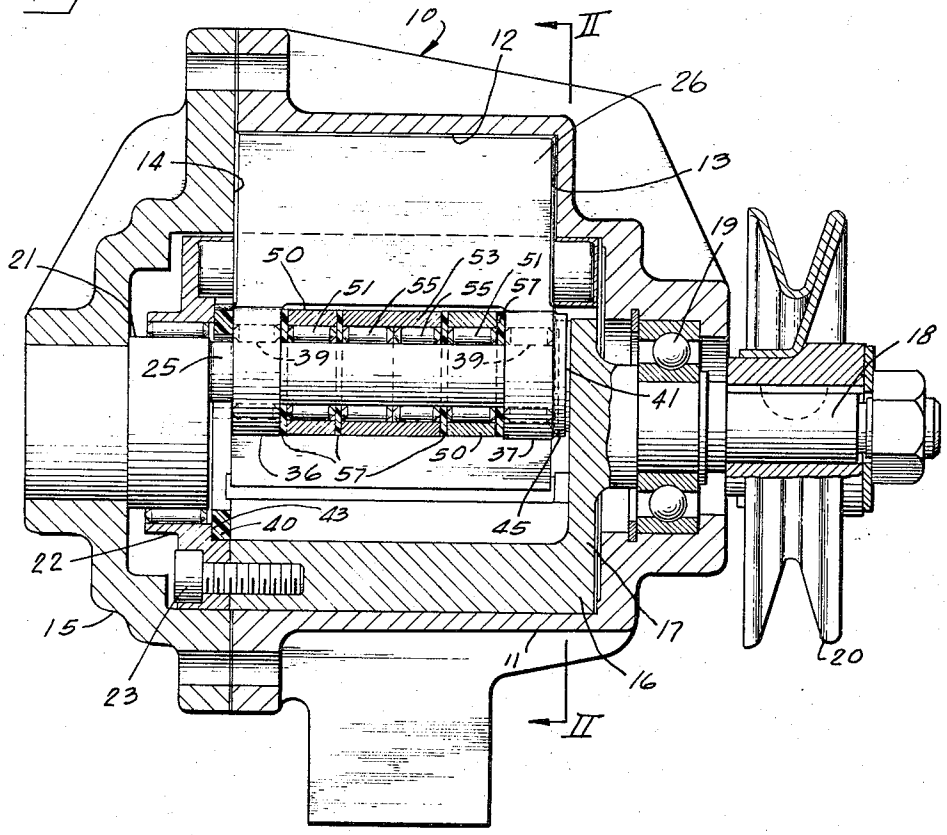
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VANE ASSEMBLY FOR ROTARY VANE COMPRESSORS

