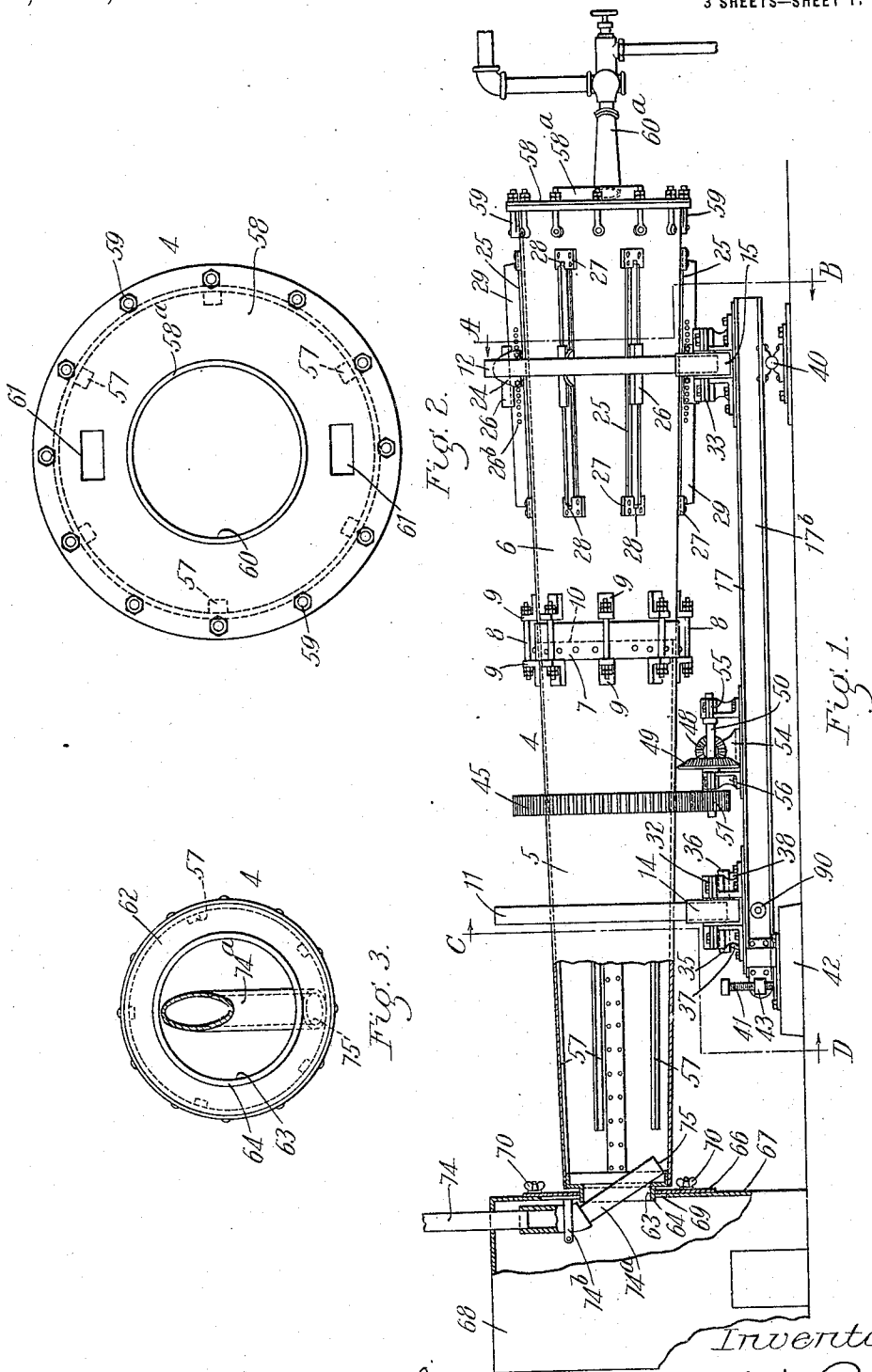


C. W. SINGER.
 APPARATUS FOR TREATING ORES.
 APPLICATION FILED JUNE 23, 1915.

1,188,567.

