DEVICE FOR WORKING MATERIAL IN AT LEAST TWO CONICAL VESSELS

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The present invention relates to mixing devices for mixing powdery, granular or plastic materials in at least two vessels having downwardly tapering conical side walls and each provided with at least one stirring member rotating about its own longitudinal axis extending parallel to the generatrix of the side wall while moving bodily about the central axis of the conical vessel.

Devices of this kind are already known. In known devices the stirring materials having the desired composition are alternately put in various vessels.

It is an object of the present invention to provide a device by which a great quantity of material having the desired composition can be worked or mixed at the same time in at least two vessels without the danger that the masses being worked in the various vessels will have different proportions or be otherwise non-uniform.

Such a device is important, because the manufacture and the employment of a single conical vessel which is provided with a stirring member and which can contain a very great quantity of material will cause difficulties. According to the present invention the material in the plurality of vessels is simultaneously worked by the stirring members and, during the treatment, material is gradually transferred from each of the vessels to at least one of the other vessels and is gradually returned again to the first vessel where the material originated. According to an aspect of the invention, a stirring member of at least one of the vessels extends, during each revolution thereof about the central axis of the related vessel, temporarily into the path of travel followed by a stirring member of another vessel.

Further objects, features and advantages of the invention will be hereinafter more fully described with reference to the accompanying drawings in which some preferred embodiments of devices according to the invention have been illustrated by way of example and in which:

Fig. 1 is a side elevation view of a device having two interconnected vessels, a part of the common vessel wall being omitted for showing the stirring members.

Fig. 2 is a partial top plan view of the device of Fig. 1.

Fig. 3 is a diagrammatic top plan view of a device having three cooperating vessels, and

Fig. 4 is a diagrammatic top plan view of a device having four cooperating vessels.

The device according to Figs. 1 and 2 is composed of two vessels 1 and 2 having frusto-conical side walls 3 and 4, with the central axes 5 and 6 of the side walls 3 and 4 being parallel, preferably vertical, and spaced apart by a distance intermediate the diameters of the side walls 3 and 4 at the top and bottom, respectively, thereof, so that the side walls 3 and 4 intersect along a hyperbolic line 7 defining a common opening between vessels 1 and 2. The common space of both vessels 1 and 2 is closed at the top by a plate 8 having a charging hole 9 therein which can be closed. Bearings 10 and 11 for vertical axes 12 and 13 are mounted on the plate 8. The axes 12 and 13 carry radial arms 14 and 15 inside the vessels 1 and 2. The axes 12 and 13 are driven by means of a horizontal shaft 16, through worms and worm gears fixed on shaft 16 and on shafts 12 and 13, respectively, and incorporated in housings 17 and 18. The shaft 16 is driven by a belt 20 passed round a pulley 19 on shaft 16. The transmissions from the shaft 16 to the axes 12 and 13 have the same gear ratio, so that the arms 14 and 15 will rotate synchronously. The arms 14 and 15 are arranged in such a way that they do not come into contact with each other during their rotation, for example, by having the arms extend radially in the same directions.

The lower ends of the vessels 1 and 2 are provided with bearings for short vertical axes 21 and 22 which, at their lower ends, carry bevel gears 23 and 24. Bevel gears 25 and 26 are mounted on a common shaft 27 and mesh with the gears 23 and 24. The shaft 27 carries a pulley 28 which can be driven by an external source of energy, e.g., an electric motor. Further the shaft 27 carries a pulley 29 constituting the driving pulley for the belt 20.

The upper ends of the axes 21 and 22 carry spherical articulated couplings or universal joints 30 and 31, by which the axes 21 and 22 drive inclined axes 32 and 33 having their upper ends rotatably supported in the arms 14 and 15.

The longitudinal axes of the axes 32 and 33 intersect the central axes 5 and 6 of the vessels 1 and 2 and always remain at the same angle with respect to the axes 5 and 6 while turning bodily about the latter as a result of the rotation of the arms 14 and 15 about the axes 5 and 6 which are coaxial with the axes 12 and 13. The longitudinal axes of axes 32 and 33 are parallel to the generatrices of the side walls 3 and 4. A suitable speed of rotation for the arms 14 and 15 is a speed of several revolutions per minute. The speed of rotation of the axes 32 and 33 about their own longitudinal axes can be much greater, for example, a rotational speed of several revolutions per minute. The lower end of each of the vessels 1 and 2 is provided with one or more sliding valves 34 and 35 for draining the mass from the vessels. The axes 31 and 32 are provided with stirring members 36 and 37 which, in the illustrated embodiment, are in the form of helical screw blades.

