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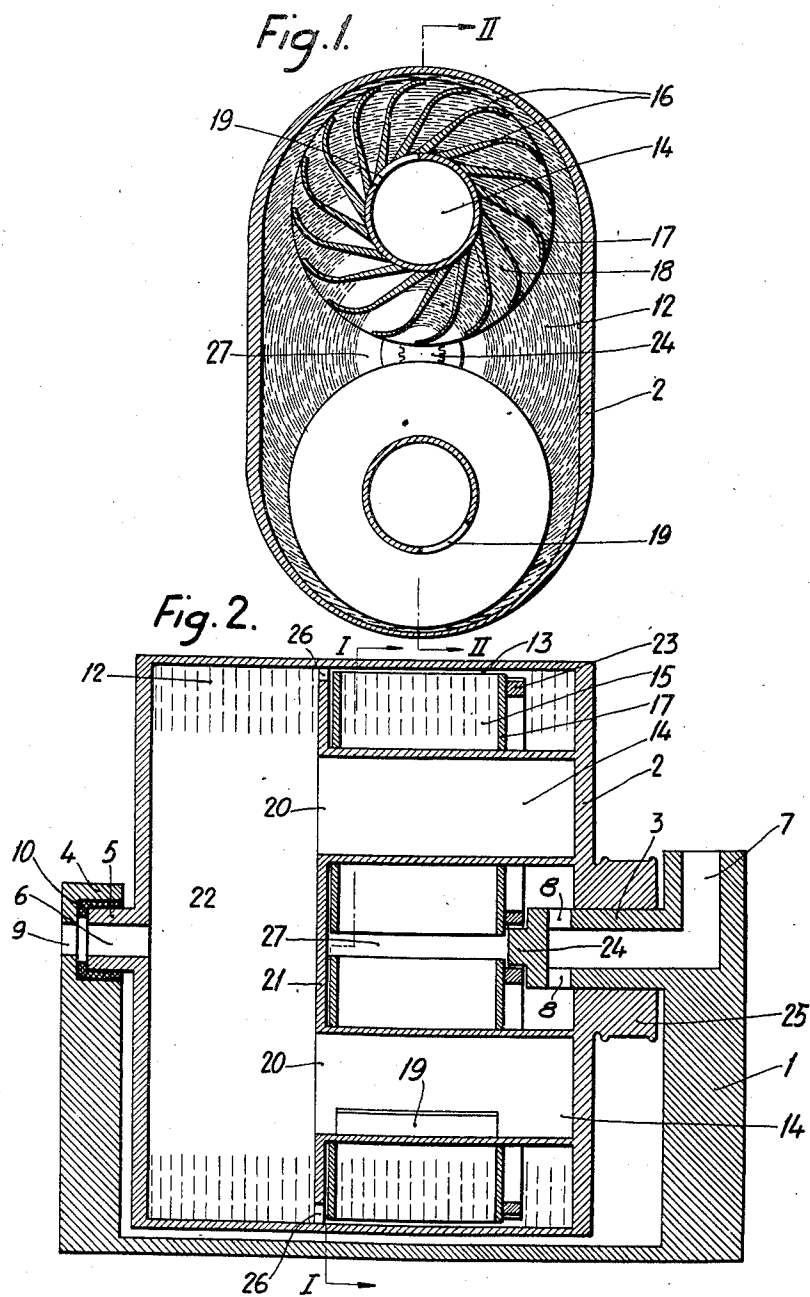
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2,364,368

FLUID PRESSURE MACHINE

Filed July 8, 1943

5 Sheets-Sheet 1



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2,364,368

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Fig. 3.

