Westinghouse Electric Corporation
Distribution and Control Business Unit
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Bloomington, Indiana 47401

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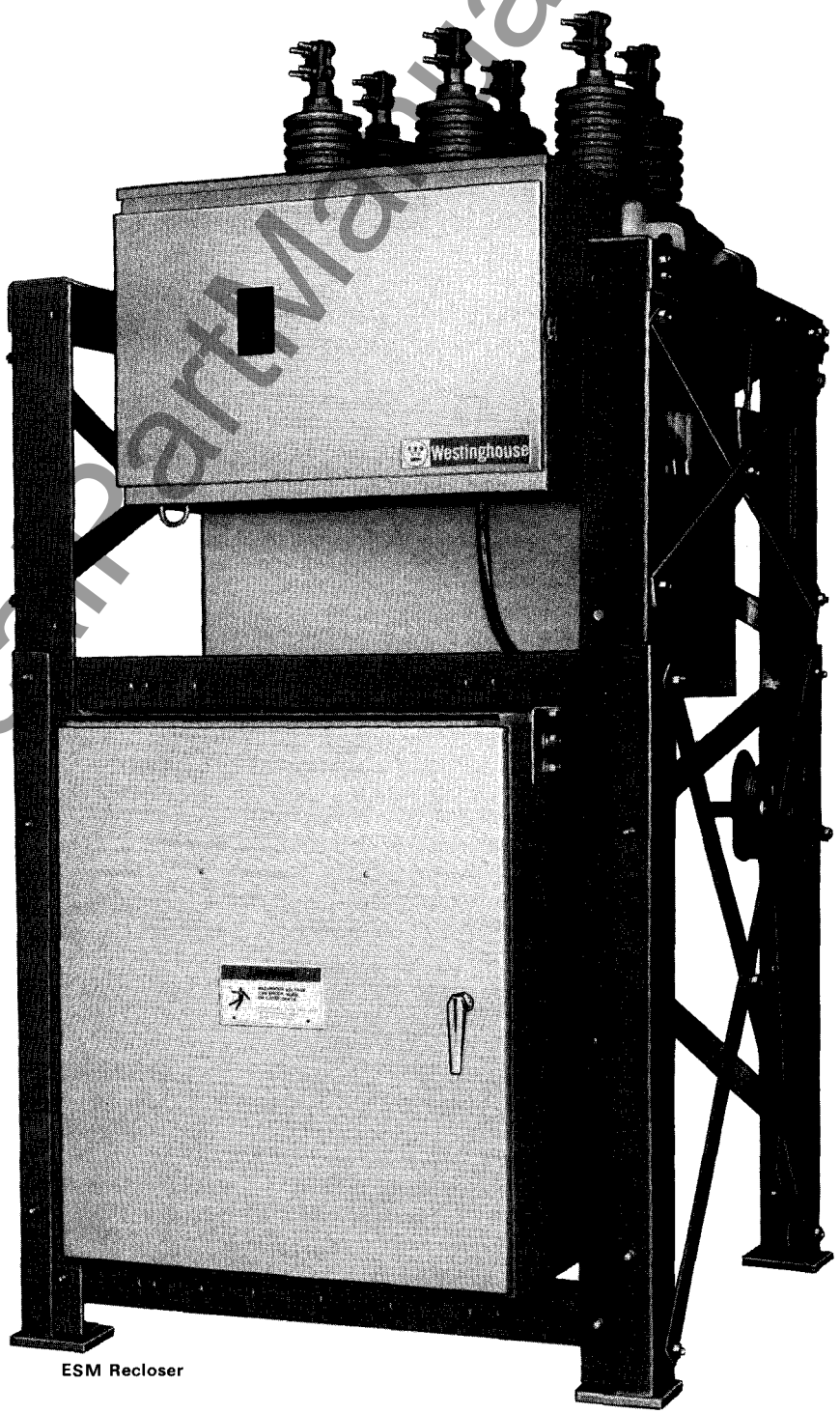
Relay and Static Control
2.4-15.5 KV, 400-800 Amperes
110 KV BIL
TYPE ES and ESM

Three Phase Automatic Oil Circuit Reclosers



ESM Recloser

Type ES and ESM Automatic Oil Circuit Reclosers

Application

The ES and ESM reclosers provide three phase fault protection for substation and line applications.

These reclosers are capable of interrupting up to 16,000 amperes symmetrical fault current on circuits rated 15.5 KV with X/R ratios up to 16.

Continuous current ratings of 400, 560, or 800 amperes are available and the duty cycle of each rating conforms to ANSI C37.60, Table 2A.

At the lower circuit voltages, 2.4 to 4.8 KV, the Westinghouse ES recloser has an interrupting rating of 12,000 amperes while the ESM is rated at 24,000 amperes.

The following data is applicable to all ES or ESM reclosers:

- Temperature Range −30°C. to +70°C.
- Basic Impulse Level 110 KV
- Maximum Design Voltage 15.5 KV
- Minimum Reclose Time 28 cycles
- Minimum Interrupting Time—3.5 cycles

The flexibility of the Westinghouse ratings permits the user to choose the correct rating for each application instead of buying equipment that is oversized for the job. The 800 ampere rating can be purchased now for traditional 560 ampere applications where growth is expected, thus delaying or avoiding the sizable expense of changing-out reclosers.

Bushings 1-3-5, where the bushing current transformers are mounted, or bushings 2-4-6 may be used as line or load bushings and the recloser is operable regardless of current flow. This is especially important, and saves substation construction cost, where reverse power flow is desirable. The recloser under these conditions is operable without having to interchange the line and load bushing connections, saving the user several hours of labor costs.

The ES800 ratings are based on a maximum temperature rise of 55°C.

