No. 855,150. PATENTED MAY 28, 1907.

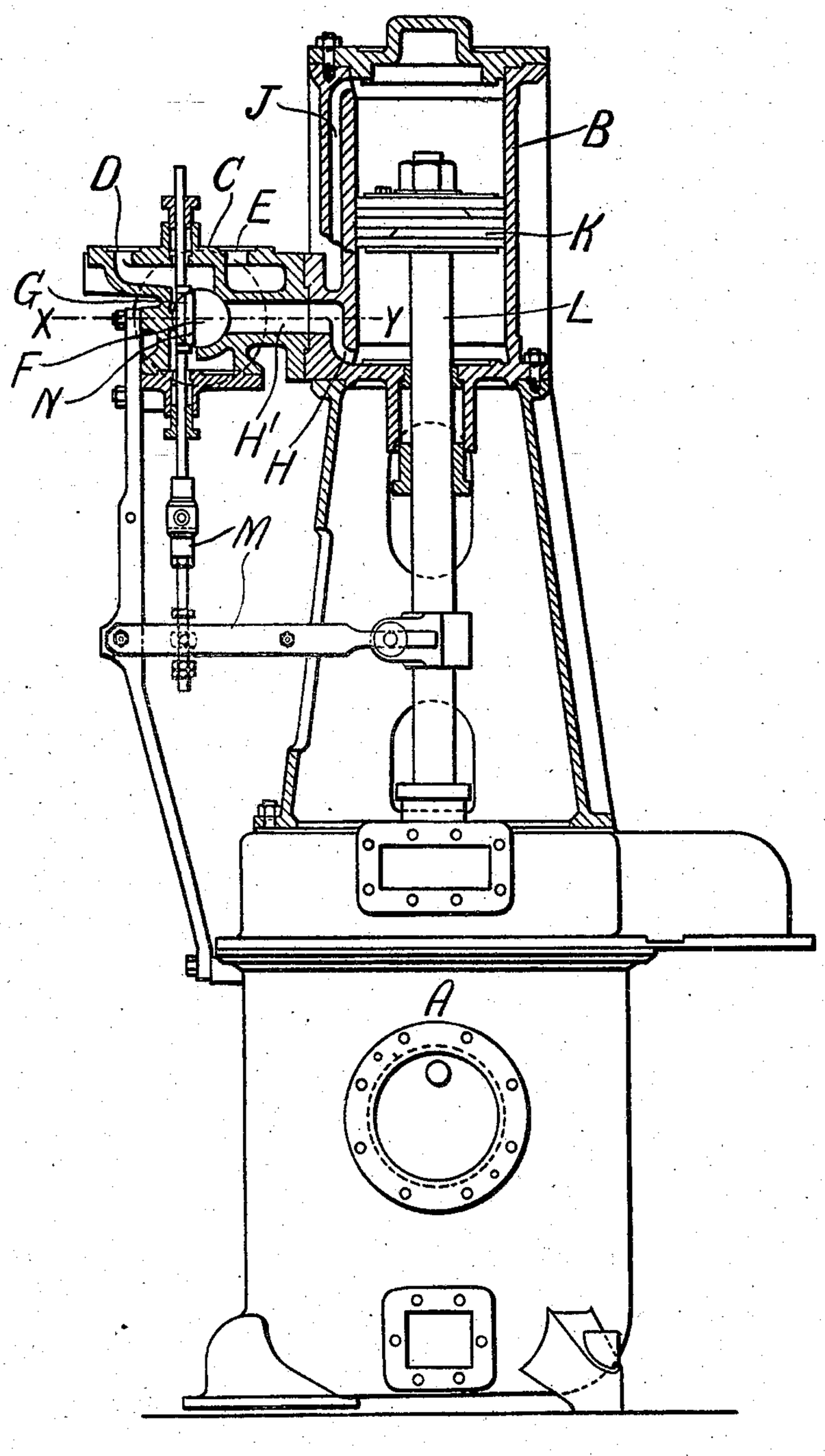
W. WEIR.