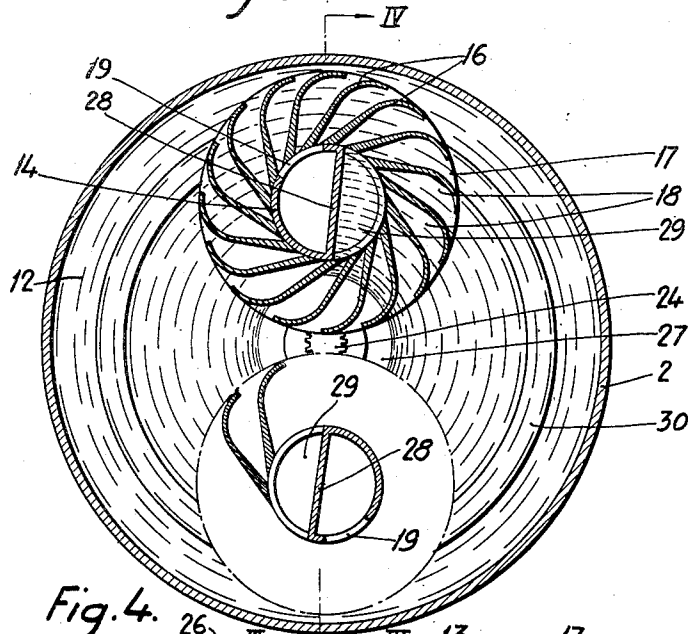
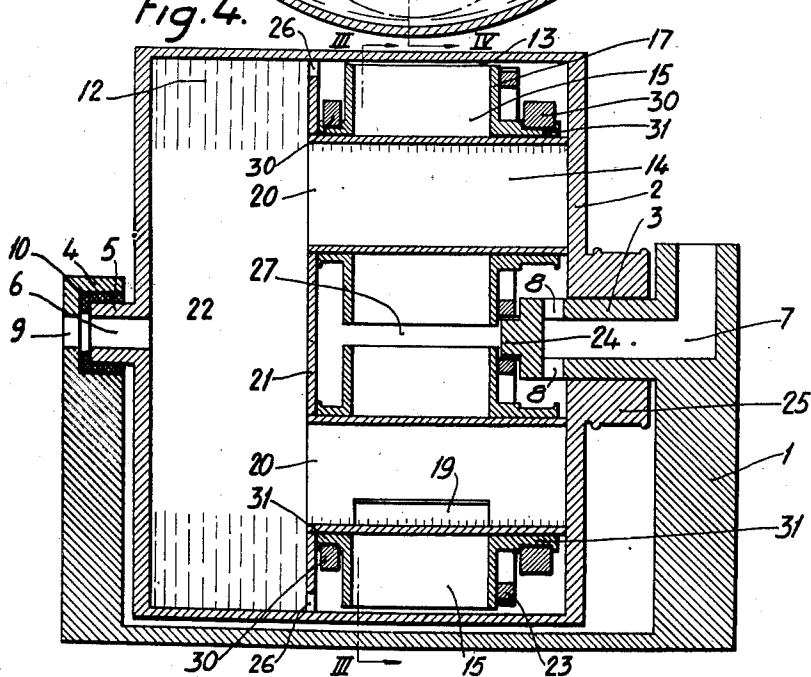


Fig. 4.



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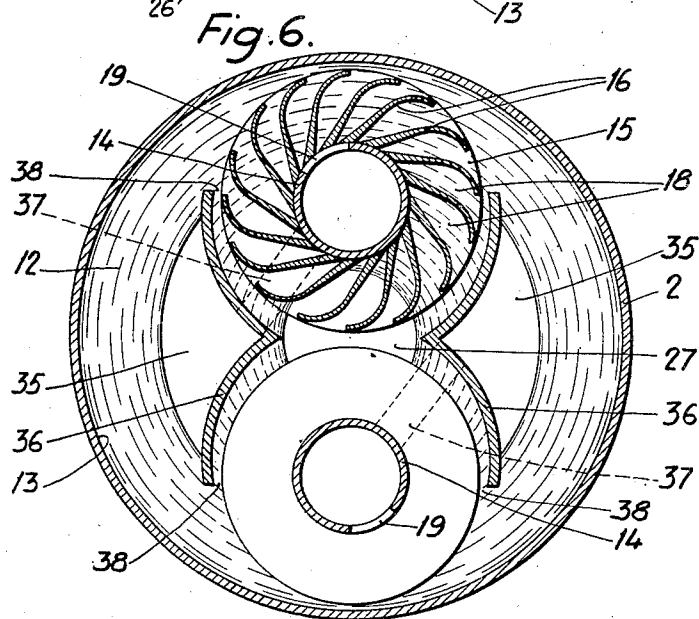
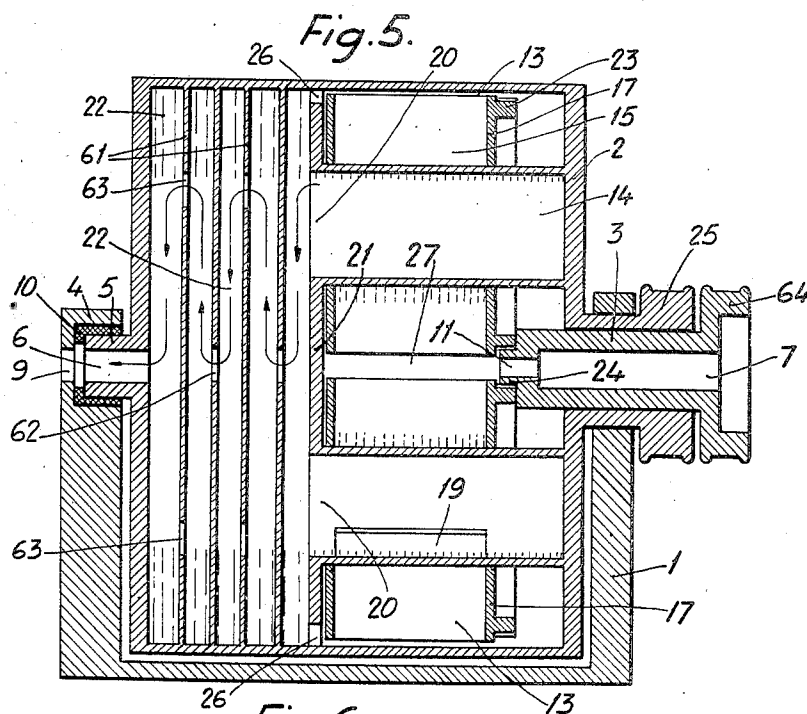
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5 Sheets-Sheet 3



