May 29, 1962 W. R. KING ETAL 3,036,737

SURGE TANK FOR FEEDING FINELY DIVIDED FLOCCULENT SOLIDS

Filed Feb. 24, 1959 2 Sheets-Sheet 1

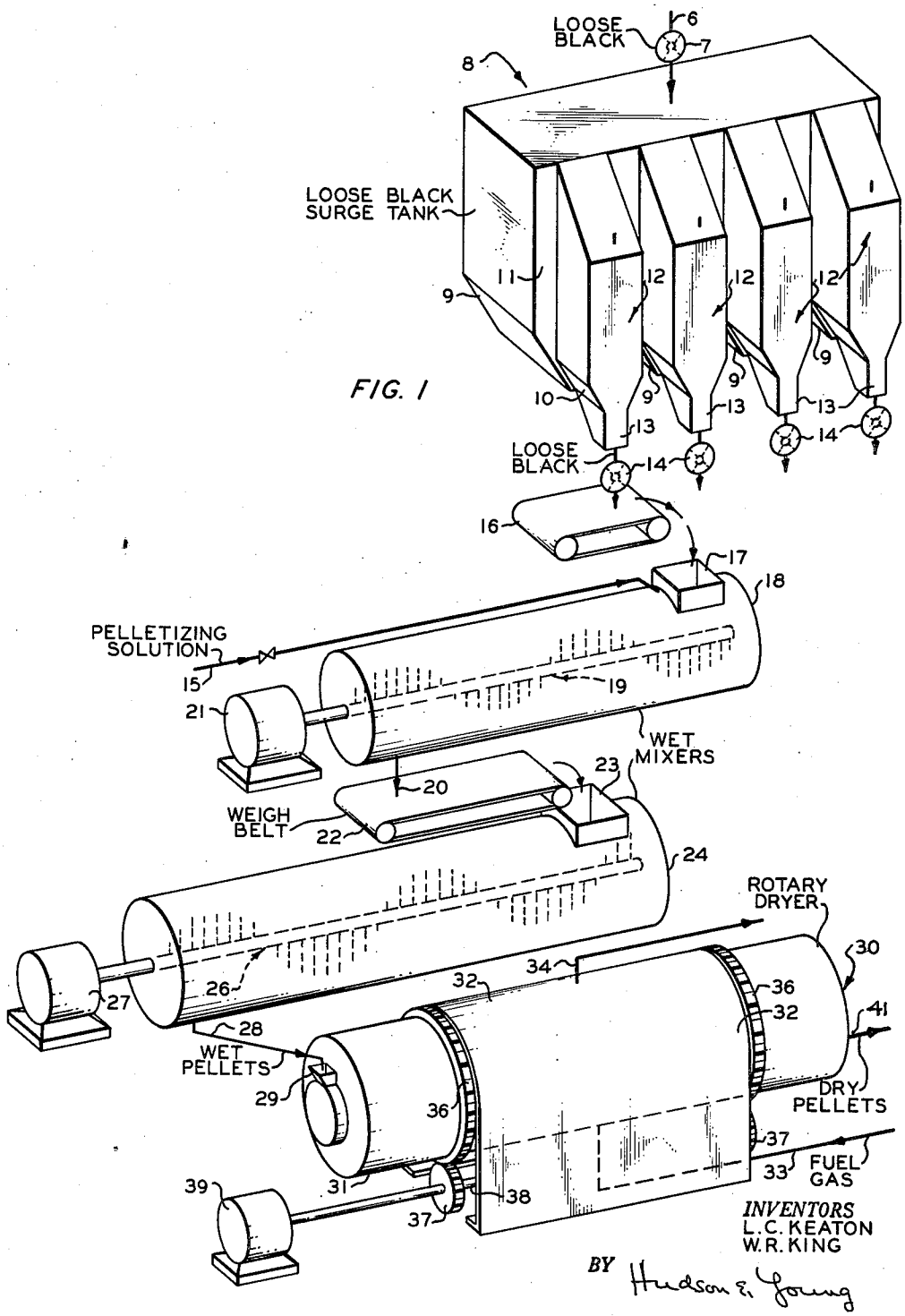


FIG. 1

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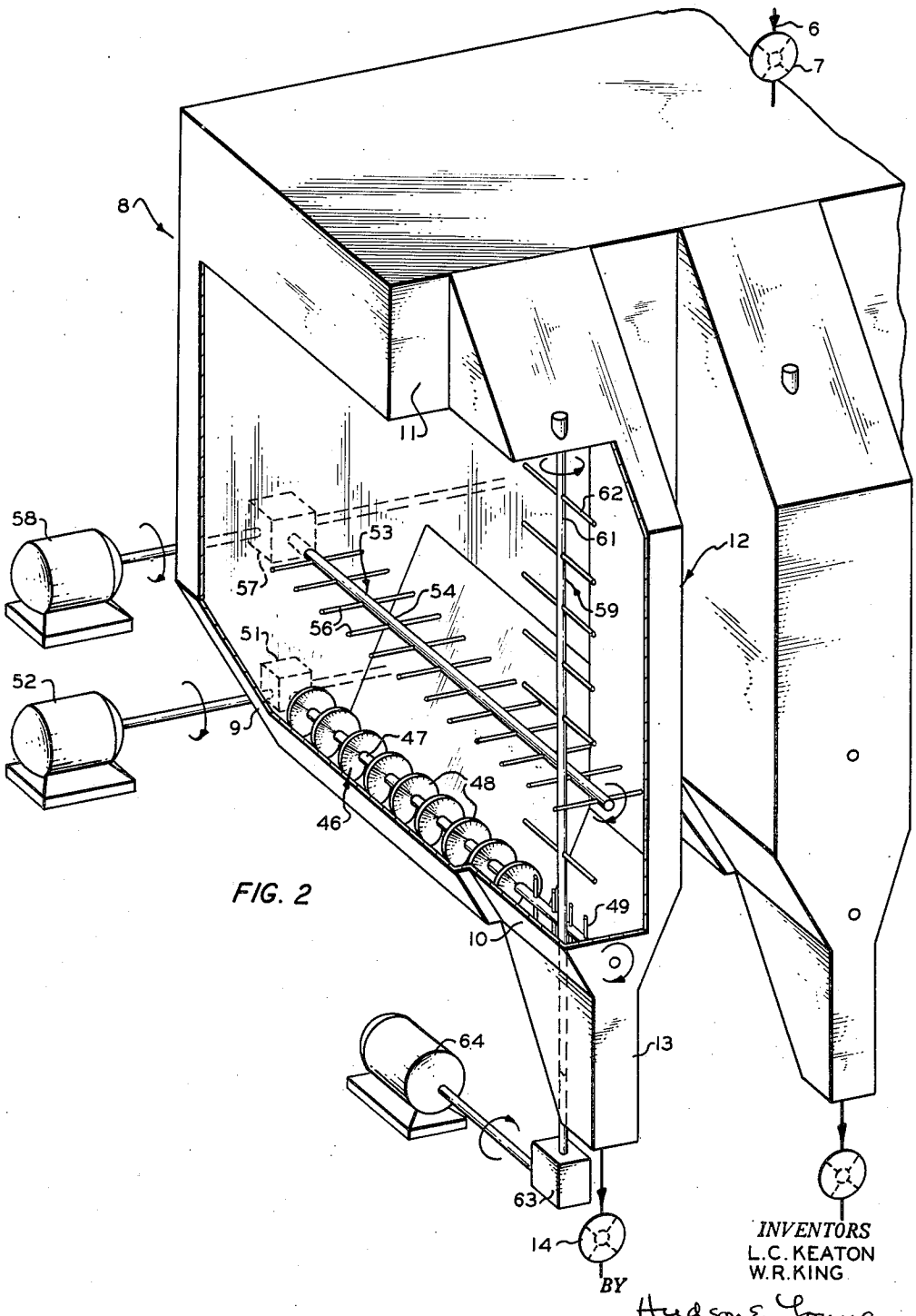


FIG. 2

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SURGE TANK FOR FEEDING FINELY DIVIDED FLOCCULENT SOLIDS

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This invention relates to a surge tank, or like receptacle, for feeding finely divided, flocculent solids therefrom. In another aspect, this invention relates to a surge tank employing augers, screws or the like, for feeding flocculent carbon black, or like finely divided powders, to pelleting equipment or the like. In another aspect, it relates to a method of feeding finely divided, flocculent solids, such as carbon black, at a constant weight per unit time from a surge tank or like receptacle.

Various manufactured materials, such as carbon black, as initially produced are extremely light, flocculent, finely divided and bulky. As such, these materials are often difficult to handle, feed, or transport. When such materials are fed from surge tanks, bins, storage tanks, hoppers, or like receptacles, these materials often tend to bridge, pack, or arch in the receptacles. Where the material gravitates through the receptacle and is fed from the bottom thereof through an outlet, the bridging, etc., of the material results in less than a constant weight or amount of material being fed from the receptacle per unit time. Where such materials are fed at a uncontrolled rate to pelleting equipment, the pelleted product often varies considerably in density and quality.

