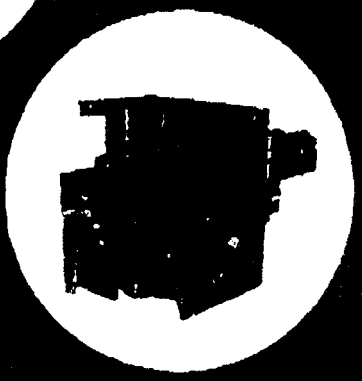
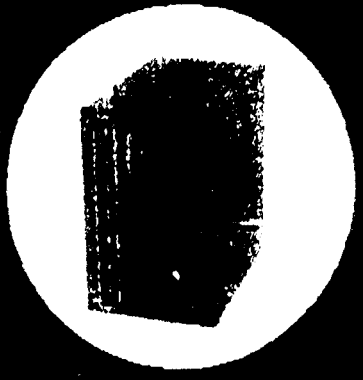
AIR CIRCUIT BREAKERS

FPE





LOW VOLTAGE
AIR CIRCUIT BREAKERS—TYPE H-2

LOW VOLTAGE
FUSED AIR CIRCUIT BREAKERS—
TYPE HL-2

SOLID STATE
OVERCURRENT RELAY—TYPE SD

FPE
FEDERAL PACIFIC ELECTRIC COMPANY
Low Voltage Distribution Equipment Division
150 Avenue L, Newark, NJ 07101 (201) 589-7500

FRÉ LOW VOLTAGE AIR CIRCUIT BREAKER—TYPE H-2

CONTROL RATINGS

Electrically operated breakers and manually operated breakers with electrical accessories will operate with control voltages applied in the ranges listed in the table to the right

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 a control transformer is provided and is rated 150 VA for breakers up to type 65H-2 and 250 VA for the larger 75H-2 and 100H-2

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 ac. Control schemes at 240V ac or 250V dc are also available

Rated Control Voltage	Closing Voltage Range Volts	Maximum Motor Current Amps.	Voltage Close Amps.	Tripping Shunt Range Volts	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	

BREAKER DIMENSIONS

The type H-2 breaker is a compact device allowing 4 high stacking in a 90 inch high switchgear column up to and including the 2000A 65H-2 frame. Refer to the table to the right for details of the number of breakers that can be accommodated in a switchgear section.

	Type	Frame Size	Max. No. of Units per Section — Section Width 25" (635 mm)	36" (914 mm)	45" (1143 mm)
AIR CIRCUIT BREAKERS 3 POLE	25H-2	600	4		
	30H-2	800	4		
	50H-2	1600	4		
	65H-2	2000	4		
	75H-2	3000		3	
	100H-2	4000		2	
	100H-2	5000		1	
	100H-2	6000			1

Line and Load Fixed Contacts and Moving Bridge Contacts in the Open Position

MAIN CONTACTS

All types of H-2 breakers have double break bridge type main contacts, with wedge contact surfaces tipped with silver tungsten sintered inlays. The angular configuration reduces the blow off forces produced by short circuit currents and thus reduces the stresses on the mechanism.

The moving main contacts are individual segments 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.

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. The current is transferred to the arcing contacts, which complete the interruption, without arcing on the main contacts.

LOW VOLTAGE AIR CIRCUIT BREAKER—TYPE H-2

INTRODUCTION

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

The advent of stored energy operating mechanisms brought out the tye 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 combines with new insulation materials brought about the type H-2 breakers. This breaker was introduced in the range up to 1600 amperes, and then extended through to the 6000 ampere frame size. In addition to improved 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 original design concepts of the type H breakers have been retained 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.

These circuit breakers are short time rated consequently they can be used in selective systems

GENERAL DESCRIPTION

The type H-2 line of air circuit breakers has been developed for use as main circuit breakers and for feeder protection, and is designed, manufactured and tested to withstand adverse service conditions. The breakers are suitable for use in utility, industrial and commercial applications.

These circuit breakers are available as fixed mounted or drawout mounted devices for application in switchgear assemblies. Wall mounted enclosures can be supplied for fixed mounted units up to 4000 amp frame size

The type H-2 breaker is assembled on a molded base of high strength thermoplastic using individual pole pieces carefully interlocked together and supported by a stainless steel frame. The moldings 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 stainless 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 of each frame size.

Self contained stored energy mechanisms are provided throughout the full breaker range Overcurrent protection is provided by a solid state tripping system, consisting of current sensors, 3 phase overcurrent relay and a self powered solenoid type shunt trip device

Manually Operated Breaker In Draw-Out Cradle

FPE LOW VOLTAGE AIR CIRCUIT BREAKER—TYPE H-2

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 cell or connected into the cell.

The drawout mechanism operating shaft is located behind a sliding gate interlock on the breaker faceplate. Lowering the gate trips the air circuit breaker. As long as the cranking handle is inserted, the breaker cannot be closed, in any position.

MAIN DRAWOUT CONTACTS

Main drawout contacts are silver plated for maximum efficiency to ensure low temperature rise at full load currents. However for sulphurous atmospheres cadmium plating is available as an option to eliminate the formation of silver sulphides, which are non-conductive.

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 amps contact uses 8 wafers approximately 1/8" (3.175mm) thick, the 1600 amp contact uses 12 wafers approximately 3/8" (9.5mm) thick and the 3000 amp contact uses two sets of 1600 amp contacts.

Above 3000 amperes a flat type line contact with individual compression springs providing line to point contact are arranged in a hollow square design. This design provides maximum conductivity with minimal space requirements.

4000 amp Box Contacts

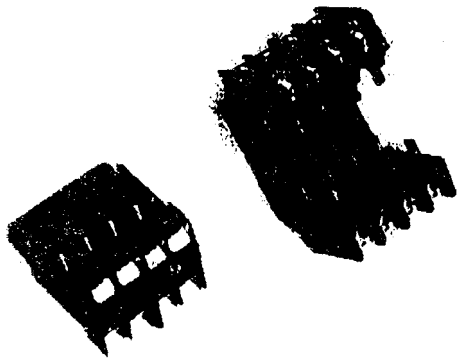
SECONDARY DRAWOUT CONTACTS

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 are designed so that control circuit can be energized or isolated in the test 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 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 40 contacts can be supplied.

The continuous current carrying 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 molding. The molding is designed with high barriers between contacts to provide proper alignment between stationary and moving parts. The movable secondary contact block fitted to the breaker assembly is spring mounted to further ensure alignment with the stationary contacts.



