INSTRUCTIONS

GEK-65519C

RECLOSING RELAY

TYPES

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RECLOSING RELAY

TYPES

ACR11E
ACR11F

DESCRIPTION

The Type ACR11E relay is a reclosing relay which automatically initiates reclosing impulses to a circuit breaker which has been tripped by a protective relay. It is essentially a timing device, consisting of a dual rated synchronous motor which drives a gear train and cam shaft with reset spring by means of a crown gear clutch with an electrically operated clutch release. The relay includes a group of cam-operated switches, an auxiliary unit and a two-position interlocking unit.

The cams can be arranged to provide for an immediate initial reclosure followed by up to three delayed reclosures, or for a delayed initial reclosure followed by one or two additional delayed reclosures. The reclosing relay resets automatically a short interval after any successful reclosure, or from its lock-out position following a successful manual reclosure. Other reclosing cycles are also possible as described under ADJUSTMENTS.

The ACR11F relay is similar in construction to the ACR11E except that all of the adjustable cams are single ended. The omission of the double ended cams eliminates the definite time automatic reset feature after any successful reclosure. If any of the automatic reclosures is successful, or if a manual reclosure after lockout is successful, reset is accomplished by the fixed flat-ended pawl at the end of the cycle. The roller actuated switches "DE", "GH-HI" and "JK" are set as outlined in the text for the ACR11E. The "RS" switch setting is made as required in the particular application. The internal connection diagram is the same for both the ACR11E and ACR11F relays and is shown in Fig. 5.

APPLICATION

The Type ACR reclosing relay is suitable for application whenever it is desired to automatically reclose a circuit breaker one or more times after it has been tripped by its protective relay. When immediate initial reclosing is used, the circuit breaker mechanism should be provided with a position switch or latch-checking switch to insure that the mechanism is ready to close the breaker before the closing coil is energized; and the protective relay contacts must reopen fast enough to prevent retripping of the circuit breaker following immediate reclosure.

A DC stepping relay Type NLA is available to provide an alarm after a specified number of reclosures and a lockout after a specified number of subsequent reclosures.

More specific information relative to application is given in the section entitled APPLICATION CONSIDERATIONS.

CONSTRUCTION

The case is suitable for either surface or semi-flush panel mounting and an assortment of hardware is provided for either mounting, see Fig. 13. The cover attaches to the case and also carries the reset mechanism when one is required. Each cover screw has provision for a sealing wire.

The case has studs or screw connections at both ends for the external connections. The electrical connections between the relay units and the case studs are made through spring-backed contact fingers mounted in stationary molded inner and outer blocks between which nests a removable connecting plug which completes the circuits. The outer blocks, attached to the case, have the studs for the external connections, and the inner blocks have the terminal for the internal connections.

The relay mechanism is mounted in a steel framework called the cradle and is a complete unit with all leads being terminated at the inner block. This cradle is held firmly in the case with a latch at the top and the bottom and by a guide pin at the back of the case. The cases and cradles are so constructed that the relay cannot be inserted in the case upside down. The connecting plug, besides making the electrical connections between the respective blocks of the cradle and case, also locks the latch in place. The cover, which is fastened to the case by thumbscrews, holds the connecting plug in place.

To draw out the relay unit, the cover is first removed, and the plugs drawn out. The latches are then released, and the relay unit can be easily drawn out. To replace the relay unit, the reverse order is followed.

A separate testing plug can be inserted in place of the connecting plug to test the relay in place on the panel either from its normal source of power or from other sources. Or, the relay unit can be withdrawn for testing and replaced by a spare relay unit.

RATINGS

The driving motor of the Type ACR11 relay is available for operation on AC only, and is dual rated continuously at the voltage and frequency indicated on the nameplate.

The auxiliary units (interlocking unit 179E, anti-pump unit 179Z, and clutch release unit 179R) can be furnished for use on either AC or DC control supplies. The interlocking and clutch release units are suitable for intermittent duty only, but the anti-pump unit is continuously rated at the voltage and frequency indicated on the nameplate.

CONTACTS

The cam operated switch contacts will make, carry and interrupt the following currents.

VOLTS	INDUCTIVE		NON-INDUCTIVE	
	ABC - GHI	RS	ABC - GHI	RS
24 DC	6	2.4	10	3
48 DC	1	0.6	1.5	0.7
125 DC	0.2	0.2	0.2	0.2
250 DC	0.1	0.1	0.1	0.1

All cam operated switches will carry 30 amps for tripping duty.

The contacts of the anti-pump unit 179Z and the interlocking unit 179E will make up to 10 amperes and will carry 1.0 ampere continuously. Its contact interruption rating is shown in the following tabulation:

VOLTS	INDUCTIVE	NON-INDUCTIVE
250 DC	0.10A	0.20A
125 DC	0.30A	0.75A
48 DC	1.20A	3.50A
230 AC	1.0 A	2.0 A
115 AC	2.0 A	4.0 A

BURDENS

The burden of the Type ACR driving motor is approximately five volt-amperes, 3.5 watts at rated voltage for either 50 or 60 cycles.

The burden of the continuously rated anti-pump unit 179Z is tabulated below for various voltages.

VOLTS	FREQ.	V-A	WATTS
*250	DC	--	8.6
125	DC	--	4.8
48	DC	--	4.6
240	60	13.5	8
120	60	13.5	8

*Includes series resistor.

The interlocking unit 179E and clutch release unit 179R, during normal operation of the relay, are only momentarily energized. The approximate burdens of the two units are shown below:

	DC	60 Cycles
179E	31 Watts	165 V-A
179R	48 Watts	240 V-A

CHARACTERISTICS

TOTAL TIME

The Type ACR relay is available with a total cycle of three minutes. This total time cycle is measured from the point where the motor starts, to the point following lockout where the relay will again reset.

GENERAL

The basic operating principles of the Type ACR reclosing relay will be explained with the aid of the schematic mechanical diagram shown in Fig. 6. Note that this diagram shows the components in neither their exact relative positions, nor to scale.

Also included in the Type ACR relay, but not shown in Fig. 6, are a two-position interlocking unit 179E and a telephone type auxiliary relay 179Z. The 179Z unit is used as an anti-pump unit.

The 179E unit (shown in Figs. 2 and 3) is a specially constructed interlocking relay. The assembly consists of two telephone type relays called "operate" and "reset" mounted side-by-side. The armatures of these two relays are mechanically interlocked by a latching arrangement located between the two relays. This interlock holds the relay in either the "operate" or "reset" position depending upon which unit was energized last. The electrical connections are such that as one of the units is energized its coil circuit is interrupted by the contacts on the adjacent unit by the action of the interlock. At the same time, the circuit for the other unit is set up by the contacts of the unit that operated.

Driving torque is transmitted from the synchronous motor through a crown-gear clutch consisting of a driving member pinned to the motor shaft, and an idler member. The idler member, which includes a star cam and a pinion, is free to slide back and forth on the motor shaft and is normally held in engagement with the stationary member by a compression spring which is a part of the clutch release seal-in switch. This compression spring acts to hold the clutch release armature in a position which forces the idler member against the stationary member of the clutch. The pinion on the idler member drives gear "A", which is pinned to the auxiliary cam shaft, causing a windup of the reset spring. The auxiliary cam shaft, which turns through slightly less than 360 degrees during a complete operating cycle of the reclosing relay, carries depressions in its body which operate the roller-actuated, snap-action switches "GH-HI", "DE", and "JK", performing auxiliary functions which will be described later. The auxiliary shaft also carries an adjustable cam segment which can be set to operate switch "RS" at any desired point in the reclosing cycle.

The front dial hub is, in turn, driven through the gear pair, "B" and "C", and makes slightly less than a half revolution during a complete operating cycle of the reclosing relay. The dial hub carries a set of adjustable cams, "D" and "E". These cams consist of round, flat plates with either two diametrically opposite projections in the case of "D" or a single projection in the case of "E". There are three single ended "E" cams. One of these cams is normally set to hold the "AB-BC" switch in the closed position, for the purpose of setting up the circuit for immediate initial reclosure. The other two are set

back-to-back, providing in effect a single cam projection which is used to operate the "MN" switch, following the immediate reclosure. This latter setting determines the time interval between the immediate initial reclosure and the resetting of the relay, if reclosure is successful, as will be described later in more detail. The double-ended cams "D", also three in number, are used to initiate delay reclosures and to reset the relay following successful delayed reclosures. One end of the cam operates switch "AB-BC", initiating a delayed reclosure. The other end of the same cam operates switch "MN" a short interval later, causing the relay to reset if the reclosure is successful. The interval between a delayed reclosure and reset is determined by the location of switch "MN" in relation to the reclosing switch "AB-BC", and thus will be the same for all delayed reclosures.

A third type of cam, designated as "F", is keyed in position on the dial hub. Its function is to operate switch "MN" and initiate reset of the relay after a manual reclosure of the breaker, with the relay in its locked-out position.

Resetting of the relay is accomplished by energizing the coil of the clutch-release unit 179R, which attracts the release armature and draws the idler member of the clutch away from the fixed driving member. This permits the gear train, cam shaft and dial hub to return to the reset position under the influence of the charged reset spring. During the reset cycle the escapement follower retards the motion of the star cam, reducing the reset speed to a point where there will be no rebound when the reset position is reached. The clutch release unit is equipped with a seal-in contact to shunt the reset contact "MN" during the reset cycle. A manual release rod is provided to permit releasing the clutch from the front of the relay so that the gear train can be turned by hand.

OPERATION

The functions of the various components described above are illustrated by Fig. 7 which shows the external connections of a typical circuit utilizing the Type ACR reclosing relays. The diagram shows the connections for an immediate initial reclosure followed by one or more delayed reclosures. All contacts in the reclosing relay, identified by the device function number 179, are shown in the position they assume with the relay in its reset position.

When the relay is connected for immediate initial reclosure, it is essential that, with the relay in its reset position, switch "AB-BC" be held in its operation position by one of the "E" cam projections ("AB" closed, "BC" open). This setting is described more fully under ADJUSTMENTS.

Immediate Initial Reclosure

When the circuit breaker trips, the 179Z unit is immediately energized through the 152b, the 101-5 contact, and the "preclosed" contact 179E1. When the 179Z unit operates it seals itself in around the 179E1 unit and also energizes the 179E "operate" coil through the 179E6 contact. The operation of the 179E unit causes the 179E5 contact to close, thus completing the circuit to the closing relay 152X through the seal-in contact 179Z1. The operation of the 179E unit also opens the 179E1 and 179E6 contacts. It further sets up the reset circuit through 179E2 and starts the timing motor through the 179E3 unit.

With this arrangement, the operating time of the 179Z and 179E units is included in the total reclosing time of the breaker. The initial reclosure can be initiated directly through the "preclosed" contact 179E1, if the 179E5 contact is bypassed, by placing a jumper between terminals 18 and 19.

When the breaker closes, the 152b contact opens, and the 179Z unit will drop out when 152X "a" opens, thus providing an anti-pump feature. As soon as the motor starts, contact "AB" will open and "BC" will close, setting up the circuit for subsequent delayed reclosures in the event that the first reclosure is unsuccessful.

Reset

A short time after the start of the timing cycle contact "MN" is operated by the single-ended cam "E" as previously mentioned. If the immediate initial reclosure was successful, the 152a1 switch will be in its closed position and the clutch release unit 179R will be energized through the contact 179E2. During the reset interval, the 179R unit is sealed in around the "MN" contact. When the reset position is reached, the "DE" contact will close, energizing the "Reset" coil of 179E. The clutch release unit 179R is released by the opening of the 179E2 contacts. The reclosing relay is now ready to initiate an immediate reclosure in the event of a subsequent opening of the circuit breaker.

Delayed Reclosures

If the circuit breaker trips again, following the immediate initial reclosure the open 152al switch prevents the reset of the relay when the "MN" contact is operated by cam "E". Consequently the relay continues to operate until the first delayed reclosure point is reached, as determined by the settings of the double-ended cams "D" on the front dial hub. The anti-pump unit 179Z will pick up as soon as the 152b switch indicates that the breaker has tripped again. Consequently, the operation of the "AB-BC" contact combination ("AB" closes, "BC" opens) by one of the "D" cams, completes the reclosing circuit, thus energizing the closing relay 152X. Even a momentary opening of the 152b switch will cause the 179Z unit to drop out, breaking its seal-in circuit. Therefore only one reclosure of the circuit breaker is possible for each operation of the "AB-BC" contacts.

When the cam projection passes and allows the "AB-BC" switch to reset, the 179Z unit will again operate if the 152b switch is closed, thus setting the circuit for subsequent delayed reclosures.

At a definite time interval of approximately 10 seconds, after the operation of the "AB-BC" contacts by a cam projection "D", the opposite end of the same cam plate operates the "MN" contact of 179. If the 152al is closed the circuit responds as described in the section entitled RESET, and the relay will return to its reset position. If the circuit breaker has retripped as the result of a sustained fault, the 152al switch will be open and the relay will continue through its cycle until the next delayed reclosure point is reached, whereupon the sequence previously described is repeated.

Lockout

If none of the attempts to reclose the breaker is successful, the relay continues to operate until the lock-out position is reached. Lockout results from the operation of the "GH-HI" switch ("GH" opens, "HI" closes) by a notch in the auxiliary cam shaft, and is indicated by the simultaneous operation of the alarm contact "JK".

