No. 702,245. Patented June 10, 1902.

A. RADOVANOVIC.

PUMP.

(Application filed Jan. 18, 1902.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.

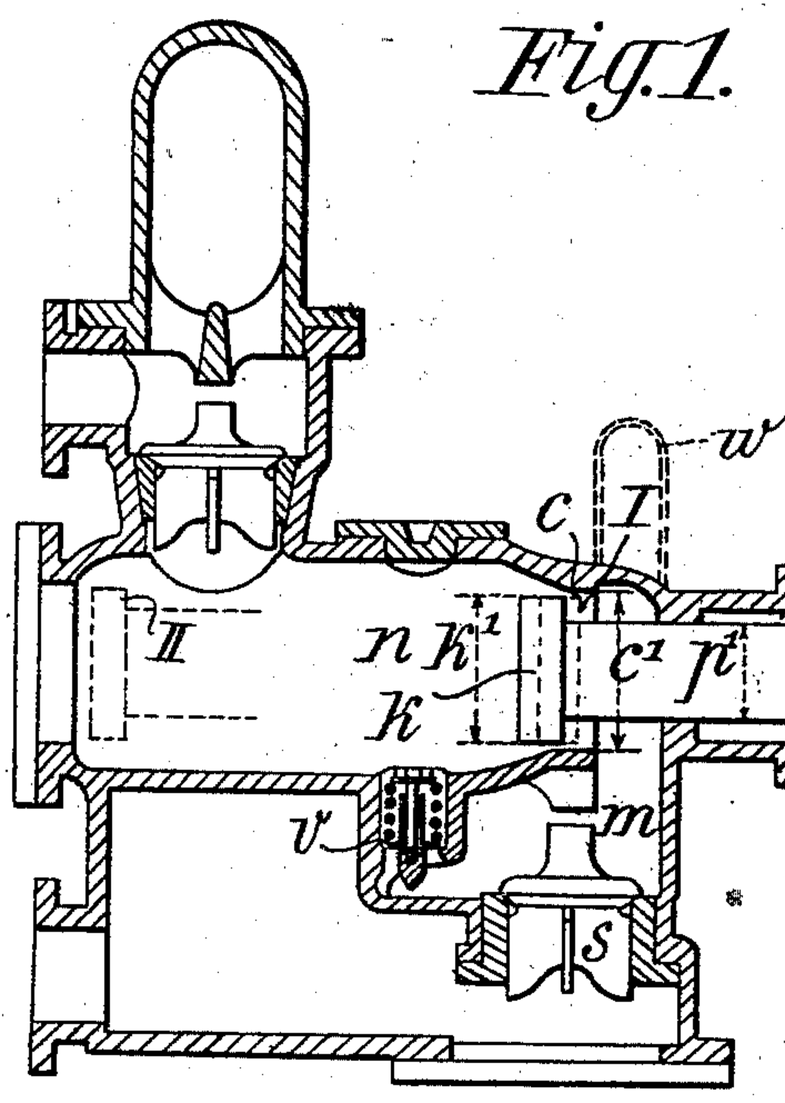


Fig. 2.

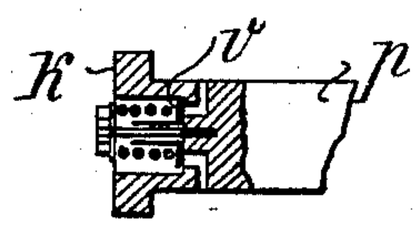


Fig. 8.

