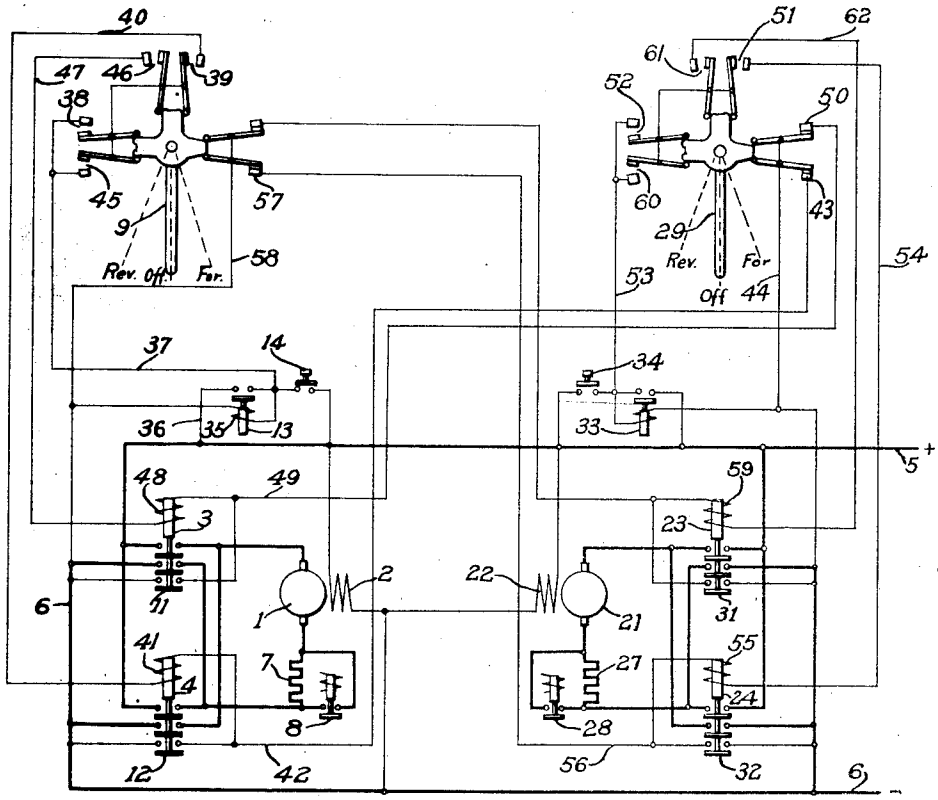
Oct. 13, 1925. 1,557,065

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MOTOR CONTROL SYSTEM

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UNITED STATES PATENT OFFICE.

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MOTOR-CONTROL SYSTEM.

Application filed February 8, 1923. Serial No. 617,735.

To all whom it may concern:

Be it known that I, GEORGE E. KING, a citizen of the United States, and a resident of Wilkinsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Motor-Control Systems, of which the following is a specification.

My invention relates to systems of motor control and it has particular relation to such systems as are employed in connection with machine-tools and the like.

The object of my invention is to automatically control the relative operations of a plurality of motors.

In many motor applications, it is possible to increase the efficiency of the work done and also to increase the production by maintaining a definite sequence of operation. It is also possible for a single operator to give adequate attention to a number of automatic machines and this procedure has become common in modern manufacturing plants.

My invention will be best understood with reference to the accompanying drawing, in which the single figure is a diagrammatic view of circuits and apparatus embodying my invention.

A motor having an armature 1 and a shunt field-magnet winding 2 may be operatively connected, through reversing switches 3 and 4, to a source of energy comprising line conductors 5 and 6. A starting resistor 7 is controlled in a familiar manner by means of an accelerating switch 8. The direction of operation of the motor armature is controlled by a master switch 9, which has been illustrated as of a type described in United States Patent 1,241,510, granted to E. A. Hanff and assigned to the Westinghouse Electric & Manufacturing Company. A plurality of interlocks 11 and 12 are mechanically attached to, and operated respectively by, switches 3 and 4. A no-voltage relay 13 is controlled by a push-button switch 14.

Electrically interlocked and co-operating with the foregoing apparatus is a substantially duplicate equipment comprising a motor having an armature 21 and a shunt field-magnet winding 22, and which is operatively connected, through a pair of reversing switches 23 and 24, to line conductors 5 and 6. An accelerating resistor 27 is controlled by an accelerating switch 28, and a master switch 29 is provided for effecting the operation of reversing switches 23 and 24. Interlocks 31 and 32 are respectively connected to, and actuated by switches 23 and 24, and the operation of a no-voltage relay 33 is effected by means of a push-button switch 34.

According to my invention, either of the motors may be operated and its direction of rotation may be reversed, at will, provided that the master switch governing the other motor occupies its illustrated and inoperative position. For example, when master switch 29 occupies its illustrated position, master switch 9 may be actuated to control reversing switches 3 and 4 in the following manner. No-voltage relay 13 is first closed by momentarily actuating push-button 14, whereby a circuit is established from line conductor 5 through switch 14 and operating coil 35 of relay 13 to line conductor 6. A holding circuit for relay 13 extends from line conductor 5 through conductor 36, relay 13, after its closure, and coil 35 to line conductor 6. When master switch 9 is actuated to the right, a circuit is established from conductor 5 through conductor 36, relay 13, conductor 37, switches 38 and 39, conductor 40, coil 41 of reversing switch 4, conductor 42, switch 43 and conductor 44 to line conductor 6. Reversing switch 4 then closes to operate the armature 1 in a direction that will be assumed as the "forward" direction of operation.

