Dec. 21, 1965 R. E. BEITER 3,224,688

SHREDDER

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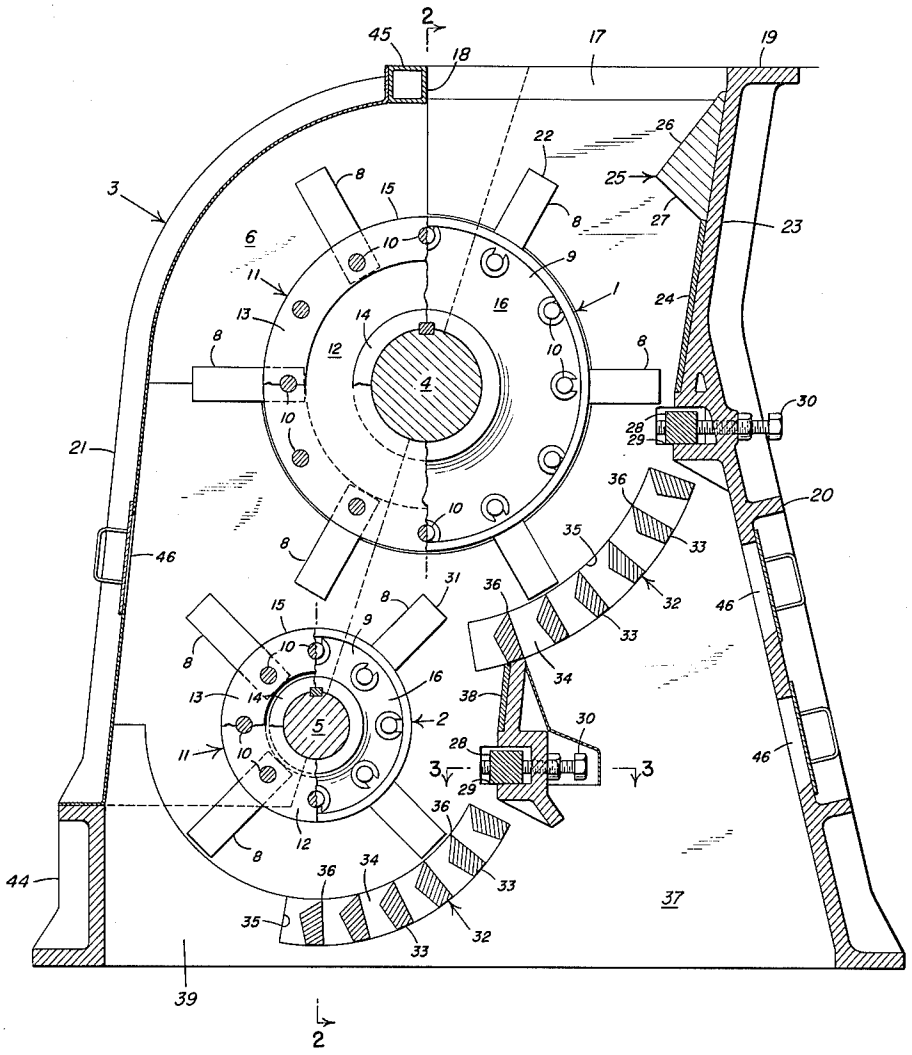


