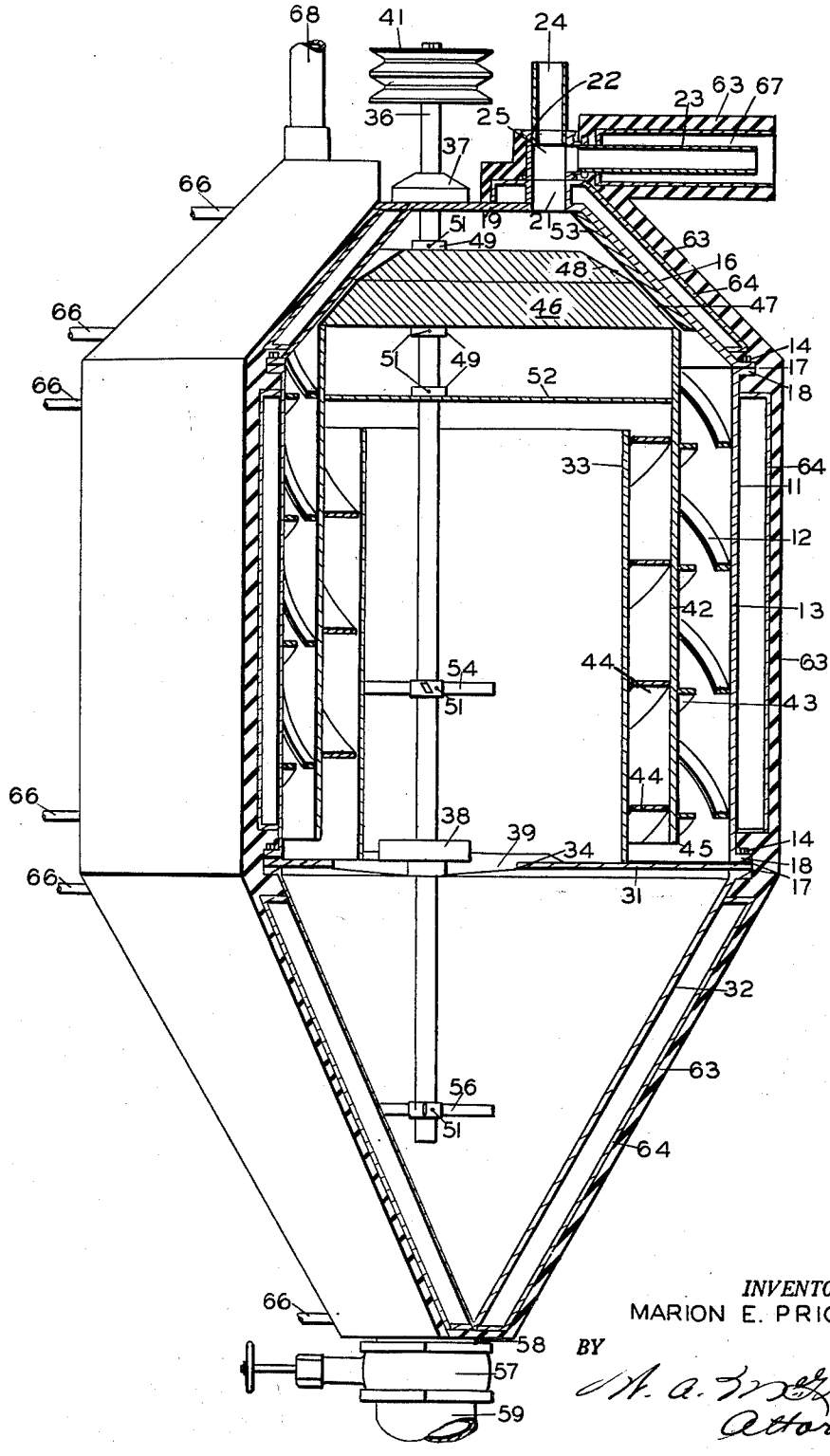
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MIXING APPARATUS

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MIXING APPARATUS

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This invention relates to a mixing apparatus adapted to mix solids materials and liquid in either continuous or batch operations to form a compound of colloidal consistency. More particularly this invention pertains to a mixing apparatus for mixing compounds in a continuous operation.

