(No Model.)

W. F. NIEBLING.
COMPRESSION PUMP.

No. 583,075. Patented May 25, 1897.

Fig. 1.

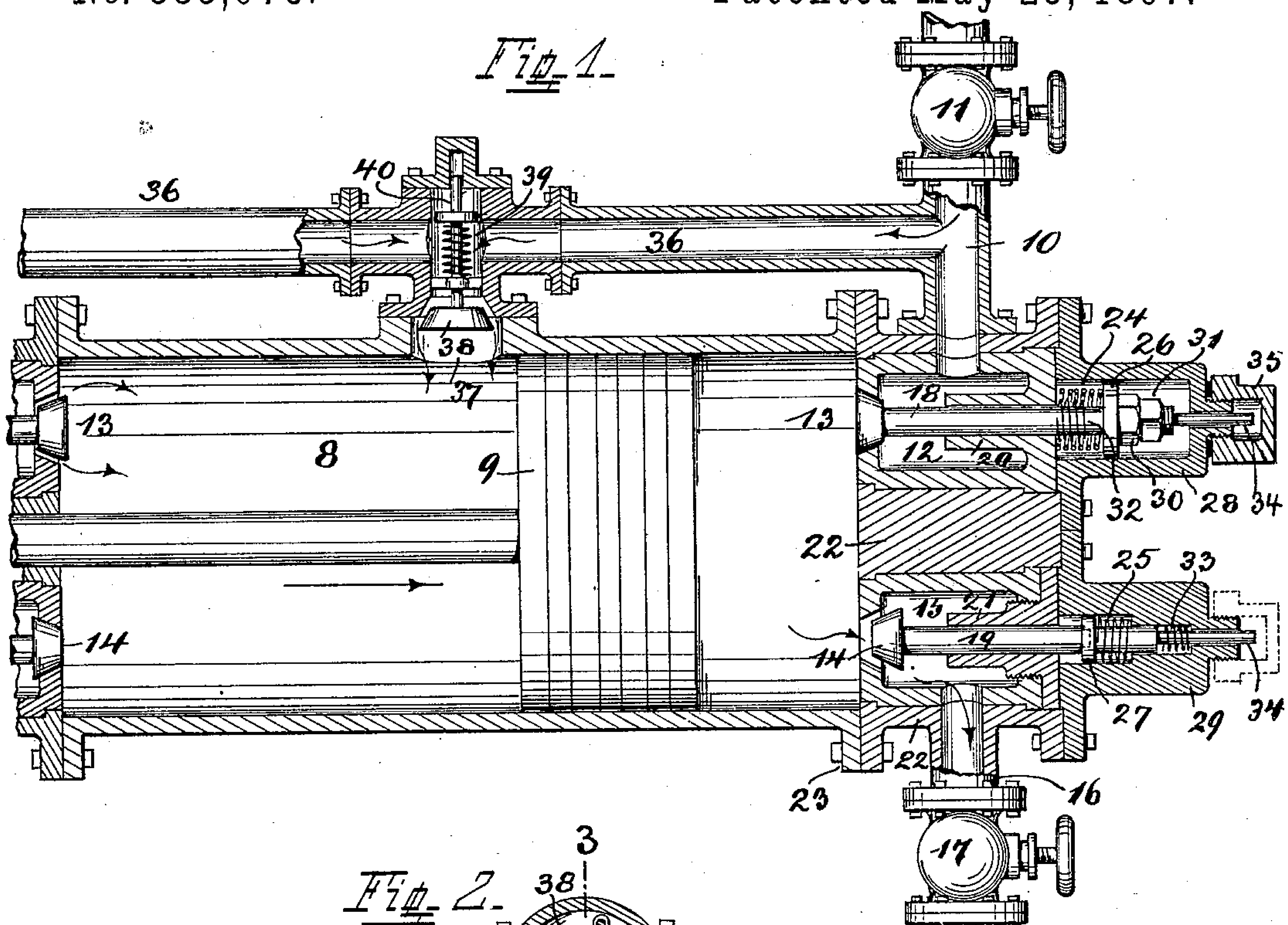


Fig. 2.

