

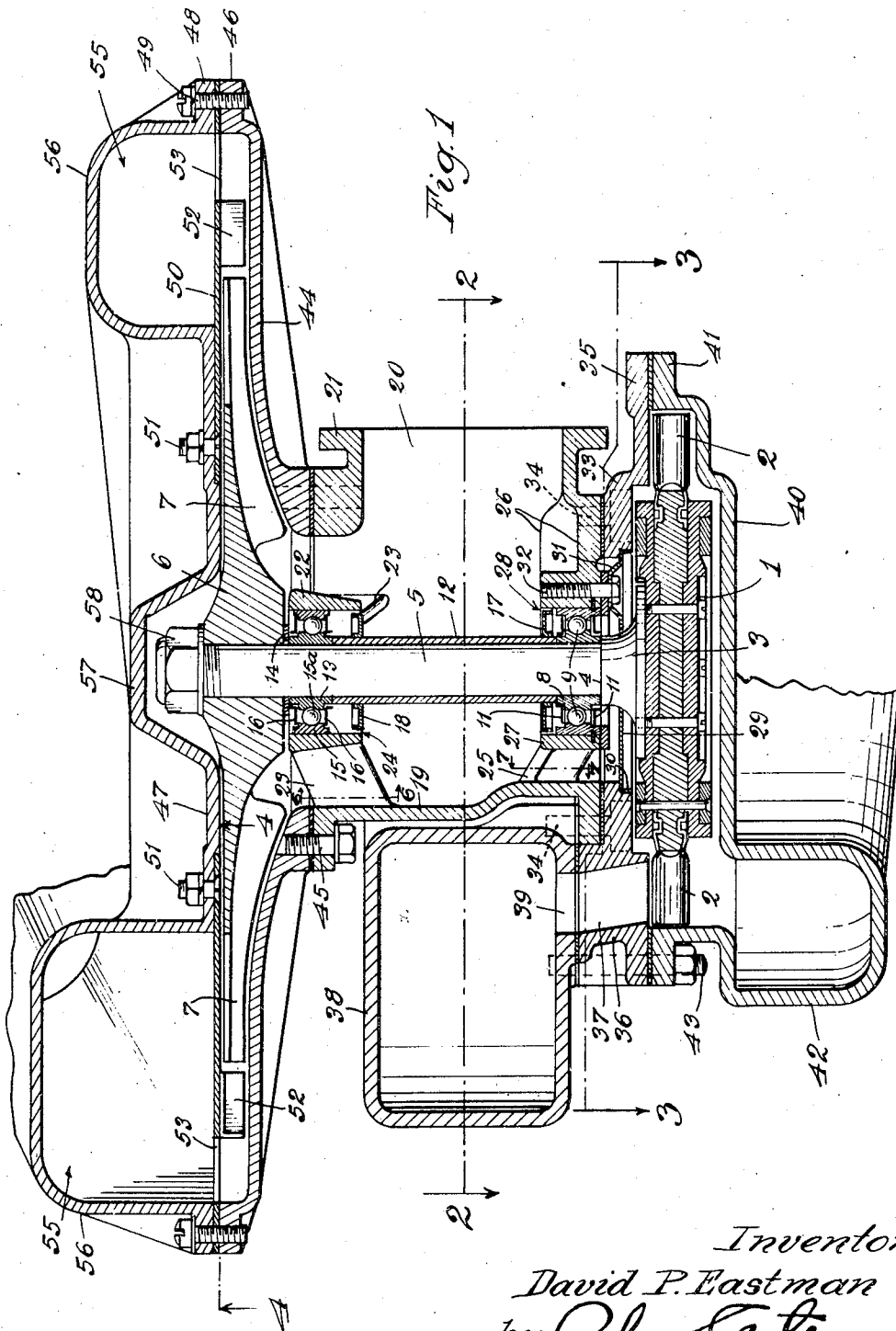
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D. P. EASTMAN
TURBOSUPERCHARGER

