United States Patent

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[54] **WEB GUIDE USING FLUID AMPLIFIER**
3 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **226/19,** 226/22
[51] **Int. Cl.** **B65h 25/18,** B65h 25/08
[50] **Field of Search** 226/22, 15, 16, 17, 18, 19, 20, 21, 23

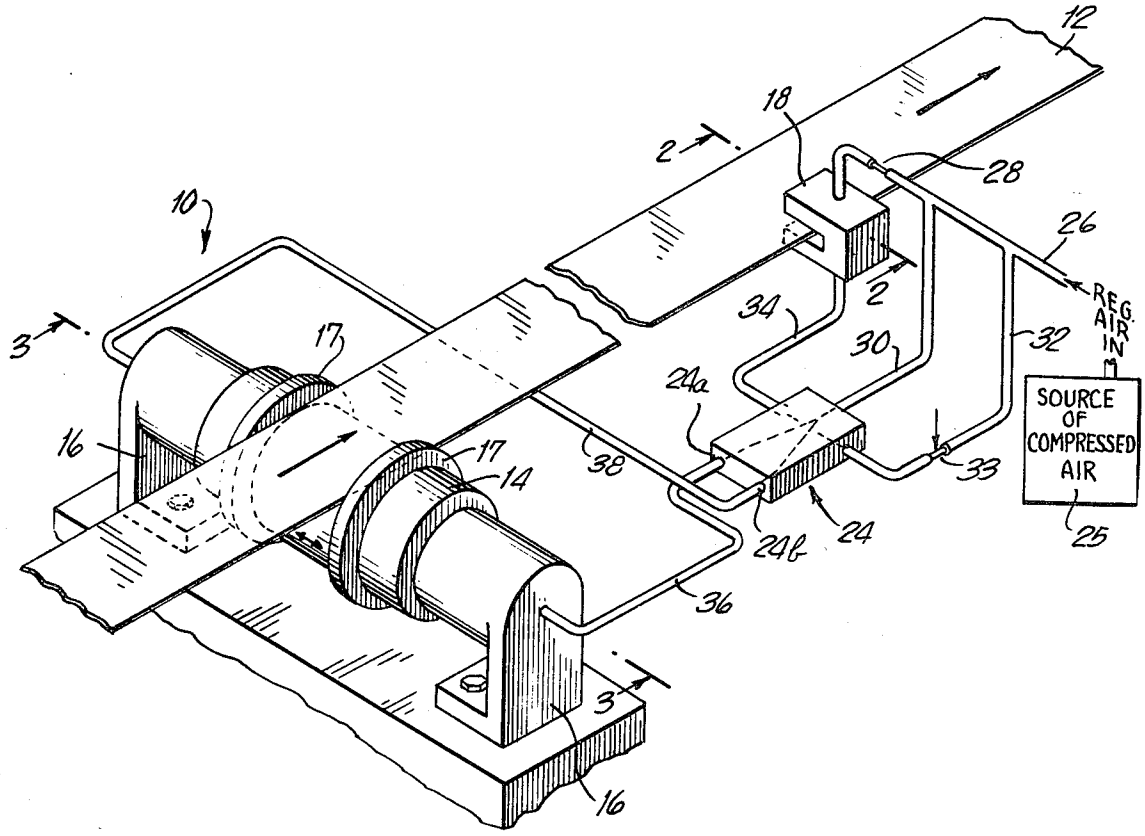
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ABSTRACT: A web shifting device, for accurately and instantaneously correcting deviations in the lateral position of a longitudinally travelling web from a normal position, including a sensing device having opposed fluid flow apertures, defining one or a plurality of fluid flow paths which are normally partially restricted by the edge of the moving web, a proportional fluid amplifier controlled by the pressures developed by variations of fluid flow in the apertures caused by the displacement of the edge of the web, and motor means controlled by the amplifier and driving a laterally movable web guide to maintain the web in its normal position.



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SHEET 1 OF 2

Fig. 1.

