

[54] **ROTARY COMPRESSOR**

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430,365 6/1935 Great Britain 418/265

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418/253, 418/257

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[58] Field of Search 418/61, 260, 265,
418/106, 137, 91, 94, 241, 253, 257, 261,
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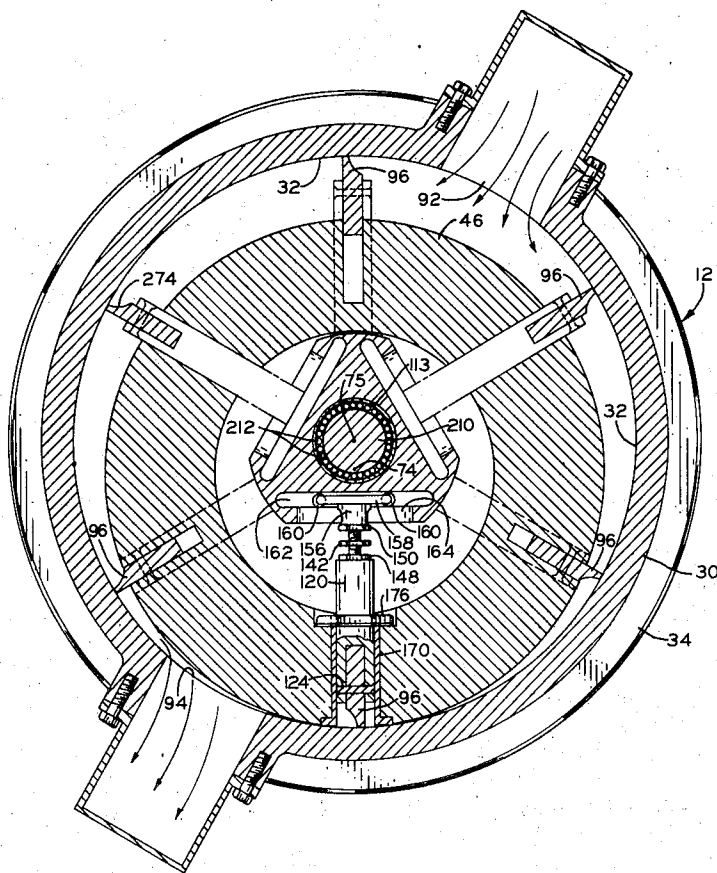
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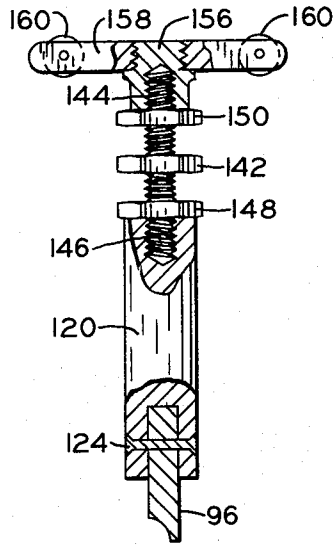
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ABSTRACT

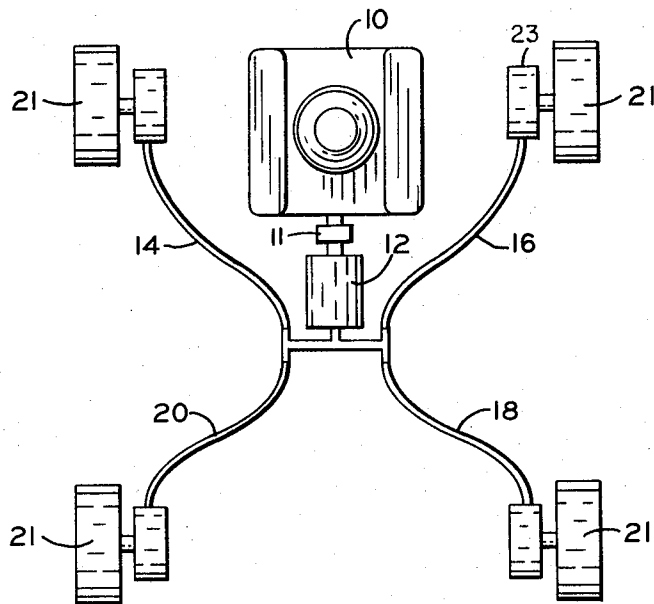
A cylindrical casing has a rotor mounted for rotation within the casing on an axis which is radially offset from the axis of the casing and the rotor drives a number of angularly spaced blades which have their center of rotation defined by the central axis of the casing. The mounting for the blades includes radial adjustment clearance from the confronting surface of the casing and the mounted radially inner portions of the blades are adapted to move chordally relatively to their mounting means as the blades rotate. The mounting for the blades are staggered both axially along the longitudinal axis of the casing and are also displaced angularly relative to each other. Between the mounted ends of the blades and the mounting means of the blades are roller means which facilitate an antifriction back and forth movement of the mounted ends of the blades relatively to the mounting means.

