United States Patent [19]

Alsted

[11] **3,710,927**

[45] **Jan. 16, 1973**

[54] BELT ALIGNING APPARATUS

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[52] **U.S. Cl.** **198/202,** 226/23

[51] **Int. Cl.** **B65g 15/62,** B65h 25/26

[58] **Field of Search** 198/202; 226/15–23

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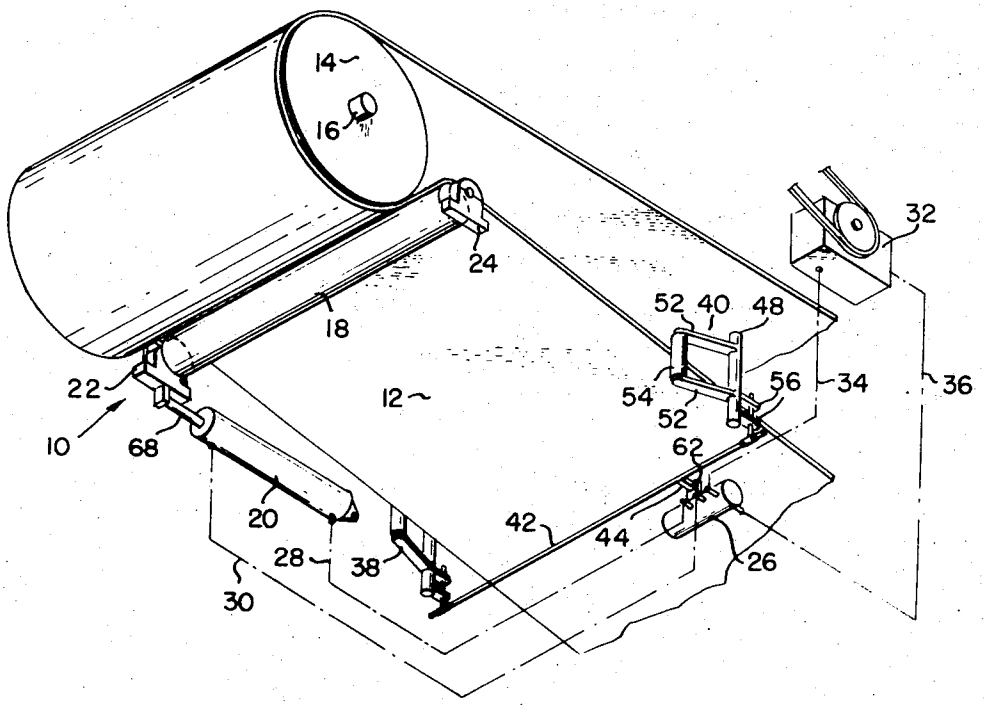
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[57] **ABSTRACT**

An adjustable roller disposed adjacent the drive roller of a belt system such that an endless belt runs thereover. A fluid actuator connected to one end of the adjustable roller and adapted to pivot the roller about its opposite end. Sensor arms including an elongate sensing portion mounted on opposed sides of the continuous belt, each sensor arm adapted to pivot about a point between its ends. The end of the elongate sensing portion of each sensor arm is disposed adjacent an edge of the endless belt while the other end of each sensor arm is adjustably connected to the ends of a longitudinal rod extending transverse the path of the endless belt. The transverse rod is interconnected at a point intermediate its longitudinal ends to a hydraulic control valve, which valve is, in turn, connected by conventional means to the fluid actuator.

