(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: 0 006 751
A1

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: 79301232.9

(22) Date of filing: 26.06.79

(51) Int. Cl.3: B 29 C 17/12, B 24 C 5/06

(30) Priority: 26.06.78 US 918707
07.06.79 US 46507

(43) Date of publication of application: 09.01.80
Bulletin 80/1

(84) Designated Contracting States: AT BE CH DE FR GB IT LU NL SE

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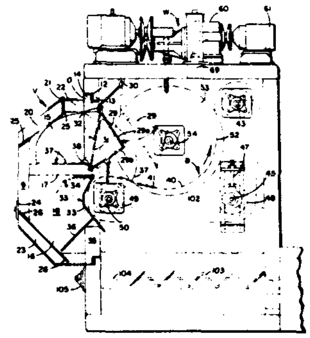
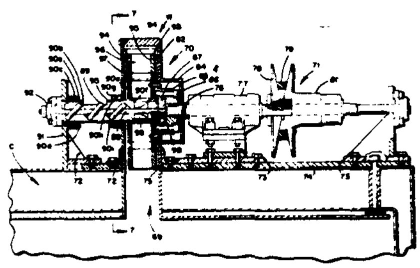
(54) **Deflashing apparatus.**

(57) A deflashing apparatus is disclosed having an insulated housing (C) defining a deflashing chamber in which a continuous belt(B) rotates for tumbling molded or die cast articles having flash thereon. The articles within the chamber are bombarded by a high velocity stream of deflashing media propelled into the chamber by a throwing wheel (93). The deflashing chamber is maintained in a cryogenic environment which lowers the temperature of articles so that the flash becomes brittle in comparison to the body portion of the article and is readily removed by the impact of deflashing media and the tumbling along the belt. A gas interlock which may be referred to as a vestibule structure (V) is additionally disclosed which forms an effective barrier to prevent the escape of the cryogenic gas during the insertion and removal of articles from the chamber. The efficiency of the deflashing process is enhanced by novel means which permit a variable adjustment during machine operation of the density, intensity, and pattern of the thrown media to ensure proper and uniform flash removal.





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# DEFLASHING APPARATUS

> The references to the drawings 9a and 9b are deemed to be deleted Rule 43 EPC.

The present invention relates to the deflashing art and more particularly to cryogenic deflashing apparatus for the removal of flash in a low temperature environment wherein the flash is embrittled for easy removal by the bombardment of a high velocity pellet media stream.

As is well know, numerous articles of manufacture are molded out of various elastomeric rubber or plastic materials, as well as being cast from metallic substances. By such molding and casting processes, there is often a residual material or flash formed on the articles in the area adjacent the interfacing mold surfaces, which is functionally and aesthetically objectionable. Typically, the practice heretofore utilized to remove such flash was either hand trimming or abrasive tumbling.

Deflashing by hand is costly and oftentimes difficult, requiring a substantial period of time and labor to be expended to properly trim the particular article. Furthermore, it is often difficult, if not impossible, to accomplish a satisfactory result as where part configuration prohibits manual access to the flash. Similarly, although tumbling of articles in an abrasive media has proven to be a useful alternative to hand trimming, the tumbling process requires substantial machine time, and is additionally substantially limited by part configurations.

As a consequence, in recent years, it has been found that highly satisfactory and economical deflashing may be accomplished by subjecting articles to a high velocity stream of deflashing media. Oftentimes, the media is of steel, rubber, or plastic pelletized shot that is thrown by an impeller or projected by a nozzle against the articles which are typically tumbled in a deflashing apparatus.

In the case of articles that are composed of resilient elastomers or plastic materials, it has been found advantageous to perform the deflashing operation in a cryogenic environment utilizing a liquified gas (such as nitrogen) that is implaced within the deflashing chamber. Due to the relatively greater thickness of the article compared to the flash, only the flash becomes brittle in a cryogenic environment, whereby it may be readily removed upon impact by the high velocity deflashing media without marring the remainder of the article.

Much of the prior art deflashing apparatus has utilized a throwing wheel or impeller which is typically supplied media through axial ports and accelerates the media along radially extending vanes to direct a media stream or pattern against the article. Although such prior art impellers have proven useful in their general application, there are substantial deficiencies associated in their use.

In particular, prior art throwing wheels have proven incapable of uniformly distributing the media over the desired work surfaces within the deflashing chamber with the majority of media stream being concentrated at a particular area designated in the art as a "hot spot". As will be recognized, such a hot spot prohibits the uniform deflashing of single or multiple parts within the chamber, as well as causing inconsistent wear on the internal components of the deflashing apparatus.

To a limited extent, the prior art deflashing apparatus has recognized this particular concentration deficiency, with USA Patent No. 2,049,466, issued to Minich, disclosing a throwing wheel having impeller blades of varigated length to vary the point of media discharge from the impeller and provide a more uniform discharge pattern. However, by such design, the speed of the media projected is substantially reduced for the shorter length vanes whereby the force of impact of the media against the part is discontinuous and non-uniform.

Further, the prior art deflashing apparatus has typically been fraught with serious transport problems of the media from a storage reservoir or hopper to the throwing wheel. These transport problems have resulted in inconsistent quantities of media being supplied to the throwing wheel and, in extreme cases, a complete discontinuance of media flow due to clogging within the transport system. With specific reference to cryogenic deflashing apparatus, such transport deficiencies become acute since discontinuance of the media pattern requires the parts to be removed from the cryogenic glasting chamber to prevent the entire part from becoming brittle in the super cooled environment. Further, such shut-downs of the apparatus significantly deteriorate the overall cost effectiveness of the device, and pose safety hazards to personnel being exposed to the low temperature cryogenic environment.

Additionally, the prior art apparatus has typically incorporated a large housing, completely surrounding the cryogenic deflashing chamber which is analogous to large reefer or refrigerator with loading and unloading of articles into the chambers requiring personnel to enter therein. Such manual entrance into the deflashing chamber is extremely dangerous, posing significant safety hazards to a personnel who may be subjected to cryogen gas poisoning and extreme cold temperatures.

In this same regard, such large prior art apparatus typically admits large quantities of moistened atmospheric air into the deflashing chamber during loading and unloading of articles. This moistened air upon being colled within the flashing chamber, forms ice upon the internal components of the apparatus which deteriorates overall machine operation and in severe cases causes machine shut-down. Thus, there exists a substantial need in the art for a deflashing apparatus which eliminates the above-mentioned operating and safety deficiencies.

## Summary of the Present Invention

The present invention provides a deflashing apparatus and more particularly a cryogenic deflashing apparatus which substantially eliminates the deficiencies of the prior art devices.

In particular, the present invention provides a novel impeller or throwing wheel mechanism wherein a control cage is axially positioned and rotatably mounted within the impeller to control the intake location of media onto the impeller vanes. The angular orientation of this control cage may be varied or oscillated during machine operation to continuously shift the area of media concentration across the deflashing chamber. As such, a substantially uniform distribution of media across the deflashing chamber is provided which eliminates inconsistencies in flash removal, as well as concentration of wear on the internal components of the device.

Further, the present invention augments this uniform distribution feature by an improved transport mechanism which delivers a consistant quantity of pellets to the throwing wheel and eliminates the tendency of the media to clog during transport from the hopper. These particular transport improvements are made possible by a novel static head, helical feed screw, and vacuum assisted transport mechanism. In operation, the static head may be pre-set to a desired level while the speed of the helical screw and magnitude of vacuum assist may be adjusted during machine operation. Thus, with the particular transport and throwing wheel mechanisms of the present invention, the density, intensity, and pattern of the media stream may be varied to meet the specific requirements of a particular article to be deflashed.

Further, the present invention overcomes the size deficiencies of the prior art by providing a rather compact deflashing apparatus which does not utilize a surrounding refrigerator housing and facilitates the utilization of conveyor handling techniques during the processing of articles through the apparatus. As such, the present invention eliminates the refrigeration units and special handling equipment heretofore utilized in the prior art.

Additionally, the prior art's temperature exposure and icing deficiencies have been substantially eliminated by the present invention's utilization of a sealed gas lock door which prohibits interaction between the cryogen environment and the atmosphere during loading and unloading of articles into the deflashing chamber. In this same regard, the present invention facilitates the automatic loading of articles into the deflashing chamber by a conveyor belt which feeds the articles from an entrance enclosure into the cryogenic deflashing chamber without directly or indirectly exposing operating personnel to cryogenic environment.

In addition, once the articles or parts have been placed within the deflashing chamber of the present invention, they are continuously tumbled beneath the deflashing media stream upon a belt maintained in proper tension by a spring tension device which compensates for the variable temperatures within the cryogenic environment. Further, the entire apparatus incorporates a plurality of baffles, air locks, and openings that may be all automatically operated. Thus, an automated device for deflashing is provided which is significantly smaller, safer, and more effective to use than the prior art deflashing apparatus.

## Description of the Drawings

These and other features of the present invention will become more apparent upon reference to the drawings wherein:

Figure 1 is a front elevational view of the deflashing apparatus of the present invention;

Figure 2 is a fragmentary right side view thereof, depicting the vestibule structure of the present invention;

Figure 3 is a left side view of Figure 1 showing the vestibule interlock operating means which have been broken away for illustration;

Figure 4 is a fragmentary view taken from the unseen side or rear of Figure 1 showing the spent media transfer feed mechanism;

Figure 5 is an elevational view of the spent media transfer feed system of Figure 4 extending from the lower to the top portion of the apparatus to provide a continuous flow of media into the storage hopper;

Figure 6 is an enlarged cross-sectional view of the transport mechanism and throwing wheel of the present invention;

Figure 7 illustrates an alternative embodiment of the interlock system of the present invention;

Figure 8 depicts a perspective view of an alternative embodiment of the present invention, depicting the apparatus with the interlock doors exposed;

Figure 9 is an enlarged cross-sectional view of the throwing wheel and transport feed mechanism of the present invention taken along the lines 9-9 of Figure 8;

Figure 9a is an enlarged perspective view of the media transport feed screw, control cage, and control cage oscillation mechanism of the present invention;

Figure 9b is a schematic representation of the variable media pattern produced by the oscillating control cage of Figure 9;

Figure 10 is a fragmentary view of the throwing wheel of the present invention taken about lines 10-10 of Figure 9;

Figure 11 is a cross-sectional view of the deflashing apparatus of the present invention taken about lines 11-11 of Figure 8; and

Figure 12 is a perspective view of the media and contaminant separation means of the present invention interconnected with the entire deflashing apparatus.

