Aug. 27, 1963 R. L. CARLSON 3,101,890

FANS HAVING RADIAL FLOW ROTORS IN AXIAL FLOW CASINGS

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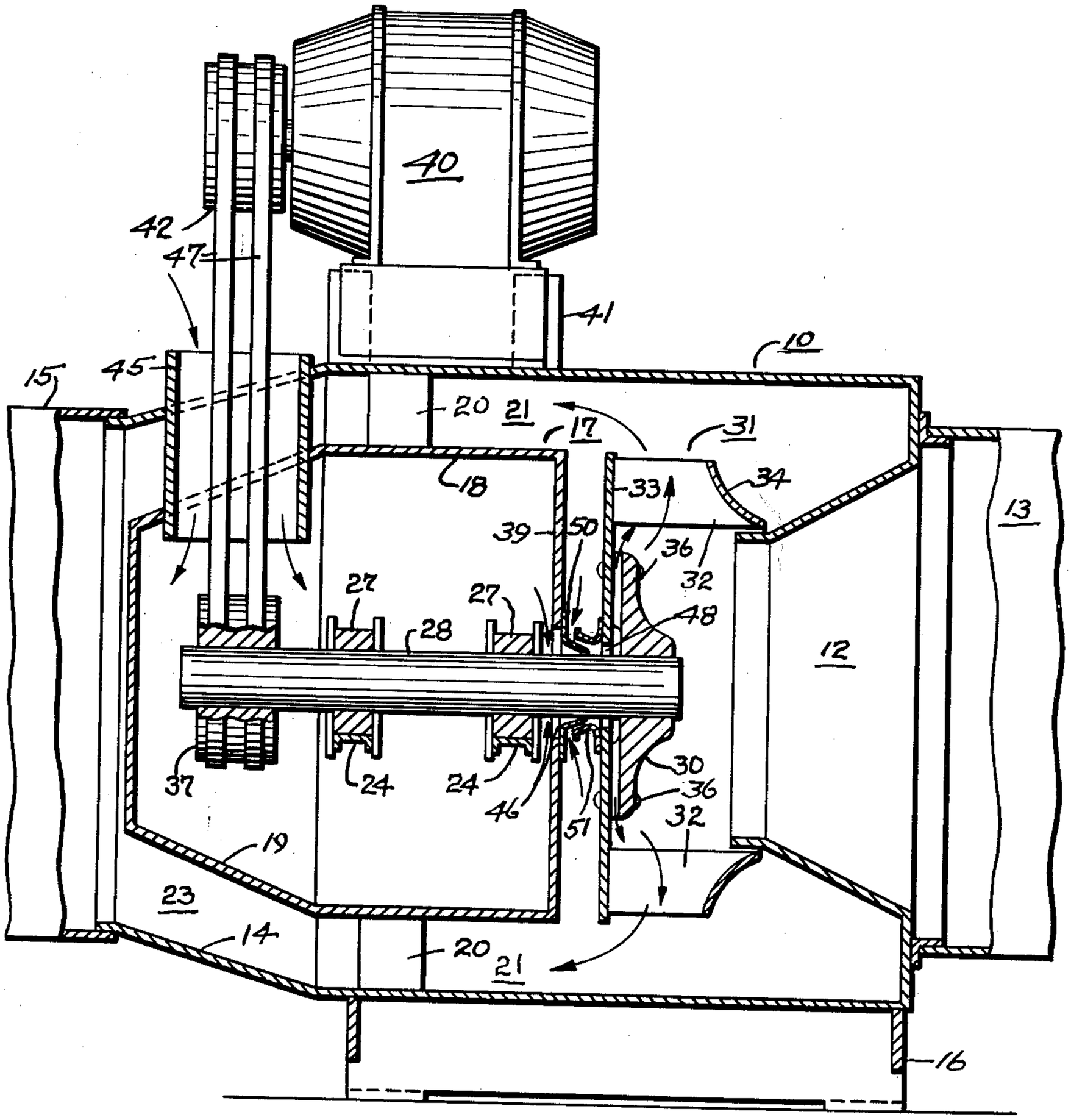
Fig. 1.



