

Aug. 25, 1936.

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2,052,155

MEANS FOR IMPELLING AND COMPRESSING GASEOUS FLUIDS

Original Filed June 12, 1933 3 Sheets-Sheet 1

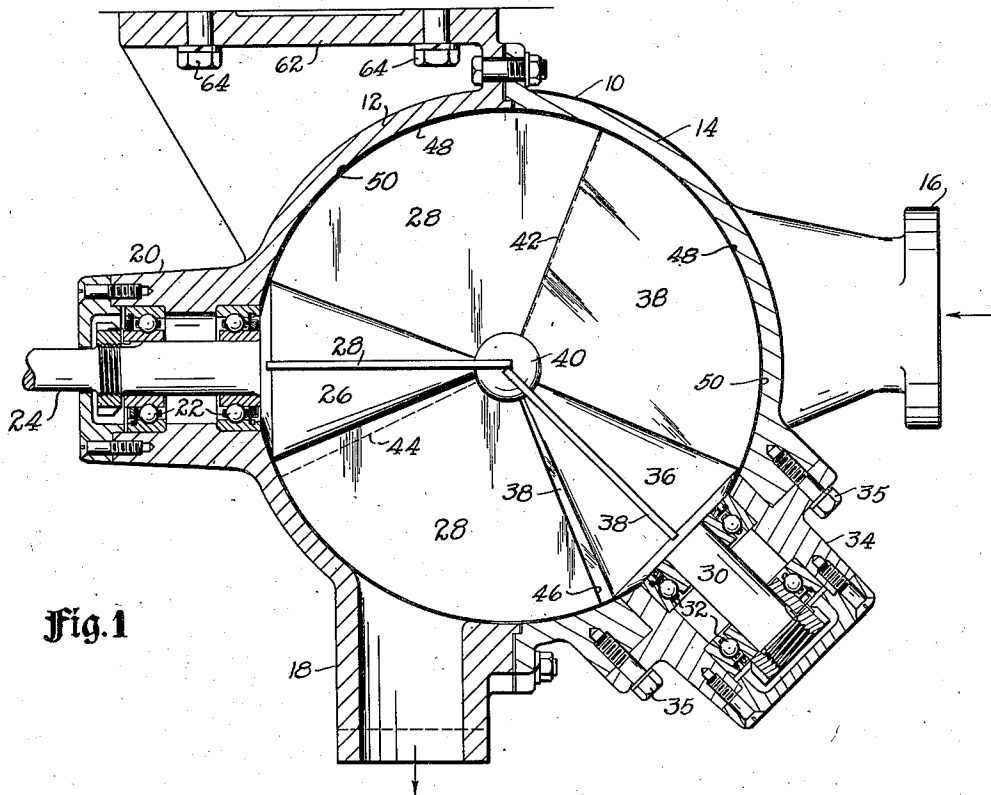


Fig. 1

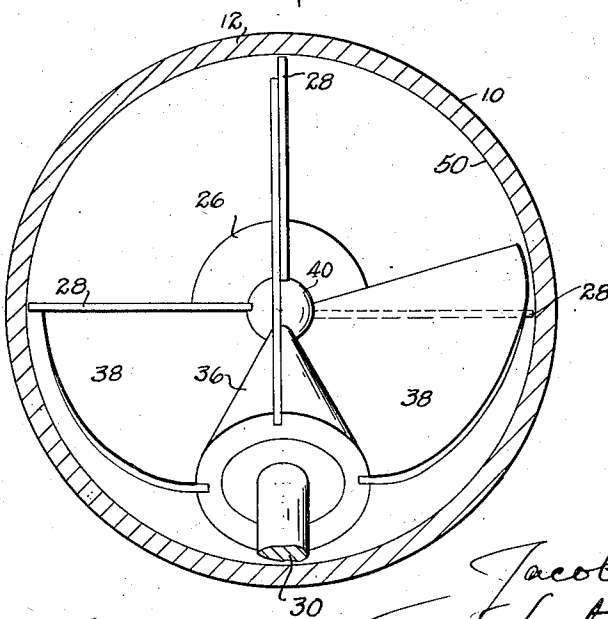


Fig. 3

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3 Sheets-Sheet 2

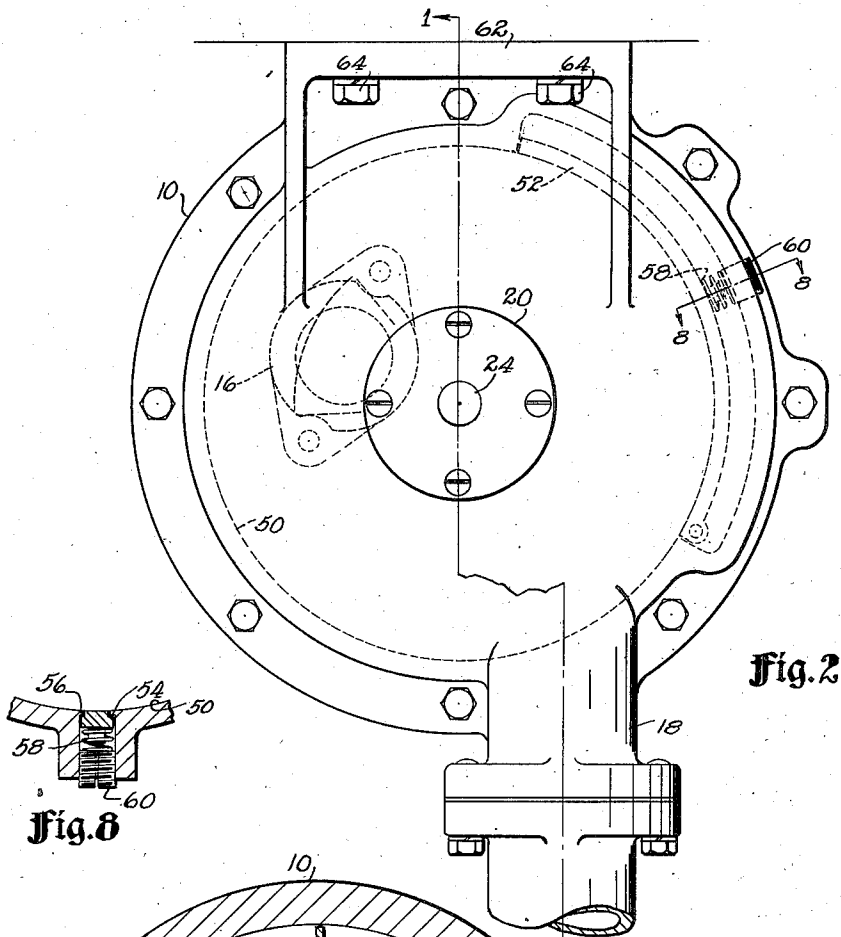


Fig. 2

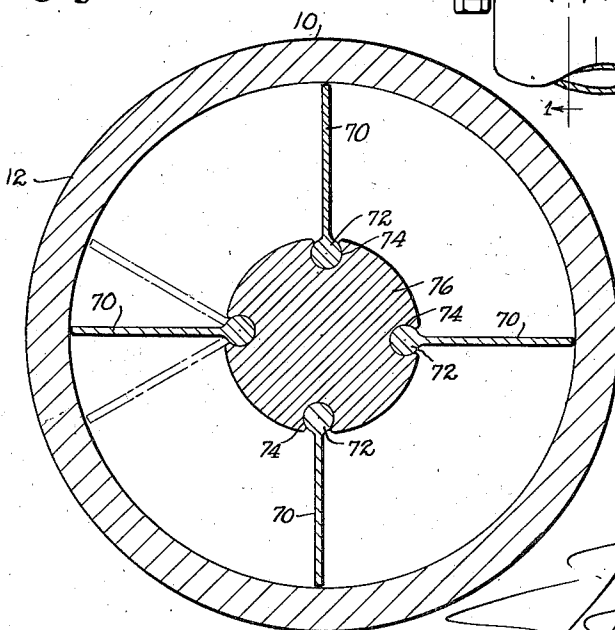


Fig. 4

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3 Sheets-Sheet 3

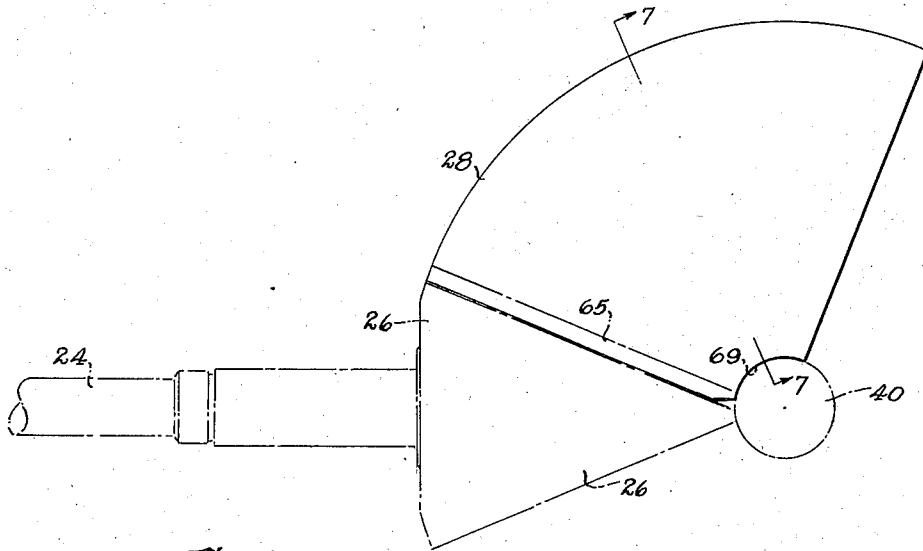


Fig. 5

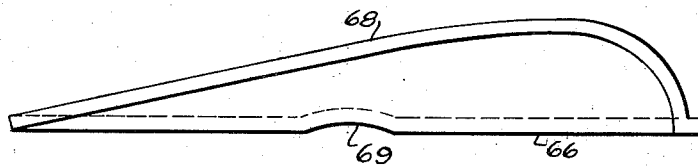


Fig. 6

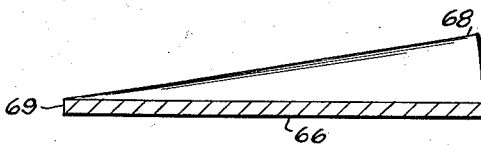


Fig. 7

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UNITED STATES PATENT OFFICE

2,052,155

MEANS FOR IMPELLING AND COMPRESS-
ING GASEOUS FLUIDS

Jacob W. Woodruff, Cleveland, Ohio, assignor, by
direct and mesne assignments, of ten per cent
to Frank M. Strock and forty per cent to
Cora L. Seizer, both of Cleveland, Ohio

Application June 12, 1933, Serial No. 675,370
Renewed January 10, 1936

14 Claims. (Cl. 230—142)

This invention relates to a means for impelling and compressing gaseous fluids and has particular reference to such a means which is simply constructed and which is adapted to move and compress a large volume of gaseous fluids at comparatively low operating speeds.

It is a general object of the invention to provide a rotary device for impelling and compressing gaseous fluids which is simple in operation, compact, relatively small in size, light in weight, and adapted to be cheaply manufactured in large or small quantities.

A specific object of the invention is to provide an air or gaseous pumping device comprising essentially an enclosed casing in which is disposed two rotating elements having axes of rotation in a common plane but disposed at an angle with respect to each other, each rotating element having blades thereon adapted to contact with and overlap the blades of the other rotating element to define contracting and expanding compartments which are substantially pressure tight.

