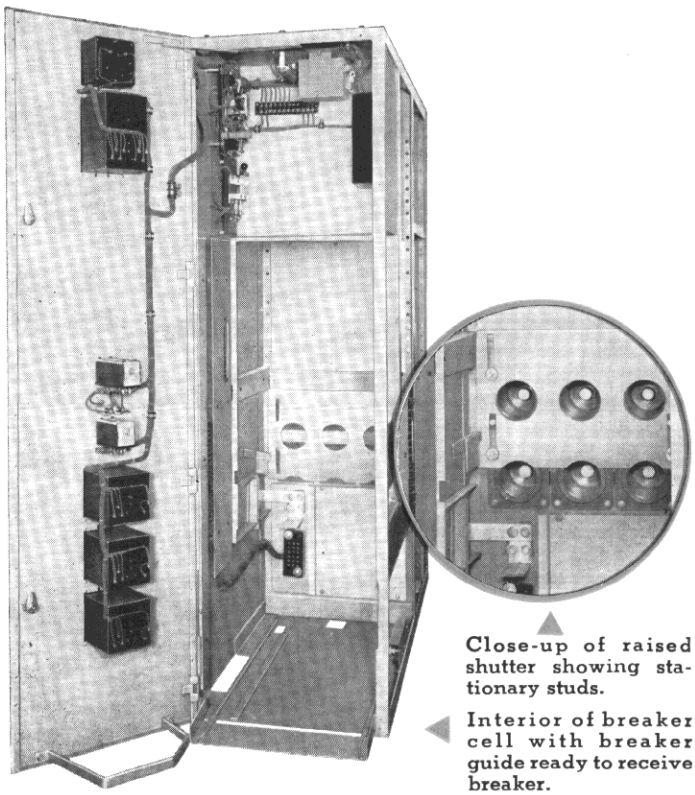


fig. 7: Ground bus and contact arrangement.

safe, easy testing

With breaker in the "test" position, secondary control is established by engagement of the secondary contacts on the breaker with the secondary contacts in the cell.

Easy engagement of the secondary contacts is accomplished as shown in figure 8.



Close-up of raised shutter showing stationary studs.

Interior of breaker cell with breaker guide ready to receive breaker.

fig. 6: Interior of metal-clad breaker cell

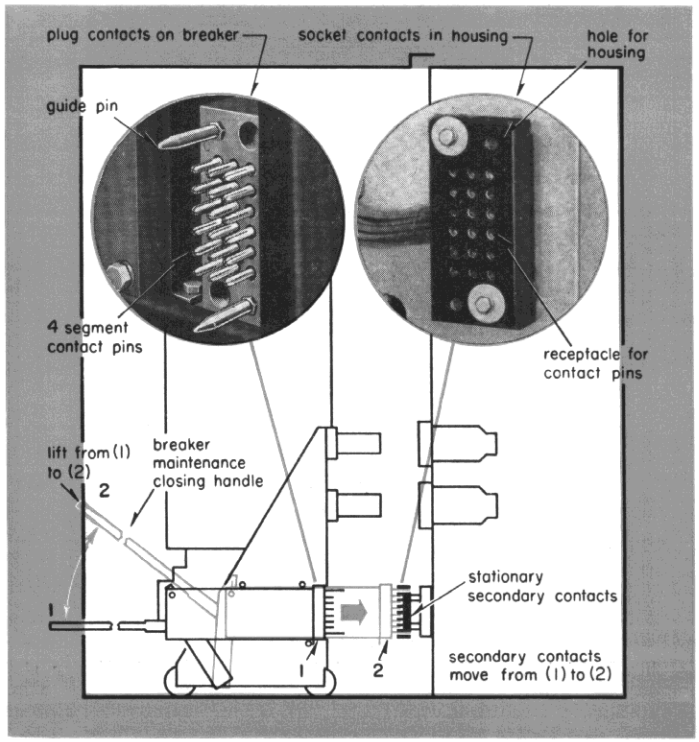


fig. 8: Engagement of secondary contacts for breaker testing.

horizontal drawout DH breaker arrangement simplifies inspection • maintenance • breaker interchange

1. **Withdrawal of DH breaker** from test position for inspection and maintenance is accomplished by a horizontal movement of the breaker . . . no vertical lifting is required. Three simple procedures:
   - DH breaker is horizontally drawn out
   - breaker barriers are removed
   - arc chute is tilted

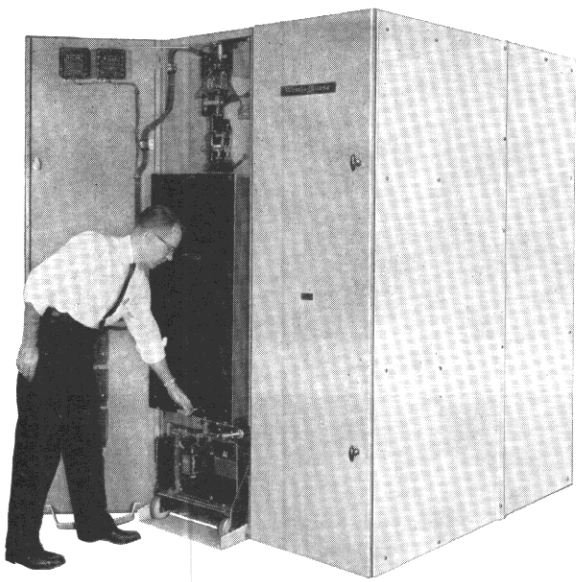


fig. 9: DH breaker is drawn from cell by straight horizontal movement

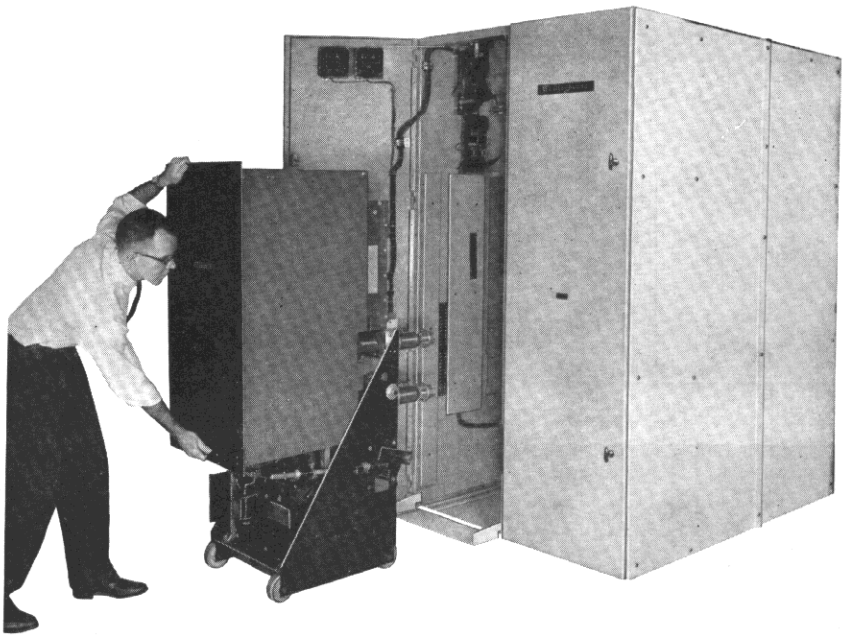


fig. 10: Breaker interphase barriers are removed by loosening bolts and sliding barriers from breaker.

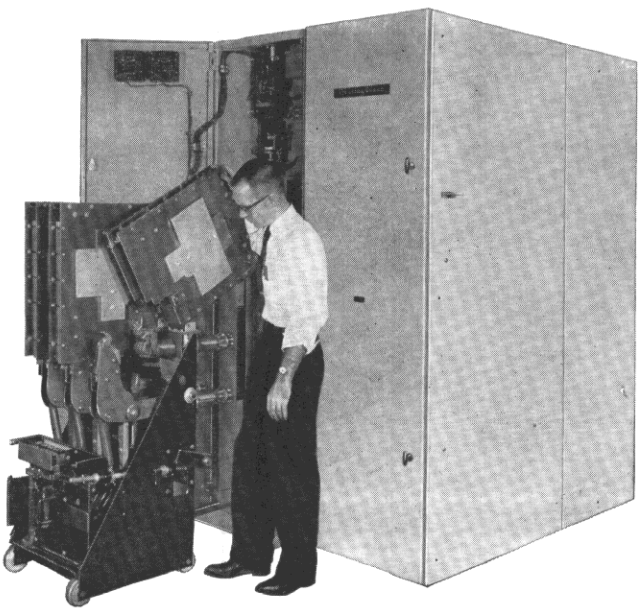


fig. 11: Easy tilting of arc chutes permits ready access to main contacts for inspection and minor maintenance. Smaller chutes are tilted by hand; larger chutes are tilted by hand-operated crank.

indoor metal-clad *continued*

1 circuit breaker compartment

2. Insertion of DH breaker is accomplished by these procedures . . .

- breaker guide automatically aligns breaker wheels with the cell rails
- breaker is moved horizontally to test position by easy manual motion
- breaker is then moved to operating position by levering-in mechanism
- power is turned on by "W" control switch

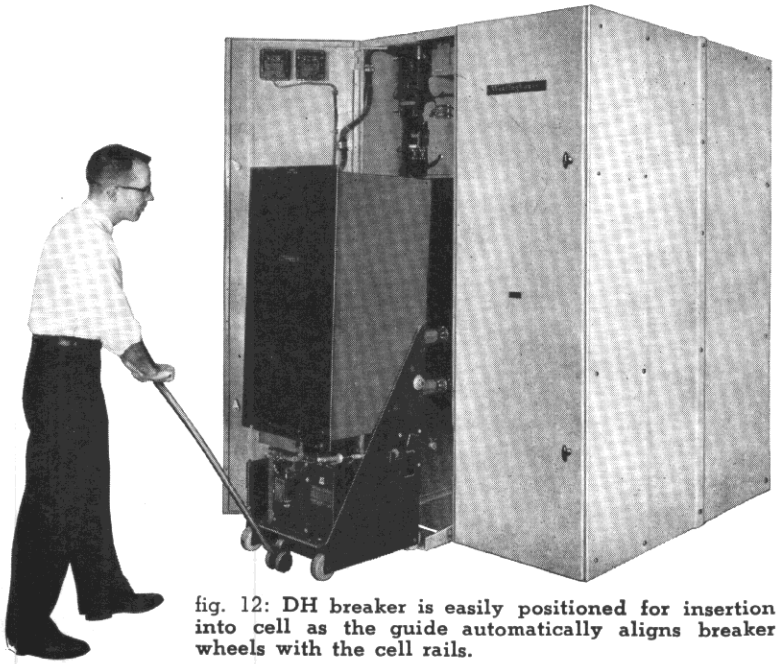


fig. 12: **DH breaker is easily positioned for insertion into cell as the guide automatically aligns breaker wheels with the cell rails.**

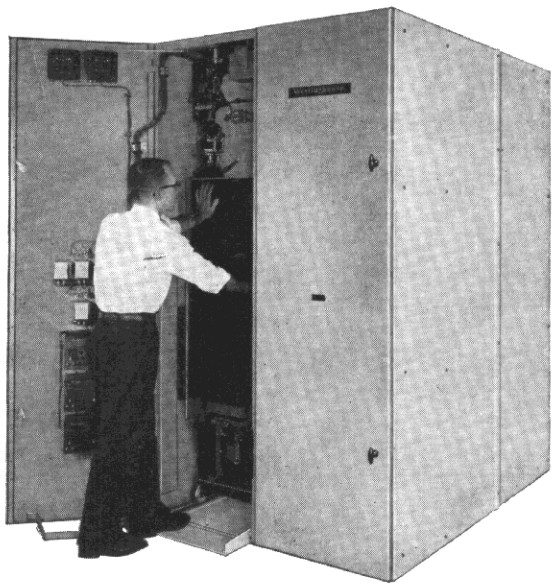


fig. 13: **DH breaker is moved horizontally into test position, being stopped by the levering-in device. The shutter remains closed.**

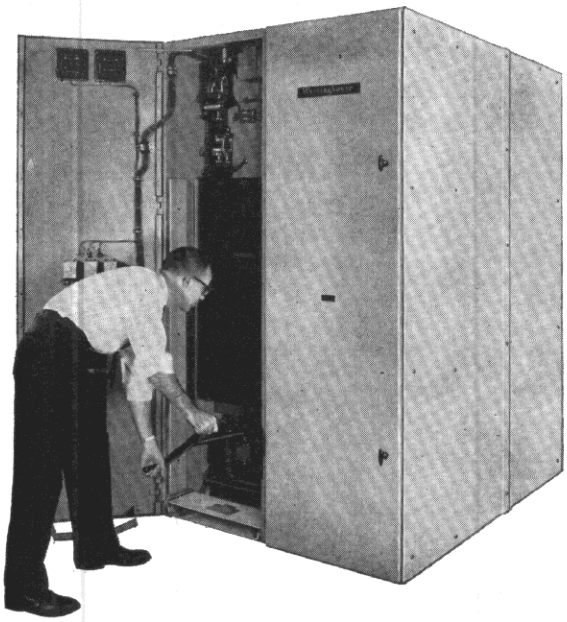


fig. 14: **The breaker is easily levered into the operating position. The shutter opens automatically.**

fig. 15: **Type "W" control switch is turned to desired position by easy finger action. Two metal barriers between operator and breaker provide complete safety when circuit is energized.**

2 current transformer and cable compartment

The current transformer and cable compartment is located to the rear of the metal-clad unit. The compartment is barriered to isolate it from other compartments. A sturdy, bolted-on rear panel provides complete exterior isolation for safety and proper ventilation, which rear sheet can be seen on the left in figure 16.