In the lock-out position of the relay, the motor circuit is transferred through contact "HI" to the 152A2 switch. Thus a successful manual reclosure of the circuit breaker restarts the motor which will run for a short period (approximately five seconds) until contact "MN" is operated by the fixed cam "F". This completes the reset circuit and causes the relay to reset as previously described.

The operating cycle described above represents a typical setting of the relay. Many other settings are possible some of which are described under ADJUSTMENTS. Fig. 9 illustrates clearly the sequence of the cam-operated contacts described above. Note that the diagram shows minumum allowable intervals between the various operations.

The elementary diagram, Fig. 8, shows the application of the reclosing relay in a typical pneumatic mechanism control scheme. The operating functions of the ACR relay are the same as previously described for the solenoid operated mechanism. The two schemes are therefore similar, except for the different types of controlling devices used in the pneumatic mechanism to accomplish its tripping and reclosing operations.

RECEIVING, HANDLING AND STORAGE

These relays, when not included as a part of a control panel will be shipped in cartons designed to protect them against damage. Immediately upon receipt of a relay, examine it for any damage sustained in transit. If injury or damage resulting from rough handling is evident, file a damage claim at once with the transportation company and promptly notify the nearest General Electric Apparatus Sales Office.

Reasonable care should be exercised in unpacking the relay in order that none of the parts are injured or the adjustments disturbed.

If the relays are not to be installed immediately, they should be stored in their original cartons in a place that is free from moisture, dust and metallic chips. Foreign matter collected on the outside of the case may find its way inside when the cover is removed and cause trouble in the operation of the relay.

ACCEPTANCE TESTS

Immediately upon receipt of the relay an INSPECTION AND ACCEPTANCE TEST should be made to insure that no damage has been sustained in shipment and that the relay calibrations have not been disturbed. If the examination or test indicates that readjustment is necessary, refer to the section on SERVICING.

These tests may be performed as part of the installation or acceptance tests at the discretion of the user.

Since most operating companies use different procedures for acceptance and installation tests, the following section includes all applicable tests that may be performed on these relays.

INSPECTION

Check the nameplate to insure that the model number and rating of the relay agree with the requisition.

Remove the relay from its case and check that there are no broken or cracked parts or any other signs of physical damage.

Press in the manual release rod projecting through the center of the dial plate, releasing the crown-gear clutch. With the release rod held in, turn the dial hub by hand through its complete operating range of approximately 180 degrees. The gear train should operate freely against the restraint of the reset spring. The dial cams "D" and "E" should operate the front switches "AB-BC" and "MN" providing approximately 1/64 inch overtravel of the roller actuator after the switch has operated. When the locked-out position is reached, the lock-out and alarm contacts on the cam shaft will be heard operating.

If the dial hub is turned further, to a point slightly beyond lockout, the "MN" switch should be operated by the fixed "F" cam. If the dial hub is now released, with the release rod still pushed in, the dial hub and gear train should return all the way to their reset positions under the influence of the reset spring.

If the relay is to provide immediate initial reclosure, the "AB" contact must be closed when the relay is in the reset position. This is accomplished by setting one of the single-ended "E" cams to operate "AB-BC" when the relay resets. Turn the dial hub a few degrees away from reset and check that "AB" opens as the hub is turned. Let the hub return slowly and check that "AB" operates.

When the relay is in its reset position switch "DE" on the cam shaft should be in the operated position. To check this, turn the dial hub a few degrees away from reset and then let it return slowly, listening for the click of switch "DE".

The armature of the clutch release unit is accessible from the rear of the cradle. Grasp the armature between index finger and thumb and pull it against the pole piece, disengaging the clutch. Check that the seal-in switch, 179R, clicks slightly before the armature strikes the pole piece. Release the armature slowly at the same time turning the front dial hub by means of the knurled knob, so that the crown gears re-engage on the tips of their teeth. The seal-in switch should reopen before the tips of the teeth meet.

The operation of the interlocking unit 179E should be checked manually. Press in the armature of the "operate" unit (lower unit) and check that the upper unit snaps open before the armature of the lower unit strikes the pole piece. Then press in the armature of "reset" unit (upper) and see that the lower unit snaps open before the armature of the upper unit strikes the pole piece.

ADJUSTMENTS

The Type ACR reclosing relay can be adjusted for either an immediate initial reclosure followed by up to three delayed reclosures, or for a delayed initial reclosure followed by up to two additional delayed reclosures. With normal adjustments, each reclosure attempt is followed after a short interval by an operation of the reset switch "MN".

The front dial hub carries a total of seven cams which are used to initiate delayed reclosures and to operate the reset switch. Three of these are single-ended cams, identified by a round hole punched in the cam projection; three are double-ended cams, each having two diagonally opposite projections; and one is a single-ended cam, having a flat-topped projection. This last-mentioned cam is keyed to the dial hub and its position is consequently fixed. All other cams can be set at any point in the operating cycle.

Changes in cam settings are made by loosening the three screws in the face of the knurled dial knob and turning the cam plates until the projections are in the desired positions. It is not necessary to remove the screws, but merely to loosen each one approximately two full turns. The cams are easily shifted by pressing against the projection in a tangential direction, using a screwdriver with a thin blade. The cams are separated by thin spacers which are keyed to the shaft, so that a given cam can be shifted without changing the settings of other cams. Changes in cam settings are facilitated by removing the nameplate, which is held by the four corner screws, although this is not absolutely necessary. After any change in cam settings be sure that the three screws in the dial face are securely tightened.

The following sections describe the settings of the cams for various reclosing sequences.

Immediate Initial Reclosure

If the Type ACR relay is to provide an immediate initial reclosure following a breaker outage, it is necessary that a cam be set to operate the "AB-BC" actuator when the relay is in its reset position. One of the single-ended "E" cams, identified by the hole in the projection, can be used for this purpose. The cam should be set so that the "AB" contact is definitely closed in the reset position, but so that it opens as soon as possible after the front dial hub starts to turn.

There are two methods of obtaining immediate initial reclosure with the Type ACR relay. One scheme is typified by the connections in Fig. 7 and has been described in the section under OPERATION. The reclosure is initiated by the successive operation of the 179Z and 179E units. This scheme is suitable for application on most circuit breakers.

For some applications where total reclosing time is critical, it may be desirable to omit the 179E5 contact from the reclosing circuit. This can be accomplished by connecting the "LC" switch directly to terminal 19. Closure of the 152b switch will now energize the 152X coil immediately through the "preclosed" contact 179E1. The 179Z coil is also energized at the same time so that the 179E unit will be operated to start the motor.

The reset of the relay following a successful immediate first reclosure results from the operation of switch "MN" by the cam projection "E". For this purpose the remaining two single-ended cams, identified by the hole in their projections, can be set back-to-back, providing in effect, a single projection. This projection should be set to operate switch "MN" at the desired interval, following the immediate reclosure. A ten second interval is suggested and the relay will be set at the factory for this unless otherwise specified.

Longer time intervals between immediate reclosure and reset can be obtained if desired by proper setting of the equivalent single projection "E". This interval is, however, limited by the desired time interval to the first delayed reclosure. The reset interval must always be at least five seconds less than the interval to the first delayed reclosure. This is necessary to insure that the reset switch "MN" will reopen before the delayed reclosing switch "AB-BC" operates. It is not recommended that the interval between immediate reclosure and reset be set for less than ten seconds.

The double-ended cams "D" should now be set to provide from one to three subsequent delayed reclosures at the desired intervals. Approximate settings can be made by means of the calibration markings shown on the dial plate. For example, if two delayed reclosures were desired, one at 30 and one at 90 seconds, one of the "D" projections would be set to line up with the 30 second marking and the remaining two "D" cams would be set back-to-back, lining up with the 90 second marking on the dial plate. It should be emphasized that such settings will be approximate. More exact settings can be made if desired, by starting with the approximate setting as described and using a timer to obtain a more exact adjustment.

The delayed reclosures are each followed in ten seconds by operation of the reset contact "MN" by the opposite end of the same cam which initiated the reclosure. This interval between delayed reclosure and reset is non-adjustable. It is set at the factory by controlling the angular displacement between the "AB-BC" and the "MN" switches, and should require no further attention. The ten second interval between a delayed reclosure and accompanying reset attempt determines the minimum permissible interval of 15 seconds between successive delayed reclosures. This allows five seconds between operation of the reset switch "MN" and of the reclosing switch "AB-BC" for the next delayed reclosure. Under no circumstances should the interval between successive delayed reclosures be reduced to a point where the reset switch "MN" is still closed when switch "AB-BC" is again operated to initiate the next delayed reclosure.

Where time settings are not specified, relays will be adjusted at the factory for immediate initial reclosure followed by two delayed reclosures, with automatic reset following each reclosure if it is successful. For this setting, an internal jumper will be connected between terminals 13 and 17 as shown by the solid line in Fig. 7. If it is later desired to change to delayed initial reclosure, this jumper should be shifted as described under CHANGING INITIAL RECLOSURE.

Delayed Initial Reclosure

When a delayed initial reclosure is desired, the connections are slightly different from these shown in Fig. 7. The internal connection will be between Terminals 13 and 12. The closing relay (152X) circuit should be connected directly to Terminal 19, thus bypassing contact 179E5. The 179E "operate" winding will now be energized immediately when the circuit breaker trips, thus starting the driving motor and initiating the delayed reclosing cycle. The adjustment of the "D" cams, for delayed reclosures at the desired intervals, is the same as described in the previous section.

When the relay is set for delayed initial reclosure and the first delayed reclosure is at least 15 seconds, the factory will also prepare the relay for immediate initial reclosure by using one of the single ended cams to hold "AB" closed. The internal jumper will be set across studs 12 and 13. This arrangement permits an easy transfer to immediate initial reclosure by merely shifting the jumper to studs 13 and 17. Of course if a change to an initial delayed reclosure of less than 15 seconds is required, it will become necessary to relieve the single-ended cam from holding "AB" closed and line it up with one of the "D" cams.

Minimum Delayed Initial Reclosure

The relay can be adjusted for a minimum delayed reclosure of approximately 2-1/2 seconds. In making this setting first be sure that the gear train is in its fully reset position. Also be sure that the two sections of the crown gear clutch are fully engaged. It may be necessary to disengage the clutch manually and turn the motor shaft, by momentarily energizing the motor coil before this condition can be realized.

One of the double-ended cams "D" should then be set so that it partially operates the roller actuator of switch "AB-BC". When the motor starts following the opening of the circuit breaker, the "AB-BC" switch will operate in about 2-1/2 seconds. The cam adjustment must be such that the "AB-BC" switch will open when the relay has reset following a reclosing sequence. It is this requirement which determines the minimum value of reclosing time. Since the crown gear clutch does not always completely re-engage when the 179R armature is released following automatic reset, the minimum reclosing time will vary up to 3/4 second above the 2-1/2 second figure.

Connections used with this setting will be the same as those for the normal delayed initial reclosure.

Changing Initial Reclosure

The change from immediate to delayed initial reclosure, or vice versa, can be easily accomplished on the Type ACR relay without recourse to extensive mechanical adjustments in the relay. Whether the first reclosure is immediate or delayed is determined mainly by the connection of contact 179E1 in the reclosing circuit.

If the relay is adjusted at the factory for immediate initial reclosure, the internal jumper will be connected between terminals 13 and 17, as shown in Fig. 7, and an "E" cam will be adjusted to hold "AB" closed when the relay is in the reset position. A subsequent change to delayed initial reclosure is accomplished by removing the relay cradle from the case and reconnecting the jumper between terminals 12 and 13. A brightly colored lead has been used for the internal jumper to aid in identification.

If the initial delayed reclosure is to be at 15 seconds or more, no further adjustment is required. For initial delayed reclosures or less than 15 seconds, the three single-ended cams "E" should be grouped together and set directly behind one of the "D" cam projections so that they will perform no function in the reclosing cycle.

If the relay is originally set for delayed initial reclosure, the internal jumper will be connected between terminals 12 and 13. It should be shifted to 13 and 17. The single-ended cams "E" should be rearranged as follows: One cam should be set to hold the "AB" contact closed, when the relay is in its reset position. The remaining two, set back-to-back should be adjusted to operate switch "MN" approximately 10 seconds from the start of the cycle. This provides for reset after a successful initial reclosure. These adjustments have been more thoroughly discussed under IMMEDIATE INITIAL RECLOSURE.

The internal jumper has been employed to facilitate the change in initial reclosure. The change in connections can be made on the internal relay connection block. It is not necessary to change connections on the back of the panel.

Omission of Quick Reset

For some applications, it may be desired to omit the quick reset feature following a successful immediate reclosure, or possibly after certain of the delayed reclosures. This may be necessary on applications where the operating time of the protective relays for minimum fault conditions is longer than the reset interval of the ACR following the attempted reclosure. This can be accomplished by proper adjustment and coordination of the single-ended cams with respect to the immediate reclosure and to the double-ended cams. Assume, for example, that the requirement is for an immediate reclosure followed by delayed reclosures at 15 and 60 seconds, with the reset omitted, following the first and second reclosures. The immediate reclosure is obtained as previously described, with one of the single-ended cams "E" set to operate "AB-BC" in the reset position. The remaining two single-ended cams should be set back-to-back at the 15 second dial marking to initiate the first delayed reclosure. The three double-ended cams "D" set back-to-back and lined up with the 60 second dial marking, provide the third and final reclosure. Note that with this arrangement, the "MN" switch is not operated after the first two reclosures, and hence the relay will not reset whether the reclosures are successful or not. No provisions are made to omit the reset attempt following final delayed reclosure.

