

W. E. SHORE.

AIR PUMP.

APPLICATION FILED JAN. 9, 1917.

1,408,649.

Patented Mar. 7, 1922.

4 SHEETS—SHEET 1.

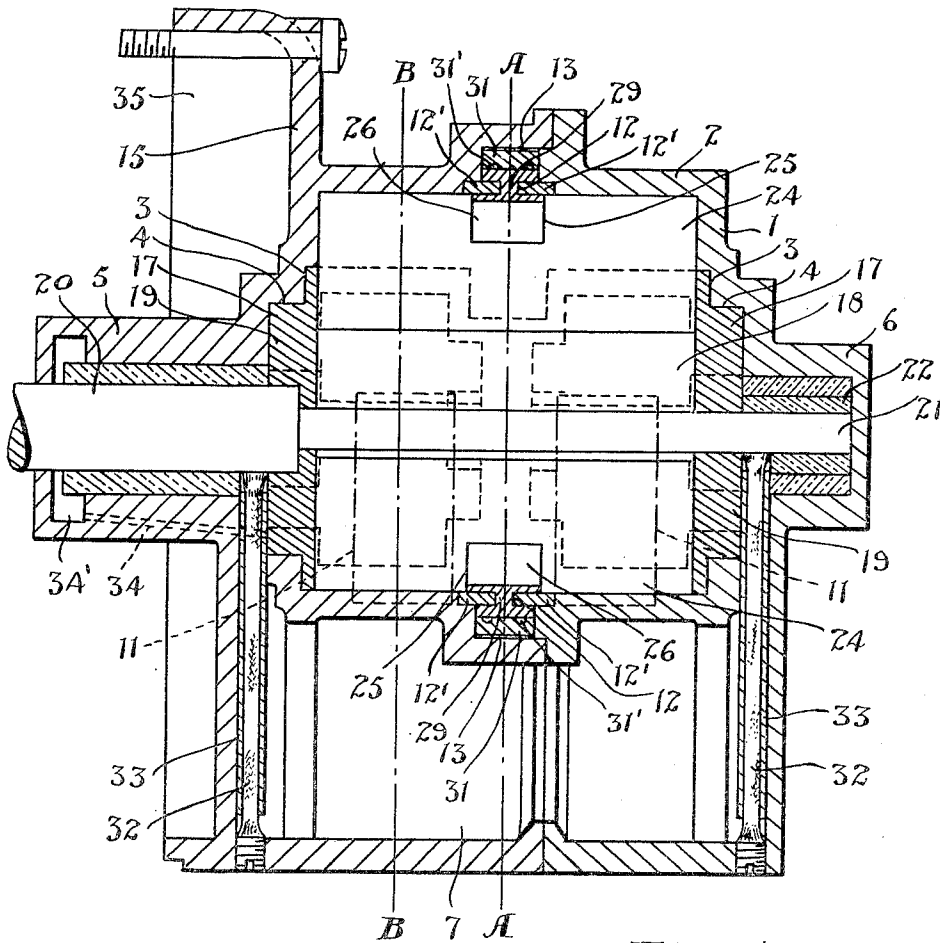


Fig. 1.

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4 SHEETS—SHEET 2.

