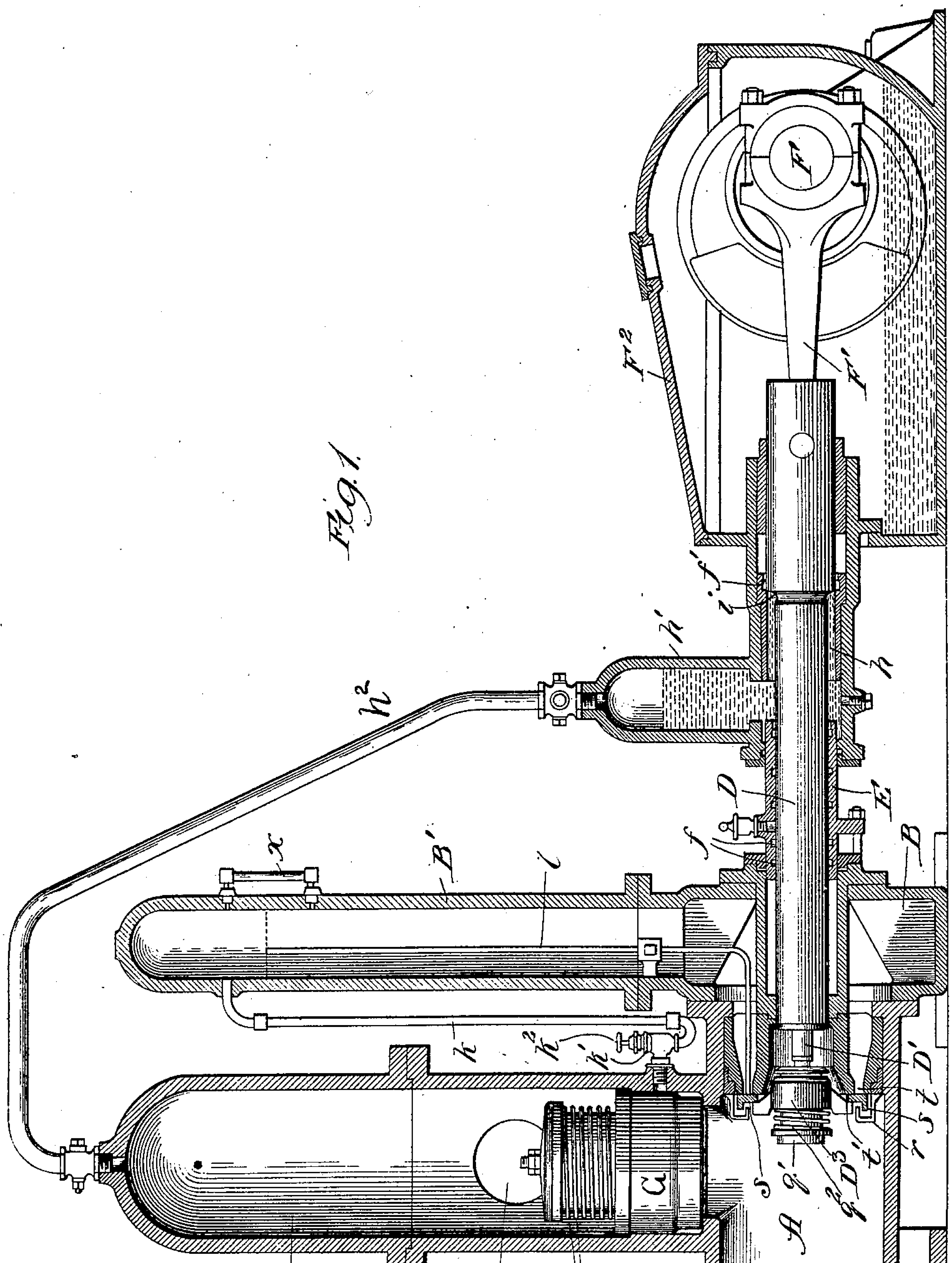
No. 632,001. Patented Aug. 29, 1899.

J. STUMPF.

HIGH SPEED PUMP.

