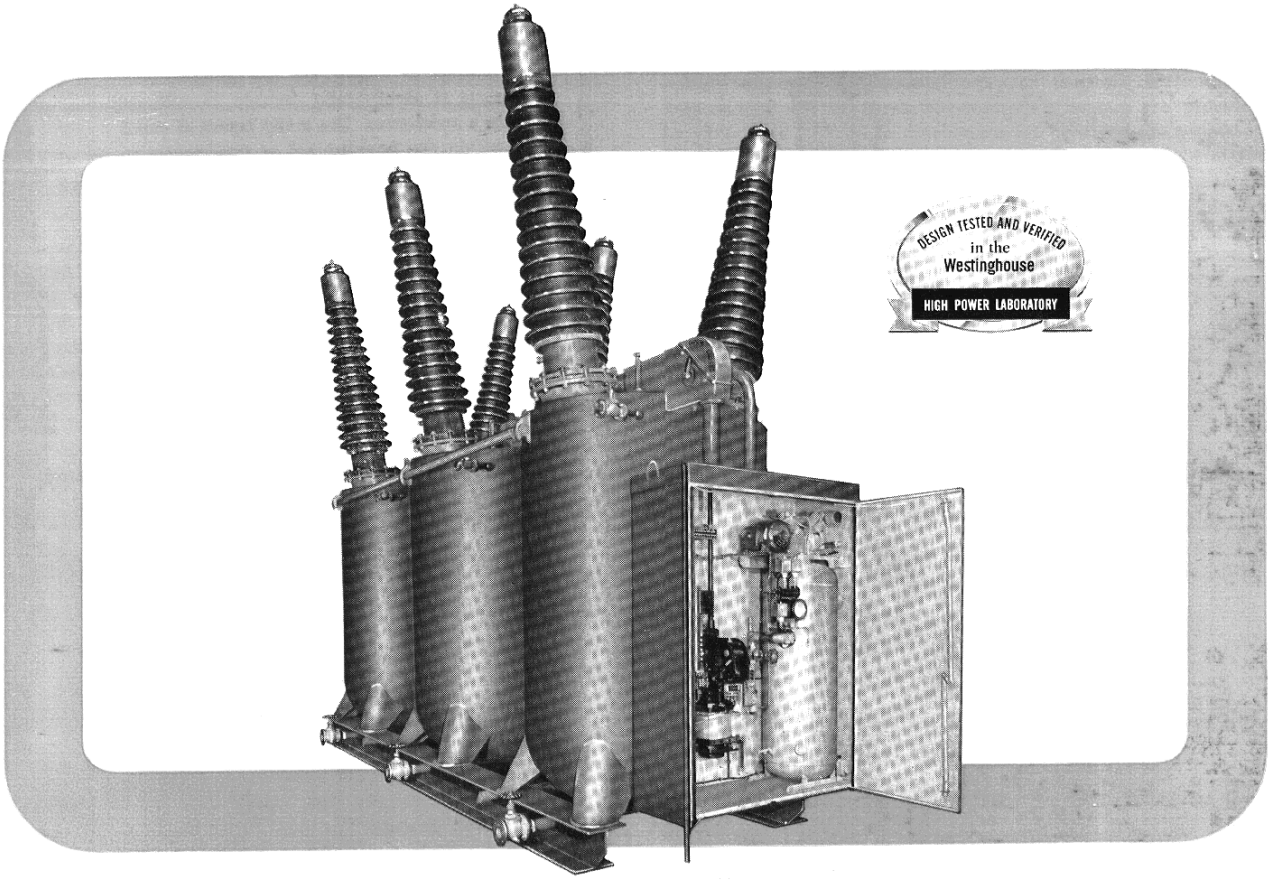
power circuit breakers

outdoor oil breakers
type GW · watch-case

230 kv to 345 kv • 1200 to 1600 amperes
3-cycle interrupting • De-ion® grid

descriptive bulletin

33-254



application

Type GW watch-case De-ion grid oil circuit breakers are designed for use on high-voltage power line circuits requiring breakers of proven interrupting capacity with fast interrupting time, and capable of high-speed reclosing.

standard ratings (60-cycle basis)

rated voltage (kv)▲	continuous current rating (amps)	interrupting capacity (3-ph mva)	interrupting time (cycles)
230	1200	5000	3
	1600	10000	3
	1600	15000	3
	1600	20000	3
345	1600	25000	3