Detailed Description of the Preferred Embodiment

Referring to Figures 1 through 6, a first embodiment of the cryogenic deflashing apparatus of the present invention is shown, being composed generally of a housing or casing C formed in a substantially rectangular configuration. The housing C is preferably fabricated from stainless steel having a double wall configuration with the voids between the opposing walls being filled with suitable insulation, such as a polyethylene foam material (not shown). This particular insulated stainless steel construction has been found to withstand wear generated by the high velocity media stream, and further prevent heat transfer from the cryogen environment to the atmosphere.

The front wall of the housing or casing C has a door D supported on hinges 10 which may be securely locked in a closed position by a fastener 11 mounted to the periphery of the casing C. A seal 12 (shown in Figure 2) is provided between the opposing flanges 13 and 14 of the front wall 19 and the door D, respectively, to provide an air-tight interface between the interior of the casing C (i.e., the deflashing chamber) and the door D. The door D extends transversely outward from the frontal wall 19 to form a vestibule having an inlet or loading section 15 and an outlet section 16 vertically oriented to one another.

As best shown in Figure 2, the inlet and outlet loading sections 15 and 16 are separated by a horizontal wall 17 which extends throughout the width of the door D and projects forwardly from the distal end of the vestibule V to reside within the vertical plane of the front wall 19 of the casing C. As will be recognized by such a design, both of the chambers 15 and 16 communicate with the interior of the casing C (i.e., the deflashing chamber) but are vertically isolated from one another. To permit manual access into the chambers 15 and 16, while the door D is maintained against the front wall 19, a pair of cover plates 20 and 23 are mounted by way of hinges 21 and 24 to the outer walls of the vestibule V. Each of the covers 20 and 23 preferably includes sealing means 25 and 26 (shown in Figure 2) as well as latch members 27 and 28 (shown in Figure 1) to seal and maintain the covers in their closed position. In this particular manner, the vestibule V forms a relatively air-tight closure or outer gas lock which effectively prohibits interaction between the loading and the unloading chambers 15 and 16 and the atmosphere.

At the areas of communication between the loading and unloading chambers 15 and 16 with the deflashing chamber, a pair of inner closure gates 29 and 33 are provided which are pivotally mounted about horizontal axes 30 and 34, respectively. As shown in Figure 2, the upper closure gate 29 extends across the opening into the loading chamber 15, and selectively engages a peripheral picture frame-like seal 32 mounted on the distal ends of the upper wall 22 and partition 17 of the door D. Similarly, the lower closure gate 33 extends across the opening from the unloading chamber 16 to the deflashing chamber, and sealingly engages a barrier wall 36. The barrier wall 36 is preferably formed as part of the vestibule V or outer gas lock and extends angularly into both the unloading chambers 16 and deflashing chamber.

As will be explained in more detail below, both of these gates 29 and 33 are movable between a closed position (as indicated by the solid lines in Figure 2) and open position (as indicated by the phantom lines in Figure 2) to allow selective communication between the loading and unloading chambers 15 and 16 with the deflashing chamber. Further, it will be recognized that in the closed positions, the gates 29 and 33 effectively isolate the vestibule V from the deflashing chamber and form, in effect, an inner gas lock which prevents the cryogen environment from interacting with the loading and unloading chambers 15 and 16.

The loading chamber 15 is additionally provided with a loading bin 37 which is pivotally mounted adjacent one end about a horizontal pivot axis 38. The bin 37 is preferably formed having radially-shaped sidewalls and an open upper end adapted to receive parts (not shown) through the access cover 20. With the parts loaded into the bin 37, the bin may be pivoted to a position indicated by the phantom lines in Figure 2 to insert or dump the parts into the deflashing chamber.

Referring again to Figure 2, the detailed construction of the deflashing chamber defined within the interior of the casing C and its tumbler mechanism may be described. As shown, an endless conveyor or belt B extends in a generally L-shaped path through the interior of the deflashing chamber having an upper course adapted to tumble parts within the chamber. In the preferred embodiment, the belt is formed of spaced stainless steel segments to permit the media to pass therethrough and is supported at both of its sides by a pair of chain members 41 which are rigidly attached thereto. These chain members 41 mate with a pair of idler sprockets 48 and 49 on their lower course and additionally extend vertically upward to engage a driving sprocket assembly 43. The idler sprockets 48 include a threaded adjustment member 47 which may be manually manipulated to adjust the tension on the chain member 41.

The upper course of the belt B is guided by a pair of large sprockets 52 (shown in phantom in Figure 2) which are carried by a pair of circular discs 53, each mounted to a common shaft 54 and journaled to the sidewalls of the casing C. In this manner, the upper surface or travel of the belt B is maintained in a concave pocket-like configuration which during movement of the belt B in the direction indicated by the arrow in Figure 2, causes the parts (not shown) disposed within the deflashing chamber to tumble and be rotated thereon.

As best shown in Figure 1, the sprocket drive 43 is driven by a chain drive 56 which extends between an external sprocket 57 mounted to the drive sprocket 43, and a sprocket 58 mounted to the outward shaft 59 of a gear box 60. The gear box 60 may be driven by a conventional motor 61 and a timing belt arrangement 62 which engages the input pulley on the gear box 60. In the preferred embodiment, the motor 61 may be of a variable speed type or alternatively the gear box 60 can be utilized to establish the speeds with which the belt B is driven. Thus, the tumbling action of the parts (not shown) within the deflashing chamber, may be adjusted to provide the most effective tumbling action for a particular operation. Further, in the preferred embodiment, the gear box 60 provides for reversible rotation so that upon completion of the deflashing operation, the belt B may travel in the direction opposite the arrow shown in Figure 2, whereby the articles (not shown) disposed upon the belt B may be moved off the belt B through the gate 33 and into the unloading chamber 16 of the vestibule V.

The deflashing chamber additionally includes means for the admittance of a cryogenic gas or liquid, which as previously mentioned, is utilized to embrittle the flash on the articles placed within the apparatus. As best shown in Figures 1 and 2, the means comprise an input fitting 65 and piping 67 and 68 which preferably extend through the upper wall of the casing C to direct the cryogen liquid stored in a reservoir (not shown) downward through the deflashing chamber. To regulate the amount of gas into the chamber, as well as the temperature therein, a metering valve 66 is additionally provided.

In Figure 6, the detailed construction of a first embodiment of the throwing wheel and media transport mechanism of the present invention is shown. The mechanism is composed generally of a throwing wheel assembly 70, a helical feed screw 89, and a driving assembly 71, which are all removably mounted to the top wall of the casing C. As shown, the throwing wheel assembly 70 is aligned with an opening 69 which extends through the top wall of the casing C to form the discharge throat of the apparatus.

The throwing wheel assembly 70 is composed of the throwing wheel or impeller 93, a housing 82, and a skirt or shroud which extends downwardly into the discharge throat 69. The wheel 93 is formed having a pair of opposed circular plates 94 with a plurality of symmetrically spaced fins or vanes 96 extending radially there-between, forming plural radial slots 95. The plates 94 and vanes 96 are preferably maintained in position by fasteners 97 extending through the vanes, and interconnecting the plates 94.

The throwing wheel 93 is axially mounted to the main drive shaft 76 of the drive assembly 71 by way of a drive section 87 and coupling 85 which are respectively attached to the wheel 93 by a plurality of fasteners 98 and keyed to the shaft 76. The shaft 76 is supported by a bearing 77 and is journaled at its distal end 73. A pulley 78 is mounted to the shaft 76 which receives a belt 79, powered by a drive motor 80, as shown in Figure 1. The speed of the drive motor 80 may either be variable via a conventional motor control (not shown) or alternatively by a pulley adjuster 81 which varies the space and thus the effective diameter of the halves of the pulley 78. Thus, by way of the drive shaft 76, the throwing wheel 93 may be rotated at variable speed to propel media (not shown) through the discharge throat 69 and into the deflashing chamber.

A helical feed screw 89 is provided to transfer the media (not shown) axially into the throwing wheel 93. As shown, the shaft 88 of the feed screw 89 is connected at one end to the drive shaft 76 and is journaled at the other end in a bearing 92 supported by an upstanding bracket 91. The feed screw 89 is enclosed within a tubular member 90 which is preferably formed of two aligned sections 90a and 90e. The section 90a includes an opening 90b which permits the deflashing media to enter the tube 90 as from a hopper 116 (shown in figures) and is maintained stationary by a flange 90c and fastener 90d secured to the angle bracket 91. The tube section 90e additionally includes an opening 90f and is rotatably mounted for angular movement about the shaft 88 of the helical feed screw 89 by a collar 90g. As will be explained in more detail in relation to Figures 9, 9a and 9b, the rotatable tube section 90e forms a control cage for the intake of media to the throwing wheel 93 which may be adjusted during operation either manually or automatically to very the pattern of media discharged from the throwing wheel 93.

In operation, media is supplied from the hopper 116 through the opening 90b in the tube section 90a to fill the area surrounding the helical feed screw 89. During this media supply, the feed screw 89 and throwing wheel 93 are rotated by the drive shaft 76 such that the media (not shown) is transported by the feed screw 89 laterally toward the throwing wheel 93. An internal impeller section 99 rigidly attached to one end of the shaft 88 of the helical screw 89 causes the media to travel upward into the throwing wheel 93, wherein, due to the rotation of the throwing wheel 93, the media is accelerated across the surface of the vanes 96 and discharged through the discharge throat 69 to bombard the articles within the deflashing chamber.