8 Claims, 6 Drawing Figures



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SHEET 1 OF 2

FIG. 1

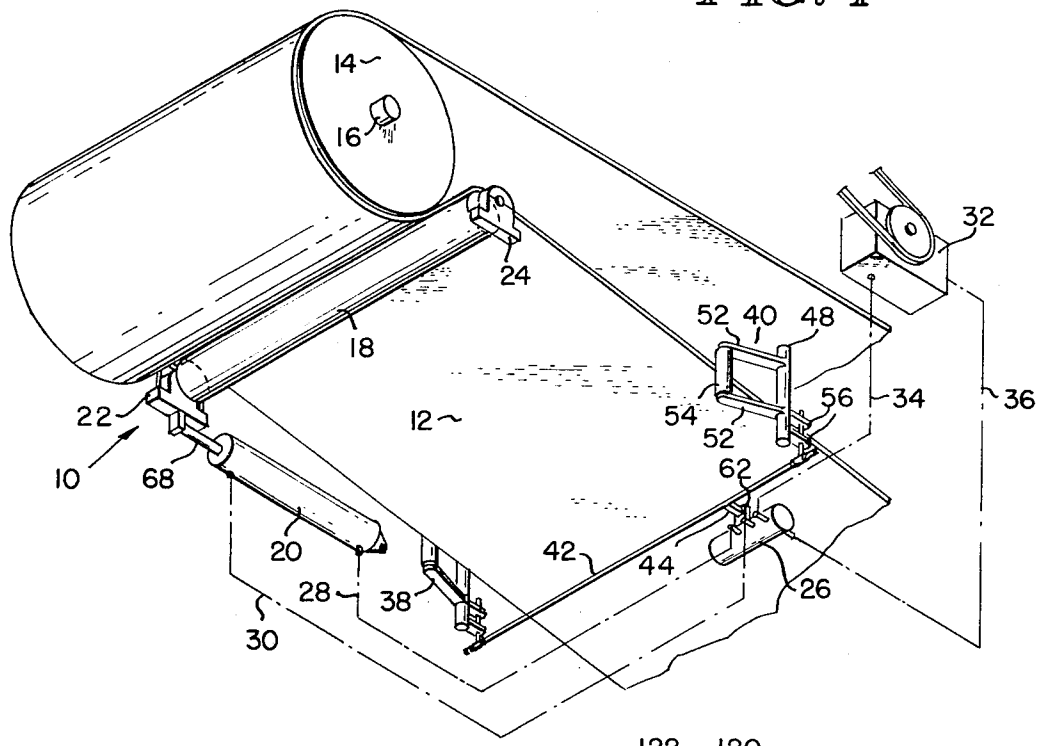
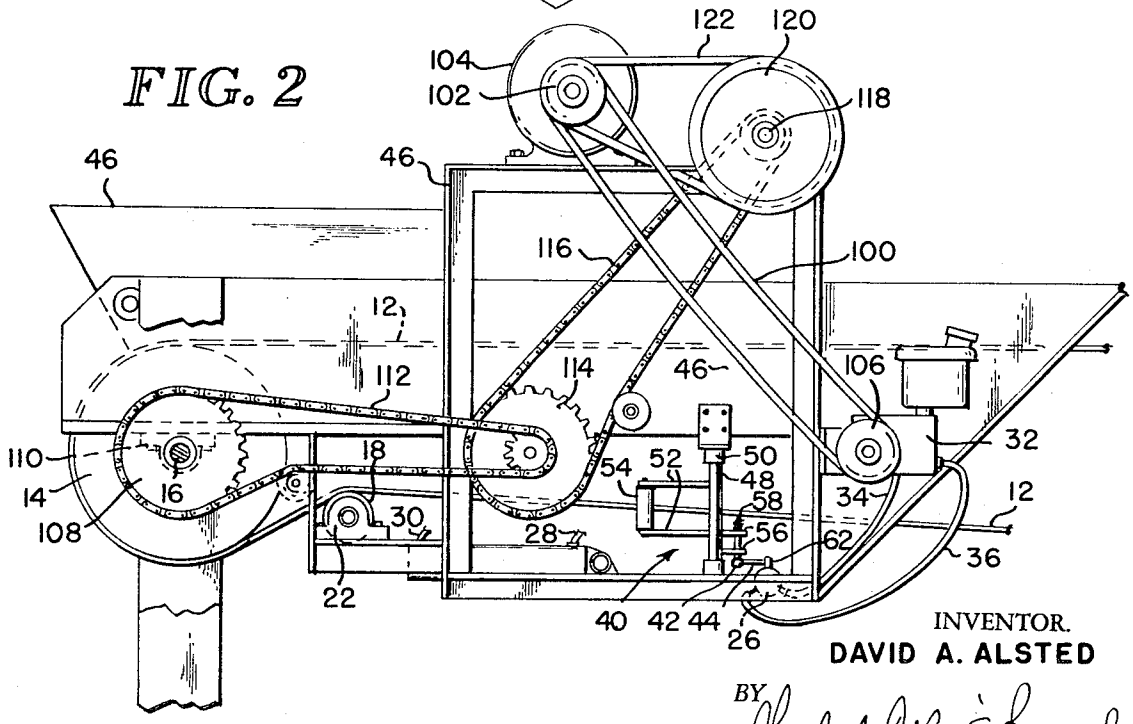


