

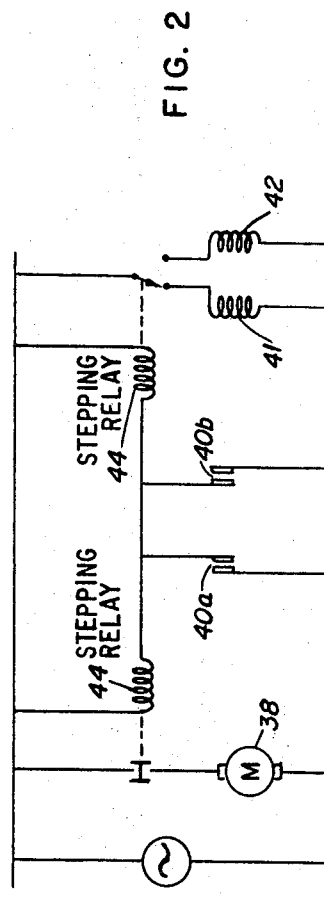
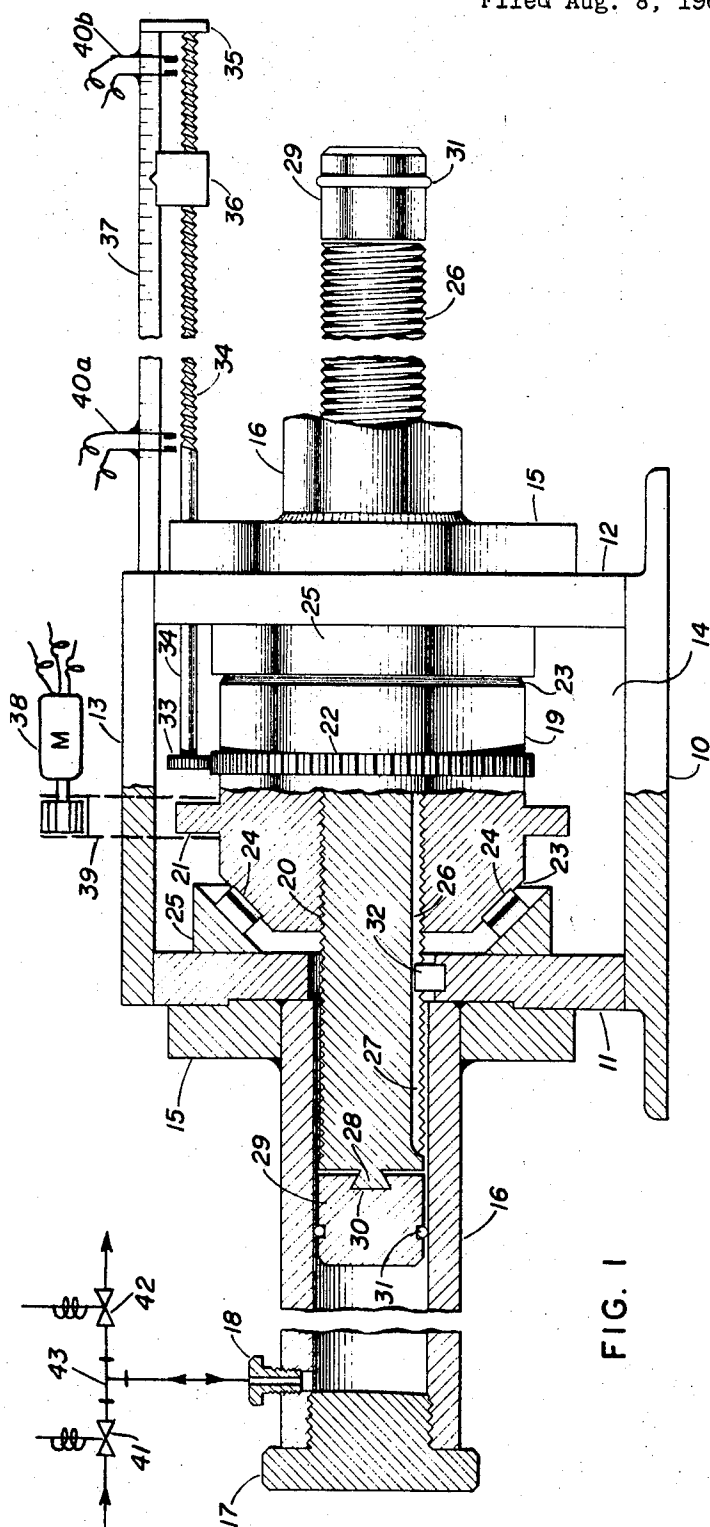
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METERING PUMP

