

ROTATIONAL BLADE FOR SHREDDER AND SHREDDER DESCRIPTION

BACKGROUND OF THE INVENTION

5 Field of the Invention

[0001]

The present invention relates to a rotational blade for a shredder that pulverizes target objects such as wood and trash, and to a shredder.

Priority is claimed on Japanese Patent Application No. 2015-118198, filed on
10 June 11, 2015, the content of which is incorporated herein by reference.

Description of Related Art

[0002]

In the related art, a shredder has been used as means for shredding target objects
15 such as wood (for example, woody materials for biomass power generation) or trash.
Examples of the shredder include a rotary shredder, a shear type shredder, and a
two-shaft shear type shredder. Each of these shredders includes a rotational blade
which is attached to a rotational shaft and in which multiple shredding blades are formed
in a circumferential direction.

20 [0003]

There is known a structure of the rotational blade in which multiple shredding
blades are attachably and detachably attached circumferentially to a blade receiving base
that is attached to the rotational shaft (for example, refer to Patent Document 1). A
shredder disclosed in Patent Document 1 has a structure in which two shredding blades
25 are disposed to overlap each other in an axial direction of the rotational shaft and the

lifetime of the rotational blade is extended by replacing the two shredding blades when the blades were worn.

Prior Art Document

5 Patent Document

[0004]

Patent Document 1: Japanese Patent Publication No. 2911416

SUMMARY OF THE INVENTION

10 Technical Problem

[0005]

In a shredder, escape of an oblong target object may occur, that is, a target object may pass through a rotational blade without being pulverized. Increasing the number of multiple shredding blades disposed in a circumferential direction is an
15 example of a method of preventing the escape of an oblong target object.

In a case where the number of shredding blades is increased, it is necessary to increase the number of attaching surfaces of the blade receiving base in the structure in which the shredding blades can be attached and detached as shown in Patent Document 1. In contrast, in a case where the number of attaching surfaces is increased, that is, in a
20 case where the circumferential width of the blade receiving base decreases, the attachment strength of the shredding blades decrease.

[0006]

An object of the present invention is to provide a rotational blade for a shredder that is capable of preventing escape of a target object without reducing an attachment
25 strength of shredding blades with respect to a blade receiving base in the rotational blade

for a shredder in which the shredding blades can be attached to and detached from the blade receiving base, and is to provide a shredder.

Technical Solution

5 [0007]

According to a first aspect of the present invention, a rotational blade includes: a blade receiving base having a plurality of attaching surfaces which are formed in a circumferential direction thereof, the blade receiving base which is configured to be attached to a rotational shaft so that an axis of the blade receiving base is coincide with
10 an axis of the rotational shaft; and a shredding blade which is capable of attaching to each of the plurality of attaching surfaces.

The shredding blade includes a first shredding blade and a second shredding blade which are attached to an attaching surface among of the plurality of attaching surfaces.

15 The first shredding blade includes: a first main surface of the first shredding blade, which is perpendicular to the axis of the rotational shaft, and which is disposed on a first side of the rotational shaft; a first contact portion which is in contact with the attaching surface; and a first cutting edge portion protruding outward in a radial direction of the rotational shaft.

20 The second shredding blade includes: a first main surface of the second shredding blade, which is perpendicular to the axis of the rotational shaft, and which is disposed on the first side of the rotational shaft, and a second main surface of the second shredding blade which is disposed opposite to the first main surface, the second main surface which is disposed on a second side of the rotational shaft; a second contact
25 portion which is in contact with the attaching surface; and a second cutting edge portion

protruding outward in the radial direction of the rotational shaft.

The first and second shredding blades are arranged in a row along the axis of the rotational shaft so that the first main surface of the first shredding blade is in contact with the second main surface of the second shredding blade.

5 The position of the first cutting edge portion is offset from the position of the second cutting edge portion in a rotational direction of the rotational shaft.

Moreover, the shredding blade may be attached to each of the plurality of attaching surfaces.

