March 21, 1939. P. V. WHITNEY 2,151,253

MATERIAL HANDLING METHOD

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Fig. 1

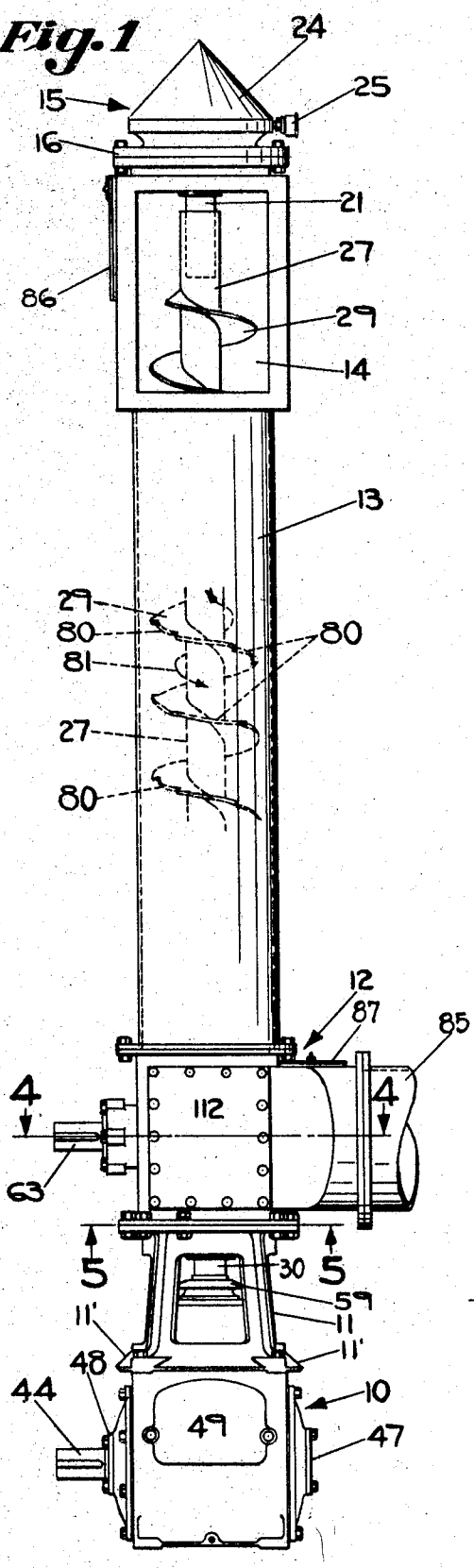

