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(54) **MACHINE FOR CRUSHING PORTABLE ELECTRONIC TELECOMMUNICATION DEVICES**

(57) A machine for crushing portable electronic telecommunication devices, has an upper feeding and crushing part (1) and a lower scrap collecting part (2). The upper feeding and crushing part (1) has a feeding hopper (3), a containment box (43) below the feeding hopper (3), the containment box (43) containing toothed rollers suitable to receive between them the electronic devices to be crushed, a kinematic chain (6) able to simultaneously move the toothed rollers and driving means (9) capable of operating the kinematic chain (6), contained int the lower scrap collecting part (2). The upper feeding and crushing part (1) can be separated from the lower scrap collecting part (2).

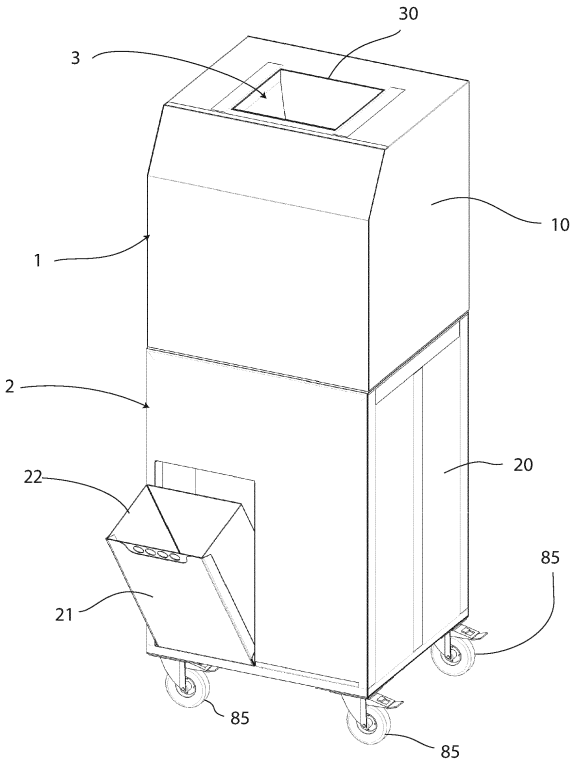

Fig. 1

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Description

[0001] The present invention relates to a machine for crushing portable electronic telecommunication devices such as mobile phones and tablets.

[0002] It is known that these electronic devices, as they are called below for simplicity, contain sensitive data. When these data must not be kept because they risk being known, the electronic devices must be destroyed. One way to destroy them, in order to prevent the data they contain from being disclosed, is to crush them.

[0003] With the aim of recovering the materials of which mobile phones are made, CN 212142813 U describes a crushing equipment for mobile phones, comprising a crushing box with a top feed inlet and a lower outlet, and a conveyor belt. An upper pair of primary crusher rollers and a lower pair of secondary crusher rollers are arranged inside the crushing box, arranged orthogonally to each other.

[0004] CN 211303321 U discloses a duct comprising a section inside which are an upper pair of rubber roller devices joined respectively to an upper pair of toothed wheels in mutual engagement, and a lower pair of toothed rollers joined to a lower pair of toothed wheels in mutual agreement. The lower pair of toothed wheels is driven by an electric motor as well as the upper pair of toothed wheels by a pair of pinions and a transmission chain.

[0005] JP 2005152881 A discloses a waste crusher, comprising a support structure, having a base and two opposite walls, a feed hopper formed by walls inclined downwards inside, a pair of toothed rollers side by side, mounted by means of respective shafts at their ends on the opposite walls, adapted to move the pair of rollers, and motor means comprising a toothed wheel capable of operating a kinematic chain.

[0006] WO 2018132174 A1 provides a modular shredder and grinder apparatus. The apparatus comprises a grinder assembly having a grinder shaft assembly, said grinder assembly having a grinder opening; and a shredder assembly movable with respect to said grinder opening to allow access to said grinder shaft assembly. Scrap material is first fed into said shredder assembly so that shredded scrap material is received through said grinder opening and further cut by said grinder shaft assembly. The shredder assembly and the grinder assembly have two separated driving means.

[0007] GB 20238965 A describes a chipper for scrab plastic. The chipper includes a feed bin for feeding a quantity of scrap plastic to a chipping mechanism which first, by means of two rotary choppers operating in conjunction, pre-chops the plastic, and then by means of a single rotary chopper finely chops the plastic. CN113713907 A discloses a device for preparing an organic fertilizer by using excrement of dead livestock and poultry. The device includes a crushing box with a lower funnel, the box containing rotationally a first pair of rollers, a second pair of rollers and a plurality of blade-holder turntables.

[0008] As previously stated, the present invention relates to a machine for crushing electronic devices and is normally intended to be used in offices.

[0009] Therefore, an object of the invention is to provide a machine that has small dimensions.

[0010] Another object is to provide a machine which is light in weight.

[0011] Yet another object of the invention is to provide a transportable machine.

[0012] Furthermore, in consideration of the power required to destroy great size devices such as tablets, a further object is to provide a machine which has a reduced power absorption, so as to be able to operate with the network powers normally available in offices.

[0013] In order to achieve the objects above indicated, the invention provides a machine for crushing portable electronic telecommunication devices, comprising

- an upper feeding and crushing part, having:
  - a base provided with a base opening,
  - a feeding hopper having a mouth facing upward that is suitable for receiving electronic devices to be crushed,
  - a roller holding box below the feeding hopper, the roller holding box containing toothed rollers suitable to receive between them the electronic devices to be crushed,
  - a kinematic chain able to simultaneously move the toothed rollers,
  - driving means capable of operating the kinematic chain, and
- a lower scrap collecting part, having a frame and a top wall provided with a top opening corresponding to the base opening of the base for the passage of the scrap downstream of the toothed rollers, and containing a scrap collecting container,

removable connection means being provided between the top wall of the lower scrap collecting part, and the base of the feeding and crushing upper part, said removable connection means being able to allow the separation of the feeding and crushing upper part from the lower scrap collecting part.

[0014] In the machine according to the invention:

- the base is further provided with a first slot,
- the top wall is further provided with a second slot matching the first slot of the base,
- the driving means is located in the lower scrap collecting part, and comprises a toothed wheel protruding upwards through both the first slot of the base and the second slot of the top wall so as to engage the kinematic chain, located in the feeding and crushing upper part,
- the kinematic chain is able to drive simultaneously a plurality of pairs of gear wheels side by side in

succession from top to bottom in the roller holding box below the feeding hopper,

so that the machine, having a mass distributed both in the upper feeding and crushing part and in the lower scrap collecting part, can be easily transported after the separation of the upper feeding and crushing part from the lower scrap collecting part.

[0015] The technical effect of the characteristics set out above derives mainly from the fact that the driving means of the plurality of pairs of toothed rollers are provided in the lower part for collecting the fragments and there is no permanent connection between the driving means and the kinematic chain which moves the plurality of pairs of toothed rollers.

[0016] The main advantages of the machine according to the present invention are represented especially by the possibility of being divided into two parts, each of which can be easily lifted and moved.

[0017] Furthermore, in order to have a power absorption compatible with its working environment, the machine is equipped with motor means which will be detailed below.

[0018] Further characteristics and advantages of the invention will become most clear from the description of embodiments of a crushing machine in question, illustrated by way of indicative and non-limiting example in the attached drawings in which:

Figure 1 is a perspective view of a machine for crushing electronic devices according to the invention;

- Figure 2 is a perspective view of a first embodiment of the machine in figure 1, without a casing and with a waste door open;
- Figure 3 is an exploded perspective view of the first embodiment of the machine in figure 2;
- Figures 4, 5 and 6 are an enlarged front view, a side view and, respectively, a plan view of a first variant of the hopper wall of the machine in figure 1;
- Figures 7, 8 and 9 are an enlarged front view, a side view and, respectively, a plan view of a second variant of the hopper wall of the machine in figure 1;

Figure 10 is a perspective view of a crushing assembly of the machine in figure 1;
Figure 11 is an exploded perspective view of the crushing assembly in figure 10;
Figures 12 and 13 are a plan view and a side view, respectively, of a first toothed disc of the crushing assembly in figure 10;
Figures 14 and 15 are a plan view and a side view, respectively, of a second toothed disc of the crushing assembly in figure 10;
Figure 16 is a top three-quarter perspective view of a second embodiment of the machine in figure 1;

- Figures 17 and 18 are three-quarter perspective views, respectively, from below and from above from a side opposite to that of figure 15; and
- Figure 19 is a simplified diagram of a hydraulic circuit installed in the second embodiment of the machine according to the present invention.

[0019] Reference is initially made to figure 1 which is a perspective view of a machine for crushing electronic devices according to the invention.

[0020] The machine has an upper feeding and crushing part, generically indicated with 1, and a lower scrap collecting part, generically indicated with 2.

