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F. D. DE VANEY

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PELLETIZING ORE FINES

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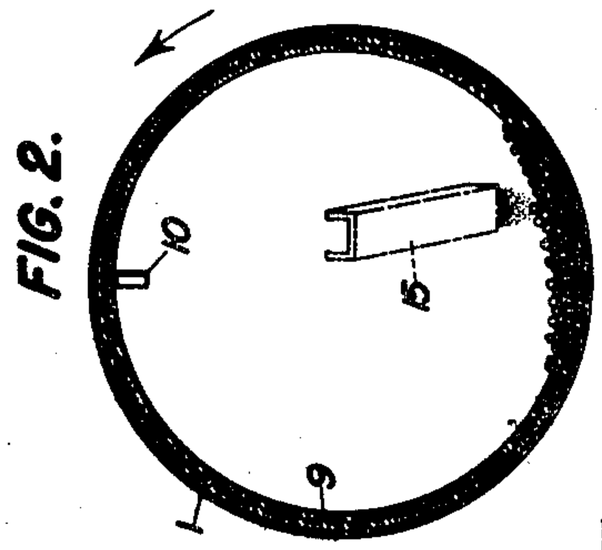

FIG. 2.

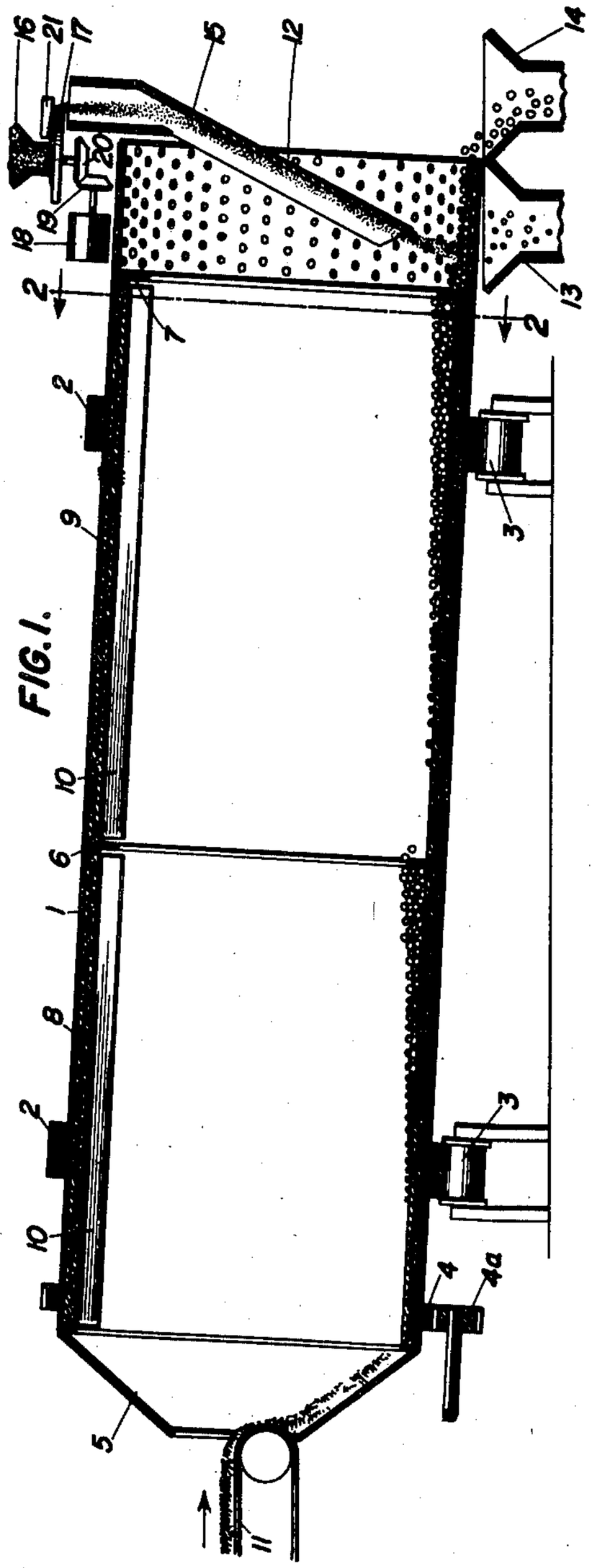

FIG. 1.

