

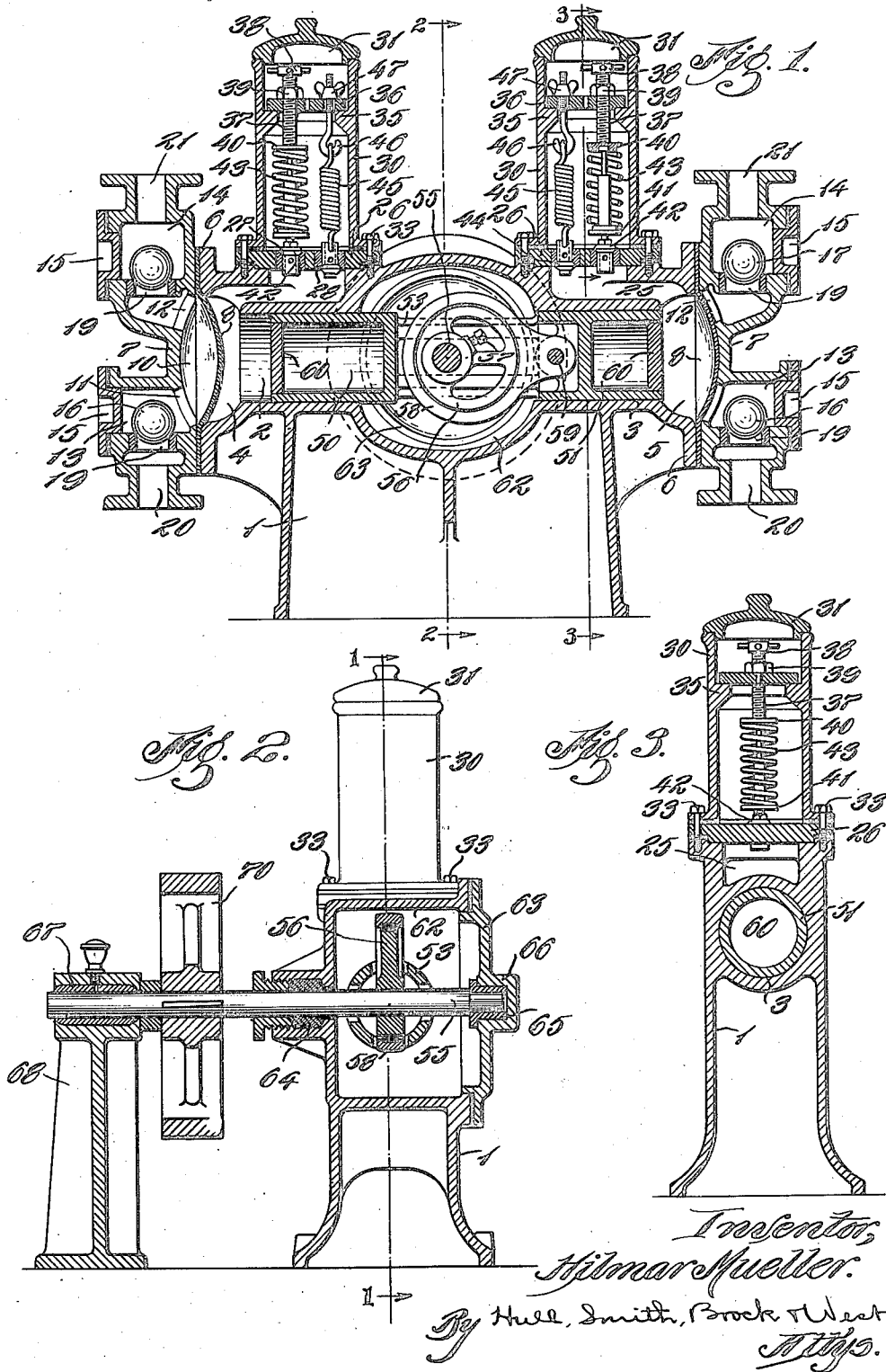
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PUMP.

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UNITED STATES PATENT OFFICE.

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To all whom it may concern:

Be it known that I, HILMAR MUELLER, a citizen of the United States, residing at Trenton, in the county of Mercer and State of New Jersey, have invented a certain new and useful Improvement in Pumps, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings.