FIG. 1

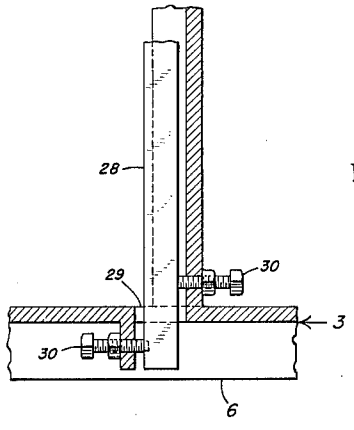


FIG. 3

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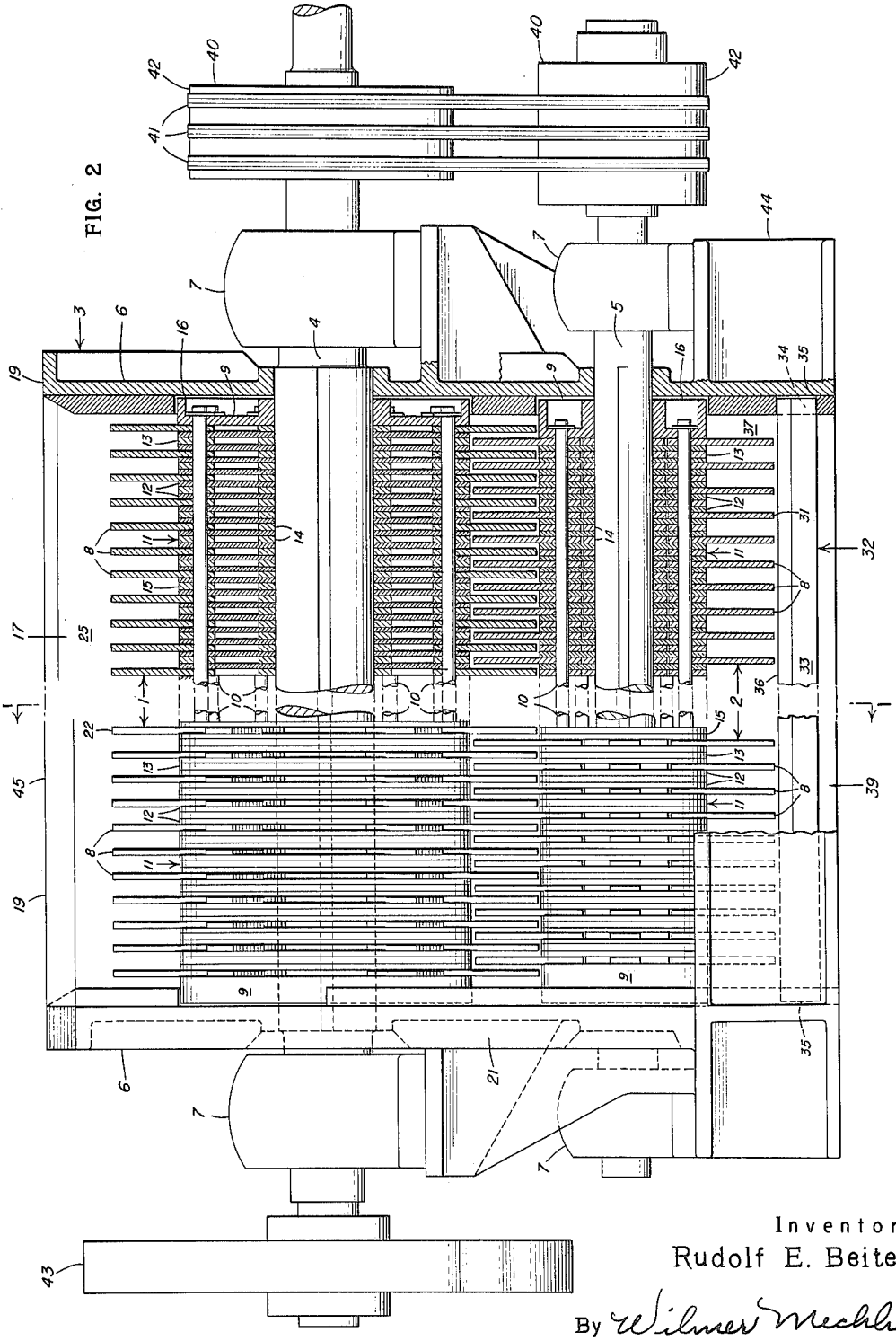
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SHREDDER

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FIG. 2



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3,224,688

SHREDDER

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This invention relates to shredders for shredding fibrous material and particularly sugar cane and like fibrous plants.

In the manufacture of sugar, it has long been the practice to shred the sugar cane at some stage in the extraction of juice from it, usually after the cane stalks have been crushed to reduce them to ribbons and in process release a large portion of the juice contained in their cellular structures. The shredding itself usually precedes pressing and macerating operations by which substantially all of the remaining juice is extracted from the cane. The cellular structure of the cane stalks is such that the juice can readily move longitudinally but can move laterally only by diffusion through the cell walls and even diffusion is difficult through the relatively less porous walls of the rind sheating the pith forming the central portion of a stalk. It thus is necessary for maximum extraction of juice that both the rind and the pith be disintegrated to divide the fibrous material laterally substantially into its individual fibers and so present the juice-containing cells in a form which readily adapts them to rupture by pressing and, by the decrease in the intervening wall thickness and increase in exposed surface area, greatly facilitates extraction by diffusion. It is this disintegration for which the shredder is responsible.

