Nov. 9, 1937. G. HOPFENSBERGER 2,098,244

ROTATING MACHINE

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Fig. 1

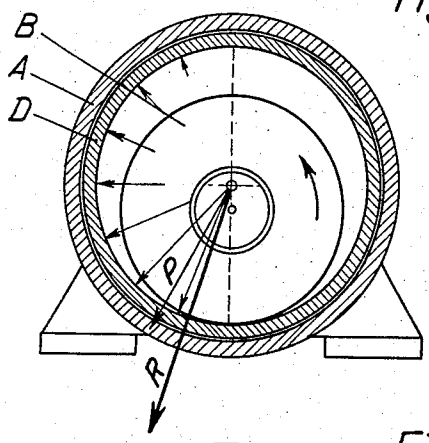



Fig. 1a

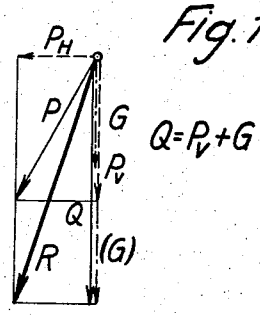



Fig. 2

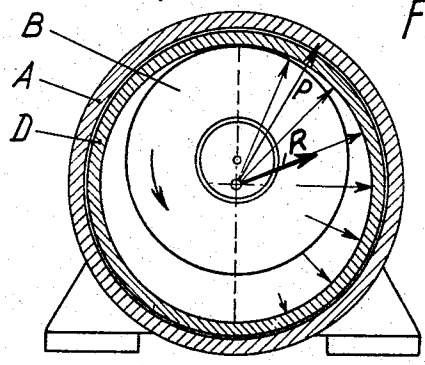



Fig. 2a

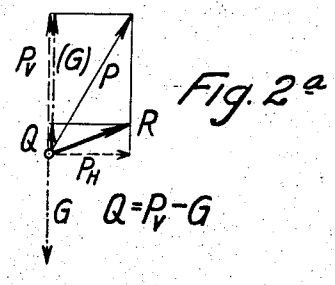



Fig. 3

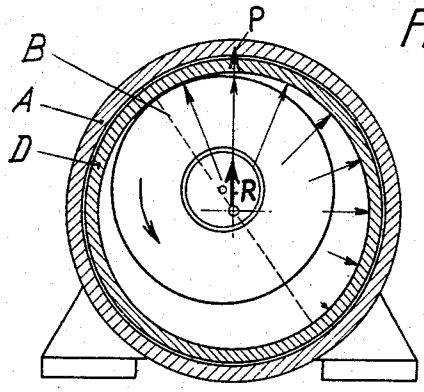
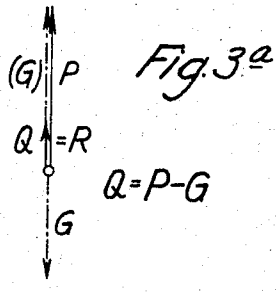



Fig. 3a




INVENTOR
GEORG HOPFENSBERGER

By C. P. Goepel.

ATTORNEY.

Nov. 9, 1937. G. HOPFENSBERGER 2,098,244

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Fig. 4

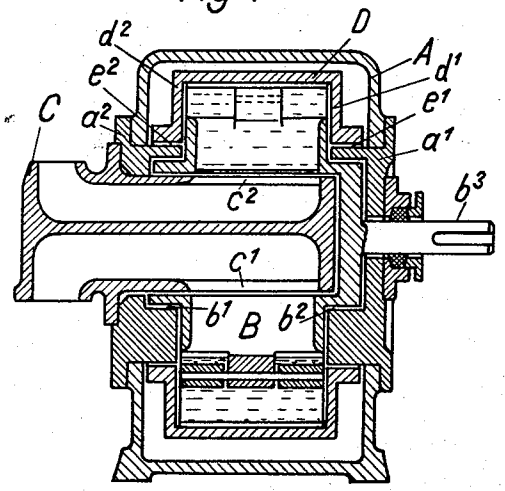



Fig. 5

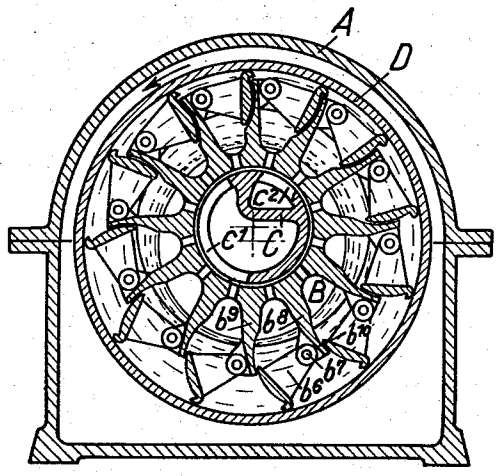
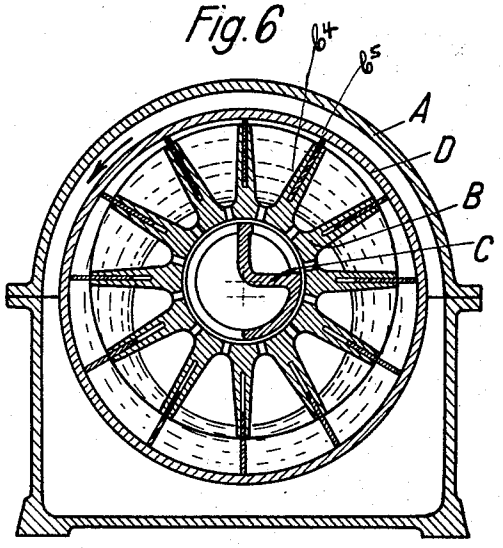



