July 31, 1945. B. C. GRIEB 2,380,752

ROTARY ENGINE OR BLOWER DEVICE

Filed Aug. 15, 1941 2 Sheets-Sheet 1

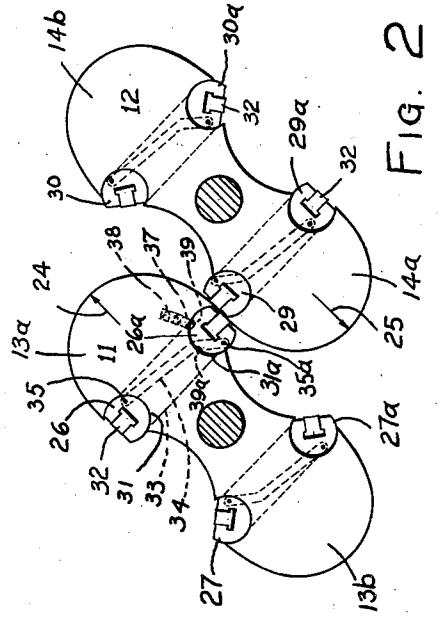


FIG. 2

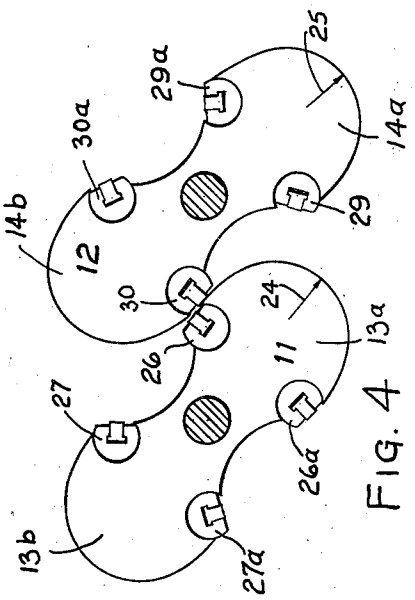


FIG. 4

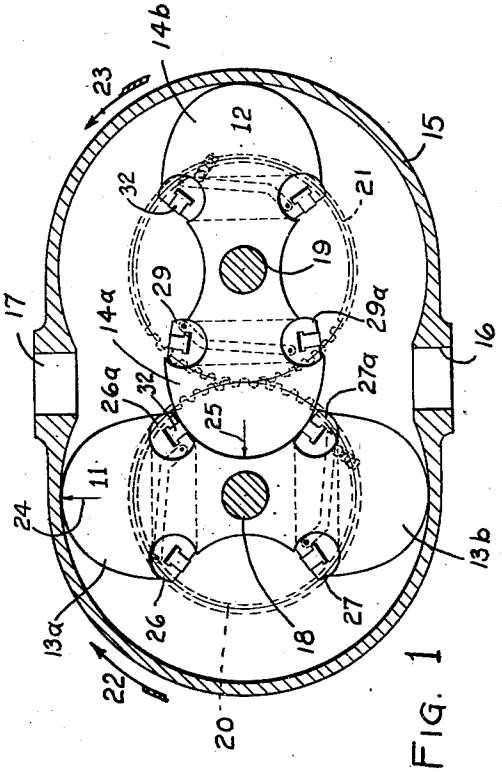


FIG. 1

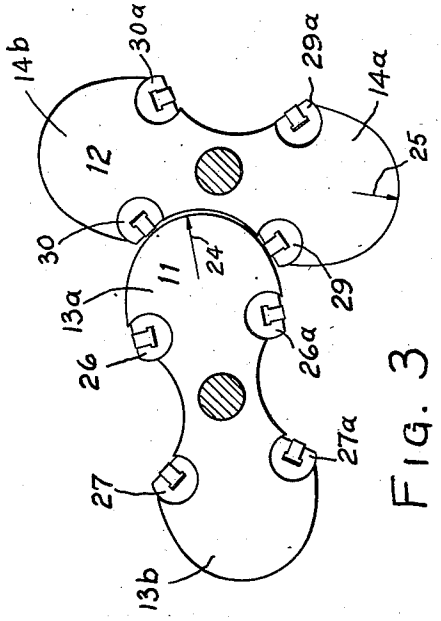


FIG. 3

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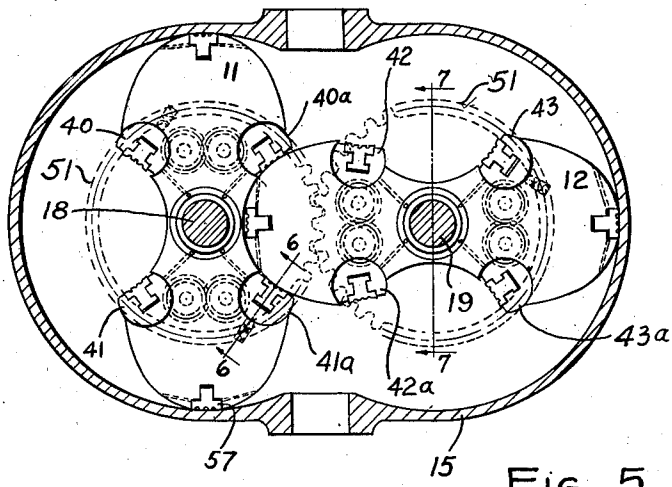
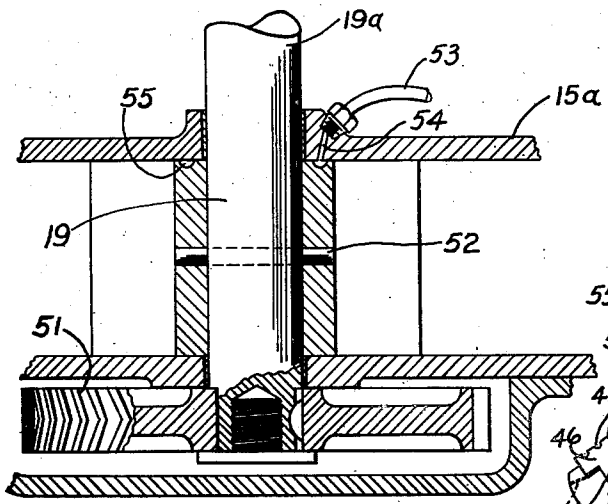


FIG. 5

FIG. 7



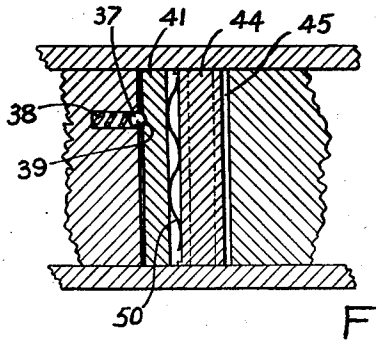
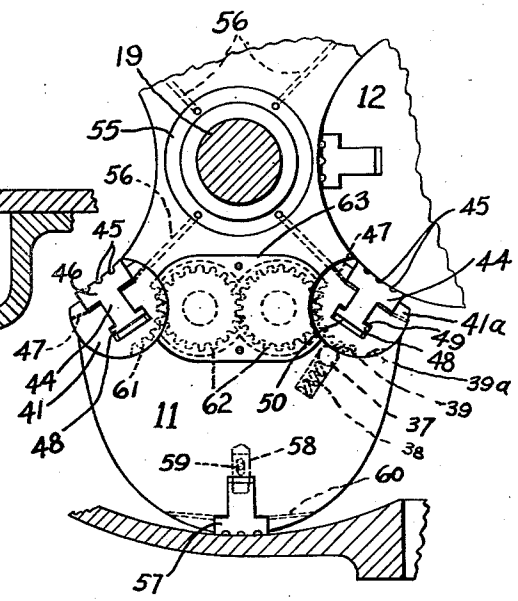


FIG. 6

FIG. 8



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ROTARY ENGINE OR BLOWER DEVICE

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12 Claims. (Cl. 230—141)

This invention relates to rotary engines, and pumps and is particularly concerned with sealing devices therefor.

One type of rotary pump or blower which has been used extensively is constructed with two or more rotating elements or impellers each having a plurality of lobes shaped to fit into each other so that they operate with close clearance between the surfaces at all times. The shafts on which the lobes are mounted are geared together so that proper relationship between the moving members is always maintained.

