

May 31, 1955

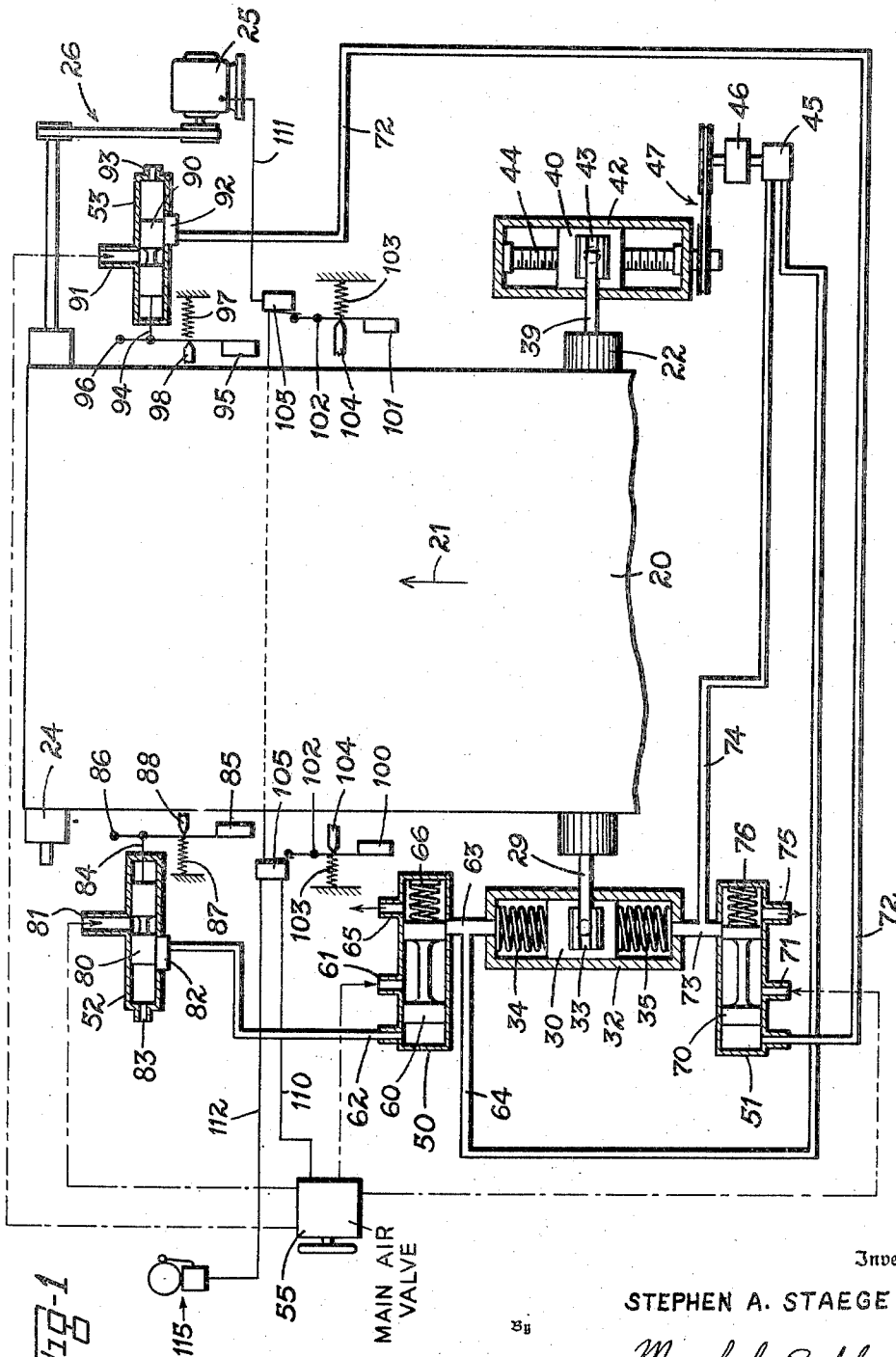
S. A. STAEGE

2,709,588

WEB GUIDE MEANS FOR A PAPER MACHINE

Filed Feb. 28, 1951

4 Sheets-Sheet 1



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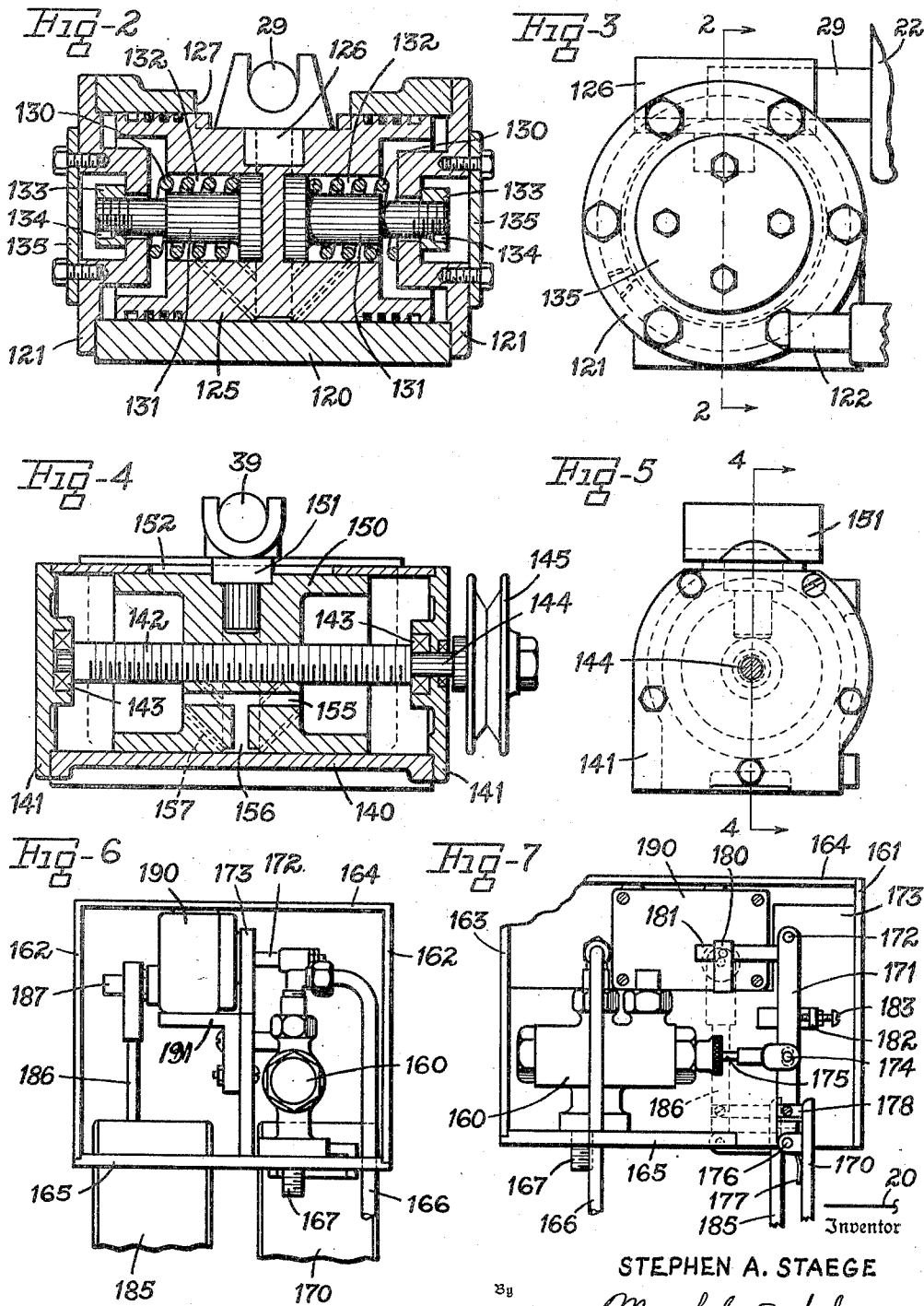
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Fig-8

