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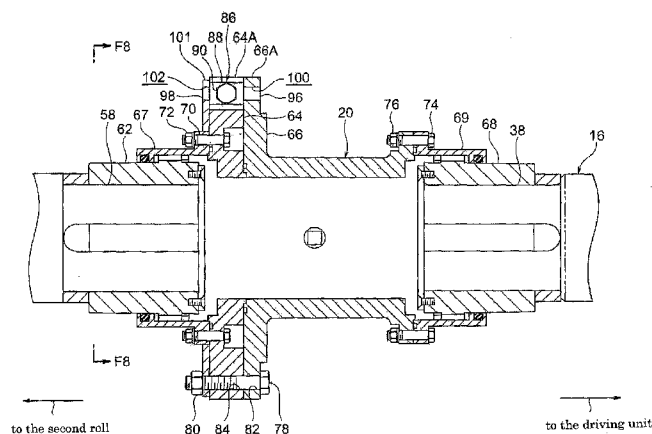
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(54) Title: BRIQUETTE MACHINE

[Fig. 7]

Fig. 7



(57) Abstract: The briquette machine of the present invention is to secure the quality of the briquettes and to improve the efficiency of matching the pockets on the outer surface of the ring. The briquette machine 10 of the present invention comprises a first roll 12 and a second roll 14. Each is ring-shaped. The axis of rotation of the first roll and that of the second roll are disposed parallel to each other and each roll has pockets 28, 30 on its outer surface whereby raw material is compressed between the pockets of the first roll and that of the second roll. It further comprises a driving unit 16 that produces a force for driving rotations, a first coupling member 18 that conveys the force driving the rotations of the driving unit to the first roll, a rotating member on the roll-side 64 that rotates with the second roll as one body, a rotating member on the side of the driving unit 66 that is rotated by the driving unit, a mechanism for adjusting the position 86 of the rotating member on the roll-side in the direction of rotation of the rotating member on the roll-side 64 relative to the rotating member on the side of the driving unit 66, and a second coupling member 20 that conveys the force driving the rotations of the driving unit to the second roll.

Description

Title of Invention: BRIQUETTE MACHINE

Technical Field

[0001] This invention is directed to a briquette machine that manufactures briquettes.

Background of the Invention

[0002] Conventionally a briquette machine that comprises a pair of rolls that solidify raw material by compressing the raw material that is supplied from a hopper and forms briquettes is known (see, for example, Patent Documents 1 and 2).

Description of Related Art

[0003] Patent Documents
Patent Document 1: JPH09-192896
Patent Document 2: JPH06-55299

Summary of the Invention

[0004] Problem to be Solved by the Invention

However, this briquette machine has the following problem. That is, if the pockets that are formed on each outer surface of the rolls do not match, the briquettes that are manufactured by the machine are likely to have misalignment or burr, which lower the quality of the briquettes.

[0005] One method that enables the pockets on one roll to match those of the other roll is by resetting the positions of the rolls. But usually the rolls are disposed within a frame that surrounds them. So, resetting the positions of the rolls would require work that would lowers the efficiency of resetting the positions of the rolls.

[0006] In view of this problem, the present invention is to provide a briquette machine that can maintain the quality of the briquettes while it can increase the efficiency of the work to match the pockets of one roll with those of the other roll.

[0007] To solve the problem, the briquette machine of the present invention comprises a first roll and a second roll that each are ring-shaped, having the axis of rotation of the first roll and that of the second roll being disposed parallel to each other and each roll having pockets on its outer surface whereby raw material is compressed between the pockets of the first roll and those of the second roll, a driving unit that produces a driving force for rotation, a first coupling member that conveys the driving force for rotation of the driving unit to the first roll, a rotating member on the roll-side that rotates with the second roll as one body, a rotating member on the side of the driving unit that is rotated by the driving unit, a mechanism for adjusting the position of the rotating member on the roll-side along the direction of the rotation of the rotating member on the roll-side relative to the rotating member on the side of the driving unit,

and a second coupling member that conveys the driving force for rotation of the driving unit to the second roll (hereafter, the first invention).

[0008] If the pockets that are formed on the outer surface of the first roll and those formed on the second roll do not match, the briquette machine having the structure of the first invention is able to have the pockets of the first roll match those of the second roll by adjusting the position of the rotating member on the roll-side along the direction of the rotation of the rotating member on the roll-side relative to the rotating member on the side of the driving unit. The adjustment of the position is carried out by the mechanism for adjusting the position that is disposed on the second coupling member. Thus the briquette machine of the present invention can compress the raw material by the co-ordinated work of the pockets of the first roll and the pockets of the second roll, of which both pockets are matched. So, the quality of the briquettes is maintained.

[0009] Further, usually the first coupling member and the second coupling member are exposed above a frame. So, by installing a mechanism for adjusting the position on the second coupling member, the efficiency in matching the pockets can be improved.

[0010] The briquette machine according to the first invention is modified to be one wherein the mechanism for adjusting the position is disposed at the position that is to the outer side in the radial direction as seen from the center of the rotating member on the side of the driving unit. The mechanism for adjusting the position comprises a nut disposed so that the axis of the nut is laid parallel to the tangential direction or the radial direction of the rotating member on the side of the driving unit, a bolt that is screwed into the nut, and a pressed portion that is formed on the rotating member on the roll-side where the tip of the bolt contacts the rotating member on the roll-side wherein the pressing force is exerted by the tip of the bolt in the tangential direction or the radial direction of the rotating member on the roll-side as the bolt is screwed into the nut (hereafter, the second invention).

[0011] In this briquette machine, if the pockets of the sides of the rolls do not match, the work that enables both pockets to match can be performed by the following process. Namely, first, the numerical correlation between the rotation of the bolt and that of the rotating member on the roll-side relative to the rotating member on the side of the driving unit is to be obtained. Next, the necessary degree of rotation of the bolt is calculated based on the data on the amount of the misalignment of the pockets that is obtained from the briquettes formed by the first roll and by the second roll and the correlation obtained as described above. If the bolt is screwed into the nuts by rotating the bolt by the degree of rotation thus calculated, the pressed portion is pressed by the end of the bolt in the tangential direction of the rotating member on the roll-side. Then the rotating member on the roll-side is rotated relative to the rotating member on the side of the driving unit so that the pockets on both sides match. In this way the efficiency of

the work for matching both pockets is improved compared with one where matching the pockets is carried out by examining the briquettes that are formed by compressing the raw material. This is because the work for matching the pockets of the present invention does not require examining the briquettes.

[0012] The briquette machine according to the second invention is modified to be one wherein the mechanism for adjusting the position is disposed to the inside in the radial direction of the outer surface of the rotating member on the roll-side and the inside in the radial direction of the outer surface of the rotating member on the side of the driving unit (hereafter, the third invention).

[0013] For this briquette machine, the mechanism for adjusting the position is disposed to the inside in the radial direction of the outer surface of the rotating member on the roll-side and the inside in the radial direction of the outer surface of the rotating member on the side of the driving unit. So, the mechanism for adjusting the position is prevented from contacting an object outside the rotating member on the roll-side and the rotating member on the side of the driving unit while the rotating member on the roll-side and the rotating member on the side of the driving unit rotate.

[0014] The briquette machine according to any one of the first, second, and third inventions is modified to be one wherein it comprises:

- a bearing unit on the fixed side that supports an axis member that is disposed on either of the first roll or second roll and that can rotate with the roll as one body;

- a bearing unit on the movable side that supports an axis member that is disposed on the other of the first and second rolls and that can rotate with the other roll as one body, the bearing unit on the movable side being movable in the direction of the radii of the first and second rolls wherein it can contact, or can retract from, the bearing unit on the fixed side;

- a spacer adjusting the gap, which spacer is disposed between the bearing unit on the fixed side and the bearing unit on the movable side and which is to form a gap between the first and second rolls;

- an hydraulic cylinder that is disposed on the side opposite the bearing unit on the fixed side with the bearing unit on the movable side laid in between, the hydraulic cylinder being disposed in such a way that its axis is positioned in the direction of the line that is in common with the radius of the first roll and the radius of the second roll, each of the radii being perpendicular to the rotating axis of the first roll and that of the second roll, and the hydraulic cylinder having a cylinder rod that has a member for adjusting the position in the axis-direction on one end;

- a pressure-detecting device that is disposed between the other end of the cylinder rod and the bearing unit on the movable side and that detects the pressure between the other end of the cylinder rod and the bearing unit on the movable side;

a hopper disposed above the first roll and the second roll;
a feeder screw disposed within the hopper, which screw pushes the raw material within the hopper down and between the first and the second rolls by the screw being rotated,
a variable-speed control motor that drives the feeder screw, and
a control unit that controls the variable-speed control motor in such a way that the rotation of the feeder screw is decreased or increased corresponding to the increase or decrease of the pressure that is detected by the pressure-detector.

[0015] For this briquette machine, for example, the rotation of the feeder screw decreases or increases in accordance with the increase or decrease of the pressure between the other end of the cylinder rod and the bearing unit on the movable side. The pressure is to increase or decrease if the force compressing the raw material between the first roll and the second roll fluctuates based on the density or the fluidity of the raw material that is supplied from the hopper. In this way the force compressing the raw material between the first roll and the second roll can be controlled. So, the profile of the thickness, and the weight of the briquettes can be made uniform.

[0016] The briquette machine according to any one of the first, second, and the third inventions is modified to be one where it comprises:

the first roll and the second roll, one of which is fixed in the direction of its radius and the other of which can contact, and retract from, the one of the first roll and the second roll in the direction of its radius;

a hydraulic cylinder that applies the pressure on the other of the first roll and the second roll if the force is exerted on the other of the first roll and the second roll in such a way that the one of the first roll and the second roll retracts from the other of the first roll and the second roll;

a hopper that is disposed above the first roll and the second roll;

a feeder screw disposed within the hopper, which feeder screw pushes the raw material within the hopper down and between the first roll and the second roll by the screw being rotated;

a variable-speed control motor that rotates the feeder screw;

a detector that detects the pressure by which the feeder screw pushes the raw material down and between the first roll and the second roll; and

a control unit that controls the variable-speed control motor so that the rotation of the feeder screw is decreased or increased in accordance with the values detected by the detector (hereafter, the fifth invention).

[0017] For this briquette machine, for example, the rotation of the feeder screw decreases or increases in accordance with the increase or decrease of the pressure with which the feeder screw pushes the raw materials down and between the first roll and the second roll. The pressure increases or decreases if the force compressing the raw material

between the first roll and the second roll fluctuates based on the density or fluidity of the raw material that is supplied from the hopper.

In this way the fluctuation of the force compressing the raw material between the first roll and the second roll can be controlled. So, the profile of the thickness, and the weight of the briquettes can be made uniform.

[0018] The briquette machine according to the fifth invention is modified to be one where the detector is a pressure detector (hereafter, the sixth invention).

[0019] This briquette machine can be more easily controlled because it detects the pressure more accurately compared with a detector that detects pressure by the electric-current value.

[0020] The briquette machine according to any one of the first, second, and the third inventions is modified to be one wherein it comprises:

- the first roll and the second roll, one of which is fixed in the direction of its radius and the other of which can contact, and retract from, the one of the first roll and the second roll in the direction of its radius;

- a hydraulic cylinder that applies the pressure on the other of the first roll and the second roll if the force is exerted on the other one of the first roll and the second roll in such a way that the one of the first roll and the second roll retracts from the other one of the first roll and the second roll;

- a hopper that is disposed above the first roll and the second roll;

- a feeder screw disposed within the hopper, which screw pushes the raw material within the hopper down and between the first roll and the second roll by the screw being rotated;

- a variable-speed control motor that rotates the feeder screw;

- a detector that detects the driving current of the driving motor that is disposed at a driving unit; and

- a control unit that controls the variable-speed control motor so that the rotation of the feeder screw is decreased or increased in accordance with the values detected by the detector (hereafter, the seventh invention).

