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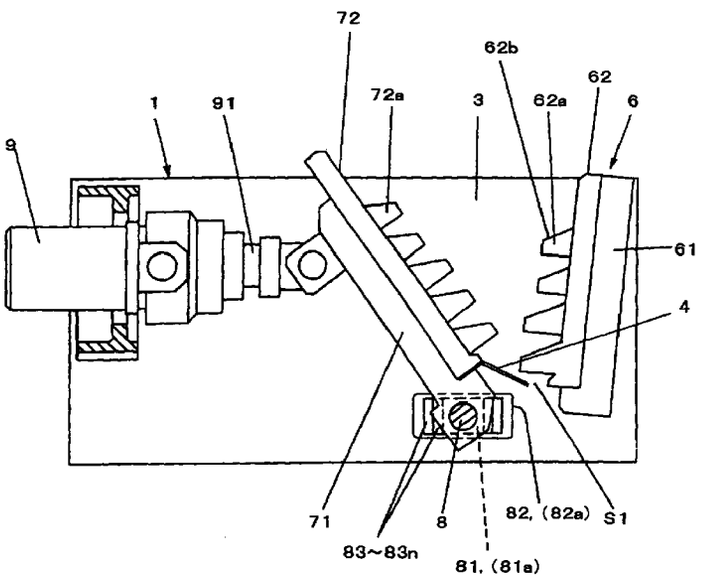
## (54) Method and apparatus for crushing-breaking long and slender weirs, runners, and other useless metal casting products

(57) A method for crushing-breaking of weirs, runners of casting products and useless casting products by supplying the runners etc into a space formed between a fixed cutter device 6 having a plurality of semi-cone shaped cutters and a rocking cutter device 7, having a plurality of semi-cone shaped cutters engaged face-to-face with the semi-come shaped cutters of the fixed cutter device. The runners etc are caught by a damper plate provided on the rocking cutter device. The rocking cutter device is moved forwardly and backwardly at least twice. The runners etc are crushed and broken in small pieces by the cutters disposed on the fixed cutter device and the rocking cutter device. The runners thus crushed and broken are discharged from a discharge outlet and put on a conveyer.

FIG.2

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## Description

### [BACKGROUND OF THE INVENTION]

#### 1. Technical Field of the Invention

The present invention relates to a method for crushing and breaking long and slender weirs, runners of casting products and useless casting products or the like (hereinafter all referred to as runners) and an apparatus therefor.

#### 2. Prior Art

The following methods and apparatus for crushing and breaking runners of casting products are known to the public. The first known breaking and crushing apparatus for runners and useless casting products utilizes an oil pressure cylinder, published in a publication of Japanese application for opposition No. Hei 8-205. The apparatus disclosed in this publication comprises a fixed cutter device installed in a frame and having a plurality of semi-cone shaped cutters disposed in a zig-zag fashion, a rocking cutter device installed in the frame and being rocked in the frame and having a plurality of semi-cone shaped cutters engaged face-to-face with the cutters on the fixed cutter device, a cylinder for rocking the rocking cutter device having a piston rod connected to an upper part of the rocking cutter device, and a discharge outlet for discharging broken-crushed casting products located below the fixed cutter device and the rocking cutter device.

The second known apparatus is a jaw-crasher published in Japanese laid-open publication No. SHO 62-279848, the jaw-crusher in this apparatus comprising fixed teeth and movable teeth, the movable teeth being movable by a toggle joint. A movable plate is provided under the fixed teeth in order to prevent falling down of crushed objects. A discharge outlet of the jaw-crusher is closed and opened by the movable plate powered by an oil pressure cylinder.

A third known apparatus is another breaking and crushing apparatus, published in Japanese laid-open publication No. SHO 60-241939, the breaking and crushing apparatus comprising a pushing member being rocked back and forth by a pushing means using a cylinder and having a plurality of plate shaped pushing cutters, and a wall (fixed member) having a plurality of plate shaped cutters engaged face-to-face with the pushing cutters of the pushing member. Useless casting products are crushed and broken by the pushing member and the fixed member. All of the crushed and broken useless casting products are caught by a movable plate located at the bottom of the apparatus, and the crushed and broken useless casting products are discharged by movement of the movable plate.

In the first mentioned prior art, runners having a long and slender shape supplied to the breaking and crushing apparatus tend to fall down and be discharged from the discharge outlet of the apparatus. Most of the runners having long and slender shape can not therefore be crushed and broken. Therefore, it is not possible for the apparatus to perform reliable and appropriate breaking and crushing of runners and the like.

In the second mentioned prior art, although the jaw-crusher discloses a movable plate for preventing the crushed objects from falling through, the movable plate is provided under the fixed teeth. The movable plate is movable independently of the movable teeth. Therefore, discharge of the crushed objects can not be carried out easily and reliably. Furthermore, an independent power source or the like is required in order to move the movable plate. Therefore, the structure of the jaw-crusher is more complex as well as more expensive.

In the last mentioned prior art, the movable plate is moved separate from movement of the pushing cutters. Therefore, movement of the movable plate and the pushing cutters are independent of each other. Therefore, discharge of the crushed objects can not be carried out easily and reliably. Furthermore, an independent power source or the like is required in order to move the movable plate. Therefore, the structure of the jaw-crusher is more complex as well as more expensive.

### [SUMMARY OF THE INVENTION]

It is an aim of the present invention to provide a method for smoothly breaking and crushing long and slender runners generated during or after casting process at a foundry. The method includes reliably catching the crushed and broken products and discharging them smoothly and automatically.

