No. 666,194. Patented Jan. 15, 1901.

H. HOERBIGER.

PUMP.

(Application filed Aug. 27, 1900.)

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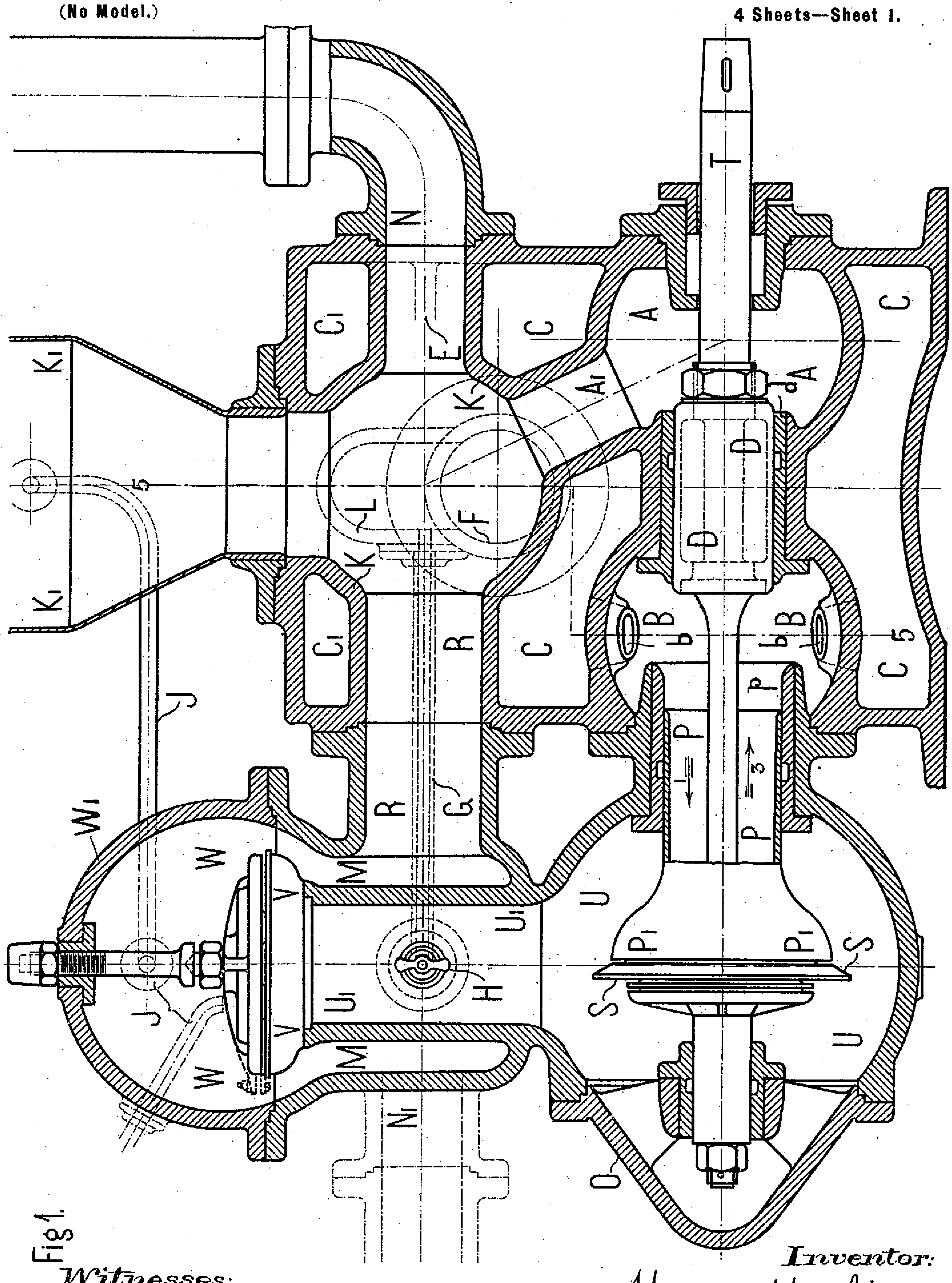

Fig. 1.

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(No Model.) 4 Sheets—Sheet 2.

Fig 2.

