

Dec. 2, 1941.

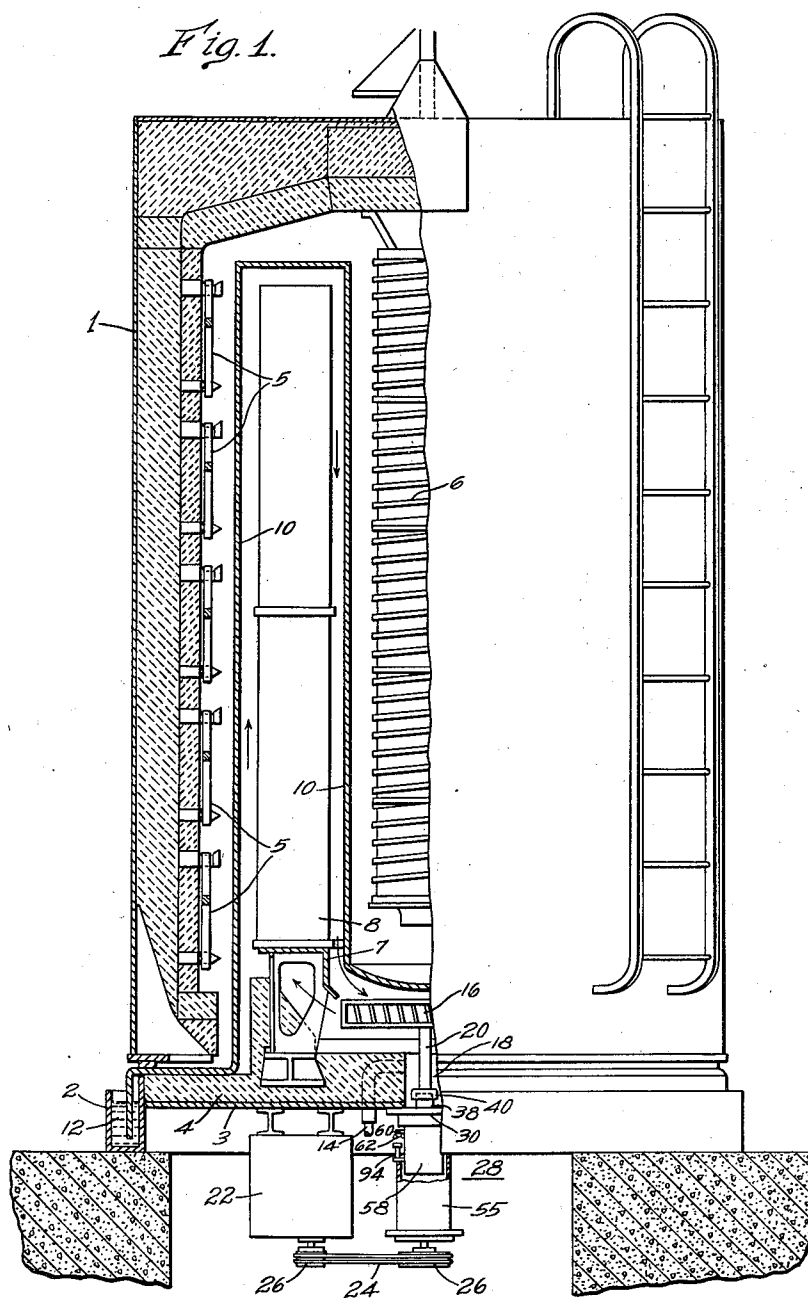
F. R. J. DAVIS

2,265,027

HEAT-TREATING FURNACE WITH CIRCULATING ATMOSPHERE

Filed July 28, 1938

5 Sheets-Sheet 1



WITNESSES:

C. J. Meller.

Bernard L. Zangwill

INVENTOR

Frederick R. J. Davis.

BY *O. B. Buchanan*
ATTORNEY

Dec. 2, 1941.

