

March 6, 1962

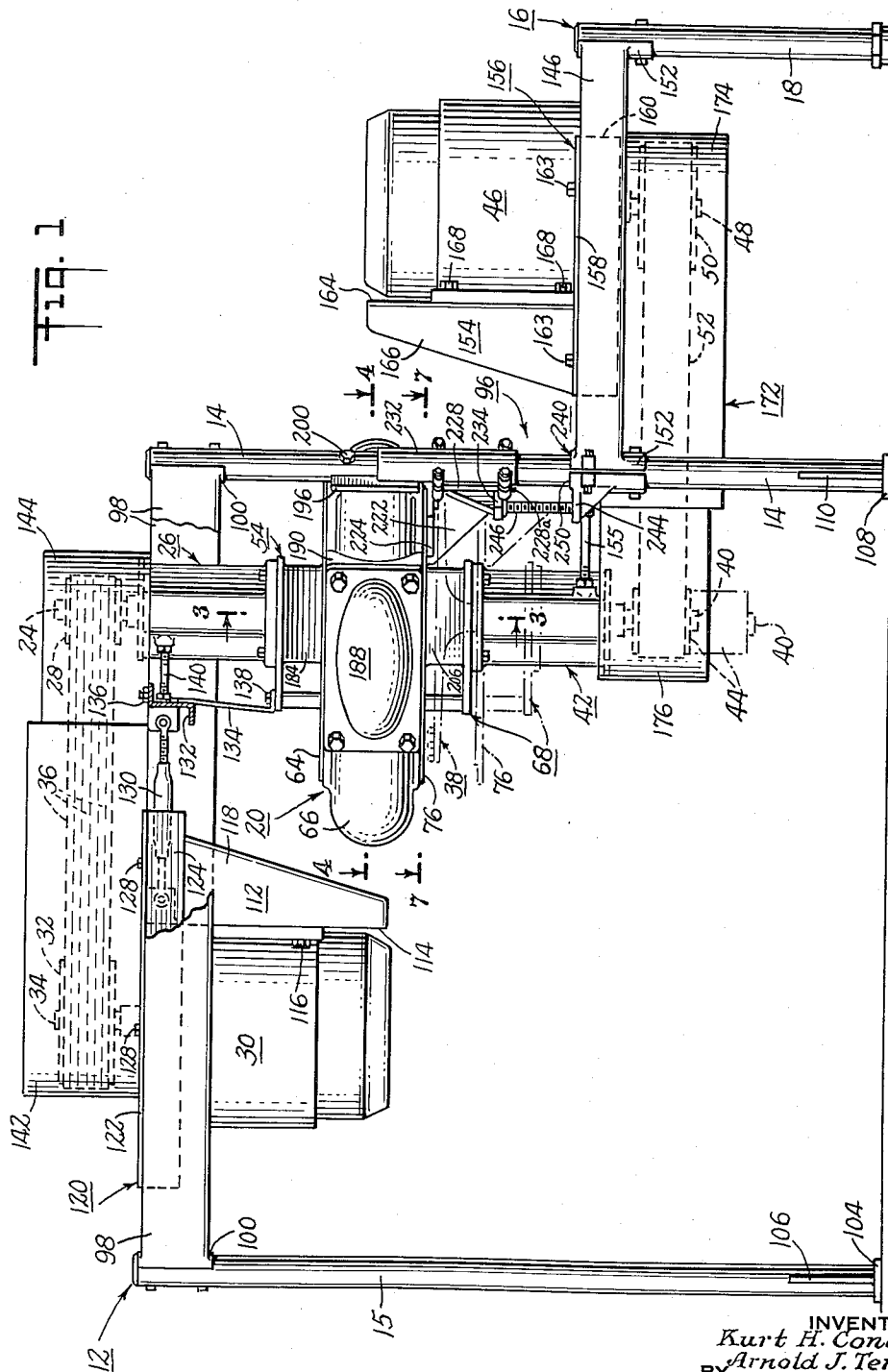
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3,023,973

CENTRIFUGAL IMPACTING APPARATUS

Filed March 17, 1959

7 Sheets-Sheet 1



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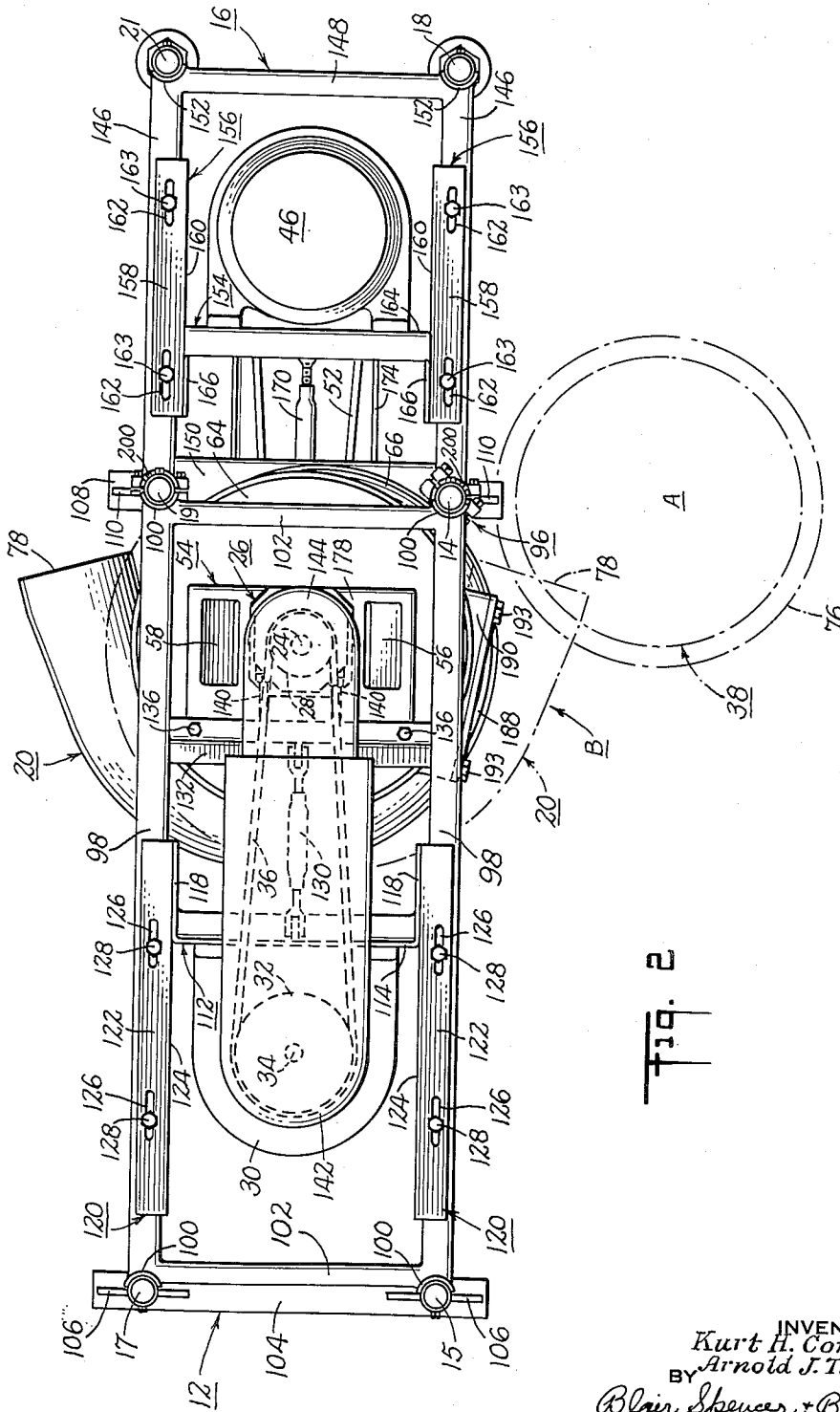