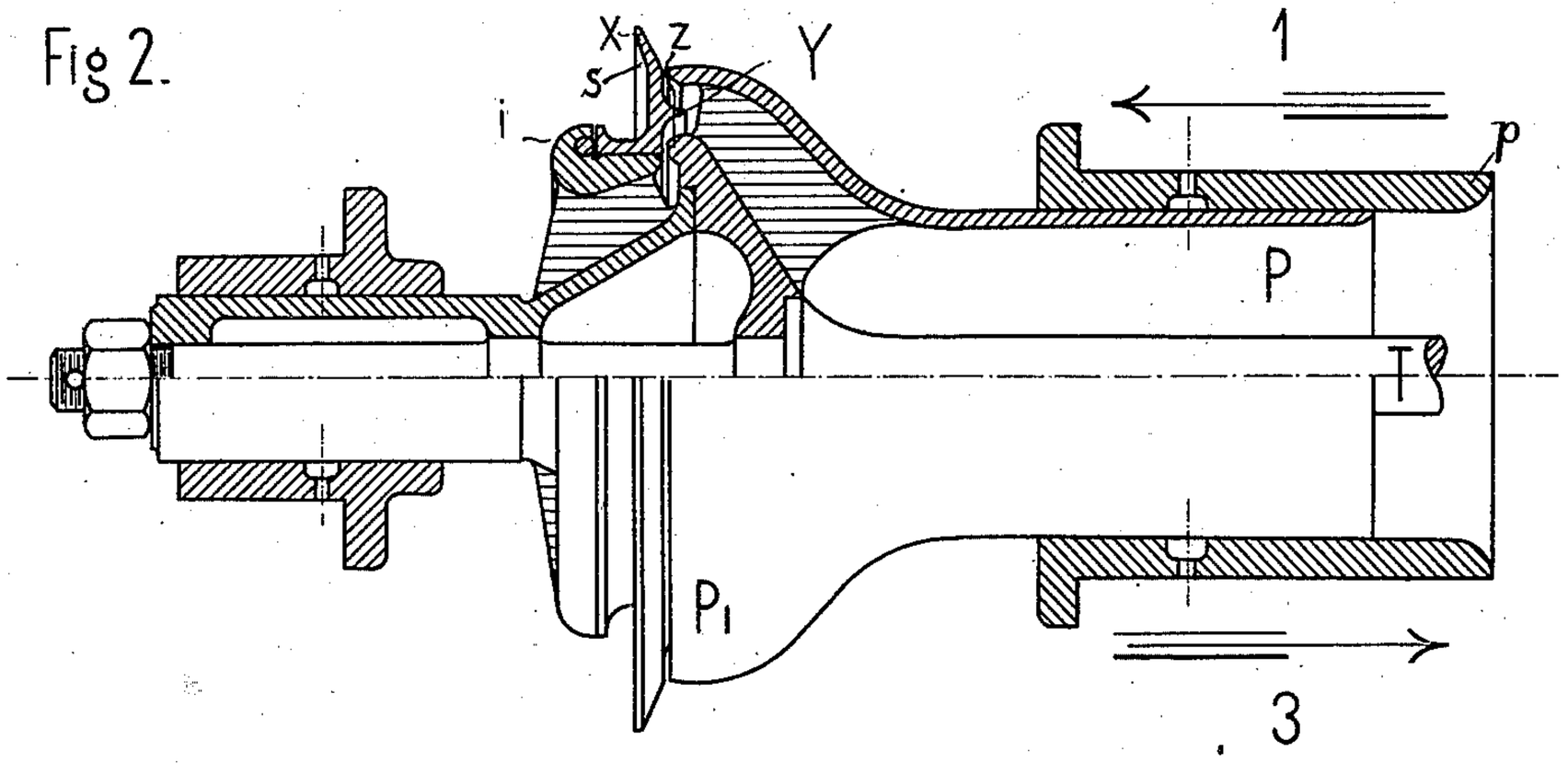
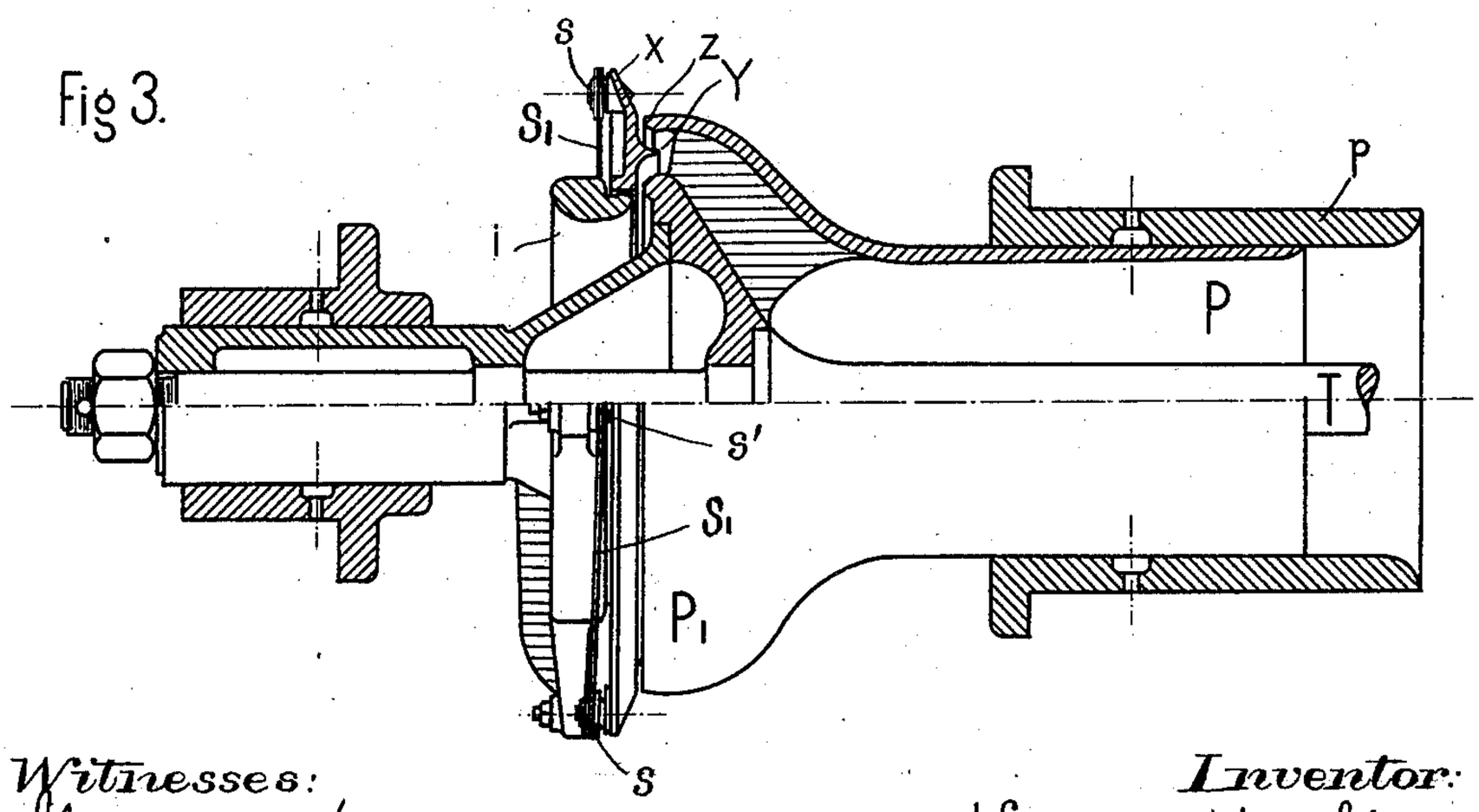