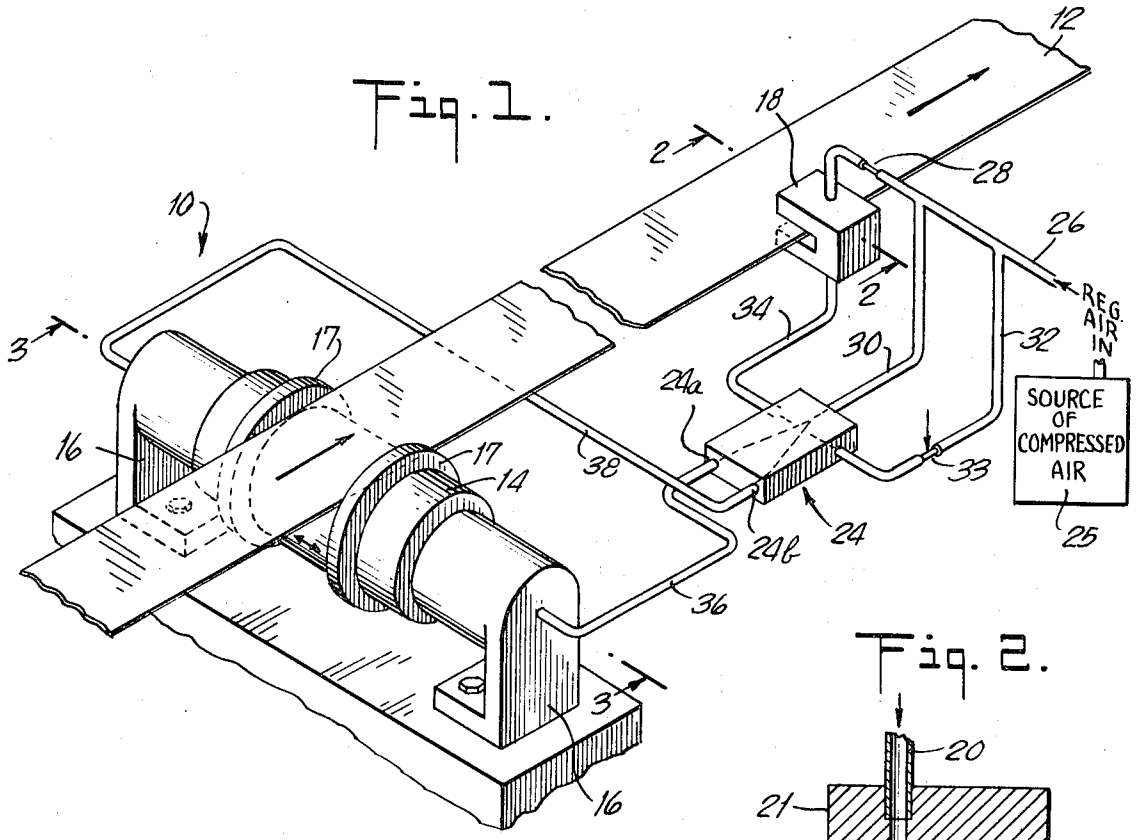
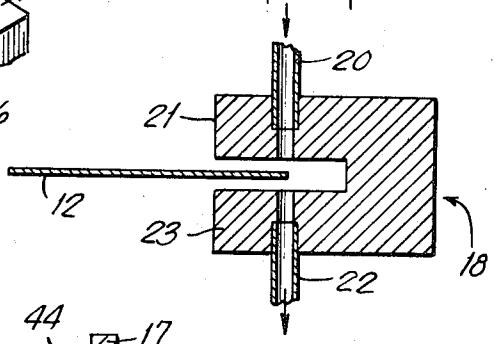


Fig. 2.