Patented June 27, 1916.

3 SHEETS—SHEET 1.



Inventor.
 Charles W. Singer by Chas. F. Perkins Atty.

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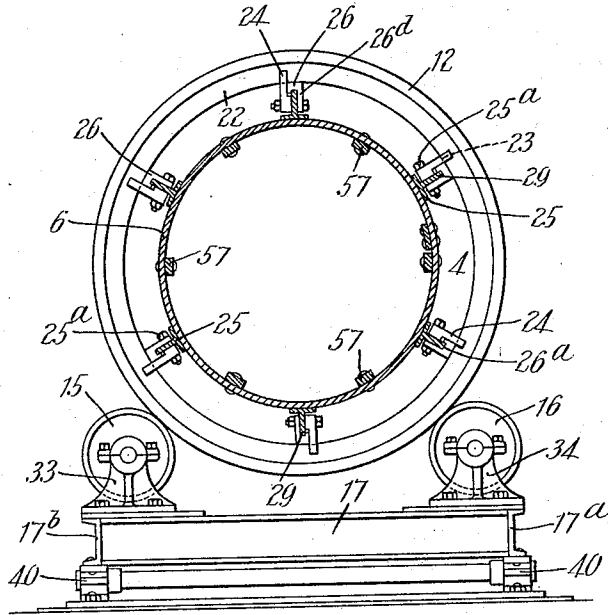


Fig. 4

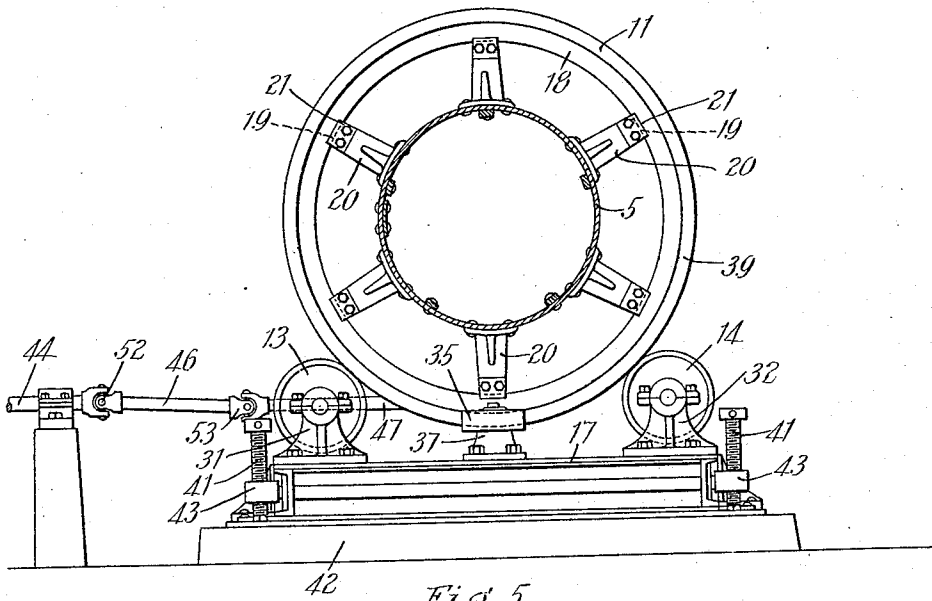


Fig. 5.

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3 SHEETS—SHEET 3.

