April 21, 1953 A. KUZINSKI 2,635,826

LATERAL WEB CONTROL

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Fig. 1

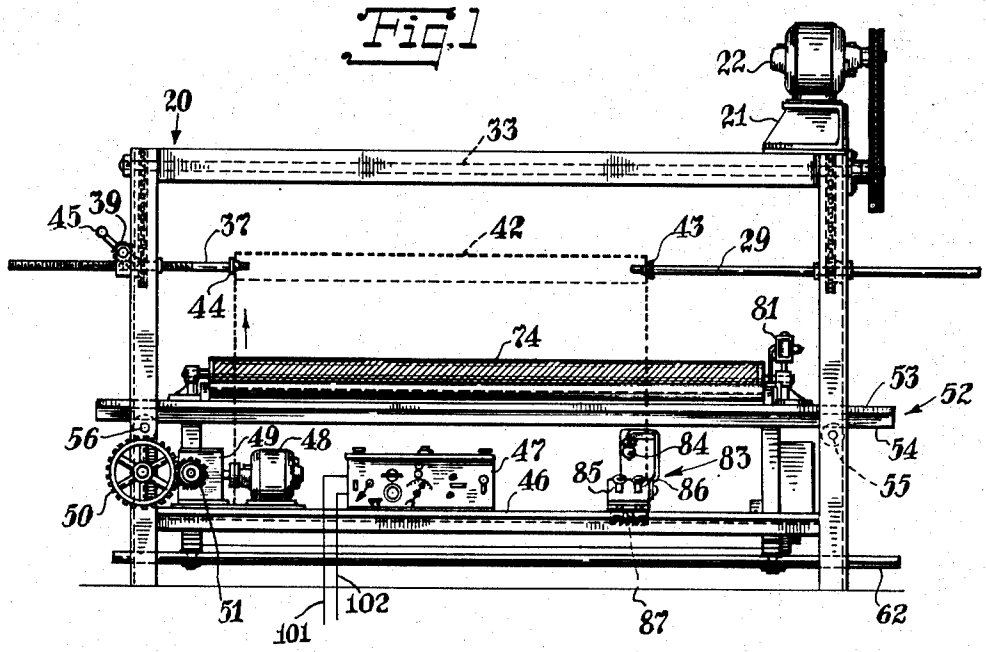
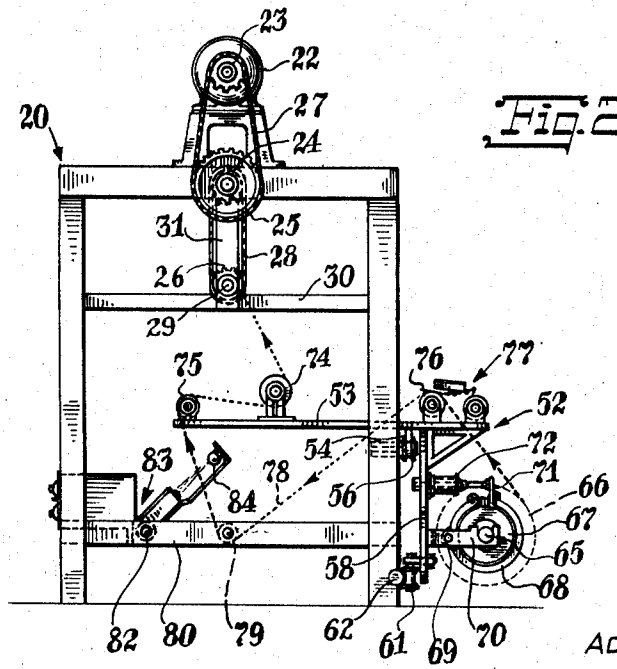