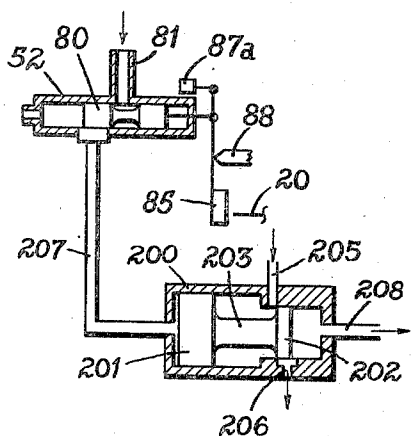


Fig-9

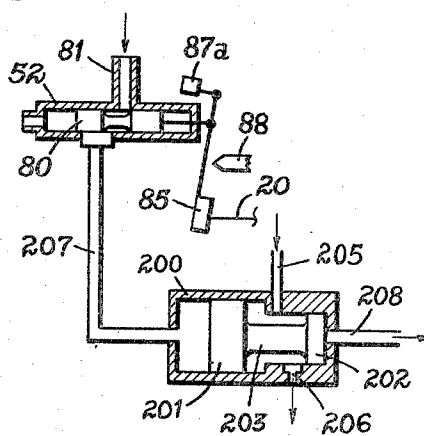


Fig-10

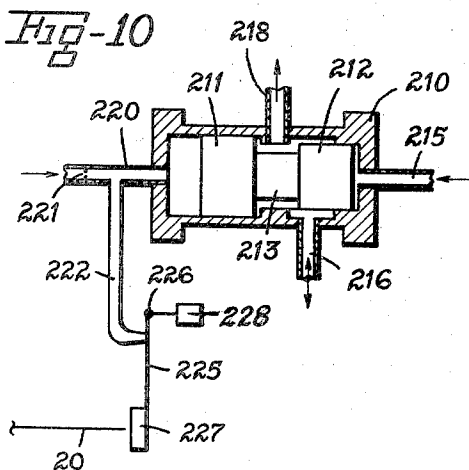


Fig-11

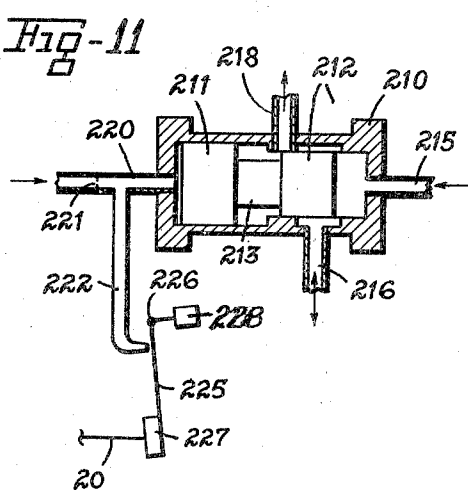
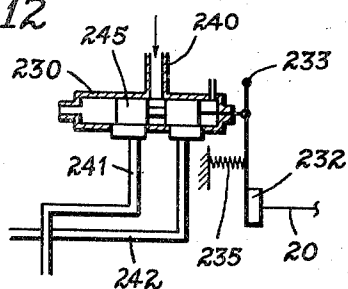


Fig-12



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WEB GUIDE MEANS FOR A PAPER MACHINE

