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R. JACKSON

2,112,848

MIXING AND BLENDING

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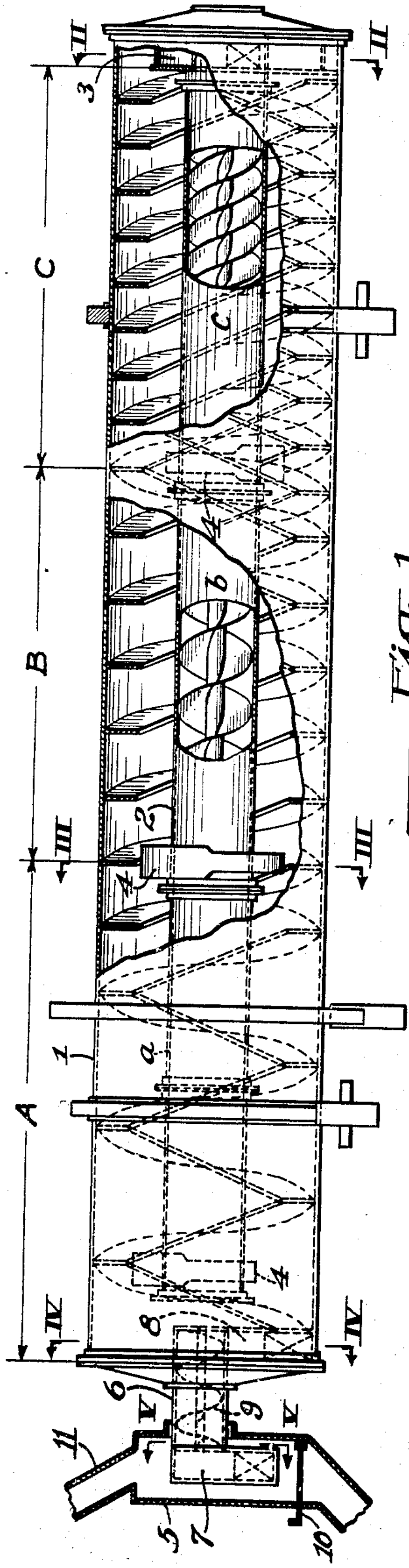

Fig. 1.

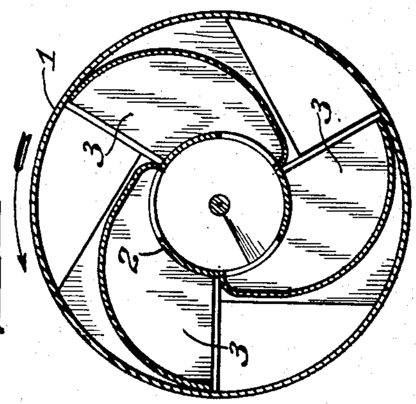

Fig. 2.

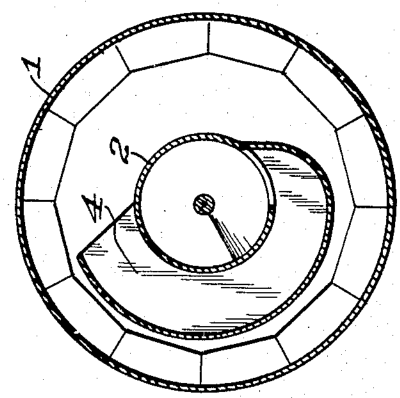

Fig. 3.

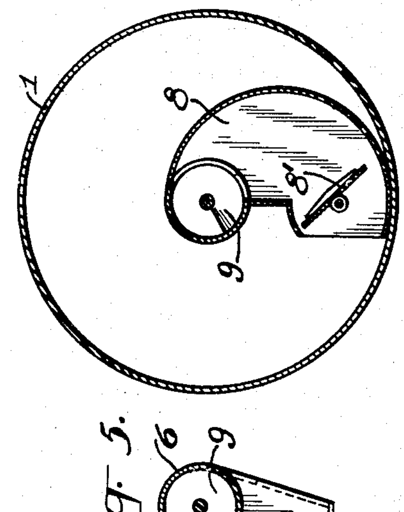

Fig. 4.

