March 21, 1961 H. L. McFEATERS 2,976,090

FURNACE TRUNNION BEARING CONSTRUCTION

Filed Dec. 19, 1958 4 Sheets-Sheet 1

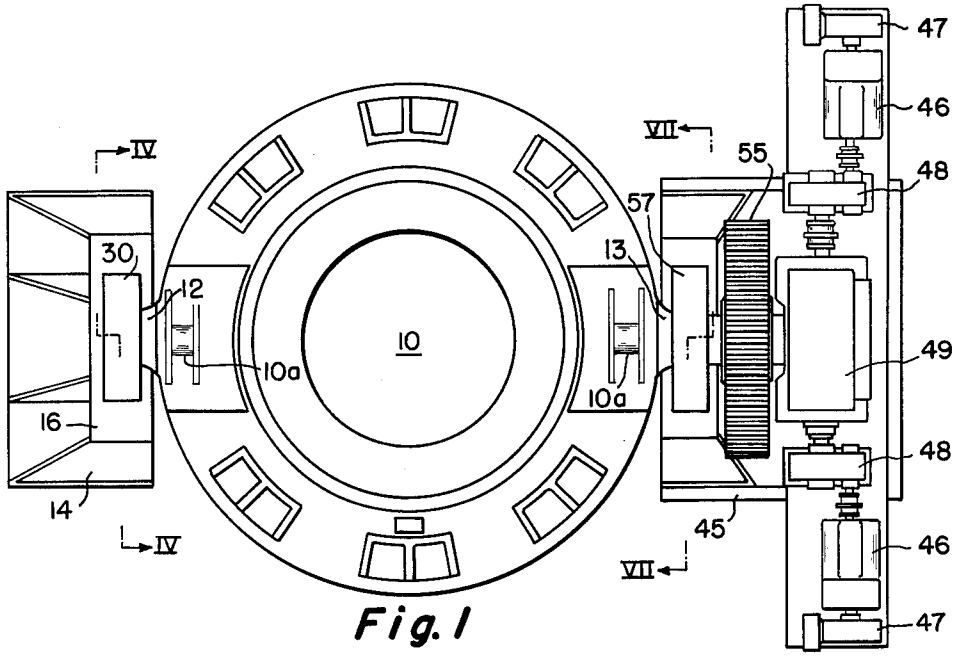



Fig. 1

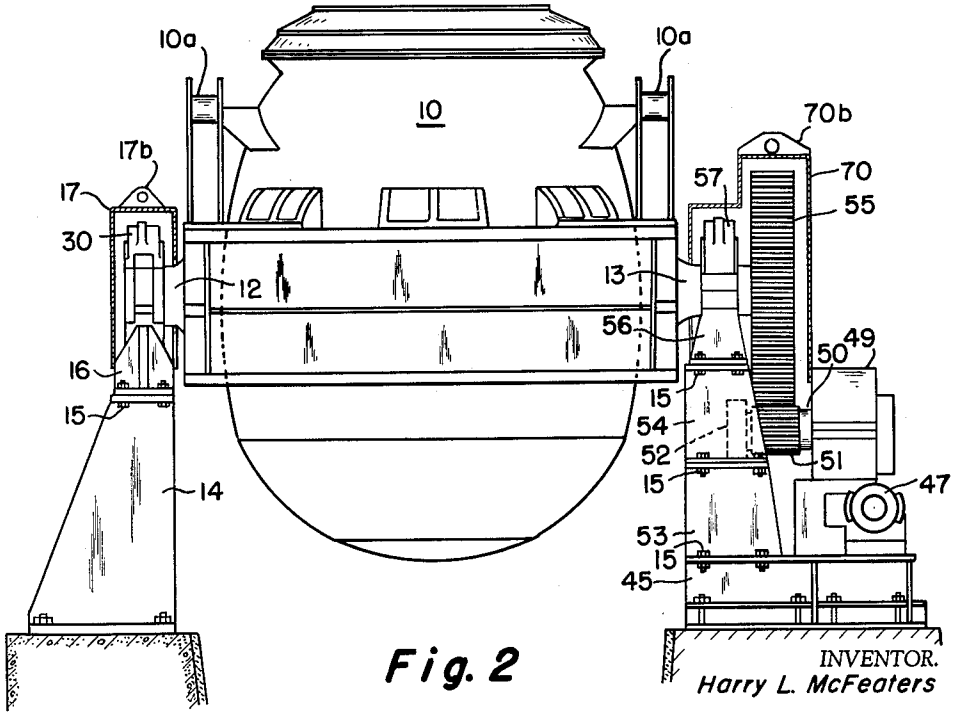



Fig. 2

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FURNACE TRUNNION BEARING CONSTRUCTION

