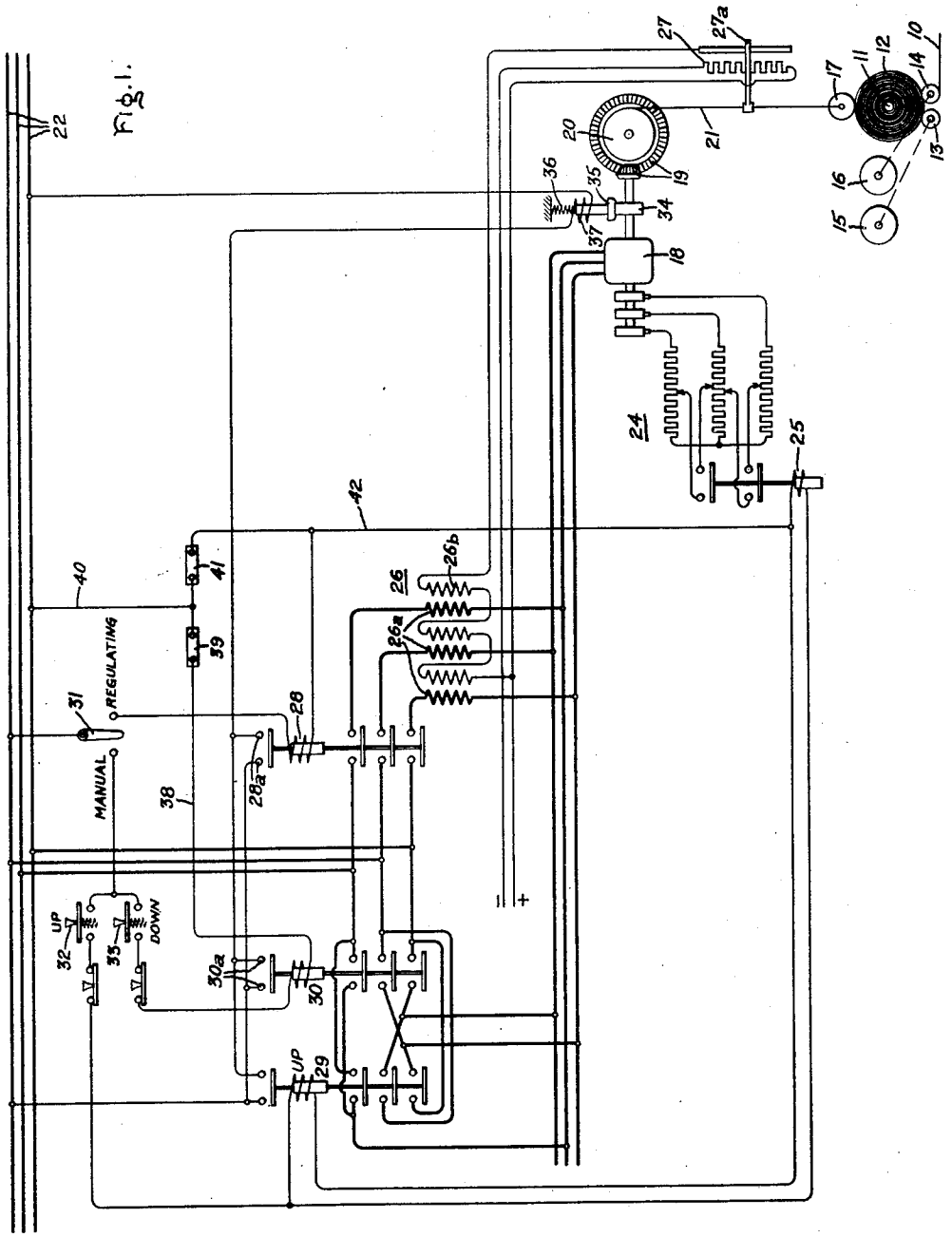
July 4, 1939. E. J. RASMUSSON 2,165,111

CONTROL SYSTEM

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Fig. 1.