Fig. 2

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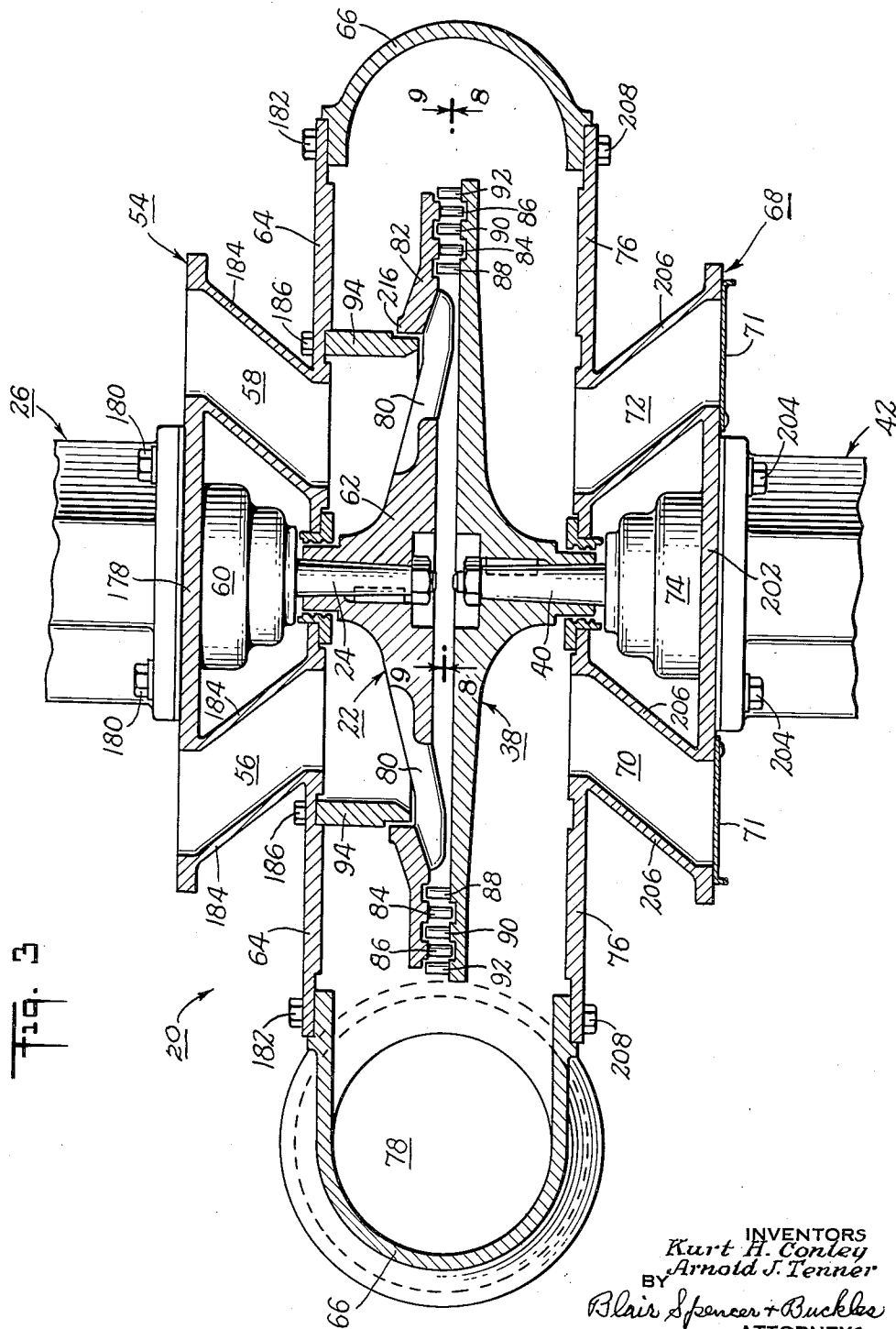


Fig. 3

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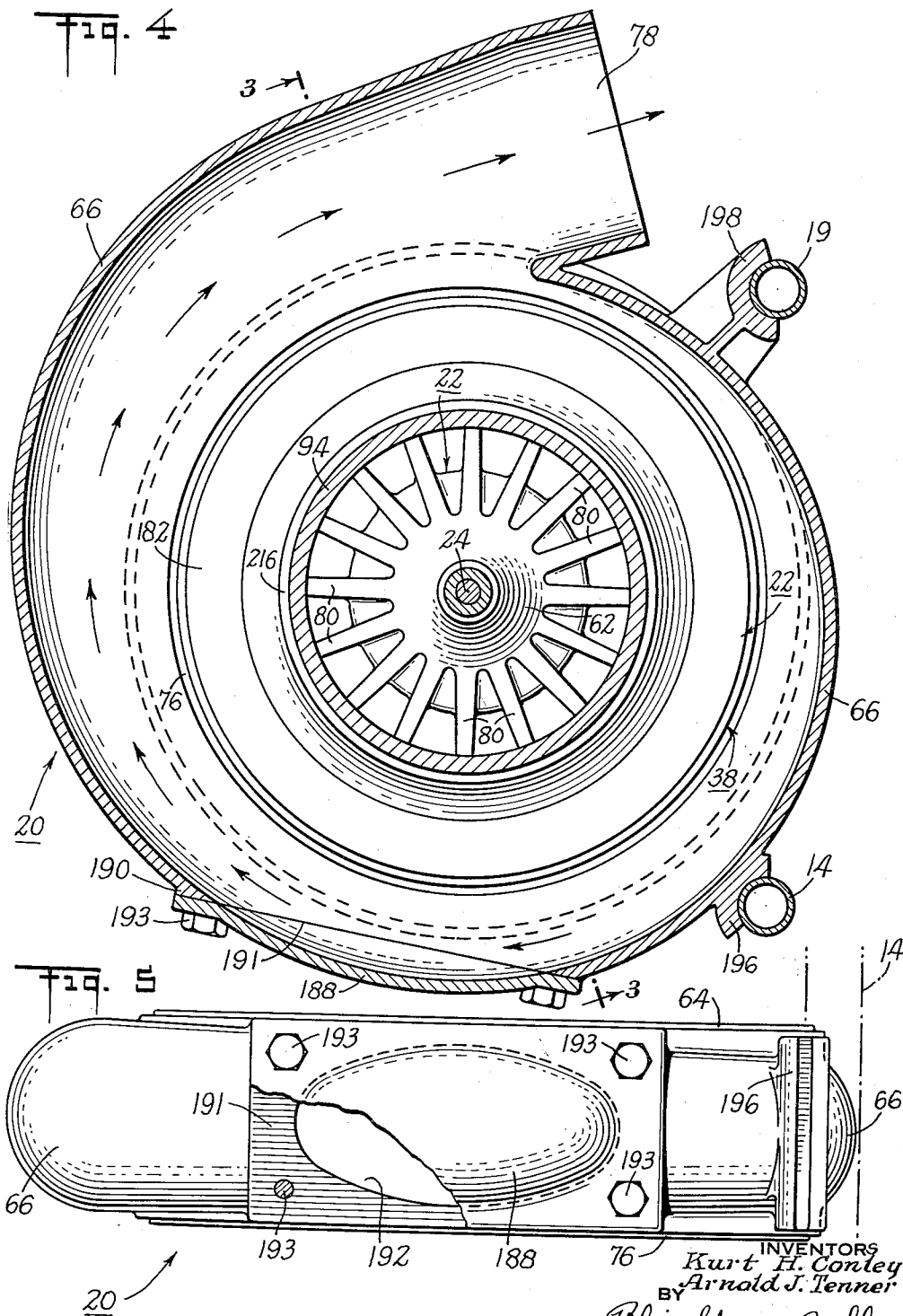
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Fig. 6