[0008]

10 In this configuration, since multiple shredding blades are attached to one attaching surface in the rotational blade for a shredder in which the shredding blades can be attached to and detached from the blade receiving base, it is possible to increase the number of cutting edge portions of the rotational blade without reducing an attachment strength of the shredding blades with respect to the blade receiving base. In addition, it
15 is possible to prevent escape of a target object by increasing the number of cutting edge portions.

[0009]

According to a second aspect of the present invention, the shredding blade further includes a third shredding blade which is attached to the attaching surface.

20 The third shredding blade includes: a second main surface of the third shredding blade, which is perpendicular to the axis of the rotational shaft, and which is disposed on the second side of the rotational shaft; a third contact portion which is in contact with the attaching surface; and a third cutting edge portion protruding outward in the radial direction of the rotational shaft.

25 The second and third shredding blades are arranged in the row along the axis of

the rotational shaft so that the first main surface of the second shredding blade is in contact with the second main surface of the third shredding blade.

The position of the third cutting edge portion is offset from the positions of the first and second cutting edge portions in a rotational direction of the rotational shaft.

5 A length between the first edge portion and the second cutting edge portion is different from a length between the second edge portion and the third cutting edge portion.

Moreover, the shredding blade which includes the first, second and third shredding blades may be attached to each of the plurality of attaching surfaces.

10 [0010]

In this configuration, since spaces between cutting edge portions adjacent to each other in the circumferential direction are different from each other, various sizes of target objects can be inserted into the spaces, and various shapes of target objects can be pulverized.

15 [0011]

According to a third aspect of the present invention, a shredder includes: a casing; a rotational shaft which is accommodated in the casing; the rotational blade according to any one of claims 1 to 4; and a spacer.

20 The rotational shaft includes a first rotational shaft and a second rotational shaft which is disposed parallel to the first rotational shaft.

The rotational blade includes a plurality of rotational blades which are attached to the rotational shaft while being spaced apart from each other in an axial direction.

25 The spacer includes a plurality of spacers which are attached to the rotational shaft while the plurality of spacers and the plurality of rotational blades alternate with each other in the axial direction.

The rotational blade attached to the first rotational shaft and the spacer attached to the second rotational shaft are disposed to have the same position in the axial direction of the rotational shaft.

The plurality of spacers overlaps each other in the axial direction.

5 Each of the plurality of spacers is formed to have a diameter smaller by the extent of an increase in the diameter of the corresponding shredding blade group which has the same position in the axial direction of the rotational shaft and in which multiple shredding blades are annularly disposed in a circumferential direction.

[0012]

10 In this configuration, it is possible to better prevent the escape of a target object.

Advantageous Effects

[0013]

According to the rotational blade for the shredder, since multiple shredding
15 blades are attached to one attaching surface in the rotational blade for a shredder in which the shredding blades can be attached to and detached from the blade receiving base, it is possible to increase the number of cutting edge portions without reducing the attachment strength of the shredding blades with respect to the blade receiving base. In addition, it is possible to prevent escape of a target object by increasing the number of cutting edge
20 portions.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014]

Fig. 1 is a side view of a shredder.

25 Fig. 2 is a top view of the shredder taken in a direction of line X1-X1 in Fig. 1.

Fig. 3 is a top view showing rotational blades and spacers in a first embodiment of the present invention.

Fig. 4 is a front view of the rotational blades and the spacers in the first embodiment of the present invention viewed in an axial direction.

5 Fig. 5 is a view (upper half view) of the rotational blade in the first embodiment of the present invention.

Fig. 6 is a view showing a method of attaching shredding blades to a blade receiving base in the rotational blade of the first embodiment of the present invention.

10 Fig. 7 is a perspective view of a cutting edge portion of the shredding blade in the first embodiment of the present invention.

Fig. 8 is a front view showing a modified example of the rotational blade in the first embodiment of the present invention, viewed in the axial direction.

Fig. 9 is a schematic view of a cutting edge portion of a rotational blade in a second embodiment of the present invention, viewed in a radial direction.

