Aug. 11, 1931. H. R. RICARDO 1,818,430

ROTARY BLOWER, PUMP, OR FLUID PRESSURE ENGINE

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FIG. 1.

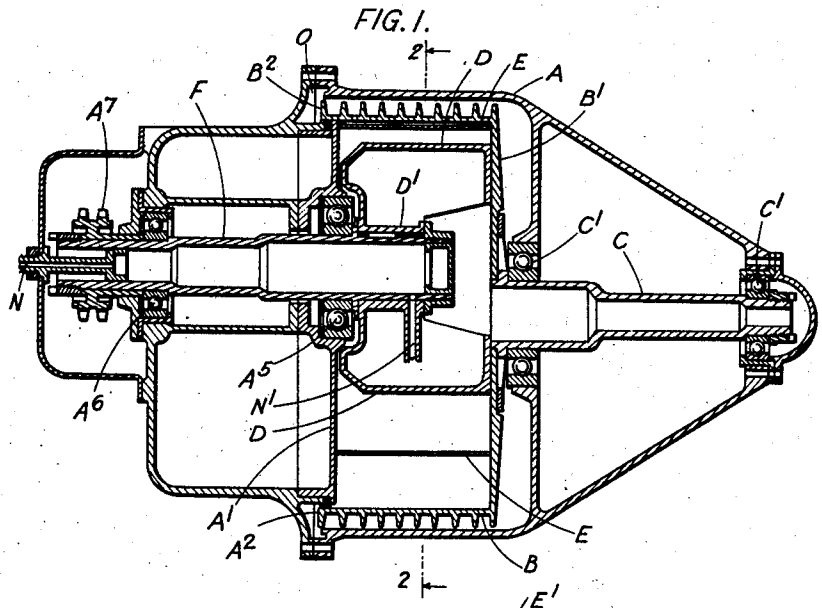
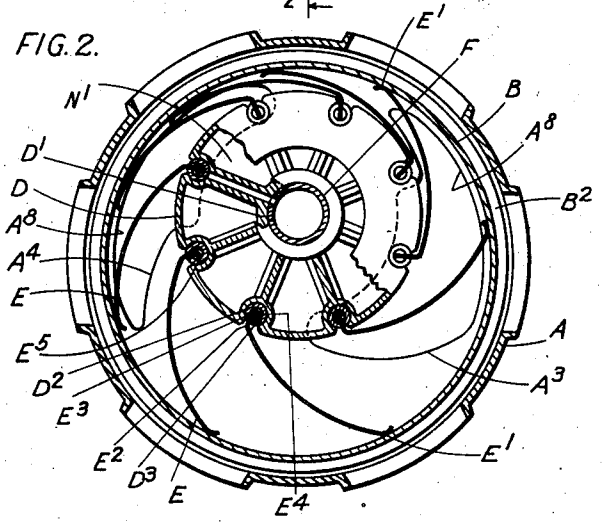


FIG. 2.



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FIG. 3.

