F. A. SIMONDS.

VACUUM PUMP.

APPLICATION FILED JULY 6, 1908.

943,848.

Patented Dec. 21, 1909.

3 SHEETS—SHEET 1.

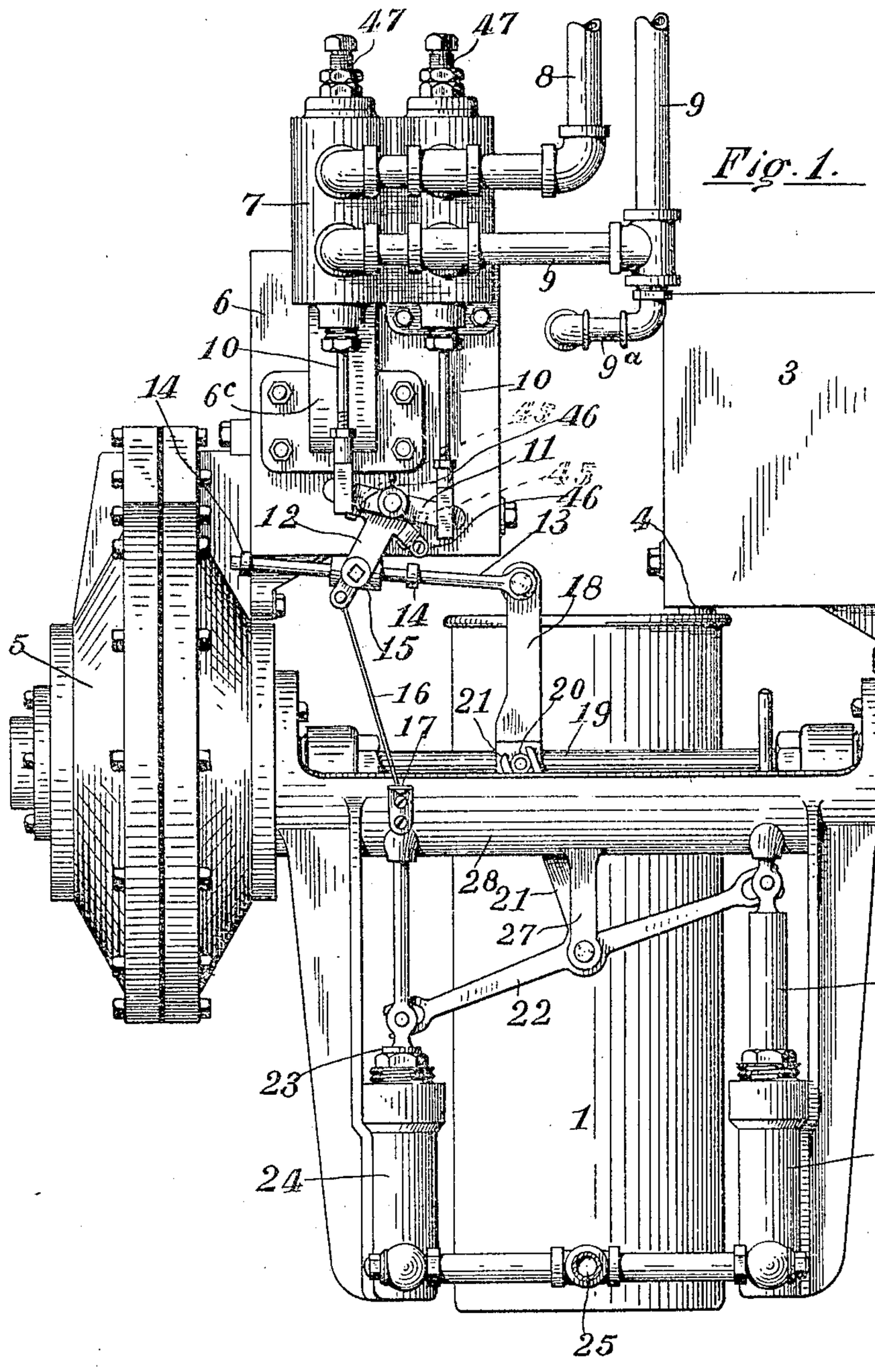

Fig. 1.