DIRECT ACTING PUMP.

APPLICATION FILED OCT. 21, 1905.

5 SHEETS—SHEET 1.

Fig. 1.



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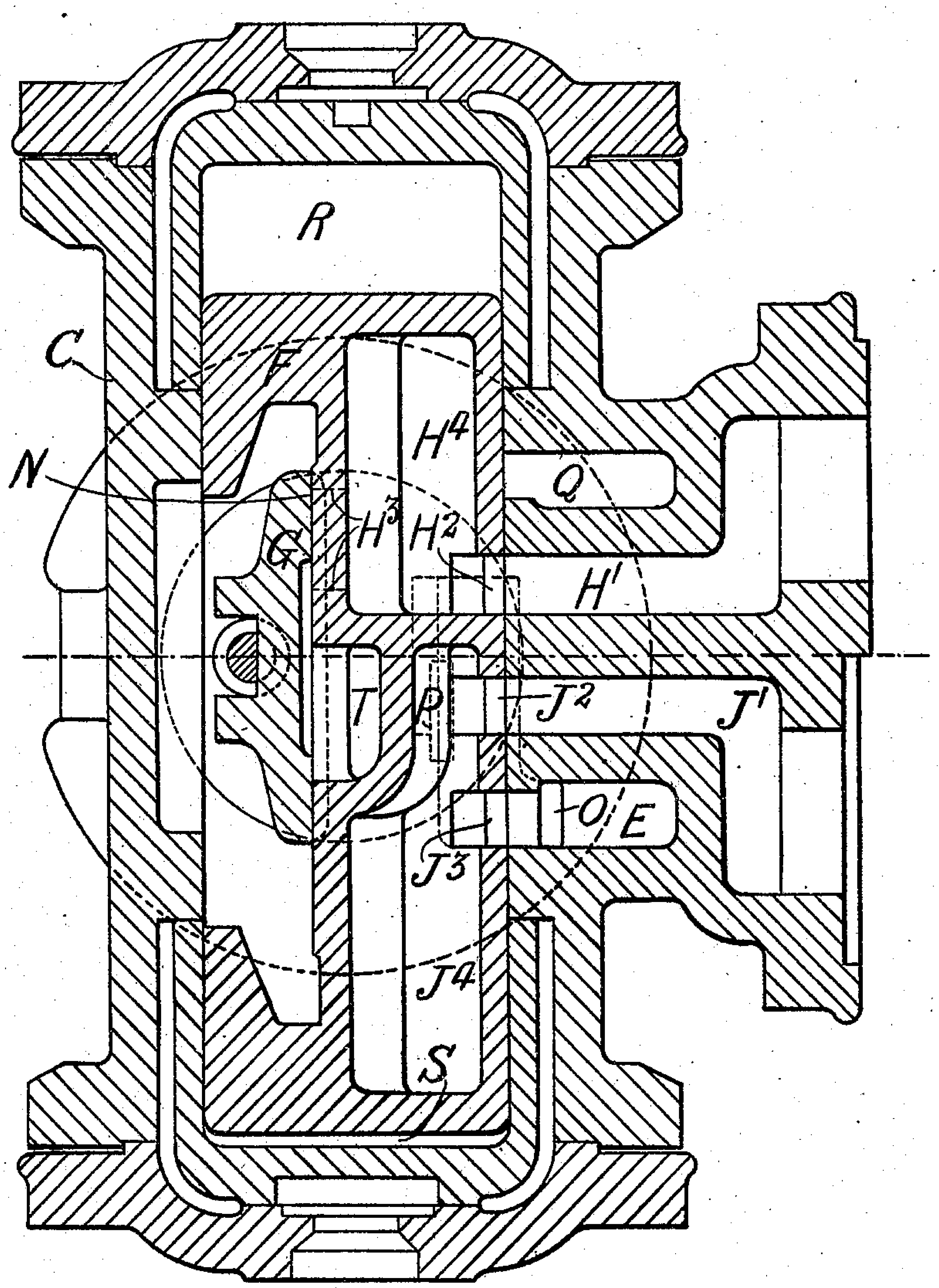
5 SHEETS—SHEET 2.