Fig 3.



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(No Model.) 4 Sheets—Sheet 3.

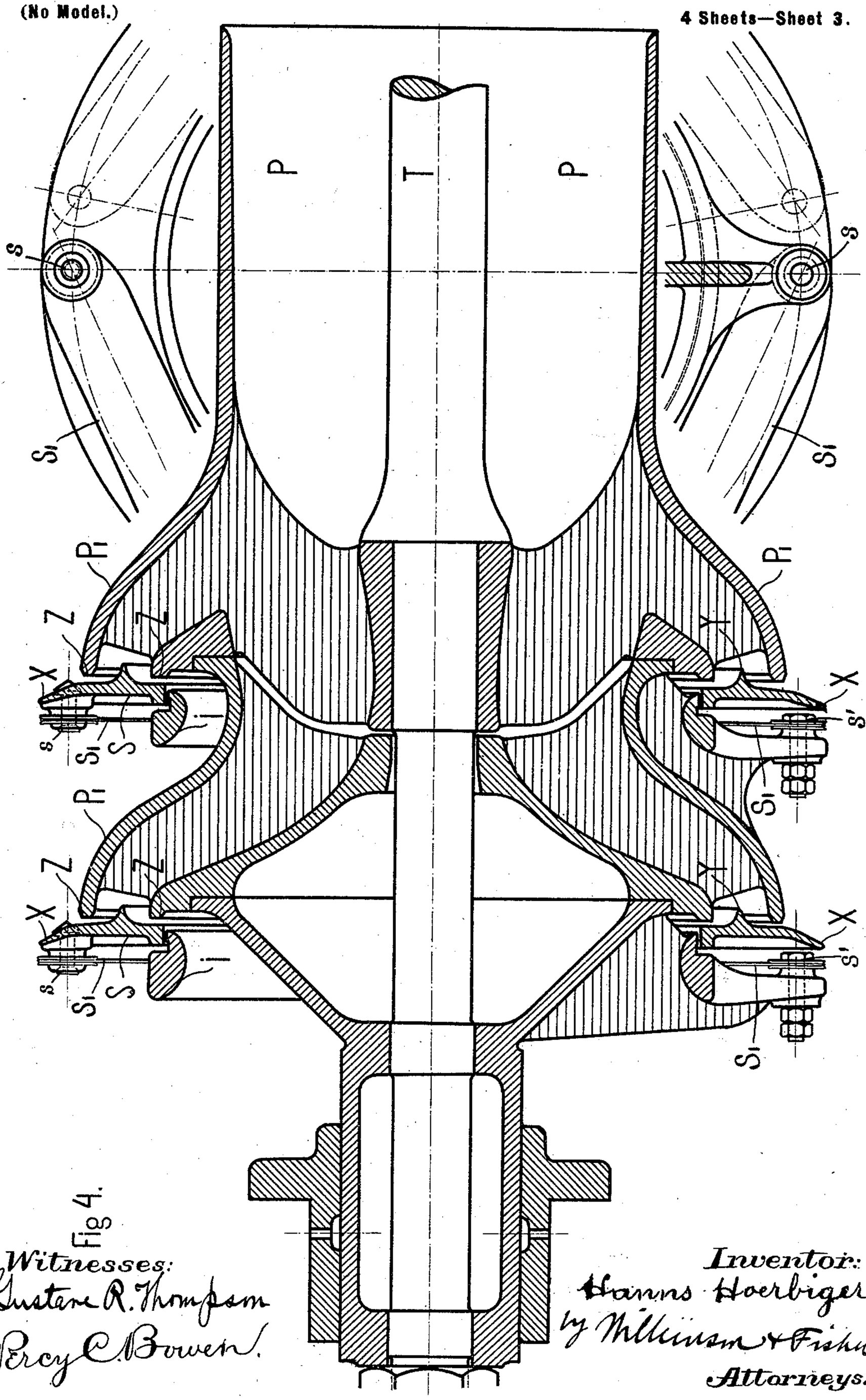

