

[54] **NOVEL GRANULATING APPARATUS OF MODULATOR CONSTRUCTION**

[75] Inventors: **Donald R. Reynolds**, Cheshire; **James L. Young**, East Haven; **Robert N. Jones**, Wallingford, all of Conn.

[73] Assignee: **Entoleter, Inc.**, New Haven, Conn.

[22] Filed: **Aug. 18, 1971**

[21] Appl. No.: **172,713**

[52] U.S. Cl. **241/73, 241/100, 241/189 R, 241/191, 241/285 A, 241/285 B**

[51] Int. Cl. **B02c 18/06, B02c 13/13, B02c 18/44**

[58] Field of Search **241/73, 86, 88, 89, 241/100, 189 R, 191, 195, 285, 285 A, 285 B, 286, 86.1, 88.1, 88.2, 88.4, 89.3**

[56] **References Cited**

UNITED STATES PATENTS

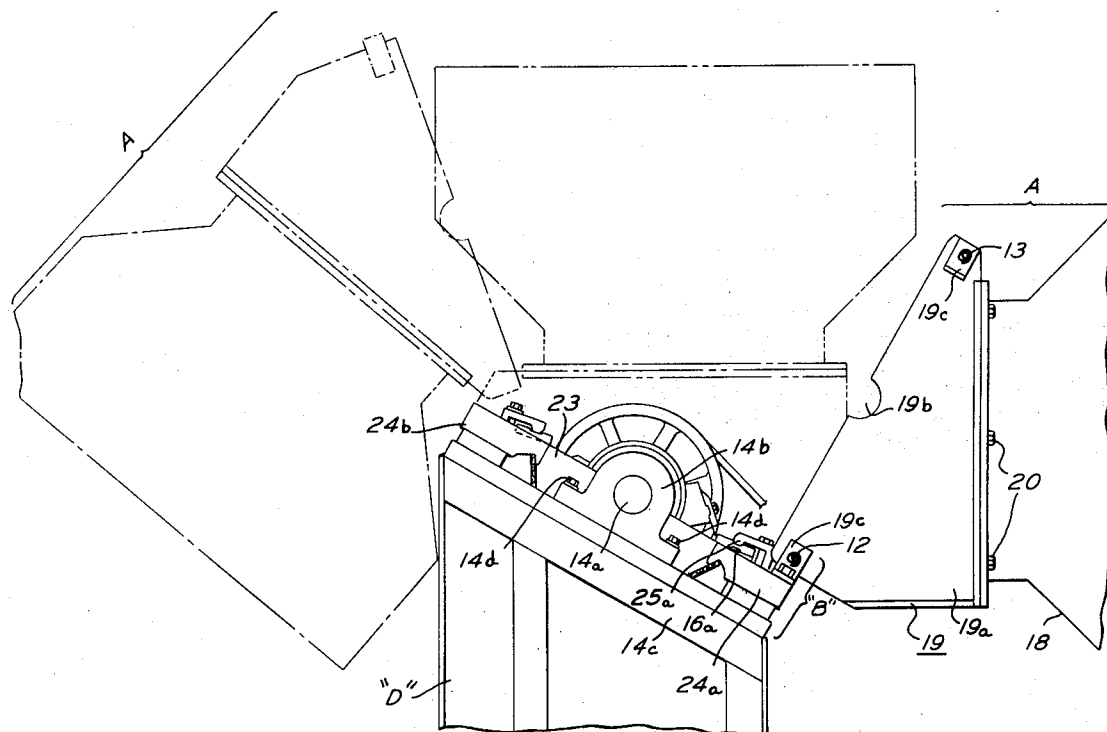
3,419,223	12/1968	Morin	241/73
2,490,564	12/1949	Vincent	241/191 X
2,593,657	4/1952	Coon	241/100 X
1,051,887	2/1913	Hiller	241/89 X
549,264	11/1895	Ball	241/73
1,847,990	3/1932	Stoner	241/73
3,360,204	12/1967	Merges	241/73
3,236,723	2/1966	Whiteside	241/191 X
133,111	11/1872	Mitchell	241/191

Primary Examiner—Donald G. Kelly
Attorney—Nelson E. Kimmelman

[57] **ABSTRACT**

A granulating machine of substantially modular construction. The hopper-input module includes baffles to prevent flyback of the material being granulated. This module is mounted pivotally at two opposite ends to a cutting module permitting it to pivot downward or upward away from the cutting module for easy access to the cutting rotor for maintenance or cleaning, for example. The cutting module includes a rotor of essentially tubular construction on which rotor-knives are mounted. The rotor itself is mounted on a base or frame to which multi-edged, stationary bed-knives are mounted without using bolts or screws. The multi-edged knives are capable of reorientation as the cutting edges become successively dulled. There is also a screen-mount module pivotally secured to the cutting module which includes a bend-free screen held in a cradle and clamped at two opposite ends by pressure elements bearing on it. The pivoting screen cradle permits access to the screen from above and to the under side of the rotor from below. Other features are described below.

