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(12) # EUROPEAN PATENT SPECIFICATION

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(54) **Positioning mechanism for calender rolls.**

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Description

Background of the Invention

This invention relates to calenders and super calenders of the type used to finish paper for printing or other applications where a relatively high smoothness is required. In such devices the paper passes between the nip of a number of rollers and by the circumferential friction of the rolls on the paper surface a polishing action is obtained. The rollers are generally arranged in a vertical stack. Iron rolls alternate with paper filled rolls, that is, rolls which are formed by placing a large number of doughnut-like paper disks on a common shaft. These paper filled rolls are largely responsible for the polishing action.

Paper filled rolls are easily damaged in the event that there is a break in the paper web being polished. When the web breaks it bunches and jams between the nips of the rollers causing unevenness on the surface of the paper filled rolls impairing the ability of such rolls to smooth the web evenly.

In an effort to avoid damage to paper filled rolls when the web breaks and to permit adjustment of the spacing between rolls, it is necessary to provide some mechanism for positioning the rolls relative to each other and, in particular, for rapidly separating them in the event of a break in the paper web or similar emergency condition which could damage the rolls. Such systems are known in the prior art and, for example, see U.S. Patent Nos. 3,777,656, 3,948,166, and 3,584,570 which disclose lifting mechanisms. Although lifting mechanisms are known, none of them has the capability of rapidly separating the rolls in the event of an emergency condition and the capability of automatically repositioning the rolls to their correct operative positions particularly when a worn paper roll has been replaced with a new roll of a different diameter.

It is accordingly an object of the invention to provide an improved positioning mechanism for calender rolls which is capable of accomplishing rapid separation of the rolls in an emergency situation.

A further object of the invention is to provide a device of the type described capable of automatically repositioning the rolls in their proper operative relation regardless of changes in the roll diameter of the rolls in the calender stack.

A further object of the invention is to provide a hydraulic cylinder lifting mechanism for a super calender which utilizes a lost motion connection to rapidly space the rolls one from the other in an emergency situation by an amount determined by the lost motion elements.

A further object of the invention is to provide a hydraulic lowering mechanism for a calender stack which can rapidly separate the rolls in the stack by a preset amount to limit damage to the rolls in the event of a paper break.

Other objects and advantages of the invention will be apparent from the remaining portion of the specification.

Brief Description of the Drawings

Figure 1 is a side elevation view of a super calender having the positioning mechanism according to the invention provided therein.

Figure 2 is a front elevation of the super calender of Figure 1.

Figure 3 is a sectional view along the lines 3—3 of Figure 2 illustrating the construction details of the mechanism according to the invention in the lowered position.

Figure 4 is a view similar to Figure 3 illustrating the mechanism in the position in which the rolls are spaced, one from the other.

Figure 5 is a schematic diagram illustrating the operation of the hydraulic circuit for operating the cylinders according to the invention.

Figures 6 and 7 are side elevational views of the bottom portion of the super calender illustrating the bottom roll support mechanism in its raised and lowered positions, respectively.

Figure 8 is an end sectional view along the line 8—8 of Figure 6.

Detailed Description

Referring to Figures 1 and 2, a super calender machine for imparting a smoothness to the surfaces of a paper web is illustrated. The web 10 is drawn from a roll 12 and passes through tension sensing rollers 14 to a stack of calender rollers generally indicated at 16. The web 10 passes back and forth between the nips of the rollers, one of which is driven with the resulting friction accomplishing the polishing action in a manner well known to those skilled in the art. Fly rolls 18 are provided to correctly position the paper web for passage between the nips of the calender rolls. The calender roll stack is formed of a combination of iron and paper filled rolls, the number and location of each type being a function of the type of paper, the smoothness desired and similar considerations. In any case, a number of paper filled rolls will be included in the stack and are subject to uneven wear or damage in the event of a break or jam in the web 10.

After passing through the nip of the bottommost pair of rollers the web leaves the calender stack and is wound onto a take up reel 20.

To detect web jams and breaks, simple detection mechanisms can be employed as, for example, an electric eye to detect a paper break. If desired, a plurality of such detectors may be employed. In the event of a break or jam, it is necessary to rapidly separate the rolls, one from the other, to avoid damaging the paper filled rolls. During normal operation the rolls are under pressure by virtue of hydraulic cylinders 23. When a break occurs, cylinders 23 must remove pressure from the rollers and begin lifting them in a manner to be described. Simultaneously, a bottom roll is rapidly lowered

allowing the remaining rolls to drop downwardly and separate until subsequently lifted by hydraulic cylinders 23. If the separation occurs quickly enough the paper web will not wedge between the nips of the rollers and damage the paper filled rolls.

Figures 2 and 3 illustrate a plurality of calender rolls 24 through 35 in a vertical stack. The rolls are mounted on either end thereof to mounting elements 36 in the case of the topmost roll, elements 38 in the case of the intermediate rolls and to elements 40 in the case of the bottom roll. The mounting elements, except element 40, are slidably secured to vertical support columns 42 on either end of the rolls permitting the rolls to be moved vertically, as desired, to separate the rolls or place them in contact for calendering. The uppermost roll 24 is connected to the load and lift cylinders 23 via the mounting elements 36. Mounting elements 38 are connected to the elements immediately above it in the stack by means of a piston and cylinder arrangement to be described in connection with Figure 3. The bottommost roll 35 is, however, not connected to other rolls. Instead, it is mounted for movement toward and away from the remaining rolls in the stack by elements 40 described in connection with Figures 6 and 7. A motor 44 drives bottom roll 35 via a shaft 46 to accomplish the calendering process in the usual manner.

Referring to Figure 3, the mounting elements forming an integral part of the lifting mechanism of the invention are illustrated. As seen in Figure 3, the web 10 passes a first fly roll 18 and then between the nip of the topmost roll 24 and the roll 25. In the illustrated embodiment roll 24 is preferably an iron roll while roll 25 is a paper filled roll. As the paper passes between the nip a polishing action occurs. As the paper continues on its tortuous path through the nips of the various rolls, additional polishing of both sides of the web is accomplished.

In order to regulate the polishing action, it is necessary that the rolls be properly compressed during operation of the super calender. The bottom roll 35 is placed in the operative position (Figure 2) and then the lift and load cylinders 23 apply pressure to the roll stack until the desired nip pressure is obtained. In order to compress the rolls, they must be free to move on the vertical column 42.

