L. D. GILBERT.

ROTARY KILN.

APPLICATION FILED OCT. 20, 1915.

1,184,174.

Patented May 23, 1916.

3 SHEETS—SHEET 1.

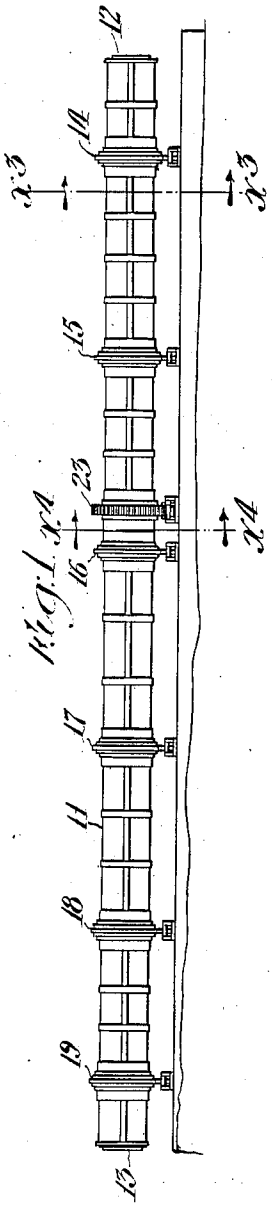


Fig. 1.

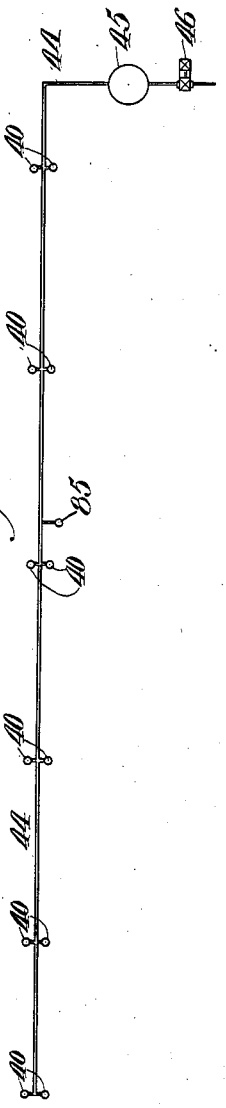


Fig. 2.

Inventor

Lloyd D. Gilbert

by Townsend Graham & Paine

his Attorneys

L. D. GILBERT.

ROTARY KILN.

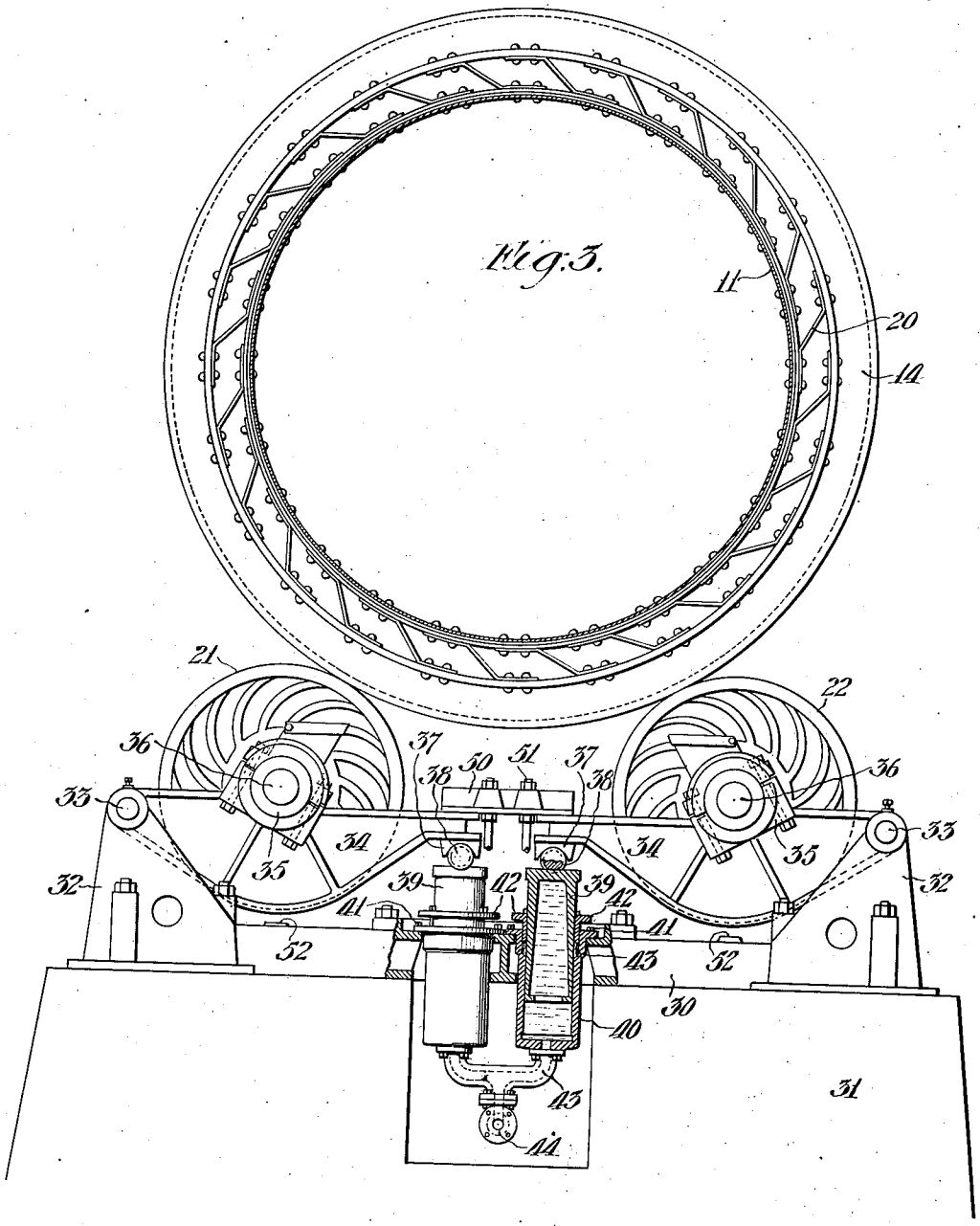
APPLICATION FILED OCT. 20, 1915.

