

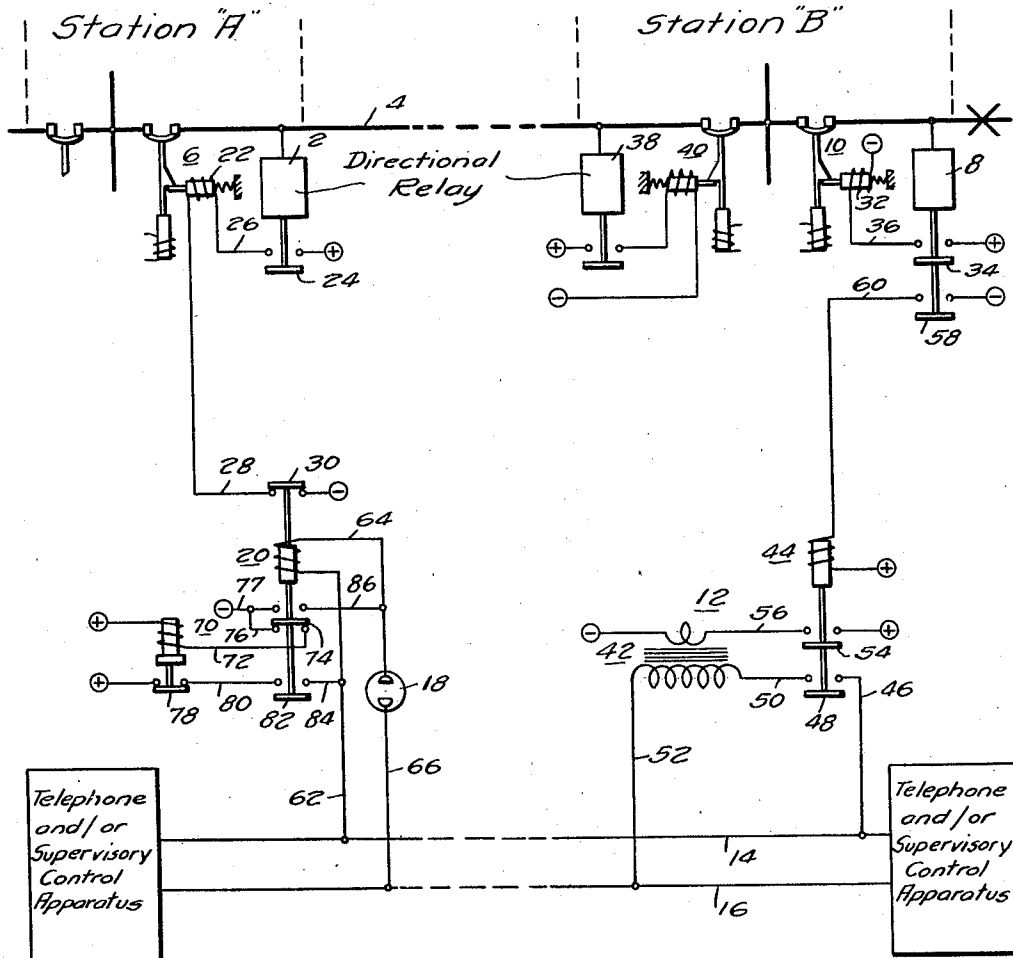
Dec. 28, 1943.

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2,337,837

PROTECTIVE SYSTEM

Filed Aug. 19, 1941



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2,337,837

PROTECTIVE SYSTEM

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Application August 19, 1941, Serial No. 407,459

7 Claims. (Cl. 175—294)

My invention relates, generally, to control systems and, more particularly, to remote relay control over telephone or supervisory control channels.

In the operation of power systems comprising a plurality of stations, the stations are often connected by a telephone system. In such systems, the telephone channel which extends between the stations is often employed as the signalling channel for remote control operations between the stations. Such remote control systems place an additional burden on the telephone line by virtue of the remote control apparatus connected to the telephone line, and thus reduce the telephone ringing energy.

An object of my invention is to provide a control system which shall function to perform certain remote control functions over a telephone or other communication channel without placing an additional burden upon the communication channel.

A further object of my invention is to provide a control system which shall function to block the operation of a breaker upon the occurrence of a fault at a remote point, and which shall function to perform such remote blocking operations over a communication system without placing any load burden upon the system.