[0021] For this briquette machine, for example, the force compressing the raw material between the first roll and the second roll fluctuates based on the density or fluidity of the raw material that is supplied from the hopper, whereupon the rotation of the feeder screw decreases or increases corresponding to the increase or decrease of the driving current of the driving motor that is disposed at a driving unit.

In this way the fluctuation of the force compressing the raw material between the first roll and the second roll can be controlled. So, the profile of the thickness, and the weight of the briquettes can be made uniform.

[0022] The briquette machine according to the seventh invention is modified to be one

wherein the detector is a current detector (the eighth invention).

[0023] This briquette machine is less expensive than one that uses a pressure detector.

[0024] The briquette machine according to any one of the first, second, and the third inventions is modified to be one where it comprises:

the first roll and the second roll, one of which is fixed in the direction of its radius and the other of which can contact, and retract from, the one of the first roll and the second roll in the direction of its radius;

a hydraulic cylinder that applies the pressure on the other of the first roll and the second roll if the force is exerted on the other of the first roll and the second roll in such a way that the one of the first roll and the second roll retracts from the other one of the first roll and the second roll;

a hopper that is disposed above the first roll and the second roll;

a feeder screw disposed within the hopper, which screw pushes the raw material within the hopper down and between the first roll and the second roll by the screw being rotated;

a variable-speed control motor that rotates the feeder screw;

a detector that detects the power consumption of the driving motor that is disposed at a driving unit; and

a control unit that controls the variable-speed control motor so that the rotation of the feeder screw is decreased or increased in accordance with the values detected by the detector (hereafter, the ninth invention).

[0025] For this briquette machine, for example, the rotation of the feeder screw decreases or increases corresponding to the increase or decrease of the power consumption of the driving motor that is disposed at a driving unit. The power consumption increases or decreases if the force compressing the raw material between the first roll and the second roll fluctuates depending on the density or fluidity of the raw material that is supplied from the hopper.

In this way the fluctuation of the force compressing the raw material between the first roll and the second roll can be controlled. So, the profile of the thickness, and the weight of the briquettes can be made uniform.

[0026] The briquette machine according to the ninth invention is modified to be one wherein the detector is a power meter (hereafter, the tenth invention).

[0027] This briquette machine is less expensive than one that uses a pressure detector.

Further, a more accurate control can be carried out by the power consumption detector compared with a current detector, because it is not affected by voltage.

[0028] Thus with the briquette machine of the present invention the quality of the briquettes can be maintained and at the same time the efficiency of matching the pockets can be improved.

Brief Description of Drawings

[0029] Fig. 1 is a front view of the briquette machine in one embodiment of the present invention.

Fig. 2 is a right side view of the briquette machine of Fig. 1.

Fig. 3 is a plane view of the briquette machine of Fig. 1.

Fig. 4 is a perspective view of the first roll and the second roll of the briquette machine of Fig. 1.

Fig. 5 is a cross section of the hopper and the feeder screw of the briquette machine of Fig. 1.

Fig. 6 is a cross-sectional side view of the first roll, and its surrounding area, of the briquette machine of Fig. 1.

Fig. 7 is a cross-sectional side view of the second coupling member, and its surrounding area, of Fig. 1.

Fig. 8 is a view of the second coupling member as seen in the F-direction.

Fig. 9 is a plane view of the fixed roll and the movable roll and their surroundings, of the briquette machine other than the one shown in Fig. 1.

Fig. 10 is a front view of the fixed roll and of the movable roll and their surroundings shown in Fig. 9, including a cross-sectional view of a part of each of them.

Fig. 11 is a diagram showing the operational sequence carried out by the control unit.

Fig. 12 is a first alternative example of the briquette machine of Fig. 1.

Fig. 13 is an enlarged view of the main part of Fig. 12.

Fig. 14 is a second alternative example of the briquette machine of Fig. 1.

Fig. 15 is an alternative example of the mechanism for adjusting the position of Fig. 1.

Embodiment to Carry out the Invention

[0030] Below an embodiment of the present invention is explained by referring to the drawings.

[0031] As seen from Figs. 1, 2, and 3, the briquette machine 10 of the first embodiment of the present invention comprises the first roll 12, the second roll 14, the driving unit 16, the first coupling member 18, the second coupling member 20, the hopper 22, the feeder screw 24, and the variable-speed control motor 26.

[0032] The first roll 12 and the second roll 14 are disposed in the frame 27. Both the first roll 12 and the second roll 14 are formed as a ring and they are disposed in such way that their axes of rotations L1, L2 are parallel to each other. As shown in Fig. 4, a plurality of pockets 28, 30, are formed on the outer surfaces 12A, 14A, of the first roll 12 and the second roll 14, respectively. The plurality of the pockets 28 of the first roll 12 and the plurality of the pockets 30 of the second roll 14 are formed at the positions

of the outer surfaces 12A and 14A, respectively, in such a way both pockets match along the circumferences of the ring-shapes of the rolls.

[0033] As shown in Figs. 2 and 3, the driving unit 16 comprises a driving motor 32 and a reducer 34. The reducer comprises a pair of output axes 36, 38, that are disposed parallel to each other. The first coupling member 18 connects one of the output axes 36 to the first roll 12. The second coupling member 20 connects the other of the output axes 38 to the second roll 14.

[0034] As shown in Fig. 5, the hopper 22 is disposed above the first roll 12 and the second roll 14. The feeder screw 24 is disposed within the hopper 22. A driven mechanism 39 is installed above the feeder screw 24.

[0035] When the driving unit 16 is driven, the briquette machine 10 causes the first roll 12 and the second roll 14 to rotate in opposite directions, by the rotational driving force of the driving unit 16 being conveyed to the first roll 12 and the second roll 14 by way of the first coupling member 18 and the second coupling member 20, respectively. Then, if the variable-speed control motor 26 is rotated, its rotational force is conveyed to the feeder screw 24 via the driven mechanism 39 whereby the feeder screw 24 is rotated and the raw material in the hopper 22 is pushed down and between the first roll 12 and the second roll 14. Then briquettes are produced from the raw material, which are compressed by the coordinated operations of the pockets 28 and 30, and then solidified.

[0036] More specifically, as shown in Fig. 6, the first roll 12 is fixed to the outer surface 40A of the rotational-axis member 40 by a fixed member 42. An axis member 44 is formed on the rotational-axis member 40 on each side of the first roll 12 in the direction of the axis of the roll, the axis members 44 having the same axis as the first roll 12. Each pair of axis members 44 is supported by the bearing unit on the movable side 46.

Also, a connecting unit on the roll-side 48 is formed on the one of the axis members 44 that is disposed closer to the first coupling member 18 than the first roll 12, the connecting unit on the roll-side 48 having the same axis as that of the one of the axis members 44.

[0037] As is shown by the numbers in the parentheses in Fig. 6, like the first roll 12, the second roll 14 is fixed to the outer surface 50A of the rotational-axis member 50 by a fixed member 52. An axis member 54 is formed on each rotational-axis member 50 on each side of the second roll 14 in the direction of the axis of the roll, the axis member 54 having the same axis as the second roll 14. Each of the pair of axis members 54 is supported by the bearing unit on the fixed side 56. Also, a connecting unit on the roll-side 58 is formed on the one of the axis members 54 that is disposed closer to the second coupling member 20 than is the second roll 14.

[0038] As shown in Fig. 7, more specifically, the second coupling member 20 comprises a fixed member on the roll side 62, a rotating member on the roll side 64, a rotating member on the side of the driving unit 66, a fixed member on the side of the driving unit 68, and sleeves 67, 69. These members are placed so that they have axes in common or have different axes that are parallel to each other.

[0039] The rotating member on the side of the driving unit 66 is placed in a position so that it has its axis in common with the connecting unit on the roll side 58 or has a different axis, i.e., one that is parallel to the axis of the connecting unit on the roll side 58. The rotating member on the side of the driving unit 66 is rotatable relative to the connecting unit on the roll side 58.

The fixed member on the roll side 62 is fixed so that it can rotate with the connecting unit on the roll side 58 as one body. The rotating member on the roll side 64 is fixed with bolts 70 and nuts 72 to the sleeve 67 that is engaged with the fixed member on the roll side 62 and is rotatable with the sleeve 67 as one body. The rotating member on the roll side 64 can rotate clockwise or counterclockwise relative to the rotating member on the side of the driving unit 66 such that it can be disposed at a position that is displaced relative to the position of the rotating member on the side of the driving unit 66.

[0040] The fixed member on the side of the driving unit 68 is fixed to the output axis 38 of the driving unit 16 and is rotatable with the driving unit 16 as one body. The rotating member on the side of the driving unit 66 is fixed with the bolts 74 and the nuts 76 to the sleeve 69 that is engaged with the fixed member on the side of the driving unit 68 and is rotatable with the sleeve 69 as one body.

[0041] The rotating member on the roll side 64 and the rotating member on the side of the driving unit 66 are fixed together by the bolts 78 and the nuts 80 and are rotatable as one body. A hole 82 of the rotating member on the side of the driving unit 66 through which the bolt 78 goes is round and a hole 84 of the rotating member on the roll side 64 through which the bolt 78 goes is, as shown in Fig. 8, a long hole that extends along the circumference of the rotating member on the roll side 64. Thus the rotating member on the roll side 64 can rotate clockwise or counterclockwise relative to the rotating member on the side of the driving unit 66, to the extent that the bolt 78 can move within the long hole that extends along the circumference of the rotating member on the roll side 64, when the fastening between the bolt 78 and nut 80 is loosened.

Thus the rotating member on the roll side 64 can be disposed at the position that is displaced relative to the position of the rotating member on the side of the driving unit 66.

[0042] The mechanism for adjusting the position 86 is placed on the second coupling member 20 and is inside in the radial direction of the respective outer surfaces 64A,

66A of the rotating member on the roll side 64 and the rotating member on the side of the driving unit 66. As shown in Figs. 7 and 8, the mechanism for adjusting the position 86 comprises a nut 88, a bolt 90, and a pressed part 92.

[0043] As shown in Fig. 8, the rotating member on the roll side 64 has a concave part 94 that is open on the outer surface and has a nut 88 and bolt 90 within the concave part. As shown in Fig. 7, the nut 88 has a pair of fixing pins 96, 98 formed along the axis of the second coupling member 20.

[0044] One fixing pin 96 is engaged with an engaging hole 100 that is formed on the rotating member on the side of the driving unit 66, and the other fixing pin 98 is engaged with an engaging hole 102 that is formed on a flange 101 of the sleeve 67. Thus the nut 88 is fixed relative to the rotating member on the side of the driving unit 66 and the sleeve 67. Also, the nut 88 is disposed on the outer side in the radial direction of the center of rotation of the rotating member on the side of the driving unit 66 and has its axis in the tangential direction of the rotating member on the side of the driving member 66. The bolt 90 is engaged with the nut 88.

[0045] As shown in Fig. 8, the pressed part 92 is formed by the inside wall of the concave part 94 and it is a part of the concave part 94. It extends in the radial direction of the rotating member on the roll side 64. The pressed part 92 has the end-part of the bolt 90 pressed on it.

For the mechanism for adjusting the position 86, when the bolt 90 is screwed into the nut 88, a pressing force F at the end of the bolt 90 in the tangential direction of the rotating member on the roll side 64 is generated in proportion to the advancement of the bolt 90. So, while loosening the fastening between the nut 78 and the bolt 80, and if the bolt 90 is screwed into the nut 88, the position of the rotating member on the roll side 64 in the rotational direction relative to the position of the rotating member on the side of the driving unit 66 can be adjusted.

[0046] As shown in Fig. 9, the bearing unit on the movable side 46 can be moved in the radial directions (X-direction) of the first roll 12 and the second roll 14 relative to the bearing unit on the fixed side 56. So, it can contact, or retract from, the bearing unit on the fixed side 56. A spacer for adjusting the gap 104 is provided between the bearing unit on the fixed side 56 and the bearing unit on the movable side 46, providing a gap between the first roll 12 and the second roll 14. The gap is adjusted by the width of the spacer for adjusting the gap 104.