This invention is particularly useful in mixing pipe protecting compounds such as those described in British Patent No. 481,606 of March 15, 1938, and in the co-pending application of Marshall Crouch, Serial No. 52438, filed October 2, 1948, and owned by the assignee of this application.

It is an object of this invention to provide a solids material and liquid mixing apparatus that is adapted to continuous operation that may be used for batch operation.

It is a further object of this invention to provide an apparatus that will thoroughly mix separate solids materials with liquids to form a compound of colloidal consistency in a continuous cycle operation.

Another object of this invention is to provide a mixing apparatus that will thoroughly mix separate solids and liquid constituents in a continuous operation and that will provide storage capacity for the mixed materials.

A still further object of this invention is to provide an apparatus to mix a metal protecting coating compound.

Other objects reside in the novel details of construction as described and shown in the following description and drawings.

Briefly stated, the present invention provides a generally cylindrical container having a helix formed on its inner walls. A cylindrical drum member is rotatably mounted within said container and has helices on its inner and outer faces. Within the rotatable drum member, a cylindrical tank is provided. The rotatable drum has a shearing cone forming a top closure member arranged in such manner that when powdered solids materials are introduced into the cylindrical container they pass between the shearing cone and a cooperating shearing plate arranged on a face of the container and are intermixed in a rubbing action. On passing the shearing cone, the solids materials and the liquids likewise introduced into the container fall down over the helices formed on the inner wall of the container and on the outer wall of the rotating drum to become thoroughly intermixed before falling on to the bottom of the container. At the bottom of the container the material passes

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through an opening connecting with the inside of the drum member and the helix on the inside of the drum member picks up the material and elevates it to the top of the tank where it is received in the tank for further agitation and storage. A rotatable shaft passing through the tank that is supported on the container and attached to the rotatable drum is provided with a suitable propeller or paddles to accomplish a further agitation within the tank.

This mixing apparatus is so arranged that the materials are thoroughly intermixed when received in the inner tank and may be removed from the tank for immediate use or may be retained in the tank for storage. Thus an apparatus is provided that may be used for either continuous or batch operations.

Details of construction of the present invention will be best understood by reference to the accompanying description and drawing in which like parts have been designated similarly and in which:

Fig. 1 is an elevation in partial section showing the elements of this invention.

Referring to Fig. 1, a cylindrical container 11 having a helix 12 formed on its inner face 13 is connected by bolts 14, cap screws or the like, to a frustro-conical entrance section 16. Cylindrical container 11 and entrance section 16 have a gasket material 17 placed between the flanges 18 formed on the cylindrical container 11 and entrance section 16. A top member 19 of entrance section 16 is provided with an opening 21 for the introduction of solids and liquid materials. Arranged on opening 21 are pipe fittings 22 or other suitable members adapted to receive feed pipes 23 and 24. Feed pipe 24 provides a passage 25 through which solids materials may be introduced by gravity feed and feed pipe 23 provides a passage 27 through which liquid material may be introduced.

Container 11 is connected with a bottom closure annulus ring 31 and a second frustro-conical delivery section 32 by bolts 14 passing through flanges 18 and is spaced apart from said annulus ring 31 and delivery section 32 by gasket material 17. An inner cylindrical tank 33 is provided within container 11 and is supported within the container and spaced from the walls thereof by annulus ring 31. Communication between inner tank 33 and delivery section 32 is provided by opening 34 in annulus ring 31.

A shaft member 36 rotatably supported on top member 19 by an adjustable thrust bearing 37 extends into container 11 and passes through

inner tank 33 and into delivery section 32. Shaft member 36 is further supported by a bearing 38 in web member 39 arranged in opening 34 of annulus ring 31. Outside of container 11 shaft member 36 is provided with a pulley 41 that may be connected by belts, chains, or the like to an electric motor (not shown) or other motive power unit.