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FLUID PRESSURE MACHINE

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Fig. 7.

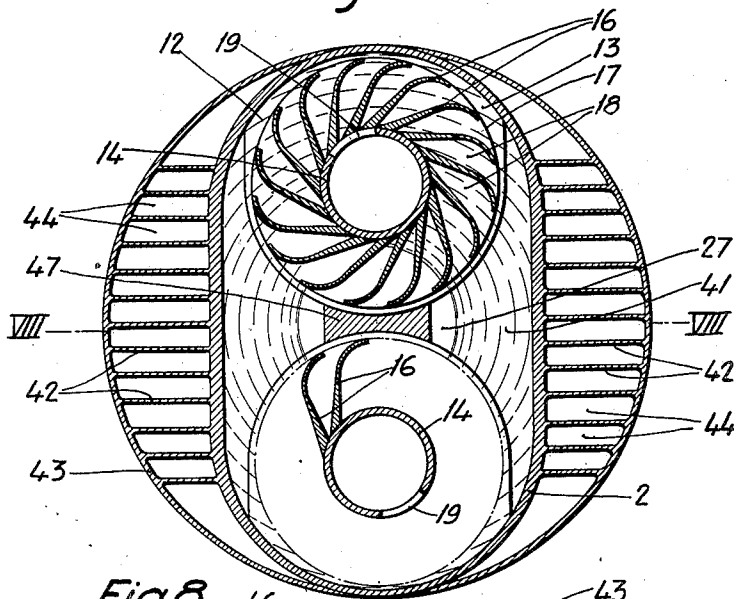
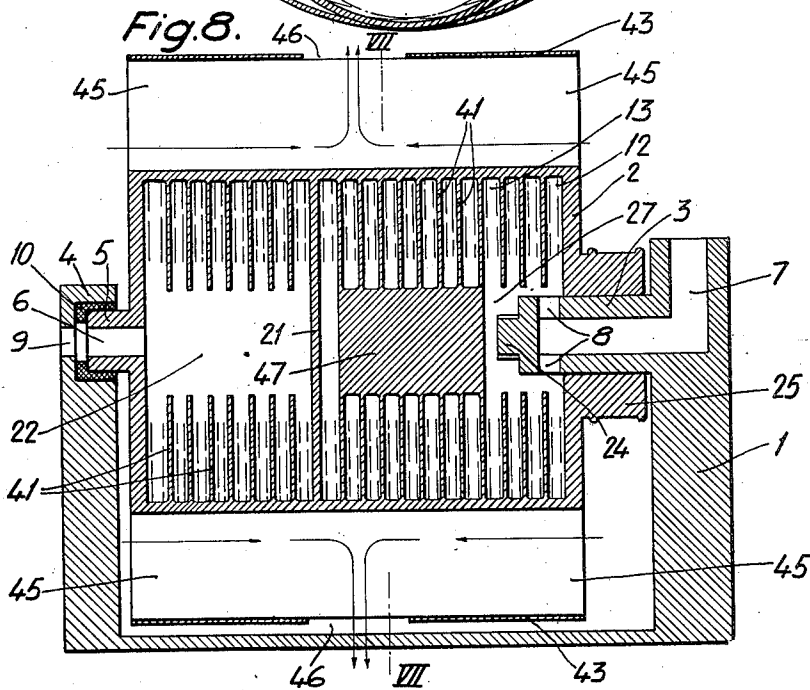


Fig. 8.



