



**INSTRUCTIONS**

**GEI-12071E**

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**TYPE AC-1 RECLOSER**  
**ROOT CAT. NO. 6070601**  
**IN DRAWOUT CASE**

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**LOW VOLTAGE SWITCHGEAR DEPARTMENT**  
**GENERAL  ELECTRIC**  
**PHILADELPHIA, PA.**

**NOTES**

# TYPE AC-1 RECLOSER

CATALOG 6070601

## Application

The AC-1 recloser is a timing device which, after a definite predetermined interval of time, automatically initiates the reclosing impulses to a circuit breaker which has been tripped by its protective device. One to three reclosures may be obtained before lockout against further reclosure impulses to a circuit breaker on a circuit still in trouble. The recloser automatically resets from the lockout position when the breaker is closed manually by means of the control switch. The AC-1 recloser may be adjusted to provide either an immediate initial reclosure or a delayed initial reclosure.

When the immediate initial reclosing feature is used the circuit breaker mechanism should be provided with a mechanism position switch or latch checking switch to check that the mechanism is ready to reclose the breaker, and the overcurrent relay contacts must be sufficiently fast in resetting after an overcurrent operation so that the breaker will not be tripped out when reclosed.

## Drawout Case

This instruction book is written to cover the above type relay mounted in the drawout case. The drawout case has studs for external connections at the bottom only. This is referred to as a "single-end" case. The electrical connections between the relay units and the case are made through stationary molded inner and outer blocks between which nests a removable connecting plug which completes the circuits. The outer block attached to the case has the studs for external connections and the inner block has terminals 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 both top and bottom and by two guide pins at the back of the case. 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 drawn to the cradle by thumb-screws, holds the connecting plug in place.

To draw out the cradle, the cover must be removed. Then, the connecting plug can be drawn out. In so doing, the trip circuit is first opened, and then the voltage circuits. After the connecting plug has been removed, the latch can be released and the cradle easily drawn out. To replace the cradle, 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 own source of current and voltage, or from other sources. Or, the cradle can

*These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.*

be drawn out and replaced by another which has been tested in the laboratory.

## Description

The recloser consists of a ball bearing motor, gear train, contact mechanism and an auxiliary relay unit all mounted in a drawout case. The motor, through the gear train, rotates a cam shaft. The cams engage pawls which operate four sets of single-pole, double-throw contacts.

The contacts from front to back are designated as follows:

- No. 1 - Set-up and reclosing (A-B-C)
- No. 2 - Motor lockout, (D-E-F)
- No. 3 - Motor transfer, (G-H-I)
- No. 4 - Bell alarm, (J-K-L)

The three front timing cams operate the No. 1 contacts. These cams may be adjusted by loosening the knurled nut at the front of the cam shaft.

A release button located on the right-hand side of the frame above the motor is provided for disengaging the driving motor from the cam shaft. When disengaged the latter may be rotated by hand to operate the contacts. The motor is of the universal series wound type. Its speed is controlled by a centrifugal governor which rapidly makes and breaks the motor circuit, thus holding its speed constant.

The auxiliary unit consists of a plunger-type magnet and operates its own two sets of contacts and a latch that engages the No. 1 and No. 2 cam-operated contacts when the device is adjusted for immediate initial reclosure, otherwise the latch is inoperative.

**NOTE:** The external connection diagram contained in this book is schematic only. It shows merely the general scheme of connections required and serves as a basis for describing the principle of operation. As there are numerous types of mechanisms available and in use, no specific connections for them are shown herein. Recommendations for specific connections may be obtained by referring complete data regarding the breaker mechanism to the nearest office of the General Electric Company.

## Operation

As the duty cycle including the immediate initial reclosure is the more commonly used, it will be covered completely.

Refer to Fig. 1 for the schematic wiring diagram (contacts shown in reset position of recloser and circuit assumed to have been tripped by means of the control switch).

Then to close manually, operation of control switch opens back contact (5) before closing the floating contact (7) so that the recloser does not move. Release of the control switch recloses contact number 5. All contacts in the circuit are now in the reset position. The "a" switch of the breaker is closed and the "b" switch is open and the mechanism position switch or latch checking switch is either open or closed depending upon the type used. In the recloser, the auxiliary unit contacts are open. A-B, D-E, G-H, and K-L are closed. The back contact (5) and the floating contact (7) of the control switch is closed, the A-B and D-E contacts are latched up but their operating levers are down.

