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ROTARY PUMP, BLOWER, OR COMPRESSOR AND THE LIKE

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Fig. 1.

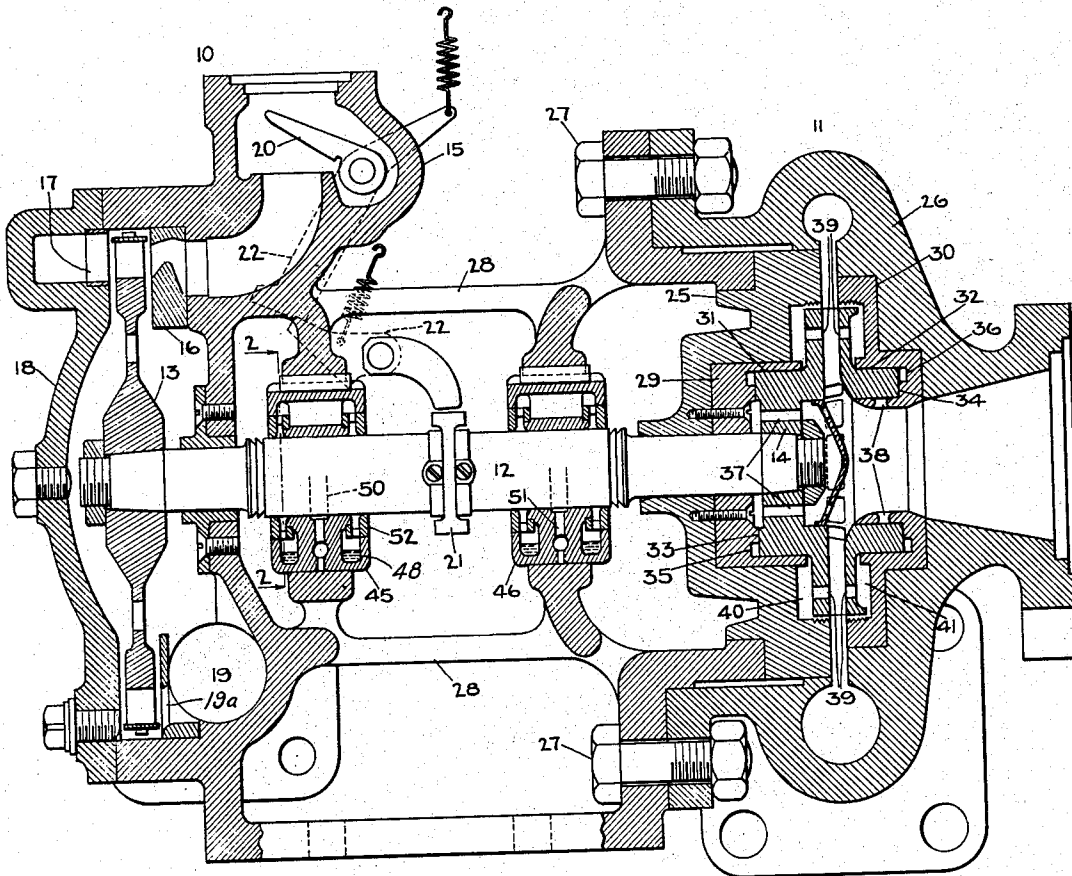
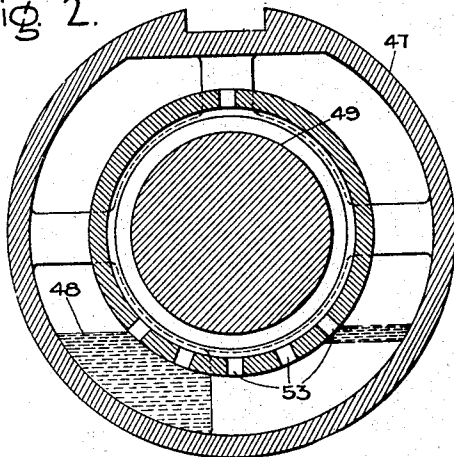


Fig. 2.



