April 8, 1952 C. B. CLOTWORTHY, JR 2,592,245

METHOD AND APPARATUS FOR MIXING MATERIALS

Filed April 23, 1949 4 Sheets-Sheet 1

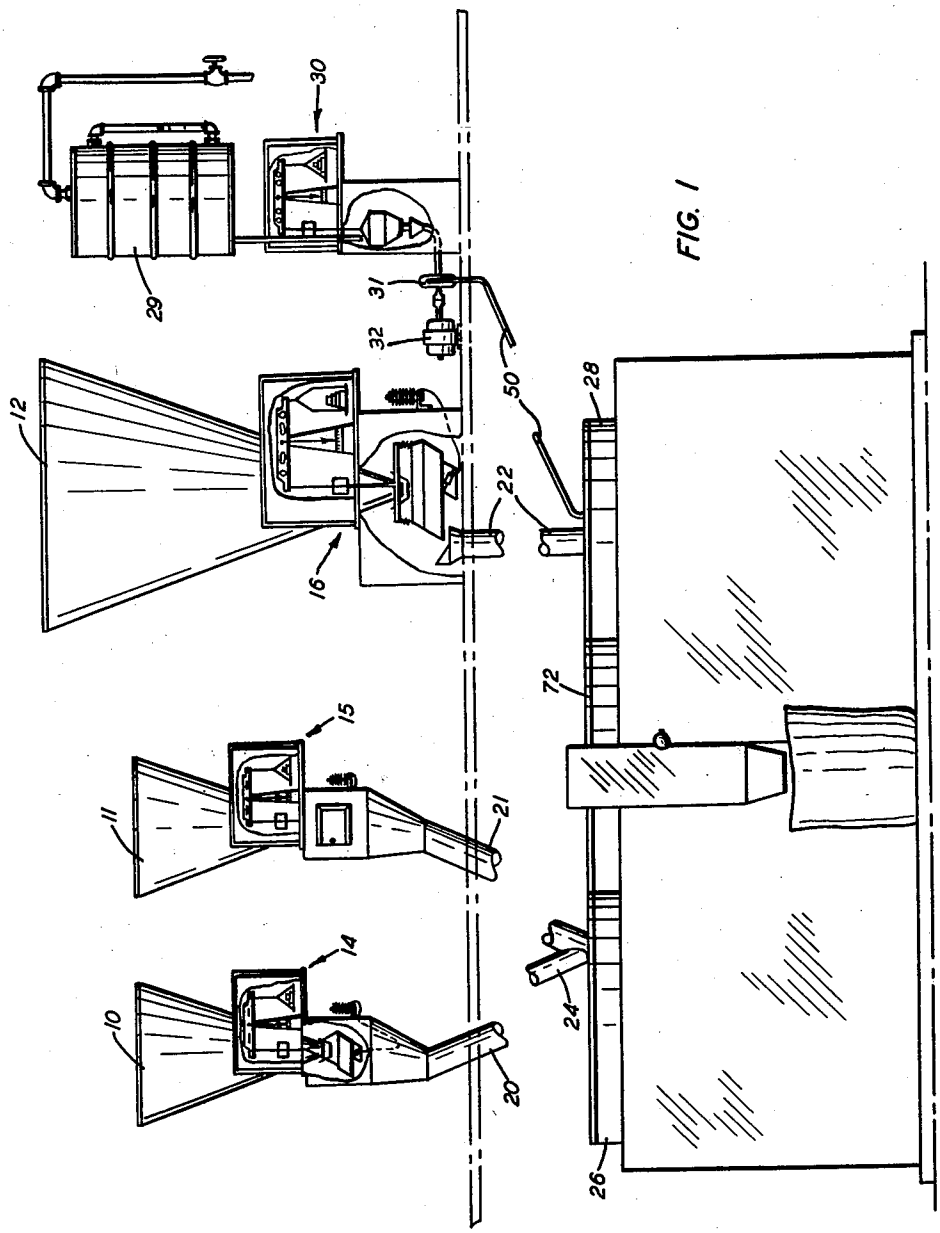


FIG. 1

INVENTOR
C. B. CLOTWORTHY, JR.
BY
ATTORNEY

April 8, 1952 C. B. CLOTWORTHY, JR 2,592,245

METHOD AND APPARATUS FOR MIXING MATERIALS

Filed April 23, 1949 4 Sheets-Sheet 2

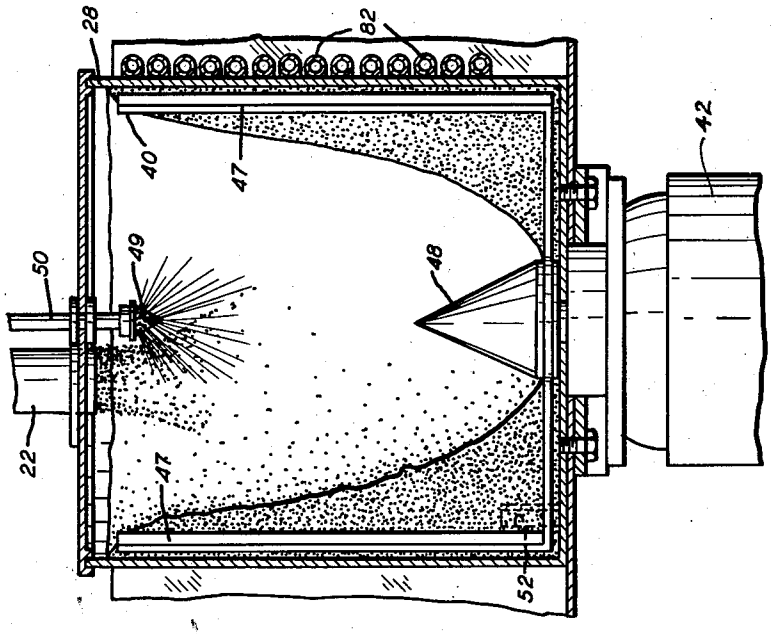


FIG. 3

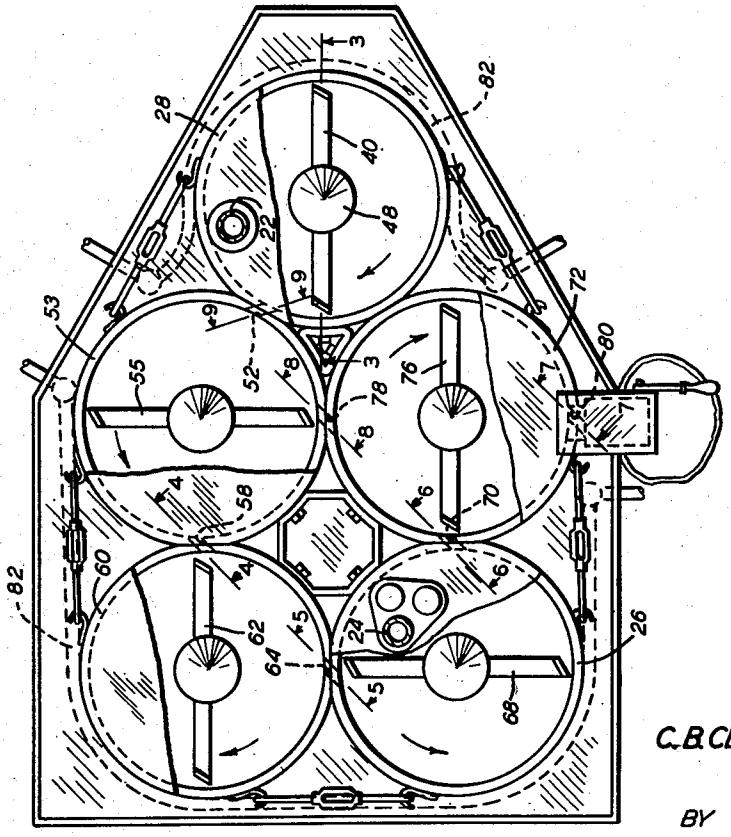


FIG. 2

INVENTOR
C. B. CLOTWORTHY, JR.
BY
ATTORNEY

April 8, 1952 C. B. CLOTWORTHY, JR 2,592,245

METHOD AND APPARATUS FOR MIXING MATERIALS

Filed April 23, 1949 4 Sheets-Sheet 3

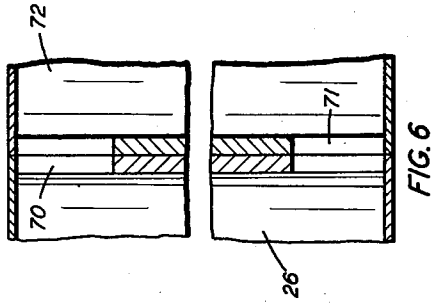


FIG. 6

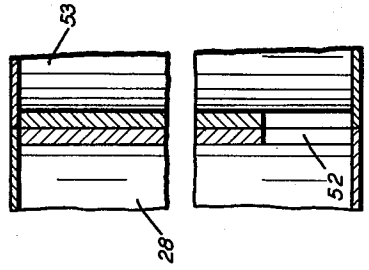


FIG. 9

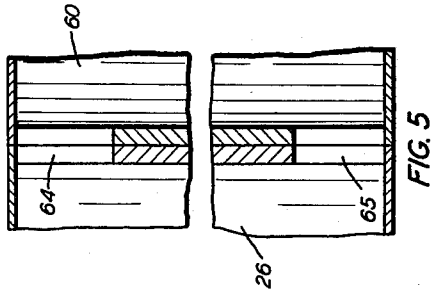


FIG. 5

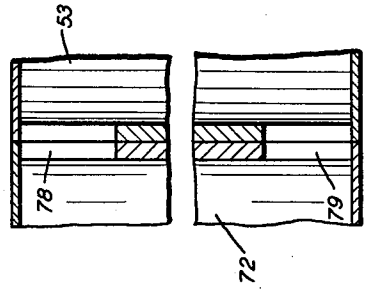


FIG. 8

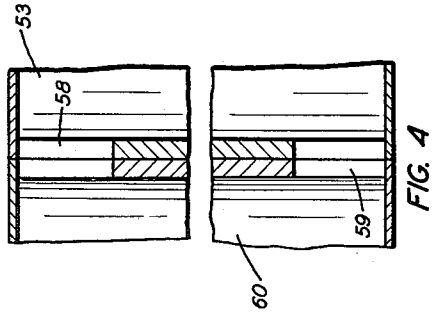


FIG. 4

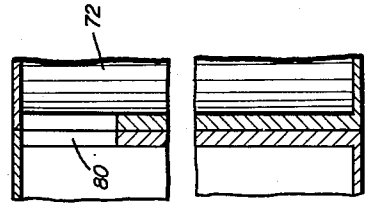


FIG. 7

INVENTOR
C.B. CLOTWORTHY, JR.
BY
ATTORNEY

April 8, 1952 C. B. CLOTWORTHY, JR 2,592,245

METHOD AND APPARATUS FOR MIXING MATERIALS

Filed April 23, 1949 4 Sheets-Sheet 4

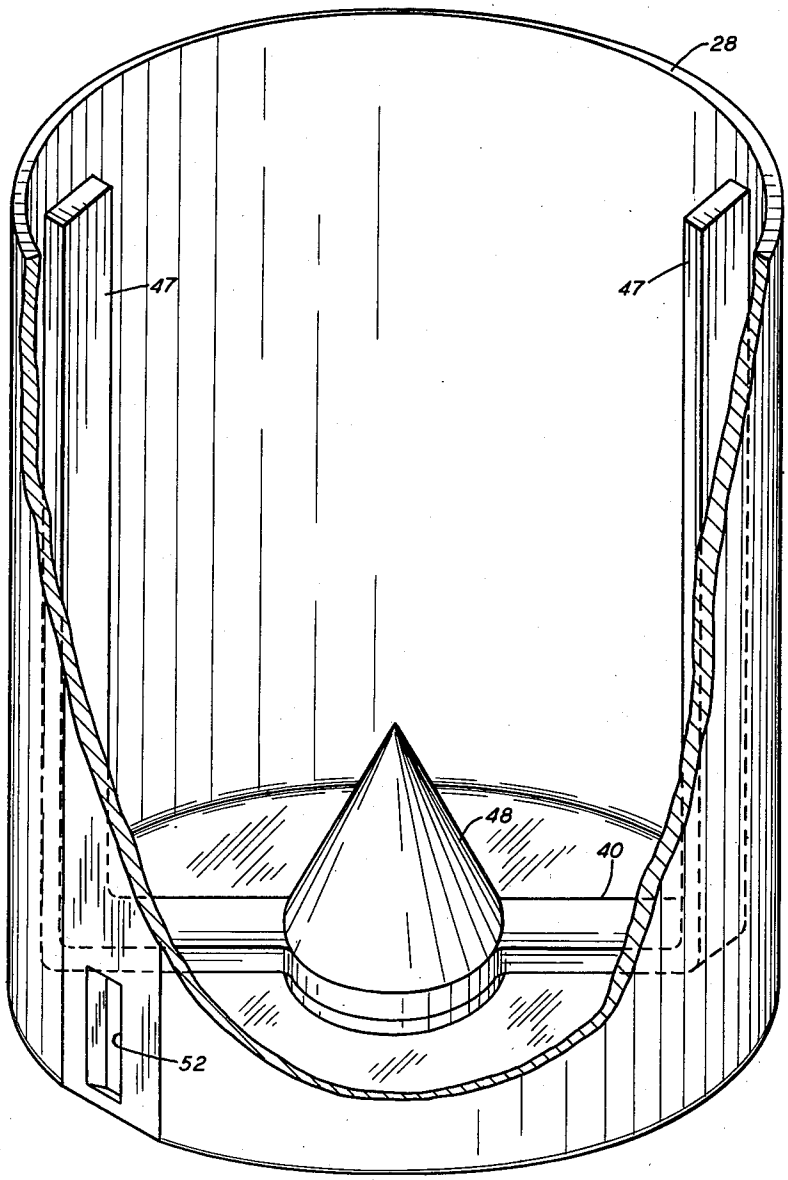


FIG. 10

