May 9, 1967 C. D. FISHER 3,318,582

MIXER

Filed Nov. 4, 1965

FIG. 1.

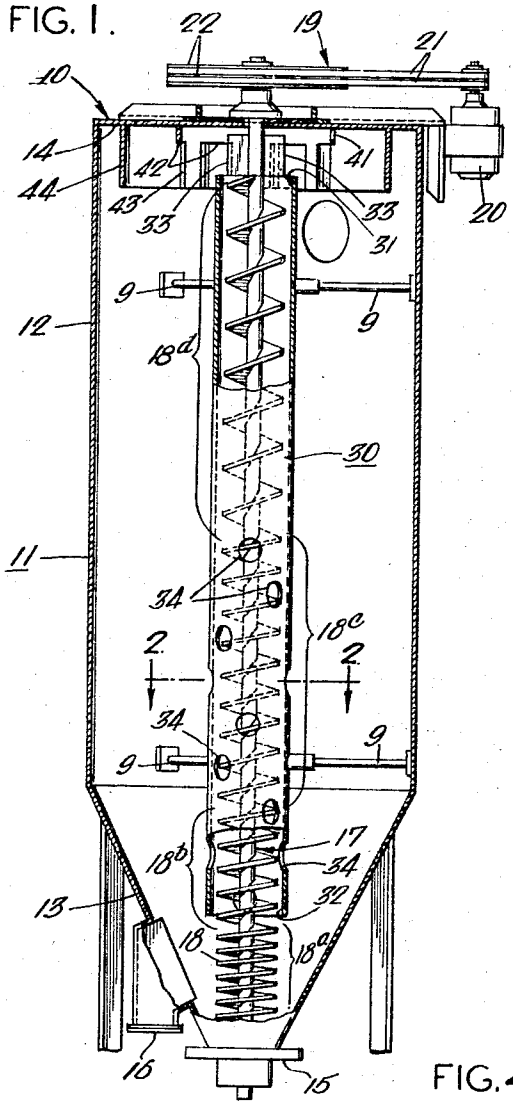


FIG. 3.

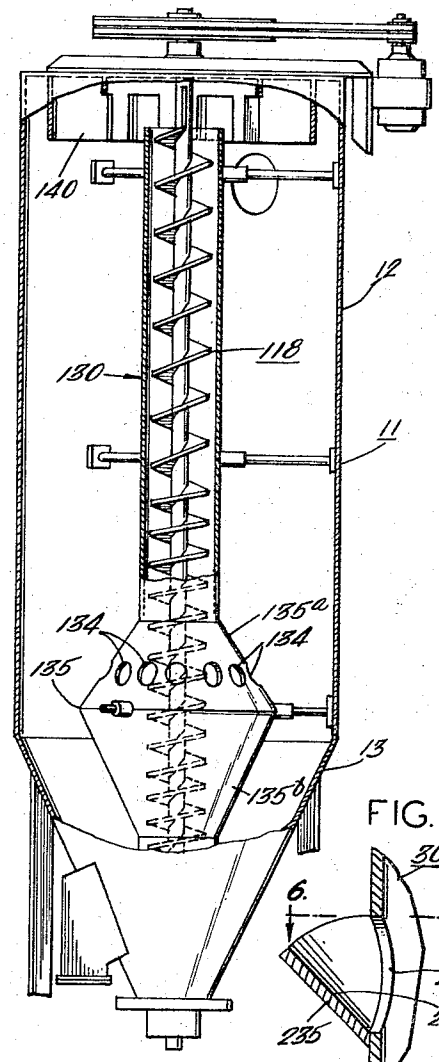


FIG. 5.

FIG. 4.

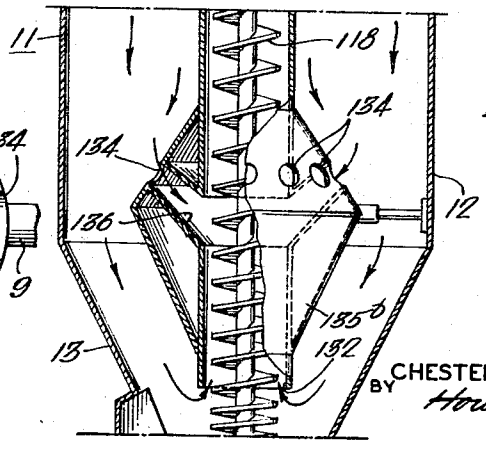


FIG. 2.

