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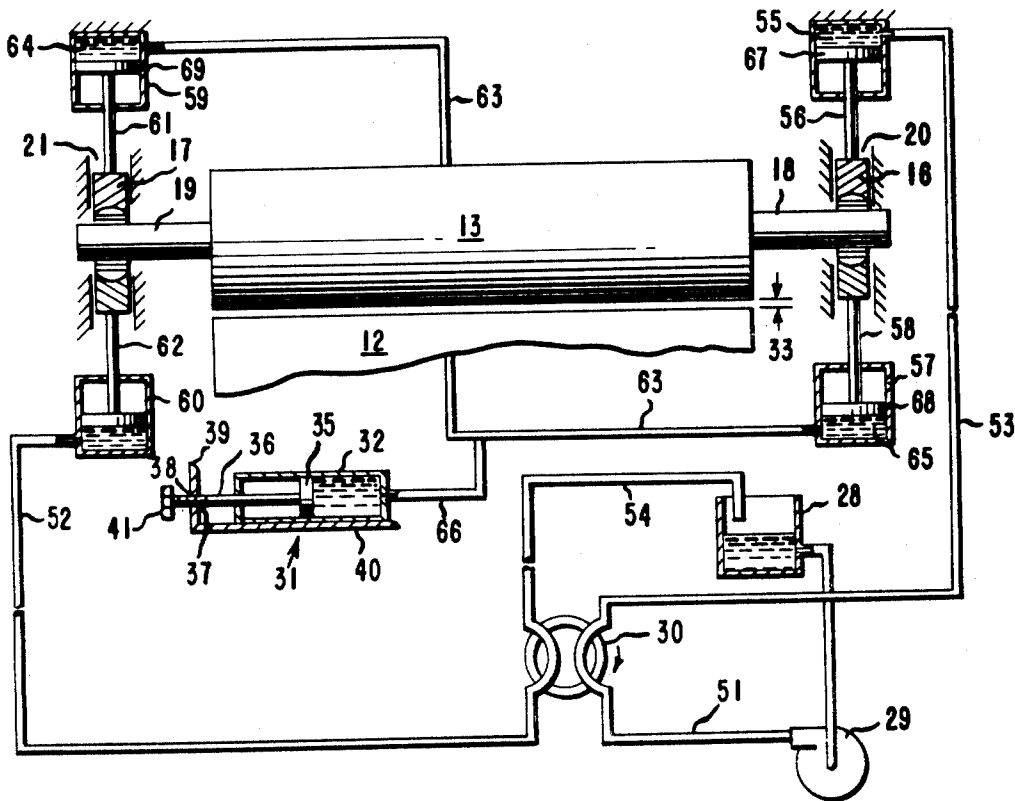
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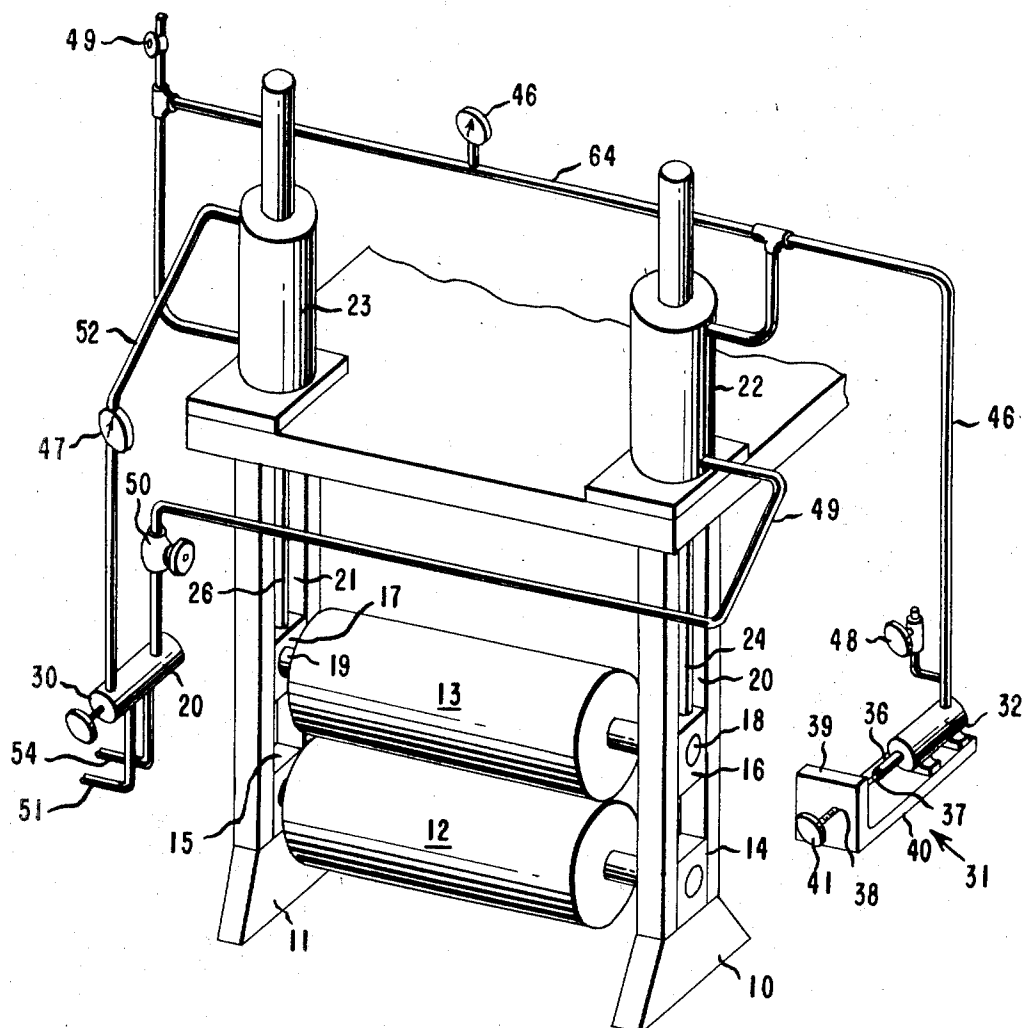
[54] **NIP ROLL APPARATUS**  
**1 Claim, 3 Drawing Figs.**  
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**68/256**  
[51] Int. Cl..... **B30b 3/04**  
[50] Field of Search..... **100/168,**  
**169, 170, 163, 164, 165, 158, 41; 68/251, 256;**  
**72/6**

