Dec. 31, 1940. O. WECHSBERG ET AL 2,226,986

BLOWER FOR ANNEALING FURNACES AND THE LIKE

Filed March 7, 1938 2 Sheets-Sheet 1

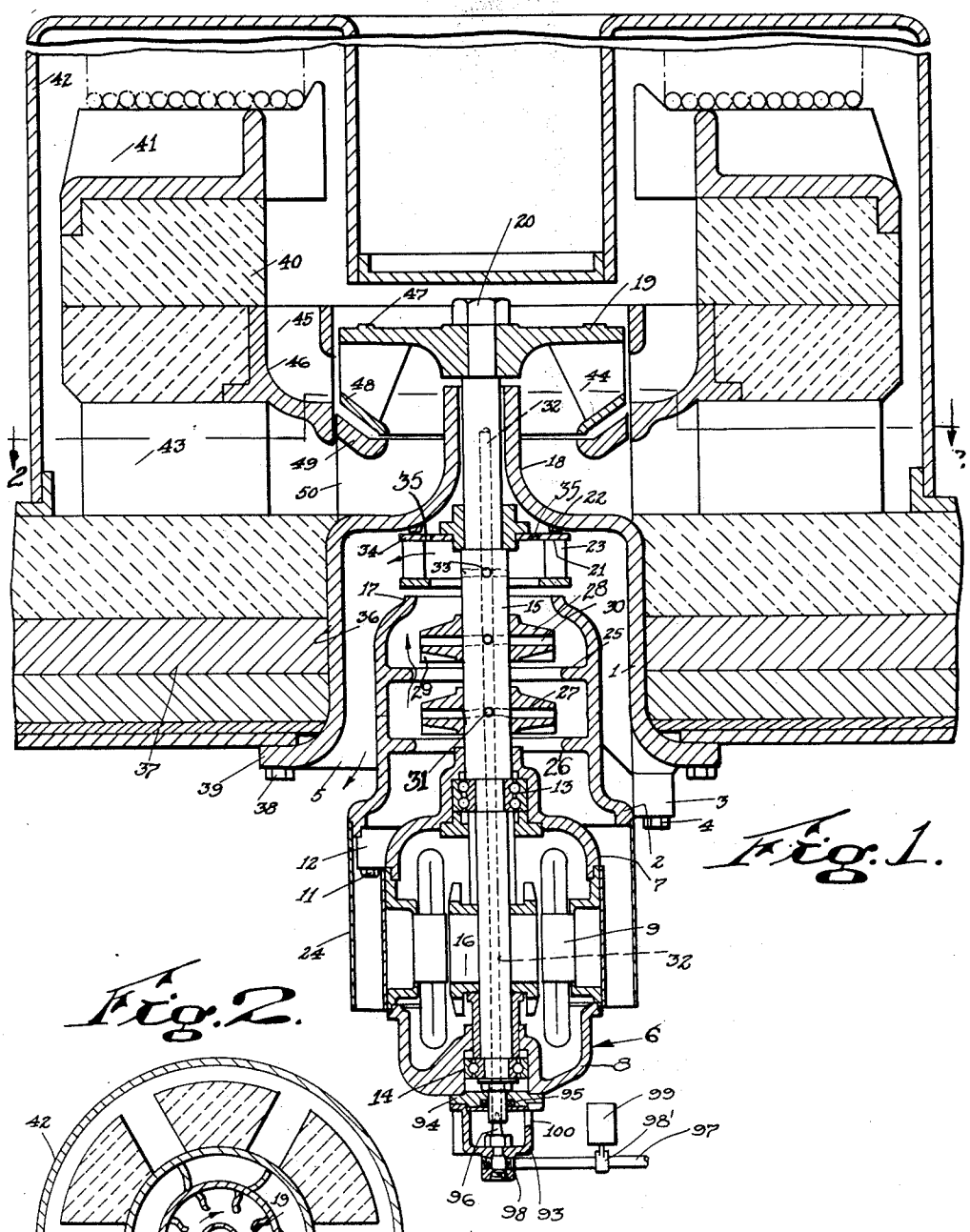
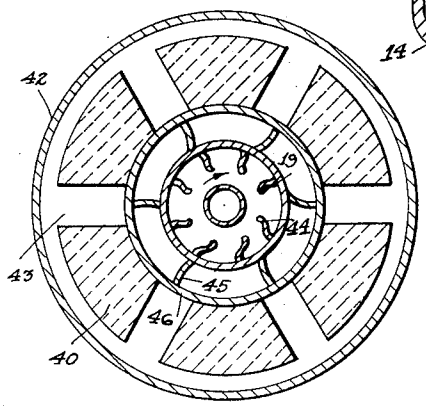


Fig. 1.