Minimum Delayed Reclosure Intervals

In a previous section it was stated that the minimum interval between immediate and first delayed reclosure and between subsequent delayed reclosures, was 15 seconds. This is true if a reset attempt is made following the immediate reclosure and each of the delayed reclosures. Shorter intervals are possible if the reset feature is omitted and the single-ended cams are adjusted properly. As an example, assume that the initial reclosure is to be delayed, occurring after five seconds, and that two additional reclosures are desired at five second intervals. The 179E1 contact is, of course, connected as previously described for delayed initial reclosure. The reclosures at five and ten seconds are obtained by setting a single-ended cam at each of these positions on the dial plate. The third reclosure at 15 seconds is obtained by setting the three double-ended cams "D" and the remaining "E" cam, back-to-back at the 15 second dial marking.

The dial markings should be used only as a reference setting, and more accurate adjustments made with the aid of a timer. It is essential that the "AB-BC" switch reopen following each reclosure. Note that a reset attempt will follow the final reclosure by 10 seconds.

Reset After Lockout

The Type ACR relay locks out, that is, its motor circuit is opened, when the "GH" contact is opened by the auxiliary cam shaft. When "GH" opens, "HI" closes, transferring the motor circuit through an "a" switch on the breaker. A successful manual reclosure following lockout will thus restart the motor. Approximately five seconds later the "MN" switch will operate, completing the circuit to the clutch release unit 179R, thus causing the relay to reset. This delay in reset after lockout prevents improper reset of the Type ACR11B relay if the breaker trips again following the manual reclosure.

Fig. 10 shows, in chart form, the wide variety of reclosing cycle patterns obtainable with this recloser. From these patterns three typical cycles have been derived.

APPLICATION CONSIDERATIONS

The Type ACR relay offers a wide degree of versatility in adjustment and application. In addition to providing for the wide choice of adjustments previously described, the relay has provisions for blocking the instantaneous trip circuit, for selective reclosing and for blocking automatic-load ratio control during the reclosing cycle. It can be used as a single-shot reclosing relay and later be readjusted as a multi-shot reclosing relay. Some of these features are described in the following sections.

Closing Relays: It is essential that the circuit breaker solenoid mechanisms have closing relays which assure complete closure of the breaker, even though the auxiliary switch on the breaker mechanism opens before closure is complete.

Control Switches: Referring to Figs. 7 and 8 it will be noted that a four-stage, Type SB-1 control switch should be provided where these relays are furnished. This switch has extra contacts which prevent the ACR relay from reclosing the breaker after it has been tripped by means of the control switch. If tripped in this manner, the breaker must be reclosed by the control switch before the automatic reclosing feature is restored.

Interrupting Ratings of Power Circuit Breakers: The derating factors applying to the interrupting ratings of circuit breakers should be checked for all applications of ACR relays.

Latch-checking Switches: In order to assure successful operation of breakers reclosed by the ACR relay adjusted for immediate initial reclosure, it is necessary to add a latch-checking switch to all trip-free solenoid mechanisms. This switch completes the closing circuit only after the mechanism latch is properly reset for the reclosure. Latch-checking switches are not required for the non-trip-free solenoids.

Overcurrent Relays: The protective relays that trip the circuit breaker must open their contacts before the breaker recloses; otherwise the breaker may immediately trip a second time even though the fault has cleared. Some of the superseded types of induction relays, such as the IA-201, are not satisfactory to use with the ACR relay adjusted for immediate initial reclosure.

Undervoltage Devices: In order to obtain full advantage of immediate initial reclosure, undervoltage devices should have a one-or-two second time delay. This prevents motor shutdown during the reclosing period.

CO-ORDINATION WITH BRANCH FUSES

On some systems involving "multi-shot" reclosing relays, the main feeder is protected by a circuit breaker and the branch feeders by fuses. This economical means of sectionalizing a system requires that a fault on a branch be cleared initially by the main breaker tripped by a high-speed relay unit. If the fault persists following immediate reclosure, it must be cleared the second time by the branch feeder fuse. To accomplish this, the contacts of the high-speed unit must be blocked following the initial trip-out. This transfers tripping of the main breaker to a time-delay unit and thus allows time for the branch fuse to clear. Contact 4 of the interlocking unit 179E can be used for this blocking function. This contact, which opens when the 179E operating unit is energized, can be connected in series with the instantaneous trip circuit as shown in Fig. 11. This will block instantaneous tripping of the breaker on the first and subsequent reclosures, thus providing time for the branch fuse to clear the fault rather than the main breaker.

Instantaneous tripping can be reinstated automatically when the relay locks out. This is accomplished by connecting the spare switch RS in parallel with 179E4 contact and by setting the adjustable cam segment to operate the RS switch when the locked-out position is reached. With this connection, if the fault is still present when the circuit breaker is manually reclosed, the trip circuit will be energized instantaneously.

SELECTIVE RECLOSING

In certain applications it is desirable to provide immediate initial reclosing if the circuit breakers are tripped by an instantaneous relay, but to eliminate the immediate reclosure and wait for the first delayed reclosure in the event that the breaker is tripped by a time-delay relay. Such a situation is easily handled with the Type ACR reclosing relay. Referring to Fig. 7, if a contact of the time-delay protective relay or an auxiliary, is connected from the positive control bus to Terminal 12 of the Type ACR relay, the interlocking unit 179E will be energized when the protective relay operates. The 179E unit will operate and open the immediate reclosing circuit before the breaker "b" switch can close.

SINGLE-SHOT RECLOSING

The Type ACR relay can be applied as a single-shot reclosing relay. To accomplish this, follow the connections shown in Fig. 7 for immediate first reclosure, using either of the "immediate reclosure" settings described under ADJUSTMENTS, adjust an "E" cam to close "AB" at reset. The "RS" contact should be connected in series with the reclosing circuit, that is, terminals 18 or 19 depending upon the adjustment. With the usual factory adjustments, the "RS" contact is closed when the relay is reset, and closes again just prior to lockout. If all delayed reclosure points occur during the period when "RS" is open, delayed reclosures will be blocked and the relay will function as a single-shot recloser. The reset time of this single-shot recloser can be controlled by the setting of the remaining two single-ended "E" cams. If the reclosure is unsuccessful, the relay will run to its locked-out position as previously described, and will reset following a successful manual reclosure. Delayed reclosures can be restored if the "RS" contact is bypassed.

FUNCTIONS OF CONTACT "RS"

The spare contact "RS" can be applied in a variety of ways. The contact is operated by a flat on an adjustable cam segment, accessible through the opening in the upper contact block on the cradle. Normally, the cam segment is adjusted so that the "RS" contact is closed in the reset position, and opens shortly after the start of the cycle, and recloses just ahead of lockout. The contact may also be connected to be open in the reset position by transferring the red lead to stud No. 10.

With the normal adjustment, the "RS" contact can be used to block automatic load-ratio control during the reclosing cycle. If the contact is connected in the control circuit, load-ratio control will be blocked while the Type ACR relay is running, but will be reinstated when the relay locks out.

The "RS" contact, with the normal adjustment, can also be used to block the instantaneous trip circuit following the second, rather than the first, reclosure if it is connected in series with this circuit. With this arrangement the initial tripout and the tripout following immediate reclosure will be instantaneous. Tripping after subsequent delayed reclosures will be time delay. The instantaneous trip circuit will be restored when the relay reaches lockout.

The "RS" contact can also be used as a spare alarm contact, if the cam segment is reset, so that the contact operates just prior to the lockout but is not operated in the reset position of the relay. In making adjustments on the "RS" contact, it should be remembered that the flat in the cam segment is dimensioned to hold "RS" contact closed for about 30 seconds at normal shaft speed.

MAINTENANCE

The relays have been completely adjusted at the factory and, except for adjustments of the front dial cams to obtain the desired reclosing intervals, no further adjustments should be required. These routine adjustments are described in the section headed ADJUSTMENTS. In the event that some of the permanent adjustments are disturbed during periodic testing or installation of renewal parts, the following suggestions will be helpful:

SWITCHES AB-BC AND MN

These switches perform the reclosing and reset functions when operated by the adjustable cams. The switch and roller actuator are mounted on spacing blocks which are clamped to the front plate by screws passing through slotted mounting holes.

The "AB-BC" switch sets up the reclosing circuit when operated by one of the adjustable cams. Its point of operation, therefore must be co-ordinated with the time-dial markings. The procedure to follow to confirm the correctness of the switch setting, is to loosen the three screws on the time-dial hub sufficiently to permit easy movement of any of the adjustable cams. Then with the relay in the fully reset position, move one of the cams toward the roller of the "AB-BC" switch. The switch will be properly set if the cam "just" causes operation of the switch, as it engages the roller from the left hand side, when its point lines up with the zero time-dial mark.

When relays are set for immediate first reclosure, which is the normal factory adjustment, the "AB-BC" switch is held closed by one of the single-ended "E" cams. The position of the cam is on the right hand side of the roller in this case, so that the switch will open as soon as possible after the front dial hub starts to turn.

The "MN" block must be adjusted in relation to "AB-BC" so that "MN" is operated 10 seconds after "AB-BC". That is, the switch roller should be about 10 degrees in a clockwise direction from a line passing through the "AB-BC" roller and the center of the dial.

It is important to check that the cams will cause the switch buttons to depress for approximately 1/64 inch overtravel as they progress by the roller to insure positive operation. On the other hand, the overtravel should not exceed the total travel of the switch button, otherwise the cam will jam against the switch.

When the motor restarts following a successful manual reclosure after lockout, "MN" should be operated about 10 seconds later by the flat-ended cams "F". After the final adjustments, check that the points of the cams clear the rivet heads on the actuator arms by at least 1/64 inch when the hub is turned. The manual release rod provides a convenient means of releasing the clutch so that the dial hub can be turned by hand during adjustments.

AUXILIARY SWITCHES

A series of switches ("DE", "GH-HI", "JK", and "RS") are operated by indentations on the auxiliary cam shaft. The relative positions of these switches in the assembly are shown by the series of pictures in Fig. 4.

Normally, the only switch requiring adjustment is "RS". This is a spare switch that can be adjusted to operate at any point in the timing cycle. It is operated by the flat on an adjustable cam segment fastened to the auxiliary shaft by set screws. This segment and its set screws are accessible through the hole in the upper contact block on the relay cradle.

All auxiliary switches are mounted on spacing blocks, which are in turn fastened to either the front or rear plates by clamp screws passing through oversize holes in the plates. They have been set at the factory to provide the operating sequences described under PRINCIPLES OF OPERATION.

Normally, the factory settings of auxiliary switches "DE", "GH-HI", and "JK" should not be disturbed. If adjustments are necessary the following sequences must be maintained.

Switch "DE" must be closed when the relay is in its reset position. When the shaft operates, this switch must open before "MN" is operated for the first time.

Switching "GH-HI" determines the lock-out position of the relay. It should operate about five seconds before the stop on the large back gear strikes the fixed stop on the rear plate.

Alarm switch "JK" must operate either simultaneously with, or slightly ahead of the lock-out switch "GH-HI".

The setting described for "GH-HI" and "JK" provides the delay in reset following a manual reclosure, which was described under LOCKOUT. If desired, these switches can be set so that reset will occur immediately following a successful manual reclosure from lockout. To accomplish this, switches should be set so that "GH-HI" operates just before the stop posts meet, and so that "JK" and "MN" operate just prior to this point. Be sure that all contacts have the prescribed 1/64 inch overtravel, and that all clamping screws are securely tightened after any switch adjustment.

CLUTCH RELEASE UNIT 178R

The clutch release unit should function as described in the earlier section headed INSPECTION. The seal-in switch is attached to a mounting strip which in turn is fastened to the clutch-release mounting bracket by means of spacers and screws. These screws pass through clearance holes in the mounting strip which permit adjustment in the operating point of the switch. These screws are accessible if the two fastening screws on the lower cradle block are removed. The block can then be swung back far enough to expose the screw heads. In its final adjustment, the seal-in switch should operate before the armature strikes the pole-piece when the armature is operated by the thumb and forefinger. When the armature is released, the seal-in switch must reopen before the tips of the clutch teeth meet. This is important since, in the reset position, the crown gears may not reengage perfectly, and it is essential that the 179R contact be open when the relay is in the reset position.

ESCAPEMENT

The speed of the gear train and cam shaft during reset is limited by an escapement consisting of a star wheel cam, fastened to the idler gear, and a cam follower. The follower pivots about a lower bearing and is guided by an upper bushing and washer. The lower bearing has an eccentric mounting screw which permits adjustment of the two projections of the follower with relation to the star wheel.

Normally, this eccentric bearing should not require adjustment during the full life of the relay. If the adjustment is inadvertently disturbed, the bearing should be reset so that a line through the two follower projections passes approximately through the center of the motor shaft, and the clamp screw re-tightened. The relay should be operated through its entire cycle by releasing the clutch and turning the knurled knob on the front. There should be some play between the follower projections and the star wheel cam at every point in the timing cycle. If there is any tendency for the follower to bind or jam, the eccentric bearing should be adjusted until the bind is eliminated. Be sure that both screws are securely tightened after adjustments are completed.

