

AUTOMATIC RECLOSER—TYPE RC

Application

The type RC recloser is a synchronous motor driven device for automatically reclosing A-C. or D-C. electrically operated breakers. It incorporates those features found desirable through years of experience in the field of automatic reclosing, and is an integral part of the complete line of Westinghouse Related Switchgear and associated apparatus.

Automatic reclosers find their chief applications for sectionalizing distribution feeders where continuity of service is of paramount importance to the load served as well as to the reliability of the main feeder.

Furthermore, from the standpoint of better service to the power consumer and improving the potential market for load-building apparatus, utilities find RC reclosers desirable for minimizing duration of power failures or reducing outages to an unnoticeable minimum length of time.

The recloser is normally arranged for a total of three reclosures, the first of which may be immediate or time delay as desired, with automatic reset if the breaker stays in, and lockout if the breaker trips immediately after the third reclosure. The recloser is anti-pumping and adaptable for either A-C. or D-C. electrically-operated breakers. For certain applications where cumulative operation should be limited, an adjustable integrating lockout device can be added, on special order, which device will lockout after a total of sixteen reclosures or less. The recloser is normally de-energized and is usually started, when the breaker is automatically tripped, by the closing of "b" auxiliary switches on the breaker mechanism. For any reclosing breaker application there must exist a proper coordination between the several elements involved. The RC recloser has been designed for this purpose, and few different models are required for the many control schemes in common use.

For any reclosing breaker applications, it is necessary to supply in addition to the recloser itself, suitable pro-

tective relay equipment, auxiliary switches, control relay, control switch and a source of control energy.

The usual reclosing breaker equipment consists of the following properly coordinated elements:

- (a) Source of control energy single phase A-C. 60 cycle, D-C. or both.
- (b) Suitable circuit breaker mechanism for the particular control energy supply, preferably with a latch checking switch, and the necessary "a" and "b" auxiliary switches.
- (c) Suitable control relay with "seal in" auxiliary contact or of the "hesitating" release design.
- (d) Suitable protective relays for automatically tripping the breaker under abnormal system conditions.
- (e) Manually operated control switch for breaker with "floating" and "slip" contacts to block action of recloser when breaker is manually tripped from control switch. Type W control switch, Style 117328, has all of above features.
- (f) "Cutout" switch to render recloser inoperative during testing or adjusting of breaker or protective relays.
- (g) RC recloser with proper motor winding and auxiliary coils for the control supply provided.

Typical schematic diagrams are shown in Fig. 6.

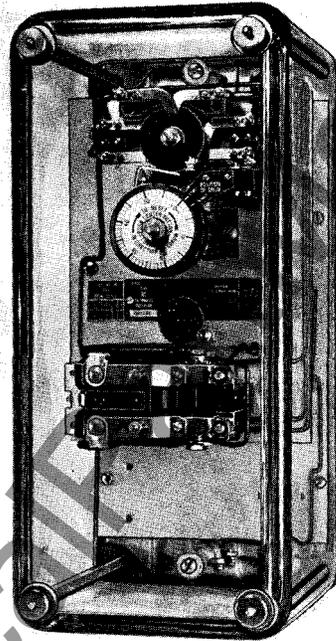


FIG. 1—TYPE RC AUTOMATIC RECLOSER FOR PROJECTION MOUNTING

General Notes on Application of Closing Equipment

Although no complete discussion of breaker closing mechanism is provided here, in applying reclosers it is necessary to investigate various mechanical details and interlocks in order to be sure that the automatic features will work satisfactorily. Westinghouse reclosers are so designed that if the proper precautions are taken, automatic reclosing can be applied to all types of electrically-operated breakers.