FIG. 2



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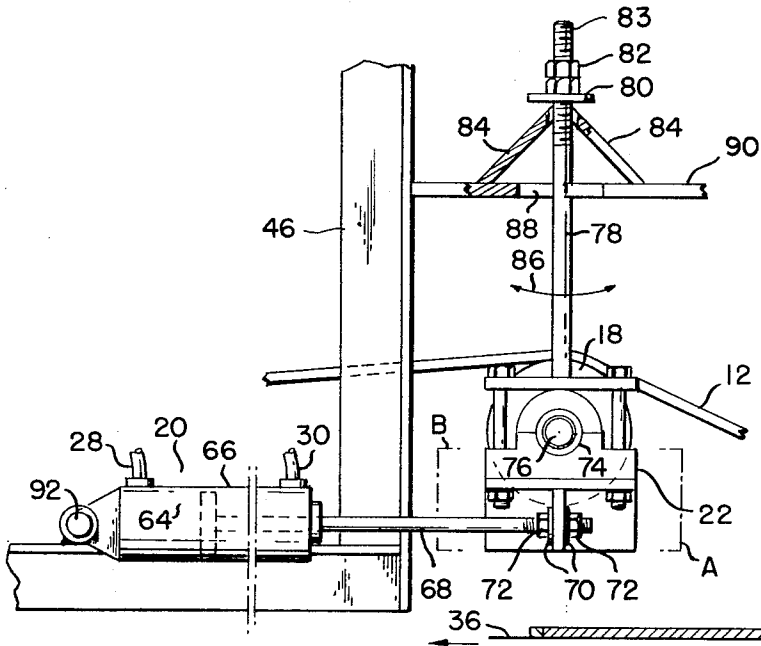


FIG. 3

FIG. 3A

FIG. 4

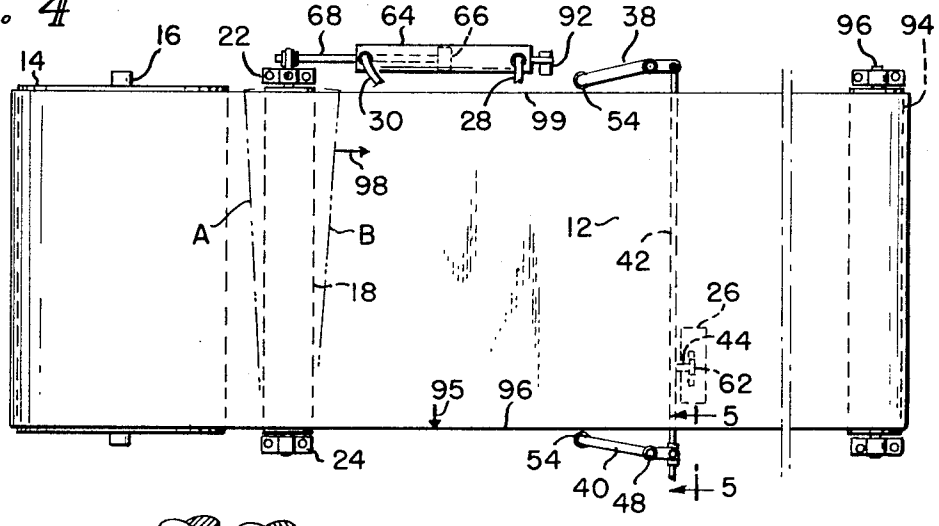
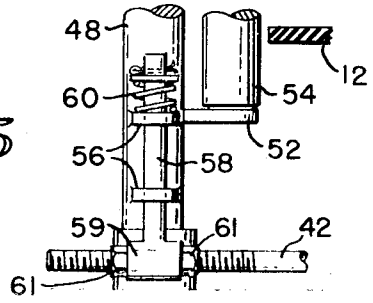


FIG. 5



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BELT ALIGNING APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates, in general, to apparatus for maintaining the alignment of an endless belt on a system of drive and support rollers on which it is trained, and in particular, to low pressure hydraulic apparatus for realigning an endless belt by pivoting a roller over which the endless belt runs in response to the misalignment of the belt as read by sensor arms disposed on opposite sides thereof.