Whatever its position in the processing line, the conventional shredder has a single rotary member enclosed in a casing and pivotally mounting a plurality of hammers or beaters which, by beating or flailing the cane delivered to the shredder against an anvil screen or grate formed of a plurality of circumferentially spaced bars disposed parallel to the rotative axis of the member, shred or disintegrate the cane laterally substantially into its individual fibers. Although effective in performing its intended function on the cane on which it acts, the conventional shredder has been found deficient in its inability to prevent part of the cane fed to it from being caught between the hammers of its single rotary member, there to interfere with the pivotal movement of the hammers and, if freed by centrifugal force abreast the usual discharge opening for foreign matter beyond the screen, being discharged from the shredder in its initial unshredded condition.

The primary object of the present invention is to correct the above deficiency in conventional shredders by providing an improved shredder wherein any cane caught between the hammers is effectively removed therefrom, thereby preventing interference with action of the hammers and ensuring that all of the cane is shredded before it is discharged.

Another object of the invention is to provide an improved shredder having not one but a plurality of hammer-carrying rotary members, each with its own anvil screen, the members being arranged in intermeshing relation for combing out and subjecting to shredding any cane that may be caught between the hammers.

An additional object of the invention is to provide an improved shredder having main and auxiliary beater members, each with its own anvil screen, the members being so arranged in intermeshing relation that cane initially is presented for action by the main member and

any caught between the hammers of that member is combed therefrom and shredded by the second member.

Other objects and advantages of the invention will appear hereinafter in the detailed description, be particularly pointed out in the appended claims and be illustrated in the accompanying drawings in which:

FIGURE 1 is a vertical sectional view of a preferred embodiment of the shredder of the present invention taken along lines 1—1 of FIGURE 2;

FIGURE 2 is a view of the shredder of FIGURE 1, partly in front elevation with the cover removed and partly in a vertical section taken along lines 2—2 of FIGURE 1; and

FIGURE 3 is a fragmentary horizontal sectional view taken along lines 3—3 of FIGURE 1.

Referring now in detail to the drawings in which like reference characters designate like parts, the improved shredder of the present invention, while adapted for shredding other fibrous plant material, is particularly designed for use in shredding sugar cane in the manufacture of sugar. Like the conventional shredder, the improved shredder is enabled to be positioned at any desired point in the manufacturing line and to shred cane whether or not the latter has previously been crushed, but will ordinarily be positioned following the crusher for shredding the crushed cane before extraction of the sucrose from the portion of the juice remaining in the cane after the crushing operation. The improved shredder, as well, is designed to facilitate the subsequent extraction of the juice by dividing the cane substantially into its individual fibers, but with the advantage over a conventional shredder that the shredding of its entire output is assured.

In its preferred form, the improved shredder is comprised of a pair or plurality of rotary beater members, one a main or primary member 1 and the other an auxiliary, secondary or supplementary member 2. The main and auxiliary beater members 1 and 2 are mounted for rotation about parallel axes in a casing or housing 3, their shafts or axles 4 and 5, respectively, for the purpose extending or projecting through the transversely spaced opposite sides or side walls 6 of the casing and being journaled in roller or like suitable journal bearings 7, each conveniently mounted exteriorly of the casing on one of the sides.

Mounted abreast, one above the other or in superimposed relation, with the main beater member 1 uppermost, the rotary members 1 and 2 are arranged in series or sequence for sequentially or successively engaging the fibrous material fed into the housing 3 and depend for beating the sugar cane on pivoted hammers or beaters 8, preferably in the form of flat plates of rectangular or other suitable shape. The hammers of each of the rotary members conveniently may be arranged in axially extending rows of a plurality of hammers each, with the rows spaced uniformly circumferentially of or about the member's shaft 4 or 5 and the hammers of the several row uniformly spaced and correspondingly disposed axially of the shaft such that each is coplanar or alnged transversely with the corresponding hammers of the other rows. With the axial spacing between adjoining hammers 8 the same for both members and sufficient to loosely receive or accommodate a hammer therebetween, the hammers of the two members are staggered or offset laterally or axially relative to each other, such that those of one member are aligned with the spacings or openings between the hammers of the other member. So arranged and with the transverse, lateral or radial spacing between the axes of the members gauged to provide a substantial transverse or radial overlap between their hammers, the hammers of each member will in-

termesh with or fit between those of the other and this intermeshing relation between the members will obtain regardless of their relative speeds or directions of rotation.

