United States Patent

[11] **3,561,741**

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[54] **RING GEAR AND MOUNTING ASSEMBLY THEREFOR**
5 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **263/33,** 74/243, 74/447, 74/450

[51] **Int. Cl.** **F27b 7/00,** F16h 55/30, F16h 55/12

[50] **Field of Search** 74/450X, 447X, 243X; 263/33CL

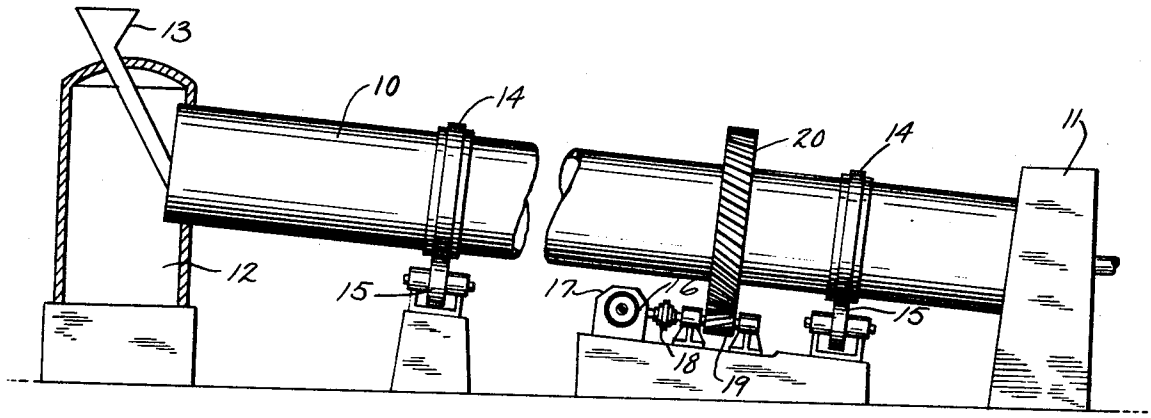
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Primary Examiner—Leonard H. Gerin
Attorneys—Donald G. Casser and Adrian L. Bateman, Jr.

ABSTRACT: A ring gear for driving a rotary apparatus that has an annular flange including radially elongated slots and the gear is bolted to the apparatus along the elongated slots to enable the apparatus to expand and contract, or otherwise deform, without distorting the ring gear.