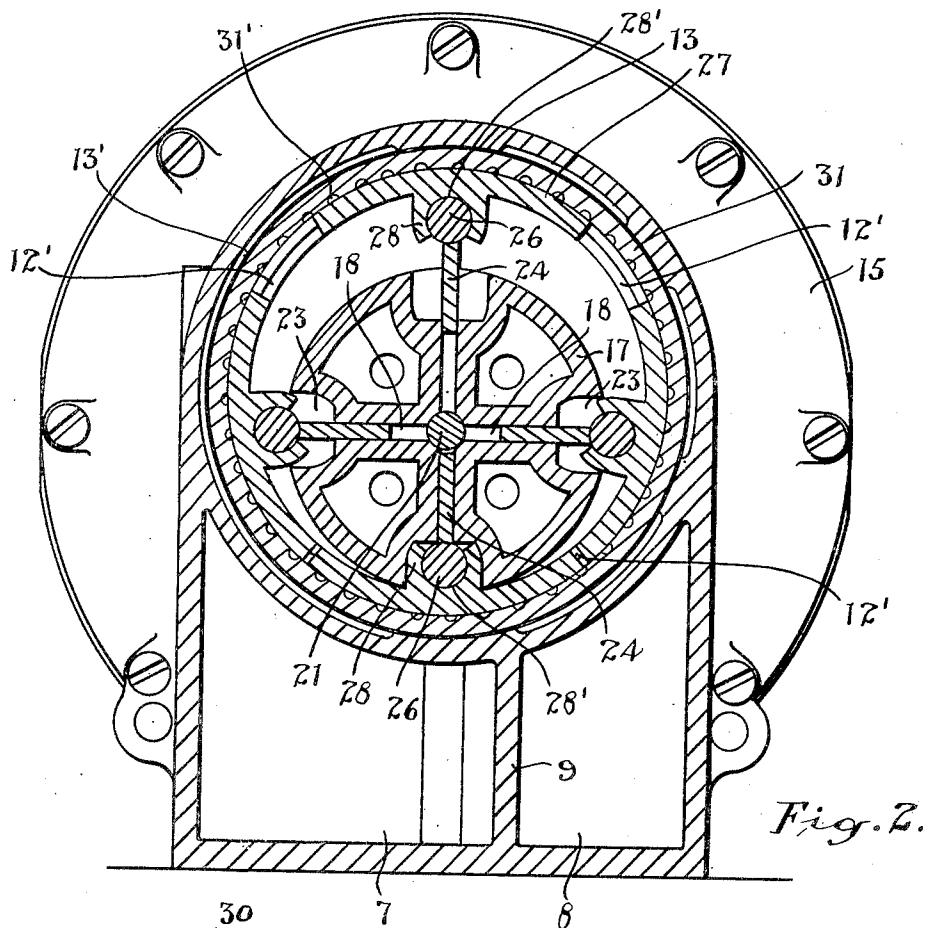


Fig. 2.

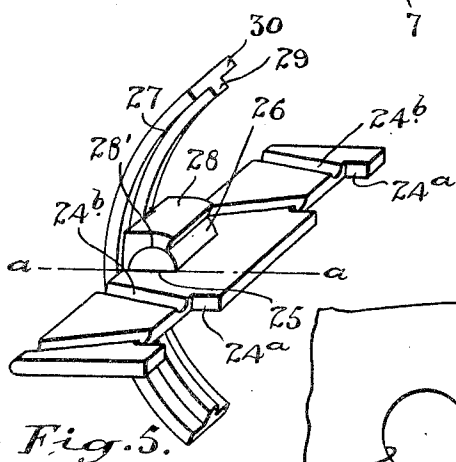


Fig. 5.

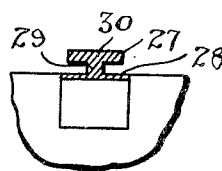


Fig. 6.

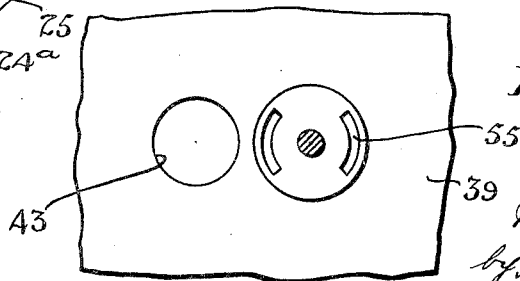


Fig. 7.

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4 SHEETS—SHEET 3.