16 Claims, 12 Drawing Figures



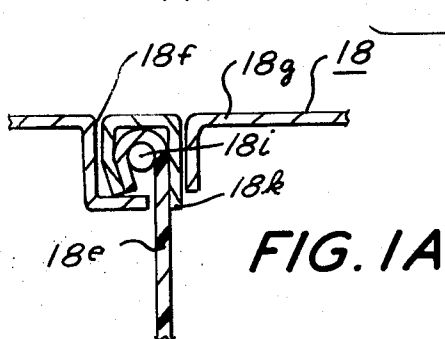
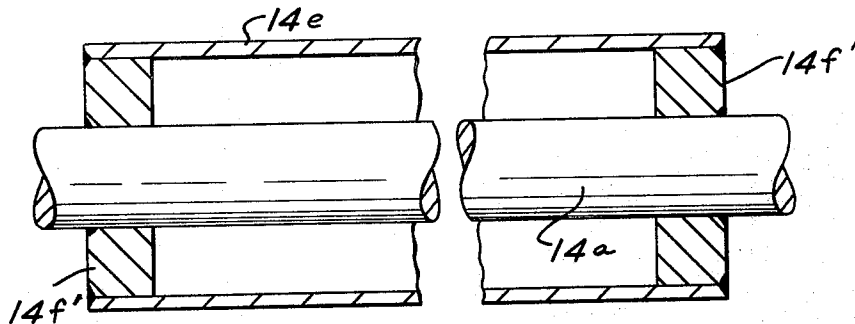