The present invention has as a primary object the improvement in operating efficiency of a rotary mechanism of this nature. The improved construction permits higher pressures to be developed at comparatively slow speeds of operation.

Another general object of the invention is to provide means whereby a rotary mechanism of this nature may be used effectively as a prime mover which may be operated by such mediums as steam or by combustion of gas mixtures.

An important object of the present invention is the provision of improved sealing devices for the impellers of rotary units. Since devices of this nature normally rely on close clearance between two convex surfaces to prevent excessive leakage, previous attempts at providing sealing devices have proved ineffective. In most rotary units of this nature, sealing devices are omitted and satisfactory operation is obtained chiefly by the use of close tolerances between the surfaces of the rotating impellers themselves and between the impellers and the casing wall.

The present invention has as an object the provision of seals which provide a comparatively long surface contact with the curved surface of an impeller. The improved sealing device has a concave shape adapted to fit against the convex surface of the co-operating impeller.

It is also an object of this invention to provide mechanism for actuating my improved sealing devices so that the impellers may be operated in either direction of rotation. With my improved seals the sealing members on opposite sides of the impellers are interconnected mechanically so that the seal unit in contact with the impeller surface controls the position of the opposite seal unit. By this construction each pair of seal units has its sealing members in the same relative position. In this manner a mechanism is provided which may be stopped at any point in its cycle and its direction of rotation reversed.

It is a further object of the invention to provide improved sealing devices between the ends of the impeller and the casing wall.

How the foregoing and other objects and advantages are attained will be evident from the following description of the drawings in which—

Figure 1 is a view partly in section of a rotary mechanism illustrating one form of sealing device according to the present invention.

Figures 2, 3 and 4 illustrate different relative positions of the impeller elements of the rotary mechanism showing the relative positions of the sealing devices for the various positions.

Figure 5 is a view similar to Figure 1 showing a somewhat different form of sealing device and operating mechanism therefor.

Figure 6 is a sectional view through a position of one of the sealing devices.

Figure 7 is a sectional view through one of the impellers showing its mounting on the shaft together with the gear mounting therefor.

Figure 8 is an enlarged view showing the sealing devices illustrated in Figure 5 together with their operating mechanism.

In Figure 1 there is shown a form of rotary device having two rotating impellers 11 and 12, each having two lobes or enlarged portions 13a, 13b and 14a, 14b. A casing 15 is provided to enclose the rotating impellers, there being openings 16 and 17 provided at opposite sides of the casing 15. The rotating members 11 and 12 are mounted upon axles 18 and 19 which are supported by the end walls of the unit, in which walls bearings are provided. In order to maintain exactly the correct relative positions for the two rotating members 11 and 12, a pair of gears 20 and 21 are provided, which gears are attached to the axles 18 and 19 and adapted to mesh as shown.

Arrows 22 and 23 indicate the direction of rotation of the impellers 11 and 12 respectively. Small arrows 24 and 25 are used in Figures 1, 2, 3 and 4 to indicate the position of the same point in each of the impellers for various positions of rotation.

Sealing devices and the operating mechanism therefor are more clearly disclosed in Figure 2 where the impellers 11 and 12 are illustrated in a different position than that in Figure 1. In Figures 2–4 the casing and gearing have been omitted for the sake of clarity.

In Figure 2 it will be seen that at each side of the lobe 13a there are provided generally circular shaped members 26 and 26a, while similar circular devices 27 and 27a are provided in the lobe 13b. Likewise the impeller 12 is provided with two pairs of sealing devices 29, 29a and 30, 30a. Each pair of sealing devices is similar in con-

struction. It will be sufficient therefore to describe the construction and operation of one pair in detail.

The circular shaped members 26 and 26a are mounted in corresponding circular apertures 31 and 31a in the lobe 13a. The parts 26 and 26a may, therefore, rotate in the apertures 31 and 31a and are prevented from moving out of the apertures because the width of the openings in the side wall of the lobe 13a is smaller than the diameter of the parts 26, 26a. In the part 26 there is provided a sealing member 32, which has a T-shaped section, there being a corresponding slot in the part 26. The shoulders of the T-section thus prevent the sealing member 32 from projecting an excessive amount when the impeller is not in sealing position. A spring member, not shown, urges the part 32 outwardly so that it always tends to make good contact with the surface of the co-acting impeller when it comes around into position. It will be seen that the sealing surface of the part 32 is concave in shape and adapted to suit the curvature of the lobe 14b.

