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G. MANNING ET AL

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FABRIC STRETCH CONTROL DEVICE

Filed June 14, 1960

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FIG. 1

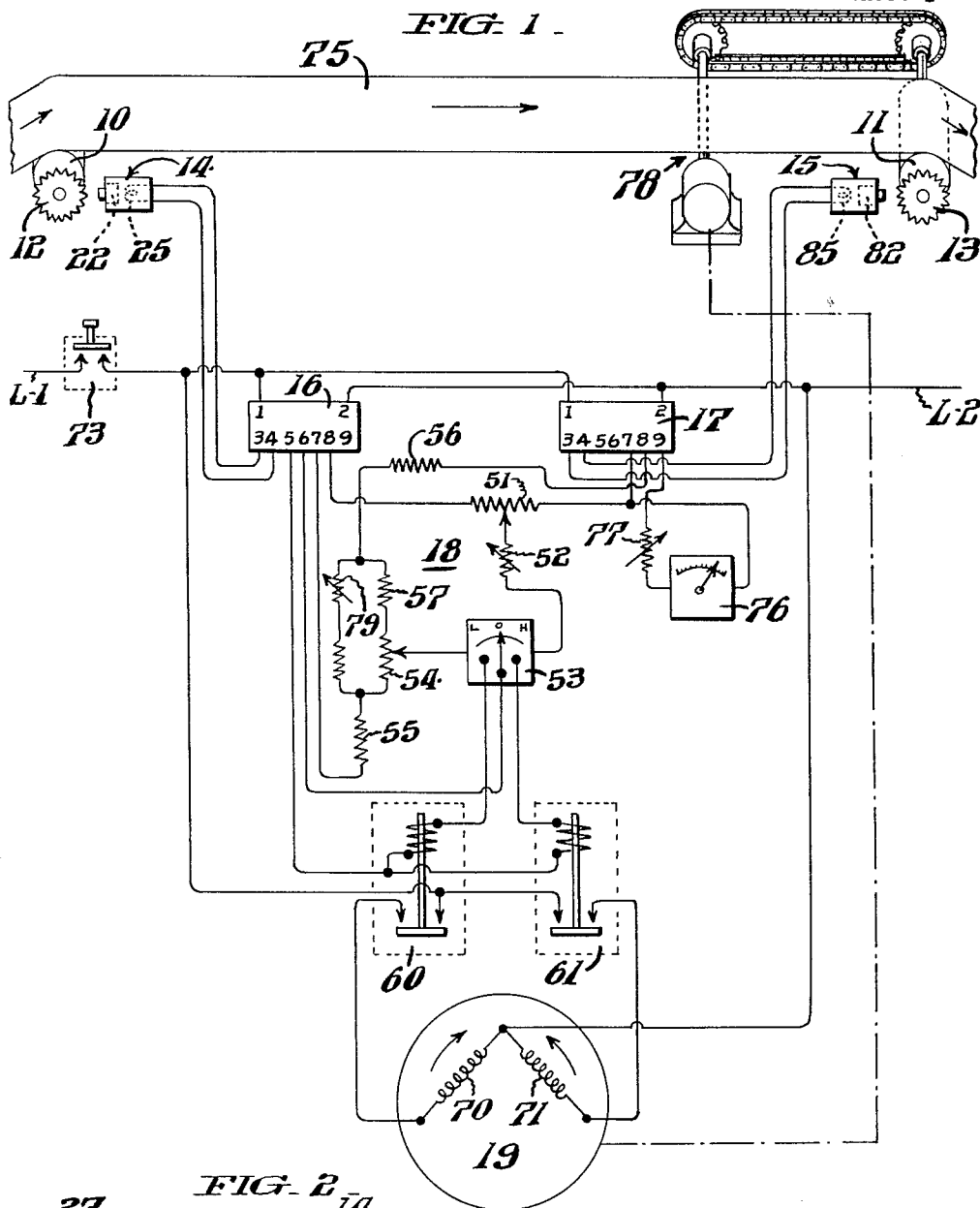
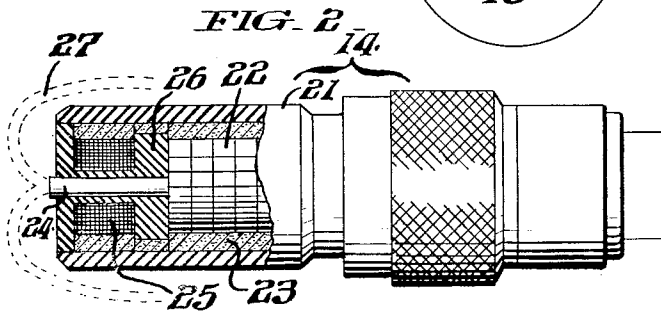