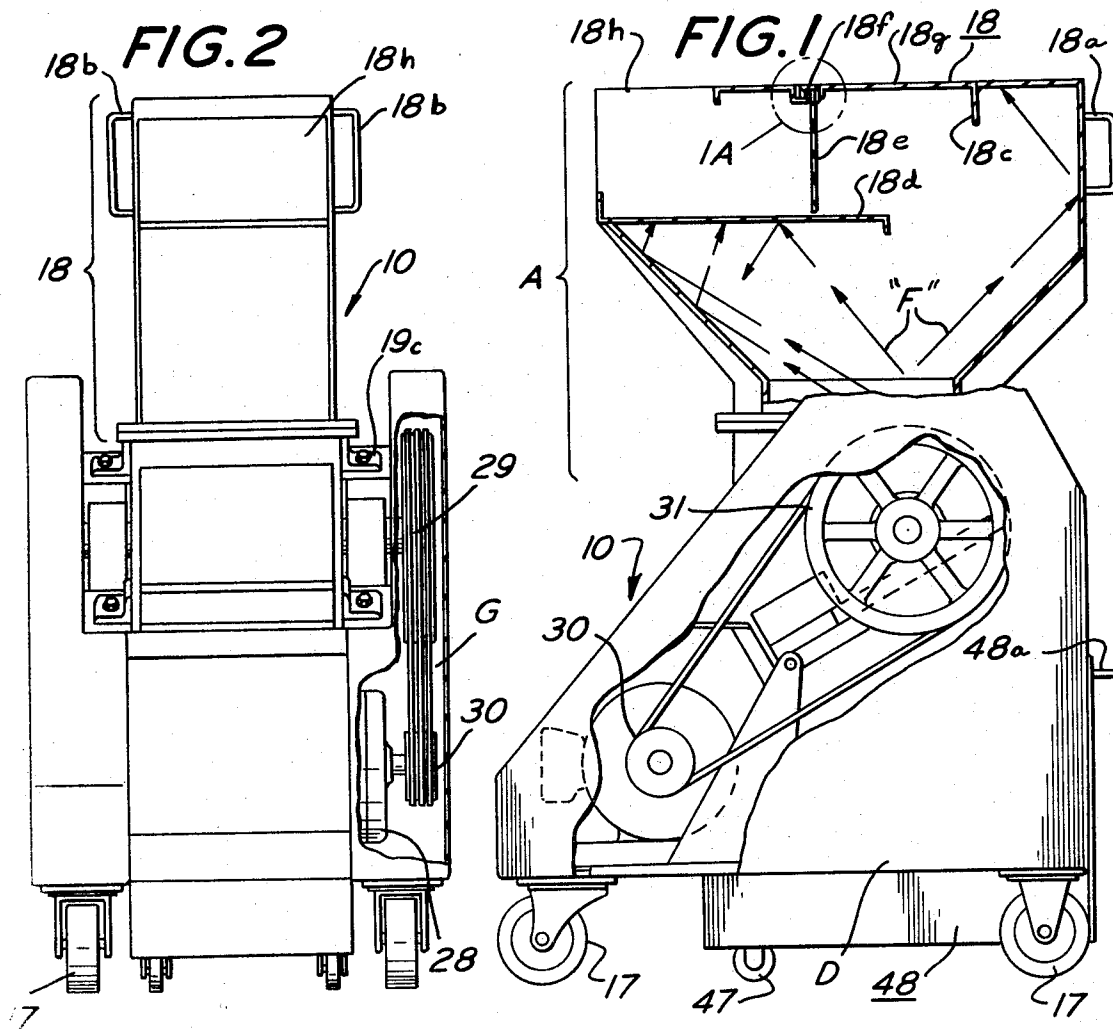
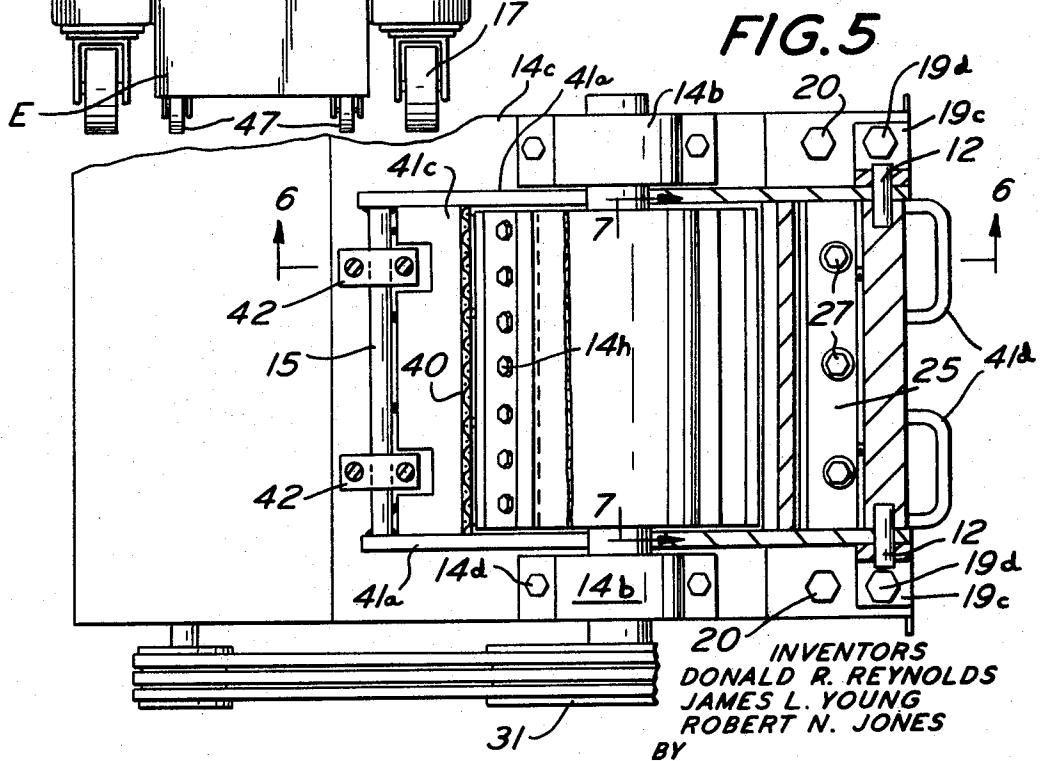
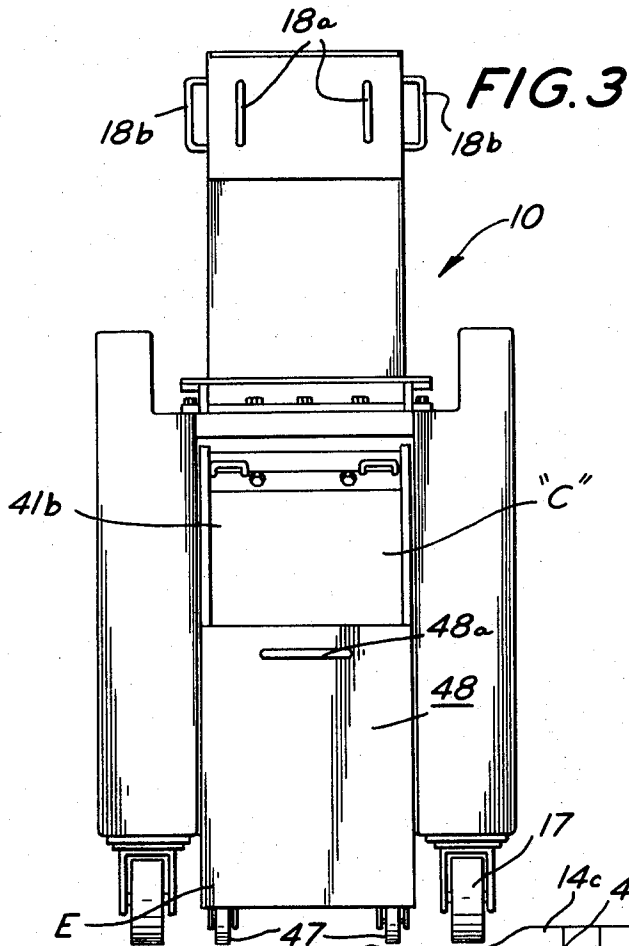


