Nov. 24, 1925. 1,563,129

L. WEIL

CENTRIFUGAL PUMP OR BLOWER AND SIMILAR MACHINE

Filed Nov. 30, 1921 2 Sheets-Sheet 1

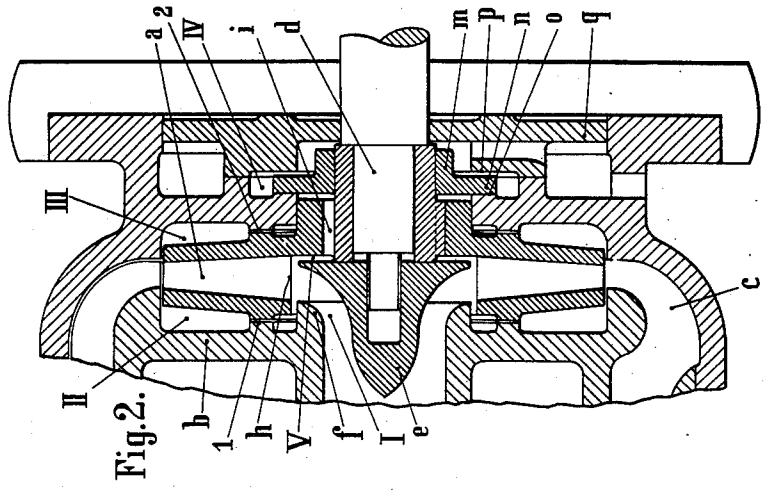


Fig.2.

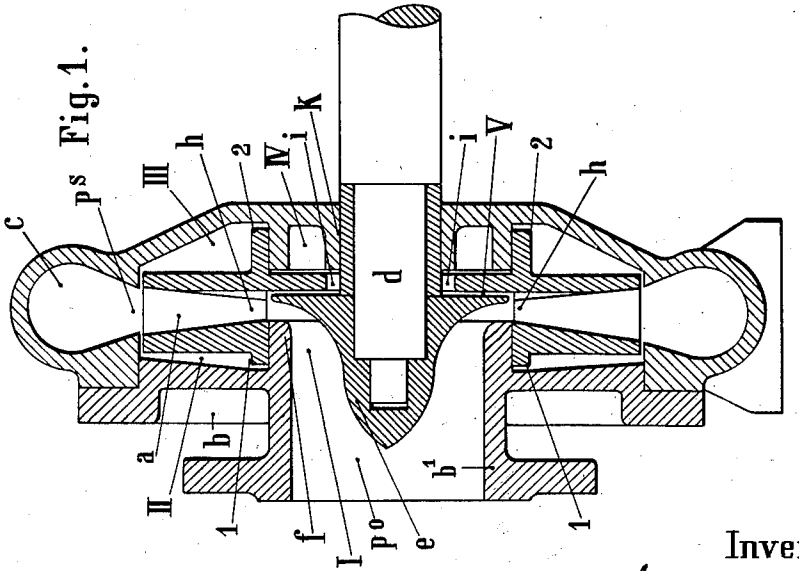


Fig.1.

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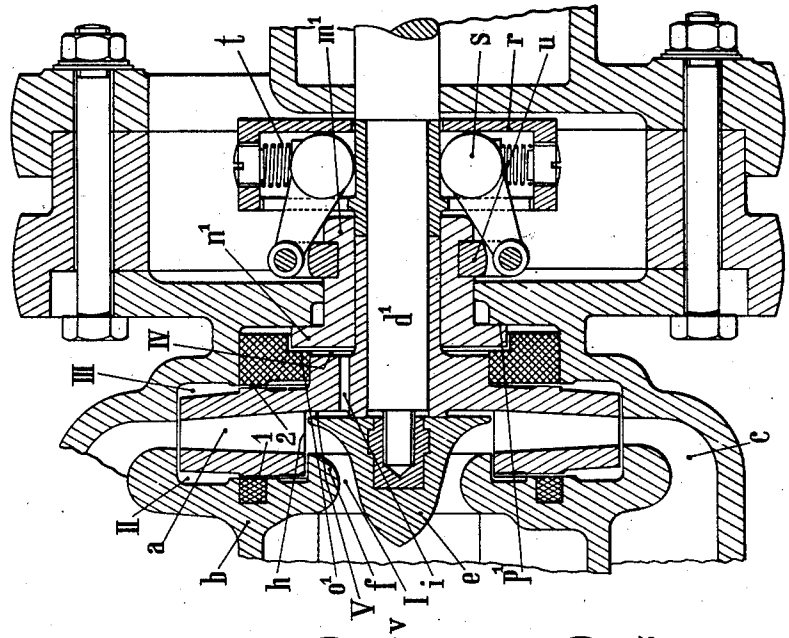
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Fig.3.



