W. P. M. GRELCK.

VACUUM PUMP.

APPLICATION FILED AUG. 4, 1906.

898,461.

Patented Sept. 15, 1908.

2 SHEETS—SHEET 1.

Fig. 1.

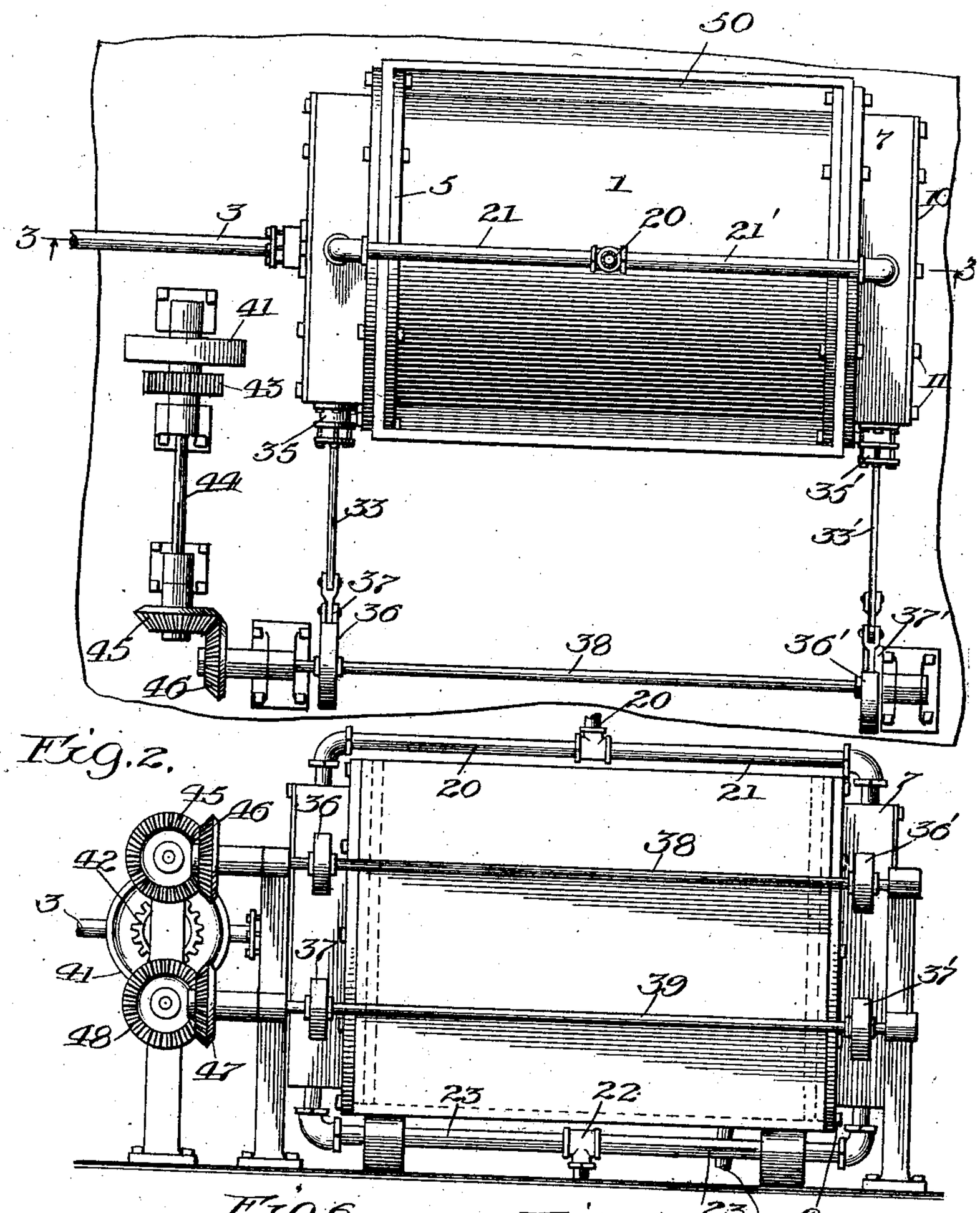


Fig. 2.