INTERLOCKING UNIT 179E

As previously described in the PRINCIPLES OF OPERATION, this unit is a mechanically interlocked device.

The operation of the latching mechanism, plus the gap and wipe of the contacts are two features that should be checked.

The latching must be positive as each of the armatures are operated by hand. To check the correctness of the adjustment, place a 1.5 mil shim between the armature and pole piece and operate the armature so that it will bear against the shim. If the latching is positive under these circumstances, the mechanical interlocking is satisfactory.

To confirm the contact adjustment, first see that all the open contacts have at least a 0.02 inch gap. Second, check the wipe on all the closed contacts, by depressing the stationary contact members and noting that the movable members follow for at least a five mil deflection. Third, check the contact wipe on those contacts that close when the armatures are operated, as follows: Place a two mil shim between the armature and pole piece, and hold the armature in the picked up position. If the contacts are closed under these conditions, the resulting wipe will be adequate when the shim is removed. Finally, check to see that these same contacts maintain their wipe when held closed by the latching arrangement alone, by deflecting the stationary members as described above to see that a five mil wipe is present.

PERIODIC INSPECTION

It is suggested that mechanical inspection of the relay be made once every six months. The relay should be turned by hand through its complete cycle and the operating sequence of the auxiliary switches checked with reference to the detailed description given above. The clutch should be released manually with the relay in the locked out position to be sure that the mechanism resets properly. The interlocking unit should be operated by hand in both directions.

CAUTION: After any mechanical inspection of the relay, be sure that the interlocking unit 179E is in its reset position before the relay is replaced in its case. When reset, the armature of the upper unit should be latched in.

PERIODIC TESTING

TIME CHECKS

When the relay is installed, reclosing intervals may be desired which differ from the settings originally made at the factory. If the approximate settings indicated by the numbers on the dial plate are not accurate enough, more exact settings may be made by following the circuit in Fig. 12 and the description which follows. The relay may be tested while in its case at the installation by using test plugs and portable test equipment including a timer, switches and a source of motor and control voltages. This scheme is illustrated by Fig. 12. The relay can also be removed from its case and replaced with a spare relay, and then checked in the laboratory with a permanent test installation. Note that the sources of rated voltage referred to in the test diagrams are the rated voltage and frequency shown on the nameplate for the motor and the control circuits.

The following paragraphs give the proper operating sequences used to check the various time intervals.

1. Reset Interval after Immediate Recloser -

   (a) Close S1 and S3.
   (b) Pulse S2 (close and open); this operates 179E, which starts the ACR motor and also the timer (179E4 opens).
   (c) Operation of MN a short time after the start of the cycle causes ACR to reset, and contact 179E4 to reclose, stopping the timer.
   (d) Read time and open switches.

The timer reading will closely approximate the interval between immediate first reclosure and accompanying reset attempt. It will be in error by the short time it takes the ACR to return to its reset position and for the 179E4 contact to reclose.

2. First Delayed Reclosure -

(a) Close S1.
(b) Pulse S2; this starts the timer and operates 179E which energized the ACR motor.
(c) Close S3 and S4 after interval for reset following immediate reclosure has passed.
(d) Operation of AB at first delayed recloser closes contact AB stopping the timer. Read this time.
(e) Upon passing of the cam operating AB the timer will again operate until MN is operated.
(f) Operation of MN sets up reset circuit resetting the relay.

If the relay is set for delayed initial recloser and the "AB" contact is not held closed while in the reset position, this step is not necessary; S3 and S4 can be closed in step (a).

3. Second or Third Delayed Recloser -

(a) Close S1.
(b) Pulse S2 (starts motor and timer).
(c) After first delayed reclosure and reset position is passed, close S3 and S4.
(d) When AB operates for second recloser, timer will stop, recording time to second.
(e) A short time later ACR will reset.
(f) Open switches.

The time interval to the third delayed reclosure can be checked by following the same procedure, but waiting until after the second delayed reclosure and reset position is passed before closing S3 and S4.

4. Interval between Delayed Reclosure and Reset -

(a) Pulse S2.
(b) Close S3, S6 and S1 in this sequence prior to operation of the AB contacts for the reset interval to be timed but after the previous reset interval has passed, if any.
(c) Open S6 immediately after the timer has started. Starting of the timer occurs due to opening of the BC contacts.
(d) Operation of the MN contact after first delayed reclosure will then cause the ACR to reset and the resultant reclosure of 179E4 will stop the timer.

While the previous time-check sequence is given primarily to facilitate the setting of required time interval, the same circuits can be used for periodic checking of time intervals.

OPERATION CHECKS

The test circuit used in the previous section can also be adapted to checking operating points of the various units.

A. Interlocking Unit 179E; Clutch Release Unit 179R.

Adjust the control voltage sources to 80 percent of the rating shown on the nameplate. Set the source of motor voltage at 80 percent of the nameplate rating. Close S1 and pulse (close and open) S2; the 179E unit should operate and the motor should drive the ACR through the complete cycle to the lock-out position.

Close S3 and S5 in this sequence. This restarts the motor and the dial moves from the lock-out position. A short time later the 179R unit should operate permitting the relay to reset. When the reset position is reached, the 179E unit should also reset. Open S3 and check that 179E1 contact between Terminals 13 and 14 is closed. This indicates whether the 179E unit resets properly at 80 percent of the rated voltage.

Note that both the 179E and 179R coils are intermittently rated, so care must be taken to remove control voltage at once in the event that a unit does not operate properly.

B. Motor

The operation of the motor at 80 percent of rated motor voltage was checked in the previous section.

C. Anti-pump Unit 179Z

Apply 60 percent of rated DC closing circuit volts if DC rated or 80 percent of rating closing circuit if AC rated between Terminals 11 and 17 and check that 179Z operates.

Do not leave voltage on continuously as possible damage to the 179E operate coil can result, should the 179E relay not operate at 60 percent voltage.

Relay 179E should operate at 80 percent voltage as checked in (A).

RENEWAL PARTS

It is recommended that sufficient quantities of renewal parts be carried in stock to enable the prompt replacement of any that are worn, broken or damaged.

When ordering renewal parts, address the nearest Sales Office of the General Electric Company, specify quantity required, name of the part wanted, and the complete model number of the relay for which the part is required.

INSTALLATION

The following sections will be helpful if it is necessary to install replacement parts.

Switches

Any of the cam-operated switches can be removed from its spacing block by taking out the two small fastening screws passing through the switch body. Before the switch is removed, take care to notice the relative position of the actuator so that it can be installed in the same position with the new switch. When leads are soldered onto the terminals of a replacement switch, the switch should be held in a horizontal position to prevent any possibility that solder will flow into the switch mechanism. Small fiber baffles are provided to prevent this, but the added precaution is advisable. Since the spacing block was not disturbed, no adjustment should be required on the replacement switch. However, since there are minor differences in the operating points of individual switches, it is advisable to recheck the operation of the switches.

The switches operated by the auxiliary cam shaft are accessible if the top cradle block is swung upwards. Since the small clamp screws are not accessible on these switches, it will be necessary to remove the spacing blocks. Remounting of the blocks will be facilitated if the original position of the block is marked with a scribing tool or sharp pencil before the clamp screws are loosened.

Clutch Release Unit 179R

The clutch release magnet and coil assembly can be removed as a unit. Remove the two screws which clamp the magnet to the formed bracket. One coil lead is connected to Terminal 3 and the other to the reset coil of 179E. Disconnect these leads, cutting the cabling twine if necessary. The assembly can now be removed, the replacement fastened in position, and its leads connected to the proper terminals. Although this change should not have disturbed the clutch release adjustments, it is advisable to check the operation of the clutch as described under MAINTENANCE.

Motor

Since the motor is not readily accessible it is suggested that the following steps be followed in making a replacement:

A. Removing the Motor

1. Be sure the relay is in the reset position.

2. Remove the square nameplate, which is held in place by four corner screws.

3. Remove the dial hub and cam assembly by unscrewing the button on the release rod and removing the slotted retaining screw in the center of the knurled knob. Note that a spot-drill marking on the cam shaft gear is aligned with a similar marking on the dial hub gear.

4. Remove switches "AB-BC" and "MN" from their spacing blocks. Do not remove the blocks. Note the relative position of the roller actuators in relation to the switches before they are removed.

5. Remove the two screws holding the 179Z unit to the rear of the front plate.

6. Remove the two screws holding the upper molded cradle block to the cradle. The block can now be swung back exposing the auxiliary switches and blocks.

7. Carefully mark the positions of the two front switch spacing blocks, using either a scriber or a sharp pencil. While this step is not essential, it does simplify the reassembly.

8. Remove the screws clamping the switch blocks to the front plate.

9. Remove the four screws holding the front plate to the hexagonal doweled spacing posts. Hold the hexagonal doweled spacing posts. Hold the hexagonal posts against turning while the screws are being loosened.

10. The front plate can now be lifted from the doweled posts and swung back exposing the motor. The relay should be resting on its back during this and the following steps so that the various units, suspended by the leads, will remain in their relative positions. Be careful not to bend the release rod during this step.

11. Clip the leads of the motor so that the leads of the new motor can be spliced to them.

12. Remove the four screws holding the motor plate in position. The motor and plate assembly as well as the rod and its guide plate can now be lifted out.

13. Remove the motor from the plate.

B. Mounting the New Motor

1. Fasten the new motor to the plate.

2. Mount the plate and motor on the four spacing posts. Note that the motor shaft must be guided into the bearing hole in the idler member and the hole in the rear outboard bearing plate. The release rod should engage with the front surface of the star wheel.

3. Place the front plate assembly in its general position by threading the release rod through the hole in the dial hub post, at the same time centering the front cam-shaft gear with the hole in the plate.

4. Before the plate is forced all the way onto the doweled posts, the two switch and block assemblies should be remounted on the rear of the plate and aligned with the scribe lines.

5. The plate can now be pressed all the way against the shoulders of the doweled posts, first aligning the bearing pin on the cam shaft with the hole in the front bearing plate. Replace the four mounting screws and tighten securely.

6. Remount the 179Z unit.

7. Remount the two front switches and roller actuators, being sure that the rollers are in their original positions.

8. Replace the hub and cam assembly, being sure that the gear tooth in "B" gear, identified by the spot, meshes with the similarly identified valley on the "C" gear.

9. Replace the hub retaining screw and knob on the release rod.

10. Before the top block is replaced, the relay should be operated by hand through a complete cycle and the operating sequence of the auxiliary switches checked. If minor readjustments are required, they can be more easily handled with the block off. If the switch operation is satisfactory, the molded block should be fastened in position.

11. Replace the nameplate.

During the reassembly steps, care must be taken to keep leads away from the moving parts and to avoid pinching lead insulation under blocks or plates.

Normally, the reset spring will not be disturbed during motor replacement, or during other adjustments. If the spring should inadvertently unwind, note that with the relay in the reset position the initial windup of the spring should be approximately 180 degrees from the free position.