A rotatable drum 42, open at one end and having a mixing helix 43 on its outer face and an elevating helix 44 on its inner face, is mounted within container 11 and supported therein by shaft member 36. At its closed end rotatable drum 42 provides a shearing cone 46 composed of conical sections 47 and 48. Conical section 47 has a slope corresponding to the slope of entrance section 16 and conical section 48 is of lesser slope. A frustro-conical shearing plate 53 corresponding in shape to entrance section 16 is affixed to the inner surface of entrance section 16 and is in cooperative and spaced arrangement with conical section 47 of shearing cone 46, when drum 42 is positioned within container 11 and bearing 37 is adjusted. Shearing cone 46 which may be of either solid or fabricated construction is attached to shaft member 36 by collars 49 and set screws 51 engaged therein. Rotatable drum 42 is likewise supported on shaft member 36 by a collar 49 and set screws 51 attached to a cylindrical stiffener web 52 welded within rotatable drum 42.

A propeller type agitator 54 is arranged for rotation within cylindrical tank 33 by attachment to rotatable shaft member 36 by means of set screws 51. A paddle type agitator 56 is arranged for rotation within delivery section 32 by attachment to shaft 36 with set screws 51.

A gate valve 57 is attached to delivery section 32 in such manner that delivery opening 58 is in communication with gate valve 57. A pipe outlet 59 is threadedly engaged to gate valve 57 to deliver mixed compound to a suitable position of use or further storage.

In operation, solids materials in predetermined amounts are conveyed to opening 21 in entrance section 16 by gravity flow and liquids or other fluids are introduced into the entrance section 16 by feed pipe 23. The solids and liquid materials pass by centrifugal force and gravity feed over conical section 48 and between conical sections 47 and shearing plate 53. As they pass between conical section 47 and shearing plate 53 the solids materials will be sheared past each other to effect a particle size reduction and a preliminary mixing of the material. After passing the shearing cone, the solids and liquid materials fall downwardly upon the oppositely wound helices which tend to deliver the material back up to the top of the rotatable drum; however, the clearance between the helices is of such dimension that part of the materials will fall off the helices and pass downwardly between them to further mix the solids and liquid materials.

The container is of such height that as the material passes from the top to the bottom undergoing constant mixing and unfolding movement, it will be thoroughly mixed by the time it reaches the bottom formed by the annulus ring 31. As the material piles up on annulus ring 31 it will pass under the open end 45 of rotatable drum 42 and be engaged by the elevating helix 44. The direction of rotation for the drum 42 and the small clearance between helix 44 and cylindrical tank 33 then causes the mixed compound to be carried up the helix 44 to a position of discharge at the top of cylindrical tank 33.

The elevated materials when discharged into cylindrical tank 33 are thoroughly mixed to form a composition of colloidal consistency that is ready for use. Gate valve 57 may be opened to continuously pass the materials through pipe outlet 59 to a position of use or, if it is desired to store a given quantity, gate valve 57 may be closed or partially closed to collect the compound in delivery section 32 and in tank 33. As the quantity of material in these storage sections increases the paddle agitator 56 and the propeller agitator 54 will constantly stir the compound to further mix the product and prevent separation of the constituents. Thus it will be seen that this apparatus is adaptable to either continuous or batch mixing operations that may be controlled with respect to the amount of compound desired.