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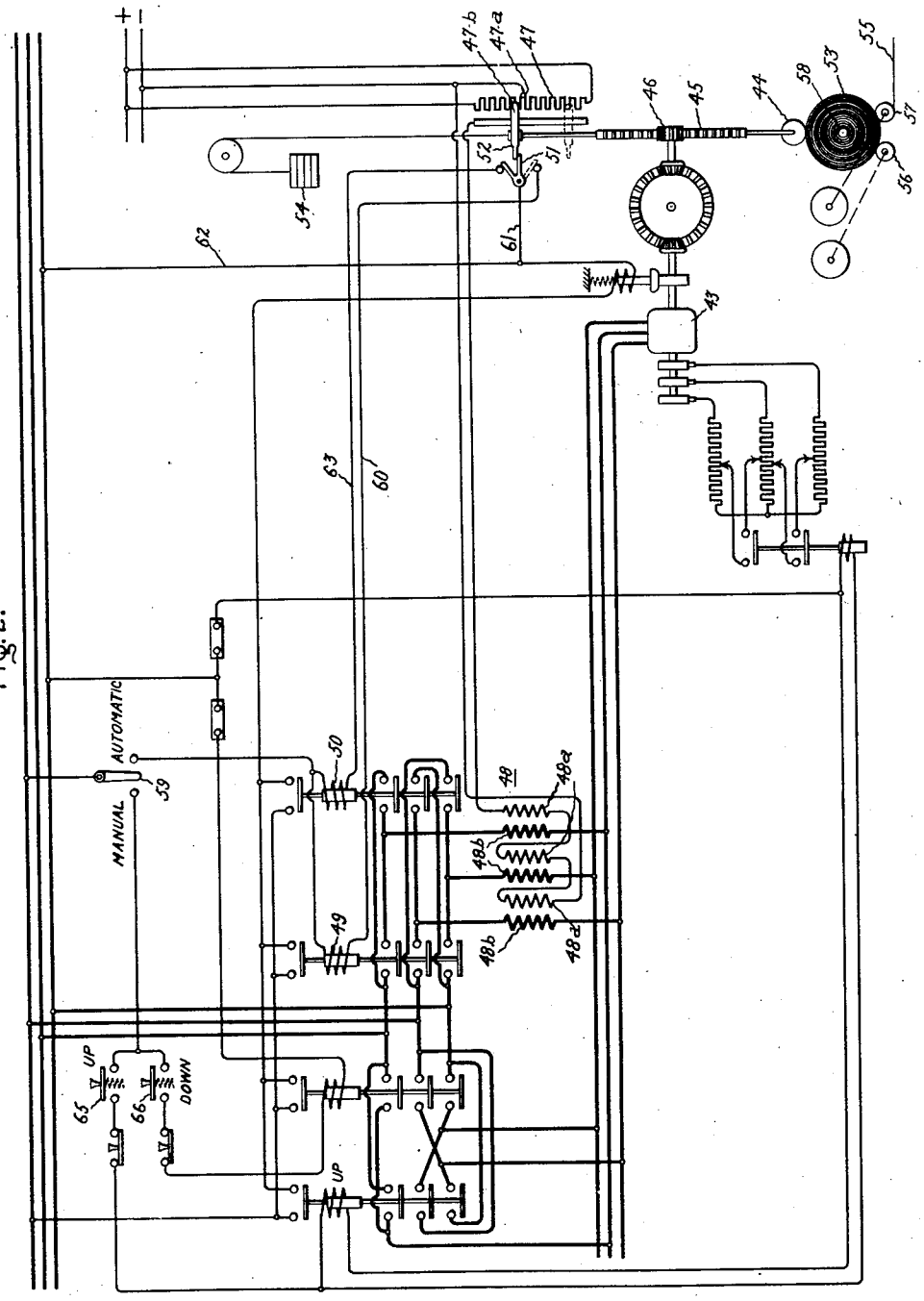


Fig. 2.

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UNITED STATES PATENT OFFICE

2,165,111

CONTROL SYSTEM

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Application August 28, 1937, Serial No. 161,457

11 Claims. (Cl. 242—66)

This invention relates to control systems, more particularly to systems for controlling apparatus performing operations on a length of material, and it has for an object the provision of a simple, reliable, and improved system of this character.

More specifically, the invention relates to systems for controlling apparatus for winding a length of material to form a roll, and a more specific object of the invention is the provision of means for controlling the winding apparatus in such a manner as to obtain a smooth and uniformly wound roll.

