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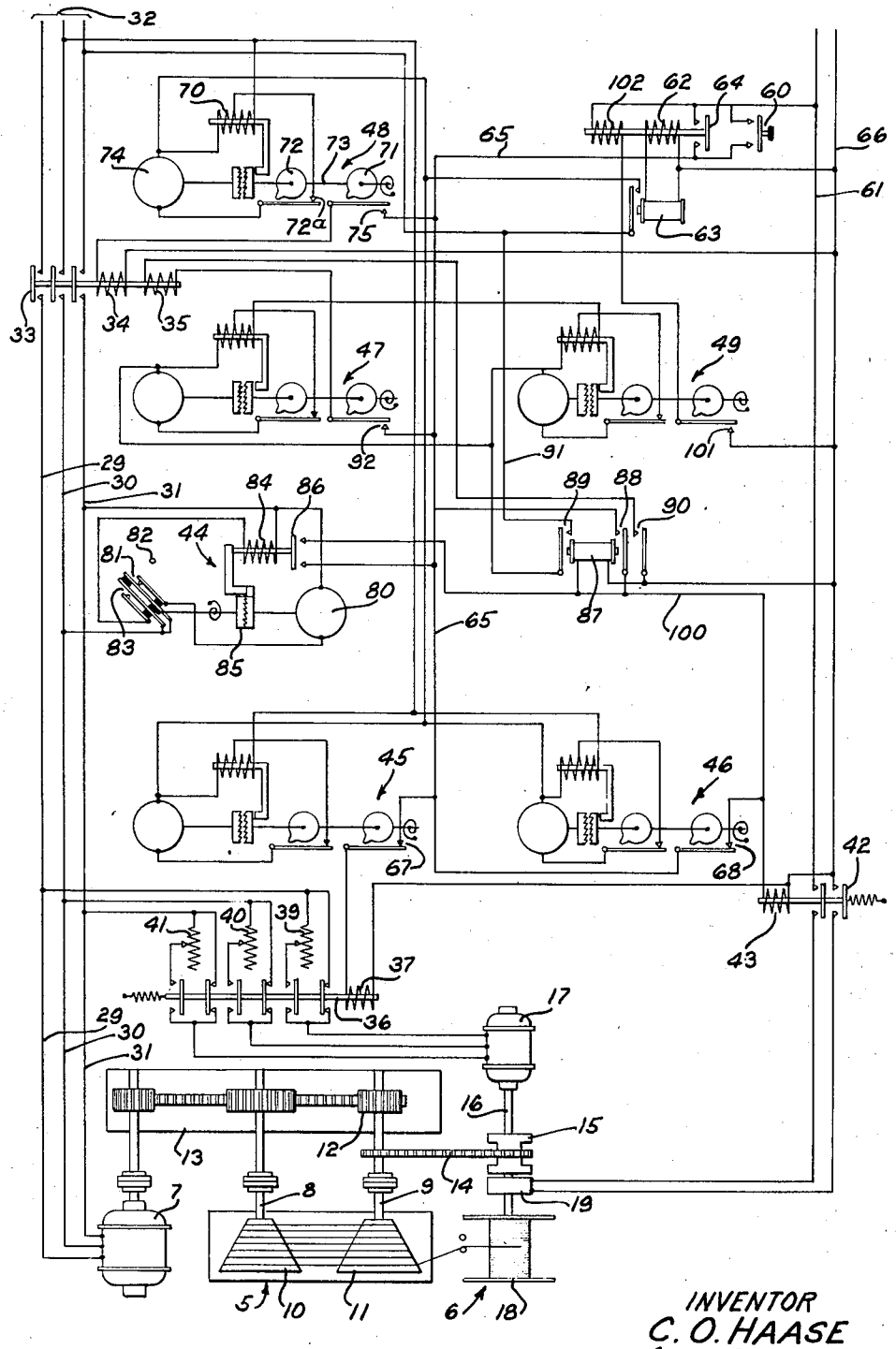

INVENTOR
C. O. HAASE
BY Emery Robinson
ATTORNEY

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WIRE DRAWING APPARATUS

Carl O. Haase, Baltimore, Md., assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York

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This invention relates to control apparatus and more particularly to apparatus for controlling the synchronization of the various parts of wire drawing apparatus during acceleration and deceleration thereof.