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SHEET 1 OF 3

Fig. 1

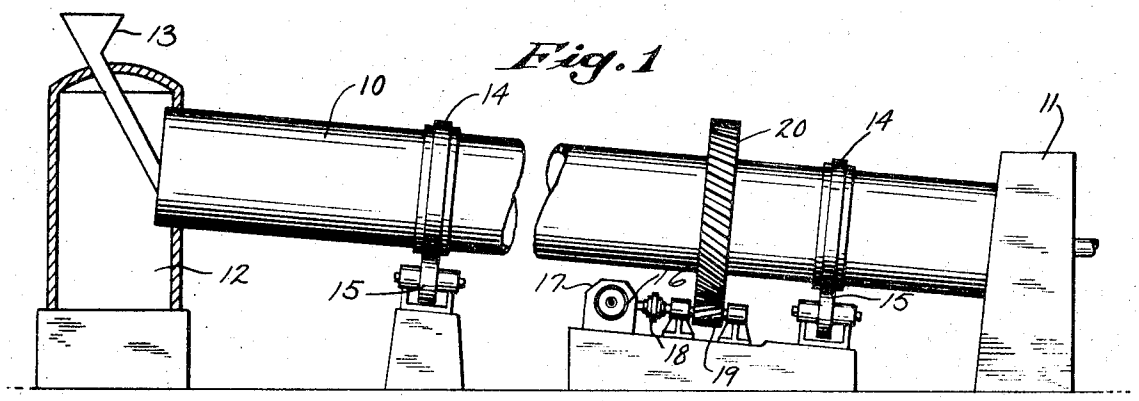
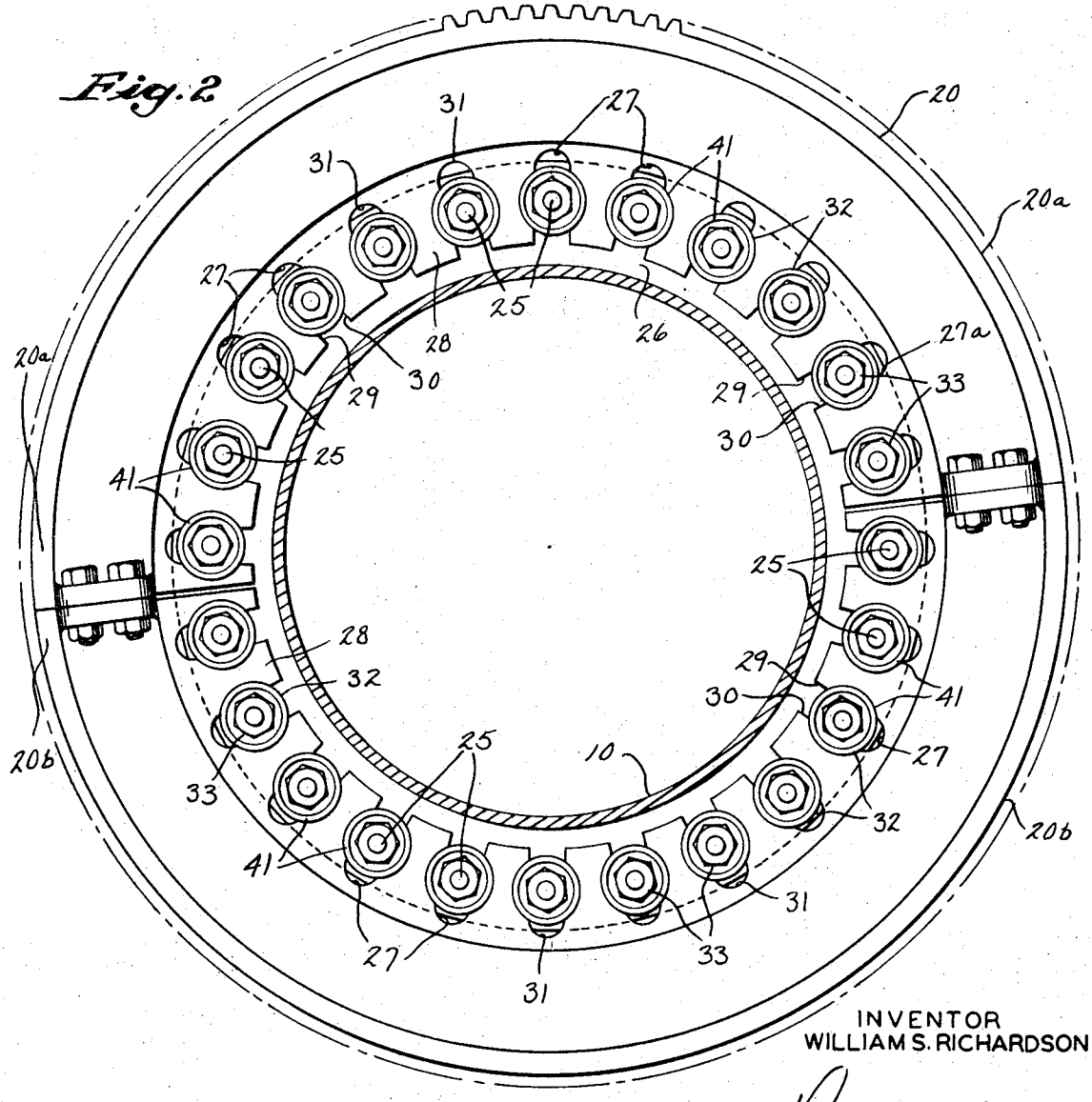