When the circuit breaker trips, the "b" switch closes, the auxiliary unit picks up, seals itself in, and then trips the latch to open contacts A-B and D-E and close contacts B-C and E-F. By the closing of the contacts E-F, the motor is connected directly across the line. The breaker closing control relay is energized through the breaker "b" switch, and contacts B-C, K-L, and those of the auxiliary unit. When the breaker closes, its "b" switches open to release the auxiliary unit and the closing control relay.

The auxiliary unit is so adjusted that it closes its own contacts and seals itself in before tripping the latch to close contacts B-C and E-F. This sequence insures the energization of the breaker closing control relay. The latch is so constructed that both contacts A-B and D-E must be held up simultaneously by the front cams to effect the latching. This construction permits the reclosures following the first one to be executed in the standard manner; that is, after the first immediate reclosure, the breaker is closed on the subsequent reclosures in the following sequence:

When the front timing cam rotates, it picks up the contacts A-B which complete the circuit for the auxiliary unit which, in turn, picks up and seals itself in. When the cam passes on, contacts A-B open and B-C close, thus completing the circuit for the closing relay. When the "b" switches open, they drop out the auxiliary unit and the closing control relay.

At the end of the cycle, if the breaker is open, the "a" switch is open; consequently, when contacts E-F open, the motor stops and the recloser is in the lock-out position. Just before the contacts E-F open, K-L opens the closing circuit and J-K closes the bell alarm circuit.

After the breaker is manually closed the recloser will start since the "a" switch is closed, and will continue to operate until contacts H-I open where it will stop because the "b" switch is open.

**Characteristics**

One of three reclosures are available at any intervals throughout the reclosing cycle; however, the reclosures may not be closer than 5 seconds apart on a 3 minute timer, and proportionately close on other timers with different total timing cycles. Furthermore, the time between the last reclosure

and the lockout position should be sufficient to allow plenty of time for the breaker to trip again if the overload is still on.

With the adjustment outlined under "Immediate Initial Reclosure Duty Cycle" the breaker closing control relay impulse for the first reclosure is obtained within 4 to 5 cycles from the closing of the breaker "b" switch, if the latch checking switch has closed. This first reclosure is one of three reclosures that may be secured during the timing cycle.

Either one, two, or three reclosures may be obtained during the timing cycle by setting the front timing cams in line with each other, or one in line with another or all separated to different points on the dial.

With the adjustments outlined under "Delayed Initial Reclosure Duty Cycle", the minimum time between the closing of the breaker "b" switch and the breaker closing relay impulse for the first reclosure can be adjusted to approximately 60 cycles. This time is obtainable on reclosers having the 3 minute total timing cycle and is proportionately greater for the longer timing cycles.

The auxiliary unit is set to pick up and seal in at 80%, or possibly a little less, of the normal voltage.

The total timing cycle may be varied plus or minus 15% of nominal by adjusting the motor governor. For any adjustment of the motor governor, the speed is maintained within plus or minus 5% for 80 to 110% normal voltage.

**Adjustments and Inspection**

1. When the recloser is received, operate the pawls by hand to see that the contacts close and open with snap action, and that there is no tendency to stick in any part of the stroke.
2. Push the release button and turn the cam shaft by hand. It should rotate freely and easily when no cams engage the pawls. When the button is released the gears should re-engage with only a slight movement of the dial.
3. The gear train should be free from oil.
4. The motor has been oiled at the factory and should not require relubrication under ordinary circumstances in less than 6 months.
5. The motor speed and consequently the duration of the total timing cycle may be adjusted by turning the motor governor screw in to decrease time or out to increase time.
6. If it is desired to change the time interval between reclosures, loosen the knurled knob on the front of the graduated dial. The front cams may then be moved to the desired position. Any one of the cams may be adjusted without disturbing the others. In any event, no two consecutive cams should be closer than 1 division (10 deg.) on the dial. If

very accurate time intervals between reclosures are desired, the cam settings should be checked by means of a timing device.