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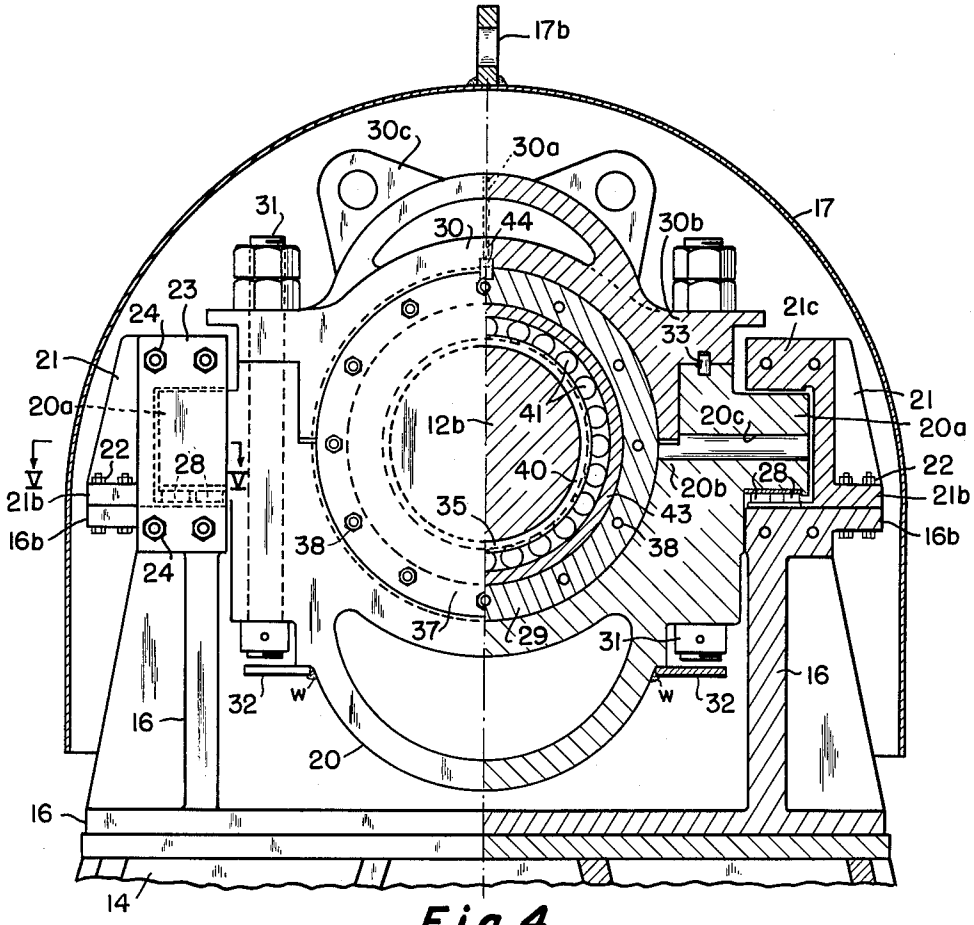



Fig. 4

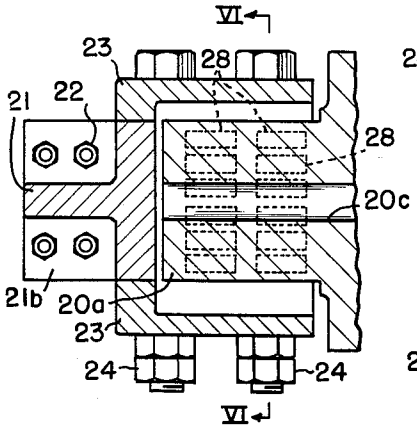



Fig. 5

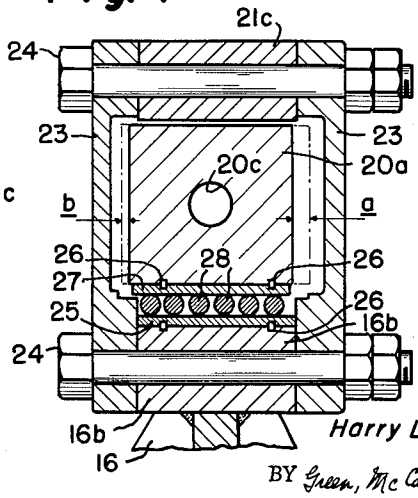



Fig. 6

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FURNACE TRUNNION BEARING CONSTRUCTION

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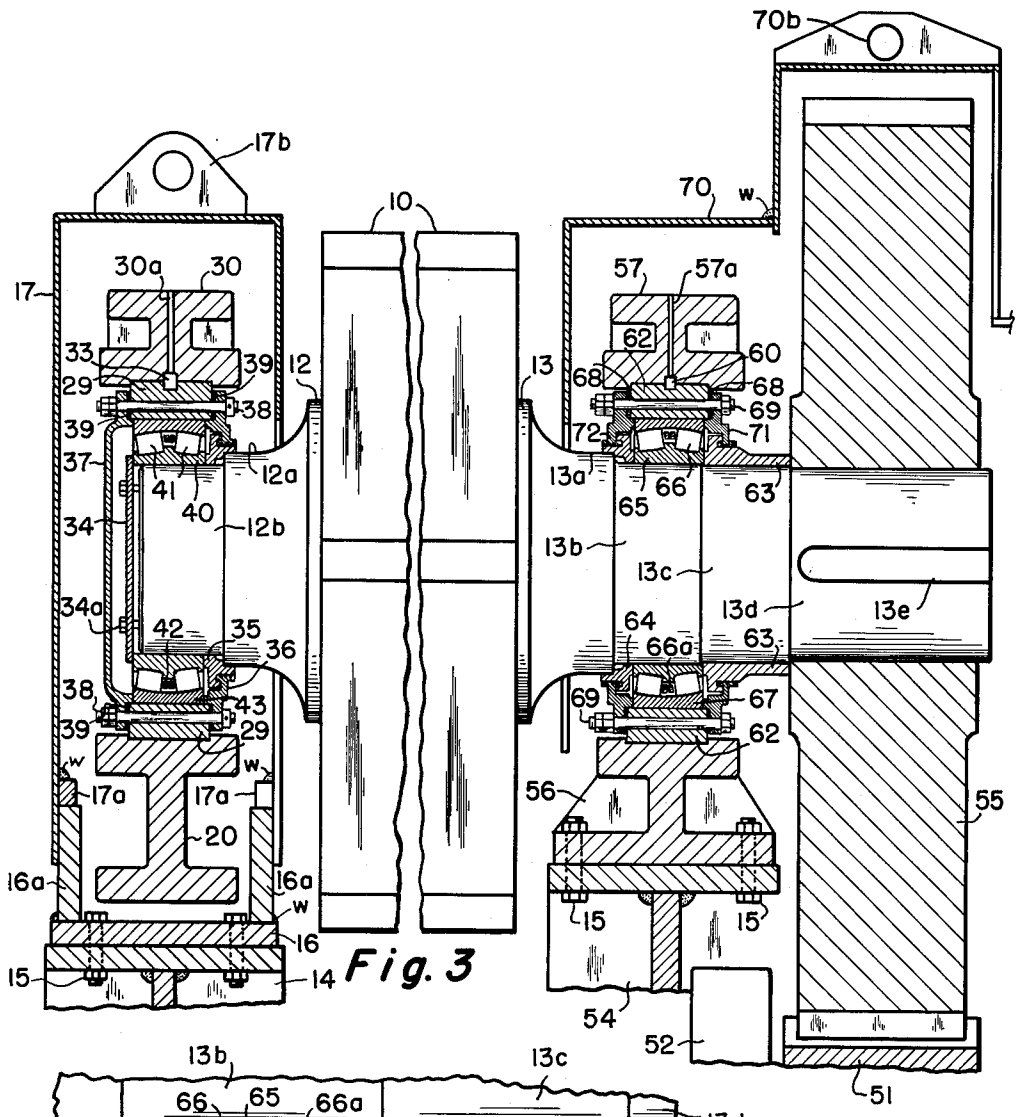