Fig. 2



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Fig. 3

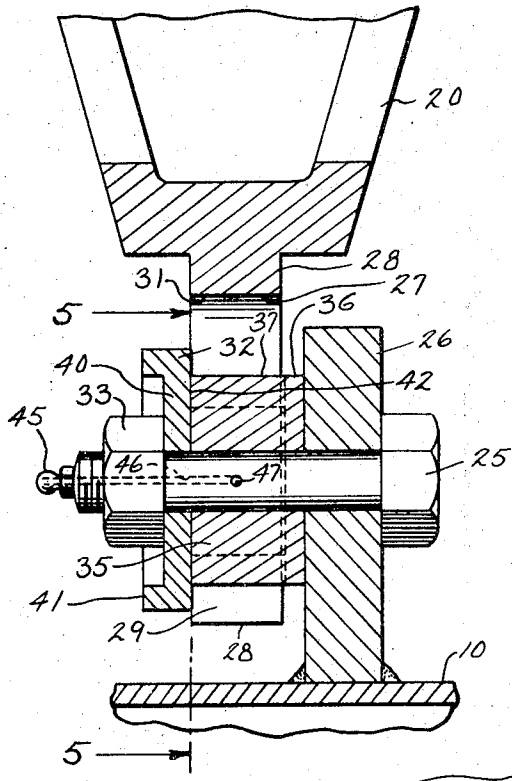
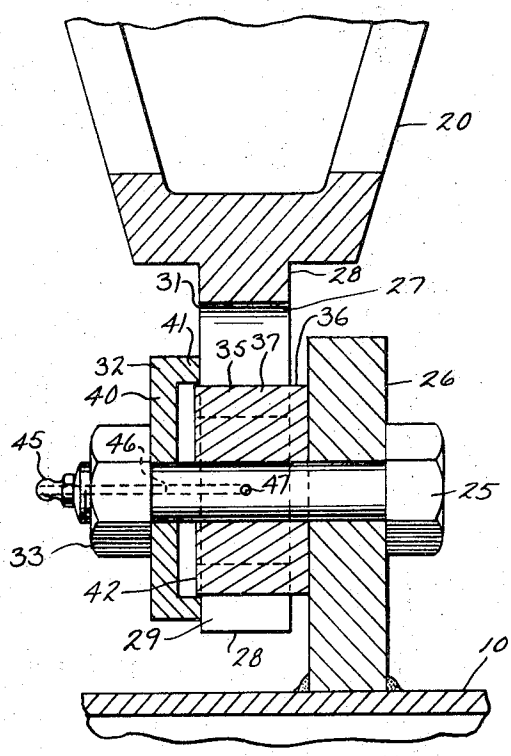


