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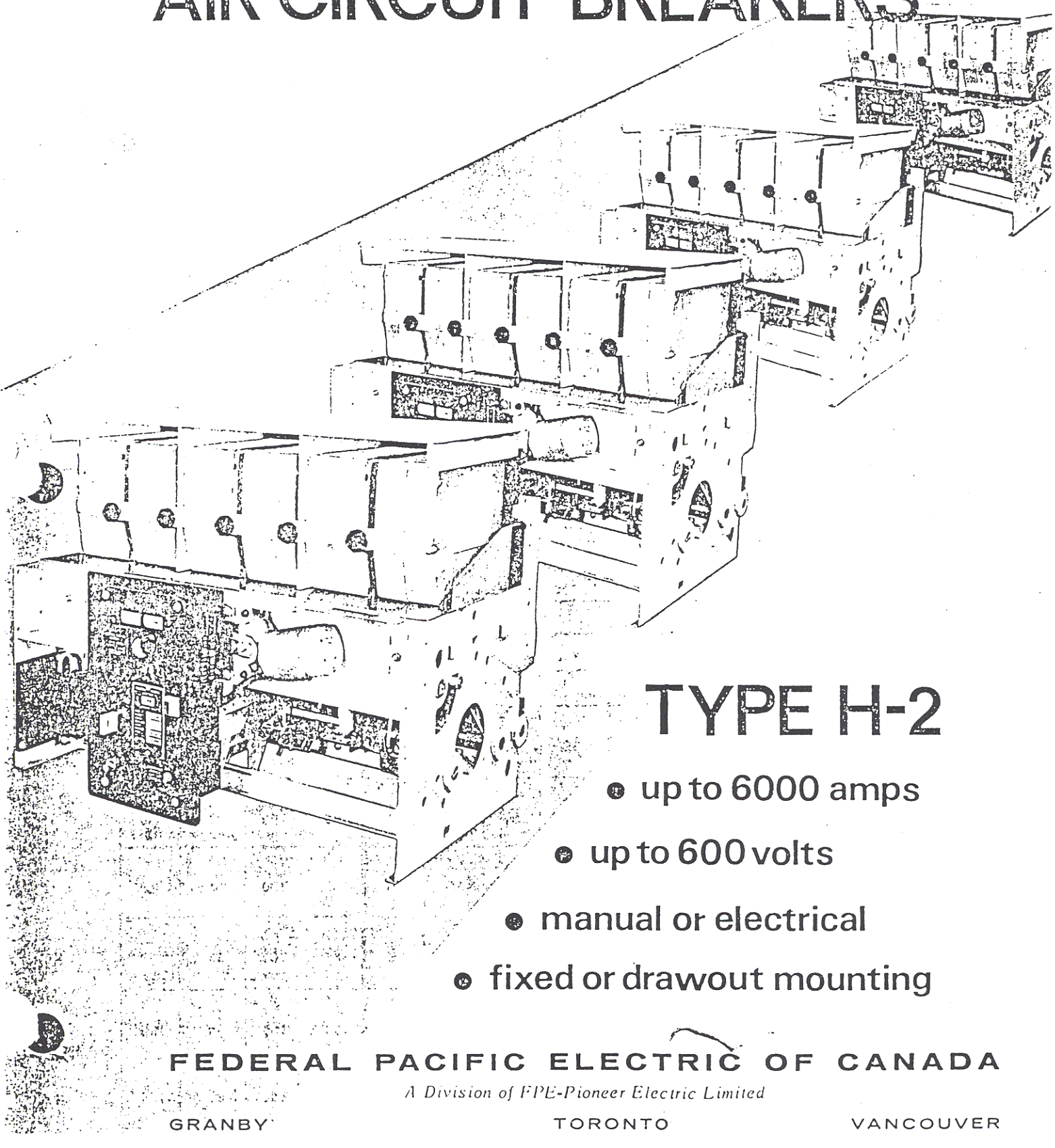
LOW VOLTAGE AIR CIRCUIT BREAKERS



TYPE H-2

- up to 6000 amps
- up to 600 volts
- manual or electrical
- fixed or drawout mounting

FEDERAL PACIFIC ELECTRIC OF CANADA

A Division of FPE-Pioneer Electric Limited

GRANBY TORONTO VANCOUVER

LOW VOLTAGE AIR CIRCUIT BREAKERS

TYPE H-2

RESEARCH AND DEVELOPMENT

Utilizing many of the design principles of the earlier type C breaker, the first type H breaker was brought out in 1953 to take advantage of new materials and production methods. It was thoroughly type tested to insure that the previous high standard of reliability had not been altered.

The advent of stored energy operating mechanisms brought out the type H-1 design still using the main contact structure and arc interrupting methods of the basic type H design.

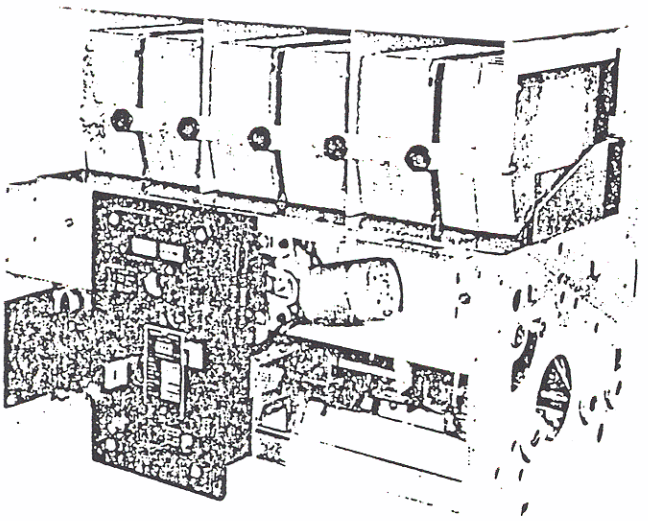
Present day demands for more compact breakers combined with new insulation materials has now brought about the type H-2 breakers. Introduced first in the range up to 1600 amperes, it has now been extended through to 4000 amp frame breakers. In addition to the improved insulation materials, improvements have been made in the contact design, arc interruption and operating mechanism to comply with the latest applicable standards and manufacturing techniques. The type H-2 breaker in addition to meeting NEMA standards also meets British and European standards.

