

DESCRIPTION

Title of Invention

BIAXIAL CRUSHER

[Technical Field]

[0001]

The present invention relates to a biaxial crusher.

Priority is claimed on Japanese Patent Application No. 2018-111871 filed on June 12, 2018, the content of which is incorporated herein by reference.

[Background Art]

[0002]

In the related art, a crusher such as a biaxial crusher is used as means for performing a crushing process with respect to waste matter such as wood (for example, wood material for biomass power generation), a bamboo material, combustible waste matter, and incombustible waste matter. In a waste matter processing facility (such as waste matter incineration plant), waste matter is processed by being crushed into a predetermined size (particle size) by means of a crusher and put into an incinerator or the like.

The biaxial crusher includes a pair of rotary shafts and a plurality of rotary blades attached to each rotary shaft. Each rotary blade includes a plurality crushing

blades provided at intervals in a circumferential direction.

[0003]

Patent Document 1 discloses, as a technique for preventing a long object such as a bamboo from slipping through a space between a pair of rotary shafts without being crushed in a biaxial crusher, a technique in which a large number of detachable crushing blades are attached.

In addition, Patent Document 2 discloses a technique in which a tip end portion of a rotary blade is formed in a mountain-like shape, a screen is formed in a valley-like shape along the rotation trajectory of the rotary blade, and waste matter is crushed into a size equal to or smaller than a predetermined size.

[Citation List]

[Patent Document]

[0004]

[Patent Document 1] Japanese Unexamined Patent Application Publication No. 2017-963

[Patent Document 2] Japanese Unexamined Patent Application Publication No. 2004-249194

Summary of Invention

[Technical Subject]

[0005]

Meanwhile, although a long object is prevented from slipping through in both of the techniques disclosed in

Patent Document 1 and Patent Document 2, a method of more efficiently crushing waste matter is desired.

For example, in the case of the technique described in Patent Document 1, crushing is performed between the pair of the rotary shafts only. Therefore, a desired particle size may not be achieved. Meanwhile, in the case of the technique described in Patent Document 2, crushing is not performed between a pair of rotary shafts and thus the advantage of being biaxial is not exhibited.

[0006]

An object of the invention is to provide a biaxial crusher with which it is possible to more efficiently crush waste matter into a size equal to or smaller than a predetermined size.

[Subject to be solved]

[0007]

According to an aspect of the present invention, there is provided a biaxial crusher which crushes waste matter, the biaxial crusher including: a pair of rotary shafts that is disposed at an interval in a horizontal direction such that the rotary shafts become parallel to each other; a plurality of rotary blades that are attached to each rotary shaft at intervals in an axial direction of the rotary shaft and perform primary crushing of the waste matter, a portion of rotation trajectories of the rotary blades attached to

one of the pair of the rotary shafts and a portion of rotation trajectories of the rotary blades attached to the other of the rotary shafts overlapping each other as seen in the axial direction; a plurality of spacers that are attached to each rotary shaft such that the spacers and the rotary blades alternate in the axial direction; and a screen part that is disposed below the pair of rotary shafts. The screen part includes a roof portion that is disposed between the pair of rotary shafts and extends in the axial direction, a roof base that supports the roof portion from below and extends in the axial direction, a screen blade base that is separated from the roof base in the horizontal direction and of which a main surface is disposed to be parallel to a main surface of the roof base in a width direction, a plurality of connection portions that connect the roof base and the screen blade base to each other with an opening provided between the connection portions adjacent to each other, and a screen blade that is attached to the screen blade base in the width direction and performs secondary crushing of the waste matter between the screen blade and the rotary blade that passes above the screen blade, and the roof portion is disposed to cover a portion of the opening.

[0008]

According to the biaxial crusher described above,

since the waste matter is subjected to the primary crushing and the secondary crushing, the waste matter can be efficiently crushed into a predetermined size and the waste matter can be crushed into a predetermined particle size more quickly.

[0009]

The biaxial crusher may further include: a casing that accommodates the rotary shaft and the screen part; a scraper that is fixed to the casing and extends in the axial direction beside the rotary shaft, the scraper including a plate-shaped first scraper piece that is disposed to be close to the spacer to fill a space between the casing and the spacer and a second scraper piece that alternately overlaps the first scraper piece in the axial direction and is disposed to be close to the rotary blade to fill a space between the casing and the rotary blade; and a scraper blade that is attached to the second scraper piece and performs tertiary crushing of the waste matter between the scraper blade and the rotary blade.

[0010]

According to such a configuration, since the waste matter is subjected to the tertiary crushing in addition to the primary crushing and the secondary crushing, the waste matter can be more efficiently crushed into the predetermined size.

[0011]

In the biaxial crusher, the rotary blade may include a plurality of crushing blades that are provided at intervals in a circumferential direction of an axis and each of which includes a protrusion of which a portion protrudes radially outward as seen in the circumferential direction, and at least one of the screen blade and the scraper blade may include a recess through which the protrusion passes.

[0012]

According to such a configuration, the waste matter can be crushed between the protrusion and the recess.

[0013]

In the biaxial crusher, the screen blade may further include an extending portion that extends toward the spacer and is close to the spacer.