Fig. 2

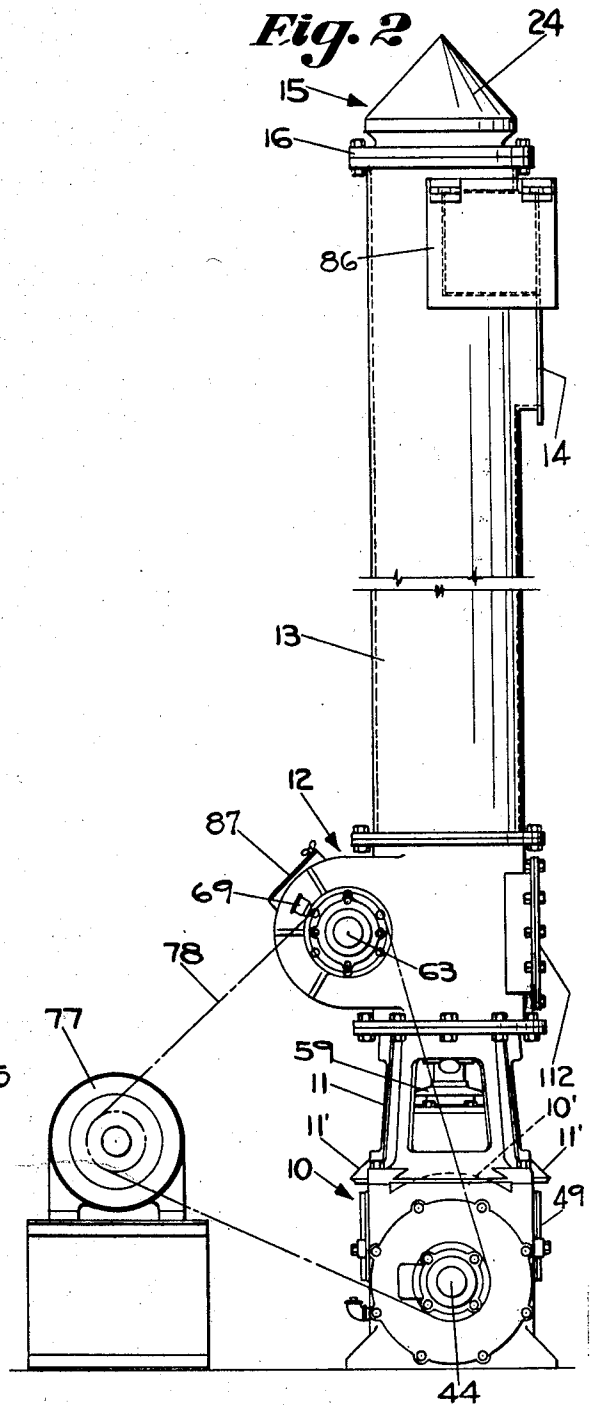

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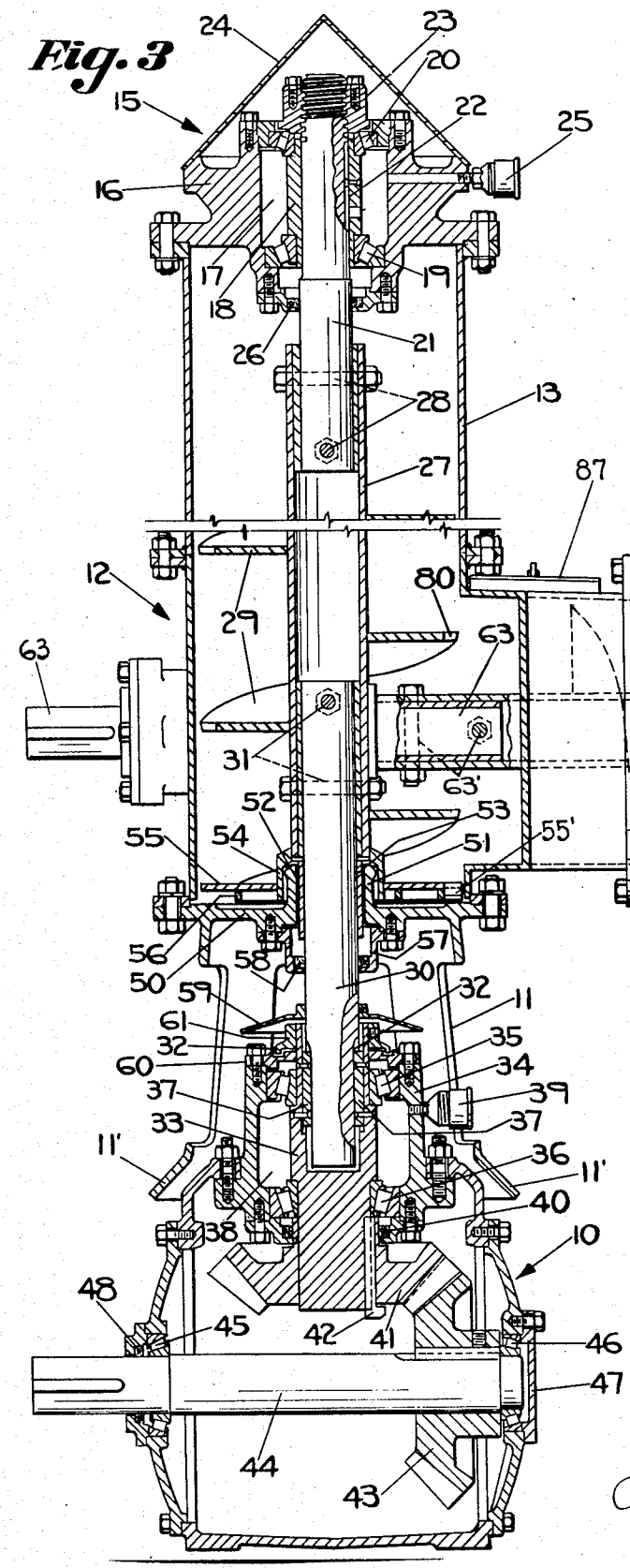
Fig. 3