This invention relates to improvements in that class of pumps wherein the pumping compartment is separated from the actuating element by a diaphragm, so that the liquid that is being moved by the pump is prevented from coming in contact with the operating mechanism.

Pumps of this character are used for moving liquid bodies containing sand, grit, or other abrasive materials; acids; or thin plastic bodies more in the nature of a solid than a liquid.

My improved pump is designed especially for conveying thin clay or "slip" of the sort from which potteryware or tiles are made, to filter presses. In this connection it is essential that the pump be restricted to a given maximum pressure so that undue strain will not be imposed upon the filter press, or upon the filter cloth thereof. Preferably, this maximum degree of pressure is variable and under the control of the operator so that the power or force of the pump may be regulated to meet the varying conditions.

While I have made reference to a specific purpose for which my pump is designed, it will be understood that I do not limit my invention to this particular use, as it will be seen from the following description that the same is equally as well adapted to the moving of various other kinds of materials, examples of which have been given above.

The objects of the invention are to provide a highly efficient pump of the aforesaid character that is comparatively simple of design; substantial of structure; very durable; easily operated; capable of a very fine adjustment for regulating the pressure or force created by the pump; wherein such adjustment may be conveniently made while the pump is in operation; wherein the working parts are easily accessible; wherein the elements, subjected to abrasive materials or acids operated upon by the pump, are comparatively cheap, durable, and readily replaceable; wherein all operating parts of

the pumping mechanism run in oil; and wherein all working parts are thoroughly inclosed and thus protected from dust or the like.

With the foregoing objects in view, and others which will become apparent as this description proceeds, my invention may be defined as consisting of the combinations of elements set forth in the claims annexed hereto and illustrated in the drawing accompanying and forming a part hereof and wherein Figure 1 is a vertical longitudinal section through the pump as indicated by the line 1—1 of Fig. 2; Fig. 2 is a central transverse section on the line 2—2 of Fig. 1; and Fig. 3 is a section through the pump in a plane parallel to that of Fig. 2, as indicated by the line 3—3 of Fig. 1.

In the present embodiment of the invention, 1 is a cast housing containing opposed cylinders 2 and 3 which open, at their outer ends, into what I may term actuating compartments 4 and 5, respectively.

The structure is substantially identical on each side of its longitudinal center, so that a description of one end will suffice for a clear understanding of the structure in its entirety.

Each end of the housing terminates in a flange 6 to which is secured, by suitable means, a member 7; and the edge of a flexible diaphragm 8 is firmly clamped between the adjacent faces of said flange and member. The member contains a pumping chamber 10, having inlet and outlet ports 11 and 12, respectively, the former leading from a valve casing 13, and the latter into a valve casing 14.

These valve casings are preferably formed integral with the member 7, and access to their interiors may be gained through openings that are closed by covers 15. Check valves 16 and 17 are contained within the respective casings 13 and 14. I prefer to make these valves of rubber and in the form of balls; and each is adapted to cooperate with a suitable seat 19 that may be fitted within the apertures controlled by the valves. Each of the valve casings 13 is formed with a flanged inlet extension 20, and each of the valve casings 14, with a similar outlet extension 21. The extensions 20 may have communicative connection with a common inlet header or manifold, and the outlet extensions 21 with a common discharge conduit. Such an arrangement will be readily

understood, and is deemed unnecessary of illustration.

A lateral passageway 25 leads from each of the compartments 4 and 5 and opens through the top of the housing. The housing surrounding the opening of each passageway is formed to receive a plate 26 containing valve seats 27 and 28; and surmounting each plate 26 is a cylindrical casing 30, the upper end of which is adapted to be closed by a cover 31. As shown, the lower end of each casing 30 has a flange bearing upon the plate 26 and through which, and the plate, screws 33 are adapted to pass and be screwed into the housing to hold the parts together. Spaced a suitable distance below the upper end of each casing 30, on the interior thereof, is a ledge 35 which supports a plate 36. A screw 37, having a hand wheel 38, is adapted to be threaded through a tapped aperture in the plate, and the screw may be held in any position to which it is adjusted by a lock nut 39. The lower end of the screw bears upon a thrust plate 40, opposed to a second thrust plate 41 that is fixed with respect to a valve 42 which coöperates with the seat 27. A spring 43 is compressed between the composed thrust plates 40 and 41 and the tension thereof may be regulated through the adjusting screw 37. A valve 44, which coöperates with the seat 26, is drawn toward the seat by a spring 45 which has one of its ends connected to the guide portion of the valve and its opposite end engaged over a hook 46 having a threaded shank that is projected upwardly through a hole in the plate 36 to receive thereabove a wing nut 47. It will be appreciated from this construction how easily the tension of the springs 42 and 44 may be regulated by removing the cover 21 and manipulating the hand wheel 38 and wing nut 47.