10 Claims, 10 Drawing Figures





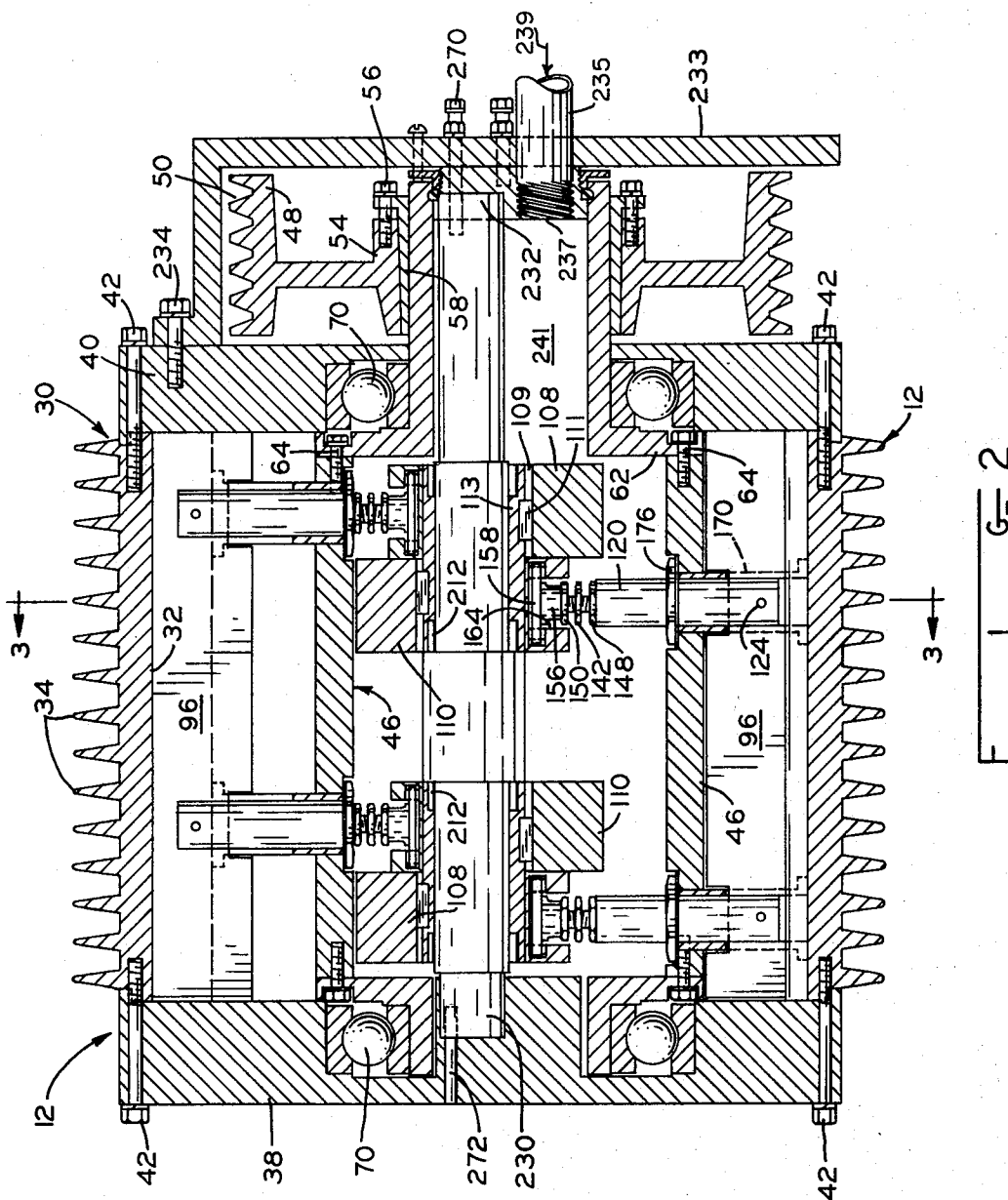
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