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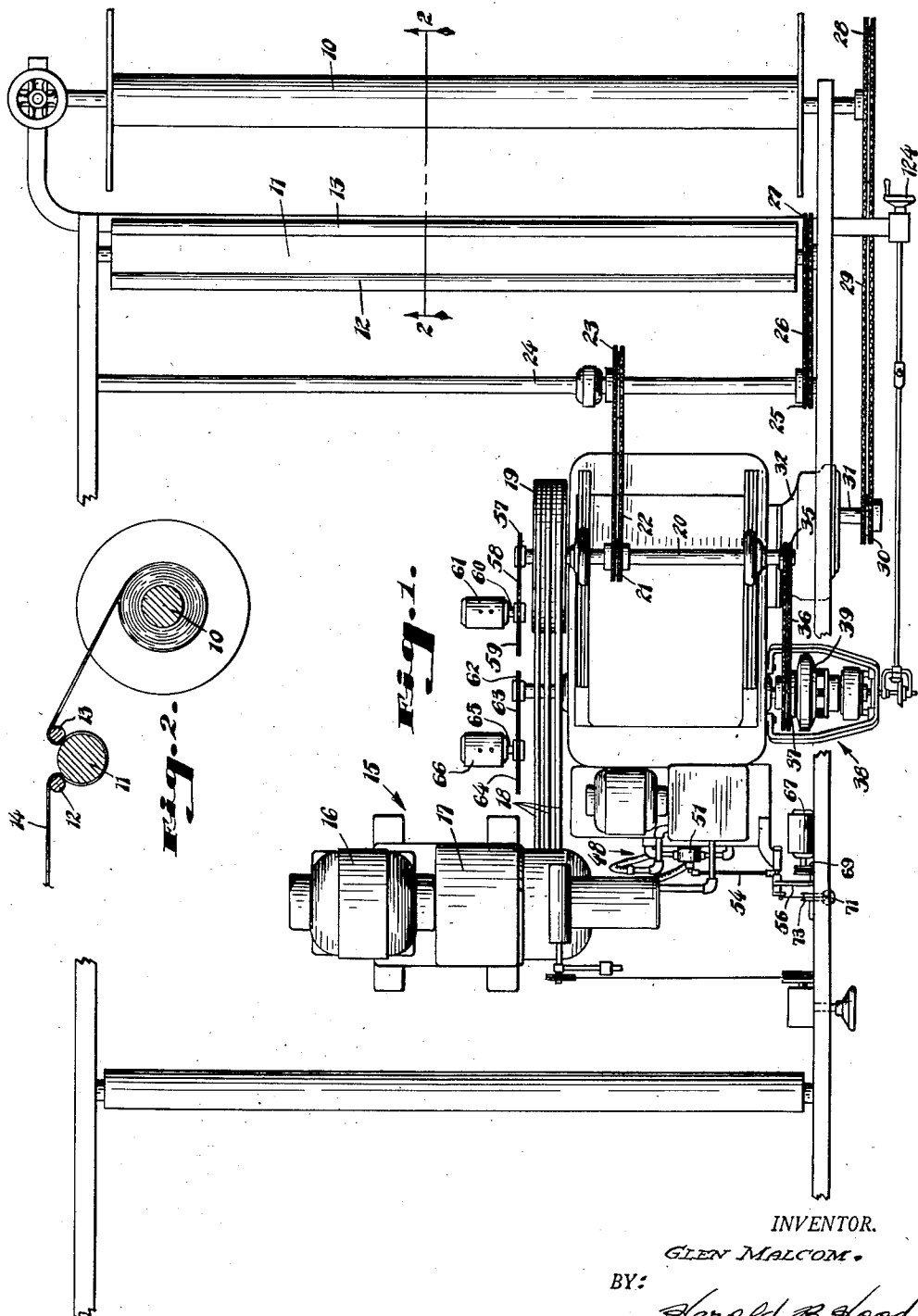
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2,581,328