FIG. 7

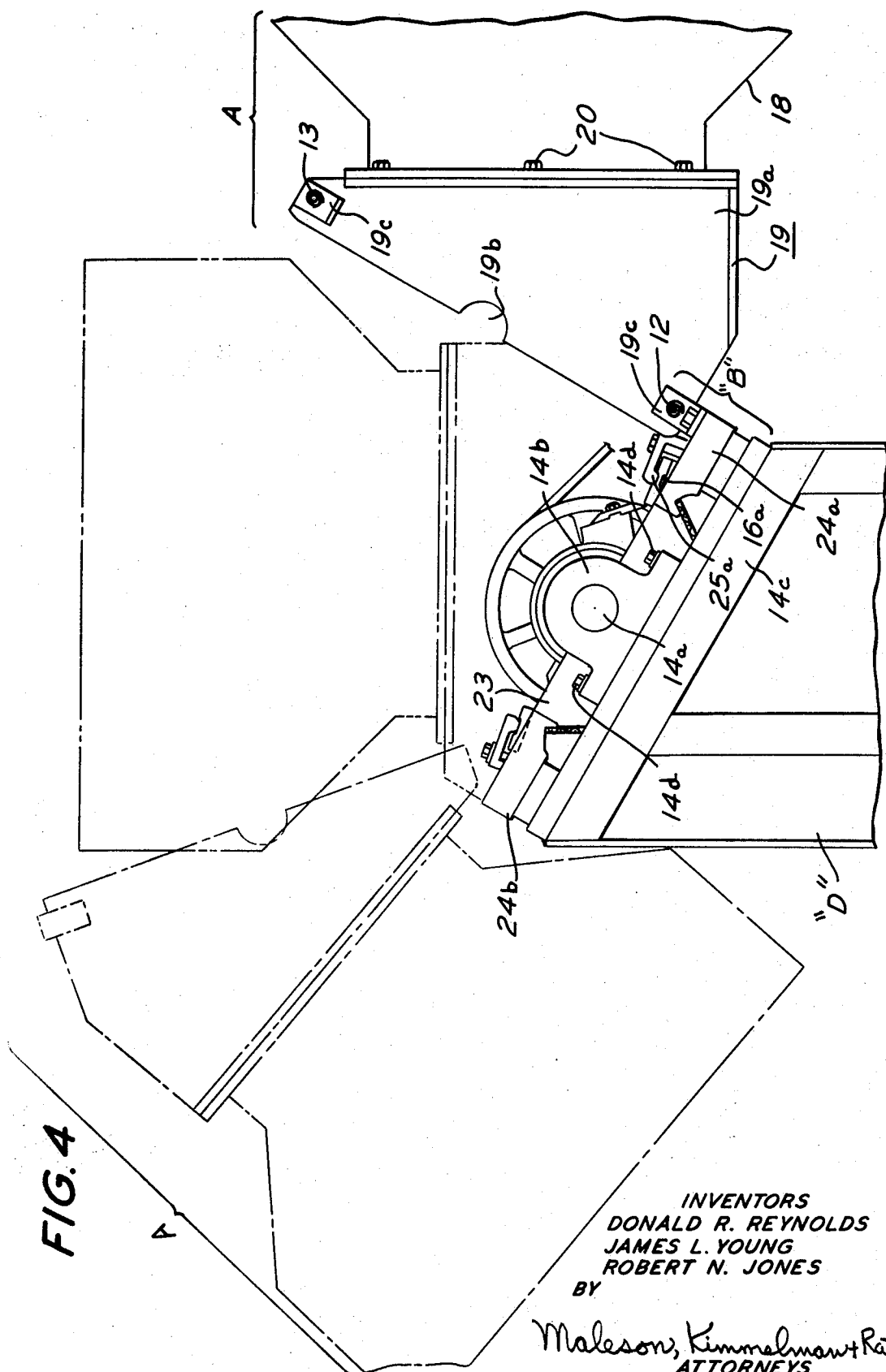
INVENTORS
DONALD R. REYNOLDS
JAMES L. YOUNG
ROBERT N. JONES

BY

Maleson, Kimmelman + Ratner
ATTORNEYS



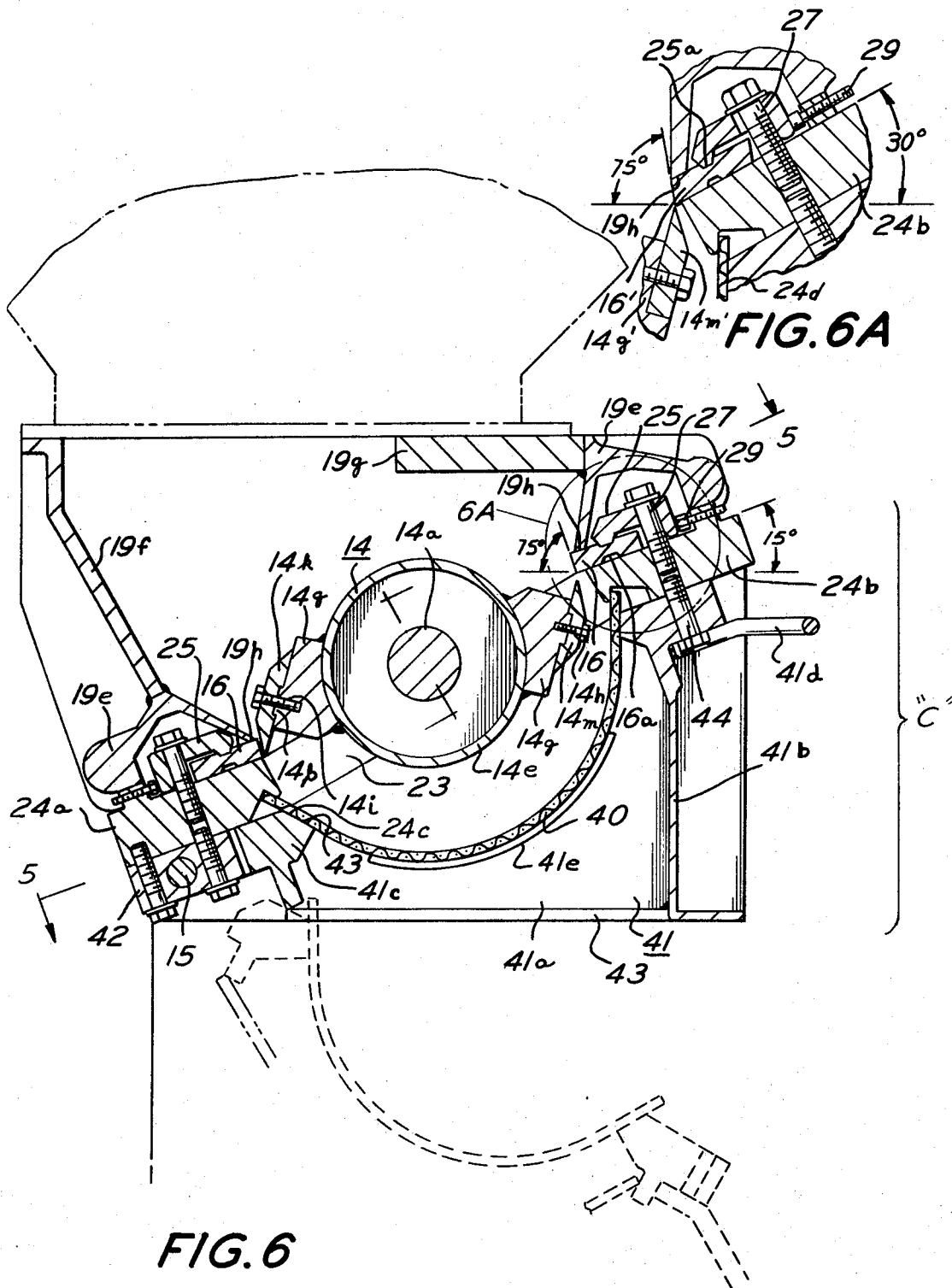
Maleson, Kimmelman & Ratner
ATTORNEYS



INVENTORS
DONALD R. REYNOLDS
JAMES L. YOUNG
ROBERT N. JONES

BY

Maleson, Kimmelmann & Ratner
ATTORNEYS



INVENTORS
 DONALD R. REYNOLDS
 JAMES L. YOUNG
 ROBERT N. JONES
 BY

Malsow, Kimmelmann & Ratner
 ATTORNEYS

FIG. 8

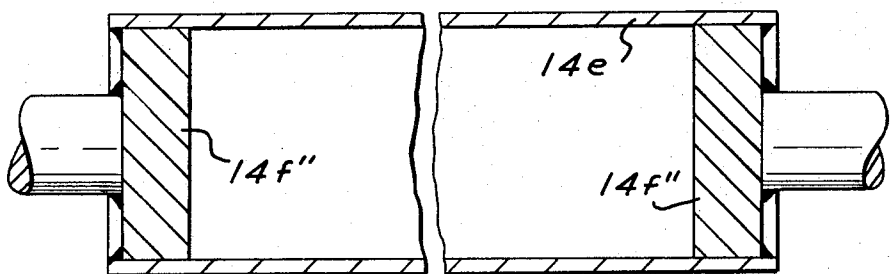
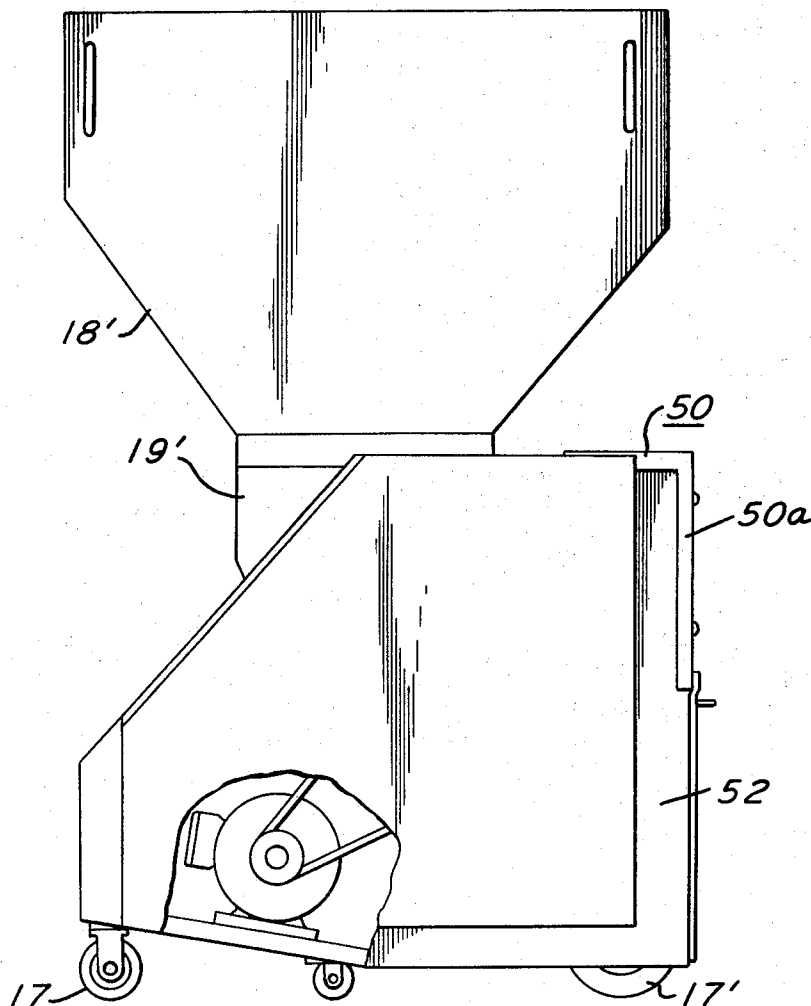
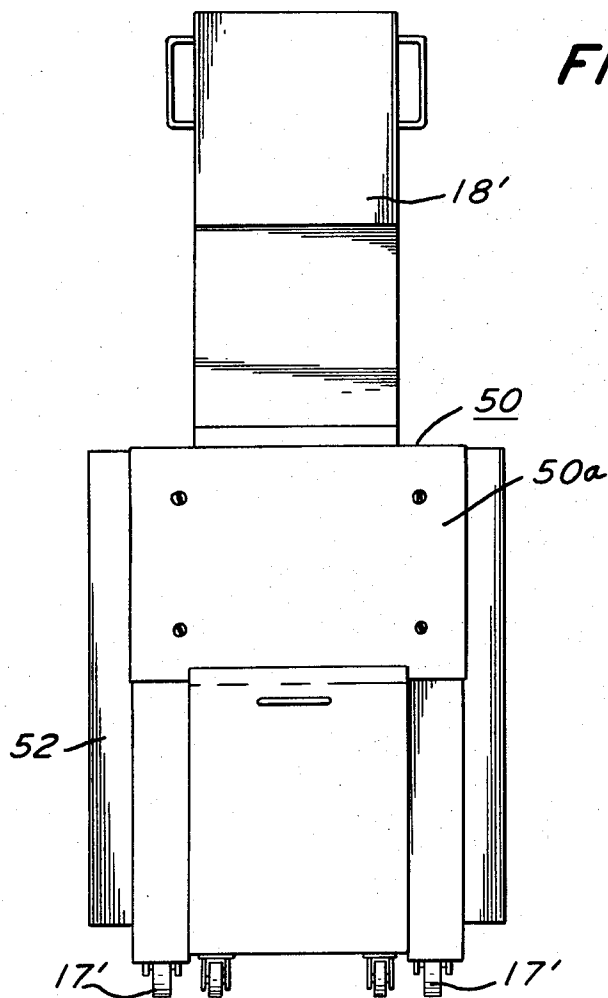


FIG. 7A

INVENTORS
DONALD R. REYNOLDS
JAMES L. YOUNG
ROBERT N. JONES

BY

Maleson, Kimmelman + Ratner
ATTORNEYS



INVENTORS
DONALD R. REYNOLDS
JAMES L. YOUNG
ROBERT N. JONES

BY

Moleson, Kimmelman + Ratner
ATTORNEYS

NOVEL GRANULATING APPARATUS OF MODULATOR CONSTRUCTION

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side-elevation, partly sectional and partly broken away, of one embodiment of the present invention.

FIG. 1A is an enlarged sectional view of part of the apparatus shown in FIG. 1.

FIG. 2 is a front elevation view, partly sectional and partly broken away of the embodiment shown in FIG. 1.

