Jan. 27, 1953 E. J. SANDERS 2,626,744

VARIABLE FLOW FLUID DISPLACEMENT ROTOR

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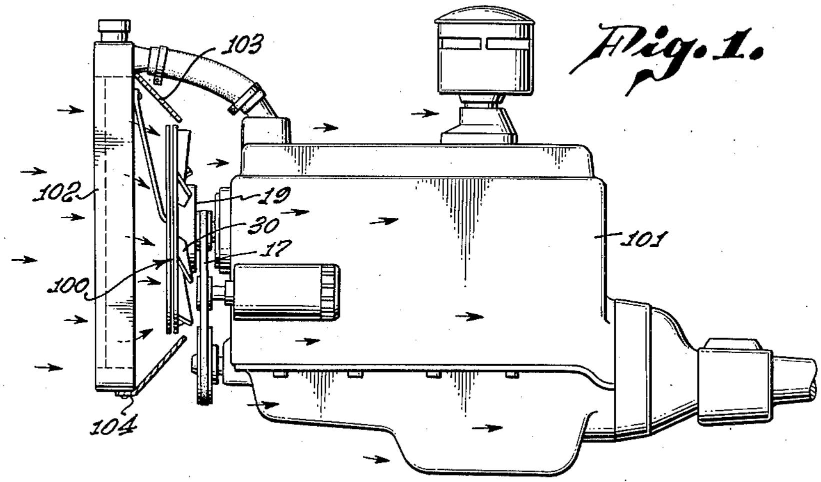

Fig. 1.

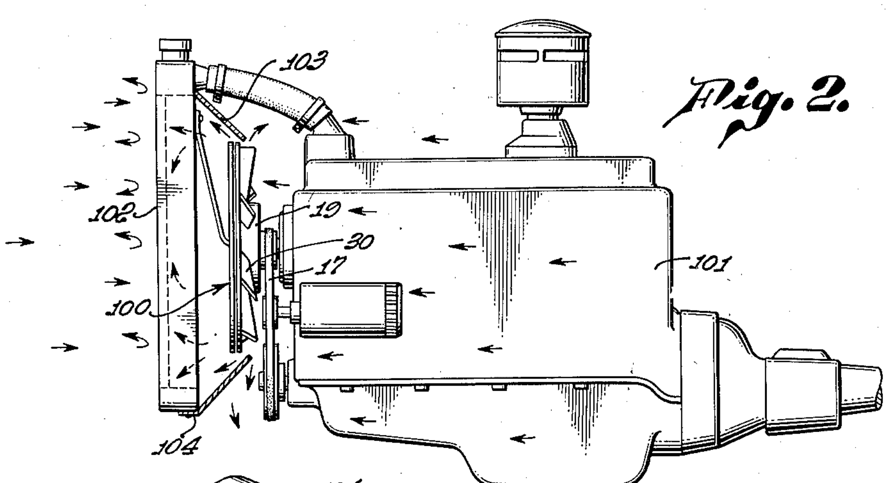

Fig. 2.

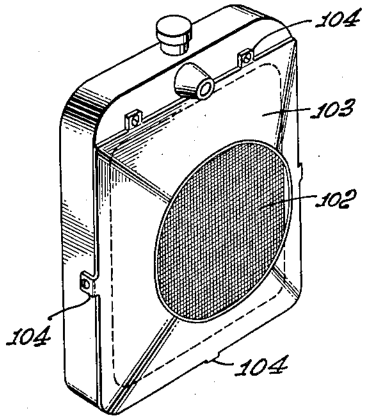

Fig. 3.

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Fig. 4.

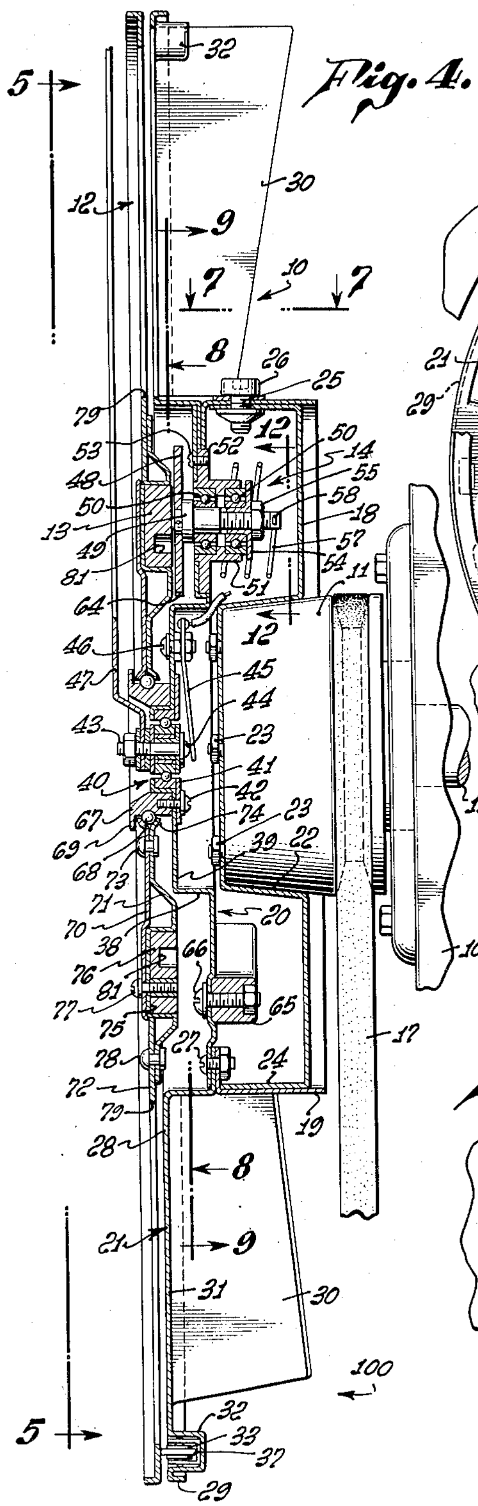

Fig. 5.