Accordingly, an object of this invention is to provide an improved surge tank, bin, hopper, or like receptacle having improved means for feeding finely divided, flocculent solids therefrom. Another object is to provide an improved surge tank or like receptacle employing augers, screws or the like, for feeding flocculent carbon black, or like finely divided powders, to pelleting equipment or the like. Another object is to provide an improved method of feeding finely divided, flocculent solids, such as carbon black, from a surge tank or like receptacle at a constant weight per unit time. Another object is to prevent the bridging, packing, or arching of flocculent material, such as carbon black, in a surge tank or like receptacle which are adapted to feed said material from the bottom of the receptacle. Another object is to feed carbon black, or like flocculent materials, from a surge tank, or like receptacle, through which said carbon black gravitates, at a constant weight per unit time. Other objects and advantages of this invention will become apparent from the following discussion, appended claims, and drawing in which:

FIGURE 1 is an isometric new illustrating the apparatus of this invention; and

FIGURE 2 is an enlarged isometric view of a portion of FIGURE 1 illustrating the details of the novel surge tank of this invention.

Although the subject invention is particularly concerned with the handling and conveying of flocculent carbon black, and for purposes of illustration is described as applied to this field of utility, it should be understood that this invention is not necessarily limited thereto; rather, the apparatus and method of this invention can be employed to handle any finely divided, solid or powder.

In the prior art of producing carbon black, in furnaces, a hot gaseous effluent containing gas, water vapor and suspended carbon black is produced and conveyed to a carbon black separation and collection system. The latter system normally comprises a series of separation means, such as an electrical precipitator, primary, secondary, and tertiary cyclone separators, and a bag filter. These items of equipment separate the suspended carbon

black from the hot gaseous effluent and it is this separated carbon black which is difficult to handle, feed or transport. Since this carbon black is an extremely fine dusty powder its apparent density is low, and it is very bulky in nature and occupies considerable shipping space. For these reasons, it is customary to reduce the bulk of the flocculent carbon black to an agglomerated form, such as pellets. The resulting pelleted product has a greater bulk density and is relatively easier to store, ship, and use in commerce.

Referring now to the drawing in which like reference numbers have been used to designate like parts, and initially to FIGURE 1, loose flocculent carbon black is fed into the upper end of surge tank 8 from a carbon black collection system, or other source, via inlet conduit 6, having a rotary valve therein, such as a star valve. The motor or other power source which rotates valve 7 can be operatively connected to level indicators, such as Roto-Bin-Dicators, mounted on surge tank 8, so as to insure a normal operating level of carbon black, e.g., 10,000 lbs., in the surge tank. Surge tank 8 generally has the form of an enclosed, rectangular-shaped receptacle with four side walls, and can be provided with suitable vent means at the top. The bottom of surge tank 8 is in the form of one or more contiguous, parallel troughs 9, the lower part of each trough preferably being rounded. The front side wall 11 of surge tank 8 is provided with one or more vertical compartments 12, in the form of forward protruding extensions of the surge tank, these compartments being in vertical alignment and normal with the center line of the adjacent troughs 9. The lower end of each compartment is also in the form of a trough 10 and may be considered as an extension of the trough 9 of the surge tank 8. Depending from the troughs 10 of each of the compartments 12 is a vertical chute outlet or feed duct 13, provided with a rotary valve 14, such as a star valve. Surge tank 8 is provided with one or more feeding devices, such as augers, screws or the like and one or more agitators, which will be described in detail hereinafter.

The carbon black fed through rotary valves 14 is conveyed to pelleting equipment or other equipment for further handling and processing. As shown in the drawing, the carbon black fed by one of the rotary valves 14 falls onto a conveying belt 16 or the like. If desired, the feed from two or more of the rotary valves 14 can be adapted to feed directly on belt 16, or other belts. The carbon black on belt 16 is conveyed to any suitable pelleting equipment known in the art, or to any other equipment, for further processing and handling.

