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CONVEYER SYSTEM AND CONTROL THEREFOR

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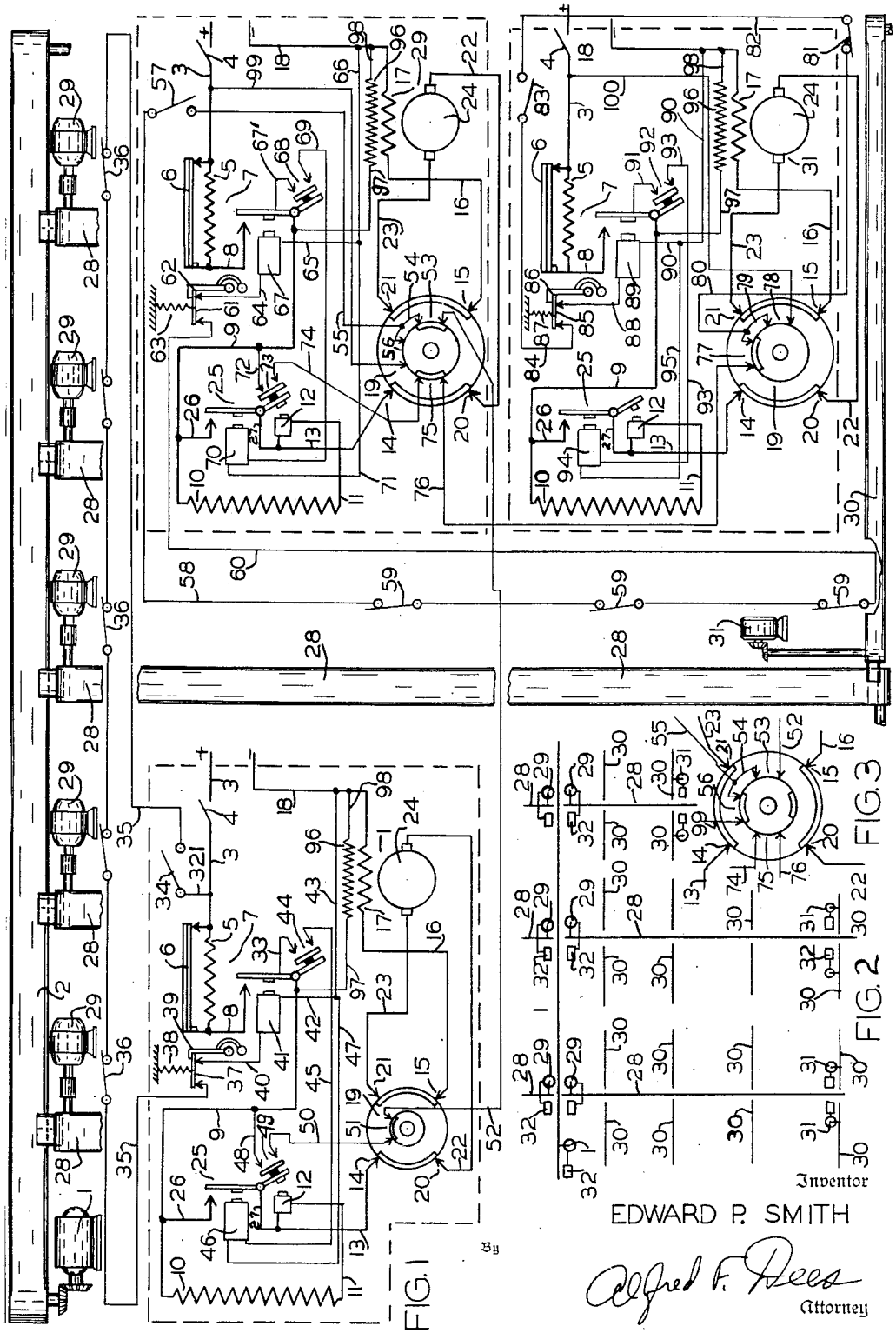


FIG. 1

FIG. 3

FIG. 2

Inventor

EDWARD P. SMITH

By

Alfred F. Rees

Attorney

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CONVEYER SYSTEM AND CONTROL THEREFOR

Edward P. Smith, Mansfield, Ohio, assignor to The Ohio Brass Company, Mansfield, Ohio, a corporation of New Jersey

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23 Claims. (Cl. 198—82)

This invention relates to motor controls generally and in its more specific aspects is directed to a plurality of inter-connected starters including motor reversing elements and adapted to prevent motion in one or more of said motors when one of them is reversely rotated or stopped, in which some of same motors may be rotated forwardly while others are reversely rotated and in which any one of the motors may be reversely rotated at any time without regard to any rotating movement of any of the other motors.

The object of this invention is to provide a system of interconnected motor starters remotely located from each other to control the direction of rotation of the motors as well as the stopping of the same motors depending upon the setting of the reversing switch for each starter.

A further object of the invention is to provide a plurality of interconnected motors and starters therefor that are remotely located one from the other in which all motors may be stopped from the starter of one of the motors but a lesser number of motors may be stopped from the other of the starters.

Another object of the invention is to provide a plurality of motors, each independently started, whose starters are interconnected in order to prevent the forward rotation of some of said motors while other of said motors are stopped or reversely rotated.