Fig. 2



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Fig. 3

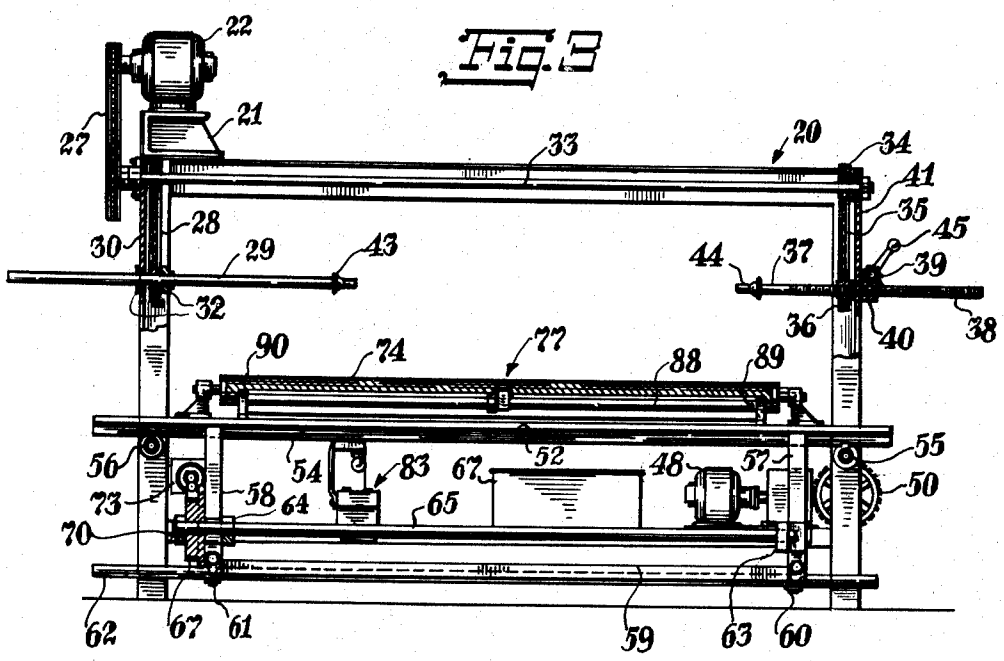


Fig. 4

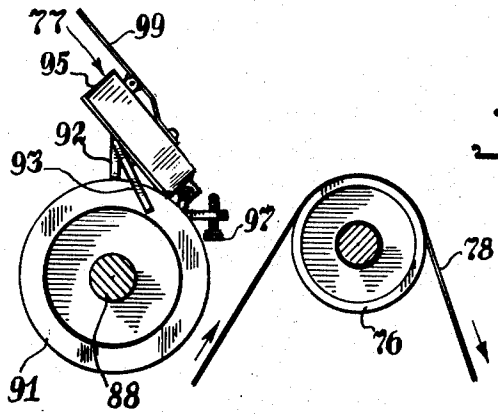
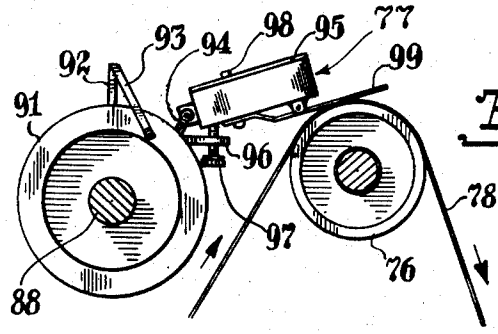


Fig. 5



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LATERAL WEB CONTROL

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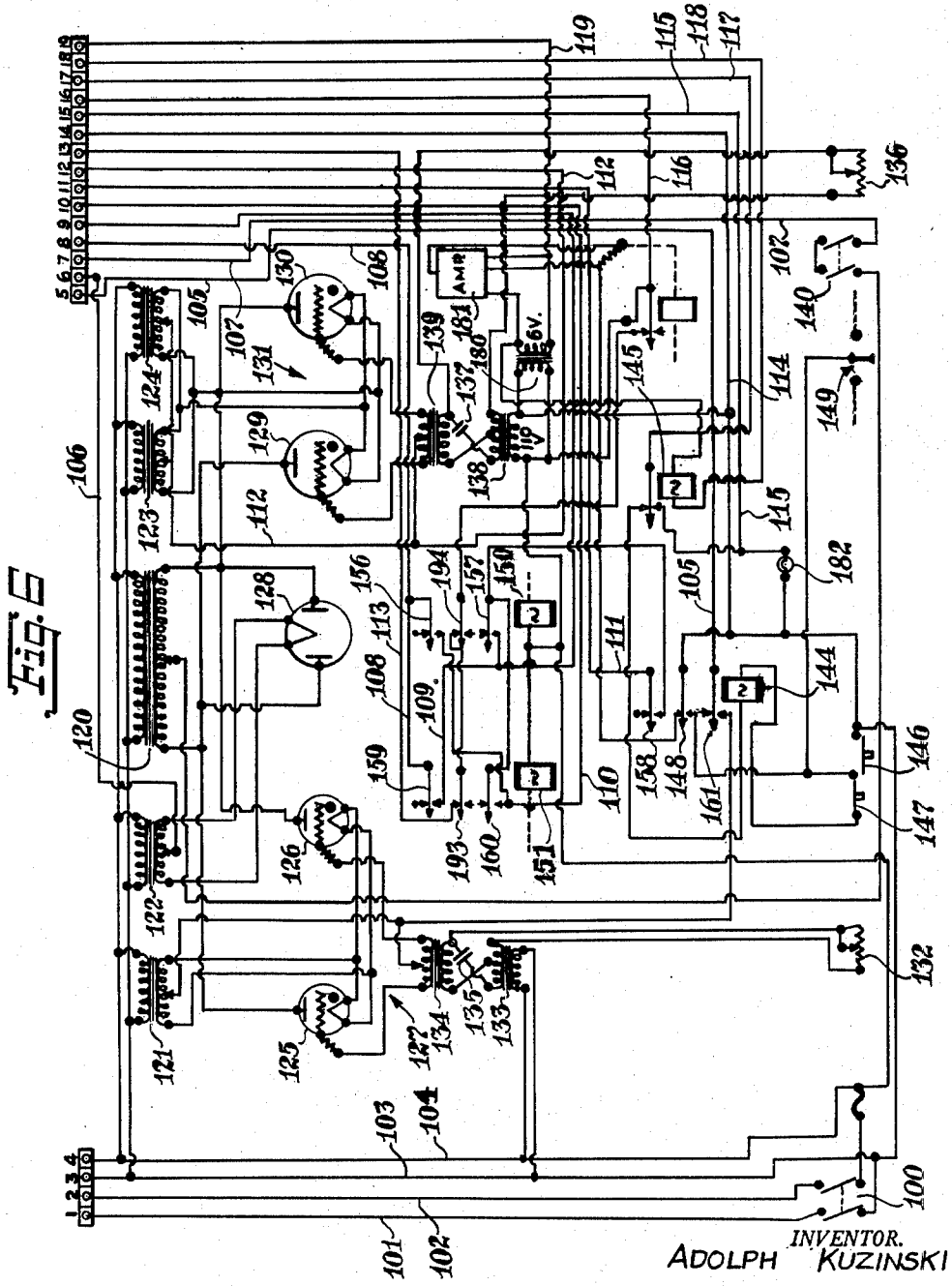