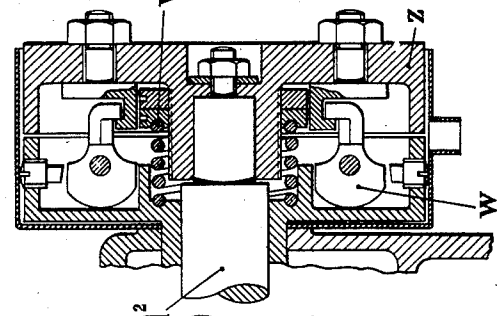
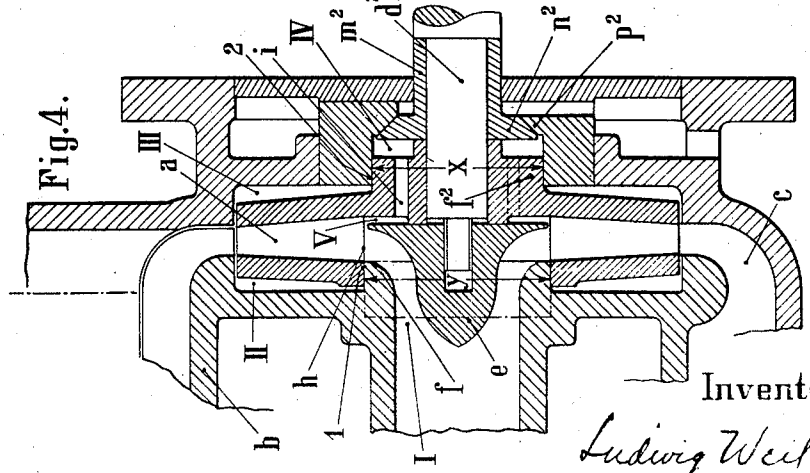


Fig.4.



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Patented Nov. 24, 1925. 1,563,129

UNITED STATES PATENT OFFICE.

LUDWIG WEIL, OF BIEBRICH, GERMANY.

CENTRIFUGAL PUMP OR BLOWER AND SIMILAR MACHINE.

Application filed November 30, 1921. Serial No. 518,938.

To all whom it may concern:

Be it known that I, LUDWIG WEIL, a citizen of Austria, and resident of Biebrich-on-the-Rhine, in the State of Prussia, German Empire, have invented new and useful Improvements in Centrifugal Pumps or Blowers and Similar Machines, of which the following is a full, clear, and exact specification.

My invention relates to improvements in centrifugal pumps or blowers and similar machines and more particularly in pumps or blowers of the type in which the end thrust on the impeller is balanced by pressure chambers containing a fluid acting in axial direction on the rotary member. One of the objects of the improvements is to provide a machine of this type in which the thrust is balanced also in case of a change of the axial pressure caused by wear and outer axial forces acting on the rotary system, so that thrust bearings may be dispensed with. Another object of the improvements is to provide a machine in which the pressure at opposite ends of the stuffing box or bearing of the impeller shaft is uniform, so that the usual packing medium and in some cases the stuffing box itself may be dispensed with. With these and other objects in view my invention consists in the matters to be described hereinafter and particularly pointed out in the appended claims.

For the purpose of explaining the invention several examples embodying the same have been shown in the accompanying drawings, in which—

Fig. 1 is a vertical longitudinal section showing a pump or blower in which the axial pressure acting on opposite sides of the bearing of the shaft is balanced only while the machine is in operation,

Fig. 2 is a similar section showing a modification in which the said axial pressure is balanced also when the machine is at rest, the machine being provided with a shiftable ring or disk which is automatically set by the difference of the pressures within the pump and outside the same,

Fig. 3 is a longitudinal section showing a modification similar to that shown in Fig. 2 in which the adjustable ring is controlled by a centrifugal governor keyed to the shaft,

Fig. 4 is a similar section showing a modification in which a valve disk secured to the shaft is controlled by a spring and a governor acting on the end of the shaft.