4 Pole Fixed and Moving Secondary Contacts

FUSED AIR CIRCUIT BREAKER—TYPE HL-2

RATING

BREAKER TYPE	FRAME SIZE AMPS	INTERRUPTING RATING				MAX. FUSE SIZE AMPS
		BREAKER C/W FUSE KA SYM.	BREAKER ONLY KA SYM.			
			600V	480V	240V	
25HL-2	600	200	22	30	42	1200
30HL-2	800	200	30	30	42	1200
50HL-2	1600	200	42	50	65	2000
65HL-2	2000	200	42	50	65	3000
75HL-2	3000	200	65	65	85	4000
100HL-2	4000	200	85	85	130	6000

MOUNTING

Type HL-2 fused air circuit breakers are supplied for drawout mounting only as the fuses are located behind the base and on the line side of the breaker. Access can be gained to the fuses when the breaker is fully withdrawn.

SINGLE PHASE PROTECTION

Single phase protection is supplied as standard on type HL-2 fused air circuit breakers. Three solenoid coils, one for each phase, are connected in parallel with the current limiting fuses. They are provided with plungers which act directly on the common trip shaft. The coils are rated 1/10 line voltage so that should a fuse blow on short circuit, even though the line voltage may be reduced, the coil will provide sufficient power to trip the breaker.

BLOWN-FUSE INDICATOR

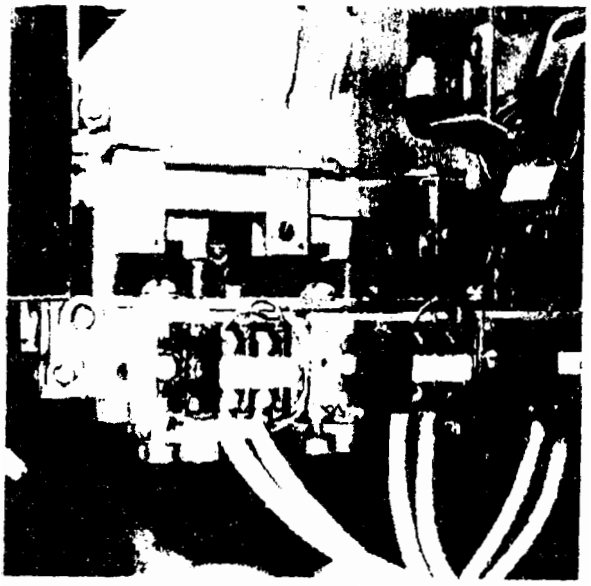
An indicator is provided which is actuated by the single phase protection coils. Should one fuse blow, the corresponding coils will trip the breaker and project an indicating bar through the faceplate. The three indicators are colored red, yellow and blue and correspond to left, center and right side fuses. When the fuse has been replaced the linkage can be reset by pushing in the indicator. The breaker can then be reclosed.

TYPICAL SPECIFICATION

The fused air circuit breakers shall be 600 volt 3 pole with continuous current ratings, trip ratings and fuse ratings as detailed later. The breakers shall be equipped with a 3-phase solid state overload relay and three current limiting Economin current limiting fuses mounted as an integral part of the breaker. Single phase protection shall be provided so that blowing of any fuse will trip the circuit breaker. A color coded indicator shall be provided on the faceplate to indicate which fuse has blown and also to lock out the breaker mechanically until the indicator is manually reset.

The breaker shall be of the stored energy closing type (manually) (electrically) operated and drawout mounting with all the attendant safety interlocks required by NEMA standards.

Breakers shall be Federal Pacific Electric Company type HL-2 or approved equal.



Single Phase Protection

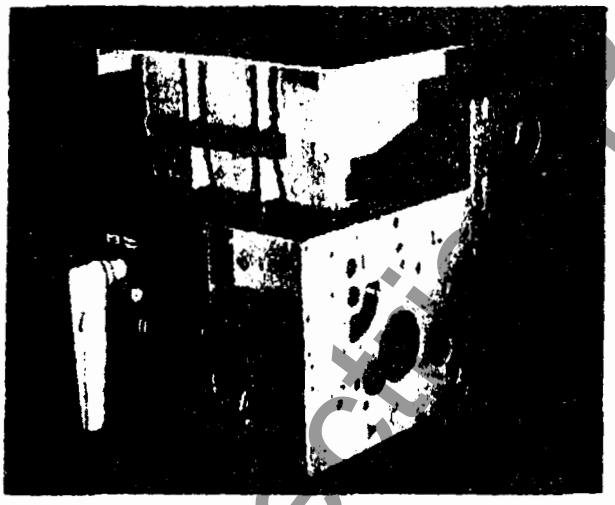
FUSED AIR CIRCUIT BREAKER—TYPE HL-2

INTRODUCTION

The type HL-2 air circuit breaker is a protective device designed primarily for service where the interrupting capacity requirements are beyond the normal air circuit breaker rating. It is a co-ordinated combination of a standard power air circuit breaker with a 3 phase solid state overcurrent relay, and Economin current limiting fuses.

The use of current limiting fuses increases the interrupting capacity of the co-ordinated device to 200,000 amperes. The air circuit breaker alone retains the standard interrupting capacity for its frame size, which ranges from 22,000 amperes symmetrical at 600 volts with a 600 ampere frame size, to 35,000 amperes symmetrical at 600 volts with a 4,000 ampere frame size.

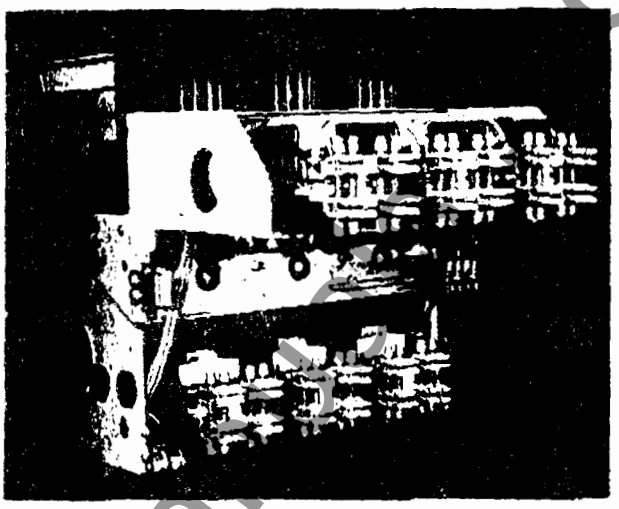
The type HL-2 fused air circuit breaker utilizes the standard type H-2 breaker, with all its attendant features. Optional accessories available with the standard breaker are also available with the fused breaker. Limitations in trip ratings are imposed depending on fuse ratings and thus trip ratings should be selected after co-ordination studies have been made. Fuses are standard FPE Economin NEMA J or NEMA L and do not require special mounting.