Fig 4.

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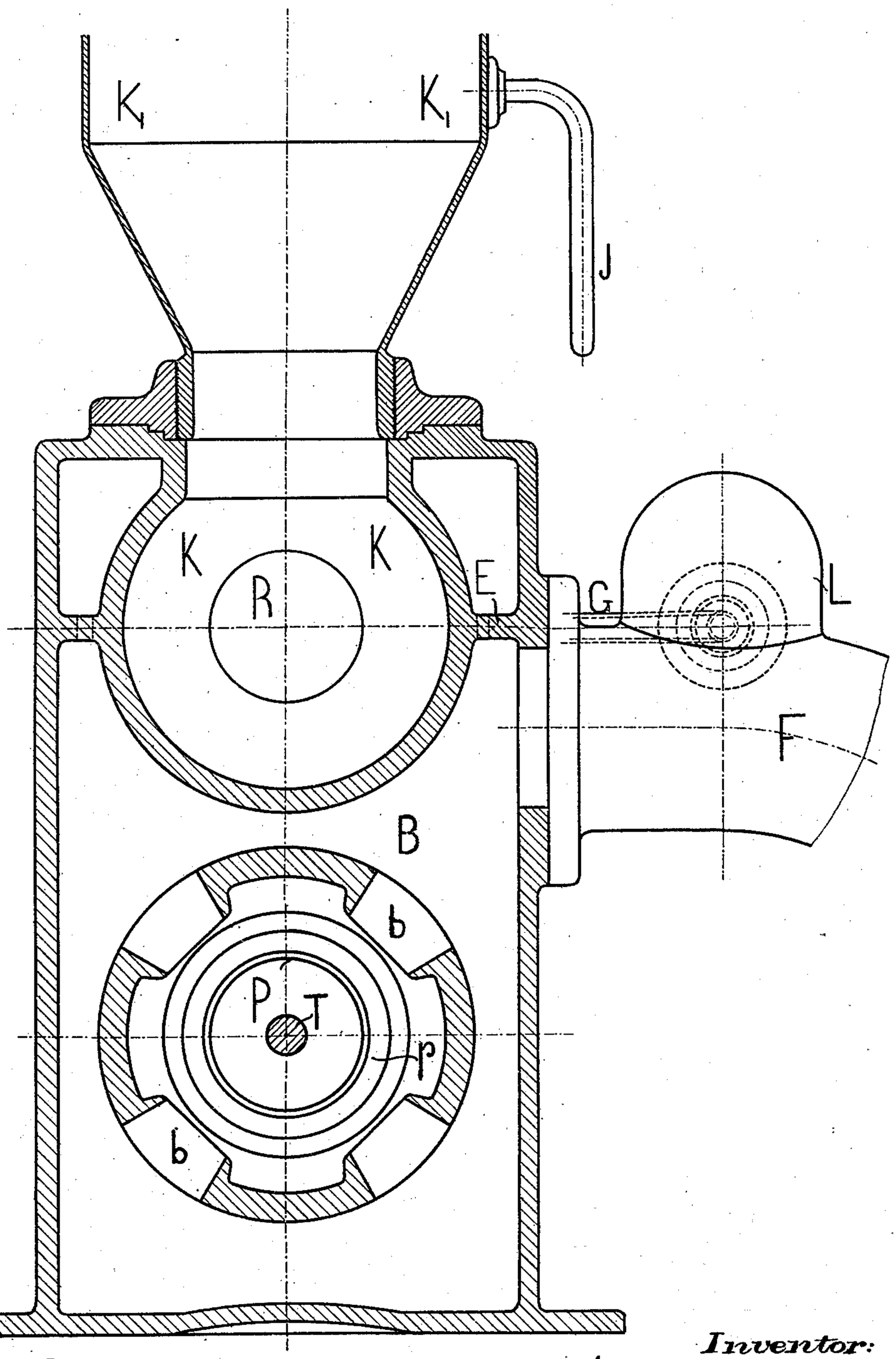
PUMP.