Fig. 6.

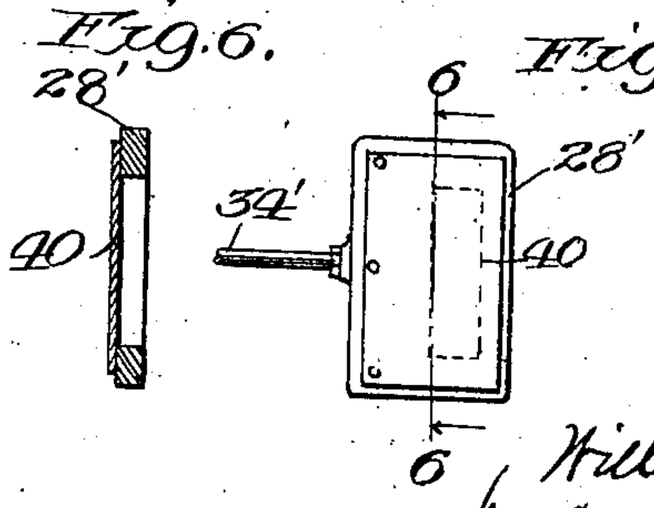


Fig. 5.

Witnesses:
Chas. Wernicke
A. S. Phillips

Inventor
William P. M. Grelck.
by Clarence A. Chamberlain Atty.

W. P. M. GRELCK.

VACUUM PUMP.

APPLICATION FILED AUG. 4, 1906.

898,461.

Patented Sept. 15, 1908.

2 SHEETS—SHEET 2.

Fig. 3.

