Oct. 10, 1950 F. DUSTAN 2,524,964

HYDRAULIC APPARATUS FOR PULSATING THE DIAPHRAGMS OF PULP MILL SCREENS

Filed July 11, 1945 3 Sheets-Sheet 1

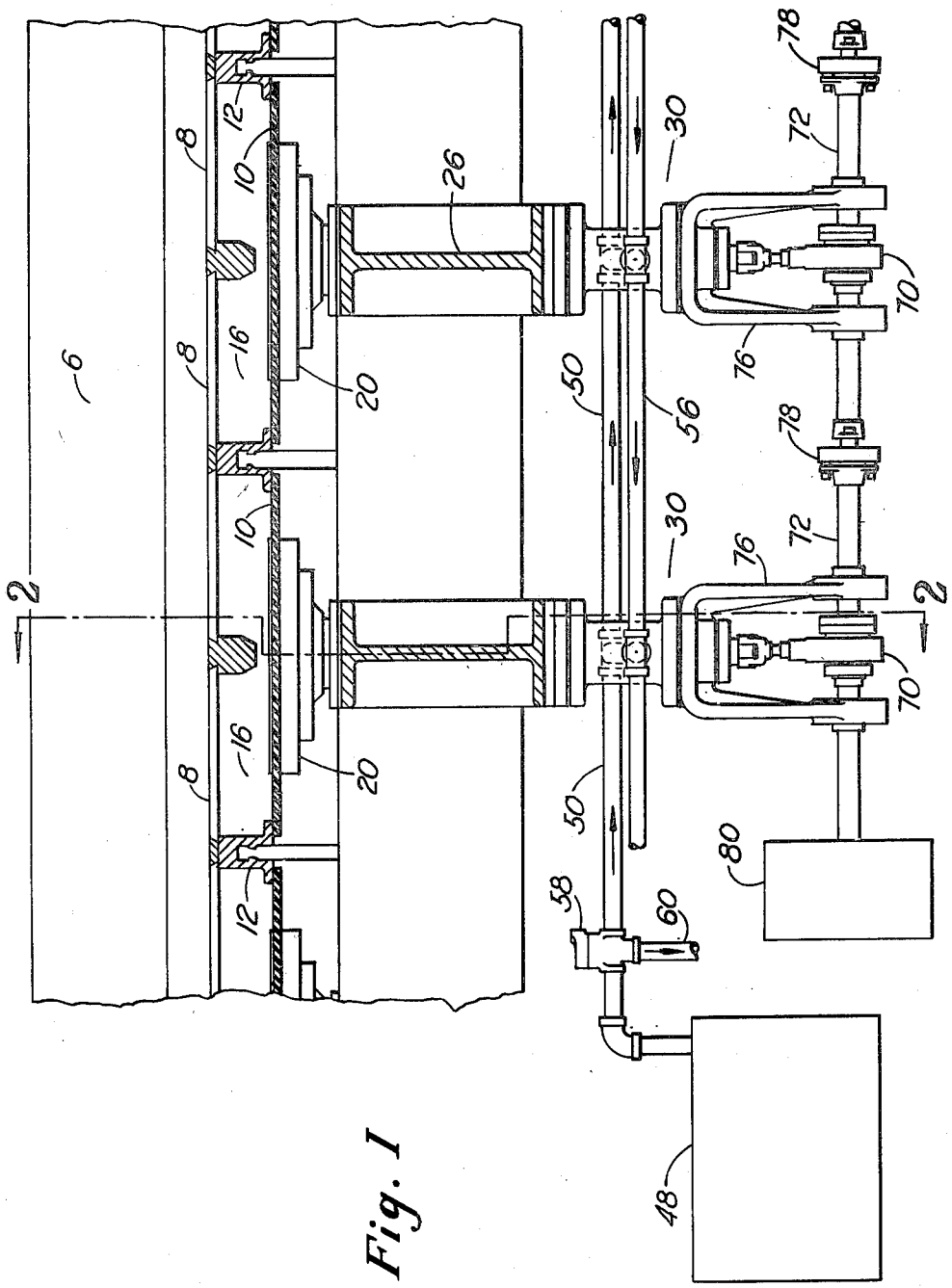



Fig. 1

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HYDRAULIC APPARATUS FOR PULSATING THE DIAPHRAGMS OF PULP MILL SCREENS