A still further object of the invention is the provision of a drive for a mine conveyer system including a main conveyer belt, a lateral conveyer belt and room conveyer belt, the motor starters for the drive motors of said conveyers being interconnected and in which the lateral and room conveyers are required to be at rest while the main conveyer is reversely rotated or stopped.

A still further object of the invention is to provide in a conveyer system for a mine, a plurality of independently driven conveyers arranged such that each succeeding conveyer belt receives material from the preceding one and in which the final drive may not be reversed without stopping the preceding conveyers and further, in which the final conveyer may be driven forwardly while the preceding conveyer may be driven reversely.

Another and still further object of the invention is to provide in a mine conveyer system a plurality of independently motor driven conveyers whose motor starters are interconnected and in which the control for any conveyer prevents motion in the preceding conveyer to avoid clogging at the terminal of any preceding conveyer.

Other and still further objects of the invention are to increase the flexibility of control, decrease operating hazards to both operators and machines due to clogging at conveyer terminals, decrease maintenance costs, and to give the operator at the terminal end of the final drive the power to forwardly start all preceding motors providing the manual control switches, therefor, have not been disturbed.

Other and further objects of the invention will occur to those skilled in the arts to which this invention pertains as the description proceeds which taken in connection with the accompanying drawing, sets forth a preferred embodiment of the invention but such disclosure is not to be construed as a limitation of the invention which is limited only by the appended claims and any and all modifications, alterations, and variations of structure coming within the spirit and scope thereof are deemed to be included herein.

In the drawing:

Fig. 1 shows a schematic wiring diagram of the motor control system superposed on a schematic conveyer layout.

Fig. 2 shows a line diagram of a mine conveyer system with a schematic representation of the motor drive and controls therefor.

Fig. 3 shows a view of the reversing switch of one of the motors in position for reversely rotating the motor connected thereto.

The operation of conveyer systems in mines involves the use of individual drives for each conveyer. These systems are so constructed and arranged that one conveyer discharges onto a succeeding conveyer with the final or terminal conveyer discharging into mine cars or other suitable conveyances for transporting the ore to the mine mouth. These conveyers are often of great length, the final or main conveyer being many time several thousand feet in length. Discharging onto the final or main conveyer are a plurality of lateral conveyers each of which may be one thousand to fifteen hundred feet in length. Discharging onto the lateral conveyers are room conveyers of about three hundred feet in length. It is apparent, therefore, that the operator of the main conveyer who is stationed at the discharge end is not able to see the terminals of the lateral conveyers or the loading or discharge ends of the room conveyers. When changing cars at the discharge end of the main conveyer, the operator must stop the motion of the main conveyer and in order to keep the main conveyer clear, it is necessary to not only stop the forward motion of the lateral conveyers but the forward motion of the room conveyer belts and in

doing so, it is further necessary that any preceding conveyers be at rest or in reverse motion although succeeding belts may be forwardly rotated. Also, if any one of the motors is stopped by reason of voluntary or involuntary action as by opening of the circuit breaker due to overload, all preceding motors will be simultaneously stopped. This invention provides a motor control system enabling the foregoing operational sequences and to enable the stopping of all conveyers from a station at the discharge end of the main conveyer. The system of control more extensively detailed hereinafter provides a master control station at the discharge end of the main conveyer and with provision for stopping the main conveyer at a plurality of places along its length, some of the controls for the purpose being located preferably at the discharge ends of the lateral conveyers and further providing means in the control circuit for the lateral conveyers for stopping their motion from any of several locations along length of said conveyer these control stations may be located, preferably at the discharge ends of the room conveyers.

The objects, advantages, and purposes set forth above are achieved in a mechanism and motor control system shown in the accompanying drawing in which 1 is the drive motor for the main conveyer belt 2 and operatively connected thereto through appropriate gearing. The motor illustrated is of the compound type but is not limited to that form of motor. A starting circuit is illustrated which comprises incoming conductor 3 having disconnect switch 4 inserted therein and terminating on one end of the blow out or overload coil 5 and thermal element 6 of circuit breaker 7 then by way of conductor 8, and the fixed and movable contact, and associated mechanism of the circuit breaker 7 and thence by means of conductor 9 leads to starting resistance 10 which limits the initial flow of current to the motor while it is gaining speed. Conductor 11 leads from resistance 10 to one side of a hold-out or timing coil 12 and conductor 13 leads from coil 12 to one of the contacts 14 of reversing switch 19. The diametrically opposite contact 15 has conductor 16 secured thereto leading thence to series field 17 and thence to conductor 18 forming the other side of the incoming line. Diametrically disposed contacts 20 and 21 of reversing switch 19 by means of conductor 22 and 23 lead to armature 24 of motor 1. The starting resistance 10 and hold-out coil 12 are in series with each other and are primarily also in series with armature 24, therefore coil 12 is energized by the starting current of the motor thereby holding contactor 25 and switch 49 open. Shortly after the closing of the circuit breaker 7 and the energization of coil 12, contactor 25 and its associated switch 49 will close thereby shunting resistance 10 and coil 12 by means of conductors 26, 27 and the elements of contactor 25, conductor 27 being connected to conductor 13 whose relationship to the motor circuit is described above.

Discharging onto main conveyer belt is a plurality of lateral conveyers 28, 28 etc. each driven by its individual drive motor 29. Only one belt 28 is shown complete and its opposite end is appropriately supported on a suitable pulley (not shown).