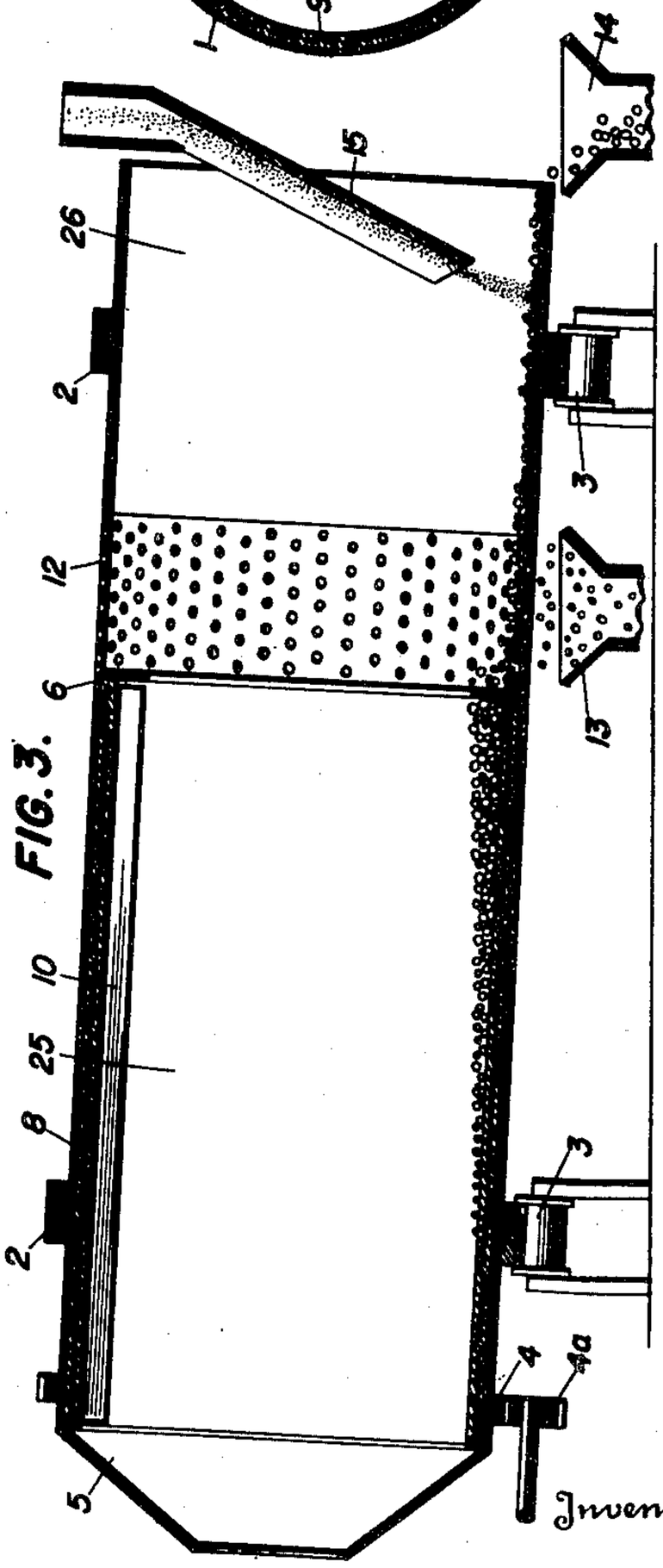

FIG. 3.

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PELLETIZING ORE FINES

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2 Claims. (Cl. 75—3)

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This invention relates to improvements in the pelletizing, or "balling up," of moisture-containing ore fines such as flotation concentrates, magnetic concentrates and the like, prior to an induration treatment of such pellets.

It heretofore was known to form moisture-containing ore fines into small balls or pellets by one or another of a variety of pelletizing methods including:

1. An "extrusion method" wherein a mass of the moist ore fines is cut into small masses of preselected size and the small masses are shaped into balls in the course of being passed through an inclined rotary drum;

2. A "snow ball" method, wherein dense nuclei of the moist ore fines are fed onto a surface of a compacted layer of moist fines adhering to the inner surface of an inclined rotary drum, and the nuclei are caused slowly to form balls by accretion of particles from said layer; and

3. A method wherein discrete ore fines (moist) are fed into an inclined rotary drum and are "balled up" in the latter, care being taken to avoid layering of the fines on the inner surface of the drum.

