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Phillips

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[54] **PARTICULATE MATERIAL MIXING MACHINE HAVING SEALING MECHANISM**

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[51] **Int. Cl.** **B01f 9/06**

[58] **Field of Search** ..... 259/3, 14, 30, 81 R, 89, 259/57, 81 A, 90, 175, 176, 177 R, 177 A

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Primary Examiner—R. Jenkins
Attorney, Agent, or Firm—Dugger, Johnson & Westman

[57] **ABSTRACT**

A particulate material mixing machine having a rotatable open ended drum with scoops fixedly attached thereto to elevate material within a stationary hood enclosing the drum open end and material received from a stationary hopper within the drum. Drum mechanism elevates material and directs it into the hopper, a baffle attached to the hood blocking any substantial flow of material from the drum to the scoops except that which passes through the hopper. The hood has an annular flange mounting a seal member to abut against the drum. The elevating mechanism includes annular mounting members having the scoops joined thereto, the mounting member adjacent the seal having cut outs opening between the seal and mounting member. The last mentioned mounting member has vanes to direct feed back through the cut outs (away from the seal) as the drum is rotated. Retainer plates extend between the scoops adjacent the cut outs and are radially adjacent the hood tubular wall portion. The hood has a discharge chute for receiving material elevated by the scoops, a top charging inlet for receiving the bulk of the material, and a charging chute to receive small quantities of material. The drum has front inclined troughs for directing material in a direction away from the hood and rear inclined troughs for directing material in the opposite direction.