OVERCURRENT PROTECTION

When a short circuit occurs the magnitude of the current and the co-ordination between the fuse and the breaker overcurrent relay will determine whether the breaker or the fuse will clear the fault. Co-ordination must be such that the breaker will not attempt to clear faults beyond its rating. As breaker contacts must withstand the peak let-through of the fuse there is a maximum size fuse which can be supplied with each breaker frame size.

Co-ordination between the breaker relay and the fuse is such that the breaker will operate to clear over-loads and faults up to its interrupting rating and the fuse will clear faults above the breaker rating.



FUSE PROTECTION

Fault current damage is a result of the excessive heat energy released and the mechanical distortion produced by magnetic forces. Both these destructive elements are proportional to the square of the short circuit current. The heat energy is also directly proportional to the time that the short circuit current flows.

Since current limiting fuses have the precise qualities of limiting both the current and the time through which it acts, fault damage will be considerably less when the fuse clears a fault as compared to the slower breaker operation on lower values of fault current. Fuses operate silently and safely without expelling any ionized gas.

SELECTION OF RATINGS

The frame size and trip ratings for type HL-2 fused breakers are selected in the same manner as for a conventional air circuit breaker. To achieve the best protection from the current limiting fuse, the smallest rating which can co-ordinate with the relay should be chosen.

Where fused breakers are used in series, co-ordination between the fuses must also be considered and reference should be made to the I^2t prearcing and total clearing energies for various fuses to ensure their co-ordination.

Where the current limiting fuse must protect equipment by virtue of its current limiting abilities, the maximum peak withstand of the equipment must be determined and a fuse selected which will limit the available current to a value less than the maximum withstand peak. The maximum withstand peak of the protected apparatus may be determined by multiplying the short circuit withstand rating in symmetrical amperes by 2.2. Then with the known value of available short circuit current in symmetrical amperes, the maximum rating of fuse can be selected from the fuse let-through curves.

LOW VOLTAGE AIR CIRCUIT BREAKER—TYPE H-2 FPE

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 molded wafer sections which each carry one normally open and one normally closed contact. Contact timing is determined by the shape of the cam and is not adjustable.

Contacts are rated at 20 amperes continuous at 600 volts ac. Interrupting rating is 15 amps ac and 6.5 amps at 250V dc. Two contacts in series are normally employed for 250V dc circuits.

A four pole switch is supplied as standard on electrically operated breakers and manual breakers where a shunt trip 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 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 Single Pole Double Throw contact is supplied and operated in conjunction with the overload lockout device. Contact is reset with the overload lockout device. Where overload lockout is not required a momentary overload alarm contact can be supplied to operate a remote flag relay.

INDICATING LIGHTS

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

OPERATIONS COUNTER

A 5 digit 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 frequent 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 lowered onto a service dolly.

The lifting device 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.

TYPICAL SPECIFICATION

Low voltage power air circuit breakers with double break main contacts 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 a 3 phase solid state direct acting overload relay 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 a push button and shall have the ability to close and latch at interrupting rating at 600 volts. 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 special 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 Type H-2 or approved equal.

FPE LOW VOLTAGE AIR CIRCUIT BREAKER—TYPE H-2

RATINGS FOR TYPE H-2 LOW VOLTAGE AC POWER CIRCUIT BREAKERS

Type	Frame Size (Amperes)	System Nominal Voltage (Volts)	Rated Max. Voltage (Volts)	Insulation Withstand (Volts)	Three Phase Short Circuit Current Rating (Kilo amperes Symmetrical)	
					Instantaneous Trip	Short Time Delay
25H-2	600	600	635	2200	22	22
30H-2	800	600	635	2200	30	30
50H-2	1600	600	635	2200	42	42
65H-2	2000	600	635	2200	42	42
75H-2	3000	600	635	2200	65	65
100H-2	4000	600	635	2200	85	85
100H-2	5000*	600	635	2200	85	85
100H-2	6000*	600	635	2200	85	85
25H-2	600	480	508	2200	30	22
30H-2	800	480	508	2200	30	30
50H-2	1600	480	508	2200	50	50
65H-2	2000	480	508	2200	50	50
75H-2	3000	480	508	2200	65	65
100H-2	4000	480	508	2200	85	85
100H-2	5000*	480	508	2200	85	85
100H-2	6000*	480	508	2200	85	85
25H-2	600	240	254	2200	42	22
30H-2	800	240	254	2200	42	30
50H-2	1600	240	254	2200	65	50
65H-2	2000	240	254	2200	65	50
75H-2	3000	240	254	2200	85	65
100H-2	4000	240	254	2200	130	85
100H-2	5000*	240	254	2200	130	85
100H-2	6000*	240	254	2200	130	85

*NON NEMA FRAME SIZES

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 instantaneous 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 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.

NO VOLT RELAY

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

The device is energized directly, or from the control transformer.

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

KEY INTERLOCKS

Two key interlocks can be mounted in the breaker faceplate using standard type VF locks with 3/8" plunger extension. When coil interlocking is required locks are mounted independent of the breaker. Padlocks can be supplied when required.