In accordance with the present invention there is provided a method for crushing and breaking weirs, runners of casting products and useless casting products sequentially by supplying the weirs, the runners of casting products and the useless casting products into a space formed between a fixed cutter device having a plurality of cone or semi-cone shaped cutters and a rocking cutter device having a plurality of cone or semi-cone shaped cutters engaged face-to-face with the cone or semi-cone shaped cutters of the fixed cutter device, characterized by the following sequential steps:

catching long and slender weirs, runners of casting products and long and slender useless casting products in the weirs, the runners and the useless casting products supplied into the space by a damper means attached to the rocking cutter device,

moving the rocking cutter device forwardly and backwardly at least twice by contraction and extension of a piston rod of a cylinder,

crushing and breaking the long and slender weirs, runners of casting products and the long and slen-

der useless casting products caught between the fixed cutter device and the rocking cutter device,

discharging the crushed-broken long and slender weirs, runners of casting products and the crushed-broken long and slender useless casting products in a direction toward the fixed cutter device via a discharge outlet formed between the fixed cutter device and the damper means over upper surfaces of the cutters of both the fixed cutter device and the rocking cutter device and through clearances formed between the cutters of the fixed cutter device and the rocking cutter device.

The present invention also aims to provide an apparatus which can smoothly break and crush long and slender runners generated during or after a casting process at a foundry, the apparatus catching the crushed and broken products and discharging them smoothly and reliably.

In accordance with the present invention there is provided a crushing and breaking apparatus for long and slender weirs, runners of casting products and long and slender useless casting products comprises:

a frame having only side plates ,

a fixed cutter device provided in the frame, having a plurality of cone or semi-cone shaped cutters,

a rocking cutter device provided in the frame having a plurality of cone or semi-cone shaped cutters disposed in a zig-zag fashion so as to be offset relative to the cone or the semi-cone shaped cutters of the fixed cutter device engaged face-to-face to the fixed cutter device, and mounted for rocking pivotally,

a damper plate provided on the rocking cutter device for closing a gap formed between a lower part of the fixed cutter device and a lower part of the rocking cutter device,

a bearing having a fulcrum shaft providing pivotal rocking of the rocking cutter device,

bearing adjustment means for adjusting forward and backward movement of the bearing,

a cylinder having a piston rod connected to an upper part of the rocking cutter device,

a rocking adjustment means for adjusting forward and backward movement of the piston rod of the cylinder, and

a discharge outlet formed between a lower part of the fixed cutter device and the damper plate of the rocking means, the discharge outlet discharging crushed and broken long and slender weirs, runners of casting products and crushed and broken long and slender useless casting products.

Other features of the invention will become more apparent upon a consideration of the following description of the preferred embodiment of the present invention, taken in conjunction with the accompanying drawings.

## [BRIEF DESCRIPTION OF THE DRAWINGS]

Fig. 1 is a perspective view showing the overall structure of the crushing and breaking apparatus according to the present invention.

Fig. 2 is a cross-sectional view showing the important features of the apparatus.

Fig. 3 is a plane view showing the overall structure of the crushing and breaking apparatus, when the rocking cutter device is in its back-most position.

Fig. 4 is a plane view showing the overall structure of the crushing and breaking apparatus, when the rocking cutter device is in its foremost position.

Fig. 5 is a side view showing the fulcrum shaft with partial cutaway.

Fig. 6 is an enlarged view of a bearing box.

Fig. 7 is a view of the cutters when the rocking cutter is in its back-most position.

Fig. 8 is a view of the cutters when the rocking cutter device is moved forwardly.

Fig. 9 is a view of the cutters when the rocking cutter device is moved backwardly.

Fig. 10 is a view of the cutters when the rocking cutter device is in its foremost position.

## [PREFERRED EMBODIMENT OF THE INVENTION]

An embodiment of the present invention (an overall mechanism of crushing and breaking of runners and discharging the crushed and broken runners) will be described hereunder.

As shown in Fig. 7, long and slender runners are supplied to a space (hereinafter referred to as crushing-breaking space) formed between a rocking plate of a rocking cutter device 7 positioned in the back-most position through a contraction of a piston rod 91 of a cylinder and a fixed plate 6 composing a fixed cutter device. The long and slender runners supplied to the crushing-breaking space are caught by a damper plate 4 provided on the rocking cutter device 7 (See Fig. 7). The long and slender runners are thus held in the crushing-breaking space thus formed. Therefore, the long and slender runners are not discharged through a discharge outlet 5 formed between a lower part of the fixed cutter device and the rocking cutter device. The long and slender runners held in the crushing-breaking space are crushed and are broken one after another in a gap formed between cutters disposed on both of the rocking cutter device and the fixed cutter device when the rocking cutter device is moved toward the fixed cutter device through an extension of the piston rod. The runners thus crushed and broken (hereinafter referred to as crushed-broken runners) fall down to the lower part of the apparatus by slipping over the upper surfaces of the cutters of both the fixed cutter device and the rocking cutter device and through the gaps between the cutters of both the cutter devices (see Fig. 8). The crushed-broken runners which have fallen down to the lower part of

the apparatus are discharged through the discharge outlet 5 formed between the lower part of the fixed cutter device 6 and the rocking cutter 7 device when the rocking cutter device is moved backwardly after reaching its foremost position. Other crushed-broken runners are still in the crushing-breaking space and on the damper plate (see Fig. 9). Thereafter, the gap between cutters is narrowed as a result of forward movement of the rocking cutter device 7 through the extension of the piston rod 91. The crushed-broken runners are further crushed and broken into smaller pieces by the forward movement and are discharged through the discharge outlet as a result of slipping over the upper surfaces of the cutters and down the gap between the cutters (see Fig. 10). The runners which have fallen down to the bottom of the apparatus as a result of widening the gap between the cutters by a backward movement of the rocking cutter device through the contraction of the piston rod are caught by damper plate. The rocking cutter device is located in a position shown in Fig. 7 (initial position) when the rocking cutter device is moved to its back-most position. Thereafter, the operation described above is carried out, and the same phenomena are observed. The operation described above shows just an example of various ways of operation.

