

Sept. 6, 1938.

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2,129,073

LIQUID PUMP

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2 Sheets-Sheet 1

Fig. 1

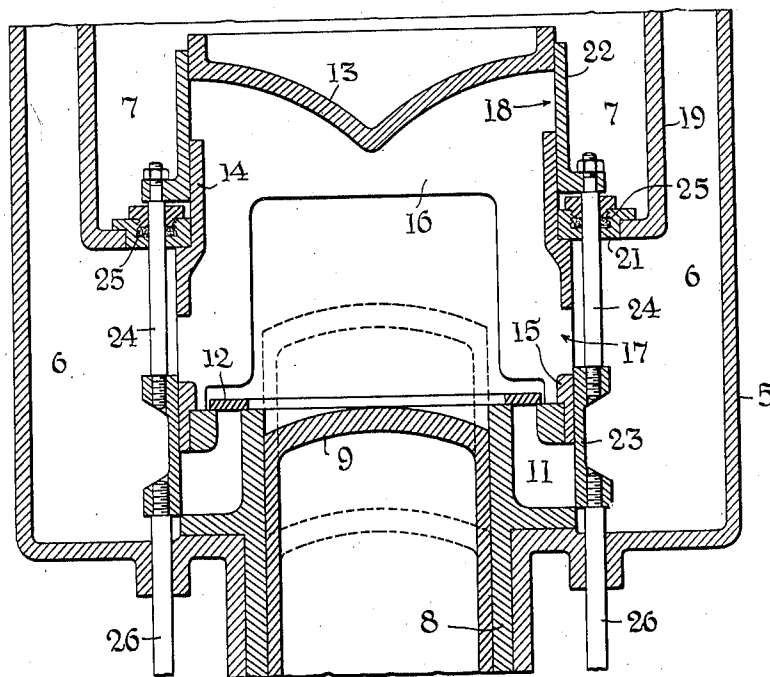
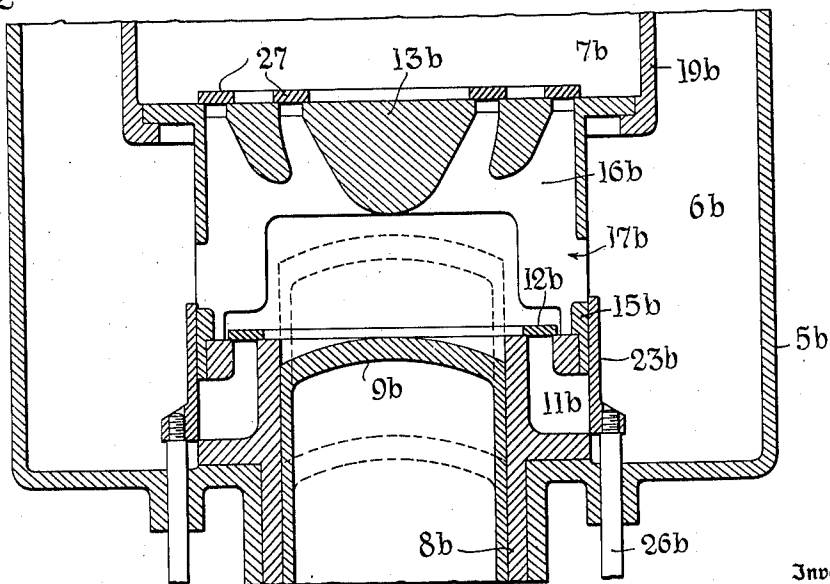