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**ABSTRACT:** A nip roll apparatus is provided having a rotatably mounted stationary roll and a cooperatively associated movable roll rotatably and slideably mounted having interconnected double-acting hydraulic cylinders operatively connected to each spindle or bearing shaft thereof whereby both ends of the movable roll may be raised or lowered synchronously without binding the roll assembly and, additionally, permit the movable roll to be canted to a predetermined degree to assure lineal contact between the stationary roll and the movable roll when one roll has a slight taper or to assure lineal contact across substantially the entire width of a product having a tapered transverse profile advancing therebetween.



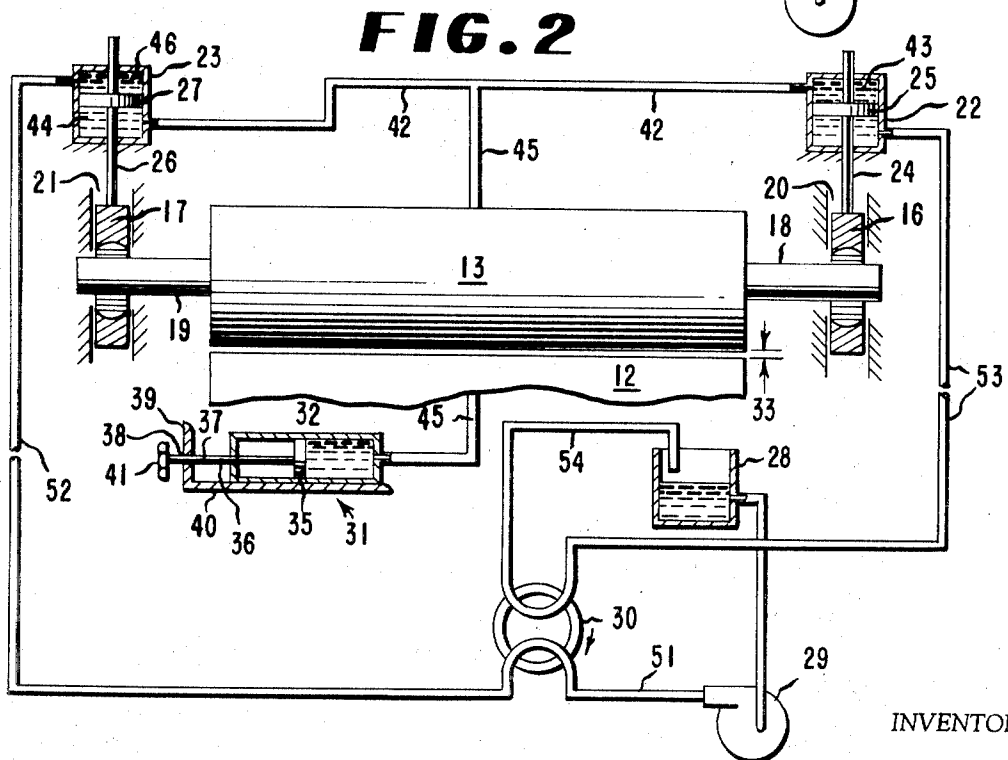
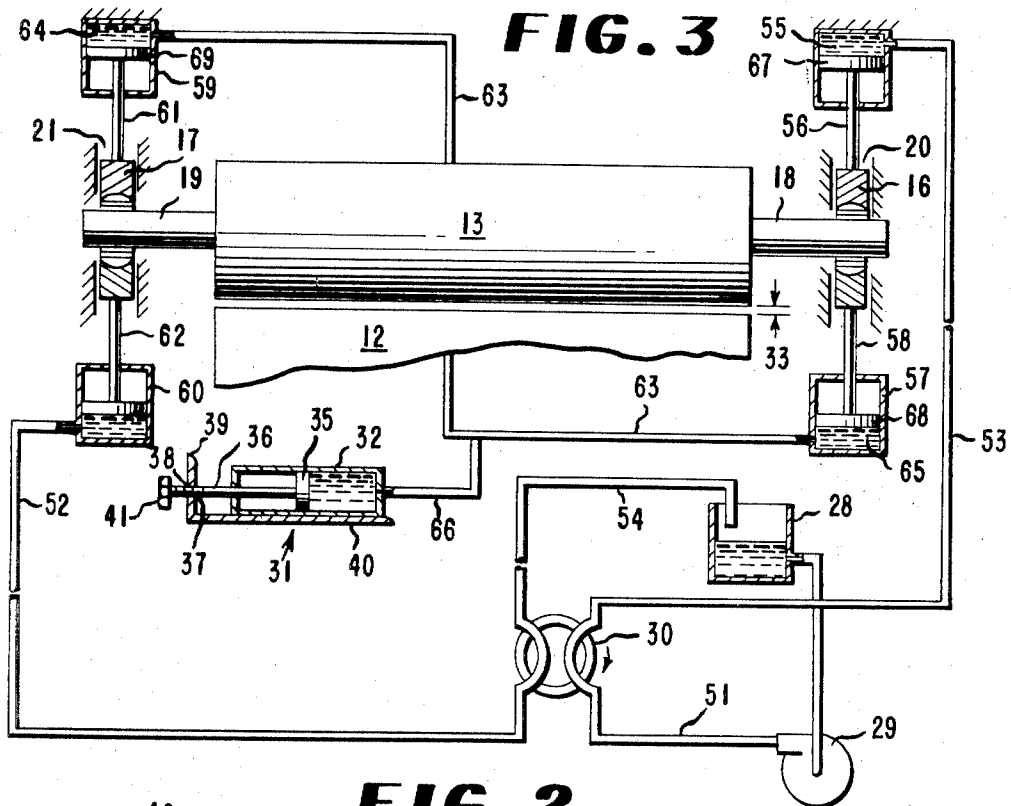
# FIG. 1



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## NIP ROLL APPARATUS

The present invention relates to a nip roll apparatus and, more particularly, is directed to improvements in and relating to nip roll apparatus having fluid control means associated therewith.

