July 3, 1951 J. R. FREI 2,558,837

PUMP

Filed April 13, 1944

Fig. 1.

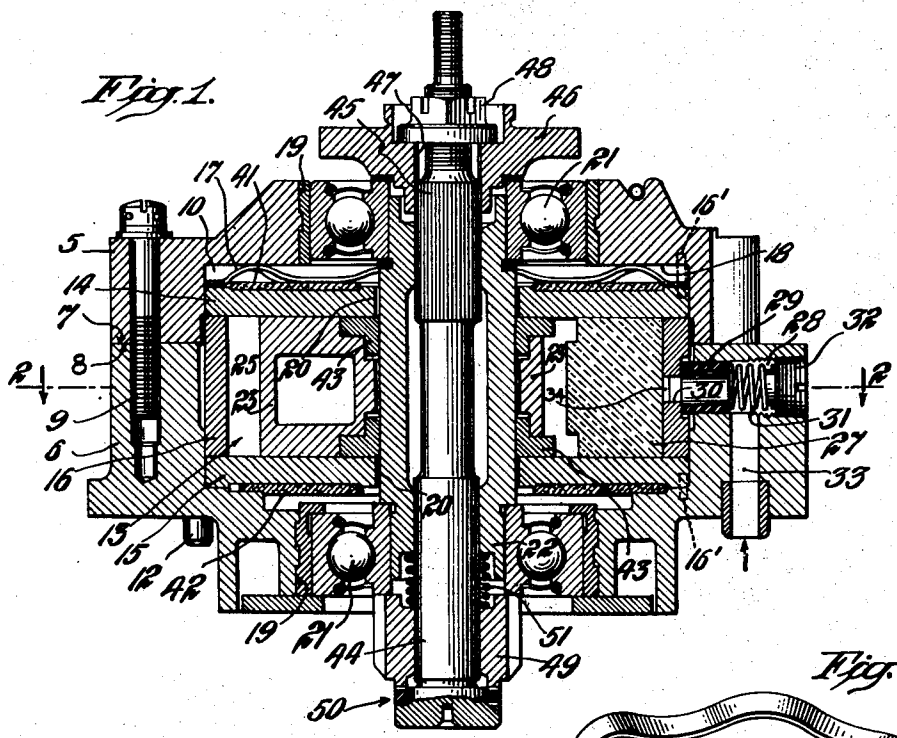


Fig. 3.

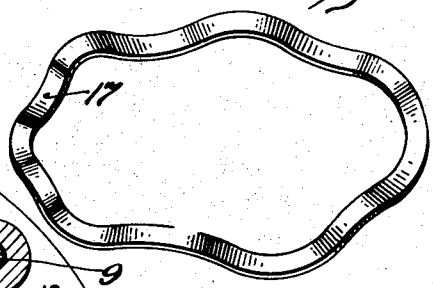
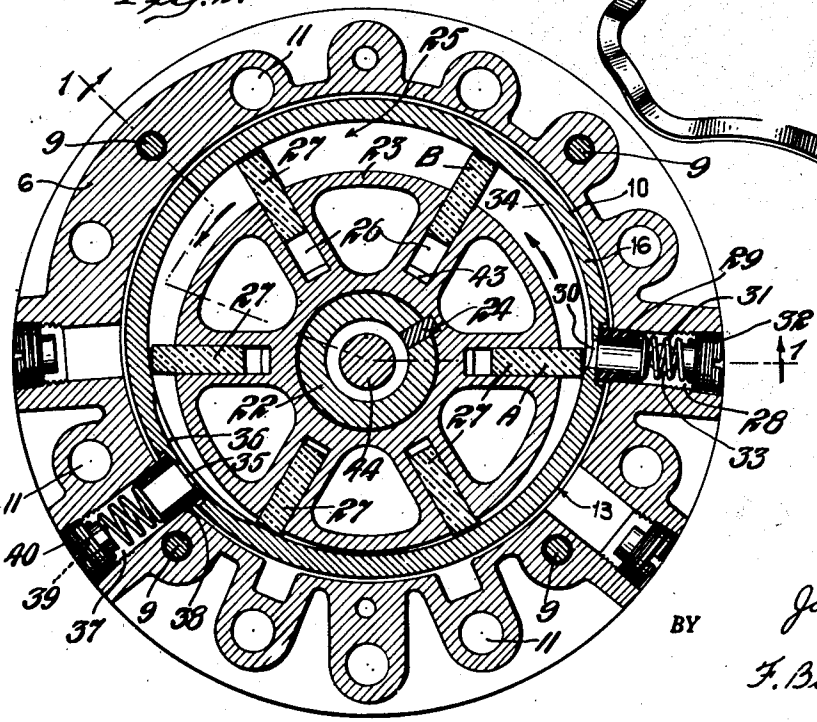


Fig. 2.



