May 7, 1963 R. L. BENINGER ETAL 3,088,688

HYDRAULIC SYSTEM

Filed Sept. 25, 1958 2 Sheets-Sheet 1

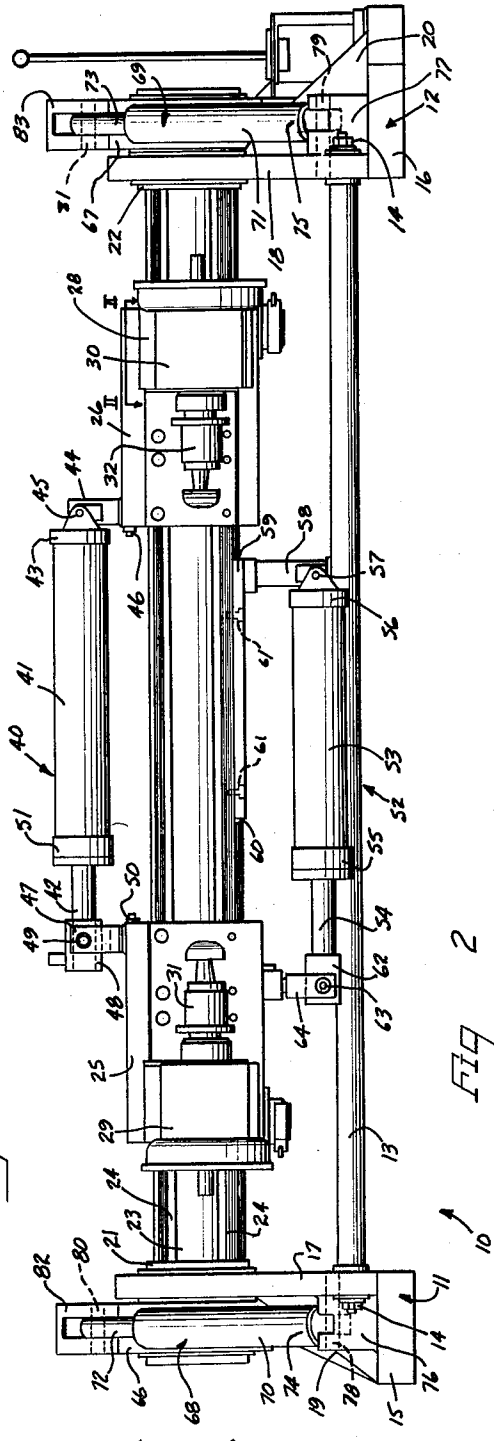


Fig 1

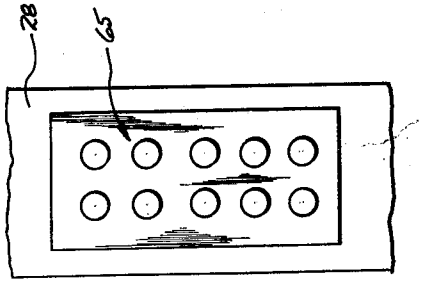


Fig 2

Inventor
ROBERT L. BENINGER
PAUL W. JACOBSEN

by Kill, Sherman, Meroni, Gross & Simpson Attys.