INVENTOR
C.B.CLOTWORTHY, JR.
BY
ATTORNEY

Patented Apr. 8, 1952

2,592,245

UNITED STATES PATENT OFFICE

2,592,245

METHOD AND APPARATUS FOR MIXING MATERIALS

Charles B. Clotworthy, Jr., Brooklandville, Md., assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York

Application April 23, 1949, Serial No. 89,358

8 Claims. (Cl. 259—64)

1

This invention relates to methods of and apparatus for mixing materials, and more particularly to methods of and apparatus for mixing the ingredients of plastic compounds.

Plasticizers and the like usually are added to plastic materials to impart plasticity and other desirable properties to the materials. In the use of such materials it is usually desirable to have a continuous flow of the material rather than to supply the material in batches, wherein much handling and storage of the materials are required. Continuous mixing methods and apparatus have been known in the past, but the proportions of the several ingredients mixed by these past known methods and apparatus have not been maintained uniform due to inability to continuously mix the ingredients in fixed proportions. The ingredients have been metered by the batch method, but then the mixing thereof has of necessity been very extensive and the amount of equipment required was very large.

An object of the invention is to provide new and improved methods of and apparatus for mixing materials.

A further object of the invention is to provide new and improved methods of and apparatus for continuously mixing and discharging ingredients of a plastic compound.

A method illustrating certain features of the invention may include advancing a plurality of ingredients of a compound along a closed path, mixing the ingredients together as they are so advanced, supplying unmixed ingredients into the closed path, withdrawing mixed ingredients from the closed path in an amount low in proportion to the total amount of ingredients in said path and recirculating a large amount of the ingredients in said path.

An apparatus illustrating certain features of the invention may include an endless chamber, means for introducing unmixed ingredients of the composition into the chamber at one portion thereof, means for advancing the ingredients through the chamber, means for mixing the ingredients together as they are advanced through the chamber, and means for continuously withdrawing mixed ingredients from the chamber.

A complete understanding of the invention may be obtained from the following detailed description of a method and apparatus forming specific embodiments thereof, when read in conjunction with the appended drawings, in which:

Fig. 1 is a fragmentary, front elevation of a portion of an apparatus for effecting one method embodying the invention;

2

Fig. 2 is a top plan view of a portion of the apparatus shown in Fig. 1;

Fig. 3 is an enlarged, vertical section taken along line 3—3 of Fig. 2;

Fig. 4 is a fragmentary, vertical section taken along line 4—4 of Fig. 2;

Fig. 5 is a fragmentary, vertical section taken along line 5—5 of Fig. 2;

Fig. 6 is a fragmentary, vertical section taken along line 6—6 of Fig. 2;

Fig. 7 is a fragmentary, vertical section taken along line 7—7 of Fig. 2;

Fig. 8 is a fragmentary, vertical section taken along line 8—8 of Fig. 2;

Fig. 9 is a fragmentary, vertical section taken along line 9—9 of Fig. 2, and

Fig. 10 is an enlarged, perspective view of a portion of the apparatus.