[0047] A hydraulic cylinder 106 is disposed on the side opposite the bearing unit on the fixed side 56 with the bearing unit on the movable side 46 laid in between. The hydraulic cylinder 106 is disposed in such a way that its axis is positioned in the direction of the line that is in common with the radius of the first roll 12 and the radius of the second roll 14, each of the radii being perpendicular to the rotating axis of the

first roll 12 and that of the second roll 14.

The hydraulic cylinder 106 comprises a cylinder body 108 and a cylinder rod 110. The cylinder body 108 is fixed to the side of a housing 112 that comprises the bearing unit on the fixed side 56, the bearing unit on the movable side 46, the first roll 12, the second roll 14, etc. The cylinder rod 110 has a piston member 114 at the middle part of it in the longitudinal direction, which piston member 114 is housed in the cylinder body 108.

- [0048] On one end of the cylinder rod 110 is formed a screw member 116, which is screwed into an adjusting nut 118. The adjusting nut 118 contacts the wall opposite the housing 112 of the cylinder body 108. The screw member 116 and the adjusting nut 118 constitute the position-adjusting member 120, wherein the position of the cylinder rod 110 in the axial direction is adjusted by controlling the advancement of the screw member 116 into the adjusting nut 118.
- [0049] A pressure detector 124 is fixed on the side wall of the bearing unit on the movable side 46, which wall is positioned opposite the bearing unit on the fixed side 56. This pressure detector 124 is disposed between the other end of the cylinder rod 110 and the bearing unit on the movable side 46 where the other end of the cylinder rod 110 contacts the pressure detector 124. The pressure produced between the other end of the cylinder rod 110 and the bearing unit on the movable side 46 is detected by the pressure detector 124. The output signal from the pressure detector 124 enters the control unit 126 through an adder and an amplifier.
- [0050] The briquette machine 10 thus constituted has the gap between the first roll 12 and the second roll 14 set by the spacer for adjusting the gap 104 under the conditions that no pressure load is generated between the first roll 12 and the second roll 14. At the same time the position of the other end of the cylinder rod 110 is adjusted so that it contacts the pressure detector 124. At this moment no output signal is sent from the pressure detector 124. Next, the position of the cylinder rod 110 is fixed by injecting hydraulic oil into one side of the piston member 114 of the cylinder body 108.
- [0051] If raw material is supplied between the first roll 12 and the second roll 14, and if pressure starts being generated on the first roll 12 and the second roll 14, the pressure that is generated between the other end of the cylinder rod 110 and the bearing unit on the movable side 46 is detected by the pressure detector 124. The signal that corresponds to the pressure enters the control unit 126 through the adder and the amplifier (not shown) (step S1 of Fig. 11).
- [0052] The control unit 126 determines if the value detected by the pressure detector 124 is within the predefined range (S2 of Fig. 11). If the value that is detected is within the predefined range, the rotation of the feeder screw 24 is maintained.
- [0053] If the control unit 126 determines that the value detected by the pressure detector 124

is greater than the predefined value (S3 of Fig. 11), the variable-speed control motor 26 is controlled so that the rotation of the feeder screw 24 is reduced (S4 of Fig. 11). If the value that is detected is less than the predefined value, the variable-speed control motor 26 is controlled so that the rotation of the feeder screw 24 is increased (S5 of Fig. 11).

[0054] If any irregular excessive pressure is generated between the first roll 12 and the second roll 14, because, for example, of some foreign matter mixed in the raw material being inserted between the first roll 12 and the second roll 14, the impact shock caused by the excessive pressure is transmitted to the cylinder rod 110 through the bearing unit on the movable side 46, liner 122, and the pressure detector 124. Then the cylinder rod 110 is moved against the resistance force of the hydraulic oil, and the impact shock is absorbed.

[0055] Next, the operation and the effect obtained in one embodiment of the present invention is explained.

[0056] If the pockets 28 and 30 formed on the outer surfaces 12A and 14A, respectively, of the first roll 12 and the second roll 14 do not match, the briquette machine 10 is able to have the pockets 28 and 30 match by having the position in the rotational direction of the rotating member on the roll side 64 adjusted relative to the rotating member on the side of the driving unit 66, by means of the mechanism for adjusting the position 86 provided on the second coupling member 20. Thus the briquette machine 10 can form the briquettes by compressing the raw material with the pockets 28 and 30 that were matched, such that the quality of the briquettes can be maintained.

[0057] Also, usually the first coupling member 18 and the second coupling member 20 are exposed beyond the frame 27. So, by installing the mechanism for adjusting the position 86 at the second coupling member 20, the efficiency of matching the pockets 28 and 30 is improved.

[0058] In the embodiment of the briquette machine 10 of the present invention, if the pockets 28 and 30 do not match, then, for example, the following procedures can be applied so as to enable the pockets 28 and 30 to be matched. That is, first the numerical correlation between (1) the rotation of the bolt 90 and (2) the rotation of the rotating member on the roll side 64 relative to the rotating member on the side of the driving unit 66 is to be obtained. Next, from the amount of the misalignment between the pockets 28 and 30, as obtained from the briquettes manufactured by the first roll 12 and the second roll 14, and the numerical correlation thus obtained, the degree of the rotation of the bolt 90 that is required is calculated. By rotating the bolt 90 and having it screwed into the nut 88 by the degree of the rotation that is calculated, the pressing force F at the end of the bolt 90 is exerted on the pressed part 92 in the tangential direction of the rotating member on the roll side 64 whereby the rotating member on the roll side 64 is rotated relative to the rotating member on the side of the driving unit

66 so that the pockets 28 and 30 are led to match. In this way based on the briquettes that were manufactured it is possible to have the pockets 28 and 30 matched without actually deciding if the pockets 28 and 30 are matched. So, the efficiency of the work to match the pockets 28 and 30 is improved.

[0059] The mechanism for adjusting the position 86 is located at a position that is to the inner sides of the outer surface 64 A and 66A of the rotating member on the roll side 64 and the rotating member on the side of the driving unit 66, respectively. So, the mechanism for adjusting the position 86 is prevented from contacting any object that is placed outside the rotating member on the roll side 64 and the rotating member on the side of the driving unit 66, while they are rotating.

[0060] Further, if the pressure generated between the other end of the cylinder rod 110 and the bearing unit on the movable side 46 varies in correspondence with the changes of the force compressing the raw material held between the first roll 12 and the second roll 14, which compressing force changes depending on the density and fluidity of the raw material supplied by the hopper 22, then this variation in the pressure increases or decreases the degree of the rotation of the feeder screw 24. Thus it becomes possible to suppress the changes in the force compressing the raw material held between the first roll 12 and the second roll 14, whereby the uniformity of the profile of the thickness, and weights of the briquettes can be maintained.

[0061] Also, the pressure detector 124 that is used as a detector can detect the pressure more accurately than can a detector that uses an electric current. So, it can more easily be controlled.

[0062] Next, one alternative embodiment is explained.

[0063] In the embodiment explained above, the rotation of the feeder screw 24 is controlled so that it increases or decreases depending on the increase or decrease of the pressure between the other end of the cylinder rod 110 and the bearing unit on the movable side 46. But a briquette machine of the following structure can also be used.

[0064] That is, as shown in Figs. 12 and 13, which illustrate a modified embodiment, the first roll 12 can contact, and retract from, the second roll 14 in the radial direction. Further, if the force is generated in such a way that the second roll 14 retracts from the first roll, then the first roll 12 is pressurized to move by the hydraulic cylinder 128. At the bottom end of the hopper 22 is provided a pressure detector 130 that detects the pressure when the raw material is pushed down and between the first roll 12 and the second roll 14 by means of the feeder screw 24. In this embodiment the variable-speed control motor 26 is controlled by the control unit 126 so that the rotation of the feeder screw 24 decreases or increases corresponding to the increase or decrease of the value that is detected by the pressure detector 130.

[0065] With the briquette machine of the alternative embodiment thus constituted, if the

pressure by which the raw material is pushed down between the first roll 12 and the second roll 14 by means of the feeder screw 24 varies in correspondence with the changes in the force compressing the raw material held between the first roll 12 and the second roll 14, which force compressing changes depending on the density and fluidity of the raw material supplied by the hopper 22, then this variation in the pressure decreases or increases the degree of rotation of the feeder screw 24. Thus it becomes possible to suppress the changes in the force compressing the raw material held between the first roll 12 and the second roll 14 whereby the uniformity of the profile of the thickness and weights of the briquettes can be maintained.

[0066] As shown in Fig. 14, a current detector 132 that detects the current of the driving motor 32 or the electric power detector 133 that detects the power consumption of the driving motor 32 can be used as a detector that is connected to both the control unit 126 and the driving motor 32 and that is positioned between them. The variable-speed control motor 26 can be controlled by the control unit 126 so that the rotation of the feeder screw 24 decreases or increases corresponding to the increase or decrease of the value that is detected by the current detector 132 or the electric power detector 133.

[0067] If the current detector 132 is used as a detector, it will reduce the cost, compared with the cost when a pressure detector is used. If the electric power detector 133 is used, it will reduce the cost, compared with the cost when a pressure detector is used. The electric power detector 133, which is not affected by the voltage, can achieve a more accurate control than can the current detector 132.

[0068] As shown in Fig. 8, in the embodiment mentioned above, the nut 88 is disposed in such a way that it has its axis running in the tangential direction of the rotating member on the side of the driving unit 66. The pressed part 92 extends in the radial direction of the rotating member on the roll side 64. However, as shown in Fig. 15, the nut 88 can be positioned in such a way that it has its axis running in the radial direction of the rotating member on the side of the driving unit 66. The pressed part 92 can be positioned in such a way that it slants against the radial direction and the tangential direction of the rotating member on the roll side 64.

[0069] Even if the mechanism for adjusting the position is constituted in this way, by rotating the bolt 90 by the degree of rotation that was previously calculated and by having it screwed into the nut 88, the component force F of the pressing force at the end of the bolt 90 that is generated against the pressed part 92 is obtained, where the component force F is generated in the tangential direction of the rotating member on the roll side 64,. Thus the component force F can rotate the rotating member on the roll side 64 relative to the rotating member on the side of the driving unit 66, whereby the pockets 28 and 30 can be matched.

[0070] In the embodiment discussed above, as the roll that is connected to the second

coupling member 20 that has the mechanism for adjusting the position 86, the second roll 14, which is on the side of the bearing unit on the fixed side 56, is used. But the mechanism for adjusting the position 86 that is disposed on the first coupling member that is connected to the first roll 12 that is on the bearing unit on the movable side 46 can also be used.

[0071] While particular embodiments of the present invention have been illustrated and described, it will be apparent to those skilled in the art that various other changes and modifications can be made without departing from the spirit and scope of the invention. It is therefore intended to cover in the appended claims all such changes and modifications that are within the scope of this invention.

[0072] The basic Japanese Patent Application, No. 2011-042973, filed on February 28, 2011, is hereby incorporated in its entirety by reference in the present application.

The present invention will become more fully understood from the detailed description of this specification. However, the detailed description and the specific embodiment illustrate desired embodiments of the present invention and are described only for the purpose of explanation. Various possible changes and modifications will be apparent to those of ordinary skill in the art on the basis of the detailed description.

The applicant has no intention to dedicate to the public any disclosed embodiments. Among the disclosed changes and modifications, those that may not literally fall within the scope of the present claims constitute, therefore, a part of the present invention in the sense of the doctrine of equivalents.

The use of the articles "a," "an," and "the," and similar referents in the specification and claims, are to be construed to cover both the singular and the plural, unless otherwise indicated herein or clearly contradicted by the context. The use of any and all examples, or exemplary language (e.g., "such as") provided herein, is intended merely to better illuminate the invention and does not pose a limitation on the scope of the invention unless otherwise claimed.