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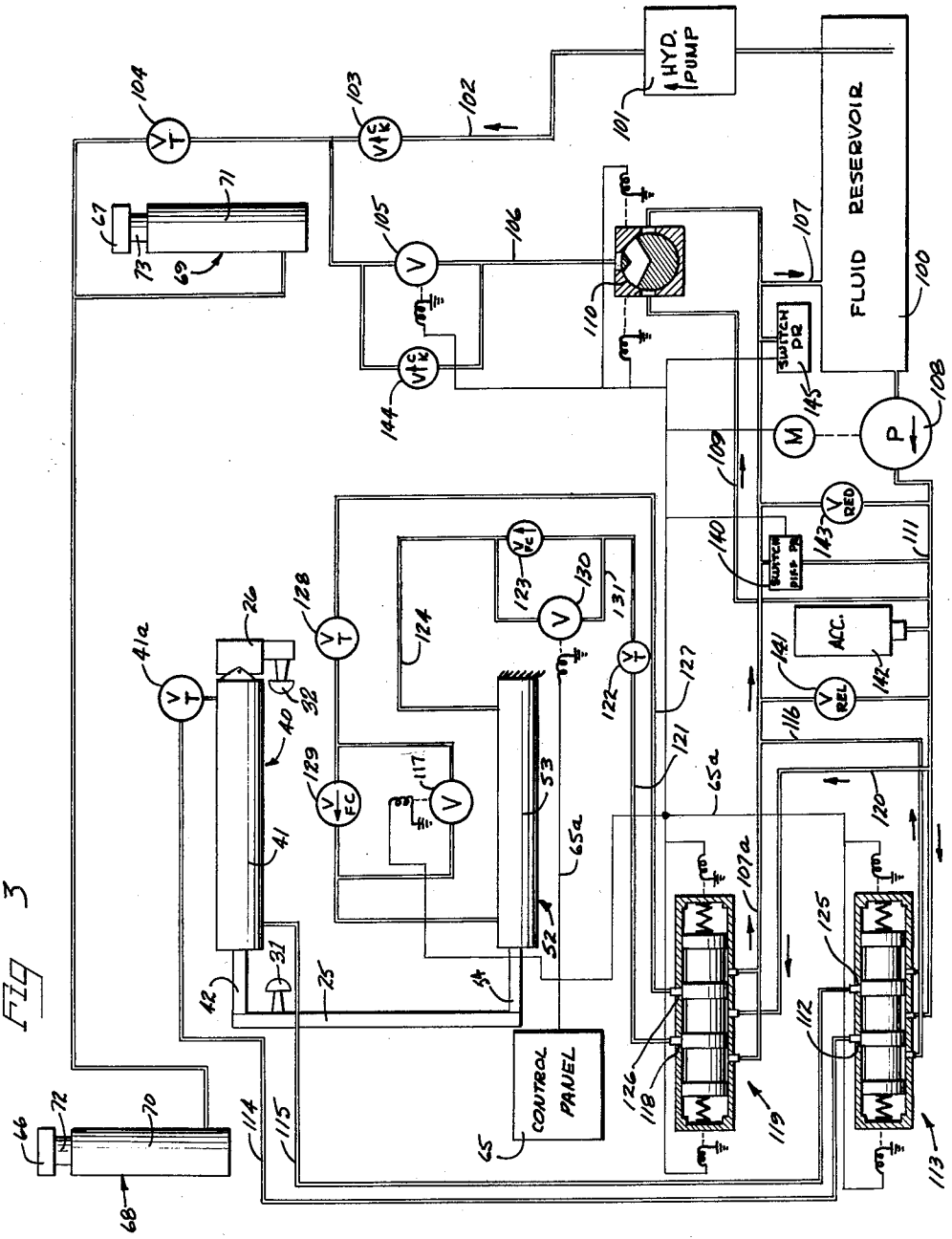


Fig 3

Inventor
ROBERT L. BENINGER
PAUL W. JACOBSEN

by Hill, Sherman, Meroni, Gross & Simpson Attys.

United States Patent Office 3,088,688 Patented May 7, 1963

3,088,688
HYDRAULIC SYSTEM

Robert L. Beninger, Sheboygan, and Paul W. Jacobsen, Kiel, Wis., assignors to H. G. Weber and Company, Inc., Kiel, Wis., a corporation of Wisconsin

Filed Sept. 25, 1958, Ser. No. 763,263
4 Claims. (Cl. 242—57.1)

The present invention relates to a hydraulic control system, and more particularly relates to an improved hydraulic control system which is adapted to control a roll stand.

This application is a continuation-in-part of our copending application entitled "Roll Stand," filed February 16, 1956, Serial No. 565,907, now U.S. Patent No. 2,973,914.

Roll stands are employed to handle rolls of web material, and more specifically lift and support a roll thereof, whereby the web of material may be pulled and thereby unwound.

While it will be appreciated that mechanisms embodying the principles of the present invention are of general utility, an embodiment thereof exemplifying the invention has been described hereinbelow in detail by way of example only and without any intention of limiting the scope of the invention in any way. While the disclosed embodiment is itself of general utility, it enjoys particular utility when embodied in a roll stand adapted to handle sheet width web rolls of material.

The control system described herein is particularly useful with roll stands which do not employ a shaft for extending through the hollow roll core.

Roll stands known heretofore have been provided with cumbersome and inefficient means for shifting the roll axially thereof in order to align the edge of the web with the equipment pulling the web from the roll. The roll gripping techniques of prior stands and the control of the prior stands have also included various difficulties.