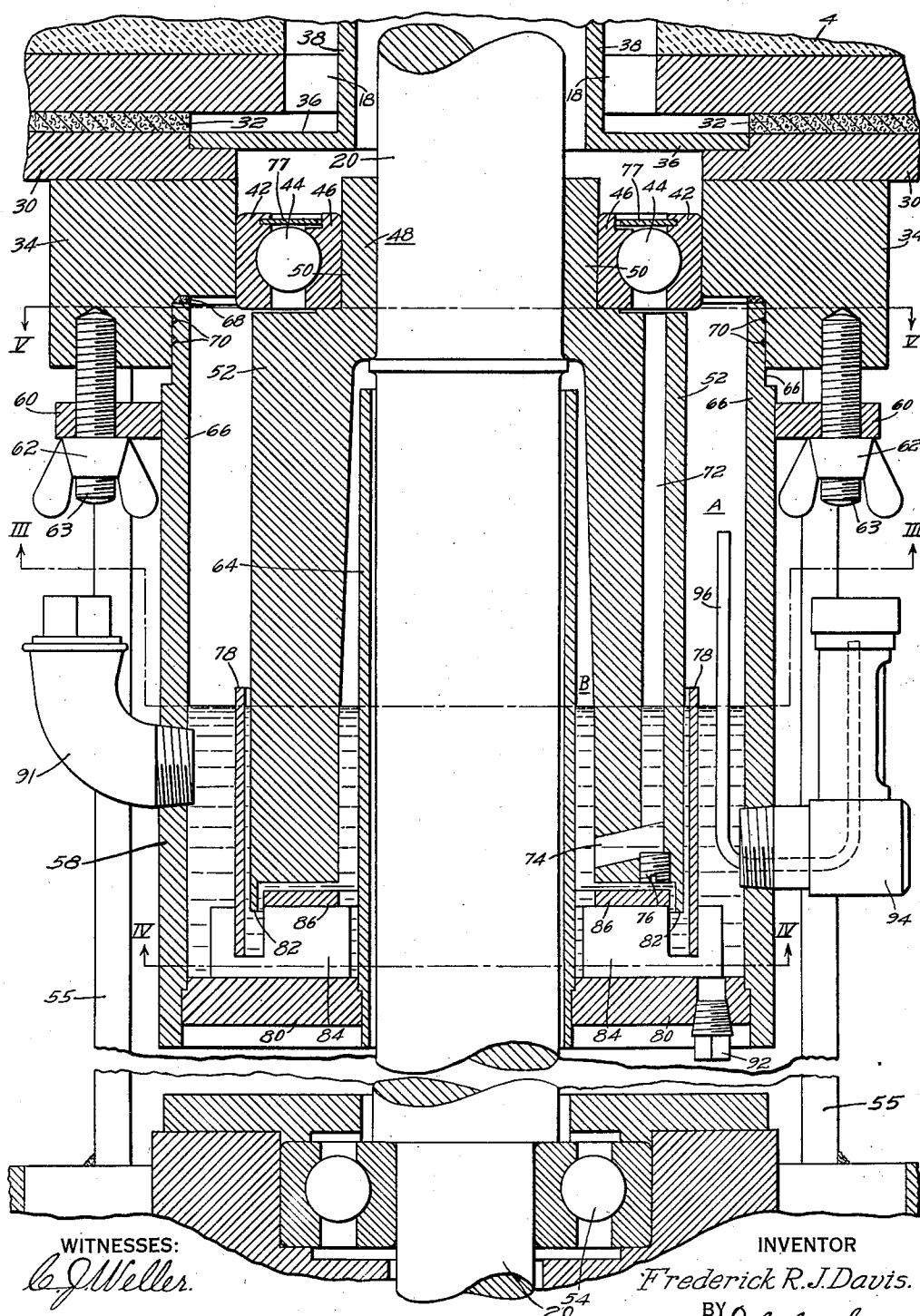
F. R. J. DAVIS

2,265,027

HEAT-TREATING FURNACE WITH CIRCULATING ATMOSPHERE

Filed July 28, 1938

5 Sheets-Sheet 2



WITNESSES:

C. J. Weller.

Bernard L. Zangwill

INVENTOR

Frederick R. J. Davis.

BY

O. B. Buchanan
ATTORNEY

Fig. 2.

Dec. 2, 1941.