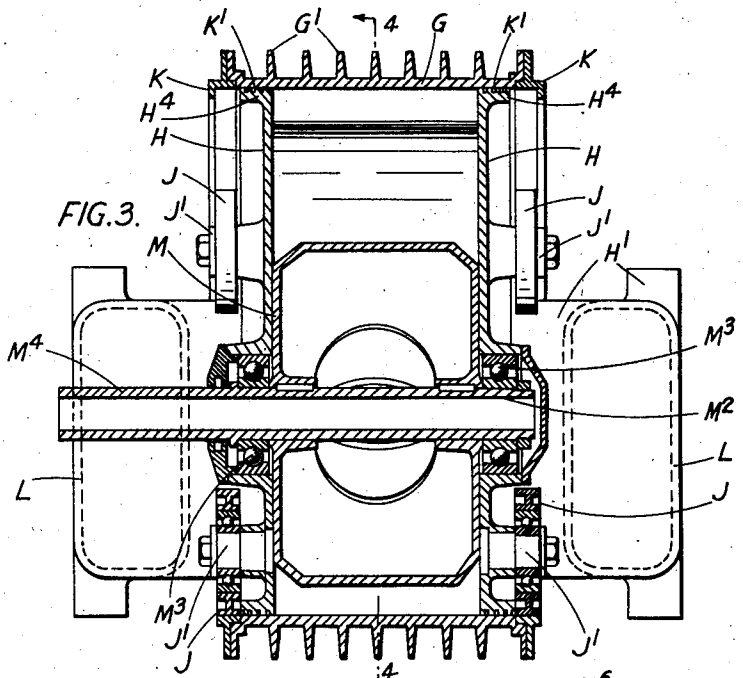
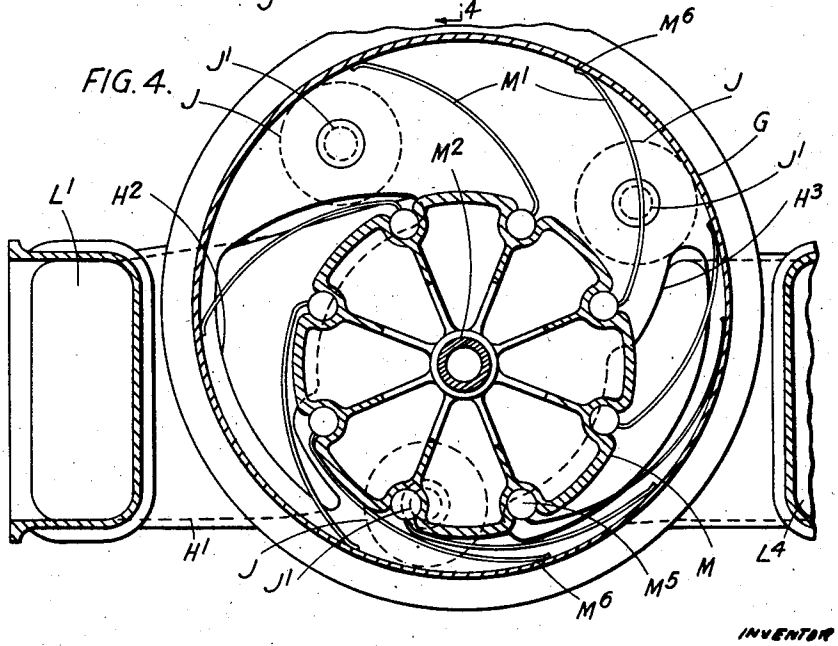


FIG. 4.



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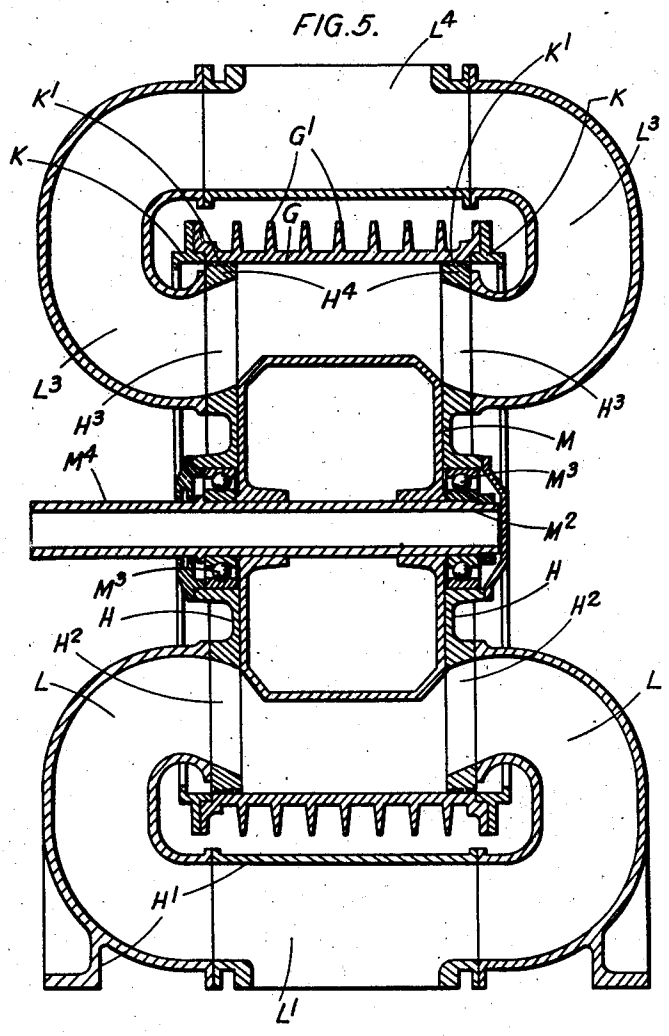
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ROTARY BLOWER, PUMP, OR FLUID PRESSURE ENGINE

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FIG. 5.



