United States Patent [19]

Nash

[11] **3,878,995**

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[54] **REFUSE SHREDDER AND CLASSIFIER**

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[73] Assignee: **Langhorn Construction Company, Inc.**, Sulphur Springs, Tex.

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[52] **U.S. Cl.** **241/79.1**; 209/120; 241/78; 241/154; 241/199

[51] **Int. Cl.** **B02c 13/04**; B07b 13/10

[58] **Field of Search** ..... 241/79, 79.1, 68, 154, 241/82, 185, 187, 194, 24, 186 R; 209/120

[56] **References Cited**

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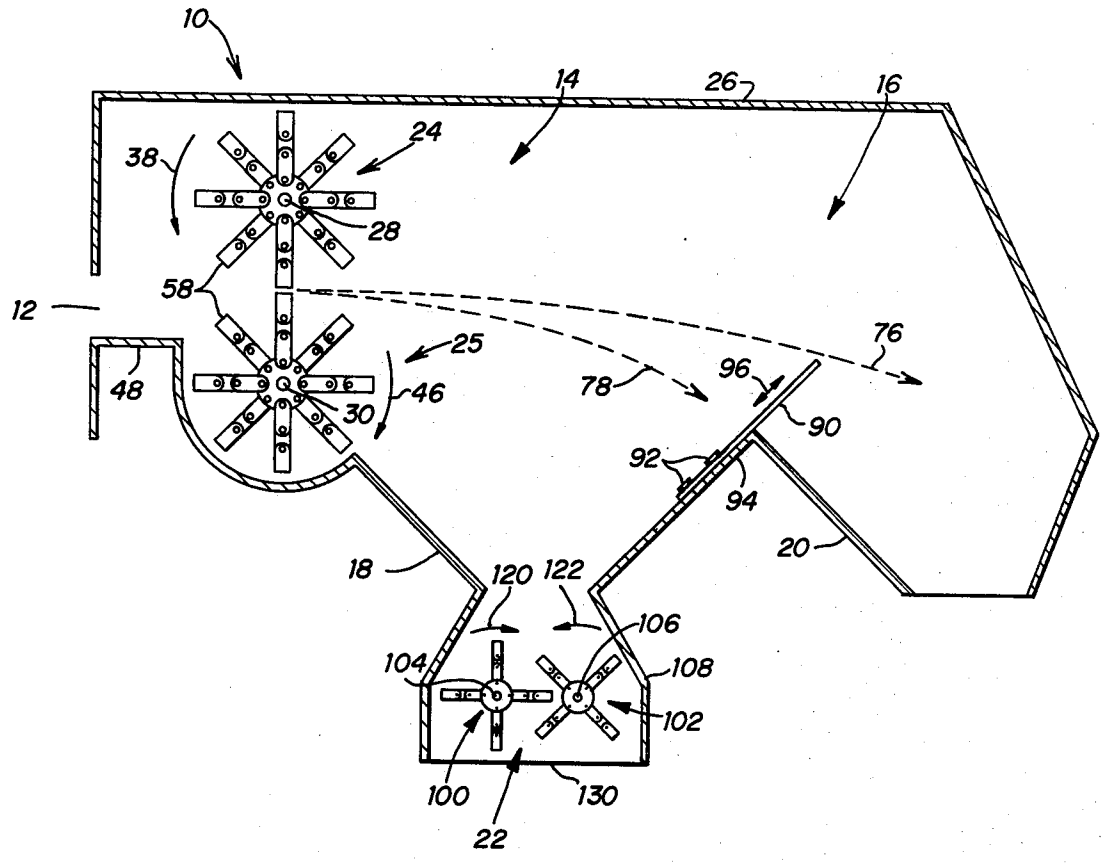
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Primary Examiner—Roy Lake
Assistant Examiner—E. F. Desmond
Attorney, Agent, or Firm—Townsend and Townsend

[57] **ABSTRACT**

An improved material shredder and classifier apparatus having a pair of rotatable shredder cylinders for shredding and horizontally projecting material in the direction of capture bins positioned away from the cylinders. Variable height baffles are positioned in the path of the material discharged from the shredder cylinders to deflect the material into the appropriate bin.