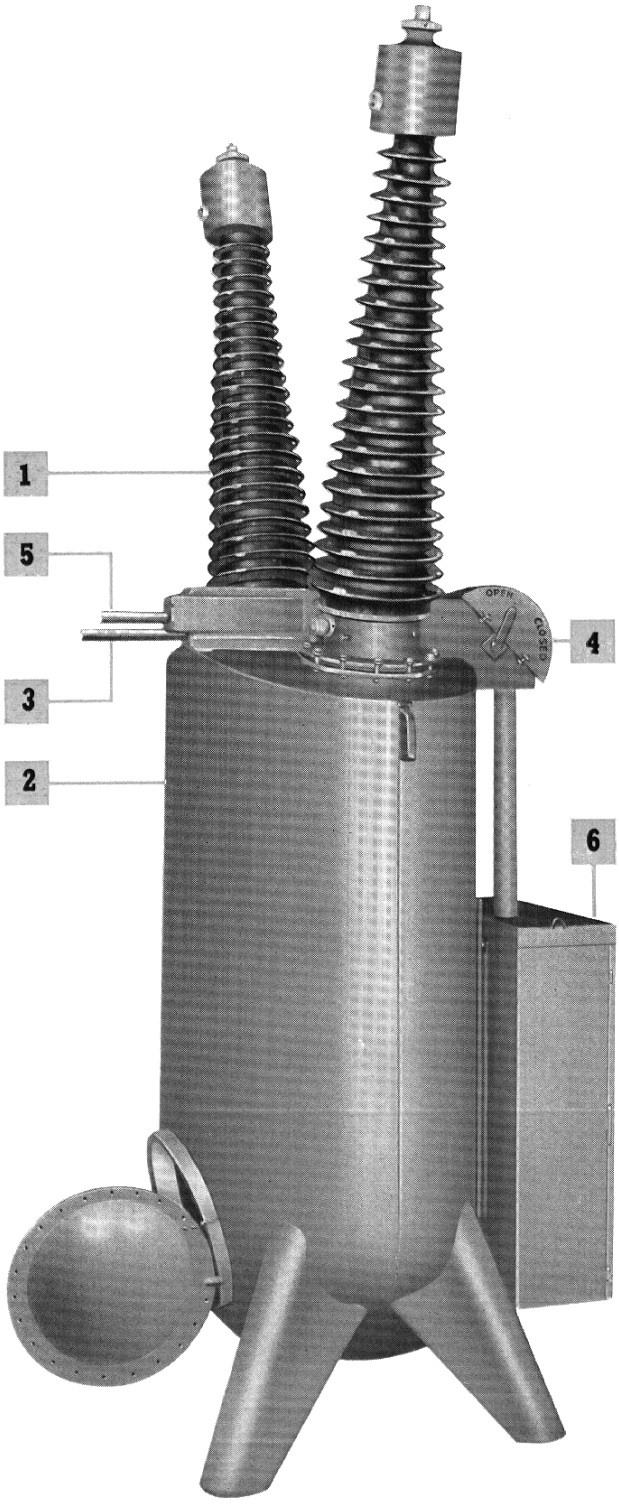
▲ For solidly grounded neutral applications.

advantages

- **type GW low oil content design** cuts maintenance time, reduces weight, and saves on oil handling facilities.
- **multi-flow and multi-break De-ion grid interrupters** insure three-cycle interruption on all currents, ample interrupting capacity, and less oil contamination.
- **type O condenser bushings** provide maximum mechanical and electrical strength with minimum size and weight. Porcelains are maintained under compression for maximum strength; spring pressure keeps oil seals intact.
- **pneumatic operating mechanisms** insure high-speed closing and mechanically trip-free opening. Roller bearing construction and absence of critical adjustments reduce maintenance.
- **high-speed reclosing** is obtained by selective tripping and fast contact movement. Reversal of contact travel on a pneumatic cushion eliminates mechanical shock.
- **unit-base mounting of 230 kv ratings** facilitates handling and reduces installation time and cost.

March, 1961
supersedes descriptive bulletin 33-254 dated July, 1956
mailed to: E/280/DB; C/331/DB

design features external



pole unit of 345 kv watch-case breaker

1 type O condenser bushings

The entrance bushings of these breakers are built on the time-proven condenser principle. The design is based on the fundamental principle of electrostatic division of voltages within a condenser. The many layers of metal foil within the bushing act as condensers in series to produce equal voltage stresses between the layers of insulation. This electrically coordinated design has produced bushings that are free from radio interference and which have the required electrical and mechanical qualities.

Each bushing is provided with a potential tap for use with an optional potential device to obtain voltage indication for use with relays and instruments. This tap is located on the mounting flange of the bushing, and is readily accessible for use in making an ungrounded power factor test on the bushing by merely removing a pipe plug. A gas chamber on the top of each bushing contains compression springs that allow for expansion or contraction. A leak-proof magnetic oil gauge indicates the oil level.

Circuit breaker bushings are interchangeable with transformer bushings of the same voltage and current rating, and with equivalent rated bushings of other manufacture built to established ASA standard dimensions.

potential device: The type PBA-2 bushing potential device for voltage indication can be provided as optional equipment. Each device in its weatherproof cabinet mounts readily on the breaker tank, and the lead-in cable for connection to the bushing tap is included.

345 kv type O condenser bushing

2 watch-case

The watch-case tank is one of the design features of this breaker. Its streamlined shape reduces the volume of oil, cuts the time required for maintenance, and minimizes the user's oil storage problem. It is fabricated of heavy boiler plate steel with all seams electrically welded, pressure tested, and carefully inspected to prevent oil leaks. Each tank is supported on four welded-on legs. Heavy tie rods between the tops of adjacent tanks insure the proper alignment of the complete three-pole breaker. Hinged manhole covers on the rear of each tank provide access to the interior for inspection and maintenance.