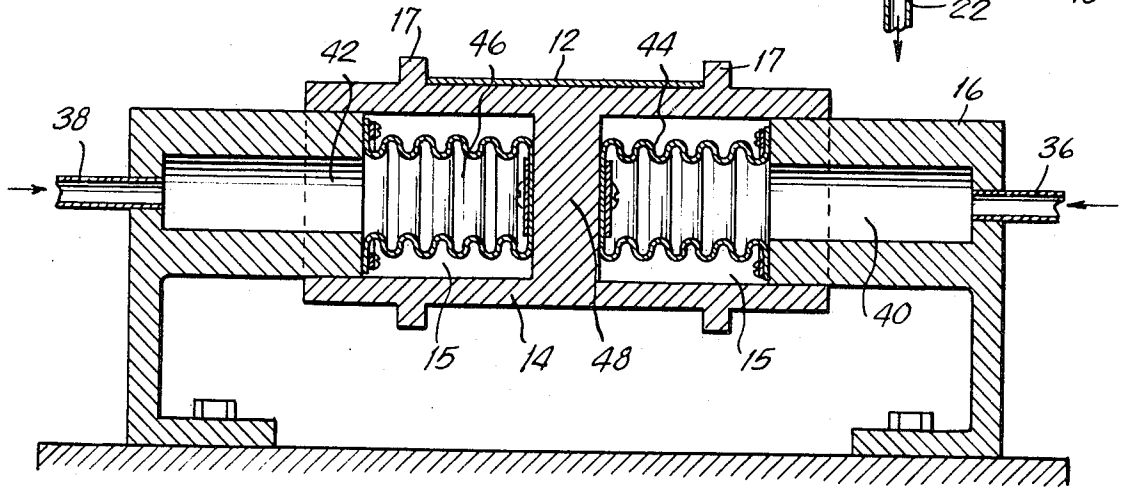


Fig. 3.

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Fig. 4.

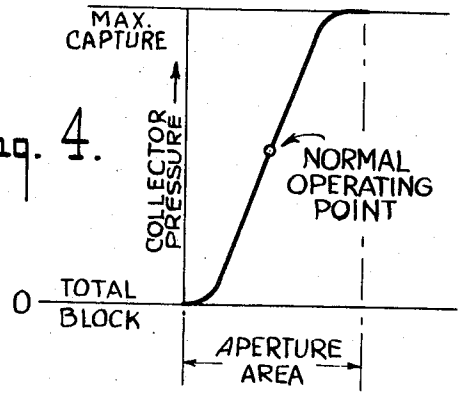
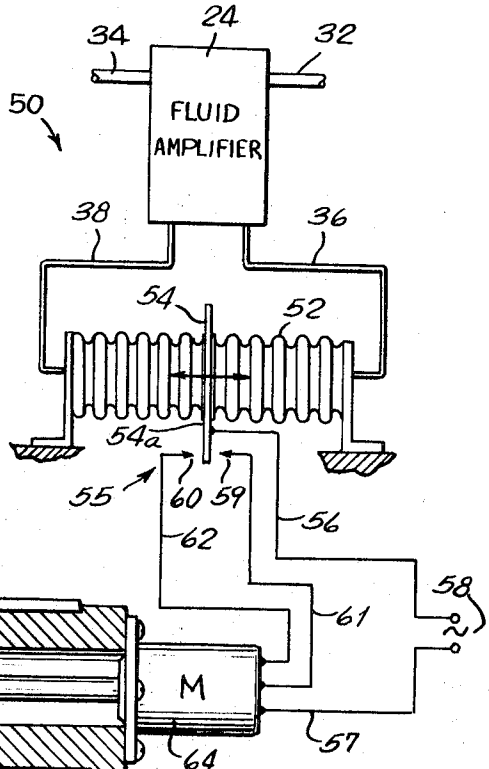
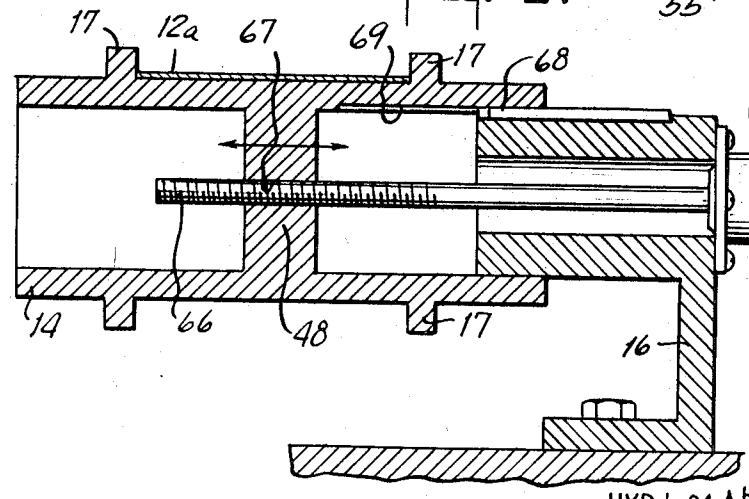


