United States Patent

[11] 3,608,797

[72] Inventors **Thomas Hindle;**
David Dugmore Banks, both of Blackburn, England

[21] Appl. No. **780,086**
[22] Filed **Nov. 29, 1968**
[45] Patented **Sept. 28, 1971**
[73] Assignee **Hindle, Son and Company Limited**
[32] Priority **Nov. 30, 1967**
[33] **Great Britain**
[31] **54464/67**

[54] **SENSING MEANS FOR CONTROLLING FELT GUIDES**
13 Claims, 12 Drawing Figs.

[52] **U.S. Cl.** **226/22**
[51] **Int. Cl.** **B65h 23/26**
[50] **Field of Search** 162/257, 262, 263, 198; 226/19, 22; 137/83; 73/37.7

[56] **References Cited**

UNITED STATES PATENTS

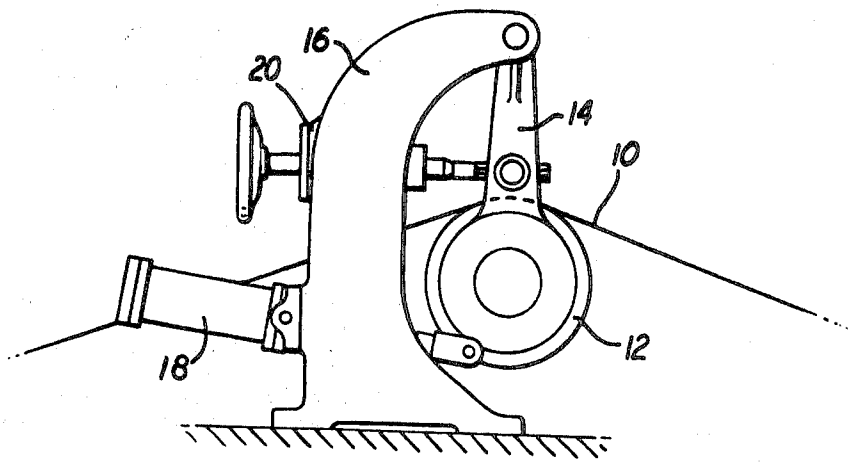
3,159,170	12/1964	Callan	226/22 UX
3,260,434	7/1966	Jacobsen	226/22 X

FOREIGN PATENTS

118,072	4/1929	Austria	226/22
561,539	8/1958	Canada	226/22

Primary Examiner—Allen N. Knowles
Attorney—Roberts, Cushman & Grover

ABSTRACT: Sensing means comprising two nozzle outlets from which jets of fluid medium can issue, supported in relation to a web travelling over a pivotally supported guide roll which is adapted to be slewed relative to one end to correct wandering of the web by a motor and linkage connecting the motor to one end of the guide roll, said nozzle outlets being positionable in relation to the web so that when the web is moving along its normal course one or both nozzle outlets may or may not be interrupted by the web, and a detector on which the jets from the nozzle outlets fall when not interrupted by the web, said detector being operable to effect operation of the motor in a direction to effect compensating slewing of the guide roll.



PATENTED SEP 28 1971

3,608,797

SHEET 1 OF 6

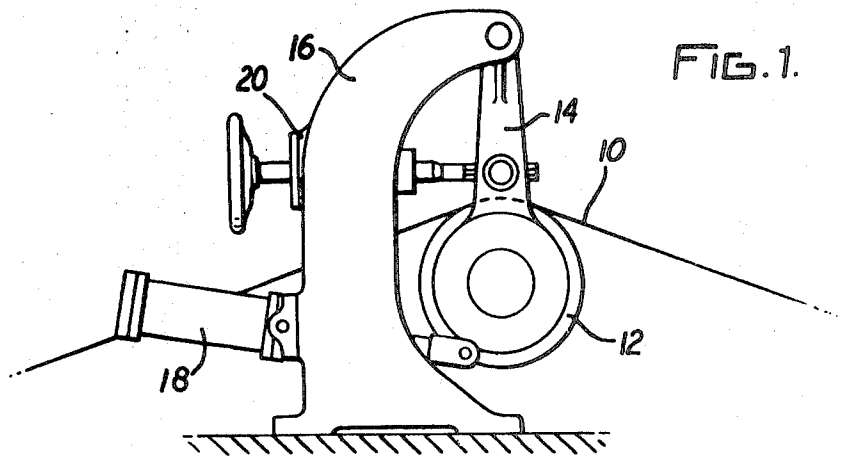


FIG. 1.

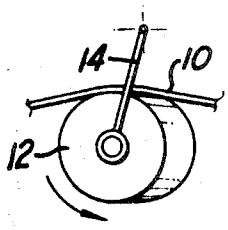


FIG. 2a.

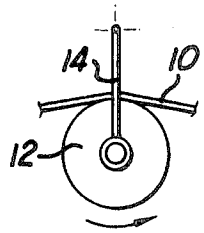


FIG. 2b.

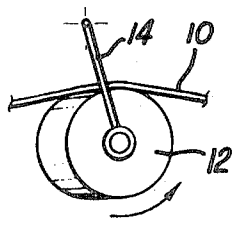


FIG. 2c.

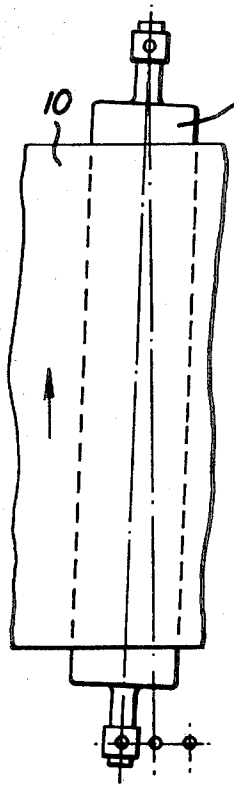


FIG. 3a.