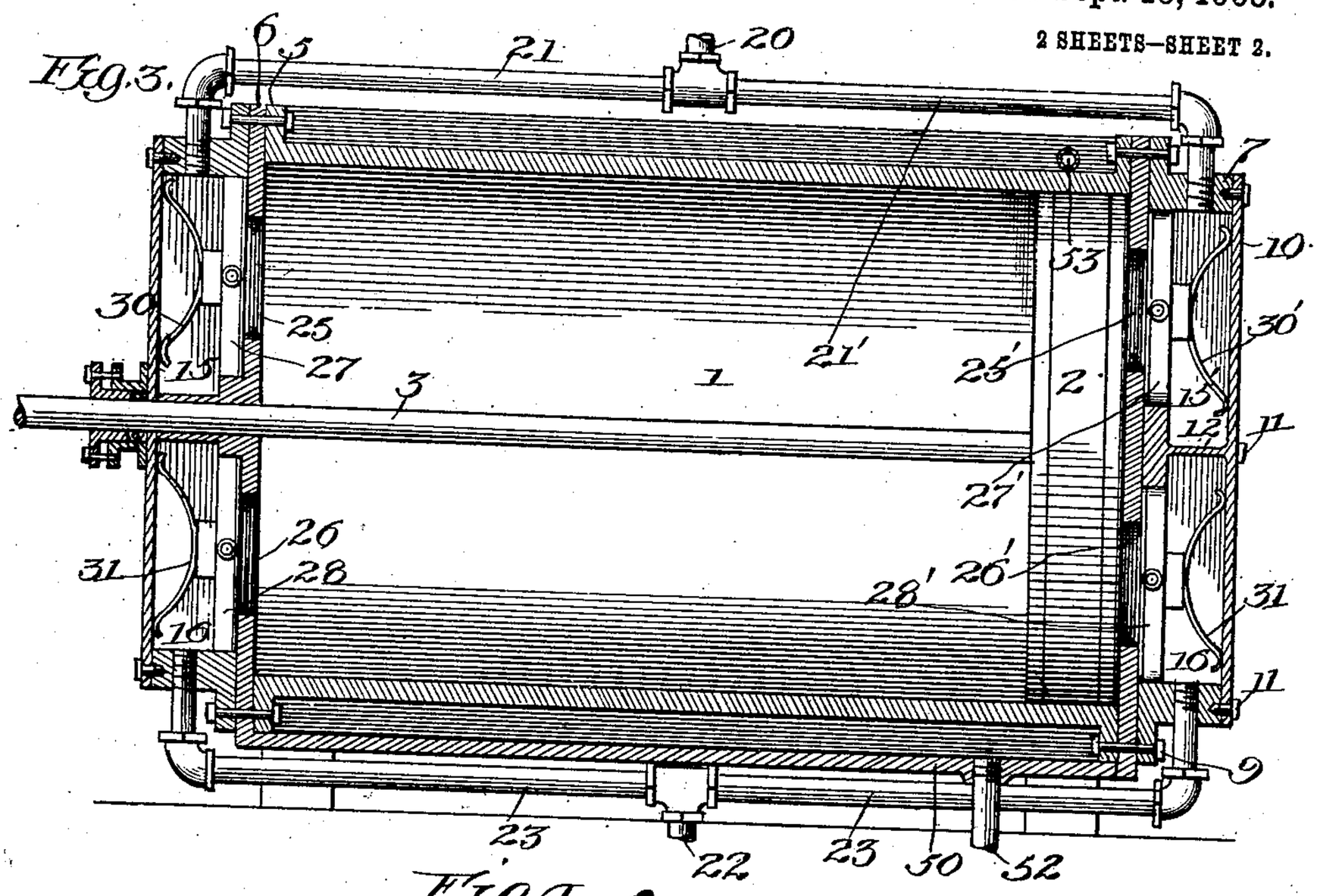
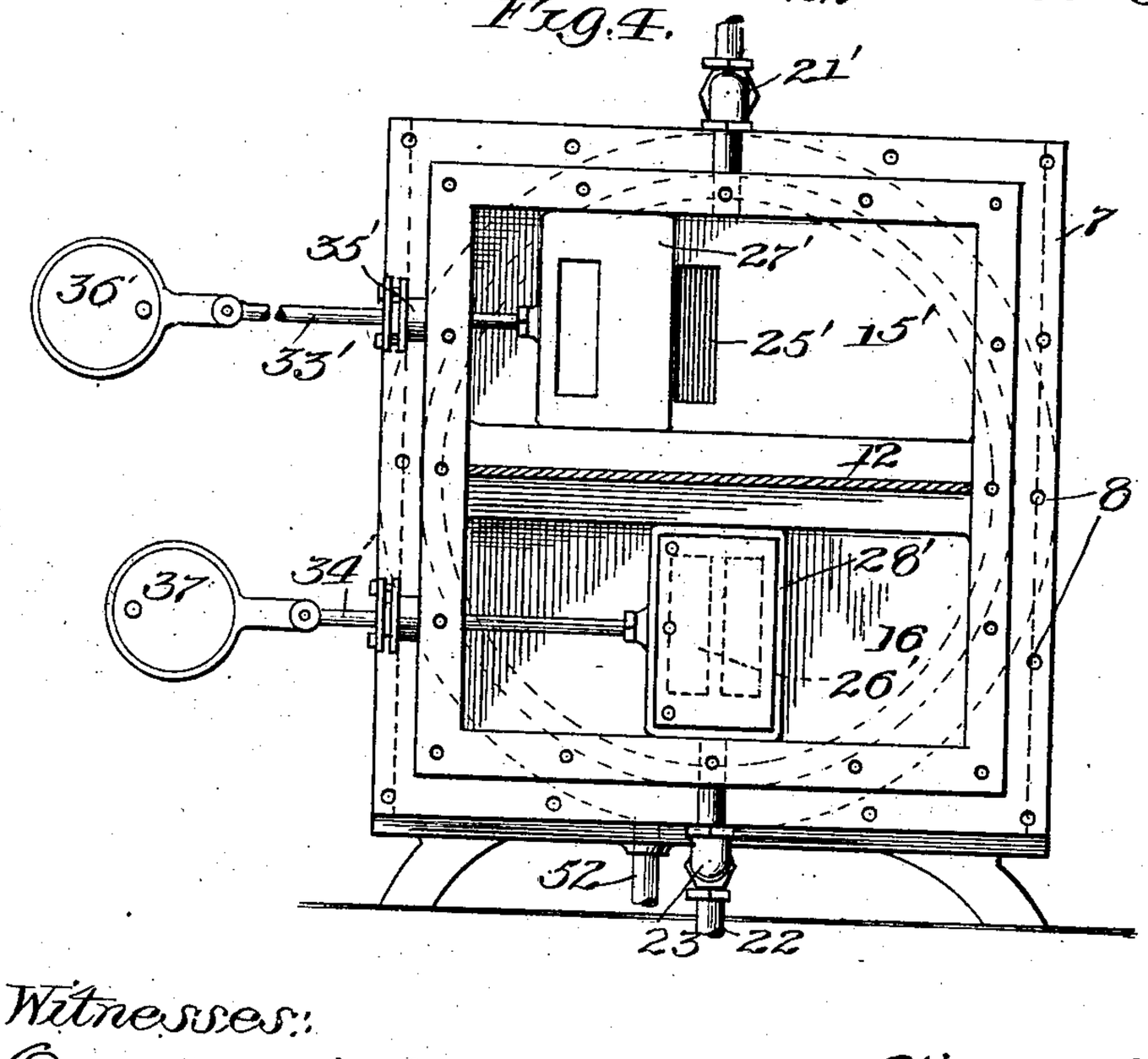


