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(54) **Airless centrifugal blast device.**

(57) An airless centrifugal blast device in the form of a two-bladed wheel mounted for rotational movement about either a horizontally or vertically disposed axis and means for off center gravitational feed of particulate media to the inner end portions of the blades (12, 14) with the particulate media feed tube (66) tapering in cross section to the discharge opening (70) and with extension of the discharge opening (70) being provided in the direction of rotation of the wheel.

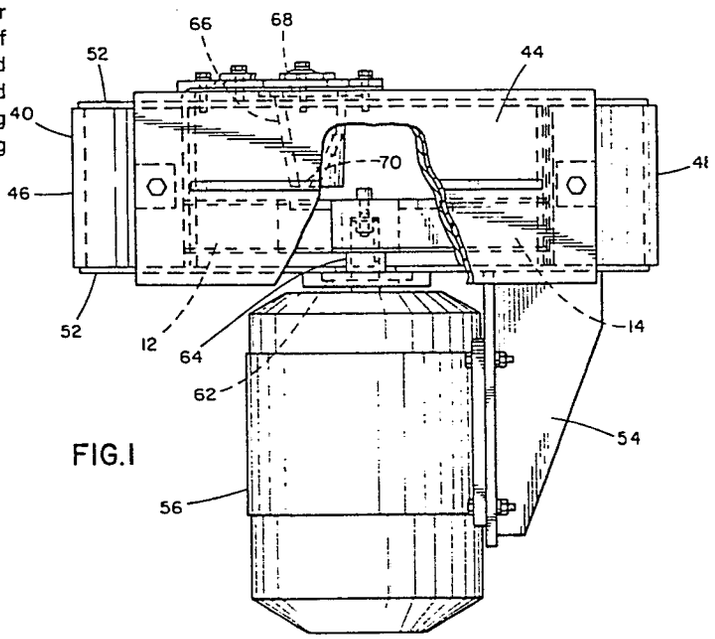

FIG.1

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AIRLESS CENTRIFUGAL BLAST DEVICE

This invention relates to airless abrasive blast wheels for projecting metallic and non-metallic particulate media for impact upon surfaces in such processes as shot peening, descaling, deburring, and other abrasive blast applications.

Generally speaking, such blast wheels comprise a simple wheel formed of two blades extending diametrically in opposite directions from a central hub mounted on a motor driven, belt driven, or the like shaft for rotational movement about a central axis of the shaft. A centrifugal two-bladed airless blast wheel of the type described is marketed in this country under the name Delta type wheel. Certain aspects of the invention, also have application to other types of single or multiple bladed wheels, wherein the particulate media is introduced for engagement with the inner portion of the blade surface for projecting from the ends thereof in response to centrifugal force imparted by rotation of the blades at high speed about the central axis.

Delta type wheels of the type heretofore produced have been found to be deficient in a number of respects. Blade change to replace worn out blades has been awkward and sometimes very difficult, and the mounted blades are inadequately supported on the central shaft. Further, the assembly is subject to vibrations,

which bring about increased wear and reduction in strength of the assembly.

The feed from the tubes used to introduce the particulate media into the path of the blades provides for an erratic flow rate which not only reduces the output efficiency of the wheel but results in lack of control of the blast pattern.

One important feature of this invention resides in the configuration of the feed tube through which the particulate media is fed to the wheel. In the past, use has been made of a tubular member of uniform cross section extending from the end of a hopper to a level which just clears the upper edge of the blades.

Because of the increasing velocity of the particulate media as it falls gravitationally downwardly through the feed tube, particulate media which fills the tube at the inlet only partially fills the tube at the outlet. It has been found that when the discharge end of the tube is only partially filled, erratic patterns result from the wandering action of the particulate media out of the feed tube.

The following tabulation gives the velocity and the density determinations made with the same particulate media for various lengths of fall through a feed tube having a 1.5 inch orifice and from an initial velocity of 92 ft./min. and a K factor for the friction of the tube walls of 0.5.

Distance of Fall	Velocity out of Discharge End of Tube	Exit Density out of Tube
3"	193.5 ft/min	47.5%
6"	257.7 ft/min	35.7%
9"	308.9 ft/min	29.8%
12"	352.9 ft/min	26.1%
24"	490.2 ft/min	18.8%

The erractic action has been overcome, in accordance with one aspect of this invention, by the use of a feed tube having a prescribed configuration in order to provide for a smooth feed of particulate media at a uniform rate which calculates out to be a maximum rate with corresponding movement in the pattern of the blast.

More specifically, the present invention provides a device for airless blast with particulate material comprising a wheel having wheel blades which extend radially outwardly from an axial portion of the wheel, means for driving the wheel in rotational movement at high speed, and means for feeding particulate material to the inner end portions of the wheel blades for engagement by the blades during rotational movement of the wheel whereby said engaged particulate material is displaced outwardly over the surfaces of the blades for projection at high velocity from the outer ends of the blades, in which the means for feeding particulate material to the blades comprises a vertically disposed tubular member

having an upper inlet in communication with a discharge opening aligned with the inner end portions of the blades and which embodies at least one of the features of a discharge opening which is at the apex of a section of decreasing cross section and/or a discharge opening having a dimension in the direction of rotation of the wheel which is greater than the crosswise dimension whereby the time of flow of particulate material onto the blades is increased thereby to increase the length of the pattern of particulate material thrown from the outer ends of the blades.