When this apparatus is to be used for the mixing of the compound specified in the aforementioned co-pending application of Marshall Crouch, it will be desirable to have some of the various sections of this mixing apparatus externally heated or cooled. For this purpose, a jacket of insulation material 63 is provided to completely surround and enclose the various sections of the apparatus and the feed pipe 23. Liquid tight jackets 64 are enclosed within insulation materials 63 and adjacent to the exposed surfaces of the mixing apparatus. When it is desired to heat the apparatus in any given section, steam or hot water or the like is introduced through pipes 66 which are in communication with the jackets 64. Likewise steam or hot water or the like may be introduced into the jacket 67 surrounding feed pipe 23. For the mixing of some compounds it may be desirable to heat the apparatus in one or more sections while cooling it in others. It is contemplated that pipes 66 will be so connected externally that they may be used to deliver either steam or a suitable coolant to the jacket 64 as desired. Likewise in the mixing of some compounds under heated or even normal operation it may be desirable to vent the interior of the mixing apparatus. For the purpose of venting the apparatus a vent pipe 68 is provided to connect the interior of entrance section 16 with the atmosphere.

Though the apparatus shown and described has been found particularly useful in the mixing of the compounds specified in the co-pending application of Marshall Crouch, it is also adaptable for the mixing of numerous other compounds. For these reasons this invention is neither limited to the mixing of the compound described nor to the form presented, but is adaptable to many compounds and to various modifications of the present form. The essential limitations are set forth in the hereunto appended claims.

What is claimed is:

1. Materials mixing apparatus comprising an enclosure, a plurality of cylindrical members within said enclosure at least partially dividing the area therein into vertically disposed passages, helix members on at least one of said cylindrical members disposed outwardly from the surface of a supporting cylindrical member toward the surface of an adjacent cylindrical member, means for introducing materials that are to be mixed into said enclosure to course through said passages in predetermined directions, the helices in downwardly directed passages being of a width

to provide adequate clearance for intermixing gravitational movement of the introduced materials downwardly past the free edge of said helices, and means for causing relative motion between at least two of said cylindrical members to increase the intermixing action in the downwardly directed passages.

2. Materials mixing apparatus comprising an enclosure, a plurality of cylindrical members within said enclosure at least partially dividing the area therein into vertically disposed passages, helix members on at least one of said cylindrical members disposed outwardly from the surface of a supporting cylindrical member toward the surface of an adjacent cylindrical member, means for introducing materials that are to be mixed into said enclosure to course through said passages in predetermined directions, the helices in downwardly directed passages being of a width to provide adequate clearance for intermixing gravitational movement of the introduced materials downwardly past the free edge of said helices and the helices in upwardly directed passages being of a width substantially corresponding to the width of said upwardly directed passages, and means for causing relative motion between at least two of said cylindrical members to increase the intermixing action in the downwardly directed passages and for elevating the materials along the helices in the upwardly directed passages.

3. Materials mixing apparatus comprising an enclosure, a plurality of cylindrical members within said enclosure at least partially dividing the area therein into vertically disposed passages, helix members on at least one of said cylindrical members disposed outwardly from the surface of a supporting cylindrical member toward the surface of an adjacent cylindrical member, means for introducing materials that are to be mixed into said enclosure to course through said passages in predetermined directions, the helices in downwardly directed passages being of a width to provide adequate clearance for intermixing gravitational movement of the introduced materials downwardly past the free edge of said helices and the helices in upwardly directed passages being of a width substantially corresponding to the width of said upwardly directed passages, a materials receiving tank within said enclosure and cylindrical members, and means for causing relative motion between at least two of said cylindrical members to increase the intermixing action in the downwardly directed passages and for elevating the materials along the helices in the upwardly directed passages toward the materials receiving tank.

4. Materials mixing apparatus comprising an enclosure, a plurality of cylindrical members within said enclosure at least partially dividing the area within said enclosure into vertically disposed upwardly and downwardly directed passages, separate oppositely wound helix members on the inner and outer cylindrical surfaces defining said downwardly directed passages, means for introducing materials that are to be mixed into said enclosure to course through said passages in their predetermined directions, the oppositely wound helices in the downwardly directed passages being conjointly of a width providing adequate clearance through said passage for intermixing gravitational movement of the introduced materials past the free edges of said helices, and means for causing relative motion between the said cylindrical members defining said downwardly directed passages to increase the intermixing action in said passages.