Filed July 11, 1945 3 Sheets-Sheet 2

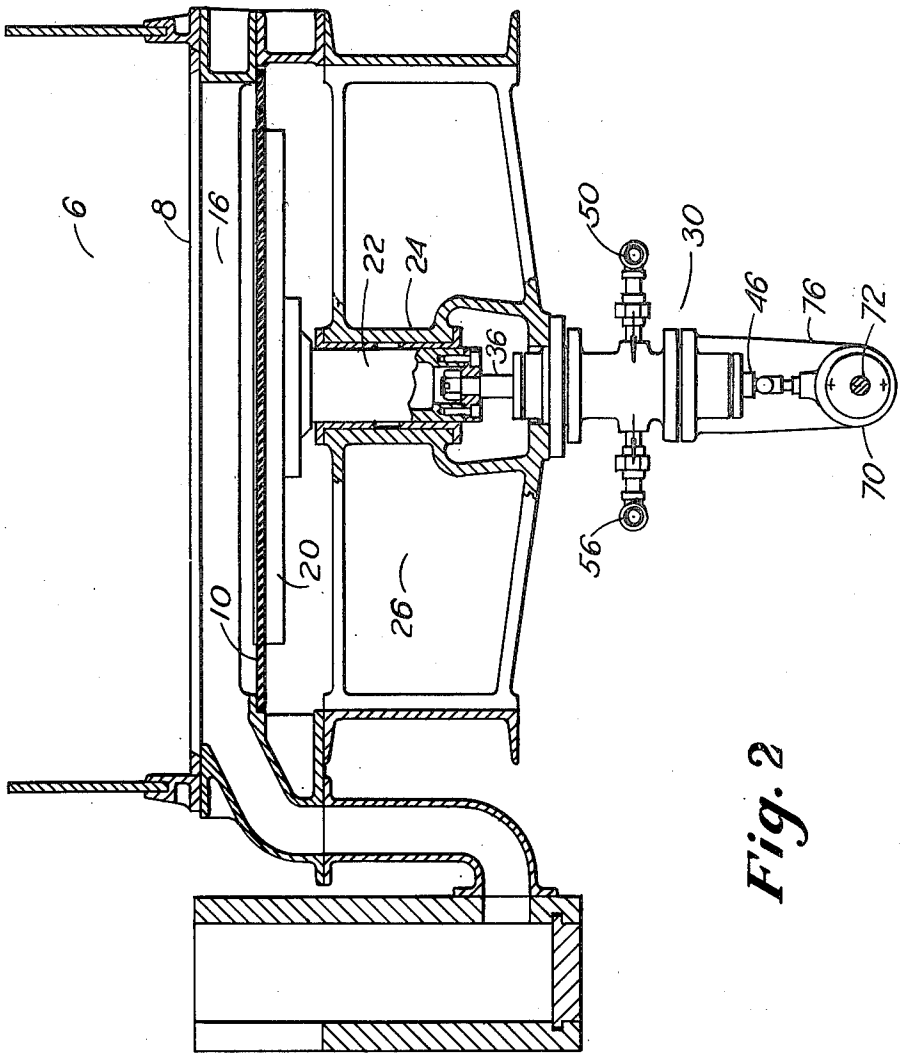



Fig. 2

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HYDRAULIC APPARATUS FOR PULSATING THE DIAPHRAGMS OF PULP MILL SCREENS