By forming the feed tube with a configuration which diminishes in cross section from the inlet end to the discharge end, the density of the particulate media at the discharge end is at substantially maximum density which assures a smooth feed at a uniform rate.

Similarly, it has also been found that the pattern thrown by the blades can be markedly lengthened to provide for greater coverage and more efficient operation by configuration of the discharge from the feed tube to lengthen the discharge of particulate media somewhat in the direction of rotation of the blades. This has the effect of increasing the time of flow of particulate media onto the face of the blade with a resultant longer particulate blast pattern. In other words, the same inner area of the blade is adapted to engage successive amounts of particulate media during

its rotational movement thereby to increase the length of the blade covered by particulate media during any one instant, with corresponding increase in the angle for projection of the particulate media from the blade.

Other features and advantages of this invention will hereinafter be described with reference to a number of preferred embodiments of the invention as shown in the accompanying drawings, in which:

Figure 1 is a side elevational view of a wheel assembly embodying the features of the invention, with portions broken away to show elements in the interior thereof;

Figure 2 is a sectional view taken along line 2-2 of Figure 1;

Figure 3 is a top plan view of the two-bladed wheel shown in Figure 1;

Figure 4 is a side elevational view of the two-bladed wheel of Figure 3;

Figure 5 is a sectional view taken along the line 5-5 of Figure 4;

Figure 6 is a sectional view taken along the line 6-6 of Figure 4;

Figure 7 is a sectional view taken along the line 7-7 of Figure 4;

Figure 8 is a perspective view of a feed tube embodying the features of this invention;

Figure 9 is a perspective view of a modification in a feed tube embodying the features of this invention;

Figure 10 is a perspective view of a further modification in a feed tube embodying the features of this invention;

Figure 11 is a front elevational view showing the wheel and feed mounted for rotational movement about a horizontally disposed axis; and

Figure 12 is a schematic side elevational view showing the relation between the wheel blades and the feed opening in a wheel of the type shown in Figure 11.

Referring now to Figures 3 to 7 of the drawings, illustration is made of the two-bladed wheel comprising a central hub 10 and a pair of blades 12 and 14 extending outwardly in parallel relation in opposite directions from the hub 10, from portions of the hub on opposite sides of the axis and spaced from the axis by an equal amount to provide a balanced wheel.

The two-bladed wheel is mounted for movement about an axis by means of a bushing 16 which is received in fitting relation within an axial bore 18 through a portion of the hub and which, in turn, is mounted on the end of a motor driven shaft 20 which extends through an axial opening 22 in the hub in contiguous relation with

the bore 18. The bushing is provided with a key 24 adapted to be received in fitting relationship within a keyway 26 in the hub for replaceably mounting the two-bladed wheel on the bushing for rotational movement therewith.

The surfaces 28 of the blades 12 and 14, facing in the direction of rotational movement, indicated by the arrow in Figure 2, constitute the front face adapted to engage the particulate media and over which the particulate media is displaced outwardly for projection from the ends of the blades in response to rotational movement of the wheel at high speed.

The front face 28 of each blade 12 and 14 is formed with a rib 30 which projects from the front face along the lower edge substantially throughout the length thereof. A similar rib 32 of lesser depth extends from the upper edge of the front face substantially throughout the length thereof except for a short inner section adjacent the hub 10 in circumferential alignment with the outlet from the feed tube through which particulate media flow into the path of the inner end portion of the blades for engagement thereby during rotational movement of the wheel.

Preferably, the two-bladed wheel is formed in one piece to enable easier assembly while providing a stronger wheel which remains well balanced during use and thereby to provide for greater stability and less vibration

during operation.

The blades 12 and 14 are usually straight members of rectangular shape having a width within the range of 1.5-4 inches and a length within the range of 3-10 inches. The ribs or flanges 30 and 32 operate to confine the particulate media for travel along the face of the blade and to minimize stray of particulate media over the edges of the blades.

As illustrated in Figures 1 and 2, the two-bladed wheel is mounted within a shroud 40 having an open side 42 through which particulate media is projected by the wheel. In the illustrated modification, the shroud is of trapezoidal shape with a back wall 44, angularly extending side walls 46 and 48 and trapezoidally shaped bottom and top walls 50.

A bracket 54 mounts an electric motor 56 from the bottom wall 50 of the shroud with the shaft 58 of the motor extending through the bottom wall for receipt of the busing 16 on the through extending portion thereof and which is adapted to be secured thereon, as by means of a cap screw 60. A rubber seal 62 is provided between the motor housing and the bottom wall 50 of the shroud and a sealing gasket 64 is provided about the shaft portion extending through the bottom wall for protection from the abrasive media.

As illustrated in Figures 1, 2 and 8, one preferred configuration for the particulate feed means comprises a feed tube 66 which tapers inwardly from the entrance end 68 to the discharge end 70 with the discharge end defining an orifice to crescent shape arranged to extend circumferentially to the axis of rotation of the wheel or to extend lengthwise in the direction of rotation of the blade.

