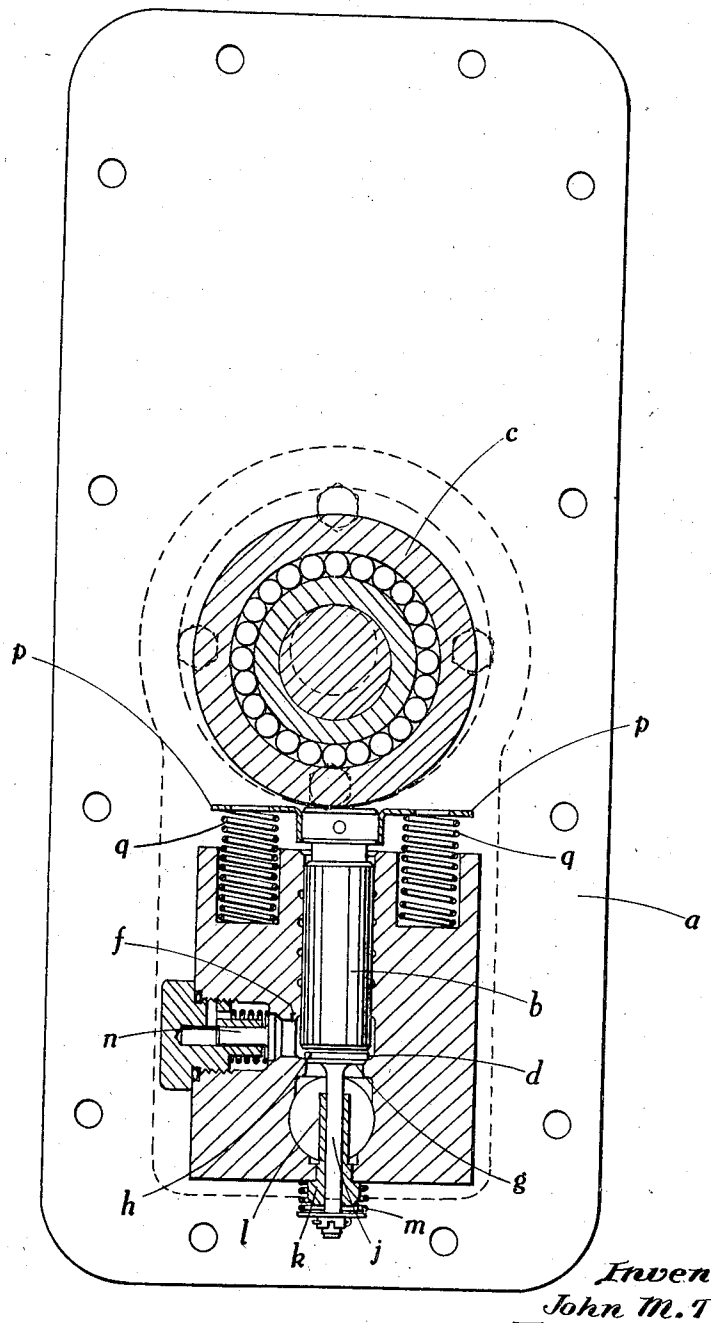
Aug. 8, 1939. J. M. TOWLER ET AL 2,168,850

RECIPROCATING RAM PUMP

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Fig. 1.



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Fig. 2.