Fig. 2



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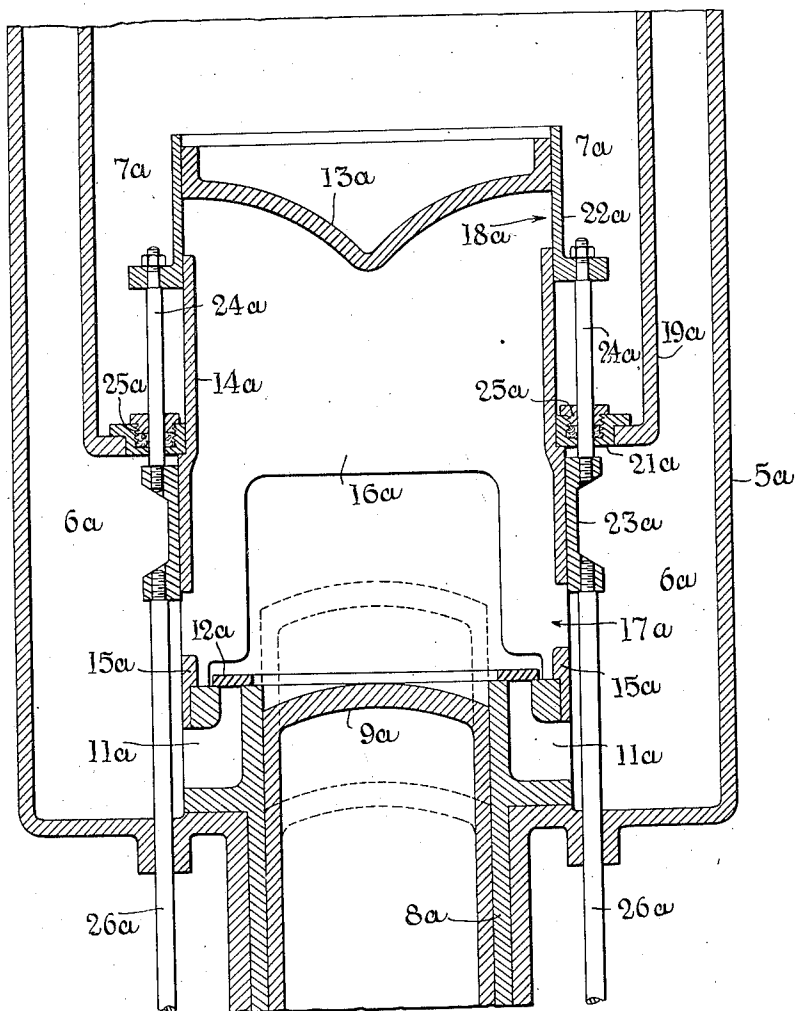
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Fig. 3



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LIQUID PUMP

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5 Claims. (Cl. 103—227)

This invention relates to liquid pumps of the reciprocating plunger type, and resides in features permitting the use of relatively high suction and discharge heads in pumps operating at high speeds.

In a prior patent, No. 2,033,852, issued March 10, 1936, I disclose and claim a reciprocating pump in which a single sleeve valve encircling the cylinder, controls both the inlet and discharge ports which are separated from each other by means of a partition forming a sealed joint with the single sleeve valve. This prior patent also shows automatic or suction operated inlet valves which are designed to operate in the initial portion of the suction stroke before the sleeve valve fully opens the inlet port, the function of the automatic valve being to permit the pump to operate successfully at high speeds and relatively high suction head.

The present invention involves features of improvement upon the pump shown in my prior patent above identified. If the structure of the prior patent be used in pumping against a high discharge head the valve operating gear is subjected to a considerable unbalanced force because the upper end of the valve sleeve is subject to discharge pressure and the lower end is subject to suction pressure. Thus the permissible discharge head in the device of the prior patent is limited by the permissible unbalanced load upon the valve gear.

One feature of the present invention involves the substitution for a single sleeve valve of two distinct sleeve valves, one controlling suction and the other controlling discharge. Each sleeve valve is balanced and the two are connected together to operate in unison by means of rods which pass through packing glands in the partition which separates the suction and discharge passages. Consequently, the unbalanced hydraulic pressures affect merely the areas of these connecting rods, the sleeve valves themselves being balanced as to the hydraulic pressures which react upon them.

Another feature of the present invention is an arrangement whereby the inlet sleeve valve, when in its open position, closes the ports leading to the automatic inlet valves, or at least throttles these ports, the effect in either case being to accelerate the closing of the automatic inlet valves. This accelerated closing permits successful operation at somewhat higher speeds.

In the accompanying drawings I show several embodiments of the invention indicating that the

features above described may be successfully used singly or in combination with each other.

In the drawings—

Fig. 1 is an axial section through the working space of a single-acting plunger pump embodying the features of invention above described. The plunger is shown in full lines at mid-stroke in the suction stroke with the valve mechanism in the corresponding position. The head end and crank end dead point positions of the plunger are each indicated in dotted lines.

Fig. 2 is a similar view showing a modification in which automatic discharge valves are used instead of a sleeve discharge valve.

Fig. 3 is a similar view of a modification in which the inlet sleeve valve does not control the automatic inlet valve ports.

