July 29, 1952 J. M. TOWLER ET AL 2,604,855

RECIPROCATING RAM PUMP

Filed Jan. 12, 1946

FIG. 1.

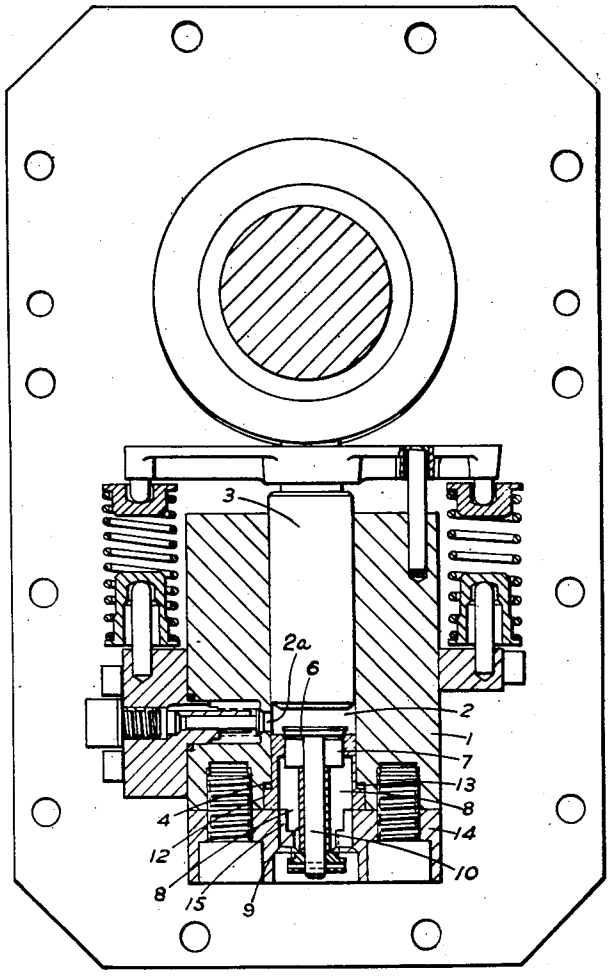


FIG. 2.

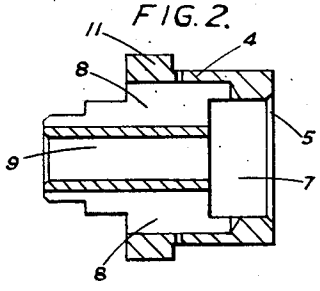
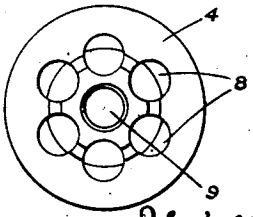


FIG. 3.



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RECIPROCATING RAM PUMP

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3 Claims. (Cl. 103—153)

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This invention relates to reciprocating ram pumps which can be used for supplying liquid at pressures up to 5000 lbs. per square inch and over, such as the pump according to U. S. Patent No. 2,168,850, which has a seating at the inner end of each pump bore to receive a mushroom type inlet valve which opens in an inward direction and the face of which is opposed by the inner end face of the pump ram.

At the very high pressures referred to above the question of stress becomes of vital importance and the presence of a stress concentration in the pump body may lead to its fracture. Such a stress concentration will be caused by a change in section in the wall of the pump bore on the pressure side of the ram. Such a change in section is produced in pumps as now constructed by the constriction in the diameter of the pump bore to form the inlet valve seating. A further disadvantage of such constriction is that it is almost impossible, by known machining methods to obtain the desired degree of parallelism throughout the effective length of the pump bore.

The object of the present invention is to provide a construction of pump which will both eliminate the above change in section and facilitate the machining of the pump bores.

In a pump according to the present invention each pump bore consists of a parallel hole extending right through the block of metal constituting the pump body and the seating for the inlet valve forms part of a separate member or bushing which fits into one end of the pump bore.

In order that the invention may be clearly understood and carried into effect we will now describe, by way of example, an embodiment consisting of a reciprocating ram pump according to U. S. Patent No. 2,168,850, constructed in accordance with the present invention and by aid of the accompanying drawings in which:

Fig. 1 is a transverse section through the improved pump.

Fig. 2 is an enlarged sectional view of the inlet valve seat bushing.

Fig. 3 is an end view of the bushing shown in Fig. 2.

In the pump according to the illustrated embodiment, the pump body 1 consists of a rectangular block of metal which is bored to provide one or more parallel holes 2 extending right through the block each to constitute a pump bore. Each such hole is ground and lapped throughout its length slidably to receive a parallel ram 3, the fit being sufficiently close as to render packing unnecessary.

Into the outer end of each said pump bore is

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pressed or pushed a flanged bushing 4 at the inner end of which is formed a conical seating 5 for an inwardly opening mushroom type inlet valve 6. Leading from the side of the pump bore 2 adjacent the valve 6 is a transverse bore constituting an outlet 2a through which pressure liquid is discharged during the delivery stroke of the associated ram 3. Extending back from the seating 5 is a circular recess 7 which constitutes an inlet valve orifice common to a plurality of inlet passages 8 which are drilled so as to break into the recess at their inner ends and which are spaced around and so as to be parallel to a central bore forming a guide 9 for the valve stem 10. The sum of the areas of the inlet passages should be equal to or greater than the area of the valve orifice.

