March 6, 1951 W. LYON 2,544,557

OSCILLATING DOCTOR FOR PAPER MACHINE

Filed Aug. 27, 1947 4 Sheets-Sheet 1

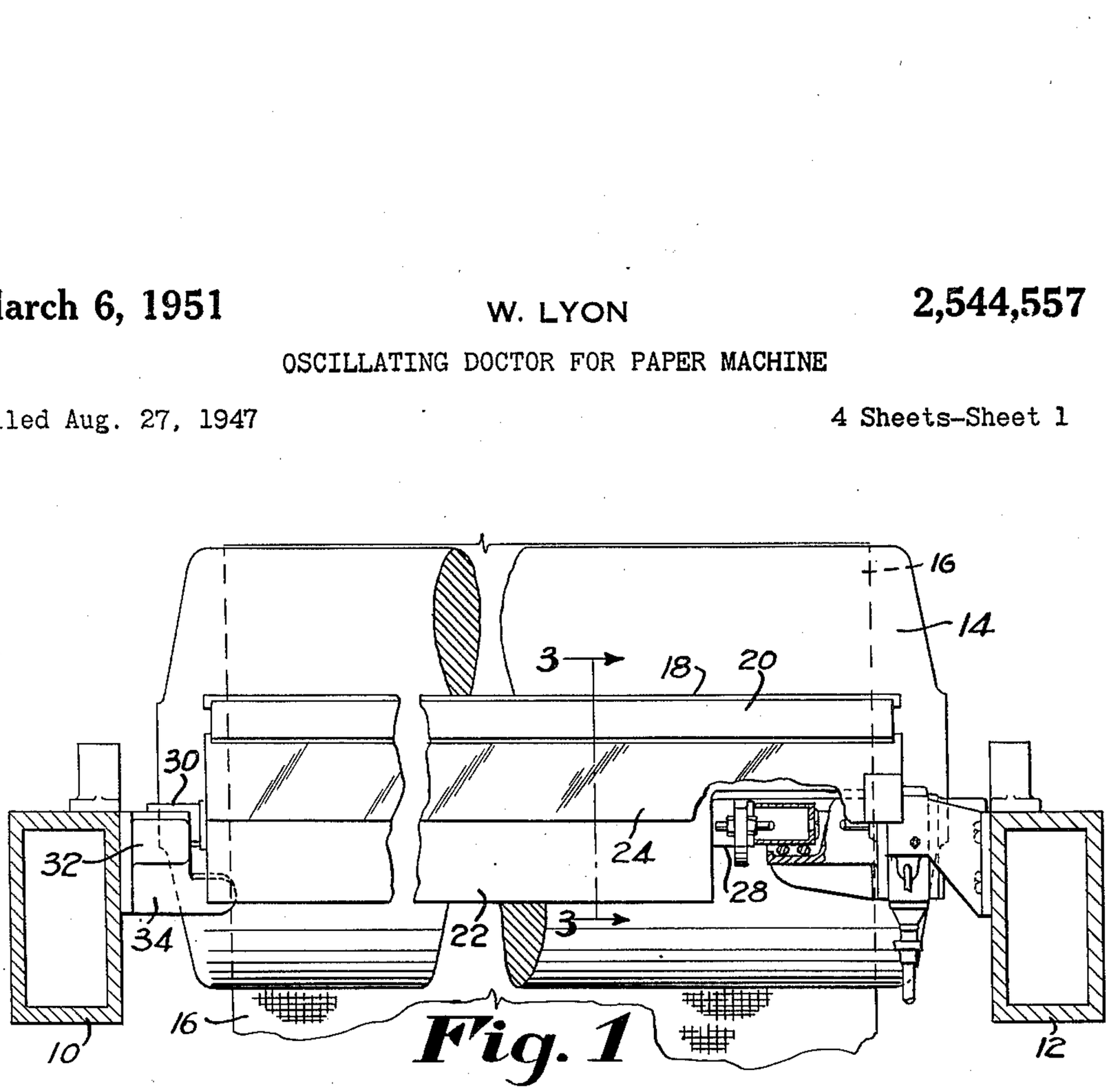


Fig. 1

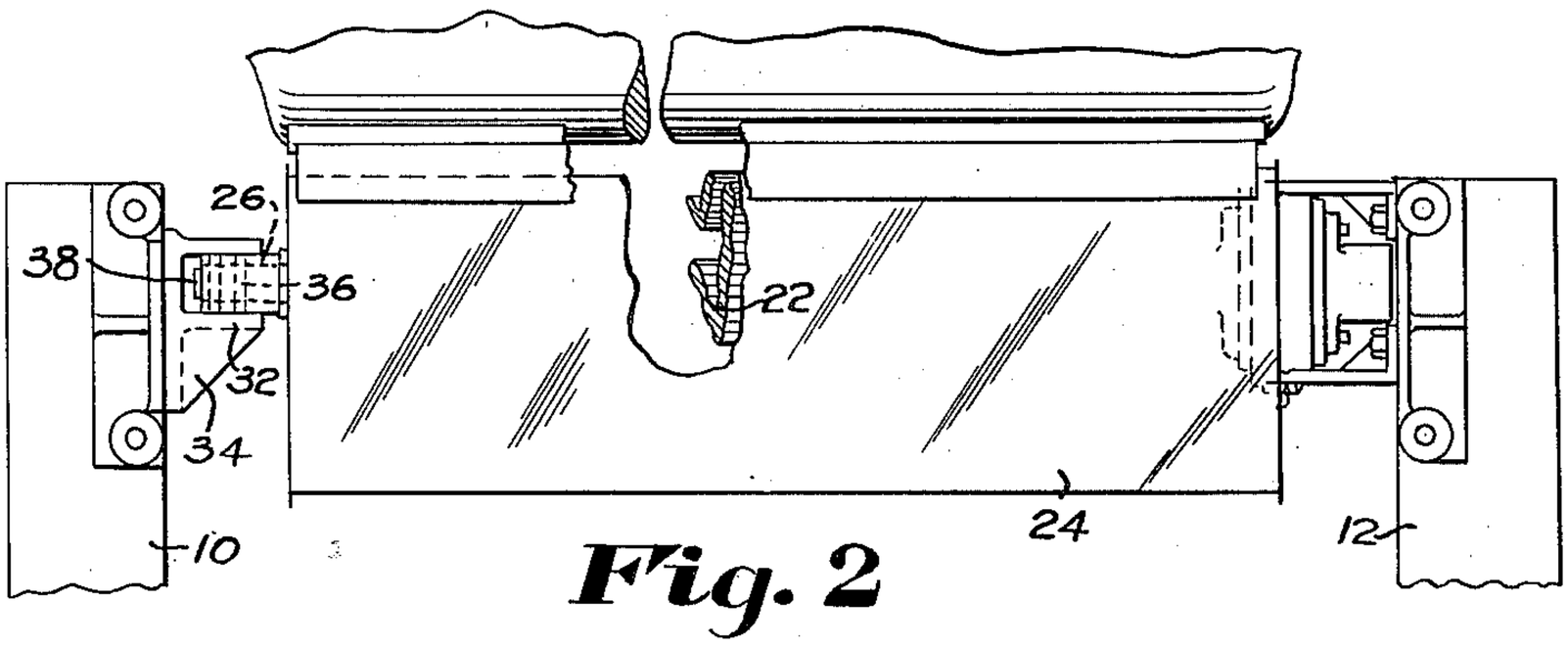


Fig. 2