3 current transformer secondary conduit

All secondary leads from the bushing current transformers are carried in a single conduit to terminal blocks within the operating mechanism housing. This location is convenient for making necessary connections to relays and instruments or for changing transformer taps.

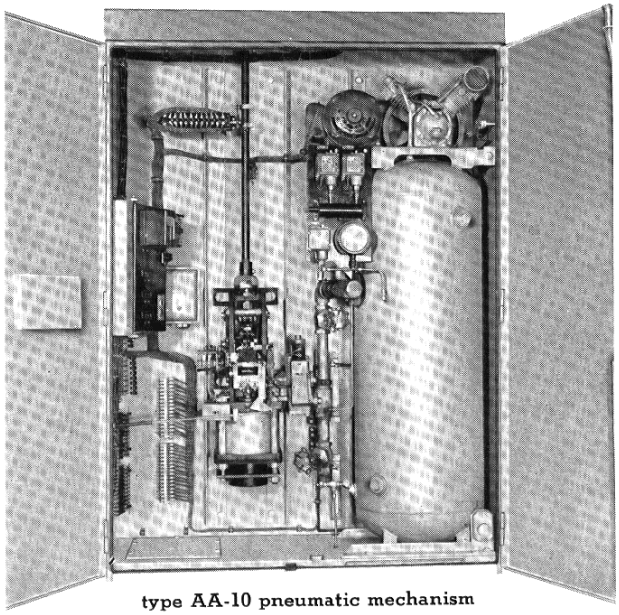
4 bell crank and position indicator

A semaphore indicator attached to the bell crank shows the position of the circuit breaker contacts. Remote indication at the control board is obtained by indicating lamps connected to a rotary switch attached to the breaker operating mechanism.

5 inter-pole pull rods

The vertical motion of the operating mechanism is transmitted through the bell crank and pull rods to the pole unit levers within each tank to control the position of the contacts. Right and left hand threads on opposite ends of the pull rods provide turnbuckle action to simplify adjustment during installation. After the contacts are set, a positive locking device eliminates loss of contact adjustment.

6 pneumatic operating mechanisms

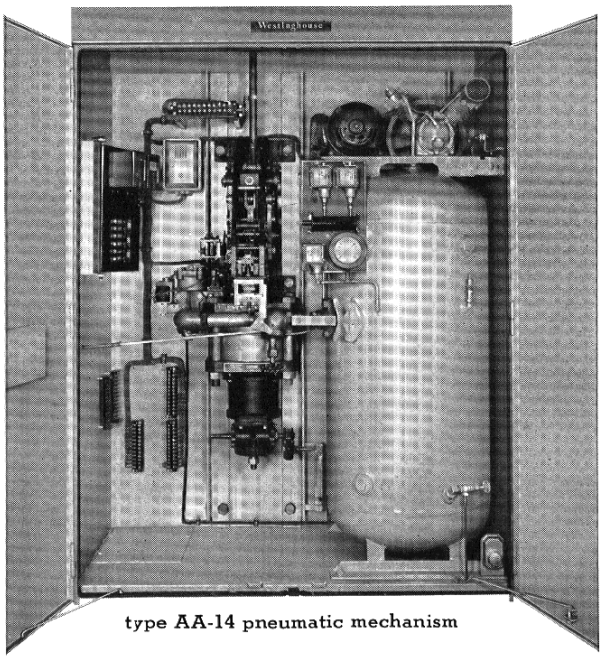


type AA-10 pneumatic mechanism

Types AA-10 and AA-14 electro-pneumatic operating mechanisms are used to close these high-capacity, heavy-duty oil circuit breakers and to provide high-speed reclosing when desired. The mechanisms are both mechanically and electrically trip-free.

Each mechanism is complete with air storage reservoir, motor-driven compressor, pressure relays, pressure gauge, and safety valve to prevent excessive pressures. At normal operating pressure, the reservoir contains sufficient air for five immediate closing operations without operation of the compressor. The condensed moisture from the reservoir is easily removed through a drain valve of the siphon-blowoff type that will not freeze shut. The air supply system meets all the requirements of the ASME and state and insurance codes.

The complete operating mechanism and air supply system are housed in a weatherproof and dustproof cabinet. Two large doors on the front, sealed with rubber gaskets, provide ready access to all parts of the mechanism for inspection and maintenance. A heater element within each cabinet provides continuous inside-outside temperature differential to prevent moisture condensation. Two additional thermostatically-controlled heaters are provided for winter use. With each mechanism are provided the necessary auxiliary switches, cutoff switch, latch checking switch, alarm switch, and operation counter. The electrically trip-free control relay and fused control knife switches are mounted on a hinged panel. Terminal blocks mounted on the side and back of the housing are provided for control and transformer wiring.