2,487,532

Filed Sept. 16, 1946

3 Sheets-Sheet 1



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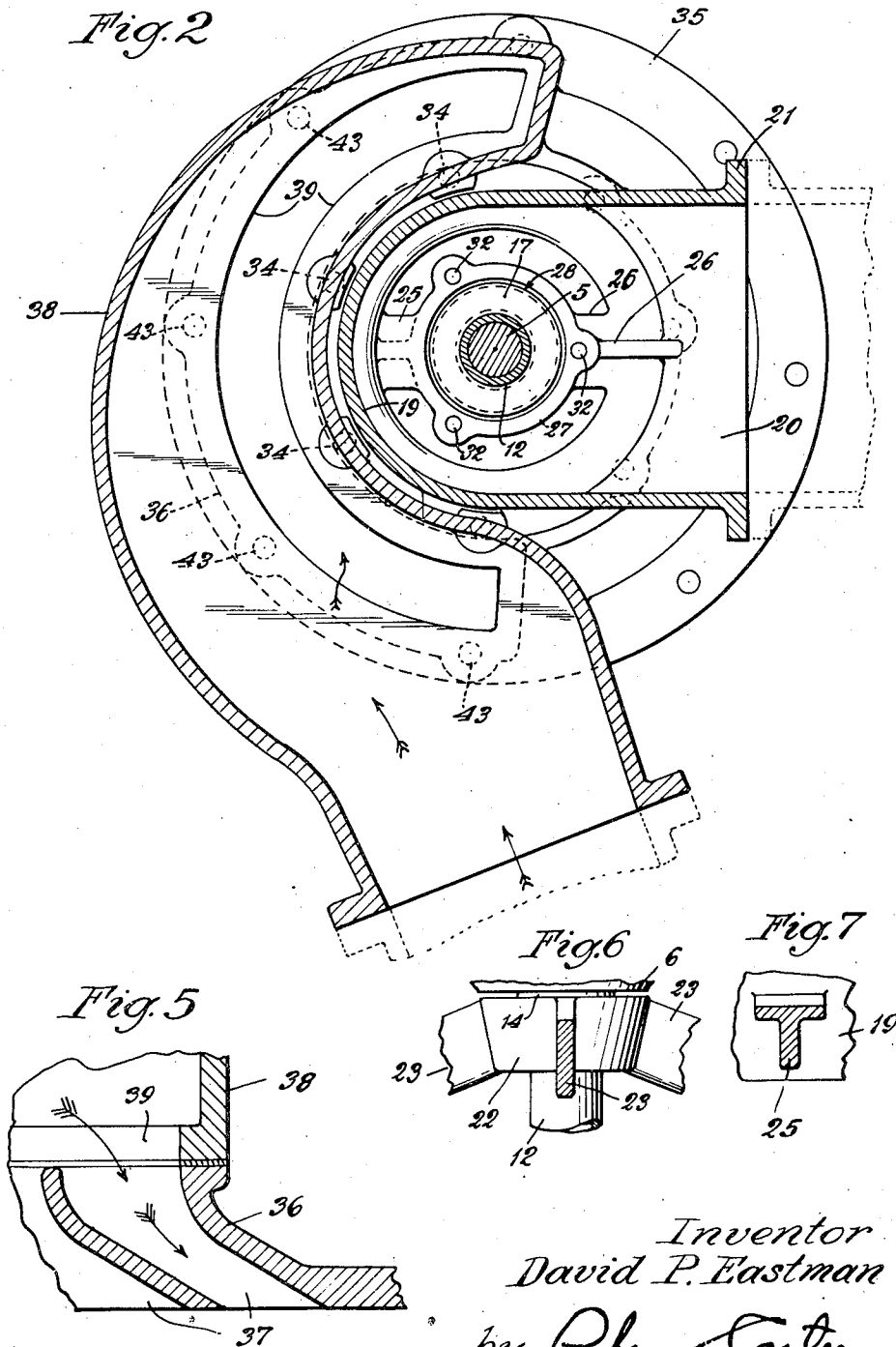
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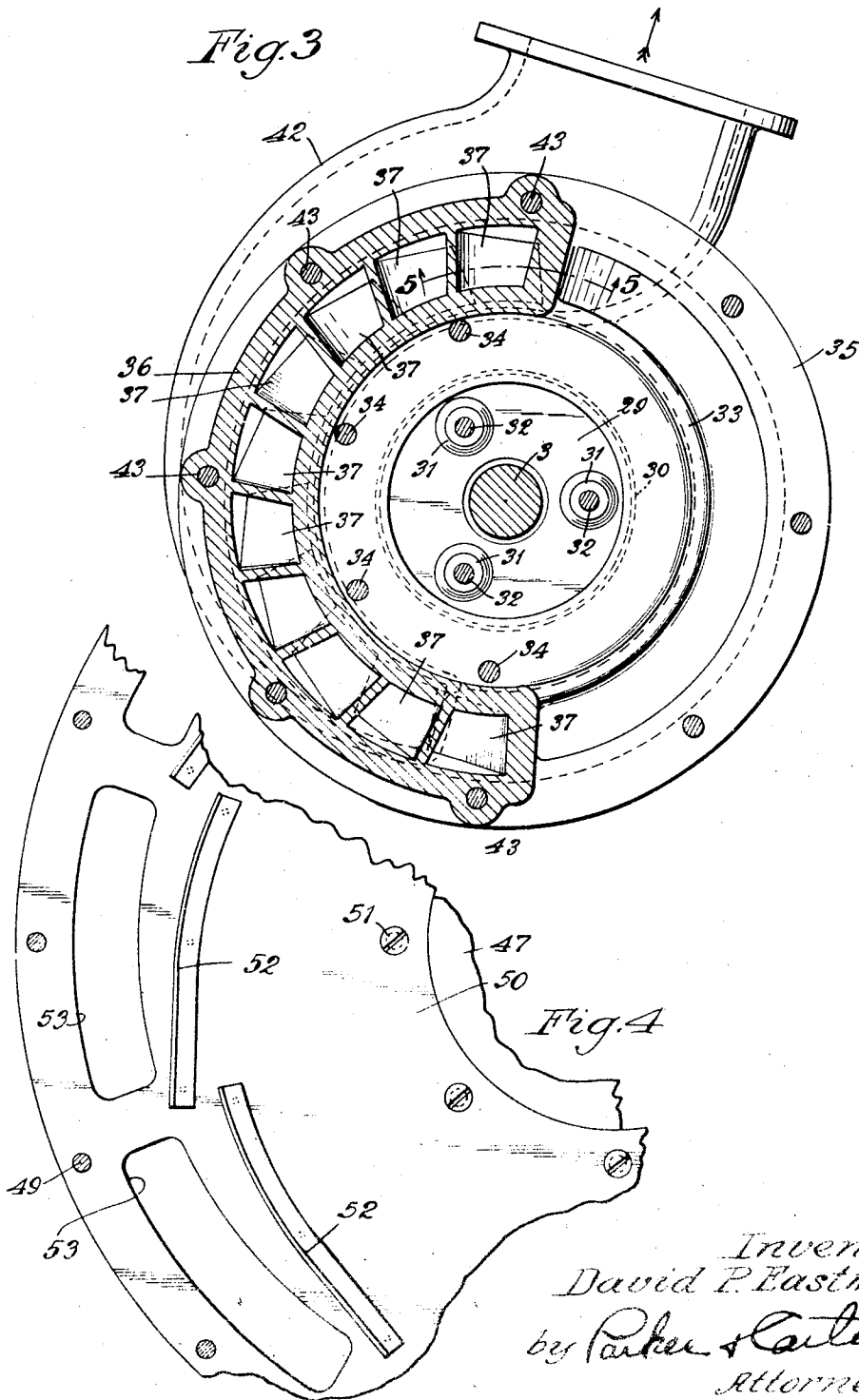
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UNITED STATES PATENT OFFICE