Accordingly, it is an object of the present invention to provide a new and improved control system for a roll stand which system may be easily and conveniently operated.

The disclosed roll stand embodying the principles of this invention has a support structure on which there is mounted a pair of parallel coextensive arms which are controllably movable together angularly, toward and away from each other, and simultaneously movable in the direction of the axis of the roll without varying the spacing between the arms. Each arm employs a roll gripping chuck so that a roll may be gripped simply by moving the arms toward the roll until the chucks grip into the core of the roll whereupon the arms may be moved angularly, or rocked, to lift the roll and thereby permit unwinding thereof. The ability of the machine to shift the roll axially permits easy and convenient edge alignment of the edge of the web or roll with the equipment utilizing the roll and unwinding it.

Accordingly, another object of the present invention is to provide an improved hydraulic system for controlling such a roll stand.

Yet another object of the present invention is to provide a fluid control system for one or more fluid actuators.

The fluid control system may also have electrically operating elements or components for controlling braking of the roll as well as operation of various electrically operated valves. Since these electrical controls are known in the art, they will not be specifically described in detail herein.

Many other advantages, features and additional objects of the present invention will become manifest to those

versed in the art upon making reference to the detailed description and the accompanying sheets of drawings in which a preferred structural embodiment incorporating the principles of the present invention is shown by way of illustrative example.

On the drawings:

FIGURE 1 is a front elevational view of a roll stand constructed to employ the principles of this invention;

FIGURE 2 is an enlarged fragmentary portion of FIGURE 1 taken along line II—II; and

FIGURE 3 is a schematic and diagrammatic illustration of the fluid control system embodying the principles of this invention.

As shown on the drawings:

The principles of this invention are particularly useful when embodied in a roll stand assembly such as illustrated in FIGURE 1 generally indicated by the numeral **10**. The roll stand **10** has a pair of end supports **11** and **12** which are fixed in spaced apart relation by a tie rod **13** secured thereto by having nuts **14** threaded onto the threaded ends of the tie rod, which threaded ends extend through appropriate apertures in the end supports **11** and **12** and which clamp the end supports between the nuts **14** and shoulders on the tie rod **13**.

Each of the end supports **11** and **12** is generally L-shaped with a relatively heavy short leg **15** and **16** respectively acting as the base footing and a longer upstanding arm or leg **17** and **18** respectively which legs on each end support are integrally cast or otherwise formed of a strong structural material such as steel or the like, and are tied together and supported by reinforcing sections **19** and **20** respectively.

At the upper end and toward the rear of each of the upstanding arms **17** and **18** of the end structures **11** and **12**, the arms carry shaft bearings or shaft bushings **21** and **22** which are secured in appropriate apertures therein and are axially aligned to support a rock-shaft **23** which is journalled therein. The shaft **23** is externally splined and is shown herein as having four elongated grooves or splines **24, 24** therein, and is of such length that it extends not only for the entire distance between the two shaft bearings or bushings **21, 22** but also therebeyond on the outer ends of each thereof.

Between the end supports **11** and **12**, the shaft **23** carries a pair of traversing bearing assemblies **25** and **26** having elements therein cooperating with the splines **24** on the shaft **23** in quadrature in such a manner that the traversing bearing assemblies **25** and **26** are co-rotatable with the shaft **23** and movable axially therealong. Each of the traversing bearing assemblies has secured thereto a radially extending arm structure, such as **28**, respectively extending toward the viewer terminating in a pair of chuck bearings **29** and **30** secured thereto. The arms with their chuck bearings **29** and **30** are symmetrical in structure, parallel, and coextensive whereby they terminate at equal distances from the shaft **23**. The chuck bearings **29** and **30** each support a chuck **31, 32** which face inwardly toward the center of the machine and toward each other.

The chucks **31** and **32** are of the type that may be inserted into the ends of a roll core and expand into gripping relation with the inner surface of the roll core. The detailed structure of the chucks is not described here inasmuch as the chucks per se are independent of this invention and have already been described in the art.

The actuator for powerably driving the arm-carrying traverse bearing assemblies **25** and **26** on moving the chucks **31** and **32** into and out of gripping relation with the core of a roll to be unwound from the roll stand, is generally indicated by the numeral **40**. The actuator **40** is a double-acting piston-cylinder assembly having a

cylinder 41 containing a piston connected to a piston rod 42. The cap end 43 of the cylinder 41 is connected through a pivot bracket 44 to the upper surface of the bearing assembly 26 as by being pinned, as by the pin 45, to the bracket 44, and the bracket 44 is secured to the bearing assembly 26 by a threaded lock pin and nut arrangement 46.