The original design concepts of the type H breakers have not been sacrificed in the type H-2 design. Double break main contacts, large creepage distances and light tripping effort are among the many quality features, providing years of reliable service on type H breakers and retained on the type H-2 design.

The following pages of detailed descriptive literature outline many significant points of quality in the latest member of the type H line of air circuit breakers.

INTERRUPTING RATINGS

Breaker Type	Frame Size AMPS	INTERRUPTING RATING IN KILOAMPS											
		600 Volts				[illegible] Volts				240 Volts			
		Inst. Trip		Short Time Delay		Inst. Trip		Short Time Delay		Inst. Trip		Short Time Delay	
		Sym.	Asym.	Sym..	Asym.	Sym.	Asym.	Sym.	Asym.	Sym.	Asym.	Sym.	Asym.
25H-2	600	22	25	22	25	30	35	22	25	42	50	22	25
[illegible]H-2	1600	42	50	42	50	50	60	42	50	65	75	42	50
65H-2	2000	55	65	55	65	65	75	55	65	85	100	55	65
75H-2	3000	65	75	65	75	65	75	65	75	85	100	65	75
100H-2	4000	85	100	85	100	85	100	85	100	130	150	85	100
100H-1	6000	85	100	85	100	85	100	85	100	130	150	85	100



GENERAL DESCRIPTION

The type H-2 breaker is assembled on a moulded base of high strength phenolic using individual pole pieces carefully interlocked together and supported by a steel frame The mouldings are deeply ribbed to provide large creepage distances between adjacent current carrying parts. The ribs also serve as stiffeners to resist bending and distortion under conditions of maximum stress.

The steel frame is manufactured to close tolerances and jig assembled to ensure accurate alignment of all parts. Close control is maintained over dimensional stability to ensure complete uniformity and interchangeability of finished breakers

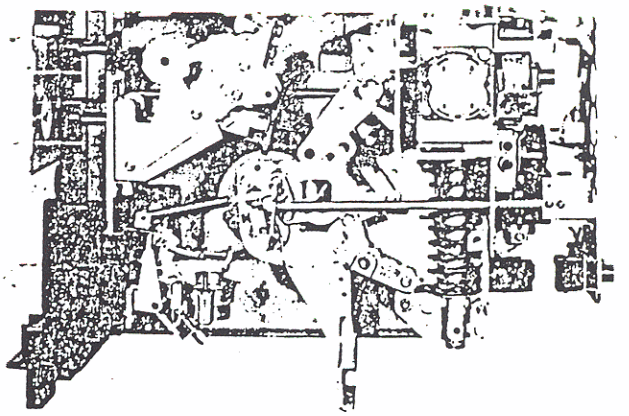
The frame is finished with a light blue high quality baking enamel which in addition to providing an attractive appearance provides more light for ease of inspection of components The cradle assembly is light beige which provides a pleasant colour contrast to the breaker frame. The faceplate is matt black to match other switchboard components.

Attention is drawn to indicators and instruction labels by the use of bright contrasting colours.

STORED ENERGY CLOSING

All type H-2 breakers have a stored energy closing mechanism whereby the energy necessary to close the breaker is stored in a compression spring by the manual or electrically operated charging mechanism. The breaker can then be closed by releasing the energy either by manual push button or electrical solenoid. The closing speed of the breaker is constant and independent of the method used to charge the compression spring, thus manually operated breakers can be used for all ratings. Spring assisted close breakers do not have this facility as the last part of the stroke of the manual handle is used to release the energy in the spring. With the Type H-2 mechanism, the spring can be charged manually and released electrically from a remote position if desired

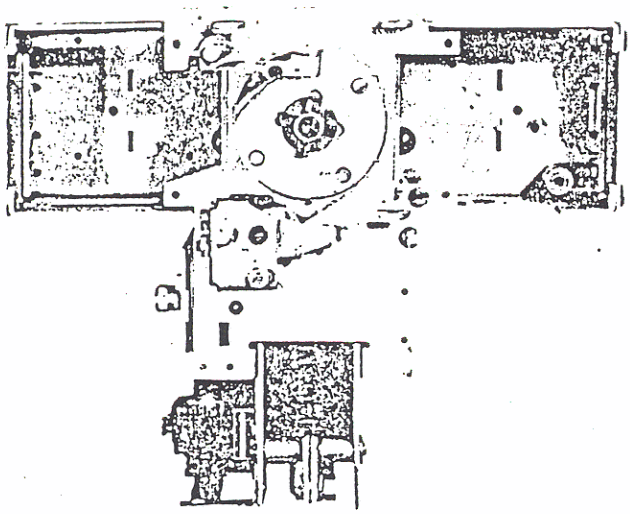
The stored energy mechanism is a separate self-contained unit which attaches to the operating mechanism and frame and does not depend on the accuracy of alignment of these parts for proper operation. A ratchet mechanism of unique design using both driving and holding pawls is actuated by either the manual handle or electric motor to compress the spring. The spring is used only for closing the breaker and is a high quality die-set spring which has unlimited life. Mechanism parts are fabricated from high quality steels, heat treated where necessary to guarantee reliability and long life.



OPERATING MECHANISM

LOW VOLTAGE AIR CIRCUIT BREAKERS

TYPE H-2



MANUAL MECHANISM

OPERATING MECHANISM

The mechanism used to close and hold the contacts closed utilizes toggles and a precision ground latch. High contact pressures require a sturdy mechanism with toggles arranged with double safety factors to prevent locking. High quality needle bearings are used at all points of high stress to prevent the mechanism from "freezing" after long periods with the breaker closed.

The high contact pressures and resultant stresses on the mechanism ensure high throw-off forces to guarantee the breaker will trip under all conditions. These high forces are restrained by a special latch design which requires an average of only 12 ounces of tripping effort.

Like the stored energy mechanism, the operating mechanism is of unitized construction and is assembled independently for attachment to the breaker frame. Only one adjustment is required for the breaker latch mechanism and this is conveniently located at the side of the mechanism compartment. The adjustment is set and locked at the factory and should not require field adjustment.

All mechanism parts are die made to ensure uniformity. Linkages have reamed holes and are equipped with high quality steel pins held in place with circlips. Close tolerances are maintained to eliminate slack in the linkage and to prevent uneven wear when subjected to many operations.