Filed July 11, 1945 3 Sheets-Sheet 3

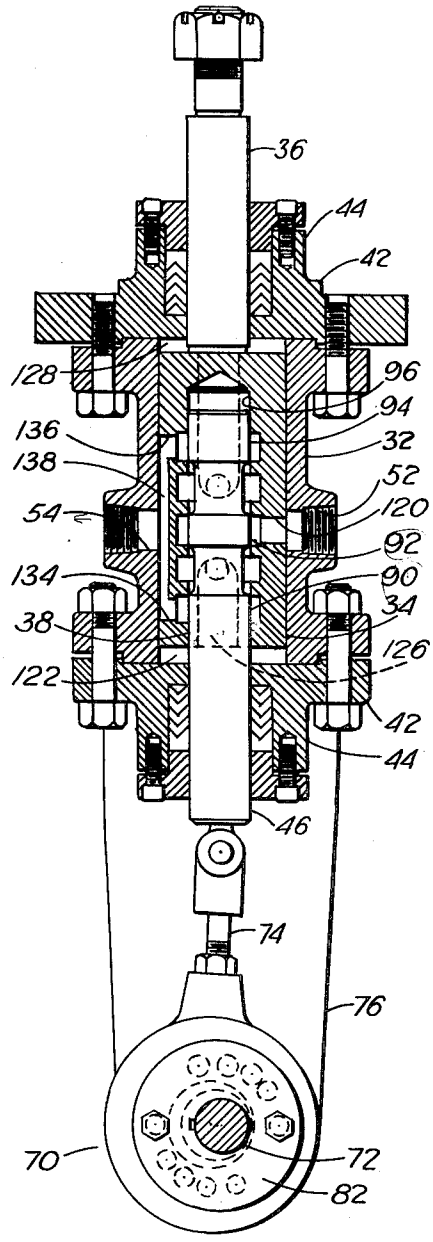



Fig. 3

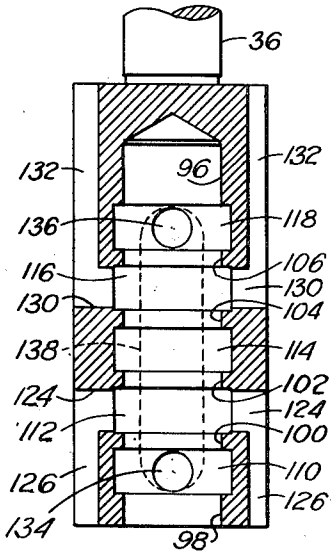



Fig. 4

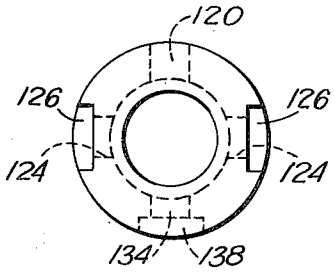



Fig. 5

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Patented Oct. 10, 1950 2,524,964

# UNITED STATES PATENT OFFICE

2,524,964

## HYDRAULIC APPARATUS FOR PULSATING THE DIAPHRAGMS OF PULP MILL SCREENS

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Application July 11, 1945, Serial No. 604,317

1 Claim. (Cl. 92—32)

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The present invention relates to hydraulic pulsating apparatus, and more particularly to improvements in apparatus for pulsating the diaphragms of flat pulp mill and paper mill screens.

In the usual arrangements, the diaphragms are vibrated by direct mechanical connections from cranks or eccentrics to provide rapidly alternating pressure and suction strokes in the diaphragm chamber. The forces involved are large, so that the moving parts must be strongly constructed and firmly supported. Because of the positive nature of the drive, there is likelihood of serious damage if the screens become clogged or if the diaphragm chamber becomes flooded.

In my prior Patent No. 2,368,291, issued January 30, 1945, there is disclosed apparatus which overcomes many of the difficulties inherent in conventional pulsating apparatus. In place of positive mechanical actuation, hydraulically operating mechanisms are provided, with individual hydraulic power drives for each diaphragm. These drives involve power pistons and cylinders, to which hydraulic fluid under pressure is admitted under the control of individual control valves adjacent each power cylinder. The control valves are actuated at high speed by mechanical means to cause fluid under pressure to be supplied alternately to one side and then the other of the power pistons. These hydraulically operating drives, in conjunction with pressure relief means for limiting the maximum value of fluid pressure that may be applied, provide normal diaphragm pulsation under favorable screening conditions, but permit the diaphragm stroke to be reduced automatically if excessive screen resistance develops, and thereby prevent damage to the machine.

In this prior arrangement there is an appreciable loss in efficiency because of the rapid reversals in flow which must occur in the piping between control valve and power cylinder in order to pulsate the diaphragms at the high frequencies generally employed. Not only is there an appreciable resilience in the piping, but it is difficult to provide and maintain tight connections under the prevailing conditions of high fluid pressure and severe vibration.

To suit various grades of stock, the diaphragm stroke must be capable of variation. In my prior arrangement, the adjustment for stroke length is provided by means of spacing collars of various thickness which function in conjunction with fixed abutments to provide positive limits to the movement of the power piston. By changing these spacing collars or shims, the

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diaphragm stroke may be varied to meet different screening conditions.

