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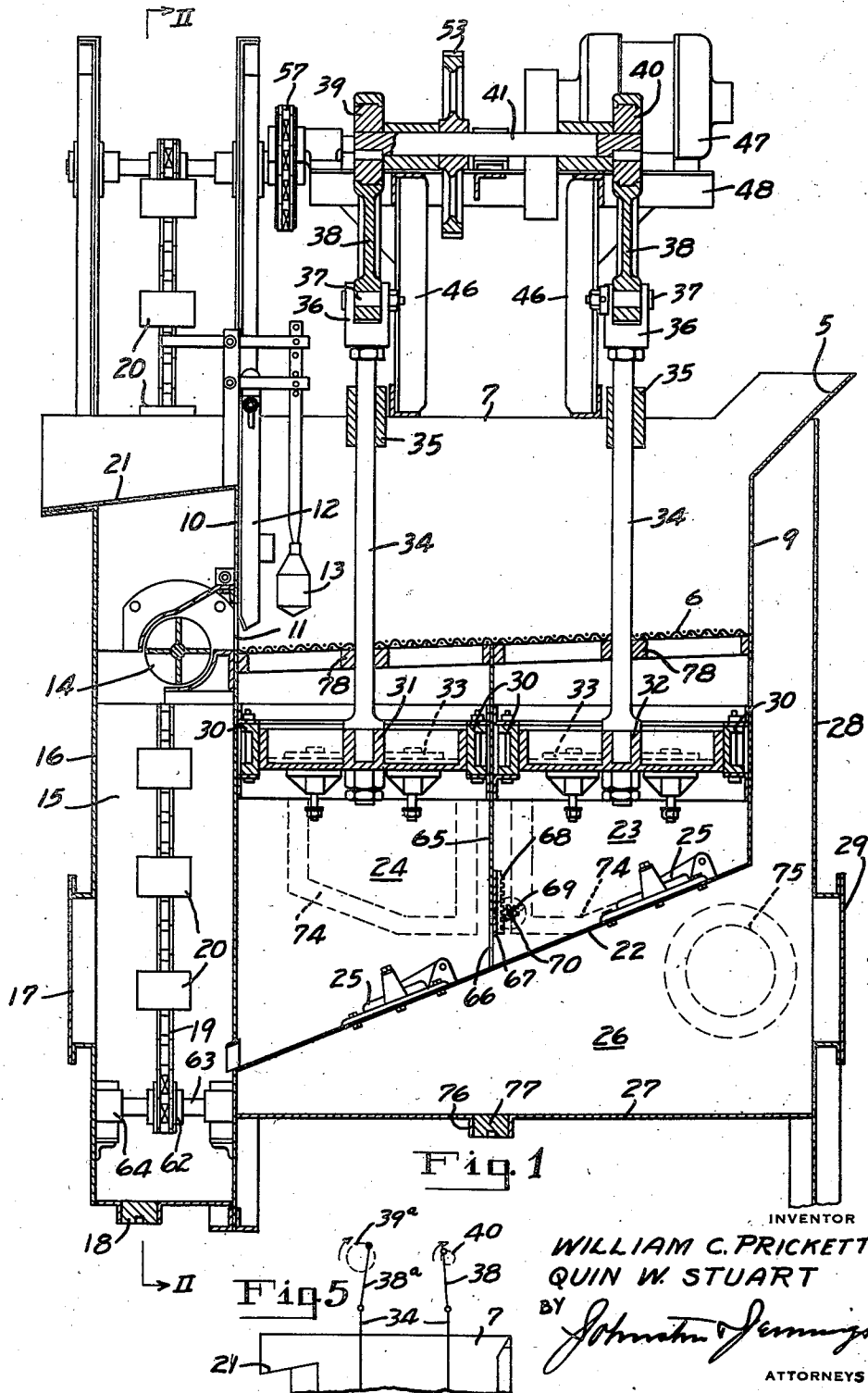
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2,269,686