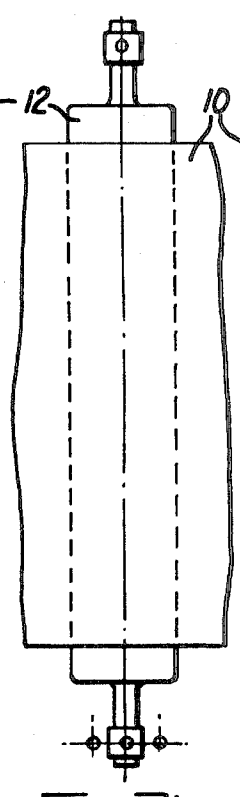


FIG. 3b.

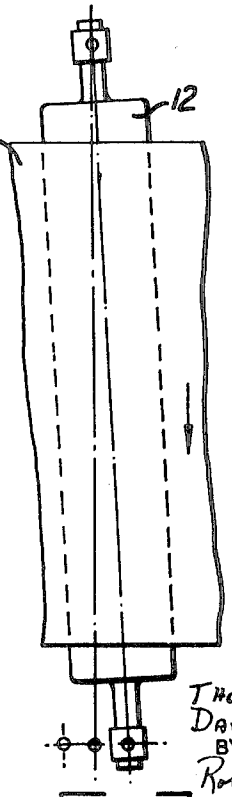


FIG. 3c.

INVENTORS
THOMAS HINDLE
DAVID DUCHMORE BANKS
BY
Robert Cushman & Grove
ATTYS

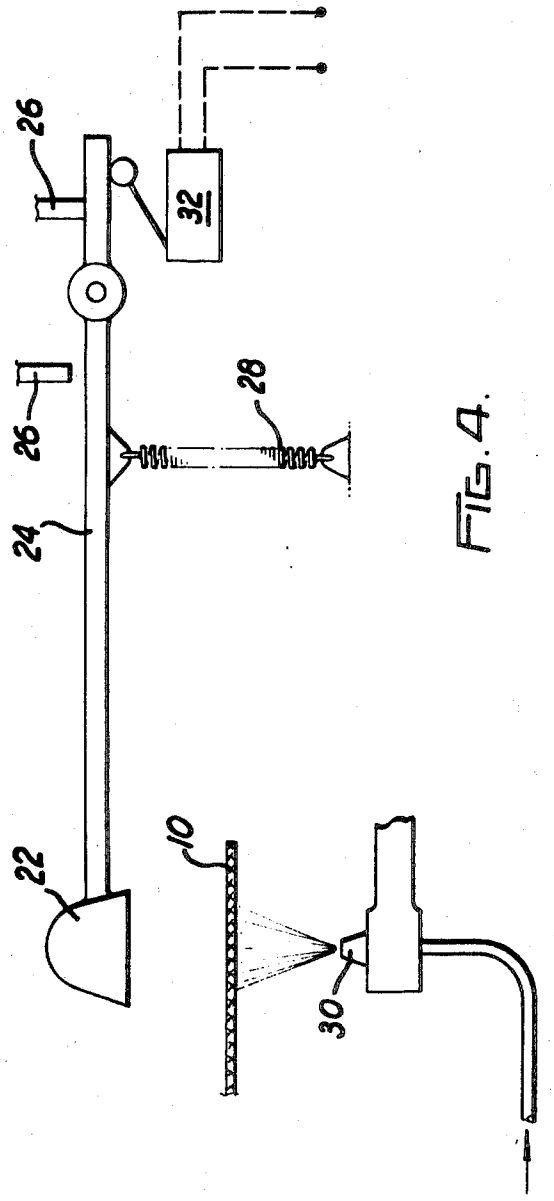


FIG. 4.

INVENTORS
THOMAS HINDLE
DAVID DYCMORE BANKS
BY
Roberts, Cushman & Grover
ATTYS.

