Aug. 14, 1962 H. A. MAEDER 3,049,270

DISPLACEMENT PUMP

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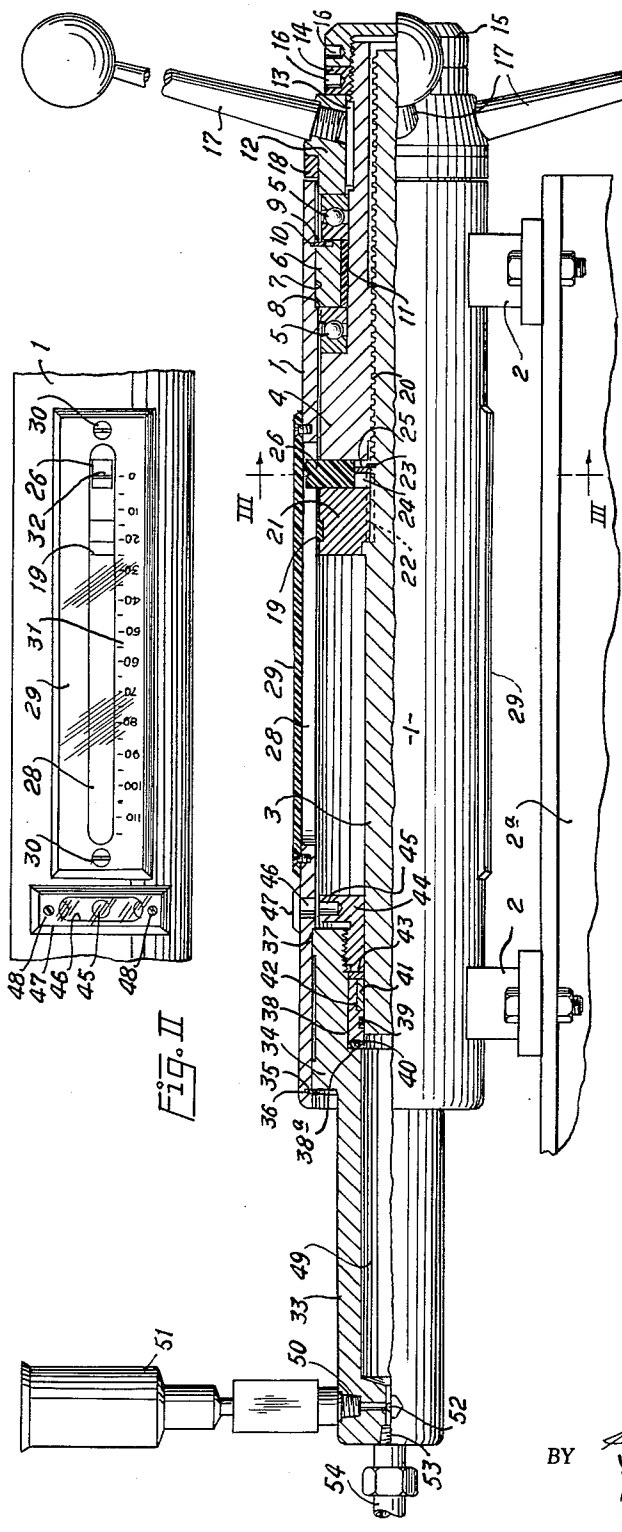


Fig. I



Fig. II

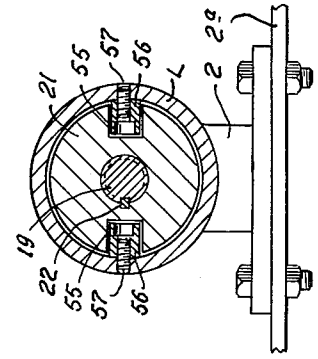


Fig. IV

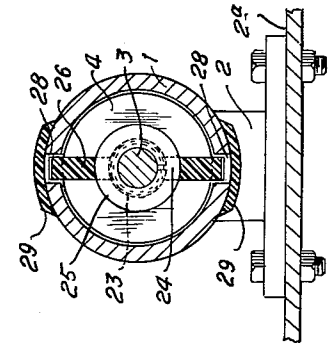


Fig. III

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# DISPLACEMENT PUMP

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This invention is concerned with a so-called "mercury pump," and is particularly concerned with a positive displacement pump employing a reservoir of mercury or other fluid through which pressure is transmitted to a vessel or container for charging such vessel or container with a predetermined and measured pressure.

