United States Patent

Lundin et al.

[15] **3,697,005**

[45] **Oct. 10, 1972**

[54] **APPARATUS FOR COMMINUTING ARTICLES**

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[22] Filed: **May 3, 1971**

[21] Appl. No.: **139,488**

[52] **U.S. Cl.** .....**241/101 M,** 241/32, 241/188 R, 241/195

[51] **Int. Cl.**.....**B02c 21/02**

[58] **Field of Search**....241/32, 101 M, 186 R, 188 R, 241/189 A, 195, 251 R, 277

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[57] **ABSTRACT**

A comminuter for reducing articles to small particles which has an upright housing with vertically spaced intake and discharge openings. Rotatable cutting blades have a vertically downwardly extending housing floor scraper with off-set scraper teeth on at least a pair of blades and upwardly extending splitting wedges. The blades are rotatably mounted within the housing and actuated by a hydraulic motor. A hydraulic pump powered by an internal combustion engine or the like is coupled with the hydraulic motor via a valve that permits the reversal of the direction of rotation of the motor and cessation of its rotation.

15 Claims, 5 Drawing Figures

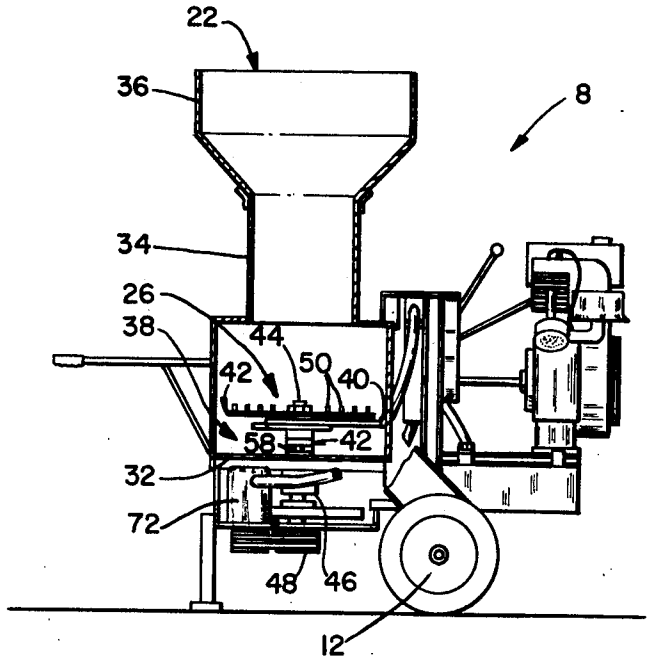
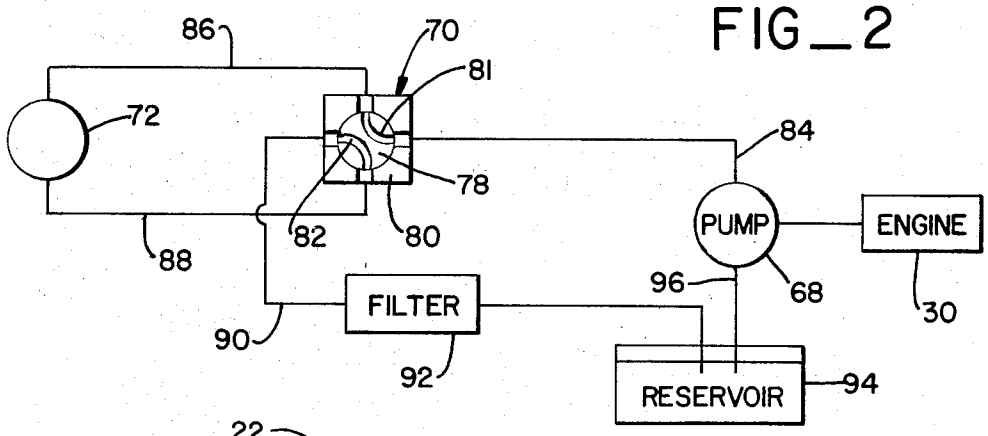