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UNITED STATES PATENT OFFICE

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ROTARY PUMP, BLOWER, OR COMPRESSOR
AND THE LIKEWalter Kieser, Berlin, Germany, assignor to
General Electric Company, a corporation of
New YorkApplication June 21, 1934, Serial No. 731,635
In Germany November 20, 1933

1 Claim. (Cl. 230—116)

The present invention relates to rotary pumps, blowers or compressors and the like driven by a prime mover, such as an elastic fluid turbine having a rotor fastened to the shaft of the compressor.

One object of the invention is to provide an improved construction and arrangement whereby axial thrust in either direction on the pump or compressor is automatically balanced or counteracted without the provision of special thrust bearings.

Another object of the invention is to provide an improved bearing arrangement.

For a consideration of what I believe to be novel and my invention, attention is directed to the following specification and the claim appended thereto in connection with the accompanying drawing which forms a part of my specification.

In the drawing, Fig. 1 represents a turbo compressor embodying my invention, and Fig. 2 is an enlarged cross sectional view along line 2—2 of Fig. 1.

The arrangement illustrated by way of example comprises a turbine 10 and a rotary pump, compressor or blower 11. The rotary parts of both the turbine and the compressor are provided in accordance with my invention on opposite overhung portions of a single shaft 12. More specifically, the turbine has a bucket wheel 13 fastened to the left-hand overhung portion of the shaft 12 and the compressor has a rotor or impeller 14 fastened to the right-hand overhung portion of the shaft 12. The turbine has a casing 15 defining an inlet for elastic fluid. A nozzle member 16 for properly directing the elastic fluid to the bucket wheel 13 is fastened to the casing 15. During operation the elastic fluid is discharged from the bucket wheel into reversing nozzles 17 fastened to an end plate 18. These nozzles reverse the direction of the elastic fluid and thus direct it back to another portion of the bucket wheel. The elastic fluid is finally discharged from the wheel and flows through an opening 19 into an exhaust conduit 19. An emergency valve 20 is provided for automatically shutting off the supply of elastic fluid to the turbine when the speed exceeds a certain value. To this end an emergency governor 21 is fastened to the turbine shaft for causing disengagement of a latch mechanism 22.

The compressor has two casing halves, 25 and 26, united by bolts 27. A portion of the left-hand casing half is integrally united with the turbine casing 15 by webs 28. Each casing half is provided with a bearing member 29 and 30 respec-

tively for the impeller 14. The latter has a left-hand cylindrical surface 31 rotating within a corresponding cylindrical surface of the member 29 and a right-hand cylindrical surface 32 rotating within a corresponding surface of the member 30. The impeller also has a left-hand end surface or face 33 facing a surface of the member 29 and a right-hand end surface or face 34 facing a corresponding surface of the member 30. The adjacent surfaces form minute clearances. In accordance with my invention I provide the members 29 and 30, which may form a part of the casing, with annular grooves or channels 35 and 36 respectively. The groove 35 faces the surface 33 and the groove 36 faces the right-hand end face 34 of the impeller. As will be clearly seen from the drawing, the channels or chambers 35 and 36 communicate with the high pressure side of the compressor through the minute cylindrical clearances defined between the cylindrical surfaces 31 and 32 of the impeller and the corresponding adjacent surfaces of the members 29 and 30. Both grooves also communicate with the inlet or suction side of the compressor. More specifically, the groove 35 communicates with the inlet side of the compressor through the small clearance between the end face 33 of the impeller and the adjacent face of the member 29 and axial bores 37 in the inner portion of the impeller. The channel 36 communicates with the inlet side of the compressor through the clearance between the end face 34 of the impeller and the adjacent surface of the bearing member 30, and through openings 38 in the latter. The outer radial portions of the impeller are provided with axial holes 39 to insure equal pressure in chambers 40 and 41 defined between the end faces of the outer impeller portions and the adjacent surfaces of the casing half 25 and the member 30 respectively. The pressures set up in this arrangement within the channels or chambers 35 and 36 depend first, upon the pressures in the inlet and the outlet of the compressor and second, upon the relative size of the clearances described above. It is important to note that the cylindrical clearances defined between the surfaces 31 and 32 of the impeller and the adjacent surfaces of the bearing members 29 and 30 remain constant, whereas the other clearances, which may be termed disk clearances, defined between the end faces 33 and 34 of the impeller and the adjacent surfaces of the bearing members 29 and 30 respectively vary in accordance with the axial thrust on the shaft. More particularly, at a definite inlet and outlet pressure in the compressor,