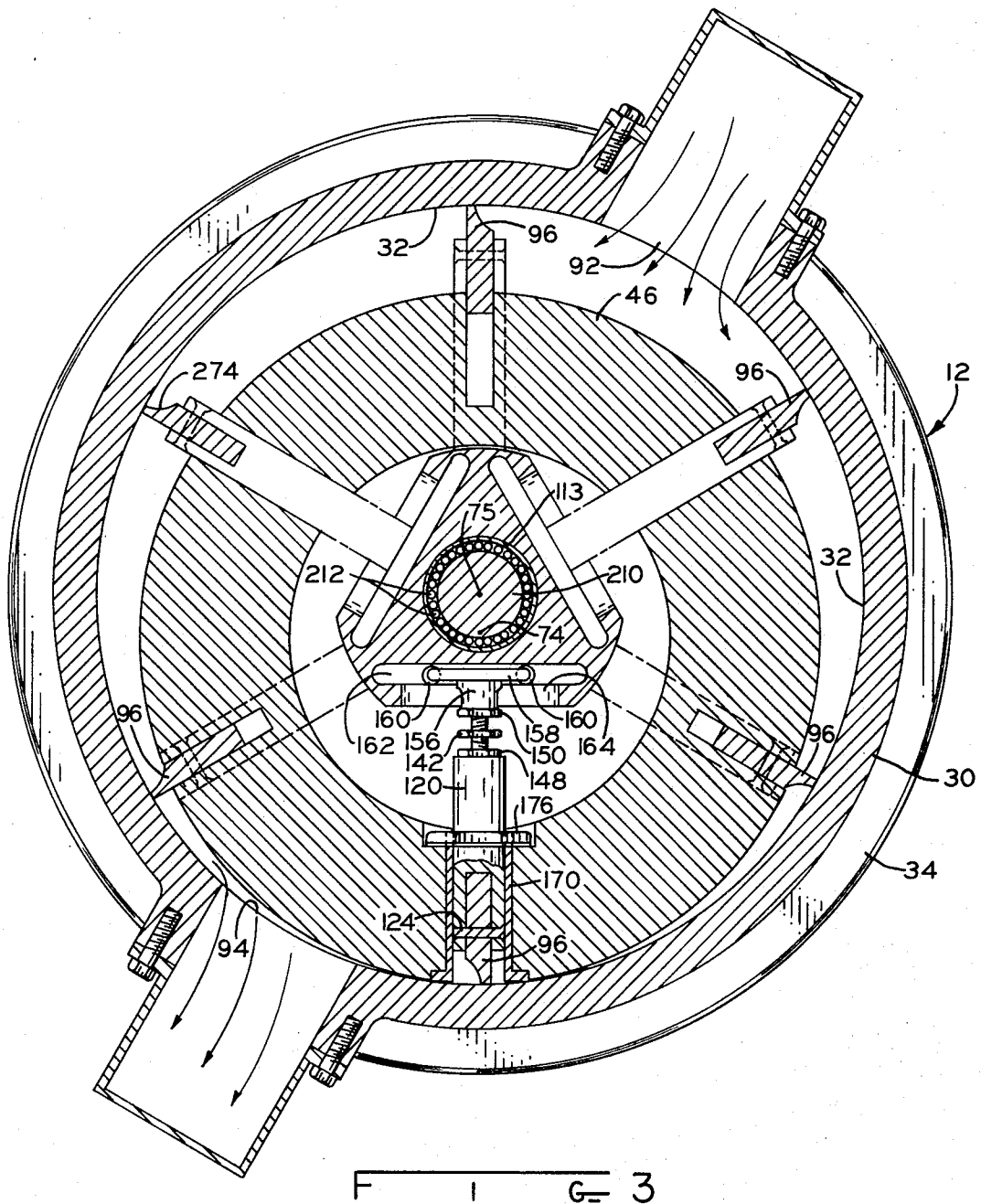
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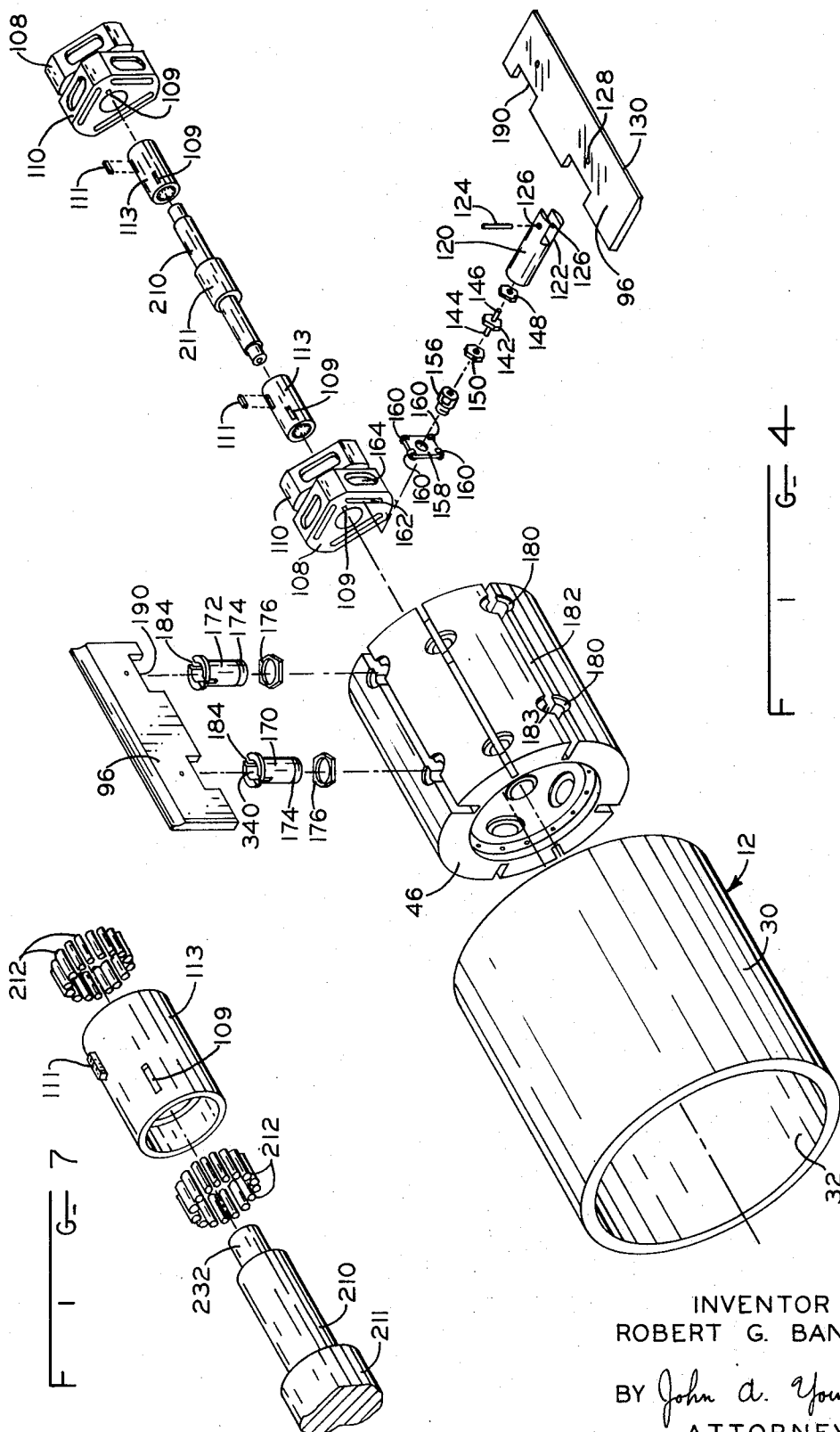