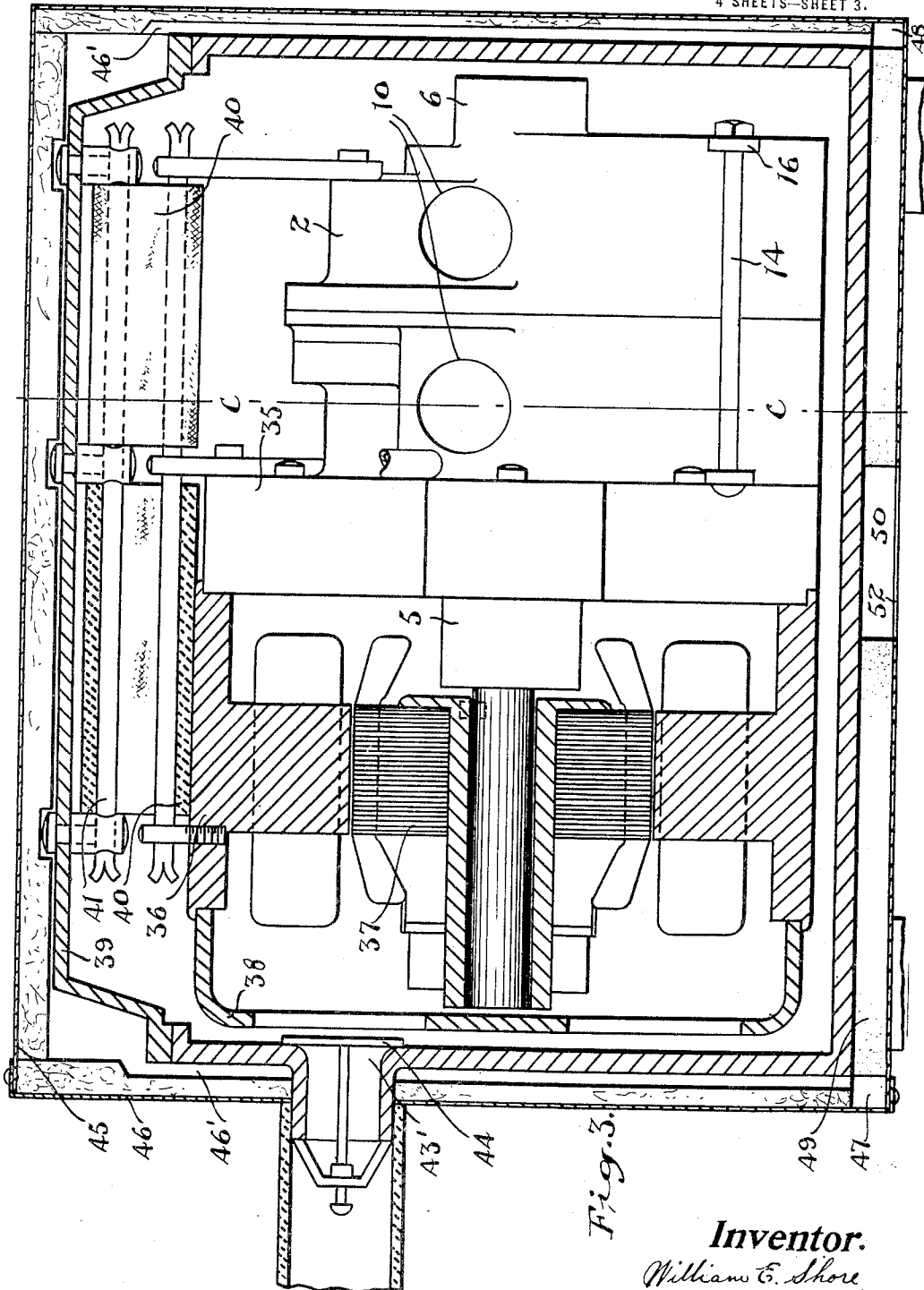


Fig. 3.

