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REMOTE-CONTROL DEVICE

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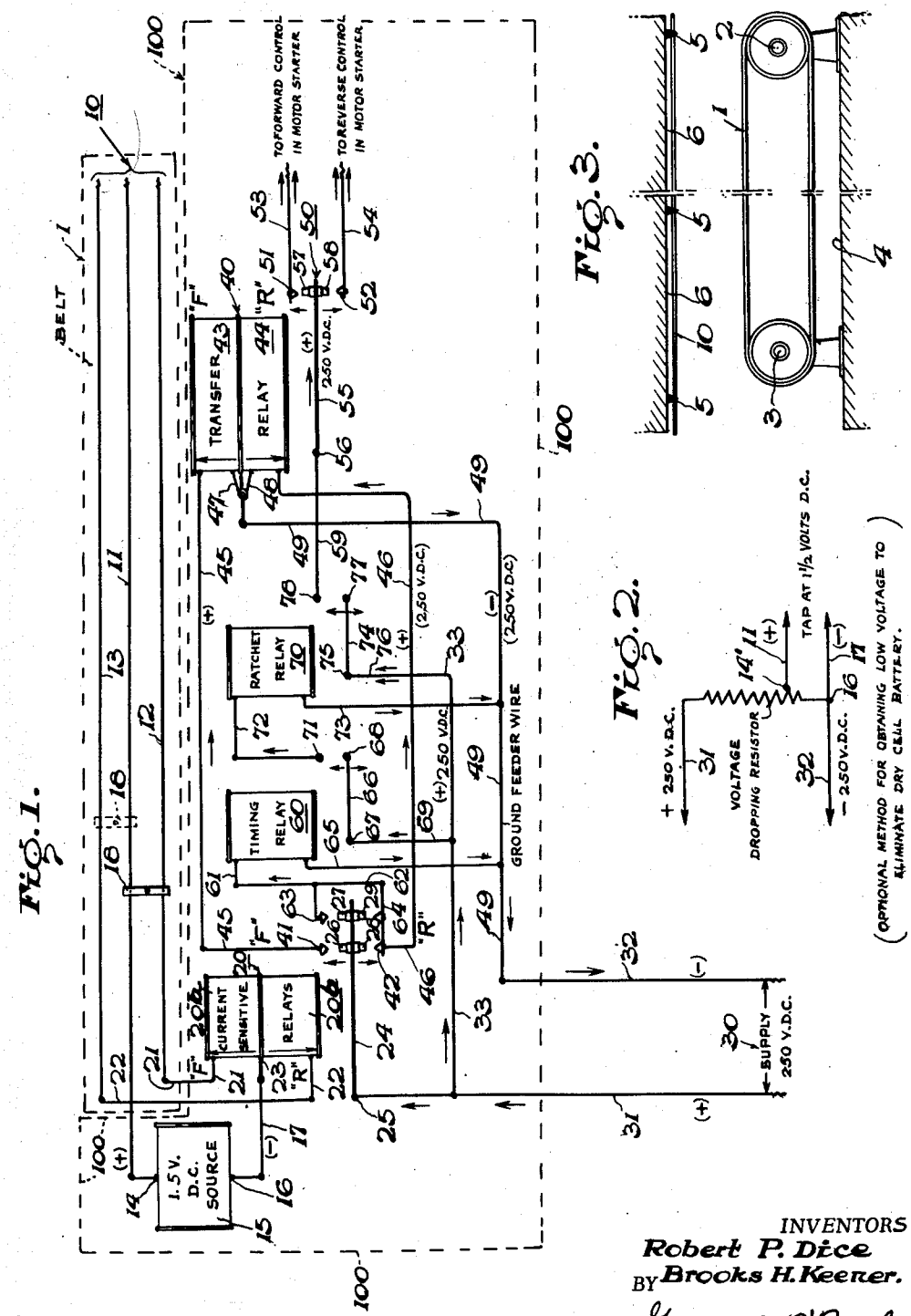


Fig. 1.