MANUAL OPERATIONS

The breaker is operated manually by rotating the manual handle counter-clockwise through approximately 180° and pressing in to engage a clutch mechanism. Then rotation clockwise through 180° will charge the closing spring. However, as the ratchet mechanism prevents fly back of the handle, two operations through approximately 90° will also charge the spring. An instruction label is provided on the faceplate to ensure correct sequence of operation. When the spring is fully charged the indicator will show "Charged".

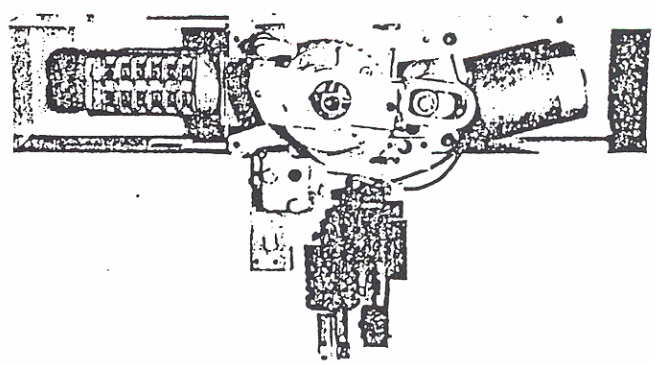
The breaker is actually closed by pressing a direct acting manual close button on the faceplate and not by the motion of the handle.

This is a significant safety feature in that it eliminates the danger of a firm grip on the handle by the operator should the breaker malfunction if closed on a fault.

Remote closing can also be accomplished by using a shunt close device which is an electrical release mechanism for the charged closing spring. This is not possible with a spring assisted manual close breaker mechanism.

The closing spring can be charged by the manual handle when the breaker is either open or closed. This feature permits a one shot re-closure using manual breakers and can be readily utilized in an inexpensive transfer switch application.

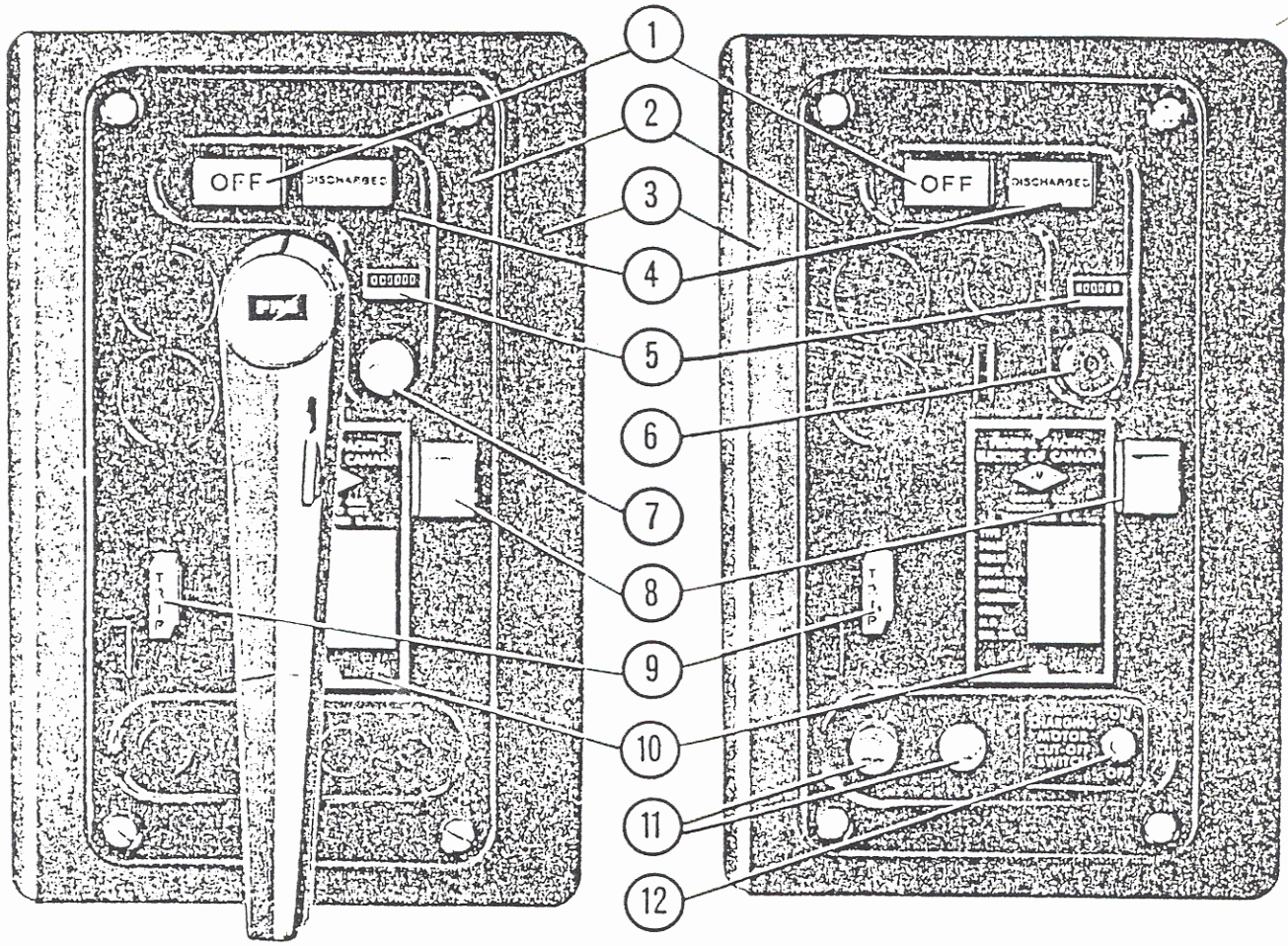
The manual handle can be padlocked with up to two padlocks to prevent charging the closing springs.



ELECTRICAL MECHANISM

TYPE H-2

CIRCUIT BREAKER FACEPLATE



MANUAL ELECTRICAL

1. On - Off indicator
2. Front plate
3. Floating trim
4. Spring charge indicator
5. Operations counter
6. Emergency manual close
7. Close button
8. Gate for draw-out crank
9. Manual trip
10. Rating plate
11. Electrical Control Buttons
12. Motor cut-off switch

ELECTRICAL OPERATION

Electrically operated breakers use a motor to operate the stored energy mechanism and compress the closing spring. The breaker is then closed by releasing the energy of the spring with the shunt close device.