[0014]

According to such a configuration, it is possible to prevent the waste matter from passing through a space between the spacer and the screen blade without being crushed.

[0015]

The biaxial crusher may further include a plurality of outer connection portions that connect the casing and the screen blade base with a second opening provided between the outer connection portions adjacent to each other.

[0016]

According to such a configuration, a space between the casing and the screen blade base can function as a screen.

[0017]

In the biaxial crusher, at least one of the screen blade and the scraper blade may be divided to correspond to each of the plurality of rotary blades.

[0018]

According to such a configuration, even in a case where the screen blade and the scraper blade are damaged due to wear or the like, the screen blade and the scraper blade can be easily replaced.

[Advantageous Effects of Invention]

[0019]

According to the present invention, since waste matter is subjected to primary crushing and secondary crushing, the waste matter can be efficiently crushed into a predetermined size and the waste matter can be crushed into a predetermined particle size more quickly.

[Brief Description of Drawings]

[0020]

Fig. 1 is a perspective view of a biaxial crusher according to an embodiment of the present invention.

Fig. 2 is a perspective view of crushing mechanisms, a screen unit, and scraper units according to the embodiment

of the present invention.

Fig. 3 is a top view of the biaxial crusher according to the embodiment of the present invention.

Fig. 4 is a sectional view taken along line IV-IV in Fig. 3.

Fig. 5 is a sectional view of a blade portion of the crushing mechanism according to the embodiment of the present invention.

Fig. 6 is an exploded perspective view of a rotary blade according to the embodiment of the present invention.

Fig. 7 is a top view for describing the shapes of a rotary blade, a spacer, and a scraper adjacent to each other in a width direction of the biaxial crusher according to the embodiment of the present invention.

Fig. 8 is a perspective view of the screen unit according to the embodiment of the present invention.

Fig. 9 is a top view of the screen unit according to the embodiment of the present invention.

Fig. 10 is a perspective view of a screen blade according to the embodiment of the present invention.

Fig. 11 is a perspective view of a first scraper piece according to the embodiment of the present invention.

Fig. 12 is a perspective view of a second scraper piece according to the embodiment of the present invention.

Fig. 13 is a sectional view of a scraper blade

according to the embodiment of the present invention as seen in an axial direction.

Fig. 14 is a view as seen along arrow XIV in Fig. 13.

Fig. 15 is a perspective view of the scraper blade according to the embodiment of the present invention.

Fig. 16 is a sectional view for describing the operation of the biaxial crusher according to the embodiment of the present invention.

Fig. 17 is a top view of a screen unit according to a first modification example of the present invention.

Fig. 18 is a perspective view of crushing mechanisms, a screen unit, and scraper units according to a second modification example of the present invention.

Fig. 19 is a top view of a screen unit according to a third modification example of the present invention.

Fig. 20 is a top view for describing the shapes of a rotary blade, a spacer, and a scraper adjacent to each other in a width direction of a biaxial crusher according to a fourth modification example of the present invention.

Fig. 21 is a top view of a screen unit according to a fifth modification example of the present invention.

[Description of Embodiments]

[0021]

Hereinafter, a biaxial crusher according to an embodiment of the present invention will be described in

detail with reference to the drawings.

The biaxial crusher of the present embodiment is a crusher that crushes waste matter such as wood, a bamboo material, combustible waste matter, and incombustible waste matter into a crushed material having a size equal to or smaller than a predetermined size (length, particle size). The biaxial crusher of the present embodiment is particularly suitable for crushing a wood material and a bamboo material containing a large amount of long waste matter.

[0022]

As shown in Figs. 1, 2, 3, and 4, a biaxial crusher 1 includes a pair of crushing mechanisms 3 including rotary blades 8, a screen unit 4 (screen part) that receives a crushed material crushed by the pair of crushing mechanisms 3 and makes the crushed material having a size equal to or smaller than a predetermined size fall to a lower side, a pair of scraper units 5, and a casing 2 accommodating the crushing mechanisms 3, the screen unit 4, and the scraper units 5. No drive device 10 constituting the crushing mechanisms 3 is shown in Fig. 1 and no casing 2 is shown in Fig. 2.

[0023]

The screen unit 4 is provided with a plurality of screen blades 29 that crush waste matter between a plurality

of the rotary blades 8 of the crushing mechanisms 3 and the screen blades 29. The scraper units 5 are provided with a plurality of scraper blades 35 that crush waste matter between the plurality of rotary blades 8 of the crushing mechanisms 3 and the scraper blades 35. In the following description, crushing performed in the crushing mechanisms 3 will be referred to as primary crushing, crushing performed between the rotary blades 8 and the screen blades 29 will be referred to as secondary crushing, and crushing performed between the rotary blades 8 and the scraper blades 35 will be referred to as tertiary crushing.

[0024]

Each of the crushing mechanisms 3 includes a rotary shaft 7, the plurality of rotary blades 8 attached to the rotary shaft 7, a plurality of spacers 9 attached to the rotary shaft 7, and the drive device 10 such as an electric motor rotationally driving the rotary shaft 7. Hereinafter, the rotary shaft 7 of one crushing mechanism 3 will be referred to as a first rotary shaft 7a and the rotary shaft 7 of the other crushing mechanism 3 will be referred to as a second rotary shaft 7b.