(Application filed Aug. 31, 1898.)

(No Model.) 3 Sheets—Sheet 1.



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(No Model.) 3 Sheets—Sheet 2.

Fig. 2.

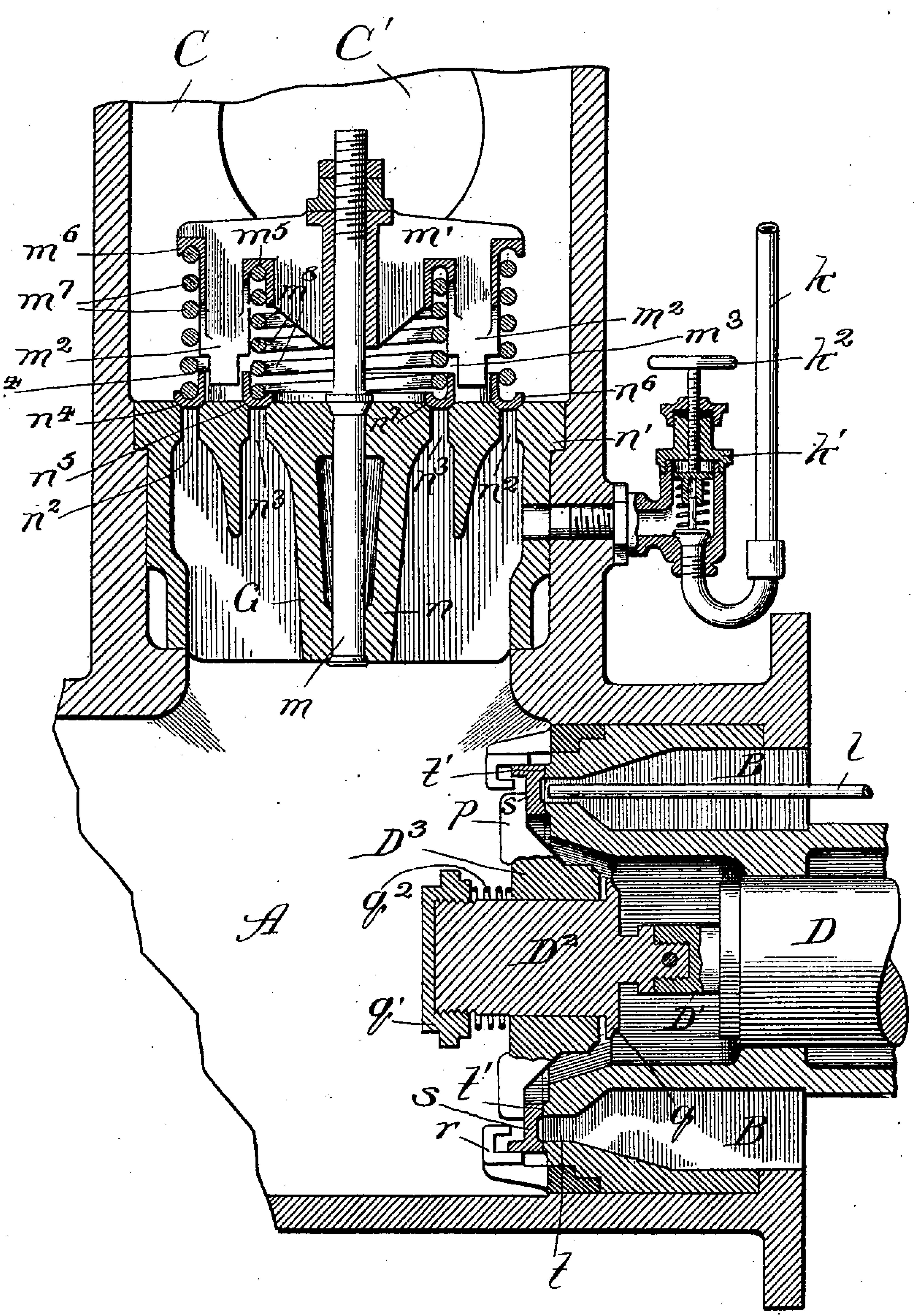

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