Fig. 2.



Inventors:
Otto Wechsberg
Helmut Werner
By Geo. A. Kennedy Jr.
Attorney

Dec. 31, 1940. O. WECHSBERG ET AL 2,226,986

BLOWER FOR ANNEALING FURNACES AND THE LIKE

Filed March 7, 1938 2 Sheets-Sheet 2

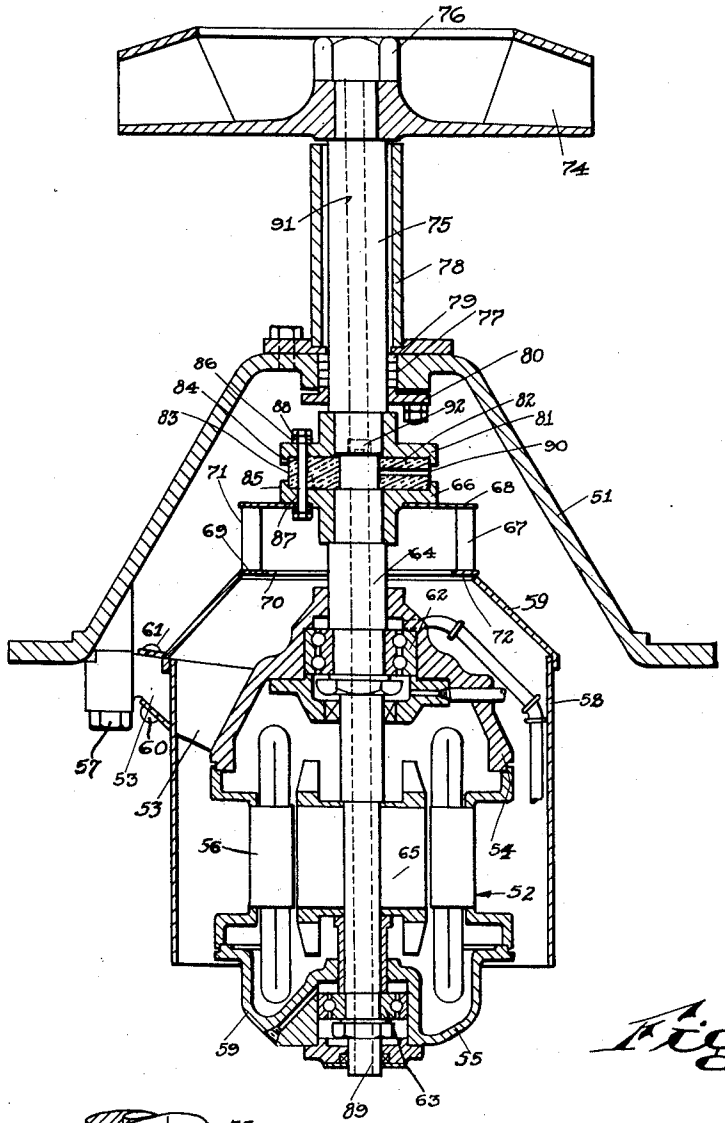


Fig. 3.

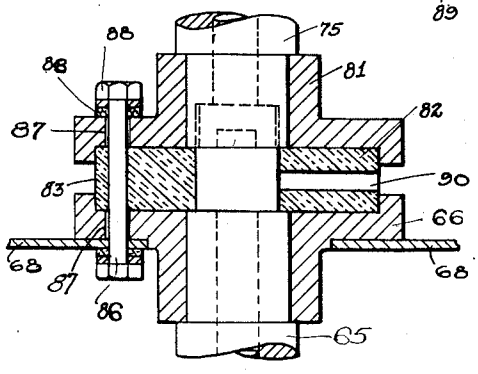


Fig. 4.