Still more specifically, the invention relates to winding apparatus in which a weight, preferably in the form of a rider roller, bears on the roll of material as it is being wound, and a further object of the invention is the provision of improved means for relieving the pressure of the rider roller on the material roll in accordance with the build-up of the material roll.

In carrying the invention into effect in one form thereof, means are provided for winding a length of material to form a roll, and a weight, preferably in the form of a roller, is provided for applying a pressure to the roll of material. An electric motor is mechanically connected to the weight roller, and a reactor is connected in circuit with the motor for reducing the torque of the motor to a value less than that required to raise the weight roller from the roll, and means are provided for varying the reactance of the reactor to vary the torque of the motor so as partially to relieve the pressure of the weight roller on the roll in accordance with the build-up of the roll.

In illustrating the invention in one form thereof, it is shown as embodied in a system for controlling the winding of paper as it comes from a paper-making machine.

For a better and more complete understanding of the invention, reference should now be had to the following specification and to the accompanying drawings in which Fig. 1 is a simple, schematic diagram of an embodiment of the invention, and Fig. 2 is a simple schematic diagram of a modification.

Referring now to Fig. 1 of the drawings, a length of material 10, such as paper in strip form, is to be wound on a mandrel 11 to form a roll 12. The roll rests upon a pair of winding drums 13 and 14. These winding drums are driven by suitable driving means illustrated as a pair of direct-current electric motors 15, 16, and in turn drive the roll 12 by peripheral engagement therewith. Motors 15 and 16 may be supplied from any suitable source such as an adjustable voltage generator (not shown). The material 10 is passed beneath winding drum 14, then upwardly and around the mandrel 11.

A weight, preferably in the form of a rider roller 17, is arranged above the roll of material and rests thereon so as to apply a pressure thereto, thereby to obtain a firmly wound roll. It is desirable to produce approximately constant pressure between the winder drums 13, 14 and roll 12 during the entire operation so as to obtain a smooth and uniformly wound roll. The actual weight of the weight roller 17 depends upon the particular installation. For example, a 4000-pound roller may be employed.

As the roll of material builds up, i. e., as the diameter increases, its weight increases in proportion to the square of the diameter, and since it is desired to maintain approximately constant pressure between the winding drums and the roll 12, it is necessary to relieve the drums of the weight of the rider roll in proportion to the building-up of the roll of paper.

For this purpose an alternating-current electric motor 18 is provided. The shaft of this motor is mechanically connected to roller 17 through gearing 19, cable drum 20, and cable 21. Motor 18 is illustrated as an alternating current, wound rotor induction motor, and is supplied from a suitable source such as the polyphase source represented by the three supply lines 22. The stalled or starting torque of an induction motor varies directly as the square of the applied voltage. The size of the motor 18 will of course depend upon the particular installation. For an installation in which a 4000-pound weight roller is used, the gear motor 18 may be designed as a 550-volt, three-phase, 60-cycle motor having a maximum stalled torque at 550 volts of 250 lb. ft. at the low speed shaft. This torque acting through the winder gearing is sufficient to raise the rider roll 17 from the roll of paper. The gear motor is capable of developing this torque for short periods of time without overheating. With 300 volts across the motor terminals, the torque is reduced to 30% of this maximum value, or 75 lb. ft. The gear motor 18 is capable of maintaining this torque continuously without rotation. When a motor is stalled and utilized merely to exert a torque, it is usually referred to as a torque motor.

In order to provide for operation of motor 18 at maximum torque, a polyphase resistor 24 is connected in the secondary circuit of motor 18. A contactor 25 serves to short-circuit the required amount of the resistor to cause the motor 18 to produce maximum torque.

