United States Patent [19]

Fountain et al.

[11] **3,750,920**

[45] **Aug. 7, 1973**

[54] **WEB GUIDE**

[75] Inventors: **Richard W. Fountain; Darrel D. Johnson,** both of Appleton, Wis.

[73] Assignee: **Gilbert & Nash Company, Inc.,** Appleton, Wis.

[22] Filed: **Apr. 5, 1971**

[21] Appl. No.: **131,011**

[52] **U.S. Cl.** **226/23,** 92/8

[51] **Int. Cl.** **B65h 25/26**

[58] **Field of Search** 226/22, 23, 15; 92/8, 9

[56] **References Cited**

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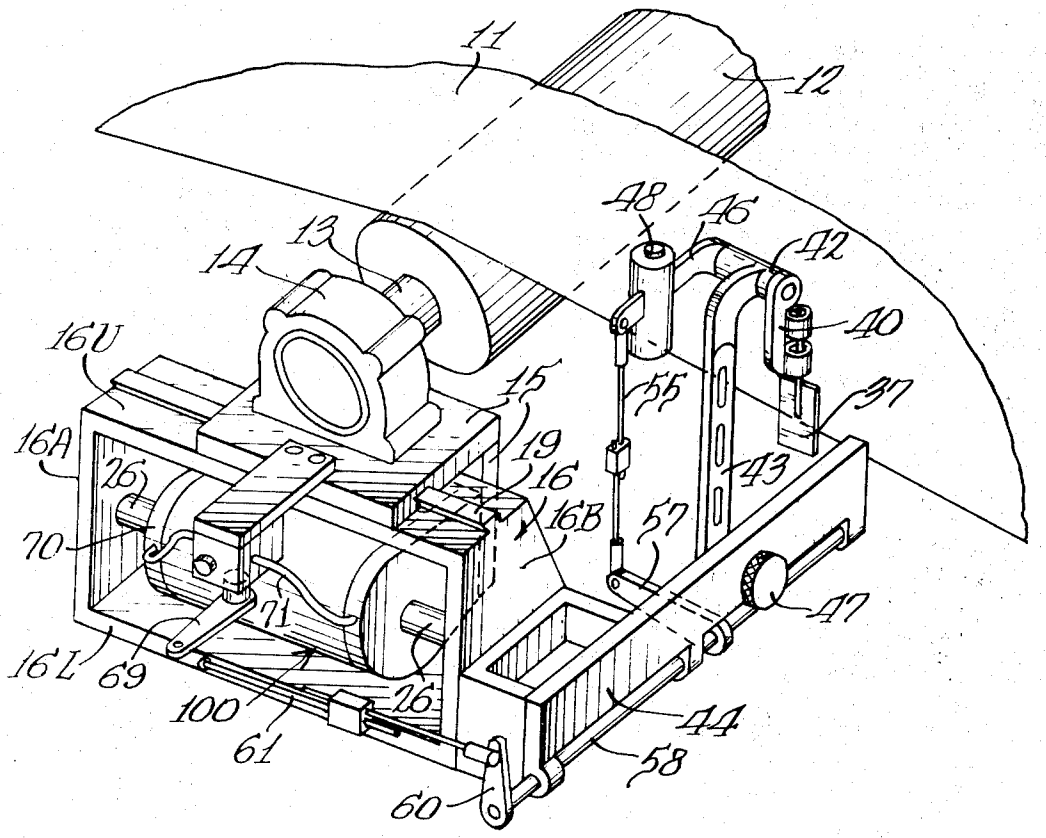
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Primary Examiner—Richard A. Schacher
Assistant Examiner—Gene A. Church
Attorney—Gary, Parker, Juettner, Pigott & Cullinan

[57] **ABSTRACT**

An improved web guide for paper wires or other webs is disclosed employing a duplex air-hydraulic cylinder unit constructed with a single piston in a cylindrical tube to move a guide roller. A web edge follower and mechanical linkage govern an air pressure valve for supplying, in response to sensed web misalignments, different pressures to the sides of the piston. This air pressure difference moves the cylinder housing coupled to the roller so as to correct the web misalignment. The piston includes a longitudinally extending oil zone between it and the bore walls and a hydraulic seal ring affixed to the cylindrical tube. The ring divides the oil zone into two chambers which change volume with piston movement. A restricted flow path between the chambers prevents overcorrection and promotes smooth motion of the piston and roller. This arrangement provides for automatic lubrication of the piston and simplified construction and operation of the web guide. The oil zone is preferably fed by oil taken from an air line lubricator unit to maintain the pressure in the oil zone at the same level as the air pressure.