[0073] 10 briquette machine
12 first roll
14 second roll
16 driving unit
18 first coupling member
20 second coupling member
22 hopper
24 feeder screw
28, 30 pocket
32 driving motor
44, 54 axis

46 bearing unit on the movable side
56 bearing unit on the fixed side
64 rotating member on the roll side
66 rotating member on the side of the driving unit
86 mechanism for adjusting the position
88 nut
90 bolt
92 pressed part
104 spacer for adjusting the gap
106 hydraulic cylinder
110 cylinder rod
120 position-adjusting member
124 pressure detector
126 control unit
128 hydraulic cylinder
130 pressure detector (detector)
132 current detector (detector)

Claims

- [Claim 1] The briquette machine comprising:
- a first roll and a second roll that each are ring-shaped, having the axis of rotation of the first roll and that of the second roll being disposed parallel to each other and each roll having pockets on its outer surface whereby raw material is compressed between the pockets of the first roll and those of the second roll;
 - a driving unit that produces a driving force for rotation;
 - a first coupling member that conveys the driving force for rotation of the driving unit to the first roll;
 - a rotating member on the roll-side that rotates with the second roll as one body;
 - a rotating member on the side of the driving unit that is rotated by the driving unit;
 - a mechanism for adjusting the position of the rotating member on the roll-side along the direction of the rotation of the rotating member on the roll-side relative to the rotating member on the side of the driving unit; and
 - a second coupling member that conveys the driving force for rotation of the driving unit to the second roll.
- [Claim 2] The briquette machine according to claim 1, wherein the mechanism for adjusting the position that is disposed at the position that is to the outer side in the radial direction as seen from the center of the rotating member on the side of the driving unit, the mechanism for adjusting the position comprising:
- a nut disposed so that the axis of the nut is laid parallel to the tangential direction or the radial direction of the rotating member on the side of the driving unit;
 - a bolt that is screwed into the nut; and
 - a pressed portion that is formed on the rotating member on the roll-side where the tip of the bolt contacts the rotating member on the roll-side wherein the pressing force is exerted by the tip of the bolt in the tangential direction or the radial direction of the rotating member on the roll-side as the bolt is screwed into the nut.
- [Claim 3] The briquette machine according to claim 2, wherein the mechanism for adjusting the position is disposed to the inside in the radial direction of the outer surface of the rotating member on the roll-side and the

inside in the radial direction of the outer surface of the rotating member on the side of the driving unit.

[Claim 4]

The briquette machine according to any one of claims 1-3, wherein the briquette machine comprises:

a bearing unit on the fixed side that supports an axis member that is disposed on either of the first roll or second roll and that can rotate with the roll as one body;

a bearing unit on the movable side that supports an axis member that is disposed on the other of the first and second rolls and that can rotate with the other roll as one body, the bearing unit on the movable side being movable in the direction of the radii of the first and second rolls wherein it can contact, or can retract from, the bearing unit on the fixed side;

a spacer adjusting the gap, which spacer is disposed between the bearing unit on the fixed side and the bearing unit on the movable side and which is to form a gap between the first and second rolls;

an oil hydraulic cylinder that is disposed on the side opposite the bearing unit on the fixed side with the bearing unit on the movable side laid in between, the hydraulic cylinder being disposed in such a way that its axis is positioned in the direction of the line that is in common with the radius of the first roll and the radius of the second roll, each of the radii being perpendicular to the rotating axis of the first roll and that of the second roll, and the hydraulic cylinder having a cylinder rod that has a member for adjusting the position in the axis-direction on one end;

a pressure-detecting device that is disposed between the other end of the cylinder rod and the bearing unit on the movable side and that detects the pressure between the other end of the cylinder rod and the bearing unit on the movable side;

a hopper disposed above the first roll and the second roll;

a feeder screw disposed within the hopper, which screw pushes the raw material within the hopper down and between the first and the second rolls by the screw being rotated,

a variable-speed control motor that drives the feeder screw, and

a control unit that controls the variable-speed control motor in such a way that the rotation of the feeder screw is decreased or increased corresponding to the increase or decrease of the pressure that is detected by the pressure-detector.

- [Claim 5] The briquette machine according to any one of claim 1-3, wherein the briquette machine comprises:
the first roll and the second roll, one of which is fixed in the direction of its radius and the other of which can contact, and retract from, the one of the first roll and the second roll in the direction of its radius;
a hydraulic cylinder that applies the pressure on the other of the first roll and the second roll if the force is exerted on the other of the first roll and the second roll in such a way that the one of the first roll and the second roll retracts from the other of the first roll and the second roll;
a hopper that is disposed above the first roll and the second roll;
a feeder screw disposed within the hopper, which feeder screw pushes the raw material within the hopper down and between the first roll and the second roll by the screw being rotated;
a variable-speed control motor that rotates the feeder screw;
a detector that detects the pressure by which the feeder screw pushes the raw material down and between the first roll and the second roll;
and
a control unit that controls the variable-speed control motor so that the rotation of the feeder screw is decreased or increased in accordance with the values detected by the detector.
- [Claim 6] The briquette machine according to claim 5, wherein the detector is a pressure detector.
- [Claim 7] The briquette machine according to any one of claims 1-3, wherein the briquette machine comprises:
the first roll and the second roll, one of which is fixed in the direction of its radius and the other of which can contact, and retract from, the one of the first roll and the second roll in the direction of its radius;
a hydraulic cylinder that applies the pressure on the other of the first roll and the second roll if the force is exerted on the other one of the first roll and the second roll in such a way that the one of the first roll and the second roll retracts from the other one of the first roll and the second roll;
a hopper that is disposed above the first roll and the second roll;
a feeder screw disposed within the hopper, which screw pushes the raw material within the hopper down and between the first roll and the second roll by the screw being rotated;
a variable-speed control motor that rotates the feeder screw;

a detector that detects the driving current of the driving motor that is disposed at a driving unit; and

a control unit that controls the variable-speed control motor so that the rotation of the feeder screw is decreased or increased in accordance with the values detected by the detector.

[Claim 8] The briquette machine according to claim 7, wherein the detector is a current detector.

[Claim 9] The briquette machine according to any one of claims 1-3, wherein the briquette machine comprises:

the first roll and the second roll, one of which is fixed in the direction of its radius and the other of which can contact, and retract from, the one of the first roll and the second roll in the direction of its radius;

a hydraulic cylinder that applies the pressure on the other of the first roll and the second roll if the force is exerted on the other of the first roll and the second roll in such a way that the one of the first roll and the second roll retracts from the other one of the first roll and the second roll;

a hopper that is disposed above the first roll and the second roll;

a feeder screw disposed within the hopper, which screw pushes the raw material within the hopper down and between the first roll and the second roll by the screw being rotated;

a variable-speed control motor that rotates the feeder screw;

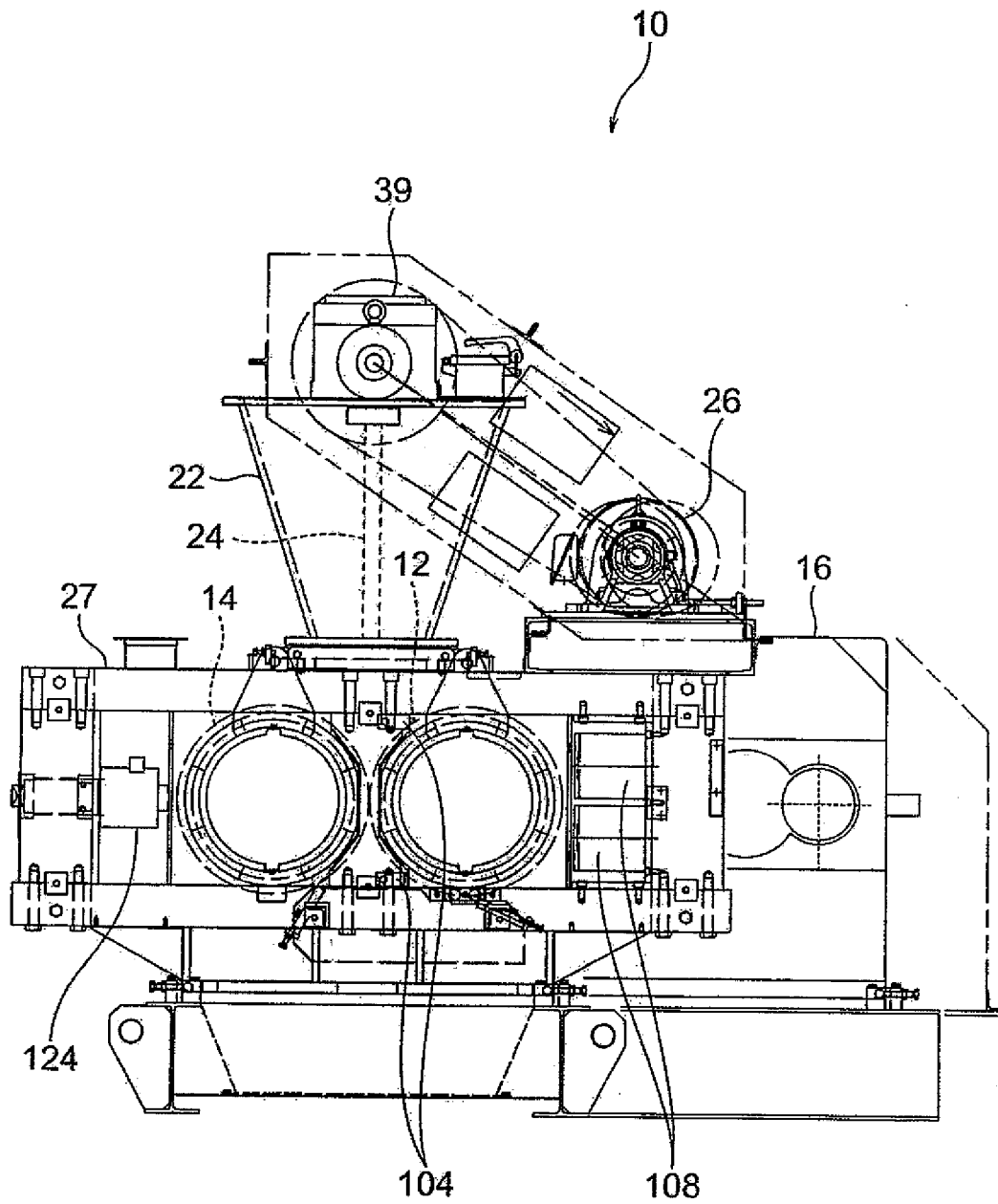
a detector that detects the power consumption of the driving motor that is disposed at a driving unit; and

a control unit that controls the variable-speed control motor so that the rotation of the feeder screw is decreased or increased in accordance with the values detected by the detector.

[Claim 10] The briquette machine according to claim 9, wherein the detector is a power meter.