INVENTOR.
Jakob R. Frei

BY

F. Bascom Smith
ATTORNEY

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Jakob R. Frei, Sidney, N. Y., assignor to Bendix Aviation Corporation, South Bend, Ind., a corporation of Delaware

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15 Claims. (Cl. 230—152)

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This invention relates to pumps and more particularly to fluid pressure pumping apparatus of the rotary type which is adapted for compressing air and like fluids.

One of the objects of the present invention is to provide novel apparatus of the above character wherein the parts are maintained in assembled relation in a novel manner which minimizes the possibility of failures caused by seizing or binding of relatively rotating parts.

Another object of the invention is to provide novel pump means which are so constructed that some of the need for accurate machining and alignment of the parts is minimized, thereby reducing the cost of manufacture and increasing the rate of production.

Still another object is to provide novel pumping apparatus of the rotary type wherein the pump casing and rotor are both permitted limited axial movement along the shaft which actuate the rotor.

A further object is to provide novel rotary pumping means wherein the rotor and casing of a pump and a housing or support therefor are novelly combined with a drive shaft for the rotor to insure proper and efficient lubrication of the engaging surfaces of the pump, rotor and casing.

Another object is to provide novel apparatus wherein a rotary pump is combined in a novel manner with a housing therefor and a drive shaft rotatably mounted in said housing.

A still further object is to provide novel means for holding parts of such pumping apparatus in assembled relation without danger of flexing or deforming said parts during assembly.

Another object is to provide a novel rotary pump which is so constructed that seizing or jamming of the rotor will not affect the continued operation of the rotor shaft.

The above and further objects and novel features of the invention will more fully appear from the following detailed description when the same is read in connection with the accompanying drawings. It is to be expressly understood, however, that the drawings are for the purpose of illustration only and are not intended as a definition of the limits of the invention, reference for this latter purpose being had primarily to the appended claims.

In the drawings, wherein like reference characters refer to like parts throughout the several views,

Fig. 1 is a sectional elevation of one form of pumping apparatus embodying the present invention, the section being taken substantially along line 1—1 of Fig. 2;

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Fig. 2 is a sectional view of said apparatus taken substantially along line 2—2 of Fig. 1; and

Fig. 3 is a detailed isometric view showing one type of resilient means which may be employed in carrying out the invention.

Referring to the drawings, there is illustrated a single embodiment of the invention in a form adapted to be used, for example, as means for supplying a compressed gaseous medium, such as air, to the interior of an electrical current distributor in the ignition system of an internal combustion engine to reduce the possibility of flashovers at high altitudes. As shown, the novel pumping apparatus includes an outer or main housing or support which comprises two principal parts or sections 5 and 6 having engaging surfaces 7 and 8 that are preferably plane surfaces. Parts 5 and 6 have oppositely facing cylindrical recesses therein and are rigidly joined together in such a manner as to prevent relative movement of one with respect to the other by any suitable means, such as screws or bolts 9, that threadedly engage lower housing member 6. Parts 5 and 6, when thus joined together, form a relatively enclosed cylindrical space 10. Preferably, a plurality of openings or holes 11 (Fig. 2) which are adapted to accommodate stud bolts 12, or the like, are provided in housing 5, 6 whereby the latter may be operatively secured within a chamber to be supercharged or to the casing of an internal combustion engine.

Slidably fitted into the cylindrical space 10 in housing 5, 6 is a fabricated cylindrical pump casing 13 comprising end plates 14 and 15 which engage opposite ends of a cylindrical wall member 16. Said plates and wall member are preferably loosely assembled and the end plates are positioned by suitable dowels 16'. The over-all length of pump casing 13 in an axial direction is somewhat less than the corresponding length of space 10 and, for a purpose to hereafter more fully appear, suitable resilient means are provided for yieldably resisting relative axial movement of the pump casing and housing 5, 6. In the form shown, said resilient means is constituted by an annular wavy leaf spring 17. Alternate crests or humps of spring 17 engage the surface of plate 14 near the periphery thereof and the other humps thereof engage the wall 18 of housing member 5 near the periphery of space 10. Spring 17 is preferably placed under an initial compression of approximately 300 pounds total pressure when the surfaces 7 and 8 of housing members 5 and 6 are drawn together by stud bolts 9. This pressure is sufficient to hold the parts of

the pump casing in assembled relation under normal operating conditions. The pressure applied by the spring is uniformly distributed around the circumference of the housing 5, 6 and the pump casing so that there is no danger of stresses being set up which might cause buckling, bending or other deformation of the assembled parts.