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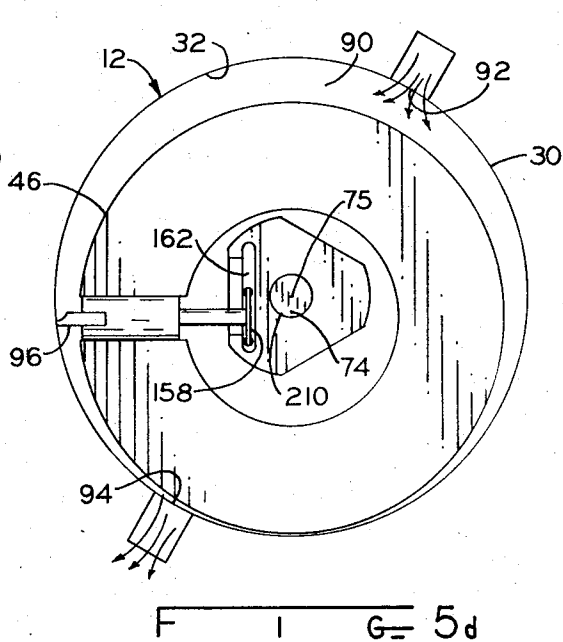
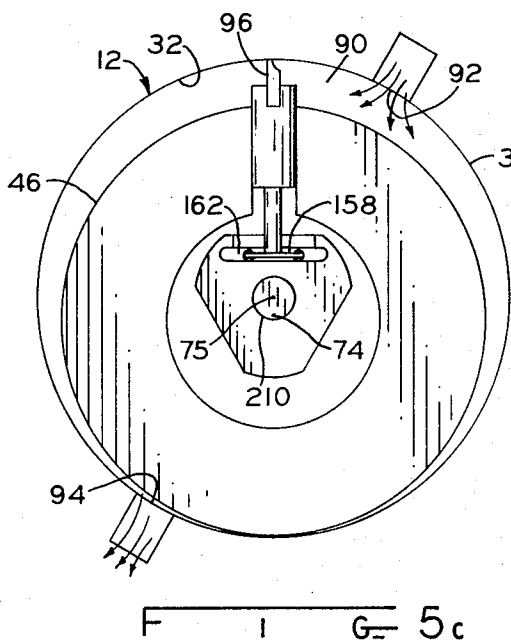
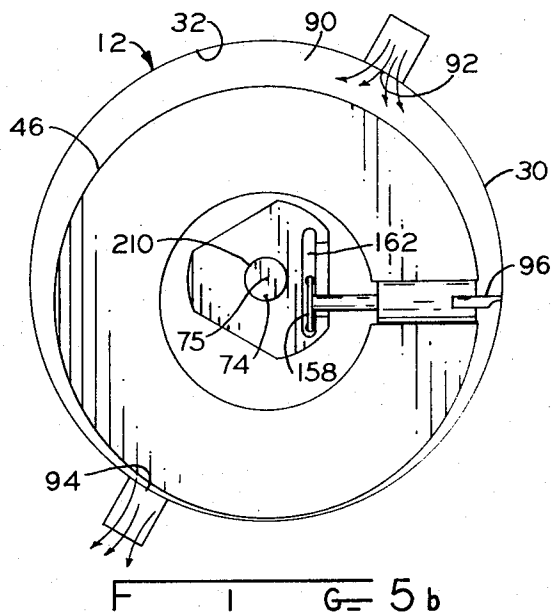
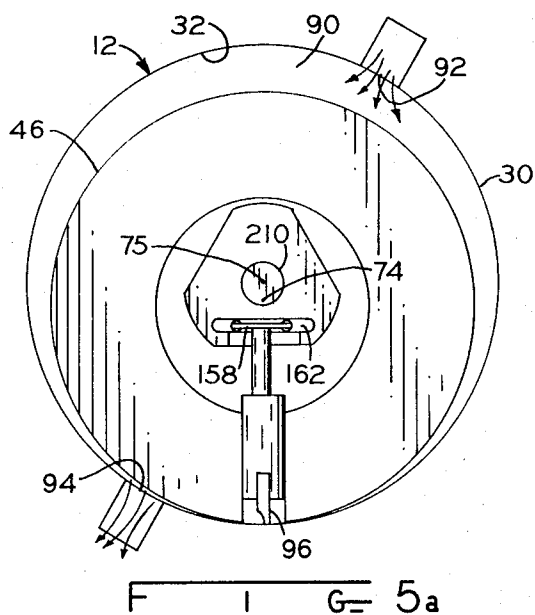
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ROTARY COMPRESSOR