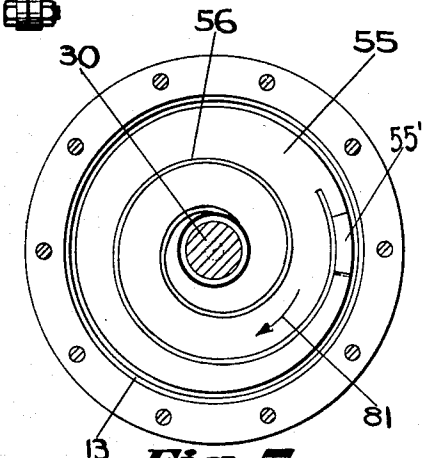


Fig. 5

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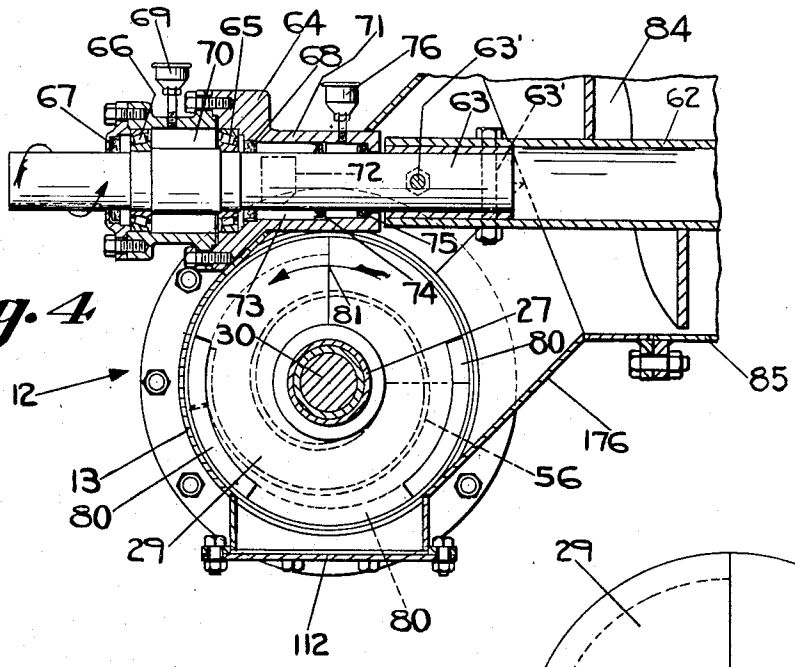

