Dec. 4, 1923. 1,476,482

R. BERRENBERG

HIGH VACUA PUMP

Filed Sept. 7, 1921

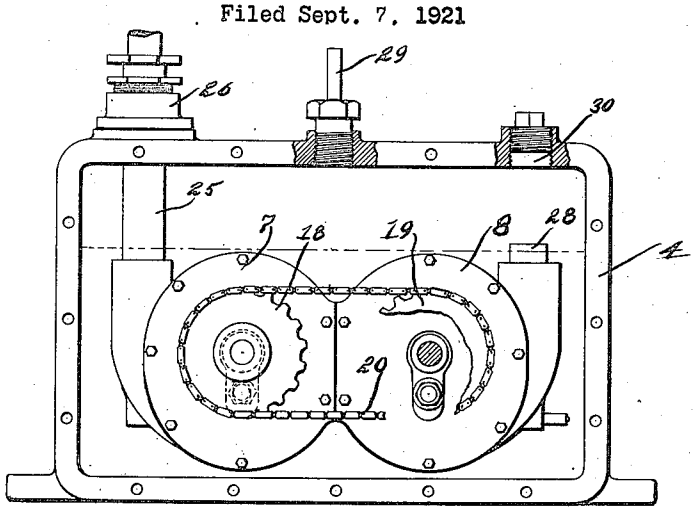


Fig. 1

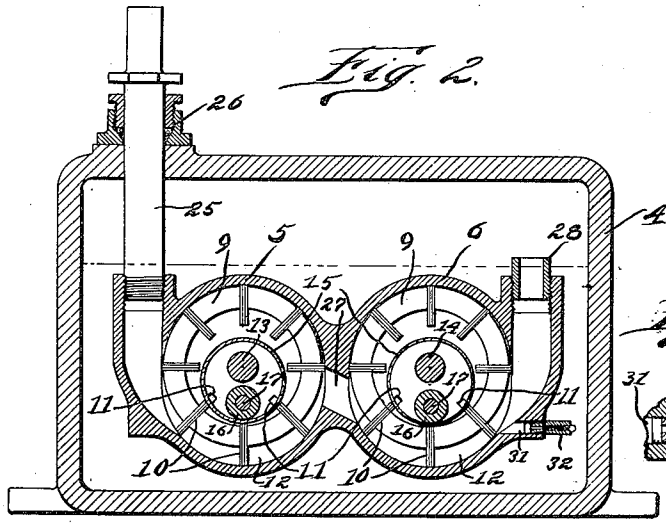


Fig. 2.

Fig. 5.

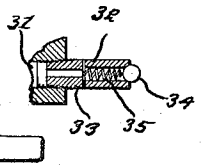


Fig. 3.

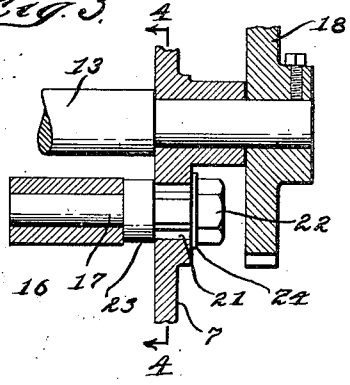
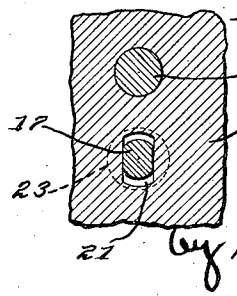


Fig. 4.



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UNITED STATES PATENT OFFICE.

REINOLD BERRENBERG, OF BOSTON, MASSACHUSETTS.

HIGH-VACUA PUMP.

Application filed September 7, 1921. Serial No. 498,984.

To all whom it may concern:

Be it known that I, REINOLD BERRENBERG, a citizen of the United States, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented a new and useful Improvement in High-Vacua Pumps, of which the following is a specification.

This invention relates to that class of rotary pump apparatus designed to produce an extremely high degree of rarefaction and more particularly to metallic pumps for producing high vacua.

High vacua are finding a rapidly extending application in numerous branches of industry and it is highly important that effective means be provided for securing vacua. High vacua is required for exhausting nitrogen lamp bulbs, vapor lamps, mercury arc rectifiers, X-ray tubes, thermos bottles etc., and to be effective the pump must combine with a high capacity, a high limiting vacuum.

The object of the present invention is to provide a very compact apparatus which will be highly efficient to produce and maintain a practically perfect vacuum, and which cannot be injured by purposely or accidentally breaking the vacuum.

Accordingly a feature of the invention contemplates the provision of a plurality of pumps, wholly immersed in vacuum oil, arranged in tandem formation and acting in series. By this arrangement what one pump may lose the other takes up, with the result that a final pressure is readily obtained of 0.000025 millimeter of mercury (0.000001 inch) measured on a McLeod gauge.