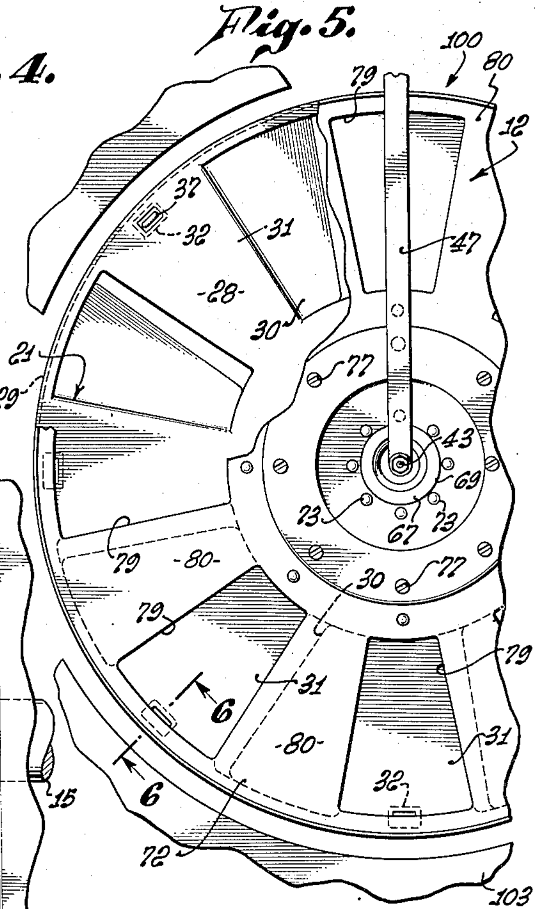

Fig. 6.

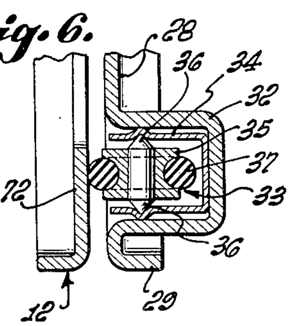

Fig. 7.

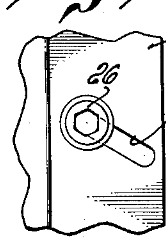

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Fig. 8.

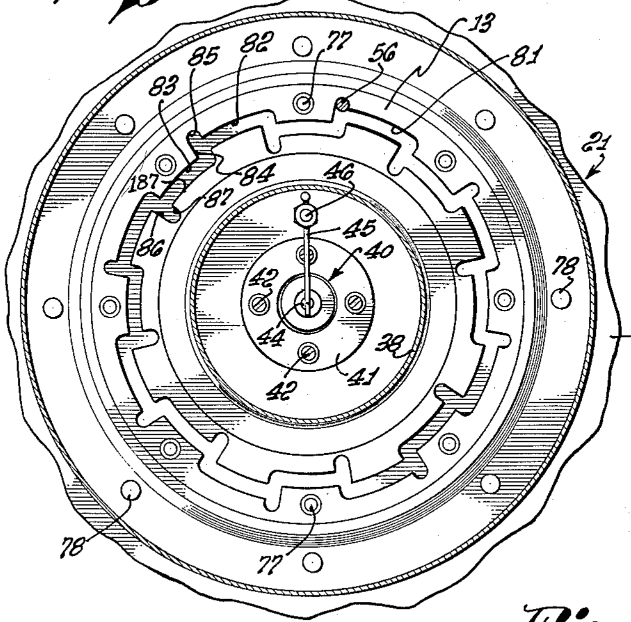


Fig. 10.

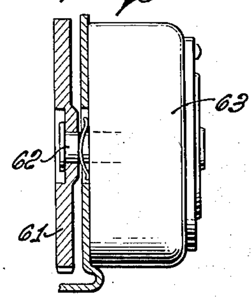


Fig. 12.

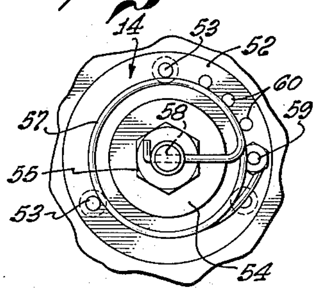


Fig. 9.

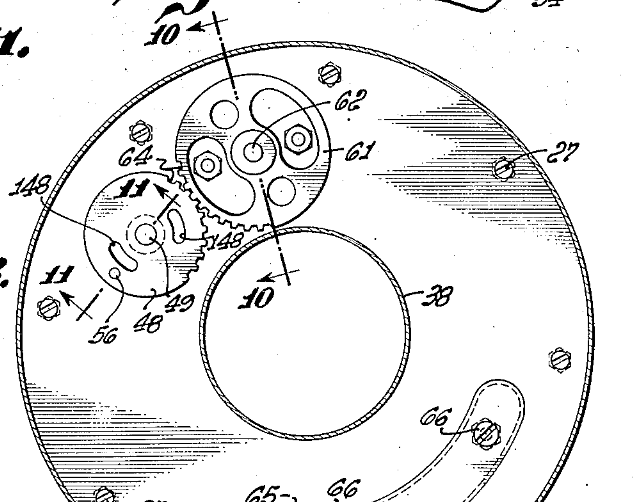


Fig. 11.

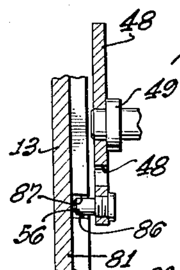


Fig. 13.