A pair of the rotary shafts 7 extends in a horizontal direction in the casing 2 such that the rotary shafts 7 become parallel to each other and is disposed to be able to rotate around axes A.

An axis A1 of the first rotary shaft 7a and an axis A2 of the second rotary shaft 7b are disposed to be separated from each other in a horizontal direction. Hereinafter, a direction along the axes A will be simply referred to as an axial direction Da. A horizontal direction orthogonal to the axial direction Da will be referred to as a width direction Y.

[0025]

Each of the first rotary shaft 7a and the second rotary shaft 7b is driven by the drive device 10. The first rotary shaft 7a is set to rotate in a direction T1 (clockwise) in Fig. 4 and the second rotary shaft 7b is set to rotate in a direction T2 (counterclockwise) in Fig. 4. That is, the first rotary shaft 7a and the second rotary shaft 7b are set such that waste matter passes through a space between the first rotary shaft 7a and the second rotary shaft 7b in a downward direction.

The first rotary shaft 7a and the second rotary shaft 7b are not rotated only in the direction T1 and the direction T2 in Fig. 4 and can also be rotated in reverse directions. For example, the rotary shafts 7 can be rotated in the reverse directions in a case where a large load is applied to the drive devices 10 during crushing or the like.

[0026]

The rotation speeds of output shafts of the drive

devices 10 can be set to any speed. The drive devices 10 can rotate the rotary shafts 7 at desired rotation speeds.

In the biaxial crusher 1, the first rotary shaft 7a is rotated at a high speed and the second rotary shaft 7b is rotated at a lower speed than the first rotary shaft 7a. The rotation speed of the first rotary shaft 7a and the rotation speed of the second rotary shaft 7b are different from each other and the rotation speed of the first rotary shaft 7a is higher than the rotation speed of the second rotary shaft 7b.

A configuration in which two rotary shafts 7 are driven by means of one drive device 10 and a gear mechanism transmitting the driving force of the drive device 10 to the two rotary shafts 7 may also be adopted. That is, a configuration in which a single drive device 10 drives a pair of rotary shafts 7 may also be adopted.

[0027]

The plurality of rotary blades 8 are attached at intervals in the axial direction Da of the rotary shaft 7. Each of the plurality of spacers 9 is attached between the rotary blades 8 that are adjacent to each other in the axial direction Da. The rotary blades 8 and the spacers 9 are alternately disposed in the axial direction Da. The width (thickness) of the rotary blades 8 in the axial direction Da and the width of the spacers 9 in the axial direction Da

are the same as each other.

[0028]

As shown in Fig. 4, the sectional shape of the rotary shaft 7 is hexagonal. The rotary shaft 7 is rotated around the axis A by the drive device 10. The sectional shape of the rotary shaft 7 may be quadrangular, for example, as long as the sectional shape is polygonal. The rotary shaft 7 may have a circular section and the spacers 9 and the rotary blades 8 may be fixed by means of a key.

[0029]

The rotary blade 8 includes a disk portion 11 (blade base) and a plurality of blade portions 12 that are detachably attached to the outer periphery of the disk portion 11 and are arranged in parallel in a circumferential direction of the axis A. The rotary blade 8 in the present embodiment includes six blade portions 12 (crushing blades 14) provided at intervals in the circumferential direction of the axis A. The blade portions 12 are attached to the disk portion 11 by means of bolts 19 (refer to Fig. 5).

[0030]

In the disk portion 11, a hexagonal center hole 11b corresponding to the sectional shape of the rotary shaft 7 is formed. The rotary shaft 7 is inserted into the center hole 11b of the disk portion 11.

The disk portion 11 has an approximately hexagonal

shape as seen in the axial direction Da. The blade portions 12 are respectively attached to six end surfaces 11a of the disk portion 11, the end surfaces 11a facing radial outer sides.

[0031]

As shown in Fig. 5, a step portion 11c including an engaging surface 11d that faces the circumferential direction of the axis A is formed on each of the six end surfaces 11a of the disk portion 11 that face the radial outer sides. A step portion 12c including an engaging surface 12d that faces the circumferential direction of the axis A is formed on an abutment surface 12a of each of the blade portions 12 that abut against the end surfaces 11a of the disk portion 11.

The step portions 11c of the disk portion 11 and the step portions 12c of the blade portions 12 are engaged with each other with the engaging surfaces 11d and 12d brought into surface-contact with each other.

[0032]

Each blade portion 12 includes the crushing blade 14 that protrudes to a radial outer side with respect to the axis A. The crushing blade 14 includes a rake surface 14a that faces a front side in a rotation direction R, a tip end 17 of the crushing blade 14, and a flank surface 14b that extends rearward from the tip end 17 as seen in the

rotation direction R.

The abutment surfaces 12a of the blade portions 12 and the end surfaces 11a of the disk portion 11 are positionally aligned with each other, with columnar pins 15 fitted into pin holes 12e formed in the abutment surfaces 12a of the blade portions 12 and pin holes 11e formed in the end surfaces 11a of the disk portion 11, the columnar pins 15 being approximately equal to the pin holes 12e and the pin holes 11e in diameter.