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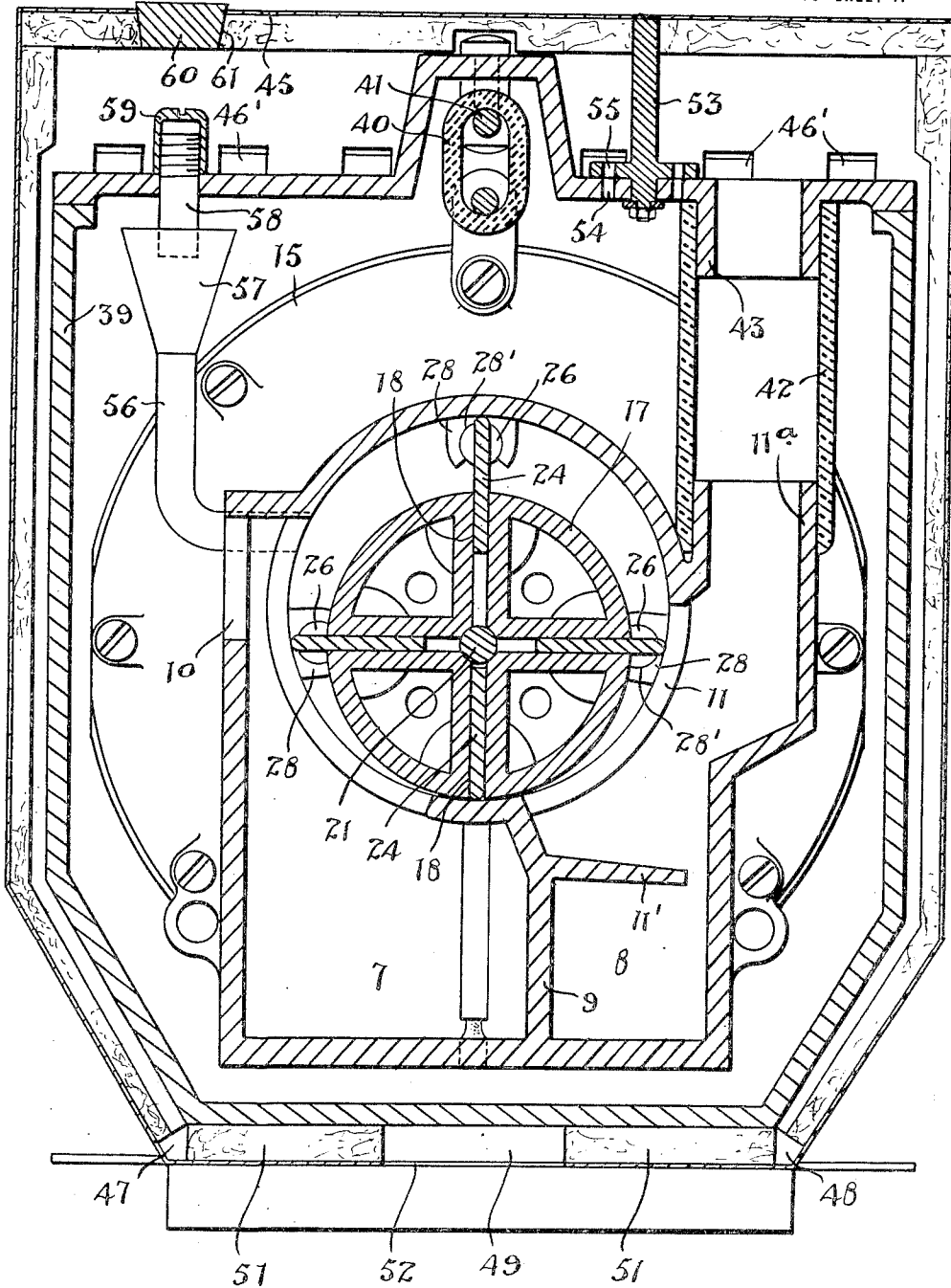
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4 SHEETS—SHEET 4.



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UNITED STATES PATENT OFFICE.

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AIR PUMP.

1,408,649.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, WILLIAM E. SHORE, a subject of the King of Great Britain, and resident of the city and State of New York, one of the United States of America, have invented certain new and useful Improvements in Air Pumps, described in the following specification and illustrated in the accompanying drawings, that form part of the same.