Fig. 6




INVENTOR
GEORG HOPFENSBERGER

BY C. P. Goepel

ATTORNEY.

Patented Nov. 9, 1937 2,098,244

# UNITED STATES PATENT OFFICE

2,098,244

## ROTATING MACHINE

Georg Hopfensberger, Heidenheim-on-the-Brenz, Germany

Application February 6, 1936, Serial No. 62,653
In Germany February 7, 1935

5 Claims. (Cl. 230—79)

The invention relates to a rotating machine containing a rotating runner (inner rotor) consisting of a number of cells and surrounded by a cylindrical drum (outer rotor) pivoted eccentrically to the runner and which is rotated by the runner by means of friction forces exerted on it by the walls which form the cells of the runner. The object achieved by the invention is a substantial reduction of the forces acting on the bearings of the rotating drum to facilitate the starting of the machine by compensating the weight of the drum by means of the working pressure.

Rotating machines are well-known as power engines, especially as internal combustion engines, as well as working machines, i. e. compressors etc., and finally also as gears. Their way of working is either without any fluid—for instance as compressors—or with an auxiliary fluid—for instance internal combustion engines etc. With this type of machine the single working cells of the runner are sealed against one another as well as against the rotating drum by mechanical means or an auxiliary fluid or both.

All these well-known designs have the disadvantage that, especially with compressors, a force resulting from sealing pressures, centrifugal pressures and working pressures is exerted on the bearings of the cylindrical drum which, with the designs thus far known, act in a vertical or approximately vertical downward direction, so increasing the normal weight of the cylindrical drum and pressing it on its bearings so that more or less great difficulties are encountered to start the machine, all the more as the cylindrical drum is not rotated positively but only by friction. It has already been attempted to remove these difficulties in the case of rotating machines working with an auxiliary fluid and equipped with special sealing devices between the individual working cells, by increasing the weights of the sealing devices subject to the centrifugal force (for example gates sliding either in or on the cell wall preferably arranged rotatably around an axle borne by the neighbouring cell wall or to tooth-like engagement between cylindrical drum and runner etc.) to increase in this way the friction forces acting on the drum. The advantage expected of this design nevertheless is, however, eliminated by the resulting disadvantage of greater wear and tear.

The present invention removes the aforementioned disadvantages by employing the working, centrifugal and sealing pressures produced by starting the machine to lift the cylinder drum, thereby producing a substantial reduction of its natural weight and diminishing the forces acting on the bearings of the machine, thus facilitating the starting of the machine and the dispensing of mechanical starting devices.

The drawings show, for the purpose of comparison, the design of a well-known rotating machine as well as modified structures according to the invention.

In this showing,

Fig. 1 is a diagrammatic showing of a conventional rotating machine, the forces acting on the bearings of the cylindrical drum being indicated as arrows;

Fig. 2 is a similar showing wherein the axis of rotation of the runner is positioned vertically above that of the cylindrical drum;

Fig. 3 is a similar showing wherein the axis of rotation of the runner is positioned above that of the drum, but the line connecting the two axes is angularly displaced from the vertical in the direction of rotation of the parts;

Figs. 1*a*, 2*a*, and 3*a* represent vector diagrams of the forces acting on the bearings of the cylindrical drums of the machines shown in Figs. 1, 2, and 3, respectively;

Fig. 4 is a longitudinal vertical section through a rotating machine provided with pivoted vanes for sealing the individual cells of the runner;

Fig. 5 is a vertical section through the machine shown in Fig. 4 taken at right angles of the showing of Fig. 4; and

Fig. 6 is a vertical transverse section through a rotating machine provided with sliding gates for sealing the cells of the runner;

In the various figures like parts are represented by like reference numerals. The stationary housing is shown at A, the runner at *b* and the cylindrical drum at D. The stationary control shaft, shown at C, is provided with inlet slot $C^1$ and outlet slot $C^2$; see Figs. 4 and 5.