CONSTANT TENSION CONTROL

Filed July 7, 1950

2 SHEETS—SHEET 1



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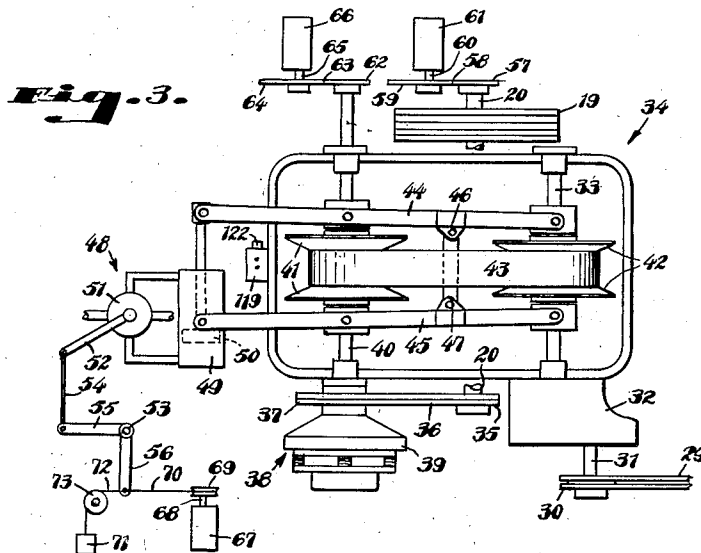
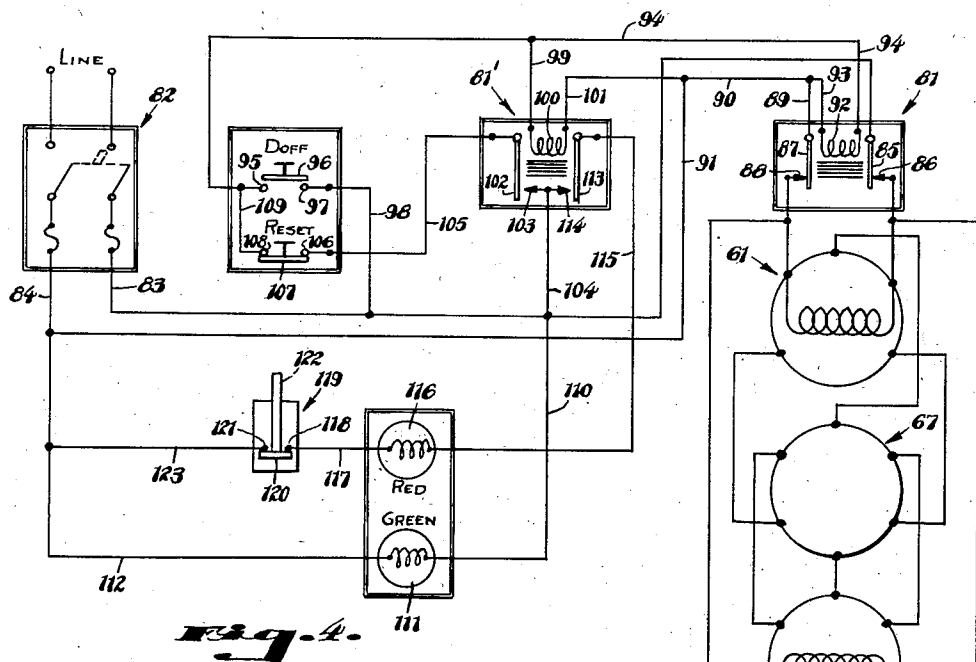
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2 SHEETS—SHEET 2



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2,581,328

CONSTANT TENSION CONTROL

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8 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, in such a fashion that tension in the material passing between the storage roll and the delivery roll shall be maintained constant throughout the cycle of operation in spite of variations in the effective diameter of the storage roll during that cycle. A further object of the invention is to accomplish such tension maintenance by measuring the value and direction of any tendency toward variation in tension through the medium of a slipping drive connection having a constant slip ratio under given load conditions, such ratio being oppositely variable in response to load variations, and transmitting that measurement, through a pair of transmitter units of a self-synchronous system, to a receiver unit of such system, and then causing that receiver unit to adjust a control element, in accordance with such measurement, to vary the angular velocity of the storage roll.