The desired effect could also be obtained with a feed tube of the type shown in Figure 9, in which the feed tube tapers inwardly from the inlet end 72 to the discharge end 74 with the outlet opening at the discharge end being of oblong or other geometric shape with the major dimension extending in the direction circumferentially of the axis or in the direction of rotation of the blade.

As of a further modification, the feed tube can be formed of two or more separate tubular members 76 and 78 of circular or polygonal cross section, each of which tapers inwardly from their inlet end 80 to the discharge 82 with the tubular members arranged circumferentially with respect to the axis of the wheel to discharge particulate media at variable distances from the blade for continuous engagement by the blade over a period of time during its rotational movement.

All of these arrangements have the effect of making increased use of the blade thereby to increase the output of the wheel, while, at the same time, increasing the area covered by the abrasive blast.

As shown in Figures 1 and 2, the feed tube 66 extends through an opening in the top plate of the shroud to a level immediately above the upper inner edge of the blade. The feed tube 66 is supported by a plate 84 that is fastened to the top surface of the top plate, as by means of lock washers 86 held down by cap screws 88. Particulate media is fed to the inlet of the feed tube 66 from a hopper (not shown) in communication therewith for gravity flow of particulate media from the hopper into the feed tube.

In operation, the wheel is rotated at high speed. The article to be treated by particulate media thrown from the wheel is positioned in front of the open side 42 of the shroud. Particulate media which falls from the discharge end of the tube 66 is engaged by the face of the blades rotating at high speed. Upon engagement with the face of the rotating blades, the particulate media is centrifugally displaced over the face of the blade and is thrown with high centrifugal force from the ends thereof, through the open side 42 onto the article in front thereof.

It will be understood that the wheel shaft can be driven in rotational movement by convention means other than an electrical motor, for example, as by an internal

combustion engine, magnetic drive, or by indirect belt or gear drive. Similarly, the shroud can vary in shape as long as it substantially encloses the wheel except for the open side wall for projection of the particulate media therethrough. The wheel can be mounted for rotational movement about a vertical axis or a horizontal axis or any angle in between.

The wheel assembly described constitutes a low cost airless blast device which is easy to operate and which utilizes minimum space and supporting equipment. The spent abrasive or other particulate media can be recovered in the usual manner for reuse, preferably after removing dust and dirt as by means of a screen, air wash, and/or magnetic separator.

When it is desired to remove the wheel for replacement or repair, it is only necessary to remove the wheel from the shaft, with or without the bushing, and to replace the wheel by reversal of the operation.

The described features are not restricted to a vertical feed to wheel blades mounted for rotational movement in a horizontal plane. It has been found that similar results can be obtained with a wheel mounted to rotate about a substantially horizontally disposed axis or along any angle between vertical and horizontal. It is required, however, to divert the vertical flow of particulate material from downward flow through the tubular member and through a hollow member which extends crosswise and which includes

the concept of decreasing cross sections to a discharge opening of the type described which faces laterally in the direction towards the adjacent outer edge of the blades to feed the particulate material onto the blades in circular alignment with the inner end portions of the blades.

Figures 11 and 12 illustrate a two-bladed wheel of the latter type mounted for rotational movement of the wheel about a horizontal axis for rotation of the blades in a vertical plane. As shown in these Figures 11 and 12, the blades 14, extend radially outwardly from the hub 10, are mounted on shaft 20 for rotational movement by the electrical driving motor 56 about their horizontal axis. It will be understood that the angle of the wheel can be varied for rotation about a vertical or horizontal axis or any angle therebetween.

In the modification shown in Figures 11 and 12, the particulate material is fed into the funnel 100 which directs the particulate material into the open upper end 104 of a feed tube 102, in the form of a tubular member having a circular opening 106 in the inner side wall in crosswise alignment and in full communication with an outer open end 108 of a conically shaped hollow body 110 having a discharge opening 112 at its inner apex end in facing relation with the blades 14. At least the position of the hollow body 110 leading into the discharge opening is of the diminishing cross section, as heretofore described

for maintaining uniform flow and control of the particulate material fed onto the blades 14.

The discharge opening 112 is of a configuration of the type heretofore described to prolong the feed of particulate material onto the inner end portions of the blades 14. Thus, the blades 14 engage successive portions of the particulate material issuing from the feed opening 112 during rotational movement of the blades 14 thereby to enlarge the pattern of particulate material projected from the ends of the blades. The various shapes of the feed openings elongated in the direction of rotational movement of the blades are illustrated in Figures 8, 9 and 10.

The conically shaped hollow body 110 is preferably mounted on the tubular member for rotational movement relative thereto about an axis substantially in endwise alignment with the axis of the wheel with the outlet opening 112 offset for crosswise alignment with the inner end portions of the blades 14 to feed the particulate material onto the inner end portions of the blades 14. By way of construction, the conically shaped hollow body 110 can be adjusted for rotational movement about its axis to locate the feed opening 112 in any desired circumferential relation relative to the wheel thereby to enable substantially precise control over the direction of the particulate material thrown from the ends of the blades 14.

For example, when the conically shaped hollow body is rotated to position the feed opening 112 at the location shown in Figure 12, the particulate material will be thrown in a spread pattern in a lateral direction. By rotation of the hollow body 110 to locate the feed opening 112 above the axis of the wheel, the pattern of particulate material thrown from the ends of the blades 14 will be in a downward direction. Similarly, the hollow body 110 can be rotated to vary the direction which will normally be in a direction about diametrically opposite the radial direction of offset of the feed opening 112 from the axis of the wheel.

