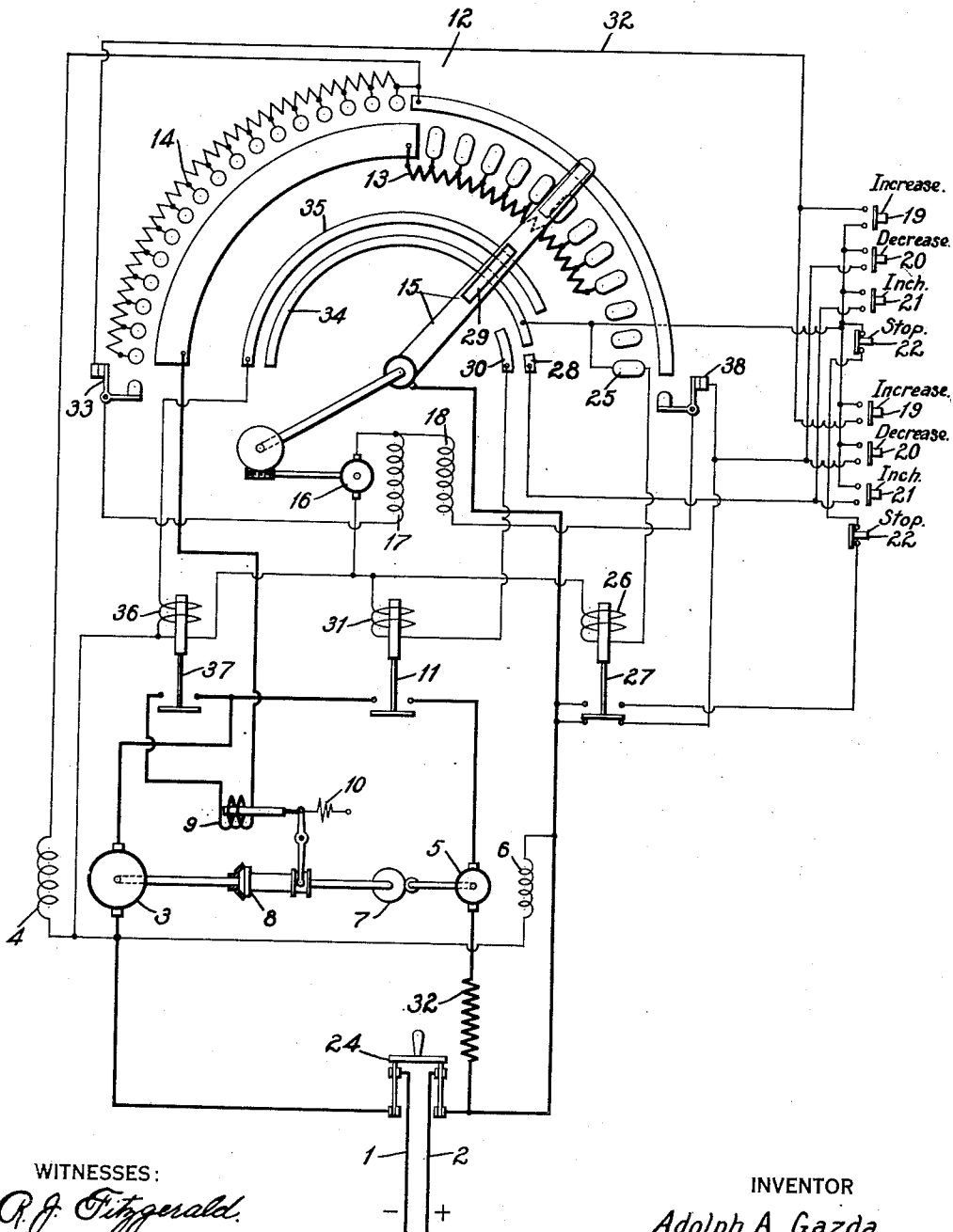


A. A. GAZDA.
MOTOR CONTROL SYSTEM.
APPLICATION FILED SEPT. 30, 1916.

1,376,426.

Patented May 3, 1921.



WITNESSES:

R. J. Fitzgerald.
J. R. Langley.

INVENTOR

Adolph A. Gazda.

BY

Wesley E. Sarr
ATTORNEY

UNITED STATES PATENT OFFICE.

