

APPLIES TO SERIAL NOS. 2000A AND ABOVE, AND 500B AND ABOVE.
For instructions on KF reclosers having serial numbers below those listed, refer to Bulletin 72042.

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CAUTION

Do not energize this equipment out of oil.

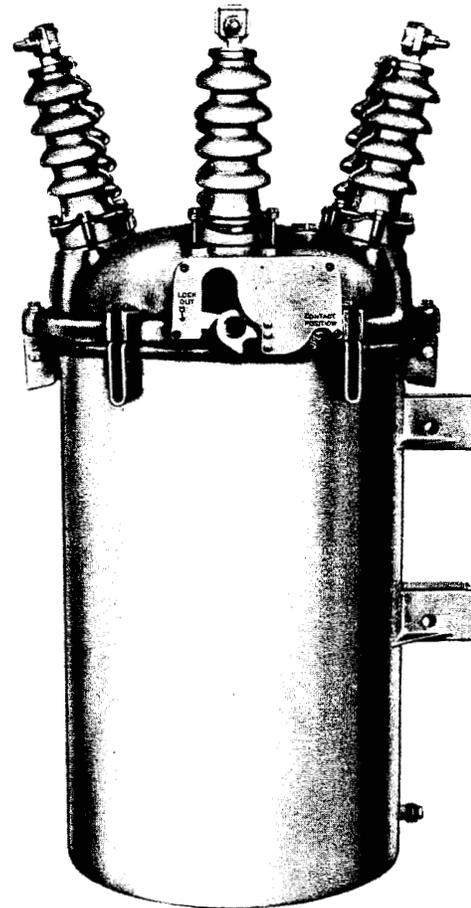


Figure 1

McGraw-Edison Type KF hydraulically controlled vacuum recloser.

GUARANTEE

Performance guarantees shall be limited to correction by repair or replacement, at McGraw-Edison's option, of such equipments or components that may fail due to defects in material or workmanship, within a period of one year from date of shipment. The guarantee is valid only if the recloser has been properly inspected upon receipt, properly installed, and has not been subjected to abnormal conditions. The Company will not, however, be liable for consequential damages, or any expenses incurred in installation or transportation.



These instructions do not claim to cover all details or variations in the equipment, procedure, or process described, nor to provide directions for meeting every possible contingency during installation, operation, or maintenance. When additional information is desired to satisfy a problem not covered sufficiently for the user's purpose, please contact your McGraw-Edison Power Systems Division sales engineer.



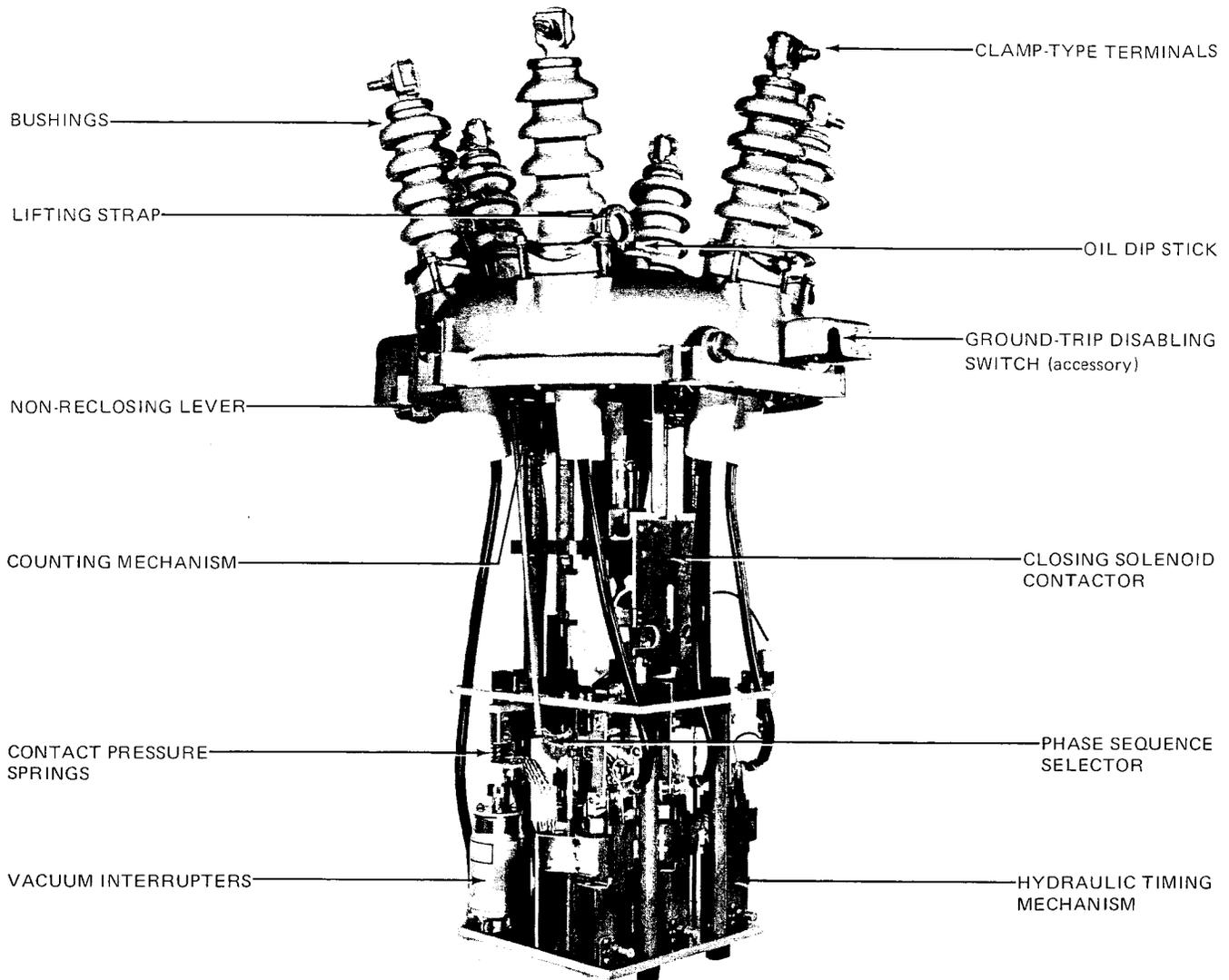


Figure 2A
Untanked view locating operating components.

SHIPMENT AND ACCEPTANCE

Each recloser is completely assembled, inspected, adjusted and tested at the factory, and is filled to the correct level with insulating oil. It is in good condition when accepted by the carrier for shipment.

Upon receipt, inspect the recloser thoroughly for damage and loss of parts or oil incurred during shipment. If damage or loss is discovered, file a claim with the carrier immediately.

Check for oil leakage and tighten all bolts that may have loosened during shipment, especially the bolts which attach the head to the tank.

HANDLING AND STORAGE

If the recloser is to be stored for some time before installation, provide a clean, dry storage area. Take care during handling and storage to minimize the possibility of mechanical damage; in particular, protect the bushings.

DESCRIPTION

RECLOSER OPERATION

The Type KF is a self-contained, three-phase overcurrent interrupting device. The recloser senses line current and times its opening operation separately on each phase. It interrupts current, sequences from fast to delayed timing, counts operations to lockout, and locks out on a three-phase basis.

After a contact opening operation, the KF recloses automatically to restore service if the fault is temporary. If the fault is permanent, the recloser repeats its opening operation and locks out after two, three, or four such operations, as preset. Should the fault clear before lockout, the counting mechanism resets for another complete program of operations.

The recloser can be set for non-reclosing operation (lock out after the first interruption) with an external non-reclosing lever.

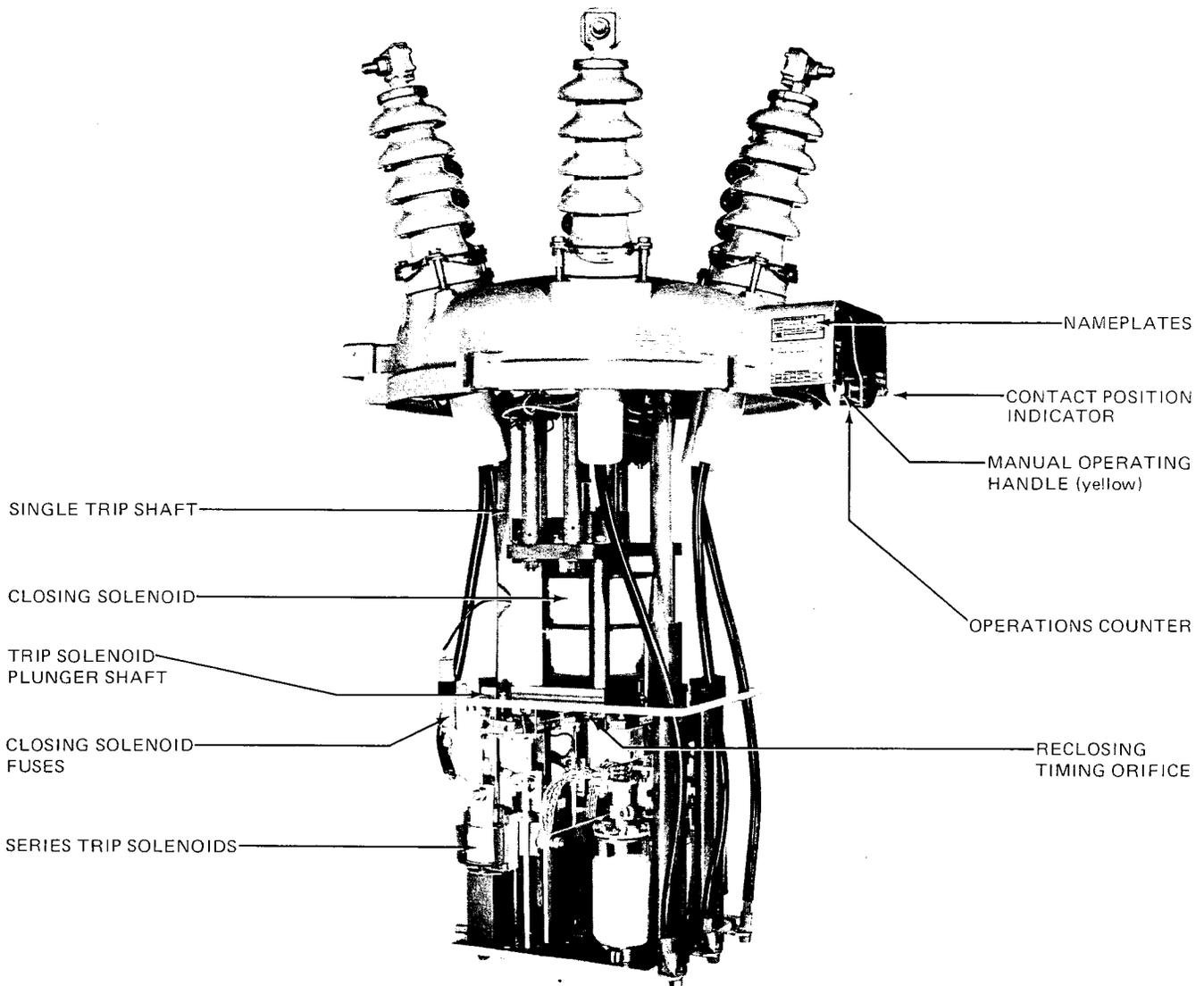


Figure 2B
Untanked view locating operating components.