Fig. 4

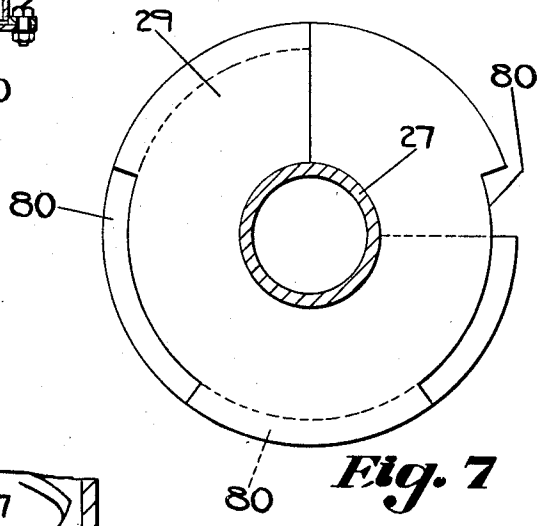

Fig. 7

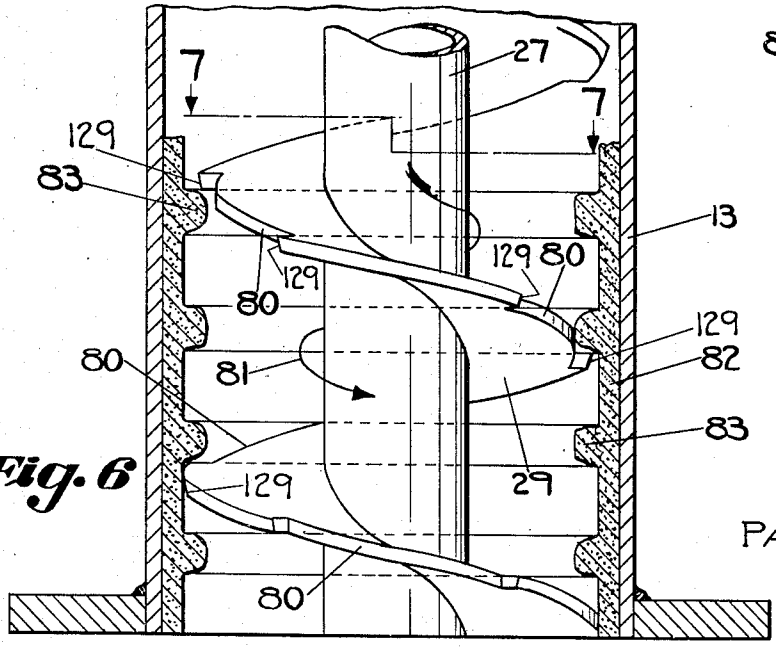

Fig. 6

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Patented Mar. 21, 1939

2,151,253

UNITED STATES PATENT OFFICE

2,151,253

MATERIAL HANDLING METHOD

Paul V. Whitney, Columbus, Ohio, assignor to The Jeffrey Manufacturing Company, a corporation of Ohio

Application October 28, 1936, Serial No. 108,041

1 Claim. (Cl. 214—152)

This invention relates to an elevating screw or spiral conveyor particularly adapted to elevate material such as spheron (lampblack), bulk cement, soda ash, zinc oxide, hydrate of lime and other granular materials.

An object of the invention is to provide a device of the above mentioned class which will convey materials without causing vibration of the apparatus, which the ordinary spiral conveyors tend to induce.

Another object of the invention is to provide a floating spiral conveyor which will not produce any stress or strain on the bearings due to expansion or contraction of the conveyor in response to temperature changes.

Still another object of the invention is to provide a combination horizontal and vertical conveyor, both of which are of the screw or spiral type in which special bearing means is provided to keep out any of the material being handled which may be very fine material.

Other objects of the invention will appear hereinafter, the novel features and combinations being set forth in the appended claim.

In the accompanying drawings,

Fig. 1 is a front elevational view of the device comprising my invention;

Fig. 2 is a side elevational view of the device of Fig. 1;

Fig. 3 is a sectional elevational view of the device of Figs. 1 and 2;

Fig. 4 is a sectional view taken on the line 4—4 of Fig. 1 looking in the direction of the arrows;

Fig. 5 is a sectional view taken on the line 5—5 of Fig. 1 looking in the direction of the arrows;

Fig. 6 is a diagrammatic sectional view showing more the mode of operation of the spiral conveyor of my invention rather than any structural detail; and

Fig. 7 is a sectional view taken on the line 7—7 of Fig. 6.

It has been found in practice that when certain materials are conveyed by a screw or spiral conveyor there is a tendency for the conveyor to be thrown into violent vibration. This is particularly noticeable on a vertical or lift conveyor of the spiral type where the material being handled is zinc oxide, and it is noticeable to a lesser extent on a horizontal screw conveyor. One of the features of the present invention includes the construction of the spiral flight so as to eliminate this undesirable vibration.

Referring particularly to the drawings, the conveyor comprises a base housing 10, which also forms a gear housing, as will be hereinafter described in more detail, upon which is supported a pedestal 11, which pedestal supports a base 12, having a removable door 112, and upon which pedestal is supported a vertically extending pipe 13 provided with a discharge opening 14, and supporting a top bearing cap 15. The bearing cap 15 comprises a casting 16, having a central bore 17 in which is carried a journal 18 mounted upon top and bottom roller bearings 19 and 20, respectively, which are carried by the casting 16.

Carried in the journal 18 is a stub shaft 21 which is keyed to said journal by a key 22. An adjusting nut 23, which may be locked in any adjusted position, is provided on the top of the stub shaft 21 and provides for adjustment of the spiral conveyor flight, as will be evident from further description. A cover plate or cap 24 is provided for covering the adjusting nut 23 and the top of the casting 16.

The central bore 17 provides a lubrication well for the bearings 19 and 20 and lubrication is supplied thereto from a grease cup 25. A removable grease seal 26 is provided for the lower portion of the central bore 17, which grease seal permits free rotation of the stub shaft 21.