In any and all of these known methods, the amount of free moisture associated with the ore fines is rather nicely correlated to the particle size distribution, and other characteristics, of the fines whereby to effect the balling up with the minimum amount of free moisture operable to effect the desired binding together of the particles into a pellet having, in the moist state, a desirable degree of cohesion of the particles. The free moisture is restricted to such minimum amount in order to minimize the cost of the fuel required—in the ensuing induration treatment—for vaporizing the water content of the pellets.

In the carrying out of any and all of the above-mentioned pelletizing methods, the compacting of the solid particles into a dense pellet forces some—and usually a substantial proportion—of the free water of the mass out into the surface layer of the pellet: the freshly formed pellets generally glisten with films of water so worked out onto the surface. When such surface-wet pellets are permitted, after discharge from the pelletizing drum, to lie in contact with each other they tend to stick together forming objectionable aggregates.

According to the present invention, such sticking together of the pellets is alleviated by "dusting" the pellets with—that is to say, by applying over their surfaces thin layers of—a small amount, of the order of a few percent by weight, of dry powderous ore fines. This "dusting" step is effected after formation of the pellets has been completed and just before the pellets are permitted to roll out of the drum.

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I have found that (1) the time and (2) the amount and (3) the manner of "dusting" are all important to the success of the improved process. Thus, (1) if the "dusting" be effected a substantial interval before the pellets are discharged (e. g., be effected when the pellets are still, say, about one-fourth of the distance from the discharge end of the drum), while the dry powderous fines adhere to the pellet properly the densifying action during the ensuing rolling will have time to work the free water out through the surface layers of dry fines, with the result that the pellets when discharged are practically as sticky and wet as before.

Again, (2) I have found that best results come (*a*) from "dusting" the pellets while they are practically at the top of their movement with the drum, and (*b*) from so adding the dry fines as to avoid the formation of a pool of dry fines in which the pellets could roll. Thus, it is preferable to direct the dry fines onto the pellets (instead of onto the drum surface), when the pellets have been carried (by the drum) as far as they will go and have just started their downward roll; when the dust is applied in the proper amount and in the proper manner the same disappears within a few inches of travel of the pellets; there is no bed or pool of dry powder rolling about in the drum.

The (3) amount of dry fines so added is important in that any addition in excess of that minimum amount necessary to "take up" the surface water adversely affects the toughness of the finally indurated pellets. Thus, I have found that when the formed and surface-wet pellets are substantially "loaded" with dry fines, the resulting pellets exfoliate badly in the furnacing treatment. But, when the applied dust is confined to a thin layer, the pellets do not undergo any substantial exfoliation on furnacing. Such minimum amount will vary somewhat, from one ore to another, but is of the order of 5% or less by weight.

I have found, further, that while the dry powderous fine material used for the "dusting" may be a portion of the starting material (e. g., concentrate) which has been dried as by extensive air drying, or drying with hot dry air, an improved result comes from using for the "dusting" a furnaced product consisting of minus 6 mesh material, 80% of which is finer than 65 mesh, screened from the pellets after induration of the latter. This furnaced material not only is completely dry

but also is desirably porous and remarkably bibulous. Incidentally, in some pelletizing and indurating installations, the "dusting" step may consume all or substantially all of the dusty waste from the indurating step.

I prefer—although the same is not an essential element of my improved process—to separate out the undersized balls from the product of desired size before "dusting" the latter; by this expedient I avoid changing the water content of material which is to be returned to the pelletizing drum. Thus, the drum may be divided into an upper longer section and a lower shorter one, with an intervening screen section. In working according to this arrangement the balls are formed in the upper section, the undersized are screened out, and only the balls of desired size are "dusted" in the final section. Or, there may be used two independently operated drums with a screen between them. In either case, it is to be emphasized that best results flow from almost immediate discharge of the pellets once they have been "dusted."

The invention will now be described in greater particularity, with reference to the accompanying drawing, in which:

Fig. 1 is a vertical sectional view through apparatus embodying the present invention;

Fig. 2 is a cross-sectional view on line 2—2 of Fig 1; and

Fig. 3 is a view similar to Fig. 1 but of a modified form of the apparatus, showing a screen section dividing a forming section from a "dusting" section.

