Sept. 2, 1952 W. REEVES 2,608,741

CONSTANT TENSION CONTROL

Filed June 16, 1950 2 SHEETS—SHEET 1

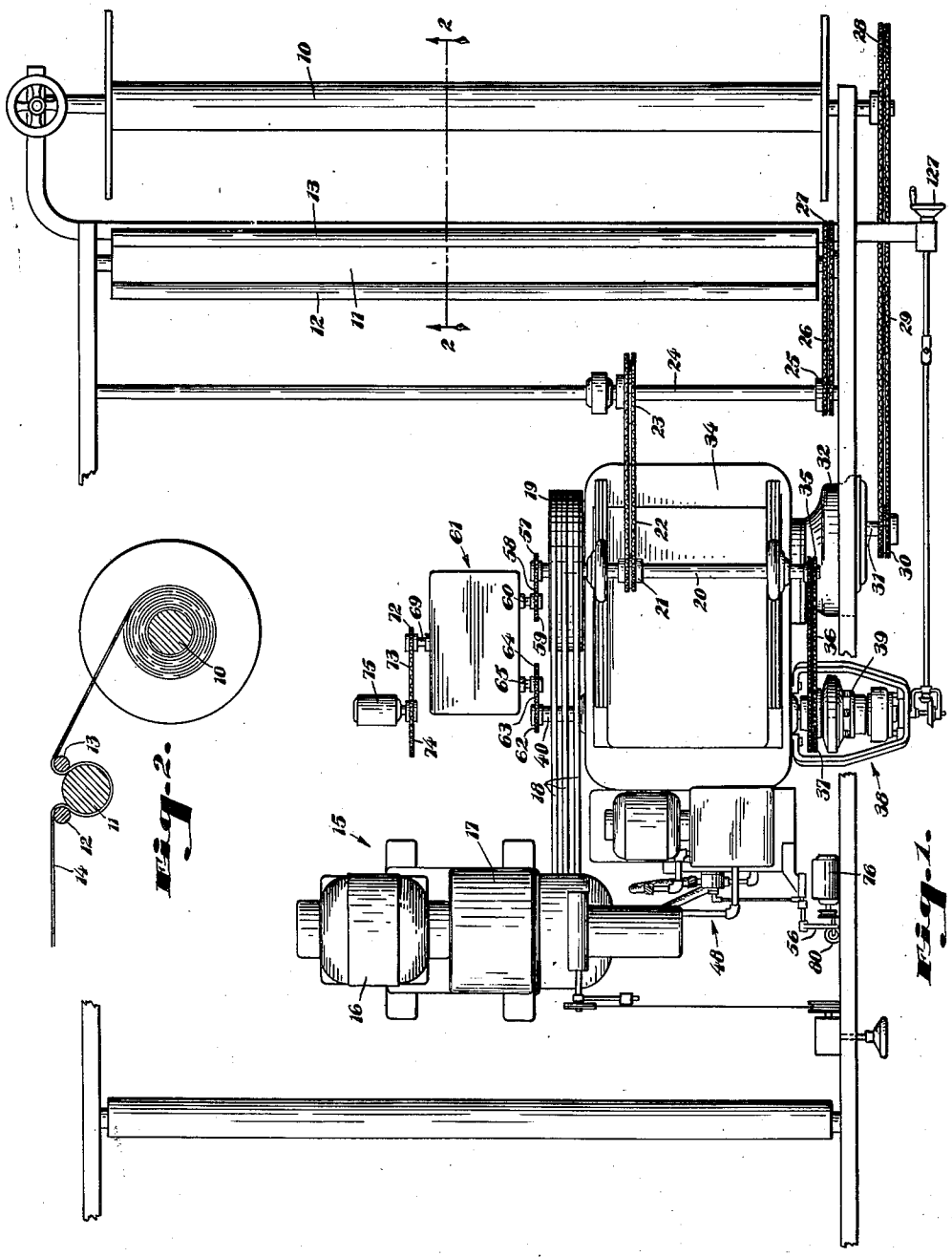


Fig. 1.

Fig. 2.