Such a pump is a precision instrument which is used in the testing laboratory and commercially for the purpose of forcing fluids into any system under great pressure and with extreme accuracy.

One of the uses for such a pump is for pressurizing a core or a sample taken from an oil well so as to simulate the formation pressure from which the core sample is taken. The core is placed in a metal capsule and pressurized at the well site and sealed for transportation to the laboratory where it is to be tested. It is pressurized to the same pressure as the formation from which it is taken, so that the oil and gas entrapped therein will not escape while being transported so that the subsequent test will reveal the natural contents of the core, the porosity, and the rate of emanation of gas and oil therefrom under various pressures.

Pumps used for this purpose in the past have been rather unstable in construction and subject to binding by reason of the fact that the guide-block to which the piston is fixed for in and out movement was mounted on parallel rods which were subject to flexure so that the piston was difficult to move and sometimes stuck by reason of bending of the rods. Such bending also causes errors in displacement readings. Inasmuch as the pump, constituting the subject matter of this invention, has no rods, and consequently no flexing, it is much more accurate.

A primary object of the present invention is to provide strength and rigidity for supporting the piston in such a pump, thus keeping the piston in proper alignment, and providing substantially friction free movement thereof with relation to the housing therefor, thus providing extreme accuracy of displacement and ease in operation.

Another object of the invention is to provide ease in assembly and convenience in operation not heretofore found in pumps of this type.

Another important object of this invention is to provide such a pump in which all working parts are totally enclosed and protected.

Suitable embodiments of the invention are shown in the drawing attached hereto in which:

FIGURE I is a quarter sectional, side elevational view of the preferred form of the pump.

FIGURE II is a fragmentary top plan view of the pump showing the piston displacement scale on the top cover.

FIGURE III is a transverse cross-sectional view taken on the line III—III of FIGURE I.

FIGURE IV is a transverse cross-sectional view of a modified form of the pump taken through the guide block, piston, and housing, showing an alternate form of bearing blocks.

Numeral references are employed to designate the various parts shown in the drawings, and like numerals indicate like parts throughout the various figures of the drawings.



In the drawing the numeral 1 indicates a hollow cylindrical housing in which a piston 3 is slidably movable. The cylindrical housing 1 may be mounted to a base or support 2*a* by means of the mounting brackets 2.

A drive nut 4 is journalled in the housing 1 on the bearings 5.

The bearings 5 are separated by means of a collar 6 which is inserted in a counterbore 7 in the outer end of the housing, such collar 6 being abutted against a shoulder 8 and held in place by a snap ring 9 inserted in an annular slot 10 in the inner side of the housing.

A nylon or other substantially frictionless bearing ring 11 is provided about the inner side of the collar 6.

The bearing assembly, just described, is held in place by means of a hub 12, extending over the outer end of the drive nut 4, which is secured to the drive nut by means of a key 13 inserted in corresponding slots in the drive nut and hub.

The hub 12 is secured in place against outward movement by means of lock nuts 14 and 15 which are threaded on the outer ends of the drive nut 4, said lock nuts having wrench-engaging recesses 16 therein.

A plurality of handles 17 are threadedly engaged to the hub 12 by which the hub and drive nut 4 may be rotated. An annular dial ring 18 extends about the hub 12 which has a scale thereon (not shown) to indicate the number of revolutions which the drive nut 4 is rotated in a given operation. The piston 3 is threadedly engaged to the drive nut 4 by means of threads 20.