The device described operates as follows: The cereals or meal constituting the materials to be mixed are dumped through the opening 9 into the vessels 1 and 2. When the axes 32 and 33 are made to rotate about their own longitudinal axes through shaft 27 and bevel gears 23, 24, 25 and 26, they raise the material locally, and the axes 32 and 33 are made to turn at the same time slowly about the central axes 5 and 6. As a consequence of such rotational movements, both the material in the vessel 1 and the material in the vessel 2 is mixed quickly, and, moreover, the material in the vessel 1 is quickly mixed with the material in the vessel 2. This intermixing is caused by the fact that the axle 32, when directed towards the vessel 2, projects through the common opening therebetween and transmits the material from the vessel 1 into the vessel 2, while the axle 33, when in the position shown in Fig. 1, similarly transmits material from the vessel 2 into the vessel 1. Each of the transmitted quantities received by a vessel from another vessel is very quickly mixed with the material already present in the receiving vessel. Thus, after a relatively short time both vessels are filled with a mass having the same homogeneous compositions, even if, during filling, one of the components is deposited for the most part.
in the vessel 1 and another component is deposited, for the most part, in the vessel 2. As having the same shape as that described above or with only small modifications can be used for other products, for example, for dairy-produce, pharmaceutical and chemical products, and the like. The angular velocities with which the stirring members rotate about the central axes 5 and 6 of the vessels, are chosen preferably in such a way that they have a simple proportion, such as, for example, 1 : 1, 1 : 2, or 2 : 3, or the like, so that interference between the stirring members can be avoided by correct initial relative positioning thereof. It will be apparent that instead of only two intersecting vessels, as in Figs 1 and 2, three or four vessels can be combined, for example, as diagrammatically shown in Figs 3 and 4. In Figs 3, thc conical vessels 40, 41 and 42 are arranged with their central axes extending parallel and spaced apart equally by distances intermediate the diameters of the vessels at the top and bottom, respectively, thereof so that the conical wall of each vessel intersects the conical walls of the other two vessels along lines which are sections of hyperbolas lying in intersecting planes enclosing an angle of 120 degrees and defining common openings between the adjacent vessels. At the top of said vessels rotating axes 43, 44 and 45 are mounted for effecting the movement of rotating axles provided with stirring members along the walls of the vessels so that the stirring members project successively through the common openings between the adjacent vessels. If the direction of rotation in each vessel is represented by the arrow 46, the movement of the material between the vessels can be represented substantially by the arrows 47, 48 and 49, for during each revolution of the arm 43 the vessel 40 supplies a considerable quantity of material to the vessel 41, and, similarly, material is transferred from vessel 41 to vessel 42 and from vessel 42 to vessel 40. Fig. 4 shows an arrangement of four vessels 50, 51, 52 and 53, with the central axes of the vessels, as seen from above, forming the corners of a square having sides of a length intermediate the diameters of the vessels at the top and bottom thereof so that the conical side wall of each vessel, for example, the vessel 50, intersects the side walls of two other vessels, for example, the vessels 51 and 52, along lines which are sections of hyperbolas and which are perpendicular to the generatrices of the said conical side wall of the related vessel, each stirring member projecting above the level of the bottom of said intersecting lines defining the common openings between adjacent vessels, and means mounting each stirring member in the related vessel for rotation about said longitudinal axis of the related vessel so that, as each stirring member passes said common opening into the adjacent vessel for ensuring intermixing of materials in said adjacent vessels. 3. In a mixing device for mixing powdery, granular or plastic materials; the combination as in claim 1, wherein said adjacent vessels are arranged with their central axes spaced apart by a distance which is intermediate the diameters of said conical side walls at the top and bottom thereof so that said common opening establishes communication between the upper portions of said adjacent vessels; and wherein each of said stirring members is a conveyor screw which is rotated about said longitudinal axis thereof in the direction for moving the materials upward along the conical side wall of the related vessel. 4. In a mixing device for mixing powdery, granular or plastic materials; the combination as in claim 1, wherein only two of said vessels are included in the mixing device and are arranged with their central axes lying in the same vertical plane. 5. In a mixing device for mixing powdery, granular or plastic materials; the combination of three identical vessels having conical side walls decreasing in diameter from the top to the bottom thereof, said vessels being mounted side-by-side with the central axis thereof and defining the common openings between adjacent vessels, at least one stirring member in each vessel having a longitudinal axis extending parallel to the generatrix of said conical side wall of the related vessel, each stirring member projecting above the level of the bottom of said intersecting lines defining the common openings between adjacent vessels, and means mounting each stirring member in the related vessel for rotation about said longitudinal axis of the related vessel so that, as each stirring member passes said common openings, the stirring member will project from the related vessel through said openings successively into the other vessels for ensuring intermixing of materials in said three vessels. 6. In a mixing device for mixing powdery, granular or plastic materials; the combination of four identical vessels having conical side walls decreasing in diameter from the top to the bottom thereof, said vessels being mounted side-by-side with the central axes thereof in parallel relation and defining the common openings between adjacent vessels, at least one stirring member in each vessel having a longitudinal axis extending parallel to the generatrix of said conical side wall of the related vessel, each stirring member projecting above the level of said intersecting line defining the common opening between the adjacent vessels, and means mounting each stirring member in the related vessel for rotation about said longitudinal axis of the stirring member and
for bodily movement about said central axis of the related vessel so that, as each stirring member passes said common openings, the stirring member will project from the vessel in which it is mounted through said openings successively into the two adjacent vessels for ensuring intermixing of materials in said four vessels.

References Cited in the file of this patent

UNITED STATES PATENTS

1,447,252  Kitchen --------------- Mar. 6, 1923

1,922,784  Sheriff et al. ------------ Aug. 15, 1933

2,345,063  Nauta --------------- Mar. 28, 1944

5 1,078,888

FOREIGN PATENTS

France --------------- Nov. 24, 1954