ADOLPH A. GAZDA, OF WILKINSBURG, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE
ELECTRIC AND MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA.

MOTOR-CONTROL SYSTEM.

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Specification of Letters Patent.

Patented May 3, 1921.

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To all whom it may concern:

Be it known that I, ADOLPH A. GAZDA, a citizen of the United States, and a resident of Wilksburg, 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 motor-control systems and it has particular relation to such systems as are employed in connection with printing presses and similar machines.

My invention has for its object to provide a simple and effective means whereby machines operated by electric power may be driven slowly at a uniform speed.

In the operation of printing presses, it is necessary that they be started slowly and gradually in order to avoid tearing the paper in the rolls and disturbing the adjustment of the several parts. It is desirable, also, to operate the press at a low speed during the preliminary work of making up or preparing for regular operation at full speed. It is essential that the press be operated at a uniform speed during the process of making up. It is practically impossible to secure satisfactory performance if the main driving motor is employed to drive the press during such operation because the motor is operated at an unstable point in its characteristic curve.

According to the present invention, I provide a main motor and an auxiliary motor which are arranged to be operatively connected for driving the press at a relatively low speed. The motors are connected by reduction gear mechanism so arranged that, when the main motor operates at a low speed, the auxiliary motor rotates at substantially its normal full speed. The armatures of the motors are connected in series and the value of the current traversing the armature of the main motor is controlled by the counter-electromotive force of the auxiliary motor when the main motor tends to operate above a predetermined speed. The operative connection of the motors is broken when the circuit of the main motor is adjusted to operate the latter at its higher speeds.

The details of my invention will be described in connection with the accompanying drawing in which the single figure is a

diagrammatic view of circuits and apparatus embodying my invention.

Line conductors 1 and 2 supply energy to a main motor, the armature of which is indicated at 3 and which may be operatively connected in any suitable manner to a printing press or other mechanism (not shown). The main motor is provided with a shunt field-magnet winding 4.

An auxiliary motor, having an armature 5 and a shunt field-magnet winding 6, is adapted to be operatively connected to the main motor by reduction-gear mechanism 7 and a friction clutch 8. The clutch 8 is controlled by a solenoid 9 and a spring 10.

The circuits of the motors are controlled by an electromagnetic switch 11 and a controller 12. The controller comprises an armature resistor 13 and a field resistor 14 which are respectively connected in series with the armature winding 3 and the field-magnet winding 4 of the main motor. The resistors are controlled by a movable arm 15 that is actuated by a pilot motor 16. The pilot motor is provided with field-magnet windings 17 and 18 which are respectively energized for operating the motor 16 and arm 15 in opposite directions.

The operation of the pilot motor is controlled by means of push-button switches 19, 20, 21 and 22, two sets or stations of which are shown by way of example. The several push buttons are designated by appropriate legends which indicate the respective effects produced upon the operation of the system by their actuation.

It may be assumed that the motors are stationary and that the arm 15 occupies its inoperative position, which is at the end of its path of movement in a clockwise direction. The clutch 8 is engaged to connect the armatures of the motors 3 and 5.

When a line switch 24 is closed, a circuit is completed which extends from line conductor 2 through switch 24, controller arm 15, contact member 25, actuating coil 26 and switch 24 to line conductor 1. The coil 26 is energized to actuate a no-voltage relay 27 to its upper position. The closing of the no-voltage relay 27 operates to complete a control circuit for the several push buttons whereby the latter are rendered effective to govern the operation of the motors.

When the controller arm is in its "off" po-

sition, the motors may be operated for any desired length of time to drive the press at a minimum speed by closing that one of the push-button switches 21 which is designated
 5 "Inch". The closing of the push-button switch completes a circuit which extends from no-voltage relay 27, which is connected to line conductor 2, through the push-button switches 22 and 21, contact member
 10 28, insulated contact member 29 on the controller arm, contact segment 30 and actuating coil 31 of switch 11 to line conductor 1. The switch 11 then closes to connect the armature of the main and auxiliary motors in
 15 series with a resistor 32.

The main motor 3 operates at a relatively low speed while the auxiliary motor 5 rotates at a comparatively high speed by reason of the fact that they are connected
 20 through the reduction-gear mechanism 7. The motors may be stopped at any desired time by releasing the push button 21 and thereby opening the circuit of the coil 31 of the switch 11. The armature circuit of the
 25 motors are thereupon opened by switch 11.