Normally, the motor operates to charge the spring whenever the breaker opens so it is ready to close immediately when the electrical close button is pressed. There is no delay while waiting for the spring to be charged and as it is expected that the normal position of the breaker is closed, the spring will be discharged relieving stresses on the stored energy mechanism. As an option, however, the motor can be connected to charge the spring after the breaker closes and thus one immediate reclosure could be obtained. A motor cut-off switch is provided at the faceplate to isolate the motor completely if required.

The motor is mounted on the stored energy mechanism and thus becomes part of that unit. It is however, readily accessible for replacement without disassembly of the breaker.

Electrically operated breakers are usually remotely controlled and thus the electrical 'close' button provided on the faceplate is normally wired to operate only when the breaker is in the "test" position. This can be altered by a jumper connection at the secondary control contacts so that the close button will operate in either or both the "engaged" or "test" positions An electrically operated breaker may also be closed manually by inserting a tool through a small aperature in the faceplate.

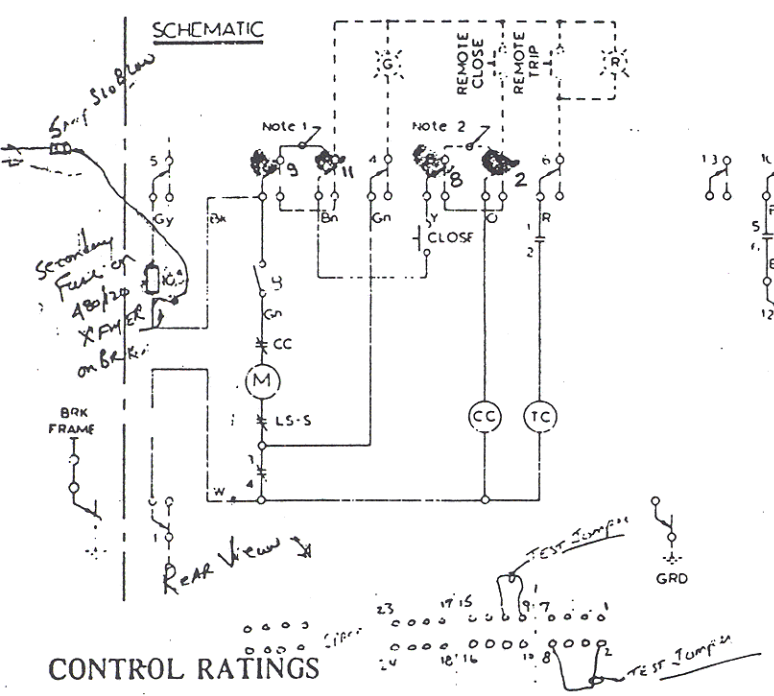
LOW VOLTAGE AIR CIRCUIT BREAKERS

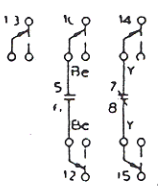
TYPE H-2

A shunt trip is provided as standard on electrically operated breakers for remote tripping. An electrical trip button is provided at the faceplate and will operate in both "engaged" and "test" positions. The manual trip button is also provided and operates in all breaker positions.

In addition to the electrical "close" and "trip" buttons one additional electrical button can be provided on the faceplate for special purpose controls such as electrical reset of lockout devices.

The shunt trip and close devices are continuously rated and thus eliminate the necessity of an anti-pumping relay. A four pole auxiliary switch is also supplied as standard with one N.O. and one N.C. contact available for customers use. Additional switch contacts can be provided up to a maximum of 8 on breakers to 1600 amps and up to 12 contacts on larger frames. Contacts are wired out to secondary contacts on drawout breakers and to a terminal block on fixed breakers.





LEGEND

8 — Motor Isolating Switch
LS-S — Limit Switch Spring
M — Spring Charging Motor
CC — Closing Coil
TC — Trip Coil

NOTES:

1. If an external interlock is required connect between D/O contacts #9 & #11 and remove jumper
2. a) Faceplate close pushbutton operable only in test position
   b) Faceplate close pushbutton operable in all positions add jumper between D/O contacts #2 & #8

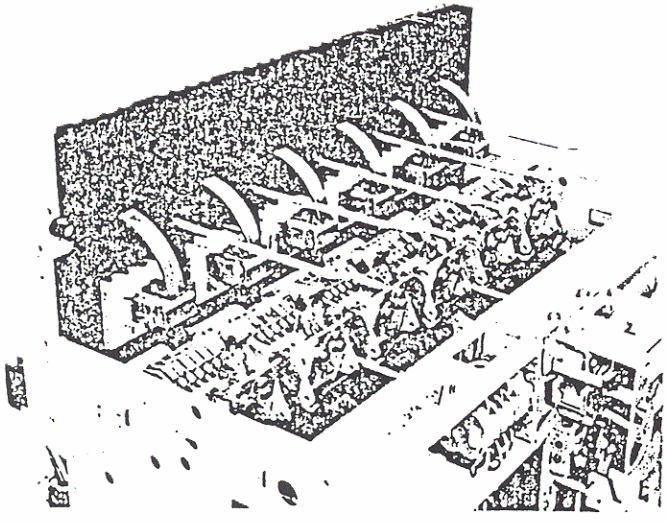
CONTROL RATINGS

Electrically operated breakers and manually operated breakers with electrical accessories will operate with control voltage applied in the ranges listed in the following table.

Where dc control power is not available, ac power is taken from the line side of the breaker or from a separate ac 60 cycle source. For supply voltages over 115V ac a control transformer is provided and is rated at 150 VA for breakers up to type 65H-2 and 250 VA for the larger 75H-2 and 100H-1.

The motor used for electrical operation is a universal motor rated 115V ac/125V dc however 48 volt dc motors are available. Control schemes at 48V dc or 24V dc are available in conjunction with the motor operating at 115V a.c. Control schemes at 240V ac or 250V dc are also available using dropping resistors in series with the motor.