In wire drawing operations, considerable difficulty has been experienced in synchronizing the operation of the capstans and take up mechanism during the acceleration and deceleration of the wire drawing apparatus due to the fact that for numerous reasons it is advisable, during the drawing operation, to drive the take up mechanism from a motor separate and distinct from the capstan driving motor. One of the major reasons for providing separate drive mechanisms for the capstans and take up mechanism is the variation in speed of rotation of the take up mechanism as the reel goes from an empty drum to a full drum.

It is an object of the present invention to provide a simple control circuit for synchronizing the operation of various parts of a material working apparatus.

In accordance with one embodiment of the invention, mechanism is provided whereby the wire drawing capstans and the take up reel are positively geared one to another during acceleration and deceleration of the wire drawing apparatus, an electric circuit being provided, including a number of timing mechanisms, for controlling the initiation of a wire drawing operation, interconnection of the wire drawing mechanism and the reeling mechanism during acceleration and deceleration thereof and the driving of the take up mechanism by a separate source of power except during acceleration and deceleration of the wire drawing mechanism.

A better understanding of the invention may be had by reference to the following detailed description when considered in conjunction with the accompanying drawing, wherein the single figure represents, diagrammatically, a wire drawing apparatus and its associated take up mechanism, together with a schematic diagram of a control circuit for controlling the operation of the apparatus.

Referring to the drawing, wherein the wire drawing apparatus is illustrated diagrammatically at 5 and a take up mechanism is shown, indicated generally by the numeral 6, the wire drawing apparatus includes a driving motor 7 for driving a pair of shafts 8 and 9, on which there are mounted wire drawing capstans 10 and 11, respectively. The shafts 8 and 9 are driven through a chain of gears 12 mounted in a suitable gear box 13. The shaft 9 drives a link chain 14, which, in turn, drives a sprocket 15 freely rotatable on a take up shaft 16. The shaft 16 is adapted to be driven by a take up motor 17 for rotating a take up reel 18. Surrounding the shaft 16 is a magnetic clutch 19, which may be of any suitable type, which, upon energization, will connect the sprocket 15 to the shaft 16, thereby to directly connect the wire drawing capstans with the take up reel. The magnetic clutch 19, as will be described in detail hereinafter, is adapted to be energized only during the acceleration and deceleration periods of the wire drawing capstans.

The motor 7 may be any kind heavy duty large horsepower motor suitable for operating a wire drawing machine, but preferably it is a synchronous motor, the direct current field of which may be applied by any suitable means after the armature comes up to speed. The motor 7 has a series of leads 29, 30 and 31 connected to it for supplying alternating current to drive it. These leads 29, 30 and 31 are adapted to be connected to a source of alternating current 32 by a switch 33. The switch 33 is of the solenoid type, which may be controlled by either of a pair of coils 34 or 35, the coil 34 serving to connect the alternating current source 32 to the leads 29, 30 and 31 and the coil 35 serving to disconnect them. The leads 29, 30 and 31 also supply power to drive the take up motor 17 and during the starting of the motor 17 a low resistance path is provided for supplying the necessary starting current to this motor. A solenoid actuated switch 36, operable under control of a coil 37, normally connects the leads 29, 30 and 31 through resistances 39, 40 and 41 to the motor.

Energization of coil 37 will connect the leads 29, 30 and 31 directly to the motor 17, shunting out the resistances 39, 40 and 41, thus applying a higher than normal voltage to the motor 17 during the acceleration period and for a short time thereafter. The coupling between the shaft 9 and shaft 16, through the magnetic clutch, is of such a ratio that the peripheral speed of a full reel of wire corresponds to the peripheral speed of the capstan. When the reel is empty, the peripheral speed of its winding surface will, therefore, be less than the peripheral speed of the capstan. This, however, is not detrimental and will result merely in a slight slippage of the wire on the capstan during the acceleration period. However, as soon as the clutch 19 is disengaged, the higher voltage applied to the motor 17 will quickly bring the reel up to its

proper speed. Due to this arrangement of the driving ratio between shafts 9 and 16 through the magnetic clutch 19, the peripheral speed of the reel can never exceed the peripheral speed of the capstan, which would result in tearing of the wire, since the maximum peripheral speed of the reel takes place when the reel is full, and the engagement of the magnetic clutch 19 during deceleration causes the reel and capstan to come to a stop at the same peripheral speeds.