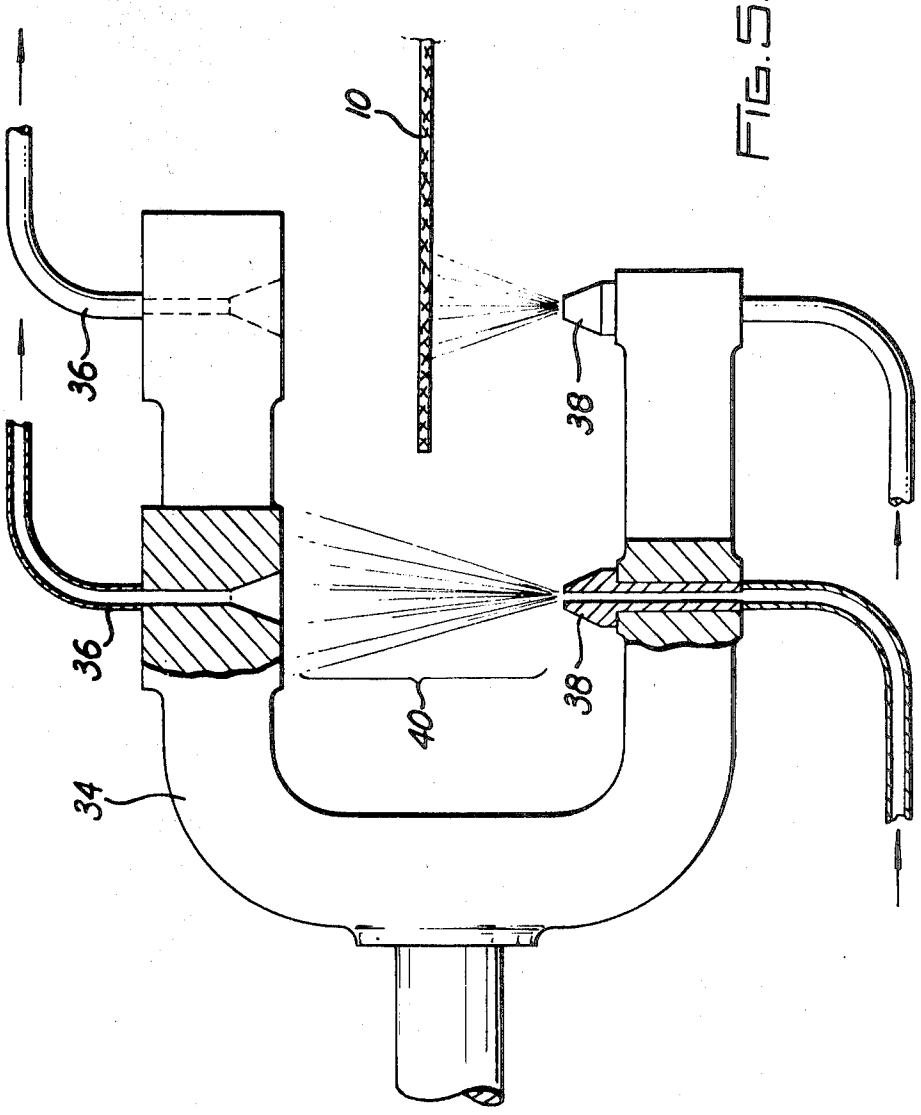


FIG. 5.