To the accomplishment of this object and such others as may hereinafter appear as will readily be understood by those skilled in the art, the invention comprises the features and combinations of parts hereinafter described and then particularly pointed out in the appended claims.

The preferred form of the invention is illustrated in the accompanying drawings in which, Figure 1 is a side elevation of the pump with the front cover removed and the top partly in section; Fig. 2 is a vertical longitudinal sectional view; Fig. 3 is a detail showing an adjustment of the blade controlling ring; Fig. 4 is a section on the line 4—4 of Fig. 3; and Fig. 5 is a sectional view of the check valve.

In the embodiment of the invention illustrated in the drawings an air tight tank 4 is provided having a removable cover (not shown) and on the rear wall of this tank is mounted the pump casing in the form of two connected generally elliptical casings 5 and 6 having removable air tight cover plates 7 and 8 respectively. The moving parts of the two pumps have the same construction as shown in my prior Patent No. 1,346,165 dated July 13, 1920, and need be described but briefly. As in said patent, each pump has a cylindrical carrier 9, provided with a series of blades or pistons 10, loosely mounted in slots 11 formed in the carrier 9. These blades form a series of rotating air propelling and transferring buckets. Each carrier 9 is arranged to fit the circular upper part of the casings 5 and 6 and leave a chamber 12 between the carrier and the casing in the lower part of the casing. Horizontal shafts 13 and 14 extend through each casing and carrier by which the carriers are rotated and one of these shafts, as 14, extends through an oil sealed bearing on the rear wall of the tank and is driven from some suitable source of power. During the rotation of the carriers the blades of each series are successively pushed outwardly in their slots, to contact with the lower wall of the casing, by a ring 15, which surrounds each shaft, and a roll 16 loosely mounted on a stud 17 secured to the casing.

In the present novel tandem arrangement of the pumps the shafts 13 and 14 are provided with sprockets 18 and 19 respectively about which travels a roller chain 20. In order to receive the sprockets the shafts project through the casing covers 7 and 8 as shown in Fig. 3.

In order to permit a change in the position of the rings 15, as the blades 10 wear, and thus cause them to continually maintain a tight joint with the inner wall of the casing a radial slot 21 (Fig. 3) is provided in the cover and the roll 16 may be clamped in said slot in different vertical positions relative to the driving shaft by means of a nut 22, threaded on the forward end of the pin 17, which draws a collar 23 against the inner face of the cover. The collar is of such diameter that it acts, with a washer 24, to seal the slot 21. The slot 21 for receiving the pin 17 is broached in the casing cover with two flat sides (Fig. 4) and the pin is slabbed off on two sides to fit the hole. In this way the pin is pre-

vented from rotating. The advantage of this construction is that in adjusting the position of the roll it moves on a radius of the carrier 9 and maintains the ring 15 concentric to the inner lower wall of the pump casing.

It may be observed here that in making the pattern for the pump casing the diameter of the lower portion of the generally elliptical opening is slightly larger than the diameter of the upper portion thereof and the two circles are joined by tangent lines. This permits the blades 10 to travel in a path which permits them to engage and be actuated by the ring 15 without knocking.

The pump within the casing 5 draws air from the article to be evacuated, for example an electric light bulb, through a pipe 25 which extends through an air-tight stuffing-box 26 on the upper wall of the tank and is connected to the bulb by a rubber tube in the usual way. The air exhausted through the pipe 25 is transferred by the blades 10 in the casing 5 to a rectangular outlet passage 27, provided in the lower portion of the common tangent partition wall joining the two casings, which also forms an inlet for the pump within the casing 6. After having been transferred through the casing 6 the exhausted air is delivered to an outlet pipe 28 from which it passes into the interior of the tank and is finally exhausted through an outlet pipe 29 having a connection to the preliminary pump. Each of the tandem pumps operates individually in the manner described in my prior patent hereinbefore referred to. It will be observed that the pump casing provides a tangent intake for the primary pump at one end, a tangent outlet for the secondary pump at the other end, and a relatively large port in the common partition wall. In practice the port 27 is one-half inch by one and one-quarter inches thus cooperating with the area of the intake and outlet ports in providing for a free passage of the exhausted air through the pump and consequent increased efficiency.

In order to seal the internal parts of the pump and thus prevent leakage of air either through the casings or from one bucket to another the tank is filled with oil or other liquid, preferably a lubricant, such as vacuum oil, to a depth indicated by the horizontal dotted lines on Figs. 1 and 2, the upper level of the lubricant being below the discharge end of the exhaust pipe 28. The lubricant is introduced in the tank through an opening 30 closed by a screw cap.