The piston rod 42 is pivotally connected through a pivot bracket 47 to the upper surface of the traverse bearing assembly 25 by being pinned to a rod extension sleeve 48 which is in turn pivotally coupled through pivots 49 to the pivot bracket 47 that is secured to the traverse bearing assembly 25 by a threaded lock pin and nut arrangement 50.

With this actuator arrangement and interconnection between the traverse bearing assemblies, admitting pressurized fluid into the cylinder 41 at the rod end 51 thereof causes such movement of the traverse bearing assemblies as will draw the same closer together, thereby moving the chucks 31 and 32 into engaging arrangement with the core of a roll. Conversely, admitting pressurized fluid into the cap end 43 of the piston cylinder assembly 40 drives the two traverse bearing assemblies axially apart, whereby the roll core may be released from the chucks. This movement also jointly requires simultaneous slower movement of an actuator 52.

The actuator 52, like the actuator 40, is mounted on universal mechanical couplings, but the actuator 52 is arranged for moving the two arm carrying traverse bearing assemblies simultaneously laterally and axially of the shaft 23 in the same direction at the same time without varying the spacing therebetween. It will be noted that the actuator 40, when hydraulically locked, acts on the bearing assembly 26 to assist in achieving this result. Thus the actuator 52 may be utilized jointly with the locked actuator 40 for edge alignment of the web of the roll with the equipment utilizing the material and pulling the web from the roll.

The actuator 52 is similar to the actuator 40 in that it is a double-acting piston-cylinder assembly having a cylinder 53 carrying an axially slidable piston therein which is connected to a piston rod 54 extending through the rod end 55 of the cylinder 53. The bore of the cylinder 53 is substantially identical in diameter to the bore of the cylinder 41, and the diameter of the piston rod 54 is substantially identical to the diameter of the piston rod 42. The cap end 56 of the cylinder 53 is pivotally connected as by a pin 57 to a pivot bracket 58 pivotally secured in a mounting block 59 provided therefor. The mounting block 59 is secured in an appropriate recess 60 to the underside of the shaft 23 by machine screws or the like 61. The piston rod 54 has a rod extension sleeve 62 secured thereto at the end thereof which is in turn pivotally secured as by a pin 63 to a pivot bracket 64, but is in turn pivotally connected to the underside of the traverse bearing assembly 25.

Thus, with this second actuator arrangement, when the actuators 40 and 52 have been provided with pressurized fluid in a manner to bring the chucks 31 and 32 into gripping relation with the roll core and then lock the traverse bearing assemblies 25 and 26 in a fixed spaced relation to each other, the supplying of further pressurized fluid to the actuator 52 causes movement of the entire traverse bearing, arm, chuck and roll arrangement to move it either to the right or to the left as desired for proper edge alignment of the web of the roll with the equipment pulling the web from the roll.

By admitting pressurized fluid into the cylinder between the cap end thereof and the piston therein, the piston and piston rod are forced to the left as the mechanism is viewed in FIGURE 1, thereby moving the entire traversing arrangement to the left. Conversely, the admission of pressurized fluid into the rod end of the cylinder between the rod end and the piston within the cylinder causes movement of the piston and the piston rod to the right, thereby moving the entire mechanism to the right as viewed in FIGURE 1.

Control for these actuators is effected by the fluid control system illustrated in FIGURE 3 as coordinated by manually operated electrical controls. While it should be clearly understood that many forms of electrical automatic controls are available, and that mechanisms embodying the principles of this invention may utilize the same without detracting from the invention, there is illustrated in FIGURE 2 a simple operator control panel shown at 65 having a plurality of electrical push button controls thereon. Push buttons may be provided to so operate the control system as to cause the following operations respectively: edge align toward the operator; edge align away from the operator; move the left chuck into engagement with the roll; move the left chuck out of engagement from the roll; move the right chuck into engagement with the roll; move the right chuck out of engagement with the roll; move both chucks simultaneously into engagement with the roll; retract both chucks simultaneously from engagement with the roll; raise the arms to thereby lift the chucks and the roll held thereby; and lower the arms to lower the roll held thereby or to place the arms in position to grip a new roll.