7. If for any reason the settings of the back cams and pawls are disturbed, their proper adjustment may be restored in the following manner:

- (a) To adjust pawls, back off on supporting screw about 1 turn, make adjustment and then tighten up screw again. To adjust cams, back off on supporting screw about 1/8 turn, make adjustment and then tighten up screw again.
- (b) The pawls in no case should be so low that their top edge is forced against the movable contact arm when the pawl is raised by the cam.
- (c) By moving the pawls down, the contacts will pick up sooner and remain closed for a longer period of time, and vice versa if the pawls are raised. The references given need not be strictly adhered to. The important point is that the sequence must be as given when the recloser is driven by the motor. The No. 4 contacts may snap up at any point beyond the 35 mark on the dial that will enable the proper adjustment to be obtained.
- (d) The sequence of operation of the cams should be as follows, when rotating in a clockwise direction.

Immediate Initial Reclosure Duty Cycle

When the recloser is set for immediate initial reclosure the pawls are assembled in the arms as shown below; the rocker arm positions are numbered from the front of the relay in all cases.

<u>Position</u>	<u>Pawl Arrangement</u>
No. 1	one pointed pawl
No. 2	one pointed pawl
No. 3	one flat-ended pawl
No. 4	one pointed and one flat ended pawl

Where a pointed and flat-ended pawl are assembled on the same arm the flat-ended pawl should be next to the arm, and the pointed pawl directly under the screw head.

Starting about one division before the lockout position the sequence of pawl operation should be as follows.

- 1. No. 4 contact arm snaps up.
- 2. No. 1 contact arm snaps up.
- 3. No. 2 contact arm snaps up, and No. 1 and No. 2 contact arms latch up.

The above three operations must not occur in any other order, but any adjacent two or all three may occur simultaneously. At this point, if the "a" switch on the breaker is open, the recloser is locked out. However, if the "a" switch is closed the recloser continues its cycle as follows:

- 4. No. 2 pawl snaps down.
- 5. No. 1 pawl snaps down.
- 6. No. 4 contact arm snaps down.
- 7. No. 3 contact arm snaps up.

The above four operations must not occur in any order, but any adjacent two or three of all four may occur simultaneously. If the "b" switch of the breaker is open the recloser coasts to the zero, or starting, position due to opening of H-I contacts when No. 3 contact arm operated.

On a subsequent timing cycle initiated by the tripping of the breaker and closing of the "b" switch the following sequence occurs:

- 8. No. 1 and No. 2 contact arms snap down.
- 9. No. 3 contact arm snaps down.

The No. 4 contact arm should not snap up until after the front pawl is approximately at the 35 mark on the dial. The pawls of No. 1 and No. 2 contact arms should be raised so that they are engaged with the cams the minimum time required to positively latch both contact arms. Contact No. 3 should snap up just enough before the zero mark on the dial is under the front pawl so that the timer will coast to the zero or reset position. These settings are secured by adjusting the cams and pawls. As a starting point in making these adjustments, set each pawl so that the top of the pawl extends about 1/16" above the top of the support. These adjustments should be varied until the preceding sequence of operation is obtained.

Note that in the reset position contacts No. 1 and 2 are held in the closed position by the latch arm, and that the cams have cleared so that the pawls reset. Thus upon the closure of the breaker "b" switch the operation of the reclosure auxiliary unit disengages the latch, closing contact BC and initiating a breaker reclosing impulse within four to five cycles after the closing of the "b" switch.

Delayed Initial Reclosure Duty Cycle

When the recloser is set for a delayed initial reclosure the pawls are assembled in the arms as shown below:

<u>Position</u>	<u>Pawl Arrangement</u>
No. 1	one pointed pawl
No. 2	three flat ended pawls
No. 3	one pointed and one flat-ended pawl.
No. 4	one pointed and one flat-ended pawl.

When a recloser is ordered and shipped from the factory set for immediate initial reclosure additional flat-ended pawls are shipped with the relay so that changeover from immediate initial to delayed initial reclosure can be easily effected. These extra pawls are fastened under one of the upper mounting nuts which clamps the relay frame to the cradle.

Starting about one division before the lockout position the sequence of operations should be as follows:

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1. No. 4 contact arm snaps up.
2. No. 2. contact arm snaps up.

At this point if the "a" switch on the breaker is open the recloser is locked out. The interval between operations 1 and 2 should be great enough so that the pawls in position No. 3 are bearing against the No. 3 cam in the lock-out position. If the "a" switch on the breaker is closed the recloser continues its cycle as follows:

3. No. 4 contact arm snaps down.
4. No. 3 contact arm snaps up.

These last two operations must not occur in opposite order but may occur simultaneously. If the "b" switch on the breaker is open the recloser will coast to zero or reset position.

