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S. A. STAEGE
SYSTEM OF CONTROL
Filed May 15, 1919

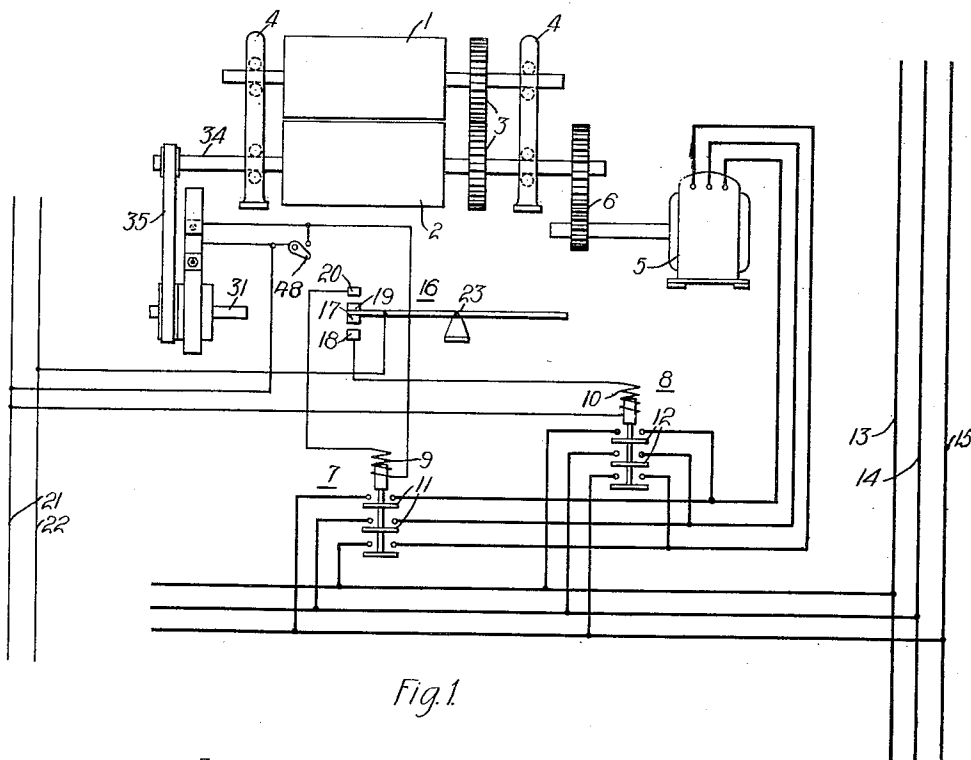


Fig. 1.

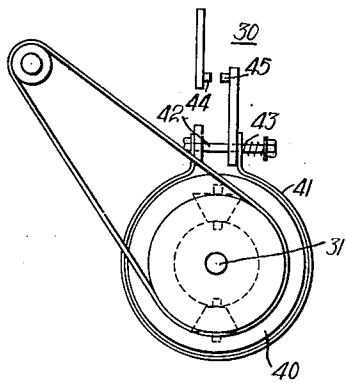


Fig. 3.

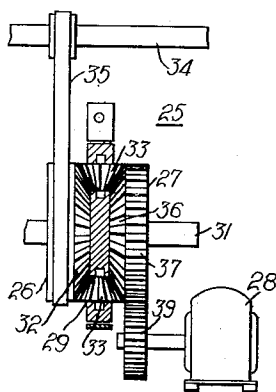


Fig. 2.

WITNESSES:

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UNITED STATES PATENT OFFICE.

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SYSTEM OF CONTROL.

Application filed May 15, 1919. Serial No. 297,297.

To all whom it may concern:

Be it known that I, STEPHEN A. STAEGE, a citizen of the United States, and a resident of Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Systems of Control, 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 electric motors.

One object of my invention is to provide a system of control for an electric motor that shall be equipped with means for effecting a very quick stopping of the motor in case of an emergency or an accident.

In many industries, motor-operated machinery is utilized, which, if not stopped instantly at times, such as in case of an accident, will cause serious injury to the operator of the machinery or to other associated machines. Thus, in a rubber mill, sets of rolls are provided for rolling and treating the crude rubber for commercial use and, at times, through carelessness or accident, the hands of the operator feeding the crude rubber to the rolls are drawn between them. In such a case, it is essential that the rotation of the rolls be stopped instantly.

The deceleration of the rolls may be effected by reversing the direction of current flow through the motor which is connected to the rolls. This method is effective for stopping the rotation of the motor but there is always the danger that the motor will immediately start to rotate in the reverse direction unless it is disconnected from the supply circuit at the proper time. If the rolls of the rubber mill should be rotated suddenly in a reverse direction after the hands of the operator had been caught between them, the sudden changing of direction of rotation would be liable to badly mangle the hands of the operator.