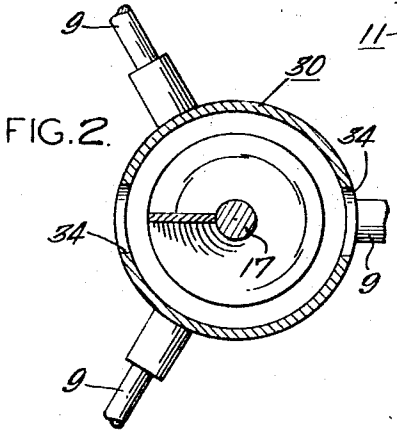
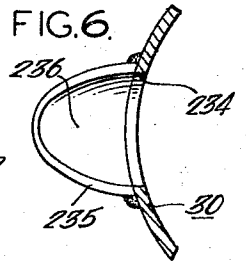


FIG. 6.



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MIXER

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The present invention relates to mixing apparatus suitable for mixing powdered or granular materials, and more particularly to vertical type mixers in which the materials to be mixed are carried continuously upward through the central portion of the mixer by a conveyor, such as a screw, and are discharged radially into the upper end of the casing for gravity return to the lower part of the casing.

Mixers of the afore-mentioned type have proved quite satisfactory in producing thorough mixing where the particles to be mixed are of a relatively uniform size. However, a problem does exist when the particles are non-uniform in weight and size, the problem being that upon the material being discharged radially from the conveyor into the upper portion of the casing, for gravity return to the lower part thereof, differences in particle weight and size cause segregation of the particles rather than an intimate mixing. This problem is effectively solved by providing a baffle located approximately midway between the discharge end of the conveyor and the outer wall of the casing. This solution is set forth in the Fisher Patent #2,731,248.

It should be understood that vertical mixers which carry material continuously upwardly through the central part of the mixer and then discharge the material radially into the casing have a primary use for mixing batches of material. In batch mixers, the amount of time necessary to effect a uniform mixing of the material contained therein is dependent primarily upon the efficiency of mixing, or the ability of the apparatus to mix large quantities of material in a rapid and efficient manner in the shortest period of time.

In view of the above, it is a principal object of the present invention to provide a vertical mixer that mixes batches of granular materials having either different or the same particle size while obtaining a substantially uniform consistency of mix faster and more economically than has heretofore been possible in this type of mixer.

Another object of the present invention is to provide means permitting admittance of material to the conveyor at at least one point in the batch in addition to the material being moved up the conveyor from the bottom of the batch, thus assuring increased efficiency of mixing.

Still another object of the present invention is to provide a vertical mixer particularly adapted for handling dry materials, which mixer will operate equally efficiently both with materials of approximately the same particle size and weight and also with dry materials of comparatively widely different particle sizes and weights, and which will in either case produce thorough and uniform mixing of the particles in a shorter period of time.

Other objects and a fuller understanding of the invention may be had by referring to the following specification and claims taken in conjunction with the accompanying drawing in which:

FIG. 1 is a fragmentary profile view of a vertical mixer constructed in accordance with the present invention;

FIG. 2 is an enlarged fragmentary sectional view taken along line 2—2 of FIG. 1;

FIG. 3 is a fragmentary profile view of another embodiment of a vertical mixer constructed in accordance with the present invention;

FIG. 4 is an enlarged fragmentary profile view of a portion of the apparatus illustrated in FIG. 3;

FIG. 5 is a fragmentary sectional view of another embodiment of apparatus which may be used in conjunction with the apparatus of FIGS. 1–4; and

FIG. 6 is a sectional view taken along line 6—6 of FIG. 5 and as if FIG. 5 were not in section.

Referring now to the drawing and particularly FIG. 1 thereof, a mixer **10** having a vertically oriented casing **11** including a cylindrical upper portion **12** and a lower funnel portion **13**, is illustrated therein. A top wall **14** and bottom wall **15** close the casing **11** and allow the casing to retain interiorly thereof a load of granular material to be mixed. The lower or funnel portion **13** of the casing **11** is provided with a discharge spout **16** which may be suitably valved to provide gravity discharge of the material upon completion of mixing. Mounted interiorly of the casing **11** and substantially coaxially therewith, is a mixing tube **30** constructed in accordance with the present invention, and supported by struts **9** so that the upper and lower or discharge and inlet terminal ends **31** and **32** of the tube are spaced respectively from the top and bottom walls **14** and **15** of the casing **11**.