Opening operations of the recloser can be all fast (time-current characteristic "A"), all delayed (time-current characteristic "B" or "C"), or any combination of fast operations followed by delayed operations up to a total of four. Fast operations clear temporary faults before branch line fuses can be damaged. Delayed openings allow time for fuses or downline reclosers to clear so that permanent faults can be limited to the smallest section of line.

Arc interruption takes place within the three sealed vacuum interrupters. Oil is used in KF reclosers for electrical insulation, but is not involved in arc interruption. The insulating oil also is used in the operations counting mechanism and in the timing of opening and reclosing operations.

The moving contacts in the vacuum interrupters are driven by release of an opening spring. Trip solenoids in series with the main recloser contacts release the opening spring (by plunger movement) when current above minimum-trip level is sensed.

Type KF reclosers equipped with ground (earth) fault tripping sense zero-sequence current through sensing current transformers located inside the recloser. When the zero-sequence current exceeds the selected minimum ground trip level and remains above that level through the selected timing period, the ground-trip mechanism operates to release the contact opening spring.

Closing energy, as well as energy to charge the opening spring, is supplied by a high-voltage closing solenoid momentarily connected phase-to-phase through a high-voltage contactor.

Figures 2A and 2B show the location of the various operating components of the KF recloser.

SPECIFICATIONS AND RATINGS

Type KF reclosers are available in two continuous current ratings:

- 280 amps
- 400 amps

Voltage

- Nominal operating 2.4-14.4 kv
- Maximum design 15.5 kv
- Impulse withstand (BIL) 1.2 x 50
microsecond wave, crest 110 kv*
- 60-hertz withstand, rms
Dry, one minute 50 kv
- Wet, ten seconds 45 kv
- RIV @ 1000 khz, @ 9.41 kv 100 microvolts max.
- Operating frequency 50-60 hz

*Not applicable across open contacts of vacuum interrupter. Insulation capabilities for this condition are less than 110 kv.

Operating Times

- Normal reclosing times 1.5-2 seconds
- Resetting times @ 25 C 1-1.5 minutes per
recloser operation

Duty Cycle

Number of Operations	Percent of Interrupting Rating	Maximum Circuit X/R Ratio
96	15-20	3
120	45-55	7
32	90-100	14
248 Total Operations		

Current and Interrupting

Series-Trip Coil (continuous amps)	Minimum Trip Current (amps)	Interrupting (rms Symmetrical amps) at 14.4 kv
5	10	500
10	20	1000
15	30	1500
25	50	2500
35	70	3500
50	100	5000
70	140	6000
100	200	6000
140	280	6000
160	320	6000
185	370	6000
225	450	6000
280	560	6000
400*	800	6000
400X*	560	6000

*Applies to 400-amp recloser only.

DIMENSIONS AND WEIGHTS

- Recloser weight with oil 500 pounds
- Bushing current transformers (set of three) 75 pounds
- Pole extension hanger 19.5 pounds
- Substation elevating structure 150 pounds
- Recloser oil capacity 33 gallons
- Standard bushing creepage 11 5/8 inches

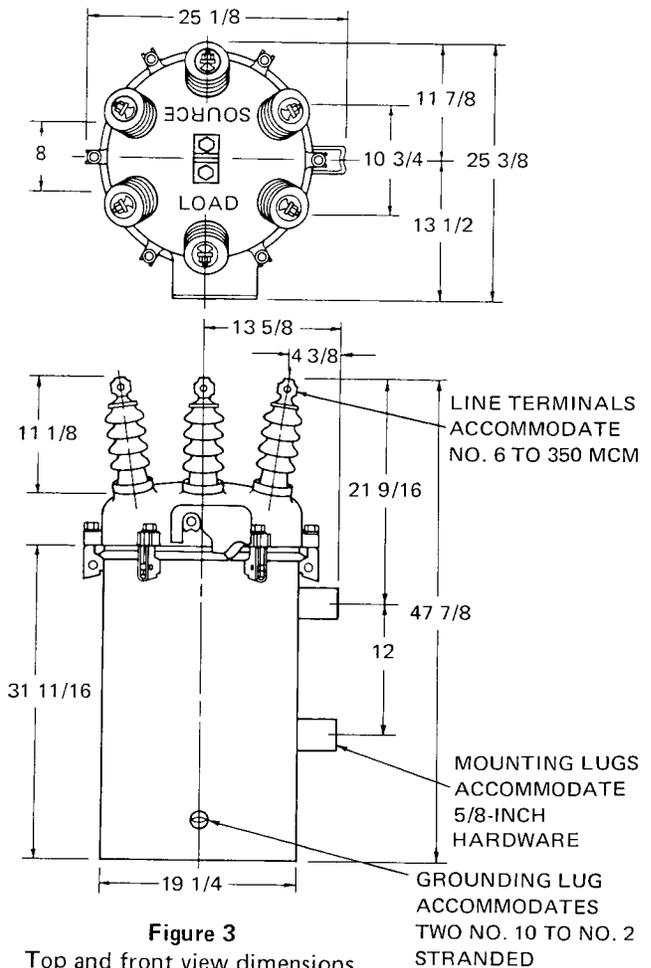


Figure 3
Top and front view dimensions.

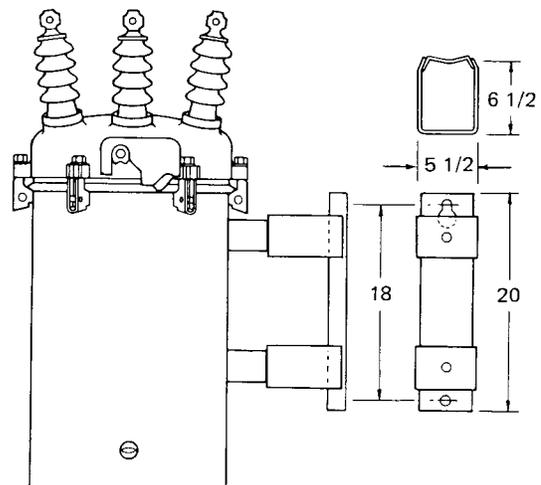


Figure 4

Mounting and clearance dimensions for pole-mounting extension hanger.

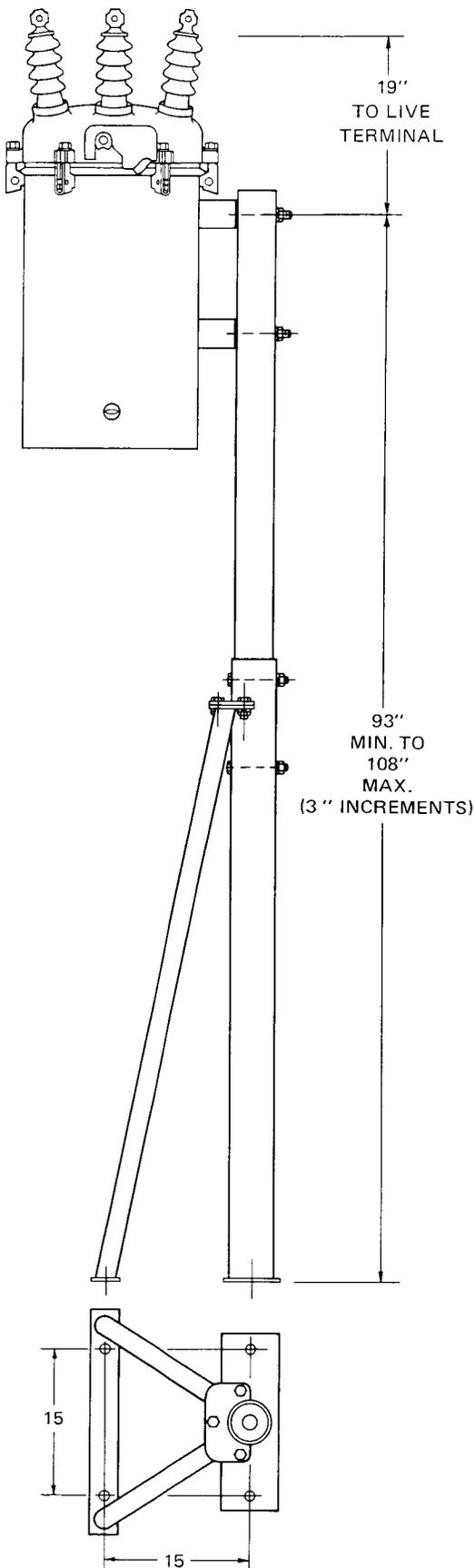


Figure 5

Mounting and clearance dimensions for substation elevating structure.

OPERATING LEVERS AND INDICATORS

Manual Operating Handle

The manual operating handle (yellow) permits manual opening and closing of an energized recloser. Pulling down the handle trips and locks open the main contacts of the recloser. Lifting up the handle closes the closing-coil contactor, and if high-voltage power is supplied to recloser bushing terminals 1 and 5, the closing coil will close the main contacts. The handle can be operated with a hookstick.

The handle is trip free. It will not impart a blow to the operator if the recloser trips on fault while the handle is being held closed. However, it will continue to reclose and trip (in excess of its number of operations to lockout) until the handle is allowed to drop to the open position.

When the recloser operates to lockout, the yellow handle drops down from under the sleet hood. It must be reset manually from the lockout position before the recloser can close.

Non-Reclosing Lever

The non-reclosing lever provides the capability of locking out the recloser on the first trip operation regardless of the operations to lockout setting inside the recloser.

The non-reclosing lever can be operated with a hookstick. For non-reclosing operation it is pulled from under the sleet hood to its down position. It must be manually returned.

The recloser can be opened or closed manually regardless of the position of the non-reclosing lever.

Contact-Position Indicator

Located on the outboard side of the sleet hood, this indicator shows the words OPEN or CLOSED in accordance with the position of the main recloser contacts.

Operations Counter

Located under the sleet hood, this three-digit mechanical counter steps with each trip operation, cumulatively recording all recloser trip operations.

Ground-Trip Disabling Handle (Accessory)

Located on the recloser head, opposite the sleet hood, this manually operated handle disables the ground-trip operation when pulled to its "blocked" position. It can be hookstick operated and will remain in the down position until manually returned.

CLOSING SOLENOID

The recloser contacts are closed and its opening spring charged by movement of a plunger magnetically drawn into the closing solenoid. The solenoid is momentarily connected phase-to-phase to the high-voltage lines (source side) through a high-voltage contactor. The solenoid plunger is accelerated downward, which through the recloser mechanism causes the:

Contact operating rod to move downward, close the vacuum interrupter contacts and compress the contact pressure springs.

High-voltage contactor to open.

Opening spring to be charged and recloser mechanism to be set up for a trip operation.

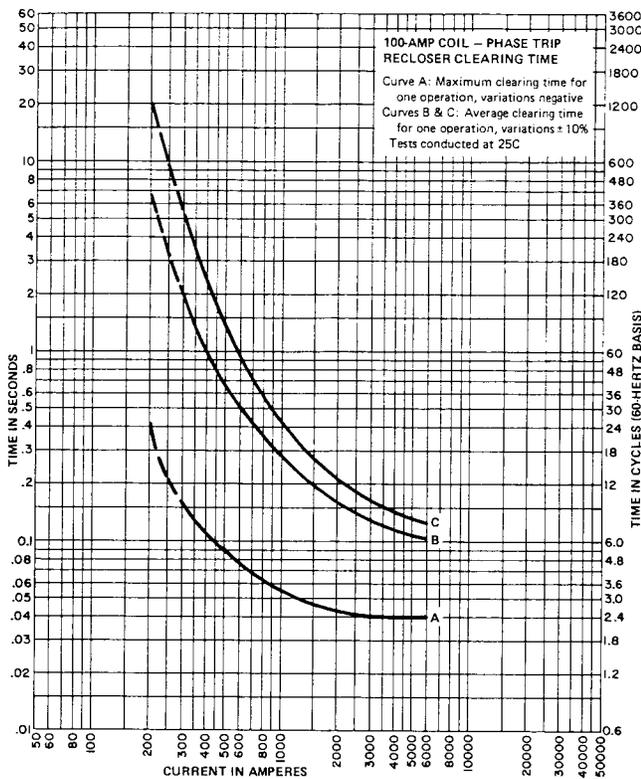


Figure 7

Typical set of Type KF recloser phase-trip time-current curves.