In the example shown in Fig. 1 my improved pump or blower consists of a casing comprising a circumferential delivery chamber c and a lid b formed with a suction pipe b^1, a rotary member or impeller a provided with vanes, and a shaft d carrying the same. To the shaft d a hub e is secured which cooperates with an inner flange f of the lid b to provide a suction duct which gradually tapers inwards and towards the inlet end of the member a and opens into the passages of the impeller a in radial direction. The rotary member a is formed on opposite sides with annular flanges 1 and 2 providing with the wall of the casing and the lid b four pressure chambers I, II, III and IV. Between the hub e and the member a there is a pressure chamber V which communicates through holes i with the pressure chamber IV located at the rear of the member a.

The operation of the pump or blower shown in Fig. 1 is as follows:

The fluid medium is drawn into the machine at a pressure indicated in Fig. 1 by the character p_o, and it is discharged at a pressure p_s. The fluid pressure within the chambers II and III is substantially the same, so that the pressure exerted by the fluid confined therein is balanced. The chamber IV communicates with the chamber III, so that the fluid pressure therein is at the beginning larger than p_o, and the differential pressure acting on the rotary member is directed towards the suction passage. However, the fluid medium flowing through the tapering inlet duct I has a strong ejector action at h, by means of which the fluid from the chambers V and IV is withdrawn in radial direction and carried along through the passages of the impeller a. Thereby the pressure within the chamber IV is reduced. The velocity of the medium at h is transformed into pressure by reason of the outwardly flaring passages of the impeller a. If an axial pressure is exerted on the rotary system in the direction towards the suction pipe b^1, that is in Fig. 1 from the right to the left, the rotating system is shifted to the left and towards the suction pipe so that the cross-sectional area of the passages h is reduced and the ejector action increased. Thereby the pressure within the

chamber IV is reduced, and the rotary system tends to move to the right. If the axial pressure acts to the right, the rotary system is shifted to the right so as to enlarge the cross-sectional area of the passages h, to reduce the ejector action and to increase the pressure within the chamber IV, until the said axial pressure is balanced.

In some cases I prefer to provide pressure chambers of such size and dimension that the maximum pressure within the chamber IV is less than the pressure outside the casing. In this case the suction caused by the ejector action relieves the stuffing box k, so that the packing thereof can be dispensed with. This feature is particularly important, where concentrated acids or lyes are pumped.

The examples shown in Figs. 2 to 4 are similar in construction to the example shown in Fig. 1, as far as the construction of the pump proper is concerned, and similar reference characters have been used to indicate corresponding parts, so that it is not necessary to repeat the description of the pump. In the modification shown in Fig. 2 in addition a ring m is mounted on the shaft d^1 or the hub of the impeller. The said ring is provided with a flange n, and it is axially shiftable on the shaft or hub for being brought into tight engagement with an annular surface o of the casing and with an annular surface p provided on a disk q fitted in the casing. By thus providing seats for the shiftable ring m, n on opposite sides thereof the pump shaft is tightened as against the casing of the blower when the fluid pressure within the casing is higher than that of the outer air as well when it is lower than that of the outer air.

In the modification shown in Fig. 3 an axially shiftable ring m^1, n^1 is provided which cooperates with two seats o^1 and p^1 provided respectively on opposite sides of the ring, the construction being similar in this respect to the construction described with reference to Fig. 2. However, for shifting the ring I provide a centrifugal governor r on the shaft d^1, which governor comprises rocking weighted bodies s and springs t. The bodies s are joined to a collar u or the like which has a bearing in an annular groove of the ring m^1. By the cooperation of the bodies s and the springs t the ring m^1, n^1 is positively shifted either to the right or left and into tightening engagement with either one of the seats o^1 or p^1. By varying the tension of the springs the pressure of the ring m^1, n^1 on its seats can be regulated, so that the tightening is independent of the fluid pressure within the pump.