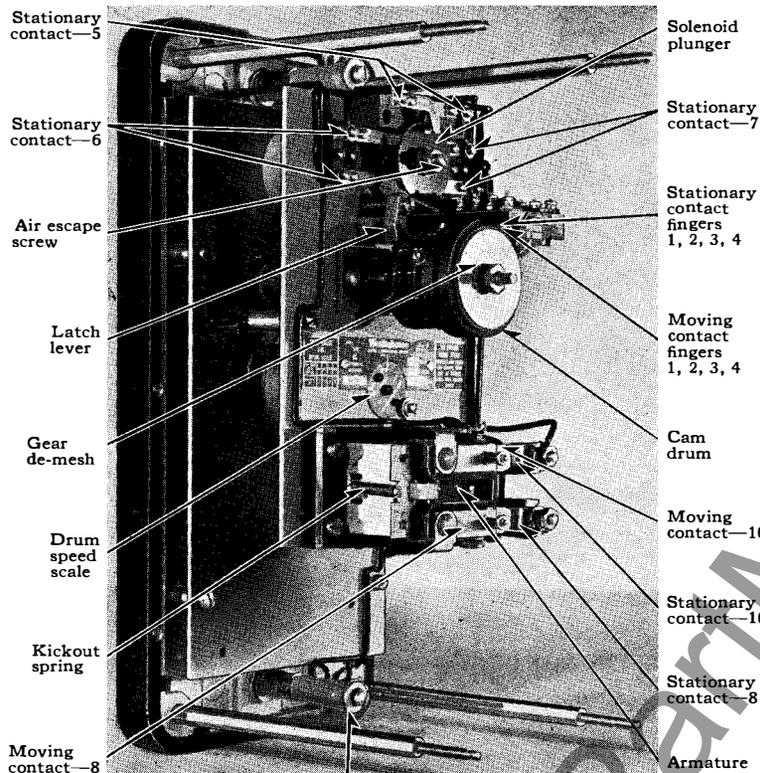
For mechanically non-trip free mechanisms the control relay cut-off must have enough time delay so that the breaker is completely latched before the energy is removed from the closing coil.

For mechanically trip-free breakers, particularly under the condition of immediate reclosing, in addition to the above, it is necessary to insure that the closing mechanism is securely latched to the breaker operating rod before energy is applied to the closing coil. Otherwise, it is possible for the recloser to energize the closing mechanism without closing the breaker. The RC recloser can take care of the above condition by means of the time delay in the solenoid element. A mechanical latch checking device must be supplied on the breaker mechanism is preferred however.

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AUTOMATIC RECLOSER—TYPE RC—Continued



Series resistor top and bottom, for auxiliary relay circuit and motor circuit respectively.
 FIG. 2—TYPE RC RECLOSER WITH COVER REMOVED
 THREE-QUARTER FRONT VIEW

In applying automatic reclosing equipment, it is also necessary to check the protective relays to be sure that their contacts will open before the breaker recloses, in order to insure the trip circuit being de-energized thus preventing unnecessary tripping.

When using initial immediate reclosure, minimum service interruptions in consumer plants will occur if proper application is made on the customer's apparatus of such under-voltage time delay, field removal, and synchronous motor unloading devices are necessary.

For some types of motor operated closing mechanisms a brake should be provided to assure the latching of the closing mechanism between successive reclosures.

For any automatic reclosing application, care should be taken to check the NEMA de-rating factors for breaker interrupting ability when choosing any particular reclosing cycle.

Where existing breaker installations are converted to automatic reclosing duty, the problem of extra control wires is quite frequently a serious one. Designs are available, whereby an extra internal contactor (known as the Z element) can be added to the RC recloser. The coil of this Z element is connected in parallel with the green indicating lamp and its double-throw contacts take the place of the usual "a" and "b" auxiliary switches normally used to control the recloser.

If all D-C. operation is required the motor is energized from a small separately mounted (vibrating type) inverter.

In Table I, a schedule of a few typical operating cycles is given to show the manner in which the #3 and #5 cam screws are set to give these reclosing cycles.

The minimum time between any two reclosure positions must not be less than:

- 10 seconds for drum speed of 60 seconds per rev.
- 15 seconds for drum speed of 90 seconds per rev.
- 30 seconds for drum speed of 180 seconds per rev.
- 60 seconds for drum speed of 360 seconds per rev.