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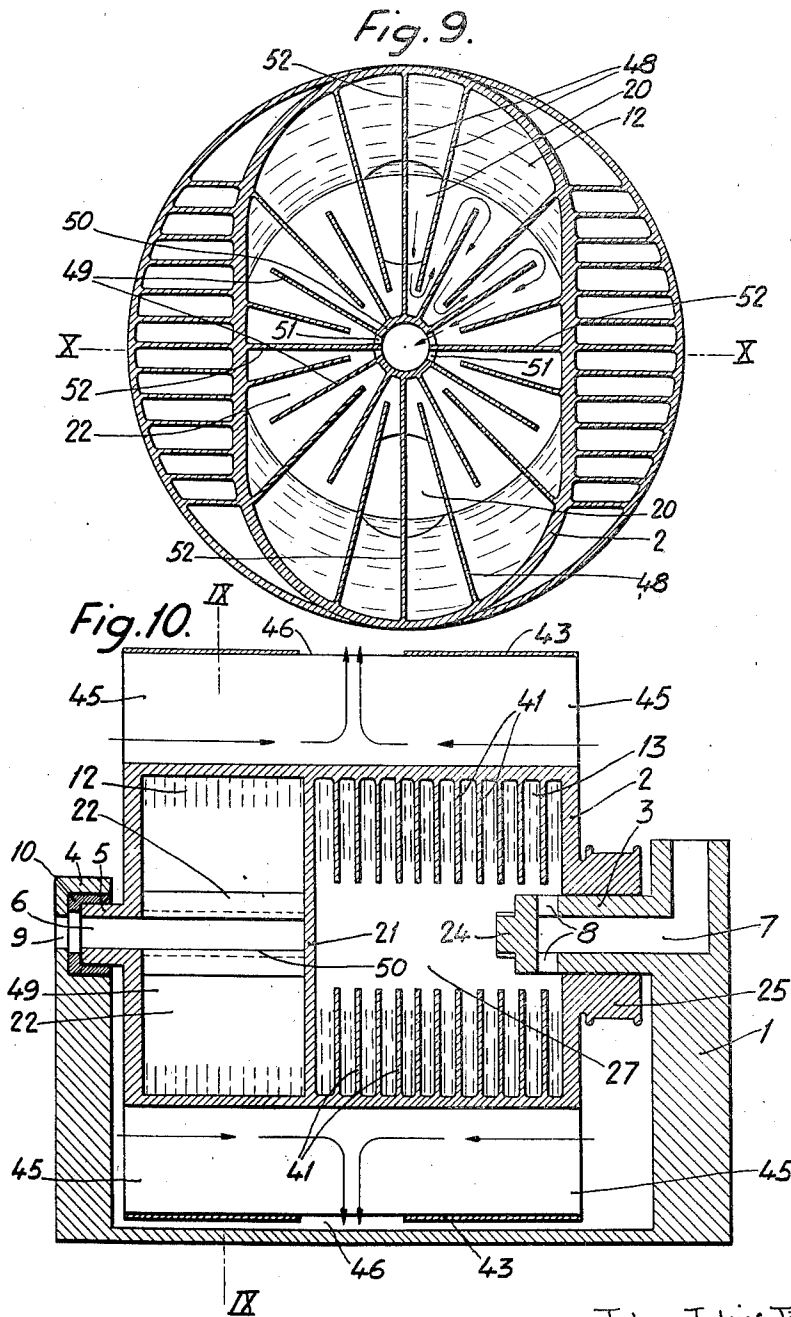
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FLUID PRESSURE MACHINE

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5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE

2,364,368

FLUID PRESSURE MACHINE

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Application July 8, 1943, Serial No. 493,803
In Sweden March 19, 1941

20 Claims. (Cl. 230—79)

The present invention relates to compressors, pumps, motors and the like, and particularly to machines of this general class consisting of a rotatable container, which is partly filled with a fluid and of means for obtaining compression or suction through a relative rotation between a central passage and the body of fluid, said body being by the centrifugal force brought to an eccentric position relatively to said passage, blade wheels adapted to rotate around hollow shafts located in said container, said blade wheels being arranged parallel with and eccentrically in relation to the geometric axis of the container, said hollow shaft having inlet and outlet for the medium to be admitted by the body of fluid and communicating with inlets and outlets in the container.

The chief feature of the invention is that the blades of each of the blade wheels define between them cells completely open towards the periphery and the centre and rest tightly against the hollow shaft of the wheel along the entire length of their inner edges. The blades may extend radially or be inclined towards the radius, or they may have a curved or angularly bent shape in relation to the radius. The cells formed between the blades receive the fluid in which the gas—for example in a compressor or the like—is caught and compressed whereafter said gas is led into the hollow shafts.