For the purpose of controlling and varying the "regulating" torque of the torque motor 18, suitable means 26 are provided for varying the voltage applied to the terminals of motor 18. This means 26 is illustrated as a saturable core type reactor having alternating-current windings 26a and a direct-current control winding 26b. These

reactors have various forms and any suitable reactor may be employed. The reactor shown has alternating-current three-phase windings 26_a, each phase having a three-legged core of iron. The center leg has a direct-current coil, and the outside legs each have one alternating-current coil. The direct-current coils are connected in series as shown. The two alternating-current coils on the outside legs of each core may be considered as a single winding and are so shown in the drawings. Reactors of this type are available upon the market, and further description of the structure is therefore unnecessary, since the structure of the reactor per se does not constitute the present invention. It is sufficient to understand that with no direct current flowing in the direct-current coil 26_b of the reactor, the voltage drop through the alternating-current coils 26_a is high, and the voltage at the motor terminals is correspondingly low. Conversely, with direct current flowing in the direct-current control winding 26_b, the iron core becomes saturated and the alternating-current voltage drop through the alternating-current coils 26_a becomes less, and a higher voltage is obtained at the motor terminals. By varying the current flowing in the direct-current control winding, any desired voltage within the range of the reactor can be obtained at the terminals of motor 18. It is possible to vary the voltage at the motor terminals between 130 volts and 300 volts. This gives a "regulating" torque of 14 lb. ft. to 75 lb. ft.

A variable resistor 27 is included in circuit with the direct-current winding 26_b of the reactor. As shown, the variable resistor 27 is connected as a potentiometer and provided with a movable contact arm 27_a for varying the amount of resistance in circuit with the direct-current winding of the reactor. This movable contact arm is illustrated as attached to the cable 21 so as to vary the potentiometer 27 in accordance with the build-up of the roll 12. It will be understood of course that the movable contact 27_a might be connected to other parts of the mechanism so as to move and vary the potentiometer 27 in accordance with the build-up of the roll 12.

A suitable switching device, illustrated as an electromagnetic contactor 28, is provided for completing the connections of the motor 18 through the alternating-current coils 26_a of the reactor to the source 22. When the contactor 28 is open, provision is made for connection of the motor 18 to the source 22 independently of the reactor 26 through one or the other of the manually controllable contactors 29, 30.

The contactor 28 serves to connect the motor to the source 22 for exerting torque in a direction to raise the roll 17. Contactor 29 when closed serves to connect the motor 18 to the source for rotation in a direction to raise roll 17, and contactor 30 when closed connects the motor to the source 22 for rotation in a direction to lower the roll 17.

A selector switch 31 when operated to its right-hand position provides automatic regulating operation of the motor under the control of the contactor 28 and the build-up of the roll 12, and when operated to its left-hand position, selector switch 31 provides for operation of the motor 18 under the control of one or the other of the manually operated push-button switches 32, 33.

An electromagnetic brake comprising a disk 34 on the shaft of motor 18 and a brake shoe 35 held against the disk by means of a spring 36 serves to prevent rotation of the motor 18 when the motor is deenergized. When any one of the contactors 28, 29, 30 is closed to energize the motor 18, a brake coil 37 is energized to release the brake shoe 35 from the disk 34 against the tension of the spring 36.

With the foregoing understanding of the apparatus and its organization in the completed system, the operation of the system itself will readily be understood from the following detailed description: The mandrel 11 is placed in the machine and the paper 10 is passed underneath the winding drum 14 and wound around the mandrel 11 preparatory to starting up the winder. As soon as the operator is ready to start operation he places the selector switch 31 in the manual position. The push-button switch 33 is then depressed to establish an energizing circuit for the lowering contactor 30. This circuit is traced from the upper supply line 22 through the selector switch 31, contacts of push-button 33, operating coil of contactor 30, conductor 38, limit switch 39, and conductor 40 to the lower part of the source 22. Contactor 30 in responding to energization closes its main contacts to connect the motor 18 to the source 22 for rotation in the lowering direction, and also closes its upper interlock contacts 30_a to complete an energizing circuit for the brake coil 37. In response to energization, brake coil 37 releases the brake. It will be noted that the motor 18 is connected to the source 22 through the main contacts of lowering contactor 30 independently of the reactor 26. As long as the push-button 33 is maintained depressed, the motor 18 is maintained energized and runs the weight roller 17 down to the mandrel. The motors 15, 16 are then started to drive the winding drums 13, 14 at slow speed. During this period the selector switch 31 is left in the manual position until the winding is well under way. As soon as the operator has an opportunity after the machine has started, the selector switch is thrown over to the regulating position, and the upward movement of weight roller 17 in response to increasing diameter of the material roll controls the variable resistor 27 to effect automatic regulation of the torque motor. When the selector switch 31 is thrown to the regulating position, the energizing circuit for the lowering contactor 30 is interrupted and the contactor opens its main contacts to disconnect the motor 18 from the source 22. Simultaneously an energizing circuit is established for the operating coil of contactor 28 through upper limit switch 41. Contactor 28 responds to energization and closes its main contacts to connect torque motor 18 to the source 22 through the alternating-current coils 26_a of reactor 26. As previously pointed out, the motor 18 is connected to the source 22 for energization in such a direction as to cause the motor 18 to exert its torque in a direction to raise the weight roller 17. In the closed position of contactor 28, the interlock contacts 28_a are closed to establish an energizing circuit for the brake operating coil 37 to maintain the brake released. After the selector switch 31 has been thrown to the regulating position, the push-button switch 33 is of course released.