Fig. 2.



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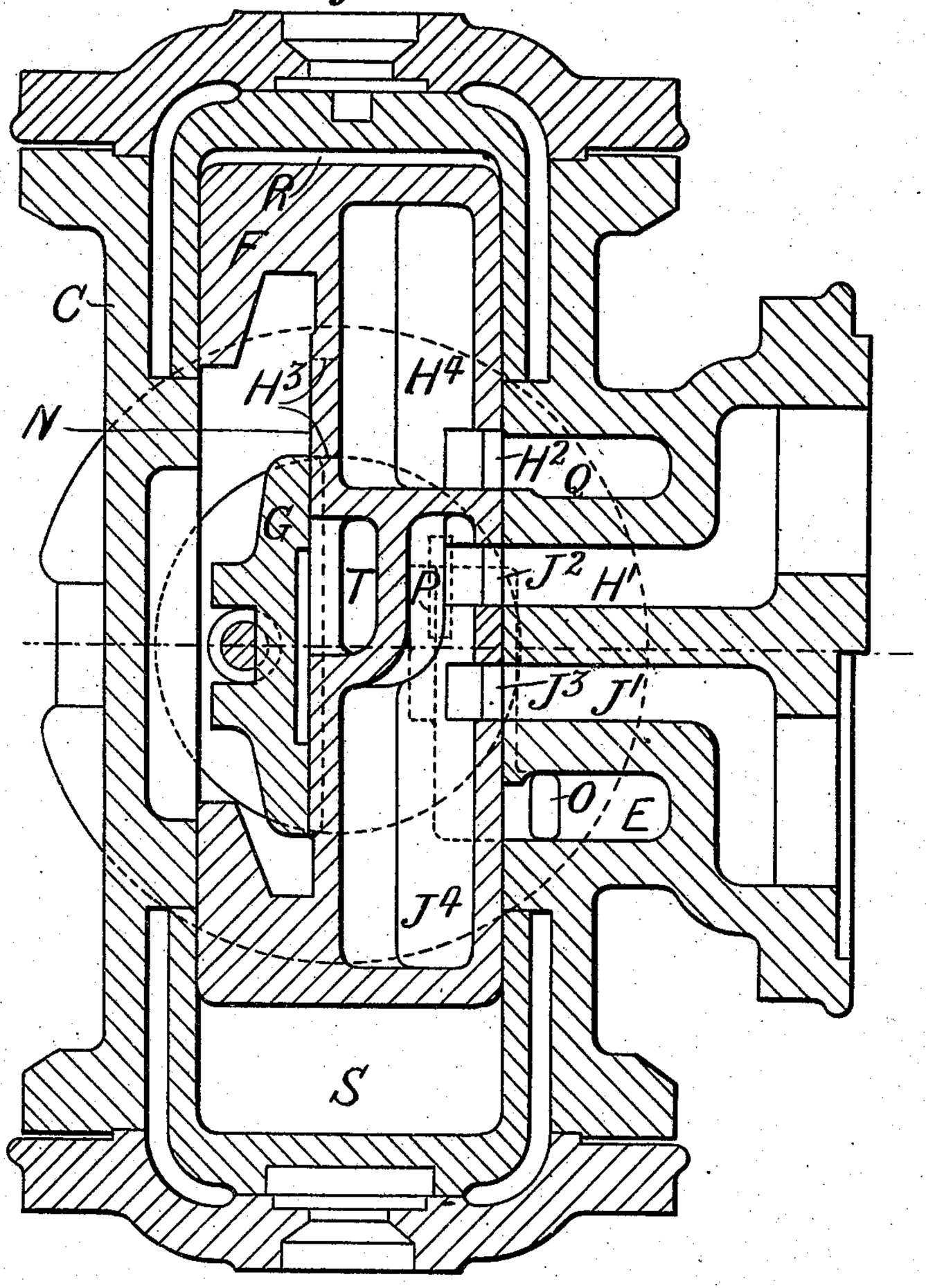
5 SHEETS—SHEET 3.