Fig. 5

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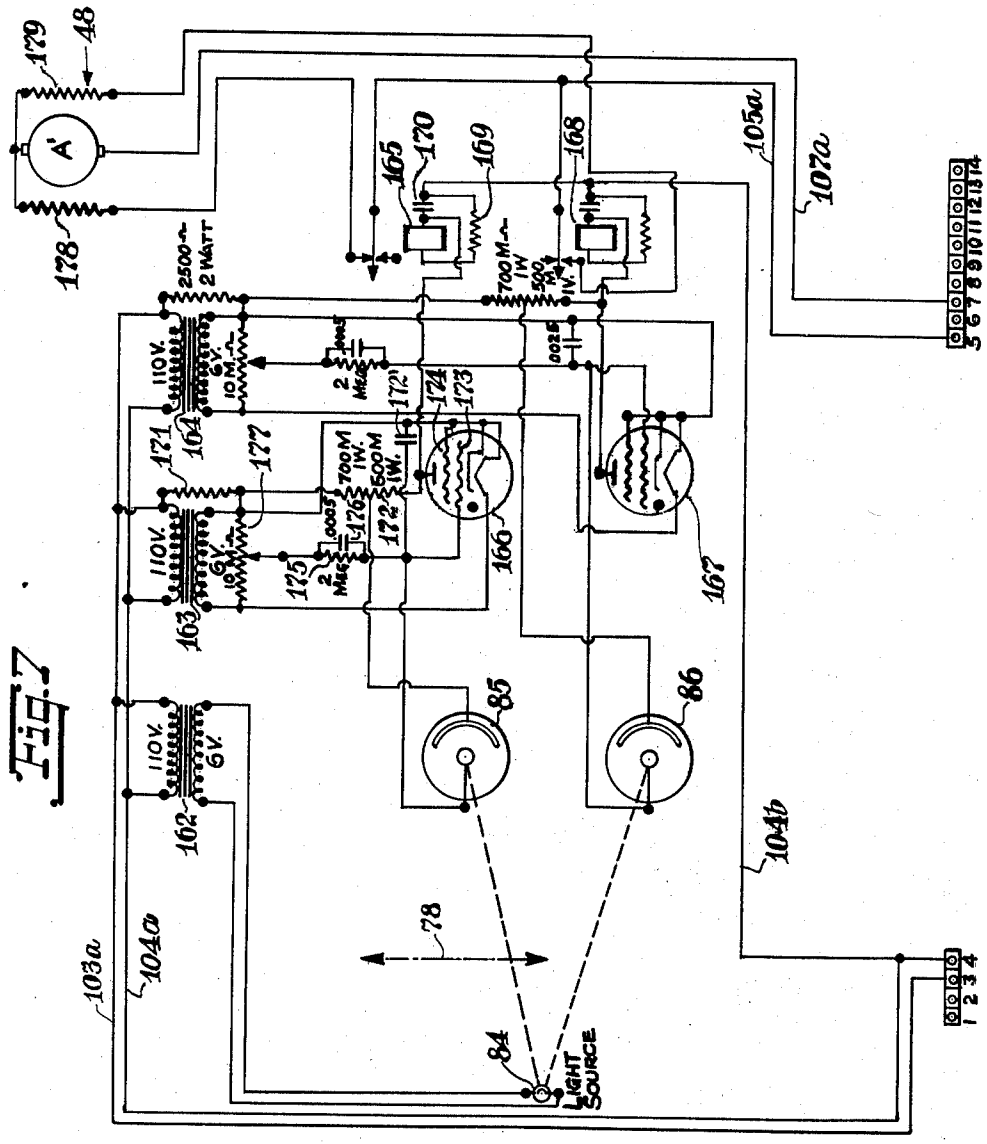