Fig. 2 shows a schematic line diagram of a conveyer belt layout for a mine system in which the belts or conveyers are indicated by lines bearing the same numbers as above, the drive motors for each of these belts indicated by circles bearing the same motor numerals as above. The rectangles 32 in Fig. 2 represent the starting boxes housing switches 4, 19, circuit breaker 7, and contactor 25. Attention is invited to the fact that two or more room conveyers may discharge onto the lateral conveyers and an indefinite number of lateral conveyers may discharge onto main conveyer 1. As each room operation is completed, its equipment is moved to a succeeding room. The line diagram shows possible room, lateral and main conveyer belt combinations.

Each of the motors 29 and 31 have the same series and starting circuits and identical controls and these along with the conductors, therefor, have been assigned the same reference numerals as for motor 1. The shunt portions of the control circuits have different connections and each of these will subsequently be discussed in detail.

It has been previously indicated that drive motor 1 for main belt 2 can be stopped anywhere along its travel. This belt when reversed is used to carry materials and persons into the mine and suitable switches are disposed along the length of travel of the main conveyer 1, some of which are preferably disposed adjacent the discharge ends of the lateral conveyers to stop the main belt and transfer men and materials to a selected lateral conveyer 28. The switches for accomplishing this result are placed in the start-stop control circuit which originates in line 3 back of disconnect switch 4 and comprises conductor 321, switch 34, conductor 35 leading to the last lateral conveyer and its return has inserted therein a plurality of maintained-contact normally-closed switches 36, referred to above, and terminating at one side of switch 37 held in a closed position by spring pressed latch 39. A spring 38 retracts or opens switch 37 when overload coil 5 withdraws latch 39. The circuit continues from switch 37 through conductor 40, to holding coil 41, and by means of conductors 42 and 43 to the main conductor 18 thereby completing the circuit. From the immediately foregoing it is apparent that upon the opening of any one of switches 36 the overload circuit breaker will have its holding coil de-energized thereby opening the circuit breaker 7. Switch 34 is the usual start-stop switch associated with and located on or immediately adjacent the starter.

Closure of switch 34 will therefore energize coil 41, close circuit breaker 7, energize motor 1 and start operation of belt 1. In the particular setting of reversing switch 19 it is intended that the belt 1 will travel forwardly. Upon the closure of circuit breaker 7 it will simultaneously close tail switch 44 associated with the tail of the movable element of circuit breaker 7. The circuit controlled by switch 44 originates in main line 3 by having conductor 33 connected between the movable element of circuit breaker 7 and one side of switch 44. Conductor 45 leads to coil 46 of contactor 25 and conductor 47 completes the circuit by leading from the coil 46 to conductor 43 and thence to main line 18. Energization of coil 46 is therefore fixed as it is subject to a constant voltage while circuit breaker 7 is closed and will cause said coil to close contactor 25, shunting starting resistance 10 some time after the closing of circuit breaker 7 as determined by the energization of holdout or timing coil 12, the initial energization of which is relatively high as the result of the flow of the starting current therethrough and which current is initially high immediately upon the closing of circuit breaker 7.

Contactor 25 and hold-out coil 12 and closing coil 46 constitute what is known as a differential switch which in this case is initially held open by coil 12 until the motor starting current has decreased to a value where the energization of coil 46 is superior to that of coil 12.

The circuit described thus far except for conductor 35 and switches 36 inserted therein, is conventional in character. Associated with the starter are the auxiliaray interlocking circuits with the other starters. One of these interlocking circuits originates in the starter of motor 1 in a conductor 48 connected to conductor 9 and therefore to line 3 and leads to one side of switch 49 associated with the tail portion of the movable element of contactor 25 and is adapted to close upon the closure of contactor 25. Conductor 50 leads from the other side of switch 49 to one side of switch 51 operated in timed relation with the reversing switch 19, usually mechanically fixed thereto. These switches 19 and 51 for ease of illustration, are shown as rotatable switches having a common axis and shown concentrically disposed about said axis. A conductor 52 leads from the other side of switch 51 to one side of a switch 53 fixed to the reversing switch 19 of the motor 29 driving lateral conveyer 28. Reversing switch 19 of motor 29 driving conveyer 28 is constructed the same as corresponding switch for the motor 1.

A jumper 54 connects the other side of switch 53 with one side of a second switch 56. Conductor 55 leads from the jumper 54 thence through start-stop switch 57, conductor 58 and maintained-contact normally-closed switches 59 and conductor 60 to one side of a switch 61 kept in a closed position by spring pressed latch 62 responsive to the overload coil 5 of the associated circuit breaker. A spring 63 opens switch 61 upon release of latch 62. Conductor 64 leads from the other side of switch 61 to holding coil 67 of circuit breaker 7 and thence by conductors 65 and 66 to conductor 18. It should be borne in mind that while this control circuit originates in the circuit of motor 1 and terminates in the circuit of motor 29 that the main lines 3 and 18 for each of motors 1, 29, and 31 are one and the same although not shown connected together on the diagram.

From the immediately foregoing it is apparent that conveyer belt 28 and conveyer belt 1 must travel forwardly, the reversing switch 19 of motor 29 as shown being assumed to be adjusted for forward rotation thereof, the same as for motor 1. The holding coil 67 is electrically associated with the operating circuit of motor 1.

