E. S. LAMMERS, JR.

MOTOR CONTROL SYSTEM.

APPLICATION FILED NOV. 3, 1917.

1,382,988. Patented June 28, 1921.

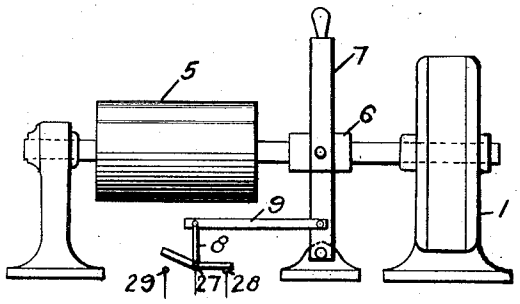


Fig. 2.

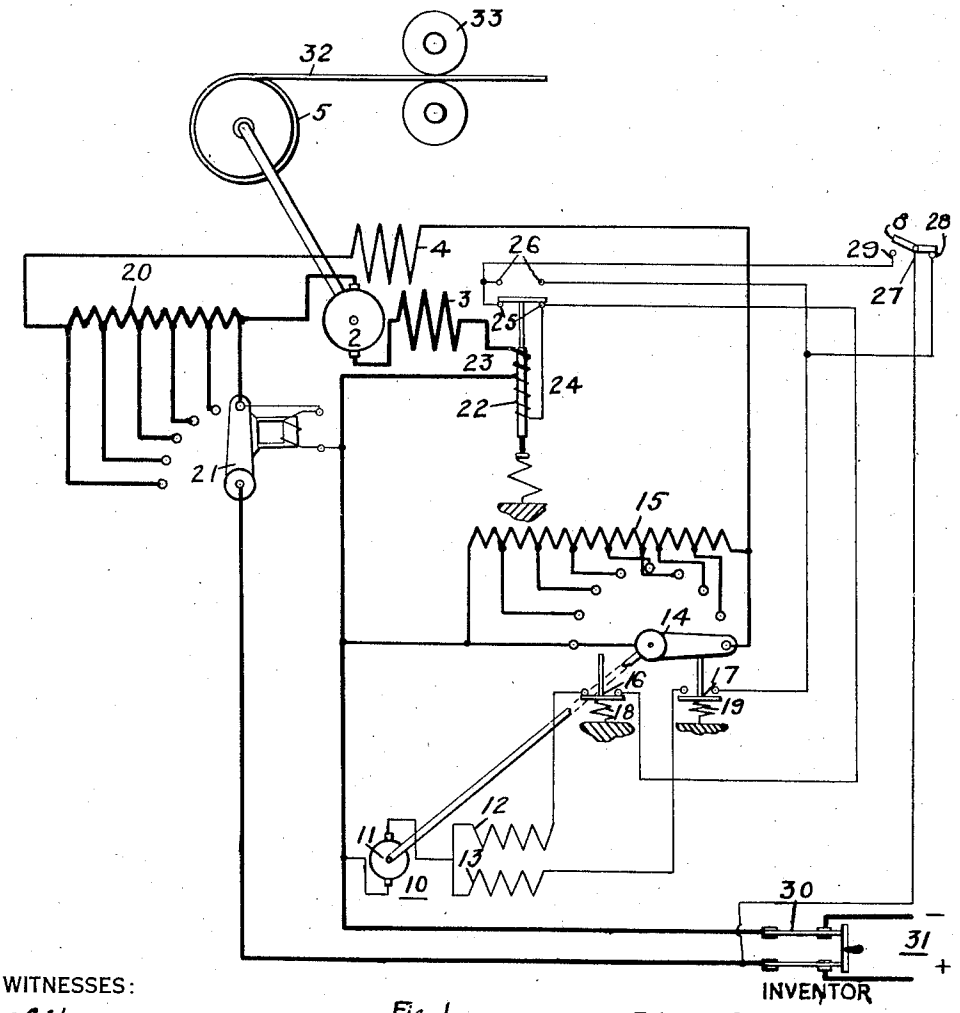


Fig. 1.

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MOTOR-CONTROL SYSTEM.

1,382,988. Specification of Letters Patent. Patented June 28, 1921.

Application filed November 3, 1917. Serial No. 200,008.

To all whom it may concern:

Be it known that I, EDWIN S. LAMMERS, Jr., 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 control and particularly to systems of control for governing the operation of winding drums that are associated with rolling mills.

One object of my invention is to provide a system of control for a winding drum that shall automatically control the speed of the drum and wind the material on the drum at an even and uniform tension.