9 Claims, 9 Drawing Figures



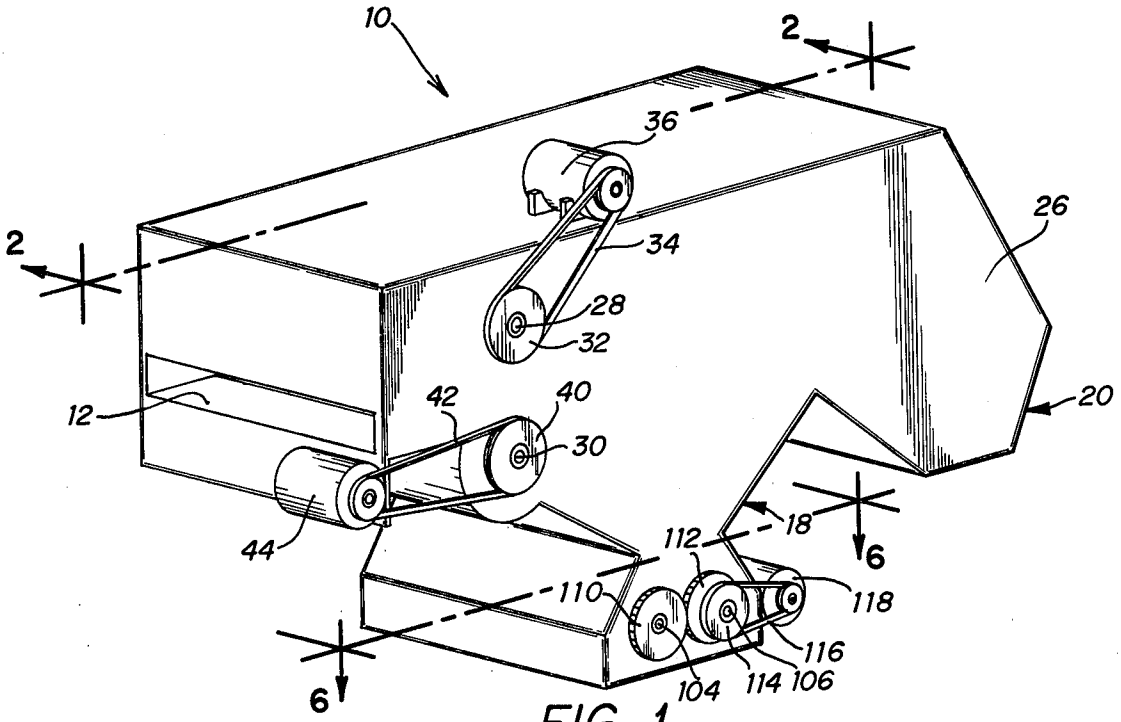

10
2
36
26
34
28
32
2
12
42
40
30
20
18
6
112
44
110
118
116
104
114
106
6

FIG. 1

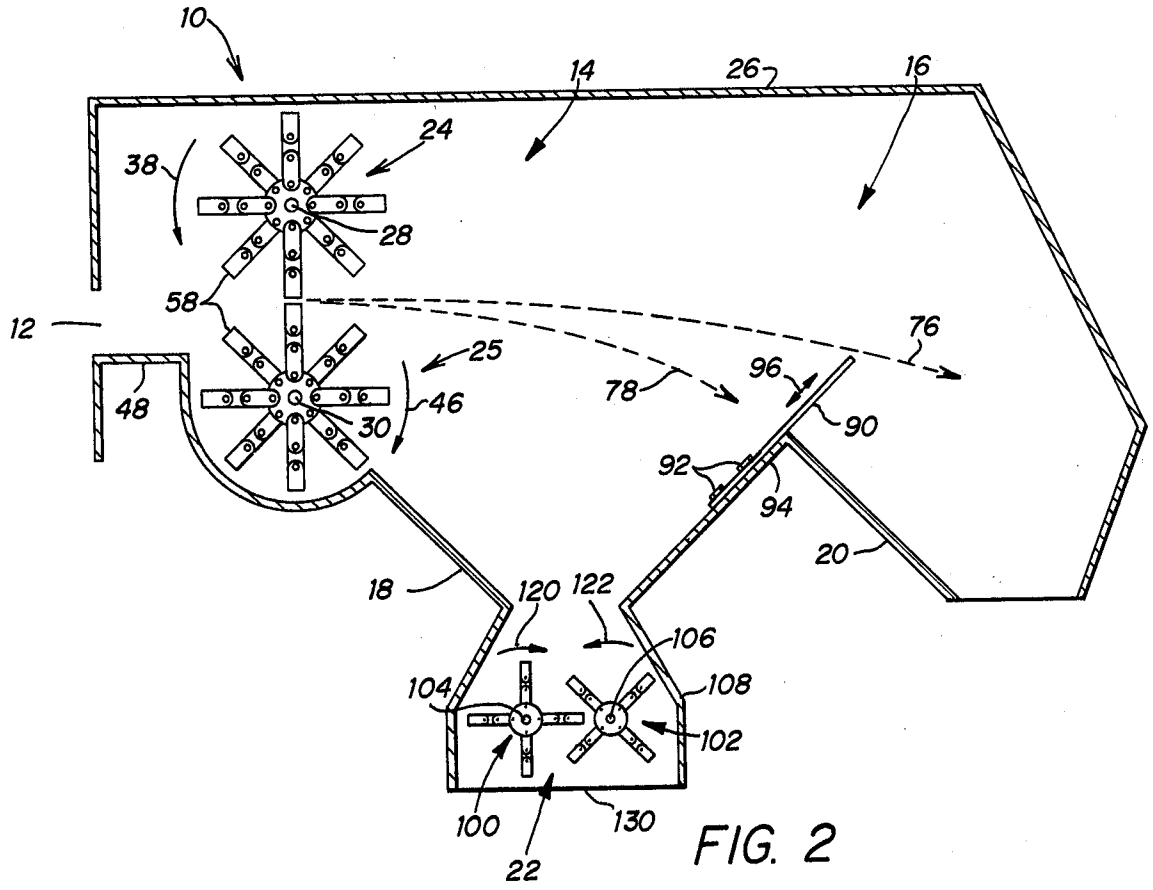

10
14
26
16
24
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28
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12
76
25
78
96
48
46
30
90
92
94
20
18
120
122
106
104
108
102
100
130
22