This compartment is exposed by the easy removal of the bolted-on rear panel as shown on the right in figure 16. Easily accessible are the upper stationary main contact supports, current transformers, cable terminals and cable supports shown in close-up figure 17.

The upper main contact supports are part of the Westinghouse "Limitrak" insulation system. The transformer primary bars are clamped securely by a support made from "Limitrak" polyester insulation. The transformer primary bars are fully insulated and the joints at the main contact supports are sealed with a polyester compound.

The ring-type current transformers utilize Hipersil wound cores, which produce metering and relaying accuracies well within established industry standards.

The illustrated cell is equipped with solderless-type terminals and cable supports for customer's primary cable connections. However, potheads are readily accommodated.

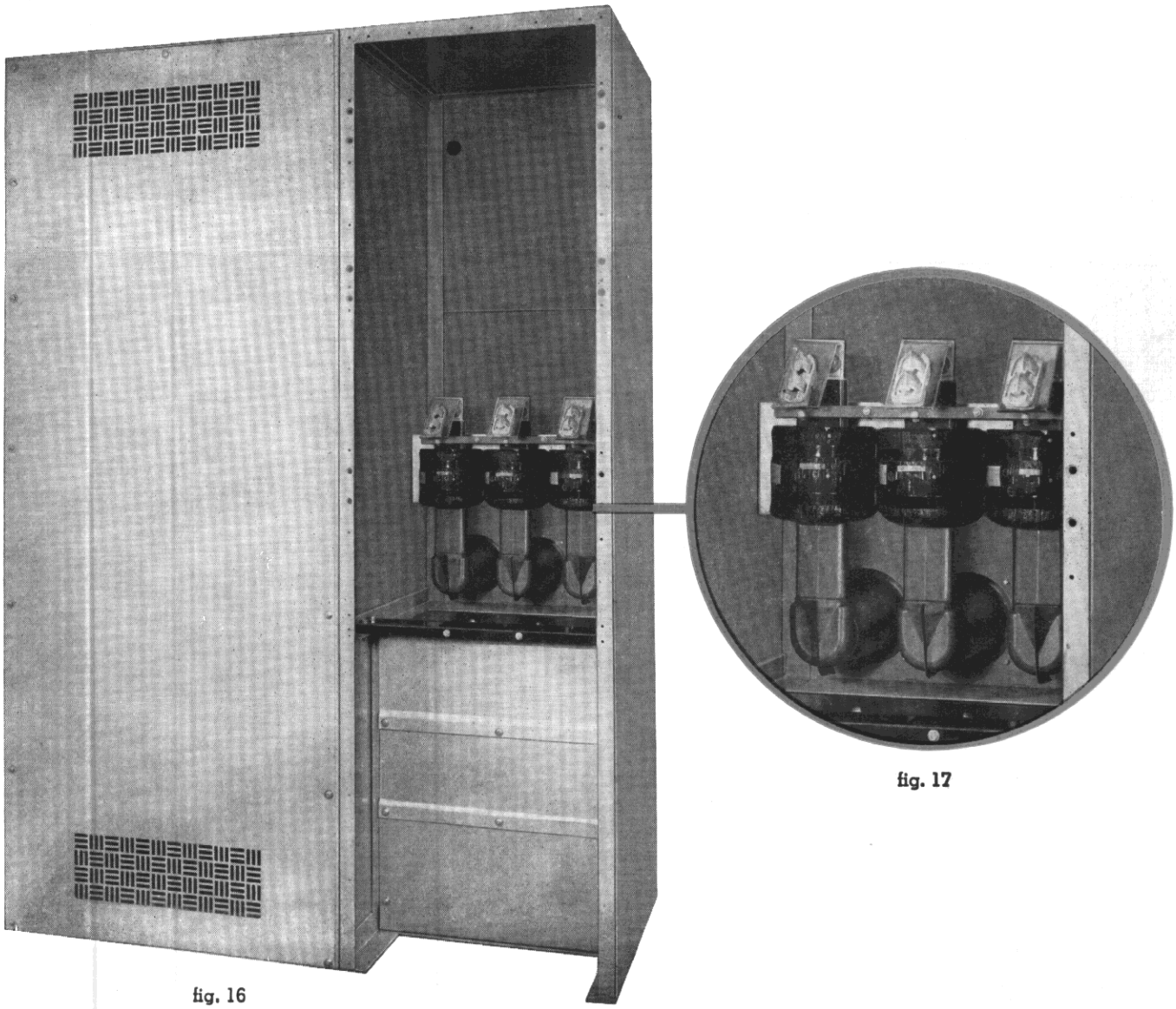


fig. 16

fig. 17

indoor metal-clad *continued*

3 main bus compartment

The main bus extends along the lower rear section of the metal-clad unit. This compartment is barriered to isolate it from other compartments. Bolted-on split covers are indicated in figure 19.

The main bus compartment is exposed by easy removal of the bolted-on split covers as shown in figure 20. Easily accessible are the lower stationary main contact supports and main bus shown in figure 18.

The lower main contact supports are part of the Westinghouse "Limitrak" insulation system. The connecting bars between the main contact supports and the main bus are fully insulated. The joints at the main contact supports and at the main bus are sealed with a polyester compound.

The insulated main bus extends the length of an assembly of two or more units and is supported between units by a "Limitrak" support. The support has no hidden surfaces that could become contaminated to form leakage paths.

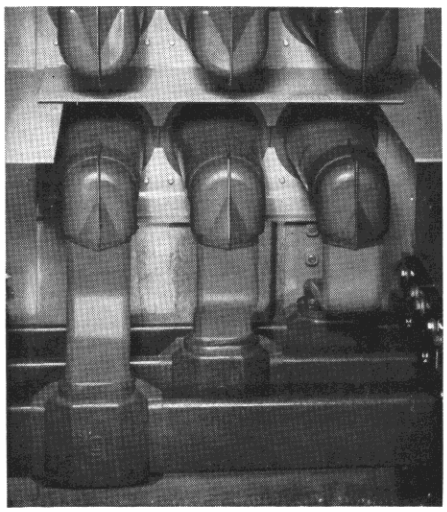


fig. 18

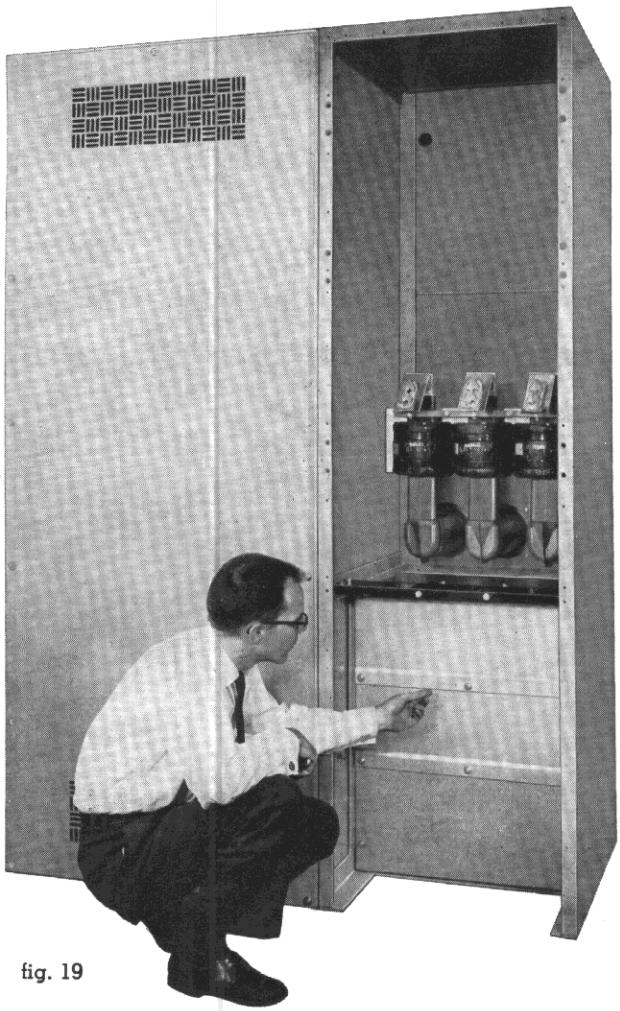


fig. 19

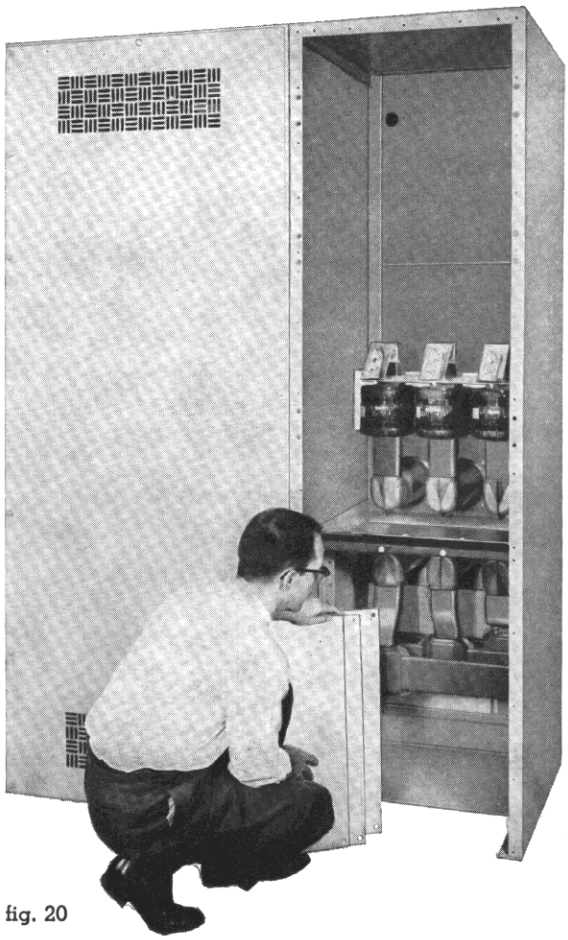


fig. 20

4 drawout potential transformer compartment

The potential transformer compartment may be located in three positions:

1. In an available auxiliary unit in the metal-clad lineup for both 5 kv and 15 kv ratings as shown in figure 21.
2. In a superstructure on top of the assembly for both the 5 kv and 15 kv ratings.
3. In a breaker unit, when space is available, at the rear above the current transformers as an integral part for only the 5 kv rating as shown in figure 22.

The potential transformers are mounted on a drawout truck that is linked to the hinged compartment door. With the compartment door closed, the potential transformers are completely isolated and the primary and secondary disconnect contacts are engaged with their respective stationary contacts to complete the circuit. Upon opening the door, the transformers are automatically withdrawn for inspection or maintenance, the primary and secondary disconnect contacts are disengaged, and the transformer primary is grounded. The transformers are protected with current-limiting fuses and are design-coordinated to withstand the basic impulse level of the metal-clad switchgear.

fig. 21

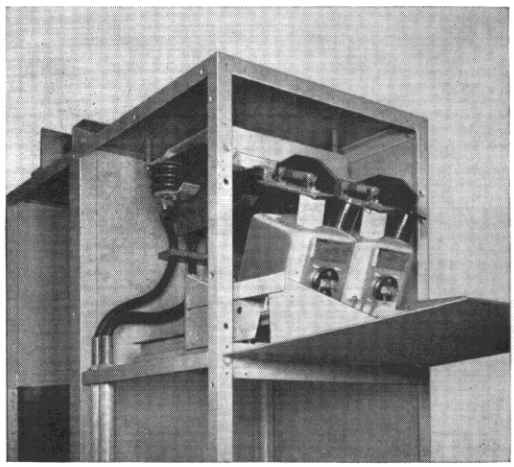


fig. 22

see application data 32-260 for . . .

standard unit arrangements; dimension drawings and tabulations; application data tables on DH breakers; potential transformers; current transformers; selector guide of standard units; how to order information

outdoor types of metal-clad

Shelterfor-M outdoor metal-clad

Shelterfor-M, the modern concept in outdoor metal-clad switchgear, was an "industry first" by Westinghouse. The name is derived from the expression "shelter for maintenance". Westinghouse Shelterfor-M outdoor metal-clad switchgear provides a sheltered aisle for inspection, maintenance and breaker interchange. Such protection permits scheduled inspections and maintenance independent of all weather conditions.