The mounting elements according to the invention include a plurality of hydraulic cylinders 50 which are interconnected one to the other. Each cylinder includes an internal piston 52 (Figure 5) and connected thereto is a piston rod 54 terminating in a rod eye 56. The rod eye has a generally rectangular opening 58 therethrough. The bottom of the cylinder housing includes a clevis 58 having a generally circular opening designated 60. The piston rod of one cylinder is connected to the clevis 58 of the cylinder immediately above it in the stack by means of a shaft or pin 62 which passes through openings 58 and 60. The uppermost cylinders associated with roll 25 have their piston rods secured to an opening in the top mounting plate 36.

It will be understood that two sets of cylinders 50 of the type illustrated in Figure 3 are provided, one set for each end of the rolls 25 through 34. The cylinders 50 are secured to end plates 64 which receive rotatably mounted shafts 66 on which the rolls are provided. A portion of the end plates 64 are received in a channel 68 in the vertical columns 42 whereby vertical movement of the calender rolls in the stack is obtained.

An important aspect of the present embodiment of the invention is the manner in which the cylinders 50 are interconnected one to the other. The pin 62, preferably cylindrical, has a flat portion 70 thereby reducing its effective diameter in the vertical direction. The pin is maintained in the position indicated in Figure 3 by a locking arrangement of any suitable type such as a locking plate. Thus, the flat 70 is always facing upward. It must engage the surface 72 of the rod eye before a roll can be lifted from above. The reduction in effective diameter of the pin 62 by providing flat 70 corresponds to a selected distance "d" by which the rolls will be passed when they are separated for emergency purposes (Figure 4).

This arrangement constitutes a lost motion connection intentionally provided in the stack for the following purpose. When the stack is in the position indicated in Figure 3 it is being compressed by the load and lift cylinders 23. Should a paper break occur, the load and lift cylinders will cease compressing the rolls and begin lifting the end plates 36 of the uppermost roll. Simultaneously, the bottom roll 35 is rapidly lowered, as will be described, permitting the intermediate rolls to be separated, one from the other, by the amount "d" of the lost motion connections. After separation the lifting cylinders 23 raise the stack in preparation for resumption of super calendering.

The result of the separation of the stack is clearly illustrated in Figure 4. It may be seen that the rod eye associated with each roll is supported on the pin 62 associated with the roll or mounting element next higher in the stack and that each of the illustrated rolls are separated one from the other by a distance "d".

Referring now to Figure 5, a hydraulic circuit for controlling each of the cylinders 50 is schematically illustrated. Cylinder 50 includes an upper oil chamber 70', a lower chamber 72 with piston 52 being vertically displaceable to alter the dimensions of chamber 70' and 72 thereby to move the piston rod 54 relative to the cylinder housing 74. The upper chamber 70' includes an oil passage 76 while the lower chamber is provided with a passage 78. Oil is supplied to the chambers by means of the hydraulic circuit schematically indicated.

The circuit includes a solenoid valve 80 con-

nected to the hydraulic line supplying fluid to the upper chamber 70', a check valve 82 and a flow regulating valve 84 in parallel therewith. The main oil line 86 supplies make up oil from a reservoir 88.

An important feature of the embodiment of the invention is the pressurizing of the make up oil reservoir 88. This may be accomplished using air pressure on the reservoir. Alternatively, a low pressure hydraulic pump can be employed and, in that case, reservoir 88 is unnecessary. The pressure is low, for example, 50 psi (350 kPa), although this value is dependent upon the size and operating characteristics of the cylinders. The pressure applied to the reservoir is solely to prevent the weight of the rod and piston assembly from eliminating the gap "d" between the pin 62 and the rod eye 56. When the rolls are lowered to their operating positions the pistons are free to move. Nevertheless, it is desired that the gaps "d" be maintained against the weight of the piston rods. The pressure applied on the oil line 86 forces enough oil into the lower oil chambers 72 to maintain these gaps.

Operation of the lifting mechanism of the present invention is as follows. Assuming that the rolls are separated due to an emergency, such as a paper break, the solenoid valves 80 will be closed and the pistons locked in place. This situation remains until the load and lift cylinders raise the rolls fully. Valves 80 then open sequentially lowering the rolls beginning with rolls 34. Lowering continues until all the pistons are at the top of the cylinders. In this state roll change outs can be made as, for example, where a roll is worn or damaged and needs to be replaced or the equipment can be turned off without danger of causing flat spots on the rolls. The valve 80 is then closed again.

When it is desired to begin the calendering operation the rolls are placed in compression. The closed solenoid valves 80 permit oil to flow from the lower chamber 72 to the upper chamber 70' via check valve 82 and the check valve portion of valve 80. Thus, roll 34 engages the bottom roll 35 and displaces oil from chamber 72 into chamber 70'. A similar operation is then performed in sequence for each of the rolls in the stack working from the bottom to the top. In this manner the stack is automatically adjusted for the current roll diameter. No manual adjustment of mechanical elements is required.

When the rolls are in contact with each other they are ready to be compressed to a desired value. The pressure from oil line 86 maintains sufficient upward force on the piston 52 to insure that the gaps "d" between the pin and rod eye are maintained. When the process is complete the stack appears as illustrated in Figure 3.

To separate the rolls the process is reversed. During normal lifting the load and lifting cylinders 23 merely lift the top roll 24 which separates rolls 24 and 25 by the amount of the gap "d" and so on down the stack. In the case of a separation due to a paper break, etc., the bottom roll 35 is dropped by the mechanism illustrated in Figures 6 and 7 rapidly separating the intermediate rolls one from the other by the amount of the lost motion connection. Simultaneously, the cylinder 23 begins the normal lifting process.

Referring now to Figures 6 and 7, the mounting elements 40 for the roll 35 are illustrated. The mounting assembly supports the bottom roll 35 and moves it between raised and lowered positions. Figure 6 illustrates the raised position while Figure 7 illustrates the lowered position. The mounting elements include a cylinder 90 having a piston rod 92. A clevis 94 is pinned to a pair of links 96 and 98. Similarly, a cylinder clevis 100 is pinned to a pair of links 102 and 104. As can be seen by comparing Figures 6 and 7, when the piston is in an extended position relative to the cylinder the link pairs are in a substantially vertical position, slightly over center, maintaining the bottom roll bearing housing 106 and the associated support structure in a raised position. The over center position maintains the raised position even in the event of hydraulic pressure loss. As shown in Figure 7, when the piston is retracted the links move inwardly lowering the bearing housing and support assembly. As indicated in the drawings, the links connect the bearing housing 106 with a support base 108.