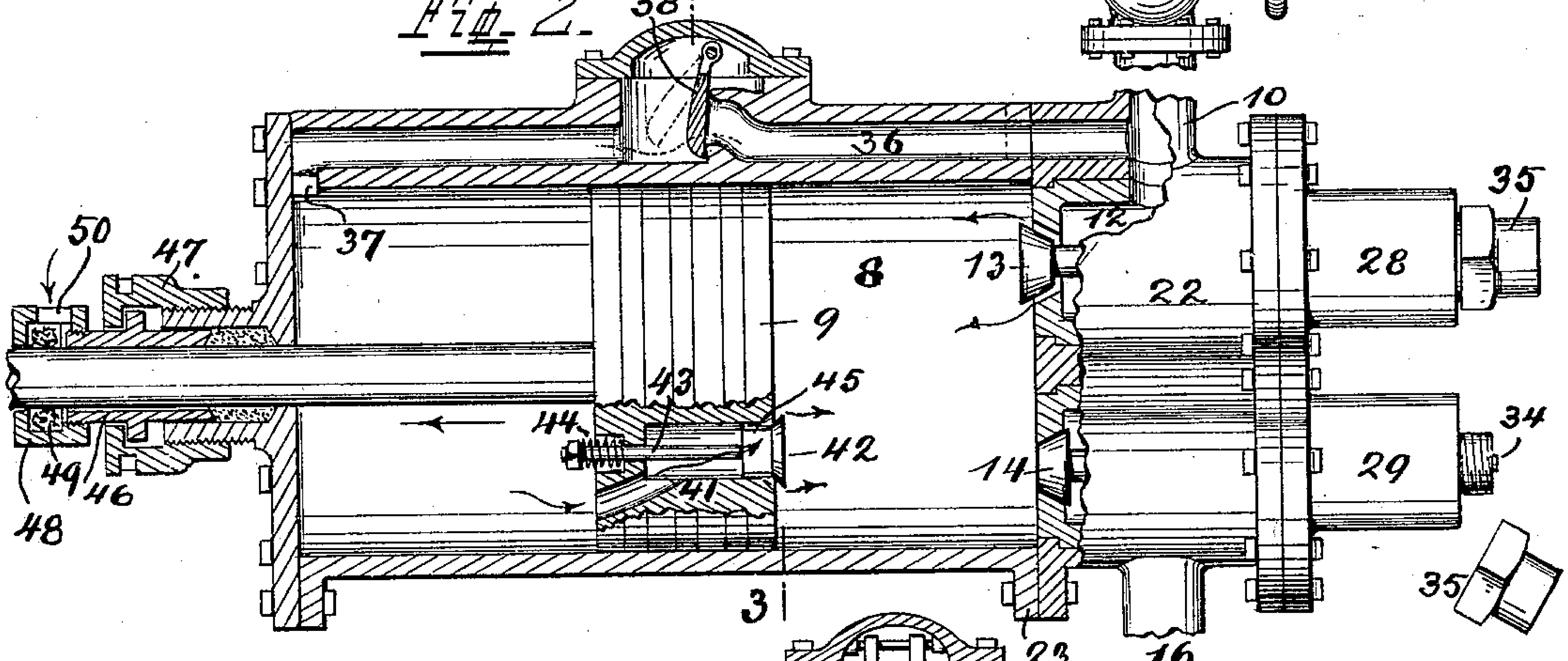


Fig. 3.