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Fig_1



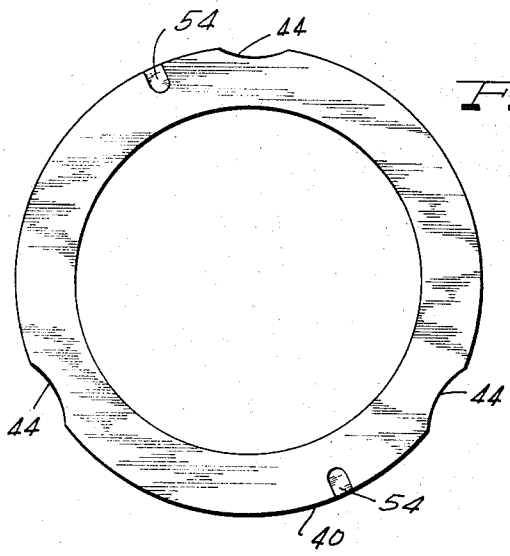




Fig_4

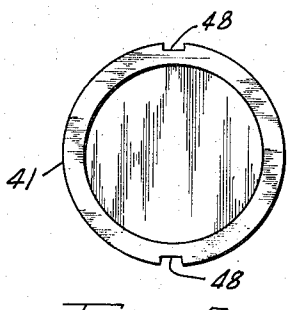



Fig_5

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VANE ASSEMBLY FOR ROTARY VANE COMPRESSORS

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Fig. 2

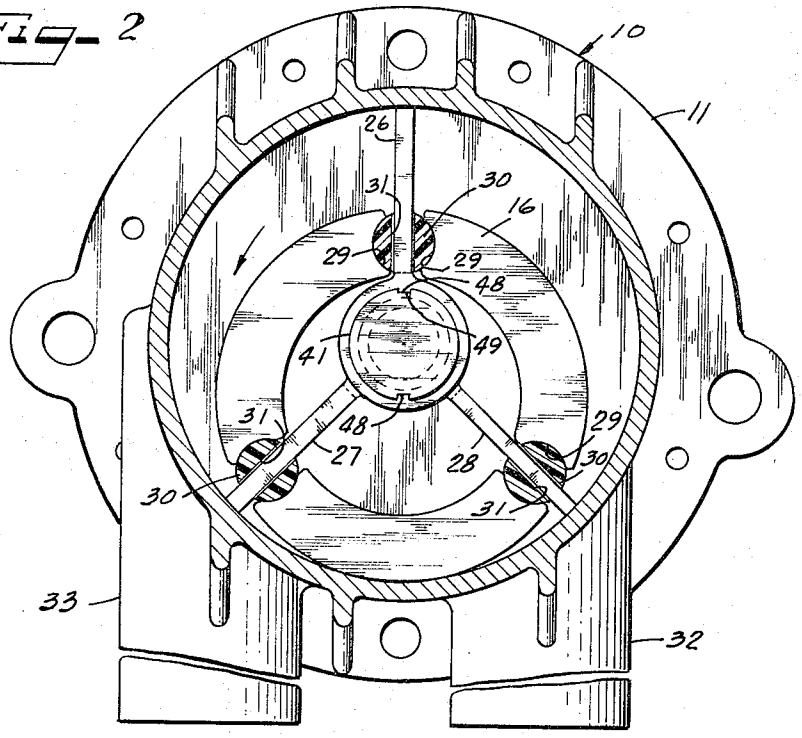
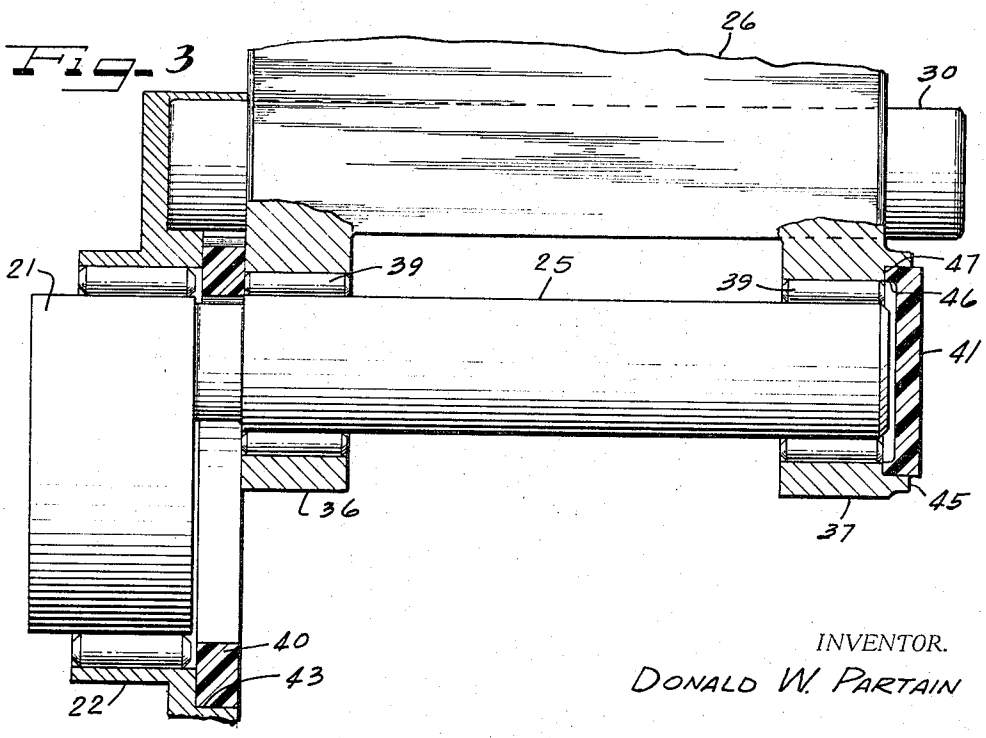



