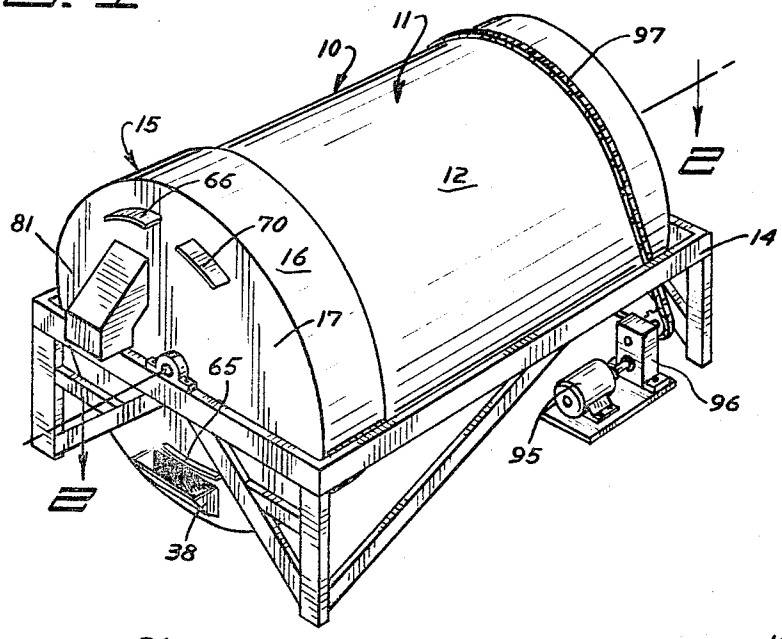
Aug. 30, 1966 C. E. PHILLIPS 3,269,707

PARTICULATE MATERIAL MIXING MACHINE

Filed Jan. 27, 1964 3 Sheets-Sheet 1

FIG. 1



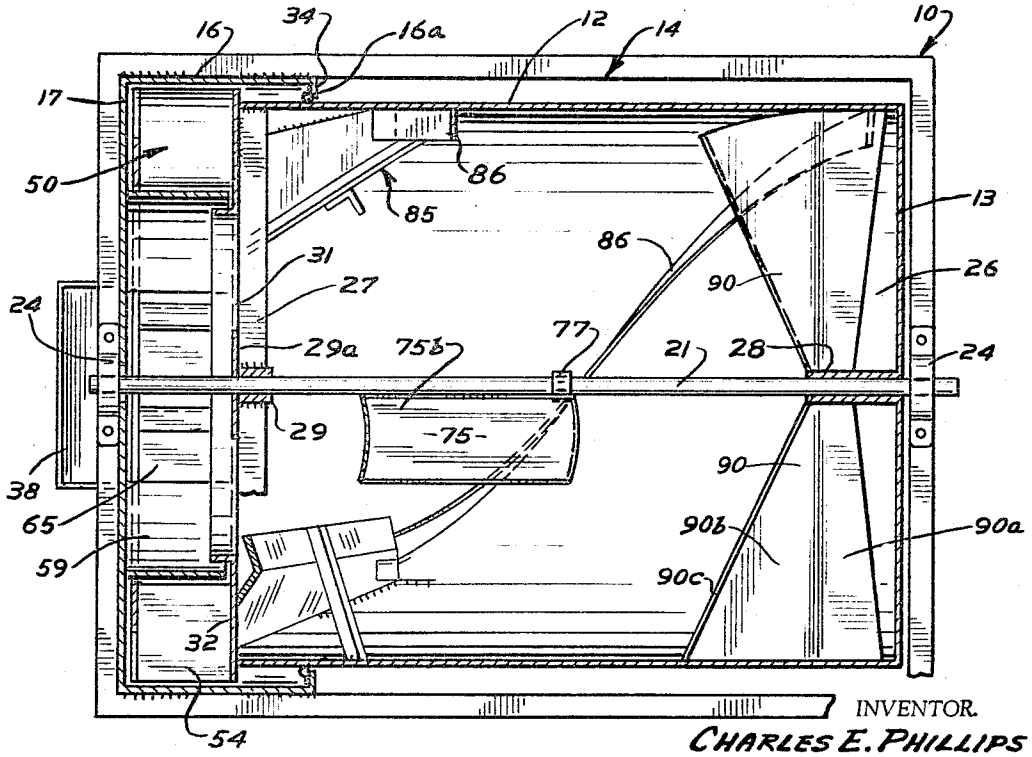


FIG. 2

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PARTICULATE MATERIAL MIXING MACHINE

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FIG. 4

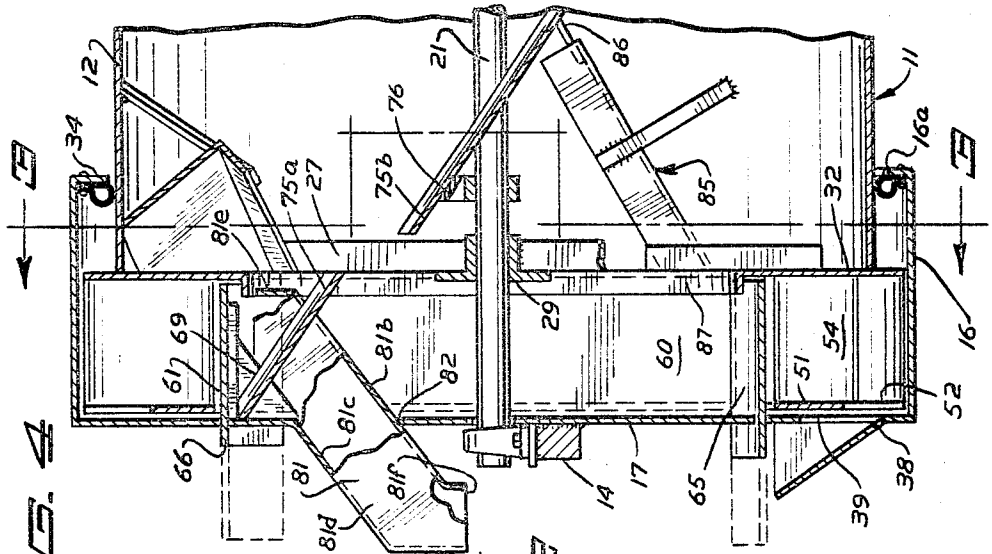
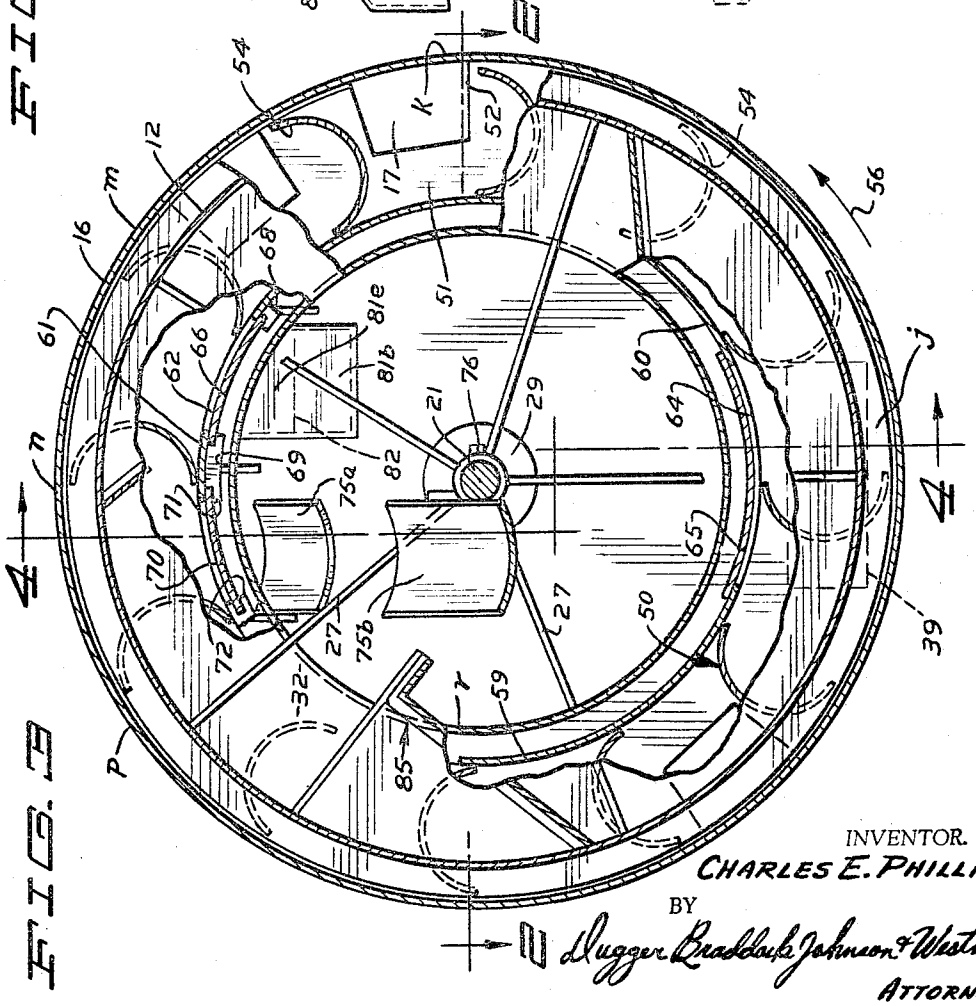