[0021] The upper feeding and crushing part 1 is covered with an upper casing 10 except at the mouth 30 of a feeding hopper 3. The lower scrap collecting part 2 is covered with a lower casing 20 and has a door 21 which can be opened for the extraction of a scrap container 22.

[0022] Reference is made to figure 2 which is a perspective view of a first embodiment of the machine of figure 1, without the upper casing 10 and the lower casing 20. Also in figure 2, the waste flap is shown open. The first embodiment of the invention differs from a second embodiment, which will be described below.

[0023] The upper feeding and crushing part 1 comprises a support structure 4, having a base 40 and two opposite walls 41, 41.

[0024] The feed hopper 3 is formed by walls inclined downwards internally and has the mouth 30 facing upwards to receive the electronic devices to be crushed.

[0025] The feed hopper 3 is arranged between the two opposite walls 41, 41 of the support structure 4 above a containment box 43. The containment box 43, below the feed hopper 3, has two opposite plates 44, 44 connected to each other by upper 46, intermediate 47 and lower 48 coplanar crosspieces. The upper coplanar crosspieces 46 support the walls of the feed hopper 3, while the other crosspieces will be described in greater detail below.

[0026] In the containment box 43 a plurality of pairs of toothed rollers are mounted side by side in succession from top to bottom under the feed hopper 3. Three pairs of toothed rollers 5 are shown in detail below. A kinematic chain 6 is able to simultaneously operate the three pairs of toothed rollers 5. Reference is also made to figure 3, which is an exploded perspective view of the first embodiment of the machine in figure 2, the upper feeding and crushing part 1 being lifted from the lower scrap collecting part 2, both the parts being without casing.

[0027] The lower scrap collecting part 2 comprises a frame 8 and a top wall 80 that is below the base 40 of the support structure 4. According to the invention, driving means, indicated generally as 9, is in the lower scrap collecting part 2; the driving means 9 comprises a toothed wheel 90, integral with a hydraulic motor, as will be seen below, capable of operating the kinematic chain 6. The top wall 80 is provided with a top opening 81 for the passage of the scrap downstream of the plurality of toothed rollers 5. Furthermore, a second slot 82 is provided in

the top wall 80 from which protrudes upwards the toothed wheel 90 of the driving means 9 so as to engage with the kinematic chain 6. The base 40 of the support structure 4 is provided with a base opening, not visible in figure 3, above the top opening 81 for the passage of the scrap along a chute 83 directed towards the scrap container 22. The base 40 of the support structure 4 also has a first slot 42 which matches the second slot 82 of the top wall 80. Between the top wall 80 and the base 40 of the support structure 4 is provided removable connection means capable of allowing the separation of the machine according to the invention in the upper feeding and crushing part 1 and in the lower scrap collecting part 2 to facilitate transport of the machine. The aforesaid removable connection means can be, by way of example, threaded couplings. They comprise threaded pins, generically indicated as 84, protruding upwards from the top wall 80, corresponding through holes 44 in the base 40 of the support structure 4 and nuts (not shown) for the threaded pins 84.

[0028] To facilitate the movement of the upper feeding and crushing part 1 without a casing, the base 40 of the support structure 4 has a pair of handles 49 projecting upwards. For the same purpose, the lower scrap collecting part 2 is equipped with swivel wheels 85.

[0029] Reference is now made to figures 4 to 6 and to figures 7 to 9 which are an enlarged front view, a side view and, respectively, a plan view of a first variant and a second variant of the hopper wall of the machine in the figure 1. In the first variant, each of the four walls indicated as 31 has an upwardly tapering profile 32 with a support side 33 intended to be fixed above the upper crosspieces 46 of the containment box 43. In the second variant, each of the four walls indicated as 34 has a straight profile 35 from the upper end 36 to its support side 37 above the upper crosspieces 46 of the containment box 43. The support side 37 has an extension 38 inclined downwards. The extension 38 is notched to flank the teeth of the toothed rollers, as will be seen below.

[0030] The containment box 43 has the side plates 44, 44 provided with holes for supporting the three pairs of toothed rollers 5 by pairs of shafts, indicated in each pair as first shaft 50 and secondo shaft 51, with which the three pairs of toothed rollers 5 are integral. This is described in greater detail with reference to figure 10, which is a perspective view of the crushing assembly of the machine in figure 1 contained in the containment box 43, without the side wall 44; reference is also made to figure 11 which is an exploded view of the crushing assembly.

[0031] The first and second shafts 50, 51 of the plurality of pairs of toothed rollers 5 are placed side by side in succession from top to bottom and mounted in aligned seats obtained in the plates 44, 44, without the need for further numerical reference. Each first shaft 50 is equipped, at its first end, with a toothed wheel, indicated generically as 52, which meshes with the toothed wheel 53 of the second shaft 51 of the same pair of shafts 50, 51. At their second end, the first shafts 50 are provided with transmission gears of the kinematic chain 6 suitable for rotating the three pairs of toothed rollers 5 simultaneously. The kinematic chain 6 comprises a transmission gear, indicated generically as 64, mounted on the second end of the first shaft 50 of each pair of shafts 50, 51 that are side by side, and a transmission pinion 65 is meshed simultaneously with a pair of transmission gears 64.

[0032] The transmission pinions 65 are mounted on transmission shafts 66 resting on the plate 45 of the containment box 43. The lowest transmission gear 64 meshes with the gear wheel 90 of the hydraulic motor capable of operating the kinematic chain 6.

[0033] The three pairs of toothed rollers 5 comprise an upper pair of toothed rollers 54, formed by first toothed discs 55 integral with their own shafts 50, 51. A first toothed disc 55 is shown in figures 12 and 13 which are a plan view and a side view thereof, respectively. The first toothed discs 55 have saw teeth 550, each of which is indicated with an oblique head and a gullet.

[0034] Below the upper pair of rollers 54 is a pair of intermediate toothed rollers 56, under which is a pair of lower toothed rollers 57. The lower toothed rollers 57 have second toothed discs 59, which can be the same in the intermediate pairs of toothed rollers 56. A second toothed roller 59 is shown in figures 14 and 15 which are a plan view and a side view thereof, respectively. The second toothed discs 59 have saw teeth 590 that are smaller than the saw teeth 550 and are able to crush the pieces broken by the toothed discs 55 into fragments.

[0035] It should be apparent that the saw teeth 550 of the first toothed discs 55 are larger in order to perform a first break of the electronic device to be crushed, and to make the pieces of the electronic device less likely to jam the toothed rollers 54 between them. The saw teeth 559 of the second toothed discs 59 of the intermediate and lower pairs of toothed rollers 56, 57 are smaller than the saw teeth 550 of the first toothed discs 55, in order to be able to crush the pieces of the electronic device.

[0036] The containment box 43, as previously mentioned, has upper crosspieces 46, intermediate crosspieces 47 and lower crosspieces 48 for connecting the opposite plates 44, 45. The upper crosspieces 46 are drilled for fixing the supporting sides 33 or 37 of the hopper walls 31 and 34, respectively. The intermediate crosspieces 47 and the lower crosspieces 48 support bars inclined downwards, indicated generically as 58, suitable for facilitating the advancement of pieces of electronic device to be crushed towards the intermediate and lower pairs of toothed rollers 56, 57.

[0037] In the lower scrap collecting part 2 of the machine according to the invention, there is provided driving means 9 ending with the gear wheel 90 of the hydraulic motor capable of operating the kinematic chain 6.

[0038] As previously stated, figures 2 and 3 show the first embodiment of the lower scrap collecting part 2, while figures 16, 17 and 18 show perspective views of the lower scrap collecting part, always indicated as 2, of the second embodiment. The two embodiments use motor means of the hydraulic type; alternatively, electric motors could

be used.

[0039] The driving means of the first embodiment comprises an electronic control unit (not shown) and a hydraulic circuit indicated generally as 92. The hydraulic circuit 92, controlled by the electronic control unit, comprises a tank 93 containing hydraulic oil, an electric pump 94, a non-return valve and a pressure limiting valve with return to the tank downstream of the electric pump 94, a pressure switch, a four-way and three-position distributor and a hydraulic motor, having a shaft on which the toothed wheel 90 capable of operating the kinematic chain 6 described above is keyed.

[0040] The driving means of the second embodiment is better shown in figures 16 to 18, but also in figure 19 which is a simplified diagram of the hydraulic circuit installed in the second embodiment. An electronic control unit controls a hydraulic circuit indicated generally as 100. The hydraulic circuit 100 comprises a tank 101 containing hydraulic oil, a pair of electric pumps 102, 103 which draw from the tank 101 through respective filters 104, 105, a non-return valve 106 downstream of the electric pump 102, and a non-return valve 107 downstream of the electric pump 103, a pressure limiting valve 108 in a return branch 110 to the tank 101 downstream of the electric pump 102, a pressure limiting valve 109 in a return branch 111 to the tank 101 downstream of the electric pump 103, a delivery branch 112 of both electric pumps 102, 103, a pressure switch 113, a four-way and three-position distributor 114 and a hydraulic motor 115. The hydraulic motor 115 has a shaft onto which the toothed wheel 90 capable of operating the kinematic chain 6 described above is keyed.