Fig. 5.





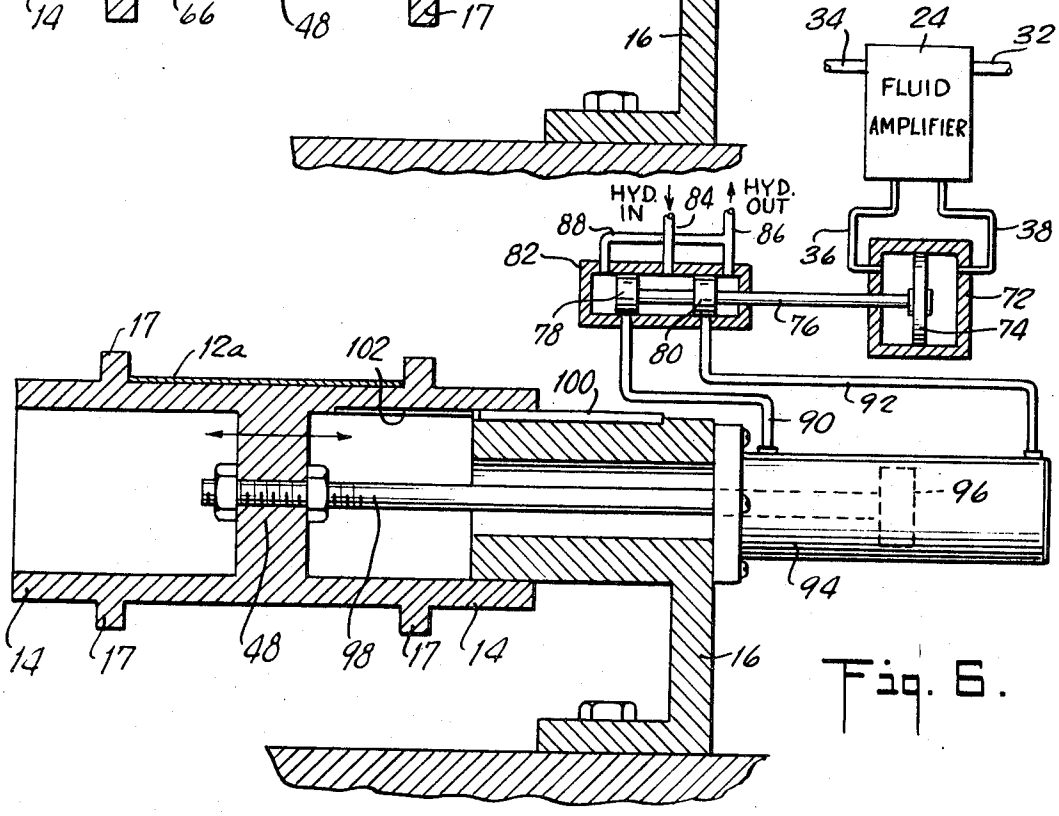


Fig. 6.

WEB GUIDE USING FLUID AMPLIFIER

BACKGROUND OF THE INVENTION

The present invention relates to a traveling web guiding apparatus and particularly to such apparatus operated by fluidic controls.

