

[54] **IN-LINE PRESSURE SIFTER**[75] Inventor: **Gilbert C. Morris**, Columbus, Ohio[73] Assignee: **The Fred D. Pfening Company**,
Columbus, Ohio[22] Filed: **Sept. 19, 1973**[21] Appl. No.: **398,676**[52] **U.S. Cl.** **209/243; 209/250; 209/332;**
209/318[51] **Int. Cl.²** **B07B 1/46**[58] **Field of Search** 209/250, 243, 246, 254,
209/326, 332, 403, 140, 14, 143, 138, 139,
36, 318; 55/37, 141, 17, 307[56] **References Cited****UNITED STATES PATENTS**

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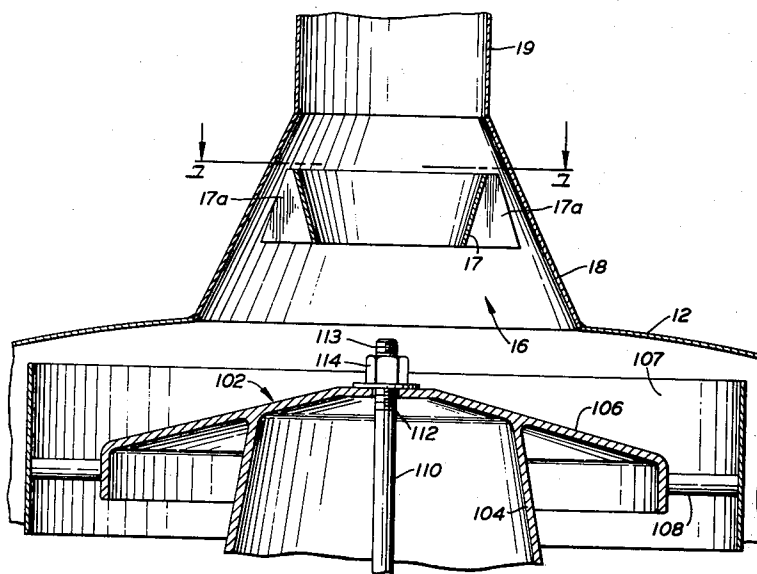
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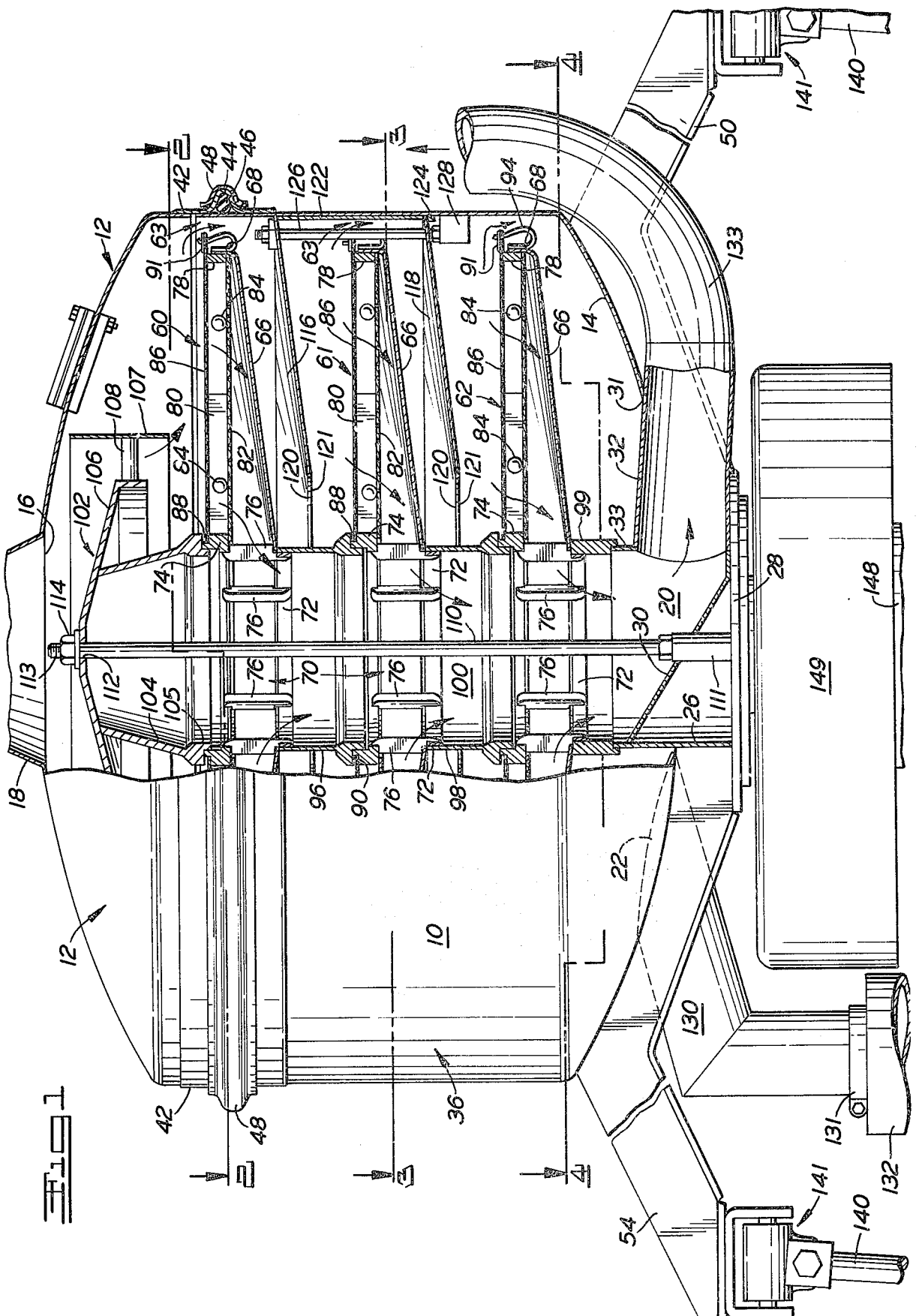
Primary Examiner—Robert Halper*Attorney, Agent, or Firm*—William S. Rambo