FIG_2



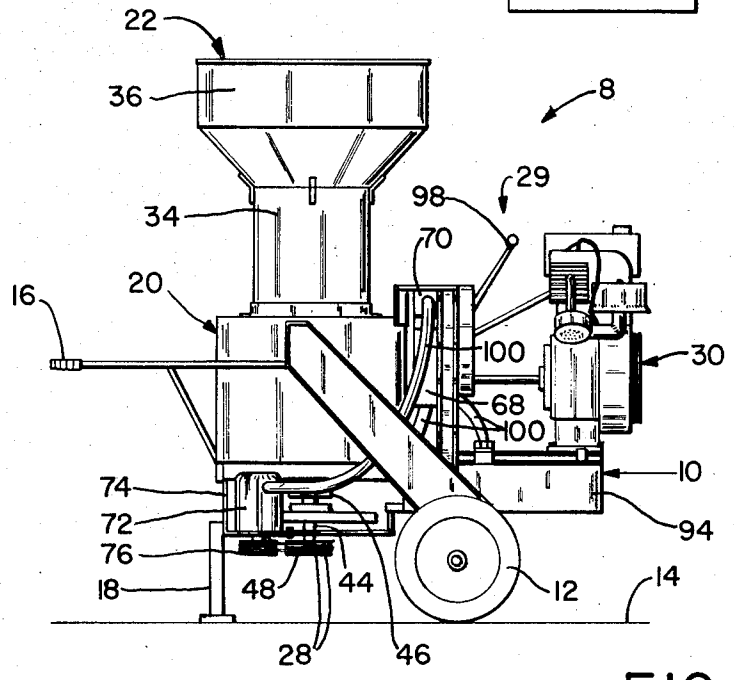


FIG_1

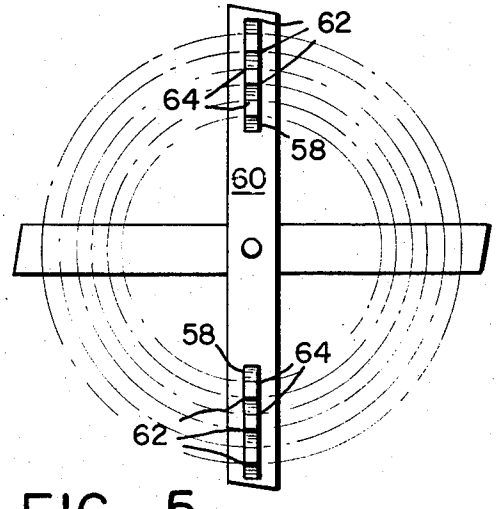


FIG_5

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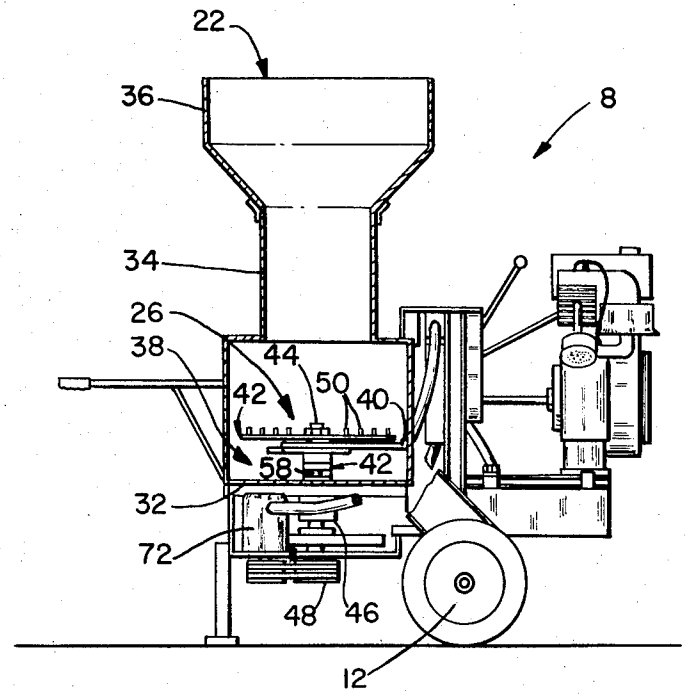
FIG_3