Inventor:
Raymond L. Carlson,
by Robert J. Palmer
Attorney

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Fig. 2.

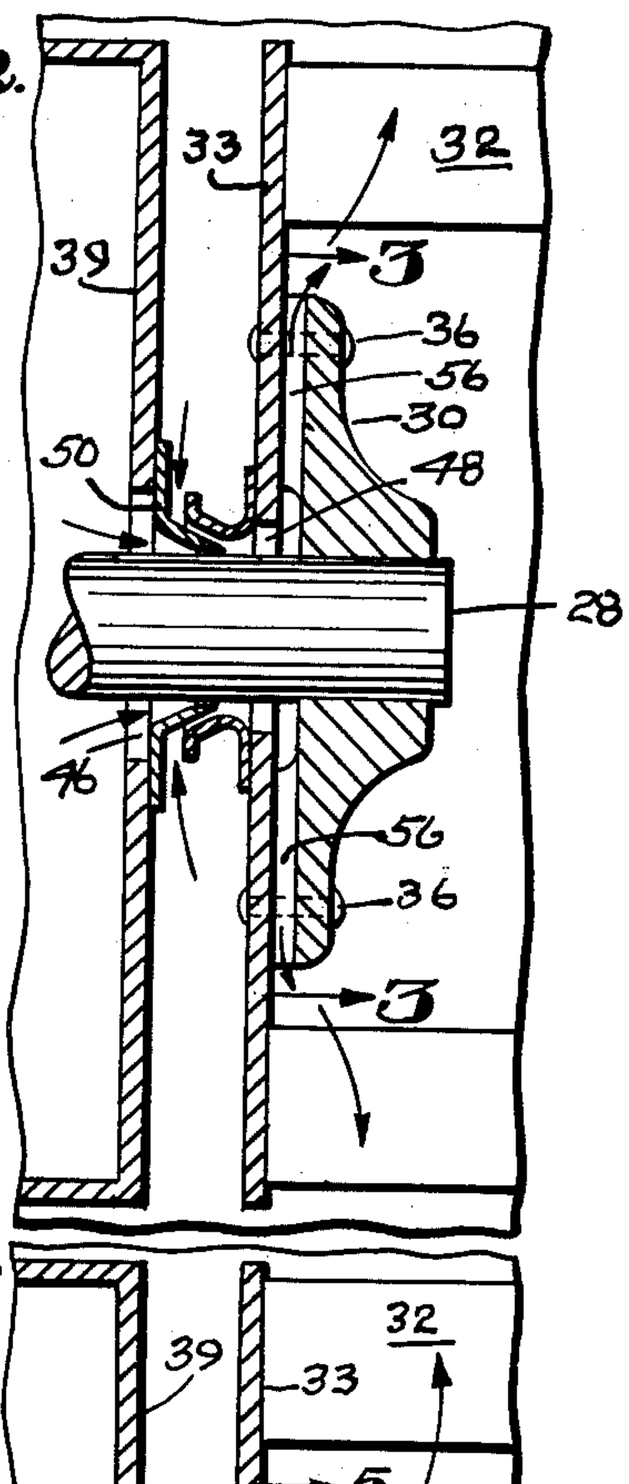


Fig. 3.