(Application filed Aug. 27, 1900.)

(No Model.) 4 Sheets—Sheet 4.

Fig. 5.



Witnesses:
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UNITED STATES PATENT OFFICE.

HANNS HOERBIGER, OF BUDA-PESTH, AUSTRIA-HUNGARY.

PUMP.

SPECIFICATION forming part of Letters Patent No. 666,194, dated January 15, 1901.

Application filed August 27, 1900. Serial No. 28,227. (No model.)

To all whom it may concern:

Be it known that I, HANNS HOERBIGER, engineer, a citizen of the Empire of Austria-Hungary, residing at Buda-Pesth, in the Empire of Austria-Hungary, 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.

The invention relates to pumps with automatically-moving suction and pressure valves as distinguished from gear-controlled suction and pressure valves.

One object of this invention is to insure a prompt valve action at exactly the proper times by a particular arrangement of the valves and certain parts of the pump and by a particular construction of such parts, whereby a quiet motion of the pump is obtained even if it is run with a very high number of strokes.

A further object is to render the valves readily accessible, whereby the inspection and maintenance of the pump are simplified and facilitated.

In the accompanying drawings, Figure 1 is a vertical longitudinal section of the pump through the axis of the cylinders, the suction and pressure valves, together with their casings, being shown in side elevation. Fig. 2 is a side elevation, partly in section, of the working piston and the suction-valve on a somewhat-larger scale. Fig. 3 is a similar view of the working piston provided with a somewhat-modified suction-valve. Fig. 4 is a central longitudinal section of the head of a working piston provided with a double valve. Fig. 5 is a section on the line 5 5 of Fig. 1, showing the suction-pipe and air-chamber in elevation.

T is the piston-rod, carrying the piston D and plunger P, working in cylinders *d* and and *p*, respectively, the plunger P being open at both ends and arranged in line with each other. As shown, the piston D is solid and of smaller diameter than the plunger P and constitutes what is called the "differential" piston. The plunger P, on the contrary, is hollow, open at the suction end, and provided with an enlarged conical or cup-shaped hollow head P′ at the pressure end. The said head P′ projects from the cylinder *p* into the pressure-chamber U and is provided with the suction-valve S. An overflow-tube U′ extends vertically from the said pressure-chamber into a small air-chamber W, arranged on top of a vertical extension M of the pump-body, such extension M surrounding the overflow-tube U′. The pressure-valve V is mounted in the upper end of the overflow-tube U′, which end is preferably enlarged to form a conical or cup-shaped head similar to the head P′ of the plunger.