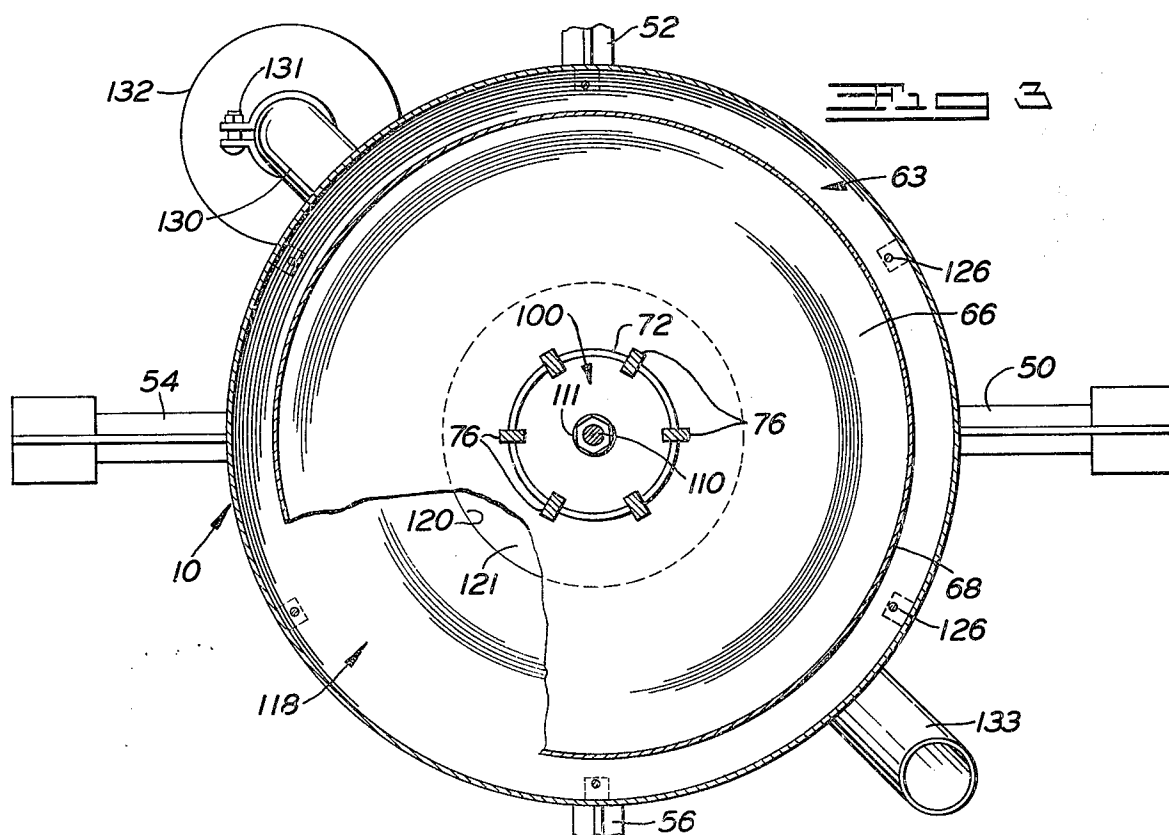
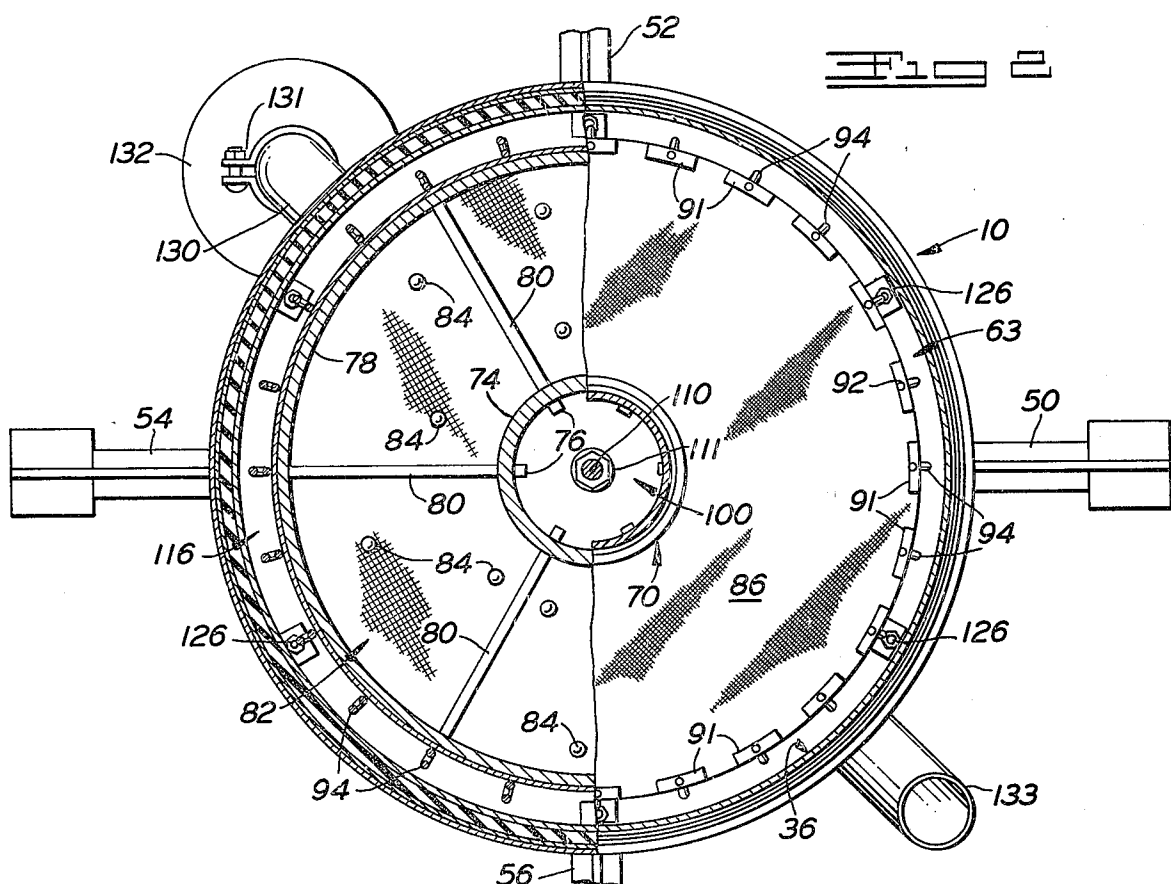
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