The bushings which are machined all to the same length have each a flange or spigot 11 at its outer end which fits into a circular recess 12 in the end face of the pump body. To compensate for inequalities in the depths of the recess and spigots a discontinuous copper or other soft metal ring 13 is disposed at the bottom of each recess and the flanges or spigots are pressed onto these copper rings by a cover plate 14 which is bored with inlet openings 15 aligning with the corresponding openings 8 provided by the bushings.

The object of the soft metal ring 13 is to hold the outer face of each bushing against the cover plate with a load slightly exceeding that due to the maximum pressure in the pump chamber acting on the area of the bushing thereby ensuring that there is no appreciable axial movement of the bushing due to the rapid change of pressure in the pump chamber between the suction and delivery strokes of the pump ram. The said rings are not intended to make a fluid tight joint which would tend to build up pressure in the recess 12 by trapping any leakage from the bore 2 along the exterior of the bushing and thus increase the load on the cover plate. The bushings themselves are a sufficiently close fit in the pump bores to prevent any appreciable leakage.

By making the bushings all the same length and holding the same in place by a flat cover plate screwed or bolted to the opposing flat surface of the pump body the valve seats and valves can be machined sufficiently accurately to ensure that the outer faces of the valves, when closed, are all substantially the same distance from the opposing ends of the pump rams. This in turn enables the clearance between the rams and the valve to be reduced to a point where the rams and valves practically contact each other.

By making the pump bores in the form of parallel holes extending right through the pump body the machining necessary to attain the high degree of accuracy required is easily performed, whilst the resulting absence of any change in section of the pump bore obviates stress concentration. Due to the small leakage which is bound to occur at the very high pressure employed between the pump bore and the pump ram and the bushing respectively the pressure within the pump bore on each delivery stroke of the ram may be plotted as a curve having an amplitude which is a maximum in the region of the pump chamber gradually diminishing to zero on either side of said region of maximum pressure.

The stepped or lower end of each bushing is of course formed by turning after the passages 8 have been drilled.

We claim:

1. In a high pressure reciprocating ram pump, a pump body having at least one pump bore extending therethrough an outlet leading from the pump bore; a bushing fitting in said pump bore at one end thereof closely enough to prevent appreciable leakage, said bushing having an inlet valve seat at the end thereof innermost within said pump bore, an inlet orifice open to said seat, a central longitudinal bore, and a number of longitudinal inlet passages arranged around said longitudinal bore and communicating with said inlet orifice, the sum total of the cross-sectional areas of said inlet passages being at least equal to the cross-sectional area of said inlet orifice; an inwardly opening mushroom valve cooperating with said seat to close said orifice and having a stem guided in said central longitudinal bore of said bushing; a flange on said bushing; said pump body having an open annular recess for receiving said flange; a packing ring axially interposed between said flange and the base of said recess; and a cover member dismountably connected to said pump body and having inlet bores therein registering and communicating with said inlet passages of said bushing, said cover member pressing said flange against said packing ring, whereby a pressure is maintained by said packing ring on said flange sufficient to prevent axial movement of said bushing due to the rapid changes of pressure that occur in the pump bore between the suction and delivery strokes of the ram.

2. In a high pressure reciprocating ram pump, a pump body having at least one pump bore consisting of a hole extending without appreciable change of diameter through the pump body an outlet leading from the pump bore, and an inlet valve assembly forming a detachable unit; said inlet valve assembly embodying an inlet valve and a bushing fitting in said pump bore at one end thereof closely enough to prevent appreciable leakage, said bushing having a valve seating at its inner end for the support of the inlet valve and a flange at its opposite end, the length of the bushing, as defined at one end by the outer face of the valve and at the opposite end by the outer face of the flanged end, being predetermined to within very fine limits, and means for locking the bushing in place within the pump bore against the pressure developed therein during the operation of the pump and

for automatically locating the same so that when assembled the outer face of the inlet valve will almost be contacted by the opposite face of the ram at the completion of each inward stroke, said means including a prepared locating face at one end of the pump body, an open annular recess in said prepared locating face of the pump body to receive the flange of the bushing, a discontinuous ring of malleable material interposed between the flange and the bottom of the recess serving as a distance piece to prevent action displacement of the bushing and by its compressability to compensate for variations from the predetermined depth of the flange and the recess due to inaccurate machining, and a cover plate for holding the bushing within the bore with the outer face of the bushing flush with the prepared locating face on the pump body, thereby to insure the correct locating of the face of the inlet valve in relation to the plunger.

3. In a high pressure pump, in combination, a pump body having a cylindrical bore extending therethrough to define a pump chamber and a transverse bore intersecting the chamber and forming an outlet for the same, a ram reciprocable within said chamber, a bushing tightly fitting in said chamber adjacent one end thereof, said bushing having a circular recess opening at its inner end, a central bore extending from said recess to the other end of the bushing, and a plurality of inlet passages extending parallel to said central bore from said other end of the bushing to said recess, a valve seat formed on the inner end of said bushing concentric with said recess and said central bore, a valve having a stem slidably received in said central bore and a portion adapted to cooperate with said seat to interrupt communication between said pump chamber and said recess, means for retaining said bushing in a fixed position in said pump chamber including a circumferential flange formed on the bushing, said pump body having an annular recess adjacent one end of the pump chamber for receiving said flange, and a cover member dismountably connected to said pump body and extending over said bushing, said cover member being formed with passage means communicating with the inlet passages in said bushing.

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