In a control system constructed in accordance with my invention, the motor is decelerated by reversing the direction of current flow through it and means is further provided for automatically disconnecting the motor from the supply circuit in a manner to prevent the rotation of the motor in a reverse direction. More specifically, the means provided, in my invention, for preventing the reverse operation of the motor,

in case of effecting an emergency stop by reversing the current flow through it, comprises a differential-gear mechanism, one end portion of which is rotated in accordance with the speed rotation of the rolls and the other end portion of which is rotated at a constant speed by any auxiliary source of power. The central portion of the differential-gear mechanism, which rotates in a direction determined by the relative speeds of the two end portions, controls a switch which effects the disconnection of the motor from the supply circuit in a manner to prevent any reverse operation of the motor. Thus, the motor is decelerated by reversing the direction of the current flow through it, and, when the speed of the motor is reduced to a predetermined point, the central portion of the differential-gear mechanism changes its direction of rotation and opens the switch which effects the disconnection of the motor from the supply circuit.

In the accompanying drawings, Figure 1 is a diagrammatic view of a control system constructed in accordance with my invention, and Figs. 2 and 3 are, respectively, front and side elevational views of the differential-gear mechanism which automatically disconnects the motor from the supply circuit.

Referring to the drawing, rolls 1 and 2 are connected together by means of gear wheels 3 and are rotatably journaled in any suitable bearing brackets or standards 4. A motor 5, such, for example, as a three-phase induction motor, is connected to the rolls by means of a set of gear wheels 6 and is adapted to operate the rolls in a forward and in a reverse direction.

Two reversing switches 7 and 8, respectively comprising energizing coils 9 and 10, and switch members 11 and 12, are provided for connecting the motor 5 to a three-phase supply circuit comprising conductors 13, 14 and 15, the switch 8 serving to connect the motor to the supply circuit for operating the rolls in a forward direction and the switch 7 serving to connect the motor to the supply circuit for operating the rolls in a reverse direction.

Adjacent to the rolls, in any convenient location, is disposed a switch 16 for selectively operating the switches 7 and 8. The switch 16 embodies a contact member 17, which is moved into engagement with a

stationary contact member 18 when it is desired to operate the rolls in a forward direction, and a contact member 19, which is moved into engagement with the stationary contact member 20 when it is desired either to operate the rolls in a reverse direction or to quickly decelerate the motor. When the contact members 19 and 20 are in engagement, the coil 9 of the switch 7 is connected across the conductors 21 and 22 of an auxiliary supply circuit and, when the contact members 17 and 18 are in engagement with each other, the coil 10 of the switch 8 is connected across the supply conductors 21 and 22. The movable contact members 17 and 19 are mounted on a pivotally mounted contact arm 23 which is controlled by the operator of the rolls.

A differential-gear mechanism 25, which is illustrated in Figs. 2 and 3 of the drawing, is provided for opening the energizing circuit of the switch 7 to disconnect the motor from the supply circuit in case the motor is decelerated by reversing the direction of current flow through it. The differential-gear mechanism comprises an end portion 26, which is rotated in accordance with the speed of rotation of the rolls 1 and 2, a second end portion 27, which is rotated at a constant speed by any auxiliary source of power, such as the motor 28, and a central portion 29, which is rotated at a speed and in a direction determined by the relative rotation of the two end portions 26 and 27 for selectively operating a switch 30. The three members 26, 27 and 29 of the differential-gear mechanism are rotatably mounted upon a suitable shaft 31.

The end portion 26 is provided with bevel gear teeth 32 on one side thereof for engaging bevel pinions 33, which are mounted in the central portion 29, and is directly connected to a shaft 34 of the roll 2 in any suitable manner, such as by a flexible connector 35. The end portion 27 is provided with bevel gear teeth 36 on one side thereof for engaging the bevel pinions 33 and gear teeth 37 on the periphery thereof for engaging a pinion 39 that is mounted on the armature shaft of the motor 28.

The central portion 29 of the differential-gear mechanism embodies a member 40 having the pinions 33 rotatably mounted therein in a manner to engage the bevel teeth of the end portions 26 and 27 and a strap member 41, which is held in frictional engagement with the member 40. The strap member 41 is held in engagement with the member 40 by means of a bolt 42, which passes through the two end portions of the strap 41, and a spring 43 which is located between one end portion of the strap 41 and the head of the bolt 42. The switch 30 embodies a stationary contact member 44 and a movable contact member 45 which is

mounted in any suitable manner upon the strap 41.