In order to provide lifting of the material to be mixed from the lower or funnel portion **13** of the casing **11** to the upper portion **12**, a conveyor **17**, in the present instance a screw or worm **18** extends vertically through the casing. The screw **18** is rotatably mounted in the bottom wall **15** and in the present instance connected at its upper end, externally of the top wall **14**, to drive means **19** including a motor **20** which through belts **21** turn pulleys **22** connected to the screw **18**. As illustrated in FIG. 1, the upper terminal end **31** of the mixing tube **30** provides the discharge opening for the material being conveyed up the tube by the conveyor **17**, and radially extending flinger paddles **33**, mounted on the shaft of the screw **18** between the top wall **14** and the discharge opening for rotation with the screw, operate to throw the material radially outwardly into the surrounding upper portion **12** of the casing **11**.

In accordance with the invention, means are provided axially of the mixing tube **30**, at least at one point other than the inlet end **32** thereof, to provide a multiple level input into the conveyor effectuating an increase in the efficiency of mixing of the material thus to be treated. To this end, at least one, in the present instance a plurality of both circumfentially and axially spaced apertures **34** are provided in the wall of the mixing tube **30** to permit entry into the rotating screw conveyor **18**. In addition, so as to provide a free flow and good metering of the material as it enters into the mixing tube **30** through the apertures **34**, and in order to meter the material properly to draw the material into the mixing tube and up the conveyor, the screw **18** is preferably of the variable pitch variety, in the present instance the variation in pitch occurring in steps. For example, the conveyor **18** illustrated in FIG. 1 has four such changes in pitch occurring between the bottom wall **15** and the discharge end **31** of the mixing tube **30**, which change occurs from the finer pitch at the bottom to the coarser pitch at the upper end of the screw in order to accommodate the increased quantity of material being conveyed to the discharge or upper terminal end **31** of the mixing tube **30**. For example, in FIG. 1 the screw **18** has four sections of flights with varying pitches which have been designated 18_a–18_d for purposes of identification. By way of example, if the diameter of the screw is 12 inches, the section of the screw having the finer pitch, 18_a may be at ⅓ or 4 inches pitch, the section having a pitch designated 18_b may be at ½ pitch or 6 inches, while the section having a pitch designated 18_c may be at ⅔ pitch or 8 inches and the final pitch of 18_d may be a full pitch of 12 inches.

The mixer **10** illustrated in FIG. 1 is particularly adapted for mixing efficiently large granular substances. For example, it has been found that when extruding from several machines a plastic such as polyethylene, chopping or cutting the plastic into small particles for example approximately ⅛ of an inch in diameter, the meld index (melting point) of the polyethylene thus extruded and cut will be different from each of the machines. Thus prior to subsequent treatment it is necessary to mix the particles in a mixer such as heretofore described to obtain a uniformity of end product for subsequent treatment. If however the weights and sizes vary somewhat, it may be preferable to insure that the material being discharged through the upper terminal end **31** of the mixing tube **30** is not segregated. This may occur because the heavier particles tend to drop near the center of the casing while the smaller particles tend to pass outwardly therebeyond towards the outer wall of the casing. With particles of varying weights it is preferable to mount a distributor or baffle unit **40** at the upper portion of the casing **11** to prevent segregation of the material. An example of a baffle unit which will prevent segregation is described in the Fisher Patent #2,731,248, which for purposes of clarification is briefly described below.

The baffle unit typically includes a cylindrical upper portion **41** secured to and depending from the top wall **14** and having a lower terminus somewhat below the discharge end **31** of the mixing tube **30**. As illustrated, the cylindrical upper portion **41** is serrated to provide a plurality of open spaces **42** alternating with solid baffle members **43**. The open spaces **42** and the baffle solid portions **43** are arranged so as to have an approximately equal angular dimension and alternate circumferentially of the mixer. With a baffle constructed in this manner, the solid materials lifted by the screw to the top of the mixing tube **30** will be flung radially outwardly by the rotating paddles **33** with sufficient force to carry to the outside wall of the casing. However the solid baffle portions **43** will intercept approximately 50% of the discharge material while the remainder of the material will pass through the openings **42**. In this manner an averaging of the discharge material across the radius and around the circumference of the casing takes place. In addition, in certain instances and under some conditions it is desirable to place an additional solid baffle radially outwardly of the baffle **40**, the additional baffle **44** being of a circumferentially continuous construction.