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METERING PUMP

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3 Claims

ABSTRACT OF THE DISCLOSURE

Reciprocating piston pump actuated by a screw feed and having readily interchangeable piston and cylinder assemblies; in one embodiment, a piston position indicator is provided.

This invention relates to a reciprocating positive displacement pump especially suitable for accurately metering fluids at a constant rate, which rate is readily capable of being changed over a wide range.

One of the advantages of the pump described herein is that its output rate can be readily varied over a wide range. Another advantage is that it is capable of accurate metering. In its double-acting embodiment it produces a continuous output. Yet another advantage is that it can handle fluids of a wide range of viscosities, including suspensions. Still another advantage resides in the fact that its wetted parts can be constructed from a wide variety of materials, and thus it can be made resistant to a broad spectrum of corrosive fluids. A further advantage includes, in one embodiment, a simple indication of fluid output volume.

Other aspects, objects, and advantages of the invention will become apparent upon study of this specification, the appended claims, and the accompanying drawing, in which:

FIG. 1 is a view, partially in vertical longitudinal section, partially in elevation, and partially broken away, of a preferred embodiment of the invention.

FIG. 2 comprises a schematic electrical diagram suitable for operation of the pump of FIG. 1.

The pump as shown in the drawing comprises a base plate 10, a left end plate 11, a right end plate 12, a cover plate 13, a rear plate 14, and a front plate, removed for clarity, which serves as the rear wall bounded by plates 10, 11, 12 and 13; parts 10-14 and the front plate together constitute the pump casing. Secured to the exterior of each end plate 11 and 12, as by studs, not shown, is a flange 15, to which in turn is fastened a cylinder wall 16 closed at its opposite end by a plug 17. Each cylinder wall is provided with a fluid passage communicating at its outward interior, such as a nipple 18. Parts 15-18 together constitute a cylinder assembly, the right cylinder assembly being partially broken away in the drawing.

Within the pump casing is a driver assembly indicated generally as 19 which comprises a hollow cylindrical block having an internal threaded bore 20, a driven spur gear 21, a drive spur gear 22, and at each end a chamfer 23 serving as a bearing race. Driver assembly 19 is mounted rotatably in the pump casing by a series of bearings 24 at each of its two ends, which bearings in turn are seated in outer bearing races 25 fastened to the interior surface of end plates 11 and 12. Threaded through bore 20, and passing through appropriate openings in end plates 11 and 12, is a threaded piston rod 26 provided with a longitudinal key slot 27 and, at each of its ends, a dovetail 28. A pair of pistons 29 are fitted at their mating dovetail grooves 30 on dovetails 28. Dovetail 28 and mating groove 30 can take any shape which allows removal of piston 29 by a sliding motion transverse to the longitudinal axis of piston rod

26. For example, dovetail 28 can comprise a frustoconical protrusion on the end of rod 26 as shown, or can alternatively be held on with a transverse wrist pin or other means. Pistons 29 can be provided with a sealing device such as O-ring 31. A key 32 is fixed in end plates 11 and 12 so as to project into slot 27.

