IN-810.6

I N S T R U C T I O N M A N U A L

TYPE FP LOW VOLTAGE

POWER CIRCUIT BREAKER

&

TYPE FM FUSEMATIC BREAKER

August 1963

P A R T I

GENERAL DESCRIPTION

This instruction manual covers the FP75-3000 circuit breaker and FM100-3000 fusematic breaker. For instructions on the FP50 series breaker, refer to instruction manual IN-810.4.

The FP75 line of low voltage power circuit breakers and fusematic breakers ranging from 2000A through 3000A continuous current at 600 volt ratings, is designed for simplicity of operation, reliability, and easy maintenance.

The FP breaker is equipped with a stored energy mechanism which is mechanically trip-free in any position of the closing cycle, three unit pole assemblies, fully field-adjustable timing devices, series trip coils, and roll-out rails. The three position drawout mechanism is operable with the door closed.

The FM100-3000 fusematic system consists of two individual drawout devices. The breaker unit is identical to a standard FP75-3000, except for addition of a Single Phasing Protection trip device. The fuse unit consists of fuses mounted on a breaker drawout truck. Key interlocks are provided, which require the breaker to be in the TEST position before the fuse truck can be racked in or out. Secondary contacts are provided on both the breaker and fuse truck to allow connection of the Single Phasing Protection device.

STANDARD ACCESSORIES

Maintenance closing handle, 1151-9252 (two required)
Cell racking-in crank, 1151-5036
Emergency charging handle, 1151-5349

P A R T I I

SHIPPING, RECEIVING, HANDLING, AND STORING

Each FP breaker and FM fusematic is thoroughly inspected and tested before leaving the factory. Breakers are shipped in individual crates. No hooks should be used in handling. Examine all equipment carefully for indication of damage sustained in transit. If damage in transit is indicated, call for an immediate inspection by the delivering carrier. Upon assessment of the damage, a claim should be filed with the carrier or, depending on the nature of the damage, an intent to file for concealed damage should be registered. For assistance in filing the claim, advise the area sales office of Federal Pacific Electric Company, giving a full description of the damage, serial number of the breaker, delivering carrier's name, and, if shipped by rail, the car number, waybill reference, and any other information that might be of help to the Company in aiding in the filing of the damage claim.

When unpacking, make sure that all items are removed from the box, including packing list, instruction book, maintenance parts, and hardware. Report any shortage immediately. See that identification tags are left on the breaker. Lifting eyelets are furnished for handling. Do not lift or handle breaker by the front box, by the operating handle, or by the secondary contacts.

Clean breaker thoroughly. To remove dust, an industrial vacuum cleaner is recommended. If the breaker can be installed in its permanent location, it is advisable to do so, even if it is not expected to be energized for some time. When breakers must be stored in buildings under construction, be sure they are kept in a space free of dust, moisture, dirt, and in an upright position. It is recommended that the breaker not be operated prior to final inspection.

P A R T I I I

INSPECTION AND INSTALLATION

Section 1. Inspection

The FP75 breaker consists of a coordinated set of assemblies, mounted on a steel frame, all carefully adjusted and locked in place for long and trouble-free operation.

To assist in properly checking and inspecting breakers prior to placing into service, the following points should be followed in the order listed:

1. Remove arc chutes.

2. Remove covers marked, "REMOVE THIS PLATE FOR EMERGENCY CHARGING." Using emergency charging handle, 1151-5349, charge each mechanism by rotating the handle clockwise 180° to positive stop.

3. Lock safety discharge interlocks to prevent accidental discharge of stored energy mechanism (Figure 2). There is a safety interlock on each mechanism.