A time clock, designated generally by the numeral 44, is provided for timing the operation of the apparatus since the length of time which it takes to draw sufficient wire to fill the reel 18 is constant for any one size of wire and the time clock is set to stop the wire drawing operation when the reel has been filled. After the reel 18 has been filled and the wire drawing operation is, therefore, to be stopped, until a new reel may be placed in position to take up the output of the wire drawing apparatus 5, the clock 44 will establish circuits to reactuate the switch 42, open the switch 33 and restore the apparatus to normal. The timing mechanisms which control the time of operation of the coils 37, 43 and 34 during acceleration of the apparatus are the time relays 45, 46 and 47, the operation of which will be described more in detail in connection with the description of the operation of the apparatus. Other timing mechanisms, designated generally by the numerals 48 and 49, control the mechanism during the deceleration and restoring thereof to normal.

A starting switch 60 is provided for initiating the operation of the machine, and after a reel 18 has been placed in position to be driven by the shaft 16 and a wire has been threaded through the wire drawing apparatus 5 and connected to the take up reel 18, the switch 60 may be closed. The closure of switch 60 will connect one side 61 of a direct current source to one side of the winding of a start coil 62 and to one side of the winding of a holding relay 63. The other side of the windings of the start coil 62 and relay 63 are connected to the other side 66 of the direct current source. The coil 62, upon energization, will close a switch 64 to lock itself operated and to connect the side 61 of the direct current line to a lead 65. The lead 65 is connected through a normally made contact 67 of time relay 45 and winding of coil 37 to the lead 66. Therefore, immediately upon the closure of the starting switch 60, the coil 37 will be energized to connect the reeling motor 17 to the leads 29, 30 and 31 through a low resistance path, i. e., shunting resistances 39, 40 and 41. Simultaneously with the operation of the coil 37, coil 43 will be energized from lead 65 over a normally made contact 68 through the coil to the lead 66 of the D. C. source. Energization of coil 43 will close the switch 42 and actuate the magnetic clutch 19. As the coil 62 is energized, relay 63 also operates to connect one of the main A. C. leads through its contact and a coil 70 of timing mechanism 48 to another one of the A. C. leads, thereby to energize the coil 70 and start the timing mechanism 48 in its cycle of operation

The timing mechanism 48 and the timing mechanisms 49 and 50, as well as the time relays 45, 46 and 47, are all similar in construction. These are commercial devices known as time relays and comprise a clutch actuating coil, such as the coil 70, for connecting contact actuating cams 71 and 72 to the shaft 73 of a synchronous motor 74. The cam 72 controls, through a break contact 72—*a*, the length of time which the motor 74 will run after it is started and the cam 71 controls an auxiliary contact 75, the time of operation of which is to be controlled by the timing device. Upon application of power to the coil 70, the clutch will be closed and power will be supplied to the motor 74 to cause it to drive the cams 71 and 72 until the cam 72 opens the circuit to the motor 74. However, as long as the power is supplied to the coil 70, the clutch will remain operated and will hold the cams in the position at which they stand when the contact 72—*a* in the circuit of the motor 74 is opened. When the coil 70 is deenergized, the clutch releases and the cams 71 and 72 are returned to a predetermined position by a spiral spring attached to shaft 73. Cams 71 and 72 may be adjusted to various positions on the shaft 73 to time the operation of the contacts associated with them.

When the timing switch 48 is operated by the closure of the contacts of relay 63, the timing switch will start to operate, and at the end of a predetermined time, approximately three seconds to allow engagement of magnetic clutch 19, will close its main contact 75, thereby to supply power to coil 34 for closing switch 33.