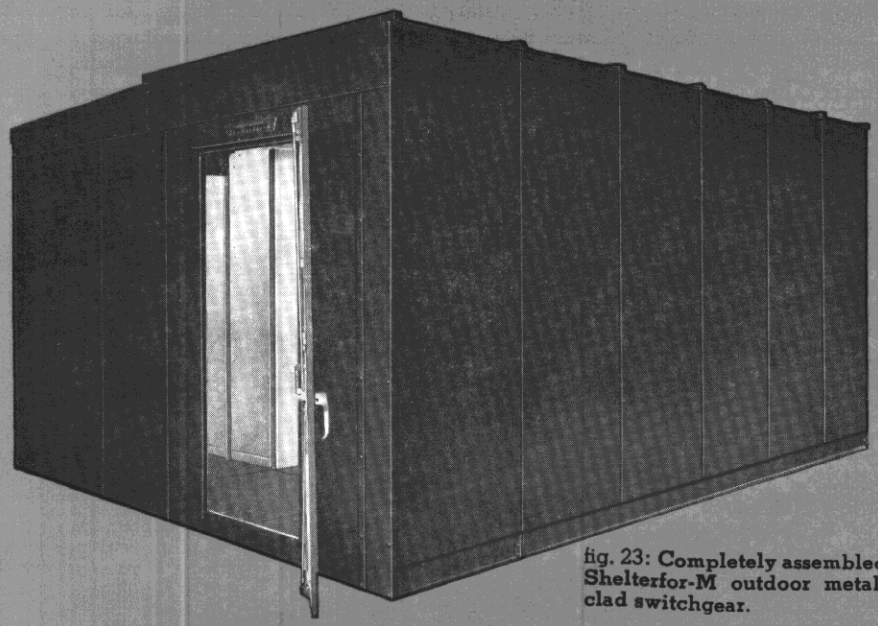


fig. 23: Completely assembled Shelterfor-M outdoor metal-clad switchgear.

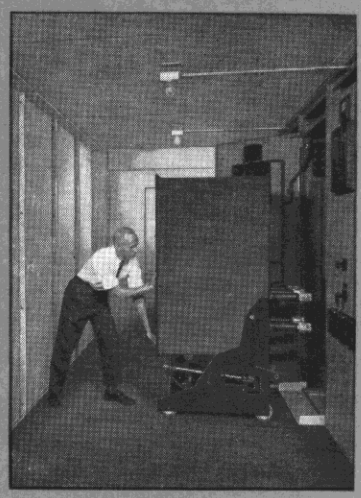


fig. 24: Shelterfor-M aisle for inspections, maintenance and breaker interchange.

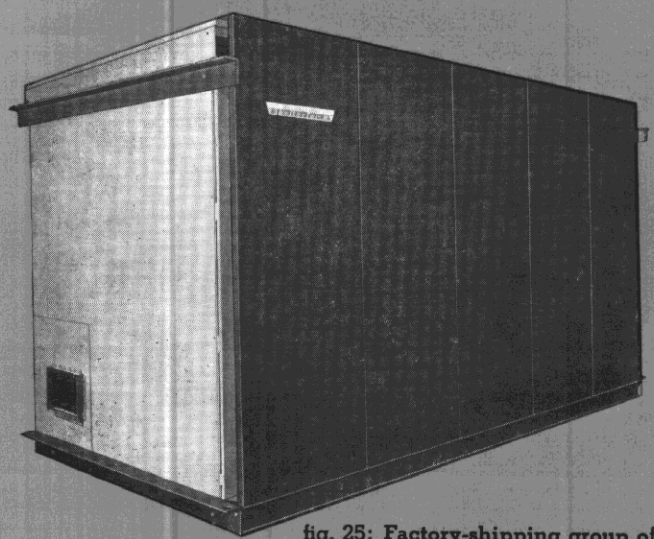


fig. 25: Factory-shipping group of Shelterfor-M outdoor metal-clad.

fig. 26: Assembly of Shelterfor-M in process.

design and construction arrangement

Shelterfor-M outdoor metal-clad utilizes indoor metal-clad switchgear with the addition of a weatherproof enclosure and a sheltered-aisle to provide all-weather protection for personnel and equipment. The description of basic design features for indoor metal-clad switchgear as covered on pages 4 to 11 applies also to Shelterfor-M outdoor metal-clad, **plus** the following design features.

In the Shelterfor-M outdoor metal-clad design, the weatherproof structure completely encloses the indoor metal-clad unit. The operating aisle consists of roof sections, end panels, floor plates and outer enclosure front panels as well as floor channels.

ventilation, heaters, outdoor accessories

Ventilation with filters is provided for both the aisle and switchgear cells. Heaters are furnished to prevent condensation.

A door is located at each end of the aisle and is equipped with internal crash hardware to permit exit even though the door is locked from the outside. The enclosure is also equipped with convenience outlets and internal illumination.

variety of standard arrangements

Shelterfor-M outdoor metal-clad is supplied in a variety of standard arrangements such as single row—single aisle . . . double row—common aisle. Shelterfor-M outdoor metal-clad retains the unit assembly type of construction to facilitate adding units to the lineup in the future.

A service area for housing batteries, relay panels and additional maintenance equipment can be supplied as an integral part of the Shelterfor-M lineup, eliminating the need for separate concrete block or brick buildings to house these facilities.

foundation arrangements

Foundation arrangements are minimized with Shelterfor-M outdoor metal-clad. A true and level concrete pad is not required because the unit can be pier-mounted. Pier mounting is possible since the steel plate floor of the operating aisle provides the level surface required for breaker withdrawal. The hinged instrument panel opens into the operating aisle and the breaker is withdrawn into the same aisle. This provides maximum use of the available space since the drawout space and instrument panel space are common.

surface protection and finishes

Thorough surface treatments are given Shelterfor-M metal-clad as protection from corrosion, and to protect the superior finished appearance. This includes the phosphatizing treatment for each component—indoor metal-clad unit, breaker frame and weatherproof enclosure—in a series of tank processes followed by prime coating and finish painting.

An additional protective coating is applied to inaccessible base surfaces as lasting protection from corrosion.

shipping plan

Shelterfor-M outdoor metal-clad is shipped with the cell units completely assembled. The Shelterfor-M aisle portion is shipped in sub-assemblies for quick, easy erection. The shipping groups consist of as many units as can be conveniently customer-handled at installation point and subject to shipping limitations.

representative applications of Shelterfor-M outdoor metal-clad

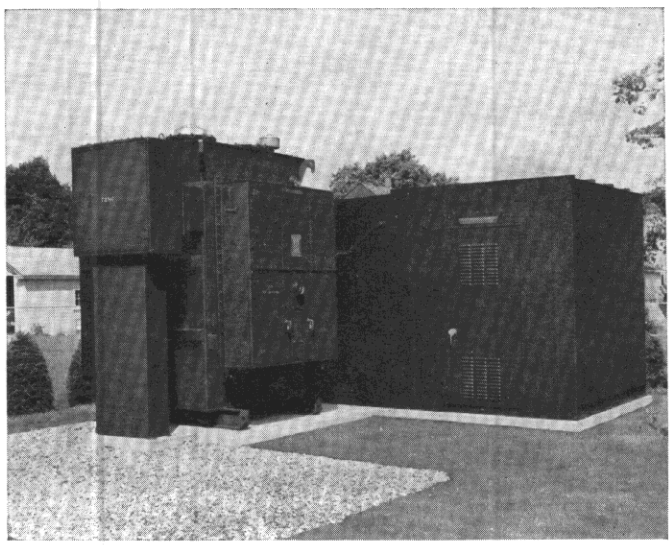


fig. 27: **In electric utility unit substation service. Affords compactness and superior performance.**

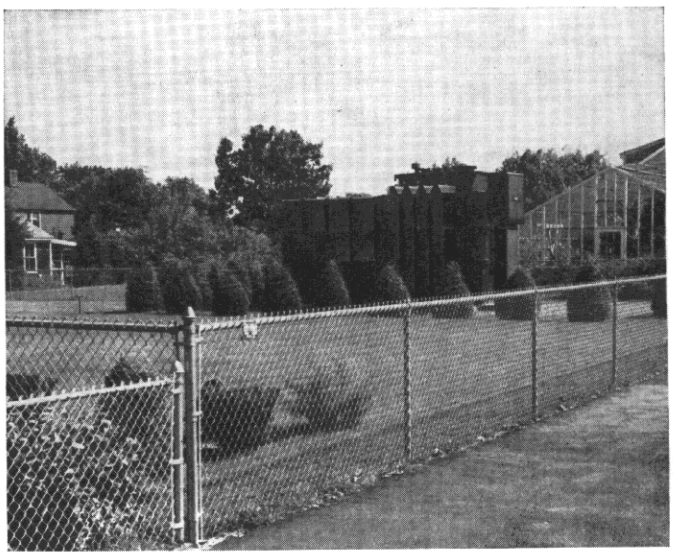


fig. 28: **In residential-commercial area. Can become "good neighbor" in overall appearance and service to community.**

outdoor types of metal-clad *continued*

Shelterfor-M outdoor metal-clad

representative applications of Shelterfor-M outdoor metal-clad

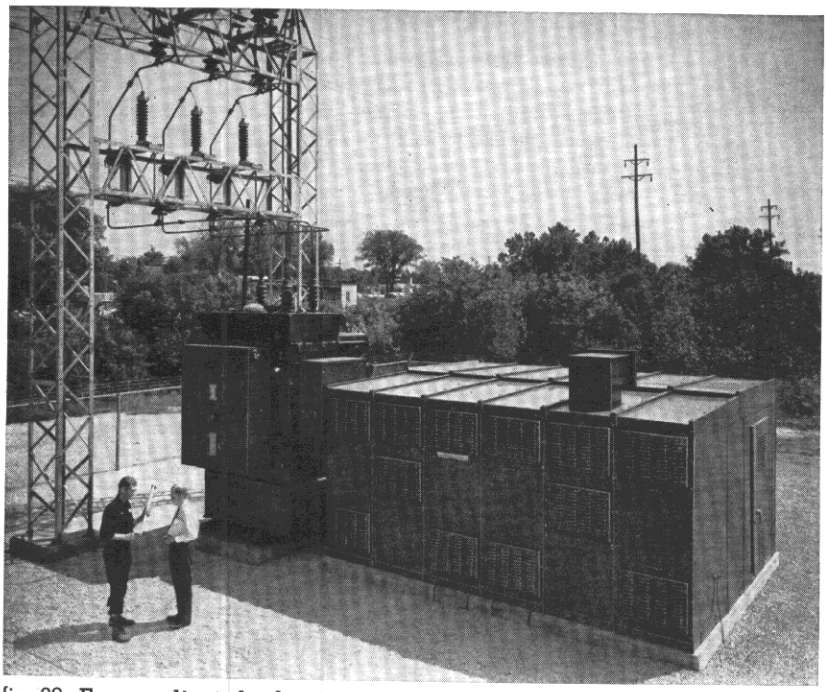


fig. 29: For coordinated substation service.

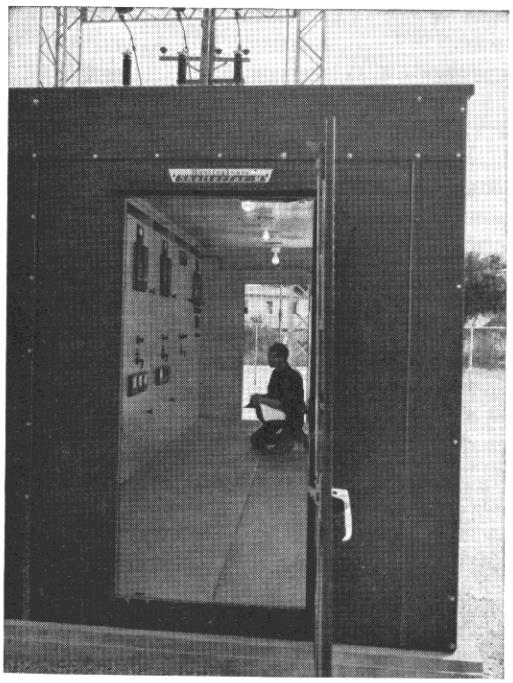


fig. 30: Close-up of sheltered service aisle for personnel and equipment.

fig. 31: Shelterfor-M switchgear in limited space—between buildings. One of early installations of Shelterfor-M.

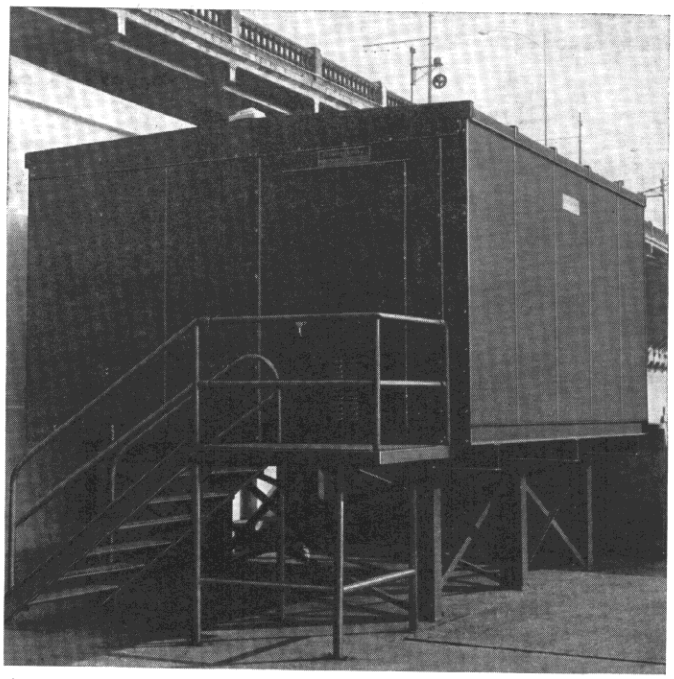


fig. 32: Shelterfor-M switchgear mounted on customer pier in location subject to high water. Another early installation.