When it is desired to operate the driven mechanism slowly and uniformly, a push button 19, which is designated "Increase", is actuated to complete a circuit for the pilot
 30 motor 16. This circuit extends from the no-voltage relay 27 through switches 22 and 19, conductor 32, limit switch 33, field-magnet winding 17, and armature 16, to line conductor 1. The pilot motor 16 then actuates the
 35 controller arm 15 in a counter-clockwise direction.

When the insulated contact member 29 engages a contact segment 34, the actuating coil 31 is again energized by a circuit which
 40 extends from no-voltage relay 27 through switches 22, contact segment 34, contact member 29, contact segment 30 and coil 31 to line conductor 1.

If the push button 19 be released while
 45 the arm 15 occupies a position to maintain the circuit just described, the motors will continue to rotate uniformly, the main motor and the mechanism to which it may be connected being operated at a low speed.
 50 An increase in the speed of the main motor 3 causes a much greater increase in the speed of the auxiliary motor 5 relative to its normal speed and the increased electromotive force of the latter causes a decrease in the
 55 value of the current traversing the armature circuits of the motors and a corresponding decrease in their speeds. The auxiliary motor thus performs the function of a governor to maintain the operation of the system at a substantially constant speed.
 60

When the preliminary operation of making up has been completed, the push button 19 is again actuated to complete the circuit of the pilot motor, as above traced, and the
 65 controller arm 15 is again actuated in a

counter-clockwise direction. When the insulated contact member 29 engages a contact segment 35, a circuit is completed which extends from the contact segment 34, which is connected to the line conductor 2, as above traced, through contact member 29, contact segment 35 and coil 36 to line conductor 1. The coil 36 is energized to close a switch 37 which connects the solenoid coil 9 in series with the armature of the main motor and
 75 the resistor 13.

The coil 9 is energized to disengage the clutch 8 against the tension of the spring 10. The motors are thus disconnected mechanically, and the mechanism is driven by
 80 the main motor alone. At substantially the same time that the contact member 29 engages the contact segment 35, it is separated from the contact segment 30 to open the circuit of the actuating coil 31 of switch 11.
 85 The latter then opens to break the circuit of the auxiliary motor 5.

The operator may hold the push-button switch 19 in its closed position until the controller arm 15 has effected the increase
 90 in speed of the motor 3 to the desired rate by removing the resistance 13 from the armature circuit and inserting a portion or all of the resistor 14 in circuit with the field-magnet winding 4. The motor 3 then rotates at its normal speed to actuate the press
 95 during its regular operation.

When it is desired to decrease the speed of the motor, a push-button switch 20 which is designated "Decrease", is actuated to complete a circuit for the pilot motor which extends from no-voltage relay 27 through the switches 22 and 20, limit switch 38, field-magnet winding 18 and armature 16 to line
 100 conductor 1. The pilot motor 16 is thus reversed to actuate the arm 15 in a clockwise direction to remove the resistor 14 from the field circuit of the motor. The push button 20 will be released by the operator when the speed of the motor has been reduced to
 110 the desired rate.

To stop the motor at any time, it is only necessary to actuate a push button 22, whereupon the coil 26 of no-voltage relay 27 and coil 36 of switch 37 are deenergized. The
 115 no-voltage relay 27 then falls to its lower position, and switch 37 opens to break the circuit of the main motor and the coil 9. The spring 10 effects the engagement of the clutch 8 in preparation for the succeeding
 120 starting operation.

When the no-voltage relay 27 is in its lower position, whether through the actuation of the "stop" button or because of a failure of voltage, the motors cannot be operated until the controller arm 15 again occupies its inoperative position. Upon the return of line voltage or the closing of line switch 24, a circuit for the pilot motor is completed which extends from line conduc-
 130

tor 2 through no-voltage relay 27, which is in its lower position, limit switch 38, field-magnet winding 18 and armature 16 to line conductor 1. The arm 15 is thus automatically returned to its inoperative position after every failure of line voltage or the stopping of the main motor, with the controller arm in an intermediate position.

Limit switches 33 and 38 operate to limit the movement of the controller arm 15 in the respective directions. It will be noted that the limit switches 33 and 38 are respectively in series with the field-magnet windings 17 and 18. When one of the limit switches is open, the circuit of the pilot motor 16 can be completed only through that field-magnet winding which causes it to rotate in such direction as to return the controller arm to an intermediate position.