Subsequent to the impact of the media upon the part, it is desirable to recirculate the spent media back into the helical feed screw 89 and throwing wheel 93 assembly. To accomplish this result, the lower portion of the deflashing chamber includes a V-shaped hopper or trough 100 formed by a pair of walls 101 that extend angularly downward from the sides of the casing C. As shown in Figures 1 through 4, the trough 100 is provided with a transfer screw 103 adjacent its apex which is mounted on a shaft 104 supported by bearings 105. The screw 103 extends through the rear wall of the case C to communicate with an insulated container 106. A motor or other means 107 may be utilized to rotate the shaft 104, causing the media accumulating in the trough 100 to be transported into the container 106.

The container 106 is preferably provided with a screen 108 sized to separate or filter the media from the flash particles freed during the deflashing process, and is positioned in an overlying relationship with the inlet 111 of a screw conveyor, designated generally by the numeral 110. As best shown in Figures 4 and 5, the screw conveyor 110 is composed of an outer flexible tube 113 which extends from the container 106 to the hopper 116 positioned above the top wall of the casing C.

A helical screw 112 having a flexible shaft 114 is disposed within the tube 113 and is connected to a motor 115. As will be recognized, by rotation of the motor 115 and flexible shaft 114, the helical screw 112 transports the media entering through the opening 111 through the tube 113 and discharges the media into the hopper 116 for entry into the transport and throwing wheel mechanism 93. Further, to facilitate the addition of supplemental media into the system, a top closure 106a is provided upon the container 106.

With the structure defined, the operation of the deflashing apparatus of Figures 1 through 6 of the present invention may be described. It will be recognized that initially the deflashing chamber is lowered to operating temperatures by the introduction of cryogen gas through the piping arrangement 67 and 68. At operating temperature, the particles or parts to be deflashed, are placed within a loading bin 37 of the vestibule V by opening the cover plate 20. During loading, both of the inner gates 29 and 33 of the vestibule V are in their closed position to prevent the transfer or interaction of the cryogenic gas contained within the deflashing chamber with the atmosphere.

Subsequently, the cover 20 is closed, sealing off the atmosphere from the vestibule V and the inner gate 29 may be released (as by removing a pin 120 shown in Figure 3, or releasing a holding means such as a crank arm 121) to move to the phantom line position, shown in Figure 2. In this position, the bin 37 containing the articles to be deflashed (not shown) may be pivoted about its axis 38 to a position indicated by the phantom lines in Figure 2, wherein the articles are dumped onto the conveyor belt B. Subsequently, the bin 37 and gate 29 may be returned to their initial position, thereby again sealing the vestibule V from the deflashing chamber.

The conveyor belt B travelling in a direction indicated by the arrows in Figure 2, tumbles the articles on its upper concave course with any articles accidentally moving out of the concavity being urged back thereon by the angularly inclined walls 29a and 29b of the upper gate 29. By timing the period that the articles are maintained within the deflashing chamber, the flash of the articles will become embrittled in comparison with the remainder or main body of the articles so that the media being discharged through the deflashing chamber by the throwing wheel 93, effectively removes the flash from the articles without marring the remainder of the articles.

After the completion of the deflashing operation, the lower gate 33 of the vestibule V may be opened to the phantom line position of Figure 2 (as by the crank 123) and the belt B may be reversed so that the articles carried by the belt B are transported into the unloading chamber 16. Subsequently, the gate 33 may be returned to its initial position to prevent the escape of the cryogen gas, and the lower closure panel 23 may be manually opened to remove the articles from the apparatus.

As will be recognized by the apparatus disclosed in Figures 1 through 6, the icing and safety hazard associated in the prior art apparatus are significantly eliminated with the vestibule V preventing cryogen/atmosphere interaction and cryogen exposure to operating personnel.

In Figure 7, a modified vestibule or gas lock arrangement is illustrated which may be substituted for the vestibule V of Figures 1 through 6. By this particular modification, the loading bin 237 includes a marginal extension or flange 225 adjacent one edge thereof which engages a sealing member 232 formed on the interior surface of the door D. Similarly, a lower seal 232a is mounted on one surface of the partition 17 which in combination with the seal 232 forms a substantially gas tight seal between the loading chamber 15 and the deflashing chamber. By this particular arrangement, the necessity of having a separate inner gate 29 (shown in Figure 1) is eliminated with the rear wall 229 of the bin 237 performing a comparable function.

The modification further provides a baffle depending downwardly from the top surface of the case C to deflect articles being tumbled during the deflashing operation back onto the concave upper course of the belt B. The baffle is preferably pivotally connected intermediate its length such that during pivoting of the bin 237 to enter parts into the deflashing chamber (in a manner previously described), the baffle may extend to a non-restrictive position indicated by the phantom lines in Figure 7.

In addition, the modified vestibule structure includes a lower gate 233 which is pivotally mounted about an axis 234 for movement between an opened and closed position indicated by the full and phantom lines respectively in Figure 7. As shown in its closed position, the gate 233 mates with a top and side seal 235 and 235a to prohibit interaction and heat transfer between the cryogen gas and the atmosphere. Further, the gate 233 serves to redirect any articles back onto the belt B which accidentally are thrown off the belt during the deflashing process.

In Figures 8 through 12, a second embodiment for the deflashing apparatus of the present invention is disclosed which is particularly suited for completely automated operation. As shown, the apparatus generally comprises a casing 300, having inner and outer spaced walls 302 and 304 respectively, which are preferably filled with an insulating material. The apparatus shown is similar to the prior embodiment, and further, a modified gas lock or vestibule 308, an automatic part conveyor 312, a belt tensioning means 370a, flash/media separator 454, and a modified media transport and throwing wheel assembly 510.

Referring to Figure 8, it may be seen that the casing 300 is provided with a door 306 which preferably extends across the entire front surface of the apparatus. The door 306 includes an outer lock or vestibule 308 which forms a substantially gas tight loading and unloading chamber 310 and 400 respectively (shown in Figure 11). Manual access to the chamber 300 is facilitated by an outer hatch 330 which is pivoted to the top surface of the vestibule 308 by a hinge 332, whereas access to the chamber 400 is similarly provided by a pair of pivoted hatches 404.

The chambers 310 and 400 are separated from one another by an automatic part conveyor 312 and are selectively isolated from the deflashing chamber 322 by a pair of gates 324 and 390. The conveyor 312 is provided with a series of flights 314 extending along its periphery, which grip and carry the parts along the conveyor 312. As shown, the conveyor 312 is driven in the direction of the arrow 318 whereby the parts carried thereon may be automatically deposited onto the tumbling belt 320 within the deflashing chamber 322. As will be recognized during this transfer of the parts from the conveyor 312 onto the belt 320, the inner gate 324, which in its closed position extends from the upper portion of the chamber 310 to slightly below the uppermost pulley 422 of the conveyor 312, pivots in the direction of the arrow 326 to reside in a position indicated by the phantom lines in Figure 11. As such, the gate 324 forms an inner gas lock which permits limited interaction of the cryogen environment in the deflashing chamber 322 with the atmospheric environment of the loading chamber 310 only during loading of articles into the deflashing chamber.

The unloading chamber 400 is additionally provided with an inner gate 390 formed having an upper and lower section 392 and 394 respectively which is pivotally mounted about an axis 396. As in relation to the gate 324, the gate 390 has a closed position (indicated by the full line in Figure 11), wherein gate 390 sealingly engages the lower wall of the chamber 400 to isolate the unloading chamber 400 from the deflashing chamber and an open position wherein the gate 390 pivots in the direction of the arrow 398 to reside in a position indicated by the phantom lines in Figure 11. In this open position, the belt 320 may be driven in a reverse direction to dump the parts carried thereon into the unloading chamber 400 in the manner previously described. Thus, from above, it will be recognized that this second embodiment also eliminates the safety hazards of the prior art by providing a vestibule chamber 308 which permits the loading and unloading of articles in the apparatus without direct exposure to the cryogenic gas environment within the deflashing chamber.

As in the previous embodiment, the deflashing chamber 322 includes a plurality of axles 350, 352 and 354 which support the belt 320 on sprockets respectively numbered 356, 358 and 360. These sprockets allow the belt 320 to travel in a substantially L-shaped configuration whereby the parts (not shown) may be tumbled in the concave pocket formed upon the upper course of the belt 320 by the pair of discs 342.

In this embodiment, however, the belt 320 is tensioned by means of a roller 364 which is mounted about an axis 366 to a support arm 368. The arm 368 is formed in a dog-leg configuration with the upper portion being connected to a rod 370 that is in turn mounted to a spring 373 and cylinder 374 arrangement. The spring 372 biases the rod 370 to provide continuous tension on the belt 320. In this manner, when the belt 320 either expands or contracts in response to the introduction or elimination of cryogen gas within the deflashing chamber 320, the belt achieves a degree of automatic tensioning due to the biasing force of the spring 372. As such, the substantial thermal contraction of the belt during operation, which often caused premature failure of the belt 320 in the prior art, has been compensated for in the present invention.

To ensure that the articles are continuously tumbled on the belt 320, a deflector 378 is additionally provided, being positioned at the interface between the vestibule 308 and the deflashing chamber 322. The deflector 378 preferably comprises an upper portion 380 and a lower portion 382 connected at a hinge point 384. The upper portion 380 is additionally connected by a hinge 386 for upward pivotal movement in a direction of the arrow 388 to a position indicated by the phantom lines in Figure 11. When disposed in its closed position, the leg 380 is angularly inclined toward the belt 320, thereby urging parts accidentally thrown thereon back onto the belt whereas in its open position, the leg 380 extends outward away from the belt 320, thereby permitting the deflashed articles to be dropped into the unloading chamber 400, without interference from the deflector 380.

