



Jan. 30, 1945.

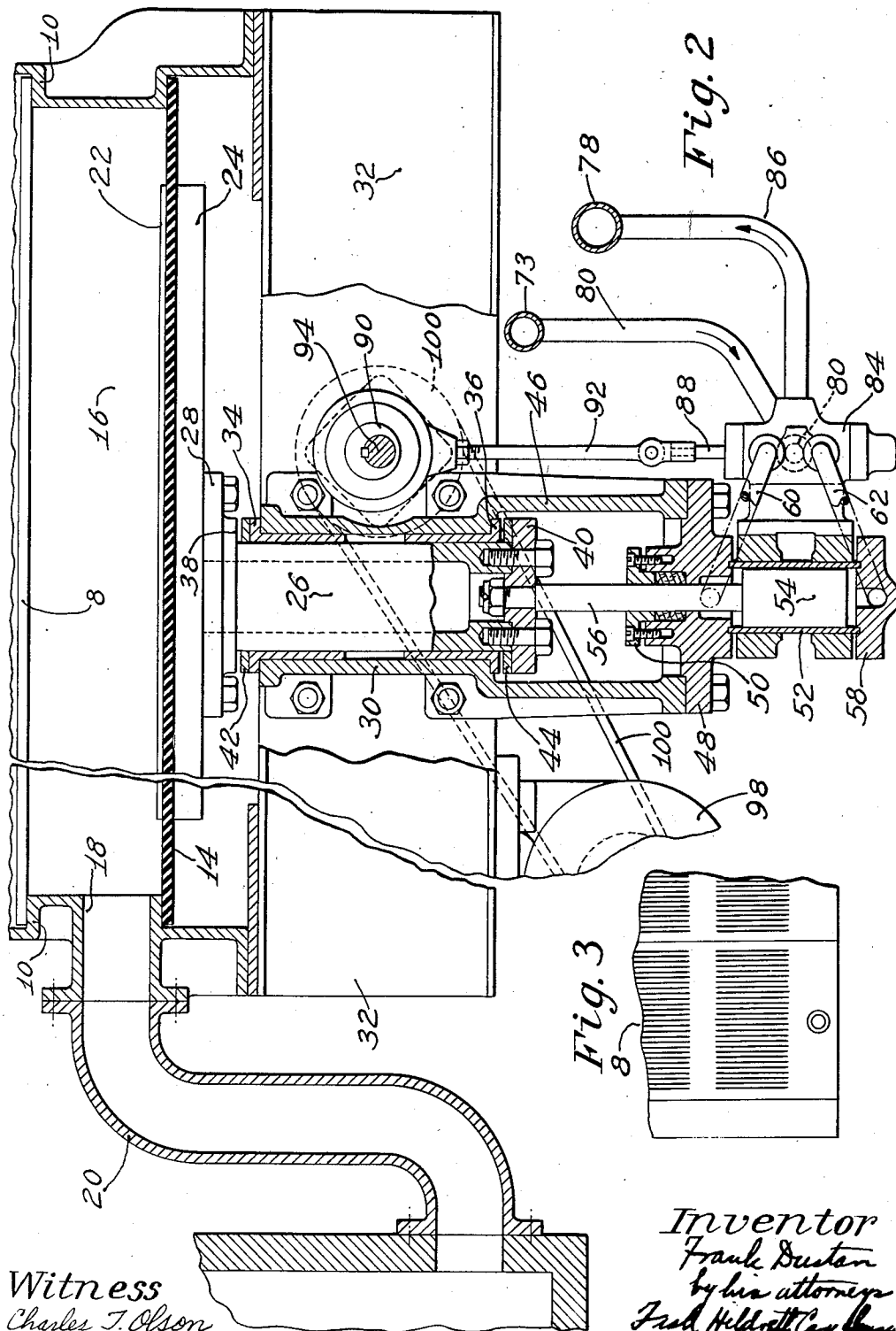
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DIAPHRAGM PULSATING APPARATUS FOR PAPER MILL AND PULP MILL SCREENS