For rotational adjustment, the outlet opening 106 of the tubular member 102 and the inlet opening 108 of the hollow body 110 are formed of circular cross section with an annular flange 114 about the inlet in telescoping relation with an annular shroud 116 about the outlet opening 106 to support the hollow body 110 on the tubular member 102. The telescoping portions can be provided with openings (not shown) through which locking pins (not shown) can be inserted when aligned to interlock the members in their assembled and adjusted relation. Alternatively, the elements may be secured in the assembled relation by suitable clamps or other locking means.

Claims:

1. A device for airless blast with particulate material comprising a wheel having wheel blades which extend radially outwardly from an axial portion of the wheel, means for driving the wheel in rotational movement at high speed, and means for feeding particulate material to the inner end portions of the wheel blades for engagement by the blades during rotational movement of the wheel whereby said engaged particulate material is displaced outwardly over the surfaces of the blades for projection at high velocity from the outer ends of the blades, characterized in that to increase the time of particulate flow onto the blades and the resultant pattern length of thrown material the particulate feeding means comprises a vertically disposed tubular member (66, 102) having an upper inlet (68, 104) in communication with a discharge opening (70, 112) aligned with the inner end portions of the blades (12, 14) and which embodies at least one of the features of a discharge opening which is at the apex of a section of decreasing cross section and/or a discharge opening having a dimension in the direction of rotation of the wheel which is greater than the crosswise dimension.

2. A device according to Claim 1, characterized in that the feed means includes a hollow body (110) having an open end portion (108) in registry with an opening (106) in the side wall of the tubular member (102) below the inlet (104) and in which the discharge opening (112) is in the end portion facing the wheel blades (14) for flow of particulate material from the inlet (104), through the

tubular member (102) and hollow body (110) onto the inner end portions of the blade (14).

3. A device according to Claim 2, characterized in that the hollow body (110) is of conical shape having its axis substantially horizontally disposed with the open end portion (108) at the base in communication with the opening (106) in the side wall of the tubular member (102) and with the discharge opening (112) at the apex.

4. A device according to Claims 2 or 3, characterized in that the axis of the conically shaped hollow body (110) is aligned with the axis of the wheel with the discharge opening (112) offset from the axis for crosswise alignment with the inner end portions of the blades (14).

5. A device according to any of Claims 2 - 4, characterized in that the hollow body (110) is rotatably mounted in said device for movement about its axis to enable adjustment of the discharge opening (112) circumferentially relative to the bladed wheel.

6. A device according to Claim 5, characterized by an annular shroud (116) about the opening (106) in the side wall of the tubular member (102) and an annular flange (114) on the hollow body (110) which receives the shroud (116) in telescoping, rotatable relation, and means for latching the hollow body (110) in its adjusted relation.

7. A device according to Claim 1, characterized by a housing (40) having a horizontally disposed bottom wall (50) and top wall (50) and an open side (42), said wheel having a pair of elongated blades (12, 14) extending continuously radially outwardly in opposite directions from the central axis of the wheel to between the top and bottom walls (50) for rotational movement relative thereto about a central vertical axis, said feeding means comprising a tube (66) extending downwardly from an opening through the top wall (50) to a discharge opening (70) at a level immediately above the upper edge of the wheel blades (12, 14) and in circumferential alignment with an inner end portion thereof but offset from the central axis in such manner that rotational movement of the blades centrifugally displaces particulate media over the face (28) of the blades (12, 14) and projects such media from the blades (12, 14) through the open side (42).

8. A device according to Claim 7, characterized by a drive shaft (58) which extends through the bottom wall (50) of the housing (40), said device including means (60) for removably mounting the hub (10) of the wheel onto the through extending portion of the shaft (58) for conjoint rotational movement and means (56) for imparting rotational movement to the shaft (58).

9. A device according to any of Claims 1 - 8, characterized in that the means for extending the discharge opening in the direction of rotation of the wheel comprises two or more separate hollow members (76, 78) arranged with

their discharge openings aligned in the direction of rotation of the wheel.

10. A device according to Claims 1 - 9, characterized in that the or each discharge opening (70, 112) is of crescent shape with the lengthwise dimension extending in the direction of rotation of the wheel.

11. A device according to Claims 1 - 9, characterized in that the or each discharge opening (70, 112) is in the shape of an oblong with the major dimension in the direction of rotation of the wheel.

12. A device according to Claims 1 - 11, characterized in that the wheel is a one-piece wheel having a hub (10) and blades (12, 14) extending radially from the hub (10).

13. A device according to Claim 12 in which the wheel is a two-bladed wheel with the blades (12, 14) extending from the hub (10) in opposite directions in spaced, parallel planes.

14. A device according to Claim 12 or 13, characterized in that the blades (12, 14) have a front face (28) and a back wall and which include a flanged portion (30) extending perpendicularly from the edge opposite the discharge opening substantially throughout the length of the blade (12, 14) and a flange portion (32) extending perpendicularly from the edge portion of the front face (28) adjacent the discharge opening (70, 112) from an inner end spaced a short distance from the hub (10) to the outer end.