Referring to Figures 9, 9a, 9b and 10, the detailed construction of the second embodiment of the media feed screw and throwing wheel assembly of the present invention may be described. As shown, the assembly is mounted to the top surface of the casing 300 in a similar manner to that previously described, with the throwing wheel 510 being aligned with a discharge opening extending into the deflashing chamber 322. However, in this embodiment, the helical feed screw 504 and impeller 510, although being axially aligned, are driven by separate motor drives such that their rotational speed may be independently variable. As will become more apparent below, this independent drive feature permits the apparatus to be finely adjusted to specifically meet the performance requirements necessitated by individual part configurations.

Referring more specifically to Figure 9 and 9a, it may be seen that the distal end of the tube 521 surrounding the feed screw 504 is provided with a collar 516 having a small opening 520 therein which allows the media to be delivered into the radially oriented spaces 524 formed between the vanes 526 of the throwing wheel or impeller 510. As in the previous embodiment, this collar 516 may be rotated about its central axis to vary the angular orientation of the opening 520 with respect to the throwing wheel or impeller 510.

It will be understood that a relationship exists between the point of introduction of media into a throwing wheel and the point of discharge of the media from the vanes of the throwing wheel (i.e., the direction of the media exiting the throwing wheel is dependent upon the angular orientation of the point of introduction of the media into the throwing wheel). Further, as previously mentioned, it has long been known that in throwing wheels having uniform length vanes 526, the media discharge from the wheel is not uniformly distributed, but rather is concentrated within a localized area of the discharge pattern typically designated as a hot spot.

To properly direct the media stream and substantially eliminate the concentration problems associated with the prior art throwing wheel apparatus, the present invention incorporates a control cage 516 which may be rotated during machine operation to continuously vary or oscillate the angular orientation of the opening 520 with respect to the impeller 510. In such a manner, the hot spot may be continuously shifted across the area of the deflashing chamber 322 thereby promoting uniform and consistent deflashing operations.

Referring to Figure 9a, it may be seen that in the second embodiment, the collar 516 includes a flange 517 adjacent the opposite end from the opening 520. This flange 517 mounts a lever arm 518 extending radially therefrom. The lever arm 518 includes an aperture 519 which is sized to receive one end of an actuator rod 523 of a pneumatic or hydraulic cylinder 525 pivotally attached to the casing 300. The rod 523 is attached to the lever arm 518 by a pair of fasteners 527 threaded onto the rod 523 and positioned on opposite sides of the handle 518. As is well known, such a fastening arrangement permits the location of the handle 518 to be adjusted along the length of the rod 523.

In operation, the cylinder 525 is energized by selective pressurization and depressurization from a controlled external pneumatic or hydraulic actuator (not shown) to reciprocate the rod 523 thereby causing the collar 516 to rotate (in a direction indicated by the arrow in Figure 9a), throughout a predetermined angular rotation consistent with the width of the deflashing chamber 322. By this rotation, the angular orientation of the opening 520 relative the throwing wheel 510 is varied, thereby shifting the area of media concentration across the width of the deflashing chamber 322.

In Figure 9b, a schematic representation of the media pattern produced by the apparatus of Figure 9a is depicted. With the opening 520 of the control cage or collar 516 disposed in position A, the media discharged from the impeller 510, although typically being dispersed throughout the deflashing chamber 322, is concentrated at the localized area indicated by the numeral MA. Subsequently, with the opening 520 being angularly rotated to the position B, the media is concentrated at the area MB located to the right (as viewed in Figure 9b) from the area MA. Similarly, the concentration of media discharged from the impeller 510 for the positions C and D of the opening 520, are indicated by the numerals MC and MD, which are located to the right of the previous media concentration area.

In the preferred embodiment, the cylinder 525 is continuously pressurized and depressurized to oscillate the opening 520 of the collar 516 throughout the sweep of the positions A through D indicated in Figure 9b. As such, the media concentration area or hot spot is continuously shifted throughout the length of the deflashing chamber 322. Thus, the parts or articles P being tumbled upon the belt 320 are uniformly deflashed during operation with the inconsistencies in component wear additionally being eliminated.

To augment the improved uniform media pattern produced by the oscillating control cage or collar 516, the present invention additionally includes an improved transport mechanism 506 which is independently driven from the throwing wheel 510 to deliver a consistent quantity of pellets to the throwing wheel 510 and eliminate the tendency of the media (not shown) to clog during transport from the hopper. As shown in Figure 9, a helical feed screw 504 is positioned coaxial with the throwing wheel 510 being connected at one end to a motor by way of a suitable flange arrangement and terminating at its other end adjacent the opening 520 of the control cage or collar 516.

The feed screw 504 is enclosed within a tubing member which, as in the previous embodiment, includes a media intake opening adjacent its top surface. A media hopper 502 is positioned above the media opening to store a predetermined quantity of media therein. In the preferred embodiment, the hopper 502 includes a level indicator and valving arrangement (not shown) which regulates the amount of media entered into the hopper 502 to provide a constant static head.

In operation, the feed screw 504 rotates under the power of the separate motor drive causing media (not shown) from the hopper 502 to travel first downwardly into engagement with the feed screw 504, and then transversely towards the collar 516. Due to the constant static head maintained within the hopper 502, the amount of media entering the feed screw 504 will be uniform. Further during this operation, the throwing wheel 510 being powered by its separate motor drive, is typically rotated at a RPM value substantially higher than rotation of the feed screw 504. This rotation develops a vacuum at the opening or port 520 of the collar 516 which acts through the collar 516 and feed tube surrounding the feed screw 504. As such, the media being transported laterally by the feed screw 504 is vacuum assisted in its travel and urged through a port 520 onto the throwing wheel 510.

Thus, by this particular arrangement, the media is constantly being acted upon during transfer from the hopper 502 to the impeller 510 (i.e., first downward by the force of the static head within the hopper 502, second transversely by the rotation of the feed screw 504, and thirdly transversely and upwardly through the opening 520 by the vacuum generated in the throwing wheel 510). As such, the inconsistent amount of media delivered to the impeller as well as the clogging problems associated in the prior art, are substantially eliminated.

Further, this particular transport throwing wheel arrangement permits the apparatus to be finely adjusted for particular deflashing operations. As will be recognized, the amount of vacuum assist, as well as the velocity of the media from the throwing wheel 510, is related to the speed of the throwing wheel 510, which may be independently controlled and varied during operation. Further, the amount of media being supplied to the wheel 510 is dependent upon the speed of the helical feed screw 504, which is additionally independently variable. Thus, by way of the present invention, the density, intensity, and the pattern of the media stream, may all be varied to suit the particular deflashing operation.

In Figures 8 and 12, the media reclaim and media/ flash separator mechanism of the present invention is illustrated. Referring particularly to Figure 8, it may be seen that the lower portion of the deflashing chamber 322 is provided with an inclined member 440 which terminates in a hopper area. As shown, the hopper includes a transport screw 442 which is driven, as in the prior embodiment, to feed the media into a reservoir container 444. The container 444 is in turn connected to a flexible conveyor means 446 (analogous to the conveyor previously described in relation to Figures 4 and 5) having a helical feed means turned by a motor 448, to lift the media delivered by the screw 442 upward in the direction of the arrow 452, and deposit the same into the separator apparatus.

The separator apparatus of the present invention basically comprises a plurality of vibratory chambers 454, 456, 458 and 460, each being provided with the respective screen thereunder, which is graduated in size from the upper to lower chambers.

In operation, the media transported through the helical feed tube 452 enters the upper chamber 454 and passes through a respective screen to the lowr chambers 456 and 458. Each of the lower chambers 456 and 458 are connected as by way of conduits 464 and 462 to the conical-shaped hopper 484. Due to the hopper 484 being maintained under vacuum, the media within the chamber 456 and 458 is rapidly drawn off and transported through the tubes 464 and 462 into the hopper 484.

The uppermost and lowermost chamber 454 and 460, respectively, are connected as by way of conduits 466 and 457 to a flash residue container 470 which is similarly maintained under vacuum. As such, the relatively large particles of flash which fail to pass through the larger mesh screen of the first chamber 454, are directly drawn out of the chamber 454, whereas the relatively smaller particles of flash which have travelled to the lowermost chamber 460 are accumulated and similarly removed from the chamber 460.

From the above, it is evident that the graduation of screens can be utilized in any suitable manner to allow for the most advantageous separation of the flash and media. However, the order of the chambers and their respective screen size is preferably maintained such that the gauge of opening in the screen decreases from the upper to lower chambers of the separator to eliminate the smallest flash particles at the lowermost chamber while drawing off the media from at least one or two of the chambers thereabove. In such a manner, a suitable separation between the media and flash of the system is accomplished.

Subsequent to the separation process, the media falls into a conical-shaped hopper 484 which is supported by legs 480 and 482. The hopper 484 is connected to a feed screw and conveyor assembly 490 that is of the helical screw type 446 previously described for conveying the media upwards into the feed hopper 502 of the throwing wheel assembly 510.

The applicant has found that when the media reaches this hopper 482, its temperature has typically been raised to an intermediate level, i.e., between the cryogenic temperature and the atmospheric temperature, which often attracts moisture and creates a frost condition. As a consequence, it is advantageous that the media should be heated to evaporate any moisture contained thereon or alternatively maintained at cryogenic temperatures throughout the entire deflashing process to avoid icing. As such, in the preferred embodiment, the hopper 444 is provided with a cal rod 494 which is connected to a power supply as by way of the electrical leads 496 to heat the media to a temperature above the dew point. Alternatively, the entire conduit 446 leading to the separator apparatus could be maintained at temperatures approaching the cryogenic temperatures, whereby the formation of ice would be prohibited. Thus, the separator apparatus of the present invention substantially separates the media from the flash liberated in the deflashing process and prevents a formation of ice on the media being transferred back to the throwing wheel apparatus 510.