5. Materials mixing apparatus comprising an enclosure having an inwardly disposed shearing surface, a plurality of cylindrical members within said enclosure at least partially dividing the area therein into vertically disposed downwardly and upwardly directed passages, helix members on more than one of said cylindrical members disposed outwardly from the surface of the supporting cylindrical member toward the surface of an adjacent cylindrical member, a shearing surface on one of said cylinders for cooperative engagement with the shearing surface on said enclosure, means for introducing materials that are to be mixed into said enclosure past the said shearing surfaces and through the said upwardly and downwardly directed passages to a point of discharge, the helices in the downwardly directed passages being of a width to provide adequate clearance for intermixing gravitational movement of the introduced materials downwardly past the free edge of said helices and the helices in the upwardly directed passages being of a width substantially corresponding to the width of said upwardly directed passages, and means for causing relative motion between said cylindrical members to effect a particle size reduction at said shearing surfaces, to increase the intermixing action in the downwardly directed passages and for elevating the materials along the helices in the upwardly directed passages.

6. A material mixing apparatus comprising a container having a conical entrance section forming a shearing cone, a helix on the inner surface of said container, a rotatably mounted cylindrical drum within said container having a shearing surface thereon for cooperative arrangement with said shearing cone, a helix formed on the outer surface of said cylindrical drum disposed in the same passage as the helix on said container and wound oppositely of the helix formed on said container, a helix formed on the inner surface of said cylindrical drum, and a tank arranged within said cylindrical drum in near contact with the free edge of the helix on the inner surface of said cylindrical drum, said shearing cone and cylindrical drum being arranged to effect a particle size reduction of the materials introduced into said container and said helices being arranged for mixing the materials as they pass downwardly between the container and the drum and for elevating materials from the bottom of the container to the top of the tank within the cylindrical drum when the drum is rotated.

7. A material mixing apparatus comprising a container having a conical entrance section forming a shearing cone, a shaft rotatably mounted on said container and extending therethrough, a helix on the inner surface of said container, a cylindrical drum mounted on said shaft for rotation within said container having a shearing surface thereon for cooperative engagement with said shearing cone, a helix formed on the outer surface of said cylindrical drum disposed in the same passage as the helix on said container and wound oppositely of the helix formed on said container, a helix formed on the inner surface of said cylindrical drum, and a tank arranged within said cylindrical drum in near contact with the free edge of the helix on the inner surface of said cylindrical drum, and paddles mounted on said shaft and in said tank for agitating the materials received therein, said

shearing cone and cylindrical drum being arranged to effect a particle size reduction of the materials introduced into said container and said helices being arranged for mixing the materials as they pass downwardly between the container and the drum and for elevating materials from the bottom of the container to the top of the tank within the cylindrical drum when the drum is rotated.

8. A material mixing apparatus comprising an enclosed housing having entrance, mixing and delivery sections, said entrance and delivery sections being of substantially frustro-conical shape, a shearing surface interiorly of said entrance section, a helically formed shelf on the inner face of said mixing section, a shaft rotatably mounted on said housing and extending therethrough, a cylindrical drum open at its bottom end having helically formed shelves on its inner and outer surfaces mounted on said shaft for rotation within said housing, a tank within said cylindrical drum for receiving mixed materials, an opening in the bottom of said tank in communication with said delivery section, paddles mounted on said shaft for agitating the mixed materials in said tank and delivery section, a gate valve for controlling the flow of materials from said delivery section, liquid and pressure tight jackets surrounding the exterior surfaces of said entrance, mixing and delivery sections, insulation covering said jackets, and pipe means for selectively introducing temperature controlling media into said jackets, a frustro-conically

shaped shearing plate on the closed end of said drum for cooperative engagement with the shearing surface of said entrance section, and means for rotating said shaft and drum to effect a particle size reduction of the materials introduced in the entrance section, an intermixing of the materials by said helices in the passages between said housing drum and tank, and a stirring of the mixed materials in the tank and on the delivery sections.

MARION E. PRICE.

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