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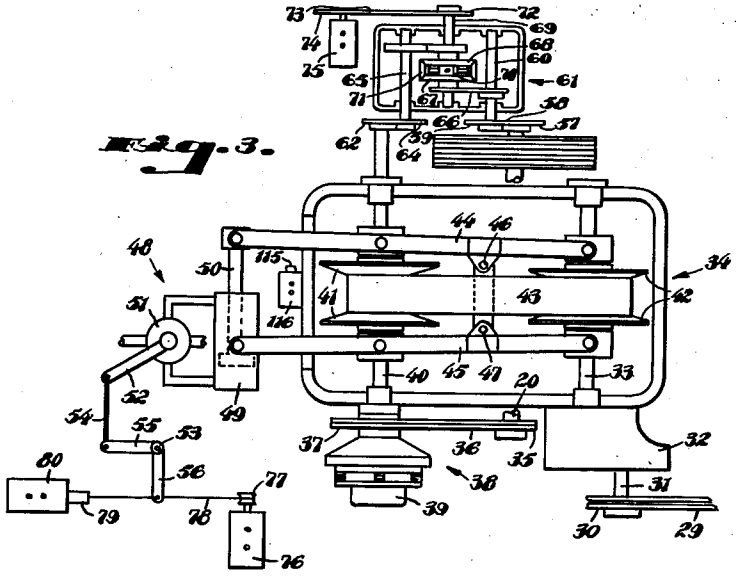


Fig. 3.

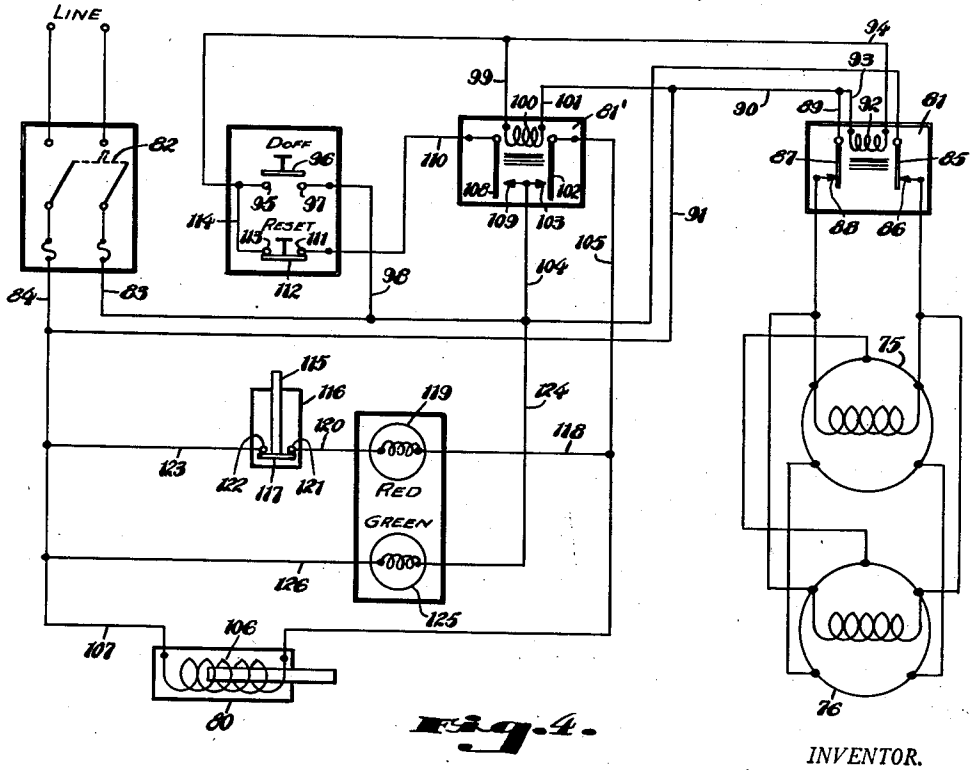


Fig. 4.

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CONSTANT TENSION CONTROL

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16 Claims. (Cl. 28—36)

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The present invention relates to a constant tension control, and more specifically to means for controlling the operation of a storage roll or the like, and a delivery roll associated therewith, under conditions such that tension in the material passing between the storage roll and the delivery roll shall be maintained constant throughout the cycle of operation. A primary object of the invention, then, is to provide mechanism establishing control over the power delivery to two such rolls of such character as to accomplish such maintenance of uniform tension.

A further object of the invention is to provide means whereby, as material builds up upon, or is removed from, a storage roll in an organization of the character above suggested, the ratio between the angular velocities of the two rolls will be progressively modified to compensate for the progressive variation in effective diameter of the storage roll. A further object of the invention is to provide means whereby, upon completion of a cycle, the starting ratio between such velocities may be readily and quickly reestablished without the necessity of reversing the entire control organization.