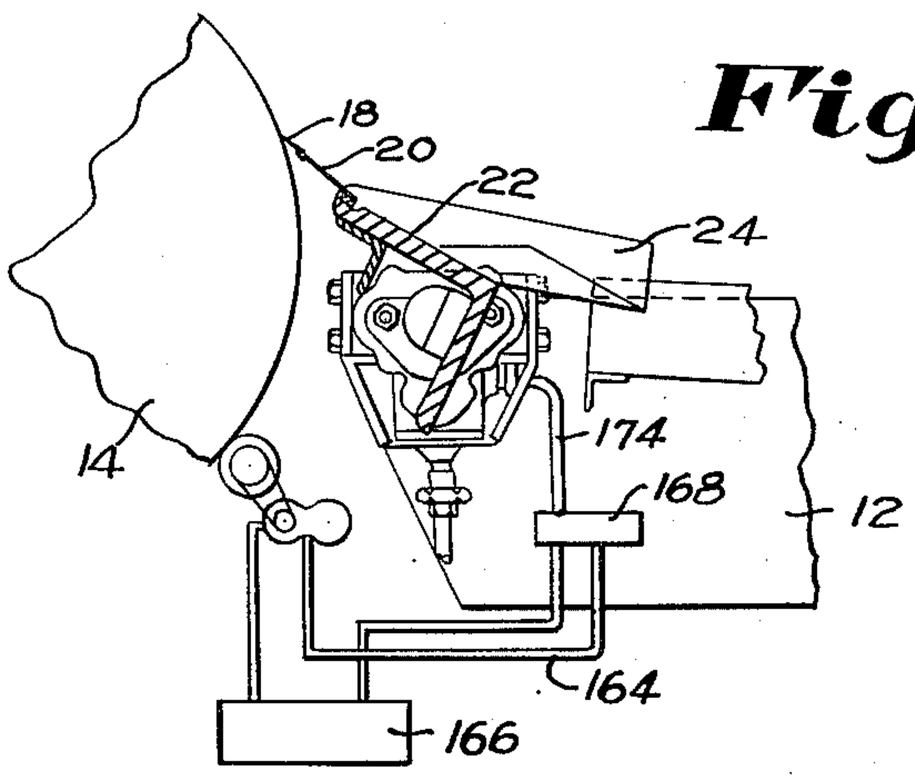


Fig. 3

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OSCILLATING DOCTOR FOR PAPER MACHINE

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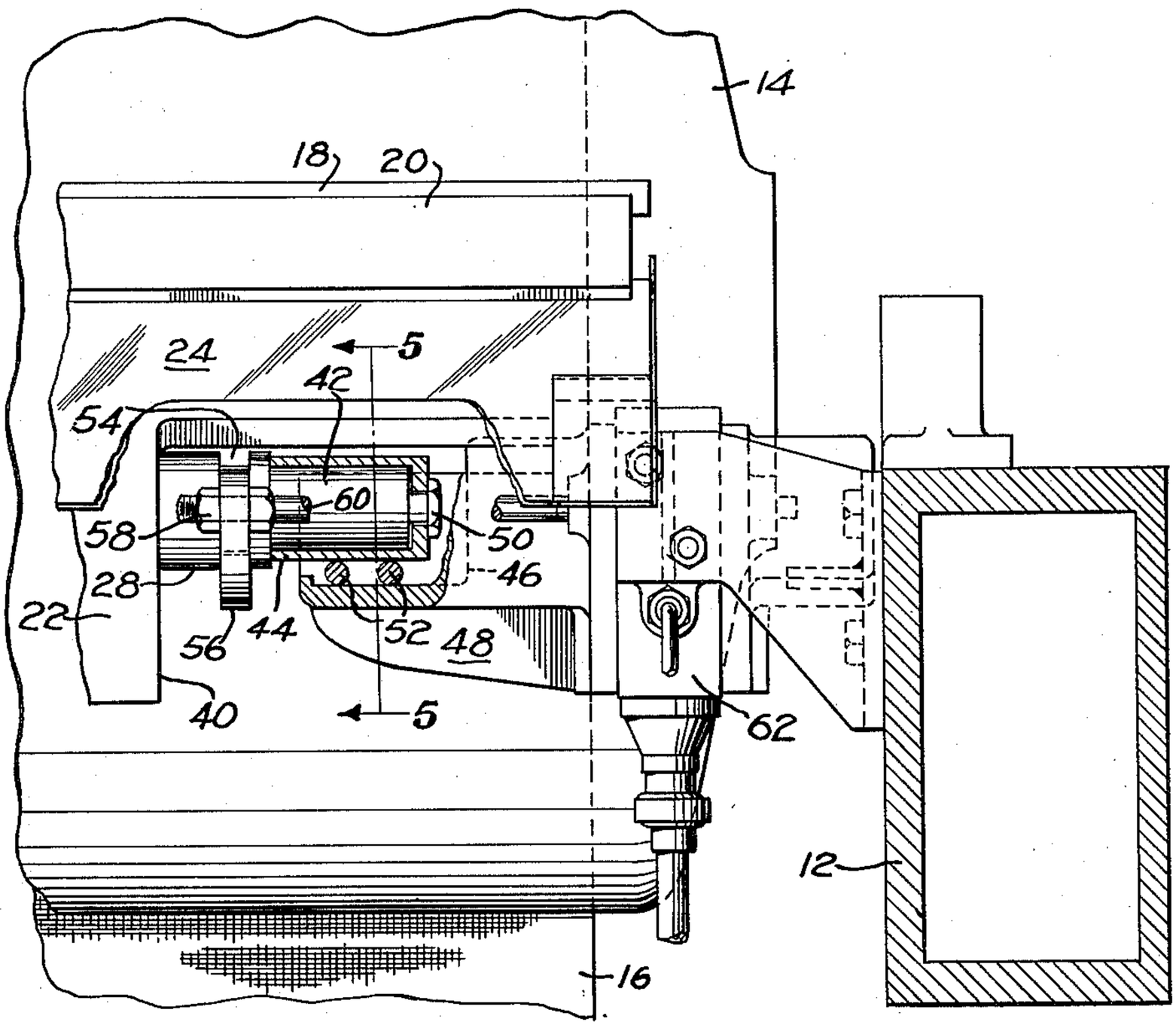