15

DETAILED DESCRIPTION OF THE INVENTION

[0015]

First Embodiment

Hereinafter, a shredder in a first embodiment of the present invention will be
20 described with reference to the accompanying drawings.

A shredder 100 in the embodiment is a two-shaft shear type shredder (multi-shaft shear type shredder) that pulverizes a target object (waste) such as woods or trash into a pulverized object having a predetermined particle size.

As shown in Figs. 1 and 2, the shredder 100 includes a casing 25, and a pair of
25 shredding mechanisms 4 configured to include rotational shafts 1 and 2 which are

accommodated in the casing 25; multiple rotational blades 3 (a plurality of rotational blades 3) which are attached to the rotational shafts 1 and 2; and multiple spacers 10 (a plurality of spacers 10), each of which is attached between rotational blades 3 adjacent to each other in an axial direction of the rotational shafts 1 and 2.

5 [0016]

Scrapers (not shown) are provided on a side surface of the casing 25 so as to face the rotational blades 3 and the spacers 10. Tip end portions of the scrapers are formed into a semi-arc shape such that the tip end portions are respectively close to circumferential surfaces of the rotational blades 3 and the spacers 10. The scraper
10 scrapes a target object interposed between the rotational blades 3.

[0017]

In the shredding mechanisms 4, an axis O1 of the rotational shaft 1 is parallel to an axis O2 of the rotational shaft 2. Hereinafter, a direction along the axes O1 and O2 is simply referred to as an axial direction A.

15 Each of the shredding mechanisms 4, the rotational blades 3 and the spacers 10 are alternately disposed in the axial direction A. As shown by reference sign T2 in Fig. 3, the width (thickness) of the rotational blade 3 in the axial direction A is the same as that of the spacer 10 in the axial direction A.

[0018]

20 The rotational blades 3 and the spacers 10 attached to the rotational shaft (a first rotational shaft) 1 and the rotational blades 3 and the spacers 10 attached to the rotational shaft (a second rotational shaft) 2 are disposed to alternate with each other in the axial direction A. In other words, the rotational blades 3 attached to the rotational shaft 1 and the spacers 10 attached to the rotational shaft 2 adjacent to the rotational shaft 1 are
25 disposed at the same position in the axial direction A of the rotational shafts 1 and 2.

[0019]

A portion of the rotational blades 3 attached to the rotational shaft 1 overlaps a portion of the rotational blades 3 attached to the rotational shaft 2 when viewed in the axial direction A. The shredder 100 shears and pulverizes a target object by rotating the rotational blades 3 around the axes O1 and O2 along with the rotational shafts 1 and 2 of the shredding mechanisms 4.

[0020]

As shown in Fig. 3, the spacer 10 includes three spacers 11 which overlap each other in the axial direction A. The rotational blade 3 includes three sets of shredding blade groups 7 which overlap each other in the axial direction A. The spacer 11 and the shredding blade group 7 have the same width (reference sign T1) in the axial direction A.

[0021]

As shown in Fig. 4, the rotational shafts 1 and 2 have a hexagonal section, and are respectively rotated around the axes O1 and O2 by a drive apparatus 5 such as an electric motor. The rotational shafts 1 and 2 may have a polygonal section, for example, a rectangular section. The rotational shafts 1 and 2 may be formed to have a circular section, and the spacer 10 and the rotational blade 3 may be fixed together with keys.

[0022]

As shown in Fig. 4, the rotational blade 3 includes multiple attaching surfaces 6a (a plurality of attaching surfaces 6a) formed in a circumferential direction. The rotational blade 3 includes a blade receiving base 6 that is attached in order for an axis of the blade receiving base 6 to coincide with the axes of the rotational shafts 1 and 2, and the three sets of shredding blade groups 7 which are attachably and detachably attached to the blade receiving base 6.

The blade receiving base 6 includes a central hole 17 having a hexagonal shape corresponding to the sectional shape of the rotational shafts 1 and 2.