18 Claims, 5 Drawing Figures

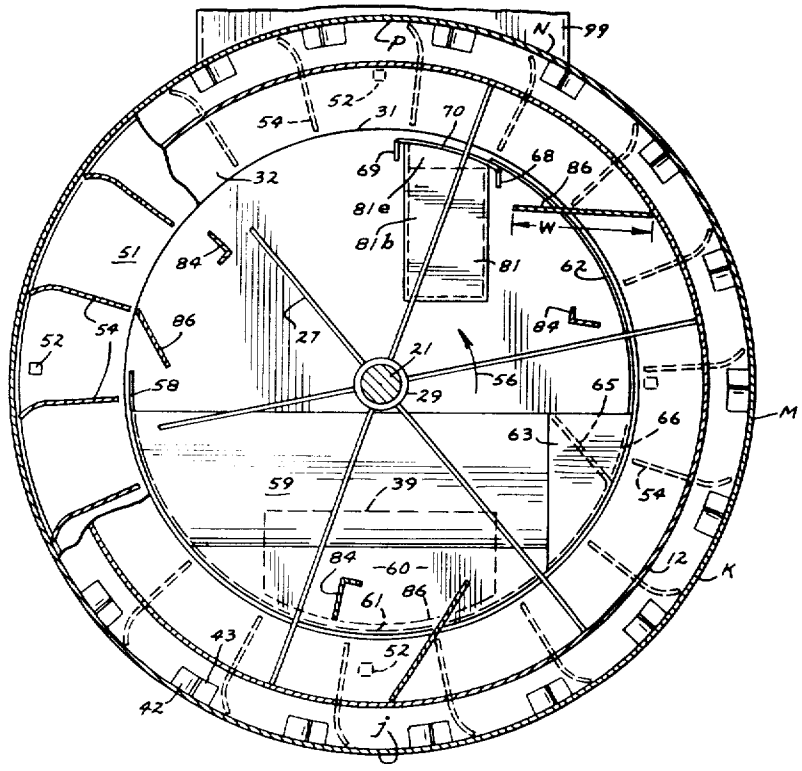


FIG. 1

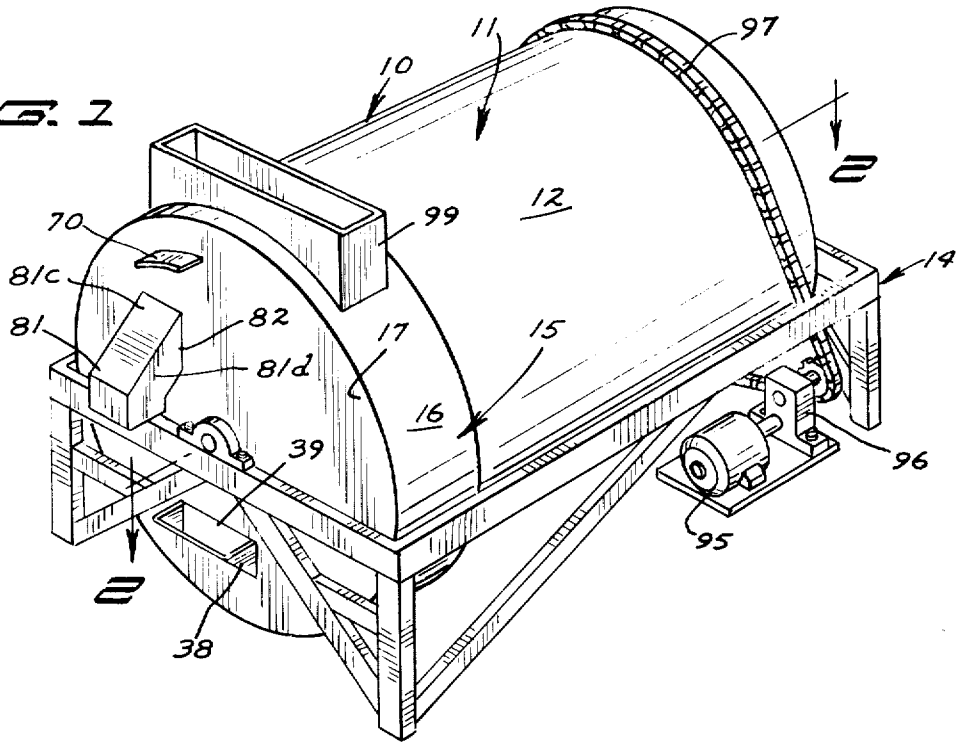
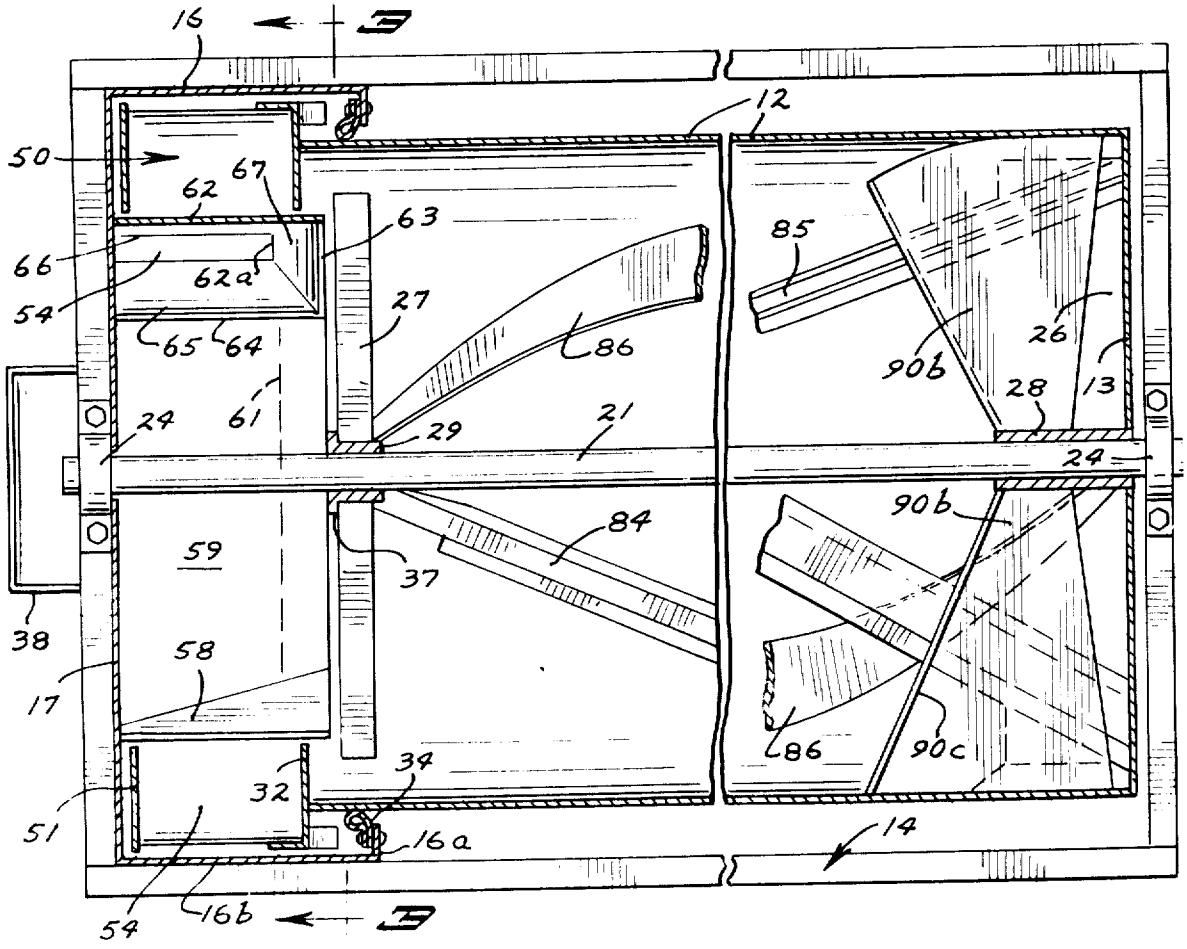

11
97
10
2
12
99
70
14
81c
82
81
17
15
81d
16
39
96
95
2
38

FIG. 2


16
3
12
50
67
62
63
85
66
62a
27
54
65
64
86
26
90b
28
13
61
24
29
21
24
59
84
90b
37
38
58
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32
51
16a
14
54
16b
3