Inventors:
Otto Wechsberg
Helmut Werner
By Geo. W. Kennedy Jr.
Attorney

Patented Dec. 31, 1940 2,226,986

UNITED STATES PATENT OFFICE

2,226,986

BLOWER FOR ANNEALING FURNACES AND THE LIKE

Otto Wechsberg and Helmut Werner, Worcester, Mass., assignors to Coppus Engineering Corporation, Worcester, Mass., a corporation of Massachusetts

Application March 7, 1938, Serial No. 194,383

10 Claims. (Cl. 230—209)

The present invention invention relates to a blower especially for use in distributing or circulating the hot gases in annealing furnaces, and is particularly directed to a blower in which the driving mechanism is kept at a suitable operating temperature by the circulation of a cooling fluid. This is a continuation-in-part of our copending application, Serial No. 126,262, filed February 17, 1937, for Blower for annealing furnaces and the like.

Where the blower operates in a high temperature, as for example, in furnaces for annealing, or otherwise treating metals, the fan is necessarily located in an atmosphere of extremely high temperature. As a result, heat from the fan is conducted along the driving shaft of the fan to the bearings which support the shaft and to the driving mechanism, which may be suitable gearing or a driving motor. It is obvious that too much heat in the bearings or driving mechanism will detrimentally affect the operation and life of the blower, and it is accordingly the principal object of the present invention to provide for so completely cooling the driving shaft for the fan, that the bearings for the shaft will not become overheated and that the driving mechanism may not be affected by the conducted heat.

In carrying out the objects of the invention the essential feature is to provide for the circulation of sufficient fluid around or through the drive shaft between the fan on the end thereof and the supporting structure, so that the heat transmitted along the shaft may be entirely dissipated and thereby keep the portions of the shaft adjacent to the bearings and driving mechanism at a relatively low temperature. This cooling action must be obtained without any connection to the interior of the furnace or oven, and the fan must be so arranged that there will be no substantial leakage of the gas from within the furnace by passing around the fan shaft or the supporting structure therefor.

Where the bearings are cooled by a structure functioning only while the blower is in operation, there is the danger of damage to the bearings upon failure of the driving mechanism for the blower Thus a further object of the present invention is to provide for keeping the bearings at a relatively low temperature even when the blower is not in operation. This feature of the invention may be obtained either by a structure which is functioning at all times or by a structure which becomes operative upon failure of the driving mechanism for the blower.

Other and further objects and advantages of the invention will hereinafter more fully appear from the following detailed description taken in connection with the accompanying drawings in which—

Fig. 1 is a vertical sectional view through a device embodying the invention, showing the device in position in the wall of an annealing furnace.

Fig. 2 is a horizontal sectional view along the line 2—2 of Fig. 1.

Fig. 3 is a sectional view similar to Fig. 1, showing a modification.

Fig. 4 is a fragmentary sectional view on a larger scale, of a part of Fig. 3.

Like reference characters refer to like parts in the different figures.

Referring first to Fig. 1, the device of the invention comprises a base 1 by which the blower is mounted in the wall of a chamber, such as a furnace or oven, as will hereinafter appear. The base 1 has connected thereto a main housing 2 which is positioned within the base and has projecting lugs 3 by which the base and housing are held in predetermined relation. Bolts 4, extending through the lugs secure the base and housing together, the latter being spaced from the base to define an annular air passage 5.

The frame 6 of an electric motor is mounted on the lower end of the housing 2 and comprises the end caps 7 and 8 between which is clamped the stationary winding 9 of the motor. The caps 7 and 8 are suitably secured together, as by bolts, not shown, and the motor frame is secured by bolts 11 to the housing 2, the bolts 11 passing through lugs 12 on the cap 7. The end caps 7 and 8 have antifriction bearings 13 and 14 which support the driving shaft 15 of the blower. The rotor 16 of the motor 6 is secured to the shaft 15, and the shaft is accordingly driven at a suitable rate of speed by the motor.

The shaft 15 projects upwardly from the motor through an opening 17 at the upper end of the housing 2, the latter being substantially larger in diameter than the shaft, and thence through a sleeve 18 forming an integral part of the base 1. The circulating fan 19 is secured to the end of the shaft 15, which projects beyond the end of the sleeve, a clamping nut 20 holding the fan securely on the end of the shaft. It will be clear that the sleeve 18 is slightly larger in diameter than the shaft 15 to permit expansion of the latter, as a result of the heating thereof, without engaging with, or binding in the sleeve.