A further feature is that the container, for example in the embodiment hereinafter described and relating to a compressor, is divided by means of stationary walls into one or more magazines for compressed gas, and one or more working chambers for the blade wheels. Said walls are provided with inlets for the gas to the magazine or the magazines, and moreover, radially outside said inlets, with peripheral openings for the flow of fluid between the compression gas magazine or magazines, on the one hand, and the working chambers for the wheels, on the other hand. By this device the fluid can be caused to oscillate between the chambers separated through the wall in accordance with the quantity of gas or the like in the magazine. Preferably, the axial length of the magazine should substantially be the same as that of the blade wheels in order to avoid great variations in the gas pressure.

According to further embodiments of the invention cooling means are provided within the container and possibly also on its outside. Said cooling means may consist of plates or flanges which may be arranged annularly on the inside

and also on the outside of the casing of the container. They may also be arranged radially or in some other way. In addition to the gas and the compression fluid being cooled by heat being led off through said flanges, also a reinforcement of the wall of the casing is obtained.

Still other features and advantages of the invention more or less dependent upon the previously mentioned features and upon the way in which the various objects are realized will be clear from the following specification which discloses preferred embodiments of the invention, reference being had to the accompanying drawings.

15 Figs. 1 and 2 show an embodiment of a gas compressor or the like, Fig. 1 being a section perpendicularly to the compressor shaft on the line I—I of Fig. 2, and Fig. 2 a section on the line II—II of Fig. 1.

20 Figs. 3 and 4 show a different embodiment, Fig. 3 being a section corresponding to Fig. 1 on the line III—III of Fig. 4, and Fig. 4 a section on the line IV—IV of Fig. 3.

Fig. 5 is another embodiment of the compressor in axial section.

25 Fig. 6 is a further embodiment viewed in cross section at right angles to the shaft.

Figs. 7, 8, 9, and 10 show two different embodiments of the compressor with cooling flanges, Fig. 7 being a section perpendicular to the compressor shaft on the line VII—VII of Fig. 8, Fig. 8 a section on the line VIII—VIII of Fig. 7, Fig. 9 a similar section as Fig. 7 on the line IX—IX of Fig. 10, and Fig. 10 a section on the line X—X of Fig. 9.

35 The same reference numerals are used throughout the specification for corresponding elements in the various figures.

Having reference to the drawings, 1 represents a frame in which a fluid container 2 is rotatably journaled on a stationary axle 3 projecting from the frame and in a bearing member 4 opposite said axle by means of a shaft end 5 provided with a channel 6. The axle 3 may also be rotatably mounted, as shown in Fig. 5, and provided with a belt pulley 64. The container 2 is then rotatably mounted on said axle 3. The axle 3 has a bore 7 serving as gas inlet and lateral openings 8 for gas. The bearing member 4 is provided with an outlet opening 9 which is tightened to the channel 6 by a packing 10. In Fig. 5 the lateral openings are omitted, and the inlet 7 is connected with a channel 11 in the below mentioned pinion 24. The container 2 contains oil or some other fluid 12. In a working cham-

ber 13 of the container blade wheels 15 are mounted on two hollow shafts 14. The blade wheels are provided with blades 16 between two side walls 17, said blades being bent forward in the direction of rotation. Between adjacent blades 16 there are formed cells 18 which are completely open towards the periphery and centre and serve as compression chambers for the gas and the centrifuged fluid. The blades rest with their inner edges along their whole length tightly against the shaft 14. Each shaft 14 has an inlet 19 for compressed gas, and an outlet 20 by which the shaft communicates with a magazine or chamber 22 for compressed gas and thus with the outlet 6, 9, said magazine being separated from the chamber 13 by means of a wall 21. The blade wheels 15 are provided with toothed rims 23 engaging the stationary pinion 24 on the axle 3 of the frame 1. Consequently, at the revolution of the container 2 through the intermediary of a belt pulley 25 or other suitable device the blade wheels 15 obtain a slower rotatory motion than the container 2. Peripheral apertures 26 allow liquid to flow to the chamber 13 when the gas pressure in the magazine 22 rises so that the diameter of the central gas space 27 decreases, and thus also the gas quantity caught by the blade wheels 15.

The blades 16 may be shaped in any other way than the one shown. For example they may extend radially or be inclined towards the radius, or they may have a curved or angularly bent shape in relation to the radius. However, it is necessary that their inner edges rest tightly against the blade wheel shaft and that they leave a free passage between periphery and centre along their whole axial length.