It will be noted that I provide a simple arrangement whereby a driven mechanism may be started slowly and gradually or may be operated uniformly at low speeds. The starting operation can occur only when the controlling mechanism is in its inoperative position.

I claim as my invention:

1. In a control system, the combination with a plurality of electric motors, of a switch for operatively connecting them to operate at a predetermined speed, and controlling means for successively effecting the operative connection of said motors, the operation of one of said motors at a relatively low speed, the disconnection of said motors mechanically and electrically and the operation of said one motor at a relatively high speed.

2. The combination with a pair of electric motors and a controller therefor for successively effecting the operation of one of said motors at a relatively low speed, the disconnection of said motors and the operation of said one motor at a relatively high speed, of means for operatively connecting said motors when said controller occupies an inoperative position.

3. In a control system, the combination with a plurality of electric motors and mechanical means for operatively connecting them, of means for connecting the armature windings of said motors in series relation and for controlling said mechanical means whereby the motors are disconnected when one of them is arranged to operate above a predetermined speed.

4. In a control system, the combination with a pair of electric motors, and means comprising reduction-gear mechanism for operatively connecting them, of means comprising a coil in series with one of said motors for controlling said connecting means, means comprising an electromagnetic switch for electrically connecting said motors in series relation, and means for controlling

the circuit of said coil and the operation of said switch.

5. In a control system, the combination with a main motor and an auxiliary motor, and reduction-gear mechanism and a clutch for operatively connecting them, of a coil in series with the main motor for controlling said clutch, a switch for controlling the connection of said motors in series relation, and controlling means for said coil and said switch for successively effecting the connection of said motors at a relatively low speed, the disconnection of said motors, both electrically and mechanically, and the acceleration of said main motor.

6. In a control system, the combination with a main motor and an auxiliary motor, and reduction-gear mechanism and a clutch for operatively connecting them, of a coil in series with the main motor for controlling said clutch, a switch for controlling the connection of said motors in series relation, and means for successively effecting the closing of said switch, the opening of said switch and the acceleration of said main motor.

7. In a control system, the combination with a plurality of electric motors and means for operatively connecting them, of controlling means for said motors comprising a controller, a pilot motor for actuating said controller; means for causing said pilot motor to effect the connection of said motors for series operation and for effecting the connection of said motors in series independently of said pilot motor.

8. In a control system, the combination with a plurality of electric motors, of controlling means therefor comprising a movable contact member, a pilot motor for actuating said contact member, an electromagnetic switch for connecting said motors in series relation, and means for causing said pilot motor to effect the closing of said switch and for closing said switch independently of said pilot motor.

9. In a control system, the combination with a plurality of electric motors and an electromagnetic switch for electrically connecting said motors, of a power-actuated member for controlling said switch, and manually operable means for controlling said member and for effecting the closing of said switch either through the actuation of said member or independently thereof.

10. In a control system, the combination with an electric motor and a controller therefor having a movable arm for effecting the starting and the stopping of said motor, of a pilot motor for actuating said arm, and a plurality of manually operable switches for controlling the operation of said pilot motor and for effecting a slow rotation of said motor independently of said pilot motor.

11. In a control system, the combination

with an electric motor and a controller there-
for having a movable arm, of a pilot motor
for actuating said arm, a plurality of man-
ually operable switches for controlling the
5 operation of said pilot motor and for effect-
ing a slow rotation of said motor inde-
pendently of said pilot motor, and means
for rendering said switches inoperative upon
a failure of voltage until said arm occupies
10 its inoperative position.

12. The combination with a plurality of
electric motors normally mechanically con-
nected together, of means for operatively
electrically connecting the same, and means
15 for successively effecting the operation of

said motors, the disconnection of said motors
mechanically and electrically, and the con-
tinued operation of one of said motors.

13. The combination with a pair of elec-
tric motors; a controller for effecting the 2
starting and the stopping of said motors,
means for actuating said controller, of a
manually operable switch for effecting the
connection of said motors to cause them to
operate independently of said actuating 2
means.

In testimony whereof, I have hereunto
subscribed my name this 26th day of Sept.,
1916.

ADOLPH A. GAZDA.