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TURBOSUPERCHARGER

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4 Claims. (Cl. 230-116)

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This invention relates to a supercharger and in the particular form shown has for one object to provide a supercharger thereafter to be associated with an internal combustion engine and to be driven by exhaust gases from that engine.

A further object is to construct a turbosupercharger in such manner as to control the heating of the various parts of the mechanism, as a result of the passage of the heated exhaust gases through the device.

A further object is to provide a turbosupercharger so arranged that cool air entering sweeps over the bearings and other moving parts to effect a positive cooling of such parts.

A further object is to construct the various members of a turbosupercharger assembly in such manner as to provide a minimum of metal for the travel of heat from the heated parts to the parts which are out of contact with the heated gases.

Other objects will appear from time to time in the course of the specification and claims.

The invention is illustrated more or less diagrammatically in the accompanying drawings, wherein:

Figure 1 is a longitudinal section through one form of the device;

Figure 2 is a transverse section taken at line 2-2 of Figure 1;

Figure 3 is a transverse section taken at line 3-3 of Figure 1;

Figure 4 is a transverse section taken at line 4-4 of Figure 1;

Figure 5 is a section taken at line 5-5 of Figure 3 and showing the nozzle box, nozzle plate and one of the buckets;

Figure 6 is a section taken at line 6-6 of Figure 1; and

Figure 7 is a section taken at line 7-7 of Figure 1.