TABLE I—OPERATING CYCLE

Auto.	Time Interval Sec.	Auto.	Time Interval Sec.	Auto.	Time Interval Sec.	Auto.	LOCATE IN LINE WITH NO. 3 CAM	ADJUSTABLE CAM DIV. ON FACE OF CAM DRUM NO. 5 CAM	Required Gear Setting
*Open	15	C & O	..	.....	..	.....	16	11	60 Sec.
*Open	15	C & O	15	C & O	15	Closing	16-31-46	11-26-41	60 Sec.
Open	0	C & O	15	C & O	60	Closing	1-11-41	56- 6-36	90 Sec.
Open	0	C & O	30	C & O	75	Closing	1-11-36	56- 6-31	180 Sec.

* No immediate initial reclosure.

C & O represents automatic closing and opening. After final closing the breaker may stay in, in which case the recloser will reset, or the breaker may trip out, in which case the recloser will lockout.

AUTOMATIC RECLOSER—TYPE RC—Continued

TABLE 2—IMMEDIATE INITIAL RECLOSURE, DEFINITE LOCKOUT AFTER THIRD RECLOSURE

PROJECTION MOUNTING			
Without Cumulative Lockout			
Style No.	Motor Rating	Auxiliary Relay Ratings X and Y	Z
1 101 735-A	115 or 230 V. 60 Cycles	115-230 V. A-C. or 125 V. D-C.	.....
1 101 737	115 or 230 V. 60 Cycles	250 V. D-C.	.....
1 101 739-A	115 or 230 V. 60 Cycles	115-230 V. A-C. or 125 V. D-C.	125 V. D-C.
1 101 741	115 or 230 V. 60 Cycles	250 V. D-C. 250 V. D-C.	.....
With Cumulative Lockout†			
1 101 735-A-S	115 or 230 V. 60 Cycles	115-230 V. A-C. or 125 V. D-C.	.....
1 101 739-A-S	115 or 230 V. 60 Cycles	115-230 V. A-C. or 125 V. D-C.	125 V. D-C.
*1 155 700	115 or 230 V. 60 Cycles	115-230 V. A-C. or 125 V. D-C.	.....
SEMI-FLUSH MOUNTING			
Without Cumulative Lockout			
1 101 736-A	115 or 230 V. 60 Cycles	115-230 V. A-C. or 125 V. D-C.	.....
1 101 738	115 or 230 V. 60 Cycles	250 V. D-C.	.....
1 101 740-A	115 or 230 V. 60 Cycles	115-230 V. A-C. or 125 V. D-C.	125 V. D-C.
1 101 742	115 or 230 V. 60 Cycles	250 V. D-C.	250 V. D-C.
With Cumulative Lockout†			
1 101 736-A-S	115 or 230 V. 60 Cycles	115-230 V. A-C. or 125 V. D-C.	.....
1 101 740-A-S	115 or 230 V. 60 Cycles	115-230 V. A-C. or 125 V. D-C.	125 V. D-C.
*1 155 701	115 or 230 V. 60 Cycles	115-230 V. A-C. or 125 V. D-C.	.....

* These styles have #6 contact isolated, primarily for use with breakers using spring closing and low voltage trip. Also for rectifier control and CSP transformers.

† The cumulative lockout is made part of the X auxiliary relay.