Nip roll apparatus having a plurality of coating rolls comprising a stationary roll that is rotatably mounted and a movable roll arranged in a nipping relationship therewith are commonly employed in such processes as the manufacture of paper, textiles, fibrous films and non-fibrous films. In some installations the nipping or movable roll is maintained in a coactive relationship with the stationary roll by exerting a force on each bearing shaft or spindle of the nipping roll by use of resilient means such as springs or fluid-operated cylinders. In other installations the nipping roll is arranged to rest upon the stationary roll during operation and also is arranged to be manipulated into and out of coactive relationship with the stationary roll. It is common practice to mount the bearing shafts or spindles of the nipping roll in movable or sliding bearings and to move the roll by use of pneumatic or hydraulic cylinders operatively connected to the sliding bearings. Such cylinders are usually double-acting types and are connected by a parallel piping arrangement so that the cylinder actuating fluid is admitted to comparable sides of each of the two cylinders simultaneously to effect movement of the nipping roll. A typical construction of such apparatus is described in U.S. Pat. Nos. 844,350; 2,138,397 and 2,479,759. A drawback associated with such apparatus is the non-uniformity of movement of the piston rods in the hydraulic cylinders thereof which causes binding of the nip roll upon ascent or descent. The foregoing is caused by unequal pressures on the comparable actuating sides of the double-acting cylinders and by the varying frictional resistance to motion of the nipping roll device. It is very difficult to assure that these pressures and resistances will be of the same magnitude on each end of the nipping roll. Additionally, no provision is made for canting the nip roll when in the operating position to accommodate non-uniform roll wear and a product having a tapered transverse profile traveling between the stationary roll and the movable roll.

According to the present invention there is provided a nip roll apparatus comprising a rotatably mounted stationary roll and a cooperatively associated movable roll rotatably and slideably mounted having interconnected double-acting hydraulic cylinders operatively connected to each bearing shaft or spindle thereof whereby both ends of the movable roll may be raised or lowered synchronously without binding the roll assembly and, additionally, permit the movable roll to be canted to a predetermined degree to assure lineal contact between the stationary roll and the movable roll when one roll has a slight taper or to assure lineal contact across substantially the entire width of a product being processed therebetween having a tapered transverse profile.

The nature and advantages of the invention will be more clearly understood by the following description and the several views illustrated in the accompanying drawings wherein like reference characters refer to the same parts throughout the several views and in which:

FIG. 1 is a perspective view of the preferred embodiment of the apparatus of the invention;

FIG. 2 is a schematic diagram showing the operative features of the preferred embodiment of the apparatus of FIG. 1; and

FIG. 3 is a schematic diagram showing the relationship and arrangement of the basic elements of the apparatus of the invention.

The nip roll apparatus herein disclosed in illustration of the invention includes opposed frame supports 10 and 11 (FIG. 1) adapted to support and accommodate therebetween a nip roll assembly consisting of stationary roll 12 and movable roll 13. The stationary roll 12 is suitably mounted for rotation as in

bearing blocks 14 and 15 in frame supports 10 and 11, respectively, but is otherwise immovable either vertically or laterally. The movable roll 13 is rotatably mounted in sliding bearings 16 and 17 in frame supports 10 and 11, respectively, and is adapted to be moved in the vertical direction either toward or away from stationary roll 12.

As shown schematically in FIGS. 1, 2 and 3, each end of movable nip roll 13 is provided with a shaft or spindle such as 18 and 19 that are mounted in self-aligning bearings 16 and 17, respectively. Bearings 16 and 17 are slideably mounted in guide slots or channels such as 20 and 21, respectively, in frame supports 10 and 11. Bearings 16 and 17 are each adapted to be mechanically linked to separate hydraulic cylinders by means of suitable piston rods operatively connected therebetween. FIGS. 2 and 3 show different arrangements for operatively connecting bearings 16 and 17 to different hydraulic cylinders.