Housing member 5, 6 and plates 14 and 15 of the pump casing are provided with concentric circular openings 19 and 20, respectively, the centers of which are eccentric with respect to the coincident longitudinal axes of cylindrical casing member 16 and cylindrical space 10. A pair of roller or ball thrust bearings 21, 21 are mounted in any well-known manner in the openings 19 in housing members 5 and 6 for rotatably supporting a hollow shaft 22. Shoulders formed on shaft 22, such as by enlarging a central portion of the shaft, operatively engage the inner races of bearings 21, 21 and the latter are thereby rendered effective to hold said shaft against appreciable axial or longitudinal movement relative to housing 5, 6 and pump casing 13. Hollow shaft 22 extends through casing 13 and has a running clearance in the openings 20, 20 in plates 14 and 15.

Within casing 13 and drivably connected to shaft 22 for axial movement relative thereto and rotation therewith is a centrifugal vane type rotor comprising a main rotor member 23 which is cylindrical and has a close running clearance with the inner surfaces of end plates 14 and 15. Member 23 is concentric with shaft 22 and is keyed or otherwise suitably secured thereto, such as by means of a key 24. The latter may be constituted by relatively fragile metal, plastic or the like so that the maximum stress on the rotating parts will be limited to the force necessary to shear said key in the event rotor 23 should seize or become locked against rotation for any reason. In one suitable embodiment key 24 is designed to shear under a force of about 40 inch/pounds. The radius of rotor member 23 is only slightly less than the shortest distance between the axis of shaft 22 and the inner wall of casing member 16, thereby producing a crescent shaped space 25 within pump casing 13.

Rotor element 23 is provided with a plurality of equally spaced radial slots 26 which extend throughout the length thereof and slidably receive vanes 27. The latter may be made of any suitable material, a plastic such as molded phenolic material being preferred, and are adapted to be thrown out into sliding substantially fluid-tight engagement with the inner wall of casing member 16 by centrifugal force when shaft 22 is rotated. If desired, vanes 27 may also be pressed toward wall member 16 by means of light springs (not shown).

One end of the crescent shaped space 25 may be connected to atmosphere or some other source of a suitable gaseous medium through a passage 28 in housing member 6, a resilient sleeve 29 of rubber or other suitable material, and an inlet port 30 in pump casing member 16. Sleeve 29 has a close fit in passage 28 and is preferably held into relatively fluid-tight engagement with casing member 16 around port 30 by suitable resilient means, such as a spring 31. The latter is held under a desired compression by a plug 32 which is threaded into passage 28. Air or other gaseous medium may be supplied to passage 28 through a passage 33 (Fig. 1) or, if desired, through a suitable opening in plug 32.

A groove 34 is preferably provided in the inner wall of casing member 16, the same extending circumferentially from inlet port 30 in the direction of rotation of rotor 23 for an angular distance somewhat less than the angle between successive vanes 27. Thus, as the rotor is rotated in the direction of the arrow (Fig. 2), air is permitted to enter space 25 between vanes A and B, for example, until vane A passes beyond groove 34. At about this point the space between said vanes reaches a maximum volume and upon further rotation said space diminishes and the air therein is compressed. The compressed air is driven into a desired space outside of housing 5, 6 through an outlet port 35 after the leading vane B passes over the nearest end of a groove 36 in the inner wall of casing member 16. Outlet port 35 communicates with a passage 37 in housing member 6 through a sleeve 38 similar to sleeve 29 and thence to the exterior of housing 5, 6 through a passage 39 in threaded plug 40. Each pair of adjacent vanes 27 form successive compression chambers, as is well understood in the art, so that air or other gaseous medium under pressure is continuously being discharged from port 39 during rotation of rotor assembly 23, 27.