In order to maintain the roll 35 level, it is necessary to insure that the links on each side move by an equal amount. For that purpose the roller chain arrangement indicated at 110 is provided. Pinned to the connection 112 between the bottom links and the base 108, for movement therewith, are sprocket wheels 113 and 115. A first roller chain 114 is pinned to the sprockets 113 and tension and link position are adjusted by turn buckle 116. Similarly a second roller chain 117 is pinned to sprockets 115. When the cylinder 90 is actuated to raise or lower the bottom roll 35, the chain arrangement requires that both link pairs must move up or down by an equal amount thereby maintaining the roll in the proper position.

As previously indicated, during normal operation the bottom roll is maintained in the raised position illustrated in Figure 6 whether or not the remaining rolls in the stack are separated. In the event of an emergency as, for example, a paper break, the cylinder 90 retracts the piston lowering the bottom roll 35, which is a driven roll. This permits rapid separation of the rolls as previously described herein.

Claims

1. A mechanism for positioning a stack (16) of vertical calender rolls (24 to 35) relative to a support frame, each roll being mounted to the frame for movement in the vertical direction comprising: means (23) for lifting and lowering

the top roll (24) of said stack, means (90, 92) for lifting and lowering the bottom roll of said stack, means interconnecting the remaining rolls (25 to 34) of said stack (16), one to the other and to said top roll (24) for movement with the latter, said mechanism characterized by: said interconnecting means including piston (52) and cylinder (50) assemblies associated with each of said remaining rolls (25 to 34), and a lost motion connecting means (62, 70, 72, 56) for interconnecting said assemblies one to the other and to said top roll, and means (72, 78, 80, 82, 84, 88) controlling operation of said assemblies to permit or prevent movement of the pistons (52) relative to the cylinders (50), whereby when the pistons (52) are permitted to move the remaining rolls (25 to 34) may be sequentially lowered and automatically positioned in contact with each other and said top (24) and bottom (35) rolls, and when the pistons (52) are prevented from moving, the rolls may be rapidly separated, one from the other, by a distance determined by the lost motion connecting means by lowering said bottom roll.

2. The mechanism of Claim 1 wherein said lifting and lowering means includes: a pair of hydraulic piston and cylinder assemblies (23) connecting the top roll to the frame for vertical movement toward and away from the remaining rolls.

3. The mechanism of Claim 1 wherein said pistons (52) have rods (54) attached thereto, said lost motion connecting means including:

(a) a rod eye (56) secured to each of said piston rods,

(b) a flange (58) secured to each cylinder, said flange having an opening (60) therein,

(c) a plurality of pin means (62) for pinning the rod eye of one assembly to the flange of one of the adjacent assemblies, said pin means dimensioned to permit a predetermined amount of movement or lost motion during movement of the rolls before causing each rod eye to move with the flange to which it is pinned, whereby the rolls can be rapidly separated one from the other by lowering said bottom roll.

4. The mechanism of Claim 3 wherein said pin means is a substantially cylindrical pin (62) received in said rod eye and flange opening, said pin having a flat (70) on one portion thereof, thereby to reduce its effective diameter, said flat determining the amount of movement or lost motion permitted by said lost motion connecting means.

5. The mechanism of Claim 3 wherein said controlling means includes means (72, 78, 88) for maintaining the lost motion spacing between said pin means and said rod eye when said pistons are permitted to move during movement of the rolls into contact with each other.

Revendications

1. Mécanisme pour positionner un empilement (16) de cylindres (24 à 35) d'une calandre verticale par rapport à un bâti formant support, chaque cylindre étant monté sur le bâti de façon à pouvoir se déplacer dans la direction verticale, comprenant des moyens (23) pour le soulèvement et l'abaissement du cylindre supérieur (24) dudit empilement, des moyens (90, 92) pour le soulèvement et l'abaissement du cylindre inférieur de l'empilement, des moyens de liaison reliant les cylindres restants (25 à 34) de l'empilement (16) les uns aux autres et au cylindre supérieur (24) de façon à leur permettre de se déplacer avec ce dernier, ledit mécanisme étant caractérisé en ce que lesdits moyens de liaison comprennent des vérins qui, comportant un piston (52) et un cylindre (50), sont associés à chacun des cylindres restants (25 à 34), et un dispositif de liaison à perte de mouvement (62, 70, 72, 56) pour relier lesdits vérins entre eux et au cylindre supérieur, et des organes (72, 78, 80, 82, 84, 88) commandant le fonctionnement des vérins de façon à autoriser ou interdire un déplacement des pistons (52) par rapport aux cylindres (50), de telle sorte que, lorsque les pistons (52) sont autorisés à se déplacer, les cylindres restants (25 à 34) peuvent les uns après les autres être abaissés et automatiquement amenés les uns au contact des autres et des cylindres supérieur (24) et inférieur (35) et, lorsque les pistons (52) sont empêchés de se déplacer, les cylindres peuvent être rapidement séparés les uns des autres d'une distance déterminée par le dispositif de liaison à perte de mouvement en abaissant le cylindre inférieur.

2. Mécanisme selon la revendication 1, caractérisé en ce que lesdits moyens de soulèvement et d'abaissement comprennent une paire de vérins hydrauliques (23) comportant un piston et un cylindre et reliant le cylindre supérieur au bâti de façon à lui permettre de se rapprocher et de s'éloigner verticalement des cylindres restants.

3. Mécanisme selon la revendication 1, caractérisé en ce qu'aux pistons (52) sont fixées des tiges (54), ledit dispositif de liaison à perte de mouvement comprenant:

a) un oeil (56) fixé à chacune desdits tiges de piston,

b) une bride (58) fixée à chaque cylindre, laquelle bride présente une ouverture (60),

c) un certain nombre de chevilles (62) pour assujettir l'oeil de la tige de piston d'un vérin à la bride de l'un des vérins adjacents, ladite cheville étant dimensionnée de façon à permettre une quantité déterminée de mouvement ou déplacement à vide durant le mouvement des cylindres avant que chaque oeil de tige de piston soit amené à se déplacer avec la bride à

laquelle il ist assujetti, permettant ainsi aux cylindres d'être rapidement séparés les uns des autres en abaissant ledit cylindre inférieur.