Various mechanisms have been produced in the past for maintaining a traveling web in proper alignment with a true or normal position over a long path. These devices have been effective to some extent but are generally of complex construction, and slow in reacting to deviations in web position. Yet it is essential in many cases that the web remain accurately and constantly in its normal lateral position for the entire length of an operation, such as where the web is to be split at some distance from the supply and takeup reels.

The instant invention provides an improved apparatus for laterally adjusting and guiding the position of a longitudinally traveling web accurately and instantaneously using a fluid amplifier device.

SUMMARY OF THE INVENTION

The apparatus of the present invention consists of four basic components: a pickup or sensing device including opposed fluid flow apertures which are normally partially restricted by the edge of the moving web and which detect changes in the fluid flow due to displacements in the lateral position of the moving web; a proportional fluid amplifier controlled by the fluid flow pressures developed in the apertures and being effective to increase the strength of the pressure signal from the pickup device; a motor controlled by the fluid amplifier; and a laterally movable web guide driven by the motor for correcting the path of web travel.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of an apparatus embodying the present invention;

FIG. 2 is a fragmentary sectional view taken on line 2–2 in FIG. 1;

FIG. 3 is a sectional view taken on line 3–3 in FIG. 1;

FIG. 4 is a graph showing the relationship of the pressure of the fluid flow collected in the receiver arm of the pickup device to the area of the receiver aperture which is not blocked by the web;

FIG. 5 is a sectional view, similar to FIG. 3, showing another form of apparatus embodying the invention; and

FIG. 6 is a sectional view of still another embodiment of the invention.

DETAILED DESCRIPTION

In FIG. 1 of the drawings, a comparatively light web 12, such as paper, tape, cloth, or metal foil, as compared with a heavy web, such as metal sheet, is shown passing over a movable guide 14 as the web 12 travels, for example, between supply and takeup reels (not shown). The guide 14 is slidably mounted on a pair of support members 16, so that the guide 14 is freely movable in a direction lateral to the path of travel of the moving web 12.

The normal path of the web 12 is located so that one edge of the web passes between the arms 21 and 23, of a stationary U-shaped pickup device 18. A stream of gas, usually compressed air, is directed through an aperture 20 in the supply arm 21 and flows across the space between the arms 21 and 23, and into an aligned aperture 22 in the receiver arm 23, as shown in FIG. 2. The compressed air is supplied to the aperture 20 of the pickup device 18 from a suitable source 25, through a conduit 26 with a restriction 28. The restriction 28 lowers the pressure of the flow to aperture 20 considerably below the supply pressure from source 25. The conduit 26 is also connected to a branch conduit 30 leading to the supply port of a fluid amplifier 24, and to an input conduit 32 for the amplifier 24, which input conduit contains a variable restriction 33 which functions in the manner of restriction 28. The amplifier

24 is of the proportional type and the receiver aperture 22 in the pickup device 18 is connected to its opposite input conduit 34. The supply pressure through conduit 30 then will be at the level of the source pressure while the control pressures through conduits 32 and 34 will be decreased and may be initially balanced by adjusting variable restriction 33.

One output 24*a* of the amplifier is connected through conduit 36 to a chamber 40 in one of the web guide supports 16, while the other output 24*b* is connected through conduit 38 to a similar chamber 42 in the other web guide support 16 as shown in FIG. 3. The chambers 40 and 42, respectively communicate with bellows 44 and 46, which are located in cooperating end chambers 15 in the movable web guide 14 and are rigidly attached to a central wall 48 in the web guide 14. Two circumferential flanges 17 on the outer surface of the guide 14 define the controlled path of travel of the web 12.

Turning now to the operation of the apparatus, as shown in FIG. 1, the web 12, after traveling over the web guide 14, passes through the interior of the pickup device 18. Under normal operating conditions, the edge of the web 12 covers approximately one-half the area of the receiver aperture 22, thus blocking part of the air or fluid flow from injector aperture 20. It will be seen that lateral displacement of the web 12 will cause either increased or decreased flow to the receiver aperture 22 resulting in a corresponding change in the collector pressure in the aperture 22.

