(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 1 775 040 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 158(3) EPC

(43) Date of publication:
18.04.2007 Bulletin 2007/16

(21) Application number: **05768817.8**

(22) Date of filing: **28.07.2005**

(51) Int Cl.:
B21D 22/28 *(2006.01)* ***B21D 24/00*** *(2006.01)*

(86) International application number:
PCT/JP2005/014252

(87) International publication number:
WO 2006/013907 (09.02.2006 Gazette 2006/06)

(84) Designated Contracting States:
IT

(30) Priority: **03.08.2004 JP 2004227039**

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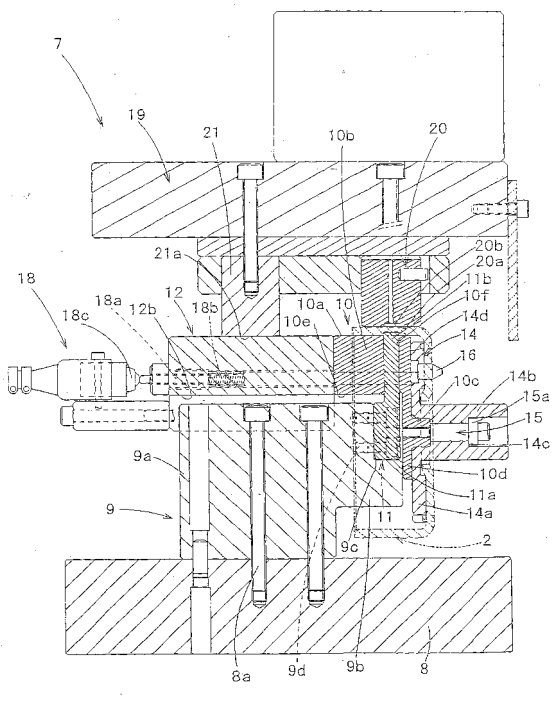
(54) APPARATUS FOR FORMING TRIGGERING PROJECTIONS IN FLYWHEEL, AND METHOD OF FORMING PROJECTIONS FOR TRIGGERING

(57) To provide a forming apparatus adapted to punch the outer periphery of the cylindrical portion of a bottomed cylindrical yoke that constitutes a flywheel to form a plurality of triggering projections without damaging the complete roundness of the yoke and with high workability. A triggering projection forming apparatus 7 is arranged in such a manner as to comprise: an inner guide body 10 to be butted against the inner periphery of the cylindrical portion 2a of a yoke; a projection forming punch 11 provided in the inner guide body 10 retractably in the punching direction; and an outer guide body 20 adapted to butt an abutting surface 20a with a receiving groove 20b for receiving the punch 11 formed therein against the outer periphery of the cylindrical portion 2a of the yoke to be pressurized, while the inner guide body 10 is connected with an auxiliary guide body 12 extending outside the cylindrical portion of the yoke 2, the auxiliary guide body 12 provided outside the cylindrical portion of the yoke 2 being adapted to receive the punching force of the outer guide body 20.

Fig. 3



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Description

[Technical Field]

[0001] The present invention relates to a technical field of an apparatus and method for forming a triggering projection in a flywheel to be fitted on a rotation axis to detect the rotational state thereof.

[Background Art]

[0002] Among flywheels of this kind, there has generally been known a type in which a permanent magnet is provided on the inner periphery of the cylindrical portion of a yoke that is formed in a bottomed cylindrical shape and a plurality of projections for receiving trigger signals (hereinafter referred to as "triggering projections") are formed circumferentially in a projecting manner outward from the outer peripheral surface of the cylindrical portion, such a flywheel being adapted to be fitted integrally over the rotation axis of an actuator, while a sensor being provided facing the cylindrical portion of the yoke to detect a magnetized projection (trigger) using the sensor and thereby the rotational state of the rotation axis (the driving state of the actuator) is detected. As a method for forming a triggering projection on the cylindrical portion of a yoke that constitutes such a flywheel, there have been proposed various methods such as: separately providing a projection to be fixed to the cylindrical portion of the yoke using integrating means such as adhesive; and punching the cylindrical portion to form a projection. Meanwhile, projections are to be formed on the outer peripheral surface of a yoke to be fitted over a rotation axis, and therefore are required to be formed without damaging the complete roundness of the yoke. In particular, when punching the cylindrical portion of the yoke to form projections, it is often the case that the cylindrical portion is deformed, and therefore means for preventing the complete roundness from being damaged is required.

[0003] In order to improve measures, there has been proposed a simple and inexpensive method for forming a projection, the method comprising: a first punching step of forming an acute-angled projection on the cylindrical portion of a yoke; and a second punching step of forming the acute-angled projection into a circular shape (For example, Japanese Published Unexamined Patent Application No. S57-148568).

[0004] Meanwhile, in accordance with the above-described conventional method, because the punching operation using a punch is adapted to be performed inside the cylinder of the yoke, it is impossible to ensure a large punching force, and it is therefore arranged that a triggering projection (pole) is formed through the first punching step in which an acute-angled projection is preliminarily formed to project significantly outward and the second punching step in which the projection is retreated inward to be a circular shape, which thus requires two punching steps, resulting in a problem in that the number of working processes is increased. In addition, because there is no member for guiding the end leading the punching in the first punching step where a large acute-angled projection is formed, the complete roundness of the cylindrical portion of the yoke can be damaged. Therefore even if tried by providing guiding on either side thereof in the second punching step, it is difficult to sufficiently compensate for the damaged roundness due to the problem of springback, etc. The problems raised here are to be solved by the present invention.

[Disclosure of the Invention]

[0005] The present invention has been made in consideration of the above-described circumstances and to solve the problems. The first aspect of the invention provides an apparatus for forming a plurality of triggering projections, which serve for receiving trigger signals, circumferentially on the outer periphery of the cylindrical portion of a bottomed cylindrical yoke that constitutes a flywheel, said triggering projections being projected toward the outer diameter side of the yoke by punching, the forming apparatus comprising: an inner guide body to be butted against the inner periphery of the cylindrical portion of the yoke; a projection forming punch provided in the inner guide body retractably in the punching direction; and an outer guide body with a receiving groove for receiving the punch formed therein, the outer guide body being adapted to pressurize the cylindrical portion of the yoke via an abutting surface to be butted against the outer periphery of the cylindrical portion of the yoke to form a projection by the punch, wherein the inner guide body is connected with an auxiliary guide body extending outside the cylindrical portion of the yoke, the auxiliary guide body provided outside the cylindrical portion of the yoke being adapted to receive the punching force of the projection by the outer guide body.

[0006] Then, with the arrangement above, the punching force of the outer guide body can be set large enough to form a projection in a single pressurizing operation while ensuring the complete roundness of the yoke.

[0007] The second aspect of the invention provides the forming apparatus according to the first aspect of the invention, wherein the auxiliary guide body is adapted to receive the punching force of the outer guide body via a spring, whereby the punching force of the outer guide body can be set larger.

[0008] The third aspect of the invention provides the forming apparatus according to the first or second aspect of the invention, wherein the auxiliary guide body is adapted to be pressurized by an outer auxiliary guide body provided integrally on the outer guide body, whereby the complete roundness of the yoke can be further ensured.

[0009] The fourth aspect of the invention provides the forming apparatus according to any of the first to third aspects of the invention, wherein the punch is provided integrally on a fixed guide body to be fixed outside the

cylindrical portion of the yoke, whereby the punching force can be set much larger.

[0010] The fifth aspect of the invention provides the forming apparatus according to any of the first to fourth aspects of the invention, wherein a rotational guide body is provided relatively rotatably in the inner guide body, the yoke being adapted to be incorporated into the inner guide body via the rotational guide body, whereby the yoke can be rotated easily relative to the inner guide body.

[0011] The sixth aspect of the invention provides the forming apparatus according to the fifth aspect of the invention, wherein between the rotational guide body and the inner guide body is provided positioning means for positioning the rotational guide body against the inner guide body, whereby the yoke can be rotated while positioned against a projection.