Referring now in detail to the drawings, there is shown an apparatus for mixing the individual ingredients of a thermoplastic compound, such as, a compound consisting principally of polyvinyl chloride, a copolymer of vinyl chloride and vinyl acetate, cellulose acetate, cellulose acetate-butyrate, or similar materials. The solid powdered constituents of such a compound are placed in hoppers 10, 11 and 12, which are large enough to store substantial volumes of these ingredients. The solid ingredients flow by gravity from the hoppers 10, 11 and 12 into the batch weighing devices 14, 15 and 16. One type of weighing device suitable for this purpose is disclosed and claimed in copending application Serial No. 89,338 filed April 23, 1949, by H. R. Leypoldt and A. T. Stoddart, for "Apparatus for Advancing Material."

The weighing devices 14, 15 and 16 may be controlled by a master control system of a type similar to the control system shown in Patent 2,100,874 to Ryan et al., and empty automatically and periodically into chutes 20, 21 and 22, respectively, at the same time. The chutes 20 and 21 handling solid fillers, stabilizers, lubricants and pigments from the hoppers 10 and 11 are connected to a common discharge pipe 24 leading into a covered mixing cylinder 26 (Fig. 2), while the chute 22 leads into a covered mixing cylinder 28. The hopper 12 and the weighing device 16 handle and dump dry, unplasticized, thermoplastic material in powdered form into the cylinder 28.

A liquid plasticizer is stored in a tank 29 from which it flows into a weighing device 30. A pump 31 is driven by a motor 32, and pumps the liquid plasticizer from the weighing device 30 into the

cylinder 28 at the same time that the weighing devices 14, 15 and 16 discharge batches of solid ingredients. The discharging action of the weighing devices 14, 15 and 16 and 30 begins simultaneously through the actuation of the control system therefore so that the various ingredients dumped by the weighing devices are kept in fixed proportions. The weighing device 30 and pump 31 supply the cylinder 28 with a plasticizer for the thermoplastic material at the same time that the thermoplastic material is supplied to the cylinder 28 from the chute 22.

The material in the cylinder 28 is revolved therein by a U-shaped paddle 40 (Fig. 2), which is rotated in a clockwise direction, as seen in Fig. 2, at a rate of speed of 180 to 200 R. P. M. when the paddle is about 20 inches in diameter, by an electric motor 42. The paddle 40 is provided with two vertical blades 47—47 and with a conical central portion 48 for deflecting material falling thereon outwardly toward the blades 47—47. The plasticizer is sprayed onto the material in the cylinder 28 by a nozzle 49 connected to the pump 31 (Fig. 1) by a pipe 50.

The blades 47—47 of the paddle 40 carry the powdered material therewith around the cylinder 28, and push it toward the perimeter of the cylinder. Consequently, the material is kept spread out and continuously mixed so that a large and continuously changing area of material is exposed to the droplets of plasticizer. As a result, the plasticizer is distributed uniformly throughout all portions of the material.

The leading faces of the blades 47—47 slope backwardly and toward the periphery of the cylinder 28 so that the material is free to slide off the blades and to drop between the wall of the container and the outer edges of the blades. The blades repeatedly pick up the material, force the material outwardly and upwardly by centrifugal action, and drop the material so that the particles of material are continuously moved and rolled. This mixing thoroughly and uniformly distributes the plasticizer into the thermoplastic material.

The plasticized portion of the material is heavier than the dry portion thereof so that the plasticized portion is discharged continuously through a tangential discharge chute 52 positioned near the bottom of the cylinder 28 and leading to a covered mixing cylinder 53, which is generally similar to the mixing cylinder 28. The chute is formed by cutting oblique communicating slots in the walls of the cylinders 28 and 53. A paddle 55, which is similar to the paddle 40 and is driven in a counterclockwise direction, as viewed in Fig. 2, at the same rate of speed as the paddle 40, mixes the mixture of thermoplastic and plasticizer entering the cylinder 53, and forces the material upwardly along the perimeter of the cylinder. The chute 52 is directed so that its entrance faces generally opposite to the direction of movement of the paddle 40 as the paddle approaches the chute 52 so that the material is forced by the paddle therethrough. The exit of the chute 52 faces in generally the same direction as that of revolution of the paddle 55 so that the paddle 55 does not push material into the chute 52.