Fig. 3

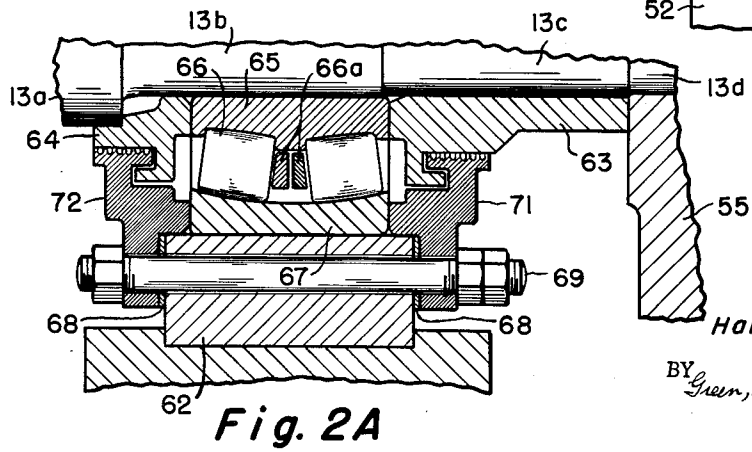



Fig. 2A

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FURNACE TRUNNION BEARING CONSTRUCTION

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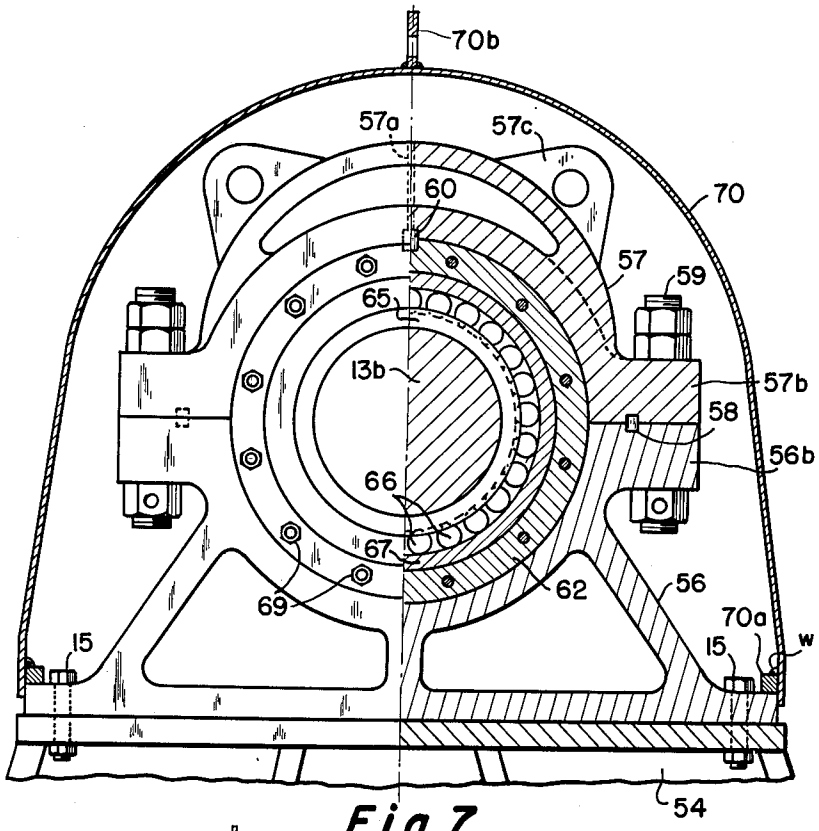



Fig. 7

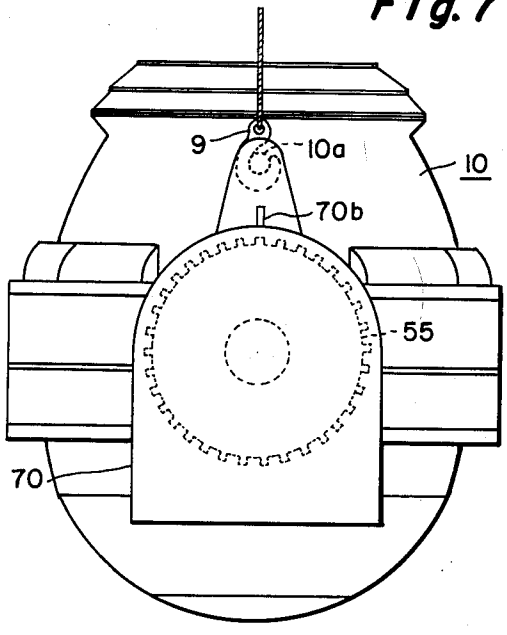



Fig. 8

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United States Patent Office 2,976,090
Patented Mar. 21, 1961



2,976,090

# FURNACE TRUNNION BEARING CONSTRUCTION

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Filed Dec. 19, 1958, Ser. No. 781,601

10 Claims. (Cl. 308—207)

This invention relates to furnace mounting structure or apparatus and particularly, to an improved type of mounting structure for a furnace or converter vessel which is subjected to rotary or turning movement in its utilization.