These and other objects and advantages of the invention will be apparent from the following detailed description taken in connection with the accompanying drawing, the single figure of which is a diagrammatic view of a power system and associated control apparatus embodying the principal features of my invention.

The invention comprises, generally, a directional relay 2 at a station A on a power circuit 4 disposed to trip a circuit breaker 6, or other apparatus unit, when excess power flows in the direction from the station A towards a station B. At the station B a directional relay 8 functions to open a circuit breaker 10, or other apparatus unit, when there is excess power flow away from the station B through the breaker 10.

The directional relays 2 and 8 may be any well-known power-directional relays which respond to power flow of fault proportions away from the stations through the circuit breakers 6 and 10, and will normally be so calibrated and timed that the relay 8 will function to close the trip circuit of the circuit breaker 10 before the relay 2 functions to close its associated trip circuit. It is to be understood that the directional relays 2 and 8 are merely illustrative of suitable relays that will perform the desired functions, and that combination of relays, such as fault relays and directional relays, may be employed for the same purpose and connected in conformance with well-known relay practice to respond to fault current flow away from the station buses.

The relay 8 functions to cause an impulse device 12 to apply an impulse to the conductors 14 and 16 of a communication system extending between the stations A and B. This impulse will be of higher potential than the telephone or supervisory control impulses normally acting on the communication system, but will be of insufficient duration to operate the telephone or supervisory control apparatus. The impulse will be of sufficiently high potential to cause the glow tube 18 at station A to conduct current to energize a relay 20 which will respond to the short impulse and prevent the directional relay 2 from opening the circuit breaker 6.

Considering the invention more in detail, the trip coil 22 of the circuit breaker 6 is energized by the relay 2 in a circuit which extends from positive potential through a contact element 24 of the relay 2, a conductor 26, the winding of the trip coil 22, a conductor 28, and a back contact 30 of the relay 20 to negative potential. The relay 8 at station B controls an energizing circuit for the trip coil 32 of the circuit breaker 10 in a circuit which extends from positive potential through a contact element 34 of the relay 8, a conductor 36, and the winding of the trip coil 32 to negative potential. A relay 38 similar to relays 2 and 8 functions to control a circuit breaker 40 at the station B in a manner similar to the functioning of relays 2 and 8 when there is excess power flow in the direction from station B to station A.

The impulse device 12 at the station B comprises a step-up transformer 42 controlled by a relay 44. The secondary winding of the transformer 42 is connected to the communication channel conductors 14 and 16 in a circuit which extends from the conductor 14 through a conductor 46, a contact element 48 of the relay 44, a conductor 50, the secondary winding of the transformer 42, and the conductor 52 to the conductor 16. The primary winding of the transformer 42 may be connected in an energizing circuit by the contact element 54 of the relay 44, this energizing circuit extending from positive potential through the contact element 54, a conductor 56, and the primary winding of the transformer 42 to negative potential. The relay 44 is connected to be energized by a contact element 58 of the relay 8 in a circuit which extends from positive potential through the winding of the relay 44, a conductor 60, and the contact element 58 to negative potential.

The relay 20 at the station A is connected to be energized by impulses of sufficiently high potential to render the glow tube 18 conductive in a circuit which extends from the conductor 14 through a conductor 62, the winding of the relay 20, a conductor 64, the glow tube 18, and a conductor 66 to the conductor 16. The ener-

gization of the relay 20 will cause its contact element to open the energizing circuit of the trip coil of the circuit breaker 6, thus preventing the trip coil from being energized when the directional relay 2 is energized.

A time delay release relay 70 at the station A is normally energized in a circuit extending from positive potential through the winding of the relay 70, a conductor 72, a contact element 74 of the relay 20 in back contact position, a conductor 76, and a conductor 77 to negative potential. When the relay 20 is energized, its contact element 74 will move from back contact position to front contact position to thereby de-energize the relay 70, and complete a holding circuit for the winding of the relay 20 which extends from positive potential through a contact element 78 of the relay 70, a conductor 80, a contact element 82 of the relay 20, conductors 84 and 62, the winding of the relay 20, a conductor 86, the contact element 74 of the relay 20 in the front contact position, and the conductor 77 to negative potential. This holding circuit for the relay 20 will be broken after the period of the time delay release of the relay 70 when its contact element 78 will move to open circuit position.