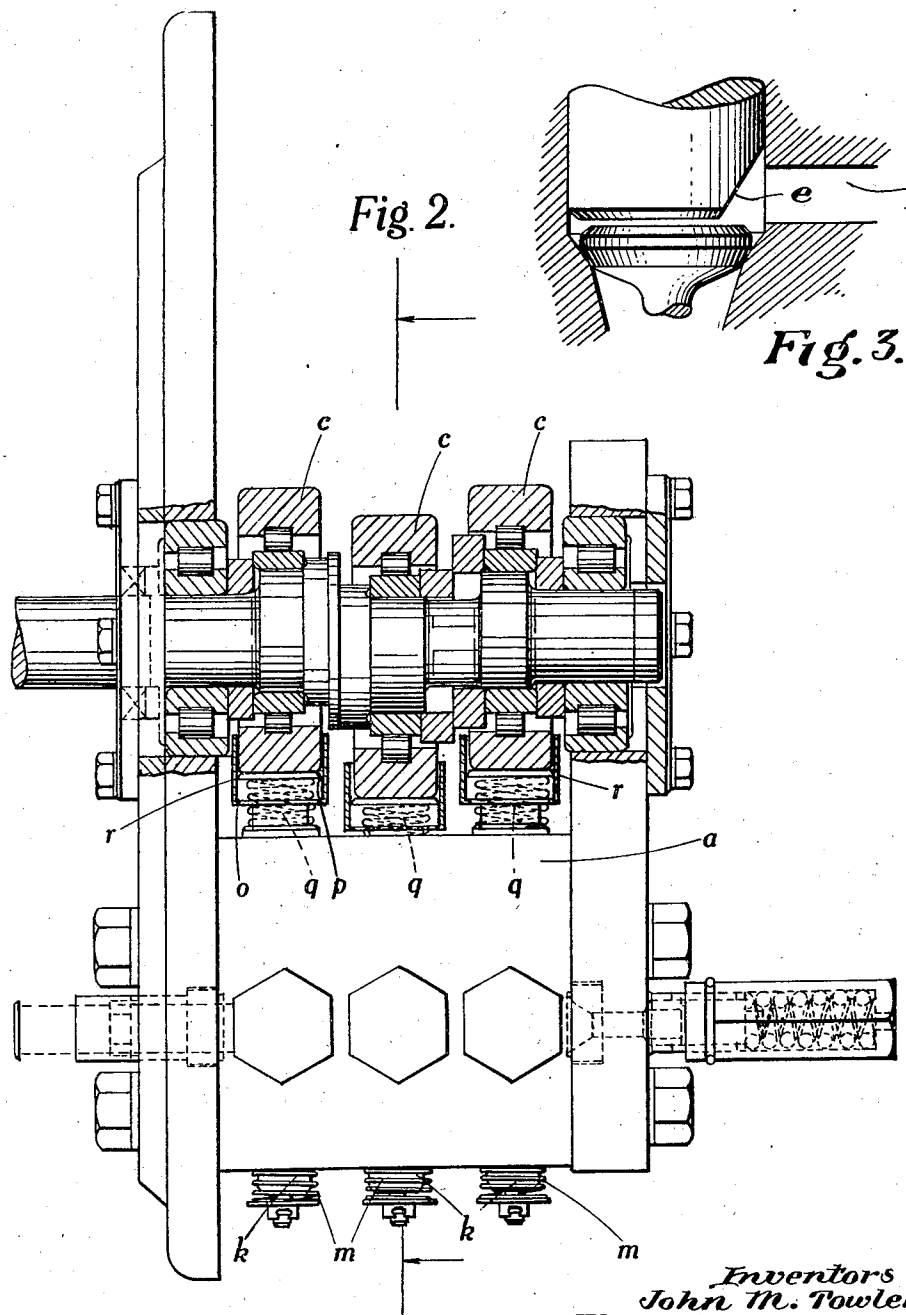


Fig. 3.

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RECIPROCATING RAM PUMP

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In Great Britain October 28, 1936

1 Claim. (Cl. 103—153)

This invention relates to reciprocating ram pumps and particularly although not essentially to such pumps which have a relatively short ram stroke and work at a high number of revolutions per minute.

One object of the invention is to provide a high speed reciprocating ram pump in which the volumetric efficiency is increased by reducing the capacity of the pump chamber.

A further object of the invention is to prevent distortion and seizure or picking up between the ram and the bore or the ram end and the eccentric when using a ram which is a very close fit in the bore by making the ram of relatively soft material and coating the exterior with a covering of chromium or other suitably hard material.

A further object of the invention is to provide in a high speed reciprocating ram pump in which the pump chamber has been reduced to a minimum in capacity by causing the pump ram to almost fill the same on each discharge stroke, means of the shiftable fulcrum type for varying the stroke of the ram such that at the termination of each inward stroke the ram approaches to within the same distance of the opposing end of the chamber no matter whether the stroke of the ram is increased or reduced.

A further object of the invention is to reduce wear between the outer end of the ram and the peripheral surface of a ball or roller bearing eccentric with which it makes direct contact by cambering either surface and preventing the ram from rotating about its longitudinal axis.

Other objects of the invention will appear from the following description and appended claim.

In the drawings:

Fig. 1 is a part transverse section through a high speed pump according to the present invention.

Fig. 2 is a similar view taken at right angles to Fig. 1 and showing in section the roller bearing eccentrics and the outer ends of the rams.

Fig. 3 is a fragmentary detail illustrating a modification of the means used to provide a clearance between the inner end of the ram and the inner end of the pump bore for the passage, during delivery, of liquid to the delivery valve.

The pump illustrated, by way of example, in the drawings is of the high speed reciprocating ram type and comprises a body *a* containing the one or more pump bores for the slidable reception of a corresponding number of rams *b*. Both the ram and its bore are ground and/or lapped so that a very close fit is provided, the clearance being in the region of $\frac{1}{10}$ of a thousandth of an inch. This closeness of fit may be relied upon for fluid tightness, the conventional gland packing, in consequence, then being dispensed with.

With such a very fine clearance the slightest distortion of the ram will cause it to seize. Each ram in these high speed pumps is driven through the medium of a roller-bearing eccentric with the circumferential outer ring *c* of which it makes direct contact. In consequence it is necessary that the rams shall be very hard to prevent the metal of the ram being picked up by the pump bore and the circumference of the ring *c* or vice-versa. If, however, this hardness is brought about by heat treatment internal stresses may be caused which ultimately result in the distortion of the ram.

We have found that the tendency both to wear and to distort will be avoided if each ram is constructed by depositing electrically a layer of chromium upon a core of a relatively softer material, for example, unhardened and normalized carbon steel of 50/60 tons tensile strength.

