June 7, 1955 J. E. WIKLUND 2,709,833

ROTARY DRUM TYPE PELLETIZING APPARATUS

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Fig. 1

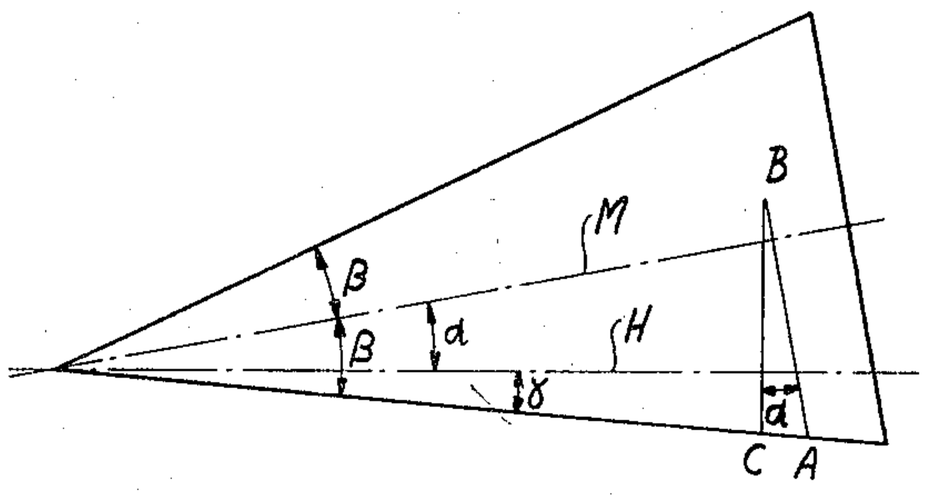

Fig. 2

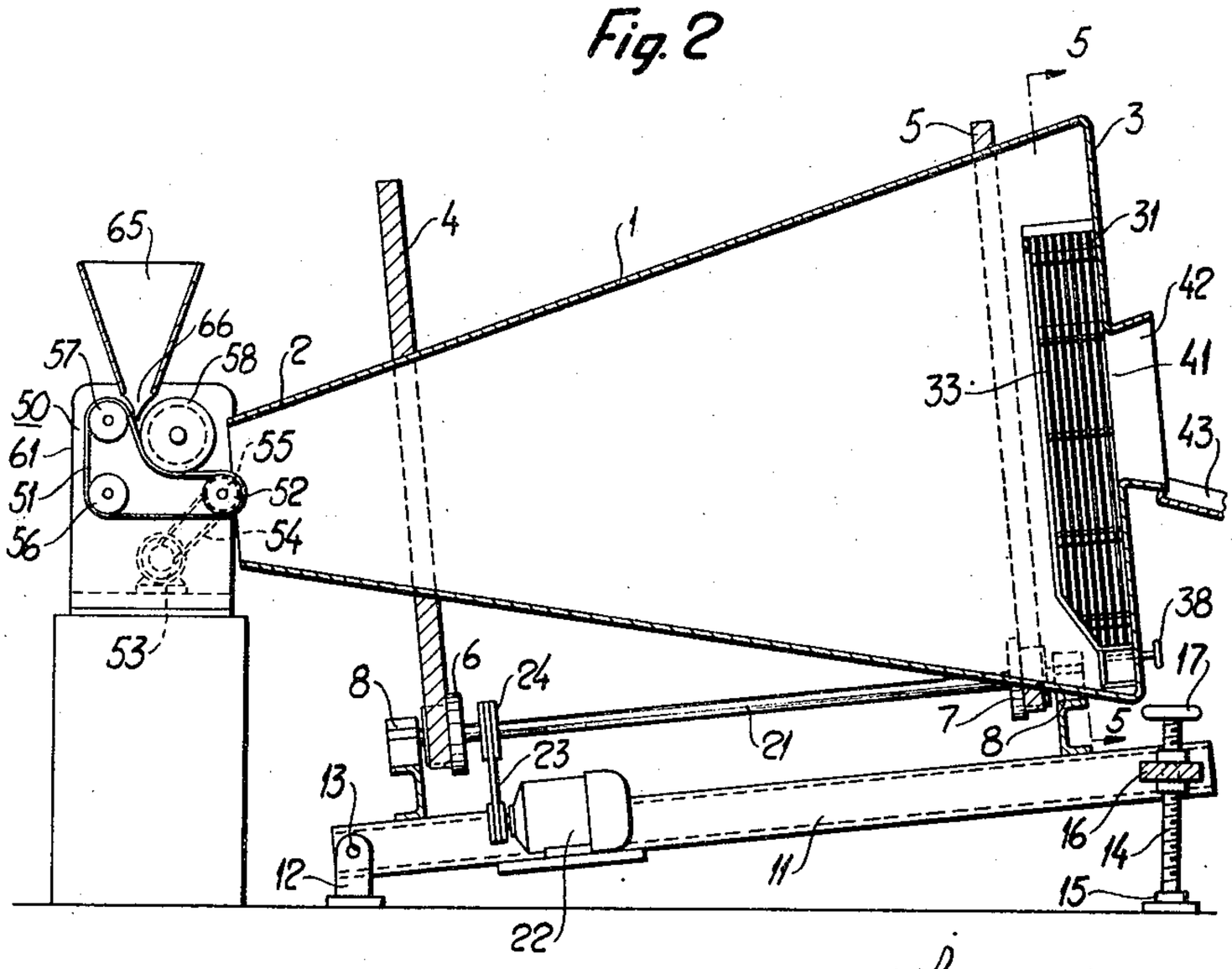

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Fig. 3