The interrupting ratings are not a function of phase or ground minimum trip. Trip values in the ES or ESM are achieved by changing tap settings on relays or static control or taps on multi-ratio bushing current transformers. This design avoids the problems associated with designs that use resistors in series with current sensors that generate high voltages in the control circuit during fault conditions.

Duty Cycle

The ES and ESM reclosers are designed to conform with the duty cycle ratings published in Table 2 of ANSI C37.60 as listed below:

Type	Line No.
ES-400	11
ES-560, ES-105	12
ES-800, ES-108	12
ESM-560	13
ESM-800	13

Specific Ratings and Benefits

Type	ES-400	ES-560	ES-800	ES-105	ES-108	ESM-560	ESM-800
Specific Ratings							
Continuous Current Maximum (Amps)	400	560	800	560	800	560	800
Four-Second Rating RMS Symm. Amps	8000	12000	12000	12000	12000	16000	16000
Maximum Interrupting Capacity RMS Symm. Amps							
4.8 Kv	8000	12000	12000	12000	12000	24000	24000
8.32 Kv	6000	10000	10000	10000	10000	20000	20000
15.5 Kv	6000	8000	8000	10000	10000	16000	16000

Basic Construction Benefits

Each recloser consists of the following major components:

- High Voltage Oil-Filled Compartment
- Mechanism Compartment
- Control Cabinet
- Substation or Pole Mounting Frame

A standard feature of the Westinghouse recloser is that each unit is completely assembled at the factory into one package which minimizes the amount of time required for field installation.

In addition, every recloser is tested at the factory to insure that the control is functioning properly. Factory testing of minimum trip values, tripping times, reset and reclose times and contact resistance minimize the de-bugging problems that the user may encounter in the field. To correct these problems in the field, the user would most likely have to spend up to four hours of labor using over-pot equipment, timing devices, and a power supply. The Westinghouse design is intended to avoid these problems.

Design Features of High Voltage Oil-Filled Compartment

- **Tank**

Welded steel construction of the high voltage tank minimizes the possibility of oil leaks which if not prevented are very costly to repair in the field.

- **Interrupters**

The grid assembly of the interrupter is hydraulically pressed together which eliminates the expense associated with inspecting and tightening bolted grid assemblies.

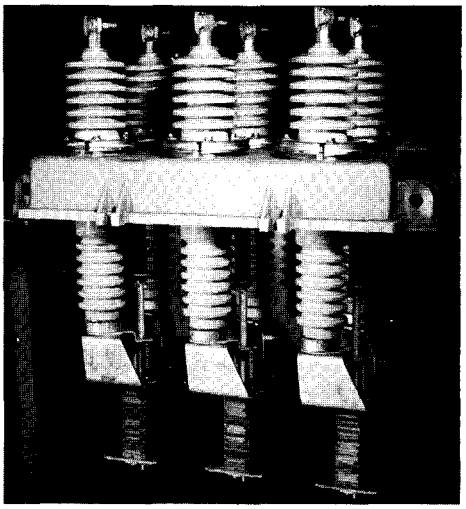
The interrupter used in the ES and ESM reclosers has one single break contact assembly per phase, making possible a reduction in maintenance time since there is only one set of three stationary and moving contacts to inspect or repair.

Removal of the stationary contact is accomplished by simply removing the bolts on the shunt and bottom plate. This results in significant labor savings to the user since the complete interrupter does not have to be disassembled for inspection. Silver tungsten contacts provide excellent arc resistance, extending the service life of the contacts.

Self-aligning, spring biased, tulip type stationary contacts are used to assure alignment and to provide a positive wiping action of the contacts to yield uniform contact pressure.

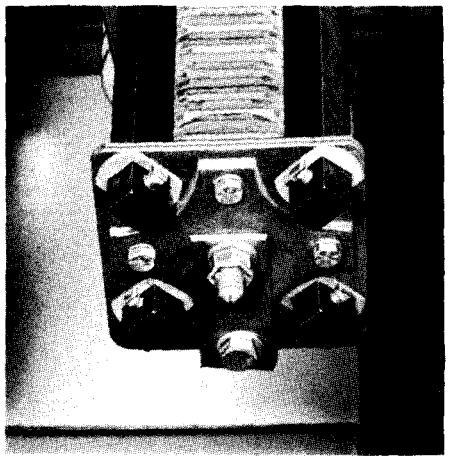
The roller guide construction assures positive contact alignment providing uniform contact pressure and increased contact life.

Silver-plated multiple roller contact construction eliminates the need for flexible shunts to connect the moving contact assembly to the bushings. Since the flexing of metals, such as shunts, enhances fatigue of the metal, the life of a shunt would be shorter than the roller type construction. The longer life of the roller contact should decrease maintenance costs by eliminating inspection and replacement of shunts.

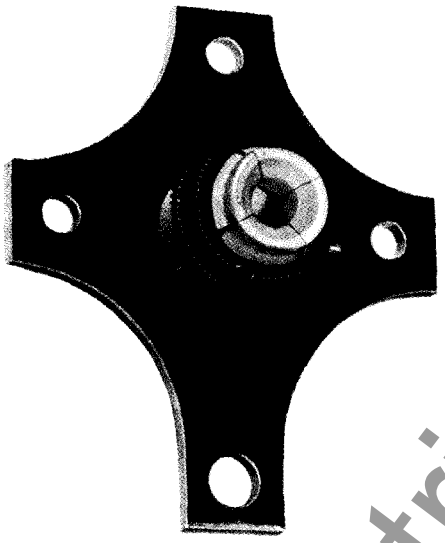


Head Casting and Interrupter Assembly

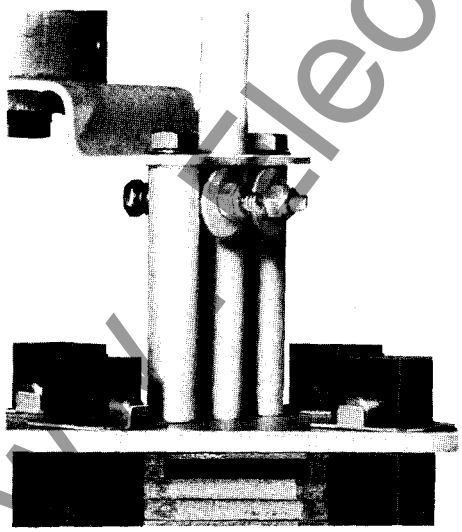
Type ES and ESM Automatic Oil Circuit Reclosers