Non-Shelterfor-M outdoor metal-clad

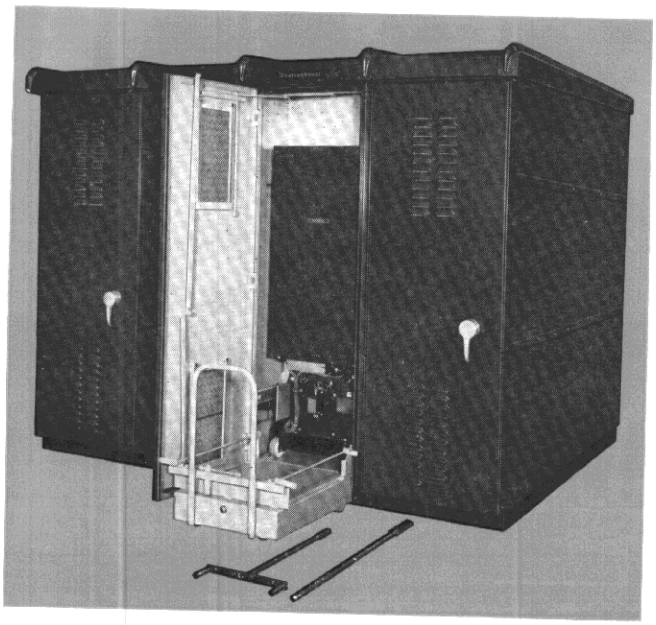


fig. 33: Non-Shelterfor-M outdoor metal-clad showing transport truck in accurate alignment with breaker cell and securely latched to stationary structure—ready for horizontal drawout movement of DH breaker. Truck latching also holds breaker firmly in position during transport.

The Non-Shelterfor-M outdoor metal-clad overall design includes the same assembled equipment as indoor metal-clad and additionally incorporates the outdoor operation features of weather proofing, heating, ventilation and breaker transport truck. In Non-Shelterfor-M metal-clad, the breaker drawout side is opposite to the instrument panel side.

stationary structure and overall weatherproofing

As indicated above, this overall design utilizes the same assembled equipment as indoor metal-clad. Compartments provide maximum use of space, safe operating arrangements and accessibility for inspection and maintenance. Removable bolted-on covers give access to high voltage circuits.

Weatherproofing is accomplished through the use of heavy gauge steel with rigid fitting and adequate sealing of seams. Front and rear doors are double-flanged for rigidity and fitted into channel frames that assure weather resistance. Roof seams are covered to provide weather seals.

Base and roof sections are integral to the individual unit, which permits later additions or rearrangement of units to suit changes in operating requirements.

panel space and control devices

Design arrangements similar to indoor metal-clad are included.

ventilation and heating

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

Heating elements are located in each cell. The combination of free-moving ventilating air and the heating elements provides outdoor units which are free from condensation.

breaker transport truck

DH air circuit breakers in this type of outdoor metal-clad are handled externally on a four-wheeled transport truck. The truck has two fixed and two swivel wheels which facilitate aligning the breaker unit with the stationary structure. This adjustable transport truck compensates for variations in the concrete mounting pad. The truck is securely latched to the stationary structure for inserting or removing the breaker element; the breaker element is latched to truck during its movement outside of the stationary structure, as shown in fig. 34.

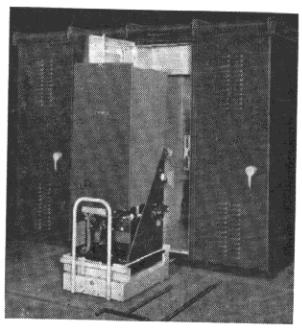


fig. 34: Close-up shows the DH breaker on transport truck after removal from cell. Crank is used for levering breaker in or out of cell. Straight bar is for maintenance closing of breaker.

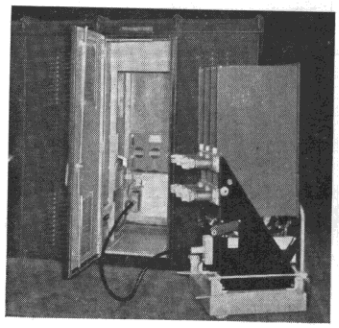


fig. 35: Special test jumper, standard accessory for breaker unit inspections, tests and maintenance.

test jumper

As a standard accessory, a test jumper is furnished to permit unit inspection, maintenance and test of the DH breaker at the switchgear site as shown in fig. 35.

all-weather undersurface coating

Undersurfaces of outdoor metal-clad receive an application of heavy, rubberized sealing material at the factory. This coating provides a thick, air-tight seal as lasting protection of the undersurfaces from costly deterioration.

see application data 32-260 for . . .

standard unit arrangements; dimension drawings and tabulations; application data tables on DH breakers; potential transformers; current transformers; selector guide of standard units; how to order information.

type DH magnetic De-ion air circuit breakers

horizontal drawout

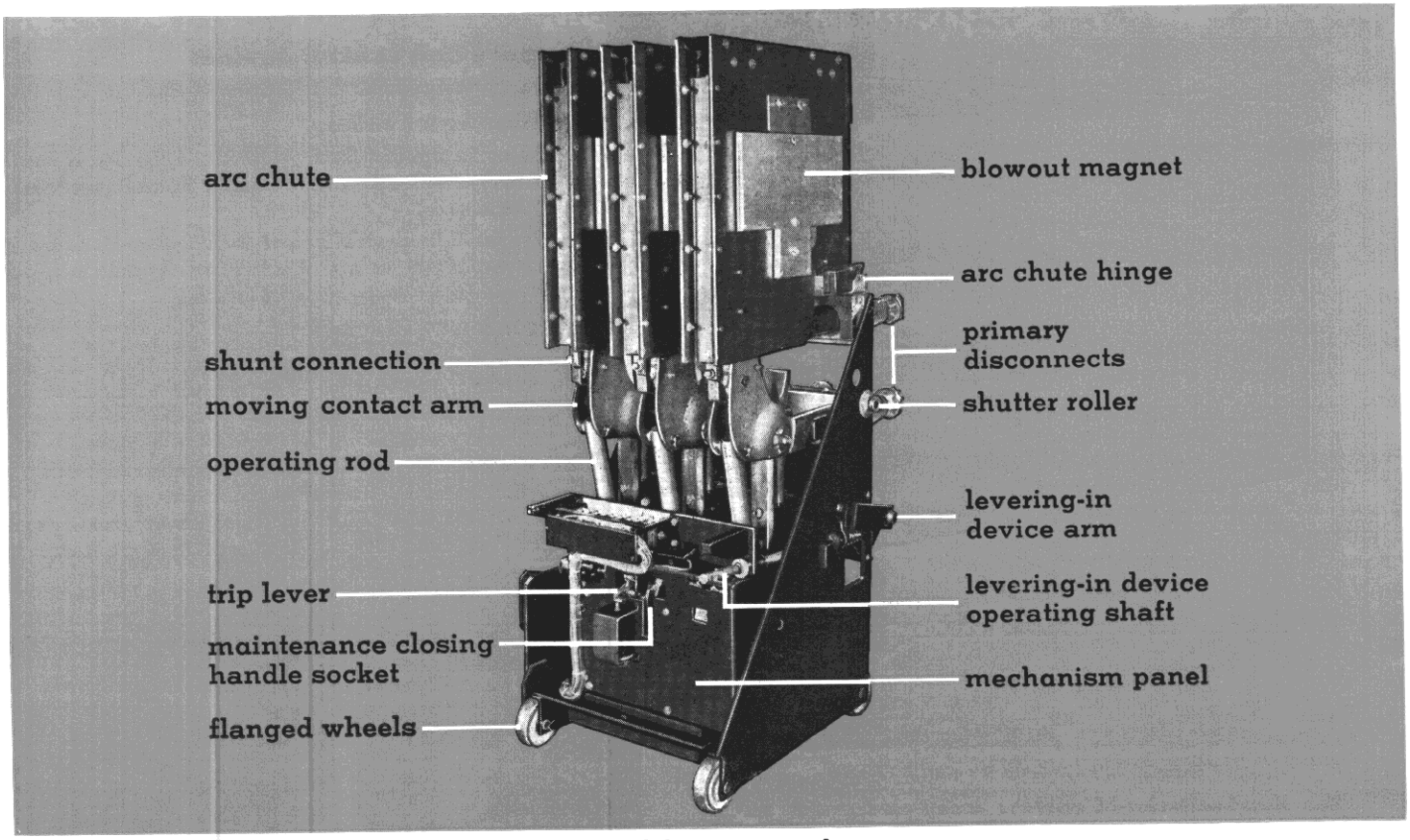


fig. 36: Type 50-DH-250, 1200 ampere breaker, front view, with barrier removed.

general construction and components

Type DH magnetic De-ion air circuit breakers, as major components of Westinghouse indoor and outdoor metal-clad switchgear, provide superior circuit protection.

Type DH air circuit breakers are 3-pole, electrically-operated, and built as horizontal drawout units. The horizontal drawout principle permits the breaker to be rolled into the cell and into contact engagement with no lifting required.

Figure 36 shows the DH breaker with the main barrier removed, the center-coil arc chutes in their operating positions, and various other component arrangements. Figure 37 shows the front and right side of a typical DH breaker completely assembled. Figure 38 shows the breaker from the left rear ready to be placed in the cell.

Part of the moving contacts, primary disconnecting contacts, insulated operating rods, auxiliary switch and part of the solenoid operating mechanism are visible. These components are supported on a welded steel frame which is mounted on flanged wheels for rolling into the metal-clad cell. In the lower part of the frame is located the levering-in device for moving the breaker into final contact engagement. This is interlocked with the mechanism to prevent inserting or withdrawing the breaker with the contacts closed, and also prevents closing the contacts unless the breaker is in the fully connected or test position.

front view

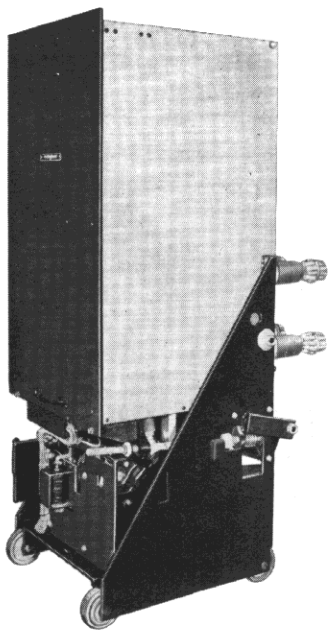


fig. 37: Type 50-DH-250, 1200 ampere breaker, completely assembled.

rear view

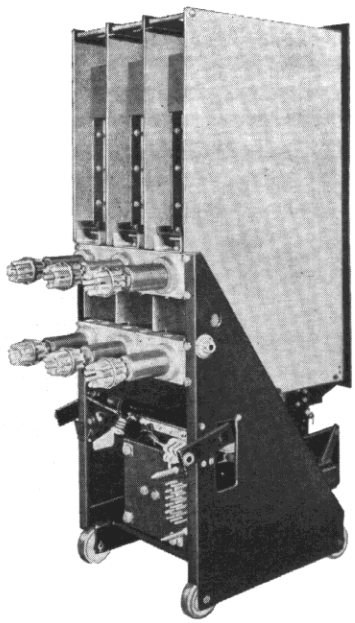


fig. 38: Same breaker, completely assembled, rear view.

arc chutes

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

The arc chutes are of the center-coil design in which the magnet is H-shaped with the cross member of the H passing through the center of the arc chute. The blowout coils are wound around the cross member of the H, and are located inside the arc chute jacket. With this arrangement, the blowout magnet becomes an integral part of each arc chute assembly. This type of arc chute construction provides the most compact interrupter for its rating and results in maximum overall dielectric strength for its size, complying with all high potential and impulse test requirements.

To provide accessibility for contact maintenance and inspection, the arc chutes are hinged at the rear. Figure 39 shows the breaker with the arc chutes tilted back. In this position, the contacts are readily available for inspection and maintenance.

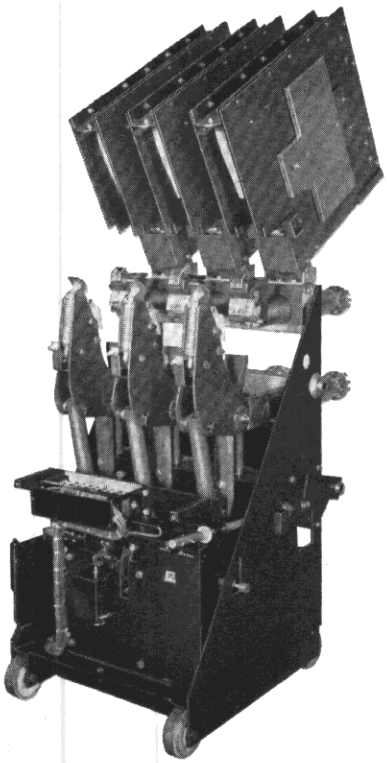


fig. 39: Type 50-DH-250, 1200 ampere breaker, with barrier removed and arc chutes tilted back for inspection.