Except that the auxiliary rotary member **2** ordinarily will be of less diameter and have a lesser number of rows of hammers than the main rotary member **1**, the members may be of the same "built-up" construction. Thus, as in the illustrated embodiment, each rotary member may have a pair of axially spaced end discs or plates **9**, each keyed or otherwise fixed against relative rotation to the related shaft **4** or **5** and disposed adjacent one of the opposite sides **6** of the casing **3** and the end discs may be connected by a plurality of rods **10** extending axially of its shaft and spaced uniformly radially from and circumferentially of or about the shaft. While each of the connecting rods **10** may pivotally mount a row of the hammers **8**, it is preferred that only alternate rods perform this function, the intervening rods in such case serving to strengthen the member.

The hammers readily are pivotally mounted in rows on the rods by aperturing the hammers adjacent their inner ends to receive the rods and the desired uniform axial spacing between the hammers may be derived, as illustrated, from spacers **11** alternating with the hammers and each in the form of a pair of spacer discs **12** and an interposed or intercalated annular element or ring **13**. The spacing between the spacers adjacent the shaft is maintained by a set of washers **14** encircling the shaft. Not only is this construction simple and effective, but it enables the rods **10** and hammers **8** of the two members to be interchanged and their remaining components to determine their outside and inside diameters.

Extending across the rotary members **1** and **2** between their end discs **9**, the hammers of the members are so intermeshed that those of each are adapted to project or extend radially between the hammers of the other substantially to or adjacent the rim or periphery **15** of the latter's hub or central portion **16** formed by its several discs **9** and **12**. As a consequence, each of the rotary members and particularly the auxiliary member **2** is enabled to clean, sweep or comb from the other any cane that may have become enmeshed in or entrapped between the latter's hammers. This self-cleaning action of the shredder, in conjunction with the anvil arrangement hereafter to be described, ensures that the action of the several hammers **8** will not be interfered with and that any cane discharged from the shredder will have been disintegrated by subjection to that action.

The main rotary member **1** is positioned or disposed in the upper portion of the casing **3** below an upwardly opening feed opening or inlet **17** in and extending substantially across the top or top wall **19** of the casing, preferably with its axis in substantial vertical alignment with the rear end or boundary **18** of the opening so as to present thereto its upper front quadrant. To accommodate or house the rotary members, the casing preferably has its front and rear walls **20** and **21**, respectively, diverging downwardly below the rotary axis of the main member **1** with the rear wall above that axis spaced from but curved substantially in correspondence or conformance with the periphery **22** of the main member of which the outer extremities of its hammers **8** are determinative. The front wall **20** of the casing over its upper portion **23**, in turn, slopes or is inclined downwardly and rearwardly toward and terminates downwardly forwardly of but adjacent the periphery **22** of the main member. Desirably fitted over the inner face of its lower part with a hard brass or like wear-resistant wear plate **24**, the upper portion **23** of the front wall **20** carries, mounts or has fixed to it above the wear plate an instanding or rearwardly projecting deflector block **25** extending across the casing anr having angularly related upper and lower faces **26** and **27**, of which the upper is inclined downwardly and rearwardly toward the upper front quadrant of the main rotary member and the lower is directed and preferably inclined downwardly and forwardly toward the front wall. With the main rotary member **1** rotating clockwise, as viewed in FIGURE 1, cane, as it enters the feed opening **18**, is deflected or directed toward that member by the upper face **26** of the deflector block **25** and, on engagement with the hammers of that member, is carried downwardly and forwardly thereby toward the lower part of the upper portion **23** of the front wall **20**, with any cane that, under the centrifugal force of the hammers might otherwise interfere with the feed, blocked from such interference and deflected downwardly by the lower face **27** of the deflector block.