FIG. 2

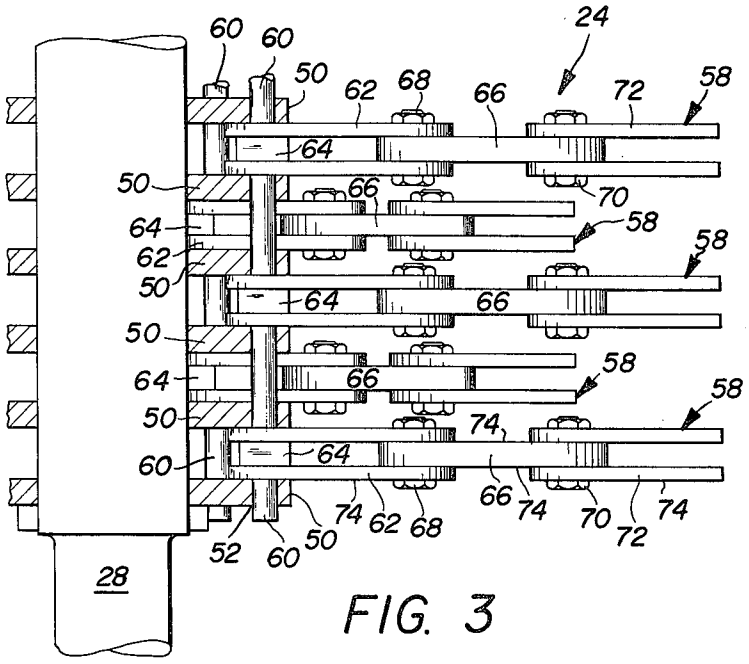

60
60
50
62
68
66
24
72
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64
50
66
70
58
64
62
50
64
66
58
50
64
66
58
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74
64
60
66
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70
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52
60
50
28

FIG. 3

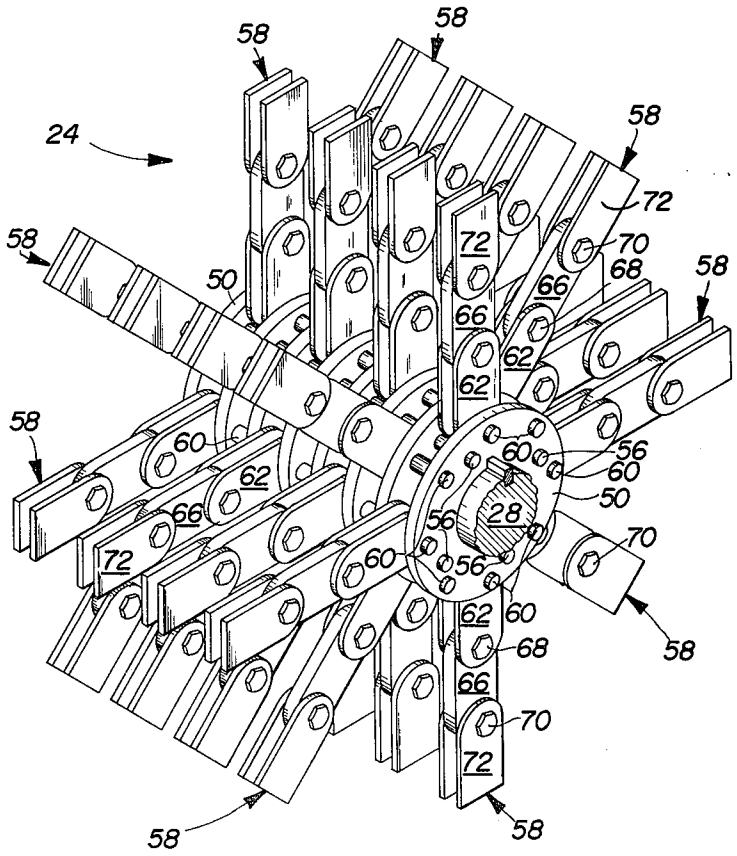

58
58
24
58
72
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72
70
68
66
66
62
62
58
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56
60
50
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28
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62
66
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66
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72
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58
58