In the present embodiment of the invention, the cams 71 and 72 are adjusted to close the contact 75 three seconds after the switch 60 closes, thereby to allow time for switches 36 and 42 to operate their respective mechanisms before the coil 34 operates.

In a similar manner, time relay 46 has its cam set to open contact 68 after thirteen seconds, dropping out magnetic clutch contact 42. With the high on motor 17, this motor will continue to accelerate until the peripheral speed of the empty reel approaches that of the capstans. Timing of relay 45 is adjusted to open contact 67 at this time, approximately thirteen seconds, restoring normal operating voltage to motor 17, thus maintaining suitable wire tension for the reeling operation during the entire drawing period. This timing has been selected as an example, but it will be understood that it may be changed as necessary when motors having slower or faster acceleration periods are used.

As soon as power is supplied to the leads 29, 30 and 31, the time clock 44 will start to operate over a circuit from lead 31 through the driving motor 80 and normally closed contacts 81 to lead 30. The time clock 44 will continue to run until contact 81 is broken by the engagement of one of its springs with an abutment 82, which may be adjusted in accordance with the length of time it takes to fill a reel 18 with wire. For example, the abutment 82 may be adjusted to open the contact 81 and close a contact 83 at the end of a fifteen minute period, which has been determined to be a sufficient period to draw a reel of a given size of wire and wind it on the reel 18. When the springs of contacts 81 and 83 strike the abutment 82, contact 83 will close before contact 81 opens, and in so doing, will connect the lead 30 through contact 83 and a clutch actuating coil 84 to lead 31, thereby to actuate the coil 84, which serves to open a clutch 85 and close a pair of contacts 86, thereby disconnecting the driving connection between the motor 80 and the contacts 81 and 83 and closing a circuit from lead 65 through contact 86, winding of a relay 87 to D. C. lead 66. Relay 87 will thus be energized and will lock up over a circuit from lead 65 through a locking contact 88 and winding of relay

87 to lead 66. The energization of relay 87 will initiate the stopping of the apparatus and its restoration to normal.

When relay 87 operates, it closes its contacts 88, 89 and 90. Closure of contact 89 will connect one of the A. C. leads at the source over a lead 91 to the motor and clutch actuating coil of timing mechanisms 47 and 49. The timing mechanism 47 has its cams set to close its main contact 92 after three seconds have elapsed, and in so doing, will complete a circuit through the coil 35 from lead 65 through contact 92, coil 35, and contact 90 to lead 66, thereby to open switch 33. The coil 35 is stronger than coil 34 and will overcome the action of coil 34 and open the switch 33 as soon as the coil 35 is energized. Simultaneously with the initiation of operation of the timing device 47, a circuit will be completed through contact 88 over a lead 100, through coil 43, to lead 66 to reenergize the coil 43. Thus, as soon as the time clock 44 initiates the stopping of the machine, coil 43 will be energized to close switch 42 and interconnect the reeling shaft 16 and wire drawing capstans 10 and 11, and after sufficient interval has elapsed to permit the clutch 19 to completely energize, the main supply of current to the motors 7 and 17 will be interrupted by the opening of switch 33. Closure of contact 89 associated with relay 87 will supply alternating current to timing mechanism 49, which has its cams set to close contact 101 after fourteen seconds have elapsed. This timing mechanism restores the entire apparatus to normal by completing a circuit from D. C. lead 66 through contact 101 and a solenoid coil 102 associated with switch 64, which coil 102 is stronger than coil 62 and operates on the switch in an opposite direction to open switch 64 after the wire drawing mechanism and reeling mechanism have come to a stop. The resetting of the mechanism takes place as an incident to the opening of switch 64, which disconnects the D. C. lead 61 from coil 62, relay 63 and lead 65. When relay 63 falls back, the direct current source will be disconnected from the timing mechanisms 45, 46 and 48 and the locking path over the lead 65 to relay 87 will also be broken, permitting the relay 87 to fall back, thereby to remove the A. C. source from timing mechanisms 47 and 49 and the direct current supply from coil 43.

Although a specific embodiment of the invention has been described hereinbefore, it will be understood that numerous modifications could be made in the apparatus without departing from the invention, which is to be limited only by the scope of the appended claims.