The progressively narrowing passage for the cane provided between the periphery **22** of the main rotary member and the upper portion **23** of the front wall **20** of the casing is designed to direct the cane to an upper of a pair of anvil bars **28** of rectangular or other suitable cross-section, each in and extending across the casing **3** vertically adjacent but below the axis or horizontal center plane of one of the rotary members and slidable transversely, horizontally or longitudinally of the casing, to vary its spacing relative to the related member, in a suitable slide or guideway **29** fixed to the casing. Insertable into their guideways **29** through one of the side walls **6** of the casing, the anvil bars **28** are settable or adjustable in their spacing relative to the related of the rotary members **1** and **2** by suitable means, such as the illustrated back-up screws or bolts **30**, which for ready adjustment are made accessible from outside the casing, those for the upper bar by extending them through the front wall **20** and those for the lower by mounting each exteriorly on one of the casing's side walls.

Disposed beyond each anvil bar along the periphery **22** of the main member or **31** of the auxiliary member is an anvil screen or grate **32**. Having an arcuately concave inner or member-confronting face substantially concentric with and curved in correspondence to the periphery of the related of the rotary members, each of the anvil screens **32** preferably is formed in the conventional manner of a plurality of circumferentially or transversely spaced screen or grate bars or cutters **33** extending across the casing **3** substantially parallel to the axis of the related rotary member and fixed at their ends, as by forming them integrally with end pieces **34** seated in seats or slots **35** in the side walls **6**. With their screen or cutter bars **33** provided with leading cutting edges **36** to assist in disintegrating the cane and the spacing between the bars such that the cane after disintegration will drop therethrough into the lower part **37** of the casing, the upper and lower anvil screens **32** are arranged in general in tandem relative to each other and have interposed therebetween a hard brass or like surfaced guide plate **38** which is anchored or fixed at its ends to the sides **6** of the casing. The guide plate connects to and is disposed below the trailing or last of the cutters **33** of the upper anvil screen and is rearwardly and downwardly inclined or sloped to lead therefrom downwardly toward the anvil bar **28** and following anvil screen **32** of the auxiliary rotary member **2**. Extending from the front wall **20** beneath the rotary members toward the rear wall **21** and defining with the latter the longitudinal or front and rear bounds of a discharge opening **39** disposed below the lower rear quadrant of the auxiliary member **2** for passing pieces of metal or other foreign matter which may have been fed into the shredder with the cane, the anvil bars and screens **28** and **32** and the intervening or interposed guide plate **38**, effectively separate the rotary members from the open lower or bottom part **37** of the casing, except over the area of the discharge opening.

While the rotary members **1** and **2** might rotate in opposite directions, it is preferred that they rotate in the same direction, clockwise as viewed in FIGURE 1, to take advantage of the consequent opposed forces in the area in

which the members intermesh, of the there oppositely moving hammers in cleaning out any cane enmeshed in hammers of either member. The preferred unidirectional rotation of the members also gives purpose to the anvil bars, the disposition of each below but adjacent the axis or horizontal center plane of its member enabling the downward force of the hammers of each member to be availed of for beating the cane against each anvil bar at substantially the point at which that force is at maximum and the adjustability in the spacing of the anvil bars relative to the peripheries of the members determining the extent to which the cane is initially shredded. By periodically adjusting the spacing between the anvil bars and the rotary members to compensate for wear, it therefore is possible to relieve the screen bars 33 of the harder part of the shredding and correspondingly increase the efficiency and service life of the screens 32.

To enable the anvil bars 28 to bear the brunt of the force of the hammers 8, it is, of course, necessary that, relative to the direction in which its member 1 or 2 rotates, each anvil bar be disposed in advance of the related screen 32. For the clockwise rotation of the rotary members of the illustrated embodiment, this in turn requires that each screen be disposed below and project rearwardly of the related anvil bar and subtend or extend along the periphery of its rotary member over at least part of the lower front quardant of the member. Also, since it is primarily in the hammers 8 of the main member 1 that cane will become enmeshed as it is fed into the shredder and almost entirely such cane that will be disintegrated by the auxiliary member 2, it is desirable that the axis of the auxiliary member be disposed rearwardly of the axis of and below the main member so that the centrifugal force on the loosened or dislodged cane will principally be that exerted by the auxiliary member, with the consequence that such cane will be thrown forwardly by that member toward the guide plate 38.