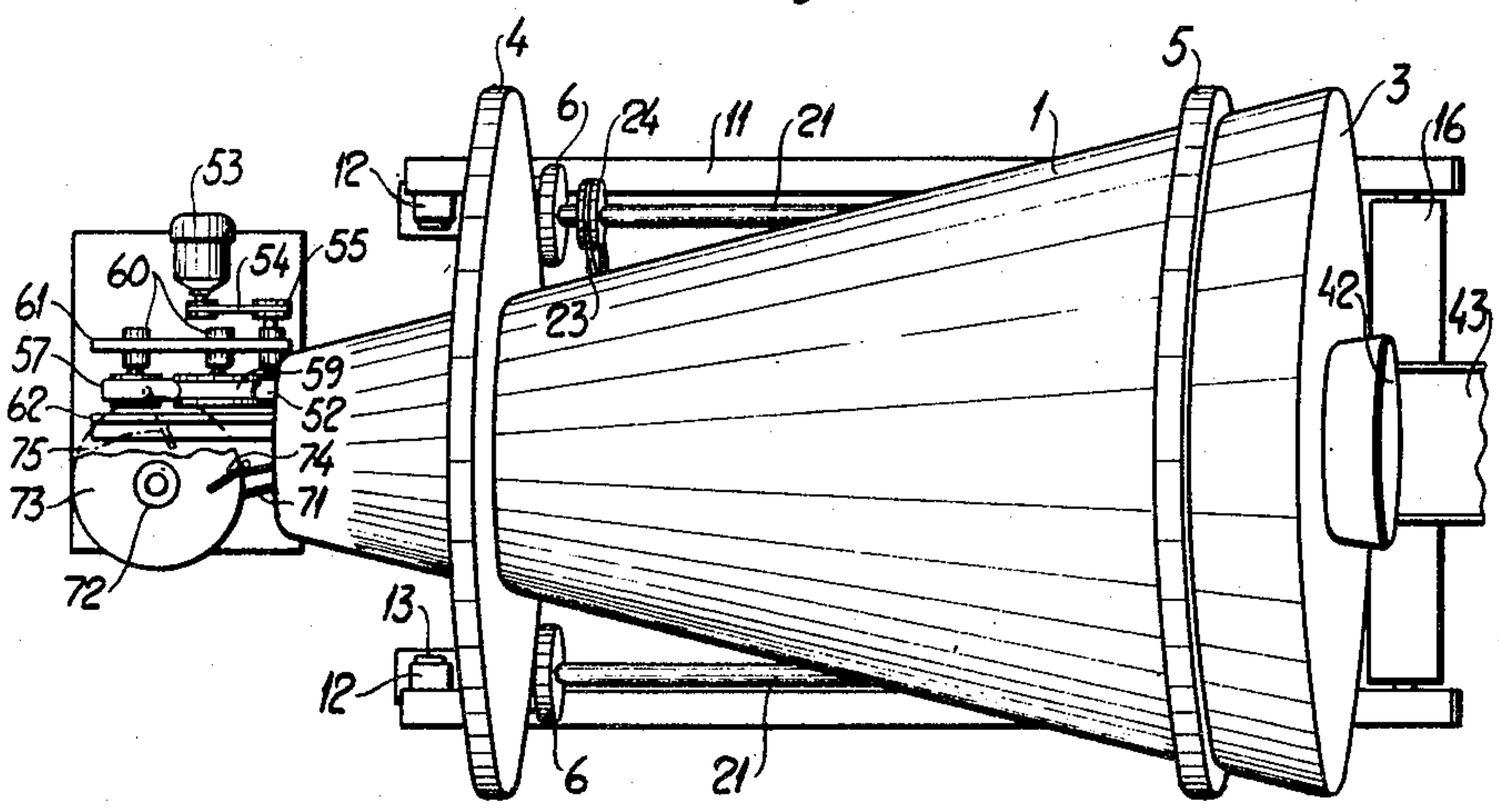

Fig. 4

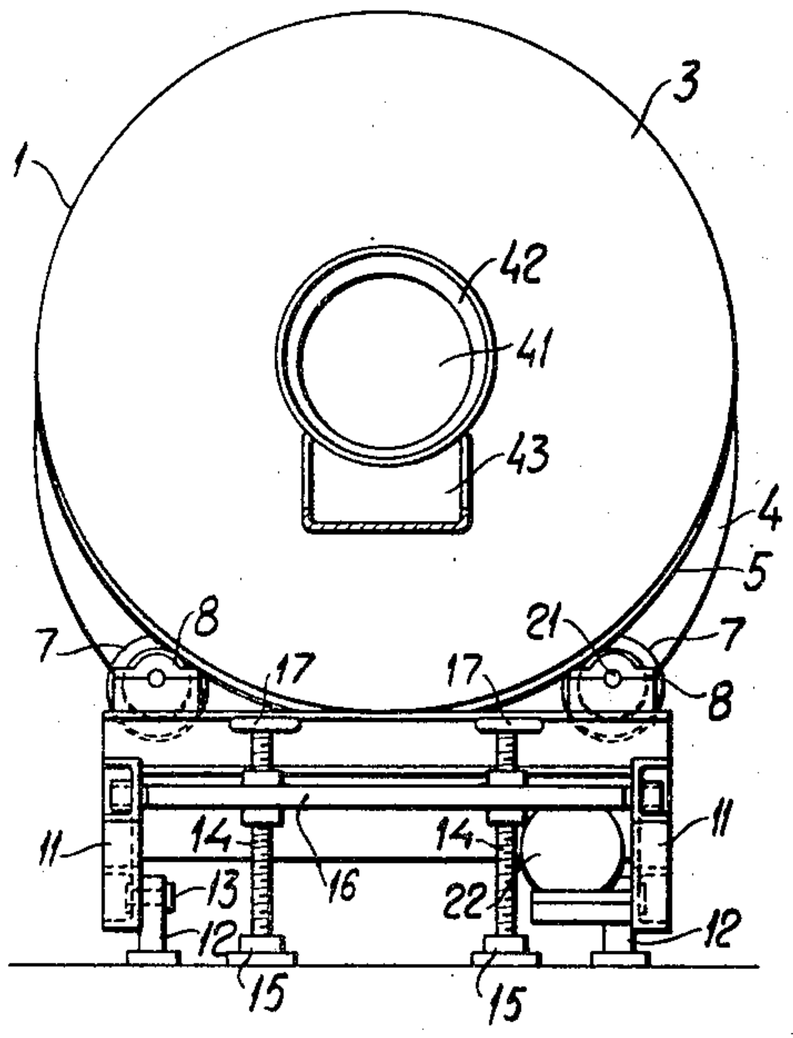

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Fig. 5