Upon the energization of coil 67 thereby closing circuit breaker 7, motor 29 will be energized and start operation of belt 28.

The closure of the circuit breaker 7 for motor 29 closes the circuit for the holding coil 70 for the contactor 25 for motor 29. This circuit originates in the movable element of circuit breaker 7, and therefore connected to line 3, by means of conductor 67' and leads to one side of a switch 68 associated with the tail portion of the movable element of the motor 29 circuit breaker and conductor 69 leads to coil 70 and thence by conductors 71 and 66 to line 18 constituting the other side of the incoming lines. Coil 70 is adapted to close contactor 25 and its tail switch 73 a predetermined time after the closure of circuit breaker 7 as determined by the setting of hold-out or timing coil 12 and the starting current therein as previously discussed thereby cutting out resistance 10 and coil 12.

The closure of contactor 25 for motor 29 sets up or initiates a control circuit for room conveyer motor 31 that originates in a conductor 72 secured at its one end to conductor 9 and therefore to conductor 3 through circuit breaker 7 and its other end is connected to one side of switch 73 associated with the tail portion of the movable element of contactor 25. Conductor 74 leads from the other side of the switch 73 to one side of a switch 75 associated with the reversing switch 19 for motor 29. Another conductor 76 leads from the other side of switch 75 to one side of a switch 77 associated with the reversing switch 19 for the motor 31.

Attention is at this point invited to the fact that switches 53, 56, and 75 are presented as rotatable switches as in the case of the same switch for motor 1 and whose axis of rotation is the same as that of the reversing switch 19 such that switches 53, 56, and 75 may be opened or closed as the case may be simultaneously with the shifting of reversing switch 19.

Switch 19 of motor 31 has another control switch 78 thereon and concentrically arranged therewith the same as with the other reversing switches 19. Between two adjacent sides of each of the switches 77 and 78, a jumper 79 is connected as illustrated and leading off from this jumper is a conductor 80 having a normally-closed switch 81 connected thereto and on the other side of said switch 81 a conductor 82 is connected leading to a switch 83. Switch 81 is normally placed somewhere near the loading end of belt 30 such that the operator may stop motor 31 at his election. Switch 83 is the usual stop-start switch, associated with the motor starter. A conductor 84 leads from switch 83 to one side of switch 85 normally held closed by a spring pressed latch 86 that is retractable by overload coil 5 and enables switch 85 to be opened by spring 87. Conductor 88 takes off from the other side of switch 85 and leads to one side of holding coil 89 for the motor 31 circuit breaker 7. A conductor 90 leads from the coil 89 to the conductor 18, constituting the other side of the line. It will be noted that the circuit just described originates in line 3 of the motor 29 but terminates in the line 18 of motor 31. The remarks above with respect to the relationship of the conductors 3 and 18 of each of the starters applies hereto. Since these lines are common, there is therefore, a completed circuit. This connection assures that motor 29 is electrically linked to motor 31, that motor 31 can rotate reversely to motor 29, must stop when 29 stops or both move in the same direction. Immediately upon the closure for circuit breaker 7 of motor 31, another circuit for the holding coil 94 of related contactor 25 is completed that originates in conductor 91 connected to the movable element of circuit breaker 7 and is therefore connected to conductor 3 that leads to one side of a switch 92 associated with the tail piece of the circuit breaker for motor 31. Conductor 93 leads from the other side of switch 92 to the holding coil 94 for contactor 25. The function and method of closure of said contactor are the same as for the previously discussed similar element for motors 1 and 29. Conductor 95 leads from coil 94 to conductor 18 by way of conductor 90 to complete the circuit for the holding coil 94.

Shunt field 96 for each of the motors is con-

nected by means of conductor 97 to conductor 9, thence through circuit breaker 7 to incoming conductor 3 and by means of conductor 98 to conductor 18, thereby making it the identical connection for each of motors 1, 29, and 31.

The previously discussed circuits for each of the motors 1, 29, and 31 are based on the assumption that the several reversing switches 19 are adjusted such that the conveyers 2, 28, and 30 are to run forward. Assume that one of the switches 34 or 36 is opened or that motor 1 is overloaded thereby opening switch 37. The action in the motors 29 and 31 will be identical since their control circuits are series connected. The opening of either of said switches 37, 36, or 34 will immediately de-energize coil 41 causing circuit breaker 7 to open. This opens switch 44 associated with the tail piece of the circuit breaker 7 opening the contactor 25 circuit for motor 1. In the particular illustration, this would occur immediately upon the opening of circuit breaker 7 because the opening of that switch opens all the other circuits because they are connected therethrough. The opening of circuit breaker 7 opens switch 46 thereof and de-energizes conductor 9 and also de-energizes holding coil 46 of contactor 25, thereby opening switch 49 which opens the circuit to holding coil 67 of circuit breaker 7 for motor 29, thus stopping motor 29. This action opens circuit breaker 7 for motor 29 and switch 68 and de-energizes wire 76, also opening the circuit to coil 89. The next action is that of opening circuit breaker 7 for the motor 31 since its holding coil 89 has been de-energized because of the de-energization of conductor 76. It is thus apparent that no forward motion of motors 29 and 31 will take place following a stopping of motor 1.