4. Mécanisme selon la revendication 3, caractérisé en ce que ladite cheville est une cheville sensiblement cylindrique (62) reçue dans l'oeil de la tige de piston et dans l'ouverture de la bride, cette cheville présentant un méplat (70) sur une seule partie de sa périphérie, afin de réduire ainsi son diamètre effectif, lequel méplat détermine la quantité de mouvement ou déplacement à vide autorisée par le dispositif de liaison à perte de mouvement.

5. Mécanisme selon la revendication 3, caractérisé en ce que lesdits organes de commande comprennent des organes (72, 78, 88) pour maintenir l'espacement, nécessaire au déplacement à vide, entre la cheville et l'oeil de la tige de piston lorsque les pistons sont mis en état de se déplacer durant le mouvement des cylindres amenant ceux-ci en contact les uns avec les autres.

Patentansprüche

1. Positionierungsmechanismus zum Positionieren eines Stapels (16) vertikal angeordneter Kalanderwalzen (24—35) relativ zu einem Traggestell, wobei jede Walze in vertikaler Richtung verschiebbar an dem Gestell gelagert ist, mit Mitteln (23) zum Anheben und Absenken der obersten Walze (24) des Stapels, Mitteln (90, 92) zum Anheben und Absenken der untersten Walze des Stapels sowie mit Verbindungsmitteln zur Verbindung der übrigen Walzen (25—34) der Anordnung (16) miteinander und mit der obersten Walze (24) zur Bewegung mit derselben, dadurch gekennzeichnet, daß die Verbindungsmittel Anordnungen aus einem Kolben (52) und einem Zylinder (50) enthalten, die jeder der übrigen Walzen (25—34) zugeordnet sind, daß ein mit Leergang versehenes Verbindungsmittel (62, 70, 72, 56) zur Verbindung der Anordnungen miteinander und mit der obersten Walze vorgesehen ist, daß Mittel (72, 78, 80, 82, 84, 88) zur Steuerung der Arbeitsweise der genannten Anordnungen vorgesehen sind, die eine Bewegung der Kolben (52) relativ zu den Zylindern (50) ermöglichen oder verhindern, so daß dann, wenn sich die Kolben (52) bewegen können, die übrigen Walzen (25—34) nacheinander abgesenkt und automatisch miteinander und mit der obersten Walze (24) und der untersten Walze (35) in Kontakt gebracht werden können, und dann, wenn die Bewegung der Kolben (52) verhindert ist, die Walzen durch Absenken der untersten Walze schnell um einen Abstand voneinander getrennt werden können, der durch die mit Leergang versehenen Verbindungsmittel bestimmt ist.

2. Positionierungsmechanismus nach Anspruch 1, dadurch gekennzeichnet, daß die Mittel zum Anheben und Absenken ein Paar einer hydraulischen Anordnung (23) aus einem Kolben und einem Zylinder enthalten, welche die oberste Walze mit dem Traggestell mit vertikaler Bewegungsmöglichkeit zu den übrigen Walzen hin und von diesen weg verbindet.

3. Positionierungsmechanismus nach Anspruch 1, dadurch gekennzeichnet, daß die Kolben (52) an ihnen befestigte Kolbenstangen (54) aufweisen, und daß die mit Leergang versehenen Verbindungsmittel folgende Teile enthalten:

(a) eine mit jeder der Kolbenstangen (54) verbundene Stangenöse (56),

(b) einen mit jedem Zylinder verbundenen Flansch (58), der eine Öffnung (60) aufweist,

(c) eine Vielzahl von stiftartigen Mitteln (62), die einen Eingriff der Stangenöse (56) einer Anordnung in den Flansch einer der benachbarten Anordnungen bewirken, wobei die stiftartigen Mittel so bemessen sind, daß bei der Bewegung der Walzen (24—35) ein bestimmter Betrag an Bewegung oder Leergang ermöglicht wird, bevor jede Stangenöse (56) zusammen mit dem mit ihr verbundenen Flansch (58) in Bewegung versetzt wird, wodurch die Walzen durch Absenkung der untersten Walze (35) schnell voneinander getrennt werden können.

4. Positionierungsmechanismus nach Anspruch 3, dadurch gekennzeichnet, daß die stiftartigen Mittel aus einem im wesentlichen zylindrischen Stift (62) bestehen, der von der Stangenöse (56) und der Öffnung (60) des Flansches (58) aufgenommen wird, und daß der Stift an einer Stelle eine Abflachung (70) zur Verringerung seines effektiven Durchmessers aufweist, wobei die Abflachung den Betrag der Bewegung oder den Leergang bestimmt, der durch die mit Leergang versehenen Verbindungsmittel ermöglicht wird.

5. Positionierungsmechanismus nach Anspruch 3, dadurch gekennzeichnet, daß die Mittel zur Steuerung Mittel (72, 78, 88) enthalten, die den den Leergang bildenden Abstand zwischen den stiftartigen Mitteln (62) und der Stangenöse (56) aufrechterhalten, wenn die Kolben sich während der Bewegung der Walzen (24—35) bis zum Kontakt untereinander bewegen können.