[0033]

As shown in Fig. 4, a portion of a rotation trajectory L81 of tip ends of the rotary blades 8 attached to the first rotary shaft 7a and a portion of a rotation trajectory L82 of tip ends of the rotary blades 8 attached to the second rotary shaft 7b overlap each other as seen in a direction along the axes A.

In other words, as shown in Fig. 7, a maximum diameter D8 of the rotary blade 8 is greater than an axis-to-axis distance DA of the first rotary shaft 7a and the second rotary shaft 7b.

[0034]

The rotary blades 8 attached to the first rotary shaft 7a and the rotary blades 8 attached to the second rotary shaft 7b are disposed to alternate in the axial direction Da.

The spacers 9 attached to the second rotary shaft 7b are disposed to be adjacent to the rotary blades 8 attached to the first rotary shaft 7a in the width direction Y and the rotary blades 8 attached to the second rotary shaft 7b are disposed to be adjacent to the spacers 9 attached to the first rotary shaft 7a in the width direction Y.

[0035]

As shown in Figs. 2 and 6, the crushing blade 14 (rotary blade 8) includes a crushing blade protrusion 16 (protrusion) that partially protrudes radially outward as seen in the circumferential direction of the axis A. The crushing blade protrusion 16 of the crushing blade 14 in the present embodiment is formed such that a central portion thereof in the axial direction Da has a sharp shape (mountain-like shape). The crushing blade protrusion 16 is formed such that the thickness thereof in the axial direction Da gradually decreases toward a radial outer side.

The crushing blade protrusion 16 includes the tip end 17 that extends in the circumferential direction and a pair of crushing blade inclined surfaces 18 that connects the tip end 17 and a main surface of the crushing blade 14 to each other. The pair of crushing blade inclined surfaces 18 is disposed such that the crushing blade inclined surfaces 18 intersect at the tip end 17. An angle formed between the pair of crushing blade inclined surfaces 18 may

be, for example, 80° to 100°.

[0036]

As shown in Figs. 3 and 7, the spacer 9 includes a spacer recess 20 of which the central portion in the axial direction Da is recessed radially inward as seen in the circumferential direction of the axis A. The spacer recess 20 is formed by a pair of spacer inclined surfaces 21 of which the diameter gradually decreases toward the central portion in the axial direction Da.

[0037]

As shown in Figs. 2, 4, 8, and 9, the screen unit 4 includes a roof portion 23 that extends in the axial direction Da below the pair of rotary shafts 7 and receives a crushed material falling from a space between the pair of crushing mechanisms 3 after being subjected to primary crushing, a roof base 24 that supports the roof portion 23 from below and extends in the axial direction Da, a pair of screen blade bases 25 disposed to be parallel to the roof base 24, a plurality of connection portions 26 that connect the roof base 24 and the screen blade bases 25 to each other, and the screen blades 29 attached to the screen blade bases 25.

[0038]

The connection portions 26 include a pair of first connection portions 27 disposed at opposite ends in the

axial direction Da and a plurality of second connection portions 28 disposed between the pair of first connection portions 27. The screen unit 4 includes a frame 30 formed by the pair of first connection portions 27 and the pair of screen blade bases 25. With the frame 30 fixed to the casing 2, the screen unit 4 is fixed to the casing 2.

[0039]

The roof portion 23 extends in the axial direction Da below the pair of crushing mechanisms 3. The roof portion 23 is disposed at an intermediate position between the pair of rotary shafts 7 as seen from above. The roof portion 23 is disposed at a position to which a crushed material crushed by the pair of crushing mechanisms 3 falls.

The roof portion 23 has a shape like a gabled roof and includes a pair of inclined surfaces 23b each of which is inclined such that the height thereof decreases toward an outer side in the width direction Y from a ridge 23a extending in the axial direction Da. That is, the pair of inclined surfaces 23b of the roof portion 23 is inclined such that the height thereof becomes low at the outer side in the width direction Y.

[0040]

The roof base 24 is a rectangular plate-shaped member of which a main surface faces the width direction Y. An upper end of the roof base 24 is connected to the vicinity

of the ridge 23a of the roof portion 23.

Each screen blade base 25 is a rectangular plate-shaped member of which a main surface faces the width direction Y as with the roof base 24. The screen blade bases 25 are disposed to be parallel to the roof base 24 while being separated from the roof base 24 in a horizontal direction.

[0041]

Each second connection portion 28 is a plate-shaped member disposed such that a main surface thereof faces the axial direction Da and intersects the main surfaces of the roof base 24 and the screen blade bases 25. The second connection portions 28 are disposed at intervals in the axial direction Da. An opening 31a through which a crushed material having a size equal to or smaller than the predetermined size passes is provided between the second connection portions 28 that are adjacent to each other in the axial direction Da. The opening 31a has a rectangular shape as seen from above. The size of the opening 31a can be appropriately changed in accordance with the size (particle size) of a crushed material to be discharged from the screen unit 4.

[0042]

The roof portion 23 is disposed to partially cover the openings 31a. The width of the roof portion 23 in the width

direction Y can be changed in accordance with the properties of a crushed material, the area of the openings 31a to be reduced by the roof portion 23, or the like.