De-ion principle of arc interruption

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

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

coordinated design arc chute with side removed shows—

1. Magnet yoke and blow-out coil.
2. Ceramic refractory material—resists thermal shock.
3. Glass polyester arc chute enclosure.

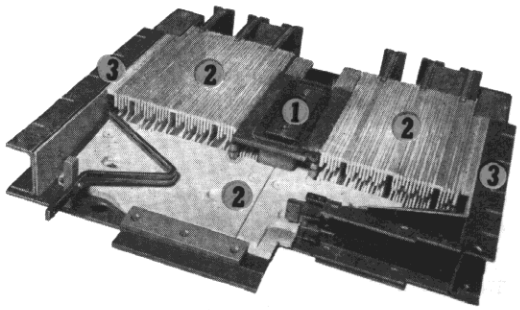


fig. 40

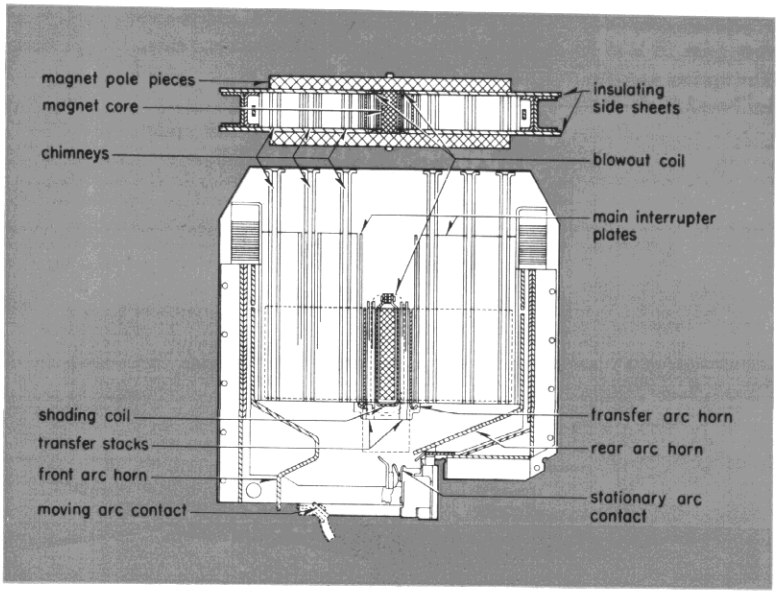


fig. 40a: Arc chute and blowout coil.

puffers

All ratings of DH breakers are equipped with air puffers to speed the interruption of low current arcs. Of diaphragm type, the puffers cause no extra friction, with no "sticking" of the assembly during operation.

type DH magnetic De-ion air circuit breakers *continued*

operating mechanisms

type DH solenoid operating mechanism

This closing mechanism for DH breakers is operated by a solenoid which pulls a moving core. The movement of the solenoid core is transmitted to the operating rods through a system of links which rotate about the operating center.

The solenoid operating mechanism is supplied as standard on all type DH breakers and has a long record of reliable service due to the sturdiness and simplicity of the design. The solenoid mechanism can be operated by d-c or rectified a-c current.

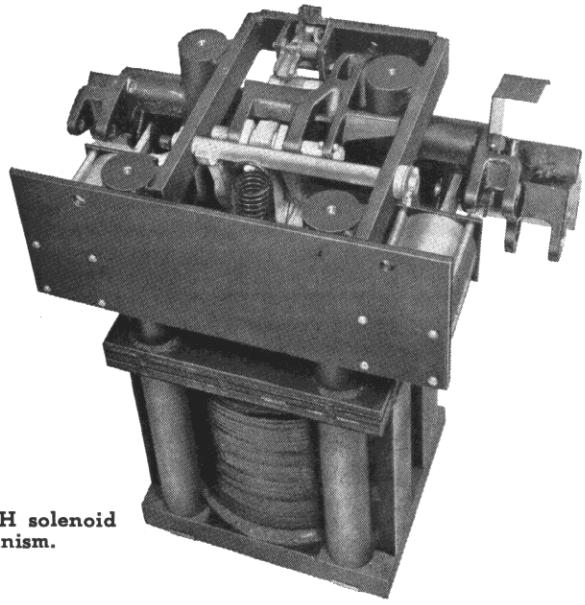


fig. 41: **Type DH solenoid operating mechanism.**

type SE spring stored energy operating mechanism

The spring stored energy mechanism can be supplied, as an option, for closing DH breakers of ratings 150 mva at 4.16 kv through 1000 mva at 13.8 kv.

In the stored energy mechanism the energy is first stored in a spring and then released for closing the breaker. The spring is compressed by means of an a-c or d-c operated motor and reduction gear in 5 to 10 seconds, depending on the breaker rating. The spring energy is expended in approximately 1/6 to 1/4 second for breaker closing.

Safety features are provided to assure discharging the spring before the breaker is withdrawn from the cell. In case of loss of control power, the spring can be compressed by hand. On reclosing duty the stored energy mechanism provides for one instantaneous reclosure with subsequent reclosures at 15 second intervals to permit time to recompress the spring.

Stored energy mechanisms are frequently applied on network systems where it is necessary to close several breakers simultaneously. The stored energy mechanism permits storing the energy at a relatively low rate, thus permitting a low demand control power source.

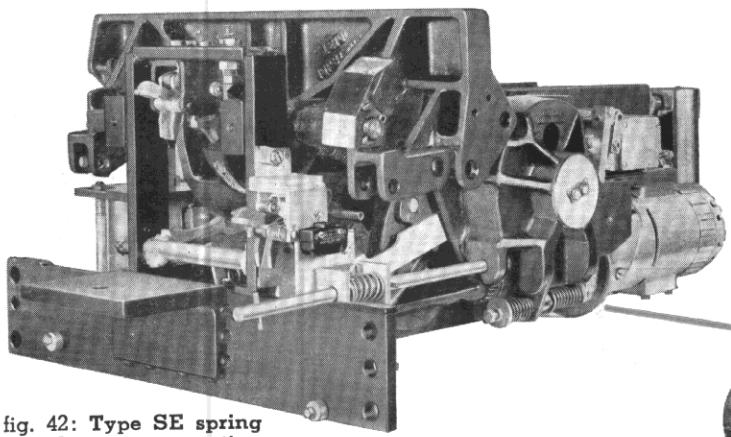


fig. 42: **Type SE spring stored energy operating mechanism.**

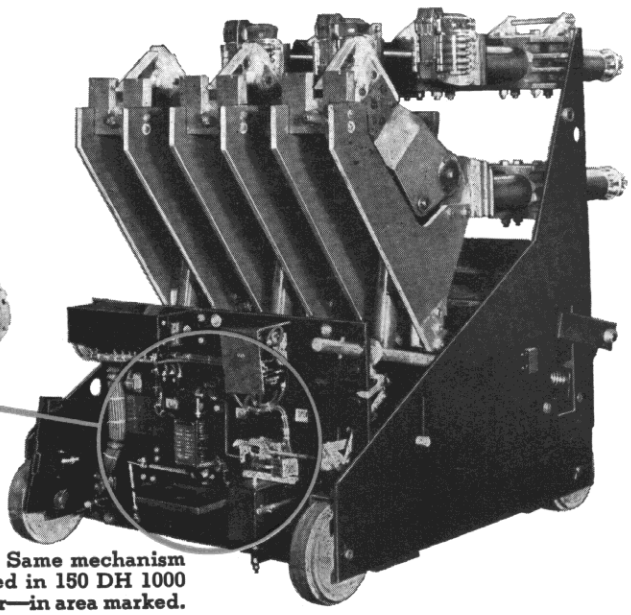


fig. 43: **Same mechanism installed in 150 DH 1000 breaker—in area marked.**

standard DH breakers and ratings

For Westinghouse metal-clad switchgear, Westinghouse offers a complete standard line of type DH breakers for circuits from 2.4 to 15 kv. Breakers of the same rating are interchangeable. Changing breakers is only a matter of minutes with the horizontal drawout arrangement as previously discussed and illustrated on pages 7 and 8.

A complete table of application data for available DH breaker types is furnished in application data 32-260, page 12.

type 50-DH-75 { 50 mva at 2.4 kv and 75 mva at 4.16 kv, 1200 amperes continuous.

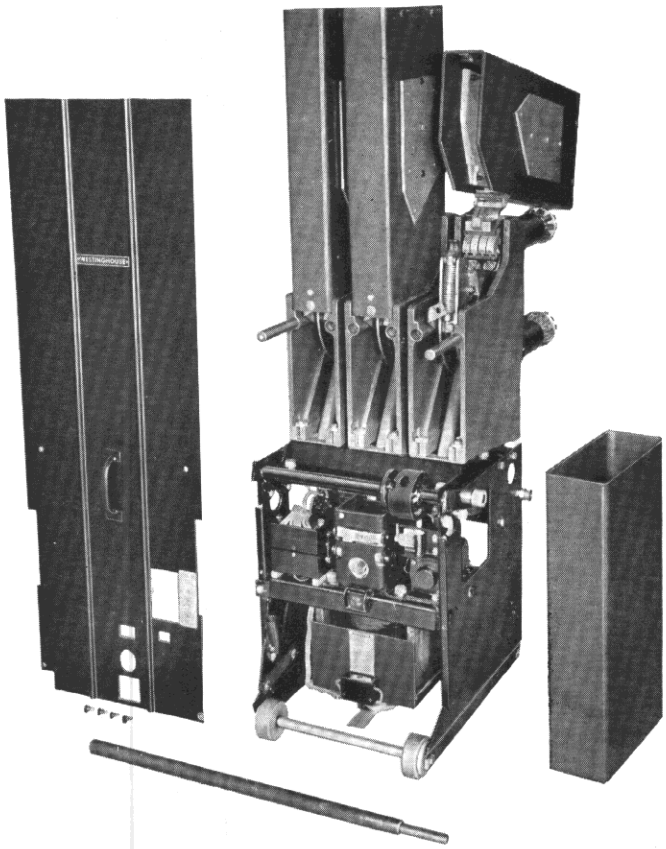


fig. 44: Steel front barrier is removed and standing at left. Right-side arc chute is tilted back on hinge to show ready accessibility for inspection and maintenance. Arc chutes of all DH breakers have H type center coil magnet arrangement.

type 50-DH-150 { 150 mva at 4.16 kv, 1200 amperes continuous

type 50-DH-250 { 250 mva at 4.16 kv, 1200 and 2000 amperes continuous

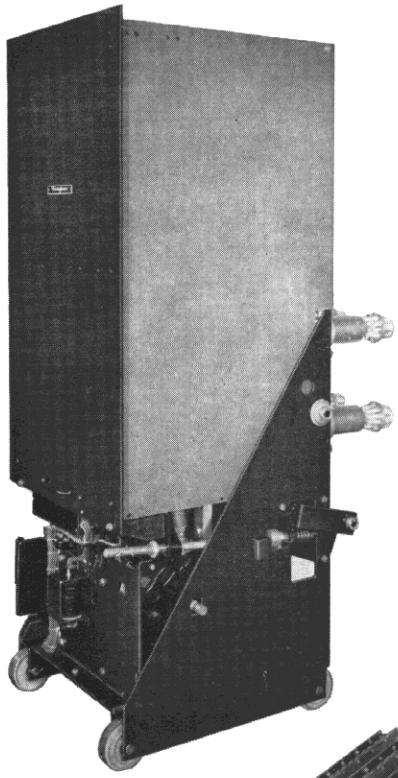


fig. 45: Completely assembled 50-DH-250 breaker, 1200 amperes.

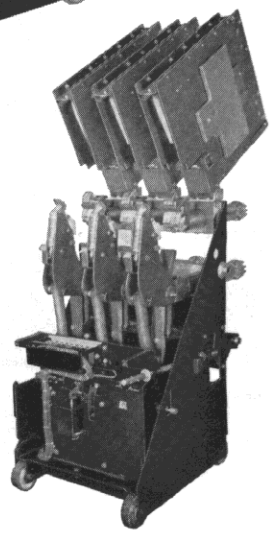


fig. 46: Main barrier removed and arc chutes tilted for inspection. Contacts easily visible and accessible.

type DH magnetic De-ion air circuit breakers *continued*

standard DH breakers and ratings *continued*

type 50-DH-350 { 350 mva at 4.16 kv, 1200 and 3000 amperes continuous

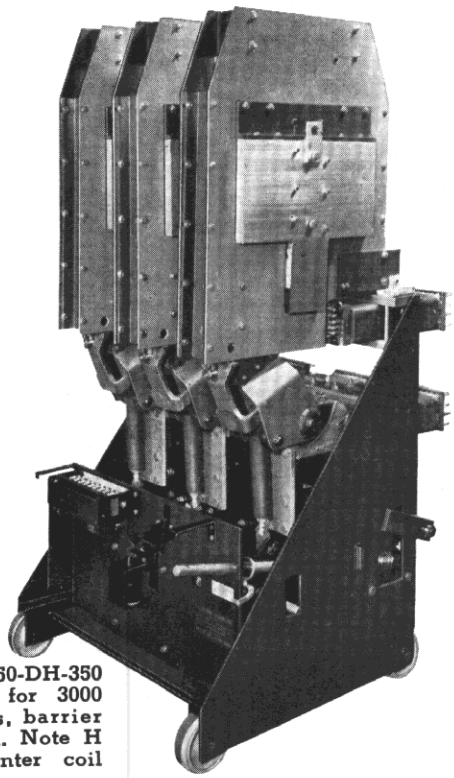


fig. 47: 50-DH-350 breaker for 3000 amperes, barrier removed. Note H type center coil magnet.