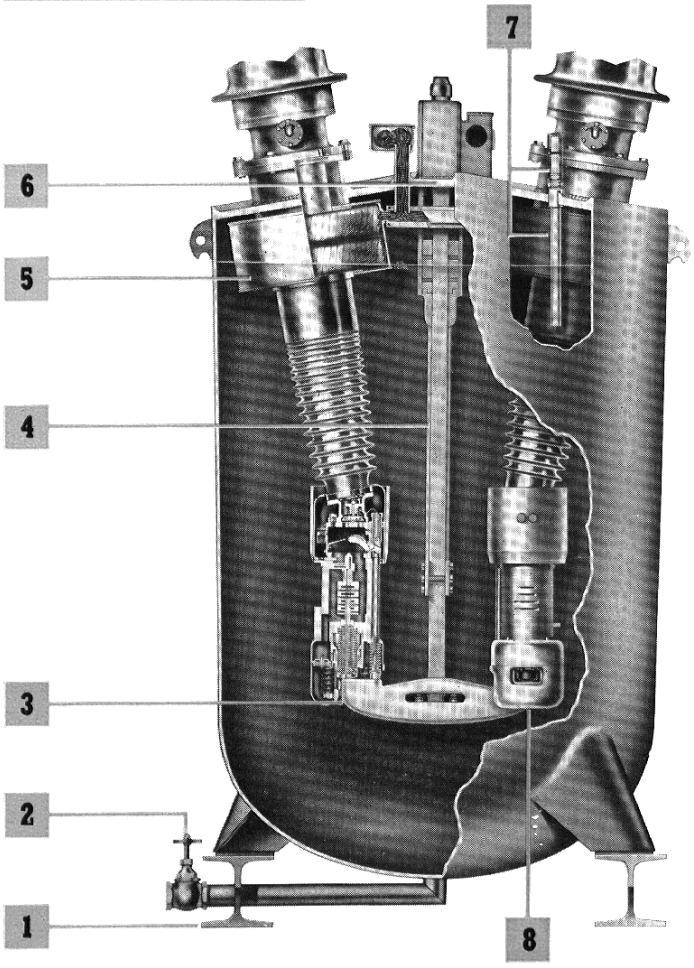


type AA-14 pneumatic mechanism

high-speed reclosing: Because of the fast interrupting time of the multi-flow and multi-break De-ion grids and extra-fast reclosing time provided by the electro-pneumatic mechanisms, these breakers are ideal for high-speed reclosing. Reclosing speeds of 20 cycles maximum (60-cycle basis) from the initial tripping impulse until the current is re-established are standard, but faster reclosing speeds may be obtained.

Types AA-10 and AA-14 pneumatic mechanisms are mechanically trip-free. Selective tripping provides unretarded opening even when the breaker is closed on a fault. The mechanisms are designed for high-speed or ultra-high-speed reclosing. Starting from a normally closed position with no high-pressure air in the closing cylinder, the breaker opens "non-mechanically trip-free"—the closing piston and the contacts remain tied together. The preset reclosing relay starts the reclosing action by admitting air into the cylinder shortly after the contacts have parted. The air pressure stops the movement of the contacts before they reach the full open position, reverses their travel, and immediately returns them to the closed position. This ability to reverse the direction of contact movement before the contacts reach the full open position holds the reclosing time to a very minimum.

design features internal



cutaway view of 230 kv watch-case breaker

1 unit base mounting

Where railroad clearances permit, the 230 kv breakers are normally supplied with the three breaker tanks factory assembled on a rigid steel base except for the bushings, De-ion grids and contacts, to permit handling as a single unit. The operating mechanism and connecting rods between the breaker tanks are installed and adjusted. The bushing current transformers are mounted in place and wired to terminal blocks in the operating mechanism housing. All secondary wiring is installed and factory tested. This construction greatly reduces installation cost and simplifies foundation design.

The breakers of higher voltages are not unit base mounted since the tanks are too tall for shipment as a unit.

2 oil drain valve

Oil drainage is made from the lowest point in each circuit breaker tank. Suitable drain valves and oil sampling valves are provided. (A filling connection is mounted on the tank top for filling the tank and for filter applications.)

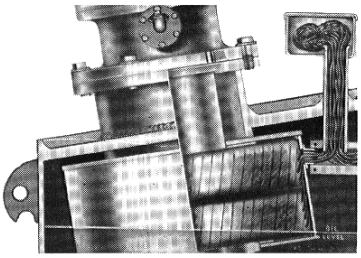
3 moving contact crossarm

A moving contact crossarm of ample conductivity bridges between the two stationary contacts to complete the circuit. The structural shape provides adequate mechanical strength and the smooth curved surfaces with rounded edges reduce the dielectric stresses.

4 Micarta® lift rod and guide

Wood-base Micarta is used for contact lift rods and guides. Laminated selected woods impregnated with phenolic resins and molded under heat and pressure produce a dense, uniform, high-strength, shock-resistant material of high dielectric strength, especially suited for this purpose.