Bottom View Showing Stationary Contact Mounting



Removable Stationary Contact



Roller Guide and Contact Construction

- **Bushings**

One piece extra creep bushings with 17.5 inch creep maintains 110 KV BIL and reduces the voltage stress on the porcelain surface by 22% when compared to standard 14 inch creep bushings. The lower voltage stress of the Westinghouse design minimizes the possibility of bushing failure.

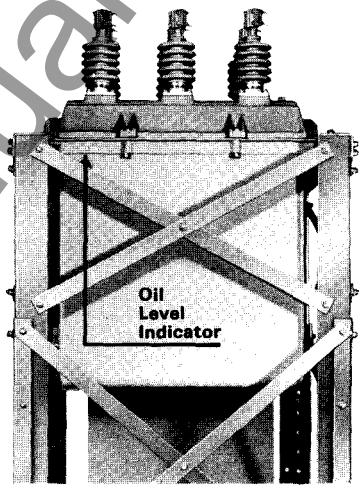
The recloser can be supplied with either a NEMA 4-hole pad or a 4-bolt clamp type connector to accommodate conductor sizes #2 through 800 mcm. This arrangement allows the purchaser to select the most suitable terminal, eliminating the need for special connectors at a possible savings of up to $300 per recloser.

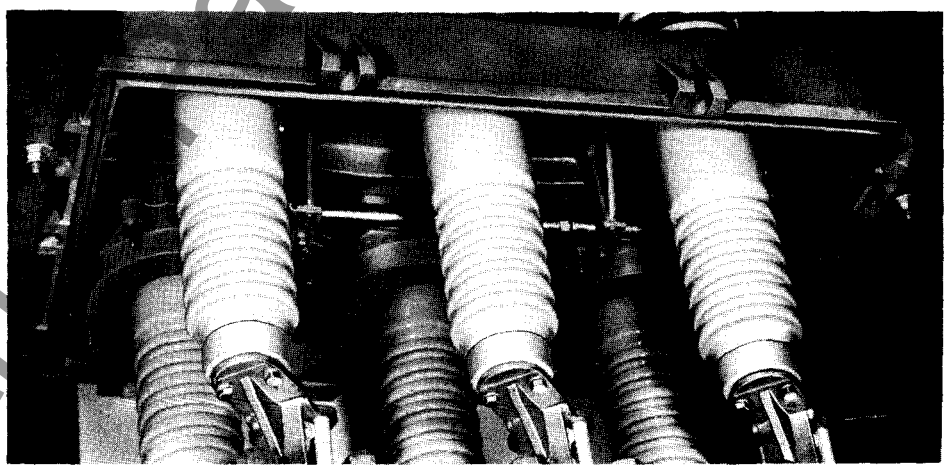
- **Multi-Ratio Bushing Current Transformers**

BCT's with relay accuracy and a burden capacity of B2.0 allow the use of meters or the future addition of burden up to 50 volt amps without having to add extra current transformers. Multi-ratio current transformers let the user choose from at least 40 values of minimum pickup current providing precise coordination.

- **Oil Level Indicator**

A visual floating ball oil level indicator is located on the tank wall to check the oil level during maintenance, saving the time that would otherwise have to be used in dropping the tank to check the oil level.





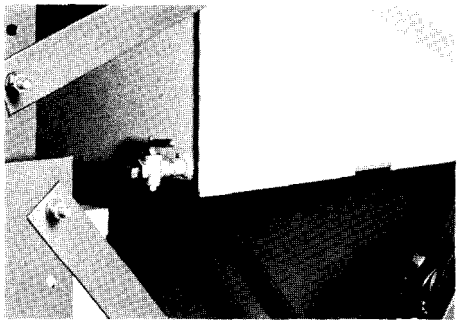
Bushing Current Transformers Mounted on Bushings 1-3-5

- **Air Relief Vent**

A standard screened and baffled relief vent safely vents the arc extinction gases to the atmosphere during interruption. This design feature prolongs the useful life of the oil dielectric reducing the number of times that the oil must be maintained or filtered.

Type ES and ESM Automatic Oil Circuit Reclosers

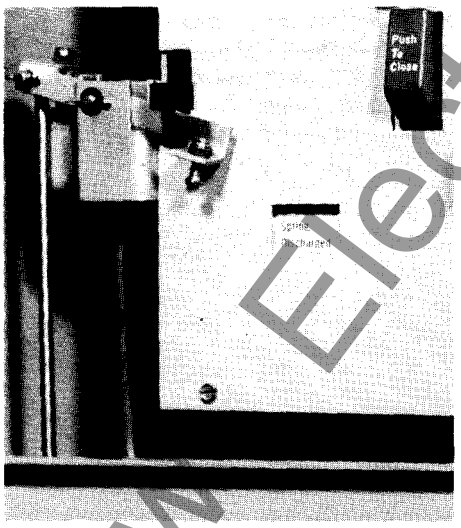
• Oil Drain and Sampling Valve
This valve, which is mounted on the side wall at the bottom of the recloser tank, provides easy access for sampling or draining the oil without having to lower the high voltage tank. The location assures that the customer does not have to provide a sump pump to completely drain the oil representing a significant savings in labor and equipment costs.