To effect the last two enumerated operations, there is provided a pair of relatively large structurally strong crank shaped lift arms 66 and 67 that are keyed or otherwise fixed onto the exposed ends of the splined shaft 23 outwardly of the arms 17 and 18 and of the end supports 11 and 12 respectively. The lift arms 66 and 67 are so fixed onto the shaft 23 that rocking or angular movement of the lift arms produces angular movement of the shaft 23. Angular movement of the lift arms 66 and 67 is effected by a pair of power actuators 68 and 69 which are of the single acting type. These actuators are hydraulic piston and cylinder assemblies including cylinders 70 and 71 respectively containing pistons connected to piston rods 72 and 73 respectively.

The cap ends 74 and 75 of the cylinders 70 and 71 are pivotally connected to pivot mountings 76 and 77 on the bases 15 and 16 of the end supports as by pins 78 and 79. The exposed ends of the piston rods 72 and 73 are pivotally connected by pins 80 and 81 to the free ends 82 and 83 of the lift arms or crank levers 66 and 67 fixed on the outer ends of the shaft 23.

By this arrangement, pressurized fluid admission into the cap ends 74 and 75 of the cylinder 70 and 71 between the cap ends and pistons within the cylinders results in the expansion of the piston-cylinder assembly to rock the cranks 66 and 67 in a clockwise direction as the assembled machine is viewed from the right of FIGURE 1, thereby rocking the shaft 23 therewith and carrying the arms such as 28 angularly therewith as these arms are fixed on the traverse bearing housings 25 and 26 carried on the shaft for co-rocking therewith. Such angular displacement of the shaft and the arms etc., when effected after the chucks have been engaged in a roll core results in lifting of the roll from the floor or stand upon which it had been resting. By bleeding off the pressurized fluid from the cap ends of the cylinders 70 and 71, gravitational forces cause the arms to be lowered.

The hydraulic control system for controlling and providing pressurized fluid to the actuators described hereinabove is illustrated in detail in FIGURE 3. In accordance with this invention, this system is a two-pressure hydraulic system having a low pressure fluid system, such as a 400 p.s.i. system, and a high pressure fluid system, such as a 5000 p.s.i. fluid pressure system. The two systems are combined into a single coordinated hydraulic system in accordance with this invention in order to minimize the necessity for the utilization of high pressure hydraulic accessories generally, yet leave available high pressure fluid for admission to the actuators 68 and 69 for raising a full roll when gripped by the

chucks 31, 32. The particular pressures referred to above are purely exemplary and have been specified merely by way of an example of fluid pressures that may be utilized in a particular size roll stand for handling a given variety of sizes and weights of rolls. Nevertheless, the upper limit of the higher pressure available is always substantially greater than the upper limit of the other system, and is always at least double.

Thus, for high pressure actuation of the actuators 68 and 69 through the fluid system, hydraulic fluid is drawn from a reservoir 100 by a high pressure manually operated hydraulic pump 101 and thence supplied through a line 102 having a high pressure check valve 103 and a needle type of flow throttling or regulating valve 104 therein, to the cap ends of the cylinders 70 and 71 of the actuators 68 and 69 for raising the arms and roll carried thereby. When the roll has been unwound but the core remains on the chucks, the arms are easily lowered by opening a normally closed high pressure by-pass valve 105, which is connected across a high pressure check valve 144, and to one side of a low pressure three-way valve 110, whereby fluid will drain from the actuators 68 and 69 through the needle valve 104, thence through the valves 105 and 110 from which the fluid will flow through the return lines 106 and 107 back to the reservoir 100. The position of the throttling valve 104 may be selected to limit the rate at which fluid may flow therethrough, a feature which is particularly advantageous for limiting the rate at which a full roll may be lowered.

It is recognized that at times it will be desired to raise the roll chucks 31, 32 when the load on them is somewhat lighter than what the machine is capable of lifting. To this end, a lower pressure may be utilized for operating the actuators 68 and 69. A pump 108 which also communicates with the reservoir 100 discharges pressurized fluid through a line 109 leading to another side of the valve 110 which is in series with the check valve 144.