Further objects of the invention will appear as the description proceeds.

One embodiment of the present invention finds its primary utility in the control of a loom beam during the winding of strands thereon; and the invention has been shown, and will be described, in that environment.

To the accomplishment of the above and related objects, my invention may be embodied in the form illustrated in the accompanying drawings, attention being called to the fact, however, that the drawings are illustrative only, and that change may be made in the specific construction illustrated and described, so long as the scope of the appended claims is not violated.

Fig. 1 is a more or less diagrammatic plan view of a control constructed in accordance with my invention associated with the beam and delivery roll of such a machine;

Fig. 2 is a fragmentary transverse section taken substantially on the line 2, 2 of Fig. 1;

Fig. 3 is a more or less diagrammatic plan view of the control mechanism per se; and

Fig. 4 is a wiring diagram.

Referring more particularly to the drawings, it will be seen that I have indicated at 10 a conventional loom beam with which is conventionally associated a delivery roll 11 flanked by idlers 12 and 13. In accordance with conventional practice, strands or other material 14 will be threaded

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between the idler 12 and the delivery roll 11, around the major periphery of the delivery roll, thence between the delivery roll and the idler 13, and thence to the beam 10, all as indicated in Fig. 2. The primary function of the present invention is to vary the angular velocity of the beam 10, and the ratio of its angular velocity to that of the roll 11, at a rate such as to maintain always a constant tension upon that region of the material 14 between the idler 13 and the effective periphery of the beam 10. Since material will progressively build up on the beam 10 to increase the effective periphery thereof, it will be obvious that, if the delivery roll 11 is driven at constant angular velocity, the angular velocity of the beam 10 must be progressively decreased.

A power source, indicated generally by the reference numeral 15, will preferably comprise an electric motor 16 with which may, if desired, be associated a speed varying transmission unit indicated at 17. For the purposes of disclosing the present invention, it will be assumed that the unit 17 is operated always at a single setting.

Suitable means, such as a plurality of V-belts 18, transmit power from the motor 16 and unit 17 to a pulley 19 fixed to a jack shaft 20 which is mounted for rotation in suitable bearings parallel with the axes of the delivery roll 11 and the beam 10. A sprocket 21 on the shaft 20 is connected by chains 22 to a sprocket 23 on a countershaft 24; and power is delivered from said shaft 24 to the delivery roll 11 through a sprocket 25, chains 26, and a sprocket 27 on the shaft 11. It will be clear that the shaft 11 will be driven always at a speed constantly proportional to the speed of the power source 15.

The beam 10 carries a sprocket 28 which is driven, through chains 29, from a sprocket 30 on the output shaft 31 of a gear unit indicated at 32, said gear unit, in turn, being driven by the output shaft 33 (Fig. 3) of a variable speed transmission 34.

A further sprocket 35 on the shaft 20 is connected by chains 36 to drive the input unit 37 of a slipping clutch indicated generally by the reference numeral 38; and the output element 39 of the clutch 38 is drivingly mounted upon the input shaft 40 of the transmission 34. The clutch 38 will be of the type in which the element 39 will slip and lag behind the element 37 by a constant ratio, so long as the torque demand applied thereto remains constant. The rate of slip, however, will vary in response to the load impressed upon the clutch, in the direction of load variation. Clutches of the character here under considera-

tion are well known in the art and, since the details of clutch structure form no part of the present invention, the clutch has been illustrated diagrammatically. One such clutch currently obtainable on the market is identified as a "Hilliard Adjustable-While-Running Slip Clutch."

One type of variable speed transmission which may advantageously be used in the practice of my invention is the well known "Reeves" type which is illustrated more or less diagrammatically in Fig. 3. Such a transmission comprises a frame in which are journalled the output and input shafts 33 and 40 upon parallel, spaced axes. An expansible V-pulley comprising mating cones 41 rotates with the shaft 40, and a correspondingly pulley comprising cones 42 rotates with the shaft 33, an edge active belt 43 providing a driving connection between said pulleys. A lever 44 is operatively connected to one disc of each pulley, through suitable thrust bearings, and a lever 45 is operatively connected to the other disc of each pulley, through thrust bearings, said levers being intermediately pivoted as at 46 and 47 so that, as the projecting ends of the two levers are moved toward each other, the cones 41 will be moved toward each other to increase the effective diameter of the input pulley, while the cones 42 will be moved away from each other to decrease the effective diameter of the output pulley, thereby increasing the speed at which the shaft 33 will be driven in response to a predetermined speed of rotation of the shaft 40. Means is provided for controlling the relative positions of the levers 44 and 45, such means, in the illustrated embodiment of the invention, comprising a fluid motor and means for controlling the same, indicated generally by the reference numeral 48. Such control means may advantageously take the form of the device illustrated and described in the patent to Harry C. Clay 2,306,541 issued December 29, 1942, the cylinder 49 of the motor being secured to the lever 45 and the piston 50 thereof being secured to the lever 44. Valve mechanism for controlling fluid flow to the motor is indicated at 51, and may include an actuating lever 52. In the illustrated embodiment of the invention, a bell crank lever 53 has one arm 55 operatively connected to the actuator 52 by a link 54, the other arm 56 of said lever being arranged for actuation by mechanism hereinafter to be described.