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UNITED STATES PATENT OFFICE

HARRY RALPH RICARDO, OF LONDON, ENGLAND

ROTARY BLOWER, PUMP, OR FLUID PRESSURE ENGINE

Application filed January 28, 1930, Serial No. 424,049, and in Great Britain February 18, 1929.

This invention relates to rotary blowers, pumps or fluid pressure engines of the type comprising a rotor eccentrically mounted within a rotatable drum and carrying a series of pivoted or sliding vanes the outer edges of which bear against the inner surface of the drum, while their ends are in contact with end plates so as to divide the space between the rotor and drum into a series of chambers which expand and contract in volume as the rotor revolves, these chambers being in communication with one or more inlet ports as they expand and with one or more outlet ports as they contract.

The object of the invention is to effect certain modifications in apparatus of the above type in which one or both of the end plates are fixed and provided with inlet and outlet ports therein, such modifications tending to reduce the leakage between the drum and the fixed end plate or plates and between the ends of the vanes and the end plates, and to improve the general structure and operation of the apparatus.

According to the present invention, there is combined with the rotary drum in a rotary blower, pump or fluid pressure engine of the above type a fixed and ported end plate which is held against rotation and is disposed within the end portion of the drum which surrounds and extends beyond the end plate in the axial direction. Either a single fixed end plate or two fixed end plates may be provided and arranged in the above manner and where two fixed end plates are employed either one or both of these may be provided with inlet and outlet ports.

Where only one fixed end plate is provided the other end plate is formed integral with or rigidly connected to the drum and serves to support it, the end plate being rigidly mounted on the end of a shaft which is carried in bearings in a fixed casing or frame. The drum is thus supported in a freely rotatable manner. In such a construction the rotor is supported in a somewhat similar manner on the end of a shaft extending through the fixed and ported end plate and carried in suitable bearings.

On the other hand where two fixed end plates are provided in an arrangement according to this invention, the end parts of the drum which surround and extend appreciably beyond the end plates are each supported on rollers which are carried by a fixed part of the casing and arranged so as to lie within those end portions of the drum which lie beyond the end plates or within annular members secured to such end portions of the drum so that the drum is rotatably supported by the rollers.

In either case each fixed end plate is conveniently provided with a cylindrical flange on its outer face and a labyrinth packing is arranged in the annular space between this flange and the adjacent end portion of the drum which extends beyond the end plate and lies around the flange.

Further, the outer edges of the ports preferably do not extend radially outwards to the outer edge of the end plate or plates, so that oil separated from the air by centrifugal action can collect around the inside of the drum without risk of its flowing through the ports. Such oil passes out between the end of the drum and the fixed end plate, through the labyrinth packing, and is conveniently collected in an annular oil collecting chamber formed in the casing around the outer edge of the drum where it extends beyond the end plate.

The invention may be carried into practice in various ways but two alternative constructions of blower according to this invention are illustrated by way of example in the accompanying drawings, in which

Figure 1 is a longitudinal vertical section of one form of blower in the vertical plane in which lies the axis of rotation of the rotor,

Figure 2 is a section on the line 2—2 of Figure 1,

Figure 3 is a similar view to Figure 1 of an alternative construction of blower,

Figure 4 is a section on the line 4—4 of Figure 3, and

Figure 5 is a longitudinal section of the blower shown in Figures 3 and 4 taken in a plane at right angles to the plane of the section shown in Figure 3 and containing the axis of rotation of the rotor.