On subsequent timing cycle initiated by the tripping of the breaker and the closing of the "b" switch the following sequence occurs:

5. No. 2 contact arm snaps down.
6. No. 3 contact arm snaps down.

Operation No. 6 may occur several seconds after operation No. 5.

For this duty cycle none of the front cams should be set to operate the No. 1 contact arm between the No. 35 mark and the zero mark on the dial (except when set for the minimum delayed reclosure as described later). The adjustment will then be such that the cams of No. 1 and No. 2 contacts operate at different times and the latch will not engage them. It is only when they are operated simultaneously that the latch will engage them. The cams and pawls should be adjusted to obtain the sequence of operations outlined above. As before for a starting point in making these adjustments, set each pawl so that the top of the pawl extends about 1/16 inch above the top of the support.

The minimum time adjustment of 60 cycles referred to under "Characteristics" is obtained by adjusting one of the front cams to raise the front pawl so that it has just snapped up when the recloser is in the reset position. Thus when the recloser is energized by the closing of the "b" switch the No. 1 cam will pass the pawl and close the BC contact as soon as the motor has restarted. It is important

when making this adjustment that the No. 2 contact arm snaps down prior to the opening of the "b" switch on the breaker. This is important because the breaker has been reclosed through the action of the No. 1 contact and it is necessary that the No. 2 contact "seal in" the motor circuit around the "b" switch of the breaker to insure completion of the recloser timing cycle.

Auxiliary Unit

1. The auxiliary unit contacts should be adjusted so they are engaged before the latch releases the contact arms on the downward stroke of the plunger.

2. After the latch has tripped and the plunger is released, there should be about 1/16" separation of the contacts.

3. The contact wipe should be about 1/16".

Maintenance

The AC-1 recloser should require very little attention except oiling of the motor once every six months. About three drops of a very thin high grade (jewel) oil should be placed in each oil tube. In very hot climates the period between oiling should be reduced or a heavier lubricant used.

The contacts should be cleaned whenever discolored, by scraping with a file or knife. Do not use sandpaper, emery or crocus cloth on contacts.

Ratings

The standard recloser device is satisfactory for operation on 125 volts d-c or 220 to 260 volts, 25-50-60 cycles. However the timing interval should be checked and readjusted where necessary when the impressed voltage differs from that given on the nameplate.

The auxiliary unit can be adjusted for use with either a-c or d-c control circuits by means of an internally mounted tapped resistor on its coil circuit.

The following table gives information regarding the auxiliary unit:

<u>VOLTAGE</u>	<u>FREQ.</u>	<u>TAP PLUG POSITION</u>
24	D-C	Ext. or 24 V-D.C.
48	D-C	Ext. or 48 V-D.C.
125	D-C	125 D-C
250	D-C	250 D-C
115	25	115 25 cycles
115	50	115 50/60 cycles
115	60	115 50/60 cycles
220 to 260	25	220 to 260 25/60 cycles
220 to 260	50	220 to 260 25/60 cycles
220 to 260	60	220 to 260 25/60 cycles

Ratings and Burden of Motor

Four ratings of motors, with operating ranges in volts as shown in the following table, are used in the AC-1. These ratings are: 24 volts d-c; 48 volts d-c; 115 volts a-c, 25-60 cycles; and a universal

motor suitable for either 125 volts d-c or 230 a-c volts, 25-60 cycles. This latter motor is also used with internal resistor or 250 volts d-c, as shown in Fig. 1. Internal resistors, similarly connected, are also sometimes used with the other motors where the AC-1 relay is to be used on other non-standard voltages.

Rated Volts		Operating Range in volts		Volt-ampere Burden at Rated Volts *	
D-C	A-C 25/60 cyc.	D-C	A-C	D-C	A-C 60 cyc.
24		19-26		13	
48		38-52		13	
	115		98-126		25
125	230	100-138	185-253	11	32
250		200-275		22	

\* This burden occurs only during the operation of the AC-1 relay as the motor, as well as the auxiliary unit coil, are normally de-energized.

Insulation Tests

The motor in the AC-1 recloser is a universal motor and therefore is designed for only a 900 v a-c insulation test, in accordance with ASA standards for rotating electrical machines.

The remainder of the relay is designed to withstand 2500 a-c volts.