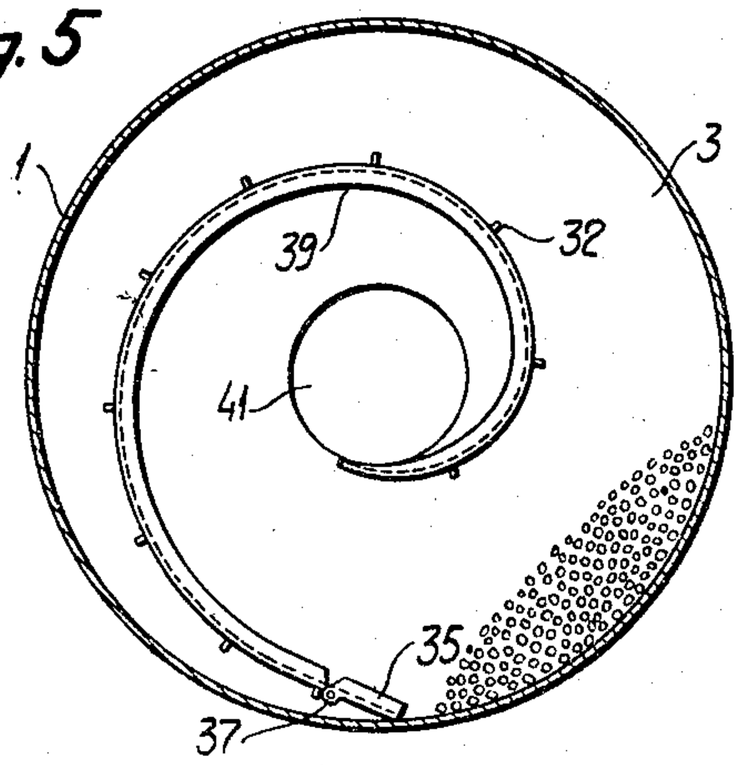


Fig. 6

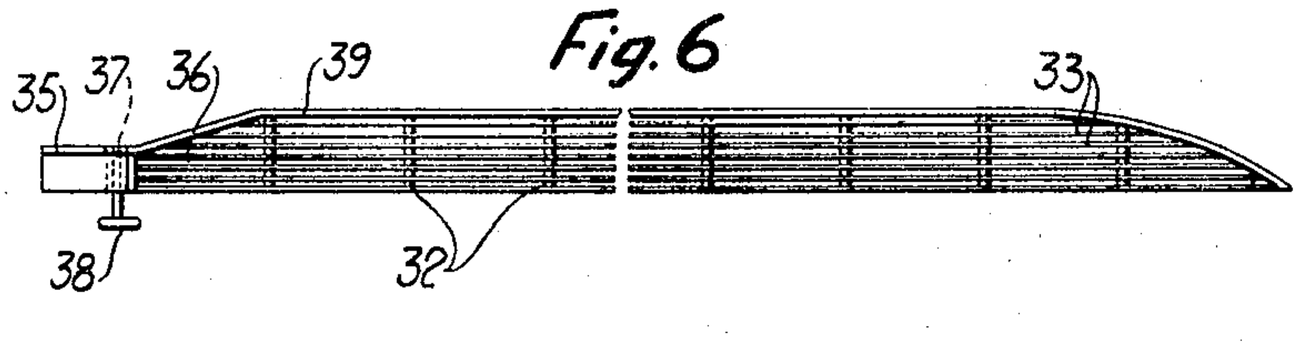
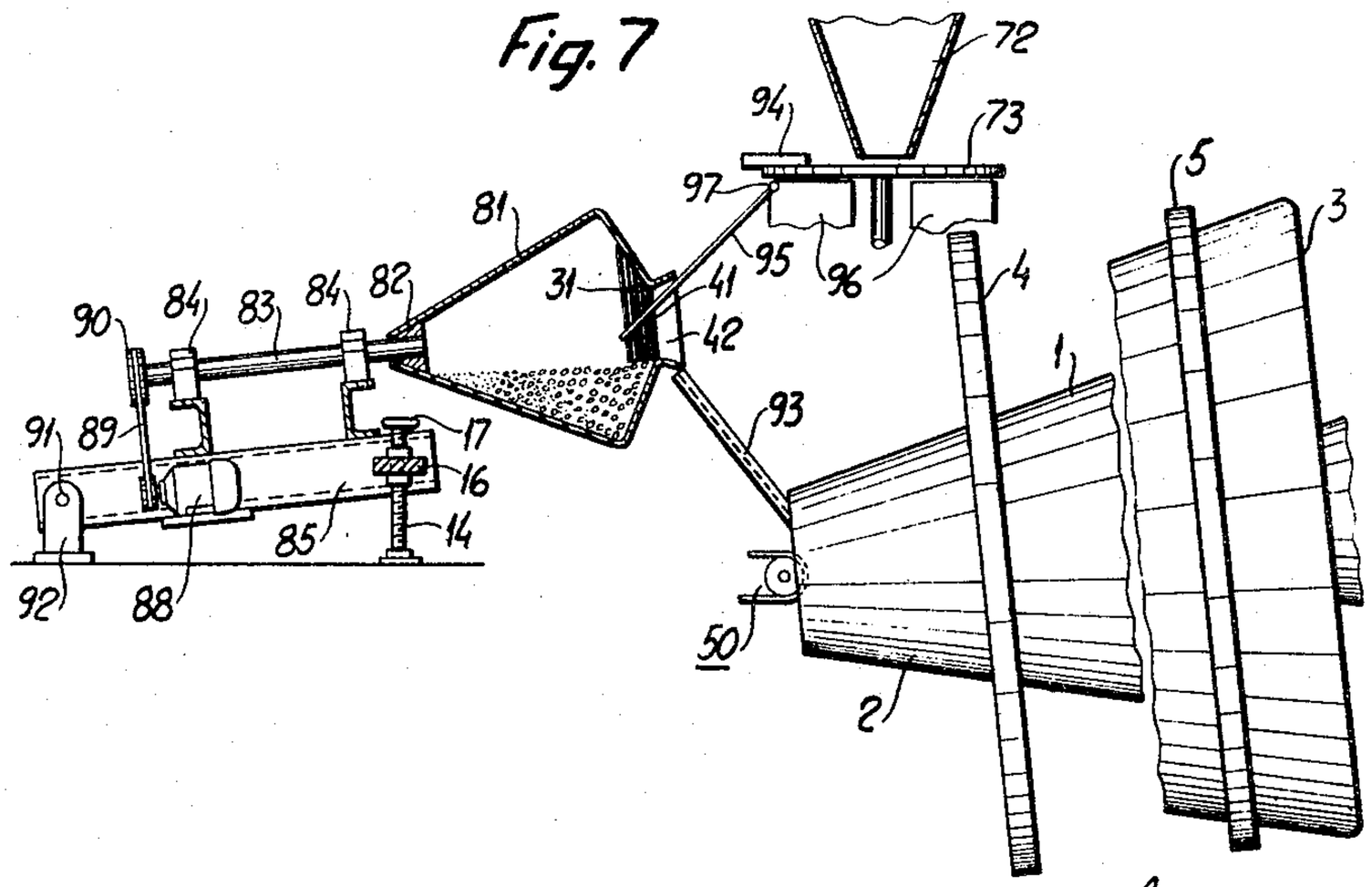