BACKGROUND OF THE INVENTION

Rotary pumps having blades which are driven by a rotor have found limited use in the prior art. One of the difficulties of prior art rotary pumps is the loss of efficiency owing to inadequate sealing and poor lubricating properties of the pump.

A further drawback of rotary pumps is that they tend to be bulky in size and fail to perform efficiently with continuous operation because of wear of the pump components, leakages, frictional losses and the like. While rotary pumps have many inherent advantages, they lack in general the efficiency and reliability which is required to perform such tasks as transmissions in automotive and other vehicular applications. It has long been known that a power plant such as an internal combustion engine could be used for running a compressor but compressors of small enough size and efficiency have not been developed to be practically employed for driving by pneumatic pressure the individual wheels of a vehicle. A difficulty preventing greater efficiency of rotary pumps has been the ability to accurately locate the blades relatively to the confronting interior walls of the casing so that leakages would not develop during the compression structure. The proper location and adjustment of the blades has been a considerable source of cost and breakdown in efficiency of rotary pumps. The art has attempted to solve the problem by providing wipers on the blades which are in constant light engagement with the casing but this has not proved to be a practical solution since the wipers are wearable and the drag effect detracts from the efficiency of the pump operation. Moreover, the light engagement which is required of the wiper section of the blade in order to be light enough in contact permits substantial leakage past the wiper.

The relative state of the art then, of rotor pumps, is that they tend to be very large in size and they also tend to be inefficient and difficult to adjust.

OBJECTS OF THE INVENTION

One of the principal objects of the present invention is to provide a rotary pump which is reduced in size and of increased efficiency so that it can be used as a power transmission means with an automobile engine, and the individual wheels of the automobile, so that the engine power is used to compress air, such air being transmitted to the individual wheels for powering the wheels under pneumatic pressure.

It is a further object of the present invention to provide a novel rotary pump in which the blades are individually adjustable in a radial sense so that the outer edges of the blade are in constant slight clearance from the interior confronting surface of the casing. I can thereby eliminate the requirement of lubrication at this point.

Another object of the invention is to provide a novel mounting for the blades whereby the blades are located at their radially inner surface on a mounting member which provides chordal movement on the mounting means.

A still further object of the present invention is to provide a novel means for lubricating the relatively movable parts of a rotary pump so that such movable parts are continuously lubricated to contribute to the

efficiency of pump operation, such lubrication occurring as a normal incidence of pump operation.

Another important feature of the present invention is to provide a novel bearing arrangement at the radially inner portion of the blade mounting which permits the blade to move chordally relatively to its mounting structure such mounting structure being rotatable with the blade.

A further feature of the present invention is the locating means by which the blade and rotor have relative radial movement as the blades and rotor revolve about their respective axes of rotations.

Other objects and features of the present invention will be apparent from a consideration of the following description which proceeds with reference, to the accompanying drawings.

DRAWINGS

FIG. 1 is a schematic view of a rotary pump which is used as a transmission between automobile engines and the respective wheels of a vehicle;

FIG. 2 is an axial sectional view of a rotary pump;

FIG. 3 is a sectional view taken on line 3—3 of FIG. 2;

FIG. 4 is an isometric exploded view of the rotary pump components;

FIGS. 5A-5B, 5C and 5D are progressive schematic views of the rotor, casing and blade showing the blade going through its intake and compressing stroke progressing by 90° increments through a full revolution of the rotor;

FIG. 6 is an enlarged detail view of the mounting means for the blade; and

FIG. 7 is an enlarged detail view of the mounting of the shaft for the rotor.