In order to avoid damage to insulation due to repeated applications of stress near its ultimate strength, there should be a differential between the level of the original acceptance test (values given above) and that of subsequent check tests. The necessity for this differential has been recognized by NEMA Standard No. 44-92, Par. SG-4-22 which rec-

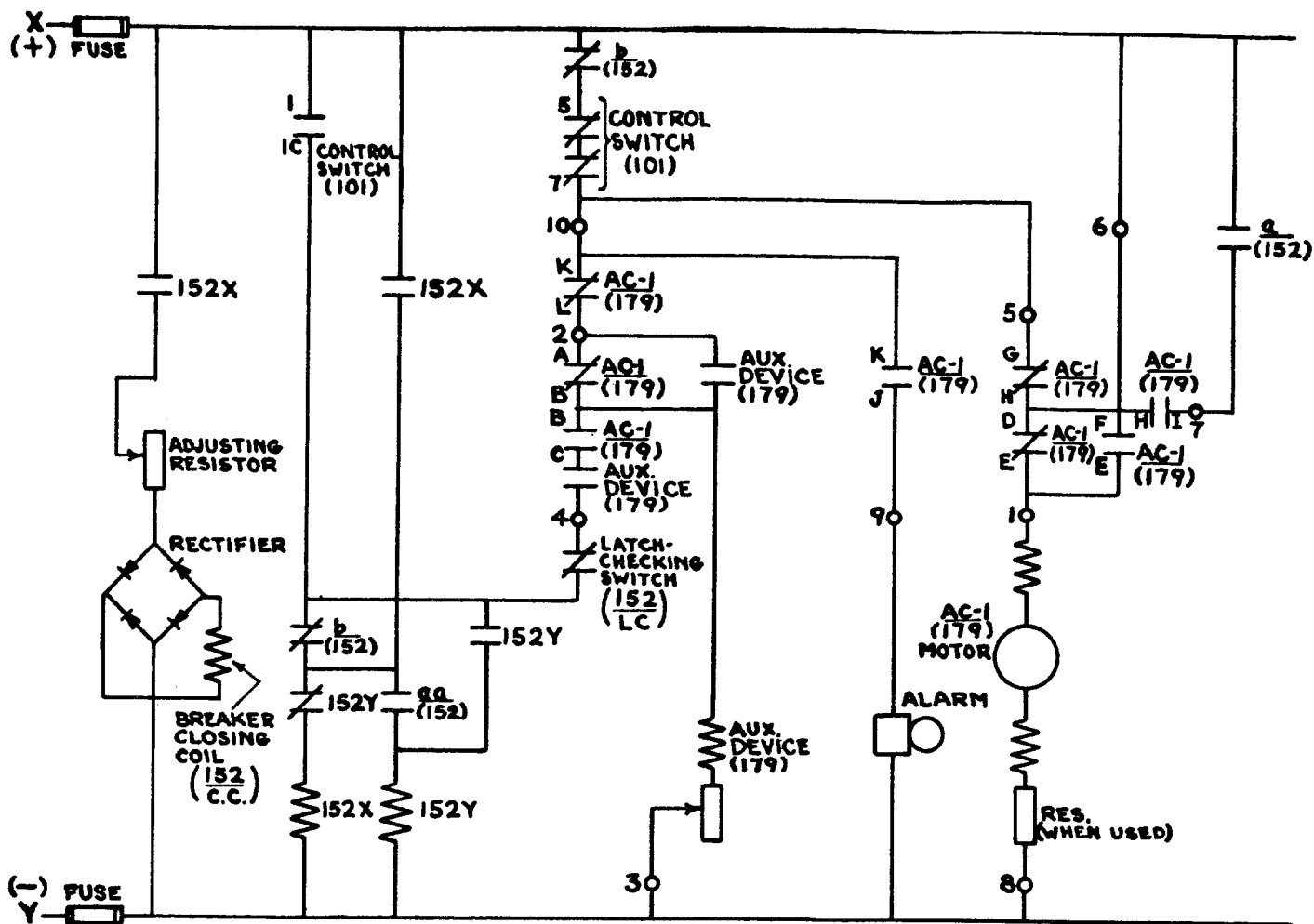
ommends testing at 0.75 times the original test values for one minute as specified for new equipment.

If it is desired to give the relay an insulation check above 900 v a-c, the motor should be disconnected by leaving stud 8 disconnected from the test supply and blocking open both throws of the D-E-F contacts; this is the second of the four sets of toggle contacts, counting from the front. This can be seen by reference to Figure 1.