Oil Drain and Sampling Valve

Design Features of the Mechanism Compartment
The recloser is tripped by a low voltage shunt trip coil which receives its signal from current transformers and a static or electromechanical relay in lieu of tripping by a high voltage series trip coil mounted in the oil-filled compartment carrying full line current at high voltage.

The Westinghouse shunt trip design provides the user with a source of tripping that is not sensitive to the temperature or the condition of the oil.



Manual Trip Lever

• Mechanism
The operating mechanism is the stored energy type and is mounted in the low voltage compartment on the front of the recloser. Accessibility is gained through a quick release removable panel, and a removable top cover and bottom plate. This makes it possible for operating personnel to perform routine mechanism inspection without entering the high voltage oil-filled compartment.

A small motor driving through a ratchet mechanism is used to charge the main closing springs. The mechanism operates the recloser contacts by supplying a spring trip, spring close driving force to the crankshaft operating all three phases simultaneously. This allows the user one trip-close-trip operation even if control power has been lost. To prevent the release of stored energy into a preloaded mechanism linkage, which could result in excessive stress, a mechanical safety interlock is provided so that the closing spring cannot be manually discharged when the recloser is in the "closed" position.

A latch check switch, located on the mechanism, is provided as a standard feature to permit electrical closing only when the mechanism is fully reset.

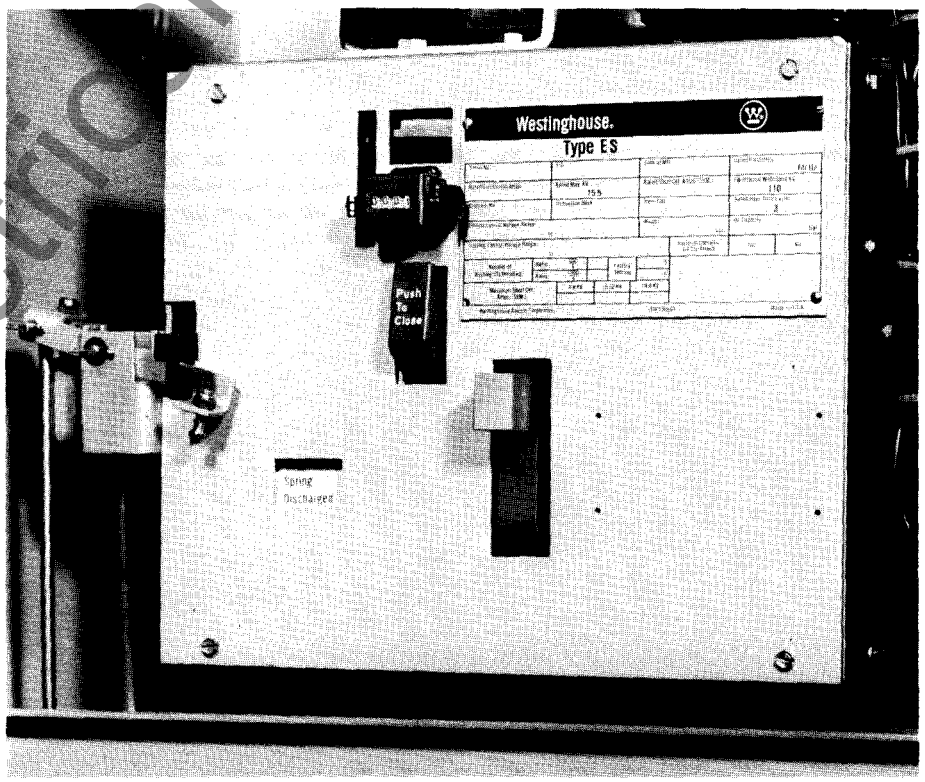
A visible flag on the mechanism front cover plate indicates the spring condition as "SPRING CHARGED" or "SPRING DISCHARGED." This positive indication tells operating personnel whether the mechanism has properly stored the energy required to close the recloser during maintenance operations.

The operator can manually close the recloser by actuating the "PUSH TO CLOSE" button which discharges the closing spring. Stored energy makes the operating speed independent of operating personnel. This feature benefits the user in that the recloser can be manually closed into an energized circuit for load pickup when control power is not available.

A manual trip lever allows the recloser to be tripped quickly under emergency conditions.

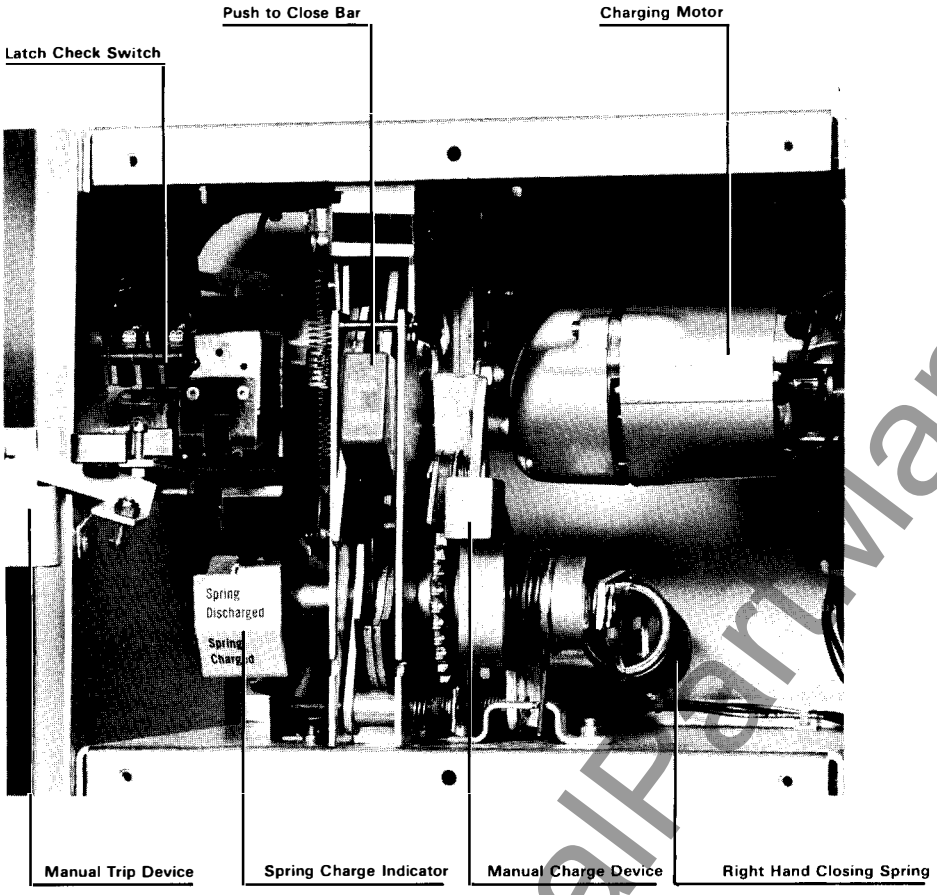
As an added safety feature, a 69 device blocks automatic reclosing after manual trip by opening the electrical reclosing circuit. An external reset device is provided for restoring the normal reclosing function.