Fig. 3.



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5 SHEETS—SHEET 4.

Fig. 4.

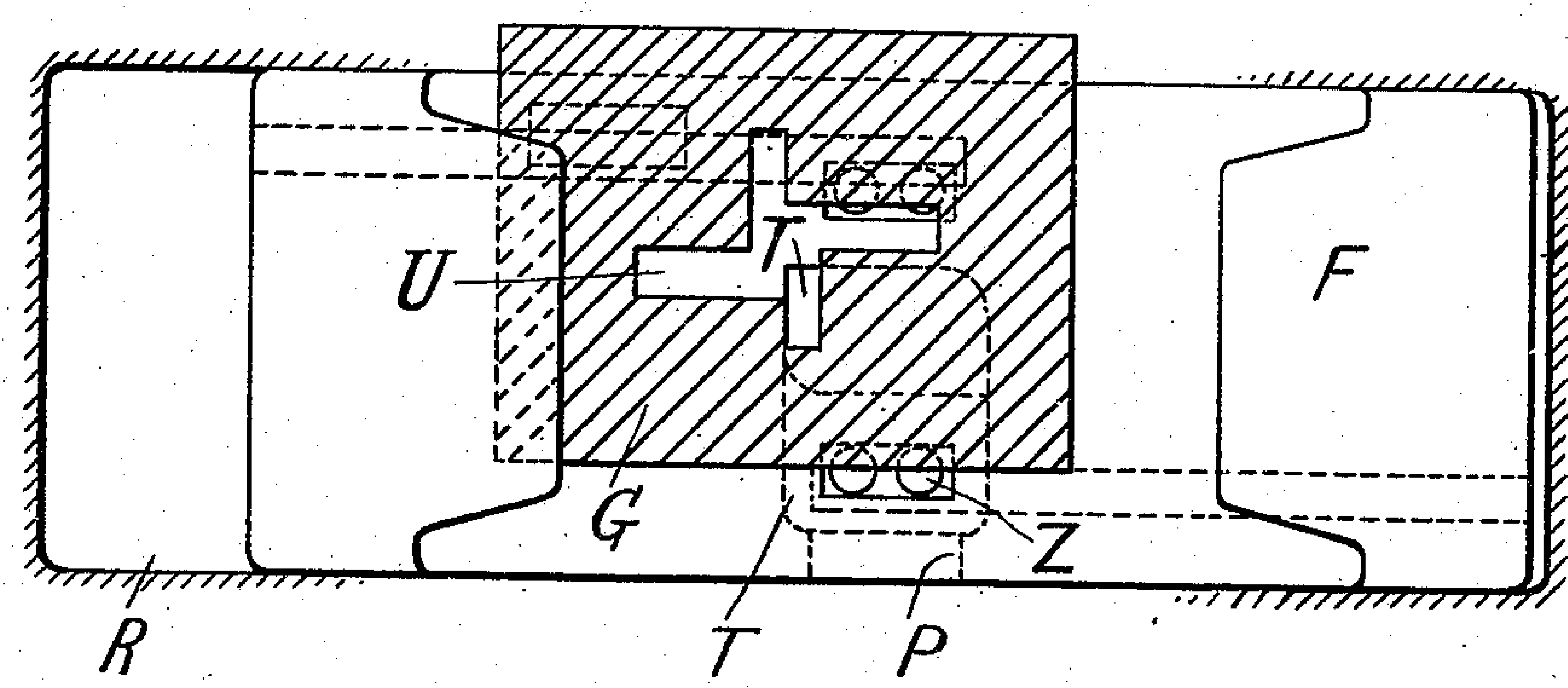
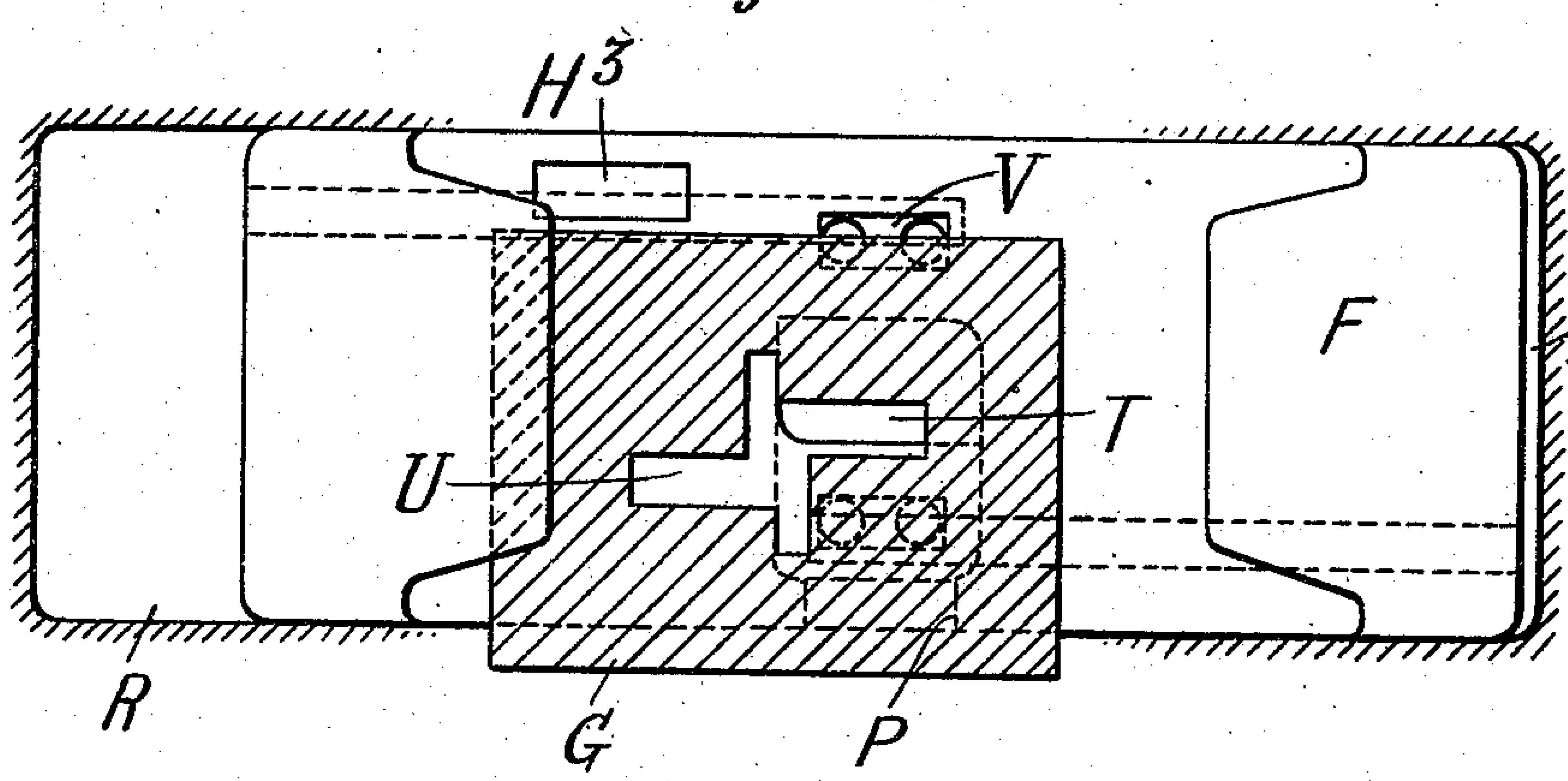


Fig. 5.