The rotational shafts 1 and 2 are inserted into the central holes 17 of the blade receiving bases 6. The blade receiving base 6 has a hexagonal shape when viewed in the axial direction. Each of six outer circumferential surfaces of the blade receiving base 6 is the attaching surface 6a to which a shredding blade 8 is attached. The axial width of the blade receiving base 6 is the same as that of the three sets of shredding blade groups 7 overlapping each other, and that (T2) of the spacer 10.

[0023]

The shredding blade group 7 has the shape of a plate and is configured to include multiple shredding blades 8 (a plurality of shredding blades 8) which are disposed in the circumferential direction. Each of the shredding blades 8 is attachably and detachably attached to the attaching surface 6a of the blade receiving base 6 such that a main surface 8s of the shredding blade 8 is perpendicular to the axes O1 and O2.

Each of the shredding blades 8 includes a cutting edge portion 9 that is formed on the outside of the axes O1 and O2 in a radial direction. Each of the shredding blades 8 includes a contact portion 21 that is in contact with the attaching surface 6a of the blade receiving base 6. The shredding blade group 7 in the embodiment includes six shredding blades 8. That is, the rotational blade 3 in the embodiment includes eighteen shredding blades 8.

[0024]

As described above, the rotational blade 3 includes the three sets of shredding blade groups 7 which overlap each other in the axial direction A such that main surfaces 7s of the shredding blade groups 7 are in contact with each other. The multiple shredding blades 8 of the shredding blade groups 7 are annularly disposed in the

circumferential directions of the rotational shafts 1 and 2.

Each of the three sets of shredding blade groups 7 includes a first shredding blade group 7a, a second shredding blade group 7b, and a third shredding blade group 7c which are formed of the shredding blades 8 having different shapes. The attachment structure of the shredding blade group 7 of the rotational blade 3 will be described based on the second shredding blade group 7b.

[0025]

As shown in Fig. 5, the shredding blade 8 of the shredding blade group 7 is attachably and detachably attached to the attaching surface 6a of the blade receiving base 6 by inserting a fixing bolt 20 into a bolt insertion hole 18 formed in the shredding blade 8, and by tightening the fixing bolt 20 to a female screw hole 19 formed in the attaching surface 6a of the blade receiving base 6.

[0026]

The attaching surface 6a of the blade receiving base 6 is provided with a stepped portion 12 that includes an engaging surface 12a oriented toward the circumferential direction. The contact portion 21, which is provided in the shredding blade 8 and is in contact with the attaching surface 6a of the blade receiving base 6, is provided with a stepped portion 13 and an engaging surface 13a corresponding to the engaging surface 12a of the blade receiving base 6.

Circular pin holes 14 and 15 are respectively formed in the attaching surface 6a of the blade receiving base 6 and the contact portion 21 of the shredding blade 8 in the rotational blade 3.

[0027]

As shown in Fig. 6, in order to attach the shredding blade 8 to the blade receiving base 6 in the rotational blade 3, one end portion of a columnar pin 16, which is

formed separately from the blade receiving base 6 and the shredding blade 8 and has substantially the same diameter as the pin holes 14 and 15, is fitted into the pin hole 15 of the shredding blade 8, and the other end portion of the pin 16 is fitted into the pin hole 14 of the blade receiving base 6 together with the shredding blade 8.

5 [0028]

At this time, the pin 16 is fitted into the pin hole 14 of the blade receiving base 6 such that the contact portion 21 of the shredding blade 8 comes into close contact with the attaching surface 6a of the blade receiving base 6, and the engaging surface 12a of the stepped portion 12 of the blade receiving base 6 comes into surface contact with and is
10 engaged with the engaging surface 13a of the stepped portion 13 of the shredding blade 8.