In order that the pumping apparatus thus provided may operate efficiently, i. e., without material leakage and friction, the running clearance between the ends of rotor element 23 and plates 14 and 15 must be kept relatively small and adequately lubricated. For the purpose of providing adequate lubrication, annular pads 41, 42 of felt or other suitable fibrous oil absorbent material are provided at each end of pump casing 13 and rings 43, 43 of a porous metal, such as sintered bronze, are provided on rotor element 23. Pads 41, 42 may be kept saturated with lubricating oil through suitable oil cups (not shown) and the oil vapors therefrom will pass through the clearance spaces between shaft 22 and openings 20 in plates 14 and 15. A sufficient quantity of the oil vapors will seep through the porous metal rings 43 to satisfactorily lubricate the adjacent end surfaces of rotor element 23 and the inner surfaces of plates 14, 15, said vapors being carried by air flowing in through space 10 and thence into the suction chamber of the pump. The oil used must be kept at a minimum consistent with satisfactory operation when the compressed air is discharged into an ignition distributor, for example.

Rings 43 are press fitted on rotor element 23 and function as bearings for shaft 22 if key 24 is caused to shear. To this end the bore through rotor 23 between rings 43 is made somewhat larger than the diameter of the shaft.

By constructing and assembling the pump casing, housing and shaft in the above-described manner whereby the pump casing and rotor are permitted some axial movement relative to the shaft against the yielding force of spring 17, the rotating parts are given a certain freedom for self-alignment. This feature materially reduces the possibility of the rotating parts being seized or locked against rotation and also reduces the accuracy with which the parts must be constructed.

Any suitable means may be provided for driving shaft 22 and, in the illustrated embodiment which is adapted for use in an ignition distributor, said means comprise a shaft 44 which extends through hollow shaft 22 and is drivably connected thereto by splines 45, or the like. The current distributing finger of the distributor or other driven member 46 may also be connected

with shaft 44 through splines 45, 47 and secured thereon by a nut 48. Freely mounted on the opposite end of shaft 44 is a pinion or splined member 49 which is adapted to mesh with a suitable drive member of an internal combustion engine. The rotative force from pinion 29 is preferably transmitted to shaft 44 through suitable adjustable coupling means 50 of the character illustrated in Spengler U. S. Patent No. 2,266,283. To effect an adjustment in the relative angular positions of pinion 49 and shaft 44, nut 48 may be loosened to permit the adjustable coupling means 50 to function. A spring 51 may be provided for yieldably holding the teeth of coupling means 51 in engagement when nut 48 is loosened.

There is thus provided novel pumping apparatus which is adapted to compress air and other gaseous mediums for supercharging ignition apparatus or the like, said pumping apparatus being novelly constructed and assembled in such a manner as to minimize the possibilities of failures during operation. Said pumping apparatus is also constructed in a novel manner to facilitate proper and adequate lubrication of the relatively moving parts of an enclosed pump unit while insuring against any excessive lubrication. Additionally, novel means are provided for positioning the assembled parts whereby careless assembly or assembling of the parts by unskilled personnel will not result in bending or buckling of the parts which would interfere with the free movement of the rotating parts.

Although only a single embodiment of the invention is illustrated and described, it is to be expressly understood that the invention is not limited thereto. For example, various changes may be made in the specific construction of the pump rotor and other parts as well as in the design and arrangement of the parts illustrated without departing from the spirit and scope of the invention as will now be apparent to those skilled in the art. For a definition of the limits of the invention, reference is had primarily to the appended claims.

What is claimed is:

1. In apparatus of the class described, a hollow housing, a shaft rotatably journalled in opposed walls of said housing, rotary pumping means in said housing including a casing with an axially movable cylindrical wall through which said shaft freely extends and a rotor having vanes engaged with said casing wall and drivably connected to said shaft for rotation therewith, said rotor including a porous metallic ring adjacent said shaft adapted to conduct a lubricant to the end wall of said casing, means in said housing for supplying a lubricant to said ring, and a wavy ring spring interposed between said housing and casing for yieldably holding said casing and rotor against movement axially of said shaft.

2. In apparatus of the class described, a hollow housing, a shaft rotatably supported and held against appreciable axial movement by thrust bearings in opposed walls of said housing, rotary pumping means in said housing including a casing with an axially movable, cylindrical wall freely surrounding said shaft and a rotor in said casing having vanes engaged with said wall and drivably connected to said shaft for rotation therewith and axial movement relative thereto, said rotor including a porous metal ring adapted to conduct a lubricant to the inner end wall of said casing, means in said housing for supplying a lubricant to said ring, and resilient means for yieldably holding said casing and rotor against movement relative to said housing in the direction of the axis of said shaft.