When the container 2 is set in rotation via the belt pulley 25, the compression liquid 12 is flung towards the periphery so that a central hollow space 27 is formed. Said space sucks in gas through the intake channel 7 of the shaft 3 and the openings 8, Figs. 2, 4, 8, 10, or the channel 11, Fig. 5. The gas is caught in the cells 18 between the blades 14 and is admitted into the liquid and compressed, whereafter via the openings 19 the gas is delivered to the shafts 14 without loss of pressure at the delivery. The compressed gas goes via the opening 20 from each shaft 14 to the magazine 22, and further through the bore 6 in the shaft end 5 and the opening 9 to a consumption or collecting place. During the continued rotatory motion of the blade wheels 15 the liquid 12 is forced to leave the cells 18 at the centre of the container 2, whereafter gas is caught again and the process is repeated.

According as the cells of the blade wheels 15 compress new gas and according as less gas is taken out through the outlets 6, 9 than what is supplied through the openings 20 the pressure in the magazine 22 rises. Thus, liquid is pressed through the openings 26 whereby the volume of the central space 27 is reduced. In this way the cells 18 of the blade wheels, after the compression has continued to a certain limit, will take up less gas. Due to the fact that the space 27 is reduced, the pressure of the compressed gas is increased because the compressing liquid ring obtains larger radial width. If not too great variations of the gas pressure are desired, the magazine 22 should be made rather large, for example with an axial length about equal to that of the blade wheels 15, compare Fig. 5, a small increase of the diameter of the chamber 22 corresponding to

a large decrease of the diameter of the space 27.

In order that the passage between the blades 16 shall be still more facilitated, the shaft 14 of each blade wheel 15 can be provided with a separating wall 28 and a recess or incision 29 preferably shaped like a segment or a sector of a circle, see Figs. 3 and 4, on that side of the separating wall which is located opposite the compression side of the blade wheel 15. It is to be observed that several such incisions 29 may be made in each shaft. When the cells 13 of the blade wheels 15 during the rotation of said wheels and of the container 2 have left the compression side and enter the gas filled central space 27, the compression liquid in the cells is forced by the arising pressure difference to flow through the central openings of the cells out into the incisions 29 and thence into the container 2 through cells situated more peripherically.

Through the above mentioned arrangement the compression liquid delivered from the cells 18 can be mixed with and cooled by the remaining liquid in the container, and it may be further cooled by separate devices for example those mentioned below before entering the blades again.

According to Figs. 3 and 4 the centrifugal forces of the blade wheels 15 can be taken up by two slide rings 30 concentric with the geometric axis of the container, said rings being freely movable in the tangential direction and mounted around axial elongations 31 of the hubs of the blade wheels 15.

Fig. 6 shows an embodiment somewhat differing from that according to Figs. 1 and 3. In this figure, only the upper blade wheel 15 is shown in section. The other wheel is seen from one end. There are two magazines 35 for compressed gas, said magazines being separated from the working chamber 13 by walls 36 parallel with the shaft of the container 2. The magazines 35 communicate with portions of the hollow shafts 14 which project axially from the blade wheels 15 through channels 37 so that compressed gas can be led to said magazines from said shafts. The gas outlets of the magazines are not disclosed here. Through the peripheral openings 38 the magazines 35 communicate with the working chamber 13 via the compression liquid. The mode of operation of the device corresponds to the one described above.

Figs. 5 and 7 to 10 illustrate cooling and other devices in connection with the earlier described compressor for cooling the gas and the compression fluid.

According to Figs. 7 and 8 the inside of the container 2, which is substantially elliptic in cross section, is provided with cooling flanges 41 projecting perpendicularly from the wall of the container, and in the chamber 13 preferably following the contour of the blade wheels 15, so that spaces intended for said wheels are formed. It is to be observed that the container also may be shaped like an 8, following the construction of the blade wheel. On the outside the container 2 is provided with cooling flanges 42 extending from the wall of the container, said flanges being parallel with the container shaft and surrounded by a cylindric casing 43 with which the flanges 42 are connected. The flanges 42 form together with the outer wall of the container 2 and the casing 43 channels 44 which in the example are provided with openings 45 at the ends of the container, and with openings 46 at the middle portion of the casing 43. In other respects the device according to said figures substantially cor-

responds to those earlier described. However, a bridge 47 is provided between the blade wheels in the chamber 27, which bridge together with the flanges 41 reinforces the walls of the container 2 or (and) reduces the central space 27 in order to increase the capacity controlling power of the magazine 22.

