July 6, 1965 W. J. CARTER, JR 3,193,192

INTERNALLY COOLED GAS PUMP

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Fig. 1.

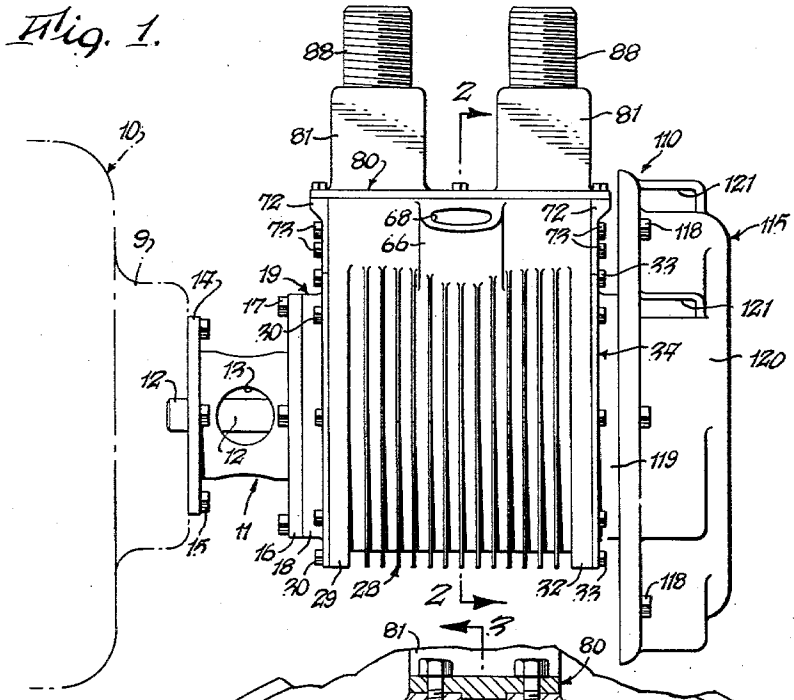

Fig. 2.