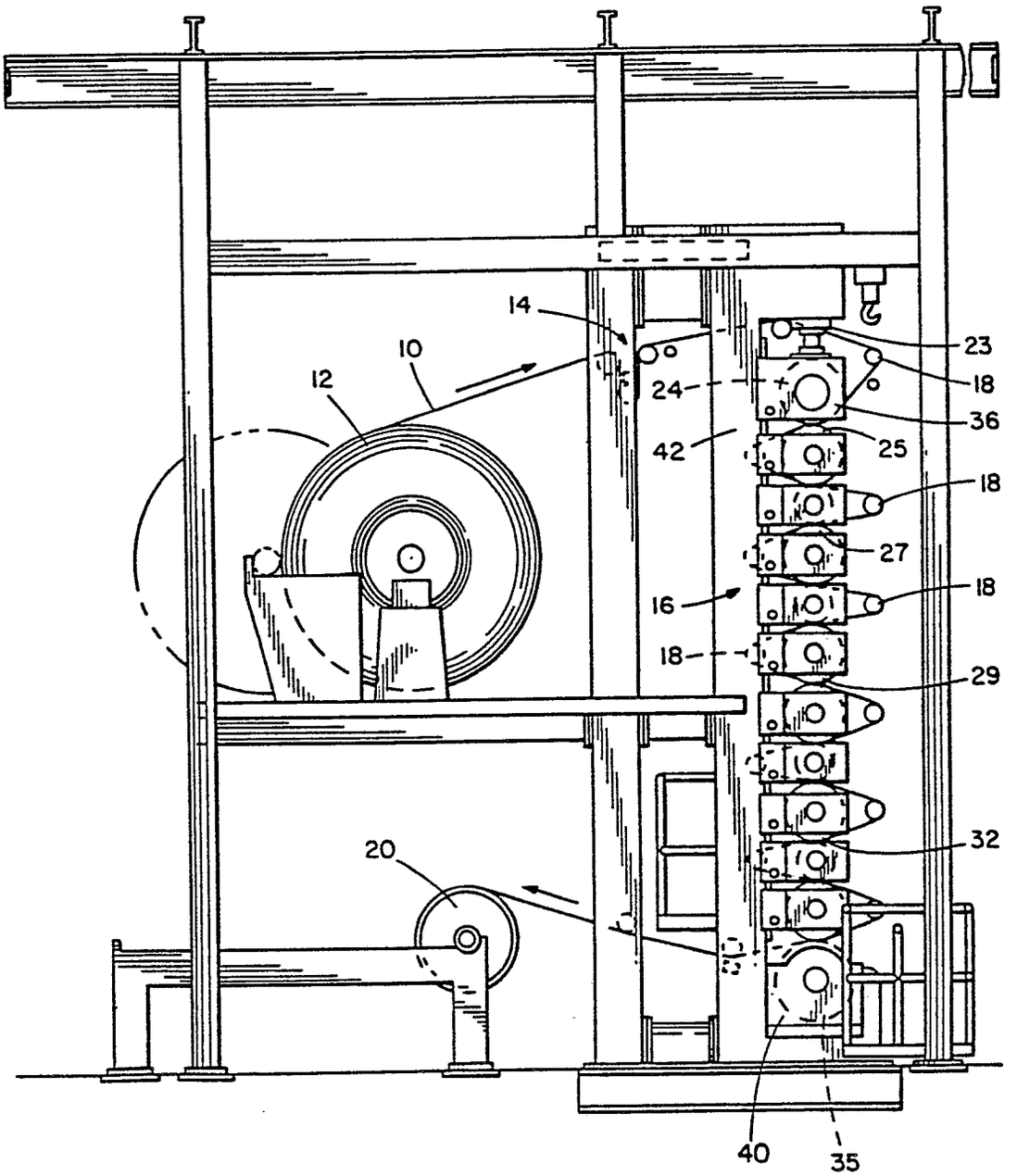

FIG.1

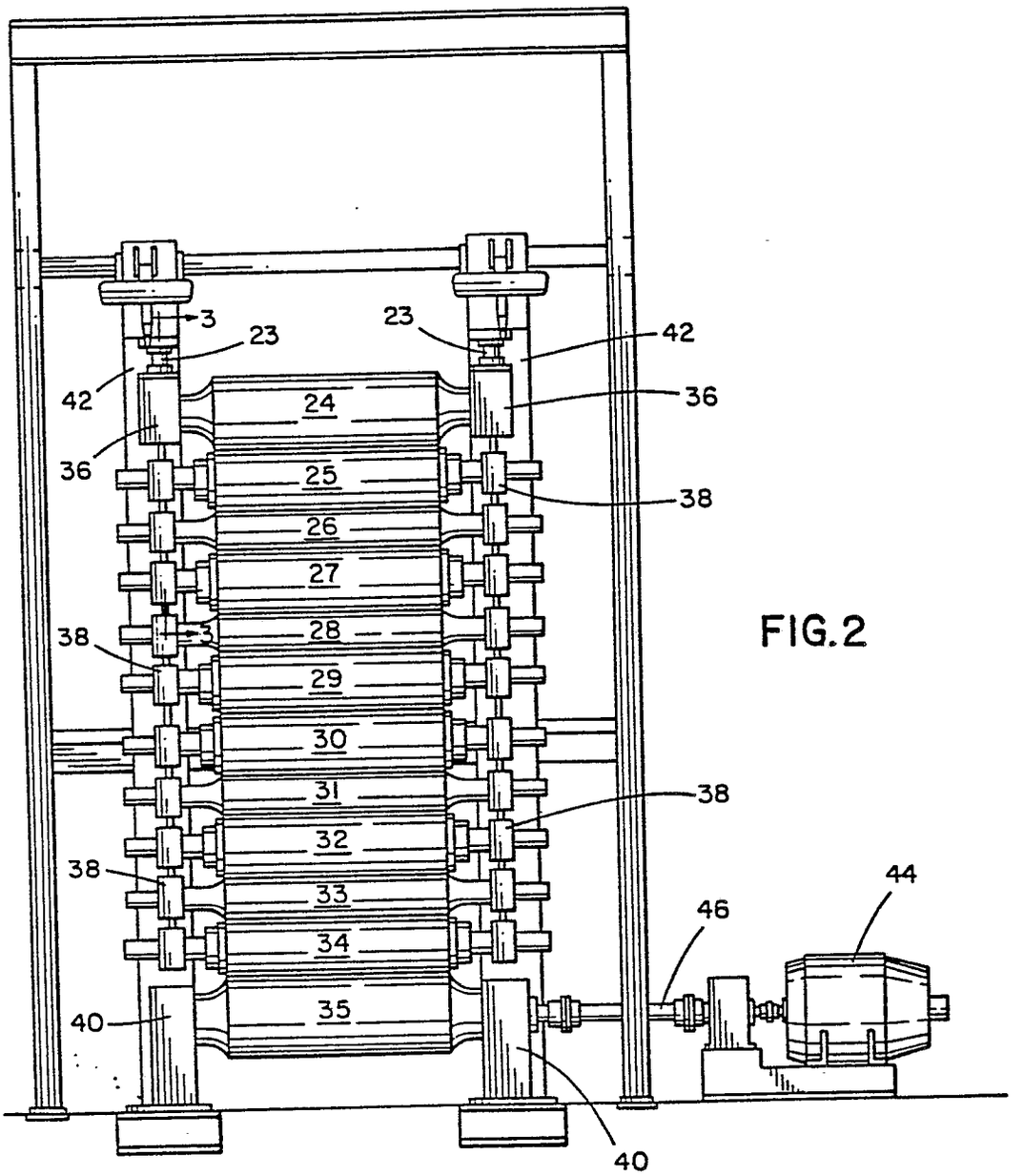
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FIG.2