Filed April 1, 1942

3 Sheets-Sheet 2



Witness  
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Fig. 4

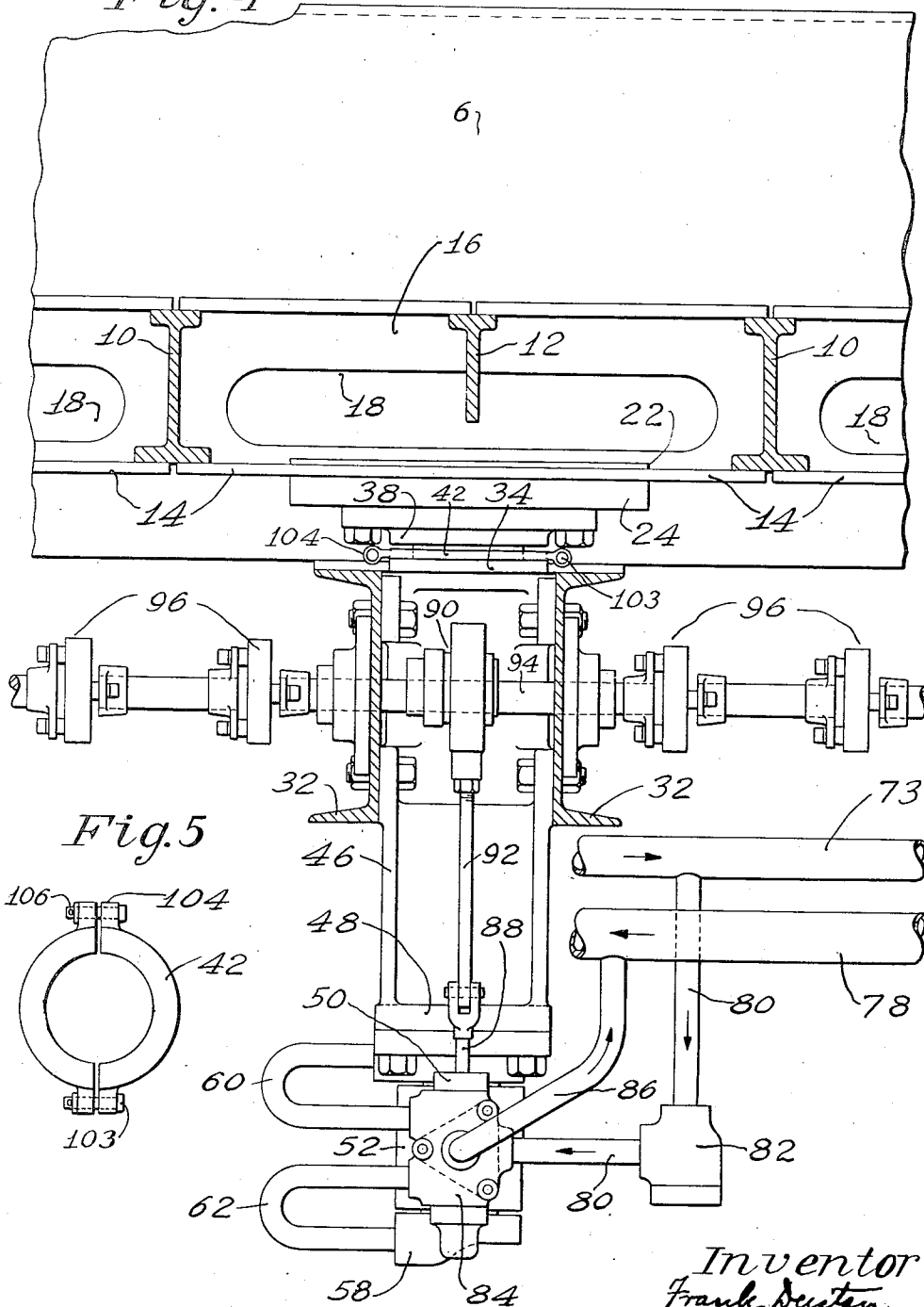


Fig. 5

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## UNITED STATES PATENT OFFICE

2,268,291

DIAPHRAGM PULSATING APPARATUS FOR  
PAPER MILL AND PULP MILL SCREENS

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mesne assignments, to National Lead Company,  
New York, N. Y., a corporation of New Jersey

Application April 1, 1942, Serial No. 437,179

5 Claims. (Cl. 92—32)

The present invention relates to apparatus for pulsating the diaphragms of flat pulp mill and paper mill screens.