When it is desired to reverse the armature 1, master switch 9 is actuated to the left to open switch 4 and to establish a circuit from line conductor 5 through conductor 36, relay 13, conductor 37, switches 45 and 46, conductor 47, coil 48 of reversing switch 3, conductor 49, switch 50 and conductor 44 to line conductor 6. Reversing switch 3 then closes to establish the "reverse" direction of operation of armature 1. It is manifest that since the operating coils 41 and 48 of switches 4 and 3, respectively, are fed through switches 43 and 50 of master switch 29, armature 1 cannot be controlled at will unless master switch 29 occupies its illustrated inoperative position.

However, armatures 1 and 21 may be simultaneously operated in a given direction corresponding, for example, to the right-hand positions of master switches 9 and 29.

In these positions, reversing switch 4 is closed and a circuit for operating coil 41 thereof extends, as previously traced, through switch 43 of master switch 29. In the right-hand position of master switch 29, switch 43 is closed and switch 50 is open. Also, switches 51 and 52 are closed. When no-voltage relay 33 is closed by means of switch 34, it is normally retained closed, since it is controlled in a manner similar to relay 13. In addition, a circuit extends from line conductor 5 through relay 33, conductor 53, switches 52 and 51, conductor 54, coil 55 of reversing switch 24, conductor 56, switch 57 and conductor 58 to line conductor 6. Reversing switch 24 is, therefore, closed to establish connections for the operation of armature 21. Armatures 1 and 21 are now rotating in given directions corresponding to the right-hand operation of master switches 9 and 29.

At the end of a certain period, master switch 9 may be automatically returned to its illustrated position and armature 1 brought to rest. Master switch 9 may be reversed, that is, moved to its left-hand position, but armature 1 is in no-wise affected thereby until armature 21 has completed its operation, when master switch 29 is returned to either its "off" position or is reversed.

After the circuit of armature 1 is interrupted, and during the continued operation of armature 21, a circuit for the operating coil 55 of reversing switch 24, is maintained independently of the position of master switch 9. That is, when master switch 29 occupies its right-hand position, a circuit for coil 55 extends from line conductor 5 through relay 33, conductor 53, switches 52 and 51, conductor 54, coil 55 and interlock 32 to line conductor 6. As soon as master switch 29 is returned either to its illustrated or to its reversed position, switches 51 and 52 are opened and coil 55 becomes deenergized.

Armature 1 may now be operated in a reversed direction whenever master switch 9 is actuated to the left and whenever master switch 29 occupies its illustrated position, or whenever it occupies its reversed or left-hand position. Reversing switch 3 is now closed by its operating coil 48, a circuit for which was previously traced and which extends through switch 50 of master switch 29, which is closed when this master switch occupies its left-hand position, in which position switch 43 is open. Armatures 1 and 21 may continue to operate for a predetermined period and when either master switch is again returned to its off position or is reversed, the other motor is not affected until its corresponding master switch is actuated. Armature 1, e. g., may complete its operation independently of master switch 29, but it may not be reversed prior to a reversal of armature 21. The holding circuit for coil 48 of reversing switch 3, which circuit is independent of master switch 29, extends from line conductor 5 through conductor 36, relay 13, conductor 37, switches 45 and 46, conductor 47, coil 48 and interlock 11 to line conductor 6. Therefore, until switches 45 and 46 of master switch 9 are opened, armature 1 will continue its operation.

Similarly, a holding circuit for operating coil 59 of reversing switch 23 extends from line conductor 5 through relay 33, conductor 53, switches 60 and 61, conductor 62, coil 59 and interlock 31 to line conductor 6. Therefore, switch 23 will remain closed and armature 21 will continue to operate independently of the position of master switch 9, until switches 60 and 61 of master switch 29 are opened.

From the foregoing description, it is apparent that a pair of motors connected according to my invention may be operated in a given direction for performing any desired work, such as is required of planers or other machine tools, and neither motor can be reversed until the other motor has completed its corresponding operation. In accordance with common practice, it is presumed that the master switches controlling the motors are mechanically operated by any desired movable element of the machine-tool equipment. According to well-known machine tool operations, the master-switches in the present instance are independently actuated and it is the purpose of my invention to provide means for controlling the motors independently of the master switches until the completion of certain given machine operations. It is impossible for the motors to be simultaneously operated in opposing directions, and, therefore, a certain desirable sequence of operations of the machines may be automatically maintained.

I claim as my invention:

1. The combination with a plurality of motors and controlling means therefor, of means for effecting the simultaneous operation of the motors, each in a given direction, and means for preventing reversal of one motor prior to reversal of another.

2. The combination with a plurality of motors and controlling means therefor, of means for effecting the simultaneous operation of the motors, each in a given direction, means for preventing reversal of one motor prior to reversal of another and means for effecting operation of one motor when another is idle.

3. The combination with a pair of motors and controlling means therefor, of means for effecting the simultaneous operation of the motors, each in a given direction, and means for insuring the completion of the

operation of each motor, for a predetermined period prior to simultaneously beginning new operations.

4. The combination with a pair of motors and controlling means therefor, of means for effecting the simultaneous operation of the motors, each in a given direction, means for insuring the completion of the operation of each motor for a predetermined period prior to simultaneously beginning new operations, and means for effecting operation of one motor when the other is idle.

5. The combination with a plurality of motors and controlling means therefor, of means comprising a pair of master switches for effecting the simultaneous operation of the motors, each in a given direction, and for preventing reversal of one motor prior to reversal of another.

In testimony whereof, I have hereunto subscribed my name this first day of February 1923.

GEORGE E. KING.