This invention relates generally to rotary kilns and particularly to means for supporting such kilns for rotation and for limited longitudinal movement as may result from expansion and contraction of the kiln. The ordinary rotary kiln such as is commonly used in the manufacture of cement comprises generally a cylindrical shell which is lined with a heat resistant material such as fire brick. The kilns are often from 6 to 12 feet in diameter and may be from 200 to 500 feet or more in length. It is necessary to provide means for supporting the weight of the kiln and its contents in such a manner that the kiln may be rotated. It is common practice to utilize wide bands of iron encircling the kiln which engage large straight faced rollers usually arranged in pairs mounted on concrete piers extending several feet above the ground. As the kilns are subjected to intense heat, the expansion and contraction of a kiln is considerable and as a result the kilns moves longitudinally on the rollers, placing tremendous stress on these elements and the piers on which they are mounted. The longitudinal movement of the kiln causes cracking and destruction of the concrete piers and necessitates stoppage of the kiln for repair of the piers and the supporting rollers.

By reason of the fact that different parts of the kiln are heated to different temperatures, it often results that the kiln may sag or be warped out of round and with the ordinary means of supporting the kiln in which there is no means provided for the rollers to accommodate for engagement with a non-circular portion of the kiln, this often results in damage to the inner heat resistant lining of the kiln.

In view of the above pointed out disadvantages of the ordinary means used for supporting elongated rotatable kilns, it is a primary object of this invention to provide a flexible means for supporting a kiln and permitting rotation thereof which is adapted to accommodate for the longitudinal movement of the kiln caused by expansion and contraction. In this connection it is an object to provide supporting means in which the parts of the supporting means which immediately engage the kiln are flexible and adaptable for movement to accommodate for a kiln which may become out of round. It is a further object of this invention to provide a supporting means in which the parts immediately engaging the kiln are subjected only to normal loads and not to forces which would normally be set up and brought to bear on the ordinary supporting structures by longitudinal shifting of the kiln.

It is also an object of this invention to provide a kiln supporting means between the kiln and a foundation which subjects the foundation to substantially vertical loads only and thereby requires only the provision of a minimum amount of concrete or other foundation. It is a further object of this invention to provide supporting means for a kiln which is self aligning and which is flexible and automatically accommodates itself to irregular loading to distribute the loading over all the supporting parts. It is also an object of this invention to provide supporting means which may be easily repaired without necessitating the stopping of the kiln.

These and other objects will be apparent from the drawings and the following description thereof. Referring to the drawings which are for illustrative purposes only:

Fig. 1 is a side elevation of a kiln and the supporting means of this invention;

Fig. 2 is a section on line 2–2 of Fig. 1;

Fig. 3 is a section on line 3–3 of Fig. 1;

Fig. 4 is an end elevation of one of the supporting units of this invention shown with relation to a fragmentary cross section of a kiln;

Fig. 5 is a side elevation of a supporting column and beam taken in the plane of line 5–5 of Fig. 4;

Fig. 6 is a fragmentary sectional view on line 6–6 of Fig. 4;

Fig. 7 is a plan view of the truck of Fig. 4; and

Fig. 8 is a fragmentary side view of the lower end of a pair of columns showing a modified form of support therefor.

More particularly describing the invention, reference numeral 11 generally indicates a cylindrical kiln which may be of any desired length and diameter. A stack structure 12 is shown at one end of the kiln. At a point intermediate its ends, the kiln is provided with a ring gear 13 which may be geared to any suitable motive power (not shown) for rotating the kiln. Spaced a short distance from the gear 13 is a flange 14 which rotatably engages a pair of beveled guide wheels 15 mounted on a suitable base 16 which rests on a concrete foundation 17. The flange 14 and guide wheels 15 prevent longitudinal movement of the immediately adjacent portion of the kiln and expansion of the kiln is outward toward each end from the flange.

The kiln is supported for rotation on a plurality of supporting structures indicated generally by...
numerals 18, 18' and 19. These supporting structures are mounted on concrete foundation units 20, 20a, and 20b and the aforementioned foundation 17. In Fig. 1 the supporting structures have been shown arranged in pairs on the particular foundation, however, although this is a preferred way of utilizing the supporting structures, it is unnecessary that the structures be so disposed.

Referring to Figs. 2 to 7 inclusive, each of the supporting structures 18 comprises a pair of substantially vertically disposed columns 22 which rest upon base plates 23. In order that the columns may rock on the bases and may support members for rocking movement at their upper ends, the columns are provided with rounded ends. In order to accomplish this, the columns are shown as consisting of H beams each provided at each end with what will be termed a cap member 24 having a rounded end. These cap members may be welded to the columns or otherwise secured thereto in any suitable manner.