LIST OF FIGURES

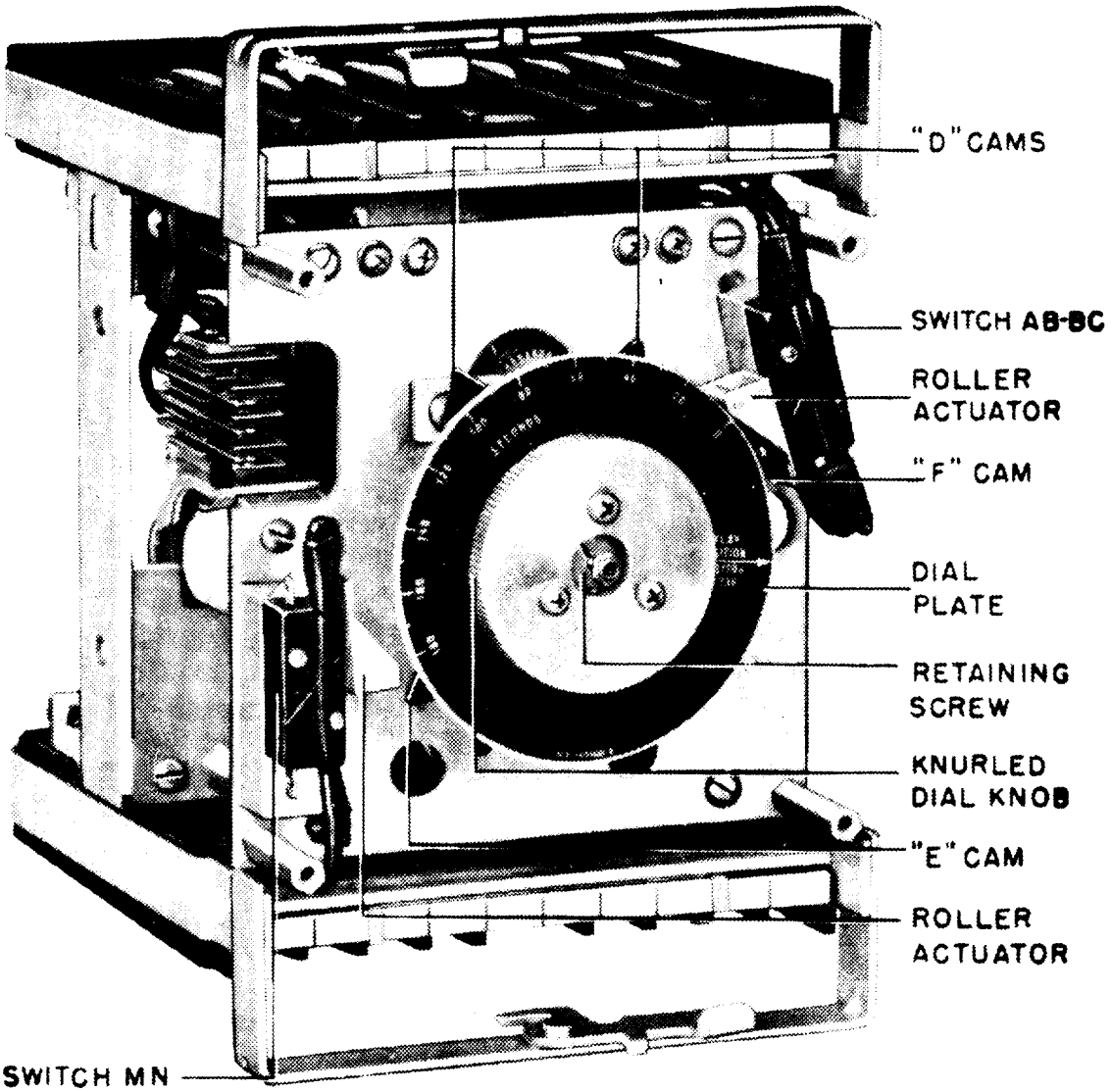


Fig. 1 (8013291) ACR Relay, Front View, Nameplate Removed

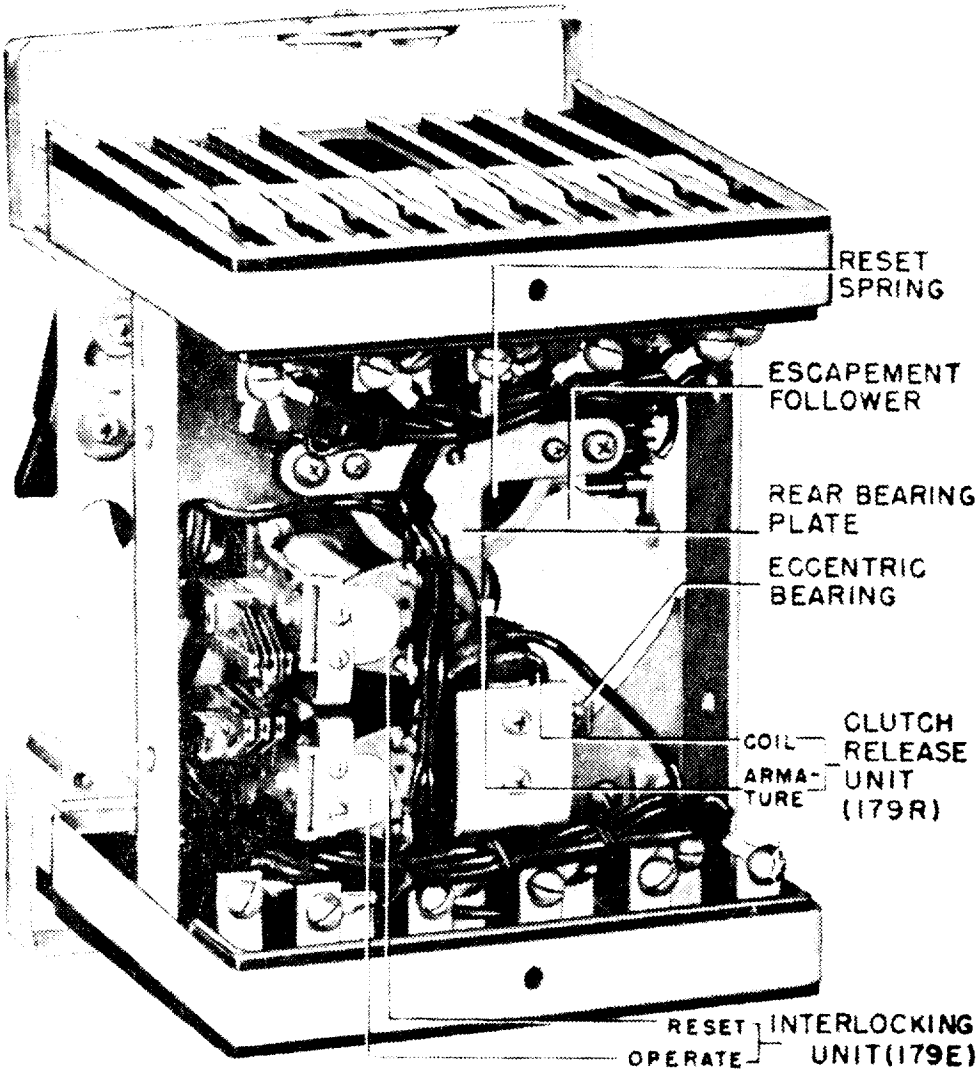


Fig. 2 (8013290) ACR Relay, Rear View

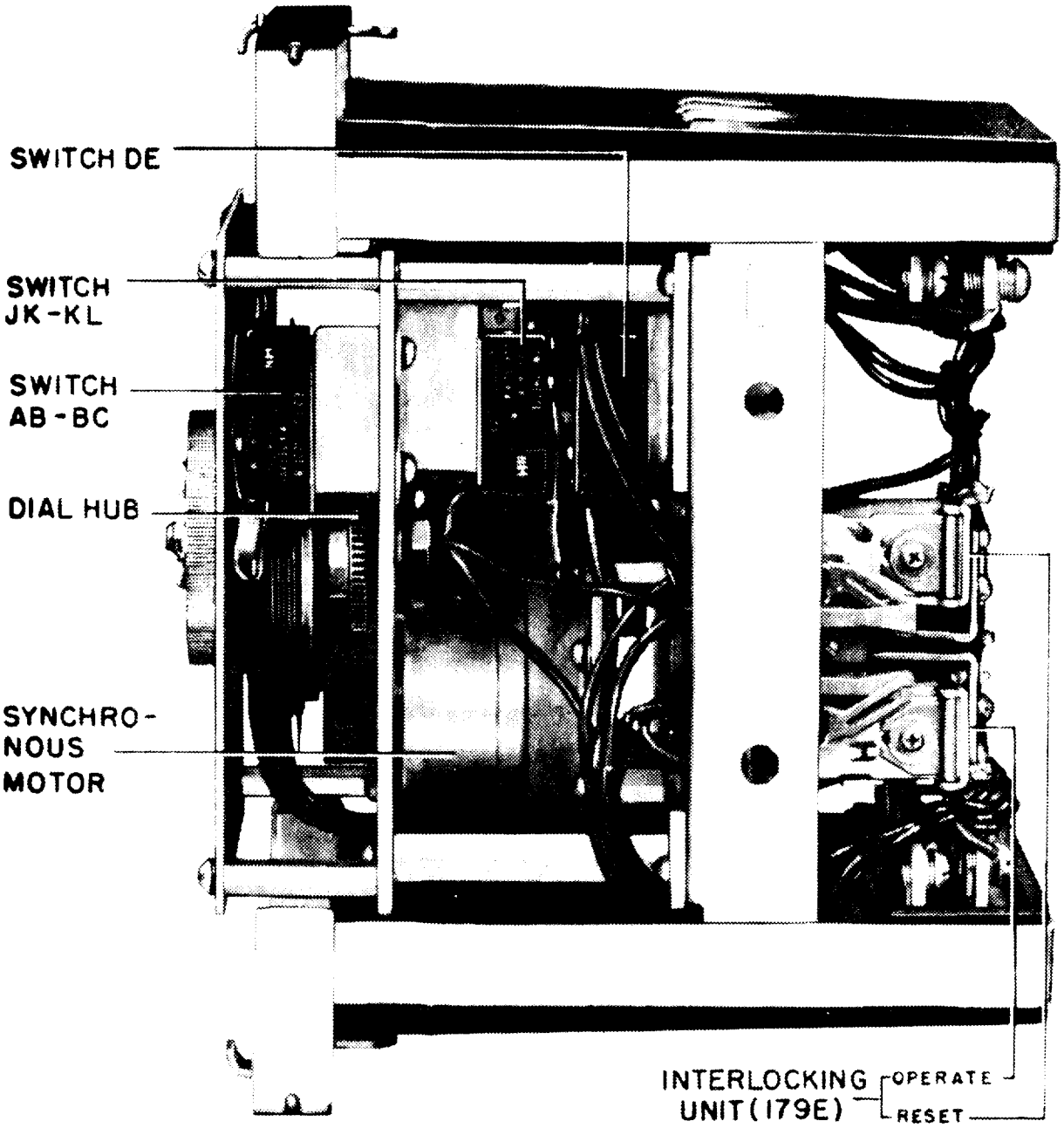


Fig. 3 (8013414) ACR Relay, Right Side View

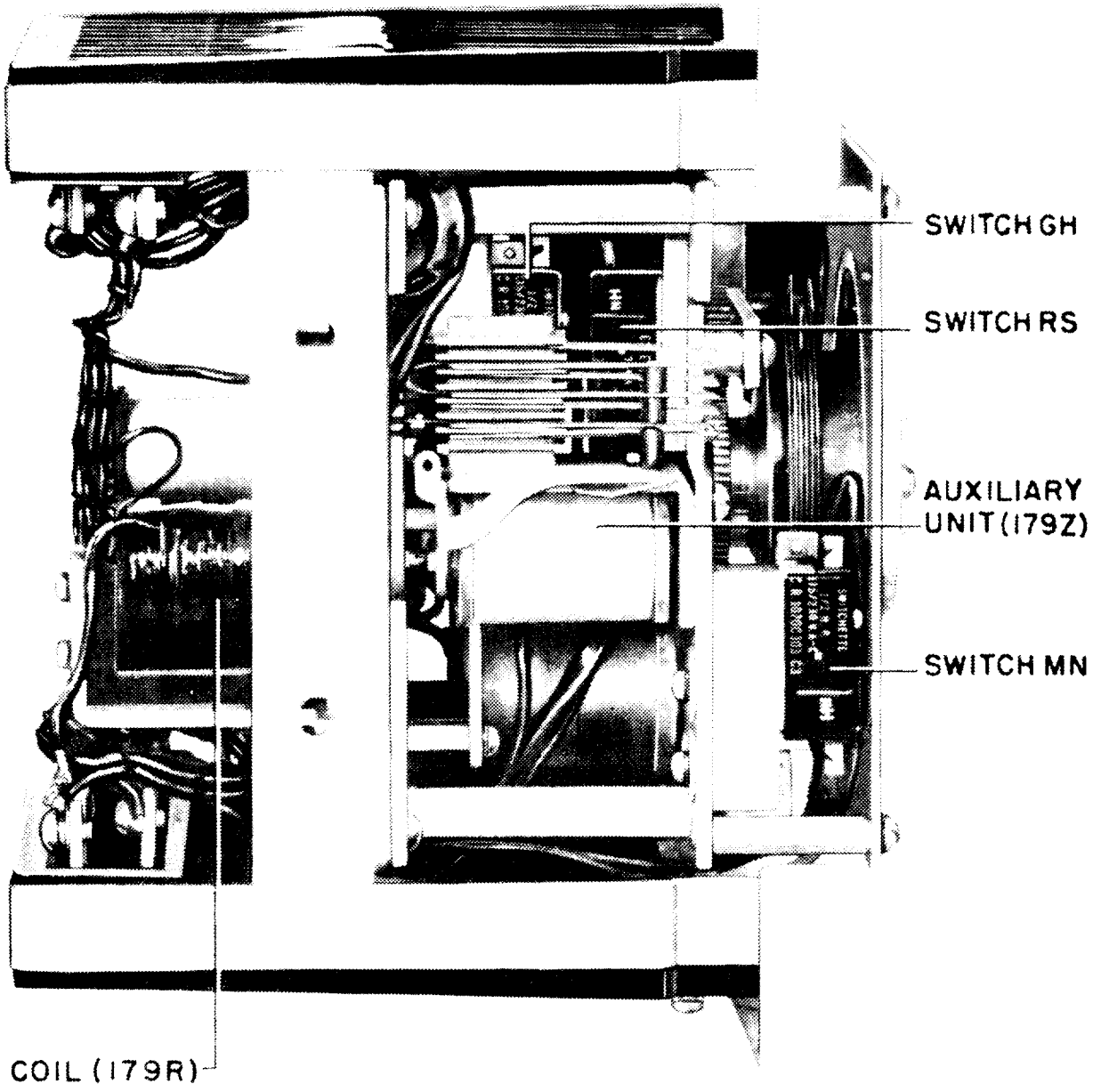
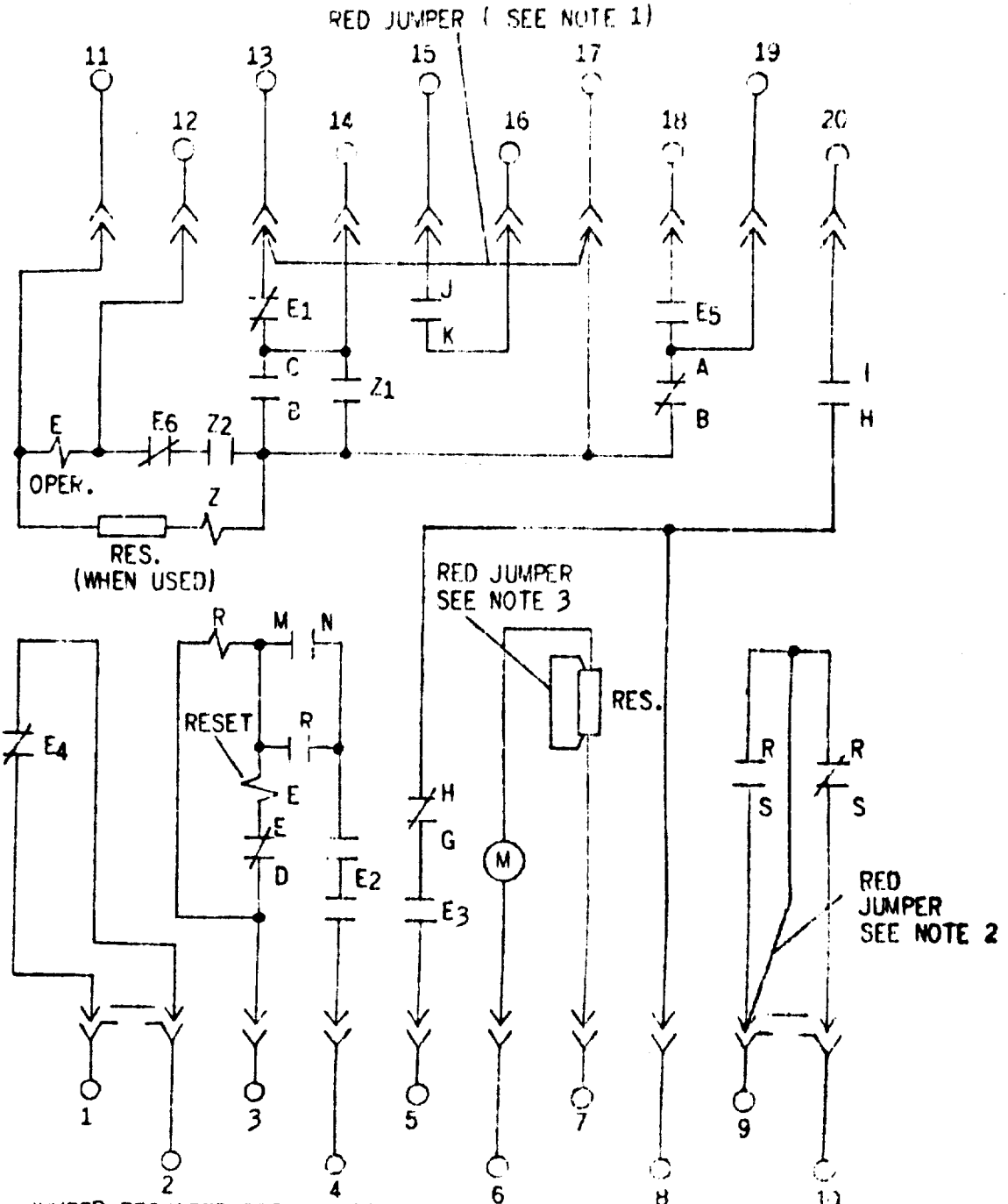