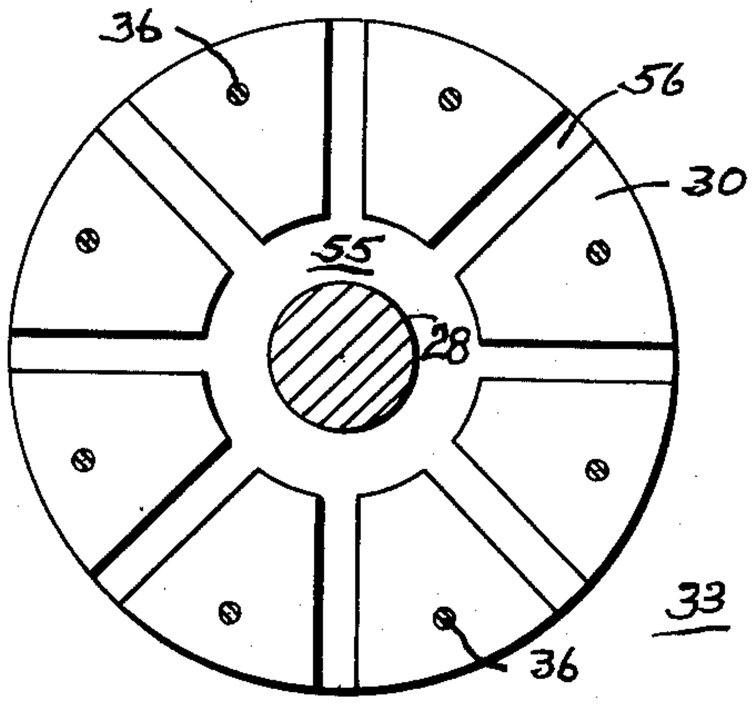


Fig. 4.

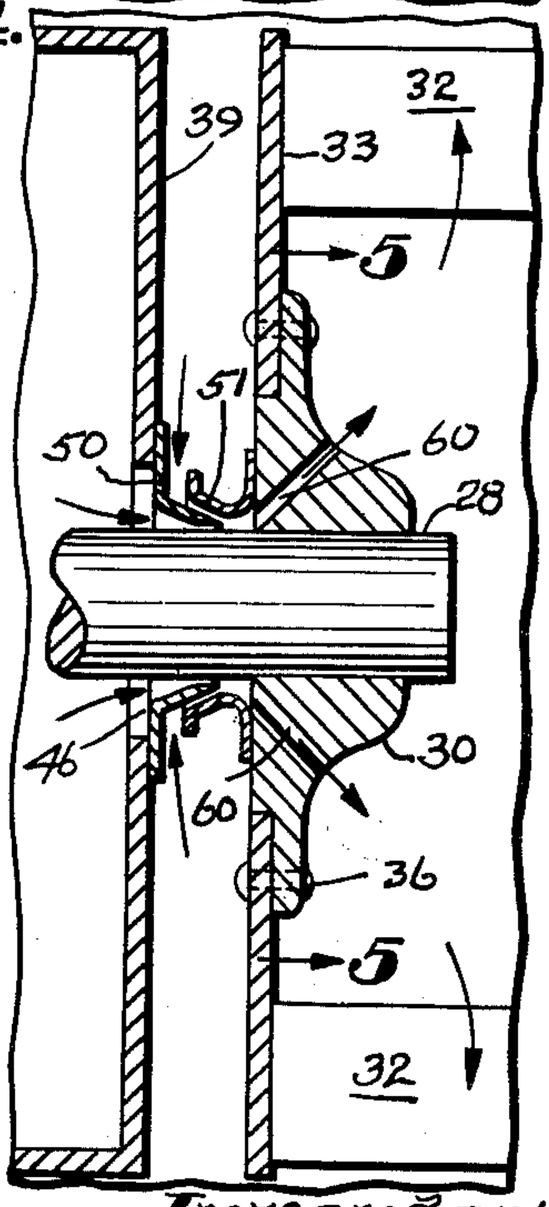
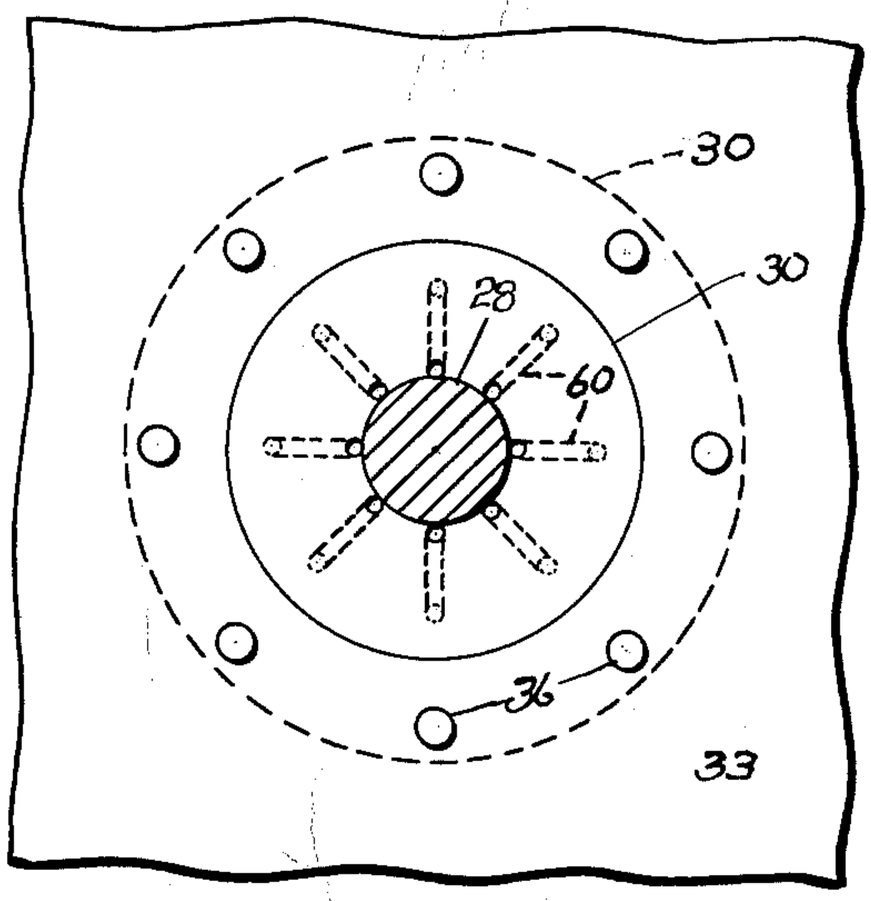