At the rotation of the container 2 the compression liquid gives off heat to the flanges 41 which lead the heat via the wall of the casing to the flanges 42. Said flanges are cooled by the air sucked through the openings 45 and blown through the openings 46 in the wall of the casing 43.

The wall of the container 2 may also in a way known per se be provided with annular flanges parallel with the cross section of the container for leading off the heat from the inner flanges 41. Said inner and outer flanges are preferably provided in the same plane.

In the magazine 22 for compressed gas the flanges 41, which are parallel with the cross section of the container, may be made as whole plates 61, see Fig. 5, without other openings than the aforementioned peripheral apertures 26 for communication of liquid between the different chambers of the container and the openings 62, 63 for the passage of the compressed gas from the blade wheel shafts 14 to the outlet 6, 9, as shown by the arrows. The apertures 63 for the passage of the gas are preferably provided in every second flange plate more peripherically and in every second plate as central apertures 62 to cause the gas to go a longer way to the outlet and thus to pass larger cooling surfaces.

In the embodiment according to Figs. 9 and 10 the parallel cooling flanges 41 in the magazine 22, which is divided into four chambers through separating walls 52, have been replaced by radial cooling flanges 48 and 49 which preferably are alternately arranged in such a way that the flanges 48 are connected with the container or magazine walls but leave a free passage at the centre around a shaft 50, while the flanges 49 located between the flanges 48 are mutually connected with one another through the shaft 50 and extend towards the periphery but end some distance from the container wall. By this arrangement the compressed gas, in order to obtain a good cooling, is forced to pass a labyrinth device formed of the flanges 48, 49 from the gas outlet 20 of the blade wheels via openings 51 in the shaft 50 to the gas outlets 6, 9 of the magazines.

The abovementioned parallel cooling flanges 41 and radial flanges 48 and 49 may also be combined so that between each pair of flange plates 41 there are provided radial flanges 48 and 49 in order to further enlarge the cooling surfaces.

Although the invention is shown in the most advantageous forms, it is evident that various modifications may be made without going beyond the scope of the invention, and therefore, I intend to be limited only as far as necessary in view of the prior art. By the expression "compressor" any machine working in the manner of a compressor is understood, including pumps and gas motors.

Having now described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a compressor, the combination of a hollow container containing a body of liquid, means to maintain said body of liquid in position by centrifugal force, hollow shafts in said container disposed parallel with and excentrically relatively

the geometric axis of the container, blade wheels mounted on each of said hollow shafts, said blade wheels having spaced blades partially submerging in said body of liquid, the whole central edges of said blades resting tightly against said hollow shafts, cells being formed between said blades receiving fluid and open towards periphery and centre, inlets in said hollow shafts, outlets from said hollow shafts, an inlet passage in the container for a medium to be admitted into said body of liquid communicating with said blade wheels, an outlet passage for said medium communicating with said blade wheels, and means to effect a relative movement between said blade wheels and the body of liquid.

2. A combination as claimed in claim 1, in which said blades extend radially.

3. A combination as claimed in claim 1, in which said blades are inclined relatively to the radial plane.

4. A combination as claimed in claim 1, in which said blades are bent substantially angularly relatively to the radial plane.

5. A combination as claimed in claim 1, in which the rotating shaft of said container is located outside said blade wheels.

6. A combination as claimed in claim 1, in which on the side opposite the inlet side of the blade wheel said hollow shaft has incisions extending towards the hollow of the shaft and formed in such a way that, after said cells have passed the inlet side said fluid, due to the arising pressure difference, flows through the central openings of the cells into the said incisions and from there through more peripheral cells into the container.

7. A combination as claimed in claim 1, in which the blade wheels have hub elongations surrounding said hollow shafts and carrying in two slide rings concentric with the geometric axis of the container, said slide rings taking up those forces of the blade wheels which are directed towards the periphery.

8. In a compressor, the combination of a hollow container containing a body of liquid, means to maintain said body of liquid in position by centrifugal force, hollow shafts in said container disposed parallel with and excentrically relatively the geometric axis of the container, blade wheels mounted on each of said hollow shafts, said blade wheels having spaced blades partially submerging in said body of liquid, the whole central edges of said blades resting tightly against said hollow shafts, cells being formed between said blades receiving fluid and open towards periphery and centre, inlets in said hollow shafts, outlets from said hollow shafts, an inlet passage in the container for a medium to be admitted into said body of liquid, communicating with said blade wheels, an outlet passage for said medium communicating with said blade wheels, means to effect a relative movement between said blade wheels and the body of liquid, a wall in said container separating said container into a chamber for the blade wheels and a magazine for said medium, said magazine communicating with said hollow wheel shafts, peripheral openings in said wall for liquid communication between said magazine and the chamber for said blade wheels, and discharge ducts in said container communicating with said magazine.