Fig. 3




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# VANE ASSEMBLY FOR ROTARY VANE COMPRESSORS

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6 Claims. (Cl. 230—157)

## ABSTRACT OF THE DISCLOSURE

Sliding vane type of pump or air compressor in which a rotor rotates about an axis eccentric of the axial center of the pump housing and sliding vanes extend from hubs journalled on anti-friction bearings mounted on a common shaft, concentric with the axial center of the housing for the compressor. In order to provide a pump in which the air has no entrained lubricant, the vanes have clearance with the wall of the pumping chamber. The hubs are arranged along the shaft in interleaving relation with respect to each other and positioner bearings in the form of washers are disposed between the interleaving hubs of the vanes. Other positioner bearings are disposed between the end hubs and opposite ends of the pumping chamber. These positioner bearings are made from materials capable of running as a bearing surface without lubrication. In order to keep lubricant leakage to a minimum, one end hub is sealed by a disc forming an end positioner bearing and the positioner bearings between the hubs take up clearance between the other hubs and seal the space between these hubs making it necessary for the lubricant to travel the entire length of the shaft if there should be any tendency for lubricant in the bearings to leak out.

### *Background of the invention*

This invention relates to improvements in compressors and more particularly relates to an improved vane assembly for compressors of the rotary vane type.

In rotary compressors or pumps of the vane type, the vanes are mounted for rotatable movement along the pumping chamber about an axis coaxial with the axis of the chamber, and are rotatably driven at a relatively high rate of speed by a rotor, rotatable about an axis eccentric of the axis of rotation of the vanes. Vane seal bearings having guide slots extending therethrough and having generally cylindrical outer surfaces provide slidable guides for the vanes in the slots of the bearings, and are pivotally mounted in the rotor for angular movement with respect thereto in accordance with angular movement of the vanes.

Since the pump is frequently used in supplying the air for smog elimination devices in the exhaust gas systems of automotive vehicles, the pump must have no entrained lubricant in its dischage air. This dry running compressor must be driven at engine speed or greater in order to yield sufficient air delivery in a suitably compact unit.

The vanes, therefore, must have clearance with the cylindrical wall of the air compressor, and in order to attain an efficient pump which will run quietly enough for automotive vehicle use and will have the necessary long life for such use, it is a prerequisite in the design of the pump that the vanes run true with a mimimum of end lash between the hubs of the vanes and rotor rotatably driving the vanes.

### *Summary and objects of the invention*

A principal object of the present invention, therefore, is to improve upon the rotary air compressors heretofore in use for supplying air for direct flame afterburners and catalytic converters for exhaust gas systems for automotive vehicles, so arranged as to more closely regulate the



end clearance between the hubs of the vanes and the rotor driving the vanes.

A further object of the invention is to provide a small and compact form of air compressor capable of operating at the high engine speeds of automotive engines, in which the vane structure is improved by so arranging the vanes as to take up end clearance between the hubs of the vanes and the rotor rotatably driving the vanes by plastic bearings forming positioners and end thrust bearings for the vanes.

A further object of the invention is to provide a simple and improved form of vane structure for rotary vane compressors, in which the positions of the vanes on the vane shaft are maintained by a plastic and bearing cap recessed in a hub of the vane, and engaging the disk of the rotor, rotatably driving the vane.

Still another object of the invention is to provide a simple and improved form of vane type air compressor capable of operating at the high engine speeds of automotive engines, in which end play of the vanes with respect to each other and with respect to the pumping chamber is taken up by plastic bearings between the hubs of the vanes and the ends of the vanes and rotor, rotatably driving the vanes.