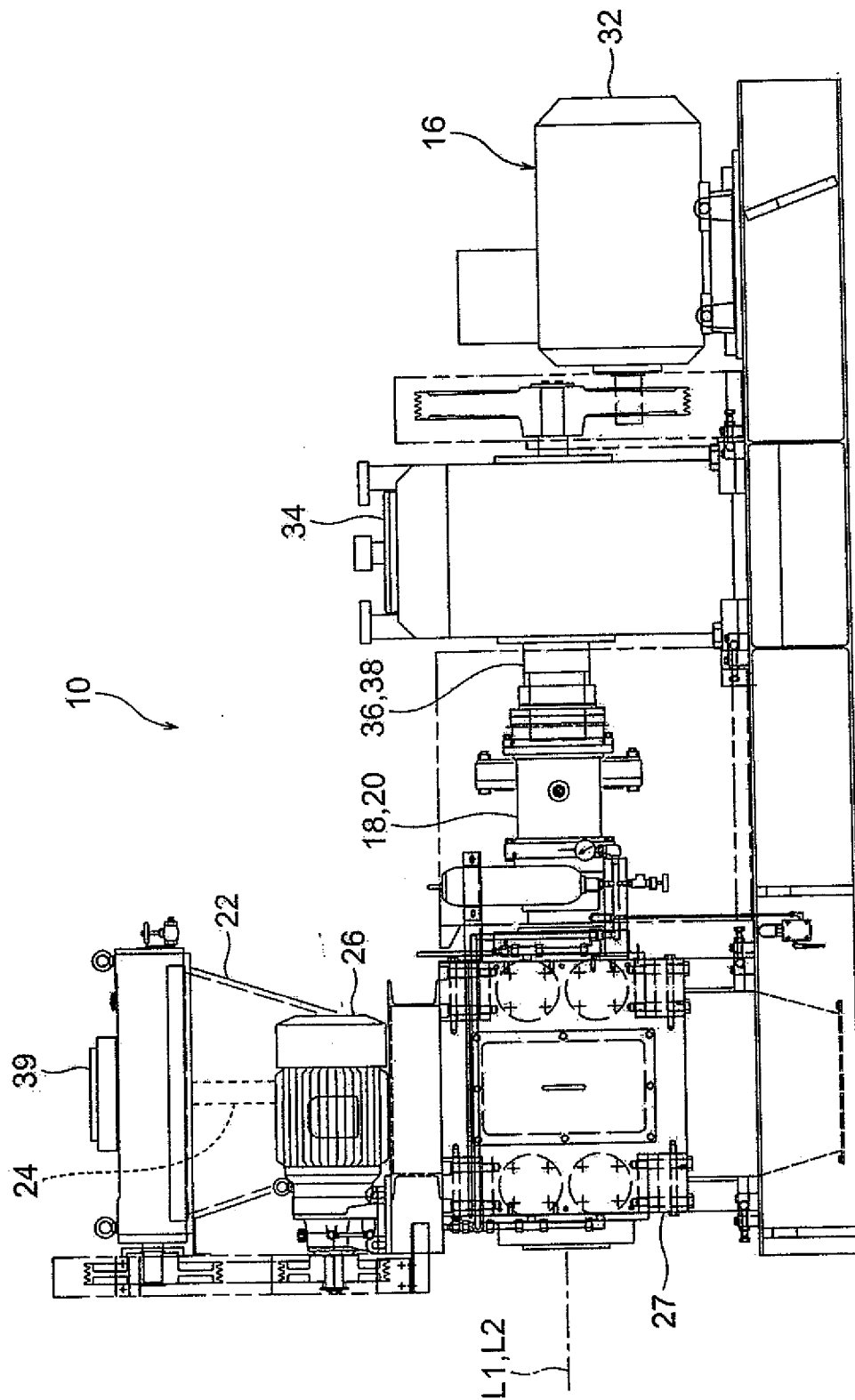
[Fig. 1]

Fig. 1



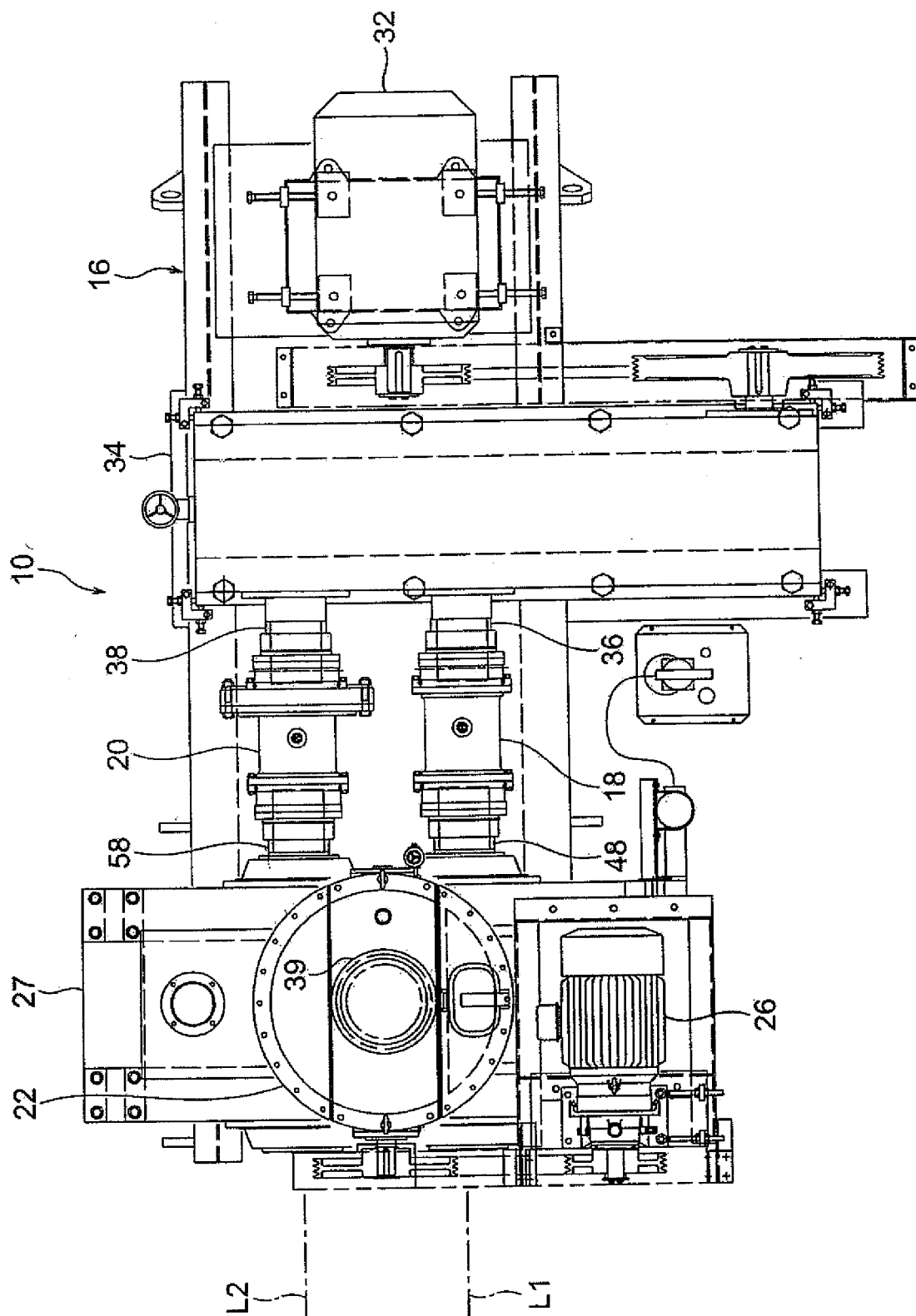
[Fig. 2]

Fig. 2



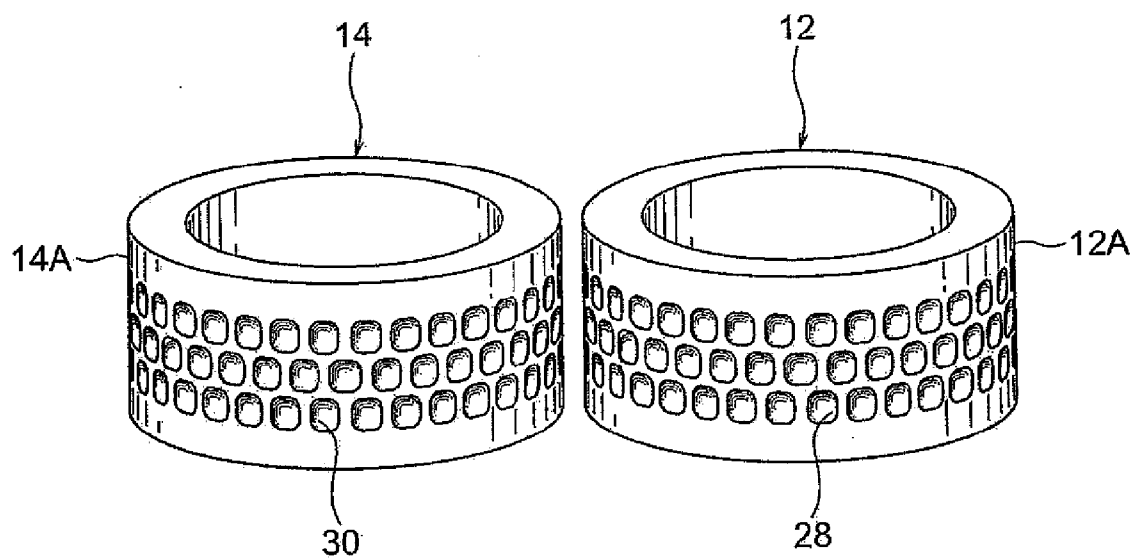
[Fig. 3]

Fig. 3



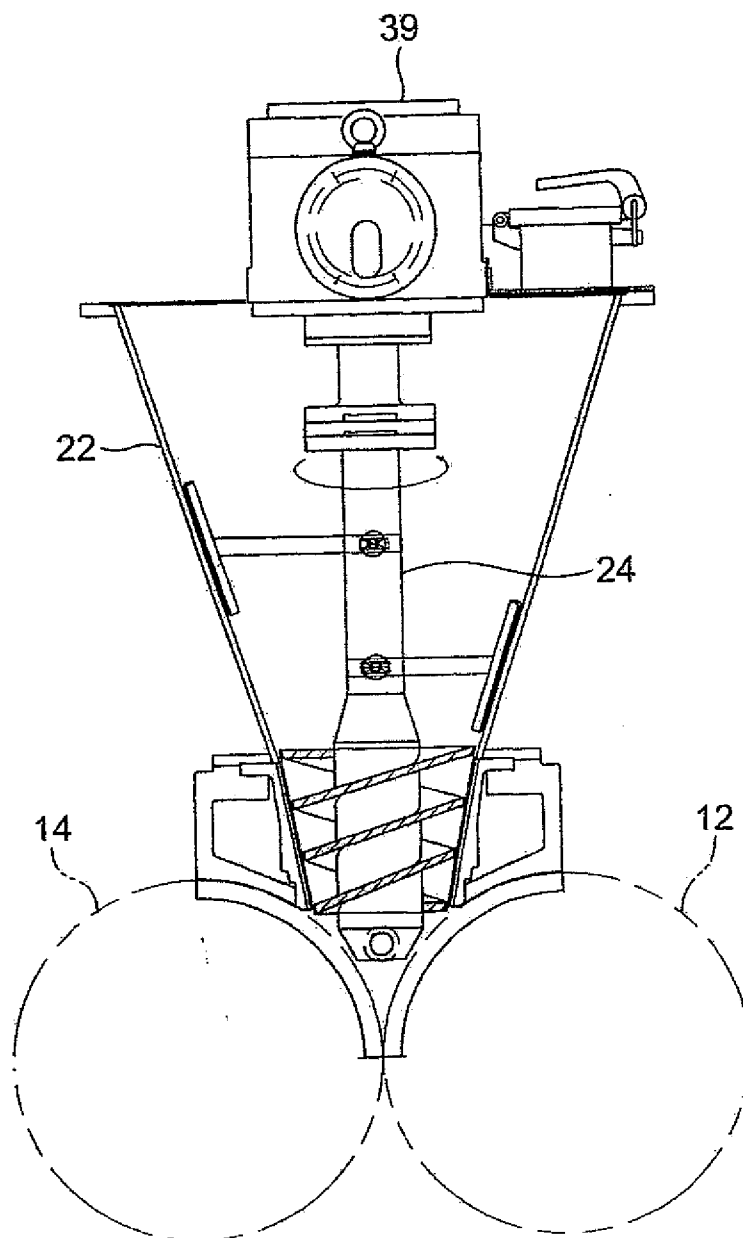
[Fig. 4]