Fig. 4 (8013413) ACR Relay, Left Side View



NOTE 1 - JUMPER REQUIRED BETWEEN 13 & 17 FOR IMMEDIATE INITIAL RECLOSURE: BETWEEN 13 & 12 FOR DELAYED INITIAL RECLOSURE.
NOTE 2 - COMMON CONNECTION OF "RS" AVAILABLE TO OBTAIN A N.O. OR N.C. CONTACT. BY ITS CONNECTION TO STUD 9 OR 10, BY JUMPER.
NOTE 3 - RESISTOR FOR DUAL RATING OF MOTOR. OMIT JUMPER FOR HIGHER RATING.

Fig. 5 (104A8965) Internal Connections for Relay Type ACR11E and ACR11F

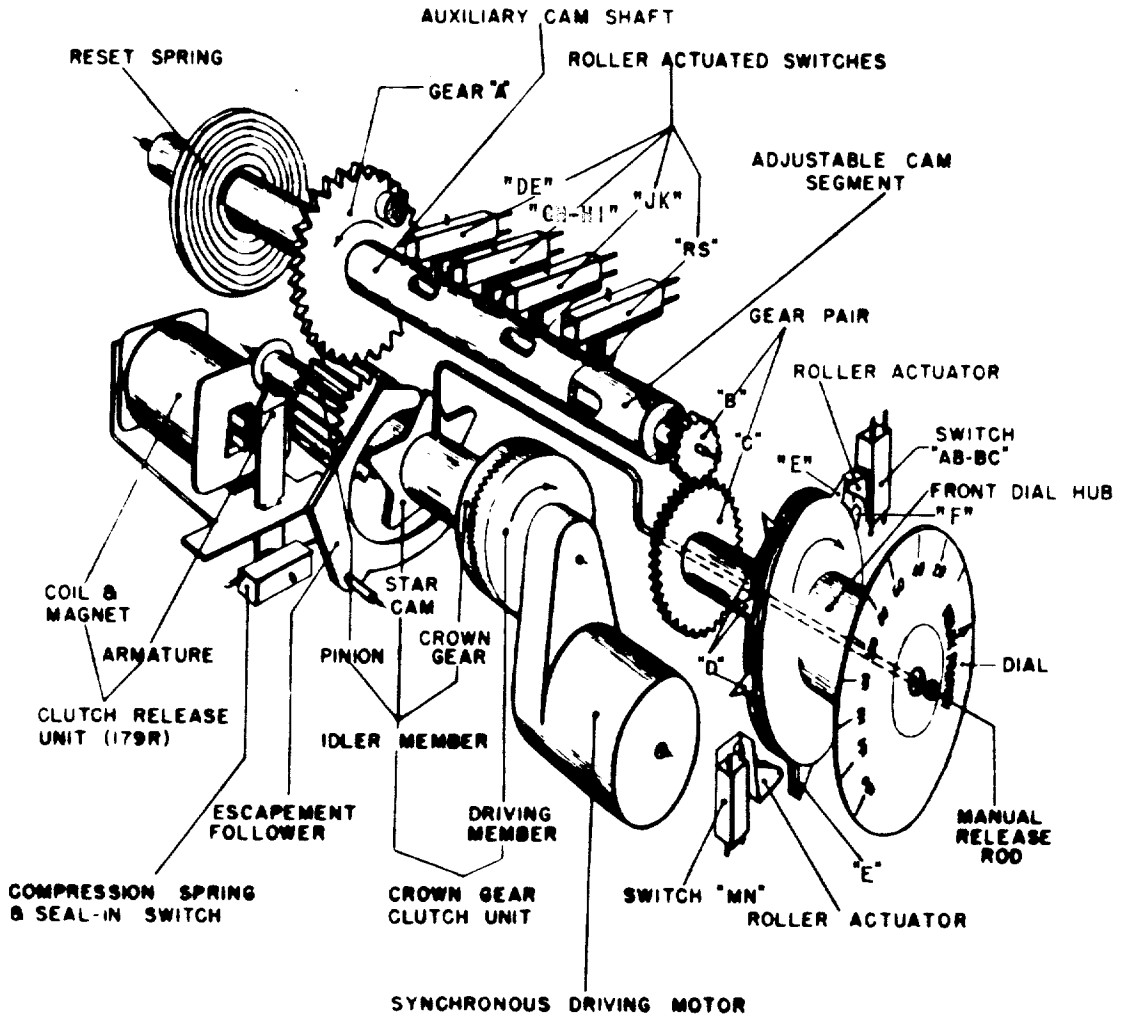
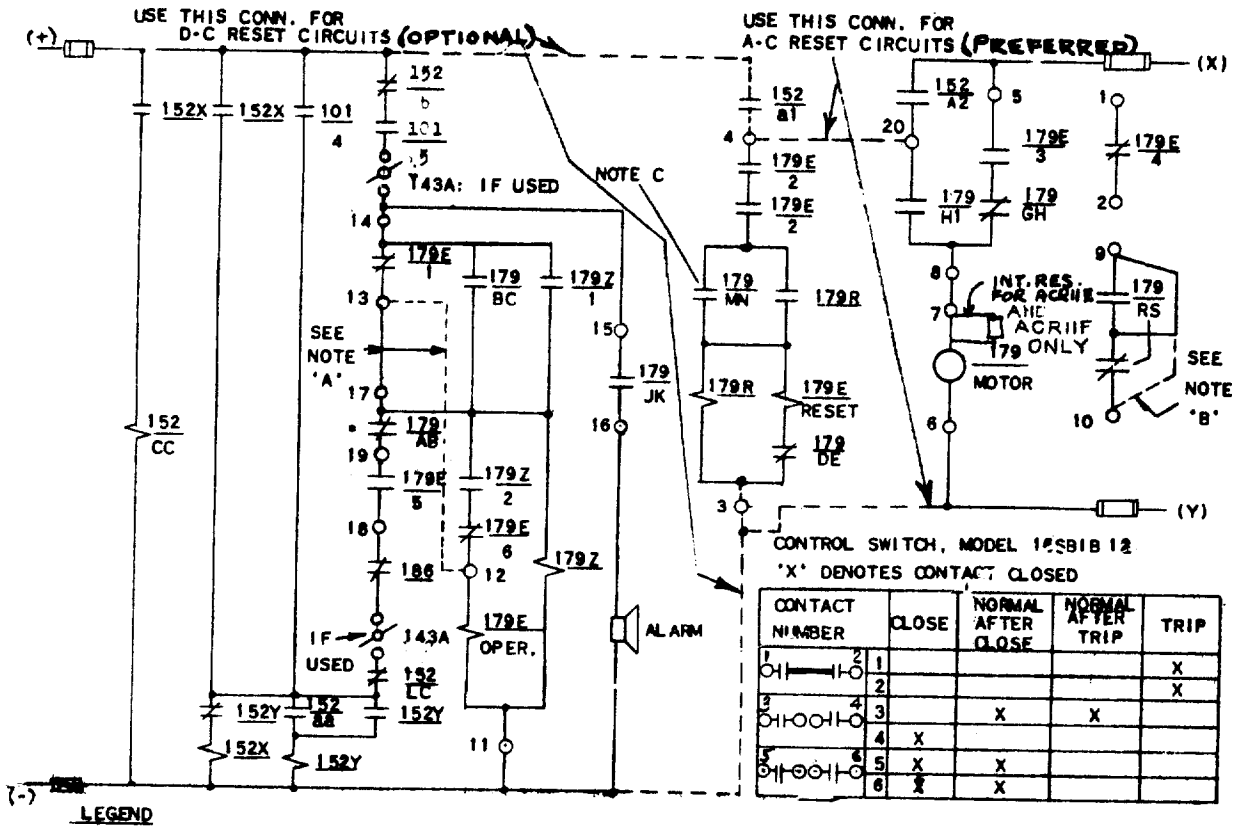


Fig. 6 (362A676-1) Schematic Representation of the Operating Mechanism in the ACR Type Relay



LEGEND

101 - CONTROL SWITCH
143A - RECLOSER CUTOUT SWITCH - IF USED
152 - POWER CIRCUIT BREAKER
152 a1 & a2 - AUXILIARY SWITCHES, CLOSED WHEN CIRCUIT BREAKER IS CLOSED
152aa - CUT-OFF SWITCH, CLOSED WHEN BREAKER OPERATING MECHANISM IS IN ENERGIZED OR OPERATED POSITION.
152b - AUXILIARY SWITCH, CLOSED WHEN CIRCUIT BREAKER IS OPEN
152CC - CLOSING COIL
152LC - LATCH CHECKING SWITCH, CLOSED WHEN CIRCUIT BREAKER MECHANISM IS LATCHED.
152X - CLOSING RELAY
152Y - CLOSING RELAY AUXILIARY
179 - RECLOSING RELAY, TYPE AC
179E - INTERLOCKING UNIT
179M - SYNCHRONOUS MOTOR
179R - CLUTCH RELEASE UNIT
179Z - ANTI-PUMP UNIT

179AB-BC - DELAYED RECLOSURE SWITCH } OPERATED BY FRONT CAMS
179MN - RESET SWITCH
179DE - LIMIT SWITCH, RESET } OPERATED BY AUXILIARY CAM SHAFT
179GH-H1 - LIMIT SWITCH, LOCKOUT
179JK - ALARM SWITCH
179RS - ADJUSTABLE AUXILIARY SWITCH (CAN BE SET TO CLOSE IN BOTH RESET AND LOCKOUT
186 - BUS DIFFERENTIAL LOCKOUT RELAY.

NOTE: SEE SHEET 2 FOR MOTOR OPERATED BREAKER CONNECTIONS

NOTE 'A' - INTERNAL JUMPER BETWEEN 13-17 FOR IMMEDIATE INITIAL RECLOSURE: SHIFT TO 12-13 FOR DELAYED INITIAL RECLOSURE.