In flat screens, the stock is introduced to the screen vat and flows over perforated or slotted screen plates. Below the plates are diaphragms which are vibrated to produce alternate suction and pressure in the chamber between the plates and diaphragm. The suction stroke of the diaphragm causes acceptable stock to be drawn through the plates, and the pressure stroke acts to lift the coarse or matted particles of pulp which may have become lodged on the plates. The diaphragms are pulsated at a high rate, frequently 800 or even more pulsations per minute.

The usual construction uses mechanical means in the form of cams, eccentrics or cranks for operating the diaphragms. Since the forces involved are very large, the moving parts must be rigidly constructed and mounted on heavy underframing. There is considerable trouble in maintaining alignment of the shafts and bearings. A more serious difficulty is that no protection is provided against damage in case of clogging of the plates; in such a case, the plates deflect excessively and may even be loosened from their fastenings. A particularly serious condition results if the chamber between plate and diaphragm becomes completely flooded through improper supervision, in which case, if the plates are not actually torn from their fastenings, the driving mechanism may be thrown seriously out of alignment.

The principal object of the present invention is to provide a diaphragm pulsating apparatus operating hydraulically and having provision for limiting the forces applied to the diaphragms to permit normal operation under favorable screening conditions and to prevent damage to any part of the machinery if excessive resistance is interposed to the motion of the diaphragm.

Another object of the invention is to provide a construction in which both the stroke and frequency of the pulsations may be readily varied. Variations in both stroke and frequency are necessary to suit various grades of stock. These changes can be made only with considerable difficulty in the usual mechanically operated systems.

With these and other objects in view, as will hereinafter appear, the present invention consists of certain novel features of construction, combinations and arrangements of parts, here-

inafter described and particularly defined in the claims.

In the accompanying drawings, Fig. 1 is a side elevation of so much of a pulp screen as is necessary for an understanding of the present invention; Fig. 2 is an elevation, partly in section, on line 2—2 of Fig. 1, and with parts broken away; Fig. 3 is a detail view of the preferred form of screen; Fig. 4 is a view similar to Fig. 1 but on an enlarged scale to illustrate details of the operating devices; and Fig. 5 is a detail view of one of the stroke adjusting collars.

The screen shown in the drawings comprises a vat 6, into which stock is introduced at one end in the usual fashion. The vat is provided with screen plates 8 of any suitable type, preferably as shown in my Reissue Patent No. 20,533, reissued October 19, 1937. The screen plates are arranged in pairs, according to usual procedure, and are mounted on supports 10 and 12. Below each pair of plates is a rubber diaphragm 14, suitably secured at its edges to the supports 10 and the frame of the vat. The space between the plates 8 and the diaphragms 14 constitutes a diaphragm chamber 16, which is provided at its end with an outlet 18 connected in the usual manner to the outlet tube 20.

Each diaphragm is secured between a thin metal upper plate 22 and a heavy lower metal frame 24. Connections are made to the frame 24 to provide for pulsating the diaphragm up and down under the action of the hydraulic means later to be described.

Secured to the lower frame 24 is a hollow cylindrical guide member 26 having at its upper end a flange 28 which is bolted to the frame 24. The guide 26 reciprocates in a bearing member 30 secured between channels 32 which extend across the under-side of the frame and form a part of the supporting structure thereof. As shown in Fig. 2, the bearing 30 has an upper flanged bushing 34 and a lower flanged bushing 36, within which the guide 26 slides.

The flange 28 is provided with a shoulder 38, serving as an abutment to limit the downward motion of the guide. At its lower end the guide is provided with a bolted flange 40, serving to limit the upward movement of the guide. In order to adjust the stroke of the diaphragm, thin collars or shims 42 and 44 may be used, the upper collar 42 overlying the flange of the bushing 34 and the lower collar 44 being carried by the flange 40. As shown in Fig. 2, the diaphragm is in its mid-stroke position. Prefer-

ably, the collars 42 and 44 are of the same thickness in order that the stroke of the diaphragm may be equal on both sides of the mid-stroke position.