A passage R leads from the bottom of the extension M to a chamber K, directly communicating with the large air-chamber K′ and with the rising main or mains N and through the passage A′ with the chamber A at the rear end of the cylinder *d*. This chamber constitutes in the pump shown the usual differential pressure-chamber.

The suction-pipe F enters into the suction air-chamber C C′, inclosing the passage R, the chambers K A, and the cylinders *d* and *p*. It will be seen that the adjacent ends of the cylinders *d* and *p* open into a chamber B, which communicates directly with the suction air-chamber C C′.

I prefer for the purpose of strengthening the structure to connect the adjacent open ends of the cylinders by a chamber B within the suction air-chamber C C′ and to establish the direct communication between the chambers C C′ and B by ports *b*, provided in the wall of the latter. A horizontal perforated partition E divides the chamber C C′ into two superposed compartments above the mouth of the suction-pipe F and serves at the same time to support the passage R and the chamber K. I prefer to arrange on the suction-pipe F at the point where it enters the chamber C C′ a small suction air-chamber L, which is connected to the pressure-chamber U by a pipe G and a small check-valve H, opening into the pressure-chamber U. For the sake of clearness the pipe G is shown as entering the pressure-chamber in the vertical tube U′, although in practice I prefer to lead it to the bottom of the pressure-chamber U. Similarly the large pressure air-chamber K′ is connected to the small pressure-chamber W by a pipe J.

The pressure-chamber U is closed by a removable cover O in front of the plunger-head P′, which cover may also serve to guide the inner end of the piston-rod T. Therefore after removing the said cover O the plunger-head is freely accessible and the suction-valve S may be readily inspected and removed. Similarly the cover W′ of the small pressure air-chamber W is removable for the purpose of rendering readily accessible the pressure-valve V.

In order to obtain a maximum port area for the liquid to pass through with a small stroke of the valve, I prefer to make the suction-valve S annular in shape, Figs. 2, 3, and 4, the seat of this valve being formed of two concentric edges Z Z on the plunger-head. The port area is thus greatly enlarged, and if the perimeter of the valve be made large, as by enlarging the plunger-head, as above stated, the port area of the valve may be made so large as not to be noticeably smaller than the free passage area of the cylindrical portion of the plunger. If necessary, two or more of such valves may be provided, the one behind the other, as shown in Fig. 4, in order to obtain a large port area even with small valve-strokes. Further, I provide on the side of the valve S toward the seat and in the center of its width a concentric rib or flange Y, triangular in cross-section, which directs the passing liquid to the edges of the valve, thereby facilitating the passage thereof. The valve S is guided either by arranging it so as to slide freely on a cylindrical portion of the valve-support *i*, Fig. 2, or by supporting it thereto by elastic links, as described in my United States Patent No. 604,326, Figs. 3 and 4.

The pressure-valve V is constructed in exactly the same way as the suction-valve S and is therefore not shown in detail. It is not necessary to provide special springs for forcing down the suction valve or valves onto its or their seats. In the case of the pressure-valve, however, it is desirable to provide such springs. The outer edge of the suction-valve is provided with a circumferential flange X, projecting outwardly and away from the seat edges Z Z, Figs. 2, 3, and 4.