Assume now that reversing switch 19 of motor 1 has been rotated 90° which will open switch 51 and reverse the connections to and from motor 1. It will be observed that the motor 1 and conveyer 2 will now reversely rotate and that the circuit is open to holding coil 67 for the circuit breaker 7 of the motor 29. Even though switch 57 might be closed this would not cause motor 29 to start by reason of the opening of switch 51 as previously stated. Since motor 29 cannot start, it is obvious by reason of the control circuits described above, that motor 31 cannot operate because the switch 73 in the energizing circuit for holding coil 89 for motor 31 is open. Therefore, motors 29 and 31 cannot rotate forwardly while motor 1 is rotating reversely. Motor 1, when rotating reversely, is subject only to the control of switches 34, 36, and overload switch 37 in the coil 41 circuit.

Assume now that the reversing switch 19 of motor 29 has been rotated to the position of Fig. 3. It will now be possible to start motor 29 because a new circuit to coil 67 has been established which comprises conductor 99 connected to conductor 3, switch 56 on switch 19 which is now closed, conductor 55 through jumper 54, switch 57, conductor 58 having switches 59 therein, conductor 60, switch 61, conductor 64, coil 67, and conductors 65, and 66 to conductor 18. It will be noted, however, that switch 75 is now open, thereby opening the circuit to holding coil 89 of circuit breaker 7 for motor 31, thus preventing any forward rotation of motor 31.

Assume that the reversing switch 19 for motor 29 (see Fig. 3) is set for reverse operation, it will be possible to operate motor 1 forwardly. The reason for this is that the only connection between motors 1 and 29 is through conductor 52. Even though switch 49 is closed, switch 53 will be open thereby causing motor 1 to operate independently of motor 29 although motor 31 is still subject to motor 29 as set forth above. By the same token, motor 29 may operate forwardly while motor 31 rotates reversely because upon rotating reversing switch 19 for motor 31, a new circuit for coil 89 is established, originating in conductor 100 connected to conductor 3, continuing through switch 78, jumper 79, conductor 80, switch 81, conductor 82, switch 83, conductor 84, switch 85, conductor 88, coil 89 and conductor 90 to conductor 18.

From the foregoing, it should be apparent that in the event motor 1 stops for any reason as by opening switch 34, motors 29 and 31 will immediately stop but switches 4, 57 and 4, 83 will remain closed until manually opened. Should motor 1 be reversely rotated, then motors 29 and 31 will also stop or remain at rest and if the respective reversing switch for each motor is rotated 90°, then those motors too may rotate reversely. It is further possible to rotate motor 1 forwardly, motor 29 reversely, hold motor 31 at rest or rotate it reversely and it is possible to rotate motor 29 forwardly and hold motor 31 at rest or reversely rotate it. Under no condition will any motor rotate forwardly if its succeeding motor is not rotating forwardly although a preceding motor may rotate reversely or be at rest. Each of the conveyers 1, 28, and 30 driven by the respective motors 1, 29, and 31 in their reverse rotations and movements, are subject only to stopping by means of an interruption or opening of the circuit of the circuit breaker holding coils of their respective motor starters and are not stoppable from the starter of a succeeding motor. The above described circuit prevents the clogging at the conveyer terminals and reduces all the hazards accompanying same.

The interconnection described above, under certain conditions, provides for a sequential starting of motors 1, 29, and 31 without manual attention and in the forward direction. Assume e. g. that motor 1 has been stopped for any reason by merely opening switch 34 whereby switches 4, 57 and 4, 83 for motors 29 and 31 respectively will remain closed thereby placing the respective motors 29 and 31 in condition for starting when the circuit breaker holding circuits for each have been closed under the influence of the starter for motor 1. When switch 34 is again closed circuit breaker 7 will close and motor 1 will start to operate and when the starting current of motor 1 has decreased sufficiently after a lapse of time after the closing of circuit breaker 7, contactor 25 will be closed. Closing of contactor 25 of the starter for motor 1 will close switch 49 and also the circuit of holding coil 67 thereby starting motor 29. When the current energizing coil 12 and motor 29 has decreased sufficiently after a predetermnied time after the closing of circuit breaker 7, contactor 25 of the starter for motor 29 will close thereby closing switch 73 and circuit for holding coil 89 thereby starting motor 31. Contactor 25 of the starter for motor 31 will close when the energizing current for motor 31 and its control coil 12 decreases a sufficient amount.

It is apparent that there will be a sequential starting of the several motors 29 and 31 in the forward direction when switches 4, 57 and 4, 83 are kept closed as for instance when either switch 34 or 36 is merely opened, after which it is again

closed. This sequential starting is based upon the lapse of time between the closing of circuit breaker 7 and contactor 25 including its tail switch for motors 1 and 29 since the contactors and tail switches of each motor control the starting of the preceding conveyer or conveyers. The control exercised in the operation of the sequential starting of the several motors is based upon the relative energization of the operating coils of the contactor 25 after the closing of circuit breaker 7 of the several starters and which in turn depends upon the reduction of the starting current as the speed of the motor increases.

It is thought that the circuit outline for three motors will suggest the connections for any number of motors by a continuation of the control circuits described. That which is regarded new, novel, and useful and which is sought to be protected by Letters Patent of the United States, is as follows.