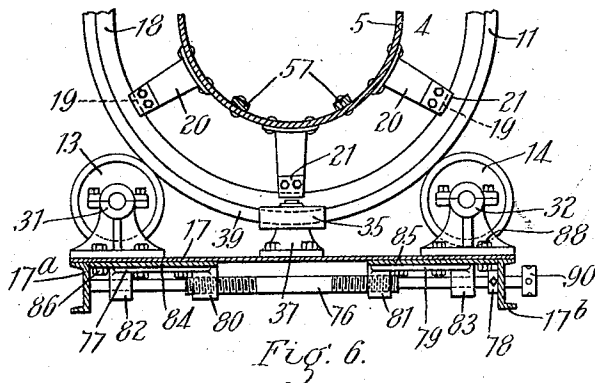


Fig. 6.

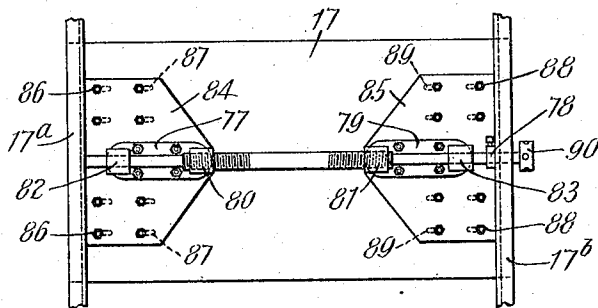


Fig. 7.

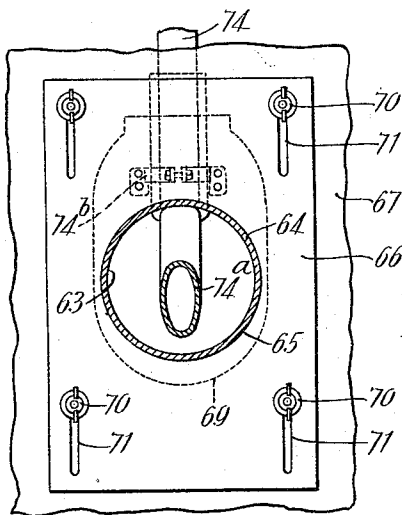


Fig. 8.

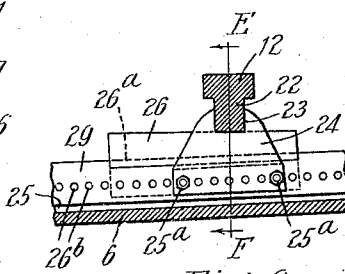


Fig. 9.

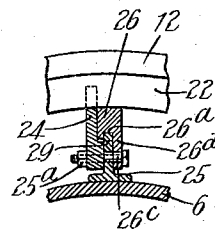


Fig. 10.

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UNITED STATES PATENT OFFICE.

CHARLES W. SINGER, OF LINDEN, WISCONSIN, ASSIGNOR TO CAMPBELL MAGNETIC SEPARATING COMPANY, A CORPORATION OF ARIZONA.

APPARATUS FOR TREATING ORES.

1,188,567.

Specification of Letters Patent. Patented June 27, 1916.

Application filed June 23, 1915. Serial No. 35,949.

To all whom it may concern:

Be it known that I, CHARLES W. SINGER, a citizen of the United States, residing at Linden, in the county of Iowa and State of Wisconsin, have invented new and useful Improvements in Apparatus for Treating Ores, of which the following is a specification.

This invention relates to means for treating ferruginous ores containing sulfids in preparation for magnetic separation, and its object is to provide an apparatus that is more efficient than those heretofore employed.

The apparatus consists primarily of a furnace of a type similar to that described in Letters Patent of the United States to Etherington, No. 1,051,494, dated January 28th, 1913, so constructed that a non-oxidizing atmosphere may be maintained in the furnace while it is in operation.

It has been demonstrated that in order to get the best results in magnetizing non-magnetic ores by heat, it is desirable to admit only sufficient air to support the combustion of the fuel without materially oxidizing the metallic constituents of the ore, and Letters Patent of the United States No. 1,053,486 dated February 18th, 1913, were issued to said Etherington for such process. It is to perform the process described in said Letters Patent that my device is especially designed and adapted, and by which the process can be practised with greater efficiency, economy and better results than heretofore, particularly because of its adaptation to the treatment of the finest material, even the lightest ore dust.