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Fig-13

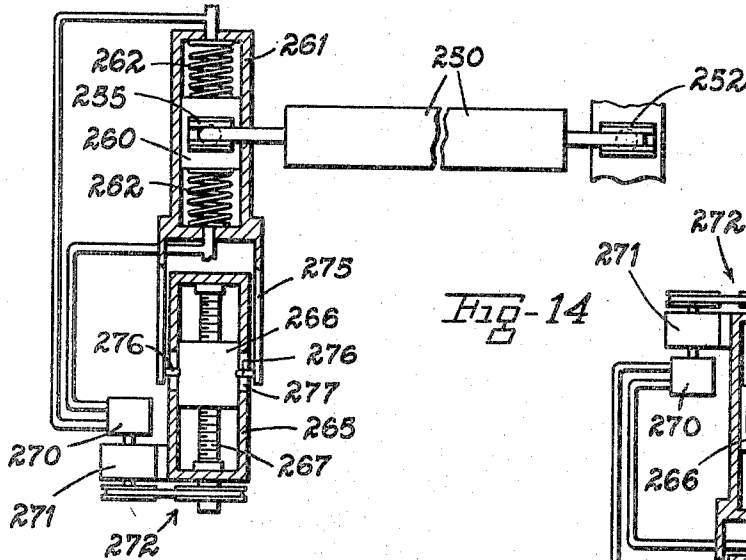


Fig-14

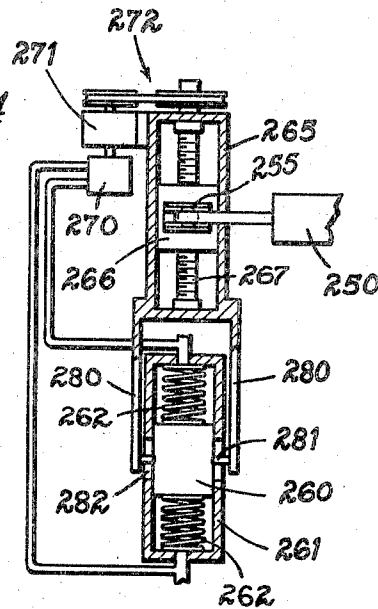


Fig-15

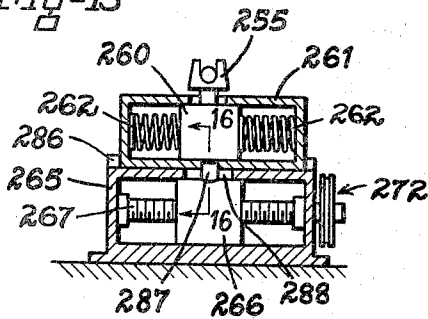


Fig-17

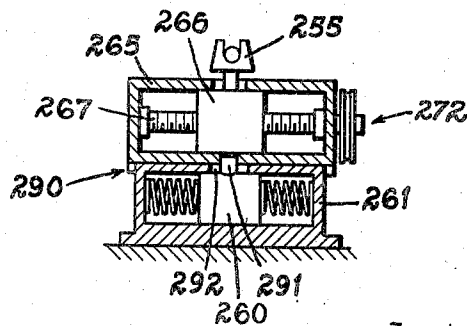
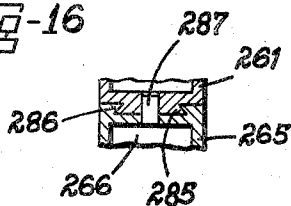


Fig-16



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WEB GUIDE MEANS FOR A PAPER MACHINE

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Application February 28, 1951, Serial No. 213,213

9 Claims. (Cl. 271-2.6)

This invention relates to a web guiding mechanism such as a guide for a wire or belt on a Fourdrinier paper machine to keep the web traveling in the proper straight path.

One of the principal objects of the invention is to provide a web guiding mechanism which is simple in construction as well as positive and economical in operation, which is quick to respond when the web moves from the desired path, which imparts a sufficiently permanent correction where required to minimize the frequency of necessary corrections, and which may be operated entirely by fluid pressure for maximum safety and minimum requirement of electrical equipment in close proximity to the paper machine.

Another object of the invention is to provide a web guiding mechanism of the type operated by feeler members on opposite sides of the web for sensing departure thereof from the proper path which is of such structural and operational characteristics that if one sensing unit should fail to return to its normal position after actuation thereof, the web will automatically operate the other feeler member to return the guide mechanism to its neutral position and thus prevent the web from running off the rolls before the defective condition of the sensing unit can be noted and remedied.

It is also an object of the invention to provide a control mechanism for a web guiding roll adapted for operation entirely by fluid pressure which may be mounted entirely at one side of the web and which will operate in such manner as to give to the guide roll a substantial but temporary corrective movement immediately upon actuation thereof and also to apply a small retained corrective movement to the guide roll to prevent further departure of the web from its desired direction of travel.

Other objects and advantages of the invention will be apparent from the following description, the accompanying drawings and the appended claims.

In the drawings—

Fig. 1 is a diagrammatic view illustrating the general arrangement of web guiding mechanism in accordance with the invention for guiding the wire of a Fourdrinier paper machine;

Fig. 2 is a detail section on the line 2—2 of Fig. 3 showing the unit supporting one end of the guide roll in Fig. 1 for quick corrective movement;

Fig. 3 is an end view of the cylinder unit of Fig. 2;

Fig. 4 is a detail section on the line 4—4 of Fig. 5 showing the cylinder unit supporting the opposite end of the guide roll in Fig. 1 for slow corrective movement;

Fig. 5 is an end view of the cylinder unit of Fig. 4;

Fig. 6 is a fragmentary elevational view of the feeler unit for the web guiding mechanism looking from the back towards the web;

Fig. 7 is a side elevational view looking from right to left in Fig. 6;

Figs. 8 and 9 are fragmentary views illustrating the operation of a different type of secondary valve for the web guiding mechanism;

Figs. 10 and 11 are fragmentary diagrammatic views illustrating the operation of another type of secondary valve;

Fig. 12 is a fragmentary diagrammatic view illustrating a double acting primary valve for use with a single feeler palm in the web guiding mechanism of the invention;

Fig. 13 is a diagrammatic view illustrating an arrangement of web guiding mechanism in accordance with the invention wherein the quick acting support and the slow acting support for the guide roll are both located at the same end of the roll;

Fig. 14 is a diagrammatic view illustrating a modification of the arrangement of Fig. 13;

Fig. 15 is a diagrammatic view illustrating another modification of the arrangement of Fig. 13;

Fig. 16 is a fragmentary section on the line 16—16 of Fig. 15; and

Fig. 17 is a diagrammatic view illustrating still another modification of the arrangement of Fig. 13.

Referring to the drawings, which illustrate preferred embodiments of the invention, Fig. 1 shows diagrammatically a web guiding mechanism of the general type shown in Staeger, 2,484,473, issued October 11, 1949, and assigned to the same assignee as the present application. In Fig. 1, the wire 20 of a Fourdrinier paper machine is shown as traveling in the direction indicated by the arrow 21 over a guide roll 22 adjacent the couch roll 24 driven by a motor 25 through a belt and pulleys indicated generally at 26. The guide roll 22 is mounted for shifting movement generally parallel to the desired direction of travel of the wire to correct lateral movement of the wire out of its desired path, and both the shifting means for the web and the sensing means for actuating the shifting means are shown as operated entirely by air pressure.

One journal 29 of the guide roll 22 is supported by a piston 30 in a double acting air cylinder 32, the journal 29 being provided with a swivel mounting 33 on piston 30, and the cylinder 32 contains springs 34 and 35 normally biasing piston 30 to a neutral position disposed centrally of the cylinder. The other journal 39 of guide roll 22 is supported by a piston 40 in a cylinder 42, and the journal is provided with a swivel mounting 43 on piston 42. A screw 44 is journaled in the ends of piston 42 and is threaded through the piston 40 to cause reciprocating movement thereof as the screw is rotated, and the screw 44 is driven by a reversible air motor 45 through a speed reduction unit 46 and a belt and pulleys indicated generally at 47.