2. Description of the Prior Art

Belt systems comprising endless belts trained on a plurality of rollers, at least one of which drives the belt about or over the others, are well known and are often used to convey bulk items such as farm produce, grain, sand or gravel. It is also well known that endless belts driven on systems of this type have a tendency to wander longitudinally with respect to the rollers on which they run. This longitudinal movement, if unchecked, allows the edge of the belt to run off the rollers and rub against the roller support apparatus or the like, often causing the edges of the belt to be ripped and frayed thereby requiring premature replacement of the belt. Although belt systems of the type considered herein are employed on many types of conveyor apparatus, and understanding that this invention is not intended to be limited to any particular apparatus, it will be convenient to discuss this invention with reference to particular equipment, namely, farm equipment such as potato pilers wherein a neoprene, cotton thread reinforced, food handling belt, for example, is entrained about a drive roller which pushes the belt over a plurality of support rollers to carry a steady stream of potatoes to a storage bin, transport vehicle or the like. Belts for this type apparatus often cost approximately $400.00, and in the past during normal use, replacement has been necessary at least once or twice a year due to excessive edge wear caused by the belt running off its support rollers. Misalignment or "wander" of the belt with respect to the rollers on which it runs may be caused by debris working its way between the belt and the rollers thereby affecting the lay of the belt on the rollers; movement of the boom on which the belt runs to distribute the stream of material within the storage area or transport vehicle; or finally, uneven loading of the material conveyed on one side of the belt or the other.

Hydraulic apparatus for maintaining the alignment of belts on rollers of a variety of designs are known. For example, Johnson, U.S. Pat. No. 2,914,957 discloses a training mechanism for belt systems wherein wide metal belts operate under stresses exceeding 85,000 psi. In particular, the Johnson patent discloses hydraulic cylinders and pistons connected to the opposed ends of an axle upon which a belt roller is mounted. These cylinders and pistons are adapted to simultaneously tilt or skew both ends of the roller about a point intermediate its ends to realign a wandering belt. A single feeder mechanism for sensing wander of the belt is resiliently mounted to continually contact a single edge of the belt, and it will be understood that in order to move the belt in a direction toward the feeler mechanism the resilient force of spring 41 (FIG. 1) must first be overcome. In the Johnson mechanism,

tensioning members 18 and 19 (FIG. 1) which substantially parallel the hydraulic cylinders and pistons are additionally necessary to regulate the tension on the belt.

Cruickshanks, U.S. Pat. No. 2,777,331 discloses apparatus particularly related to guiding the "wire" of a Fourdrinier paper making machine. Palm guides *m* (FIG. 2) are disposed on each side of the band to be guided and are mounted on a shaft connected through a mechanical linkage to a valve which governs the movement of a pair of hydraulic rams mounted on opposite sides of one end of a roller axle. The Cruickshanks apparatus is peculiarly suited for use with a belt having an uneven edge or "high" part (column 3, line 29), a feature apparently peculiar to the bands of Fourdrinier machines. In Cruickshanks, the hydraulic rams are demotivated before the edge of the belt allows the palm to return to its original position thereby checking the tendency of the apparatus to "hunt" although the result is a minor permanent relative displacement of the palms from their original position (column 3, lines 43–50).

Finally, Hoffman U.S. Pat. No. 3,119,535 discloses apparatus for correcting the unwanted lateral movement of a steel strip during processing. In Hoffman, a relatively complicated misalignment sensing apparatus including a laterally movable carriage mounted on a fixed support overlying the path of travel of the steel strips is provided. The strip edge rollers 10 and 13 (FIG. 1) are positively biased to contact the strip edges by means of cables 15 and counterweights 17. To eliminate constant hunting or shifting, Hoffman provides a connecting rod 28 (FIG. 1) extending generally between the control valve and the correcting roll such that movement of the correcting roll initiated by the valve causes connecting rod 28 to, in turn, pivot the control valve relative to its core to close the valve.

From all of the above, it will be understood that the aligning of belts or the like by skewing one or more carrying rolls is, as such, old in the art, and, as described hereafter, it is in the unique arrangement and operation of the belt alignment sensing apparatus and the interconnected pivoting roller means that the present invention lies.

BRIEF SUMMARY OF THE INVENTION

The present invention includes apparatus for use in combination with a conventional belt and roller system and includes a roller adapted to be pivoted about one end by a fluid actuator means controlled by a two-way valve having a neutral position at which point no fluid is pumped through the valve to the fluid actuator and the fluid actuator is thus at rest. The valve is normally in the neutral position when the endless belt is properly aligned on its support and drive rollers. Pivotally mounted sensor arms are disposed opposite each other adjacent the edges of the endless belt and are adapted to sense any lateral wander of the belt and adjust the fluid actuator control valve to realign the belt. A connecting rod is disposed transverse the belt and adjustably connected to the sensor arms at its ends, and floatingly interconnected with the control valve at a point between its ends. The configuration of the sensor arms, which will be discussed more completely hereafter, and the substantially free floating intercon-

nection of the rod and the control valve provide an extremely sensitive corrective response to belt misalignment. Further, the adjustable roller may be positioned immediately prior to and adjacent the drive roller such that it increases the angle of wrap of the belt about the drive roller.