Fig. 7

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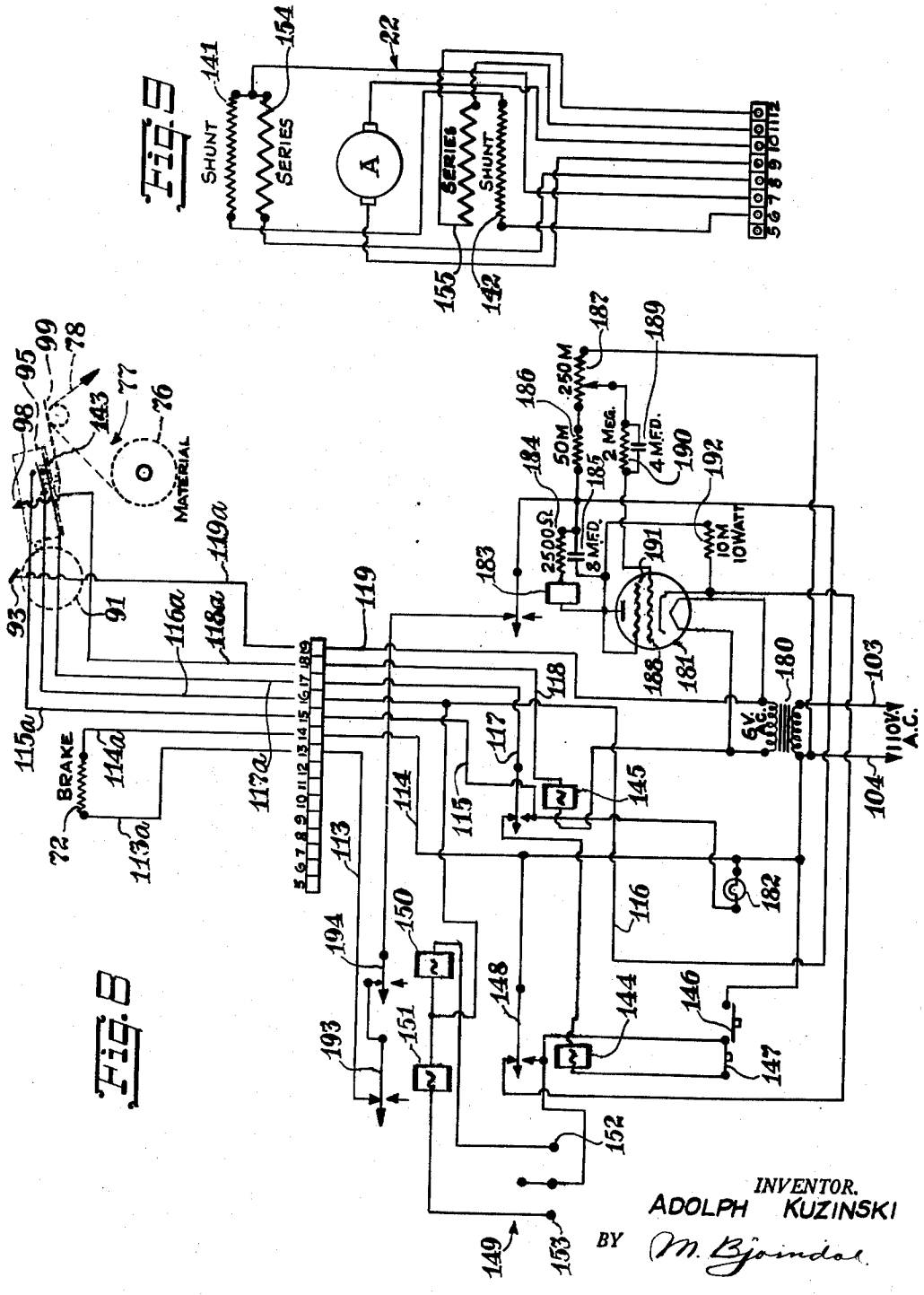
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LATERAL WEB CONTROL

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5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE

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LATERAL WEB CONTROL

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Application November 7, 1947, Serial No. 784,627

2 Claims. (Cl. 242—76)

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The present invention relates to machines for transferring a web of material from one core or tube onto another.

In the continuous processing of sheet materials, such as the dyeing of fabrics or the printing of wall paper, it is customary to stitch or paste together successive lengths of material which are thereupon wound into a roll. For sales purposes, however, it is desirable to rewind each manufacturing length of material on an individual tube, this being conveniently done by means of a machine usually referred to as a tubing machine.

In the tubing machines as heretofore constructed, there is provided means for holding a supply roll, means for holding a take-up tube, and a motor for driving the latter tube whereby the material will be unwound from the supply roll and wound upon the tube. The workman operating the machine has one hand (or his foot) on the control switch while with the fingers of the other hand he feels the material in order to detect the seam at the juncture of two successive lengths. When the seam is reached, he stops the machine, cuts or rips the material at the seam, removes the loaded tube and puts a new tube in its place. Frequently the operator is also required to control manually, e. g. by means of a handwheel, the lateral position of the web in order to compensate for transverse deviations from a predetermined course.

The described position of the operator during the running periods of the machine is fatiguing, as is the continuous vigilance required, thus detracting from his efficiency in changing the tubes whereby the output of the machine tends to drop appreciably below its theoretical value. The speed of his reactions, furthermore, will vary so that the seam will not always be arrested in the most suitable position, hence either requiring the completion of the winding process by hand or the unwinding of the excess material from the take-up tube.

It is, therefore, an object of the present invention to provide a machine, of the character described, in which the detection of the seam and the stopping of the machine are carried out by fully automatic means.

Another object of the invention is to provide a machine, of the character described, in which the lateral control of the web is carried out by fully automatic means.

A further object of the invention is to provide, in a machine of the character described, automatic means for lateral web control which

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may be adjusted in simple manner for different tolerances.

Yet another object of the invention is to provide, in a machine of the character described, electronic means for stopping the machine by means of a brake and for automatically releasing said brake after a predetermined time interval.

A still further object of the invention is to provide, in a machine of the character described, a control circuit of simplified design using switching means responsive to alternating current.

Thus the invention, according to certain features thereof, contemplates the provision of a tubing machine having means for holding a supply roll, means for holding a take-up tube, a motor driving said tube, detector means adapted to stop the motor when the seam is reached, automatic means controlling the lateral position of the web while the material is being transferred from the supply roll to the take-up tube, and switch means whereby the operator, having removed the loaded tube and put a new tube in its place, may re-start the machine whereupon the cycle is repeated automatically.