Fig. 2.

Fig. 3.

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REMOTE-CONTROL DEVICE

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This invention relates to remote control devices for electrically driven apparatus adapted to be activated by magnetic relays, and more particularly to an electrical switch control arrangement for belt conveyors or the like.

Heavy duty conveyor belts, of the character uesd for transportation of material, and personnel, are usually continuously driven from a single power source, for example, an electric motor, having magnetic relays associated therewith, whereby actuation of the motor may be controlled from a point remote therefrom. The belts are of appreciable length, in some instances three or four thousand feet long, and from a practical operational standpoint, control means must of necessity be provided at spaced points along the path of travel of the belt, so that the belt may be stopped or started, as desired, at points remote from the power source, to permit loading or unloading material, and for personnel.

Heretofore, it has been suggested to effect remote control of conveyor belts of the abovementioned type by means of push button control stations or pull-out switches located at spaced points along the path of travel of the belt. While the prior suggested remote control arrangements are satisfactory to effect control from a plurality of predetermined locations lengthwise of the belt, they are open to the objection that they do not permit continuous control, that is to say, control of the conveyor belt from any point along its travel.

Belt conveyors are particularly adaptable for use in coal mining operations by reason of their sturdy performance, under heavy loads, and the fact that such conveyors can be installed and operated in mine passageways of comparatively small clearances. Special problems of safety are encountered in subterranean work, such as coal mines, where the belts are used to transport personnel and tools, as well as coal. Because of the dangers incident to the transportation of personnel on conveyor belts, stringent safety regulations are in force in various mining areas, which require, among other things, that the belt be equipped with a continuous switch control whereby the belt may be stopped or started at any time by a person riding thereon. In other words, according to coal mining regulations presently effective in certain mining areas, positive control of the conveyor belt must be provided for each linear foot of the conveyor travel.

After considerable research and experimentation, we have found that the deficiencies of conventional spaced control switch arrangements, with respect to continuous control as required by present mining regulations, can be overcome by providing a three-wire continuous switch installation along the entire course of travel of the belt conveyor.

An object of our invention is to provide an improved continuous switch control arrangement for conveyor belts.

Another object of our invention is to provide

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an improved continuous switch system of low voltage, for the control of the motor used to drive a conveyor belt, whereby to permit substantially instantaneous stopping, starting, and reversal of the direction of travel of the belt at any time, by any person riding the belt.

Yet another object of our invention is to provide a continuous, bare wire, overhead switch installation, powered from a low voltage source, and designed to operate differential, low voltage relays, whereby to energize and control the motor used to drive a conveyor belt, from any point along the path of travel of the belt.

Still another object of our invention is to provide a three-wire continuous overhead switch installation, extending above or to one side of the conveyor belt along its entire course of travel, the wires being connected to a differential relay adapted to be energized by bridging or apposing the central wire with either of the two side wires, whereby to control the motor used to drive the belt.

A further object of our invention is to provide a central system in which the relay switching mechanisms are severally mounted in a cabinet, desirably associated with the motor control cabinet whereby the only exposed lines which can be contacted by personnel riding on the conveyor belt are the low voltage wires, forming the continuous switch, which can be grasped by the hand and apposed to effect contact and switching control, or the wires may be bridged by a jumper, tool, or other conductive device.

With these and other objects in view, which may be incident to our improvements, the invention consists in the parts and combinations to be hereinafter set forth and claimed, with the understanding that the several necessary elements comprising our invention may be varied in construction, proportions and arrangements, without departing from the spirit and scope of the appended claims.

In order to make our invention more clearly understood, we have shown in the accompanying drawings means for carrying the same into practical effect, without limiting the improvements in their useful applications to the particular constructions, which for the purpose of explanation, have been made the subject of illustration.

In the drawings:

Figure 1 is a schematic wiring diagram of the novel control system herein;

Fig. 2 is a detail schematic showing of a line-powered low voltage source, and

Fig. 3 is a schematic view, in broken section, of a conveyor belt mounted in a mine seam.