Fig. 3

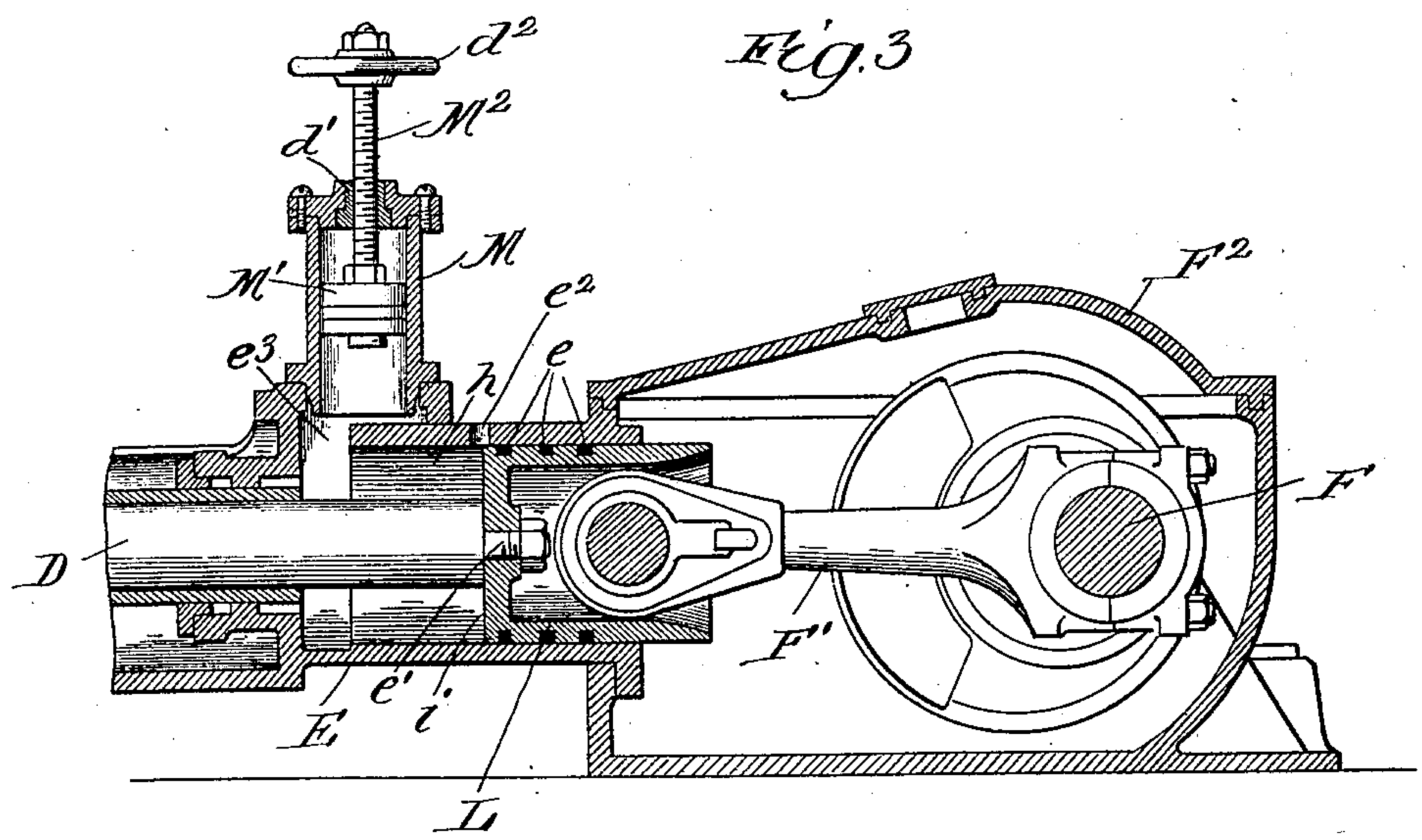
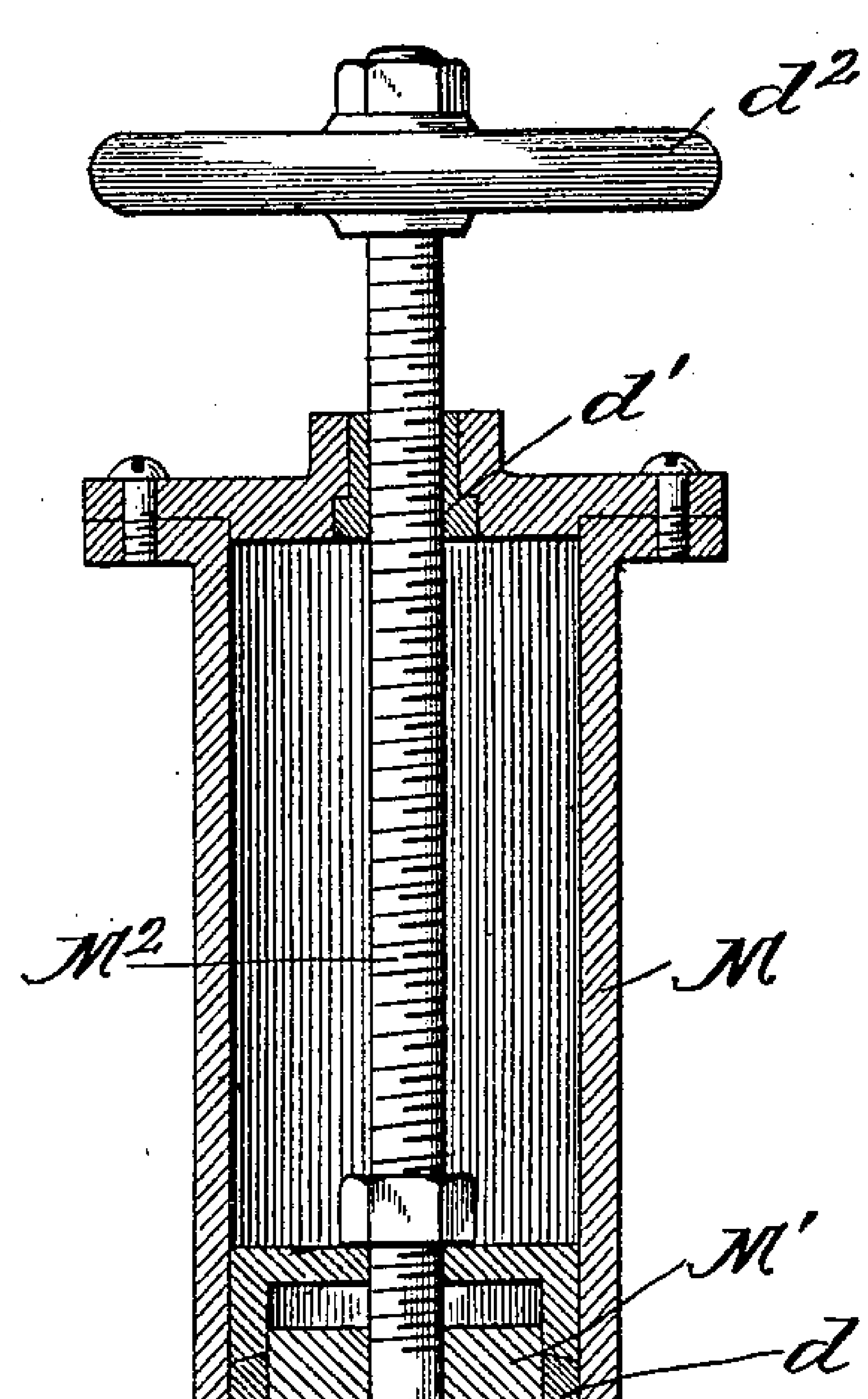