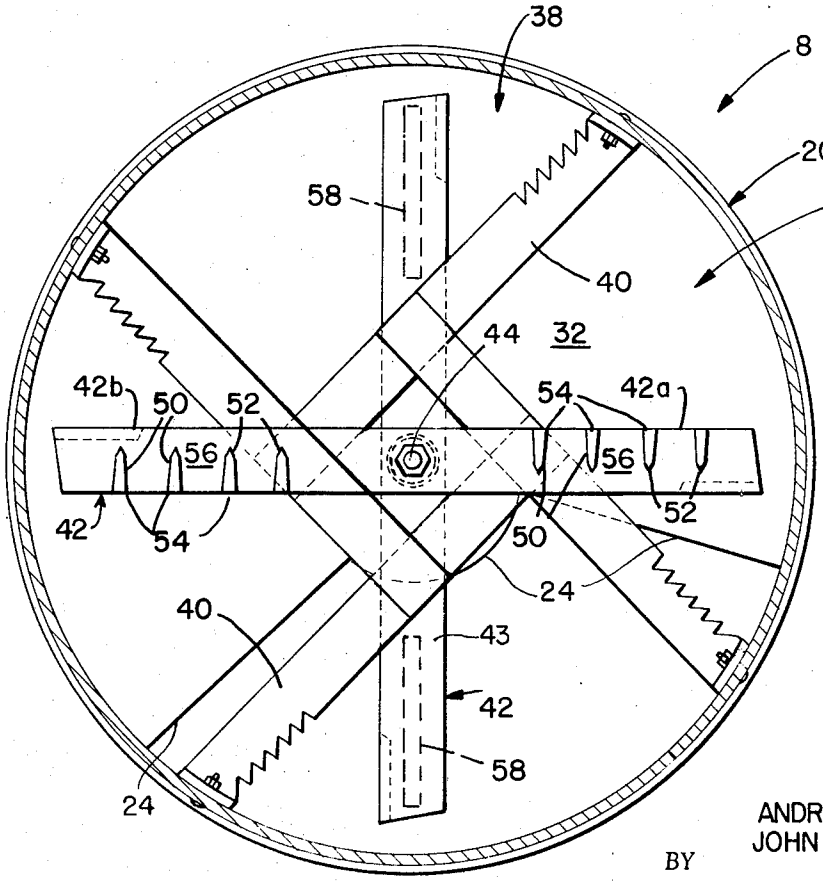


FIG_4

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APPARATUS FOR COMMINUTING ARTICLES

BACKGROUND OF THE INVENTION

To prevent the pollution of the environment through discharge of large and therefore slowly decomposing organic matter such as shrubbery, tree limbs and the like, comminuters or disintegrators are increasingly employed. The comminuters reduce the size of the matter to small particles which, when placed in the open atmosphere or under ground, decomposes readily without polluting and disfiguring the surroundings.

The comminuters require substantial power for their operation which is normally supplied by an internal combustion engine. Such engines are readily available and render the unit self-contained and mobile. By their nature, the comminuters are massive, have heavy cutting blades that rotate at high speeds, and are hazardous unless the comminuting chambers within which the blades rotate are securely shielded and enclosed.

From time to time oversized articles placed into the chamber, or a too rapid filling thereof, can jam the blades. To make the comminuter operable again, the chamber must be opened and the jamming article must be removed. This is time consuming and a potential safety hazard since failure to close the chamber before restarting the engine can seriously or fatally injure the operator. Prior art comminuters of the type under consideration herein require that the jamming articles be manually removed from the chamber, or at least from between the blades, before the apparatus can be restarted. Thus, they exhibit all the above referred to safety hazards.