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 plan view of an embodiment of my invention shown in association with a loom beam;

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

Fig. 3 is a somewhat diagrammatic illustration of a variable speed transmission, the elements of the self-synchronous system associated therewith, and means for adjusting the parts of the transmission; and

Fig. 4 is a wiring diagram.

Referring more particularly to the drawings, it will be seen that I have shown a loom beam 10 supported in suitable bearings, and a delivery roll 11 flanked by idlers 12 and 13, arranged upon axes parallel with the axis of the loom beam. A strand or strands of material 14 will be fed between the idler 12 and the delivery roll 11,

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partially around the delivery roll, thence between the delivery roll and idler 13, and so to the beam 10 upon which it is to be wound.

A power source for the entire mechanism illustrated is indicated generally by the reference numeral 15, and, in the illustrated embodiment of the invention, comprises an electric motor 16 connected to drive through a speed-varying unit 17. For the purposes of the present disclosure, it may be assumed that the unit 17 will remain always in one setting.

A plurality of V-belts 18 provide a driving connection from the unit 17 to a pulley 19 fixed on a shaft 20 supported in suitable bearings upon an axis parallel to that of the beam 10. Sprockets 21 on the shaft 20 are connected by chains 22 to drive sprockets 23 fixed on a parallel shaft 24; and sprockets 25 are connected through chains 26 to drive sprockets 27 fixed on the roll 11. Thus, the roll 11, in the illustrated embodiment of the invention, is positively driven at a velocity constantly proportional to the velocity of the power source 15.

Sprockets 28 drivingly connected to the beam 10 are driven, through chains 29, from sprockets 30 on the output shaft 31 of a gear unit 32 which, in turn, receives power from the output shaft 33 (Fig. 3) of a variable speed transmission indicated generally by the reference numeral 34. Sprockets 35 on the shaft 20 are connected by chains 36 to drive the input element 37 of a slipping clutch indicated generally by the reference numeral 38. This clutch will be of the type which provides a substantially fixed slip ratio between its input element and its output element during continuance of predetermined load conditions, but in which that slip ratio is variable oppositely in response to opposite variations of the load driven through the clutch. The output element 39 of the clutch 38 is operatively connected to the input shaft 40 of the transmission 34, whereby the shaft 40 is driven through the slipping clutch 38.

In the illustrated embodiment of the invention, I have shown a conventional "Reeves" variable-speed transmission in which a pair of allochiral cones 41, mounted upon the shaft 40 for axial adjustment relative thereto, comprise a driving pulley, while a similar pair of cones 42 comprise a driven pulley, an edge active belt 43 providing a driving connection between said pulleys. A lever 44 is operatively associated, through thrust bearings, with one disc of each pair, while a lever 45 is similarly associated with the other disc of each pair, said levers being fulcrumed, inter-

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mediate their ends, as at 46 and 47. This arrangement is such that, when the projecting ends of the levers 44 and 45 are moved toward each other, the discs 41 will be moved toward each other to increase the effective diameter of the pulley defined thereby, while the discs 42 will be correspondingly moved away from each other to decrease the effective diameter of the pulley defined thereby, thereby increasing the velocity at which the pulley 42 and the shaft 33 will be driven in response to constant speed rotation of the shaft 40. Obviously, separation of the projecting ends of the levers 44 and 45 will modify the speed ratio between the shafts 40 and 33 in the opposite direction.