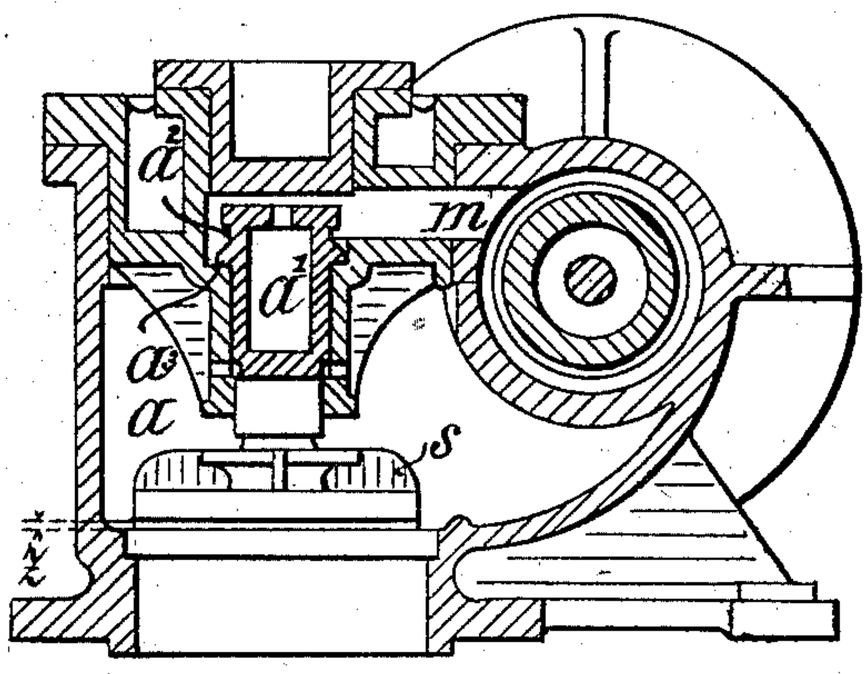


Fig. 4.

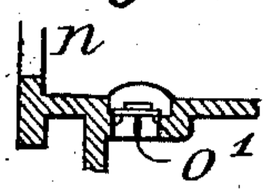
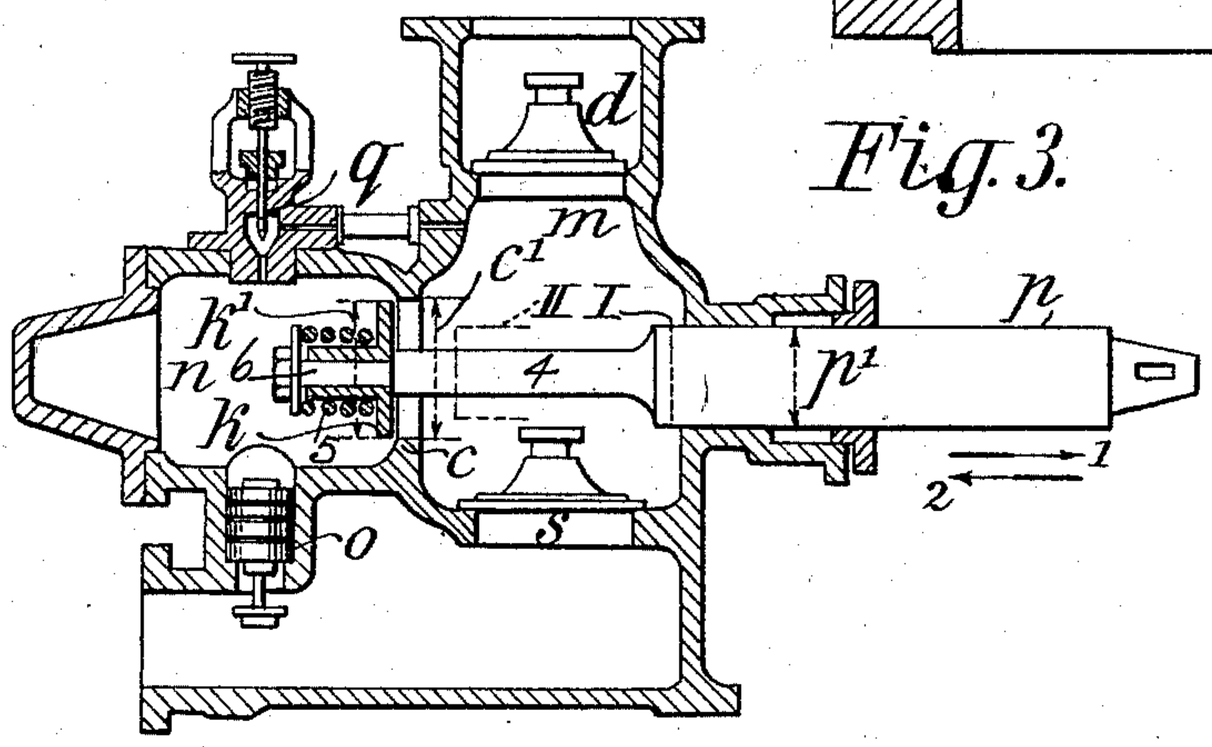


Fig. 3.



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(No Model.) 3 Sheets—Sheet 2.

Fig. 5.