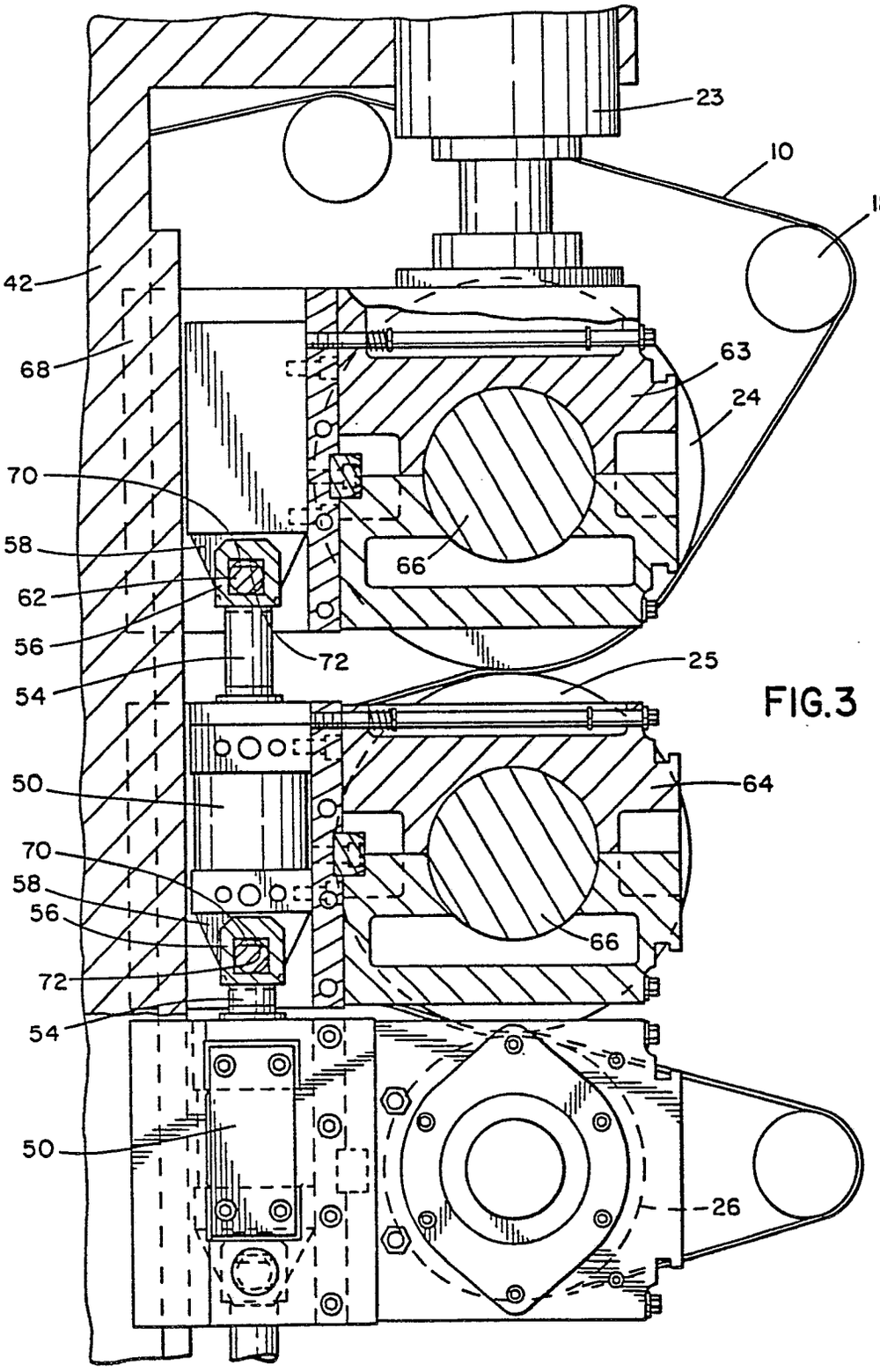
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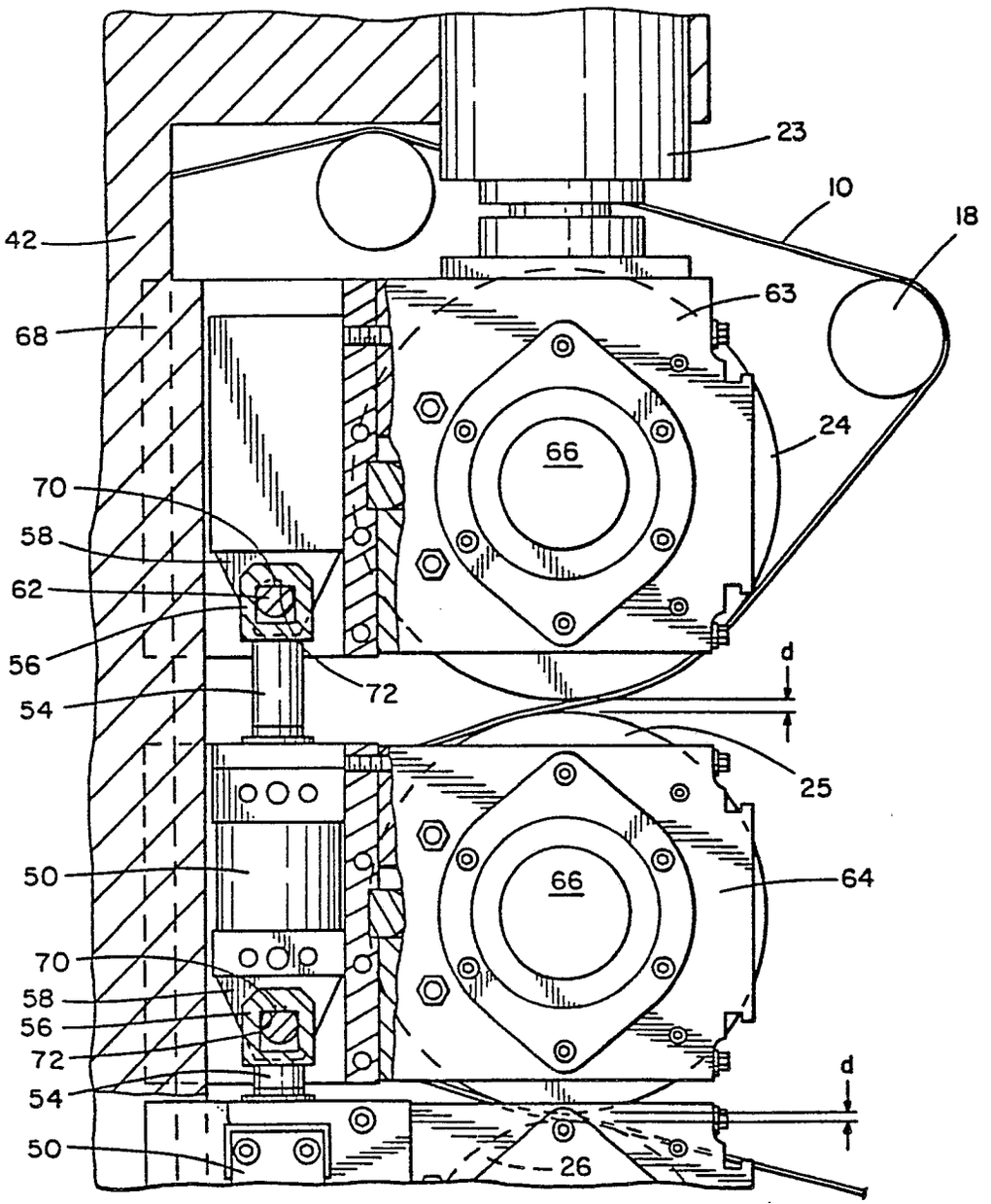
FIG.3