Like parts are indicated by like symbols throughout the specification and drawings.

In the particular form here shown the invention comprises a turbine wheel, a shaft to which the wheel is fixed, a fan or impeller also fixed to the shaft and suitable bearing members. This constitutes the moving part of the assembly. In addition to the moving part the device comprises housing members, for the fan or impeller, another general housing to support the bearings, a nozzle box or housing through which the exhaust gases reach a nozzle plate, a housing for the turbine wheel and an exhaust gas collector to which the exhaust gases move after passing through the nozzle plate and impinging upon the turbine buckets.

The turbine proper comprises a wheel portion 1 upon which are fixed buckets 2. Many different sorts of wheel and bucket constructions may be used and the invention is not limited to any

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particular turbine wheel. The wheel may be conveniently provided with a hub portion 3 terminating in a shoulder 4. A shaft 5 may be formed as a separate member and secured to the wheel or may be formed integrally with the wheel or some part of it. Upon the upper end of the shaft 5 is a fan or impeller 6 which includes air moving members 7.

Positioned about the shaft 5 and seated against the shoulder 4 is the inner race 8 of the lower anti-friction bearing which includes balls or roller members 9, an outer race 10 and bearing closing members 11, 11. A spacer 12 is positioned about the shaft and seated against the upper face of the bearing race 8. The race 13 of an upper bearing is positioned about the shaft 5 and seated against the upper end of the spacer 12. A washer 14, if desired, may be inserted between the upper end of the bearing race 13 and the impeller 6. Ball or other rolling members 15a are positioned in the race 13 and the bearing is completed by an outer race 15 and bearing closure members 16, 16.

"Slingers" 17 and 18 are positioned upon the spacer 12 and respectively adjacent the lower and upper bearing.

As a means for supporting and closing the bearing and the shaft, a housing member 19 is positioned about the bearing and shaft. It is provided with an inlet opening 20 about which a flange 21 may be positioned. To the flange may be attached any desired inlet passage member. A ring like member 22 is supported adjacent the upper portion of the housing 19 upon legs 23. The outer race 15 of the upper bearing assembly is positioned in the ring 22. A substantial clearance 24 is provided between the slinger 18 and the bearing supporting ring 22.

Adjacent the lower end of the housing 19 is provided a pair of legs 25, 26. These legs support a ring like member 27 within which the outer race 10 of the lower bearing assembly is supported. A substantial clearance 28 is provided between the slinger 17 and the ring 27. A partition member 29 is supported adjacent the lower end of the housing 19, but preferably includes a downwardly depending peripheral flange 30 and may include one or more depressions 31 within which screws 32 are received and by means of which it is secured either to the legs 25, 26 or to the ring 27. The partition member 29 is not in contact with the portion 3 but approaches it closely to reduce the clearance between the two members as far as possible.

A generally plate like member 33 is secured to the lower face or adjacent the lower end of the housing 19 by screws 34 or otherwise. Throughout a portion of its diameter the member 33 includes a peripheral flange 35 and throughout another portion of its diameter it is enlarged as at 36 to

provide one or more nozzle openings 37. A nozzle box 38 is positioned upon the nozzle plate 33 and is in register with the enlarged portion 36. It is provided with a slot or with a plurality of openings 39 which register with the nozzle or nozzles 37. It will be noticed that the nozzle box is out of contact with the housing 19 and that an air space is provided between the two members which assists in cooling and which limits the possibility of direct transfer of heat from the nozzle box through which the heated exhaust gases move to the housing 19 and thence to the bearings and other members which it is desired to maintain as cool as possible.

A combined turbine housing and exhaust gas collector includes a member 40 which throughout a part of its diameter comprises a flange portion 41 adapted as shown particularly in Figure 1 to contact and to be secured to the flange portion 35. The member 40 includes an enlarged exhaust collecting passage forming member 42 which generally corresponds in plane to the exhaust gas nozzle box 38. Bolts or other fastening means 43 secure the parts together. The housing members thus far described provide means for enclosing and supporting the shaft 5 and the bearings as well as means for conducting exhaust gases to and from the turbine. The housing means described below serve to close the fan or impeller.