[0041] Some components of the hydraulic circuit 100 in figures 16 to 18 are marked with the same reference numbers as in figure 19.

[0042] The embodiment with two electric pumps allows the machine performances to be optimized in the event of reduced electrical network power. With reference to figure 19, the machine can be made to start from the electronic control unit with only the electric pump 102 so as not to exceed the maximum electrical power absorption. In fact, at start-up the two electric pumps 102 and 103 together could absorb more than the available power. If necessary, the electronic control unit could also activate the second electric pump 103, reducing the engagement of the electric pump 102. In the event of excessive resistance from the material to be crushed, the distributor 114 can reverse the direction of rotation of the hydraulic motor 115 and then of the toothed wheel 90 to therefore reverse the motion of the kinematic chain 6. This operation allows any material that may get stuck between the saw teeth 550 of the toothed discs 54 to free itself in order to be able to resume crushing again with the resumption of the regular direction of the hydraulic motor 115. If the maximum permitted pressure is exceeded, the distributor 114, under the control of the electronic unit, will ensure that the oil returns to the tank 101.

Claims

1. A machine for crushing portable electronic telecommunication devices, comprising

- an upper feeding and crushing part (1), having:

  - a base (40) provided with a base opening,
  - a feeding hopper (3) having a mouth (30) facing upward that is suitable for receiving electronic devices to be crushed,
  - a containment box (43) below the feeding hopper (3), the containment box (43) containing toothed rollers suitable to receive between them the electronic devices to be crushed,
  - a kinematic chain (6) able to simultaneously move the toothed rollers,
  - driving means (9) capable of operating the kinematic chain (6), and

- a lower scrap collecting part (2), having a frame (8) and a top wall (80) provided with a top opening (81) corresponding to the base opening of the base (40) for the passage of the scrap downstream of the toothed rollers, and containing a scrap container (22),
removable connection means being provided between the top wall (80) of the lower scrap collecting part (2), and the base (40) of the upper feeding and crushing part (1), said removable connection means being able to allow the separation of the upper feeding and crushing part (1) from the lower scrap collecting part (2),
the machine being **characterized in that**:

  - the base (40) is further provided with a first slot (42),
  - the top wall (80) is further provided with a second slot (82) matching the first slot (42) of the base (40),
  - the driving means (9) is located in the lower scrap collecting part (2), and comprises a toothed wheel (90) protruding upwards through both the first slot (42) of the base (40) and the second slot (82) of the top wall (80) so as to engage the kinematic chain (6), located in the upper feeding and crushing part (1),
  - the kinematic chain (6) is able to drive simultaneously a plurality of pairs (5) of gear wheels side by side in succession from top to bottom in the containment box (43) below the feeding hopper (3),

so that the machine, having a mass distributed both in the upper feeding and crushing part (1) and in the lower scrap collecting part (2), can be

easily transported after the separation of the upper feeding and crushing part (1) from the lower scrap collecting part (2).

2. The machine according to claim 1, wherein said removable connection means is threaded couplings comprising:

- threaded pins (84) projecting upwards from the top wall (80) of the lower scrap collecting part (2),
- through holes (44) in the base (40) of the upper feeding and crushing part (1) matching said threaded pins (84), and
- nuts for said threaded pins (84).

3. The machine according to claim 1, wherein the base (40) of the upper feeding and crushing part (1) has a pair of handles (49) projecting upwards.

4. The machine according to claim 1, wherein the upper feeding and crushing part (1) is covered with an upper casing (10) except in correspondence with the mouth (30) of the feeding hopper (3).

5. The machine according to claim 1, wherein the scrap collecting part (2) is covered with a lower casing (20) and has a door (21) suitable to be opened for the extraction of the scrap container (22).

6. The machine according to claim 1, wherein the driving means (9) comprises an electronic control unit and a hydraulic circuit (92; 100), controlled by the electronic control unit and including

- a tank containing hydraulic oil (93; 101),
- at least one electric pump (94; 102, 103),
- a non-return valve (106, 107) and a pressure limiting valve (108, 109) with return of the hydraulic oil to the tank downstream of each electric pump (94; 102, 103),
- a pressure switch (113),
- a four-way and three-position distributor (114), and
- a hydraulic motor (115), having a shaft on which said toothed wheel (90), capable of operating the kinematic chain (6), is keyed.

7. The machine according to claim 1, wherein

- each pair of the plurality of pairs of toothed rollers (5) side by side in succession from top to bottom under the feeding hopper (3) has a first shaft (50) and a second shaft (51), the first shaft (50) being equipped, at its first end, with a first toothed wheel (52), the second shaft (51) being equipped, at its first end, with a second toothed wheel (53), the first toothed wheel (52) of the first shaft (50) being in engagement with the second toothed wheel (53) of the second shaft (51) of the same pair of toothed rollers (5), and
- the kinematic chain (6) adapted to simultaneously move the plurality of pairs of toothed rollers (5) comprises a transmission gear (64) mounted on the second end of the first shaft (50), and a transmission pinion (65) in simultaneous engagement with a pair of transmission gears (64),

the lower transmission gear (64) being in engagement with said toothed wheel (90) capable of operating the kinematic chain (6).

8. The machine according to claim 7, wherein the plurality of pairs of toothed rollers (5) comprises an upper pair of toothed rollers (54), an intermediate pair of toothed rollers (56), below the upper pair of toothed rollers (54), and a lower pair of toothed rollers (57).

9. The machine according to claim 1, wherein said containment box (43) comprises two opposite plates (44, 45) connected to each other by coplanar crosspieces (46, 47, 48), of which the highest ones (46) support the walls (31; 34) of the feeding hopper (3) and the other ones support bars (58) inclined downwards and designed to facilitate the advancement of pieces of electronic device to be crushed towards the toothed rollers (5).

10. The machine according to claim 1, wherein the upper pair of toothed rollers (54) is formed by first toothed discs (55) integral with their side-by-side shafts (50, 51), each first toothed disc (55) having first saw teeth (550) with an oblique head and a gullet, and the two intermediate and lower pairs of toothed rollers (56, 57), underneath the upper pair of toothed rollers (54), are formed by second toothed discs (59), each second toothed disc (59) having saw teeth (590) smaller than the saw teeth (550) of the first toothed disc (54).