Fig. 4



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UNITED STATES PATENT OFFICE.

JOHN STUMPF, OF BERLIN, GERMANY.

HIGH-SPEED PUMP.

SPECIFICATION forming part of Letters Patent No. 632,001, dated August 29, 1899.

Application filed August 31, 1898. Serial No. 689,925. (No model.)

To all whom it may concern:

Be it known that I, JOHN STUMPF, a subject of the Emperor of Germany, residing at Berlin, Germany, have invented certain new and useful Improvements in High-Speed Pumps, (for which I have filed applications for patents in foreign countries as follows: Germany, February 8, 1898; England, May 13, 1898; Denmark, February 26, 1898; Italy, May 30, 1898; Hungary, May 8, 1898; Russia, May 13, 1898; Sweden, May 10, 1898; Norway, May 18, 1898; Spain, June 6, 1898; Switzerland, May 16, 1898; Austria, March 23, 1898; Belgium, March 2, 1898, and France, February 26, 1898;) 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 the letters of reference marked thereon, which form a part of this specification.

My invention relates to improvements in the construction of hydraulic pumps, adapting them to be operated effectively at high speed, say at the rate of from three hundred to five hundred revolutions or strokes per minute. Such a high rate of speed is desirable where, for example, the pump is coupled immediately to an electric motor without interposed speed-reducing mechanism.

My object is to provide a pump so constructed that when running at a very high speed each stroke of the piston or plunger will cause the inflow and discharge of the full complement of fluid, and my object is further to provide means for avoiding any change of pressure upon the joints of the plunger-operating mechanism.

In the drawings, Figure 1 is a longitudinal section of a pump constructed to operate at high speed and provided with my improvements; Fig. 2, an enlarged broken section through the pump suction and discharge valves; Fig. 3, a broken view showing another form of mechanism for avoiding change in the direction of pressure upon the joints of the plunger-operating mechanism, and Fig. 4 an enlarged section of the air-cylinder or governing-chamber shown in Fig. 3.

A is the suction and fore chamber of the pump, B a water-supplying chamber, and C the pressure-dome or air-chamber at the discharge side of the pump.

D is a plunger working in a horizontal guide-cylinder E, which extends through the chamber B.

Around the cylinder B, at the chamber A, is an annular port t, which is surrounded in the chamber A by an annular valve-seat t', upon which fits a movable ring or annular valve s. At intervals around the suction-valve s are stationary brackets r, which limit the lift or movement of the valve from its seat.

The plunger D is reciprocated from a crank F through the medium of a connecting-rod F'. The crank and crank-driver are incased in a close housing F^2 to provide for good retention of the lubricant. At the inner end of the plunger D is an extension-rod D', carrying a cylindrical head D^2, provided at its end adjacent to the rod D' with an annular stop or shoulder q. On the cylindrical head D^2 is a sliding sleeve or collar D^3, provided with a series of radially-extending arms p, adapted to impinge against the suction-valve s, as hereinafter described. Screwed upon the outer end of the head D^2 is a cap or stop q', and surrounding the head and confined between the stop q' and sleeve or collar D^3 is a spring q^2, which tends normally to press the sleeve D^3 against the stop q.

In the lower end of the air-chamber C, at the opening between the same and the chamber A, is a stationary chambered plug-piece G, provided with a central boss n and a top n', provided with two annular and concentric series of openings n^2 n^3, respectively, opening at their upper ends into annular concentric recesses n^4 n^5, respectively, in the upper surface of the plug, forming valve-seats. Fastened upon a bolt m, which passes through the plug G, is a head m', formed with a series of downward-extending parts m^2, forming at their ends inner and outer concentric valve-guides m^3 m^4, respectively. At the upper end of the part m^2 are inner and outer concentric sockets m^5 m^6, respectively. Fitting upon the valve-seat n^4 is a valve-ring n^6, which slides upon the guide m^4, and fitting upon the seat n^5 is a valve-ring n^7, which slides upon the guide m^3. Surrounding the parts m^2 and bearing in the socket m^6 is a spring m^7, which bears upon the valve n^6 and presses it normally upon its seat; and at the inner side of the parts m^2 is a spring m^8, which at its upper end bears in the socket m^5 and at its lower end bears upon the valve n^7 to press it normally against the seat n^5.