4 Claims, 5 Drawing Figures



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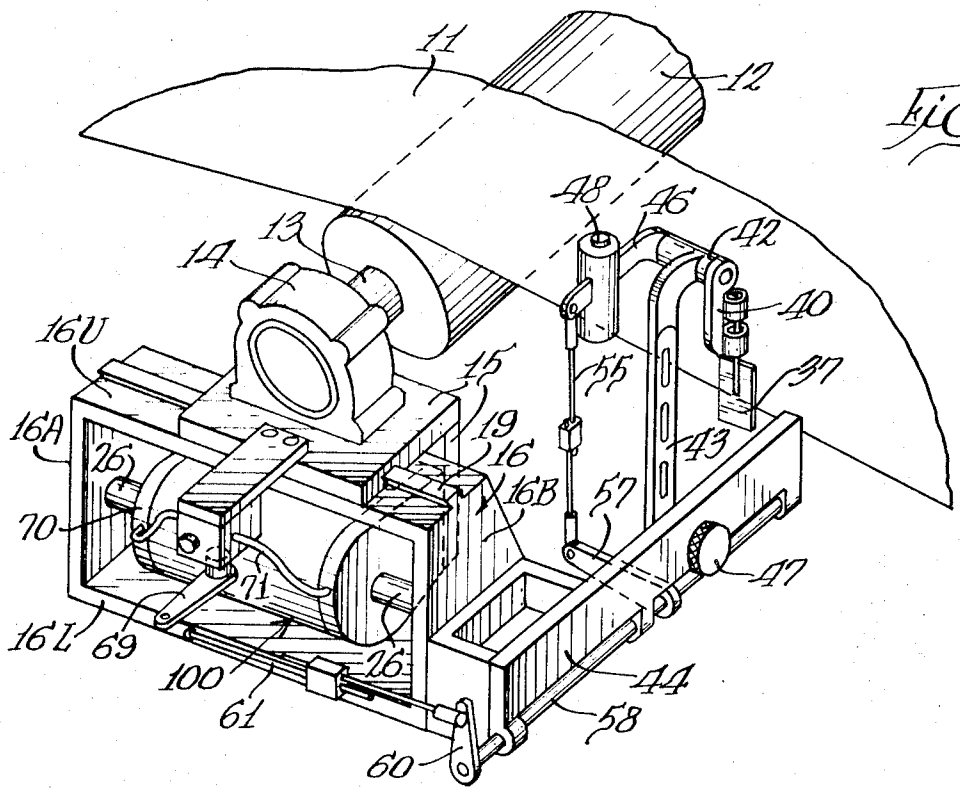


Fig. 1.

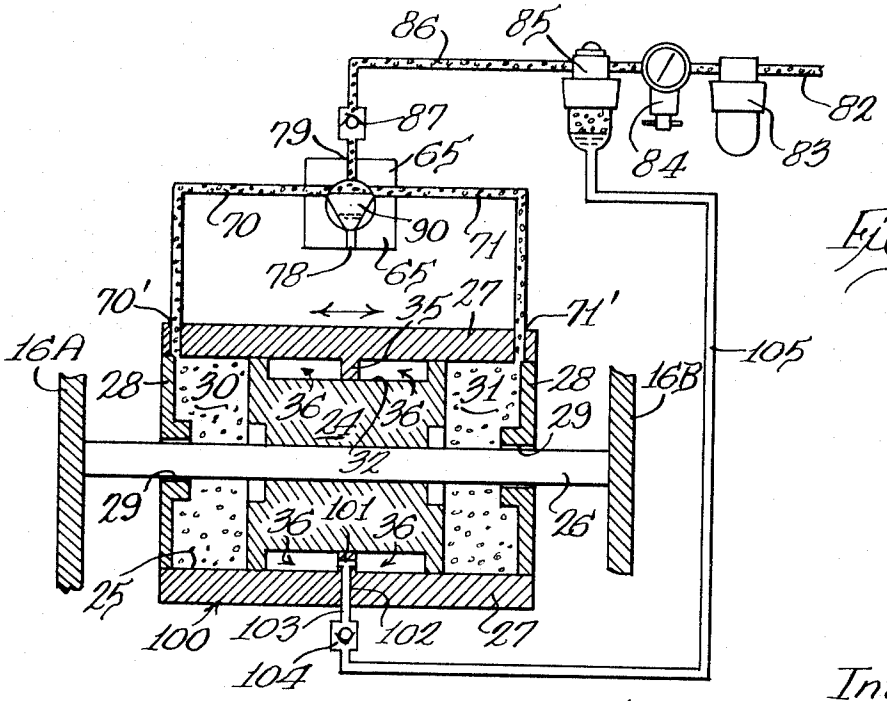


Fig. 2.