F. R. J. DAVIS

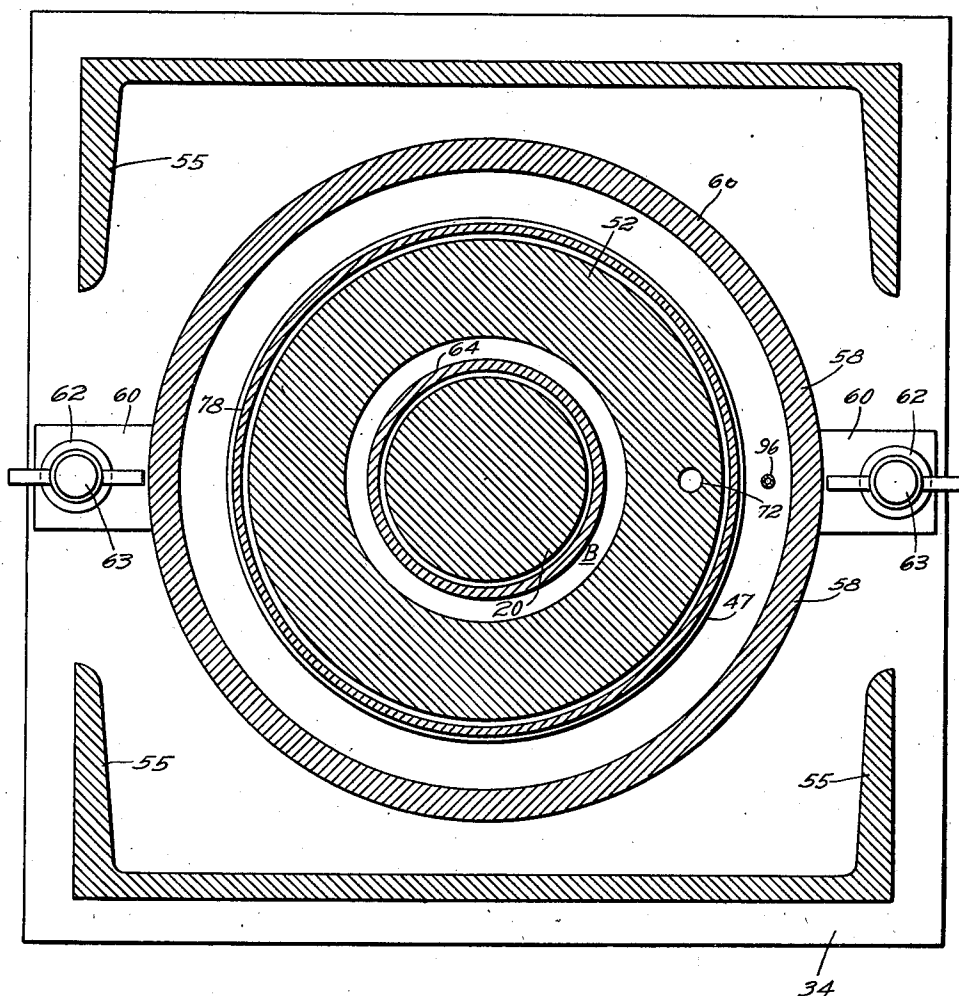
2,265,027

HEAT-TREATING FURNACE WITH CIRCULATING ATMOSPHERE

Filed July 28, 1938

5 Sheets-Sheet 3

Fig. 3.



WITNESSES:

C. J. Miller.

Bernard L. Zangwill

INVENTOR

Frederick R. J. Davis.

BY

O. B. Buchanan

ATTORNEY

Dec. 2, 1941.

F. R. J. DAVIS

2,265,027

HEAT-TREATING FURNACE WITH CIRCULATING ATMOSPHERE

Filed July 28, 1938

5 Sheets-Sheet 4

Fig. 4.

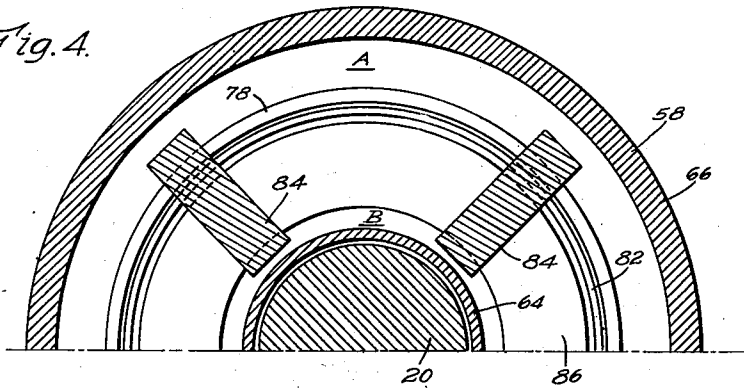
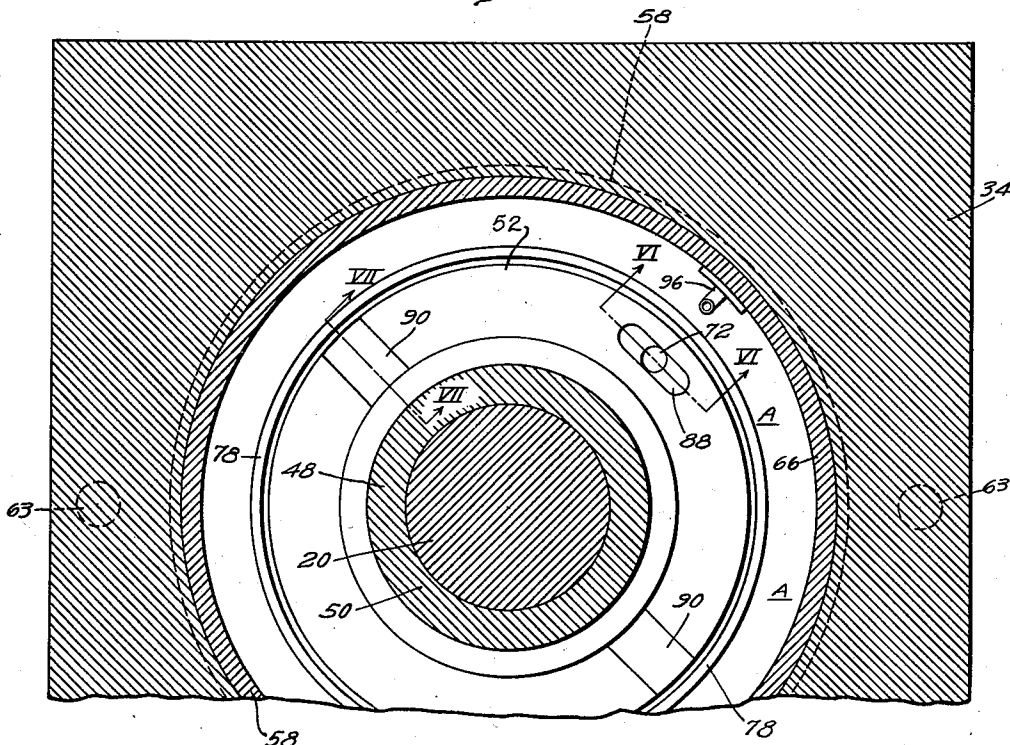


