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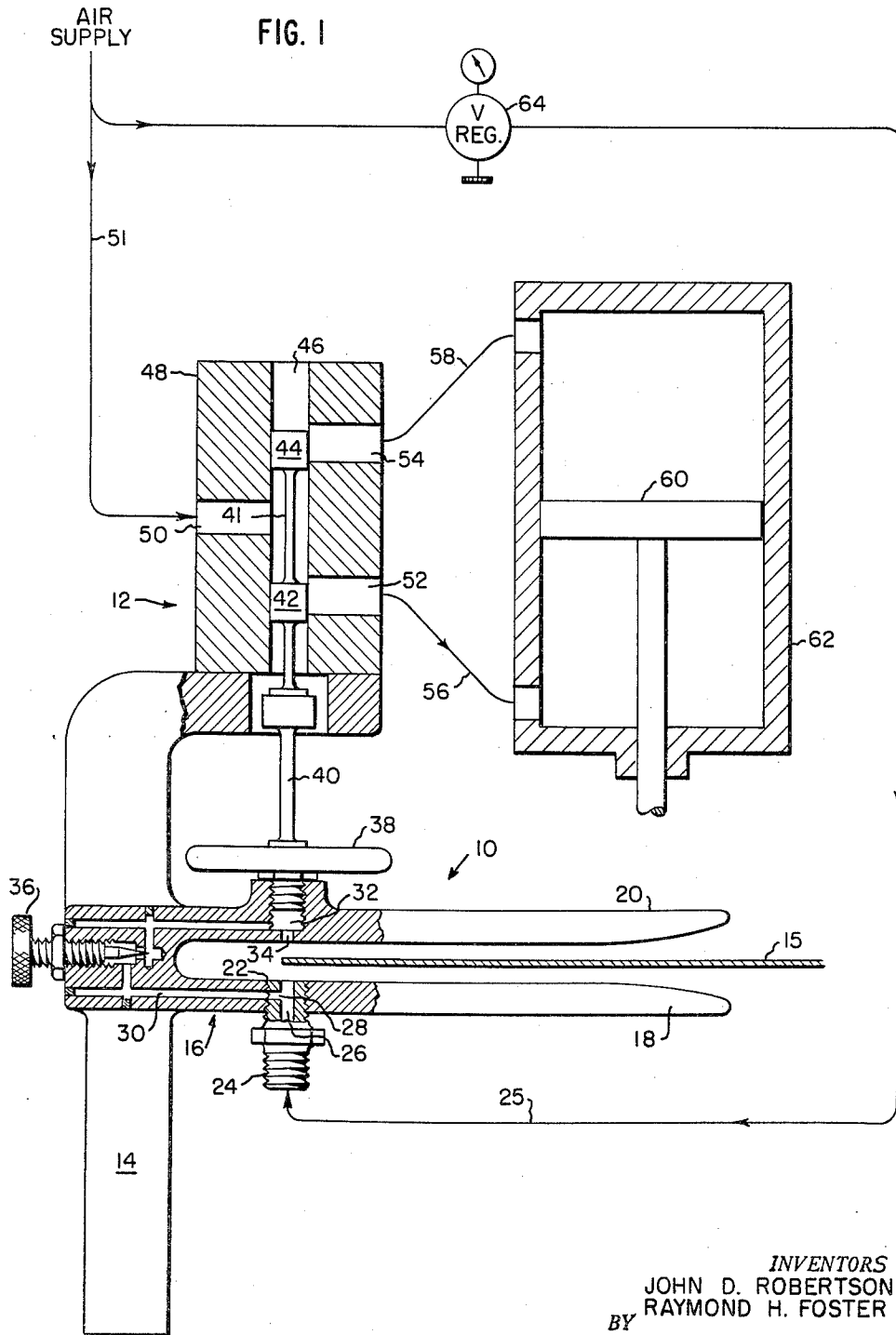
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SENSING DEVICE FOR WEB GUIDING MECHANISMS

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2 Sheets-Sheet 1



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SENSING DEVICE FOR WEB GUIDING MECHANISMS

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This invention relates in general to control systems for guiding traveling flexible sheet materials and more particularly comprises improvements in gaseous-pressure-responsive mechanisms for sensing and correcting lateral deviation of a traveling sheet.

In accordance with a preferred embodiment of this invention lateral deviation of a traveling sheet is detected by the marginal edge of the sheet interrupting a stream of air jetted towards a receiving chamber formed in a sensing head. An expandible diaphragm or bellows interconnects with the receiving chamber and is volumetrically responsive to variations in the amount of air admitted to the chamber. The expansible diaphragm is, in turn, operatively connected with a multi-position valve so that a change in the size of the diaphragm is effective to shift the position of the valve. This valve is placed in line with means for pneumatically operating a web shifting apparatus such as that shown in our co-pending application Serial No. 825,074 filed July 6, 1959, so as to correct for whatever lateral deviation is detected at the sensing head.