The operation of this pump is the following: After the piston-rod T has reached the forward position—the end of the pressure-stroke—it commences its rearward movement—the suction-stroke—in the direction of the arrow 3, Figs. 1 and 2. At the very moment when the movement of the piston-rod is reversed the pressure-valve V has closed and the suction-valve has to be opened. In order to insure the prompt closing of the suction-valve at the proper time, it is sufficient to make this valve as light as possible, to reduce its stroke and the resistance of the liquid to the movement of this valve as far as possible, (which latter is obtained by the rib Y,) and to employ strong valve-closing springs S′, each spring having one end secured to the circular valve S, as at *s*, and the other end secured to the part *i* of the plunger-head, as at *s*′. (See Figs. 3 and 4.) At the end of the pressure-stroke the valve-body and the mass of the liquid in the hollow plunger P and the cylinder *p* have come to rest, and consequently are stationary when the piston-rod, together with the plunger, begins the return or suction stroke. The valve, owing to its inertia, has a tendency to lag behind the plunger, and, moreover, the resistance of the liquid to any movement of the valve, which resistance is increased on purpose by the flange X on the outer edge of the valve, acts to retard the movement of the valve. Consequently the plunger recedes in the first instance of the suction-stroke of the piston-rod from the suction-valve until the latter is engaged by the valve-support, with the result that the suction-valve is opened promptly at the very beginning of the suction-stroke without the aid of special springs or valve-gear. It will be understood that the frictional resistances to be overcome by the suction-valve in so moving relatively to the plunger-head should be as small as possible The suction-valve now being open, the liquid in the pressure-chamber U and that in the hollow plunger P and in the cylinder *p* are in direct communication, and as the total volume of liquid in the pressure-chamber plus that in the plunger and in the cylinder is in no way altered when the plunger makes the suction-stroke the plunger, together with the suction-valves, moves during the suction-stroke in a practically stationary mass of liquid, the liquid passing merely from one side of the valve to the other, and in so doing it has to overcome only a comparatively very small resistance at the valve, the port area of the valve being, as above stated, nearly as large as the free sectional area of the plunger. During the suction-stroke of the rod T the piston D forces liquid from the chamber A into the chamber K and thence into the rising mains, and at the same time it draws liquid into the suction air-chamber C C′ from the suction-pipe F. When at the end of the suction-stroke the piston-rod reaches the rear dead-center position, the suction-valve closes again, owing to the momentum acquired during the movement of the piston-rod, or if the friction is too great it begins at least to close and is completely closed in the first instant of the pressure-stroke of the piston-rod (in the direction of arrow 1, Figs. 1 and 2) by the resistance of the liquid in the pressure-chamber U against the forward movement of the said valve, such resistance being increased by flange X. Thus a prompt closing of the suction-valve is insured. At the same time the pressure-valve V is opened by the pressure exerted by the plunger P on the liquid in the pressure-chamber U, so that during the pressure-stroke of the piston-rod liquid is forced from the pressure-chamber U through the tube U′ and valve V into the small air-chamber W, whence it flows down

through the extension M and passage R to the chamber K. Now as during the pressure-stroke the front end of the plunger P is closed by the suction-valve S liquid is drawn by this plunger into the suction-chamber from the suction-pipe F and at the same time the piston D draws liquid from the chamber K into the chamber A and forces liquid from the inner end of the cylinder *d* into the suction air-chamber C C′. The diameter of the plunger P being, as shown, larger than that of the piston D, more liquid is drawn into the suction air-chamber C C′ by the plunger during the pressure-stroke than is forced into the same chamber by the piston D, and similarly during the same stroke more liquid is forced into the chamber K by the plunger P than is drawn therefrom by the piston D. On the other hand, during the suction-stroke the piston D forces, as above stated, liquid into the chamber K and draws liquid into the suction air-chamber C C′. Consequently during both the suction and the pressure strokes liquid is drawn from the suction-pipe F and delivered into the rising main or mains, and thus the flow of the liquid in the suction-pipe and in the rising mains is practically continuous. The air-chambers L and W contribute considerably to this latter effect by taking up and equalizing local rises of the liquid and by facilitating the separation of air from the liquid and causing it to take place at the most advantageous places.

The suction and the delivery of the liquid being practically continuous, the danger that the level of the liquid in the suction air-chamber C C′ will sink so far that air may enter into the plunger P is greatly reduced and is still further reduced by the pipe G, provided with check-valve H, and connecting the small air-chamber L with the pressure-chamber U, through which pipe any excess of air is drawn during the suction-stroke of the piston-rod into the pressure-chamber and is then forced out through the valve V during the following pressure-stroke.

By arranging the large pressure air-chamber K′ directly above the chamber K, which communicates with the passages R, A′, and A and the main or mains N, it exerts its equalizing influence uniformly upon all of these passages and mains, and thereby notably contributes to the quiet and regular working of the pump. The large pressure air-chamber K′ is connected with the small pressure air-chamber W by the pipe J, as above stated, this pipe reaching down in the chamber W to a level slightly above that of the pressure-valve V. Therefore if the air-pressure in W becomes higher than that in K′ the surplus of air escapes from W to K′ through J. Thus the liquid in the small pressure air-chamber W is maintained at a constant level a little above the valve V, so as to seal such valve and to prevent air from returning to the tube U′ and the pressure-chamber U. The height of the liquid column above the pressure-valve V being thus small and practically constant, this valve will have to overcome in opening the inertia of a small quantity of liquid only, whereby the power consumed in opening this valve is greatly diminished. As the liquid escaping through the pressure-valve V has to flow down around the tube U′ in the extension M in order to reach the passage R when the valve is about to close, the prompt closing of such valve is assisted by this movement of the liquid.

From the above it will be seen that the prompt automatic operation of the valves at exactly the proper times is initiated, produced, or at least assisted by the momentum and the inertia of the liquid, and the suction-valve will work the more regularly and reliably the more rapidly (up to a certain limit never reached in practice) the pump is run. The movement of the liquid in the suction-pipe and in the rising mains being practically continuous, as above stated, the liquid column will never break in any of them. Therefore this pump is particularly adapted for being run at high speeds.