FIG. 4

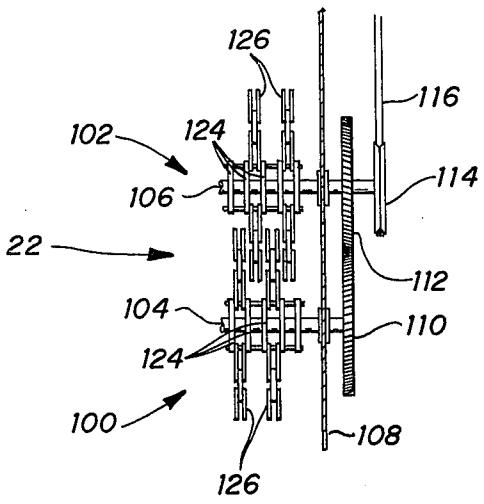


FIG. 6

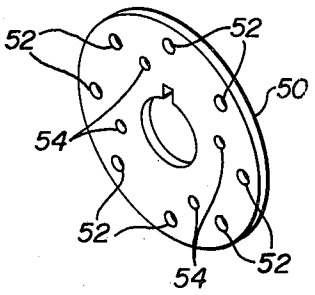


FIG. 5

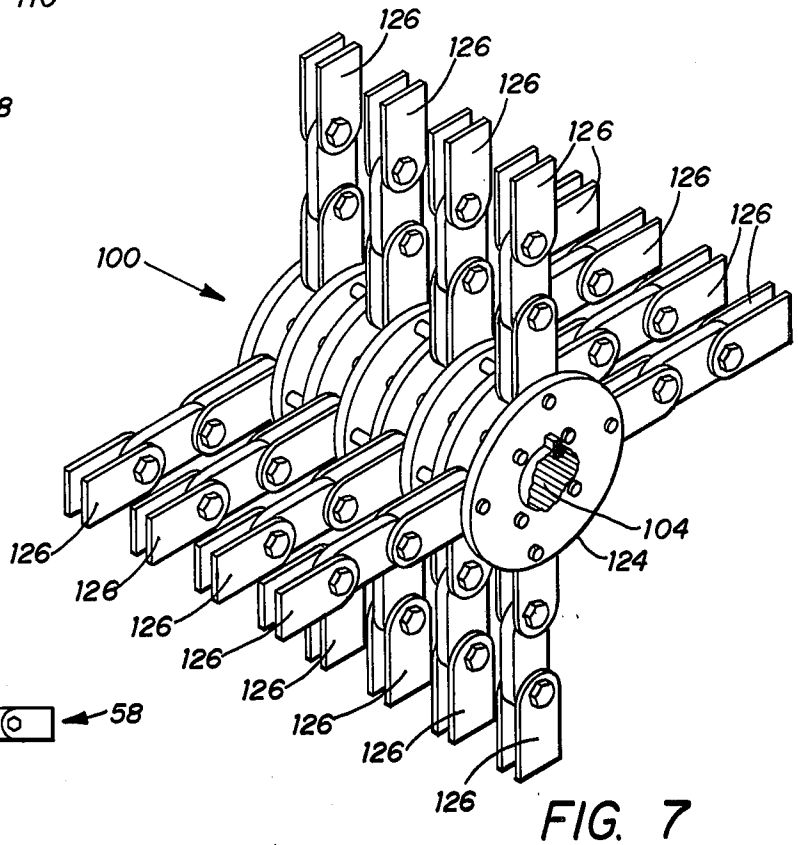


FIG. 7

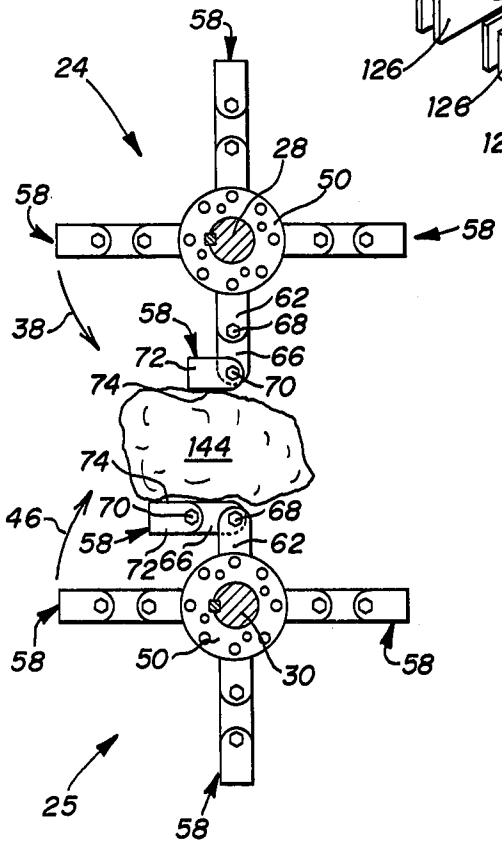


FIG. 8

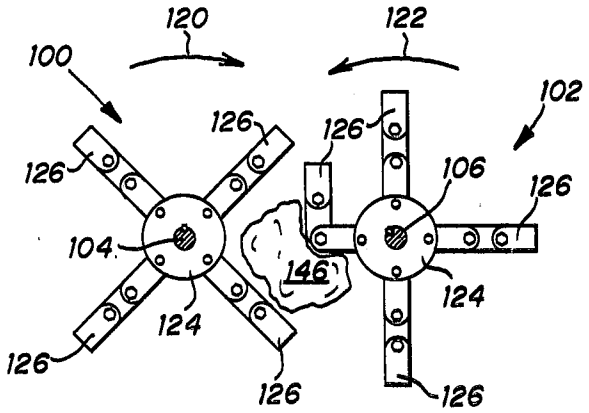


FIG. 9

of articulated flails are not offset by 45° angles, and shafts **104** and **106** are separated such that the flails **126** will overlap as shown in FIGS. **2, 6,** and **9.**

The flails **126** on the cylinders **100** and **102** will not contact or interfere with each other due to the offset relationship of the two cylinders. This offset is best illustrated in FIG. **6** and is accomplished by mounting flails **126** between every other pair of discs **124.** This overlapping action of the individual flails will cause a finer shredding of the material passing through the secondary shredder portion. The shredded material exits the secondary shredder portion **22** by means of openings **130** where the material can be suitably transported to an incinerator or the like.