The bearing member 30 is provided with skirt portions 46 extending below the parts previously described and carrying at the bottom a head 48 having a stuffing box 50. A small hydraulic cylinder 52 is secured to the head 48. The cylinder has a piston 54 connected by a rod 56 which passes through the stuffing box to the member 40 at the bottom of the diaphragm guide cylinder. A hydraulic supply tube 60 is connected into the head 48 above the piston 54, and a lower tube 62 is connected to the cylinder head 58 at the bottom of the cylinder. As clearly shown in Fig. 1, one hydraulic cylinder 52 is provided for each diaphragm.

The diaphragm is pulsated by applying hydraulic pressure alternately through the pipes 60 and 62. The hydraulic system for supplying the cylinders 52 comprises, as shown in Fig. 1, a hydraulic pump 64 driven by a motor 66. The pump has an inlet pipe 68 leading from a reservoir 70 of oil or other suitable liquid. The outlet of the pump is connected by a pipe 72 to a main pressure line 73 through a relief valve 74 having a discharge pipe 76 to return excess liquid to the reservoir. The system is provided with a main return line 78 which parallels the main pressure line 73. As shown in Fig. 1, the lines run under the screen frame adjacent to the cylinders.

For each hydraulic cylinder, a branch pressure line 80 is connected to the main line 73 and leads through a check-valve 82 to a four-way control valve 84, to which are connected the tubes 60 and 62 leading to the top and bottom of the hydraulic cylinder 52. A branch return line 86 runs from each four-way valve to the main return line 78.

The four-way valves 84 are of well-known construction and need not be described in detail. It is sufficient to note that when the operating rod 88 of the four-way valve is in one position, the pressure line 80 is connected to the upper supply tube 60 and the lower supply tube 62 is connected to the return line 86, and when the rod 88 is in its other position, the pressure line 80 is connected to 62 and 60 is connected to the return line 86. Therefore, when the rod 88 is reciprocated at the desired pulsation frequency of the diaphragm, pressure is alternately applied to the top and bottom of the piston 54. The reciprocating action of the four-way valve is accomplished by an eccentric drive 90 connected to the rod 88 by a connecting rod 92 and operated by a continuously rotating shaft 94. As shown in Fig. 1, an individual shaft 94 is preferably provided for each unit, and the several shafts 94 are connected by flexible couplings 96 in order to avoid the necessity of careful alignment. The shafts 94 are driven by a motor 98 through a variable speed belt drive 100.

The control shaft is required to transmit only a small amount of power, namely, that necessary to operate the control valves. The eccentrics 90 are angularly displaced with respect to one another so that the pulsations of the several diaphragms are staggered after the manner of the firing order in an internal combustion engine, thus preventing excessive vibrations from developing in the structure.

In operation, the pump 64 is designed for a delivery slightly in excess of that required to

operate the diaphragm. Preferably the pump is of the constant-volume type. Consequently, the relief valve 74 will continually operate to discharge some oil back to the reservoir through the relief line 76. Under normal conditions a fairly constant volume of oil will flow through the discharge pipe 76 because of the staggered operation of the diaphragms. The relief valve is set to maintain in the pressure line 73 a pressure just sufficient to pulsate the diaphragms through the normal stroke under favorable screening conditions. If unfavorable conditions start to develop, as by clogging of a pair of plates or flooding of a diaphragm chamber, the pressure in line 73 will not be sufficient to move the diaphragm through its full stroke against the added resistance caused thereby; consequently, the stroke of the diaphragm will be reduced or, in the case of a completely flooded air chamber, will stop altogether. The reduced amount of oil consumed by cylinder 52, under this condition, will cause an increase of flow through the discharge line 76 from relief valve 74. Thus, the relief valve prevents any overload from being imposed upon the diaphragm and the actuating mechanism, and the entire structure is protected from the excessive racking which is incident to the existing mechanically operated screen frames under similar conditions.

Since the reduced motion or stoppage of a diaphragm under unfavorable conditions results in an increase of discharge through the pipe 76, this increase of flow may be used to warn the operator of improper functioning of the system. To this end a metering device, indicated generally at 102, is included in the pipe 76. The metering device may be a flow-meter of any usual or preferred form, and may, if desired, be connected to operate any suitable alarm. Since the relief flow is sensibly constant under normal operating conditions, the warning device is sensitive to an immediate change of conditions such as would be occasioned by limitation of the movement of even a single diaphragm.