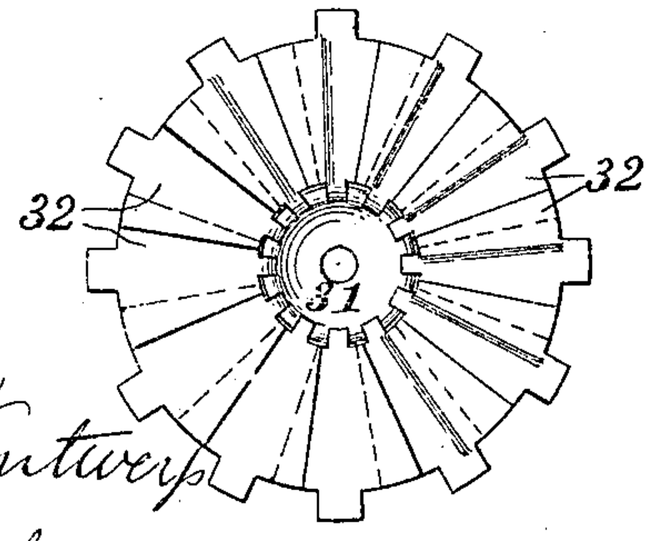

Fig. 9.

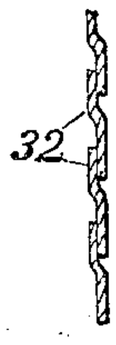

Fig. 10.

Witnesses
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3 SHEETS—SHEET 2.