The pump of this invention can further be provided with an indicator assembly including a driven spur gear 33, a shaft 34 threaded at its outer end, an outboard shaft bearing 35, and an indicator pointer 36 having a longitudinal internal threaded bore corresponding to the threads on shaft 34 and a longitudinal key slot on its upper surface engaging an indicator bar 37. Bar 37 is fastened at its inboard end to the pump housing, and shaft 34 is further supported by a bearing, not shown, in end plate 12.

Operation of the metering pump is now described. A suitable power source such as an electric motor 38, preferably of variable speed, is connected as by a chain drive 39 to gear 21. The drive preferably enters the pump casing through cover plate 13. Energizing the power source causes rotation of driver assembly 19 including gears 21 and 22. Rotation of driver assembly 19 causes, by virtue of key slot 27, key 32, and threads 20, a longitudinal movement of piston rod 26 either to the left or to the right, depending on the "hand" of threads 20 and the direction of rotation of assembly 19. Movement of rod 26 causes corresponding movement of pistons 29 linked directly thereto. Assuming the movement to be to the right, fluid is drawn into the left cylinder by way of nipple 18 on the left end, and other fluid in the right cylinder which has been drawn in on a previous cycle is now expelled via a nipple 18 on the right cylinder, which is not shown in the drawing. Drive gear 22 causes gear 23 to rotate in the opposite direction, which turns shaft 34. The threads on shaft 34 then move indicator 36 along bar 37, which can be calibrated in any desired manner. The threads of shaft 34 and of rod 26 are preferably of a related pitch per inch but opposite hand, so that indicator 36 can be positioned directly over the face of piston 29 and will always indicate the location of the piston. A similar indicator can be used in conjunction with each piston, but is shown here only over the right piston.

Indicator 36 can also be used as a novel control for the pump as follows: Position sensing switches, such as microswitches 40a and 40b, can be mounted in a slideable or fixed position on bar 37 so as to be actuated by indicator 36. Actuation of a switch 40 can then be caused through suitable relays 44, to reverse direction of the pump drive motor. Thus, when the piston 29 reaches one end of its stroke, one of the switches 40 on bar 37 will be actuated to cause the pump to reverse its travel direction. These same microswitches can also be used to actuate solenoid valves 41 and 42 on the pump inlet and discharge lines connected to nipples 18. One useful way of connecting such inlet and discharge lines is to connect a T 43 to each of the two nipples 18. One arm of each of the two Ts is connected through, e.g., a solenoid valve 41 to a source of the fluid being pumped, and serves as the pump inlet or suction. The remaining arm of each of the two Ts is connected through a similar valve 42 to the fluid receptacle or point of fluid use, and serves as a pump discharge. As mentioned, the solenoid valves in the pump suction and discharge lines can be actuated by microswitches 40 on bar 37 sensing the desired point of ending a pump stroke as reflected by indicator 36.

It will be obvious that a pump according to the present invention can be built with only one piston and cylinder, although a double-acting pump as shown in the drawing is preferred. It is also obvious that each of the two cylinders can be used on separate duty, i.e., the two cylinders can be piped independently so as to handle a different fluid in each cylinder.

An important feature of the present pump resides in its extreme flexibility as to the nature and pumping rate of fluids which it is capable of handling. Cylinder wall 16 can be fabricated from a wide variety of materials, and can include a sleeve liner of such as glass, Teflon, ceramic, polyethylene, etc. Piston 29 and plug 17 can be similarly treated. Piston 29 can be slideably sealed to the interior of cylinder wall 16 by lap fitting, an O-ring as shown, expandable piston rings, etc. The volumetric capacity of this pump can be varied widely, and in several manners. First, the stroke-limiting microswitches can be slideably mounted on bar 37, and can be so positioned as to utilize any desired fraction of the total potential pump stroke. Secondly, the pump drive motor speed can be varied so as to change the amount of time required per stroke. Thirdly, and perhaps most importantly, the pump is so designed that the entire cylinder assembly and piston can be quickly and easily interchanged. The cylinders shown in the figure are of minimum capacity in that their I.D. is just large enough to contain piston rod 26. However, the pump capacity can be substantially increased quite quickly by simply unbolting flange 15 from end plate 11 and/or 12, disconnecting the piping from nipple 18, sliding the cylinder off, replacing piston 29 with one of larger diameter by use of its dovetail or similar connection, and then installing a larger-bore cylinder by its flange 15, and connecting the piping to the corresponding nipple 18. Indicator bar 37 can be provided, for instance, with spring clips at its ends to hold in place along its length replaceable scales calibrated to match the volumetric capacities of any number of cylinder and piston diameters.