The above and other features and objects will become more clearly apparent from the following detailed description, taken in conjunction with the accompanying drawing in which:

Fig. 1 is a front view,

Fig. 2 is a side view, and

Fig. 3 is a rear view of a machine according to the invention;

Figs. 4 and 5 show the seam detecting device in inoperative position and operative position, respectively;

Fig. 6 is a circuit diagram representing the main control circuit;

Fig. 7 is a circuit diagram representing an arrangement for the lateral web control;

Fig. 8 shows the brake and seam detector circuits and gives a more detailed illustration of part of the circuit shown in Fig. 6; and

Fig. 9 illustrates the connections to the main driving motor.

Referring first to Figs. 1, 2 and 3, the machine representing an embodiment of the invention will be seen to comprise a frame **20** supporting a motor base **21** which carries the main driving motor **22**. Motor **22** drives, by way of sprockets **23**, **24**, **25**, **26** and chains **27** and **28**, a shaft **29** lodged in bearings which are formed by a crossbar **30** and a vertical member **31** of the frame **20**, collars **32** serving to prevent any axial displacement of the shaft. Sprockets **24**, **25** are fixed to a shaft **33** extending longitudinally of

the frame 20, said shaft having fixed to its other end a sprocket 34 connected by a chain 35 to a sprocket 36. Sprocket 36 turns a shaft 37 which is formed with peripheral grooves 38 cooperating with the teeth of a manually rotatable ratchet 39. Shaft 37 is slidably held in a bearing 40 supported by a vertical member 41 of the frame 20. Fig. 1 shows how a take-up tube 42 is mounted between chucks 43, 44 provided on the positively driven shafts 29 and 37, respectively. To remove the tube 42, the ratchet 39 is rotated clockwise (as viewed in Fig. 1) by means of a crank 45, thereby displacing the shaft 37 outwardly. After insertion of a new take-up tube, the crank 45 is rotated counter-clockwise (as viewed in Fig. 1) until the chucks 43, 44 are in tight engagement with the ends of the tube, insuring the rotation thereof under the control of motor 22.

Fastened to the frame 20 by any convenient means (not shown) is a plate 46, preferably formed by an angle iron, which supports the electronic control cabinet 47, the auxiliary motor 48 and the gear box 49. The cabinet 47 contains the circuit elements subsequently discussed in connection with Figs. 6 and 8. The box 49 houses reduction gearing (not shown) which couples the motor 48 to a gear 50 by way of a pinion 51 mounted on the box. A carriage or frame generally indicated at 52 comprises a platform 53 to whose underside is secured a vertical blade 54 supported on two spaced rollers 55, 56. One of the rollers, e. g. 55, is driven from the gear 50 over a transmission system not shown. The carriage 52 further comprises depending members 57, 58 joined together by a horizontal member 59, these members supporting spaced rollers 60, 61 engaging a guide rod 62. Also supported on the carriage 52, as by brackets 63, 64 secured to the members 57 and 58 thereof, is a rod 65 adapted to carry the supply roll 66 (Fig. 2). The rod 65 carries a brake comprising a disc 67, mounted on the rod, and a steel band 68 cooperating therewith. The band 68 is fixed at one point, as at 69, to a bracket 70 secured to member 58 and is attached at another point, 71, to the armature of a solenoid 72 which is also secured to the member 58 by means of a plate 73.

Carried on the platform 53 of a carriage 52 are a measuring roller 74, two tension rollers 75, 76 and a micro-switch 77 subsequently described. As shown in Fig. 2, the web 78 from supply roll 66 passes first around the tension roller 76, then around a stationary roller 79 supported by suitable means, such as crossbars 80 (only one shown), on the frame 20, next around the roller 75 and finally around the measuring roller 74 whereupon it is taken up by the tube 42. The measuring roller 74, having a knurled surface as shown in Figs. 1 and 3, is entrained by the web 78 and actuates a counting device 81 which measures the number of revolutions of roller 74 and, thereby, the length of the material passing through the machine. The device 81 may be of any known construction.

Mounted on a rod 82, which may be supported in similar manner as the roller 79, is the scanning apparatus 83 comprising a source of light 84 and two photocells 85, 86. The apparatus 83 is located adjacent the right-hand edge of the web 78, as viewed in Fig. 1, and its angular position on the rod 82 is adjustable as by means of a set screw 87. A rotation of the apparatus 83 about the rod 82 will result in varying the sensitivity of the apparatus with respect to lateral deviations of the web as will subsequently become clear from a description of the circuit diagram of Fig. 7.

The micro-switch 77 represents the seam detector mentioned above and its mechanical features are shown in detail in Figs. 4 and 5. A rod 88 is supported on the platform 53 by means of brackets 89, 90 (Fig. 3). The rod 88 carries the body 91 which may be of any convenient form, e. g. may be drum-shaped as shown in the drawing. (It will be understood that both the angular and the axial position of the drum on the rod 88 are fixed.) Rising from the body 91 are an arm 92 supporting a metal plate 93, an arm 94 having pivoted thereon the switch box 95, and an arm 96 carrying an adjustable screw 97. The box 95 carries externally a button 98 and a switch arm 99. The button 98 and the metal plate 93 form a pair of external contacts, operated by the box, which are closed when the latter is in its upturned or inoperative position as shown in Fig. 4. The switch arm 99 operates a set of internal contacts (not shown in Figs. 4 and 5). The latter contacts are in a first position when the switch is at rest, as in Fig. 4, or when the arm 99 rides lightly on the material 78 as determined by the adjustment of screw 97. If now, in the position illustrated in Fig. 5, a seam should pass between the roller 76 and the switch arm 99, the latter will be lifted slightly, thus being displaced with respect to the box 95 which is seated on the screw 97. This relative movement of the arm 99 will throw the internal contacts of the switch into a second position as will be more fully described hereinafter with reference to the circuit diagram of Fig. 8.