4. Remove right- and left-hand accelerating springs (Figure 3).

5. Insert maintenance closing handles, 1151-9252, as in Figure 4, and slowly operate simultaneously until arcing contacts touch. All arcing contacts should make simultaneously with a permissible variation of 1/32 maximum. Movable arcing contact fingers should align with stationary arcing contacts. If misalignment or misadjustments are observed, refer to part four of this manual, "MAINTENANCE," for adjusting instructions. Movable arcing contacts are designed with side clearances for better guidance inside the arc chutes. A side-to-side movement of 1/8 is allowable. Close breaker and check overtravel on main contacts. Remove maintenance closing handles and trip breaker.

6. Replace pull-off springs.

7. Inspect each arc chute to be sure no plates are damaged. Replace chutes on breaker. Move contacts in, by hand, and tighten arc chutes only after contacts move in and out freely.

8. Release discharge safety interlocks (Figure 2). NOTE: To avoid possible injury, NEVER handle or touch any movable part of the breaker when the stored energy mechanism is charged, without first applying safety interlocks. Operate closing release solenoid manually, with vigor, releasing both stored energy mechanisms simultaneously. Breaker will close. NOTE: The Close button on escutcheon will NOT close breaker unless control power is connected. Depress red trip lever on escutcheon to open the breaker.

9. Recharge stored energy mechanisms and close breaker. Slowly move series trip coil magnet (armature) to fully closed position. Breaker should trip before armature touches pole face assembly. Repeat this procedure on all poles.

10. Check retaining rings and hardware for tightness.

11. Basket and finger assembly should be secured and retaining bolts tightened. Contact finger must be free of dirt and foreign particles. Secondary female contacts mounted on breaker must operate freely.

12. Electrically, the stored energy mechanism is charged by a fractional horsepower ratchet-type A.C./D.C. universal motor. Identification, voltage ranges, and current requirements are specified below. The stored energy mechanism is charged, electrically, in approximately one second. Two motors of identical ratings are used.

CHARGING MOTORS FOR FP BREAKERS
STORED ENERGY MECHANISM

Voltage Rating	F.P.E. Part #	Motor	FLA.	LRA.
48V A.C./48V D.C.	162-007	15058	20.0	50
115V A.C./125V D.C.	162-004	14976	6.5	25
230V A.C./250V D.C.	162-006	14978	6.1	12

240V maximum--use control power transformer for higher voltage

From wiring diagram supplied with equipment, or from the standard diagram in Part VII of this manual, locate motor terminals on secondary contacts and connect required power source.

Motors will charge when power is applied and automatically shut off when charging cycle is completed.

Breaker cannot be closed with the maintenance closing handle unless the stored energy mechanism is charged. On all electrically operated FP breakers, the stored energy mechanism will recharge immediately following a closing operation--ready for instant reclosure, if needed.

13. From wiring diagram, locate terminals on secondary contacts and connect proper control power supply and controls for shunt close and shunt trip attachments. Close and open breaker five times, electrically, and check for proper operation.

14. Disconnect control power supply. Do not leave breaker in the charged and/or closed position while in storage.

15. When the FM100-3000 is furnished, check the separate fuse truck, using applicable procedures as listed above.

Section II. Installation

Before installing breaker in cell, check the following points inside cell:

1. Secondary contact support--make sure all connections are tightened and adjusted to proper dimensions.

2. Ground connections should be tight.

3. Removable extension rails should fit and lock properly in cell.

4. Breaker wheels should be free and well lubricated.

5. Main contact stabs should be tight and free of dust and dirt.

6. Check condition of insulating transite plate in roof of case. Screws should be tight.

7. Remove control power fuses.

8. Place breaker on installed extension rails. Make sure all four wheels are in rail grooves.

9. Drawout mechanism on breaker should be in OUT position.

10. While depressing trip lever, push breaker inside the cell until racking-in cranks engage a positive stop. This is the OUT position. Remove rail extensions and store in cell.

11. Close door slowly and latch; make sure that the metal mask which is provided on the outside of front box moves freely back as it comes in contact with the door. The door should close all the way with the breaker in the OUT position.

12. Depress trip lever and insert racking-in crank, 1151C5036 (Figure 5). Rotate crank clockwise until breaker reaches TEST position. At this point, interlock bar will drop into slot on cell floor when racking-in crank is removed. This locks breaker in TEST position and releases trip interlock.