Inventors:
Richard W. Fountain
Darrel D. Johnson
By Gary, Parker,
Juettner, Pigott & Cullinan Attys

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Fig. 3.

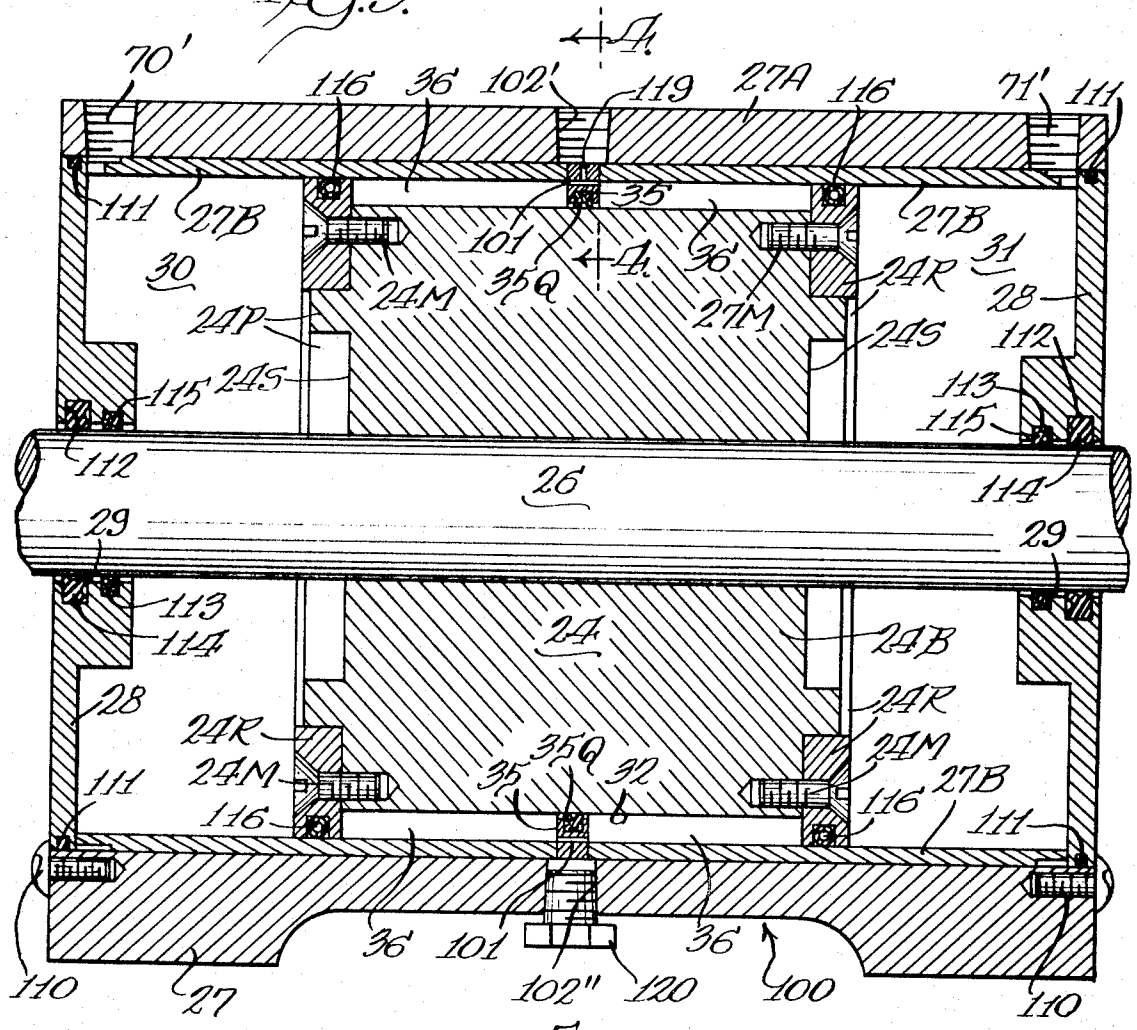


Fig. 4.