Fig. 7



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ROTARY DRUM TYPE PELLETIZING APPARATUS

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Claims priority, application Sweden July 4, 1951

13 Claims. (Cl. 18—1)

The present invention relates to the manufacture of pellets by rolling pulverulent material in a rotary drum and is particularly concerned with the pelletizing of pulverulent or fine-grained ores. It is particularly suitable for pelletizing roasted pyrite and may with advantage be employed for lead ore concentrates, such as lead sulphide.

The primary object of the invention is to produce pellets without returning unpelletized material and undersized pellets as is necessary in all prior methods known to applicant. Another object is to obtain pellets of uniform size. A further object is to perform the pelletizing in two stages by first creating nuclei in a separate drum.

These objects and other advantages that will be easily understood by those familiar with the present art will be obtained according to the invention by using drums having the form of a frustum of a cone and arranging the central axis of the drum at an adequate inclination to the horizontal plane with the wide end of the drum at a higher level than the small end.

The invention will now be described with reference to the accompanying drawings illustrating the principle of the invention and some embodiments thereof, it being, however, understood that the invention is not limited to the embodiments illustrated.

In the drawings:

Fig. 1 illustrates the theory of the invention.

Fig. 2 is a vertical section, through the longitudinal axis, of apparatus constituting the preferred embodiment of the invention; Fig. 3 is a plan view of a modification of the embodiment shown in Fig. 2, whereas Fig. 4 is a frontal view thereof and Fig. 5 a vertical section along the line 5—5 in Fig. 2. Fig. 6 illustrates a screening device employed in the embodiment of Fig. 2.

Fig. 7 illustrates an embodiment in which two drums according to the invention are employed in series.