[0029]

Due to the engagement between the stepped portions 12 and 13, the shredding blade 8 is positioned with respect to the blade receiving base 6, and circumferential
15 movement of the shredding blade 8 is limited. In addition, due to the fitting of the pin 16 into the pin holes 14 and 15, axial movement of the shredding blade 8 with respect to the blade receiving base 6 is limited. Since the pin holes 14 and 15, which are respectively formed in the blade receiving base 6 and the shredding blade 8, and the pin 16 are formed into a circular shape having substantially the same diameter, the fitting of
20 the pin 16 into the pin holes 14 and 15 limits axial movement of the shredding blade 8 with respect to the blade receiving base 6. Accordingly, it is possible to dispose and attach the blade receiving base 6 at a predetermined position while positioning the shredding blade 8 by only fitting the pin 16 into the pin holes 14 and 15. In addition, it is easily possible to firmly fix the shredding blade 8 with the fixing bolt 20.

25 [0030]

Hereinafter, the shape of the cutting edge portion 9 will be described in detail.

As shown in Fig. 7, the cutting edge portion 9 includes a cutting face 30; a flank 31; and a cutting edge 32 which forms a ridge between the cutting face 30 and the flank 31.

The cutting edge portions 9 are rotated in a rotational direction shown by reference sign

5 R by rotation of the rotational shafts 1 and 2. The cutting edge 32 in the embodiment is parallel to the axial direction A.

[0031]

The spacer 10 is provided between rotational blades 3 which are attached to the rotational shafts 1 and 2 and are adjacent to each other in directions of the axes O1 and

10 O2, and defines an axial gap between the rotational blades 3. As shown in Fig. 3, the spacer 10 includes three spacers 11. Each of the spacers 11 has a columnar shape having a spacer central hole 23 having a polygonal shape. The rotational shafts 1 and 2 are inserted into the spacer central holes 23.

[0032]

15 As described above, the first shredding blade group 7a, the second shredding blade group 7b, and the third shredding blade group 7c have different shapes. That is, a first shredding blade 8a of the first shredding blade group 7a, a second shredding blade 8b of the second shredding blade group 7b, and a third shredding blade 8c of the third shredding blade group 7c have different shapes. Specifically, the positions of the

20 cutting edge portions 9 of the first shredding blade 8a, the second shredding blade 8b, and the third shredding blade 8c are offset from each other in the rotational direction R.

A set of three shredding blades 8 attached to one attaching surface 6a is referred to as a shredding blade 22 (i.e. a shredding blade assembly 22). Multiple shredding blades 8 of the shredding blade 22 overlap each other in the axial direction A such that

25 the main surfaces 8s are in contact with each other. The rotational blade 3 has a

structure in which each of the shredding blades 22 are attached to a respective the multiple attaching surfaces 6a.

[0033]

As shown in Fig. 4, the cutting edge portion 9 of the first shredding blade 8a is formed on a foremost leading side in the rotational direction R. The cutting edge portion 9 of the third shredding blade 8c is formed on a foremost trailing side in the rotational direction R. The cutting edge portion 9 of the second shredding blade 8b is formed between the cutting edge portion 9 of the first shredding blade 8a and the cutting edge portion 9 of the third shredding blade 8c.

10 [0034]

As shown in Fig. 4, the cutting edge portions 9 of the shredding blades 8 are formed such that a circumferential distance (space) C1 between the cutting edge portion 9 of the first shredding blade 8a and the cutting edge portion 9 of the second shredding blade 8b, a circumferential distance C2 between the cutting edge portion 9 of the second shredding blade 8b and the cutting edge portion 9 of the third shredding blade 8c, a circumferential distance C3 between the cutting edge portion 9 of the third shredding blade 8c and the cutting edge portion 9 of the first shredding blade 8a attached on a trailing side in the rotational direction R are different from each other.

Specifically, the cutting edge portions 9 of the shredding blades 8 are formed such that the distances C2, C1, and C3 are increased in the listed sequence. All of the distances C1, C2, and C3 may not be necessarily different from each other, and at least one distance may be different from the other distances.

[0035]

As shown in Fig. 3, a maximum outer diameter (diameter defined by the position of the cutting edge 32 of the cutting edge portion 9) D1 of the first shredding

blade group 7a, a maximum outer diameter D2 of the second shredding blade group 7b, and a maximum outer diameter D3 of the third shredding blade group 7c are different from each other.