Fig. 4

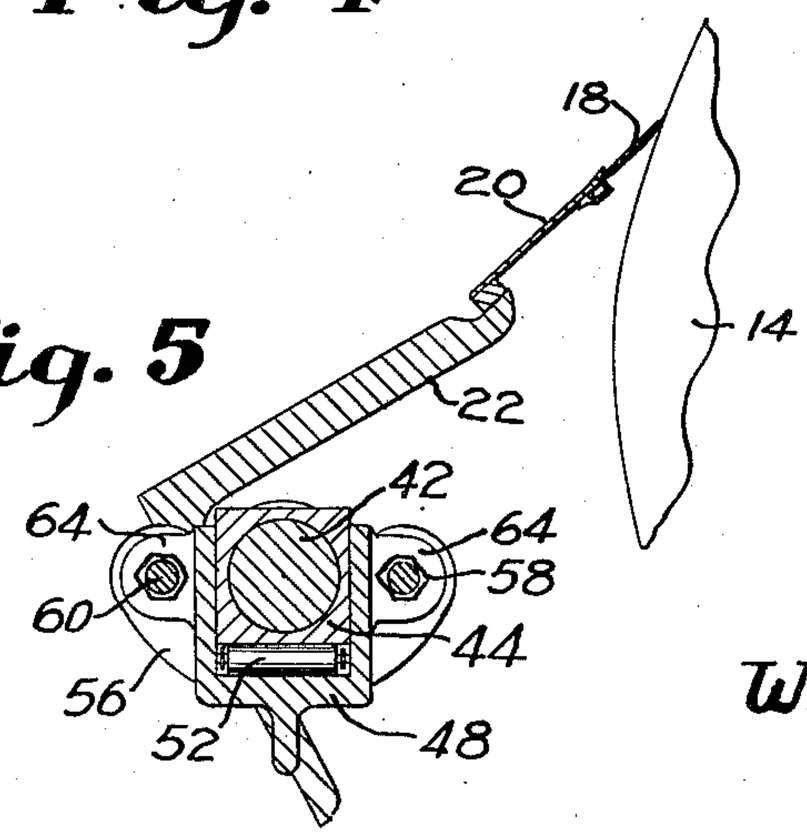


Fig. 5

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OSCILLATING DOCTOR FOR PAPER MACHINE

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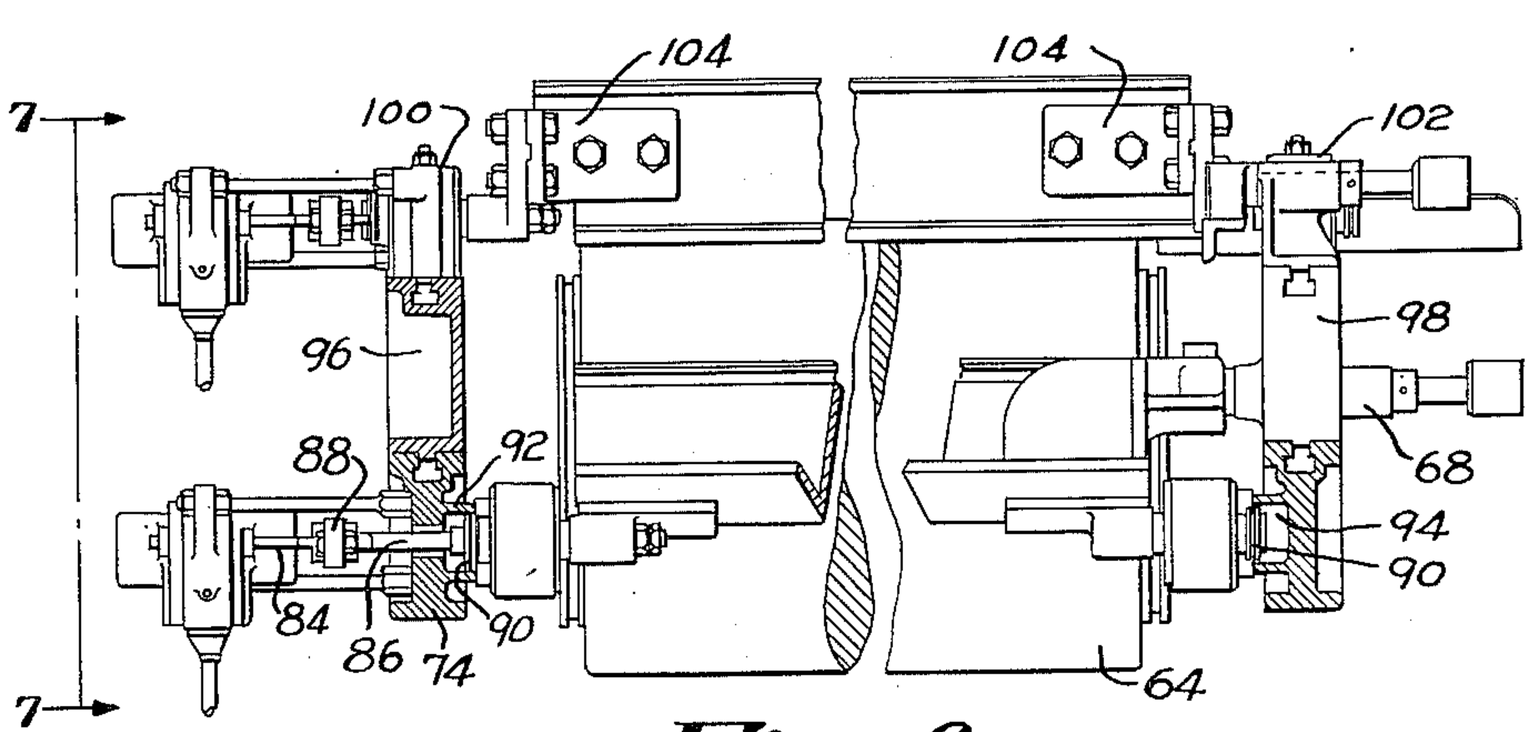