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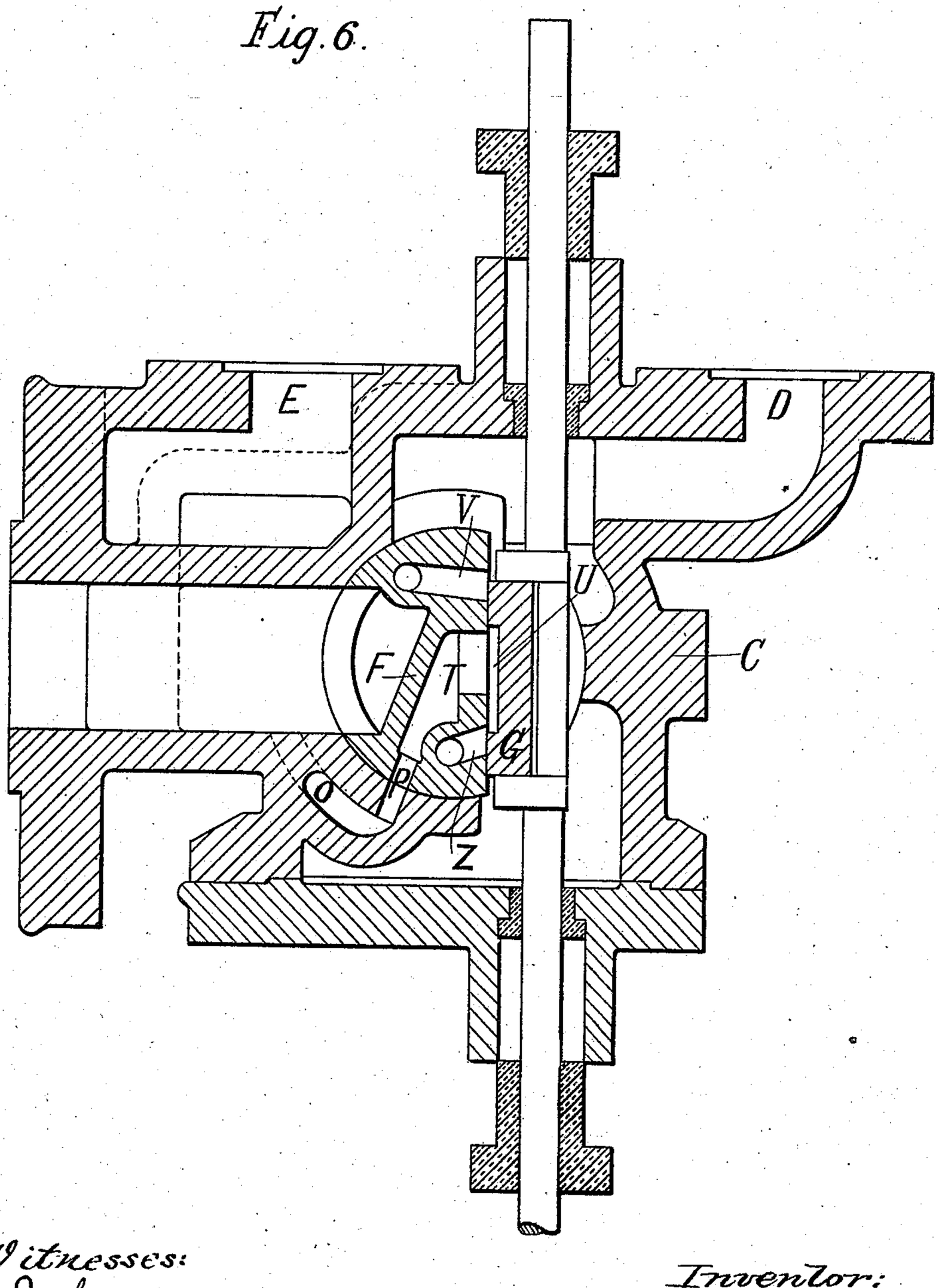
5 SHEETS—SHEET 5.