The material is discharged continuously from the cylinder 53 into a covered mixing cylinder 60 through tangential discharge chutes 58 and 59 (Figs. 2 and 4) positioned near the tops and bottoms of the cylinders 53 and 60 and directed so that they receive the material being revolved in the cylinder 53. Since the chutes 58 and 59 are positioned near the top and bottom of the cylinder 53, the average density of the materials discharged therethrough is the same as that of the average of the entire portion of the mixture in the cylinder 53. A paddle 62, which is similar to the paddles 40 and 55 and is revolved in a clockwise direction, as viewed in Fig. 2, at the same rate as the paddles 40 and 55, carries the material entering the cylinder 60 from the cylinder 53 around the cylinder 60 so that the ingredients of this material are mixed together. The chutes 58 and 59 extend in a direction with respect to the revolutions of the paddles 55 and 62 such as to receive material from the cylinder 53 and not receive it from the cylinder 60.

The material is forced outwardly and upwardly by the action of the paddle 62, is repeatedly dropped and picked up, and is discharged through top and bottom discharge chutes 64 and 65 (Fig. 5) facing opposite to the direction of rotation of the paddle 62. The material discharged through the chutes 64 and 65 into the cylinder 26 is picked up by a paddle 68 revolved in a direction opposite to that of the paddle 62. The paddle 68 which is of the same construction as the paddle 40, picks up the material and forces it upwardly and outwardly, and mixes it with fillers and pigments discharged into the cylinder 26 by the discharge pipe 24.

The material is discharged continuously from the cylinder 26 through top and bottom discharge chutes 70 and 71 (Figs. 2 and 6), which are directed so as to permit the force on the material in the cylinder 26 to move the material therethrough into a covered mixing cylinder 72. The material is mixed further in the cylinder 72 by a paddle 76, which is like the paddle 40. The paddle 76 picks up the material, moves it outwardly and upwardly in a clockwise direction, as viewed in Fig. 2, and thereby mixes it. This movement causes a substantial portion of the material to be discharged continuously through top and bottom tangential chutes 78 and 79 (Fig. 8) into the cylinder 53 for recycling, and the rest of the material to be discharged continuously through a top tangential exit chute 80. The material discharged through the chute 80 has been thoroughly mixed and plasticized, and is suitable for use in various molding or extrusion operations.

The material discharged from the cylinder 72 into the cylinder 53 is mixed with the plasticized thermoplastic material entering the cylinder 53 through the discharge chute 52 from the cylinder 28, and is high in proportion to the total quantity of the plasticized thermoplastic material. Thus, the material entering the cylinder 53 through the discharge chute 52 from the cylinder 28 is mixed with previously mixed material, and any variation in proportions of the materials that may be caused by the operation of the batch-metering apparatus are eliminated as the materials are cycled along the path described hereinabove. Likewise, any irregularity in the performance of any one or more of the mixing operations is smoothed out by the recycling procedure. Heating coils 82—82 serve to heat the ingredients in the cylinders 26, 28, 53, 60 and 72 during the mixing thereof.

The outer edges of the blades of the paddles 40, 55, 62, 68 and 76 are sufficiently far from the walls of the cylinders 28, 53, 60, 26 and 72, respectively, to prevent the material from being caked on or wedged against the walls of the cylinders, and are sufficiently close to these walls to insure that the paddles keep the material spread out thin and high on the heated walls.

Hence, the material is discharged continuously through the upper discharge chutes as well as the lower discharge chutes, and is constantly picked up and dropped in each cylinder. A radial clearance between the edge of the blades and the walls of the cylinders of about one-half of an inch has been found to be successful for mixing thermoplastic compounds including polymerized vinyl chloride.

The paddles effect a wiping action on the material so that it is continuously rolled and agitated. Inasmuch as there are no corners in the side walls of the cylinders, there are no pockets to permit stagnation in the apparatus. Since the liquid plasticizer and the thermoplastic material are mixed thoroughly while in the mixing cylinder **28**, all the plasticizer is used to wet the pure thermoplastic material and none is wasted on the ingredients added to the mixture in the cylinder **26**. The total mixed material withdrawn for use during a given period is equal to total unmixed ingredients added during that period, but a much larger mass is passing through the chambers.