This invention also includes a purging system that prevents the accumulation of lint within the chamber and its orifice and also assists in the detection of lateral deviation.

Another embodiment of this invention features a sensing finger mounted in proximity to the web edge and which is moved in response to lateral shifting of the web. Movement of the finger operates the outlet valve of a pneumatic head which is connected to a source of pressurized air. Operation of the outlet valve will cause an expandible bellows to change in size and, through a novel flexible coupling, control the position of a multi-position valve. As in the first embodiment this multi-position valve is in line with a pneumatic means to control the position of the web. This embodiment also includes a novel arrangement for mounting the sensing finger and for controlling by magnetic means the valve action of the pneumatic head.

A general object of this invention is to improve the handling of traveling sheet materials.

Another object of this invention is to provide a gaseous-pressure-responsive device for sensing and correcting lateral deviation of traveling sheet material.

Yet another object of this invention is to provide a relatively simple and inexpensive mechanism for guiding traveling sheet materials yet one that is at the same time highly efficient and dependable in operation.

Still another object is to provide a sensing device that is immediately responsive to any lateral deviation of a traveling web.

These and other objects and features will more readily appear from a detailed description of preferred embodiments of this invention, with reference being made to the accompanying drawings in which—

FIG. 1 is a view in side elevation partly in section and somewhat diagrammatic, illustrating one embodiment of the invention,

FIG. 2 is a view in side elevation partly in section illustrating a modification of the invention,

FIG. 3 is a cross-sectional view taken along the line 3—3 of FIG. 2, and

2

FIG. 4 is a cross-sectional view on a somewhat larger scale of the flexible coupling shown in FIG. 2.

Referring now to FIG. 1 of the drawing the reference character 10 generally indicates a pneumatic sensing head coupled to a 4-way valve 12 with both elements being mounted on a common support 14. Traveling flexible sheet material such as cloth, paper, woven screen, etc. (herein referred to as a web) is indicated by the reference character 15. This sensing head 10 is fashioned with a bifurcated frame 16 having a lower fork 18 and an upper fork 20 spanning opposite sides of the web 15 and extending for some distance out over the web.

A threaded opening 22 is formed in the lower fork 18 to receive a nipple 24 which is connected to a source of low pressure air by way of a conduit 25. The nipple 24 is provided with an axial nozzle 26 extending there-through and a radial passage 28 interconnecting with a passage 30 in the frame 16. This passage 30 extends through the frame 16, through a needle valve 36 and into a chamber formed in the upper fork 20. This chamber is provided with an orifice 34 aligned opposite the nozzle 26. Attached to the upper fork 20 of the frame and in communication with the chamber 32 is an expandible diaphragm or sheet metal bellows 38. This diaphragm will expand or contract in response to changes in pressure within the chamber 32. The air which passes from the conduit 25 into the nozzle 26 is maintained at a pressure of one p.s.i. or less, for example, and jets out from the nozzle towards the orifice 34. The marginal portion of the web 15 will normally pass in close proximity to the path of the air jet and interrupt the flow of the jet. Should the web deviate to the right (FIG. 1) and out of the path of the jet compressed air will enter the orifice 34 and pressure will be built up within the chamber 32 which will cause the diaphragm 38 to expand. Such expansion will cause a valve rod 40, connected to the diaphragm by a flexible coupling 40, to move within the 4-way valve 12.

The valve rod 41 is provided with a pair of spaced pistons 42, 44 adapted to reciprocate within the cylindrical chamber 46 of the valve 12. The valve is provided with one inlet 50 communicating with the chamber 46 and two outlet ports 52 and 54. A conduit 51 supplies compressed air (45 p.s.i. for example) to the inlet 50. The air will be conducted through either outlet 52 or 54 depending on the position of the piston rod 41 unless the valve rod is in a neutral position with both outlets closed by the piston.

Connected with the valve 12 by conduits 56, 58 is a pneumatic cylinder 62 having a piston 60 mounted for reciprocation therein. The piston is operatively connected with a movable apparatus suitable for shifting the direction of a traveling web.

It will be obvious now that the apparatus described herein comprises a web guiding system in which the function of the sensing head 10 and the valve 12 is to detect lateral deviation of the traveling web and correct therefor by moving the piston 60 and thereby alter the direction of the web.