11. The machine according to claim 1, wherein the scrap collecting part (2) is equipped with swivel wheels (85).

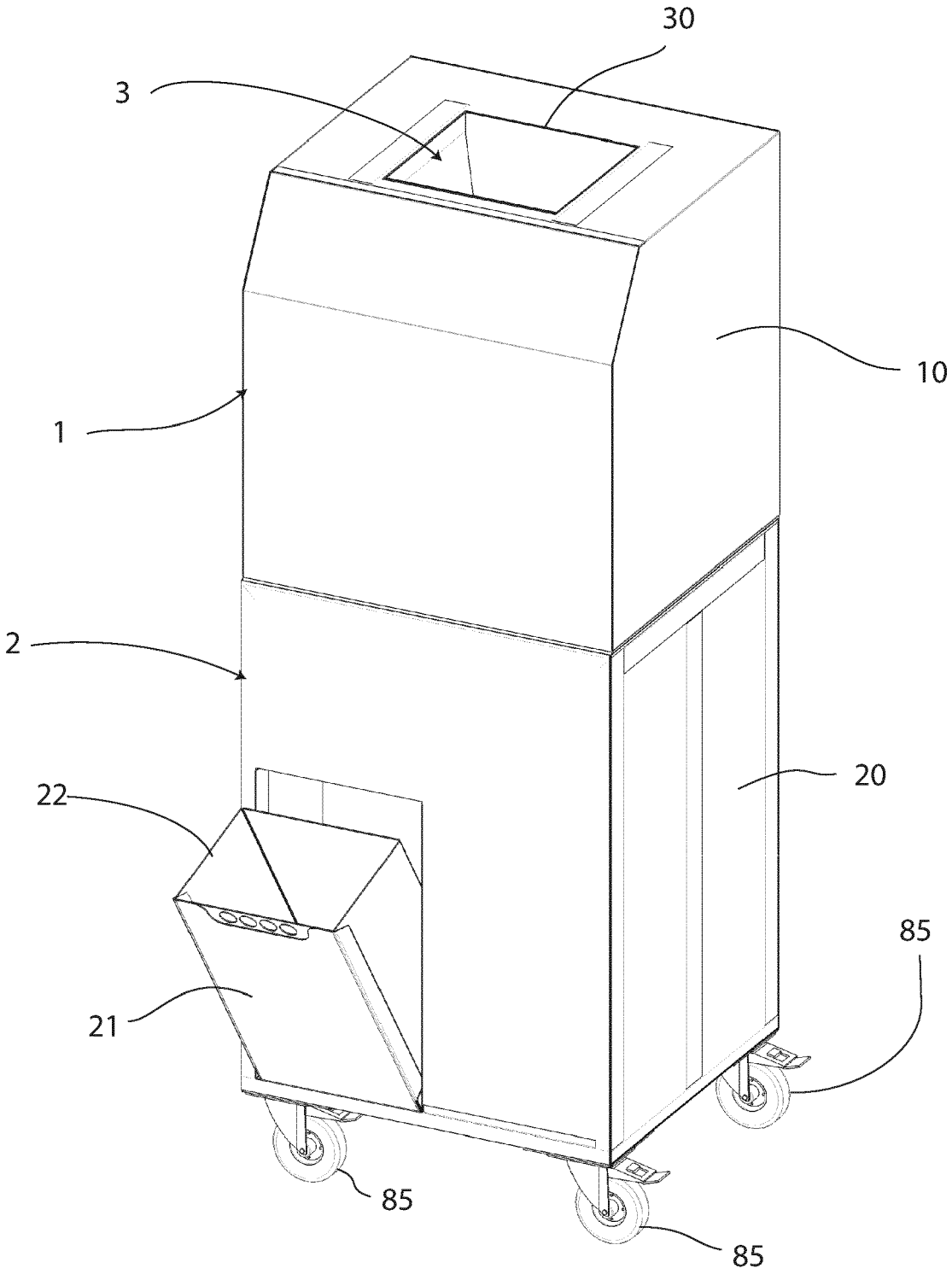


Fig. 1

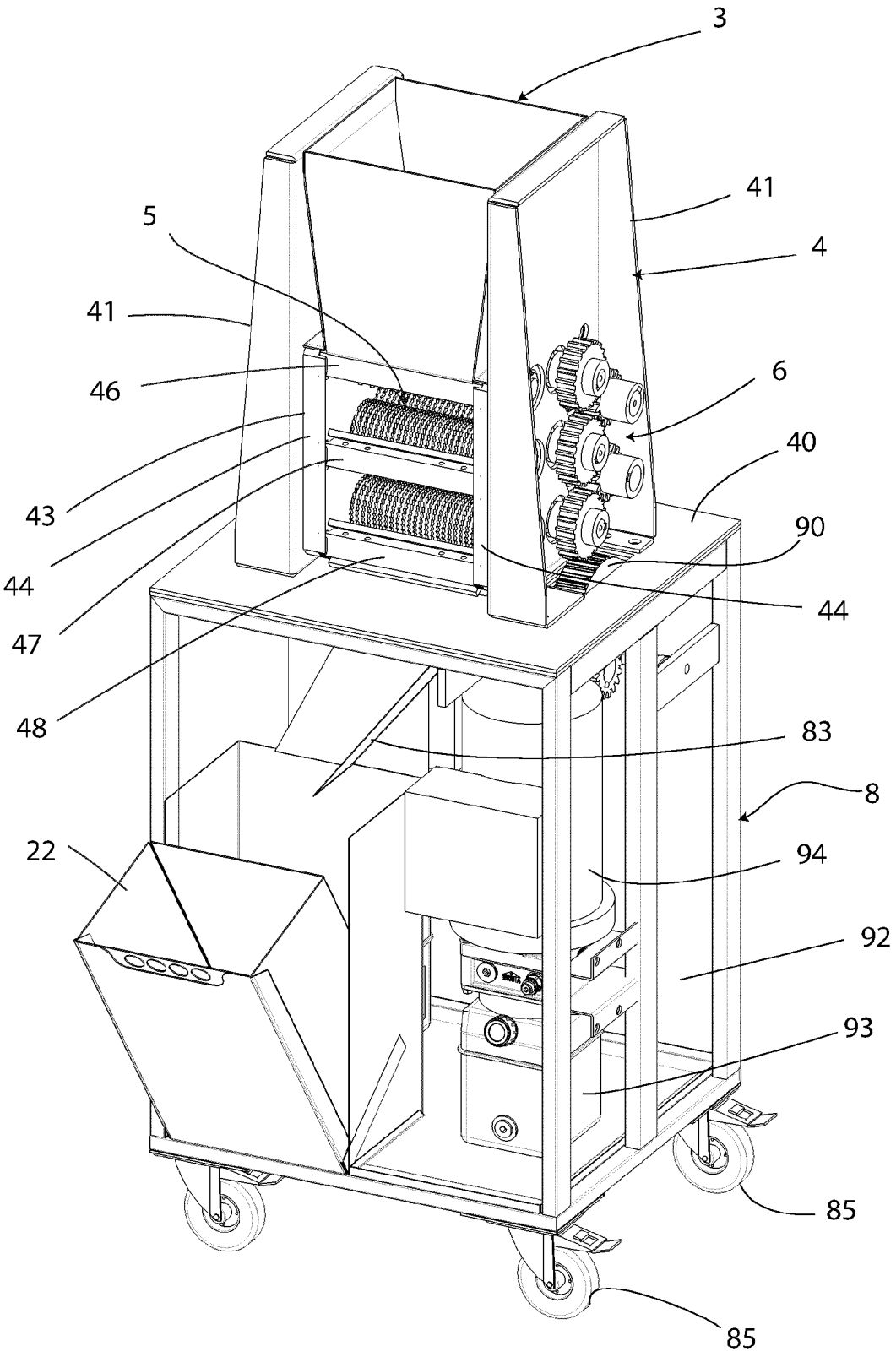