13. Install control power fuses; circuit is now energized. The motors will charge the stored energy mechamisms, and closing and tripping control circuits become energized in the TEST position.

14. Open door and make sure that grounding contact in cell is now in contact with the breaker. Close door and check breaker electrically for proper closing and opening operation.

    If breaker operates properly, rack breaker back to OUT position and leave there until ready to put into service.

15. When putting into service, insert racking-in handle, rotate clockwise until breaker is in OPERATE position. When properly racked in, the interlock bar will be free to drop into another slot, locking the breaker in position. The trip interlock will be released and the interlock bar will drop when the racking-in crank is removed.

16. When the FM100-3000 is furnished, the points listed above, relative to cell, stationary contacts, contact stabs, and racking-in assembly, should also be checked on the fuse truck. Note that a trip interlock is not furnished on the fuse truck. Fuse truck has two positions only--"IN" and "OUT." Positive stops in the gear train determine proper location of the breaker in both the "IN" and "OUT" positions.

P A R T I V

MAINTENANCE

The breakers and all component parts have been tested extensively for performance, per NEMA Standards SG.3-3-17 and SG.3-3-18, and have proved to be satisfactory with a wide margin of safety.

In accordance with NEMA Standard SG.3, Part 6, a periodic maintenance schedule should be established. For the convenience of the user, a simple log sheet is provided with every breaker to ensure proper maintenance and years of trouble-free operation. It should be kept and followed conscientiously, especially in cases where breakers are required to operate under more adverse conditions.

The following instructions and adjustments should be followed carefully:

Main and Arcing Contacts Adjustment

"A" - Main contact press	25-35 pounds, measured at point of contact
"B" - Overtravel mains	1/8-1/32

"C" - Arcing contact press	22-25 pounds, measured at a point 1-1/4 below tip of contact
"D" - Gap (distance) between mains when arcing contacts touch	1/8-1/32

CHECK POINTS (Figures 6 and 7)

1. Stationary arcing contacts--make sure that retaining screws and contacts are tight.

2. Main contacts should be clean and free.

3. Make sure all retaining rings are in place.

4. Make sure nylon spacer is in place.

5. Roller, 1101-9231, must roll free on its pivot pin.

6. Surfaces marked "F" should be lubricated by a thin film of "Conducto-Lube," No. 240-200, before assembly.

Contacts must be inspected after every known short circuit interruption and also should be inspected at regular inspection periods. If contacts are found to be worn or excessively pitted, they should be dressed or replaced.

CAUTION: When reinstalling the arc chutes, adjust the retaining screw holder on the arc chute retaining bar so that the arcing contacts do not come in contact with the arc chute baffles.

CONTACT ASSEMBLY

To repair or replace movable arcing contacts, proceed as follows (Figure 6):

1. Charge stored energy mechanism and lock discharge safety interlock (Figure 2).

2. Remove arc chutes.

3. Remove arc chute retaining bar.

4. Remove insulating block and push fork assembly.

5. Tighten movable arcing contact's adjusting screw until springs are solid, and remove retaining pins.

6. Remove arcing contact pivot pin and replace movable arcing contacts. Both contacts should be replaced at one time.

7. Make sure nylon bushings are in place and in good condition while replacing movable arcing contact.

Reassemble, following the same sequence of operations, and adjust per Figures 6 and 7. In most cases, it is not necessary to replace contacts, but occasional redressing and readjusting are recommended.

To replace stationary arcing contacts (Figure 6), remove unit pole assembly, replace main stud and arcing contact assembly, 1151-5023.

Adjust contacts per Figures 6, 7, and 8.

STORED ENERGY MECHANISM

Check latch engagements and adjust, if necessary, by moving safety discharge interlock (Figure 2) to proper position. Make sure springs are in place and in good condition. Remove motors to make sure roller is free and well lubricated. Reinstall motors. Make sure that all retaining rings are in place. Check mechanism to ensure that all moving parts are free and well lubricated.