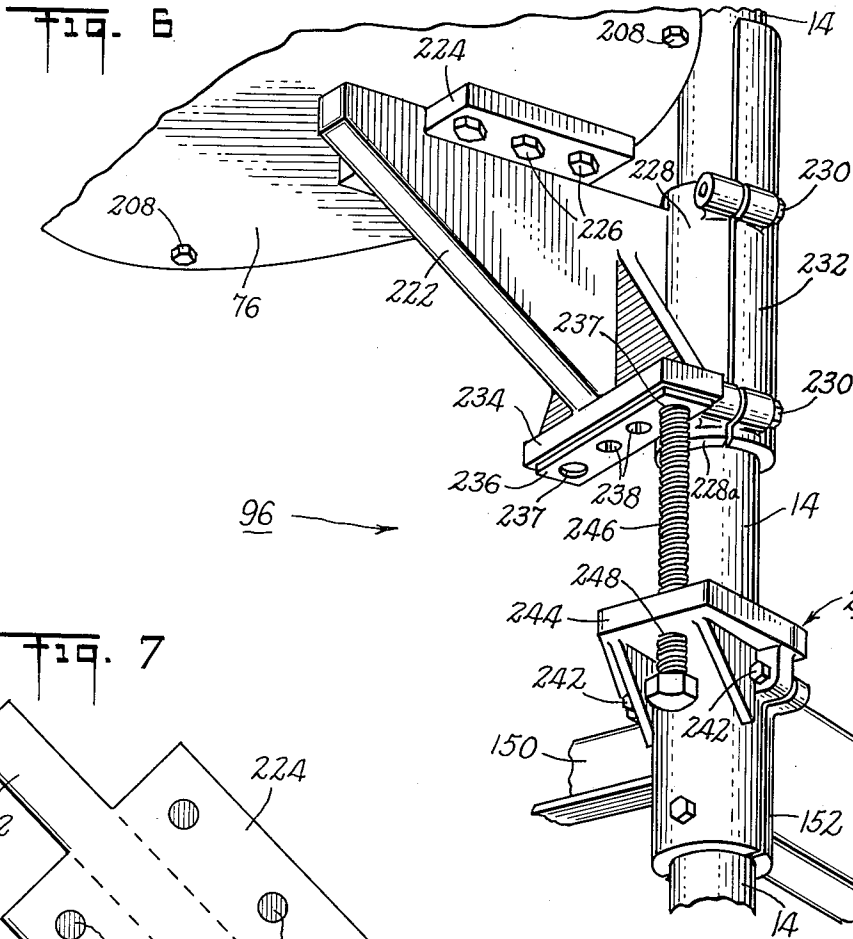
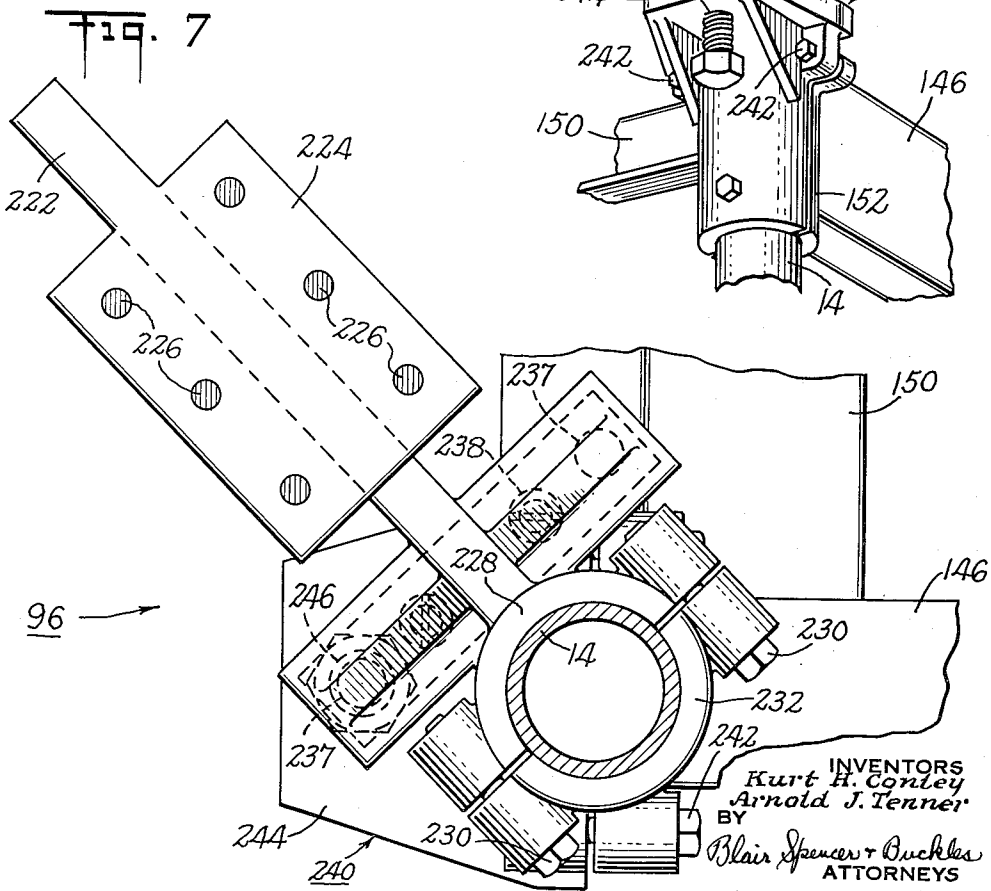


Fig. 7



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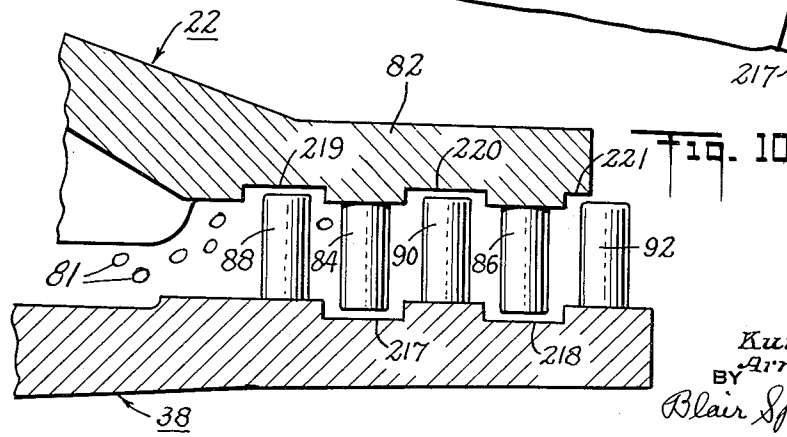
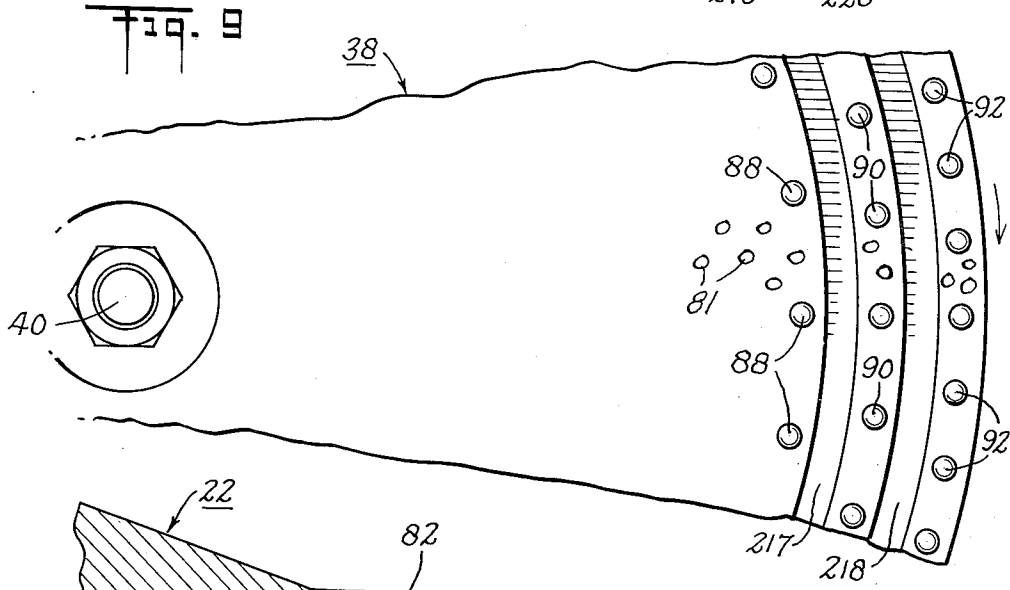
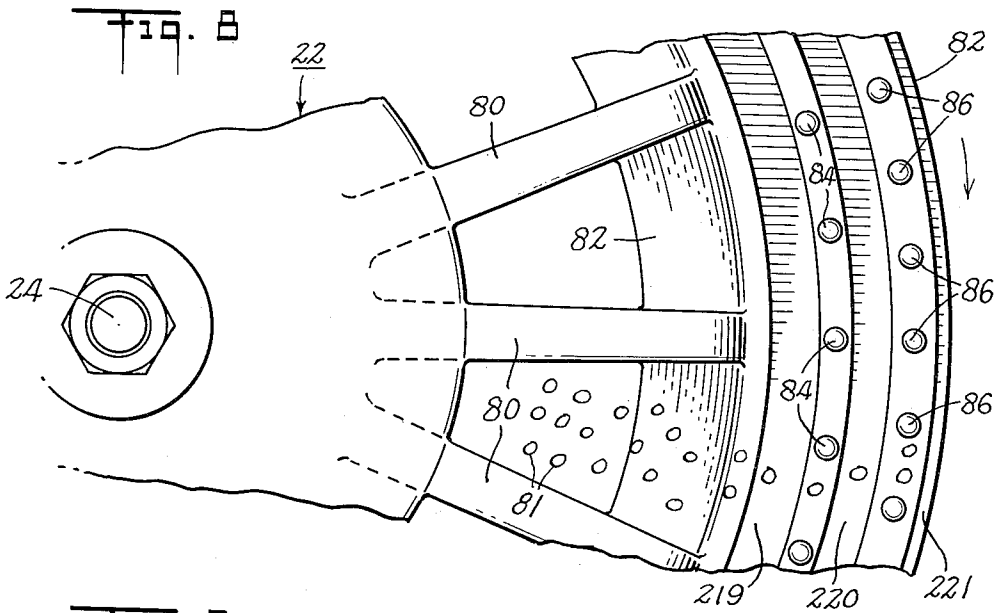
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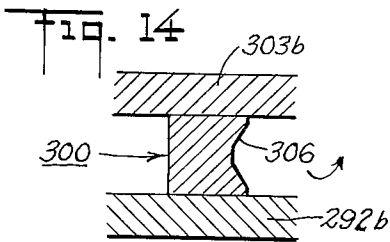
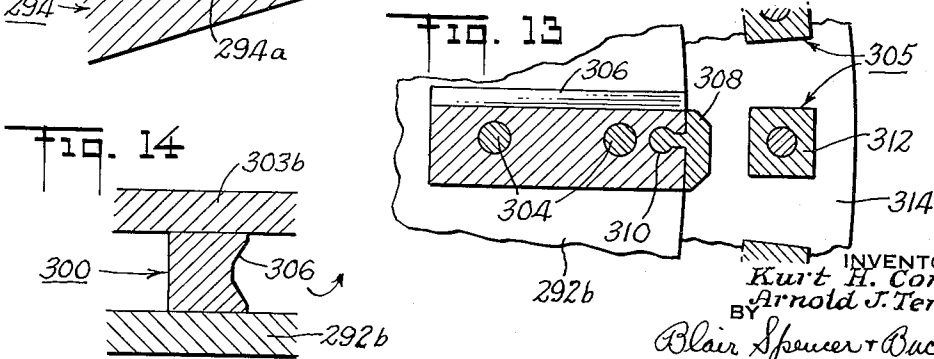
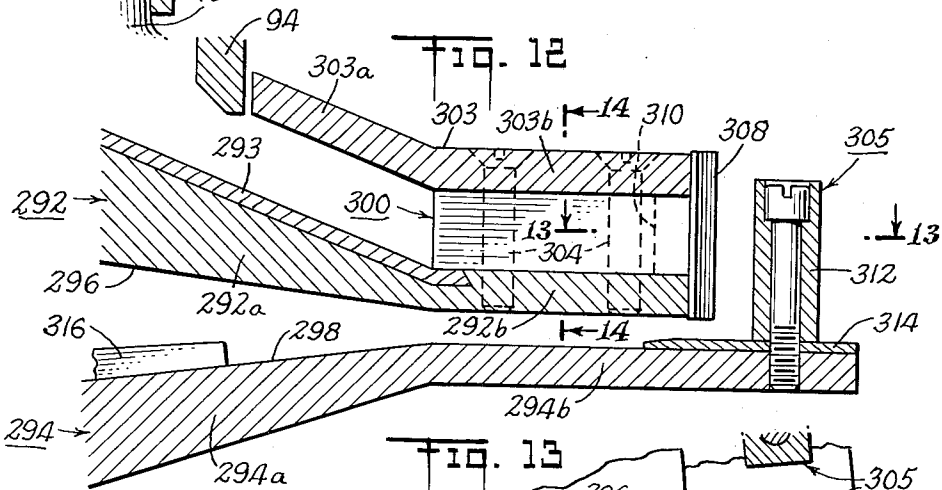
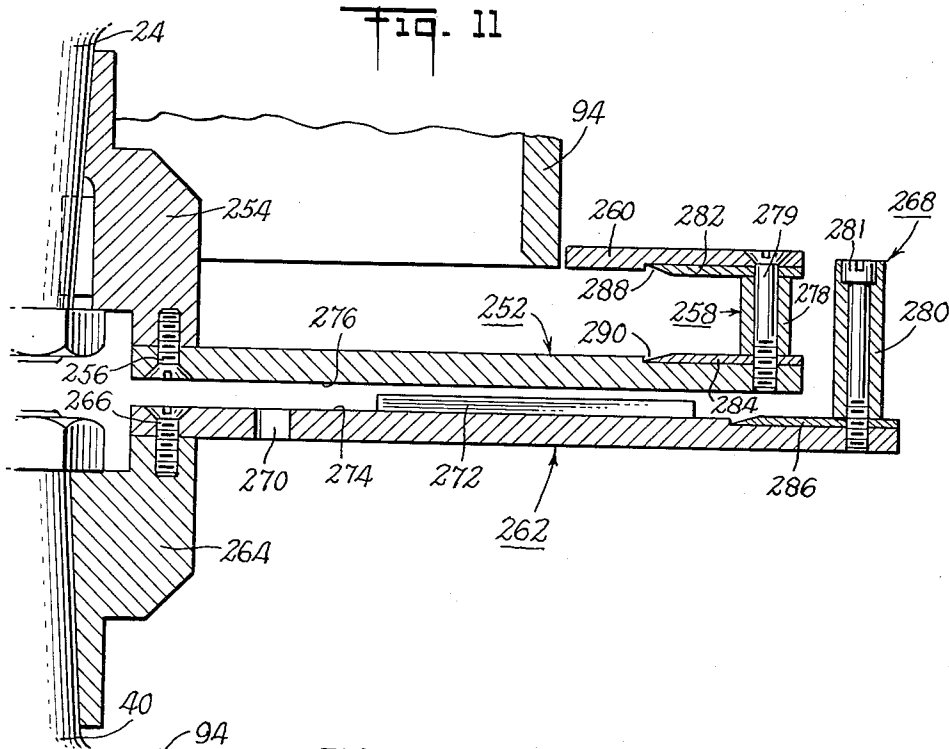
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CENTRIFUGAL IMPACTING APPARATUS