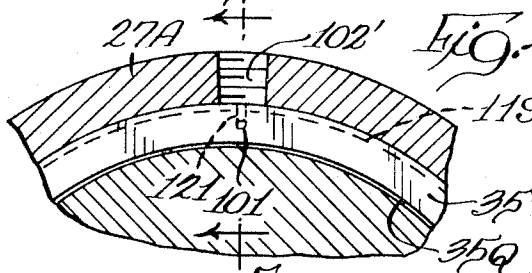
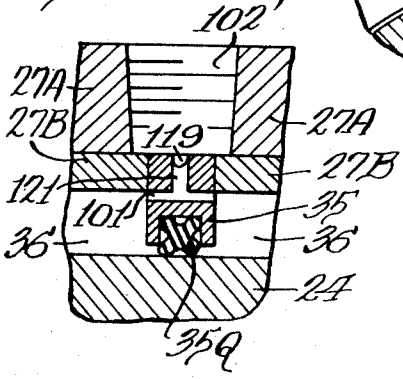


Fig. 5.



Inventors:
Richard W. Fountain
Darrel D. Johnson
By Gary, Parker,
Juettner, Pigott & Cullinan Atty's

WEB GUIDE

FIELD OF THE INVENTION

The present invention relates to an improved web guide of the type that may be used with paper forming wires or screens, blankets, or other traveling webs and is particularly concerned with an improved device for sensing misalignment of the web and for automatically realigning it.

BACKGROUND OF THE INVENTION

The present invention is directed to an improvement in the web guide disclosed and claimed in U.S. Pat. No. 2,877,013 entitled "Guide for a Traveling Web" which issued on Mar. 10, 1959 in the names of Herbert L. Wendshul and David E. Lamon and is assigned to the assignee of the present invention.

Web guides of the Wendshul and Lamon type have functioned well and met with general commercial acceptance, especially in the paper making industry wherein large and extremely long continuous webs, flts and wires, are employed. These web guides realign the web by shifting one end of a roller that is carrying the web in response to the sensing of web misalignment by a mechanical follower. The alignment sensing device in response to a sensed misalignment, alters the position of a special valve which, in turn, supplies and removes air pressure from opposite ends of a piston in a cylinder. The piston is normally fixed and the cylinder housing is caused to move and carry along one end bearing of the web roll. In these prior art guides, two cylinders had to be employed in the same housing — the air cylinder and a second hydraulic cylindrical tube parallel to that of the air pressure cylinder. This second cylinder was filled with oil and a restrictive flow passage was formed in the piston to allow oil to flow from one side to the other. The later cylinder served to damp the erratic movement tendencies of the piston or air cylinder and to prevent overcorrection.

This dual cylinder construction for the roll moving element, while working satisfactorily, required precision machining and fitting to insure that the cylinders were parallel. If these cylinders were not parallel, the pistons would bind. The requirement that both pistons be parallel lead to them being formed in the same housing in a side-by-side arrangement and thus limited the capacity of the power piston for a given housing size.

SUMMARY OF THE INVENTION

In overcoming these drawbacks and for achieving other advantages, the present invention provides an improvement in a web guide of the above described type wherein the web roll moving element is formed of a single cylinder that performs the functions of the prior two cylinders. This is accomplished by including an hydraulic zone defined betwen the piston and the tube or bore, a fixed seal in that zone dividing it into two parts and means restricting hydraulic flow therebetwen.

The hydraulic zone is preferably a void of a generally torus shape formed in the side walls of the piston while the hydraulic seal is preferably an outstanding ring fixed to the bore wall and extending to the piston's wall in the torus void. With this construction, changes in air pressure between the ends of the piston results in motion damped by the oil forced to flow from one side of the seal to the other.

The hydraulic damping is achieved without any sacrifice in air piston size. This results in more power for the same size when compared with prior two cylinder units. Put another way, the present invention allows for smaller and simpler guide roll moving units for a given power requirement. The combined cylinder also has fewer seals and wearing parts resulting in economy of manufacture and maintenance. Furthermore, the unit is self-lubricating by reason of the presence of the oil zone adjacent to the bore walls.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention, together with the further advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawing, in the several figures of which like reference numerals identify like elements, and in which:

FIG. 1 is a perspective view of a web guide in its environment of use;

FIG. 2 is a schematic drawing of the fluid systems and the power cylinder of the web guide of FIG. 1, which schematic is useful in understanding the operation of the present invention;

FIG. 3 is a longitudinal sectional detailed view of the power cylinder of FIG. 1;

FIG. 4 is a fragmentary transverse sectional view of the cylinder of FIGS. 1 and 3, as seen from the line 4—4 of FIG. 3; and

FIG. 5 is a fragmentary sectional view of a portion of the cylinder of FIGS. 1, 3 and 4 as seen from the line 5—5 of FIG. 4.