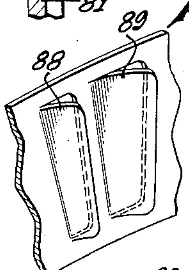
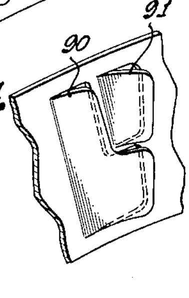


Fig. 14.



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Patented Jan. 27, 1953

2,626,744

UNITED STATES PATENT OFFICE

2,626,744

VARIABLE FLOW FLUID DISPLACEMENT ROTOR

Elmore J. Sanders, San Gabriel, Calif.

Application April 24, 1950, Serial No. 157,765

18 Claims. (Cl. 230—270)

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This invention relates generally to improved variable flow fluid displacement rotors adapted broadly for any of various uses in either creating a flow of fluid or rotating in response to such a flow.

In my copending application Serial No. 49,507, I have disclosed a variable flow vaned rotor device comprising a pair of sections mounted for rotation together and adapted for rotary adjustment to different relative angular positions to vary the rate of fluid displacement through the device. A major object of the present invention is to provide improvements in the device of the above application and especially to provide improved means for controlling the relative angular positions of the two rotatable sections in that arrangement. Particularly contemplated is the provision of positioning mechanism in which the relatively slight movement of a single detent element or pin carried by one of the sections and engaging the other section serves effectively to control the relative angular positions of the sections. As will appear, the position controlling mechanism of the present invention is especially designed for operation by an extremely small actuating force, such as may be exerted by a small electric solenoid requiring relatively little power for its operation. This feature is particularly important where the fan is to be used as a cooling air fan for an internal combustion engine, in which case it will ordinarily be necessary to control the fan by battery current.

Structurally, the positioning apparatus may include a holding element carried by one of the two rotatable sections for shifting movement between a pair of control positions, and acting in those positions to engage the other section in a manner rotatively interconnecting the sections in different relative angular positions. For most effective operation of the mechanism, it is desirable that the detent element be movable radially of the device during its shifting movement. The positioning apparatus may be so formed that when the detent element is shifted from one position to the other the sections are permitted first to rotate relatively through a predetermined angle and are then automatically locked in a new position. Subsequent movement of the holding element in the opposite direction permits further relative rotation of the sections to a different position.

More specifically, this highly effective type of operation may be attained by the use of a movable detent element carried by one section and successively engageable with a series of alternately offset stop shoulders positioned about the other section. Upon movement from engagement with any one of these shoulders, the sections are permitted to rotate relatively until the detent engages and is stopped by the next successive shoulder. Adjacent each shoulder, I preferably provide a locking notch or recess within which the detent is received after a shifting movement to positively rotatively interlock the sections in their new angular relation. As will appear, the stop shouders, locking notches, and certain shifting control shoulders later to be described may all be formed together in a simple and yet highly effective manner by the provision of a single essentially annular labyrinth recess adapted to movably receive the pin and having irregular walls forming the various shoulders and notches.

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It has been discovered that when the device of the present invention is employed as a suction fan, there is a decided tendency for the two rotatable sections to be drawn together in a manner causing wear, increasing the frictional resistance to their relative rotation, and creating noise upon their change of position. An additional object of the present invention is to counteract this tendency for the two sections to be drawn together by providing rotatable bearing means between the sections retaining them a predetermined distance apart at all times. Preferably, I employ for this purpose a number of rollers spaced angularly about the outer edge of one section and engaging the other section with relatively little friction.

Certain preferred rotors embodying the invention are especially designed and adapted to serve as cooling fans for internal combustion engines. A further object of the invention is to provide baffling means adapted to effectively direct a flow of air through an engine radially when the fan is used for this purpose. Specifically, I may provide a tubular shroud extending between the outer edges of the fan and radiator and acting to positively confine the cooling air for travel in a predetermined path. In this connection, a particular feature of the invention involves the provision of a fan and baffle installation so designed as to produce a heavy flow of cooling air through the radiator in a first direction when the fan is in its open condition, and tending to create a relatively slow reverse flow of warmer air in the closed condition of the fan. For instance, in an automobile cooling system, the fan may create the usual rearward flow of air through the radiator when in cooling condition and then create a slow forward flow of warm air from over the engine when in closed condition, thus preventing any appreciable radiator cooling effect in that closed condition of the fan due to the motion of the vehicle.

The above and other features and objects of the present invention will be better understood from the following detailed description of the typical embodiment illustrated in the accompanying drawings, in which:

Fig. 1 is a side view of an air circulating system for an internal combustion engine and showing the path of air flow when the fan is in its open condition;

Fig. 2 is a view corresponding to Fig. 1 but showing the path of air flow with the fan in closed condition;

Fig. 3 is a perspective view of the air directing shroud extending between the engine radiator and fan;

Fig. 4 is an enlarged vertical section through the fan of Figs. 1 and 2;

Fig. 5 is a fragmentary front view of the fan taken on line 5—5 of Fig. 4 and partly broken away to show the rear bladed section;

Fig. 6 is an enlarged fragmentary section through one of the outer spacing rollers taken on line 6—6 of Fig. 5;

Fig. 7 is an enlarged fragmentary view taken on line 7—7 of Fig. 4;

Fig. 8 is a transverse section through the device taken on line 8—8 of Fig. 4 and showing especially the form of the labyrinth recess in the forward section;

Fig. 9 is a transverse section taken on line 9—9 of Fig. 4 and showing the pin actuating gear mechanism;

Fig. 10 is an enlarged fragmentary section taken on line 10—10 of Fig. 9 and showing the rotary solenoid and its associated gear;

Fig. 11 is a section taken on line 11—11 of Fig. 9 showing the detent pin and its carrying disk;

Fig. 12 is an enlarged fragmentary view showing the spiral spring for returning the pin to normal and taken on line 12—12 of Fig. 4; and

Figs. 13 and 14 are fragmentary perspective view of two variational blade designs.