FIG. 3 is an elevation view of the apparatus shown in FIGS. 1 and 2, taken from the rear.

FIG. 4 is a fragmentary, side elevation view of the cutting module, the screen-mount module, the supporting frame showing the various positions that the input-hopper module may assume.

FIG. 5 is a fragmentary plan view, partly in section, taken along the section lines 5—5 in the direction indicated in FIG. 6.

FIG. 6 is a fragmentary, partly sectional and partly phantom representation of the input-hopper module, the chopping module and the screen-mount module taken along the section line 6—6 in FIG. 5.

FIG. 6A is an enlarged sectional view of a modification of the knives in the cutter module as pictured in FIG. 6.

FIG. 7 is a sectional view of part of one form of rotor used in the present invention.

FIG. 7A is a fragmentary sectional view of another form of rotor used in the present invention.

FIG. 8 is a side elevation view, partly broken away, of another form of the present invention.

FIG. 9 is a rear elevation view of the apparatus shown in FIG. 8.

DETAILED DESCRIPTION OF THE DRAWINGS—OVERALL ASSEMBLY

Referring now to FIGS. 1—6, one form of the novel granulator is indicated generally at the numeral 10. It comprises a top input-hopper module indicated generally within brackets at "A" (FIG. 1), a cutter module indicated generally at "B" (FIG. 4), a screen-mount module indicated generally at "C" (FIG. 6), a housing or frame indicated generally at "D" (FIG. 1) and a wheeled output bin indicated generally at "E" (FIG. 3). As may be seen, the hopper-input module A is mounted to the cutter module B and pivots either downward (clockwise as shown in full lines in FIG. 4) about pivot pins 12 or upward (counter-clockwise as shown at the left in FIG. 4 in phantom lines) about pins 13. In either position, the cutter module is exposed from the top for maintenance or cleaning. This feature is very useful where the machine is placed in a permanent position and cannot swing open in one of the two possible positions. If desired, counterweights may be added at the ends of the cutter module to assist in swinging it.

The cutter module B is of integral construction and includes rotor assembly 14 mounted thereupon and the bed knives 16. The cutter module may be removed as a unit from the entire machine by disconnecting it from the supporting frame or housing D.

The screen-mount module C includes screen 40 within screen cradle 41 and is releasably secured to the cutter module B at one end and pivotally mounted

thereto at the other end by pivot pin 15 (FIG. 6). This allows its upper end to swing down thereby affording access to the screen, the cradle, and the under side of the rotor assembly.

The bin E fits within the housing at the rear of the machine below the screen-mounted module. It is equipped with wheels 17 permitting the bin to be rolled away from the rest of the machine after a grinding operation has been completed. Power assembly "G" comprising a motor 28, belts 29 and sheaves 30 and 31 are disposed within housing D.

HOPPER-INPUT MODULE

The hopper-input module comprises an upper hopper section indicated generally at the numeral 18 (FIG. 2) having an inlet 18h and a lower input section 19 attached thereto by bolts 20, for example (FIG. 4), or by any other method such as welding. The input section 19 constitutes the top part of the cutting chamber when fastened in place above the rotor assembly.

The hopper includes two rear handles 18a and two side handles 18b to facilitate detachment or pivoting of the hopper-input module. Also within the upper portion 18a are a number of fixed baffles 18c and 18d positioned to prevent flyback of the material from the rotor in representative trajectories indicated schematically by the arrows designated by the letter "F." In addition, there is a removable Neoprene or other elastomeric flap of curtain 18e that may be inserted through a slot 18f formed in the top horizontal wall 18g of the hopper. The upper end of flap 18e is bent around rod 18i and retained in place by a metal channel 18k (FIG. 1A).

The lower input section 19 has two side walls 19a with aligned arcuate cut-outs 19b that fit over the shaft 14a of the rotor assembly 14 when the hopper-input A is fastened at both ends to the cutter module B. There are four L-shaped members 19c fastened to the outer ends of the two sets of pivot pins 12 and 13 respectively. The pivot pins 12 and 13 may be "roll pins" that are inserted in round passageways formed in the lower terminal portions 19e of section 19. These roll pins are generally spiral in cross section and have one tapered end. They are driven partially into the passageways and the inserted portions expand outwardly so that they are substantially non-rotatable within the passageways. The diameter of their ends protruding from the passageways is slightly smaller than the apertures in the L-shaped members 19c.

When the module A is attached to the cutter module B, bolts 19d are screwed through apertures in the bases of the L-shaped members 19c into threaded holes in the top screen retainer bars 24a and 24b. These bars are shown as being joined by lateral horizontal bars 23. One of these portions 19e is welded to descending wall portion 19f whereas the other, identical portion 19e is welded to a horizontal member 19g. Since they are identical, it is much cheaper to make the input section 19. As may be seen, each of these channel members 19e can be extruded and welded to the portions 19f and 19g respectively. Each channel member has a lower edge 19h which is contiguous with the top forward surface of the bed knives 16. These edge portions help to keep the input material within the rotor processing area since the rotor blades often hit the material above the bed knives.

CUTTER MODULE

The cutter module B, as previously stated, includes a tubular rotor assembly 14 mounted on a shaft 14a which is supported by bearing 14b mounted to the block 14c by means of, for example, bolts 14d. The sheave 31 is fixedly mounted on one end of the rotor shaft 14a. The rotor assembly also includes a tubular member 14e with discs 14f welded to its interior surface at both ends. The rotor shaft itself may be friction-welded to the discs which may themselves be friction-welded to the inner surface of tube 14e. Tube 14e may be standard steel tubing, if desired. The advantages of the present tubular rotor over conventional solid rotors are many. For a given mass, compared to a solid rotor, the moment of inertia is greater at the impact or cutting point. A solid rotor really adds nothing to the strength of the assembly since it actually must support itself. With the tubular rotor, there is less start-up horsepower required and in the steady state there is less frictional drag and wear on its bearings.