FIG. 3



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PARTICULATE MATERIAL MIXING MACHINE

Filed Jan. 27, 1964 3 Sheets-Sheet 3

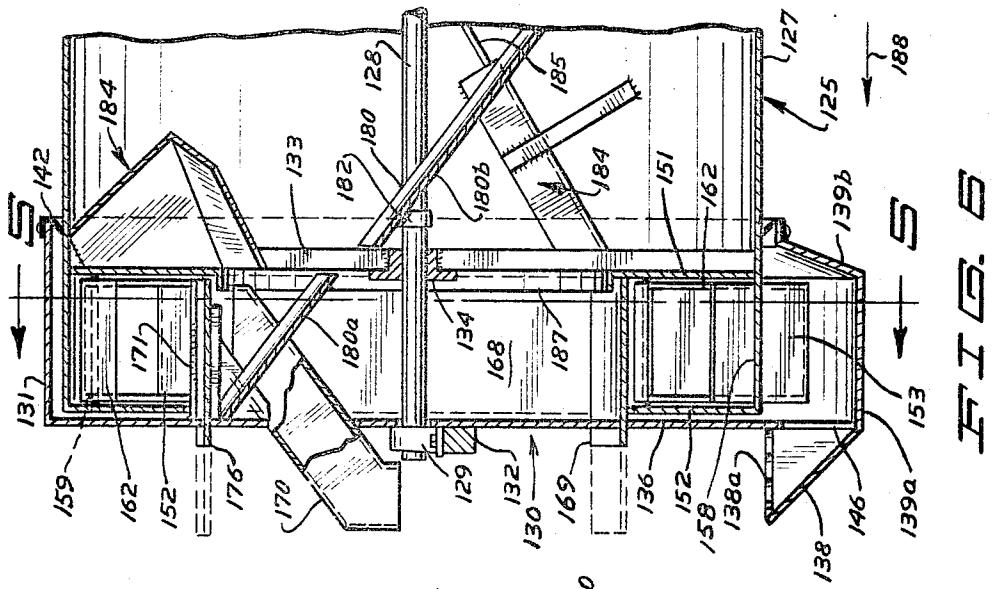


FIG. 6

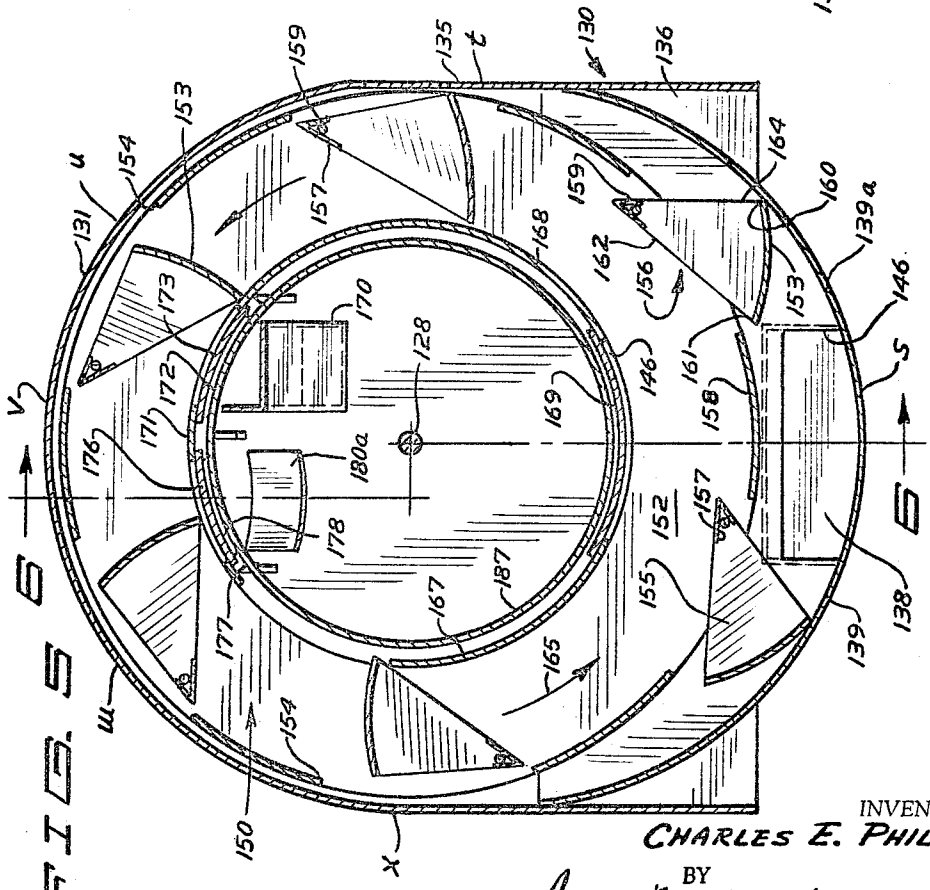


FIG. 5

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3,269,707

PARTICULATE MATERIAL MIXING MACHINE

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11 Claims. (Cl. 259—3)

This invention relates to improvements in rotary drum apparatus for mixing or blending particulate materials, for example, livestock feeds of different particle sizes, density, and other physical characteristics, fertilizer and other miscellaneous materials in either a dry or moist condition. More particularly this invention relates to improvements in a machine of the aforementioned nature that is of a construction for directing and conveying material that has been elevated by the machine to a rearward portion of the machine as the material descends in order to obtain a faster mixing action.

The present invention is an improvement over the invention described in my patent, Patent No. 3,088,711 granted May 7, 1963; my co-pending application Serial No. 100,623, filed April 4, 1961, and now Patent No. 3,147,956; and my co-pending application Serial No. 340,354 entitled Blending and Mixing Apparatus which has been filed the same day as this application.

One of the objects of this invention is to provide new and novel mechanism in a rotary drum type mixer of a large capacity for facilitating the loading of material into the drum. A further object of this invention is to provide new and novel mechanism in a rotary drum type mixer having a stationary end wall for transferring particulate material through an aperture in said end wall into the rearward interior portion of the rotary drum of the mixer while it is rotating and selectively to discharge the material that has been transferred into the drum through said stationary wall while the drum is rotating.