A sprocket 57 carried on an extension of the jack shaft 20 is connected, by a chain 58, to drive a sprocket 59 on a shaft 60 of a differential mechanism 61. A sprocket 62 on an extension of the input shaft 40 of the transmission 34 is connected, by a chain 63, to drive a sprocket 64 on a second shaft 65 of the unit 61. The unit 61 may preferably be of the type fully illustrated and described in the patent to William R. Perry 2,168,071 issued August 1, 1939. As shown in Fig. 3 hereof, the shaft 60 is connected by a chain 66 to drive a sun gear 67 loosely mounted on an intermediate shaft 69; the shaft 65 is gear connected to drive a sun gear 68 loosely mounted on the shaft 69; and a carriage 70, fixed to the shaft 69, carries a series of planetary gears 71 meshing with the gears 67 and 68. It will be clear that the differential mechanism will measure any difference in velocity between the shafts 20 and 40, and that the shaft 69 will be rotated at a rate, and in a direction, determined by one-half the algebraic sum of the velocities of the shafts 20 and 40.

A sprocket 72 on the shaft 69 is connected by a chain 73 to drive a sprocket 74 on the armature spindle of a transmitter unit 75 of a self-synchronous system. Suitable electric connections between the unit 75 and a receiver unit 76 of such self-synchronous system effectively lock the armatures of the two self-synchronous units together, when those electric connections are established. A drum or pulley 77 on the armature spindle of the unit 76 is operatively associated with a strand 78 connected to the lever arm 56. Rotation of the drum 77 in one direction will shift the lever 53 in a counter-clockwise direction; and the valving mechanism is such that such movement of the lever 53 will supply fluid to the motor 48 to cause said motor to move the associated ends of the levers 44 and 45 away from each other. This control mechanism is such that each position of the lever 53 will produce a corresponding relative position of the levers 44 and 45.

The strand 78 is continued to the core 79 of a solenoid 80. The relation between the solenoid and the lever 53 is such that energization of the solenoid will tend to move the lever 53 in a clockwise direction. In some instances, a counterweight may take the place of the solenoid 80.

In Fig. 4, I have indicated the units 75 and 76 and conventional electric connections locking together the armatures of said units, a switch unit 81 being shown, arranged to dominate those electric connections. Assuming the connections between the two self-synchronous units to be established, the operation of the control, as thus far described, will be as follows:

A strand or strands of material 14 being threaded past the delivery roll 11 and to the beam 10, in the manner illustrated in Fig. 2, the motor 16 will be energized to drive the assembly. In the beginning of a cycle, and assuming the roll 11 and the beam 10 to be of equal peripheral dimensions, the roll and the beam will be driven at equal angular velocities. Upon the completion of its first revolution, however, the effective diameter of the beam 10 will begin to increase as the material 14 is laid thereon. Since the two rotors are moving at equal angular velocities, this increase in effective diameter of the beam 10 will tend to increase the tension in the stretch of material extending between the delivery roll and the beam. This increase in tension will have a braking effect on the beam 10; and that effect will be transmitted, through the chain 29 and unit 32, to the output shaft 33 of the transmission 34, and thence, through the belt 43, to the input shaft 40 of the transmission. The rate of slip between the parts of the clutch 38 will thus tend to increase, thereby causing the shaft 65 of the differential unit 61 to lag behind the shaft 60 thereof. The shaft 69 will measure that change in the rates of rotation of the shafts 60 and 65, whereby the armature of the transmitter unit 75 will be turned. The armature of the receiver unit 76 will thereby be turned to a corresponding degree to wind in on the strand 78 and shift the lever 53 in a counter-clockwise direction, whereby the valving mechanism 51 will cause the motor 48 to increase the distance between the ends of the levers 44 and 45, whereby the speed ratio between the shafts 40 and 33 of the transmission 34 will be modified to reduce

the velocity of the shaft 33. Thereby, the angular velocity of the beam 10 will be progressively reduced, at a rate such as to maintain a constant degree of tension in the stretch of material extending between the delivery roll 11 and the beam 10.