Fig. 4



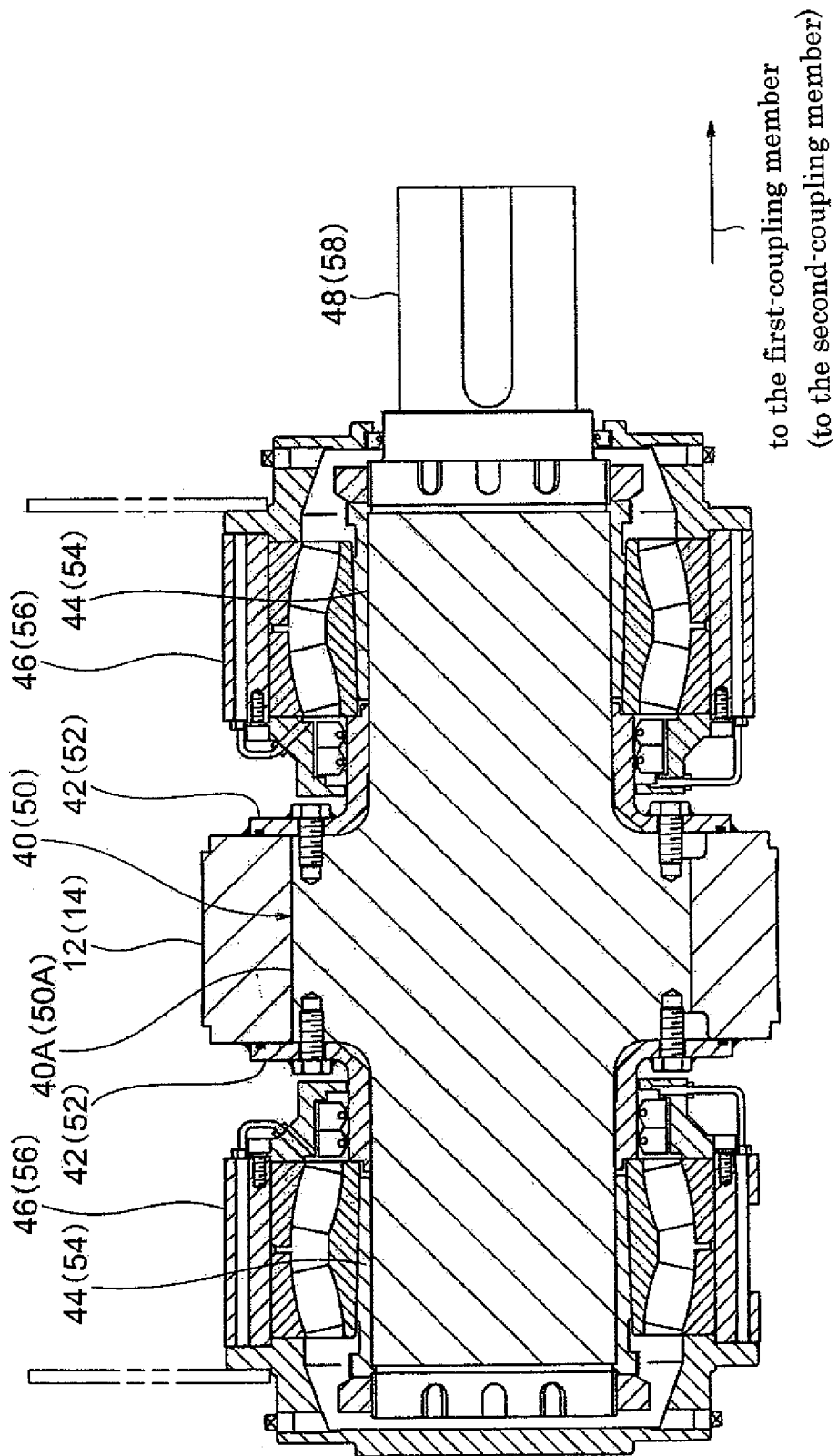
[Fig. 5]

Fig. 5



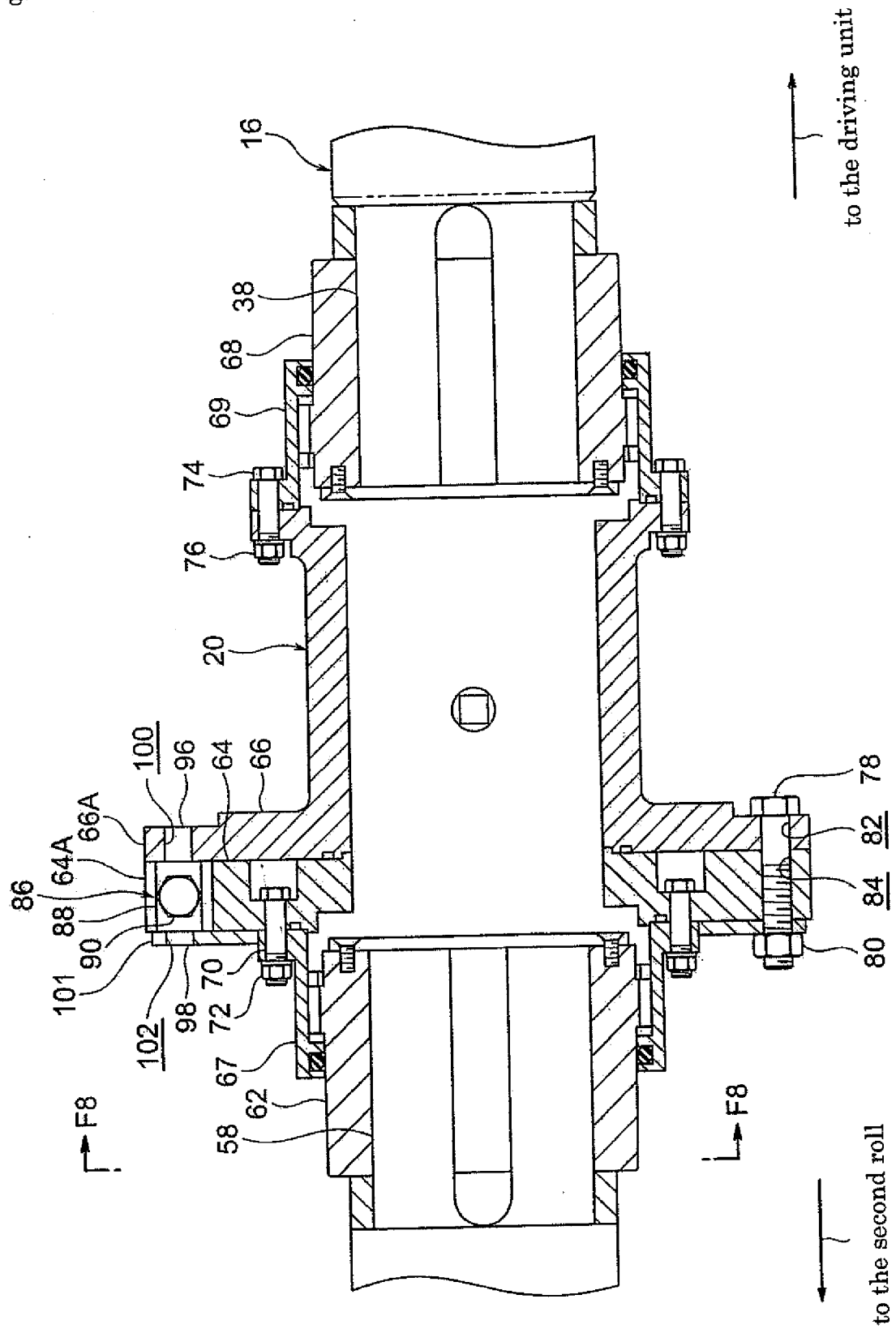
[Fig. 6]

Fig. 6



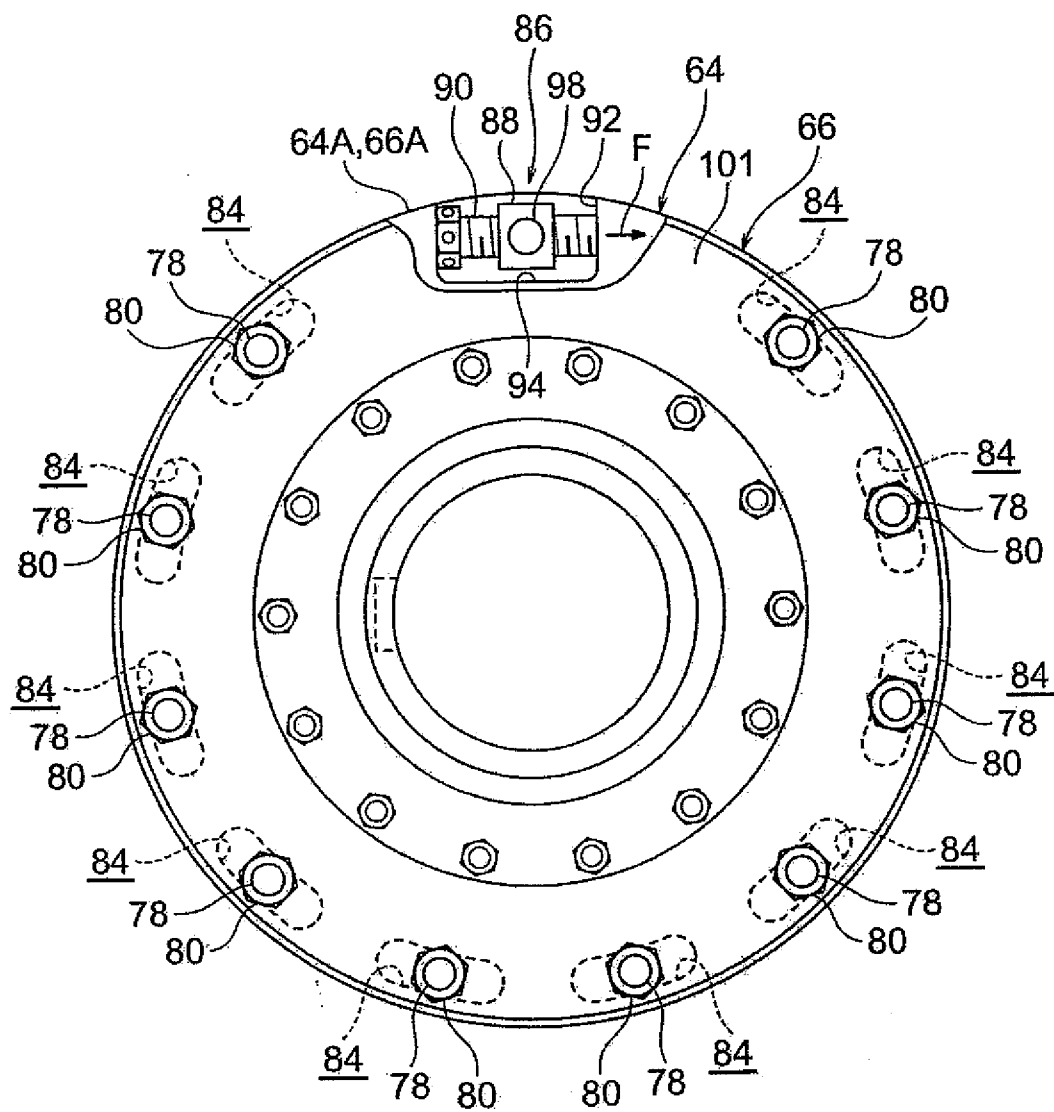
[Fig. 7]