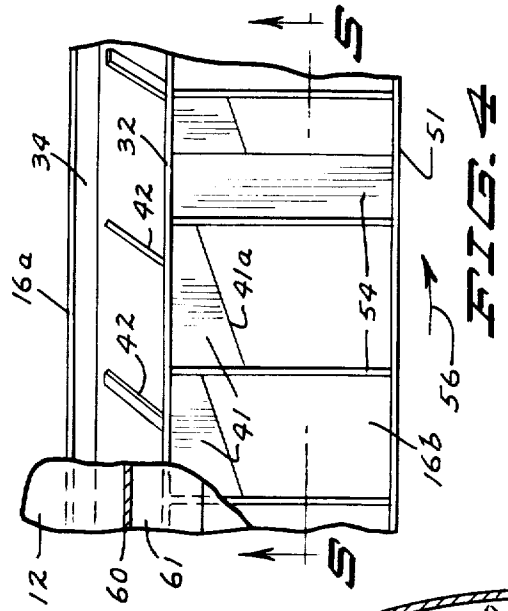


FIG. 4

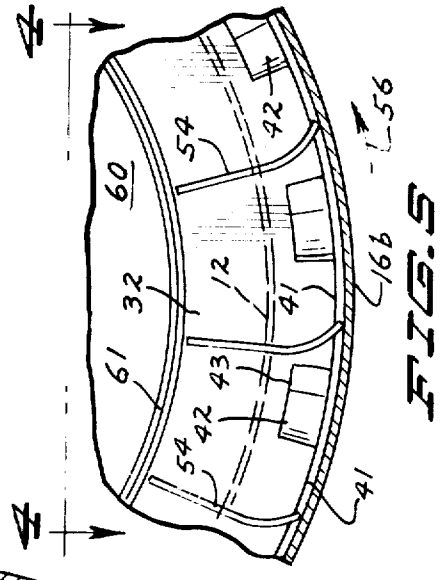


FIG. 5

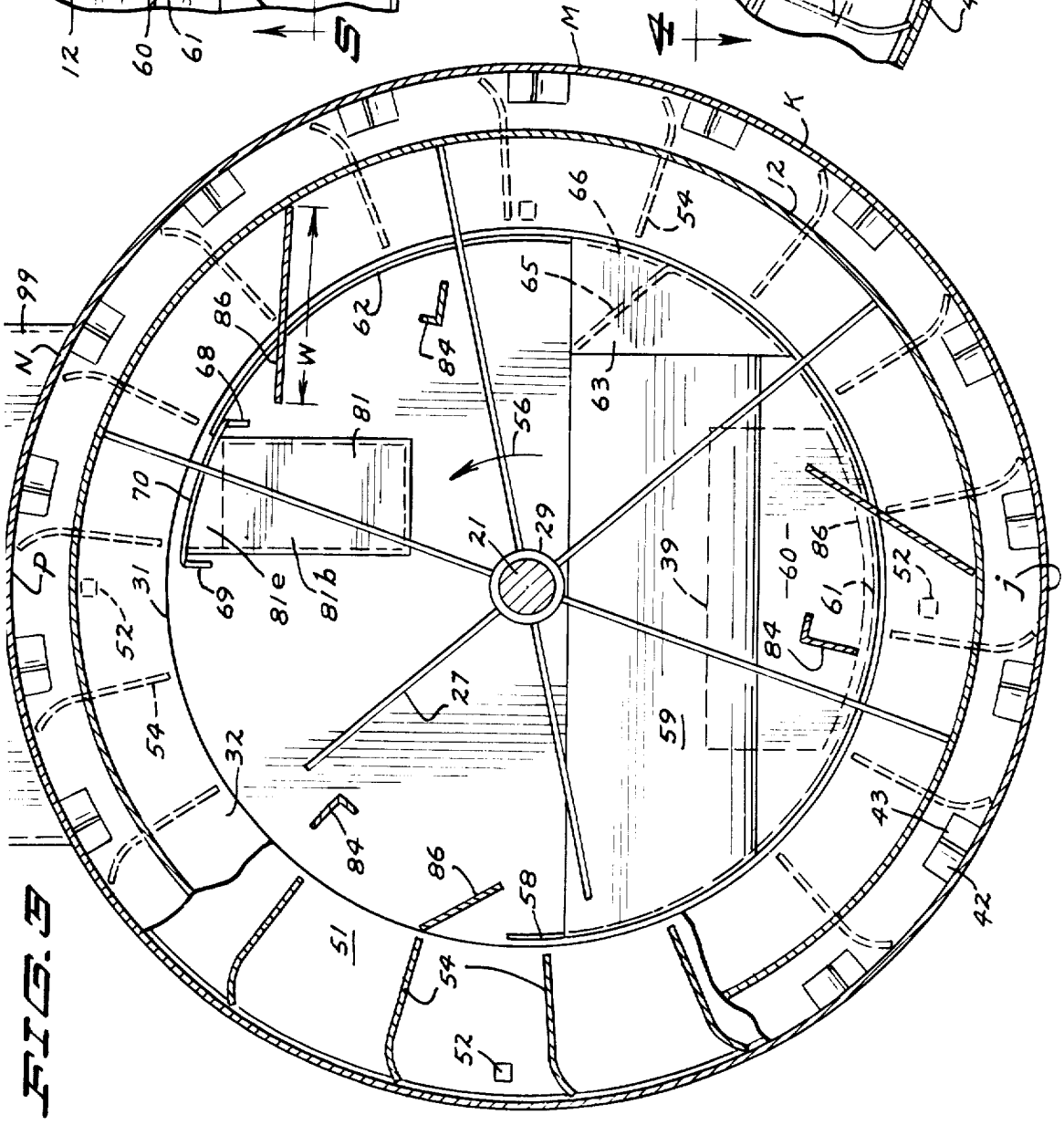


FIG. 3

PARTICULATE MATERIAL MIXING MACHINE HAVING SEALING MECHANISM

BACKGROUND OF THE INVENTION

A particulate material mixing machine having a stationary hood enclosing the one end of a rotary drum, said drum and hood having cooperating mechanisms for feeding material from the hood into the drum and alternately discharging material from the drum through the hood discharge chute.

With machines for mixing particulate material that have a stationary hood providing an end wall of a rotary drum, for example machines such as disclosed in my U.S. Pat. Nos. 3,259,372, 3,269,707 and 3,552,721 granted July 5, 1966, Aug. 30, 1966 and Jan. 5, 1971 respectively, after the substantial use, the seal between the drum and hood wears and permits leakage of material. In order to overcome problems of the above mentioned nature as well as obtain other advantages, this invention has been made.

SUMMARY OF THE INVENTION

The invention is directed to providing structure on rotary feed elevating mechanism on a rotary drum to move feed away from a seal between the drum and the stationary hood as the drum rotates to prevent build up of feed adjacent the seal.

BRIEF DESCRIPTION OF THE DRAWINGS

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

FIG. 1 is a perspective, somewhat schematic view of the particulate material mixing machine of this invention;

FIG. 2 is an enlarged vertical transverse sectional view generally taken along the line and in the direction of arrows 2—2 of FIG. 1 with a central portion broken away, said view more clearly illustrating 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 and also the structure for causing the material in the drum to be more thoroughly mixed and directed into the transfer mechanism;

FIG. 3 is an enlarged vertical transverse sectional view generally taken along the line and in the direction of the arrows 3—3 of FIG. 2 to more fully illustrate the transfer mechanism including mechanism for controlling the discharge of material, portions of said view being broken away at various axial positions to more fully illustrate other portions of the transfer mechanism;

FIG. 4 is an enlarged, fragmentary, horizontal cross sectional view generally taken along the line and in the direction of arrows 4—4 of FIG. 5, to more clearly illustrate the structure for returning material adjacent the seal between the stationary hood and the feed elevating mechanism back into the feed elevating mechanism; and

FIG. 5 is a fragmentary vertical transverse sectional view generally taken along the line and in the direction of arrows 5—5 of FIG. 4 to further illustrate the structure for returning feed from adjacent the seal.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring in particular to FIGS. 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 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 shaft **21**. The shaft **21** at either axial end is mounted on appropriate portions of the frame members of the frame generally designated **14**, by mounting 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 FIG. **2**, 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 shaft **21**. Rotatably mounted on the shaft adjacent the end wall **13** is a mounting member **28**. A plurality of radial spider members **26** at their one ends are fixedly connected to the member **28** and at the opposite ends to 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** that at the one ends are welded to the annular members **29** which mounts said spider members **27** on the shaft and at the opposite ends are welded to the drum wall **12**. As may be noted from FIG. **2**, the spider members **27** are located a substantial distance axially rearwardly of the hood end wall **17**. If shaft **21** is stationary as disclosed in U.S. Pat. No. 3,269,707, then members **28, 29** are bearing members while if the shaft is rotatably mounted then members **28, 29** may be welded to the shaft.