An important feature of my invention resides in providing a furnace of gradually tapering form from end to end, free from obstructions to the passage of the ore, and also free from obstructions to the passage of the heat. With this form of construction it is possible to roast more ore with same fuel as more ore is exposed to the heat at a given time and there is greater freedom of draft, owing to the fact that the products of combustion are carried away and do not block the heat from passing through.

Other improvements reside in the ore mixers of reduced size which merely stir without precipitating the ore into the line of draft, and the position of the feed pipe

delivery orifice below the line of draft, both of which features prevent the loss of fine ore particles.

The term "line of draft" whenever used herein shall be understood to include the space embraced within imaginary straight lines drawn from all points in the periphery of the air inlet to corresponding points in the periphery of the air outlet, and in this sense I have used the expression in the specification and the claims.

Any suitable mode of supporting and rotating my improved kiln may be utilized to advantage, though I prefer to employ the improved mechanism of my invention described and claimed in my companion application for Letters Patent, Serial Number 875,255, and hereinafter described in detail.

In the accompanying drawing Figure 1 represents a side elevation of my furnace or kiln; Fig. 2 represents an elevation of the discharging end of the same; Fig. 3 represents an elevation of the receiving end thereof; Fig. 4 represents a transverse section of Fig. 1 through the line A—B, showing the rollers 15 and 16 and their supporting brackets in side elevation. Fig. 5 represents a transverse section of Fig. 1 through the line C—D, and shows the rollers 13 and 14 and their brackets in side elevation. Fig. 6 is a detail elevation of the means for adjusting the positions of the brackets 31 and 32. Fig. 7 is a detail plan of the under side of the same. Fig. 8 is an elevation of the side of the smoke chamber adjacent the kiln showing the sliding plate 66 and its clamping means. Figs. 9 and 10 are details of portions of the blocks 26 and T irons 25 showing their relation and the wedge form of the former, Fig. 10 being a section on line E—F of Fig. 9.

Referring to the drawing, 4 is the shell of my furnace or kiln composed of the tapering sections 5 and 6, the section 5 being preferably constructed of three-eighths inch boiler iron, and the section 6 adjacent the burners preferably constructed of one-half inch boiler iron. To the outer side of the head 58 secured to the larger end of the section 6 by the bolts 59 is secured an annular flange 58^a which surrounds the central opening 60 through which the flame from a hydro-carbon burner 60^a is projected into the furnace. For my purpose I prefer to use the

type of burner shown in the United States Letters Patent to Barker, No. 825,290 issued July 10th, 1906. But any burner employing either fuel oil, coal gas or the like, and capable of producing a jet of flame when projected by a blast of air into the furnace will suffice for my purpose. It is unnecessary to illustrate in detail the construction of the burner as the same is a matter of common knowledge. Any blast of heat from a source outside of the kiln is within the scope of my invention.

The collar 7 riveted to the larger end of the section 5 in such manner as to project beyond the edge of the section, is adapted to receive the smaller end of section 6, and to secure together the sections 5 and 6 in the relation shown in Fig. 1 with their edges in abutment when said sections are thus assembled, so as to form a continuous and gradually tapering furnace or kiln free from transverse shoulders or obstructions on the inside. Bolts 8 extending through lugs 9 secured by any suitable means to the sections 5 and 6 respectively adjacent the collar 7 serve to bind the sections 5 and 6 together and form a tight joint 10 between them. Longitudinally disposed on the interior of the kiln 4 are shallow strips of steel 57 adapted to stir and mix the ore as the kiln is rotated. These shallow strips need not be more than one inch or one and a half inches in height, and approximately one or two inches in width, forming a little more than longitudinal ribs or corrugations sufficient for the purpose of agitating the ore slightly without lifting it to any material extent.