It is an object of the present invention, therefore, to provide belt aligning apparatus adapted to maintain the alignment of a belt while minimizing wear on the edges of the belt.

Another object is to provide belt aligning apparatus adapted for use with belts having a low edge strength.

Another object of the present invention is to provide durable, inexpensive and compact apparatus, the operation of which is unaffected by wet or dirty conditions.

One more object is to provide belt aligning apparatus wherein the misalignment sensing means includes a pair of pivotally mounted sensor arms each having elongate sensing portions on one end and being adjustably connected at their other ends to a longitudinal connecting rod.

Still another object is to provide belt aligning apparatus which is extremely sensitive to belt wander.

An additional object is to provide apparatus wherein transverse belt wander is reduced to approximately one-half inch to either side.

Still another object is to provide belt aligning apparatus wherein the adjustable belt aligning roller additionally increases the angle of wrap of the belt on the drive roller.

Still another object is to provide belt aligning apparatus including a two-way control valve having a neutral position and a connecting rod interconnecting therewith and adapted to move with respect thereto with minimal drag.

One more object is to provide a belt aligner for use with food handling apparatus such as a potato piler wherein the belt aligner may be driven by the belt driving motor.

Other and additional advantages will be apparent from the following description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partial perspective view of a typical belt aligning apparatus made according to the present invention, including the fluid connecting lines shown in dashed line.

FIG. 2 is a partial side elevation view of the belt aligning apparatus of the present invention, including a portion of the support frame and belt drive means of the belt system.

FIG. 3 is a partial side elevation view of the fluid actuator means connected to one end of the adjustable roller of the present invention.

FIG. 3A is a detailed cross sectional view of the valve means for actuating the cylinder and its piston.

FIG. 4 is a partial plan view of the belt aligning apparatus of the present invention, including the adjustable roller shown pivoted about one end in dashed line.

FIG. 5 is a partial side elevation view of a typical connection between the sensor arms and the transverse connecting rod.

DETAILED DESCRIPTION OF THE INVENTION

Referring first to FIG. 1, belt aligning apparatus **10** is disclosed mounted on a portion of a belt system comprising endless belt **12** which is trained around drive roller **14** mounted on axle **16**. Belt aligning apparatus **10** includes, in general, an adjustable roller **18** over which belt **12** runs, fluid actuator means **20** connected to end support **22** of adjustable roller **18** and adapted to pivot the roller about its opposite bearinged end support **24**. Control valve **26** is interconnected with fluid actuator means **20** by conventional hydraulic fluid carrying lines **28** and **30** schematically shown in dashed line in FIG. 1. Pump **32** is interconnected with valve **26** by means of conventional hydraulic fluid carrying lines **34** and **36** and is adapted to maintain fluid pressure in the control valve **26** at all times.

Sensor arms **38** and **40** are disposed opposite each other adjacent the edges of belt **12**. Connecting rod **42** is adjustably connected at its longitudinal ends to the short ends of the sensor arms and includes normally extending member **44** mounted intermediate its ends and interconnected with control valve **26**.

Referring now to FIG. 2, a portion **46** of a support frame for both the belt system and the belt aligning apparatus is disclosed. As described heretofore, frame **46** may be a portion of a farm produce conveying system such as a potato piler, or any other apparatus including a movable belt adapted to convey bulk articles.

Sensor arm **40** includes substantially vertical support shaft **48** pivotally mounted on support frame **46** in bearings **50**. Elongate fingers **52** extend normally outward from support shaft **48** and belt contacting roller **54** is mounted vertically between the end portions of fingers **52**. Roller **54** includes internal bearings to allow it to rotate freely and a hardened outer surface to resist wear caused by contacting the edge of belt **12**. Fingers **52** and roller **54** define an elongate sensing member adapted to be disposed immediately adjacent, but out of contact with, one side edge of belt **12**. Short fingers **56** extend normally outward from shaft **48** at an oblique angle with respect to fingers **52**. Fingers **56** are rotatably interconnected with vertical member **58** by conventional spring, flat washer, and cotter pin means **60** as best seen in FIG. 5. Vertical member **58** includes cylindrical fitting **59** disposed on its lower end and adapted to slidably encircle connecting rod **42**. Connecting rod **42** includes threaded end portions on which nuts **61** are disposed on opposite sides of fitting **59**. It will be readily understood that movement of nuts **61** on the threaded end portions of rod **42** allows the placement of vertical member **58** with respect to rod **42** to be changed thereby allowing the placement of belt contacting roller **54** with respect to the edges of belt **12** to also be modified. As belt **12** stretches and narrows with age, belt contacting rollers **54** may be progressively moved such that when the belt **12** is aligned on its support and drive rollers, contacting rollers **54** are adjacent but out of contact with the edges of belt **12**. It will be readily understood that pivotal sensor arm **38** disposed adjacent the other edge of belt **12** is substantially the mirror image of sensor arm **40** and thus will not be described in detail.