Rated Control Voltage	Closing Voltage Range Volts	Maximum Motor Current Amps.	Shunt Close Amps.	Tripping Voltage Range Volts	Shunt Trip Amps.
48V dc	—	—	—	28- 60	—
125V dc	90-130	11	0.89	70-140	0.89
250V dc	180-260	6	1.10	140-280	1.10
115V ac	95-125			95-125	
230V ac	190-250	Inrush 12	1.4	190-250	1.4
460V ac	380-500	Full load 6		380-500	
575V ac	475-630			475-630	



MAIN CONTACTS

All type H-2 breakers have double break on the main contacts. The fixed main contacts are chamfered at an angle of 30° to the base and have silver tungsten alloy contacts in a continuous strip. The angular configuration reduces the blow off forces produced by short circuit currents and thus the stresses on the mechanism.

The moving main contacts are individual segments with silver tungsten alloy tips, and are fully insulated from each other and the carrying arm. They are free floating and self-aligning with two compression springs per contact. High contact pressures ensure the breakdown of corrosive films and dirt and ensure that the contacts do not lift when closing against fault currents to the maximum rating of the breaker.

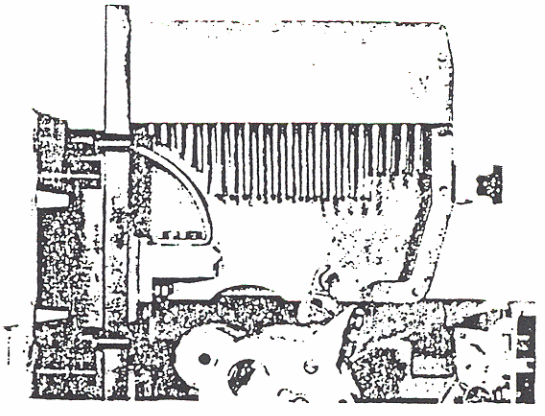
When the breaker opens under loads or short circuits, the main contacts part first and because of the double break design a wide air gap is quickly established which practically eliminates arcing on the main contacts. The main contacts are then no longer in the path of the short circuit current and thus are not subject to any further heating.

ARC CONTROL

During the opening cycle the current is transferred to the arc control path after the main contacts have parted. The current is diverted around the main contacts by a heavy copper braid connected below the main contacts and to the moving arcing contact. After a substantial air gap is established on the main contacts the arcing contacts part.

The fixed and moving arcing contacts are large copper extrusions and the silver tungsten alloy contact surfaces are large to ensure that the brazing will not fail even under repeated operations on short circuits. The upper parts of the contacts are curved to form an arc runner which assists in extending the arc in the chute.

As the arc is drawn between the arcing contacts, the arc current magnetizes two heavy steel plates on the sides of the arc chute. The magnetic field produced forces the arc farther up into the chute where the action of the de-ion plates will pull the arc still further inside and at the same time cool it and break it into many small series arcs. As the arc travels up into the chute it is also extended as it is cooled and then extinguished.

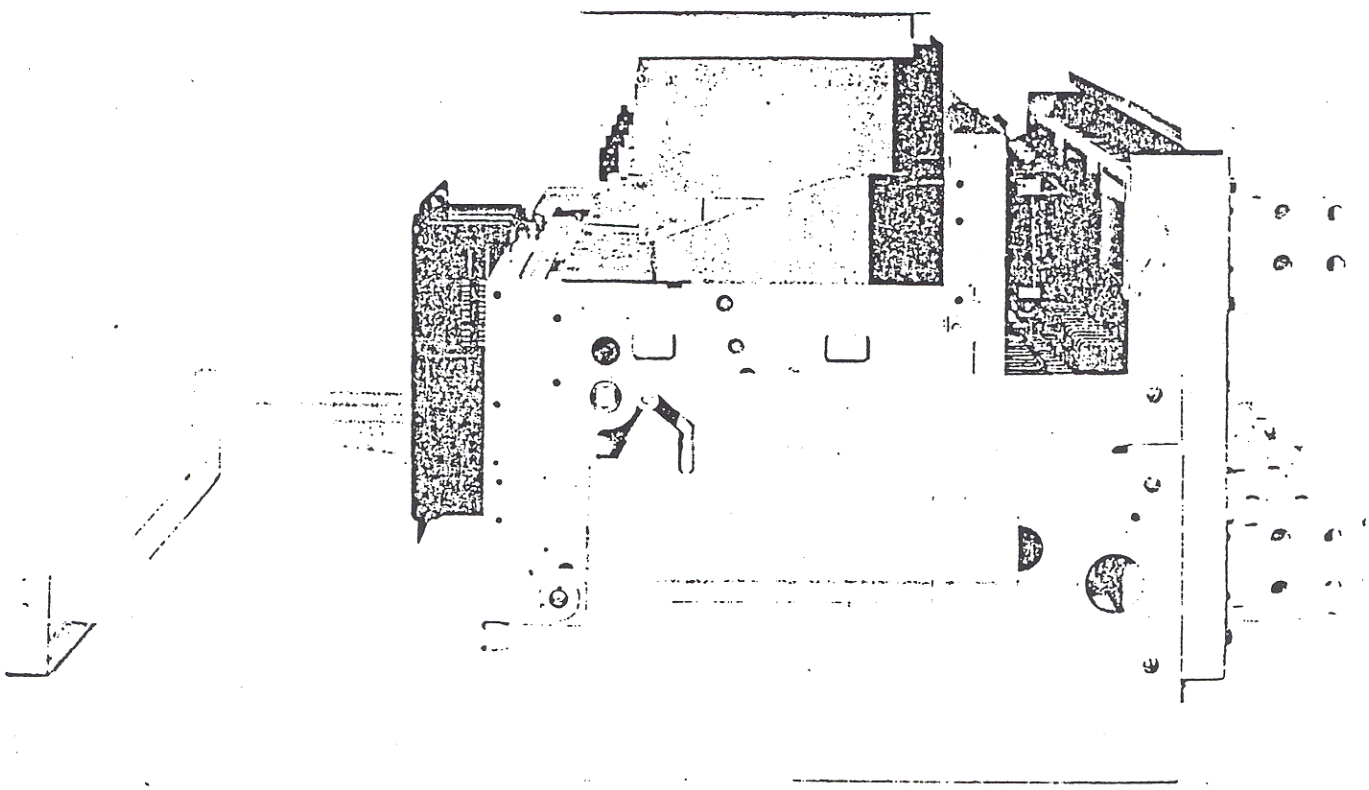


The arc chute is moulded from a special material "Krismalex" and has a special ceramic coating on the sides where the arc is the hottest, to prevent burning and imbedding of copper particles. Ceramic baffles are also provided at the top of the chute. While the arc chute is held firmly in place by a removable clip, it can be conveniently removed for inspection of contacts.