Referring first to Fig. 1, the invention is based on the theory that, due to the conical shape of the drum and the inclination of the central axis M thereof relative to the horizontal plane H with the wide end of the drum at a higher level than the small end, the pulverulent material supplied to the drum and pellets formed therein can be suitably distributed in the length direction of the drum and the non-pelletized pulverulent material be moved within the drum in opposite direction to the pellets to be discharged. The apex angle of the drum cone is 2β and the central axis is supposed to form an angle α with the horizontal plane. The inclination α must be less than half of the apex angle, that is $\alpha < \beta$. Supposing that a particle is situated at the point marked A, this particle upon rotation of the drum and due to the friction against the wall of the drum will follow the wall and move in a plane perpendicular to the central axis until it reaches point B from where, due to gravity, it will fall down along the slope of the material the shortest way towards the bottom of the drum to point C in a vertical plane perpendicular to the horizontal plane.

As will be evident from Fig. 1, this vertical plane forms the angle α with the plane along which the particle was lifted from point A to point B. When returned to the bottom at point C, the particle has moved a distance towards the apex of the cone, the magnitude of the distance being a function of the angle α but being independent of the apex angle 2β. As the height to which the particle will be lifted, that is the position of point B, is dependent on the degree of filling of material in the drum, the position of point C will also be a function of said filling. In case the particle is a pellet or, generally speaking, is rounded off, it will also follow the way described from A to B and from B to C but when arrived at C it will have a tendency to roll on the bottom of the drum in a direction from the apex of the cone because the bottom is sloping by an angle γ being the difference between the angles β and α. The larger pellets, the greater is the tendency to move in said direction. Therefore, the larger pellets will collect at the wide end of the cone and smaller pellets remain in earlier sections of the cone until they have grown by picking up fine material to the size of the large pellets. The material wandering towards the apex of the cone will either form nuclei or meet nuclei formed near the apex. These nuclei grow successively by picking up fine material and form ultimately a pellet which will have a tendency to wander towards the wide end of the cone as described.

The preferred embodiment of the pelletizing apparatus shown in Fig. 2 consists of a drum 1 in the form of a truncated cone of sheet metal. For some kinds of material, such as pulverized roasted pyrite, the drum for a capacity of about 3 tons an hour may have a length of about 3 meters, a diameter at the small end of 0.5 meter and a diameter at the wide end of 2 meters. The apex angle of the drum cone will then be about 28°. The drum is provided with annular rings 4 and 5, by which the drum is supported on two pairs of flanged wheels 6 and 7, respectively. These wheels are journalled in bearings 8 secured to a frame structure 11 which is supported pivotally at the small end of the drum on a standard 12 about a shaft 13. At the wide end of the drum the frame 11 is supported by two screws 14 rotatable by hand-wheels 17 in axial bearings 15. The screws 14 are mounted in ears 16 having threaded bores matching the threads of the screws 14. By turning the wheel 17, the frame 11 can be raised or lowered until the drum axis will obtain the desired angle α relative to the horizontal plane.

At the one side of the drum the supporting wheels 6 and 7 are fixedly mounted on a common shaft 21 which is driven by a motor 22, mounted on the frame 11, over the belt 23 and the pulley 24. This belt and pulley transmission should preferably be of the type permitting variation of the gear so that the speed of rotation of the drum may be adjustable, such as between 3 and 10 revolutions per minute in a drum of the above dimensions.

At the wide end of the drum a discharge device in the form of a spiral grid 31 is provided which is best seen in Fig. 5. It is supposed that the drum rotates with the bottom portion in a direction from the spectator. As will be seen from Fig. 6, which illustrates the screen folded up, the screen consists of a plurality of supporting bars 32 secured to the end wall 3 of the drum. To these bars a series of strings or threads 33 are secured as by welding. The threads may be 5 millimeters thick and should preferably be fitted at a distance of about 15 millimeters or, generally, at a distance equal to the minimum size wanted of the pellets. The width of the grid depends largely upon the capacity of the drum and it has been found that the width of 0.4 meter will be satisfactory at an output of up to at least 3 tons per hour, provided

that the degree of selection of the drum is satisfactory. The grid has at the peripheral end a smaller shovel part **35**, **36** which, in the embodiment shown, has a front part **35** of impervious sheet material which is connected to the grid portion **36** of the shovel by a hinge **37** in a manner that the plate **35** can be rotated by the hand-wheel **38** at the outside of the wall **3** so as to be adjusted into a desired position relative to the peripheral wall of the drum in order that the degree of discharge can be regulated. The main portion of the grid is wider than the shovel portion for the purpose of spreading out the pellets collected by the shovel so that the pellets can be effectively freed from adhering fine material and pellets which are too small may fall back into the drum when the grid upon rotation of the drum passes the pellets towards the center of the drum, where the pellets are discharged through opening **41** in end plate **3** and the short collar **42** to discharge board **43**. For the purpose of keeping the pellets on the grid the latter is provided with a list **39**. At its central end the width of the grid successively decreases in order to move the pellets carefully to the opening **41** so as to be discharged. Through the spiral form of the discharge grid the pellets are smoothly passed to the central discharge opening **41** and it is preferred to let the spiral pass through 360° so that the pellets will be discharged at about the same radius of the drum at which they were caught by the grid.

