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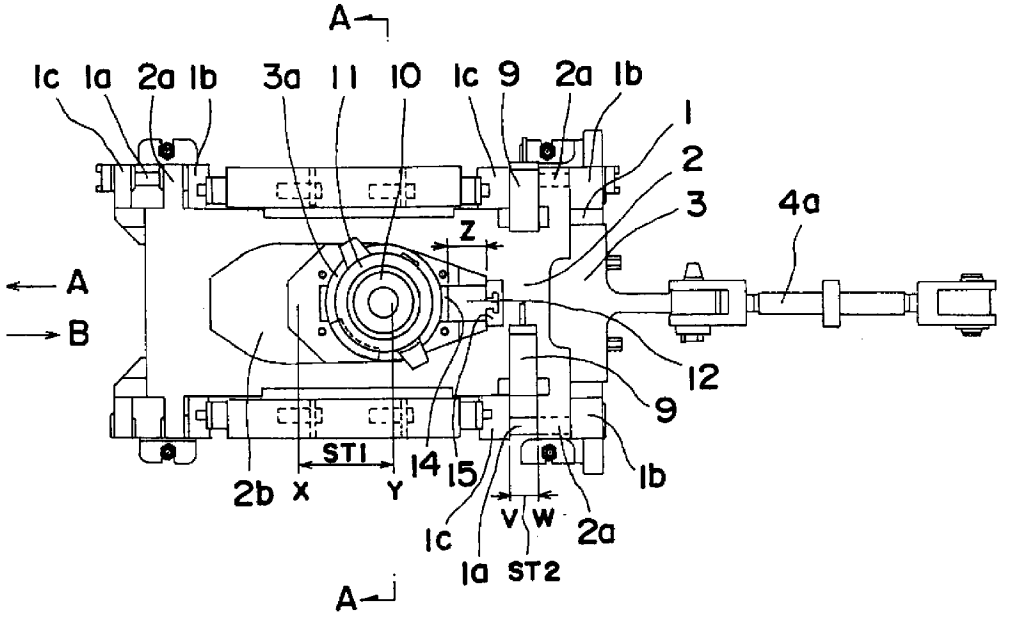
(54) **OPERCULE COULISSANT POUR DISPOSITIF A BUSE**
(54) **SLIDING GATE NOZZLE DEVICE**



(57) A sliding gate nozzle device is disclosed which, even when the position of a retreat or advance limit of a sliding metal frame changes, can effect the application of a surface pressure and ensure a gap for the entry of surface pressure blocks therein and which can relieve the applied surface pressure easily. The sliding gate nozzle device comprises a fixed metal frame 1, an opening/closing metal frame 2 movable with respect to the fixed metal frame 1, a sliding metal frame 3 disposed between the fixed metal frame 1 and the opening/closing metal frame 2 and slidable up to a limit position, and a surface pressure applying mechanism which presses the opening/closing metal frame 2 against the fixed metal frame 1 when the opening/closing metal frame moved to a surface pressure applying position W. In the sliding gate nozzle device, the opening/closing metal frame 2 is co-moveded with the sliding metal frame 3 and a surface pressure applying member 12 which prevents the sliding metal frame 3 from reaching the above limit position when the opening/closing metal frame 2 has reached the surface pressure applying position W is disposed removably between the opening/closing metal frame and the sliding metal frame. The "limit position" means an advance or retreat limit in a movable stroke range of the sliding metal frame.

ABSTRACT

A sliding gate nozzle device is disclosed which, even when the position of a retreat or advance limit of a sliding metal frame changes, can effect the application of a surface pressure and ensure a gap for the entry of surface pressure blocks therein and which can relieve the applied surface pressure easily.

The sliding gate nozzle device comprises a fixed metal frame 1, an opening/closing metal frame 2 movable with respect to the fixed metal frame 1, a sliding metal frame 3 disposed between the fixed metal frame 1 and the opening/closing metal frame 2 and slidable up to a limit position, and a surface pressure applying mechanism which presses the opening/closing metal frame 2 against the fixed metal frame 1 when the opening/closing metal frame moved to a surface pressure applying position W. In the sliding gate nozzle device, the opening/closing metal frame 2 is co-moveded with the sliding metal frame 3 and a surface pressure applying member 12 which prevents the sliding metal frame 3 from reaching the above limit position when the opening/closing metal frame 2 has reached the surface pressure applying position W is disposed removably between the opening/closing metal frame and the sliding metal frame. The "limit position" means an advance or retreat limit in a movable stroke range of the sliding metal frame.