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 Filed Mar. 17, 1959, Ser. No. 799,930
 15 Claims. (Cl. 241-275)

This invention relates to apparatus for centrifugally impacting a flowing product to break and reduce the individual particles of the product. This apparatus may be used successfully in the milling of flour or other products from wheat, rye, corn, potatoes, tapioca or other grown products requiring extraction or separation of ingredients or fractions thereof. It may also be used for the reduction of certain inert materials such as asbestos, plasters, and the like. This apparatus may likewise be used for reducing, mixing, blending and otherwise processing a wide variety of materials.

With conventional single rotor centrifugal impacting apparatus, operational impacting speeds and capacities are quite limited. Centrifugal impacting apparatus incorporating two counter-rotating rotors with cooperating impactor elements produces better impacting results, because of the higher relative impacting velocities and capacities thereby made possible. By the mounting and alignment of the contacting rotors must be very precise to provide proper cooperation between the impactor elements and to prevent bridging or clogging of impacted material therebetween. Furthermore, the supporting frame must be adapted to withstand static loads, dynamic stresses and torque loads, such as those introduced by uneven inflow of the granular materials to be treated, and the necessary alignment must still be maintained.

In addition, free access to the impacting rotors for cleaning and adjustment is needed, and it is further desirable that the apparatus be constructed to permit convenient partial disassembly, to facilitate the changing of impactor elements and rotors as required. A construction permitting the substitution of pairs of rotors of different designs is also desirable to accommodate different products to be treated.

All of these desired features—interchangeability of rotors, partial disassembly, and convenient access for alignment and adjustment—must preferably all be incorporated in a construction sufficiently sturdy to withstand high static and dynamic loads.

Accordingly, the principal object of the present invention is to provide economical centrifugal impacting apparatus affording greatly improved impacting action. Another object of the invention is to provide apparatus of the above character incorporating two cooperating rotors driven by separate drive systems mounted on a unitary supporting frame. A further object of the invention is to provide apparatus of the above character according to convenient access to the rotors for inspection, cleaning, adjustment, etc. Another object of the invention is to provide apparatus of the above character affording a selectable plurality of discharge paths for the material treated to facilitate the combining of the apparatus with other equipment in a continuous treatment installation. Another object of the invention is to provide apparatus of the above character adapted for quick and convenient partial disassembly for purposes of unhindered cleaning, repair and replacement of rotors and impacting elements. A further object of the invention is to provide apparatus of the above character incorporating a torque-resistant and stress-resistant supporting frame. Another object of the invention is to provide apparatus of the above character providing convenient alignment of impacting rotors and driving means for most efficient operation. Another object of the invention is to provide apparatus of the

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above character adapted to accommodate a variety of differently shaped impacting rotors for purposes of treating different types of materials. Still another object of the invention is to provide apparatus of the above character incorporating interchangeable rotor housing elements, thereby increasing the useful life of the apparatus. Other objects will be in part obvious and in part pointed out hereinafter.