In the example shown in Fig. 4 a ring m^2 is secured to the shaft d^2, and its flange n^2 is in the form of a conical valve body adapted to engage a conical seat p^2 formed on a part of the wall of the casing of the pump or blower. To hold the valve body in tightening contact with its seat a compression spring v is provided at the end of the shaft d^2, which spring forces the shaft d^2 to the right and the valve body on its seat. The spring is enclosed within a casing z, which also encloses weighted rockers w. When the pump or blower is in operation the rockers w are rocked outwards so as to compress the spring v and to unseat the valve body n^2. Therefore, the tightening surfaces are not subject to wear when the pump is in operation. In order that the axial displacement of the shaft d^2 be small, I provide means for setting the spring v on the shaft.

Fig. 4 also shows other means for unseating the valve body n^2 while the pump is in operation. As shown the diameters y and x of the tightening flanges f and f^2 are different on opposite sides of the rotary member, the diameter x of the rear flange f^2 of the member being smaller than the diameter y of the tightening flange f located at the front or suction side of the pump. Therefore the fluid pressure within the chamber III acts on a larger area of the member a than the fluid pressure within the chamber II, so that the differential pressure on the member a is directed to the left. In the preferred form shown in the figure the dimensions are such that the differential pressure exceeds the pressure exerted by the spring v when the pump is at rest. Therefore the diameter x of the flange f^2 is smaller than the diameter y of the flange f.

While Fig. 4 shows two means for unseating the valve m^2, n^2, viz. the weighted bodies w and the difference of the diameters x and y, I wish it to be understood, that in some cases only one of said means is provided in the pump or blower.

While in describing the invention reference has been made to particular examples embodying the same, I wish it to be understood that my invention is not limited to the constructions shown in the figures, and that various changes may be made in the general arrangement of the pump or blower and the construction of its parts.

What I claim is:

1. A machine of the class described, comprising a casing having an inlet passage and a discharge passage, a rotary member formed with passages intermediate the inlet and discharge passages and adapted when rotated to force a fluid medium from the inlet passage to the discharge passage, a fluid chamber, a passage through which the fluid medium entering the rotary member acts on the fluid confined within said chamber for varying the pressure thereof, and means controlled by the pressure of the fluid within the chamber for varying the

flow of the fluid medium through said passages.

2. A machine of the class described, comprising a casing having an axial inlet passage and a circumferential discharge passage, a rotary member formed with passages intermediate the inlet and discharge passages and adapted when rotated to force a fluid medium from the inlet passage to the discharge passage, a fluid chamber, a passage through which the fluid medium entering the rotary member acts on the fluid confined within said chamber for varying the pressure thereof, and means controlled by the pressure of the fluid within the chamber for varying the flow of the fluid medium through said passages.

3. A machine of the class described, comprising a casing having an inlet passage and a discharge passage, an axially shiftable rotary member formed with passages intermediate the inlet and discharge passages and adapted when rotated to force a fluid medium from the inlet passage to the discharge passage, said rotary member being adapted when shifted axially to vary the flow of the medium, a fluid chamber provided by said casing and rotary member in position for causing the fluid confined therein to act on the rotary member in axial direction, and a passage through which said fluid medium when entering the rotary member acts on the fluid within said chamber for varying the pressure thereof.

4. A machine of the class described, comprising a casing having an inlet passage and a discharge passage, an axially shiftable rotary member formed with passages intermediate the inlet and discharge passages and adapted when rotated to force a fluid medium from the inlet passage to the discharge passage, said rotary member being adapted when shifted axially to vary the flow of the medium, a fluid chamber provided by said casing and rotary member in position for causing the fluid confined therein to act on the rotary member in axial direction, and a passage connecting said chamber and passages for the fluid medium and opening into the inner end of the intermediate passages of the rotary member substantially in the direction of the flow of the medium through the same.

5. A machine of the class described, comprising a casing having an inlet passage and a discharge passage, an axially shiftable rotary member formed with passages intermediate the inlet and discharge passages and a hub bordering said inlet passage with a radial wall and adapted when rotated to force a fluid medium from the inlet passage to the discharge passage, said hub being adapted when axially shifting the rotary member to vary the flow of the medium, a fluid chamber provided by said casing and rotary member in position for causing the fluid confined therein to act on the rotary member in axial direction, and a passage opening into the inner end of the intermediate passages of the rotary member through which said fluid medium acts on the fluid within said chamber for varying the pressure thereof.