Fig. 6

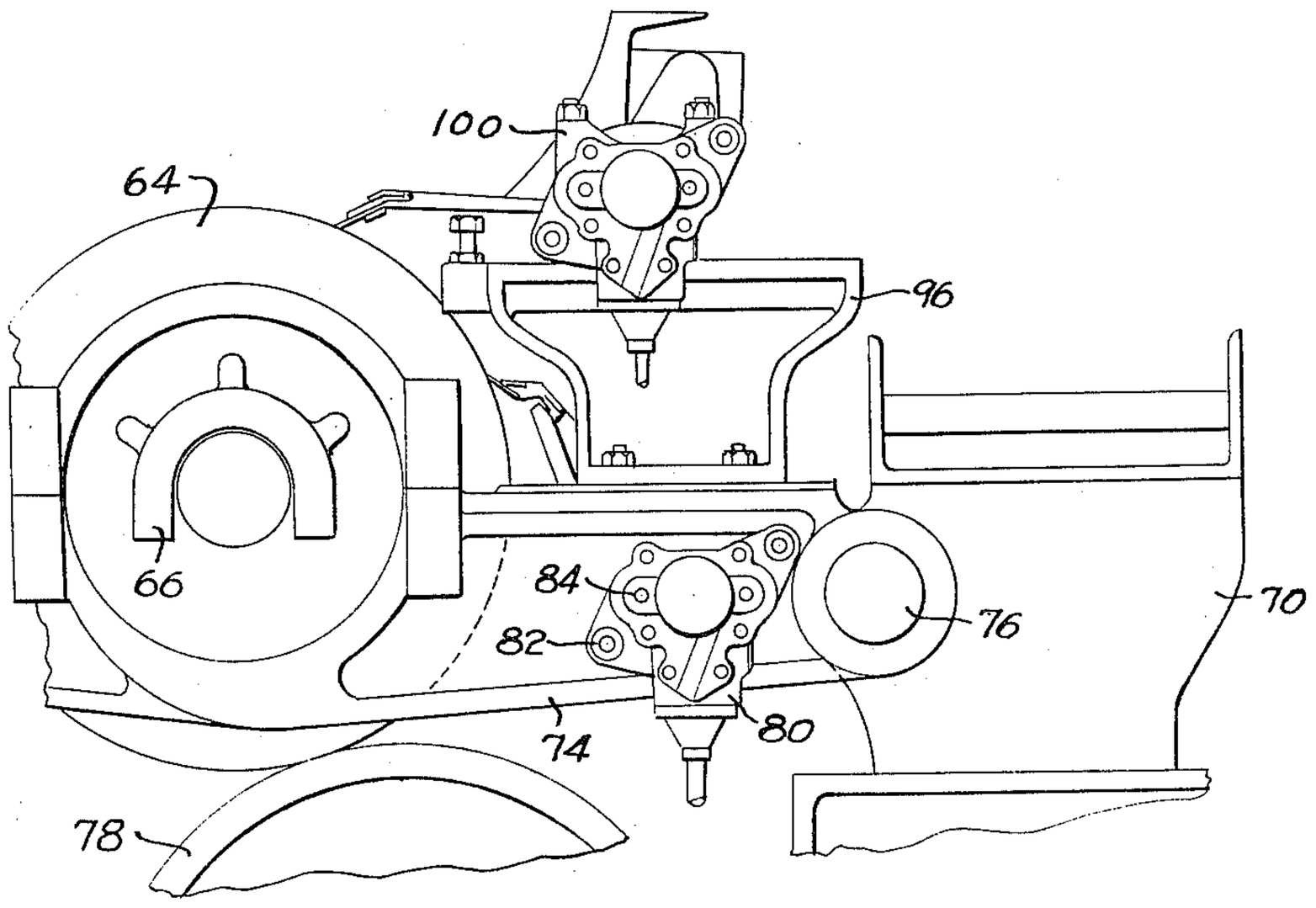


Fig. 7

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OSCILLATING DOCTOR FOR PAPER MACHINE

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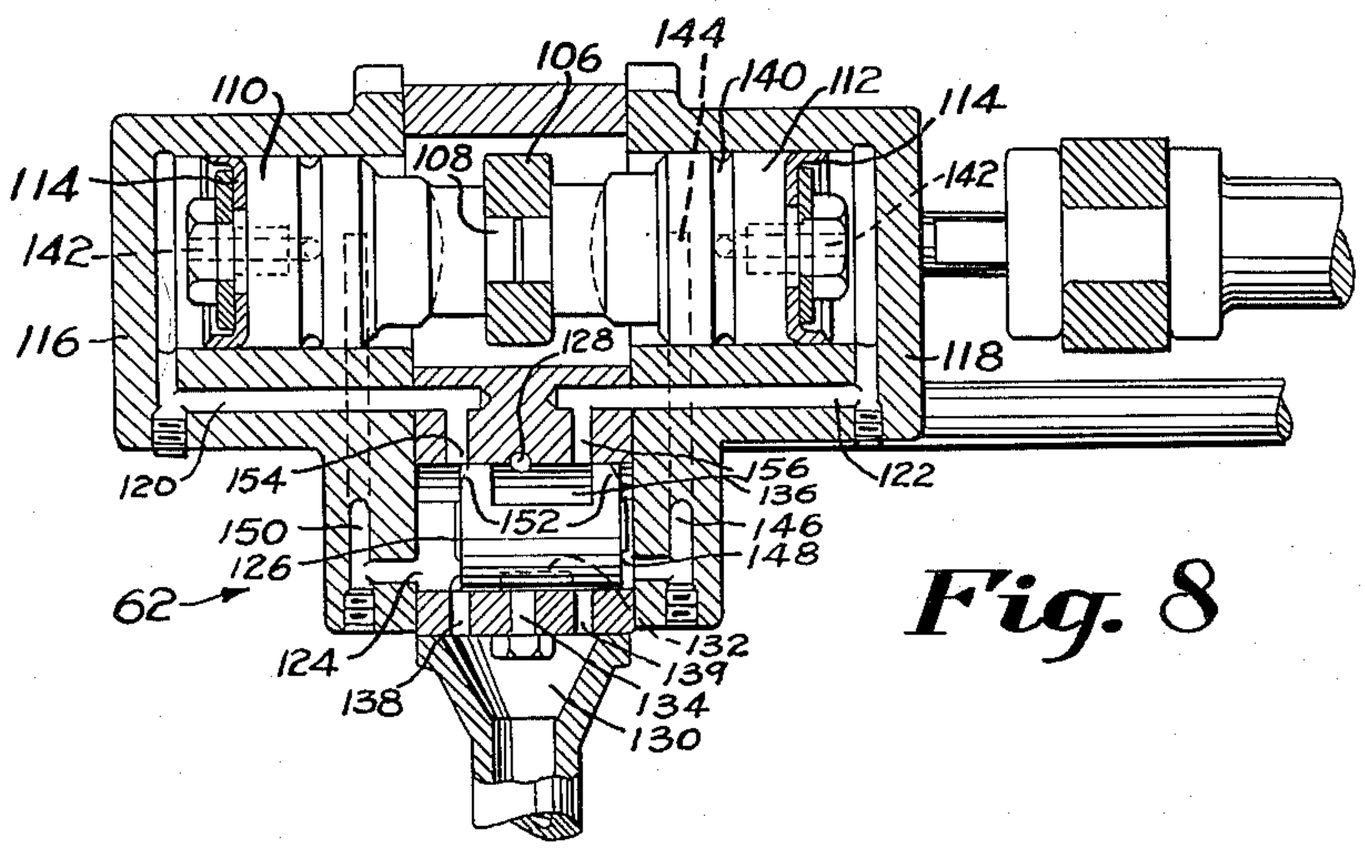