The cylinder 32 and air motor 45 are controlled by a pair of secondary air valves 50 and 51 arranged for alternative operation to cause simultaneous movement of pistons 30 and 40 in linearly opposite directions. The secondary valves 50 and 51 are in turn actuated by primary or pilot air valves 52 and 53 respectively of the three-way type which are mounted on opposite sides of wire 20, and all of these valves are shown as supplied with pressure air from a common main air valve 55.

The secondary air valve 50 includes a double ended piston 60 having a central portion of reduced diameter, and this valve is connected at 61 with the main air valve 55 and at 62 with its associated primary valve 52. A line 63 connects the interior of valve 50 with one end of the cylinder 32, and another line 64 leads from air line 63 to the air motor 45. The valve 50 is also provided with an exhaust outlet 65, and a spring 66 is shown as arranged to bias piston 60 normally to a position shutting off the pressure from the pressure inlet 61 to the line 63 and connecting the line 63 directly with the exhaust outlet 65. When piston 60 moves against spring 66 to open valve 50, a direct pressure connection is completed from

inlet 61 to line 63 and hence to the cylinder 32 and also through line 64 to the air motor 45.

The secondary air valve 51 is of similar construction, including a similar piston 70, pressure connection 71, connection 72 to the associated primary valve 53, and a line 73 to the opposite end of the cylinder 32 from the line 63. Also a line 74 leads from line 73 to the air motor 45 to rotate the latter in the opposite direction from the air pressure supplied through line 63, and the valve 51 is provided with an exhaust outlet 75 and a spring 76 operating on piston 70 in the same manner as described for the spring 66 and piston 60.

The primary or pilot valve 52 for secondary valve 50 also includes a double ended piston 80, and it is connected at 81 with the main air valve 55. An outlet 82 from valve 52 connects with the line 62 to secondary valve 50, and valve 52 also has an exhaust outlet 83. The valve piston 80 is connected by rod 84 to a feeler palm 85 which is pivoted at 86 in position to engage the edge of the wire 20 if the latter should shift out of its desired straight line path by a predetermined relatively small amount, for example $\frac{1}{2}$ inch. A counterbalance such as the spring indicated at 87 normally biases the palm 85 toward the wire, and a stop such as shown at 88 may be used to establish a neutral position for palm 85. The primary valve 53 for secondary valve 51 is similar in construction to valve 52 as described, and it includes a double ended piston 90, a pressure connection 91 with main air valve 55, an outlet 92 connecting with the line 72 to secondary valve 51, and an exhaust outlet 93. The piston rod 94 is connected with a feeler palm 95 pivoted at 96 and provided with a counterbalance 97 and stop 98 similar to the corresponding parts for palm 85.

In operation with this arrangement, so long as the wire 20 runs in a straight path without contact with either of the palms 85 and 90, the guide mechanism remains at rest, with the piston 30 in neutral position and air motor 45 not in operation. If wire 20 should depart from its straight path, for example to the left as viewed in Fig. 1, as soon as it pushes palm 85 the small increment necessary to shift piston 80 to the open position of valve 52 in which the pressure inlet 81 will connect with pressure outlet 82, the air pressure will be transmitted through line 62 to secondary valve 50 and against the end of piston 60, forcing the latter against spring 66 and opening the connection for air pressure through inlet 61 and line 63 to cylinder 32. The piston 30 will accordingly be immediately shifted against spring 35, in the direction opposite to arrow 21, thus shifting guide roll 22 into a position at an angle to the wire and causing the latter to move to the right as viewed in Fig. 1. The piston will hold this shifted position only as long as the wire is in contact with palm 85, and as soon as the palm is moved back and the valve piston 80 is in the position shown in Fig. 1, the pressure in valve 50 and in piston 32 will be relieved, and since the piston 32 will then be connected to the exhaust outlet 65 of valve 50, piston 30 will return to its neutral or centered position.

At the same time the air pressure is supplied to the cylinder 32, it is also supplied through the line 64 to the air motor 45 to cause the latter to rotate the screw 44, and the arrangement of the gearing and driving is such that screw 44 will rotate in the direction to cause the piston 40 to move in the opposite direction linearly with respect to piston 30, i. e., upwardly as viewed in Fig. 1, but in the same direction in an angular sense. The motor 45 operates only so long as the valves 50 and 52 remain open, which is ordinarily a very short interval lasting only until the corrective movement of the guide roll 22 effected by the stroke of piston 30 has caused the wire to shift out of contact with the palm 85. The piston 30 then immediately returns to its neutral position and motor 45 stops, but the piston 40 will remain in its new or moved position. It will also be seen that if the initial movement of the wire is to the right from its proper path

as viewed in Fig. 1, and thus into contact with the palm 95, the reverse operation would take place, with the valves 53 and 51 opening to admit air to cylinder 32 and motor 45 in such manner as to shift piston 30 upwardly as viewed in Fig. 1 and to cause motor 45 to rotate in the direction to move piston 40 downwardly.

This web guiding mechanism has another important advantage in addition to its above operating characteristics which is that air pressure can be applied to the operating parts thereof in both directions simultaneously without causing damage and without permitting the wire to run off the rolls. This is particularly important in the event that one valve should temporarily become stuck or inoperative in open piston and fail to close after the wire has moved out of contact with the associated palm. In such case, the wire would move to the opposite side and actuate the other palm and valves, thus admitting air pressure to both ends of cylinder 32 simultaneously and also applying pressure in both directions to the air motor 45. The opposed pressures in cylinder 32 would counteract each other so that piston 30 would return promptly to its centered position, and motor 45 would stop as a result of the balanced opposed pressures applied thereto, thus maintaining the guide roll 22 in the position it would normally have with the wire running straight. The wire thus would run reasonably straight for at least a sufficient interval to permit the operator to observe the defective valve condition and take steps to correct it before the wire could begin to run off the rolls.