A generally annular mounting flange **32** is welded 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 member **29** but substantially less than the inner diameter of the drum tubular wall **12**. Thus member **29** and flange **32** provide an annular opening **31**, other than for spider members **27**, to permit axial movement of material into and out of the confines of the drum tubular wall.

Referring to FIG. **2**, it is to be noted that the hood has an inwardly extending flange **16*a*** located axially opposite the mounting flange **32** from the hood end wall, a resilient annular 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. Seal member **34** is substantially axially spaced from mounting flange **32** and radially inwardly of the cylindrical, axially elongated portion **16*b*** of the hood.

In order to permit loading the drum while it is rotating, the hood tubular wall top portion is provided with a top inlet opening (not shown). Advantageously a chute **99** is attached to the hood for directing material through the top inlet opening. However, it is to be understood chute **99** need not be part of the machine.

Normally most, if not all, of the material is loaded through chute 99. A chute 38 is welded to the hood end wall for directing material through the opening 39 provided in said end wall. The chute 38 is usually used for only adding small quantities of material that are to be added to the main mixture, the ingredients of which are fed through chute 99. Port 39 is located at a lower elevation than shaft 29 and has a lower edge at a higher elevation than the axially adjacent parts of the inner peripheral edge of annular flange 51. Desirably chute 38 extends inwardly through port 39 and has its bottom wall (not shown) extending in overhanging relationship to the lower adjacent part of flange 51, a topwall (not shown) extending downwardly and axially toward wall 13 to terminate adjacent a plate 60, and side walls (not shown) joining the top and bottom walls for directing material fed through chute 38 adjacent and axially between flanges 32 and 51, and preferably axially between flange 51 and plates 41 that are described hereinafter. 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 permit discharge of material, there is provided the transfer mechanism generally designated 50 that includes control mechanism which will be described hereinafter.

The transfer mechanism includes the aforementioned mounting flange 32 and the second annular mounting flange 51 that has substantially the same inside and outside diameters as that of flange 32. Mounting flange 51 is retained axially adjacent the hood end wall as shown in FIG. 2. Further the inner peripheral edge of flange 51 is located radially more remote from the shaft 21 than any portion of the peripheral edge of port 39. In order to prevent a buildup of material between flange 51 and end wall 17, which would result in the drum being pushed axially away from wall 17, flange 51 is provided with a plurality of small ports 52 (for example four) which are angularly spaced from one another and are of varying distances from shaft 21. Ports 52 permit material between the flange 51 and end wall 17 moving axially back into the space between flanges 32, 51.

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. The adjacent portions of the mounting flanges 32, 51 form end walls for the scoop members.

Referring in particular to FIGS. 4 and 5, extending between the radially outer edge portions of each adjacent pair of scoops 54, abutting against mounting member 32 and joined to the scoops and the mounting member is a generally arcuate, trapezoidal retainer plate 41. Each plate 32 has a minor base joined to the leading scoop 54 (in direction of arrow 56) and a major base joined to the circumferential adjacent trailing scoop 54 at the radially outer edge portions thereof. Preferably the length of the major base is less than 30 percent of the axial distance between mounting members 32, 51. The arcuate edge 41*a* of plate 41 is more closely adjacent mounting member 32 than member 51 and more closely approaches members 32 in the direction of arrow 56. Advantageously the major base is greater than twice the axial length of the minor base. Further, the radius of curvature of each plate 41 is about the same as the outer radius of mounting member 32.

A cut that first extends generally radially inwardly from the outer peripheral edge of mounting member 32 and thence is arcuately curved in a direction opposite arrow 56 is made in mounting member 32 just in back of (direction opposite arrow 56) each scoop, and then the cut portions of the mounting member are bent about radial lines to provide vanes 42 and cut outs 43. Advantageously the retainer plate minor base is of about the same length or greater than the length of the radial cut. As may be noted from FIG. 4, the vanes diverge from the remainder of the mounting member in the direction of arrow 56 to extend more closely adjacent the seal 34 then said remainder of the mounting member 32. The maximum arcuate length of each vane is substantially less than half of maximum arcuate spacing of adjacent pair of scoops 54, for example, about 20 – 40 percent of the maximum arcuate spacing of the adjacent pair of scoops. The arcuate length of each vane usually is greater than the radial height thereof. Further each vane is located further radially outwardly of the axis of rotation of the drum than tubular wall 12. Advantageously the radial height of each vane is about half the radial spacing between wall portion 16*b* and drum wall 12, while each vane extends axially outwardly of the remainder of the mounting member 32 at an angle of about 60°. As a result, the vanes extend the major part of the axial distance between the remainder of the mounting member 32 and the seal 34, but do not bear against the seal.

Secured to the hood end wall and made up of a plurality of joined together sections is a baffle, said baffle including an arcuate section 58 that extends arcuately adjacent to the inner circumferential edges of the scoop mounting members, has an arcuate edge joined to the hood end wall, and has a terminal axially extending top edge at about the same elevation as the axis of rotation of the drum. A generally planar baffle section 59 has its front edge joined to the hood end wall, is inclined downwardly at a relatively steep angle in a the direction toward the rear wall, and has its rear edge substantially more closely axially adjacent to the rear wall than the mounting member 32, and has one edge joined to the lower edge of arcuate section 58. The rear edge of inclined section 59 is at a lower elevation than shaft 21. A vertical, transverse section 60 has its upper edge joined to the rear edge of section 59 and has a circumferential edge joined to the rear edge of arcuate flange section 61. Section 61 has an outer radius of curvature slightly less than the inner radius of curvature of mounting member 32, is closely adjacent an arcuate portion of mounting member 32, and extends distances both axially substantially more closely adjacent and more remote of the hood end wall than mounting member 32. The axial length of flange section 61 that extends on each axial side of mounting member 32 is many times greater than the clearance between the flange section and the mounting member. One transverse edge of flange section 61 is joined to section 58 and the opposite transverse edge is joined to a transverse edge portion of an arcuate baffle section 62 at about the elevation of the juncture of sections 59, 60. One arcuate edge of section 62 is joined to the hood end wall while the opposite arcuate edge is spaced about the same distance from the hood end wall as section 60. The axially extending edge of section 62 that

is opposite flange section **61** in part terminates above the discharge chute **81**. Further, section **62**, flange section **61** and arcuate section **58** have substantially the same radii of curvature.