Fig. 2

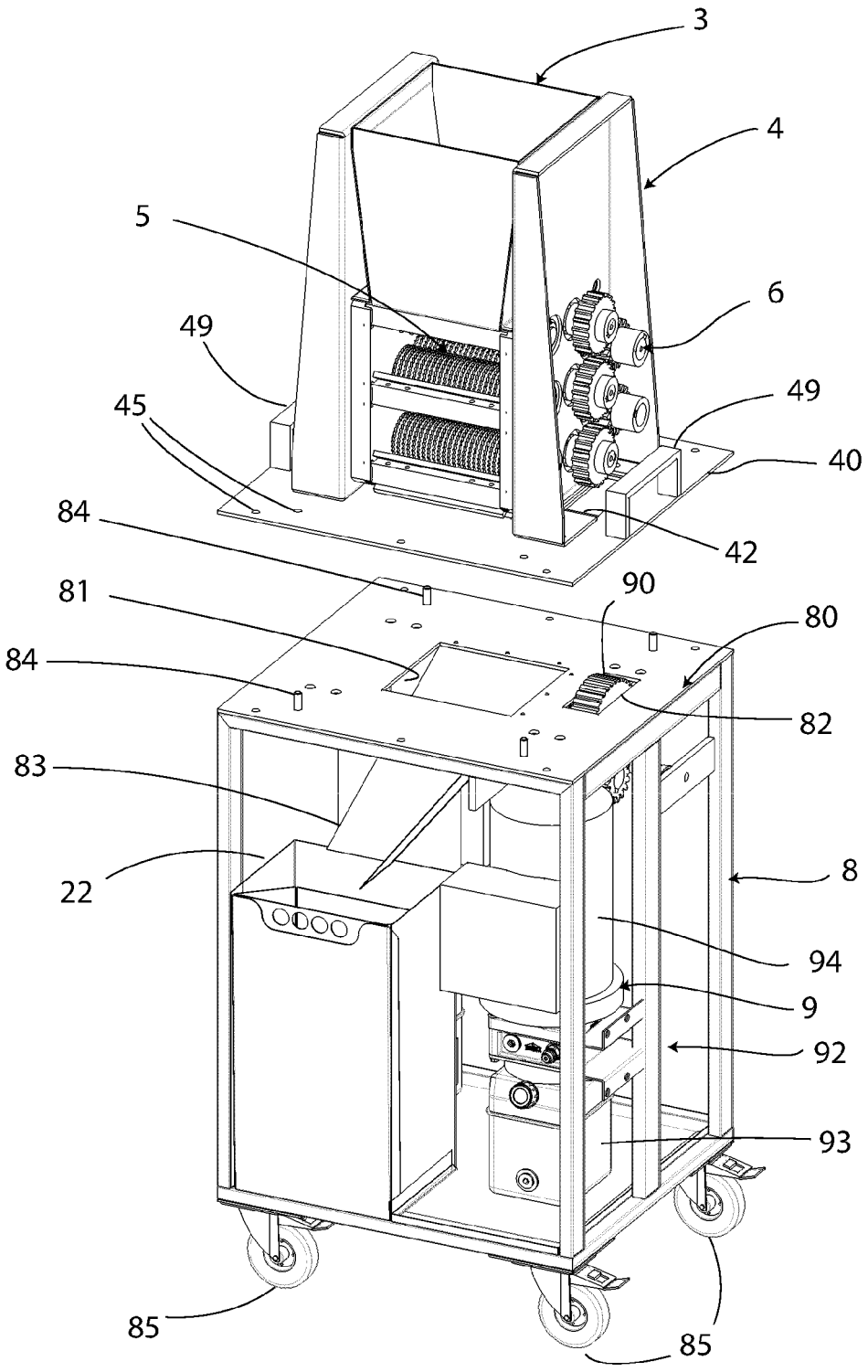


Fig. 3

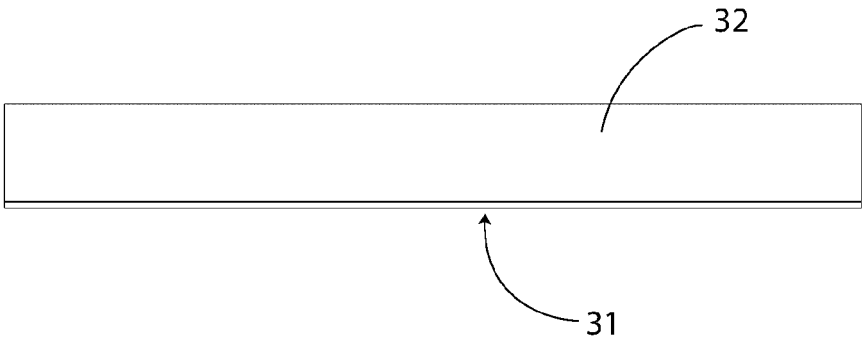


Fig. 6

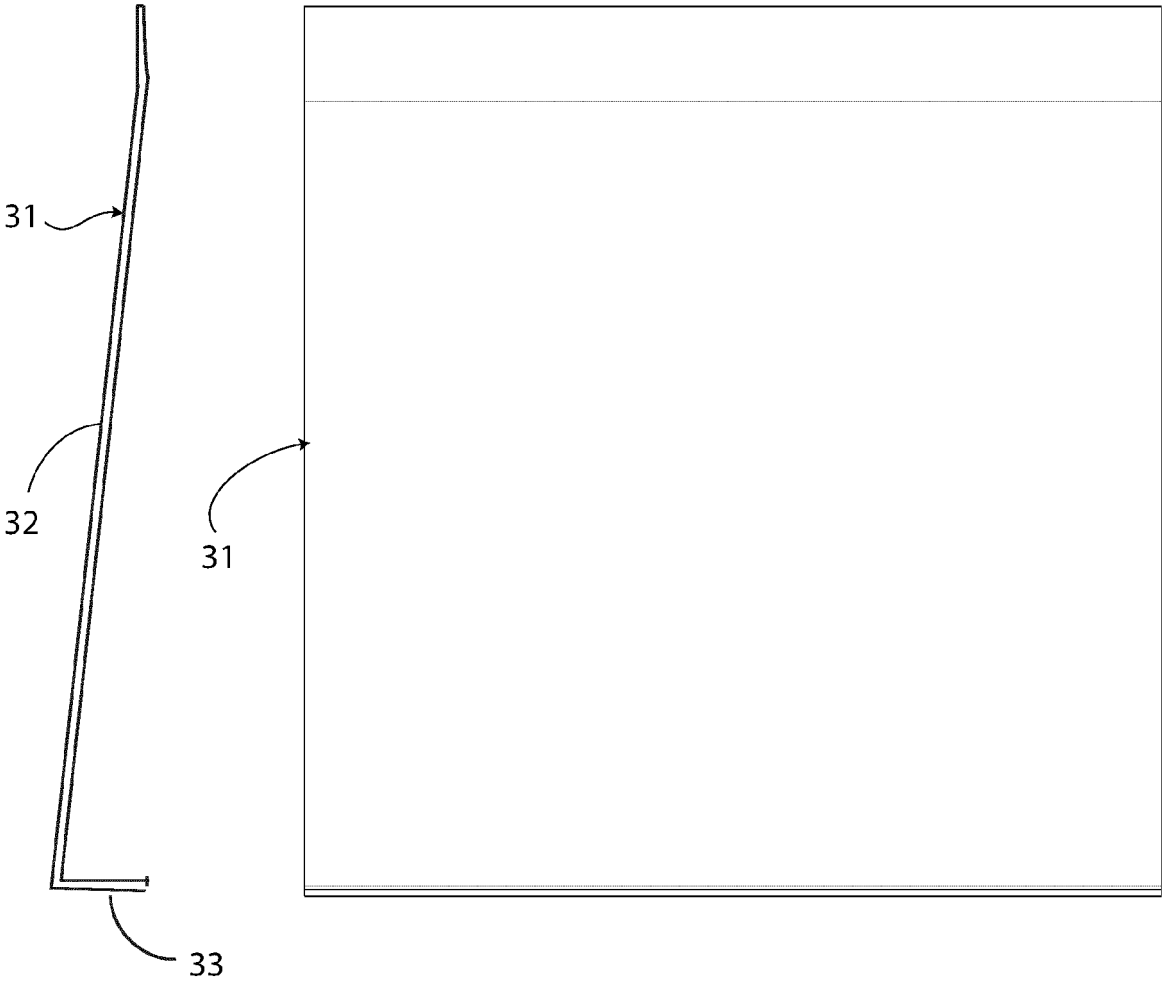
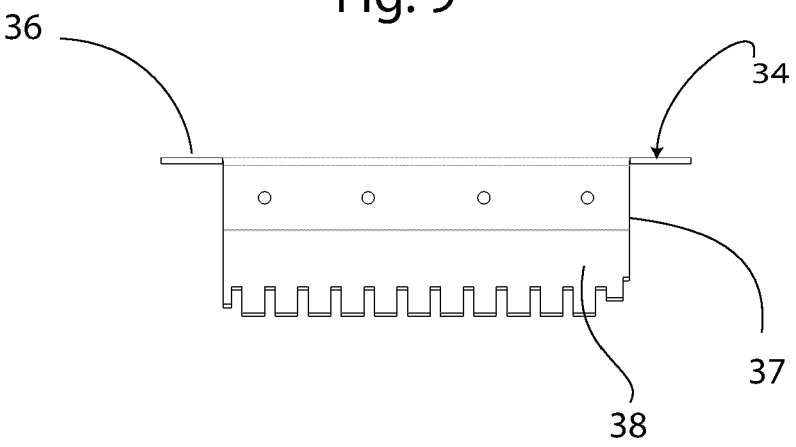