In order to control strokes of the piston, the number of the strokes in a certain period of time and the operation procedure, a number of control methods can be employed. For instance, automatic controls include a control based on contact, a control based on numerical values, a control based on detection, or a control using a computer for achieving accuracy of the control. Various switches such as limit switches or the like, counters and sensors and the like are used for carrying out the control based on contact and the computer control. By employing the control methods stated above, optimum operation of the apparatus can be carried out in accordance with the size of the runners supplied to the apparatus, quantity of the runners, property of the runners and the like, as well as ensuring proper operation. In addition, the apparatus of the present invention may employ automatic control by automatically stopping the piston rod of the cylinder in response to a signal from pressure sensors and automatically restarting the piston after the automatic stop. The apparatus in the present invention comprises all the features required for carrying out optimum crushing and breaking and for accomplishing efficient and stable crushing and breaking as well as ensuring proper operation.

An example of how to shift the position of the fulcrum of the rocking cutter device is described with reference to Fig. 2. The fulcrum is supported by bearing boxes 81. The bearing boxes are inserted into slots 82 formed in a pair of side frames of the apparatus through a plurality of spacers. The position of the bearing boxes can be shifted by changing the number of the spacers.

Both the fixed cutter device and the rocking cutter device, described in detail later, are provided on a frame consisting of two side plates 2 and 2a. An inlet 3 for input of the long and slender runners W, and the damper plate 4 for catching the runners W are provided between the fixed cutter device and the rocking cutter device installed in the frame. A gap S1 formed between a lower part of the fixed cutter device and the rocking cutter device is closed when the rocking cutter device is in its back-most position (see Fig. 3, Fig. 7 and Fig. 9). A discharge outlet 5 for discharging crushed-broken runners W2 is formed between the damper plate 4 and the fixed cutter device when the rocking cutter device approaches the fixed cutter device (see Fig. 10). The size of the discharge outlet 5 can be changed on demand by adjusting the length of the damper plate 4 or by shifting the bearing boxes 81 described later. Thus, the apparatus can be operated with high efficiency even when size, quantity, property and other factors of the crushed-broken runners has been changed. The damper plate 4 is moved so as to trace an arc of circle. In accordance with the movement, discharge of the crushed-broken runners is carried out smoothly, and the damper plate 4 is moved without a hitch.

The fixed cutter device 6 is installed at one end of the frame 1. The fixed cutter device 6 comprises a base plate 61 fixed in the frame 1 and a plurality of semi-cone shaped cutters 62a disposed in a zig-zag fashion on a cutter attachment 62 attachable to the base plate 61. The length of the semi-cone shaped cutters 62a disposed on the cutter attachment 62 gradually increases from the upper part of the cutter attachment 62 to the lower part. The upper surfaces 62b of the cutters 62a (the slipping surfaces) are formed such that the crushed-broken runners W1 slip over the slipping surfaces. In order to engage the fixed cutter device 6 with the rocking cutter device, spaces are formed between adjacent semi-cone shaped cutters 62a disposed in a zig-zag fashion on the fixed cutter device 6. Also, clearances are formed for the crushed-broken runners W1 to fall down to the lower part of the apparatus when the fixed cutter device 6 is engaged with the rocking cutter device.

The rocking cutter device 7 is provided at almost the midpoint of the frame 1 and supported on a fulcrum shaft 8 so as to oppose the fixed cutter device 6. The rocking cutter device 7 comprises a rocking plate 71 rockable within the frame 1 and a plurality of semi-cone shaped cutters 72a disposed in a zig-zag fashion on a cutter attachment 72 attachable to the rocking plate 71. The upper surfaces 72b of the cutters 72a (the slipping surfaces) are formed such that the crushed-broken runners W1 slip over the slipping surfaces. The semi-cone shaped cutters 72a are formed in a tapered shape. The cutters 72a of the rocking cutter device 7 engage with the cutters 62a of the fixed cutter device, and the length of the semi-cone shaped cutters 72a gradually increases from the upper to the lower part of the cutter attachment 72.

The fulcrum shaft 8 is supported by a couple of ful-

crum bearing boxes 81, 81a. The fulcrum bearing boxes 81 are inserted into slots 82 formed in the pair of side plates 2, 2a of the frame 1 through a plurality of spacers 83 to 83n (hereinafter referred to as spacers 83). Thus, the position of the fulcrum bearing boxes 81 can be shifted by changing the number of the spacers 83 inserted into the slots. The fulcrum shaft 8 is positioned at the center of the slot 82 when the same number of the spacers 83 are inserted into the both sides of the fulcrum bearing boxes 81 as shown in Fig. 1. The fulcrum shaft 8 is shifted toward the right hand side when additional spacers are inserted into left hand side of the fulcrum bearing boxes 81 (not shown). On the other hand, the fulcrum shaft 8 is shifted toward the left hand side when additional spacers are inserted into the right hand side of the fulcrum bearing boxes 81 (not shown). Each of the fulcrum bearing boxes 81 comprises a bush 811, a bearing 812, and a plurality of keys 813. Thus, it is possible for the fulcrum bearing boxes 81 to prevent abrasion of the fulcrum shaft 8, realizing easy maintenance and the like. Movement of the fulcrum shaft 8 is carried out automatically using a load on the fulcrum shaft 8 detected by a sensor 814. A pair of bearing adjustment means 815 are provided on the side plates 2 of the frame to adjust the number of the spacers 83 inserted into either the left or right hand side of the fulcrum bearing boxes 81 in response to detected signals. Thus, in the apparatus of the present invention, the optimum crushing-breaking force can be applied to the rocking cutter device 7. Furthermore, less abrasion of both the semi-cone shaped cutters 62a of the fixed cutter device 6 and the semi-cone shaped cutter 72a of the rocking cutter device 7 occurs.