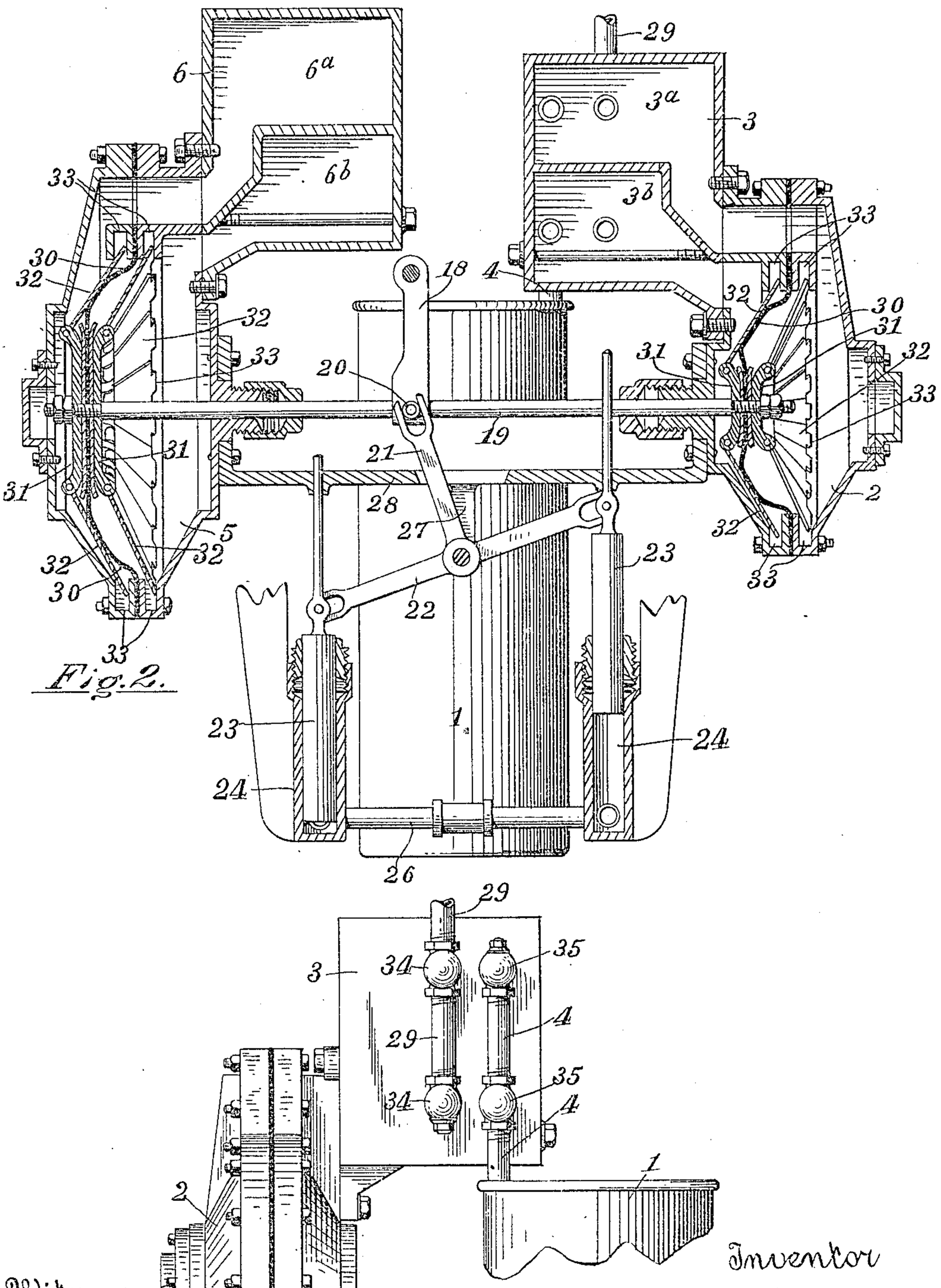

Fig. 2.

Fig. 8.

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3 SHEETS—SHEET 3.