A hood over the arc chutes together with inter-phase barriers is provided on all breakers except type 25H-2 and 50H-2. The hood does not need to be removed for inspection of contacts. The use of a hood allows metal partitions in the switchboard to be placed as close as 1½" above the arc chutes without any danger of ground faults during breaker operation.

LOW VOLTAGE AIR CIRCUIT BREAKERS

TYPE H-2



DRAWOUT MECHANISM

The drawout mechanism provides three positions for the breaker:

(a) Engaged – Primary and secondary contacts energized.

(b) Test – Primary contacts isolated; secondary contacts energized.

(c) Disengaged – Primary and secondary contacts isolated.

A positive gear drive operable through the breaker faceplate with the enclosure door closed, operates a cam lever on each side of the drawout cradle to move the breaker through its positions. The enclosure door can be opened with the breaker in any of the three positions.

The breaker is guided accurately and smoothly on grooved non-metallic wheels fastened to the outside of the breaker frame. As the breaker is cranked in from the "disengaged" position, the grounding contact is engaged first. This is a sturdy phosphor onze to copper contact which ensures a positive ound connection to the breaker frame The secondary or control contacts make next as the breaker reaches the "test" position. Finally the main contacts are made as the breaker reaches the "engaged" position. A positive stop on the mechanism and a safety interlock all ensure the breaker is fully engaged before it can be closed. Breaker position is also clearly shown by an indicator on the side of the faceplate

When the breaker is cranked out the reverse sequence takes place After the breaker reaches the "disengaged" position and the enclosure door is opened, folding tracks can be pulled down to roll the breaker by hand fully clear of the enclosure exposing all the plug-in contacts for examination

SAFETY INTERLOCK

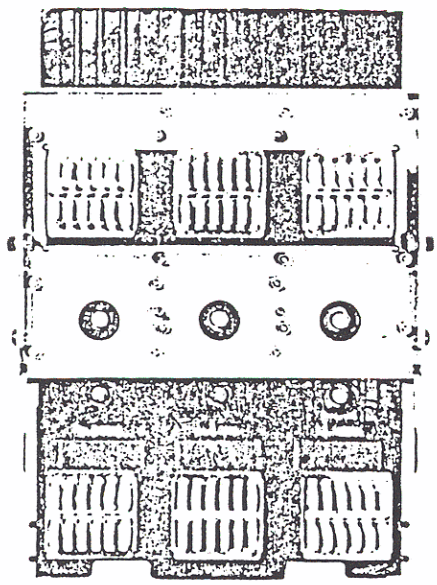
The drawout mechanism is provided with a safety interlock to ensure that the breaker is open before it is either withdrawn from the main contacts or engaged onto the main contacts.

The drawout mechanism operating shaft is located behind a sliding tab on the breaker faceplate. Unless the breaker is open the tab cannot be lifted and the drawout crank cannot be inserted.

After the breaker has been tripped, lifting the tab holds the breaker mechanism in the tripped position and prevents reclosure As the drawout crank is turned, the tab cannot be returned to allow the breaker to close until the breaker has moved fully to one of its designated positions of "engaged", "test" or "disengaged".

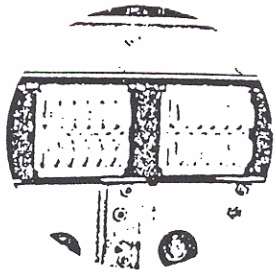
MAIN DRAWOUT CONTACTS

Main drawout contacts are silver plated for maximum efficiency as standard to ensure low temperature rise at full load currents. However, in sulphurous atmospheres cadmium type plating is usual to better inhibit corrosion at the contacts.

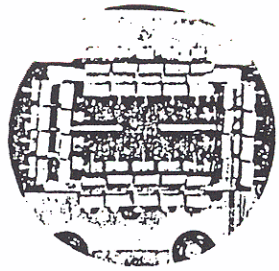


1600 AMP CONTACTS

For breakers up to 3000 amperes, wafer type contacts held in a basket with individual springs per pair of contacts ensure a reliable self-aligning free floating connection The 600 amp contact uses 6 wafers approximately ⅛" thick, the 1600 amp contact uses 12 wafers approximately ¼" thick and the 3000 amp contact uses two sets of 1600 amp contacts.

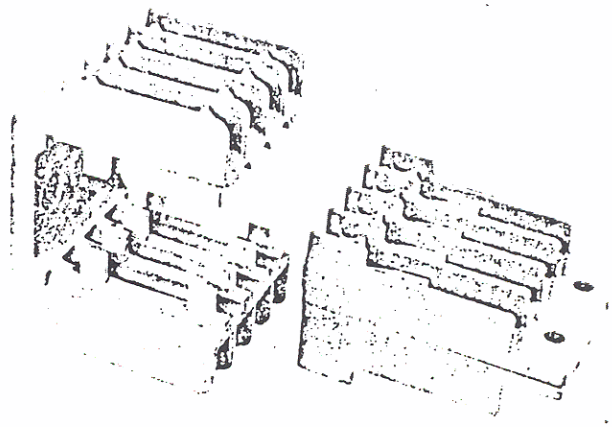


3000 A CONTACTS



4000 A CONTACTS

Above 3000 amperes a flat type contact with individual compression springs providing line to point contact are arranged in a hollow square design. This design permits the most economical use of material consistant with low temperature rise



SECONDARY CONTACT BLOCK WITH SET OF 8 CONTACTS.

SECONDARY DRAWOUT CONTACTS

Secondary drawout contacts are provided on drawout breakers to automatically connect or disconnect control circuits, as the breaker moves through its positions on the drawout cradle the contacts of the [illegible] control circuit can be energized [illegible] position. These connections can be changed in the field when required.