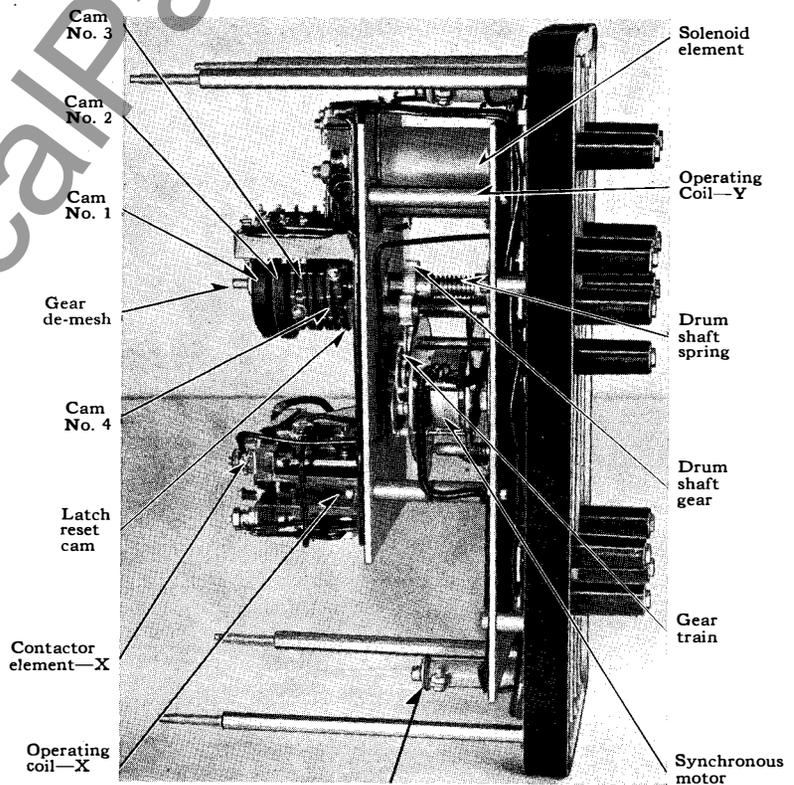
Note: Recloser can be supplied with X, Y, and Z coils for 24 or 48 volts, D-C. on special order.

For 25 cycle applications when 125 volt or 250 volt D-C. breaker control is used, use a 60 cycle recloser and add inverter S#1008549 (plus potentiometer resistor for 250 V. D-C.) for motor circuit. Where breakers are 25 cycle A-C. operated, use type GR recloser.

Type RC automatic reclosers may be sold for use only with circuit breakers manufactured by Allis-Chalmers Mfg. Company, Delta Star Elec. Co., General Elec. Co., Pacific Elec. Mfg. Co., Roller Smith Co., and Westinghouse Elec. & Mfg. Co.

Features

- (1) Synchronous Motor Driven Cams.
- (2) Oilless Bearings—No oiling, no maintenance.
- (3) Motor leads brought out to separate terminals, to separate motor circuit from auxiliary relay circuits. This permits wider application for a given style recloser.
- (4) Motor has suitable series resistor allowing application on 230 volts or 115 volts, 60 cycle control source.
- (5) The auxiliary relays within the case have suitable coils and magnetic circuits to permit use on either 125 volts D-C., 115 volts A-C., or 230 volts A-C. control source without change. Facilitates easy station change-over to battery control.
- (6) Addition of Z-element to recloser eliminates necessity of additional control wiring when applying the RC recloser to existing electrically operated breakers. (Fig. 4).
- (7) Projection or semi-flush mounting.
- (8) Available for standard fixed or Plug-in mounting.



Series resistor top and bottom, for auxiliary relay circuit and motor circuit respectively