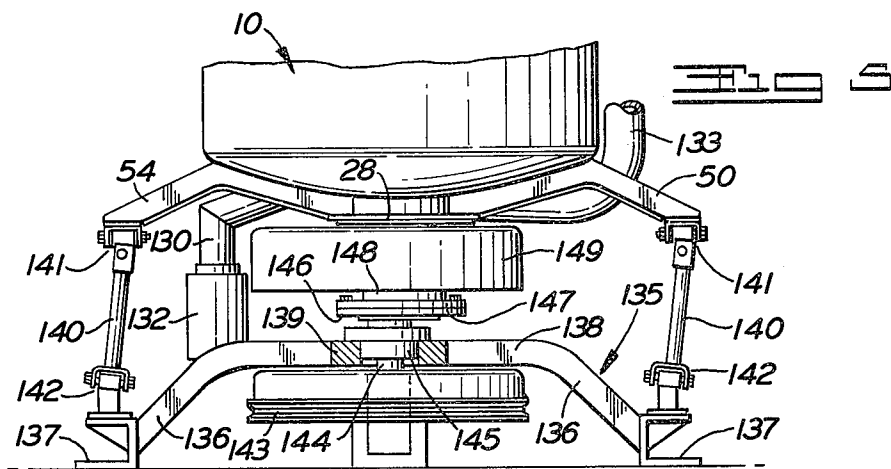
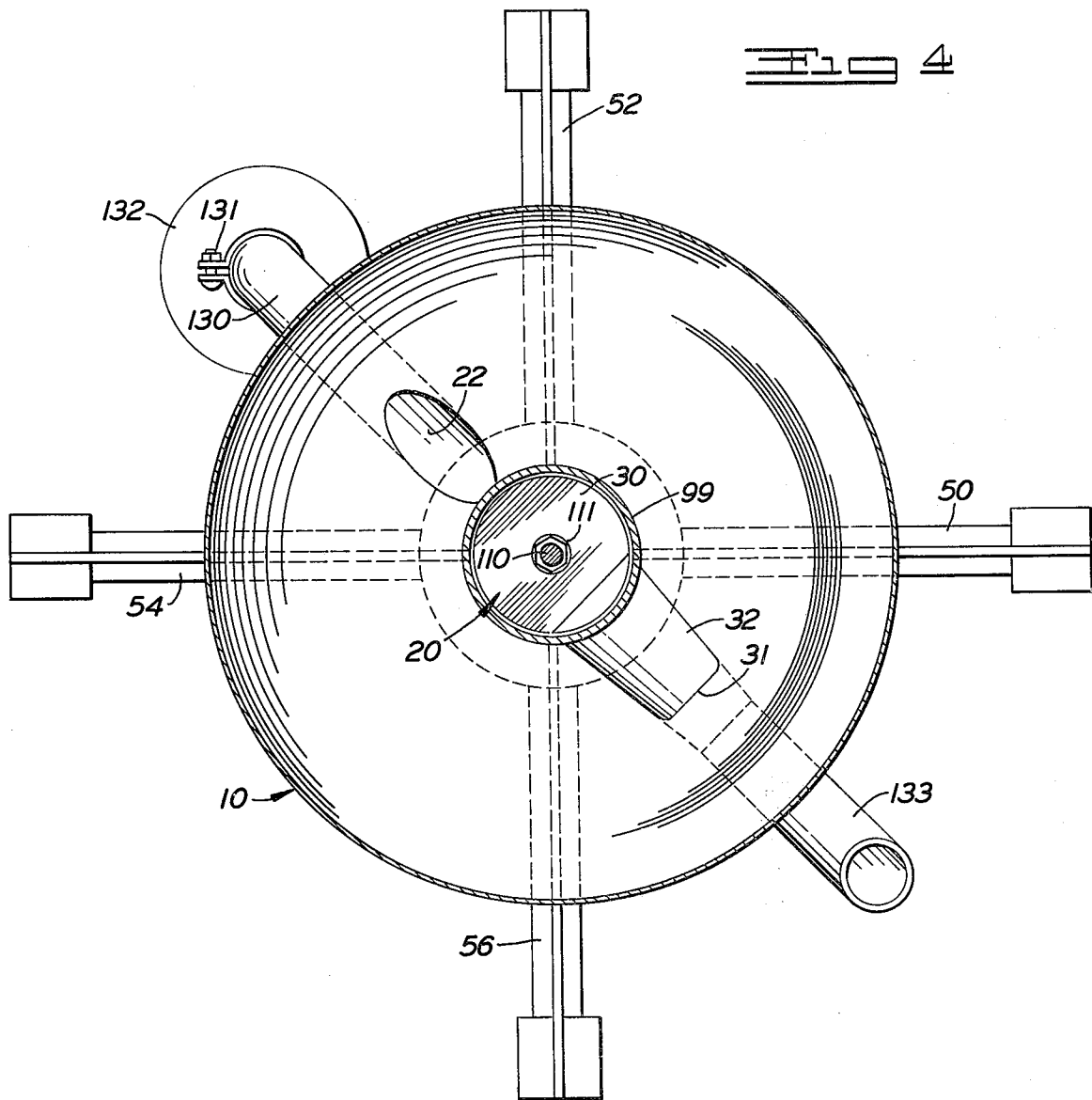
ABSTRACT