The diameter of the spacer 11 of each of the spacers 10 corresponds to the
5 maximum outer diameter of the corresponding shredding blade group 7 adjacent to the each spacer 10 in a horizontal direction (direction shown by reference sign W) perpendicular to the axial direction A. Specifically, each of the spacers 11 is formed to have a diameter smaller by the extent of an increase in the maximum outer diameter of the corresponding shredding blade group 7 having the same position in the axial direction
10 A as the each spacer 11.

More specifically, the diameter of each of the spacers 11 is set such that there is a predetermined minimum gap G between the each spacer 11 and the cutting edge 32 (the cutting edge portion 9) of the corresponding shredding blade group 7. As described above, since the maximum outer diameter D1 of the first shredding blade group 7a, the
15 maximum outer diameter D2 of the second shredding blade group 7b, and the maximum outer diameter D3 of the third shredding blade group 7c are different from each other, the diameters of the spacers 11 of the spacer 10 are different from each other. As shown in Fig. 3, a diameter S2 of a spacer 11b corresponding to the second shredding blade group 7b having the largest maximum outer diameter is smallest, and a diameter S1 of a spacer
20 11a corresponding to the first shredding blade group 7a having the smallest maximum outer diameter is largest.

[0036]

In the embodiment, since multiple shredding blades 8 are attached to one attaching surface 6a, and the positions of the cutting edge portions 9 are offset from each
25 other in the circumferential direction, it is possible to better prevent escape of a target

object compared to a structure in which one shredding blade is attached to one attaching surface.

In addition, it is possible to increase the number of cutting edge portions while ensuring the circumferential widths of the attaching surfaces compared to a structure in which the number of attaching surfaces is increased and the number of cutting edge portions is increased. That is, it is possible to increase the number of shredding blades while ensuring an attachment strength between the shredding blade 8 and the blade receiving base 6.

[0037]

Since the structure is adopted in which multiple shredding blades 8 are attached to one attaching surface 6a, it is possible to decrease the axial width of the shredding blade 8. It is possible to further increase a shredding force at an initial stage of pulverization due to a decrease in the width of the shredding blade 8. Since the circumferentially offset shredding blades 8 apply a shredding force to a target object in consecutive order, pulverization progresses smoothly, and the number of reverse revolutions of the rotational shafts 1 and 2 is decreased which is caused by an overload during pulverization, and thus, it is possible to reduce a shredding time.

[0038]

Since each of the spacers 11 is formed to have a diameter smaller by the extent of an increase in the diameter of the shredding blade group 7 having the same position in the axial direction A as the each spacer 11, it is possible to better prevent escape of a target object.

[0039]

Since the structure is adopted in which multiple shredding blades 8 are provided on one blade receiving base 6, it is possible to produce a pulverized object having a small

pulverized particle size (pulverization width) compared to the structure in which one shredding blade 8 is provided on one blade receiving base 6.

Since the distances C1, C2, and C3 between the cutting edge portions 9 are not the same, spaces S between cutting edge portions 9 adjacent to each other in the circumferential direction are different from each other. Accordingly, various sizes of target object can be inserted into the spaces S, and various shapes of target object can be pulverized.

[0040]

In the rotational blade 3, it is possible to replace only the shredding blade 8, and thus, compared to a shredding blade, of which the cutting edge portion is integrated in the related art, it is easy to replace the rotational blade 3 (the cutting edge portion 9). As a result, it is possible to reduce the length of time required to replace the rotational blade 3, and it is possible to reduce a cost.

[0041]

Hereinafter, a modified example of the first embodiment will be described.

As shown in Fig. 8, in the modified example, two shredding blades 8B of a rotational blade 3B are attached to one attaching surface 6a of the blade receiving base 6. In other words, the shredding blade 22 attached to one attaching surface 6a is configured to two shredding blades 8.