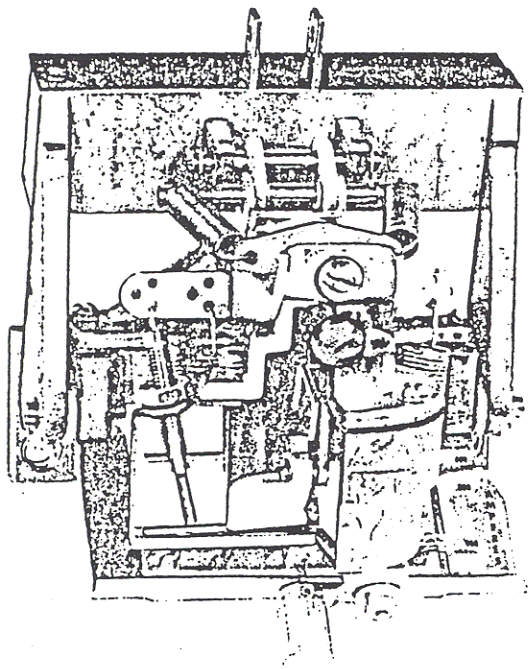
The contacts are supplied in sets of 8 in one contact block with power supply to [illegible] on the left side viewed from the front. Control power supply terminals are separated from other control circuits by a blank terminal thus providing double arc gap and creepage distances at these points A maximum of 32 contacts can be supplied.

The continuous current carry capacity of the contacts is conservatively rated at 30 amps continuous and is suitable for voltages up to 600 volts.

Contacts are formed copper, cadmium plated and mounted in a polycarbonate moulding The moulding is designed with high barriers between contacts and the disconnecting parts shrouded so that contacts cannot be made until they are aligned.

LOW VOLTAGE AIR CIRCUIT BREAKERS

TYPE H-2



STANDARD TRIP RATINGS		
Breaker Type	Overcurrent Trip Ratings (100% Calibration)	Instantaneous Trip Range
25H-2	40, 50, 70, 90, 100, 125, 150, 175, 200, 250, 300, 350, 400, 500, 600.	8-15 times Overcurrent Trip Ratings
50H-2	200, 225 250, 300, 350, 400, 500, 600, 800, 1000, 1200, 1600	8-15 times
65H-2	300, 350, 400, 500, 600, 800, 1000, 1200, 1600, 2000	4-10 times
75H-2	1600, 2000, 2500, 3000	4-10 times
100H-2	2000, 2500, 3000, 3500, 4000	4-10 times
100H-1	5000, 6000	4-10 times

OVERCURRENT RELAYS

All type H Breakers are supplied with the type PA direct acting overcurrent relay. These relays are dual magnetic type consisting of a long delay element and an instantaneous element. A series coil is used on breakers 600 amperes and below, while a single conductor provides sufficient magnetic flux for all ratings over 600 amperes. The very efficient magnetic design permits operation of the relay at very low ampere-turn values and thus the coil normally associated with air circuit breaker relays is completely eliminated for all ratings over 600 amperes. In addition, coils used on the lower ratings employ much lower current densities than usual for this type of device and thus will operate at much lower temperatures.

This is particularly significant as relay coils are a major source of heat and, because of their critical location at the bottom of the breaker, any heat contributed will rise and affect contact heating. Type PA relays have, to a large extent, eliminated this source of heat.

The pick-up point, that is the current rating at which the relay will begin to operate, is adjustable in the field with calibration points at 80, 100 and 160% of the continuous current rating of the trip coil. It should be noted that the trip coil rating limits the continuous rating of the breaker to the 100% rating of the coil for all breakers 600 amperes and below.

The long delay is obtained by means of a displacement type dashpot utilizing a special silicon oil with practically constant viscosity characteristics so that overall tripping characteristics remain constant throughout a very wide range of ambient temperatures.

Three standard time bands are available which are factory set and sealed. Medium time band is supplied as standard unless otherwise specified.

The [illegible] is supplied with a calibration mark at 10 times the relay continuous rating unless otherwise specified. The instantaneous pick-up is field adjustable and additional calibration marks can be provided at small additional cost.

[illegible] a mechanical timing device is introduced to retard the instantaneous action of the relay. This is an optional [illegible] and provides adjustable delay [illegible] 3 or 25 cycles.

ACCESSORIES

SHUNT TRIP

The shunt trip is a solenoid device which when energized acts directly on the breaker trip shaft to trip the breaker. Coils are continuously rated and interchangeable with all standard control ratings available (See rating data). A shunt trip is supplied as standard on electrically operated breakers except where a no-volt trip is required and can be used for remote tripping. The shunt trip described above is separate from the special shunt trip device used with the solid state overload relay.

SHUNT CLOSE

The shunt close device is identical to the shunt trip described above but is used to release the energy stored in the closing spring to close the breaker from a remote position. It is standard on electrically operated breakers and is available as an optional extra on manually operated breakers.

UNDERVOLTAGE RELAY

The undervoltage relay is basically an ac solenoid holding up a heavy weight which will trip the breaker mechanically when the supply voltage falls below 50% of normal. Tripping action may be instantaneous or delayed. Delay is adjustable from 0 to 5 seconds.

The device is energized from the control transformer through a self-contained early close contact. A link connected to the breaker closing mechanism holds up the weight mechanically until the auxiliary contact closes.

If voltage is available on the line side terminals, the coil is energized and will hold the weight and allow the breaker to close. Ratings are 115, 230, 460 & 575 volts ac 60 cycle. Burden is 100 VA.

AUXILIARY SWITCH

These switches are rotary cam operated devices ensuring positive opening and closing with silver to silver double break contacts. The switch is built up from moulded wafer sections which each carry one pair of contacts either normally open or normally closed. Contact timing is determined by the shape of the cam and is set at the factory. This precludes field alterations except by replacing the switch.

Contacts are rated at 20 amperes continous at 600 volts ac. Interrupting rating is 15 amps ac and 0.5 amps at 250 Vdc. Two contacts in series are normally employed for 250 V dc circuits.

A four pole switch is supplied as standard on electrically operated breakers and manual breakers where a shunt trip or close is required. At least 2 contacts are available for customers' use, one normally open and one normally closed. Eight pole and 12 pole switches are available as optional extras.

OVERLOAD LOCKOUT DEVICE

The overload lockout device prevents reclosing the breaker either manually or electrically after the breaker has been tripped by the overload relay, until this device is manually or electrically reset.