Fig. 1 also shows the air guide mechanism provided with auxiliary palms for emergency operation in the event that the wire should move too far in one or the other direction laterally without being corrected for, as in the case of failure of the air pressure or other defective condition. These emergency palms 100 and 101 are shown as mounted laterally outside of the palms 85 and 95, for example $\frac{1}{2}$ inch further from the wire, for operation by the wire only in the event of failure of the air system to respond with sufficient rapidity upon actuation of either of palms 85 or 95. Each of the emergency palms 100 and 101 is shown as pivoted at 102 and provided with a spring counterbalance 103 and stop 104 similar to the corresponding parts for the palms 85 and 95.

Each of the palms 100 and 101 is also shown as operating to control one of a pair of microswitches 105 which may be connected in different ways as desired to effect emergency control of other parts of the paper machine. Fig. 1 shows the switches 105 as connected diagrammatically at 110 with the main air valve 55 to cut off the air pressure supply to the web guide, as may be readily done with the valve 55 of the solenoid operated type. Also, the switches 105 are shown diagrammatically at 111 as connected to shut off the drive motor 25 for couch roll 24, and they may also be connected at 112 with an audible or visual alarm such as is represented by the bell 115 in Fig. 1. Thus whenever the wire guide fails to respond with sufficient rapidity, as might happen for example in the event of failure of the air pressure, the emergency palms and associated switches will operate to prevent the wire from running off the rolls or other damage resulting from failure of the wire to run straight.

It is important for optimum results with the web guide of the invention that the piston 30 be returned to an accurately centered neutral position in cylinder 32 when the air pressure is cut off, and Figs. 2 and 3 show a cylinder unit of special construction for this purpose. The cylinder 120 corresponds to the cylinder 32 and is provided with end covers 121 bolted thereto and fitted at 122 for attachment to the air pressure lines from the associated secondary valves. The piston 125 corresponds to piston 30 and carries a swivel mounting 126 for the journal 29 of the guide roll 22, the cylinder 120 being slotted at 127 for movement of the swivel with

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piston 125. At each end of piston 125 is a relatively heavy spring 130 corresponding to the springs 34 and 35 in Fig. 1, and each spring is retained between the inner surface of the end cover 121 of the cylinder and the head of a plunger 131 extending into a bore 132 in each end of the piston.

The springs 130 are preloaded and accurately adjusted to balance each other by means of nuts 133 on the outer ends of plungers 131, the nuts and plungers being locked together by lock screws 134 after adjustment, and the end covers 121 have removable caps 135 for access to nuts 133. Thus when air pressure is applied to one end of the piston, it is moved against the spring 130 at its opposite end, but the other spring is held against expansion beyond the limit permitted by its associated stud 131 and nut 133, and when the pressure is released, the compressed spring expands until piston 125 returns to its centered position defined by the two plungers and springs. The springs 130 are accordingly preferably preloaded to a sufficient extent to assure this return movement of the piston to its centered position irrespective of friction or other normal resistance thereto, for example a preloading to about 1500 pounds in the fully expanded position permitted by the plungers 131 and stop nuts 133.

Figs. 4 and 5 show in detail a cylinder unit suitable for use as the cylinder 42 of Fig. 1. It includes a cylinder 140 having end covers 141 in which a screw 142 is rotatably supported by bearings 143, and the journal 144 of screw 142 extends through one end cover 141 to receive a pulley 145 for connection with the drive as indicated at 47 in Fig. 1. The piston 150 corresponds to piston 40 in Fig. 1 and carries a swivel 151 for the journal 39 of guide roll 22. The cylinder 140 is slotted at 152 to guide piston 150 for longitudinal movement within the cylinder while preventing rotation thereof. Adequately frictionless operation of the piston is obtained with cylinder 140 filled with lubricating oil, and piston 150 is shown as provided with suitable passages 153, 156 and 157, for properly distributing this oil as the piston moves within the cylinder.

Figs. 6 and 7 show in detail a suitable mounting unit for one of the primary air valves and feeler palms in the web guiding mechanism of Fig. 1. The pilot valve 160 is mounted within a housing comprising a front panel 161, sides 162, back panel 163, a top 164 and a bottom 165. The tube 166 connects the valve with the air pressure supply and corresponds to the connection 81 in Fig. 1, and the outlet for connecting this valve to its associated secondary valve is indicated at 167 and corresponds to the outlet 82 in Fig. 1. The main palm 170 is supported by a bar 171 pivoted on a pin 172 extending laterally from a bracket 173 on the front panel 161 of the housing, and the bar 171 is pivoted at 174 to the piston rod 175 corresponding to the rod 84 in Fig. 1. The palm 170 is pivoted at 176 to rod 171 and is provided with a torsion spring 177 and stop 178 cooperating to maintain the palm and rod normally in alignment while permitting the palm to pivot on the rod, clockwise as viewed in Fig. 7, to prevent injury from excessive lateral movement of the web. Instead of a spring counterbalance, the rod 171 is provided with an adjustable counterweight 180 on an arm 181, and the stop for limiting movement of the palm toward the wire comprises a bracket 182 on bracket 173 provided with an adjustable stop bolt 183.

The emergency palm 185 is carried by a rod 186 pivoted on a shaft 187 extending laterally from the casing of the micro-switch 190 corresponding to either of the switches 100 or 105 in Fig. 1 and carried by an angle 191 bolted to the bracket 173. The rod 186 may be arranged in any convenient way as indicated diagrammatically in Fig. 1 to operate the switch 190 when the wire engages palm 185 as described in connection with Fig. 1. This unit may accordingly be readily mounted

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in a desired location adjacent the wire or other web to be guided and connected as indicated in Fig. 1 with its associated secondary air valve and other equipment. Also, with both the main and emergency palms thus carried by the same support within a common housing, the entire unit may be readily shifted or adjusted as required to the proper operating clearance of both palms with respect to the normal position of the adjacent edge of the web.

Figs. 8 and 9 illustrate diagrammatically the operation of a somewhat different form of secondary valve which may be used in place of either of the valves 50 or 51 and which is completely air actuated and not spring loaded. In Figs. 8 and 9 the primary valve is shown as of the same construction and arrangement as the valve 52 in Fig. 1, except that the palm 85 is provided with a counterweight 87a in place of the spring 87. The secondary valve 200 has a double ended piston therein comprising a large end 201, a small end 202 and an intermediate section 203 of smaller diameter than the end 202. The valve 200 is connected at 205 to a source of air pressure, such as the valve 55 in Fig. 1, and the line 206 is adapted for connection to the cylinder 32. A line 207 leads from the primary valve 52 to valve 200 supporting the large end 201 of the piston, and valve 200 is vented at 208 adjacent the small end 203 of the piston.