Although my invention has been devised for use with any suitable furnace, such as a Bessemer converter vessel, it is particularly useful in the rapidly developing field of oxygen furnaces, where increasingly larger size capacities of furnace vessels are being employed.

Heretofore, those skilled in the art have carefully avoided the used of anti-friction bearings in an installation, such as here involved, and this trend has been furthered by the present-day trend toward larger and larger sizes of vessels. Anti-friction bearings have not heretofore been found to be practical in such a utilization for a number of reasons, including the large amount of dust and furnace dirt which is present and tends to accumulate, and the intense heat of 3,000° F. and higher which may be employed.

I have found that there is a definite need in the art for an improved type of bearing construction or mounting for turnable vessels or furnaces and that this need becomes greater as the size of the vessels increases, and where inaccuracies in the supporting structure are to be avoided. I have determined that accuracy of mounting of a vessel or furnace has become of great importance with the use of a so-called closed or interfitting hood for the mouth of the vessel. In such an installation, it is necessary to accurately align the interfitting nose and mouth portions of the furnace and the hood and in such a manner that they can be readily and accurately moved into and out of an interfitting and fluid-sealing-off relationship with respect to each other.

I have been able to solve the problem heretofore presented in connection with conventional types of furnace mounting installations for rotating or tiltable furnace movement and in spite of the severe operating conditions involved. I have been able to meet the factors involved by providing a sealed-off unit type of bearing installation that permits expansion of the furnace, that is accurately self-aligning, and that permits removing the furnace from its trunnion stands and driving connections while maintaining the sealed-off relation and mounting of its bearing units. One of the factors involves providing a method or structure to, for the first time, make practical the utilization of anti-friction bearings. I completley enclose them as cartridge units, and in such a manner, as to permit the removal of the units with the furnace while they are in position on its trunnion shafts, such as may be desirable when the furnace is to be moved to a relining station for replacement of its inner refractory lining. My construction also makes possible the use of a flexible coupling such as shown and described in my Patent No. 2,483,017.

I provide a dust casing or cover for my bearing units that serves as an outer shield against furnace dust and dirt, and which may also be moved with the furnace when



it is to be removed from its stands for repair or maintenance purposes. I also provide a flat or ladder type of anti-friction bearing for mounting the trunnion bearing cartridge or unit on the expansion side of the furnace to provide for transverse or horizontal expansion of the furnace to provide for transverse or horizontal expansion of the trunnion shell, which may be in the order of as much as 1 to 1½ inches. I have discovered that it is essential to provide for this expansion and particularly, on the so-called expansion side or end of the furnace which is the side opposite the drive side. By doing so, I have been able to provide a more or less fixed bearing on the drive side, and to provide both the expansion and drive sides with anti-friction bearing mountings which simplify the driving installation and greatly decrease the horsepower requirements for rotating or turning the vessel or furnace during its utilization.

When used with a Bessemer converter which usually has an air connection attached to the trunnion ring, my anti-friction bearing construction eliminates movement of the centerline of rotation, thus preventing wear on the gland and packing of the air pipe which is usually mounted on the end of the trunnion.

It has thus been an object of my invention to find a solution to the problem heretofore presented in mounting or rotatably positioning a furnace or vessel, such as used in the refining of metal, such as by a Bessemer, and particularly by an oxygen-blow process;

Another object of my invention has been to meet factors which will make it practical to use anti-friction bearings in a furnace mounting;

A further object of my invention has been to devise a new and improved mounting structure for a rotatable or tiltable furnace;

A still further object has been to devise a bearing mounting construction for a furnace which may be carried with the vessel trunnions when the vessel is to be repaired or reconditioned.

These and other objects will appear to those skilled in the art from the drawings and the description of the illustrated embodiment.

In the drawings,

Figure 1 is a top plan view of a furnace installation employing my invention;

Figure 2 is a view in elevation on the same scale as and of the installation of Figure 1;

Figure 2A is an enlarged fragmental view showing features of my trunnion bearing cartridge construction, with particular reference to the driven end or side of the furnace;

Figure 3 is an enlarged side sectional view in elevation of the construction of Figure 2, with the vessel broken away to illustrate side mounting structure and bearing units employed in mounting and supporting the furnace trunnions;

Figure 4 is an end view in elevation and partial section, taken along line IV—IV of Figure 1, to further illustrate the mounting and bearing construction of an expansion side or end of the installation; it is on the same scale as Figure 3;

Figure 5 is a horizontal fragmental section taken along the line V—V of Figure 4, and of enlarged scale with respect thereto, to particularly illustrate side expansion bearing mountings on the expansion side or end of the furnace installation;

Figure 6 is a vertical sectional fragment, taken at right angles to and on the scale of and along line VI—VI of Figure 5;

Figure 7 is an end view in elevation and partial section, on the same scale as Figure 4, taken along the line VII—VII of Figure 1, and showing the bearing construction and mounting on the drive side of the furnace;

And, Figure 8 is a somewhat diagrammatic end view in elevation, taken from the drive side of the furnace shown in Figures 1 and 2, on the same scale as such figures, and illustrating how the furnace, its bearing units, dust covers, and its drive pinion may be lifted from the trunnion mounting when the furnace is to be moved, as by an overhead crane, to a repair station.

In Figures 1 and 2 of the drawings, I have shown a vessel or furnace **10** having a pair of side-positioned, upwardly-projecting lifting lugs **10***a* that are secured thereto for lifting the furnace as a unit into and out of its stands, see also Figure 8. An overhead crane or hoist having suitable hooks **9** may be employed to engage the lugs **10***a*, see Figure 8. The vessel **10** is shown provided with a trunnion shaft **12** on its outer or expansion side and a trunnion shaft **13** on its driven or fixed side. The expansion side, as shown particularly in Figures 1 and 2, has an upright, lower or floor stand **14** which is shown secured by bolt and nut assemblies **15** to an upper stand **16** which directly carries its bearing construction.