Relative inefficiencies in the comminution of articles by prior art devices increases the frequency with which the machines become jammed and require the relatively frequent opening of the disintegrating chamber. For example, the introduction of large articles say relatively large diameter limbs, often taxes the cutting blades beyond their capacity and can stall them. Furthermore, in devices which employ cutting blades disposed just above a flat floor plate and having downwardly and rearwardly extending scrapers to move debris on the floor plate towards a discharge opening in the plate can under certain circumstances, when the debris comprises wet substances, pack such substances against the floor plate instead of scraping them therefrom. This results in a debris buildup which exerts an axial force to the rotating blades, causes substantial friction losses, and can permanently deform and damage the blades. To rectify the situation, the machine must again be opened for cleaning, thereby again representing a safety hazard.

SUMMARY OF THE INVENTION

The present invention provides a comminuter with a reversible drive that permits a reversal of the direction of rotation of its cutting blades. In most instances of jamming of the blades a reversal of the direction of their rotation, that is a reversal of the force applied to the blades, is sufficient to loosen the blades so that thereafter they can continue to operate without the need for manually removing the jamming article. In addition thereto, the frequency of machine jamming caused by articles too large to be readily disintegrated by the blades is substantially reduced through the

provision of splitting wedges on the side of the blades first contacted by the entering articles. The splitting wedges initially split or crack the incoming article so that their actual disintegration by the blades is substantially easier to thereby remove many causes of machine jamming. Lastly, machine jamming, stalling, or damage to the cutting blades from a wet debris-cake buildup on the floor plate is prevented by providing vertically downwardly extending scrapers. The efficiency of the scrapers is enhanced by offsetting the teeth on the scrapers on different blades with respect to the axis of rotation of the blades to prevent all teeth from moving along identical grooves.

Broadly speaking, a comminuting apparatus constructed in accordance with the invention comprises a frame and an upright hollow body defining an intake opening at the upper end, a discharge opening at the lower end, and having floor means extending at least partially across a lower end of the body. Rotatably mounted cutting blades are disposed above the floor means for contacting and comminuting the articles. A motor is mounted to the frame and drives the cutting blades via drive means that includes means for reversing the rotation of the blades and for stalling their rotation independently of the motor means.

In the preferred embodiment of the invention the drive means comprises a hydraulic drive having a hydraulic pump actuated by an internal combustion engine or the like mounted to the support frame and a hydraulic motor coupled to a shaft of the blades via V-belts or the like. Valve means is interposed between the pump and the motor and permits a reversal of the fluid flow through the motor for reversing the direction of rotation of the blades and the interruption of the fluid flow independently of the operation of the internal combustion engine and the pump to halt the blade rotation.

A comminuting apparatus constructed in accordance with the invention is self-contained, readily and relatively inexpensive to construct and seldom, if ever, jams to such an extent that reversal of the direction of rotation of the blades would not remove the cause for jamming. The frequency with which the chamber must be entered for the removal of jammed articles or of a debris-cake built up upon the bottom plate is therefore greatly reduced, thus reducing the chances of injury to the operator.

In addition to the substantially safer operation of the comminuting apparatus, the present invention provides a relatively inexpensive drive that insulates the power source, i.e., the internal combustion engine, from at least partial shock loads due to blade jamming and the like. The drive mechanism coupling the blades with the internal combustion engine is virtually fool-proof so that its operation even by inexperienced personnel will not lead to costly damage of the drive. Furthermore, the drive is subject to little wear and requires little or no maintenance or repair to substantially enhance its economic attractiveness of the comminuter.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of a comminuting apparatus constructed in accordance with the invention;

FIG. 2 is a schematic diagram of the reversible hydraulic drive for the comminuting apparatus shown in FIG. 1;