INVENTORS
THOMAS HINDLE
DAVID DYGMORE BANKS
BY
Roberts, Cushman & Grover
ATTYS

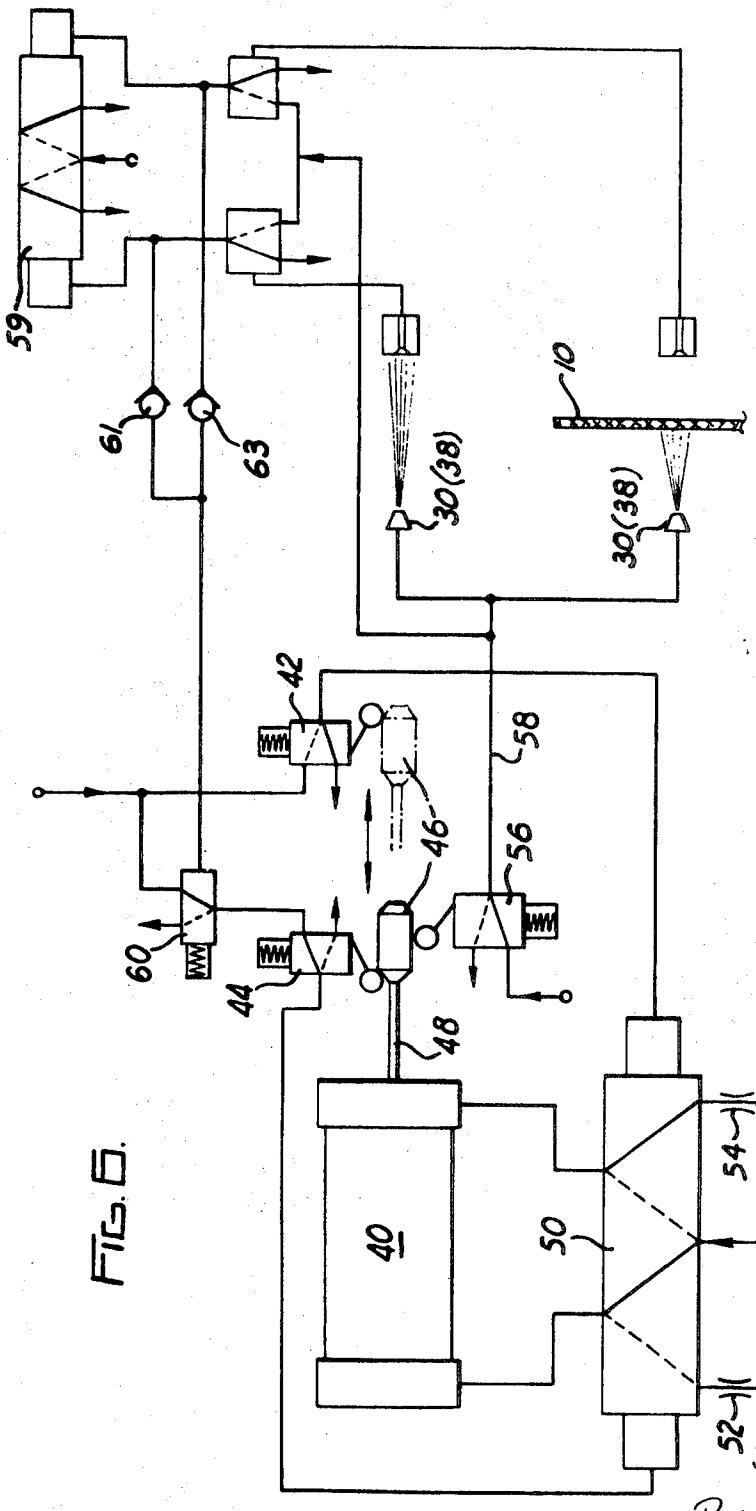
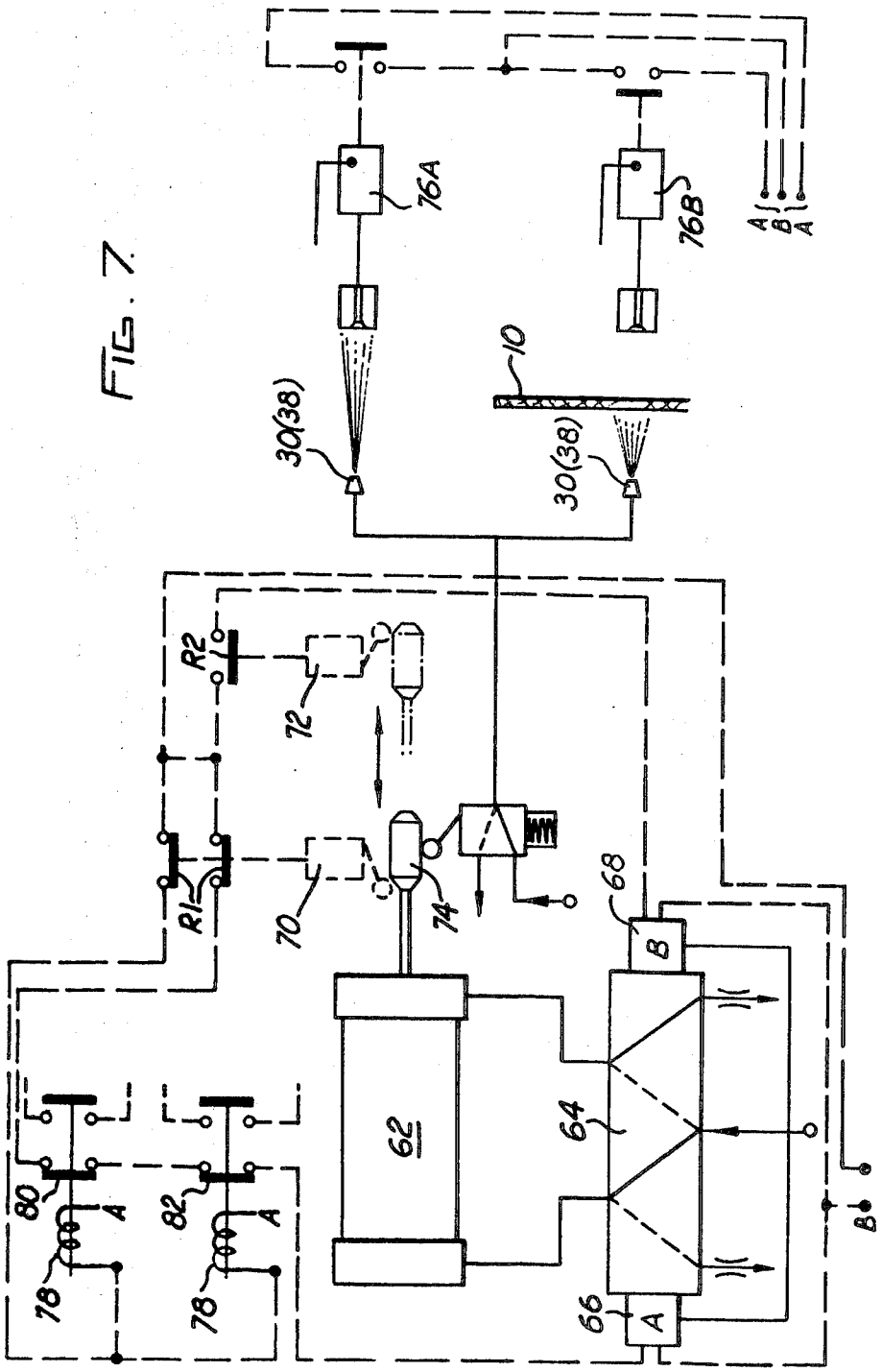


FIG. 6.

INVENTORS
THOMAS HINDLE
DAVID DUCHORE BANKS
BY
Roberts, Cushman & Grover
ATTYS.

FIG. 7.



INVENTORS
THOMAS HINDLE
DAVID RUGMORE BANKS
BY
Roberts, Cushman & Grover
ATTYS.