The contents of the control cabinet 47 are illustrated diagrammatically in Fig. 6. The cabinet has nineteen terminals 1–19 to the first two of which power is supplied externally from alternating current mains, not shown. A master switch 100 connects the conductors 101, 102 extending from these terminals to conductors 103, 104 forming a pair of auxiliary bus bars. Conductors 103, 104 are connected to the terminals 3 and 4, respectively. In similar manner, conductors 105 through 119 are connected to respective terminals 5 through 19.

Connected in parallel between the bus bars 103 and 104 are the primaries of a main or plate transformer 120 and four auxiliary or heater transformers 121, 122, 123, 124. The secondary of transformer 121 supplies heater current to the filaments of two thyratrons 125, 126 forming a first full-wave rectifier 127. The secondary of transformer 122 supplies heater current to the filament of a second full-wave rectifier 128 shown as a double diode. The secondaries of transformers 123 and 124 in parallel supply heater current to the filaments of two thyratrons 129, 130 representing a third full-wave rectifier 131. The output of rectifier 127 is controlled by a potentiometer 132, serving to shift the phase of the grid voltage applied to the thyratrons 125, 126 from conductors 103, 104 by way of transformers 133, 134; the potentiometer 132 forms part of a reactive coupling circuit which includes a condenser 135 and connects the secondary of transformer 133 to the primary of transformer 134. The output of rectifier 131 is controlled in analogous manner by a potentiometer 136 which is in series with a condenser 137, connected between the windings of two transformers 138, 139 which serve to energize the grids of thyratrons 129, 130.

The plates of thyratrons 125 and 129 and the

left-hand plate of double diode 128 are connected to the left-hand terminal of the secondary of main transformer 120, with the remaining rectifier plates connected to the right-hand terminal thereof. A plate switch 140, when thrown, serves to extend the conductor 107 to the center tap of this secondary so as to make this conductor the common plate lead for all the rectifiers. As the conductor 106 is connected to the center tap of the secondary of transformer 122, this conductor represents the cathode return for rectifier 128 which therefore will be connected between terminals 6 and 7 as soon as both the main switch 100 and the plate switch 140 are closed. From a glance at Fig. 9, it will be seen that the two shunt windings 141, 142 of motor 22 are connected in series between terminals 6 and 7 so that these two windings will be energized as soon as the said switches are thrown.

Referring briefly to Fig. 8 wherein the switch box 95 and adjoining parts have been shown in dotted lines, it will be seen that the metal plate 93 and the button 98 are connected to terminals 19 and 18, respectively, by way of conductors 119*a* and 118*a*. Thus, these two terminals will be short-circuited when the box 95 is in its upturned position as in Fig. 4. The switch arm 99 controls an armature 143 in switch box 95, said armature 143 being connected to a conductor 116*a* and thereby normally short-circuits the terminals 16 and 17 over a back contact connected to a conductor 117*a*; when the switch arm is actuated, however, this short circuit is broken and the armature 143 short-circuits, instead, the terminals 15 and 16 over a front contact connected to a conductor 115*a*.

A main relay 144, Fig. 6, has its winding connected to conductor 117 over a back contact of an interrupter relay 145. Since, in the normal condition of the micro-switch 77 (box 95 turned down, arm 99 unactuated), terminals 17 and 16 are short-circuited as described above, the circuit of relay 144 will be extended over conductor 116 to bus bar 104. Bus bar 103 may be connected to the winding of relay 144 by the closure of a push button 146, by way of a circuit breaker 147 which may also be in the form of a push button. Relay 144 thereupon energizes and locks over a front contact associated with the middle one of its three armatures, indicated at 148. Armature 148 also extends the bus bar 103 to the movable arm of a three way switch 194.

A forward relay 150 and a reverse relay 151 have their windings connected in parallel to the bus bar 104. Switch 149, as shown in Fig. 8, is arranged to complete either the energizing circuit for relay 150 over its right-hand contact 152 or the energizing circuit for relay 151 over its left-hand contact 153. (These connections have not been completed in Fig. 6 so as not unduly to complicate the drawing.) Operation of the forward relay 150, for example, energizes the armature A and the series windings 154, 155 of motor 22 (Fig. 9) over a circuit which can be traced from plate terminal 7 through winding 154 to terminal 8, thence over conductor 108, armature 156 and front contact of relay 150, conductor 110 to terminal 10, via armature A to terminal 9, over conductor 109, front contact and armature 157 of relay 150, front contact and armature 158 of relay 144 and conductor 111 to terminal 11 and through winding 155 to terminal 12. Conductor 112 is connected to the center taps of the secondaries of transformers 123 and 124 in parallel, thus completing the circuit through rectifier 131. If the

reverse relay 151 had operated, the circuit would have run from terminal 8 over conductor 108 to the armature 159 and front contact of relay 151, thence via conductor 109, terminal 9, armature A (with the current flowing in a direction opposite as before to terminal 10 and over conductor 110, front contact and armature 160 of relay 151, front contact and armature 158 of relay 144 and conductor 111 to terminal 11, the remaining connections being identical.

