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(54) **METHOD FOR REPLACING CHOKE RING OF VERTICAL CRUSHER AND VERTICAL CRUSHER**

(57) Provided is a method for replacing a choke ring of a vertical shredder including a feed hopper, a shell, a shredding mechanism, a discharge ring, and a choke ring disposed between the shell and the discharge ring and forming a gap between it and the shredding mechanism, the gap allowing shredded fractions to fall therethrough, the feed hopper, the shell, and the discharge ring forming a hollow space therein, the vertical shredder including a spacer forming an extended space that extends the hollow space along a direction of an axle. The method includes: a clamping pressure reduction step of reducing or releasing clamping pressure between members clamping the spacer; a spacer detachment step of removing the spacer after the clamping pressure reduction step; and a choke ring replacement step of replacing the choke ring by pulling it radially outward using a space ensured by the spacer detachment step.

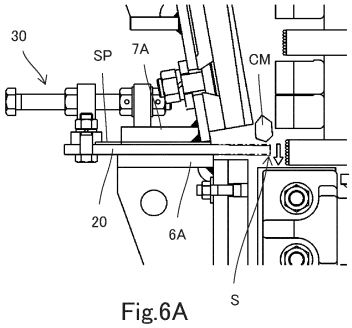

Fig.6A

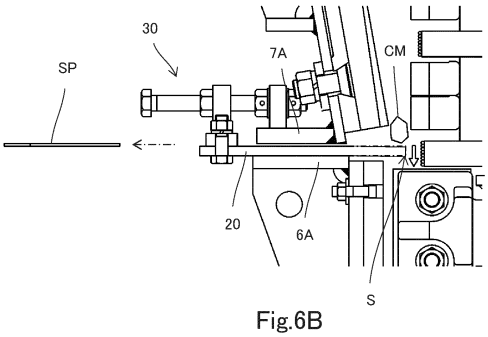

Fig.6B

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Description

Technical Field

[0001] The present invention relates to a method for replacing a choke ring of a vertical shredder that shreds discarded home appliances, bulky or noncombustible wastes, scrap metal, etc. and to a vertical shredder.

Background Art

[0002] Vertical shredders are used to perform shredding processes on large home appliances and other wastes for their reuse as resources and other purposes.

[0003] A vertical shredder includes: a feed hopper into which objects to be shredded are fed; a shell disposed below a lower end of the feed hopper; a shredding mechanism configured to rotate around an axle provided at the center of the shell; a discharge ring into which shredded fractions shredded between the shell and the shredding mechanism fall; and a choke ring disposed between a lower flange of the shell and an upper flange of the discharge ring and configured to form a gap between the choke ring and the shredding mechanism, the gap allowing the shredded fractions to fall therethrough.

[0004] The shredding mechanism is composed of a rotor configured to rotate around the axle and a breaker provided above the rotor. The rotor includes disks arranged in a plurality of stages (e.g., three stages) in the vertical direction and a plurality of shredding grinders supported on outer peripheral portions of the disks such that the shredding grinders can freely rotate. After being coarsely shredded by the breaker, the objects to be shredded are finely shredded between shell liners provided inside the shell and the shredding grinders.

[0005] Patent Literature 1 discloses a fraction size adjustment device of a shredder. In the fraction size adjustment device, each of movable choke rings, as separated by the intervention of members thicker than the movable choke rings between a lower flange of a shell and an upper flange of a discharge ring, is advanceable and retractable in the radial direction of the shell, and an outer end of each movable choke ring is protruded outward relative to the flanges. The protruded end of each movable choke ring and an outer side of the shell are coupled by means of a screw or cylinder jack, and the jack allows each movable choke ring to advance and retract radially.

[0006] Patent Literature 2 discloses a fraction size adjustment mechanism of a shredder. In the fraction size adjustment mechanism, movable choke rings that can advance and retract radially are provided at a plurality of locations between a lower flange of a shell and an upper flange of a discharge ring, and an inner peripheral edge of each movable choke ring is formed as a comb edge with a plurality of cutouts. Each movable choke ring is provided with a moving means to advance and retract it radially and a securing means to secure the movable choke ring integrally between the lower and upper flanges at a predetermined position.

[0007] The fraction size adjustment mechanism of a shredder as disclosed includes the movable choke ring that is formed of two ring plates, i.e., an upper choke ring plate with a comb edge and a lower choke ring plate with an arc peripheral edge, and the lower choke ring plate is movably overlapped on the upper choke ring plate such that the arc peripheral edge of the lower choke ring plate overlaps the cutouts of the comb edge of the upper choke ring plate at any positions. Thus, the fraction size adjustment mechanism is configured to set a predetermined gap between the rotor and the inner peripheral end of the comb edge, where the predetermined gap is at or below a set fraction size, and to enable fine adjustment to the fraction size.

Citation List

Patent Literature

[0008]

Patent Literature 1: Japanese Unexamined Utility Model Application Publication No. H5-074641

Patent Literature 2: Japanese Unexamined Patent Application Publication No. 2003-117414

Summary of Invention

Technical Problem

[0009] Both of the above mechanisms are configured to regulate the size of the gap between the lower end of the shredding mechanism and the inner distal edge of the choke ring by radially advancing and retracting the choke ring and thereby adjust the fraction size of the shredded fractions falling through the gap into the discharge ring.

[0010] Once the choke ring wears, the lower flange of the shell is jacked up from the upper flange of the discharge ring to form a slight gap between the flanges, through which the choke ring is pulled radially outward for replacement with a new choke ring.

[0011] However, if shredded factions having been shredded between the shell liners and the shredding mechanism fall onto, and collide with, the inner distal end region of the choke ring as they fall into the discharge ring, a distortion effect may occur that causes the inner distal end of the choke ring to be inclined downward over time.

[0012] In such cases, when one attempts to pull the distorted choke ring radially outward for its replacement, the choke ring would not be pulled radially outward because the distorted region of the choke ring gets caught in the slight gap formed between the flanges.

[0013] This problem is due to difficulty in jacking up the lower flange enough to ensure a sufficient gap between

the flanges, which is because the feed hopper, which is a large and heavy object, is installed directly above the shell provided in the vertical shredder and also a frame of the vertical shredder is restrained by the foundation.

[0014] In such cases, a quite cumbersome operation is required, which involves using a hoist to pull up and remove the shredding mechanism, which is a heavy object installed inside the shell, from the shell and then an operator entering the shell to pull the choke ring radially inward through the slight gap formed between the flanges and mount a new choke ring, following by reinstalling the shredding mechanism inside the shell.

[0015] In view of the conventional problems described above, an object of the present invention is to provide a method for replacing a choke ring of a vertical shredder and a vertical shredder that allow the choke ring to be pulled radially outward by ensuring a gap of the required size between the lower flange of the shell and the upper flange of the discharge ring.

Solution to Problem

[0016] To achieve the above object, a method for replacing a choke ring of a vertical shredder is provided in accordance with the present invention. As a first feature of the method for replacing a choke ring of a vertical shredder, which includes: a feed hopper into which objects to be shredded are fed; a shell disposed below a lower end of the feed hopper; a shredding mechanism configured to rotate around an axle provided at a center of the shell; a discharge ring into which shredded fractions shredded between the shell and the shredding mechanism fall; and a choke ring disposed between a lower flange of the shell and an upper flange of the discharge ring and configured to form a gap between the choke ring and the shredding mechanism, the gap allowing the shredded fractions to fall therethrough, the feed hopper, the shell, and the discharge ring being configured to form a hollow space therein, the vertical shredder including a spacer configured to form an extended space that extends the hollow space along a direction of the axle, the method includes: a clamping pressure reduction step of reducing or releasing clamping pressure between members clamping the spacer, during replacement of the choke ring; a spacer detachment step of removing the spacer after the clamping pressure reduction step; and a choke ring replacement step of replacing the choke ring using a space ensured by the spacer detachment step.

[0017] Forming an extended space that extends the hollow space, formed by the feed hopper, the shell, and the discharge ring, via the spacer along a direction of the axle can ensure an extra space that, upon removal of the spacer in the spacer detachment step following the clamping pressure reduction step to reduce or release the clamping pressure between the members clamping the spacer, can be used to lift the lower flange of the shell from the upper flange of the discharge ring by an extra amount equal to the extended space ensured by the spacer during replacement of the choke ring. In other words, the gap is extended by the thickness of the spacer, allowing even a choke ring with a distorted radial inner distal end to be pulled radially outward.

[0018] In addition to the first feature above, the method for replacing a choke ring of a vertical shredder in accordance with the present invention has a second feature that the choke ring replacement step is a step of replacing the choke ring by utilizing the extended space ensured by the spacer detachment step to thereby ensure a space between the upper flange of the discharge ring and the lower flange of the shell, the space being required for replacement of the choke ring.

[0019] Regardless of where in the hollow space, formed by the feed hopper, the shell, and the discharge ring, the spacer forming the extended space is located, an extra space can be ensured that can be used to lift the lower flange of the shell from the upper flange of the discharge ring by an extra amount equal to the extended space ensured by the spacer, allowing for ensuring a necessary gap for pulling radially outward even a choke ring with a downwardly bent distal end.

[0020] In addition to the first or second feature above, the method for replacing a choke ring of a vertical shredder in accordance with the present invention has a third feature that the method further includes, after the choke ring replacement step, a spacer assembly step of mounting the spacer between the members to restore clamping pressure between the members.

[0021] After replacing the choke ring, the spacer is mounted between the members, whose clamping pressure has been reduced or released in the clamping reduction step, to thereby restore the clamping pressure between the members. This completes the spacer assembly step.

[0022] A vertical shredder is provided in accordance with the present invention. As a first feature of the vertical shredder, which includes: a feed hopper into which objects to be shredded are fed; a shell disposed below a lower end of the feed hopper; a shredding mechanism configured to rotate around an axle provided at a center of the shell; a discharge ring into which shredded fractions shredded between the shell and the shredding mechanism fall; and a choke ring disposed between a lower flange of the shell and an upper flange of the discharge ring and configured to form a gap between the choke ring and the shredding mechanism, the gap allowing the shredded fractions fall to therethrough, the feed hopper, the shell, and the discharge ring being configured to form a hollow space therein, the vertical shredder includes a spacer configured to form an extended space that extends the hollow space along a direction of the axle, wherein the spacer is mounted between any adjacent ones of respective members constituting the feed hopper, the shell, and the discharge ring or mounted within any of the members.

[0023] In order to replace a choke ring whose distal

end has been bent downward due to the shredding process, it is necessary to ensure a sufficient gap between the lower flange of the shell and the upper flange of the discharge ring. However, it is difficult to lift the lower flange of the shell, including the feed hopper disposed directly above the shell and secured via support frames, from the upper flange of the discharge ring. In such cases, mounting the spacer between any adjacent ones of the respective members constituting the feed hopper, the shell, and the discharge ring or within any of these members to ensure a space required for replacement of the choke ring can ensure a lift amount by which the lower flange of the shell is lifted from the upper flange of the discharge ring, where the lift amount corresponds to the space formed by removing the spacer.

[0024] In addition to the first feature above, the vertical shredder in accordance with the present invention has a second feature that the spacer is divided into a plurality of spacer pieces.

[0025] The spacer is a member to extend the hollow space, formed by the feed hopper, the shell, and the discharge ring, in the direction along the axle. If provided as a single body, the spacer would be very large and heavy, making the operation of mounting and detaching the spacer itself quite cumbersome as it would require heavy machinery etc. In contrast, by dividing the spacer into a plurality of spacer pieces, each spacer piece can be small and lightweight, improving operational efficiency.

[0026] In addition to the second feature above, the vertical shredder in accordance with the present invention has a third feature that the vertical shredder further includes a protruding piece at an outer edge of the spacer, the protruding piece protruding outward.