LOW VOLTAGE AIR CIRCUIT BREAKER—TYPE H-2

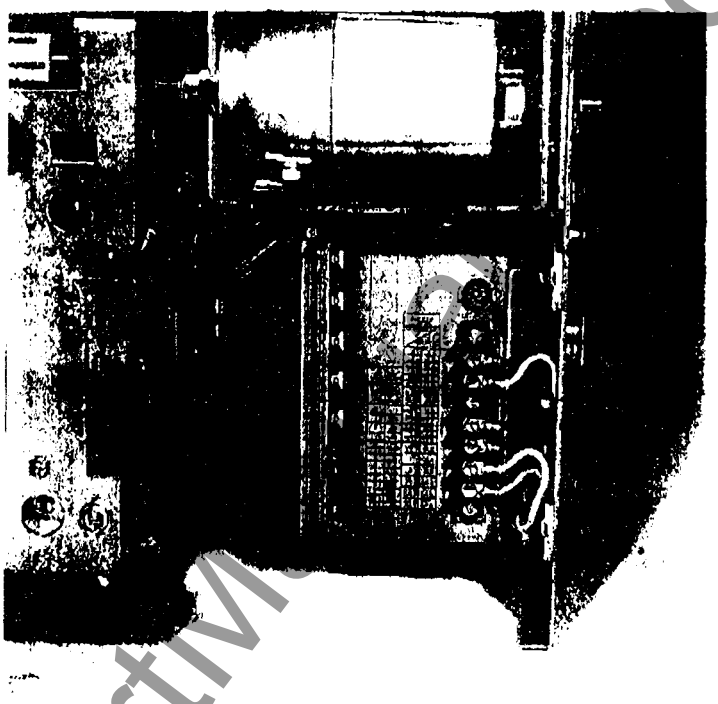
OVERCURRENT RELAYS

All the type H-2 breakers are normally supplied with type SD-2 solid state overcurrent relays. These relays, contain a long time element with a pick-up which is adjustable, at definite intervals from 0.7 to 1.3 times the current sensor tap setting and an instantaneous element with a pick-up that is adjustable, at definite intervals from 4 to 12 times the current sensor tap setting. The output of the relay energizes a shunt trip. No external power source is required for tripping the breaker.

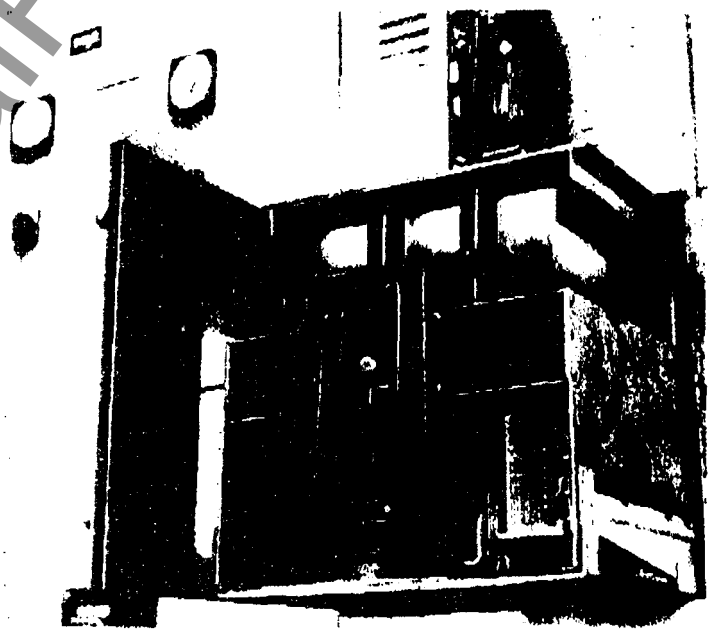
A type SD-3 relay with short time element, along with long time and instantaneous elements, is available as an option. The short time element pick-up is adjustable at definite intervals from 2 to 10 times the current sensor tap setting.

The type SD-5 overcurrent relay has the same elements as the type SD-2 plus a ground fault element with an adjustable pick-up at definite intervals of 0.2, 0.5, and 0.75 times the current sensor tap setting. An SD-6 relay has the same elements as the SD-3 relay plus the ground fault element.

These relays require current sensors which are mounted on each pole of the breaker. For tap settings of current sensors and various options on these relays refer to Pages 13 and 14.



SD-3 Relay in Breaker

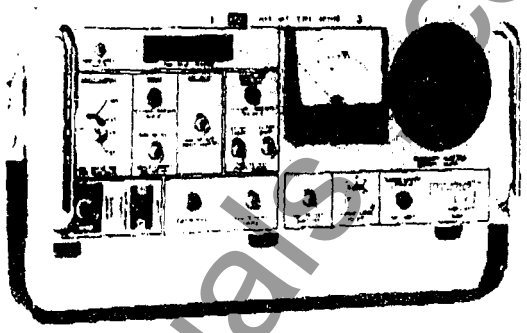


Breaker assembly withdrawn from cell.

SOLID STATE OVERCURRENT RELAY—TYPE SD

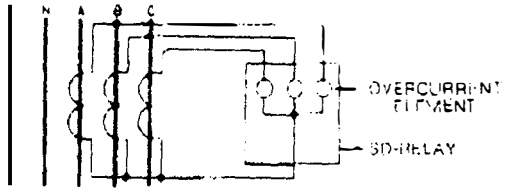
FIELD TEST UNIT TYPE DDT-SD

A portable test device is available to provide accurate testing of the calibration and operation of all functions of the relay. The test set will also check the output tripping energy provided by the relay to the shunt trip device. The test unit is plugged into a convenient receptacle provided on the faceplate of the relay. A 120 volt ac 750VA supply is required to power the test unit and can be derived from any source.

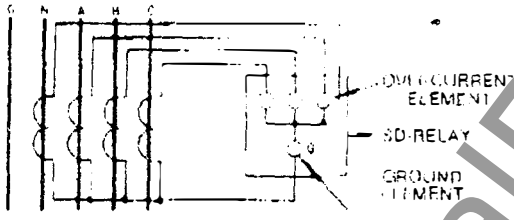


CURRENT SENSOR CONNECTION DIAGRAMS

(A) 3ø 3W undergrounded system
3ø 4W system without ground fault protection



(B) 3ø 4W system with ground fault protection



Note: System must be solidly or resistor grounded on the line side of neutral sensor. Resistor must let through more current than the ground fault pick-up setting on relay.

System must not be grounded on the load side of the neutral sensor.

(C) 3ø 3W system with ground fault protection
(Neutral solidly grounded)
3ø 3W ungrounded system (see note below)

Note: Since there will not be any significant ground current in the ungrounded system, the ground fault element will not pick-up on the first phase to ground fault. It will operate on the second phase to ground fault providing this fault is on another feeder and phase from the first fault.

This G element will only pick-up on a phase to ground to phase fault.

TYPICAL SPECIFICATION

A solid state three phase overcurrent relay shall be supplied with the air circuit breaker. The solid state elements shall be mounted on plug-in printed circuit boards. The relay shall be designed to function within the published characteristic curves for single phase and three phase balanced loads and all arrangements of unbalanced loads. The trip system shall function within the rated characteristics of the breaker under normal operating conditions, short circuit interruption and electrical and mechanical endurance.

The relay shall contain long time pick-up, instantaneous, (short time delay) (ground fault) elements. These elements shall operate independently. The long time, (short time) (ground fault) elements shall have field selectable bands. All calibrated points shall be set by a definite position selector switch on the relay faceplate.

The relay shall be supplied complete with a local trip indication which will describe the type of fault as an overload, short circuit or ground fault (optional). In addition contacts shall be provided to initiate a remote indication system.