[0043]

The screen blades 29 are fixed to the screen blade bases 25 and cooperate with the rotary blades 8 to perform secondary crushing of a crushed material that remains on the screen unit 4 without falling through the openings 31a. The screen blades 29 are divided into a plurality of parts corresponding to the rotary blades 8. Each screen blade 29 is a plate-shaped member of which a main surface faces the width direction Y. The screen blades 29 are fixed to outer surfaces (surfaces facing outer sides in width direction Y) of the screen blade bases 25 by means of fastening members such as bolts 41.

[0044]

As shown in Fig. 10, a screen blade recess 39 through which the crushing blade protrusions 16 of the rotary blade 8 pass is formed at each screen blade 29. The screen blade recess 39 includes a pair of screen blade inclined surfaces 40 that corresponds to the crushing blade inclined surfaces 18 of the crushing blade protrusions 16. The screen blade inclined surfaces 40 are disposed such that a slight gap is provided between the screen blade inclined surfaces 40 and the rotation trajectories of the crushing blade inclined

surfaces 18.

[0045]

As shown in Figs. 2, 3, and 4, the scraper units 5 include scrapers 32 that are fixed to side walls 2a of the casing 2, extend in the axial direction Da beside the rotary shafts 7, and protrude toward the rotary blades 8 and the spacers 9 and the scraper blades 35 attached to the scrapers 32.

The scrapers 32 prevent waste matter from falling to a space between the rotary blades 8 and the casing 2 or scrape waste matter interposed between the rotary blades 8.

[0046]

The scrapers 32 include a plurality of plate-shaped first scraper pieces 33 corresponding to the spacers 9 and a plurality of plate-shaped second scraper pieces 34 corresponding to the rotary blades 8. The first scraper pieces 33 are disposed to be close to the spacers 9 such that to fill spaces between the casing 2 and the spacers 9. The second scraper pieces 34 are disposed to be close to the rotary blades 8 to fill spaces between the casing 2 and the rotary blades 8. The scrapers 32 are formed with the first scraper pieces 33 and the second scraper pieces 34 alternately overlapping each other in the axial direction Da.

[0047]

As shown in Fig. 11, each first scraper piece 33 includes a first upper surface 42 that faces an upper side and of which the height decreases away from the side wall 2a of the casing 2 and a first lower surface 43 that faces a lower side and of which the height increases away from the side wall 2a of the casing 2. The first upper surface 42 and the first lower surface 43 extend up to the vicinity of an outer peripheral surface of the spacer 9.

The first scraper piece 33 is provided with a scraper protrusion 46 corresponding to the spacer recess 20 of the spacer 9. The scraper protrusion 46 is curved to match an outer peripheral surface (spacer recess 20) of the spacer 9. The scraper protrusion 46 includes a tip end 47 that extends in the circumferential direction and a pair of scraper protrusion inclined surfaces 48 that connects the tip end 47 and a main surface of the first scraper piece 33 to each other.

[0048]

As shown in Fig. 12, each second scraper piece 34 includes a second upper surface 44 that faces an upper side and of which the height decreases away from the side wall 2a of the casing 2 and a second lower surface 45 that faces a lower side and of which the height increases away from the side wall 2a of the casing 2. The second upper surface 44 and the second lower surface 45 extend up to the vicinity

the rotation trajectories of the crushing blades 14 of the rotary blade 8.

The second scraper piece 34 is provided with a scraper recess 49 corresponding to the crushing blade protrusions 16 of the rotary blade 8. The scraper recess 49 is curved to match the rotation trajectory of the rotary blade 8. The scraper recess 49 is formed by a pair of scraper recess inclined surfaces 50 that gradually extends in a direction away from the closest axis A toward a central portion in the axial direction Da.

[0049]

The first scraper pieces 33 and the second scraper pieces 34 are formed such that the first upper surfaces 42 and the second upper surfaces 44 are disposed on the same plane and the first lower surfaces 43 and the second lower surfaces 45 are disposed on the same plane when the first scraper pieces 33 and the second scraper pieces 34 are caused to alternately overlap each other in the axial direction Da.

[0050]

As shown in Figs. 13 and 14, the scraper blades 35 are attached to the second lower surfaces 45 of the second scraper pieces 34 and cooperate with the rotary blades 8 to perform tertiary crushing of waste matter. The scraper blades 35 are divided into a plurality of parts

corresponding to the rotary blades 8. The scraper blades 35 are plate-shaped members and are fixed to the second lower surfaces 45 of the second scraper pieces 34 by means of fastening members such as the bolts 41.

As shown in Fig. 15, a scraper blade recess 51 corresponding to the crushing blade protrusions 16 of the rotary blade 8 is formed at each scraper blade 35. The scraper blade recess 51 includes a pair of scraper blade inclined surfaces 52 that corresponds to the crushing blade inclined surfaces 18 of the crushing blade protrusions 16.

[0051]

As shown in Fig. 7, the spacer 9 and the rotary blade 8 are formed such that a slight gap G is provided between the spacer inclined surfaces 21 and the crushing blade inclined surfaces 18 when the crushing blade protrusion 16 of the rotary blade 8 becomes closest to the spacer recess 20 of the spacer 9. That is, the shape of the rotation trajectory of the crushing blade protrusion 16 of the rotary blade 8 and the shape of the spacer recess 20 of the spacer 9 are complementary.