Fig. 8

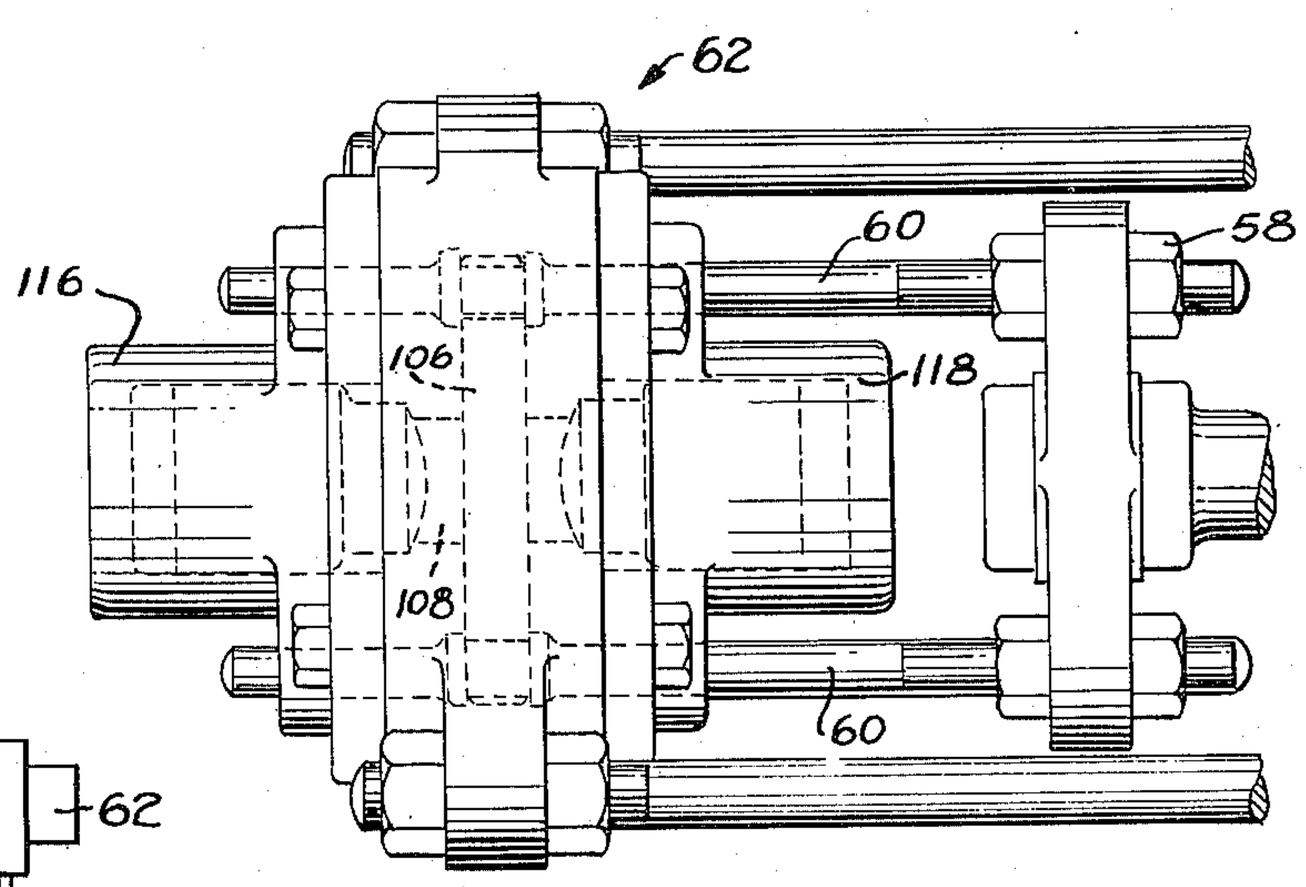


Fig. 9

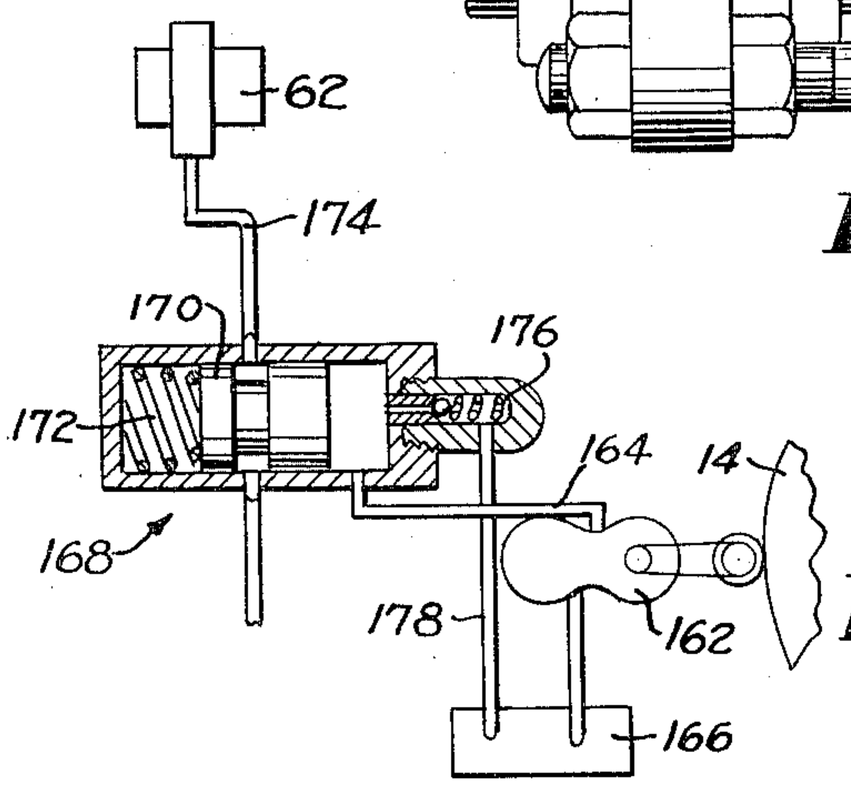


Fig. 10

William Lyon,
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BY Ross C. Burrey

Patented Mar. 6, 1951 2,544,557

# UNITED STATES PATENT OFFICE

2,544,557

## OSCILLATING DOCTOR FOR PAPER MACHINES

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Application August 27, 1947, Serial No. 770,807
In Great Britain March 1, 1945

9 Claims. (Cl. 92—74)

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This invention relates to paper machinery, and more particularly to arrangements for controlling the doctor blade or blades used on the rolls of such machinery.

The art has long recognized the advisability of reciprocating a doctor blade to avoid localized wear between the blade and the roll. Where this has been accomplished by gearing, the mechanism is cumbersome and interferes with general servicing of the roll. Moreover, positive gearing between the roll and the reciprocating mechanism for the doctor maintains a cyclic fixed relationship between the blade and the roll surface resulting in a localized wear pattern between the blade and the roll. The prior art has proposed hydraulic actuation as a means of overcoming the difficulties occasioned by the use of gears but all such arrangements have necessitated very substantial modification of the doctor blade supports. Such modifications are often in conflict with the intended application of the doctor, since the design of the doctor blade support is dictated by the type of roll to which the doctor is applied. For example, a doctor blade support which would serve excellently well on a top press roll is completely unsuited to operating on a breast roll. The present invention therefore contemplates a hydraulic actuating means which can be adapted to various doctor blades with a minimum of modification in the design.

Modern high speed paper making machines are already of great length, notwithstanding the fact that the amount of space allowed for the operators to obtain access to the various parts of the machine has been cut down to the minimum. Existing mechanical oscillating gear cannot be applied to many of the places where it is desirable to oscillate the mechanism without interfering with the operation of the paper machine, or alternatively making its operation dangerous for the operators.

In the case of new machines, the designers are very reluctant to extend the length of the machine merely to provide facilities for fitting oscillators. It is therefore an additional object to provide an oscillating mechanism which may be applied either to existing equipments or to those newly manufactured, without interfering with space requirements, and which will have a minimum of exposed parts so as to minimize the risk of injury to the operators.

Since reciprocation of the doctor blade during periods when the roll is at rest would also produce excessive local wear, it is a further object

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to provide an arrangement for discontinuing reciprocation during such periods.