Fig. 5.

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MIXING AND BLENDING

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9 Claims. (Cl. 259—3)

This invention relates to the mixing and blending of granular or powdered materials, and specifically to the mixing and blending of such materials in large quantities such as, for example, carload lots of approximately 60,000 pounds.

Heretofore it has been difficult to blend or mix together several kinds of granular or powdered materials of different characteristics so intimately, so completely, and so uniformly that every sack of the mixture in a carload shipment would contain identical proportions of the several ingredients and be of identical quality. Modern specifications and mass production manufacture require a mixing apparatus capable of obtaining and maintaining uniformity throughout a large quantity of mixed materials.

The primary object of the invention is to provide an improved method and apparatus of the character stated which is capable of carrying out a mixing and blending operation with a minimum amount of physical labor.

A further object of the invention is to provide a mixer capable of conveying material in opposite directions at the same time and in which the material as it travels through the apparatus is automatically divided into several predetermined paths or streams of flow.

A further object of the invention is the provision of a process whereby granular or powdered materials are mixed or blended more completely in less time than heretofore known.

A further object of the invention is the provision of a method for mixing materials whereby several portions of the mass, into which it is divided, are conveyed in opposite directions, individual portions being reintroduced to the mass at spaced intervals along the path traversed by the original mass.

A still further object of the invention is to provide a rotary conveyor having associated therewith means to positively divide the traveling mass into several units and to direct each such unit along its path of travel.

In the accompanying drawing forming a part of this specification, Fig. 1 is a side elevation of the assembled apparatus with part of the shell broken away, showing a portion of the longitudinal conveying mechanism;

Fig. 2 is a section taken on line II—II of Fig. 1, showing the scoop feeders;

Fig. 3 is a section taken on line III—III of Fig. 1, which shows the dual feeding screws, together with one of the central tube discharge units;

Fig. 4 is a section taken on line IV—IV of Fig. 1, showing a scoop feeder provided with a gate for regulating discharge of the material;

Fig. 5 is a section taken on line V—V of Fig. 1, showing the discharger scoop.

The apparatus of this invention consists essentially of an external cylindrical drum, relatively long in proportion to its diameter, together with an inner cylindrical drum coaxial with the outer drum. The outer drum may be equipped with circular tires and supported on fixed rollers, or the tires and rollers may take the form of suitable gearing. The particular form of support and power mechanism is immaterial, so long as reversible rotation of the unit about its horizontal axis is possible. Both the outer drum and the inner cylinder are provided with helical blades, and for the sake of convenience, will be hereinafter referred to as helical "flights". The term "flight" will be regarded as defining the particular blading in a predetermined section of the apparatus as, for instance, single helical flight or double helical flight. The inner cylinder is provided with several discharger units for emptying the material from the inner cylinder into the outer drum. Suitable scoop feed and discharge units are provided at appropriate places in the apparatus for moving the material being mixed from one section of the machine to another, according to the direction of rotation of the drum. The outer drum receives and discharges material through a single feeding and discharging unit which is provided at either end with scoops.

The outer drum in its preferred form comprises an elongated casing 1 which for clarity and convenience may be regarded as being of three sections, A, B, and C. Each of these sections extends approximately for a distance of about one-third the length of the outer drum. Inside of and coaxial with the drum is unitarily mounted a cylindrical tube 2 of a length slightly less than that of the outer drum. Likewise, the inner cylindrical tube may be regarded as comprising three sections, *a*, *b*, and *c*. Rigidly secured to the inner surface of the outer drum are conveying means which, in the preferred form, are flights of helical blades. In section A there is provided a single helical flight; in section B, a double helical flight, and in section C, a triple helical flight. Within the inner cylindrical tube and rigidly secured thereto are similar flights of helical form: section *a*, having a single helical flight, section *b*, a double helical flight, and section *c*, a triple helical flight. It is to be noted that the "hand" of these flights is opposite to that of the "hand" of the flights of the outer drum, so that upon rotation of the drum, material will be conveyed along the length of the inner cylinder in a direction opposite to that in which it is traveling along the outer drum. Therefore, whether blending or discharging, material is being moved in both the outer drum and inner cylinder at the same time, but in opposite directions.