It is another object to provide means in connection with a device of the character referred to wherein the pressure of the delivered gaseous fluid developed may be regulated by simple adjustments of mechanical parts, and which provides for such regulation in a simple and efficient manner. Such a device is also intended to make possible the continuous delivery of a gaseous fluid at a constant pressure, regardless of a varying intake pressure.

Another specific object is to provide an impeller and compressor device which is particularly adapted for use as a supercharger in connection with internal combustion engines, such as are commonly used in automobiles and airplanes. It is well known that supercharging of the gaseous fuel used will increase the power of such engines, particularly at high altitudes, and it is especially desirable that such a supercharging device operate efficiently at comparatively low speeds, and such is an included object of my device.

It is another object to provide a device of this character which is readily and conveniently mounted adjacent an internal combustion engine of the type referred to and which requires only a single driving connection therewith for the successful and efficient operation of a pair of separate rotating members in the device having contacting and overlapping blades disposed thereon, one of the rotating members being driven by

the other through the contacting of their respective blades.

Other and more specific objects of the invention will be apparent as it is more fully understood from the following description taken in connection with the attached drawings, which illustrate a preferred and operative embodiment of my invention, in which

Fig. 1 is a cross sectional view in elevation of an assembly of that embodiment.

Fig. 2 is an end elevation view looking from the left of Fig. 1.

Fig. 3 is a diagrammatic internal view looking from the right of Fig. 1.

Fig. 4 is a diagrammatic internal view, partly in section, of a method of attaching blades to a rotating member.

Fig. 5 is a diagrammatic view in elevation showing another method of attaching blades to a rotating member.

Fig. 6 is a view of one form of curved blade which may be used.

Fig. 7 is a view taken along the line 7—7 of Fig. 5.

Fig. 8 is a cross sectional view taken along the line 8—8 of Fig. 2.

Referring to the drawings, the embodiment there shown comprises a substantially spherical casing 10 preferably made in two half portions 12 and 14 to facilitate assembly. An air or gaseous fluid inlet is shown at 16 and a similar outlet is shown at 18. A projecting journal box at 20 is adapted to have mounted therein ball bearings 22 for supporting a driving shaft 24, having integral therewith a cone-like rotating member or hub 26 in which is secured at proper intervals therearound blades 28. In the same plane and disposed at an angle with respect to the driving shaft 24 is a driven shaft 30 which may be disposed in ball bearings 32 in a removable journal housing 34 secured to the hollow spherical casing 14 as by bolts 35. Also integral with the driven shaft 30 is a cone-shaped hub member 36, similar to the cone-shaped hub member 26, and having secured thereto blades 38. Disposed between the adjacent ends of the hub members 26 and 36 and having a bearing and pressure tight fit therebetween is a spherical bearing member 40, such as a single ball bearing, adapted to form a pivotal bearing for the rotation of the hub members 26 and 36.

As is more clearly indicated in Fig. 3, the form of my invention illustrated has four blades disposed on each of the hub members 26 and 36. As before stated, the shaft 24 is the driving shaft

and the shaft 30 is the driven shaft. When rotary motion is imparted to the shaft 24, the blades 28 on the hub member 26 contact with the blades 38 on the hub member 36, thereby imparting rotary motion thereto. In their uppermost position, as viewed in Fig. 1, the blades on respective hub members contact and overlap slightly, as is shown at 42, and as the blades rotate and travel downwardly they overlap until at their bottommost position they are almost wholly overlapped, and the edge of the downwardmost blade 38 being as indicated at 44, and the edge of the downwardmost blade 28 being as shown at 46. The peripheral edge 48 of each of these blades makes a substantially pressure-tight fit with the internal wall 50 of the hollow spherical housing 10. Similarly, the contacting edges of the blades 28 and 38 so fit, as do the contacting edges between the hub members, blades and spherical bearing member 40. It is therefore clear that as the blades move from their uppermost minimum overlapping position to their downwardmost maximum overlapping position the spaces defined by adjacent pairs of contacting and overlapping blades 28 and 38 comprise substantially sealed or gas-tight compartments, which have their largest volumetric capacity at the top of the casing, or nearest the intake port 16, and their minimum or smallest volumetric capacity at the bottom of the casing, or adjacent the exhaust port 18. Thus the air or gaseous fluid received through the intake is impelled and compressed during the rotary motion of the blades and expelled through the exhaust port at a pressure corresponding to the diminished volumetric capacity of the imprisoned space, in addition to that developed due to the impelling force imparted thereto by the movement of the blades.