It is desirable in the treatment of exceedingly fine dusty ores to avoid as much as possible the precipitation of the ore into the path of the air blast which is driven into the furnace. These fine dusty ores contain metals in such microscopic particles that they are readily carried into the flue if exposed to the direct action of the air blast. The employment of these shallow strips 57 or their equivalents in the form of slightly ribbed or corrugated surfaces, is of the greatest importance in the recovery of a high percentage of the metal content of the ore, and I have found from actual experience that such strips, ribs or corrugations are adequate for the purpose of agitating the ore sufficiently to present it to the heat to the best advantage and secure the requisite magnetization of the ore. The head 58 of the section 6 is provided with discharge ports 61 adjacent the periphery of the head through which the roasted ore is discharged.

62 is a cap riveted to the feed extremity of the section 5 provided with a central flanged annular aperture 63, the flange 64 of which protrudes through the aperture 65 in the plate 66 slidably clamped to the wall 67

of the smoke chamber or flue 68, and through the aperture 69 in the wall 67 which aperture is made larger than the aperture 65 which closely surrounds the flange 64. The screw clamps 70 engage the vertical slots 71 which permit the kiln together with the plate 66 to be elevated or depressed without disturbing the position of the smoke chamber 68.

74 is the telescoping upper section of the feed pipe through which the raw ore is delivered into the kiln, 74^a is the adjustable lower section positioned so that the orifice 75 is entirely below the aperture 63 and therefore the line of heavy draft, which relation is at all times maintained by securing the adjustable section 74^a by any suitable means as the bracket 74^b to the plate 66.

The location of the discharging end of the feed pipe into the kiln below the opening into the flue or smoke chamber, is an important feature in that the ore falling therefrom is not deposited into the path of the blast of air or draft through the kiln. The importance of this consists in avoiding the loss of the fine particles of ore into the flue by reason of being caught up in the currents of air that are circulating through the kiln. The furnace or kiln is rotatably supported by the track rings 11 and 12, which encircle the sections 5 and 6 respectively and rest respectively on the rollers 13 and 14 journaled in brackets 31 and 32, and rollers 15 and 16 journaled in brackets 33 and 34 supported on the bed of the furnace 17. The ring 11 is provided on the inside with an annular flange 18, which rests loosely in the slots 19 formed in the brackets 20, which are riveted to the section 5.

In Fig. 5 the grooves 19 are shown to be formed by riveting plates 21 to both sides of the brackets 20, so that the plates project beyond the extremities of the brackets. The ring 12 is provided with an annular flange 22, which rests loosely in slots 23 formed in the guides 24 which guides are fastened to the T irons 25 by the bolts 25^a. The ring 12 rides freely upon the grooved blocks 26 which are also bolted to the T irons 25. The grooves 26^a in the blocks 26 embrace and slidably engage the uprights 29 of the T irons 25 which are provided with a series of bolt holes 26^b one inch apart registering with similar series of holes 26^c in the extension sides 26^d of the blocks 26. Owing to the fact that the surfaces of the blocks adjacent the flange 22 of the ring 12 are not parallel to the lines of bolt holes 26^c the blocks are adapted to operate as wedges as they may be adjusted on the T irons in various relations to the guide members 24 and thus all caused to bear simultaneously against the flange 22 of the ring 12 or not, as desired. The ends of the T irons 25 are loosely supported in sockets 27 which con-

5 consist of plates bolted or otherwise secured
 to the shell of section 6 in such manner as
 to provide a space sufficient for the T irons
 25 to slide freely under the same. The
 10 plates 27 forming the sockets are also pro-
 vided with slots 28 adapted to receive the
 upright portions 29 of the T irons 25 and
 to allow the same to freely play therein as
 a result of the unequal expansion and con-
 15 traction of the T irons 25 and the section 6.
 This means of slinging the ring 12 permits
 free and independent contraction and ex-
 pansion of the parts connected therewith,
 and yet provides a secure assemblage of the
 20 same. The means described of slinging the
 ring 11 also permits certain freedom of in-
 dependent contraction and expansion of the
 section 5 but the ring 11 being located a
 greater distance from the source of heat
 25 than the ring 12 is located, it is not neces-
 sary to employ an arrangement to compen-
 sate for this expansion and contraction so
 elaborate as that provided for the ring 12.