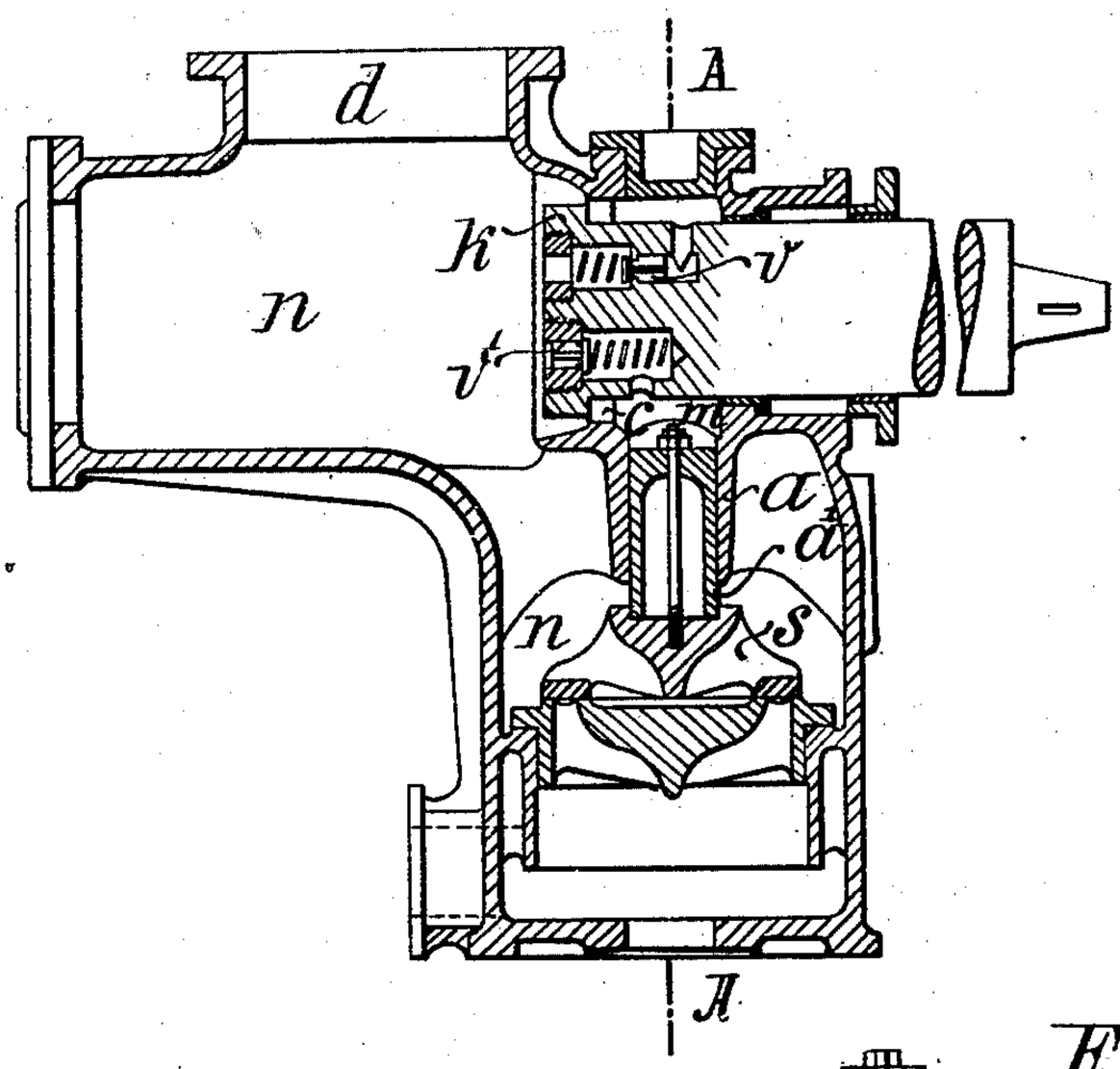


Fig. 6.

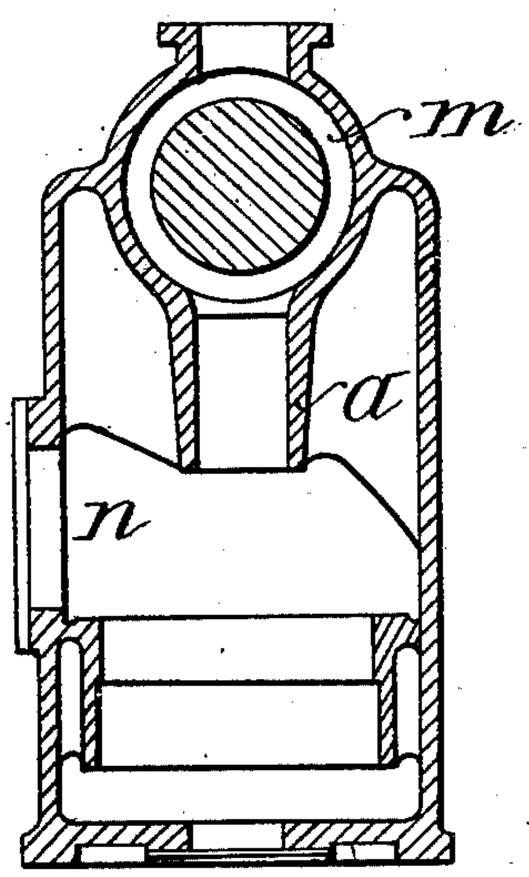


Fig. 10.