I claim:

1. In a motor control system, the combination; a reversible drive motor for a main conveyer; a reversible drive motor for a lateral conveyer; a reversible drive motor for a room conveyer; a starter including a reversing switch for each motor; means interconnecting each of said starters; means in the motor starter for said main conveyer and included in said interconnecting means to stop said lateral conveyer motor and said room conveyer motor; and means associated with said main conveyer motor starter and included in said interconnecting means to prevent the forward rotation of said lateral and room conveyer motors while said main conveyer motors is reversely rotated.

2. In a motor controlling system; a reversible first motor; a second reversible motor; a third reversible motor; a plurality of starters, one for each of said motors; circuit means connecting the starters for said first and second motors; circuit means connecting the starters for second and third motors; means in said first mentioned circuit means to stop all of said motors; means in said second mentioned means to stop said second and third motors; means in the starter for said first motor to prevent the forward rotation of said second and third motors during the reverse rotation of said first motor; and means in the starter of said second motor to prevent rotation of said third motor; each of said means operatively associated with each of said interconnecting means.

3. In a conveyer system including a plurality of conveyers; a first conveyer and a reversible drive motor therefor; a second conveyer and a reversible drive motor therefor; a third conveyer and a drive motor therefor; an individual starter for each of said motors; means associated with the starter for said first motor to stop motion of all of said conveyers; means associated with the starter for said second motor to stop said second and third conveyers but allowing continuation of movement of said first conveyer; means associated with the starter for said first motor to prevent forward movement of said second and third conveyers while said first conveyer is reversely moved; and means associated with the starter for said second motor to prevent forward rotation of said third conveyer while said second conveyer is reversely rotated and allowing said first conveyer to be moved forwardly or reversely.

4. In a motor driven conveyer system including a plurality of conveyers; a first conveyer and a motor to drive same; a second conveyer discharging onto said first conveyer and a motor to drive same; a third conveyer discharging onto said second conveyer and a motor to drive same; a plurality of motor starters, one for each of said motors, and each starter including a reversing switch, a contactor and a circuit breaker; closing coils for each of said circuit breakers and said contactors; circuit means connected between said first and second starters including a switch actuated by the contactor of said first motor to stop said conveyers when the contactor and switch are open; circuit means connected between said second and third motors including a switch actuated by said contactor of the second motor to stop said second and third motors when said contactor and switch are open; and a holdout coil operatively associated with each contactor and energized by the starting current of its respective motor to control the closing of the contactor and its associated switch whereby the contactor will have a time lag in its closing operation after the closing of its circuit breaker; the closing coils of said circuit breakers for the second and third starters included in said circuits respectively; said circuit breaker coils de-energized upon the opening of said circuits.

5. In a motor control; a first motor; a second motor; a third motor; an individual starter for each motor; each starter including a contactor, a holding coil therefor, and a circuit breaker with a holding coil therefor; a first circuit extending between the starter for said first and second motors which includes the holding coil of the circuit breaker for said second motor; a second circuit extending between the starters for said second and third motors which includes the holding coil for the circuit breaker for said third motor; an energizing circuit for the holding coil for the circuit breaker of said first motor; an energizing circuit for the holding coil of the circuit breaker for said second motor; an energizing circuit for the holding coil of the circuit breaker for said third motor; each of said energizing circuits having switch means therein; means associating said first circuit and said energizing circuit for said second motor; means associating said second circuit with the energizing circuit for said third motor; said circuits arranged such that all motors may be stopped upon the opening of said energizing circuit for said first motor; and further arranged such that only said second and third motors are stopped upon the opening of the energizing circuit for the holding coil of the circuit breaker for said second motor.

6. In a mine conveyer system; a first conveyer, a motor for driving same and a starter including a reversing switch for said motor; a second conveyer, a motor for driving same and a starter including a reversing switch for said motor; a third conveyer, a motor for driving same and a starter including a reversing switch for said motor; an auxiliary switch operably associated with each reversing switch; a control circuit for the starter of said first motor and extending parallel to said first conveyer; means connecting the auxiliary switches; a plurality of switches arranged in said circuit extending parallel to said first conveyer; the opening of any of said switches stopping all of said motors; said auxiliary switches being so arranged that when said first motor is reversed said second and third motors are at rest and further, that said first motor may rotate forwardly while said second and third motors operate reversely.

7. In a conveyer system; a first conveyer; a

second conveyer discharging onto said first conveyer; a third conveyer discharging onto said second conveyer; a motor to drive each of said conveyers; a starter for each of said motors including a reversing switch; circuit means interconnecting each of said starters; switch means operatively associated with said circuit means to stop the motion of all of said conveyers, said switch means included in a circuit paralleling said first conveyer; means associated with said reversing switches to prevent the forward motion of said second and third conveyers while said first conveyer is at rest, said means also including other means to prevent the motion of any previous conveyer when its following conveyer is moving reversely; and said means enabling some of said conveyers to operate forwardly while other of said conveyers are operating reversely.

8. In a motor control for a plurality of motors in combination; a first motor; a second motor; a third motor; an individual starter for each motor including a reversing switch, a circuit breaker and a contactor; a circuit interlocking the contactor and reversing switch of the first motor starter with the reversing switch and circuit breaker of the second motor; a circuit interlocking the contactor and reversing switch of the second motor with the reversing switch and circuit breaker of the third motor; a holding circuit for the circuit breaker of the first motor starter, the opening of said holding circuit arresting motion of all motors by opening said first contactor thereby opening each of said two circuits; a reversing of said first motor opening said first mentioned circuit thereby preventing the starting of said second and third motors; and a reversing of said second motor stopping said third motor by opening said second mentioned circuit.