The position of the three-way switch 149 will thus determine the sense of rotation of motor 22 whereby the material may be wound upon the take-up tube 42 in either a clockwise or a counterclockwise direction as desired.

When the relay 144 was energized, its armature 161 extended over a front contact the conductor 105 to the cathode return of rectifier 127 at the center tap of the secondary of transformer 121. Thus there was prepared an energizing circuit for the auxiliary motor 48 as will be seen from Fig. 7.

Fig. 7 illustrates the operation of the marginal control 83. Connected between the conductors 103*a* and 104*a*, which extend from terminals 3 and 4, are the primaries of three step-down transformers 162, 163 and 164. Transformer 162 energizes the lamp 84. Transformer 163 forms part of an energizing circuit for a relay 165, said circuit also including the photocell 85 and a gas filled tetrode 166. Transformer 164, photocell 86 and gas filled tetrode 167 are included in a similar energizing circuit for a relay 168. Since the two energizing circuits are identical, only one of them will be discussed in detail. Transformers 163 and 164 supply heater current to the tetrodes 166 and 167, respectively.

The plate of tetrode 166 is connected to the terminal 4 over the winding of relay 165, a resistor 169 in series therewith and a conductor 104*b*. The series combination of relay 165 and resistor 169 is shunted by a condenser 170. In an actual embodiment the magnitude of resistor 169 was 2500 ohms and the capacity of condenser 170 was 4 microfarads, these values as well as others indicated on the drawing being given merely by way of illustration and not limitation. The load circuit of tetrode 166 is completed by a connection between the cathode thereof and the terminal 3 which includes a resistor 171 and the conductor 103*a*. A very large resistor 172, designed as a voltage divider, is shunted across the cathode-anode circuit of tube 166.

The cathode of tetrode 166 is coupled through a condenser 172' to the control grid 173 of that tube and is galvanically connected to the second grid 174 thereof. Grid 173 is directly connected to the anode of photocell 85 and is also connected, by way of anode resistor 175 shunted by condenser 176, to the slider of a potentiometer 177 bridged across the secondary of transformer 163. The cathode of photocell 85 is connected to the intermediate terminal of voltage divider 172. Resistor 171 also serves to connect one terminal of the primary winding of transformer 163 to a corresponding terminal of the secondary winding thereof, the coupling between the two windings being arranged in such a way that the plate potential and the control grid potential of tube 166 will be substantially in phase.

As long as the photocell 85 is non-conductive, the voltage on the control grid of tube 166 will rise sufficiently during each positive half-cycle to ignite the tube, thereby causing the flow of a pulsating current which will charge the condenser 170 and, after an interval determined by

the time constant of the elements 169, 170 will energize the relay 165. If, however, the photocell 85 is excited and becomes conductive, the voltage drop across the anode resistor 175 will lower the potential on grid 173 during positive half-cycles so that the tube 166, having been de-energized during a negative half-cycle will not reoperate whereupon relay 165 releases.

The normal position of the web 78, with respect to the light source 84 and the photocells 85 and 86 is as indicated in Fig. 7 by a dot-dash line with the arrowheads indicating the possible displacement of the web. Thus, under normal conditions, the light will impinge on the photocell 86 but will be cut off from the cell 85. This means that relay 165 will be operated while relay 168 will be at rest and none of the windings 178, 179 of motor 48 will be energized. Suppose, now, that the web 78 shifts in such a manner (upward in Fig. 7) that light may fall on the cell 85. Relay 165 will release and a circuit will be closed from terminal 5 over conductor 105a, armature and back contact of relay 165, winding 178 and armature A' of motor 48, conductor 107a to terminal 7. This energizes motor 48 in one sense of rotation whereby the position of the web will be restored. If, however, the web deviates in the opposite direction (downward in Fig. 7), the photocell 86 will become non-conductive and relay 168 will operate, closing an obvious circuit through armature A' and winding 179 of motor 48 which thereupon rotates in the reverse sense, likewise restoring the web 78 to its normal position.

From an inspection of Fig. 7 it will also be clear how a rotation of the scanning device 83 about the rod 82 (Fig. 2) varies the limits within which the web 78 may be laterally displaced without effecting the operation of motor 48. Thus it will be seen that clockwise rotation of the apparatus 83 as viewed in Fig. 2 will have the effect of increasing the distance between the web 78 and the source of light 84 while bringing the web closer to the photocells 85, 86. In this position the tolerance will be greater since a wider linear displacement of the edge of the material within the limits of the triangle 84, 85, 86 will be possible. Conversely, a counter-clockwise rotation of the apparatus 83 about the rod 82, as viewed in Fig. 2, will decrease the tolerance by placing the web 78 closer to the lamp 84. In this simple manner the desired degree of margin control may be conveniently selected.