Fig. 5.



WITNESSES:

C. J. Weller.

Bernard L. Zangwill

INVENTOR

Frederick R. J. Davis.

BY *O. B. Buchanan*
ATTORNEY

Dec. 2, 1941.

F. R. J. DAVIS

2,265,027

HEAT-TREATING FURNACE WITH CIRCULATING ATMOSPHERE

Filed July 28, 1938

5 Sheets-Sheet 5

Fig. 7.

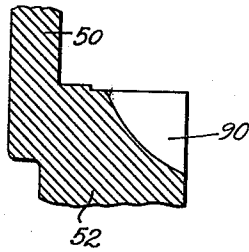


Fig. 6.

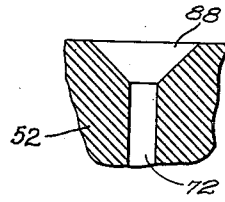
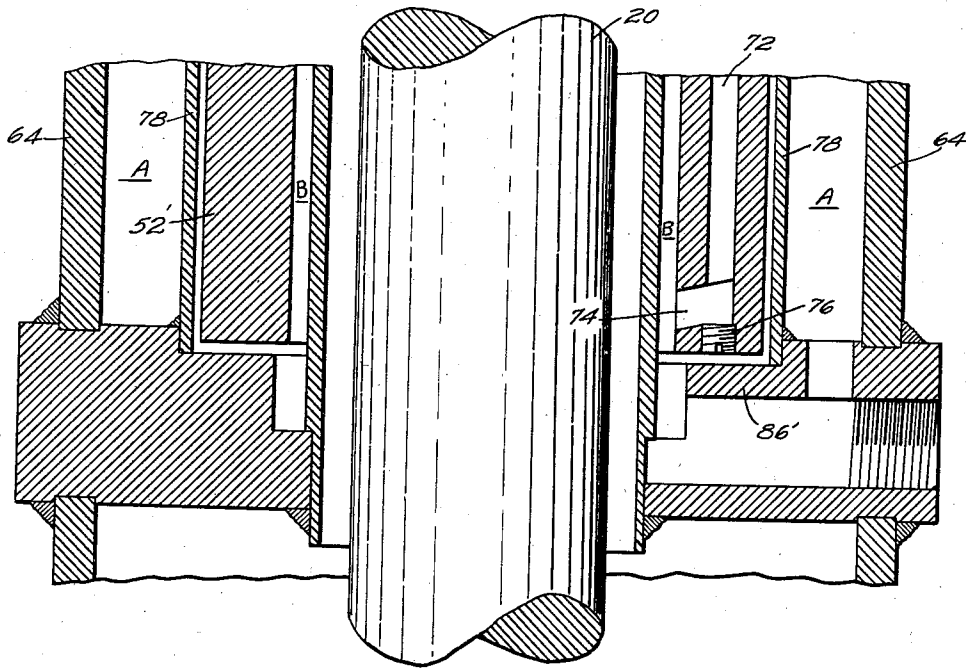


Fig. 8.



WITNESSES:

C. J. Miller.

Bernard L. Zangwill

INVENTOR

Frederick R. J. Davis.

BY

O. D. Buchanan
ATTORNEY

UNITED STATES PATENT OFFICE

2,265,027

HEAT-TREATING FURNACE WITH
CIRCULATING ATMOSPHERE

Frederick R. J. Davis, Irwin, Pa., assignor to
Westinghouse Electric & Manufacturing Com-
pany, East Pittsburgh, Pa., a corporation of
Pennsylvania

Application July 28, 1938, Serial No. 221,719

6 Claims. (Cl. 263—2)

In some types of furnaces, and particularly in heat treating furnaces, the atmosphere within the furnace may be other than air, or may be at a pressure other than atmospheric. In either case all joints are usually made tight or seals 5 provided to prevent the leakage of the inside atmosphere, or intermixing of exterior air therewith.

