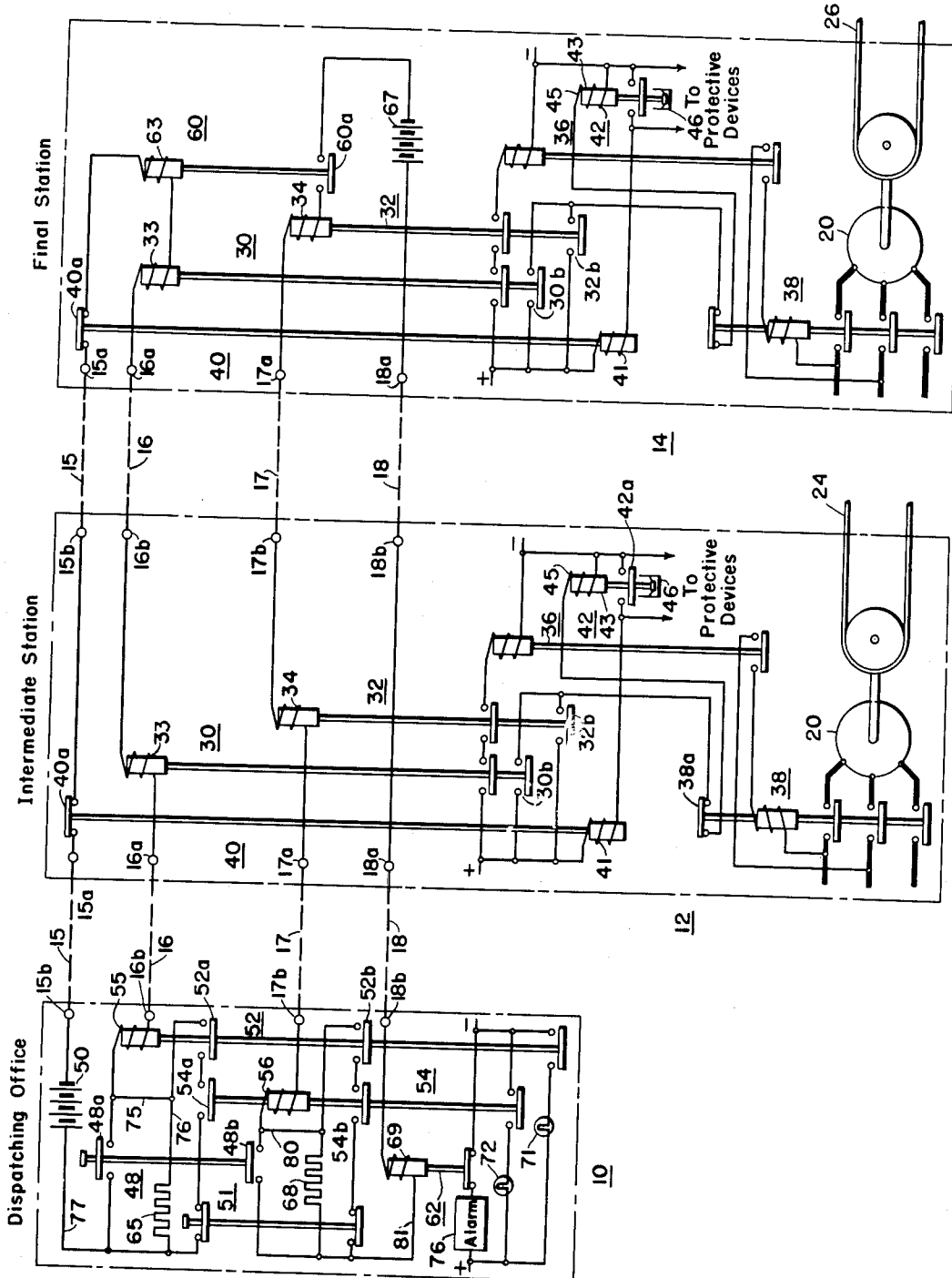


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REMOTE CONTROL SYSTEMS

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WITNESSES:

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2,743,397

REMOTE CONTROL SYSTEMS

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Our invention relates generally to remote control systems, and it has reference in particular to a remote control system for controlling apparatus at a plurality of remote stations.

One of the objects of our invention is to provide for controlling apparatus at a plurality of remote stations substantially simultaneously.