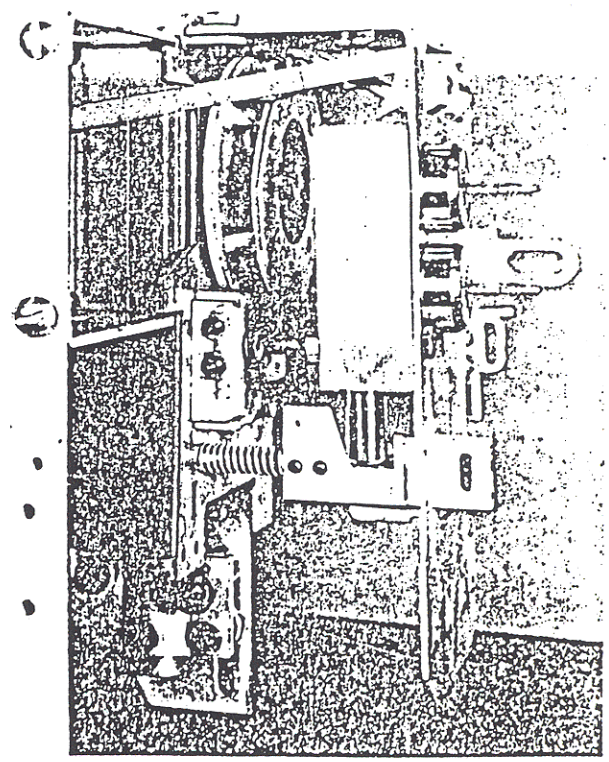
The breaker is held in a tripped position mechanically and a contact is opened in the closing circuit when this device has operated.

ALARM CONTACTS

A SPDT contact is supplied and operated in conjunction with the overload lockout device. Contact is reset with the overload lockout device.

KEY INTERLOCKS

Two key interlocks can be mounted in the breaker faceplate using standard type VF locks with ¼" plunger extension. When cell interlocking is required locks are mounted independent of the breaker. Type VF lock is used with ⅜" plunger extension padlocks and can be supplied when required.



LOW VOLTAGE AIR CIRCUIT BREAKERS

TYPE H-2

INDICATING LIGHTS

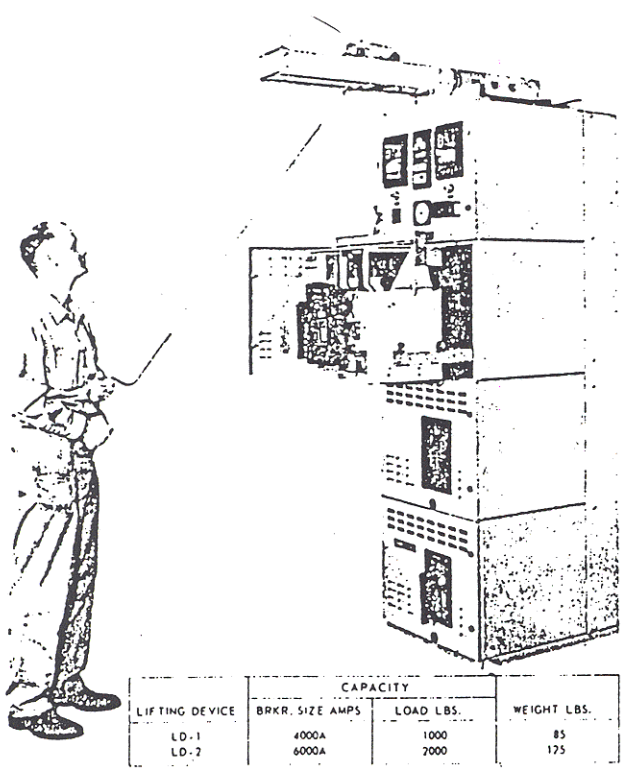
Indicating lights are not mounted on the breaker faceplate as the repeated jarring from breaker operation limits the life of the lamp bulbs. They are normally mounted on the enclosure door with connection to the breaker through the secondary contacts.

OPERATIONS COUNTER

A 6 digit Veeder Root counter can be supplied mounted in the faceplate of the breaker. This device is mechanically driven by the "charge-discharge" indicator and is recommended where breakers will be subjected to severe switching duty.

LIFTING DEVICES

When it is necessary to remove circuit breakers from the Switchgear assembly for service or maintenance a lifting device can be provided to facilitate breaker handling. When the breaker is drawn out on its tracks the lifting yoke is readily hooked onto the breaker frame. The breaker can then be lifted off the tracks and and lowered onto a service dolly.



LIFTING DEVICE	CAPACITY		WEIGHT LBS.
	BRKR. SIZE AMPS	LOAD LBS.	
LD-1	4000A	1000	85
LD-2	6000A	2000	175

The type LD-1 attaches to the switchboard column and is used where the top of the switchgear assembly is accessible at the front and it is convenient to lower the breaker on a dolly.

The track for this device mounts on the front section of the switchgear only and does not interfere with the rear bus section which remains clear for conduit or bus duct entry. The hoist boom moves laterally on the track installed on the switchgear and the hoist itself moves backwards or forwards on the boom. A locking device will hold the hoist in any desired location. The boom complete with hoist weighs only 85 pounds and is readily removable for use on other assemblies or for storage.

Lifting yokes are available for all FPE Air Circuit Breakers, Fusematics and Service Protectors.

TYPICAL SPECIFICATION

Low voltage power air circuit breakers shall be 3 pole 600 volt class with continuous current ratings and trip ratings as detailed on the plans. Interrupting ratings will be in accordance with NEMA Standards for the frame and/or their application in a (fully rated) (selective) (cascade) system. Breakers shall have 3 (dual magnetic) (solid state) direct acting overload relays and shall be trip free in operation. Stored energy closing mechanisms (either manually or electrically charged) shall be used for all ratings, with breakers being closed by means of push button. An emergency manual spring charging handle shall be supplied for electrically operated breakers.

Breaker faceplate shall have "on-off" indicator, spring charge indicator, provision to padlock manual handle, provision to lock breaker in "off" position, and provision to lock drawout mechanism. Electrically operated breakers must have provision for emergency manual closing by inserting a tool through the faceplate. A control isolating switch shall be provided on the faceplate to isolate the supply to the spring charging motor.

Breakers shall be Federal Pacific Electric Type H-2 or approved equal.