In operating the pump, after having introduced the lubricant and attached the articles to be evacuated at 25, the connection to said articles is shut off, and the preliminary pump, connected at 29, is started. This draws all the air from the tank and the oil, creating a vacuum in the tank, which is requisite because air makes moisture which prevents an efficient evacuation. On opening the connection to the articles the evacuation of the air therein is effected, by the combined action of the tandem pumps, to the desired degree. By this mode of operation excessive strain on the rubber pipes to the lamps is avoided.

When the pump is idle, if atmospheric pressure is not introduced in the tank, oil will be drawn into the casings 5 and 6 by the vacuum, through the bearings or any other opening. On again starting the pump this oil must be first discharged. Great pressure is required to discharge the accumulated oil through the outlet 28 and to provide for a quick discharge under low pressure a bore 31 communicates with the base of the outlet 28, in which bore a check-valve 32 is seated. The check-valve comprises a holder 33 (Fig. 5) having a threaded end and a seat for a ball 34 at the other end. The holder is bored through, having an enlarged opening adjacent the valve-seat in which is housed a coiled spring 35 attached to the ball and to the holder in any convenient manner. Very little pressure is required to extend the spring and force the ball from its seat in discharging the entrapped oil. The passage 27 between the casings is formed with a bottom sloping toward the second pump so that, under the conditions just described, the oil will flow freely from one pump to the other.

The nature and scope of the present invention having been indicated and the preferred embodiment of the invention having been specifically described, what is claimed as new, is:—

1. A vacuum pump apparatus comprising two rotary air pumps arranged within casings that are connected in tandem by a common tangent partition wall having an opening therethrough forming an outlet for one pump and an inlet for the other, said casings being enclosed in a tank and wholly immersed in oil.

2. A vacuum pump apparatus comprising two rotary air pumps arranged in tandem within casings separated by a partition wall having an opening therethrough forming an outlet for one pump and an inlet for the other, said casings being enclosed in a tank and wholly immersed in oil, and said opening having a bottom which slopes downwardly from the first to the second pump to facilitate the discharge of entrapped oil within the first pump.

3. In a rotary vacuum pump apparatus of the type in which a cylindrical carrier provided with a series of radial sliding blades is arranged at the upper wall of a generally elliptical casing and said blades are forced outwardly at the lower portion of said cas-

ing by engagement with a ring concentric to the lower wall of said casing, a freely rotatable roll bearing on the interior surface of said ring and co-operating with said blades to hold the ring in place, and means permitting a bodily adjustment of said roll radially of said carrier.

4. In a rotary vacuum pump apparatus of the type in which a cylindrical carrier provided with a series of radial sliding blades is arranged at the upper wall of a generally elliptical casing and said blades are forced outwardly at the lower portion of said casing by engagement with a ring concentric to the lower wall of said casing, a roll bearing on the interior surface of said ring and co-operating with said blades to hold the ring in place, having a supporting pin projecting through a radial slot in said casing, and means for adjustably holding said pin in said slot.

5. In a rotary vacuum pump apparatus of the type in which a cylindrical carrier provided with a series of radial sliding blades is arranged at the upper wall of a generally elliptical casing and said blades are forced outwardly at the lower portion of said casing by engagement with a ring concentric to the lower wall of said casing, a roll bearing on the interior surface of said ring and co-operating with said blades to hold the ring in place, having a supporting pin at least one side of which is slabbed off projecting through a radial slot in said casing, a collar on said pin inside the casing larger than the slot, and means outside the casing for adjustably clamping the pin in said slot.

6. A vacuum pump apparatus comprising a tank, a pump casing within the tank containing two rotary pumps arranged in tandem with a connecting opening through the common tangent partition wall, an air inlet to one pump entering from outside the tank, and an air outlet from the other pump discharging within the tank, said parts being immersed in oil to a level below the discharge end of said outlet but above the top of the pump casing.

7. A high vacua pump comprising a tank having an inlet for attaching the article to be evacuated and an outlet for attaching an exterior pump to preliminarily create a vacuum within the tank, a pump casing within the tank containing two rotary air pumps arranged in tandem the common tangent partition having a connecting opening therethrough, said casing being wholly immersed in oil, a tangent intake at one end of the casing connecting with the tank inlet, and a tangent outlet at the other end of the casing extended to discharge above the level of the oil.

8. A high vacua pump, comprising a single casting having casings for two rotary pumps in tandem arrangement each having its own shaft with a common tangent partition wall between said casings having an opening therethrough forming an outlet and inlet for the primary and secondary pumps respectively, said casting having an intake for the primary pump drawing from outside the tank, to which intake the article to be evacuated is attached, and an outlet for the secondary pump discharging within the tank, and an oil bath covering said casting the surface of which is below the level of the discharge end of said secondary pump outlet.

In testimony whereof I have signed my name to this specification.

REINOLD BERRENBERG.