In the above figures the actuating mechanism for the plunger and the valve is not indicated, for the reason that it is conventional and follows generally the arrangement used in connection with my prior patent above identified. Ordinarily the plunger would be reciprocated by a crank, and the valve sleeves would be actuated by eccentrics or cranks angularly displaced from the plunger operating crank by substantially 90°. Thus when the plunger is at mid-stroke, the valve sleeve is at one or the other limit of its motion, and vice versa. Actuating mechanisms of this type are standard in the art.

Referring first to Fig. 1, 5 represents a housing which together with the partition 19 forming a part thereof, defines a suction passage 6 which encircles the working space of the pump and a separate discharge passage 7 which also encircles the upper portion of the working space of the pump. Pressed into the housing 5 is a cylinder liner or bushing 8 in which the pump plunger 9 reciprocates. The plunger 9 makes a close sliding fit in the liner 8 and may be provided with packing means, though none is indicated in the drawings and none is strictly necessary. Formed in the upper end of the liner 8 are a series of auxiliary inlet ports 11 which lead from the suction passage 6 to the working space above the plunger 9 and are controlled by automatic valve means here conventionally represented as a simple ring valve 12.

Seating on the upper end of the liner 8, and sealing therewith, is a combined head and grid port structure comprising the head element proper 13, an annulus 14, and a second annulus 15, all connected together by a series of plate-like radial vanes 16. The annulus 15, whose form is clearly indicated in the drawings, encircles the upper end

of the liner 8 and seats thereagainst. The annulus 14 separates the main inlet ports 17 from the discharge ports 18. The inlet passages 6 are separated from the discharge passages 7 by the annular partition 19, above mentioned, and this partition 19 is sealed to the annulus 14 by means of an annular filler piece 21.

The above construction is adopted to facilitate assembly. The structure provides a working space having at its upper end an annular series of grid discharge ports 18 and below these an annular series of grid inlet ports 17. The grid ports 18 are controlled by an annular sleeve valve 22, the controlling edge of which is the lower edge. The grid ports 17 are controlled by an annular sleeve valve 23, the upper edge of which is the controlling edge. The sleeve valves 22 and 23 are connected together by rods 24 which pass through stuffing boxes 25 in the annular member 21.

It will be observed that the inlet and discharge ports open in alternation with each other and that when the inlet port is fully open, or substantially so, as indicated in Fig. 1, the sleeve valve 23 closes the auxiliary inlet ports 11. While I prefer complete closure of the ports 11, partial closure accelerates the closing movement of the automatic valve 12 and therefore attains a useful result.

The valves 22 and 23 are reciprocated by valve rods 26 which are actuated in harmony with each other by eccentrics on the crank shaft.

The two sleeve valves shown in Fig. 1 are what might be described as of the inside cut-off type, that is, the controlling edges of the two sleeve valves 22 and 23 are the proximate edges. This arrangement is essential if the sleeve valve 23 is to control the auxiliary inlet ports 11.

If this last feature is not desired, then the construction shown in Fig. 3 can be used. In this figure, the structure is similar to that described with reference to Fig. 1 and similar parts are identified by the reference numerals used in Fig. 1, differentiated by the letter a.

In Fig. 3, the upper or outer edge of the sleeve valve 22a is the controlling edge and the lower or outside edge of the sleeve valve 23a is the controlling edge. In other words, the sleeve valves are of the outside cut-off type. It follows that during the operation of the pump, motion of the sleeve valves in Fig. 3 is the reverse of the motion of the sleeve valves in Fig. 1. When the sleeve inlet valve of Fig. 3 is fully opened, no throttling of the auxiliary inlet ports 11a occurs. In fact these ports are never throttled by the sleeve valve 23a.

The structure illustrated in Fig. 3 has the advantage secured by using separate inlet and discharge sleeve valves but lacks the advantage secured by controlling the auxiliary inlet ports by the inlet sleeve valve. It is also inferior to the structure shown in Fig. 2 because the structure is necessarily higher, a very important point under certain conditions of installation.

In Fig. 2 a modified construction is shown in which automatic discharge valves of the ring type are substituted for the sleeve discharge valve shown in Fig. 1, but the sleeve inlet valve conforms to the arrangement shown in Fig. 1. In Fig. 2 a housing 5b defines the inlet passage 6b and the discharge passage 7b, the two being separated by an annular partition 19b. A liner 8b, similar to the liner 8, receives a reciprocating plunger 9b. There are auxiliary inlet ports 11b

controlled by an automatic inlet valve 12b. The head structure 13b is formed with annular ports controlled by automatic ring discharge valves, conventionally indicated at 27. Formed integrally with the head structure 13b are the radial vanes 16b which terminate in an annulus 15b similar in form and function to the annulus 15 of Fig. 1. There are grid inlet ports 17b which are controlled by a sleeve inlet valve 23b, which also controls the auxiliary inlet ports 11b. The inlet valve is actuated by valve rods 26b, similar to the valve rods 26 of Fig. 1.