This construction results in a ram which is free from distortion through internal stresses and which has a protective surface which is about twice as hard as hardened steel. With such a ram picking up or seizing even when working in steel bores is entirely prevented. Further in the case of pumps which work with water, the chromium deposit will prevent corrosion.

In the pump according to the present invention the conventional form of pump chamber of comparatively large capacity is dispensed with, its place being taken by a small clearance space necessitated by the provision of a passage for the liquid to the delivery outlet. In Fig. 1 this space is indicated at *d* and is formed by a slight circumferential enlargement of the inner end of each bore, whilst in the modification illustrated in Fig. 3 the same effect is produced by bevelling the ram as at *e* where it opposes the delivery passage, which is indicated at *f*.

By causing each ram almost completely to fill the inner end of each bore at each delivery stroke, the volumetric efficiency of the pump is greatly increased. To permit of this, the inlet valve *g* is situated at the bottom end of each pump bore and such valve is of the automatically operating mushroom type having a flat face *h* which opposes in parallel relationship a corresponding flat face *i* at the bottom of each ram. At the reciprocation of each ram it is caused, at the termination of each inward or delivery stroke, to move so close to the inlet valve that the two opposing flat faces

h and *i* respectively almost touch each other, leaving only a small working clearance between them. This results in a partial vacuum being formed over the face of the inlet valve on each outward or suction stroke which materially assists in opening the valve. It also results in the expulsion of almost all air or gas which may become locked in the pump chamber so that under normal conditions the pump will be self-priming. It also permits the pump to be run at high speeds without cavitation or undue shock or vibration. The stem *j* of the inlet valve has its axis co-axial with the axis of the ram and is situated on the side of the valve remote from the pump chamber and it works in a valve guide *k* so arranged in relation to the inlet passage *l* that such passage is restricted as little as possible. The valve is held on its seating by means of a light spring *m* and the diameter of the valve is almost as large as the diameter of the pump bore so as still further to reduce restriction on the flow of liquid past the valve. The delivery valve *n* is arranged, in the present example, at right angles to the inlet valve and as close as possible to the inner end of each pump bore so as thereby to minimize the capacity of the pump chamber, which, of course, is comprised by the space between the suction and delivery valve seats.

In the pump illustrated the rams are prevented from rotating for the purpose of reducing wear and/or abrasion. If the rams are free to rotate then when the ram end wears hollow due to contact with the cylindrical surface of its eccentric, the turning of the ram will destroy the line contact between the ram end and the surface of the eccentric. Further the concave surface of the ram end formed by such wear may in turn cause wear of the surface of the eccentric so that the latter surface becomes cambered. Further the tiny particles of metal resulting from such wear will enter the oil in the crank case of the pump and have a deterimental effect on the ball or roller bearings of the eccentrics.

The above troubles are obviated in a pump according to the present invention by a combination of two things, (1) preventing the rams from rotating and (2) by making the ram ends convex, or cambering the surfaces of the eccentrics, such convexity or cambering being very slight for example in the region of a few thousandths of an inch so that the line of contact between the ram end and the surface of the eccentric is not seriously reduced.

In the example illustrated in Figs. 1 and 2 of the drawings the rams are prevented from rotating by providing each ram end with a light metal crosshead *o*. Each crosshead is pinned or otherwise secured to the outer end of its ram and is formed or otherwise provided with lateral wings *p* to form bearers for the ram return springs *c* and spaced flanges *r* to engage the sides of the eccentric ring *c*. The convexity of the ram ends or surfaces of the eccentrics being in the region of a few thousandths of an inch only, is incapable of being illustrated.

In lieu of the cross head illustrated in Figs. 1 and 2, the rotation of the rams may be prevented by cutting a groove or slot across each ram end of slightly greater width than the eccentric *c* and of such a depth that the sides of the groove or slot reside on either side of the eccentric ring and thus prevent the ram from rotating.

A similar result may be obtained by making the ends of the rams square, one face thereof either engaging a flat guide surface attached to the pump body, or, in the case of a multi-ram pump, engaging the corresponding face of the adjacent ram end and so on throughout the series of rams.

What we claim is:

A high speed reciprocating liquid pump comprising a body having a pump bore, a ram slidable within said pump bore, and substantially completely filling the same at the termination of each inward stroke, said pump bore having an inlet opening at the inner end and opposite the inner end of said ram, a conical valve seat on the inside of said inlet opening, an inwardly opening automatically operating mushroom valve cooperating with said seat and having a diameter slightly less than that of the ram, said pump bore having a discharge outlet in its side wall at the bottom thereof, a valve therefor, a high speed power driven means for rapidly moving said ram to produce a comparatively short stroke, each inward movement of which causes the bottom end of the ram to substantially contact the upper face of said mushroom valve and almost completely to cover said discharge outlet whereby the said ram almost completely empties the bore of liquid before each suction stroke by discharging the same through the discharge outlet, and spring means for causing the suction stroke.

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