As shown in FIGS. 1 and 2, bearing 16 is mechanically linked to double-acting hydraulic cylinder 22 by means of piston rod 24 that is connected at one end to bearing 16 and at its other end to piston 25 in cylinder 22. In similar fashion, bearing 17 is linked to double-acting hydraulic cylinder 23 by means of a piston rod 26 that is connected at one end to bearing 17 and at its other end to piston 27 in cylinder 23.

A hydraulic system operatively connects hydraulic cylinders 22 and 23. This system comprises hydraulic fluid sump 28, hydraulic fluid pump 29, four-way control valve 30 and leveling means 31 interconnected as shown in FIG. 2 by suitable conduit means. Leveling means 31 comprises a cylinder 32 having a piston 35 and piston rod 36 assembly operatively disposed therein. Piston rod 36 has a threaded portion 37 operatively connected in threaded engagement with threaded opening 38 in flange 39 of support 40 and is provided with a knob 41 at one end. The closed hydraulic system depicted in FIG. 2 interconnects the hydraulic fluid containing chambers in double-acting hydraulic cylinders 22 and 23 and leveling means 31 into a self-contained hydraulic system. As shown in FIGS. 1 and 2, conduit 42 is connected between hydraulic chamber 43 in hydraulic cylinder 22 and hydraulic chamber 44 in hydraulic cylinder 23, and conduit 45 is connected between cylinder 32 of leveling means 31 and conduit 42.

Each of hydraulic cylinders 22 and 23 are double-acting cylinders having double piston rod extensions and characterized by identical or equivalent geometric dimensions. The distribution of equal forces on piston rods 24 and 26 may be achieved even while the rolls are operating by adjusting leveling means 31 until the reading of pressure gauge 46 is one-half of the pressure reading at the pressure regulator 47. Other components which are employed in the hydraulic system installation include filling and bleeding valves 48 and 49 for removing all air from the system and, preferably, flow control valve 50 for controlling the rate of movement of the nip roll 13 upon being actuated.

In operation, fluid pump 29 discharges pressurized hydraulic fluid into conduit 51 which is operatively connected to either one of conduits 52 or 53 by four-way control valve 30 while conduit 54 (connected to sump 28) is operatively connected to the other one of conduits 52 or 53. The schematic diagram of FIG. 2 shows the pressurized fluid being admitted into conduit 52 which acts upon the effective area of piston 27 in hydraulic cylinder 23 thereby causing a downward force to be exerted upon piston rod 26 and a transmission of hydraulic forces through conduit 42 to chamber 43 in hydraulic cylinder 22 resulting in a downward force upon piston 25 therein which is transferred to piston rod 24. The resulting force on piston rod 24 is of the same magnitude as the force exerted on piston rod 26. Each piston rod, 24 and 26, transmits the resulting forces to respective sliding bearings 16 and 17 for moving spindles 18 and 19 equal distances.

The salient feature of the apparatus of the present invention resides in the closed hydraulic system which interconnects hydraulic chamber 43 in hydraulic cylinder 22 with hydraulic chamber 44 in hydraulic cylinder 27 and includes the hydrau-

lic volume and system associated with the leveling means 31 that is connected between hydraulic cylinders 22 and 27. At any fixed operating setting of the leveling means 31, the volume of hydraulic fluid displaced by the downward movement of piston 27 in hydraulic cylinder 22 will effect a corresponding movement of piston 25 in hydraulic cylinder 22. The effective areas of pistons 25 and 27 in hydraulic cylinders 22 and 27 are equal so that the linear displacement of piston rod 24 will equal that of piston rod 26. Thus, the linear displacement of bearings 16 and 17 will be equal.