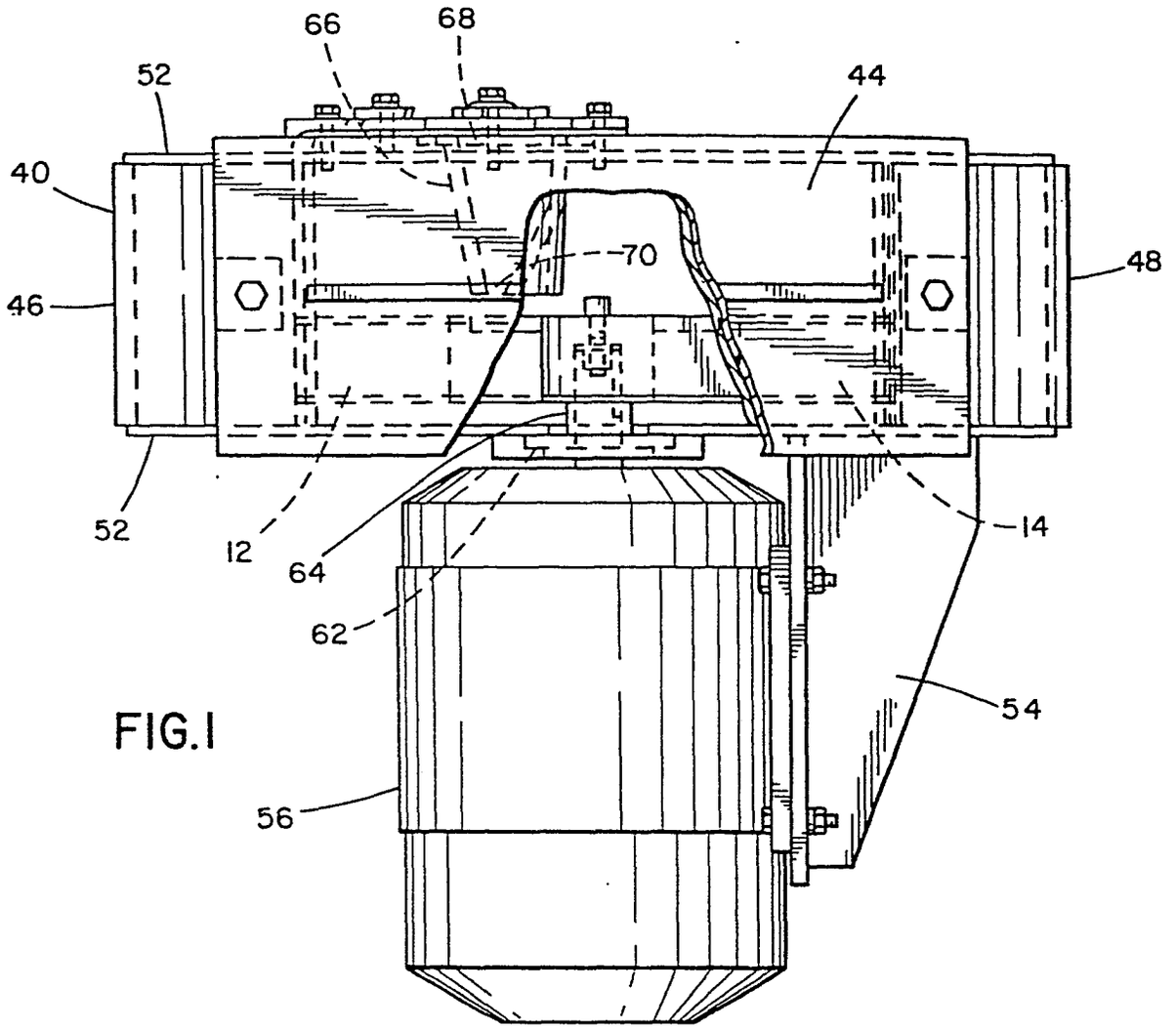

FIG.1

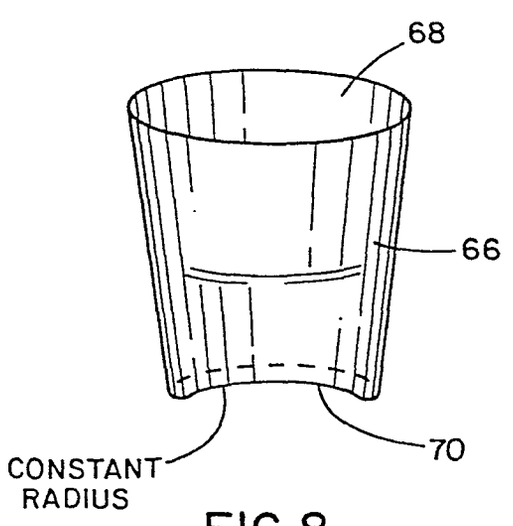

FIG.8

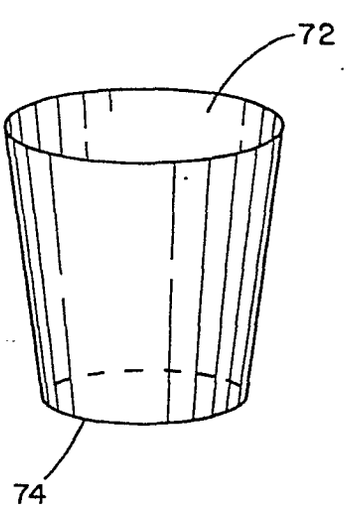