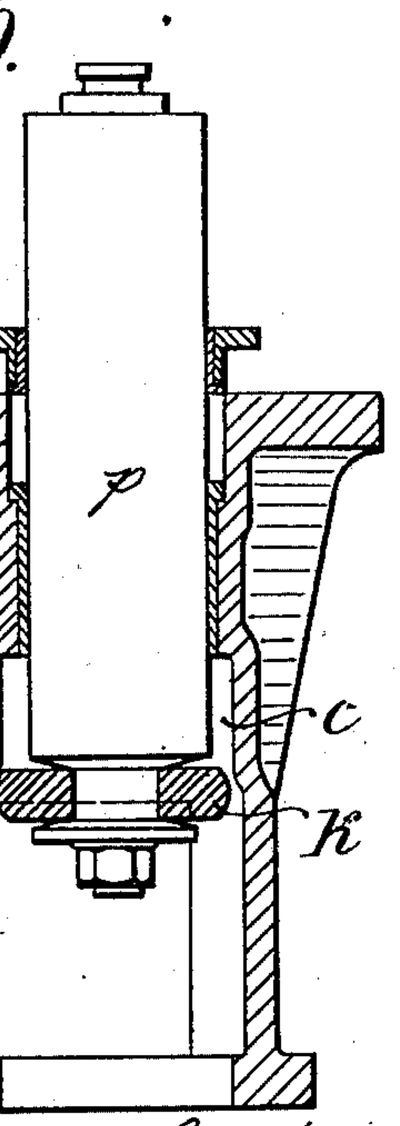


Fig. 7.

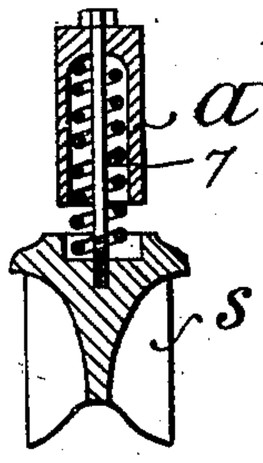
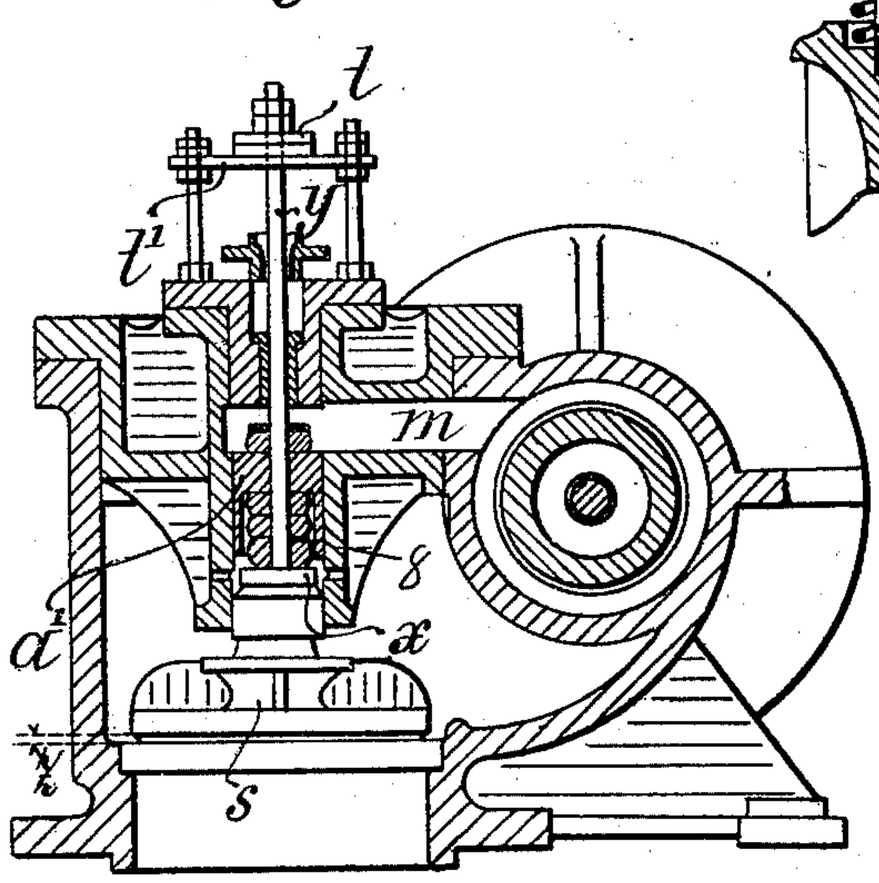


Fig. 9.



