

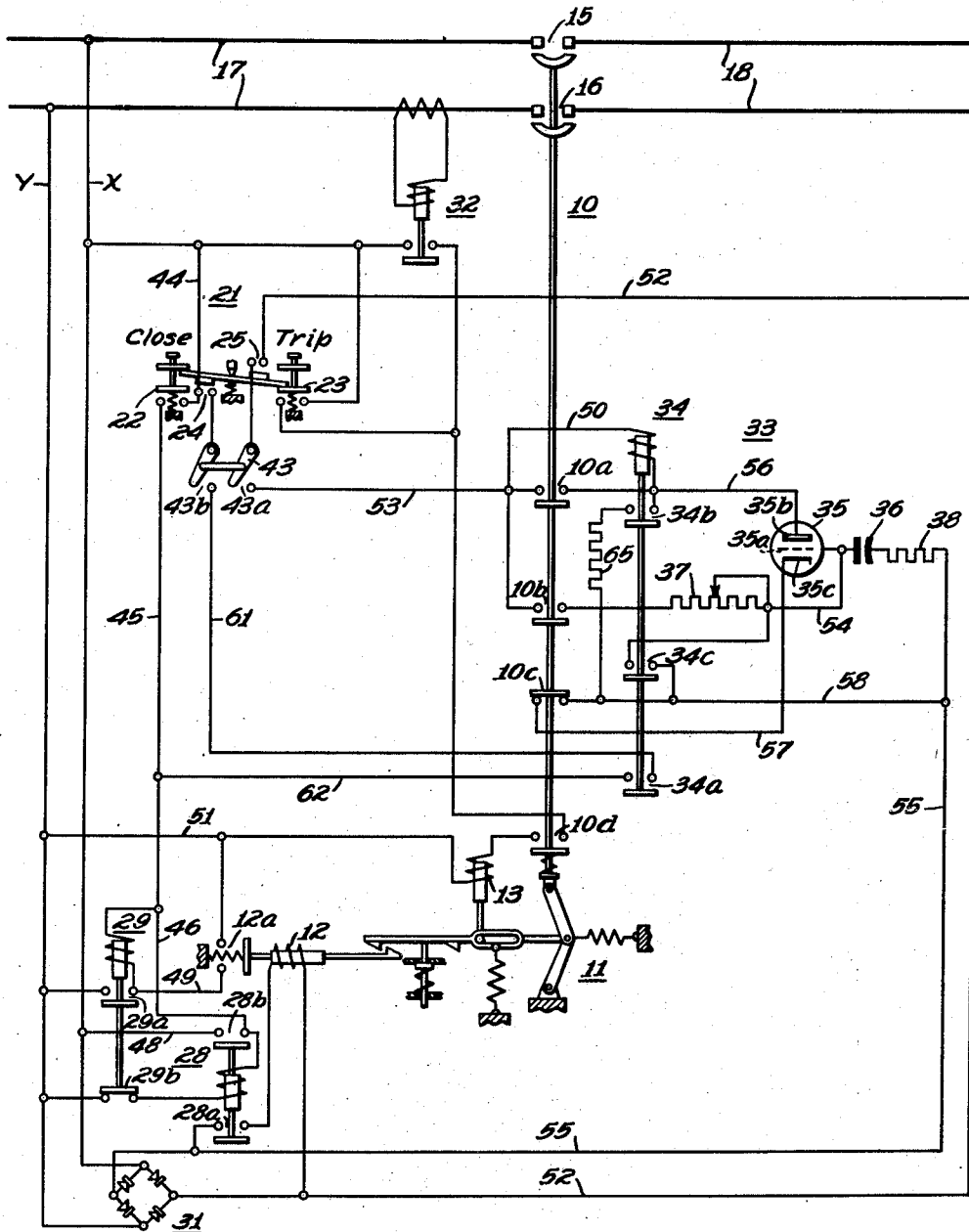
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RECLOSING CONTROL SYSTEM FOR CIRCUIT BREAKERS

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RECLOSING CONTROL SYSTEM FOR
CIRCUIT BREAKERS

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My invention relates, generally, to circuit breaker control systems, and, more particularly, to a system for effecting an automatic reclosing operation of a circuit breaker in response to the opening thereof.

The object of my invention, generally stated, is to provide a circuit breaker control system which shall be of simple construction, reliable in operation, and which may be economically manufactured and installed.

A more specific object of my invention is to provide an automatic recloser of the electronic time-delay type for a circuit breaker.

A still more specific object of my invention is to provide for effecting the automatic reclosure of a circuit breaker in response to the automatic opening thereof by means of a reclosing relay, the energization of which is controlled by a spaced discharge device, the conductivity of which is controlled by a potential or grid bias derived from a charged condenser.

Another object of my invention is to provide, in a system of the character described, for limiting the number of automatic reclosures of a circuit breaker within a predetermined time period by means of a space discharge device, the conductivity of which is controlled by the potential of a charged condenser which is alternately charged at different adjustable rates and discharged during the closed and open periods of the breakers, respectively.

A further object of my invention is to provide for using a 3-element electronic tube and a condenser connected to control the grid bias of the tube as a time-delay relay in a system of the character described for preventing more than a predetermined number of reclosures of the breaker within a predetermined time period.

These and other objects of my invention will become more apparent from the following detailed description of a specific example when read in connection with the drawing, in which the single figure is a diagrammatic view of a circuit breaker control system embodying the principles of my invention.

In practicing my invention in one form thereof, the control system for the breaker is so arranged that the breaker is closed in response to the operation of a control switch to the closed position which energizes the closing relay or contactor which in turn effects energization of the closing coil or mechanism of the breaker in the usual manner. An energizing or charging circuit, including a variable resistor, for a condenser is closed when the breaker closes. Under normal

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conditions when the breaker remains closed for a predetermined time, the condenser is charged to its full capacity. The condenser is connected to the grid element of a space discharge device in the form of a 3-element vacuum tube, so as to subject the grid element to a positive voltage bias. The operating coil of this relay is connected in an energizing circuit in series with the electronic tube, that is, the plate and cathode elements thereof and normally closed contact members of the breaker. The conductivity of the electronic tube is controlled by the positive bias voltage impressed on the grid by the condenser, so that, if the tube is sufficiently conducting at the time the breaker is opened in response to a fault, the reclosing relay will be energized and operated to energize the closing relay of the breaker and effect the reclosure thereof. When the reclosing relay closes, it also establishes a discharge circuit for the condenser to completely discharge it. The charging circuit of the condenser is interrupted when the breaker opens and is reestablished as soon as the breaker closes. If the breaker stays closed or reclosed for a period of time sufficient to recharge the condenser to a potential of such magnitude as to again render the tube conducting, the breaker will be reclosed in response to another opening operation thereof. If, however, the breaker re-opens immediately or within the period required for the condenser to recharge, it will remain locked out. The recharging period of the condenser may be varied by the variable resistor connected in the charging circuit.

Referring now to the drawing, there is shown in diagrammatic form a control system embodying the principal features of my invention for controlling the operation of a circuit breaker 10 of known construction having a trip-free operating mechanism 11, including closing means in the form of a closing coil 12 and trip means in the form of a trip coil 13. Any other suitable breaker arrangement may be used.

The breaker 10 is also provided with main contact members 15 and 16, connecting supply conductor 17 and load conductors 18. It is also provided with a plurality of auxiliary contact members 10a, 10b, etc., which will be referred to hereinafter.

The breaker 10 may be manually controlled by a control switch 21 of known construction operable to close and trip positions and provided with main close contact members 22, main trip contact members 23 and auxiliary or slip contact members 24 and 25 which remain in the position to which they are operated by one operation of

the switch until the switch is actuated to another operating position.

The usual relay arrangement for controlling the closing coil 12 is provided comprising, a closing relay 28 and a cut-off relay 29. In this instance, the closing coil 12 is energized by direct current from the positive and negative terminals of a rectifier 31 connected to the supply conductors 17 through control conductors X and Y.

In order to provide for effecting an automatic reclosure of the breaker in response to the opening operation thereof, such as may be effected by a fault-responsive relay 32, the arrangement indicated generally by the numeral 33 is utilized and which may be, for convenience, referred to as a recloser. The recloser 33 comprises a reclosing relay 34, a spaced discharge device or tube 35, a condenser 36, a variable resistor 37 and a discharge resistor 38.

The numeral 43 designates a cut-off of automatic cut-off switch which is operable to its closed position to render the recloser 33 effective.

As will be described more in detail hereinafter in connection with the operation of the system or recloser, the arrangement is such that the breaker 10 is or may be initially closed by operation of the control switch 21 and is automatically reclosed in response to an automatic opening thereof through the functioning of the recloser 33.

Assuming that the cut-off switch has been closed and the supply conductors 17 are energized, the breaker may be closed by actuating the control switch 21 to the closed position, in which contact members 22, 24 and 25 are closed.

The closure of contact members 22 completes an energizing circuit for the closing relay 28 which extends from conductor X through conductor 44, contact members 22, conductors 45 and 46, coil of relay 28 and normally closed contact members 29b of relay 29 to conductor Y.

Upon the closure of relay 28, its contact members 28a establish an obvious energizing circuit for the closing means 12. The closure of its contact members 28b in conjunction with auxiliary contact members 12a on the breaker mechanism establishes an energizing circuit for the cut-off relay 29 which extends from conductor X through conductor 48, contact members 28b, conductor 46, coil of relay 29, conductor 49, auxiliary contact members 12a and conductor 51 to conductor Y.

Upon operation of the cut-off relay 29, its contact members 29b are opened to deenergize the closing relay 28 and its contact members 29b closed to establish an obvious holding circuit for the relay.

It will be readily understood that this arrangement provides an anti-pump circuit for the circuit breaker.

Assuming that the breaker 10 has been closed and has remained closed for a predetermined length of time, the condenser 36 has been charged through a circuit which extends from positive conductor 52, contact members 25 of the control switch, contact members 43a, conductor 53, auxiliary contact members 10b, variable resistor 37, conductor 54, condenser 36 and resistor 38 to the negative control conductor 55.

It will be noted that the variable resistor 37 is included in this circuit and the charging time of the condenser 36 will be determined by the setting of this resistor. It is also to be noted that this circuit is completed only when the breaker

10 is in its closed position and its auxiliary contact members 10b are closed.

It will be observed that the condenser 36 is connected to the grid or control element 35a of the tube in such manner as to subject it to the necessary positive grid bias to maintain it in a conducting condition. This is the normal operating condition of the system or recloser while the breaker is in closed position.

Assuming now that the breaker is tripped as a result of the operation of the fault relay 32 which establishes an obvious energizing circuit for the trip coil 13. When the breaker opens, its auxiliary contact members 10c establish an energizing circuit for the reclosing relay 34 which extends from energized conductor 53 through conductor 50, coil of relay 34, conductor 56, plate 35b, cathode 35c, conductor 57, auxiliary contact members 10c and conductor 58 to the negative control conductor 55. If the tube 35 is in conducting condition, as it will be under these operating conditions, the reclosing relay 34 will be operated to its closed position to effect the operation of the closing mechanism of the breaker. It also functions to close a discharge circuit for the condenser 36 and to close its holding circuit.

The operating circuit for the closing coil 12 which is established by the operation of reclosing relay 34 extends from conductor X through conductor 44, contact members 24 of the control switch, contact members 43b, conductor 61, contact members 34a, conductors 62 and 46, coil of relay 28 and contact members 29b to conductor Y. As soon as this circuit is established, the breaker 10 is immediately reclosed. This again establishes the charging circuit for condenser 36 through contact members 10b of the breaker.

As soon as the relay 34 closes, it establishes a holding circuit through its contact members 34b, resistor 65 and conductor 58 to negative conductor 55. When the breaker closes, however, its auxiliary contact members 10a shunt the coil of relay 34 and it is opened.

As referred to hereinbefore, as the reclosing relay 34 operates, it discharges the condenser 36 through its contact members 34c and discharge resistor 38. Therefore, the condenser is completely discharged at the time the breaker is reclosed and starts to charge. The charging rate is determined by the setting or adjustment of the variable resistor 37. The tube 35 will not be rendered sufficiently conducting to effect a second operation of the reclosing relay 34 in response to another opening of the breaker until a sufficient length of time has elapsed to permit the condenser 36 to be recharged to a predetermined value. It will be apparent, therefore, that, if the breaker 10 re-opens, such as may happen in the event that the fault still exists, it cannot be automatically reclosed if it has reopened before the tube 35 has been rendered conducting, or, in other words, until the tube has been subjected to a sufficient amount of positive grid bias by the condenser 36 to again render it conducting.

If, however, the fault has cleared and the breaker 10 remains closed for a predetermined length of time, the condenser 36 will be recharged to full value and a second reclosing operation automatically effected in response to a subsequent opening operation of the breaker.

It will be readily understood that the breaker may be selectively closed and tripped at any time by the operation of the control switch 21.

In view of the foregoing description of a specific embodiment of my invention, it will be ap-

parent that I have provided a recloser for a circuit breaker which is of extremely simple construction and which may be economically manufactured and used. The arrangement is such that mechanical relays are reduced to a minimum. The timing operation is effected by the use of a space discharge device and a condenser for controlling the conductivity of the discharge device. Thus, it is apparent that the apparatus or parts of the recloser may be combined in a compact and rugged relay assembly.

While I have disclosed and described a specific embodiment of my invention, it will be apparent that various changes and modifications may be made therein without departing from the principles of the invention.

I claim as my invention:

1. A system for controlling the operation of a circuit breaker having closing and tripping means comprising, relay means operable to effect operation of the closing means to close the breaker, an energizing circuit for said relay means, an electronic relay connected in said energizing circuit to control the energization of the relay means in response to the opening operation of the breaker, said electronic relay having a control element operable in response to a predetermined bias voltage to render the relay conducting and thereby render said energizing circuit effective, a condenser connected to said control element and normally charged when the circuit breaker is closed to render the electronic relay conducting, and a variable resistance connected in circuit relation with the condenser for controlling its rate of charging, thereby to provide for effecting an immediate reclosure of the breaker in response to the opening thereof and to prevent further reclosures of the breaker in the event that it reopens prior to the time the condenser is recharged to such extent as to again render the electronic relay conducting.

2. The combination with a circuit breaker having opening and closing means, of a reclosing relay operable to effect the operation of the closing means, an energizing circuit for the reclosing relay including switch means actuated to closed position in response to an opening operation of the breaker and a space discharge device having a control element, a condenser connected to the control element of the space discharge device to control the conductivity of said device, a charging circuit for the condenser including switch

means actuated to closed position only when the breaker is closed so that the condenser is charged only during such time that the breaker is closed, and a discharge circuit for the condenser including switch means actuated to closed position in response to the operation of the reclosing relay to effect the operation of the closing means of the breaker so that the condenser is discharged every time the breaker opens, whereby the reclosing relay is normally operative to effect a single immediate reclosure of the breaker unless the breaker remains closed on the initial reclosure for a sufficient period of time to permit the condenser to recharge to such degree as to again render the space discharge device conductive.

3. A recloser for a circuit breaker having closing and opening means comprising, a condenser, a charging circuit for the condenser which is disposed to be closed only when the breaker is closed, a variable resistance connected in said charging circuit for varying the charging rate of the condenser, a discharge circuit for the condenser which is closed only when the breaker is open, a reclosing relay operable to effect the operation of the closing means of the breaker, an energizing circuit for the reclosing relay which is closed in response to the opening of the breaker, a space discharge device having a control electrode connected in said energizing circuit, circuit means connecting the condenser to the control electrode to subject the discharge device to a control voltage to maintain it in a conducting condition, whereby the breaker is automatically reclosed immediately in response to the opening thereof and subsequent reclosures prevented unless the breaker remains closed for a period of time of such duration as to permit the condenser to recharge and again render the discharge device conducting.

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