*The expansion side*

Referring to Figure 3, the upper stand **16** has a pair of upwardly-projecting, cover-mounting side bars or members that are fixedly secured thereto, as by weld metal *w*, to cooperate with and slidably receive a dust cover **17**. The dust cover **17** has a pair of spaced-apart side mounting strips **17***a* secured, as by weld metal *w*, along portions of its inner side walls or plate members to rest upon the mounting plates or bars **16***a* and support the dust cover **17** thereon. The lower end portions of the side wall portions of the dust cover are shown in a frictionally-mounted, side-positioned and downwardly-projecting relationship with respect to the side members **16***a*. The inner plate or side wall member of the dust cover is provided, as shown in Figure 3, with a downwardly-open slot to bypass the trunnion shaft **12**. It is thus apparent that the dust cover **17** may be lifted out of position with respect to the upper stand **16** by hooking a crane hook, such as **9**, through its lifting lug **17***b*.

As shown particularly in Figure 3, the trunnion shaft **12** for the expansion side of the apparatus has an intermediate portion **12***a* of reduced diameter which is of bell shape from the main body of the shaft, and has an end portion **12***b* of further reduced diameter which defines a step or offset with a cylindrical end of the portion **12***a*.

Referring to Figure 4, the upper bearing stand **16** is provided with a pair of transversely spaced-apart, outwardly-projecting, mounting shelf or flange portions **16***b* which receive and mount a transversely spaced-apart pair of cooperating, outwardly-projecting, shelf or flange portions **21***b* of a pair of side closure or intermediate housing parts **21** that rest upon and project upwardly from the upper stand **16**. Bolt and nut assemblies **22** are provided for removably securing the shelf portions **16***b* and **21***b* together.

The inner sides of the intermediate parts or members **21** are offset and each has an upper, inwardly-extending, shelf portion **21***c* which, with the shelf portion **16***b*, defines a housing closure for outwardly-projecting, rectangular-shaped, side-mounting, expansion end side-bridging or side-support portions **20***a* of a lower bearing casting or housing half **20**, see also Figures 5 and 6. As illustrated particularly in Figures 4 and 5, the end or bridging portions **20***a* have centrally-positioned, outwardly-projecting, axial-core inserts **20***c* for strengthening them and about which the housing part **20** may be cast. Vertical sides of the transversely-offset or bridging portions **20***a* are enclosed by a side housing having side plate members **23**, see Figure 6, that have offset central, open or side window portions to permit transverse movement, see Figure 4. Ordinarily, a one inch clearance allowance for transverse expansion has been found to be satisfactory; in Figure 6, *a* and *b* represent movement of the portion **20***a* which may be effected under heat expansion conditions.

The side plate members **23** are shown mounted in position in abutment against sides of the shelf portions **16***b* and **21***c* by bolt and nut assemblies **24**, see Figures 5 and 6. It will be noted that these bolt and nut assemblies project through such shelf portions to complete the enclosure of the side mounting portions **20***a*. Figures 5 and 6 show that the expansion end portions **20***a* have a clearance fit with the shelf portion **21***c* and the side wall of the part **21**.

An inset, planar-face, lower slide bearing member **25** is carried by the shelf portion **16***b* and may be secured thereto by dowels **26**. A similar, upper, slide bearing member **27** is carried by the under-face of each expansion end portion **20***a* and may be secured thereto by dowels **26**. Ladder bearings **28** of a pin or cylindrical type are operatively carried between the bearing members **25** and **27**, as shown particularly in Figures 4 to 6, inclusive, and as shown in Figure 5, are arranged in ladder groups or transversely-aligned rows. Thus, it will be apparent that the expansion end portions **20***a* are mounted for transverse movement to automatically allow for expansion when the furnace is heated-up, without any binding of such end portions with respect to their enclosing housing parts.

As shown particularly in Figures 3 and 4, the lower bearing casting or housing part **20** has a semi-circular bore half which cooperates with a similar bore half of an upper bearing casting or housing part **30**. These bores carry a circular, outer, closure ring **29** for the main bearing assembly at the expansion or floating end of the furnace. The upper part **30** has an interfitting cooperating relationship with the part **20**, as shown particularly in Figure 4, and also has a pair of spaced-apart side shelf portions **30***b* which rest upon the side-mounting, expansion end portions **20***a* of the part **20** and are secured thereto by dowels **33**. As shown in Figure 3, the part **30** has radial access holes **30***a* to each of the dowels **33**.

For convenience in handling, the upper housing part **30** has a pair of lifting lugs **30***c*, see Figure 4. Rod and nut assemblies **31** extend vertically through the upper and lower housing parts **30** and **20**, as shown particularly in Figure 4, to secure them together. Side flange pieces **32** are shown welded in Figure 4 to project from the lower housing part **20** and extend beneath the assemblies **31** to prevent dropping them when their bolts are removed.

As shown in Figure 3, the end trunnion shaft portion **12***b* is provided with an end cap or plate **34** which is secured in position thereto by threaded bolts **34***a* that extend within the end face of the portion **12***b*. It will be noted that the cap **34** rests along its outer peripheral edges against outer edges of an inner bearing sleeve **40** to hold it in position against an inner end closure ring **35**. The ring **35** is offset along its inner side to rest both upon the trunnion end portions **12***a* and **12***b*. The ring **35** also interfits and interlatches with a ring closure member **36**. The ring closure member **36**, on its inner side, has a rim portion that abuts against an inner edge of an outer bearing sleeve **43**, and a flange portion that abuts against an inner edge of the outer closure ring **29** of the bearing assembly. End ring **36**, like end rings **71** and **72** of the fixed bearing cartridge, see Figure 2A, has grease-retaining grooves along the face of its radially-inner foot portion.