Renewal Parts

When ordering renewal parts, describe the required part in detail and give the catalog number and rating of the relay as they appear on the nameplate.

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- NOTES-
- 1-WHEN USING D-C CONTROL SOURCE OMIT ADJUSTING RESISTOR AND RECTIFIER IN BREAKER CLOSING COIL CIRCUIT.
  - 2-NUMBERS IN PARENTHESES ARE DEVICE FUNCTION NUMBERS.
  - 3-STUD NUMBERS ARE FOR AC-1 IN DRAWOUT CASE.

- Q -AUX. SWITCH OPEN WHEN BREAKER IS OPEN
- b -AUX. SWITCH CLOSED WHEN BREAKER IS OPEN
- QQ -CUTOFF SWITCH CLOSED WHEN BREAKER OPERATING MECHANISM IS IN OPERATED POSITION
- 152 X -CLOSING RELAY FOR 152
- 152 Y -CUTOFF RELAY FOR 152
- 152 -CIRCUIT BREAKER

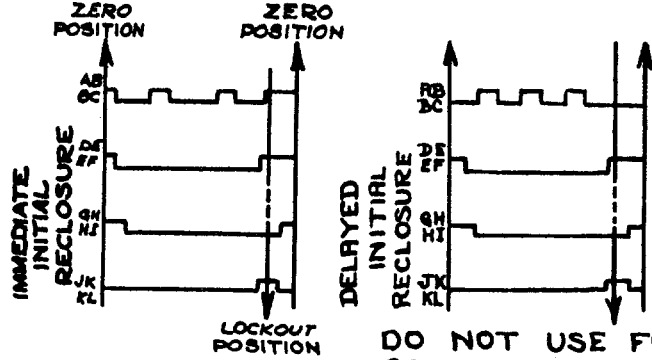
HANDLE END	CONTACT NUMBER	NORMAL AFTER TRIP	CLOSE	NORMAL AFTER CLOSE	TRIP
1     1c     2	1		X		
	2				X
3     4	3		X		X
	4		X		
5     5c     6	5	X		X	
	6				
7     7c     8	7		X	X	
	8		X	X	

CONTROL SWITCH (101) SB1B2 - SPRING RETURN TO NORMAL - X DENOTES CONTACT CLOSED

FIG. 1  
ELEMENTARY DIAGRAM FOR AC-1 RECLOSER AND SOLENOID OPERATED MECHANISM (DRAWOUT CASE)