With the rotary members 1 and 2 intermeshed such that the hammers of each will sweep from the other any cane entrapped therebetween and the bottom part 37 of the casing closed below the rotary members by the anvil screens 32 and related structures, except for the discharge opening 39 between the trailing end of the lower screen and the rear wall 21 of the casing, any cane entering the casing can pass therefrom ony through the screens and, since it can only pass therethrough after it has been disintegrated, all cane, as it is discharged from the casing, is in a disintegrated condition. At the same time, the combing of each rotary member by the other prevents any cane, which in the conventional shredder is readily entrapped in the hammers of its single rotary member, from interfering with the pivoting of the hammers.

The rotary members 1 and 2 may be driven individually but, since rotating in the same direction, conveniently are driven by a single electric motor or like drive (not shown) connected to the shaft 4 of the main member. The shaft 4 in turn is drivably connected to the shaft 5 of the auxiliary member preferably by means by which their relative speeds can be varied as needed for most efficient shredding, a driving connection particularly suited for the purpose being the illustrated multi-sheaved pulleys 40 connected by a plurality of V-belts 41 and having their sheaves 42 adjustable to vary the axial spacing therebetween. Steadied by a flywheel 43 on its shaft 4, the main rotary member may be driven at a speed of around 1200 r.p.m., comparable to that of the single rotary member of the conventional shredder. The auxiliary rotary member 2, on the other hand, will usually be driven at a higher speed, for example 2300 r.p.m., particularly if, as in the illustrated embodiment, its diameter is less than that of the main member.

For ready assembly and maintenance, it is preferred that the sides 6 of the casing be dividable or separable along a line intersecting the axes of the two rotary members and that the rear wall 21, from the base 44 of the casing upwardly to the cross member 45 bounding the rear end of the feed opening 17, be removable as a unit. It also will be found advantageous to provide in the front and rear walls 20 and 21 a plurality of normally covered inspection holes 46 through which the operation and condition of the shredder can be observed.

From the above detailed description, it will be apparent that there has been provided an improved shredder which, unlike conventional shredders, is self-cleaning and ensures the shredding of all of the cane fed to it. It should be understood that the described and disclosed embodiment is merely exemplary of the invention and that all modifications are intended to be included that do not depart from the spirit of the invention or the scope of the appended claims.

Having described my invention, I claim:

1. A shredder for shredding fibrous material comprising a pair of rotary beater members mounted for rotation in the same direction about parallel axes and arranged in series for sequentially engaging material fed to said shredder, each of said members having a hub portion and a plurality of beaters pivoted to and projecting substantially radially from said hub portion and axially staggered relative to and intermeshing with beaters of the other member for removing material caught between the beaters of either member, and an anvil bar and a plurality of cutter bars for each of said members, each of said bars extending substantially parallel to the axis of its member, and said bars of each member being arranged in circumferentially spaced relation along a periphery thereof with the anvil bar in the lead.

2. A shredder for shredding fibrous material comprising a pair of rotary beater members mounted for rotation in the same direction about parallel axes and arranged in series for sequentially engaging material fed to said shredder, each of said members having a hub portion and a plurality of beaters pivoted to and projecting substantially radially from said hub portion and axially staggered relative to and intermeshing with beaters of the other member for removing material caught between the beaters of either member, and a transversely adjustable anvil bar and a plurality of fixed cutter bars for each of said members, each of said bars extending longitudinally substantially parallel to the axis of its member, and said bars of each member being arranged in circumferentially spaced relation along a periphery thereof with the anvil bar in the lead.

3. A shredder for shredding fibrous material comprising a casing, a pair of rotary beater members mounted in said casing for rotation in the same direction about parallel axes and arranged in series for sequentially engaging material fed to said shredder, each of said members having a plurality of pivoted beaters projecting substantially radially from its axis and axially staggered relative to and intermeshing with beaters of the other member for removing material caught between the beaters of either member, and an anvil bar and a plurality of cutter bars in said casing for each of said members, each of said bars extending longitudinally substantially parallel to the axis of its member, said bars of each member being arranged in circumferentially spaced relation along a periphery thereof with the anvil bar in the lead, and means for adjusting the spacing between each anvil bar and the periphery of its member.