To illustrate the operation of the invention, assume that for some reason the web 15 deviates to the right in FIG. 1. The marginal portion of the web will move away from the orifice 34 and the air jet directed towards the orifice from the nozzle 26. This jet of air, coupled with the purging air admitted to the chamber 32 through the passage 30, will cause the diaphragm 38 to expand. The expansion will move the valve rod 41 upwards so that the piston 44 will open the port 54 to the compressed air and at the same time the piston 42 will open the port 52 to the atmosphere. In this position compressed air will pass through conduit 58 and the piston 60 will move downward to shift the web, through a suitable web

shifting device, to the left until it reaches its proper course. This air on the opposite side of the piston 60 will exhaust through the port 52 and out through the lower end of the chamber 46.

From what has been said it will be obvious that should the web deviate to the left, closing the orifice 34, the diaphragm 38 will collapse and the valve rod will move downward to shift the direction of the air conduit 56 so as to move the piston 60 upwards whereby the web will be shifted to the right.

Under normal conditions when the web is traveling in its correct path the web edge will only partially interrupt the air jet so that the system will be in balance with both outlet ports closed by their respective pistons. It is desirable under such conditions that there be a slight leakage of air past the pistons 42, 44 into the pneumatic cylinder. This will keep a balanced pressure in the system and will make it more responsive upon actuation of the valve.

In FIG. 2 there is illustrated a modification of the invention in which a sensing finger is used to detect lateral deviation of the web rather than the jet of air previously described.

In this embodiment a frame 70 forms, in part, a housing 71 for a sensing mechanism 72 and a 4-way valve 74, with a cover 73 enclosing an end thereof. The upper portion of the frame is fashioned into a table 76 over which the web 15 passes. A selva plate 78 holds the web flat against the table. The plate itself is held in position by a pair of leaf springs 80 (only one of which appears in the drawing), each fitted to a post 82 extending upwardly from the table 76.

Aligned openings 84 and 86 are formed in the table 76 and the housing 71 respectively to accommodate an elongated sensing finger 88. The finger is pivotally mounted to a supporting arm 134 of the sensing head 72 by a pin 190 and counter-balanced by a weight 92 fastened to its lower portion. The upper portion of the finger has a slightly curved surface and is intended to bear against the edge of the web 15. A conical valve 90 is mounted on the finger and arranged to move in and out of an outlet 96 formed in a valve seat 98. The valve seat 98 is threaded to a valve frame 100 which has a central chamber 102 in communication with the outlet 96. A constant flow of compressed air is introduced to the chamber 102 through a passage 104 and a conduit 106. A needle valve 105 is installed in the conduit to control the flow of air as desired.

Mounted to the valve frame 100 and communicating with the chamber 102 through passage 108 is an expandible diaphragm 110 similar both in construction and operation, to the diaphragm 38 described in FIG. 1.

A flexible coupling 112 connects the diaphragm to the 4-way valve 74 which is similar to the 4-way valve 12 of FIG. 1. Compressed air (45 p.s.i. for example) is introduced to the valve through an inlet T 114 connected to the conduit 106. A pair of outlet ports 116, 118 connect to a pneumatic cylinder (not shown) and serve the same purpose as the ports 52, 54 of FIG. 1.

The operation of the device is as follows: assuming that the web 15 deviates to the right (FIG. 2) the finger 88, being in contact with the edge thereof, will pivot clockwise about its pin 190. This movement will carry the conical valve 90 away from the valve seat so as to allow the air within the chamber 102 to escape through the outlet 96. With no pressure being built up within the chamber 102 the diaphragm will remain in a collapsed condition. Compressed air will be directed through the outlet port 118 to operate a suitable mechanism for correcting the path of the traveling web.

Obviously, if the web has deviated to the left the outlet 96 will be closed and a pressure will be built up within the chamber 102 that will cause the diaphragm 110 to expand. This will shift the position of the 4-way valve so that compressed air will be directed through the port

116 to actuate a mechanism for moving the web to the right.

As in the first embodiment the device shown in FIG. 2 will reach a balanced condition when the web is traveling in its proper path. The passage 96 will be only partially closed by the valve disc and the diaphragm will only be partially expanded thereby. This will shift the 4-way valve to a neutral position.

In order that the conical valve 90 will seat properly against the valve seat 98, the valve is mounted on the finger 88 in a self-aligning manner. As seen in FIG. 2 the valve 90 is provided with a stem 120 that projects through a somewhat enlarged opening in the sensing finger. A spring 130 is coiled about the stem and is seated between a pair of spaced washers 124 with a cross pin 126 locking the assembly upon its stem. By this arrangement the conical valve has a certain amount of play to compensate for any misalignment of parts. This insures full and proper seating of the disc upon closure of the outlet 96.