A guide block 21 is secured to the piston 3 by means of a key 22 which is disposed in corresponding grooves in the piston and the guide block and abuts against a washer 25 to hold the key in place. The washer 25 also abuts against the guide block 21 to hold the guide block in place. Snap ring 23 is disposed in an annular groove in the piston 3 and abuts against washer 25 to hold it in place. An annular, substantially frictionless bearing ring 19, preferably made of nylon, extends about, and slidably engages, the inner wall of the housing 1 as the piston 3 moves longitudinally in the housing. Diametrically opposed nylon bearing blocks 26 are inserted in a transverse slot 24 formed on the inner end of the guide block 21, such bearing blocks 26 being in contact with the drive nut 4 at the other end. The bearing blocks 26 extend into elongated slots 28 cut through the wall of the housing 1. The bearing blocks 26 constitute slidable key members and may move longitudinally in the slots 28 but hold the piston 3 against rotation.

A transparent plastic cover 29 is secured over each slot 28 by means of screws 30. A scale 31 is provided on the inner side of one of the covers 29 along the slot 28. A reference line 32 is formed on the bearing block 26 which can be viewed through the transparent cover 29 to thereby indicate the exact displacement of the piston 3.

The covers 29 also protect the interior working parts of the pump from abrasive foreign material, thus greatly prolonging the life and accuracy of the drive screw, piston and bearings.

A hollow cylinder 33 has an enlarged inner end 34 which may be inserted in the end of the housing 1 and secured therein by means of a snap ring 35 secured in an annular groove 36 formed on the inner side of the housing 1. The enlarged end 34 is abutted against a shoulder 37 in the inner end of the housing 1.

A packing assembly, including a support ring 38, is disposed between the inner side of the enlarged end 34

of the cylinder 33 and the piston 3. Resilient seal rings 39 and 40 are carried by support 38 and provide a seal between the cylinder 33 and the piston 3. A frictionless bearing ring 41, such as nylon, is provided in a recess 42 on the inner side of the packing support 38 to provide ease in the slidable movement of the piston 3.

The packing support 38 is held in place against an annular shoulder 38*a* by means of a gland nut 44 which is threadedly engaged to the enlarged end 34 of the cylinder 33 and bears against a retainer ring 43. The gland nut 44 has tool engaging holes 45 therein which are accessible through an access port 46 in the wall of the housing 1 to permit the gland nut 44 to be adjusted after assembly.

The cylinder 33 provides a reservoir 49 which may be filled with mercury or other liquid. The outer end of the cylinder 33 is provided with a threaded port 50 in which an auxiliary mercury container 51 may be attached for the purpose of refilling the reservoir after the pump has been used. Another threaded attachment port 52 is provided in the cylinder 33 for the attachment of a pressure gauge (not shown), and a threaded port 53 is provided in the outer end of the cylinder 33 to which the vessel or system to be pressurized may be attached through the conduit 54.

The operation of the pump is as follows: The handles 17 are grasped and the hub 12 and drive nut 4 are rotated on the bearings 5. Since the drive nut 4 is held against longitudinal movement in the housing 1, the piston 3 will move on the threads 20. As the piston 3 moves inwardly the bearing blocks 26 slide in the slots 28 and the nylon bearing 19, carried by the guide block 21, slides along the inner surface of the housing 1.

Thus it will be seen that the piston 3 is centered in the housing and supported therein, and has substantially frictionless longitudinal movement with respect thereto, the only friction being provided by the substantially frictionless nylon surfaces at 19, 26 and 41, and the packing 39. As the piston 3 moves inwardly pressure is built up in the mercury reservoir 49 which is transmitted by the incompressible fluid therein to the vessel or system being pressurized.

A modified construction is shown in FIGURE IV of the drawing wherein longitudinal grooves 55 are formed in guide block 21 to slidably engage square guide rails 56 secured to the inside of housing 1 by Allen screws 57, threaded through passages provided through the wall of the housing 1. Guide rails 56 are substantially the same length as slots 28, which they replace in the modified structure.