OPERATING MECHANISM

Make sure that all retaining rings and springs are in place and that the mechanism is free. Replace nylon bumper rollers, if excessive wear is evident. Make sure that the operating mechanism resets, when the stored energy mechanism is charged slowly, and that the trip shaft is free. It should take no more than 20-22 ounce inches of torque to trip the breaker.

GENERAL

Make sure that all current-carrying parts are secured and that associated hardware is tight. Basket and finger assembly should be secured, but free enough to compensate for misalignment in cell.

P A R T V

ACCESSORIES

SHUNT TRIP

The shunt trip attachment is mounted directly below the trip shaft. It is a nonadjustable solenoid intended for intermittent duty only, and its circuit should be interrupted only by an auxiliary contact.

SHUNT CLOSE

The shunt close attachment is mounted on top of the stored energy mechanism and is used to discharge the stored energy mechanism, electrically, and to close the breaker. It is a nonadjustable intermittent duty device, and its circuit should be interrupted by an auxiliary contact.

UNDERVOLTAGE ATTACHMENT

The undervoltage attachment is a continuous duty device which can be provided with or without a time delay, and which mechanically trips the breaker if the voltage drops to 30% or 60% of normal voltage. It is mechanically resettable, with no auxiliary contact in its circuit.

The undervoltage time delay mechanism is of the surface tension delay type. The time delay is controlled by the viscosity of a fluid, and is adjusted at the factory.

To inspect the undervoltage attachment, hold the movable armature by hand, close the breaker, and slowly release the armature. Before the armature is fully opened, the spring loaded plunger will be released and will strike the trip lever and trip the breaker. Check for missing retaining rings and loose or missing screws and bolts. Check condition of coil. If undervoltage attachment is noisy while being energized, clean faces of both armatures.

AUXILIARY SWITCH (Figure 11)

A six pole auxiliary switch normally is provided.

It is mounted on top of the stored energy mechanism, on the right-hand side of the breaker, and is operated by the main movable contacts. All contacts are operated by nylon cams and are adjusted, at the factory, to any of the following combinations:

Normally open	Normally closed
Early open	Early closed
Late open	Late closed

The position and condition of all contacts can be seen and inspected through a transparent dust cover.

Load and interrupting capacity

TYPE R-4 AUXILIARY SWITCH INTERRUPTING RATING IN AMPS

Volts	D.C. Noninductive	D.C. Inductive	A.C. Noninductive	A.C. Inductive
	S I N G L E B R E A K			
24	20.0	15.0	--	--
48	10.0	7.5	--	--
115	--	--	50	30
125	2.5	2.0	--	--
230	--	--	25	15
250	0.5	0.45	--	--
	D O U B L E B R E A K			
24	50.0	40.0	--	--
48	25.0	20.0	--	--
115	--	--	80	60
125	12.0	7.0	--	--
230	--	--	50	30
250	2.25	2.0	--	--

BELL ALARM SWITCH (Figure 12)

A bell alarm switch attachment is mounted on the right-hand side of the breaker and will function only when the breaker is tripped by the overcurrent trip units. It can be manually and/or electrically reset. Closing of the breaker also resets the alarm switch.

To check the alarm switch attachment, trip breaker with trip button, then with shunt trip. In both cases, the switch should not be actuated. Trip breaker by moving the series trip coil magnet; the switch should operate.

P A R T V I

OVERCURRENT TRIP DEVICES

GENERAL DESCRIPTION

The direct acting series coils and magnet assemblies provide the energy to operate the overcurrent time delay device and to trip the circuit breaker, thus, interrupting sustained overcurrents and faults. Each magnet is adjusted at the factory and calibrated for either 2000 to 2500 amperes, or 3000 amperes.