My invention relates to a seal for an element protruding through the furnace, which element 10 is capable of motion and is mounted or guided by a bearing which requires lubrication.

More specifically, the element is a shaft which is guided in whole or part by a bearing, in turn 15 secured in the furnace base, and which must be lubricated.

It is an object of my invention to provide a seal for an aperture in a furnace base or the like through which a vertical member extends and which member has motion imparted thereto. 20

It is a further object of my invention to provide an oil seal for a vertical, rotatable shaft extending through a furnace base, with the oil of the seal also lubricating and cooling the bearing supporting the shaft.

It is still another purpose of my invention to provide a seal of the type aforementioned which will not deteriorate with wear.

It is another purpose of my invention to provide a seal of the type aforementioned which does not require adjustment or attention other than an occasional replenishment of the lubricating and sealing oil.

It is a further object of my invention to provide a seal of the type aforementioned which is simple of construction, easy of manufacture, rugged, and eminently satisfactory in its operation.

A general object of my invention is to provide a leak-proof bearing housing, an oil circulating and cooling means for the bearing and an oil seal, all in a single unit.

It is still another object of my invention to provide a unit as aforesaid which can be readily assembled in and dismantled from a furnace.

It is a further object of my invention to provide a lubricating means for a guide bearing of a vertical, rotatable shaft, which lubricating means employs a centrifugal pump whereby any head drop of the oil is due only to internal friction within the pump. This head drop is low because there are no relatively rotating parts in the path of the oil, the path of the oil being confined, in my invention, to the runners of the pump rotating with the shaft.

my invention I employ a tubular member which I term an "oil finger." This oil finger is fitted to and rotates with the shaft that passes through an aperture in the base of the furnace. About the shaft is an annular oil pot into which the oil finger extends. The outer wall of this pot is sealed to the base of the furnace and the oil within the pot in conjunction with the oil finger forms the remainder of the seal. The finger has means for directing oil in a continuous stream onto the bearing which guides the shaft. This stream of oil after passing through the bearing flows back into the seal so that a continuous circulation of oil obtains when the shaft rotates. In my invention I further provide a device which reduces the swirling of the oil by the oil finger as the latter rotates in the oil seal. These specific elements and their operational relationship form additional features of my invention.

I so design my oil finger that I secure full advantages of a centrifugal pump for forcing the oil to the bearing. My device takes advantage of centrifugal force for changing the static oil in the oil chamber into an oil stream, and an important feature of my invention lies in the full use and application of centrifugal pressure for raising the oil, without drainage of oil or loss of oil volume and pressure.

Further innovations of my invention will be apparent from the following description, and accompanying drawings, on varying scales, in which

Figure 1 is a vertical view, partly in section and partly in elevation, schematically showing my invention applied to a particular furnace,

Fig. 2 is a vertical sectional view through the oil seal,

Fig. 3 is a sectional view taken on the line III—III of Fig. 2,

Fig. 4 is a sectional view taken on the line IV—IV of Fig. 2,

Fig. 5 is a sectional view taken on the line V—V of Fig. 2,

Fig. 6 is a sectional view taken on the line VI—VI of Fig. 5,

Fig. 7 is a sectional view taken on the line VII—VII of Fig. 5, and

Fig. 8 is a sectional view of a modification of a detail of my oil seal.

Referring more particularly to Figure 1, I show my invention applied to an electrically heated bell type furnace, although I desire it to be distinctly understood that my invention is applicable to any type of furnace regardless of the means by which the heat is generated or sup-

To accomplish the above and other objects of

plied thereto. The furnace is shown as having a bell 1 resting upon a base 2. The base 2 comprises a metallic shell 3 supporting fire brick or any other refractory 4 of good insulating properties. The furnace has electrical side heating elements 5 and center heating elements 6. Upon the base is a charge supporting frame 7 upon which a charge 8 is placed. A hood 10 completely encases the charge and is sealed on the outside by a water seal 12. Within the hood is a protective atmosphere supplied by an inlet pipe 14 and which may pass from the hood through an outlet pipe (not shown). Protective atmosphere is circulated by means of a centrifugal fan 16. In order to rotate this fan the base is provided with an aperture 18 through which passes a shaft 20 driven by a motor 22 secured to the shell 3 in any suitable manner. The drive between the motor and shaft is shown as comprising belts 24 and pulleys 26. Sealing the aperture is my improved oil seal and lubricating means generally indicated as 28.