PULSATING JIG

Filed May 29, 1939

2 Sheets-Sheet 1



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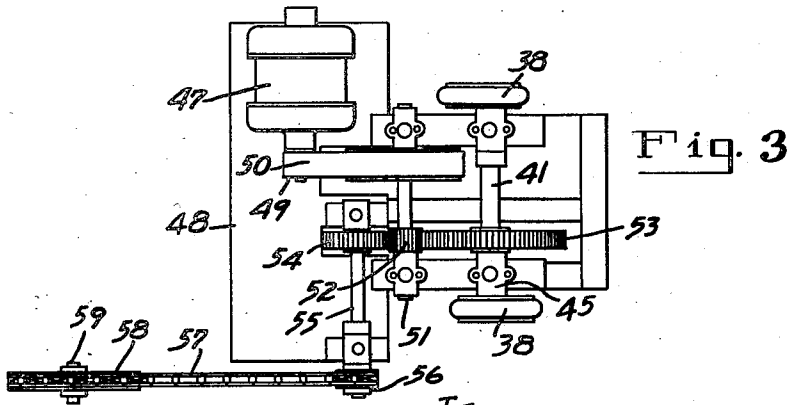


Fig. 3

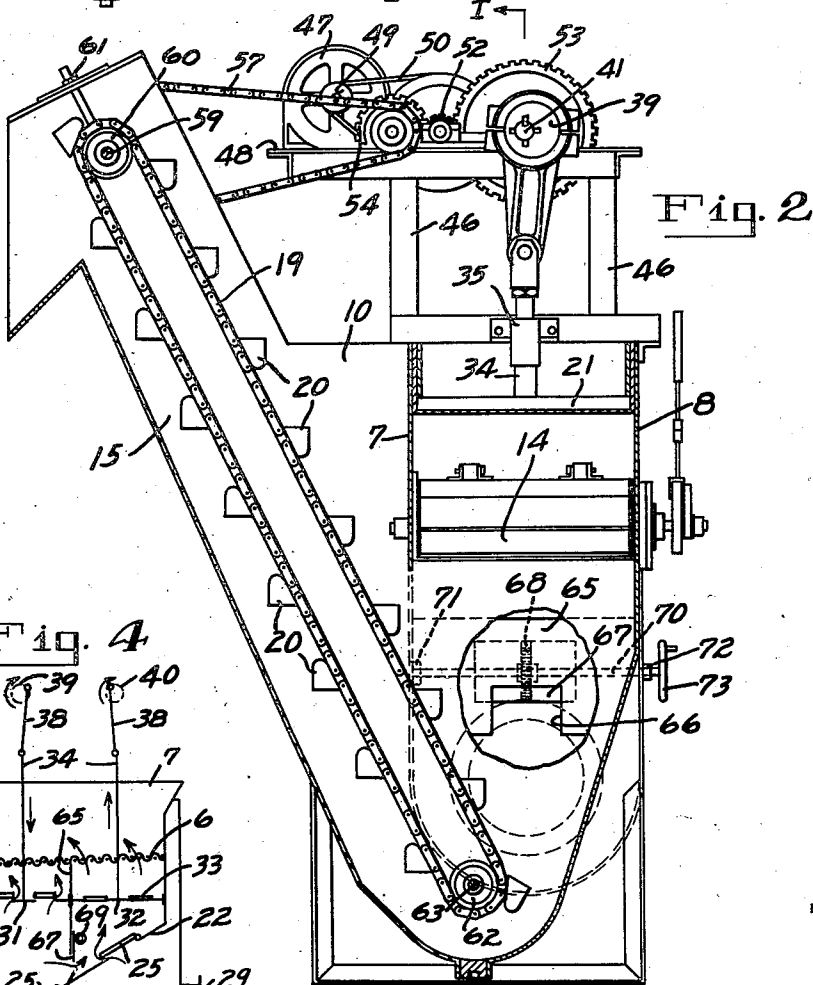


Fig. 2

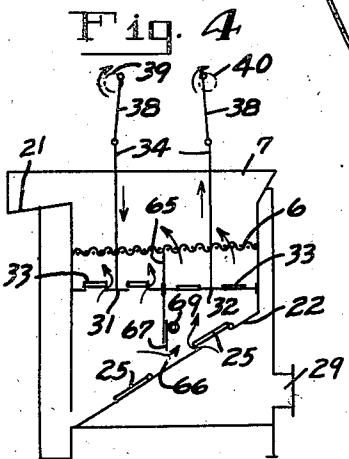


Fig. 4

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2,269,686

PULSATING JIG

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Application May 29, 1939, Serial No. 276,340