1,184,174.

Patented May 23, 1916.

3 SHEETS—SHEET 2.

Fig. 3.



Inventor

Lloyd D. Gilbert

by Townsend Graham & Flamm

his Attorneys

L. D. GILBERT.

ROTARY KILN.

APPLICATION FILED OCT. 20, 1915.

1,184,174.

Patented May 23, 1916.

3 SHEETS—SHEET 3.

Fig. 5.

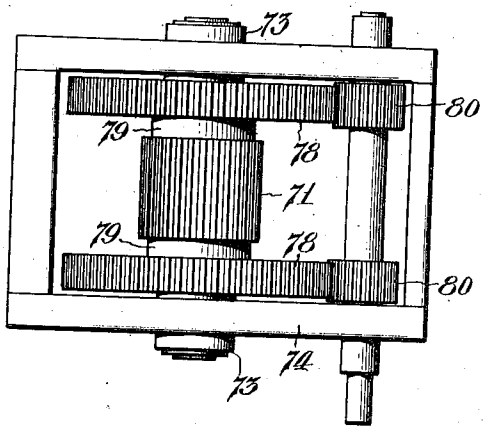


Fig. 6.

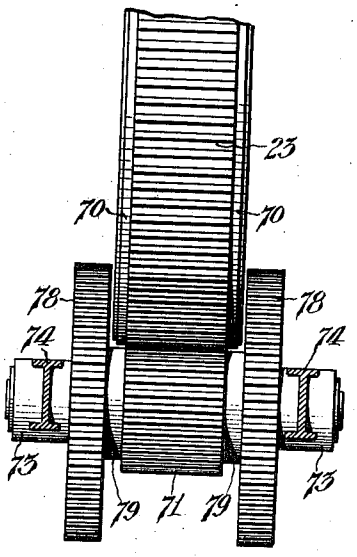
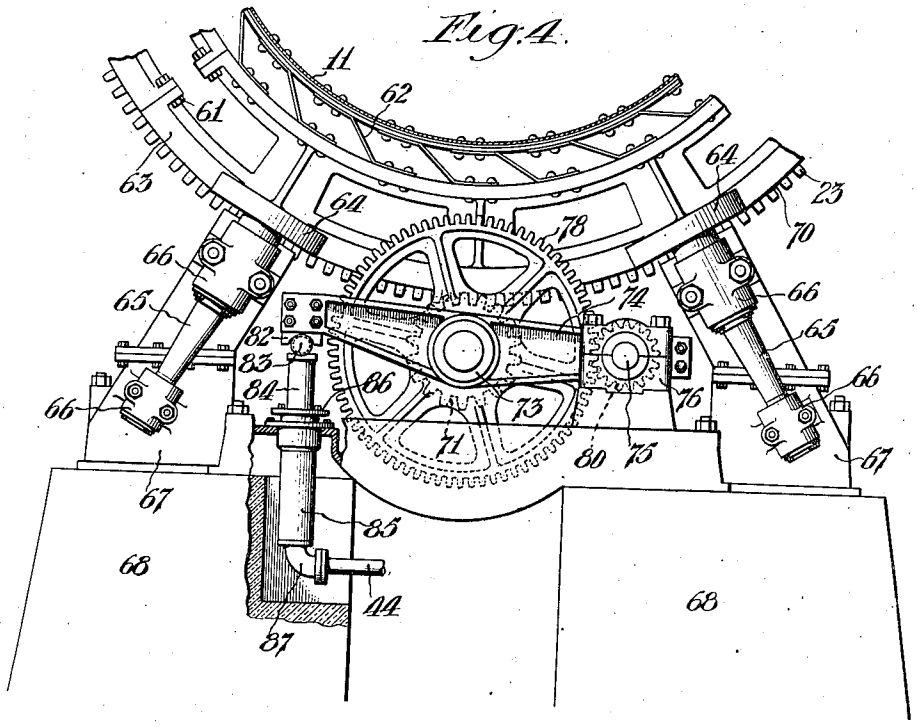