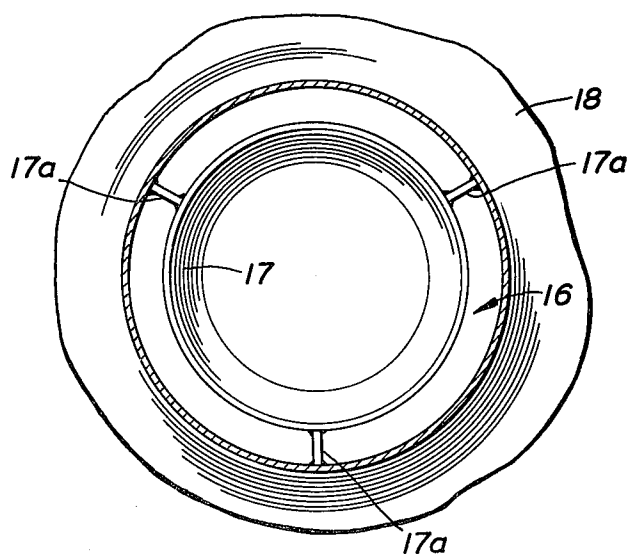
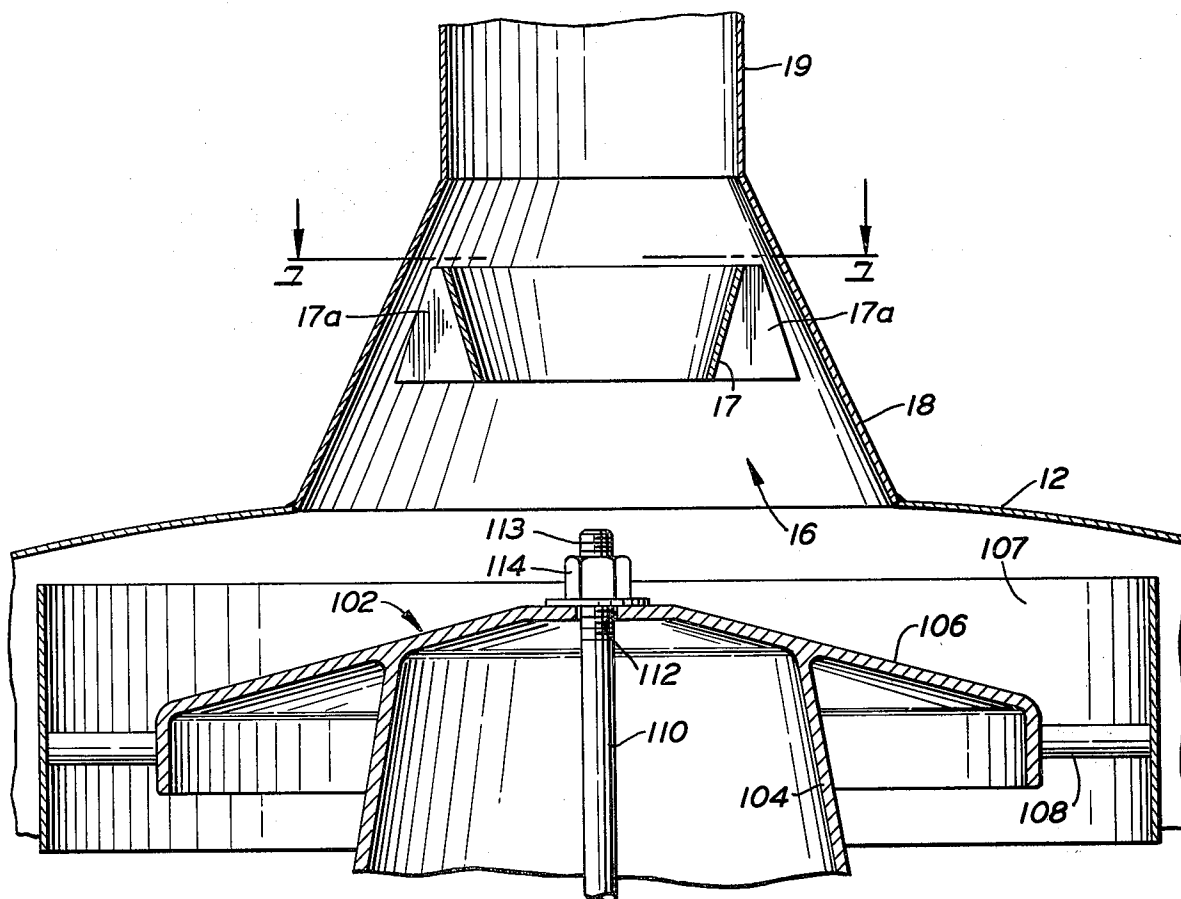
A gyratory, industrial-type pressure sifter adapted to be connected in a conduit or conveyor pipe system and through which air-entrained, pulverulent solids are caused to flow under pressure, whereby to sift and separate oversize solids from the air-conveyed fines, the sifter being characterized by a novel arrangement of sieves and baffles which promote the efficient, substantially uninterrupted sifting of air-entrained fines during their flow through the associated conveyor conduit system, while ensuring the removal from the influent solids of any oversize particles or contaminants.