It will be clear that, if the organization were used for unwinding material from a storage reel, a tendency toward reduction in the tension in the stretch of material between the storage roll and the delivery roll would result in a reduction in the rate of slip between the parts of the clutch 38 to produce rotation of the shaft 69 in the opposite direction. An opposite arrangement of the connection between the unit 76 and the motor 48 would cause the motor to be actuated to shift the ends of the levers 44 and 45 toward each other, thereby increasing the angular velocity of the shaft 33.

In the illustrated organization, when the beam 10 has been filled to desired capacity, it is desirable to stop further operation of the control while the beam is doffed, and it is highly desirable that the control be returned to starting condition promptly, so that there may be no delay in preparing to load a new beam. I accomplish such prompt return through the mechanism now to be described.

A main switch 82 is arranged to connect the switching mechanism of Fig. 4 into an electric power line. The electric connections between the units 75 and 76 are dominated by the switch 82 and comprise line wires 83 and 84 leading from opposite sides of the switch 82. The line wire 83 is connected to a movable arm 85 of the switch unit 81, said arm 85 normally being in contact with a terminal 86 of the self-synchronous system connections. A second movable switch arm 87 is normally in contact with the opposite terminal 88 of said connections; and a wire 89 connects said switch arm 87 with a wire 90, from which a wire 91 leads to the line wire 84. A relay, comprising a magnet coil 92, dominates the switch arms 85 and 87, being operable, upon energization of said magnet coil, to shift the arms 85 and 87 out of contact with the terminals 86 and 88. One end of the coil 92 is connected by a wire 93 with the wire 90, and so with the line wire 84, while a wire 94 leads from the opposite end of said coil to a terminal 95 of a manually controlled, normally open switch. Said switch includes a bridge piece 96 movable to bridge the terminal 95 and a terminal 97, the terminal 97 being connected by a wire 98 with the line wire 83. Obviously, when the manual switch is actuated, to bridge the terminals 95 and 97, the coil 92 will be energized to break the electrical connection between the self-synchronous units 75 and 76.

The bridge piece 96 also establishes an energizing circuit for a relay in a switch unit 81', comprising a magnet coil 100. One end of the coil 100 is connected by a wire 99 with the wire 94, while the other end of said coil 100 is connected by a wire 101 with the wire 90. Thus, when the terminals 95 and 97 are bridged, an energizing circuit for said coil 100 is established from line wire 83 through wire 98, terminal 97, bridge piece 96, terminal 95, wire 94, wire 99, coil 100, wire 101, wire 90, and wire 91 to line wire 84. A switch arm 102 is dominated by the coil 100 and, upon energization of said coil, is moved into contact with a terminal 103. A wire 104 connects said terminal 103 with line wire 83, while a wire 105 connects the switch arm 102

with one end of the coil 106 of the solenoid 80, the opposite end of said coil being connected by wire 107 with line wire 84. Thus contact of the switch arm 102 with the terminal 103 establishes an energizing circuit for the solenoid 80 leading from line wire 83 through wire 104, terminal 103, switch arm 102, wire 105, coil 106, and wire 107 to line wire 84..

Thus it will be seen that manual shifting of the bridge piece 96 into engagement with the terminals 95 and 97 not only breaks the electric connections through which the transmitter unit 75 dominates the receiver unit 76, but also energizes the solenoid 80 to return the levers 44 and 45 to starting position without at all affecting the unit 61 or the transmitter unit 75.

The switch unit 81' includes also a switch arm 108 dominated by the relay coil 100 and movable, upon energization of said coil, into contact with a terminal 109. The arm 108 is connected by wire 110 with a terminal 111 normally engaged by a bridge piece 112 which engages also a terminal 113 connected by wire 114 with wire 94. The terminal 109 is connected to wire 104. Thus, upon energization of the coil 100, a holding circuit for said coil is established, leading from line wire 83 through wire 104, terminal 109, switch arm 108, wire 110, terminal 111, bridge piece 112, terminal 113, wire 114, wire 94, wire 99, coil 100, wire 101, wire 90, and wire 91 to line wire 84.