OPERATION OF THE DEVICE

In operation, refuse is fed into the apparatus **10** through the opening **12** and into the primary shredder portion **14** and between the rotating shredder cylinders **24** and **25.** As can be seen in FIG. **8,** the refuse **144** is forcibly struck by the sharp edges **74** of the individual flails **58** to shred the refuse.

The individual flails **58** are positioned on the shredder cylinders **24** and **25** such that they will not normally contact the next adjacent flail when in operation and thus, will not interfere with the operation of the other flails. In addition, the flails **58** are each pivoted about the rods **60** and will fold about the nut and bolt assemblies **68** and **70.** Although these flails **58** can pivot and fold as described above, this movement is limited to rotation about axes parallel to the axis of shafts **28** and **30,** and therefore, each set of four flails is restricted to move between one pair of adjacent discs **50** and will not contact or interfere with the operation of flails of another set (between the next adjacent pair of discs **50**).

As softer and fibrous materials such as paper and the like fall into the primary shredder portion **14,** the flails **58** will contact the material and sharp edges **74** will shear, cut into and shred the material as the shredder cylinders **24** and **25** rotate.

As harder materials such as tin cans, scrap metal, and the like fall into the primary shredder portion **14,** the flails will be deflected in a staggered fashion. In FIG. **8,** the progressive or staggered deflection of the flails **58** is illustrated. The refuse **144** pictorially illustrates a hard substance which is difficult to penetrate by the flails **58.** One of the upper flails **58** on shaft **28** is illustrated in contact with the refuse **144.** This flail **58** has its outer leg **72** rotated back approximately 90° about nut and bolt assembly **70** to allow the passage of the refuse **144** through the primary shredder portion **14.** This deflection of the flail **58** about nut and bolt assembly **70** leaves the remainder of the flails **58** free to operate in its normal shredding position.

The lower flail **58** on shaft **30** contacting the refuse **144** illustrates the further staggered deflection of the flail **58.** This flail **58** is deflected about nut and bolt assembly **68,** with the legs **72** and **66** at an angle with respect to the leg **62.** This lower flail **58** illustrates a further step or staggered deflection of the flails to allow the passage of rigid articles of refuse **144** of various sizes through the primary shredder portion **14,** while providing an efficient operation of the flails. It is also apparent that the flails **58** could be deflected about the rods **60** to allow a further staggered deflection of the flails **58** to enable the passage of even larger articles of refuse **144.**

It is also important to note that the individual flails **58** are positioned on the shredder cylinders **24** and **25** and are of such a size that when normally deflected as illustrated in FIG. **8,** the flails will not contact or interfere with adjacent flails to cause a backlash type action. This improves the overall efficiency of the shredder cylinders, by assisting in maintaining the flails in the normal operating position.

As refuse leaves the primary shredder portion **14,** it is horizontally projected across the apparatus **10** as illustrated in FIG. **2** by arrows **76** and **78.** This projection of the refuse across the apparatus **10** is caused by the flails **58** contacting and accelerating the refuse as the flails **58** rotate with cylinders **24** and **25.**

Ideally, all the articles in the refuse leaving the primary shredder portion will have approximately the same velocity. The articles with the smallest drag per weight ratio such as glass, metal, wood and the like will be projected the furthest, with those articles with larger drag per weight ratio such as paper, carboard and the like being projected shorter distances.

Thus, by correctly positioning the baffle **90** between the bins **18** and **20,** the lighter materials with larger drag per weight ratios will be collected in bin **18** while the heavier, more dense materials with smaller drag per weight ratios will be collected in bin **20.** By adjusting the vertical height of baffle **90,** the separation of the articles of refuse leaving the primary shredder portion **14** can be adjusted.

The articles of refuse entering bin **20** can then be separately reclaimed as desired. The articles of refuse entering bin **18** move down into the secondary shredder portion **22.**

The operation of this secondary shredder portion is identical to the primary shredder. The flails **126** on cylinders **100** and **102** are prevented from interfering by the offset arrangement. In FIG. **9,** the cylinders **100** and **102** are illustrated with an article of refuse **146** therebetween. This article of refuse **146** illustrates the deflection of one of the flails **126** when a rigid article of refuse improperly falls into bin **18.** This deflection is similar to that illustrated in FIG. **8** and assists in reducing damage to the secondary shredder portion **22,** due to rigid articles falling therein.

As the shredded refuse leaves the secondary shredder portion through opening **130,** it can be incinerated as desired.