The cylinder 9 is connected to the rocking plate 71 through a piston rod 91. The rocking cutter device 7 is pivoted around the fulcrum shaft 8 by contraction of the piston rod 91 of the cylinder 9. The rocking cutter device is pivoted forwardly and backwardly to the fixed cutter device 6. A large crushing-breaking force is supplied to the semi-cone shaped cutter 72a of the rocking cutter device 7 as a result of efficient conveyance of the pushing force of the cylinder, due to the piston rod 91 being connected to the upper part of the rocking cutter device 7. In other words, the lever and fulcrum principle is and utilized in the present invention. Therefore, crushing and breaking of the long and slender runners can be carried out smoothly and reliably regardless of the size of the runners. In the drawings, W shows long and slender runners, W1 shows weirs, runners and other useless casting products, and W2 shows crushed-broken runners, crushed-broken weirs and crushed-broken useless casting products.

The method of the present invention utilizes the following steps. Long and slender runners are supplied to the crushing-breaking space formed between the fixed cutter device having a plurality of semi-cone shaped cutters and a rocking cutter device having a plurality of semi-cone shaped cutters engaged face-to-face with the semi-cone shaped cutters of the fixed cutter device. A pushing force is applied to an upper part of the rocking cutter device, so that a large crushing-breaking force is applied to the cutters, after the runners supplied are caught by the damper plate, which is provided at a lower part of the rocking cutter device. The long and slender runners are crushed and broken by the force. The crushed-broken runners are then discharged from the discharge outlet formed between the fixed cutter device and the damper plate. The long and slender runners are caught by the damper plate, and the runners thus caught are crushed and are broken easily and quickly. In addition, there is no probability of discharging uncrushed or unbroken runners.

The apparatus of the present invention allows the position of the fulcrum of the rocking cutter device within the slot formed in the side frames to be shifted. Therefore, it is possible to prevent abrasion of the cutters, realizing easy maintenance and accomplishing application of the optimum crushing-breaking force to the long and slender runners.

Further to the above, the apparatus of the present invention is composed so as to crush and break the long and slender runners by engagement of the fixed cutter device and the rocking cutter device by pushing the upper part of the rocking cutter device having the damper plate by the cylinder. Therefore, the crushing-breaking apparatus in the present invention has the following advantages that the long and slender runners are always caught by the damper plate. Another advantage is that the apparatus can be formed in smaller size without extra cost because no independent power source for the damper plate is required. Thus, less room is required at the foundry. Further practical advantages such as facilitating and maintaining connection with other equipments such as conveyers or the like in the foundry are provided.

While the invention has been described in its preferred embodiments, it is to be understood that the words which have been used are words of description rather than limitation and that changes within the purview of the appended claims may be made without departing from the true scope of the invention.

## Claims

1. A method for crushing and breaking weirs, runners of casting products and useless casting products sequentially by supplying the weirs, the runners of casting products and the useless casting products into a space formed between a fixed cutter device having a plurality of cone or semi-cone shaped cutters and a rocking cutter device having a plurality of cone or semi-cone shaped cutters engaged face-to-face with the cone or semi-cone shaped cutters of the fixed cutter device, characterized by the following sequential steps:

catching long and slender weirs, runners of casting products and long and slender useless casting products in the weirs, the runners and the useless casting products supplied into the space by a damper means attached to the rocking cutter device,

moving the rocking cutter device forwardly and backwardly at least twice by contraction and extension of a piston rod of a cylinder,

crushing and breaking the long and slender weirs, runners of casting products and the long and slender useless casting products caught between the fixed cutter device and the rocking cutter device,

discharging the crushed-broken long and slender weirs, runners of casting products and the crushed-broken long and slender useless casting products in a direction toward the fixed cutter device via a discharge outlet formed between the fixed cutter device and the damper means over upper surfaces of the cutters of both the fixed cutter device and the rocking cutter device and through clearances formed between the cutters of the fixed cutter device and the rocking cutter device.

**2.** A crushing and breaking apparatus for long and slender weirs, runners of casting products and long and slender useless casting products comprising:

a frame (1) having only side plates (2),

a fixed cutter device (6) provided in the frame, having a plurality of cone or semi-cone shaped cutters,

a rocking cutter device (7) provided in the frame having a plurality of cone or semi-cone shaped cutters disposed in a zig-zag fashion so as to be offset relative to the cone or the semi-cone shaped cutters of the fixed cutter device (6) engaged face-to-face to the fixed cutter device, and mounted for rocking pivotally,

a damper plate (4) provided on the rocking cutter device for closing a gap formed between a lower part of the fixed cutter device and a lower part of the rocking cutter device,

a bearing (81) having a fulcrum shaft (8) providing pivotal rocking of the rocking cutter device,