Fig. 4



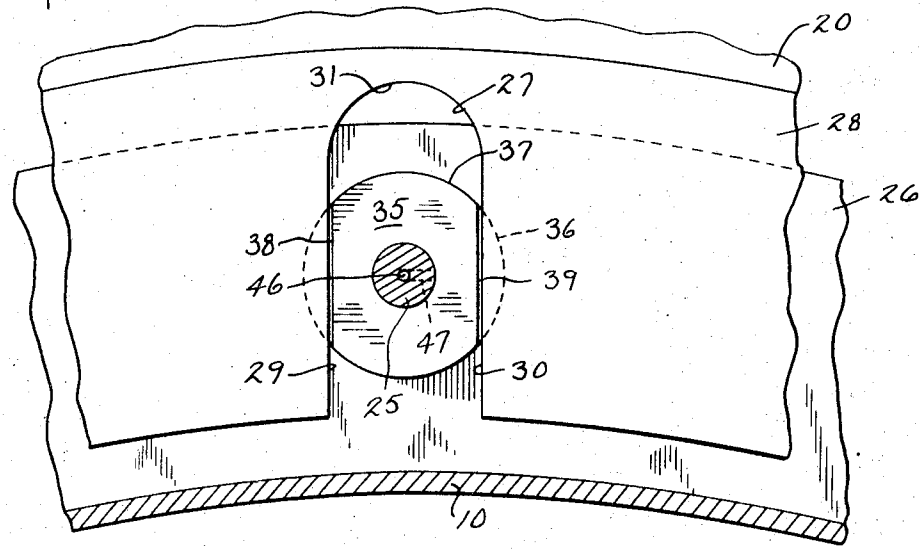


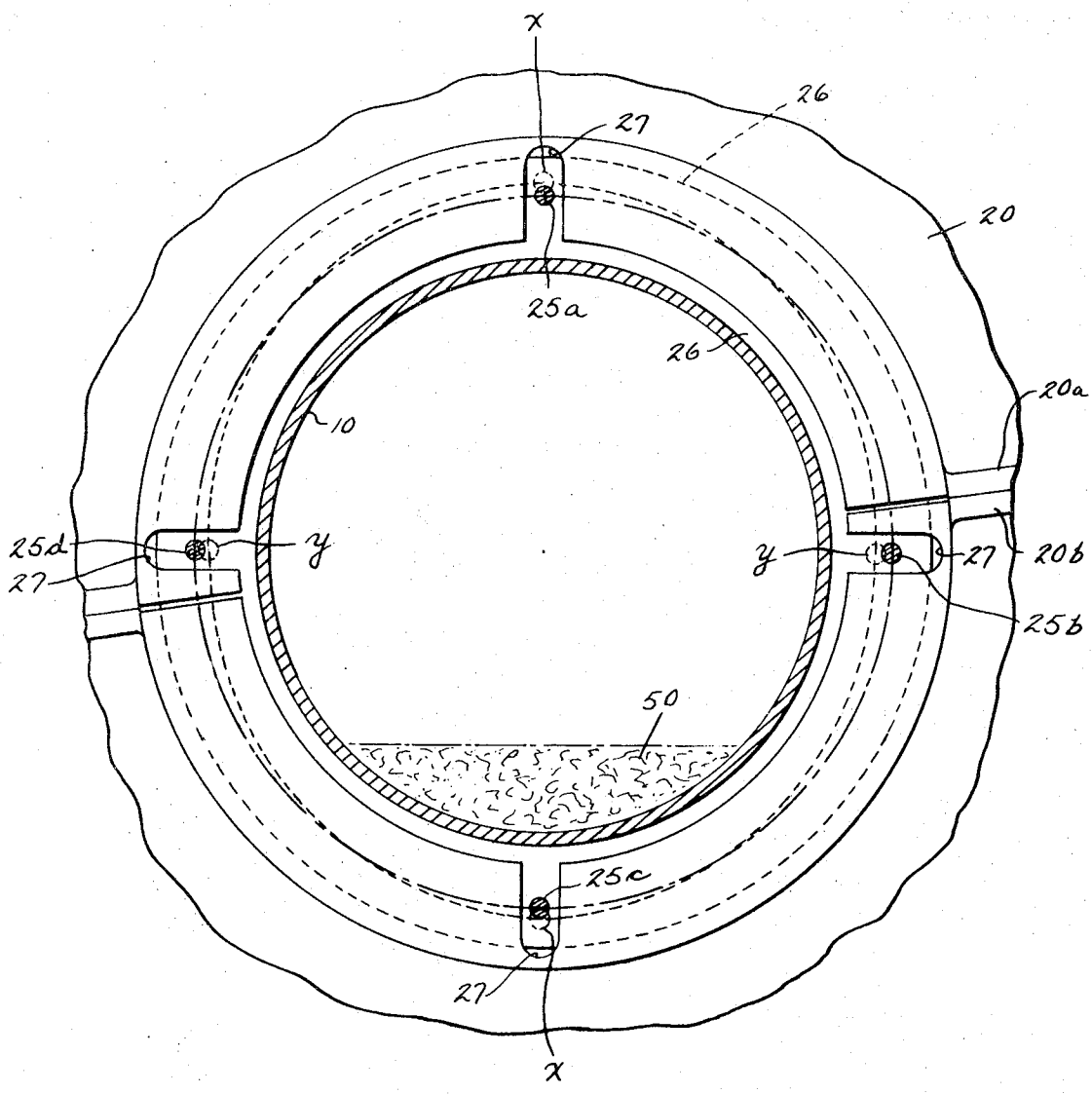
Fig. 5

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Fig. 6



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RING GEAR AND MOUNTING ASSEMBLY THEREFOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

The technical residence of this invention is the art of mounting a ring gear which encircles a rotary apparatus for driving the same in such fashion as to enable the ring gear to maintain its shape and remain properly aligned with its associated driving pinions in spite of physical distortion of the rotary apparatus.