From the above, it will be recognized that the embodiment of Figures 8 through 12 is particularly suitable for completely automatic operation. In this regard, it is evident that the opening of the outward hatch 330 of the vestibule structure 308 may be readily accommodated by pneumatic or hydraulic means such as a hydraulic actuator 410 extending therefrom and interconnected to the door by way of a pivot point 414 In addition to the foregoing pneumatic or hydraulic cylinder 410, there can be various other means such as a rack and pinion or individual motor drives (not shown) incorporated within the sidewalls 302 and 304 of the casing 300 to drive the inner gates 324, 380 and 392 between open and closed positions. Similarly, the speed of the motors, as well as the operation of the control cage 516, may be controlled by the use of a variety of electrical or electromechanical linkages. As such, all the elements of the apparatus can be advantageously automated and connected to a digital control system (not shown) for providing a timed processing of material or articles through the apparatus.

Thus, the system can function entirely under automatic control down to the point of loading and unloading on a conveyor. As a consequence, the present invention provides a substantial improvement over the prior art deflashing apparatus.

CLAIMS:

1. A cryogenic deflashing apparatus, having a casing, means for admitting a refrigerant within said casing, means for tumbling articles to be deflashed within said casing, and means for projecting a deflashing media into said casing when said articles are being tumbled therein, characterised by

means providing an inlet section and an outlet section for supplying said articles to and removing said articles from said casing while precluding the admission of ambient air into and the escape refrigerant from said casing.

2. The apparatus of Claim 1 further characterized in that said means providing an inlet section and an outlet section form a vestibule having inner and outer sealing closures for each section.

3. The apparatus of Claim 1 further characterized in that said means providing an inlet section and an outlet section comprises a vestibule having an upper outer sealing closure and a lower outer sealing closure, an intermediate inner wall, and upper and lower sealing closures engageable with said intermediate wall.

4. The apparatus of Claim 1 further characterized in that said means for providing an inlet section includes a moving belt upon which articles to be deflashed may be loaded for moving said articles into said casing.

5. A cryogenic deflashing apparatus having a housing, means for admitting a cryogenic gas within said housing, and means for tumbling articles within said housing, characterised by a media transport and throwing wheel mechanism comprising:

a rotatable throwing wheel having a plurality of spaced radially extending vanes;

feed screw means coaxial with said throwing wheel for transporting media toward said throwing wheel;

a collar coaxially positioned adjacent one end of said feed screw means having a media induction port communicating with said throwing wheel; and

means for varying the angular orientation of said induction port relative to said throwing wheel during rotation of said throwing wheel, said varying means providing a variable pattern of media being thrown from said throwing wheel.

6. The apparatus of Claim 5 further characterized in that said varying means comprises actuator means mounted to said collar for selectively rotating said collar between a first and second position selected to provide a uniform media pattern throughout said housing.

7. The apparatus of Claim 6 further characterized in that said actuator means continuously oscillates said collar between said first and second positions.

8. The apparatus of Claim 5 further characterized in that said throwing wheel is driven to rotate by a first motive means, and said screw means is driven to rotate by a second independent motive means.

9. The apparatus of Claim 8 further characterized in that said first and second motive means includes means for varying the rotational speed of said throwing wheel and said feed screw so that the amount of media and the velocity of media being thrown from said throwing wheel may be independently adjusted during operation.

10. The apparatus of Claim 8 wherein said feed screw means is positioned within a tubular member extending between a hopper and said collar, said hopper storing a predetermined static quantity of said media, and said media being continuously acted upon during transport through said apparatus by said static quantity of media within said hopper, the rotation of said feed screw within said tubular member, and vacuum developed at said outlet by the rotation of said throwing wheel.

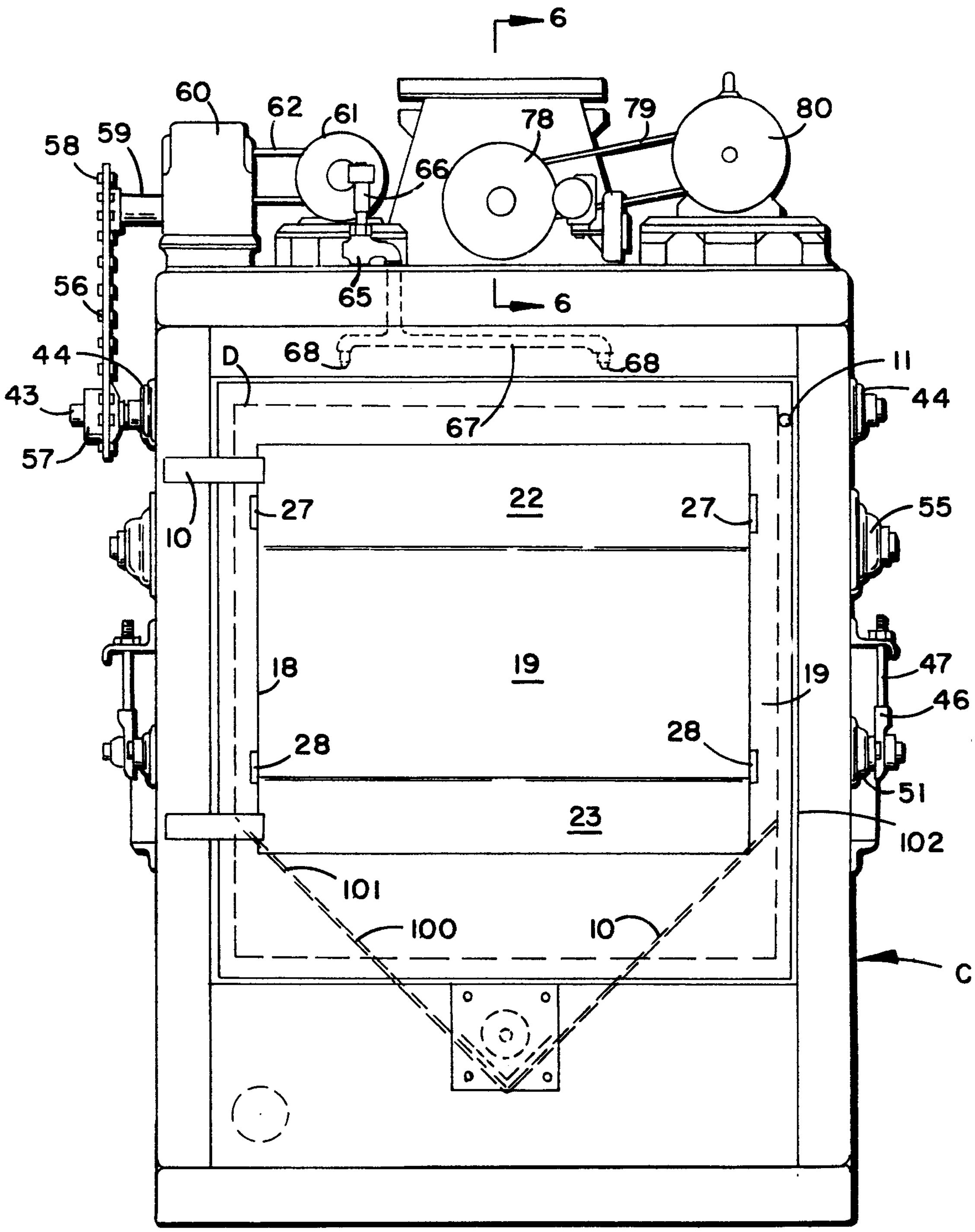
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FIG. 1

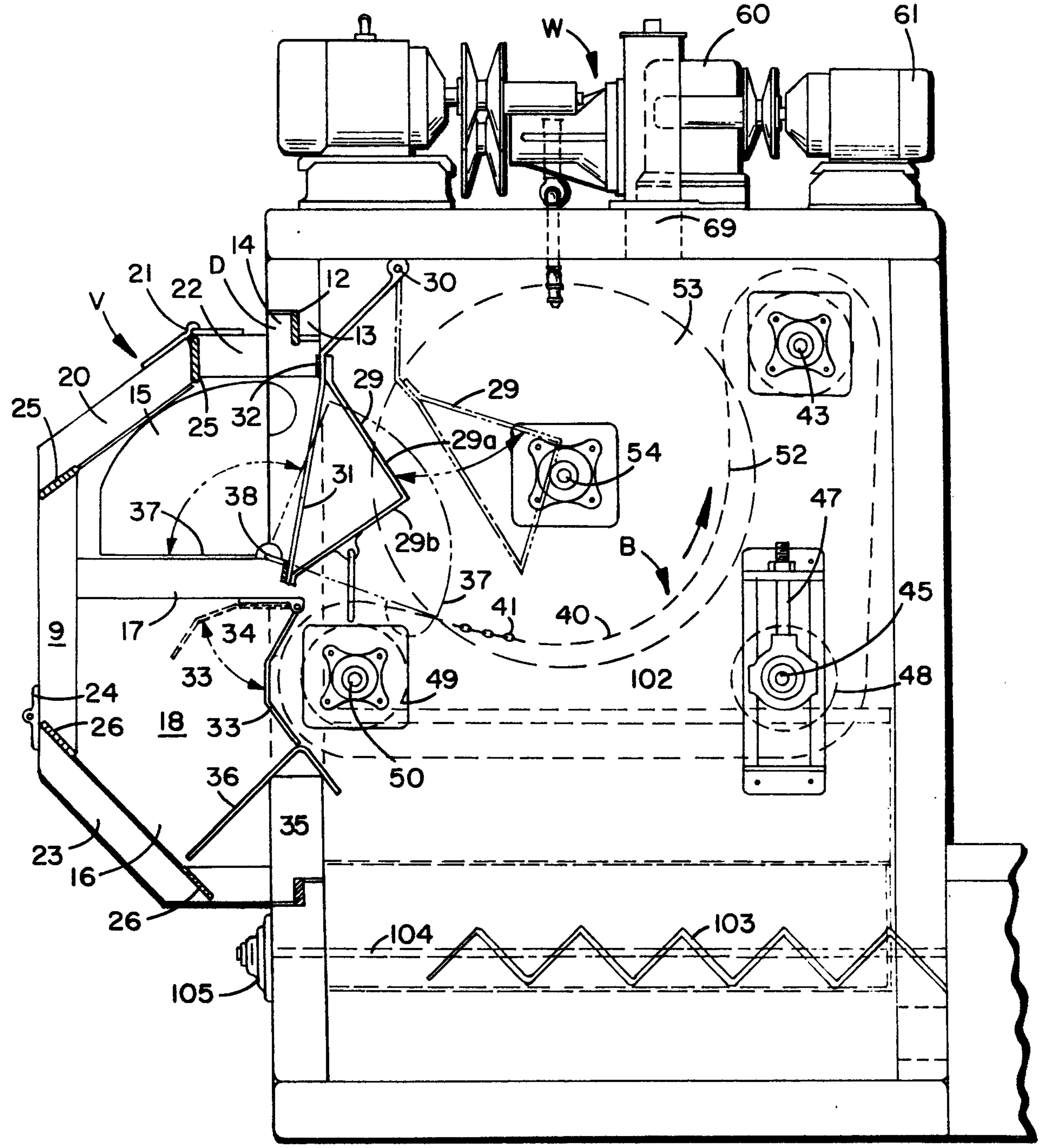
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FIG. 2