Fig. 7



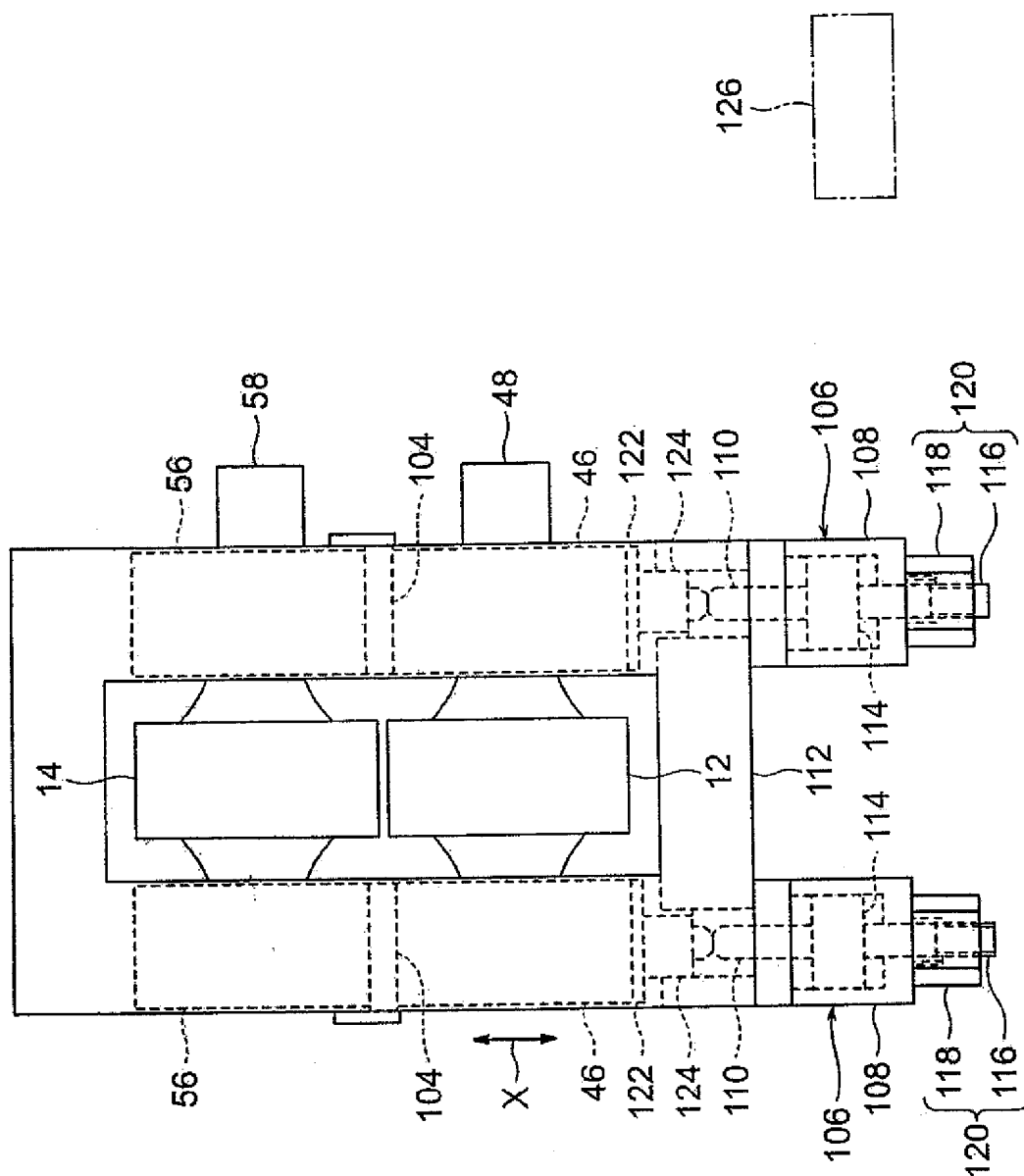
[Fig. 8]

Fig. 8



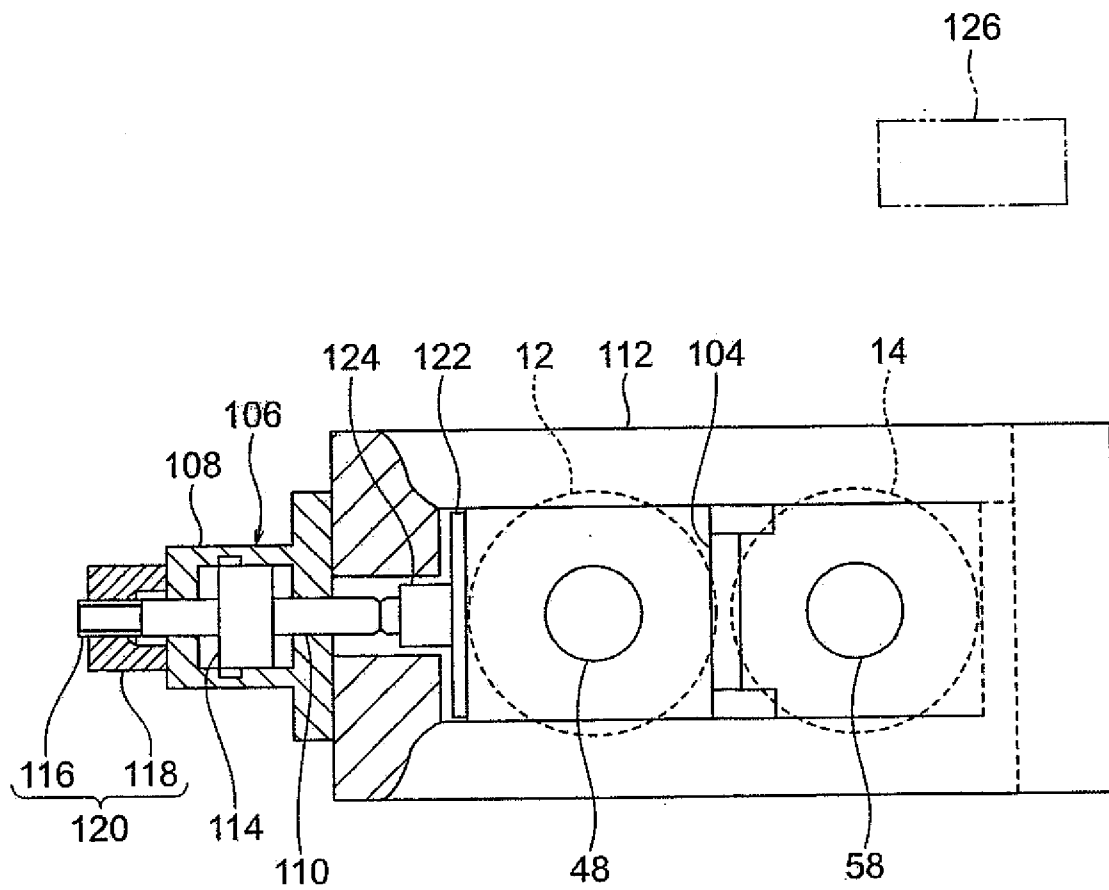
[Fig. 9]

Fig. 9



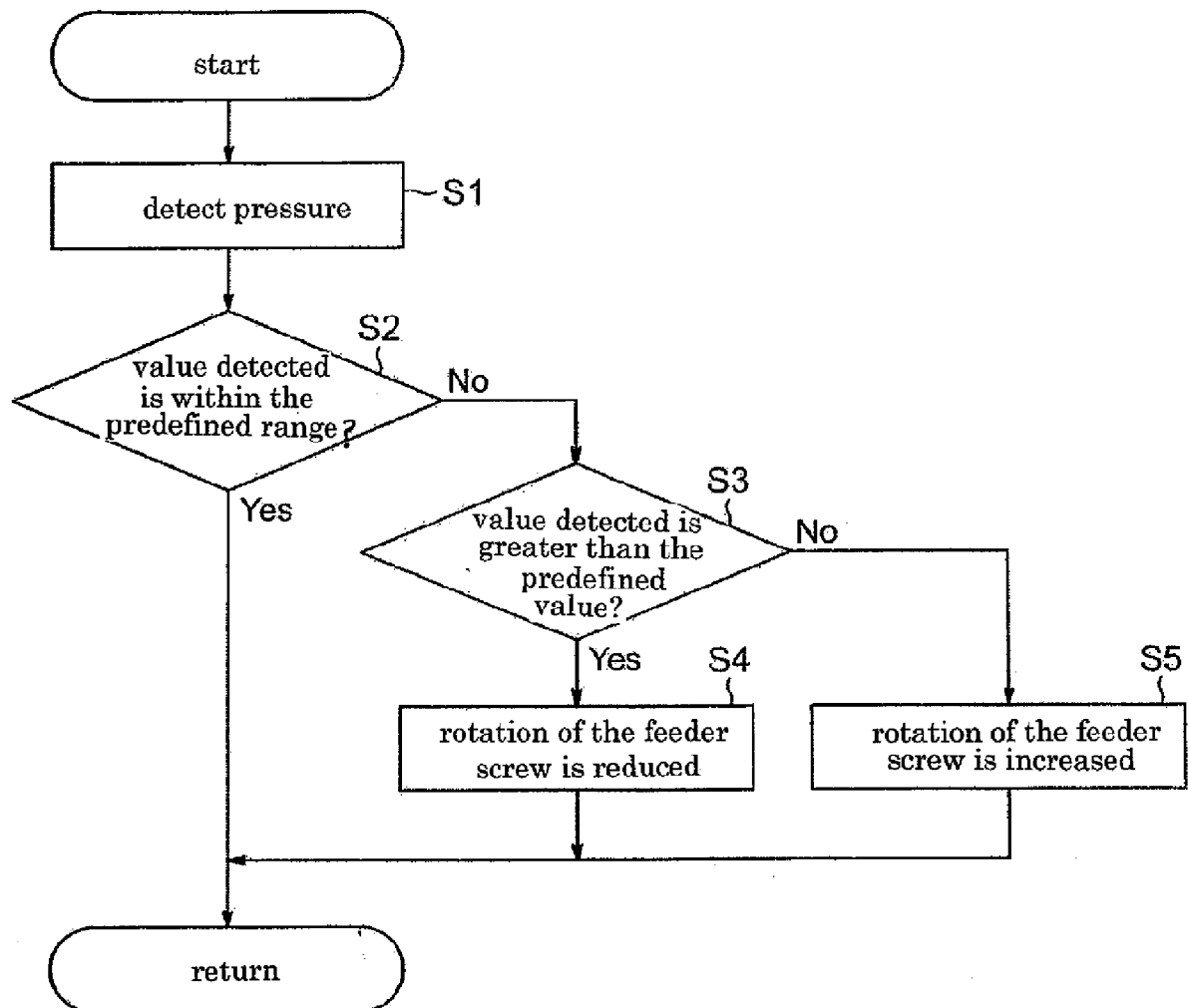
[Fig. 10]

Fig. 10



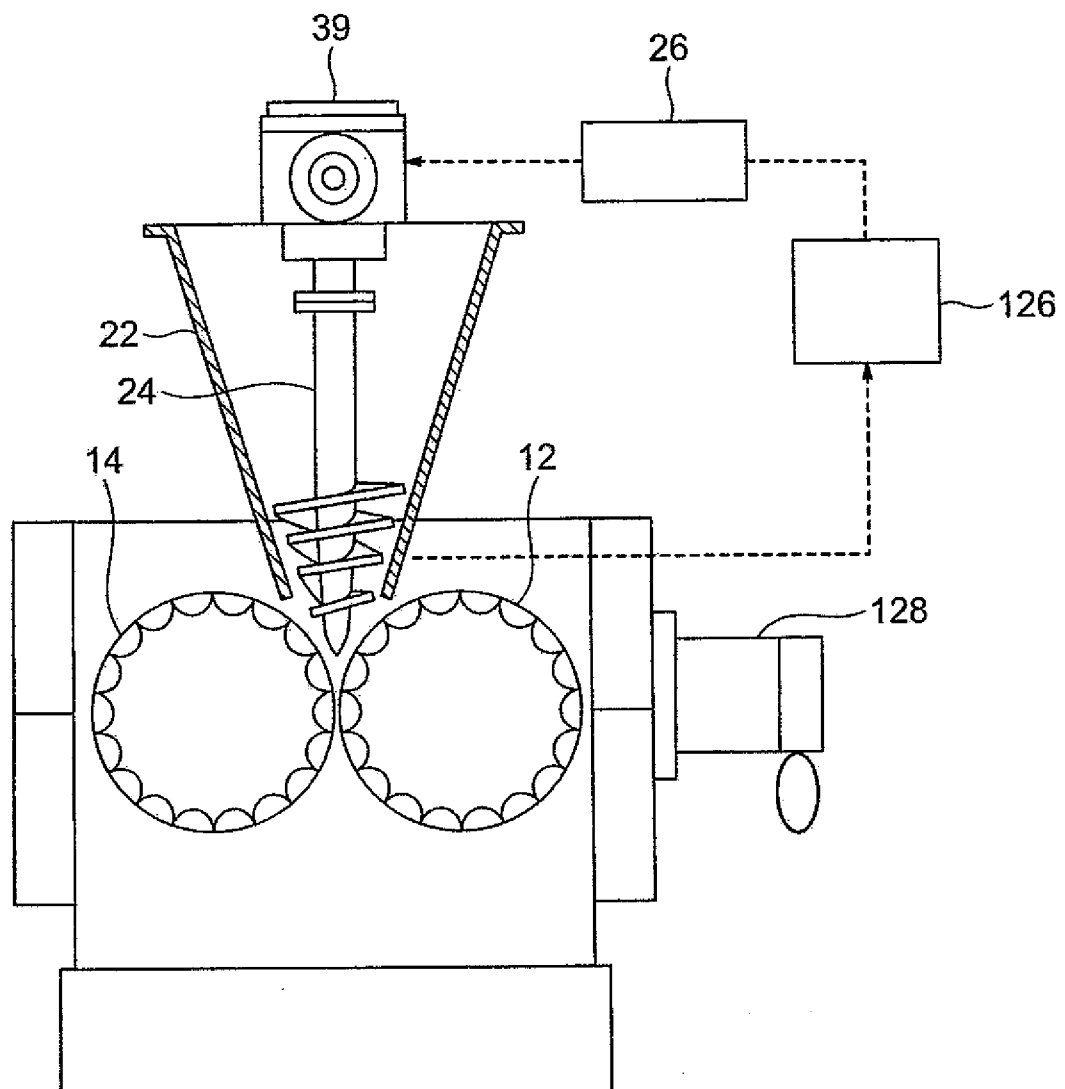
[Fig. 11]