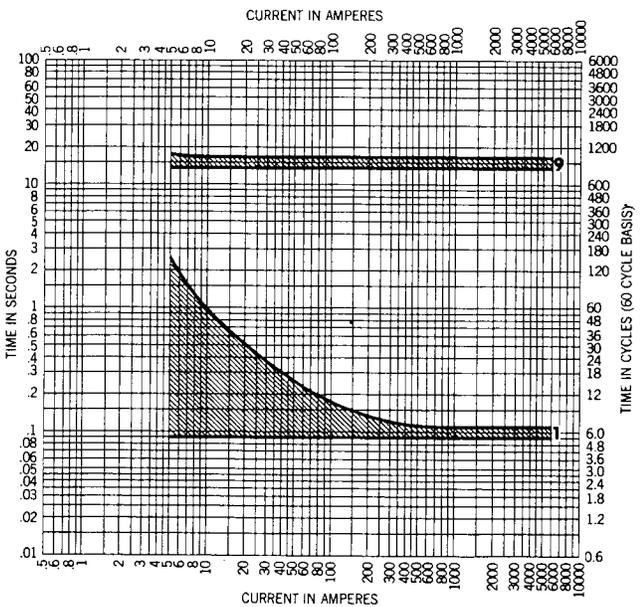


Figure 8

Typical time-current characteristics for ground (earth) fault tripping. From total of nine selections available, fastest and slowest characteristics are illustrated.

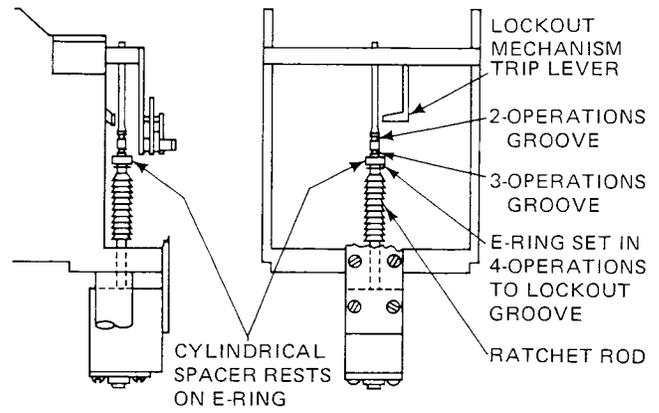


Figure 9

Operations to lockout setting.

SETTINGS AND ADJUSTMENTS

Operating characteristics and settings of Type KF reclosers are preset and tested at the factory, and identified on the nameplates. They can, if necessary, be changed. The recloser must first be removed from its tank.

OPERATIONS TO LOCKOUT

The number of operations to lockout (2, 3, or 4) is set on the upper portion of the ratchet rod (Figure 9) which is located above the intergrator housing on one end of the mechanism frame. Position of the cylindrical spacer on the ratchet rod, held in place by an "E" ring snapped into one of three grooves (shown in Figure 9 in the four operations to lockout setting) determines the number of trip operations to lockout.

One operation to lockout is set with the non-reclosing lever as described under "Operating Levers and Indicators".

NOTE: The operations counting mechanism counts both phase- and ground-trip operations.

To change the operations to lockout setting:

1. Remove the "E" ring from beneath the spacer.
2. Move the spacer to the groove required for the number of operations to lockout wanted (Figure 9).
3. Assemble the "E" ring in the groove.
4. Make sure the spacer is down against the "E" ring.

RECLOSING TIME

Reclosing time of 1.5 to 2 seconds cannot be changed.

MINIMUM TRIP

Phase

Minimum phase trip current level is determined by the series trip coil size selected. On KF reclosers phase minimum trip is twice the continuous rating of the series trip coil. It can be changed only by changeout of the trip coil.

Ground

Minimum ground trip current level is established by the minimum-trip resistor clamped to a terminal strip (Figure 10) on the recloser mechanism frame. A label on the resistor identifies the minimum-trip current programmed, which should agree with the value stamped on the ground-trip nameplate fastened to the recloser head.

Ground minimum trip current can be changed to any of those listed earlier by changeout of the minimum-trip resistor.

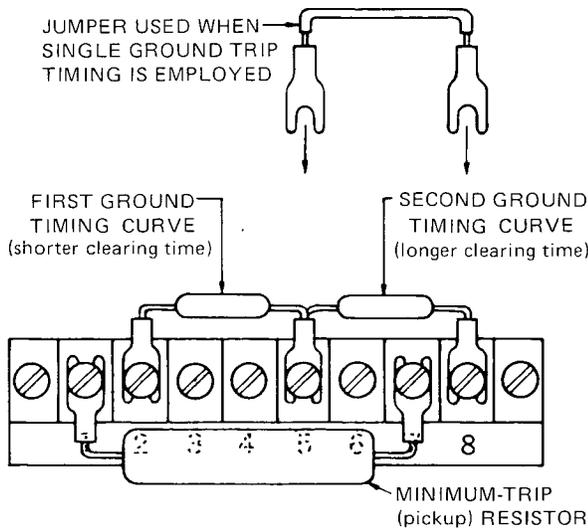


Figure 10

Ground trip programming components.

DELAYED TIME-CURRENT CHARACTERISTICS

Phase-Trip Timing

Delayed time-current characteristics available with KF reclosers are “B” (delayed) or “C” (extra-delayed) as shown in Figure 7. Reclosers are factory set and tested to operate on the curve specified on the recloser nameplate. Setting is made by position of the timing plate. The lower letter of the two stamped on the plate is the curve in use.

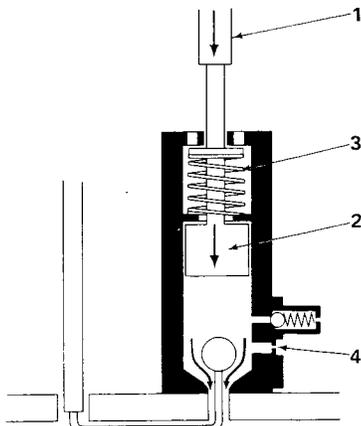


Figure 11A

Timing on fast operations.

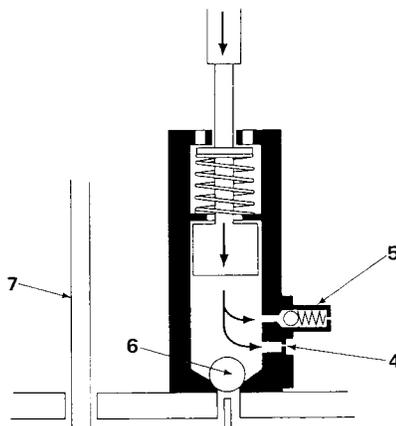


Figure 11B

Timing on delayed operations.

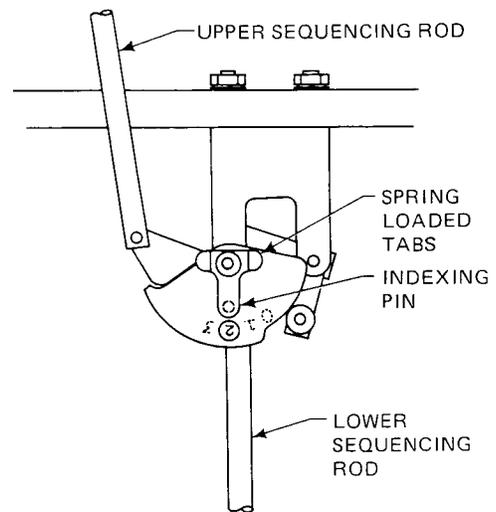


Figure 11C

Setting the number of fast phase-trip operations.

Timing can be changed to the other curve by reversing the plate. Time-current testing is strongly recommended to assure that desired results have been achieved.

NOTE: There is a timing plate on each phase. Any change or testing must be performed identically on all three phases.

Ground-Trip Timing

The terminal strip shown in Figure 10, located on the recloser mechanism frame, connects the ground trip programming components to the ground-trip circuitry. A label on the timing resistor identifies the clearing time programmed. When the dual ground trip accessory is furnished, two timing resistors will be included as shown.

The slower ground-trip curve (longer clearing time) is established by the right-hand resistor and occurs after operations on the faster curve (see “Setting for Ground Trip” in next section).

Either curve can be changed by a changeout of the timing resistor.

NUMBER OF FAST AND DELAYED OPERATIONS

All KF reclosers can be programmed on phase tripping for fast followed by delayed operations or all delayed operations. KF reclosers equipped with ground tripping can be programmed to have all ground-trip operations on a single ground timing curve; if the dual-timing accessory is furnished, ground-trip operations can be on two (one faster, one slower) ground timing curves.

Settings for Phase Trip

The number of fast phase-trip operations (0, 1, 2, or 3) is set on the indexing dial located above the series trip coils. A single setting governs the number of fast phase-trip operations for all three phases.

The number of time-delayed operations is automatically determined when the fast-operations setting is made. The number of delayed operations is the difference between the fast-operation setting and the number of operations to lockout. Of course, the delayed operations are preceded in each sequence by the fast operations (except where no fast operations are programmed).

To change the setting:

1. Pull the spring-loaded tabs to withdraw the indexing pin from the cam plate.
2. Rotate the tabs and cam plate until the desired number of fast operations appears in the circular window.
3. Release the tabs, and make sure the indexing pin engages both plates.

Settings for Ground Trip

When the KF recloser is equipped with the dual ground trip timing accessory, the number of operations on the faster of the two ground trip timing curves is set on the indexing dial located on the end of the recloser mechanism frame just above the lockout integrator.

The number of operations on the slower timing curve is automatically determined when the faster-curve setting is made. The number of slower-curve operations is the difference between the faster-curve setting and the number of operations to lockout. Of course, the slow-curve operations are preceded in each sequence by the faster-curve operations.

To change the setting:

1. Pull the spring-loaded tabs to withdraw the indexing pin from the cam plate.
2. Rotate the tabs and cam plate until the desired number of faster-curve operations appears in the circular window.
3. Release the tabs, and make sure the indexing pin engages both plates.

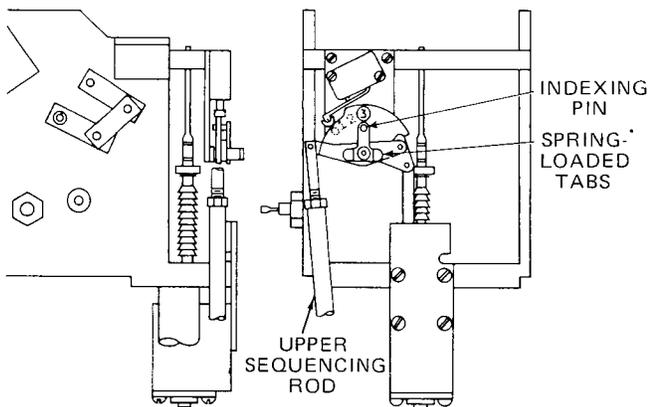


Figure 12

Setting the number of fast ground trip operations.

