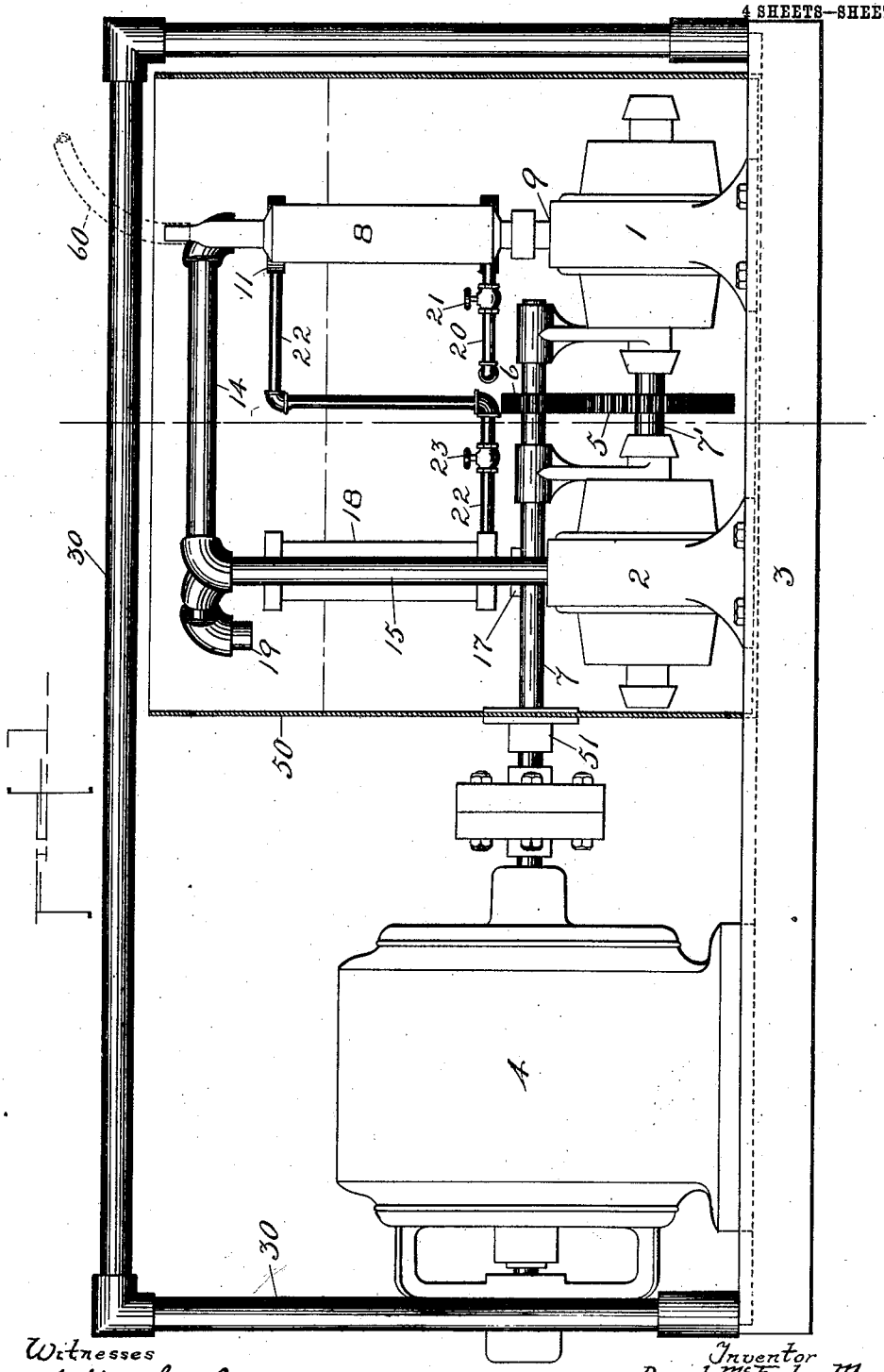
No. 846,933. PATENTED MAR. 12, 1907.

D. McF. MOORE.

ROTARY VACUUM PUMP.

APPLICATION FILED MAY 20, 1904.