Mechanical means, indicated generally by the reference numeral 48, is provided for controlling the positions of the levers 44 and 45. Such means may advantageously take the form of the control device illustrated and described in the patent to Harry C. Clay 2,306,541 issued December 29, 1942. Thus, the mechanism 48 may comprise a fluid motor including a cylinder 49 connected to move with the lever 45 and a piston 50 reciprocally mounted in the cylinder 49 and operatively connected to the lever 44, together with the valving means 51 for controlling relative movement of the cylinder 49 and piston 50. The valving means includes a control lever 52. In the illustrated embodiment of the invention, a bell crank lever 53 has one arm 55 connected by a link 54 to the lever 52 so that movement of its other arm 56 in opposite directions will result in opposite movements of the lever 52.

A sprocket 57 carried on an extension of the shaft 20, is connected by a chain 58 to drive a sprocket 59 carried on the rotor or armature 60 of a transmitter unit 61 of a self-synchronous system. A sprocket 62 on the shaft 40 is connected by a chain 63 to drive a sprocket 64 on the armature 65 of a second transmitter unit 66. Electrical connections are established between the units 61 and 66 and a receiver unit 67, whereby the output voltages of the transmitter units are oppositely impressed upon the receiver unit. Thus, so long as the output voltages of the units 61 and 66 are equal, the armature 68 of the receiver unit 67 will be locked against rotation; but when a difference exists between the output voltages of the two transmitter units, the armature 68 of the receiver unit will be rotated in a direction, and at a rate, determined by the direction and magnitude of that difference.

It will be noted that the shaft 20 will rotate always at a constant speed, while the speed of the shaft 40 will always be somewhat lower, since it is driven through the slipping clutch 38, and will vary somewhat in response to variations in the slip ratio of the clutch 38. In order that the output voltage of the unit 66 may equal that of the unit 61 during continuance of normal slip ratio within the clutch 38, the two units 61 and 66 may be differently wound to compensate for the difference in speed, or the ratio in the drive train between the shaft 40 and the armature 65 may differ from that in the drive train between the shaft 20 and the armature 60. The armature 68 of the receiver unit 67 carries a drum 69 upon which is wound a cable 70 connected to the arm 56 of the bell crank lever 53. Obviously, as the armature 68 rotates in one direction, the cable 70 will be wound in to swing the lever 53 in a counter-

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clockwise direction. In order that the assembly may be responsive to shift the lever 52 in either direction, means is provided for resiliently opposing such movement of the lever 53. In the illustrated embodiment of the invention, a second cable 72, likewise connected to the lever arm 56, passes over a guide pulley 73 and supports a counterweight 74 of such value as to be capable of shifting the lever 53 in a clockwise direction upon opposite rotation of the armature 68 to pay out the cable 70.

In operation, the delivery roll 11 will be rotated to feed the strand 14 toward the beam 10 at a constant lineal velocity. While I have illustrated an embodiment of my invention in which the delivery roll 11 is driven from the power source 15, it will be clear that its rotation might be otherwise controlled.

As shown, and assuming that the transmission 34 is initially set to cause rotation of the beam 10 at the velocity of the roll 11, it will be obvious that, as material begins to build up on the beam 10, the effective diameter of the beam is thereby increased, whereby tension in that reach of the strand extending between the beam and the idler 13 will build up. When that tension for which the mechanism is preliminarily set is attained, the clip in the clutch 38 will be such as to lock the armature 68 of the receiver unit 67. As the system continues to operate, there will be a tendency for the tension in the critical reach of the strand 14 to increase further, which will cause excessive slip in the clutch 38, whereby the shaft 40 and its transmitter unit 66 will lag behind the shaft 20 and its transmitter unit 61. Thereby, the armature 68 will be rotated to swing the lever 53 in a counter-clockwise direction to shift the lever 53 to actuate the motor 48 to separate the levers 44 and 45, thereby reducing the rotational speed of the shaft 33. Thus, the tension in the critical reach of the strand will be reduced and the optimum slip ratio will be reestablished in the clutch 38 to reestablish equilibrium between the two voltages impressed on the unit 67. Actually, of course, in practice, the clutch 38 will continuously slip by an amount slightly in excess of its optimum slip ratio, whereby the armature 68 will be continuously rotated to maintain, at all times, the predetermined tension value in the critical reach of the strand.