In the construction illustrated in Figures 1 and 2, the blower comprises a fixed casing or support A in which is mounted a freely rotatable drum B. The drum B is closed at one end and carried by a disc-like end plate B^1 rigidly connected to or formed integral with the end of the drum B and mounted on the end of a shaft C which extends from the centre of the end plate B^1 on the side remote from the drum and is carried in bearings C^1 in the casing A so as to support the drum B and end plate B^1 in a freely rotatable manner. Arranged within the other end of the drum so that the drum extends beyond it in an axial direction is a fixed end plate A^1 formed integral with or rigidly carried by the casing A, a labyrinth packing or the like A^2 being provided between the periphery of the end plate and the interior surface of the drum. A working clearance is conveniently provided between the interior surface of the drum and both the periphery of the end plate A^1 and the portion of the casing surrounded by the end of the drum, the drum B being provided with ribs B^2 on its outer circumferential surface to assist the cooling thereof.

Disposed eccentrically within the drum B is a cylindrical rotor D having pivoted thereto adjacent to its periphery a series of vanes E the outer edges of which bear against the interior surface of the drum B while the lateral edges of each vane make contact respectively with the rotatable end plate B^1 closing one end of the drum and the fixed end plate A^1 lying within and closing the other end of the drum.

Formed in the fixed end plate A^1 are an inlet port A^3 and an outlet port A^4 formed so as to communicate with the spaces between the vanes E.

The rotor D is conveniently supported on the shaft F engaging a suitable hub or socket D^1 within the rotor D and extending through the fixed end plate A^1, this shaft being supported in bearings A^5, A^6 within the end plate A^1 and casing A respectively and carrying a sprocket or gear wheel A^7 whereby the rotor can be driven.

As will be seen each vane E in the construction illustrated is of curved form, the mean curvature being intermediate between the curvature of the outer surface of the rotor D and that of the inner surface of the drum B. Further, each vane is of such dimensions measured from its inner edge, where it is pivoted to the rotor D, to its outer edge where it bears against the drum B, that when it is in its most closed position, i. e. with its outer face lying against that part of the drum B which lies closest to the rotor D, it will overlap to a substantial extent the vane immediately behind it.

The dimensions of the rotor D and drum B and the distance between their axes of rotation are further preferably such that the minimum clearance between these members is just sufficient to allow the vanes thus to overlap without fouling one another.

The radius of curvature of the vanes may either be substantially constant as shown from their inner to their outer edges or may vary either uniformly or otherwise. Thus, the radius of curvature of each vane may increase in a substantially uniform manner from its inner to its outer edge. In any case the outer edge of each vane where it bears against the drum B is conveniently slightly turned inwards towards the rotor D as shown at E^1 so as to prevent the relatively sharp outer edge of the vane coming into contact with the drum when the vane is in its most open position, i. e. its most nearly truly radial position.

The vanes may be constructed in various ways but preferably are formed of sheet metal, the inner edge of each vane either being bent on itself to form a cylindrical bead which lies in a part-cylindrical longitudinal slot D^3 in the rotor so as to constitute a pivot or hinge for the vane, or being rigidly connected as shown to a rod-like pivot member D^2 freely mounted in a part-cylindrical slot in the rotor. Thus the pivot member D^2 may be of tubular form and provided with a longitudinal slot through which extends the inner edge portion E^2 of the vane. The edge portion E^2 of the vane is divided into sections E^3, E^4 by a series of slits normal to the edge, and these sections are bent out of the plane of the adjacent part of the vane, adjacent sections E^3, E^4 being bent in opposite directions so that when white or other fusible metal E^5 is run into the interior of the tubular pivot D^2 so as to fill it, these bent portions E^3, E^4 of the vane form an interlock between the white metal and the edge of the vane whereby such edge is firmly locked in position within the tubular pivot member D^2.