FIG. 2



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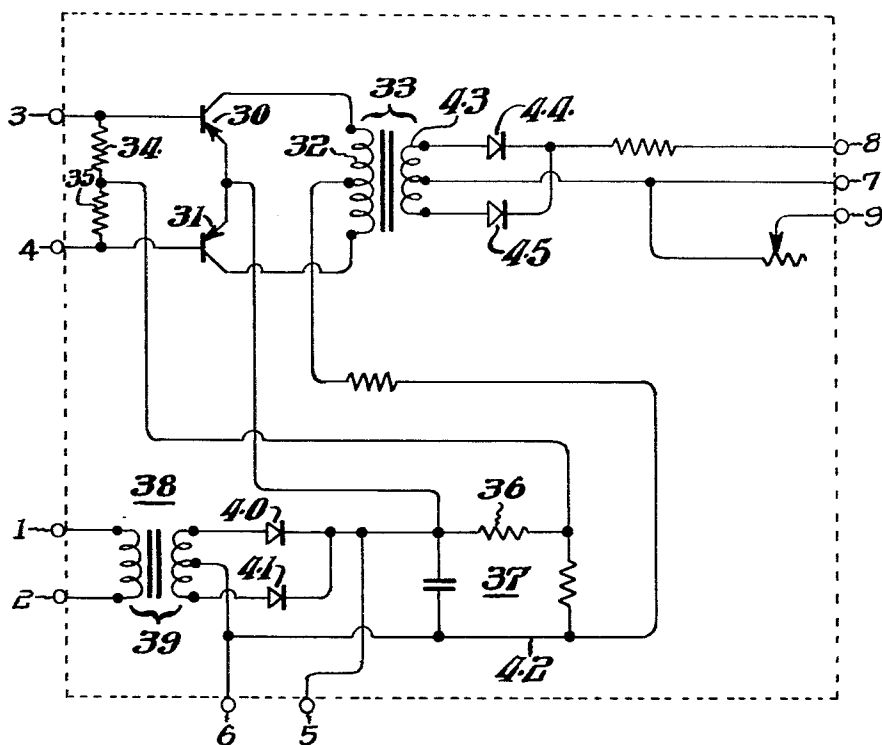
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FIG. 3



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FABRIC STRETCH CONTROL DEVICE

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4 Claims. (Cl. 26—54)

This invention relates to apparatus for controlling selectively and automatically the percentage to which a fabric or the like is stretched between the input and output of a processing machine.

The stretch control apparatus of our invention may be adjusted to provide a selected percentage of stretch, or a selected percentage of slack (negative stretch), as may be desired according to the type of fabric and the type of processing operation.

Our invention will be clear from a consideration of the following description of a preferred embodiment selected for illustration in the drawing in which:

FIG. 1 is a wiring diagram, partly schematic, partly diagrammatic, of apparatus which embodies our invention;

FIG. 2 is a view, partly in section, of one type of pick-up device suitable for use in the apparatus of FIG. 1; and

FIG. 3 is a schematic wiring diagram of the contents of the amplifier units shown in block diagram form in FIG. 1.

In describing the preferred embodiment of our invention illustrated in the drawings, specific terminology is resorted to for the sake of clarity. However, it is not our intention to be limited to the specific terms so selected, and it is to be understood that each specific term includes all technical equivalents which operate in a similar manner to accomplish a similar purpose.

Referring now to the drawings, the reference numeral 75 in FIG. 1 represents a fabric moving from left to right between input roller 10 and output roller 11 of a processing apparatus of some sort. The speed of movement of fabric 75 is directly proportional to the speed of rotation of rollers 10, 11.