An outer end closure cap member **37** has a rim portion that abuts against the outer edge of the outer bearing sleeve **43** and an outer flange portion that abuts against an outer edge of the closure ring **29**. Bolt and nut assemblies **38** extending through the closure ring **29**, the end ring **36**, and the outer cap member **37** to hold the main bearing parts in an assembled relationship on the trunnion shaft **12** and seal them against the introduction of dirt and dust. In Figure 3, sealing gaskets **39** are shown disposed between the parts **29**, **37** and **36**.

As also shown in Figures 3 and 4, the outer closure ring **29**, along its inner periphery, carries the bearing sleeve **43** that is positioned in an opposed relationship

with the inner bearing sleeve 40. The bearing sleeve 40 is positioned about and on the trunnion shaft portion 12*b* and cooperates with the outer bearing sleeve 40 to operatively carry anti-friction, trunnion bearing, pairs of spherical rollers 41 therebetween. As shown particularly in Figure 3, the bearing rollers 41 ride in inset races provided by the inner bearing sleeve 40 and ride on a cancave face of the outer bearing sleeve 43. A pair of spacer elements 42 are carried by a central ridge portion of the inner bearing sleeve 40, are of wedge shape, and are positioned between the bearing rollers 41 of each bearing pair to hold them in an operatively spaced relationship within the bearing assembly. As shown in Figure 4, the closure ring 29 may be secured to the upper housing part 30 by suitable means such as dowels 44.

*Drive side of the construction*

As shown in Figures 1 and 2, a platform 45 is provided for a drive assembly which may include a pair of electrical motors 46 which are mounted at opposite sides of the platform. Each motor 46 is provided with a conventional magnetic brake 47, and its drive shaft is shown connected to an intermediate speed reducer unit 48 which is, in turn, connected to a common, high ratio, speed reducer 49 which ties-in the drives of both motors. The unit 49 has, as shown in Figure 2, a drive shaft 50 that projects outwardly therefrom and is journaled at 52 within an upper trunnion stand 54. It will be noted that the upper trunnion stand 54 is positioned on the lower stand 53 which is, in turn, positioned on the platform 45. Nut and bolt assemblies 15 are employed to secure these parts together in an upwardly-projecting relationship. The shaft 50 has a drive pinion 51 keyed or feathered thereto which intermeshes with a spur drive wheel or gear 55 for actuating a drive trunnion shaft 13 for the fixed or drive side of the furnace 10.

As shown in Figure 3, the trunnion shaft 13 has a first, bell-shaped, reducing shaft portion 13*a*, a second bearing shaft portion 13*b* of reduced diameter, a third portion 13*c* of further reduced diameter, and an end portion 13*d*. It will be noted that the portion 13*b* defines a shelf edge or ridge with cylindrical edges of the portions 13*a* and 13*c*. The end portion 13*d* is shown as having a slightly reduced diameter with respect to the portion 13*c* and as provided with a keyway 13*e* for securely mounting the drive gear 55 thereon. It will be noted that the anti-friction bearing constructions for both ends of the furnace 10 are somewhat similar, but that the construction for the non-driven or floating side is provided with additional means providing for a floating mounting of its housing support, while the driven side is not.

As shown in Figures 3 and 7, the anti-friction bearing is provided with a lower housing part, half or casting 56 that is securely mounted on the upper stand 54 by bolt and nut assemblies 15. The lower part has a pair of outwardly-projecting flange or shelf portions 56*b* that cooperate with similar portions 57*b* of an upper housing part or casting 57. Dowels 58 may be provided for locking these parts together, and bolt and nut assemblies 59 extend through their shelf portions to securely mount them in position with respect to each other and their semi-circular bore halves in a complementary relationship, to define an outer support for an outer bearing support ring 62. Dowels 60 are shown interposed between the ring 62 and the upper housing part 57. In Figure 3, radial access opposings 57*a* are shown to aid in mounting and removing each dowel 60.

As shown in Figure 3, a spacer sleeve 63 is mounted over the trunnion portion 13*c*, between the gear 55 and an inner bearing sleeve 65, and has upper portions interlatching with an outer closure ring member 71. The member 71 has an inner rim portion that abuts against an outer bearing sleeve or part 67 and an outer flange portion that abuts against an outer side edge of the closure ring 62. An outer end closure ring 72 has a rim that abuts against the inner side edge of the outer bearing sleeve 67, and a flange portion that abuts araingst the outer side edge of the closure ring 62. At its radical inner portion the end closure ring 72 interfits with an inner end spacer ring 64 that is offset to ride or fit with both the shaft portions 13*a* and 13*b* and to abut against the outer side edge of inner bearing sleeve 65. Gaskets 68 are interposed between the end ring parts 71 and 72 and the closure ring 62, and the entire bearing assembly is held in an interfitting, closed-off, sealed relationship by bolt and nut assemblies 69 which are carried by the end rings 71 and 72 and the peripheral closure ring 62.

As shown in Figures 2A and 3, the anti-friction bearing for the drive side is somewhat similar in construction to the anti-friction bearing for the expansion side. The outer bearing sleeve 67 is positioned within the inner periphery of the ring 62 to carry pairs of spherical rollers 66 which also ride in inset races provided by the inner bearing sleeve 65. Wedge-shaped spacer elements 66*a* are carried by a central ridge portion of the sleeve 65 between the rollers 66. The end rings 71 and 72 are shown provided with foot portions that engage spacer sleeve 63 and ring 64 and that having grease grooves therein. It will be noted that the foot portion of the ring 36 (see Figure 3) that engages the ring 35 of the bearing construction for the expansion side also has grease grooves therein.