[0052]

The spacer 9 and the first scraper piece 33 are formed such that a slight gap is provided between the spacer inclined surfaces 21 of the spacer 9 and the scraper protrusion inclined surfaces 48 of the first scraper piece

33. That is, the shape of the spacer recess 20 of the spacer 9 and the shape of the scraper protrusion 46 of the first scraper piece 33 are complementary.

[0053]

The rotary blade 8 and the second scraper piece 34 are formed such that a slight gap is provided between the crushing blade inclined surfaces 18 and the scraper recess inclined surfaces 50 when the crushing blade protrusion 16 of the rotary blade 8 becomes closest to the scraper recess 49 of the second scraper piece 34. That is, the shape of the rotation trajectory of the crushing blade protrusion 16 at the time of rotation of the rotary blade 8 and the shape of the scraper recess 49 of the second scraper piece 34 are complementary.

[0054]

As shown in a part P of Fig. 2, the rotary blade 8 and the screen blade 29 are formed such that a slight gap is provided between the crushing blade inclined surfaces 18 and the screen blade inclined surfaces 40 when the crushing blade protrusion 16 of the rotary blade 8 becomes closest to the screen blade recess 39 of the screen blade 29.

[0055]

Similarly, the rotary blade 8 and the scraper blade 35 are formed such that a slight gap is provided between the crushing blade inclined surfaces 18 and the scraper blade

inclined surfaces 52 when the crushing blade protrusion 16 of the rotary blade 8 becomes closest to the scraper blade recess 51 of the scraper blade 35.

A gap between the rotary blade 8 and the screen blade 29 and a gap between the rotary blade 8 and the scraper blade 35 are smaller than a gap between the spacer 9 and the scraper 32 and a gap between the rotary blade 8 and the scraper 32.

[0056]

As shown in Fig. 16, in the biaxial crusher 1 configured as described above, when waste matter W1 is put into the casing 2, the rotary blades 8 of the first rotary shaft 7a rotate in the direction T1 and the rotary blades 8 of the second rotary shaft 7b rotate in the direction T2 which is opposite to the direction T1 so that primary crushing of the waste matter W1 is performed. Crushed materials W2 are discharged to a space below the pair of rotary shafts 7 and fall onto the roof portion 23. The crushed materials W2 falling onto the roof portion 23 are guided to any side in the width direction Y by the inclined surfaces 23b. The crushed material W2 having a size equal to or smaller than a predetermined size from among the crushed materials W2 falls to a lower side via the openings 31a of the screen unit 4. That is, the crushed material W2 having a size equal to or smaller than the predetermined

size is discharged from the biaxial crusher 1 without being further crushed.

[0057]

Meanwhile, the crushed material W2 remaining on the screen unit 4 without falling through the openings 31a is guided to spaces between the screen blades 29 and the rotary blades 8 with the rotary shafts 7 rotating and is subjected to secondary crushing. That is, in the biaxial crusher 1 of the present embodiment, the crushed material W2 subjected to crushing (primary crushing) performed by the pair of crushing mechanisms 3 is further crushed.

[0058]

The crushed material W2 discharged to the outside of the screen unit 4 after being subjected to the secondary crushing falls to the lower side via openings 31b between the screen unit 4 and the casing 2. Here, the crushed material W2 that is caught between the crushing blades 14 of the rotary blades 8 without falling through the openings 31b between the screen unit 4 and the casing 2 is guided to spaces between the scraper blades 35 and the rotary blades 8 and is subjected to tertiary crushing.

[0059]

According to the above-described configuration, since waste matter is subjected to primary crushing performed by the crushing mechanisms 3 and secondary crushing performed

by the screen blades 29, the waste matter can be efficiently crushed into a predetermined size and the waste matter can be crushed into a predetermined particle size more quickly.

In addition, since tertiary crushing is performed by the scraper blades 35, the efficiency of the crushing can be improved.

[0060]

That is, since the crushing blade protrusions 16 are provided at the crushing blades 14 of the rotary blades 8, and the screen blades 29 and the scraper blades 35 corresponding to the crushing blades 14 are provided at the screen unit 4 and the scrapers 32, a crushed material can be further crushed.

[0061]

In addition, since the screen blades 29 and the scraper blades 35 are divided to correspond to the rotary blades 8, replacement can be performed with respect to only a necessary place in a case where the screen blades 29 or the scraper blades 35 are worn. That is, the cost of operating the biaxial crusher 1 can be reduced.

In addition, since the screen blades 29 are fixed to outer sides of the screen blade bases 25, attachment and detachment of the screen blades 29 can be performed easily.

[0062]

Note that, in the above-described embodiment, the

screen unit 4 is provided with the screen blades 29 for secondary crushing and the scraper units 5 are provided with the scraper blades 35 for tertiary crushing. However, the invention is not limited thereto. For example, the scraper units 5 may be provided with no scraper blade 35.