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No. 702,245. Patented June 10, 1902.

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PUMP.

(Application filed Jan. 18, 1902.)

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Fig. 11.

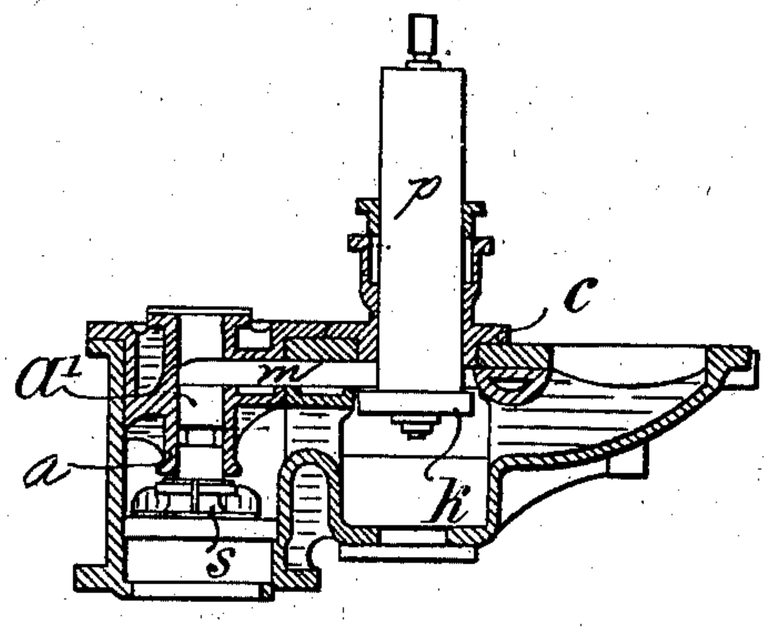


Fig. 12.

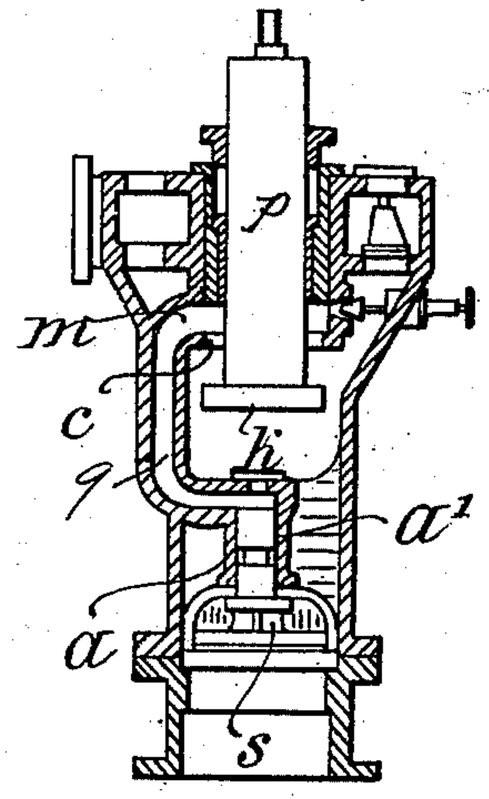


Fig. 13.

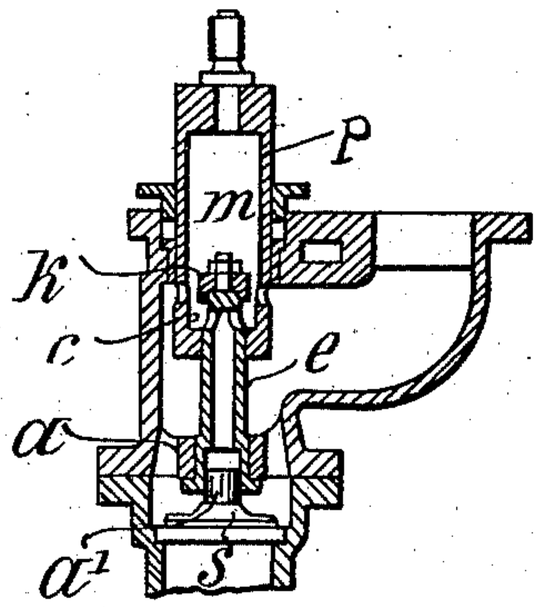
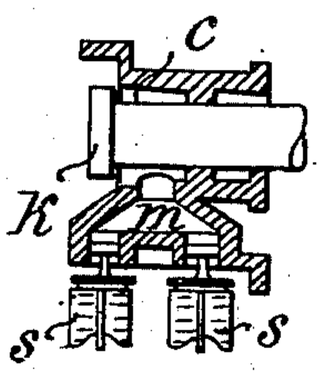


Fig. 14.