12 Claims. (Cl. 209—457)

Our invention relates to a pulsating jig in which a plurality of relatively movable pumping plungers are set and operated to force water, in regulable volume and in an effective manner, so as to improve and perfect the stratification on the jig screen bed of material of different specific gravity during its traverse of the jig tank.

More particularly our invention contemplates associating the independently operable, pumping plungers with separate hutches having a regulable by-pass whereby the movements of the plungers can be coordinated so as to pump a net volume of water upwardly with a reverse flow through the material on an undivided screen bed.

Our invention further contemplates means for effecting a course regulation of the water volume pumped by the setting of the cams or eccentrics which actuate the plungers so as to give them the desired relative motion, and a fine regulation by the setting of valve means to control the by-pass opening between the hutches.

Our invention further comprises the novel details of construction and arrangements of parts which in their preferred embodiments only are illustrated in the accompanying drawings, in which:

Fig. 1 is an enlarged vertical cross-sectional view taken on the line I—I of Fig. 2.

Fig. 2 is a vertical cross-sectional view taken on the line II—II of Fig. 1, with the wall broken away between the elevator tank and the adjacent hutch.

Fig. 3 is a plan view of the drive mechanism omitting any showing of the tanks.

Fig. 4 is a diagrammatic view illustrating the operation of plungers set with their actuating eccentrics offset 90°, the arrows indicating the reverse directions of movement of the plungers and the flow of water through the hutch by-pass and intake valves induced by the pumping action.

Fig. 5 is a partial diagrammatic view corresponding to Fig. 4 and showing different sized eccentrics for operating the plungers.

Similar reference numerals refer to similar parts throughout the drawings.

In the embodiment of our invention illustrated, we show a pulsating pumping jig comprising a suitable feed chute 5 at one end thereof down which the material to be washed is fed onto the inclined jig screen 6 between the side walls 7 and 8 and end walls 9 and 10, to which walls the screen is suitably secured in the usual manner. The wall 10 is provided with a slate gate outlet 11 controlled by a slide valve 12 operated by a

float 13 in the manner well understood in this art. Slate is discharged by a rotary slate gate 14 into an end elevator tank 15 defined between the walls 7, 8 and 10 and an outer end wall 16, said tank having a clean out opening 17, a valve controlled bottom drain 18, and suitably mounted therein an endless chain elevator 19 carrying buckets 20. The water that is pumped upwardly through the jig screen, in the manner later described, passes off from the jig tank over the discharge chute 21, carrying with it the coal or lighter material that has been separated from the slate by the jiggling action while the material is making its traverse of the jig tank.

An inclined wall 22 defines the bottom of what may be termed the hutch, which in our construction is divided into a number of separate compartments, two being shown, and which are respectively designated by the numerals 23 and 24. We provide the customary valves 25 for the admission of water to each of these hutch compartments from the water well 26 defined by the bottom wall 27, the walls 7, 8, 9, and 10, and an outer wall 28, in which is a suitable manhole or clean out 29.

In the hutch compartments we mount suitable plunger guides 30, and plungers 31 and 32, which are similar and mounted for relative vertical movement in their respective guides. Each plunger carries any suitable number of valves 33 mounted to open upwardly and control ports through the plungers, and each is connected at its center to its respective plunger rod 34 which is confined to vertical movement by an upper guide bearing 35 and at its upper end is pivotally connected by means of a yoke 36 and pin 37 to an eccentric strap 38 rounding its respective eccentric 39 or 40. The plunger 31 works in compartment 24 and is operated by the eccentric 39, while the plunger 32 works in compartment 23 and is operated by the eccentric 40.