30 35 and 36 are guide rolls supported in
 vertical bearings in the brackets 37 and 38,
 and are adapted to bear against the opposite
 sides of the rim 39 of the ring 11, and there-
 by to prevent longitudinal displacement of
 the furnace or kiln. The bed 17 is pivotally
 35 supported at one extremity at 40, and is ad-
 justably supported at the other extremity by
 the jack screws 41 operating in screw
 threaded collars 43 secured to the bed of the
 furnace, said jack screws resting upon the
 40 base 42.

45 44 is the main shaft which transmits the
 power through the auxiliary shafts 46, 47,
 the beveled gears 48, 49, the counter shaft 50
 and the pinion 51 to the gear ring 45 se-
 50 cured to section 5 of the furnace. The shaft
 46 is connected with the shafts 44 and 47 by
 means of the universal joints 52 and 53
 which permit the bed 17 to be elevated or
 depressed by the jack screws 41 without
 55 disturbing the position of the shaft 44. The
 beveled gear 48 is keyed to the shaft 47
 which is mounted in bearings in the bracket
 54 supported on the bed 17. The beveled
 gear 49 in mesh with the gear 48 is keyed to
 60 the shaft 50 mounted in bearings in the
 brackets 55 and 56 secured to the bed 17.
 The pinion 51 is also keyed to the shaft 50.

65 In Figs. 6 and 7 is shown adjusting means
 to compensate for the wearing away of the
 contact surface of the track rings 11 and 12
 which if not counteracted permits of a grad-
 ual sinking of the kiln 4 and consequent ex-
 cessively deep meshing and jamming of the
 gear ring 45 with the pinion 51 and ultimate
 70 destruction of the latter. This means con-
 sists of the following parts: The right and
 left screw 76 is journaled to rotate in bear-
 ings 82 and 83 of brackets 77 and 79 respec-
 tively, the right hand threaded portion en-
 75 gaging a lug 80 fast to the bracket 77 and

the left hand threaded portion engaging a
 lug 81 fast to the bracket 79. The screw
 76 is held against longitudinal displacement
 by abutting against the side wall 17^a of the
 bed 17 at one extremity thereof and has fast
 80 thereto a collar 78 which abuts against the
 side wall 17^b of the bed 17 near its other ex-
 tremity. The brackets 77 and 79 are secured
 to plates 84 and 85 respectively, disposed
 85 beneath the bed 17. Bolts 86 passed through
 the plate 84, base of the bracket 31 and slots
 87 in the bed 17, and bolts 88 passed through
 the plate 85, base of the bracket 32 and
 slots 89 in the bed 17 secure the plate 84 to
 90 the bracket 31 and the plate 85 to the
 bracket 32. It is obvious that by turning
 the terminal nut 90 with which the right
 and left screw 76 is provided, the plates 84
 and 85, and thus the brackets 31 and 32 to
 95 which they are bolted may be brought into
 greater or less proximity, as desired, within
 the latitude permitted by the length of the
 slots 87 and 89 and according to the direction
 in which the nut 90 is turned; by bringing
 100 the brackets 31 and 32 into greater prox-
 imity the rollers 13 and 14 are likewise
 brought closer together and thus the gradual
 diminution in the peripheral dimension of
 the track rings 11 and 12 caused by fric-
 105 tional wearing away of the surface in con-
 tact with the rollers 13 and 14 and the roll-
 ers 15 and 16 is compensated, substantially
 the same relation between the positions of
 the kiln 4 and bed 17 is at all times main-
 110 tained and hence an effective and economic
 operative relation between the gear ring 45
 and pinion 51, eliminating tendency to de-
 struction of the latter.