Relatively low pressure fluid from the pump 108 also operates the remainder of the hydraulic system for gripping the roll, reelasing the roll, and edge aligning to either lateral direction of the roll stand. Thus, to move only the left chuck 31 out of the roll core, pressure fluid from the pump 108 flows through a supply or outlet line 111 through the left side 112 of a four-way valve 113, here illustrated as being solenoid actuated, and thence through the line 114 and a throttling valve 41*a* to the cap end of the cylinder 41 of the actuator 40. At the same time, the rod end of the actuator 40 is drained through a line 115 leading to the right side 125 of the four-way valve 113 which is then in communcation with a return line 116 that leads to the return line 107 and thence to the fluid reservoir 100.

To move only the left chuck 31 out, not only must the actuator 40 be actuated, but the aligning actuator 52 must also be actuated and for this purpose a by-pass valve 117 is opened as is also the left side 118 of a second four-way valve 119, also shown as being solenoid actuated. The fluid flows from the pump 108 through a line 120, through the left side 118 of the valve 119, thence through a line 121, through flow regulators 122 and 123 and a line 124 to the cap end of the aligning actuator 52. The rod end thereof is drained through the flow control valve 129 and the parallel connected bypass valve 117, thence through the line 127 leading via the valve 119 to the return lines 107*a* and 107 and the reservoir 100.

The valves 123 and 129 are variable-restriction constant flow valves which have a free-flow direction as indicated by the arrow in the symbol, and which control flow therethrough to a constant flow rate in a direction opposite to the arrow. Valves of this type are known in the trade as "flow control valves," an illustration of which type is shown in U.S. Patent No. 2,845,087. To move only the right chuck 32 out requires only opening of the left side 112 of the valve 113 since the fluidly locked aligning actuator 52 will then hold the left chuck 31 in place.

To move only the left chuck 31 in to grip a roll core, fluid is supplied through the pump 108 and its outlet line 111 to the right side 125 of the four-way valve 113, and flows therethrough and through the line 115 to the rod end of the actuator 40. At the same time, the cap end thereof is drained through the line 114, through the left side 112 of the valve 113 and thence through the return lines 116 and 107 back to the reservoir. Also at the same time, the right side 126 of the four-way valve 119 is opened for supplying pressurized fluid from the pump 108 through the line 120, through the right side 126 of the four-way valve 119 thence through the line 127 leading therefrom through a pair of regulators 128 and 129 to the rod end of the aligning actuator 52. During this operation, the valve 130 is open to conduct a portion of the fluid being drained from the cap end of the actuator 52 around the flow control valve 123 leading through the return lines 131 and 107 to the reservoir 100, via the valve 119.

The flow regulating or throttling valves 122 and 128 preferably comprise needle valves and are so shown in the drawing.

Moving only the right chuck 32 in requires only opening of the right side 125 of the four-way valve 113 to supply fluid therethrough and through the line 115 to the rod end of the actuator 40. The fluidly locked aligning actuator 52, will, of course, hold the left chuck 31 steady under such circumstances, and fluid is returned from the cap end of the actuator 40 via the lines 114, 116 and 107.

It is also possible to operate this fluid system so that the chucks 31 and 32 move simultaneously toward each other, or simultaneously away from each other at substantially the same rate. This result can be obtained by operating the various valves substantially in the manner described above to obtain inward or outward movement of only the left chuck, but wherein the otherwise energized by-pass valve 130 or 117 is closed. When only the left chuck 31 is moved to engage the roll, fluid flows from the right side 125 of the four-way valve 113 to the actuator 40 and from the right side 126 of the four-way valve 119, with the valve 130 opened. A further requirement for this result, namely movement of only the left chuck, is that the flow through these two valves 113 and 119 must be equal. If the flow controls 123 and 129 be selected or set to conduct one half the volumetric flow capacity needed for only the left chuck to move in an engaging or disengaging direction, then de-energization of the valve 117 or 130 halves the flow and both of the chucks 31 and 32 are caused to move at substantially the same rate toward or away from each other to engage or disengage the roll therebetween. Since the valve 41*a*, and one or both of the valves 122 and 128 are set to allow equal flow in one direction through the valves 113 and 119, they will also be thereby allowing equal flow in the opposite direction such as is employed to disengage the left chuck 31 wherein the fluid passes through the left side 112 of the four-way valve 113 and the left side 118 of the valve 119, the valve 117 being open. Upon closing of the valve 117, all the drainage flow from the actuator 52 must pass through the flow control valve 129, and hence the chucks 31 and 32 move apart from each other and from the roll in a disengaging fashion simultaneously at substantially the same rate.