These two eccentrics are mounted on a common shaft 41 in any suitable manner which will permit one to be set with any desired lead from 0° to 180° with reference to the other. The adjustment may be accomplished by means of a key and any desired number of slots provided therefor in either the eccentric, as shown, or in the shaft. The shaft 41 is mounted in suitable bearings 45 supported on any suitable frame work above the jig tank. A motor 47 is mounted on a supporting platform 48 on said frame 46 and drives the eccentric by a transmission comprising a motor pulley 49, a belt 50, a counter-shaft 51 and a small pinion 52 meshing with a

large pinion 53 on the shaft 41, and also a relatively small pinion 54 on a countershaft 55, suitably mounted and carrying on its overhung end a sprocket 56 which, by means of a chain 57 and a sprocket wheel 58, drives a shaft 59 carrying the upper sprocket 60 for the elevator chain 19. The shaft 59 is provided with tension adjustment means 61 and the lower end of the elevator chain passes around sprockets 62 mounted on a shaft 63 suitably journaled in a bearing 64 near the bottom of the elevator tank 15.

A vertical partition wall 65 separates the hutch compartments 23 and 24 and extends upwardly to the screen 6. It carries the inner slide guides 30 for the plungers 31 and 32. This partition 65 is provided with a bottom by-pass port 66 which is controlled by a slide valve 67 adjusted by means of a rack 68 fast thereon and meshing a pinion 69, fast on a shaft 70 which has one end mounted in a step bearing 71 on the inner face of the tank wall 7 while the other end of the shaft extends outwardly through wall 8, being sealed by a suitable gland 72 and rotated by a hand wheel 73 externally accessible, whereby the valve 67 can be raised or lowered to regulate the cross sectional area of the by-pass 66 between the hutches. Suitable manholes 74 are provided in the tank wall 7 to give access to each hutch compartment and water is supplied to the wall by an inlet indicated at 75. A drain 76 for the well is closed by a plug indicated at 77.

The plunger rods 34 pass upwardly through suitable cross members 78 of the screen bed frame which serve as lower guides that in cooperation with the upper guides 35 confine these rods to linear movement.

In operation, assuming the well 26 and the jig tank filled with water up to the overflow level of chute 21 and a supply of coal and slate in position on the screen bed 6, if the two plungers 31 and 32 are actuated by like eccentrics 39 and 40, set in corresponding position on the shaft 41, then the plungers will move in unison and they will pump their full displacement capacity of water, drawing same in past the valves 25 and 33 and lifting it on their upstroke through the screen bed, thus producing the same pumping action as would be obtained with a single pumping plunger.

If, however, it be desired, as is customarily the case, to reduce the volume of water to only that requisite for the proper stratification and separation of the materials of different specific gravity under treatment, then it is possible with our jiggling mechanism to vary the volumetric flow of water pumped through the jig tank from that equal to the full displacement capacity of both plungers to any lesser capacity. This effect is accomplished as follows, reference now being had to the diagrammatic showing in Fig. 4, in which it will be noted that the eccentrics are of like size and set 90° apart so that assuming their rotation, as indicated by the arrows, the plunger 31 will be moving downwardly, as shown by the arrow along its rod, while the plunger 32 will be completing its rise and will be practically stationary with its valves closed. The valves in plunger 31 will be open for by-passing water into the jig tank. As soon as the eccentric actuating the plunger 32 passes dead center, this plunger will also begin to move downwardly following plunger 31, which at the time will be approaching the limit of its down stroke. Thus the two plungers will for a part of each cycle move down-

wardly together and in this movement the valves 33 of both plungers will be opened to by-pass water into the jig tank, which upon the reversal of motion of the plungers will be forced upwardly through the screen and the bed thereon and force the stratification of the latter.