A dust cover or housing 70 is provided for both the bearing assembly and the gear 55 and, as shown, has an inner side wall that is provided with an open slot, so that it may fit over and be lifted off the portion 13*a* of the trunnion shaft 13, see Figure 3. The cover 70 also has lifting lugs 70*b* for convenience in handling it. As shown in Figure 7, a mounting strip 70*a* is secured, as by weld metal *w*, at a spaced position along the inside of the lower end portions of the cover 70 to rest upon a lower shelf portion of the lower housing part 56 and, in such a manner, that the lower edge portion of the dust cover will have a frictional fit with the outer edges of the shelf portion, as disclosed.

*The overall structure*

A study of Figure 2 in view of Figure 8 shows that when the furnace 10 is to be removed from its stand, this may be accomplished by removing bolts 15 of its upper bearing stands 16 and 56 and then lifting it as a unit by its lifting lugs 10*a*, using the hooks 9. Thus, the furnace 10, its complete bearing assemblies, as well as the gear 55, and the upper stands 16 and 56 may be lifted off the lower stands and moved to a station at which repairs are to be made. At such repair station or location, then the dust covers 17 or 70 may be removed by lifting them if the bearing parts are to be lubricated or inspected. However, if as usual, the furnace 10, itself, is to be relined or repaired, the dust covers may remain in place and the sealed bearing units need not be disturbed. When the furnace unit has been removed, easy access is provided to both the ring gear 55 and to the pinion 51 without the need for removing the motor drive mechanism.

When the repair work on the furnace is completed, its unit assembly is lifted back into position and its upper stands 16 and 56 again secured, so that the gear 55 again meshes with the drive pinion 51. It is thus apparent that the bearing assemblies at the sides or ends of the furnace are fully protected throughout the operation.

It should also be noted that, as indicated from a study of Figures 1 and 4 to 6, inclusive, the non-driven side of the furnace is free to expand by reason of the flat, ladder type of bearings which carry its trunnion shaft bearing housing or cartridge parts. In other words, the upper and lower housing parts 30 and 20 are carried as a unit within clearance-providing slide bearing mountings for transverse movement in an amount sufficient to produce a full high temperature utilization of the furnace without dam-

age to the trunnion shaft bearing assembly, itself. It will be noted that the expansion slide bearing provides for endwise or sidewise expansion of the furnace **10**, longitudinally as to its trunnion shaft **12**. There is an automatic self-aligning action as to the housing parts of the trunnion shaft bearing assembly or cartridge, while at the same time, the bearing and drive assembly for the trunnion shaft **13** is held in a substantially stationary relationship. That is, the furnace **10** is permitted to expand as to its one side or end from its fixed or driven side or end.

It may be noted that a flexible coupling such as shown in my Patent No. 2,483,017 may be used, if desired. The trunnion shaft bearing parts **40** to **43** and **65** to **67** may be of a commercial type such as supplied by the Bantam Bearings Division of the Torrington Company.

Summarized briefly, I provide anti-friction bearing cartridge units for opposite trunnion shafts or shaft ends of the furnace unit, whose inner bearing sleeves are positioned on a cylindrical portion of one diameter, and whose radially-outwardly spaced-apart and opposed outer bearing sleeves are encircled or carried by peripheral rings. The inner and outer sleeves of each unit carry the operating bearing elements, and end ring assemblies (axially opposed along the trunnion shaft) cooperate with adjacent cylindrical portions of different diameters of the trunnion shaft to define, with the peripheral ring, an enclosing or sealing cartridge for the active bearing elements. Such end ring assemblies of each unit abut against opposite sides of the inner and outer bearing sleeves and the peripheral ring and are secured in position by removable bolt and nut assemblies which extend through their members and the peripheral ring.

The bearing assemblies are provided with encircling or surrounding housings and the housing of one bearing assembly is provided with side-projecting mounting portions which are enclosed by and positioned on shelf portions of an outer housing. This is done in such a manner as to provide for expansion movement of the inner housing, its anti-friction bearing assembly and cartridge with the associated trunnion shaft, longitudinally with such shaft, when the furnace is heated-up and thus expanded. This slide expansion relationship is accomplished by a flat type of bearing construction which rolls on pins in accordance with the expansion and contraction of the furnace. The bearing elements of expansion units on opposite sides of the trunnion shaft are carried by opposed, substantially planar, bearing surface members for controlled movement of the shaft anti-friction bearing assembly with the trunnion shaft at the non-driven end or side of the furnace.

What I claim is:

1. In a turnable furnace having lifting lugs and oppositely extending trunnion shafts, a pair of anti-friction bearing cartridges operatively positioned over the trunnion shafts, associated bearing stands for each of said bearing cartridges, driving mechanism operatively connected to one of the trunnion shafts to turn the furnace within said bearing cartridges, said driving mechanism having a driving pinion, a gear on said one trunnion shaft in a meshing lift-out relationship with respect to said driving pinion, the cartridge for the other trunnion shaft having transversely-outwardly-projecting mounting portions, said mounting portions being perpendicular to and lying substantially in alignment with the axial plane of and in a vertically-balanced relation with the other trunnion shaft, an expansion housing for said outwardly-projecting portions, said housing being removably secured to the associated bearing stand, so that it and said bearing cartridge may be lifted as a unit with the furnace, and a housing removably positioning the other bearing cartridge on its associated bearing stand, so that the other bearing cartridge may be lifted as a unit with said gear and the furnace.

2. In a tiltable furnace construction having trunnion shafts projecting from opposite sides thereof, a pair of anti-friction bearing assemblies, one of said bearing assemblies carrying anti-friction bearings in one enclosed cartridge and journaling one of the trunnion shafts centrally therein, the other bearing assembly carrying anti-friction bearings in a second enclosed cartridge and journaling the other trunnion shaft centrally therein, a pair of spaced-apart stands each removably supporting an associated one of said cartridges, driving means operatively connected to the one trunnion shaft for actuating said shaft to turn the furnace within said cartridges, opposed bridging means projecting transversely from said second cartridge and substantially centrally of and perpendicular to the axis of the other trunnion shaft, and said opposed bridging means operatively positioning said second cartridge within its associated stand in a vertically-balanced relation with respect to the associated other trunnion shaft for expansion and contraction movement axially with the associated other trunnion shaft.