2. Description of the Prior Art

The problem sought to be solved with the present invention is typically encountered with driving apparatus for cement kilns and will be explained with reference thereto. Cement kilns and the like are extremely long, large diameter tubes lined with refractory materials supported by heavy circumferential rings resting on trunnion roller amounts and driven by a ring gear bolted to a flange on the kiln shell. The ring gear is drivingly connected to a pair of pinions mounted on a foundation and powered by suitable motors and speed reducers for rotating the kiln. The raw materials are introduced at one end and discharged at the other after being cooked during their passage through the kiln by hot gases form the burner section at one end. Since the ring gear surrounds the kiln somewhat near its middle, the gears are generally split into 180° segments and bolted together after being assembled about the kiln. The kiln shell, being subjected to extreme temperature changes, expands, contracts, becomes egg-shaped and may undergo other physical deformation, thereby putting heavy stress on the split bolts holding together the ring gear segments. In consequence, even with the heaviest practical prestressed bolting, the splits between the gear segments, which pass down through the root between two adjacent teeth, have a tendency to open up to thereby increase the space between the teeth and induce fatigue fractures due to impact loading as a driving pinion crosses the split.

Several solutions to the above problem are revealed in the patent literature. U.S. Pat. No. 1,184,174 advocates mounting the pinion for driving the ring gear in a movable cradle so that the pinion can follow the ring gear in its irregular motion resulting from distortion of the driven apparatus. U.S. Pat. No. 2,269,700 recommends restricting longitudinal movement of the kiln by a flange near the ring gear that engages wheels mounted on a foundation to direct expansion of the kiln outwardly towards each end, combined with supporting columns designed to accommodate such expansion. A combination of rigidly mounted and resiliently mounted rollers is disclosed in U.S. Pat. No. 2,830,802 which are arranged to restrict movement of the kiln in such fashion as to reduce change in the meshing of the ring gear and its driving pinions. A chain drive utilizing rigidly connected and articulately connected links is presented in U.S. Pat. No. 3,386,718 to accommodate distortion of the kiln.

None of the foregoing arrangements has proved entirely satisfactory or particularly efficacious toward solving the problem under consideration, however, and the present invention submits a new concept for its resolution.

SUMMARY OF THE INVENTION

Briefly, this invention discloses a ring gear bolted to a flange extending about a rotary apparatus wherein the connecting bolts pass through radially elongated slots formed in the ring gear. The bolts are thereby permitted to move radially within the slots if the apparatus distorts, but this will not impair the driving alignment of the ring gear. Special washers are also shown for use in conjunction with a ring gear of the above construction that are particularly adapted for facilitating installation of such ring gears.

A principle object of the invention as to mount a ring gear relative to its driven apparatus such that the apparatus can move radially under the effects of physical distortion, but such movement will not affect the shape of the ring gear. Another principle object is to provide means for mounting a ring gear on its driven apparatus that will accommodate relative movement between the apparatus and the ring gear. A more specific object is to provide the particular apparatus hereinafter described and claimed.

DESCRIPTION OF THE DRAWINGS

The ensuring description sets forth the details of the present invention, in terms sufficient to instruct persons skilled in the art as to its practice, by reference to an illustrated embodiment and discussion of some permissible variations, it being understood that the description is intended to illustrate, not limit, this invention and that other embodiments and variations not specifically discussed are possible within the scope of the present invention. In the drawings:

FIG. 1 is a side view of a cement kiln driven by a ring gear mounted in accordance with the principles of this invention;

FIG. 2 is an end view of the ring gear;

FIG. 3 is a sectional view of a portion of the ring gear illustrating its attachment to the kiln when it is ready to be operated, and FIG. 4 is a similar view showing an initial step during installation of the gear;

FIG. 5 is an enlarged view showing a connecting bolt used to attach the ring gear to the kiln; and

FIG. 6 is a diagrammatic view to illustrate the effects of distortion of the kiln with the ring gear of this invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

FIG. 1 illustrates a rotary cement kiln **10** comprising a long cylindrical body mounted for rotation in an inclined position. The lower end of the kiln **10** is inserted with a hood **11** that encloses the combustion apparatus and the upper end of the kiln extends into a chamber **12** where raw materials are fed into the kiln through hopper **13**. A plurality of rings **14** are attached to the kiln at spaced intervals along its length and engage trunnion mounted rollers **15** to support the kiln in its desired position.