It is well known that a hydraulic valve tends to tighten and resist initial movement when fluid is

present therein, and that a significant force is required to change the position of the hydraulic valve to cause fluid to flow through different fluid carrying lines to activate a hydraulic cylinder and piston, for example. In belt aligning apparatus of the instant class, this initial force is supplied by the edge of the misaligned belt bearing on an alignment sensor positioned therebeside. In the past, the repeated bearing of the edge of the belt on the sensors with sufficient force to overcome the drag of the hydraulic valve has rapidly caused the belts, which are structurally relatively weak in the transverse direction, to get mushy along their edges and tend to fray. As discussed above, some of the known prior art exacerbated this problem on at least one edge of the belt by additionally requiring the belt edge to overcome the opposing force of a spring or other system biasing the alignment sensor thereagainst.

In the instant invention, sensing fingers **52** are substantially longer than fingers **56** and thus the pivoting of the sensor arm when belt **12** runs against roller **54** generates leverage sufficient to easily overcome any drag in control valve **26** or in the linkage system, thus giving the belt aligning apparatus an extremely sensitive and quick responding correctional ability, while minimizing the force with which the belt edge must bear on the sensor arm to cause it to pivot. Additionally, there are no resilient members associated with control valve **26**, and thus the valve is free-acting, i.e., connecting rod **42** is "floatingly" connected thereto. As disclosed, control valve **26** is of the double acting type and includes a neutral or closed position shown in FIG. 3A which it maintains while belt **12** is properly aligned on its support and drive rollers and is thus not in contact with the lever arms **38** and **40**. When valve **26** is in the neutral position, hydraulic fluid from pump **32** flows through the valve and is returned to the pump and does not flow to the fluid actuator **20**. Member **44** which extends outwardly from transverse connecting rod **42** includes downwardly depending portion **62** which is connected to a member such as a piston (not shown) floatingly mounted within valve **26** to move freely therein. By the term "floatingly mounted" is meant that the piston within valve **26** is freely movable in response to the movement of rod **42** and that no springs or other biasing means are connected thereto the piston within the valve is shown to be in neutral position. It will be seen that upon movement of rod **42** in either direction the return ports to line **36** are shut as will either line **28** or **30**. Thus, the fluid pressure will be directed to the desired end of the cylinder **64** for pivoting of adjustable roller **18**.

Pump **32** is of the positive displacement type and includes hydraulic fluid line **34** through which fluid is continually pumped to valve **26**, and return line **36** whereby the fluid is returned directly to the pump reservoir when the control valve is in the neutral position and it is not used to move fluid actuator **20**. It has been found beneficial to operate pump **32** to generate a relatively low hydraulic pressure in the neighborhood of 25–35 psi in that this low pressure minimizes wear on the hydraulic components, as well as minimizing the drag factor of hydraulic valve **26**.

Referring additionally to FIG. **3**, it will be seen that fluid actuator **20** includes hydraulic cylinder **64** having cooperating piston **66** mounted on piston rod **68** therein. As will be readily understood, control valve **26** is adapted to direct fluid to flow through either conduit **28** or **30** to cause piston **66** to move longitudinally within cylinder **64**. Piston rod **68** is connected to the base of end bearing mount **22** of adjustable roller **18** by conventional washers and bolts **70** and **72**. Bearing **74** mounted on support **22** is of the floating, pillow block type, and axle **76** upon which adjustable roller **18** is disposed is mounted for rotation therein. Bearing support **22** includes vertical rod **78** having washer **80** and nut **82** threaded on its upper end. Nut **82** holds rod **78** in the peak support **84** such that it may pivot thereabout in the directions indicated by arrow **86**. Notch **88** is provided in transverse frame member **90** to accommodate pivotal rod **78**. From FIG. **3** it will be understood that rotation of nut **82** on end threads **83** of rod **78** allows the end of adjustable roller **18** to be raised or lowered to increase or decrease the pressure on the near edge of the belt **12** to facilitate initial centering of the belt with respect to the rollers. This pivotal support for the end of roller **18** minimizes drag and wear which might arise if the adjustable end were slidably mounted on frame **46**, for example. Minimization of drag throughout the components of the instant invention is important to allow the apparatus to react quickly to misalignment of the belt **12**.