INSTALLATION AND OPERATION

PRELIMINARY CHECKS

Before installing the recloser:

1. Check for proper oil level. An oil-level dipstick is located in the top of the recloser head. Make sure oil level is between limits specified on the dipstick.
2. If recloser has been stored or is being relocated, test the dielectric strength of the oil. On new equipment the dielectric strength of the oil should be 26 kv. See reference data R280-90-1 for more information.
3. Check that ratings and settings on the recloser nameplates are correct for the planned installation.
4. If recloser has been untanked, the hydraulic timing mechanism may contain trapped air. This will cause erratic operation until the air is expelled from the mechanism.

To do this, manually pump the trip-coil plungers while the timing mechanism is completely submerged in oil. Four pumps on *each phase* should expel the air. Then, without allowing the mechanism to project above the oil surface, complete the retanking procedure.

When retanking, be sure gasket seats properly and that the six head bolts are tightened to 25-35 ft-lb torque.

MOUNTING

The recloser can be placed in its tank in any of six positions to facilitate location of operating handles, indicators, and bushings with respect to tank-mounting lugs.

When *lifting* the recloser for mounting or any other purpose, follow approved safety practices with lifting methods and equipment. The single lifting lug provided on KF reclosers is intended for vertical lifting. Lift the load smoothly and do not allow it to shift.

Direct Mounting

Using the two tank-mounting lugs, KF reclosers can be mounted directly if *adequate electrical and physical clearances* can be allowed. The recloser should be mounted using 5/8-inch-diameter hardware, which must be furnished by the customer.

When mounting the recloser on a flat surface, be sure to use adapter plates (shipped with recloser) between the tank lugs and the flat surface.

Pole Mounting

KF reclosers can be pole mounted by using the pole-mounting extension hanger shown in Figure 4. Hardware to attach the extension hanger to the recloser is included with the hanger. Be sure to use flat-surface adapter plates between recloser tank lugs and extension hanger lugs. Hardware to mount on the pole must be furnished by the customer.

Typical pole-mounted installations are shown in Figure 13 and 14.

Substation Elevating Structure

KF reclosers can be substation mounted by using the substation elevating structure shown in Figure 5. Hardware to attach the recloser to the elevating structure is furnished with the structure. Hardware to anchor the structure must be furnished by the customer.

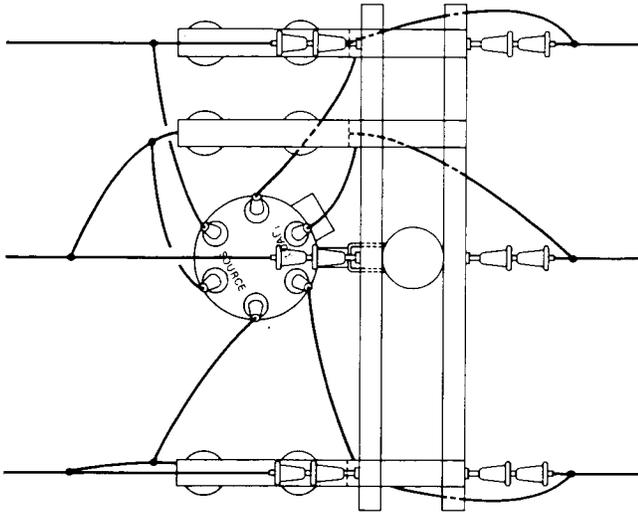


Figure 13

Typical KF recloser installation with crossarm mounted bypass switches.

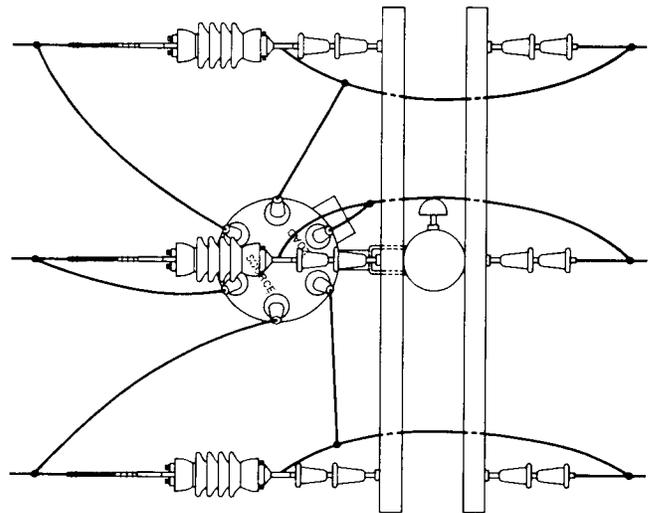


Figure 14

Typical recloser installation with inline bypass switches.

MAIN CONNECTIONS

It is desirable to provide the recloser with bypass switches and surge protection as shown in Figure 15. Lightning protection on both sides of the recloser is advisable. However, if protection is provided on only one side, it should be located on the source side for line installations, and on the load side for substation installations.

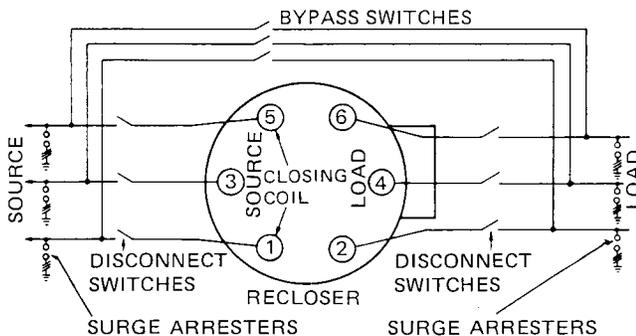


Figure 15

Suggested protection scheme for Type KF recloser.

Make *ground* connection to the ground terminal located on the recloser tank, near the bottom. The ground terminal accommodates two No. 10 solid to No. 2 stranded conductors.

Make *high-voltage* line connections to recloser bushing terminals in accordance with SOURCE and LOAD markings on the head casting. Bushing terminals accommodate No. 6 to 350 MCM conductor.

IMPORTANT: To provide operating energy for the high-voltage closing solenoid, source leads *must be* connected to terminals 1, 3, and 5 marked SOURCE on the head casting. The high-voltage closing solenoid is connected between terminals 1 and 5 during a closing operation.

INITIAL OPERATION

With the recloser connected as shown in Figure 15 and source-side high-voltage lines energized, the recloser can be placed in service. Follow approved local practice, which may involve closing line-disconnect switches (or jumpers), closing the recloser manually (with yellow handle), and then opening the bypass circuit.

ROUTINE OPERATION

Once the recloser is closed and in service it operates automatically when overcurrent conditions demand. However, once locked out it must be manually closed by returning the yellow handle to its up (closed) position.

NOTE: The lockout integrator piston begins resetting immediately after lockout at the rate of 1- to 1.5-minutes per recloser operation registered. Closing the recloser prior to complete reset may result in fewer operations to lockout if a fault is then present.

MANUAL OPERATION

Energized Recloser

Energized KF reclosers can be operated manually by hookstick movement of the yellow manual operating handle—up to close; down to open.

De-Energized Recloser

A manual *closing* tool (KA90R) is available for slow closing of *de-energized* reclosers. With recloser de-energized, proceed as follows:

1. Make sure yellow handle is in the closed position.
2. Remove pipe plug in side of recloser head and insert closing tool.
3. Engage the main operating shaft, and rotate the tool about 1/4 turn clockwise to close the recloser contacts. Avoid forcing the closing tool beyond the stop; doing so may shear the pin on the closing shaft.
4. A de-energized recloser can be tripped open merely by pulling the yellow operating handle down.

NOTE: Be sure to replace the pipe plug in the head casting before placing the recloser in service.

TESTING

Type KF reclosers are carefully tested and adjusted at the factory to operate according to the published data. Well-equipped test facilities, a detailed testing procedure and trained personnel assure accurate calibration. Permanent records are kept of each recloser's test performance. Each recloser leaves the factory ready for installation.

Preinstallation testing is not necessary. However, should verification of recloser operation prior to installation be desired, the following characteristics can be checked:

1. Number of operations to lockout
2. Number of fast openings
3. Satisfactory operation of the closing solenoid
4. Minimum-trip current
5. Reclosing time
6. Operation of the non-reclosing feature

The test findings should agree with the information shown on nameplates attached to the sleet hood.

PRECAUTIONS

The recloser can be test tripped with a low-voltage a-c source; but for automatic (electrical) closing, a high-voltage a-c source is required. For personnel safety, the recloser and high-voltage transformer should be enclosed in a test cage to prevent accidental contact with high-voltage parts. Proper grounding and test procedures should be observed. All metering and measuring equipment should be located outside the test cage.

WARNING

Do not attempt to trip KF reclosers using a d-c source such as a storage battery. The vacuum interrupters may be severely damaged if interruption of a d-c arc is attempted.

CAUTION

Do not energize this recloser out of oil.

IMPORTANT: When testing phase minimum trip current, be sure to disable ground-trip function. Testing on individual phases without disabling ground trip will cause the ground-trip function to operate.

TESTING EQUIPMENT REQUIRED

A suggested test circuit is shown in Figure 16. The following equipment is required for this circuit:

1. *Variable autotransformer*—230 volts 20 amps.
2. *Low-voltage transformer T2*—Ratio and kva size depends upon size of recloser trip coil and maximum current to be used.
3. *Ammeter*—Full scale deflection should be at least 300 percent of recloser rating. Use of current transformer may be required.
4. *Cycle counter or other timing device.*
5. *High-voltage transformer T1*—Used to operate high-voltage closing solenoid. In general, a 50-kva transformer having an impedance of about three percent will be satisfactory if the source impedance is reasonably low. Low-side rating should equal voltage of available test source. High side should equal voltage of recloser's closing solenoid. Be sure minimum allowable voltage shown in table below is maintained at recloser terminals during the two- to three-cycle interval the closing solenoid is energized.

Closing Solenoid Rating (kv)	Closing Solenoid Code Number	Minimum Allowable Voltage at Recloser When Solenoid is Energized—(volts)
50-Hertz		
6.0	51	5100
11.0	52	9350
13.2	53	11220
14.4	54	12240
60-Hertz		
2.4	21	2040
4.16–4.8	22	3540
6.0	31	5100
12.0–13.2	30	10200
14.4	27	12240

TEST PROCEDURE—ELECTRICAL CLOSING

Assemble and connect the equipment as shown in Figure 16.

WARNING

Solidly ground leads X and Z and interconnect to the recloser tank. DO NOT connect leads W and Y to the SAME PHASE. Dangerous voltages to ground exist on the phase connected to Y.

Operation of Closing Solenoid

1. Trip the recloser manually by moving manual operating (yellow) handle down to LOCKOUT position, then move the yellow handle up to its CLOSED position.
2. Energize the high-voltage transformer T1. The recloser should close immediately, indicating correct operation of the closing solenoid.

WARNING

Solidly ground leads X and Z and interconnect to the recloser tank. DO NOT connect leads W and Y to the SAME PHASE. Dangerous voltages to ground exist on the phase connected to Y.