In Fig. 1, the inclined sheet metal drum 1 is supported by annular rings 2, 2 on rollers 3, 3 and is rotated by means of ring gear 4 in cooperation with a driving gear 4*a*. The upper end of drum 1 is partially closed by a truncated conical sheet metal member 5 which is fixed to drum 1. 6 is a barrier ring fixed to the interior surface of drum 1 at approximately the midpoint therealong, and 7 is a similar barrier ring at the lower end of drum 1. The drum is lined, from the mouth of cone 5 to barrier ring 7, with a foraminous lining, e. g., expanded metal lath sections 8 and 9, serving to "anchor" a layer of compacted moist ore fines to the interior surface of the drum. Stationary scraper members 10, 10 are mounted (by mounting means not shown) parallel to the inner surface of drum 1 and at an adjustable distance from linings 8 and 9 for limiting the extent to which a layer of moist ore fines, introduced into drum 1 by means of feed belt 11, may form on the interior surface of said drum.

The drum 1 at its lower end carries a cylindrical extension 12 in the form of a perforated sheet metal section the perforations of which are adapted to pass minus $\frac{5}{16}$'' particles. Beneath this screen section 12 is a receiver 13 for catching the undersized material, and beneath the open mouth of section 12 is a similar receiver 14 for catching pellets of the desired size range.

Into the mouth of screen section 12 there projects a dust-feeding chute 15. The low (i. e., discharge) end of chute 15 is located 6 to 8 inches inside of screen section 12 and at approximately the upper limit of the travel of the pellets on the inclined surface of the rotating drum, whereby gravitationally to deliver a small stream of dry powderous fines onto pellets at the top of their travel. Dust feeding chute 15 is provided with dry powderous fines from a hopper reservoir 16 by means of revolving disc 17, driven by motor 18, through gear mechanism 19, 20, and adjustable scraper 21.

The process was carried out in the above described apparatus as follows: The ore fines starting material was an aqueous pulp of magnetic concentrate, from taconite; it was essentially all minus 65 mesh, and 50% or more was minus 325 mesh. The pulp was dewatered to about 10.8% free water, and the resulting mass was pugged, and thereupon fed to an extrusion device (not shown) adapted to divide the mass into "slugs" (i. e., little masses), of about $\frac{3}{8}$ inch diameter. These latter were carried to the mouth of cone 5 by endless belt 11, rolled off of the belt and down the cone onto a layer of compacted moist ore fines retained about the interior surface of drum 1 by the foraminous lining 8, 9 of the latter, and formed into dense pellets by continued rolling over said compacted layer.

A relatively small stream of dry ore fines—all minus 6 mesh in particle size—was discharged from chute 15 onto the pellets rolling over the interior surface of screen section 12. The pellets almost instantly became coated with thin layers of the dry ore fines. The undersized pellets were screened through screen section 12 and caught at 13, the material of desired size being caught at 14.

The pellets, as discharged, were dull in appearance, and looked "dry," whereas immediately before the "dusting" step they had glistened with films of water which had been squeezed out to the surfaces of the pellets by densification of the pellets during their formation.

The "dusted" pellets were stored, for several hours, in layers many inches thick, without any sticking together. When subjected to induration treatment (i. e., "firing"), they did not stick together, and did not exfoliate to any material extent.

Fig. 3 illustrates a slight modification of the above-described apparatus. According thereto, the screen section 12 is positioned between the upper, lined, pellet-forming section 25 of the drum and an unlined, lower, "dusting section" 26 of the latter. In the operation of the modified apparatus, the pelletized product from section 25 is screened as it passes over section 12, whereby to rid the same of undersized pellets, and thereafter is "dusted" while passing over section 26.

While the invention has been described, above, with reference to use of an inclined rotary drum as the means for forming the moist ore fines into pellets or small balls, it is to be understood that it is applicable also in a case where the "balling up" is effected in known manner by rolling on another inclined surface, e. g., on an inclined plate.

I claim:

1. In the process of pelletizing homogeneously moistened ore fines which involves rolling a charge consisting of such moist fines in an inclined rotary drum, in the course of which rolling procedure moisture is worked out of the interior of the pellets onto the surfaces so that the finished pellets glisten and tend to stick to each other by reason of the excessive amount of moisture on their surfaces, the step of preventing the sticking together of the formed pellets which consists in applying a few percent by weight of dry ore fines to the surfaces of the formed pellets, at a locus near the uppermost travel of the pellets and where the latter are rolling onto themselves,

and thereupon promptly discharging the resulting non-sticky pellets from the drum.

2. The process defined in claim 1, in which the dry ore fines dusted onto the formed pellets consist essentially of an indurated product of the same composition as that of the pellets and being minus 6 mesh material 80% of which is finer than 65 mesh, the amount of said dry ore fines being about 5% by weight based on the dry weight of the pellets.

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