[0012] The seventh aspect of the invention provides the forming apparatus according to the sixth aspect of the invention, wherein the positioning means is adapted to be interlocked with the pressurizing operation of the outer guide body, whereby it is possible to form a projection accurately and reliably.

[0013] The eighth aspect of the invention provides a method for forming triggering projections on a flywheel, wherein an apparatus for forming a plurality of triggering projections, which serve for receiving trigger signals, circumferentially on the outer periphery of the cylindrical portion of a bottomed cylindrical yoke that constitutes a flywheel with the triggering projections being projected toward the outer diameter side of the yoke by punching, comprises: an inner guide body to be butted against the inner periphery of the cylindrical portion of the yoke; a projection forming punch provided in the inner guide body retractably in the punching direction; and an outer guide body with a receiving groove for receiving the punch formed therein, the outer guide body being adapted to pressurize the cylindrical portion of the yoke via an abutting surface to be butted against the outer periphery of the cylindrical portion of the yoke to form the projection by the punch; and an auxiliary guide body being connected to the inner guide body and extending outside the cylindrical portion of the yoke, said method comprising such steps that after setting the yoke on the inner guide body with no punch projecting, the outer guide body is pressed against the outer periphery of the yoke to form the projection, the auxiliary guide body provided outside the cylindrical portion of the yoke being adapted to receive the punching force of the outer guide body.

[0014] Then, with the arrangement above, the punching force of the outer guide body can be set large enough to form a projection in a single pressurizing operation while ensuring the complete roundness of the yoke.

[0015] In accordance with the first aspect of the invention, the punching force of the outer guide body can be set large enough to form a projection in a single pressurizing operation while ensuring the complete roundness of the yoke.

[0016] In accordance with the second aspect of the invention, the punching force of the outer guide body can be set larger.

[0017] In accordance with the third aspect of the invention, the complete roundness of the yoke can be further ensured.

[0018] In accordance with the fourth aspect of the invention, the punching force can be set much larger.

[0019] In accordance with the fifth aspect of the invention, the yoke can be rotated easily relative to the inner guide body.

[0020] In accordance with the sixth aspect of the invention, the yoke can be rotated while positioned against a projection.

[0021] In accordance with the seventh aspect of the invention, it is possible to form a projection accurately and reliably.

[0022] In accordance with the eighth aspect of the invention, the punching force of the outer guide body can be set large enough to form a projection in a single pressurizing operation while ensuring the complete roundness of the yoke.

[Brief Description of the Drawings]

[0023]

[Fig. 1] Fig. 1 (A) and Fig. 1 (B) are a front elevational view and a cross-sectional view along X-X of a flywheel, respectively.

[Fig. 2] Fig. 2 (A) and Fig. 2 (B) are a front elevational view and a cross-sectional view along X-X of a yoke, respectively.

[Fig. 3] Fig. 3 is a side cross-sectional view of a triggering projection forming apparatus.

[Fig. 4] Fig. 4 is a plan view of the triggering projection forming apparatus.

[Fig. 5] Fig. 5 is a front elevational view of the triggering projection forming apparatus.

[Fig. 6] Fig. 6 is a bottom plan view of a movable side member that constitutes the triggering projection forming apparatus.

[Fig. 7] Fig. 7 is an enlarged side cross-sectional view of a substantial part illustrating the punching operation of a punch.

[Best Mode for Carrying Out the Invention]

[0024] Next will be described an embodiment of the present invention with reference to Figs. 1 to 7.

[0025] In the figures, the numeral 1 indicates a flywheel adapted to be fitted over the crankshaft of the engine of a motorcycle, the flywheel 1 comprising a yoke 2 formed of ferromagnetic material (e.g. iron) in a bottomed cylindrical shape, and on the inner peripheral surface of the cylindrical portion 2a of the yoke 2 is provided a magnet holder 3 via integrating means such as adhesive, the magnet holder 3 and a holder pin 3a disposed on the

opening side of the cylindrical portion 2a supporting multiple pairs of permanent magnets 4.

[0026] Further, in the cylindrical bottom portion 2b of the yoke 2 that constitutes the flywheel 1 is opened a through hole 2c concentrically with the cylindrical portion 2a, and on the outside surface of the cylindrical bottom portion 2b is provided a boss plate 5 integrally. The boss plate 5 comprises a disk-shaped plate portion 5a and a boss cylindrical portion 5b positioned around the central axis of the plate portion 5a to be fitted and joined to the through hole 2c of the yoke. In the plate portion 5a and the cylindrical bottom portion 2b of the yoke are opened a plurality of caulking through holes 5c, 2d, and the yoke 2 and the boss plate 5 are to be caulked and fixed integrally by inserting a caulking pin 6 into each of the caulking through holes 5c, 2d. Also, the boss cylindrical portion 5b projects from the through hole 2c to inside the cylindrical portion 2a of the yoke (toward the cylindrical bottom portion 2b) when fixed integrally to the yoke 2, the cylindrical hole 5d being formed in such an inclined manner that the hole diameter decreases the closer to the opening side of the cylindrical portion 2a of the yoke, and further in the cylindrical hole 5d being carved a key groove 5e. The thus arranged flywheel 1 is adapted to be connected interlockingly with a crankshaft so as not to be rotated by allowing the boss cylindrical portion 5b to be fitted over the crankshaft via the key groove 5e.

[0027] On the outer peripheral surface of the cylindrical portion 2a of the yoke are then formed circumferentially a plurality of axially long triggering projections 2e in a projecting manner outward therefrom. The projections 2e are formed circumferentially at a predetermined angular interval (30 degrees in the present embodiment) within an angular range of 240 degrees not all around the cylindrical portion 2a by an appropriate number (9 pieces in the present embodiment). Then, the flywheel 1 is formed by incorporating required members such as permanent magnets 4 into the yoke 2 with the projections 2e formed preliminarily on the outer periphery thereof by punching the cylindrical portion 2a. A triggering projection forming apparatus 7 embodying the present invention is employed as means for thus forming triggering projections 2e on the cylindrical portion 2a of the yoke.

[0028] On a fixed pedestal 8 that constitutes a fixed side in the forming apparatus 7 are provided a fixed guide body 9 and an inner guide body 10 to be butted from within the yoke to the inner peripheral surface of the cylindrical portion 2a of the yoke according to the present invention.

[0029] That is, the square rear end portion 9a (the left portion in the side cross-sectional view of Fig. 3 and leading end portion in the direction of incorporation of the yoke 2) of the fixed guide body 9 is fixed integrally to the fixed pedestal 8 via a vertically oriented fixing bolt 8a. Meanwhile, the front end portion 9b of the fixed guide body 9 is formed while keeping a predetermined clearance against the upper surface of the fixed pedestal 8, where the yoke 2 is adapted to be fitted over the front end portion 9b by incorporating the lower part of the cylindrical portion 2a of the yoke 2 into the clearance. Then, a recessed portion 9c for integrally fixing a punch 11 according to the present invention thereto is provided in the front end portion 9b in a recessed manner rearward, and the punch 11 comprises: a rectangular base portion 11a provided in the lower end portion thereof; and a body portion 11b projecting upward from the upper end surface of the base portion 11a and adapted to form a projection 2e on the yoke 2, the rectangular base portion 11a being fixed to the recessed portion 9c of the fixed guide body via a fixing bolt 9d. Then, the body portion 11b is disposed in such a manner, when the punch 11 is in a fixed state, as to project upward from the upper surface of the front end portion 9b (fixed guide body 9) and that the front end surface of the punch 11 is flush with the front end surface of the fixed guide body 9.