A cyclometer operations counter, which indicates the number of trip operations, is located behind the window in the mechanism cabinet permitting the user to determine if operations have occurred without having to incur the added labor cost of removing the housing door.

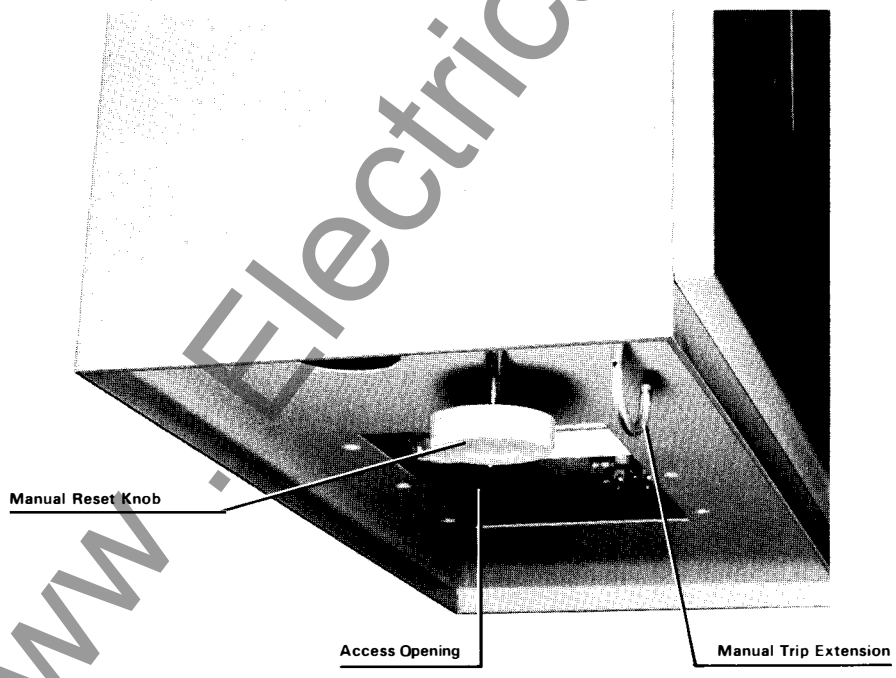


Mechanism Front View

Type ES and ESM Automatic Oil Circuit Reclosers



Mechanism Details, Cover Removed, Front View



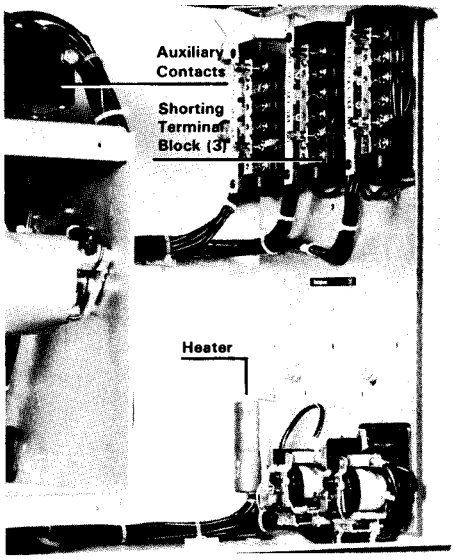
Bottom View of Mechanism Compartment, showing Access

Other Features Incorporated in the Mechanism Compartment of the Recloser Include:

- Heaters that are mounted in the weatherproof mechanism cabinet as well as in the control cabinet. Combined with gasketed doors, the heaters provide a climate that protects the control components from moisture.

- Shorting type terminal blocks located in the mechanism compartment permit ratio changing of the bushing current transformers under load. This design provides a safety feature to operating personnel and eliminates the need to by-pass and de-energize the recloser while taps are being changed.

- Two spare auxiliary contacts are provided for the customer's use which eliminates the cost of purchasing a separate auxiliary switch when only one or two extra contacts are needed.



Type ES and ESM Automatic Oil Circuit Reclosers

Design Features of the Control Cabinet

Most ES and ESM reclosers are provided with electro-mechanical overcurrent phase and ground relays as the typical panel shows. The reclosing relay is generally a solid state relay, type RCS-II, although the electro-mechanical RC reclosing relay is available.

A solid state overcurrent and reclosing package can also be provided that typically performs all of the functions associated with the electro-mechanical relay control.