Assuming the contact members 17 and 18 to be in engagement for operating the switch 8, the motor 5 is connected across the supply conductors 13, 14 and 15 for operating the rolls 1 and 2 in a forward direction. Moreover, it is assumed that the motor 28 is connected to any suitable source of power and is operated at such speed that the end portion 27 of the differential-gear mechanism rotates at a considerably less speed than the end portion 26 which is connected to the set of rolls 1 and 2. Thus, the main portion 26, if rotating at a higher speed than the end portion 27, will control the central portion 29 of the differential-gear mechanism and will give it a movement of rotation in a counter-clockwise direction such as to maintain the contact members 44 and 45, of the switch member 30 in engagement with each other.

In case of an accident, the switch 16 is reversed to disengage the contact members 17 and 18 and to engage the contact members 19 and 20 and thus de-energize the switch 8 and operate the switch 9 to reverse the direction of current flow through the motor 5. The motor 5 and the rolls 1 and 2 are rapidly decelerated and, when the speed of rotation of the end portion 27 of the differential-gear mechanism 25 is greater than the speed of rotation of the end portion 26, the end portion 27 governs the operation of the central portion 29. Accordingly, the central portion 29 effects a movement of rotation in a clockwise direction to open the switch 30. The switch 30, which is included in the energizing circuit of the reversing switch 7, de-energizes the switch 7 and thus disconnects the motor 5 from the supply circuit and, consequently, insures the motor 5 and the rolls 1 and 2 against rotation in a reverse direction.

By adjusting the speed of rotation of the end portion 27, it is apparent that the differential-gear mechanism will operate to open the switch 30 at any desired speed of rotation of the rolls 1 and 2. Preferably, the switch 30 is opened when the rolls 1 and 2 are rotated very close to zero speed. In case it is desired to operate the rolls in a reverse direction, independent of the safety device, the auxiliary switch 48 is provided for short-circuiting the switch 30, as is indicated in Fig. 1 of the drawing.

In order to simplify the description of my invention, the usual control circuits for governing the operation of the main motor have been omitted. Moreover, although I have illustrated my invention by means of a three-phase induction motor, it is equally applicable to any direct-current motor.

Modifications in the system and in the arrangement and location of parts may be

made within the spirit and scope of my invention and I desire, therefore, that only such limitations shall be imposed as are indicated in the appended claims.

5 I claim as my invention:

1. In a control system for a set of rolls, a main electric motor for operating said rolls in a forward and in a reverse direction, current reversing means for the main motor, an auxiliary motor, and means comprising a differential gear jointly controlled by said rolls and the auxiliary motor for deenergizing the main motor and for rendering the current reversing means ineffective after
15 a reversal of motor current.

2. In a control system for a plurality of rolls, the combination with a supply circuit, a main motor adapted to operate said rolls, two switches for connecting the motor to the supply circuit and for controlling the direction of motor current to provide reversal thereof, and a master switch for selectively energizing said switches, of an auxiliary motor, a differential gear having members thereof respectively rotated by said main motor and said auxiliary motor, and means controlled by the planetary members of the differential gear for opening the controlling circuit of said master switch in case the speed of said rolls upon a reversal of current falls below a predetermined value, corresponding to the speed of the auxiliary motor.
30

3. In a control system for a set of fabric-treating rolls, a polyphase supply circuit, a polyphase motor for operating the rolls in

a forward and in a reverse direction, a pair of multi-pole switches for alternatively connecting said motor to said supply circuit for forward or reverse drive, and means differentially connected to said rolls for deenergizing the reverse drive switch to effect stoppage of the motor and the rolls when the speed thereof reaches a relatively low value. 40

4. In a control system for a set of fabric-treating rolls, a three-phase supply circuit, a three-phase induction motor for operating the rolls, two electrically-operated three-pole switches for connecting said motor to said supply circuit for forward or reverse drive, a manually-operated switch for selectively energizing said switches, an auxiliary constant-speed motor, a differential device having members thereof respectively rotated by said induction motor and said auxiliary motor, and a switching device controlled by the planetary portion of said device for deenergizing the reverse drive switch to effect stoppage of the motor and the rolls when the speed thereof reaches a relatively low value. 50

5. In a control system for a set of fabric-treating rolls, a supply circuit, a motor for operating said rolls, switches for effecting reversal of the current through said motor to effect dynamic braking and means differentially connected to said rolls for effecting interruption of said reversed motor current to prevent reversal of said rolls. 60

In testimony whereof, I have hereunto subscribed my name this 3rd day of May, 1919. 70

STEPHEN A. STAEGE.