In the operation of the system, the telephone and/or supervisory control apparatus functioning between stations A and B over the conductors 14 and 16 will normally use impulses having potential values lower than the potential necessary to render the glow tube 18 conductive, and the relay 20 will, therefore, not be affected by the telephone and/or supervisory control impulses. The circuit comprising the winding of the relay 20 and the glow tube 18 connected to the conductors 14 and 16 will be substantially the same as an open circuit with normal potentials on the conductors 14 and 16, since the glow tube 18 will not be rendered conductive except at higher potentials.

When a fault occurs on the power circuit 4 beyond the station B from station A, as at X, the directional relay 8 will operate to trip the circuit breaker 10 and to energize the relay 44 which, in turn, will energize the primary winding of the transformer 42 and connect the secondary winding of the transformer 42 to the conductors 14 and 16. The charging current for the primary winding of the transformer 42 will cause an impulse to be generated in the secondary winding of the transformer 42 of considerably higher potential than the normal telephone or supervisory control impulses acting on the conductors 14 and 16. This single high potential impulse will render the glow tube conductive and energize the relay 20 to block the operation of the trip coil 22 of the circuit breaker 6, as hereinbefore described. Thus the relay 2 will be blocked from operating in the event that there is any delay in the opening of the circuit breaker 10.

The operation of the relay 20 will also close its own holding circuit, and will be maintained energized by means of this holding circuit until the time delay relay 70 opens its contact element 78 to thereby open the holding circuit of the relay 20. This time delay release of the relay 20 is provided to insure that the circuit breaker 10 at the station B is tripped before the trip circuit of the circuit breaker 6 at station A is returned to normal condition by the movement of the contact element 30 of the relay 20 to closed circuit position.

In the event that a fault should occur on the conductor 4 between the stations A and B, the directional relays 2 and 33 will function to sectionalize the section of the power circuit between stations A and B, since such a fault will not disturb the tripping circuit for the circuit breaker 6 at the station A. It is to be understood that any well-known time delay means may be employed at the station A to delay the release of the relay 20 after it is momentarily energized by the blocking impulse. It is further understood that the power circuit will normally comprise other conductors, as for a three-phase line, that the circuit breaker will control each of these conductors, and that the directional relays, which are shown as connected to a single conductor for convenience of illustration, will be connected to the three-phase power circuits in any well-known conventional manner.

Thus, it will be seen that I have provided a control system which shall function to block the operation of a breaker upon the occurrence of a fault at a remote point, and which shall function to perform such remote blocking operation over a communication system without placing any load burden upon the system.

In compliance with the requirements of the patent statutes, I have shown and described herein a preferred embodiment of my invention. It is to be understood, however, that the invention is not limited to the precise construction shown and described, but is capable of modification by one skilled in the art, the embodiment herein shown being merely illustrative of the principles of my invention.

I claim as my invention:

1. In a control system, a first circuit breaker and a second circuit breaker disposed at first and second stations on a power circuit, a communication channel extending between the stations normally subjected to current impulses of predetermined potential, means responsive to a fault on the power circuit between said stations for opening the circuit breaker at the first station, means responsive to a fault on the power circuit beyond the second station for applying an impulse to the communication channel of higher potential than the normal communication impulses acting on the channel, and means at the first station responsive to said higher potential which is higher than the potentials of the normal communication impulses for rendering the circuit breaker opening means at the first station inoperative.
2. In a control system, a first circuit breaker and a second circuit breaker disposed at first and second stations on a power circuit, a communication channel extending between the stations normally subjected to current impulses of predetermined potential, means responsive to a fault on the power circuit between said stations for opening the circuit breaker at the first station, means responsive to a fault on the power circuit beyond the second station for applying an impulse to the communication channel of higher potential than the normal communication impulses acting on the channel, a glow tube at the first station disposed to be acted upon by potentials applied to the communication channel and responsive to said higher potential which is of higher value than the potential of the normal communication impulses, and means controlled by said glow tube for rendering the circuit breaker opening means at the first station inoperative.