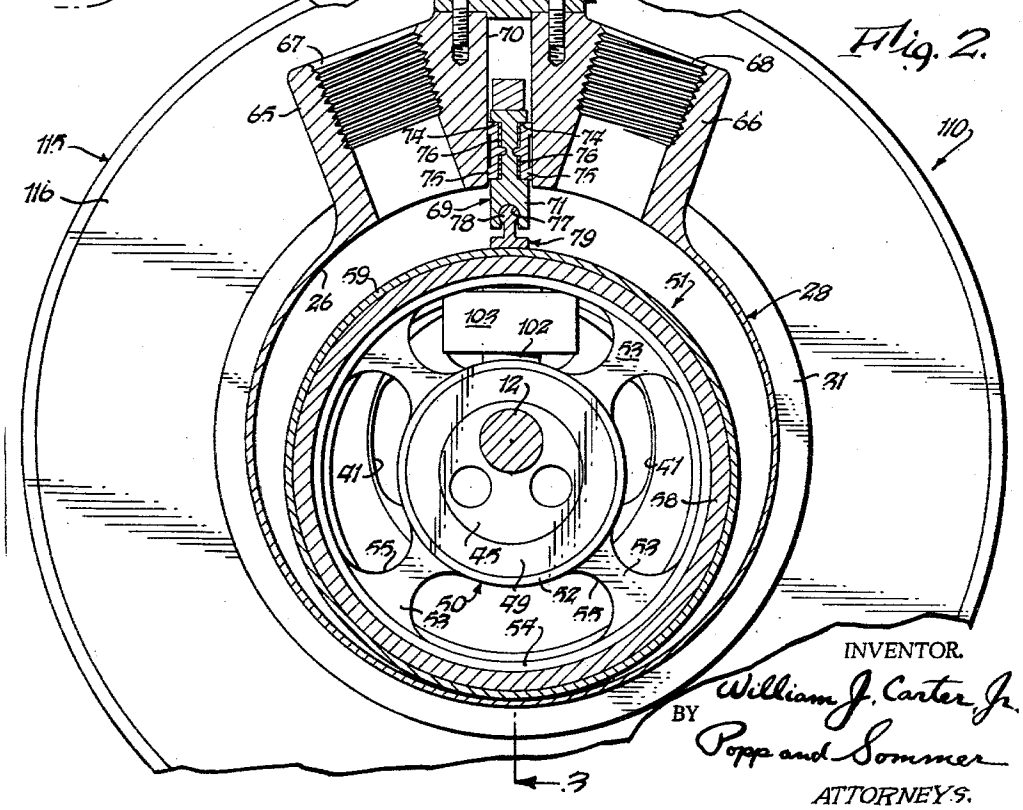

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Fig. 3

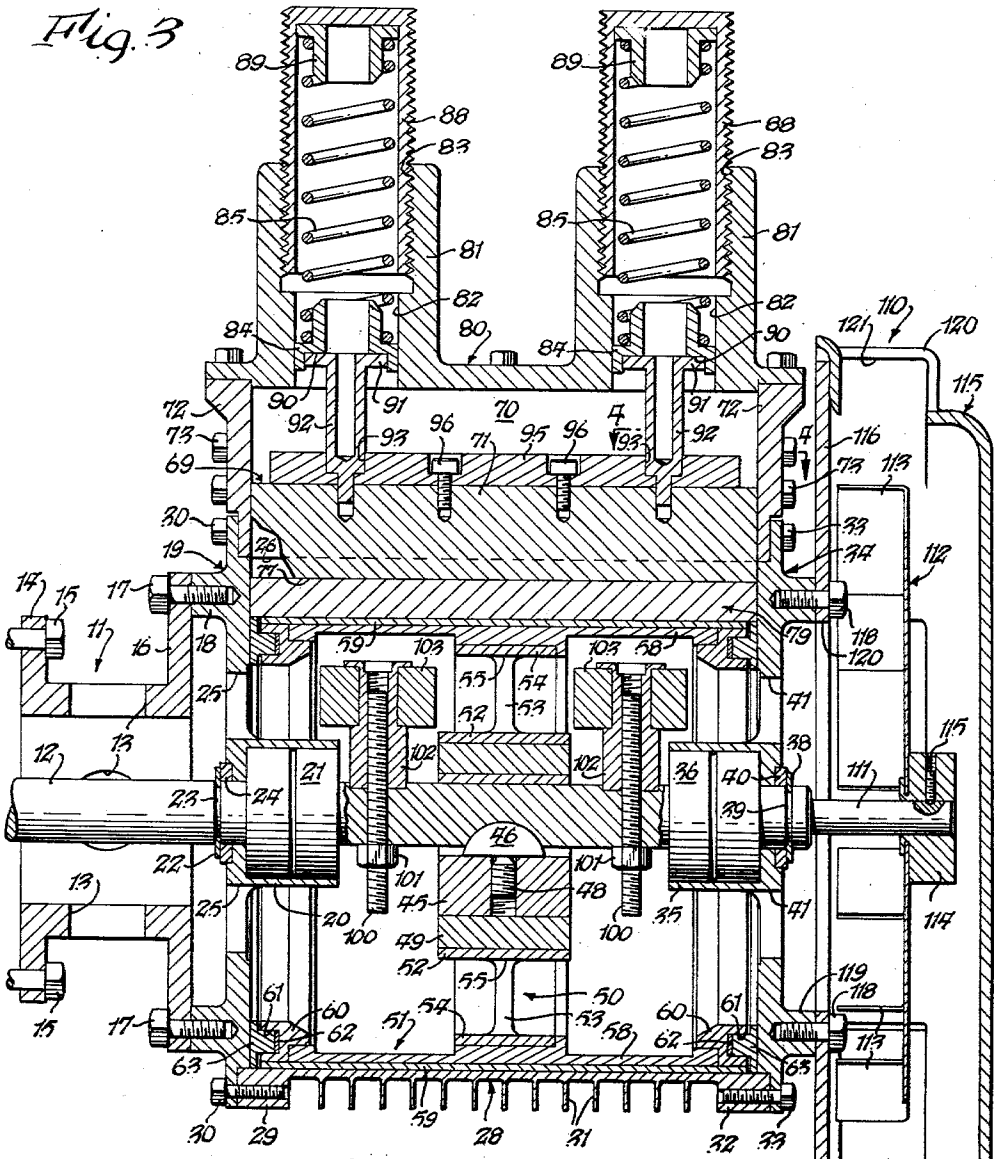
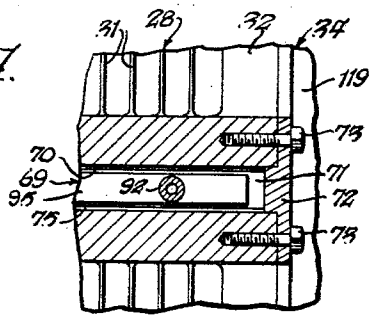