That is, as shown in the modified example, the number of shredding blades 8 attached to one attaching surface 6a is not limited to three. For example, in a case where the width of the rotational blade 3 in the axial direction A is desired to be reduced, as shown in this modified example, the number of overlapping shredding blade groups 7 is preferably decreased.

[0042]

Second Embodiment

Hereinafter, a rotational blade for a shredder in a second embodiment of the present invention will be described with reference to the accompanying drawings. The points of difference of the embodiment from the first embodiment will be mainly

5 described, and a description of the same portion will be omitted.

As shown in Fig. 9, in the embodiment, the cutting edge 32 of a cutting edge portion 9C of a shredding blade 8C of a rotational blade 3C is not parallel to the axial direction A, but is inclined with respect to the axial direction A.

[0043]

10 Specifically, a portion of each of the cutting edges 32 of the first shredding blade 8a and the third shredding blade 8c on an axial second side A2 is inclined toward the trailing side in the rotational direction R. A portion of the cutting edge 32 of the second shredding blade 8b on an axial first side A1 is inclined toward the trailing side in the rotational direction R.

15 In other words, the cutting edges 32 of three shredding blades 8C attached to one attaching surface 6a are inclined with respect to the axial direction when viewed in the radial direction of the rotational shafts 1 and 2. In addition, inclination directions of adjacent shredding blades 8 are opposite to each other.

[0044]

20 Hereinafter, the operation of the rotational blade 3C in the embodiment will be described. As shown in Fig. 9, when a target object is pulverized by the cutting edge portions 9 of the shredding blades 8, a pulverized object is directed as shown by reference sign F due to the inclination of the cutting edges 32. Since the pulverized object is oriented to either side in the axial direction A, a thrust force is applied to the
25 rotational shafts 1 and 2 in the axial direction A.

[0045]

In the embodiment, when the cutting edge portions 9 have pulverized a target object, a pulverized object is allocated to the axial first side A1 and the axial second side A2, thrust forces applied to the rotational shafts 1 and 2 cancel out each other.

5 Accordingly, it is possible to reduce a load applied to the rotational shafts 1 and 2 during pulverization.

[0046]

The rotational blades for a shredder in the embodiments of the present invention have been described. The present invention is not limited to the embodiments, and
10 changes can be appropriately made insofar as the changes do not depart from the concept of the present invention.

For example, the rotational blades in the embodiments are provided in a two-shaft shear type shredder; however, the present invention is not limited to that case, and the rotational blades can be also applied to a single-shaft rotary shredder or the like.

15 In addition, division of spacers is not necessarily required, and one spacer may be used for multiple shredding blade groups 7 which overlap each other in the axial direction A.

[0047]

While preferred embodiments of the invention have been described and shown
20 above, it should be understood that these are exemplary of the invention and are not to be considered as limiting. Additions, omissions, substitutions, and other modifications can be made without departing from the spirit or scope of the present invention.

Accordingly, the invention is not to be considered as being limited by the foregoing description and is only limited by the scope of the appended claims.

Reference Signs List

[0048]

1: ROTATIONAL SHAFT

2: ROTATIONAL SHAFT

5 3: ROTATIONAL BLADE

4: SHREDDING MECHANISM

5: DRIVE APPARATUS

6: BLADE RECEIVING BASE

6a: ATTACHING SURFACE

10 7, 7a, 7b, 7c: SHREDDING BLADE GROUP

7s: MAIN SURFACE

8, 8a, 8b, 8c: SHREDDING BLADE

8s: MAIN SURFACE

9: CUTTING EDGE PORTION

15 10: SPACER (MULTIPLE SPACERS)

11: SPACER

12: STEPPED PORTION

12a: ENGAGING SURFACE

14: PIN HOLE

20 15: PIN HOLE

16: PIN

17: CENTRAL HOLE

18: BOLT INSERTION HOLE

19: FEMALE SCREW HOLE

25 20: FIXING BOLT

21: CONTACT PORTION

22: SHREDDING BLADE (SHREDDING BLADE ASSEMBLY)