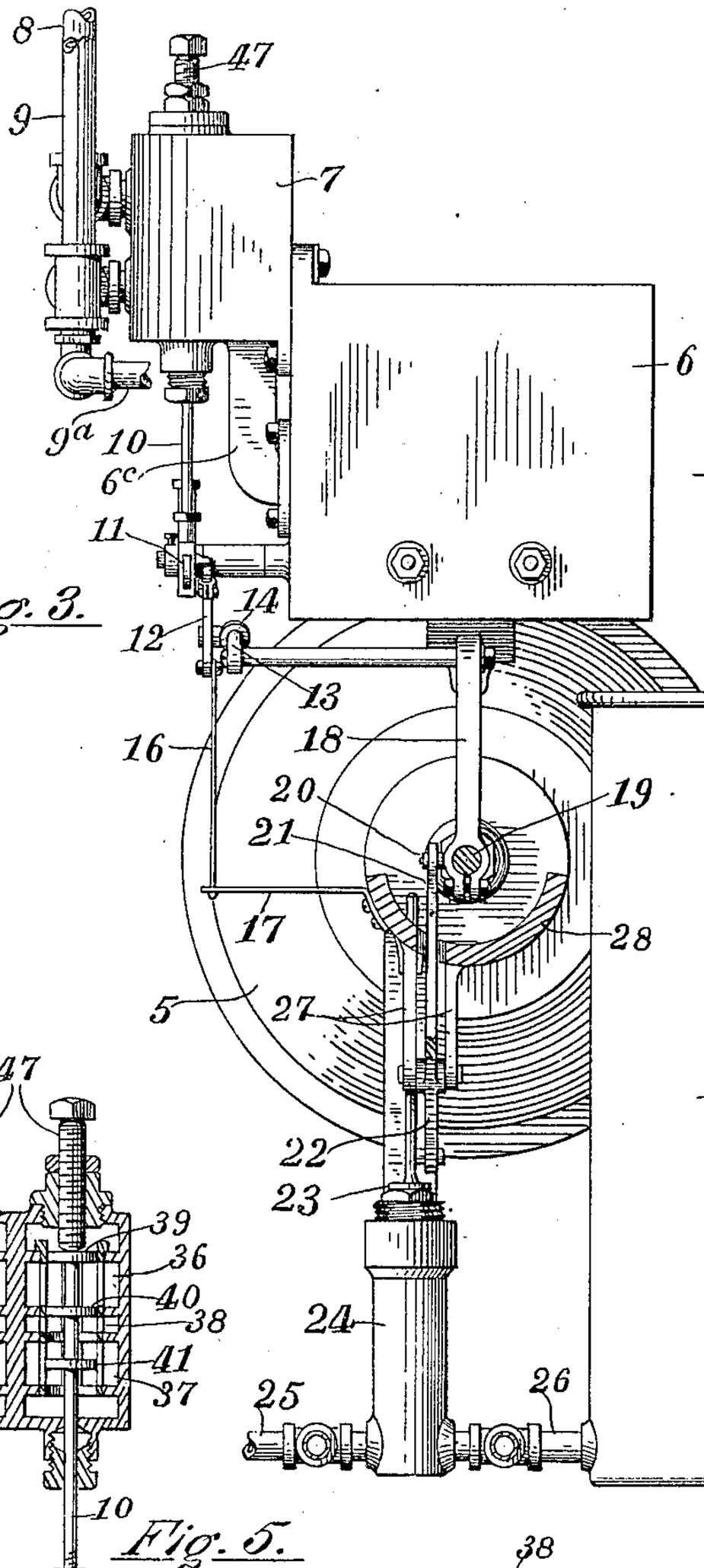

Fig. 3.

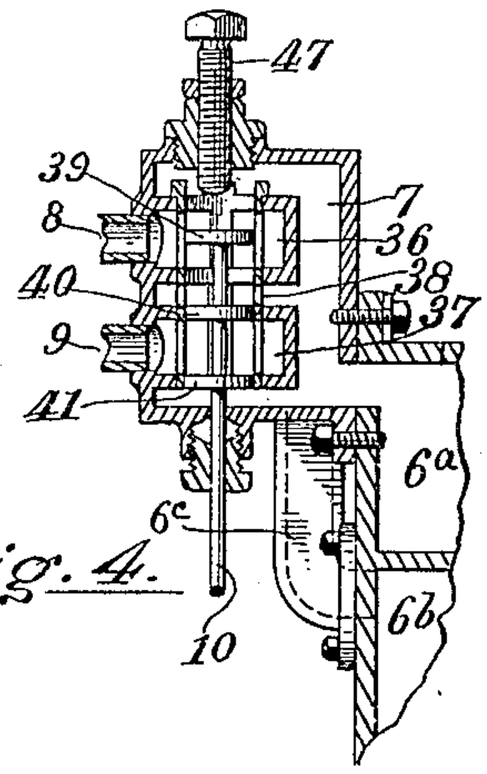

Fig. 4.

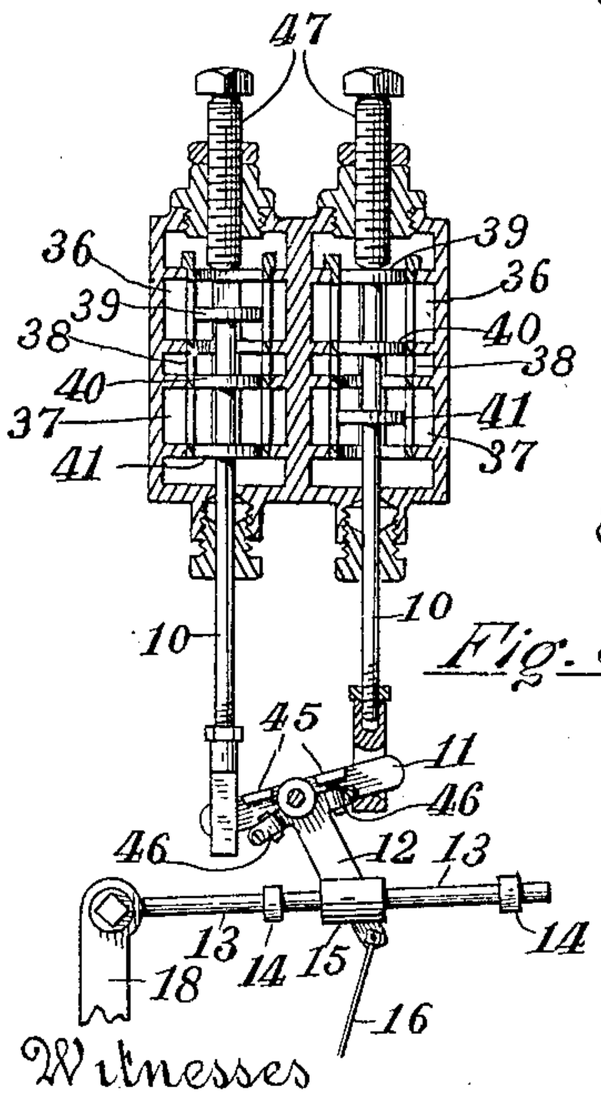

Fig. 5.