FIG. 4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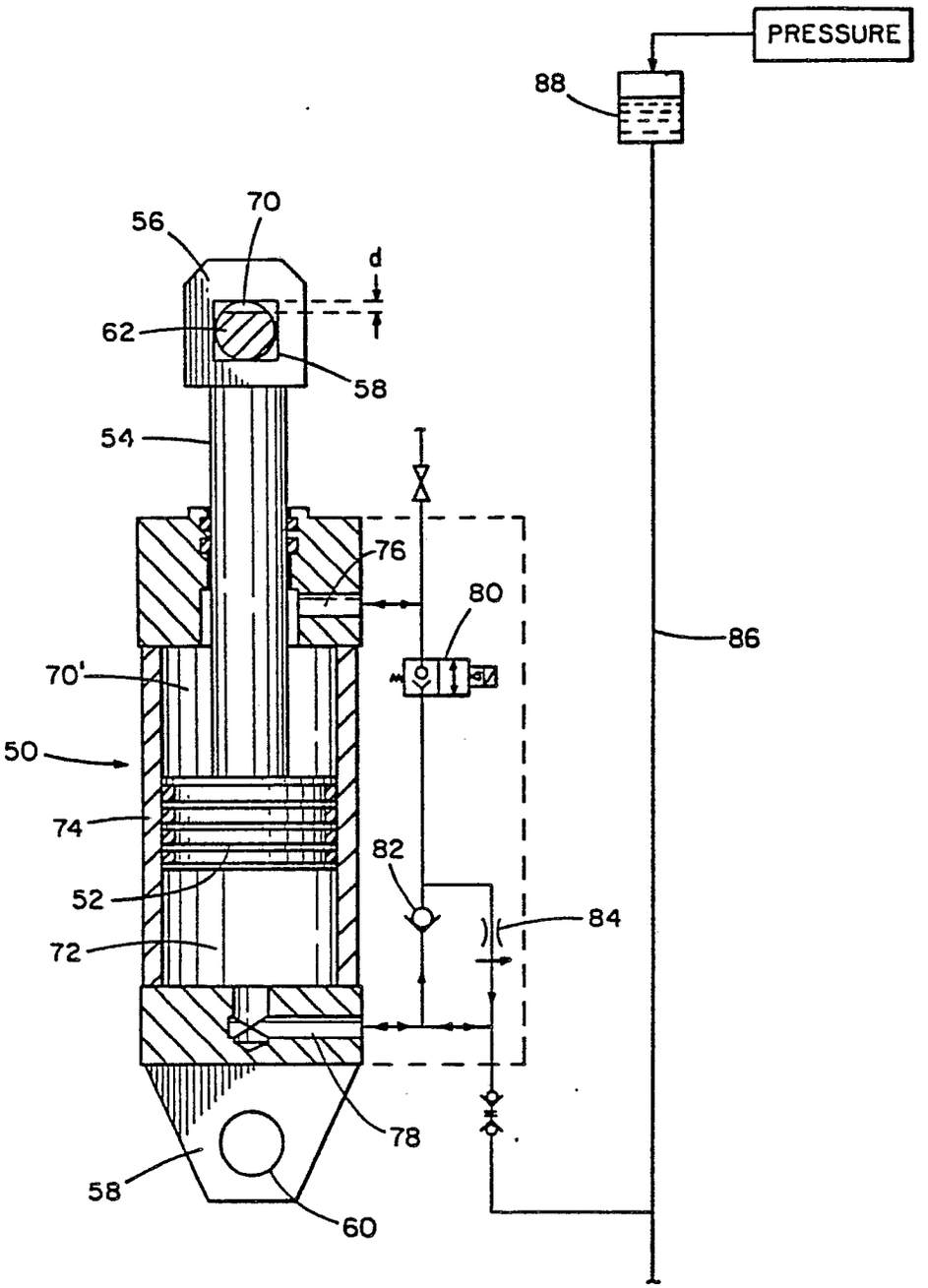