3. In apparatus of the class described, a rotatable shaft, pump means comprising a cylindrical casing surrounding said shaft, and a rotor in said casing drivably connected to said shaft for rotation therewith and axial movement relative thereto, said casing being free for axial movement with said rotor as a unit relative to said shaft, and unitary resilient means engaged with said casing at spaced points for yieldably resisting axial movement of said casing and rotor relative to said shaft.

4. In apparatus of the class described, a shaft, means for rotatably supporting said shaft, pumping means comprising an axially movable casing freely surrounding said shaft and a rotor in said casing drivably connected to said shaft for rotation therewith and axial movement relative thereto, means for rotatably supporting said shaft independently of said casing, and an annular resilient member of irregular formation having contact with said casing at spaced points for yieldably resisting axial movement of said casing and rotor as a unit relative to said shaft.

5. In apparatus of the class described, a shaft, means for rotatably supporting said shaft and for holding the same against longitudinal movement relative thereto, fluid compressing means comprising an axially movable casing surrounding said shaft in eccentric relation therewith and a rotor in said casing drivably connected to said shaft for rotation therewith, said casing comprising a cylindrical wall member and end plates loosely assembled therewith and capable of axial movement relative to said shaft, and means including a wavy ring spring holding said wall member and end plates in assembled relation and against axial movement relative to said shaft.

6. In a rotary pump, a casing, a rotatable shaft extending through said casing, and a rotor in said casing connected to said shaft for rotation therewith, said rotor including a porous ring adjacent said shaft adapted to receive and conduct a lubricant to end walls of the casing adjacent thereto.

7. In a rotary pump, a casing, a rotatable shaft extending into said casing, and a rotor in said casing connected to said shaft for rotation therewith, said rotor comprising a main member and a porous metallic lubricant containing ring mounted on said member adjacent said shaft and forming a portion of the end wall of said rotor.

8. In apparatus of the class described, a rotor having a bore therethrough comprising a main member and a porous metallic lubricant containing ring inset in said member, the surface of said ring forming a portion of the wall of said bore and a portion of the end wall of the rotor.

9. In apparatus of the class described, a casing, a rotatable shaft extending through said casing, and a rotor in said casing connected to said shaft for rotation therewith, said rotor comprising a main member and at least one porous metallic lubricant containing ring inset in said member adjacent said shaft and forming a portion of the end wall of the rotor, said ring being angle-shaped in radial cross-section.

10. In apparatus of the class described, a rotatable element, means for rotatably supporting said element, a stationary casing surrounding said element comprising a substantially cylindrical member and end plates in contact therewith, an annular wavy leaf spring interposed between said casing and said supporting means for hold-

ing said plates and member in assembled relation, and a rotor wholly disposed in said casing operatively connected to said element for rotation therewith.

11. In apparatus for compressing a gaseous medium, a rotatable shaft, a casing circumscribing said shaft, a rotor in said casing comprising a main member and a pair of bearing rings mounted on said member spacing the latter from said shaft, and shearable means drivably connecting said member to said shaft for rotation therewith.

12. In apparatus for compressing a gaseous medium, a rotatable shaft, a casing surrounding said shaft, a rotor in said casing comprising a main member and a pair of bearing rings mounted on said member spacing the latter from said shaft, and frangible means drivably connecting said member to said shaft for rotation therewith, said connecting means being constituted by a key adapted to shear in response to an overload.

13. In pump apparatus for compressing a gaseous medium, a hollow housing comprising at least two parts rigidly secured together, a rotatable shaft extending through and journalled in said housing, a pump casing in said housing around said shaft comprising a plurality of loosely assembled elements, resilient means interposed between said casing and said housing for holding said elements in assembled relation, said resilient means comprising an annular member having alternately arranged high and low portions engaging said housing and said casing, respectively, a rotor wholly disposed in said casing, and means for operatively securing said rotor to said shaft for rotation therewith.

14. In pump apparatus for compressing a gaseous medium, a hollow housing comprising at least two parts rigidly secured together, a rotatable shaft extending through and journalled in said housing, a pump casing in said housing around said shaft comprising a plurality of loosely assembled elements, an annular wavy resilient member in said housing for holding said elements in assembled relation, a rotor wholly disposed in said casing, a shearable key operatively securing said rotor to said shaft for rotation therewith, and soft metallic bearing means for said shaft on said rotor to permit free rotation of said shaft if rotation of said rotor is prevented.

15. In apparatus of the class described, a rotatable driven element, a rotor member surrounding said element, annular soft metallic means mounted on said member spacing the latter from said element, and frangible means drivably connecting said member to said element for rotation therewith.

JAKOB R. FREI.

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