A housing member 44 is secured by screws 45 or otherwise to the housing 19. The housing member 44 is shaped to close the impeller and preferably correspond generally in shape to the impeller. The member 44 may terminate in a peripheral flange 46. An upper impeller housing member 47 closes the top of the impeller cavity and may terminate in the flange 48 which by means of screws 49 is secured to the flange 46. A plate 50 which may be generally annular in plane is positioned between the two housing sections 44 and 47. It may be secured to the section 47 by bolts 51 or otherwise. At its outer edge it may be gripped between the flanges 46 and 48. Fixed to or formed integrally with the member 50 is a plurality of diffuser vanes 52. An opening or openings 53 are provided in the member 50 and these furnish a path for the air from below the plate 50 to the chamber 55 formed within the curved member 56 which is preferably integral with the member 47. Any of the housing members above described may be formed integrally or have several parts joined together. A raised portion 57 may be formed in the member 47 to surmount the nut 58 which holds the various parts of the rotating assembly fixed upon the shaft 5. The chamber 55 may be joined to any suitable discharge through which air from the impeller moves to a point of use. This will ordinarily be the internal combustion engine with which the supercharger is associated and from which the exhaust gases which drive the turbine are discharged into the turbine nozzle box.

It will be realized that, whereas, I have described and illustrated a practical and operative device, nevertheless many changes may be made in the size, shape, number and disposition of parts without departing from the spirit of my invention. I therefore wish my description and drawings to be taken as in a broad sense illustrative or diagrammatic, rather than as limiting me to my precise showing.

In particular the invention is not limited to any one arrangement of nozzles. For some purposes it has been found that the nozzles extend

around only a part of the turbine wheel and the device is shown in that manner. However, the nozzles and the nozzle box might extend around the entire diameter of the device or around a greater portion than that shown. Whatever the extent of the nozzle box and nozzle plate may be the nozzle box will be so formed as to be out of physical contact with the housing 19 and thus it will be so formed as to provide a substantial clearance between it and the nozzle box and hence a substantial air space between the two members. This air space comprises both a break in the possible metal path for heat flow and also an air space through which air may circulate to accomplish cooling.

It is also to be noted that a minimum of metal is provided for the direct flow of heat from the housing 19 to the bearings which support the shaft and the rotating assembly. Thus at this point also the design is such as to make the direct flow of heat from the heated nozzle box to the bearings as unlikely as possible. These considerations are important because the exhaust gases are inevitably hot and for high efficiency should be hot. For satisfactory operating conditions of the bearing and other moving parts, however, it is important that the heat of such members be held relatively low. Throughout the design of this invention means have been taken to limit and to reduce the metal path for the flow of heat to the bearings and means have further been provided to sweep the bearings and associated parts with the relatively cooler incoming air. The device therefore whatever its details might be, comprises means for inhibiting the flow of heat to the bearings and associated parts and comprises further means for accomplishing the rapid flow of cooling air over the bearings and associated parts.

Various gasket spacing and positioning means are shown which have not been described in detail. Their use and construction is obvious and their details form no particular part of the invention.

The use and operation of the invention are as follows:

The device in the form shown will normally be associated with an internal combustion engine. It may, however, be associated with any source of heated gas to which it is desired to furnish air for combustion. Thus its use is not limited to association with a conventional internal combustion engine.

Whatever type of combustion device the supercharger is associated with a connection is made between the source of burned gases and the nozzle box. Another connection is made between the chamber through which the air is discharged from the impeller and the point at which this air is to be used. In the case of an internal combustion engine the nozzle box is connected to the exhaust manifold and the discharge from the impeller is connected to the carburetor in the case of a carbureting engine or to the cylinder or cylinders in the case of a non-carbureting engine.

When the engine operates the exhaust gases pass from it to the nozzle box and thence through the nozzle plate and against the turbine buckets thus causing rotation of the turbine wheel and the parts which are arranged to be driven by it. The exhaust gases move from the turbine buckets through the exhaust collector and are discharged.

As the turbine wheel is rotated the shaft 5 and impeller 6 rotate with it. Air is drawn into

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the housing 19 through the opening 20 and moves to the impeller and outward from the impeller through the passage 55. As the cool air is drawn through the opening 20 and into the housing 19 it sweeps over the shaft 5, the spacer 12 and bearings. The slingers 17 and 18 serve to keep air as far as possible out of the bearings. They counteract the tendency of the fan or the shaft or any other rotating parts which might tend to draw air into the bearings. Although the invention is not limited to any particular form of bearing construction that shown is a closed or sealed bearing construction packed with grease or other lubricant and the air is caused to circulate about the bearings. In this circulation the slingers 17 and 18 assist.