Fig. 5.



Inventor:
Raymond L. Carlson,
by Robert J. Palmer Attorney

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FANS HAVING RADIAL FLOW ROTORS IN AXIAL FLOW CASINGS

Raymond L. Carlson, Canton, Mass., assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

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This invention relates to fans having radial flow rotors in axial flow casings, and has as objects to cool the bearings of such rotors, and to provide seals for preventing gases handled by such fans from escaping into the rooms where the fans are located.

In fans having radial flow rotors in outer axial flow casings, it is customary to support the shafts of the rotors and the bearings for the shafts, within inner casings behind the rotors. Such fans are often used to handle hot and contaminated gases which may overheat their bearings, and which may escape into the rooms in which the fans are located.

This invention uses the hub of the rotor of such a fan as an auxiliary fan which draws in room air to cool the bearings, and to form an air seal to prevent the escape of gas along the rotor shaft into the room where the fan is located. In one embodiment of this invention, the hub has radial slots formed in its back side for forming radial passages between it and the back plate of the rotor. In another embodiment of this invention, a series of passage producing holes is provided through the hub from its back side to its front side, and uniformly spaced apart around the shaft. The passages so formed, act as auxiliary fan blades.

This invention will now be described with reference to the annexed drawings, of which:

FIG. 1 is a side section of a fan embodying this invention;

FIG. 2 is an enlarged section of the hub, the rotor back plate, the upstream end wall of the inner casing, and the seal rings between the back plate and the end wall, of FIG. 1;

FIG. 3 is a section along the lines 3—3 of FIG. 2;

FIG. 4 is a view similar to FIG. 2 but showing a hub having differently formed auxiliary fan passages, and

FIG. 5 is a section along the lines 5—5 of FIG. 4.

Referring to the drawings, a generally cylindrical outer casing 10 has its upstream wall 11 turned inwardly to form an inwardly converging, conical, gas inlet passage 12 connected to a gas supply duct 13. The casing 10 has at its downstream end, a converging wall 14 formed as a frustrum of a cone, which is connected to a gas outlet duct 15. The casing 10 is supported on a base 16.