It will be obvious if the eccentrics are set 180° apart that they will have corresponding movements in reverse directions at all times and thus they will effect no pumping action whatsoever. A setting of 180° apart is therefore what may be termed a "full" overlap of the pumping strokes, while any relative angular displacement of the eccentrics between 180° and 0° apart results in what may be termed "partial" overlap of the pumping strokes. Therefore, when the eccentrics are set 90° apart, as shown, the effect will be to pump a volume equal substantially to one-half of the combined displacement of the plungers. It is important to note that the by-pass 66 is requisite for the effective control of the volume of water pumped, otherwise the valve 33 of the descending plunger would immediately open upon the start of its down stroke and remain open throughout that stroke, and therefore the two plungers would pump to their displacement capacity. If, however, the by-pass port 66 is provided, the valve 33 of the descending plunger may remain closed during part or all of its down stroke, depending on the relative position of the other plunger. For instance, if the plunger 31 starts up as plunger 32 starts down, then there will result a by-passing of water between the hutches 23 and 24 and there will be no intake of water by the opening of any valve 25 unless the opening 66 is inadequate to by-pass the volume of water being displaced by the downgoing piston without establishing a back pressure which would open the valves 33 of the latter plunger and permit it to take in above it a new supply of water. As the valve 68 is closed therefore this by-pass becomes more throttled and the descending plunger valves must by-pass through its valves an increasing volume of water in position to be lifted through the screen. Thus it may be said that the relative setting of the eccentrics 39 and 40 produces a rough control of the volume of water to be pumped by the jig while the manipulation of the by-pass hutch valve 68 will produce a fine regulation of the water volume being pumped so as to produce the exact effect desired from the jig. In its simplest embodiment, our invention comprises two similar plungers capable of relative displacement in their respective operating cycles to control approximately the net volume of water to be pumped relative to the full displacement capacity of both plungers, with a by-pass valve interposed and adjusted to provide a readily accessible means to get a fine regulation of the net volume of water pumped in each complete cycle of both pistons.

It will be noted in Fig. 4 that the water being pumped by the upgoing plunger is forced after passing through the screen to flow laterally over the partition 65 to satisfy the displacement of the adjacent downgoing pistons. When the plungers are in reverse position and 31 is moving up and 32 is moving down, the water being lifted by plunger 31 will travel in a reverse direction to the arrows above the screen bed in passing partition 65 and thus there will be a reversal of flow in a zone of very effective stratification established across the center of the jig tank. The volume of water that will overflow into the chute 21 will represent the net capacity of the pump

according to its setting by which is meant the excess of water that will be lifted beyond that that is by-passed through the port 66 and that net volume will of course be the amount that is taken in by means of the valves 25 from the well of the jig.

This water supply may be always fresh or returned in circuit in accordance with the general practice and the coal and lighter values passing off with the water may be collected and recovered in any practical manner.

In Fig. 5 we show a fragmental view corresponding to Fig. 4 in which the eccentric 39a is relatively larger than the eccentric 40, and in order not to modify the standard size of the plunger rods 34, we use a relatively elongated sleeve connection 38a. The eccentric 39a will impart a longer stroke to the plunger 31 than is imparted by the eccentric 40 to the plunger 32, though the timing of the two cycles is the same as in Fig. 4. Under certain circumstances it may be desirable to have either of the eccentrics the larger and to have the difference in length of stroke regulated according to the results sought to be obtained in the treatment of the material traversing the screen bed 6.

The essentials for obtaining our improved jigg action are comprehended within the provision of separate pumping plungers operating under subdivisions of the screen bed with their plunger cylinders in communication below, and with any conventional hutch means through which replacement water can be drawn in past automatic valves responsive to plunger suction, in combination with means which will control the amount of replacement water drawn in and therefore the volumetric flow of water pumped through the jig tank. We may control such volumetric water flow by employing a drive means for the plungers which will permit of a regulation of the period of overlap of their pumping strokes, because, when the plunger strokes are equal and there is no pumping stroke overlap, no water will be pumped through the jig, and when they are timed so that they have 100% pumping stroke overlap the volumetric flow of water pumped through the jig is equal to the full pumping capacity of all plungers. The regulation of the pumping stroke overlap between these limits will determine the volume of water pumped through the jig. The volume of water pumped may also be controlled by valving the communication between the pumping cylinders because any throttling of the by-pass flow of water between cylinders will result in an increased demand for replacement water in the pumping cylinders and a check in the subsidence of water where the plungers are descending. These regulating functions may be jointly employed to regulate the pumping action of the jig.