Another object of our invention is to provide for operating apparatus at a plurality of remote stations simultaneously, and for stopping the apparatus at all stations in the event that apparatus at any one of the stations fails to start.

It is also an object of our invention to provide in a remote control system for a belt conveyor system, for starting and stopping a plurality of conveyor belt motors at a plurality of remote stations simultaneously.

Yet another object of our invention is to provide in a remote control system for apparatus at a plurality of remote stations for so interlocking the apparatus at the remote stations that the apparatus at all of said stations is either operating or is stopped.

It is a further object of our invention to provide in a remote control system for controlling apparatus at a plurality of remote stations simultaneously, and providing continuous signal channel supervision between stations.

Another important object of our invention is to provide in a remote control system for a plurality of motors driving serially related conveyor belts, for controlling the operation of the motors over a pair of signal channels connecting the remote stations where the motors are located to a dispatching office.

Other objects will in part be obvious, and will in part be explained hereinafter.

In one embodiment of our invention, a plurality of motors driving serially related conveyor belts are simultaneously controlled from a single dispatching office by means of line relays connected one in each signal channel at each remote station for jointly controlling the operation of the motor at that station. The line relays are responsive to line currents above a predetermined value, and energization of the signal channels is maintained at this level by line relays at the dispatching office which become deenergized when the current drops below the predetermined value, so as to reduce the energization of both signal channels below the predetermined value. The signal channels are continuously supervised by line supervision relays which respond to a line current below the predetermined value.

For a more complete understanding of the nature and scope of our invention, reference may be made to the following detailed description which may be read in connection with the accompanying drawing, in which the single figure is a diagrammatic view of a remote control system embodying the invention in one of its forms.

Referring to the drawing, the reference numerals 10, 12 and 14 may denote generally equipment at a dispatcher's office, any one of a number of substantially

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identical intermediate stations, and a final or most remote station, respectively. The dispatcher's office 10, intermediate station 12 and remote station 14 are disposed to be connected by a pair of signal channels comprising conductors 15, 16 and 17, 18, respectively, which may be connected to incoming and outgoing terminals 15a, 16a, 17a, 18a and 15b, 16b, 17b, 18b respectively, of the different stations. The apparatus to be controlled at each of the intermediate stations and the final station may, for example, comprise motor 20 which may be connected in driving relation with conveyor belts 24 and 26 which are disposed in a series or cascade relation for conveying material from one belt to the other between the stations.

In order to provide for controlling the motor 20 at the intermediate station, which may be taken as typical of any one of a plurality of such intermediate stations, line relays 30 and 32 may be provided, having operating windings 33 and 34 connected respectively in series circuit with the conductors 16 and 17 of the two signal channels. The line relays 30 and 32 may be arranged to operate only in response to a line current above a definite predetermined value, and they may be arranged for jointly controlling the operation of a switch or relay 36 which is disposed to effect operation of a circuit breaker or contactor 38 for connecting the motor 20 to a source of electrical energy.

To insure simultaneous operation or stopping of all of the motors in the system, a control relay 40 may be provided, having an operating winding 41 and a contact member 40a connected in series circuit with the conductor 15 of the one signal channel for interrupting said signal channel. Operation of the control relay 40 may be effected by means of a time delay relay 42 having a contact member 42a for providing an energizing circuit for operating winding 41, and an armature 43 disposed to be actuated in response to energization of an operating winding 45. A dash-pot 46 may be provided for retarding operation of relay 42. The operating winding 45 may be connected to a source of control voltage through a normally-closed contact member 38a of the circuit breaker 38, and make contact members 30b and 32b of line relays 30 and 32 so as to provide for operating the control relay in the event that the circuit breaker 38 fails to close within a predetermined time after operation of either one of the line relays 30 and 32. Other protective devices such as temperature relays, overload relays and the like may be connected to provide operating circuits for control relay 40 in shunt with contact member 42a.

By referring to the drawing it will be seen that control of the motor 20 at the final station 14 is effected by means of line relays 30 and 32 in a manner identical with that described in connection with the equipment at the intermediate station 12. A switch 36 is likewise provided for effecting operation of a circuit breaker 38 for connecting the motor 20 to a source of alternating current. A control relay 40 is also provided for operation under the control of a time delay relay 42 in a manner similar to that hereinbefore described in connection with the description of the apparatus at the intermediate station.