It is to be understood, of course, that the foregoing disclosure relates only to a preferred embodiment of the present invention and that numerous alterations may be utilized to practice the present invention without departing from the spirit and scope of the invention as defined in the appended claims.

I claim:

1. Apparatus for shredding material including material particles of differing shapes, sizes and densities and for classifying shredded particles into particle groups of differing densities and shapes comprising: a housing defining a shredding chamber, a pair of vertically spaced shredder cylinders mounted for discharging shredded particles in a generally horizontal direction into the chamber, at least two bin means for receiving shredded particles, the bin means being spaced in the direction of discharge of the shredded particles from the cylinders, baffle means disposed between the bin means and

projecting upwardly so as to interrupt the ballistic flight of particles with a greater density for guiding such greater density particles into means positioned proximate the cylinders, and means permitting movement of the baffle means in a generally vertical direction so as to allow a variation in the density of particles collected in the proximate bin means without changing the relative position of the bin means.

2. Apparatus according to claim **1** including a pair of shredding cylinders disposed beneath the proximate bin means for receiving shredded particles collected therein and for further shredding and disintegrating such particles, and means for discharging the particles collected in the closer bin means after their further disintegration, and means for discharging particles collected in the second bin means.

3. Apparatus for shredding particles of varying sizes shapes and densities and for classifying shredded particles according to their densities and shapes into at least two groups the apparatus comprising a housing defining a shredding chamber, a pair of rotatable shredder cylinders mounted for shredding the particles and for generally horizontally projecting the shredded particles through the chamber, each cylinder having a plurality of radially extending flails which are circumferentially and axially spaced over the cylinder, each flail being defined by no more than three flail links, means for pivotally securing the links to each other, means for pivotally securing each link to each link to the corresponding cylinder, first and second bin means spaced in the direction of flight of the shredded particles for receiving the rejected particles, means separating the bin means for each other so as to collect shredded particles of a greater density in one of the bin means and shredded particles of a lighter density in the other one of the bin means, and means for discharging the shredded particles from the bin means.

4. Apparatus according to claim **3** including a second set of rotating shredder cylinders and means for guiding the shredded particles from one of the bin means to the second set of cylinders, each second set of cylinders including a plurality of flails constructed and mounted in the same manner in which the flails of the first set of cylinders are constructed and mounted.

5. Apparatus according to claim **4** wherein the first set of cylinders are vertically spaced a sufficient distance to prevent an overlapping of the flails of the respective cylinders, and wherein the cylinders of the second set are horizontally spaced apart a distance so that the flails of the second set of cylinders overlap.

6. Apparatus according to claim **4** wherein each of the flails of the first and second cylinder sets include an outermost link defined by a pair of independent segments, and including means for attaching said segments to a remainder of the flails for independent pivotal movement of the segments with respect to the remainder.

7. Apparatus according to claim **3** wherein the separating means includes means for adjusting the height of the separating means relative to the first set of shredder cylinders to correspondingly change the density of shredded particles collected in the bin means.

8. Apparatus for shredding particles of various sizes, shapes and densities and for classifying and collecting the shredded particles according to their relative densities and shapes comprising a housing defining a shredding chamber, a first set of rotatable shredder cylinders mounted for shredding the particles, the shredder cylinders being positioned for horizontally projecting the shredded particles through the chamber, at least two bin means spaced in the direction of flight of the shredded particles in the chamber for receiving such particles, baffle means disposed between the bin means including means for adjusting the effective height of the baffle means with respect to the first set of shredder cylinders so that shredded particles are classified and received in the respective bin means according to the density and the relative shape of the shredded particles and so that the density and the shape of the particles collected in the first bin means can be varied by varying the effective height of the baffle means, a second set of shredder cylinders mounted beneath at least one of the bin means for receiving shredded particles therefrom and for further disintegrating such particles, each of the shredder cylinders in the first and second sets including a plurality of circumferentially and axially spaced apart flails, each flail being defined by no more than three links, means pivotally interconnecting the links, means pivotally connecting each flail to the respective cylinder, and outermost link of each flail being defined by a pair of spaced apart independent link segments pivotally attached to a remainder of the flail for independent pivotal movement of the segments of each pair of segments, means spacing the cylinders of the first sets so that the flails do not overlap, and means spacing the cylinders of the second set so that the flails do overlap.

9. Apparatus according to claim **7**, wherein each outermost link segment defines at least three cutting edges which face in the direction of rotation of the respective cylinder.

* * * * *

REFUSE SHREDDER AND CLASSIFIER

BACKGROUND OF THE INVENTION

The present invention relates generally to improvements in material shredders. In another aspect, this invention relates to a new and improved refuse shredder which shreds and classifies refuse.

DESCRIPTION OF THE PRIOR ART

In the handling and disposal of refuse, such as residential and industrial refuse and waste materials, it has been common practice to collect the refuse and to reduce its ultimate volume and thereafter either incinerate and/or otherwise dispose of the resultant ash or shredded refuse by placing the same in a land fill.

To improve these municipal waste disposal systems, it has been found that if refuse is first shredded, incineration can be more efficiently accomplished. It has also been found that the more finely the refuse can be shredded, the more efficient the incineration process.