Referring to the drawings, and more particularly to Fig. 3, there is shown a continuous conveyor belt 1, mounted on drive rollers 2, 3, rotatably supported on members 4, adapted to rest on the floor 4' of a mine. Suitable insulators 5 are secured to the mine roof 6, and support the bare wires of the continuous switch installation, designated generally by the numeral 10.

Referring now to Fig. 1, the continuous switch installation 10 will be seen to comprise a center positive wire 11, a lateral, forward control wire 12, and a second lateral reverse control wire 13. The positive wire 11 is connected to the positive pole 14 of a low voltage D. C. battery 15, while the lateral wires 12, 13 are connected to negative pole 16 of the battery through a common line 17, and a differential relay designated generally by the numeral 20. As shown in Fig. 2, the low voltage battery may be replaced by connecting the wires 11 and 17 to the variable and fixed taps, respectively, of a voltage-dropping resistor appropriately connected to the 250 volt D. C. supply, which will be discussed more in detail hereinafter.

The differential relay 20 is comprised of a "forward" coil 20*a* and a "reverse" coil 20*b*. These coils are provided with a common output 23 connected to return line 17, and separate input leads 21, and 22, severally connected to switch wires 12 and 13. The high-power side of the relay comprises a conductive armature 24, pivotally mounted as at 25, in conductive relation with an input line 31 of a 250 volt D. C. supply, designated generally by the numeral 30, having a return line 32. The armature 24, which is normally biased to neutral position, carries "forward" contacts 26, 27 and "reverse" contacts 28, 29. The contacts 26 and 28 are severally adapted to respectively engage "forward" contact 41 and "reverse" contact 42 of a differential relay 40.

The relay 40 is composed of armature 55, a "forward" coil 43 and a "reverse" coil 44, severally connected through input lines 45, 46, to contacts 26 and 28 of differential relay 20. The return leads 47, 48 of the coils 43, 44, are connected through ground feeder wire 49 to the 250 volt D. C. return line 32. The differential relay 40 is adapted to control a switch mechanism 50 having a "forward" contact 51, and a "reverse" contact 52 leading through lines 53, 54, to the "forward" and "reverse" controls of the motor starter relays, not shown. The conductive armature 55 is pivoted at 56, and is provided with contacts 57, 58, adapted to severally contact motor starter control contacts 51, 52.

A time delay relay 60 and a ratchet relay 70 comprise the balance system for the electrical actuating members. The relay 60 is of the quick-shut, slow-open type, and its input 61 is connected through bridge 62, to contacts 63, 64, severally apposed by contacts 27 and 29, of the differential relay 20. The output side of coil 60 is connected through return leads 65 to the ground feeder wire, or bus bar 49, previously described. The armature 66 is normally biased in the open position, and is pivoted at 67, being provided with contact 68 is its free end. Lead 69 connects armature 66 with high voltage D. C. input line 33. The contact 68 of armature 66 of relay 60 is apposable to contact 71 of input lead 72 of a ratchet relay 70, having a return lead 73 connected to ground feeder wire or bus bar 49. Armature 74 of relay 70 is pivoted at 75, and is connected through lead 76 to D. C. input line 33. Its contact 77 is apposable to fixed contact 78, which is connected to input lead 59 of armature 55 of differential relay 40. Armature 55, as noted, functions as the movable switch element of transfer switch 50.