Secured to the shell 3 is an annular plate member 30. This plate member is secured to the base by means of bolts or any other fastening means and has interposed between it and the shell a gasket 32, preferably of an asbestos material. Depending from the plate 30 and made integral therewith, as by welding, is a frame or ring 34 having stepped round bores, and on the other side of the plate 30 and also made integral therewith is a dust catcher comprising an annular base 36 with an upstanding cylindrical member 38. The dust catcher member 38 surrounds the shaft 20 and the latter has a cap 40 secured to the shaft covering the space between the member 38 and the shaft 20, so that dust from within the furnace cannot fall into the oil seal 28.

Fitted to the inner periphery of the inner step in frame 34 is a ball race 42 of a ball bearing 44 having an inner ball race 46. As shown in the figures, an irregular hollow tubular member 48 is gas-tightly fitted or secured to the shaft 20. In its preferred form, the tubular member 48 is generally cylindrical and comprises a cylindrical portion 50 which is gas-tightly fitted to and around the shaft 20, and a second cylindrical runner portion 52 of somewhat larger diameter than the shaft 20 and in concentric relation thereto. The two cylindrical portions 50 and 52 of the tubular member 48 are integral, with the runner portion 52 depending from the portion 50 and so arranged that the tubular member 48 is somewhat zigzag or stepped in any axial sectional view therethrough. While I have shown the tubular member 48 so that it has the appearance of two superposed hollow tubular member-portions in the form of hollow cylinders, with the upper one of lesser inner diameter than the lower one, it is obvious that the shaft 20 may be formed with a protruding part equivalent to the portion 50, and the cylindrical runner portion 52 may be secured to such a protruding part in any gas-tight manner. The ball race 46 fits around the portion 50 so that the shaft 20 is maintained in alignment within the aperture 18 by the bearing 44, another bearing 54 below the seal serving to take the vertical thrust of the shaft as well as providing a second aligning means for the shaft 20. The lower bearing parts and supports are secured in place by channels 55 secured in any suitable manner to the frame 34.

An annular oil chamber or pot 58 has aper-

tured ears 60 and may be secured to the frame 34 by means of wing nuts 62 threaded on bolts 63 imbedded in the frame 34 and passing through the apertured ears 60.

The pot 58 is annular in form and comprises an inner wall 64 paralleling the shaft in close proximity thereto and an outer wall 66 which fits against the inner periphery of the larger step in the frame 34. In order to provide an air tight seal between the frame 34 and the wall 66, I employ a gasket 68 between the edge of the wall 66 and the frame 34. As an additional precaution I may apply cement in grooves 70 in the exterior surface of the wall 66 to insure a seal between the pot and the frame 34 which is absolutely air tight. The oil in the oil pot 58 completes the seal of the aperture 18 and also lubricates the bearing 44 in a manner now to be described.

The normal level of the oil in the oil pot 58, when the shaft is stationary and the fan not in operation, is as shown. The cylindrical runner portion 52 depends into the oil pot 58, with its lower end considerably below the oil level of the oil in the oil pot. The cylindrical runner portion 52 of the tubular or cylindrical member 48 has drilled therein a vertical hole 72. A second substantially horizontal hole 74 is also drilled in the cylindrical runner portion 52 to meet the hole 72. The resultant passage in the cylindrical runner portion 52 has one opening in proximity to the balls of the ball bearing 44 and the other opening axially inwardly thereof below the oil level so that oil tends to flow into the passage as it seeks a natural level. The vertical bore 72 is closed at its bottom end by a screw 76 so that when the cylindrical member 48 rotates oil will be forced upward through the bore 72 by the centrifugal action upon the oil. In this way a continuous jet of oil is supplied to the bearing 44.

Any oil tending to go upwardly beyond the bearing 44 is diverted back by an annular sealing ring 77 pressed into a suitable groove in the stationary race 42 and extending over a shoulder formed in the upper part of the rotating race 46. Clearance is provided between the ring 77 and race 46 to allow free rotation of the latter, and also has an additional purpose to be described subsequently.

A slight clearance is provided between the upper edge of the cylindrical runner portion 52 and the lower edge of the stationary ball race 42 to permit free rotation of the former and additionally to permit oil which has been forced into the bearing to flow back into the oil pot.

The clearance between the ring 77 and race 46, and the clearance between the cylindrical runner portion 52 and the race 42 also serve the purpose of providing a vent whereby the pressure within the furnace is transmitted to the space A between the outer wall 66 of the pot 58 and the outer surface of the cylindrical runner portion 52. The gas pressure in the furnace (which ordinarily does not exceed 2" of water) will be transmitted through the ball bearing to the space A, thereby depressing the oil level in this space and raising it in the space B between the inner wall 64 of the pot and the inner surface of the cylindrical runner portion 52 until the difference in the height of the oil in the spaces A and B represents the difference of pressure between the furnace gas pressure applied to the oil in the space A and atmospheric pressure applied to the oil in space B. I deliberately make the space

B much smaller in cross sectional area than space A so that the amount of oil displaced will cause only a slight lowering of the oil level in space A.