DUAL MAGNETIC OVERCURRENT TRIP DEVICE (TD-1) (Figure 13)

The dual magnetic overcurrent trip device, in combination with the series coil and dual armature magnet, provides inverse, long delayed tripping for all overcurrents below the instantaneous pick-up setting and the adjustable instantaneous tripping. All devices are factory calibrated and can be adjusted in the field.

SELECTIVE OVERCURRENT TRIP DEVICE (TD-2) (Figure 13)

The selective overcurrent trip device, in combination with the series coil and dual armature magnet, provides inverse, long delayed tripping for all overcurrents below the short delay pick-up setting, and provides short delayed tripping for all overcurrents and faults above the short delay pick-up setting. All devices are factory calibrated and can be adjusted in the field.

SINGLE PHASING PROTECTION

When fuses are used to protect circuits feeding three phase motors or similar reactive apparatus, there is always the possibility, upon the blowing of one fuse only, that the apparatus, single phased, will burn out. To eliminate this danger, fusematic air circuit breakers incorporate three single phase trip coils, one in parallel with each of the three main fuses. Each trip coil is approximately a one thousand-turn coil, wound to operate down to 1/10 of line voltage.

Each of the single phase trip coils can be looked upon as a shunt trip, continuously energized by the voltage drop across its fuse. Under normal conditions, the "fuse drop" voltage is zero, but it immediately rises to a value of full phase voltage--when the load fuse blows. This energizes the single phase trip coil, causing the common trip bar to unlatch and trip the fusematic air circuit breaker. The coil is specifically rated at 1/10 line voltage to assure instantaneous operation, even when the fusematic air circuit breaker is used as a motor starter. In this case, although the back E.M.F. induced in the motor winding is equal to phase voltage, because of phase angle displacement, the resultant voltage drop across the fuse is sufficient to trip the fusematic air circuit breaker.

METHOD OF OPERATION

A. <u>Series Magnet</u>

The current through the circuit breaker pole provides the magnetomotive force to energize the magnet assembly. The clapper-type armature exerts the force on the push rod which operates the trip unit and trips the circuit breaker.

B. Dual Magnetic Overcurrent Trip Device (TD-1) (Long Time Delay and Instantaneous Trip)

The long delay overcurrent trip device consists of a dash pot which operates by the positive displacement of a liquid through a fixed orifice, and an adjustable tension coupling spring which permits the push rod to move rapidly when the force from the magnet exceeds a predetermined value. The lever ratio between the push rod and the dash pot is adjustable, permitting the time delay to be varied. There are three calibrated positions or adjustment bands. The three bands are identified as minimum, intermediate, and maximum. In addition to the long delay band adjustment, there is an adjustable tension spring which prevents motion of the push rod for currents below the maximum desired continuous current. This is the long delay pick-up. It is adjustable from 80% to 160%, with calibrated points at 80%, 100%, 120%, 140%, and 160%.

The tension in the coupling spring determines the current at which the dash pot will be mechanically by passed. This is the instantaneous pick-up adjustment. The instantaneous element has a maximum setting of twelve.

C. Selective Service Trip Device (TD-2) (Long Delay and Short Delay)

The selective service trip device is similar to the dual magnetic trip device, except that it has a rigid coupling link in place of an instantaneous pick-up coupling spring, and it has a mechanical escapement timing device which provides a short delay for high values of overcurrents and for faults. The long delay dash pot is identical to that used on the dual magnetic trip device. The short delay device is operated by a separate armature in the series magnet assembly. It has an adjustable pick-up spring with calibrated settings at 5, 7.5, and 10 times the coil and magnet setting. In addition, the short delay has a band adjustment with calibrated points for the minimum, intermediate, and maximum bands.

MAINTENANCE & ADJUSTMENTS

REMOVE BREAKER COMPLETELY FROM CELLS BEFORE SERVICING.

A. Series Coil and Magnet Assembly

The series magnet requires no maintenance other than cleaning, periodically, to remove dust and dirt which may accumulate on bearings and pivots of the magnet armatures. All pivots and bearings are made of nylon, and no lubrication is required.