The invention accordingly comprises the apparatus embodying features of construction, combinations of elements and arrangements of parts which will be exemplified in the construction hereinafter set forth, and the scope of the invention will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawings, in which:

FIGURE 1 is a side elevation view, partially cut away, of impact milling apparatus incorporating one embodiment of the present invention;

FIGURE 2 is a top plan view of the apparatus shown in FIGURE 1;

FIGURE 3 is a fragmentary sectional elevation of a portion of the apparatus shown in FIGURE 1, and taken along the line 3-3, in FIGURES 1 and 4;

FIGURE 4 is a sectional top plan view of the central portion of the apparatus shown in FIGURE 1, and taken along the line 4-4;

FIGURE 5 is an elevation view, partially cut away, of the portion of the apparatus shown in FIGURE 4;

FIGURE 6 is a fragmentary bottom perspective view of the structure generally shown in FIGURE 7;

FIGURE 7 is a fragmentary top view, partially in section, of the structure shown in FIGURE 6 and taken along line 7-7 in FIGURE 1;

FIGURE 8 is a fragmentary bottom plan view of the top rotor of FIGURE 3 and taken along line 8-8;

FIGURE 9 is a fragmentary top plan view of the bottom rotor of the apparatus shown in FIGURE 3 and taken along line 9-9;

FIGURE 10 is an enlarged fragmentary vertical section of a portion of the rotors shown in FIGURE 3;

FIGURE 11 is a fragmentary vertical section of the rotors used in another embodiment of the invention;

FIGURE 12 is a fragmentary vertical section of the rotors which may be used in still another form of the invention;

FIGURE 13 is a fragmentary horizontal sectional view taken along line 13-13 of FIGURE 12; and

FIGURE 14 is a fragmentary vertical section taken along line 14-14 of FIGURE 12.

Referring now to the drawings in detail, there is shown in FIGURES 1 and 2 a supporting frame generally indicated at 12 incorporating supporting posts generally indicated at 14, 15, 17 and 19, and a sub-frame generally indicated at 16, supported on legs generally indicated at 18 and 21. A rotor housing generally indicated at 20 is supported by central posts 14 and 19 and by frame 12 in a manner to be more fully described hereinafter.

Referring to FIGURE 3, showing an enlarged sectional view of rotor housing 20, a receiving rotor generally indicated at 22 is keyed to a drive shaft generally indicated at 24, and shaft 24 extends through a suitable series of journal bearings (not shown) in a bearing casing generally indicated at 26. As best seen in FIGURES 1 and 2, a pulley generally indicated at 28 is keyed to the upper end of shaft 24, and frame 12 supports a driving motor 30 having a pulley 32 keyed to its drive shaft 34 as will be described in greater detail hereafter. Pulleys 28 and 32 are drivingly connected by suitable belting 36.

Returning to FIGURE 3, a processing rotor generally indicated at 38 is keyed to a shaft 40 which extends down-

wardly through suitable journal bearings (not shown) in a lower bearing casing generally indicated at 42. A pulley 44 is keyed to the lower end of shaft 40 as best seen in FIGURE 1, and sub-frame 16 supports a driving motor 46 whose shaft 48 has a pulley 50 keyed thereto. Suitable belting generally indicated at 52 drivingly connects pulleys 44 and 50. Preferably motors 30 and 46 are constructed to drive the receiving and processing rotors 22 and 38 in opposite directions.

Turning now to FIGURE 3, it will be seen that the rotor housing comprises an upper inlet casing generally indicated at 54 which includes inlet chutes 56 and 58 disposed on the opposite sides of the lower portion 60 of bearing casing 26 and converging toward the central portion or hub 62 of the receiving rotor 22. Inlet casing 54 also includes a housing plate 64 which rests upon and is secured to a volute central section 66 of housing 20. A lower air inlet casing generally indicated at 68 includes air inlet chutes 70 and 72 similarly located with respect to the upper portion 74 of bearing casing 42. Lower inlet casing 68 also includes a housing plate 76 secured to volute section 66 in any suitable manner. The shape of the volute central section 66 may be comprehended by reference to FIGURE 4 where it will be seen to increase gradually in radial dimension to form the product outlet 78; outlet 78 may be connected to any suitable ducting (not shown) for conveying the processed material away from the machine.

Referring to FIGURES 3 and 8, it will be seen that receiving rotor 22 has a series of radially extending vanes 80 running between hub 62 and the outer ring portion 82 thereof. Rotor 38 merely comprises a substantially flat disc and the outer portions of the two rotors face each other and have extending therefrom a series of impactors. More particularly, receiving rotor 22 has two rows of impactors 84 and 86 extending downwardly therefrom while processing rotor 38 has impactors 88, 90 and 92 extending upwardly therefrom, as shown in FIGURES 3, 8, 9 and 10. As will be apparent in FIGURES 3 and 11, impactors 84 and 86 are disposed between impactors 88, 90 and 92 as will be presently described in greater detail. Although these impactors may take a variety of shapes, in the preferred embodiment they are shown as substantially cylindrical pins. Further, the shape and position of these impacting members may vary according to the character of the material to be processed by the machine. Also, it is to be noted that the space between the impactors, indeed all spaces through which the material being processed travels, should be larger than the individual particles being processed so that the action of the machine is one of pure impact as distinguished from a grinding or mashing action.

It will now be apparent that when motors 30 and 46 (FIGURE 1) are started to drive the rotors 22 and 38 in opposite directions through shafts 24 and 40, a product to be treated may be fed to the receiving rotor through the chutes 56 and 58. As the material drops upon the hub 62 of the receiving rotor, it is flung outwardly between the vanes 80 by centrifugal force and is guided under ring portion 82 by a collar 94 depending from top plate 64 of upper inlet casing 54. Thus, the material is forced at very great velocities against impactors 88 and then continues along an outward path with violent impact as it passes between and hits impactors 84, 86, 90 and 92. From thence it is flung outwardly into the volute portion 66 of casing 20. It should be noted that motors 30 and 46 are designed to drive rotors 22 and 38 at very high speeds, and this creates a draft of air which enters with the product through the inlet chutes 56 and 58, together with other air which is drawn in via air inlet chutes 70 and 72. This air and the processed product are thereby not only forced outwardly, but whirled in a general circular path as indicated by the arrows in FIGURE 4, to be forced from the machine through product outlet 78 as seen in FIGURES 2 and 4.

It will be obvious that the machine and particularly

the rotor portions thereof must be accessible for cleaning and servicing. For this purpose the lower casing 68 and associated parts, which include processing rotor 38, lower air inlet casing 68, and lower bearing casing 42, are all pivotally and slidably mounted on central post 14 by supporting mechanism generally indicated at 96. Thus by structure to be presently described, the rotor 38 and associated mechanism may be lowered clear of volute casing 66 to the position generally indicated by dot-dash lines in FIGURE 1, and then pivoted about post 14 to a position such as that generally indicated by dashed lines at A in FIGURE 2, so that the processing rotor 38 as well as the interior of the volute casing and the receiving rotor 22 may all be readily accessible for servicing, cleaning, etc.

The structure supporting rotor housing 20 and the associated driving means in the preferred embodiment of the invention are best seen in FIGURES 1 and 2, where top frame 12 is seen to comprise end members 102 joined at their ends to the ends of side members 98, which are provided at each end with end sockets 100 adapted to interfit with supporting posts 14, 15, 17 and 19. These posts are secured in sockets 100 by bolting, welding, or the like. The end members and side members comprising frame 12 may be of any standard structural shape, such as channels, angle sections or box sections. Posts 15 and 17 are joined to an end anchor plate 104 and secured thereto by anchor webs 106. Central posts 14 and 19 are likewise joined to a central anchor plate 108 and secured thereto by anchor webs 110.

An upper motor bracket generally indicated at 112 includes a transverse mounting plate 114 to which motor 30 is secured by bolts 116. Mounting plate 114 is provided with longitudinal flanges 118 preferably welded to depending flanges 124 of angle members 120, whose upper horizontal flanges 122 are slidably supported by side members 98. The depending flanges 124 of angle members 120 are positioned inside and adjacent to their respective supporting side members 98, as best shown in FIGURE 1, and the upper flanges 122 of these angle members are provided with longitudinal slots 126 which receive bolts 128 threaded into side members 98. Bolts 128 may thus be tightened to secure motor bracket 112 to frame 12, or they may be loosened to permit longitudinal sliding adjustment of the motor, whereby the distance between motor shaft 34 and receiving rotor shaft 24 may be changed to adjust the operating tension of belting 36.

An adjustable turnbuckle 130 is secured to transverse mounting plate 114 and to a crossbeam 132 spanning frame 12 transversely and welded to side members 98. Crossbeam 132 may be of any structural shape, but it is preferably of Z-shaped cross-section for increased rigidity. Turnbuckle 130, joining slidable motor bracket 112 to fixed cross beam 132, is thus adapted to change the position of motor bracket 112 after bolts 128 have been loosened.

A depending mill support plate 134 is adjustably connected to crossbeam 132 by threaded studs 136, as shown in FIGURES 1 and 2, and the lower end of this plate is joined by bolts 138 to upper inlet casing 54. Two torque braces 140 are each connected to crossbeam 132 and to the upper end of upper bearing casing 26.

The structural advantages of this combination of mill supporting elements are more fully described in the co-pending application of Kurt H. Conley, Serial Number 744,602, filed June 25, 1958.