Operation of the line relays 30 and 32 may be effected from the dispatcher's office 10 by means of control switches such as the "start" push-button switch 48, which provides for connecting a battery 50 at the dispatcher's office in series with the conductors 15 and 16 of the one channel and completes a connection between the conductors 17 and 18 of the other channel. A "stop" push-button switch 51 may be provided in conjunction with line relays 52 and 54 having operating windings 55 and 56 connected in circuit with the conductors 15, 16 and

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17, 18 respectively for maintaining the circuit connections provided by the push-button switch 48 in each of the signal channels.

In order to provide continuous supervision of the two signal channels, a line supervision relay 60 may be provided at the final station in connection with the one signal channel while a line supervision relay 62 is provided at the dispatching office in connection with the other. The line supervision relay 60 has an operating winding 63 connected in series circuit relation with the conductors 15 and 16 of the one channel, and has a contact member 60a connected in series circuit with the conductors 16 and 17 of the other channel. The relay 60 is disposed to operate in response to a line current much less than the predetermined value required to operate the line relays. Such a current may be normally transmitted through the conductors 15 and 16 by connecting them by means of a resistor 65 at the dispatching office to provide a closed circuit including the battery 50, conductors 15 and 16, and relay 60, which permits such a limited value of current to flow in the line. A battery 67 may be connected in series with the conductors 17 and 18 at the final station, and a resistor 68 may be connected between the conductors 17 and 18 at the dispatching office to provide for the flow of the limited line supervision current through the operating winding 69 of the line supervision relay 62. The relay 62 may be arranged to energize an alarm device 70 to indicate a fault on either one of the signal channels, and lamps 71 and 72 controlled by the line relays 52 and 54 may be provided for indicating the energized condition of the signal channels.

With the system normally deenergized, an energizing circuit will be provided for the line supervision relay 60 extending from the battery 50 through conductors 15 and contact members 40a of the several control relays, operating winding 63 of the line supervision relays, operating windings 33 of the several line relays 30 and conductors 16, operating winding 55 of the line relay 52, conductor 75, conductors 76, resistor 65, and conductor 77 to the other terminal of the battery 50. Relay 60 accordingly operates to the energized position. This completes an energizing circuit for the line supervision relay 62 from the battery 67 through contact member 60a, the operating windings 34 of the several line relays 32 and conductors 17, operating winding 56 of the line relay 54, conductor 80, resistor 68, conductor 81, operating winding 69 and conductor 18, back to battery 67, so as to effect operation of the line supervision relay 62. The currents passed by the resistors 65 and 68 are sufficiently limited to prevent operation of any of the line relays.

In order to start the several motors 20, the push-button switch 48 may be depressed. This completes shunt circuits around the resistors 65 and 68 through contact members 48a and 48b, thus greatly reducing the impedance of the signal channels and permitting currents to flow therein of the predetermined value necessary to operate the several line relays. Line relays 52 and 54 operate to the energized positions, providing shunt holding circuits through contact members 52a, 54a and 52b, 54b around the resistors 65 and 68 respectively, to maintain the predetermined value of operating current necessary for the line relays. At the intermediate and remote substations, line relays 30 and 32 also operate to the energized positions, completing obvious energizing circuits for the switches 36, which in turn complete operating circuits for the circuit breakers 38 to connect the motors 20 to sources of alternating current.

In the event that any one of the circuit breakers 38 does not close and stay closed, time delay relay 42 will commence to time out since an energizing circuit is provided therefor through contact members 38a and 32b. At the end of this timing period, a circuit is provided through contact member 42a for energizing the operating winding 41 of control relay 40. Operation of any one of the control relays 40 interrupts the circuit through

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conductors 15 of the signal channel at contact member 40a. This deenergizes line supervision relay 60, as well as line relays 30 and 52, effecting deenergization of the switches 36 at every station, and opening all of the circuit breakers 38 to disconnect the motors from the sources. In addition, deenergization of line relay 52 at the dispatching office interrupts the holding circuits for the two signal channels through contact members 52a and 52b respectively, thus effectively reinserting resistors 65 and 68, thereby deenergizing line relays 32 and 54 of the second signal channel. Operation of control relay 40 may also be effected by any of the protective devices associated therewith to effect deenergization of the line supervision relay 60. This results in interruption of the connection between conductors 17 and 18 of the second signal channel at contact member 60a so that the line relays for both channels are deenergized. Line supervision relay 62 at the dispatching office will therefore return to the deenergized position energizing the alarm 70.