Referring first to Figs. 1 and 2, a variable fan 100 is shown mounted at the forward end of an internal combustion engine 101 and in spaced relation to the radiator 102. Tubular shroud 103 extends rearwardly from the outer edge of the radiator to a position about the fan to direct air between the radiator and fan. This shroud is of rectangular section corresponding to the radiator at its forward edge and converges rearwardly to a circular section only slightly larger than the fan (see Fig. 2). At its rear edge, the shroud extends to a condition of axially overlapping relation with the fan, as shown, to effect a relatively slow forward flow of air through the radiator in the closed condition of the fan. The exact manner in which this forward flow of air is created will be brought out at a later point in describing the operation of the device. The shroud is mounted in the illustrated position in any suitable manner, as by mounting ears 104 welded to the radiator.

As best seen in Fig. 4, the variable flow fan itself comprises essentially a rear vaned fan section 10 carried by and rotatable with the usual fan driving hub 11 on the engine, a forward shutter section 12 mounted for rotation with and relative to the rear section and having an annular detent cam member 13 mounted on its rear face, and a detent mechanism 14 carried by the fan section and cooperating with the member 13 to control the relative angular positions of the two sections and thereby the rate of axial fluid flow through the device. Hub 11 is carried by the usual shaft 15 driven by V-belt 17.

The two sections of the rotor device are each formed essentially of a number of circular and annular sheet metal parts designed especially for inexpensive manufacture. The rear fan section, for instance, includes a circular mounting plate 18 attachable to the forward end of the driving hub 11, an annular bracket plate 19, an annular inner mechanism carrying plate 20 forming with plates 18 and 19 a hollow inner hub portion of the section, and an outer annular vaned plate 21. Mounting element 18 has a central rearwardly facing recess 22 formed to receive driving hub 11 and attachable to that hub by nuts 23 threaded onto the usual fan mounting studs. It is contemplated that the formation of this attaching plate may be varied to permit attachment of the device to driving hubs of various designs while the rest of the mechanism remains unchanged. Element 18 extends radially outwardly from its central recessed attaching portion and then axially at an outer location to form a cylindrical outer mounting portion 24 to which the rest of the fan device may be attached as a unit. To permit such attachment, bracket plate 19 is cylindrical and receivable about the outer cylindrical portion 24 of the mounting element 18, and contains a number of peripherally spaced and angularly extending fastener slots 25 registering with corresponding openings in the mounting element and through which screws 26 extend for rigid attachment of the fan to the mounting element. At its forward end, member 19 is turned inwardly to form an annular flange attachable by a number of angularly spaced screws 27 to the overlapping edge portions of the inner and outer fan section plates 20 and 21.

The outer vaned annular member 21 extends first forwardly from its point of connection by screws 27 to the other fan section parts and then radially outwardly at 28 to an outer rearwardly turned reinforcing rim 29. As best seen in Fig. 5, this outer radial portion 28 of the sheet metal member 21 is cut and deformed at angularly spaced locations to form a series of spaced fan blades or vanes 30 extending angularly to the rear and acting to induce a rearward flow of air upon rotation. Preferably, the area of the material deformed to form each of these blades is substantially the same as the areas of each of the undeformed intermediate shutter surfaces 31.

At the outer edge of each of the shutter surfaces 31, the sheet metal of plate 21 is locally bulged to form a forwardly facing recess 32 within which roller 33 is rotatably mounted to serve as a bearing for engaging the forward shutter section of the device to maintain the fan and shutter sections in predetermined spaced relation.

Referring to Fig. 6, recess 32 may be of essentially rectangular radial section to receive a U-shaped spring metal bearing member 34. Body 35 of roller 33 presents a pair of laterally projecting tapered pin portions 36 receivable within predetermined indentations in the sheet metal bearing member 34 to rotatably mount the roller. The body of the roller carries an outer O-ring 37 of rubber or the like received within a pre-formed annular recess in the surface of the roller body and acting to engage the shutter section of the apparatus. Because of the unique formation of rollers 33 and their spring metal bearing members 34, these elements may be quickly and easily inserted into their respective mounting recesses with a minimum of difficulty and expense.

The inner sheet metal part 20 of the fan section is separately formed in order that it may be bodily removed from the rest of the apparatus and replaced when the parts of the detent mechanism carried by this plate become worn. Plate 20 extends first radially inwardly from its point of attachment to the other parts by screws 27, then forwardly at 38, inwardly at 39 and finally forwardly and inwardly about the outer race of contact mounting bearing 40. The outer race of this bearing is retained at its rear side by a retainer plate 41 attached by screws 42 to the rear face of plate 20. Stationary terminal screw 43 extends through and is rigidly attached to the inner race of bearing 40, and has a rear contact head 44 engageable by contact arm 45 mounted to but insulated from plate 20 by screw 46. This contact arm is in turn electrically connected to a detent actuating solenoid, as will later appear. Terminal screw 43 is attached at its forward end to a stationary electrical lead 47, and is suitably insulated from bearing 40.

Detent mechanism 14 includes a detent control disk 48 mounted for rotation at the forward side of the fan section of the device by a rearwardly extending shaft 49 rigidly connected to the disk and rotatable within spaced bearings 50. These bearings are received at opposite sides of an inner annular projection within tubular mounting member 51 whose forward peripheral flange 52 is attached to plate 20 by screws 53. Shaft 49 is threaded at its rear end for connection to a bearing retainer 54, which also serves as a dust cap for the bearings. Retainer 54 is locked in its assembled relation to shaft 49 by nut 55.