SLIDING GATE NOZZLE DEVICE

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a sliding gate nozzle device for a molten metal vessel in which the application and relief of a surface pressure between a slide plate and a fixed plate are performed by movement of an opening/closing metal frame.

Description of the Prior Art

A sliding gate nozzle device provided to a molten metal vessel having a flow path for taking out molten steel or the like from the vessel which can be opened and closed as necessary, has been used widely because of its capability of accurate control of the flow.

Such a sliding gate nozzle device has types of a two-plates type comprising a combination of an upper fixed plate and a lower sliding plate, and a three-plates type comprising two upper and lower fixed plates and a sliding plate arranged therebetween. And generally, the sliding gate nozzle device is provided with a mechanism for applying a specified surface pressure to sliding surfaces between adjacent plates to prevent the penetrating molten steel into the gap between the plates. The said surface pressure is determined at a range not causing any obstacle in operation.

As means for application of the above surface pressure, a coil spring is usually used, and a bolt-type tightening mechanism is used for applying and relieving the pressure. According to the bolt-type tightening mechanism, however, it needs bolting work that is very hard and muscular for operators by use of a tool in a hot atmosphere. And it causes heat-seizure troubles on bolts to disturb vessel rotation.

A method for simplifying the surface pressure applying and relieving mechanism without any manual working has been disclosed in Japanese Patent Laid Open No. 9-122899 by filed by the inventions of this application.

The method will be described briefly hereinafter in reference with from Fig. 5 to Fig. 8 ;

In reference with FIG. 5 showing a bottom view of a sliding device and FIG. 6 showing a vertical sectional view taken on line A-A in FIG. 5, brackets 1b and 1c are mounted at predetermined positions of a fixed metal frame 1 and hinge shafts 1a are mounted therebetween. On the other hand, an opening/closing metal frame 2 is provided with a pair of brackets 2 a fitted on the hinge shafts 1a. The metal frame 2 is

connected to the fixed metal frame 1 and moves in the direction A or B in the figure by a length of ST2 with respect to the fixed metal frame 1, by a change in position of the brackets 2a relative to the hinge shafts 1a .

A sliding metal frame 3 installed in between the fixed metal frame 1 and the opening/closing metal frame 2 so as to be movable in the same direction as the moving direction of the metal frame 2. The sliding metal frame 3 is connected to a rod 4a which is connected to a hydraulic cylinder 4. A nozzle mounting sleeve 3a disposed in the sliding metal frame 3 is adapted to abut an edge portion of an opening 2b formed in a predetermined position of the opening/closing metal frame 2, whereby the sliding metal frame 3 is movable within a range limited to the length of ST1 with respect to the metal frame 2.

FIG. 7 is a schematic diagram of a surface pressure applying mechanism, in which (a) shows a surface pressure relieved state and (b) shows a surface pressure applied state. As shown in FIG. 7, a pair of spring chambers 7 are mounted sideways of the opening/closing metal frame2, and in a corresponding relation thereto a pair of hangers 8 are mounted sideways of the fixed metal frame 1. A plurality of compression coil springs 7a are housed within each spring chamber 7, and an actuating block 7b which is urged downward by the coil springs 7a and which is movable vertically in the plane of the paper, is supported at the lower ends of the coil springs 7a.

For applying a surface pressure load between the opening/closing metal frame 2 and the fixed metal frame 1, the sliding metal frame 3 is moved in the direction of B in an abutted state against the rightmost end of the opening 2b, thereby causing the metal frame 2 to move in the direction of B in FIG. 5. As a result, as shown from FIG. 7(a) to 7(b), toggle pins 8a secured to each hanger 8 and engaging pins 7c secured to the underside of the actuating block 7b come into engagement with each other and the toggle pins 8a stand up and compress the compression coil springs 7a in each spring chamber 7 through the actuating block 7b. And then, a resilient reaction force of the compression coil springs 7a acts in a direction to bring down the fixed metal frame 1, whereby a surface pressure is applied to sliding surfaces (see FIG. 6) of a fixed plate 5 and a sliding plate 6.