the pressures in said chambers vary in response to changes in thrust on the shaft and automatically balance or counteract the axial thrust in either direction on the shaft. If, for example, the shaft 5 is moved somewhat towards the right, the clearance between end face 34 of the impeller 14 and the adjacent surface of the bearing member 30 is reduced and the clearance between the left-hand end face 33 of the impeller and the adjacent surface of the bearing member 29 is increased. The cylindrical clearances as mentioned above remain constant. These changes in clearances in turn automatically cause an increase in pressure being set up in the chamber 36 and a drop in pressure within the chamber or channel 35, to the effect that a resultant hydraulic force is automatically set up, counteracting the thrust on the shaft and causing the impeller to return to its normal position. Thus the chambers 35 and 36 communicating through cylindrical or radial clearances with the discharge side of the compressor and through disk or axial clearances with the suction side of the compressor define hydraulic means for automatically counteracting or balancing thrust forces on the shaft. This balancing takes place with thrust forces acting in either direction and permits the omission of special thrust bearings.

Another important feature of the invention is the arrangement and the design of the bearings. The turbo compressor is provided with a double bearing comprising a bearing 45 supported by the turbine casing 15 and a bearing 46 supported by the compressor casing half 25. The emergency governor 21 is fastened to the shaft intermediate the bearings 45 and 46. Each bearing has an integral casing 47 defining a chamber or a container for lubricant 48 and a bearing surface 49 for the shaft 12 to be supported. A central portion of the bearing has a groove 50 cut into the bearing surface communicating through a radial bore or bores 51 with the container for lubricant 48. Lubricant is supplied to the groove 50 by the

pumping action of the shaft in the bearing. It has been found that with this kind of bearing the oil is forced out of the bearing, apparently due to the fact that the rotating shaft imparts to the air in the casing a peripheral component so that with the conversion of the speed of the circulating air into pressure an excess pressure is set up in the bearing casing. This drawback is overcome with my invention by the provision of a ring 52 at each end of the bearings, which ring 10 has a plurality of radial bores 53. During operation the oil forced into the groove 50 spreads axially along and around the shaft until it reaches the openings 53, whence it flows into the oil container 48. The air set in circulation by the shaft 15 is deprived of its peripheral component as it passes through the radial bores 53. This eliminates or reduces the setting up of excessive pressures and also reduces to a considerable extent the leakage of oil along the shaft. 20

Having described the method of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof, I desire to have it understood that the apparatus shown is only illustrative and that the invention may be carried out by other means. 25

What I claim as new and desire to secure by Letters Patent of the United States, is:

The combination of a compressor having a shaft, a prime mover for driving the compressor 30 having a rotor fastener to the shaft, the compressor having a casing and an impeller fastened to the shaft, and members fastened to the casing facing cylindrical and end surfaces of the impeller, each member having a recess communicating 35 through clearances defined between corresponding cylindrical surfaces and end faces of the impeller and the members with the outlet and the inlet of the compressor to automatically set up hydraulic forces responsive to and counteracting 40 the axial thrust on the shaft.

WALTER KIESER.