1 Claim, 7 Drawing Figures









IN-LINE PRESSURE SIFTER

BACKGROUND OF THE INVENTION

The present invention relates generally to apparatus for sifting pulverulent solids such as edible flours, and more particularly to an improved, motor-driven gyratory sifter for "in-line" connection in a pressurized air conveyor conduit system for sifting air-entrained pulverulent solids being conveyed through such conduit system.

In the baking industry it has been common practice, if not a legal requirement, to sift flour upon its removal from a storage receptacle or bin and immediately prior to making the flour into dough, so as to remove from the flour all undesirable oversize particles and contaminants. Commercial sifters are generally of two types, namely: gravitational sifters in which influent materials are caused to pass by gravity through a series of gyrating or vibrating sieves, and pressure-type sifters through which air-entrained pulverulent solids are conveyed under pressure through a system of sieves which provide for the removal of undesired oversize particles or "overs" from the desirable fines or "throughs." Of these two types of sifters, the pressure-type is, by far, the more desirable since it lends itself to relatively higher speed and volume sifting and provides for a more sanitary, closed circuit operation. However, prior art pressure-type sifters of which I am aware are relatively complicated in their construction, are comparatively large and expensive, and are difficult to service and maintain.

SUMMARY AND OBJECTS OF THE INVENTION

The present invention provides an in-line pressure sifter which comprises a generally vertically arranged cylindrical outer casing or housing adapted to be driven in bodily, orbital or gyrating movement about a vertical axis and having an axially located, baffle-containing inlet at its upper end through which air-entrained pulverulent solids may be introduced under pressure within the housing with the solids being partially separated from the main air stream and directed more or less evenly toward a series of vertically spaced annular sieve and baffle assemblies positioned in the housing around an axially extending air passage, and so arranged as to cause the fines or "throughs" to pass through one or more sieves, and thence through the axially extending passage for readmixture with and reentrainment in the air passing under pressure through a main outlet of the housing. The larger size particles or "overs" carried in the influent solids are caused to pass radially outwardly across the sieve assemblies and are ultimately separated from the sifted fines and discharged by gravitational flow through a second outlet formed in the bottom of the housing in laterally offset relation to the main pressure outlet of the housing.

The primary object of this invention is to provide an improved, in-line pressure sifter of compact and mechanically simplified construction which may be readily disassembled for servicing, cleaning or repair, and which may be economically manufactured and maintained.

Another object is to provide a pressure-type sifter which is capable of handling a comparatively high rate of flow of materials therethrough without clogging or wastage of desirable fines.

A further object is to provide a pressure sifter in which the velocity of air passing through the sieve elements is relatively low, so as not to force-blast or extrude undesired large size particles through the sieve elements, and in which there is an initial, partial separation of the influent solids from the air at the inlet of the sifter prior to the passage of the solids onto and/or through the sieve elements.

Still another object is to provide a pressure sifter whose internal structure is made up principally of inter-fitting parts having machined interfaces which provide low tolerance, substantially crevice-free fits without the need for a multitude of gaskets which might otherwise present sanitation problems.