In addition, in the above-described embodiment, the screen blades 29 are provided with the screen blade recesses 39 and the scraper blades 35 are provided with the scraper blade recesses 51. However, the invention is not limited thereto. At least one of the screen blades 29 and the scraper blades 35 may have a simple shape without a recess.

[0063]

[First Modification Example]

Hereinafter, a crusher according to a first modification example of the present invention will be described in detail with reference to the drawings. Note that, in the present modification example, the description will be made focusing on a difference between the modification example and the above-described embodiment and description on the similar part will be omitted.

As shown in Fig. 17, screen blades 29B in the present modification example include screen blade protrusions 54 (extending portion) that are adjacent to the screen blade recesses 39, extend toward the spacers 9, and are close to the spacers 9. The screen blade protrusions 54 extend up

to the vicinities of the outer peripheral surfaces of the spacers 9. Each screen blade protrusion⁵⁴ includes a tip end 55 and a pair of screen blade protrusion inclined surfaces 56 formed such that a slight gap is provided between the spacer inclined surfaces 21 and the screen blade protrusion inclined surfaces 56.

[0064]

According to the above-described modification example, it is possible to prevent waste matter from passing through a space between the spacers 9 and the screen blades 29 without being crushed.

[0065]

[Second Modification Example]

Hereinafter, a crusher according to a second modification example of the present invention will be described in detail with reference to the drawings. Note that, in the present modification example, the description will be made focusing on a difference between the modification example and the above-described embodiment and description on the similar part will be omitted.

As shown in Fig. 18, screen blades 29C in the present modification example are integrally formed. That is, the screen blades 29C in the present modification example are not divided to correspond to the rotary blades 8.

[0066]

According to the above-described modification example, it is possible to improve the rigidity of the screen blade 29C and to improve the rigidity of the screen unit 4. In addition, it is possible to reduce the number of the bolts 41 for fixing the screen blade 29C to the screen blade base 25.

Note that, the screen blades 29B in the first modification example can also be integrally formed as with the screen blades 29C in the second modification example.

[0067]

[Third Modification Example]

Hereinafter, a crusher according to a third modification example of the present invention will be described in detail with reference to the drawings. Note that, in the present modification example, the description will be made focusing on a difference between the modification example and the above-described embodiment and description on the similar part will be omitted.

As shown in Fig. 19, the screen blades 29 in the present modification example are fixed to inner sides of the screen blade bases 25 although the screen blades 29 in the embodiment are fixed to the outer sides of the screen blade bases 25. That is, the screen blades 29 in the present modification example are fixed to surfaces of the pair of screen blade bases 25 that face each other.

[0068]

According to the above-described modification example, the screen blades 29 are supported by the screen blade bases 25 (frame body) when the screen blades 29 receive the torque of the rotary blades 8. Accordingly, it is possible to prevent the screen blades 29 from falling off due to the rotation torque of the rotary blades 8 and thus it is possible to reduce the number of the bolts 41.

Note that, the screen blades 29B in the first modification example may be fixed to the inner sides of the screen blade bases 25 and the screen blades 29 to be fixed to the inner sides of the screen blade bases 25 may be integrally formed.

[0069]

[Fourth Modification Example]

Hereinafter, a crusher according to a fourth modification example of the present invention will be described in detail with reference to the drawings. Note that, in the present modification example, the description will be made focusing on a difference between the modification example and the above-described embodiment and description on the similar part will be omitted.

As shown in Fig. 20, the crushing blade 14 of the rotary blade 8 in the present modification example includes a crushing blade protrusion 16A that is rectangular as seen

in the circumferential direction of the axis A.

[0070]

The spacer 9 in the present modification example includes a spacer recess 20A that has a rectangular shape corresponding to the rotation trajectory of the crushing blade protrusion 16A. Similarly, the second scraper piece 34 in the present modification example includes a scraper recess 49A that has a rectangular shape corresponding to the rotation trajectory of the crushing blade protrusion 16A and the first scraper piece 33 includes a scraper protrusion 46A that has a rectangular shape corresponding to the spacer recess 20A. Although not shown, a screen blade recess 39A of the screen blade 29 and a scraper blade recess 51A of the scraper blade 35 also have rectangular shapes corresponding to the rectangular crushing blade protrusion 16A.

[0071]

According to the above-described modification example, it is possible to positively crush waste matter between the rotary blades 8 and the scrapers 32.

[0072]

[Fifth Modification Example]

Hereinafter, a crusher according to a fifth modification example of the present invention will be described in detail with reference to the drawings. Note

that, in the present modification example, the description will be made focusing on a difference between the modification example and the above-described embodiment and description on the similar part will be omitted.

As shown in Fig. 21, in the present modification example, the screen blade bases 25 and the side walls 2a of the casing 2 are connected by a plurality of outer connection portions 58. Since the plurality of outer connection portions 58 are provided, a plurality of second openings 31c are formed between the screen blade bases 25 and the casing 2. That is, in a biaxial crusher in the present modification example, a screen is provided between the screen unit 4 and the casing 2 also.

[0073]

Each outer connection portion 58 is a plate-shaped member disposed such that a main surface thereof faces the axial direction Da and intersects main surfaces of the screen blade bases 25 and the side walls 2a. The outer connection portions 58 are disposed at intervals in the axial direction Da. The second opening 31c through which a crushed material having a size equal to or smaller than a predetermined size passes is provided between the outer connection portions 58 that are adjacent to each other in the axial direction Da. The size of the second opening 31c can be appropriately changed.