9. A conveyer system; a first, second and third conveyer arranged in succession and transversely disposed, one with respect to the other; and individual drive motor for each of said conveyors; a motor starter for each of said motors, each starter including a starting resistance shunting contactor, a circuit breaker, a reversing switch and auxiliary switch means on each reversing switch; an independent holding circuit for the circuit breaker of the starter for said first motor; a holding circuit for the circuit breaker of the starter for said second motor; means connecting said contactor of said first starter, an auxiliary switch on the reversing switch of said second starter and said holding circuit for the circuit breaker of said second circuit; a holding coil circuit for the circuit breaker of said third starter; means connecting the contactor of said second starter, a second auxiliary switch on the reversing switch of said second starter, the auxiliary switch on the reversing switch for said third motor and the holding circuit for the circuit breaker of said third motor; each of said conveyers stopping when the said holding circuit for said first motor is broken; circuit means to cause said second conveyer to run reversely while said first conveyer runs forwardly; and other circuit means to cause said third conveyer to run reversely while said second conveyer runs forwardly.

10. In a mine conveyer system; a first, second, and third conveyer; an individual motor for each of said conveyers; a starter for each of said motors; control means to stop the motion of said second and third conveyers when said first conveyer has stopped; control means to prevent motion of said second and third conveyers when said first conveyer is reversely moved; control means to prevent motion of said third conveyer when said second conveyer is reversely rotated; and each of said control means being so constructed and arranged that any succeeding conveyer may move in a reverse direction to that of the preceding conveyer.

11. In a conveyer system; a plurality of conveyers; an individual drive motor for each conveyer; a starter for each individual motor; circuit means connecting the starters of each of said motors; said circuit means including switches to stop all conveyers preceding any conveyer that has been stopped; and other means included in said circuit means to prevent movement of any preceding conveyers to any one conveyer that has been reversed in its movement

12. In a conveyer system; a first and second conveyer; an individual motor to drive each conveyer; a motor starter for each motor including a reversing switch; a circuit connecting said starters; means associated with said first starter included in said circuit to stop said second conveyer when said first conveyer has been stopped; and other means associated with said first starter and included in said circuit to prevent movement of said second conveyer when said conveyer has been reversed in its movement.

13. In a conveyer system; a first conveyer; a second conveyer discharging onto said first conveyer; an individual drive motor for each conveyer; an individual starter for each motor including a reversing switch, a contactor and a circuit breaker; an individual holding coil for each contactor and circuit breaker; a control circuit for the holding coils of each circuit breaker; said control circuits being co-extensive in length with the conveyers they control; a plurality of normally-closed contact switches in each circuit; a circuit connecting said starters which includes the circuit breaker holding coil circuit of the starter for said second motor; the holding coil circuit for the motor for said first conveyer controlling the stopping of said second motor; and said circuit having other means therein to prevent movement of said second conveyer when said first conveyer is in reverse movement.

14. In a conveyer system; a first conveyer; a second conveyer; an individual motor for each conveyer; an individual starter for each motor, each starter including a reversing switch, a circuit breaker and a holding coil for each circuit breaker; a holding coil control circuit for each starter; auxiliary switches operatively associated with each reversing switch; circuit means originating in the starter of said first motor and terminating in the starter of said second motor, the holding coil circuit for said second starter included in said circuit means; said auxiliary switches preventing forward motion of said second conveyer when said first conveyer is reversely moved.

15. In a motor control system; a reversible drive motor; a starter for said motor including a circuit breaker, a contactor and an associated timing coil; a second reversible drive motor; a starter for said second motor including a circuit breaker and a contactor; holding coils for each of said contactors and said circuit breakers; a circuit for the circuit breaker holding coil of said first starter; a circuit for the holding coil of the contactor of said first starter including a switch associated with the circuit breaker of said first motor and adapted to close simultaneously there-

with; a circuit for the circuit breaker holding coil of said second starter; a circuit connecting said starters which includes said circuit breaker holding coil circuit for said second starter and a switch closable upon the closing of said contactor; means in said circuit connecting the starters to prevent the forward rotation of said second motor when said first motor is reversely rotating and to prevent forward rotation of said second motor when said first motor is at rest; a circuit for the holding coil of the contactor of said second starter closable upon the closure of the circuit breaker for said second starter including a switch associated with said circuit breaker in said second starter; said second motor starting a predetermined time after the starting of said first motor, and said timing coil governing the closure of its associated contactor and closure of said circuit connecting said starters.