[0030] Meanwhile, the inner guide body 10 comprises a guide body portion 10b having a circular outer peripheral surface 10a with the same curvature as that of the inner peripheral surface of the cylindrical portion 2a of the yoke so as to be butted against the inner peripheral surface except for the lower part of the cylindrical portion 2a of the yoke, and with a longitudinal length greater than the cylindrical length of the yoke 2. Further, the inner guide body 10 is provided integrally with a disk portion 10d positioned in the front end of the guide body portion 10b and comprising a boss portion 10c that is provided concentrically with the yoke 2 to be fitted thereon. In the guide body portion 10b are also formed a rectangular recessed portion 10e opened downward and a through hole 10f through which the body portion 11b of the punch moves vertically. It is then arranged as will be described hereinafter that when the inner guide body 10 is incorporated so that the body portion 11b of the punch is inserted into the through hole 10f, the recessed portion 10e is to be fitted freely over the front end portion 9b of the fixed guide body 9 and the rear surface of the disk portion 10d is to be disposed close to and facing the front surface of the punch 11, so that the inner guide body 10 and the fixed guide body 9 can move vertically relatively to each other.

[0031] Further, the rear end surface of the guide body portion 10b of the inner guide body 10 is connected integrally with an auxiliary guide body 12 according to the present invention by means such as bolting. The auxiliary guide body 12 is formed as an elongated member comprising supporting piece portions 12a extending leftward and rightward from the yoke 2, and is provided with the upper surface which exists in the same position as the upper tangent of the circular plane 10a of the inner guide body as shown in the front elevational view of the forming apparatus 7 in Fig. 5. In the lower surface of the auxiliary guide body 12 is also formed a recessed portion 12b having the same shape as that of the recessed portion 10e formed in the guide body portion 10b, the recessed portion 12b being adapted to fit the rear end portion 9a of the fixed guide body 9 thereinto freely. Then, a pair of

guide bolts 12c run through each of the left and right supporting piece portions 12a of the auxiliary guide body 12 in such a manner as to be fitted freely thereinto and not to come out thereof, where the base end portion of the guide bolts 12c is fixed to the fixed pedestal 8. Further, on each guide bolt 12c is fitted a vertically long coil spring 13 between the lower surface of the auxiliary guide body 12 and the upper surface of the fixed pedestal 8, whereby the auxiliary guide body 12 is supported on the fixed pedestal 8 together with the inner guide body 10 connected integrally with the auxiliary guide body 12 while being supported by the coil springs 13.

[0032] Here, the coil springs 13 are adjusted in such a manner that the triggering projection forming apparatus 7 is fixed integrally in the fixed guide body 9 and that the upper end of the body portion 11b of the punch that runs through the inner guide body 10 does not project from (e.g. is brought into approximately the same plane as, namely is flush with) the upper end surface of the auxiliary guide body 12 and the inner guide body 10 when the triggering projection forming apparatus 7 is in a non-operational state where a movable side member to be described hereinafter is not operated (indicated by the virtual line in Fig. 7).

[0033] It is further arranged that in the non-operational state, a vertical clearance S is formed between the recessed portions 10e, 12b of the inner guide body 10 and the auxiliary guide body 12 and the upper end surface of the fixed guide body 9 so that the inner guide body 10 and the auxiliary guide body 12 are allowed to move downward toward the fixed guide body 9 by the clearance S as a punching margin, and that the clearance S has a vertical dimension larger than the amount of projection of the projections 2e.

[0034] In front of the inner guide body 10 is also provided a rotational guide body 14. The rotational guide body 14 comprises: a disk-shaped disk portion 14a having a diameter smaller than the outer diameter of the disk portion 10d of the inner guide body; and a supporting cylindrical portion 14b projecting forward along the central axis of the disk portion 14a. Then, the rear end portion of the supporting cylindrical portion 14b is adapted to fit the boss portion 10c of the inner guide body thereinto relatively rotatably so that the disk portion 10d of the inner guide body is incorporated concentrically into the rotational guide body 14.

[0035] It is noted that the rotational guide body 14 and the inner guide body 10 are adapted to be connected relatively rotatably with each other by threadably fitting the leading end of a fastening bolt 15, which is inserted from in front of and runs relatively rotatably through the supporting cylindrical portion 14b, into the boss portion 10c. In this case, the head portion 15a of the fastening bolt 15 is adapted to be butted against a stepped portion 14c formed inside the supporting cylindrical portion 14b to prevent the rotational guide body 14 from coming out forward of the inner guide body 10.

[0036] In the disk portion 14a of the rotational guide body 14 are then supported penetratingly positioning pins 16 in a projecting manner forward therefrom facing two preset caulking through holes 2d among those opened in the cylindrical bottom portion 2b of the yoke. Further, on the outer periphery of the disk portion 14a of the rotational guide body are formed circumferentially four positioning recessed portions 14d notched inward. Also, in the outer diameter portion of the disk portion 14a of the rotational guide body are formed engaging recessed holes 14e at the same angular interval (30 degrees) and by the same number (nine pieces) as that of the projections 2e, the engaging recessed holes 14e being formed by recessing the rear end surface of the disk portion 14a forward into a spherical shape. It is noted that the nine engaging recessed holes 14e are formed in such a manner that the hole centers thereof are positioned at the same radius from the central axis of the supporting cylindrical portion 14b.

[0037] It is noted that the numeral 17 indicates a locking pin to be installed in the inner guide body 10 in a longitudinally oriented manner, the leading end of the locking pin 17 being arranged retractable forward from the disk portion 10d of the inner guide body, and adapted to be disengageably engaged with a spherical engaging recessed portion 14f formed in a preset position in the outer diameter portion of the rotational guide body 14. Thus, when incorporating the rotational guide body 14 into the inner guide body 10, engaging the locking pin 17 with the engaging recessed portion 14f allows the rotational guide body 14 to be positioned rotationally (circumferentially) against the inner guide body 10.

[0038] Also as will be described hereinafter, between the inner guide body 10 and the rotational guide body 14 is provided a positioning device (corresponding to the positioning means of the present invention) 18 for positioning and engaging the rotational guide body 14 against the inner guide body 10 facing the projections 2e. The positioning device 18 comprises: a pin shaft 18a provided longitudinally movably in a longitudinally long hole that allows the inner guide body 10 and the auxiliary guide body 12 to communicate with each other with the leading end thereof adapted to be engaged disengageably with one of the engaging recessed holes 14e formed in the disk portion 14a of the rotational guide body; an urging spring 18b for urging the pin shaft 18a toward the rotational guide body 14; and a detection sensor 18c adapted to output a detection signal when the pin shaft 18a is engaged with one of the engaging recessed holes 14e based on the urging force of the urging spring 18b.

[0039] Then, when incorporating the yoke 2 into the inner guide body 10 to be in a preset forming set state, the yoke 2 is to be incorporated by inserting the positioning pins 16 projecting from the rotational guide body 14 into the two preset caulking through holes 2d, where in the outer diameter portion on the cylindrical bottom portion 2b of the yoke are formed circumferentially four positioning pieces 2f projecting cylindrically inward, whereby the yoke 2 is to be incorporated integrally into the

rotational guide body 14 (inner guide body 10) while positioned rotationally so as not to be rotated by allowing the positioning pieces 2f to be fitted freely into the positioning recessed portions 14d formed in the outer peripheral portion of the disk portion 14a of the rotational guide body as well as the positioning pins 16 to be incorporated penetratingly into the caulking through holes 2d.

[0040] It is noted that the yoke 2 is positioned concentrically with the rotational guide body 14 in the forming set (incorporated) state above, and that thus incorporating the yoke 2 allows the inner peripheral surface of the cylindrical portion 2a of the yoke to be brought into contact with, at least, the circular plane 10a of the inner guide body as indicated by the virtual line in Fig. 7. Further, in the forming set state above, the pin shaft 18a of the positioning device 18 is adapted to be engaged with one engaging recessed hole 14e positioned in one rotational end portion (leading the rotation of the rotational guide body 14) among the nine holes 14e formed in the rotational guide body 14 (refer to Fig. 5). Also, in the forming set state above, the auxiliary guide body 12 arranged in the rear end portion of the inner guide body 10 is disposed outside the cylindrical portion of the yoke 2.