In operating a set of rolls such as above described, it is normally necessary to maintain a constant nip opening 33 between each roll. This is easily attained by the apparatus of the present invention by use of leveling means 31. The movable nip roll 13 is brought into contact with stationary roll 12 and the hand control knob 41 is adjusted to provide for no clearance between the abutting rolls. A clockwise adjustment of the hand control knob 41, as shown in FIGS. 1 and 2, causes piston 35 in leveling means 31 to move to the right thereby to add a volume of hydraulic fluid into conduit 45 and conduit 42 connected thereto thereby to effect a decrease in the relative vertical separation between the pistons 25 and 27 of hydraulic cylinders 22 and 23 thereby causing the movable nip roll 13 to move incrementally about its geometric center in a counter-clockwise direction. A reversal of the adjustment of knob 41 will move piston 35 to the left (as shown in FIG. 2) and cause a removal of hydraulic fluid from conduits 45 and 42 and result in vertical movement of pistons 25 and 27 in hydraulic cylinders 22 and 23 in a direction away from each other thereby to effect a slight clockwise movement of nip roll 13 about its geometric center. It is seen from the foregoing that the leveling means 31 permits adjustment of movable nip roll 13 to accommodate between rolls 12 and 13 products having a tapered profile even while the rolls are in operation, and to assure lineal contact between rolls 12 and 13 even if one or both rolls has a slight taper.

When the nip roll 13 is adjusted to have zero clearance 33 between its surface and the surface of stationary roll 12 or between its surface and the surface of the product passing over the surface of stationary roll 12, the hydraulic pressure generated in conduit 52 will be twice the pressure that is generated in the closed hydraulic system between cylinders 22 and 23. Thus, the forces exerted on spindles 18 and 19 of the movable nip roll 13 by piston rods 24 and 26 will be equal. It should be noted that the foregoing force distribution exists only when the coacting rolls are in an abutting relationship and when all of the hydraulic cylinders are of the same or equivalent geometric design. Products such as a web having a tapered thickness profile or gauge distribution from one edge to the other edge thereof can thus be subjected to uniform squeezing action by the apparatus of the present invention. As previously stated, the configuration of the nip clearance 33 can be set while rolls 12 and 13 are in operation without resorting to the use of mechanical linkage adjustments. The accuracy of the setting required for use with a web having an irregular transverse gauge profile is achieved by adjusting the leveling means 31 until the pressure of the hydraulic fluid in conduit 42 is equal to one-half of the pressure of the hydraulic fluid in conduit 52.

In another embodiment of the apparatus of the invention shown schematically in FIG. 3, the bearing 16 is mechanically linked to hydraulic cylinder 55 by means of piston rod 56 operatively connected therebetween, and bearing 16 also is linked to hydraulic cylinder 57 by means of piston rod 58 operatively connected therebetween. In similar fashion, bearing 17 is mechanically linked to hydraulic cylinders 59 and 60 by means of piston rods 61 and 62.

A hydraulic system operatively connects hydraulic cylinders 55, 57, 59 and 60. This system comprises hydraulic fluid sump 28, hydraulic fluid pump 29, four-way control valve 30 and leveling means 31 interconnected as shown in FIG. 3 by suitable conduit means. Conduit 63 is connected between hydraulic chamber 64 in hydraulic cylinder 59 and hydraulic

chamber 65 in hydraulic cylinder 57. Conduit 66 is connected between cylinder 32 of leveling means 31 and conduit 63.