Fig. 4



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INTERNALLY COOLED GAS PUMP

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3 Claims. (Cl. 230—210)

This invention relates to a gas pump of the type in which a squeeze roll has orbital movement in a cylindrical working chamber in line contact with the wall thereof and operates in conjunction with a sliding vane to pump air from an inlet at one side of the vane to an outlet at the opposite side thereof. This type of pump is particularly useful as a dry air pump in which liquid lubricant is not added as a mist or otherwise, to the incoming air to reduce wear on the pump, the rotor or squeeze roll having essentially rolling contact both with the cylindrical casing and with the vane.

The principal object of the present invention is to increase the life of such a pump when used as a dry air pump.

Another object is to provide such a dry air pump in which the running temperature is reduced to a minimum.

Another object is to provide such a pump which can be driven in either direction.

Other objects and advantages will be apparent from the following description and drawings in which:

FIG. 1 is a side elevational view of an internally cooled dry gas pump embodying the present invention and showing the same mounted upon the end head of an electric motor the casing of which is shown in broken lines.

FIG. 2 is an enlarged fragmentary sectional view taken generally on line 2—2, FIG. 1.

FIG. 3 is a vertical longitudinal central section taken generally on line 3—3, FIG. 2.

FIG. 4 is a fragmentary horizontal section taken generally on line 4—4, FIG. 3.

The internally cooled air pump forming the subject of the present invention is shown as mounted on the end head 9 of an electric motor 10 by means of a flanged coupling sleeve indicated generally at 11 and through which the shaft 12 of the pump extends and can be coupled to the motor shaft (not shown) in any suitable manner. This flanged coupling sleeve 11 is provided in its side wall with a plurality of large openings 13, these openings being important to the present invention in that they provide air inlets for internally cooling the pump as hereinafter described. This flanged coupling sleeve 11 is shown as having one outwardly projecting annular end flange 14 secured to the motor end head 9 by bolts 15 and having an annular end flange 16 projecting radially outwardly from its opposite end and secured by screws 17 to an axially projecting head 18 of one annular end head 19 of the pump.

This annular end head 19 has a hub 20 in which the pump shaft 12 is journalled by means of an antifriction bearing 21, the shaft being held against endwise displacement with reference to the hub 20 by means of a lock ring 22 in a groove 23 in the shaft 12 and bearing against a brass washer 24 set into the hub 20. An important feature is that surrounding this hub 20 the end head 19 has a plurality of openings 25 extending therethrough and through which cooling air from the coupling sleeve 11 is drawn into the cylindrical working chamber or bore 26 of the body or casing 28 of the pump. The end head 19 is secured to one rim 29 of this cylindrical body or casing 28 of the pump by screws 30 or in any other suitable manner.