The graph of FIG. 4 shows the relationship between the collector pressure and the unblocked area of the receiver aperture 22. If the web 12 deviates from its normal path, the edge will be laterally displaced, altering the amount of air recieved by aperture 22. Greater presence of the web edge in the air or fluid flow causes blockage of the flow and lesser presence of the web edge causes maximum capture of the flow, both conditions resulting in a variation in pressure in the control input conduit 34 to fluid amplifier 24. It should be apparent that fluid may be injected through both apertures 20 and 22 at different pressures with the difference in pressures being indicated in the amplifier input pipe 34.

The use of a proportional fluid amplifier permits the path of travel of the web 12 to be continuously corrected in the following manner. The air or fluid flow from source 2 passes through the amplifier 24, is split into two portions, and leaves through the outputs 36, 38. The decreased pressure flow from inputs 32, 34 controls the degree of splitting and may be adjusted so that the outputs each receive one-half the fluid flow such as by adjusting restriction 33. When the pressure signal from the pickup device 18 indicates that the web 12 has deviated from its normal path, the resulting pressure differential at the control point in the amplifier 24 causes a different splitting of the supply flow and hence different pressures in the output lines 36, 38. The increased pressure in one of the cylinders 40 or 42 in the web guide support 16 causes the appropriate bellows 44 or 46 to expand, thus pushing against the wall 48 and laterally displacing the web guide 14. For example, if the web 12 is displaced in the direction of total blockage of the receiver aperture 22, there will be a decrease in pressure in input 34. The pressure of input 32 will then cause the supply to split unequally, the bulk of the fluid entering output conduit 36. This additional fluid pressure injected into cylinder 40 by output 36 will cause bellows 44 to expand, displacing the wall 48 and hence the web guide 14 to the left. The flanges 17 on the outer surface of the guide 14 engage the web 12 and displace it accordingly. When the pressure in line 34 again returns to its balance level displacement of the guide 14 and web 12 will cease. At this point the web 12 is returned to its normal lateral position. Movement of the web 12 in the other direction will cause the system to function in the reverse manner.

Alternative means may be used for guiding traveling webs of heavier material such as metal sheet. The same pickup device and fluid amplifier is used as in the system described above but more powerful drive mechanisms for the web guide 14 are employed in view of the heavier web.

One modified embodiment is shown in FIG. 5 using an electrically operated web guide adjusting apparatus. In this embodiment the outputs 36, 38 from the fluid amplifier 24 are connected to the opposite ends of a dual bellows device 52 which is divided substantially in half by a movable wall 54. A lower extension 54*a* of the wall 54 operates as a contact plate for an electrical switch 55. A lead 56 is attached to the plate extension 54*a* and to an alternating current power supply 58. Two contacts 59 and 60 are the opposite poles of the switch 55 so that when the plate 54 is moved by pressure unbalance in the dual bellows 52, contact is made with one or the other of the two poles. Both poles 59 and 60 are connected through respective leads 61 and 62 to an electric motor 64 on the web guide support 16. Lead 57 connects the power supply 58 with the electric motor 64. The motor 64 will be operated in one direction or the reverse direction, depending on which pole is contacted.

The output shaft of the motor 64 operates as a rotating screw 66 with a threaded end which is received cooperatively in a threaded bore 67 in the central wall 48 of the web guide 14. The cooperating screw 66 and bore 67 act as a drive to laterally displace the guide 14 when the motor 64 is actuated. The direction of shaft rotation will determine the direction of guide displacement. A key 68 on support 16 riding in a keyway 69 on the guide 14 prevents the web guide 14 from rotating with the screw 66. Thus when the heavy web 12*a* is displaced, the indicative signal from input line 34 will cause the bellows 52 to be displaced by the amplifier 24 output, operating motor 64 accordingly.