The mode of operation of the fluid system for utilizing either high or low pressure fluid to raise the arms and the roll by supplying fluid to the actuators 68 and 69 has been described above. The mode of operation of the system will now be described by which the two chucks are moved simultaneously to either the right or the left for purposes of edge aligning the web to either the right or the left for proper alignment thereof with the equipment pulling the web from the roll supported at the ends

of the arms on the chucks. For edge aligning toward the right, only the right side **126** of the four-way valve **119** is opened to supply fluid from the pump **108** via the line **120** and via the right side **126** of the valve **119**, thence through the line **127**, the regulators **128** and **129** to the rod end of the aligning actuator **52**. It is an inherent property of the flow control valves such as **123** and **129** to allow free flow of fluid in the direction of the arrow, and to control or regulate the rate of flow in the opposite to the arrow, the regulated rate being substantially constant for a wide range of input pressures or pressure drops. Thus the valves **117** and **130** are left in the closed position for edge alignment. The fluidly locked actuator **40** maintains the two chucks in their proper spaced relation for proper continuous gripping of the roll while the actuator **52** is moving the entire traverse assembly to the right. Moving the entire traverse assembly to the left requires merely opening the left side **118** of the four-way valve **119**, whereby fluid flows therethrough from the pump **108** to the line **121**, regulators **122** and **123**, and the line **124** to the cap end of the actuator **52**. The rod end is of course drained during this operation through the flow control valve **129** at a controlled constant rate as described hereinabove and the entire traverse assembly will move to the left for proper edge alignment of the web. Thus the valve **117** is left in closed position.

Thus a heavy roll may be raised by manually operating the high pressure pump **101**, its rate of raising being governable by the position of the valve **104**. Light rolls may be raised by opening the left side of the three-way valve **110**, the rate again being governable by the position of the valve **104**. To lower any roll, the valves **105** and the right side of **110** are opened, the rate of lowering being dependent upon the position of the valve **104**. If the check valve **144** throttles the raising of the roll with low pressure, the valve **105** may also be opened simultaneously with the left side of the valve **110**. Ordinarily, this is not necessary.

Thus also the edge alignment of the web of the roll is controlled by operating solely the four-way valve **119**. When the right side **126** is opened to line pressure, the web moves to the right as shown in FIGURE 1, and when the left side **118** is opened to pressure, the web moves to the left. The rate at which such movement occurs is determined by the setting of the flow control valves **123** and **129**. Each of these controls the volumetric rate at which fluid is exhausted from the cylinder **53**, such controlled rate of flow being in a direction opposite to the arrow. Edge alignment ordinarily requires a relatively low rate of movement, and therefore it would defeat this purpose of the flow regulators **123** and **129** to simultaneously open the by-pass valve **117** or **130** which spans or extends around whichever flow control is determining the flow rate. Further, ordinarily no purpose would be served by opening the by-pass valve **117** or **130** which by-passes the fluid control which is not then regulating the rate of volumetric flow, since such flow control allows substantially free flow in the direction of the arrow. The throttling valves **128** and **122** of course are set so that they do not substantially interfere with or restrict the relatively lower flow rate established by the flow control valves **129** and **123**.

To move the right chuck **32** alone, only the four-way valve **113** is employed. To engage the chuck with the roll core, the right side **125** is opened to pressure, while to disengage the right chuck, the left side **112** is opened to pressure. The rate of movement in either direction is controlled by the position of the throttling or regulating valve **41***a*.

To move only the left chuck, it is necessary to employ both of the four-way valves **113** and the valve **119**. To engage the left chuck **31**, the right side **125** of the valve **113** and the right side **126** of the valve **119** are simultaneously opened, as is also the by-pass valve **130**. In order for the right chuck to remain stationary, it is necessary that the flow through the valves **113** and **119** under this condition be effectively equal, which equality can be obtained by positioning the throttling valves **41***a* and at least one of **122** and **128**. To disengage the left chuck from the roll core, the left side **112** of the valve **113** and the left side **118** of the valve **119** are simultaneously opened together with the by-pass valve **117**. Again, the effective flow to the two actuators **40** and **52** must be equal which condition is automatically obtained when the flow has been equalized in the other direction.