When the plunger D is in the position shown in the figures, the radial arms p on the yielding collar D^3 bear against the ring-valve s and press it against the seat t'. In the movement of the plunger to the left in the figures to discharge liquid from the chamber A the arms p leave the ring-valve s, which is held to its seat by the pressure of the liquid. This movement of the plunger forces liquid from the chamber A upward through the openings or discharge-ports n^2 n^3, lifting the valves n^4 n^5 against the resistance of the springs m^7 m^8. The liquid thus discharged into the air-chamber C compresses the air therein and is discharged through the outlet C'. When the plunger reaches the end of its discharge-stroke, the springs m^7 m^8 seat the valves n^4 n^5, and in the backward movement or suction-stroke of the plunger liquid is drawn into the chamber A through the annular port t from the chamber B, which communicates with the water-supply. When the pressure is taken off the liquid by the initial return movement of the plunger, the valve s is lifted or opened by the pressure from the chamber B until it strikes the stops presented by the brackets r. As the plunger nears the end of its suction-stroke the radial arms p engage the valve s and press it to its seat, at the same time slightly compressing the spring q^2. The valve-closing mechanism described is especially desirable in connection with a "suction lift-valve," by which is meant a suction-valve which "lifts" from or moves out of contact with its seat to open as distinguished from a slide-valve which moves along its seat to open or close. My object is by my construction more especially to prevent shock or jar in the closing of suction lift-valves.

In order that the pump may work to its full capacity in each stroke of the plunger, it is necessary that the chamber A shall be filled with liquid in each suction-stroke of the plunger; in other words, that as much liquid shall enter the chamber in the suction-stroke as will occupy the space displaced by the plunger. This requires that the liquid shall enter through the port t with sufficient force and rapidity to fill the chamber A with the same rapidity as the plunger D recedes therefrom. To accomplish this rapid filling of the chamber A when the pump is running at high speed, I provide upon the inlet-chamber B a reservoir or suction air-chamber B' of a height exceeding materially that of the discharge-valves n^6 n^7. By preference the suction air-chamber is of about the same height as the discharge air-chamber C. The liquid entering the chamber B rises in the air-chamber B' to present a liquid column so high that by its weight it will produce sudden opening of the valve s and insure rapid filling of the chamber A during the suction-stroke of the plunger. The height of the liquid column in the chamber B' is maintained by an ejector-pipe l, which extends from near the top of the chamber B' to a point directly beneath or behind the suction-valve s at the annular port t. The flow of liquid at the mouth of the pipe l effects continual sucking off of the air from the upper part of the chamber B', thereby maintaining the same height of the liquid column. In order that the air may be sucked rapidly from the air-chamber B', as when the pump is initially started and the accumulation of air in the chamber B' has lowered the column below the top of the ejector-pipe l, I provide a supplemental air-suction pipe k, extending from near the top of said chamber to the chamber A, near the outlet-ports n^2 n^3, as shown. Interposed in the pipe k is a check-valve k', which may be of the form shown in Fig. 2, which seats in the direction of the chamber B'. By means of a handle k^2 the valve may be pressed firmly against its seat to remain permanently closed. By screwing up the handle k^2 the pressure upon the valve may be released, so that in the suction-stroke of the plunger D air will be drawn through the pipe k from the top of the chamber B', while none can return to said chamber in the discharge-stroke of the plunger. When the liquid column is of the proper height in the chamber B', as may be determined at the gage x, the vavle k' may be permanently closed, or if the ejector-pipe l is not employed or will not draw off the air as fast as it accumulates the valve k' may be left open to a more or less slight extent.

The gist of this part of my invention lies in providing a water column on the suction side of the pump in an air-chamber closed at the top to provide a head of liquid which by its weight will produce rapid opening of the suction-valve and quick filling of the suction and discharge chamber of the pump and in providing means for drawing off the air from the said suction air-chamber to maintain the liquid column at the proper height, and my invention includes drawing off the air through an ejector-pipe, as the pipe l, or suction-pipe, as the pipe k, extending to the suction and discharge chamber of the pump, or both. The permanently high liquid column maintained in the suction air-chamber by its weight effects the necessary rapid opening of the suction-valve and rapid filling of the chamber A to cause the full complement of liquid to enter and be discharged from the chamber A in each stroke of the plunger when the latter is moving at very high speed.