When the roll 12 is first started with a few wraps around the mandrel 11, the weight roller 17 is in its lowermost position and consequently the movable contact 27_a is in its lowermost position so that the coils 26_b of the reactor are short-circuited and carry no current. As a result of

this, the voltage drop across the alternating-current coil 26_a of the reactor is maximum, and the voltage applied to the terminals of torque motor 18 is therefore minimum. Thus, the motor 18 exerts minimum torque, and substantially the entire weight of the weight roller 17 rests upon the roll 12.

After the roll 12 has been started, the speed of the motors 15, 16 which drive the winding drums 13, 14 is adjusted to the desired value by suitable speed controlling means (not shown). As previously pointed out, the motor 18 exerts a torque tending to raise the weight roller 17 but the torque of the motor is reduced to such a low value by the reactor 26 that motor 18 is unable to raise the weight roller 17 and consequently merely exerts a stalled torque.

As the winding mechanism continues to wind the roll 12 and the diameter of the roll 12 increases, the weight roller 17 is raised in accordance with the build-up of the roll, and the torque motor 18 maintains tension in the cable 21 as the roller 17 is raised. Also, the position of the movable contact 27_a which is connected to the cable 21 is changed, i. e. the movable contact 27_a is moved upwardly to apply an increasing voltage to the coils 26_b of the reactor in accordance with the build-up of the roll 12, and this increases the direct current flowing in the direct-current windings 26_b of the reactor, thereby decreasing the voltage drop across the reactor coils 26_a and increasing the voltage applied to the terminals of torque motor 18. This of course increases the torque of motor 18 and partially relieves the pressure of the weight roller 17 on the roll 12. The mechanism between the weight roller 17 and the variable resistance 27 is arranged and properly designed so that the reactance of the reactor is adjusted to limit the torque of the motor at first to give the full benefit of the weight roller on the mandrel, and as the roll of paper increases in size and weight, the weight of the weight roller is relieved by the increasing torque of the torque motor in accordance with the square of the diameter of roll 12 to maintain approximately constant weight or constant pressure on the winding drums 13, 14.

Thus, it will be seen that as the diameter of the roll 12 increases, the excitation of the reactor 26 increases so that its effectiveness in blocking out torque from the torque motor decreases as the diameter of the roll 12 increases. In this way, the weight is gradually lifted from the roll 12 as the diameter increases from the minimum starting diameter to maximum diameter when the roll is completed.

After completing the roll and relieving the weight of the weight roller 17 in proportion to the square of the diameter, as previously set forth, the torque motor 18 can be utilized to lift the weight roller completely away from the roll 12 so that the latter may be lifted out of the winder. This is accomplished by switching the selector switch 31 from its regulating position to its manual position and depressing the "up" push-button switch 32. As the selector switch 31 leaves its regulating position, the energizing circuit for the contactor 28 is interrupted, thereby allowing contactor 28 to open its main contacts to interrupt the connections from motor 18 to the source 22 and also to open its interlock contacts 28_a to deenergize the brake coil 37. When the push-button switch 32 is depressed with the selector switch 31 in the manual position, an energizing circuit is established for the operating coil of "up" contactor 29 and for the operating coil of contactor 25. These circuits are traced from the upper supply line through the selector switch 31, contacts of push-button 32, operating coils of contactors 29 and 25 in parallel and thence by conductor 42, limit switch 41, and conductor 40 to the lower side of the supply source. Contactor 29 in responding to energization closes its main contacts to connect the motor 18 to the supply source independently of the reactor 26 so that full voltage is applied to its terminals. Simultaneously, the upper interlock contacts of contactor 29 are closed to establish a circuit for the brake operating coil 37, thereby to release the brake 35 or to hold it released if it has not already set. Contactor 25 in closing short-circuits a portion of the secondary resistance 24 so that the motor 18 now develops its maximum torque which is sufficient to raise the weight roll 17 from contact with the paper roll 12. The motor continues to raise the weight roller as long as push-button 32 is maintained depressed.