The driving connection between the motor shaft 34 and the upper mill driven shaft 24 preferably incorporates a plurality of flexible driving belts 36 between multi-grooved pulleys 32 and 28, which are mounted on shaft 34 and shaft 24, respectively. As pointed out above, the adjustment of turnbuckle 130 changes the distance between the shafts 34 and 24, thereby adjusting the tension of belting 36 for the most efficient operation. A telescoping drive cover forms a safety-guard surrounding the fast-moving belts 36 and pulleys 28 and 32, and this drive

cover includes an open-ended belt cover 142 enclosing pulley 32 and a portion of belting 36 and secured to motor bracket 112, and an interfitting open-ended pulley cover 144 enclosing pulley 28 and the remainder of belts 36, and secured to upper bearing casing 26 or to cross-beam 132.

Supporting means for motor 46 and the associated driving mechanism for processing rotor 38 (FIGURE 3) are shown in FIGURES 1 and 2. Sub-frame 16 comprises side members 146, end member 148 and central crosspiece 150. The ends of side members 146 are provided with end sockets 152 to accommodate legs 18 and 21 and central posts 14 and 19, and the legs and posts may be held in position in these sockets by welding or bolting as described above with respect to the main frame 12. End member 148 and central crosspiece 150 span the width of sub-frame 16 and join the ends of side members 146 adjacent end sockets 152. A lower motor bracket generally indicated at 154 includes angle members 156 having upper horizontal flanges 158 slidably resting upon the upper surfaces of side members 146 with depending inner vertical flanges 160 positioned inside and adjacent their respective side members 146. The upper flanges 158 of these angle members are provided with longitudinal slots 162 adapted to receive bolts 163 which are inserted therethrough into tapped holes in side members 146. Motor mounting plate 164 spans sub-frame 16 between angle members 156 and is provided with longitudinal flanges 166 welded to depending flanges 160 of angle members 156. Motor 46 is bolted or otherwise secured to mounting plate 164 by bolts 168 and an adjustable turnbuckle 170 joins mounting plate 164 to central crosspiece 150. Adjustment of this turnbuckle facilitates the sliding adjustment of motor bracket 154 by causing angle members 156 to slide upon their supporting side members 146. Bolts 163 may be tightened to clamp motor bracket 154 in any desired position.

A pair of longitudinal torque braces 155 connect the lower bearing casing 42 to the central crosspiece 150 of sub-frame 16.

As described above, shaft 40, on which processing rotor 38 is mounted, projects from the lower end of lower bearing casing 42 and pulley 44 is keyed on this lower projecting end of shaft 40. A pulley 50 is keyed to the downwardly projecting shaft 48 of motor 46 and flexible belting 52 joins the two pulleys to complete the driving connection between motor 46 and the processing rotor 38. Belting 52 preferably takes the form of a plurality of flexible belts joining multigrooved pulleys 44 and 50, and optimum belt tension is maintained by the sliding motor bracket adjustment described above. The torque braces 155 aid in maintaining bearing casing 42 in position. These belts and pulleys are guarded by a second telescoping drive cover generally indicated at 172, which includes an open-ended belt cover 174 covering pulley 50 and a portion of belts 52 and secured to motor bracket 154, and an interfitting pulley cover 176 covering pulley 44 and the remainder of belts 52 which is secured to the lower bearing casing 42.

Referring now to FIGURE 3, it will be seen that the preferred form of rotor casing 20 includes three separate elements which are connected by bolts, or the like: upper inlet casing 54, lower air inlet casing 68 and volute housing section 66.

Upper inlet casing 54 includes a base plate 178 bolted to upper bearing casing 26 by bolts 180, and a housing plate 64 joined to base plate 178 by the side walls 184 of inlet chutes 56 and 58. Base plate 178 and housing plate 64 are provided with suitable openings to accommodate the projecting lower portion 60 of bearing casing 26 and shaft 24 and its associated fittings, respectively. Feed chutes 56 and 58 preferably converge, as shown in FIGURE 3, to direct the inflowing material to be treated toward central hub 62 of receiving rotor 22. Annular collar 94 is secured by bolts 186 to the under-

side of housing plate 64 in such a position that the collar fits within the rim or ring portion 82 of receiving rotor 22.

Rotor housing section 66, as shown in FIGURES 3 and 4, comprises a generally annular housing of volute horizontal cross-section, with a discharge outlet 78 at its periphery. Volute section 66 surrounds rotors 22 and 38 and is bolted to housing plate 64 of inlet casing 54 by bolts 182.

Volute housing 66 is provided with an access door 188 mounted on its periphery, as shown in FIGURES 2, 4, and 5. A peripheral portion of volute housing 66 extends radially to form a projecting door flange 190 with a flat outer face 191. The door flange 190 surrounds a generally elliptical door opening 192 affording access to the interior of volute housing 66 (FIGURE 5). Door 188 is connected to face 191 of flange 190 by bolts 193, threaded into tapped holes in face 191, or by other suitable fastening means. If desired, door 188 may be hinge connected to flange 190, and closed by a suitable latch arrangement (not shown in the drawings). Anchor brackets 196 and 198 are formed on or joined to the periphery of volute 66 and adapted to accommodate central posts 14 and 19, respectively, these brackets being held in position by bolts 200 passing through suitable holes in the posts and thence into tapped holes in the anchor bracket. Volute rotor casing 66 is thus firmly anchored to the posts supporting the main frame. It will be seen in FIGURE 4 that anchor bracket 198 projects farther from the outer wall of volute 66 than does bracket 196 because the volute has a smaller external radius at anchor bracket 198 than at anchor bracket 196.

The arrows in FIGURE 4 indicate generally the path of air and treated material leaving the rotors and passing around the interior of the volute toward discharge outlet 78. Feed chutes 56 and 58, shown in detail in FIGURE 3, may be connected to suitable ducting, adapted to convey air and the material being treated to the apparatus, and discharge outlet 78 may likewise be connected to similar ducting to convey the impacted material to further treatment operations.

Rotor housing 20 also includes air inlet casing 68 as shown in FIGURE 3, and this inlet casing, like inlet casing 54, includes a base plate 202 secured by bolts 204 to lower bearing casing 42, and joined to the housing plate 76 by the walls 206 of air inlet chutes 70 and 72. Air inlet casing 68 is joined by bolts 208 to volute rotor casing 66, and both base plate 202 and housing plate 76 provide apertures accommodating projecting upper portion 74 of lower bearing casing 42 and shaft 40 and its associated fittings, respectively.

As indicated in FIGURE 3, casing 54 and air inlet casing 68 are preferably identical and may be interchanged, one for the other, to provide an extended useful life for the apparatus. Manufacturing costs are also reduced by employing the same structure to form both the upper and lower portions of rotor housing 20. Furthermore, volute casing 66 is preferably designed so that it may be reversed and installed upside down to place discharge outlet 78 in an alternative position B on the opposite side of the structure, as shown in FIGURE 2, for convenience in adapting the apparatus to be linked and installed with adjacent processing machinery in the most useful and space-saving manner.

The preferred form of substantially co-axial and concentric rotors 22 and 38 are shown in FIGURES 3, 4, 8, 9 and 10. Receiving rotor 22 is provided with a hub portion 62 bolted and keyed to the end of shaft 24, and an annular ring or rim portion 82 joined to hub portion 62 by a series of generally circumferentially spaced radial vanes 80, adapted to cooperate with collar 94 in guiding the material being treated from the vicinity of hub 62 downwardly and outwardly, under the impetus of centrifugal force, whence it passes underneath rim 82 and toward the impactors 84, 86, 88, 90 and 92. As

shown in FIGURE 10, rim 82 is joined to hub 62 by vanes 80. Further, this rim 82 is provided with an inner shoulder 216 outside annular collar 94 and co-operating therewith in directing material being treated downwardly towards the impactors. As shown in FIGURES 8 and 10, rim 82 is preferably provided with two concentric annular rows of impactors 84 and 86 projecting downwardly and generally perpendicular. These impactors may have any desired shape, but round cylindrical impactor pins have been found to be preferable in many impacting operations.

Processing rotor 38 is preferably an integral disc keyed to its driving shaft 40 and likewise having concentric annular rows of impactors 88, 90 and 92 projecting upwardly and generally perpendicular. As seen most clearly in FIGURE 10, receiving impactors 84 and 86 are preferably designed to fit between and intermesh with processing impactors 88, 90 and 92. It will be noted that processing rotor 38 is provided with annular grooves 217 and 218 having substantially greater width than the diameter of impactors 84 and 86 and generally positioned adjacent the projecting ends of those impactors. Rim 82 of receiving rotor 22 is likewise provided with spaced annular grooves 219, 220 and 221, positioned adjacent the projecting ends of processing impactors 88, 90 and 92. Grooves 219 and 220 are wider than the diameters of impactors 88, 90 and 92, and partial groove 221 is similarly spaced from impactors 92 to provide ample clearance therebetween. It will be seen from FIGURE 10 that substantial spaces are provided between each row of impactors and the bottom and sides of the corresponding opposite groove into which that row of impactors projects slightly, and that the spaces between the adjacent rows of impactors are also substantial. All of these spaces are preferably designed to be substantially larger than the dimensions of the particles being treated between the two rotors, to avoid building-up, bridging or clogging of this material between impacting elements and adjacent members.