Referring to the diagram of the forces which are represented on Figs. 1, 2, 3, 1*a*, 2*a* and 3*a*, it will be seen that P represents the force resulting from the sealing, centrifugal and working pressures which force may be resolved into components $P_H$ and $P_V$ which act on the bearings. With the known arrangement shown in Fig. 1 the force $P_V$ acting vertically on the bearing is increased by the weight G of the cylindrical drum D drawn along by the runner so that there results a total load of the value $Q=P_V+G$ on the bearings in the vertical direction. To this force is to be added the power $P_H$ acting in a horizontal direction. The total load or resultant R on the bearings is in this way highly unfavourable.

With the arrangement shown in Figs. 2 and 2a, the normal weight G is to be deducted from the vertical force Pv, so that the resultant force $Q=P_V-G$ acting vertically on the bearings is directed opposite to the force of gravity, thus substantially unloading the bearings. One disadvantage of this arrangement is the fact that force $P_H$ acting on the bearing in a horizontal direction brings with it a slight increase of the total load R which nevertheless is compensated by the simplicity of this design. This defect is overcome by the design shown in Figs. 3 and 3a in which the axis of rotation of the runner B is situated above that of the cylindrical drum D, but not exactly in a vertical direction as in Fig. 2, the line joining these axes being rotated somewhat from the vertical in the direction of rotation of the parts.

In Figs. 4 to 6 two examples of rotating compressors with an auxiliary fluid are shown, i. e. in Figs. 4 and 5 with rotatable sliding gates, and on Fig. 6 with radially sliding gates.

With the rotating compressor according to Figs. 4 and 5 the cylindrical drum D with its side walls $d^1$ and $d^2$ rotates in a stationary housing A with lateral covers $a^1$ and $a^2$ in the bearings $e^1$ and $e^2$.

The cell wheel or runner B rotates in bearings $b^1$ and $b^2$ of the aforementioned covers $a^1$ and $a^2$ and is driven from its shaft $b^3$. In the stationary control cylinder C inlet slots $C^1$ and outlet slots $C^2$ are arranged. The sealing of the neighbouring cells against one another and against the drum D is effected by sealing devices $b^6$ which are designed as pivoted vanes with their pivot points $b^7$ mounted on the neighbouring cell wall $b^8$. These pivoted vanes $b^6$, during rotation of the runner, are retracted within the cells of the runner, a clearance space being provided for this purpose in the adjacent cell walls.

With the rotating compressor according to Fig. 6 the sealing of the neighbouring cells against one another and against rotating drum D is effected by sliding gates $b^5$ which are movable in a radial direction within the cell walls $b^4$.

It results from the foregoing description that the purpose of the invention, i. e. to reduce to a substantial extent the load on the bearings of the cylindrical drum of the proper weight of the latter, is attained by the designs referred to.

It is obvious that various changes and modifications may be made in the details of construction of the above specifically described embodiment of this invention without departing from the spirit thereof, such changes and modifications being restricted only by the scope of the subjoined claims.

I claim:

1. In a rotating machine, a rotating cylindrical drum mounted on bearings, a multiple-cell runner mounted eccentrically with respect to said drum and rotating within said drum, an auxiliary fluid between said drum and said runner and means for sealing the cells of said runner, the axis of rotation of said runner being above that of said drum and being so disposed that the resultant of the sealing, centrifugal action, and working forces substantially completely counteracts the action of gravity.

2. In a rotating machine, a stationary external housing, a cylindrical drum rotating in bearings mounted in said housing, a multiple-cell runner mounted to rotate within said drum, the axis of rotation of said runner being above that of said drum and being disposed in such manner that the line connecting the two axes is angularly displaced from the vertical in the direction of rotation of the parts, thereby substantially equalizing the forces acting on the bearings of said drum, said forces including the action of gravity and the sealing, centrifugal and working forces.

3. In a rotating machine, a stationary external housing, pairs of separate bearings eccentrically mounted in said housing, a cylindrical drum rotating in one pair of said bearings within said housing, a multiple-cell runner rotating in another pair of said bearings within said drum, an auxiliary liquid disposed between said drum and said runner and means for sealing the cells of said runner mounted on said runner, the axis of rotation of said runner being so disposed with relation to that of said drum that the forces acting on the bearings of said drum are substantially counteracted by the equalization of the sealing, centrifugal action, and working forces to that of the action of gravity.

4. The rotating machine of claim 3 wherein the cylindrical drum is rotated only by the sealing means pressed against it by the effect of the centrifugal force.

5. In a rotating machine, a stationary external housing, two opposed pairs of bearings mounted in opposite sides of said housing, one of said pairs of bearings being eccentric to said other pair, a cylindrical drum mounted in one of said pairs of bearings for rotation within said housing, a multiple-cell runner mounted in the other pair of bearings for rotation within said cylindrical drum, the axis of rotation of said runner being above that of said cylindrical drum and disposed in such manner that the force on said cylindrical drum resulting from the sealing, centrifugal and working forces opposes the force of gravity acting on said cylindrical drum, thereby reducing the load on its bearings.

GEORG HOPFENSBERGER.