As shown in the drawing, the carbon black on belt 16 is fed to the inlet hopper 17 of a first wet mixer or pelletizer 18 where the loose carbon black is initially mixed with pelletizing solution, such as an aqueous solution of crude blackstrap molasses which acts as a binder and hardening agent, supplied via line 15. Wet mixer 18 is provided with an axially aligned rotatable mixer flight 19, driven by motor 21; the mixer flight can comprise a rotatable shaft in which is inserted a plurality of pins arranged in a double helical pattern. The initially pelleted carbon black is fed from the other end of pelletizer 18 through an outlet or chute 20 and drops onto a weigh belt conveyor 22. Weigh belt 22 can be operatively connected to the motor or other power source which rotates star valve 14 so as to regulate the same and maintain a constant rate of flow of carbon black over belt 22. The wet pelleted carbon black on weigh belt 22 can be dropped onto a suitable agitating conveyor which polishes, shapes or densifies the pellets. Alternatively, as shown in the drawing, the initially pelleted carbon black on weigh belt 22 is fed to the inlet hopper 23 of a second wet mixer or polishing pelletizer 24 which, like wet mixer 18, is provided with a rotatable mixer flight 26 rotated by motor 27.

The wet pelleted output (approximately 50% moisture) from the wet mixer 24 drops out of the other end thereof via chute 28 into the feed hopper 29 of a conventional rotary dryer 31. Dryer 31 consists of a revolving cylinder 31, slightly inclined from the horizontal, which is housed in a furnace casing 32, the latter being provided with a plurality of burners arranged around the base thereof, the burners being supplied with fuel gas via line 33, the flue gases being discharged from the furnace casing via line 34. Rotation of the dryer cylinder 31 can be accomplished by any well known means; for example, the cylinder can be provided with two gears 36 driven by gears 37 which are affixed to a rotatable shaft 38 driven by motor 39. The resultant dry pelleted carbon black (approximately 1% moisture, or less) is discharged at the other end of the dryer 30 via discharge means 41, the dry pellets being then conveyed to suitable classifying and bagging equipment.

The improved surge tank of this invention will now be discussed in detail, reference now being made to FIGURE 2.

Disposed within the bottom portion of each trough 9 of surge tank 8 and extending the length thereof is auger means or screw-feeding means 46. The latter comprises a horizontal rotatable shaft 47 to which is affixed a plurality of circular flights 48 arranged in any suitable helical fashion. These flights 48 extend substantially along the entire length of trough 9. That portion of rotatable shaft 47 which extends into the trough 10 of the vertical compartment 12, above chute 13, is provided with a plurality of spaced, diametrically opposed, radial agitating rods or pins 49. Auger means 46 is rotated by a suitable gear mechanism 51 powered by motor 52 or the like.

Surge tank 8 can also be provided with agitator means 53 which can be vertically disposed above each auger means 46 at a point near the top of trough 9. Agitator means 53 comprises a horizontal rotatable shaft 54 which extends across the length of the surge tank 8 and is provided with a plurality of regularly spaced, diametrically opposed, radial rods or pins 56 or the like. The shaft 54 is similarly rotated by a gear mechanism 57 which can be powered by the motor 52, or, alternatively, as shown in the drawing, by another motor 58.

Surge tank 8 can also be provided with vertically aligned agitator means 59 disposed within each compartment 12. Agitator means 59 comprises a vertical rotatable shaft 61 provided with a plurality of regularly spaced, diametrically opposed, radial rods or pins 62, which extend the length of rod 61 down to a point just above the rods 49 of auger means 46. Shaft 61 depends through the rear, forwardly-tapered wall of feed chute 13 and this shaft is driven by suitable gear mechanism 63 which in turn is powered by motor 64 or the like.

In place of motors 52, 58, 64, and gear mechanisms 51, 57, 63, the various shafts can be rotated by any other suitable means, such as chain belts or the like. The various rotary valves 14 can also be rotated by any suitable means, such as motors, or by the same chain belts used to rotate the various shafts.

The rotary valves shown in the drawing can be any feeding device such as a star valve or other gas lock valve. The star valve is a well known feeding device similar to a revolving door having a paddle wheel with radial blades which allow the passage of solids by gravity as the paddle wheel rotates, while two or more of the radial blades obstruct or substantially prevent the unregulated passage of gas through the feeding device in either direction.

In operation, loose flocculent carbon black, having an apparent density of 1–3 lbs./cu. ft., is fed, e.g., at a rate of 1,000 to 10,000 lbs./hr., via inlet conduit 6 through star valve 7 into the upper end of the surge tank 8. The carbon black accumulates within the surge tank 8 and when a suitable operating level of carbon black is attained, the carbon black is fed from the surge tank 8 via chutes 13 and star valves 14. To accomplish this feeding of the carbon black from the surge tank 8, auger means 46 are rotated, the carbon black accumulating in the troughs 9 being fed therefrom toward chutes 13 at the bottoms of compartments 12. In order to prevent the carbon black within the surge tank 8 from bridging, packing or arching, particularly above star valves 14, either or both of agitators 53, 59, are rotated, the rotation of pins 56, 62, causing the carbon black within the surge tank to be continuously agitated. The agitation of the carbon black in the surge tank 8 is also aided by the rotating pins 49 on the end of the auger means 46. This agitation also causes the flocculent carbon black to compact, the density of the surge tank output being greater than that of the feed thereto. As a result of the constant rotation of auger means 46 and agitation means 53, 59, the compacted carbon black, having a density of 5–8 lbs./cu. ft., will be fed from the surge tank at a constant weight per unit period of time.