9. A combination as claimed in claim 8, in which said separating wall is disposed perpendicularly to the rotation shaft of the container.

10. A combination as claimed in claim 8, in which said separating wall is disposed substantially parallel with the rotation shaft of the container.

11. A combination as claimed in claim 8, in which said separating wall is located in such a way that the axial length of said magazine is approximately at least as large as the axial length of the blade wheels, the periphery of said blade wheels, viewed in the axial direction, being located substantially outside the elongation of the inlet passage, said inlet passage being provided in the center of rotation of the container and parallel with the shaft of the container.

12. In a compressor, the combination of a hollow container containing a body of liquid, means to maintain said body of liquid in position by centrifugal force, hollow shafts in said container disposed parallel with and eccentrically relatively to the geometric axis of the container, blade wheels mounted on each of said hollow shafts, said blade wheels having spaced blades partially submerging in said body of liquid, the whole central edges of said blades resting tightly against said hollow shafts, cells being formed between said blades receiving fluid and open towards periphery and centre, inlets in said hollow shafts, outlets from said hollow shafts, an inlet passage in the container for a medium to be admitted into said body of liquid communicating with said blade wheels, an outlet passage for said medium communicating with said blade wheels, means to effect a relative movement between said blade wheels and the body of liquid, and spaced cooling flanges projecting from the wall of said container, said flanges forming reinforcements for the container walls.

13. A combination as claimed in claim 12, in which cooling flanges project from the inner wall of said container and cooling flanges project from the outer wall, said inner cooling flanges following the contour of said blade wheels so that recesses for said wheels are formed.

14. A combination as claimed in claim 12, in which cooling flanges projecting from the inner wall of the container are annular and disposed perpendicularly to the container shaft.

15. A combination as claimed in claim 12, in which plate-shaped cooling means are provided within the container, said cooling plates being provided with flow-through apertures.

16. A combination as claimed in claim 12, in which annular cooling flanges projecting from the inner wall of the container follow the contour of said blade wheels so that recesses for said wheels are formed, and a bridge is provided centrally between the blade wheels, said bridge connecting the flanges and separating the recesses for said blade wheels, said recesses being substantially circular.

17. A combination as claimed in claim 12, in which said container is elliptical in cross-section,

spaced cooling flanges projecting from the inner wall some distance towards the centre, said flanges being perpendicular to the container shaft, spaced cooling flanges projecting from the outer wall of the container parallel with the container shaft, a substantially cylindric casing surrounding said external flanges, said external flanges being rigidly connected with said casing, and forming channels therebetween, and openings at the ends and at the middle portion of said casing, so that air currents arising in said channels at the rotation of the container to carry away heat led off by said internal flanges.

18. In a compressor, the combination of a hollow container containing a body of liquid, means to maintain said body of liquid in position by centrifugal force, hollow shafts in said container disposed parallel with and eccentrically relatively to the geometric axis of the container, blade wheels mounted on each of said hollow shafts, said blade wheels having spaced blades partially submerging in said body of liquid, the whole central edges of said blades resting tightly against said hollow shafts, cells being formed between said blades receiving fluid and open towards periphery and centre, inlets in said hollow shafts, outlets from said hollow shafts, an inlet passage in the container for a medium to be admitted into said body of liquid, communicating with said blade wheels, an outlet passage for said medium communicating with said blade wheels, means to effect a relative movement between said blade wheels and the body of liquid, a wall perpendicular to the shaft of rotation in said container separating the chamber for the blade wheels and a magazine for said medium, said magazine communicating with said hollow wheel shafts, spaced cooling flanges projecting from the inner wall of said container into the chamber for said blade wheels some distance from the centre, said flanges being perpendicular to the container shaft and cooling means projecting into said magazine.

19. A combination as claimed in claim 18, in which said cooling means projecting into said magazine consist of spaced plates, arranged perpendicularly to the container shaft and provided with flow-through apertures which are centrally located in each second plate and more peripherally located in the other plates.

20. A combination as claimed in claim 18, in which said cooling means consist of flanges projecting radially from the inner wall into said magazine, a hollow central axial member being arranged in said magazine, said member having openings communicating with said magazine, and flanges fixed to said central member and projecting radially and ending some distance from the periphery, said last mentioned flanges being provided between adjacent ones of said first mentioned flanges projecting from the inner wall of the magazine.

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