Another modification embodying an hydraulically operated device 70 correcting the path of the traveling web is shown in FIG. 6. In this embodiment, the outputs in conduits 36, 38 from the fluidic amplifier 24 control the operation of a cylinder 72 containing a piston 74. The piston 74 is displaced in one direction or the other in response to signals from the amplifier 24. The rod 76 of the piston 74 operates a spool valve 82 containing lands 78, 80. Pressure input to the valve 82 from the hydraulic supply is through pipe 84 while return to the supply is through pipes 86 and 88. Output pipes 90, 92 from valve 82 are connected to the opposite ends of a drive cylinder 94, which is attached to the web guide support 16. The pipes 90 and 92 supply operating pressure to the opposite sides of a piston 96. The output rod 98 of piston 96 is connected to the central wall 48 of the web guide 14. A key 100 in guide support 16 rides in a keyway 102 in guide 14 and prevents any rotation of the web guide 14 upon lateral movement of the piston rod 98.

In operation the outputs in conduits 36 and 38 from the fluid amplifier 24 control the displacement of the piston 74 in the cylinder 72. Piston rod 76 in turn controls the operation of spool valve 82. The output pressure from valve 82 subsequently controls the operation of the piston 96 in the drive cylinder 94 whose output rod 98 displaces the web guide 14. Thus, when the web 12*a* deviates from its normal lateral position, for example totally blocking the receiver port 22, the pressure in input conduit 34 will drop, causing more of the supply fluid in the fluid amplifier 24 to be directed through output 36, as described above. This action forces piston 74 toward the opposing output conduit 38, as shown in FIG. 6, so that the supply pressure in valve 82 is diverted into output pipe 92. The pressure entering pipe 92 into cylinder 94, forces piston 96 toward the web guide support 16 moving the central wall 48 and the web guide 14 in a direction to return the web 12*a* to its proper position. Deviation of the web in the other direction will cause the system to operate in just the reverse manner.

It is apparent that one or a number of such guidance systems may be used with a single web depending on the length of the traveling web. Thus, an improved traveling web guide apparatus is provided which accurately and instantaneously adjusts the position of the web when it deviates from its normal position, and which is of comparatively simplified construction requiring a minimum of operating power.

I claim:

1. Apparatus for maintaining a lightweight, traveling web in a given path comprising:
   a. means for guiding the web in the given path;
   b. means for displacing the guiding means;
   c. means for controlling the displacing means; and
   d. means for sensing the web position and actuating said controlling means,

the improvement wherein the controlling means comprises a proportional fluid amplifier, including:
   i. a power stream;
   ii. first and second output chambers;
   iii. a first control input for directing said power stream to divide the flow thereof between said first and second output channels in varied proportions, said first control input being in communication with said sensing means for receiving a pressure signal therefrom and being located to divert a greater portion of said power stream flow respectively into said first or said second output channels in response to pressure indicating a deviation of said web in one or the other transverse direction from said given path; said proportional fluid amplifier means providing a substantially immediate response at said output channels to said deviation and maintaining that response continuously until said web returns to said given path;

and said guiding means comprises:
   i. a pair of support members arranged on opposite sides of said path; and
   ii. a guide member slidably mounted on said support members for movement transversely of said path and having means defining two variable volume chambers at its opposite ends, one chamber communicating with said first output channel and the other communicating with said second output channel, which chambers vary reversely in volume in response to pressure signals from said channels to move said guide member transversely of said path.

2. Apparatus as claimed in claim 1 wherein said guide member comprises a cylindrical spool having chambers defined in its opposite ends slidably accommodating said support members therein, the volumes of said chambers being varied reversely by the sliding movement of said spool on said support members; and annular guide flanges on the outer surface of said spool for engaging the edges of said web.

3. Apparatus as claimed in claim 2, wherein said chambers contain bellows connected between said spool and said support members for receiving the pressure signals in their interiors.