When the lever 44 reaches starting position, it engages the plunger 115 of a normally closed limit switch 116, said plunger carrying a bridge piece 117. A wire 118 leads from the wire 105 to one terminal of a lamp 119, the opposite terminal of which is connected by a wire 120 with a terminal 121 of the switch 116. Bridge piece 117 electrically connects terminals 121 and 122, the latter of which is connected by wire 123 with line wire 84. Thus, when coil 100 is energized to move switch arm 102 into engagement with terminal 103, the lamp 109 is energized; and it will remain energized until plunger 115 is engaged and shifted by arm 44 to open switch 116.

A wire 124 connects line wire 83 with one side of a lamp 125, the other side of which is connected by wire 126 with line wire 84 so that, whenever the switch 82 is closed, the lamp 125 will be energized.

The switch arm 108 dominates, also, a holding circuit for the coil 92 of the switch unit 81, said circuit being traced from line wire 83 through wire 104, terminal 109, switch arm 108, wire 110, terminal 111, bridge piece 112, terminal 113, wire 114, wire 94, coil 92, wire 93, wire 90 and wire 91 to line wire 84. After the levers 44 and 45 have attained starting position, as indicated by the deenergization of the lamp 119, and when a new beam has been installed for loading, the operator will press the button associated with the bridge piece 112 to break the holding circuits for the coils 92 and 100, whereupon the switch parts will return to the positions in which they are illustrated, thus breaking the energizing circuit for the coil 106 and reestablishing the locking connections between the units 75 and 76.

Preferably, the clutch 38 will be capable of adjustment while running to vary the torque transmission capacity of the clutch, thereby varying the value of the gross tension maintained in the stretch of material between the idler 13 and the beam 10; and I have shown a hand wheel 127 for effecting such adjustment.

I claim as my invention:

1. A constant tension control mechanism com-

prising a rotor, a delivery roll to control the lineal velocity of material passing between said rotor and said delivery roll, means for driving said delivery roll at predetermined speed, and means for driving said rotor at variable speeds comprising a power source, a speed-varying transmission comprising a first shaft, a second shaft, means providing a driving connection between said shafts, and an element shiftable oppositely to vary oppositely the transmission ratio between said shafts, means connecting said power source to drive said transmission first shaft, said last-named means including a slipping clutch, means connecting said transmission second shaft to drive said rotor, a differential mechanism including a first sun gear, a second sun gear, a planetary gear meshing with said sun gears, and a carriage supporting said planetary gear, means connecting said transmission first shaft to drive said first sun gear, means driving said second sun gear at a velocity constantly proportional to the speed of said delivery roll, a transmitter unit of a self-synchronous system having an armature drivingly connected to said carriage, a receiver unit of a self-synchronous system having an armature operatively connected to shift said transmission shiftable element, and electric connections between said units enforcing rotation of said receiver armature in response to rotation of said transmitter armature.

2. The mechanism of claim 1 including switch mechanism dominating said electric connections and operable to open said connections to free said receiver armature from the domination of said transmitter armature.

3. A constant tension control mechanism comprising a rotor, a delivery roll to control the lineal velocity of material passing between said rotor and said delivery roll, means for driving said delivery roll at predetermined speed, and means for driving said rotor at variable speeds comprising a power source, a speed-varying transmission comprising a first shaft, a second shaft, means providing a driving connection between said shafts, and an element shiftable oppositely to vary oppositely the transmission ratio between said shafts, means connecting said power source to drive said transmission first shaft, said last-named means including a slipping clutch, means connecting said transmission second shaft to drive said rotor, a differential mechanism including a first sun gear, a second sun gear, a planetary gear meshing with said sun gears, and a carriage supporting said planetary gear, means connecting said transmission first shaft to drive said first sun gear, means driving said second sun gear at a velocity constantly proportional to the speed of said delivery roll, a fluid motor operatively connected to said transmission shiftable element to shift the same, self-compensating valve mechanism controlling fluid flow to said fluid motor, and means connecting said carriage to actuate said valve mechanism progressively upon progressive rotation of said carriage to shift said transmission element progressively in one direction.

4. The mechanism of claim 3 including means operable to render ineffective said means connecting said carriage to actuate said valve mechanism.

5. The mechanism of claim 4 including means operable, when said connecting means is so rendered ineffective, to shift said transmission shiftable element in the opposite direction.