An additional object of this invention is to provide new and novel transfer means in a rotary drum type mixer and blender apparatus that will charge a rotary drum including positively conveying the material to the rearward end of the drum and at the same time continuously positively convey at least some of the material in the drum through an arcuate path of an angle of at least 45° relative to the horizontal even though only a small quantity of material is in the drum. Still another object of this invention is to provide in a rotary drum mixer, new and novel mechanism to permit loading of the mixer while it is rotating and is operable for selectively conveying elevated material to a rearward portion of the drum or to discharge said material from an elevated condition to facilitate the transfer of material from the drum into sacks or other suitable receptacles.

A still further object of this invention is to provide in a rotary drum type mixer, a plurality of scoops and associated elements wherein the only parts moveable relative to the drum are the scoops, a retaining door, a door for selectively permitting a discharge of material from the drum, and a door for selectively controlling the conveyance of elevated material to a rearward portion of the drum.

Other and further objects are those inherent in the invention herein illustrated, described and claimed and will become apparent as the description proceeds.

To the accomplishment of the foregoing and related ends, this invention then comprises the features hereinafter fully described and particularly pointed out in the claims, the following description setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principles of the invention may be employed.

The invention is illustrated with reference to the drawings in which corresponding numerals refer to the same parts and in which:

FIGURE 1 is a perspective, somewhat schematic view of the first embodiment of the particulate material mixing machine of this invention:

FIGURE 2 is an enlarged vertical transverse sectional view generally taken along the line and in the direction of arrows **2—2** of FIGURE 1 and **2—2** of FIGURE 3 to more clearly illustrate the mechanism for transferring material in the stationary hood into the rotary drum and for positively conveying the material to a substantial elevation where it is selectively discharged or permitted to descend to the general level of the material in the drum at a location substantially rearwardly of the stationary hood and also the structure for causing the material in the drum to be more thoroughly mixed and directed into the transfer mechanism;

FIGURE 3 is an enlarged vertical transverse sectional view generally taken along the line and in the direction of the arrows **3—3** of FIGURE 4 to more fully illustrate the transfer mechanism including mechanism for controlling the transference of material to a rearward portion of the drum and the discharge of material from the drum, portions of said view being broken away at various axial positions to more fully illustrate other portions of the transfer mechanism;

FIGURE 4 is an enlarged, fragmentary, vertical longitudinal cross sectional view generally taken along the line and in the direction of arrows **4—4** of FIGURE 3, the control doors being shown in the solid lines in a position for retaining material already in the drum in the drum, the bottom retaining door being shown in dotted lines for permitting material in the drum falling into the scoops, and the top control door being shown in dotted lines for permitting material elevated by the scoops to descend onto the chute to be conveyed to the rearward portion of the drum;

FIGURE 5 is a vertical transverse sectional view generally taken along the line and in the direction of arrows **5—5** of FIGURE 6 to illustrate the second embodiment of the particulate material mixing machine of this invention; and

FIGURE 6 is a fragmentary, vertical longitudinal cross sectional view generally taken along the line and in the direction of arrows **6—6** of FIGURE 5, the control doors being shown in solid lines in a position for retaining material in the drum as the drum is rotated, the dotted line position of the lower door being for transferring material in the drum into the scoops to permit the material from the drum being elevated by the scoops, and the dotted line position of the chute controlled door illustrating the position for permitting material to descend onto the chute to be delivered to a rearward portion of the drum.

Referring in particular to FIGURES 1 and 2 there is illustrated a perspective view and a longitudinal horizontal cross sectional view of the particulate material mixing machine, generally designated **10**, of the first embodiment of the invention. The apparatus **10** includes a large cylindrical drum **11** having a tubular outer wall **12** and a rear end wall **13** mounted to revolve on its axis and supported on a stationary shaft **21**. The stationary shaft **21** at either axial end is mounted on appropriate portions of the frame members of the frame generally designated **14**, by clamp members **24**.

There is provided a stationary hood, generally designated **15**, having a tubular outer wall **16** and a stationary end wall **17**, the tubular outer wall **16** being of a substantially larger diameter than tubular wall **12** and concentrically located relative to the front axial end portion of the drum. As may be noted from FIGURES 2 and 4,

a portion of a tubular wall **16** overlays a portion of the tubular drum wall. Extending axially through the drum and at one end projecting through the end wall **13** and at the opposite end through the end wall **17** is the aforementioned shaft **21**. Rotatably mounted on the shaft adjacent the end wall **13** is a bearing **28**. A plurality of radial spider members **26** are at their one ends fixedly connected to the bearing **28** and at their opposite ends to the drum wall **12**. The adjacent edges of the spider members may also be welded to the drum end wall **13**. At the opposite axial end of the drum wall **12** there is provided a plurality of radially extending spider members **27**, each of which are at one end welded to the flanged bearing **29** that mounts said spider members **27** for rotation on the stationary shaft and at the opposite end are welded to the inner peripheral surface of the drum wall **12**. As may be noted from FIGURE 4, the spider members **27** are located a substantial distance axially rearwardly of the hood end wall **17**.

An annular mounting flange **32** is welded to the spider members **27** and to the forward edge of the tubular wall **12**. The outer diameter of the flange **32** is slightly less than the inner diameter of the hood tubular wall **16**; and the inner diameter is substantially larger than the maximum diameter of the radial flange **29***a* of bearing **29** but substantially less than the inner diameter of the drum tubular wall **12**. Thus flange **29***a* and flange **32** provides an annular opening **31**, other than for spider members **27** and trough and chute mechanism to be described hereinafter, to permit axial movement of material into and out of the confines of the drum outer wall.

Referring to FIGURE 4, it is to be noted that the hood has an inwardly extending annular flange **16***a* located axially opposite the mounting flange **32** from the hood end wall, a resilient annual seal member **34** being mounted on said annular flange **16***a* to bear against the tubular outer wall **12** of the drum to form a seal therewith.

In order to permit loading the drum while it is rotating, a chute **38** is welded to the hood end wall for directing material downwardly through the rectangular opening **39** provided in said end wall adjacent the lowermost axially extending portion of the hood tubular wall. That is, the lowermost horizontal edge of the opening **39** is located at a lower elevation than the lowermost portion of the tubular drum wall. In order to permit particulate material being moved through the chute **38** and port **39**, and thence transferred into the tubular drum housing while the said drum housing is rotating and at the same time to selectively retain the material within the drum there is provided the transfer mechanism generally designated **50** which includes control mechanism which will be described hereinafter.

The transfer mechanism includes the aforementioned annular mounting flange **32** and a second annular mounting flange **51** that has substantially the same outside diameter as that of flange **32** but a substantially larger inside diameter. Mounting flange **51** is fixedly attached to flange **32** and retained in axial spaced relationship by the structure to be described hereinafter. However, at this time it is to be noted that the mounting flange **51** is retained axially adjacent the hood end wall as shown in FIGURE 4 and that it is of a greater radial dimension than the maximum radial distance to the lower edge of the inlet port **39**. Further the inner peripheral edge of flange **51** is located radially more adjacent the shaft **21** than any portion of the peripheral edge of port **39**. In order to permit the flow of the material from port **39** onto the hood tubular wall in the space axially between the flanges **32** and **51**, flange **51** has a plurality of circumferentially spaced cut outs **52**.

A plurality of scoop members **54** are welded at axially opposite edges to flanges **32** and **51** respectively in circumferentially spaced relationship to extend completely around the circumference of the hood within the confines of said hood. As may be noted from FIGURE 3 each of the scoops is arcuate in transverse cross section; and if each scoop in transverse cross section is semi-circular as illustrated in the drawings, then the diameter of each scoop extends substantially co-extensive with a radial line passed through the axis of rotation of the drum. The adjacent portions of the mounting flanges **32, 51** form end walls for the scoop members. Each of the scoops opens in the direction of rotation of the drum which is indicated by arrow **56**.