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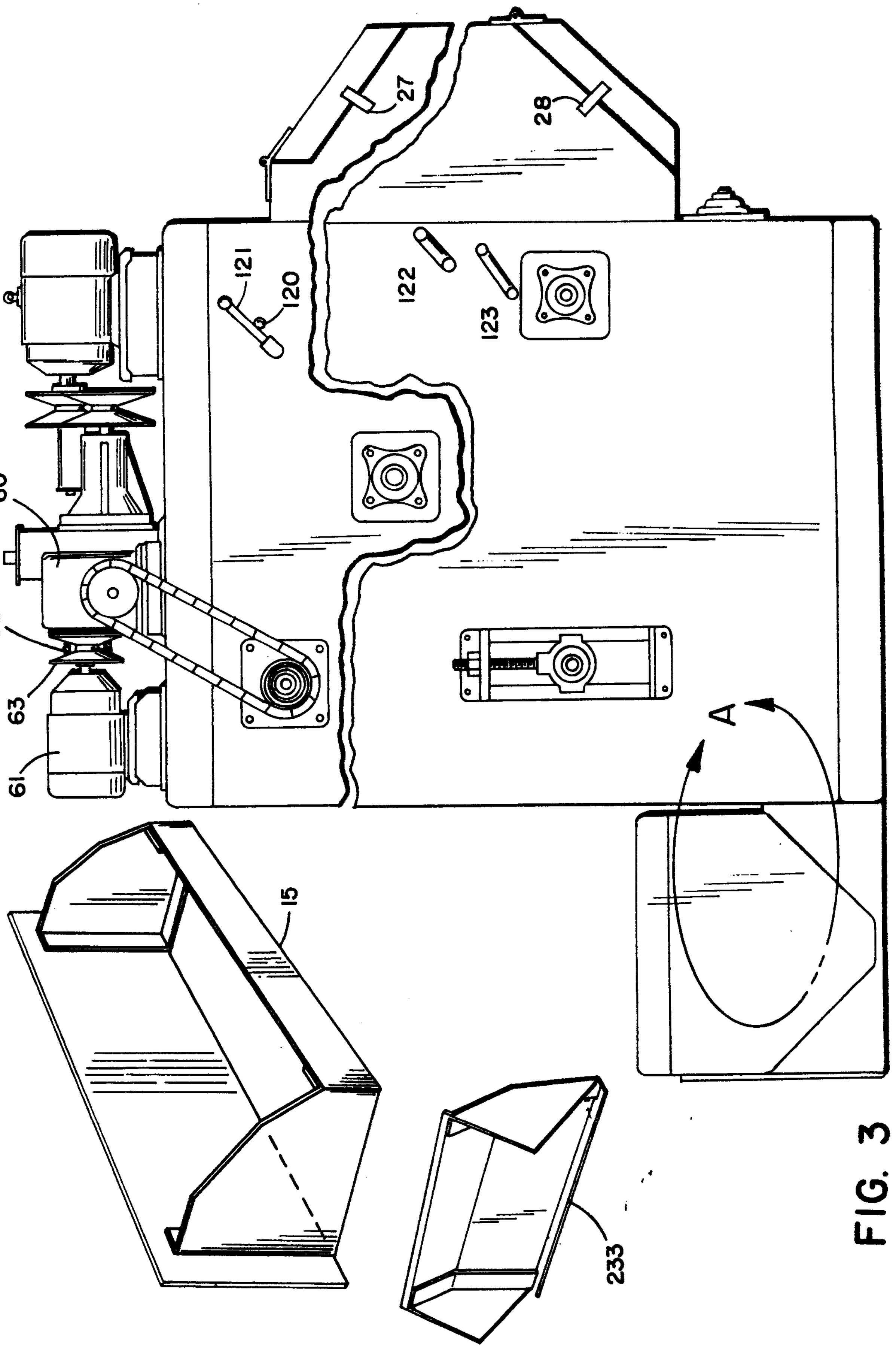


FIG. 3

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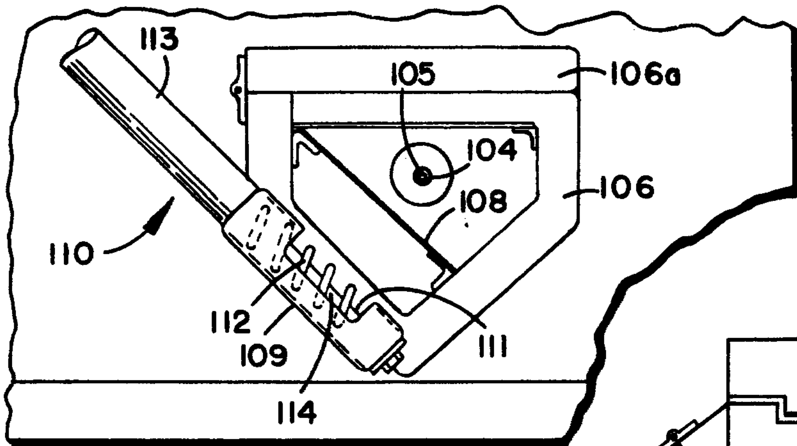