The operation of the system is as follows: Assuming that continuous switch members 11 and 12 are bridged by a conductive bridging member 18, flow of current is established from battery 15, positive switch wire 11, jumper 18, return switch wire 12, input lead 21 of coil 20*a*, and common line 17. The coil 20*a* is energized, and armature 24 is attracted toward the relay, with the result that contacts 26 and 41 are apposed, as are contacts 27 and 63. With the closing of these contacts, the 250 volt D. C. power flows through input line 31, armature 24, contacts 26, 41, and line 45, to the "forward" coil 43 of the differential or transfer relay 40, returning through line 47 and ground feeder wire 49 to the negative side 32 of the 250 volt D. C. supply. When the coil 43 is energized, armature 55 is attracted toward the differential relay 40, effecting contact between contacts 57 and 51 of the "forward" control line 53. Simultaneously, with the energizing of coil 43, contacts 27 and 63 are apposed, and 250 volt D. C. power flows through input lead 61 to the timing relay 60, returning through lead 65 to ground feeder wire 49 and line 32. When coil 60 is energized, its armature 66 is attracted, apposing contact 68 to contact 71, thereby establishing a conductive circuit from 250 volt D. C. input line 33, and connecting line 69 to the input line 72 of the ratchet relay 70. This relay has a return line 73, connected to the ground feeder wire 49. When ratchet relay 70 is energized, armature 74 is attracted, apposing contact 77 to contact 78. Circuit is thereby established between positive feed line 33 of the 250 volt D. C. circuit, and lead 59 of transfer relay 40, so that current flows through armature 55, contacts 57 and 51, and "forward" control line 53, to the "forward" motor control mechanism.

When the jumper 18 is removed, current ceases to flow through coil 20*a*, deenergizing it, and armature 24 is biased to its neutral position, breaking the 250 volt D. C. "forward" control circuit, and no current flows through coil 43 of transfer relay 40, nor through timing relay 60. Due to the special characteristics of the latter, its armature 66 breaks slowly, establishing a gap between contacts 68 and 71, thereby deenergizing ratchet relay 70. By reason of the special construction of ratchet relay 70, its armature 74 remains in the circuit closing position, and current will continue to flow from the positive side of the 250 volt D. C. supply, through line 33, leads 76 and 59, and armature 55, to the "forward" motor control line 53.

When it is desired to reverse the direction of travel of the conveyor belt, the wires 11 and 13 may be bridged, as shown by the dotted line position of jumper 18. Under these circumstances, current flows from low voltage battery 15 through continuous switch wires 11 and 13, "reverse" coil 20*b* of the low voltage differential relay 20, and return 17 to battery 15. The armature 24 is repelled out of its neutral position towards the "reverse" side, whereby contact is established between contacts 28, 42, and 29, 64, and the 250 volt D. C. supply line 31, is thereby connected, through line 46, to the input side of coil 44 of transfer relay 40. Armature 55 is then repelled, and the 250 volt D. C. supply is transferred to the "reverse" control line 54. Simultaneously with the flow of current through line 31, armature 24, bridge 62 and input lead 61 to timing relay 60, armature 66 is again attracted, closing the 250 volt D. C. circuit through lines 69 and 72 to the ratchet relay 70. The relay is energized and its armature 74 attracted, closing the circuit from the 250 volt input line 33 to transfer relay armature 55 and "reverse" control lead line 54.

It will be seen that with the improvements of

the present invention, a simple foolproof continuous switch control system for continuous conveyor belts is provided, and which is under immediate and direct control of any person riding the belt at any and all times, and at any and all points along the path of travel of the belt. Further, it will be seen that not only may an individual stop the belt, but may cause it to pursue a "forward" or "reverse" direction of travel solely by contacting the appropriate combination of switch wires, whereby, due to the holding action of ratchet relay 70, current is caused to flow continuously from the 250 volt D. C. supply to the appropriate side of the motor control relays. It will also be appreciated that the novel control system herein comprises four relay installations, which may be mounted together in a single control cabinet, adjacent to, or as a part of the motor control cabinet, all as indicated generally by the dotted line 100, and that the only parts of the switch system which are exposed are the continuous switch wires 11, 12, 13, which by the very nature of their installation and mode of operation, are required to be exposed. Under such conditions, personnel are at all times in full command of the operation of the belt, from any point along the belt.