Secured to the hood end wall and made up of a plurality of angularly spaced arcuate sections is an axially extending baffle, the baffle being located more closely adjacent the axis of rotation of the drum than the radially innermost portions of the scoops but closely adjacent thereto. Further the baffle is of an axial length to extend very closely adjacent to the corresponding radial portion of mounting flange **32**. The aforementioned baffle includes an arcuate section **59** that extends from approximately 270° angular position (position *r* of FIGURE 3) of the drum rotary cycle to an angular position adjacent the trailing edge of the chute inlet port **39**. A second arcuate section **60** of the baffle extends from adjacent the opposite vertical edge of inlet port **39** to a position angularly in advance of the 135° rotary position of the drum (position *m*). An arcuate bottom closure member **65** is slidably extended through an arcuate slot in the hood end wall **17** and is of an angular dimension to have opposite edges overlay the adjacent edges of baffle sections **59** and **60**. As may be noted from FIGURE 4, the bottom closure is of an axial length to in the solid line closed position have one transverse edge closely adjacent the mounting flange **32** and an opposite transverse edge portion extending exteriorly of the hood end wall. Further it is to be noted that the closure **65** may be withdrawn to a dotted line position of FIGURE 4 to open at least the major portion of the port **64** defined by adjacent longitudinal edges of the baffle sections **59** and **60**, and arcuate portions of end wall **17** and flange **32**. Either handles (for example, U-shaped) or lever mechanism may be attached to the exterior portion of the bottom closure to facilitate moving the bottom closure between the aforementioned positions.

The aforementioned baffle includes a third arcuate baffle section **61** that extends a slight angular distance on either side of about the 180° angular rotary position of the drum (position *n*). For selectively closing the port **62** defined by adjacent longitudinal edges of baffle sections **60, 61** and arcuate portions of mounting flanges **32, 51** there is provided a discharge closure member (door) **66**. As may be noted from FIGURE 3 the leading edge of this discharge closure underlies the trailing edge of baffle section **61** and the trailing edge of said closure underlies the leading edge portion of baffle section **60**. The closure **66** is slidably extended through an arcuate slot provided in the hood end wall and is of an axial length to in the closed solid line position of FIGURE 4 be closely adjacent a portion of mounting flange **32** and has an axially extending end portion located exteriorly of the hood end wall. The closure **66** may be provided with handles, or appropriate lever mechanism connected thereto, for moving the closure between the solid line position of FIGURE 4 and the withdrawn dotted line position to at least partially unblock opening **62**. In order to mount the closure **66** for slideable movement there are provided bracket members **68** and **69** at opposite longitudinal edges of the closure **66**, said brackets having shoulders against which said closure abuts to retain said longitudinal edges of the closure closely adjacent the overlying portions of the arcuate baffle sections **60** and **61**.

Slideably mounted on a second shoulder of bracket **69** to have one edge portion underlie the leading edge of baffle section **61** is a mixing control closure **70** which is of an axial length in a closed position to have one transverse edge closely adjacent a portion of mounting flange **32** and an opposite transverse edge located exteriorly of

the hood end wall **17**. The closure **70** extends through an appropriate arcuate slot in the hood end wall and is moveable from the solid line position of FIGURE 4 to a dotted line position of said figure to at least partially open the opening **71** which is substantially defined by the hood end wall **17**, the leading edge of the baffle section **61**, the angularly adjacent portion of mounting flange **32** and a mounting bracket **72** which has a shoulder for slidably mounting the leading edge portion of said closure. With reference to the brackets **68**, **69** and **72** it is to be mentioned that they are welded or otherwise fixedly secured to the hood end wall **17**. Brackets (not shown) may be mounted on the hood end wall to extend forwardly thereof to slideably support closures **65**, **66** and **70** in their withdrawn position. Also a fourth arcuate baffle section may be provided to have a trailing edge portion overlie the leading edge of closure **70**, however, if it is provided, a substantial angular space is provided between said arcuate baffle section and the trailing edge of baffle section **59**.

When the drum is rotating and feed is advanced by scoops over arcuate section **61**, and the closure **70** is withdrawn to at least a partially open position, the particulate material will fall through port or opening **71** onto the chute **75** which includes downwardly and rearwardly inclined chute portions **75***a* and **75***b*.

The chute portion **75***a* has a transverse edge secured to the hood end wall **17** and extends longitudinally directly beneath the opening **71**. A second lower transverse edge of chute portion **75***a* is located axially adjacent the angularly adjacent spider members **27**. Appropriate braces (not shown) are provided and mounted on shaft **21** or the hood end wall for retaining the chute portion **75***a* in the aforementioned position. Advantageously the chute portion **75***a* is arcuate in transverse cross section, however, it is to be understood that it may be provided with upright flanges at either longitudinal edge.

The second chute portion **75***b* has one transverse edge portion closely adjacent the spider members **27** and on the opposite side thereof from chute portion **75***a*, said one transverse edge portion being at a lower elevation than the lowermost transverse edge of chute portion **75***a*. The aforementioned edge portion of chute portion **75***b* is mounted on the stationary shaft **21** by appropriate frame members **76** which may include a clamp, an upright brace and a bracket secured to the chute portion **75***b*. Chute portion **75***b* extends within the drum a substantial distance longitudinally rearwardly in a downwardly direction, the opposite lower end being attached to the stationary shaft by frame members **77** which may include a clamp. The details of construction of frame members **76**, **77** may be widely varied within the limits of this invention and therefore it is to be understood that the specific frame members shown in the drawings are not to be a limitation on the invention.

The chute portions **75***a* and **75***b* are mounted at an angle such that particles falling or descending through opening **71** onto chute portion **75***a* will slide along said chute portion and for the most part have sufficient axially rearward motion imparted thereto to land on chute portion **75***b*. Likewise the chute portion **75***b* is mounted to be inclined at an angle so that the material received from chute portion **75***a* will descend along said chute portion **75***b* to the lower rearward end thereof. Further the difference in elevations of the lowermost end of chute portion **75***a* and the forwardmost end chute portion **75***b* is sufficient so that the majority of material will travel the axial distance between said chute portions, it being understood that a certain amount of the material will be deflected by the spider members **27** as the drum is rotated.

Located beneath the closure **66** is the inlet portion of the discharge chute **81**, said chute having an inlet opening that in a horizontal plan view is approximately the same dimension and shape as the plan view of the discharge opening **62**. The chute **81** has an inclined bottom wall **81***b* that extends axially adjacent the spider members **27** and to an elevation somewhat lower than bracket **68**. The chute top wall **81***c* extends axially slightly inwardly of the end wall **17**. The chute also includes side walls **81***d*. To the angular advanced side wall there is joined an upwardly extending rectangular portion and to the bottom wall there is joined an upright arcuate portion **81***e*. The last two mentioned portions extend to a higher elevation than the maximum elevation of the bottom wall to preclude a substantial amount of material that descends through opening **67** being carried by inertia from within the confines of the discharge chute. The chute **81** is mounted to have an intermediate portion extend through the port **82** formed in the hood end wall **17** with the inner portion being located within the confines of the hood, the remaining portion extending forwardly of the hood end wall. The chute **81** has the discharge opening **81***f* which is located at approximately the same elevation as the shaft **21** and is axially forwardly of the hood end wall.

To preclude an undesirable amount of material in the confines of the drum falling between the flange **32** and the adjacent edges of the baffle and bottom closure into the scoops, an axially extending retainer ring **87** is integrally formed with or welded to the inner circumferential edge of flange **32**. The retainer ring extends a small axial distance toward the hood end wall and is of a diameter to have adjacent portions located radially inwardly of the closures **65**, **66** and **70** and baffle sections **59**, **60** and **61** respectively but radially outwardly of the angularly adjacent portions of the discharge chute **81**.