The kiln **10** is rotated by motor **16** driving a speed reducer **17** that is connected through coupling **18** to pinion **19** which meshes with the ring gear **20**, there usually being two such pinions **19** on opposite sides of the ring gear but only one is visible in FIG. 1.

The apparatus as described to this point is of the usual construction and, except to illustrate a typical field of use, forms no part of the present invention which is directed to the construction of the ring gear **20** and the manner in which it is attached to the kiln.

In FIG. 2 the ring gear **20** of this invention has two segments **20***a* and **20***b* which are bolted together to form an annular gear. The ring gear is attached by a plurality of spaced connecting bolts **25** to an annular flange or collar **26** attached to the kiln **10**. There are 24 connecting bolts shown in the drawings, but this number can be varied to suit the particular apparatus. Each connecting bolt **25** passes through a slot **27** formed in the annular gear flange **28**, the slots being shaped, according to this invention, to allow radial movement of the connecting bolts **25** and including, see particularly slot **27***a*, spaced parallel sidewalls **29** and **30** connected by a curved end wall **31** in the particular form shown herein. The slots thus have a U-shaped configuration with the sidewalls **29** and **30** having their inner ends opening onto the innermost periphery of the gear flange **28** and their outer ends connected by the end wall **31**. Other shapes for the slots can also be used, e.g. radially elongated ovals. The slots **27** have an open end along the innermost edge of the gear flange **28**. A washer **32**, whose structure is described in detail below, is associated with each bolt **25** and a nut **33** is threaded onto each bolt to hold the gear in place.

FIGS. 3—5 illustrate in further detail the construction of the ring gear **20** of this invention and its new mode of attachment to the kiln **10**. Each connecting bolt **25** passes through a spacer block **35** which is inserted within a slot **27**. The spacer block **35** includes a circular head **36** which is positioned

between the kiln flange **26** and the gear flange **28** and extends beyond the sidewalls **29** and **30** of the slot **37**, see FIG. **5**. There may be a slight clearance on the order of .002 inches—.003 inches between the head of the spacer block and the surface of the gear flange. With further reference to FIG. **5**, a spacer block **35** also includes a body portion **37** that extends through a slot **27**, which body portion **37** has flattened sides **38** and **39** adjacent walls **29** and **30** respectively of the slot, the walls **38** and **39** being slightly spaced therefrom (about .002 inches—.003 inches) to allow the body of the spacer block to slide within the slot.

The washers **32**, see now FIGS. **3** and **4**, include a flat head **40** and an annular flange **41**. When the ring gear **20** is first attached to the kiln **10** in an unloaded condition and after all connecting bolts **25** are loosely inserted between the gear flange **28** and the kiln flange **26**, the washers **32** are positioned as illustrated in FIG. **4** in which condition the annular flange **41** of each washer contacts the gear flange **28** and clamps the gear into position as the gear is being adjusted to its proper alignment. The inner diameter of the flange **41** is larger than the diameter of the adjacent end **42** of the spacer block so that the washer can contact the gear in this fashion. Approximately every third bolt **25** is reamed to a precision fit with its hole through the kiln flange **26** and its hole through the spacer block **35** after the desired gear alignment has been obtained and while the washers **32** are in the position of FIG. **4**, this is to provide for the transmission of the driving torque. The remaining bolts **25**, however, need only have a loose fitting with their corresponding flange and spacer block holes. Once this alignment has been achieved, the washers **32** are reversed to the position illustrated in FIG. **3** in which their heads **40** contact the end **42** of each spacer block **35** in the particular position achieved during the alignment process. This construction of the washer **32** thereby facilitates alignment and installation of the ring gear **20** and is also adapted for satisfactory running after alignment has been obtained. Shims may be added between the spacer blocks and the washers as are necessary for suitable alignment.