[0027] In normal use, the spacer is pressed between the members that clamp the spacer from above and below. Accordingly, even after reducing or releasing the clamping pressure between the members clamping the spacer, the spacer may stick to the upper or lower member and may not be easily detached. However, forming an outwardly protruding piece at the outer edge of the spacer allows the spacer to be detached by means of applying a blow or other mechanical force to the protruding piece or engaging a tool with the protruding piece.

[0028] In addition to any one of the first to third features above, the vertical shredder in accordance with the present invention has a fourth feature that a thickness of the spacer is at least greater than an estimated maximum deformation amount of distortion of the choke ring generated in a distal end side thereof by impact of shredded fractions.

[0029] Forming the spacer with a greater thickness than an estimated maximum deformation amount of distortion of the choke ring allows the choke ring to be pulled radially outward in a suitable manner.

[0030] In addition to any one of the first to fourth features above, the vertical shredder in accordance with the present invention has a fifth feature that the feed hopper is supported on a support frame via a support portion, the support frame being built around the vertical shredder, the support portion being provided around the feed hopper, and the spacer is mounted between a lower flange of the feed hopper and an upper flange of the shell.

[0031] By supporting the feed hopper, which is a heavy object, on the support frame, the feed hopper can be lifted upward relative to the support frame, the spacer mounted between the lower flange of the feed hopper and the upper flange of the shell can be easily removed, and the space that has been occupied by the spacer can be utilized as a space for lifting the lower flange of the shell from the upper flange of the discharge ring.

[0032] In addition to any one of the first to fourth features above, the vertical shredder in accordance with the present invention has a sixth feature that the feed hopper includes an upper feed hopper and a lower feed hopper, the upper feed hopper being supported on a support frame via a support portion, the support frame being built around the vertical shredder, the support portion being provided around the feed hopper, the lower feed hopper being flanged onto the upper feed hopper, and the spacer is mounted between a lower flange of the upper feed hopper and an upper flange of the lower feed hopper.

[0033] By supporting the feed hopper, which is a heavy object, on the support frame, the feed hopper can be lifted upward relative to the support frame, the spacer mounted between the lower flange of the upper feed hopper and the upper flange of the lower feed hopper can be easily removed, and the space that has been occupied by the spacer can be utilized as a space for lifting the lower flange of the shell from the upper flange of the discharge ring.

[0034] In addition to any one of the first to fourth features above, the vertical shredder in accordance with the present invention has a seventh feature that the spacer is disposed between an upper flange of the discharge ring and a lower flange of the shell, and positioned and secured at a position where the spacer is not hit by collisions of shredded fractions falling into the discharge ring.

[0035] By installing, in addition to the choke ring, the spacer between the upper flange of the discharge ring and the lower flange of the shell at a position where the spacer is not hit by collisions of shredded fractions falling into the discharge ring, the gap between the flanges will be extended by the thickness of the spacer upon removal of the spacer, during replacement of the choke ring, through a slight gap created by, for example, jacking up the lower flange of the shell from the upper flange of the discharge ring. This allows even a choke ring with a distorted radial inner distal end to be pulled radially outward.

[0036] In addition to the seventh feature above, the vertical shredder in accordance with the present invention has an eighth feature that the choke ring is configured to be radially advanceable and retractable between the upper flange of the discharge ring and the lower flange of the shell through use of a position adjustment mech-

anism, and the spacer is superimposed on the choke ring, and positioned and secured between the upper flange of the discharge ring and the lower flange of the shell such that the spacer is restricted from radial movement.

[0037] The gap between the choke ring and the shredding mechanism can be regulated through use of the position adjustment mechanism, whereby the fraction size of the shredded fractions can be regulated. Further, since the spacer superimposed on the choke ring is positioned and secured between the upper and lower flanges regardless of operation of the position adjustment mechanism, situations can be avoided where the shredded fractions accidentally hit the spacer as they fall into the discharge ring.

Advantageous Effects of Invention

[0038] As described above, the present invention provides a method for replacing a choke ring of a vertical shredder and a vertical shredder that allow the choke ring to be pulled radially outward by ensuring a gap of the required size between the lower flange of the shell and the upper flange of the discharge ring.

Brief Description of Drawings

[0039]

Fig. 1 is a partial cut-away view of a vertical shredder.
Fig. 2 is a fragmentary longitudinal sectional view of the vertical shredder.
Fig. 3 is a fragmentary longitudinal sectional view of the vertical shredder in which a spacer is disposed between a lower flange of a shell and an upper flange of a discharge ring.
Fig. 4 is a fragmentary cross-sectional view of the vertical shredder in which the spacer is disposed between the lower flange of the shell and the upper flange of the discharge ring.
Fig. 5A is a fragmentary cross-sectional view, in which the spacer shown in Fig. 4 is shaded, and Fig. 5B is a plan view of the spacer.
Fig. 6A is a fragmentary sectional view with the spacer disposed between the lower flange of the shell and a choke ring, and Fig. 6B is a fragmentary sectional view before the spacer is disposed.
Figs. 7A-7C are fragmentary views illustrating different modes of the choke ring and the installation of the spacer.
Fig. 8 is a schematic rear view of the vertical shredder.
Fig. 9 is a schematic side view of the vertical shredder.
Fig. 10A is a plan view of the upper flange of the shell, Fig. 10B is a plan view of the spacer divided in the circumferential direction of the upper flange of the shell, Fig. 10C is a plan view of the spacer disposed on a top face of the upper flange of the shell, and Fig. 10D is a fragmentary sectional view showing the spacer fastened with a bolt between a lower flange of a feed hopper and the upper flange of the shell via gaskets.
Fig. 11A is a plan view of an upper flange of a lower feed hopper, Fig. 11B is a plan view of the spacer divided in the circumferential direction of the upper flange of the lower feed hopper, Fig. 11C is a plan view of the spacer disposed on a top face of the upper flange of the lower feed hopper, and Fig. 11D is a fragmentary sectional view showing the spacer fastened with a bolt between a lower flange of an upper feed hopper and the upper flange of the lower feed hopper via gaskets.

Best Mode for Carrying out the Invention

[0040] A method for replacing a choke ring of a vertical shredder and a vertical shredder in accordance with the present invention will be described below with reference to the drawings.

[0041] As shown in Fig. 1, a vertical shredder 1 is an apparatus to perform shredding processes on large household appliances and other wastes for their reuse as resources and other purposes. The vertical shredder 1 includes, among others, a shredding process unit 5 and an electric motor 3 for driving the shredding process unit 5, which are provided on an apparatus frame 2 secured to a concrete floor.

[0042] The shredding process unit 5 includes, among others, a discharge ring of a tubular shape secured to the apparatus frame 2, a shell 7 of a tubular shape disposed above the discharge ring 6, and a shredding mechanism 8 attached to an axle 4 disposed at the center of the shell 7. The axle 4 is drivingly coupled to the electric motor 3 via a power transmission mechanism such as a belt.

[0043] A feed hopper 40 is provided above the shell 7, and objects to be shredded transported by an apron conveyor mechanism (not shown) are dropped and fed into the shell 7 through a feed opening 11 formed in a side wall of the feed hopper 40. An explosion air release duct 12 is provided on a top surface of the feed hopper 40, and the feed hopper 40 is equipped on its back side with an opening door (not shown) for introduction of a crane mechanism, such as a hoist, to lift the shredding mechanism 8.

[0044] Built around the vertical shredder 1 are support frames F composed of a plurality of vertical frames F1 and a plurality of horizontal frames F2 bridging between the vertical frames F1. A floor member (not shown) serving as a scaffold for operators is placed between the plurality of horizontal frames F2. For example, H-beam steel is used for the horizontal frames F2. The feed hopper 40, which is a heavy object, is supported on a portion of the support frames F via support portions. It should be noted that the support frames F shown in Fig. 1 are depicted

only for illustrative purposes to facilitate understanding, and differ from the configuration of the actually installed support frames F.

[0045] Fig. 2 illustrates a longitudinal section of the shredding process unit 5. The shell 7 is formed in a tubular shape having a circular cross-section with a diameter that gradually increases from the bottom to the top. A plurality of shell liners 13 are disposed inside the shell at predetermined intervals. The shell is made of rolled steel for general structures (SS), and the shell liners 13 are made of wear-resistant castings. The term "shell 7" as used in the present embodiment refers to the concept including the shell liners 13.

[0046] The shredding mechanism 8 is composed of a rotor 17 that rotates around the axle 4 and a breaker 14 provided above the rotor 17. The breaker 14 includes a pair of breaker arms 15, 16 radially extended from the axle 4. The rotor 17 includes disks 18 vertically arranged in three stages, and a plurality of shredding grinders 19 are supported on outer peripheral portions of the respective disks 18 such that the shredding grinders 19 can freely rotate.

[0047] As the breaker 14 and the rotor 17 rotate along with the axle 4, objects to be shredded fed into the shell 7 are first struck by the breaker arms 15, 16 to be coarsely shredded, and the coarsely shredded fractions are then finely shredded between the shredding grinders 19 of the rotor 17 and the shell liners 13. The shell liners 13 are not limited to a structure that is disposed so as to cover the inner side of the shell 7, and may be any structure that is disposed within the shell 7 and can shred the shredded fractions between it and the shredding mechanism; the shell liners 13 may include protrusions such as those protruding radially inward from the inner side of the shell 7.

[0048] Choke rings 20 are disposed between a lower flange 7A of the shell 7 and an upper flange 6A of the discharge ring 6. Shredded fractions CM fall into the discharge ring 6 through a gap S formed between the lowermost disk 18 of the rotor 17 and the choke rings 20 disposed around the periphery of that disk 18. The shredded fractions CM fallen into the discharge ring 6 are swept inside the discharge ring 6 by a sweeper 6S that is installed therein and rotates along with the axle 4, and are thus discharged through an opening formed in a side wall of the discharge ring 6 to a discharge opening 60 formed in the apparatus frame 2.

[0049] As the shredded fractions CM fall into the discharge ring 6, they may fall onto, and collide with, the inner distal end region of any choke ring 20, which causes gradual wear of the inner distal end of the choke ring 20 and its downwardly inclining distortion over time. Increase in size of the gap S caused by such wear may lead to increase in fraction size of the shredded fractions CM. Accordingly, the choke rings 20 are moved inward to adjust the gap S. However, once the wear amount becomes so large that there is no more adjustment margin for the gap S, replacement with a choke ring 20 without any wear and distortion is needed. After the replacement, the distorted choke ring 20 can be repaired for reuse through sheet metal processing, build-up processing, or other processing.

[0050] To replace the choke ring 20, the lower flange 7A of the shell 7 is lifted from the upper flange 6A of the discharge ring 6 to form a slight space (gap) between the upper flange 6A of the discharge ring 6 and the lower flange 7A of the shell 7, and the choke ring 20 is pulled radially outward through the space (gap).

[0051] However, if the inner distal end of the choke ring 20 is inclined downward, the distorted region of the choke ring 20 would get caught in the slight gap formed between the flanges, making it impossible to pull the choke ring 20 radially outward.

[0052] Thus, the vertical shredder 1 includes a spacer SP for forming an extended space that extends a tubular hollow space, formed by the feed hopper 40, the shell 7, and the discharge ring 6, in the direction along the axle 4.

[0053] When replacing the choke ring 20, the spacer SP is first removed and the space ensured by the spacer SP is utilized to form a gap between the upper flange 6A of the discharge ring 6 and the lower flange 7A of the shell 7, through which the choke ring 20 will be pulled. Further details are given below.

First Mode of the Spacer

[0054] A first mode is described below.

[0055] Fig. 3 is a fragmentary longitudinal sectional view of the vertical shredder 1 including the spacer, and Fig. 4 is a fragmentary cross-sectional view of the vertical shredder 1. Fig. 4 omits illustration of the shredding mechanism 8 provided inside the shell 7. Fig. 5A illustrates the fragmentary cross-section, in which the spacer SP shown in Fig. 4 is shaded.