A slot 33 extends through the impeller between the rotatable parts 26 and 26a. In this slot is located a link 34, which is pivoted at 35 to the part 26 and at 35a to the part 26a. By means of this link any rotary movement of the part 26 imposes on the opposite part 26a a corresponding rotary movement. The relative positions of the pivots 35 and 35a are such that the rotation of part 26 causes rotation of the part 26a in the opposite direction. Therefore, the parts 26 and 26a are always in relatively similar positions with respect to the longitudinal center line of the impeller.

In operation the sealing units 26 and 26a oscillate through an angle between certain limit positions. There is provided a spring loaded ball 37, the spring being illustrated at 38. The ball may fall into either depression 39 or 39a, depending upon the extreme position to which the parts 26 and 26a are moved. Similar parts are illustrated in Figures 6 and 8 to a larger scale. This ball device illustrates one means for retaining the sealing parts 26, 26a so that they will not change position accidentally during the portions of the cycle of rotation when neither seal is in contact with a surface of the co-operating impeller, for example the position shown for seals 27, 27a in Figure 2.

The action of the seals will best be seen by consideration of Figures 1, 2, 3 and 4, noting the various relative positions of the impellers and the sealing devices with respect thereto. In Figure 1, impeller 11 is shown in a vertical position, while impeller 12 is at 90° thereto. The end of the lobe 14a fits into the corresponding recess in the impeller 11. In this position both the seals 26a and 27a are in contact with the surface of the impeller and are acting as effective seals. After the impellers have turned through a small angle from the position shown in Figure 1, the seal 27a moves away from the surface of lobe 14a so that it no longer seals. The seal 26a, however, remains in contact with the surface of the lobe 14a until it reaches the position illustrated in Figure 2. In this figure the impellers are shown rotated 45° from their position in Figure 1.

In the position of Figure 2 the seal 29 has just come into contact with the surface of the lobe 13a and is in position to act in its sealing capacity. The seal 26a, as mentioned above, is still in contact with the surface of the lobe 14a. A small amount of rotation past the position in Figure 2 will cause seal 26a to break away from the surface of the lobe 14a. Seal 29, however, has taken up the sealing action from this point and remains in effective sealing contact until the impeller 12 has rotated through an angle of slightly more than 45°, i. e. slightly beyond the vertical position. Figure 3 illustrates the position of the impellers just prior to the time when impeller 12 reaches this vertical position. Here it will be seen that seal 29 is still in contact with the surface of lobe 13a, and seal 30 is just about to make contact with the surface of lobe 13a. When the impeller 12 reaches the vertical position, the relationship of seals 29 and 30, with respect to lobe 13a, will be the same as the relationship of the seals 26a and 27a are with lobe 14a in Figure 1. As indicated in Figure 3 the impellers have travelled through approximately 90° from the position in Figure 1, or ¼ revolution. Operation of the seals will be similar for the next ¼ revolution as will be evident from Figure 4 in which the impellers are shown rotated to a position 40° beyond the horizontal for the left impeller. Here it will be seen that the seals 26 and 30 are now in almost similar positions to the seals 26a and 29 in Figure 2. In Figure 4, however, seal 30 is approaching completion of its sealing action against the lobe 13a and seal 26 has not yet assumed its sealing position against the lobe 13b.

It should be noted that there is an overlap in the sealing action at the 45° position as indicated by reference to Figures 2 and 4, the seal 26 being effective before the seal 30 becomes ineffective. Similarly there is an overlap at the point illustrated in Figure 1 in which the seal 26a makes contact with the lobe 14a a short interval before the seal 27a lifts away from the lobe 14a.