5 bushing-type current transformers



Type GW breakers are normally equipped with six multi-ratio bushing-type current transformers of relay accuracy mounted one on each bushing of the breaker. Space is available for mounting two transformers per bushings on breakers rated 230 kv. On 345 kv breakers, space is available for three transformers per bushing. The standard transformers are of the multi-ratio, 5-lead design, type BYM, with maximum ratios of 1200/5 or 2000/5 ampere, and 10-L-800 accuracy. Linear couplers used for bus differential protection, or metering accuracy transformers, can be supplied. All transformers conform to NEMA and ASA published standard accuracies.

When installed within the breaker, metal transformer cases provide mechanical protection and support the transformers in place. All the leads from the transformers are completely metal-enclosed and brought through the single conduit to terminal blocks mounted at a convenient location in the operating mechanism housing.

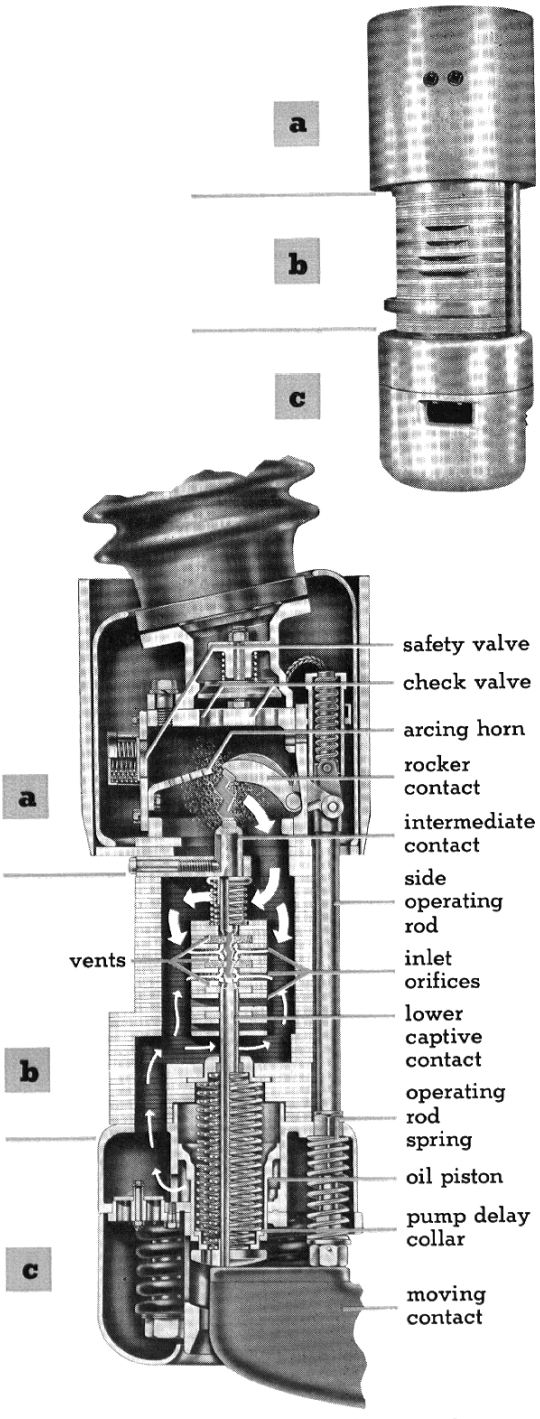
6 pole unit lever system

A simple lever system inside each tank transmits the motion from the pull rods into straight-line vertical movement for the contact lift rods. Hydraulic bumpers cushion the opening stroke and eliminate rebound. Gas-tight seals prevent the gas from passing from one pole unit to another, or into the mechanism housing.

7 float-type oil gauge

A float-type oil gauge is mounted on the top of each tank. Since the glass section of this gauge is mounted above the oil level, accidental breakage will not cause an oil leak.

8 De-ion grid interrupter construction and operation



Type MF-3A grid cut away to show the action during interruption. White arrows show oil flow. Type MF-3F is similar except for finger type contacts instead of butt type.

types MF-3A and MF-3F grids

Types MF-3A and MF-3F multi-flow De-ion grids used on 230 kv breakers provide highly effective circuit interruption. They consist essentially of three chambers:

a. The upper pressure chamber, in which a pressure-generating arc is drawn between the upper and intermediate contacts.

b. The central interrupting chamber, in which the arc drawn between the intermediate and lower contacts is confined, de-ionized, and extinguished. This chamber is formed of vulcanized fiber plates bolted together with wood-base Micarta tie rods with heavy springs to maintain proper pressure between plates.

c. The lower contact chamber, containing the captive contact spring and the auxiliary oil pump.

three-cycle fault current interruption

When the breaker is called upon to open under fault conditions, the breaker accelerating springs act through the lift rod to open the moving contacts rapidly. Three springs open the lower contact inside the grid and at the same time the rocker-type upper contact is opened by the action of the spring-operated side operating rod extending from the moving contact to the top of the grid.

As the contacts part, the pressure-generating arc drawn in the upper chamber, between the upper and intermediate contacts, forces the oil in the center chamber through the inlet orifices into and along the closely confined main interrupting arc. Gases formed by contact of oil with the arc pass through exhaust vents in the grid into the main body of oil in the breaker tank.