Fig. 4.



Inventor

Lloyd D. Gilbert

by Townsend Graham & Kain

his Attorneys

UNITED STATES PATENT OFFICE.

LLOYD D. GILBERT, OF LOS ANGELES, CALIFORNIA.

ROTARY KILN.

1,184,174. Specification of Letters Patent. Patented May 23, 1916.

Application filed October 20, 1915. Serial No. 56,877.

To all whom it may concern:

Be it known that I, LLOYD D. GILBERT, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles, State of California, have invented a new and useful Rotary Kiln, of which the following is a specification.

My invention relates to cement, or similar rotary kilns. In the art of making Portland cement, or similar materials, it is common practice to put the raw materials into a cylindrical kiln which is slightly inclined so that the materials travel through it as it is slowly rotated, the kiln being internally fired so that the material therein is evenly roasted in its progress therethrough. In the production of Portland cement considerable economies are effected by the use of large kilns. In a plant at present being built in California the kilns are nine feet in diameter and two hundred feet long, and even larger kilns are in commercial use. These kilns are formed of sheet steel, and are lined with fire brick. It is of course rather difficult to fabricate steel cylinders of this diameter and length which shall be perfectly straight, and it is practically impossible to allow any considerable flexibility in the shell as any bending thereof tends to destroy the fire brick lining. Great difficulty has therefore been experienced in supporting the kilns so that they may rotate freely without introducing stresses in the shell. This condition is aggravated where the kiln is stopped for any reason and an unequal expansion takes place throwing it considerably out of line.

The principal object of my invention is to provide means for supporting a cement kiln or a similar structure in such a manner that the shell of the kiln will not be dangerously stressed even where the axis of the kiln varies considerably from a straight line.

It is common practice to support such kiln on a plurality of rollers, and to drive the kiln by means of a pinion on a shaft fixed in the supporting structure. This pinion meshes with a gear fixed to and surrounding the shell of the kiln, and if the kiln is slightly out of line the pitch line of the gear may run eccentrically so that the gear teeth do not mesh properly. It has been common practice in the past to use gears and pinions having cast teeth preferably somewhat longer than the standard. Any gears which are run out of mesh are quite wasteful of power, and wear excessively, and it is quite desirable to use cut gears, the true economy of which is only obtained, however, when they are in proper relationship.

A further object of my invention is to provide means whereby the gears are kept in proper mesh regardless of any variations in the movement of the kiln.

Further objects and advantages will be made evident hereinafter.

Referring to the drawings which illustrate one embodiment of my invention: Figure 1 is a somewhat diagrammatic view of a cement kiln as equipped with my invention. Fig. 2 is a diagrammatic plan view of the fluid pressure system as used therewith. Fig. 3 is a section on an enlarged scale on a plane represented by the line x^3—x^3 of Fig. 1 looking in the direction of the arrows. Fig. 4 is a similar elevation on the same scale as Fig. 3 on a plane represented by the line x^4—x^4 of Fig. 1 looking in the direction of the arrows. Fig. 5 is a partial plan view of the driving gears. Fig. 6 is a partial elevation of these gears.