Fig. 11



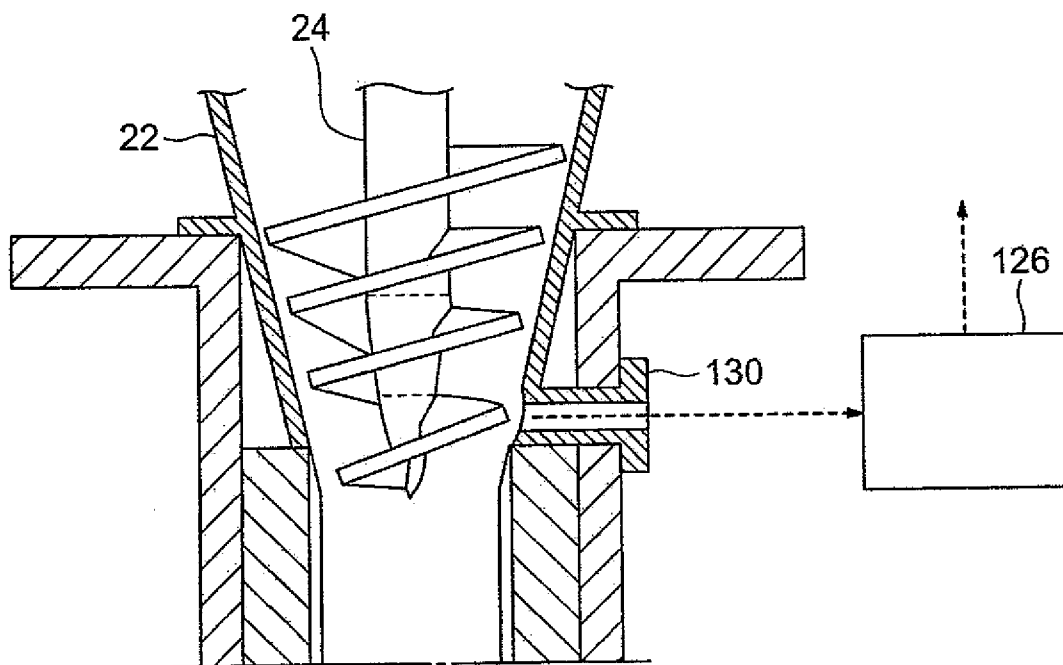
[Fig. 12]

Fig. 12



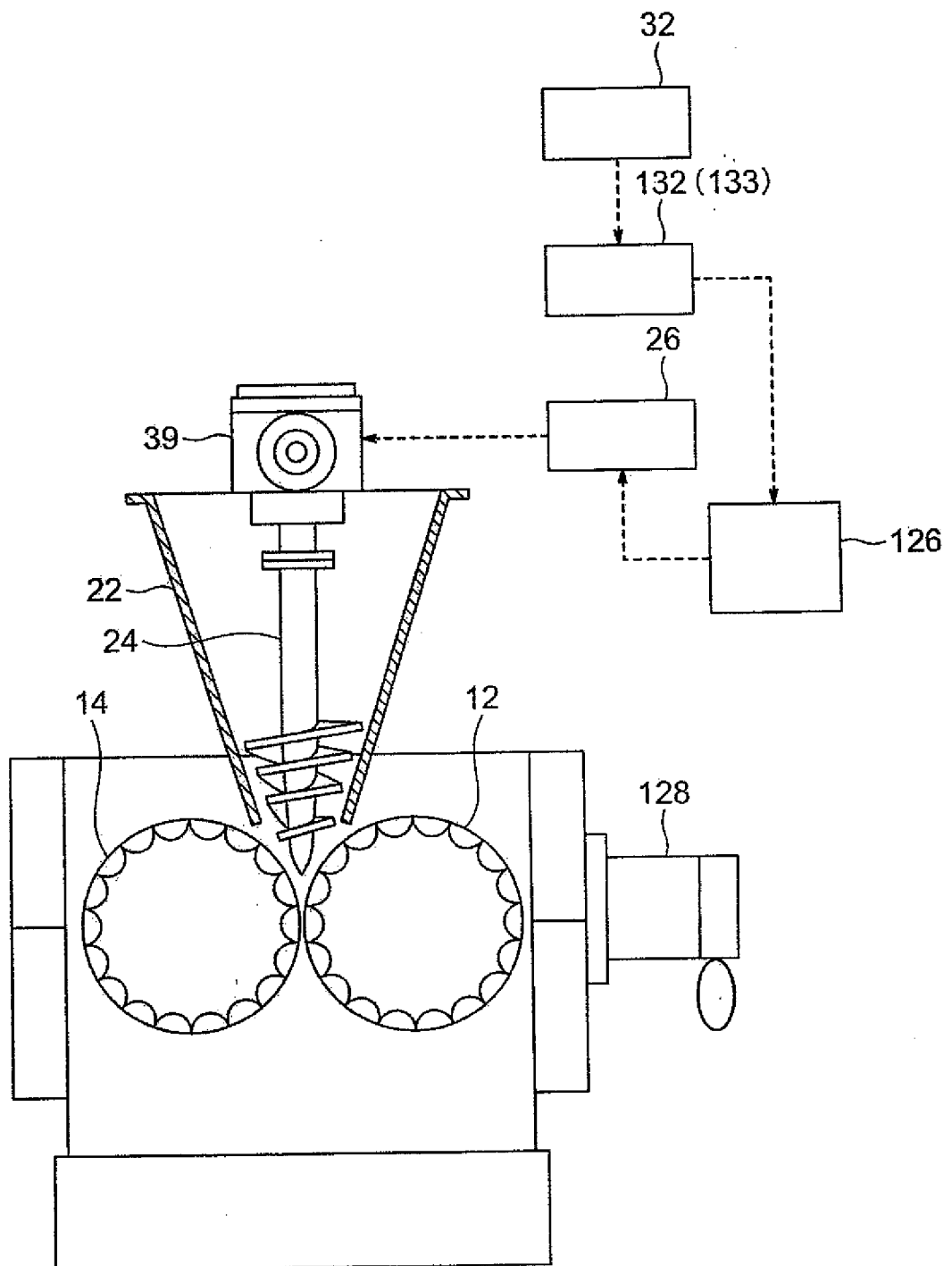
[Fig. 13]

Fig. 13



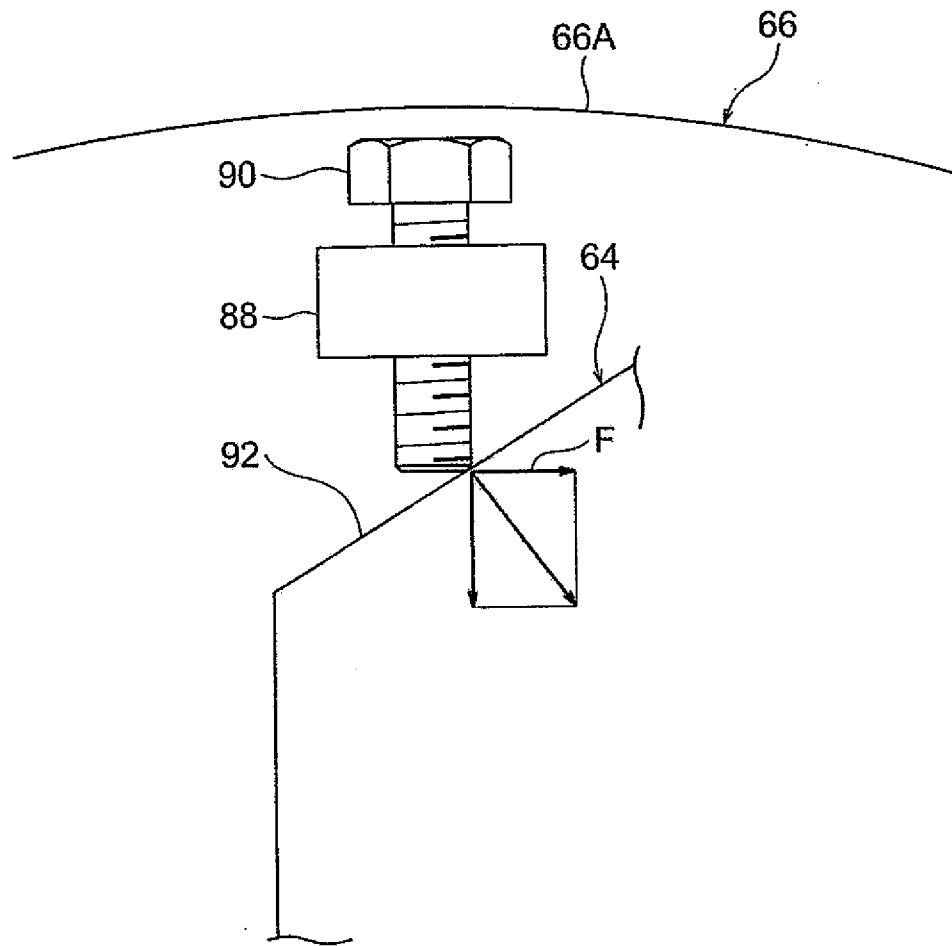
[Fig. 14]

Fig. 14



[Fig. 15]

Fig. 15



INTERNATIONAL SEARCH REPORT

International application No
PCT/JP2011/004791

A. CLASSIFICATION OF SUBJECT MATTER
INV. B30B11/16 B30B15/30 B30B3/04 B30B11/00
ADD.

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)
B30B

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

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

EPO-Internal, WPI Data

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Y	the whole document	4-10
Y	US 5 547 357 A (BERGENDAHL HANS-GEORG [DE]) 20 August 1996 (1996-08-20) column 3, lines 34-38; claim 11	4
Y	JP 58 128136 A (HITACHI LTD) 30 July 1983 (1983-07-30) abstract; figures	5,6
Y	JP 10 128100 A (SHIN MEIWA IND CO LTD) 19 May 1998 (1998-05-19) abstract; figures	7,8
	-/-	



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

12 January 2012

Date of mailing of the international search report

20/01/2012

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Authorized officer

Labre, Arnaud

INTERNATIONAL SEARCH REPORT

International application No

PCT/JP2011/004791

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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