Opposed pistons 50 and 51 occupy the respective cylinders 2 and 3, the pistons being incorporated in an integral structure including bars 53 which connect the adjacent ends of the cylinders. The bars are so spaced, circumferentially of the structure, as to not interfere with the driving shaft 55, or the eccentric 56 that is secured to the shaft by a set screw 57. The eccentric is encircled by a strap 58 that has connection, through a wrist pin 59 with the inner end of the piston 51. The pistons are made hollow for lightness and their outer ends are closed by heads 60. The eccentric, and the parts associated therewith, are situated within a central chamber 62 of the housing, the chamber having a large circular opening at one side that is closed by a cover 63. The drive shaft 55 enters the chamber 62 through the side wall thereof, and the aperture of the wall through which the shaft extends is effectually closed by means of a packing gland 64 to prevent egress of oil. The end of the shaft inside the

chamber has bearing in a bushing 65 that is set within a boss 66 of the cover 63; and the opposite end of the shaft is journaled within a bearing 67 of a standard 68. A driving pulley 70 is shown as secured to the shaft between the standard 68 and the pump housing.

When the pump is in readiness for use, the actuating chambers 4 and 5, with their lateral passageways 25, and the portions of the cylinders 2 and 3 that are unoccupied by their respective pistons, are filled with a suitable liquid, such as oil. A quantity of the same liquid may be present in the casings 30.

Now when the shaft 55 is driven and the eccentric 56 rotated, reciprocatory movement will be imparted to the pistons to alternately displace and replace the liquid in the outer ends of their cylinders. With no resistance offered to the flow of material through the pumping compartments 10, this will result in the diaphragms 8 being vibrated to the full extent of their movement. Accordingly upon each pulsation of each diaphragm, the full capacity of the corresponding pumping compartment will be moved. Now let it be supposed that a head of pressure has been attained on the outlet side of the pump sufficient to block outward movement of the diaphragms. Under these circumstances, the liquid in the actuating compartments will be circulated through what may be termed the accumulating chambers of the casings 30, the valves 42 lifting against the tension of the springs 43 to permit the passage of the liquid into the casings 30 upon the outstroke of the pistons, and the valves 44 opening in opposition to the springs 43 to allow the liquid to flow back into the actuating compartments in response to the suction created by the instroke of the pistons. As the pressure within the outlet conduit becomes less, the diaphragms will resume movement to an extent proportionate to the fall in pressure, while a lesser quantity of liquid is circulated through the casings 30.

Inasmuch as the degree of pressure which it is possible to create within the actuating compartments is dependent upon the tension of the springs 43, and the pressure in the pumping compartments must be substantially identical with that in the actuating compartments, it will be seen that the maximum force of the pump may be varied at will through the adjustment of the springs 43 by means of the adjusting screws 37. This may be done without suspending the operation of the pump, by simply removing the covers 31 and turning the hand wheels 38.

Any oil consumed through lubrication or which leaks past the pistons into the chamber 62, thus depleting the supply within the actuating compartments, is automatically replaced from the casings 30, and the supply

within these casings may be very conveniently replenished from time to time.

When the apparatus is used for pumping acids, the valve chambers and pumping compartments should be galvanized, enameled, or protected by a coating of other suitable material that is unaffected by acid; or they might be made of porcelain or similar substance.