In order to facilitate the partial disassembly of the operative elements of the apparatus and to permit the withdrawal of processing rotor 38 and its associated mechanism from rotor housing 20, withdrawal means generally indicated at 96 in FIGURE 1 are shown in greater detail in FIGURES 6 and 7. Hinge bracket 222, having a base plate 224 bolted to lower plate 76 of rotor housing 20 by bolts 226, is slidably and rotatably clamped to central posts 14, as best shown in FIGURE 6. Hinge bracket 222 is provided with a slidable socket 228 adapted to accommodate post 14 and to be clamped thereto by through bolts 230, joining the socket to clamping member 232. The hinge bracket is also provided with a generally horizontal base 234 having a removable pressure pad 236 mounted on the underside of the base 234 by screws 238. A fixed bracket 240 is also mounted on post 14 and clamped to one of the end sockets 152 of sub-frame side member 145 by bolts 242. Fixed bracket 240 is provided with a generally horizontal platform 244, and means associated with this fixed bracket are provided for raising and lowering hinge bracket 222 on post 14. In a preferred form of the invention, this raising and lowering means takes the form of a jackscrew 246 threaded upward through a tapped hole 248 in platform 244 and bearing against the underside of pad 236. Thus, the apparatus may be prepared for partial disassembly by removing bolts 208, thereby disconnecting air inlet housing 68 from volute 66, disconnecting belting 52 from pulley 44, disconnecting torque braces 155 and loosening bolts 230. The processing rotor 38 and its associated supporting elements are thereby freed so that they are supported only by hinge bracket 222 on post 14. The lowering of jackscrew 246 permits hinge bracket 222 to slide downward on central post 14 until the lower end 228a of its socket 228 rests upon shoulder 250 of fixed bracket 240. At this point, rotor 38 has descended clear

of volute 66 and the entire lowered assembly may be rotated about post 14 outwardly, with hinge bracket 222 resting upon shoulder 250. In this position, it will be seen that both rotors are freely accessible and all parts of rotor housing 20 may be reached conveniently for cleaning, repairs, changing of parts and the like.

As shown in FIGURE 6, jackscrew 246 bears against a recess 237 near one end of pad 236, and this pad is adapted to be reversed, end for end, with jackscrew 246 thereafter bearing against a recess near the opposite end of the pad. The entire withdrawing assembly 96 is also adapted to be installed on the second central post 19, so that the lower processing rotor assembly may be swung outward on the side of the apparatus which is most convenient in any installation. The reversibility of pad 236, mentioned above, adapts hinge bracket 222 for mounting on either of the posts 14 or 19.

The operation of the machine will be understood by referring to the various figures. Motors 30 and 46 are started and rotors 22 and 38 are thereby driven at high speeds, preferably in opposite directions. Granular or fibrous material of any desired particle size is then introduced to the apparatus through feed chutes 56 and 58, together with air or any other desired gases. The moisture content of the accompanying air or gases may be regulated to facilitate the impacting operation. Material to be impacted is directed by feed chutes 56 and 58 to hub 62 of rotor 22, where it is flung outwardly under the impetus of centrifugal force toward collar 94. The material then descends between vanes 80 and is given further radial acceleration by the action of these vanes and also by the high speed rotary motion of processing rotor 38. The material is thus driven at high velocity to the impactors 84, 86, 88, 90 and 92, and is violently flung and impacted therebetween, the material passing at all times through spaces between the various elements which are larger than the particle size of the material being treated, so that bridging and clogging of treated material in the impacting area is minimized or eliminated. The impacted stock and the air admitted therewith, as well as any additional air admitted through air inlet passages 70 and 72, thereafter travels around the interior of the volute 66 as described above and passes therefrom through discharge outlet 78. Air inlet valves 71 are pivotally mounted in inlet passages 70 and 72 to control the amount of additional air admitted therethrough.

It will be seen from the foregoing discussion that all of the elements supporting and anchoring the rotor housing and bearing casings to the main frame and the sub-frame cooperate to resist both static loads and dynamic stresses with great efficiency. Anchor brackets 196 and 198 are well adapted to anchor rotor housing 20 to central posts 14 and thereby maintain proper operating alignment of receiving rotor 22 and processing rotor 38. Since withdrawing means 96 is well adapted for the partial disassembly of the apparatus, the rotors 22 and 38 may be replaced by other pairs of rotors of different designs which may be adapted for the treatment of different types of materials. Thus, for example, there is shown in FIGURE 11, another embodiment of the invention including a pair of rotors of different construction. Here a receiving rotor generally indicated at 252 is formed as a flat disc joined to hub 254 by screws 256, and hub 254 is bolted and keyed to receiving rotor shaft 24. A single peripheral row of angularly spaced receiving impactors generally indicated at 258 join the periphery of receiving rotor 252 with a generally horizontal annular ring 260 spaced upwardly therefrom and positioned just outside the lower end of collar 94. A processing rotor generally indicated at 262 is likewise formed as a flat disc and secured to hub 264 by screws 266, and hub 264 is keyed to processing rotor shaft 40. Processing rotor 262 is provided with a peripheral row of angularly spaced impactors generally indicated at 268, projecting upwardly near the outer edge of rotor 262 and surrounding receiv-

ing impactors 258. Processing rotor 262 is also provided with one or more central air entrance openings 270 and generally radial fan blades 272 mounted on its adjacent face 274 and projecting towards adjacent face 276 of receiving rotor 252. The impacting portions of these two rotors may be provided with abrasive resistant surfaces to improve the wearing qualities of the rotors. Thus, as shown in FIGURE 11, the receiving and processing impactors are provided with abrasion resistant sleeves 278 and 280, respectively; ring 260 is provided with a plate 282, rotor 252 is provided with a plate 284 and rotor 262 is provided with a plate 286. More particularly, sleeves 278 and 280 are secured by screws 279 and 281. Such abrasion resistant surfaces may, for example, be formed of high hardness steels or ceramic materials. Segments 282 and 284 of receiving rotor 252 and its ring 260 preferably have entry ramps 288 and 290 sloping toward each other to narrow the space between ring 260 and rotor 252 near the impactors 258. These ramps direct the material to be treated toward the central portions of impactors 258 and spread the material over the effective surfaces of both rows of impactors. When plates 282 and 284 are mounted in circumferential grooves, as shown in FIGURE 11, the leading edges of ramps 288 and 290 are preferably recessed in these grooves, as shown, to induce eddies in passing air and material to be impacted, thus minimizing abrasion of the groove-shoulders adjacent these entry ramps. Air passing through openings 270 and driven outwardly between the rotors by blades 272 aids in expelling impacted materials from the impactors into volute 66.

Another pair of impacting rotors forming another embodiment of my invention is illustrated in FIGURES 12, 13, and 14. Here, the receiving rotor 292 and the processing rotor 294 are not flat, as shown in FIGURE 11, but are formed with concave adjacent faces 296 and 298, respectively, to form an air inlet space between them having a vertically diminishing thickness, which may be designed to produce a Venturi effect upon the air passing through this air inlet passage. Fan blades 316 are mounted on surface 298 of rotor 294. The receiving rotor 292 has a lower plate with a downwardly sloping central portion 292a on which an abrasion resistant wear plate 293 is mounted, and an outer substantially horizontal portion 292b. The receiving rotor also includes an upper ring 303 having a downwardly sloping inner portion 303a surrounding collar 94, and a substantially horizontal outer portion 303b immediately above portion 292b.

The receiving impactor elements 300 are radially disposed between horizontal portions 292b and 303b, and impactor elements 300 preferably extend from sloping portions 292a and 303a to the periphery of the rotor. These impactors 300 preferably take the form of solid blocks held in position by screws 304, and having generally concave radial grooves 306 formed in their leading edges, i.e., in the faces which strike the material to be treated. These grooves channel and direct the treated material toward the central portion of the processing impactors 305, to provide more efficient impacting action.

Processing rotor 294 has an upwardly sloping central portion 294a, and a horizontal portion 294b, with a row of radially spaced impactors 305 extending upwardly therefrom adjacent its periphery. The impactors 305 and the processing rotor 294 may be provided with abrasive-resistant surfaces 312 and 314 in the manner shown in FIGURE 12. If desired, the impactors 305 may take the form of square or polygonal pins, as shown in FIGURE 13, rather than the round pins shown in FIGURES 8, 9 and 10. The outer ends of impactors 300 are also provided with abrasive-resistant inserts 308 keyed into suitable end slots 310 in the impactors; these inserts extend vertically so that the inserts cover the outer ends of the impactors and the peripheries of plate 292 and ring 303. Inserts 308 are thus well adapted to cooperate with

impactors 305 to provide rebound or ricochet impacting effect.