The compacted carbon black fed from the surge tank 8 through the star valves 14 is then conveyed to the pelleting equipment, or other equipment, for further processing and handling. Since the operation of this other equipment is well known, it will not be described in detail in the interest of brevity.

Various modifications and alterations of this invention will be apparent to those skilled in the art without departing from the scope and spirit of this invention; and it is to be understood that the foregoing discussion and accompanying drawing merely sets forth preferred and illustrative embodiments of this invention which should not be construed so as to unduly limit the same.

We claim:

1. An enclosed surge tank having a generally rectangular shape with a trough at the lower end, inlet means for feeding finely divided, fluocculent solid material into the upper end of said surge tank, rotatable feeding means disposed adjacent the bottom of said trough and extending substantially the length thereof, outlet means adjacent one extremity of said trough through which said material can be fed by said feeding means, said feeding means comprising a horizontal rotatable shaft having a helical screw attached thereto which extends the length of that portion of said shaft above said trough, said rotatable shaft having a plurality of spaced radially extending rods attached to that portion of said shaft adjacent said outlet means, said outlet means depending from the bottom of said trough, rotary valve means disposed within said outlet means, and rotatable agitator means which comprises two rotatable shaft means having a plurality of spaced, radially extending rods, one of which is horizontally disposed within said surge tank adjacent the top of said trough and in parallel alignment therewith, the other of said shaft means being vertically disposed within said surge tank in vertical alignment with said outlet means.

2. A receptacle having a trough at the lower end thereof, inlet means for feeding a finely divided, flocculent solid material into the upper end of said receptacle, rotatable feeding means disposed adjacent the bottom of said trough and extending substantially the length thereof, outlet means adjacent one extremity of said trough through which said material can be fed by said feeding means, said feeding means comprising a horizontal first rotatable shaft having a helical screw attached thereto which extends the length of that portion of said shaft above said trough, said first rotatable shaft having a plurality of spaced radially extending rods attached to that portion of said shaft adjacent said outlet means, said outlet means depending from the bottom of said trough so that flocculent material in the receptacle can flow through said outlet by means of gravity, rotary valve means disposed within said outlet means for feeding said material therefrom at a controlled weight per unit time, and rotatable agitator means disposed within said receptacle to compact said material and minimize bridging of the same within said receptacle,

said agitator means comprising a second rotatable shaft horizontally disposed within said receptacle adjacent the top of said trough and in parallel alignment therewith having a plurality of spaced radially extending rods, and further comprising a third rotatable shaft vertically disposed within said receptacle in vertical alignment with said outlet means having a plurality of spaced, radially extending rods.

3. An enclosed surge tank having a generally rectangular shape with a plurality of contiguous parallel troughs at the lower end of said surge tank, inlet means for feeding finely divided flocculent solid material into the upper end of said troughs, a rotary valve disposed within said inlet means, a plurality of rotatable feeding screws each disposed adjacent the bottom of one of said troughs and extending substantially the length thereof, each of said feeding screws comprising a horizontal first rotatable shaft having a helical screw attached thereto which extends the length of that portion of said shaft above one of said troughs, a plurality of outlet means each adjacent one extremity of one of said troughs through which said material can be fed by said feeding screw, said first shaft having a plurality of spaced radially extending rods attached to that portion of said shaft adjacent said outlet means, each of said outlet means depending from the bottom of one of said troughs, a plurality of rotary valve means each disposed in one of said outlet means, the speed of rotation of said plurality of rotary valve means being controlled by motor means which are operatively connected to a weigh belt conveyor to maintain a constant rate of flow of said solid material through said rotary valve means, and a plurality of rotatable agitator means disposed within said surge tank to compact said material and minimize bridging of the same within said surge tank, said agitator means comprising a first series of said agitator means and a second series of said agitator means, each of said agitator means of said first and second series comprising a rotatable shaft having a plurality of spaced, radially extending rods, each of said agitator means of said first series being horizontally disposed within said surge tank adjacent the top of one of said troughs and in parallel alignment therewith, and each of said agitator means of said second series being vertically disposed within said surge tank in vertical alignment with one of said outlet means.

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