Hanging from the stub shaft 21 and supported thereby is a vertical pipe 27 which is bolted to said stub shaft 21, as by bolts 28. Mounted upon the pipe 27 and rigidly attached thereto, as by welding, is a continuous spiral or helical flight 29. The flight 29 extends from the bottom of the base 12 to a position above the discharge opening 14, and when rotated, will be effective to elevate any material in the pipe 13, and automatically discharge it from said discharge opening 14 in an obvious manner.

Adjacent the bottom of the pipe 27 it is provided with a stub drive shaft 30 which is bolted thereto as by bolts 31. The drive shaft 30 is provided with one or more keyways 32 and extends into a telescoping quill 33 which is mounted upon a bracket 34 by upper and lower roller bearings 35 and 36, respectively, said bracket 34 being carried by the base housing 10. The quill 33 is provided with one or more keys 37 which ride in the keyways 32 and thus transfer any rotary motion of the quill 33 to the drive shaft 30. It will be noted that the quill 33 is supported entirely independently of the drive shaft 30, and that said drive shaft 30, pipe 27, spiral flight 29 and stub shaft 21 are all supported from the casting 16 through the roller bearing 19. It is thus evident that pipe 27 is free to expand and contract without any resulting stresses or strains in any of the bearings, the keyways 32 being free to slide up and down along the keys 37, 37.

The bracket 34 provides a lubrication well 38 adapted to receive grease from the grease cup 39 to lubricate the bearings 35 and 36. A grease seal 40 is provided at the bottom of the bracket 34 to prevent a loss of grease from the well 38.

Adjacent its bottom, the quill 33 carries a beveled pinion gear 41 which is keyed thereto by a key 42 and which is driven from an inner-meshing beveled gear 43 carried upon a counter

shaft 44 mounted in roller bearings 45 and 46 in the base housing 10. A removable cap 47 covers the bearing 46 and a grease seal 48 is provided adjacent the bearing 45.

To provide access to the base housing 10, a removable door 49 is provided. In operation, the base housing 10 will be provided with sufficient lubrication to maintain the gears 41 and 43, and the bearings 45 and 46 properly lubricated at all times.

It is to be noted that the pedestal 11 is provided with an integral plate 50 which forms a bottom for the housing formed by the pipe 13. Said plate 50 is provided with an integral upstanding flange 51 adjacent its center, which provides a large bearing surface 52 which may contact with a bearing ring 53 carried by the drive shaft 30, should said shaft 30 be deflected from its normal axial position. That is, the ring 53 does not normally contact the bearing surface 52 of the flange 51, but upon any appreciable deflection of said drive shaft 30, contact therebetween will take place.

It is to be noted that adjacent its bottom, the pipe 27 carries an inverted cup 54 which surrounds the flange 51 and carries a revolving plate 55 which provides a false bottom for the pipe 13.

It will be evident that in the operation of the device, the material being elevated might tend to get between the plates 55 and 50, or in other words, beneath the plate 55. To counteract this tendency, the plate 55 carries a spiral flight 56 (see Figs. 1 and 5) which is so wound that it is effective to move any material between the plates 50 and 55 toward the outer circumference thereof. At its outer edge the plate 55 is provided with a plow or scraper 55' which scrapes the top of plate 50 and thus elevates onto the spiral flight 29 the material which is conveyed outwardly by the spiral 56.

It is also to be noted that the cup 54 and flange 51, as well as the ring 53, cooperate to provide a labyrinth seal to prevent any material which is within the base 12 and between the plates 50 and 55 from working its way through the opening through which drive shaft 30 extends. In order to reduce even further the chance of material effectively passing through said opening, and reaching any of the bearings therebelow, a cap 57 provided with a dirt and grease seal 58 is provided on the bottom of the plate 50. Below the cap 57 the shaft 30 also carries a disc or canopy 59 which will throw any material which reaches it, laterally, for elimination through the four openings in the pedestal 11, or through the space between the top of the housing 10 and the lower skirts 11', 11', as shown in Fig. 3, the top of the housing 10 at 10' on opposite sides being curved as shown in Fig. 2, to afford laterally extending chutes to prevent accumulation of such material.