Fig. 8 shows the valve 200 in its closed position, and Fig. 9 shows the open position thereof for operation of cylinder 32. In the position of Fig. 8, the air pressure applied at 205 is effective against both ends of the piston, but because of the different sizes of the two piston ends, it forces the piston to the left, closing the outlet 206. When the air pressure is applied through line 207 from the primary valve, the pressure against the inner surface of the piston end 201 will be overcome, and the piston will be moved to the right as shown in Fig. 9, opening the direct connection from the inlet 205 to the outlet 206. When the primary valve closes, the passage 81, and at the same time connects passage 207 to exhaust, the unbalanced piston areas will again cause movement of the piston to the left and back to the position of Fig. 8.

Figs. 10 and 11 show another construction of primary and secondary valves suitable for use in the web guide mechanism of Fig. 1. The secondary valve 210 is generally similar to valve 200, including a double ended piston having a large end 211, a small end 212 and a still smaller intermediate section 213. The valve 210 also has an inlet connection 215 opposite the small end of the piston from the main source of air pressure, an outlet 216 for connection to cylinder 32, and an exhaust outlet 218. Valve 210 is also provided with a connection 220 supporting the larger end 211 of the piston which leads directly from the main source of air pressure and is provided with a constriction from an orifice 221. A nozzle 222 leads from the line 220 between the orifice 221 and valve 210, and the end of this nozzle is normally closed by a flapper 225 which is pivoted at 226 and carries a feeler palm 227 and a counterweight 228.

This bleeder arrangement of the nozzle, orifice and flapper acts as a pilot to control valve 210. In the normal position of the parts the flapper 225 is held in closed position against the end of nozzle 222 by counterweight 228, and thus the air pressure against large end 211 of the piston forces it to its position closing the pressure inlet 215 and providing an open connection from outlet 216 to the exhaust outlet 218. When the wire 20 engages palm 227 and forces the flapper 225 away from the end of the nozzle, the incoming pressure air will be able to discharge from the nozzle at a faster rate than that at which it comes in through orifice 221. As a result, there is a pressure drop supporting the large end 211 of the piston, and the full air pressure against the small piston end 212 forces the piston to the left as shown in Fig. 11, thus shutting off the exhaust outlet 218 and

providing a direct connection from the pressure inlet 215 to the outlet connection 216 to the cylinder 32. When the flapper again closes after the wire has moved away from the palm, the reverse operation takes place, and the pressure builds up against the larger end of the piston until it forces the piston back into its closed position shown in Fig. 10.

Fig. 12 shows an arrangement of pilot valve 230 suitable for use in the web guide mechanism of Fig. 1, with a single feeler palm 232 for correcting sidewise movement of the wire 20 in either direction, the valve 230 being of the four-way type as compared with the three-way type in Fig. 1. The palm 232 is pivoted at 233 and provided with a spring 235 of such strength as to maintain the palm in contact with the wire at all times but with this spring being sufficiently light to avoid exerting any appreciable lateral bias against the wire. The valve 230 is provided with a single pressure inlet 240, which may come from the main air valve 55 in Fig. 1, but it has two pressure outlet lines 241 and 242, with the line 241 being adapted for connection with secondary valve 50 in Fig. 1 and the line 242 similarly adapted for connection with the primary valve 51 in Fig. 1.

In operation, the double ended piston 245 normally closes both outlets to the air pressure but permits exhaust from the secondary valve, and it will remain in this position since the air pressure is balanced against the inner surface of both ends thereof. If the wire should move in either direction, the feeler 232 will move with it, thus shifting the piston accordingly and opening a connection to the proper one of the outlet lines 241 and 242. This sensing unit may accordingly be used in place of the two primary valves and feeler palms in Fig. 1 without change of the other parts therein and will operate to effect correction of sidewise movement of the wire in the same manner as described in connection with Fig. 1.

Figs. 13 to 17 show several alternative arrangements of web guiding mechanism in accordance with the invention which are constructed for mounting entirely on one side of the web, and which offer all the advantages of the other arrangements as described while also requiring considerably less piping as well as being more readily serviced as a result of their centralized location. In each of these arrangements, one end of the guide roll 250 is provided with a simple swivel mounting at 252 arranged to permit pivotal movement of the roll about a fixed axis. At the other end of the guide roll are located both a fluid pressure cylinder unit as described for effecting quick corrective movement of the guide roll and also a fluid pressure motor unit for effecting a small retained corrective movement.

Thus referring to Fig. 13, the movable end of the guide roll is shown as supported by a swivel mounting 253 on the piston 260 in a cylinder 261 which corresponds to the cylinder 32 as described and is provided with springs 262 for biasing cylinder 260 to the desired neutral position. The cylinder 261 is mounted in tandem relation with a frame 265 which corresponds to the cylinder 42 in Fig. 1 and supports a piston or other movable member 266 for slow reciprocating movement effected by a screw 267 driven by a fluid pressure motor 270 through a speed reduction unit 271 and a belt drive 272. The cylinder or frame 265 in this arrangement is stationary, and the cylinder 261 is mounted for movement with the movable member 266 by means such as the yoke arms 275 which straddle frame 265 and are connected to member 266 by pins 276 slidable in slots 277 in the side of the frame.

As shown in Fig. 13, the cylinder 261 and motor 270 are provided with air pressure lines arranged in the same manner as for the corresponding parts in Fig. 1 for operation by primary and secondary control valves as described above. Thus whenever the web moves to such extent as to cause actuation of either of the secondary

valves, pressure will be applied simultaneously to both the cylinder 261 and the motor 270 in such manner as to cause simultaneous movement of the piston 260 and the movable member 266 in the same direction, and not in linearly opposite directions as is the case when the cylinder unit and motor unit are mounted at opposite sides of the web. There will therefore be an immediate corrective movement of piston 260 in cylinder 261, and at the same time the motor will move the movable member 266 and through it the cylinder 261 itself. Accordingly, when the pressure is discontinued, the piston 260 will return to its centered position in cylinder 261, but the cylinder itself will be in a new or moved position to provide the desired retained effective movement of the end of the guide roll as in the other forms of the invention already described.