Dotted line showing A in FIG. **3** indicates the position of roller support **22** and roller **18** when fluid is directed by valve **26** through conduit **28** into cylinder **64** to extend piston rod **68** therefrom. Dotted line showing B indicates the position of bearing support **22** and roller **18** when fluid is directed by valve **26** through conduit **30** to cause piston **66** to move inwardly such that it draws piston rod **68** into the cylinder **64**.

Cylinder **64** is pivotally mounted on support **92** to allow the cylinder to freely follow both the arcuate movement of roller support **22** to prevent piston **66** from binding therein.

Referring now to FIG. **4**, the operation of the belt aligning apparatus **10** on a belt system including continuous belt **12**, drive roller **14** mounted on shaft **16** and free rolling support roller **94** mounted on shaft **96** is disclosed. As illustrated, rollers **54** on pivotal sensor arms **38** and **40** are positioned spacedly adjacent each side of the belt **12** when the belt is properly aligned centrally on rollers **14**, **18** and **94**. If, for any reason, belt **12** begins to travel or wander longitudinally with respect to the rollers in the direction illustrated by arrow **95**, the edge **96** of belt **12**, after moving a very short distance, contacts roller **54** on elongate sensing arm **40**. This contact causes sensor arm **40** to pivot about its support shaft **48** such that connecting rod **42** is moved in the direction opposite arrow **95**. The movement of connecting rod **42**, and integral member **62** connected within control valve **26** causes the valve to move from the neutral position and allow hydraulic fluid to flow through conduit **30** (see FIGS. **1** and **2** also). The pumping of hydraulic fluid through conduit **30** into cylinder **64** causes piston **66** to move toward support **92** such that it draws piston arm **68** into the cylinder. Adjustable roller **18** connected to piston arm **68** thus pivots about end support **24** in the direction indicated by arrow **98** to dotted line position B. Bearing support **24** is adapted to pivot slightly to accommodate the pivotal movement of the distal end support **22** of the roller **18**.

As is well known, movement of end 22 of roller 18 in the direction of arrow 98 changes the transverse tension of the belt and causes it to move longitudinally with respect to the rollers on which it is trained in a direction opposite the direction indicated by arrow 95. As belt 12 returns toward its point of desired central alignment, belt edge 99, after moving a very short distance contacts the sensing roller 54 mounted on sensor arm 38 and pivots arm 38 such that rod 42 and integral member 62 begin to move valve 26 to its initial neutral position to cut off the flow of hydraulic fluid to fluid actuator 20. The simultaneous closing of valve 26 while belt 12 is realigned allows roller 18 to return to its original position transverse belt 12 at substantially the same time the belt assumes a centrally aligned position. This simultaneous repositioning of the roller 18 and belt 12 substantially eliminates the continuous "-hunting" problem common to many prior art aligning mechanisms.

From the above, it will be readily understood that misalignment of the belt in the direction opposite arrow 95 causes elongate sensor arm 38 to actuate control valve 26 such that roller 18 is pivoted to position A shown in dashed line in FIG. 4. Pivoting the roller to this position causes belt 12 to return to its proper central alignment on rollers 14 and 96. Again, as belt 12 returns to proper alignment, sensor arm 40 is pivoted by the belt edge 96 such that valve 26 is progressively closed and the flow of hydraulic fluid to the fluid actuator 20 is progressively diminished.

While the travel of belt 12 on roller 18 when it is positioned at an angle with respect to the belt has been described above in terms of change in transverse tension on the belt, it is believed that an additional factor in this movement is the tendency of the belt to follow a line perpendicular to the axis of a roller over which it runs. Thus in FIG. 4, this tendency is in part responsible for the movement of belt 12 opposite the direction indicated by arrow 95 when roller 18 is pivoted to position B.

It has been found that maintaining proper alignment of an endless belt on one roller of a system results in the belt alignment being maintained on a plurality of rollers within a certain distance near the adjustable roller. In a system such as that disclosed in the drawings, a single aligning roller is sufficient to maintain the alignment of the entire system. Thus, although the present belt aligning apparatus acts immediately and directly to align belt 12 on adjustable roller 18 and on adjacent drive roller 14, it will be understood that alignment on these rollers causes the belt to align itself properly on all rollers of the belt system. The apparatus of the instant invention provides a near instant correctional response to misalignment of the belt and in completed embodiments of the invention has reduced wander of the belt to a one-half inch maximum in either direction.