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UNITED STATES PATENT OFFICE.

ANDREAS RADOVANOVIC, OF ZURICH, SWITZERLAND.

PUMP.

SPECIFICATION forming part of Letters Patent No. 702,245, dated June 10, 1902.

Application filed January 18, 1902. Serial No. 90,342. (No model.)

To all whom it may concern:

Be it known that I, ANDREAS RADOVANOVIC, a subject of the Emperor of Austria-Hungary, residing at Zurich, Switzerland, have invented certain new and useful Improvements in Pumps; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters and figures of reference marked thereon, which form a part of this specification.

This invention relates to means for closing the suction-valves of plunger-pumps by hydraulic pressure, so as to prevent the valves from hammering when the pumps are running at high speed.

Referring to the drawings, in which like parts are similarly designated, I have shown several forms of plunger-pumps made in accordance with this invention.

Figure 1 is a vertical longitudinal section showing the enlargement or head *k*, forming part of the main plunger. Fig. 2 is a sectional detail view of a modified form of the enlargement or head. Fig. 3 is a vertical longitudinal section showing a modified structure provided with relief-valves. Fig. 4 is a detail view of one of the valves capable of being used in connection with the structure shown in Fig. 3. Fig. 5 is a vertical longitudinal section showing a suction-valve controlled by an auxiliary piston. Fig. 6 is a section taken on line A A, Fig. 5, the valve *s* and piston *a'* being removed; Fig. 7, a section of a modification of the suction-valve-controlling piston, shown in Fig. 5. Fig. 8 is a vertical cross-section showing a suction-valve located to one side of the plunger. Fig. 9 is a similar view of a modification. Fig. 10 is a horizontal section of a pump shown in Fig. 8; Fig. 11, a longitudinal section showing both suction-valve and plunger moved vertically; Fig. 12, a like view where valve and plunger are coaxial. Fig. 13 is a vertical section of a vertically-moving plunger having a modified form of enlargement or head. Fig. 14 is a partial longitudinal sectional view showing a plurality of suction-valves.

In all the figures, *p* is the main plunger, and *k* is the enlargement or head, either forming part of, connected to, or coöperating with the main plunger, and *s* is the suction valve or valves, through which water enters directly or indirectly to the pump-chamber.

In the example shown in Fig. 1 the plunger *p*, which is moved between its extreme position I and II during the suction stroke in the direction indicated by the arrow 1 and during the delivery-stroke in the direction indicated by the arrow 2 is provided at its inner end with an enlargement or head *k*, forming part thereof, whose diameter *k'* is greater than that *p'* of the plunger *p*, which passes through the stuffing-box 3. The enlargement or head *k* enters shortly before the end of the suction stroke into a short cylinder *c*, which separates a chamber *m*, containing the suction-valve, from the pump-chamber *n*, and which cylinder *c* is only slightly greater than the diameter *k'* of the enlargement. In Fig. 1 the enlargement is shown as just commencing to enter the cylinder *c*. When the enlargement *k* enters the cylinder *c*, hydrostatic pressure is produced in the valve-chamber *m*, as the liquid displaced by the enlargement can escape from the chamber *m* into the chamber *n* only through the space left between the plunger-head *k* and the cylinder *c* and is greatly throttled in passing. The pressure thus produced presses the suction-valve *s* to its seat.

In order to prevent the pressure in the chamber *m* from being suddenly produced—*i. e.*, with a shock—the chamber *n* is contracted or reduced toward the short cylinder *c*, so that when the plunger-head *k* is about to enter the cylinder *c* the throttling of the passing liquid, and consequently the pressure in the chamber *m*, commences gradually and the suction-valve is closed without a shock. The same result might be obtained by placing over the chamber *m*, as indicated in dotted lines in Fig. 1, an air chamber or vessel *w*, in which a quantity of air would be compressed. To prevent an excessive pressure in the chamber *m*, I provide a relief-valve *v* either in the pump-cylinder, Fig. 1, or on the plunger, Fig. 2, suitably loaded, so that it will open into the pump-chamber *n* when the pressure in said chamber *m* exceeds a predetermined limit, thus providing a larger area for the passage of liquid from chamber *m* to that *n*.