FIG.9

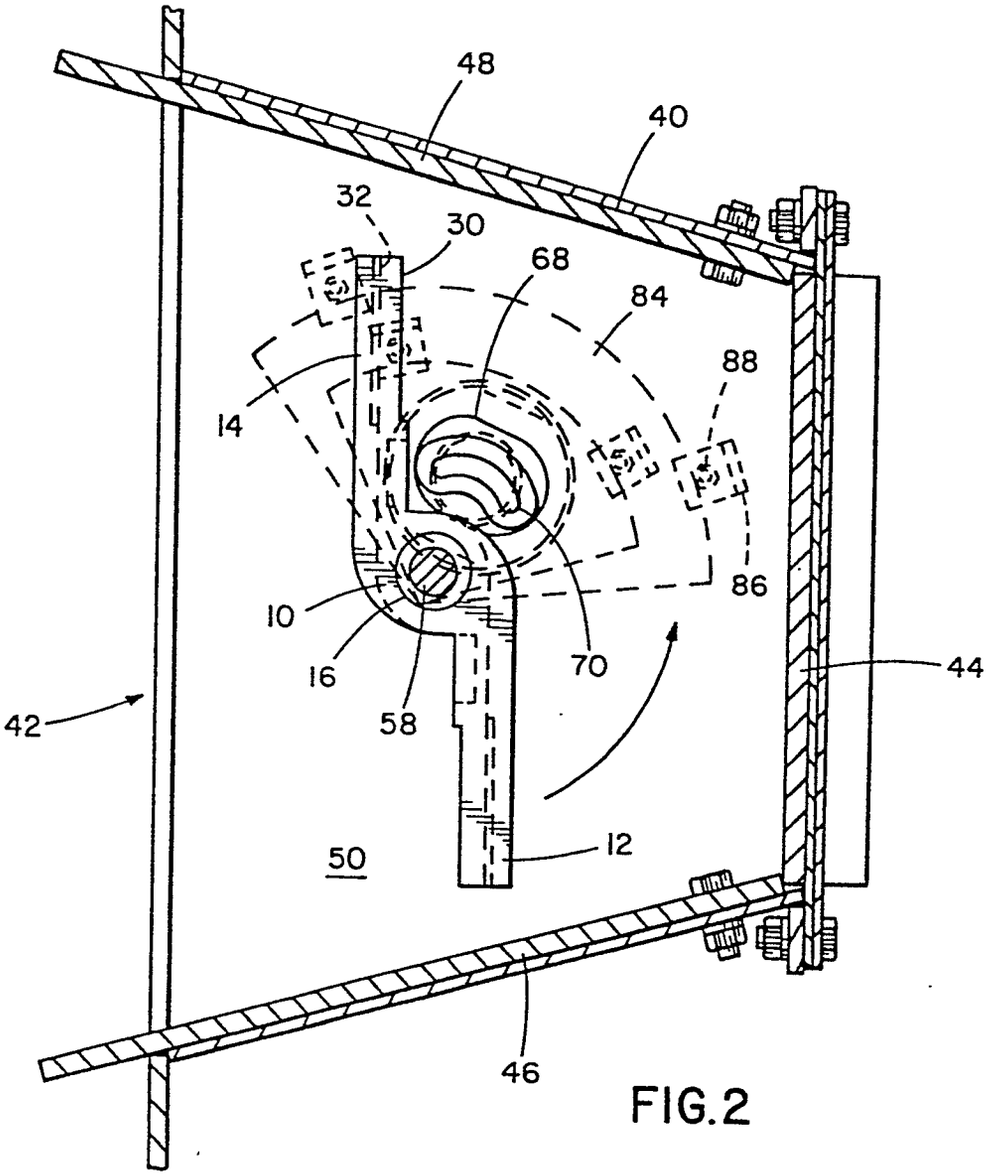
48
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FIG.2