Fig. 4.



Witnesses:
C. W. Nemick
A. S. Phillips

Inventor
William P. M. Grelck
by Clarence Chamberlain
Atty.

UNITED STATES PATENT OFFICE.

WILLIAM P. M. GRELCK, OF ELGIN, ILLINOIS, ASSIGNOR TO ELGIN MILK AND CREAM COMPANY, OF ELGIN, ILLINOIS, A CORPORATION OF ILLINOIS.

VACUUM-PUMP.

No. 898,461. Specification of Letters Patent. Patented Sept. 15, 1908.

Application filed August 4, 1906. Serial No. 329,166.

To all whom it may concern:

Be it known that I, WILLIAM P. M. GRELCK, a citizen of the United States, residing at Elgin, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Vacuum-Pumps, of which the following is a specification.

My invention relates to mechanism for exhausting the air from vacuum pans, vats and the like.

It is the common practice in evaporating milk, sap, syrup and other aqueous fluids to do this *in vacuo*. The temperature at which the water is evaporated may thereby be much reduced and the rapidity by which it is taken off greatly increased. The more rapid and complete the reduction in the atmospheric pressure, the more speedy and economical becomes the process of condensation. But the machines which have been designed for this purpose do not make a complete vacuum at each stroke of the operative mechanism. A theoretically complete vacuum is impossible, but such mechanism usually has used a cylinder and piston with some form of D cut-off valve to control the tank and cylinder exhausts. The passages and chambers of such valves are of considerable size and, together with other elements, embrace in comparison with the available cylinder capacity, not less than ten per cent. of the whole. This loss takes place and is repeated at every stroke of the piston and represents a great loss of efficiency in practical operation. In my invention the capacity of the communicating portions outside the cylinders is practically reduced to nothing with a correspondingly great increase of efficiency and economy of practical results. These statements also apply to condensation or compression apparatus, and my improved machine is adapted for use as a compressor with similar advantages of efficiency and economy. I shall describe it as a vacuum machine, but it is to be understood that the description and claims are applicable to it in either capacity.

The principles of my invention are illustrated in the drawings, in which:

Figures 1 and 2 respectively represent a plan view of and side elevation of one embodiment of my invention; Fig. 3 is an enlarged vertical section of the cylinder on the line 3—3 of Fig. 1; Fig. 4 is an end view of the same, with the outer casing removed; Fig. 5 is a detailed view of a cylinder exhaust valve, and Fig. 6 is a vertical section of the same on the line 6—6 of Fig. 5.