In the construction shown in Fig. 1 the plunger D is thickened toward its outer or rear end to establish a ring-surface i. The guide-cylinder E is enlarged along its outer end portion to produce a chamber h, the forward end of which terminates in an oil chamber or cup h', communicating through a pipe

h^2 with the top of the dome or discharge air-chamber C. Between the cup h' and the chamber A the cylinder E is provided with inner annular grooves f, forming a water sealing, and at the rear end of the chamber h the enlarged part of the cylinder E is provided with a bushing or stuffing f' to seal it around the plunger against the escape of air. The chamber or oil-cup h' is partly filled with oil which lubricates the plunger. In the forward or discharge stroke of the plunger the ring-surface i forces oil back into the cup h', which latter exerts pressure against the air in the upper part of the cup and pipe h^2 and dome C. In the return or suction stroke of the plunger the expansion of the air in the dome C, pipe h^2, and cup h' exerts force against the said ring-surface to assist in the movement of the plunger. Thus the force against the ring-surface overbalances any suction action against the plunger and the inertia of the moving parts in a manner to prevent jar upon the joints of moving parts and to cause the pump to run smoothly. The air in the chamber h forms a fluid resistance medium interposed in the path of the abutment formed by the ring-surface i. Thus there will be no change in the direction of pressure of the plunger against the plunger-actuating mechanism. In practice the ring-surface or abutment i should be of the proper area to permit the resisting fluid in the chamber h to overcome the greatest inertia of the reciprocating parts under the acceleration of speed as well as the resistance due to the suction action upon the plunger. All connecting-pins, bearing-boxes, &c., will thus be caused to rest against one another under the pressure against the abutment, so that the joints and bearings will never jar in the running of the pump.

In Figs. 3 and 4 I have shown another means for providing a fluid resistance medium in the path of the abutment. In this construction I provide upon the end of the plunger D, to move therewith, a piston L, working in the chamber h and provided with packing-rings e, as shown. The piston is rigidly secured to the plunger D, as by means of the nut and bolt e' or in any other suitable way and is pivotally connected with the connecting-rod F', as shown. In the side of the chamber or cylinder h is an air-inlet opening e^2. At e^3 is an opening surmounted by a cylinder or air-fluid-pressure-governing chamber M. In the cylinder M is a piston M', provided with a suitable packing d, which causes the piston to fit the cylinder closely. The piston is upon a threaded stem M^2, which passes through an internally-threaded nut d' in the top of the cylinder, beyond which it is provided with a handle or hand-wheel d^2. By turning the handle d^2 the piston M' may be raised and lowered in the cylinder to increase or diminish the space therein. The cylinder M takes the place of the oil chamber or cup h' and the pipe connection h^2 with the dome C. In the suction-stroke of the plunger the piston L is moved to the position shown in Fig. 3, wherein it uncovers the inlet e^2, and in the discharge-stroke of the plunger the abutment i is moved to compress the air in the chamber h, which by offering resistance tends to press the moving parts in the direction of the crank F, and thus prevent play of the joints or jarring when the plunger changes to the suction-stroke. Each time the plunger reaches the end of its suction-stroke the port e^2 is uncovered, so that in the event of any leakage of air from the chamber h it will be immediately replenished to atmospheric pressure. The resistance of the air in the chamber h to the abutment i may be increased or diminished by lowering or raising the piston M', which thus forms a means for governing the resistance. In practice when the pump is first started the piston may be raised to the top of the cylinder M to cause the air to offer comparatively little resistance to the discharge-stroke of the plunger, and when the pump is at full speed the piston M' may be lowered to increase the resistance of the air to a point where it will give the proper back pressure and thus prevent jarring of the joints, as stated. While in Fig. 1 the oil-cup construction tends to contribute perfect lubrication to the parts, no means are shown for changing the pressure of the fluid resistance medium. The means shown in Figs. 3 and 4 for governing or controlling the resistance of the fluid medium is an advantage in many cases, and for that reason it may be regarded as the preferred construction.