SPECIFIC WORKING EMBODIMENTS OF THE INVENTION

Referring now to the drawings an internal combustion engine 10 drives a rotary pump 12 through variable speed drive 11 to generate a supply of compressed air which is transferred through lines 14, 16, 18 and 20 to turbine wheels 23 located at respective wheels 21 of an automobile or other vehicle.

Although the present invention has any desired application where a lightweight, small-size and efficient compressor is concerned, it was developed principally for use in automobiles. Between the engine and the compressor I can also introduce a variable speed drive such as hydraulic or hydromatic transmission which enables the user to control by variable speed in driving automobiles. It should be understood, however, that this is only one application of the present invention and the following description of application to automotive application is by way of illustration and not limitation.

The rotary pump consists of a casing 30 having a jacketed cylindrical internal surface 32 and a number of cooling vanes 34 which extend outwardly from the cylindrical surface 32. The casing has end walls 38 and 40 which are secured by bolts 42 or the like to the end walls 38 and 40. Within the casing 30 is a rotor 46 which is driven by a drive wheel 48 connected by variable speed 50 to the automobile engine. Drive 48 is fastened through hub 54 and bolts 36 to a sleeve 58 and the sleeve in turn is connected to rotor 46 through axle flange 62 which is directly connected to the rotor 46 through bolts 64. The rotor is mounted at its opposite

ends on ball bearings 70, 70 which are received in end walls 38 and 40 to permit rotation of the rotor.

Referring to FIGS. 5A-5D the rotor 46 is located on an axis of rotation designated generally by reference numeral 74, such axis being located offset from the geometric axis 75 of casing wall 32 so that between the rotor 46 and interior surface 32 is a lunular space 90 having an inlet 92 and an outlet 94. The overall function of the rotary pump is to induct air from inlet 92, compress it and then discharge such compressed air through the outlet 94. The induction and compression are obtained by means of a series of angularly spaced blades 96, a total of six such blades being shown in the present invention spaced at 60° intervals around the circumference of the rotor. Rotor blades do not turn on the same axis of rotation 74 as the rotor 46. Instead the blades 46 rotate on the geometric center line 75 of the casing 32, this axis being represented by reference numeral 75 (See FIGS. 2, 5A-5D). As a result of the differential mounting of blades and rotor, the blades are successively, (starting in FIG. 5A to 5B) moved to first create a vacuum in the lunular space rotating from 12:00 to 3:00 position; the so created vacuum will produce an induction of air in moving from the 3:00 to 12:00 position and the air will then be compressed and discharged in moving from the 12:00 to 9:00 position (FIGS. 5C-5D).

The present invention is vitally concerned with the positioning and adjusting of the blades 96 and maintaining lubricated the relative sliding surfaces of movable components of the rotor, blade and mounting structure for the blade.

The six blades 96 are mounted three on each of two sets of axially spaced angularly offset mounting blocks or members 108 and 110, (FIG. 4). The individual blades of each set of blades are displaced at 120° intervals and are carried on block sets 108 and the other set of three blades also positioned 120° apart are mounted on blocks 110. The relationship of the two interleaved sets of three blades is that adjacent blades are 60° apart from each other. What connects the blade 96 (FIG. 4) to the associated mounting block is a rod 120 having a slot 122 with a pin 124 fitted through aligned openings 126, 126 of the rod 120 and an opening 128 in the blade 96. The blade is held at each of its ends and is adjusted so that it very carefully and evenly clears the confronting surface of the casing wall 32, but with a constant slight clearance therebetween; the outer blade edge is nonwearable at the tapered end 130 of the blade, and the slight clearance does not permit significant leakage across the clearance nor does it require lubrication.

An important feature of this invention is that the rod 120 is radially adjusted by means of an adjustor wheel 142 having oppositely threaded bolt sections 144, 146 and coating threaded openings in rod 120 and stud screw 156. Once adjusted the screw sections are clamped by clamping nuts 148, 150. The stud 156 has flats 159 and is locked to a keeper plate 158 in threaded opening 154. The stud has an internal threaded opening 161 to receive bolt section 144. The keeper plate 158 has small rollers 160 one at each of the corners thereof and is received within a slot 162 with the bolt section 142 extending through a track 164 of mounting blocks 108, 110. The function of the keeper plate 158 is to hold the wiper blade 96 while still permitting a chordal movement of the keeper plate 158

relatively to the mounting blocks 108, 110. This can best be seen with reference to FIG. 3 where it can be seen that the keeper plate for the blade at 60° position is midway in the track 164 and as the blade moves counterclockwise the keeper plate 158 travels back and forth in the track, leaning first against one side edge and then the opposite side edge of the slot. The pumping action is developed because of the different centers of rotation of the blades 96 and the rotor 46. The rotor 46 rotates on one axis of rotation and the blades about a different axis of rotation, the two axes being identified as axes 74 and 75, respectively.