In order to facilitate the mixing of material and movement of material from within the confines of the drum tubular wall **12** to a location axially between mounting flanges **32** and **51**, especially when the drum is in a near empty state, there is provided a plurality of troughs generally designated **85** and spiral mixing blades **86**. For the particular machine illustrated there are provided three circumferentially spaced troughs. (See FIGURES 2–4. Each of these views illustrate the troughs at the same point of the rotary cycle.) Also for the particular machine illustrated there are provided three spiral mixing blades **86** that are fixed on and projected inwardly from the interior surface of the drum wall **12**. These blades are preferably made in spiral form as indicated and angularly shaped so that each blade preferably extends circumferentially in the drum in the general neighborhood of 180° at an angle approximately 45° to a plane perpendicular to the axis of the rotation of the drum. Each blade has one end closely adjacent the drum rear end wall and an opposite end in part overlying the respective trough **85**. As the drum rotates, these blades feed material toward the troughs, and at the same time the material falling over the inner radial edges of the blades becomes more thoroughly mixed than if they were not provided.

Each of the troughs **85** is generally the same construction and is fixedly attached to the drum to rotate therewith. Accordingly the angular position of the troughs continuously varies as the drum rotates and therefore for the purposes of facilitating description of the troughs, the only trough described in this paragraph will be the one appearing at the upper left corner of FIGURE 2. The trough includes a generally planar oblique plate that is inclined downwardly in a direction towards the hood end wall **17**. In a direction at right angles to the aforementioned direction, the aforementioned plate is also inclined downwardly and outwardly at an acute angle with reference to a radial line passing through the line of juncture of the plate with the tubular drum wall. Further the transverse dimension of the edge of the oblique plate most closely adjacent the hood end wall is substantially greater than the corresponding dimension of the axially opposite end. The dimension of the first mentioned edge

of the oblique plate is sufficiently great that the oblique plate in part opens directly into an area within the confines of the retainer ring **87** in order that the trough may direct material into said area. Secured to the trailing edge of the oblique plate is a generally right angle upright flange. Accordingly as the drum rotates the trough through the lowermost elevated position of the rotary cycle, the trough directs particulate material forwardly into the confines within the retaining ring and axially between the hood end wall **17** and the spider member **27**. The excess material that cannot be handled in the last mentioned area falls over the free edge of the upright flange and descends to the general level of the material in the drum to facilitate a more thorough mixing of material in the drum. In order to support each trough there are provided braces. A more detailed description of the troughs and the mounting thereof can be found in the previously mentioned co-pending application of mine which was filed the same day as this application.

Mounted in the rear end of the drum are a pair of baffles **90**, one being on either diametric side of the bearing **28** and having a longitudinal edge attached thereto. Each of the baffles **90** includes a generally planar portion **90***a* located substantially in a common plane of the axis of rotation of the drum, the rearward edge of the portion **90***a* being secured to an edge of the adjacent spider member **26** or else overlying the respective spider member. Each of the baffles also includes an inclined triangular portion **90***b* that has a rearward edge integral with the forward edge of the respective portion **90***a*. Portions **90***b* form an obtuse angle with portions **90***a* to open in a direction opposite the direction of rotation of the drum. The portions **90***a* are diametrically opposed to one another and the triangular portions **90***b* are oppositely inclined in an axial direction away from the stationary hood. Thus the rotation of the drum and baffle portions **90***a* impart a generally circulating motion to the feed about an axis parallel to the axis of rotation of the drum. In addition to the aforementioned circulating action, the axially inwardly and rearwardly inclined surfaces of portions **90***b* of the baffles **90** impart a generally circulating action to the feed in circles about an axis extending generally perpendicular to the axis of rotation of the drum. Thus due to the baffles inclined surfaces **90***b* a more thorough mixing action is provided than if surface portions **90***b* were not provided. As an example of the slope of surface portion **90***b* but not as a limitation thereon, the edge **90***c* may extend about a 45° angle relative to the axis of rotation of the drum while the upper planar surface **90***b* of the left hand baffle of FIGURE 2 forms approximately a 30° angle with the horizontal when the plane of portions **90***a* is horizontal.

Suitable power actuating mechanism for the drum **10** is diagrammatically shown in FIGURE 1 and may comprise an electric motor **95** operably connected through suitable speed reduction mechanism **96** to a sprocket chain and ring gear **97** affixed on the outer periphery of the tubular wall of the drum. Thus the drum may be rotated at a suitable speed, usually in the order of two to five r.p.m. in the direction of the arrow **56**.

The structure of the first embodiment of the invention having been described, the operation thereof will now be briefly set forth. Assuming that the drum is in an emptied condition, and being rotated and closure members **65**, **66** and **70** are closed, the particulate material to be mixed is dumped into chute **38** where under the action of gravity it flows through the hood inlet port **39** and thence through the cut outs **52** of the mounting flange **51** that are located adjacent the inlet port **39**. The material flows through the cut outs under the action of the gravity to the bottom of the hood tubular wall **16** to be located adjacent position *j* (0° drum rotary position) axially between flanges **32**, **51** and circumferentially between angularly adjacent pair of scoops **54**. As the drum rotates to move a scoop from position *j* angularly in advance in the direction of rotation of the drum (arrow **56**) to a more elevated condition, the material is precluded from falling into the confines of an annular formed geometric extension of the retainer ring and axially between end wall **17** and spiders **27** by baffle section **60**. Thus as a scoop is angularly advanced from a position generally in the area of position *j*, the material being moved over the hood tubular wall moves radially inwardly over the scoop toward baffle section **60**, and subsequently in advance of position *k*, is largely moved over section **60**.

As the scoop advances the material angularly to position *m*, it is moved over the closure member **66**, provided said closure member is in a closed position, thence over the baffle section **61** to position *n*; and if the closure **70** is in a closed position thence to position *p* where the material descends to fall upon the radially inner surface of baffle section **59** and subsequently onto the radially inner surface of closure **65** and baffle section **60**. The material continuously builds up on the inner surfaces of baffle sections **59**, **60** and closure **65** and subsequently overflows the retainer ring **87** to be within the confines of the drum tubular wall **12**. At this time the material within the drum is lifted by a trough and due to the inclination of the trough, is moved from about the *j* position toward about a 90° drum rotary position to be directed back into the space above baffle sections **59** and **60** and closure **65**. As additional material is fed through the chute **38** and transferred into the drum in the aforementioned manner, the level builds up in the drum adjacent the mounting flange sufficiently to be of a greater depth than the height of the mixing blades at their lowermost angular position and accordingly falls over the top of the mixing blades and gradually works to the end **13** of the drum. This procedure will continue until the drum is loaded, all the time the material being continuously mixed.

In order to expedite the mixing of the material, prior to or about the time material is being fed into chute **38**, the closure **70** is withdrawn to an open condition. Accordingly as material flows through the chute **38** to the *j* position and subsequently carried through the action of the scoops to the *n* position, instead of flowing over the advanced edge of the bracket **72** or arcuate baffle section if provided, the material falls through the opening **71** onto chute portion **75***a*. The material falling onto chute portion **75***a* descends to the lower end thereof and other than for that deflected by the rotary movement of the spider members **27**, thence onto chute portion **75***b*. Material flows over chute portion **75***b* toward the rearward end of the drum. When the drum is empty, or nearly empty, all the material falling off of the rearward end of chute **75***b* is caused to move axially toward the hood end wall **17** through the action of the spiral flanges and the troughs to subsequently fall onto the inner surfaces of baffle section **60** and closure **65** and subsequently onto the baffle section **59**. However the level of material gradually builds up throughout the drum as it is loaded. As the result of providing the chute **75**, material is more thoroughly mixed in a much shorter period of time than if the chute **75** were not provided. Accordingly during the machine loading step and during most of the mixing operation the closures **66** and **65** are in a closed position and the closure **70** is in an opened condition.