To regulate the amount of pressure developed an adjustable escape means is provided in the form of a segmental peripheral element 52 interfitting with the hollow spherical casing 10 through shoulders 54, coacting with shoulders 56 on the casing 10, the element 52 reacting against pressure from a spring 58. The segmental member is shown as pivoted to the casing at one end near the outlet, and near the place where the blades form compartments of the smallest size. The pressure exerted by the spring may be adjustable as by use of a regulating screw 60. The mechanism just described may be positioned on the inside periphery of the casing 10, as shown, so that as pressure is built up during the downward rotary movement of the blades the segmental element 52 may be depressed against the spring pressure and thereby permit escape of the compressed fluid or air from one imprisoned space to that following or adjacent it. In this manner the pressure which has been built up is not entirely wasted but is permitted to escape into an adjacent space of lower pressure, thereby conserving the energy expended in building up such a pressure and greatly improving the efficiency of the apparatus.

The casing 10 and the parts associated therewith may be secured to any convenient surface, as by a bracket 62 and bolts 64, in such a manner as to provide for connection of the driving shaft 24 to a convenient driving source, such for example as the main crankshaft or an auxiliary shaft of an internal combustion engine.

The blades 28 and 36 may be connected to their respective hub members 26 and 36 as is indicated in Fig. 5, wherein there is shown a blade 28 as being secured in a slot 65 of the hub

member 26, as by welding, dovetailing, bolting, or the like.

While many forms and shapes of blades, either curved or straight, may be used, I have found that one form which provides for an efficient operation is a shape such as is shown in Fig. 6. As there shown, the edge 66 of the blade 68 is adapted to be secured to a hub member and the notched or concave edge 69 is adapted to make a bearing fit with a spherical bearing member, such as the ball bearing 40. The characteristic of this shape of blade is that when suitably mounted on a hub member and assembled in a hollow spherical casing, a straight line drawn from the center of a ball bearing member, such as that indicated at 40, radially outwardly, will be along the surface of the blade. It will thus be seen that if such a straight line represents in part the contacting radial edge of a blade on the opposing hub member, a piston-like seal is effected between the two blades. This radial edge of the blade sweeps across the face of the coacting blades and the contact therebetween is interrupted at about the instant the hub is reached, the two blades then interchanging contacting portions without breaking the seal therebetween, the radial edge of the latter blade then sweeping across the adjacent face of the former blade.

An advantage of the curved form of blade is that it permits the seal between contacting blades to be effectively maintained even though the contacting blades slide across one another at different relative speeds during a cycle of operation. Other forms and shapes of blades may of course be worked out to produce a like effect.

While in Figs. 1, 3 and 5 the blades are indicated as having a rigid connection with their hub members, I have also found that good results may be obtained when the connection between the driven blades and their hub is a swivel connection, such as is indicated in Fig. 4. As there shown, each blade 70 has an enlarged edge 72 of substantially circular section, which interfits a coacting slot 74 in the hub member 76. This permits a straight or non-curved driven blade to more snugly and tightly contact with the driving blade during rotation thereof. The driven blade will of course make such a snug contact by virtue of the pressure exerted upon it due to the compressing of the gas between adjacent pairs of blades during the downward movement thereof, and as the pressure increases the contact between the driven and driving blade is improved thereby.