At the same time, the brackets 2a of the opening/closing metal frame 2 come into abutment with the brackets 1b of the fixed metal frame 1 located on the hydraulic cylinder 4 side to ensure a gap which is for a surface pressure block 9 to get in between the brackets 1c and 2a, the surface pressure block 9 being pivotally secured at one end thereof to the metal frame 2. When the surface pressure block 9 is turned and fitted into the said gap, the motion of the metal frame 2 is locked during casting work.

In this device, the position Y of a retreat limit, which is one end of the stroke ST1 of the sliding metal frame 3, is a position at which nozzle holes of the fixed plate 5 and sliding plate 6 are aligned with each other and become fully open and at which the toggle pins 8a rise upon movement of the opening/closing metal frame 2 through the sliding metal frame 3 and a surface pressure is developed. The position is also a position to ensure a gap for entry of the surface pressure block 9 between the brackets 1c and 2a.

Thus, the position of retreat limit of the opening/closing metal frame 2 depends on the position of retreat limit Y of the sliding metal frame 3. When the position Y changes, the retreat limit position of the metal frame 2 also changes.

In the sliding nozzle device, for example, wear of a connection in a drive system or an error of a set position of a plate brick or a dimensional error of the brick causes a change in the retreat limit position of the sliding metal frame.

For example, in driving the sliding frame with use of such a bell crank mechanism as shown in FIG. 8 showing a molten metal vessel provided with a driving source at its side, a long-term use causes wear of a connection, which causes a play in the stroke motion. This play motion may result in that the stroke of the sliding metal frame becomes smaller, the retreat limit position shifts a little to the side opposite to the hydraulic cylinder, and the nozzle holes of the upper and lower plates are no longer aligned at the retreat limit position. In such a case, there usually is adopted a method in which the spacing between the hydraulic cylinder and the sliding metal frame is adjusted to correct the displacement of the sliding metal frame.

Further, the nozzle holes of the plates are sometimes displaced from each other due to an error in the preset positions of the plates or a dimensional error of the plates. To correct this displacement, the position of retreat limit of the sliding metal frame is corrected, which may result in a change in the retreat limit position of the sliding metal frame.

In the sliding gate nozzle device of such a type in which the retreat limit of the opening/closing frame and that of the sliding metal frame are coincident with each other, such a change in the retreat limit position of the sliding metal frame causes a change in the retreat limit position of the opening/closing metal frame, it is brought out of a problem that the application of a surface pressure becomes difficult .

When the retreat limit position of the opening/closing metal frame shifts to the side opposite to the hydraulic cylinder, the toggle pins will no longer rise to a sufficient extent. It causes problem that the surface pressure thereon becomes insufficient and it is no longer possible to ensure a gap for entry of the surface pressure block between the

brackets.

SUMMARY OF THE INVENTION

It is a subject of the present invention to solve the above-mentioned problems involved in the conventional sliding gate nozzle device. More specifically, an object of the present invention is to provide a sliding gate nozzle device capable of effecting the application of a surface pressure even in the event of a change in the position of retreat limit or advance limit of the sliding metal frame and capable of easily relieving the surface pressure so as to ensure a gap for entry therein of a surface pressure block.

According to the present invention, in order to achieve the above-mentioned object, there is provided in one aspect thereof a sliding gate nozzle device comprising a fixed metal frame, an opening/closing metal frame movable with respect to the fixed metal frame, a sliding metal frame disposed between the fixed metal frame and the opening/closing metal frame and slidable up to a limit position, and a surface pressure applying mechanism which presses the opening/closing metal frame against the fixed metal frame when the opening/closing metal frame has been moved to a surface pressure applying position, characterized in that the opening/closing metal frame is interlocked with the sliding metal frame and that a surface pressure applying member which prevents the sliding metal frame from reaching the said limit position when the opening/closing metal frame has reached the surface pressure applying position is disposed removably between the opening/closing metal frame and the sliding metal frame. The "limit position" herein means an advance or retreat limit in a movable stroke range of the sliding metal frame.