Referring now to the detail construction and operation of the sealing devices themselves, it will be seen that in the sealing device 26a in Figure 1, the concave surface of the sealing element 32 is in contact with the surface of the lobe 14a over an appreciable length, the curvature of the seal being adapted to suit the convex curvature of the surface of the lobe 14a. Due to the use of a spring device, and if desired, means for admitting pressure to the rear of the sealing element 32, as will be described in connection with the form of device illustrated in Figure 5, a very positive seal is produced. Such a seal is greatly superior to one which involves a flat surface or convex surface in contact with the surface of the impeller lobe. In order to maintain intimate contact with the lobe 14a throughout the angle of rotation when the seal 26a is performing its function (that is, during rotation from the position of Figure 1 to the position in Figure 2), the sealing device 26a must change its angular relationship with respect to the impeller 11. As will be seen in Figure 2 the element 32 of seal 26a still maintains its concave surface in proper contact with the surface of the lobe 14a, due to the fact that the part 26a has turned on its axis into position to permit this. The rotation is, of course, accomplished because the part 32 must follow the surface of the lobe 14a and therefore moves the part 26a to the required angle.

Rotation of the sealing part 26a also causes rotation of the opposite sealing part 26 because of the interconnection between these parts by the

link 34. In this fashion the part 26 is positioned so that as rotation continues it will be in proper position to contact the lobe 14b and pass the seal 30 without any possibility of jamming. Its action in this respect will be seen clearly by referring to Figures 3 and 4. In Figure 3 the position of the part 26 is shown after the part 26a has completed its sealing function, but before the seal 26 has rotated into effective position. In Figure 4 the sealing parts 30 and 26 have approached each other and the seal 26 is just coming into position on the lobe 14b. The angular position of the part 26 is correct for making this initial contact. In Figure 4 it will be evident that the seal 27 is also in proper position for making contact with surface of lobe 14b.

This rotation of the seals to a proper position for their next contact may also be followed by reference to Figures 1, 2 and 3. In Figure 1 the seals 29 and 29a are in position with the sealing surface approximately parallel to the longitudinal axis of the impeller. These seals were set in this position by the angle of contact of seal 29a with lobe 13b just as it completed its sealing action. Seal 29 was, therefore, positioned so that it will make the proper contact when it reaches the position in Figure 2. In passing from the position in Figure 2 to Figure 3 it will be seen that the seal 29 has been rotated around to its other position in which the surface of the seal 29 (and also seal 29a) makes an acute angle with the longitudinal axis of the impeller. The seals 29 and 29a are now in the same relative position as the seal 30. Thus the seal 29a is properly positioned for its next contact.

It will also be obvious from a study of the drawings that rotation of the impellers may be stopped at any point and the direction of rotation reversed. The sealing elements will be in proper position to make their sealing contact for the opposite direction of rotation as well.

Referring now to Figures 5 to 8, there is illustrated a rotary device generally similar to that illustrated in Figures 1 to 4. The seals and operating mechanism for actuating the seals are constructed differently. The impellers in Figure 5 have been designated 11 and 12 as in the case of Figure 1. The sealing devices in Figure 5 are designated 40 and 40a, 41 and 41a, 42 and 42a, 43 and 43a. The detail construction of the sealing devices will be more clearly seen in Figure 8 where a portion of impeller 11 is shown with the sealing devices 41 and 41a mounted therein. The actual sealing elements are shown at 44. These sealing elements are shaped to provide a wider contact with the surface of the impeller during sealing than was the case with the seals in Figure 1. Grooves 45 are formed in the concave sealing surface of the widened portion 46 of the sealing element. These grooves cause increased sealing action since they provide a series of edge contacts which under most conditions give improved sealing over a single edge contact. Further, the grooves act as channels which wipe the surface and pick up any excess oil. This oil is deposited in the grooves and tends to further enhance the sealing action.

Small openings in the form of drill holes 47 are provided in the sealing devices 41 and 41a, which holes 47 lead to the rear surface of the widened part 46. Thus with the seal in effective position, as shown by the position of 41a, the pressure in the chamber formed between the impellers and the casing may enter through the holes 47 and develop a pressure urging the sealing element 44 tightly against the surface of the impeller 12.

The sealing element 44 is shaped at its back end similar to the sealing element shown in Figure 1, having a projection 48 which may contact the cooperating surface 49 in the sealing unit 41a. This construction allows for slight movement of the sealing element 44 to permit intimate sealing contact, but prevents the element 44 from projecting unduly during parts of the rotation when it is not acting in its sealing capacity.