One problem which has made the fine shredding of refuse materials difficult is that residential and industrial refuse contains articles of a variety of sizes, shapes and materials. Even when larger objects are removed, the remaining articles range from low density which are readily shredded, such as fabric, light plastics, paper and cardboard to the dense articles many of which are difficult if not impossible to shred such as glass and metal containers, wooden articles and the like. Apparatus which are designed to finely shred light low density articles such as paper, cardboard and the like cannot efficiently operate on unsorted refuse because heavy rigid articles can cause damage or even jam the apparatus. Conversely, apparatus designed specifically to shred dense articles will not efficiently shred lighter articles.

In addition, in some instances, it is desirable to eliminate fine shredding of heavy rigid articles completely and to separate these articles from the refuse so that they can be either reclaimed, crushed or completely eliminated from the incineration process. This classification and separation of the articles in the refuse is difficult due to the variations in the constituents. For example, refuse collected during rain or other types of precipitation will contain more moisture, and thus the fibrous articles such as paper, cardboard and the like will be denser and harder to separate from the heavier articles.

Therefore, according to one embodiment of the invention, an improved material shredder and classifier apparatus is provided which includes rotatable shredder cylinders which shred and project the shredded material horizontally toward bins to separate the articles according to their density and weight.

According to another embodiment of the present invention, the improved material shredder and classifier is provided with variable height separator baffles to provide control of the separation process.

According to another embodiment of the invention, an improved material shredder and classifier apparatus with rotatable shredder cylinders and articulated bar flails thereon is provided.

OBJECTS OF THE INVENTION

An object of the present invention is the provision of an improved material shredder.

Another object of the present invention is the provision of an improved material shredder and classifier.

Still another object of the present invention is the provision of an improved shredder and classifier which is simple and inexpensive to manufacture, operate and service.

Other objects and many of the attendant advantages of this invention will be readily appreciated by those of ordinary skill in the art as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings in which:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates a perspective view of the improved shredder and classifier apparatus of the present invention;

FIG. **2** illustrates a section of the device taken on line **2—2** of FIG. **1** looking in the direction of the arrows;

FIG. **3** is an enlarged detailed view of the flails and their attachment to one of the primary rotating shredder cylinders;

FIG. **4** is a perspective view of a portion of one of the primary shredder cylinders of the present invention with the flails attached thereto;

FIG. **5** is an enlarged perspective view of one of the primary shredder discs;

FIG. **6** is a partial section taken on line **6—6** of FIG. **1** looking in the direction of the arrows;

FIG. **7** is a perspective view of a portion of one of the secondary shredder cylinders of the present invention with the flails attached thereto;

FIG. **8** is an enlarged section view illustrating a portion of the primary shredder cylinders with refuse therebetween; and

FIG. **9** is a view similar to FIG. **8** illustrating the secondary shredder cylinders with refuse therebetween.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, wherein like reference characters designate like or corresponding parts throughout the several views, there is shown an improved shredder and classifier apparatus which for purposes of description is identified by reference numeral **10.** This apparatus **10** is of the type which can be utilized to shred waste or refuse materials so that the refuse may be more efficiently incinerated or reclaimed as desired.

The apparatus **10** has a feed opening **12** adjacent the top thereof for the injection of refuse into a primary shredder portion **14** of the apparatus **10.** As will be hereinafter described in more detail, this primary shredder portion **14** initially shreds the material and projects the shredded material into a classifier portion **16** where the shredded material is classified into two separate bins **18** and **20,** as will be hereinafter described in more detail. The apparatus **10** is designed so that the lighter, shredded fibrous materials will fall into the bin **18** and will enter a secondary shredder portion **22** where the materials can be finely shredded. The heavier materials enter the bin **20** where they can be acted on by magnetic belts, grids or the like to separate the reclaimable materials therefrom as desired.

The primary shredder portion **14** is formed with two counter rotating shredder cylinders **24** and **25** which are mounted within the chamber of the sheet metal

housing **26** of the apparatus **10.** The cylinders **24** and **25** are identical in construction and are fixed to parallel spaced shafts **28** and **30,** respectively, which are rotatably supported from the sides of the sheet metal housing **26** by suitable bearings not shown. The shaft **28** has a sprocket **32** which is connected to an endless belt **34** and is driven by an electric motor **36.** This motor **36** in turn drives the shaft **28** and cylinder **24** in the direction as shown by arrow **38.**

In a likewise manner, the shaft **30** has a suitable sprocket **40** attached thereto, which engages an endless belt **42** which is in turn driven by an electric motor **44.** In this manner, the shaft **30** and cylinder thereon are rotated by motor **44** in the direction of arrow **46.**

A suitable guide housing **48** is provided adjacent to the feed opening **12** to cause the material injected through opening **12** to flow into the primary shredder portion **14** and between the shredder cylinders **24** and **25.**