Among the many features of the relay control are the following:

- Optional mounting positions of the control cabinet provide flexibility in locating the recloser within the substation saving several feet of control cable, substation space, and substation bus. This savings is realized because in addition to the standard front recessed location, the control cabinet can be located on the rear or left hand side of the substation frame to accommodate special requirements as shown in 38-722 F WE A.

- The hinged door of the control cabinet allows full access to the control panels and eliminates the time required to remove and replace a bolted cover every time access is needed to the control cabinet. Provisions exist for padlocking the cabinet door to prevent entry or tampering by unauthorized personnel.

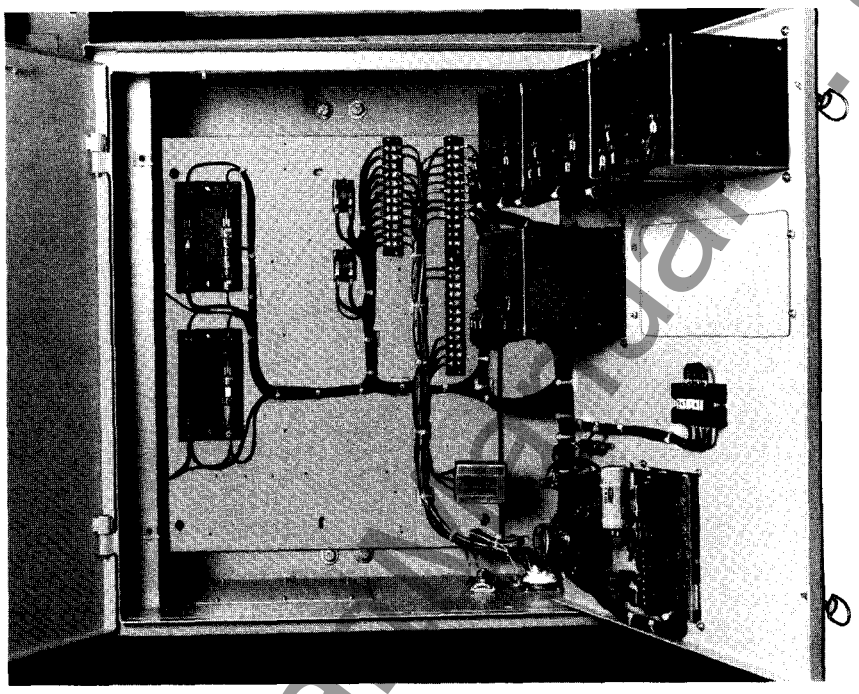
- A hinged panel is provided in the control cabinet in order to provide full access to all items mounted on and behind the panel. This decreases the time required to inspect or maintain control items mounted in the cabinet

- Control wiring is installed at the factory by using a wiring harness that ensures uniformity of wiring and simplifies troubleshooting in the field.

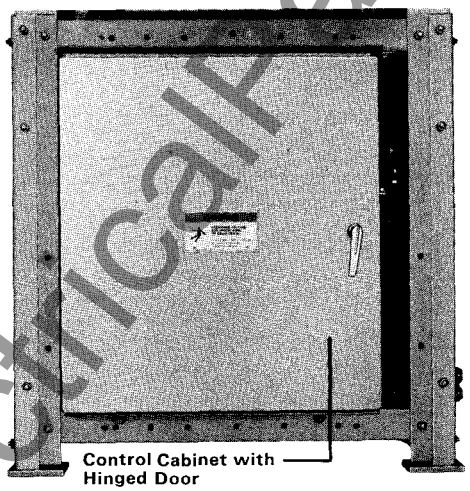
- A fused knife switch in the control circuit provides overcurrent fault protection for the control circuit and makes a visible disconnect readily available for maintenance.

- The spring charging motor and the close and trip coils can be supplied to operate on 115 or 230 VAC. The close and trip coils may also be supplied to operate on 24, 48, or 125 VDC. The various options of control voltages permit the user some flexibility by allowing the use of the most convenient source or existing station supply, saving the cost associated with providing a new or different source of control power.

The recloser can also be tripped from a capacitor trip device located in the control cabinet. This device stores DC that is available for tripping when close-in faults could drop the station AC control voltage below the level required for AC tripping. This device has the reliability of a battery, but eliminates the maintenance normally associated with batteries as well as the cost of a small station battery.



Typical Control Cabinet with Hinged Panel Open

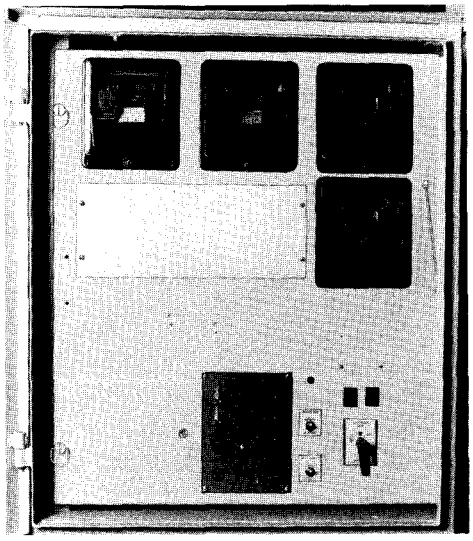


Control Cabinet with Hinged Door

- Overcurrent relaying can be supplied either with electro-mechanical relays or static relays. The extended range HI-LO overcurrent relays provide the user with a wider range of built-in current settings which may permit standardization on one control package minimizing application problems.