In Figure 6 a cross section through the sealing device 41a is shown. Behind the sealing element 44 is a flat corrugated spring 50 which urges the sealing device into contact with its sealing surface. The ball device 37 is also illustrated in this view, where it will be seen that it fits into recess 39, these parts being similar to those shown in Figure 2.

Figure 7 shows a cross sectional view through the impeller axle 19. In this figure the gearing which interconnects the two impeller axles to synchronize the operation of the impellers is illustrated at 51. Gear 51 is preferably the herringbone type in order to provide for quiet operation with a minimum of backlash, thereby giving accurate positioning of the impellers at all times during operation. The impeller is pinned for rotation with the axle by pin 52.

The end of the axle 19 opposite to the gear 51 projects through the end casing 15a as at 19a to provide a shaft upon which may be mounted a pulley, sprocket, or other means for either applying power to the rotary mechanism or taking power from the device, depending upon whether the mechanism is being used in the capacity of a blower or pump, or in the capacity of an engine.

The manner in which lubrication is applied to the moving parts of the impeller, particularly the sealing device, will be clear by reference to Figures 7 and 8. Oil is supplied through pipe 53, from which it passes through the hole 54 into the annular groove 55 in the impeller boss just outside the axle. In Figure 8 drill holes 56 are shown leading from the annular groove 55 to the sealing units 41 and 41a.

In Figures 5 and 8 it will be seen that seals 57 have been provided at the tips of the impellers so that improved sealing action between the impellers and the casing is also produced. The seals 57 are retained by pins 58 which in turn are guided by smaller pins 59 so that the seals 57 are held in substantially operative position with provision for slight end movement. A spring similar to spring 50 used for seals 41 and 41a may be used to urge the seal 57 into sealing contact. Also small holes 60 are provided to admit the pressure to the back side of the seal 57 to further improve the sealing action.

In order to cause the seals of the impeller of Figures 5 and 8 to move in unison, gearing mechanism is used to interconnect the opposite seals of each pair. In the cylindrical portion of the sealing unit there is provided a region having teeth 61 which are adapted to engage with the gears 62. There are two gears 62 provided for each pair of seals in order to cause the cylindrical members of the pair to rotate in the proper direction with respect to each other. The gears 62 are preferably mounted in suitable recesses in the impeller and enclosed by a cover member 63, the surface of which is preferably flush with the surface of the impeller.

This form of actuating mechanism is robust and provides accurate positioning of the seals even after long service.

From the foregoing it will be evident that by my improved sealing mechanism I have been able to produce a large increase in the effectiveness of a rotary mechanism of the general type disclosed. The positive nature of the sealing action which may be produced with my device will be seen from the results of tests in which a blower unit, which normally produced a pressure of 7 pounds per square inch at 1500 R. P. M., was able to produce, when equipped with the sealing device of the present invention, a pressure of approximately 50 pounds per square inch at 100 R. P. M. With my improved sealing device it is practical to utilize efficiently a rotary mechanism of this type as an internal combustion engine or other type of power medium.

The use of movable seals having concave sealing surfaces provides a novel sealing mechanism which is at the same time comparatively simple to manufacture. By positioning these articulated seals in the proper relative position with respect to the center of rotation, taking into account the shape of the impeller, it is possible to provide a sufficient overlap in sealing action so that at all times during revolution of the mechanism the sealing action remains effective. In the present invention the design of the seals is such that the proper proportion of the cylindrical part is cut away to provide easily assembly of the sealing unit in the impeller. Once assembly is complete with the interconnecting elements attached, the mounting of the seals is secure against accidental displacement. This improved type of seal also provides automatically for wear and is capable of taking care of any irregularities in the surface so that optimum sealing is obtained under all conditions of operation.

I claim:

1. A rotary device having a casing with inlet and outlet openings and a plurality of impellers with at least two lobes each, said impellers being rotatably mounted in said casing, the rotational relationship of the impellers being such that the lobe of one impeller contacts another impeller at a position between its lobes, a pair of sealing units incorporated in each lobe in a position to contact the surface of a lobe of another impeller, each sealing unit being adapted to rotate with respect to the lobe in which it is mounted, and a mechanical interconnection between the units providing for interrelated rotational movements.