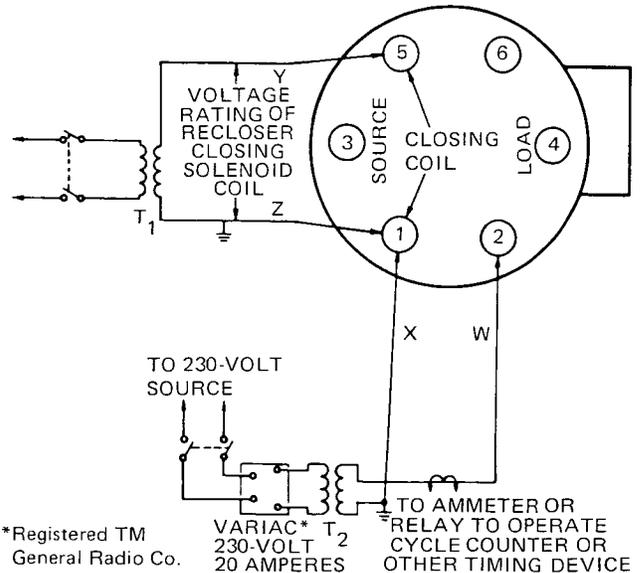


Figure 16

Suggested test set up for low-voltage a-c tripping and high-voltage closing. Be sure to check PRECAUTIONS on page 11.

Minimum-Trip Current

PHASE A (Bushings 1 and 2)—Connect leads X and W from low-voltage transformer T2 to bushing terminals 1 and 2 respectively, and proceed as follows:

1. With manual operating handle in its CLOSED position, energize high-voltage transformer T1 to close the recloser.
2. De-energize transformer T1.
3. Energize the Variac and slowly raise the voltage from zero, noting the ammeter reading.
4. As the trip-solenoid plunger starts to move, the trip-solenoid impedance will rise causing a decrease in current. The *maximum* ammeter reading before the current decreases is the *minimum-trip current*.

PHASE B (Bushings 3 and 4)—Connect leads X and W from low-voltage transformer T2 to bushing terminals 3 and 4 respectively, and repeat Steps 1, 2, 3 and 4 above.

PHASE C (Bushings 5 and 6)—Before applying any voltage to Phase C reverse the high-voltage transformer leads; connect grounded lead Z to Bushing 5 and hot lead Y to Bushing 1. Then connect the low-voltage transformer test leads X and W to Bushings 5 and 6 respectively, and repeat Steps 1, 2, 3 and 4 above.

Fast Operations, Reclosing Time, Operations to Lockout

With the test circuit connected as shown in Figure 16, proceed as follows:

1. Move the yellow manual operating handle to its CLOSED position and energize the high-voltage transformer T1 to close the recloser. Leave T1 energized.
2. Set the Variac high enough to cause the recloser to trip readily (suggest 300 percent of series trip solenoid current rating).
3. Energize the low-voltage transformer T2. The recloser should trip, reclose, and continue tripping and reclosing through its programmed sequence to lockout.
4. Observe the following:
 - A. Count the number of fast operations by watching the contact position indicator on the sleet hood.
 - B. Read reclosing time from the timing device arranged to record the period during which the current is not flowing.
 - C. Count the number of operations to lockout by counting the trip operations until the yellow handle drops.

IMPORTANT: When repeating tests, be sure to allow enough time for the lockout integrator piston to reset. Time required is 1- to 1.5-minutes per recloser trip operation.

Operation of Non-Reclosing Feature

While testing on any phase as described above, the non-reclosing feature also can be verified.

1. Pull down the non-reclosing lever.
2. Repeat test steps 1, 2 and 3 above.
3. The recloser should not reclose after the first trip and the yellow handle should drop indicating recloser lockout.

TEST PROCEDURE—MANUAL CLOSING

When manual closing is employed, instead of electrical closing, the high-voltage transformer and its associated equipment, wiring and precautions are eliminated since there are no high voltages involved.

Refer to instructions covering *manual closing of a de-energized recloser* for closing procedure when using the manual closing tool. The best procedure is to have one man operate the closing tool while another regulates the tripping circuit and observes test results.

IMPORTANT: After each recloser trip, about two seconds elapse (reclosing time) while the closing-solenoid plunger is moving upward. Near the end of this time period two metallic clicks will be heard. The first is the main toggle latch resetting; the second is the closing-solenoid contactor closing. As soon as these clicks are heard, the closing tool can be turned to close the recloser.

Minimum-Trip Current

PHASE A (Bushings 1 and 2)—Connect leads X and W from low-voltage transformer T2 to bushing terminals 1 and 2 respectively, and proceed as follows:

1. With manual operating handle in its CLOSED position, manually close the recloser.
2. Energize the Variac and slowly raise the voltage from zero, noting the ammeter reading.
3. As the trip-solenoid plunger starts to move, the trip solenoid impedance will rise causing a decrease in current. The *maximum* ammeter reading before the current decreases is the *minimum-trip current*.

PHASE B (Bushings 3 and 4)—Connect leads X and W from low-voltage transformer T2 to bushing terminals 3 and 4 respectively, and repeat Steps 1, 2 and 3 above.

PHASE C (Bushings 5 and 6)—Connect leads X and W from low-voltage transformer T2 to bushing terminals 5 and 6 respectively, and repeat Steps 1, 2 and 3 above.

Fast Trip Operations, and Operations to Lockout

To check the number of fast operations on Phase A, connect leads X and W on low-voltage transformer T2 to bushing terminals 1 and 2 respectively, and proceed as follows:

1. Move the yellow manual operating handle to its CLOSED position and manually close the recloser.
2. Set the Variac high enough to cause the recloser to trip readily (suggest 300 percent of series trip solenoid current rating).
3. Energize the low-voltage transformer T2. The recloser should trip.
4. *Immediately* after hearing the two clicks, close the recloser manually for the next trip operation (see **IMPORTANT** note under **TEST PROCEDURE—MANUAL CLOSING**).

When employing manual closing in the operations counting tests, always close and trip the recloser without appreciable delay. Otherwise extra fast trip operations to lockout may occur due to partial resetting of the sequence and lockout pistons.

5. Observe the number of fast trip operations, and the number of operations to lockout. When lockout is reached, the yellow manual operating handle will drop down and the manual closing mechanism will become inoperative.

TEST PROCEDURE—GROUND TRIP OPERATION

With recloser de-energized, operation of the ground fault sensing circuits and accessory mechanism can be checked by having current in excess of the ground minimum trip level flowing through one phase of a closed recloser. A low-voltage a-c source such as was used to check phase minimum trip should be adequate, assuming that ground minimum trip is lower than phase.

Ground Minimum Trip Current

Connect leads X and W on low-voltage transformer T2 to one pair of bushing terminals (1 and 2, 3 and 4, or 5 and 6) and proceed as follows:

1. Move the ground trip disabling switch to its closed (up) position.
2. Move the yellow manual operating handle to its closed position and manually close the recloser.
3. Energize the Variac and slowly raise the voltage from zero, noting the ammeter reading when the recloser trips.

Fast-Trip, Slow-Trip Sequence (Accessory)

When the ground trip dual timing accessory is furnished, its sequence can be checked as follows:

1. With ground-trip disabling handle and yellow handle up, manually close the recloser.
2. Set the Variac high enough to cause ground trip, but not so high as to have current in excess of the phase minimum trip level.

NOTE: Test current should be sufficiently above the ground minimum trip level so that line fluctuations will not cause it to fall below the ground minimum trip level for more than one cycle, as this causes the timing period to start over.

3. Energize the low-voltage transformer T2. The recloser should trip.
4. Immediately after hearing the two clicks (as described under TEST PROCEDURE—MANUAL CLOSING) close the recloser manually for the next trip operation.

When employing manual closing in the ground-trip operations-counting tests, always close and trip the recloser without appreciable delay. Otherwise extra ground-trip operations may occur due to partial resetting of the lockout piston.

5. Observe the number of fast ground-trip operations, the number of slower ground-trip operations, and the number of ground-trip operations to lockout. When lockout is reached, the yellow manual operating handle will drop down and the manual closing mechanism will become inoperative.

RADIATION INFORMATION



It is possible for X-radiation to result when voltage in excess of the 15.5-kv rated maximum voltage is applied across the open-contact gap of a KF vacuum interrupter. Such radiation can become a health hazard on long exposure at close range. When performing high-voltage tests on KF vacuum reclosers, personnel safety can be insured by noting the following information and taking the necessary precautions.

1. American National Standard C37.09-1964 “A-C High Voltage Circuit Breakers” allows tests after delivery which include application of 75 percent of rated low-frequency withstand voltage across open contacts of the interrupters. This voltage for KF reclosers is 37.5 kv ac rms (1 min. dry) or 53 kv dc (1 min. dry).

NOTE: To prevent possible interrupter damage, dc test source should be limited to 100 milliamps maximum.

2. At these voltages, radiation is negligible when interrupters are mounted in the KF recloser operating structure, installed in the oil-filled recloser tank, and have contacts open to the recommended 3/8-inch open-contact gap.
3. Testing at voltages higher than those listed in Item 1 may cause radiation emission injurious to personnel. If testing is to be performed at voltages above those listed in Item 1, additional radiation shielding is required.
4. Vacuum interrupter testing above 50 kv ac rms is not recommended.

CHECK OF VACUUM INTERRUPTERS

The following procedure can be used in routine verification tests of vacuum interrupters in new KF reclosers.

1. With the yellow handle, open the recloser contacts to their 3/8-inch recommended contact gap. This can be checked by observing the travel, from closed to open, of the contact erosion groove on the interrupter’s moving-contact shaft.
2. Retank the recloser in its oil-filled tank.
3. Perform a hi-pot test across the open vacuum interrupter contacts on each phase, at 37.5 kv rms ac or 53 kv dc.

NOTE: To prevent possible interrupter damage, dc test source should be limited to 100 milliamps maximum.

4. The interrupters should withstand the test voltage for one minute and should not load down the source.

ACCESSORIES

The Type KF recloser may be provided with a number of factory installed accessories which enable it to fill a variety of application requirements.

Operation and testing information for the Ground (Earth) Fault Tripping accessories (KRK514FA single timing and KRK514FB dual timing) and the Ground Trip Disabling Switch accessory (KRK333FA) has been integrated with the recloser operation and testing information found earlier in this manual.

Connection or operating instructions on the remaining KF recloser accessories, when required, are found in the following sections.

BUSHING MOUNTED MULTI-RATIO CURRENT TRANSFORMERS

Bushing Current Transformers have only one primary turn—the bushing rod that carries current from the bushing terminals to the recloser’s interrupters. Different ratios are obtained by connecting to a tapped secondary winding.

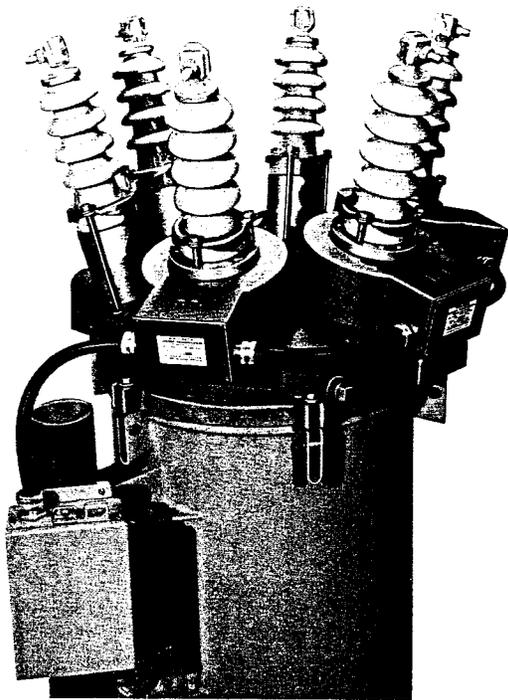


Figure 17

Bushing Current Transformers wired to a junction box.