Disk 48 threadedly carries a forwardly projecting detent pin or lug 56 at an eccentric location and acts to move that pin radially of the fan upon rotation of the disk. A spiral spring 57 received about shaft 49 and member 51 normally operates to rotate disk 48 in a direction moving pin 56 outwardly. For this purpose, one end 58 of the spring is connected to the threaded rear end of shaft 49, and the other end 59 of the spring is turned inwardly for selective reception within any of a number of openings 60 spaced about flange 52 of member 51. As will be appreciated, the tension of the spring is regulated by insertion of its forward end within different ones of these openings 60.

At a position angularly adjacent disk 48, plate 20 carries a gear wheel 61 driven through shaft 62 by a rotary solenoid 63 mounted to the rear face of the plate (see Figs. 9 and 10). Wheel 61 and disk 48 have interengaging gear teeth 64 extending about a portion of their peripheries and acting to transmit rotation of the solenoid and its gear into rotation of the disk 48 and consequent radial movement of detent pin 56. The solenoid when energized tends to rotate in a direction moving pin 56 inwardly against the tendency of coil spring 57. Upon deenergization of the solenoid, spring 57 then returns pin 56 to a radially outer position. The energization of the solenoid is remotely controlled, as by a conventional thermostatic switch responsive to the cooling water temperature in an internal combustion engine. Current is supplied to this solenoid through the metallic body of the fan device, and through lead 47, contact screw 43, and contact 45.

As seen in Figs. 4 and 9, plate 20 carries a counterweight 65 mounted by screws 66 at a location opposite the detent mechanism and servicing to balance this plate about its axis of rotation. Also, disk 48, gear wheel 61, and their associated parts, are balanced about their respective axes, by the formation of suitable openings 148 in the gear and disk, to avoid any tendency for actuation of the detent mechanism by centrifugal force upon rotation of the device as a whole. Finally, shaft 49, disk 48, and their associated parts, are balanced to the front and rear of bearings 50.

On its forward face, plate 20 carries an annular forwardly projecting inner bearing race element 67 attached to the plate by the screws 42 and serving to rotatably mount the forward shutter section 12. About its outer face, this bearing race has an annular groove within which balls 68 are received. At its forward edge, bearing race 67 has an outwardly projecting flange 69 for protecting the balls and their engaging surfaces from dust.

The forward shutter section 12, like the rear fan section 10, is formed of a number of annular sheet metal plates. Specifically, section 12 includes a pair of inner forward and rear plates 70 and 71, and an outer annular apertured plate 72. The two inner plates 70 and 71 are interconnected near their inner edges by rivets 73, and their inner edges are oppositely curved at 74 to form together a substantially semi-cylindrical outer race engaging the balls 68. Outwardly of connecting rivets 73, the rear plate 71 is deformed to present an annular rearwardly facing recess 75 rectangular in radial section for receiving an annular detent cam member 13, which is preferably formed of hard rubber or similar quietly operating though long wearing material. This cam element may be bonded directly to plate 71 or retained by screws 77 serving also to interconnect the two plates 70 and 71.

Outwardly of the detent cam, plate 71 is connected by rivets 78 to the outer annular shutter plate 72. This outer plate extends parallel and closely adjacent the outer vaned plate 21 of the fan section. Plate 72 has a number of radially enlarging angularly spaced apertures 79, between which the plate forms intermediate shutter surfaces 80. These apertures 79 and shutter surfaces 80 are substantially equal in angular extent and are spaced in correspondence with the blades 30 and shutter surfaces 31 of the fan section. With the two sections 10 and 12 in the relative angular positions of Fig. 5, shutter surfaces 31 of the rear section extend across apertures 79 of the forward section to close those apertures and preclude the passage of any substantial amount of air through the device. When, however, the two sections are relatively rotated to a condition in which shutter surfaces 31 are immediately opposite shutter surfaces 80 and blades 30 of the rear section are positioned opposite apertures 79 of the forward section, the fan blades are exposed and free to draw air through apertures 79.

The relative angular position of sections 10 and 12 is determined by the radial shifting movement of detent pin 56 relative to detent cam 13. For this purpose, cam 13 contains a relatively narrow rearwardly facing, essentially annular labyrinth recess or groove 81 extending about the face of the cam element and within which the detent pin is movably received (see Figs. 8 and

11). This labyrinth recess comprises a succession of arcuate portions 82 and 83 extending alternately at two different radial distances from the center of rotation of the device. At one end of each of the outer arcuate portions 82 of the recess, the cam element presents a radial stop shoulder 84 against which the pin abuts after a shifting movement. Adjacent each shoulder 84, the wall of the recess contains an outwardly extending locking notch 85 into which the pin is movable to lock the sections in certain predetermined relative angular positions. Similarly, at a corresponding end of each inner portion 83 of the cam recess, the cam element presents a radial shoulder 86 radially offset from shoulders 84, and an inwardly extending locking notch 87. The various inner and outer arcuate portions 82 and 83 of the labyrinth recess interconnect at the location of the locking branches 85 and 87. The angular extent of each of the arcuate portions of the recess is equal to the angular extent of the shutter surfaces 31 and 80, apertures 79 and the openings formed by blades 30.

In use, the fan is mounted to driving hub 11 by first separately attaching mounting element 18 to the hub and then attaching the rest of the device to this mounting element by screws 26. A source of controlled current is then connected to solenoid 63 through the body of the engine and lead 47. Hub 11 is normally driven continuously, and the effectiveness of the fan to draw air varied by controlling the relative angular position of the two rotating sections 10 and 12. With rotary solenoid 63 deenergized, spring 57 acts to rotate disk 48 through shaft 49 in a direction moving detent pin 56 carried by the disk radially outwardly and into one of the outwardly extending locking notches 85 of recess 81, as for instance, to the position of Fig. 8. In this condition, the fan section 10 and shutter section 12 are rotatably interlocked, with fan blades 30 received directly behind apertures 79 in the shutter section. The fan blades consequently serve to draw air axially through apertures 79. Upon energization of solenoid 63, the solenoid rotates gear wheel 61 and through it disk 48 against the tendency of spring 57 and in a direction moving pin 56 radially inwardly from within locking branch 85 of the cam recess and to a radius corresponding to the next adjacent inner arcuate portion 83 of the cam recess. With the pin moved inwardly to this condition, the shutter section is free to move angularly relative to the fan section through a predetermined arc and until the pin engages the next successive radial shoulder 86 by which such relative angular movement is limited.