For mixing some materials it may be desirable to introduce the materials in a different order and to different chambers than the order of introduction of and chambers to which the materials described hereinabove are introduced. This may be easily effected merely by changing the location of the discharge pipe **24** from the cylinder **26** to the one of other cylinders desired. Or, introduction of the materials into several of the chambers may be done.

The above-described method and apparatus for mixing materials serve to continuously discharge materials of unvarying proportions, even though batch methods of supplying materials to the mixing apparatus are used. Hence, the batch weighing method can be used without interfering with the continuity and uniformity of the operation of the mixing apparatus. Obviously, the method and apparatus can be used with continuous metering of materials thereto with excellent results.

What is claimed is:

1. The method of continuously mixing the ingredients of a plastic compound, which comprises the steps of mixing measured amounts of plastic material and a plasticizer, to form plasticized material, introducing the plasticized material continuously into an endless path at a predetermined point therein, introducing into the path at a second point therein measured amounts of solid ingredients to be mixed with the plasticized material, advancing the plasticized material and the solid ingredients along the path, mixing the solid ingredients and the plasticized material as they are advanced along the path to form a compound, and withdrawing only a portion of the compound from the path at a third point therein.

2. The method of continuously mixing the ingredients of a plastic compound, which comprises the steps of introducing periodically into a chamber measured amounts of plastic material and a plasticizer, mixing the plastic material and the plasticizer in the chamber to form plasticized material, introducing the plasticized material continuously into an endless path at a predetermined point therein, introducing periodically into the path at a second point therein measured amounts of solid ingredients to be mixed with the plasticized material, advancing the plasticized material and the solid ingredients continuously along the path, mixing the solid ingredients and the plasticized material continuously as they are advanced along the path to form a compound, heating the materials as they are mixed, and continuously withdrawing a portion of the compound from the path at a third point therein.

3. A mixer, which comprises a series of cylinders mounted in tangentially contacting upright positions in which they form an endless chain, a plurality of paddles mounted one for each in the cylinders for revolution about the longitudinal axes of the cylinders, means for revolving the paddles on said axes in directions such that each paddle is revolved in a direction opposite to that of the paddles in the cylinders immediately adjacent thereto, the cylinders having interconnecting slots therein of which each slot faces the paddle in one of the cylinders in which the slot is formed as that paddle approaches the slot and faces away from the paddle in the other cylinder as that paddle approaches the slot so that material in the first-mentioned cylinder is forced by the first-mentioned paddle through the slot and is picked up by the other paddle, so that material is advanced from cylinder to cylinder along the endless chain, a pre-mixing cylinder mounted in tangential contact with one of the first-mentioned cylinders, the latter two cylinders having intercommunicating slots designed to feed material from the pre-mixing cylinder into the other cylinder, a paddle mounted rotatably in the pre-mixing cylinder, means for revolving the paddle in the pre-mixing cylinder in a direction such as to agitate material and force it through the last-mentioned slots, means for introducing periodically unmixed materials into the pre-mixing cylinder, the cylinder from which material is discharged into the cylinder into which material is discharged from the pre-mixing cylinder having a discharge slot, and means for introducing periodically another material into one of the first-mentioned cylinders other than the cylinder having the discharge slot therein and other than the cylinder into which the pre-mixing cylinder discharges.

4. A mixer for powdered material, which comprises a cylindrical vessel, a second cylindrical vessel, said vessels being mounted on parallel vertical axes and in close relationship with one another, means for introducing powdered material into one of the vessels, a pair of agitators mounted one for each in the vessels for revolution about the longitudinal axes of the vessels, and means for rotating the agitators in opposite directions, said agitators being provided with blades sloping backwardly and toward the walls of the vessels as they are revolved so that they tend to push powdered material in the vessels against the walls of the vessels, the vessels being provided with an intercommunicating passage extending in a direction such that powdered material is forced therethrough from the first-mentioned vessel to the second-mentioned vessel by movement of the material by the agitator in the first-mentioned vessel and material is not forced from the second-mentioned vessel by movement of material therein by the agitator therein, the blades of the agitators extending along the walls from the bottoms of the vessels substantially to the passage therein.

5. The method of continuously mixing the ingredients of a plastic compound, which comprises the steps of mixing a batch of measured amounts of plastic material and a plasticizer, periodically introducing the plasticized material

from the batch into an endless path, introducing into the path measured amounts of solid ingredients to be mixed with the plasticized material, advancing the plasticized material and the solid ingredients together around the path a plurality of times, mixing the plasticized material and the ingredients as they are advanced along the path to form a compound, continuously withdrawing compound from the path, and controlling the periodic introduction of ingredients to maintain constant proportions in the withdrawn composition.