After the machine has been loaded and the material sufficiently mixed, loading through the chute **38** is discontinued and the closure **65** is moved to an opened condition and the closure **66** is likewise moved to an opened condition. Optionally the closure **70** may be moved to a closed condition. As the result of the closure **65** being moved to an opened condition the material being fed toward the hood end wall through spilling over the retaining ring **87** flows downwardly through the now unblocked opening **64** between baffle sections **59** and **60** to

adjacent position *j*. Material falling to the position *j* is angularly advanced by the immediately angularly rearward scoop to position *m* and thence descends through the opening **62** to the inlet of the chute **81**. The material falling through the inlet of the chute **81** passes through the outlet **81***f* into a bag or a suitable receptacle. The spiral blades and troughs continuously feed material axially forwardly over the retaining ring **87** to subsequently be carried by scoops to an elevated position to be discharged through the chute **81**. This process is continued until the drum is substantially empty. After the drum has been emptied, the closures **65** and **66** are again moved to a closed condition and the closure **70** moved to an open condition, provided, that it had not been left in an open condition.

Two advantages of the first embodiment of this invention over that described in my co-pending application and patent are that material is positively conveyed to a rearward portion of the drum and it utilizes fewer moving parts that move relative to the rotation of the drum while at the same time the drum is loaded while it is rotating.

The first embodiment of the invention having been described, the structure of the second embodiment, generally designated **125**, will now be set forth. The second embodiment of the invention is illustrated in FIGURES 5 and 6. The machine **125** includes a large cylindrical drum having a tubular outer wall **127** and a rear end wall (not shown) rotatably mounted on the stationary shaft **128** by spider members **133** and flange bearing **134** at the front end portion of the shaft, and spider members and a bearing (not shown) at the opposite axial end of said shaft. The shaft **128** at either axial end is clamped to the frame **132** through clamps **129**. The clamps and end portions of the shaft may advantageously be provided with cooperating key and key way portions, or other structure may be provided, to prevent the shaft rotating.

There is provided a stationary hood, generally designated **130**, having an axially extending arcuate wall portion **131** that extends over a portion of approximately the upper angular one half of the tubular drum wall **127** in a manner corresponding to the extension of the upper half of the hood tubular wall over the drum tubular wall of the first embodiment. Vertical, axially extending flanges **135** are formed integral with opposite lower edges of the arcuate wall **131** to depend therefrom, there being a hood end wall **136** joined to the forward edges of the arcuate wall **131** and vertical flanges **135**. One end portion of shaft **128** extends through the central portion of the hood end wall **136**, while the opposite end extends through the drum rear end wall (not shown) and is affixedly attached through the aforementioned spider members and bearing (not shown) to the rear end of the drum outer wall **127** such that the rear wall and wall **127** rotate relative to shaft **128**.

Located generally diametrically opposite the top portion of the arcuate wall **131** is a loading bin **139** of generally the same construction described in U.S. Patent 3,088,711 into which the material to be transferred into the drum is fed. The bin has an appoximately semicircular bottom wall **139***a*, preferably having a radius of curvature corresponding to that of the drum wall **127**, that at the forward end is attached to the hood end wall **136**, and a longitudinally rearwardly and upwardly inclined rear wall **139***b* having an arcuate flange. As may be noted from FIGURE 5, the upper longitudinal edges of the bottom wall **139***a* abut against the respective hood flange **135** at an elevation substantially above the lowermost part of the drum tubular wall and substantially below the junction of wall **131** and flanges **135**.

The hood end wall has an inlet port **146** opening onto the inner surface of the bottom wall **139***a*, there being a chute **138** with a grilled floor plate **138***a* through which material is fed into the chute by gravity flow to be directed through inlet port **146** onto the loading bin bottom wall. To be noted is that the upper horizontal edge of inlet port **146** is located at a lower elevation than the lowermost portion of the drum tubular wall.

A generally annular resilient seal member **142** is fixedly attached to the rearward edge of the arcuate wall **131** and the flange portion of the loading bin rear wall **139***b*, which is shaped to form a continuation of the axial rear portion of wall **131**, to generally form a fluid seal with the drum outer wall **127** as the drum rotates relative to said seal and members **131** and **139***b*. Thus the hood which includes the loading bin encloses the forward end portion of the drum.

In order to transfer material from the loading bin to an area within the confines of the drum tubular wall **127** there is provided the transfer mechanism generally designated **150**. The transfer mechanism **150** includes axially spaced annular mounting flanges **151** and **152**, the mounting flange **152** being closely adjacent the hood end wall **136**. A retainer ring **187** is integrally joined to the inner peripheral edge of flange **151** similarly as described with reference to ring **87**. The mounting flange **151** at its outer peripheral edge is welded to the front edge of the drum outer wall **127**. A plurality of circumferentially spaced arcuate wall sections **158** are provided, the forward edge of each wall section being welded to the adjacent outer peripheral edge of the mounting flange **152** and the opposite edge advantageously being integrally formed with the forward edge of the tubular drum wall **127**. The adjacent axially extending edges of a pair of arcuate wall portions **158** together with intermediate portions of the mounting flanges **151** and **152** define a scoop opening **154**, the openings **154** being located axially to be verticaly above the bottom wall of the loading bin.

A series of scoops (generally of the construction described in U.S. Patent 3,088,711), generally designated **156**, are pivotally supported on circumferentially spaced horizontal rods **159** which are located adjacent the leading edge of the respective scoop opening **154**. The ends of each rod are respectively attached to an inner peripheral edge portion of mounting flange **152** and an axially opposite portion of the mounting flange **151**. Each scoop has a leading outer axially extending edge **160** adapted to to slide along the arcuate wall **139***a* of the loading bin to gather material through an outer opening **164** at the outer edges of the scoop. There is also an inner opening **162** at the inner side of the scoop from which the material is discharged as hereinafter described.

Each scoop has axially spaced somewhat triangular shaped wall portions (triangular plates) **155**, the rod **159** being extended through the apex portions thereof, and an arcuate wall **153** joined to the correspondingly curved base edges of portions **155**. The inner edge of each generally triangular plate is of a substantially greater length than the outer edge. A flanged cross brace **157** is attached to the apexed portions of the triangular plates.

The leading edge **160** of the scoop arcuate wall, the outer edges of the triangular plates and a longitudinal edge of the cross brace define the outer opening **164** of a scoop. The inner opening **162** is defined by the inner edges of the triangular plates, the inner edge **161** of the scoop arcuate wall and the respective edge of the cross brace **157**.

Secured to the adjacent portions of the hood end wall, and made up of a plurality of angularly spaced arcuate baffle sections is an axially extending baffle. The aforementioned baffle is located radially closely adjacent the inner peripheral edge of the mounting flange **152**, and is of an axial length to extend very closely adjacent to the corresponding radial portion of the mounting flange **151**. The baffle includes an arcuate section **167** that extends from approximately the 270° angular position (position *x*) of the drum rotary cycle to an angular position substantially directly above the trailing edge of the inlet port **146**. A second arcuate section **168** of the baffle extends

from angularly adjacent the opposite edge of the inlet port **146** to a position angularly in advance of the 135° rotary position of the drum to the angular location *u*. An arcuate bottom closure member **169** is slideably extended through an arcuate slot in the hood end wall **136** and is of an angular dimension to have opposite longitudinal edges overlay the adjacent edge portions of baffle sections **167, 168**. As may be noted from FIGURE 5 the bottom closure is of an axial length to in the solid line position have one transverse edge closely adjacent the mounting flange **151** and an opposite edge portion extending exteriorly of the hood end wall **136**. The closure **169** may be moved between the axial positions described relative to the bottom closure of the first embodiment of the invention for selectively opening and blocking the port **146** which in part is defined by adjacent longitudinal edges of baffle sections **167** and **168**.