According to the present invention, in another aspect thereof, there is provided a sliding gate nozzle device comprising a fixed metal frame, an opening/closing metal frame having an opening and slidable with respect to the fixed metal frame, a sliding metal frame disposed slidably between the fixed metal frame and the opening/closing metal frame, and a surface pressure applying mechanism which presses the opening/closing metal frame against the fixed metal frame when the opening/closing metal frame has been moved to a surface pressure applying position, characterized in that a sleeve is provided projectingly on the sliding metal frame, the sleeve being fitted in the said opening to move the opening/closing metal frame through the opening, and that a surface pressure applying member having a predetermined effective size is mounted removably between the said sleeve and an end face of the said opening.

Preferably, the effective size of the surface pressure applying member is longer than the gap between the sleeve and the opening when the opening/closing metal frame

is in the surface pressure applying position and when the sliding metal frame has been moved to a maximum in the surface pressure applying direction.

As the surface pressure applying mechanism there may be adopted a biasing force applying means disposed between the fixed metal frame and the opening/closing metal frame.

According to this invention, the following meritorious effects can be revealed ;

The surface pressure can be applied no matter how the position of the sliding metal frame.

Divergence of the nozzle holes caused by stroke change of the sliding metal frame and size error of the plates can be adjusted easily.

It becomes possible to dispose a drive source sideways of the molten metal vessel; that is, even a motor-driven actuator or the like which varies greatly in its stop position can be used as a drive source.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a bottom view of a sliding nozzle device having a surface pressure applying mechanism according to an embodiment of the present invention;

FIG. 2 is a vertical sectional view taken on line A-A in FIG. 1;

FIG. 3 is a perspective view showing a schematic structure of a surface pressure block;

FIG. 4 is a bottom view showing operations of various components in applying or relieving a surface pressure by a sliding motion of a sliding metal frame 3, in which (a) shows a relieved state of a surface pressure just after replacement of a plate brick, (b) shows an applied state of the surface pressure, and (c) shows an applied state of the surface pressure after the end of casting;

FIG. 5 shows a conventional sliding nozzle device provided with a surface pressure applying mechanism;

FIG. 6 is a vertical sectional view taken on line A-A in FIG. 5;

FIG. 7 is a schematic diagram of the surface pressure applying mechanism, in which (a) shows a relieved state of a surface pressure and (b) shows an applied state of the surface pressure; and

FIG. 8 is a side view of a molten metal vessel with a drive source attached to a side face thereof.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

In FIG. 1, a metal frame 1 is fixed to the bottom of a molten metal vessel and

an opening/closing metal frame 2 is installed adjacent the fixed metal frame 1 so as to be movable in the direction of arrow A or B, and the sliding metal frame 3 is installed between the fixed metal frame 1 and the opening/closing metal frame 2 in the same direction as the moving direction of the opening/closing metal frame. This feature is the same as in the conventional sliding nozzle device as described referring to from Fig.5 to Fig.8.

More specifically, brackets 1b and 1c are projected at predetermined positions of the fixed metal frame 1 and hinge shafts 1a are installed horizontally therebetween. On the other hand, the opening/closing metal frame 2 is provided with brackets 2a which are fitted on the hinge shafts 1a. Through the hinge shafts 1a and the brackets 2a the opening/closing metal frame 2 is connected to the fixed metal frame 1 so as to be movable in the direction of A or B in the figure with a stroke of ST2.

The sliding gate nozzle device shown in FIG. 1 is designed so that a surface pressure is relieved when the opening/closing metal frame 2 moves in the direction of A and reaches the position of an advance limit V of stroke ST2 and is applied when the frame 2 moves in the direction of B and reaches the position of a retreat limit W of stroke ST2.

On the other hand, as shown in FIG. 2, a fixed plate 5 is fixed to and held by the fixed metal frame 1 and likewise a sliding plate 6 is fixed to and held by the sliding metal frame 3, the upper surface of the sliding plate 6 is served as a sliding surface relative to the fixed plate 5.