A further object of the invention is to provide an economical and efficient vane type of air compressor arranged with a view toward dry operation of the compressor at the speed of rotation of the engine of an automotive vehicle, to provide secondary air for automotive exhaust gas catalytic or direct flame afterburners, in which clearance between the individual vanes and end walls of the rotor is taken up by self-lubricating plastic positioner bearings, reducing end play between the vanes and the rotor to the minimum requirements for free efficient and long life operation of the rotor.

These and other objects of the invention will appear from time to time as the following specification proceeds and with reference to the accompanying drawings wherein:

FIGURE 1 is a fragmentary longitudinal sectional view taken through a rotary air compressor constructed in accordance with the principles of the present invention;

FIGURE 2 is a fragmentary vertical sectional view of the compressor, taken substantially along line II—II of FIGURE 1;

FIGURE 3 is an enlarged partial fragmentary sectional view of a portion of the compressor, with certain of the vanes removed in order to illustrate the means for taking up end clearance of the outer hubs of one of the vanes.

FIGURE 4 is an end view of a vane positioning bearing for maintaining one end of the vane in position; and

FIGURE 5 is an end view of the opposite vane positioning bearing.

In the embodiment of the invention illustrated in FIGURES 1 and 2 of the drawings, I have shown a rotary vane air compressor **10** including a pump housing **11** having an interior cylindrical wall **12**. The interior cylindrical wall **12** extends between an integrally formed end wall **13** of the pump housing and an opposite end wall **14**, formed by the inner end face of a removable end cap **15**. Within the cylindrical wall **12** is an annular rotor **16**, mounted for rotation about an axis eccentric of the axis about which the cylindrical wall **12** is struck. The rotor **16** has an end disk **17** recessed within the end wall **13**, and has an integrally formed shaft **18** extending outwardly through the wall **13** and journalled in the end wall of the compressor housing on an antifriction bearing **19**. The shaft **18** is shown as having a pulley **20** on its outer end, which may be driven from the in-

ternal combustion engine of an automotive vehicle in a conventional manner.

Mounted in the end cap 15 of the pump housing is a stationary shaft 21 extending inwardly of said housing concentric with the axis of rotation of the shaft 18 and forming a bearing mounting for an end cap 22, for the opposite end of the rotor from the disk 17. The end cap 22 may be secured to the rotor as by machine screws 23 or any other suitable securing means.

The stationary shaft 21 is shown as having an integrally formed shaft 25 extending therefrom across the pump housing eccentric of the axis of rotation of the shaft 18 and rotor 16 and concentric with the axis about which the cylindrical wall 12 is struck. The stationary shaft 25 forms a pivotal mounting for three circumferentially spaced vanes 26, 27 and 28 rotatably mounted on the shaft 25 in a manner which will hereinafter be more clearly described as this specification proceeds. The rotor 16 is shown in FIGURE 2 as having sets of three equally spaced facing generally semi-cylindrical arcuate recesses 29 therein. The recesses 29 may be formed by drilling to form bores open to opposite sides of the rotor to contain vane seal bearings 30. One end of each bearing 30 is rotatably journalled in the end plate 17 of the rotor 16 and the other end of each bearing is journalled in the end cap 22. The cylindrical vane seal bearings 30 have slots 31 extending diametrically therethrough forming guide slots for the respective vanes 26, 27 and 28 and effecting rotatable movement of said vanes about the wall 12 of the pumping chamber upon rotation of the rotor 16. The vane seal bearings 30 not only serve to seal and form guides for the vanes 26, 27 and 28, but also seal the pumping chamber extending between the exterior of the rotor 16 and the internal cylindrical wall 12, between an arcuate intake port 32 and an exhaust port 33.

The intake port 32 is shown in FIGURE 2 as being angularly spaced from the region of the lap of the rotor 16 with the cylindrical wall 12 of the pumping chamber. The outlet port 33 leads from the pumping chamber on the incoming side of the region of lap of the rotor 16 with the cylindrical wall of the pumping chamber. The rotor 16 thus acts as a seal in the lap space between the intake and outlet ports, in a conventional manner.