Fig. 6.



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UNITED STATES PATENT OFFICE.

WILLIAM WEIR, OF CATHCART, SCOTLAND.

DIRECT-ACTING PUMP.

No. 855,150. Specification of Letters Patent. Patented May 28, 1907.

Application filed October 21, 1905. Serial No. 283,763.

To all whom it may concern:

Be it known that I, WILLIAM WEIR, a subject of the King of the United Kingdom of Great Britain and Ireland, residing at Cathcart, county of Renfrew, Scotland, have invented certain new and useful Improvements in Direct-Acting Air-Pumps, of which the following is a specification.

This invention relates to improvements in direct-acting air pumps of the single acting type where these are driven by direct-acting steam cylinders, and is designed more particularly to render the working of these more efficient, more economical in steam consumption, more compact, and less variable in the relative speed of the upward and downward strokes.

It is well known that the working of single acting air pumps when driven by direct double acting steam cylinders is unsatisfactory on account of the great difference in the load on the air pump bucket on the upward and downward strokes.

My improvements are applicable to single acting air pumps driven by direct acting steam cylinders which may be fitted with any suitable type of steam actuated valve, but which are preferably provided with a valve of the character herein shown and described.

The invention is illustrated by the accompanying drawings of which

Figure 1 shows a single single-acting air pump driven by a single direct-acting steam cylinder fitted with steam actuated valve, and with my improvements, Figs. 2 and 3 are sections across the line X, Y of Fig. 1 and represent plan views to a larger scale of a steam actuated valve of the Weir type arranged with my improvements for driving the steam cylinders of single direct-acting air pumps, the valves being shown in different positions. Figs. 4 and 5 are sectional views looking on the back of the main valve. Fig. 6 is a cross vertical section of the steam distribution chest and valves.

In Fig. 1, A is the air pump of the usual type with foot bucket and head valves, or alternatively of the suction valveless type having only head valves. B is the steam cylinder and C the steam actuated valve chest with usual valve gear M.

According to one modification the steam cylinder B is arranged with the usual ports H and J leading from the steam actuated valve chest to the lower and upper ends of the cylinder respectively.

Referring to Fig. 2 which shows the steam actuated valve F in such a position that the steam piston K, Fig. 1 is at the bottom end of its stroke and commencing its upward stroke, steam is admitted to the valve chest through the supply branch D then through the port H^3 on the valve face N, (this port being open above the valve G, Fig. 5) then into the cavity H^4 through the port H^2, port H^1, port H, and thus to the cylinder B below the piston K causing it to make its upward stroke. At the same time the steam on the upper side of the piston K, is exhausted to the atmosphere or condenser through the ports J, J^1, J^2, J^3 into E, the final exhaust outlet. After making the upward stroke the piston K comes to the top end of the cylinder and the valve F is thrown over and reversed in the usual manner of the Weir valve and takes the position shown in Fig. 3 through the intermediary of the valve G, the operation of which is as follows:— On the upward stroke of the piston K, the valve G is moved in the same direction and at the same time, until the small cavity U in the valve G, Fig. 4, covers the ports V and T and allows the steam in the small cylinder R to escape through the ports V, T, P and O to the final exhaust port E. At the same time pressure steam from the port D is allowed to pass through the port Z in the valve F, Fig. 4, to the small cylinder S, and, exerting its force therein, to drive the valve F into the position shown in Fig. 3. In this position the port H^2 has cut off the steam supply through H^1 and is now opposite a blind port Q. The high pressure steam remaining on the under side of the piston K passes through H, H^1 and J^2 into J^3, J^1 and J, to the top of the piston K where it expands and acts on the differential area between the top of the piston and the bottom of the piston *i. e.* the area of the rod L, thus causing the pump to make the downward stroke. This rod L is made of such a diameter as will furnish sufficient area for the steam to act on to cause the pump to make its downward stroke. In most cases it is found that the normal dimensions of the rod are sufficient as the load on the air pump piston is so slight on its downward stroke.