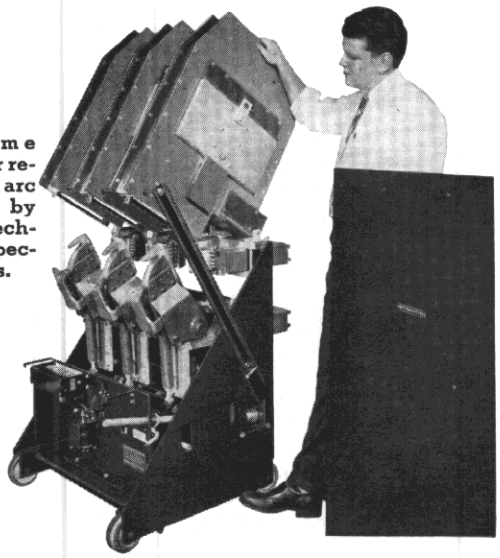


fig. 48: Same breaker, barrier removed, shows arc chutes tilted by levering-in mechanism for inspection of contacts.

type 75-DH-250 { 250 mva at 7.2 kv, 1200 and 2000 amperes continuous

type 75-DH-500 { 500 mva at 7.2 kv, 1200 and 2000 amperes continuous

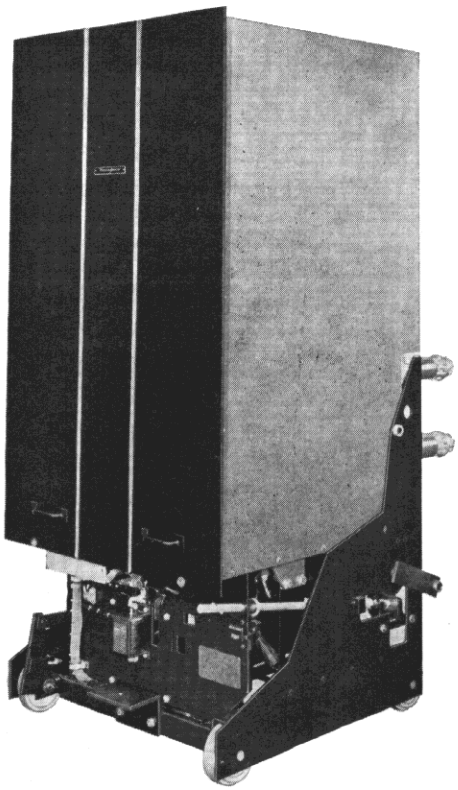


fig. 49: 75-DH-500 breaker, completely assembled.

type 150-DH-150 { 150 mva at 13.8 kv, 1200 amperes continuous
type 150-DH-250 { 250 mva at 13.8 kva, 1200 and 2000 amperes continuous
type 150-DH-500 { 500 mva at 13.8 kv, 1200 and 2000 amperes continuous
type 150-DH-750 { 750 mva at 13.8 kv, 1200 and 2000 amperes continuous

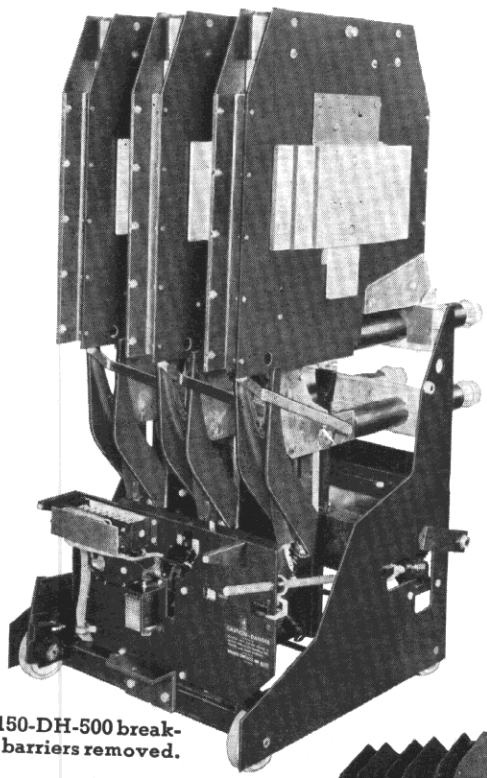


fig. 50: 150-DH-500 breaker with barriers removed.

fig. 51: Same breaker, showing arc chute being tilted by levering-in mechanism.

type 150-DH-1000 { 1000 mva at 13.8 kv, 1200 and 3000 amperes continuous

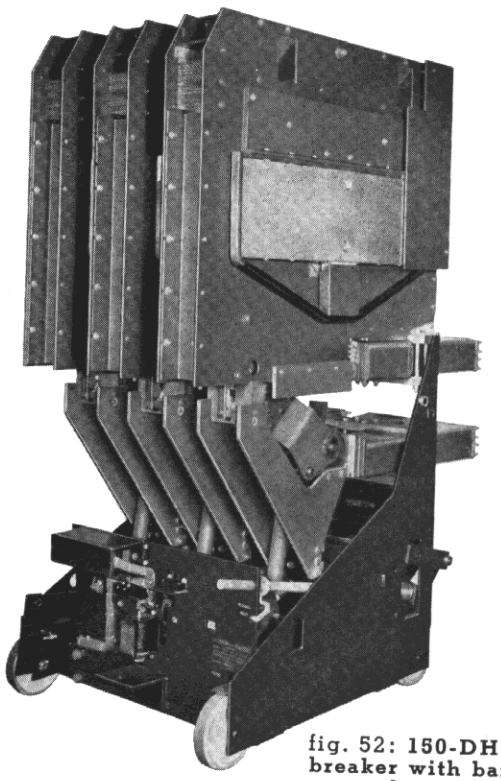


fig. 52: 150-DH-1000 breaker with barriers removed.

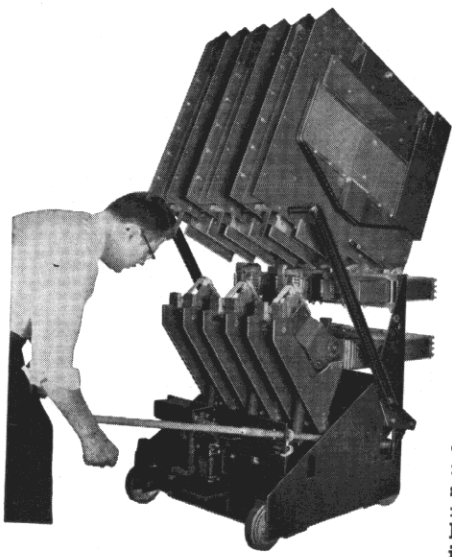


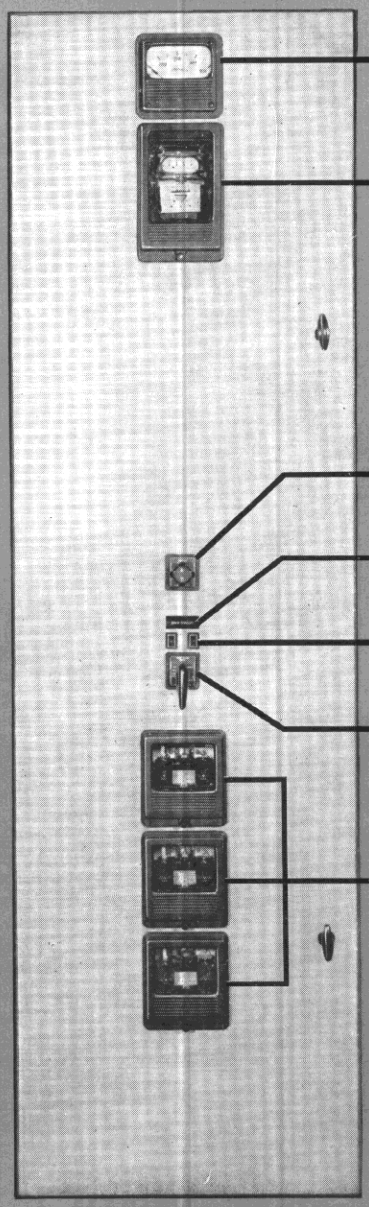
fig. 53: Same breaker with arc chutes being tilted for contact and arc chute inspection by means of arc chute tilting attachment. Crank is same device normally used for levering breaker into cell.

devices · accessories · finishes for indoor and outdoor metal-clad

Components such as relays, meters, instruments, indicating lamps, control switches and instrument transformers are manufactured in various Westinghouse plants and shipped to the switchgear assembly location for incorporating with the metal-clad assembly. All these components meet the high standard of Westinghouse products.

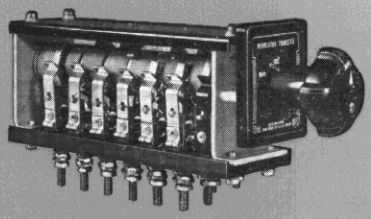
panel devices

typical panel equipment



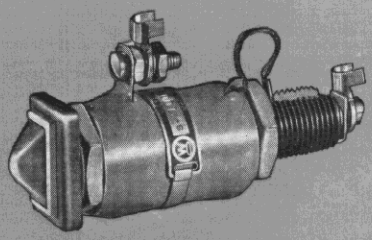
control switches

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



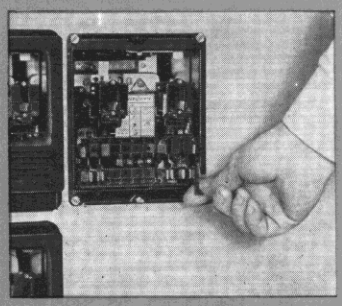
indicating lamps

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.



Flexitest relays

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



terminal blocks

Sturdy terminal block has solderless connectors with reversible marking strip.

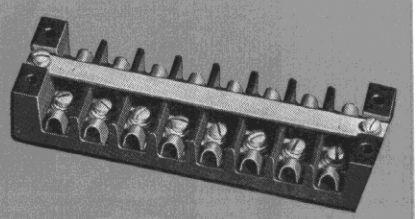


fig. 54

grounding and test devices

These devices are designed for insertion into the metal-clad switchgear unit housing to provide a convenient means (1) to ground the circuit for maintenance work; (2) to apply potential for cable testing; and (3) to furnish access to bus and line circuits for "phasing-out" tests.

The minimum equipment 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.

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 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 power is expected to clear the circuit as this device has no interrupting ability.

test accessories

Test cabinets are designed for wall mounting and provide a means for testing breaker operation remote from the assembly. The test cabinets include a complement of control devices for breaker operation testing. Test cabinets are used for indoor equipment. A test jumper is used for outdoor equipment to facilitate breaker testing with the breaker on the transport truck.