Fig. 5

Fig. 4

Fig. 9



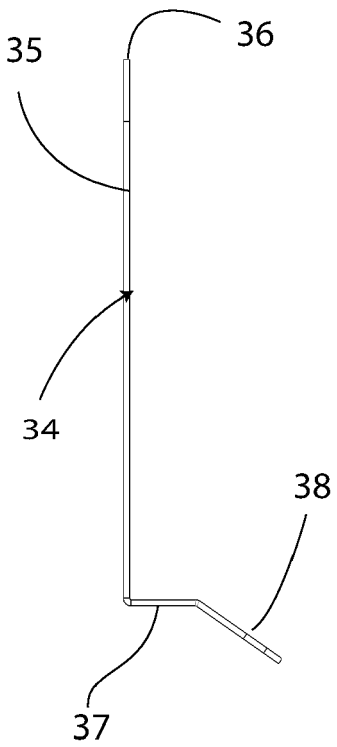


Fig. 8

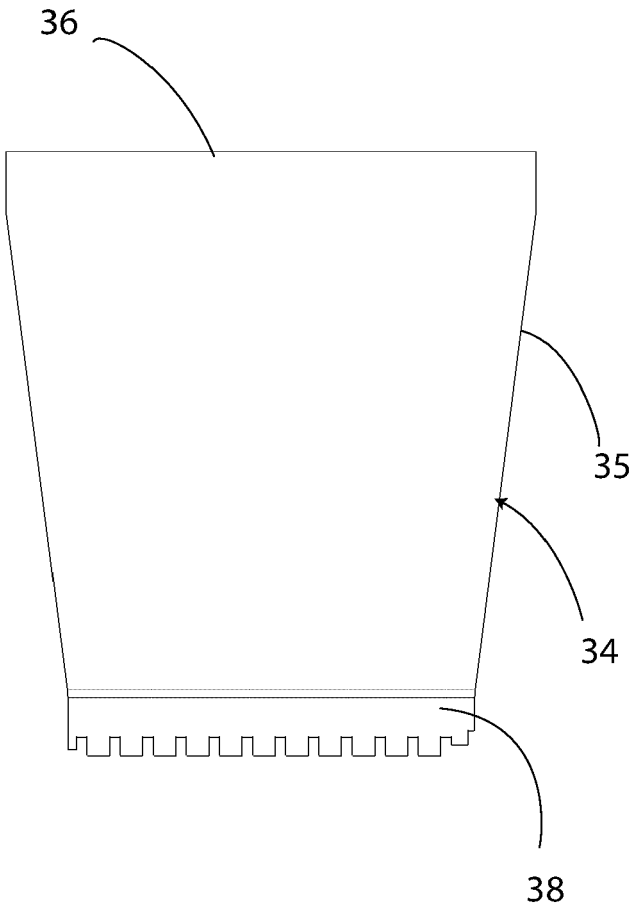


Fig. 7

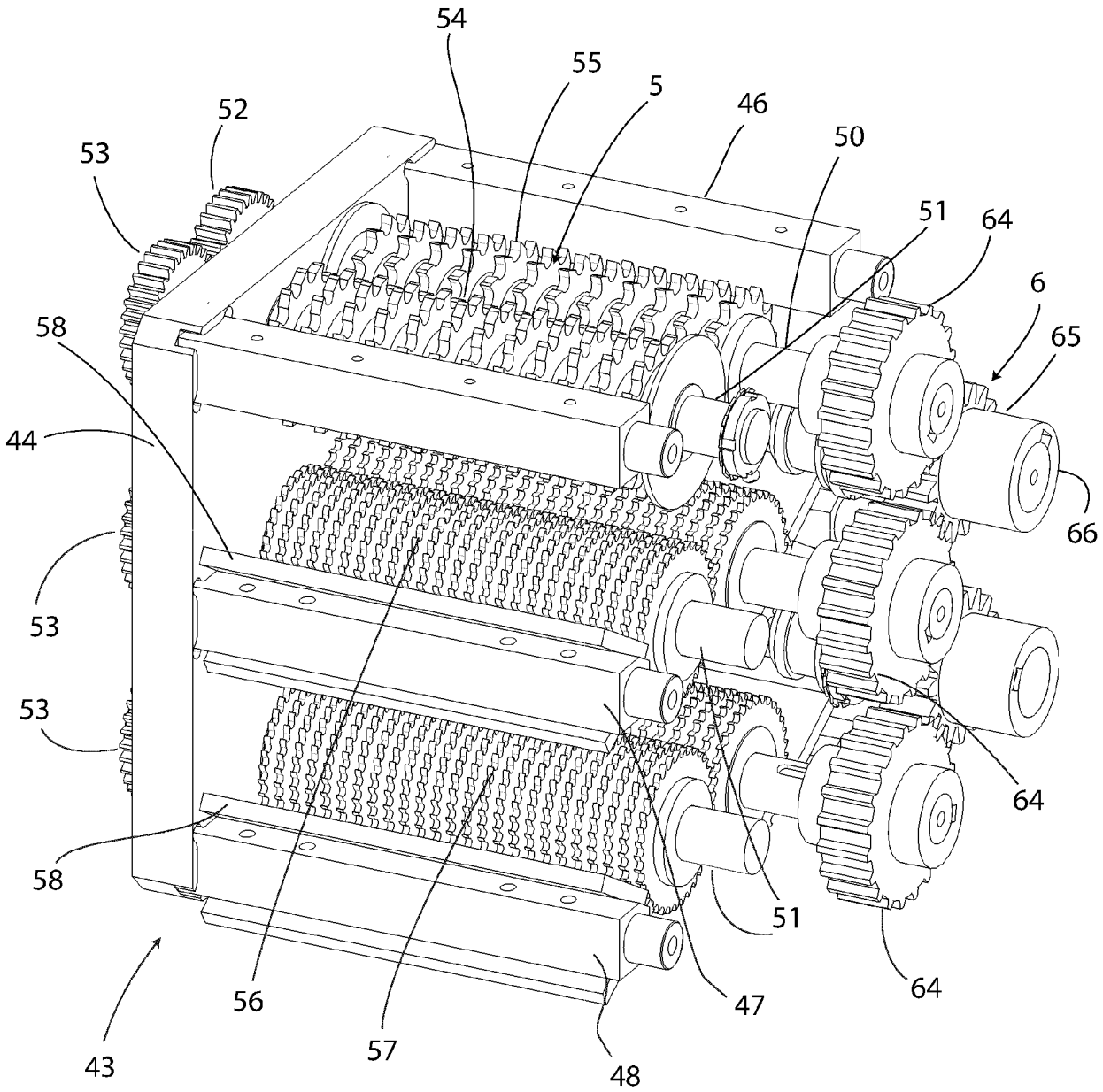


Fig. 10

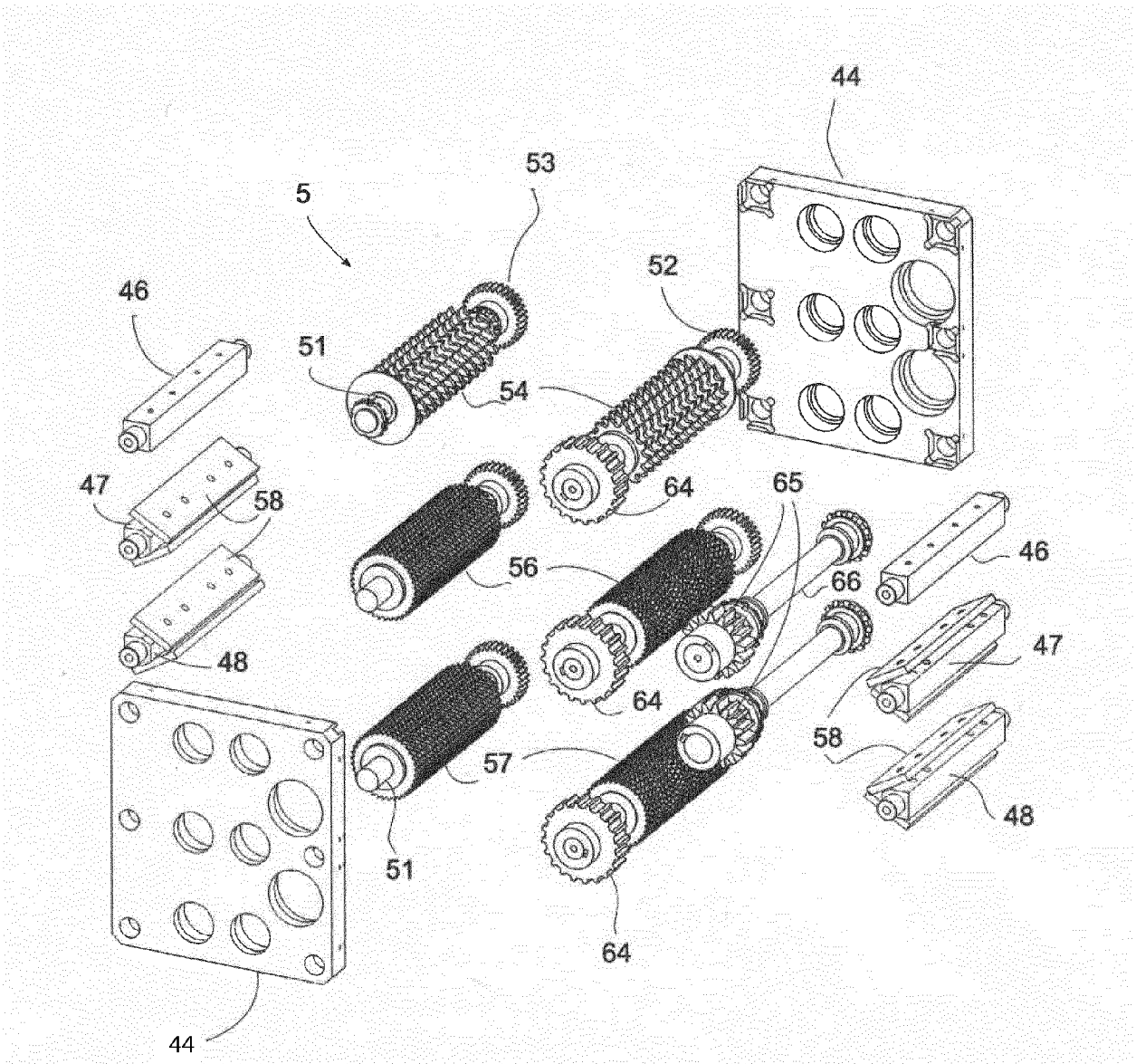


Fig. 11

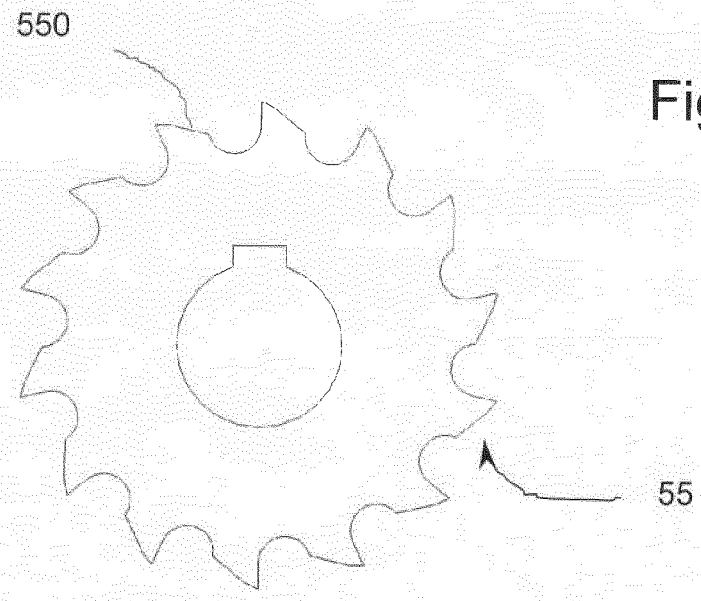


Fig. 12