It may additionally be pointed out that the bracket 34, which is a complete housing, is provided with a removable cap 60 which cooperates with a labyrinth packing ring 61 carried by the top of the quill 33 to seal the well 38 against any foreign matter, thus protecting the bearings 35 and 36. The flinger 59 protects the mechanism beneath same from ingress of foreign matter.

The very elaborate precautions employed to protect the bearings 35 and 36 have been found necessary for the particular type of materials that these conveyors handle, which tend to work their way into any available opening unless seriously discouraged.

To provide for the feeding of material to the vertical screw conveyor above described, I provide a horizontal screw conveyor which feeds into the base 10 through an opening (see Fig. 4). Said horizontal screw conveyor preferably comprises a trough or pipe 85 and a spiral flight, similar in construction to flight 29, mounted upon a tube or pipe 62, which tube or pipe is rigidly attached to the drive shaft 63. The drive shaft 63 is mounted in a special housing 64 upon a pair of roller bearings 65 and 66. A grease seal 67 is provided for the bearing 66 and a grease seal 68 is provided for the bearing 65. A grease cup 69 is provided to supply grease to the grease compartment 70 and to the bearings 65 and 66.

In order to protect the bearings 65 and 66 against ingress of the material being conveyed, the housing 64 is provided with an elongated integral extension 71 which has on its bottom an opening or discharge door 72. The opening 72 provides for the free discharge of any material which is in the compartment 73, which compartment is bound by seals 68 and 74. The extreme end of the extension 71 is also provided with a grease seal 75. Grease may be supplied to the space between the seals 74 and 75 by a grease cup 76.

It will be evident that when grease is forced into the compartment 70 from the cup 69, any excess may work its way through the grease seal 67 or the seal 68, generally the latter. Any such excess grease will then be received in the compartment 73, and may be discharged through the opening 72. In a similar manner grease may be forced into the compartment between the seals 74 and 75 from the grease cup 76 and any excess will move past the seal 74 or 75, and preferably the former, into the compartment 73 and be discharged through the opening 72. Any of the granular material being conveyed, which works its way past the seals 75 and 74, cannot reach the bearings 65 and 66, but will be discharged from compartment 73 through the opening 72. By replacing the grease in the cup 76 and forcing new grease into the compartment between the seals 74 and 75, the old grease therein, contaminated with material being conveyed, may be forced out, preferably through the seal 74, which is the least effective of the two seals, and through the opening 72, as aforesaid. It is thus evident that the bearings 65 and 66 will be protected from ingress of the material being conveyed, at all times.

As previously mentioned, the tube or pipe 62 of the horizontal conveyor 84 which carries a screw flight, may be pinned or keyed at 63', 63', to the drive shaft 63 to be rotated thereby and convey material into the base 12. A guide conduit 176 is provided for directing material from said horizontal conveyor 84 through the opening into said base 12 where it will be elevated by the vertical screw conveyor flight 29. As seen in Fig. 2 of the drawings, both the horizontal and the vertical conveyors may be driven from a single electrical motor 77 through a single drive chain or belt 78, which rides on sprockets associated with the shafts 44 and 63 of said conveyors.

Attention is now directed particularly to Figs. 6 and 7 and to the special construction of the flight of the upright conveyor, which may also be the construction of the flight of the horizontal conveyor, which eliminates the tendency for said conveyors, and particularly the vertical conveyor, to vibrate when conveying material, particularly such material as zinc oxide. As shown in said

figures, at intervals around the periphery of the spiral flight 29, a spiral notch 80 is provided by removing a portion of the periphery of the flight material. This spiral notch 80 preferably has an angular extent of approximately, though slightly less than, 90 degrees, and extends radially inwardly from the periphery of the flight a relatively small amount, preferably not more than 25 percent of the normal radial dimension of said flight, and in general, approximately only 15 percent.

It is preferred to space the periphery of the spiral conveyor flight a short distance from the inner wall of the enclosing casing and provide such periphery at intervals in staggered relation, with shallow elongated notches 80, so as to provide shearing or knife edges at 129 which act on the coating of material which forms on such inner wall, thereby preventing such coating from interfering with the free rotation of the spiral conveyor flight. For instance, if the conveyor is vertical, as shown in Fig. 6, additions to the coating 82 will be so cut into by the shearing or knife edges 129, 129 at the ends of the notches 80, as to continually prevent the coating from being built up to such an extent as to pack and cause chattering of the conveyor flight by binding of the latter with such packed coating. That is to say, altho the periphery of the conveyor flight is spaced from the inner wall of the casing by means of the spaced notches 80 with their end shearing or knife edges 129, 129, the depth of the coating is maintained shallow thereby preventing the same from interfering with the free rotation of the conveyor flight, while at the same time the circular rungs of material 83, 83, spaced apart vertically as shown in Fig. 6, co-operate with the staggered arrangement of the notches 80, 80 to prevent gravity down flow of the material past the periphery of the conveyor flight during operation of the latter to lift the material for discharge from the opening 14 shown in Fig. 1.