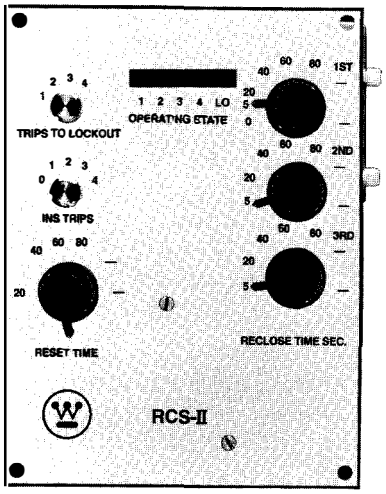
- The reclosing relay provided on most ES and ESM reclosers is the RCS-II which is located on the hinged panel. The RCS-II utilizes solid state timing to control reclosing. Dial settings allow selection of reset time, reclose time for each operation, number of instantaneous trips, and the number of trips to lockout. This design feature eliminates the need to purchase new components to change any of the reclosing settings saving the cost of material, labor, and inventory carrying charges. A version of this relay utilizing electro-mechanical timing to control reclosing can also be provided.

Both the RCS-II and RC reclose relays have the reset after reclose feature. The reset timer begins after reclose as shown in the above illustration. This feature allows a shorter reset time. Reset time need only be coordinated with maximum trip time at minimum trip setting. This feature also provides cold load pickup.



Typical Hinged Panel

Type ES and ESM Automatic Oil Circuit Reclosers



RCS-II

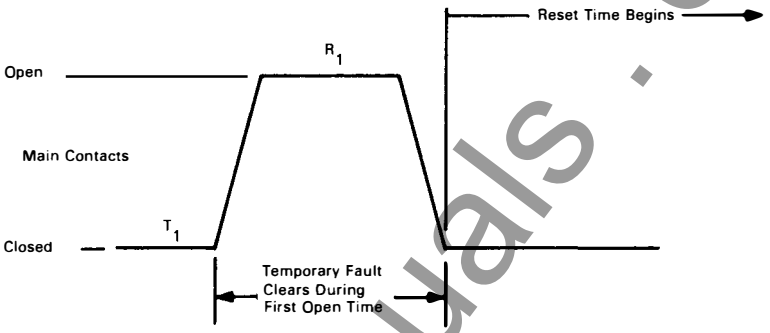
To understand how the reset after reclose feature works, assume the recloser is locked out and the fault still exists. Operate the control switch to close recloser. The recloser will operate on the last selected trip curve. In most cases this will be a time delay operation. After the reset time, the control will reset to its programmed operational sequence. Reset time begins at the end of the time selected for the recloser to reset to a pre-programmed sequence.

Control reset times can be reduced as a result of this standard feature since there is no cumulative timing effect. Shorter reset times minimize the possibility of a recloser lockout during a series of temporary faults. An unnecessary outage caused by lockout means customer inconvenience.

• Another standard design feature of the ES and ESM reclosers located in the control cabinet is an anti-pump scheme (X-Y) that prevents repeated closing into faults if the electrical close switch is held in the closed position. Danger to station personnel and equipment is reduced and the need for maintenance normally associated with pumping is eliminated.

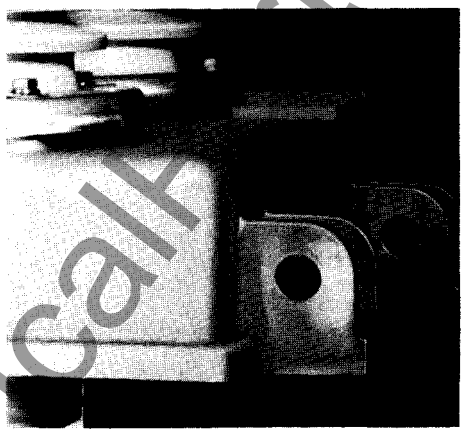
Design Features of the Substation Frame
The substation mounting frame is adjustable and can be field adjusted without special tools in 3-inch increments to obtain between 79 inches and 109 inches from live parts to ground. This feature makes it possible for the user to match the recloser to the height of the existing substation bus resulting in a significant savings in phase connection labor and material. This feature also eliminates the cost of purchasing and assembling a frame extension. See 38-722 F WE A for details.

Installation and Maintenance Features
There are several features about the ES and ESM recloser that make it easier for the user to install the recloser and perform routine maintenance.



RCS-II and RC Reset After Reclose Feature

• The head casting is sealed to the high voltage oil filled tank with a cork neoprene gasket that is cemented in the gasket seating grooves of the casting. These grooves control the gasket compression and insure proper alignment thus providing a positive seal. A major benefit of this design is that the gasketing technique allows the recloser to be shipped with oil, saving the user the time required to fill the recloser in the field.



Lifting Lugs

• Lifting lugs are located on each corner of the head casting. This design feature provides equal distribution of load forces when the recloser is lifted or moved, reducing the possibility of damage during installation.

• The rugged construction of the recloser minimizes the possibility of damage during shipment or handling. The frame is constructed of galvanized angle iron and the high voltage compartment is made of welded steel which is covered by a strong aluminum head casting. This construction could save the user the time and expense of repairing a recloser damaged in shipment before installation.

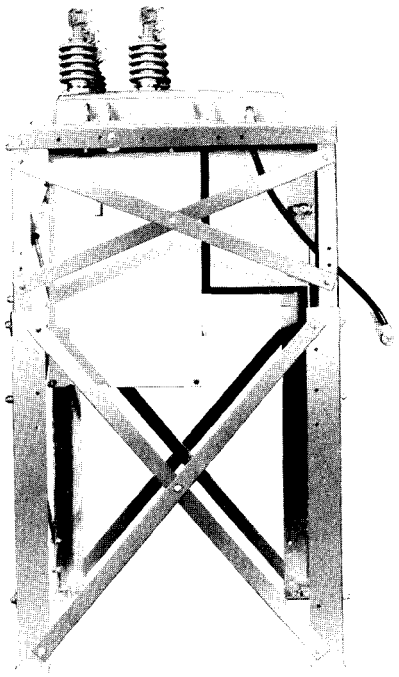
• The substation and pole mounting frames and hardware are hot dipped galvanized which provides the user with a big savings by eliminating periodic repainting.