DETAILED DESCRIPTION

Referring in detail to the drawings and especially FIG. 1, thereof, a web guide constructed in accordance with the present invention is there depicted and is generally designated by the numeral **10**. The web guide **10** serves to guide a traveling web, indicated by the numeral **11**, which may comprise a paper forming wire or screen, a traveling blanket or other type of web or belt which it may be desired to maintain in a substantially constant path during its travel. A guide roll **12** is employed to control the lateral movement of the web. The roll **12** is disposed tranversely to the axis of the web and the web will normally assume a position such as to bring its longitudinal axis at rightangles to the axis of the guide roll. Hence, by inclining the axis of the roll **12** in one direction or the other a force is exerted upon the web to move it laterally in a predetermined direction.

The web guide **10** comprising the present invention is directed to a mechanism which so inclines the roll **12** in response to an undesired lateral movement of the web, such inclination functioning to return the web to its desired path.

The roll **12** is carried upon an axle **13**, only one end portion of which is illustrated, the opposite end portion being journaled in a bearing (not shown) which has a degree of freedom to move as the axis of the roll is inclined. Such self-aligning bearings are well known in the art. The opposite end portion of the axle **13** is journaled in a self-aligning bearing **14** which is mounted upon a movable carriage **15** which functions to move the bearing **14** so as to incline the axis of the roll **12** relative to its normal position.

The movable carriage **15** is slidably mounted upon a stationary frame member **16** which is secured to a stationary portion of a paper making machine or the like (not shown). The movement of the carriage **15** is substantially parallel to the general direction of travel of the web and in order to restrain the carriage for movement in this direction, the upper portion of the carriage is provided with a groove which registers with a guide rib **19** carried by the stationary frame **16.** Mechanical restraints of other types may be substituted.

The stationary frame **16** comprises a box structure, which comprises upper rail **16U**, lower rail **16L** and end rails **16A** and **16B**. The carriage **15** comprises a downwardly extending panel to which is secured a power cylinder unit **100,** which is constructed in accordance with one main feature of the present invention. The unit **100** is disposed lengthwise within the box frame **16** and includes a rod or shaft **26** which extends from both ends of the cylinder unit **100** to have its ends bear against the internal surface of the side walls **16A** and **16B**.

To detect lateral movement of web **11** from its normal position, a sensing element is employed, the sensing element comprising a palm or feeler **37.** The palm **37** includes a vertical rotary pin which is journaled in sleeves or bearings carried by an arm **40,** the latter being carried by a rotatable shaft journaled in a bearing **42.** The bearing **42** is carried at the upper end of a stationary bracket **43** mounted upon the stationary portion of the machine. A locking screw having a hand wheel **47** for adjustably securing bracket **43** to bracket **44** is provided. Thus, palm **37** is held in a fixed position relative to the stationary portion of the machine, but is free to swing or pivot vertically about arm **40** to dispose its surface in alignment with the adjacent edge of the web **11.**

An arm **46** is connected to the opposite end of the shaft through the bearing **42** and carries a block **48.** The arm **46** is adjustably and pivotally connected to a generally vertical link **55.**

At its opposite end, link **55** is pivotally connected to an arm **57** which, in turn, is rigidly mounted upon a shaft **58** journaled in bearings formed integral with the stationary bracket **44.** An arm **60** is rigidly secured to the opposite end portion of shaft **58** and the opposite end of said arm is pivotally connected to an end of a link **61.**

A supporting plate **63** is secured to the movable carriage and carries a four-way valve **65.** The structural features of valve **65** will be hereinafter more fully described, but in general it is manipulated by the rotation of a shaft which rotates in response to the pivoting of an arm **69** which is pivotally connected to the link **61.** The valve **65** has two air pressure outlets connected by hoses **70** and **71** to opposite ends of the cylinder unit **100** to supply the motive power thereto. Mechanical or fluid operated systems, other than described herein, to transmit motion between palm **37** and arm **69** may be substituted. The valve **65** also includes an air pressure line inlet **79** (FIG. **2**) for connection to a mill instrument air pressure line and an atmospheric air pressure outlet **78.** The four-way valve **65** moves together with the movable carriage **15.**