Fig. 14 shows an arrangement generally similar to that of Fig. 13 except that it is the cylinder 261 which is mounted in stationary position, while the cylinder or frame 265 is mounted for movement with the piston 260. Thus the frame 265 is shown as provided with yoke arms 280 connected with piston 260 by pins 281 slidable in slots 282 in the wall of the cylinder 261. The operation of this form of the invention is the same as that described in connection with Fig. 13 except that since cylinder 261 is stationary, the rapid corrective movement of piston 260 will cause similar movement of the frame 265, while at the same time the movable member 266 will be driven at its slow rate within frame 265 so that when pressure is relieved, the frame 265 will return to its previous position but the member 266 will in the meantime have moved therein to a new position establishing the desired retained corrective movement of the guide roll.

Figs. 15 and 16 show another arrangement similar to that shown in Fig. 13 except that the cylinder 261 is mounted directly on the cylinder or frame 265 for movement with the movable member 266, and the swivel 255 is mounted on piston 260 in substantially the same manner as shown for the corresponding parts in Fig. 2. The bottom side of cylinder 261 is provided with a slide portion 285 slidable in a complementary track portion 286 in the upper side of frame 265. Also, a pin 287 connects the movable member 266 with the cylinder 261 and is slidable in a slot 288 in the upper wall of frame 265. The operation of this arrangement is substantially identical with that already described in connection with Fig. 13.

Fig. 17 shows an arrangement which is effectively the converse of that shown in Figs. 15 and 16 in that the cylinder 261 is stationary and has the cylinder or frame 265 mounted directly thereon, as by means of the same general track arrangement shown in Fig. 16 and indicated at 290. The connection between the frame 265 and piston 260 is formed by a pin 291 set in the piston and slidable in a slot 292 in the upper wall of cylinder 261. The operation of this arrangement is accordingly substantially the same as that described in connection with Fig. 14.

Any of the arrangements shown in Figs. 13 to 17 may be employed wherever it is desired to locate all of the web guiding mechanism at one side of the web, and such arrangements may provide substantial economies with respect to the piping and connections required for conducting the pressure fluids to and from the several operating parts, as well as materially facilitating servicing as a result of the localization of the several portions of the apparatus. With any of these arrangements, any of the illustrated forms of pilot valves may be used as already described, and in particular it will be noted that complete localization of the web guide mechanism at one side of the web will be effected by employing the four-way type of pilot valve illustrated in Fig. 12, since this type of valve requires only a single palm and may therefore be mounted on the same side of the web with the operating parts of the web guiding mechanism, thus fur-

ther reducing the required length of piping and further facilitating maintenance.

While the forms of apparatus herein described constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to these precise forms of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. Apparatus for maintaining a traveling web in a predetermined desired path of travel, comprising a guide roll extending generally transversely of said path of travel and in running contact with said web, a cylinder substantially parallel with said path, a piston reciprocable in said cylinder, means supporting one end of said roll on said piston for movement therewith to change the angular relation between said roll and said path, means biasing said piston to a neutral position intermediate the ends of said cylinder, a support for the other end of said roll movable parallel with said piston, means including a reversible fluid pressure motor for effecting movement of said support at a predetermined slow rate, means including a first valve for supplying fluid pressure simultaneously to said cylinder and to said motor to cause movement of said piston in one direction and operation of said motor in the direction to move said support in the opposite direction linearly from said piston, means including a second valve for simultaneously supplying fluid pressure to said cylinder and to said motor in the opposite direction from said first valve to cause movement of said piston and support in the reverse directions from said first valve, each of said valves including a movable member operable by fluid pressure, sensing means including at least one feeler member positioned for actuation by said web upon lateral movement thereof from said desired path, and means controlled by said sensing means for selectively applying fluid pressure to one or the other of said valves to operate said movable member therein.

2. Apparatus for maintaining a traveling web in a predetermined desired path of travel, comprising a guide roll extending generally transversely of said path of travel and in running contact with said web, a cylinder substantially parallel with said path, a piston reciprocable in said cylinder, means supporting one end of said roll on said piston for movement therewith to change the angular relation between said roll and said path, a spring within each end of said cylinder for biasing said piston in opposite directions, stops limiting the biasing action of said springs to establish a predetermined neutral position of said piston substantially equidistant the ends of said cylinder, selectively operable means including a valve for applying fluid pressure to either end of said support to effect rapid movement thereof against said biasing means, a support for the other end of said roll movable substantially parallel with said piston, means including a reversible fluid pressure motor for effecting movement of said support at a predetermined slow rate, means for sensing a departure of said web from said path, and a control operated by said sensing means for actuating said pressure applying means to effect application of pressure to said piston and for simultaneously applying fluid pressure to said motor to cause said rapid movement of said piston and said one end of said roll in the direction to correct the path of travel of said web and simultaneously to operate said motor in the direction to cause said support and the other end of said roll to move at said slow rate in the opposite direction linearly with respect to said piston.

3. Apparatus for maintaining a traveling web in a predetermined desired path of travel, comprising a guide roll extending generally transversely of said path of travel and in running contact with said web, a cylinder substantially parallel with said path, a piston reciprocable in said cylinder, means supporting one end of said roll on said piston for movement therewith to change the angu-

lar relation between said roll and said path, a spring within each end of said cylinder for biasing said piston in opposite directions, stops limiting the biasing action of said springs to establish a neutral position of said piston, a support for the other end of said roll movable parallel with said piston, means including a reversible fluid pressure motor for effecting movement of said support at a predetermined slow rate, means including a first valve for supplying fluid pressure simultaneously to said cylinder and to said motor to cause movement of said piston in one direction and operation of said motor in the direction to move said support in the opposite direction linearly from said piston, means including a second valve for supplying fluid pressure simultaneously to said cylinder and to said motor in the opposite direction from said first valve to cause movement of said piston and support in the reverse directions, each of said valves including a movable member operable by fluid pressure, sensing means including at least one feeler member positioned for actuation by said web upon lateral movement thereof from said desired path, and means controlled by said sensing means for selectively applying fluid pressure to one or the other of said valves to operate said movable member therein.