In the form of my invention illustrated in these drawings a kiln is employed having a shell 11 formed of steel plate sections bolted or riveted together, this shell having a lining of fire brick which is not shown in the drawings. When in use the raw material is fed into the end 12 hereinafter called the feed end, and is discharged through the end 13 hereinafter called the burning end. The burning end 13 is slightly lower than the feed end 12, and the kiln is fired through the burning end the products of combustion being taken off at the feed end to suitable stacks not shown. If any economy is to be obtained the shell 11 must be of considerable length and quite large diameter, shells two hundred feet long, and nine feet in diameter or larger not being at all unusual. Secured on the shell 11 are a series of circular tires 14, 15, 16, 17, 18 and 19, these tires all being similar in form and dimension, and being adjustably secured to the shell 11 by means of plates 20 as shown in Fig. 3. These tires are for the purpose of supporting the kiln, rollers 21 and 22 being provided for this purpose. A girth gear 23 is secured near the center of the shell 11, and the kiln is driven thereby rolling freely on the rollers 21 and 22 which support each of the tires 14, 15, 16, 17, 18 and 19. The above described construction is already common to the cement kiln art, the rollers 21

and 22 being, however, solidly secured to a supporting member in all the kilns which have previously been in operation. Obviously it is a difficult matter to fabricate a long cylinder of steel plates which will be perfectly concentric with a central axis passing therethrough. It is an extremely difficult matter to so attach the tires to the shell that they will roll perfectly true and even, and if they are so erected originally there is a considerable likelihood of the shell warping when heated so as to throw the various tires out of alinement. This produces two very serious results. First, it causes the tires to roll eccentrically so that a very variable pressure is exerted on the rollers 21 and 22, and internal strains are exerted on the shell itself, producing a slight movement thereof which tends to grind and crack out the fire brick. Second, any distortion of the shell tends to throw the girth gear out of alinement so that it does not mesh properly with the driving pinion causing undue friction between the gear and the driving pinion, and causing undue wear and loss of power at this point. In my invention I support the rollers 21 and 22 so that the load thereon is perfectly equalized.

Referring to Fig. 3 it will be seen that a support 30 is provided, this support being secured to a foundation 31, and having bearing brackets 32 at either end thereof in which rocker shafts 33 are free to turn. The rocker shafts 33 support one end of roller cradles 34, these roller cradles having bearings 35 formed thereon in which shafts 36 fixed in the rollers 22 are free to turn. The inner ends of the cradles 34 have roller blocks 37 secured thereon, these blocks resting on rollers 38, and the rollers 38 resting on the top of pistons 39, these pistons sliding in cylinders 40 which are rigidly secured by bolts 41 to the support 30. A follower 42 compresses packing 43 around the cylinder 40 making a tight joint therearound. A special T pipe fitting 43 connects the cylinders 40 of the rollers 21 and 22 in pairs so that the spaces inside the cylinders 40 below the pistons 39 are in open communication with each other. All of the pipe fittings 43 are connected to a common supply pipe 44, this supply pipe connecting with an accumulator 45 in which the pressure is maintained constant by a pump 46. The accumulator 45 and the pump 46 are shown diagrammatically in Fig. 2, any convenient form of pressure regulating and maintaining device being suitable for use in this connection.

Each of the tires 14, 15, 16, 17, 18 and 19 is supported on rollers 21 and 22 similar to those shown in Fig. 3. The load on the tires 14 and 19 is purposely made somewhat less than the load on the intermediate tires 15, 16, 17, and 18, this being accomplished by so spacing the tires that the end tires 14 and 19 have considerable less weight to support. A uniform pressure being maintained in the pipe 44 it is evident that the rollers 21 and 22 supporting the tires 14 and 19 would tend to raise somewhat higher than the intermediate rollers, due to the lesser load thereon, thus tending to introduce strains in the shell 11. To prevent this a limit stop member 50 is provided in connection with the cradles 34 of the end tires 14 and 19, this stop 50 being connected to the support 30 by means of bolts 51, and serving to positively limit the distance the rollers 21 and 22 of the end tires 14 and 19 can be raised. Formed on the support 30 at either side thereof are small bosses 52 against which the cradles 34 strike when pressure is released in the cylinders 40.

For the purpose of driving the kiln the girth gear 23 is provided, this girth gear preferably being made in sections which are bolted together at 61, the sections being secured to the shell 11 by means of plates 62. A bearing face 63 is turned on either side of the gear 23 and rollers 64 run thereon for the purpose of holding the kiln in proper longitudinal alinement, the rollers 64 being secured to shafts 65, carried in bearings 66, secured to a support 67, which rests on a suitable foundation 68. Secured on either side of the gear 23 outside the teeth 69 thereof are two machined rings 70, these rings being turned off, and having outside diameter exactly equal to the pitch diameter of the girth gear 23. A main pinion 71 meshes with the girth gear 23 being rigidly secured in bearings 73 secured in a gear cradle 74. The gear cradle 74 is pivoted on a shaft 75 carried in suitable bearings 76 secured on the support 67. Secured on the shaft 72 on either side of the pinion 71 are a pair of transmission gears 78, these gears having hubs 79 which are turned down to the pitch diameter of the pinion 71, the pinion 71 being of such a width that the hubs 79 can rest against and roll on the rings 70 on the gears 23. Transmission pinions 80 are formed on the shaft 75 meshing with the transmission gears 78, the shaft 75 being driven through a coupling 81 from any suitable source of power not shown. Secured on one end of the cradle 74 is a roller block 82 which rests on a roller 83, the roller 83 resting on the top of a piston 84 similarly constructed to the piston 39 shown in Fig. 3. The piston 84 slides in a cylinder 85 through a stuffing box 86. The cylinder 85 is connected through a suitable pipe fitting 87 with the pipe 44.