In accordance with our invention, input roller 10 and output roller 11 are each provided with a toothed gear, 12 and 13 respectively, at least the teeth of which are made of material having relatively low magnetic reluctance and high magnetic permeability (at moderate values of flux density), as for example, a ferrous metal material. These toothed gears rotate with the rollers 10, 11 and may be conveniently affixed to the shafts or journals of the rollers.

Mounted adjacent to each gear 12, 13 is a magnetic proximity switch or pick-up device 14, 15, respectively. Each of the devices 14, 15 has therein a permanent magnet 22, 22 for establishing at each location a magnetic field through which the teeth of the gears 12, 13, respectively, pass to induce in windings 25, 25 of the devices 14, 15 alternating voltages of approximately sine wave shape whose mean or average area is a direct linear function of the speed of rotation of the respective gear.

The voltages developed at devices 14, 15 are amplified, as by input amplifier 16 and output amplifier 17, and the amplified voltages are compared in a differential or comparison circuit 18 which has been previously adjusted to obtain a desired stretch of fabric. If the stretch condition should become other than that desired, a signal is developed which is applied to a reversible servo-motor 19 to increase or decrease the speed of rotation of either output roller 11 or input roller 10, thereby to obtain the desired condition of stretch. In the particular embodiment illustrated, it is the output roller which is controlled in speed.

The magnetic pick-up devices 14, 15 may be identical

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and may take the form illustrated in FIG. 2, wherein pick-up device 14 is shown. The device comprises a generally tubular stainless steel shell 21 having therein a permanent magnet 22 imbedded in a resin potting 23. A pole piece 24 extends axially from the magnet and projects slightly from the front end of the device. Surrounding the pole piece 24 is a coil of copper wire 25 wound upon an insulated spool 26. Permanent magnet 22 establishes a magnetic field 27 which extends outwardly from the end of the pole piece 24 and returns through the air to the other end of the magnet (the direction of the magnetic field depending of course upon the polarity of the magnet 22).

In the apparatus of FIG. 1, the pick-up devices 14, 15 are positioned sufficiently close to the respective gears 12, 13 that the teeth of the rotating gears pass through the magnetic fields of the respective devices. The passage of the high permeability material through the magnetic fields causes the reluctance of the fields to vary in a periodic manner, thus causing the flux in the pole piece and in the air to increase and decrease in a periodic or sine wave manner at a rate dependent upon the speed of rotation of the particular gear. The periodically changing flux at each device induces periodic or sine wave voltages in the windings of the coils 25, 25, and the voltages so induced are applied to terminals 3, 4 of the input and output amplifiers 16, 17 respectively. These may preferably be solid-state amplifiers.

Reference will now be made to FIG. 3 which illustrates schematically the contents of the input and output amplifiers 16, 17, both amplifiers being similar internally, only the external connections being slightly different. It will be seen that if no voltage is being applied to terminals 3, 4 from the pick-up devices 14 or 15 (as is the case when the rollers 10, 11 are not rotating) the transistor amplifier circuit (which includes transistors 30, 31, the center-tapped primary 32 of transformer 33, and the base resistors 34, 35) is balanced, since the same D.-C. voltage is applied between the emitter of each transistor and the common junction of the base resistors 34, 35. The D.-C. voltage so applied is that developed across resistor 36 of the filter network 37 of the power supply 38. The power supply 38 includes the power transformer 39 having a center-tapped secondary, the full wave rectifier comprising the diodes 40, 41, and the filter network 37. It is assumed, of course, that the power "on" switch 73 of FIG. 1 is in closed position. It will be seen that when the primary of transformer 39 is connected to a source of power, for example, to a 115-volt 60-cycle source, a D.-C. voltage is developed across resistor 36 which is most positive at the left end of the resistor and less positive at the right end, relative to the center-tap lead 42 which may be considered to be at reference potential.

It will be understood from the above that when the fabric rollers 10, 11 are motionless, the transistor amplifier circuit in each of the input and output amplifiers 16, 17 is in a balanced condition, with substantially equal currents flowing in opposing directions through each half of the center-tapped primary 32 of transformer 33, with the result that no voltage is induced in the secondary winding 43. Thus, there is no voltage difference between terminals 7 and 8 of either of the amplifiers 16, 17.