Thus the apparatus of the present invention provides numerous advantages, including rigid, lightweight support for the counter-rotating impacting rotors combined with easy accessibility via door 188 of volute 66 for cleaning and repair of the rotors. Convenient partial disassembly is also provided to permit free access to the rotors for repairing and cleaning the rotors and rotor casing, and for substituting different pairs of receiving and processing rotors. The structural elements of the present invention are well adapted to resist static and dynamic stresses, as described above, and the various adjustable elements supporting the bearing casings and the driving motors permit convenient alignment of the rotating elements for efficient impacting operation and efficient driving adjustment.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained and, since certain changes may be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

We claim:

1. In centrifugal impacting apparatus, in combination, a supporting frame, a driving motor mounted on said supporting frame, supporting members joined to said frame, a rotor casing suspended from said frame, an impacting rotor, means rotatably supporting said rotor in said casing, means forming a driving connection between said rotor and said motor, a sub-frame below said supporting frame and extending from and connected to some of said supporting members, a second driving motor mounted on said sub-frame, a second impacting rotor, means rotatably mounting said second impacting rotor in concentric relation to said first-mentioned impacting rotor in said casing, means forming a driving connection between said last-mentioned driving motor and said last-mentioned rotor, and means forming braces interconnecting said frame and said sub-frame with said casing and forming a rigid support for the rotating parts of the apparatus.

2. In centrifugal impacting apparatus, in combination, a supporting frame, supporting members joined to said frame, a rotor casing suspended from said frame, an impacting rotor, means rotatably supporting said rotor in said casing, driving means for rotating said rotor, a sub-frame below said supporting frame and extending from and connected to at least one of said supporting members, a second impacting rotor, means rotatably supporting said second rotor adjacent to said first-mentioned rotor in said casing, driving means mounted on said sub-frame for rotating said second rotor in a direction opposite to said first-mentioned rotor, and means forming a rigid support for the rotating parts of the apparatus.

3. In centrifugal impacting apparatus, in combination, a supporting frame, supporting members joined to said frame, a rotor casing suspended from said frame, a receiving rotor, means including an upper bearing casing rotatably supporting said receiving rotor in said casing, driving means for rotating said receiving rotor, a sub-frame below said supporting frame and extending from and connected to at least one of said supporting members, a processing rotor, means including a lower bearing casing rotatably supporting said processing rotor adjacent to said receiving rotor in said casing, driving means for rotating said processing rotor, and means forming a rigid support for rotary parts and including a torque brace connecting said upper bearing casing to said frame and a second

torque brace connecting said lower bearing casing to said sub-frame.

4. In centrifugal impacting apparatus, in combination, a supporting frame, supporting members joined to said frame, a rotor casing suspended from said frame, a receiving rotor, means including an upper bearing casing above said receiving rotor for rotatably supporting said receiving rotor in said casing, driving means for rotating said receiving rotor, a sub-frame below said supporting frame and displaced laterally therefrom and connected to at least one of said supporting members, a processing rotor, means including a lower bearing casing rotatably supporting said processing rotor adjacent to said receiving rotor in said casing, driving means associated with said sub-frame for rotating said processing rotor, and means forming a rigid support for the rotating parts of the apparatus and including a supporting plate adjustably connecting said upper bearing casing to said frame.

5. In centrifugal impacting apparatus, in combination, a supporting frame, supporting members joined to said frame, a rotor casing suspended from said frame, a receiving rotor, impacting pins on said receiving rotor, means rotatably supporting said receiving rotor in said casing, driving means for rotating said receiving rotor, a sub-frame below said supporting frame and laterally displaced therefrom and connected to at least one of said supporting members, a processing rotor adjacent to said receiving rotor in said casing, impacting pins extending said processing rotor, driving means associated with said sub-frame for rotating said processing rotor, and means forming a rigid support for the rotating parts of the apparatus, said rotor casing including an upper inlet casing incorporating feed chutes adapted to conduct material to be impacted to said receiving rotor, whereby said material is hurled outwardly by centrifugal force to be hit by said impactors.

6. In centrifugal impacting apparatus, the combination of a casing having a detachable section, a frame, means fixedly connecting said casing to said frame, a receiving rotor, a processing rotor, first means rotatably mounting said receiving rotor in said casing, second means mounting said processing rotor in said detachable section thereof, impacting pins extending from said rotors and spaced from the axes thereof, means forming a product inlet to direct material to be treated onto said receiving rotor, and means forming a sliding connection between said detachable section and said frame whereby said processing rotor and said second mounting means may be removed from said casing.

7. In centrifugal impacting apparatus, the combination of a casing having a detachable section, a frame, means fixedly connecting said casing to said frame, a receiving rotor, a processing rotor, first means rotatably mounting said receiving rotor in said casing, second means mounting said processing rotor in said detachable section, said second mounting means including a member connected to said processing rotor which passes through and is mounted in said section, impactors mounted on said rotors and spaced from the axes thereof, means forming a product inlet to direct material to be treated onto said receiving rotor, means forming a sliding bracket connecting said detachable section to said frame, and lowering means associated with said bracket and said frame whereby said processing rotor and said section may be lowered from said casing.

8. In centrifugal impacting apparatus, the combination of a casing having a lower detachable section, a frame including a supporting post, means fixedly connecting said casing to said frame, a receiving rotor, a processing rotor below said receiving rotor, means rotatably mounting said rotors in said casing, said mounting means including a drive shaft for said processing rotor which passes through and is mounted in said section, impactors mounted on said rotors and spaced from the axes thereof, means forming

a product inlet to direct material to be treated onto said receiving rotor, a sliding hinge bracket pivotally mounted on said central post and connecting said detachable section to said post, and lowering means associated with said hinge bracket and said frame whereby said processing rotor and said mounting means therefor may be lowered from said casing and pivoted about said post to afford access to said rotors and said casing.

9. In centrifugal impacting apparatus, the combination of a casing having a lower detachable section, a frame, means fixedly connecting said casing to said frame, a receiving rotor, a processing rotor, means rotatably mounting said rotors in said casing, said mounting means including a shaft for said processing rotor which passes through and is mounted in said detachable section, impactors mounted on said rotors and spaced from the axes thereof, means forming a product inlet to direct material to be treated onto said receiving rotor, a sliding bracket connecting said detachable section to said frame, a fixed bracket mounted on said frame, and jacking means associated with said fixed bracket and said sliding bracket and adapted to raise and lower said sliding bracket whereby said processing rotor and said mounting means therefor may be lowered from said casing.

10. In centrifugal impacting apparatus, the combination of a casing having a lower detachable section, a frame, means fixedly connecting said casing to said frame, a receiving rotor, a processing rotor, means rotatably mounting said rotors in said casing, said mounting means including a drive shaft for said processing rotor which passes through and is mounted in said detachable section, impactors mounted on said rotors and spaced from the axes thereof, means forming a product inlet to direct material to be treated onto said receiving rotor, a sliding bracket connecting said detachable section to said frame, a fixed bracket mounted on said frame, and a jackscrew threaded in said fixed bracket and adapted to bear against said sliding bracket to raise and lower said sliding bracket whereby said processing rotor and said section may be lowered from said casing.

11. In centrifugal impacting apparatus, the combination of a casing having a lower detachable section, a frame means fixedly connecting said casing to said frame, a receiving rotor, a processing rotor, means rotatably mounting said rotors in said casing, said mounting means including a drive shaft for said processing rotor which passes through and is mounted in said detachable section, impacting pins extending from said rotors and spaced from the axes thereof, an upper detachable section forming a part of said casing associated with said receiving rotor and including a product inlet adapted to direct material to be treated onto said receiving rotor, and means forming a sliding connection between said lower detachable section and said frame whereby said processing rotor and said detachable section may be removed from said casing.

12. The combination of claim 11 in which said upper detachable section and said lower detachable section are interchangeable.

13. In centrifugal processing apparatus, the combination of a frame, a casing which is fixedly connected to said frame and has a detachable section, at least one rotary processing means mounted in said casing through said detachable section, and means connected to said frame, to said section and to said rotary means for withdrawing said rotary means and said section from said casing, said withdrawing means being positionally adjustable with respect to said frame.

14. The invention according to claim 13 wherein said rotary processing means is an impacting means and said withdrawing means slides on said frame and is constructed and arranged to enable movement of said section and said rotary means substantially axially to permit access thereto.

15. The invention according to claim 14 wherein said

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withdrawing means is also constructed and arranged to move said section and said rotary means in a direction transverse to its axis.

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