The lower end of each column 22 is adapted to bear on the base plate 23 which is anchored to the foundation by means of the anchor bolts 25. In order to limit lateral movement of the bases of the columns each of the plates 23 is provided with a pair of spaced upwardly extending flanges 26 which may be welded to the plates 23. These flanges are provided with apertures at each end in order to accommodate the bolts means 27 and 27'. This construction forms in effect a socket or seat for the reception of the lower end of a column.

At their upper ends each pair of columns supports what will be termed a cradle assembly 28 which is adapted to support the klin 11. The cradle assembly comprises what will be termed inverted trucks 30, one on each of the columns. The trucks 30 (see Figs. 4, 5 and 7) are each comprised of a seat element 31 which is provided with a recess 32 to accommodate the upper end of a column 22. The seat element is provided with a concave recess 33 which is adapted to receive a cylindrical beam 34. Suitable straps 35 extend over the beam and are attached to the seat element by means of the bolts 36. This construction serves to secure the seat element and beam together and at the same time permits of rotative adjustment of the beam in the seat.

The beam 34 is provided with two flat recesses 38, each of which is adapted to receive a cross arm 39, preferably of spring material, which is securely fastened to the beam by means of bolts 40. The beam is provided with the bosses 41 to provide an abutting face for the heads of the bolts. A plate 42 extends across the top of the two spaced cross arms serving to connect them and strengthen the assembly. This plate is attached to the members by the bolts 40 which extend through the plate as well as through the beam 33 and cross arms 39.

Near their outer ends each cross arm is provided with a bearing block 44. These are adapted to bear 45 around a shaft 46 at one end and a shaft 45' at the other. The shafts extend between the cross arms transversely thereof and have mounted thereon a pair of flanged wheels 46, 46' respectively. In the form of the invention shown, it is preferred that the shafts 45, 45' be removably mounted by means of suitable antifriction bearings means 44 and that the flanged wheels be secured to each shaft in spaced relation, however, it is of course within the scope of the invention to provide other means of rotatably mounting the wheels. The wheels are provided with their flanges on adjacent sides thereby providing a guide means to insure the wheels running on the tracks or rails 48 on the klin, subsequently to be described.

Each set of columns is provided with a pair of tie rods 50 which extend freely through holes 51 in the ends of the beams 34. It is to be noted that the holes 51 are larger in diameter than the diameter of the tie rods. The outer ends of the tie rods are threaded and provided with nuts 52 which engage against washers 53. These washers are provided with a curved inner face which corresponds to the outer surface of the beam. With this construction limiting rocking out of each inverted truck 30 is permitted by reason of the fact that the tie rods 50 extend freely through the holes 51 in the beams. The wheels are thereby able to automatically accommodate themselves to any non-circular portions of the tracks 48 of the klin.

It may be desirable in some instances to provide each set of supporting means 18 with a lateral bracing means such as indicated at the extremity of the klin in Fig. 1 and by the sets 18' and as more clearly shown in Figs. 3. Thus in Fig. 3 the columns 22 are each provided with lateral braces 54 pivotally connected at their upper ends by means of bolts 54' to the column 22 and having their lower ends mounted on base plates 23' similar to the plates 23. The lower ends of the braces 54 are rounded but extend generally diagonally to the longitudinal axis of the braces. A tie rod 55 is provided which extends from the lower end of each column 22 substantially horizontal to the lower end of the braces 54. This construction prevents any possibility of the supporting means 18' extending out of line or permitting lateral movement of the klin wherever such supporting means are placed. When the braced supporting means is placed at the end as shown in Fig. 3 any warp of the klin between such support and the central support is accommodated by the intermediate support 16 which may move laterally as may be required.

The klin itself is provided with circular rails generally indicated by reference numeral 48 upon which the wheels 45 and 45' are adapted to ride. These rails are spaced in pairs as shown in Fig. 1 and comprise a member 56 which is welded to or otherwise secured to the outer metal wall 57 of the klin. To this is secured the rail 58 by means of the circular strips 59 and welding 60.

The sets of supports 19 indicated in Fig. 1 are in all respects similar to the sets 18 except that the columns are much shorter in length.

In operation of the klin, the klin is rotated by means of any suitable motive power connected to the gear wheel 13. Suitable means are provided for heating the klin and during heating and periods of cooling, when the klin may be out of production for any reason, the klin expands and contracts several inches. During the expansion and contraction the sets of supporting means 18, 18' and 19 are free to rock and accommodate for any longitudinal movement of the klin caused by either contraction or expansion. It is apparent that at all times the beams 34 will be disposed parallel to the longitudinal axis of the klin thereby insuring that the trucks and the flanged wheels thereon will properly engage the rails 48 on the klin. The reason for this is that the columns 22 are free to rock or tilt with respect to both the foundation upon which they rest and with respect to the trucks mounted at their upper ends.
When the columns are placed in pairs as shown in the drawings it is sometimes desirable to provide for unequal vertical movement of the columns. This is accomplished by having the lower ends of the columns 22 rest upon a beam 65 (see Fig. 8) which is supported intermediate its ends by a plate 66 having a slightly rounded upper face. The plate 65 is mounted on a plate 67 which rests on a concrete foundation 68, being secured thereto by a bolt 69. This construction permits the beam 65 to rock with consequent vertical movement of the columns 22.