A better understanding of the operation of the valve **65** and cylinder unit **100** may be gained by reference to FIG. **2.** In that figure, pipe **82** connects with a source of air or other compressible fluid under pressure. The pipe **82** connects into a conventional filter **83** which is connected with a conventional pressure regulator **84** and which, in turn, connects with a lubricator **85.** From the lubricator **85** an air pressure pipe **86** connects to a check valve **87.** As will be explained in detail below, the check valve **87,** while not strictly necessary for the successful practice of the primary features of the invention, is a highly desirable feature. Thus, fluid under a pressure determined by the regulator **84** feeds through the check valve **87** to the high pressure inlet **79** of the valve **65.** The valve **65** has a rotor **90** which rotates or oscillates in response to the pivotal movement of the arm **69** (FIG. **1**) and thus in response to the linked feeler **37** and web **11.** Oscillation of rotor **90** alternately from the neutral position shown, serves to admit air under pressure to one and to vent air under pressure from the other of the lines **70** and **71,** the vented line bleeding to atmosphere via the low pressure outlet **78.**

As can also be seen in FIG. **2,** the cylinder unit **100** includes a piston **24** rigidly secured to the rod **26.** A cylinder bore **25** is defined by a housing **27** and is enclosed by means of circular end plates **28,** which have sealed bearings **29** for slidably receiving the shaft **26** and for allowing relative motion between the housing **27** and the fixed shaft **26** and piston **24.** The cylindrical bore **25** is thus divided by the piston **24** into two air pressure chambers **30** and **31** which are in communication through respective inlets **70'** and **71'** with the pressure lines **70** and **71.**

In accordance with a primary feature of the invention, the piston **24** is provided with a generally torus shaped cutout or circumferential recess **32** to define a hydraulic zone between the cylinder **27** and the piston **24.** The recess **32** is preferably rectangular in longitudinal cross-section. Affixed to the inner surface of the cylindrical wall **25** of the housing **27** is a ring **35** which extends to the circumferential surface of the recess **32** and divides the hydraulic zone into two chambers **36—36,** whose sizes respectively are varied complementally by the relative position of the piston **24** and housing **27,** that is their combined volume remains constant. Fluid flow between the chambers **36** is governed by metering orifices **101** through the ring **35.**

The oil in the hydraulic chambers **36** is maintained under pressure and any loss is replenished via the orifices **101** through an inlet **102** from an oil line **103.** The oil line **103** preferably is connected through a check valve **104** to an oil line **105** fed from the air line lubricator **85.**

The purpose of the check valves **87** and **104** is to prevent reverse flow of the fluids, both air and oil, should an air failure occur external to the web guide **10.** Because the air can be exhausted at unequal rates from the cylinder on either side of piston **24,** motion of the cylinder could be caused during an air failure which would prevent the cylinder or guide from stopping at its point of last correction under these conditions. The hydraulic fluid offers a resistance to motion when no power is applied to the air cylinder and the guide, therefore, tends to stay at its point of last correction during an air failure.

The oil line **105** is connected to the oil drain outlet of the otherwise conventional lubricator **85** and thus supplies oil to the hydraulic chambers **36** under pressure to insure that these are full at all times, and also to insure that any fluid which is lost at the seals of the piston **24** is replaced by oil under the same pressure as

the air in the cylinder, thereby preventing entry of air into the hydraulic zone.

Referring now to FIGS. **3, 4** and **5**, the preferred construction of the power cylinder unit **100** will be described. As shown, the housing **27** may include a cylindrical body **27A** and a pair of longitudinally spaced tube sections **27B** fitted therein. The head plates **28** are fitted into the ends of the body **27A** against the sections **27B** and held in place by a number of machine screws **110** about their circumference. The outer edge of each head plate includes a groove for accommodating a seal **111**, while the inner or piston rod receiving bearing **29** thereof includes a pair of adjacent but spaced apart grooves **112** and **113** for receiving respectively a wiper seal **114** and a quad ring seal **115**.

The piston **24** includes a generally cylindrical shaped body section **24B** which is of an outer diameter somewhat less than the inner diameter of the tubes **27B**. The body **24B** is affixed to the piston rod **26** in any convenient manner and has end surfaces **24S** which include an outstanding ring projection **24P**. Seated around the ring projections **24P** are piston rings **24R** which are affixed to the body **24B** by means of a plurality of machine screws **24M**.