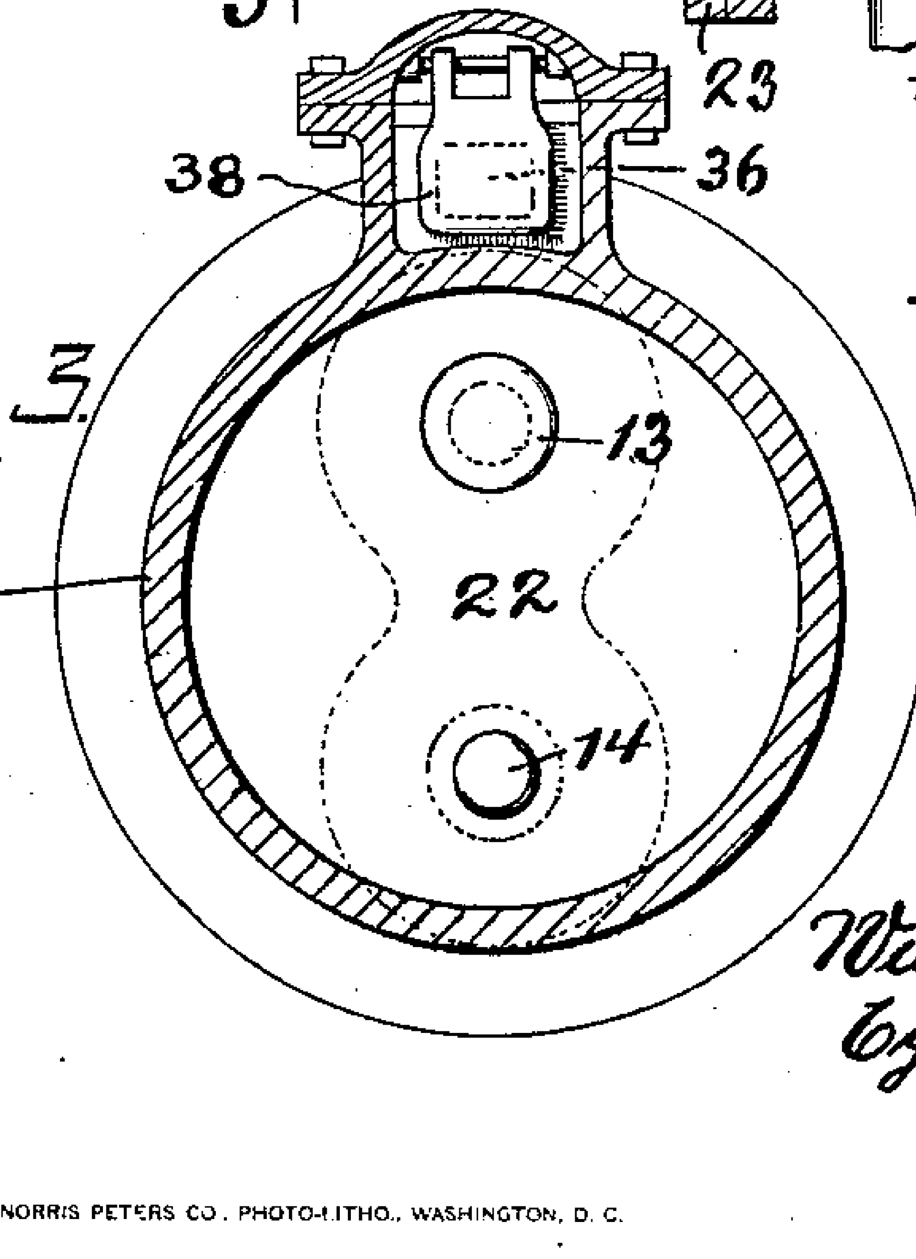
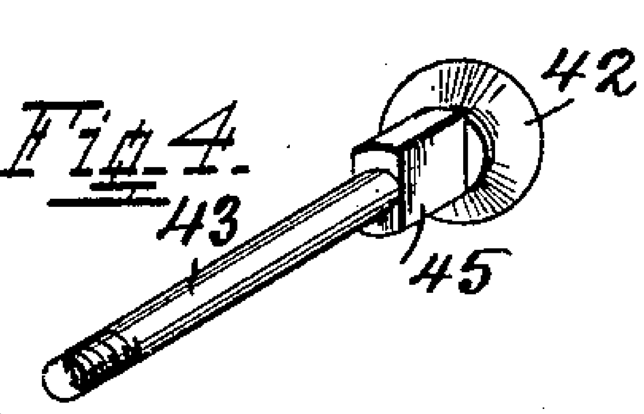


Fig. 4.



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UNITED STATES PATENT OFFICE.

WILLIAM F. NIEBLING, OF CINCINNATI, OHIO.

COMPRESSION-PUMP.

SPECIFICATION forming part of Letters Patent No. 583,075, dated May 25, 1897.

Application filed July 16, 1894. Serial No. 517,655. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM F. NIEBLING, a citizen of the United States, and a resident of Cincinnati, Hamilton county, State of Ohio, have invented certain new and useful Improvements in Compression-Pumps; and I do 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, attention being called to the accompanying drawings, with the reference-numerals marked thereon, which form a part of this specification.

This invention relates to pumps for the purpose of compressing fluids, either liquid or gaseous; and it is especially well adapted for pumps which operate against heavy pressures like, for instance, such as are used in connection with ice or refrigerating machines.

The leading feature of this invention is a construction which increases the capacity of the work actually performed by the pump by filling the cylinder thereof more completely with gas on the suction-stroke than is now the case.

In the following specification, and particularly pointed out in the claims at the end thereof, is found a full description of my invention, its operation, parts, and construction, the latter being also illustrated in the accompanying drawings, in which—

Figure 1 shows in a longitudinal section such a compression-pump provided with my improvements, the latter shown as applied to a double-acting pump. Fig. 2 shows in a similar view my invention applied to a single-acting pump. Fig. 3 is a cross-section on line 3 3 of Fig. 2. Fig. 4 is a perspective view of the auxiliary valve.

8 is the pump-cylinder, within which reciprocates the piston 9 in the usual manner. The latter is operated by a steam-engine or by any other suitable motor.

My invention is adaptable to either double or single acting pumps, and I proceed first to describe it as applied to a double-acting pump.