FIG. 3 is a fragmentary side elevational view, in section, and illustrates interior portions of the comminuting apparatus;

FIG. 4 is an enlarged plan view, in section, of the interior of the comminuting apparatus; and

FIG. 5 is a bottom end view of rotatable blades including vertically downwardly extending scraper blades having offset teeth constructed in accordance with the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring first to FIG. 1, a comminuting apparatus 8 comprises a frame 10 including means mounting a wheel 12 for movement of the apparatus over ground 14, a handle 16 and support legs 18 which maintain the apparatus in an upright position. A hollow body 20 including an intake chute 22 on its upper end and a discharge opening 24 in a floor plate 32 is mounted to the frame. Comminuting means 26 are disposed interiorally of the body 20 in a comminuting chamber 38 and are driven via V-belts 28 by drive means 29 actuated by an internal combustion engine 30 or the like.

Intake chute 22 comprises a neck portion 34 that terminates in an outwardly extending top funnel 36 raised substantially above ground 14 and having a relatively large diameter of several feet. Articles to be comminuted are thrown into the funnel and are automatically guided into neck 34 and hence into comminuting chamber 38. However, the high positioning of the top edge of the funnel and its relatively large diameter of several feet prevents the operator from extending his hand downwardly into neck 34 or the comminuting chamber where flying particles and/or the comminuting means can seriously injure him.

Referring to FIGS. 1, 3 and 4, comminuting means 26 disposed in chamber 38 comprises a stationary blade set 40 secured to body 20 and a rotatable blade set 42 having at least one pair of oppositely disposed rotating blades 42*a* and 42*b* mounted to a drive shaft 44. The rotatable blade set includes opposing blades 42*a* and 42*b* positioned above stationary blade set 40 and blades 43 disposed between the stationary blade set and floor plate 32. The rotating blades are secured to a shaft 44 that extends downwardly through the floor plate and is rotatably mounted in a bearing 46 on the underside of the floor plate. A lower free end of the shaft mounts a conventional V-belt sheave 48.

In use, articles entering the comminuting chamber through intake chute 22 are grasped by the rotating blades, driven against the stationary blades and thereby disintegrated. To aid the disintegration process a plurality of splitting wedges 50 are secured to at least a pair of opposing blades, namely upper blades 42*a* and 42*b* and equally distributed from adjacent shaft 44 to adjacent an outer end of the blades at uniform intervals. The wedges terminate in chisel ends 52 that define the leading edges of the wedges, face in the direction of rotation of the blades and are set back from the leading edge of the blades. The remainder of the wedge tapers outwardly and rearwardly to a back side 54. The wedges are firmly secured, e.g., welded to an upper side 56 of the blades.

For splitting or cracking tree limbs as frequently encountered in fruit orchards, excellent results have been obtained with wedges that have a total height of no more than about one inch, a total length from chisel end 52 to back side 54 of no more than about 2.25 inches and a maximum width (at the back side) of no more than about 0.75 inches. The leading edges of the wedges were set back from the leading edges of the corresponding rotatable blades by at least about ¼ to ½ inch. The spacing between the wedges was about 1½ inches. In use, the insertion of relatively large wooden limbs did not jam the rotating blades since the splitting wedges first split or cracked the limbs before their disintegration.

Referring now to FIGS. 3 and 5, scraper plates 58 are secured to underside 60 of at least some, i.e., the lower pair of opposing rotatable blades 43. The scraper plates depend vertically downward from blades 43, and have a sufficient length so that teeth 62 of the plates are just slightly above floor plate 32 when installed in chamber 38. Plates 58 are further offset with respect to the axis of rotation by one-half the pitch between teeth 62 so that the circles prescribed by the rotating teeth of one plate are aligned with the circles prescribed by rotating troughs 64 of the other plate. In this manner floor plate 32 is more thoroughly cleaned of debris and the formation of relatively deep grooves in the debris on the floor plate is prevented.