The relay shall derive its power from current sensors which shall have a minimum of two tap connections brought out on the sensor face. The relay shall operate in conjunction with a high energy solenoid shunt trip. No external power supply shall be required to trip the breaker. The relay shall be a type SD solid state device, as manufactured by Federal Pacific Electric Co.

A portable test device shall be provided which shall be capable of checking the calibration of all functions of the relay. It shall be also capable of checking the energy output level of the relay and be operable from a 120 volt 750VA supply. The test device shall be type DDT-SD as manufactured by Federal Pacific Electric Company.

SOLID STATE OVERCURRENT RELAY—TYPE SD

FIELD ADJUSTMENTS

Switches for field selection of the various current pick-up levels and time delays are provided on the relay faceplate, grouped in a vertical column, and paired according to the characteristic controlled.

LONG TIME

The pick-up setting is adjustable from 0.7 to 1.3 times the current sensor tap setting with calibration points at 0.7, 0.8, 0.9, 1.0, 1.1 and 1.3 times. Pick-up tolerance is ±8%.

The independent Long Time delay characteristics are adjustable from 2 seconds to 30 seconds with 10 calibration points at 2, 4, 6, 8, 10, 14, 16, 22, 26 and 30 seconds. The time intervals shown are at 6 times the current sensor tap setting. The band width is ±10% of the times shown.

SHORT TIME

The pick-up setting is adjustable from 2 to 10 times the current sensor tap settings with calibration points at 2, 3, 4, 6, 8 and 10 times. Pick-up tolerance is ±8%.

The independent Short Time delay characteristics are adjustable from 0.11 to 0.45 seconds with calibration points at 0.11, 0.25, 0.33 and 0.45 seconds. The band-width is ±10% of the times shown.

INSTANTANEOUS

The pick up setting is adjustable from 4 to 12 times the current sensor tap setting with calibration points at 4, 5, 6, 8, 10 and 12 times. There is also an "OFF" position on the selector switch. Pick-up tolerance is ±8%.

GROUND FAULT

The pick-up setting is adjustable from 0.2 to 0.75 times the current sensor tap setting with calibration points at 0.2, 0.5 and 0.75 times. Pick-up tolerance is ±8%.

The ground fault element has a definite time delay characteristic for fault currents in excess of 10 times the sensor tap setting. For fault currents below this value it has an inverse time characteristic.

The definite time delay characteristics at the 10 time current level are adjustable from 0.08 to 0.32 seconds with calibration points at 0.08, 0.14, 0.2, 0.27 and 0.32 seconds. The bandwidth is ±10% of the time shown.

OPTIONS

LOCAL INDICATION

Up to three lamps can be provided on the faceplate of the relay to indicate the type of fault that caused the relay to operate i.e. LONG TIME; INSTANTANEOUS/SHORT TIME and GROUND FAULT if the G.F. element is included in the relay.

When the breaker has tripped the relay will automatically reset allowing the breaker to be reclosed. The lamps are manually reset by a pushbutton mounted on the front of the relay thus indication is retained even after the relay has reset.

The lamps are solid state light emitting diodes (L.E.D.) and are ideally suited to withstand the shock vibrations which occur when the breaker is opened and closed. A separate 120 volt ac 1.0 VA auxiliary supply, derived from the line side of the circuit breaker, is required to power the lamps and the remote indication relay.

REMOTE INDICATION

Facilities for remote indication can be provided by three sets of dry, normally open contacts rated 2.0 resistive at 240 volts ac located within the relay. These contacts can be field connected through a terminal strip mounted on the rear of the relay. The pushbutton which resets the local indicators also resets the internal auxiliary relays used for remote indication.

LOAD INDICATION

A vertical edgewise mounted analog meter can be provided on the faceplate of the relay. This meter continuously monitors the load current on the 3 phases and indicates the highest single phase value during normal operation. The meter is scaled in multiples of the tap setting selected with the full scale deflection being at 1.5 times the tap setting. The meter is protected against high fault conditions.

SOLENOID TRIP UNIT

The shunt trip is a solenoid device which operates from a high energy input signal from the solid state relay, therefore, no separate trip supply is necessary. However, if the breaker has to be tripped by some other external means such as remote pushbuttons, other types of protective relays etc., then an additional conventional shunt trip must be added to the breaker plus the necessary shunt trip supply to operate it.

OPERATIONAL CHARACTERISTICS

RELAY

Relay tolerances indicated are at a nominal ambient temperature of 25°C and are stable over a temperature range of -20°C to +55°C.

SENSORS

— Insulation withstand test voltage, 2200 volts with the relay disconnected
— Insulation, Class B (130°C)
— Thermal 1 second rating, 80 times maximum sensor tap setting
— Continuous thermal rating at 30°C ambient, 1.75 times the maximum sensor tap setting
— Mechanical short time current rating, 125 times the maximum sensor tap setting
— Impulse withstand level, up to 10kV

SOLID STATE OVERCURRENT RELAY—TYPE SD

INTRODUCTION

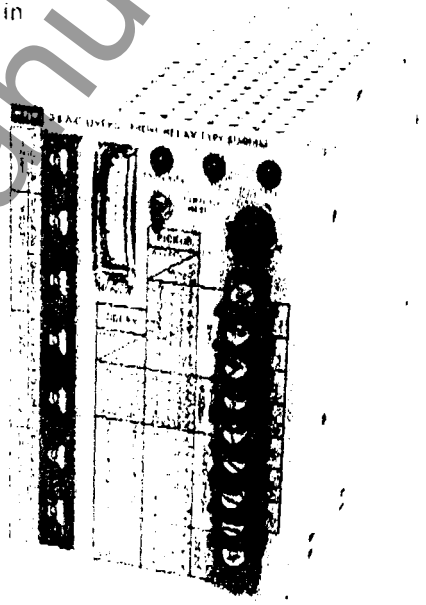
The complexity of today's power systems demands reliability, closer tolerances and greater stability of protective relay characteristics than previous standards required.

The Federal Pacific SD solid state overcurrent relay has been developed to meet these new requirements and to overcome other shortcomings of electro-mechanical relays. It is completely self powered, taking the tripping energy from the current through the breaker without any auxiliary power supply.

It is also very desirable to be able to identify the type of fault which caused the relay to react, i.e. overload, short circuit or ground fault. The type SD relay can, as an option, provide this information both locally on the relay itself or remotely by contacts supplied within the relay.