In order to permit material in the drum being fed into the path of movement of the scoops **54**, there is provided a hopper that has a vertical axially extending plate **64**. The hopper will only be briefly described as it is described in greater detail in U.S. Pat. No. 3,552,721. Plate **64** has one edge joined to inclined baffle section **59**, and an edge at the elevation of the front edge of section **59**. A second hopper plate **63** is joined to plate **64**, section **60**, section **61** and arcuate section **62**. Plate **63** is parallel to the hood end wall and perpendicular to plate **64**.

An inclined planar plate **65** is joined to and extends between the hood end wall and plate **63**, and has a bottom edge that in part is extended along the juncture of baffle sections **61, 62**. Plate **65** extends parallel to the axis of rotation of the drum and is inclined downwardly and away from the vertical plane of said axis. The lower corner portion of baffle section **62** that is adjacent the hood end wall is cut away to in conjunction with the bottom edge of plate **65** provide a hopper outlet **66** that opens into the path of movement of the scoops. The axial length of the cut out is the same as the spacing of flange section **61** from the hood end wall, the arcuate edge portion **62***a* of section **62** forming one edge of the hopper outlet. A second plate **67** is inclined downwardly toward the hood end wall. Plate **67** is joined to the adjacent portion of plate **65**, baffle section **62** along edge **62***a*, and joined to baffle section **62**. Plates **65, 67** are inclined at angles that the particulate material normally will flow freely downwardly along the surface thereof. Further plates **63, 64** are joined to the adjacent portions of baffle sections and the inclined plates; and serve as reinforcing members.

The top edges of plates **65, 67** along with the portions of baffle section **62** and the hood end wall at the same elevation provide a hopper inlet, the hopper inlet being located horizontally on the opposite side of shaft **21** from baffle section **58** and at a slightly lower elevation than shaft **21**. Further, the hopper inlet is located in a horizontal direction more remote from shaft **21** than the discharge chute inlet and at a substantially lower elevation. The hopper outlet is located at a substantially higher elevation than port **39**, and angularly between port **39** and the inlet of discharge chute **81** in the direction of arrow **56** angularly in advance of port **39**.

An arcuate discharge closure member (door) **70** is provided to selectively block the discharge chute inlet. As may be noted from FIG. **3**, the trailing edge of the closure member underlies the leading edge portion of baffle section **62**. The closure **70** is slidably extended through an arcuate slot provided in the hood end wall, is of an axial length to, in a closed position be closely adjacent and underlie a portion of mounting flange **32**, and has an axially extending end portion located exteriorly of the hood end wall. The closure **70** may be provided with handles, or appropriate lever mechanism connected thereto, for moving the closure between the closed position and a withdrawn position to at least partially unblock the discharge chute inlet. In order to mount the closure **70** for slidably movement, there are provided bracket members **68** and **69** at opposite longitudinal edges of the closure **70**, said brackets having shoulders against which said closure abuts.

The chute **81** has an inclined bottom wall **81***b* that extends axially adjacent the spider members **27** and a top wall **81***c* that 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 moves over the leading edge of baffle section **62** being carried by inertia beyond 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**, the inner portion being located within the confines of the hood, and the remaining portion extending forwardly of the hood end wall. The chute **81** has the discharge opening located at approximately the same elevation as the shaft **21**.

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 spiral mixing blades **86** that project inwardly from the interior surface of the drum wall **12**. The construction of these blades is more fully set forth in U.S. Pat. No. 3,552,721. As the drum rotates, these blades feed material toward the hood end wall, and at the same time the material falling over the inner radial edges of the blades becomes more thoroughly mixed than if said blades were not provided. Additionally, the end portions of the blades adjacent mounting member **32** elevate material in the drum to the elevation of the hopper inlet, baffle section **60** and plate **63** serving to prevent any substantial flow of material off the ends of the blades until the end of the respective blade is at the elevation of the hopper inlet. Thence material flows axially off the end of the blade to fall into the hopper inlet. Preferably each blade end adjacent the mounting member is inclined relative a radial line of the drum such as shown in FIG. **3** so as to elevate a greater amount of material to the elevation of the hopper inlet than if said blades were not so inclined. Advantageously the width of the end portions (dimension W) of FIG. **3** of the spiral blades adjacent the hood may be greater than the corresponding dimension of said blades at a location axially rearwardly in the drum.

Mounted in the rear end of the drum are a pair of baffles **90**, one being on either diametric side of member **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 **90** also includes an inclined triangular portion **90***b* that has a rearward edge integral with the forward edge of the respective portion **90***a*. Advantages of using baffles **90** are set forth in U.S. Pat. No. 3,269,707, while the construction thereof is set forth in greater detail in U.S. Pat. No. 3,552,271.