FIG. 4

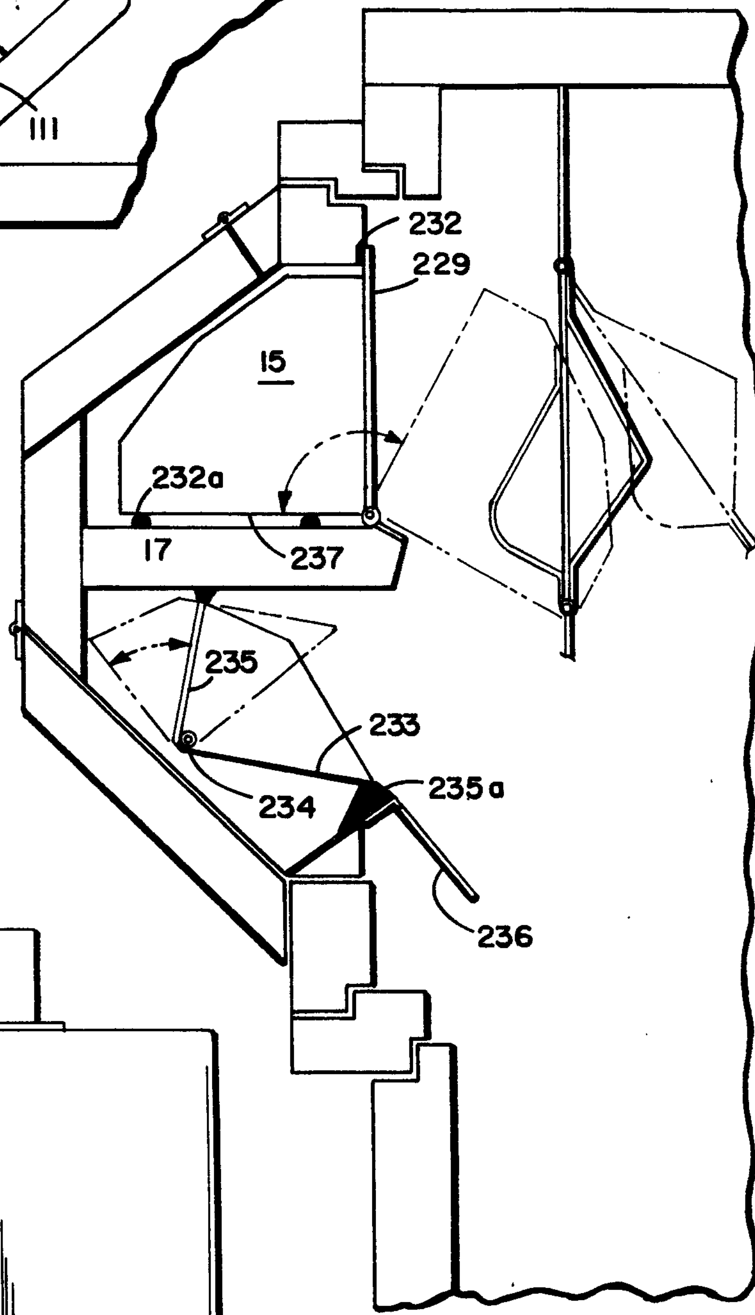


FIG. 7

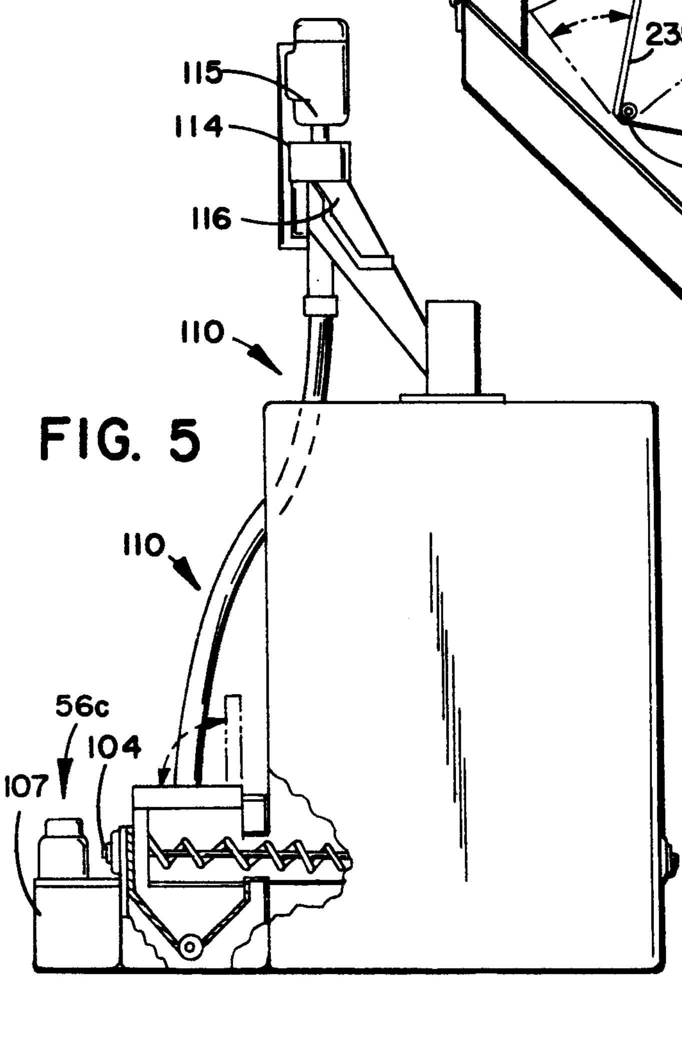


FIG. 5

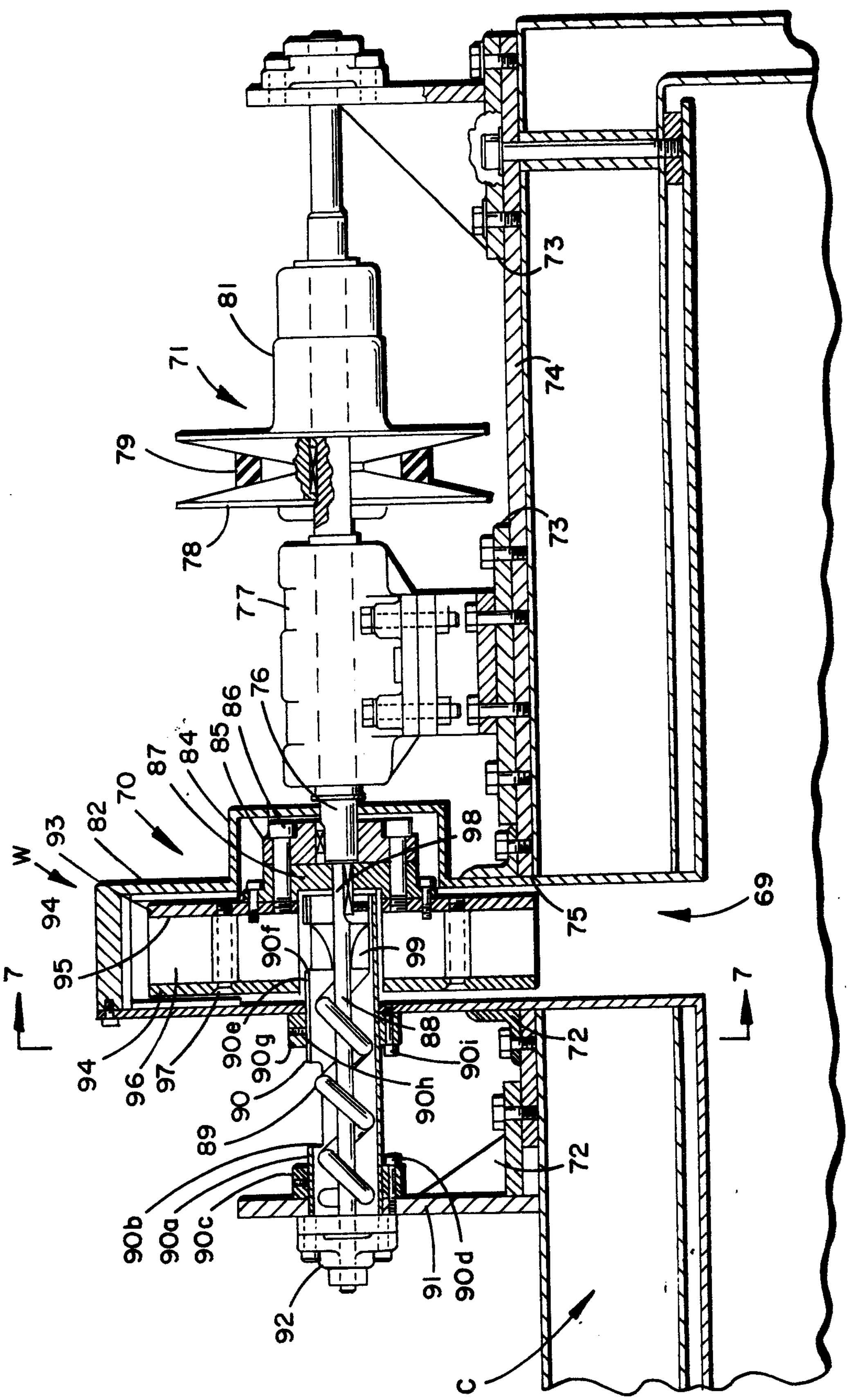
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FIG. 6

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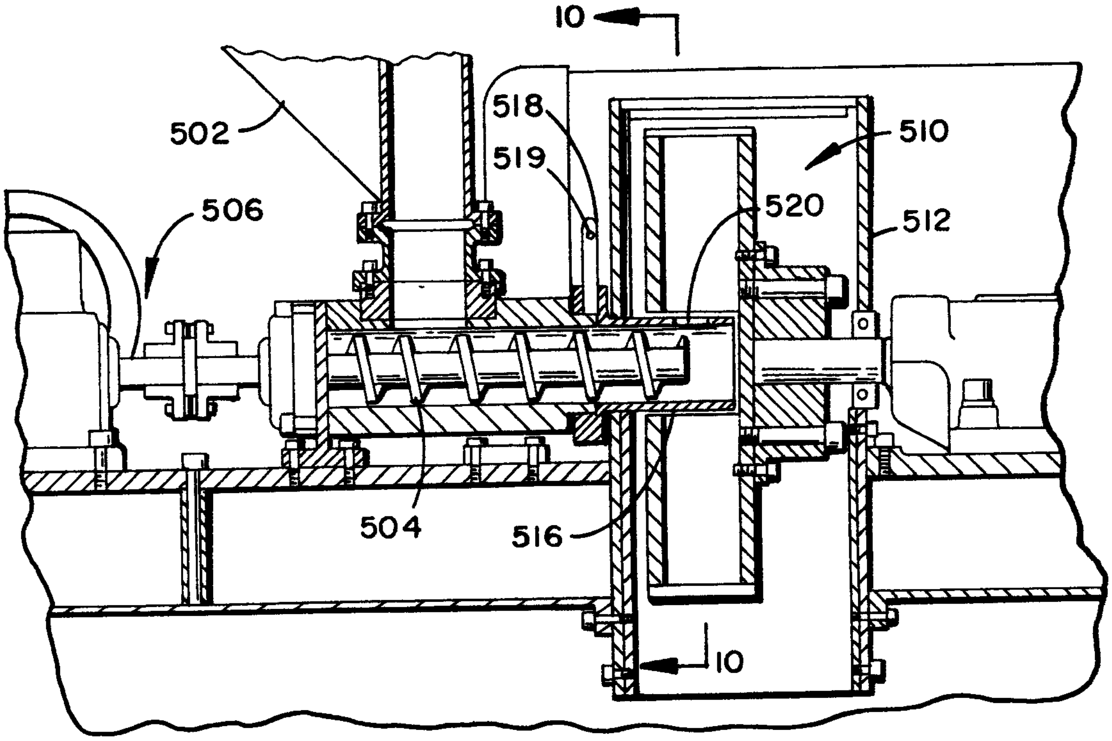