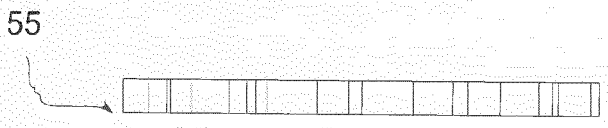


Fig. 13

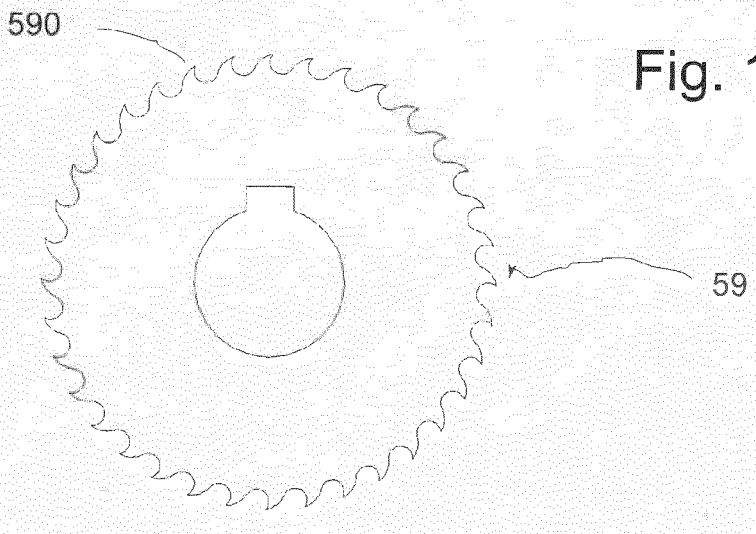


Fig. 14

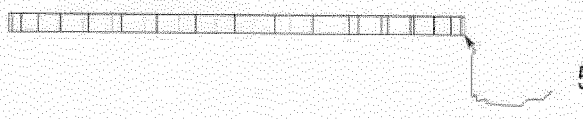


Fig. 15

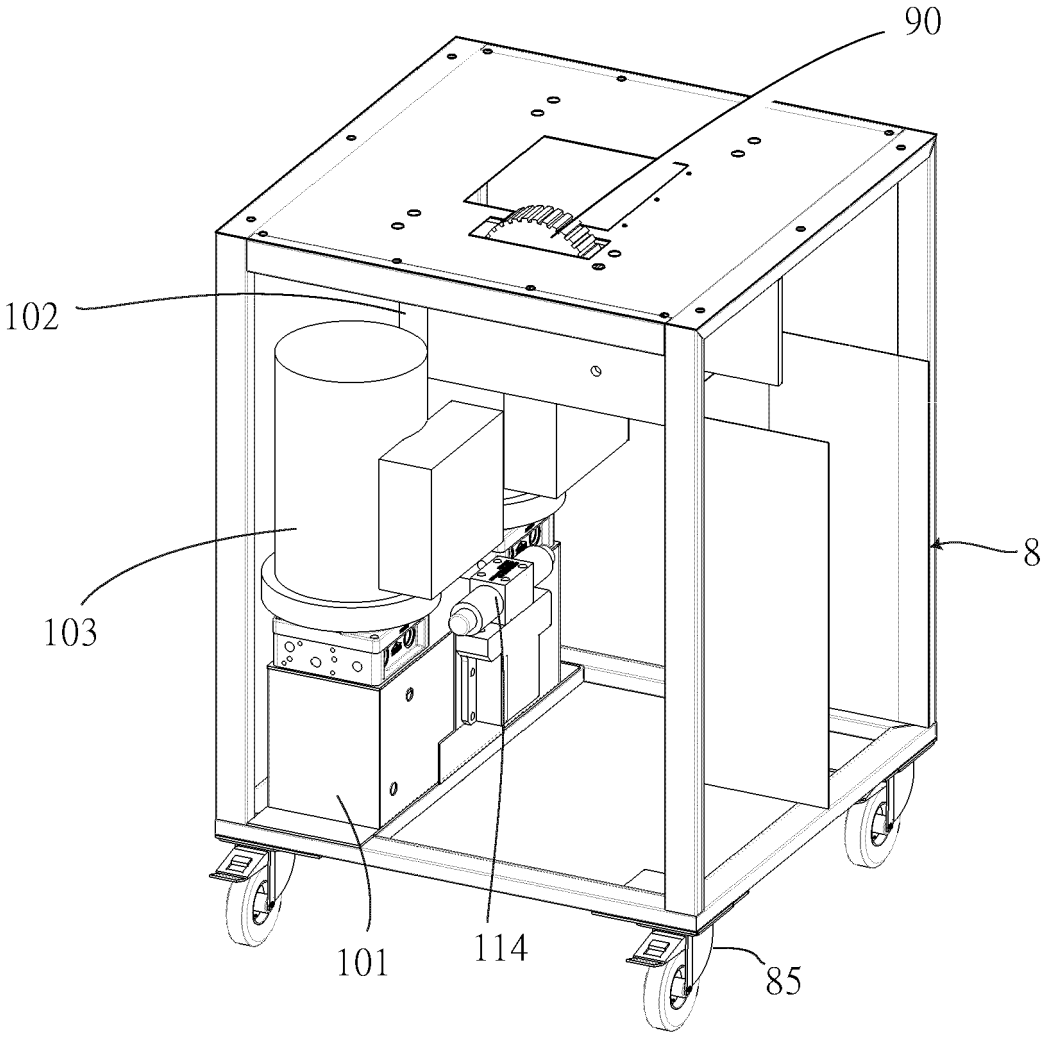


Fig.16

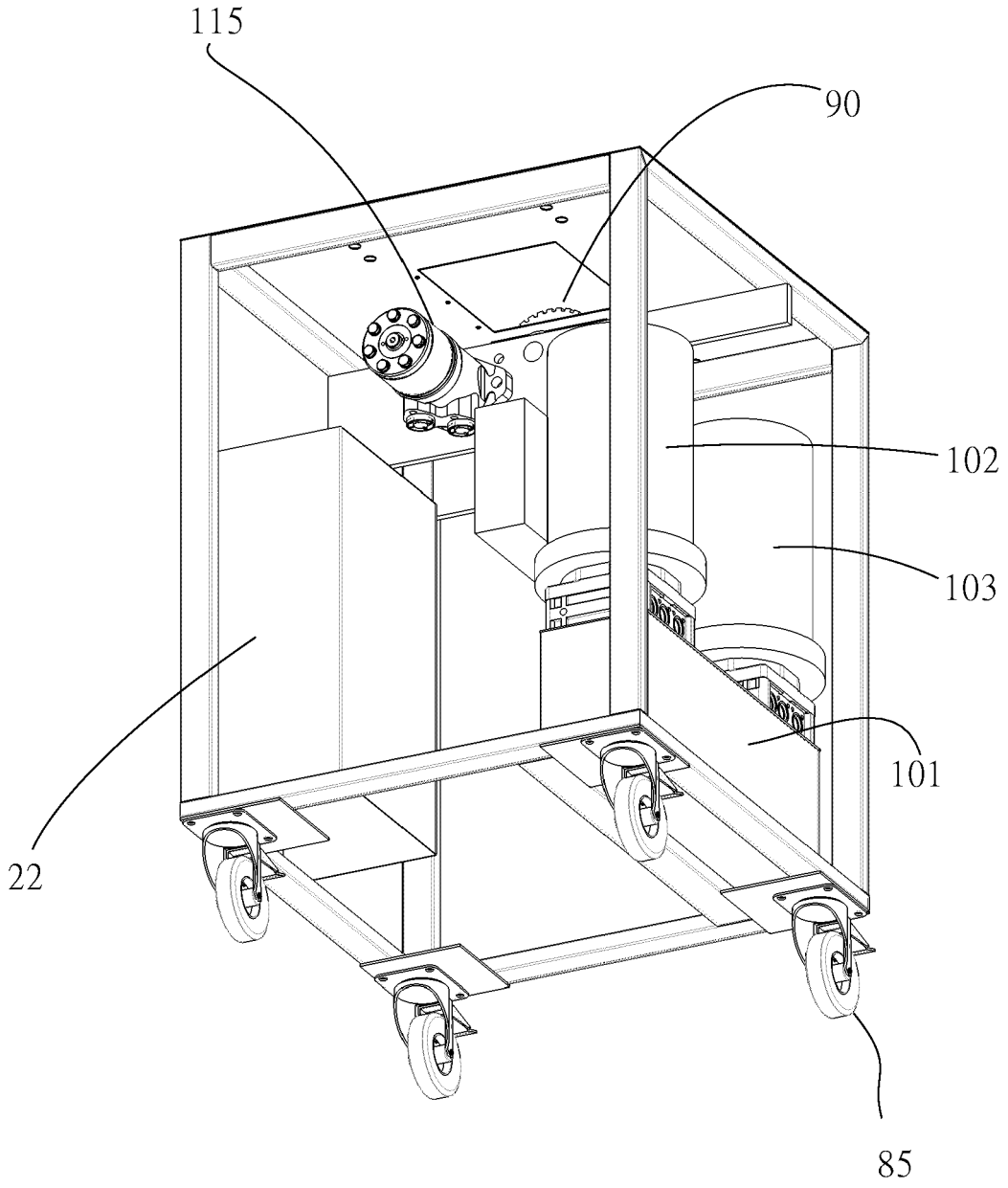


Fig. 17

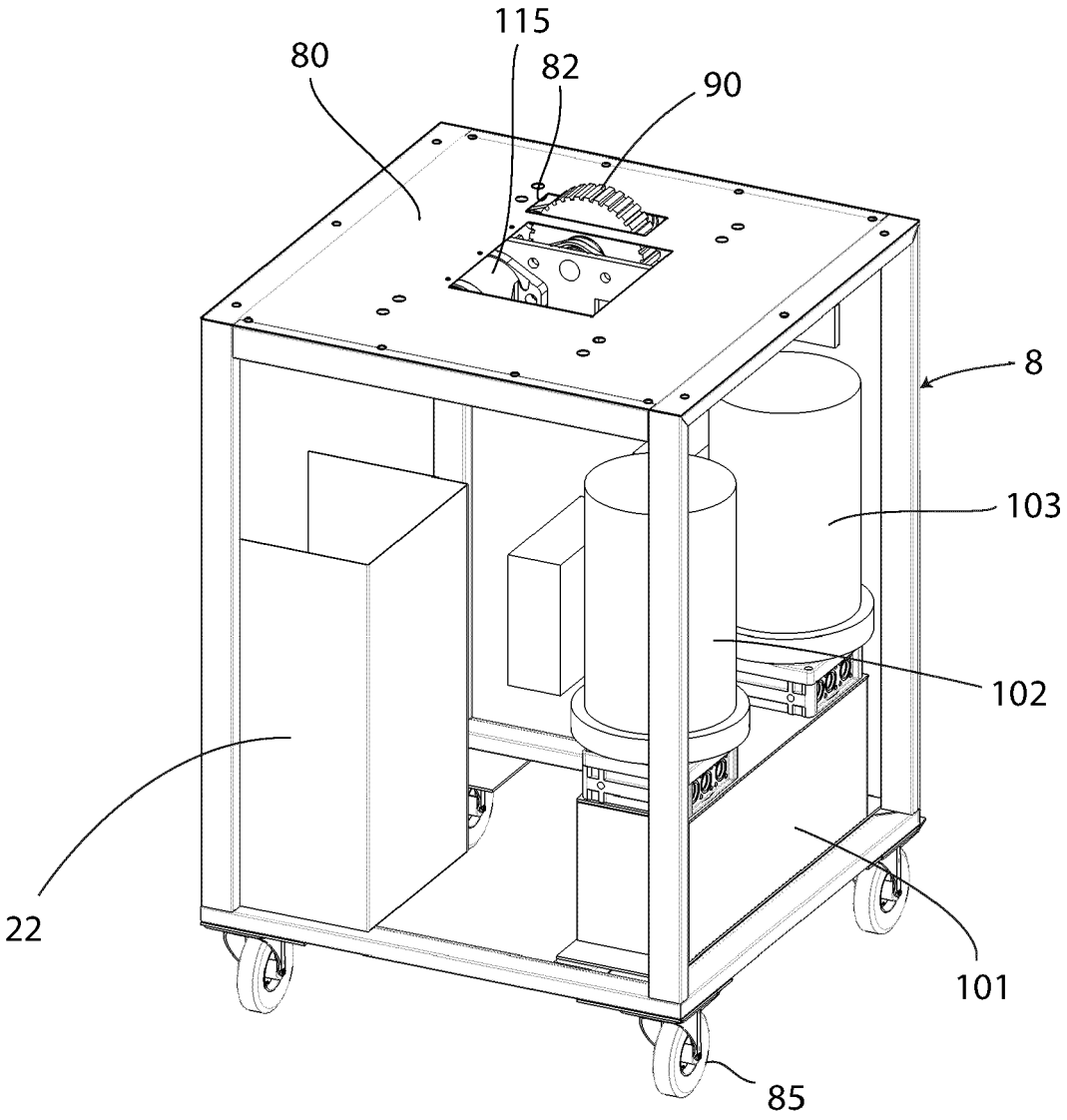