When, however, the rollers 10, 11 are rotating, periodic or sine wave voltages are induced in the windings 25, 25 of magnetic pick-up devices 14, 15, as described above, and these voltages are applied to the input and output amplifiers 16, 17, being in each case applied across the resistors 34, 35, in series. As a result, transistors 30 and 31 are alternately cut off and saturated, one being cut off when the other is saturated. Thus, at a given time, the current flow through one section of the center-tapped primary 32 is substantially different from that through the

other, and a square-wave voltage is induced in the secondary 43 which is rectified by diodes 44, 45 and applied across the terminals 7, 8 of the particular amplifier unit 16, 17. The amplitude of the square-wave voltage is substantially fixed, but the average area is a direct linear function of input frequency, and hence of the rotational speed of toothed gears 12, 13. With the diodes 44, 45 poled as shown in FIG. 3, the voltage at terminal 8 is positive relative to that at terminal 7.

Returning now to FIG. 1, it will be seen that the voltage appearing between terminals 7, 8 of the input amplifier 16 is applied across a circuit comprising, in series, the left-hand portion of the potentiometer 51, the adjustable resistor 52, the stretch indicator meter 53 (which may conveniently be a zero-center contact-making D.-C. millimeter), the lower section of potentiometer 54, and the resistor 55. Since the voltage at terminal 8 is positive, current will tend to flow through the stretch indicator meter 53 in a direction from right to left as viewed in FIG. 1.

Similarly, the voltage appearing between terminals 7, 8 of output amplifier 17 and which is positive at terminal 8, is applied across a circuit comprising, in series, resistors 56, 57, the upper part of potentiometer 54, the stretch indicator meter 53, the resistor 52, and the right-hand section of potentiometer 51. Thus, current tends to flow through the stretch indicator meter 53 in a direction from left to right as viewed in FIG. 1.

It will be seen that the current which tends to flow through the stretch indicator meter 53 as a result of the voltage developed between the terminals 7, 8 of the output amplifier 17 is opposite in direction to that which tends to flow through the stretch indicator meter as a result of the voltage developed at terminals 7, 8 of the input amplifier 16.

It will be recalled that the voltage developed at terminals 7, 8 of the output amplifier 17 is a function of the speed of rotation of toothed gear 13 of output roller 11 while the voltage developed at the terminals 7, 8 of the input amplifier 16 is a function of the speed of rotation of toothed gear 12 of input roller 10. Thus, if the potentiometer 54 is adjusted to provide a balanced current circuit when the induced voltages are equal, then when gears 12 and 13 are driven rotationally at the same speeds equal currents will tend to flow through the stretch indicator meter 53 in opposing directions and the net current flow through the stretch indicator meter will be zero. Alternatively, the potentiometer 54 may be so adjusted that there is no net current flow through the stretch indicator meter 53 when the rotational speed of the output gear 17 exceeds that of the input gear 16 by a selected amount, or vice versa. In other words, by adjustment of potentiometer 54, the circuit may be adjusted to provide for a balanced current condition in the stretch indicator meter for any desired relationship between the rotational speeds of the input and output rollers 10, 11.

Potentiometer 51, variable resistors 52, 77 and 79, and speed indicator meter 76 are primarily for calibrating the apparatus at various speeds. The meter 76 may, for example, be calibrated to read the speed of output roller 11 in yards per minute.

If, after the apparatus has been adjusted for a desired rotational speed relationship between rollers 10 and 11, the speed of one roller relative to that of the other should depart from the condition selected, the voltage developed at terminals 7, 8 of the amplifiers will no longer have the required relationship to that developed at terminals 7, 8 of the other amplifier and a net current will flow through the meter in one direction or the other. Such current will cause the needle switch of the meter to depart from its center position "O" and contact will almost immediately be made with either the "L" or "H" contacts, according to the direction of current flow. When the switch needle makes contact at either "L" or "H," a circuit is closed through one or the other of relays 60, 61, i.e.,

through either the low stretch relay 60 or the high stretch relay 61, and current flows through the relay coil to actuate the relay armature. It will be seen that this current is derived from terminals 5, 6 of input amplifier 16, and that across terminals 5, 6 a D.-C. voltage exists which is derived from the power supply transformer 38, the full wave rectifier 40, 41 and the filter network 37.