It will be seen that my invention comprises a simple rotary apparatus having two main rotating parts with radially projecting blade members adapted to overlap a minimum amount at an intake point and passing through a given rotational movement overlap a maximum amount, thereby compressing an imprisoned quantity of air or gas from atmospheric pressure to a predetermined higher pressure, depending upon the reduction in volumetric space and the impelling force imparted thereto. It will further be seen that the apparatus employed comprises simple well-known mechanical movements with a minimum of parts associated therewith. In addition, there is provided means for efficiently regulating the pressure developed by such an apparatus.

While I have described my invention chiefly with reference to an impeller and compressor, it will be obvious from the disclosure made that it can be put to many other uses. For example, by simple modifications it could be made to func-

tion as a universal coupling between two shafts. I therefore do not wish to be limited to any specific uses, but include all uses within the spirit and scope of the appended claims.

5 I claim:

1. The combination of a pair of rotating members having intersecting axes of rotation, a bearing element interfitted between said members at said intersection, whereby differential motion
10 therebetween is permitted, and a plurality of radially extending blades on each of said rotating members, the blades being operable to maintain the bearing element at said intersection.

2. The combination of a pair of rotating elements, blades on each element, and a casing enclosing said elements and blades, said blades cooperating together and with said casing to form compartments of unequal size, and means responsive to pressure in one of said compartments
20 for effecting a gas passage between the compartments, said means comprising a groove in said casing and extending between a plurality of the compartments formed by said blades, a member positioned in said groove and pivotally secured
25 to the casing adjacent the end of the groove nearest the compartment of smallest size.

3. In a compressor and impeller a substantially hollow spherical casing having an intake and an exhaust port, rotatable blades within said casing, means whereby said blades form a plurality of contracting and expanding chambers adapted to receive gas through said intake port and compress it while moving toward said exhaust port, and means responsive to pressure of
30 the gas in one of said compartments for permitting escape of pressure to another of said compartments, said means comprising a groove in said casing and extending between a plurality of the compartments formed by said blades, a member positioned in said groove and pivotally secured
40 to the casing near the position where the compartments are of smallest size.

4. The combination of a pair of rotating members having intersecting axes of rotation, a plurality of substantially radially extending blades on each of said rotating members, the blades contacting so that rotation is imparted to one of said rotating members by the other of said rotating members, a bearing member interfitted between said rotating members at said intersection, said bearing member comprising a substantially spherical element, adjacent portions of the blades on each of the rotating members having edge portions adapted to engage said spherical element
50 throughout a substantial portion of its circumference and to form a pressure-tight seal therebetween.

5. The combination of a pair of rotating members having intersecting axes of rotation, a plurality of substantially radially extending blades on each of said rotating members, the blades contacting so that rotation is imparted to one of said rotating members by the other of said rotating members, a bearing member interfitted between
60 said rotating members at said intersection, said bearing member comprising a substantially spherical element, adjacent portions of the blades on each of the rotating members having edge portions adapted to engage said spherical element throughout a substantial portion of its circumference and to form a pressure-tight seal
70 therebetween, the blades being operable to support said spherical element at said intersection.

6. The combination of a pair of rotating elements, blades on each element, and a casing enclosing

said elements and blades, said blades cooperating together and with said casing to form compartments of unequal size, means responsive to pressure in one of said compartments for effecting a gas passage between the compartments,
5 said means comprising a groove in said casing and extending between a plurality of the compartments formed by said blades, a member positioned in said groove and movably secured to the casing, and means yieldingly urging said member radially inwardly.

7. In a device of the class described, a casing having a chamber therein, a pair of rotating elements positioned in said casing and having intersecting axes of rotation, a plurality of radially
15 extending blades on each of said rotating elements, each of the blades on one of said rotating elements being adapted to engage a blade on the other of said rotating elements throughout an entire revolution of said rotating elements, the blades cooperating with each other in pairs and with the casing to define compartments of wide circumferential extent relative to the thickness
20 of the blades and of varying size during rotation of the said elements.