Further describing my invention with reference to the drawings, in which like characters of reference denote like parts throughout: 1 is an exhaust cylinder containing the piston head 2, which is operatively connected by the piston rod 3 to any suitable or practical driving mechanism, by which reciprocating motion may be given. The cylinder barrel 4 is flanged at 5 in the usual manner, by which cylinder heads may be attached. The cylinder heads should preferably be extended beyond the circle of the cylinder in rectangular form, and rectangular casings 7, which may be of cast metal, are provided with openings 8 through which they may be secured to the cylinder heads by the bolts 9. An external plate 10 is secured to the casing 7 by the tap bolts 11. The said casing 7 should have a partition 12 by which the space within the casing and between the cylinder head and the outer casing may be divided into two chambers 15 and 15′, 16 and 16′ at either end of the cylinder.

20 represents a pipe connecting with any tank or chamber which is to be exhausted and which by the branches 21 and 21′ is connected to the tank exhaust chambers 15 and 15′. A similar pipe 22 may be open to the external air and is connected by the branches 23 and 23′ to the cylinder exhaust chambers 16 and 16′. Ports 25 and 25′ in the cylinder head communicate with the corresponding tank exhaust chambers, and cylinder ports 26 and 26′ communicate with the cylinder exhaust chambers. Within the said chambers are slide valves 27 and 27′, 28 and 28′ which should be suitably machined on their under faces, as well as on their upper and lower edges and adapted to move in suitable guides across the ports. When in operation the air pressures involved will normally keep these slide valves in contact with the cylinder head, but to keep them in this position when not under pressure spring or similar guides 30 and 30′, 31 and 31′ may be employed. The valves should be connected by suitable valve stems 33 and 33′, 34 and 34′ passing through glands 35 and 35′, etc. These are attached to eccentrics 36, 36′, 37

and 37′ carried on the shafts 38, 39 parallel with the axis of the exhaust cylinder. These shafts may be connected up and driven in any convenient way. A practical means by which they may be actuated in fixed relation to each other is shown in the drawings in which 41 is a wheel to be connected in fixed relation to the source of power (not shown) by which the piston rod 3 is actuated. A gear 42 is connected therewith which meshes with the pinion 43 on the shaft 44. On the other end of said shaft is the bevel gear 45 meshing with the bevel gear 46, which is secured to the eccentric shaft 38. By similar means the eccentric shaft 39 may be driven by means of the bevel gears 47 and 48. It will be seen that by giving any desired throw to the eccentrics and by giving them the proper relation to each other, which may be done by the mechanism shown, or any other similar one which will readily occur to one skilled in the art, the cut-off valves may be actuated to such distances and in such relation to each other as may be desired.

The lower slide valves 28 and 28′ which control the cylinder exhaust should have perforations corresponding to the ports which they control and an auxiliary valve of some form should be provided to control the said opening. This may be of the hinged type and comprise a sheet of spring metal 40.