As the rotor 46 rotates it drives the blades 96 about the axis of rotation 75 defined by the geometric center line of the casing wall 32, the blades 96 are maintained a constant slight clearance on the casing wall 32 but there will be imposed on the interior keeper block 158 the requirement of chordal movement back and forth within the slot 162 such movement being permitted by the keeper plate 158 as it effortlessly moves back and forth within the slot 162 on its corner mounted rollers 160.

There further occurs between the blades and the rotor a relative radial movement. Rods 120 reciprocate within sleeves 170, 172 having threaded ends 174 which are secured by nuts 176 and lock washers to openings 180 of the rotor. The rotor is slotted in 182 and so are the ends 184 of the sleeves 170, 172 so that the edges 190 of the blades can fit into the slots 182 and 184. It should be noted in FIG. 4 that the openings 180 are staggered around the circumference of the rotor so that the blades 96 are connected successively to sets 108 and sets 110 of the mounting blocks. In this way, mounting structure for the blades of adjacent blades are not in interfering relation to each other.

The mounting blocks 108, 110 are disposed on shaft 210 through needle bearings 212. The opposite ends of the shaft 210 are fixed on end plates 230 and 232 which in turn are secured to end plate 38 and wall member 233. Bolts 234 are used to mechanically secure the ends of the shaft which are prevented from moving. The shaft 210 is held against movement once it is properly placed by bolts 270, 272 or the like. Within wall member 233 is a conduit 235 terminating in opening 237 and providing a means whereby lubrication is supplied in the direction of the arrow 239 to the interior chamber 241 of the pump. This interior chamber 241 which receives lubricant, is separated from the air chamber (FIG. 3) including the induction and compression chambers so that none of the air inducted, compressed and discharged, is contaminated by oil. The reason for this is that the radial movement of the blades within the rotor is effectively sealed at all times as against passage of oil from the interior chamber 241 to the air compression, induction and discharge chambers (FIG. 3). For maximum efficiency the end of each blade is tapered as indicated by reference numeral 274, FIG. 3, and the taper oppositely to the direction of counterclockwise rotation of the rotor as indicated in FIG. 3.

To lubricate the mounting blocks 108 and 110 all that is required is a splashing connection with the oil within the rotor to cause a flow of lubricant to lubricate the rotating surface of the needle bearings 212 which support the locating members 108, 110 on the shaft 210. Likewise, rod 120 is lubricated in its back and forth movement within 170.

The central 211 portion of the shaft 210 is stepped and serves to separate the locating and mounting members 108, 110 by the correct amount. The spaced support give the blades by the pairs of members 108, 110 at the opposite ends of the shaft 210 give a reliable and sturdy mounting effect to the blades 96.

OPERATION

In operation, the automobile engine 10 communicates driving force, in some suitable manner, as by gearing, belts or the like to drive 48 which drives the rotor 46 about its center of rotation 74. The rotor being connected with the blades 96 cause the blades 96 to rotate about center of rotation 75 defined by the geometric center of the casing 30. As the blades rotate, they will successively induct air from 92, compress it, and expel such compressed air through the outlet 94 as the blades rotate in a counterclockwise direction starting from the position in FIG. A and proceeding to FIGS. 5B, 5C, and 5D.

The blades are adjusted at their ends by means of adjuster wheels 142 which define the position of the blade end and therefore the entirety of the blade relatively to the confronting surface 32 of the casing. The blade surface 130 is maintained a constant slight clearance from the confronting surface 32 of the casing 30 and as the blade rotates, the inner end of the blade which is held by means of keeper plate 150 will cause the keeper plate 150 to shift back and forth in a chordal sense within slot 162.

Note from FIGS. 5A-5D that rod 120 moves back and forth within sleeve 170. The sleeve is wearable and is replaced from time to time as the need arises. The back and forth chordal movement of keeper plate 158 which accompanies rotation of the wiper blade does not impede the rotation of the rotor since bearings 160 facilitate the described chordal movement. The mounting blocks 108 and 110 which rotate with the blades 96 are supported on needle bearings 212 relatively to the shaft 210 so that similarly does not impede rotation of the rotor 46. Blocks 108, 110 have keyways 109 fastening to keys 111 of sleeves 113 on shaft 210.

In addition to the chordal movement between the keeper plate 158 and the locating members 108, 110, the rod 120 which secures the blade moves radially within a sleeve 170. The blade is received at its inner edge within slot 182 of rotor 46 and slot 184 of sleeve 170 to hold the blade against movement as it revolves. There is only a slight radial loading of the blade 96 inwardly so that the needle bearings 212 do not have to be of substantial size. The needle bearings are well lubricated by oil within the rotor in the manner previously described as are pins 120 which move slidably within bearings surfaces 340 of the sleeves 170.