DESCRIPTION

The type SD Overcurrent Relay is a solid state trip system comprising current sensors, a solid state 3 phase overcurrent relay and a high input energy, direct acting, SOLENOID type shunt trip device. The sensors, relay and shunt trip are mounted as an integral part of the power air circuit breaker to provide complete overcurrent, short circuit and ground fault protection (if required). Several options can be provided as indicated in the following table. When a load ammeter is provided it monitors the load on each of the phases and indicates the highest value of current present in any phase.



RELAY MODELS AVAILABLE

Catalogue No.	Relay Characteristics and Options
SD-2	Long Time, Instantaneous
SD-3	Long Time, Short Time, Instantaneous
SD-3I	As SD-3 + local indication (2 LED lamps)
SD-3IR	As SD-3 + local indication and contacts for remote indication
SD-3IM	As SD-3 + local indication plus load ammeter
SD-3IRM	As SD-3 + local indication and contacts for remote indication plus load ammeter
SD-5	Long Time, Instantaneous, Ground Fault
SD-6	Long Time, Short Time, Instantaneous+Ground Fault
SD-6I	As SD-6 + local indication (3 LED lamps)
SD-6IR	As SD-6 + local indication and contacts for remote indication
SD-6IM	As SD-6 + local indication plus load ammeter
SD-6IRM	As SD-6 + local indication and contacts for remote indication plus load ammeter

NOTE—A 120V ac 1VA supply is required when the indication option is provided.

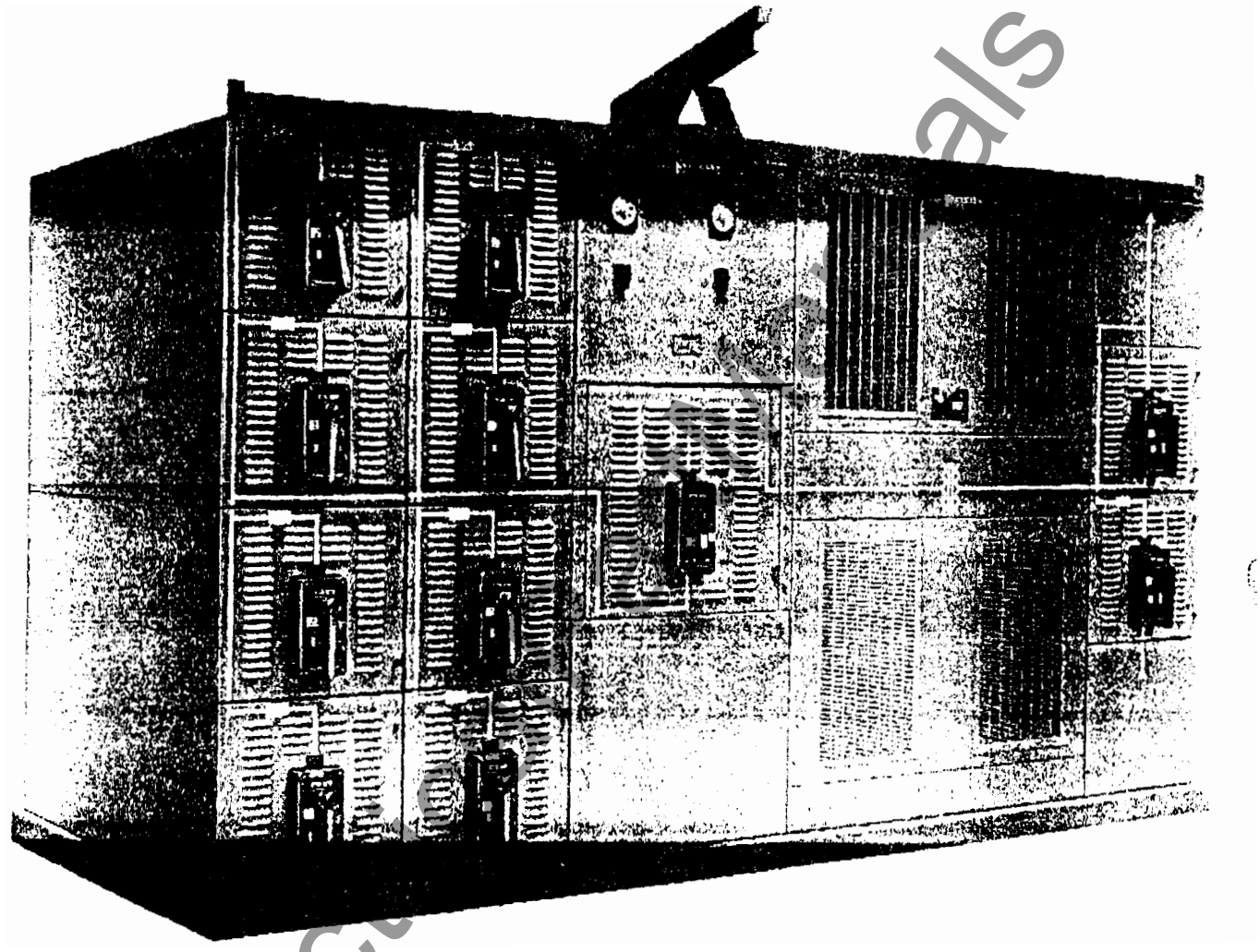
CURRENT SENSORS AND TRIP RATINGS

There are 9 types of current sensors available, each of which is sized to be mounted on one or more ratings of Federal Pacific power circuit breakers. Sensors of the same type are mounted on each of the poles of the circuit breaker (and the external neutral, if ground fault protection is required). Each sensor has a minimum of two taps and the selection of one of these taps establishes the trip rating of the system. The same solid state relay can be used for each tap selected therefore the basic trip rating of the breaker can be changed easily by simply changing the sensor tap settings.