It is contemplated that various changes and modifications might be made within the scope of the invention and it is intended to cover such changes as come within the claims.

I claim as my invention:

1. In combination, a kiln, foundation means beneath said kiln, upright kiln supporting members resting on said foundation means at points spaced longitudinally of the kiln, said supporting members being free to tilt a limited distance in a plane parallel to the longitudinal axis of the kiln, and means interposed between said kiln and each of said supporting members for rotatably mounting said kiln.

2. In apparatus for supporting a rotary kiln or the like, a foundation; a substantially vertical column supported on said foundation for rocking movement; means including longitudinally spaced wheels for engaging the object to be supported, said means being mounted for rocking movement on said column; and means limiting lateral movement of said means for engaging the object to be supported.

3. In combination, a cylindrical kiln; a rail encircling said kiln and mounted thereon; a foundation; a substantially horizontally disposed beam mounted on said foundation and extending at right angles to the longitudinal axis of the kiln, said beam being mounted for rocking movement on said foundation; a pair of spaced columns supported on and adapted to rock on said beam; an inverted truck resting on and rockable on each column, said trucks having spaced wheels engaging said rail and forming a cradle for said kiln; and means connecting said trucks.

4. Means for supporting a kiln for rotation and for limited longitudinal movement resulting from expansion and contraction comprising: a foundation; a pair of spaced substantially vertical columns mounted on said foundation for tilting movement; means including a tie rod connecting said columns at their upper ends for preventing spreading thereof; and cradle means supported on said columns for rocking movement thereon, said cradle means including rotatable members adapted to engage the kiln.

5. Means for supporting a kiln for rotation and for limited longitudinal movement resulting from expansion and contraction comprising: a foundation; a pair of spaced substantially vertical columns mounted on said foundation for tilting movement; means including a tie rod connecting said columns at their upper ends for preventing spreading thereof; an arm mounted on each of said columns transversely to the longitudinal axis of the kiln, said arms being rockable on said columns; and a pair of spaced rotatable members on each of said arms adapted to engage the kiln; said arms and rotatable members together forming a cradle for said kiln.

6. Means for supporting a kiln for rotation and for limited longitudinal movement resulting from expansion and contraction comprising: a foundation; a pair of spaced substantially vertical columns mounted on said foundation for tilting movement; an inverted truck mounted on each of said columns for rocking movement thereon and having wheels adapted to engage the kiln, said trucks forming a cradle for the reception of the kiln; and a tie rod connecting said trucks.

7. Means for supporting a kiln for rotation and for limited longitudinal movement resulting from expansion and contraction comprising: a foundation; a pair of spaced substantially vertical columns mounted on said foundation for tilting movement; an inverted truck mounted on each of said columns for rocking movement thereon and having wheels adapted to engage the kiln, said trucks forming a cradle for the reception of the kiln; a tie rod connecting said trucks; and a lateral brace extending from each of said columns to said foundation.

8. In apparatus for supporting a rotary kiln or the like, a foundation; a column pivotally mounted on said foundation, said column having a rounded upper end; an inverted truck adapted to rest on said said column, said truck including a seat element for engaging the lower end of said column and means for limiting movement of said truck laterally of the kiln or the like to be supported.

9. In combination a foundation; a pair of spaced substantially vertical columns adapted to rest on said foundation and rock thereon; a beam on each of said columns adapted to rest and rock thereon; a tie rod connecting said beams; a pair of cross arms mounted on each beam, said cross arms on one column being oppositely inclined to those on the other column, the lower ends of said cross arms being inwardly of said columns; and flanged wheels mounted at each end of each pair of said cross arms.

10. In combination, a cylindrical kiln; a rail encircling said kiln and mounted thereon; a foundation; a pair of columns supported and adapted to rock on said foundation; an inverted truck resting on and rockable on each column, said trucks having spaced flanged wheels engaging said rail at spaced points and forming a cradle for said kiln.

11. In combination, a cylindrical kiln; a rail encircling said kiln and mounted thereon; a foundation; a pair of columns supported and adapted to rock on said foundation; an inverted truck resting on and rockable on each column, said trucks having spaced flanged wheels engaging said rail at spaced points and forming a cradle for said kiln; and means for permitting relative vertical movement of said columns.

MICHAEL TRESHOW.