FIG. 3—TYPE RC RECLOSER WITH COVER REMOVED
RIGHT HAND SIDE VIEW

AUTOMATIC RECLOSER—TYPE RC—Continued

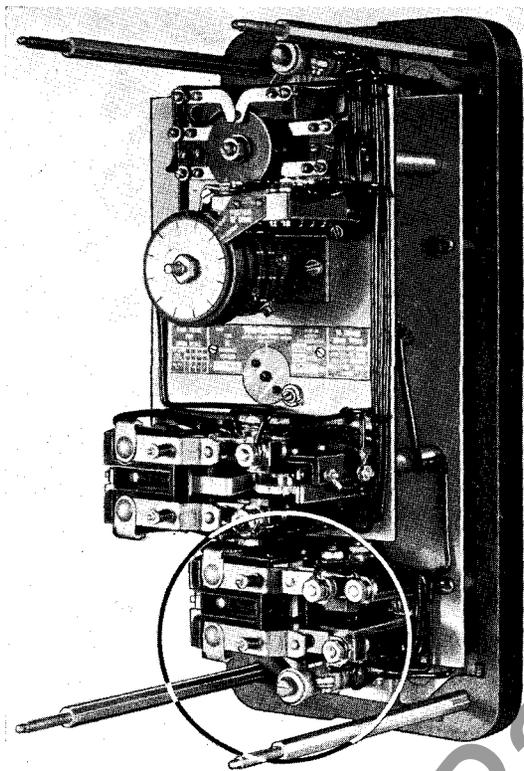


FIG. 4—TYPE RC RECLOSER WITH Z-ELEMENT SHOWN IN CIRCLE

Construction

The type RC recloser consists essentially of a synchronous motor-driven set of cams and normally two self-contained auxiliary relay elements which provide immediate or delayed initial reclosure, and also provide for several subsequent timed reclosures. Figures 2 and 3 show the arrangement of parts for the general design of RC reclosers.

The type RC recloser is mounted on a metal base with a molded glass cover. The base has terminals in the rear for external connections. The recloser is suitable for mounting on any of the usual panel materials—steel, slate or ebony asbestos. Various combinations of voltage coils and assembly of elements can be obtained for either projection surface or semi-flush panel mounting. All electrical contacts are silver to silver and of ample carrying capacity for the service required of them. All new Standard RC reclosers have (11) eleven rear connected terminals. The internal wiring arrangement for models without Z element is shown in Fig. 5. For models using the Z element its coil is connected

in the recloser circuit with several internal wiring changes.

The same drilling plan and outlines apply to all models. Figures 7 and 8 show these for both projection mounting and semiflush mounting.

Reclosers are available for "plug-in" case and contact or for fixed mounting with screw-held terminals. Plug-in mounting permits removal without disconnecting any leads. There need be no removal of parts and no lengthy disruption of protective circuits as a spare unit can promptly be inserted in place of the removed circuit. This feature permits central laboratory testing.

The synchronous motor driving the cam drum is arranged for either 115 or 230 V., 60 cycle single phase supply by the use of a 115 V. motor winding and a small series resistor. The latter is bypassed by a jumper for 115 V. operation. Fifty cycle motors are available for the RC recloser but not 25 cycle.

The contactor and solenoid elements are available for the more common control voltages such as 115 and 230 V., A-C. 125 and 250 V., D-C. Coils. 24 V. and 48 V., D-C. are not standard but can be supplied on special order.