When the armature of either relay 60 or 61 is actuated, a circuit is closed at the contacts of the relay which connects the power supply line L-1, L-2 across one or the other of the windings 70, 71 of reversible servo-motor 19. As indicated in FIG. 1 by the dot-and-dash line, servo-motor 19 is connected, for example, to the speed-change screw (not shown) of a drive motor and adjustable transmission 78 and as a result the rotational speed of output roller 11 is changed in a direction and to an extent necessary to effect a balanced current condition at the stretch indicator meter 53.

In FIG. 1, we have shown the input roller 10 to be a constant speed roller driven by means not shown, and we have shown means for adjusting the speed of the output roller 11 in response to the control voltage developed. It may, however, under some conditions, be more desirable to hold the exit speed constant and to adjust the entering speed. This, of course, can readily be done by connecting the servo-motor 19 to an adjustable transmission motor connected to the input roller 10 instead of to the output roller 11, as selected for illustration in FIG. 1.

While a preferred embodiment of our invention has been described in some detail, it will be obvious to one skilled in the art that various modifications may be made without departing from the invention as hereinafter claimed.

Having thus described our invention, we claim:

1. Apparatus for controlling the stretch of a fabric and the like between the input and output rollers of a processing machine, said apparatus comprising; first and second toothed gears at least the teeth of which are of metal of relatively high magnetic permeability, said gears being mounted for rotation with said input and output rollers, respectively; first and second magnetic devices mounted adjacent to the teeth of said first and second gears, respectively, for establishing respectively first and second magnetic fields in the path of rotation of the teeth of said first and second gears, each of said magnetic devices including a winding for inducing voltages therein in response to changes occurring in the magnetic fields resulting from movement therethrough of said gear teeth, said induced voltages being proportional to the respective speeds of rotation of said toothed gears and also of said input and output rollers; differential comparison means coupled to said windings of said first and second devices for comparing the voltages induced in said windings; and means coupled to said comparison means and responsive to a voltage difference between said compared voltages for altering automatically the speed of rotation of one of said input and output rollers in a direction to reduce said voltage difference.

2. Apparatus for controlling the stretch of a fabric and the like between the input and output rollers of a processing machine, said apparatus comprising: first and second toothed gears at least the teeth of which are of a metal of relatively high magnetic permeability, said gears being mounted for rotation with said input and output rollers, respectively; first and second magnetic devices mounted adjacent to the teeth of said first and second gears respectively, each of said devices having a permanent magnet therein for establishing respectively first and second magnetic fields in the respective paths of rotation of the teeth of said first and second gears, each of said devices also including a winding for inducing voltages therein in response to changes in the magnetic fields resulting from the movement therethrough of the teeth of said gears, said induced voltages being proportional to the respective speeds of rotation of said gears and also of said input and

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output rollers; differential comparison means for comparing the voltages induced in said windings of said first and second devices and for developing a differential current in one direction or the other; first and second relays coupled to said comparison means for actuating one or the other of said relays in response to a differential current being developed; a reversible motor having windings connected in the armature circuits of said first and second relays and energizable for rotation in one direction or the other in response to the actuation of one or the other of said relays; and means coupled between said reversible motor and one of said input or output rollers for altering the speed of rotation of the associated toothed gear in a direction and to an extent to reduce the differential current to a preselected value.

3. Apparatus as claimed in claim 2 characterized in

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that said differential comparison means includes a zero-center contact-making millimeter having a zero needle-arm and first and second contacts one or the other of which is contacted by the needle-arm when the needle-arm departs from zero-center position, thereby to close a circuit through one or the other of said first and second relays.

4. Apparatus as claimed in claim 3 further characterized in that said differential-comparison means includes a potentiometer means for so adjusting the comparison means that said needle-arm is at zero-center position when the rotational speed of said output roller is related to that of said input roller in a preselected manner.

No references cited.

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