The cylindrical casing or body 28 of the pump is shown as having external cooling fins 31 and to its opposite rim

32 is secured, as by screws 33, a circular end head 34 which is generally similar to the end head 19. Thus, this end head 34 of the cylindrical pump casing or body 28 has a hub 35 in which the pump shaft 12 is journalled by means of an antifriction bearing 36. Endwise displacement of the pump shaft 12 is prevented by a lock ring 38 set into a groove 39 in the pump shaft and bearing against a brass washer 40 set into the outer end of the hub 35. An important feature of the invention is the provision of a plurality of openings 41 through the end head 34 and through which cooling air is withdrawn from the working chamber or bore of the pump as hereafter described.

Within the cylindrical working chamber or bore 26 of the pump casing a cylindrical eccentric 45 is secured, as by a key 46, to the pump shaft 12. This eccentric 45 can be held in position by a set screw 48 bearing against the key 46, and on the periphery of this eccentric 45 is secured a bearing bushing 49 of a sintered metal impregnated with a lubricant. On this lubricant impregnated bearing bushing 49 is journalled the hub 50 of squeeze roll indicated generally at 51. This hub 50 comprises an inner cylinder 52 journallled on the lubricant impregnated bushing 49 and connected by spokes or an apertured radial wall 53 with an outer cylinder 54, these spokes providing among them openings 55 through which the cooling air can flow. A cylinder 58 is fixed to the outer cylinder 54 of the hub 50 and carries an outer facing in the form of a cylinder 59 of a resilient organic plastic material. Desirably this facing 59 can be of a rigid polyurethane cast on the periphery of the cylinder 59 and machined to the cylindrical diameter required. This facing 59 can also be provided with a dry lubricant, such as molybdenum disulfide.

The periphery of this casing sleeve 59, preferably so provided with a solid lubricant, has line contact with the cylindrical working chamber or bore 26 of the pump casing 28 and since this facing is concentric with the bearing bushing 49 on the eccentric 45, it will be seen that it has orbital movement and pure rolling contact with the cylindrical face or bore 26 as the pump shaft 12 rotates.

Means are provided for sealing the opposite ends of the squeeze roll 51, the inner faces of the end heads 19 and 34, these means preferably being constructed as follows:

The numeral 60 represents a ring fixed to each end of the cylindrical body 58 of the roller and over which the plastic facing sleeve 59 extends. Each ring 60 has a concentric groove 61 which opens axially outwardly therefrom and which contains a resilient spacing ring 63 made of rubber or the like. Each spacing ring 62 biases an annular sealing ring 63 contained in the groove 61 against the opposing face of the corresponding end head 19 or 34.

The cylindrical casing or housing 28 of the pump is formed to provide gas inlet and outlet bosses 65, 66. These bosses are shown as being provided at the top of the housing or casing 28 on opposite sides of a vertical plane intersecting the axis of the working chamber 26 and as having, respectively, internally threaded gas inlet and outlet openings 67, 68 providing communication between the exterior of the pump casing 28 and its working chamber 26.

Between the inlet and outlet openings 67, 68, the pump is provided with a vane indicated generally at 69 mounted for vertical sliding movement in the pump housing or casing 28 and engaging the periphery of the plastic facing sleeve 59 of the squeeze roll 51. This vane is mounted in a vertical slideway 70 through the top of the valve body or casing 28 and extending from one end of this casing or body to the other and having sidewalls which are parallel with a vertical plane intersecting the axis of

the pump shaft 12. The slide comprises a main metal bar 71 having its ends in contact with the inner faces of the end plates 72 secured by screws 73 to the ends of the pump casing 28 and having longitudinal grooves 74 in its opposite vertical faces. These grooves contain sealing bars 75 which are urged into sealing contact with the side walls of the way 70 by resilient backing 76 of rubber or the like. The bottom of the bar 71 is provided with a cylindrical groove 77 which is opened at its bottom and which contains the cylindrical head 78 of a shoe 79 which bears against the periphery of the plastic facing sleeve 59 for the roller 51.