The legs 25 and 26 are sufficiently small so that the major portion of the ring 27 is free about the periphery and entering air moves past the legs 25 and 26 about the ring 27 and below the lower bearings coming in contact with the partition member 29. Thus of the rotating assembly all of the assembly is swept by entering cooling air and is thus cooled. As pointed out above the nozzle box itself is spaced away from all other parts of the assembly except the nozzle plate and even where the nozzle box and nozzle plate are in contact with each other the parts are so shaped as to reduce that contact to a minimum and thus positively to limit the direct metal path along which heat may flow from the nozzle box to other parts of the assembly. Although the turbosupercharger of this application is useful in connection with internal combustion engines, it is not limited to that use and it could be used in connection with refrigeration. In one possible refrigeration use the supercharger would supply air to another turbine which would then cool the air by expansion or otherwise.

I claim:

1. In combination, a rotating assembly including a shaft, a turbine rotor thereon, a gas impeller thereon, a housing surrounding the shaft, and comprising the sole path for air to said impeller, bearings freely open within said housing for supporting said shaft, parts supported within said housing, said bearings being supported in said parts, relatively narrow members joining said parts to said housing, a housing for said impeller, a nozzle box adapted to conduct exhaust gases to the turbine wheel and a nozzle plate in communication with said nozzle box and said turbine wheel, an exhaust gas collector positioned on the side of said rotor away from said impeller and positioned to receive exhaust gases after they have contacted the turbine wheel, said nozzle box extending about less than the total circumference of said first mentioned housing leaving a region having no nozzles about said wheel, said nozzle box being positioned away from said first mentioned housing and provided with it an air gap, and an inlet to said first mentioned housing, said inlet being substantially axially aligned with said region.

2. In combination, in a turbosupercharger, a rotating assembly including a shaft, a turbine wheel thereon, a gas impeller thereon, a housing fully surrounding the said shaft, bearings freely supported within said housing for supporting said shaft, parts supported within said housing, said bearings being supported in said parts, relatively

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narrow members joining said parts to said housing, a housing for said impeller, a nozzle box adapted to conduct exhaust gases to the turbine wheel and a nozzle plate in communication with said nozzle box and said turbine wheel, an exhaust gas collector positioned on the side of said wheel away from said impeller and positioned to receive exhaust gases after they have contacted the turbine wheel, said nozzle box and nozzle plate extending about less than the total circumference of said first mentioned housing leaving a region having no nozzles about said wheel, said nozzle box being positioned away from said first mentioned housing and provided with it an air gap, and an inlet to said first mentioned housing, said inlet being substantially axially aligned with said region.

3. In combination, in a turbosupercharger, a rotating assembly including a shaft, a turbine wheel thereon, a gas impeller thereon, a housing surrounding the shaft, separated bearings for supporting said shaft, parts supported within said housing, said bearings being supported in said parts away from the walls of said housing, relatively narrow members joining said parts to said housing, a housing for said impeller, a nozzle box adapted to conduct exhaust gases to the turbine wheel and a nozzle plate in communication with said nozzle box and said turbine wheel, an exhaust gas collector positioned to receive exhaust gases after they have contacted the turbine wheel, said nozzle box, nozzle plate and exhaust gas collector extending about less than the total circumference of said first mentioned housing, said nozzle box being positioned away from said first mentioned housing and provided with it an air gap, and an inlet to said first mentioned housing, positioned to direct inwardly moving air over said shaft, said bearings and adjacent parts to cool them.

4. In combination in a turbosupercharger, a shaft, a turbine wheel mounted thereon, and an impeller mounted thereon, housing members for said shaft, said turbine wheel and said impeller, the shaft housing member shaped to define an air inlet passage about said shaft and to said impeller, a gas passage member adapted to deliver exhaust gases to the turbine wheel, bearings for supporting said shaft, a pair of legs supporting one of said shaft bearings from said shaft housing, only one of said legs being connected to said housing, adjacent said exhaust gas passage member, the other of said legs being positioned in the path of inswept cool air, said legs shaped to provide a minimum path for the passage of heat.

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