Fig.18

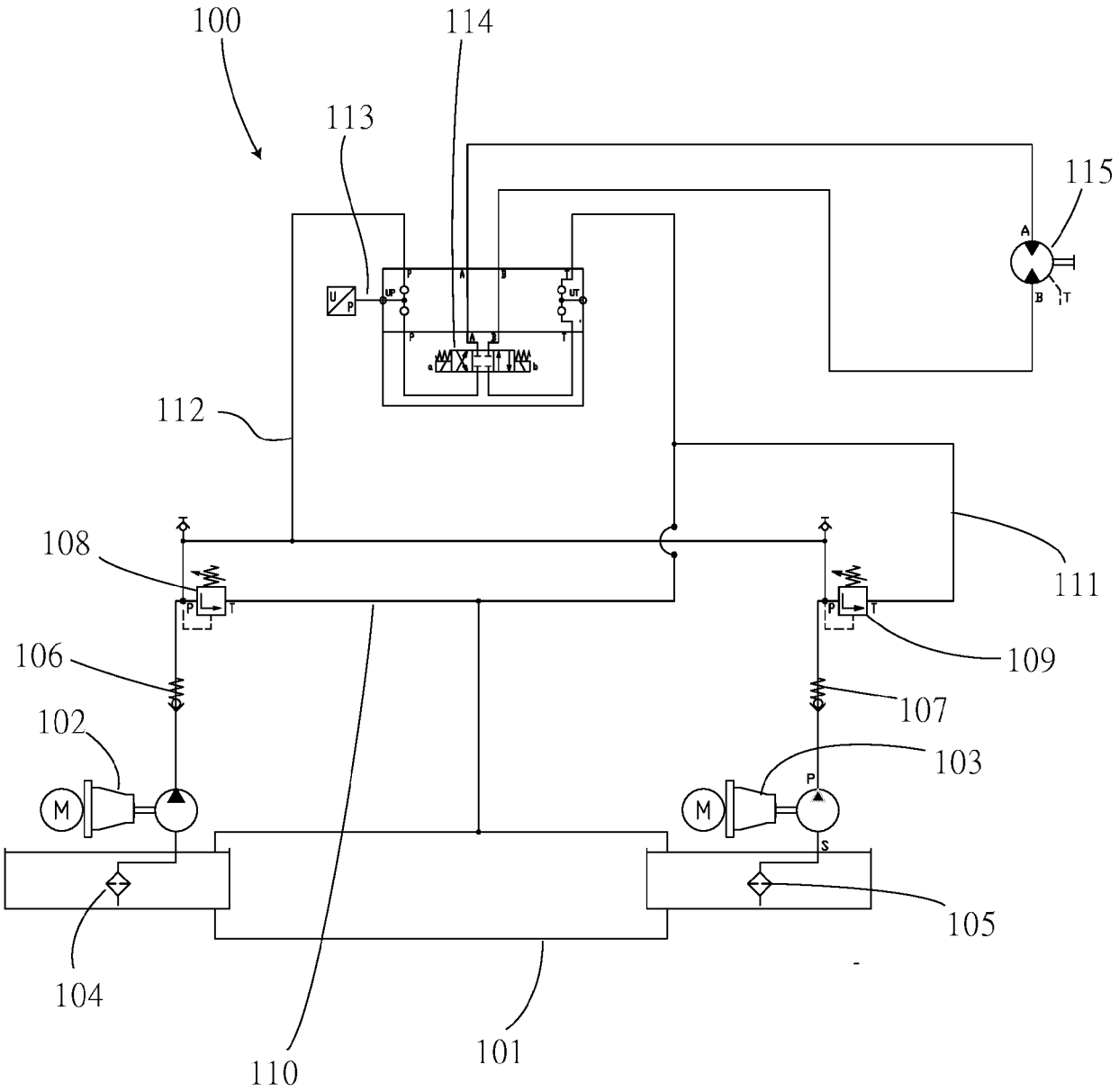


Fig. 19

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 212142813 U **[0003]**
- CN 211303321 U **[0004]**
- JP 2005152881 A **[0005]**
- WO 2018132174 A1 **[0006]**
- GB 20238965 A **[0007]**
- CN 113713907 A **[0007]**