Referring now in particular to the vane structure of the invention and the vane positioning bearings taking up end clearance between the vanes, in FIGURES 1 and 3 the vane 26 is shown as being mounted on the shaft 25 on widely spaced hubs 36 and 37, rotatably journalled on the shaft 25 on needle bearings 39. The hubs 36 and 37 form widely spaced generally radially inward continuations of opposite ends of the vane 26.

The vane 26 is maintained in position on the shaft 25 with a minimum of end clearance by spaced positioning bearings 40 and 41 forming end bearings for the hubs 36 and 37 respectively. The positioning bearings may be made from a plastic material having both lubricating and bearing qualities, a suitable material being a commercial form of Teflon. Another material may be a commercial form of nylon plastic bearing material.

The positioning bearing 40 is shown as being in the form of an annulus fitting within an inwardly opening annular shouldered recess 43 formed in the inner face of the end cap 22. The bearing 40 is shown in FIGURE 4 as having three equally spaced arcuate notches 44 formed therein registering with the vane bearing seals 30. These arcuate notches and bearing seals, together with recesses 54, 54 engaged by locking lugs (not shown), retain the positioning bearing 40 from rotation with respect to the rotor.

The positioning bearing 41 is in the form of an end cap fitting within an annular flange 45, extending axially outwardly of the hub 37 and inwardly of the peripheral margin of said hub. The end cap 41 has an inwardly extending flanged portion 46 engaging a shoulder 47 of the hub 37 formed by the axial flange 45. The end cap 41 also has a pair of diametrically spaced positioning notches 48, 48 formed therein, registering with diametral lugs 49, 49 extending inwardly of the flange 47, to retain the end cap 41 from rotation.

The vane 27 also has a pair of laterally spaced diametral hubs 50, 50 extending therefrom journalled on the shaft 25 on needle bearings 51, 51. The vane 28 has a hub 53 extending radially inwardly therefrom and mounted on the shaft 25 between the hubs 50, 50 and journalled on the shaft 25 on needle bearings 55. Between the insides of the hubs 36 and 37 and the respective hubs 50, 50 and between the insides of the hubs 50, 50 and the hub 53 is a series of take-up bearings 57, which may be in the form of washers made from the same material as the positioning bearings 40 and 41, to take up end clearance between the hubs and to thereby provide a controlled end clearance between the hubs 36 and 37 and the rotor 16, and also between the hubs 36 and 37 and the adjacent hubs 50, 50 as well as between the hubs 50, 50 and the hub 53 to reduce the end lash of the vanes to minimum requirements requisite for economical, efficient and high speed operation of the compressor.

It should here be noted that since the end hub 37 is sealed by the disk or positioning bearing 41 and the balance of end clearance is taken up by the washers 57, leakage of lubricant from the needle bearings is maintained to a minimum. If lubricant is to leak it must travel the entire length of the shaft to the positioning bearing 40. Since the washers 57 provide many restrictions retaining lubricant to the bearings, the bulk of lubricant is maintained in the bearings.

A vane assembly has thus been provided in which the end clearance between the vanes and between the rotor may be maintained in a minimum, to reduce all end play and lash or side weaving of the vanes with respect to each other, and with respect to the rotor. Since the rotor is located with respect to the housing by bearing 19, the required minimum end clearances between the vanes and the housing and the vanes and end cap are established for optimum compressor performance.

While I have herein shown and described one form in which the invention may be embodied, it may be understood that various variations and modifications in the invention may be attained without departing from the spirit and scope of the novel concepts thereof.