Still another object is to provide such a device which is of simple, dependable and rugged construction, and which can be manufactured and installed at a cost which is low considering the objects to be satisfied.

The above and other objects and advantages of the invention will best be understood by reference to the following detailed specification of the invention, reference being had to the accompanying drawings, in which:

Fig. 1 is a sectional elevation of a typical paper machine showing the application of the improved doctor arrangement to the breast roll,

Fig. 2 is a plan view of the same,

Fig. 3 is a sectional view taken on the line 3—3 of Fig. 1,

Fig. 4 is an enlarged view of the right-hand portion of Fig. 1, parts being broken away for clarity of illustration,

Fig. 5 is a fragmentary sectional view taken on line 5—5 of Fig. 4,

Fig. 6 is a plan view of the application of the invention to an upper press roll of a paper machine,

Fig. 7 is a side view of the same,

Fig. 8 is a longitudinal sectional view of the self-reversing hydraulic motor employed in connection with the invention,

Fig. 9 is a plan view of said motor, and

Fig. 10 is a diagrammatic view of an arrangement for interrupting the oscillation whenever the associated roll is stationary.

Referring now to Figs. 1 to 3 of the drawings, numerals 10 and 12 designate respectively the side frame members of a typical form of Fourdrinier machine, between which is journalled the breast roll 14, by means of journals (not shown). The wire of the machine passes around the breast roll as shown at 16. It will be observed from Figs. 1 and 2 that the effective width of breast roll 14 is so nearly equal to the space between the main side supports 10 and 12 there is little or no space between either of the side supports and the ends of such roll. A doctor blade 18 and doctor blade holder 20 are carried by a rigid supporting angle beam 22 in a manner known per se. A usual form of chute or trough 24 may be secured to the angle beam 22 to direct away from the roll any material which is doctored from its surface.

Angle beam support 22 is rigidly connected adjacent its opposite ends to stub shafts 26 and 28 each of which is rotatably received in a bear-

ing block of square cross-section. Bearing block **30** at the left end of the doctor support (looking at Figs. 1 and 2) is slidably received within an upwardly open square pocket **32** of a support bracket **34** bolted to frame member **10**, so that block **30** is held against rotation within said pocket but is freely slidable therein to a limited extent. Anti-friction bearings such as rollers **36** (Fig. 2) may be interposed between block **30** and the bottom of pocket **32** to facilitate this sliding movement. A shoulder bolt **38** secures the end of stub shaft **26** to the end of block **30** so that the latter is carried with the stub shaft during reciprocation, but permitting free rotative movement of these parts relative to one another.