6. A machine of the class described, comprising a casing having an inlet passage and a discharge passage, an axially shiftable rotary member formed with passages intermediate the inlet and discharge passages and a hub having a radial flange bordering said inlet passage, said rotary member being adapted when rotated to force a fluid medium from the inlet passage to the discharge passage, said hub being adapted when shifted axially with the rotary member to vary the flow of the medium, fluid chambers formed by the casing and at opposite sides of the rotary member and communicating with said discharge passage, a fluid chamber formed by the casing and a part of the wall of the rotary member in position for causing the fluid confined therein to act on the rotary member in axial direction, and a fluid chamber formed between said radial flange of the hub and the wall of the rotary member, the last named fluid chamber opening into the inner end of the intermediate passages of the rotary member and communicating with said chamber formed by the casing and part of the rotary member and with said inlet passage.

7. A machine of the class described, comprising a casing having an inlet passage and a discharge passage, a rotary member formed with passages intermediate the inlet and discharge passages and adapted when rotated to force a fluid medium from the inlet passage to the discharge passage, a fluid chamber communicating with the discharge passage, a passage connecting said chamber with the inlet passage and opening into the inner end of the intermediate passages of the rotary member substantially in the direction of the flow of the fluid medium passing through the same, and means controlled by the pressure of the fluid within the chamber for varying the flow of the fluid medium through said passages.

8. A machine of the class described, comprising a casing having an inlet passage and a discharge passage, an axially shiftable rotary member formed with passages intermediate the inlet and discharge passages and adapted when rotated to force a fluid medium from the inlet passage to the discharge passage, said rotary member being adapted when shifted axially to vary the flow of the medium, a fluid chamber provided by said casing and rotary member in position for causing the fluid confined therein to act on the rotary member in axial direction, and a passage opening into the in-

ner end of the intermediate passages of the rotary member and through which said fluid medium acts on the fluid within said chamber for varying the pressure thereof, the dimensions of the casing and rotary member being such that the pressure within said fluid chamber does not exceed the pressure of the air surrounding the machine.

9. A machine of the class described, comprising a casing having an inlet passage and a discharge passage, an axially shiftable rotary member formed with passages intermediate the inlet and discharge passages and adapted when rotated to force a fluid medium from the inlet passage to the discharge passage, said rotary member being adapted when shifted axially to vary the flow of the medium, a shaft on which said rotary member is mounted and which passes through the wall of the casing, metallic tightening means between said shaft and the wall of the casing, a fluid chamber provided by said casing and rotary member in position for causing the fluid confined therein to act on the rotary member in axial direction, and a passage opening into the inner end of the intermediate passages of the rotary member and through which said fluid medium acts on the fluid within said chamber for varying the pressure thereof.

10. A centrifugal pump or blower, comprising a casing provided with inlet and outlet passages, a rotary member within said casing formed with passages intermediate said inlet and outlet passages and adapted when rotated to force a fluid medium from the inlet passage to the outlet passage, a shaft carrying said rotary member and mounted in the wall of the casing, a fluid chamber provided by the casing at the part thereof where the shaft passes into same, and a passage opening into the inner end of the intermediate passages of the rotary member in a direction parallel to that of the flow through said intermediate passage and through which passage the fluid medium flowing through the machine continuously acts on the fluid within said chamber.

11. A centrifugal pump or blower, comprising a casing provided with inlet and outlet passages, a rotary member within said casing formed with passages intermediate said inlet and outlet passages and adapted when rotated to force a fluid medium from the inlet passage to the outlet passage, a shaft carrying said rotary member and mounted in the wall of the casing, a fluid chamber provided by the casing at the part thereof where the shaft passes into the same, and a passage forming a continuous connection between said fluid chamber and said passages through which the fluid medium flows and opening into the inner end of the intermediate passages of the rotary member in a direction parallel to that of the flow through said intermediate passage to form therewith an ejector for reducing pressure within the chamber.

12. A centrifugal pump or blower, comprising a casing provided with inlet and outlet passages, a rotary member within said casing formed with passages intermediate said inlet and outlet passages and adapted when rotated to force a fluid medium from the inlet passage to the outlet passage, a shaft carrying said rotary member and mounted in the wall of the casing, a fluid chamber provided by the casing at the part thereof where the shaft passes into the same and communicating with said outlet passage, and a passage of variable width connecting the chamber with said passages through which the fluid medium flows at the inlet side thereof and opening into the same in a direction parallel thereto to form therewith an ejector for reducing the fluid pressure within said chamber.