10 is one of the inlet-pipes, controlled by a valve 11, through which the expanded fluid, ammonia-gas in this case, after having done its work, enters valve-chamber 12, from whence, by the suction caused by the receding piston, it is drawn into the cylinder, being admitted by the ingress-valve 13. On its return stroke the advancing piston compresses the contents of the cylinder and forces them through the now yielding discharge-valve 14 into the valve-chamber 15, from whence, through an outlet-pipe 16, it passes to the refrigerating system to do its work. This outlet-pipe is also controlled by a valve 17, which, however, like valve 11, has nothing to do with the actual operation of the pump. The object of these valves is simply to disconnect the pump from the pipe system in case stoppage for access for any purpose is desired—as, for instance, for repairs or to reduce the pumping capacity where several pumps work in series. Valves 13 and 14 are carried by stems 18 and 19, which are guided by sleeves 20 and 21, formed by inward extensions of the heads of the respective valve-chambers 12 and 15. The castings of these latter are contained within a head 22, bolted to a flange 23 of cylinder 8. The valves are held normally to their seats by springs 24 and 25, acting against shoulders 26 and 27 on the valve-stems and contained within housings 28 and 29, bolted by means of flanges against the outer end of head 22, whereby also the valve-chamber castings are held in position within said head. Shoulders 26 and 27, by closely fitting the interior diameter of housings 28 and 29, act also as additional guides to the valve-stems. Shoulder 26 forms part of a nut 30, screwed onto valve-stem 18 and held in position by a jam-nut 31. Shoulder 27 is simply a collar at the end of one section of valve-stem 19, which latter in this case is preferably in two parts, loosely jointed at this collar.

32 and 33 are cushion-springs acting in opposite direction to springs 24 and 25 and whereby the lift of the valves is limited. The end of each valve-stem carries an extension 34, which reaches through the open end of each housing 28 and 29. The motion of the ends of these extensions may be observed at any time, disclosing thereby the manner in which the valves operate and the extent of their movement. Except during the time such observations are made, it is preferable to have caps 35 placed over the open ends of

the housings to prevent the escape of ammonia-fumes.