FIG. 5

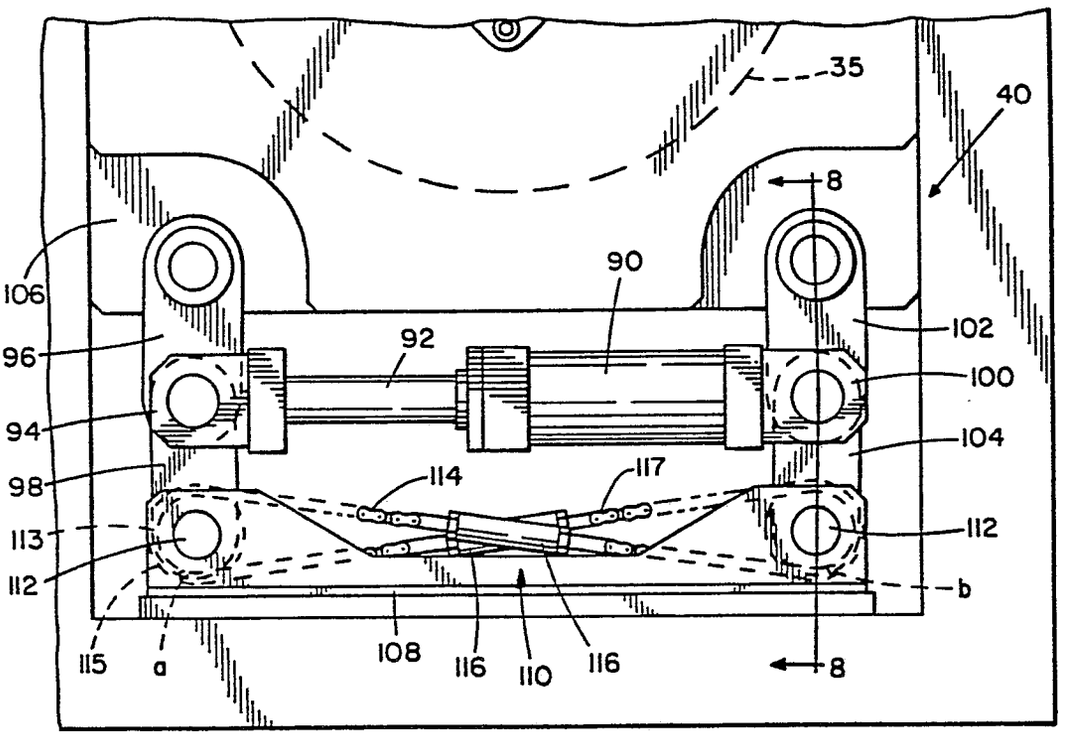
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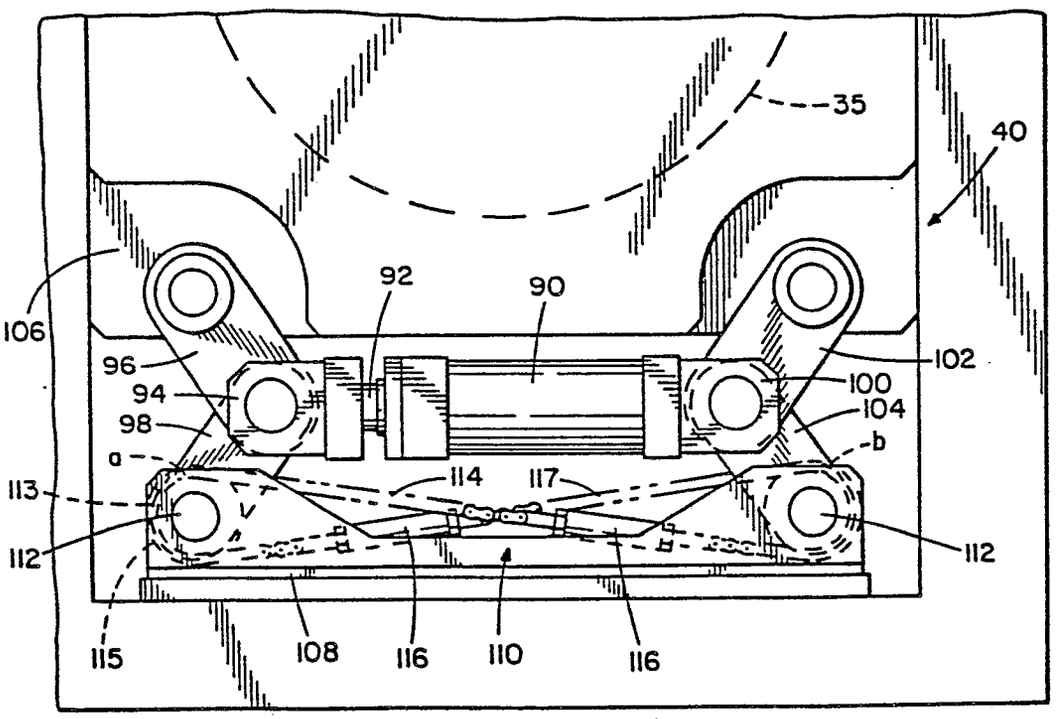
FIG.6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116

FIG.7

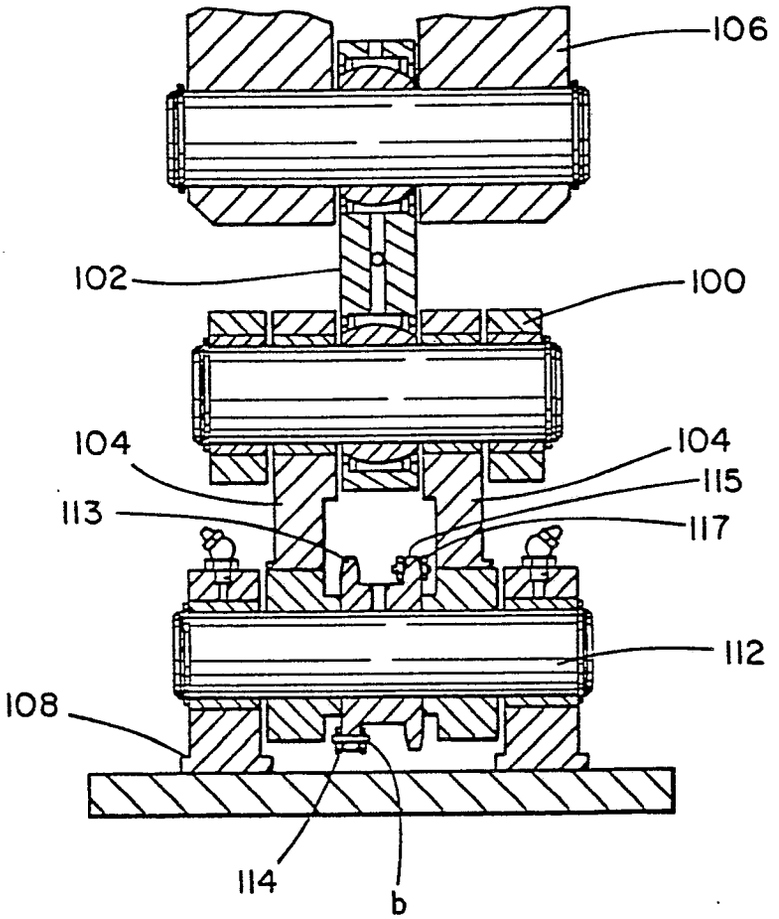

FIG. 8