Terminals of the secondary winding taps are in the transformer housing. The connected ratio can be changed in the field to any of those tabulated.

Transformer Ratios and Accuracies

Ratio	Relay Accuracy Class	Metering Accuracy Class		
		.3B-0.5	.6B-1.0	1.2B-2.0
600:5	C100	.3B-0.5	.6B-1.0	1.2B-2.0
500:5	C100	.3B-0.5	.6B-1.0	1.2B-2.0
400:5	C50	.3B-0.2	.6B-0.5	1.2B-2.0
300:5	C50	.3B-0.2	.6B-0.5	1.2B-2.0
200:5	—	—	.6B-0.2	1.2B-0.5
100:5	—	—	—	—

Connections

Customer connections to the secondary taps are made in the bushing current transformer junction box as shown in Figure 18.

Figure 19 shows the BCT terminal block “as shipped” and “in service”. Note that in the “as shipped” condition, the 1, 3, and 5 terminals are each short-circuited to the grounding bar with a thumbscrew. After external connections are made, the three thumbscrews are removed and stored in the corners of the terminal block. The round-head machine screw remains in the COM terminal position.

THUMBSCREWS SHORT CIRCUIT TERMINALS 1, 3, AND 5 UNTIL SECONDARY CONNECTIONS ARE MADE

THUMBSCREWS STORED IN CORNERS OF BLOCK AFTER SECONDARY CONNECTIONS ARE MADE

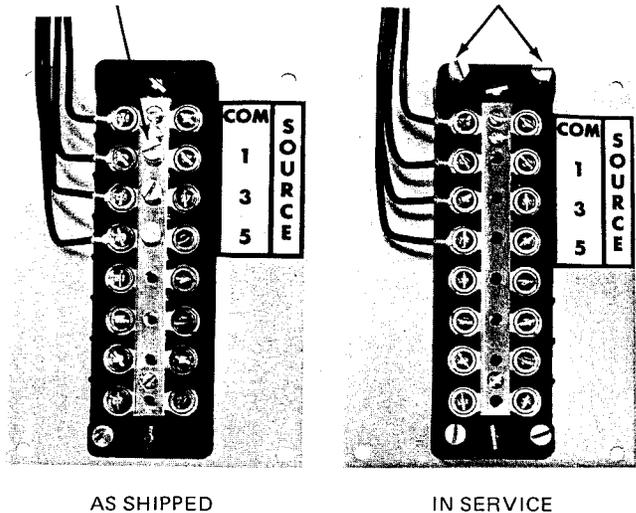


Figure 19

Position of shorting thumbscrews in BCT terminal block.

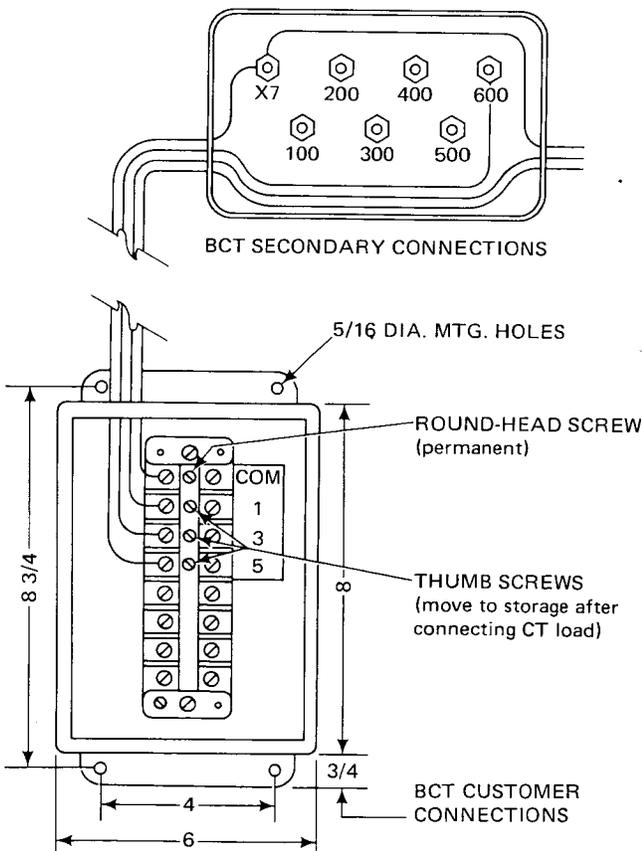


Figure 18

BCT secondary tap wired to junction box for customer connections.

ACCESSORY-CONNECTION JUNCTION BOX

Customer connections to the Auxiliary Switch, Lockout Indicating Switch, Shunt Trip, Shunt Lockout, and Low-Voltage Closing accessories are made in the Accessory-Connection Junction Box. Consequently, this Junction-Box accessory (KRK433FA or B) must be specified whenever any of the above accessories are required.

The KRK433FA Junction Box, which is used with the above accessories, includes terminal strips for customer connections and a six-foot long cable to interconnect junction box and recloser. When the Shunt Close accessory is included along with any of the above accessories, the KRK433FB Junction Box is used which includes an additional cable for connecting the junction box to the Shunt Close accessory.

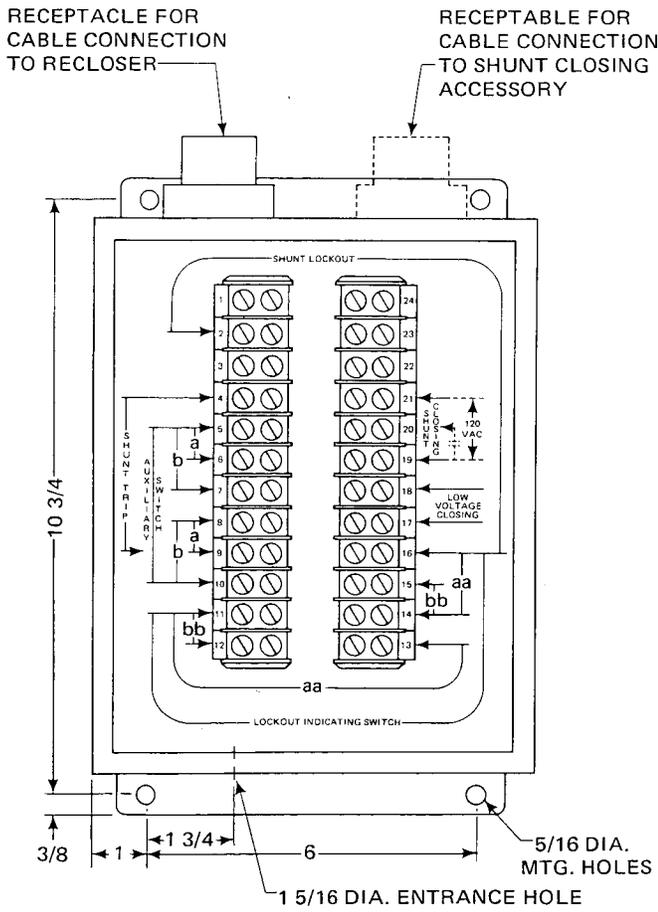


Figure 20

Accessory Junction Box with customer connection terminals identified.

AUXILIARY SWITCH

Remote indication of recloser contact position can be accomplished with the Auxiliary Switch accessory. The contacts of the auxiliary switch also can be used to switch other circuits in accordance with the opening and closing of the recloser contacts.

A two stage switch is provided (see NOTE) each containing one independent set of contacts—'a' and 'b'. When the recloser contacts are open, the 'a' contacts are also open and the 'b' contacts are closed. How auxiliary switch and recloser contacts are related is tabulated below. The contacts cannot be changed.

When recloser contacts are	open	closed
Auxiliary 'a' contacts are	open	closed
Auxiliary 'b' contacts are	closed	open

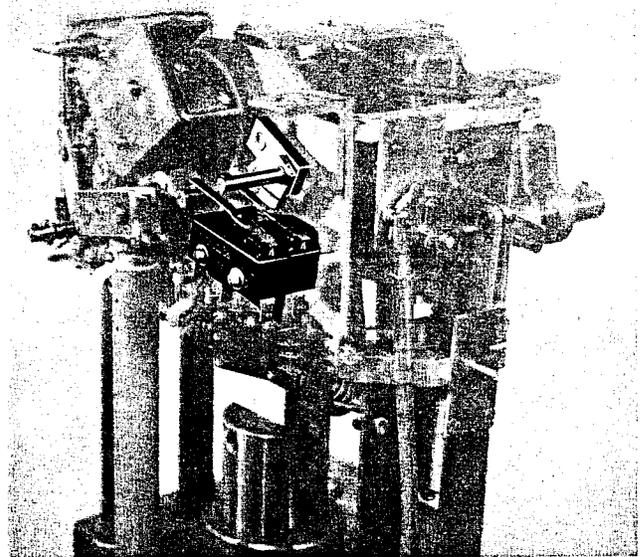


Figure 21

Auxiliary Switch mounted on side of recloser mechanism frame.

Interrupting Ratings of Auxiliary Switch

Volts	Current (amps)
120 ac	15
240 ac	15
24 dc	2
48 dc	3/4
125 dc	1/2
250 dc	1/4

Connections

Customer connections to auxiliary switch contacts are made at terminals 5 through 10 in the accessory junction box, as shown in Figure 22.

NOTE: When the Shunt Trip accessory is included on the recloser, one stage of the Auxiliary Switch accessory (terminals 8, 9 and 10 in the junction box) is used to switch the Shunt Trip accessory. The second Auxiliary Switch stage (terminals 5, 6 and 7) is available for customer use.

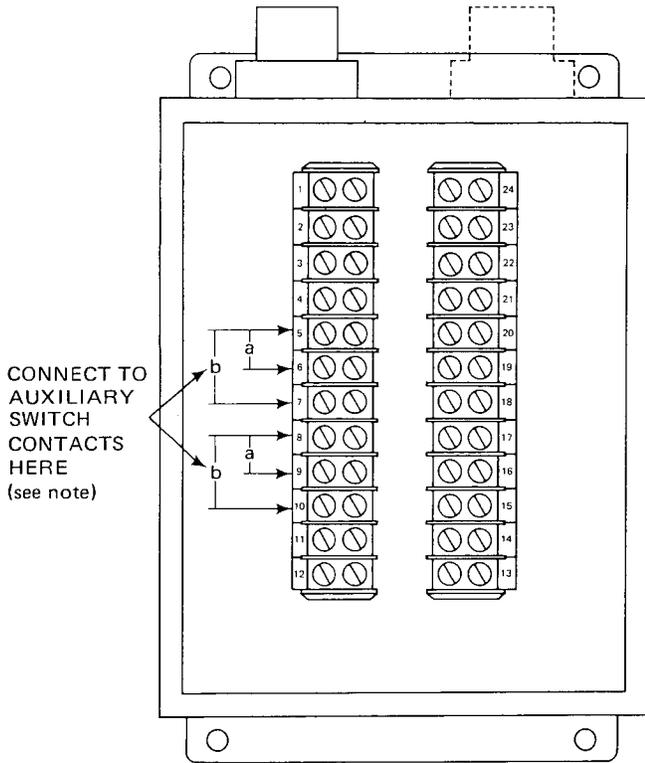


Figure 22
Auxiliary Switch connections.