The piston rings form the end walls of the torus shaped cutout **32** of the piston **24** and provide an air-oil seal by means of an O-ring seal **116** set in a groove formed in its outer surface.

The hydraulic zone dividing ring **35** is seated between and attached to the edges of the tube sections **27B** and includes a groove in its inner surface in which a quad ring **35Q** is seated to form an oil seal between that surface and the outer surface of the piston body **24B** which moves relative thereto. A plurality of orifices **101** are formed in the ring **35** to allow metered flow from one chamber **36** to the other.

As best shown in FIGS. **4** and **5**, the oil pressure from the inlet **102'** is communicated to the chambers **36** by means of a groove **119** on the outer surface of the ring **35** encircling the ring **35** and a plurality of passageways **121** therefrom to the mid points of the orifices **101** through the ring **35**.

A number of potential inlets **102''** may be formed in the outer portion of the cylinder body **27A** to allow the oil inlet line **102** to be attached at any convenient location and to increase the number of applications (vertical, horizontal or other) for the cylinder **100**. A plug such as the plug **120** may be used to close off the unused inlets or the passageway **119** may not be formed in the ring **35**. The inlets plugged by plug **120** are also used to bleed air from hydraulic chambers **36**.

Similarly, a plurality of air inlets **70', 71'** may be provided to simplify the installation of the cylinder in different types of web guides. The air ports and oil supply ports are preferably at four points sequentially located 90° apart about the circumference of the housing **27**.

OPERATION

In overall operation, the web guide **10** functions to realign a misalignment in the web **11** (FIG. **1**) by shifting the position of the roller **12**. This is done by sensing the magnitude and direction of misalignment by the position of the feeler **37**. The block **48** functions as a counterweight to move the linkage connected to the palm **37** so that said palm lightly contacts and follows the edge of the web **11**. In the normal position of the device, that is, when the web moves along the desired path, the four-way valve **65** communicates equal pressures to the lines **70, 71**. The direction and amount of any displacement of the feeler **37** is communicated by the linkages including the arms **40, 46**, the link **55**, rotatable members **58**, the arm **60** and linkage **61** to the valve arm **69**. When the arm **69** is in its central position the pressure on each side of piston **24** is equal, being the same as the pressure in pipe **86**.

However, when the web **11** deviates in either lateral direction from its normal path, palm **37** is either moved by the web edge or is caused to follow the web edge thereby moving the plam linkage, the arm **69** of valve **65** is moved and valve **65** thereby vents through line **70** or **71** on one or the other side of piston **24**.

The pivotal displacement of the arm **69** in direct response to the feeler displacement rotates the rotor **90** (FIG. **2**) causing the decrease in air pressure in one of the lines **70** or **71** (depending upon the direction of rotation of the rotor **90**). This drop in pressure is communicated to the one or the other (but never both at the same time) of the chambers **30** or **31**. This drop in air pressure causes a force to be applied to the cylinder housing **27** to tend to move it and thus the bearings **14**, axle **13** and roller **12** (FIG. **1**).

The movement of the housing **27** relative to the fixed piston **24** is resisted by the rise in pressure of the relatively incompressible hydraulic fluid in one of the chambers **36** and is damped and slowed by the relatively small size of the orifices **101**. This reduces hunting or overcorrection by the piston **24**. The cylinder unit **100** is thus powered by a compressible fluid, air, which applies pressure between the cylinder head plates **28**, and the piston body **24** to initiate linear movement. Between the piston body **24** and the same cylinder bore as used by the air cylinder a non-compressible fluid, oil, is maintained. The hydraulic sealing ring **35** divides the oil portion **36** of the cylinder. As the air causes movement of the piston, oil is moved from one side to the other through the metering orifices **101** in the ring **35** to allow movement. The same piston seals are used both to contain air and oil and to prevent intermixture between the air and hydraulic fluids.

This provides an air cylinder **100** which is hydrualically dampened to give a smooth hydraulic cylinder motion and is contained in a common cylinder housing **27** having a single piston rod **26** which may be double ended as shown or may be single ended if desired. The speed of motion is controlled by the combination of air pressure, orifice characteristics, and oil viscosity. Further with each stroke of the cylinder the oil lubricates the piston tube wall making the unit **100** self-lubricating. It provides a maximum of linear movement for minimum space requirement.