For cooling the motor and shaft adjacent to the supporting bearings, a centrifugal cooling fan 21, of any suitable form, is located on the shaft 15 directly above the opening 17 in the housing 2, being positioned between said opening and a flat annular surface 22 provided by the base 1. The rotation of the fan thus sets up, through vanes 23 incorporated in the fan, a flow of air in the direction indicated by the arrows, the air being discharged through the

annular space provided between the housing 2 and base 1. The suction established by the fan 21 draws cool air in between the frame of the motor and a cylindrical shell 24 secured to and depending from the housing 2 and the cool air moves upwardly through the annular space or chamber between the housing 2 and the driving shaft for the fan, thus cooling the motor and the shaft.

For more effective cooling of the driving shaft, the housing 2 has inwardly extending flanges 25 and 26 between which is positioned a hub 27 secured to the driving shaft 15 for rotation therewith. A similar hub 28 is positioned between the upper flange 25 and the opening 17 in the upper end of the housing. Each of these hubs has radiating fins 29 extending radially of the hub for more effective radiation of heat from the hubs and shaft and to aid in the circulation of the cooling medium. The hubs are relatively wide adjacent to the shaft and taper to a relatively narrow periphery to aid the flow of air therearound. The hubs are substantially as large in diameter as the inner diameter of the flanges 25 and 26 to cause the air passing upwardly within the housing 2 to circulate over the entire surfaces of the hubs.

Each of the hubs has radial channels 30, Fig. 1, therein which are in line with corresponding channels 31 in the shaft 15. The channels 31 intersect a vertical bore 32 in the shaft 15, the bore extending from the lower end thereof to a point adjacent the upper end. In manufacture, it may be desirable to have the bore extend the entire length of the shaft and a suitable plug placed in the upper end thereof. The rotation of the hubs 27 and 28, together with the suction established by the fan 21, causes a movement of air upwardly through the bore 32 in the shaft 15 and discharges it through the channels 30, thereby effectively cooling the shaft to a point above the upper bearing for the shaft. In addition, the shaft 15 may have radial channels 33 intersecting the bore 32 in alinement with the fan 21.

The circulating fan 19 is frequently intended to operate in an atmosphere of inert gas and to prevent the cooling air from passing upwardly between the shaft 15 and the sleeve 18, the upper plate 34, which forms a part of the cooling fan 21, has small perforations 35, so that the space between the shaft and the sleeve 18 is maintained under a slight vacuum, with the result that no air passes upwardly into the chamber in which the fan is located. The amount of inert gas entering the blower from the furnace is negligible because of the relatively slight vacuum. Any suitable means, not shown, may be provided for assuring a supply of grease to the bearings at both ends of the motor.

One example of an installation where a fan of the character above described would be especially useful is best shown in Fig. 1. Referring to this figure, the base 1 of the device is positioned within a cylindrical opening 36 in the bottom wall 37 of a suitable chamber, which in the drawings is an annealing furnace, being held therein by bolts 38 passing through a flange 39 on the base. The bottom wall 37 has plates of insulating material and within the annealing furnace are located annular rings 40 of suitable insulating material, on the top of which the material to be annealed is positioned. The material, in the particular embodiment shown, is coils of wire which are stacked on supports 41 on the annular rings. An annular hood 42 covers the material to be annealed and suitable means, not shown, provide for heating the gas within the hood. The fan 19 directs the inert gas in a circular path, the gas passing upwardly along the inside of each coil of wire and downwardly adjacent the outside of the chamber, being directed back to the underside of the fan through the channels 43 provided in one of the supporting rings 40. By the provision of a positive current of gas within the furnace, it is possible to assure a uniform heating of the material within the furnace without overheating of any portions thereof. At the same time, although the fan which establishes the gas currents is in an atmosphere of extremely high temperature, the provision for cooling the driving shaft of the fan is such that the driving shaft and the mechanism associated therewith does not become sufficiently hot at the bearings thereof to affect the operation of the blower in any way whatever. It will be noted that the blower provides for the circulation of the cooling fluid without the necessity for any auxiliary apparatus for circulating the cooling fluid.