4 SHEETS—SHEET 1.



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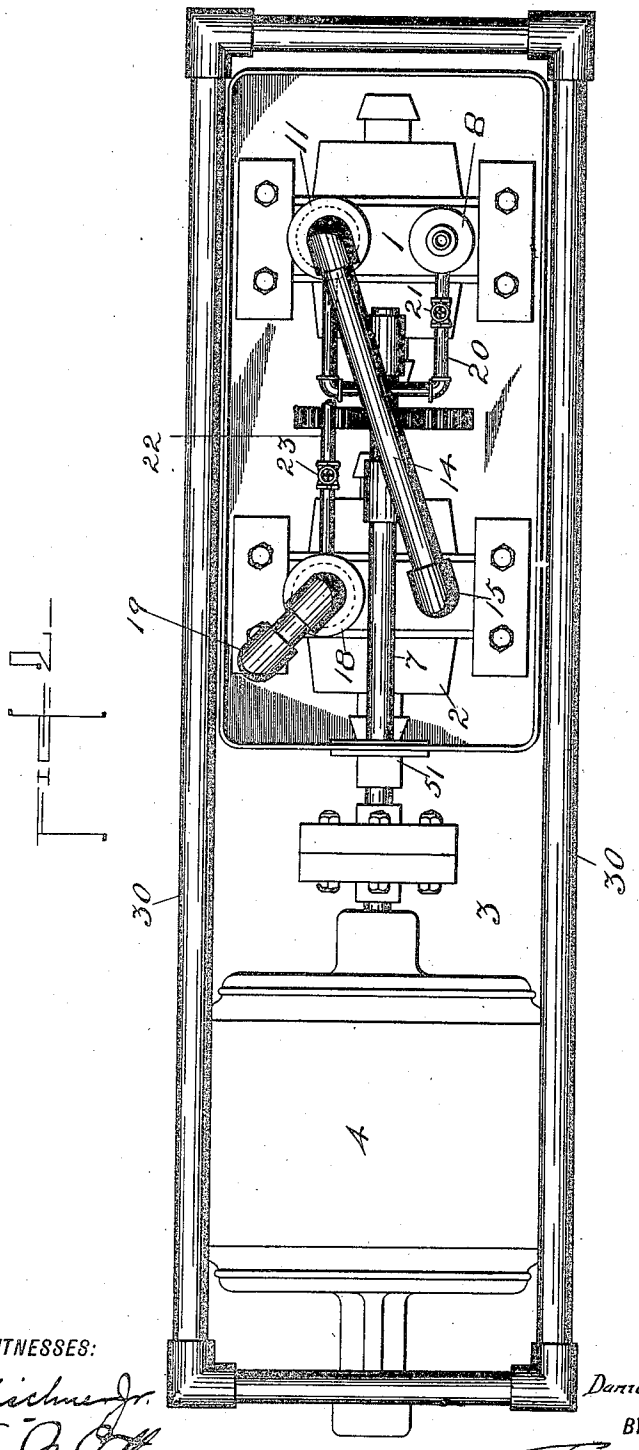

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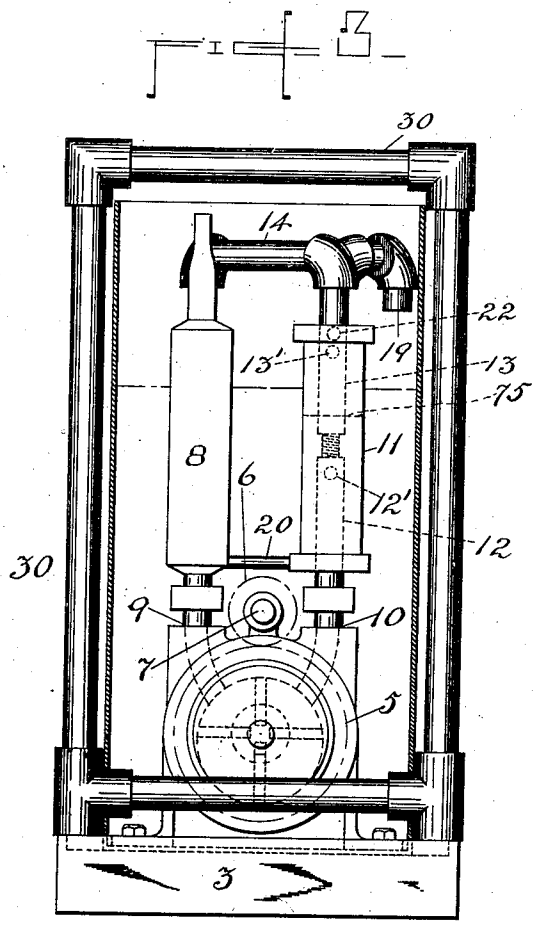