Lubrication of the blower is conveniently effected through a pipe N delivering oil into the interior of the shaft F whence it flows through passages N^1 to the bearings D^2 of the blades E. The oil passes through the bearings D^2 and is thrown outwards by centrifugal force against the inner periphery of the drum B where it serves to lubricate the tips of the blades E. As shown, the outer edges A^8 of the ports A^3, A^4 do not extend radially outwards to the edge of the end plate A^1 and in this way the lubricating oil is enabled to collect on the inner periphery of the drum without passing through the ports. Oil flows out between the end of the drum B and the fixed end plate A^1 through the labyrinth packing A^2 and is thrown outwards into and collected in an annular oil collecting chamber O formed in the casing around the end of the drum, means being provided for withdrawing the oil from such chamber. If desired grooves

may be provided in the inner face of the periphery of the drum where it surrounds the end plate A^1 to assist the flow of oil between these members and thence through the labyrinth packing. In order to prevent as far as possible the collection of oil on the outside of the drum B, the end rib B^2 is disposed radially within the oil collecting chamber O as shown in Figure 1, so that the oil is thrown from this rib directly into the chamber O. In this way copious lubrication of the moving parts is made possible without risk of the air delivered by the blower being undesirably oil-laden or of oil escaping from the blower.

In the alternative construction illustrated in Figures 3, 4 and 5 the blower comprises a freely rotatable drum G closed at each end by a fixed end plate H rigidly connected to or forming part of a fixed support or casing H^1 and disposed within the end portion of the drum, each end plate H having an inlet port H^2 and an outlet port H^3 therein. The drum G overlaps and extends beyond the end plates H in an axial direction as shown and is supported at each end on three rollers J mounted to rotate upon fixed pivots J^1 carried by the plates H, these rollers engaging bearing rings K rigidly connected to the ends of the drum so that the drum is supported on the rollers in a freely rotatable manner. A labyrinth packing K^1 is provided between the periphery of a flange H^4 on each end plate H and the inner surface of the drum G as shown.

The two inlet ports H^2 respectively in the two end plates H communicate through curved passages L with a common inlet chamber L^1 while similarly the two outlet ports H^3 communicate through similar curved passages L^3 with a common outlet chamber L^4.

Mounted eccentrically within the drum is a cylindical rotor M carrying a series of pivoted or hinged vanes M^1 similar to the vanes E in the construction shown in Figures 1 and 2, the rotor being supported on a shaft M^2 mounted in bearings M^3 in the casing and extending beyond one side of the casing as shown at M^4 so as to enable it to be driven. As in the construction shown in Figures 1 and 2, the inner end of each vane M^1 is rigidly connected to a cylindrical bearing member M^5 freely mounted in a part-cylindrical longitudinal slot in the rotor M, the vanes being of such length in relation to the diameter of the outer surface of the rotor and that of the inner surface of the drum G that when the vanes are in their most closed position, i. e. when they engage a part of the drum G which lies nearest to the rotor M, they overlap one another to a substantial extent. Further, the outer edge of each vane where it engages the drum is slightly turned inwards towards the rotor as shown at M^6 so as to prevent the sharp outer edge of the vane engaging the drum when such vane is in its most nearly truly radial position.

The drum is conveniently provided with radiating ribs or fins as indicated at G^1 and the circumferential portion of the casing is cut away or provided with openings so as to enable the cooling fins G to transfer their heat to the air as far as possible.

In either of the constructions more particularly described above the apparatus should be so assembled as to leave a running clearance of say a few thousandths of an inch between the rotor D or M and the end plates A^1, B^1 and H, H, and between the periphery of the end plates A^1, H and the inner surface of the drum B or G where it surrounds such end plates, these clearances, however, being as small as is practicable so as to reduce leakage therethrough.

What I claim as my invention and desire to secure by Letters Patent is:—

1. A rotary compressor including in combination a rotatable drum, at least one end of which is open, a fixed end plate having an unbroken circumferential edge lying within and adjacent to the inner surface of the open end of the drum so that the end of the drum extends freely beyond the end plate, the end plate being provided with inlet and outlet ports the outer edges of which are displaced radially inwards from its unbroken circumferential edge, a rotor eccentrically mounted within the drum, a series of vanes carried by the rotor and bearing against the inner circumferential surface of the drum, and means for supplying lubricant to the interior of the drum, whereby a film of lubricant is constantly maintained on the inner periphery of the drum and can flow slowly out between the end plate and the drum and escape from the free end of the drum as it is renewed from within.