Suitable power actuating mechanism for the drum **10** is diagrammatically shown in FIG. **1** and may comprise an electric motor **95** operably connected through suitable speed reduction mechanism **96** to a sprocket, chain and a 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 rpm in the direction of the arrow **56.**

Mounted on the tubular drum wall to rotate therewith are a first plurality of inclined, elongated troughs **84.** The front end portion of each trough **84** is located so as not to interfere with a spiral blade directing material forwardly; i.e. either the front edge is radially spaced the same or a greater distance from the tubular wall than the inner radially edge of the transversely adjacent portion of the spiral blades, or else the trough front end portion is located more closely adjacent the transversely adjacent part of the mixing blade angularly in advance thereof than it is to the corresponding portion of the next blade angularly rearwardly thereof. Also the front edge of each trough **84** is axially spaced from the hood end wall about the same or a slightly greater distance than spider members **27.** The rear edge of each trough **84** is preferably located more closely adjacent rear wall **13** than flange **32** but spaced from the rear wall by a substantial distance, for example, by at least one third of the axial length of the tubular wall **12.**

The troughs **84** are inclined to, as the drum rotates in its normal direction of rotation, direct material toward the drum rear wall, the troughs not being movable relative to the drum. The troughs **84** are equally circumferentially spaced and have their front end portions adjacent and angularly rearwardly of the transversely adjacent portion of a mixing blade. Due to the spacing of the trough front end portions from the tubular wall, when the drum is in a near empty state, the material is free to move relative the tubular wall whereby the mixing blades will cause the material to be angularly advanced and moved axially toward the hood. Thus troughs **84** do not prevent the drum being emptied. However, when the drum is about one third or more filled with material and rotating in the direction of arrow **56,** material has built up on the tubular wall in the direction of arrow **56** sufficiently to be "scooped up" by the front end portion of a trough **84** and a substantial part of the scooped up material thereon slides along the length of the trough to descend axially rearwardly of the midportion of the tubular wall and on the transverse opposite side of the shaft from the respective trough front end portion. Additionally the troughs **84** are inclined such that material starts to discharge off the rear end portion when the rear end portion is at a higher elevation than the shaft.

A plurality of elongated inclined second troughs **85** are provided in the drum to rotate therewith. Troughs **85** are mounted in the drum to direct material axially forwardly as the drum rotates in its normal direction of rotation. The rearward edge of each trough **85** abuts against, and may be welded to the drum adjacent the juncture of walls **12, 13.**

The rear end portion of each trough **85** is a substantial distance angularly rearwardly of the front end portion. Additionally, each trough **85** is inclined to, as it extends forwardly, be progressively closer to the shaft; and if of sufficient length to extend beyond the minimum radial spacing from the shaft, then extend further away from the shaft. Preferably the troughs **85** are of a length to have their front edges located axially between the midpoint of the tubular wall and the flange **32** and not closer to flange **32** than about one third of the axial length of the tubular wall. Thus, preferably the troughs **85** discharge material axially forwardly of the location that troughs **84** discharge material; and at the time the trough is inclined to have material discharge off the front end thereof, the front end portion is higher than the shaft. Through the provision of troughs **84, 85,** which rotate with the drum, material is mixed substantially faster and more thoroughly than if the troughs were not provided. Additionally, through the use of troughs **84, 85,** for a given diameter drum, tubular walls of substantially greater axial lengths may be used and still obtain good mixing than if the troughs were not provided. The construction and mounting of troughs **84, 85** is set forth in greater detail in U.S. Pat. No. 3,552,721.

The structure of the invention has 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 member **70** is closed, the particulate material to be mixed is dumped through chute **99** to fall through the inlet opening in tubular wall **16** at a location axially between flanges **51, 32** to descend to plate **59.** In the event this inlet opening is of an arcuate length or located to in part open above closure **70** and/or baffle **62,** the scoops in being rotated in the direction of arrow **56** move the material thereover to an angular position p where it descends to plate **59** and slides thereover to fall within the confines of drum wall **12.**

Although only small quantities of material are fed through chute **38,** and usually not until the bulk of material is fed through chute **99,** when material is dumped into chute **38,** under the action of gravity, it flows through the hood inlet port **39** 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 an angularly adjacent pair of scoops **54.** As the drum rotates to move a scoop from position j angularly 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 the drum wall **12** by mounting member **32** and baffle sections **60, 61.** As a scoop **54** 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 the radially inner edge thereof. When the scoop has been advanced to position *k* (about 65° drum rotary position), the inner edge of the scoop is adjacent the lower edge of plate **65;** and as the scoop advances past the hopper inlet, a small quantity of material may fall over the inner edge of the scoop into the path of movement of the following scoop. At the time the scoop has been advanced to position m (about 80° drum rotary position), the inner edge of the scoop is adjacent the upper edge of the hopper outlet, and thence as the scoop continues to be rotated in the direction of arrow **56,** the material is moved over the surface of baffle section **62.**

As the scoop advances the material angularly to position *n* (about 165° drum rotary position), it moves over closure member **70,** provided said closure member is in a closed position, and thence to position *p* (about 180° drum rotary position) where the material descends to fall upon baffle section **59** and then slides thereover to fall within the confines of the drum wall **12.**

As material falls onto drum wall **12** (fed through either or both of chutes **38** and **99**), the spiral blades **86** will cause such material to flow toward mounting mem-

ber 32 and be elevated to fall off the ends of the spiral blades into the hopper inlet. The material flowing into the hopper inlet passes through the hopper outlet onto a scoop carrying material that had flowed through chute 38, if any; or if the scoop does not have additional carrying capacity, the hopper fills up and material flows over the top edges of the hopper. As additional material is transferred into the drum (fed in through either or both of the chutes 38, 99), the level builds up in the drum adjacent mounting member 32 and baffle section 60 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. At this time the troughs 85 direct (convey) material forwardly to cause the material to become thoroughly mixed. Also troughs 84 aid in mixing the material. This procedure will continue until the drum is loaded, all the time the material continuously being mixed.

After loading, if any, through chute 38 is discontinued, the scoops remove substantially all the material on hood wall 16 adjacent chute 38 whereby the material fed therethrough is transferred into the drum. Thereafter, mixing may be continued with material flowing through the hopper being elevated and then the elevated material descending onto baffle section 59 at angular position *p*. However, the scoops angularly between the hopper outlet and the lower part of wall 16 prevent any significant flow of material that has passed through the hopper moving generally in a direction opposite arrow 56 to a position adjacent the lowermost part of wall 16 axially between flanges 32, 51; i.e. the scoops at this time keeping the lowermost portion of the hood substantially free of material.