[0056] As shown in FIG. 3, the spacer SP is mounted between the lower flange 7A of the shell 7 and the upper flange 6A of the discharge ring 6. In the present embodiment, the spacer SP is disposed on the top surface of the choke rings 20. However, the spacer SP may be disposed either above or below the choke rings 20, as long as it is located between the lower flange 7A of the shell 7 and the upper flange 6A of the discharge ring 6.

[0057] As shown in Figs. 4 and 5A, choke ring guides 22 with a generally triangular shape in plan view are provided at 60° intervals between the lower flange 7A of the shell 7 and the upper flange 6A of the discharge ring 6, and the six choke rings 20 with a generally rectangular shape in plan view and the spacer SP are disposed between the respective choke ring guides 22 in such a manner that the choke rings 20 and the spacer SP are superimposed on each other. It should be noted that the number of the choke ring guides 22 and the choke rings 20 are not limited to six.

[0058] The choke ring guide 22 guides the choke ring 20 in the direction in which the choke ring 20 is inserted and pulled, and serves as a distance piece to maintain

a fixed distance between the lower flange 7A of the shell 7 and the upper flange 6A of the discharge ring 6. The choke ring guide 22 is fastened to the lower flange 7A with bolts. The thickness of the choke ring guide 22 is set to the same as a combined thickness of the choke ring 20 and the spacer SP.

[0059] The choke ring 20 is formed of a flat plate with a generally rectangular shape in plan view, with both sides being parallel to each other. A radial inner edge of the choke ring 20 is arc-shaped to form a slight gap between it and the outer periphery of the disk 18 provided to the rotor 17, and the arc-shaped portion is formed with a large number of comb-like cutouts 20C.

[0060] The choke ring 20 is mounted between the upper flange 6A and the lower flange 7A and along right and left sides of the choke ring guide 22 through use of a position adjustment mechanism 30 such that the choke ring 20 can advance and retract radially, and the gap S between the comb formed in the radial inner edge of the choke ring 20 and the outer edge of the lowermost disk 18 provided to the rotor 17 is adjusted, whereby the fraction size of the shredded fractions CM is regulated to the extent that the shredded fractions CM fall through the gap S.

[0061] Each choke ring 20 is perforated with a pair of slots 20A that are parallel to both sides thereof and also perforated, between the pair of slots 20A, with a slot 20B with a larger diameter than the slots 20A. The pair of slots 20A serve as bolt insertion holes for fastening the choke ring 20 between the upper flange 6A and the lower flange 7A via bolts 23 and nuts 24 so that the choke ring 20 does not move under the impact during shredding (see Fig. 3).

[0062] The slot 20B serves as an insertion hole for insertion of a jack bolt 25 that is used to lift the shell 7. The jack bolt 25 is screwed into a threaded hole drilled in the lower flange 7A of the shell 7, and a lower end of the jack bolt 25 is inserted through the slot 20B to abut on the upper flange 6A of the discharge ring 6. In this state, the jack bolt 25 is further rotated, causing the lower flange 7A, i.e., the shell 7, to be lifted from the upper flange 6A (see Fig. 3). The slots 20A and the slot 20B are formed to enable adjustment to the radial position of the choke ring 20 while any load on the choke ring 20 is eliminated in this manner.

[0063] The position adjustment mechanism 30 includes a threaded bolt 32 rotatably held on a base 31 welded to the lower flange 7A, and a moving piece 33 screwed to the threaded bolt 32. The moving piece 33 is secured to the choke ring 20 via an attaching portion 34. The threaded bolt 32 is held such that it can rotate freely with respect to the base 31 but cannot move horizontally. Rotating the head of the threaded bolt 32 with a tool, such as a wrench, causes the moving piece 33 screwed to the threaded bolt 32 to move horizontally, which in turn causes the choke ring 20, to which the moving piece 33 is attached, to move radially.

[0064] The spacer SP located between the upper flange 6A and the lower flange 7A is provided to ensure a space for pulling the choke ring 20 radially outward between the lower flange 7A of the shell 7 and the upper flange 6A of the discharge ring 6 when the replacement operation for the choke ring 20 is needed. As described above, the choke ring 20 is configured to be radially advanceable and retractable between the upper flange 6A and lower flange 7A through use of the position adjustment mechanism 30, and the spacer SP is superimposed on the choke ring 20 and positioned and secured between the upper flange 6A and lower flange 7A. Also, the spacer SP is divided into a plurality of spacer pieces along the circumferential direction between the upper flange 6A and the lower flange 7A.

[0065] As shown in Figs. 5A and 5B, radial inner and outer sides of the spacer SP are arc-shaped, and its right and left ends are in parallel so as to conform to the right and left ends of the choke ring 20. The spacer SP is formed, on its radial outer side, with two protruding pieces SP5 protruding outward relative to the outer edge of the lower flange 7A. In addition, the spacer SP is formed with openings SP3, SP4 through which the bolts 23 and the jack bolt 25 described above can be inserted. In addition to configuring the spacer SP such that its right and left ends conform to the right and left ends of the choke ring 20 as shown in Figs. 5A and 5B, the spacer SP may be divided into multiple equal parts along the circumferential direction.

[0066] Unlike the slots 20A, 20B formed in the choke ring 20, the openings SP3, SP4 formed in the spacer SP are round holes, so that the spacer SP is restricted from radial movement and positioned and secured at a predetermined position between the lower flange 7A and the upper flange 6A.

[0067] In this example, a radial inner edge SP1 of the spacer SP is disposed to be flush with, or slightly protruding relative to, the inner edge of the lower flange 7A and secured at a position where the radial inner edge SP1 is not hit by collisions of the shredded fractions CM falling into the discharge ring 6. Also, a radial outer edge SP2 of the spacer SP is secured to be flush with the outer edge of the lower flange 7A, so that the protruding pieces SP5 protrude relative to the outer edge of the lower flange 7A. The radial inner edge SP1 of the spacer SP may be retracted radially outward relative to the inner edge of the lower flange 7A. In such cases, the radial width of the spacer SP may be up to about half the radial width of the lower flange 7A and upper flange 6A.

[0068] As shown in Figs. 6A and 6B, once the inner edge of the choke ring 20 is distorted downward, it becomes necessary to lift the shell 7 using the jack bolts 25 described above to form a gap between the lower flange 7A and the upper flange 6A and pull the choke ring 20 radially outward to replace it with a new choke ring 20.

[0069] As the gap formed between the lower flange 7A and the upper flange 6A is only about 1 mm to 2 mm, the distorted portion may get caught in the gap and make it

difficult to pull out the choke ring 20. Even in such cases, by removing the spacer SP preliminarily interposed between the lower flange 7A and the upper flange 6A, the gap between the lower flange 7A and the upper flange 6A is extended by the thickness of the spacer SP, which allows for pulling out the choke ring 20 well.

[0070] In the present embodiment, the choke ring 20 is made of a wear-resistant steel plate and set to be 25 mm thick. The spacer SP is made of SUS and set to be 5 mm thick.

[0071] The thickness of the spacer SP may be at least greater than an estimated maximum deformation amount of the distortion of the choke ring 20 that would be generated in its distal end side by the impact of the shredded fractions CM. The estimated maximum deformation amount is a value determined by the shredding throughput of the vertical shredder 1, the type of objects to be shredded by the vertical shredder 1, and the material and thickness of the choke ring 20, and is thus not a fixed value. For example, the thickness of the spacer SP is set in the range of 2 mm to 10 mm, preferably 4 mm to 6 mm. This is true for the thickness of the spacer SP in second and third modes described below.

[0072] When replacing a choke ring 20, the jack bolts 25 are inserted through the respective six choke rings 20 to lift the shell 7 evenly from the upper flange 6A of the discharge ring 6 and remove the position adjustment mechanism 30 provided to the choke ring 20 to be replaced.

[0073] Then, after extending the gap by pulling the jack bolt 25 and further removing the spacer SP, the replacement operation for the choke ring 20 is performed. In cases where the spacer SP is adhered to the lower flange 7A or the choke ring 20, such adhesion can be easily broken by inserting a jig through holes formed in the protruding pieces SP5 to apply a pull force or by delivering a mechanical impact on the protruding pieces SP5.

[0074] Upon replacing the choke ring 20, the spacer SP is remounted and the position adjustment mechanism 30 is assembled. After positioning the choke ring 20 at a predetermined position using the position adjustment mechanism 30, the jack bolt 25 is inserted to maintain the gap between the upper flange 6A and lower flange 7A, and then the same operation is repeated for other spacers SP.

[0075] Instead of the jack bolts 25, small hydraulic jacks can be used to evenly lift the shell 7. In such cases, preferably, the hydraulic jacks are installed at three locations that form a center angle of about 120 degrees.

[0076] In the above embodiment, the single-piece choke ring 20 that is formed, on its radial inner edge, with the comb-like cutouts 20C as shown in Fig. 7A has been described. However, the configuration of the choke ring 20 is not limited to this example.

[0077] For example, as shown in Fig. 7B, a choke ring 20 with a simply arc-shaped radial inner edge devoid of the comb-like cutouts 20C can be superimposed with the spacer SP in a similar manner as well. Also, as shown in Fig. 7C, two upper and lower choke rings 20 can be provided, where the upper choke ring is configured with a choke ring configured similarly to the choke ring 20 shown in Fig. 7A while the lower choke ring is configured with a choke ring with a simply arc-shaped radial inner edge, as configured similarly to the choke ring 20 shown in Fig. 7B, such that the lower choke ring is used to adjust the depth of the comb-like cutouts 20C.

Second Mode of the Spacer

[0078] A second mode will be described below.

[0079] As shown in Figs. 8 and 9, the feed hopper 40 is installed directly above the shell 7. The feed hopper 40 is supported on the support frames F (horizontal frames), which are built around the vertical shredder 1, via a plurality of support portions 41 provided around the tubular side wall of the feed hopper 40, and is secured with bolts B1 and nuts N1.

[0080] The spacer SP is mounted between a lower flange 40A of the feed hopper 40 and an upper flange 7B of the shell 7.

[0081] As shown in Figs. 10A through 10D, the upper flange 7B of shell 7 is formed in an annular shape in plan view and includes a plurality of securing bolt holes 7h in the circumferential direction. Likewise, the lower flange 40A of the feed hopper 40 is formed in an annular shape in plan view and includes bolt holes at positions corresponding to the bolt holes 7h.

[0082] The spacer SP, as divided into a plurality of spacer pieces in the circumferential direction, is disposed along a top surface of the upper flange 7B of the shell 7. The spacer SP includes an arc-shaped radial inner edge SP1 and an arc-shaped radial outer edge SP2, and the radial width of the spacer SP is set such that its outer side is flush with an outer surface of the upper flange 7B while its inner side is at a slightly retracted position relative to an inner surface of the upper flange 7B. In addition, right and left edges of the spacer SP are shaped to extend along the radial direction.

[0083] The spacer SP is formed, on its radial outer side, with the two protruding pieces SP5 protruding outward relative to the outer edge of the upper flange 7B. The number of protruding pieces SP5 is not particularly limited. In addition, the spacer SP is formed, on its radial inner side, with cutouts SP6 with an open end through which the bolt described above can be inserted.

[0084] The spacer SP is disposed between the upper flange 7B of the shell 7 and the lower flange 40A of the feed hopper 40 such that the spacer SP is clamped from above and below via gaskets 40P, and is fastened with bolts B2 and nuts N2.

[0085] When removing the spacer SP from between the upper flange 7B of the shell 7 and the lower flange 40A of the feed hopper 40, the fastened bolts B2 are first loosened, followed by loosening bolts B1 that secure the support portions 41 to the support frames F (horizontal frames). Then, for example, lifting equipment such as a

hoist is used to lift the feed hopper 40 from the support frames F (horizontal frames). This reduces or releases the clamping pressure between the upper flange 7B of shell 7 and the lower flange 40A of feed hopper 40, which are the members to clamp the spacer SP.