At the right end of the doctor support beam (see Fig. 4) a portion **40** of such beam is cut away to provide space for a bearing similar to that just described, as well as for the installation of the reciprocating motor to be described below. More specifically, stub shaft **28** at this end of the doctor is provided with an end portion **42** of reduced diameter rotatably received within the cylindrical bore of a bearing block **44** whose outer profile is square (see Fig. 5) so as to slide within the upwardly open box support **46** of a support bracket **48** bolted or otherwise secured to frame member **12**. As in the case of the bearing at the opposite side of the machine, a shoulder bolt **50** passes freely through an aperture in the end of block **44** and is threaded into shaft **28**, a slight clearance being provided between the end of this shaft and the inner end wall of the block to permit free rotation of shaft **28** therein. Anti-friction rollers **52** support the block **44** upon the bottom wall of the box **46**. Thus, the bearing blocks, the doctor blade support beam, the blade support and the blade may be reciprocated freely as a unit laterally of the machine, while the support beam and parts carried thereby may additionally be rotated to a limited extent to enable the blade to be withdrawn from the surface of roll **14**. Moreover, the upwardly-open box-like support **32** and **46** permit the entire doctor assembly to be lifted out and replaced in the identical position with respect to the roll **14**.

The manner in which the doctor support is periodically and automatically reciprocated across the face of roll **14** will now be described, it being understood that the purpose of such reciprocation is to prevent the formation of localized ridges or imperfections in either the roll or the doctor blade, as might occur if the same point on the doctor were continuously in contact with the same zone of the roll, or if a cyclic relation existed between roll and blade. Stub shaft **28** is provided with an annular groove **54** which receives an upwardly open crosshead **56** (Fig. 4) provided with laterally extending ears to which are secured as by nuts **58** the ends of a pair of drive rods **60** extending inside the hydraulic motor **62**, and which may receive sliding support from a pair of laterally extending ears **64** (Fig. 5) preferably integral with the square box structure **46**. Since drive rods **60** are spaced equally on opposite sides of the stub shaft **28**, it is clear that a reciprocation of such rods by the motor **62** will cause the entire doctor support structure to slide easily back and forth across the face of roll **14** without binding, and that the doctor blade itself is free to rotate to a limited extent in its axial bearings, either to accommodate for slight eccentricities in the roll **14**, or to enable the blade to be withdrawn from the surface of the roll for changing or for other reasons.



Additionally, it will be observed that since the square bearing blocks **30** and **44** are received within upwardly open box formations **32** and **46**, and cross-head **56** passes beneath the stub shaft **28**, the entire doctor structure, including bearing blocks **30** and **44**, can easily be lifted away from its support and drive means when such operation is necessary, without in any way disturbing the bolted support brackets or the drive motor mounting, or the angular relation between the roll surface and the doctor blade when the parts are replaced. This is a very valuable feature particularly when it is necessary to change the clothing on the machine; for example, the Fourdrinier wire carried by a breast roll.

Figs. 6 and 7 illustrate the application of the improved form of doctor drive as applied to a double doctor arrangement for use on a top press roll. Since the arrangements for the two doctors are duplicates of one another, only that for the lower of the pair (as seen in Fig. 7) will be described in detail. The top press roll is indicated by numeral **64**, and is supported as by bearings **66** and **68** mounted upon the opposite machine frames, one of which is shown at **70**, in the usual pivoted journal frames or supports **74** (Fig. 7), whose purpose is to permit a limited swinging of the press roll **64** about the axle **76**, thereby to press against the lower roll **78** (or upon an interposed felt) with a regulated pressure.

Hydraulically reciprocating drive motor **80** for the lower doctor assembly is bolted to swinging journal frame **74** as by support bolts **82**. The operating rods **84** of the motor, two in number, are here again spaced equally on opposite sides of the doctor operating shaft **86**, and connected thereto by a cross-head **88**. Unlike the previous embodiment, however, the combination of sliding and rotating movement of the doctor is achieved by journalling the same as at **90** within opposed cylindrical pockets **92** and **94** secured to the support frames, said pockets being sufficiently deep to accommodate a limited amount of sidewise reciprocation of the doctor assembly. The operating shaft **86** passes from the crosshead **88** through an aperture in frame member **74**.

The above arrangement is duplicated for the upper doctor assembly, except that in this case the motor and doctor supports are mounted upon a pair of pillow blocks **96** and **98** respectively secured as by keyways upon the upper surfaces of the swinging journal frames, bolsters **100** and **102** providing the necessary bearing support for the doctor assembly and for the hydraulic motor. Since it is obviously impossible with this arrangement to lift the entire doctor assembly bodily out of its mounting, as was done in the previously described arrangement, the doctor blades and their supports are here shown as secured bolted brackets such as indicated at **104** (Fig. 6), which enable the doctor support to be removed bodily when occasion requires. However, these doctors, like those previously described, are capable of the free swinging movement toward and away from press roll **64** by virtue of the cross-head connections between the doctor operating shafts and the respective hydraulic motors.

In accordance with the invention, a specialized form of hydraulic reciprocating drive motor is

provided to cause the desired lateral traverse of the doctor blade support.

As best shown in Figs. 8 and 9, the doctor is connected to a cross-head 106 secured around central shaft 108 carrying at its outer ends hydraulic pistons 110, 112. These pistons are provided with cup leathers 114 and are adapted to oscillate in a pair of cylinders 116, 118 having inlet passages 120, 122, respectively, at their ends connected one at a time to a valve chamber 124 in which oscillates an automatic shuttle element 126 controlling the passage of pressure liquid from an inlet 128 to passages 120, 122, alternately. A passage 130 leads to exhaust or relief. The shuttle valve 126 is guided by forming a recess 132 in it into which a stop pin 134 engages.

This shuttle valve further has a recess 136 in communication alternately with the passages 120 and 122.

In operation pressure liquid, preferably oil under pressure, is passed from the inlet 128 to the recess 136 and thence to either cylinder 116, 118 through passage 120 or passage 122. In the position shown in Fig. 8, this pressure liquid can pass to passageway 122 in the cylinder block to displace the piston 112 at the outer end of its stroke inwardly from the outer end of its cylinder, driving piston 110 towards the outer end of its cylinder.

Liquid behind the piston 110 can escape by passage 120 into the valve chamber 124 and thence through outlet port 138 communicating with the exhaust 130.

As the piston 112 subject to pressure from the passage 122, reaches its end position, a groove 140 in it communicating with an axial passage 142 in the piston head, comes into coincidence with a groove 144 in the cylinder communicating with passage 146 leading to the space 148 behind the shuttle valve 126 thus flicking it across so that the pressure inlet 128 now communicates through recess 136 with the passage 120 causing the piston elements 110, 112, to move back in the opposite direction carrying with them the crosshead 106 attached to the doctor.