6. The mechanism of claim 5 in which said last-named means is independent of said carriage and of said power source.

7. A constant tension control mechanism comprising a rotor, a delivery roll to control the lineal velocity of material passing between said rotor and said delivery roll, means for driving said delivery roll at predetermined speed, and means for driving said rotor at variable speeds comprising a power source, a speed-varying transmission comprising a first shaft, a second shaft, means providing a driving connection between said shafts, and an element shiftable oppositely to vary oppositely the transmission ratio between said shafts, means connecting said power source to drive said transmission first shaft, said last-named means including a slipping clutch, means connecting said transmission second shaft to drive said rotor, a differential mechanism including a first sun gear, a second sun gear, a planetary gear meshing with said sun gears, and a carriage supporting said planetary gear, means connecting said transmission first shaft to drive said first sun gear, means driving said second sun gear at a velocity constantly proportional to the speed of said delivery roll, a fluid motor operatively connected to said transmission shiftable element to shift the same, self-compensating valve mechanism controlling fluid flow to said fluid motor, a transmitter unit of a self-synchronous system having an armature drivingly connected to said carriage, a receiver unit of a self-synchronous system having an armature connected to actuate said valve mechanism progressively in one direction, upon progressive rotation of said receiver armature in one direction, electric connections between said units to enforce rotation of said receiver armature in response to rotation of said transmitter armature, switch means dominating said electric connections and operable to break the same to free said receiver armature from the domination of said transmitter armature, and electric motor means operatively connected to said valve mechanism and operable, when said receiver armature is so freed and said electric motor means is energized, to actuate said valve mechanism in the opposite direction.

8. The mechanism of claim 7 including an energizing circuit for said electric motor means, said switch means dominating said energizing circuit and being arranged to close said energizing circuit when, and only when, said electric connections between said units are broken.

9. A constant tension control mechanism comprising a rotor, a delivery roll to control the lineal velocity of material passing between said rotor and said delivery roll, means for driving said delivery roll at predetermined speed, and means for driving said rotor at variable speeds comprising a power source, a speed-varying transmission comprising a first shaft, a second shaft, means providing a driving connection between said shafts, and an element shiftable oppositely to vary oppositely the transmission ratio between said shafts, means connecting said power source to drive said transmission first shaft, said last-named means including a slipping clutch, means connecting said transmission second shaft to drive said rotor, a differential mechanism including a first sun gear, a second sun gear, a planetary gear meshing with said sun gears, and a carriage supporting said planetary gear, means connecting said transmission first shaft to drive said first sun gear, means driving said second sun gear at a velocity constantly proportional to the speed of said delivery roll, a fluid motor operatively con-

nected to said transmission shiftable element to shift the same, self-compensating valve mechanism controlling fluid flow to said fluid motor, a transmitter unit of a self-synchronous system having an armature drivingly connected to said carriage, a receiver unit of a self-synchronous system having an armature connected to actuate said valve mechanism progressively in one direction, upon progressive rotation of said receiver armature in one direction, electric connections between said units to enforce rotation of said receiver armature in response to rotation of said transmitter armature, a normally-closed switch in the electric connections between said units, relay means operable, upon energization, to move said switch to open position to break said connections to free said receiver armature from the domination of said transmitter armature, electric motor means operatively connected to said valve mechanism and operable, when said receiver armature is so freed and said electric motor means is energized, to actuate said valve mechanism in the opposite direction, an energizing circuit for said electric motor means, a normally open switch in said energizing circuit, relay means operable, upon energization, to close said normally-open switch, an energizing circuit for said relays, said relays being connected therein in parallel, and a normally-open manually-operable switch in said last-named energizing circuit.

10. The mechanism of claim 9 including a holding circuit for said relays independent of said manually-operable switch, a normally-open switch connected in said holding circuit, said last-named relay being operable, upon energization, to close said last-named normally-open switch, and a normally-closed manually-operable switch connected in said holding circuit.