The aforementioned baffle includes a third baffle section **171** that extends a slight angular distance on either side of about the 180° angularly rotary position of the drum (adjacent position *v*). For selectively opening and closing the port **172**, defined by adjacent longitudinal edges of baffle sections **168, 171**, there is a discharge closure member **173**. One longitudinal edge of the discharge closure underlies the adjacent edge portion of the baffle section **168**. The closure **173** is slideably extended through an arcuate slot provided in the hood end wall and is slidably mounted in said position by structure corresponding to that described relative to the first embodiment. A mixing control closure **176** has one longitudinal edge underlying the adjacent edge portion of the baffle section **171**, and an opposite edge underlying a baffle section **177** that is of a relatively small angular dimension and located angularly in advance of the baffle section **171** at angular location *w*. The closure **176** is slidably extended through an arcuate slot provided in the hood end wall **136** and is mounted by structure similar to that described by the first embodiment for movement between a withdrawn position at least partly opening the port **178** between the adjacent longitudinal edges of baffle sections **171, 177** and a position closing said port **178**. Similarly as with the first embodiment, the baffle section **167, 168, 171** and **177** have the forward edges fixedly secured to adjacent inner surface portions of the hood end wall **136**. Also suitable braces (not shown) may be provided for supporting the baffle sections of each embodiment in the above described relationship.

When the drum is rotating to advance a scoop from approximately the 0° rotary position (position *s* of FIGURE 5) to the 90° (*t* position) the outer edge **160** of the scoop slides along the bottom wall **139***a* of the loading bin. Due to the curvature of said bottom wall, the scoop is pivoted about the rod **159** such that the inner edge **161** is successively brought more closely adjacent the baffle as the drum advances the scoop from the *s* position to the *t* position. The bottom wall of the loading bin and the baffle section **168** are curved such that when the outer edge **160** of the scoop is adjacent the *t* position, the inner edge **161** will abut against the arcuate baffle section **168** and the feed on the scoop arcuate wall will move inwardly towards said baffle section as the scoop is moved from the *t* position to the *u* position. The feed is then carried over the baffle section **168** to the *u* position where it is brought directly over the port **172**. When the closure **173** is moved to at least partly open port **172**, the particulate material carried by the scoop will fall through the port **172** into the inlet opening of the discharge chute **170**. In this connection it is to be noted that the discharge chute **170** is of substantially the same construction and at a similar location as the discharge chute of the first embodiment, and functions in a similar manner; and therefore will not be further described.

Angularly in advance of the discharge chute and underlying the closure member **178** is the upper portion **180***a* of the longitudinally extending, rearwardly and downwardly inclined chute **180**, portion **180***a* being mounted on the hood end wall. The rearward, lower portion **180***b* of the inclined chute **180** is mounted on the stationary shaft by frame member **182** and frame members (not shown) in the manner described relative to the first embodiment. Thus, the mounting of chute portion **180***a* and **180***b* and their functions correspond to that of chute portion **75***a* and **75***b* of the first embodiment.

The second embodiment of the mixing machine **125** also includes a plurality of troughs **184** and spiral mixing blades **185** that are of a construction and mounted similarly to troughs **85** and mixing blades **86** of the first embodiment of the invention. Likewise the machine **125** includes baffles at the rearward end of the drum (not shown) that correspond to baffles **90** of the first embodiment. As the construction of the rearward end of the drum of the machine **125** and the structure mounted therein advantageously may be of the same construction as that described relative to the corresponding parts of the first embodiment of the invention it has not been illustrated nor will be further described. Also the structure for drivingly rotating the drum of the machine **125** relative to shaft **128** and the stationary hood **130** is the same as that illustrated and described relative to the first embodiment.

The structure of the second embodiment of the invention having been described, the operation thereof will now be briefly set forth. Assuming that the drum is in an emptied condition and being rotated, and that closure members **169, 173** and **176** are each in a closed solid line condition; the particulate material to be mixed is dumped into the loading chute **138** through the grilled top plate **138***a* where under the action of gravity the material flows through the hood inlet port **146** and thence onto the floor **139***a* of the loading bin **139** to be located adjacent position *s* beneath and axially between flanges **151** and **152**. As the drum rotates, the scoop **156** angularly rearwardly of the port **146** is advanced to be adjacent port **146** and has its outer edge **160** abutting against the bottom wall of the loading bin to gather material into opening **164** and to drag the material over the loading bin bottom wall. As this scoop is carried by the rotation of the drum angularly toward the *t* position, the scoop is pivoted about its rod **159**, due to the curvature of the bin bottom wall, such that the inner edge **161** is progressively moved to be more closely adjacent the arcuate baffle section **168**. As this scoop is advanced past the *t* position, through the action of gravity, it pivots such that the inner edge **161** abuts against the baffle section **168** to thereby prevent material falling out of the scoop and thence descending to a lower level. Also at this time the material carried by the scoop moves over the scoop arcuate wall **153** to be more closely adjacent baffle section **168** and subsequently through the inner scoop opening **162** to be dragged over baffle section **168**.

As the scoop advances the material angularly to position *u*, the material is moved over the closure member **173**, provided said closure member is in a closed position, thence over the baffle section **171** to position *v*; and if the closure **176** is in the closed position, thence to position *w* where it descends to the radially inner surface of baffle section **167**. Material thus continuously builds up on the inner surfaces of baffle sections **167, 168** and closure **169** to subsequently flow rearwardly over the retainer ring **187** to be within the confines of the drum tubular wall **127**. At this time the material flowing into the drum is lifted by the troughs **184** to be moved back axially over the retainer ring onto members **167, 168, 169**. Subsequently the level of the material builds up throughout the drum in the manner described relative to the first embodiment.

In order to expedite mixing material, prior to or about the time the material is fed into the chute **138**, the closure member **176** is moved to an open condition. Accordingly as the material is moved over the leading edge of the

baffle section **171** (*v* position) it descends through opening **178** to fall onto chute section **180***a* of chute **180** rather than being carried to the *w* position. Material falling on chute section **180***a* is rearwardly directed through gravity flow to fall on chute section **180***b*, and subsequently off the rearward edge of said chute onto the rearward bottom portion of the drum. The material in the rearward portion of the drum is constantly directed in an axially forward direction (arrow **188**) through the provision of the spiral baffles. By leaving the closure **176** in open condition during the loading operation, material is more thoroughly mixed in a much shorter period of time than if the chute were not provided. Accordingly during the machine loading step and during at least most of the mixing operation, the closure **176** is in an open condition and the closures **173** and **169** are in closed positions.

After the material has been thoroughly mixed, the closure **169** is moved to an opened condition, closure **173** to an opened condition, and optionally closure **176** to a closed condition. By opening closure **169**, the material located on the inner peripheral surfaces of baffle sections **167** and **168** flows through the port **146** that is in part defined by adjacent longitudinal edges of said baffle sections to move radially onto arcuate plates **158** or through the scoop opening **162** therebeneath. In the event that the material falls on an arcuate plate **158**, as the drum is rotated, the material slides angularly rearwardly to fall through the angularly rearwardly adjacent opening **154** and inner scoop opening **162** to thence be carried by the scoop to positions *t* and then to position *u* as previously described. Since at this time the closure **173** is open, upon the material being moved to position *u*, it descends through port **172**, next through the inlet opening of the discharge chute **170** and is then discharged through the chute outlet into sacks or suitable receptacles placed at or below said chute outlet. During this time the spiral blades and the troughs continuously feed material axially forwardly (arrow **188**) over the retaining ring to subsequently pass through the port **146** intermediate baffle sections **167** and **168** to be carried by the scoops to the position *u* and thence discharged. After the drum has been emptied, the closures **169** and **173** are again moved to a closed position and the closure **176** moved to an open condition, provided it had previously been closed.