Periodically pins 130 may be adjusted by means of the wheels 142 but such adjustment is infrequent since there is no wear surface in the tapered edge 130 of the blade 96. Likewise, the relatively movable surface between 120 of the pin and opening 340 of sleeve 170 is slight and if wear does occur, the entire sleeve 170 is replaceable by removing the nut 176; note that the head of the sleeve is received within a recess 183 of the rotor 46.

The described construction permits a slight but effective clearance between the blade 96 and the casing wall 32 and the rotation of the blades by the rotor as the two turn on their respective axes of rotation will be freely

permitted by developing chordal movement of the keeper plate mounting structure for the blades on their locating blocks as previously described.

There is only a slight leakage across the clearance provided between the blade and the casing surface 32 since the rotor rotates at speeds in the order of 500-2,000 RPM and higher and the leakage rate is negligible and does not detract from the efficiency of the pump.

As described, the rotary pump can either serve as a transmission or for any compressor application where a lightweight relatively small size compressor is needed.

The outer wall of the casing can be jacketed (not shown) and the heat derived from compression has numerous application such as heating the interior of an automobile or the like. Also, the efficiency which is obtained from the described structure makes the compressor especially suited for power transmission where, from a prime source, there is a need for compressed air to operate pneumatic pressure actuated equipment. Obviously, such applications as marine equipment are comprehended. It is easy to dismantle this rotary compressor and it is equally easy to assemble it. An important feature is that it can run for an indefinite period without attention to wearable components which are all effectively lubricated and are relatively wear resistant as well as being noncritical when slightly worn.

The compressor because of its efficiency and unique brake construction and mounting can be reduced both in weight and size thereby opening heretofore impractical areas of usage.

Although the present invention has been illustrated and described in connection with the few selected example embodiments it will be understood that these are illustrative of the invention and are by no means restrictive thereof. It is reasonably to be expected that those skilled in this art can make numerous revisions and adaptations and it is intended that such revisions and adaptations will be included within the scope of the following claims as equivalents of the invention.

What is claimed is:

1. A pump comprising a cylindrical casing having inlet and outlet openings, a pump rotor having a geometric center disposed radially offset from the geometric center of said casing to form a crescent shaped spacing between said rotor and casing, a plurality of angularly spaced blades driven by and carried by said rotor and having a mounting means which defines the center of said casing, means for adjusting the radial dimension of each of said blades to provide both for radial movement through a companion opening in said pump rotor and without interference therewith, said adjustment providing a predetermined and relatively slight but constant clearance between the end of each blade and the confronting surface of said casing, means forming a rolling connection between each inner blade and said mounting means to provide a frictionless rolling contact between each inner blade and the coacting mounting means which retains said companion blade end and further providing chordal movement between such radially inner connected end of each blade and its coacting mounting means, and means for driving said rotor whereby said blade as it is rotated by said rotor about the geometric center of said casing produces variable volume chambers successively inducting, compressing and discharging fluid between inlet and outlet openings respectively.

2. The pump construction in accordance with claim 1 including a lubricated inner chamber formed between the interior of said pump rotor and said mounting means and sealingly separated from the chamber formed by the confronting surfaces of the outer pump rotor and the inner casing wall whereby substantially all of the lubricating material is excluded from the inducted, compressed and discharged fluid as such fluid moves between inlet and outlet openings respectively.

3. The structure in accordance with claim 1 including locating means, coaxial openings formed in said locating means, a shaft having an antifriction bearing received in said openings and disposed at the geometric axis of said casing whereby said blades are revolved about such shaft from the relative rotational movement occurring between said rotor and said casing.

4. The structure in accordance with claim 1 wherein said adjusting means between said blades and said mounting means is comprised of threaded means having an adjustable nut which is turned to regulate the radial position of each end of said blade relatively to the confronting interior surface of said casing whereby each blade is adjusted to be in close proximity to such casing surface and concentric therewith.

5. The structure in accordance with claim 1 wherein said mounting means is triangularly shaped and provides 120° spacing for three angularly spaced blades, and triangularly spaced second mounting means disposed in angular offset relation with said first mounting means for a second set of three blades.

6. The pump construction in accordance with claim 1 including bearing means for rotatably supporting the opposite ends of said rotor in opposite end walls of said casing.

7. The structure in accordance with claim 1 including a variable speed drive between a motor and said pump whereby said pump is operated at variable speed and output is determined by said motor.

8. The structure in accordance with claim 1 including fluid outlets from said pump, turbine means associated with a vehicle wheel to be powered by the fluid furnished from said pump, and power means for operating said pump.

9. The pump construction in accordance with claim 1 including means for supplying the interior of the rotor with a quantity of lubricating oil which is dispersed between said mounting means and the center of said casing, a rotor shaft, and bearing means provided between said shaft and said mounting means.

10. The pump construction in accordance with claim 9 including sleeves mounted in said rotor end and associated with each blade end, a rod slidably received through each sleeve and operatively secured to said blade end, the lubrication within said rotor being dispersable on the bearing surfaces between said rod and sleeve to permit sliding movement which occurs as the rotor and blade mounting means revolve about their respective axes of rotation.

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