115 The operation of my improved apparatus
 is as follows: The kiln 4 is set at the de-
 sired pitch by means of the screws 41 which
 serve to elevate or depress the bed 17 on
 which the kiln is supported through engage-
 120 ment with the screw threaded collars 43
 secured to the bed 17. The carbon burners
 are then adjusted to give the desired mix-
 ture of oil and air and angle of projection
 of flame and ignited. Power is applied to
 the shaft 44 and thus the kiln 4 slowly ro-
 125 tated on the rings 11 and 12 and rollers
 13, 14, 15 and 16. Crushed raw ore is de-
 livered into the feed pipe under section 74
 and discharged from the orifice 75 at the
 upper end of the kiln at a point below the
 130 line of draft. Thus particles of fine dusty
 ores are not blown back through the open-
 ing 63 but are deposited on the bottom of
 the kiln and subjected to the heat from the
 burners. As the kiln rotates the mixers
 135 57 slightly stir or agitate the ore, thus pre-
 senting the various particles successively
 to the heat, but do not lift the ore any
 substantial distance owing to their shallow
 construction, and so all possibility of drop-
 140 ping the ore back into the path of the blast

is obviated. Advanced by the force of gravity the ore gradually travels in a body along the bottom of the kiln, first becoming heated and then roasted and the ferruginous constituents magnetized as the particles are subjected to the greatest degrees of heat in the section 6, and finally reaching the head 58 is discharged through the ports 61. If the ore exhibits tendency to under roasting the period of subjection to the flame may be lengthened by depressing the feed end of the kiln 4 by means of the screws 41; if it appears to be over roasting the kiln may in like manner be elevated and the period shortened; in this manner the rate of speed of the ore through the kiln may be accurately controlled and adapted at all times to the character of the ore under treatment. If any adjustment of the pitch of the kiln is to be made the clamps 70 are first loosened thus permitting the flange 64 to move the plate 66 to conform to the altered position of the flange. As the plate 66 is moved the position of the adjustable feed pipe section 74^a secured thereto is correspondingly altered and the proper relation between the orifice 75 and the aperture 63 thus maintained. After the adjustment is made the clamps are then turned down to hold the plate firmly in the required new position. In making adjustments of the brackets 31 and 32 to compensate for the wearing of the track rings 11 and 12, it is first necessary to jack the kiln up in order to take the weight off of the rollers 13 and 14. The nut 90 is then turned the required amount to bring the rollers into such proximity as to effect a proper meshing relation between the gear ring 45 and pinion 51. The kiln is then unjacked and again eased on to the rollers. Owing to the novel free system of assemblage of parts in my apparatus the life of the kiln shell is greatly prolonged; when however the section 6 which is subjected to the greatest heat becomes burnt out a new section may readily be substituted by removing the bolts 8 and detaching the section 6 from the section 5 and bolting on the new section, such of the T irons, lugs, sockets, blocks and guide members being retained for assembling with the new section as are fit for further usage. The head 58 may likewise be unbolted and bolted on the new section if still intact. In dismantling the lugs 9, sockets 27, T irons 25, blocks 26, guide members 24 and bolts 59, the bolts 8 are first unbolted allowing section 6 to be separated from section 5 and removed to a convenient place. The blocks 26 and guide members 24 are then unbolted and the ring 12 is slipped off. Then the rivets are sheared on lugs 9, sockets 27 and bolts 59, thus allowing the head 58, T irons 25, lugs 9, sockets 27 and bolts 59 to be removed. The

sockets 27 to secure one end of the T irons 25 are then riveted in their proper positions on one end of new section 6, the T irons slipped into place and the remaining sockets 27 placed over the other ends of the T irons and riveted to the shell, care being taken that sufficient space for expansion of the T irons is provided. The lugs 9 and bolts 59 are then riveted in place, ring 12 slipped on, and blocks 26 and guides 24 bolted to the T irons to secure ring 12 in proper position. Head 58 is then bolted on and section 6 fitted in to section 5 and bolted. The kiln is now ready for further operation.

While I do not limit my invention to any particular size, dimensions or proportions, as I find that a great variety of sizes may be successfully employed, a kiln in which the section 5 is ten feet long and constructed of boiler iron $\frac{3}{8}$ inch thick and the section 6 is eight feet long and constructed of $\frac{1}{2}$ inch boiler iron and which tapers from 24 inch diameter at the feed end to 36 inch diameter at the discharge end has been demonstrated to be highly efficient.

What I claim and desire to secure by Letters Patent is:

1. A furnace for roasting ore provided with means for confining the draft there-through within a space which does not extend to the interior surface of the furnace wall, and interior projections of a size adapted to stir the ore without precipitating the same into the line of draft through the furnace.

2. An apparatus for treating ores in preparation for magnetic separation, comprising in combination a rotatable furnace provided with an air inlet and an air outlet, a source of heat created outside of said furnace, means for projecting a blast of heat into said furnace, means for confining the draft therethrough within a space which does not extend to the interior surface of the furnace wall and projections on the interior wall of the furnace of a size adapted to stir the ore without precipitating the same into the line of draft through the furnace.

3. An apparatus for treating ores in preparation for magnetic separation, comprising in combination a rotatable furnace provided with means for confining the draft therethrough within a space which does not extend to the interior surface of the furnace wall, said means embodying an air inlet, and an air outlet of less area than a cross section of the feed end of the furnace, a source of heat created outside of said furnace, means for projecting a blast of heat into said furnace, an ore feed pipe so disposed that the delivery orifice of said feed pipe is located without the line of draft through the furnace, and interior projections of a

size adapted to stir the ore without precipitating the same into the line of draft through the furnace.

4. An apparatus for treating ores in preparation for magnetic separation, comprising in combination a rotatable furnace provided with means for confining the draft therethrough within a space which does not extend to the interior surface of the furnace wall, said means embodying an air inlet, and an air outlet of less area than a cross section of the feed end of the furnace, a source of heat created outside of said furnace, means for projecting a blast of heat into said furnace, an ore feed pipe protruding through said air outlet and so disposed that the delivery orifice of said feed pipe is located entirely below the lowest point in the periphery of the air outlet, and interior projections of a size adapted to stir the ore without precipitating the same into the line of draft through the furnace.

5. An apparatus for treating ores in preparation for magnetic separation, comprising in combination a furnace embodying a rotatable unlined metallic shell composed of a plurality of frusto-conical sections secured together and forming continuously tapering interior and exterior walls, provided with means for confining the draft therethrough within a space which does not extend to the interior surface of the furnace wall, said means embodying an air inlet, and an air outlet of less area than a cross section of the feed end of the furnace, a source of heat created outside of said furnace, means for projecting a blast of heat

into said furnace, an ore feed pipe so disposed that the delivery orifice of said feed pipe is located without the line of draft through the furnace, and interior projections of a size adapted to stir the ore without precipitating the same into the line of draft through the furnace.

6. An apparatus for treating ores in preparation for magnetic separation, comprising in combination a furnace embodying a rotatable unlined metallic shell composed of a plurality of frusto-conical sections secured together and forming continuously tapering interior and exterior walls, provided with means for confining the draft therethrough within a space which does not extend to the interior surface of the furnace wall, said means embodying an air inlet, and an air outlet of less area than a cross section of the feed end of the furnace, a source of heat created outside of said furnace, means for projecting a blast of heat into said furnace, an ore feed pipe protruding through said air outlet and so disposed that the delivery orifice of said feed pipe is located entirely below the lowest point in the periphery of the air outlet, and interior projections of a size adapted to stir the ore without precipitating the same into the line of draft through the furnace.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses, this 27th day of May 1915.

CHARLES W. SINGER.

Witnesses:

CHAS. A. COOK,
EARLE C. WEARING.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."