After mixing is complete, the closure 70 is at least partially opened whereby material elevated to position n is free to flow into the discharge chute inlet axially between the closure and chute portion 81*e*. If the closure is only partially open, some of the material elevated to position n will be discharged through chute 81 and the rest will be moved over the closure to position p to descend onto baffle section 59.

The material falling through the inlet of the chute 81 passes through the chute outlet into a bag or a suitable receptacle. The spiral blades continuously feed material axially forwardly and elevate the material to pass through the hopper to be subsequently moved by the scoops to an elevated position to be discharged through chute 81.

All during the filling of the drum and the mixture of the material, material radially adjacent the front edges of troughs 84 can move relative to said front edges in a direction opposite arrow 56, i.e. not advanced angularly as fast as the trough. After the drum has been filled to a level that is about the same as the radial spacing of the front edges of troughs 84 from the tubular wall 12, material is moved by the troughs 84. About the time the drum is one-third filled, material builds along the tubular wall in the direction of arrow 56 to a sufficient height that the front end portions of troughs 84 will "scoop up" material which, for the most part slides rearwardly along the trough as the drum rotates. However, when the drum is in a near empty state, the material radially adjacent a trough 84 front edge when the trough is in its lower angular position is not axially moved rearwardly but rather passes therebeneath to be axially moved forwardly by the next angularly rearward mixing blade.

The emptying process is continued until the drum is emptied. Then the closure 70 is moved to a closed position to ready the apparatus of this invention for mixing another batch of material.

Due to tolerance clearance radially between hood end wall portion 16*b* and a mounting flange 32 that does not have vanes 42 (nor retainer plates 41), after some use, sufficiently material can collect axially between flange 16*a* and the mounting flange 32 that seal 34 wears sufficiently to permit leakage. However, through the provision of the vanes 42, as the respective vane moves along the bottom part of the hood, material contacted by the vane axially between the remainder of the mounting flanges 32 and flange 16*a* is moved axially toward flange 51 to move through the axially adjacent cut out 43 as the vane moves to progressively higher elevations. The axially adjacent retainer plate 41 serves to minimize feed moving between flange 32 and wall portion 16*b* toward a location between flanges 32, 16*a*, the feed between the scoops that is adjacent flange 32 being carried by the retainer plates. Feed that flows through a cut out 43 adjacent the bottom portion of the hood toward the seal is forced by the respective vane to move through the cut out in an opposite axial direction as the cut out moves to a higher elevation. Also, due to edges 41*a* being inclined to be progressively further from flange 32 in a direction opposite arrow 56, feed on the hood wall portion 16*b* between the cups that does not move onto plates 41 is pushed toward flange 51 by said edges to minimize feed passing beneath flange 32 toward a location between flanges 32, 16*a*. Additionally, feed passing from the drum between flanges 61, 32 falls onto or toward plates 41 to be carried thereby instead of being able to fall to a position contacting wall 16*b* closely adjacent flange 32. Through the provision of vanes 42 and the retainer plates, the unit could be operated without seal 34 insofar as possible escape of feed is concerned, the seal being necessary to block the escape of dust.

As one example of the invention but not otherwise as a limitation thereon, with scoops 54 being 12 inches apart at the outer peripheral edges of mounting flanges 32, 51, the leading edge (minor base) of a retainer plate is 2 inches wide while the trailing edge is 5 inches. Further the radially extending edge of cut out 43 is 2 inches while the arcuately extending edge is about 4 inches.

Even though the vane and retainer plate mechanism has been described with reference to a particular machine, it can be used on other mixing machines, for example the first embodiment described in my copending application Ser. No. 347,812, filed Apr. 4, 1973 and U.S. Pat. No. 3,259,372. Further it is to be understood that the vanes may be separate members welded to an annular mounting member 32 that has the cut outs described.

What is claimed is:

1. In a machine for mixing particulate materials, a drum, means for mounting the drum to revolve about a substantially horizontal axis in one normal angular direction, said drum having a tubular wall and a rear wall at one axial end thereof, said tubular wall having a front annular edge portion, a stationary hood enclosing the opposite end of the drum, said hood having an end wall adjacent said front edge portion and a tubular wall por-

tion having a first annular part of substantial axial length surrounding said front edge portion and a second part extending between said first part and said hood end wall, annular seal means mounted on at least one of the first part and the drum for providing a seal between the first part and the drum, and a generally annular flange mounted on the front edge portion axially between the seal means and the hood end wall and extending radially toward the first part to within close proximity of the first part, said flange being mounted to rotate with the drum, the improvement comprising said annular flange having a plurality of circumferented spaced cut outs adjacent the radially outer peripheral portion thereof and vanes that extend toward the seal means in the direction of normal rotation of the drum for directing material back through the cut outs toward the hood end wall as the drum is rotated in said normal direction, said vanes at least in part being located radially between the drum and said first part.

2. The apparatus of claim 1 further characterized in said flange has an annular portion having said cut outs, said cut outs opening radially toward said hood tubular portion and said vanes extending axially relative the drum axis of rotation at least a major portion of the distance between said flange annular portion and the seal means and being joined to said flange annular portion.

3. The apparatus of claim 2 further characterized in that the vanes at their juncture with the flange annular portion are of radial heights at least as nearly as great as the radial depths of the cut outs and of lengths greater than their radial heights.

4. The apparatus of claim 1 further characterized in that said hood and drum have cooperating means in part mounted by said hood and in part by said drum to rotate therewith for elevating material from a low position to a higher position as the drum is rotated and selectively discharging at least part of the above mentioned elevated material exterior of the hood, the drum cooperating means including a plurality of scoops, first generally annular means including said flange for mounting said scoops on the drum in circumferentially spaced relationship to rotate with said drum, said scoops being joined to said flange on the opposite side thereof from the seal means, and second means for elevating material within the drum to an elevation intermediate the lower and uppermost portions of the drum and directing the last mentioned elevated material toward the hood end wall, said second means being mounted in the drum to rotate therewith and extending axially more closely adjacent to the rear wall than said scoops, the hood cooperating means including a discharge chute mounted on the hood end wall, said chute having an inlet axially beneath an upper portion of the drum cooperating means to receive material from a scoop, and an outlet opening exteriorly of the hood, and means for selectively blocking flow of material from a scoop to the chute inlet.