In operation, the downwardly extending scraper plates continuously sweep over floor plate 32 and prevent the accumulation of disintegrated debris. The plates move the debris over discharge opening 24 for removal from comminuting chamber 38. The vertical orientation of the plates with respect to cutting blades 43 assures a scraping action of the plates even if the debris is wet or forms a plastic substance so that the buildup of a wet debris-cake on the floor plate, resulting friction losses and possible damage to the rotatable blades are prevented.

Referring to FIGS. 1 and 2, drive mechanism 29 preferably comprises a hydraulic drive system 66 that derives its power from internal combustion engine 30. The hydraulic drive is defined by a pump 68 coupled to engine 30 and hydraulically connected via a four-way valve 70 to a hydraulic motor 72. The hydraulic motor is suitably mounted to a mounting bracket 74 which depends downwardly from support structure 10. A V-belt sheave 76 cooperates with sheave 48 and drives the latter via V-belts 28.

Valve 70 is a four-way valve with a neutral position (when the control member 78 is 45° from the position shown in FIG. 2) in which the fluid circuit between pump 68 and motor 72 is interrupted so that the motor, and therewith blade 42, cease to rotate even though engine 30 and pump 68 continue in operation. The four-way valve includes a control member 78 movable in a housing 80 and having passages 81, 82 which alternatively connect pressure line 84 from pump 68 with one of the hydraulic lines 86 or 88 to the motor. The other passage in member 78 fluidly connects the other one of the hydraulic motor lines with a return line 90 for recirculation of hydraulic fluid past a filter 92 into a tank or reservoir 94. A suction line 96 of pump 68 withdraws the hydraulic fluid from the reservoir.

Pump 68 and valve 70 are suitably mounted to support structure 10 with mounting posts and/or brackets and the valve includes an actuator such as handle 98 for placing it in its different operating modes. Conven-

tional high pressure hoses **100** are connected to the ports of the pump, the valve and the hydraulic motor to define the hydraulic lines schematically illustrated in FIG. **2**.

In use, internal combustion engine **30** is started and valve **70** is maintained in its neutral position until the comminuting operation is to begin. Thereafter, handle **98** is operated to actuate hydraulic motor for rotation in its normal direction. Should rotatable blades **42** become jammed, handle **98** of valve **70** is operated to reverse the direction of rotation of the hydraulic motor and to thus unjam the blade.

Although it is presently believed that best results are obtained when employing a hydraulic drive for transmitting the power from engine **30** to rotatable blades **42**, other drives which at least permit reversal of the direction of rotation of the blades and which preferably include a neutral position, can of course be employed. Thus, the hydraulic drive can be replaced with suitable gear trains, alone or in combination with clutches, and like drives should that be more desirable.

We claim:

1. Apparatus for disintegrating articles such as limbs comprising a housing mounted to a support structure and having a substantially inaccessible interior, a stationary blade set disposed in the interior, a rotatable blade set in the interior and axially spaced from the stationary set, a hydraulic motor mounted to the support structure for rotating the rotatable set, a source of a pressurized hydraulic fluid connected with the hydraulic motor, and means operatively disposed between the source and the motor for regulating the hydraulic fluid flow and thereby the hydraulic motor for controlling and changing the rotation of the rotatable set.

2. Apparatus according to claim **1** wherein the regulating means includes means for interrupting the fluid flow between the source and the motor for the de-activation of the motor independently of the source.

3. Apparatus according to claim **1** wherein the regulating means includes means for reversing the fluid flow through the motor to thereby reverse the direction of rotation of the rotatable set and facilitate the dislodging of objects within the housing without opening the housing.

4. Apparatus for comminuting waste products into relatively fine particles comprising:

a frame;

an upright hollow body defining an intake opening at the upper end, a discharge opening at the lower end, and floor means extending at least partially across a lower end of the body;

rotatably mounted cutting blades disposed above the floor means for contacting and comminuting the waste products;

motor means mounted to the frame and defining a power source for rotating the blades; and

drive means operatively connecting the motor means with the blades and including means for reversing the rotation of the blades independently of the motor means, and means for disengaging the connection between the motor means and the blades to alternatively permit the blades to remain stationary or to rotate while the motor means is operating.