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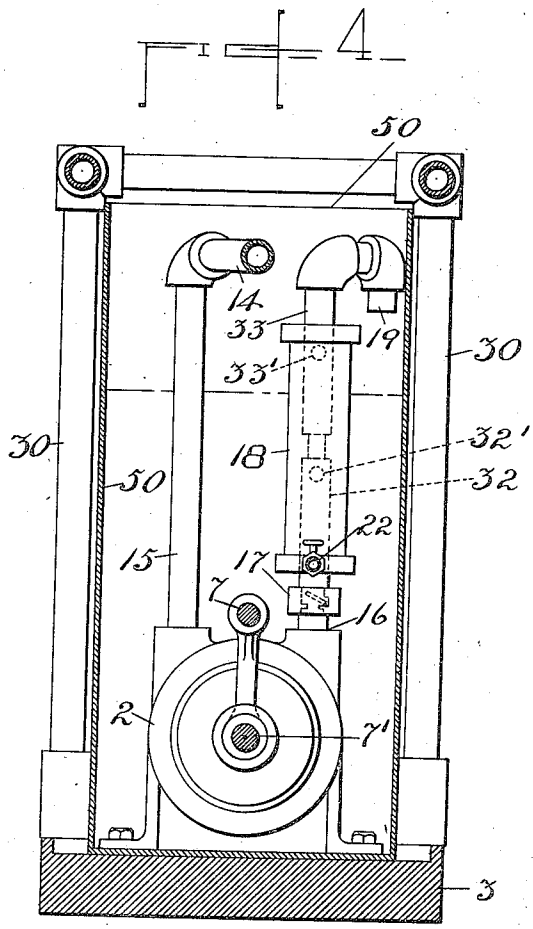

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UNITED STATES PATENT OFFICE.

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ROTARY VACUUM-PUMP.

No. 846,933. Specification of Letters Patent. Patented March 12, 1907.

Application filed May 20, 1904. Serial No. 208,825.

To all whom it may concern:

Be it known that I, DANIEL McFARLAN MOORE, a citizen of the United States, and a resident of Newark, in the county of Essex and State of New Jersey, with post-office address as above, have invented certain new and useful Improvements in Rotary Vacuum-Pumps, of which the following is a specification.

My invention relates to air-pumps employed for producing a vacuum; and the object of the invention is to provide a simple and efficient apparatus embodying a rotary pump or pumps driven by mechanical power and suitable for use in producing a vacuum in electric lamps of any type, more particularly incandescent electric lamps of the type devised by me and termed "vacuum-tube lamps."

By my improved apparatus I provide a substitute for the ordinary mercury-pump and by mechanical power am enabled to attain a vacuum of much higher degree than it has hitherto been possible to obtain by the use of air-pumps of the mechanical type in which pistons or vanes rotating have been used.

My invention consists in certain improvements in the construction and manner of combining rotary vacuum-pumps, as hereinafter more particularly described and then specified in the claims.

In carrying out my invention I propose not only to immerse the pumps in an oil-bath, but I also provide means for introducing oil to the inlet side of the pump, which oil operates as a seal and as a lubrication for the rotary wings or valves.

In my improved apparatus the oil-bath, in which the pump and the principal connections thereof are immersed, serves the very important purpose of sealing the pump and its connections against the admission of the atmosphere through leaky bearings, loose stop-cocks, or other leaks and assures an efficient operation of the same when provision is made for circulating oil through one or more of the pumps employed in the combination. The oil-bath also serves the further improved purpose of lubricating the gearings and shaft or shafts employed in rotating the pump and which for the best results should be run at a high speed. It also serves to absorb and dissipate the heat due to the operation of the apparatus.