Thus when mixing a material of uniform granular size and weight, the baffle such as above described is not necessary while if the granular size and/or weight vary, a baffle such as above described may be preferable to obtain a uniform mix.

When mixing large granular particles such as polyethylene pellets approximately ⅛ of an inch in size with a fine granular material such as a powder, a mixture results that has poor flow characteristics. In addition, mixtures of powders of relatively fine size, generally have poor flow characteristics. Such mixtures have a tendency to form arches and not flow freely at the break between the cylindrical portion **12** and the funnel portion **13** of the mixer. If the materials do not flow freely at this break between the cylinder and the cone, a poor mix of this portion of a non-flowing material will be obtained from the mixer. This problem may be circumvented by modifying the apparatus in accordance with the present invention. Such a modified apparatus is illustrated in FIGS. 3 and 4 and includes a mixing tube **130** having a variable pitch screw **118** rotatably mounted therein, in the present instance a two-step conveying screw. At the lower portion of the tube **130** is a radial enlargement **135** having an outwardly and downwardly flared upper portion **135***a* and, in the present instance, an inwardly tapered or inverted conically shaped lower portion **135***b*. As illustrated the inverted cone **135***b* is located on the center tube **130** at the approximate critical junction between the cylindrical portion **12** and the funnel shaped portion **13**. With the addition of the inverted cone **135***b* on the center tube **130**, the tendency to arch at the critical break between the cylindrical portion **12** and the funnel shaped portion **13** is prevented, and the two non-free flowing types of mixes described above will pass freely down between the space between the funnel portion **13** and the inverted cone **135***b* into the elevating screw at the inlet **132**.

In order to provide a flow of material into the mixing tube **130** in addition to the material entering the inlet end **132** of the tube, the outwardly and downwardly tapered portion **135***a* is provided with a plurality of circumferentially spaced apertures **134**, in the present instance in the same radial plane, leading into an inverted conical passageway **136**. Because of the outward flare of the portion **135***a*, the apertures **134** will permit quantities of substantially uniform grain size of fine, non-free flowing powder, or a mixture of fine non-free flowing powder and larger granular material, to enter unimpeded into the passageway **136** and thus enter the flights of the screw conveyor **118**. An example of the type of material which could be mixed effectively with a mixer such as heretofore described with reference to FIGS. 3 and 4 is the large sized polyethylene granulars, above discussed, with a powdered granular coloring material.

It should be recognized that in utilizing a mixer such as illustrated in FIGS. 3 and 4 with a material that is to be mixed which includes a large granular substance and a powdered or fine non-free flowing powder, a baffle **140**, similar to the baffle **40** such as heretofore described, is desirable so as to prevent stratification or segregation of the powder and the large particles. However, in the instance where a fine powder such as a polyethylene plastic powder is to be mixed with other fine powders, such as polyvinyl chloride powders, pharmaceutical powders, metallic oxides or the like, it has been found that the baffle such as heretofore described, although not impeding the mixing process, is unnecessary and may be dispensed with.

In order to provide a free flow of material into either the mixing tube **30** associated with the mixer **10** illustrated in FIG. 1 or the mixing tube **130** associated with the mixer shown in FIG. 3, it may be desirable to modify the apertures **34** as illustrated in FIGS. 5 and 6. To this end, an aperture **234** is illustrated as having an outwardly projecting or protruding, semi-conical lip portion **235** which form a chute-like pocket **236** permitting a free flow of material from the casing into the mixing tube without the risk of "bridging" or clogging of the aperture.

Thus the apparatus of the present invention permits of more uniform mixing by providing passageways which permit a flow of material into the mixing tube at at least one level in addition to the normal or conventional feeding point at the lower terminal end of the mixing tube. In this manner the processing time is decreased and the efficiency of mixing is increased.

Thus although the invention has been described with a certain degree of particularity, it should be understood that the present disclosure is only exemplary of the invention, and that numerous changes in the details of construction, and the combination and arrangement of parts may be made without departing from the spirit and scope of the invention as hereinafter claimed.