[0086] The spacer SP is then pulled radially outward and removed to ensure a space between the upper flange 7B of the shell 7 and the lower flange 40A of the feed hopper 40. In cases where the spacer SP is adhered to the lower flange 40A or the upper flange 7B, such adhesion can be easily broken by inserting a jig through holes formed in the protruding pieces SP5 to apply a pull force or by delivering a mechanical impact on the protruding pieces SP5.

[0087] Further, as described in the first mode, the jack bolts 25 are screwed into the respective threaded holes for the jack bolts 25 formed in the lower flange 7A of the shell 7 to thereby lift the shell 7 evenly from the upper flange 6A of the discharge ring 6 and remove the position adjustment mechanism 30 provided to the choke ring 20 to be replaced. At this time, a gap with the thickness equivalent to the thickness of the spacer SP will be formed between the upper flange 6A of the discharge ring 6 and the lower flange 7A of the shell 7.

[0088] Then, the jack bolt 25 is pulled out and the replacement operation is performed for one choke ring 20. Upon replacing the one choke ring 20, the position adjustment mechanism 30 is reassembled and used to position a choke ring 20 at a predetermined position, and after inserting the jack bolt 25 to maintain the gap between the upper flange 6A and lower flange 7A, the same operation is repeated for other choke rings 20.

[0089] Upon completion of the replacement operation, the jack bolts 25 are removed, and the lower flange 7A of the shell 7 and the upper flange 6A of the discharge ring 6 are fastened with the bolts 23.

[0090] Then, all the removed spacers SP are inserted between the upper flange 7B of the shell 7 and the lower flange 40A of the feed hopper 40, and the lifted feed hopper 40 is lowered using a hoist or other equipment. The upper flange 7B of the shell 7 and the lower flange 40A of the feed hopper 40 are fastened with the respective bolts B2 and nuts N2, followed by fastening the support portions 41 to the support frames F (horizontal frames) with the bolts B1 and nuts N1.

Third Mode of the Spacer

[0091] A third mode will be described below.

[0092] As shown in Figs. 8 and 9, the feed hopper 40 disposed directly above the shell 7 is supported on the support frames F (horizontal frames F2), which are built around the vertical shredder 1, via the plurality of support portions 41 provided around the feed hopper 40, and is secured with the bolts B1 and nuts N1. The configuration of the feed hopper 40 is the same as in the second mode described above, except for the installation location of the spacer SP.

[0093] The feed hopper 40 is divided into an upper feed hopper 44 and a lower feed hopper 46, and the spacer SP is mounted between a lower flange 44A of the upper feed hopper 44 and an upper flange 46B of the lower feed hopper 46.

[0094] As shown in Figs. 11A through 11D, the upper flange 46B of the lower feed hopper 46 is a keyhole-shaped in plan view, in which an annular portion 461 is connected to a rectangular portion 462 serving as an input portion for a conveyor mechanism that transports objects to be shredded, and includes a plurality of securing bolt holes 46h in the circumferential direction. Likewise, the lower flange 44A of the upper feed hopper 44 is keyhole-shaped in plan view, in which a circular portion is connected a rectangular portion, and includes bolt holes at positions corresponding to the bolt holes 46h.

[0095] The spacer SP, as divided into a plurality of spacer pieces in the circumferential direction, is disposed along a top surface of the upper flange 46B of the lower feed hopper 46. The spacer SP disposed on the annular portion 461 includes an arc-shaped radial inner edge SP1 and an arc-shaped radial outer edge SP2, which are formed such that the radial outer edge SP2 is flush with an outer surface of the upper flange 46B and the radial inner edge SP1 is at a slightly retracted position relative to an inner surface of the upper flange 46B.

[0096] The spacer SP disposed on the rectangular portion 462 is formed in a rectangular shape in plan view, with its outer side flush with the outer surface of the upper flange 46B and its inner side at a slightly retracted position relative to the inner surface of the upper flange 46B.

[0097] Each spacer SP is formed, on its radial outer side, with the two protruding pieces SP5 protruding outward relative to the outer edge of the upper flange 46B. The number of protruding pieces SP5 is not particularly limited. In addition, each spacer SP is formed, on its radial inner side, with cutouts SP6 with an open end through which the bolt described above can be inserted.

[0098] As shown in Fig. 11D, the spacer SP is inserted between the lower flange 44A of the upper feed hopper 44 and the upper flange 46B of the lower feed hopper 46 such that the spacer SP is clamped from above and below via gaskets 46P, and is fastened with bolts B3 and nuts N3.

[0099] When removing the spacer SP from between the lower flange 44A of the upper feed hopper 44 and the upper flange 46B of the lower feed hopper 46, the fastened bolts B3 are first loosened, followed by loosening the bolts B1 that secure the support portions 41 to the support frames F (horizontal frames). Then, for example, lifting equipment such as a hoist is used to lift the feed hopper 40 from the support frames F (horizontal frames). This reduces or releases the clamping pressure between the lower flange 44A of the upper feed hopper 44 and the upper flange 46B of the lower feed hopper 46, which are the members to clamp the spacer SP.

[0100] The spacer SP is then pulled radially outward and removed to ensure a space between the lower flange

44A of the upper feed hopper 44 and the upper flange 46B of the lower feed hopper 46. In cases where the spacer SP is adhered to the lower flange 44A or the upper flange 46B, such adhesion can be easily broken by inserting a jig through holes formed in the protruding pieces SP5 to apply a pull force or by delivering a mechanical impact on the protruding pieces SP5.

[0101] Further, as described in the first mode, the jack bolts 25 are screwed into the respective threaded holes for the jack bolts 25 formed in the lower flange 7A of the shell 7 to lift the shell 7 evenly from the upper flange 6A of the discharge ring 6 and remove the position adjustment mechanism 30 provided to the choke ring 20 to be replaced. At this time, a gap with the thickness equivalent to the thickness of the spacer SP will be formed between the upper flange 6A of the discharge ring 6 and the lower flange 7A of the shell 7.

[0102] Then, the jack bolt 25 is pulled out and the replacement operation is performed for one choke ring 20. Upon replacing the one choke ring 20, the position adjustment mechanism 30 is reassembled and used to position a choke ring 20 at a predetermined position, and after inserting the jack bolt 25 to maintain the gap between the upper flange 6A and lower flange 7A, the same operation is repeated for other choke rings 20.

[0103] Upon completion of the replacement operation, the jack bolts 25 are removed, and the lower flange 7A of the shell 7 and the upper flange 6A of the discharge ring 6 are fastened with the bolts 23.

[0104] Then, all the removed spacers SP are inserted between the lower flange 44A of the upper feed hopper 44 and the upper flange 46B of the lower feed hopper 46, and the lifted feed hopper 40 is lowered using a hoist or other equipment. The lower flange 44A of the upper feed hopper 44 and the upper flange 46B of the lower feed hopper 46 are fastened with the respective bolts B3 and nuts N3, followed by fastening the support portions 41 to the support frames F (horizontal frames) with the bolts B1 and nuts N1.

[0105] While the above second and third modes are discussed using examples where the spacer SP is mounted between the flanges via gaskets, a configuration is also possible where only the gaskets are used to ensure the functionality of the spacer SP. Preferred materials for the gaskets include rigid resin.

[0106] Any of the spacers described in the above first to third modes can be used for suitable replacement operation for the choke rings 20. That is, the spacer SP may be mounted between any adjacent ones of the respective members 6, 7, and 40 constituting the feed hopper 40, the shell 7, and the discharge ring 6 or may be mounted within any of these members 6, 7, and 40.

[0107] As described above, a method for replacing a choke ring of a vertical shredder in accordance with the present invention includes: a clamping pressure reduction step of reducing or releasing clamping pressure between members clamping the spacer during replacement of the choke ring; a spacer detachment step of removing the spacer after the clamping pressure reduction step; and a choke ring replacement step of replacing the choke ring using a space ensured by the spacer detachment step.

[0108] The choke ring replacement step is a step of replacing the choke ring by utilizing the extended space ensured by the spacer detachment step to thereby ensure a space between the upper flange of the discharge ring and the lower flange of the shell, the space being required for replacement of the choke ring.

[0109] The method further includes, after the choke ring replacement step, a spacer assembly step of mounting the spacer between the members to restore the clamping pressure between the members.

[0110] The embodiments described above are merely examples of the present invention. It will be readily appreciated that various modifications can be made to specific structures, shapes, dimensions, etc. of the components as appropriate to the extent that such modifications still provide the functions and benefits of the present invention.

Reference Signs List

[0111]

1	Vertical shredder
2	Apparatus frame
3	Electric motor
4	Axle 4
5	Shredding process unit
6	Discharge ring
6A	Upper flange
60	Discharge opening
7	Shell
7A	Lower flange of the shell
7B	Upper flange of the shell
8	Shredding mechanism
13	Shell liner
14	Breaker
15, 16	Breaker arms
17	Rotor
18	Disk
19	Shredding grinder
20	Choke ring
40	Feed hopper
40A	Lower flange of the feed hopper
40P	Gasket
44	Upper feed hopper
44A	Lower flange of the upper feed hopper
46	Lower feed hopper
46P	Gasket
46B	Upper flange of the lower feed hopper
SP	Spacer

Claims

1. A method for replacing a choke ring of a vertical shredder, the vertical shredder including: a feed hopper into which objects to be shredded are fed; a shell disposed below a lower end of the feed hopper; a shredding mechanism configured to rotate around an axle provided at a center of the shell; a discharge ring into which shredded fractions shredded between the shell and the shredding mechanism fall; and a choke ring disposed between a lower flange of the shell and an upper flange of the discharge ring and configured to form a gap between the choke ring and the shredding mechanism, the gap allowing the shredded fractions to fall therethrough, the feed hopper, the shell, and the discharge ring being configured to form a hollow space therein, the vertical shredder including a spacer configured to form an extended space that extends the hollow space along a direction of the axle, the method comprising:

   a clamping pressure reduction step of reducing or releasing clamping pressure between members clamping the spacer, during replacement of the choke ring;
   a spacer detachment step of removing the spacer after the clamping pressure reduction step; and
   a choke ring replacement step of replacing the choke ring using a space ensured by the spacer detachment step.

2. The method for replacing a choke ring of a vertical shredder according to claim 1, wherein the choke ring replacement step is a step of replacing the choke ring by utilizing the extended space ensured by the spacer detachment step to thereby ensure a space between the upper flange of the discharge ring and the lower flange of the shell, the space being required for replacement of the choke ring.

3. The method for replacing a choke ring of a vertical shredder according to claim 1 or 2, further comprising, after the choke ring replacement step, a spacer assembly step of mounting the spacer between the members to restore clamping pressure between the members.

4. A vertical shredder including: a feed hopper into which objects to be shredded are fed; a shell disposed below a lower end of the feed hopper; a shredding mechanism configured to rotate around an axle provided at a center of the shell; a discharge ring into which shredded fractions shredded between the shell and the shredding mechanism fall; and a choke ring disposed between a lower flange of the shell and an upper flange of the discharge ring and configured to form a gap between the choke ring and the shredding mechanism, the gap allowing the shredded fractions fall to therethrough, the feed hopper, the shell, and the discharge ring being configured to form a hollow space therein, the vertical shredder comprising:

   a spacer configured to form an extended space that extends the hollow space along a direction of the axle, wherein
   the spacer is mounted between any adjacent ones of respective members constituting the feed hopper, the shell, and the discharge ring or mounted within any of the members.

5. The vertical shredder according to claim 4, the spacer is divided into a plurality of spacer pieces.

6. The vertical shredder according to claim 5, further comprising a protruding piece at an outer edge of the spacer, the protruding piece protruding outward.