4. A shredder for shredding fibrous material comprising a casing, a pair of rotary beater members mounted in said casing for rotation in the same direction about parallel axes and arranged in series for sequentially engaging material fed to said shredder, each of said members having a plurality of pivoted beaters projecting substantially radially from the axis thereof and axially staggered relative to and intermeshing with beaters of said other member for removing material caught between the beaters of either member, anvil means extending along a periphery

of each of said members, and means for varying the relative speeds of rotation of said members.

5. A shredder for shredding fibrous material comprising a casing, main and auxiliary rotary members mounted respectively in upper and lower portions of said casing for rotation in the same direction about parallel axes, each of said members having a plurality of pivoted beaters projecting radially from the axis thereof and axially staggered relative to and intermeshing with beaters of the other member for removing material caught between the beaters of either member, said casing having a feed opening opening downwardly onto an upper front quadrant of said main member and a discharge opening for foreign matter opening downwardly from a lower rear quadrant of said auxiliary member, and means extending from a front wall of said casing below the axis of said main member to said discharge opening, said means including for each member an anvil bar adjustable horizontally relative to the axis of its member, and a plurality of fixed cutter bars, said bars of each member each extending substantially parallel to the axis thereof and together being disposed in circumferentially spaced relation along the periphery of the member with the anvil bar in the lead, and guide means leading from a trailing cutter bar of said main member toward the anvil bar of the auxiliary member.

6. A shredder for shredding fibrous material comprising a casing, main and auxiliary rotary members mounted respectively in upper and lower portions of said casing for rotation in the same direction about parallel axes, each of said members having a plurality of pivoted beaters projecting radially from the axis thereof and axially staggered relative to and intermeshing with beaters of the other member for removing material caught between the beaters of either member, said casing having a feed opening opening downwardly onto an upper front quadrant of said main member and a discharge opening for foreign matter opening downwardly below a lower rear quadrant of said auxiliary member, and means extending from a front wall of said casing beneath said members to said discharge opening, said means including for each member anvil means subtending a lower front quadrant thereof.

7. A shredder for shredding fibrous material comprising a casing, main and auxiliary rotary members mounted mounted in said casing for rotation in the same direction about parallel axes, the axis of said auxiliary member being disposed rearwardly of the axis of and below said main member, each of said members having a plurality of pivoted beaters projecting radially from the axis thereof and axially staggered relative to and intermeshing with beaters of the other member for removing material caught between the beaters of either member, said casing having a feed opening opening downwardly onto an upper front quadrant of said main member and a discharge opening for foreign matter opening downwardly below a lower rear quadrant of said auxiliary member, and means extending from a front wall of said casing beneath said members to said discharge opening, said means including for each member an anvil bar adjustable horizontally relative to the axis of its member, and a plurality of fixed cutter bars, said bars of each member each extending substantially parallel to the axis thereof and together

being disposed in circumferentially spaced relation along the periphery of the member with the anvil bar in the lead, and guide means leading from a trailing cutter bar of said main member toward the anvil bar of the auxiliary member.

8. A shredder for shredding fibrous material comprising a plurality of rotary beater members mounted abreast with beaters relatively staggered and axially intermeshing for removing material between the beaters of either member, said members being arranged in series for sequentially engaging material fed to said shredder, and a plurality of anvil and cutter means one for each of said members.

9. A shredder for shredding fibrous material comprising a plurality of rotary beater members rotatable about parallel axes and arranged in series for sequentially engaging material fed to said shredder, each of said members having a plurality of pivoted hammers projecting radially from its axis and axially staggered relative to and intermeshing with hammers of another member for removing material caught between the hammers of either member, and a plurality of anvil and cutter means one adjacent a periphery of each of said members for cooperating with the hammers thereof.

10. A shredder for shredding fibrous material comprising a pair of rotary beater members mounted abreast with beaters relatively staggered and axially intermeshing for removing material caught between the beaters of either member, said members being arranged in series for sequentially engaging material fed to said shredder, and a pair of cooperating anvil and cutter means each individual to and extending along a periphery of one of said members.

11. A shredder for shredding fibrous material comprising main and auxiliary beater members mounted for rotation in the same direction about parallel axes and arranged in series with said main member leading for sequentially engaging material fed to said shredder, each of said members having a plurality of pivoted beaters projecting substantially radially from the axis thereof and axially staggered relative to and intermeshing with beaters of the other member for removing material caught between the beaters of either member, and a pair of anvil and cutter means each individual to and extending along a periphery of one of said members.

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