During such relative movement of the sections, the inward shifting movement of the pin is limited by engagement with wall or shoulder 187 extending along the inner side of the recess. As the pin engages shoulder 86, it reaches a position opposite one of the locking notches 87 and is urged into that locking branch by the solenoid. The fan and shutter sections are thus rotatively interlocked in a second relative angular position in which shutter surfaces 31 of the fan section are received directly behind apertures 79 of the shutter section to close those apertures and prevent the passage of any substantial amount of air axially through the device. The sections remain in this relative condition until the solenoid is again deenergized and spring 57 is free to move pin 56 outwardly into the next successive outer arcuate portion 82 of the cam recess for movement through a second arc to the next successive locking position in which the fan is again opened. Relative movement of the sections when permitted by pin 56 is effected as a result of the natural tendency for the then undriven shutter section to slow under the influence of air resistance.

When the fan is closed against axial fluid flow by reception of shutter surfaces 31 of the fan section behind apertures 79 of the shutter section, the device commences to act as a centrifugal impeller, in which vanes 30 draw air forwardly from the rear of the fan and discharge it radially outwardly (see Fig. 2). As this air is drawn forwardly toward the fan, it passes slowly over and is warmed by the engine. Since the rear edge of shroud 103 extends to a position of axially overlapping relation with the fan blades, it picks up a part of this radially outward flow of warm air created by the fan in its closed condition and directs that air forwardly to pressurize the space in front of the shutter section. A certain amount of this warm air under pressure passes forwardly through the radiator to prevent any sharp and undesired drop in the radiator temperature.

It is contemplated that the metal of the outer plate portion 21 of fan section 10 may be deformed to present two or more fan blades within the angular extent of one of the shutter section apertures 79. Figs. 13 and 14 represent two possible dual blade arrangements which might be used. For instance, in Fig. 13, I provide a first relatively small blade 88, followed by a relatively large main blade 89. In Fig. 14, I show a main blade 90 and a smaller blade 91 of shorter radial dimension and positioned alongside the outer portion of the main blade.

I claim:

1. A rotor device comprising a rotatable first section having fluid passing apertures, an axially adjacent second section rotatable with and relative to said first section and carrying shutter means adapted to vary the effective fluid passing area of said apertures upon relative rotation between the sections, angularly disposed fluid displacement blades mounted for rotation with the sections and positioned in fluid transferring relation to said fluid passing apertures, a detent lug mounted to one of the sections for movement relative thereto between a pair of control positions, means on the other section engageable by the lug in said two positions respectively to interconnect the sections for rotation together in different relative angular positions, and means for controlling the movement of said lug between its two positions to thereby control the relative angular positions of said sections and the fluid displacement therethrough.

2. A rotor device comprising a rotatable first section having fluid passing apertures, an axially adjacent second section rotatable with and relative to said first section and carrying shutter means adapted to vary the effective fluid passing area of said apertures upon relative rotation between the sections, angularly disposed fluid displacement blades mounted for rotation with the sections and positioned in fluid transferring relation to said fluid passing apertures, a detent lug mounted to one of the sections for movement relative thereto between a pair of control positions, the other section having angularly spaced stop shoulders relatively offset for engagement with the lug in said two positions respectively to interconnect the sections for rotation together in different relative angular positions, and means

for controlling the movement of the lug between said control positions to thereby control the relative angular positions of said sections and the fluid displacement therethrough.

3. A rotor device comprising a rotatable first section having fluid passing apertures, an axially adjacent second section rotatable with and relative to said first section and carrying shutter means adapted to vary the effective fluid passing area of said apertures upon relative rotation between the sections, angularly disposed fluid displacement blades mounted for rotation with the sections and positioned in fluid transferring relation to said fluid passing apertures, a detent lug mounted to one of the sections for movement relative thereto between a pair of control positions, the other section having angularly spaced stop shoulders relatively offset for engagement with the lug in said two positions respectively to interconnect the sections for rotation together in different relative angular positions, means on said other section forming locking notches adjacent the stop shoulders and within which the detent lug is receivable to positively rotatively interlock the sections in said relative angular positions, and means for controlling the movement of the lug between said control positions to thereby control the relative angular positions of said sections and the fluid displacement therethrough.

4. A rotor device comprising a rotatable first section having fluid passing apertures, an axially adjacent second section rotatable with and relative to said first section and carrying shutter means adapted to vary the effective fluid passing area of said apertures upon relative rotation between the sections, angularly disposed fluid displacement blades mounted for rotation with the sections and positioned in fluid transferring relation to said fluid passing apertures, a detent pin mounted to one of the sections for shifting movement between a pair of control positions, the other section having angularly spaced stop shoulders alternately offset for engagement by the pin in said two positions respectively to interconnect the sections for rotation together in different relative angular positions, shoulders on said other section limiting the shifting movement of said pin after disengagement from one stop shoulder and until its relative angular movement to the position of the next successive stop shoulder, means on said other section forming lock notches adjacent said stop shoulders and into which the pin moves after said angular movement between stop shoulders to positively rotatively interlock the two sections, and means for controlling the shifting movement of said pin to thereby control the relative angular positions of said sections and the fluid displacement therethrough.