In operation, fluid pump 29 discharges pressurized hydraulic fluid into conduit 51 which is operatively connected to either one of conduits 52 or 53 by four-way control valve 30 while conduit 54 (connected to sump 28) is operatively connected to the other one of conduits 52 or 53. The schematic diagram of FIG. 3 shows the pressurized fluid being admitted into conduit 53 which acts upon the effective area of piston 67 in hydraulic cylinder 55 thereby causing forces to be exerted on piston rods 56 and 58. Part of the force acting on piston rod 56 is transmitted to shaft or spindle 18 by means of bearing 16 while the remainder of the force is transmitted by piston rod 58 to piston 68 which acts on the hydraulic fluid in cylinder 57 causing a pressure to be generated in the fluid chamber 65 thereof which is transmitted by means of the hydraulic fluid in conduit 63 to the hydraulic chamber 64 in hydraulic cylinder 59. A resulting force is generated on piston 69 in hydraulic cylinder 59 and transmitted to the spindle 19 by means of piston rod 61 and bearing 17. No force is transmitted to piston rod 62 since hydraulic cylinder 60 is directly connected to the sump 28 by means of conduits 52, 54 and four-way valve 30. When the effective areas of pistons 68 and 69 in hydraulic cylinders 57 and 59 are equal, and the rolls 12 and 13 are abutting one another, the force on piston rod 56 will be twice that exerted on piston rod 61 and the force on piston rod 61 will be equal to that exerted on piston rod 58. The principle of operation of the leveling means 31 is the same as that described hereinabove in connection with FIGS. 1 and 2. That is, a clockwise adjustment of knob 41 causes piston 35 in leveling means 31 to move to the right thereby to add a volume of hydraulic fluid into conduits 66 and 63 thereby to effect a decrease in the relative vertical separation between the pistons 68 and 69 in hydraulic cylinders 57 and 59 thereby causing the movable nip roll 13 to move incrementally about its geometric center in a counter-clockwise direction. A reversal of the adjustment of knob 41 will move piston 35 to the left (as shown in FIG. 3) and cause a removal of hydraulic fluid from conduits 66 and 63 which results in a vertical movement of pistons 68 and 69 in hydraulic cylinders 57 and 59 in a direction away from each other and a slight clockwise movement of nip roll 13 about its geometric center. Thus, leveling means 31 permits adjustment of movable nip roll 13 to accommodate between rolls 12 and 13 products having a tapered profile even while the rolls are in operation, and to assure lineal contact between rolls 12 and 13 even if one or both rolls has a slight taper.

When the nip roll 13 is adjusted to have zero clearance 33 between its surface and the surface of stationary roll 12 or between its surface and the surface of the product passing over the surface of stationary roll 12, the hydraulic pressure generated by pump 29 in the fluid side of hydraulic cylinder 55 will be twice the pressure that is generated in the closed hydraulic system between cylinders 57 and 59. Thus, the forces exerted on spindles 18 and 19 of the movable nip roll 13 by piston rods 56 and 61 will be equal. As earlier noted, the foregoing force distribution exists only when the coacting rolls are in an abutting relationship and when all of the hydraulic cylinders are of the same or equivalent geometric design.

I claim:

1. Apparatus comprising:

a frame;

a stationary roll rotatably mounted in said frame;

a movable roll rotatably and adjustably mounted in said frame adjacent said stationary roll for providing a nip opening therebetween;

actuating means operatively connected to said movable roll for moving said movable roll in relation to said stationary roll, which actuating means comprises cylinders adapted for hydraulic actuation having a piston and rod assembly operatively connected to movable bearings secured to each shaft extension of said movable roll, said cylinders being operatively connected by conduit means adapted to

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convey a hydraulic fluid, including a hydraulic pump and valve means operatively connecting said hydraulic pump to said conduit means whereby hydraulic fluid discharged into said conduit means through said valve means is adapted to actuate the piston in at least one of said cylinders for transmitting a hydraulic force to at least one other of said cylinders moving said piston rod in each of said cylinders and each of said movable bearings secured thereto; and

leveling means operatively connected to said actuating means for canting said movable roll thereby to adjust said nip opening permitting lineal contact between said stationary roll and said movable roll when one of said rolls has a slight taper and lineal contact of said roll surfaces

across substantially the entire width of a product having a tapered transverse profile advancing therebetween, which leveling means comprises a cylinder adapted to receive a hydraulic fluid having a piston and rod assembly, said cylinder operatively connected by conduit means adapted for conveying hydraulic fluid to said actuating means whereby adjustment of said piston and rod assembly in said cylinder of said leveling means is adapted to increase or decrease the hydraulic fluid pressure in said actuating means for transmitting a greater force to one of said shaft extensions of said movable roll than the force exerted on the other shaft extension thereof thereby to cant said movable roll and adjust the nip opening between said movable roll and said stationary roll.

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