The present invention is concerned with improvements in hydraulically operating pulsating apparatus of the general type disclosed in my prior patent, whereby to increase the effectiveness of operation. One of the objects is to provide mechanism which permits the stroke adjustment to be made in a simple and precise manner without the use of shims, collars or other positive limit stops.

Another object of the invention is to provide hydraulic pulsating apparatus in which the power cylinder and the control valve are combined in a single compact unit so as to eliminate intervening connecting pipes and thereby afford very short paths for the flow of hydraulic fluid between control valve and power cylinder.

It is likewise an object of the invention to provide an improved hydraulic power amplifying mechanism of compact and efficient arrangement, capable of providing a power stroke or movement that reproduces rapidly and accurately a stroke or displacement taking place at a relatively low energy level.

In the drawings illustrating the invention in its preferred form, Fig. 1 is a view in side elevation of a portion of a pulp mill screen, showing the driving mechanisms for two diaphragms thereof; Fig. 2 is a sectional elevation of the machine, taken on the line 2—2 of Fig. 1; Fig. 3 is a detail sectional elevation of an hydraulic pulsating unit; Fig. 4 is a sectional detail of the power piston thereof, turned 90° about its axis from the position shown in Fig. 3; and Fig 5 is an end view of the power piston shown in Fig. 4.

The screen shown in Figs. 1 and 2 is, in its general features, of conventional construction and arrangement. A vat 6, into which the stock is introduced, is provided with flat screen plates 8 which are preferably of the type shown in my Reissue Patent No. 20,533, dated Oct. 19, 1937. Mounted below each pair of plates is a rubber diaphragm 10, secured at its edges to the vat frame 12. The space between the plates and the diaphragm constitutes the diaphragm chamber 16.

Connection to the central portion of the diaphragm is made by means of a frame 20 to which the diaphragm is clamped. The frame is secured to the upper end of a guide member 22 which slides within a cylindrical guideway 24 in cross member 26.

To reciprocate the diaphragms, the guide members 22 are connected to hydraulic power drive units 30 which are mounted on the cross

members 26 directly below the guides. These power units embody within a single casing the controlling as well as the driving elements of an hydraulic system, so as to provide a compact arrangement having extremely short flow paths for the hydraulic fluid.

The units comprise a power cylinder 32 within which is a power piston 34 having a drive rod 36 for connection to the guide 22. Movement of the power piston is under the control of a piston valve 38 which operates within the power piston, the latter thus serving as a cylinder for the piston valve in addition to its function as power piston. The cylinder 32 is closed at its ends by heads 42 having stuffing boxes 44 to provide a seal for the drive rod 36 and piston valve rod 46.

To actuate the hydraulic driving unit, fluid under pressure is supplied from a motor-driven hydraulic pump indicated generally at 48 and similar to that shown in my Patent No. 2,368,291. The fluid is distributed by a line of piping 50 to the inlet port 52 of each cylinder, and is discharged through exhaust port 54 to a return line 56 running to the pump. A relief valve 58 maintains substantially constant fluid pressure in the supply line 50, returning excess fluid through a by-pass 60 directly to the pump.

The hydraulic driving units operate to pulsate the diaphragms at a stroke and frequency determined by the stroke and frequency imparted to the piston valves. To reciprocate the piston valves, each driving unit has associated therewith an eccentric drive assembly 70 mounted on a shaft 72 and connected to the piston valve rod 46 by a link 74. Each shaft is independently journalled in the lower ends of arms 76 depending from the driving unit 30. Couplings 78 connect the several shafts, which are driven by a variable speed drive 80 of conventional construction. Adjustment for stroke length is provided by means of a conventional two-part eccentric disc 82, the outer portion of which may be locked in any one of several positions relative to the inner member to vary the throw or stroke.

The arrangement of power piston and piston valve, by which the former is caused to reproduce at a high power level the movement of the latter, will now be described. The piston valve is provided with three lands 90, 92 and 94, these lands being separated by piston sections of reduced diameter. The upper end of the piston valve slides in a blind passage 96 in the power piston, and the piston valve rod emerges from the power piston through a bore 98.