3. A furnace construction as defined in claim 2 wherein the associated stand of said second cartridge has means for freely sliding said opposed bridging means therein in accordance with axial expansion and contraction of the associated other trunnion shaft.

4. A furnace construction as defined in claim 2 wherein, the associated stand of said second cartridge has a pair of planar surface bearing members, said opposed bridging means each having a planar surface bearing member in an opposed relationship with an associated planar surface bearing member of said pair, at least a pair of rows of bearing pins are operatively positioned between the opposed planar surface bearing members of the associated stand and said bridging means, and the associated stand has enclosing wall portions limiting free movement of said bridging means therewithin.

5. In a tiltable furnace construction having trunnion shafts projecting from opposite sides thereof, self-aligning anti-friction bearing-containing enclosed cartridges operatively mounted on and centrally journaling each of the trunnion shafts, stands for removably supporting the furnace on said bearing cartridges, drive mechanism operatively connected to one trunnion shaft for turning said trunnion shafts within said bearing cartridges, the bearing cartridge for the other trunnion shaft having a pair of opposed transversely-outwardly-projecting bridging portions, the associated stand for the other trunnion shaft having a pair of opposed housings receiving and enclosing said opposed bridging portions for sliding movement therein axially of the other trunnion shaft, said bridging portions lying perpendicular to and substantially in alignment with the axial plane of the other trunnion shaft for moving their associated cartridge in a vertically-balanced relation with the other trunnion shaft in the direction of its axis in accordance with expansion and contraction of the vessel, and means securely mounting said bearing cartridges on their associated trunnion shafts, so that said cartridges may be removed from said stands as units with the furnace.

6. A furnace construction as defined in claim 1 wherein, said bearing cartridge for the other trunnion shaft comprises an inner bearing sleeve positioned about the trunnion shaft, an outer bearing sleeve in a radially-spaced-apart relation with the inner bearing sleeve, spherical bearing type bearings operatively carried between said inner and outer bearing sleeves, a peripheral enclosure ring about said outer bearing sleeve, end closure ring means inter-engaging with said peripheral enclosure ring and said inner and outer bearing sleeves to close-off the spacing between said inner and outer bearing sleeves, and means projecting through said peripheral enclosure ring and engaging said end enclosure ring means to securely mount them in position with respect to each other.

7. A furnace construction as defined in claim 1 wherein, said bearing cartridge for the other trunnion shaft has

horizontally-parted and complementary enclosing portions that are vertically-offset with respect to each other, and one of said enclosing portions carries said mounting portions.

8. An expansion type of anti-friction bearing assembly for a trunnion shaft of a tiltable furnace which comprises, an anti-friction bearing-containing enclosing cartridge unit operatively positioned centrally over and about the trunnion shaft to journal it, a housing carrying said cartridge unit and having a pair of vertically-centrally positioned and transverse side-projecting bridge portions of rectangular shape, and a stand housing having transversely-spaced side windows defined by shelf portions and limiting wall portions for receiving said pair of bridge portions and positioning them in a freely longitudinally-movable relation on said shelf portions and between the limiting wall portions.

9. In an anti-friction bearing assembly to be removably mounted on a stand for journaling a trunnion shaft of a tiltable furnace and wherein the trunnion shaft has adjacent cylindrical portions of different diameters, an inner bearing sleeve race positioned on an end cylindrical portion of smaller diameter of the shaft, an outer bearing sleeve race in a radially-outwardly spaced-apart and aligned relation with said inner sleeve race, bearing elements operatively carried by said inner and outer sleeve races, a peripheral ring about said outer sleeve race, end enclosure means engaging forward edges of said peripheral ring and said outer race, an end ring assembly positioned on the end portion of smaller diameter and on an adjacent cylindrical portion of larger diameter of the shaft and engaging back edges of said inner and outer sleeve races and said peripheral ring to define an enclosing bearing cartridge with said end closure means and said peripheral ring; bolt means cooperating with and securing said end closure means, said end ring assembly and said peripheral ring in the defined positioning; a housing having transversely-parted and complementarily-offset interfitting housing parts positioned about and enclosing said peripheral ring, means cooperating with said housing parts to removably secure them together, at least one of said housing parts having transverse side-bridging portions projecting perpendicular to the longitudinal axis of the trunnion shaft and substantially in alignment with the plane thereof, and a bearing stand longitudinally-slidably receiving said bridging portions to permit expansion and contraction of said housing longitudinally with the axis of the trunnion shaft.

10. In a tiltable furnace construction having trunnion shafts projecting from opposite sides thereof, a pair of anti-friction bearing assemblies, one of said bearing assemblies carrying anti-friction bearings in one enclosed cartridge and journaling one of the trunnion shafts centrally therein, the other bearing assembly carrying anti-friction bearings in a second enclosed cartridge and journaling the other trunnion shaft centrally therein, a pair of spaced-apart stands each removably supporting an associated one of said cartridges, means securely mounting said bearing cartridges on their associated trunnion shafts, so that said cartridges may be removed from said stands as units with the furnace, opposed bridging means projecting transversely from said second cartridge and substantially centrally of and perpendicular to the axis of the other trunnion shaft, and said opposed bridging means operatively positioning said second cartridge within its associated stand in a vertically balanced relation with respect to the associated other trunnion shaft for expansion and contraction movement axially with the associated other trunnion shaft.

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UNITED STATES PATENT OFFICE

# CERTIFICATION OF CORRECTION

Patent No. 2,976,090 March 21, 1961

Harry L. McFeaters

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 60, for "completley" read -- completely --; column 2, line 4, beginning with "to" strike out all to and including "furnace" in line 6, same column 2; column 3, line 6, for "mounting" read -- mountings --; column 6, line 3, for "araingst" read -- against --; line 6, after "ride" insert -- on --.

Signed and sealed this 15th day of August 1961.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents