Oct. 24, 1933. B. G. KLUGH 1,931,499

APPARATUS FOR PREPARING ORES FOR SINTERING

Original Filed June 14, 1926 2 Sheets-Sheet 1

Fig. 1

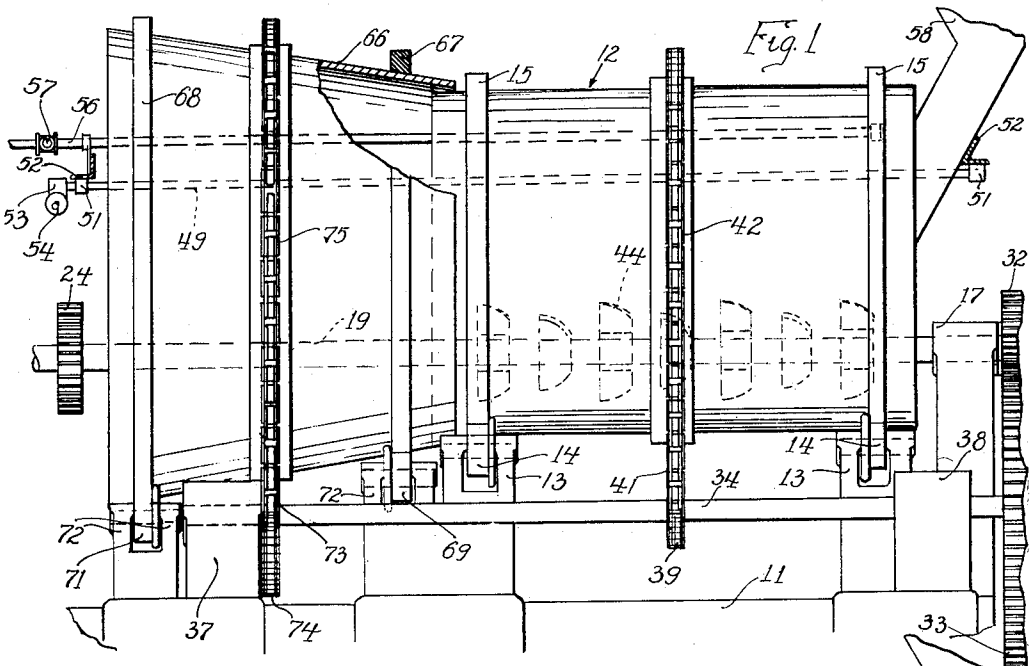


Fig. 2.

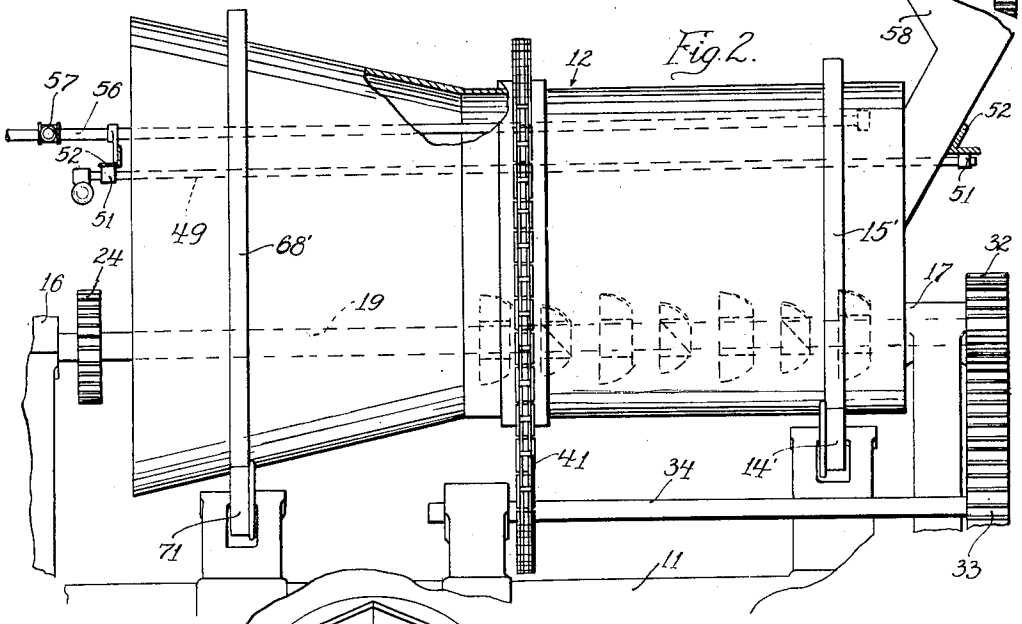
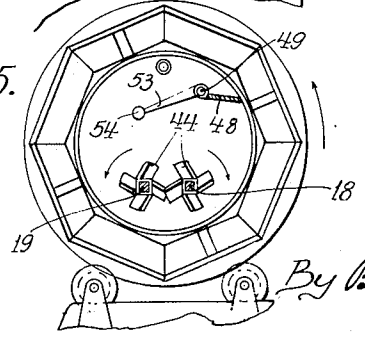


Fig. 5.



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Original Filed June 14, 1926 2 Sheets-Sheet 2

Fig. 3

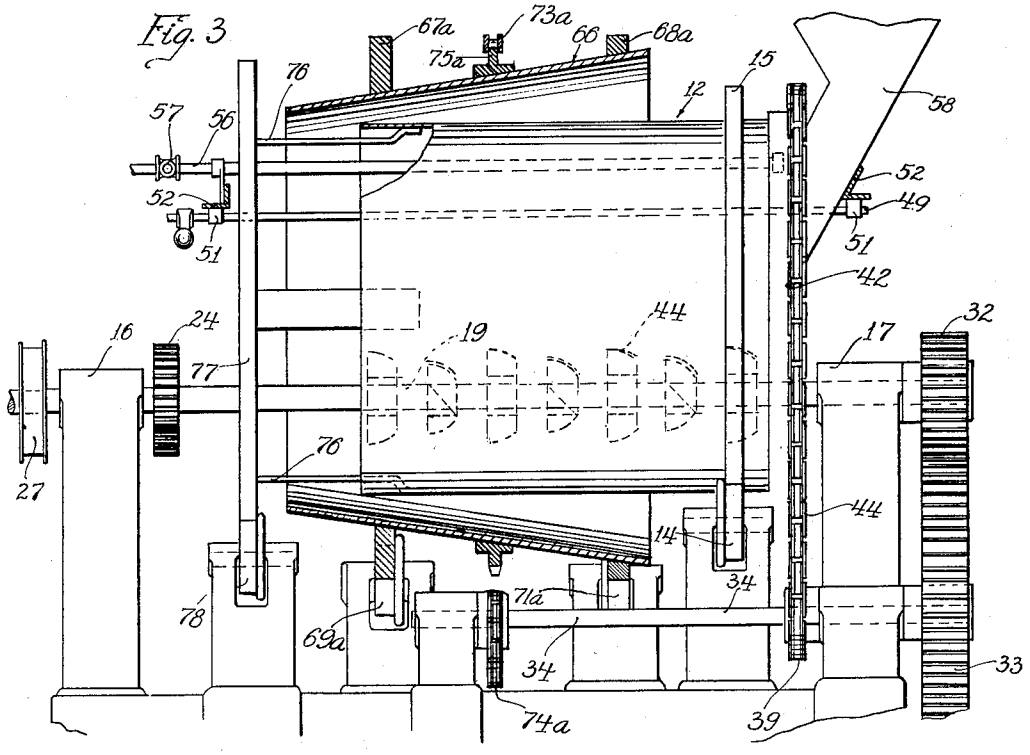
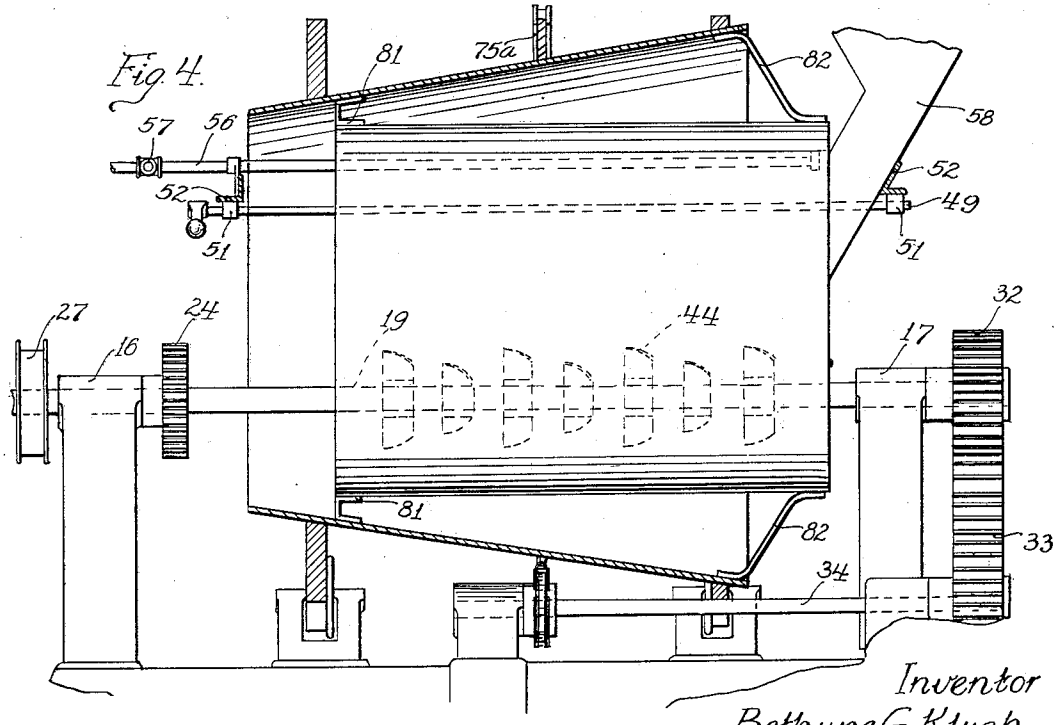


Fig. 4.



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APPARATUS FOR PREPARING ORES FOR SINTERING

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Original application June 14, 1926, Serial No. 115,763. Divided and this application July 23, 1930. Serial No. 469,962

12 Claims. (Cl. 18—1)

The present invention relates to an improved apparatus designed for preparing powdered or pulverized ores for sintering. An apparatus of the general type to which the present invention relates is illustrated and described in my pending application, Serial No. 115,763, filed June 14, 1926 which has become Patent 1,778,193, of which application this is a division.

In preparing ores for sintering it is necessary that water and fuel be added to the ore and thoroughly intermixed therewith to form a substantially homogeneous mass. With some ores such a thorough mixing of the materials in a suitable mixing apparatus is sufficient to prepare them for the sintering operation. With other ores, however, such as those of a plastic nature, and more particularly when being mixed with finely divided carbonaceous fuel, there is a tendency for the ore to agglomerate into large masses under the tumbling action of the mixing cylinder, which tends to prevent the thorough admixture of the carbonaceous fuel therewith. It has been found that such ores are better prepared for the sintering operation by first mixing the materials in a suitable mixing device to first accomplish the required intimacy of mixture of the fuel and ore, and then to subject the resultant mixture, which has been properly moistened in the mixing device, to a "balling" operation so as to produce small globular aggregates of uniform composition. This transforming of the material into such aggregates is desirable as it tends to increase its speed of sintering in down draft sintering apparatus.

With the above in view, it is the principal object of the present invention to provide means for "balling" the mixture after the ore has been passed through the mixing apparatus and has been brought to the proper consistency for this "balling" operation.

Other objects and advantageous features of my invention will be apparent from the following description thereof taken in connection with the accompanying drawings, in which—

Fig. 1 is a side elevational view, somewhat diagrammatic in character, illustrating my improved "balling" means in the form of a cone associated with a mixing apparatus for "balling" the material after the mixing thereof;

Fig. 2 is a similar view illustrating a "balling" cone which is contiguously joined to the mixing cylinder;

Fig. 3 is a side view of another embodiment wherein the "balling" cone extends back over the mixing cylinder;

Fig 4 illustrates another form of this latter embodiment; and

Fig. 5 is a transverse sectional view through one of the "balling" cones, illustrating a polygonal contour which may be given these cones.

I have illustrated and shall describe my improved "balling" means in connection with a mixing apparatus of the type shown and described in my above mentioned pending application, but it is to be understood that such improvements may be applied to any other suitable type of mixing apparatus.

As illustrated in Fig. 1, the machine comprises a bed or base frame 11 above which is supported the revolving cylinder 12. Four pairs of bearing blocks 13 rise from this bed, two pairs at each side of the cylinder 12, and support the journal ends of four flanged rollers 14. Adjacent its ends the cylinder 12 has secured thereto circular treads or rings 15 which roll on the flanged rollers 14, whereby the cylinder is supported for rotary motion. The flanges of the rollers 14 engage on the inner sides of the tread rings 15, thereby holding the cylinder against endwise shifting movement.

Rising from the ends of the bed 11 are two bearing standards 16 and 17 in which are journaled the ends of two blade supporting shafts 18 and 19 which pass through the cylinder 12 adjacent the lower portion thereof. The two shafts 18 and 19 are geared together for rotation in opposite directions by means of spur gears mounted on these shafts in meshing relation. Only the spur gear 24 mounted on the shaft 19 is illustrated in Figs. 1 to 4 as only one of the blade supporting shafts is illustrated therein. In the construction shown the shaft 19 is extended beyond the bearing standards 16 for mounting a suitable driving element 27, (Fig. 3) such as a pulley or gear, through which driving energy is transmitted to the machine. Those portions of the two shafts 18 and 19 which extend through the cylinder 12 may be of square or polygonal section for mounting the blade units.

The right hand end of the shaft 19 is extended beyond the right hand bearing support 17 for receiving a spur pinion 32 which meshes with a large spur gear 33. This large spur gear is mounted on a countershaft 34 extending alongside the cylinder 12 and journaled in spaced bearings mounted on frame extensions 37 and 38. Secured to the intermediate portion of this countershaft, as shown in Fig. 1, is a small sprocket wheel 39 over which tracks a driving chain 41. This chain passes around a sprocket ring 42 which is secured to the outer circumference of the cylinder

12, preferably at a point intermediate the tread rings 15.

It will be apparent that as a result of this driving relation between the shafts and the cylinder, driving rotation imparted to the pulley 27 in the direction indicated will result in rotation of the two shafts 18 and 19 in opposite directions, and in rotation of the cylinder 12 in a counterclockwise direction as viewed in Fig. 5.

Mounted on the shafts 18 and 19 at spaced points along their lengths within the cylinder 12 are a plurality of paddles or mixing blade units 44. It is not believed to be necessary to describe these mixing blade units in detail herein as they have nothing to do with the present invention and are described in detail in my above-mentioned pending application. It will suffice to mention here that each of the blades 44 is disposed helically relative to its hub so that it will have a feeding pitch for gradually feeding the material back through the cylinder along the bottom thereof; also that the blade units on one shaft are offset or staggered relative to those on the other shaft, so that the blade arms will clear each other.

To remove any material tending to adhere to the side walls of the cylinder 12 there is provided a scraper 48, see Fig. 5, which scraper extends longitudinally of the cylinder from end to end thereof, as shown in Figs. 1 to 4. This scraper is preferably positioned to engage the inner wall of the cylinder at a point approximately above the shaft 18. The scraper is mounted on a shaft 49, the ends of which project beyond the ends of the cylinder 12 for mounting in bearings 51 carried by a stationary frame structure 52 embracing the ends of the cylinder. Arms 53 extending from the ends of this scraper shaft 49 support counterweights 54 which tend to hold the scraper pressed against the side wall of the cylinder. The scraper preferably extends forwardly against the direction of rotation of the cylinder so that the action of shearing the material from the wall of the cylinder will operate to press the scraper with greater pressure against this side wall.

The water for admixing with the ore is sprayed downwardly from an apertured spray pipe 56 extending longitudinally of the cylinder adjacent the upper part thereof. The volume of water projected through these downwardly opening spray apertures can be regulated by the control valve 57.

The ore is fed to the mixer through an inlet chute 58 which discharges into the right hand end of the cylinder. The hopper is supported in any suitable manner, as by the framework 52 which supports the scraper 48.

In the operation of the mixing device the ore is admitted at a predetermined rate through the feeding hopper 58, creating a bed of the material in the bottom of the cylinder in the zone of the blades. These blades, by their opposite rotation in the directions indicated in Fig. 5 will tend to confine this material in a pile in the lower part of the cylinder. Moreover, the two sets of blades, by rotating in the directions indicated, have the action of throwing the material upwardly between the two shafts in a veritable shower of material, which falls back upon the blades and upon the sides of the cylinder. The consequent agitation or stirring of the material will present new surfaces to the action of the water projected down from the overhead spray pipe 56. As the material becomes somewhat plastic or adhesive it will tend to adhere to the side walls of the cylinder, being carried up to the scraper 48. The scraper will remove such adhering material and drop it back into the zone of action of the blades, and particularly the blades on the shaft 18. These blades, by rotating downwardly toward the center will tend to draw such loosened material back into the center of the pile being agitated. Any spraying of the material laterally in the opposite direction is defeated by the motion of the cylinder which immediately carries the material back into the zone of blade action. It is not desired to tumble the material in the cylinder, and this tumbling is avoided by rotating the cylinder at a relatively low speed, as described in my pending application above identified.

The action of the several blades on both shafts 18 and 19 is to feed the material progressively along the bottom of the cylinder simultaneously with their mixing action. The completely moistened and mixed material is finally discharged over the outlet end of the cylinder and into an apparatus for "balling" the mixture following its mixing and moistening in the cylinder 12, in order to transform the mixture into small spherical aggregates.

Coming now to my improved "balling" apparatus with which my present application has more particularly to do, as shown in Fig. 1, 66 indicates a rotating drum or chamber, preferably of conical form, which is associated with the mixing device above described. As shown in said figure, this drum 66 is positioned adjacent the left hand end of the mixing cylinder. As illustrated, the shafts 18 and 19, the scraper 49 and the spray pipe 56 extend through the balling drum, but the blade units 44 on the shafts 18 and 19 are not extended into this drum, and hence the material precipitated into the drum is not subjected to any further mixing thereby. In the embodiment illustrated in said Fig. 1 the balling drum is provided with tread rings 67 and 68 adjacent its ends, which tread rings track on flanged rollers 69 and 71 the journal ends of each of which are supported in pairs of bearing blocks 72, two pairs of which bearing blocks rise from the bed 11 on each side of the balling drum 66. It will be seen, therefore, that the balling drum is mounted to rotate on the bed in a manner similar to the cylinder 12, and the balling drum is held against endwise shifting movement by the flanges of the rollers 69 and 71 engaging on the inner sides of the tread rings 67, 68. The discharging end of the mixing cylinder 12 extends a short distance into the smaller end of the balling drum 66 as shown, and the large end of the drum can be arranged to discharge into a chute or receptacle, as desired. Such chute or receptacle is not illustrated as it forms no part of the present invention and any receiving means suitable for the purpose may be employed.

The balling drum 66 is driven by a chain 73 passing over a sprocket wheel 74 on the countershaft 34 and tracking over a sprocket ring 75 secured to the circumference of the balling drum. If desired, the balling drum may be driven at a higher speed than the mixing cylinder 12 to augment the tumbling and balling action of the material, as will be readily understood.

In Fig. 2 I have illustrated the same general relation of balling drum and mixing cylinder, with the exception that in this embodiment the balling drum is secured directly to the end of the mixing cylinder so as to rotate therewith. In

this construction the cylinder is provided with but one tread ring 15' which tracks on rollers 14', this tread ring and these rollers corresponding to those at the right hand end of the cylinder in the construction illustrated in Fig. 1. In this modified form of construction the balling drum is provided with a tread ring 68' which tracks on rollers 71', these parts being similar to the tread ring 68 and rollers 71 illustrated in Fig. 1. In this construction but a single drive chain 41 is necessary to drive the cylinder and balling drum, as will be appreciated.

In the modified form illustrated in Fig. 3 the conical balling drum is extended backwardly over the mixing cylinder 12, this affording a relatively short, compact construction. In this form the inner end of the mixing cylinder is provided with extending arms 76 which are fastened to a tread ring 77 tracking on the rollers 78. The balling cone 66*a* is provided with tread rings 67*a* and 68*a* tracking on pairs of rollers 69*a* and 71*a*. In this construction, the balling cone 66*a* is adapted for rotation independently of the mixing cylinder 12, and to this end is provided with a sprocket ring 75*a* over which tracks a chain 73*a* which passes over a sprocket wheel 74*a* mounted on the countershaft 34. Consequently, if desired, this balling cone may be rotated at a higher speed than the mixing cylinder 12. In this construction the discharge end of the balling cone may empty into any suitable chute or receptacle below the mixing cylinder. In this instance the driving chain 41 for the cylinder 12 tracks over a sprocket ring 42 at the feed end of the cylinder.

In Fig. 4 the same general relation of mixing cylinder and balling cone is employed except that these two elements are connected together for simultaneous rotation. Small angle brackets 81 may be secured between the discharge end of the mixing cylinder and the small end of the balling cone. Likewise larger brackets 82 may be secured between the inlet end of the mixing cylinder and the discharge end of the balling cone. In this construction the drive is directly to the sprocket ring 75*a* encircling the outer circumference of the balling cone.

The action of the balling cone in each of the preceding embodiments is to carry a portion of the moistened material up along its side wall and to thereupon drop this material, allowing it to roll downwardly and agglomerate into spherical form by adherence between the moistened particles. Simultaneously with this downward rolling motion of the material along the side walls of the cone, the material is also rolled longitudinally of the cone towards its larger end, which latter rolling motion also assists in agglomerating the material into spherical form. The pitch of the cones is such that the action is automatic in that when the material has united in spheres of sufficient size these spheres or balls will roll down the slope of the cone and discharge at the large end thereof; while the material which has not been balled will have a much slower rate of feed down the slope of the cone to the discharge end thereof.

In Fig. 5 I have illustrated a polygonal formation which I may give either of the balling cones described in the preceding embodiments. This polygonal contour is advantageous in that it secures a more pronounced balling action. This follows from the fact that the mixture resting on each surface of the polygon will rise to a certain angle, at which point the material will roll back over its surface. The finer, unballed portion will tend to cling to the polygonal surface at higher angles, with the result that the small aggregates rolling over such fine portion will result in the fine portion tending to adhere thereto, thereby increasing the size and degree of sphericity of such aggregates. This polygonal formation of balling cone, in particular, can be rotated at higher speed than the mixing cylinder, or securing effective balling of the mixture.

While in the specification the invention has been described as applicable for use in connection with the preparation of ores for sintering, it is to be understood that it may also be used in connection with the preparation for sintering of blast furnace flue dust, or any other material that it is desirable to "ball" after having been mixed with a suitable fuel, and the appended claims are therefore to be construed accordingly.

I claim:

1. In apparatus for preparing materials for sintering, the combination of a cylinder disposed substantially horizontally, a shaft within said cylinder, mixing blades on said shaft, the lower portion of said cylinder defining a trough bottom for said mixing blades, means for rotating said shaft and said cylinder, and a balling cone coextensive with the discharge end of said cylinder for balling the mixture after it has been mixed in said cylinder.

2. In apparatus for preparing materials for sintering, the combination of a rotating trough, a mixing element revolving within said trough, and a chamber substantially coextensive with and flaring outwardly in conical form from said trough and receiving the mixed material therefrom for balling this material, said chamber being relatively long and having a pitch which will retain the material therein until it is completely balled.

3. In apparatus for preparing materials for sintering, the combination of a generally cylindrical drum disposed substantially horizontally, a pair of shafts within said drum disposed on opposite sides of the vertical axial plane thereof, mixing blades on said shafts operating adjacent the lower side of said drum, means for rotating said shafts and said drum, said shafts being rotated in opposite directions, and a revolving conical shell receiving the material directly from said drum for balling the same.

4. In apparatus for preparing materials for sintering, the combination of a generally cylindrical drum disposed substantially horizontally, a shaft within said drum, mixing blades on said shaft operating adjacent the lower side of said drum, means for rotating said shaft and said drum, and a balling shell of conical polygonal form receiving the material from said drum, the inner surfaces of said shell being longitudinally continuous and having a pitch which will only discharge the balled material.

5. In apparatus for preparing materials for sintering, the combination of a mixing chamber disposed substantially horizontally, a mixing element within said chamber adjacent the lower side thereof, a balling chamber receiving the mixed material from said mixing chamber, and means for rotating said mixing and balling chambers at different speeds.

6. In apparatus for preparing materials for sintering, the combination of a mixing chamber disposed substantially horizontally, a mixing element within said chamber adjacent the bottom thereof, means for rotating said chamber and said mixing element, and a balling chamber surround-

ing said mixing chamber and receiving the mixed material therefrom.

7. In apparatus for preparing materials for sintering, the combination of a mixing cylinder disposed substantially horizontally, a shaft within said cylinder having mixing blades thereon operating adjacent the bottom of said cylinder, means for rotating said shaft and said cylinder, and a conical balling shell supported substantially concentrically of said cylinder with the small end of said shell adjacent the discharge end of said cylinder and the large end of said shell adjacent the inlet end of said cylinder.

8. In apparatus for preparing materials for sintering, the combination of a rotating chamber comprising a mixing portion of generally cylindrical form and a balling portion flaring outwardly from said mixing portion substantially in continuation of said mixing portion, and a power driven rotating mixing element operating within the mixing portion of said chamber.

9. In apparatus for preparing ores for sintering, the combination of a generally cylindrical shell disposed substantially horizontally, a mixing element operating within said shell, the lower portion of said shell functioning as a trough for said mixing element, means for rotating said shell and said mixing element, and a secondary shell receiving the mixed material from said first shell and comprising a plurality of angularly disposed longitudinally continuous surfaces for balling the mixed material therein.

10. In apparatus for preparing ores for sintering, the combination of a horizontally disposed cylinder, supporting rollers, tread rings on said cylinder tracking on said rollers, a shaft within said cylinder, mixing blades on said shaft, the lower portion of said cylinder functioning as a trough for said mixing blades, means for rotating said cylinder and said shaft, a conical shell extending coextensively from the discharge end of said cylinder for receiving the mixed material from said cylinder, supporting rollers, and a tread ring on said conical shell tracking on said rollers for rotatably supporting said shell, said shell functioning to ball the mixture received from said cylinder, and means for rotating said mixing and balling chambers at different speeds.

11. In apparatus for preparing ores for sintering, the combination of a conical shell disposed substantially horizontally, means for feeding the ore to the small end of said shell, and means for rotating said shell, the inner surface of said shell being of polygonal cross-section, the polygonal faces thereof being relatively smooth and continuous longitudinally of the shell and having a pitch which will result in the ore being carried upwardly along the sides of the shell for rolling downwardly and forwardly toward the discharge end thereof, whereby the ore is caused to agglomerate in spherical form prior to discharge from said shell.

12. In apparatus for preparing materials for sintering, the combination of a generally cylindrical drum disposed substantially horizontally, a shaft within said drum, mixing blades on said shaft operating adjacent the lower side of said drum, means for rotating said shaft and said drum, and a revolving conical shell receiving the material directly from said drum for balling the same.

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