The multi-flow principle of arc interruption uses a number of inlet orifices and exhaust vents proportioned to the voltage rating. As the moving contact uncovers successive inlet orifices the flow of fresh oil from the pressure generating chamber de-ionizes the entire length of the arc and interrupts it at a minimum length and in the shortest time.

The symmetrical arrangement of the inlet orifices and vents within the grid structure provides balanced flow and reaction forces. The flow of oil and gas centers the arc in the interrupting chamber away from the fiber plates, minimizing wear of the interrupter.

Following the interruption, the arc gases and carbonized oil are flushed through the vents and replaced by fresh oil in preparation for the next operation. This flushing action is provided by the operation of a spring driven piston located at the bottom of the grid. The check valve in the top of the pressure chamber opens to release the residual gas and the chamber refills with fresh oil.

During normal operations this open valve permits circulation of oil through the grid to cool the current carrying parts.

As a protective feature, a safety valve is provided to open if the gas pressure within the pressure chamber should become too great during an interrupting operation.

low current operation

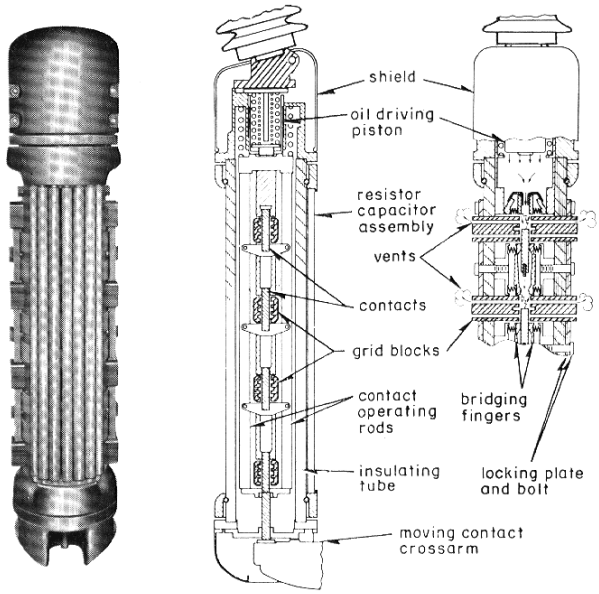
To assure three-cycle interrupting time for low magnetizing and line-charging currents, the oil driving piston at the bottom of the grid augments the oil flow from the pressure arc. To avoid arc re-strikes and overvoltage surges when interrupting line-charging currents, the oil piston action is purposely delayed. Interruption is attempted only after the contacts are parted sufficiently to support the double voltage which will appear across the contacts one-half cycle after interruption.

scavenging action for reclosing duty

At higher currents, where the pressure-arc generates greater pressure than that obtainable from the piston, the piston does not operate until after the arc is interrupted; it then serves to flush the arc products from the grid. This is particularly important on high speed reclosing where it is desirable to clean out the gases from the first interruption before the circuit breaker may be called to open the circuit again within 20 cycles or less.

continued on page 6

8 De-ion grid interrupter construction and operation • *continued*



Type MB-4 345 kv grid. Type MB-3 is similar except for three sets of contacts instead of four.

types MB-3 and MB-4 grids

three-cycle fault current interruption

The types MB-3 and MB-4 have, respectively, three and four sets of finger and bayonet contacts in series mounted in a ladder arrangement within a heavy insulating tube. The contact elements are unit assemblies that operate in unison and require no critical adjustment. The stationary contacts are heavy-duty, silver-plated fingers with arc-resisting silver tungsten surfaces that provide long life. The moving contacts are properly spaced and insulated from each other by wood-base Micarta rods.

Under normal operating conditions with the breaker carrying load current oil circulates by natural convection through a spring biased inlet check valve located at the bottom of the grid, the exhaust passages in the interrupter blocks and out through the check valve in the top of the grid to cool the current carrying parts.

On fault operation of the breaker as the accelerating springs act through the lift rod to drive the cross arm toward the open position, two accelerating springs in the top casting assembly of the grid drive the interrupter contacts toward the open position. Arcs are drawn between the captive moving contacts and the stationary finger contacts within the fiber interrupter blocks. The heat from these arcs volatilizes some of the oil and generates a pressure which immediately closes the check valves.

Since the grid is now essentially a sealed vessel except for the exhaust vents in the interrupter blocks, the pressure generated by the arcs forces oil to flow into the two intake passages on each side of the interrupter blocks and axially along the arc to de-ionize it and interrupt the flow of current. The gases formed by contact of the oil with the arc pass through the exhaust passages in the interrupter block and into the main body of oil in the breaker tank. Each interrupter block has one main unobstructed exhaust passage-way out each end of the assembly with two additional vents having pressure relief devices which will open on high capacity faults and allow additional venting. Thus a self-generated pressure and oil flow principle is utilized in the tubular type grids to interrupt the flow of fault current.

During interruption, voltage distribution between the two interrupters in each pole is equalized by a series of high resistance carbon resistor units shunting each interrupter.