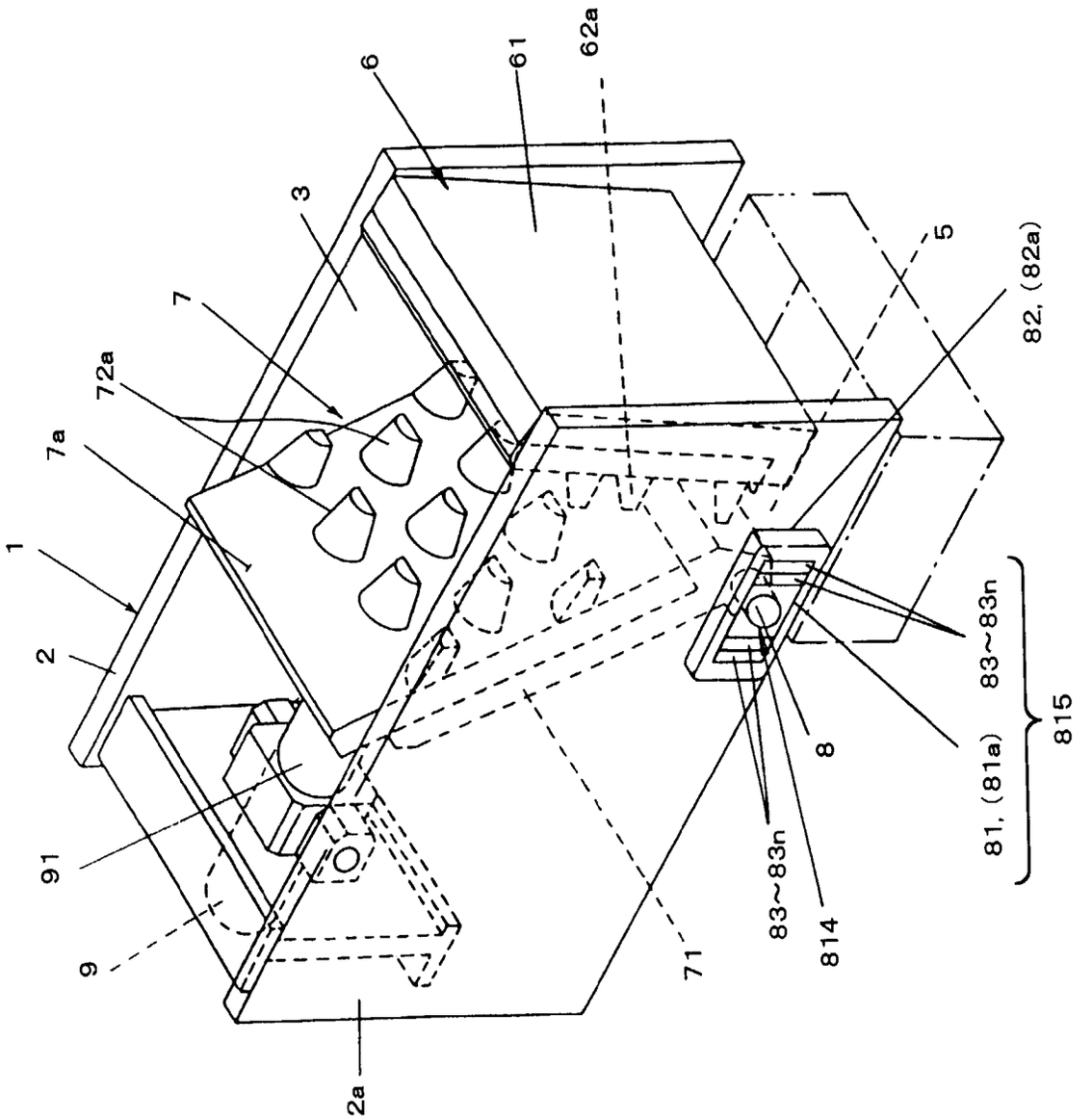
bearing adjustment means (815) for adjusting forward and backward movement of the bearing,

a cylinder (9) having a piston rod connected to an upper part of the rocking cutter device,

a rocking adjustment means for adjusting forward and backward movement of the piston rod (91) of the cylinder, and

a discharge outlet (5) formed between a lower part of the fixed cutter device (6) and the damper plate (4) of the rocking means, the discharge outlet discharging crushed and broken long and slender weirs, runners of casting products and crushed and broken long and slender useless casting products.

FIG.1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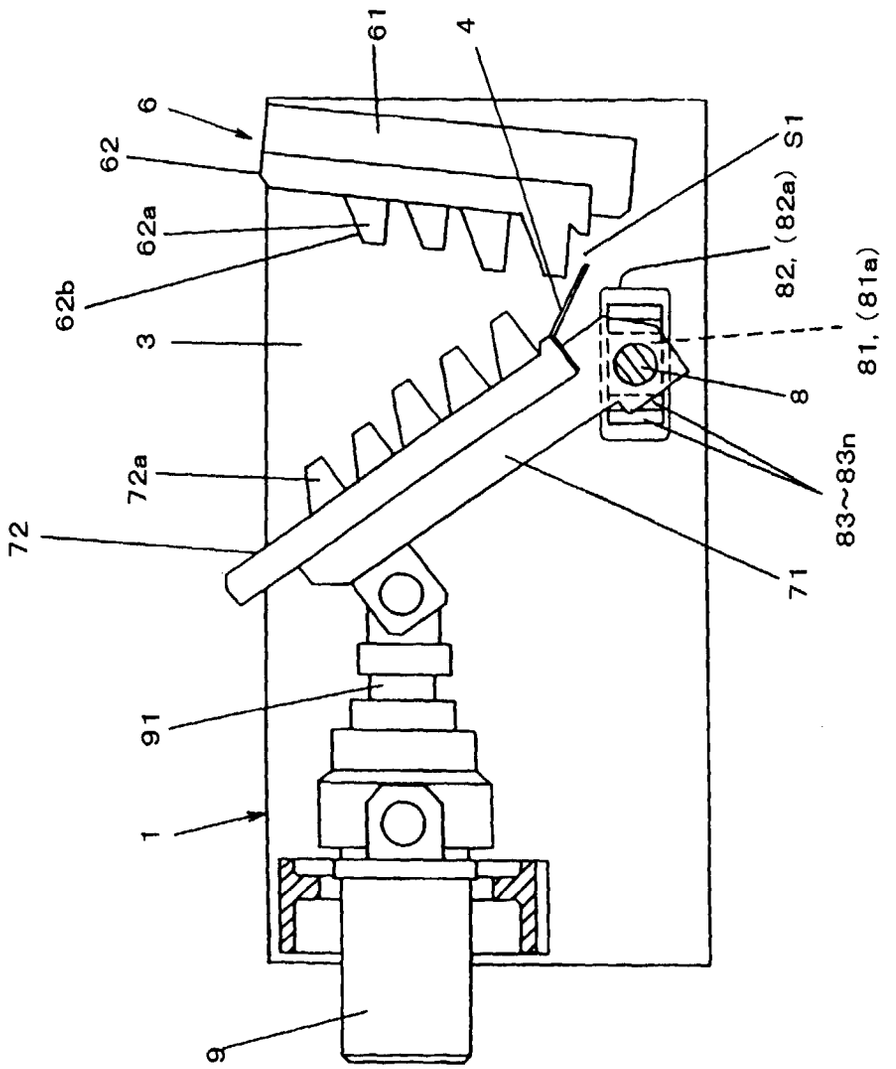