One of the objects of the invention is, to produce a small machine of the rotary type in which a pump and motor are very compactly arranged and the machine is of such size as to be suitable for use in player pianos or small refrigeration plants or may be used as a high pressure blower.

A further object is to reduce vibration to the minimum and to construct the machine, its driving mechanism and means of support so that the noise of operation is practically eliminated.

Still further objects are to effect a thorough ventilation of the working parts by maintaining a constant flow of air around the machine, thereby ensuring the maintenance of the machine at a low temperature, and also eliminating danger from fire through sparking at the commutator of the operating motor, and further to reduce the cost of construction and maintenance to the minimum.

The principal features of the invention consist in arranging the pump and driving motor within an enclosing casing which is spaced from the machine and a constant flow of air is circulated through the surrounding space by said pump, and in arranging the pump rotor and the armature of the driving motor, upon a common shaft carrying the outward thrust of the piston vanes by a floating, non-journalled ring.

It is well known that a constant circulation of air around fast moving machines is very effective in preventing high temperatures, consequently by arranging the pump and its operating mechanism within a closed chamber and causing a constant circulation of air through said chamber the machine will be maintained at a constant temperature and the liability of igniting dust or causing fire through sparking will be greatly reduced.

In the drawings, Figure 1 is a longitudinal vertical mid-sectional view of the pump.

Figure 2 is a cross sectional view through the machine on the line A—A of Figure 1.

Figure 3 is a vertical longitudinal sectional view through the vacuum chamber enclosing the pump and driving motor, the motor and suspension being shown in part section.

Figure 4 is a vertical cross sectional view of the pump on the line B—B of Figure 1 and on the line C—C of Figure 3.

Figure 5 is a detail perspective view of one of the piston vanes and supporting shoe.

Figure 6 is a cross sectional view of the supporting shoe on the line a—a of Figure 5.

Figure 7 is a detail plan view showing the valve for controlling the vacuum.

Like numerals of reference indicate corresponding parts in each figure.

The apparatus as herein shown and described comprises a pump casing and frame for the fields of the motor which are rigidly connected together and are supported within an enclosing housing so as to be sound and fire proof.

The pump casing is provided with a cylindrical chamber in which a rotor with sliding vanes is eccentrically journalled and the shaft carrying the rotor extends through one of the journals and carries the armature of the electric motor.

Referring to the drawings, the main casing 1 of the pump is formed with a cylindrical portion 2 having eccentrically arranged recesses 3 and 4 at each end.

Journal bearings 5 and 6 are arranged at each end of the cylinder concentric with the recesses 3 and 4.

The base of the machine is formed with wells 7 and 8 extending longitudinally and separated by the longitudinal web 9.

Intake ports 10 are arranged in the cylinder wall communicating with the well 7 and discharge ports 11 communicating with the well 8. An oil baffle 11' extends from the web 9 below the discharge port.

The cylinder 2 is formed with an annular slot 12 arranged midway of its length communicating with an annular recess 13. Rings 12' of hard metal are embedded in the metal of the cylinder at each side of the slot 12 to present a smooth bearing surface.

The cylinder casing is divided intermediate of its length preferably at the centre

and the sections are secured together by the bolts 14 which are secured at one end in the laterally extending flange 15 and at the other end extend through the lugs 16.

- 6 The cylindrical rotor 17 is formed with the transverse radial slots 18 and is preferably divided centrally of its length to allow the proper machining of the radial slots. The ends of the rotor extend into the eccentrically arranged recesses 3 in the ends of the cylinder and the reduced circular end portions 19 are adapted to fit into the eccentric end recesses 4. The lower side of the rotor engages the cylinder wall 15 at the bottom in a running fit.

- The shaft 20 is secured in one end of the rotor and is formed with a reduced portion 21 extending through the sections of the rotor. A bushing 22 is rigidly secured on the outer end of the reduced end of the shaft securing the rotor sections in place. The portions of the shaft and bushing extending beyond the rotors are journaled in the bearings 5 and 6.