Within the body of the power piston are four internal lands, 100, 102, 104 and 106, which, in cooperation with the piston valve, define five spaced annular regions 110, 112, 114, 116, and 118. The central region 114 receives hydraulic fluid under pressure through a port 20 which communicates with inlet port 52 over the normal range of movement of the power piston. Communication between region 112 and the cylinder chamber 122 below the power piston is provided by a pair of oppositely disposed ports 124 which open into downwardly directed channels 126 along the piston wall. In similar fashion region 116 communicates with the upper cylinder chamber 128 by way of ports 130 and channels 132. The end regions 110 and 118 are provided with ports 134 and 136 which open into a common channel 138 communicating with exhaust port 54 in the cylinder wall.

The power piston thus cooperates with the piston valve to provide a four way valve for controlling fluid admission and discharge to the power cylinder. By reason of this identity of the power piston with the cylinder for the piston valve, the follow-up relationship that is characteristic of a servomechanism is inherently provided.



The mode of operation by which the power piston is caused to reproduce with great accuracy a movement or displacement of the piston valve may readily be traced. Starting with the parts as shown in Fig. 3, with the power piston and piston valve at their mid-positions, assume that a clockwise rotation of shaft 72 takes place, thereby raising the piston valve. This permits fluid to flow from central region 114 past pilot piston land 92 into the region 112 and thence to the cylinder chamber 122 below the power piston. A relatively short and rigidly defined passage is provided for the supply of fluid under pressure from the inlet 52 to the working chamber 122. The opposed ports 124 and channels 126 aid in balancing the fluid pressures acting laterally on the power piston.

At the same time that the piston valve is admitting fluid to the underside of the power piston, communication is provided between the exhaust port 54 and the upper chamber 128 to permit the discharge of hydraulic fluid therefrom. The flow path is by way of channels 132 into annular region 116, thence past land 94 into region 118 and through port 136 to the discharge channel 138.

From this upward movement of the piston valve there consequently results an upward movement of the power piston. This movement reaches a limit determined by the new position of the piston valve, since the admission of fluid terminates when land 92 of the piston valve becomes centered between lands 102 and 104 of the power piston.

Because of the short flow paths and the rigid nature of the passages, the power piston is able to follow accurately the movements of the piston valve even though these movements take place with great rapidity. Reciprocation at a frequency of several hundred cycles per minute may readily be followed, with the stroke of the diaphragm determined by the length of stroke imparted to the piston valve as determined by the setting of the adjustable eccentric 82.

As disclosed in my prior patent, it is desirable that the pulsations of the several diaphragms take place in staggered sequence rather than in synchronism, so as to minimize vibration in the machine as a whole. Furthermore, the stroke length should be correlated with pulsation frequency to suit the particular stock. As pointed out in that patent, it is generally suitable to have the stroke and frequency inversely proportional, in which event the consumption of hydraulic fluid by the power units remains substantially constant. By setting the by-pass relief valve to maintain a pressure adequate for normal diaphragm pulsation, proper operation over the usual range of adjustments of stroke and frequency is provided. In the event unfavorable screening conditions develop, involving reduced diaphragm amplitude or a complete stoppage, the by-pass valve serves to limit the forces developed by the driving unit and thereby prevent damage or destruction to the mechanisms associated with the involved section.

While the hydraulic driving unit has been described in association with mechanism for pul-

sating pulp mill and paper mill screens; it is not limited to such embodiment, but may be employed effectively in other applications where an hydraulic servomechanism is required that is capable of accurate and efficient operation at high frequencies and where a compact coaxial arrangement of the control and power output elements is advantageous.

I claim:

Hydraulic pulsating apparatus for pulsating the diaphragms of flat paper mill and pulp mill screens comprising a power cylinder, a power piston reciprocable within the cylinder, a piston rod connected to the diaphragm, a piston valve within the power piston, the piston valve having lands and passages cooperating with the power piston to form a four-way control valve for causing the power piston substantially to reproduce the movement of the piston valve, means for supplying hydraulic fluid under pressure to the control valve, a rotating drive shaft, an eccentric on the drive shaft having relatively adjustable parts to provide adjustment of eccentric stroke, and connections between the eccentric and the piston valve for positively reciprocating the piston valve in accordance with the stroke of the eccentric.



FRANK DUSTAN.


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