If one of the signal channels becomes either short-circuited or open-circuited while the apparatus is in the deenergized position, the line supervision relay for the faulted signal channel will immediately be deenergized, since in both instances the battery source of energy is located at the opposite end of the signal channel from the line supervision relay. If the line supervision relay 62 is deenergized because of a fault or open circuit of either of the conductors 17 and 18 the alarm 70 will be directly energized. If the fault occurs on either of the conductors 15 or 16, line supervision relay 60 will be deenergized. This in turn interrupts the line supervision circuit between conductors 17 and 18 at contact members 60a, resulting in deenergization of line supervision relay 62 and energization of the alarm 70. An open circuit or short circuit on either one of conductors 15, 16 thus operates relay 60 to deenergize the system. Either one of these faults on conductors 17, 18, results in operation of alarm relay 62 and deenergization of line relay 54 to deenergize the system.

From the above description and the accompanying drawing, it will be apparent that we have provided in a simple and effective manner for simultaneously controlling the operation of a plurality of devices such as motors which may be located at relatively widely-spaced remote stations as will be the case in connection with a conveyor belt system having a plurality of serially related conveyor belts for effecting continuous transmission of material between widely spaced points. In such a system, simultaneous control of the motors is extremely important and we have attained this by providing for simultaneously starting all of the motors and for stopping them all in the event of a failure of one of them to start, or of stoppage of any one of them by means of any one of a number of protective devices (after it may have been started). By using two interlocked signal channels, one of which is energized from the dispatching office end and the other from the remote end, positive control, prevention of interference and complete channel supervision are provided.

Since certain changes may be made in the above-described construction and different embodiments of the invention may be made without departing from the spirit and scope thereof, it is intended that all the matter contained in the above description and shown in the accompanying drawing shall be considered as illustrative and not in a limiting sense.

We claim as our invention:

1. In a remote control system for apparatus at a plurality of remote stations connected by only a pair of signal channels to a dispatching office, means including a relay connected in circuit with each signal channel at each station for operating apparatus at the station, time delay means at each station controlled by said relays at such station operable to effect deenergization of at least one signal channel if the apparatus at said station is not

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operated within a predetermined time, and means including a switch at the dispatching office operable to selectively energize and deenergize both channels.

2. In a system for controlling apparatus at a plurality of remote stations, a pair of signal channels connecting said stations to a dispatching office, a line relay at each station connected in circuit with each signal channel for effecting operation of apparatus at the station, means including contacts of both relays for controlling apparatus at each station, circuit means including time delay means at each station responsive to operation of the line relays for effecting deenergization of the signal channels, protective means for the apparatus at each station operating in a circuit local to its station for effecting deenergization of the signal channels, and means including switch means at a control station for selectively energizing and deenergizing the channels.

3. A system for controlling apparatus at a plurality of remote stations connected by a pair of separate signal channels each connecting the stations in series to a dispatching office comprising, a switch at each station operable to control the apparatus at said station, means including a line relay connected in series with each channel at each remote station for jointly controlling the apparatus switch at said remote station, means including a control relay at each remote station for opening one of said signal channels in the event that the switch at said station fails to operate within a predetermined time after either of its associated line relays operates, a switch at the dispatching office operable for effecting energization of said channels, and supervision means including a supervision relay connected in series with one signal channel at the most remote station and having contacts connected in series with the other signal channel.

4. In a remote control system for apparatus at a plurality of remote stations connected to a dispatching office by a pair of signal channels the combination of, a switch at each remote station operable to control the apparatus at said remote station, means including a line relay connected in series with each channel at each remote station to jointly effect operation of the switch at said station, a control relay at each remote station having contacts connected in series with one of the channels, a time delay relay at each station, circuit means connecting the time delay relay to operate in response to operation of one of the line relays in the event the switch does not operate within a predetermined time to effect operation of the control relay, and circuit means for energizing the channels including switch means at the dispatching office.