When the weight roller 17 has been raised sufficiently to allow the full roll 12 to be removed from the winder mechanism, the push-button 32 is released. This interrupts the energizing circuits for contactors 29 and 25, thereby allowing these contactors to open and to deenergize the motor 18. Contactor 29 in opening interrupts the energizing circuit for the brake coil 37, and the spring 36 sets the brake shoe 35 against the disk 34 so that the weight roller 17 is held in an elevated position to allow removal of the full roll 12.

After removal of the full roll 12 from the winder mechanism, the foregoing operation is repeated.

Thus the control of the torque motor is seen to be automatic during the winding operation and is controlled by push-button stations after the roll is completed in diameter and when the new roll is being introduced into the winding mechanism.

The arrangement disclosed in the modification of Fig. 2 is similar in most respects to the system of Fig. 1, and differs from it primarily in that the torque motor 43 which raises the weight roller 44 is provided with a reversing control and is connected to the roller 44 through a rigid connection illustrated as a rack and pinion 45, 46. The terminals of the potentiometer 47 are connected to one side of the direct current supply source, and an intermediate point 47_a of the potentiometer is connected to the other side of the source. The control winding 48_a of the saturable reactor 48 is connected across the intermediate point 47_a of the potentiometer and the movable contact thereof so that the torque of the torque motor 43 is gradually reduced as the movable contact 47_b travels from either end of the potentiometer toward the intermediate point 47_a. A pair of directional contactors 49, 50 is provided for controlling the direction of torque of motor 43, and the energization of these contactors is controlled by a reversing type limit switch 51 which in turn is actuated by a finger 52 movable in accordance with the build-up of the roll 53. If desired, a counterweight 54 may be provided to assist in raising the weight roller. A selector switch 59 when moved to its right-hand position provides automatic regulating operation of the motor 43 under the control of contactors 49 and 50 and the build-up of roll 53, and when moved to its left-hand position, it provides operation of motor 43 under the control of one or the other of the manually operated push-buttons 65, 66.

The operation is as follows: The material 55 is led through the winder rolls 56, 57 and started upon the mandrel 58 in the manner previously described in connection with the system of Fig. 1. After this is completed, the selector switch 59 is thrown to the automatic position. Limit switch 51 will be in the lower position as indicated in dotted lines, and the movable contact 47_b will also be at the lower end of the potentiometer resistance 47, as indicated in dotted lines. As switch 59 is moved to the automatic position, an energizing circuit is completed for the operating coil of contactor 49 that is traced from the upper side of the supply source through switch 59, operating coil of contactor 49, conductor 60, switch 51, and thence by conductors 61 and 62 to the opposite side of the supply source. As a result of its energization, contactor 49 closes and connects the motor 43 to the supply source through the reactance windings 48_b of the saturable reactor for rotation in a direction to lower the roller 44. Thus the torque of motor 43 is applied to force the weight roller 44 against the material roll 53 so that at starting the torque of the motor 43 is added to the weight of the roller 44. Since the movable contact 47_b is in its lowermost position, maximum voltage is applied to the direct current control winding of the saturable reactor with the result that the reactance of the reactor is minimum, and maximum voltage is applied to the motor. Consequently, the motor 43 applies maximum torque.

As the diameter of the material roll 53 increases, the weight roller 44 rises and moves the movable contact member 47_b upwardly on the potentiometer 47, thereby decreasing the voltage applied to the control winding of the reactor and also decreasing the voltage supplied to the motor 43 so that the torque of the motor 43 is decreased as the diameter of the material roll 53 increases. The parts are so calculated and designed that the sum of the forces represented by the torque of motor 43, the weight of weight roller 44, and the weight of material roll 53 remains substantially constant as the diameter of roll 53 builds up.