Having thus described my invention, what I claim is:—

1. In a pump, the combination of a chambered casing; a diaphragm dividing the chamber into a pumping compartment and an actuating compartment, the former having valve controlled inlet and outlet ports and the latter being adapted to be filled with fluid; means for alternately displacing and replacing the fluid; an accumulating chamber communicating with the actuating compartment and of sufficient capacity to accommodate the displaced fluid; and means resisting the flow of fluid into the accumulating chamber.

2. In a pump, the combination of a chambered casing, a diaphragm dividing the chamber into a pumping compartment and an actuating compartment, the former having valve controlled inlet and outlet ports and the latter being adapted to be filled with fluid, means for alternately displacing and replacing the fluid, an accumulating chamber communicating with the actuating compartment, means resisting the flow of fluid into the accumulating chamber, and further means for regulating the resistance of the former means.

3. In a pump, the combination of a chambered casing, a diaphragm dividing the chamber into a pumping compartment and an actuating compartment, the former having valve controlled inlet and outlet ports and the latter being adapted to be filled with a fluid, means for alternately displacing and replacing the fluid, an accumulating chamber communicating with the actuating compartment, and means of variable resistance for controlling the flow of fluid into the accumulating chamber.

4. In a pump, the combination of a chambered casing, a diaphragm dividing the chamber into a pumping compartment and an actuating compartment, the former having valve controlled inlet and outlet ports and the latter being adapted to be filled with fluid, means for alternately increasing and decreasing the effective capacity of the actuating compartment, an accumulating chamber communicating with the actuating compartment, and means of variable resistance for controlling the flow of fluid into the accumulating chamber.

5. The combination of a casing containing a cylinder, a member closing one end of the cylinder and containing a pumping com-

partment having valve controlled inlet and outlet ports, a flexible diaphragm separating the cylinder from the compartment, an accumulating chamber communicating with the cylinder, and means resisting the flow of fluid into the accumulating chamber.

6. The combination of a casing containing a cylinder and an actuating compartment into which the cylinder opens, a member for closing the actuating compartment and containing a pumping compartment having valve controlled inlet and outlet ports, a flexible diaphragm separating the compartments, an accumulating chamber communicating with the actuating compartment, and means resisting the flow of fluid into the accumulating chamber.

7. The combination of a casing containing a cylinder and an actuating compartment into which the cylinder opens, a member for closing the actuating compartment and containing a pumping compartment having inlet and outlet ports, the member incorporating valve casings with which said ports communicate, ball valves within said casings, a flexible diaphragm separating the compartments, an accumulating chamber communicating with the actuating compartment, and means resisting the flow of fluid into the accumulating chamber.

8. The combination of a chambered casing, a diaphragm dividing the chamber into a pumping compartment and an actuating compartment, the former having valve controlled inlet and outlet ports and the latter being adapted to be filled with a fluid, means for alternately increasing and decreasing the effective capacity of the actuating compartment, an accumulating chamber communicating with the actuating compartment, a valve for controlling the flow of fluid from the actuating compartment into the accumulating chamber, a spring tending to maintain said valve closed, and means for varying the tension of said spring.

9. The combination of a chambered casing, a diaphragm dividing the chamber into a pumping compartment and an actuating compartment, the former having valve controlled inlet and outlet ports and the latter being adapted to be filled with a fluid, means for alternately increasing and decreasing the effective capacity of the actuating compartment, an accumulating chamber communicating with the actuating compartment, valves controlling the circulation of fluid through the accumulating chamber, a spring tending to seat the valve opposing the flow of fluid from the actuating compartment to the accumulating chamber, and means for varying the tension of the said spring.

10. The combination of a casing containing a chamber and a cylinder opening into the chamber, a diaphragm dividing the chamber into a pumping compartment and

an actuating compartment wherewith the cylinder communicates the former having valve controlled inlet and outlet ports, a piston within the cylinder, means for reciprocating said piston, the casing having a passageway opening through the side thereof and communicating with the actuating compartment, a second casing applied to the first and having a chamber registering with the passageway, a partition separating the last mentioned chamber from the passageway, said partition having through ports establishing communication between the chamber and passageway, a member arranged transversely of the second casing and spaced from the aforesaid partition, a screw threaded through said member, a valve for closing one of the aforesaid through ports of the partition, a compression spring interposed between said valve and said screw, a second valve for closing the other through port and arranged reversely to the former valve, and means tending to maintain the second valve closed.