What is claimed is:

1. A mixer for mixing granular materials comprising: a substantially vertical casing having a top wall and a bottom wall connected thereto, a mixing tube supported in said casing naving an upper discharge and lower inlet end spaced from said top wall and said bottom wall respectively, a variable pitch conveying screw mounted in said tube for moving said material up said tube from said inlet to said outlet, said screw having a finer pitch at said inlet than at said outlet, a radial enlargement connected to said mixing tube and having an outwardly and downwardly flared upper portion, a plurality of circum-

ferentially spaced apertures positioned in said flared portion to provide a passageway for the flow of said material in said casing into the conveying screw.

2. A mixer for mixing granular materials in accordance with claim 1 including an inverted conical passageway connecting said apertures with said screw.

3. A mixer for mixing granular materials in accordance with claim 1 including an inverted conically shaped lower portion connected to said downwardly flared upper portion.

4. A mixer for mixing granular materials in accordance with claim 3 wherein said casing comprises a cylindrical upper portion and a funnel shaped lower portion, and wherein said inverted conical portion is located approximately at the break between said cylindrical upper portion and said funnel shaped lower portion to prevent arching of non-free flowing materials being mixed in said mixer.

5. A mixer for mixing granular materials in accordance with claim 1 including radially extending flinger paddles mounted on said conveying screw between said discharge end of said tube and said top wall for flinging material radially from said discharge end.

6. A mixer for mixing granular materials in accordance with claim 5 including a baffle secured to and depending from said top wall, said baffle having a plurality of open spaces alternating with solid baffle members and located circumferentially of the casing.

7. A mixer for mixing granular materials comprising: a substantially vertical casing having a top wall and a bottom wall connected thereto, a mixing tube supported in said casing having an upper discharge and lower inlet end spaced from said top wall and said bottom wall respectively, a variable pitch conveying screw mounted in said tube for moving said material up said tube from said inlet to said outlet, said conveying screw having a finer pitch at the inlet end of said tube and a coarser pitch at the discharge end of said tube, and a plurality of circumferentially and axially spaced apertures in said tube to provide passageways for the flow of said material into said tube at various axial levels of said tube.

8. A mixer for mixing granular materials in accordance with claim 7 wherein at least some of said apertures have an outwardly projecting lip portion forming a chute-like pocket for passing material from said casing into said conveying screw.

9. A mixer for mixing granular materials in accordance with claim 7 including radially extending flinger paddles mounted on said conveying screw between said discharge end of said tube and said top wall for flinging material radially from said discharge end.

10. A mixer for mixing granular materials in accordance with claim 7 including a baffle secured to and depending from said top wall, said baffle having a plurality of open spaces alternating with solid baffle members and located circumferentially of the casing.

11. A mixer for mixing granular materials comprising: a substantially vertical casing having a top wall and a bottom wall connected thereto, a mixing tube supported in said casing having an upper discharge and lower inlet end spaced from said top wall and said bottom wall respectively, a variable pitch conveying screw mounted in said tube for moving material up said tube from said inlet to said outlet, said tube having a radial enlargement adjacent the inlet end of said tube, said enlargement having an outwardly and downwardly flared upper portion and a plurality of circumferentially spaced apertures in said flared portion, an inverted conical passageway connecting said apertures with said conveying screw to provide a flow of material from said casing into said conveying screw.

12. A mixer for mixing granular materials in accordance with claim 11 including radially extending flinger paddles mounted on said conveying screw between said discharge end of said tube and said top wall for flinging material radially from said discharge end.

13. A mixer for mixing granular materials in accordance with claim 11 including a baffle secured to and depending from said top wall, said baffle having a plurality of open spaces alternating with solid baffle members and located circumferentially of the casing.

14. A mixer for mixing granular materials in accordance with claim 11 including an inverted conically shaped lower portion connected to said downwardly flared upper portion.

15. A mixer for mixing granular materials in accordance with claim 14 wherein said casing comprises a cylindrical upper portion and a funnel shaped lower portion, and wherein said inverted conical portion is located approximately at the break between said cylindrical upper portion and said funnel shaped lower portion to prevent arching of non-free flowing materials being mixed in said mixer.

16. A mixer for mixing granular material in accordance with claim 7 wherein said variable pitch screw is stepped having at least two variations in pitch.

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