FIG. 9

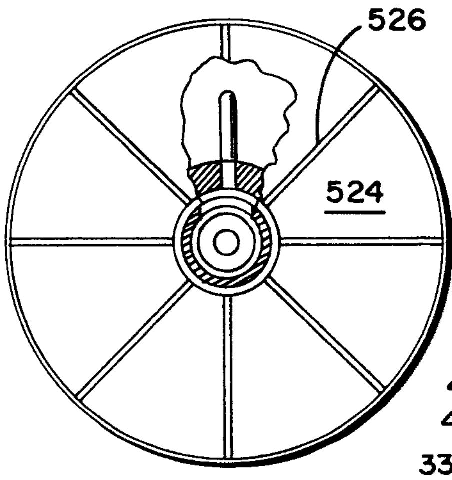


FIG. 10

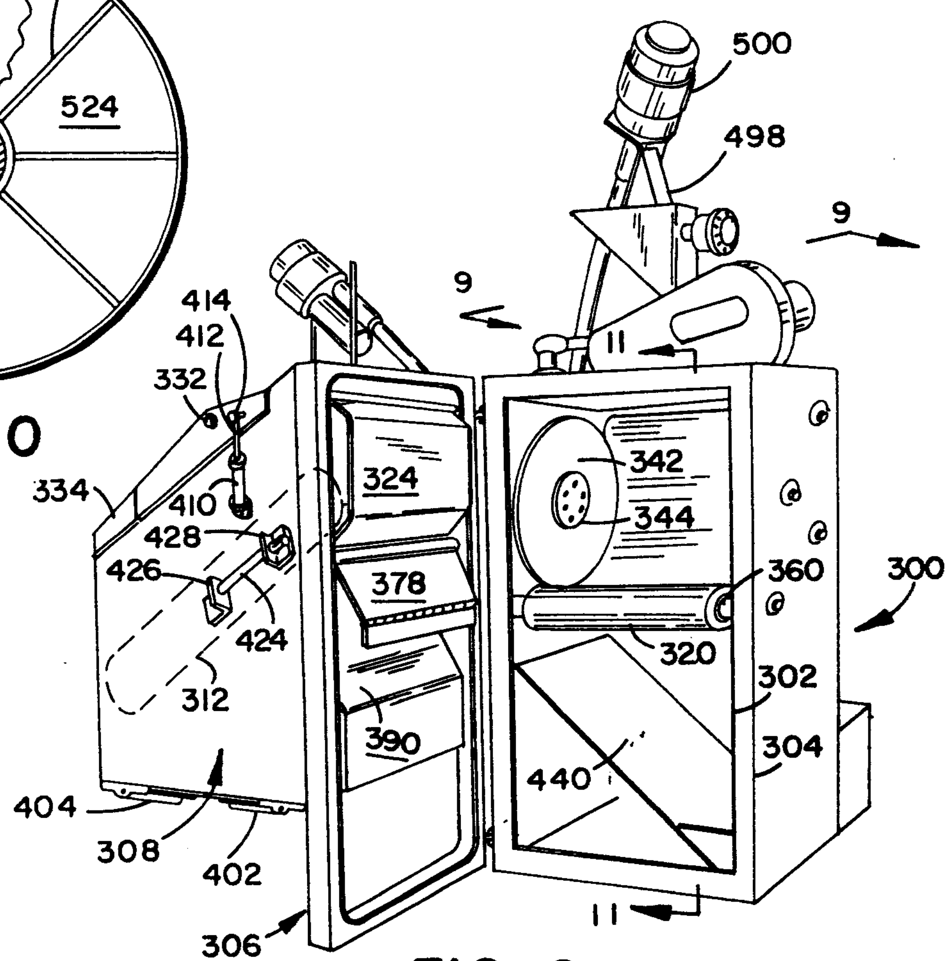


FIG. 8

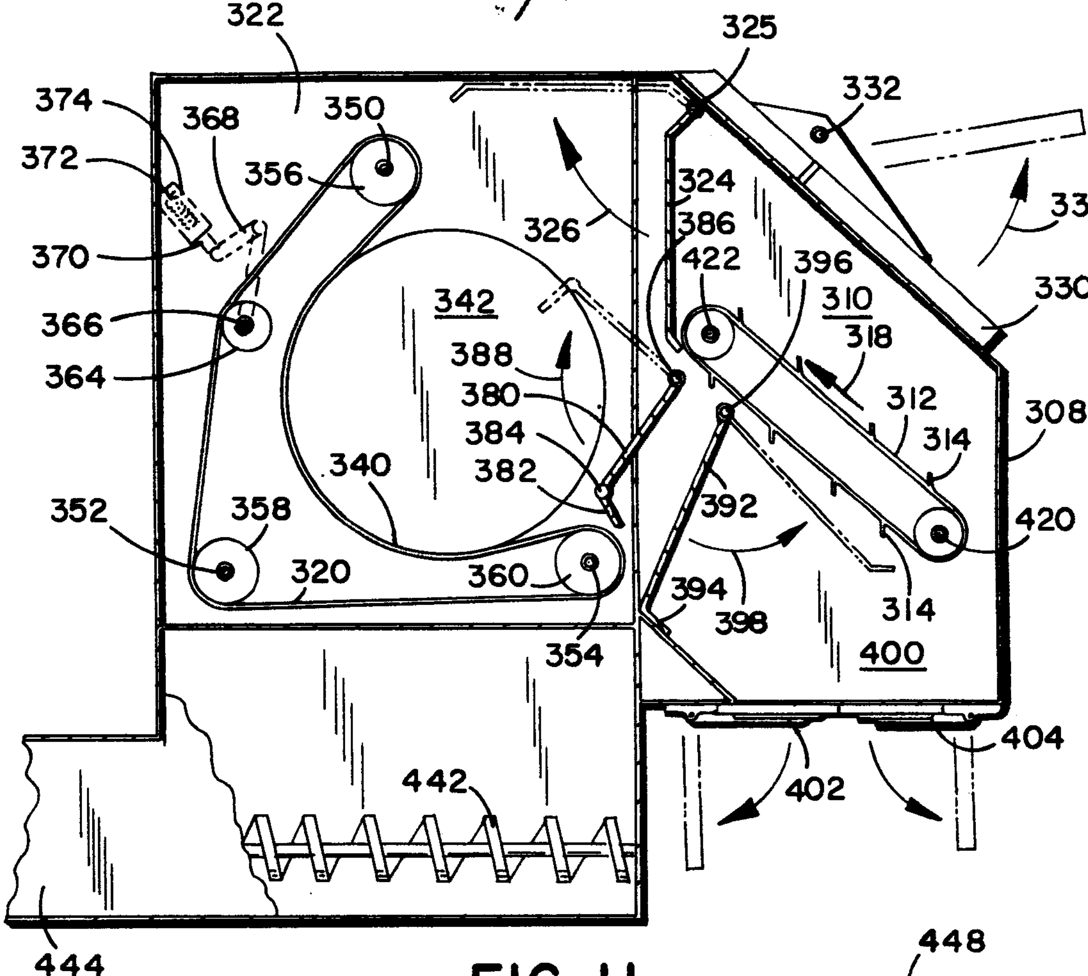
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FIG. 11

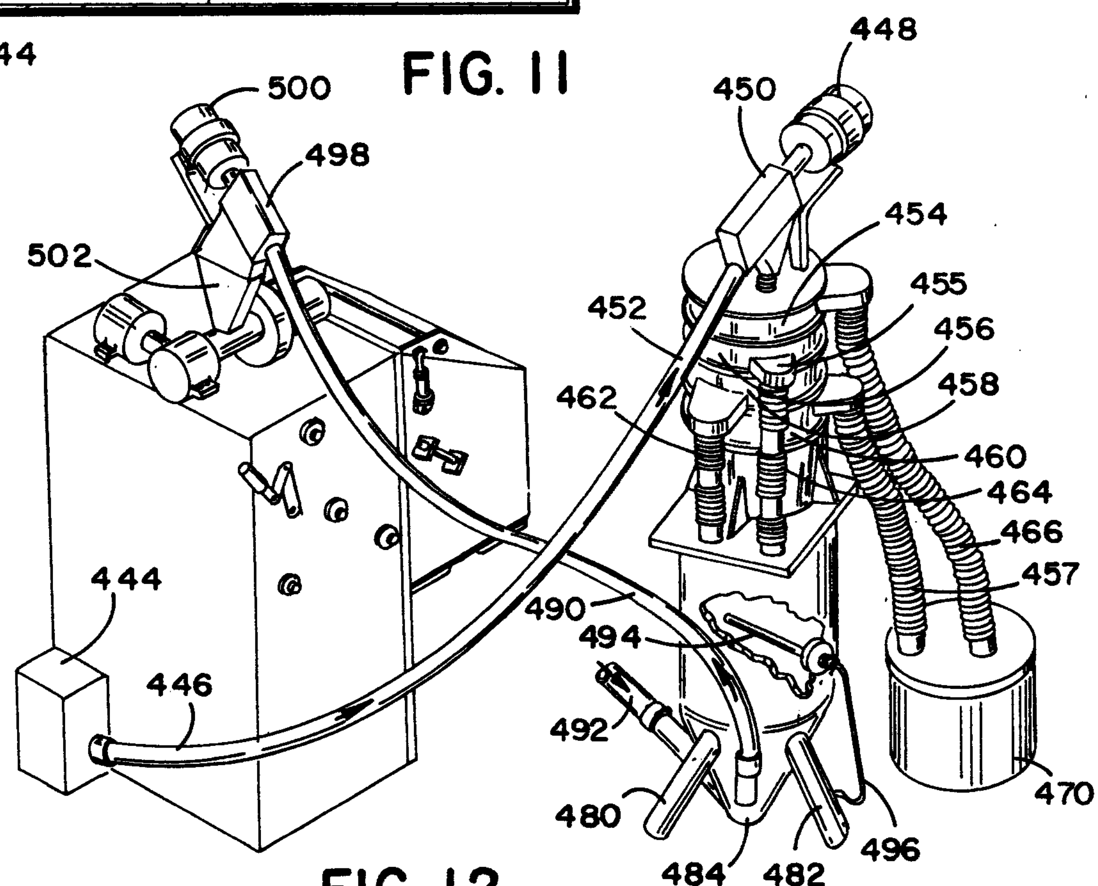
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FIG. 12

0006751

Application number

European Patent Office

# EUROPEAN SEARCH REPORT

EP 79 301 232.9

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim |
|---|---|---|
| | US - A - 3 378 959 (W.A. McCORMICK JR.)<br>* column 1, line 68 to column 2, line 33; fig. 3 and 4 *<br>& DE - A - 1 479 596<br>-- | 1 |
| | US - A - 2 708 814 (J.C. STRAUB)<br>* column 2, lines 14 to 36; fig. 1 *<br>& DE - B - 1 017 048<br>-- | 5,6 |
| D | US - A - 2 049 466 (MINICH)<br>* page 2, column 1, lines 43 to 70; fig. 1 and 2 *<br>---- | |

**CLASSIFICATION OF THE APPLICATION (Int. Cl.3)**

B 29 C 17/12
B 24 C 5/06

**TECHNICAL FIELDS SEARCHED (Int.Cl.3)**

B 24 C 5/06
B 29 C 17/12
B 29 H 3/06

**CATEGORY OF CITED DOCUMENTS**

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 | 12-10-1979 | BRUCK |

EPO Form 1503.1 06.78