The symmetrical arrangement of the inlet orifices and vents within the interrupter blocks provide balanced oil flow and reaction forces. The flow of oil and gas centers the arc within the interrupting block away from the fiber plates thus minimizing wear of the interrupters. They are easily removable from the assembly for inspection.

The symmetrical construction of the interrupter blocks makes it possible to invert them in the grid structure and in effect double their operating life.

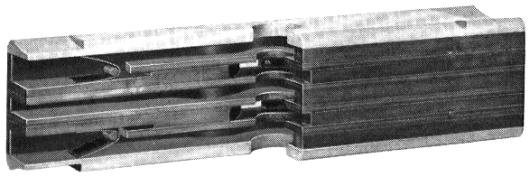
When these blocks are removed, the contact surfaces can be easily inspected. The complete stationary and moving contact assemblies can be withdrawn from the tube when necessary for maintenance without disturbing the alignment of the tube or pump assembly.

low current operation

A spring driven oil piston is located in the top casting assembly. During high current operation the back pressure generated by the arcs is sufficient to stall the movement of the oil piston but for low current operation the oil piston operates to augment the oil flow due to the self-generated pressure to achieve three-cycle interrupting time even for low magnetizing and line-charging currents. To avoid arc restrikes and the resulting overvoltage surges when interrupting line charging currents, the oil piston action is purposely delayed. Interruption is attempted only after the contacts are parted sufficiently to support the double voltage which will appear across the contacts one-half cycle after interruption.

scavenging action for reclosing duty

At the higher currents, where the arcs generate greater pressure than that obtainable from the piston, the piston does not operate until the arc is interrupted, it then serves to flush the arc products from the grid. This is particularly important on high speed reclosing where it is desirable to clean out the gases due to the first interruption before the circuit breaker may be called to open the circuit again within 20 cycles or less.



grid interrupter block, cutaway view

outdoor oil breakers
type GW · watch-case

230 kv to 345 kv • 1200 to 1600 amperes
3-cycle interrupting • De-ion grid

selector guide

standard ASA ratings: 3 pole
2-CO 15 sec. duty cycle

	rated voltage	230 kv				345 kv
	type	2300GW 5000	2300GW 10000	2300GW 15000	2300GW 20000	3450GW 25000
ratings: Ratings based on recommendations of EEI—AEIC—NEMA joint committee on power circuit breakers. For definitions, see t. d. 33-060.						
voltage ratings	rated . . . . . kv	230▲	230▲	230▲	230▲	345▲
	maximum design . . . . kv	242	242	242	242	362
	min. for rated mva . . . kv	220	220	220	220	330
current ratings	continuous, 60 cycle amp	1200	1600	1600	1600	1600
	momentary . . . . . amp	19500	39000	58500	78000	66000
	4-second . . . . . amp	13000	26000	39000	52000	44000
interrupting ratings	3-phase . . . . . mva	5000	10000	15000	20000	25000
	rated voltage . . . . . amp	12500	25000	37500	50000	42000
	maximum . . . . . amp	13000	26000	39000	52000	44000
	opening . . . . . cycles	3	3	3	3	3
insulation level	60-cycle test . . . . . kv	425	425	425	425	555
	impulse withstand . . . kv	900	900	900	900	1300
components						
pneumatic mechanisms	type	AA-10	AA-10	AA-14	AA-14	AA-14
De-ion grids	type	MF3-A	MF3-F	MB-3	MB-3	MB-4
bushing current transformers	relaying accuracy . .	10L800	10L800	10L800	10L800	10L800
	maximum ratio	1200/5	2000/5	2000/5	2000/5	2000/5
	additional available ratios . . .	100 500 200 600 300 800 400 900 1000	300 1100 400 1200 500 1500 800 1600	300 1100 400 1200 500 1500 800 1600	300 1100 400 1200 500 1500 800 1600	300 1100 400 1200 500 1500 800 1600
condenser bushings	type	IC	IC	IC	IC	0
weight and oil requirements						
net weight with oil	lb	71800	74100	76530	76530	183000
shipping weight less oil . .	lb	43500	44000	45800	45800	106000
tank diameter	in.	51 x 84	51 x 84	51 x 84	51 x 84	63 x 109
oil capacity	gal.	4200	4260	4305	4305	10800
operating currents						
pneumatic mechanism	closing (125v, d-c) . amp	9	9	18	18	18
	tripping (125v, d-c) amp	20	20	30	30	30
	motor (230v, a-c) . . amp	9.5	9.5	9.5	9.5	9.5

▲ For solidly-grounded neutral applications.

specification details

included with standard circuit breaker:

Wemco® "C" universal oil in tank cars or non-returnable drums
six condenser bushings with combination potential and power factor test tap, threaded for terminal connection
bushing terminals; specify type (clamp or tube) and size
six type BYM multi-ratio bushing current transformers
cases and supports for bushing current transformers
weatherproof metal conduit for transformer leads to mechanism housing
oil drain valve, filling connection and sight gauge for each pole unit
mechanical "open" and "closed" indicator
accelerating springs
maintenance closing device (one per station)
weatherproof mechanism housing and mechanism (see below)

pneumatic mechanism housing includes:

pneumatic closing mechanism, 48, 125 or 250 volts d-c (specify)■
shunt trip coil, 48, 125 or 250 volts d-c (specify)■
control relay panel with electrically trip-free control relay
■*Refer to Westinghouse if other control voltages or a-c control required*
air compressor and reservoir with automatic controls
three 2-pole fused knife switches; one for control circuit, one for heater circuit, and one for compressor motor
necessary terminal blocks
type W auxiliary switch, 11-pole
type W cutoff switch, 2-pole
latch-checking switch
operation counter
thermostatically controlled space heaters

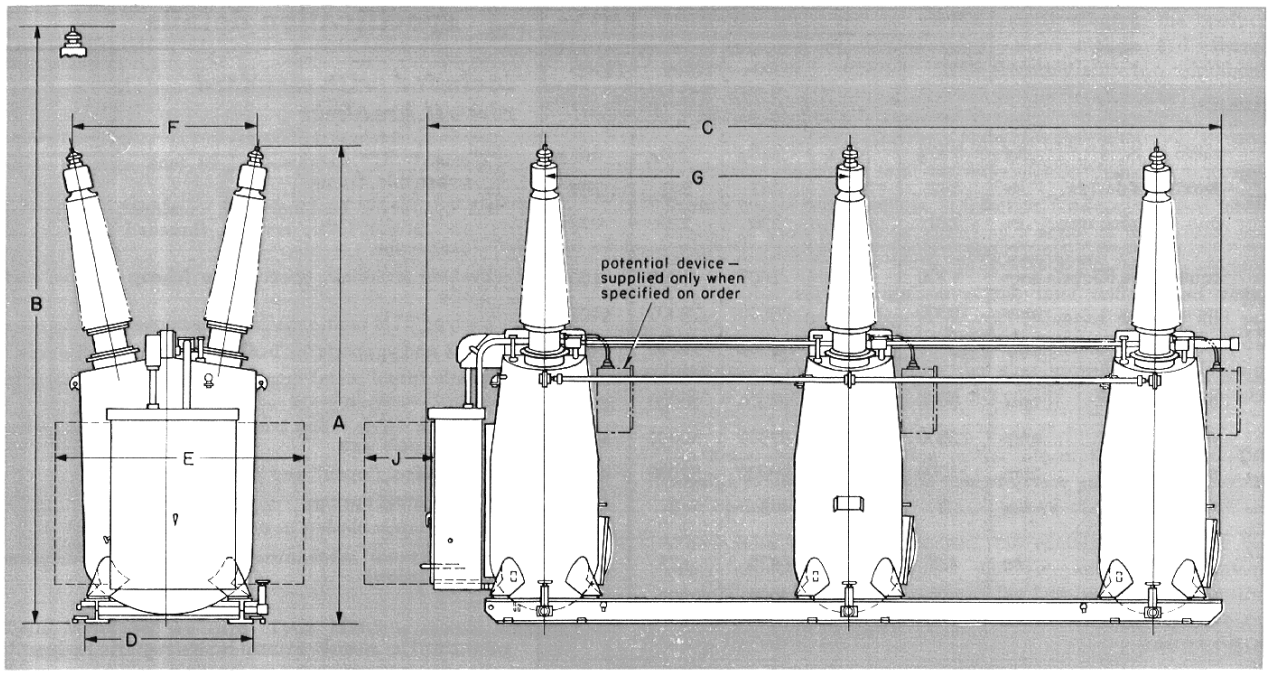
optional equipment available at extra cost:

(for details see price modifications 33-240)

flood-proofed mechanism housing
extra creepage or high altitude bushings
linear couplers for bus differential relaying
metering type bushing current transformers
expansion terminals
key interlocks
440-volt control or three-phase motor for pneumatic mechanism
special relays, meters, instruments and cabinets

dimensions

inches • approximate, not for construction purposes



breaker type	rated kv◉	dimensions A	B▲	C	D	E	F	G	J●
2300 GW 5000	230	233	312	279	84	122	90	96	32
2300 GW 10000		233	312	279	84	122	90	96	32
2300 GW 15000		233	312	279	84	122	90	96	32
2300 GW 20000		233	312	279	84	122	90	96	32
3450 GW 25000	345	332	432	394	..	134	143	144	33

◉ For solidly-grounded neutral applications.
▲ Space required from floor to remove bushing, allowing approximately 10 inch clearance between end of stud and tank flange.
● Space required to open mechanism door.

further information

prices:

complete breakers—price list 33-220
spare parts—price list 33-320
condenser bushings—price list 33-320

description:

type AA pneumatic operating mechanisms—descriptive bulletin 33-350
condenser bushings—descriptive bulletin 33-354
De-ion grids—descriptive bulletin 33-355
bushing-type current transformers—descriptive bulletin 33-356
type PBA-2 bushing potential device—descriptive bulletin 33-357

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