SENSORS AVAILABLE

Sensor Type	Ampere Taps on Current Sensor	Breaker Frame Size and Type
CSD-1.5	50, 70, 100, 150	600A 25H-2 800A 30H-2 1600A 50H-2 2000A 65H-2
CSD-6	250, 400, 600	600A 25H-2 800A 30H-2 1600A 50H-2 2000A 65H-2
CSD-8	400, 600, 800	800A 30H-2 1600A 50H-2 2000A 65H-2
CSD-16	1000, 1200, 1600	1600A 50H-2 2000A 65H-2
CSD-20	800, 1200, 2000	2000A 65H-2
CSD-30	1200, 2000, 3000	3000A 50H-2 3000A 75H-2 4000A 75H-2 4000A 100H-2 5000A 100H-2
CSD-40	1800, 3000, 4000	4000A 75H-2 4000A 100H-2 5000A 100H-2
CSD-50	3000, 5000	5000A 100H-2
CSD-60	4000, 6000	6000A 100H-2

AIR CIRCUIT BREAKERS—TYPE H



1000 KVA Substation, 480-208/120 Volts, with Type H Breakers
Primary Main Breaker, 1600 amp., 480 volts, Type 50 H-2
Primary Feeder Breaker, 800 amp., 480 volts, Type 30 HL-2
Secondary Main Breaker, 3000 amp., 208/120 volts, Type 75 H-2
Secondary Feeder Breakers, 800 amp., 208/120 volts, Type 30 HL-2

LOW VOLTAGE AIR CIRCUIT BREAKER—TYPE H-2

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 contact 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 arcing contact is a casting, and moving arcing contacts are large copper extrusions with large silver tungsten alloy contact surfaces. The upper parts of the contacts are curved to form arc runners which assist in extending the arc into the arc 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 molded from a special material, "Krismatex," 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 arc chute. While the arc chute is held firmly in place, a removeable clip allows it to be conveniently removed for inspection of contacts.

A hood over the arc chutes together with inter-phase and phase to ground flash barriers is provided on all breakers.

Arc Chute

DRAWOUT MECHANISM

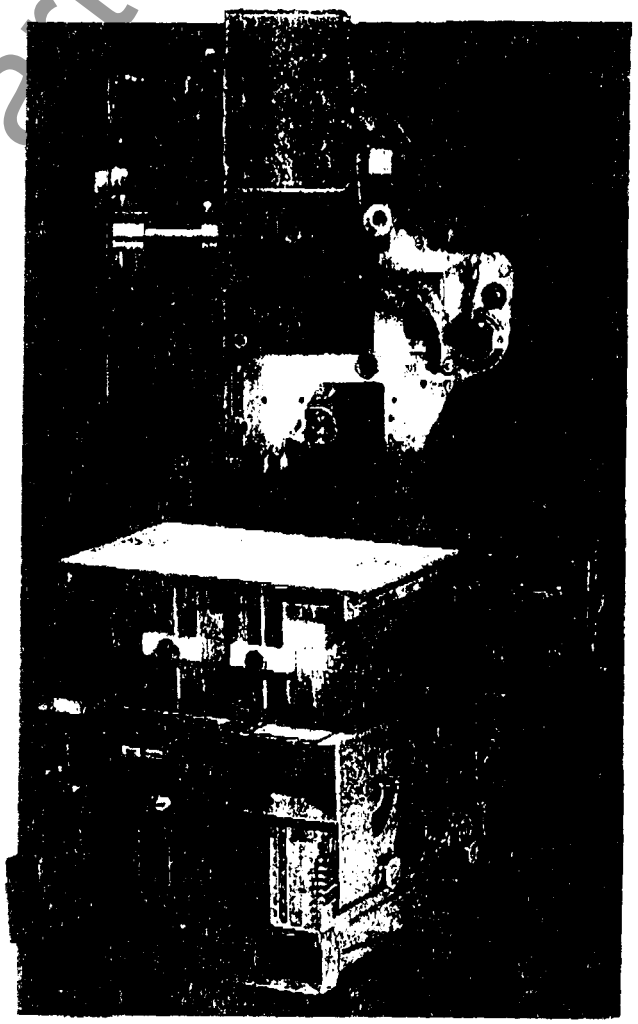
The drawout mechanism provides three positions for the breaker with the door closed.

(a) Engaged — Primary and secondary contact energized
(b) Test—Primary contacts isolated; secondary contacts energized.
(c) Disengaged—Primary and secondary contacts isolated.

A positive worm 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. Normally the door can be opened with the breaker in any position. An optional door interlock can be provided to trip the breaker if the door is opened.

The breaker is guided accurately on grooved wheels fastened to the outside of the breaker frame. As the breaker is cranked in from the "disconnected" position, the grounding contact is engaged first. This is a sturdy phosphor bronze to copper contact which ensures a positive ground 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 "connected" position. A positive stop on the mechanism ensures that the breaker is fully connected before it can be closed. Breaker position is also clearly shown by indicators on the side of the faceplate box.

Whenever 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.



LOW VOLTAGE AIR CIRCUIT BREAKER—TYPE H-2

OPERATING MECHANISMS

Two types of operating mechanisms are available on the complete range of type H-2 circuit breakers, manual for local control and electrical for both local and remote operation. A stored energy function is employed in each type of operating mechanism to give positive control of closing speed, and is independent of the operator.

For manual operation the manual handle is rotated counter clockwise and is pressed to engage a clutch mechanism. Rotating the handle clockwise approximately 180° will charge the closing spring. A ratchet mechanism allows a pause anywhere during the charging stroke without handle fly back. The breaker is closed by pressing a direct acting manual close button on the breaker faceplate.

Remote closing can also be accomplished by the use of a shunt close accessory which is an electrical release mechanism. The closing spring can be charged manually when the breaker is open and left in charge position, to be released from a remote position.

For electrical operation a motor to operate the stored energy mechanism is supplied. The breaker is then closed by releasing the energy of the spring with a shunt close device. Normally the motor operates to charge the spring when the breaker opens so it is ready to close immediately when the electrical close button is pressed. As an option however the motor can be connected to charge the spring after the breaker closes to provide one immediate reclosure. A shunt trip is provided on all electrically operated breakers.

A motor cut off switch is provided behind the breaker faceplate. The faceplates of both types of operating mechanisms, include on-off indicators, charge-discharge indicators, manual trip button, provision for key interlocks and operation counter. The manually operated mechanism includes provision for padlocking the handle and the electrically operated mechanism includes provision for a manual handle for emergency use.

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.