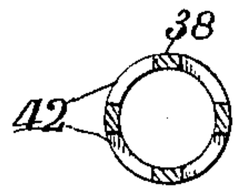

Fig. 6.

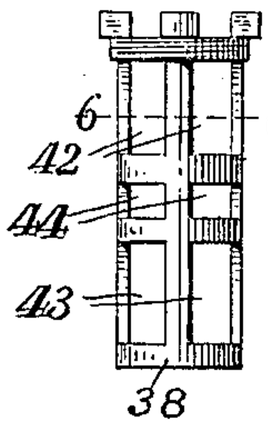

Fig. 7.

Witnesses

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UNITED STATES PATENT OFFICE.

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VACUUM-PUMP.

943,848. Specification of Letters Patent. **Patented Dec. 21, 1909.**

Application filed July 6, 1908. Serial No. 442,145.

To all whom it may concern:

Be it known that I, FRANK ARTHUR SIMONDS, a citizen of the United States of America, residing at Grand Rapids, in the county of Kent and State of Michigan, have invented certain new and useful Improvements in Vacuum-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.

My invention relates to improvements in vacuum pumps, and more particularly to such pumps adapted to be used with steam heating systems, and its object is to provide a simple and reliable device that is not likely to get out of order; that will operate under light pressures and with little frictional resistance, and to provide the same with various new and useful features hereinafter more fully described and particularly pointed out in the claims, reference being had to the accompanying drawings in which;

Figure 1 is an elevation of a device embodying my invention; Fig. 2 the same with portions in vertical section; Fig. 3 an elevation of the motor end of the device viewed from the direction of the pump end of the same; Fig. 4 a detail in vertical section through one of the steam valves that operates the motor; Fig. 5 a detail showing a vertical section at right angles to Fig. 4; Fig. 6 is a transverse section on the line 6—6 of Fig. 7; Fig. 7 an enlarged detail of the bushing for the steam valves; Fig. 8 a detail of a portion of the pump mechanism, shown in elevation; Fig. 9 a detail of one of the diaphragm supports; and, Fig. 10 a sectional detail of the same.

Like numbers refer to like parts in all of the figures.

1 represents any convenient tank or reservoir to receive the water of condensation removed from the heating system by means of the pump 2.

3 represents a water chest interposed between the return pipe 9 and the pump to prevent unduly heating the pump. This water chest is connected by a pipe 4 with the tank 1 into which tank the water from the pump is discharged.

5 is a pressure motor constructed the same as the pump, and preferably made of a larger size to operate the pump under light pressures.

6 is a water tank interposed between the steam chests 7 and the pressure motor whereby the steam is prevented from reaching the pressure motor, and the motor operated by water pressure, thus keeping the motor cooler than if steam were admitted thereto. The steam chest 7 communicates with the boiler or other steam supply by a pipe 8, and is provided with an exhaust pipe 9 preferably discharging into the steam line of the heating system and having a drain pipe 9^a to discharge water of condensation therefrom.

10 are valve rods to oppositely move the valves for controlling the steam to operate the motor. These rods are alternately moved by a rocker bar 11 pivoted at the middle and engaging the rods 10 at its respective ends. This bar is alternately oscillated on its pivot by a T-shaped lever 12 having arms 46 alternately engaging lugs 45 on said bar which lever is operated by a sleeve 15 slidable on a rod 13 and alternately engaged at its respective ends by adjustable collars 14 on said rod. This lever 12 is also operated to move the valves suddenly in opposite directions by means of a push rod 16 pivoted to the lever at its upper end and engaging an upwardly acting spring 17 at its lower end. The rod 13 is moved longitudinally by an arm 18 fixed on the piston rod 19 which connects the motor and pump. Mounted on this piston rod is also a stud 20 having a friction roller thereon, engaged by the forked end of a lever 21, which lever is rigidly connected to a beam 22 pivoted at the middle on a hanger 27 extending downward from the yoke 28 which connects the pump and motor. This beam is connected at its respective ends to plungers 23 of the pumps 24 which pumps force the water from the tank 1 through the pipes 25 to the boiler, being connected with the said tank 1 by pipes 26 to receive water therefrom.