For the most part of the rotary cycle of the drum, the scoops are limited in their "inward radial pivotal movement" about their respective pivot rods **159** through the provision of baffle sections **168**, **167**, **171** and **177**. In the event the closure members **173**, **176** are in a fully opened condition, the aforementioned inward radial movement is limited by the retainer ring; and likewise when a scoop is moved angularly between adjacent edges of baffle sections **167** and **177**, the pivotal movement thereof is limited by the retainer ring. During a portion of the angular movement of the scoops, adjacent positions *t* and *x*, the maximum outward movement of the scoops about their pivots **159** is limited by the angularly adjacent portions of the vertical flanges of the hood. To be mentioned is that the illustrated radial spacing between the retainer ring and angularly adjacent baffle sections of the transfer means is somewhat exaggerated in order to more clearly illustrate these members.

As an example of approximate dimensions of one size of the machine of the first embodiment but not as a limitation on the invention, the machine exclusive of the discharge chute may be 6′ 1″ long, the tubular wall **12**, 6′ 2″ in diameter, the axial distance between outer radial surfaces of flanges **32**, 51 one foot, the transverse width of the discharge chute 10″, the transverse horizontal width of the chute **75** about one foot, the axial horizontal length of chute portion **75***b* 3½′ and the vertical height of the lower transverse edges of chute portion **75***b* 18″ above the vertical adjacent lower portion of the tubular drum wall **12**.

As many widely apparently different embodiments of this invention may be made without departing from the spirit and scope thereof, it is to be understood that I do not limit myself to the specific embodiments herein.

What I claim is:

1. In a machine for mixing particulate material, a frame, a generally horizontal shaft mounted on said frame, a drum having a tubular wall and a rear end wall mounted on said shaft to revolve about the shaft axis, means for rotating the drum in a given direction, a stationary hood having an end wall at the opposite axial end of said tubular wall to enclose the opposite end of said tubular wall, hood and drum cooperating generally annular means, in part mounted by said hood, and in part by said drum to rotate therewith, for elevating material from a vertically lower position as the drum is rotated, and selectively discharging the elevated material exteriorly of said hood and alternately positively conveying the elevated material toward the drum rear wall as the drum is rotating and means connected to said hood for feeding material into the hood under the flow of gravity to a lower angular portion of the drum cooperating means.

2. The structure of claim **1** further characterized in that the drum cooperating means includes a plurality of circumferentially spaced scoops and means for mounting said scoops on the drum in the aforementioned relationship for rotation therewith and that the hood cooperating means includes a plurality of circumferentially spaced arcuate baffle sections mounted on the hood adjacent the scoops and radially inwardly thereof to limit the radial movement of material and closure means mounted on the hood to selectively permit radial movement of material that has moved axially forwardly from the drum between two baffle sections to the angularly lower scoops to be elevated thereby, a discharge chute on the hood end wall having an inlet opening underlying a scoop in an upward vertical angular position and closure means vertically located between the last mentioned scoop and the discharge chute inlet opening and angularly adjacent the trailing edge of one of said baffle sections for alternately permitting material carried by a scoop over the last mentioned baffle section to flow into the discharge chute and to block the discharge chute inlet opening.

3. The structure of claim **1** further characterized in that the hood cooperating means includes a chute portion mounted on the hood end wall to extend axially beneath an upper annular portion of the drum cooperating means and inclined axially rearwardly in a downward direction and moveable means for alternately blocking flow of material from said upper annular portion to said chute portion and permitting flow into said chute portion.

4. The structure of claim **3** further characterized in that said shaft is stationarily mounted on the frame and that a second rearwardly inclined chute portion is mounted on said shaft within the confines of the drum to receive material from the first mentioned chute portion and convey it toward the drum end wall.

5. A machine for mixing particulate material comprising a frame, a generally horizontal, longitudinally extending stationary shaft mounted on said frame, a drum having a tubular wall and a rear end wall at one end of said tubular wall rotatably mounted on said shaft and having the shaft extended through said rear end wall, a stationary hood having an end wall with the shaft extended therethrough to enclose the opposite end of the tubular wall, generally annular means mounted on said opposite end of said tubular wall for elevating material from a lower annular portion of said hood, a discharge chute mounted on said hood to in part extend beneath an annular upper portion of said material elevating means at a higher elevation than said shaft and in part exteriorly of said hood for discharging the elevated material as it descends, longitudinally extending rearwardly and downwardly inclined chute means having one portion mounted by said hood to extend beneath an annular upper portion

of said material elevating means and a second portion mounted on said stationary shaft axially within said tubular wall for positively conveying descending elevated material toward said drum rear wall, and baffle and control means mounted on said hood to extend axially toward said rear wall for acting in conjunction with said elevating means for selectively controlling the flow of material to be discharged through said discharge chute, to be directed rearwardly by said chute means and to permit material moved axially forwardly in the drum into the confines of said elevating means to move radially into said elevating means to be elevated thereby.

6. The structure of claim **5** further characterized in that the elevating means includes an annular mounting flange joined to said opposite axial end of the tubular wall and a plurality of circumferentially spaced scoops connected to said mounting flange, that said baffle and control means includes two arcuate baffle sections overlying angularly lower scoops, said baffle sections having angularly spaced longitudinal edges at a lower elevation than said shaft and a transverse edge closely adjacent said mounting flange and a closure member mounted on said hood for movement to in one position block the flow of material downwardly between said adjacent longitudinal edges to the scoops there beneath and alternately to permit the aforementioned radial movement of material.

7. The structure of claim **6** further characterized in that one of the aforementioned baffle sections has a leading longitudinal edge closely adjacent an angularly rearward edge of the discharge chute, and that said baffle and control means includes a second closure member on said hood for movement to in one position block the flow of material moved by said scoops into said discharge chute and to in a second position permit the aforementioned discharge of material.

8. The structure of claim **7** further characterized in that said baffle and control means includes a third baffle section underlying an upper angular portion of the elevating means and having one longitudinal edge closely adjacent the leading longitudinal edge of the second closure member so that with said second closure member in a material blocking condition material is carried thereover onto said third baffle section by the material elevating means and a second longitudinal edge above and adjacent the trailing edge of the first mentioned chute portion.

9. The structure of claim **8** further characterized in that said hood includes a loading bin, that said elevating means includes a second annular mounting flange closely adjacent said hood end wall and circumferentially spaced arcuate wall sections extending between the outer peripheral portions of said mounting flanges to define scoop openings, said loading bin extending to a substantial lower elevation than the radially adjacent arcuate wall sections and being axially located therebeneath and means for mounting said scoops on said flanges including the aforementioned connection to the first mentioned mounting flange to pivot through the respective scoop opening to extend into the loading bin and a retained position entirely radially more closely adjacent the shaft axis than the periphery of said scoop opening.

10. The structure of claim **8** further characterized in that said elevating means includes a second annular mounting flange closely adjacent the hood end wall and that said scoops are fixedly attached to said second flanges.

11. In a machine for mixing particulate materials a frame, a generally horizontal stationary shaft mounted on said frame, a drum having a tubular wall and a rear end wall at one end of said tubular wall rotatably mounted on said shaft, a stationary hood having an end wall at the opposite axial end of said tubular wall to enclose said opposite end of the tubular wall, annular transfer means on said opposite end of the tubular wall and axially within said hood for elevating material from a lower portion of the hood as the drum is rotating, and permitting it to discharge from said elevated condition toward a lower annular portion of said hood, means connected to the lower portion of said hood for under the flow of gravity directing material to the lower angular portion of the transfer means to be elevated thereby, a discharge chute on said hood end wall in part extending beneath an upper annular portion of said transfer means and having an inlet opening beneath said upper portion of said transfer means, means mounted on said hood for movement between a position blocking said discharge chute inlet opening and a second position permitting elevated material to fall into said discharge chute inlet opening, means located at least in part beneath an upper annular portion of the transfer means for directing elevated material toward said rear wall and means mounted on said hood for movement between a position blocking the flow of elevated material to said material directing means and a second position permitting elevated material to fall onto said material directing means to be directed toward said rear wall.

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