[0041] Meanwhile, the upper movable pedestal 19 that constitutes the triggering projection forming apparatus 7 as a movable side member (die) is interlocked with operating means not shown in the figures vertically (in the punching direction for the projections 2e) movably. To the lower end surface of the movable pedestal 19 are fixed integrally an outer guide body 20 positioned forward facing the inner guide body 10 to be butted against the outer peripheral surface of the cylindrical portion 2a of the yoke and an outer auxiliary guide body 21 positioned rearward to be butted against the upper surface of the auxiliary guide body 12. On the outer guide body 20 is formed an abutting surface 20a having the same curvature as the outer diameter of the cylindrical portion 2a of the yoke, the abutting surface 20a being adapted to have a circumferential length not to interfere with the projections 2e to be formed adjacently to the cylindrical portion 2a of the yoke. In the abutting surface 20a is further provided a punch receiving groove 20b facing the projections 2e in a recessed manner.

[0042] Meanwhile, the outer auxiliary guide body 21 comprises a flat abutting surface 21a to be butted against the flat upper surface of the auxiliary guide body 12, the abutting surface being adapted to move vertically integrally with the outer guide body 20 based on the vertical movement of the movable pedestal 19 and to pressurize the auxiliary guide body 12 when the outer guide body 20 pressurizes (applies punching force to) the outer peripheral surface of the cylindrical portion 2a of the yoke.

[0043] It is noted that the movable pedestal 19 is adapted to move downward (the outer guide body 20 is adapted to apply punching force) based on the input of a detection signal from the detection sensor 18c that constitutes the positioning device 18, whereby the outer guide body 20 performs no pressurizing operation with no detection signal input, which allows the projections 2e to be formed accurately and reliably.

[0044] Then, when the yoke 2 is incorporated into the inner guide body 10 in a preset forming set state, the pin shaft 18a of the positioning device 18 is engaged with one engaging recessed hole 14e positioned in one rotational end portion as mentioned above, where the downward movement of the movable pedestal 19 allows the outer guide body 20 to pressurize the outer peripheral surface of the cylindrical portion 2a of the yoke to apply punching force to the inner guide body 10, whereby the inner guide body 10 is to move downward, and the punch 11, which does not project from the circular plane 10a of the inner guide body 10 in the forming set state, is to project from the circular plane 10a of the inner guide body, and thus the body portion 11b of the punch is to press up the inner peripheral surface of the cylindrical portion 2a of the yoke to form the first projection 2e at the punch receiving groove 20b of the outer guide body 20 (refer to the solid lines in Fig. 3, Fig. 4, Fig. 5, and Fig. 7).

[0045] In the case above, the outer guide body 20 is to pressurize the cylindrical portion 2a of the yoke to move the inner guide body 10 downward and thereby to form the projection 2e, where the punching force acting on the inner guide body 10 is to be received by the coil springs 13 against the urging force through the auxiliary guide body 12 positioned outside the cylindrical portion of the yoke 2. Thus, the forming apparatus 7 is arranged in such a manner that the punching force of the outer guide body 20 can be received by the coil springs 13 that are positioned outside the cylindrical portion of the yoke 2 and supported on the fixed pedestal 8, whereby the yoke 2 cannot be interfered with even if the punching force of the outer guide body 20 may be increased, which allows the projections 2e to be formed with a large punching force.

[0046] Further, in the case above, the outer guide body 20 is adapted to move downward together with the outer auxiliary guide body 21 positioned rearward, where the outer guide body 20 is to pressurize the cylindrical portion 2a of the yoke and the outer auxiliary guide body 21 is to pressurize the auxiliary guide body 12. Thus, with the downward movement of the inner guide body 10 when receiving punching force for forming the projections 2e, the auxiliary guide body 12 is also pressurized by the outer auxiliary guide body 21 to move downward, resulting in that both the inner guide body 10 and the auxiliary guide body 12 move downward similarly, which allows the complete roundness of the cylindrical portion 2a of the yoke to be further ensured.

[0047] After the first projection 2e is thus formed on the cylindrical portion 2a of the yoke, the supporting cylindrical portion 14b of the rotational guide body 14 is to be rotated by a predetermined angle (30 degrees) to allow the portion adjacent to the first projection 2e to form the second projection 2e to face the punch 11 provided in the inner guide body 10, where because the positioning

device 18 is provided between the rotational guide body 14 and the inner guide body 10, the rotation from the forming set state (forming state for the first projection 2e) in the direction indicated by the arrow shown in Fig. 5 allows the pin shaft 18a embedded in one engaging recessed hole 14e formed in one circumferential end portion to pop out of the engaging recessed hole 14e automatically, and then to face the engaging recessed hole 14e positioned second from the circumferential end portion to embed into and engage with the engaging recessed hole 14e automatically. It is thus arranged that the yoke 2 is rotated by 30 degrees from the forming set state, and the rotational guide body 14 and the yoke 2 are positioned at the position to form the second projection 2e. Then, the movable pedestal 19 is to move downward again as mentioned above, while the rotational guide body 14 and the yoke 2 are set facing the position to form the second projection 2e, to allow the (punching) pressurization by the outer guide body 20, so that the second projection 2e is formed on the cylindrical portion 2a of the yoke.

[0048] Then, the third to ninth projections 2e are to be formed by rotating the rotational guide body 14 to be positioned sequentially by the positioning device 18 to allow the pressurization by the outer guide body 20.

[0049] In the thus arranged present embodiment, because when forming the projections 2e on the outer periphery of the cylindrical portion 2a of the yoke 2 that constitutes the flywheel 1 the inner and outer guide bodies 10, 20 are butted, respectively, against the inner and outer peripheral surface of the cylindrical portion 2a of the yoke, the complete roundness of the yoke 2 can be ensured. Also, in this case, in the inner guide body 10 to be butted against the inner periphery of the cylindrical portion 2a of the yoke is provided the auxiliary guide body 12 connected outside the cylindrical portion of the yoke 2, whereby the punching force to be received by the inner guide body 10 when the outer guide body 20 pressurizes the cylindrical portion 2a of the yoke is to be received by the auxiliary guide body 12 disposed outside the cylindrical portion of the yoke 2, which makes it possible to receive a larger punching force relative to the case where the punching force of the outer guide body 20 is received inside the cylindrical portion 2a of the yoke, and therefore to form the projections 2e in a single punching formation, resulting in an improvement in operability in the forming operation.

[0050] Further, in this case, because the projections 2e are formed to be received by the punch receiving groove 20b formed on the abutting surface 20a of the outer guide body 20, and in the vicinity of the projections 2e, the cylindrical portion 2a of the yoke is guided by the inner and outer guide bodies 10, 20, the cylindrical portion 2a of the yoke cannot be deformed through a punching formation, which allows the projections 2e to be formed without damaging the complete roundness of the yoke 2.

[0051] In addition, with the arrangement embodying the present invention, because the auxiliary guide body 12 is adapted to be pressurized by the outer auxiliary guide body 21 provided integrally on the outer guide body 20 to move in the same way as the inner guide body 10, both the inner guide body 10 and the auxiliary guide body 12 move downward similarly, whereby there can be no difference in the amount of downward movement between the front and rear end portions of the inner guide body 10, which allows the complete roundness of the yoke 2 to be further ensured.

[0052] Also, because the punch 11 is fitted integrally to the fixed guide body 9 fixed outside the cylindrical portion of the yoke 2, the punching force in a punching formation can be set large, which allows the projections 2e to be formed on the yoke 2 further easily and workably.

[0053] Furthermore, in the inner guide body 10 is provided the rotational guide body 14 relatively rotatably, and the yoke 2 is to be incorporated thereinto while positioned rotationally against the rotational guide body 14 to perform punching operation while rotating the yoke 2 together with the rotational guide body 14, which makes it easy to sequentially form a plurality of projections 2e on the cylindrical portion 2a of the yoke, resulting in an improvement in workability in the forming operation.

[0054] Further, the positioning device 18 is provided between the inner guide body 10 and the rotational guide body 14, which makes it easy to set the rotational guide body 14 and the yoke 2 to a preset position to form the projections 2e, resulting in a further improvement in workability.