• A tank lifter with better than a 4:1 gear ratio and a quick release brake can be provided, if specified. The lifter makes it possible for one person to lower the tank. As a safety feature, the quick release brake prevents the tank from falling if the handle is accidentally released during operation. This feature eliminates special winching equipment and a second person is not needed.

• Every recloser is provided with a manual trip lever. The recloser can be tripped by an external trip lever to perform maintenance and/or inspection with the high voltage circuit energized and without having to open any compartments to gain access to the lever.

The lever provides a back-up tripping system in the event that control power is lost and, most importantly, the lever minimizes the time required to trip the recloser under emergency conditions.

• Eyelet terminal connectors are used on the control wiring in order to provide more secure connections. This minimizes receiving inspection expense in that connections do not shake loose during shipment.



Type ES and ESM Automatic Oil Circuit Reclosers

Options and Accessories

• Three Type GA-332 mini-ammeters with a 0.5 amp scale can be mounted on the hinged control panel. This feature provides built-in indication of instantaneous load current. Each hinged panel is punched to mount these meters either at time of purchase or at a later date by the user. This benefits the user since it eliminates the need for separate installation which adds labor cost and material expense.

If required, thermal demand ammeters instead of mini-ammeters can be added either at time of purchase or at a later date by the customer. This flexibility is available to the user because the panel punching is standardized and will accept either set of ammeters at any time.

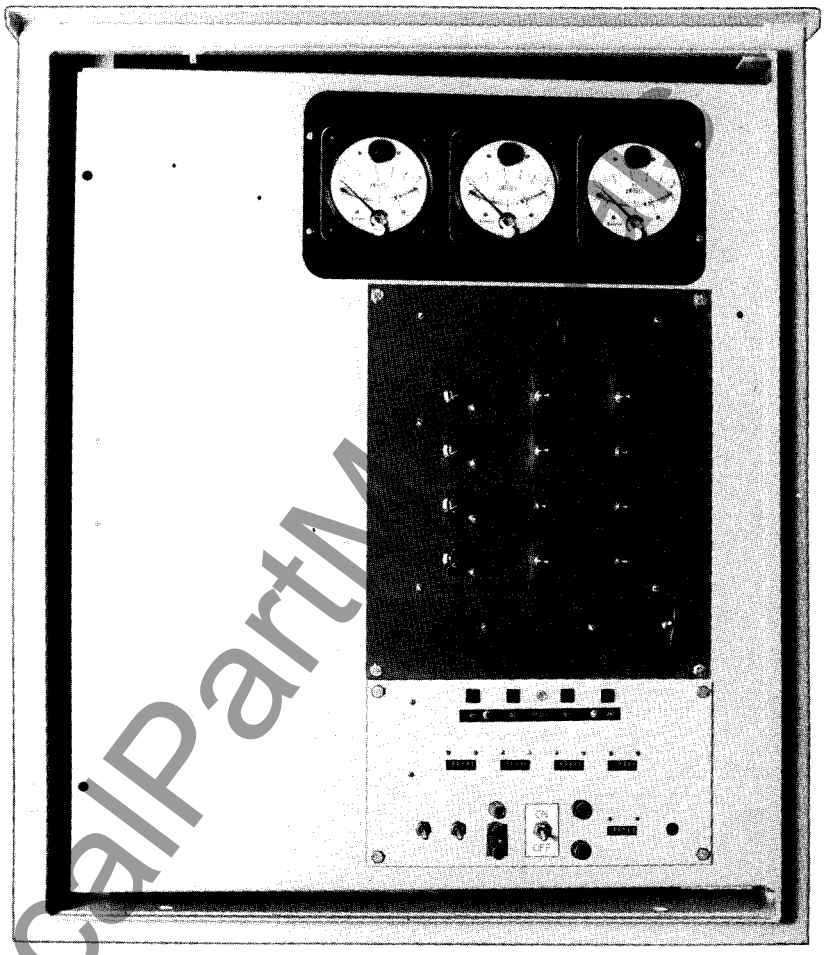
• Instead of electro-mechanical relay control, static overcurrent and reclosing relays can be provided in a package that mounts on the hinged panel. All the features of this control are described in other bulletins, but listed below are a few of the major features:

- Either of two phase time delay curves
- Either of three phase instantaneous curves
- Phase instantaneous trip selector
- Variable reset times
- Variable reclose times
- Battery test device
- One shot to lockout switch
- Cold load pickup switch
- Separate ground unit
- Separate instantaneous unit

The static control operates on d.c. Each control includes a battery trip device consisting of a ni-cad battery and a trickle charger mounted in the control cabinet. This provides the user with a self-contained d.c. control power source and eliminates the need for a station battery and a d.c. circuit.

A battery test device, including a panel mounted voltmeter, a load resistor, and switches, provides a convenient means for the user to periodically check the condition of the battery under load.

A portable static control calibrator test set has been designed to facilitate testing and checking the calibration of time current settings. This permits on-site checking without removing the recloser to a relay shop saving several hours of labor and transportation cost.



Typical Static Control Hinged Panel

A plug-in connector is provided on each end of the control cable on all pole mounted reclosers. This simplifies connection and disconnection of the control from the recloser mechanism which reduces labor costs associated with the installation of the recloser or control.

When purchasing a static control for substation frame mounting, it is highly desirable to select the option of a plug-in connector to make it easy to connect the static control calibrator to the static control.

In the control cabinet there are provisions for a 15 ampere, 120 volt outlet. The convenience of a 120 volt receptacle in the control cabinet should save time in connecting power tools to the control power source in the substation.

Other accessories that are available:

- Remote trip and close
- Oversize control cabinet
- Surge arresters
- CBT control power transformers
- Ground wire monitoring scheme.

Further Information

PL 38-720
AD 38-723
38-722 F WE A

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