While I prefer to construct and apply my improvements as shown and described, the details may be variously modified without departing from the spirit of my invention as defined by the claims.

What I claim as new, and desire to secure by Letters Patent, is—

1. In a liquid-pump, the combination with a suction air-chamber communicating with the suction-pipe and with the inlet of the pump suction and discharge chamber, of an exhaust-conduit leading at one end from the suction air-chamber and exposed, for its discharge, at the opposite end to the suction action of the pump-plunger, substantially as and for the purpose set forth.

2. In a liquid-pump, the combination with the suction and discharge chamber, the suction and discharge valves, and the plunger working in said chamber, of a suction air-chamber at the outer side of the suction-valve, means for maintaining a column of the liquid in said air-chamber to a level materially exceeding the height of the said discharge-valve, and air-exhausting means comprising an ejector-pipe extending from the upper end portion of said air-chamber and terminating close to the inlet-port of the said suction and discharge chamber, substantially as and for the purpose set forth.

3. In a liquid-pump, the combination with

the suction and discharge chamber, the suction and discharge valves, and the plunger working in said chamber, of a suction air-chamber at the outer side of the suction-valve, means for maintaining a column of the liquid in said air-chamber to a level materially exceeding the height of the said discharge-valve, and air-exhausting means comprising a pipe extending from the upper end portion of said air-chamber to the said suction and discharge chamber, and a check-valve interposed in said pipe, substantially as and for the purpose set forth.

4. In a liquid-pump, the combination with the suction and discharge chamber, the suction and discharge valves, and the plunger working in said chamber, of an inlet-chamber B communicating with the suction and discharge chamber through a suction-port *t* at the said suction-valve, a chamber B′ on the chamber B extending to a height materially above the height of the said discharge-valve, means for maintaining a column of the liquid in the chamber B′ to a level materially exceeding the height of the said discharge-valve, and an air-exhaust conduit leading at one end from the upper part of the chamber B′ and exposed, for its discharge, at the opposite end to the suction action of said plunger, substantially as and for the purpose set forth.

5. In a liquid-pump, the combination with the suction and discharge chamber, and the discharge-valve, of a plunger-cylinder extending to said chamber, an inlet-port around said cylinder for the chamber, a ring-valve seating upon said port, a plunger in the cylinder movable into and out of the suction and discharge chamber through the said ring-valve, and means upon the plunger for engaging and seating said valve in the movement of the plunger to the end of its suction stroke, substantially as and for the purpose set forth.

6. In a liquid-pump, the combination with the suction and discharge chamber, and the discharge-valve, of a plunger-cylinder extending to said chamber, an inlet-port around said cylinder for the chamber, a ring-valve seating upon said port, a plunger in the cylinder movable into and out of the suction and discharge chamber through the said ring-valve, and means for closing the said ring-valve in the movement of the plunger to the end of its suction stroke, comprising a yielding head upon the inner end of the plunger having ring-engaging projections, substantially as and for the purpose set forth.

7. In a pump, the combination with the suction and discharge chamber and a suction lift-valve, of a pump-plunger separate from the suction-valve and means upon said plunger within said chamber for seating the suction-valve in the movement of the plunger toward the end of its suction stroke, substantially as and for the purpose set forth.

8. In a pump, the combination with the suction and discharge chamber and an annular suction lift-valve, of a pump-plunger separate from the suction-valve and means upon the plunger within said chamber for seating the suction-valve in the movement of the plunger toward the end of its suction stroke, substantially as and for the purpose set forth.

9. In a pump, the combination with the suction and discharge chamber and a suction lift-valve, of a pump-plunger separate from the suction-valve and means for seating the suction-valve in the movement of the plunger toward the end of its suction stroke, comprising a yielding head upon the plunger within said chamber having valve-engaging projections, substantially as and for the purpose set forth.

In witness whereof I have hereunto signed my name, this 5th day of August, 1898, in the presence of two subscribing witnesses.

JOHN STUMPF.

Witnesses:
C. A. DAY,
CARL ALBRECHT.