4. Apparatus for maintaining a traveling web in a predetermined desired path of travel, comprising a guide roll extending generally transversely of said path of travel and in running contact with said web, a cylinder substantially parallel with said path, a piston reciprocable in said cylinder, means supporting one end of said roll on said piston for movement therewith to change the angular relation between said roll and said path, a spring positioned within each end of said cylinder for biasing said piston in opposite directions, a plunger located within each end of said cylinder and including a head position adapted to engage said piston, the opposite end of said plunger forming a seat for one end of the associated said spring, end covers on said cylinder forming seats for the opposite ends of said springs, each said plunger extending movably through the adjacent said cover, outer end members mounted on said plungers for engagement with said covers to form stops limiting the movement of said plungers toward said piston, said outer end members being adjustable on said plungers to effect preloading of said springs establishing an accurately predetermined neutral position for said piston in said cylinder, means for sensing a departure of said web from said path, and a control operated by said sensing means for applying fluid pressure to one or the other end of said cylinder to cause movement of said piston against one of said springs for shifting said one end of said roll in the direction to correct the path of travel of said web.

5. Apparatus for maintaining a traveling web in a predetermined desired path of travel, comprising a guide roll extending generally transversely of said path of travel and in running contact with said web, a cylinder substantially parallel with said path, a piston reciprocable in said cylinder, means supporting one end of said roll on said piston for movement therewith to change the angular relation between said roll and said path, means biasing said piston to a neutral position intermediate the ends of said cylinder, a support for the other end of said roll movable parallel with said piston, means including a reversible fluid pressure motor for effecting movement of said support at a predetermined slow rate, a pair of pressure actuated control valves for supplying fluid pressure simultaneously to said cylinder and to said motor, connections from said valves to said cylinder and said motor to cause simultaneous movement of said piston in one direction and operation of said motor in the direction to move said support in the opposite direction linearly from said piston upon the opening of one of said valves and to cause movement of said piston and operation of said motor in the reverse directions upon the opening of the other said valve, and

an actuating unit associated with each of said valves for sensing movement of said web laterally from said path, each said sensing unit including a pilot valve adapted to open to supply actuating pressure to the associated said control valve and a feeler member for operating each said pilot valve mounted for actuation by said web upon lateral movement thereof from said path.

6. Apparatus maintaining a traveling web in a predetermined desired path of travel, comprising a guide roll extending generally transversely of said path of travel and in running contact with said web, a cylinder substantially parallel with said path, a piston reciprocable in said cylinder, means supporting one end of said roll on said piston for movement therewith to change the angular relation between said roll and said path, means biasing said piston to a neutral position intermediate the ends of said cylinder, a support for the other end of said roll movable parallel with said piston, means including a reversible fluid pressure motor for effecting movement of said support at a predetermined slow rate, a pair of pressure actuated control valves connected respectively to supply pressure to opposite ends of said cylinder for effecting movement of said piston, a connection from each said control valve to said motor for simultaneously supplying fluid pressure for operation of said motor in the direction to move said support in the opposite direction linearly from said piston, means normally maintaining said control valves in closed position, a pilot valve for supplying actuating pressure to each said control valve, a feeler member for operating each said pilot valve mounted for actuation by said web upon lateral movement of said web from said path, and means normally maintaining said feeler member in neutral position with said pilot valve closed.

7. Apparatus for maintaining a traveling web in a predetermined desired path of travel, comprising a guide roll extending generally transversely of said path of travel and in running contact with said web, a cylinder substantially parallel with said path, a piston reciprocable in said cylinder, means supporting one end of said roll on said piston for movement therewith to change the angular relation between said roll and said path, means biasing said piston to a neutral position intermediate the ends of said cylinder, a support for the other end of said roll movable parallel with said piston, means including a reversible fluid pressure motor for effecting movement of said support at a predetermined slow rate, a pair of pressure actuated control valves connected respectively to supply pressure to opposite ends of said cylinder for effecting movement of said piston, a connection from each of said control valve to said motor for simultaneously supplying fluid pressure for operation of said motor in the direction to move said support in the opposite direction linearly from said piston, means normally maintaining said control valves in closed position, a pilot valve for supplying actuating pressure to said control valves, said pilot valve having a neutral position and being adapted upon movement from said neutral position in either direction to supply actuating pressure to one or the other said control valve, a feeler member for operating said pilot valve mounted for actuation by said web, means biasing said feeler member into engagement with said web for movement with said web to open said valve upon lateral movement with said web, and means for locating said feeler member in a neutral position maintaining said pilot valve in said neutral position when said web is traveling in said path.

8. Apparatus for maintaining a traveling web in a predetermined desired path of travel comprising a guide roll in running contact with said web, means mounting one end of said roll for pivotal movement about a fixed

axis, a linearly movable support for the other end of said roll, a fluid pressure cylinder adjacent said movable support and forming a first frame, a piston forming a movable member reciprocable in said cylinder, means biasing said piston member to a neutral position in said cylinder, a second frame adjacent said cylinder, a second movable member reciprocable in said second frame in the same direction as said piston, means including a reversible fluid pressure motor for effecting movement of said second movable member at a predetermined slow rate, said frames being arranged one in stationary position and the other for movement with the one of said movable members in said stationary same, means connecting said movable support to the other of said movable members for movement therewith with respect to said movable frame, means for sensing a departure of said web from said desired path of travel, and means controlled by said sensing means for effecting application of fluid pressure to both said cylinder and said motor to cause rapid movement of said piston and slow movement of said second movable member in the direction to provide a substantial temporary movement of said movable support in the direction to correct the path of travel of said web during application of pressure to said cylinder and also to provide a small retained movement of said movable member in said correcting direction.

9. Apparatus for maintaining a traveling web in a predetermined desired path of travel, comprising a guide roll extending generally transversely of said path of travel and in running contact with said web, a cylinder substantially parallel with said path, a piston reciprocable in said cylinder, means supporting one end of said roll on said piston for movement therewith to change the angular relation between said roll and said path, means biasing said piston to a neutral position intermediate the ends of said cylinder, an additional support for one end of said roll movable parallel with said piston, means including a reversible fluid pressure motor for effecting movement of said movable support at a predetermined slow rate, means including a first valve for supplying fluid pressure simultaneously to said cylinder and to said motor to cause movement of said piston in one direction and operation of said motor in the direction to move said support in the proper direction to cause movement of said roll in the same angular direction as imparted thereto by the accompanying movement of said piston, means including a second valve for simultaneously supplying fluid pressure to said cylinder and to said motor in the opposite direction from said first valve to cause movement of said piston and support in the reverse directions from said first valve, each of said valves including a movable member operable by fluid pressure, sensing means including at least one feeler member positioned for actuation by said web upon lateral movement thereof from said desired path, and means controlled by said sensing means for selectively applying fluid pressure to one or the other of said valves to operate said movable member therein.

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