I claim as my invention:

1. In a rotary air compressor,
a housing having an interior cylindrical wall,
a rotor journalled for rotation in said housing about an axis eccentric of the axis of said wall,
a stationary shaft concentric with the axis of said wall and extending within said rotor,
bearing seals pivotally mounted in said rotor and having flat guiding faces,
a plurality of vanes journalled on said shaft and extending radially therefrom through said bearing seals toward said interior cylindrical wall,
said vanes having hubs interleaving each other on said shaft,
individual anti-friction bearings mounting said hubs on said shaft,
positioning bearings cooperating with the outer end hubs, for maintaining said vanes in position on said shaft and governing clearance between said vanes and said rotor,
one of said positioner bearings sealing one end hub and held from rotation with respect thereto,
another of said positioner bearings being mounted in an end wall of said rotor and engaging an opposite end hub, and held from rotation with respect to said rotor, and
other positioner bearings disposed between said hubs and taking up clearance therebetween and cooperat-

ing with said positioner bearing sealing one end hub, to maintain lubricant leakage to a minimum, and

all of said positioner bearings being made of a material capable of running as bearing surfaces without lubrication.

2. A rotary air compressor in accordance with claim 1 wherein the positioner bearing mounted in an end wall of said rotor is an annular bearing extending about said shaft and wherein the positioner bearing sealing the end of the hub opposite said annular bearing is a bearing cap recessed in said end hub and having bearing engagement with the associated end wall of said rotor, and preventing the leakage of lubrication into said rotor.

3. A rotary air compressor in accordance with claim 1 wherein one vane has a pair of parallel spaced hubs at opposite lateral ends thereof and the other vanes have interleaving hubs disposed inwardly of the hubs of said one vane, wherein one of the first mentioned positioner bearings is in the form of an annular bearing recessed in an end wall of said rotor and engaging an end hub of said one vane, wherein the opposite positioning bearing is an end cap recessed in an opposite end hub of said one rotor and having bearing engagement with an end wall of said rotor, and sealing said hub from the leakage of lubricant into said pumping chamber, and wherein the bearings are all made from a plastic bearing material.

4. A rotary vane air compressor comprising:

a housing having a hollow interior portion having spaced parallel end walls and an inner peripheral cylindrical wall between said end walls,

a rotor journalled in said end walls and including,

a first shaft,

an anti-friction bearing journalling said shaft in one end wall of said housing and locating said rotor with respect to the end walls of said housing, the axis of said shaft being eccentric of the axis about which said cylindrical wall is struck,

a disc on the inner end of said shaft recessed within said one end wall and rotatable with respect thereto,

at least three segments extending axially of said disc from one end wall toward the other and having arcuate facing recessed portions having vane seal bearings rotatably mounted therein,

a cap for the end of said rotor opposite from said disc,

means securing said cap to said segments and means journalling said cap in an associated end wall,

a second shaft rigidly mounted in an end wall of said housing concentric of the axis about which said cylindrical wall is struck, and extending within said housing and end cap between said end walls,



at least three vanes rotatably mounted on said second shaft and extending radially of the axial center of said second shaft through said vane seal bearings and terminating in radial spaced relation with respect to said internal cylindrical wall,

one vane having a pair of parallel spaced hubs at opposite lateral ends thereof and the other vanes having interleaving hubs disposed inwardly of the hubs of said one vane,

radial bearings journalling said hubs on said second shaft,

axial positioner bearings between said hubs taking up clearance between said hubs and sealing the spaces therebetween,

a positioner bearing sealing one end hub of said one vane and having bearing engagement with an end wall of said rotor,

a second positioner bearing recessed in said rotor and engaging the opposite end hub of said one vane and forming an end bearing therefor,

said positioner bearings being made from a material capable of running as bearing surfaces without lubrication and maintaining a closed lubricant leakage path extending along said shaft from said one end hub having bearing engagement with one end wall of said rotor, to the other end hub of said one vane.

5. An air compressor in accordance with claim 4 wherein the bearing sealing said one end hub and having bearing engagement with said rotor is a plastic bearing cap mounted in said one end hub of said vane, wherein means are provided for holding said bearing cap from rotation relative to said hub, wherein the bearing recessed in an end wall of said rotor and having bearing engagement with the opposite end hub of said one vane is an annular plastic bearing, and wherein means are provided for holding said annular plastic bearing from rotation with respect to said rotor.

6. An air compressor in accordance with claim 5 wherein the axial bearings between said hubs are in the form of washers made from a thin plastic bearing material.


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