A charge or batch of material entering the inlet end of the mixer is conveyed along the outer drum from left to right (Fig. 1) by the helical flights secured to the inner surface of the outer drum. While passing through section A of the drum, the material may be regarded as being moved in a single "stream". Upon reaching section B, the double helical flights of blades in that section divide the single "stream" into two "streams" of material and likewise the double "stream" passing from section B to section C is divided into three "streams", due to the triple helical flights of the latter section. Hence, what was a single "stream" of advancing material in section A is now a triple "stream" in section C.

At the extreme right-hand end of the mixer and enclosed within the end of the drum are three scoop feeders 3. These scoops are of the same hand and are disposed in such a manner that each scoop picks up material which is being conveyed along the outer drum by the triple helical flights and deposits it into the inner cylindrical tube 2. Within section *c* of the inner cylindrical tube, the conveying means are triple helical flights of blading of a hand opposite to the hand of the flights of the outer drum. Material which has been picked up by the scoop feeders 3 is delivered to one in particular of the three spaces between the three distinct and separate sets of helical flights and is conveyed from right to left in three "streams" for a distance of approximately one-third the length of the inner cylindrical tube.

Mounted on the central tube between sections *a*, *b*, and *c* are discharging means 4 (see Figs. 1 and 3). These dischargers are so arranged that each one discharges material from only one of the spaces established by the helical flights within the inner cylindrical tube. The material is emptied into the outer drum, where it again resumes its travel toward the right-hand end of the drum. After one "stream" of material is emptied into the outer drum by the discharger between sections *b* and *c*, the remaining double "stream" continues on through section *b* until reaching the discharger between sections *a* and *b*. Here, another "stream" is deflected into the outer drum and the single remaining "stream" permitted to pass along section *a* where, upon reaching the last discharger, it likewise is emptied into the outer drum.

At the left-hand end of the machine there is located a feeding and discharging unit 5. A relatively small feed-and-discharge neck 6 is provided on the axis of the drum. At either end of this neck are scoop feeders 7 and 8, one being located outside the drum, the other within the head of the drum. A discharge regulating gate 8' is mounted on the scoop 8. These scoop feeders are of opposite hand, so that when rotation of the drum is such that the external feeder 7 is picking up material, the internal scoop feeder 8 will discharge material into the drum. The conveying element of the unit 9 is a single helical screw, and affords appropriate movement of the material from the external feeder into the internal feeder or vice versa, according to the direction of rotation of the drum. A gate 10 serves to permit discharge of the blended material at appropriate times.

In operation, the gate 10 is closed and the material to be mixed or blended fed into the supply hopper 11. The drum is rotated in a direction (counter-clockwise looking at Fig. 2) such that the material is picked up by the external scoop feeder and delivered to the inside of the drum. As the material travels through the drum, it is successively divided into separate streams and continues its travel until it contacts the three scoop feeders at the right-hand end of the machine. Here each stream is deflected into its own separate space which is established by the triple helical flights within section *c* of the inner cylindrical tube. The direction of travel of the material is now reversed, and as the material progresses from section to section through the inner cylindrical tube, the streams of material successively decrease in number. The discharger units mounted on the inner tube serve to each discharge one stream of material and return the same to the outside drum.