In the example shown in Fig. 3 the enlargement or head k is slidable on the end of a reduced extremity 4 of the plunger p and acts itself as a safety-valve. A spring 5 holds the enlargement or head normally against a shoulder between the reduced portion 4 and the spindle end 6, on which said plunger is threaded. The same figure shows also a controllable overflow-valve q, located and controlling communication of fluid between the chambers m and n.

The delivery-valve d of the pump may be arranged either over the chamber m, as shown in Fig. 3, or over the chamber n, as desired.

By suitably choosing the time when the plunger-head k is to enter the short cylinder c, by making their relative diameters c' and k' of suitable size, by properly loading the safety-valve, and finally by suitably adjusting the overflow-valve q the commencement of the pressure in the suction-valve chamber and its amount can be regulated in such a way that the suction-valve is closed without shock immediately before or exactly on the dead-point. If, however, the suction-valve closes before the end of the stroke of the plunger, a partial vacuum will be produced in the chamber n during the remainder of the stroke of the plunger. To prevent such a partial vacuum from being formed, there is arranged in the chamber n either a small auxiliary suction-valve o', Fig. 4, which opens into the chamber n from the suction-pipe of the pump, or a suitable loaded piston o, Fig. 3. The former allows liquid to enter the chamber n and the latter itself moves into the chamber n to a sufficient extent to fill a space equivalent to the displacement of the remainder of the plunger, and thus prevent the formation of a vacuum.

Fig. 5 is a longitudinal section, and Fig. 6 a cross-section corresponding to the line A A of Fig. 5, the valve s and piston a' being removed, of a plunger-pump, in which the chamber m, which the plunger-head enters at the end of the suction-stroke, is separated from the pump-chamber n, into which the suction-valve opens by an intermediate cylinder a, that contains a piston a', connected to the suction-valve s.

The hydrostatic pressure which is produced when the head enters the cylinder c acts upon the valve-seating piston a' to press it and the connected suction-valve s upon its seat. The suction-valve is therefore closed, not by a pressure acting directly upon it, but by means of a piston a', which receives the hydrostatic pressure in the chamber m. When the suction-valve closes, there is therefore no hydrostatic pressure upon it, so that suction can still take place during the closing movement of the suction-valve.

The valve-seating piston a' can be connected to the suction-valve either rigidly, as shown in Fig. 5, or elastically, as shown in Fig. 7, where a spring 7 is interposed between said piston a' and valve s, as shown. To prevent the occurrence of excessive pressure or the formation of a vacuum in the chamber m, valves v and v', opening in opposite directions, are arranged in the plunger-head.

Plunger-pumps may be so constructed according to this invention that the suction-valve will not be pressed quite up to its seat, but will be pressed to within a short distance therefrom. Examples of such pumps are shown in Figs. 8 to 13, of which Figs. 8 and 9 are vertical sections of pumps with suction-valves situated somewhat to the side of the plunger, and Fig. 10 is a horizontal section of the pump shown in Fig. 8.

In the example shown in Fig. 11 the suction-valve is at one side of and parallel to the axis of the plunger of the pump, and in those shown in Figs. 12 and 13 the suction-valves are coaxial with the plungers.

The valve-seating piston a', Figs. 8 and 9, bears on the valve s, but is not attached thereto. Its movement toward the valve under the pressure produced in the chamber m by the entrance of the plunger-head k into the cylinder c is limited, as shown in Fig. 8, by a collar a^2, which bears against a corresponding surface a^3 on the cylinder a. In the example shown in Fig. 9 the piston a' presses by means of an elastic buffer 8 against a disk x on a rod y, which is provided at the top with an adjustable disk t, that abuts against a cross-bar t', and thereby limits the downward movement of the disk x. By this means the valve s is not pressed quite down on its seat by the pressure in the chamber m, but is brought to a short distance z thereof, so that when it closes at the beginning of the delivery-stroke it has only to move through this distance. The stroke of the piston a' can be limited in any other suitable manner.

The head k, Fig. 10, is a flexible plate, and can therefore act as a safety-valve to allow the passage of fluid between it and the walls of the short chamber c. The buffer shown in Fig. 9 between the piston a' and the valve s can also serve the same purpose.