23: SPACER CENTRAL HOLE

25: CASING

5 30: CUTTING FACE

31: FLANK

32: CUTTING EDGE

100: SHREDDER

O1: AXIS

10 O2: AXIS

T1: AXIAL WIDTH

T2: AXIAL WIDTH

R: ROTATIONAL DIRECTION

What is claimed is:

1. A rotational blade comprising

5 a blade receiving base having a plurality of attaching surfaces which are formed in a circumferential direction thereof, the blade receiving base which is configured to be attached to a rotational shaft so that an axis of the blade receiving base is coincide with an axis of the rotational shaft, and

a shredding blade which is capable of attaching to each of the plurality of attaching surfaces,

10 wherein the shredding blade includes a first shredding blade and a second shredding blade which are attached to an attaching surface among of the plurality of attaching surfaces;

wherein the first shredding blade includes:

15 a first main surface of the first shredding blade which is perpendicular to the axis of the rotational shaft, and which is disposed on a first side of the rotational shaft,

a first contact portion which is in contact with the attaching surface, and

a first cutting edge portion protruding outward in a radial direction of the rotational shaft;

20 wherein the second shredding blade includes:

a first main surface of the second shredding blade, which is perpendicular to the axis of the rotational shaft, and which is disposed on the first side of the rotational shaft, and a second main surface of the second shredding blade which is disposed opposite to the first main surface, the second main surface which is disposed on
25 a second side of the rotational shaft,

a second contact portion which is in contact with the attaching surface,
and

a second cutting edge portion protruding outward in the radial direction
of the rotational shaft;

5 wherein the first and second shredding blades are arranged in a row along the
axis of the rotational shaft so that the first main surface of the first shredding blade is in
contact with the second main surface of the second shredding blade; and

 wherein the position of the first cutting edge portion is offset from the position
of the second cutting edge portion in a rotational direction of the rotational shaft.

10

2. The rotational blade according to claim 1,

 wherein the shredding blade further includes a third shredding blade which is
attached to the attaching surface;

 wherein the third shredding blade includes:

15 a second main surface of the third shredding blade which is
perpendicular to the axis of the rotational shaft, and which is disposed on the second side
of the rotational shaft,

 a third contact portion which is in contact with the attaching surface,
and

20 a third cutting edge portion protruding outward in the radial direction of
the rotational shaft;

 wherein the second and third shredding blades are arranged in the row along the
axis of the rotational shaft so that the first main surface of the second shredding blade is
in contact with the second main surface of the third shredding blade;

25 wherein the position of the third cutting edge portion is offset from the positions

of the first and second cutting edge portions in a rotational direction of the rotational shaft; and

wherein a length between the first edge portion and the second cutting edge portion is different from a length between the second edge portion and the third cutting edge portion.

3. The rotational blade according to claim 1,

wherein the shredding blade is attached to each of the plurality of attaching surfaces.

4. The rotational blade according to claim 2,

wherein the shredding blade is attached to each of the plurality of attaching surfaces.

5. A shredder comprising:

a casing;

a rotational shaft which is accommodated in the casing ;

the rotational blade according to any one of claims 1 to 4; and

a spacer;

wherein the rotational shaft includes a first rotational shaft and a second rotational shaft which is disposed parallel to the first rotational shaft;

wherein the rotational blade includes a plurality of rotational blades which are attached to the rotational shaft while being spaced apart from each other in an axial direction;

wherein the spacer includes a plurality of spacers which are attached to the

rotational shaft while the plurality of spacers and the plurality of rotational blades alternate with each other in the axial direction;

wherein the rotational blade attached to the first rotational shaft and the spacer attached to the second rotational shaft are disposed to have the same position in the axial

5 direction of the rotational shaft;

wherein the plurality of spacers overlap each other in the axial direction; and

wherein each of the plurality of spacers is formed to have a diameter smaller by the extent of an increase in the diameter of the corresponding shredding blade group

which has the same position in the axial direction of the rotational shaft and in which

10 multiple shredding blades are annularly disposed in a circumferential direction.