It is obvious that instead of forming the shuttle valve chamber 124 containing the shuttle valve 126 within a unitary casting containing the cylinders 116, 118, this may if desired be formed as a separate unit connected with the passages 120, 122 and 146, 150 respectively by connection pipes.

Chamfers 152 are formed at the ends of the valve so that the valve faces controlling ports 154 and 156 of passages 120 and 122 are only very slightly wider (by a few thousandths of an inch) than the ports 154 and 156. The recess 136 is slightly longer than the shortest distance between the ports 154 and 156 so as to ensure that one port is slightly open to pressure liquid before the other finally closes during movement of the valve.

Thus during operation there will be little danger of the valve stopping in an intermediate position since although closure of the port 156 for example during movement of the valve from right to left will prevent any further feed of liquid through the port 156 and through passages 122 and 146 to the space 148, nevertheless the port 154 will by this time be open to pressure liquid so as to cause movement of the pistons 110 and 112 from left to right to cause displacement of liquid from the right hand end of the cylinder 118, first through passages 142, 144 to space 148 and then through port 156 to space 148 whereby to ensure completion of the movement of the shuttle valve



from right to left. In this connection it is to be noted that the right hand outlet port 139 does not open until after the port 156 has opened to exhaust into the right hand end part of the chamber 124. It is also to be noted that left hand exhaust port 138 closes before the valve reaches the end of its stroke. Displacement of liquid from the left hand end of the valve casing can however continue through the passage 142 whose outlet in the cylinder 116 is not closed until the piston 110 approaches its mid stroke.

It will be appreciated that the hydraulic oscillating gear of the present invention can be built compactly and with a minimum of exposed moving parts and that, in operation, the rate of oscillation can be readily adjusted and that since the movement of the doctor depends upon the valumetic displacement of the operating liquid fed to the pistons, a steadily progressive movement of the doctor across the roll is achieved.

A valuable feature of the operating gear of the present invention is its reliability since stoppage of a doctor in a paper making machine is liable to give rise to considerable damage and expensive repairs as well as loss of production.

In order to prevent the reciprocating motion of the doctor blade from occurring when the roll being doctored is at a standstill, which would tend to cause local wear upon the roll surface along a transverse line, the doctor motors of any of the above arrangements may be provided with a control which is sensitive to the rotation of the breast or press roll. As shown in Fig. 10, such a control may comprise any known or convenient type of hydraulic pump, such as gear type pump 162 driven from the roll being doctored, either by a frictional contact wheel engaging the face or side of the roll, or by pulley or gear drive, and connected to supply pressure fluid through a duct 164 from a sump 166 and to a valve generally designated by 168. This valve may comprise a spool 170 shiftable against the pressure of a spring 172 to open the supply line 174 of main hydraulic fluid to the doctor motor 62, whenever the pressure of fluid from pump 162 exceeds a predetermined amount. A safety or relief valve 176 of conventional construction may be provided to pass excess oil pumped by pump 162 through a drain line 178 and back to sump 166. Thus whenever roll 14 (or any equivalent roll being doctored) comes to a standstill, the pressure in line 164 will drop to a point at which spring 172 will shift spool 170 to the right and close the supply line 174, causing a cessation of the reciprocatory movement of the doctor. Upon resumption of rotation of the roll 14, pump 162 will cause a build-up of pressure behind spool 170 sufficient to shift the spool to its Fig. 10 position, whereupon reciprocation of the doctor blade will again ensue.

It will be seen from the above specification that I have provided an apparatus satisfying all of the objects of my invention in a relatively simple and highly efficient manner, but obviously many changes and modifications may be made in the specific details of construction without departing from the spirit of the invention as defined in the appended claims.

I claim:

1. Doctor blade mechanism comprising: a rigid doctor blade support; a pair of axially aligned stub shafts rigidly secured, one at each end of said support; a pair of integral bearing members each rotatably receiving and enclosing one of said stub shafts with an ordinary journal fit, said bearing members having polygonal exterior

cross-section, and a pair of supports slidably receiving said bearing members, said supports comprising troughs conforming to the exterior cross-section of said bearing members, the upper sides of said troughs being open to permit removal of the bearing members therefrom.

2. Doctor blade mechanism according to claim 1 including means penetrating said stub shafts for securing said bearing members to said stub shafts against axial separation.

3. Doctor blade mechanism according to claim 1 in which one of said stub shafts has a circumferential groove adjacent the inner end of its bearing member; a cross-head having a semicircular cutaway portion in its upper side engaging said groove, and means for reciprocating said crosshead.

4. Doctor blade mechanism according to claim 3 including means penetrating said stub shafts for securing said bearing members to said stub shafts against axial separation.

5. Doctor blade mechanism comprising: a rigid doctor blade support; a pair of axially aligned stub shafts rigidly secured at each end of said support; a bearing for each of said stub shafts, each of said bearings providing for simultaneous reciprocation and rotation of said stub shafts therein, a reciprocating hydraulic motor, and means including a connection acting in a plane containing the axis of said stub shafts for connecting said motor to one of said shafts to reciprocate said support, said connecting means being rotatably free of said stub shafts.

6. Doctor blade mechanism as set forth in claim 5 in which the hydraulic motor has at least one piston mounted coaxially with the stub shafts.

7. Doctor blade mechanism comprising: a roll to be doctored; a doctor blade support adjacent said roll; a hydraulic motor for reciprocating said support; a line supplying fluid to said motor;



a normally closed valve in said line; a pump driven by the rotation of said roll, and means connecting said pump to said valve for opening the same when the roll is rotated.

8. Doctor blade mechanism comprising a rigid doctor blade support, a pair of axially aligned stub shafts rigidly secured one at each end of said support, a pair of bearing members each rotatably receiving and enclosing one of said stub shafts, said bearing members having polygonal exterior cross-sections and a pair of supports slidably receiving said bearing members, said supports comprising open troughs conforming to the exterior cross-section of said bearing members, one of said stub shafts having a circumferential groove adjacent the inner end of its bearing member, a cross-head having a semicircular cut-away portion in its upper side engaging said groove and means for reciprocating said cross-head.

9. Doctor blade mechanism according to claim 8, including means for securing said bearing members to said stub shafts against axial separation.

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