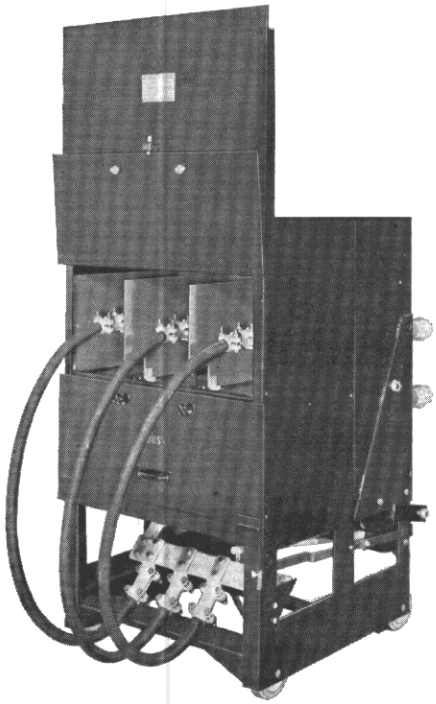


fig. 55: **minimum equipment device**

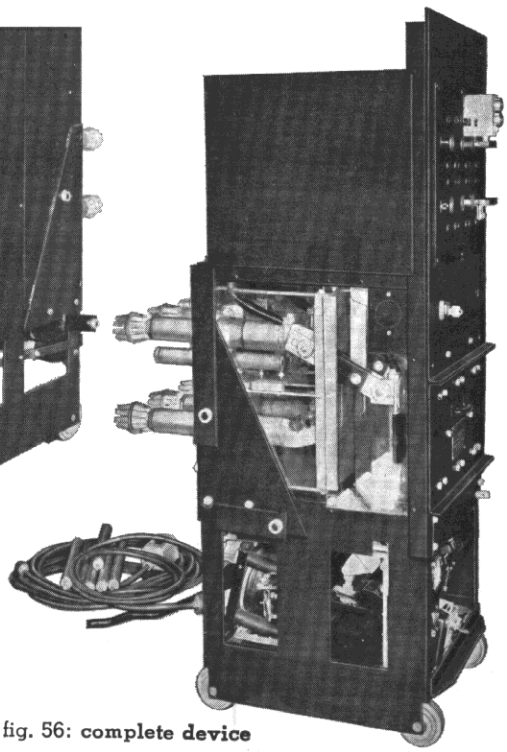


fig. 56: **complete device**

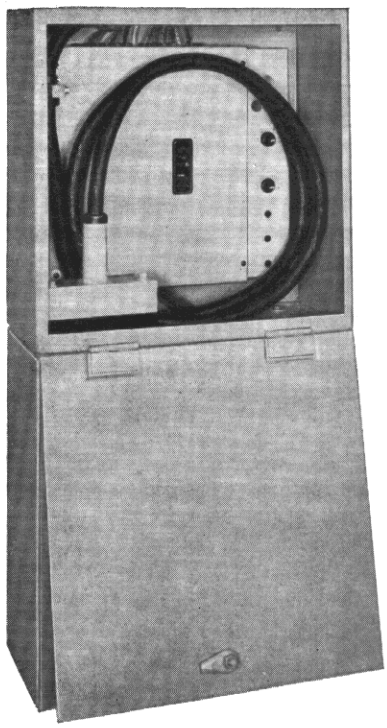


fig. 57: **A-c test cabinet for breaker operation from a-c source.**

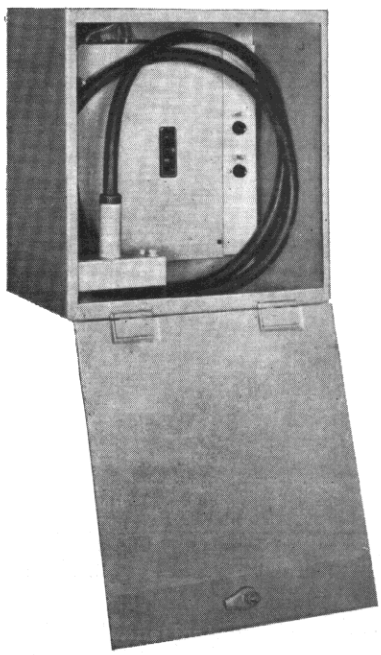


fig. 58: **D-c test cabinet for breaker operation from d-c source.**

devices, accessories, finishes *continued*

electric motor-operated dolly for DH breakers

Westinghouse type PD motor-operated dolly is available, as an extra accessory, to provide powered movement of horizontal drawout DH air circuit breaker elements. This dolly permits the movement of the breaker from one location to another and for positioning the breaker for "racking-in" within the cell.

The front drive wheels are made of a special composition which provides adequate strength to support the breaker weight and furnish required traction. Slow and accurate motion is imparted to the drive wheels by a chain driven through gears by the drive motor.

The motor for the dolly can be supplied for operation on any one of these power sources: 240 volts or 120 volts, 60 cycles a-c; and 250 volts or 125 volts d-c.

Figures 59 and 60 show the dolly in disengaged and engaged positions.

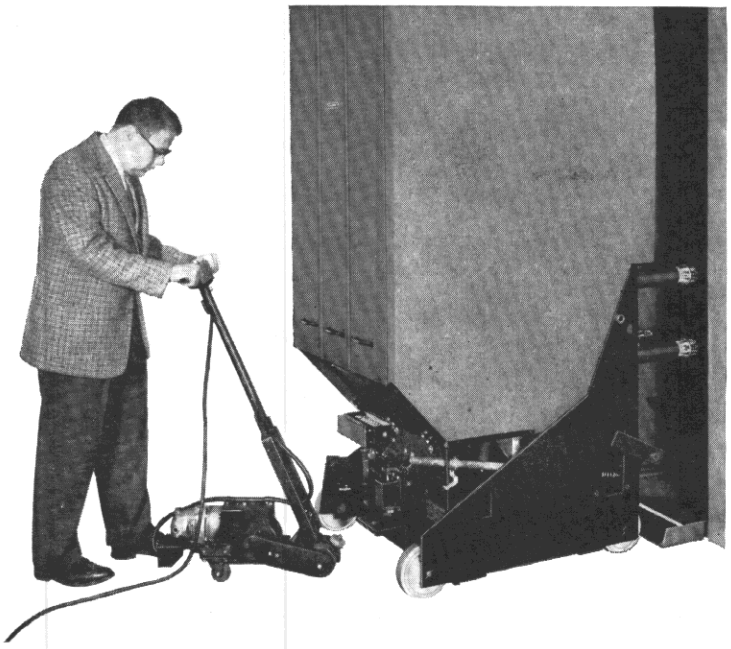


fig. 59: **Dolly disengaged from breaker element.** Engagement is accomplished by inserting the engaging device, located above the wheels, into the front part of the breaker frame.

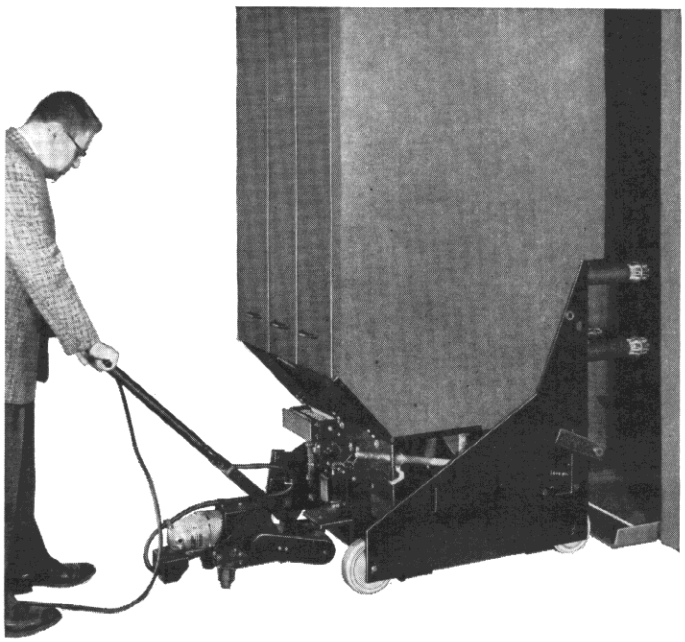


fig. 60: **Electric dolly movement of 1000 mva breaker into cell.** Forward-stop-reverse control is conveniently located on end of handle. Direction of dolly easily controlled by lateral movement of dolly handle.

surface finishes and protection

Westinghouse metal-clad switchgear is given a thorough Phosphatizing and priming treatment to assure protection from corrosion and to provide a superior base for the finish surface coat. Standard finish for indoor switchgear is light gray ASA #61 Munsell notation 8.3G 6.1/0.54. Outdoor switchgear is dark gray ASA #24 Munsell notation 10B 2.4/1.18.

insulation for indoor and outdoor metal-clad

"Limitrak" insulation system

"Limitrak", an exclusive Westinghouse insulation system, provides superior, balanced protection in metal-clad switchgear. The easy-to-clean designs minimize accumulation of potential conductive materials and eliminate hidden creepage paths.

"Limitrak" glass polyester insulation is a track-resistant, flame-retardant material. It is used for sheets, bars and molded shapes in metal-clad switchgear. Tests have proved "Limitrak" to be 300 times more track resistant than ordinary grades of glass polyester, and 1200 times more track resistant than phenolic material.

"Limitrak" coating on DH breaker bushings combines the track-resistant characteristics of "Limitrak" materials with the high dielectric strength and characteristics of all Westinghouse bushings.

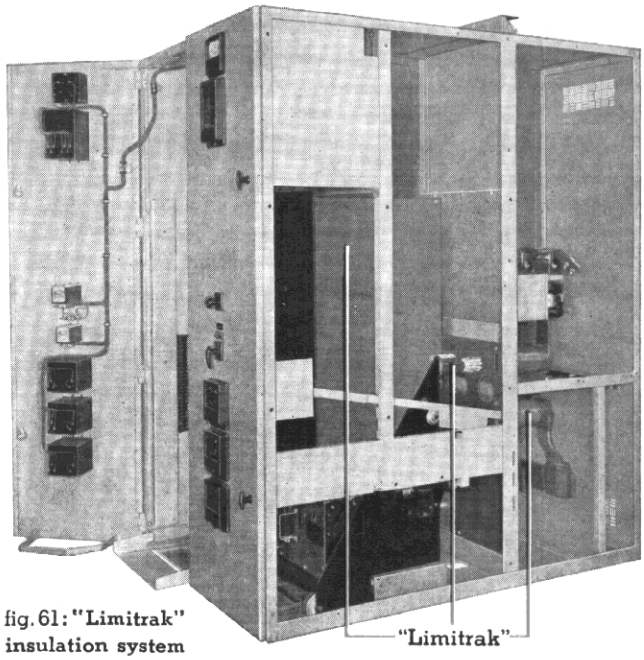


fig. 61: "Limitrak" insulation system in metal-clad switchgear

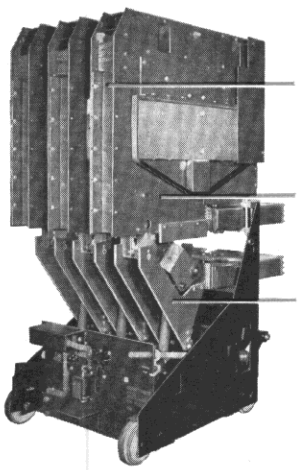


fig. 62: "Limitrak" on DH breaker.

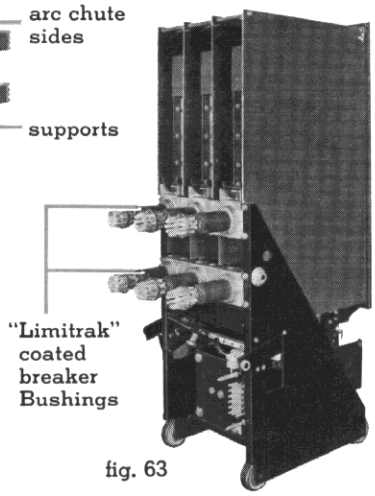


fig. 63

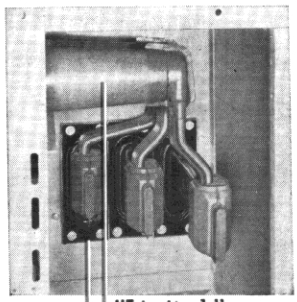


fig. 64

joint insulation

A Westinghouse developed polyester compound is applied to main contact support joints and main bus joints. This compound provides superior flame-retardant qualities and high dielectric strength and maintains the balanced level of insulation in metal-clad switchgear.

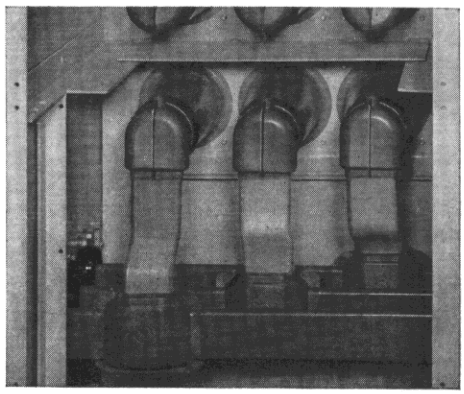


fig. 65

metal-enclosed group phase bus for indoor and outdoor metal-clad

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. This bus can be supplied for indoor and outdoor applications.

These bus assemblies are completely metal-enclosed. The main bus is insulated copper or aluminum, mounted on supports made of track resistant, flame retardant insulating material 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.

Standard group phase main bus assemblies are made in either 1200, 2000 or 3000-ampere capacity in 3, 4, 6 and 8 foot lengths, with insulation and overall dimensions as required for either 4160 or 13800 volt applications.

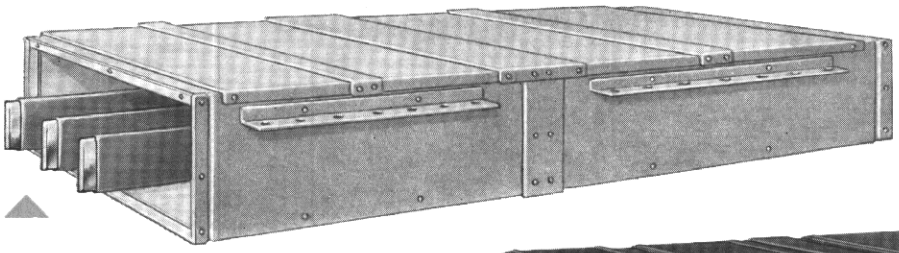


fig. 66: **Metal-enclosed group phase bus for indoor service.**

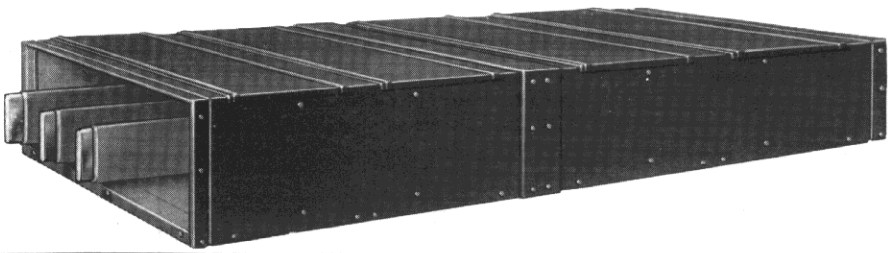


fig. 67: **Metal-enclosed group phase bus weatherproofed for outdoor service.**

safety to personnel with Westinghouse metal-clad switchgear

• complete isolation of cell live parts

Grounded metal barriers isolate and prevent accidental contact with live primary major sections. A metal shutter automatically covers the primary stationary contacts while the breaker is being interchanged. Primary contacts are enclosed and isolated in a support which is a part of the "Limitrak" insulation system.