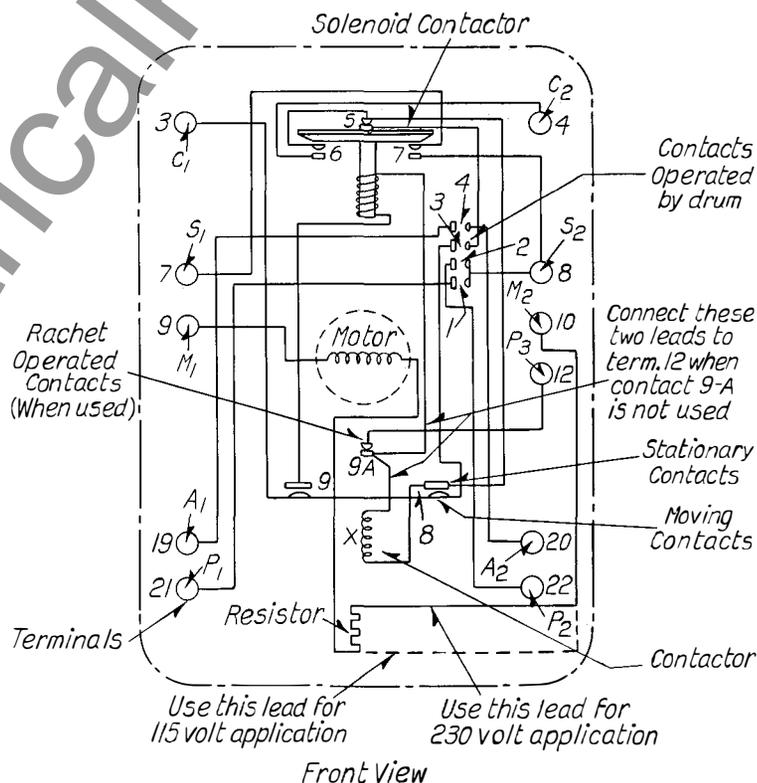


FIG. 5—TYPICAL INTERNAL DIAGRAM

AUTOMATIC RECLOSER—TYPE RC—Continued

The most popular assembly of RC recloser is the one with synchronous motor arranged for 115 or 230 V. 60 cycle and the auxiliary elements for either 230 V. 60 cycle or 125 V., D-C. breaker control. This model is carried in stock completely assembled for projection panel mounting. Certain stock parts are carried to permit changing over this recloser Style 1101735 to many of the other more commonly used types of reclosers.

Solenoid Element (179Y)

This auxiliary device is located in the upper part of the recloser and is a solenoid with a magnetic stainless steel plunger riding in a bronze tube which is closed at one end. When its coil is energized the movement of the plunger is slightly retarded, as normally the only escape for the imprisoned air is through a small clearance between the plunger and the bronze tube. This time delay feature is used with mechanically full-automatic breaker mechanisms where no checking device is available on the latch mechanism. When non-automatic breaker mechanisms or trip-free mechanisms equipped with latch checking contacts are used, the time delay feature is not required and quick action of this plunger can be obtained by removal of the "air escape screw" on the front of the solenoid plunger which allows the air to escape through the hole in the plunger. There is no intermediate air adjustment.

Synchronous Motor-Driven Cam (179M)

The synchronous motor drives a gear train which in turn rotates the cam drum. The time for one revolution of this cam drum can be readily adjusted to give one revolution in 60, 90, 180 or 360 seconds. The face of the cam drum is marked in 60 divisions, so that with the 60-second gear setting, each of the divisions represents one second. For any of the other gear settings the simple multipliers shown on the nameplate give the value in time of each division on the cam drum. This scale marking greatly facilitates the adjustment of cam screws for "setting up" the desired reclosing cycle as described in Table I and associated paragraphs.

A pushbutton (gear de-mesh) at the front of the drum disengages the gears from the cam. It should be used when

ever the drum is moved by hand either to change the gear speed, to check the cam operation, or to set the cam screws. The drum should always be rotated in the direction of the arrow, counter-clockwise—Never clockwise.

Typical Electrical Connections

The RC recloser can be used for either A-C. or D-C. closing of breakers. Figure 6 shows a typical schematic wiring for A-C. control where the number of control wires is not a factor, that is, where the recloser is mounted adjacent to its breaker.

Certain designs of reclosers which include an extra auxiliary relay (known as the Z element), are available for use wherever it is desirable to employ only the minimum number of control wires between a switchboard and a remotely controlled breaker. No additional control is required for this model.

The synchronous motor is normally energized from either 220 V., A-C. in case of rectox operated solenoid mechanism (where the operating transformer can run the motor) or 115 V., A-C. from any available source such as station lighting current or potential transformer.

The motor takes but 8 V-A. when running and is designed for intermittent service. It has a 15 minute continuous service rating without injurious heating.

For cases where D-C. breaker control is used and an A-C. supply for the synchronous motor cannot be considered reliable, the motor can be energized by an Inverter. This is a mechanical vibrator operated from 125 V. or 250 V. D-C. and delivers 60 cycle impulses to the motor. Such an Inverter is supplied only on special order.

The contactor element 169X and solenoid element 179Y are also designed for intermittent duty. When operated from 60 cycle A-C. the two devices draw 150 V-A. from the control circuit, on D-C. circuits they draw approximately 50 watts.

Normally #6 contact, which imitates the impulse to close the breaker, is wired in series with #8 contact and in this way does not open any current since 179Y 8 contact, will open ahead of 179Y 6. With this connection 179Y 6 will close and carry up to 5 amp. Where special breaker closing mechanisms are used and it is not feasible to have 179Y 6 in series with 179Y 8, then the interrupting rating of 179Y 6 must be ob-

served. This is limited to $\frac{1}{2}$ amp. at 125 V. D-C., $\frac{1}{4}$ amp. 250 V. D-C., 1 amp. 115 V., A-C. or $\frac{1}{2}$ amp. 220 V. A-C. Where the control relay takes higher values of current and 179Y 6 must be independent of 179X 8, an interposing auxiliary relay should be used to keep within the above interrupting limits.

The burdens for the various parts of the recloser will not exceed the following:

Contact Element, Device 179X—

Open Position—60 V.A.
60 Cycles Closed Position—40 V.A.

Solenoid Element, Device 179Y—

Open Position—90 V.A.
60 Cycles Closed Position—40 V.A.

Synchronous Motor 8 V.A.

These burdens occur only during operation of the recloser since the motor and coils are de-energized both in the lockout and the start positions. The parts of the recloser are designed for intermittent duty or for 15 minutes continuously. This provides ample power for operation under the most severe temperature conditions, and at the same time gives a larger factor of safety than is usually provided for devices which are used only intermittently.

Adjustments

The question of time intervals between reclosures has received considerable attention in the application of automatic reclosing oil circuit-breakers and it is evident that special conditions and types of service may require different time settings. The greater percentage of feeder troubles are temporary, and thus the breaker usually remains closed upon the first reclosure following an automatic opening. For this reason it is usually advantageous, from service continuity standpoint, to make the first reclosure immediately. Succeeding reclosures will generally be spaced at increasing intervals of time. On this basis the duty cycle of 0-15-60 second intervals has received considerable favor among operators. The time intervals, however, can readily be adjusted as desired by changing the location of the #3 and #5 screws on the drum of the recloser.

Practically any desired duty cycle can be obtained since the #3 cam screws which determine the time of reclosure can be set most anywhere around the drum and there is a wide range of drum speeds available.