5. A control system for apparatus at a plurality of remote stations connected to a dispatching office by only a pair of signal channels comprising, means including a line relay connected in series with each channel at each remote station and responsive to a current above a predetermined value jointly controlling the apparatus at said station, a line supervision relay connected in series with each channel responsive to a current below the predetermined value, means normally energizing each channel to provide a current below said predetermined value for operating the line supervision relays, switch means energizing the channels to produce a current above said predetermined value, and circuit means including a relay connected in each channel operable in response to reduction of the current in said channel below said predetermined value, to reduce the current in the other channel to a value below said predetermined value.

6. In a remote control system for apparatus at a plurality of remote stations, a pair of signal channels connecting the stations in series relation with a dispatching office, a switch at each remote station operable to effect operation of apparatus at said station, a line relay connected in circuit with each channel at each station jointly controlling operation of the switch at said station, means including a control relay at each station effecting deener-

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gization of one of said channels, a time delay relay at each station effecting operation of the control relay in response to operation of one of the line relays in the event the switch at said station fails to operate within a predetermined time, and circuit means effecting energization of said channels simultaneously.

7. A remote control system for simultaneously controlling apparatus at a plurality of remote stations connected to a dispatching office by a pair of continuous signal channels comprising, means including a switch at each remote station controlling the apparatus at said station, a line relay connected in series with each signal channel at each remote station operable to jointly control the switch at said station, a control relay at each station having contacts in series with one of the channels, a time delay relay at each remote station, circuit means connecting the time delay relay to operate in response to operation of either one of the line relays at said station more than a predetermined time before the switch operates to effect operation of the control relay at said remote station, means including a switch at the dispatching office operable to effect energization of one of the channels, and relay means operable in response to energization of said one channel to effect energization of the other channel.

8. Remote control equipment for one of a plurality of remote stations comprising, a switch operable to control electrical apparatus at said station, a pair of line relays each connected between incoming and outgoing terminals of a different signal channel, circuit means effecting operation of the switch in response to joint operation of the line relays, a control relay having contacts connected in series with the terminals of one signal channel, and circuit means including a time delay relay controlled by the line relays effecting operation of the control relay if the switch does not operate within a predetermined time after operation of either one of the line relays.

9. In remote control equipment for apparatus at a plurality of remote stations, a pair of signal channels connecting the station, terminal connections for each of said signal channels at each station, a switch controlling the apparatus, means including a line relay connected in series with terminals of each channel and having contacts jointly controlling operation of the switch, a control relay having contacts connected in series with the terminals of one signal channel, and means including a time delay relay controlled by the line relays, said time delay relay being operable a predetermined time after one of the line relays operates if the switch does not operate to effect operation of the control relay to interrupt said one signal channel.

10. Remote control equipment for apparatus at a remote station disposed to be connected to a dispatching office by a pair of signal channels comprising, terminals for each of said signal channels, a switch controlling said apparatus, means including a line relay connected between terminal connections of each signal channel to jointly control operation of the switch, a control relay having contacts connected in series with the terminals and line relay of one signal channel, circuit means effecting operation of the control relay including a time delay relay operable if the switch does not operate within a predetermined time after operation of either of the line relays, and a line supervision relay connected between the terminals of said one signal channel and having contacts connected in series with the terminals of the other channel.

11. Control equipment for apparatus at a plurality of remote stations disposed to be connected to a dispatching office by only a pair of signal channels comprising, a battery at the dispatching office, impedance means connecting the battery in circuit with one signal channel, a supervision relay at the most remote station connected in series with said channel and responsive to the current

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in the channel through said impedance means to complete said signal channel, a battery at the most remote station connected in series with said other signal channel, a supervision relay at the dispatching office, impedance means connecting said supervision relay in circuit with said other channel to permit a limited current to flow to operate the supervision relay, means including a line relay connected in series with each channel at each remote station operable in response to a current greater than said limited value to jointly effect operation of apparatus at said remote station, switch means at the dispatching office operable to provide a connection normally

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effecting a current flow in each channel above said limited value, and means including a relay connected in each channel operable to jointly provide a circuit maintaining said connection in each channel so long as the current flow in each channel remains above said limited value.

References Cited in the file of this patent

UNITED STATES PATENTS

1,463,168	Kintzing	July 31, 1923
1,753,958	West	Apr. 8, 1930
2,313,975	Spear	Mar. 16, 1943