[0055] The positioning device 18 is also interlocked with the detection sensor 18c, and thus the outer guide body 20 can perform no pressurizing operation until being set to the positioned state, whereby the projections 2e can be formed more accurately and reliably.

[0056] It will be appreciated here that the present invention is not restricted to the above-described embodiment, and it is also possible to arrange that the rotational guide body is rotated mechanically, though rotated manually in the above-described embodiment.

[Industrial Applicability]

[0057] As described above, an apparatus and a method for forming triggering projections on a flywheel according to the present invention are useful for a triggering projection forming apparatus and a method for forming triggering projections on a flywheel which detects the rotational state, and especially useful because formations are realized without damaging to the complete roundness of the cylindrical portion of a yoke.

Claims

1. An apparatus for forming a plurality of triggering projections, which serve for receiving trigger signals, circumferentially on the outer periphery of the cylindrical portion of a bottomed cylindrical yoke that con-

stitutes a flywheel, said triggering projections being projected toward the outer diameter side of the yoke by punching, the forming apparatus comprising: an inner guide body to be butted against the inner periphery of the cylindrical portion of the yoke; a projection forming punch provided in the inner guide body retractably in the punching direction; and an outer guide body with a receiving groove for receiving the punch formed therein, the outer guide body being adapted to pressurize the cylindrical portion of the yoke via an abutting surface to be butted against the outer periphery of the cylindrical portion of the yoke to form a projection by the punch, wherein the inner guide body is connected with an auxiliary guide body extending outside the cylindrical portion of the yoke, the auxiliary guide body provided outside the cylindrical portion of the yoke being adapted to receive the punching force of the projection by the outer guide body.

2. The apparatus for forming triggering projections on a flywheel according to claim 1, wherein the auxiliary guide body is adapted to receive the punching force by the outer guide body via a spring.

3. The apparatus for forming triggering projections on a flywheel according to claim 1 or 2, wherein the auxiliary guide body is adapted to be pressurized by an outer auxiliary guide body provided integrally on the outer guide body.

4. The apparatus for forming triggering projections on a flywheel according to any of claims 1 to 3, wherein the punch is provided integrally on a fixed guide body fixed outside the cylindrical portion of the yoke.

5. The apparatus for forming triggering projections on a flywheel according to any of claims 1 to 4, wherein a rotational guide body is provided relatively rotatably in the inner guide body, the yoke being adapted to be incorporated into the inner guide body via the rotational guide body.

6. The apparatus for forming triggering projections on a flywheel according to claim 5, wherein between the rotational guide body and the inner guide body is provided positioning means for positioning the rotational guide body with respect to the inner guide body.

7. The apparatus for forming triggering projections on a flywheel according to claim 6, wherein the positioning means is adapted to be interlocked with the pressurizing operation of the outer guide body.

8. A method for forming triggering projections on a flywheel, wherein an apparatus for forming a plurality of triggering projections, which serve for receiving trigger signals, circumferentially on the outer periphery of the cylindrical portion of a bottomed cylindrical yoke that constitutes a flywheel with the triggering projections being projected toward the outer diameter side of the yoke by punching, comprises: an inner guide body to be butted against the inner periphery of the cylindrical portion of the yoke; a projection forming punch provided in the inner guide body retractably in the punching direction; and an outer guide body with a receiving groove for receiving the punch formed therein, the outer guide body being adapted to pressurize the cylindrical portion of the yoke via an abutting surface to be butted against the outer periphery of the cylindrical portion of the yoke to form the projection by the punch; and an auxiliary guide body being connected to the inner guide body and extending outside the cylindrical portion of the yoke, said method comprising such steps that after setting the yoke on the inner guide body with no punch projecting, the outer guide body is pressed against the outer periphery of the yoke to form the projection, the auxiliary guide body provided outside the cylindrical portion of the yoke being adapted to receive the punching force of the outer guide body.