• safe circuit breaker operation in test position

In test position the breaker primary contacts are disengaged and isolated from the live cell contacts. The secondary contacts may be extended and engaged for testing breaker operation with complete safety.

• fully insulated primary buses and connections

A balanced high level of dielectric strength is maintained throughout the complete metal-clad switchgear unit.

• mounting and isolation of drawout potential transformers in separate compartment

Primary and secondary contacts are automatically disconnected before the transformers or fuses are accessible. Potential transformer cases are automatically grounded when the transformer is in its energized position.

• positive grounding of breakers and cells

All circuit breakers and cells are connected to a ground bus having a momentary rating at least equal to the highest momentary rating of any circuit breaker in the assembly. The breaker frame is grounded before the primary contacts engage.

• positive interlocking devices assure greater safety of breaker operation

Automatic interlocks are arranged so that the breaker contacts must be open to move breaker either in or out of "operate" position. Interlocks also prevent closing contacts if breaker is between "operate" and "test" positions. Breaker must be totally in or totally out of "operate" position to close the contacts.

• metal-enclosed overall structure prevents access of unauthorized personnel

• factory design proving in Westinghouse high power laboratory assures safe operation within rated capacity

This testing design proves the switchgear for normal operation of its equipment and for maximum safety to personnel.

design proving and production testing

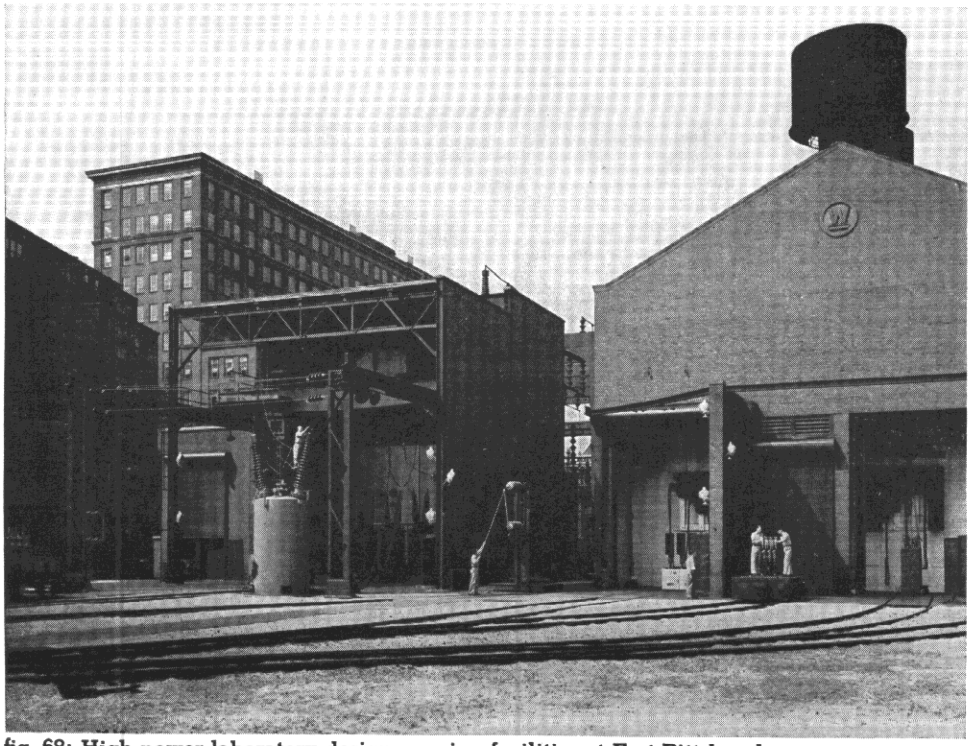


fig. 68: High power laboratory design proving facilities at East Pittsburgh.

design proving

A representative assembly of each new Westinghouse metal-clad switchgear design is given extensive tests in our high power laboratory at East Pittsburgh in compliance with NEMA, ASA and AIEE Standards. Every design of DH breakers for metal-clad switchgear has been design proven in this high power laboratory, and tested up to and beyond its interrupting rating.

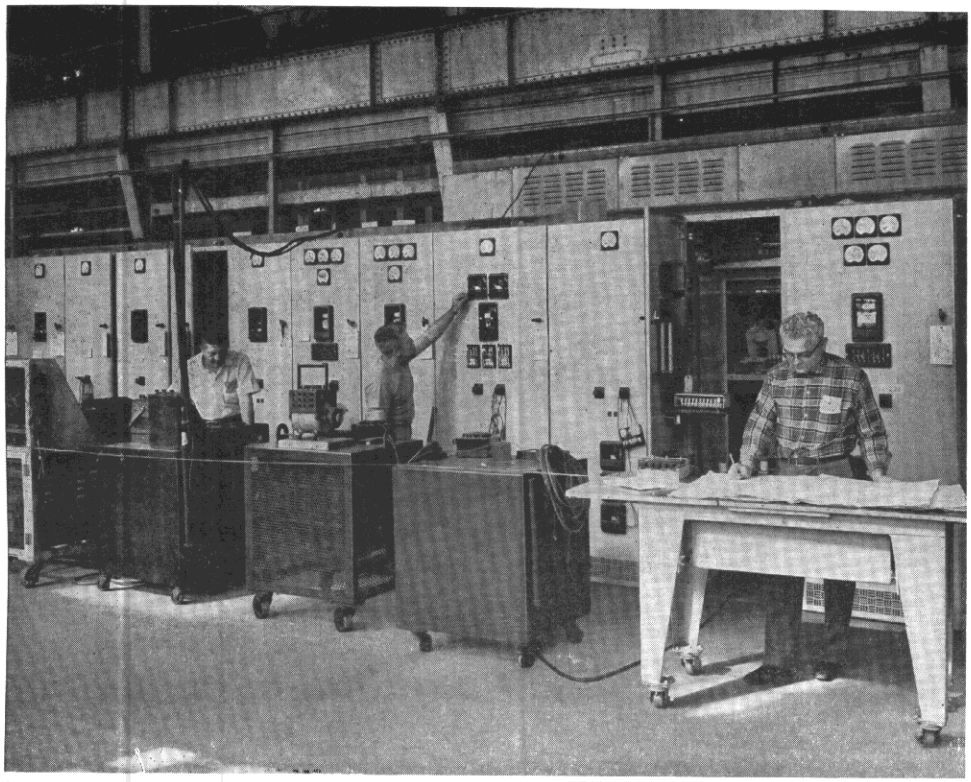


fig. 69: Manufacturing test facilities

production testing

Rigid quality control procedures are adhered to throughout the manufacturing process of every component of Westinghouse metal-clad switchgear.

Each metal-clad switchgear assembly is tested before shipment to assure proper functioning of the equipment. The operation of relays is checked . . . breaker elements are inserted into the cells . . . and control circuits are completed to assure proper, correct breaker operation. The relative polarity of the current and potential circuits is verified and the assembly is given a 60-cycle dielectric test.

Production tests in Manufacturing Dept. assure proper metal-clad switchgear functioning.

representative installations

Westinghouse metal-clad switchgear

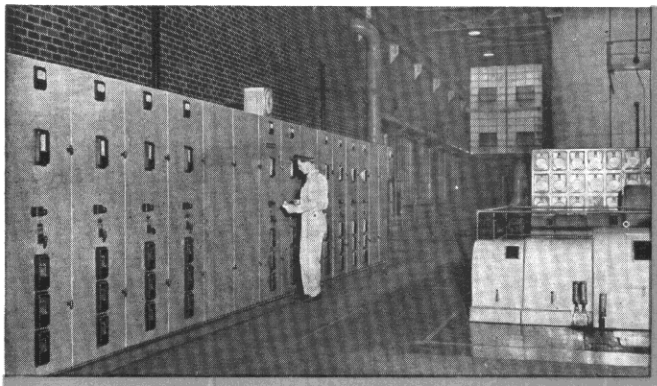


fig. 70: Indoor metal-clad switchgear for industrial plants.

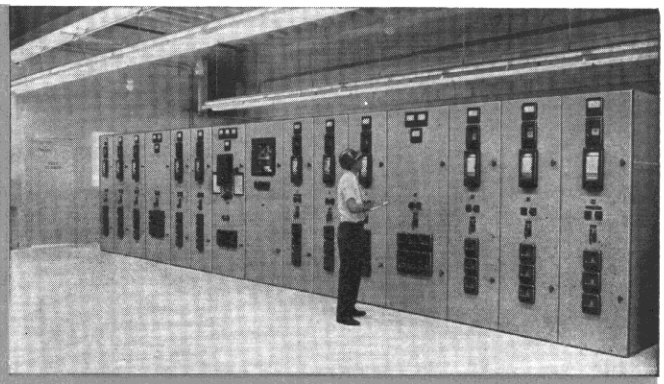


fig. 71: Indoor metal-clad switchgear for generating stations.

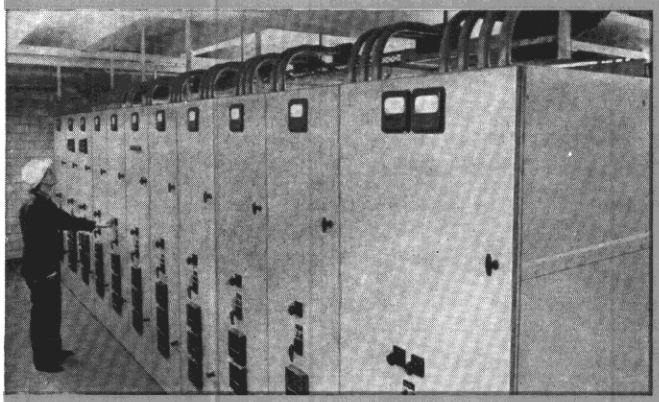


fig. 72: Indoor metal-clad switchgear for electric utilities—station auxiliary service.

fig. 73: Shelterfor-M outdoor metal-clad switchgear for unit substation.

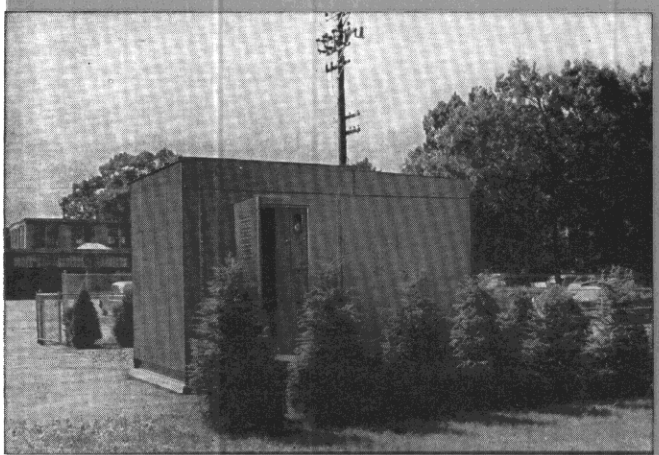


fig. 74: Shelterfor-M switchgear can harmonize in residential areas . . opened door shows protected, roomy service aisle for personnel and equipment.

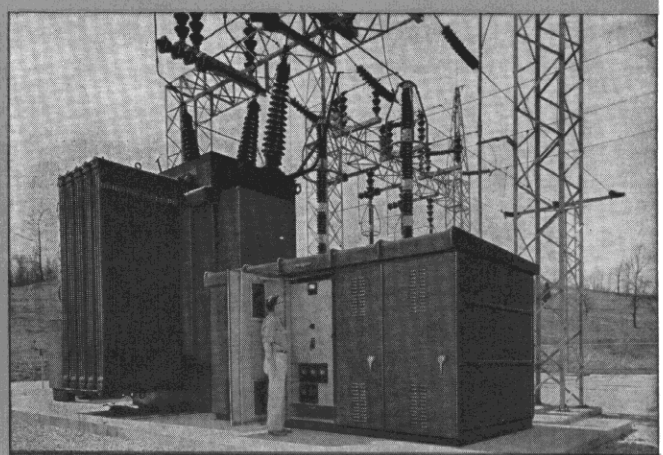


fig. 75: Non-Shelterfor-M outdoor metal-clad switchgear for unit substation.

further information: application: application data 32-260

Westinghouse Electric Corporation
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