The fan 19 for the circulation of the inert gas within the furnace may be of any suitable character, but is shown as an impeller type having vanes 44, Fig. 2, cooperating with similar vanes 45 on an annular ring 46 mounted on one of the annular insulating rings 40. The vanes 44 are positioned between the hub 47 of the fan and an annular ring 48, which acts as a guide for the gas currents. A corresponding ring 49 integrally connected to the base 1 by webs 50 cooperates in guiding the inert gas within the furnace through the fan.

The blower has been shown in connection with one specific form of annealing furnace, but it is equally applicable to other installations where the circulating fan must be located in an atmosphere of relatively high temperature which would affect the operation of the blower if no provision were made for cooling.

With reference now to Fig. 3, which shows a modified form of the device, the base 51 is mounted within the wall of the furnace or oven in a manner similar to that of the base 1 above described. A driving motor 52 is secured to the base, as by lugs 53, which are integral with one of the end caps 54 and 55 between which is clamped the stationary winding 56 of the motor. The lugs 53 are connected to the base by suitable bolts 57.

A housing 58 surrounds the motor in spaced relation thereto to define an annular passage therebetween, and the upper portion 59 of the housing is spaced from the base 51 to define an annular passage outside of the housing. The housing is secured as by rivets 60 and 61 to the lugs 53.

The end caps 54 and 55 of the motor are provided with suitable anti-friction bearings 62 and 63 which support the drive shaft 64 of the motor. The rotor 65 is mounted on the shaft 64 and the latter is accordingly rotated at the desired rate by the motor.

The shaft 64 projects upwardly from the motor and has a flanged ring 66 secured to the end thereof, as by being shrunk on the shaft, and directly below the flanged ring is mounted a cooling fan 67. The fan comprises an upper disk 68 secured to the flanged ring, a flat lower disk 69 having a large central opening 70 and vanes 71 extending between the two disks. The disk 69

is positioned just above the central opening 72 at the upper end of the housing 58, and, as a result of the rotation of the fan, air is drawn upwardly between the motor 57 and the depending skirt of the housing for cooling the motor and bearings and the air is discharged outwardly by the fan 67 to escape downwardly through the annular passage between the housing and the base.

The circulating fan 74, which is positioned within the furnace, is mounted upon the upper end of a shaft 75, being held thereon as by a clamping nut 76. The shaft extends downwardly through a central opening 77 in the upper end of the base 51 and also through a sleeve 78 which extends upwardly from the opening 77. Suitable packing 79 may be provided within the opening 77 to prevent leakage of hot gases from within the furnace with a gland 80 to hold the packing in position.

On the lower end of the shaft 75 is mounted a flanged ring 81 similar to the ring 66, and a disk 82 of solid insulating material is positioned between the two flanges to hold them in spaced relation. The insulation utilized may be of any suitable character which will withstand the high temperatures encountered, one form of this insulation being that commercially available under the trade name of "electrobestos." The disk of insulating material has its outer cylindrical surface 83 machined to fit securely within the axially-extending annular flanges 84 and 85 on the flanges 81 and 66 respectively, and the two flanges with the insulation therebetween are held together by suitable bolts 86.

As best shown in Fig. 4, the openings 87 in the flanges 66 and 81, through which the bolts 86 extend, are larger in diameter than the bolts, to prevent the conduction of heat from the upper to the lower flange, and the heads of the bolts, as well as the nuts on the opposite ends thereof, are insulated from the flanges by small washers 88 of insulating material, preferably of the same character as that forming the disk 82. Thus the shafts 75 and 65 are held in accurate alinement with each other and function as a unitary shaft without the possibility of the conduction of any substantial amount of heat along the shaft from the circulating fan 74 to the bearings 62 in the motor. The insulating disk 82 is effective whether the motor is functioning or at rest, and accordingly acts as a safeguard in the event of a power failure which would otherwise result in damage to the bearings 62.