LOCKOUT INDICATING SWITCH

Remote indication of recloser lockout can be accomplished with the Lockout Indicating Switch accessory. The contacts of the Lockout Indicating Switch also can be used to switch other circuits based on whether or not the recloser is locked out.

A two stage switch is provided (see NOTE) each containing one independent set of contacts—'aa' and 'bb'. When the recloser is locked out, the 'bb' contacts are closed and 'aa' contacts open. See tabulation below for relationship of recloser and indicating switch contacts. The contacts cannot be changed.

When recloser is	locked out	not locked out
Indicating switch 'aa' contacts are	open	closed
Indicating switch 'bb' contacts are	closed	open

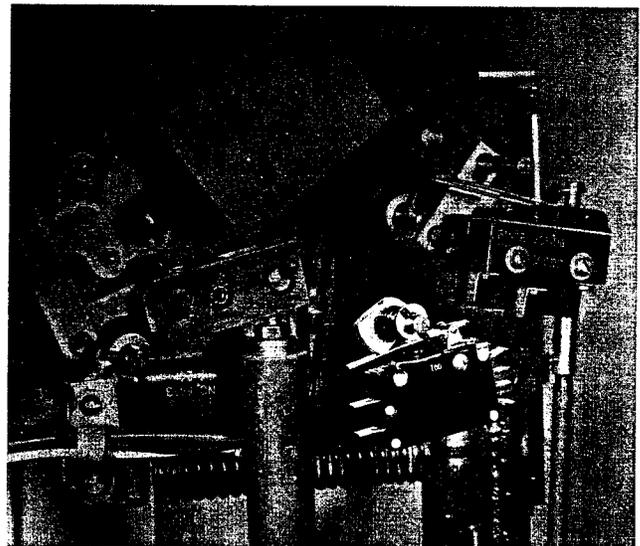


Figure 23
Lockout Indicating Switch mounted on side of recloser mechanism.

Interrupting Ratings of Lockout Indicating Switch

Volts	Current (amps)
120 ac	15
240 ac	15
24 dc	2
48 dc	3/4
125 dc	1/2
250 dc	1/4

Connections

Customer connections to lockout indicating switch contacts are made at terminals 11 through 16 in the accessory junction box as shown in Figure 24.

NOTE: When the Shunt Lockout accessory is included on the recloser, one stage of the Lockout Indicating Switch accessory (terminals 14, 15 and 16 in the junction box) is used to switch the Shunt Lockout accessory. The second Lockout Indicating Switch stage (terminals 11, 12 and 13) is available for customer use.

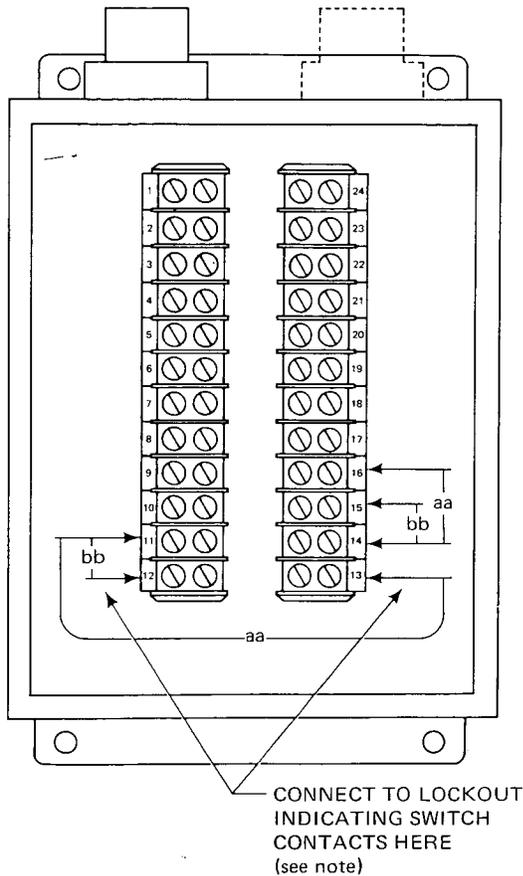


Figure 24
Lockout Indicating Switch connections.

SHUNT TRIP ACCESSORY

The Shunt Trip accessory will cause a recloser trip operation when it is energized by an external control circuit. Automatic reclosing will occur, and the number of operations to lockout will be the same as when the series trip solenoids operate. The Shunt Trip accessory cannot be used on reclosers that include the Ground (Earth) Fault Tripping accessory.

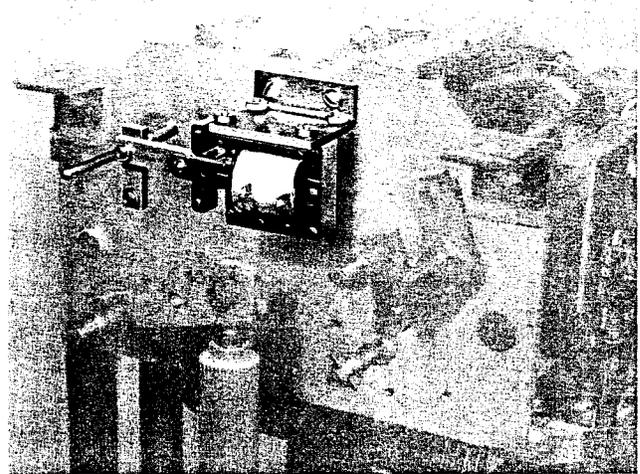


Figure 25
Shunt Trip accessory mounted on side of recloser mechanism.

Shunt Trip Accessory Ratings

Catalog Number	Rated Voltage	Current Required (amps)
KRK410FA	24 ac	7.0
	24 dc	2.0
KRK410FB	48 ac	3.5
	48 dc	1.0
KRK410FC	120 ac	1.8
	125 dc	.5
KRK410FD	240 ac	.9
	250 dc	.25

Total time to open recloser contacts using the Shunt Trip accessory is 0.033 seconds (or 2 cycles on a 60-Hz basis).

A two-stage auxiliary switch is provided as part of the Shunt Trip accessory. One stage is employed in the switching of the Shunt Trip accessory; the second stage—to which connections are made at terminals 5, 6 and 7 in the accessory junction box—is available for customer use. Operation and ratings of the auxiliary switch are the same as described earlier for the Auxiliary Switch accessory.

Connections

Customer connections to the Shunt Trip accessory are made at terminals 4 and 9 in the accessory junction box as shown in Figure 26.

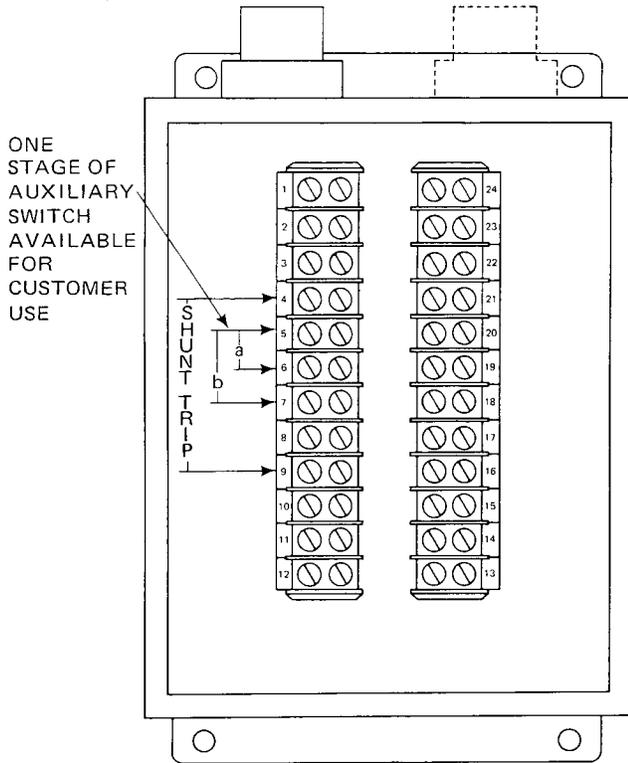


Figure 26

Connections for Shunt Trip accessory and available stage of Auxiliary Switch.

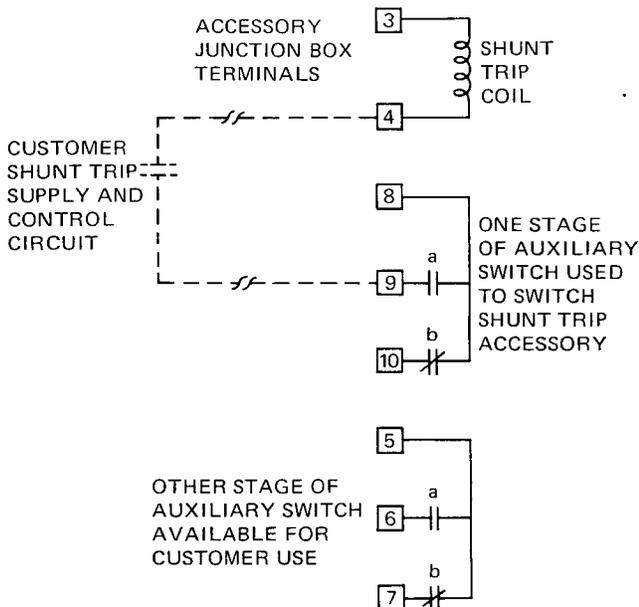


Figure 27

Schematic of Shunt Trip accessory connected through auxiliary switch "a" contact.

SHUNT LOCKOUT ACCESSORY

When energized through an external control circuit, the Shunt Lockout accessory will cause the recloser to trip and its mechanism to lockout. The recloser's yellow manual operating handle will drop to its lockout position, providing a visual indication that the recloser is locked out.

Closing from lockout can be accomplished manually by moving the yellow handle up to its closed position, or remotely with the Shunt Closing accessory.

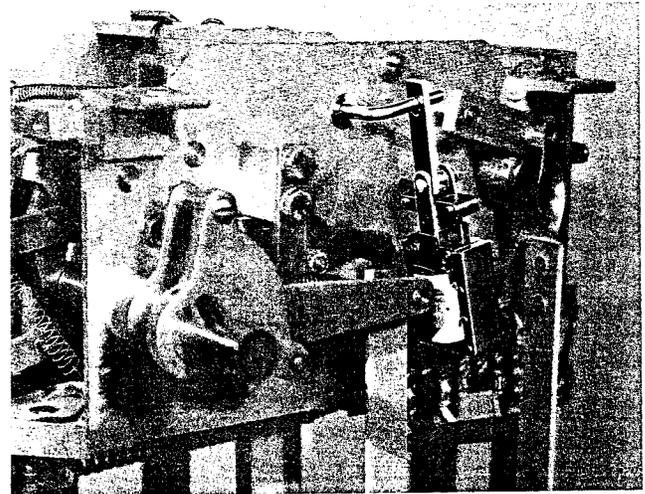


Figure 28

Shunt Lockout accessory mounted on side of recloser mechanism.

Shunt Lockout Accessory Ratings

Catalog Number	Rated Voltage	Current Required (amps)
KRK409FA	24 ac	7.0
	24 dc	2.0
KRK409FB	48 ac	3.5
	48 dc	1.0
KRK409FC	120 ac	1.8
	125 dc	.5
KRK409FD	240 ac	.9
	250 dc	.25

Time to open recloser contacts and lockout the mechanism using the Shunt Lockout accessory is 0.05 seconds (or 3 cycles on a 60-Hz basis).