The drum now described is preferably put at an inclination of 5 to 7° at least when pelletizing roasted pyrite of relatively even grain size distribution and containing about 60% of a grain size less than 0.1 millimeter. In this connection, it should be noted that it is commonly considered necessary that roasted pyrite should contain more than 90% of grains less than 0.1 millimeter to be pelletizable.

The drum may be charged with pulverized material, such as roasted pyrite or iron ore, in any convenient manner through the small end **2** or through the discharge opening **41** or through both, it being, however, advantageous to supply the charge near the discharge end of the drum. The distribution will then take place automatically as explained with reference to Fig. 1. Particularly in case the pellet nuclei shall be created in the drum itself, the finest material should preferably be supplied to the sections near the small end of the drum, which promotes the creation of nuclei, because in this section the charge is free from pellets which would crush the small nuclei.

The charging of the drum will be best carried out by the throwing apparatus **50** illustrated in Figs. 2 and 3. This apparatus consists of a band **51** which is preferably only a few millimeters thick, such as 3 millimeters, and about 1 decimeter wide. This band is passed over a pulley **52**, which is driven by a motor **53** over the belt **54** and pulley **55**, and is further passed over the idlers **56** and **57**, the latter of which being positioned at a level above pulley **52** and so far behind the latter as to permit a press roller **58** to be accommodated at about the same level as idler **57** between the latter and pulley **52** above the band **51** so as to press this band downwards to such an extent that the band will run on to pulley **52** in an approximately horizontal direction. The idler **57** and the press roller **58** are so closely positioned as to form a V-shaped space between the band **51** and roller **58**. Roller **58** is provided with a groove **59** about 30–40 millimeters wide and of about 10 millimeters' depth. Pulley **52**, idlers **56** and **57** and press roller **58** are rotatably mounted on shafts journalled in bearings **60** mounted in a stand wall **61**. At the opposite side the pulley, idlers and roller are protected by a cover plate **62** which can be easily removed when, for instance, band **51** has to be exchanged.

Over the V-shaped space referred to above a hopper **65** is arranged for the material to be pelletized. The hopper has lateral lips **66** forming side walls of the hopper in the V-shaped space.

When running at an appropriate speed, band **51** will throw the material fed into groove **59** with sufficient power into the drum so that the material will be distributed and supplied to the sections best suited for the pelletizing operation. Due to the air resistance, a practical separation as to grain size will be obtained when the throwing apparatus is positioned at the small end of the drum. The coarser particles will reach the sections of the drum near the discharge end whereas part of the fine material will be upheld in the sections nearer to the small end **2**.

The drum is preferably charged with so much material that in the sections near the discharge end of the drum the height of the charge reckoned along a radius will become about a quarter of the diameter of the drum, the height decreasing successively towards the small end.

In some cases, it may be preferred to charge a minor portion, for instance, 2–10% of the charge directly to the small end of the drum as over the feed board **71**.

The pulverulent material is charged to the feeding apparatus through a hopper **72** over the turn-table **73** provided with a scraper **74** for feed board **71** and scraper **75** for feed hopper **65**.

The creation of nuclei is promoted by increasing the speed of the turning-over of the bulk of the pulverulent material rolled in a drum. In the pelletizing of some materials or for speeding up the operation, it may, therefore, be advantageous to create nuclei in a separate drum especially adapted for the creation of nuclei. Such arrangement is illustrated in Fig. 7. The big drum **1** may be of the same size and structure as that described with reference to Figs. 2–6 and it may also be equipped with a throwing apparatus **50** of the same kind as that described above. The nucleus creating drum **81** is of a more compact shape than drum **1** and its drum cone has a greater apex angle than that of drum **1**, for instance, being of the order of 60°. The length of the drum may be about 1 meter and its inclination with regard to the horizontal plane may be about 10–15°. As illustrated, the drum is rigidly secured at its small end **82** to a shaft **83** journalled in bearings **84** mounted on a frame **85**. Shaft **83** is driven by motor **88** over belt **89** and pulley **90**. The drum **81**, once being positioned at an inclination suitable for the creation of the desired nuclei, usually need not be adjusted, and therefore, frame **85** may be stationary. Nevertheless, the frame may be pivotable about shaft **91** secured to standard **92**. At the opposite end a screw **14** may be arranged in the same manner as illustrated and described with reference to Fig. 2.