Fig. 1

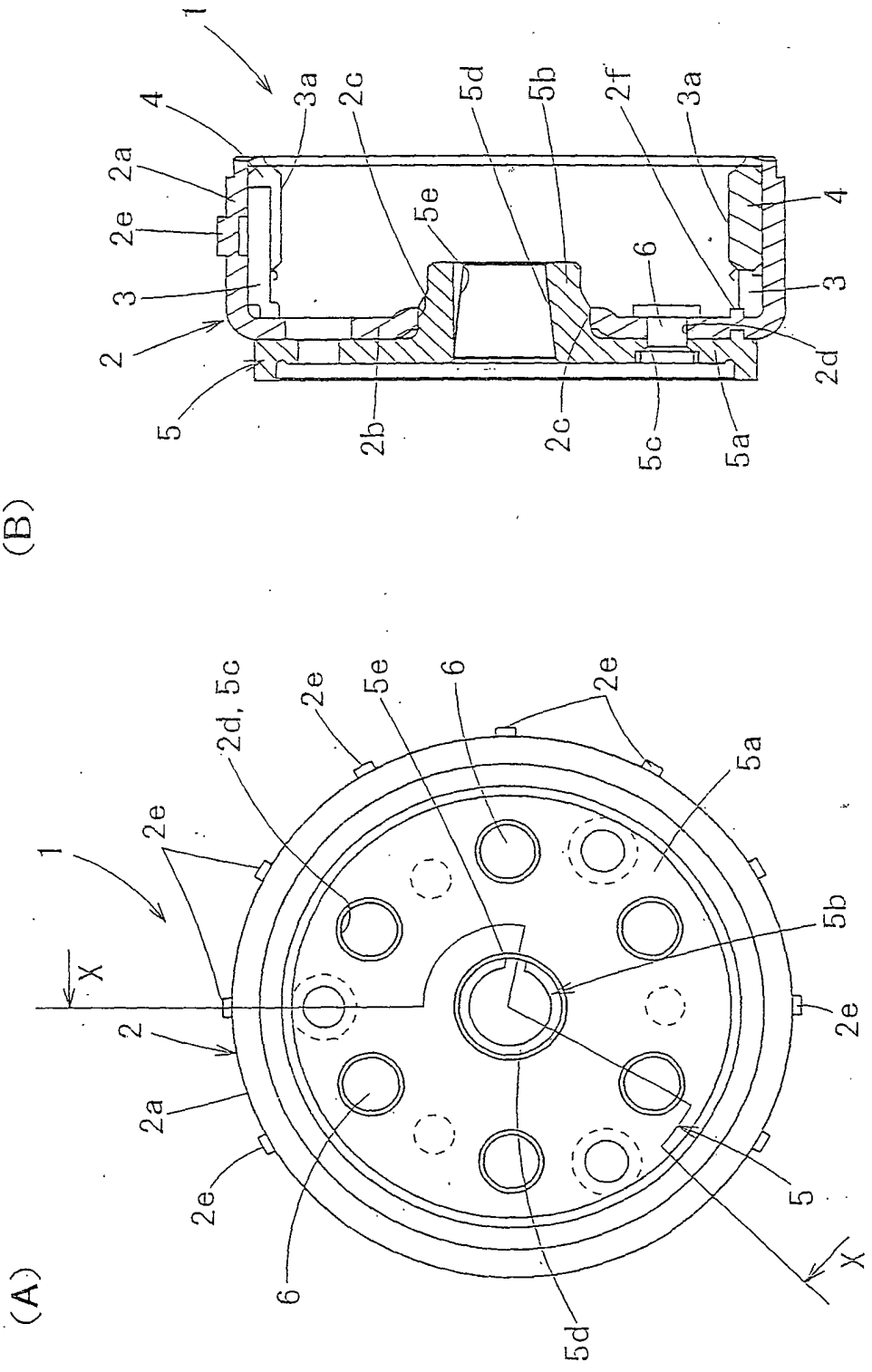


Fig. 2

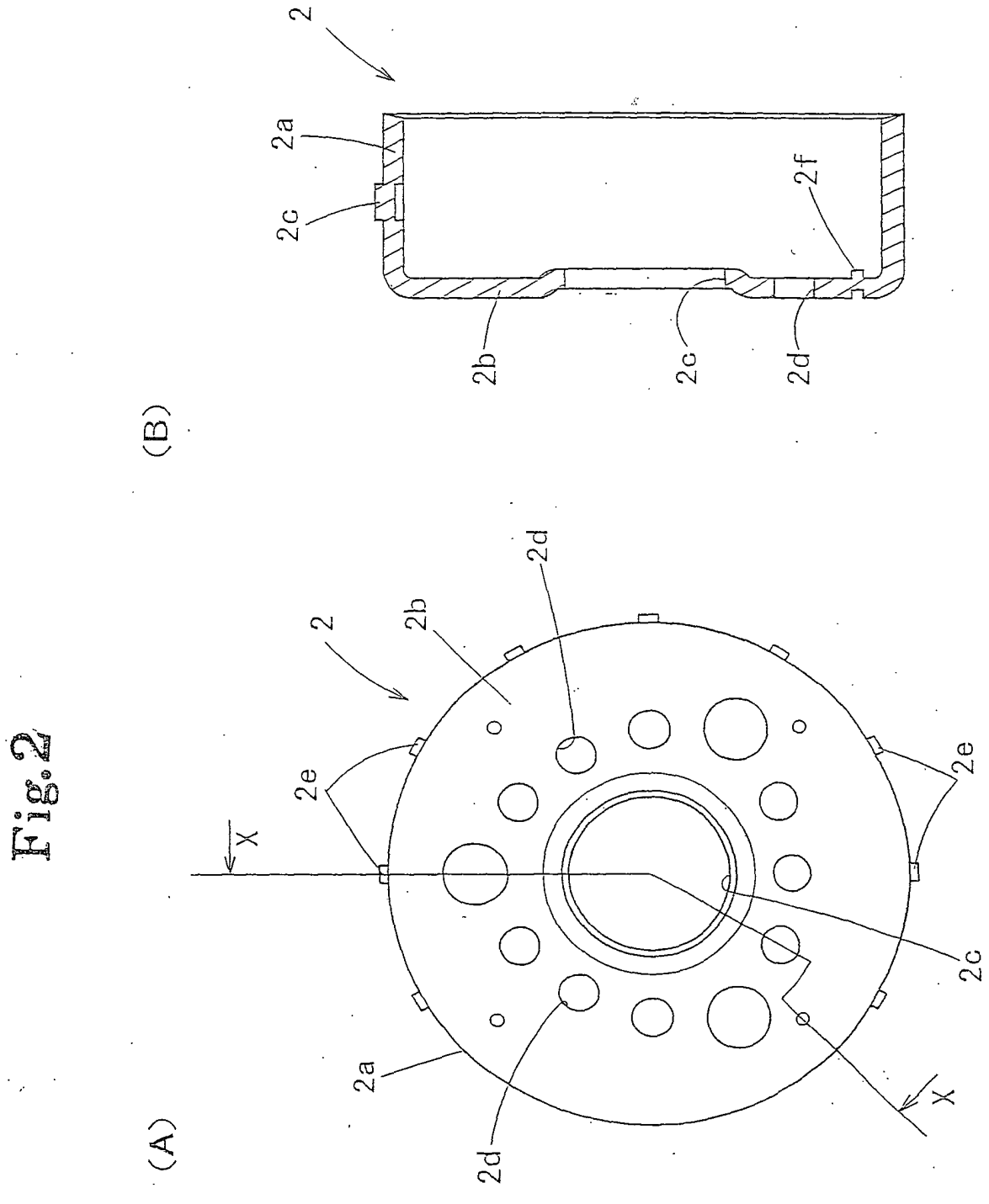
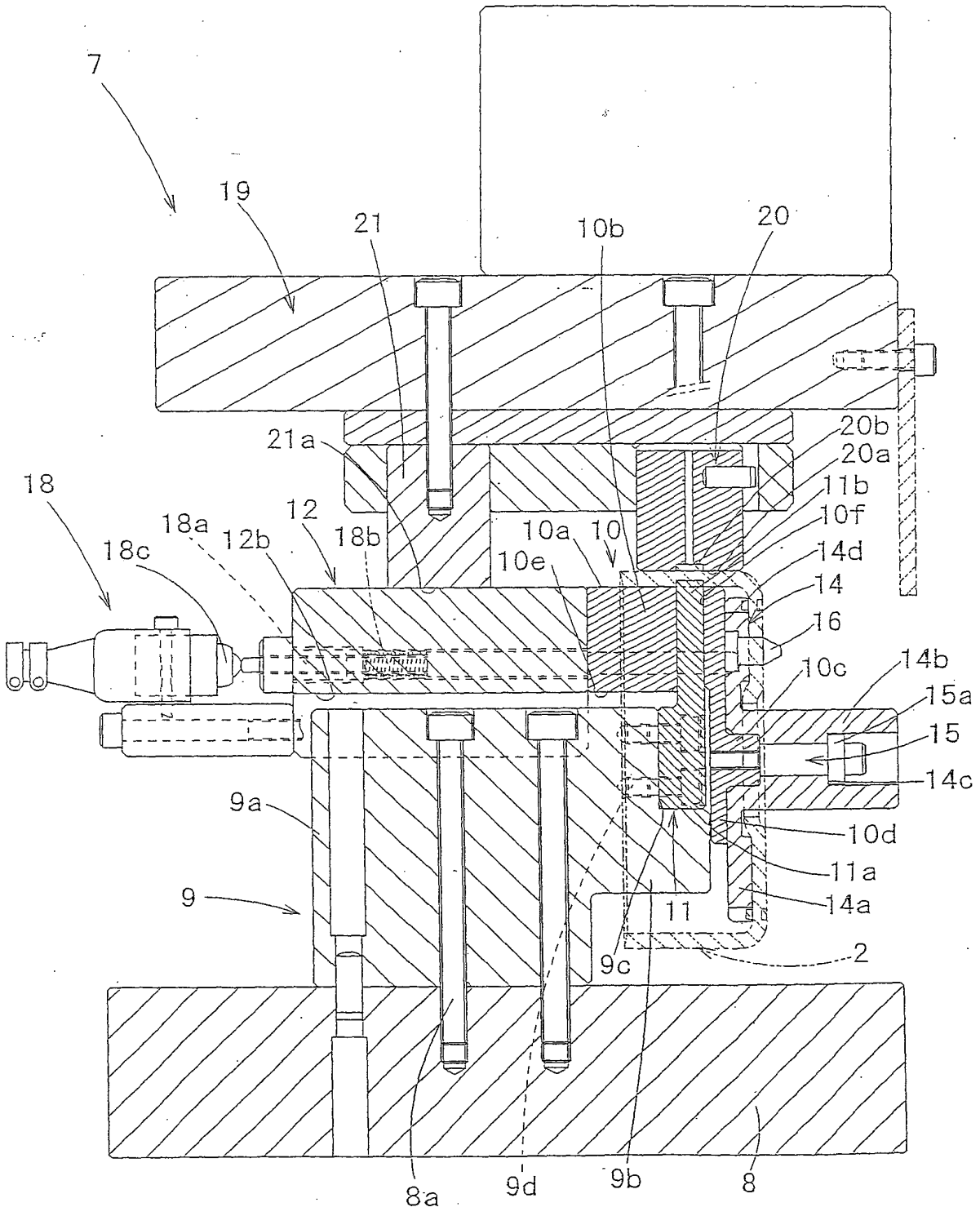