In operating a cold rolling mill, it is very often desirable to wind the cold strips or rods as they leave the rolls of the mill in the form of coils upon a drum, and, moreover, it is found that the quality of the material being rolled is materially increased by keeping a predetermined tension on the strip or rod while the same is being wound. In many of the mills now in service, the winding drum is geared to the last set of rolls in order to be operated thereby. Thus, as the diameter of the coil of wound material increases, the tension on the material between the drum and the last set of rolls is increased, and, consequently, there is a tendency to pull the material from the rolls at a higher linear speed and stretch the same. In order to allow for the above increased tension on the material being wound, a slip gear is provided in the gear connection, but such a slip gear has proved to be very unsatisfactory in operation.

In a control system constructed in accordance with my invention, the winding drum is connected to a separate motor, the speed of which is controlled in accordance with the tension on the material between the last set of rolls and the winding drum.

In the accompanying drawing, Figure 1 is a diagrammatic view of a control system constructed in accordance with my invention, and Fig. 2 is a detail view of the connection between the motor and the winding drum.

Referring to the drawing, a motor 1, having an armature 2, a series-field winding 3 and a shunt-field winding 4, is connected to a winding drum 5 in any convenient manner by means of a clutch 6 which is controlled by an operating handle 7. A double-throw switch member 8 is connected to the operating handle 7 by an arm 9 in order to be operated thereby, for a purpose to be set forth hereinafter.

A pilot motor 10, having an armature 11 and field windings 12 and 13, is provided for governing the operation of an arm 14 of a rheostat 15 the resistor of which is included in the circuit of the shunt-field winding 4. A switch 16, which is included in the circuit of the field winding 12, and a switch 17, which is included in the circuit of the field winding 13, are adapted to be operated by the rheostat arm 14 in the respective extreme positions thereof. The switches 16 and 17 are normally maintained closed by means of the springs 18 and 19 or by any other approved means.

A starting resistor 20, having a contact arm 21, is provided in circuit with the motor 1. A compound-wound relay 22, having a series coil 23 disposed in series with the motor 1 and a shunt coil 24, is provided for governing the operation of the pilot motor 10. The relay 22 is adapted to bridge contact terminals 25 in the released position, and, in an operative position, is adapted to bridge contact terminals 26. The switch member 8 is adapted to bridge contact terminals 27 and 28 when the motor 1 is disconnected from the winding drum 5 and to bridge contact terminals 27 and 29 when the motor 1 is connected to the winding drum 5 by means of the clutch 6. A switch 30 is provided for connecting the system to any suitable source of direct current.

Assuming the system to be in the condition illustrated on the drawing, and the motor 1 to be connected to the source of power 31, with the starting resistor 20 excluded from circuit by means of the rheostat arm 21, a section of material from a set of rolls 33 may be connected to the winding drum 5 in order to be wound thereon. When the material 32 is connected to the winding drum 5, the clutch 6 is operated to connect the motor 1 to the drum 5 and to bridge contact terminals 27 and 29 by means of the switch member 8. The motor 1 is operated at a

slow speed for winding the material 32 upon the drum 5, and a circuit is completed for the pilot motor 10, which may be traced from the positive supply conductor through the contact terminals 27 and 29, which are bridged by the switch member 8, contact terminals 25, which are bridged by the contact member of the relay 22, switch 16, field winding 12 and armature 11 to the negative supply conductor. The two field windings 12 and 13, which are associated with the pilot motor 10, are adapted to rotate the motor in opposite directions when severally energized, the energization of the field winding 12 effecting the rotation of the motor 10 in a counter-clockwise direction, and the energization of the field winding 13 effecting the rotation of the pilot motor 10 in a clockwise direction. Thus, when a circuit for the motor 10 is closed through the field winding 12, as above set forth, the rheostat arm 14 is operated in a counter-clockwise direction in order to insert sections of the resistor of the rheostat 15 in circuit with the shunt-field winding 4 of the motor 1.