As the movable contact 47_b approaches the intermediate point 47_a of the potentiometer resistance, the movable finger 52 engages the bifurcated member of the switch 51 and snaps it from the lowermost position illustrated in dotted lines to its upper position in which it is illustrated in full lines in the drawing. When the movable contact member 47_b engages the intermediate point 47_a of the potentiometer resistance, zero voltage is applied to the direct current winding of the saturable reactor and minimum voltage is applied to motor 43 and consequently, motor 43 exerts minimum torque. As the switch 51 is snapped from its lower to its upper positions, the energizing circuit for lowering contactor 49 is interrupted and a similar circuit for hoisting contactor 50 is completed through conductor 63. Contactor 50 closes in response to energization and connects motor 43 to the source for energization in the reverse direction. As a result of this, the direction of the torque exerted by motor 43 is reversed so that it now adds to the counterweight 54 and subtracts from the weight of the weight roller 44. In other words, it tends to raise the weight roller 44, but its torque being insufficient to lift the weight roller from the material roll, it merely reduces the pressure of the weight against the roll.

As the diameter of the material roll 53 continues to increase, the movable contact member 47_b passes the intermediate point 47_a of the resistance and begins to increase the voltage applied to the control winding of the reactor 48, which results in increasing the voltage applied to the motor 43, thereby increasing the torque exerted by the motor 43 and further reducing the pressure of the weight against the roll.

The torque of the motor 43 continues to increase until the material roll 53 is completed.

After the material roll 53 is completed, the selector switch 59 is thrown from the automatic to the manual position, and the up pushbutton switch 65 depressed. From this point on the operation is the same as previously described in connection with Fig. 1 and repetition is therefore unnecessary.

Thus, it will be seen that when the material roll 53 is first started and during the initial stages of the build-up of this roll, the torque of motor 43 adds to the weight of roll 44 and is gradually reduced as the roll builds up; and that during the latter stages of the build-up of roll 53 the torque of motor 43 opposes or subtracts from the weight of weight roller 44 and is gradually increased in accordance with further build-up of the roll so that the pressure between material roll 53 and winder rolls 56, 57 remains substantially constant during the entire winding operation. The advantages of this modification over the modification of Fig. 1 is that the weight roller 44 and the motor 43 can be smaller in size than the corresponding elements in the arrangement of Fig. 1, and thus a considerable saving in first costs is effected.

Although in accordance with the provisions of the Patent Statutes, this invention is described as embodied in concrete form, it will be understood that the invention is not limited to the apparatus and connections illustrated, since modifications and alterations will readily occur to persons skilled in the art without departing from the true spirit of this invention or from the scope of the annexed claims.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. A control system for winder drives and the like comprising means for winding a length of material to form a roll, a weight bearing on said roll for applying pressure thereto and means for controlling said pressure comprising an electric motor mechanically connected to said weight, a saturable core type reactor in circuit with said motor, and means for varying said reactor in accordance with the build-up of said roll.

2. A control system for winder drives and the like comprising in combination, means for winding a length of material to form a roll, a weight roller for applying pressure to said roll, and means for controlling the pressure of said weight on said roll comprising an alternating current electric motor mechanically connected to said roller, a saturable core type reactor in circuit with said motor and means operable by said winding means in accordance with the build-up of said roll for varying the reactance of said reactor.

3. A control system for winder drives and the like comprising in combination, means for winding a length of material to form a roll, a weight roller for applying pressure to said roll, and means for partially relieving the pressure of said weight roller in accordance with the build-up of said roll comprising an alternating-current electric motor mechanically connected to said roller,

a saturable core type reactor in circuit with said motor, and means actuated by said roll for varying the reactance of said reactor.

4. A control system for winder drives and the like comprising means for winding a length of material to form a roll, a weight roller for applying a pressure to said roll, and means for varying the pressure of said weight roller on said roll comprising an alternating-current torque motor, a reactor in circuit with said motor for controlling the torque of said motor, means for reducing the torque of said motor to a value less than required to raise said weight, and means actuated in accordance with the build-up of said roll for controlling said reactor to increase the torque of said motor thereby partially to relieve the pressure of said weight on said roll.