FIG.2

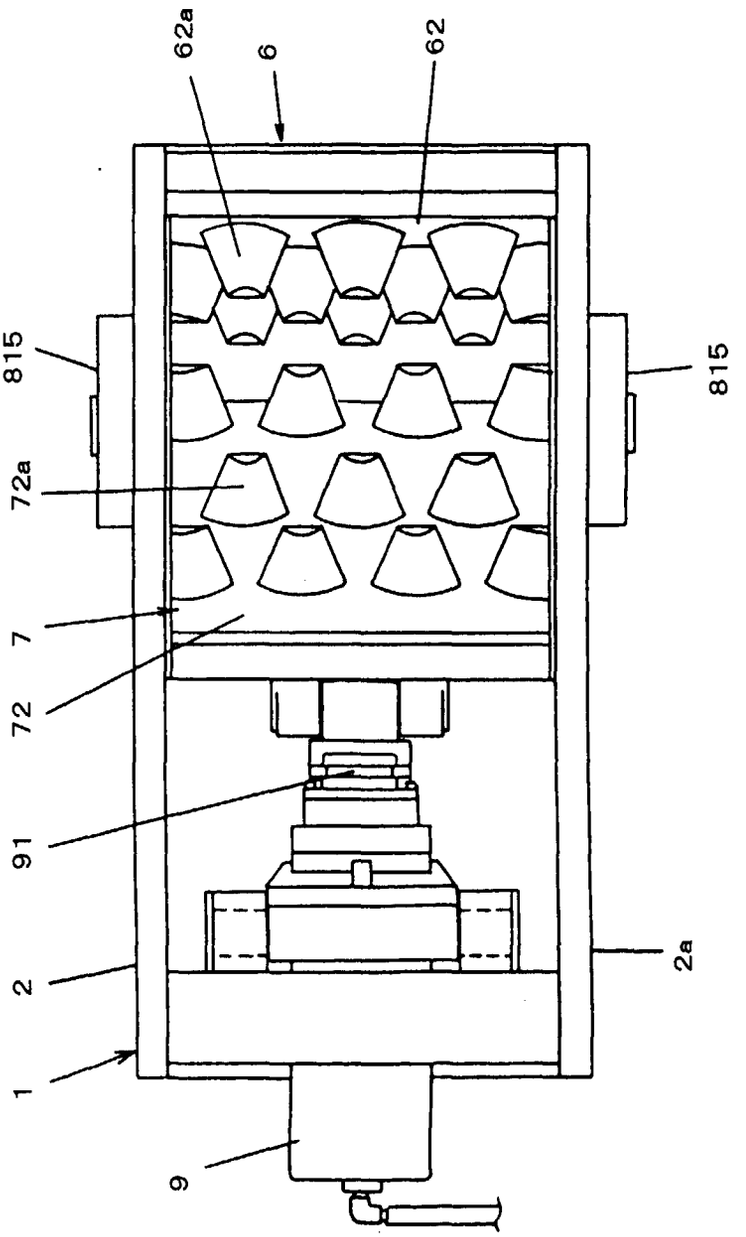



FIG.3

FIG.5

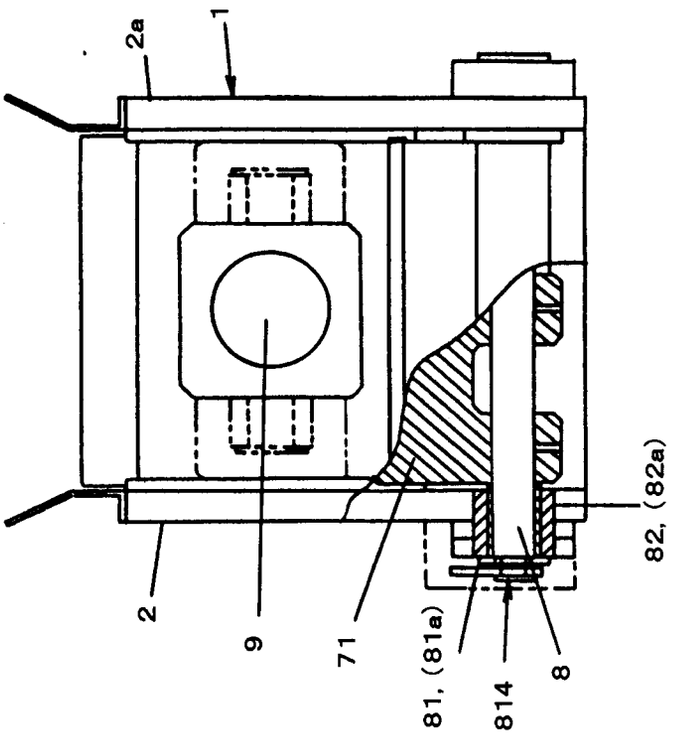



FIG.4

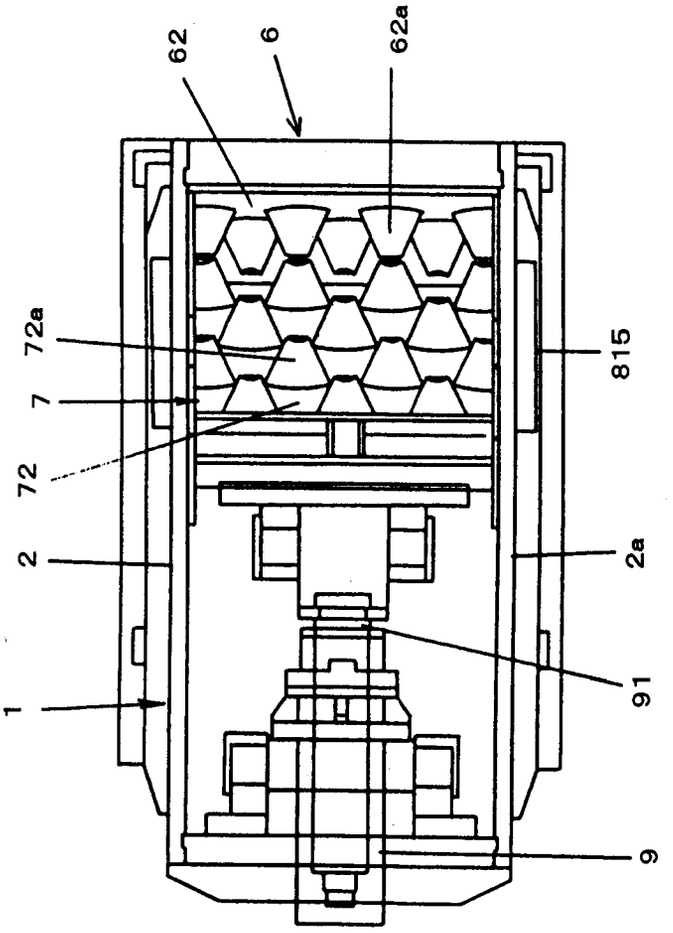


FIG.6

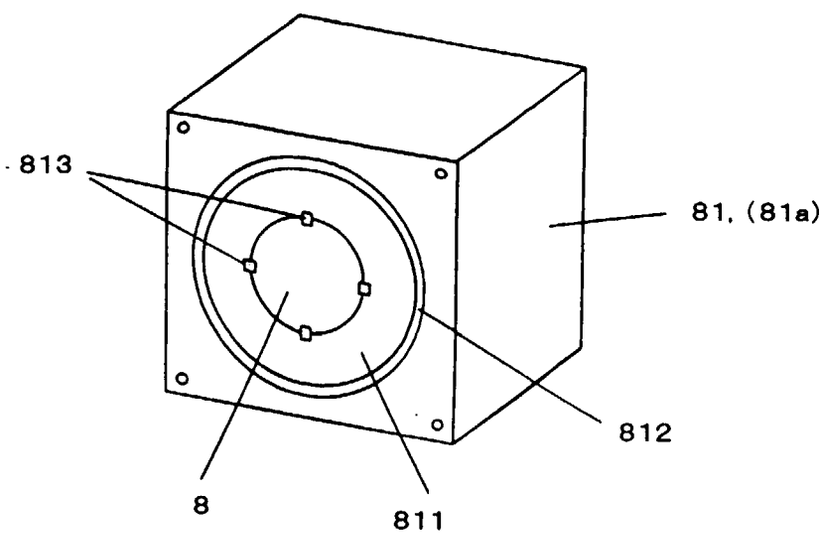


FIG.7

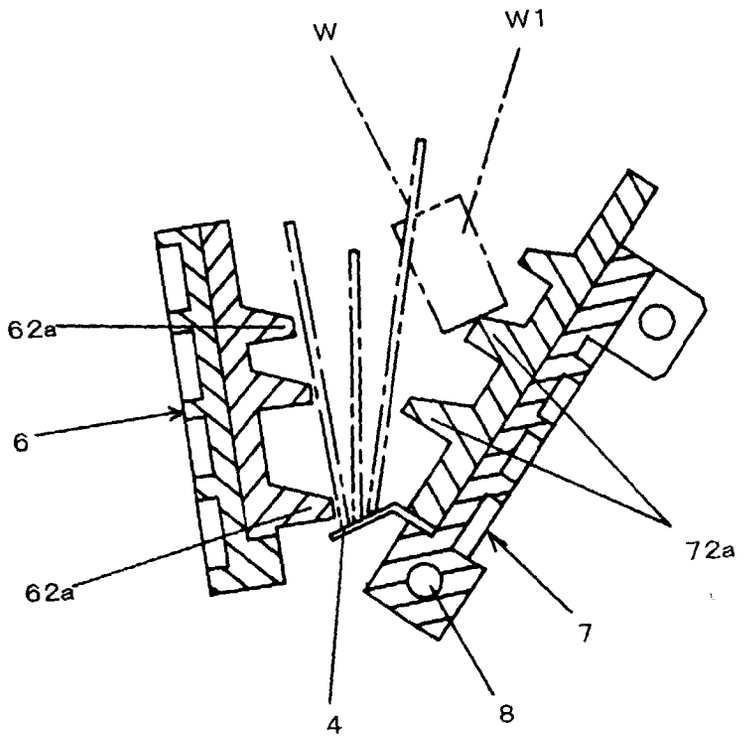


FIG.8

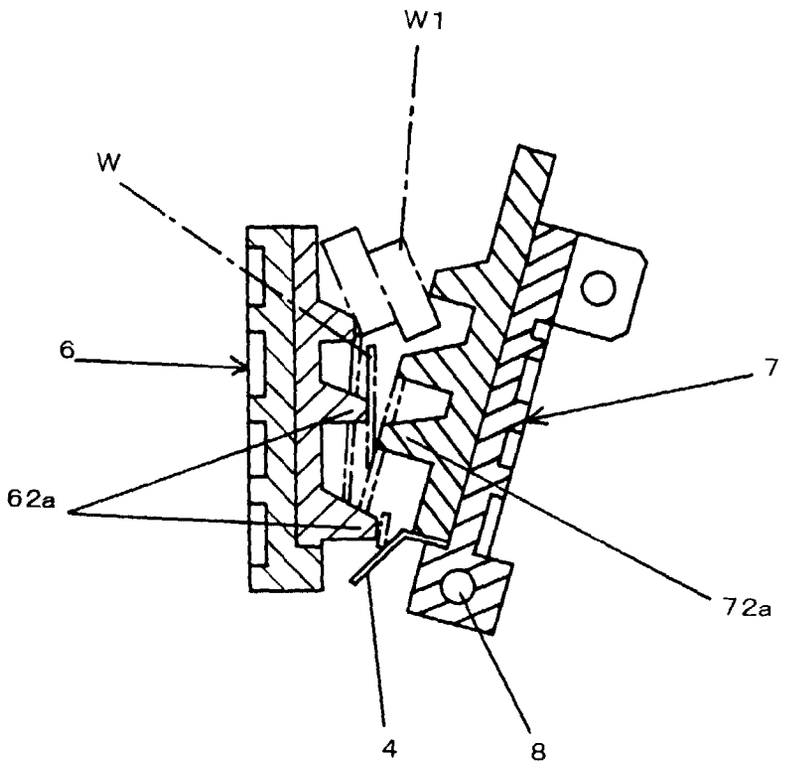


FIG.9

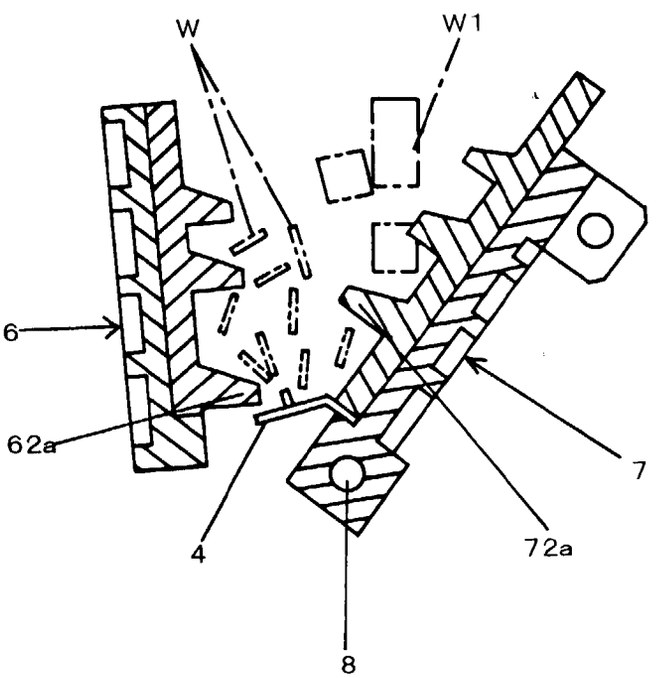
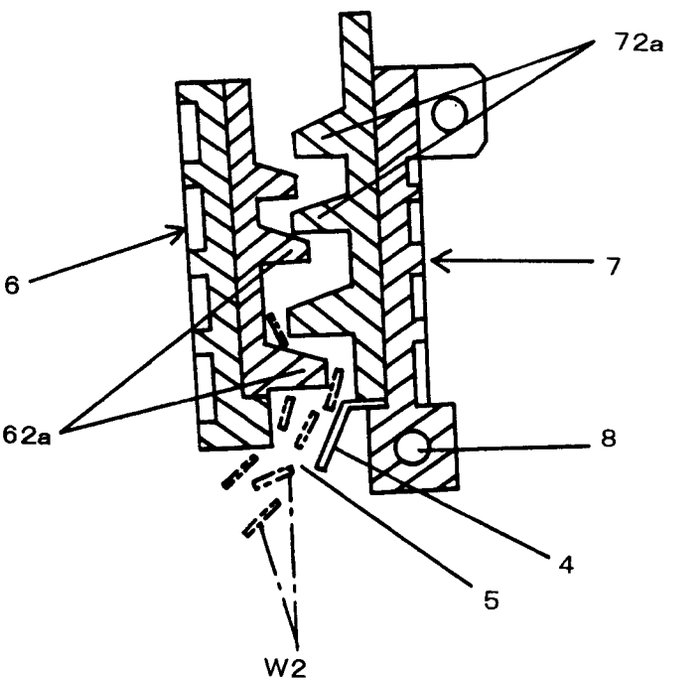


FIG.10



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# EUROPEAN SEARCH REPORT

Application Number
EP 97 30 1799

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| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int.Cl.6) |
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The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 8 August 1997 | Verdonck, J |

CATEGORY OF CITED DOCUMENTS

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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

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| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int.Cl.6) |
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The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 8 August 1997 | Verdonck, J |

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