The method of operation of my invention is as follows: The parts being assembled as shown and no pressure being applied to the pipe 44, the kiln is erected on the rollers 21 and 22, the cradles 34 resting on the bosses 52. Crude oil under pressure is then

forced into the pipe 44 by means of the pump 46, this pressure being regulated by the accumulator 45. Pressure from the pipe 44 is transmitted to the pistons 39 and 84 lifting the kiln bodily until the end cradles 34 strike against the stop 50. The pressure is then increased until the tires 14, 15, 16, 17, 18 and 19 revolve about the same axis as nearly as is possible. The pressure in the cylinder 85 acting against the end of the cradle 74 forces the main pinion 71 into mesh with the gear 23, forcing the hub 79 solidly against the rings 70 on the girth gear 23. The pressure in the cylinder 84 is such that the pinion 71 and the girth gear 23 are held solidly in mesh even where the girth gear 23 does not rotate about the axis of the kiln, the pinion 71 following the girth gear 23 up and down to take care of any irregularities in the motion thereof. The main pinion 71 is driven through the gear 78 and the pinions 80 from any convenient source not shown.

Should there be any accidents to the oil supply system the cradles 34 are settled until they rest on the bosses 52 so that there will be no danger of injuring the kiln due to failure of the pressure on any of the rollers 21 and 22.

I claim as my invention:—

1. In a cement kiln, a shell having a series of tires formed thereon, a series of rollers on which said tires roll, and means for so connecting said rollers that a uniform pressure is exerted on each roller.

2. In a cement kiln, a shell having a series of tires formed thereon, a series of rollers on which said tires roll, a fluid piston secured to each roller in such a manner as to take a portion of the load thereon, a cylinder for each piston, and means for maintaining a constant pressure in all of said cylinders.

3. In a cement kiln, a shell having a series of tires formed thereon, a series of rollers on which said tires roll, a roller shaft for each roller, a supporting structure, a series of cradles each cradle being pivoted on said structure and carrying one of said roller shafts, and means for connecting said cradles in such a manner that the loads on said rollers is equalized.

4. In a cement kiln, a shell having a series of tires formed thereon, a series of rollers on which said tires roll, a roller shaft for each roller, a supporting structure, a series of cradles each cradle being pivoted on said structure and carrying one of said roller shafts, pistons each connected to one of said cradles, cylinders in each of which one of said pistons slides, and fluid means for exerting the same pressure on each of said pistons so that there will be a uniform pressure on each of said rollers.

5. In a cement kiln, a shell having a series of tires formed thereon, a series of rollers on which said tires roll, a roller shaft for each roller, a supporting structure, a series of cradles each cradle being pivoted on said structure and carrying one of said roller shafts, pistons each connected to one of said cradles, cylinders in each of which one of said pistons slides, pipe means for connecting all of said cylinders together, and means for maintaining a uniform fluid pressure in said pipe means.

6. A driving gear for a cement kiln comprising a toothed girth gear secured to and surrounding the kiln, a main pinion for driving said gear, a pinion shaft on which said pinion is secured, a cradle in which said shaft turns, a fixed support to which said cradle is pivoted, means for driving said pinion shaft, and means by which said cradle is adjusted to hold said pinion and gear in the proper relationship regardless of any eccentricity of shape or movement of said gear.

7. A driving gear for a cement kiln comprising a toothed girth gear secured to and surrounding the kiln, a main pinion for driving said gear, a pinion shaft on which said pinion is secured, a cradle in which said shaft turns, a fixed support to which said cradle is pivoted, means for driving said pinion shaft, and elastic means for holding said pinion and gear in the proper relationship.

8. In a cement kiln, a shell, a series of tires secured to and surrounding said shell, a pair of rollers for each of said tires on which said tires turn, fluid means for exerting the same pressure on each of said rollers, and means for limiting the upward movement of each set of end rollers.

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 15th day of October, 1915.

LLOYD D. GILBERT.