5. A rotor device comprising a rotatable first section having angularly spaced fluid passing apertures and intermediate shutter surfaces, an axially adjacent second section rotatable with and relative to said first section and carrying shutter means adapted to vary the effective fluid passing area of said apertures upon relative rotation between the sections, angularly disposed fluid displacement blades mounted for rotation with the sections and positioned in fluid transferring relation to said fluid passing apertures, a detent lug mounted to one of the sections for movement relative thereto between a pair of control positions, the other section having stop shoulders spaced angularly in correspondence with the angular extents of said apertures and

shutter surfaces and relatively offset for engagement with the lug in said two positions respectively to interconnect the sections for rotation together in different relative angular positions, and means for controlling the movement of the lug between said control positions to thereby control the relative angular positions of said sections and the fluid displacement therethrough.

6. A rotor device comprising a rotatable first section having fluid passing apertures, an axially adjacent second section rotatable with and relative to said first section and carrying shutter means adapted to vary the effective fluid passing area of said apertures upon relative rotation between the sections, angularly disposed fluid displacement blades mounted for rotation with the sections and positioned in fluid transferring relation to said fluid passing apertures, holding mechanism operable to interconnect said sections for rotation together in different relative angular positions, said mechanism including means mounted to one of the sections for rotation therewith and for movement relative to both sections transversely of their axis of rotation and operable to control the relative positioning of said sections in accordance with said transverse movement, and means for controlling said transverse movement of the element to thereby control the relative angular positions of said sections and the fluid displacement therethrough.

7. A rotor device comprising a rotatable first section having fluid passing apertures, an axially adjacent second section rotatable with and relative to said first section and carrying shutter means adapted to vary the effective fluid passing area of said apertures upon relative rotation between the sections, angularly disposed fluid displacement blades mounted for rotation with the sections and positioned in fluid transferring relation to said fluid passing apertures, holding mechanism operable to interlock said sections for rotation together in different relative angular positions, said mechanism including a positioning element mounted to one of the sections for rotation therewith and about the axis of rotation of said one section and for radial movement relative thereto and operable to engage the other section and control the relative positioning of the sections in accordance with said radial movement, and means for controlling said radial movement of the element to thereby control the relative angular positions of said sections and the fluid displacement therethrough.

8. A rotor device comprising a rotatable first section having fluid passing apertures, an axially adjacent second section rotatable with and relative to said first section and carrying shutter means adapted to vary the effective fluid passing area of said apertures upon relative rotation between the sections, angularly disposed fluid displacement blades mounted for rotation with the sections and positioned in fluid transferring relation to said fluid passing apertures, a detent pin mounted to one of the sections for radial movement relative thereto, the other section containing an essentially annular recess within which said pin is movably received comprising a series of interconnecting arcuate portions extending alternately at two different radial distances from the axis of rotation of the sections, whereby radial movement of the pin between positions at said two radial distances respectively from the axis of rotation permits relative rotation of the two sections an angular distance corresponding to the length of one of said arcuate

portions of the recess, the walls of said recess containing locking notches at the ends of said arcuate portions within which the pin is receivable to positively rotatively interlock the sections after their relative movement between a pair of relative angular positions, and means for controlling the radial movement of said pin to thereby control the relative angular positions of said sections and the fluid displacement therethrough.

9. A rotor device comprising a rotatable first section having fluid passing apertures, an axially adjacent second section rotatable with and relative to said first section and carrying shutter means adapted to vary the effective fluid passing area of said apertures upon relative rotation between the sections, angularly disposed fluid displacement blades mounted for rotation with the sections and positioned in fluid transferring relation to said fluid passing apertures, holding mechanism operable to interconnect said sections for rotation together in different relative angular positions, said holding mechanism including a movable positioning element carried by one of the sections for rotation therewith about the axis of rotation of the sections and for swinging movement relative thereto about an axis radially offset from the axis of rotation of the sections and operable to control the relative positioning of the sections in accordance with said swinging movement, and means for controlling said swinging movement of the positioning element to thereby control the relative angular positions of the sections and the fluid displacement therethrough.

10. A rotor device comprising a rotatable first section having fluid passing apertures, an axially adjacent second section rotatable with and relative to said first section and carrying shutter means adapted to vary the effective fluid passing area of said apertures upon relative rotation between the sections, angularly disposed fluid displacement blades mounted for rotation with the sections and positioned in fluid transferring relation to said fluid passing apertures, holding mechanism operable to interconnect said sections for rotation together in different relative angular positions, said holding mechanism including a wheel mounted to one of the sections for rotation therewith about the axis of rotation of the sections and for rotation about a second axis offset from said axis of rotation of the sections, a detent pin eccentrically carried by the wheel and engageable with the other of said sections to control the relative positioning of the sections in accordance with rotation of the wheel about said second axis, and means for rotating the wheel about said second axis to move the pin and thereby control the relative angular positions of the sections and the fluid displacement therethrough.

11. A rotor device comprising a rotatable first section having fluid passing apertures, an axially adjacent second section rotatable with and relative to said first section and carrying shutter means adapted to vary the effective fluid passing area of said apertures upon relative rotation between the sections, angularly disposed fluid displacement blades mounted for rotation with the sections and positioned in fluid transferring relation to said fluid passing apertures, holding mechanism operable to interconnect said sections for rotation together in different relative angular positions, said holding mechanism including a wheel mounted to one of the sections for rotation about an axis offset from the axis of rotation of the sections, a detent pin eccentrically carried by the wheel and engageable with the other of said sections, a second wheel rotatably mounted to said one section at a location angularly adjacent said first wheel and connected in driving relation thereto, and means for rotating said second wheel to drive the first wheel and move the pin to thereby vary the relative angular positions of the sections and the fluid displacement therethrough.