A two-stage lockout indicating switch is provided as part of the Shunt Lockout accessory. One stage is employed in the switching of the Shunt Lockout accessory; the second stage—to which connections are made at terminals 11, 12 and 13 in the Junction Box accessory—is available for customer use. Operation and ratings of the lockout indicating switch are the same as described earlier for the Lockout Indicating Switch accessory.

Connections

Customer connections to the Shunt Lockout accessory are made at terminals 2 and 16 in the accessory junction box as shown in Figure 29.

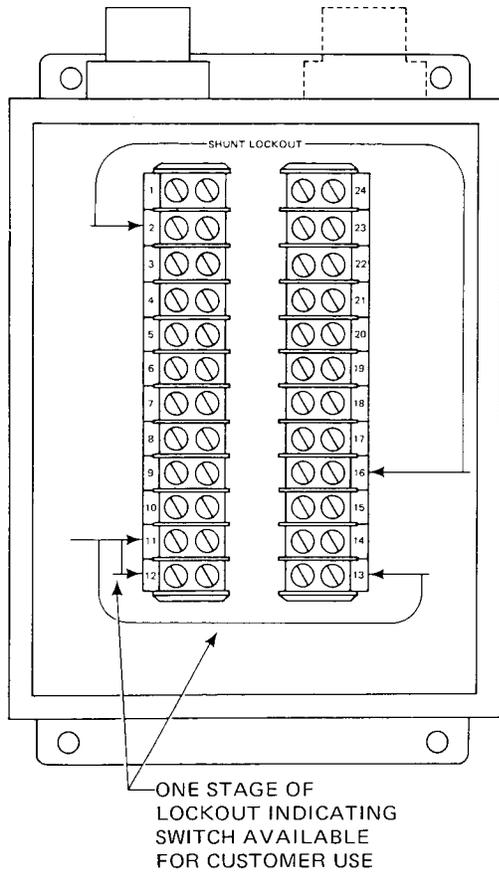


Figure 29

Connections for Shunt Lockout accessory and available stage of Lockout Indicating Switch.

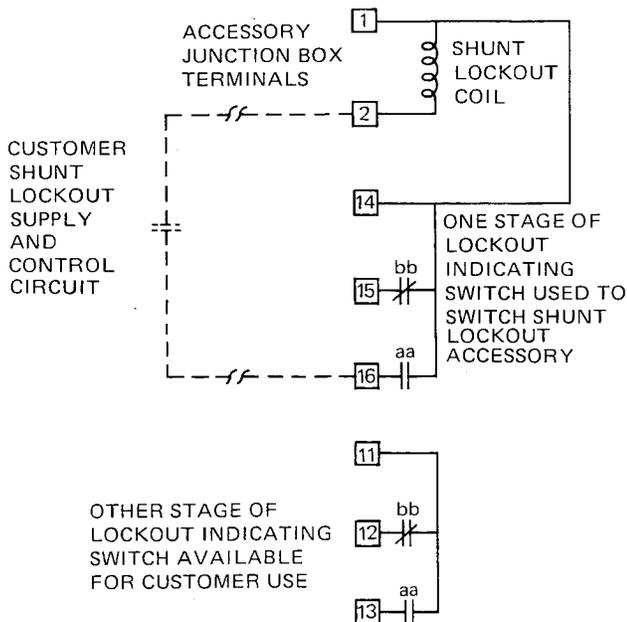


Figure 30

Schematic of Shunt Lockout accessory connected through one stage of the Lockout Indicating Switch accessory.

SHUNT CLOSE ACCESSORY

When energized through an external control circuit, the Shunt Close accessory initiates a closing operation by moving the recloser's yellow manual operating handle to its CLOSE position. This actuates the high-voltage closing solenoid contactor to energize the solenoid and close the recloser.

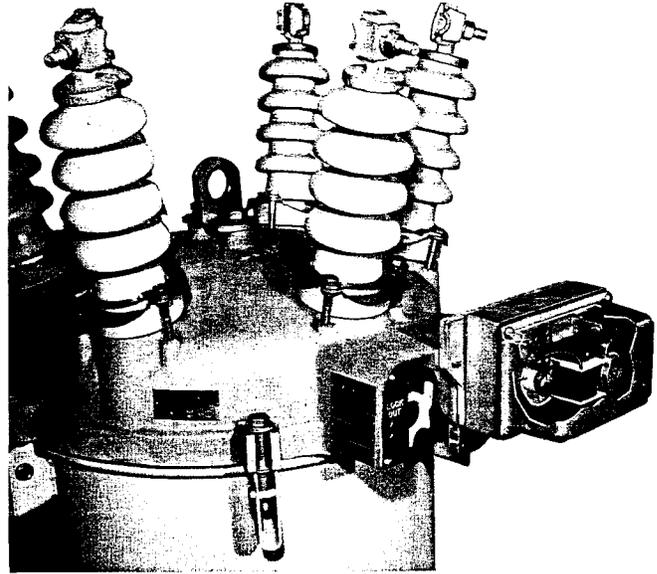


Figure 31

Shunt Close accessory mounted on recloser sleet hood.

Electrical ratings of the Shunt Close accessory are voltage—120 vac; current—1.25 amps inrush and 0.5 amp steady state; operating time—2 seconds.

Connections

The external control circuit for the Shunt Close accessory requires a three-wire connection including a normally-open momentary contact.

When the contact is closed, a relay is energized which closes the circuit to the accessory motor. On completion of the closing operation, switches restore the accessory circuits to normal.

When the Shunt Close accessory is on a KF recloser that also includes one or more of the following accessories

- Auxiliary Switch
- Lockout Indicating Switch
- Shunt Trip
- Shunt Lockout
- Low-Voltage AC Closing

external control circuit connections are made to terminals 19, 20 and 21 in the accessory junction box as shown in Figure 32.

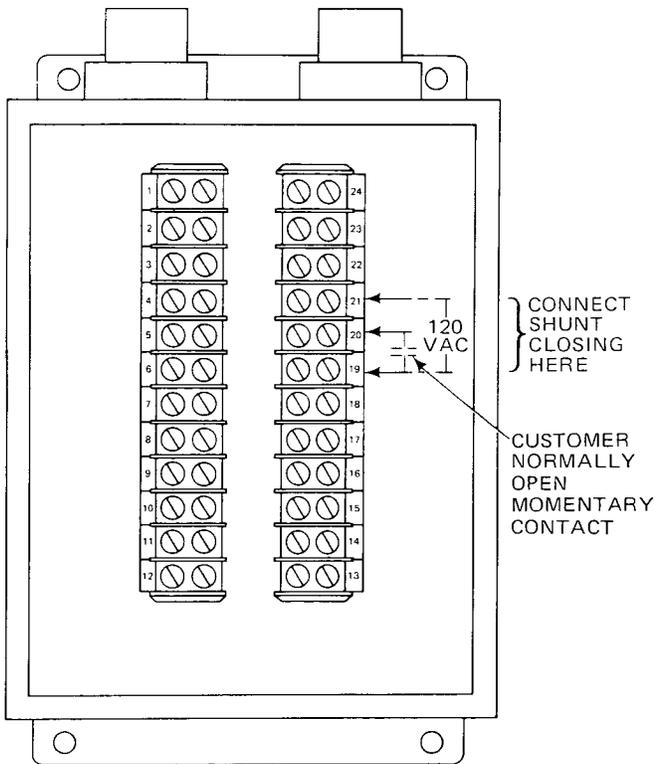


Figure 32

Connections for Shunt Close accessory when accessory junction box is furnished.

When none of above listed accessories are included on the recloser, the accessory junction box is not required and connections for the Shunt Close accessory are made in the accessory housing as shown in Figure 33.

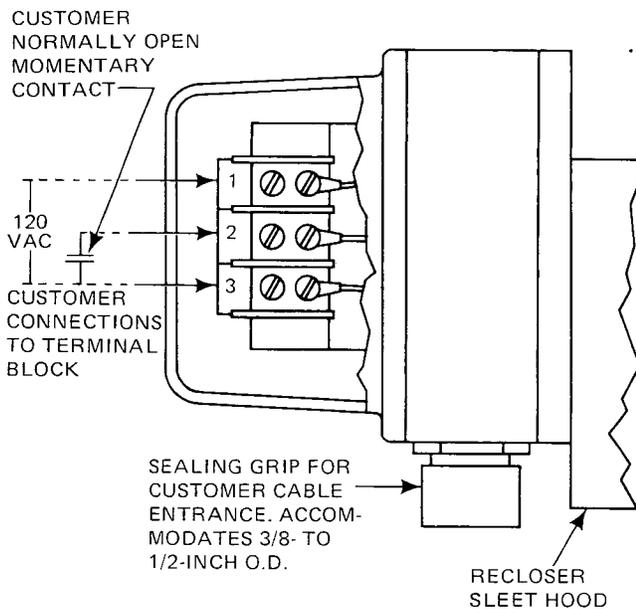


Figure 33

Connections for Shunt Close accessory when accessory junction box is not furnished.

LOW-VOLTAGE CLOSING

When the proper closing coil is specified and a Low-Voltage Closing accessory is included, the KF recloser can employ low-voltage a-c or d-c power for closing. The proper coil is specified by code number in the recloser catalog number; the Low-Voltage Closing Accessory provides the alternate closing-solenoid contactor and the factory-installed wiring required to accommodate the low-voltage closing power.

Low-Voltage Closing Accessory Ratings

Catalog Number	Rated Voltage	Current Required (amps)	Operating Time (60 Hz basis)
KRK413FA	120 ac	40	5 cycles
KRK413FB	240 ac	25	5 cycles
KRK413FC	125 dc	40	5 cycles
KRK413FD	250 dc	25	5 cycles

Connections

Connect low-voltage closing power supply to terminals 17 and 18 in the accessory junction box as shown in Figure 34.

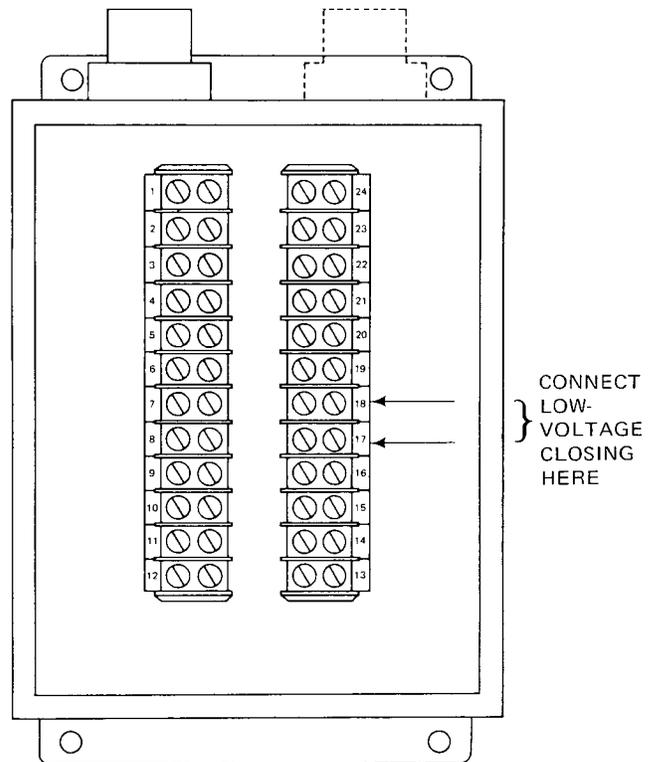


Figure 34

Low-Voltage Closing connections.



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