It may, therefore, be observed that my construction provides a combined oil seal and lubricating means. When the shaft rotates, the cylindrical member 48 throws a jet of oil into the bearing 44 and at the same time the submerging of the end of the cylindrical runner portion 52 in the oil insures a seal between the interior atmosphere of the furnace and the outside air. It is, of course, understood that the fits between the base 3, the plate 30, the ring 34 and the upper edge of the oil pot wall 66 are such as to be air tight, as is the fit between the shaft and the cylindrical member 48.

It may be further observed that the ring 77 provides a means which will prevent oil, either thrown by the jet or by centrifugal action in the bearing, from entering the furnace through the aperture 18.

To further facilitate oil circulation, the drilled hole 72 may have its outlet opening flared, as shown at 88 of Figs. 5 and 6. Also at different points along the top of the cylindrical runner portion 52 slots 90 may be formed permitting oil to flow more readily back into the oil pot. However, these last expedients are refinements to the more general principles of my invention and can be omitted if desired, since the force of the oil jet can be controlled by the size of hole 72, and the clearance between the cylindrical runner portion 52 and bearing 44 made sufficiently large to insure adequate drainage of oil from the bearing to the oil pot. This drainage is moreover aided by the centrifugal action of the upper surface of the cylindrical runner portion 52 which will tend to throw the oil outward.

As the cylindrical member 48 rotates, a swirling action of the oil might occur in the space A which has been deliberately made relatively large compared to the space B for the reasons aforesaid. In order to limit and minimize this swirling action, I secure a cylinder 78 in the oil pot, which cylinder is closely spaced from the cylindrical runner portion 52. I prefer to make this cylinder 78 protrude above the oil level in the oil pot, with its lower end terminating somewhat above a base plate 80 of the oil pot to provide an oil passage between the spaces A and B, below the cylinder 78. To further reduce the swirling of oil, the cylindrical runner portion 52 is provided with a depending flange 82, and a spider member is provided on the base 80, having spaced webs 84 upon which an annular disc 86 is secured having its outer periphery in proximity to the flange 82 but having a slightly smaller outside diameter. Such a construction provides a narrow labyrinth passage at the lower end of the rotating tubular or cylindrical member 48.

The webs 84 further supply a convenient means upon which to mount the cylinder 78, since I may form these webs with cut-out portions in which the cylinder member 78 may rest.

The oil pot has the additional common appurtenances such as a filler pipe 91, drain plug 92, and an oil gauge 94 having an equalizer tube 96.

In Fig. 8, I show a modified construction of the expedients for limiting swirling of oil in the oil pot when the tubular or cylindrical member 48 rotates. In Fig. 8, the cylindrical runner portion 52' is the equivalent of the cylindrical runner portion 52 of the prior embodiment, with

the exception that its bottom end is not provided with a flange such as the flange 82. The cylindrical runner portion 52' terminates only slightly above the base plate of the oil pot.

The base plate is centrally, cylindrically cut away or grooved to provide a short vertical wall to which the swirl-limiting cylinder 78 may be secured, so that only a narrow oil space is provided on the outside of the lower part of the cylindrical runner portion 52'. To permit a sufficient quantity of oil to flow from the oil space A to the oil space B, the base plate of the oil pot has a relatively deep central groove near the inner wall of the oil pot, and has holes therein, such as shown in the lower right of Fig. 8, through which oil in the space A can flow to the space B.

While I have illustrated my invention in forms which I now believe to be the best mode of application thereof, it is obvious that many changes may be made within the spirit and scope of the device which I have introduced. The bearing force-lubrication means, which has been shown and described herein, is claimed per se in a divisional case, Serial No. 339,447, filed June 8, 1940.

I claim as my invention:

1. In combination, a furnace having a charge-heat-treating chamber in which the charge is enveloped by a gaseous atmosphere, said furnace comprising a base for said heat-treating chamber, said base having an aperture therethrough; a fan in said heat-treating chamber for circulating the gaseous atmosphere in said heat-treating chamber; means comprising a rotatable shaft extending through said aperture, for driving said fan; a bearing for said shaft, below said fan; sealing means for preventing leakage of gas through said aperture, said sealing means comprising an oil pot secured to said base, exposed to the surrounding atmosphere, and a tubular-member means gas-tightly secured to and around said shaft, and depending into oil in said oil pot, said tubular-member means being operative during rotation of said shaft, for directing oil from said oil pot to said bearing for lubricating said bearing.