5. Apparatus according to claim **4** including scraper means extending downwardly from at least a pair of blades for moving debris on the floor means towards the discharge opening, the scraper means comprising plates depending substantially perpendicularly downwardly from the blades.

6. Apparatus according to claim **5** wherein lower edges of the plates define scraper teeth, and wherein the teeth on one plate having a spacing from the axis of rotation of the blades which differs from the spacing of the teeth on the other plate.

7. Apparatus according to claim **4** including disintegrating wedges extending upwardly from at least a pair of blades, the wedges facing in the direction of rotation of the blades and being spaced over the length of the blades from adjacent the axis of rotation to adjacent an outer end of the blades.

8. Apparatus according to claim **7** wherein leading edges of the wedges are set back from leading edges of the blades.

9. Apparatus according to claim **7** wherein the leading edges of the wedges are defined by chisel edges, and wherein the wedges have a maximum width transverse to their direction of movement of no more than about 0.75 inches.

10. Apparatus according to claim **9** wherein the wedges have a height of no more than about one inch and an overall length, in the direction of their movement, of no more than about 2.25 inches.

11. Apparatus according to claim **4** wherein the drive means comprises a hydraulic drive.

12. Apparatus according to claim **11** wherein the means for reversing the direction of rotation and the means for disengaging comprises valve means disposed between a hydraulic pump and a hydraulic motor of the hydraulic drive for selectively reversing the fluid flow through the hydraulic motor and for selectively bypassing the fluid flow from the pump past the hydraulic motor to thereby reverse the direction of rotation of the blades and maintain them stationary, respectively, while the hydraulic pump continues to operate.

13. Apparatus for comminuting articles into small particles comprising: a frame, an upright housing mounted to the frame, cover means secured to the housing, the cover means including an intake chute communicating the housing interior with the exterior, the intake chute having a sufficient size for receiving the articles and permitting their passage into the housing while shielding the housing interior and preventing a person from accidentally reaching into the housing interior without first removing the cover, a floor member defining a lower end of the housing and including a discharge opening positioned on one side of the housing, a plurality of cutting blades rotatable about a substantially vertical axis, means mounting the blades within the housing, a plurality of splitting wedges arranged over at least one of the blades from adjacent the axis to an outer end of the blades, the wedges including a leading edge facing the direction of rotation of the blades set back from a leading edge of the blades and extending upwardly from the blades so that articles approaching the blades are first contacted and split by the wedges before their disintegration by the blade, and means for rotating the cutting blades so

that the insertion of articles through the intake chute means causes the comminuting of the articles and their discharge through the discharge opening.

14. A self-contained comminuting apparatus for the disintegration of articles into small, readily disposable particles comprising: a support structure, a disintegration chamber having a raised intake chute constructed to prevent direct access to the chamber interior and thereby shield an operator from injuries through contacts with parts and objects in the chamber while the apparatus is in operation, the chamber further including a discharge opening adjacent a lower end thereof, disintegrating blades rotatably mounted within the chamber for contacting and disintegrating articles received from the chute means, an internal combustion engine mounted to the structure for supplying the necessary power to rotate the blades, a hydraulic pump operated by the engine, a hydraulic motor mounted for rotating the blades, hydraulic lines for fluidly connecting the pump and the motor and passing pressurized fluid through the motor, and valve means interposed in the lines for reversing the fluid flow through the motor without affecting the operation of the pump, whereby the rotation of the blades can be reversed through operation of the valve means to clear objects jamming the blades without opening the chamber.

15. Apparatus according to claim 14 including means for selectively preventing the flow of pressurized fluid through the motor so that the blades can remain stationary while the engine continues to operate.

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