The piston unit **100** causes the roller **12** to be slowly moved until the web returns to its correct position or until the housing is moved to its limit of motion. In either case, when the web returns to its desired location the feeler **37** through the linkage returns the valve to its neutral position in which the air pressure in each line **70, 71** is equal.

As the cylinder housing moves, the carriage **15** moves and hence bearing **14** shifts the end of shaft **13** to cant or incline the roll **12** relative to the web **11**. It can readily be seen that when the cylinder unit's housing and movable carriage thus move, valve **65** moves therewith and consequently, although the palm linkage

functioned to initiate the movement, the movement of the valve relative to the linkage functions to return the rotor **90** to its normal position. Hoence, there is no tendency for the device to perform an overcorrecting action, the device having, what may be referred to, as a self-zeroing action.

Although the device comprising the present invention is shown as controlling the path of travel of a substantially horizontally moving web, and wherein the carriage moves in a substantially horizontal manner to effect such control, it is to be understood that a substantially vertically moving web may also be controlled merely by disposing the mechanism at right-angles to its shown position. To effect the control of such a vertically moving web the carriage **15** will, in response to the sensing mechanism, move in a substantially vertical manner. Similarly any intermediate angles may be provided for in practicing the present invention.

It is to be understood that the device comprising the present invention may be employed in guiding paper-forming wires and screens, traveling blankets, belts and the like all of which are referred to as "webs". For purposes of convenience and clarity, the four-way valve **65**, which functions as a control valve, is referred to in the appended claims as a "control valve".

ADVANTAGES OF THE INVENTION

As should now be apparent an improved web guide has been described and its mode of operation detailed. It should also be now appreciated that the above described invention offers a number of advantages over previous web guides including that described in the aforementioned U.S. patent. It should be apparent that the unit **10** provides a larger air piston area and, therefore, more power is available for the web guide using essentially the same space.

The use of a common single output rod prevents misalignment between the two rods required by previous web guides. Previously the air cylinder rods and hydraulic cylinder rods of such guides had to be parallel in these dimensions or the guide would bind.

Further, the combined cylinder unit has many less seals and wearing parts than previous units and more stability is insured because of the location of the air-oil seals and pistons to absorb thrust loading at the rods.

Because air may be bled from the cylinder at any point around the cylinder circumference this cylinder may be used in any position.

The construction allows for the use of high temperature seals of the Teflon and Viton types resulting in both lower friction and improvement of performance in high ambient temperature applications.

As the cylinder unit is positioned, the air cylinder tube is constantly being lubricated by the oil in the hydraulic cylinder. It is, therefore, essentially a self-lubricated cylinder and corrosion resistant materials may be used for all external parts: brass, bronze and stainless steels. Manufacturing difficulties in the previous two-cylinder design made this much more difficult. The invention thus provides a more powerful web guide that is easier to construct and maintain.

While a particular embodiment of the invention has been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from the invention in its broader aspects and, therefore, the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. Web guide apparatus wherein a guide roll in surface contact with a traveling web is shifted in response to the movement of a movable feeling device in contact with the lateral edge of the web, comprising the combination of a frame, a carriage movably mounted on the frame and carrying one end of the guide roll, a cylinder mounted on the carriage and movable therewith, a piston rod fixedly associated with said frame and extending through both ends of the cylinder, a double headed piston secured to said rod, slidably engaged in said cylinder and defining first and second chambers therwith, an area of reduced diameter around said piston between the ends thereof defining a third chamber between said piston and cylinder, means for supplying said third chamber with hydraulic fluid under pressure, barrier means for resisting flow of hydraulic fluid in said third chamber upon movement of said cylinder relative to said piston, valve means connected to said first and second chambers and having an inlet and an exhaust outlet, means for supplying said inlet with high fluid pressure, said valve means being operab le to supply fluid pressure to one of said first and second chambers while exhausting fluid pressure from the other of said chambers, and means connecting said movable feeling device to said valve means for operation thereof.

2. The apparatus of claim **1** wherein check valve means are provided on the inlet of said valve means for allowing flow of pressure fluid only into said valve means, whereby said cylinder is not moved by a sudden decrease in pressure fluid.

3. The apparatus of claim **2** wherein the means for supplying said third chamber with hydraulic fluid includes check valve means allowing flow only toward said third chamber.

4. The apparatus of claim **2** wherein the area of reduced diameter around said piston is in the shape of a torus, and said barrier means comprises a ring member extending from said cylinder and sealably and slidably engaging the reduced diameter portion of said piston and dividing said chamber, said ring member having a restricted orifice therethrough.

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