- 25 23 are pockets formed in the periphery of the rotor arranged centrally of its length and extending equidistant each side of the radial slots 18.

- 30 The piston vanes 24 are slidably arranged in the slots 18 in the rotor and are provided with notches 24^a in the inner ends to avoid compression at the inner ends of the slots.

- Grooves 24^b extend outwardly from the notches to the outer edges which are rounded where they engage the cylinder wall.

- 35 25 are notches in the outer rounded edges of the vanes 24 arranged midway of their length adapted to receive the cylindrical shaped members 26 which are secured to the vanes so that the outward periphery is arranged slightly inward of the outer edge of the vane.

- 27 are arc-shaped shoes of T-shape in cross section each having in the centre a lug 28 of a width equal to the width of the notch in the vane. This lug is formed with a cylindrical recess 28' to receive the cylindrical portion 26 of the vane. The web portions 29 of the shoes fit snugly in a running fit in the annular slot 12 in the cylinder and the head 30 fits within the annular recess 13, the inward surfaces of said head engaging the outer surfaces of the bearing rings 12'. The shoes thus support the piston vanes so that the outer edges are held in contact with cylinder wall.

- 31 is a floating ring arranged within the recess 13 and engaging the outer faces of the shoes 27 in running contact and holding the shoes in running contact with the bearing rings 12' and absorbing the centrifugal outward thrust of the vanes thus eliminating thrust against the cylinder wall. The ring 31 rotates with the shoes and floats upon an oil packing contained in the re-

cesses 13' formed in the outer wall of the recess 13.

The inner periphery of the ring 31 is provided with a plurality of small recesses 31' which carry oil so as to ensure proper lubrication of the contacting surfaces of the floating ring and shoes. The frictional contact of the shoes is sufficient to carry the ring around with them but the shoes are free to slip within the ring in relation the one to the other in their compensating movement due to the difference between the axial centre about which the shoes rotate and the centre of the rotor in which the piston vanes are held. As the frictional contact of the shoes is greater than the frictional contact of the ring upon the surrounding casing the ring 31 rotates in unison with the rotor. The movement of the shoes within the ring is very slight, consequently the running frictional contact of the shoes is reduced to the minimum and as the ring is floated in the lubricant very high speed of operation is obtainable.

As the main casing 1 is divided transversely at the recessed portion 13 and slot 12 the shoes and rings are readily placed in position and when the sections of the casing are clamped together the said shoes and rings are completely enclosed in an oil tight receptacle in which a packing of oil is constantly maintained by the rotating action of the shoes.

The lubrication of the main bearings 5 and 6 is effected by the wicks 32 arranged in the tubes 33 leading upwardly from the intake well 7 and the overflow from the bearing 5 is returned through the duct 34. The duct 34 leads from the recess 34' inwardly to the end recesses 4 of the cylinder and while the suction through this duct is very slight it is sufficient to cause a constant circulation of oil through the bearing.

The flange 15 on the casing 1 is formed with a cylindrical extension 35 to which the field section 36 of the electric motor for driving the pump is secured.

The motor armature 37 is secured to the shaft 20 at the outer end of the main bearing 5 and a cap 38 is secured to the outer end of the field casing to carry the brushes and leads.

The arrangement of the motor armature directly upon the pump shaft close to the outer bearing of the pump obviates the necessity of any outer bearing. This effects great economy in weight and bulk and also in cost of manufacture and provides a self contained compact unit.

The power unit, comprising the motor and pump is supported within and free from contact with the walls of the enclosed casing 39, being shown suspended by the flexible bands 40 which are supported from rods 41 secured in the top of the casing so that no

portion of the metal parts of the power unit will touch or rest upon the casing.

The outlet port 11 communicates with a hollow cylindrical extension 11^a of the pump case and a flexible tube 42 connects said extension with a hollow boss 43 formed on the casing 39.

In the form of the device herein shown the inlet opening 10 of the pump opens into the chamber surrounding the pump and the pump exhausts the air from this chamber.