The speed of the motor 1 and the tension on the material 32 which is being wound on the drum 5 are increased in accordance with the resistance inserted in circuit with the field winding 4 by means of the rheostat 15, and, moreover, the current taken by the motor 1 varies directly with the tension on the material 32 between the winding drum and the rolls. When the tension on the material 32 has been increased to a predetermined value, the compound relay 22 is operated by means of the increased current flowing through the series coil 23 to break the connection between the contact terminals 25 and to bridge the contact terminals 26. Thus, the circuit previously traced through the field winding 12 and the pilot motor 10 is broken and a circuit is completed through the field winding 13 and the pilot motor 10, which may be traced from the positive supply conductor through the contact terminals 27 and 29, which are bridged by the switch member 8, contact terminals 26, which are bridged by the contact member of the relay 22, switch 17, which has been closed by reason of the rheostat arm 14 being moved from its extreme position, field winding 13 and armature 11 to the negative supply conductor. Thus, the rheostat arm 14 is operated in a clockwise direction in order to short-circuit portions of the resistor of the rheostat 15 from the circuit of the shunt-field winding 4 and thus reduce the speed of the motor 1 and the tension on the material 32 which is being wound upon the drum 5. In case the load on the motor 1 is reduced a predetermined amount, the compound relay 22 is released in order to again increase the speed of the motor and the tension on the material 32.

When the clutch 6 is operated by the arm 7 to disconnect the winding drum 5 from the motor 1, the switch member 8 is operated to bridge the contact terminals 27 and 28 and to complete a circuit through the field winding 13 and the pilot motor 10 in order to operate the rheostat arm 14 in a counter-clockwise direction until the switch 17 is operated thereby and the resistor of the rheostat 15 is completely short-circuited. Thus, whenever the clutch 6 is operated to connect the winding drum to the motor, the motor will be operating at a reduced speed by reason of the resistor of the rheostat 15 being short-circuited from the circuit of the field winding 4.

The compound relay 22 is provided with the shunt winding 24 which is energized in the released position for compensating for any sluggishness in the operation thereof and thus increases the sensitiveness of the operation thereof.

Modifications in the system and arrangement and location of parts may be made within the spirit and scope of my invention, and such modifications are intended to be covered by the appended claims.

I claim as my invention:

1. In a system of control, the combination with a motor having an armature and a shunt-field winding, and a source of energy for said motor, of a relay having a pair of actuating coils respectively in series with said armature and connected to said source, and means controlled thereby for varying the energization of said shunt-field winding in accordance with the load conditions of the motor, said source-connected coil being energized only when said other coil is energized below a predetermined degree.

2. The combination with a main motor having an armature, a shunt-field-magnet winding and a resistor in series with said winding, of a pilot motor for controlling said resistor having a pair of field-magnet windings for respectively effecting the operation of said pilot motor in opposite directions, and a two-position switch having an actuating coil in series with said armature and a second actuating coil that is energized only when the switch is in one position, said switch being adapted to energize one of said pilot-motor field-magnet windings in each of its positions.

3. The combination with a main motor having a shunt-field-magnet winding, a resistor in series therewith and a controller for said resistor, of a pilot motor for said controller having a pair of field-magnet windings for respectively effecting the operation of said pilot motor in opposite directions, and a pair of normally closed switches, one in circuit with each of said pilot-motor windings, and one of which is adapted to be opened when said controller occupies one

position and the other of which is adapted to be opened when said controller occupies another position.

4. The combination with an operating mechanism, a driving motor therefor having armature and field-magnet windings, and means for connecting said motor to said mechanism, of means comprising a variable resistor and a pilot motor controlled in accordance with the position of said connecting means for increasing the excitation of said field-magnet winding in accordance with the load upon said motor and for automatically decreasing the excitation of said field-magnet winding upon the disconnecting of said motor from said mechanism.

5. In a system of control for a winding drum, the combination with a motor for operating the drum and a clutch for connecting said motor to said drum, said motor having a variable resistor associated therewith for controlling its speed, and a controller for said resistor having a normal position, of means operable when said clutch is in its operative position to actuate said controller from said normal position when the load upon said motor is increasing and to actuate said controller toward said normal position when the load upon said motor is decreasing, said means being operable to automatically actuate said controller toward said normal position when said clutch is in its inoperative position.

6. In a system of control for a winding drum, a motor having an armature and a field winding for operating the drum, a rheostat for governing the energization of the field winding, and a pilot motor controlled by a current relay in circuit with the motor for governing the operation of the rheostat to control the motor speed, of means for disconnecting the drum from the motor and for thereupon effecting the operation of said pilot motor to return the rheostat to its initial position.

7. In a system of control for a winding drum, the combination with a main motor for operating the drum, and means comprising a pilot motor for automatically controlling the speed of the motor to wind the material on the drum at a given tension, of means for disconnecting the motor from the drum and for simultaneously effecting the operation of said pilot motor to reduce the speed of the main motor.

In testimony whereof, I have hereunto subscribed my name this 12th day of Oct., 1917.

EDWIN S. LAMMERS, JR.