As is best seen in FIG. 2, adjustable roller 18 is positioned immediately adjacent drive roller 14 such that its top portion is above the lower surface of roller 14 thereby increasing the angle of wrap of the belt about the drive roller 14. Increasing the angle of wrap on the drive roller tightens the grip of the belt on the roller and thereby reduces slippage of the belt on the roller and consequent belt wear and, more important in the instant context, reduces the tendency of the belt to wander longitudinally on the roller. Positioning the adjustable roller as shown in FIG. 2 also increases the wrap of the belt on the adjustable roller thereby accentuating the transverse tightening or loosening effect on the belt of the arcuate movement of adjustable roller 18.

Referring again to FIG. 2, the drive system of the belt aligning apparatus is disclosed. Belt 100 extends from a double channeled pulley 102 on motor 104 to pulley 106 on pump 32. Drive roller 14 includes sprocket 108 mounted on axle 16 which is connected to the machine support frame by pillow block roller bearing 110. Sprocket 110 is driven through a conventional drive system including chain 112, double sprocket 114, chain 116, sprocket 118, pulley 120 and belt 122. It has been found that motor 104 need be no greater than 5 horsepower to provide sufficient power to drive both pump 32 and belt system drive roller 14 on a conventional potato piler or the like. Of course, it will be understood that the size of the drive motor as well as the sizes of pump 32 and fluid actuator 20 may be varied as required by the size and use of the belt to be aligned.

The invention may be embodied in other specific forms without departing from the spirit or central characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore to be embraced therein.

What is claimed is:

1. In a belt system including a support frame, a drive roller and at least one support roller in generally parallel spaced relation therewith on said support frame, and a continuous belt trained on said rollers, means for maintaining said belt aligned on said rollers comprising:
   - fluid actuator means connected to one end of said support roller and adapted to pivot said roller about its opposite end;
   - rod means extending transversely of said belt, valve means connected to said fluid actuator means and adapted to control the flow of fluid therein,
   - said valve means comprising a double acting valve having a neutral position and, also having a resilient unbiased piston therein, said piston being interconnected with said rod and adapted to move with said rod,
   - elongated sensor arms connected to each end of said rod and adapted to move said rod in response to the misalignment of said belt; and
   - pump means for maintaining fluid pressure in said valve means.

2. The apparatus of claim 1 wherein said elongate sensor arms include elongate sensing portions disposed adjacent the opposed sides of said continuous belt to sense the misalignment thereof.

3. The apparatus of claim 1 wherein each of said sensor arms is pivotally mounted on said support frame at a point between its ends.

4. The apparatus of claim 1 wherein each of said sensor arms is pivotally mounted on said support frame at a point between its ends such that the portions on opposed sides of said support point are unequal.

5. The apparatus of claim 1 wherein the pivotally mounted support roller is disposed adjacent said drive

roller to increase the angle of wrap of said belt about said drive roller.

6. The apparatus of claim 1 wherein the pivotally mounted support roller is disposed adjacent said drive roller to increase the angle of wrap of said belt about said support roller.

7. In a belt system including a drive roller and at least one support roller mounted in generally parallel spaced relation on a support frame, and an endless belt trained about rollers, means for maintaining the alignment of said belt on said rollers comprising:

a rod means extending transversely of said belt, an adjustable roller disposed adjacent said drive roller and adapted to increase the angle of wrap of said endless belt about said drive roller, said adjustable roller adapted to be pivoted about one end;

a hydraulic cylinder and piston means connected to the end of said adjustable roller opposite said pivoted end for pivoting said adjustable roller;

hydraulic valve means connected to said hydraulic cylinder and piston means and adapted to control the flow of fluid in said cylinder in response to the movement of said rod floatingly interconnected therewith, said rod interconnected with said hydraulic valve means at a point between the ends of said rod;

sensor arms pivotally mounted on said support frame, said sensor arms adjustably connected at one end to the longitudinal ends of said rod while the opposite ends of said sensor arms are disposed adjacent the side edges of said endless belt to monitor the alignment of said belt;

said sensor arms adapted to move said rod in response to the misalignment of said belt;

a hydraulic pump means adapted to maintain fluid pressure in said hydraulic valve means.

8. The apparatus of claim 7 wherein said sensor arms are pivotally mounted at points nearer the ends connected to said rod than the ends disposed adjacent the side edges of said belt.

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