The details of construction of one of the primary shredder cylinders **25** are illustrated in FIGS. **3, 4** and **5,** wherein the shaft **28** is shown with cylinder **24** attached thereto. It is to be understood, of course, that the construction of the shaft **30** and cylinder **25** is identical to the construction of shaft **28** and cylinder **24.** The shredder cylinder **24** is constructed by rigidly attaching a plurality of discs **50** to the shaft **28.** These discs **50** are spaced along the length of the shaft **28** with their surfaces extending normally to the axis of the shaft. Each of the discs **50** has eight radially spaced circular holes **52** near the periphery thereof. In addition, each disc **50** is provided with four smaller radially spaced holes **54** which are spaced radially within the larger holes **52.** Stiffener rods **56** are inserted through the aligned holes **54** in the discs **50** of the shredder cylinder **24.** A set of a plurality of articulated bar flails **58** is attached between adjacent discs **50** by means of cylindrical rods **60** which are inserted through the aligned holes **52.**

As can be seen in FIGS. **3** and **4,** each set of four flails **58** is attached between each pair of discs **50** with the flails spaced at 90° from each other by inserting the rods **60** through openings in one end of the flail **58.** The adjacent set of flails **58** is identically mounted between the next adjacent pair of discs **50** except that these flails **58** are offset by 45° from the adjacent flails. This 45° offset of adjacent flail sets is repeated along the length of the shredder cylinder **24.** It should be understood, of course, that the selection of four flails between each pair of discs is preferred in the embodiment illustrated and that other configurations could also be used as desired. As can be seen in FIG. **2,** the shredder cylinders **24** and **25** are positioned a sufficient distance apart that the individual flails **58** will not come into contact during rotation.

By attaching the flails **58** as shown, the flails **58** can rotate about the rods **60** during the shredding operation. In FIGS. **3** and **4,** it can be seen that each of the flails **58** is provided with a first inner leg **62** having a pair of links which are pivotally attached by means of rods **60** to the discs **50.** A spacer **64** is positioned on the rods **60** between the links. An intermediate leg **66** has one end pivotally attached by nut and bolt assembly **68** to the inner leg **62.** The other end of the intermediate leg **66** is pivotally attached by the nut and bolt assembly **70** to an outer leg **72** having a pair of links. Each of the flails **58** are formed from material having rectangular cross sections with sharp corners or edges **74** which serve as sharp shearing edges and aid the flails **58** in shredding refuse as the flails come into contact with the refuse.

In operation, the individual flails **58** will be forcibly moved into contact with refuse coming between the cylinders **24** and **25.** This action of the flails **58** will shred the refuse and project it in a horizontal direction away from the primary shredder portion **14** as shown by arrows **76** and **78** of FIG. **2.** An explanation of the operation of the primary shredder portion **14** in projecting shredded refuse in the direction of arrows **76** and **78** is complex due to the variety of types, shapes and sizes of articles which leave the primary shredder portion **14.** For purposes of description, it is sufficient to note that the heavier and denser articles will be given an initial velocity and kinetic energy by the rotating cylinders **24** and **25** with the path of motion of these articles represented by arrow **76.** This path, represented by arrow **76,** is illustrative of paths on articles on which the effective drag is minimal.

The path illustrated by arrow **78** is representative of the path of lighter particles such as paper, fabric, and the like. This arrow **78** illustrates the path and materials upon which drag has a substantial effect to cause the material to lose kinetic energy and tend to fall short of the path of the arrow **76.**

Positioned within the path of the articles leaving this primary shredder portion **14** and between the bins **18** and **20,** is an adjustable baffle assembly **90.** This baffle assembly **90** can be used to select the materials which will enter bins **18** and **20,** respectively. The baffle **90** is releasably attached by means of bolts **92** to a rigid portion **94** extending between the bins **18** and **20.** Slots or other suitable means are provided on the baffle **90** for allowing it to be selectively vertically positioned in the path of the articles to be moved with respect to the rigid portion **94** as illustrated by arrows **96.**

Thus, it can be seen that lighter materials will normally enter bin **18** whereas the heavier materials such as glass, metal, and the like will normally enter bin **20** where they may be further separated and processed by magnetic belts, grids or other suitable apparatus as desired. The lighter materials will then fall down into the bin **18** and enter the secondary shredder portion **22.**

As can be seen in FIGS. **2, 6** and **7,** the secondary shredder portion **22** is constructed with two secondary shredder cylinders **100** and **102** which are fixed to parallel spaced rotatable shafts **104** and **106,** respectively. These shafts are mounted by suitable bearings (not shown) to the walls of the housing **108** of the secondary shredder portion **22.** The shafts **104** and **106** have meshing gears **110** and **112,** respectively. In addition, the shaft **106** has a sprocket **114** which is connected through an endless belt **116** to an electrical motor **118.** Thus, it can be seen that motor **118** drives shafts **104** and **106** in the directions of arrows **120** and **122,** respectively.

The cylinders **100** and **102** are very similar to the cylinders **24** and **25** and are provided with a plurality of discs **124** between which are attached sets of four articulated flails **126.** These articulated flails **126** are identical in construction to the flails **58** and are attached to the discs **124** in a manner identical to that illustrated with respect to the shredder cylinders **24** and **25.** The difference between the shredder cylinders **100** and **102** and shredder cylinders **24** and **25** is that adjacent sets