7. The vertical shredder according to any one of claims 4 to 6, wherein a thickness of the spacer is at least greater than an estimated maximum deformation amount of distortion of the choke ring generated in a distal end side thereof by impact of shredded fractions.

8. The vertical shredder according to any one of claims 4 to 7, wherein

   the feed hopper is supported on a support frame via a support portion, the support frame being built around the vertical shredder, the support portion being provided around the feed hopper, and
   the spacer is mounted between a lower flange of the feed hopper and an upper flange of the shell.

9. The vertical shredder according to any one of claims 4 to 7, wherein

   the feed hopper comprises an upper feed hopper and a lower feed hopper, the upper feed hopper being supported on a support frame via a support portion, the support frame being built around the vertical shredder, the support portion being provided around the feed hopper, the lower feed hopper being flanged onto the upper feed hopper, and
   the spacer is mounted between a lower flange of the upper feed hopper and an upper flange of the lower feed hopper.

10. The vertical shredder according to any one of claims 4 to 7, wherein the spacer is disposed between an upper flange of the discharge ring and a lower flange

of the shell, and positioned and secured at a position where the spacer is not hit by collisions of shredded fractions falling into the discharge ring.

11. The vertical shredder according to claim 10, wherein

the choke ring is configured to be radially advanceable and retractable between the upper flange of the discharge ring and the lower flange of the shell through use of a position adjustment mechanism, and
the spacer is superimposed on the choke ring, and positioned and secured between the upper flange of the discharge ring and the lower flange of the shell such that the spacer is restricted from radial movement.

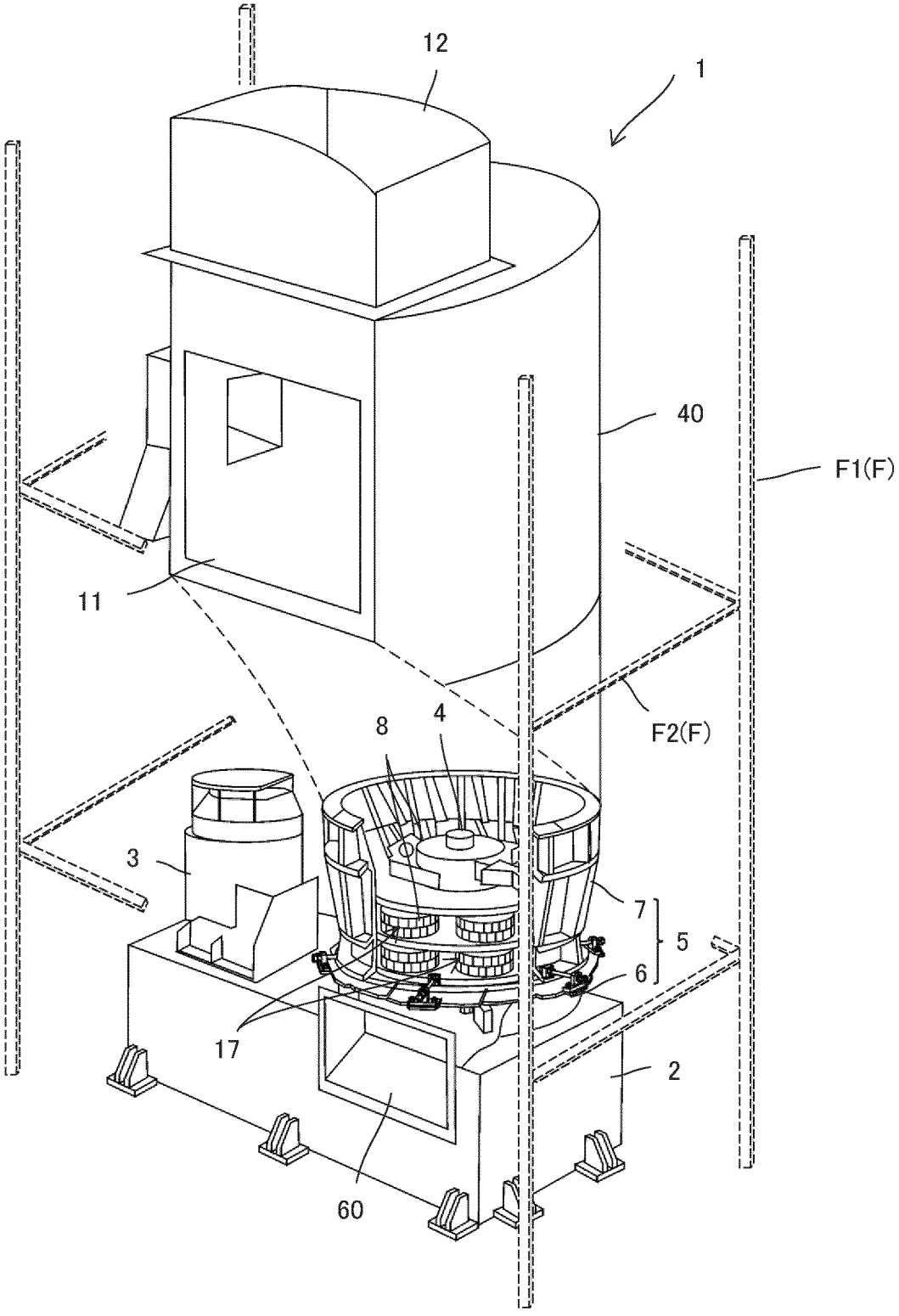


Fig.1

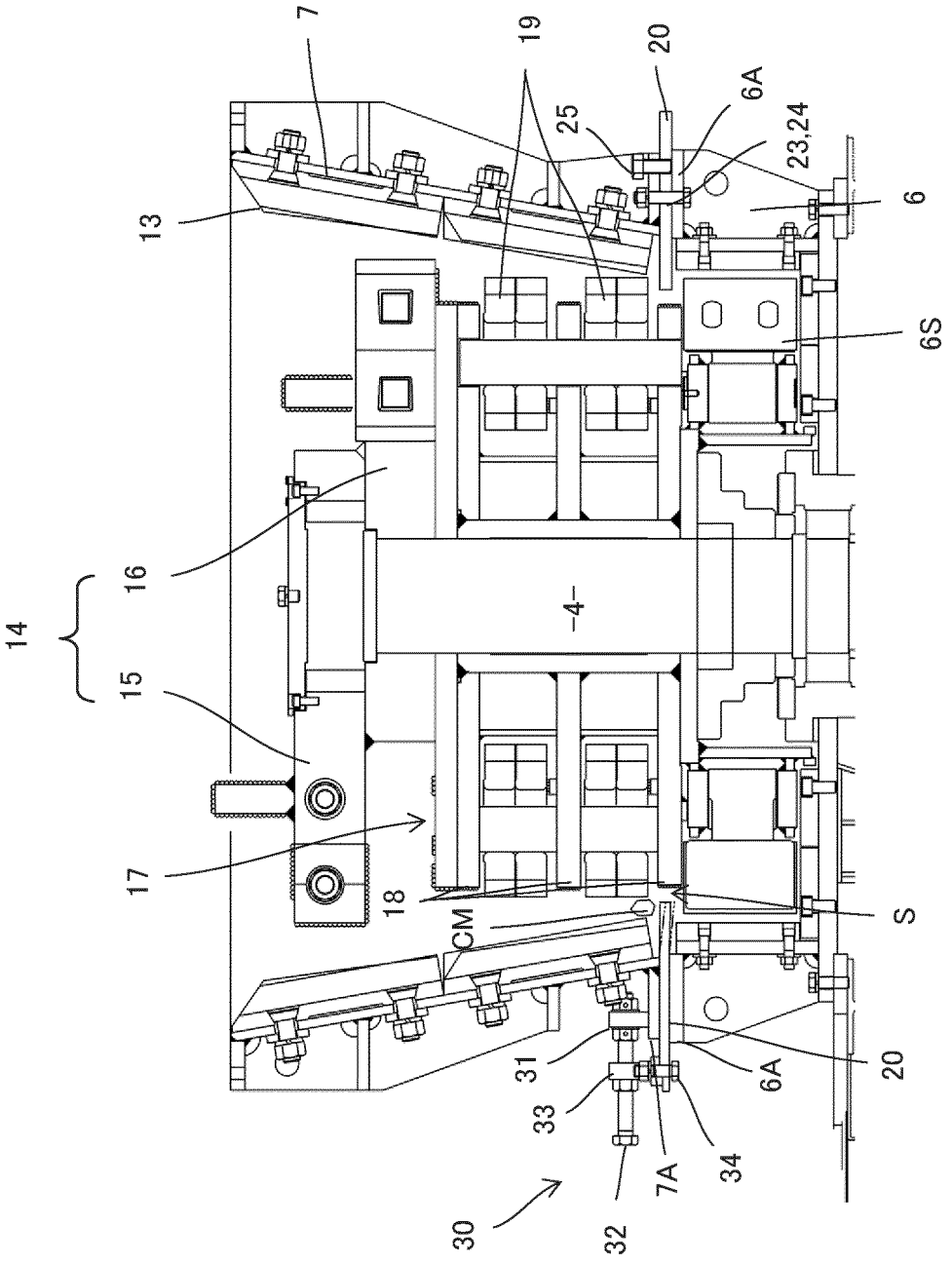
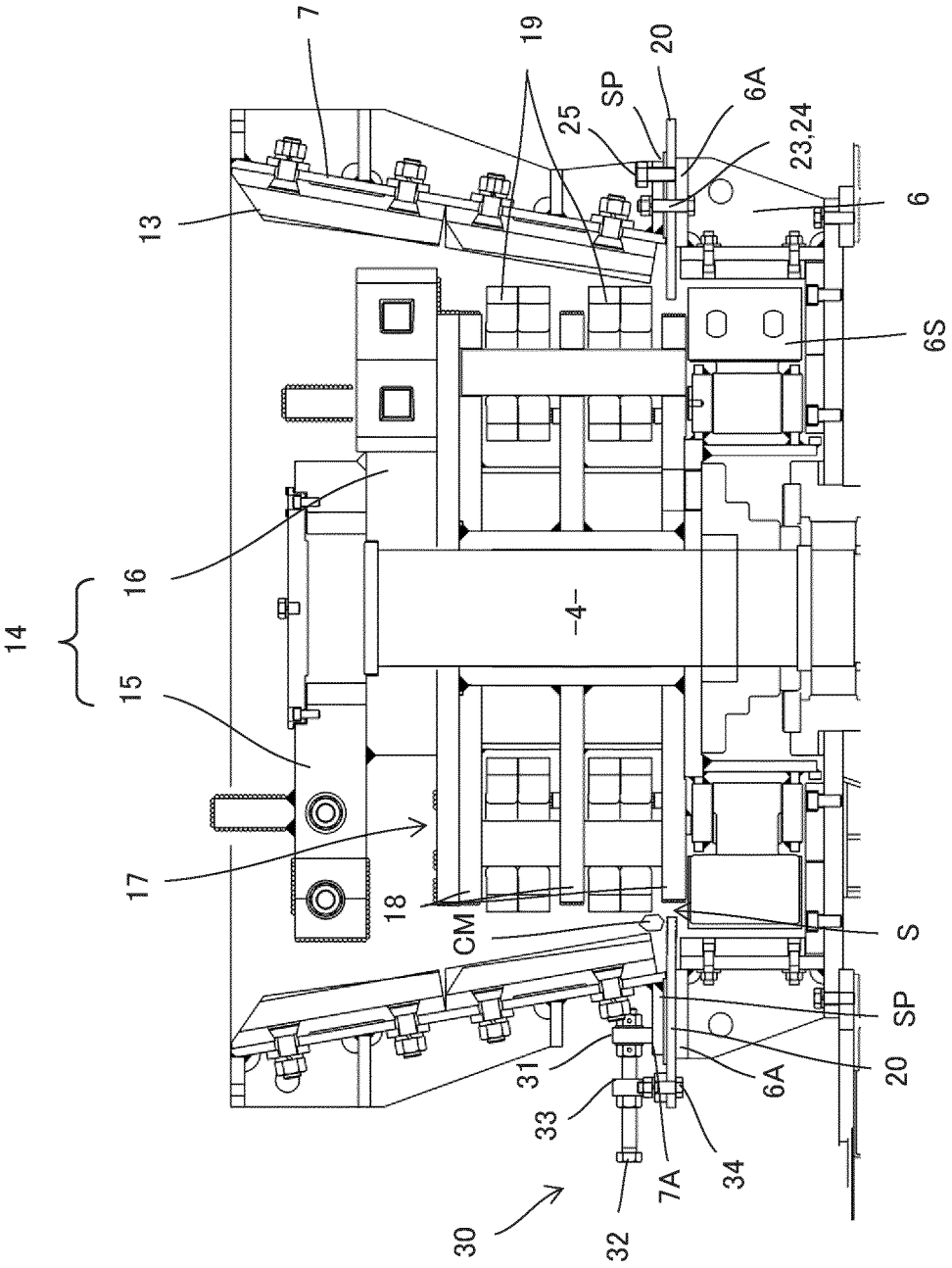