An inner casing 17 has a cylindrical upstream portion 18, and a converging downstream wall 19 shaped as a frustrum of a cone, supported from and concentric with the outer casing 10 by spin removing vanes 20 within an annular passage 21 between the cylindrical portions of the inner and outer casings. The walls 14 and 19 are concentric, with the wall 19 converging more than the wall 14 so as to form a diverging passage 23 between the walls 14 and 19.

Supported on rails 24 which extend horizontally across the interior of the inner casing 17, and which are secured at their ends to the inner surface of the wall 18, are bearings 27 for rotary shaft 28. The shaft has attached to its upstream end hub 30 of centrifugal or radial rotor 31 having blades 32 secured to a back plate 33 and a front plate 34. The rotor 31 has an axial inlet between the outer end of its front plate 34 and the inner end of the passage 12. The back plate 33 is secured to the hub 30 by rivets 36. A pulley 37 is attached to the downstream end of the shaft 28.

The inner casing 17 has a downstream end which is closed by end wall 38, and has an upstream end which is closed by end wall 39 except that the latter has a clearance opening 46 for the shaft 28. The wall 39 extends parallel to and is spaced axially from the back plate 33 of the rotor 31. The back plate 33 has a clearance opening 48 around the shaft 28.

An electric motor 40 has a base 41 attached to the top of the casing 10, and has a pulley 42 on its shaft aligned vertically with the pulley 37. The walls 14 and 19 have a hollow fairing 45 extending therethrough in vertical alignment with the pulleys 37 and 42. Belts 47 on the pulleys 37 and 42 extend through the fairing 45.

An annular ring 50 is attached to the upstream side of the wall 39 around the opening 46, and converges within the space between the wall 39 and the back plate 33, towards the back plate. An annular ring 51 is attached to the downstream side of the back plate 33 around the opening 48 and diverges within the space between the wall 39 and the back plate 33, towards the wall 39 and around the converging portion of the ring 50.

The hub 30 has a central, circular recess 55, and has eight, equally spaced-apart, radially extending slots 56 which extend from the recess 50 to the periphery of the hub.

In the operation of FIG. 1, the rotation of the rotor 31 by the motor 40, cause gas to be drawn in through the duct 13 and passage 12, and discharged by the rotor, radially in a spiral. The gas discharged by the rotor is turned axially by the inner and outer casings 17 and 10 respectively, and passes through the annular passage 21. Near the downstream end of the passage 21, the vanes 20 remove the spin from the gas, recovering pressure therefrom, the straightened-out gas passing through the passage 29 into the outlet duct 15.

For aerodynamic reasons, it is customary to place the bearings of this type of fan in the inner casing 17 which is closed except for the connection of its interior through the hollow fairing 45 to the atmosphere around the fan, and except for the clearance opening 46 in its end wall 39. When hot gas passes through the annular passage 21, the interior of the inner casing 17 may be so heated that the bearings 27 may be damaged. For preventing this, the hub 33 is provided with the central opening 55 and the radial slots 56 in its downstream side. The slots act as radial fan blades when the hub is rotated, and draw air through the fairing 45, into the inner casing 17 around the bearings 27, through the openings 46 and 48 into the blades of the rotor 31 where it is discharged with the gas drawn through the passage 12 into the annular passage 21. This air cools the bearings 27.

Gas from the rotor 31 which leaks through the space between the back plate 33 and the wall 39 and would otherwise leak into the inner casing 17 and through the fairing 45 into the room in which the fan is located, is prevented from passing into the inner casing by the seal rings 50 and 51 which deflect such gas towards the opening 48 in the back plate 33, and cause such gas to be induced into the opening 48 by the ejector action of the air flowing through the opening 46 and the converging portion of the ring 50 which acts as an ejector muzzle.

The embodiment of the invention shown by FIGS. 4 and 5 is similar to that shown by FIGS. 1–3 except that instead of the central recess 55 and the radial slots 56 being provided in the back side of the hub 30, and the back plate 33 being provided with a central opening 48 around the shaft 28, the hub has eight holes 60 equally spaced-apart around the shaft drilled through the hub, with their axes diverging away from the back side of the hub. The inlets of the holes are at the back side of the rotor closely adjacent to the adjacent portion of the shaft 28, the seal ring 51 extending around such inlets.