The case of the pump 2 and pressure motor 5 are substantially alike in construction and each consists of a lenticular chamber in which is mounted a flexible diaphragm 30 (preferably of rubber), the edge of which is clamped between the two members of the case.

The rod 19 extends through each diaphragm 30 at its respective ends, and on this rod at the respective sides of each diaphragm and clamping the same is a pair of disks 31 to each of which is pivoted the in-

ner ends of radial supporting plates 32 having slidably overlapping edges. The outer ends of which plates are inserted in recesses 33 in the case and movable therein to permit the middle of the diaphragm 30 to move to and fro within the case.

The water chest 3 receives the water of condensation and air from the return side of the system through the pipe 29, the same being provided with check valves 34. This chest is divided into an upper compartment 3^a and a lower compartment 3^b, each adapted to contain sufficient water to fill the pump and each communicates with the interior of the case at its respective side of the diaphragm.

The pressure motor is constructed the same as the pump, except on a larger scale, having the diaphragm 30, the disks 31, and the supporting plates 32 pivoted to the disks at their inner ends and movable in recesses at their outer ends. The water chest 6 is in like manner to the water chest 3 divided into upper and lower compartments 6^a and 6^b respectively communicating with the interior of the case at the respective side of the diaphragm.

The pipe 4 connecting the water chest 3 with the tank 1 is also provided with check valves 35 to check out the water from the chest to the tank, and check valves 34 serving to check the water into said chest. The steam chest 7 also communicates with the respective chambers 6^a and 6^b, as illustrated in Fig. 4, being so organized that one of the valves communicates with the chamber 6^a and the other valve communicates with the chamber 6^b.

Fig. 4 shows a section through the valve that communicates with the chamber 6^a, the other valve being in communication with the chamber 6^b through a separate passage 6^c. Each of the said valves consists of a balanced piston, having three heads 39, 40, and 41 spaced apart an equal distance, and the valve casing is provided with two chambers projecting within the steam chest, the chamber 36 communicating with the steam pipe 8, and the chamber 37 communicating with the exhaust pipe 9, and the heads of the valves are spaced apart a distance equal to the distance between the upper and lower walls of these chambers and a tubular bushing 38 extends vertically through each of said chambers and is provided with ports opposite each chamber and opposite the space between the chambers, as at 42, 43, and 44, in Figs. 6 and 7. Each bushing opens at its respective ends and the valve reciprocates therein to alternately connect the pipes 8 and 9 with the passages to the respective sides of the diaphragm. 47 are adjustable screws forming stops to limit the movement of the valves. On the bar 11 are lugs 45 alternately engaged by the oppositely projecting arms 46 of the lever 12 to tilt the bar 11.

In operation, the steam admitted through the pipe 8 passes to the respective valves and thence is admitted to and exhausted from the respective sides of the diaphragm in the pressure motor. When a valve is in its lowest position, the heads 40 and 41 are in the plane of the upper and lower walls of the chamber 37 which closes said chamber and shuts the exhaust passage. The upper head 39 is midway of the walls of the upper chamber 36, and the steam is thus permitted to flow out above and below said head. When the valve is moved upward, the exhaust passage is opened and the inlet passage closed in like manner. As the rod 19 moves, one of the collars 14 will contact the sleeve 15, and thus move the lever 12 in the same direction. As the lever passes the mid-position, the upward thrust of the rod 16 due to the spring 17 will suddenly throw the lever 12 away from the vertical position and thus instantly shift the valves, which shifting reverses the direction of pressure on the diaphragm of the pressure motor. The steam at all times acts on the surface of the water in the water chest 6 and alternately forces the same against the respective sides of the diaphragm. The pump 2 is operated by the movement of the rod 19, and the valves 34 and 35 operate therewith in the usual manner to check the water and air into and out of the pump, a quantity of water remaining in the chest 3 between the steam and the diaphragm of the pump. At each reciprocation of the rod 19, the plungers 23 of the pumps 24 are operated to force water from the tank 1 into the boiler through the pipes 25. The device thus automatically maintains a vacuum on the return line of the system and feeds the water back into the boiler.