For further cooling of the bearings and for decreasing the amount of heat conducted along the shaft 64, the latter is hollow, having a central bore 89 open at both ends thereof. The disk 82 has radially extending openings 90, which, during a rotation of the shaft, provide for an outward movement of the air through the passages by reason of centrifugal force, thereby providing for a constant inflow of cool air through the opening in the lower end of the shaft and for a discharge of air into the base around the outer ends of the passages 90. The amount of heat conducted from the circulating fan 74 downwardly toward the motor may be further decreased by providing the shaft 75 with a central bore 91, the lower end of which is sealed by a plug 92. It is well known that a hollow shaft will conduct heat much less rapidly than a solid shaft since the cross-sectional area of metal for transmitting heat is greatly decreased when the shaft is hollow.

By this structure the bearing 62 is kept cool at all times when the motor is functioning, since the fan 67 provides for a circulation of cool air around the bearing, and since the radial openings 90 provide for a movement of cool air through the shaft 64. In the event that the motor fails to operate, the bearing 62 will still be protected against overheating since the disk of insulating material 82 will resist the transfer of heat from the upper shaft 75 to the lower shaft 64 and prevent any damage to the bearing.

The structure of Figs. 1 and 2 may be similarly protected against overheating upon failure of the motor to function. To this end a cap 93 is mounted on the lower end of the end cap 8 through the medium of a disk 94 which has packing 95 therein. Suitable bolts, not shown, may hold the cap and disk in position. The cap has an upwardly extending nozzle 96 which extends into the end of the bore 32 in the shaft 15. The nozzle is smaller than the bore so that there is a passage between the nozzle and the bore for the discharge of cooling fluid directed within the shaft by the nozzle and the pressure of the cooling fluid is such that the nozzle discharges fluid upwardly to a point between the upper bearing 13 and the lowermost radial channel 31 in the shaft 15. A supply of cooling fluid is provided by a conduit 97 connected to a port 98 in the cap 93 and the supply of cooling fluid is controlled by a valve 98' which is normally closed and held closed by a solenoid 99 connected in the power supply for the motor. Upon failure of the power supply, the solenoid is deenergized and the valve 98 automatically opens so that the cooling fluid will be directed upwardly within the shaft 15. An opening 100 is provided in one side of the cap for the discharge of the cooling fluid flowing out of the shaft.

While the blower is operating, air is circulated through the chamber defined by the housing 2, the latter acting as a partition to define the annular chamber around the radial hubs 27 and 28. The housing 2 is spaced from the base 1 to define a passage which communicates at its upper end with the chamber inside of the housing 2, and this passage is in effect a continuation of the chamber within the housing so that air drawn upwardly through the chamber by the fan 21 can be discharged outwardly through the passage between the housing and base.

From the foregoing, it will be apparent that the device functions to maintain the bearings cool during fan rotation by circulating a coolant around said bearings or through the shaft to a point between the bearings and the fan. A further protection is the provision for preventing transfer of heat to the bearings when the motor is not rotating, either by circulating a cooling fluid through the shaft, as in Fig. 1, or by breaking the shaft and inserting insulation between the fan and the adjacent bearing. The shafts 64 and 75 are functionally integral, being rigidly connected together where the insulation is inserted, and function as a single shaft. Thus, in certain of the claims, the term "shaft" includes the alined shafts 64 and 75, as will be apparent.

We claim:

1. A blower, comprising a housing adapted to be positioned in the wall of a chamber within which hot gases are located, a shaft journalled in said housing with its inner end extending beyond the housing and into the chamber, a fan on said inner end, bearings provided by the housing for the shaft, radial fins on the shaft, said

housing having a partition defining a second chamber closely surrounding the fins and within which the fins are positioned, said partition also defining a passage communicating with the outside of the first chamber and extending from the end of the second chamber adjacent to the fan, and means on the shaft for circulating a cooling fluid through said second chamber and passage.

2. A blower, comprising a housing adapted to be positioned in the wall of a chamber within which hot gases are located, a shaft journalled in said housing with its inner end extending beyond the housing and into the chamber, a fan on said inner end, bearings provided by the housing for the shaft, said shaft being hollow from the end opposite the fan to a point between the fan and the adjacent bearing, a partition forming a part of said housing and defining a second chamber surrounding the shaft and communicating with the atmosphere outside of the first chamber and means on the shaft for circulating a cooling fluid through said shaft and discharging the fluid into said second chamber.