In FIG. 7 the shaft is shown passing through annuli 14f' and welded thereto. In FIG. 7a the shaft is in two parts, each projecting into and being welded to one of the discs 14f'.

Welded to the outer surface of tubular member 14e are two elongated knife seats 14g disposed at 180° with respect to one another. These seats contain a plurality of aligned threaded holes 14i which are engaged by bolts 14h which pass through corresponding holes in the rotor knives 14k. As shown in FIG. 6, the rotor knives are elongated, trapezoid-sectioned metallic members whose longer base edges have been sharpened. Longitudinal grooves 14p are formed in the base surfaces of the knives which mate with correspondingly shaped ridges 14m in the outer surfaces of the rotor knife seats 14g thereby helping to immobilize the rotor knives.

This rotor assembly is superior to conventional rotor assemblies because most of the weight is disposed in the knife seats toward the outside. The use of the double-edged rotor knives 14k enables significant manufacturing savings to be made and also enables quick replacement of any dulled rotor knife by simply reversing its position.

In conventional granulators, the bed or stationary knives often are formed with holes permitting retaining bolts to pass through them into threaded apertures. When holes are formed in such knives and they are then hardened, stresses are produced which reduce their overall strength. If the holes are to be formed after hardening, expensive drilling techniques such as electrical discharge techniques are required. In some cases, other conventional bed knives are merely surface-hardened and then holes are drilled, but this makes the cutting edges subject to premature attrition. In the present invention, it should be noted that the bed knives 16 and 16' have no holes or slots formed therein.

The bed knives 16 rest upon the upper surfaces of the screen-retaining bars 24a and 24b. As shown in FIG. 6, the bed knives 16 have a substantially rectangular cross section with two longitudinal grooves 16a formed therein. These grooves are engaged by the clamping effect of the lower edges 25a of top knife retainer channel members 25 which are bolted as shown to threaded apertures formed in the screen-retaining bars 24a and

24b. The only holes are in the channels 25 but they do not come into contact with the input material and are not subjected to direct impact shocks. The holes through which the bolts 27 pass may be made somewhat larger than the shanks of the bolts themselves to permit members 25 to be adjusted laterally to the desired spacing of the bed knife edges from the edges of the rotor knives. This may be done by loosening bolts 27 a little then turning the jack screws 29 with a wrench to change the position of its head, then re-tightening the bolts 27, making sure that the head of screw 29 bears upon the outside wall of channel 27.

The essentially rectangular-sectioned, square-edged bed knives 16 of FIG. 6 can be replaced by the parallel-gram-sectioned, angled-edged knives 16' shown in FIG. 6A. If so, it will be seen that the knives 16' will have two rather than four possible cutting edges.

These knives, as well as the bed knives 16 shown in FIG. 6 are disposed at an angle to the horizontal. Knives 16 are disposed at 30° and the angle of its front edge is at 75° to the horizontal. Knives 16 are disposed 15° to the horizontal with their front or cutting edges at 75° to the horizontal. Of course, the particular angles will depend on the shape of the bed knives, the geometry of the input section, etc.

FIG. 6A also shows an embodiment in which the rotor knives 14m' are substantially in the form of one longitudinal half of the two-edged rotor knives 14m shown in FIG. 6. Thus, they have only one cutting edge and they are bolted to a cut-out portion of the knife seat 14g' which does not have any ridge formed thereon.

SCREEN-MOUNT MODULE

Screen-mount module C includes a screen carrier or cradle indicated generally at the numeral 41. It contains sidewalls 41a and rear wall 41b as well as a forward pivoting frame portion 41c. The hinge rod 15 passes through two respectively aligned apertures in two blocks 42. The blocks 42, in turn, are bolted to threaded apertures formed in the underside of the top screen-retaining bar 24a. Two portions of the forward portion 41c are cut out to accommodate the blocks 42 as shown in FIG. 5. One of the angled surfaces 43 of the portion 41c supports the lower edge portion of the screen 40 from below as shown in FIG. 6. The sides of the screen are supported by two curved ridges 41e protruding inwardly from the side walls 41a.

When it is desired to gain access to the upper surface of the screen 40 or the lower side of the rotor assembly 14, the bolts 44 (FIG. 6) are unscrewed and the entire mount 41 is pivoted downward by the operator whose hands press down on handles 41d as shown in phantom in FIG. 6. When the handles are pressed down the forward section 41c also moves down and hinge rod 15 rotates. When the handles are moved up the screen moves to the left riding on the ridges 41e until it comes to its proper rest position. When the screen cradle is in place the forward section 41c closes off the screen and gives that subassembly strength. In its proper rest position, the screen, which has a continuously curved contour is secured at one end by the conjoint action of the lip 24c and the surface 43. Its other end is retained by the corresponding lip of member 24b and the corresponding surface 45.

The screens of conventional granulators have a longitudinal U-shaped cross-section and horizontal flanges

joined to each upper end. The screen are locked in place by clamps which engage both sides of the flanges. At the junctions of the flanged and curved portions, there are a number of inherent fatigue points. In such screens, recognition of the existence of these inherent weak regions has led to the absence of any apertures or to providing just a few apertures so as to strengthen these regions.

In the present invention the screen 40 does not have any bent, flat portions and as a result, there are no localized stress regions. Consequently more holes in the screen can be provided since a greater portion of the screen can be used for the screening process. Alternatively, even if there are the same number of holes or apertures, since more area is available, there can be more "land" between the holes. As a matter of fact, both the number of holes and the amount of intermediate land can be increased without appreciably reducing the overall strength of the screen.

REMOVABLE BIN

A removable bin E is shown which comprises an essentially box like container 48 mounted on four wheels 47 and having a handle 48a. The bin 48 is rolled under the opening 43 in the screen-mount cradle 41 so that the pieces which have been ground up and passed through the screen 40 may be removed from the machine. The entire machine apart from the bin is supplied with four wheels 17 to permit its being rolled to any place.