After the desired mixing and blending has taken place and the machine is to be discharged, the direction of rotation of the drum is reversed. Upon reversal, the material in the drum outside the central tube then is moved toward the left-hand or feed end of the machine, where the discharger inside the feed end will serve as a pick-up scoop. The helical flight in the feed-and-discharge unit, together with the external scoop, will now operate to convey material out of the drum into the hopper, where it is discharged for delivery.

The result of this action is a uniform and efficient blending. I have been able to blend, in the practical operation of a large machine, various sizes, kinds and quantities of material which may be charged to the drum in any desired sequence and in any desired proportions.

I claim:

1. In a mixing and blending machine, an outer revoluble drum, a unitarily mounted inner cylinder, helical conveyors disposed within said drum and cylinder for feeding material in opposite directions, means for feeding material from said outer drum into said inner cylinder and a plurality of discharging means spaced axially on said inner cylinder for discharging material from said inner cylinder to said outer drum.

2. In a mixing and blending machine, an outer revoluble drum, a unitarily mounted inner drum, helical feeding conveyors rigidly secured to the inner surfaces of said drums for progressively feeding material in opposite directions simultaneously, means for feeding material from said outer drum into said inner drum and a plurality of axially spaced discharging means on said inner drum for discharging material from said inner drum to said outer drum.

3. In a mixing and blending machine, unitarily mounted revoluble inner and outer drums, means rigidly secured to the interior of said drums for feeding material through said drums simultaneously in opposite directions, means for feeding material from said outer drum into said inner drum and a plurality of axially spaced discharging means mounted on said inner drum for discharging material from said inner to said outer drum whereby the travel of said discharged material is reversed.

4. In a mixing and blending machine, inner and outer co-axial revoluble drums, each having

helical conveyors rigidly mounted on their inner surfaces, the outer conveyor comprising flights which progressively increase in number at pre-determined points from the supply end toward the discharge end of the outer drum, the inner conveyor comprising flights which progressively decrease in number at pre-determined points from the supply end toward the discharge end of the inner drum, means for feeding material from said outer drum into said inner drum and means for discharging material from said inner drum to said outer drum.

5. In a mixing and blending machine, unitarily mounted revoluble inner and outer drums, conveying means rigidly secured to the inner surfaces of said drums for simultaneously feeding material through said drums in opposite directions, said conveying means comprising progressively increasing and decreasing sectional flights from the supply ends of said drums, respectively, and means axially mounted on said inner drum at the points of decrease of the flights for discharging material from said inner to said outer drum.

6. In a mixing and blending machine, unitarily mounted revoluble inner and outer drums, conveying means rigidly mounted on the interior surfaces of said drums to progressively move material in said drums in opposite directions at the same time, said conveying means comprising a plurality of sectional progressively increasing and decreasing flights of blading, means for feeding material from said outer drum into said inner drum and means axially mounted on said inner drum at the points of decrease of the flights for discharging material from said inner to said outer drum, thereby reversing the direction of movement of the discharged material.

7. The method of mixing and blending granular material which comprises conveying said material in one direction, dividing said material at certain points of its travel into an increasing number of portions, reversing the direction of travel of each said portion, successively decreasing the number of portions at predetermined points during the reversed movement, and causing each said reversed portion to be positively fed in the direction of its initial movement.

8. The method of mixing and blending granular material which comprises dividing said material into an increasing number of portions successively during the initial forward movement of said material, reversing the direction of flow of all of said portions, and decreasing the number of said reversed portions successively at pre-determined points of its travel by causing one of said reversed portions to unite with other material and be fed in the direction of said initial movement at each of said pre-determined points.

9. The method of mixing and blending granular material which comprises dividing an original stream of material into an increasing number of streams successively during the initial forward movement of said material, reversing the direction of flow of all of said streams, and decreasing the number of said reversed streams successively at pre-determined points of its travel by causing one of said reversed streams to unite with said original stream and be fed in the direction of said initial movement at each of said pre-determined points.

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