For a further and more complete understanding of this invention and the various objects and advantages thereof, reference is made to the following description and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS:

FIG. 1 is a sectional-elevational view of a pressure sifter according to this invention with a portion of its outer casing broken away to show internal structure;

FIG. 2 is a horizontal sectional view taken substantially along the line 2—2 of FIG. 1 and showing particularly the uppermost sieve assembly of the sifting machine;

FIG. 3 is a similar view taken substantially along the line 3—3 of FIG. 1 with a portion of the sieve assembly broken away to show the underlying baffle plate;

FIG. 4 is a similar view taken substantially along the line 4—4 of FIG. 1 and showing particularly the outlet passages associated with the bottom wall of the sifter housing;

FIG. 5 is a fragmentary side elevational view on a comparatively smaller scale and showing the gyratory drive mechanism for the sifter;

FIG. 6 is an enlarged, detailed fragmentary vertical sectional view taken through the inlet portion of the sifter; and

FIG. 7 is a fragmentary horizontal sectional view taken along the line 7—7 of FIG. 6.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT;

By reference to the accompanying drawings, it will be seen that the present sifter comprises a generally cylindrical outer casing or housing 10 formed with an upper closure portion or lid 12 and a lower closure wall or bottom 14. The lid 12 of the housing 10 is formed with an axial inlet port 16 which is defined by an inverted funnel-shaped conduit 18 to the upper end of which is connected a remotely extending pipe or conduit 19 for supplying the influent, air-entrained pulverulent solid particles under pressure. The inlet port 16 contains a frusto-conical, diverter or separator ring 17 which is supported in inwardly spaced, coaxial relation to the inner wall of the inverted funnel-shaped conduit 18 by means of three vertically arranged gusset plates 17a. The ring 17 thus defines a relatively shallow funnel which tapers downwardly and axially inwardly in opposite relation to the taper of the conduit 18 for a purpose which will be hereinafter more fully explained.

A main axially disposed outlet 20 is provided in the bottom 14 of the housing for exhausting air-entrained sifted particles or fines which are also referred to in the

art as "throughs." A secondary port 22 is also formed at the bottom 14 of the housing 10 and is laterally displaced from the central axis of the housing. The discharge port 22 provides for the gravitational discharge of the larger size, unsifted particles which are separated from the sifted "throughs." The outlet chamber or port 20 is formed centrally and axially in the lower end of the housing 10 by a cylindrical tube 26 welded in an axial opening formed in the bottom wall 14 of the housing 10. The lower end of the tube is closed and supported on a metal plate 28 which is connected with the orbital or gyratory drive mechanism for the sifter as will be hereinafter described. The outlet chamber 20 is provided intermediate the ends thereof with a downwardly inclined, elliptical diverter wall 30 which functions to direct the effluent air and sifted fines or "throughs" to a laterally or radially outwardly extending outlet conduit 32 which extends through and is welded in an opening 31 formed in the bottom 14 of the housing and in an opening 33 formed in the tube 26 (see FIG. 1).

The lid 12 is formed or otherwise provided along its lower edge with a sealing skirt or rim 42 which frictionally fits over and around the upper end of the housing body 10. The skirt 42 is preferably formed in its intermediate portion with a radially enlarged U-shaped bend 44 which defines an annular pocket to receive and retain a resiliently flexible sealing ring or gasket 46. A split-type locking ring 48 fits over the bend 44 to securely clamp the skirt 42 in fluidtight relation to the housing body 10.

The housing 10 is further equipped with a supporting base frame made up of four radially outwardly extending legs 50, 52, 54 and 56 and the base plate 28 (see FIGS. 4 and 5). Each of the legs 50, 52, 54, and 56 is of inverted T-shape cross section and has its inner end portion shaped to conform to the curvature of the bottom wall 14 of the housing. The legs are preferably seam welded to the bottom of the housing and to the outwardly projecting lower end portion of the tube 26, and to the upper surface of the plate 28. The legs 50, 52, 54 and 56 serve to support the sifter for bodily gyratory or orbital movement as will be hereinafter more fully explained.

Mounted coaxially within the housing 10 are three, relatively vertically spaced, annular sieve assemblies 60, 61, and 62, the outer peripheries of which are spaced inwardly from the sidewall 36 of the housing to provide an annular space 63 for the passage of unsifted, larger size particles ("overs") between the outer periphery of each sieve assembly and the housing. The three sieve assemblies are identical, and a description of one such assembly shall apply to all. Each sieve assembly includes an annular, funnel-shaped, imperforate bottom wall or pan 66 formed with an upturned outer peripheral lip 68. The bottom pan 66 is preferably of stamped sheet metal, and provides an axially inwardly, downwardly sloping surface to direct sifted fines ("throughs") toward the axis of the housing.

The inner edge of the bottom pan 66 is welded or otherwise suitably fastened to a central hub assembly 70 which includes a lower ring member 72, an upper ring member 74 and a plurality of angularly related spacer bars or columns 76. The spacer bars 76 are notched to receive the ring members 72 and 74, and rigidly support the ring members in vertically spaced relation. The spaces between the column members 76 provide for the passage of sifted fines into the axial pas-

sage of the sifter. The sieve assembly further includes an outer rim or ring 78 which is connected in concentric relation to the hub ring 74 by a plurality of angularly spaced radial spokes or walls 80 (see FIG. 2). The outer rim 78 is also welded or otherwise rigidly secured to the upturned peripheral lip 68 of the bottom pan 66.