The operation of my machine is as follows: Assuming the piston head to be at the position shown in Fig. 3, the ports 25′ and 26 should be uncovered by the slide valves while 25 and 26′ are closed. The piston head being moved to the other end of the cylinder, air from the exhaust tank will flow through the pipe 20, the branch 21′, the tank exhaust chamber 15′ and the port 25′ to fill the bore of the cylinder, the normal air behind the piston head being expelled from the bore through the port 26 and its corresponding passages. When the piston head has completed its travel, being in as close contact with the head 6 as is safely possible, the motion is reversed and the previously opened slide valves closed, while the valves 27 and 28′ are opened. The movement of the piston head to its first position will exhaust air through the pipe 20, the branch 21, the tank exhaust chamber 15 and the port 25 to fill the cylinder in the rear of the piston, while the air in front of the piston which, at its previous movement had been drawn there from the exhaust tank, will be expelled through the port 26′. Such expulsion, however, will not be immediate. The air in front of the piston having been drawn from the tank to be exhausted under less than atmospheric pressure the slide valve 28′ having been moved, as it should be by its corresponding eccentric, until the opening therein registers with the port 26′, the normal movement of air would be inward to restore the equilibrium, but the valve 45 on the slide valve 28′ prevents ingress of air and the initial movement of the piston will be aided by the exhaust air in front of it until the equilibrium is restored. At this point the plate valve 40 will release and the inclosed air will flow freely through the port into the cylinder exhaust chamber and thence to the open air. It will be seen that a great economy of power is obtained by this action, constantly increasing as the degree of exhaustion in the tank progresses. With the exhaustion of each stroke the vacuum is increased and on the return this vacuum will act for a longer period to aid the operation of the piston and until the equilibrium with the external air pressure is restored. It will be seen that as the vacuum becomes more perfect, this directly aids the operation of the piston and the amount of power required during the whole process is increased but little if any. It will further be seen that the amount of dead space in the cut-off mechanism is limited to the actual area of the ports and the thickness of cylinder heads in which they are placed. This is so slight as to be of very little importance. The entire contents of the cylinder are exhausted at each stroke, less only the capacity of the ports and the necessary clearance of the cylinder head.

To prevent heating of the apparatus in use, it is desirable to surround the cylinder with a water jacket. The cylinder heads being rectangular, I prefer to have the outer walls 50 of the water jacket follow the interior edges of the cylinder heads, thus forming a rectangular casing around the circular cylinder and providing thereby greater space for the water. The water may be supplied to the water jacket through the pipe 52 and withdrawn therefrom through the opening 53.

I claim:

1. In a vacuum pump, a cylinder, a piston moving therein, a casing secured to the cylinder head, a transversely-extending partition in said casing dividing the same into a plurality of chambers out of communication one with the other, ports in the cylinder head establishing communication between said chambers and the cylinder, a transversely-slidable cylinder exhaust valve in each chamber of said casing to control said ports, and an auxiliary valve carried by each exhaust valve.

2. In a vacuum pump, a cylinder, a piston moving therein, a tank exhaust chamber external to the cylinder head, a port between the said chamber and the cylinder, a valve to control the port, an exhaust chamber external to the head and separated from the tank exhaust chamber, a port between the said exhaust chamber and the cylinder, an exhaust valve to control said port, and

means in connection with said exhaust valve for holding the exhaust until equilibrium with the outside pressure is obtained.

3. In a vacuum pump, a cylinder, a piston moving therein, a tank exhaust chamber external to the cylinder head, a port between the said chamber and the cylinder, a sliding valve to control the port, an exhaust chamber external to the head and separated from the tank exhaust chamber, a port between the said exhaust chamber and the cylinder, a sliding valve to control the same, and an auxiliary valve carried by said sliding valve.

4. In a vacuum pump, a cylinder, a piston acting therein, tank exhaust chambers at opposite ends of the cylinder external thereto, ports connecting said chambers and the cylinder, valves to control said ports, cylinder exhaust chambers at opposite ends of the cylinder external thereto, ports connecting the last named chambers to the cylinder, and sliding valves to control said ports, the tank chamber at each end of the cylinder being separated from the cylinder exhaust chamber at the same end, and means in connection with said sliding-valves for holding the exhaust until equilibrium with the outside pressure is obtained.

5. In a device of the character described, a cylinder exhaust valve adapted normally to control its port, and an auxiliary valve thereon adapted to prevent ingress of external air after exhaustion until the external pressure and the pressure in the exhaust end of the cylinder are in equilibrium.

6. In a vacuum pump having inlet and exhaust valves connected with either end of the cylinder, and means for actuating the valves in relation to the piston movement, means connected with the exhaust valve for holding the exhaust until, on the return of the piston, equilibrium with the outside pressure is obtained.

In witness whereof I have hereunto set my hand, this 31st day of July A. D. 1906, in the presence of two subscribing witnesses.

WILLIAM P. M. GRELCK.

Witnesses:

C. K. CHAMBERLAIN,

A. S. PHILLIPS.