A grease fitting **45** is attached to each bolt **25** and communicates with an axial grease passage **46** connected to a radial grease passage **47** for supplying lubricating grease between the bolts **25** and the spacer blocks **35**.

The diagram of FIG. **6** illustrates the effects of distortion of the kiln **10** when loaded with a charge **50** on the relative position of the kiln and ring gear **20**. This will be described with reference to bolts **25***a*, **25***b*, **25***c* and **25***d*, the other bolts being omitted from the diagram for the sake of clarity. Before any distortion takes place, the bolts **25***a*, **25***b*, **25***c* and **25***d* are in their solid-line positions of FIG. **6**. Assuming the weight of the charge **50** is sufficient to cause the kiln **10** to change its shape slightly or the kiln distorts due to thermal effects, a slight egg-shaped configuration will result in which the kiln will elongate along its vertical axis and shorten along its horizontal axis. The bolts **25***a* and **25***c* will move in an outward radial direction relative to the center of the kiln, along their respective slots **27** in the gear flange, to their dotted line positions indicated by the letter *x* in FIG. **6**. Concurrently, the bolts **25***b* and **25***d* will move radially inwardly toward the center of the kiln **10**, also moving along their respective slots **27**, to their dotted line positions indicated by the letter *y*. This movement of the kiln in relation to the ring gear is made possible by the elongated slots in the gear flange through which extend the connecting bolts joining in the gear to the kiln flange. The flattened sides of the spacers **35** arranged as illustrated in FIGS. **3**—**5** aid in guiding such movement along the slots. Movement along other axes is accommodated in the same fashion. This movement, which may be very slight and on the order of a few thousands of an inch, prevents distortion of the ring gear by reason of expansion and contraction of the kiln, or other radial distortion of the kiln, and also prevents the imposition of stress on the bolts holding together the two segments of the ring gear due to any such radial distortion.

There has thus been described a ring gear according to this invention which includes a gear flange having a plurality of spaced slots that are elongated in the radial direction and which accommodate connection bolts for joining the ring gear to a flange or similar structural portion of the apparatus to be driven by the gear. The connecting bolts are adapted for radial movement within such elongated slots under the influence of radial deformation of the apparatus to which the gear is connected. As another feature, the bolts extend through spacer members which are inserted within the elongated slots of the gear flange and flat sides of the same configuration as the sides of the slots for guiding movement of the bolts therealong. Washers of a particular configuration especially adapted to facilitate installation and subsequent running of the apparatus also have been described.

I claim:

1. In a ring gear of the type have an inner annular flange which is to be joined by connecting bolts to an apparatus to be driven by the ring gear, the improvement wherein:

a plurality of slots are defined in the flange of the ring gear, there being one slot for each connecting bolt; and

each slot is radially elongated to accommodate radial movement of a connecting bolt therein.

2. A ring gear according to claim **1**, wherein each slot comprises a generally U-shaped opening comprising spaced parallel straight sidewalls with their inner ends opening onto the innermost periphery of said annular flange of the ring gear, and an end wall connecting the opposite ends of the sidewalls.

3. An apparatus of the type including (1) a rotary apparatus including an annular flange, (2) a ring gear encircling the apparatus for driving it and having an annular gear flange, and (3) connecting bolts extending between the annular flange of the apparatus and the gear flange for connecting the gear to the apparatus, the improvement wherein: (1) the ring gear includes a plurality of slots defined along the gear flange, there being one slot for each connecting bolt, and each slot is radially elongated; and the connecting bolts are adapted to radial movement within the elongated slots.

4. Apparatus according to claim **3**, further including a spacer member inserted in each elongated slot and through which each connecting bolt extends, said spacer member including sidewalls arranged to engage sidewalls of the slots during radial movement of the connecting bolts within the slot.

5. Apparatus according to claim **4**, further including a washer on each connecting bolt, said washer having a flat head portion and a circumferential flange extending thereabout, said circumferential flange being larger than the spacer member in each slot and adapted to contact the gear flange during installation and alignment of the gear, and said head of each washer being adapted to contact an end of a spacer member after installation of the apparatus.