3. In a control system, a first circuit breaker

and a second circuit breaker disposed at first and second stations on a power circuit, a communication channel extending between the stations normally subjected to current impulses of predetermined potential, means responsive to a fault on the power circuit between said stations for opening the circuit breaker at the first station, means responsive to a fault on the power circuit beyond the second station for applying an impulse to the communication channel of higher potential than the normal communication pulses acting on the channel, a series circuit comprising a glow tube and the winding of a relay connected in parallel circuit relation with the communication channel at the first station, said glow tube being responsive to said higher potential which is of higher value than the potential of the normal communication impulses for effecting the operation of the relay, and means controlled by said relay for rendering the circuit breaker opening means at the first station inoperative.

4. In a control system, a first circuit breaker and a second circuit breaker disposed at first and second stations and a power circuit, a communication channel extending between the stations subjected to current impulses of predetermined potential, means responsive to a fault on the power circuit in between said stations for opening the breaker at the first station, impulse applying means at the second station for applying a current impulse to the communication channel of higher potential than the normal communication impulses acting on the channel, said impulse applying means being normally disconnected from the communication channel, means responsive to a fault on the power circuit beyond the second station for connecting said impulse applying means to the communication channel and causing it to apply an impulse to the communication channel, a glow tube at the first station disposed to be acted upon by potentials applied to the communication channel and responsive to said higher potential which is of higher value than the potential of the normal communication impulses, and relay means controlled by said glow tube for rendering the circuit breaker opening means at the first station inoperative.

5. In a control system, a first circuit breaker and a second circuit breaker disposed at first and second stations on a power circuit, a communication channel extending between the stations and normally subjected to current impulses of predetermined potential, means responsive to a fault on the power circuit between said stations for opening the breaker at the first station, impulse applying means at the second station for applying when energized an impulse to the communication channel of higher potential than the normal communication impulses acting on the channel, said impulse applying means being normally disconnected from the communication channel, means responsive to a fault on the power circuit beyond the second station for energizing and connecting said impulse applying means to the communication channel to apply an impulse to the communication channel, a series circuit at the first station comprising a glow tube and the winding of a relay connected in parallel circuit relation with the communication channel, said glow tube being responsive to said higher potential which is of higher value than the potential of the normal communication impulses, and means controlled by said relay for rendering

the circuit breaker opening means at the first station inoperative.

6. In a control system, a first circuit breaker and a second circuit breaker disposed at first and second stations on a power circuit, said breakers being provided with opening means, a communication channel extending between the stations normally subjected to current impulses of predetermined potential, first relay means responsive to a fault on the power circuit between said stations for actuating the opening means of the breaker at the first station, impulse applying means at the second station for applying when energized an impulse to the communication channel of higher potential than the normal communication impulses acting on the channel, said impulse applying means being normally disconnected from the communication channel, second relay means at the second station responsive to a fault on the power circuit beyond the second station for actuating the opening means of the breaker thereat, additional relay means at the second station controlled by said second relay means for energizing said impulse applying means and connecting it to the communication channel to apply an impulse to the communication channel, a series circuit at the first station comprising a glow tube and the winding of a relay connected in parallel circuit relation with the communication channel, said glow tube being responsive to said higher potential which is of higher value than the potential of the normal communication impulses, contact means controlled by said relay for rendering the circuit breaker opening means at the first station inoperative, and means for causing said relay to maintain said circuit breaker opening means inoperative for a predetermined length of time.

7. In a control system, a first circuit breaker and a second circuit breaker disposed at first and second stations on a power circuit, said breakers being provided with opening means, a communication channel extending between the stations normally subjected to current impulses of predetermined potential, fault responsive relay means at the first station responsive to a fault on the power circuit between the first and second stations for effecting operation of the opening means of the breaker at the first station, impulse applying means at the second station for applying a direct current impulse to the communication channel of higher potential than the normal communication impulses acting on the channel, said impulse applying means being normally disconnected from the communication channel, relay means at the second station including fault responsive relay means responsive to a fault on the power circuit beyond the second station for effecting operation of the opening means of the breaker thereat and for connecting said impulse applying means to the communication channel to apply an impulse thereto, a glow tube at the first station disposed to be acted upon by potentials applied to the communication channel and responsive only to said direct current impulse, first relay means controlled by said glow tube for rendering the circuit breaker opening means at the first station inoperative, and second time delay relay means controlled by said first relay means for causing said first relay means to maintain said circuit breaker opening means inoperative for a predetermined length of time.

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