The structure shown in Fig. 2 permits an arrangement which is even lower and more compact than that shown in Fig. 1, the advantage arising from the fact that the upper edge of the valve 23b is the controlling edge, so that the valve moves downward from the main inlet ports into the space occupied by the auxiliary inlet ports. The automatic discharge valve mechanism takes even less space than the sleeve discharge mechanism of Fig. 1 because it is unnecessary to provide lateral ports.

The feature of eliminating or minimizing the unbalanced pressure in the sleeve valve permits the use of the pump herein disclosed, with high discharge heads, while the feature of throttling the auxiliary inlet ports permits the use of higher speeds at high suction heads. As pointed out this last arrangement permits a reduction of overall height. Combination of the various features indicated in Fig. 1 allows the use of a high speed reciprocating pump with suction and discharge heads, each of which is high, and produces a very compact mechanism.

In the drawings, the construction has been simplified as much as possible in order to emphasize the principles of the invention, and it is to be understood that refinements of design well known in the art, may be resorted to without departing from the spirit of the invention. For example, while the automatic valves illustrated are of elemental simplicity, there is nothing in the invention which precludes the use of highly refined types of valve such as are well known in the art, and nothing to preclude the use of valve closing springs where their use is considered desirable. The use of such springs is not, however, a feature of the present invention, and therefore not illustrated.

What is claimed is:

1. In a liquid pump of the expansible chamber type, the combination of means forming a working space having spaced main inlet and discharge ports and an auxiliary inlet port; reciprocating liquid-displacing means for varying the volume of said working space; a reciprocable balance sleeve valve encircling said working space and controlling said discharge port; a reciprocable balanced sleeve valve encircling said working space and controlling said main inlet port, said valve serving to close said auxiliary inlet port at least partially when the main inlet port is fully open; a suction operated valve also controlling said auxiliary inlet port; and means connecting said sleeve valves to move in unison in such manner as to open the discharge and main inlet ports in alternation, said connecting means being substantially unaffected by the differential between suction and discharge pressures.

2. In a liquid pump of the expansible chamber type, the combination of means forming a working space having spaced inlets and discharge ports; reciprocating liquid-displacing means for varying the volume of said working space; a re-

reciprocable balanced sleeve valve encircling said working space and controlling said discharge port; a reciprocable balanced sleeve valve encircling said working space and controlling said inlet port; and means connecting said sleeve valves to move in unison in such manner as to open said discharge and inlet ports in alternation, said connecting means being substantially unaffected by the differential between inlet and discharge pressures.

3. In a liquid pump of the expansible chamber type, the combination of means forming a work space having spaced main inlet and discharge ports and an auxiliary inlet port; reciprocating liquid-displacing means for varying the volume of said working space; a reciprocable balanced sleeve valve encircling said working space and controlling said discharge port; a reciprocable balanced sleeve valve encircling said working space and controlling said main port; a suction operated valve controlling said auxiliary inlet port; and means connecting said sleeve valves to move in unison in such manner as to open said discharge and main inlet ports in alternation, said connecting means being substantially unaffected by the differential between inlet and discharge pressures.

4. In a liquid pump of the expansible chamber type, the combination of means forming a work-

ing space having spaced main inlet and discharge ports and an auxiliary inlet port; reciprocating liquid-displacing means for varying the volume of said working space; valve means controlling said discharge port; a reciprocable balanced sleeve valve encircling said working space and controlling said main inlet port, said valve serving to close said auxiliary inlet port at least partially when the main inlet port is fully open; a suction operated valve also controlling said auxiliary inlet port; and means substantially unaffected by the differential between inlet and discharge pressures for driving the discharge valve means from said balanced valve.

5. In a liquid pump of the expansible chamber type, the combination of means forming a working space having a discharge port and two series of peripheral inlet ports, one series being main inlet ports and the other being auxiliary inlet ports; valve means controlling the discharge ports; automatic valve means controlling said auxiliary inlet ports; and a balanced sleeve valve reciprocable to close said main and auxiliary inlet ports in alternation, whereby the space occupied by the series of auxiliary ports is availed of to accommodate motion of the sleeve valve, and the required space for the inlet valve mechanism is minimized.

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