Fig.2


7
19
20
SP
6A
25
23,24
13
6
6S
16
14
15
4
17
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CM
S
SP
20
6A
31
33
34
7A
32
30

Fig.3

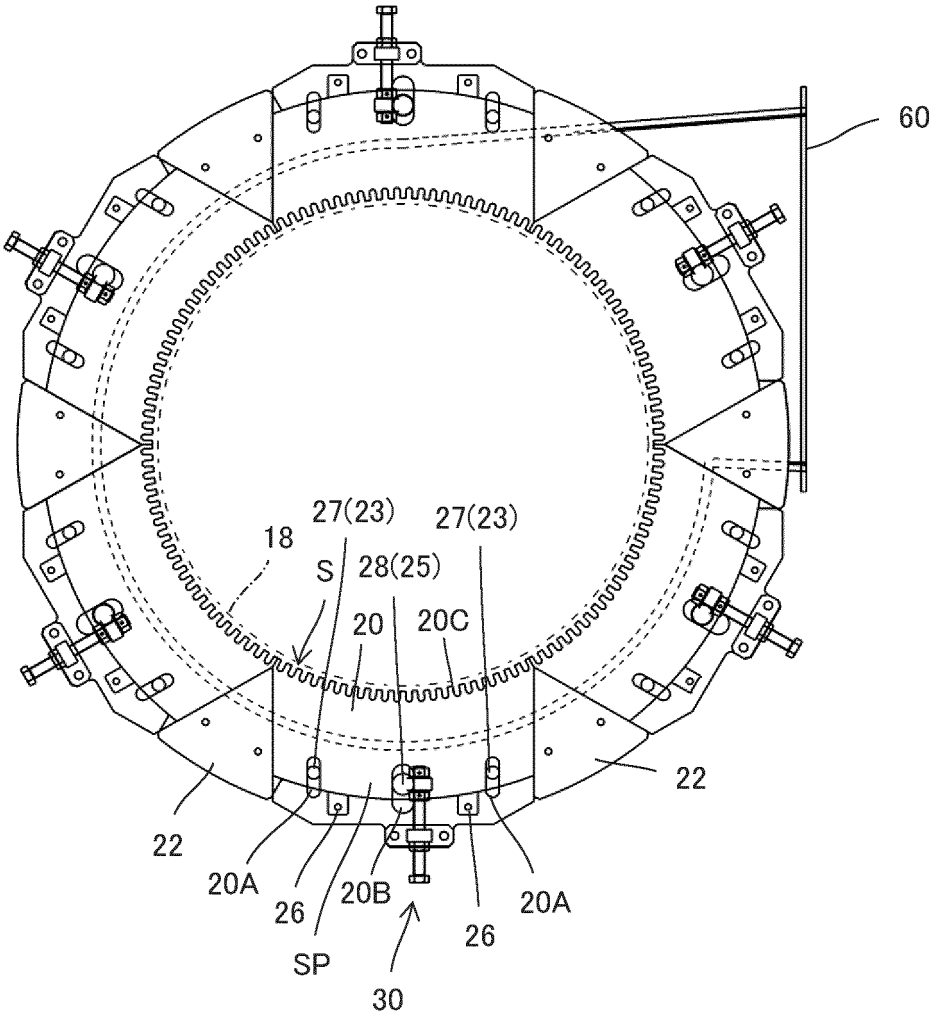


Fig.4

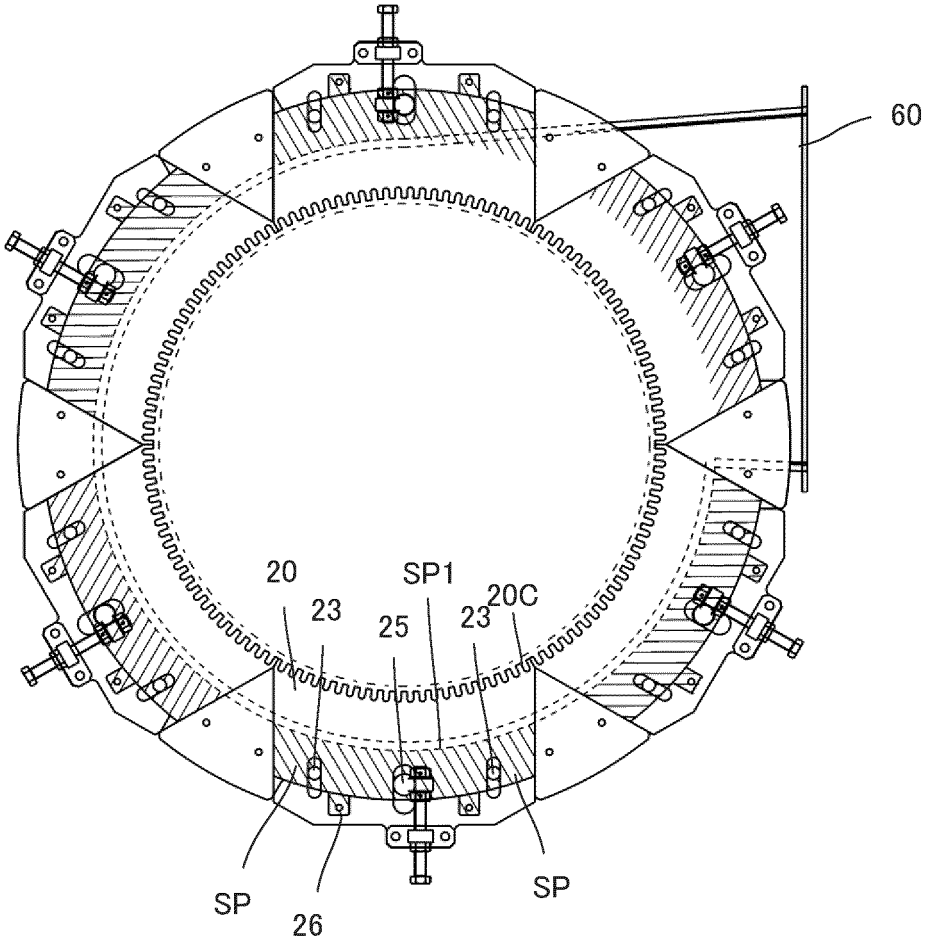


Fig.5A

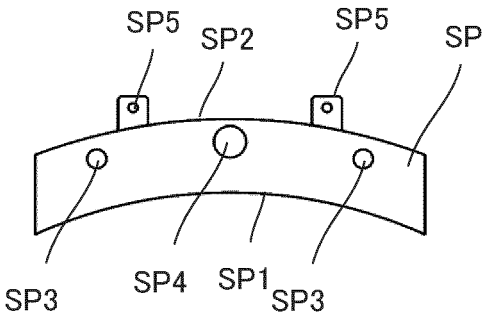


Fig.5B

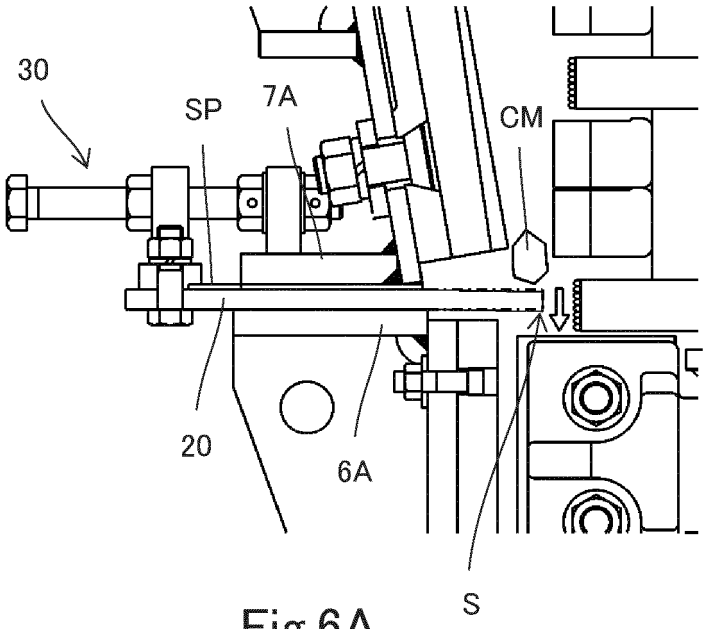


Fig.6A

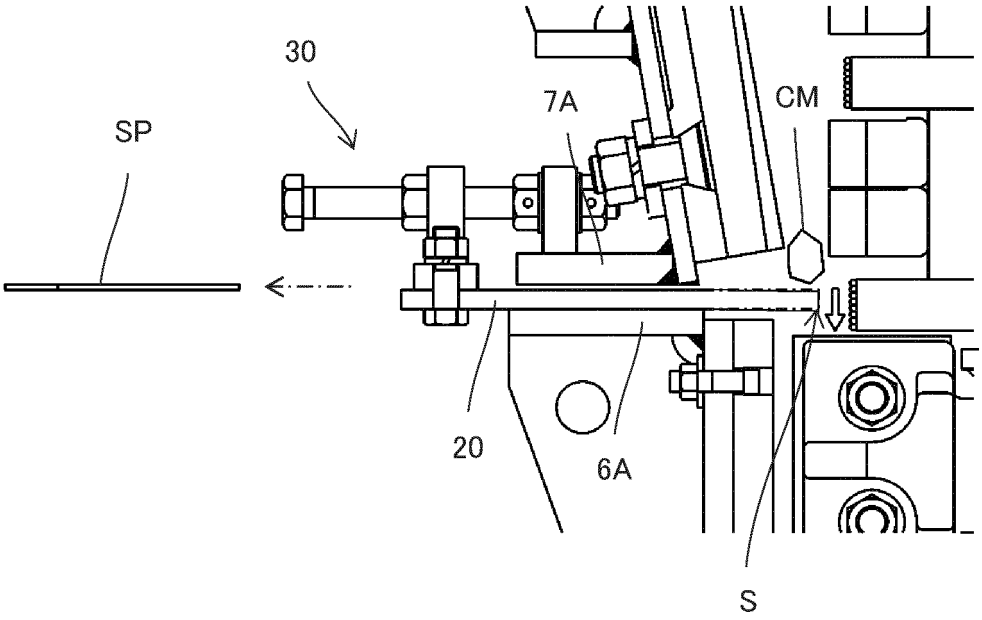


Fig.6B

Fig.7A

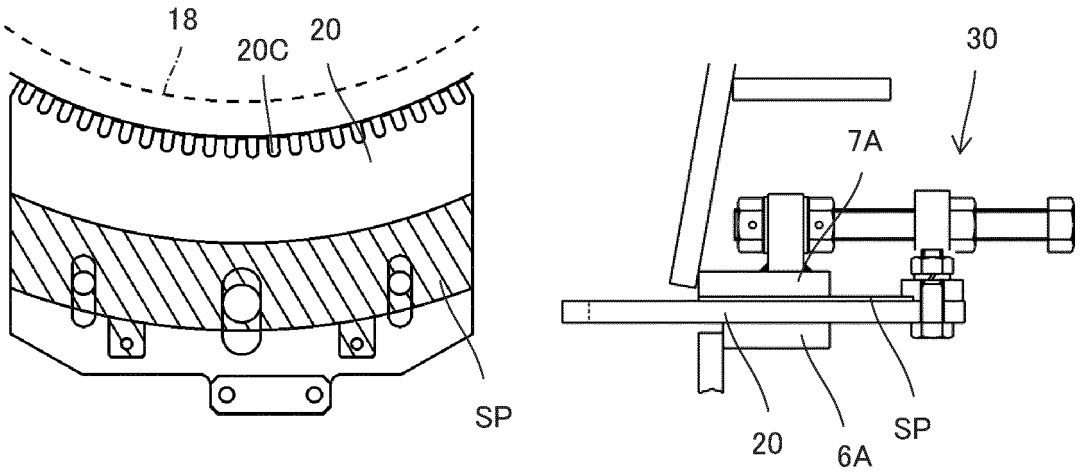


Fig.7B

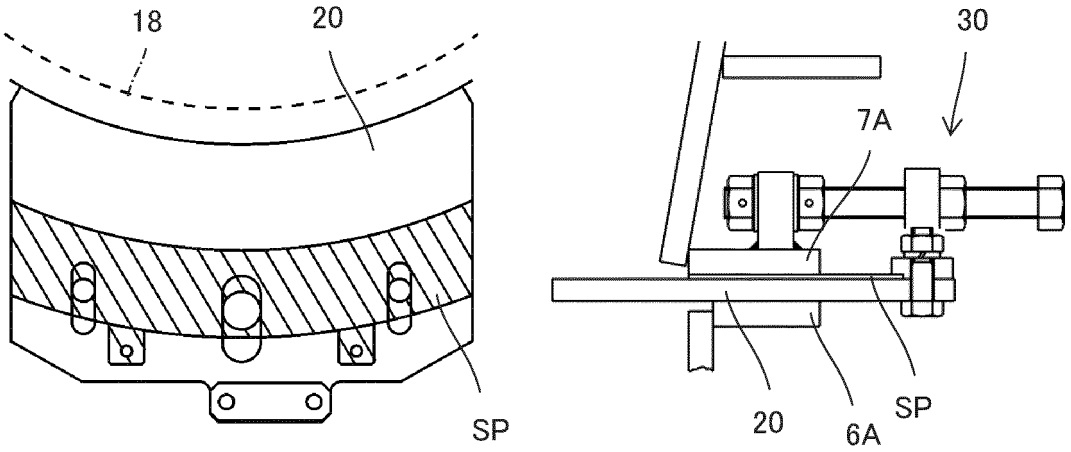
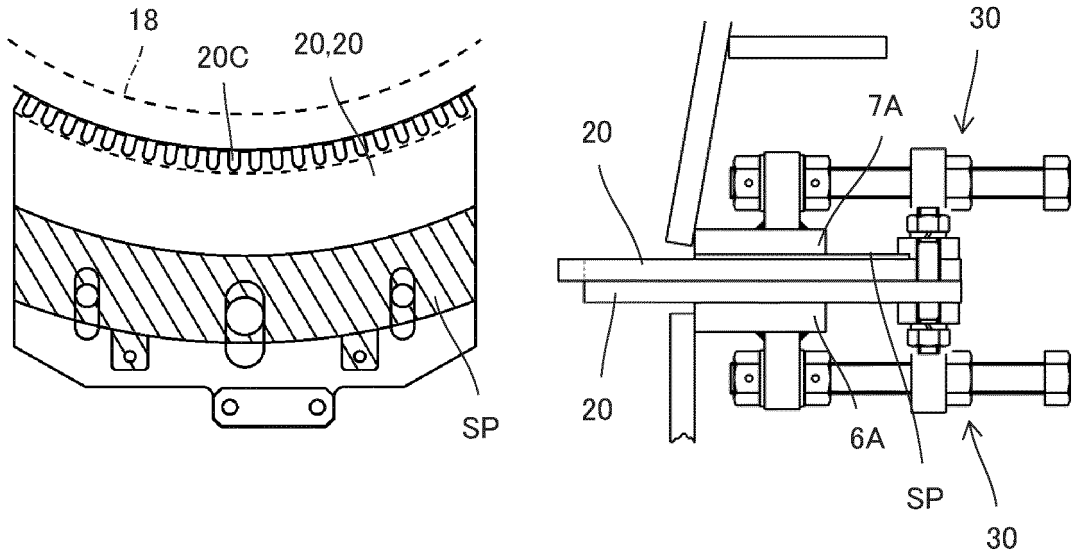