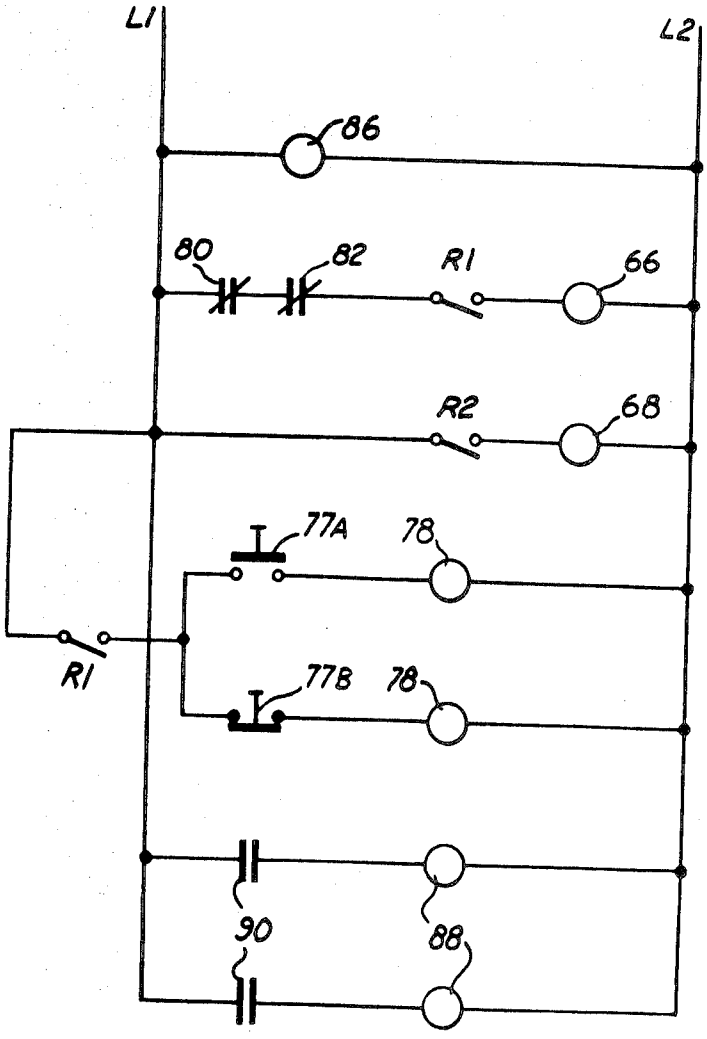


FIG. 8.

INVENTORS
THOMAS HINDLE
DAVID DUGMORE BANKS
BY
Roberts, Cushman & Grover
ATTYS.

SENSING MEANS FOR CONTROLLING FELT GUIDES

Fundamentally, such guiding mechanisms consist of a guide roll (or roller) which is friction driven by the travelling felt. Usually the angle of wrap of the felt round the periphery of this roll ranges between 20° and 40° according to the frictional characteristics of the surface of the roll and the contacting face of the felt. The guide roll is mounted in free-running bearings and is adapted to be forcibly slewed over, in the mean plane of the felt at that point, out of parallelism with the other rolls over which the felt runs in its endless course, in such a manner as to steer the wandering felt back to its midway or normal running track. The movement of the roll is controlled by sensing apparatus which senses the position of the felt, and upon detection of a wandering of the felt from the normal running track, the roll is slewed as aforesaid to cause the felt to return to its normal running track.

In one well known, but now obsolete form, of guiding mechanism, the guide roll is displaced to a variable degree out of parallelism by mechanical means actuated by the edges of the wandering felt, each of which was adapted to ride more or less on a side pulley which was thereby rotated sufficiently to slew over the guide roll to the degree necessary to prevent further deviation of the felt from its intended or normal track.

More commonly, some form of servomechanism has been employed to slew the guide roll under control of a hinged spade or feeler urged by spring pressure against one edge of the felt. In all the above forms of felt guide, however, the guide roll's displacement from parallelism, i.e., angle of slew, is graded according to the extent by which the felt, at any given moment, is deviating from its intended running track. In operation, therefore, such guide rolls assume a floating position and remain continuously out of parallelism, thereby serving merely to resist the felt's further deviation from its intended track.

Such continuous one-way guiding action between the guide roll and the felt increases the rate of abrasive wear of that face of the felt which runs in frictional contact with the guide roll, and also causes the felt structure to be more or less permanently distorted out of its original longitudinal and transverse straightness, thereby necessitating progressively intensified guiding action, with the consequence that the useful life of the felt is seriously impaired. In some cases, the permanent distortion so acquired may render the felt totally unguidable, although it is otherwise apparently fit for further useful service.

The above-described drawbacks are obviated or very appreciably diminished by the construction and method of operation of the guiding mechanism disclosed in U.S. Pat. No. 3,043,153, which is characterized by the following distinctive features:

a. The guide roll is retained in its neutral or approximately parallel position by suitable centralizing spring pressure so long as the felt does not wander beyond a prescribed limit on either side of its midway or normal running track, such neutral position of the guide roll being preset by suitable adjustment of a handwheel.

b. If, however, the felt wanders sideways beyond the prescribed limit, the guide roll is automatically slewed over in the appropriate direction to steer the felt back to its normal track, such slewing movement of the guide roll in either direction being effected by a double-acting slave cylinder suitably powered by compressed air, so as to overcome the pressure of the centralizing spring and to slew over the guide roll in the appropriate direction to the full extent provided (such extent being adjusted to suit the working conditions) thereby ensuring a prompt response by the felt to the steering action of the guide roll.

c. As soon as the felt has been guided back to its mid way or normal running track, the slave cylinder is deenergized and the guide roll is automatically returned to its neutral or approximately parallel position under the urge of the centralizing spring. If this neutral position is well chosen, the guide roll occupies that position for some 80 percent or more of the running time, and is only occasionally slewed over in one direction or the other for relatively short guiding operations. This distinctive method of operation minimizes surface abrasion of the felt and the tendency to permanent distortion of its structure, which are both accentuated when the method of operation entails the guide roll assuming a continuously slewed position in one direction.

d. According to the said British Pat. No. 899,001, the wandering of the felt from its midway or normal running track is sensed by a hinged feeler or spade which is spring pressed against one edge of the felt and adapted to actuate a control valve and thereby to pressurize the slave cylinder in the particular manner described.

e. Alternatively, according to the said U.S. Pat. No. 3,043,153, the wandering of the felt is sensed by photoelectric means wherein two light rays are suitably located so as to be interrupted or not, singly or both together, by one edge of the felt, and the control valve is thereby actuated by electric solenoids so as to pressurize the slave cylinder in the particular manner described. This photoelectric sensing means is preferred because it avoids all physical contact, and thus the inevitable abrasive wear which is caused by a feeler or spade rubbing against the edge of the felt.