6. A mixer, which comprises a closed upright cylindrical vessel having a discharge opening in the cylindrical wall thereof at a substantial distance from the bottom of the vessel, means for introducing powdered material in the upper portion of the vessel, a rotatable shaft mounted in alignment with the longitudinal axis of the vessel, means for rotating the shaft, and a generally L-shaped paddle connected to the shaft and revolved in the vessel thereby, one arm of the paddle extending along the bottom of the vessel from the central portion thereof for forcing powdered material on the bottom of the vessel toward the cylindrical wall of the vessel and the other arm of the paddle extending along the wall of the vessel from the bottom thereof substantially to the discharge opening in the cylindrical wall of the vessel, the last-mentioned arm of the paddle being substantially parallel to the longitudinal axis of the vessel, being spaced slightly from the wall of the vessel and sloping opposite to the direction of rotation, whereby substantially the entire mass of the powdered material is moved by the paddle without packing the material between the paddle and the walls of the vessel.

7. An apparatus for incorporating a plasticizer into a powdered plastic material, which comprises a closed upright cylindrical vessel having a discharge opening in the cylindrical wall thereof at a substantial distance from the bottom of the vessel, means for introducing powdered plastic material into the upper portion of the vessel, a rotatable shaft mounted in alignment with the longitudinal axis of the vessel, means for rotating the shaft, a generally L-shaped paddle connected to the shaft and revolved in the vessel thereby, one arm of the paddle extending along the bottom of the vessel from the central portion thereof for forcing powdered material on the bottom of the vessel toward the cylindrical wall of the vessel and the other arm of the paddle extending along the wall of the vessel from the bottom thereof substantially to the discharge opening in the cylindrical wall of the vessel, the last-mentioned arm of the paddle being substantially parallel to the longitudinal axis of the vessel, being spaced slightly apart from the wall of the vessel and the forward face thereof sloping backwardly from the inwardly positioned portion of that face to the outwardly positioned portion of the face as the paddle is revolved, whereby the powdered plastic material is mixed while being centrifugally urged toward and up the cylindrical wall of the vessel to the discharge opening, and means for applying plasticizing material to the powdered plastic material on the walls of the vessel.

8. An apparatus for incorporating a plasticizer into a powdered plastic material, which comprises a closed upright cylindrical vessel having a discharge opening in the cylindrical wall thereof at a substantial distance from the bottom of the vessel, means for introducing powdered plastic material into the upper portion of the vessel, a rotatable shaft mounted in alignment with the longitudinal axis of the vessel and extending through the bottom of the vessel, means for rotating the shaft, a generally L-shaped paddle connected to the shaft and revolved in the vessel thereby, one arm of the paddle extending along the bottom of the vessel from the central portion thereof for forcing powdered material on the bottom of the vessel toward the cylindrical wall of the vessel and the other arm of the paddle extending along the wall of the vessel from the bottom thereof substantially to the discharge opening in the cylindrical wall of the vessel, the last-mentioned arm of the paddle being substantially parallel to the longitudinal axis of the vessel, being spaced slightly apart from the wall of the vessel and the forward face thereof sloping backward from the inwardly positioned portion of that face to the outwardly positioned portion of that face as it is revolved, a conical deflector mounted on and connected to the upper end of the shaft for guiding the powdered material toward the cylindrical wall of the vessel, and means positioned in the upper portion of the vessel for spraying liquid plasticizer toward the powdered plastic material on the walls of the vessel.

CHARLES B. CLOTWORTHY, JR.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
644,649	Walter	Mar. 6, 1900
682,292	Sukalle	Sept. 10, 1901
808,599	Crichfield	Dec. 26, 1905
882,925	Boynton	Mar. 24, 1908
1,605,596	Langelier	Nov. 2, 1926
1,722,433	Kirschbraum	July 30, 1929
1,983,319	Simpson	Dec. 4, 1934
2,005,950	Moroney et al.	June 25, 1935
2,128,447	Wright	Aug. 30, 1938
2,201,552	Ahlmann	May 21, 1940
2,263,790	Vermillion	Nov. 25, 1941
2,498,125	Knudsen et al.	Feb. 2, 1950