I claim—

1. In a pump the combination with a cylinder, open at both ends, a pressure-chamber at one end thereof and a suction-chamber at the other end thereof, of a hollow plunger, open toward the suction-chamber, working in such cylinder, an enlarged head at the end of the plunger projecting into the pressure-chamber, an annular valve or valves carried by such head, means for reciprocating the plunger in the said cylinder and means for connecting the pressure-chamber with the rising mains substantially as and for the purpose described.

2. In a pump the combination of two cylinders open at both ends and in line with each other, a suction-chamber directly communicating with the adjacent ends of the said cylinders, means for connecting the opposite ends of the cylinders with the rising mains, a hollow plunger open toward the suction-chamber, working in one cylinder, an enlarged head at the end of the plunger projecting into the pressure-chamber, an annular valve or valves carried by such head; a solid piston working in the other cylinder and a piston-rod connecting the plunger and the piston substantially as described.

3. In a pump the combination of a cylinder open at both ends, a smaller cylinder also open at both ends and in line with the larger cylinder, a suction-chamber communicating with the adjacent ends of both cylinders, a pressure-chamber at the other end of the larger cylinder, means for connecting the other end of the smaller cylinder with the mains, a hollow plunger open toward the suction-chamber working in the larger cylinder, an enlarged head on the end of said plunger, projecting into the pressure-chamber, an annular valve carried by said head, a solid piston working in the smaller cylinder, and a piston-rod con-

necting the plunger and the piston; substantially as described.

4. In a pump the combination of a cylinder open at both ends, a suction-chamber at one end thereof, a pressure-chamber at the other end thereof, a tube extending vertically from the said pressure-chamber and having an enlarged head at its upper end, an annular valve or valves, carried by such head, a vertical extension of the pump-casing, surrounding such tube, a small pressure air-chamber on top of such extension above the annular valve or valves, a hollow plunger open toward the suction-chamber working in the said cylinder an enlarged head at the end of the plunger projecting into the pressure-chamber, an annular valve or valves carried by such head, means for reciprocating the plunger in the said cylinder and means for connecting the bottom of the said vertical extension with the rising mains, substantially as described.

5. In a pump the combination of a cylinder open at both ends a suction-chamber at one end thereof, a pressure-chamber at the other end thereof, a tube extending vertically from the said pressure-chamber and having an enlarged head at its upper end, an annular valve or valves carried by such head, a vertical extension of the pump-casing, surrounding such tube, a small pressure air-chamber on top of such extension above the annular valve or valves, a large pressure air-chamber communicating with the rising mains, a passage connecting the bottom of the said extension with the large pressure air-chamber, a hollow plunger open toward the suction-chamber working in the said cylinder, an enlarged head at the end of the plunger projecting into the pressure-chamber, an annular valve or valves carried by such head, and means for reciprocating the plunger in the said cylinder substantially as described.

6. In a pump the combination of a cylinder open at both ends, a suction-chamber at one end thereof, a pressure-chamber at the other end thereof a tube extending vertically from the pump-chamber, an annular valve or valves on top of such tube, a vertical extension surrounding the tube, a small pressure air-chamber on top of such extension and above the said valve or valves a large pressure air-chamber communicating with the rising mains a passage connecting the bottom of the said extension with the large pressure air-chamber, a pipe connecting, the large pressure air-chamber with said small air-chamber, a hollow plunger open toward the suction-chamber working in the said cylinder, an enlarged head at the end of the plunger projecting into the pressure-chamber, an annular valve or valves carried by such head and means for reciprocating the plunger in the said cylinder substantially as described.

7. In a pump the combination of a cylinder open at both ends, a suction-chamber at one end thereof, a pressure-chamber at the other end thereof, a tube extending vertically from the pressure-chamber, an annular valve or valves on top of such tube a vertical extension surrounding the tube, a large pressure air-chamber, a chamber in the pressure-conduit, passages connecting this latter chamber with the bottom of the extension, the large pressure air-chamber and the rising mains, a hollow plunger open toward the suction-chamber working in the said cylinder, an enlarged head at the end of the plunger projecting into the pressure-chamber, an annular valve or valves carried by such head and means for reciprocating the plunger in the said cylinder substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

HANNS HOERBIGER.

Witnesses:
LOUIS GERSTER,
LOUIS VANDORY.