As heretofore noted, the spacing collars or shims 42 and 44 are changeable to allow for different diaphragm strokes. To facilitate the change, each collar is preferably made in split form as shown in Fig. 5, the two halves of the collar being secured together after assembly about the guide 26 by shouldered pins 103 in bosses 104 and held in place by cotter pins 106.

It is customary to operate at varying stroke lengths and frequencies for different grades of stock. In general, the longer the stroke the lower the frequency. Hence, when the stroke is changed by inserting collars of different thickness, the frequency will be varied by adjusting the speed of the eccentric drive shaft 94. The most satisfactory conditions have been found to obtain when the stroke and frequency are inversely proportional, or at least approximately so. For example, the machine may be operated at 800 strokes per minute with a stroke of  $\frac{1}{8}$  in., 533 strokes per minute with a stroke of  $\frac{1}{4}$  in., or 400 strokes per minute with a stroke of  $\frac{1}{2}$  in. Thus, when the spacing collars are changed, a corresponding change is made in the variable-speed drive 100. Under such conditions, the oil consumption of the diaphragm operating cylinders 52 is substantially constant, that is, slightly less than the delivery of the constant volume type pump 64; hence no adjustments thereof are necessary and the meter 102 stands ready at all

times to warn of any increase of discharge from the relief valve 74 arising from the reduced motion or stoppage of any one or more of the diaphragms.

Although the preferred embodiment of the invention has been illustrated and described, it will be understood that the invention is not limited to such preferred embodiment, but may be varied within the scope of the appended claims.

Having thus described my invention, I claim: 10

1. In diaphragm pulsating apparatus for flat paper mill and pulp mill screens, the combination with a reciprocating guide connected with a diaphragm, a bearing in which the guide reciprocates, a pump, pressure-relief means for the pump, a piston connected to the guide a control device to deliver fluid from the pump to the piston to reciprocate the guide alternately up and down, and means for adjusting the stroke of the diaphragm to positive predetermined limits, said means including a split spacing collar surrounding the guide.

2. In diaphragm pulsating apparatus for flat paper mill and pulp mill screens, the combination with a plurality of reciprocating guide members individually connected with a diaphragm, of hydraulic means for reciprocating the diaphragms individual hydraulic motors connected with the guide members, a control valve for each motor disposed immediately adjacent thereto, an eccentric device for operating each control valve, and a common drive for the several eccentric devices, the eccentrics being angularly displaced with respect to one another to stagger the operation of the diaphragms.

3. Diaphragm pulsating apparatus for flat paper mill and pulp mill screens comprising, in combination with a plurality of diaphragms, individual hydraulic motors associated therewith, a source of fluid pressure, individual control 40

means connected with each hydraulic motor in close proximity thereto for controlling the delivery of fluid from the source to each motor, and individual driving connections from the motors to the respective diaphragms, said driving connections including individual abutment means to provide positive individual adjustment of the stroke of each diaphragm independently of fluid pressure and frequency.

4. Diaphragm pulsating apparatus for flat paper mill and pulp mill screens comprising, in combination with a plurality of diaphragms, individual hydraulic motors associated therewith, a source of fluid pressure, individual control means connected with each hydraulic motor in close proximity thereto for controlling the delivery of fluid from the source to each motor, individual driving connections including reciprocating guides from the motors to the respective diaphragms, and spacing collars surrounding the guides and forming individual abutment means to provide positive individual adjustment of the stroke of each diaphragm independently of fluid pressure and frequency.

5. Diaphragm pulsating apparatus for flat paper mill and pulp mill screens comprising, in combination with a plurality of diaphragms, individual hydraulic motors associated therewith, a source of fluid pressure, a control valve for each motor disposed immediately adjacent thereto, individual driving connections from the motors to the respective diaphragms, said driving connections including individual abutment means to provide positive individual adjustment of the stroke of each diaphragm independently of fluid pressure and frequency, and means for controlling operation of the valves in a timed relation to stagger the pulsations of the several diaphragms.

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