This arrangement affords such a lining or coating for the inner wall of the casing as to effectually enclose the conveyor flight to enable the latter to operate at maximum efficiency without vibration or chattering, and with minimum consumption of power.

It should also be noted by reference to Fig. 6, that the outer edges of the knife edges 129 are not shown parallel with the inner wall of the casing 13 but are tapered to a sharp cutting point to increase the digging or cutting action on the coating or lining of material, thereby reducing friction to a minimum by preventing the periphery of the flight between notches from wiping or binding against the coating 82.

In the operation of the device comprising my invention, the motor 77 will drive the shafts 63 and 44, the first being operative through the horizontal conveyor mechanism to convey material into the base 12 through the conduit 176 and the opening into the base 12. Shaft 44 will be effective through the above described gear train to drive the spiral flight 29 in the direction indicated by the arrow 81, which will elevate the material and discharge it automatically from the discharge opening 14 onto any desired mechanism, such as a chute leading to another spiral conveyor. The material being conveyed, particularly if zinc oxide, will form along the inner walls of the pipe 13, as indicated at 82, with spaced peripheral rings 83 at intervals, as determined by the positions of the notches 80. It has been found in practice that the notches 80 do not decrease the capacity of the elevator to any appreciable extent and they are very effective to eliminate entirely the vibration of the elevator, which otherwise takes place.

It may be mentioned that, according to applicant's information and knowledge, this device is the very first spiral conveyor capable of elevating zinc oxide vertically in a successful operation. It may also be mentioned that said device is very useful to elevate said material, or any comparable material, on an incline, or to convey it horizontally. In general, spiral conveyors tend to vibrate when conveying such material whether vertically, on an incline, or horizontally, the vibration being more pronounced in the first case and the least pronounced in the last case. With my invention, vibration thereof has been eliminated in all cases.

Considerable saving of power is effected by means of my improvements, particularly when zinc oxide is conveyed by means of a spiral flight conveyor, either vertically, horizontally or on an incline. Various materials in a powdered state, particularly zinc oxide, have a tendency to form such a compact lining or coating on the inner wall of the casing as to cause binding between the periphery of the conveyor flight and such packed lining. But by providing the periphery of the spiral conveyor flight with serrations, saw teeth, spaced cutting or shearing edges, or in some instances merely roughening the peripheral edge of the conveyor flight, I am enabled to break away the coating continually being deposited, to maintain the lining at a shallow depth and thereby free the conveyor flight for most efficient operation. In other words by means of my improvements vibration and undue friction are avoided while at the same time the lining of material which does remain as shown at 82 in Fig. 6 forms an effective enclosure to prevent leakage during conveying operations.

When the conveyor is of the inclined or horizontal type, the guide for the conveyed material may be a trough, either with an open top or with a cover. However, if desired, a cylindrical casing may be employed with the inclined and horizontal types of conveyors, as illustrated at 85 in Fig. 3.

In addition to the previously described elements of the device, it is to be noted that a pivoted access and relief door 86 is provided adjacent the discharge opening 14 and a pivoted access door 87 is provided to afford access to the interior of base 12.

Obviously those skilled in the art may make various changes in the details and arrangement of parts without departing from the spirit and scope of the invention as defined by the claim hereto appended, and I therefore wish not to be restricted to the precise construction herein disclosed.

Having thus described and shown an embodiment of my invention, what I desire to secure by Letters Patent of the United States is:

The method of conveying zinc oxide without vibration which comprises introducing the material into a trough having a spiral conveyor flight therein which makes a close fit with the trough walls and has a rough edge to cut into the zinc oxide which coats the trough walls, and rotating said spiral conveyor flight to convey said zinc oxide while said rough edge cuts into said coating.

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