The casing 39 is provided with a suction inlet 43' and this inlet is connected in a suitable manner with the vacuum chest of the piano playing mechanism. A valve 44 is arranged in the opening 43' and closes said opening immediately the pump ceases to operate owing to the differences in pressure between the pump and the vacuum chest, consequently in the event of the motor becoming short circuited and burning out or of a fire generating in the motor case through any cause the valve will close all communication with the outer air and the fire will be immediately extinguished as the ingress of fresh air to the case will cease. This is a very important feature as all possibility of fire being communicated to the interior of the piano will be obviated.

As the suction 43' to the casing 39 is not directly connected with the pump inlet the entire space within the said casing 39 surrounding the power unit forms a vacuum space and therefore forms an effective deadener of sound and eliminates practically all transference of metallic sound vibrations which might occur in the power unit. The partial vacuum formed causes a reduction of temperature which acts as an effective cooling agent and the machine is thus kept from overheating.

The casing 39 is surrounded by an outer casing 45 which is preferably formed of sheet metal having a removable cap 46 at one end. The interior of the casing 45 is lined with a soft material such as felt which contacts with and supports the casing 39 and entirely eliminates the transference of any sound vibration from the power unit.

The discharge opening from the casing 39 communicates with the space within the outer case 45 and the air discharged therefrom finds egress through a plurality of ducts 46' formed in the side and end felt packing. These ducts lead to the ducts 47 and 48 at the bottom corners of the case 45 and the ducts 47 and 48 communicate with the longitudinal and transverse ducts 49 and 50 arranged in the bottom felt pads 51. An opening 52 is arranged in the centre of the bottom of the case 45 through which the discharge air escapes.

The surrounding outer casing with its plurality of ducts arranged in the soft felt

material forms an effective muffler to the discharge and all noise of operation of the machine is eliminated.

In the operation of the machine, the shaft 20 and motor carried thereon are rotated on the operation of the motor and the vanes 24, having their outer edges held in constant and uniform contact with the cylinder wall by the shoes 27 and floating ring 31, expel the air through the discharge and create a uniform suction through the inlet or suction opening 10 and through the suction opening 43 in the casing 39, and consequently maintaining a uniform vacuum in the vacuum chest of the piano playing mechanism.

In order to regulate the vacuum created I provide a regulating valve 53 which is arranged upon the case 39 and is here shown in the form of a rotatable disc valve. This valve covers the ports 54 in the casing 39 leading to the vacuum chamber and is provided with slots 55 adapted to be brought into register with the ports 54 on the rotation of the valve. The pressure of discharge thus enters the vacuum chamber and modifies the vacuum.

Oil is supplied to the machine through the tube 56 secured in the pump casing and extending upwardly being provided at the top with a funnel end 57.

A feed tube 58 is secured in the top of the casing 39 above the funnel end of the tube 56 and is closed by a suitable cap 59. A plug 60 closes the opening 61 in the outer muffler case. Direct connection of any metal parts is avoided.

A machine such as described is very compact and occupies very little space, it is a complete unit and the difficulties of leakage through a multiplicity of connections are avoided. The operation is extremely smooth and without noise and the construction is extremely simple and the manufacturing cost is therefore reduced to the minimum. The simplicity of construction also greatly facilitates the repair or renewal of parts.

The machine herein shown and described as having the pump inlet connected with the chamber surrounding the pump and motor but it must be understood that such arrangement may be changed without materially altering any of the principal features so long as the operating mechanism is kept cool by a constant circulation of air while it is running.

What I claim as my invention is:—

1. An air pump comprising, a rotary pump, an electric motor rigidly connected to said pump, a rigid casing enclosing said motor and pump and forming a vacuum chest therearound, flexible bands supported longitudinally within said casing, suspension members connected with said pump and mo-

tor and supported from said bands, and a flexible discharge connected with said pump and extending through said casing.