SEQUENCE OF CONTACT OPERATION



DO NOT USE FOR CATALOG K-6178903

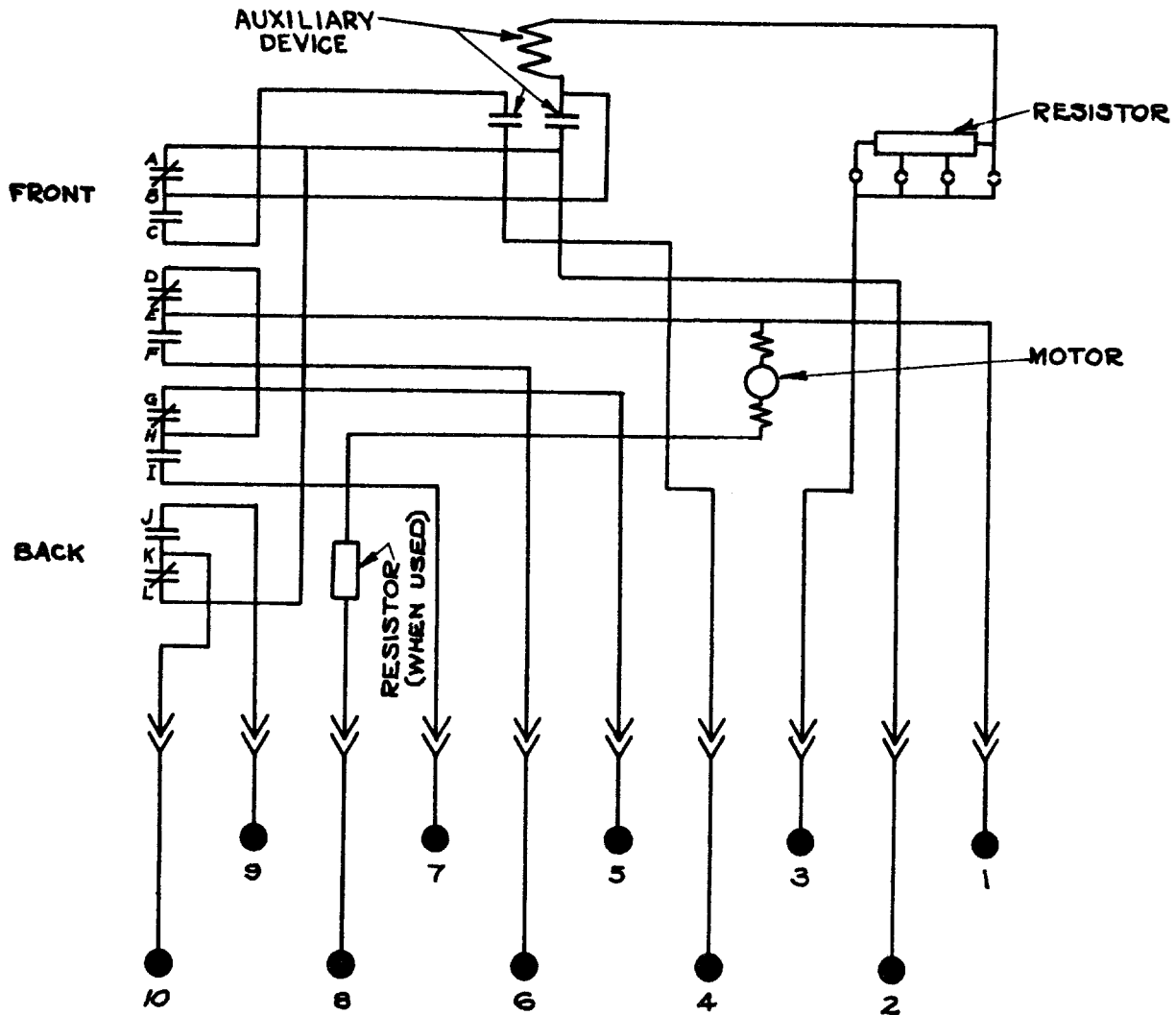
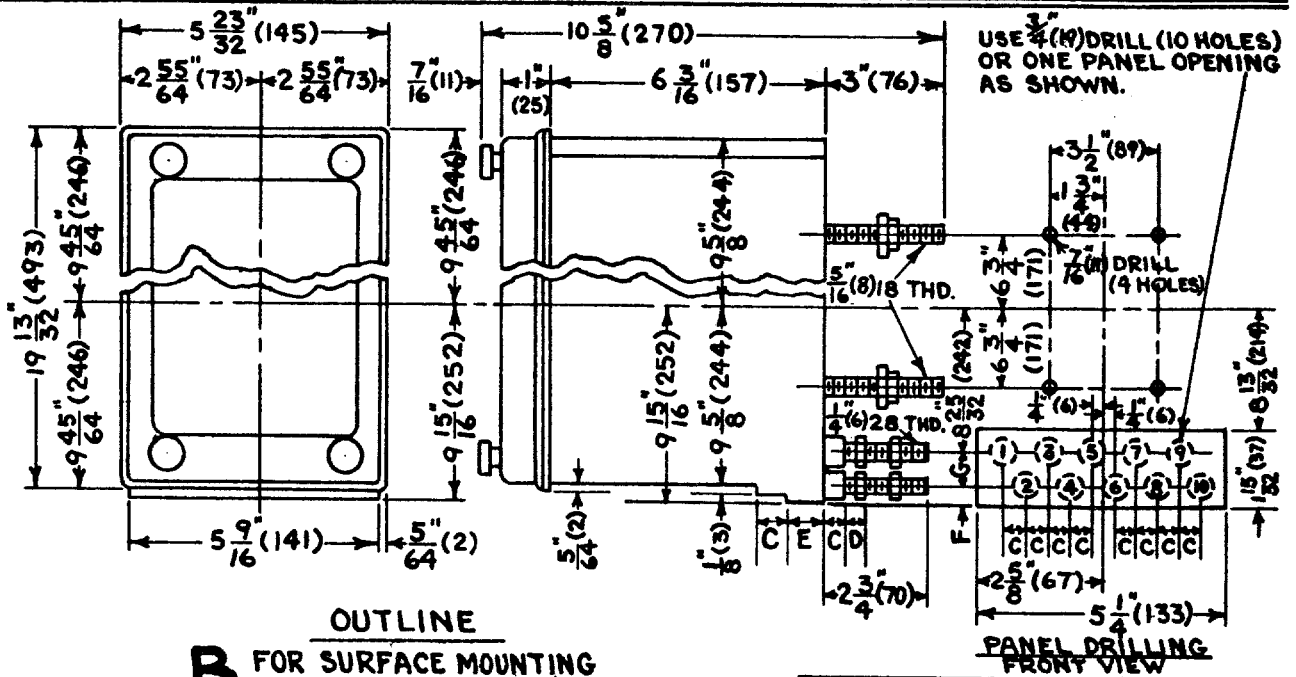
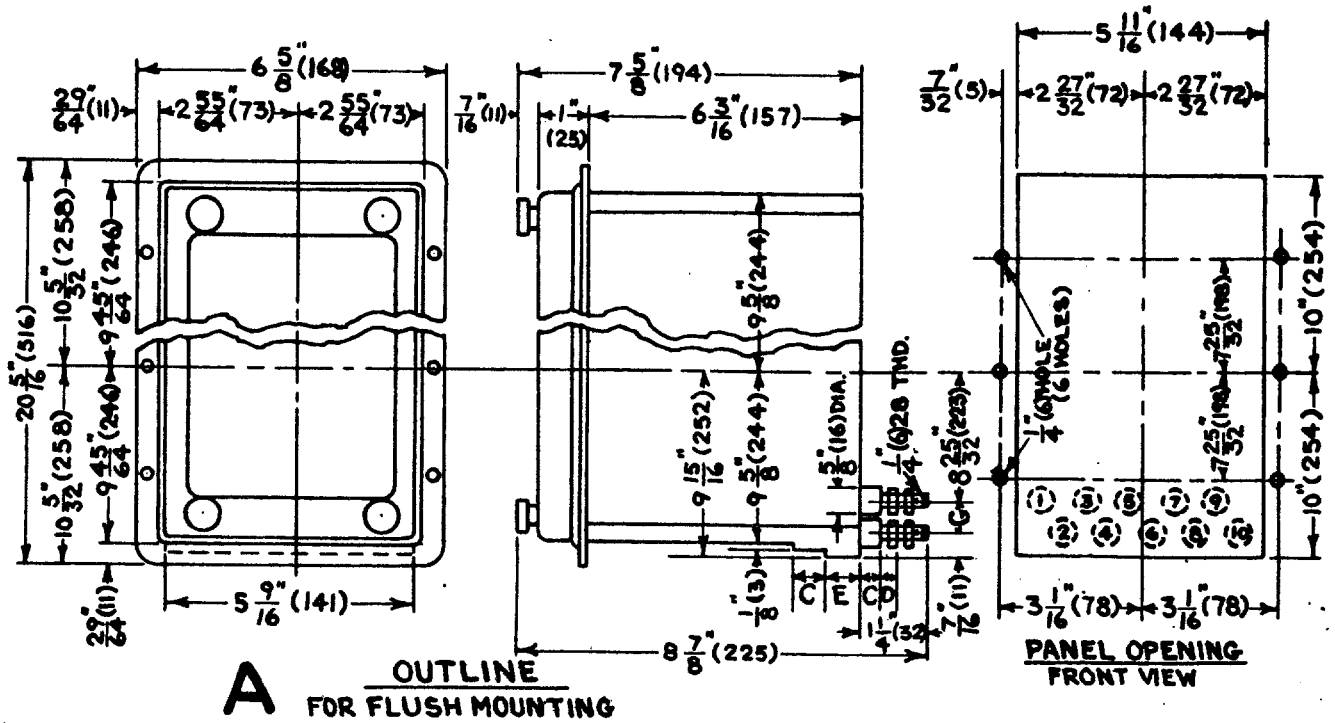


FIG. 2  
INTERNAL CONNECTIONS FOR AC-1 RECLOSER (BACK VIEW)



	C	D	E	F	G
ENGLISH	$\frac{1}{2}$	$\frac{7}{32}$	$\frac{3}{16}$	$\frac{1}{16}$	$\frac{23}{32}$
METRIC	(13)	(5)	(21)	(11)	(18)

FIG. 3  
OUTLINE AND PANEL DRILLING FOR DRAWOUT CASE-THREE  
UNIT-SINGLE END