By the use of the supporting radial plates 32, I am able to use quite thin rubber diaphragms 30, the same being supported by these plates resulting in a considerable advantage in that there is less resistance and friction than with heavier diaphragms, and also less water remaining in the discharge side at each stroke.

I do not herein claim the particular pump or motor herein shown, but reserve the same for a separate application in accordance with the requirements of the Office for division of this application.

What I claim is:—

1. The combination of, a pressure motor having a chamber and a movable member dividing the chamber into two separate compartments, a water chest having separate compartments communicating with the respective compartments of the motor and adapted to contain sufficient water to prevent access of steam to the motor, a valve

for each compartment of the chest to admit and exhaust steam to and from said compartment, a rocker bar to operate the valves, a pivoted T-shaped lever to operate the rocker bar, a sleeve pivoted to the lever, a rod slidable in the sleeve, collars on the rod engaging the sleeve, means for connecting the rod to the pressure motor to move the rod, and a spring connected to the lever to shift the same.

2. The combination of, a pressure motor having a reciprocating flexible diaphragm and a lenticular case divided into two separate compartments by the diaphragm, a water chest having separate compartments each communicating with the case at the respective sides of the diaphragm and adapted to contain sufficient water to prevent access of steam to the motor, a valve to control the flow of steam to and from each compartment of the chest, a rocker bar pivoted at the middle and connected to the valves at its respective ends, a T-shaped lever engaging the rocker bar at opposite sides of its pivot, a sleeve pivoted to the lever, a rod slidable in the sleeve, means for connecting the rod to the motor, collars on the rod and engaging the respective ends of the sleeve, a thrust rod pivoted to the lever, and a spring engaging the thrust rod.

3. The combination of, a pressure motor having a reciprocating member, a chest communicating with the motor at one side of said member and adapted to contain sufficient water to prevent access of steam to the motor, an inlet chamber and an exhaust chamber spaced apart a distance equal to the stroke of the valve and projecting into said chest, each chamber having parallel walls spaced apart communicating with the motor at one side of said member, a tubular bushing extending through both chambers and having ports within said chambers and also between the same, a piston valve reciprocable in said bushing and having three heads spaced apart the same distance as the walls of each chamber, and means for reciprocating said valve.

4. In a pressure motor, the combination of a lenticular case, a flexible diaphragm reciprocable in said case and dividing the same into two separate chambers, two steam chests communicating with the interior of the case at the respective sides of the diaphragm, a water chest interposed between each steam chest and the case, a balanced piston valve in each steam chest, a rocker bar pivoted at the middle and connected at its respective ends to the respective valves to oppositely shift the same, lugs on the side of said bar, a T-shaped lever alternately engaging the lugs, a sleeve pivoted to the lever, a rod slidable in the sleeve, means for connecting the rod to the reciprocable diaphragm to move the rod, collars on the rod to engage the respective ends of the sleeve, a push rod engaging the lever, and a spring engaging the push rod to yieldingly force the same toward the lever.

5. The combination of, a diaphragm pump and a diaphragm pressure motor, a piston rod connecting the same, a water chest to the pump and a water chest to the motor, each chest having a separate compartment communicating with the respective sides of the pump and the motor and adapted to contain sufficient water to prevent access of steam to said pump and motor, valves to control the flow of steam to and from the chest of the motor, an arm on the piston rod connected to the valves to operate the same, a tank to receive water from the pump, a feed pump communicating with the tank, a lever to operate the feed pump, and a stud on the piston rod to operate the lever.

6. The combination of, a pressure motor and a pump, each comprising a lenticular chamber and a flexible diaphragm reciprocable in the chamber, a piston rod connecting said diaphragms, a water chest having separate compartments communicating with the pressure motor at the respective sides of the diaphragm, valves to control the flow of steam to and from said compartments, means for connecting said valves with the piston rod to operate the valves, a tank to receive water from the pump, feed pumps communicating with the tank, a pivoted beam to operate the feed pumps, a forked lever to operate the beam, and a stud on the piston rod engaging the forked lever.

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

FRANK ARTHUR SIMONDS.

Witnesses:
PALMER A. JONES,
LUTHER V. MOULTON.