Secured to the underside of the rings 74 and 78 is an annular, relatively wide mesh grille or screen 82 which provides a foraminous floor surface for a plurality of balls or rolling elements 84 which are loosely confined in the spaces between adjacent spoke walls 80. Finally, each sieve assembly carries across its upper face an annular, fine mesh sifting screen 86. The annular sifting screen or sieve 86 is formed with a central, circular opening 88 bounded by a solder-reinforced edge which closely embraces a stepped shoulder 90 formed on the upper surface of the inner ring 74. The screen or sieve 86 is also provided along its peripheral edge with a multiplicity of relatively circumferentially spaced, sheet metal reinforcing tabs 91 which are formed with through openings 92 for attachment to a like number of spring tensioning hooks 94 carried along the periphery of the bottom pan 66. The spring hooks 94 are arranged to detachably hold the screen or sieve 86 in tight contact with the upper supporting surfaces of the inner and outer rings 74 and 78 and apply equally spaced outwardly directed tension forces to the screen to prevent undesired wrinkling thereof.

Positioned axially between the three sieve assemblies 60, 61 and 62 are a pair of cylindrical spacer rings 96 and 98, and positioned between the lowermost sieve assembly 62 and the upper end of the tube 26 is a third spacer ring 99. Each of the spacer rings 96, 98 and 99 are notched or rabbeted at their lower ends to receive the upper ends of the rings 74 and the tube 26, and the spacer rings define with the sieve assemblies an axial passage 100 which extends centrally and vertically from the upper end of the tube 26 to a deflector or distributor cap 102 mounted atop the uppermost sieve assembly 60.

The deflector cap 102 is thus positioned beneath the inlet opening 16 and the funnel shaped separator ring 17, and serves the dual purpose of closing the upper end of the axial passage 100 and distributing the incoming solid particles generally radially outwardly and then downwardly within the sifter housing. For this purpose, the cap 102 is formed with a frusto-conical main body portion 104 formed at its lower end with a notched skirt 105 which sealingly engages the top ring 74 of the uppermost sieve assembly 60. The cap 102 also includes a downwardly sloping, overhanging lid portion 106 and a circumferential baffle ring 107 which is supported in outwardly spaced, concentric relation to the lid portion 106 on radial arms or spokes 108.

The vertically spaced sieve assemblies 60, 61 and 62, the spacer rings 96, 98 and 99 and the deflector cap 102 are detachably clamped in vertically stacked, unitary relation by an elongated fastener bolt or rod 110 which extends from a threaded socket 111 welded to the base plate 28. The rod 110 extends axially upwardly through the axial passage 100 and through a central opening 112 formed in the lid 106 of the diverter cap 102, and terminates in an externally threaded upper end portion 113 to which is threaded a clamping nut 114.

A pair of annular funnel-shaped baffles 116 and 118 extend generally radially inwardly and downwardly

from the inner side wall 36 of the housing 10 and are interposed between the adjacent sieve assemblies. These baffles terminate in circular inner edges 120 which are spaced radially outwardly from the spacer rings 96 and 98 to provide annular drop-through passages 121 adjacent the outer walls of the spacer rings.

The baffles 116 and 118 are supported in vertically spaced apart, parallel relationship by a pair of spacer rings 122 and 124 which are secured to the inner side wall of the housing 10, and by a plurality of clamping bolt assemblies 126 which are carried on brackets 128 welded at circumferentially spaced intervals to the inner side wall of the housing 10.

Welded in the radially offset, secondary outlet 22 of the bottom wall 14 is a downwardly extending, elbowed conduit or pipe 130 whose lower end is sealingly connected by a clamping band 131 with the mouth of a closed, cylindrical can or drum 132. The drum 132 is provided to collect the unsifted, larger size particles ("overs") which are discharged by gravity from the bottom of the housing 10. The outlet conduit 32 through which the sifted, air-entrained fines are discharged is also provided with a remotely extending pipe or conduit 133.

As shown particularly in FIG. 5, the entire housing 10 and its supporting legs 50, 52, 54 and 56 are mounted for orbital or gyratory movement in a circular path and in a generally horizontal plane on a relatively stationary, floor-supported base frame which is indicated generally by reference numeral 135. The base frame 135 comprises four radially projecting cross legs 136 disposed in general vertical alignment with the legs 50, 52, 54 and 56 of the housing 10. Each of the legs 136 terminates at its outer end in a channel-shaped foot rest 137, and each comprises a relatively elevated or raised central portion 138 which is connected with an annular bearing ring or journal 139. Each of the legs 50, 52, 54 and 56 of the housing 10 is connected with a corresponding foot rest 137 of each leg of the base frame by means of a connecting rod 140 having universal joint connections 141 and 142 at either end thereof. As will be readily apparent, the connecting rods 140 and universal joints 141 and 142 anchor the sifter housing to the base frame 135, while at the same time permitting the desired orbital or gyratory movement of the housing and its contents.

The sifter housing 10 is adapted to be driven in the aforesaid circular orbital path by a conventional, counterbalanced eccentric drive mechanism which includes a motor-driven V-belt pulley 143 which drives an axial shaft 144. The shaft 144 is supported for rotation in a thrust bearing 145 carried in the journal 139. The shaft 144 terminates at its upper end in a flanged and eccentric connector plate 146 which is bolted to a cooperative flanged plate 147 carried on the hub 148 of a counterweight bell housing 149. The hub of the counterweight bell housing provides a journal or bearing support for a stub shaft, not shown, which is connected with and depends axially from the base plate 28 of the housing 10. Thus, the axis of the housing 10 is disposed in eccentric, axially offset relation to the pulley shaft 144, so that when the pulley 143 and shaft 144 are driven in axial rotation by an electric motor-driven belt, not shown, the hub 148 and the counterweight housing 149 will rotate with a crank motion to carry the housing stub shaft in a circular horizontal orbit without axial rotation thereof.