Such modified guide block and bearing block assemblies serve to center and support the piston 3 against rotation and lateral movement with respect to the housing 1 but permit the piston to move longitudinally in the housing.

A matter of importance is the ease in assembly of this pump in that the cylinder 33 is inserted in the outer end of the housing 1 and secured in place by a snap ring 36, thereby eliminating threading. The bearing collar 21 is also held in place by a snap ring 23, eliminating threading.

It will thus be seen that I have provided improvements in a pump of the type described wherein all movable parts are supported and maintained in exact alignment, providing ease and accuracy in operation, ease in assembly, and protecting operating parts from damage by foreign material.

I claim:

1. In a device of the class described, a tubular housing; an elongated piston slidably disposed in the housing; a drive nut rotatably disposed in one end of the housing and being threadedly engaged about one end of the piston; means to hold the drive nut against longitudinal movement in the housing; co-engageable means between the housing and piston to prevent rotation between the housing and piston; means for rotating the drive nut on the exterior of the housing; a hollow cylinder attached to the other end of the housing having a fluid reservoir therein, the outer end of said piston being slidably extended into the cylinder and being in communication with the fluid reservoir; and seal means between the piston and the inner wall of the cylinder.

2. The combination called for in claim 1 wherein the inner end of the cylinder is abutted against an annular shoulder in the housing and is held against outward movement by a snap ring engaged with a shoulder on the cylinder and extending into an annular recess provided on the inner side of the housing.

3. In a device of the class described, an elongated tubular housing; an elongated piston slidably disposed in said housing and extending substantially the full length thereof; a guide member attached about the piston intermediate the ends thereof and having slidable contact with the inner wall of the housing; a threaded portion on one end of the piston inside the housing; a drive nut having an interiorly threaded portion rotatably extending into the housing and being threadedly engaged about the threaded portion of the piston; means engaged between the drive nut and housing to hold the drive nut against longitudinal movement inwardly of the housing; co-engageable slidably related means between the housing and the piston to prevent relative rotation between the housing and piston; a hollow cylinder attached to the outer end of the housing having an elongated bore therein constituting a fluid reservoir; the outer end of said piston being slidably disposed in said bore and arranged to move inwardly and outwardly of the bore when the drive nut is rotated; seal means between the outer end of the piston and the inner wall of the bore; and operating means attached to the drive nut exteriorly of the housing to permit rotation of same.

4. The combination called for in claim 3 wherein the co-engageable, slidably related means comprises an elongated slot in the wall of the housing; and a key member attached to the piston extending into the slot and being movable longitudinally therein.

5. The combination called for in claim 3 wherein the slidably related, co-engageable means comprises a slot in the piston and an elongated guide rail attached to the inner side of the housing and extending into the slot, the said slot being movable longitudinally along the guide rail.

6. In a device of the class described, an elongated tubular housing; a hollow cylinder inserted in the outer end of the housing; an annular shoulder in the housing against which the cylinder is abutted; an annular groove on the inner side of the housing near the end thereof; an annular external shoulder on the cylinder; a retaining member inserted in the groove and overlapping the external shoulder, to hold the cylinder in the housing; a bore in the cylinder, having an enlarged portion at the inner end thereof; sealing means disposed in the enlarged portion; a gland member threadedly engaged in the outer end of the enlarged portion of the bore arranged to engage the sealing means; a peripheral access port in the wall of the housing; spaced tool engaging holes in the gland member accessible through the port whereby the gland member may be rotated from exteriorly of the housing to adjust the seal means; an elongated piston slidably disposed in the housing, having the inner end thereof extending into the bore of the cylinder and slidably engaging the seal means; a threaded portion on the other end of the piston; a drive nut extending into the housing and having an internally threaded portion in threaded engagement with said threaded portion of the piston; means to prevent movement of the drive nut inwardly of the housing; means to rotate the drive nut from exteriorly of the housing; and co-engageable slid-

ably related means between the piston and the housing to prevent relative rotation therebetween.

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