Fig. 3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16
10c
14b
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9b
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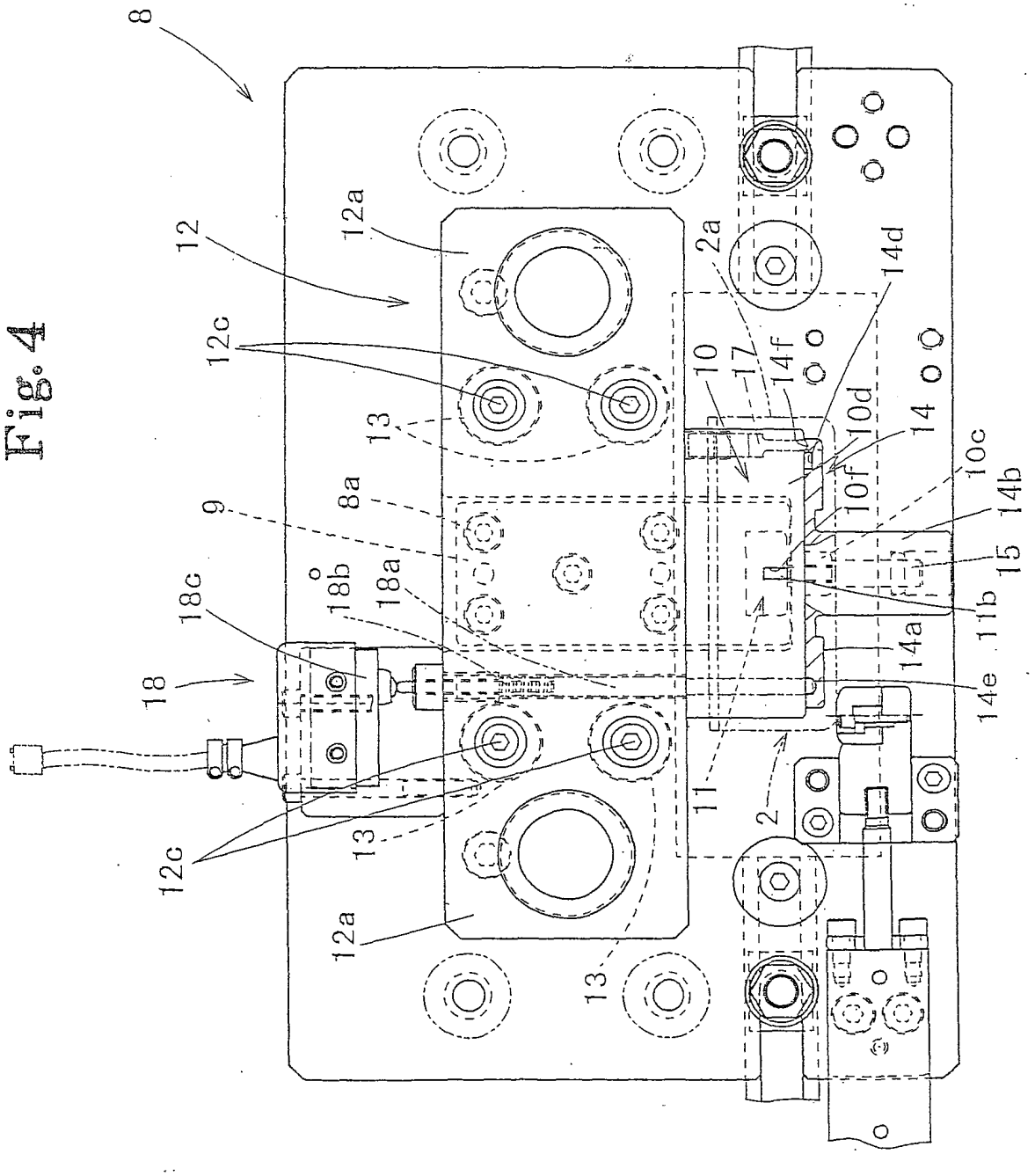
Fig. 4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14e
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2
12a
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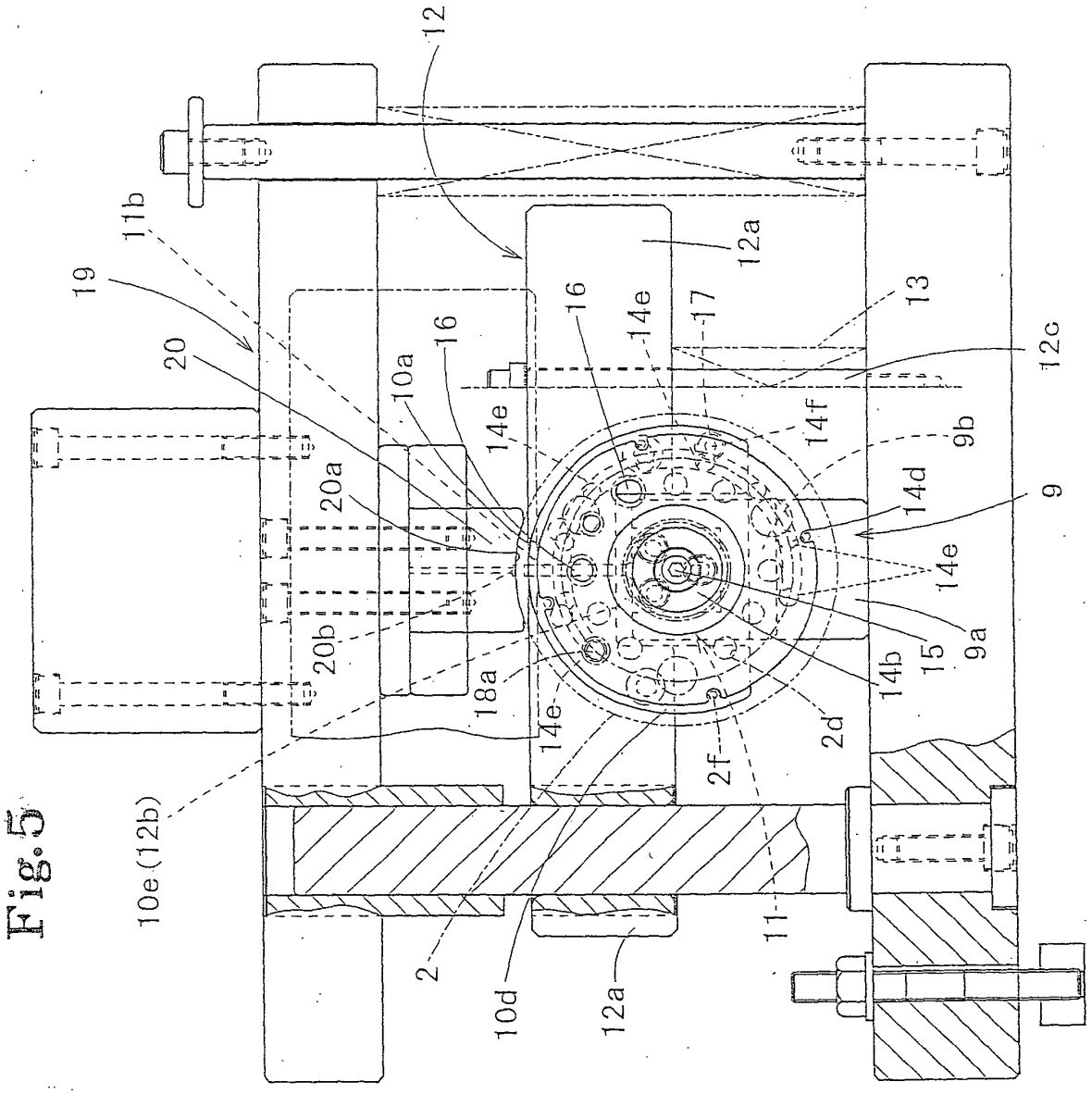
Fig.5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2
10d
12a
11