The object of the present invention is to provide alternative sensing means for sensing the wandering of a travelling web such as a felt or fourdrinier wire from its midway or normal running track, such means avoiding all abrasive action on the felt or wire and serving to actuate the means, such as the slave cylinder of the felt guide described in British Pat. No. 899,011, for slewing the guide roll.

According to the present invention there is provided sensing means for sensing the wanderings of a travelling web, such as a papermakers felt or a fourdrinier wire, which passes over a guide roll equipped with means for slewing such roll to correct the web wanderings, said sensing means comprising two nozzle outlet means from which jets of a fluid medium, preferably compressed air or water can issue, said outlet means being positionable in relation to the travelling web so that when same is running in its normal track, one or both of the jets may or may not be interrupted by the web, and detector means onto which the jets fall when not interrupted by the web, and which supply the signals to control the means for slewing the guide roll.

Thus, it will be appreciated that with the jets suitably positioned in relation to the web, if the web wanders off its normal track a jet will either be interrupted or the interruption of a jet will be removed but in either case, a signal is delivered to the slewing means to affect slewing of the guide roll to correct the web wandering.

In adapting this sensing means to a felt running on a paper machine, it is preferable to space the jet nozzle outlets and their associated detectors sufficiently far apart to ensure that these components are not fouled by the felt or it seam. In a paper machine the gap or clear distance between the nozzle outlets and the detectors requires to be between 3 and 6 inches, or thereabouts, depending upon the tension of the felt and the distance between the adjacent felt carrier rolls on each side of the sensing location.

Furthermore, the jets of fluid require to have a rate of flow, and an initial velocity and sense of direction such as will ensure that they are not appreciably deflected by incidental draughts, including that caused by the high-speed movement of the felt itself. These requirements make the use of compressed air preferable in the application, for example, at a pressure high enough to ensure that the sensing jets (when not interrupted by the intervening felt) reliably cross the gap between the nozzle outlets and their respective detectors.

Preferably, the sensing means incorporates a cutoff or jet timer means which, when effective, cuts off intermittently the flow of fluid from the nozzle outlets, in order to economize in the fluid medium.

The invention also resides in an automatic guiding mechanism for a travelling web such as a papermakers felt or a fourdrinier wire including a guide roll over which the web passes and which is slewable by means for slewing the roll to correct web wanderings, and sensing means as aforesaid operatively connected to such slewing means.

The invention furthermore provides a papermaking machine with an automatic guiding mechanism as aforesaid.

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, wherein:

FIG. **1** is a side elevation of a guide roll of an automatic guiding mechanism for an endless travelling papermakers felt or fourdrinier wire;

FIG. **2***a*, *b* and *c* show diagrammatically, and in side elevation, the positions which can be taken up by the guide roll during the course of travelling of the felt; while

FIGS. **3***1*, *b* and *c* show plan views respectively corresponding to the roll positions shown in FIGS. **2***1*, *b* and *c;*

FIG. **4** shows diagrammatically part of a sensing means according to a first embodiment of the invention;

FIG. **5** shows diagrammatically a sensing means according to a second embodiment of the invention;

FIG. **6** shows diagrammatically the components of the one embodiment of a jet timer or cutoff means;

FIG. **7** shows diagrammatically the components of another embodiment of a jet timer or cutoff means; and

FIG. **8** is a wiring diagram for the circuit used in the jet timer means shown in FIG. **7**.

Referring firstly to FIG. **1** the travelling felt or wire is indicated at **10** and is guided over a guide roll **12** which is carried in bearings on the lower ends of suspension arms **14** which are pivotally connected at their upper ends to suspension brackets **16**.

One of said brackets **16** has slewing means for slewing the guide roll **12** to one side or the other as clearly indicated in FIGS. **2***a—c* and **3***a —c*, and such slewing means comprises a double-acting pneumatic slave cylinder **18**. The same bracket **16** also carries a centralizing means **20** for returning the roll **12** quickly to a mean position after the supply of pressure air to the slewing cylinder **18** has been removed.

The supply of pressure air is through a distributor control valve which when actuated, and depending upon its position, directs pressure air to one side or the other of cylinder **18** causing slewing of roll **12** to one side or the other as shown in the FIGS. **2***a—c* and **3***a—c*.

The roll **12** is slewed as previously explained to correct wanderings of the felt **10** from its normal track and the signals which indicate such wanderings are utilized to position the distributor to ensure that the roll **12** is slewed in the correct direction. The distributor valve may be moved by mechanical means, pressure fluid, or electromechanical means such as solenoids.

The above elements are clearly described and illustrated in U.S. Pat. No. 3,043,153, and reference may be had to such patent for a further understanding of the elements illustrated.

Referring now to FIG. **4**, the part of the sensing means shown is one of the nozzle outlets and an associated detector means, but it will be understood that there are two such units associated with the edge or edges of the felt **10** to sense wanderings of such felt **10** in both directions.

Each detector means consists of a vane or cup **22** secured to the outer end of a hinged lever **24**, the angular movement of which lever **24** is limited in both directions by suitable stops **26**. The weight of the lever **24** and its cup **22** is partially counterbalanced by a spring **28** (or equivalent weight) so as to be responsive sensitively to the normal pressure due to the impact of the jet from the nozzle which is indicated by the numeral **30** or the absence thereof, on the cup. The cup lever **24** is adapted to actuate the changeover contacts of a microswitch **32** in response either to the steady impact of the jet on the cup, or by its absence due to the jet being interrupted by the intervening felt **10**. The two jets and detectors are employed to actuate, by electromagnetic or other means, the distributor control valve of the guide roll's slewing cylinder in the general manner and with the effect described in U.S. Pat. No. 3,043,153.