The vane 69 and its shoe 79 is biased downwardly and to this end the upper end of the way 70 is enclosed by a cap 80 secured by screws or in any other suitable manner. This cap has upwardly extending integral bosses or sleeves 81 each of which is provided with a vertical throughbore 82, the outer end of which is internally threaded as indicated at 83. Each bore 82 contains a cylindrical sleeve or follower 84 which is biased downwardly by a helical compression spring 85. Each helical compression spring is arranged in an externally threaded sleeve 88 screwed into the threads 83 of the corresponding boss 81 and closed at its upper end. A centering sleeve 89 is preferably interposed between the upper end of each compression spring 85 and the closed top of the corresponding externally threaded sleeve 88. The lower end of each follower 84 is recessed and in this recess 90 is fitted the upper end head 91 of a stem 92, the lower end of which fits into a recess 93 in the corresponding end of a bar 95. This bar 95 extends longitudinally along the top of the main bar 71 of the vane 69 and is secured thereto, as by screws 96.

It is desirable that the eccentric 45 be counterbalanced and to this end it is flanked by a pair of screws 100 which extend through the pump shaft 12 in a plane intersecting the axis and salient face of this eccentric 45. These screws are secured to the pump shaft by a pair of nuts 101 and 102, the latter being each of cylindrical form and carrying a circular counter weight 103.

The pump is completed by a blower indicated generally at 110. The shaft of this bore comprises a reduced extension 111 of the pump shaft 12 on the side of the pump opposite from the mounting collar 11. The blower wheel 112 is preferably made of sheet metal with tangentially arranged blades 113 and secured to a hub 114 which is in turn secured, as by a set screw 115, to the extension 111 of the pump shaft 12. The shroud or casing 115 of the blower is secured to the end head 34 and for this purpose is shown as comprising a circular plate 116 secured by screws 118 to an annular axially projecting rib 119 of the end head 34 and having a circular opening 120 which forms the eye or inlet of the blower and is in communication with the openings 41 in the end head 34. A shell 120 is secured at its margin to the plate 116 and is provided with openings 121 through which air is expelled by the fan wheel 112.

In the operation of the pump embodying the present invention, the pump shaft 12 is rotated in the direction to move air from the inlet 67 to the outlet 68, this being counterclockwise as viewed in FIG. 2. As the pump shaft rotates the eccentric or cam 45 moves the squeeze roll 51 in an orbital path with its resilient cylindrical coat or face 59 in continuous substantially line contact with the bore 26, there preferably being a slight squeezing of the resilient facing 59 to insure against any clearance between this facing and the bore 26 and vane 69 during the orbital movement. It will be noted that the contact between the roll 51 and the bore 26 is a pure rolling contact and that this is also substantially true with the vane 69. This adapts this type of pump for use as a dry air pump in which liquid lubricant is not added to the incoming air for pump lubricating purposes and hence does not have to be removed from the outgoing air if such liquid lubricant is not desired. It is desirable with the present pump, that the working surfaces of the working chamber 26, roll 51 and vane 69 be provided with a dry lubricant, such as molybdenum disulfide or graphite.

With such counterclockwise rotation of the pump shaft 12, as the squeeze roll 51 rotates around in contact with the bore or working chamber 26 from the position shown in FIG. 2, it decreases the size of this working chamber 26 on the right hand side of the vane 69 and increases the size of this chamber on the left hand side of this vane, thereby to draw air into through inlet 67 and expel it through the outlet 68. When the salient part of the eccentric 45 traverses the vane 69, the working chamber 26 is on the opposite side of the squeeze roll 51. This vane 69 is guided in the vertical guideway 70 of the pump casing 28 and is urged downwardly into engagement with the resilient facing 59 by the springs 85.

Assuming that the pump is operated at 2,000 r.p.m., it will be seen that there would be a substantial internal temperature rise if the pump were not adequately cooled internally. In accordance with the present invention, the pump is internally cooled by ambient air circulated by the blower 110. This air enters the openings 13 of the coupling sleeve 11 and passes through the openings 25 in the pump end head 19 into the interior of the squeeze roll 51. This air then passes through the openings 55 in the hub 50 of this roll 51 and through the openings 41 into the eye or inlet 120 of the blower 110. This air is then discharged by the blower wheel 112 through the openings 121 of the case 115 of the blower.