Fig.6

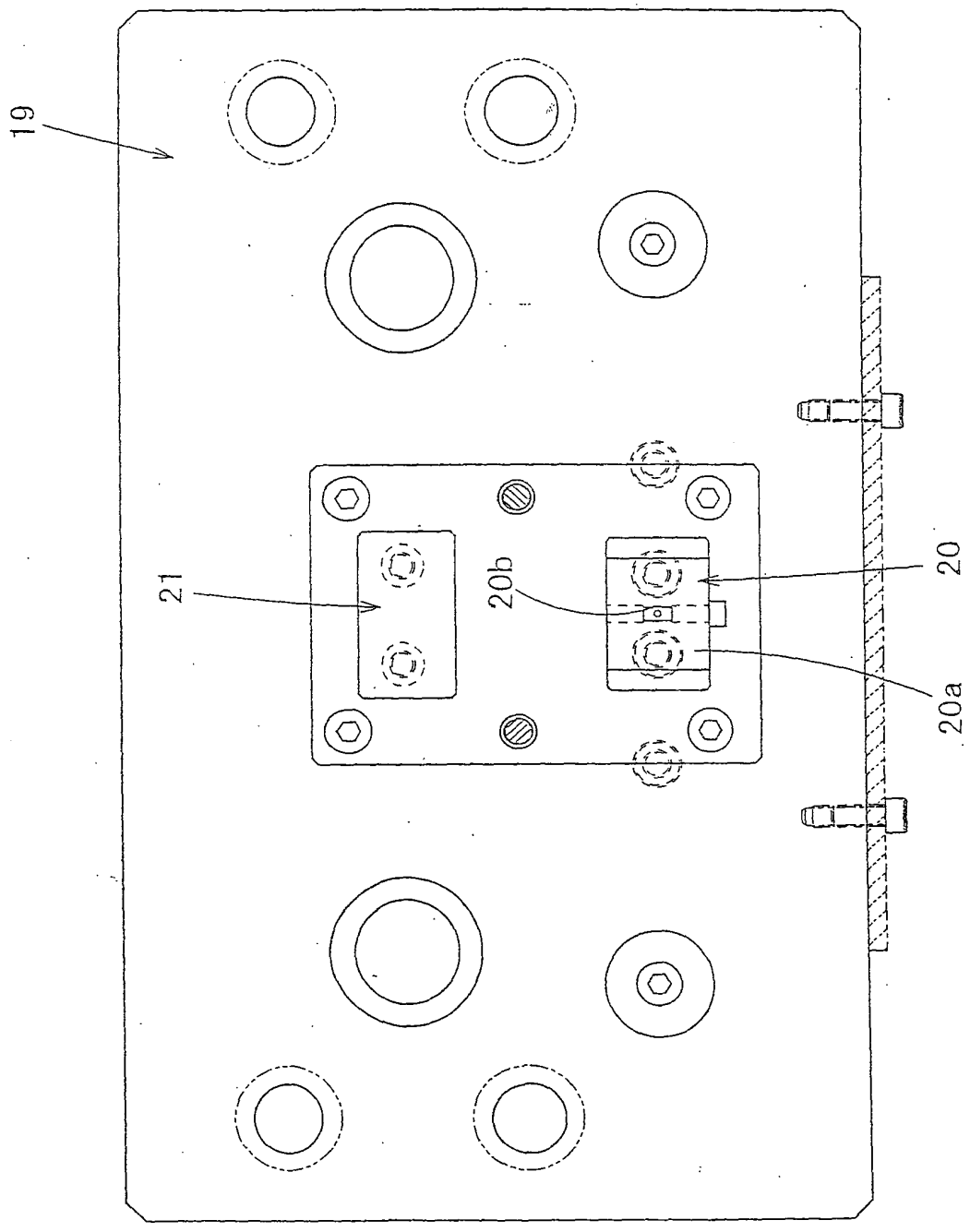
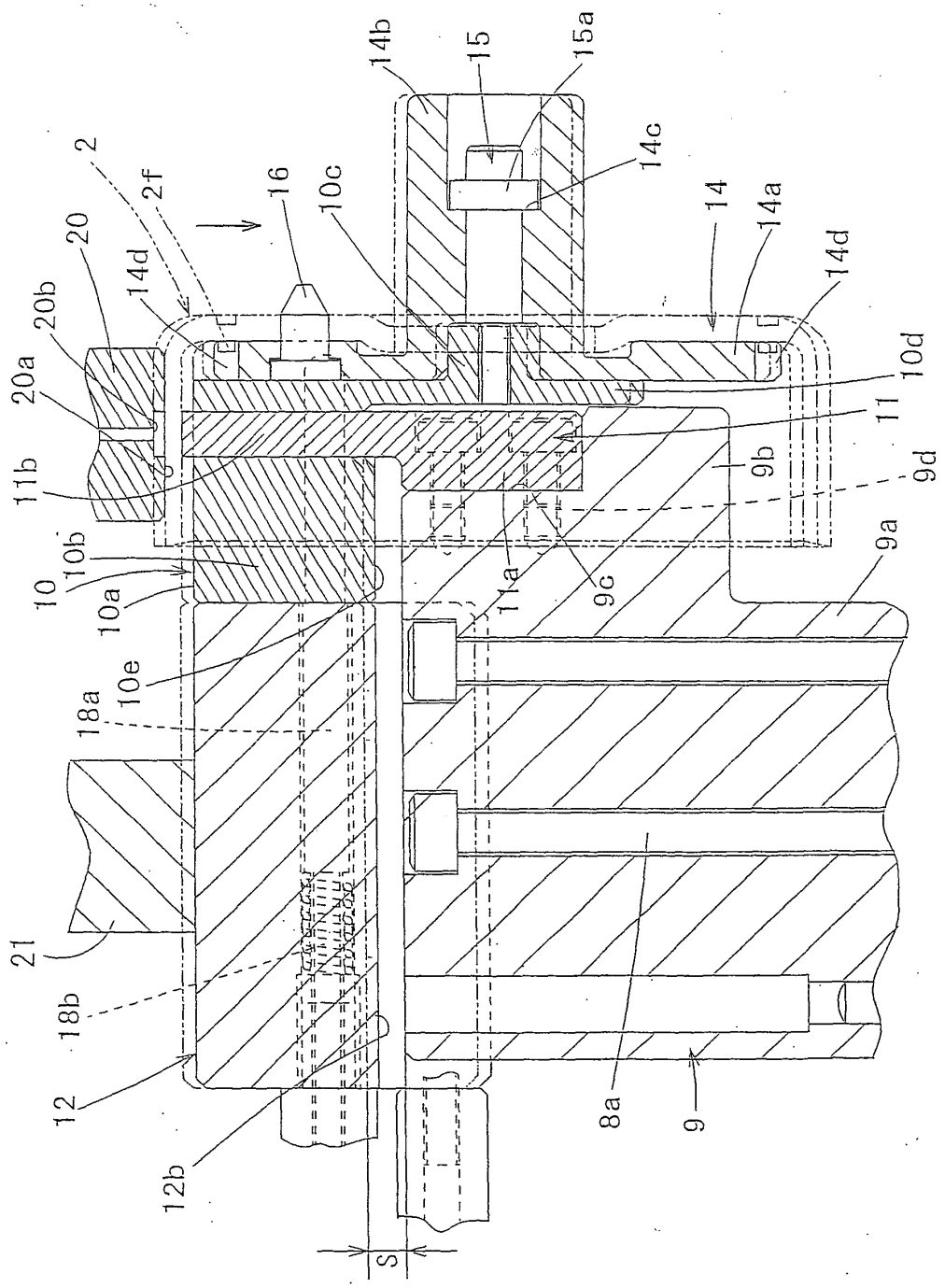


Fig. 7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9c
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18b
12
8a
9
12b
S

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2005/014252

A. CLASSIFICATION OF SUBJECT MATTER
B21D22/28 (2006.01), ***B21D24/00*** (2006.01)

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)
B21D22/28 (2006.01), ***B21D24/00*** (2006.01), ***B21H5/00*** (2006.01),
H02K15/00 (2006.01)

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

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2005
Kokai Jitsuyo Shinan Koho	1971-2005	Toroku Jitsuyo Shinan Koho	1994-2005

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2002-113528 A (Toyota Motor Corp.), 16 April, 2002 (16.04.02), Full text (Family: none)	1-8
A	JP 11-33660 A (Mazda Motor Corp.), 09 February, 1999 (09.02.99), Full text (Family: none)	1-8
A	JP 2002-315277 A (Honda Motor Co., Ltd.), 25 October, 2002 (25.10.02), Full text (Family: none)	1-8

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
01 November, 2005 (01.11.05)	15 November, 2005 (15.11.05)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (April 2005)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 57148568 A **[0003]**