In the accompanying drawings, Figure 1 is a side elevation of an apparatus embodying my invention. Fig. 2 is a plan of the same. Fig. 3 is an end elevation showing the first pump of the series and its principal connections. Fig. 4 is a similar view looking in the same direction of the second or last pump of the series, the drive-shaft and the pipe connection being shown in section.

In carrying out my invention I propose to employ a rotary pump of any preferred construction, but preferably one of the revolving-vane type or one in which radial wings or valves work in an eccentric casing provided with inlet and outlet ports, as well understood in the art.

In the drawings I show two pumps 1 2 and an inclosed liquid-tight tank 50. (Illustrated in Fig. 1 in vertical section.) The pumps and tank are mounted on a suitable base 3, upon which is also mounted, preferably, the rotary driving-motor 4 of the apparatus, which motor 4 is preferably an electric motor and suitably coupled with the main driving-shaft 7 of the apparatus, said shaft 7 passing through an oil-tight stuffing-box 51 in the tank 50. The parts may be inclosed in a suitable frame 30, of cast-iron tubing, secured to the base 3. The drive-shaft 7 may obviously be the shaft for the rotary member of the pump or pumps, but by preference is a counter-shaft geared to the pump-shaft through gears 6 and 5. The latter gear 5 is on the shaft 7', which carries the rotary member of both pumps and has the gear 5 secured to it between the pumps. The shaft 7 is mounted within the tank 50 on suitable bearings secured to the vacuum-pump casings, as shown at the meeting ends thereof. This construction is adopted to give strength to the drive members of the apparatus, as well as to balance up the shafting and to give smoothness of operation. All the mechanism with the exception of the motor 4 is inclosed, as shown, in the casing 50, which holds oil to a height sufficient to immerse the pump or pumps and the driving connections. For an oil I prefer to use a heavy mineral oil—such, for instance, as cylinder stock-oil.

1 indicates the high-vacuum pump of the

combination or that which is connected directly to the pipe or tube 60, joined to the receptacle in which the vacuum is to be produced or maintained, while 2 is the low-vacuum pump or the one whose outlet forms the termination of the system and is joined to the outlet 19, from which the air exhausted from the receptacle escapes.

Between the pipe 60 and the inlet 9 for pump 1 is interposed the cylinder 8, which is made, as shown, of a larger size than the pipe 60 and connections in order that it may act as a reservoir. Outlet 10 of the pump is coupled to a cylinder or receptacle 11 of suitable construction to provide an oil-trap for oil passing with the air through the outlet 10. For this purpose the receptacle 11, which is preferably of glass, may be provided with a pipe 12, forming a continuation of the outlet 10 and rising in the tube 11 to a suitable height, where it is provided with an outlet-port 12′. The oil collecting in the bottom of the cylinder or receptacle 11 is returned by a pipe 20 to the inlet port or pipe 9, the flow being regulated, if desired, by a valve 21. The air which passes through the port 12′ into the cylinder 11 is delivered through the port 13′ in a pipe 13, which enters the top of the receptacle 11, and through said pipe 13 the air passes by a pipe 14, as shown, to the inlet port or pipe 15 of the second member or pump 2 of the series. The outlet 16 of the latter may be connected to a receptacle 18 of similar construction to the receptacle 11. For this purpose the outlet may terminate in a pipe 32, rising in the receptacle 18 and provided with a port 32′, this construction serving to provide at the bottom of the cylinder 18 a trap for oil which may pass from the first to the second member of the series. From the cylinder 18 the air passes through the port 33′ in a pipe 33, entering the cylinder, and finally to the outlet 19, which, as shown, is suitably arranged to deliver into the tank 50, so that any escaping oil will be returned thereto. From the trap at the bottom of cylinder 18 a pipe 22 leads to the cylinder 11. In said pipe is a stop-cock 23, which is closed during normal operation. When, however, the pump stops, the opening of this valve or stop-cock 23 will permit the oil trapped in 18 to return by back pressure to the cylinder 11 and back to the pump 1, as already described, through pipe 20.