The relative positions of the suction-valve and the axis of the plunger of the pump can be arranged as desired. Thus the valve s can be arranged at the side of the plunger and with its axis parallel thereto, as shown in Fig. 11, or coaxial with the plunger, as shown in Figs. 12 and 13. In the former figure there is a by-pass 9, forming part of and leading from the chamber m to the cylinder a. Fig. 13 shows an arrangement in which the cylinder c is formed in the hollow plunger p, while the enlargement k is mounted on a stationary hollow rod e, through which the hydrostatic pressure is transmitted to the piston a'.

Instead of one valve s, several may be arranged in the chamber m, as shown in Fig. 14.

The pump itself may be of any desired construction and may be a single-acting, double-acting, or differential pump. The valves may likewise be of any suitable kind.

Having thus described my invention, what I claim as new therein, and desire to secure by Letters Patent, is—

1. In a pump, the combination with the pump-chamber, suction-valve and chamber, and a short cylinder interposed between them, of a plunger having an enlargement thereon to move in the pump-chamber and cylinder, whereby hydrostatic pressure is produced in the suction-valve chamber to seat said valve, substantially as described.

2. In a pump, the combination with the pump-chamber, suction-valve and chamber, and a short cylinder interposed between them, of a plunger having an enlargement thereon adapted to move into the short cylinder and vent fluid from the latter to the former chamber and communicate hydrostatic pressure to said valve, substantially as described.

3. In a pump, the combination with a pump-chamber having a reduced end, a suction-valve chamber and valve therein, and a short cylinder between the reduced end of the pump-chamber and valve-chamber; of a plunger and an enlargement on the end thereof to move in the pump-chamber and cylinder, to coöperate with the reduced end of the pump-chamber and cylinder to produce hydrostatic pressure on the suction-valve, substantially as and for the purpose set forth.

4. In a pump, the combination with the pump-chamber, suction-valve and chamber, and a short cylinder between the two chambers, of a plunger, an enlargement thereon coöperating with the short cylinder to vent liquid between the two chambers and produce hydrostatic pressure on the suction-valve, and means to prevent the formation of a partial vacuum in the pump by reason of the displacement of the plunger, substantially as described.

5. In a pump, the combination with the pump-chamber, suction-valve and chamber, and a cylinder between the two chambers, of a plunger, an enlargement thereon coöperating with the cylinder to vent liquid between the two chambers and produce hydrostatic pressure on the suction-valve, and auxiliary means to vent fluid between the two chambers, substantially as described.

6. In a pump, the combination with the pump-chamber, suction-valve and chamber, and a cylinder between the two chambers, of a plunger, an enlargement thereon coöperating with the cylinder to vent fluid between the two chambers and produce hydrostatic pressure on the suction-valve, auxiliary means to vent fluid between the two chambers and means to prevent the formation of a partial vacuum in the pump, substantially as described.

7. In a pump, the combination with the pump-chamber, suction-valve and chamber, and a cylinder between the two chambers, of a plunger, an enlargement thereon coöperating with the cylinder to vent fluid between the two chambers and produce hydrostatic pressure on the suction-valve, and auxiliary means on the enlargement to vent fluid between the two chambers, substantially as described.

8. In a pump, the combination with the pump-chamber, suction-valve and chamber and a short cylinder between the two chambers; of a plunger, a yielding enlargement on the plunger coöperating with the cylinder to vent fluid between the two chambers and produce hydrostatic pressure on the suction-valve, and auxiliary valve-controlled means to vent fluid between the two chambers, substantially as and for the purpose set forth.

9. In a pump, the combination with the pump-chamber, suction-valve and chamber and a short cylinder between the two chambers; of a plunger having a reduced end and a spring-held enlargement on the end thereof coöperating with the cylinder to vent fluid between the two chambers and produce hydrostatic pressure on the suction-valve, substantially as and for the purpose set forth.

10. In a pump, the combination with the pump-chamber, suction-valve and chamber, and a short cylinder interposed between them, of a plunger and an enlargement thereon adapted to yield to a predetermined fluid-pressure, whereby hydrostatic pressure is produced in the suction-valve chamber to seat said valve, substantially as described.

11. In a pump, the combination with the pump-chamber, suction-valve and chamber, and a short cylinder between the two chambers; of a plunger having a reduced end, a spring-held enlargement on the end of the reduced portion coöperating with the cylinder to vent fluid between the two chambers and produce hydrostatic pressure on the suction-valve, auxiliary valve-controlled means to vent fluid between the two chambers, and an auxiliary piston adapted to move into the pump-chamber to prevent the formation of a vacuum therein, substantially as and for the purposes set forth.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

ANDREAS RADOVANOVIC.

Witnesses:
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EDUARD BRÁNEY.