B. Dual Magnetic Overcurrent Trip Device (TD-1) (Long Delay and Instantaneous Trip)

The circuit breakers are shipped with the trip devices installed and properly adjusted. It is only necessary to keep the devices reasonably clean. They are lubricated for the life of the circuit breaker and must not be lubricated again.

C. Selective Service Trip Device (TD-2) (Long Delay and Short Delay)

The maintenance and adjustment of the selective service trip device is the same as for the dual magnetic trip device.

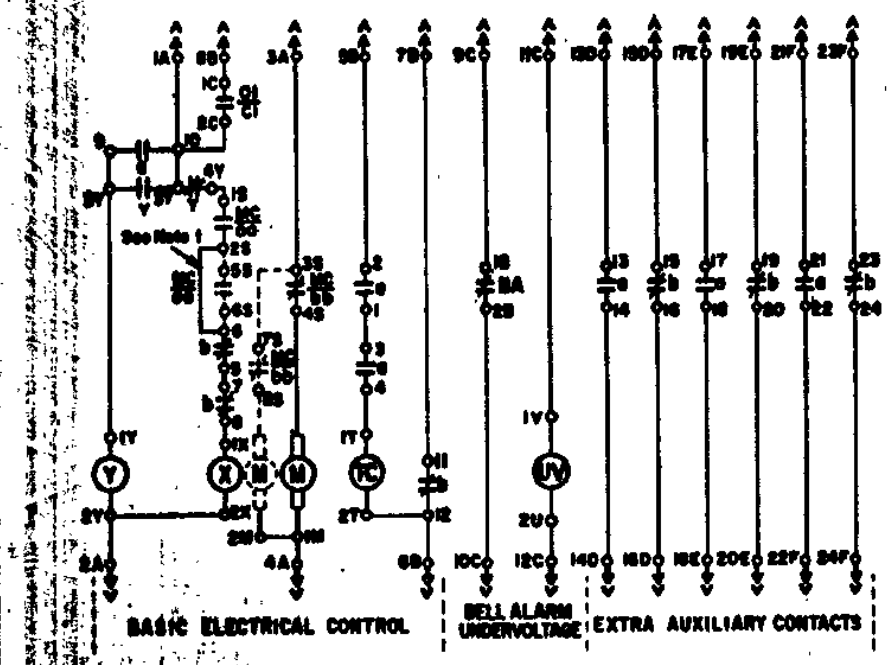
D. Series trip units must be recalibrated, on the circuit breaker, if they are removed or replaced in the field. The factory should be contacted if the series trip units require servicing.

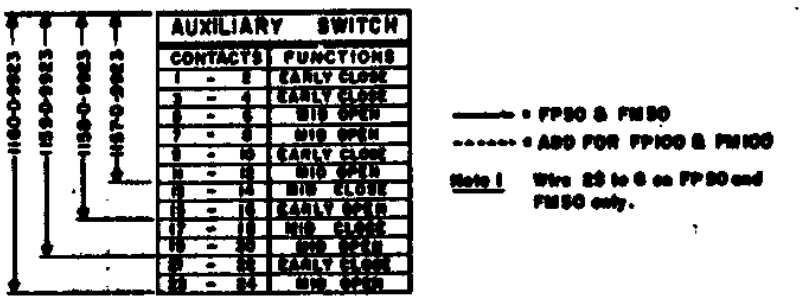
PART 7

DEFINITION OF SYMBOLS

TC	—	Trip coil
TC1	—	A phase fuse trip coil
TC2	—	B phase fuse trip coil
TC3	—	C phase fuse trip coil
X	—	Closing release coil
Y	—	Anti pump relay
M	—	Spring charging motor
MC/aa	—	NO } Motor cut off switch (Shown with
MC/bb	—	NC } closing mechanism spring discharged)
a	—	Auxiliary switch contact (open when breaker is open)
b	—	Auxiliary switch contact (closed when breaker is open)