AUTOMATIC RECLOSER—TYPE RC—Continued

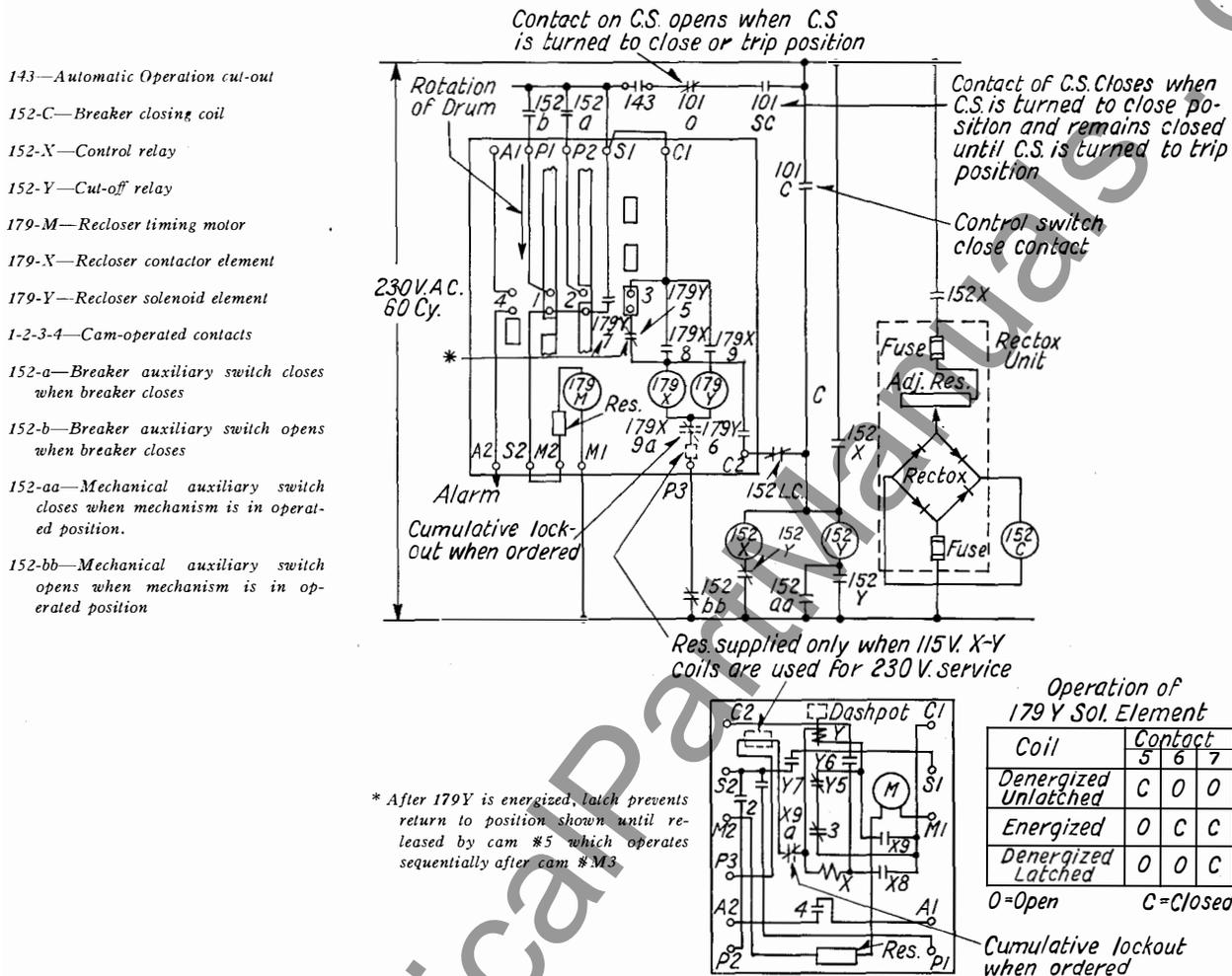


FIG. 6—SCHEMATIC DIAGRAM FOR CIRCUIT-BREAKER AUTOMATIC RECLOSING USING TYPE RC RECLOSER, SET FOR IMMEDIATE RECLOSURE (SHOWN IN START POSITION) A-C. CONTROL CIRCUIT WITH RECTOX OPERATED CLOSING SOLENOID

Description of Operation With Recloser Adjusted for Initial Immediate Reclosure

Referring to the schematic diagram, Fig. 6—contacts 1 and 2 control the operation of the recloser motor, causing it to start after the automatic opening of the breaker and then to stop at the “start” or “lockout” position, depending on whether the breaker remains closed or trips out after the final reclosure. Once started, the motor drives the cam continuously forward until contact 1 or 2 opens. Contact 3, actuated by adjustable cam screws, controls the time at which reclosures are to oc-

cur. Contact 4 is an auxiliary contact which may be used to energize an alarm circuit if the recloser “locks out” or other purposes such as control of “fast and delayed time tripping” of the reclosing breaker. The function of the other contacts can best be understood by describing in detail the sequence of operation of the RC recloser following an automatic opening of a breaker. With the RC recloser in its “start” position and adjusted for one immediate initial and two subsequent timed reclosures, assume that the breaker trips due to a fault. Circuit-breaker “b” auxiliary switch 152-1 and “bb” switch 152-3 close. Simultaneously energizing

the motor 179M through contact 179-1, and the coil of the contactor element, 179X, through cam contact 179-3, and contact 179Y-5, also integrating lockout contact 179-9A when furnished. The contactor element, device 179X, when energized, seals itself in through one of its own contacts 179X-8 while its other contact 179Y-9 energizes the coil of 179Y. Upon the closure of contact 179Y-6, the circuit-breaker control relay is energized and causes the circuit-breaker to close. Circuit-breaker auxiliary switches 152-1 and 152-3 then open and “a” auxiliary switch 152-2 is closed. The opening of 152-3 de-energizes the auxiliary elements, 179X and



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