In the embodiment of the sensing means according to the invention as shown in FIG. **5**, the nozzle outlets and detector means are carried in the respective limbs of a U-shaped bracket **34**, such limbs lying on opposite sides of the felt **10**. The detectors in this case are pitot tubes **36** and the nozzles are indicated by **38**. Each jet issuing from a nozzle **38**, when not interrupted and thereby deflected by the intervening felt **10**, is sensed by the opposed pitot tube **36** located in axial alignment with the nozzle **38** and suitably spaced therefrom to provide the necessary gap **40**. Each such pitot tube **36** is connected to a sensitive pressure-actuated changeover switch (not shown in FIG. **5**) which, as in the previous example, is employed to actuate, by electromagnetic or other means, the control valve of the guide roll slewing cylinder.

In a modification of the embodiment described in relation to FIG. **5**, each such pitot tube **36** is connected by piping to a sensitive pressure-actuated valve. These two pressure-actuated valves are adapted to actuate the control valve of the guide roll slewing cylinder. In this case, the control valve is of the pilot type, capable of being shot over in one direction or the other by fluid pressure. This particular variation of the invention is preferred for some applications because it relies solely upon pneumatic components.

Any of the above forms of the invention may readily be adapted for operation in response to jets either of compressed air or water supplied under pressure from any convenient source. In practice, however, compressed air jets are preferred for dryer felts and water jets for wires, while either air or water jets are suitable for wet felts.

Reference has already been made to the necessity to employ compressed air at a pressure sufficiently high to ensure effective sensing response across a gap of 3 to 6 inches or thereabouts. The operating principle of the felt guide described in U.S. Pat. No. 3,043,153 is ideally suitable for operation in combination with ancillary means for economizing in the consumption of the fluid jet medium, i.e., the compressed air, by the sensing jets, because the guide roll remains stationary in its neutral position for relatively long periods at a time, only occasional guiding action being required.

The sensing air jets may, therefore, be controlled by cut off means so that they operate intermittently, so long as the felt continues to run in its normal track, on the basis, for example, of 5 seconds on, and 25 seconds off, thereby effecting a saving of some 80 percent in jet air consumption. It is preferred, however, that the jets be restored to continuous operation when the felt has wandered sideways sufficiently to initiate corrective guiding action, only reverting to the routine intermittent operation after the felt has been guided back to its normal running track.

The above-described economical control of the jet air is provided by an ancillary cut off means hereinafter referred to as the jet timer of which two possible embodiments, any one of which may be used with any of the embodiments of the sensing means as hereinbefore described, are shown in FIGS. **6** and **7**.

The jet timer shown in FIG. **6** consists of a cylinder **40** with a double-acting piston which is powered by compressed air under the control of a pair of trip valves **42**, **44**, each of which is actuated, in turn, by a linear cam **46** fixed on the end of the protruding piston rod **48**. The trip valves **42**, **44** in turn momentarily pressurize the springless reversing valve **50** which is thereby shot over first in one direction and then in the other, so providing continuous reciprocation of the piston of cylinder **40** and the linear cam **46**. The number of double strokes per minute made by the timer piston is readily adjustable to suit requirements by means of variable chokes **52**, **54** fitted to the exhaust ports of reversing valve **50**.

The said linear cam **46** also serves to actuate a valve **56** connected in the pipeline **58** supplying compressed air to the jet nozzles **30** or **38**, but this valve **56** is held open by the cam **46**

only when the piston of cylinder 40 is within a short distance from the end of its stroke in one particular direction. Throughout the remainder of the outer stroke and the corresponding part of the subsequent inner stroke, valve 56 thus remains closed, and the air supply to the jet nozzles is cut off. The relative timing of the open and closed periods is readily adjustable by suitable displacement of the valve 56 relative to the stroke of the linear cam.

The piston of cylinder 40 (and therefore the cam) may be caused to stall at that end of the stroke where the cam 46 holds the jet valve 56 open. This stalling is effected by a pressure-sensitive valve 60 which, when and so long as pressure air is admitted to either end of the guide roll slewing cylinder 18 blocks the action of the appropriate trip valve 44.

In normal operation, therefore, the timer piston in cylinder 40 reciprocates continuously at a suitably adjusted rate of double strokes per minute, and provides an intermittent supply of compressed air to the sensing jet nozzles just so long as the felt 10 remains in jets normal track. When, however, the felt wanders sufficiently far sideways to initiate corrective guiding action, slewing slave 18, control valve 59 has pressure air applied to one end and such pressure air, through a check valve 61 or 63 positions the pressure-sensitive valve 60 to cause blocking of the appropriate trip valve 44 and the timer piston in cylinder 40 stalls at that end of its stroke where the jet valve 56 is held open, so providing a continuous supply of air to the sensing jet nozzles 30 or 38.

As soon as the felt 10 has been guided back to its normal track, both ends of the slave cylinder are opened to exhaust (to permit the spring to centralize the piston and the guide roll) whereupon the said pressure sensitive valve 60 opens and allows the piston 40 to resume its continuous reciprocation and the sensing jet nozzles to revert to their intermittent operation.