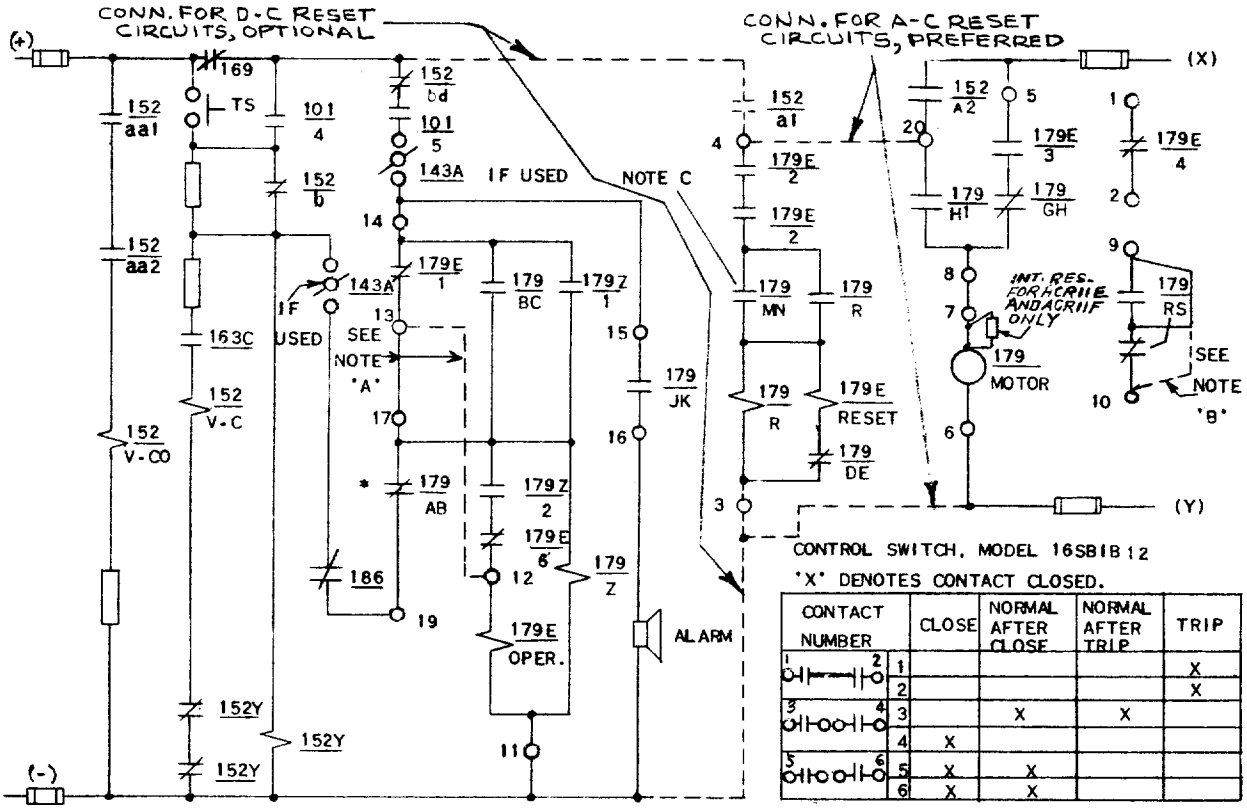
* - CONTACT 'AB' HELD CLOSED IN RESET POSITION BY CAM FOR IMMEDIATE INITIAL RECLOSURE: THIS ADJUSTMENT NOT NECESSARY FOR DELAYED INITIAL RECLOSURE.

'GH' OPERATES 5-10 SECONDS FROM END OF TRAVEL: 'RS' OPERATES SLIGHTLY AHEAD OF 'GH'. WHEN MOTOR RESTARTS, 'RS' REMAINS CLOSED UNTIL 'MN' IS OPERATED BY FLAT ENDED CAM.

NOTE 'B': COMMON CONNECTION OF 'RS' AVAILABLE TO OBTAIN A N.O. OR N.C. CONTACT BY ITS CONNECTION TO STUD 9 OR 10.

NOTE 'C': REMOVE A-C SUPPLY WHENEVER D-C SUPPLY FOR 179R IS REMOVED, WITH DC RESET CIRCUITS.

Fig. 7 (362A572-16 SH 1) External Connections, Typical Application of ACR Relay Used with Solenoid Operated Circuit Breaker



CONTROL SWITCH, MODEL 16SB1B12

'X' DENOTES CONTACT CLOSED.

CONTACT NUMBER		CLOSE	NORMAL AFTER CLOSE	NORMAL AFTER TRIP	TRIP
1-2	1				X
	2				X
3-4	3		X	X	
	4	X			
5-6	5	X	X		
	6	X	X		

101 - CONTROL SWITCH
143A - RECLOSER CUTOUT SWITCH IF USED
152 - POWER CIRCUIT BREAKER
152a1 & a2 - AUXILIARY SWITCH, CLOSED WHEN CIRCUIT BREAKER IS CLOSED.
152aa1 - CUT-OFF SWITCH, OPERATED BY PISTON
152aa2 - CUT-OFF SWITCH, OPERATED BY LATCH
152b - AUXILIARY SWITCH, CLOSED WHEN BREAKER IS OPEN
152bd - AUXILIARY SWITCH, CLOSED WHEN BREAKER IS OPEN. CAPABLE OF FINE ADJUSTMENT.
152V-C - CONTROL VALVE CLOSING COIL
152V-CO - CONTROL VALVE CUT-OFF COIL
152Y - ANTI PUMP RELAY OF 152
163C - PRESSURE CUTOUT, OPEN ON LOW PRESSURE
169 - PERMISSIVE CONTROL DEVICE OPENED BY MANUAL TRIPPING DEVICE ON MECHANISM (HAND RESET TO CLOSE)

179 - RECLOSING RELAY, TYPE ACR
179E - INTERLOCKING UNIT
179M - SYNCHRONOUS MOTOR
179R - CLUTCH RELEASE UNIT
179Z - ANTI PUMP UNIT OF 179
179AB-BC - DELAYED RECLOSURE SWITCH } OPERATED BY FRONT CAMS
179MN - RESET SWITCH
179DE - LIMIT SWITCH, RESET
179GH-H1 - LIMIT SWITCH, LOCKOUT
179JK - ALARM SWITCH
179RS - ADJUSTABLE AUXILIARY SWITCH (CAN BE SET TO CLOSED IN BOTH RESET AND LOCKOUT) } OPERATED BY AUXILIARY CAM SHAFT
TS - TEST SWITCH
186 - BUS DIFFERENTIAL LOCKOUT RELAY.

NOTE 'A' - INTERNAL JUMPER BETWEEN 13-17 FOR IMMEDIATE INITIAL RECLOSURE: SHIFT TO 12-13 FOR DELAYED INITIAL RECLOSURE.

* - CONTACT 'AB' HELD CLOSED IN RESET POSITION BY CAM FOR IMMEDIATE INITIAL RECLOSURE: THIS ADJUSTMENT NOT NECESSARY FOR DELAYED INITIAL RECLOSURE.

'GH' OPERATED 5-10 SECONDS FROM END OF TRAVEL: 'RS' OPERATES SLIGHTLY AHEAD OF 'GH'. WHEN MOTOR RESTARTS 'RS' REMAINS CLOSED UNTIL 'MN' IS OPERATED BY FLAT ENDED CAM.

NOTE 'B': COMMON CONNECTION OF 'RS' AVAILABLE TO OBTAIN A N.O. OR N.C. CONTACT BY ITS CONNECTION TO STUD 9 OR 10.

NOTE 'C': REMOVE A-C SUPPLY WHENEVER D-C SUPPLY FOR 179R IS REMOVED, WITH D-C RESET CIRCUITS.

Fig. 8 (376A987-13) External Connections, Typical Application of ACR Relay Used with Pneumatically Operated Circuit Breaker

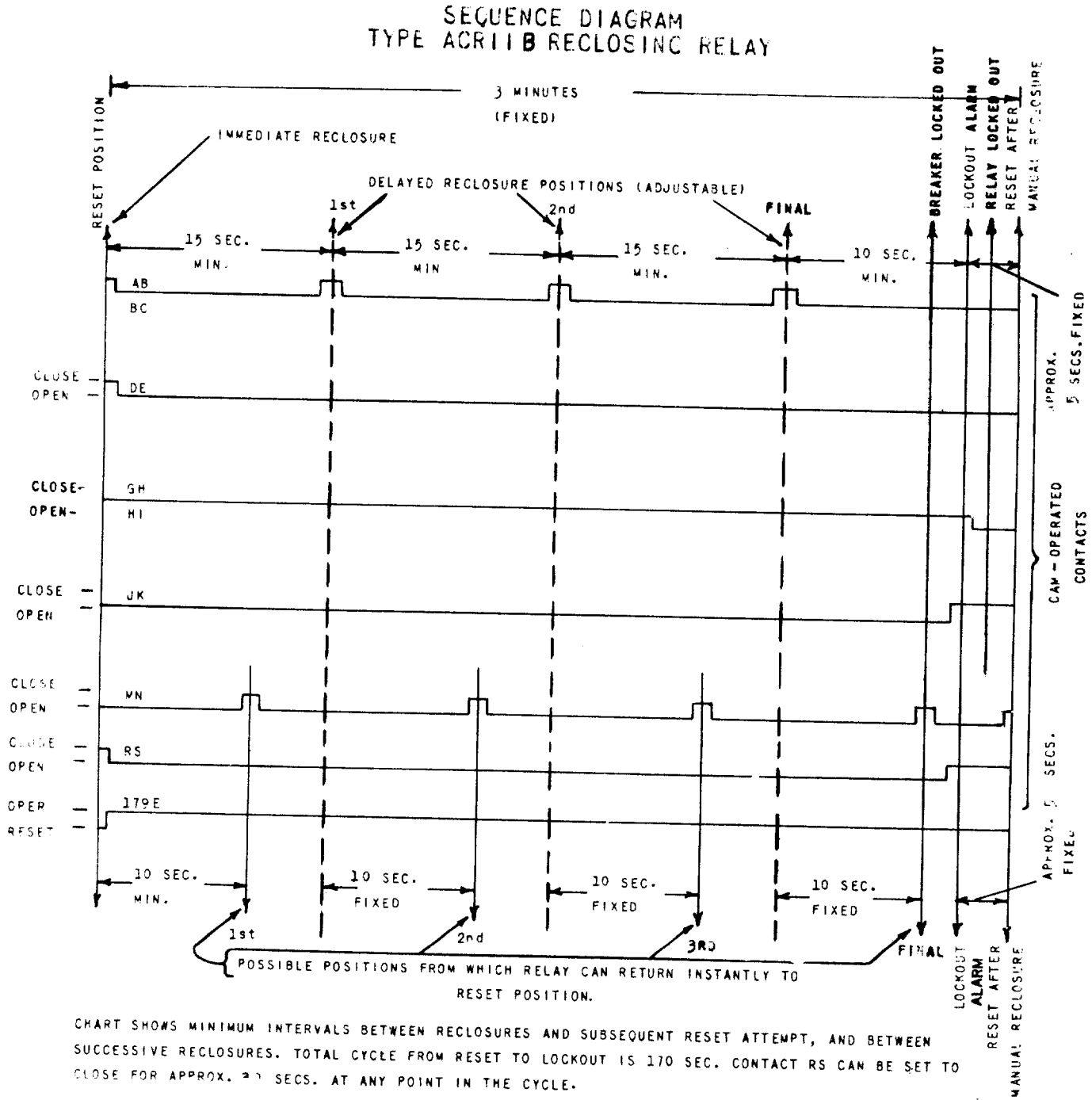
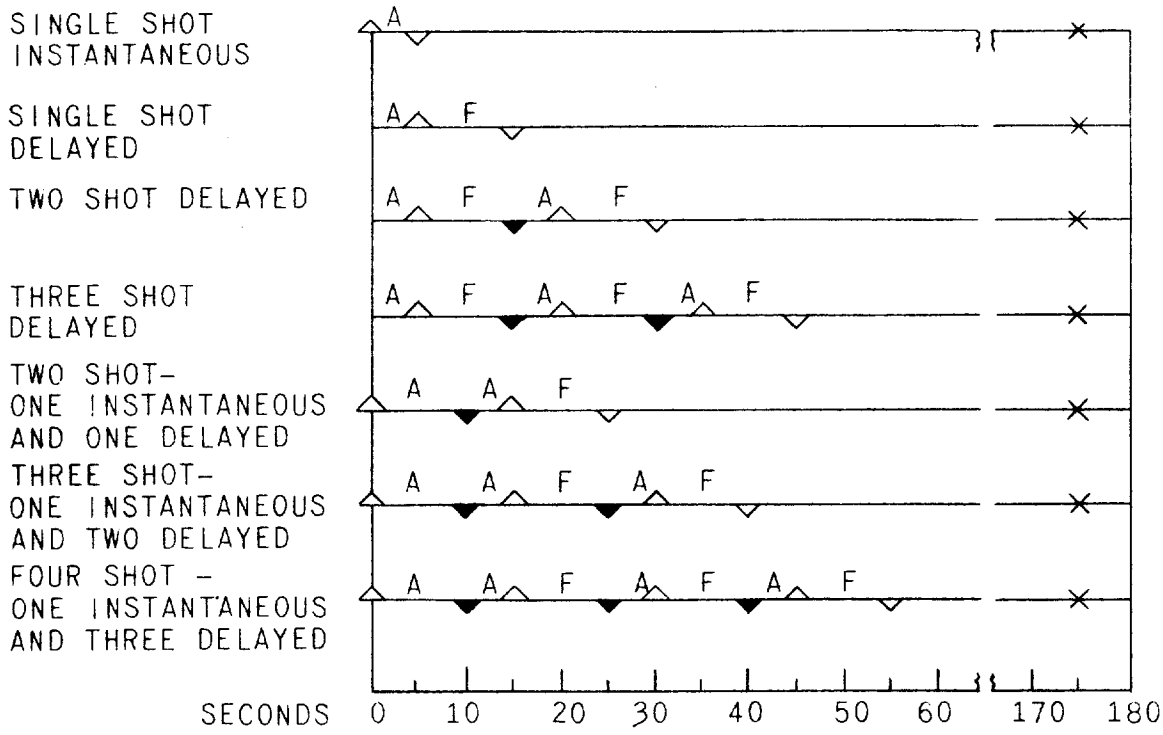


CHART SHOWS MINIMUM INTERVALS BETWEEN RECLOSURES AND SUBSEQUENT RESET ATTEMPT, AND BETWEEN SUCCESSIVE RECLOSURES. TOTAL CYCLE FROM RESET TO LOCKOUT IS 170 SEC. CONTACT RS CAN BE SET TO CLOSE FOR APPROX. 2) SECS. AT ANY POINT IN THE CYCLE.