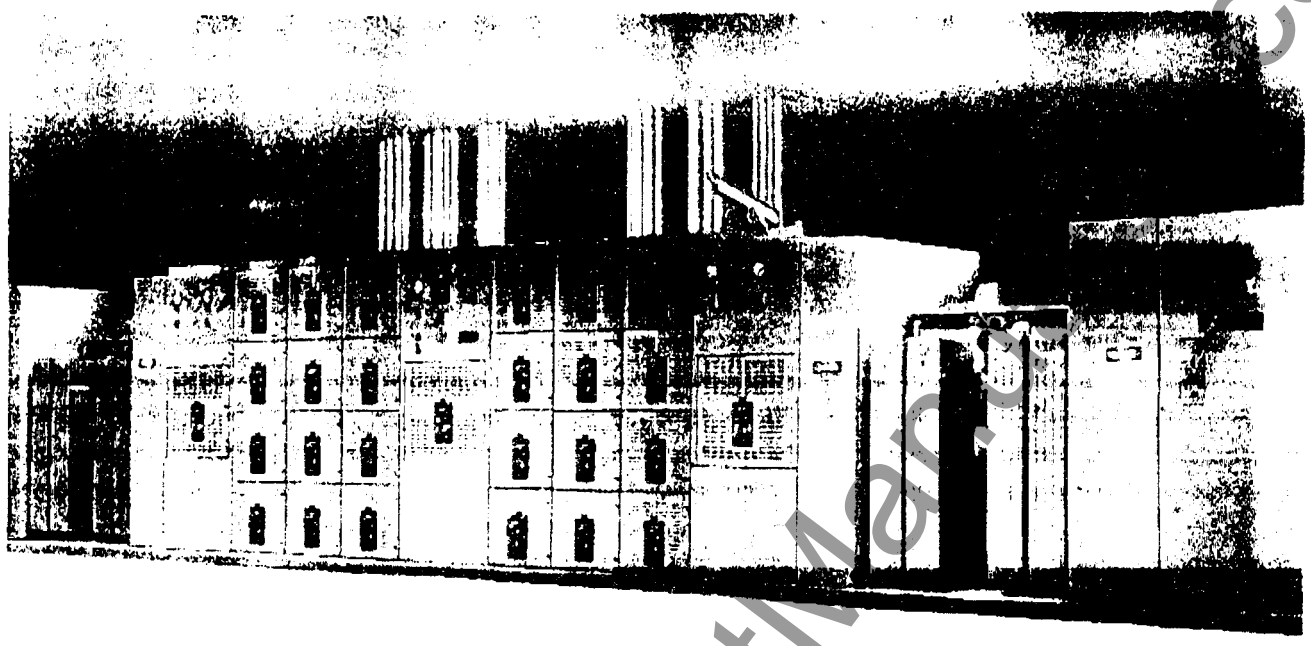
In addition to the electrical "close" and "trip" buttons one additional electrical button can be provided on the faceplate for special purpose controls such as electrical reset of lockout devices.

Electrical Operating Mechanism

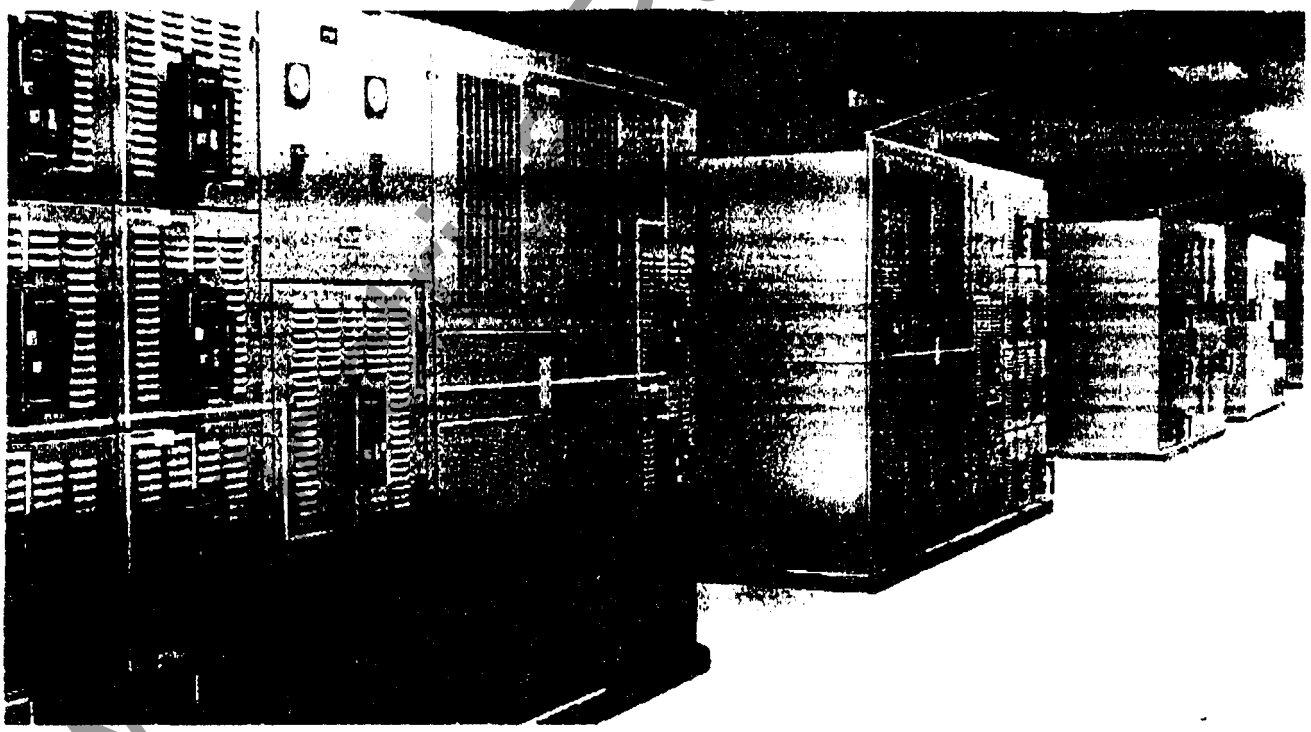
The shunt trip and close devices are continuously rated. A four pole auxiliary switch is also supplied as standard with one N.O. and one N.C. contact available for customers use. Additional switch contacts can be provided up to a maximum of 20 on any breaker. Contacts are wired out to secondary contacts on drawout breakers and to a terminal block on fixed breakers.

On drawout mounted breakers, a gate interlock prevents insertion of the drawout crank with the breaker closed. Operation of this gate to insert the drawout crank handle will open the breaker and discharge the main closing spring.

AIR CIRCUIT BREAKERS—TYPE H



2500 KVA Double Ended Substation, 13,800-480/277 Volts, with Type H Breakers.



1000 KVA Substations, 480-208/120 Volts, with Type H Breakers.

FEDERAL PACIFIC ELECTRIC COMPANY
Low Voltage Distribution Equipment Division
150 Avenue L, Newark, NJ 07101 (201) 589-7500

Clyde Geigel

AK 2-50-2

600A TRIPS.

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W/O 125.

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412
963
0808

Terry

C&C

AK1-50-2

125A.

269C282G2

115A.C.

#400

Jim

HK 350

3000A

NEW 1000A.