Conventional output hoppers in conventional granulators usually have output drawers which are removed when full. In those granulators, beneath the drawer there is a shelf on which a lot of debris collects and this enclosure, having a number of corners and being dark, is difficult to clean. In the present embodiments, there are no shelves below the bins so that whatever spills over the bin goes directly on the floor and can easily be cleaned, especially if the granulator is rolled to a different spot. By equipping the bins 48 with wheels, they can be parked temporarily on the side as soon as they are rolled out. A new one can then immediately be rolled under the apparatus. The bins can also be equipped with air pumps to permit air conveyance of the granulated material therein.

FIGS. 8 and 9

In FIG. 8, a slightly different embodiment is shown in which the rear wheels 17' are larger than the front wheels 17 and also the exterior wall 52 extends further down so as to partially cover the wheels 17'. Also, the lower edge of the hopper portion 18' does not include the flanges shown in FIGS. 1 and 2 which are at the junction of the hopper 18 with the input section 19'.

In the embodiment depicted in FIGS. 1-6, the motor is shown mounted in an essentially horizontal position. However, in FIGS. 8 and 9 the motor is shown mounted in a tilted fashion. This helps to keep the front-to-back dimension of the machine shorter. Furthermore, by tilting the floor on which the motor rests, there is no necessity for increasing the top-to-bottom dimensions to accommodate different motor sizes. Since the machine is relatively short and low, it is more economical of space which is an important factor in certain installations.

In FIGS. 8 and 9, there is a safety panel 50 across the back of the machine just above the bin handle. The

panel 50 is mounted to cooperate with an interlock (not shown) adjacent it on the inside which cuts off the power whenever the safety panel 50 is removed. It also helps to discourage unauthorized access to the bolts which retain the hopper and screen-mount modules in place. The panel 50 also includes vertical side ears 50a which prevent the sheave guards 52 from being removed unless the panel 50 is previously removed.

In the embodiment of FIG. 2 there is a guard around the sheave belt assembly G. The cover on the opposite side may be used to house, if desired, an optional flywheel mounted on the rotor shaft. The flywheel does increase the torsion effects, but does not lead to bending of the rotor shaft. If no such flywheel is mounted, the housing on the other side of the rotor may be used for installing sound-proofing material.

GENERAL REMARKS

It may be seen that the forms of invention described herein have many convenience and safety factors. By providing that the cutter or rotor module is essentially independent, it can be disposed at any angle on any type of frame. Furthermore, being independent, it may more easily be insulated from the lower frame on which it rests with respect to vibration and noise. This may be accomplished simply by inserting rubber or other elastomeric gaskets between the cutter module and the frame. As illustrated, the cutter module is also stronger since it is not dependent upon the supporting frame for bearing support. This type of construction can be adapted for use for many different purposes, i.e., in other types of mills such as hammer-mills, cage mills, ring mills, breaker mills, etc.

The construction of the novel apparatus also enables the reversal (back to front and vice versa) of the hopper-input and cutter modules and the direction of rotation of the rotor can be changed accordingly.

We claim:

1. Apparatus comprising:

a. an input section to which materials to be processed are applied,

b. a rotor module adjacent said input section, said input section being pivotally connected at both ends to said rotor module, said rotor module including a supporting base, bearings for a rotor mounted to said base, and a rotor supported by said bearings, and

c. a frame to which said rotor module is releasably secured, said rotor module also being releasably connected to said input section.

2. The apparatus according to claim 1 wherein said rotor comprises a unitary tube having a substantially hollow inner portion to whose outer surface a plurality of cutter knives are mounted at spaced intervals thereon.

3. The apparatus according to claim 2 wherein said cutter knives are double-edges and bolted to heavy elongated knife seats that are welded to the outside surface of said tube.

4. The apparatus according to claim 3 wherein said knives have a trapezoidal cross-section and longitudinal grooves in their bases and wherein said knife seats have corresponding mating ridges formed in their outer surfaces.

5. Comminuting apparatus or the like comprising:

a. a hopper-input module,

- b. a cutter module, said hopper-input module being pivotally connected to said cutter module at two opposite points, and
- c. a screen-mount module pivotally connected to said cutter module at least one point, said screen being 5 fixedly mounted to prevent axial movement by clamping means at both ends thereof.
6. The apparatus according to claim 5 wherein said screen-mount module is disposed generally below said cutter module and includes a cradle carrying said 10 screen which pivots downwardly from said cutter module thereby affording access to the underside of said cutter module.
7. The apparatus according to claim 5 wherein said cutter module includes a rotor comprising a unitary 15 tube whose central portion is generally hollow and a plurality of cutter knives connected to the outer surface of said tube.
8. The apparatus according to claim 7 wherein said cutter module includes at least one stationary bed knife 20 which is unperforated.
9. The apparatus according to claim 8 wherein said stationary knife is mounted solely by clamping means.
10. The apparatus according to claim 5 wherein said hopper-input module is pivotally mounted to said cut- 25

ter module at two points.

11. The apparatus according to claim 5 with the addition of a container disposed to receive material processed by said cutter module, said container being constructed to roll into said apparatus to a position adjacent said cutter module or away therefrom.

12. The apparatus according to claim 8 wherein said stationary knife has a plurality of cutting edges.

13. The apparatus according to claim 12 wherein the transverse cross-section of said knife is shaped like a parallelogram.

14. The apparatus according to claim 13 wherein said knife has at least one groove running longitudinally thereof adapted to be engaged by a clamp member.

15. The apparatus according to claim 7 wherein said rotor comprises a plurality of heavy knife seats affixed to the surface of said tube and said plurality of knives are affixed to said knife seats.

16. The apparatus according to claim 9 wherein said hopper-input module has at least one lower portion constructed to convey the input material toward said cutter module, said lower portion also shielding said clamping means and portions of said stationary knife from impact with input material.

* * * * *

30

35

40

45

50

55

60

65