01	—	Control switch O1 local, C1 close
BA	—	Bell alarm switch
PF	—	Power fuse
UV	—	Undervoltage device
A	—	Main power circuit - A phase
B	—	Main power circuit - B phase
C	—	Main power circuit - C phase





TYPE FP & FN ELECTRICALLY OPERATED A.C.B. SCHEMATIC DIAGRAM

FP BREAKER OPERATING SEQUENCE

1. Control switch O1-C closed.
2. "X" coil is energized thru "b" contact of the "Y" relay, "b" contact of the breaker auxiliary switch, and "aa" contact of the motor cut-off switch.
3. Stored energy closing spring released via "X" coil, closing breaker.
4. Closing breaker operates auxiliary switch opening "b" contacts and closing "a" contact thus energizing anti pump "Y" relay and de-energizing "X" coil.
5. "Y" relay remains energized via seal-in contact thus providing anti-pumping lockout of "X" coil if $\frac{O1}{C1}$ is held closed.
6. "Y" relay is de-energized when $\frac{O1}{C1}$ contact is opened.
7. Closing breaker, closes auxiliary switch "a" contacts permitting the breaker to be tripped electrically when control power is switched to auxiliary stabs 5B and 6B.
8. Motor cut-off switch contact "bb" closes when spring discharges and re-opens when spring is fully charged.
9. Auxiliary switch "b" contact closes when the breaker is tripped.
10. Motor cut-off switch contact "aa" closes when the closing mechanism spring is fully charged.
11. The breaker will close when control switch $\frac{O1}{C1}$ is closed.

P A R T V I I I

MINIMUM RECOMMENDED SPARE PARTS

FP75-3000 & FM100-3000 BREAKERS

Description	Required	Part No.
Moving arcing contacts	12	1151A9986
Upper stud assembly	3	1151B5023
Main stationary contact assembly	24	1151A9354
Leading contacts	6	1152A9354
Cluster assembly	6*	1151B1024
Arc chutes	6	1151D9566

*12 required for FM100-3000 breaker

SHUNT CLOSE ATTACHMENTS (common for all FP breakers)

480 volts A.C., 60 cycles	1	1151B5359
115 volts A.C., 60 cycles	1	1152B5359
230 volts A.C., 60 cycles	1	1153B5359
48 volts D.C.	1	1151B5359
125 volts D.C.	1	1152B5359
250 volts D.C.	1	1153B5359

SHUNT TRIP ATTACHMENTS (common for all FP breakers)

48 volts A.C., 60 cycles	1	1151A5326
115 volts A.C., 60 cycles	1	1152A5326
230 volts A.C., 60 cycles	1	1153A5326
48 volts D.C.	1	1151A5326
125 volts D.C.	1	1152A5326
250 volts D.C.	1	1153A5326

RECOMMENDED SPARE PARTS (continued)

UNDERVOLTAGE ATTACHMENT (common for all FP breakers)

Description	Part Numbers	
	delayed	instantaneous
115 volts A.C.	1151-9458	1151-9456
230 volts A.C.	1152-9458	1152-9456
460 volts A.C.	1153-9458	1153-9456
575 volts A.C.	1154-9458	1154-9456
125 volts D.C.	1155-9458	1155-9456
250 volts D.C.	1156-9458	1156-9456

MOTORS TO CHARGE FP BREAKER STORED ENERGY MECHANISM
(common for all FP breakers)

Description	Part No.	Motor	FLA.	LRA.
Note: Two motors of specified voltage required for FP75-3000				
48V A.C./48V D.C.	162-007	15058	20.0	50
115V A.C./125V D.C.	162-004	14976	6.5	25
230V A.C./250V D.C.	162-006	14978	6.1	12

Maximum 240V, use control power transformer for higher voltages.

	Part No.
Emergency manual charging handle	1151C5349
Maintenance closing handle	1151-9252
Drawout crank	1151C5036