2. In combination, a furnace having a charge-heat-treating chamber in which the charge is enveloped by a gaseous atmosphere, said furnace comprising a base having an aperture therethrough; a fan in said heat-treating chamber for circulating the gaseous atmosphere in said heat-treating chamber; means comprising a rotatable shaft extending through said aperture for driving said fan; a bearing for said shaft; a generally tubular member encircling said shaft, said generally tubular member being gas-tightly secured to and around said shaft for rotation therewith, and comprising a tubular-runner-portion below said bearing, spaced about and from said shaft; an oil pot about said shaft having a stationary wall between said tubular-runner-portion and said shaft; said tubular-runner-portion having means, operative during rotation of said shaft, for lubricating said bearing with oil in said oil pot, said tubular-runner-portion extending into said oil pot for preventing, in cooperation with the oil in said oil pot, leakage of gas along said shaft, and means for preventing gas-leakage through said aperture between said base and said oil pot.

3. A furnace having a heat-treating chamber for heat-treating a charge in a controlled atmos-

phere under a slight pressure, said furnace comprising a base, a fan in said heat-treating chamber, a rotatable shaft extending through an aperture in said base and to which said fan is secured, motor means outside said furnace, for rotating said shaft, a bearing for said shaft, said bearing being below said fan, a generally tubular member gas-tightly secured to and around said shaft for rotation therewith, said generally tubular member comprising a substantially cylindrical-runner-portion means concentrically positioned with respect to said shaft, an oil pot below said bearing, having inner and outer walls, said substantially cylindrical-runner-portion means depending into said oil pot between said walls and extending below the oil level of the oil adapted to be contained in said oil pot, said substantially cylindrical-runner-portion means being operative during rotation of said shaft for delivering oil adapted to be contained in said oil pot, for lubricating said bearing, and gas sealing means between said oil pot and said base.

4. A furnace having a heat-treating chamber for heat-treating a charge in a controlled atmosphere under a slight pressure, said furnace comprising a base, a fan in said heat-treating chamber, a shaft extending through an aperture in said base, and to which said fan is secured, motor means outside said furnace, for rotating said shaft, a bearing for said shaft, said bearing being below said fan, a generally tubular member gas-tightly secured to and around said shaft for rotation therewith, said generally tubular member comprising a substantially cylindrical-runner-portion means concentrically positioned with respect to said shaft, a substantially annular oil pot about said shaft below said bearing, said oil pot having inner and outer walls, said substantially cylindrical-runner portion means depending into said oil pot between said walls and extending below the oil level of the oil adapted to be contained in said oil pot, said substantially cylindrical-runner-portion means being operative during rotation of said shaft to pump oil adapted to be contained in said oil pot, for lubricating said bearing, said cylindrical-runner-portion means being positioned further from said outer wall than said inner wall, and gas-tight sealing means between said oil pot and

said base, whereby leakage of gas through said aperture in said base is prevented.

5. A furnace having a heat-treating chamber for heat-treating a charge in a controlled atmosphere under a slight pressure, said furnace comprising a base, a fan in said heat-treating chamber, a shaft extending through an aperture in said base and to which said fan is secured, motor means outside said furnace, for rotating said shaft, a bearing for said shaft, said bearing being below said fan, a generally tubular member gas-tightly secured to said shaft for rotation therewith, said generally tubular member comprising a substantially cylindrical runner-portion concentrically positioned with respect to said shaft, a substantially annular oil pot about said shaft below said bearing, said oil pot having inner and outer walls, said substantially cylindrical runner-portion depending into said oil pot between said walls and extending below the oil level of the oil adapted to be contained in said oil pot, said substantially cylindrical runner-portion being provided with means, operative during the rotation of said shaft, for directing oil adapted to be contained in said oil pot, to said bearing, said cylindrical runner-portion being positioned further from said outer wall than said inner wall, gas-tight sealing means between said oil pot and said base, whereby leakage of gas through said aperture in said base is prevented, and means for limiting the swirling of the oil in said oil pot due to rotation of said substantially cylindrical runner-portion.

6. In combination, a device having a chamber in which a gaseous atmosphere is to be maintained, said chamber comprising a base wall having an aperture therethrough; a rotatable shaft extending through said aperture; a bearing for said shaft, said bearing being below said chamber; means for preventing gas-leakage through said aperture and for lubricating said bearing, said means comprising an oil pot, a tubular runner-portion means gas-tightly secured to and about said shaft below said bearing, said tubular runner-portion means depending into the oil in said oil pot and operative during rotation of said shaft for raising oil from said oil pot for lubricating said bearing; and means for gas-tightly securing said oil pot to said base.

FREDERICK R. J. DAVIS.