13. A centrifugal pump or blower, comprising a casing provided with inlet and outlet passages, a rotary member within said casing formed with passages intermediate said inlet and outlet passages and adapted when rotated to force a fluid medium from the inlet passage to the outlet passage, a shaft carrying said rotary member and mounted in the wall of the casing, metallic tightening means between said shaft and casing, a fluid chamber provided by the casing at the part thereof where the shaft passes into the same, and a passage through which the fluid medium flowing through the machine acts on the fluid within said chamber, said passage opening into the passage formed in the rotary member in a direction parallel thereto.

14. A centrifugal pump or blower, comprising a casing provided with inlet and outlet passages, a rotary member within said casing formed with passages intermediate said inlet and outlet passages and adapted when rotated to force a fluid medium from the inlet passage to the outlet passage, a shaft carrying said rotary member and mounted in the wall of the casing, a ring carried by said shaft and adapted for engagement with the casing for providing a tight joint between the shaft and the casing, and means controlled by the rotation of the rotary member to relieve the pressure of the ring on its seat.

15. A centrifugal pump or blower, comprising a casing provided with inlet and outlet passages, a rotary member within said casing formed with passages intermediate said inlet and outlet passages and adapted when rotated to force a fluid medium from the inlet passage to the outlet passage, a shaft carrying said rotary mem-

ber and mounted in the wall of the casing, a ring slidable on said shaft and adapted with its opposite faces for tightening engagement with seats provided by the casing, a fluid chamber within said casing in position for acting by the pressure of the fluid confined therein on the ring, and a passage through which the fluid medium acts on the fluid within said chamber for varying the pressure thereof.

16. A centrifugal pump or blower, comprising a casing provided with inlet and outlet passages, a rotary member within said casing formed with passages intermediate said inlet and outlet passages and adapted when rotated to force a fluid medium from the inlet passage to the outlet passage, a shaft carrying said rotary member and mounted in the wall of the casing, a ring slidable on said shaft and adapted for tightening engagement with a seat provided by the casing, and means on said shaft operating by centrifugal force and connected with said ring for seating and unseating the same.

17. A centrifugal pump or blower, comprising a casing provided with inlet and outlet passages, a rotary member within said casing formed with passages intermediate said inlet and outlet passages and adapted when rotated to force a fluid medium from the inlet passage to the outlet passage, a shaft carrying said rotary member and mounted in the wall of the casing, a ring slidable on said shaft and adapted for tightening engagement with a seat provided by the casing, and regulatable means on said shaft operating by centrifugal force and connected with said ring for seating and unseating the same.

18. A centrifugal pump or blower, comprising a casing provided with inlet and outlet passages, a rotary member within said casing formed with passages intermediate said inlet and outlet passages and adapted when rotated to force a fluid medium from the inlet passage to the outlet passage, an axially shiftable shaft carrying said rotary member and mounted in the wall of the casing, a ring secured to said shaft and adapted for tightening engagement with a seat provided by the casing, and adjustable means acting on said shaft and tending to seat said ring.

19. A centrifugal pump or blower, comprising a casing provided with inlet and outlet passages, a rotary member within said casing formed with passages intermediate said inlet and outlet passages and adapted when rotated to force a fluid medium from the inlet passage to the outlet passage, an axially shiftable shaft carrying said rotary member and mounted in the wall of the casing, a ring secured to said shaft and adapted for tightening engagement with a seat provided by the casing, an adjustable spring acting on said shaft in axial direction and tending to force the ring on its seat, and means operating by centrifugal force and acting on said spring in a direction for unseating the ring.

20. A centrifugal pump or blower, comprising a casing provided with inlet and outlet passages, a rotary member within said casing formed with passages intermediate said inlet and outlet passages and adapted when rotated to force a fluid medium from the inlet passage to the outlet passage, an axially shiftable shaft carrying said rotary member and mounted in the wall of the casing, a ring secured to said shaft and adapted for tightening engagement with a seat provided by the casing and pressure chambers provided by the casing and rotary member at opposite sides of the rotary member and communicating with the passages for the fluid medium, the area of the rotary member acted upon by the fluid medium within the chambers being different so that a differential pressure is produced which tends to unseat said ring.

In testimony whereof I have affixed my signature.

LUDWIG WEIL.