What is claimed is:

1. A control mechanism for a wire drawing apparatus which has separate motors for driving the wire drawing mechanism and the take up mechanism comprising means for connecting the take up mechanism for operation by both motors during acceleration and deceleration of the drawing mechanism, and means operable in timed relation to said connecting means for applying a higher than normal voltage to the take up mechanism motor.

2. A control mechanism for a wire drawing apparatus which has separate motors for driving the wire drawing mechanism and the take up mechanism comprising means for connecting the take up mechanism for operation by both motors during acceleration and deceleration of the drawing mechanism, and means operable in timed relation to said connecting means for providing a low resistance path to the take up mechanism motor during acceleration of the drawing mechanism.

3. A control mechanism for wire drawing apparatus which has separate motors for driving the wire drawing mechanism and for driving the take up mechanism comprising a single manually operable switch for initiating a cycle of operation of the apparatus, a main timing mechanism and auxiliary timing mechanisms controlled by said switch for controlling the drawing mechanism and the take up mechanism, and means under control of said switches for connecting the drawing and take up mechanisms during acceleration and deceleration of the drawing mechanism.

4. Apparatus for synchronizing the operation of a wire drawing apparatus and its associated take up mechanism comprising a switch for initiating the operation of the take up mechanism and the drawing apparatus, means under control of said switch for interconnecting the drawing and take up mechanism for a predetermined interval, means also under control of said switch for supplying power to operate the drawing and take up mechanisms, said last mentioned means being operable to supply said power after a lapse of a predetermined interval after the operation of said switch, a timing device for timing the duration of operation of said apparatus, and means under control of said timing device for interconnecting the drawing apparatus and take up mechanism during deceleration of the drawing apparatus.

5. Apparatus for synchronizing the operation of a wire drawing apparatus and its associated take up mechanism comprising a switch for initiating the operation of the take up mechanism and the drawing apparatus, means under control of said switch for interconnecting the drawing and take up mechanism for a predetermined interval, means also under control of said switch for supplying power to operate the drawing and take up mechanisms, said last mentioned means being operable to supply said power after a lapse of a predetermined interval after the operation of said switch, a timing device for timing the duration of operation of said apparatus, and means under control of said timing device for interconnecting the drawing apparatus and take up mechanism during deceleration of the drawing apparatus and for restoring the control apparatus to normal.

6. Apparatus for synchronizing the operation of a wire drawing apparatus and its associated take up mechanism comprising a switch for initiating the operation of the take up mechanism and the drawing apparatus, means under control of said switch for interconnecting the drawing and take up mechanism for a predetermined interval, means also under control of said switch for supplying power to operate the drawing and take up mechanisms, said last mentioned means being operable to supply said power after a lapse of a predetermined interval after the operation of said switch, a timing device for timing the duration of operation of said apparatus, and means under control of said timing device for interconnecting the drawing apparatus and take up mechanism during deceleration of the drawing apparatus and for restoring the control apparatus to normal after the drawing mechanism and take up mechanism have come to a stop.

7. In a wire drawing apparatus having separate motors for supplying power to the drawing apparatus and the take up mechanism thereof,

a magnetic clutch for connecting the drawing apparatus to the take up mechanism, and a plurality of time relays operable to supply the proper power to the motors at predetermined intervals and to energize the magnetic clutch during acceleration and deceleration of the drawing apparatus.

8. A control apparatus for wire drawing apparatus comprising a start switch, a time delay relay associated with said start switch for supplying current to the apparatus after a predetermined interval, a time relay operable under control of said start switch for supplying power to interconnect the drawing and take up mechanism of said drawing apparatus during acceleration of the drawing apparatus, a timer for controlling the operative time of the drawing mechanism, and means controlled by said timer for supplying power to interconnect the drawing and take up mechanism during deceleration of the drawing mechanism.

9. In a wire drawing apparatus, a capstan, a take up reel, and means for coupling the reel and capstan during deceleration at a ratio in which the peripheral speed of a full reel is substantially equal to the peripheral speed of the capstan.

CARL O. HAASE.