11. The combination of a casing containing a chamber and a cylinder opening into the chamber, a diaphragm dividing the chamber into a pumping compartment and an actuating compartment wherewith the cylinder communicates, the former having a valve controlled inlet and outlet ports, a piston within the cylinder, means for reciprocating said piston, the casing having a passageway opening through the side thereof and communicating with the actuating compartment, a second casing applied to the first and having a chamber registering with the passageway, a partition separating the last mentioned chamber from the passageway, said partition having through ports establishing communication between the chamber and passageway, a member arranged transversely of the second casing and spaced from the aforesaid partition, a valve for controlling one of the aforesaid through ports of the partition, the same opening into the chamber, means tending to maintain said valve closed, a second valve for controlling the other through port and arranged reversely to the former valve, an anchorage device supported from the aforesaid member, and a tension spring connecting the last mentioned valve with said anchorage device.

12. The combination of a casing containing a chamber and a cylinder opening thereinto, a flexible diaphragm dividing the chamber into a pumping compartment and an actuating compartment wherewith the cylinder communicates, the former having valve controlled inlet and outlet ports, a piston within the cylinder, means for reciprocating the piston, the casing containing a passageway opening at one end through the top of the casing and communicating at the

other with the actuating compartment, a plate closing the outer end of the passageway, said plate having two through ports one having a valve seat on the outside of the plate and the other a valve seat on the inside of the plate, a casing surmounting the plate, a removable cover closing the upper end of the casing, a member disposed transversely of the casing adjacent its upper end, a valve applied to that valve seat occurring on the outer side of the plate, an adjusting screw threaded through the member substantially in axial alinement with said valve, a compression spring interposed between said valve and screw, a valve applied to the valve seat on the inner side of said plate, a hook suspended from the aforesaid member, and a tension spring connecting the second mentioned valve with said hook.

13. The combination of a housing containing opposed cylinders that are in axial alinement with each other and opening at their outer ends into chambers, diaphragms dividing said chambers into actuating compartments, wherewith the cylinders communicate, and pumping compartments, the latter having valve controlled inlet and outlet ports, the housing having a central chamber into which the cylinders open, a unitary piston structure having end portions within the cylinders and a central skeleton portion connecting the end portions, a driving shaft supported transversely of the central chamber, driving connections between the shaft and piston structure, means for driving the shaft, the housing having passageways opening through the top of the housing and communicating with the actuating compartments, a plate closing the outer end of each passageway, said plate having through ports one of which is surrounded by a valve seat on the outer side of the plate and the other by a valve seat on the inner side of the plate, an open top casing surmounting each plate and containing an accumulating chamber, a removable cover closing the upper end of each casing, a valve for cooperation with each valve seat of each plate, springs tending to maintain the valves closed, and means within the casings for adjusting the tension of certain of said springs and accessible through the open ends of the casings.

14. A pump of symmetrical design on each side of its longitudinal center and comprising a housing containing a central chamber and opposed alining cylinders opening at their outer ends into actuating compartments, members applied to the opposite ends of said housings and each containing a pumping compartment and valve casings communicating with said compartment through respective inlet and outlet ports, valves within said casings, flexible diaphragms having their edge portions clamped between said members and the ends

of the housing the housing containing pas-
sageways, each passageway opening at one
end through the top of the housing and com-
municating at the other end with one of
5 the actuating compartments, casings sur-
mounting the housing and containing accu-
mulating chambers registering with the
passageways, partition plates separating
the accumulating chambers from the pas-
10 sageways, said plates containing through
ports, opposed valves controlling the
through ports of each plate, springs tending
to maintain said valves closed, means with-

in the casings for adjusting the tension of
certain of said springs, the said casings hav- 15
ing openings through which access may be
had to said adjusting means, removable clo-
sures for said openings, a piston structure
having end portions within the opposed cyl-
inders, a driving shaft supported trans- 20
versely of the central chamber, driving con-
nections between said shaft and the piston
structure, and means for driving said shaft.

In testimony whereof, I hereunto affix my
signature.

HILMAR MUELLER.