Fig. 9 (362A613-7) Sequence Diagram for ACR Relays



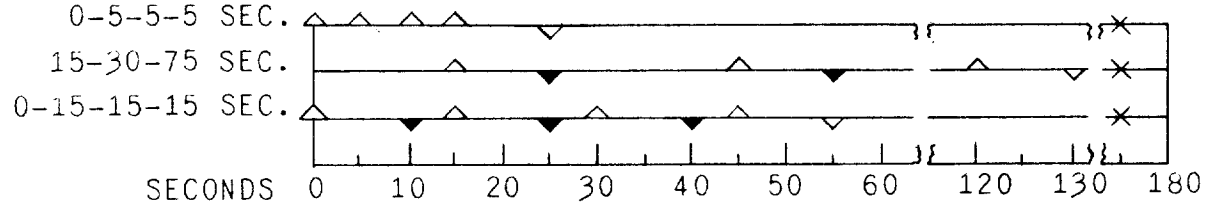
NOTE: RESET AFTER MANUAL RECLOSURE FOLLOWING LOCKOUT OCCURS 5 SECONDS AFTER RELEASE OF CONTROL SWITCH TO NEUTRAL POSITION.

LEGEND

△ AUTOMATIC RECLOSURE
▽ FINAL AUTOMATIC RESET
▼ OPTIONAL INTERMEDIATE AUTOMATIC RESET

A -ADJUSTABLE INTERVAL - MINIMUM VALUE 5 SECONDS
F -FIXED INTERVAL - 10 SECONDS
X -LOCKOUT

CHART OF AVAILABLE RECLOSING PATTERN CYCLES OF THE ACR11B RELAY, SHOWING MINIMUM INTERVALS.



TYPICAL RECLOSING CYCLES DERIVED FROM ABOVE CHART BY VARYING INTERVALS AND OMITTING OPTIONAL RESETS.

Fig. 10 (377A183-2) Chart of Available Reclosing Pattern Cycles of the ACR Relays Showing Minimum Intervals

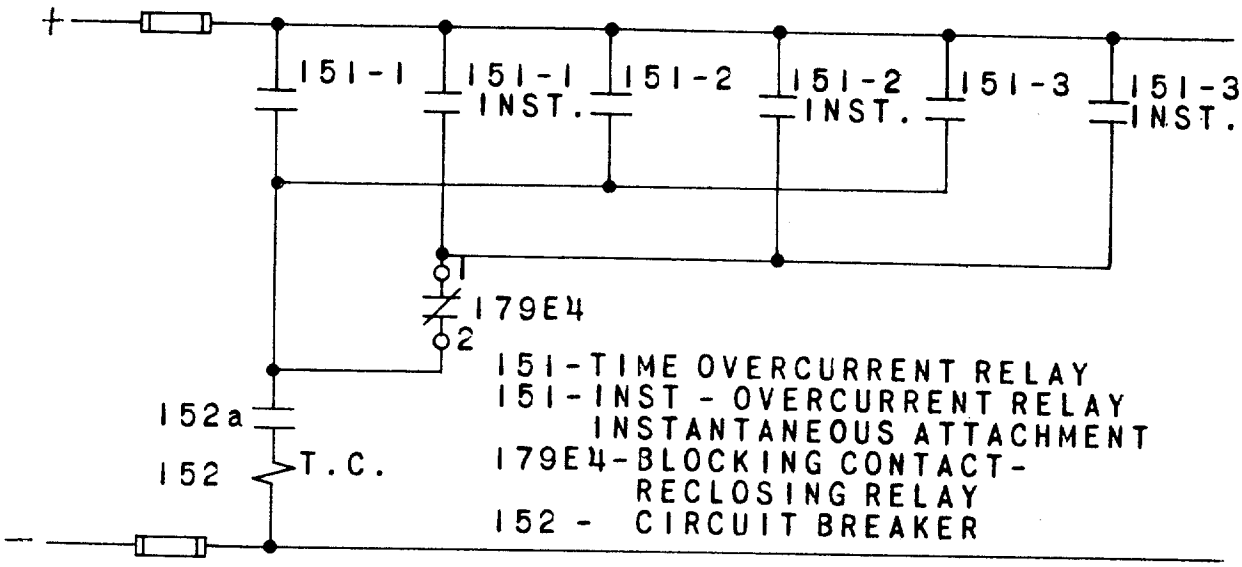


Fig. 11 (6556530-0) Typical Application of the ACR Relays Contact-to-Block Instantaneous Trip Circuit

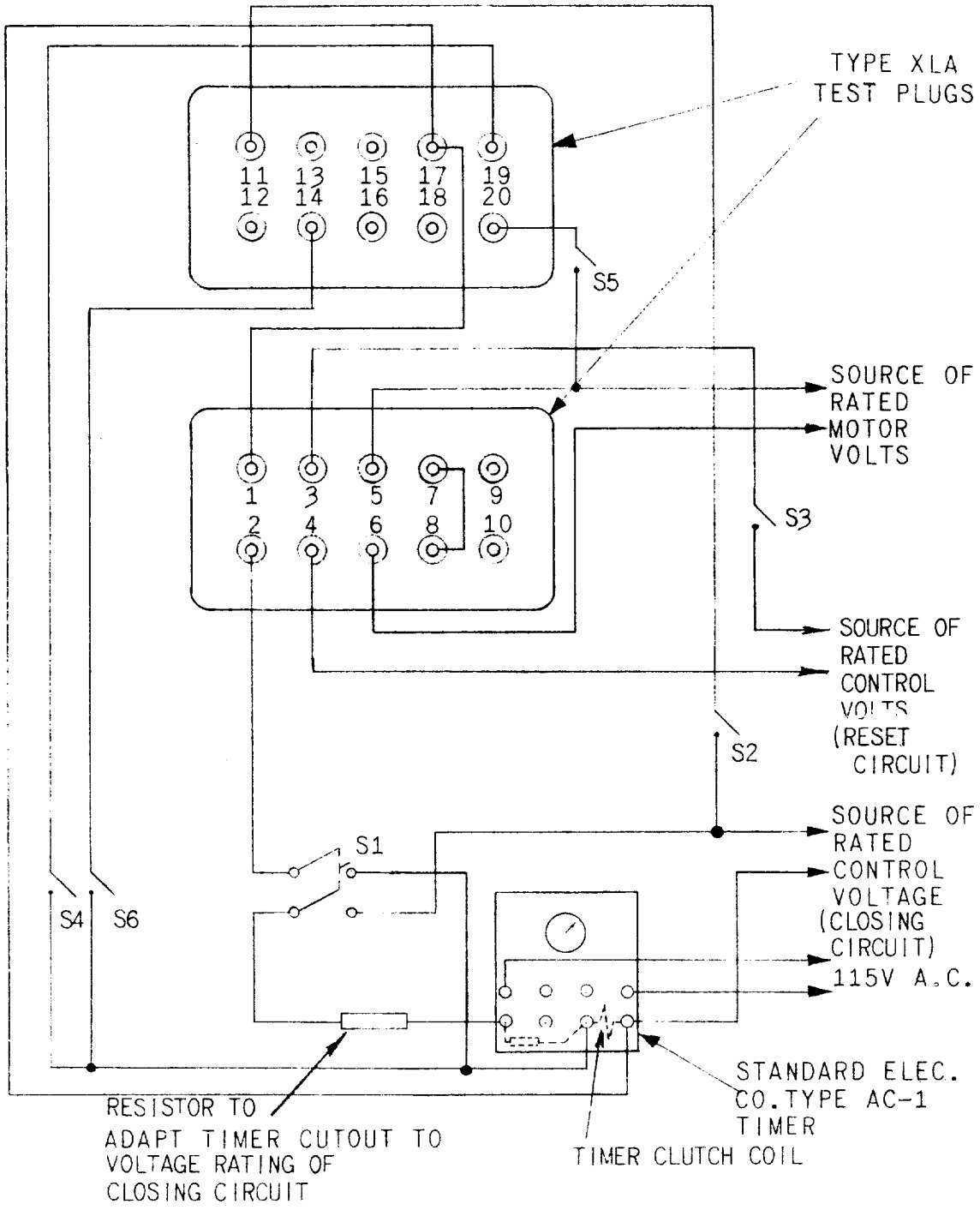
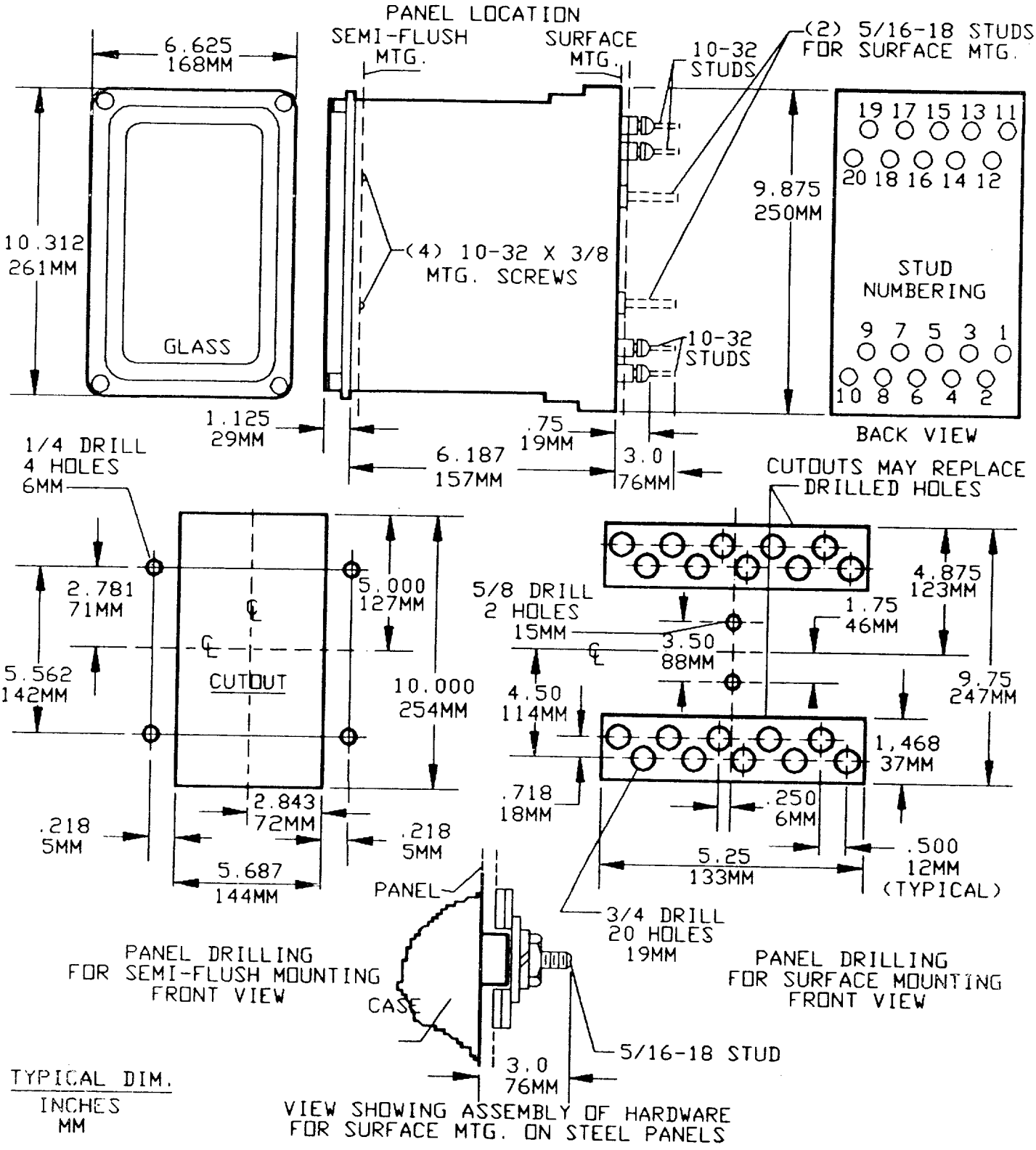


Fig. 12 (362A672-2) Test Connections for ACR Relays



* Fig. 13 (6209272-7) Outline and Panel Drilling Dimensions for ACR Relays

* Revised since last issue

GE Power Management

215 Anderson Avenue
Markham, Ontario
Canada L6E 1B3
Tel: (905) 294-6222
Fax: (905) 201-2098
www.ge.com/indsys/pm