5. A control system for winder drives and the like comprising in combination, winding drum means for winding a length of material to form a roll, a weight roller for applying a pressure to said roll, and means for varying said pressure comprising an alternating-current torque motor, a reactor in circuit with said motor for controlling the torque of said motor, means for reducing the torque of said motor to a value insufficient to raise said roller from said roll and means for controlling said reactor to increase the torque of said motor in accordance with the build-up of said roll thereby partially to relieve the pressure of said roller on said roll and to maintain the total pressure on said drum means substantially constant.

6. A control system for winder drives and the like comprising a pair of spaced apart drums for supporting and winding a length of material to form a roll, a weight roller bearing on said roll thereby to produce a pressure between said roll and said drums, and means for varying the pressure of said weight roller on said roll comprising an electric torque motor mechanically connected to said roller, a saturable core type reactor having a reactance winding in circuit with said motor and a direct-current control winding, a variable resistance in circuit with said direct-current winding and means for varying said resistance as a function of the build-up of said roll thereby to increase the torque of said motor and to partially relieve the pressure of said roller on said roll thereby to maintain the pressure between said roll and drums substantially constant.

7. A control system for winder drives and the like comprising means for winding a length of material to form a roll, a weight roller bearing on said roll for applying a pressure thereto, an electric motor mechanically connected to said weight roller, a brake for said motor, a source of supply for said motor, a saturable core type reactor for controlling the torque of said motor, a switching device for connecting said motor to said source through said reactor, means responsive to actuation of said switching device for releasing said brake, and means actuated in accordance with the build-up of said roll for varying the reactance of said reactor thereby to increase the torque of said motor to partially relieve the pressure of said weight roller on said roll.

8. A control system for winder drives and the like comprising means for winding a length of material to form a roll, a weight roller for applying a pressure to said roll, a torque motor mechanically connected to said roller, a saturable core type reactor having an alternating-current winding and a direct-current control winding, a source of power, a switching device for connecting said motor through the alternating-current winding of said reactor to said source for rotation in a direction to raise said roller, a variable resistor included in circuit with said direct-current winding, means for varying said resistor to increase the torque of said motor so as to relieve the pressure of said roller on said roll in accordance with the build-up of said roll, a pair of reversing switching devices for connecting said motor directly to said source for rotation in opposite directions, manually operated devices for effecting energization of said reversing switches, and a selector switching device for selectively placing said motor under the control of said reactor and variable resistor or under the control of said manually operated devices.

9. A control system for winder drives and the like comprising in combination, means for winding a length of material to form a roll, a weight bearing on the periphery of said roll, for applying a pressure thereto, and means for controlling the pressure of said weight on said roll comprising an electric motor mechanically connected to said weight, means for energizing said motor to add its torque to said weight during the initial build-up of said roll, means for reversing the torque of said motor at a predetermined amount of build-up of said roll, and means for progressively decreasing the torque in accordance with the build-up of said roll during said initial build-up and for progressively increasing said torque after said reversal.

10. A control system for winder drives and the like comprising in combination, means for winding a length of material to form a roll, a weight bearing on the periphery of said roll for applying a pressure thereto, and means for controlling the pressure of said weight on said roll comprising an electric motor mechanically connected to said weight, means operable during the initial stages of winding said roll for controlling said motor to force said weight against said roll, means for decreasing the torque of said motor in accordance with the build-up of said roll, means operable after a predetermined amount of build-up for reversing the torque of said motor and means operable in accordance with further build-up for increasing the torque of said motor.

11. A control system for winder drives and the like comprising in combination, means for winding a length of material to form a roll, a weight bearing on the periphery of said roll for applying a pressure thereto, and means for controlling the pressure of said weight on said roll comprising an alternating current motor mechanically connected to said weight and having electrical connections to a source and reversing means in said connections, means for actuating said reversing means to cause the torque of said motor to add to the pressure of said weight when the build-up of said roll is less than a predetermined value, a saturable core type reactor having an alternating current winding in said connections and a direct current control winding, a variable resistor for varying the current flowing in said control winding, means for actuating said reversing means at said predetermined value to reverse the torque of said motor and means for varying said resistance to decrease the torque of said motor as the build-up of said roll increases to said predetermined value and for increasing said torque after said reversal.

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