2. A rotary device having a casing with inlet and outlet openings and a plurality of impellers rotatably mounted in said casing, each of said impellers having at least two lobes, means causing rotation of the impellers to provide interengagement of the lobes of one impeller with the space between the lobes of another impeller, a pair of sealing units incorporated in each lobe, each sealing unit being located to seal against the convex surface of an adjacent impeller lobe and adapted to rotate with respect to the lobe in which it is mounted, and means which upon rotation of one sealing unit causes corresponding rotation of the other sealing unit.

3. A rotary device having a casing with inlet and outlet openings, a pair of impellers mounted therein for rotation, said impellers being geared together to cause operation in predetermined relationship whereby the lobes of one impeller interengage the space between the lobes of the other impeller, said impellers further having enlarged ends in the form of lobes, sealing devices mounted in pairs on said lobes with provision for controlled oscillation with respect thereto, each pair of devices being mechanically interconnected to provide for sealing contact with the surface of the engaging impeller lobe.

4. In a rotary mechanism, a plurality of lobed impellers adapted to rotate in interengaging relationship, each impeller having a plurality of sealing devices mounted therein in position to seal against the surface of an impeller, means providing for positive intercontrolled oscillating movements of one of said devices with another of said devices.

5. For a rotary mechanism, a plurality of lobed impellers adapted to rotate in interengaging relationship, means for providing a seal between adjacent impellers including a pair of sealing devices associated with each lobe, one of said devices being mounted at each side of each lobe for movement therewith, link means interconnecting each pair of sealing devices to cause both devices to move together, said link means being pivotally connected to said sealing devices.

6. For a rotary mechanism, a plurality of lobed impellers adapted to rotate in interengaging relationship, means for providing a seal between adjacent impellers including a pair of sealing devices associated with each lobe, one of said devices being mounted at each side of each lobe for movement with respect thereto, toothed means to interconnect each pair of sealing devices so that movement of one sealing device causes corresponding movement of the other.

7. For a rotary mechanism having a plurality of interengaging impellers, a sealing device mounted in each of said impellers adapted to seal against the surface of an engaging impeller, said sealing device having provision for rotational movement between limiting positions, means for retaining said device against accidental displacement from the limiting positions.

8. For a rotary mechanism, a pair of interacting impellers each having two lobes, a pair of sealing units rotatably mounted on the sides of each lobe, each pair of said units being mechanically interconnected for corresponding movement, a spring-loaded ball member for each pair of units adapted to engage in a recess in one of said units whereby said pair of units is retained in proper position during that portion of rotation when it is out of sealing contact with the lobe of the interacting impeller.

9. For a rotary blower type mechanism, a plurality of interacting lobed impellers, a pair of sealing devices mounted in each lobe in a manner to permit limited rotational movement about their axes, said sealing devices being adapted to contact the convex surface of a lobe of one of the interacting impellers, each of the said sealing devices having a seal element associated therewith, and a mechanical interconnection between each pair of sealing devices adapted to provide a positive interrelation of movement.

10. A rotary mechanism having a casing with inlet and outlet openings, a plurality of lobed impellers rotatably mounted in said casing and adapted to rotate in interengaging relationship, a pair of sealing devices movably mounted in each lobe of said impellers, each of said sealing devices having a concave sealing surface adapted to contact the convex surface of an adjacent impeller, means interconnecting both devices of each pair whereby the movement of one sealing device of a

pair incidental to maintaining sealing contact between the concave and convex surfaces is transmitted to the other device of the pair.

11. For a rotary device, a lobed impeller having a pair of circular shaped recesses therein, a cylindrical segment adapted to rotate in each of said recesses, a seal element mounted in each of said segments, said seal elements having concave sealing surfaces and a mechanical interconnection between said pair of cylindrical segments adapted to transmit rotational movements therebetween.

12. A rotary blower device having a casing with inlet and outlet openings and a plurality of interacting impellers rotatably mounted therein, a pair of sealing units movably supported on each of said impellers, each sealing unit having a concave grooved sealing surface adapted to seal against the convex surface of one of said impellers, and means interconnecting the units of the pair adapted to cause corresponding movement of one unit upon movement of the other unit of the pair.

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