2. An air pump, comprising, a rotary pump, an electric motor connected to said pump, a casing enclosing said motor and pump and forming a vacuum chest therearound, the discharge from the pump opening through the top of the casing enclosing the vacuum chamber, an outer casing enclosing the vacuum casing and having a plurality of ducts in its inner walls communicating with the discharge from the pump and leading to a final discharge opening in the bottom of the outer casing.

3. An air pump, comprising, a rotary pump, an electric motor connected to said pump, a casing enclosing said motor and pump and forming a vacuum chest therearound, the discharge from the pump being external to the casing enclosing the vacuum chamber, an outer casing surrounding the vacuum chest casing and spaced therefrom and having an air outlet, a lining of soft material arranged between the inner and outer casing, and ducts arranged in said lining leading from the pump discharge to the outlet.

4. In an air pump, in combination, a cylinder, a rotor eccentrically journaled in said cylinder, piston vanes slidable in said rotor, arc-shaped shoes pivotally connected to said piston vanes centrally of their length, and a floating ring member frictionally engaging said shoes and rotating therewith and maintaining the outer edges of the piston vanes in constant and uniform contact with the cylinder wall.

5. In an air pump, in combination, a cylinder casing having an annular recess arranged intermediate of its length, annular bearing flanges arranged at the inward side of said recess, a rotor eccentrically arranged in said cylinder, radial piston vanes slidably arranged in said rotor, shoe members connected to said piston vanes and formed of flange portions adapted to engage said annular bearing flanges and to operate within said annular recess and a floating ring loosely arranged within said annular recess and having an external diameter smaller than the internal diameter of said recess, said ring frictionally engaging the outer surface of said shoes and adapted to rotate with said shoes and to absorb the outer thrust of the piston vanes.

6. In an air pump, in combination a cylinder casing having an annular recess arranged intermediate of its length, annular bearing flanges arranged at the inward side of said recess, a rotor eccentrically arranged in said cylinder, radial piston vanes slidably arranged in said rotor, shoe members

connected to said piston vanes and formed of flange portions adapted to engage said annular bearing flanges and to operate within said annular recess and a floating ring loosely arranged within said annular recess and having an external diameter smaller than the internal diameter of said recess, said ring frictionally engaging the outer surface of said shoes and adapted to rotate with said shoes and to absorb the outer thrust of the piston vanes and having its inner surface engaging the said shoes provided with a plurality of oil ducts.

7. An air pump, comprising, in combination, a cylinder casing divided transversely midway of its length and having the meeting faces each formed with an annular recess adapted to form a closed annular recess, bearing rings inserted in the meeting ends of said cylinder sections having their inner surfaces forming a continuation of the cylinder surface, the adjacent edges of said rings being spaced apart to form a narrow slot communicating with the annular recess, a rotor within said cylinder, radial piston vanes slidably arranged in said rotor and engaging the wall of the cylinder, arc-shaped shoe members pivotally connected to said piston vanes and adapted to bear upon said bearing rings, and a floating ring arranged within said annular recess and frictionally engaging the outer surface of said shoes.

8. In an air pump, in combination, a cylinder, a rotor eccentrically journaled in said cylinder, piston vanes slidable in said rotor and each formed with a centrally arranged notch in the outer edge and a cylindrical enlargement at said notched portion, arc-shaped shoes each having an inwardly extending lug pivotally engaging the cylindrical enlargement of the piston vane and closing the notch in the vane, and a floating ring frictionally engaging said shoes and rotating therewith and retaining the outer edges of the piston vanes in constant engagement with the cylinder wall.

9. In an air pump, in combination, a cylinder casing, a rotor eccentrically journaled in said cylinder and formed in two sections being divided centrally of its length and having radial slots extending longitudinally from end to end, each of said slots having pockets arranged at the outer side and midway of the length thereof, piston vanes slidably arranged in said slots, shoe members having lugs pivotally connected to said piston vanes, said lugs being adapted to extend into the pockets in said rotor, and means for supporting said shoes concentric with the cylinder.

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