In the outlet 16 of the pump 2 a suitable back-pressure valve 17 is located for the purpose of stopping the backflow of air through the pump 2 and causing back circulation of oil to take place through pipe 22, as just described, when the valve 23 is open. When the pump is started, a suitable amount of oil is introduced in the pump 1 through the pipe 20 by opening the valve 21 and allowing it to flow from the bottom of the cylinder 11, into which a suitable quantity of oil has been previously introduced. The course of the oil during operation of the pump is through the cylinder 8, thence through port 9 into pump 1, the blades of which force the oil mingled with air out at port 10 and through outlet-port 12′. The oil falls to the bottom of the receptacle 11 and is trapped there, while the air passing out through the opening 13′ is carried by pipe 14 to the pump 2, then through an inlet-port 15 of the latter and through said pump to the outlet 16 through the back-pressure valve 17, opening upward and into the cylinder 18, where any entrained oil is trapped, as in the cylinder 11. The air passes on from cylinder 18 to the outlet 19, which is the outlet-port of the series of exhausting devices and which, as already stated, opens into the tank 50 in order that any oil escaping may be recovered. The oil trapped in cylinder 11 is permitted to pass back to port 9, the flow being regulated by valve 21. The oil thus circulated in the pump 1 helps to draw the air through said pump by mixing with it, the two being separated in cylinder or receptacle 11, in which circulation of the air is baffled or delayed and the oil permitted to drop to the bottom of the cylinder.

In starting the pump or when drawing large quantities of air through it the oil in cylinder 11 will foam, due to the vacuum produced by pump 2, and same will pass or tend to pass over into the pump 2, but will there be dropped in cylinder 18. This oil may be returned to cylinder 11, when desired, through the pipe 22 by opening the valve 23, which, however, must be closed during normal operation.

All pipe and other joints, especially those above the oil-bath, must be made absolutely air-tight by soldering or other efficient means.

By maintaining a column of oil in the cylinder 11 at a level above the outlet-port 12′—as, for instance, at the level indicated by the horizontal dotted line 75—said column will operate as a back-pressure valve to effectually prevent the return of air forced through the outlet of the first pump of the series thereof, giving a still more effective action to the apparatus.

What I claim as my invention is—

1. The combination with a pair of rotary pumps working in series in an oil-bath, of an oil-collecting cylinder or receptacle, a pipe opening into said receptacle and forming a continuation of the outlet for the first pump of the series, and a second pipe connecting the air-space of said receptacle with the inlet for the second pump of the series.

2. The combination substantially as described, of two rotary pumps working in series in an oil-bath, an oil-collecting chamber having two connections, one leading from the outlet of the first pump of the series and

the other to the inlet of the second pump of the series, an oil-collecting chamber or trap for the oil passing from the outlet of the second pump and means for returning the oil to the inlet side of the first pump.

3. The combination with a pair of rotary pumps working in tandem or series, of an oil-trap connected with the outlet of the series, a return pipe or connection for returning the oil to the inlet of the series, a shut-off valve in said return-pipe and a back-pressure valve between the outlet of the series and the point of connection of said return-pipe.

4. The combination with two rotary pumps connected up in series, of an intermediate chamber adapted to collect oil, a pipe leading into said chamber above the bottom thereof and joined to the outlet of the first pump of the series, and a second pipe or connection leading from said chamber above the level of the oil and joined to the inlet of the second pump of the series.

5. The combination with a pair of rotary vacuum-pumps, of an oil-bath, a cylinder or receptacle 11, a pipe 12 forming a continuation of the outlet from the first pump of the series and rising in said cylinder, said pipe being provided with an outlet-port above the level of the oil collecting in the bottom of said cylinder, a return-pipe for returning the oil to the inlet-port of the first pump, a pipe 13 connected with the air-space in the receptacle 11 and joined to the inlet-port of the second member or pump, a receptacle 18 in which terminates a pipe joined to the outlet of the second pump of the series, and means for returning the oil trapped in said receptacle to the cylinder or receptacle 11.

Signed at New York, in the county of New York and State of New York, this 18th day of May, A. D. 1904.

DANIEL McFARLAN MOORE.

Witnesses:
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