12. A rotor device comprising a rotatable first section having fluid passing apertures, an axially adjacent second section rotatable with and relative to said first section and carrying shutter means adapted to vary the effective fluid passing area of said apertures upon relative rotation between the sections, angularly disposed fluid displacement blades mounted for rotation with the sections and positioned in fluid transferring relation to said fluid passing apertures, holding mechanism operable to interconnect said sections for rotation together in different relative angular positions, said holding mechanism including a first gear wheel mounted to one of the sections for rotation about an axis offset from the axis of rotation of the sections, a detent pin eccentrically carried by said wheel and engageable with the other of said sections, a second gear wheel mounted to said one section at a location angularly adjacent said first wheel and connected in driving relation thereto, and a rotary solenoid carried by said one section and operable to rotate said second gear wheel and through it the first gear wheel to move the pin and thereby control the relative angular positions of the sections and the fluid displacement therethrough.

13. A rotor device comprising a rotatable first section having fluid passing apertures, an axially adjacent second section rotatable with and relative to said first section and carrying shutter means adapted to vary the effective fluid passing area of said apertures upon relative rotation between the sections, angularly disposed fluid displacement blades mounted for rotation with the sections and positioned in fluid transferring relation to said fluid passing apertures, holding mechanism operable to interconnect said sections for rotation together in different relative angular positions, said holding mechanism including a detent element movably mounted to one of the sections and engageable with the other section, and a rotary solenoid operable to shift said element between a pair of control positions to thereby control the relative angular positions of the sections and the fluid displacement therethrough.

14. A rotor device comprising a rotatable first section having fluid passing apertures, an axially adjacent second section rotatable with and relative to said first section and carrying shutter means adapted to vary the effective fluid passing area of said apertures upon relative rotation between the sections, angularly disposed fluid displacement blades mounted for rotation with the sections and positioned in fluid transferring relation to said fluid passing apertures, holding mechanism operable to interconnect said sections for rotation together in different relative angular positions, said holding mechanism including a disk mounted to one of the sections for rotation about an axis radially offset from the axis of rotation of the sections, a detent pin eccentrically carried by said disk for movement radially of the sections between a pair of control positions upon rotation of the disk, the other section having an essentially annular recess within which the pin is movably received and comprising a

series of interconnecting arcuate portions extending alternately at two different radial distances from the axis of rotation of the sections, whereby radial movement of the pin between positions at said two radial distances respectively from the axis of rotation of the sections permits relative rotation of the sections an angular distance corresponding to the length of one of said arcuate portions of the recess, the walls of said recess containing locking notches at the ends of said arcuate portions within which the pin is receivable to positively rotatively interlock the sections after their relative movement between a pair of relative angular positions, and a rotary solenoid carried by said one section and operable to rotate said disk and thereby move the pin radially to control the relative angular positions of the sections and the fluid displacement therethrough.

15. A rotor device comprising a rotatable first section having fluid passing apertures, an axially adjacent second section rotatable with and relative to said first section and carrying shutter means adapted to vary the effective fluid passing area of said apertures upon relative rotation between the sections, angularly disposed fluid displacement blades mounted for rotation with the sections and positioned in fluid transferring relation to said fluid passing apertures, holding mechanism operable to interconnect said sections for rotation together in different relative angular positions, means operable to control said holding mechanism to control the relative angular positions of the sections and the fluid displacement therethrough, and a plurality of bearings rotatable about axes different from the axis of rotation of the sections and engaging and spacing apart said sections at locations spaced about said axis of the sections.

16. A rotor device comprising a rotatable first section having fluid passing apertures, an axially adjacent second section rotatable with and relative to said first section and carrying shutter means adapted to vary the effective fluid passing area of said apertures upon relative rotation between the sections, angularly disposed fluid displacement blades mounted for rotation with the sections and positioned in fluid transferring relation to said fluid passing apertures, holding mechanism operable to interconnect said sections for rotation together in different relative angular positions, means operable to control said holding mechanism to control the relative angular positions of the sections and the fluid displacement therethrough, a plurality of rotatable rollers carried by one of said sections at locations spaced thereabout and engaging the other section to maintain the sections in predetermined spaced relation, and a plurality of U-shaped members for rotatively mounting said rollers each receivable within a recess in said one section and deformable into retaining relation with the associated roller upon insertion into said recess.

17. A rotor device comprising a rotatable first section having fluid passing apertures, an axially adjacent second section rotatable with and relative to said first section and carrying shutter means adapted to vary the effective fluid passing area of said apertures upon relative rotation between the sections, angularly disposed fluid displacement blades mounted for rotation with the sections and positioned in fluid transferring relation to said fluid passing apertures, one of said sections having a separately formed removable central portion, holding mechanism carried by said removable central portion of said one section and engageable with the other section to interconnect said sections for rotation together in different relative angular positions, and control mechanism operable to actuate said holding mechanism to change the relative positions of said sections while the sections are rotating, said holding mechanism including means carried by said removable central portion of said one section for rotation with the sections and movable relative to both of the sections.

18. A rotor device comprising a rotatable first section having fluid passing apertures, an axially adjacent second section rotatable with and relative to said first section and carrying shutter means adapted to vary the effective fluid passing area of said apertures upon relative rotation between the sections, angularly disposed fluid displacement blades mounted for rotation with the sections and positioned in fluid transferring relation to said fluid passing apertures, an annular member of rubber-like material mounted to one of said sections for rotation therewith and having an irregular but essentially annular detent recess facing the other section, a detent element movably carried by the other section for rotation therewith and for movement relative thereto and extending into said recess to cooperate therewith in interconnecting said sections selectively in different relative angular positions, said annular member forming shoulders engageable by said detent element in different positions thereof to maintain the sections in said different relative positions, and means for controlling the movement of said detent element relative to said other section to thereby control the relative angular positions of said sections and the fluid displacement therethrough.

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