[0074]

According to the above-described modification example, a space between a casing and a screen blade base can function as a screen.

[0075]

Hereinabove, the embodiment of the present invention has been described in detail with reference to the drawings. However, a specific configuration is not limited to the embodiment and design changes can be made without departing from the gist of the present invention.

[Industrial Applicability]

[0076]

According to the biaxial crusher described above, since waste matter is subjected to primary crushing and secondary crushing, the waste matter can be efficiently crushed into a predetermined size and the waste matter can be crushed into a predetermined particle size more quickly.

[Reference Signs List]

[0077]

- 1: biaxial crusher
- 2: casing
- 2a: side wall
- 3: crushing mechanism
- 4: screen unit (screen part)
- 5: scraper unit

7: rotary shaft
7a: first rotary shaft
7b: second rotary shaft
8: rotary blade
9: spacer
10: drive device
11: disk portion
11a: end surface
11b: center hole
11c: step portion
11d: engaging surface
12: blade portion
12a: abutment surface
12c: step portion
12d: engaging surface
14: crushing blade
14a: rake surface
14b: flank surface
15: pin
16: crushing blade protrusion
17: tip end
18: crushing blade inclined surface
19: bolt
20: spacer recess
21: spacer inclined surface

23: roof portion
23a: ridge
23b: inclined surface
24: roof base
25: screen blade base
26: connection portion
27: first connection portion
28: second connection portion
29: screen blade
29B: screen blade
29C: screen blade
30: frame
31a, 31b: opening
31c: second opening
32: scraper
33: first scraper piece
34: second scraper piece
35: scraper blade
39: screen blade recess
40: screen blade inclined surface
41: bolt
42: first upper surface
43: first lower surface
44: second upper surface
45: second lower surface

46: scraper protrusion
47: tip end
48: scraper protrusion inclined surface
49: scraper recess
50: scraper recess inclined surface
51: scraper blade recess
52: scraper blade inclined surface
54: screen blade protrusion
55: tip end
56: screen blade protrusion inclined surface
58: outer connection portion
A (A1, A2): axis
Da: axial direction
G: gap
Y: width direction

Claims

[Claim 1]

A biaxial crusher which crushes waste matter, the biaxial crusher comprising:

a pair of rotary shafts that is disposed at an interval in a horizontal direction such that the rotary shafts become parallel to each other;

a plurality of rotary blades that are attached to each rotary shaft at intervals in an axial direction of the rotary shaft and perform primary crushing of the waste matter, a portion of rotation trajectories of the rotary blades attached to one of the pair of the rotary shafts and a portion of rotation trajectories of the rotary blades attached to the other of the rotary shafts overlapping each other as seen in the axial direction;

a plurality of spacers that are attached to each rotary shaft such that the spacers and the rotary blades alternate in the axial direction; and

a screen part that is disposed below the pair of rotary shafts,

wherein the screen part includes

a roof portion that is disposed between the pair of rotary shafts and extends in the axial direction,

a roof base that supports the roof portion from

below and extends in the axial direction,

a screen blade base that is separated from the roof base in the horizontal direction and of which a main surface is disposed to be parallel to a main surface of the roof base in a width direction,

a plurality of connection portions that connect the roof base and the screen blade base to each other with an opening provided between the connection portions adjacent to each other, and

a screen blade that is attached to the screen blade base in the width direction and performs secondary crushing of the waste matter between the screen blade and the rotary blade that passes above the screen blade, and

wherein the roof portion is disposed to cover a portion of the opening.

[Claim 2]

The biaxial crusher according to claim 1, further comprising:

a casing that accommodates the rotary shaft and the screen part;

a scraper that is fixed to the casing and extends in the axial direction beside the rotary shaft, the scraper including a plate-shaped first scraper piece that is disposed to be close to the spacer to fill a space between the casing and the spacer and a second scraper piece that

alternately overlaps the first scraper piece in the axial direction and is disposed to be close to the rotary blade to fill a space between the casing and the rotary blade; and

a scraper blade that is attached to the second scraper piece and performs tertiary crushing of the waste matter between the scraper blade and the rotary blade.

[Claim 3]

The biaxial crusher according to claim 2,

wherein the rotary blade includes a plurality of crushing blades that are provided at intervals in a circumferential direction of an axis and each of which includes a protrusion of which a portion protrudes radially outward as seen in the circumferential direction, and

wherein at least one of the screen blade and the scraper blade includes a recess through which the protrusion passes.

[Claim 4]

The biaxial crusher according to claim 3,

wherein the screen blade further includes an extending portion that extends toward the spacer and is close to the spacer.

[Claim 5]

The biaxial crusher according to any one of claims 2 to 4, further comprising:

a plurality of outer connection portions that connect the casing and the screen blade base with a second opening provided between the outer connection portions adjacent to each other.

[Claim 6]

The biaxial crusher according to any one of claims 2 to 5,

wherein at least one of the screen blade and the scraper blade is divided to correspond to each of the plurality of rotary blades.