The drum **81** has a discharge grid **31** of the same type as described above and a discharge collar **42** for the nuclei to be discharged and fed to feed board **93** feeding the nuclei into the small end **2** of drum **1**. Since the nuclei are very small as compared with the pellets formed in drum **1**, the dimensions of grid **31**, particularly the distance between the threads **33**, have to be adapted to the minimum size wanted of the nuclei.

The pulverulent material to be used for the creation of nuclei is fed through hopper **72** to turn-table **73** and scraped off by scraper **94** to be passed on to feed board **95** which is inserted into drum **81** through the discharge opening **41** thereof. The feed board **95** is pivoted to the frame **96** holding the turn-table **73** as by shaft **97**. The pivotal arrangement of board **95** makes it feasible to control to a certain extent the feed to the drum **81** so that the material can be supplied to an adequate section thereof. The turn-table **73** should be located so as also to supply the hopper of throwing apparatus **50**.

What is claimed is:

1. Pelletizing apparatus comprising a drum having the form of a frustum of a cone and being positioned with its apex end downwards so that the central axis of such cone forms a positive acute angle of inclination with the

horizontal smaller than half of the apex angle of such cone, support means for the drum, an end wall at least at the peripheral portions of the wide end of the drum, means adjacent an end of the drum for charging the latter with fine-grained material to be pelletized, means for discharging pellets from said peripheral portions of the wide end of the drum, and means for rotating the drum about its central axis.

2. Pelletizing apparatus as claimed in claim 1, in which the apex angle of said cone is greater than 6° and smaller than 70°.

3. Pelletizing apparatus as claimed in claim 1, in which the apex angle of said cone is of the order 15 to 40°.

4. Pelletizing apparatus as claimed in claim 1 for preparing nuclei for pellets, in which the apex angle of said cone is of the order of 45 to 65°.

5. Pelletizing apparatus as claimed in claim 1 further comprising a discharge grid projecting perpendicularly and inwardly from said end wall at the wide end of the drum, said grid extending spirally from a point near the periphery of the drum in the direction opposite to the direction of rotation of the drum to a point in the vicinity of the centre of the drum.

6. Pelletizing apparatus as claimed in claim 5, in which said end wall has a central discharge opening and the central end of said spiral discharge grid extends to said discharge opening.

7. Pelletizing apparatus as claimed in claim 5, in which said grid extends spirally through an angle of about 360°.

8. Pelletizing apparatus as claimed in claim 5, in which the width of said grid is reduced at the peripheral end thereof.

9. Pelletizing apparatus as claimed in claim 5, in which the width of said grid successively tapers at the central end thereof.

10. Pelletizing apparatus as claimed in claim 5, in which said grid has a shovel at its peripheral end, said shovel being pivoted at the grid so as to make the distance of the edge of the shovel from the peripheral wall of the drum adjustable.

11. Pelletizing apparatus as claimed in claim 10, in which said shovel is secured to a shaft extending through said end wall, said shaft having means outside said end wall for its rotation for the purpose of adjusting the position of the shovel.

12. Pelletizing apparatus as claimed in claim 1, in which the charging means is a charging apparatus adjusted to supply the majority of the fine-grained material to sections of the drum at some distance from but near the wide end of the drum.

13. Pelletizing apparatus as claimed in claim 12, in which said charging apparatus is a throwing apparatus positioned at the small end of the drum.

References Cited in the file of this patent

UNITED STATES PATENTS

773,356	Waggoner	Oct. 25, 1904
987,554	Coggeshall	Mar. 21, 1911
1,695,362	Bourges	Dec. 18, 1928
1,921,114	Brackelsberg	Aug. 8, 1933
1,931,499	Klugh	Oct. 24, 1933
2,158,513	Lloyd	May 16, 1939
2,268,816	Gabeler et al.	Jan. 6, 1942
2,436,771	Hood	Feb. 24, 1948