In the jet timer in FIG. 7 the timer piston 62 is controlled by a springless reversing valve 64 provided with twin solenoids 66, 68, each of which is momentarily energized in turn at the ends of the piston stroke by one of the pair of trip switches 70, 72 actuated by the linear cam 74. In this variation, the timer piston is stalled by the action of pressure-sensitive switches 76A and 76B which cause energization of one of two control relays 78 which opens isolating contacts 80 or 82 thus opening the circuit of reversing solenoid 66 when and as long as either end of the guide roll slave cylinder is pressurized.

The wiring diagram for the jet timer shown in FIG. 7, is shown in FIG. 8 and it will be seen clearly that assuming that there is no wandering of the felt 10 so that the isolating contacts 80, 82 remain closed as the piston in cylinder 62 reciprocates back and forth so reversing switches R1 and R2 are alternately closed causing alternate actuation of solenoids 66 and 68 and therefore reciprocation of reversing valve 64.

Should however, wandering of felt 10 take place such that pressure switch 76A or 76B is actuated to close contacts 77A or 77B and cause energization of one of relays 78, so isolating contacts 80 or 82 will be opened and solenoid 66 will be deenergized, resulting in that the piston of cylinder 62 is stalled in the position shown with the jet valve 74 (FIG. 7) open to allow the pressure air to be continuously supplied to the nozzles until the wandering of felt 10 has been corrected, in which case, the contacts of switch 76A or 76B are opened, the appropriate control relay 78 deenergized so that solenoid 66 again becomes energized and reciprocation of the reversing valve 64 and piston of cylinder 62 continues.

An indicator lamp 86 is connected across the electrical supply to indicate that a potential exists across the circuit.

The solenoids 88 and contacts 90 shown in FIG. 8 are for controlling the position of the slave cylinder control valve and are operated by contacts 77A and 77B.

In order to avoid erroneous sensing of the sideways position of the felt when and so long as the air jets are suspended, the cam actuated jet air valve 56 or 76 may also control the supply of compressed air to the control valve of the guide roll slave cylinder, thereby ensuring that this latter cannot be energized while the sensing jets are cut off. Alternatively, a separate valve similarly cam actuated may be used for this purpose.

When air jets are used as a means of sensing the sideways wandering of a felt or the like, the above described jet timer is a useful ancillary or complementary component because of the economy it effects in the consumption of compressed air by the jets. Furthermore, due to such economy, the jet air may readily be at a pressure amply high enough to ensure reliable actuation of the detectors.

When water jets are used, in a similar manner in respect to wet felts or fourdrinier wires, the water for the jets is preferably supplied under pressure by a continuously running pump, and consequently there is no particular advantage to be gained in this case by intermittent operation of the jets.

What we claim is:

1. Sensing means for sensing the wanderings of a travelling web which passes over a guide roll equipped with means operable in response to signals for slewing such guide roll to correct the web wanderings, said sensing means comprising two nozzle outlet means from which jets of a fluid medium can issue, said outlet means being positionable in relation to the travelling web so that when the web is running in its normal course one or both of the jets may or may not be interrupted by the web, detector means onto which the jets fall when not interrupted by the web for supplying signals to the means for slewing the guide roll to effect its operation, and jet timer means for insuring that the jets of fluid issue from the nozzle outlets intermittently during the operation of the sensing means.

2. Sensing means according to claim 1, wherein the detector means comprises two lever arms which are deflectable by the jets from the nozzle outlet and switch means actuatable by such deflection of the lever arms.

3. Sensing means according to claim 1, wherein said detector means comprises two pitot tubes and two pressure-sensitive switches operatively connected thereto.

4. Sensing means according to claim 1, wherein the jet timing means includes a pneumatic cylinder with a reciprocable piston which carries a switch actuating member, reversing switches which are actuated by said switch actuating member during reciprocation to cause reciprocation of a pilot valve which controls the flow of pressure air to the cylinder, and a jet valve which is opened by said valve actuating member for a part of the period of the reciprocation of the piston, said jet valve being in the pressure fluid supply line to the nozzle outlets.

5. Sensing means according to claim 4, wherein the jet timer means includes isolating means such that the pressure fluid issues continuously from the jet nozzle outlet when a web wandering has been detected and until it is corrected.

6. Sensing means according to claim 4, wherein the reversing switches operate pneumatic valves to cause pressure air to be applied in turn to the ends of the pilot valve.

7. Sensing means according to claim 4, wherein the reversing switches operate solenoids connected to the respective ends of the pilot valve.

8. Sensing means according to claim 5, wherein said isolating means includes a check member which is operated as a result of the sensing of a wandering of the web and when so operated prevents any displacing force from being applied to the end of the pilot valve so that the piston is stalled in a position in which the jet valve remains opened.

9. Guiding means according to claim 1, wherein the slewing means comprises a slave cylinder which is double acting so that the roll can be slewed to either side of a mean position.

10. Guiding means according to claim 9, including a control valve which controls the supply of pressure fluid to the slave cylinder.

11. Guiding means according to claim 10, wherein the sensing means is coupled to the control valve to control the positioning of same by pneumatic or electromechanical means.

12. Guide means according to claim 1, including centralizing means acting on said guide roll so that when the supply of pressure fluid to the slewing cylinder is cut off the guide roll is returned to the mean position by said centralizing means.

13. Guide means according to claim 12, wherein there is means pivotally supporting one end of the guide roll and means suspending the other end of the guide roll for movement forwardly and rearwardly in the plane of the course of the web, said latter means comprising a link pivotally supported at its upper end and containing intermediate its ends a journal in which said other end of the roll is supported, and wherein the slewing means and centralizing means are connected to said link, respectively, below and above the axis of the guide roll.