In certain instances, small amounts of the fluid being handled will be wiped behind the piston into the interior of the pump casing. The pump can be provided with seals, not shown, to isolate such fluid from lubricant which can be provided in the bottom of the pump casing to lubricate the various gears therein. Suitable seal installations include mounting an annular seal on the inner face of end plates 11 and 12 so as to surround rod 26 and bear against the flat end surfaces of driver assembly 19; this is the preferred seal location, in that it permits access of bearings 24 to lubricant in the pump casing sump. However, annular seals can alternatively be located so as to engage the outer cylindrical surface of driver assembly 19 adjacent its ends, i.e., between a spur gear 21 or 22 and the adjacent chamfer 23. In either event, the small sub-chamber between such annular seal and the corresponding inner face of the piston can be suitably drained or vented to the exterior of the pump casing.

The pump of this invention is eminently suited for metering fluid at a fixed but readily changeable rate, such as a catalyst or reactant solution or suspension to a chemical reactor. The pump can be used for proportioning fluids by varying its drive motor speed responsive to the rate of another fluid, or by mechanically interconnecting, as by a chain drive, two or more pumps of this invention having the same or different cylinder diameters.

While the invention has been described in terms of certain embodiments thereof, it is to be understood that it is not limited thereto and includes a variety of operating conditions and means useful for carrying out the invention.

What is claimed is:

1. A reciprocal pump comprising a housing means, rotatable drive means within said housing means, said rotatable drive means including an internally threaded bore

along the axis of rotation of said drive means, bearing means rotatably mounting said drive means within said housing means, externally threaded piston rod means extending through opposite walls of said housing means and through and threadedly engaging said threaded bore, said piston rod means including a groove means in its external surface substantially parallel to its longitudinal axis and further including piston-engaging means on one end, piston means engageable with said piston-engaging means by motion substantially transverse to said longitudinal axis of said piston rod means, keying means affixed to said housing means and engageable in said groove means, cylinder means extending beyond said piston means and including flange means adjacent one end thereof, said flange means being releasably fastened to said housing means, and said cylinder means further including a closure means for and a fluid passage means adjacent the end of said cylinder means opposite said flange means, an indicator means comprising shaft means substantially parallel to the longitudinal axis of said piston rod means, said shaft means being threaded along at least a portion of its length, means for imparting rotary motion to said shaft means in fixed proportion to rotation of said drive means, pointer means having an internally threaded bore and adapted to traverse the threaded portion of said shaft, and means for preventing rotational movement and permitting axial movement of said pointer means.

2. The pump of claim 1 further including T conduit means, one arm of which communicates with said fluid passage means, a first solenoid-actuated valve means communicating with a second arm of said T conduit means, a second solenoid-actuated valve means communicating with the third arm of said T conduit means, a pair of position-sensing switch means responsive to movement of said pointer means, and means for closing one of said solenoid-actuated valve means and opening the other of said solenoid-actuated valve means upon actuation of one of said pair of switch means and for opening said one valve means and closing the other said valve means upon actuation of the other of said pair of switch means.

3. The pump of claim 2 further provided with power means for effecting rotation of said rotatable drive means, and means for reversing the direction of said power means responsive to actuation of either one of said pair of switch means.

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