As to mode of operation, the pump described represents a type well known in this class of machinery. There exists an objection, however, with many of them, which is the impossibility to obtain for compression by the piston at each working stroke a completely-filled cylinder—meaning a cylinder filled with gas with the same pressure and density as prevails in the inlet-pipe. This is on account of the resistance of spring 24 preventing suction-valve 13 from opening at once to admit gas when the piston recedes. When this valve finally does open, the piston has traversed part of the way, and as a consequence gas enters only during the remainder of the stroke. Unless special means are employed, this objection—that is, difference in pressure between the gas in the cylinder and that in the inlet-pipe, caused by the resistance of the intervening spring-controlled valve 13—cannot be overcome. The difference is, however, greater than the difference caused by the resistance of the spring alone, because inasmuch as the filling of the cylinder is a matter of time, however short, and is directly depending on the effective duration of the suction stroke of the piston, meaning the time during which the piston actually draws gas into the cylinder, it follows from the fact that such effective time is shortened by the belated opening of the spring-controlled suction-valve. The time during which the filling of the cylinder proceeds is also shortened, and the latter instead of receiving a charge of gas at a density equal to the pressure in the inlet-pipe, less the difference caused by the spring resistance of valve 13, receives it at a still greater reduced density. This is for the further reason that the stroke of the pump is governed by the positive stroke of the actuating-motor, usually a steam-engine connected to the pump. Such engine reciprocates the pump-piston, but follows out its own independent action and irrespective of the quantity of gas drawn in by the latter, and the engine-piston enters upon its return stroke from the turning-point, whether the pump-cylinder is as full of gas as it can possibly be or not, there being no dependent interaction between the two cylinders or machines in this respect. Thus in using figures and taking the average pressure in the inlet-pipe, which is about twenty pounds, and assuming the resistance of valve 13 to be five pounds, the density or pressure of the gas within the cylinder, instead of being fifteen pounds, the highest attainable pressure in such a pump, is even less, by reason of the reduced time during which the receding piston is enabled to draw gas through the late-opening suction-valve. The gas in the cylinder thereby becomes diffused and the piston on its return or working stroke, instead of compressing a cylinder completely filled with gas at a density nearly corresponding with the one in valve-chamber 12, less the difference caused by the spring-resistance of valve 13, advances a lesser quantity of gas through valve 14 than it could have done otherwise during the same time. It will thus be seen that the actual working time and capacity of the piston-stroke is not completely utilized as far as quantity of gas compressed and expelled is concerned and the pump does less work at a given time than it could do otherwise. In pumps of short stroke this loss is considerable, the quantity of gas received being from one-fourth to one-third less than what could actually be compressed at the same time. To overcome this objection and supply the cylinder before the piston starts on the compression-stroke with sufficient gas to fill the former at a density or pressure equal to the one in the inlet-pipe, less the difference caused by the spring-resistance of valve 13, I provide additional means to supply gas independently of said ingress-valve 13. These means consist of a passage or side pipe 36 from each supply-pipe 10, which enters the cylinder by a port 37. Communication through this port is controlled by a check-valve 38, held to its seat by a spring 39 of a resistance not exceeding the one of spring 24 and guided by a valve-stem 40, as shown in Fig. 1. As will be seen, the piston after having passed and while receding from port 37 will draw additional gas into the cylinder therethrough, which comes from pipe 10 through passage 36 and the open check-valve, whereby the supply admitted by valve 13 is augmented and the receiving capacity of the cylinder is practically increased by lengthening the time of the effective part of its piston-stroke and by the time the steam-engine causes the pump-piston to return more gas has entered than would have been the case otherwise. Thus, in order to be plainer and using again the figures mentioned before, according to which the highest attainable pressure within the cylinder was fifteen pounds, and assuming the pressure of the gas inside the cylinder to have risen to ten pounds at the moment the piston passes the check-valve, the latter will naturally open and remain open until the pressure of the gas within the cylinder equals the one in the inlet-pipe, less the spring-resistance of the valves. In this manner the receiving capacity of the cylinder is increased by means independent from and not controlled by the regular suction-valve 13. The same takes place at the other half of the cylinder when the piston returns, when the check-valve acts in the same capacity. I am aware that other means have been devised to overcome this difficulty and to obtain a completely-filled cylinder. Such means are, however, only applicable to single-acting pumps and cannot be used on the type of a pump just now described, which is double-acting. With certain modifications my construction may, however, be adapted to single-acting pumps, such as illustrated in Fig. 2, where passage 36 is continued to the extreme other end of the cylinder, where its discharge-port 37 is located. The passage in this case may form a part of the cylinder-casting. The piston is provided with a port 41, controlled by a valve 42, guided by a stem 43 and held in position by a spring 44 of similar strength to the springs before mentioned. The enlarged part of this stem, whereby the same is guided near its front end, is cut away on each side, as shown at 45, to permit the gas to pass. The suction caused by the working or compression stroke of the piston opens check-valve 38 and causes the larger part of the cylinder to fill. On the return stroke and before ingress-valve 13 opens the valve in the piston opens and permits the gas behind the latter to escape to the other side, the closing check-valve preventing escape back to feed-pipe 10. It will thus be seen that the receiving capacity of the cylinder, which is impaired by the late opening of the ingress-valve, whereby, as a consequence, the time during which the piston draws in gas is also shortened, is counteracted by my auxiliary valves, which increase the receiving capacity of the cylinder, independent of the regular ingress-valve, and aid to fill the former to the full obtainable limit.

The gland 46 of the stuffing-box, through which the piston passes, is held in place by a nut 47. The former is extended outwardly and carries on its outer end, which is screw-threaded, an oil-chamber 48, which surrounds the piston-rod and through which the latter passes on its motion. A feeder 49, of any suitable absorbent material—like cotton, for instance—surrounds the piston-rod and applies to it the lubricant contained in the oil-chamber. The latter receives its supply through an opening 50. As will be seen from the manner of its connection, this oil-chamber is removable without necessitating removal of the gland or disturbing the packing.

Having described my invention, I claim as new—

1. In a compression-pump, the combination of a reciprocating piston and a pump-cylinder, valve-chests at each end of the latter, an ingress and a discharge valve in each valve-chest, inlet-pipes 10, to the valve-chest of each ingress-valve, a passage or side pipe 36, connecting the inlet-pipe 10, to one valve-chest at one end with the inlet-pipe to the valve-chest at the other end, a port 37, connecting the side pipe with the cylinder midway between the latter's ends and a valve 38, controlling communication by port 37, between side pipe 36 and the cylinder.

2. In a compression-pump, the combination of a pump-cylinder with ingress and discharge valves at one end, a reciprocating piston, a supply-passage to the ingress-valve, a supply-passage 36 to the cylinder, entering the same by a port 37 at the other end of the cylinder, through which an additional supply of gas may enter independent of the regular ingress-valve, a check-valve in passage 36, remote from where the valves are located and a valve in the piston to permit the gas entering through port 37 to pass to the other side of the piston.

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

WILLIAM F. NIEBLING.

Witnesses:

WM. KRAMER,

C. SPENGEL.