5. The apparatus of claim 4 further characterized in each scoop has an axially elongated, radially outer edge located in close proximity to the hood second part, that each cut out is located angularly between a circumferentially adjacent pair of scoops and located substantially more closely adjacent the leading scoop of the respective pair of scoops in said normal direction than the trailing scoop.

6. The apparatus of claim 5 further characterized in that there is provided a retainer plate that extends between each said pair of scoops and joined to the radially outer edges thereof, is of an axially length less than the half the axial length of the scoops, abuts against the flange, and is arcuately curved to be within close proximity to the hood second part, said cut outs opening to the space between the flange and the hood end wall radially inwardly of the retainer plates.

7. The apparatus of claim 6 further characterized in that each retainer plate has an edge axially remote from the flange that extends between the respective pair of scoops and more closely approaches the flange in said normal direction.

8. The apparatus of claim 6 further characterized in that each cut out has a trailing edge that extends predominantly radially, that the flange has an annular portion having said cut outs opening through the outer peripheral edge thereof and that the vanes have predominantly radially extending edge portions joined to the flange annular portion adjacent the cut out trailing edges.

9. In a machine for mixing particulate materials, a drum, means for mounting the drum to revolve about a substantially horizontal axis in one normal angular direction, said drum having a tubular wall and a rear wall at one axial end thereof, said tubular wall having a front annular edge portion, a stationary hood enclosing the opposite end of the drum, said hood having an end wall adjacent said front edge portion and a tubular wall portion having a first annular part of a substantially larger diameter than said front edge portion and of a substantial axial length surrounding said front edge portion and a second part extending between said first part and said hood end wall, annular seal means on at least one of the first part and the drum for providing a seal between the first part and the drum, drum cooperating means in part mounted by said hood and in part by said drum to rotate therewith for elevating material from a low position to a higher position as the drum is rotated and selectively discharging at least part of the above mentioned elevated material exterior of the hood, the drum cooperating means including a plurality of scoops, first and second axially spaced, generally annular means for mounting said scoops on the drum in circumferentially spaced relationship to rotate with said drum, said scoops extending axially between the first and second annular means, said first annular means including a generally annular flange portion that is joined to the front edge portion to rotate therewith, extends radially within close proximity of the hood tubular wall portion, and is at least in part located axially between the scoops and seal means and substantially axially spaced therefrom, said scoops having radially outer, axially extending edges, and a retainer plate that extends between each pair of circumferential adjacent scoops and joined to the radially outer edges thereof, is of an axially length less than the half the axial length of the scoops, and many times greater than the axial thickness of the flange portion, abuts against the annular flange portion, and is arcuately curved to extend within close proximity to the hood second part.

10. The apparatus of claim 9 further characterized in that each retainer plate has an edge axially remote from the annular flange portion that extends between the respective pair of scoops and more closely approaches the annular flange portion in said normal direction.

11. The apparatus of claim 9 further characterized in that said flange portion has circumferentially spaced

cut outs between circumferentially adjacent pairs of scoops that open radially toward the hood tubular portion and other than for the cut outs has an outer peripheral edge in close radial proximity to said hood tubular wall portion and that vanes are joined to the annular flange portion for moving material between the flange portion and said seal means through the cut outs as the drum is rotated in said normal direction.

12. The apparatus of claim 11 further characterized in that the flange portion has predominantly radially extending edges defining trailing edges of the cut outs in relation to said normal direction and that the vanes are joined to the flange portion adjacent said trailing edges, and have radially outer edges that extend away from said flange portion in close proximity to said first part.

13. The apparatus of claim 12 further characterized in that said flange portion has an inner diameter substantially less than the drum tubular wall inner diameter, that said first part has a cylindrical portion and an annular seal mounting portion that extends radially inwardly from its cylindrical portion, that the seal means is mounted on the seal mounting portion radially inwardly of the cylindrical portion, and that the vanes extend a major portion of the distance between the flange and the seal mounting portion.

14. The apparatus of claim 12 further characterized in that the vanes are generally planar and that the include angle in said normal direction between the plane of the flange portion and the plane of a vane is about 60°.

15. The apparatus of claim 12 further characterized in that said second annular means comprises a second annular flange that is between the hood end wall and the annular flange portion and axially adjacent the hood end wall, said second flange having a plurality of angularly spaced cut outs of varying radial spacings from said axis to permit material between the flange and hood end wall moving therethrough to prevent a buildup of material that would move the flange away from the hood end wall.

16. A machine for mixing particulate materials comprising a drum, means for mounting the drum to revolve about a substantially horizontal axis in one normal angular direction, said drum having a tubular wall and a rear end wall at one axial end thereof, a stationary hood enclosing the opposite end of the drum, said hood having an end wall adjacent the end of the drum opposite the drum rear wall, and hood and drum cooperating means in part mounted by said hood and in part by said drum to rotate therewith for elevating material from a low position to a higher position as the drum is rotated and selectively discharging at least part of the above mentioned elevated material exterior of the hood, the drum cooperating means including a plurality of scoops, first generally annular means for mounting said scoops on the drum in circumferentially spaced relationship to rotate with the drum and an annular flange joined to said scoops axially remote from the first annular means and being closely adjacent the hood end wall, the annular flange having a smaller number of cut outs than the number of scoops that are angularly spaced from one another and of varying radial spacings from said axis to permit material between the flange and hood end wall moving therethrough to prevent a buildup of material that would move the flange away from the hood end wall.

17. The apparatus of claim 16 further characterized in that the flange has an inner peripheral edge, and that the hood end wall has an inlet port having an edge furtherest radially remote from said axis that at its maximum spacing from said axis is closer to said axis than said inner peripheral edge.

18. The apparatus of claim 17 further characterized in that said hood has a top charging inlet, and that the hood has annular seal means surrounding the drum that is axially opposite the annular means from the flange forming a seal with the drum and that the annular means includes an annular portion and means on the annular portion for returning material radially between the hood and drum and axially between the seal means and the annular portion to a location axially between the flange and annular portion as the drum is rotated in said one normal angular direction.

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