Fig.7C



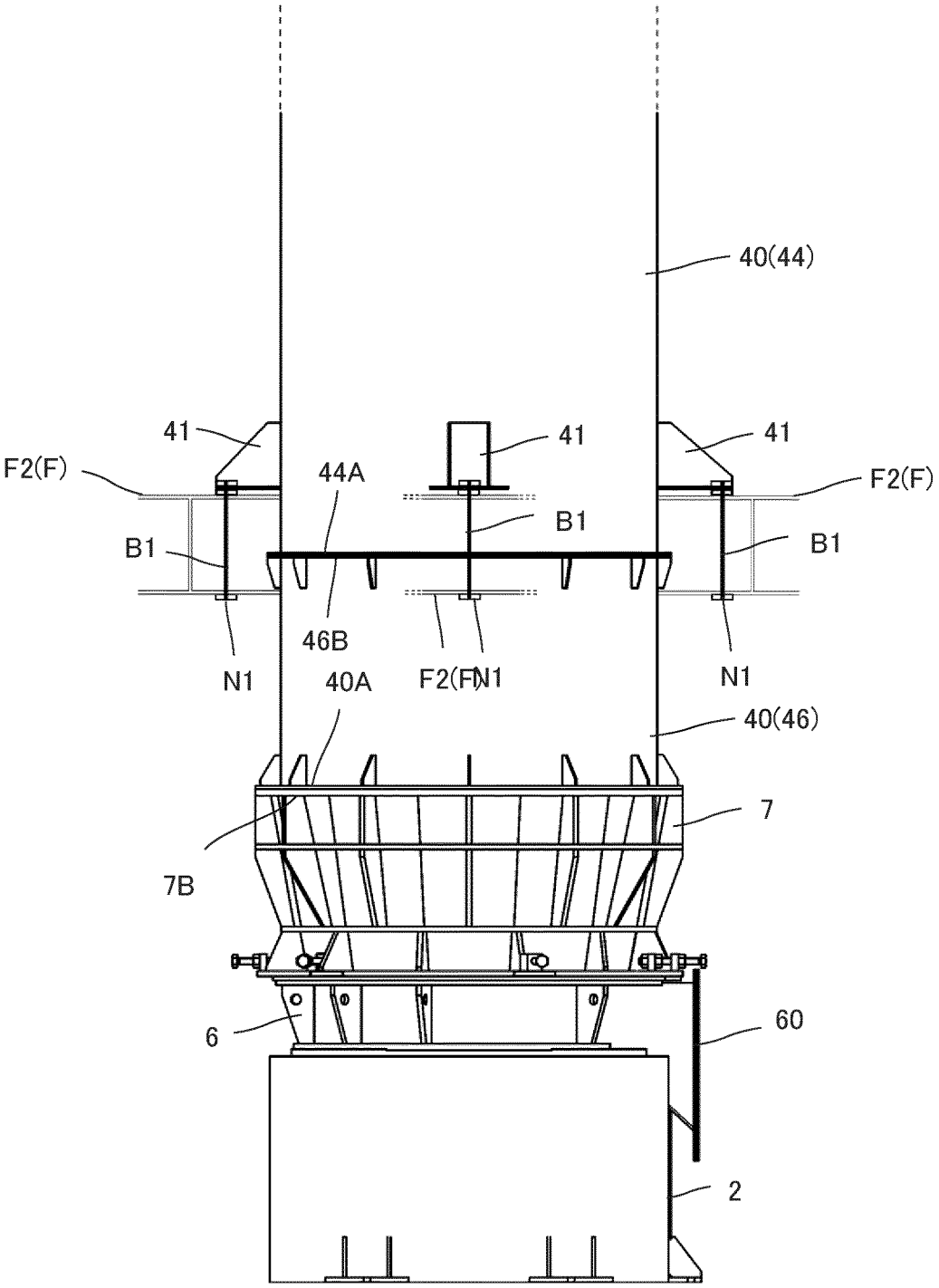

40(44)
41
41
41
F2(F)
44A
F2(F)
B1
B1
B1
46B
N1
40A
F2(F)
N1
N1
40(46)
7
7B
6
60
2

Fig.8

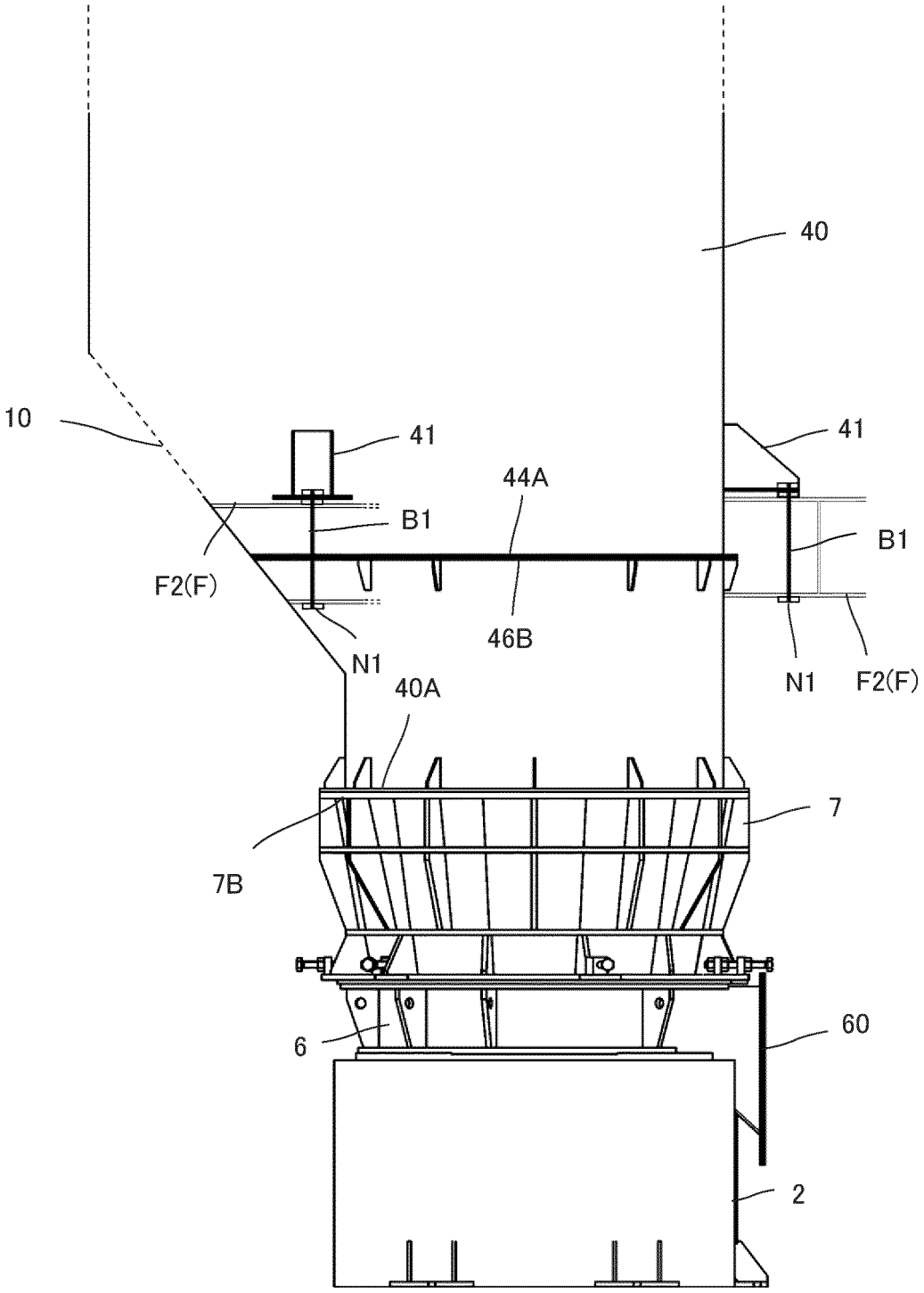


Fig.9

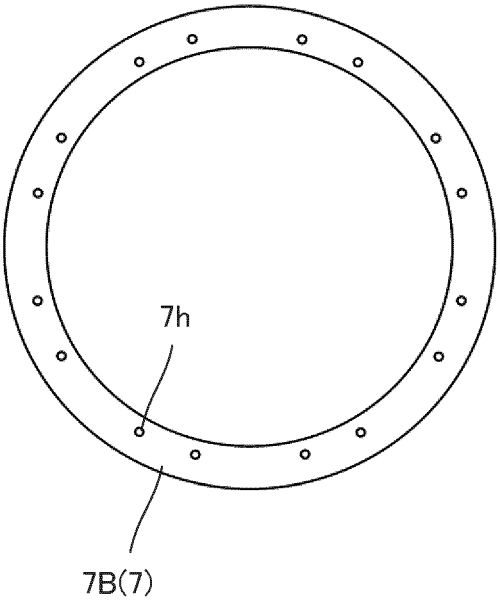


Fig.10A

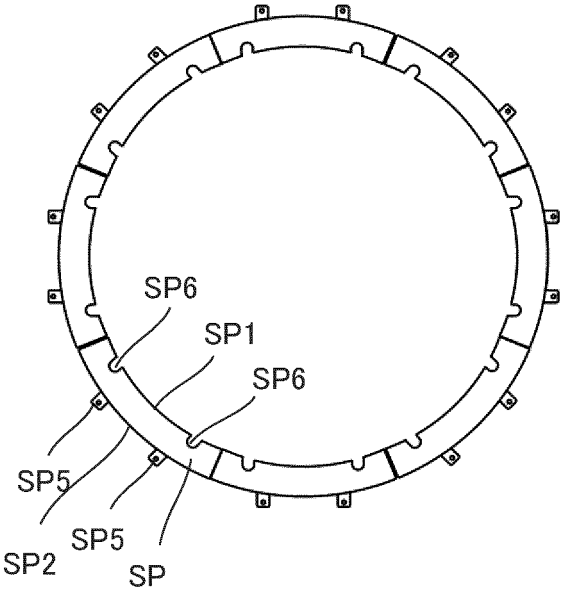


Fig.10B

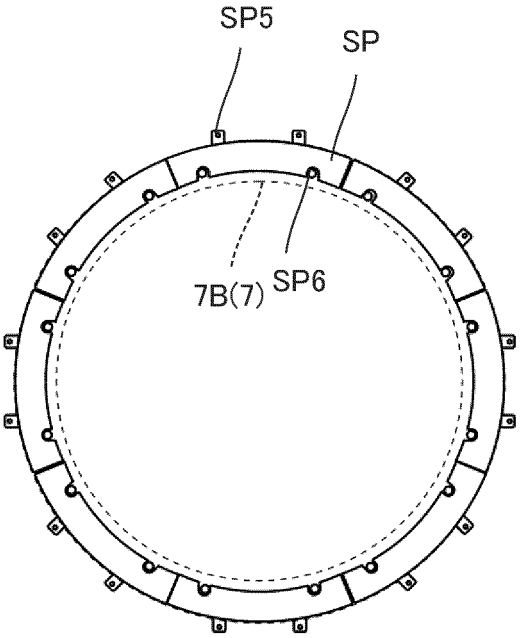


Fig.10C

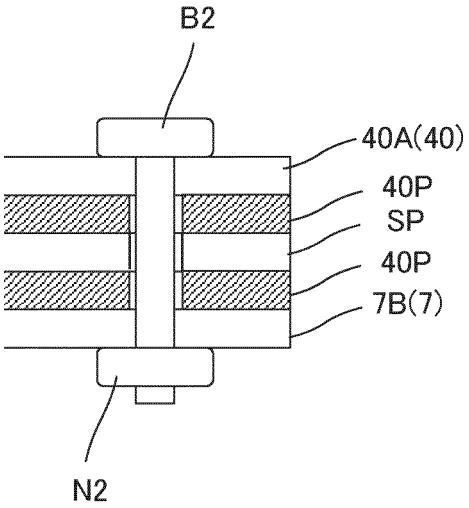


Fig.10D

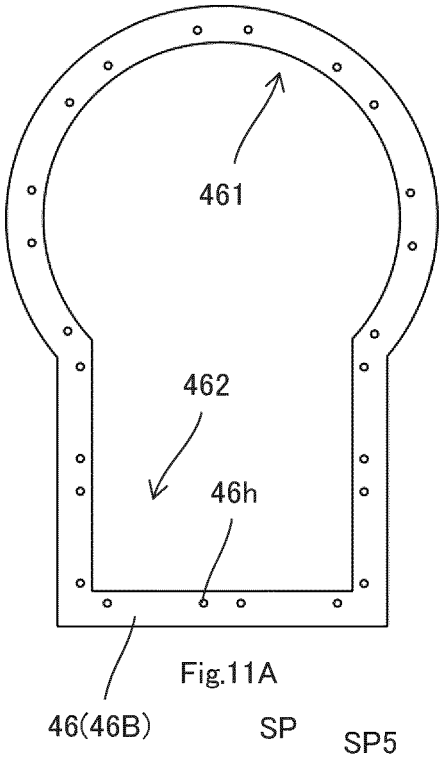


Fig.11A

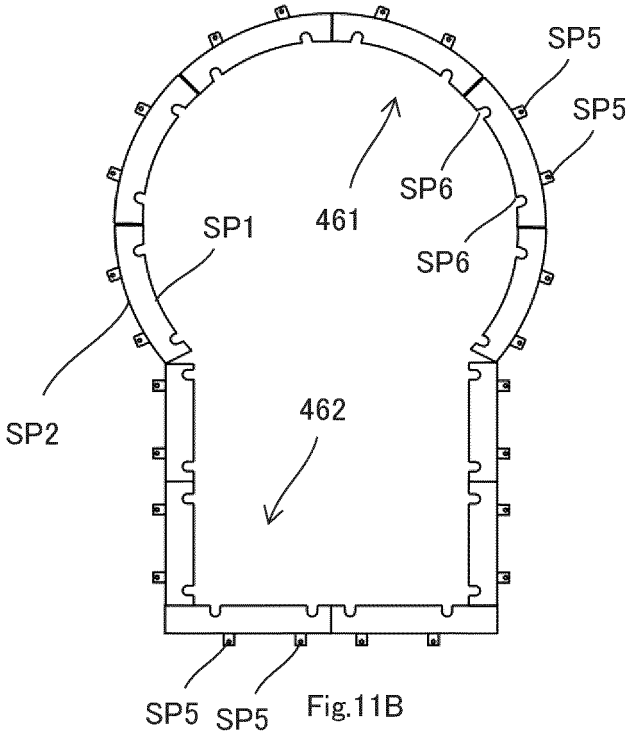


Fig.11B

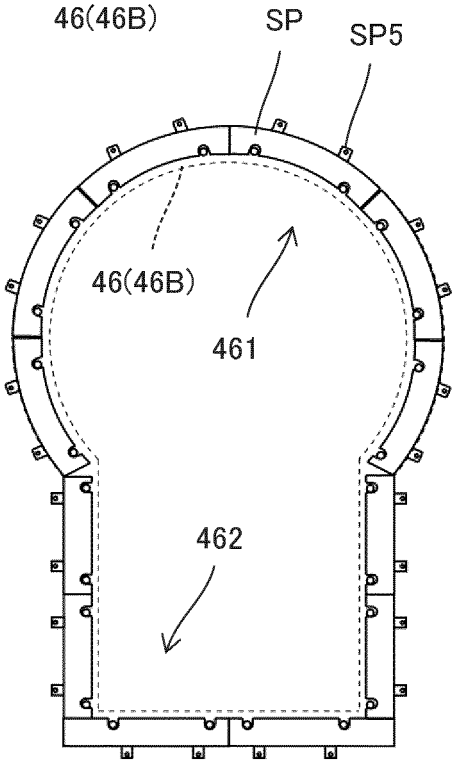


Fig.11C

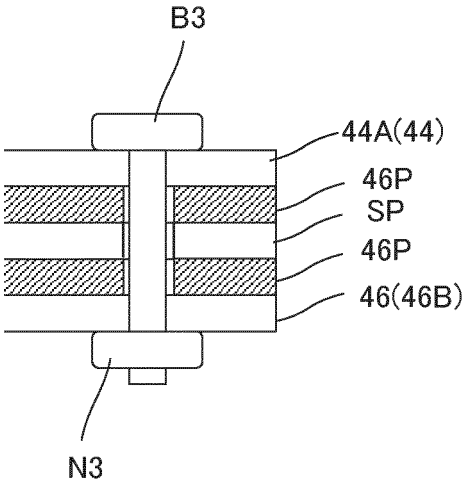


Fig.11D

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2021/044515

A. CLASSIFICATION OF SUBJECT MATTER

B02C 13/14(2006.01)i; ***B02C 13/26***(2006.01)i; ***B02C 13/284***(2006.01)i
FI: B02C13/14; B02C13/26 Z; B02C13/284

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B02C13/00-31, 23/00-16

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2022
Registered utility model specifications of Japan 1996-2022
Published registered utility model applications of Japan 1994-2022

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2003-117414 A (KUBOTA CORP.) 22 April 2003 (2003-04-22) paragraphs [0009]-[0034], fig. 1-5	4-7, 10-11