In operation, pulverulent solid particles to be sifted are conveyed by air under pressure and delivered in a downward flow through the inlet conduit 19 of the sifter. The flowing stream of air and entrained solid particles then passes into the outwardly flaring conical member 18 where the air tends to expand outwardly toward the inner wall surface of the inlet member 18, while the heavier solid particles, due to their inertia, tend to flow straight into the funnel shaped separator ring 17 from whence they are focused or funneled toward the center of the deflector cap 102. The ring 17 thus functions to focus the majority of the influent solid particles onto the cap 102 and makes an initial partial separation of such solids from the influent air. The major proportion of solid particles are then deflected radially outwardly by the lid portion 106 of the deflector cap 102 and then downwardly by the baffle ring 107 onto the uppermost sieve assembly 60. Because the cross sectional area of the sifter housing is several times that of the inlet conveyor pipe 19, the velocity of the influent air and entrained solid particles is greatly reduced upon entry into the upper end portion of the housing. A proportion of the influent air and entrained solids will, however, by-pass the uppermost sieve assembly 60 and will flow downwardly through the annular space or passage 63 at the periphery of the uppermost sieve assembly and then be diverted axially inwardly by the baffle 116 and thence to the second sieve assembly 61.

The gyratory movement of the entire sifter will cause the smaller size particles or fines to be sifted through the sieve screens 86 and the grilles 82. The sifted fines and air will then be directed radially inwardly by the imperforate bottom pans 66 of the sieve assemblies into the axial passage 100 for discharge at relatively high velocity through the outlet port 20 and conduits 32 and 133. At the same time, the solid particles which are larger than the mesh size of the sieve screens 86 will migrate to the outer periphery of the sieve assemblies, and will eventually fall through the passages 63 at the outer edges of the sieve assemblies and be directed axially inwardly and thence downwardly by the baffles 116 and 118 onto the next subjacent sieve assembly. The descending unsifted, larger size particles will eventually fall by gravity from the periphery of the lower most sieve assembly 62 onto the sloping bottom wall 14 of the housing 10 where they will pass through the secondary outlet 22, through the conduit 130, and thence into the receiver can or drum 132.

As will be understood, the entire interior of the sifter housing will be subject to substantially the same pressure as the influent air entering the inlet port 18. However, since the secondary outlet 22, conduit 130 and collector drum 132 are normally closed against the flow of air therethrough, all influent air will be directed through the axial passage 100 and thence outwardly through the discharge conduits 32 and 133 under velocity flow, and the effluent air will carry with it the sifted fines.

The gyratory movement of the sifter not only produces the desired circular orbital movement of the sieve assemblies, but also causes the spherical ball elements 84 to roll and bounce against the under surfaces of the sieve screens 86 to prevent undesired bridging and blockage of the screens 86 by the influent solids.

In view of the foregoing, it will be seen that the present invention provides a structurally simplified, yet

highly efficient in-line pressure sifter which is particularly suited for the high-speed, large volume sifting of flour during its air-entrained conveyance from a storage silo or bin to a smaller size hopper or receptacle preparatory to dough-making operations. The present sifters are characterized by a non-clogging, multiple sieve arrangement which may be readily disassembled for cleaning or repair of worn parts. A further advantage of the present sifter resides in its ability to positively separate over sized solid particles and contaminants from the desired sifted fines by causing the oversized particles to flow by centrifugal and gravitational forces in directions radially outwardly from the sieves while causing the sifted fines to flow with entraining air through the sieves and thence radially inwardly to the axial outlet passage of the sifter.

While a single preferred embodiment of the invention has been illustrated and described in detail, it will be understood that various modifications in design and details of construction are possible without departing from the spirit of the invention which is defined by the following claims.

I claim:

1. In a gyratory pressure sifter which includes a generally vertically arranged housing having an upper end closure provided with an inlet for air-entrained solid particles to be sifted and a lower end closure having a

primary outlet for the discharge of air-entrained, sifted fines and a secondary outlet for the gravitational discharge of unsifted, larger size solid particles from said housing, and a plurality of generally horizontally arranged, vertically spaced apart sieve assemblies positioned in said housing between said upper and lower end closures; that improvement which comprises: an upwardly tapering frusto-conical inlet conduit having a wider lower end connected with the upper end closure of said housing and defining a downwardly and outwardly flaring inlet passage into said housing; and a downwardly tapering funnel-shaped separator ring positioned intermediate the ends of said inlet conduit and in coaxial, inwardly spaced relation thereto, said separator ring being spaced downwardly from the upper end opening of said inlet conduit and having a mouth opening of approximately the same size as the upper end opening of said inlet conduit, and being arranged to funnel the relatively heavier solid particles entering said inlet conduit inwardly toward the axis of said housing while permitting outward expansion of the relatively lighter air stream as it passes downwardly through said inlet conduit to thereby effect a partial separation of solid particles from the incoming air stream.

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