Connected across the bus bars 103, 104 (Figs. 6 and 8) is a step-down transformer 180 which supplies low-voltage alternating current to conductors 118 and 119. The transformer also provides heater current for an amplifier 181, shown as a tetrode in Fig. 8. The relay 145, previously referred to, is a low voltage relay in series with conductor 118 which becomes energized when the contacts 93, 98 are closed. Relay 145 opens the operating circuit of the main relay 144 which therefore cannot be energized when the switch box 95 is in its upturned position as shown in Fig. 4. At the same time a circuit through an alarm lamp 182 will be closed: Conductor 103, lamp 182, front contact and armature of relay 145, conductor 117, terminal 17, conductor 117a, back contact and armature 143 of switch 77, conductor 116a, terminal 16, conductor 116, conductor 104. This will advise the operator that the machine is not in condition to function and will cause him to lower the switch box 95, whereupon the relay 145 will become de-energized, relay 144 will operate and lamp 182 will be extinguished.

At this point it may be well to note that the micro-switch 77 is preferably of a type in which the armature 143 is tripped by the arm 99 so as to remain in actuated position until manually restored to normal. In this case, since the energizing circuit for the main relay 144 leads over the back contact and armature of the switch, it will not be possible to start the machine with the armature 143 off normal and the alarm lamp 182 will be lit over a circuit which includes conductors 115 and 115a, front contact and armature 143 of switch 77, conductor 116a and conductor 116.

The load circuit of amplifier tube 181 extends from the cathode thereof over a back contact and armature 148 of relay 144 to the bus bar 104 and from bus bar 103 by way of a relay 183 to the plate of the tube. Relay 183 is in series with a resistor 184 and is shunted by a condenser 185, the arrangement representing a time delay circuit similar to the circuit 169, 170, of Fig. 7. Two very large resistors 186 and 187, the latter designed as a potentiometer, are connected across the bus bars 103 and 104, the control grid 188 of tube 181 being connected to the slider of potentiometer 187 by way of a condenser 189 and grid leak 193. The second grid 191 of tube 181 is connected to the plate thereof. A large resistor 192 is bridged across the tube as is customary.

It will be seen that tube 181 will be energized as soon as the master switch 100 has been closed and as long as the relay 144 remains unoperated. It will also be seen that an energizing circuit for the solenoid 72 of the brake described in connection with Fig. 2, shown here schematically as an impedance, leads from conductor 104 over conductor 114, terminal 14, conductor 114a, solenoid 72, conductor 113a, terminal 13, conductor 113, back contact and armature 193 of relay 151, back contact and armature 194 of relay 150, back contact and armature of relay 183 to the conductor 103. Thus, when the switch 100 is initially thrown, the solenoid 72 will be energized over the circuit described; at the same time, however, the vacuum tube 181 will conduct pulsating direct current, charging the condenser 185 and eventually operating the relay 183 which opens its back contact de-energizing the solenoid 72 and releasing the brake. The period during which the brake is applied will be determined by the time constant of the circuit elements 184, 185.

The operation of the arrangement described is as follows: Let us assume that the machine has been running for a while, thus the condenser 185 is completely discharged. The main relay 144 is energized as is one of the start relays 150, 151. Accordingly, although the circuit of solenoid 72 is closed at the armature of relay 183, it will be open either at the armature 193 or at the armature 194. Suppose, now, that the relay 144 is momentarily de-energized; this may happen as a result of an actuation of the switch arm 99 or upon manual depression of the release button 147 by the operator whereby the holding circuit of the relay will be opened. Relay 150 or 151 (whichever had been energized) is released at armature 148, thereby closing the operating circuit for the solenoid 72 so that the brake is applied to the shaft 65 carrying supply roll 66. At the same time the release of the start relay de-energized motor 22 while the circuit of motor 48 is open at the armature 161. The tube 181 becomes conductive, energizing in due time the relay 183

whereupon the brake is released and the machine is ready to be started up anew.

It will thus be seen that by the present invention I have produced a machine which is fully automatic to the extent that the operator need attend only to the changing of the take-up tubes and supply rolls and to the starting of the machine. The invention, however, is not limited to the particular embodiment described and illustrated; thus the arrangement need not be used for the detection of seams but may be utilized to detect other variations in the thickness of a web of material, in such a manner that the machine will be arrested automatically when either abnormally thick or (with obvious modifications of the switch 77) abnormally thin portions of material are encountered. Various other adaptions and modifications may be made by persons skilled in the art without exceeding the spirit and scope of the invention as defined in the objects and in the appended claims.

I claim:

1. In a tubing machine of the character described the combination of a frame; a motor driven tubing spindle adjustably mounted in said frame; a plurality of rollers rotatably mounted upon said frame; a second frame mounted upon said rollers supported by said first frame; a second motor drive mounted upon said first frame and coupled to one of said rollers carrying said second frame, whereby said second frame may be driven back and forth parallel to the axis of said tubing spindle; a supply roll rotatably mounted upon said second frame; a web of material to be tubed stretched from said supply roll to said tubing spindle; a plurality of guide rolls rotatably mounted in contact with said web between said supply roll and said tubing spindle; a pair of photo-electric cells mounted on said first frame near an edge of said web; a light source mounted on the other side of said web, in line with the edge of same, said light source being placed in such a position relative to said web that only one of said photo-electric cells is illuminated when the web is in its normal position, and electric control apparatus operated by said photo-electric cells whereby said second motor drive is actuated and whereby said supply roll and said web may be kept in proper relation to said tubing spindle.

2. A tubing machine as described in claim 1 where said pair of photo-electric cells and said light source are adjustably mounted upon a transverse member in said first frame whereby said photo-electric cells and said light source may be set to control the tubing of webs of various widths.

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