It will be further noted that the control arrangement not only permits starting, stopping and reversal of direction of travel of the belt, as desired, in normal operation, but it also provides locked control to prevent accidental movement of the conveyor during loading, unloading, or repair thereof.

While we have shown and described the preferred embodiment of our invention, we wish it to be understood that we do not confine ourselves to the precise details of construction herein set forth by way of illustration, as it is apparent that many changes and variations may be made therein, by those skilled in the art, without departing from the spirit of the invention, or exceeding the scope of the appended claims.

What is claimed is:

1. A coal mine belt conveyor control system, comprising in combination, a continuous belt conveyor, electric power means for driving the conveyor, relay control means for controlling the belt conveyor drive, and switch control means for actuating the relay controls, said control means including current sensitive relays, a low voltage D. C. source, and continuous switch means comprising a positive current lead and two return leads, said leads being of bare wire and mounted adjacent the conveyor belt, means connecting the positive lead to the current source, and means connecting the return leads to the current sensitive relays, a common return from the relays to the D. C. source; the said switching means being effective upon bridging of the positive lead and either of the return leads to selectively actuate one of the current sensitive relays, whereby to control the conveyor drive.

2. A safety conveyor belt control system for coal mine conveyor belts, comprising a continuous three-wire switch mounted along the path of the belt and comprising a positive lead and two return leads, a low voltage power source connected to the said leads, the return leads including current sensitive relays operative to control the belt conveyor drive, the said switch wires being bare and adapted to be apposed by grasping or otherwise bridged by personnel riding the conveyor belt, whereby upon bridging the circuit between the positive lead and either of the return leads the circuit to the current sensitive relays is closed and the conveyor belt drive is selectively controlled.

3. A low voltage continuous switch control system and high voltage power drives for coal belt conveyors, comprising a continuous switch mounted along and adjacent the path of the conveyor belt and comprising three bare wires, including a positive lead and a pair of return leads, the said switch wires being so mounted as to be grasped and apposed, or otherwise bridged by personnel riding the belt, whereby to effect contact between the positive lead and either of the return leads and selectively stop the conveyor or start it in either direction.

4. A 1.5 v. D. C. continuous switch control system for 250 v. D. C. power drives for coal belt conveyors, comprising a continuous switch mounted along and adjacent the path of the conveyor belt and comprising three bare wires, including a positive lead and a pair of return leads, the said switch wires being so mounted as to be grasped and apposed, or otherwise bridged by personnel riding the belt, whereby to effect contact between the positive lead and either of the return leads and selectively stop the conveyor or start it in either direction.

5. In a safety switch mechanism for the control of high voltage operating circuits, a continuous switch comprising a bare positive wire and at least one bare return wire, a low voltage D. C. current supply, means conductively connecting the said current supply to the said switch wires, and including at least one current sensitive relay in the return line, and a high voltage D. C. operating circuit including a high voltage current supply and a normally open switching member comprising the armature of the current sensitive relay, whereby when the switch wires are bridged, the relay is energized, the armature switch is closed, and the high voltage operating circuit is energized.

6. Safety switching mechanism for reversible drive, motor-driven conveyor belts having motor relay controls for forward and reverse control of belt travel, comprising a continuous switch mounted over and above a conveyor belt, said switch comprising three parallel bare wires, a low voltage D. C. current source, means connecting the center switch wire to the positive side of the D. C. supply, a differential relay comprising a pair of current sensitive relays, an input lead to each of the said relays, said leads being severally connected to the other continuous switch wires, a common return from the relays to the D. C. source, means for selectively energizing said relays comprising metallic conductors apposable to the positive switch wire and either of the return switch wires, an electromagnetically responsive armature movable to two separate operating positions by the said relays, high voltage current controls operatively associated with the said armature to selectively establish forward and reverse motor relay control circuits, a high voltage D. C. current supply connected on its positive side to the said armature, whereby when bridging contact is established between the positive switch wire and either of the return switch wires, one of the current sensitive relays is energized and the armature is selectively moved to one of its circuit closing positions.

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