Fig. 5 is a view looking on the back of valve

G and on face N of valve F and shows the relative positions of valves G and F after the latter has been steam driven into the position shown in Fig. 2. These valves are now in the required positions for the commencement of the upward stroke of the pump.

Fig. 6 is a cross vertical section of the steam distribution chest C and valves F and G, showing the connection from small cylinder S through port Z, cavity U, ports T, P and O, to final exhaust E. When the valve G is at the top end of its travel, as in Fig. 4, the small cylinder R is placed in communication with the final exhaust E through ports V, T, P and O. The arrangement of the steam actuated valve and chest differs only from the ordinary Weir arrangement in that no direct steam supply port is used for the top end of the cylinder, and the main ports are so arranged as shown on the drawings that the original supply of steam to the under side of the piston is transferred at the conclusion of the upward stroke of the piston through the valve to the upper side of the piston, this being permissible on account of the cubical capacity of the cylinder above the piston being somewhat larger than the cubical capacity below the piston due to the differential area of the rod. It is also evident that the cavity J^4 is subject alternately to pressure and exhaust and therefore this cavity cannot be used for receiving the exhaust steam from the valve throwing motive cylinders S and R as is usually the case. The special cavity T is therefore arranged in the valve F leading to a separate port P which communicates with the final exhaust E by another port O in the steam chest for the purpose of exhausting pressure steam from the valve throwing motive cylinders S and R.

It is quite evident that as this invention consists of the improved arrangement of the steam ports of steam actuated valves, particularly for direct-acting steam driven air pumps it is applicable to any type of steam actuated steam distributing valve on account of its application being so simple and easily comprehended, and on this account I have only shown it on the drawings as applied to one well-known type of steam actuated valve.

Having now described my invention what I claim and desire to secure by Letters Patent of the United States is:—

1. In a pumping apparatus, the combination with a single acting air pump provided with a piston, of actuating means therefor comprising a single cylinder, a steam actuated piston in said cylinder, a piston rod connecting said pistons, said piston rod providing differential areas on the opposite sides of said steam actuated piston, a steam actuated valve for alternately admitting steam to the side of said steam actuated piston to which said piston rod is attached to cause said steam actuated piston to move in one direction to produce the effective stroke of said pump piston, and for transferring said steam from said last-mentioned side to the opposite side to cause said steam actuated piston to move in the opposite direction to produce the idle stroke of said pump piston, and means, connected to said piston rod, for controlling the movements of said valve.

2. In a pumping apparatus, the combination with a single-acting air pump, of actuating means therefor comprising a cylinder having a pair of ports, a piston in said cylinder, a piston rod connecting said piston and said pump, and means for alternately admitting steam to one side of said piston to cause said piston to move in one direction to produce the effective stroke of said pump, and for permitting said steam to pass to the opposite side of said piston during the idle stroke of said pump, said means comprising a casing, a valve slidably mounted within said casing, said valve being provided with a system of passages adapted to control the passage of steam to and from said cylinder ports and with a second system of passages adapted to control the passage of steam to and from the ends of said casing beyond said valve, and means connected to said piston-rod for controlling the passage of steam to and from said second system of passages.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

WILLIAM WEIR.

Witnesses:

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JNO. ARMSTRONG, Junr.