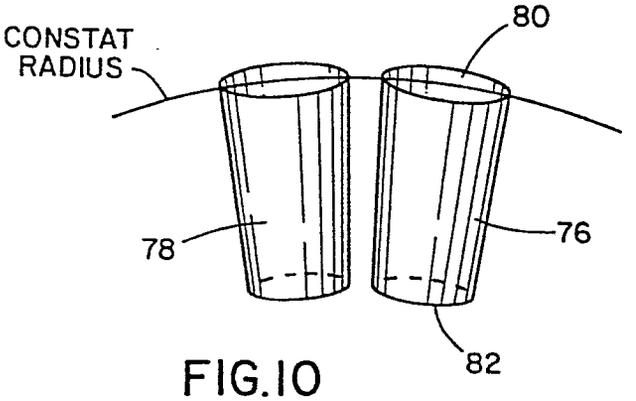

CONSTAT
RADIUS
80
78
76
82

FIG.10

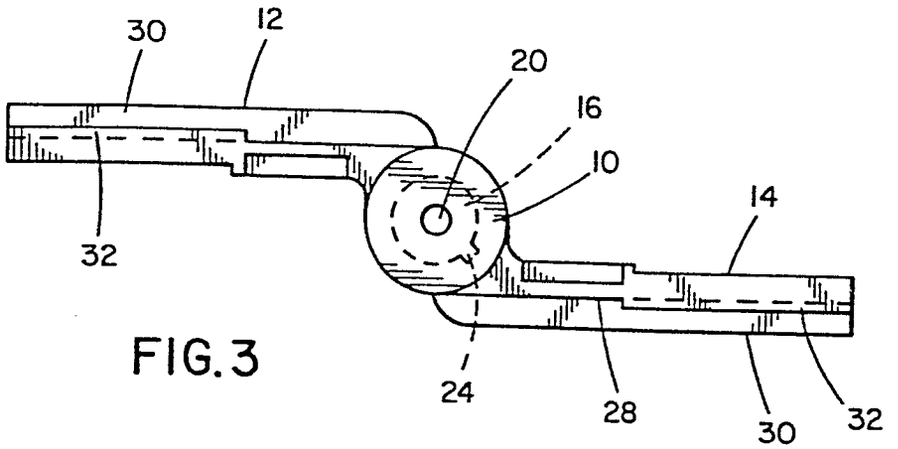


FIG.3

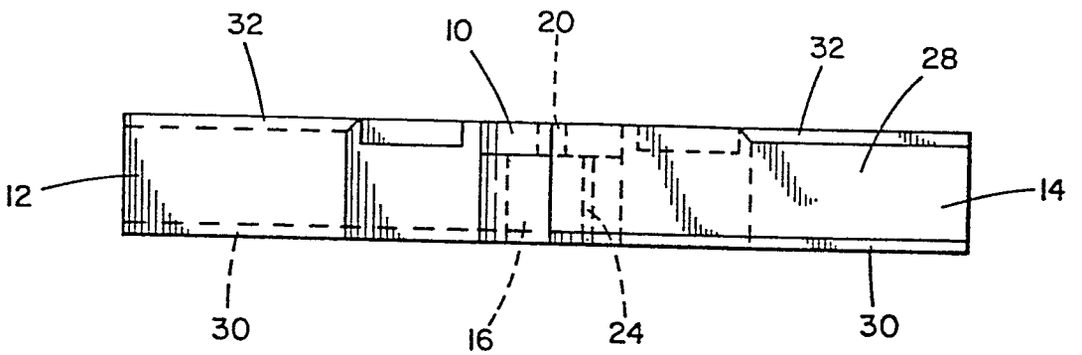


FIG.4

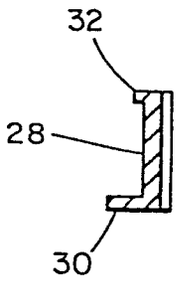


FIG.5

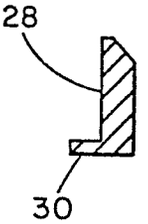


FIG.6

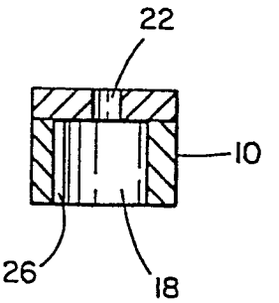


FIG.7

FIG.11

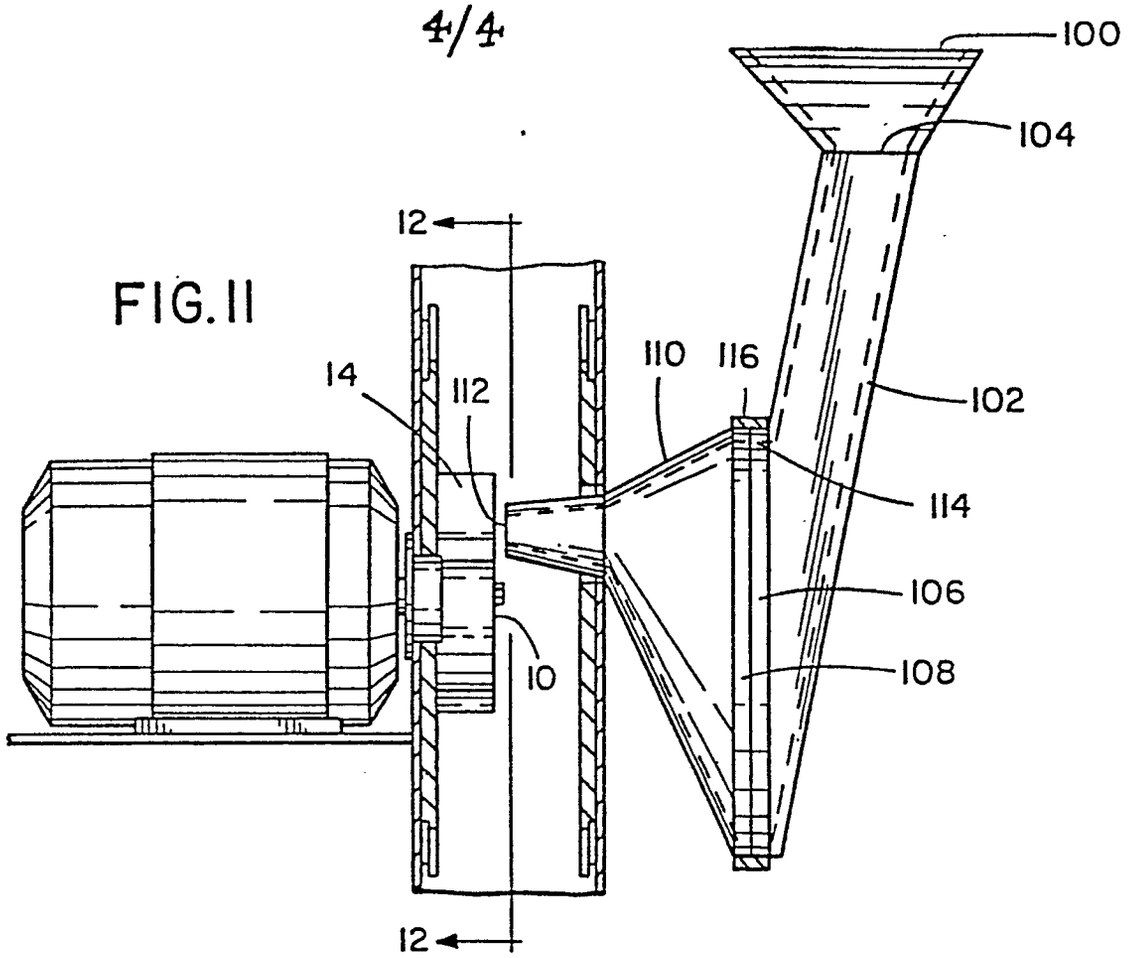
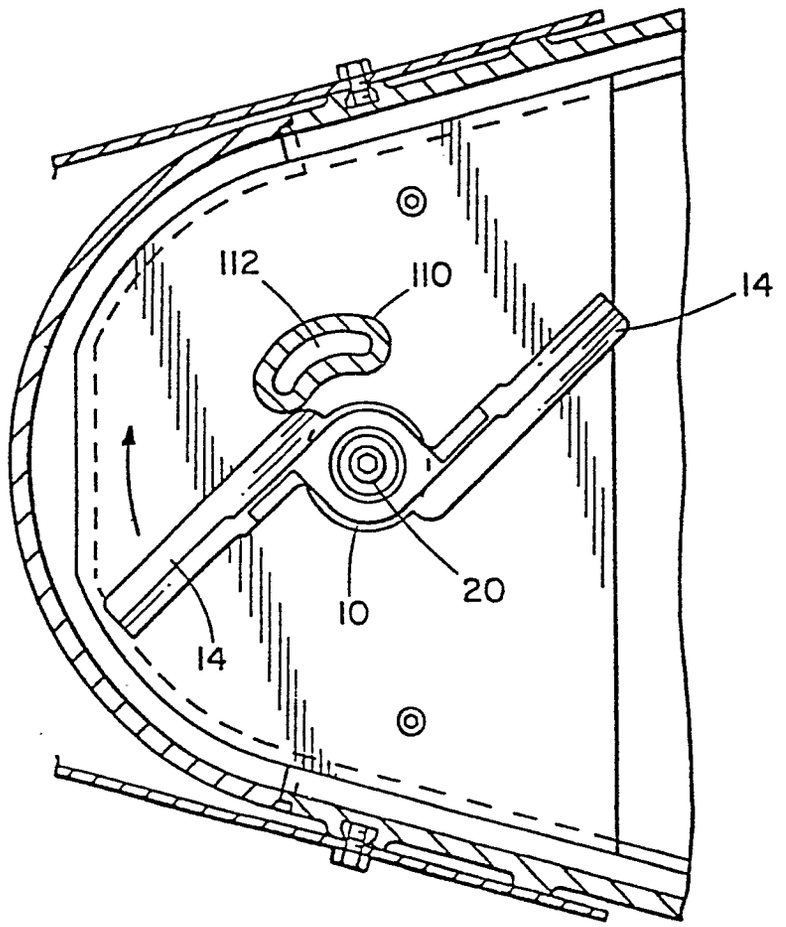


FIG.12



European Patent Office

EUROPEAN SEARCH REPORT

Application number
EP 80 30 1825.8

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl.³)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
	US - A - 2 295 926 (BOESGER) * page 2, left column, lines 3 to 14 and 31 to 53 * --	1,5,8	B 24 C 5/06
	CH - A - 117 608 (GEIGER) * complete document * --	1,7,8	
	US - A - 2 204 637 (UNGER) * page 2, left column, lines 60 to 75; fig. 1, 2 * --	1	TECHNICAL FIELDS SEARCHED (Int. Cl.³)
A	US - A - 2 363 437 (PETERSON) --		B 24 C 5/06
A	DE - U - 1 673 091 (BADISCHE MASCHINENFABRIK) --		
A	IT - A - 522 676 (GRAZIOLI) --		
A	US - A - 2 131 143 (QUINN) --		
A	CH - A - 207 111 (GROCHOLL) --		CATEGORY OF CITED DOCUMENTS
A	CH - A - 446 944 (VEB GIESSEREIANLAGEN) ----		X: particularly relevant A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: conflicting application D: document cited in the application L: citation for other reasons
			&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Berlin	11-03-1981	MARTIN

EPO Form 1503.1 06.78