To obtain simultaneous movement of both chucks toward each other and away from each other for engaging and disengaging the core, the valves are set the same as for movement of the left chuck only, but with the by-pass valves **130** and **117** left in a closed position. Further, the volumetric regulating capacity of the flow controls **129** and **123** must be set to effect one-half the flow rate employed during the movement of the left chuck only. If it is not desired to have the feature of moving both chucks simultaneously at the same rate with the instant hydraulic circuit, the flow controls **129** and **123** may be set to any lower rate of flow, whereby a still slower rate of edge alignment may be obtained.

As used herein and also in the hydraulic industry, the term "flow control" is limited to that type of device which allows substantially unrestricted flow in one direction, and which regulates or effects a substantially constant restricted flow rate in the opposite direction, the constancy of which varies negligibly in response to a wide range of input pressures or pressure drops.

The electrical system for controlling the various valves may take any desired known form. Thus in FIGURE 3, the control panel **65** is shown as communicating with the various electrical solenoids by an electrical cable assembly **65***a*.

Also, the hydraulic system may be provided with various other hydraulic components, such as a differential pressure switch **140**, a hydraulic relief valve **141**, a hydraulic accumulator **142**, a pressure switch **145**, and a pressure reducer or regulating valve **143**. The pressure reducer **143** may be set to maintain a constant discharge pressure, such as 100 p.s.i., whereby the return lines and the fluid reservoir are maintained under pressure, to thereby preclude cavitation of the hydraulic fluid.

Commercially available components for the fluid system when adapted to handle a pressurized liquid, frequently also include drain ports for the return of internal leakage. Since this feature is well known, all such drain lines have been omitted from this drawing to avoid complexity. Similarly, various components, such as valves, may be electrically actuated and pilot operated. Also therefore, to avoid complexity, all pilot operating lines have also been omitted from the drawing.

Although various minor modifications might be suggested by those versed in the art, it should be understood that we wish to embody within the scope of the patent warranted hereon all such embodiments as reasonably and properly come within the scope of our contribution to the art.

We claim as our invention:

1. In a hydraulic control system for a roll stand having an axially stationary shaft, and a pair of substantially parallel roll-supporting arms slidably carried on the shaft, the improvement comprising: a first actuator adapted to be operatively connected between a first of the arms and the shaft for moving the arm along the shaft axially; and a second actuator having bore and rod diameters equal to said first actuator and adapted to be operatively connected between said first arm and the second arm for moving the second arm axially along the shaft with respect to said first arm, corresponding ends of said actuators being adapted to act on said first arm.

2. In a hydraulic control system for a roll stand hav-

ing an axially stationary shaft, and a pair of substantially parallel roll-supporting arms slidably carried on the shaft, the improvement comprising: a first actuator adapted to be operatively connected between a first of the arms and the shaft for moving the arm along the shaft axially; a second actuator having bore and rod diameters equal to said first actuator and adapted to be operatively connected between said first arm and the second arm for moving the second arm axially along the shaft with respect to said first arm, corresponding ends of said actuators being adapted to act on said first arm; a pair of four-way valves; a pair of lines for each four-way valve respectively communicating it with the ends of one of said actuators; first flow regulating means in at least one of said lines to said first actuators; second flow regulating means in one of said lines to said second actuator; said first flow regulating means being selectably operable to effect volumetric flow rates which are substantially equal to and which are one-half of the rate effected by said second flow regulating means, whereby said first arm may be moved alone by said system when said rates are equal, and said arms may be uniformly brought together or separated by said system when said first flow regulating means is controlling at said one-half rate.

3. In a hydraulic control system for a roll stand having an axially stationary shaft, and a pair of substantially parallel roll-supporting arms slidably carried on the shaft, the improvement comprising: a first actuator adapted to be operatively connected between a first of the arms and the shaft for moving the arm along the shaft axially; and a second actuator having an effective size equal to said first actuator and adapted to be operatively connected between said first arm and the second

arm for moving the second arm axially along the shaft with respect to said first arm, corresponding ends of said actuators being adapted to act on said first arm.

4. In a hydraulic control system for a roll stand having an axially stationary shaft, and a pair of substantially parallel roll-supporting arms slidably carried on the shaft, the improvement comprising: a first actuator adapted to be operatively connected between a first of the arms and the shaft for moving the arm along the shaft axially; and a second actuator adapted to be operatively connected between said first arm and the second arm for moving the second arm axially along the shaft with respect to said first arm, corresponding ends of said actuators being adapted to act on said first arm.

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