In Fig. 4, I have diagrammatically illustrated the two transmitter units 61 and 66 and the receiver unit 67, together with the locking connections therefor, supplied from a line through a main switch 82. Line wire 83 leads from one side of the switch 82 to one switch arm 85 of a switch assembly 84, said arm normally being in contact with a terminal 86 on one side of the locking connections. A terminal 88 at the other side of the locking connections is normally contacted by a switch arm 87 which is connected, by wires 89, 90 and 91, with a line wire 84 at the opposite side of the switch 82. During the cycle of operation above described, the switch arms 85 and 87 are in their illustrated positions, and the self-synchronous system is in operative condition.

When a beam has been filled, it must be doffed, and the system should be readily returned, quickly and easily, to a starting speed ratio during the short period required to replace the filled beam with a new beam to be filled. Such return of the system is simplified, in the em-

bodiment of my invention illustrated, by the means now to be described.

The switch arms 85 and 87 are located within the actuating influence of a relay including a coil 92, one end of which is connected by a wire 93 with the wire 90, and the other end of which is connected by a wire 94 to a terminal 95 of a normally open switch including a bridge piece 96 movable to a position bridging terminals 95 and 97. A wire 98 leads from the terminal 97 to line wire 83. When the beam has been filled and is to be doffed, the bridge piece 96 is manually moved into engagement with terminals 95 and 97, thereby establishing an energizing circuit for the coil 92 leading from wire 83 through wire 98, terminal 97, bridge piece 96, terminal 95, wire 94, coil 92, wire 93, wire 90, and wire 91 to line wire 84. Energization of the coil 92 immediately shifts the switch arms 85 and 87 out of engagement with their respective contacts 86 and 88, thereby breaking the connections of the self-synchronous system and freeing the unit 67 from domination by the units 61 and 66. The counterweight 71 will now swing the bell crank lever 53 in a clockwise direction, unwinding the cable 70 from the drum 69 which, with the armature 68, will rotate freely after the connections of the self-synchronous system have been broken.

The above-mentioned movement of the bridge piece 96 closes, also, an energizing circuit for a relay in a second switch assembly 81', including a coil 100, one side of which is connected by wire 99 to the wire 94, and the other side of which is connected by wire 101 with the wire 91. This circuit may be traced from wire 83 through wire 98, terminal 97, bridge piece 96, terminal 95, wire 94, wire 99, coil 100, wire 101, and wire 91 to wire 84.

Energization of the coil 100 shifts switch arm 102 into contact with a terminal 103, said terminal being connected by wire 104 with wire 83. The switch arm is connected by wire 105 to a terminal 106 of a normally closed switch including a bridge piece 107 which engages also a terminal 108 connected, by wire 109, with wire 94. Closure of the switch arm 102 upon the terminal 103 establishes a holding circuit for the coil 92 leading from wire 83 through wire 104, terminal 103, switch arm 102, wire 105, terminal 106, bridge piece 107, terminal 108, wire 109, wire 94, coil 92, wire 93, wire 90 and wire 91 to wire 84; and a holding circuit for the coil 100 following, as traced above, to wire 94 and thence through wire 99, coil 100, wire 101 and wire 91 to wire 84. The locking connections of the self-synchronous system, thus, will remain broken, once the button carrying the bridge piece 96 has been pressed, until the button carrying the bridge piece 107 is subsequently pressed to break the holding circuits.