To avoid undue wear on moving parts and unnecessary looseness in the mounting of the sensing finger 88 the lower end thereof is formed with side portions 132 through which the pin 190 passes to engage the arm 134. As seen best in FIG. 3 the pin 190, which is preferably made of resilient metal, is formed with one or more coils 136 and engages the finger at 138 under tension. The pin is thereby held in fixed position relative to the finger and pivots with it. Whatever wear occurs from the pivoting will take place on the pin rather than the finger. Since the pin 190 is an inexpensive item in relation to the finger, a savings in maintenance is achieved while at the same time effecting a snug assembly.

Extending outwards from the valve frame 100 towards the metallic sensing finger is a magnet 140 which has the function of biasing the balanced finger 88 counterclockwise. The magnet is arranged in such a fashion that it will have its strongest attraction for the finger when the passage 96 is fully closed by the conical valve 90. It will be apparent that with the valve closed the pressure built up within the chamber 102 will have a maximum tendency to force the valve open. The function of the magnet, therefore, is to bias the finger counterclockwise (and thereby close the valve) to counteract the air pressure within the valve tending to bias the finger clockwise (and thereby open the valve). As the finger is moved away from the magnetic field by the web, the attractive force will diminish. It is intended that the ratio between attractive force of the magnet for the finger and the air pressure tending to open the valve, will remain constant whatever the position of the finger so that the total effect will be to maintain a balanced valving arrangement of constant sensitivity and operative response.

In FIG. 4 there is illustrated a cross-section of the flexible coupling 112 which may be used not only in the mechanism of FIG. 2 but also may be used with equal advantage in the embodiment of FIG. 1. Although it is intended that the 4-way valve 74 be mounted in alignment with the sensing head 72 it is desirable to have a flexible coupling between them rather than one that is rigid. The reason for this lies in the fact that the parts of the 4-way valve are made to close tolerances and any slight error in alignment may cause binding or undue friction between the working parts. The flexible coupling which is shown here will compensate for any misalignment.

Referring more particularly to FIG. 4 the coupling is fabricated with two unions 142, 144 for engagement respectively with the diaphragm 110 and a valve rod 145 of the 4-way valve. Each union has a threaded portion as at 146 and 148 and a reduced portion as at 150 and 152. The reduced portions having a diameter about equal to the diameter of the threaded portion measured at the base of their threads.

A coil spring 154, having the same pitch as the threads is screwed over each threaded portion of the unions as shown. A somewhat loosely fitting pin 160, seated in sockets 156 and 158 maintains the two unions in spaced relation to one another and also keeps the spring 154 under tension. It will be noted that the thread engaging portions of the spring are not under tension while the central portion is stretched somewhat. It will also be noted that the reduced portions 150, 152 prevent undue bending of the coupling. It has been found that the assembly gives just the proper amount of controlled flexibility necessary for optimum performance of the sensing device.

From the foregoing, the principles, concepts and modes of operation of the herein disclosed invention will be readily apparent, and it will be evident that many changes in and departures from the exemplary specific disclosures may be resorted to without departing from them, and within the invention as defined by the appended claims.

What we claim and desire to obtain by Letters Patent of the United States is:

1. Apparatus for detecting lateral deviation of a traveling web and adapted to actuate pneumatic motive means in response to said deviation, comprising a 4-way valve adapted to control admission of pressurized gas to said motive means, an expandible bellows, a flexible coupling connecting said bellows to said valve, a pneumatic head having a chamber formed therein communicating with said bellows, said chamber being connected to a source of pressurized gas, means for controlling the flow of said gas into said chamber, said head being provided with an outlet for said gas, a self-aligning valve member for restricting said outlet, said member being mounted on a sensing finger pivotable in response to lateral deviation of said web, a pin having a tensioned portion fixedly mounted on said member and engaging said finger with said head, and magnetic means urging said valve member to a closed position.

2. A web edge sensing mechanism adapted for actuating a fluid motor in response to lateral deviations of

said web edge, comprising a housing having a chamber formed therein, said chamber adapted to be connected to a source of gas under pressure, an expansible bellows mounted on said housing and communicating with said chamber, valve means adapted for selectively admitting pressurized gas to said fluid motor, said bellows being operatively connected with said valve means for control thereof, said housing having an outlet port formed therein for the escape of said gas, a valve member, and a sensing finger pivotally mounted on said housing and supporting said valve member for movement in response to lateral deviation of the web to valve said outlet for regulating the release of fluid therefrom in accordance with the lateral position of said web, thereby to control the expansion of said bellows for controlling said valve means.

3. A web edge sensing device according to claim 2 wherein said housing is provided with control means for adjusting the flow of said fluid to said chamber.

4. A web edge sensing device according to claim 2 wherein said sensing finger and said housing are provided with magnetically attractive means arranged to urge said valve member towards a closed position with respect to said outlet.

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