8. In a device of the class described, a casing having a substantially spherical chamber therein, a pair of rotating elements positioned in said casing and having intersecting axes of rotation, a plurality of radially extending blades on each
30 of said rotating elements, each of the blades on one of said rotating elements being adapted to engage a blade on the other of said rotating elements throughout an entire revolution of the said rotating elements, the blades cooperating
35 with each other in pairs and with the casing to define compartments of varying size during rotation of the said elements, said blades being thin relative to the size of the intervening compartments.

9. In a device of the class described, a casing having a chamber therein, a pair of rotating elements positioned in said casing and having intersecting axes of rotation, a plurality of radially extending blades on each of said rotating
45 elements, each of the blades on one of said rotating elements being adapted to engage a blade on the other of said rotating elements throughout an entire revolution of the said rotating elements, rotary movement of one of said rotating
50 elements being transmitted to the other of said elements through said blades, the blades cooperating with each other and with the casing to define compartments of varying size during rotation of the said elements, the circumferential
55 width of the compartments being materially greater than the thickness of the blades.

10. In a device of the class described, a casing having a chamber therein, a pair of rotating elements positioned in said casing and having intersecting axes of rotation, a plurality of radially
60 extending blades on each of said rotating elements, each of the blades on one of said rotating elements being adapted to engage a blade on the other of said rotating elements throughout an entire revolution of the said rotating elements, a bearing member positioned between said rotating elements at the intersection of the axes
65 of rotation, said bearing member comprising a substantially spherical element, the blades being operable to support said spherical element at said intersection, the blades cooperating with each other and with the casing to define compartments of varying size during rotation of the
70 said elements.

11. In a device of the class described, a casing having a substantially spherical chamber therein, a pair of rotating elements extending into said chamber, and having intersecting axes of rotation, a plurality of blades on each of said rotating elements, each of said blades being constructed of rigid material of relatively thin cross section and having a base margin secured to one of said rotating elements, each of said blades extending from the wall of the spherical chamber radially inwardly substantially to the center of said spherical chamber, the blades being curved whereby each of the blades on one of said rotating elements is in engagement with one of the blades associated with the other of said rotating elements throughout a complete revolution of said rotating elements, the blades cooperating with each other and with the casing to define compartments of varying size during rotation of said elements.

12. In a device of the class described, a casing having a substantially spherical chamber therein, a pair of rotating elements extending into said chamber and having intersecting axes of rotation, a spherical bearing member positioned between said rotating elements at the intersection of said axes of rotation, a plurality of blades on each of said rotating elements, each of said blades being constructed of rigid material of relatively thin cross section and having a base margin secured to one of said rotating elements, each of said blades extending from the wall of the spherical chamber radially inwardly substantially to the center of said spherical chamber, the blades being curved whereby each of the blades on one of said rotating elements is in engagement with one of the blades associated with the other of said rotating elements throughout a complete revolution of said rotating elements,

the blades cooperating with each other and with the casing to define compartments of varying size during rotation of said elements.

13. In a device of the class described, a casing having a substantially spherical chamber therein, a pair of rotating elements extending into said chamber and having axes of rotation intersecting substantially at the center of said spherical chamber, a plurality of blades on each of said rotating elements, each of said blades being constructed of rigid material of relatively thin cross section and having a base margin secured to one of said rotating elements, the blades being curved whereby each of the blades on one of said rotating elements is in engagement with one of the blades associated with the other of said rotating elements throughout a complete revolution of said rotating elements, the blades cooperating with each other and with the casing to define compartments of varying size during rotation of said elements.

14. In a device of the class described, a casing having a substantially spherical chamber therein, a pair of rotating elements extending into said chamber and having intersecting axes of rotation, a plurality of blades on each of said rotating elements, each of said blades being constructed of rigid material of relatively thin cross section and having a base margin secured to one of said rotating elements, each of said blades extending from the wall of the spherical chamber radially inwardly substantially to the center of said spherical chamber, there being radial edge contact between coacting blades throughout the entire revolution of said elements, the blades cooperating with each other and with the casing to define compartments of varying size during rotation of said elements.

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