It will be noted that the coolant in the form of this ambient air passes in intimate contact with the antifriction bearings 21 and 36 which support the pump shaft 12. It will also be noted that this cooling air passes in intimate contact with the inside face of the squeeze roll 51 thereby to cool this roll against the temperature developing as a result of compressing the gas. It will also particularly be noted that this air passes in intimate relation to the bearing provided by the lubricant impregnated bushing 49 which is the center of the pump. It has been found that with such cooling of the pump, its life can be increased from less than thirty-five working hours to over five hundred working hours.

The pump can be driven in either direction and when driven in a reverse direction the flow of the compressed air and cooling air will be reversed. If reversibility in service is an important consideration a more efficient design of the blades 113 of the blower wheel 112 for such service would be adopted and the motor 10 could, of course, be reversible.

I claim:

1. In a gas pump having a casing with a cylindrical bore, end heads for said casing defining with said bore a working chamber, a shaft journalled in said end heads generally concentric with said working chamber, an eccentric bearing on said shaft, a roller of smaller diameter than and arranged in said bore to have contact with said end heads and journalled on said eccentric bearing to have substantially line rolling contact with said bore as said shaft rotates, and a vane parallel with said roller engaging the pheriphery thereof and moving in a radial way in said casing to divide the space in said working chamber between said bore and roller into inlet and outlet chambers having gas inlets and outlets respectively; the combination therewith of means for cooling said eccentric bearing comprising means providing passages axially through said end heads and roller and around said eccentric bearing, and means moving a coolant through said passages.

2. In a gas pump having a casing with a cylindrical bore, end heads for said casing defining with said bore a working chamber, a shaft journalled in said end heads generally concentric with said working chamber, an eccentric bearing on said shaft, a roller of smaller diameter than and arranged in said bore to have contact with said end heads and journalled on said eccentric bearing to have

substantially line rolling contact with said bore as said shaft rotates, and a vane parallel with said roller engaging the periphery thereof and moving in a radial way in said casing to divide the space in said working chamber between said bore and roller into inlet and outlet chambers having gas inlets and outlets respectively; the combination therewith of means for cooling said eccentric bearing comprising means providing passages axially through said end heads and roller and around said eccentric bearing, a fan housing secured to one of said end heads and having its inlet communicating with the passage in said one of said end heads, a fan wheel in said fan housing fixed to said shaft, a mounting sleeve fixed generally concentrically to the exterior of the other of said end heads and adapted to mount the gas pump on the end head of an electric motor, said mounting sleeve being provided with ventilation holes leading to the exterior thereof.

3. In a gas pump having a casing with a cylindrical bore, end heads for said casing defining with said bore a working chamber, a shaft journalled in said end heads generally concentric with said working chamber, an eccentric bearing on said shaft, a roller of smaller diameter than and arranged in said bore to have contact with said end heads and journalled on said eccentric bearing to have substantially line rolling contact with said bore as said

shaft rotates, and a vane parallel with said roller engaging the periphery thereof and moving in a radial way in said casing to divide the space in said working chamber between said bore and roller into inlet and outlet chambers having gas inlets and outlets respectively; the combination therewith of means for cooling said eccentric bearing comprising means providing passages axially through said end heads and roller and around said eccentric bearing, a mounting sleeve fixed generally concentrically to the exterior of one of said end heads and adapted to mount the gas pump on an end head of an electric motor, said mounting sleeve being provided with ventilation holes leading to the interior thereof, and means moving a coolant through said passages and ventilation holes.

References Cited by the Examiner

UNITED STATES PATENTS

2,162,851	6/39	Lister.	
2,673,028	3/54	Cornelius	230—211 X

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