16. In a motor control system; a first motor; a starter for said motor including a reversing switch, a circuit breaker, a contactor and an associated timing coil; a second motor; a starter for said second motor including a reversing switch, a circuit breaker and a contactor; individual holding coils for each of said contactors and circuit breakers; a circuit for the circuit breaker holding coil in the starter for said first motor; a circuit for the holding coil for the contactor in the starter for said first motor including a switch mechanically associated with the circuit breaker in said first starter and closable simultaneously with the said circuit breaker; a circuit for the circuit breaker holding coil in said second starter; a circuit connecting said starters which includes said circuit for the circuit breaker holding coil in said second starter and a switch associated with the contactor in said first starter to close the circuit connecting the starters; a switch associated with the reversing switch of said first starter and a switch associated with the reversing switch in said second starter; said second motor started upon the closure of the contactor in said first starter, said contactor closing a time interval after the closure of the circuit breaker in said first starter, said timing coil determining the time of closing of said circuit connecting said starters; said switches associated with said reversing switches of said first and second starters preventing forward rotation of said second motor when said first motor is reversely rotated and stopping of said second motor when said first motor is reversed; other switch means associated with the reversing switch for said second starter includable in the circuit breaker holding coil circuit in said second starter enabling said second motor to rotate reversely while said first motor rotates reversely or is at rest; and said reversible switches simultaneously operable with switches mechanically connected thereto.

17. In a motor starter; a circuit breaker and a holding coil therefor; a contactor, a holding coil therefor to close the contactor and a timing coil associated therewith; a reversing switch; and a starting resistance; a circuit for the holding coil for said circuit breaker; a circuit for the holding coil for said contactor including a switch operable by said circuit breaker; said contactor having a time lag in closing after the closure of said circuit breaker, said time determined by said timing coil; said contactor shunting said starting resistance; a switch means associated with said contactor and closable simultaneously therewith; switch means associated with said reversing switch; said last mentioned switch means connectible in series with said switch associated with said contactor to control other circuits connectible thereto.

18. In a motor starter; a circuit breaker and a holding coil therefor; a contactor, a closing coil therefor and a holdout coil initially opposing the closing coil, both coils operatively associated with said contactor; a starting resistance; a reversing switch; an auxiliary switch means operatively associated with said reversing switch; a starting circuit including said circuit breaker, said resistance, said timing coil, and said reversing switch; a circuit for the holding coil of said circuit breaker which upon closing effects the energization of the closing coil; the closing of the circuit breaker effecting the closing of the starting circuit and the energization of the holdout coil, the energized holdout and closing coils cooperating to close said contactor to shunt said resistance a predetermined time after the closure of said circuit breaker holding coil circuit; a circuit for said contactor holding coil including a switch associated with said circuit breaker closable simultaneously with said circuit breaker; and a switch associated with said contactor; said last mentioned switch and said auxiliary switch means on said reversing switch adapted to control other motor circuits connected thereto.

19. In a conveyer system; a first conveyer, a motor to drive same, and a starter including a contactor for said motor; a second conveyer, a motor to drive same and a starter for said motor; circuit means connecting said starters to control the starting of said second conveyer from said first starter, the said circuit means including a switch to close the circuit and timing means associated with the contactor in said first starter to effect a closing of the switch, said timing means having a time lag in its operation in effecting the closing of said circuit means; and means to prevent forward movement of said second starter while said first starter is at rest and to prevent forward movement of said second conveyer while said first conveyer is reversely rotated.

20. A motor starter adapted to control the operation of a motor and to be electrically connected to a second motor starter whereby the operation of the second motor starter may be controlled by the first motor starter, comprising in combination, a circuit breaker and a coil to close the same, a starting resistance to control the initial current to the motor, a contactor to shunt out the resistance a predetermined time after initial energization of the motor, a coil to close the contactor, a timing coil associated with the contactor and connected in series with the resistance to determine the time lag between the closing of the contactor and the closing of the circuit breaker, a circuit for the closing coil for the circuit breaker, a circuit for the closing coil for the contactor and including a switch operable by the circuit breaker to close and maintain the circuit closed while the circuit breaker is closed, a reversing switch having two positions in either of which the motor is operable whereby the direction of rotation of the motor may be changed, circuit control means associated with the reversing switch and operable in unison therewith and electrically connectible with said second starter whereby said second starter may be supplied with current when said reversing switch is in one position and the motor operating in one direction and deprived of current when the reversing switch is in the other position and the said motor is operating in the reverse direction,

and a switch associated with the contactor and closable simultaneously therewith whereby current to said circuit control means is supplied thereto after a predetermined time after the closing of said circuit breaker.

21. In a conveyer system; a first conveyer unit; a second conveyer unit; a motor in each unit to drive said conveyers; starter means in each unit including a directional control for each of said motors; means in the starter of said second motor responsive to means in said first conveyer unit to stop said second motor when said first motor is stopped or has its direction of rotation reversed; and means electrically connecting said two last means to enable either one of said conveyers to operate reversely without regard to the direction of movement of the other.

22. In a conveyer system; a first conveyer unit including a motor to operate same; a second conveyer unit including a motor to operate same, said second conveyer unit discharging onto said first conveyer unit; means to electrically interconnect said conveyer units, said means constructed and arranged such that said second conveyer unit will be stopped when said first conveyer unit is stopped or has its direction of movement reversed and in which said first conveyer unit may operate forwardly or reversely without regard to movement in said second conveyer unit and in which said second conveyer unit may move reversely while said first conveyer unit moves forwardly or reversely.

23. In a conveyer system; a first conveyer unit including a reversible motor to drive same and a starter for said motor; a second conveyer unit including a motor to drive same and a starter for said motor; a contactor and a circuit breaker in each starter; means connecting the contactor of said first starter with the circuit breaker of said second starter to start the second starter after the closure of the contactor in said first starter and preventing forward operation of said second conveyer while said first conveyer is operating reversely.

EDWARD P. SMITH.