While we have shown our invention in but two forms, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various other changes and modifications, without departing from the spirit thereof, and we desire, therefore, that only such limitations shall be placed thereupon as are specifically set forth in the appended claims.

What we claim is:

1. In a jig, the combination with a hutch divided into a plurality of compartments, a perforate deck over the compartments for receiving material to be treated, automatic valve means to supply water to the compartments, and pump-

ing plungers in each of the compartments, of means to vary the pumping action of the plungers comprising means to drive the plungers with their pumping strokes partially overlapping, and a valve between the compartments for restricting the flow of water from one compartment to the other.

2. A jig according to claim 1, in combination with externally controllable valve means to regulate the volumetric flow of water between hutch compartments.

3. A jig according to claim 1, in which the plungers are driven by separate actuators mounted on a common shaft, said actuators being angularly adjustable with respect to each other to effect the partial overlap of the pumping strokes.

4. A jig according to claim 1, in which the drive for the plungers comprises means to vary the relative timed relationship of the plunger cycles to produce the variable partial overlap of their pumping strokes.

5. A jig according to claim 1, in which the drive for the plungers comprises means to give the plungers strokes of different length and variable partial overlap of their pumping strokes.

6. A jig comprising a jig tank having a screen bed with means to introduce and discharge therefrom the material to be treated, a hutch tank below the screen bed subdivided into two compartments by a partition having therein a by-pass port, valve means to regulate the size of said port, valve means for the admission of water to each hutch compartment, a plunger reciprocable in each hutch compartment and having automatic pumping valves, a drive shaft, eccentrics relatively and angularly adjustable on the drive shaft to reciprocate the plunger with their strokes partially overlapping thereby to vary the timing of the relative cycles of the plungers they respectively control, and driving connections from each eccentric to its respective plunger.

7. A jig according to claim 6, in which the plungers and eccentrics are respectively alike in size.

8. A jig according to claim 6, in which the eccentrics are respectively different in size.

9. In a jig having a screen bed with means for the supply thereto of material to be separated and means for the discharge of the separated materials, separate pumps having cylinders in communication with different sections of said screen bed and plungers adapted to force water upwardly through their respective bed sections, means to drive said plungers with their pumping strokes partially overlapping, a hutch tank beneath the plungers having separate compartments in communication with said cylinders and a valve controlled source of replacement water supply for each of the hutch tank compartments.

10. In a jig having a screen bed with means for the supply thereto of material to be separated and means for the discharge of the separated materials, separate pumps having cylinders in communication with different sections of said screen bed and plungers adapted to force water upwardly through their respective bed sections, means to drive said pump plungers with their pumping strokes partially overlapping, a valve controlled connection between the lower ends of said cylinders, and hutch means for said cylin-

ders having automatic replacement water supply valves.

11. A jig according to claim 10, in which the drive means for the plungers is designed and arranged to maintain pumping strokes of substantially equal length for all plungers while varying the timed relation of said strokes to increase or decrease the duration of partial overlap of their pumping strokes according to the desired volumetric flow of water through the jig to its discharge.

12. In a jig, the combination with a hutch divided into a plurality of compartments, a perforate deck over the compartments for receiving

material to be treated, automatic valve means to supply water to the compartments, and pumping plungers in each of the compartments, of a valve between said compartments to regulate the flow of water from one compartment to the other, and drive means for said plungers to regulate the volumetric flow of water through the jig by driving the plungers with their strokes partially overlapping thereby varying the effective pumping action of the plungers with respect to each other.

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