2. A rotary compressor including in combination a rotatable drum, an end plate rigidly connected to and closing one end of the drum, the other end of the drum being open, a shaft which extends from this end plate on the side thereof remote from the drum, a supporting casing, bearings for the shaft in the supporting casing, a fixed end plate having an unbroken circumferential edge lying within and adjacent to the inner surface of the open end of the drum so that the end of the drum extends freely beyond the end plate, this end plate being provided with inlet and outlet ports, the outer edges of which are displaced inwards from its unbroken circumferential edge, a rotor eccentrically mounted within the drum, a shaft supporting the rotor and extending through the fixed end plate, a series of vanes carried by the rotor and bearing against the inner circumferential surface of the drum, and means for supplying lubricant to the interior of the drum.

3. A rotary compressor including in combination a rotatable drum, at least one end of which is open, a fixed end plate having an unbroken circumferential edge lying within and adjacent to the inner surface of the open end of the drum so that the end of the drum extends freely beyond the end plate, the end plate being provided with inlet and outlet ports the outer edges of which are displaced radially inwards from its unbroken circumferential edge, a labyrinth packing between the end plate and the inner circumferential surface of the drum, a rotor eccentrically mounted within the drum, a series of vanes carried by the rotor and bearing against the inner circumferential surface of the drum, and means for supplying lubricant to the interior of the drum whereby a film of lubricant is constantly maintained on the inner periphery of the drum and can flow slowly out between the end plate and the drum and escape from the free end of the drum as it is renewed from within.

4. A rotary compressor including in combination a rotatable drum open at both ends, a fixed end plate having an unbroken circumferential edge lying within and adjacent to the inner circumferential surface of each open end of the drum so that the ends of the drum extend freely beyond the end plate, each end plate being provided with inlet and outlet ports having their outer edges displaced radially inwardly from the unbroken circumferential edge of the end plate, a rotor eccentrically mounted within the drum, a series of vanes carried by the rotor and bearing against the inner circumferential surface of the drum, and means for supplying lubricant to the interior of the drum.

5. A rotary compressor including in combination a rotatable drum at least one end of which is open, a fixed end plate having an unbroken circumferential edge lying within and adjacent to the inner surface of the open end of the drum so that the end of the drum extends freely beyond the end plate, the end plate being provided with inlet and outlet ports, the outer edges of which are displayed radially inwards from its unbroken circumferential edge, a rotor eccentrically mounted within the drum, a series of vanes carried by the rotor and bearing against the inner circumferential surface of the drum, means for supplying lubricant to the interior of the drum, whereby a film of lubricant is constantly maintained on the inner periphery of the drum and can flow slowly out between the end plate and the drum and escape from the free end of the drum as it is renewed from within, and an annular oil collecting chamber surrounding the free end of the drum.

6. A rotary compressor including in combination a rotatable drum, an end plate rigidly connected to and closing one end of the drum, the other end of the drum being open, a shaft which extends from this end plate on the side thereof remote from the drum, a supporting casing, bearings for the shaft in the supporting casing, a fixed end plate having an unbroken circumferential edge lying within and adjacent to the inner surface of the open end of the drum so that the end of the drum extends freely beyond the end plate, this end plate being provided with inlet and outlet ports, the outer edges of which are displaced inwards from its unbroken circumferential edge, a rotor eccentrically mounted within the drum, a shaft supporting the rotor and extending through the fixed end plate, a series of vanes carried by the rotor and bearing against the inner circumferential surface of the drum, means for supplying lubricant to the interior of the drum, and an annular oil collecting chamber surrounding the free end of the drum.

7. A rotary compressor including in combination a rotatable drum, at least one end of which is open, a fixed end plate having an unbroken circumferential edge lying within and adjacent to the inner surface of the open end of the drum so that the end of the drum extends freely beyond the end plate, the end plate being provided with inlet and outlet ports, the outer edges of which are displaced radially inwards from its unbroken circumferential edge, a labyrinth packing between the end plate and the inner circumferential surface of the drum, a rotor eccentrically mounted within the drum, a series of vanes carried by the rotor and bearing against the inner circumferential surface of the drum, means for supplying lubricant to the interior of the drum whereby a film of lubricant is constantly maintained on the inner periphery of the drum and can flow slowly out between the end plate and the drum and escape from the free end of the drum as it is renewed from within, and an annular oil collecting chamber surrounding the free end of the drum.

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

HARRY RALPH RICARDO.