Preferably, I will provide a light signal system for indicating the current conditions of the parts of the system. Thus, a wire 110 leads from the wire 83 to one side of a light bulb 111, the other side of which is connected by wire 112 with line wire 84. So long as the switch 82 is closed, the light 111 will be energized. The switch mechanism 81' includes a second switch arm 113 which, upon energization of the coil 100, will be moved into contact with terminal 114. The terminal 114 is connected by wire 104 with line wire 83, and the switch arm 113 is connected by wire 115 with one side of a light bulb 116. The other side of said light bulb is connected, by wire 117,

through normally closed switch 119, to wire 123 and so to line wire 84. Thus, when the coil 100 is energized, the bulb 116 will be lighted; and it will stay lighted, to show that the system is in the course of returning to starting position, until the lever 44 strikes and moves the plunger 122 on which is carried bridge piece 120 normally bridging the terminals 118 and 121 of the switch 119.

When the operator sees that the light 116 has been extinguished, he knows that the system is in condition to be restarted by depression of the reset button carrying the bridge piece 107. When that button is depressed, the holding circuits for the relays 92 and 100 will be broken, and the switch arms 85, 87, 102 and 113 will return to their illustrated positions, whereafter the cycle above described will be restarted.

Clutches of the character indicated at 38 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 available on the market is identified as a "Hilliard adjustable-while-running slip clutch." The hand wheel 124 is operable to vary the torque transmission capacity of the clutch 39, thereby varying the value of the gross tension maintained in the stretch of material between the idler 13 and the beam 10.

It will be clear that the illustrated mechanism will be effective to control tension in the same way, if the roll 10 is operating as an unwinding roll, by driving the rotor 68 in the opposite direction as the effective diameter of the roll 10 decreases during unwinding.

I claim as my invention:

1. 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 transmitter unit of a self-synchronous system having an armature operatively connected to rotate at a velocity constantly proportional to the velocity of said delivery roll, a second transmitter unit having an armature driven through said slipping drive connection, the effective voltage deliveries of said transmitter units being equal during continuance of such fixed slip ratio, a receiver unit having an armature, electric connections between said transmitter units and said receiver unit impressing the outputs of said respective transmitter units oppositely on said receiver unit armature, and means operatively connecting said receiver unit armature to shift said element.

2. The device of claim 1 in which said speed-varying means comprises an input shaft, an output shaft, means for transmitting power from said input shaft to said output shaft, and means controlled by said element for varying the speed ratio between said shafts, said output shaft being connected to drive said storage roll, said slipping drive connection transmitting power to said input shaft.

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3. The device of claim 2 in which said second transmitter unit armature is driven from said input shaft at a velocity constantly proportional to the velocity of said input shaft.

4. The device of claim 1 in which the means operatively connecting the receiver unit armature to shift said element includes a fluid motor having a movable member connected to shift said element, valve means dominating said member, and a cable connected to said valve means and wound upon said armature.

5. The device of claim 4 including means resiliently resisting movement of said valve means in response to winding-in rotation of said receiver unit armature.

6. The device of claim 5 in which said means resisting movement of said valve means is a counterweight.

7. The device of claim 1 including switch means in said electric connections operable at will to break said connections thereby freeing said receiver unit armature from the domination of said transmitter units.

8. In a device of the class described, a storage roll, a delivery roll, a power source, means connecting said power source to drive said delivery roll at a velocity constantly proportional to that of said power source, a transmitter unit of a self-synchronous system, having a rotor, means

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connecting said rotor to rotate at a velocity constantly proportional to that of said delivery roll, a speed-varying transmission comprising an input shaft, an output shaft, means for transmitting power between said shafts and an element shiftable oppositely to vary oppositely the speed ratio between said shafts, means connecting said power source to drive said input shaft 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 second transmitter unit having a rotor, means connecting said input shaft to drive said second transmitter unit rotor at a velocity constantly proportional to that of said input shaft, a receiver unit having a rotor, electric connections between said transmitter units and said receiver unit operative to lock said receiver unit rotor against rotation during continuance of such fixed slip ratio and to enforce rotation of said receiver rotor in one direction upon increase in such ratio and rotation of said receiver rotor in the opposite direction upon decrease in such ratio, and means operatively connecting said receiver unit rotor to shift said element.

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No references cited.