In the operation of FIGS. 4 and 5, the holes **60** act as auxiliary fan blades which when the rotor **31** is rotated, draw air from the atmosphere around the fan through the opening **46**, the interior of the inner casing **17** around the bearings **27**, and the fairing **45**. The seal rings **50** and **51** act to prevent the escape of gas from the rotor into the atmosphere around the fan, as described in connection with FIGS. 1–3.

What is claimed is:

1. In a fan having an outer casing, circular in section, a smaller inner casing, circular in section, within said outer casing and concentric therewith, said inner casing having a closed downstream end wall, and having an upstream end wall having a central opening around the axis of said casings, a radial flow fan rotor having a back plate adjacent to and extending substantially parallel to said upstream wall, said rotor having a front plate spaced from said back plate and having fan blades supported between said plates, a hub attached to said back plate, a shaft attached to said hub and extending through said central opening into said inner casing, bearings in said inner casing around said shaft, and having air supply means extending through said outer casing into said inner casing, the combination therewith of auxiliary fan means for drawing air through said supply means into the interior of said inner casing and said central opening and discharging such air into said fan blades, said auxiliary fan means comprising passages in said hub having air inlets adjacent to said shaft and having air outlets spaced from said shaft larger distances than said inlets are spaced from said shaft, and sealing means for preventing the escape of gas from said rotor through said central opening, said sealing means comprising an annular ring attached to said upstream end wall around said central opening, and having a first portion converging towards said hub and a second annular ring attached to said rotor around said air inlets and having a portion around and spaced from said first portion.

2. In a fan having an outer casing, circular in section, a smaller inner casing, circular in section, within said inner casing and concentric therewith, said inner casing having a closed downstream end wall, and having an upstream end wall with a central opening around the axis of said casings, a radial flow fan rotor having a back plate adjacent to and extending substantially parallel to said upstream end wall, said rotor having a front plate spaced from said back plate and having fan blades supported between said plates, a hub having a portion attached to said back plate, a shaft attached to said hub and extending through said central opening into said inner casing, bearings within said inner casing around said shaft, and having air supply means extending through said outer casing into said inner casing, the combination therewith of auxiliary fan means for drawing air through said supply means into said inner casing and through said central opening and discharging such air into said fan blades, said

auxiliary fan means comprising radial slots in the downstream side of said hub portion, said plate having a clearance opening around said shaft at the inner ends of said slots, and sealing means for preventing the escape of gas from said rotor through said central opening into said inner casing, said sealing means comprising an annular ring attached to said upstream wall around said central opening and having a first portion converging towards said hub, and a second annular ring attached to said back plate around said clearance opening and having a portion around and spaced from said first portion.

3. In a fan having an outer casing, circular in section, a smaller inner casing, circular in section, within said inner casing and concentric therewith, said inner casing having a closed downstream end wall, and having an upstream end wall with a central opening around the axis of said casings, a radial flow fan rotor having a back plate adjacent to and extending substantially parallel to said upstream end wall, said rotor having a front plate spaced from said back plate and having fan blades supported between said plates, a hub attached to said back plate, a shaft attached to said hub and extending through said central opening into said inner casing, bearings within said inner casing around said shaft, and having air supply means extending through said outer casing into said inner casing, the combination therewith of auxiliary fan means for drawing air through said supply means into said inner casing and through said central opening and discharging such air into said fan blades, said auxiliary fan means comprising a plurality of spaced apart holes extending from adjacent to said shaft into the downstream side of said hub through said hub with their axes diverging towards said blades, and sealing means for preventing the escape of gas from said rotor through said central opening into said inner casing, said sealing means comprising an annular ring attached to said upstream wall around said central opening and having a first portion which converges towards said hub, and a second annular ring attached to the downstream side of said hub around said shaft, and having a portion around and spaced from said first portion.

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