Y	JP 4-87645 A (KUBOTA CORP.) 19 March 1992 (1992-03-19) examples, fig. 1, 2	4-7, 10-11
Y	JP 2000-254532 A (KUBOTA CORP.) 19 September 2000 (2000-09-19) paragraphs [0020], [0024], fig. 1, 4, 7-9	10-11
A	JP 11-244716 A (MITSUBISHI ELECTRIC CORP.) 14 September 1999 (1999-09-14)	1-11
A	JP 2013-132631 A (EARTH TECHNICA KK) 08 July 2013 (2013-07-08)	1-11
P, X	JP 6947904 B1 (KUBOTA ENVIRONMENTAL SERVICE INC. CO.) 13 October 2021 (2021-10-13) claims, paragraphs [0015]-[0052], fig. 1-6	1-11

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
02 February 2022	**15 February 2022**
Name and mailing address of the ISA/JP **Japan Patent Office (ISA/JP)** **3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915** **Japan**	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2021/044515

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 2003-117414 A	22 April 2003	(Family: none)	
JP 4-87645 A	19 March 1992	(Family: none)	
JP 2000-254532 A	19 September 2000	(Family: none)	
JP 11-244716 A	14 September 1999	(Family: none)	
JP 2013-132631 A	08 July 2013	(Family: none)	
JP 6947904 B1	13 October 2021	(Family: none)	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP H5074641 U **[0008]**
- JP 2003117414 A **[0008]**