11. In a device of the class described, a delivery roll and a storage roll, said delivery roll being driven at a velocity constantly proportional to the lineal velocity of a strand running between said rolls, and means for controlling tension in that reach of such strand extending between said rolls, comprising speed-varying means for driving said storage roll including an element shiftable oppositely to vary oppositely the speed at which said storage roll is driven, and including a slipping drive connection having a substantially fixed slip ratio under predetermined load conditions, such ratio being oppositely variable in response to opposite load variations, a differential mechanism including a first sun gear, a second sun gear, a planetary gear meshing with said sun gears, and a carriage supporting said planetary gear, means driving said first sun gear at a velocity constantly proportional to that of said delivery roll, means driving said second gun gear through said slipping drive connection at a velocity constantly proportional to the output velocity of said slipping drive connection, a transmitter unit of a self-synchronous system having an armature drivingly connected to said carriage, a receiver unit of a self-synchronous system having an armature operatively connected to shift said element, and electric connections between said units enforcing rotation of said receiver armature in response to rotation of said transmitter armature.

12. The device of claim 11 including switch means in said electric connections operable to break said connections thereby freeing said receiver unit armature from the domination of said transmitter unit.

13. In a device of the class described, a delivery roll and a storage roll, said delivery roll being driven at a velocity constantly proportional to the lineal velocity of a strand running between said rolls, and means for controlling tension in that reach of such strand extending between said rolls, comprising speed-varying means for driving said storage roll including an element shiftable oppositely to vary oppositely the speed at which said storage roll is driven, and including a slipping drive connection having a substantially fixed slip ratio under predetermined load conditions, such ratio being oppositely variable in response to opposite load variations, means for measuring the direction and degree of variation in such slip ratio including a self-synchronous receiver and means for transmitting such variations to said receiver to effect rotation of the receiver armature oppositely in response to opposite variations in such slip ratio, and means operatively connecting said armature to shift said element.

14. In a device of the class described, a delivery roll and a storage roll, said delivery roll being driven at a velocity constantly proportional to the lineal velocity of a strand running between said rolls, and means for controlling tension in that reach of such strand extending between said rolls, comprising speed-varying means for driving said storage roll including an element shiftable oppositely to vary oppositely the speed at which said storage roll is driven, and including a slipping drive connection having a substantially fixed slip ratio under predetermined load conditions, such ratio being oppositely variable in response to opposite load variations, a differential mechanism including a first sun gear, a second sun gear, a planetary gear meshing with said sun gears, and a carriage supporting said planetary gear, means driving said first sun gear at a velocity constantly proportional to that of said delivery roll, means driving said second sun gear through said slipping drive connection at a velocity constantly proportional to the output velocity of said slipping drive connection, a transmitter unit of a self-synchronous system having an armature drivingly connected to said carriage, a receiver unit of a self-synchronous system having an armature, electric connections between said units enforcing rotation of said receiver armature in response to rotation of said transmitter armature, a fluid motor operatively connected to said transmission shiftable element to shift the same, self-compensating valve mechanism controlling fluid flow to said fluid motor, said receiver unit armature being connected to actuate said valve mechanism progressively in one direction, upon progressive rotation of said receiver unit armature in one direction, a normally-closed switch in the electric connections between said units, relay means operable, upon energization, to move said switch to open position to break said connections to free said receiver armature from the domination of said transmitter armature, electric motor means operatively connected to said valve mechanism and operable, when said receiver armature is so freed and said electric motor means is energized, to actuate said valve mechanism in the opposite direction, an energizing circuit for said electric motor means, a normally-open switch in said energizing circuit, relay means operable, upon energization, to close said normally-open switch, an energizing circuit for said relays, said relays being connected therein in parallel, and a normally-open manually-operable switch in said last-named energizing circuit.

15. In a device of the class described, a deliv-

ery roll and a storage roll, said delivery roll being driven at a velocity constantly proportional to the lineal velocity of a strand running between said rolls, and means for controlling tension in that reach of such strand extending between said rolls, comprising speed-varying means for driving said storage roll including an element shiftable oppositely to vary oppositely the speed at which said storage roll is driven, and including a slipping drive connection having a substantially fixed slip ratio under predetermined load conditions, such ratio being oppositely variable in response to opposite load variations, means for measuring the direction and degree of variation in such slip ratio including a self-synchronous receiver and means for transmitting such variations to said receiver to effect rotation of the receiver armature oppositely in response to opposite variations in such slip ratio, a fluid motor connected to shift said shiftable element, self-compensating valve mechanism controlling fluid flow to said fluid motor, said receiver armature being operatively connected to actuate said valve mechanism, and switch means for rendering said transmitting means ineffective.

16. The device of claim 15 including electric motor means operatively connected to actuate said valve mechanism, said switch means including means for energizing said electric motor means when, and only when, said transmitting means is so rendered ineffective.

WALTER REEVES.

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