3. A blower, comprising a housing adapted to be positioned in the wall of a chamber within which hot gases are located, a shaft journalled in said housing with its inner end extending beyond the housing and into the chamber, a fan on said inner end, bearings provided by the housing for the shaft, said shaft being hollow from the end opposite the fan to a point between the fan and the adjacent bearing, a second fan on said shaft, the latter having openings to cause circulation of air from within the shaft to the outside thereof as the fan operates, a chamber surrounding said shaft, and fins on said shaft within the chamber, said second fan causing a movement of cooling fluid through said chamber.

4. A blower adapted for the circulation of hot fluids, comprising a housing adapted to be positioned in the wall of a chamber within which the fluids are circulated, bearings provided by said housing, a shaft journalled on the bearings with its inner end extending into the chamber, a fan on said inner end, said shaft being hollow from the end opposite the fan to a point between the fan and the adjacent bearing, radial fins on the shaft between the fan and the adjacent bearing, said housing having a partition defining a chamber within which the fins are positioned, and a second fan on the shaft for circulating cooling air around the fins, said shaft having openings therein adjacent to the fins and intersecting the hollow center of the shaft, whereby said second fan provides for a movement of cooling air through the shaft and out the openings as well as around the fins.

5. A blower, comprising a housing adapted to be positioned in the wall of a chamber within which hot gases are located, a shaft journalled in said housing and extending into said chamber, bearings for said shaft, a fan on the end of said shaft, said shaft having a bore extending from the end opposite to the fan to a point between the fan and the adjacent bearing, means for circulating a cooling fluid through said bore in response to rotation of the fan, and other means operative when the fan is not rotating for circulating a collant through said bore.

6. A blower, comprising a housing adapted to be positioned in the wall of a chamber within which hot gases are located, a shaft journalled in said housing, bearings for said shaft, a fan within the chamber and connected to the shaft, means for circulating a coolant through the shaft adjacent to the bearings in response to rotation of the shaft, and means operative when the shaft is not rotating for keeping the shaft cool adjacent to the bearing nearest to the fan.

7. A blower, comprising a housing adapted to be positioned in the wall of a chamber within which hot gases are located, a shaft journalled in said housing, bearings for said shaft, a fan within the chamber and connected to the shaft, means for circulating a coolant through the shaft adjacent to the bearings in response to rotation of the shaft, and means operative when the shaft is not rotating for keeping the shaft cool adjacent to the bearings, said last means comprising an insulating disk positioned in the shaft between the fan and the adjacent bearing.

8. A blower comprising a housing adapted to be positioned in the wall of a chamber within which hot gases are located, a shaft journalled in said housing with its inner end extending beyond the housing and into the chamber, a fan on said inner end, bearings provided by the housing for the shaft, at least one radial fin on the shaft, said housing having a partition defining a second chamber closely surrounding said fin, and a second fan on the shaft between the first fan and the fin for circulating a cooling fluid through said second chamber, said partition also providing a return passage from the second fan to the atmosphere outside the first chamber.

9. A blower comprising a housing adapted to be positioned in the wall of a chamber within which hot gases are located, a shaft journalled in said housing with its inner end extending beyond the housing and into the chamber, a fan on said inner end, bearings provided by the housing for the shaft, said shaft being hollow from the end opposite the fan to a point between the fan and the adjacent bearing, and a second fan on said shaft, said shaft having openings therein to cause circulation of air from within the shaft to the outside thereof as the second fan operates, said housing having a partition defining a second chamber communicating with the atmosphere outside the second chamber and into which the air from within the shaft is discharged.

10. A blower adapted for the circulation of hot fluids, comprising a housing adapted to be positioned in the wall of a chamber within which the fluids are circulated, bearings provided by said housing, a shaft journalled on the bearings with its inner end extending into the chamber, a fan on said inner end, said shaft being hollow from the end opposite the fan to a point between the fan and an adjacent bearing, at least one radial fin on the shaft between the fan and the adjacent bearing, said housing having a partition defining a second chamber closely surrounding the fin and within which the fin is positioned, and a second fan on the shaft for circulating cooling air around the fin and through the second chamber, said shaft having openings therein adjacent to the fins and intersecting the hollow center of the shaft, whereby said second fan provides for a movement of cooling air through the shaft and out the openings as well as around the fins, said second chamber communicating at opposite ends with the atmosphere outside the first chamber.

OTTO WECHSBERG.
HELMUT WERNER.