The sliding metal frame 3 is provided with a sleeve 3a projecting downward from the underside of the opening/closing metal frame 2 through an oblong-shaped opening 2b formed in the frame 2, and a lower nozzle 10 is attached to the sleeve 3a through a holder 11.

The sliding metal frame 3 is connected to a rod 4a which is connected to a drive source (not shown) and which is movable forward and backward. With the advancing and retreating motions of the rod 4a, the sliding metal frame 3, like the opening/closing metal frame 2, is free to move in the directions of arrows A and B.

However, as seen from FIG. 1, the movable range of the sliding metal frame 3 is limited to the range represented by stroke ST1 from the position of an advance limit X in which the front face of the sleeve 3a abuts an end portion on the direction A side of the opening 2b up to the position of retreat limit Y in which an opening of the lower nozzle 10 is aligned with the opening 5a of the fixed plate 5.

As shown in FIG. 3(a), end portions 9a of a pair of surface pressure blocks 9 are pivotally secured to the bottom of the opening/closing metal frame 2 in the vicinity of

the brackets 2a positioned on the rod 4a side. The paired surface pressure blocks 9 are routable around the respective end portions 9a. The surface pressure blocks 9 are turned into engagement with the hinge shafts 1a of the fixed metal frame 1, as shown in FIG. 3(b) if necessary, whereby even if the opening/closing metal frame 2 has trend to move in the direction A in FIG. 1, the movement thereof is prevented by engagement of brackets 2a with the surface pressure blocks 9. During a casting work, it is necessary that the surface pressure blocks 9 be surely engaged with the hinge shafts 1a to prevent movement of the opening/closing metal frame 2.

Turning back to FIG. 1, between an outer peripheral surface of the sleeve 3a positioned in the opening 2b of the opening/closing metal frame 2 and an inner end face on the B direction side of the opening 2b, a surface pressure applying member 12 is secured, removably to the metal frame 2. Through the surface pressure applying member 12 it is made possible to retreat the opening/closing metal frame 2 in interlock with retreat of the sliding metal frame 3, as will be described later.

In the device shown in FIG. 1, the gap between B direction-side surface 14 of the sleeve 3a and an inner surface 15 of the opening 2b in the opening/closing metal frame 2 opposed to the surface 14, after the surface pressure applying member 12 is removed and the sliding metal frame 3 is moved in the maximum range in the direction of B, which is the sliding direction, is previously determined to be 20 mm. And the effective size Z of the surface pressure applying member 12 is set at 30 mm. The "effective size" of the surface pressure applying member 12 means a longitudinal length of the portion of the surface pressure applying member 12 which portion enters the opening 2b, as indicated at Z in FIG. 1.

Thus, it is necessary that the effective size Z of the surface pressure applying member 12 being longer, preferably 2 mm or more, than the size of the gap formed between B direction-side surface 14 of the sleeve 3a and the inner surface 15 of the opening 2b in the opening/closing metal frame 2 opposed to the surface 14. If the said value is shorter than 2 mm, it follows that the variation in the retreat limit position of the sliding metal frame 3 can be tolerated up to only 2 mm, which is not practical.

If the effective size Z of the surface pressure applying member 12 is the same as the size of the above gap, the position of retreat limit of the opening/closing frame 2 is completely dependent on the retreat limit position of the sliding metal frame 3, so that when the retreat limit of the sliding metal frame 3 changes, the opening/closing metal frame 2 can no longer move up to its retreat limit, that is, it becomes impossible to effect the application of a surface pressure.

The surface pressure applying member 12 is provided to prevent the position of

retreat limit W of the opening/closing metal frame 2 from being influenced by a change in the retreat limit position of the sliding metal frame 3. For example, even when the retreat limit position of the sliding metal frame 3 shifts 5 mm in direction A from the initially set position Y in FIG. 1, if the effective size Z of the surface pressure applying member 12 is longer by 5 mm or more than the size of the foregoing gap, the retreat limit W of the opening/closing metal frame 2 does not change even when the position of the sliding metal frame 3 is adjusted.

The surface pressure applying member 12 is mounted only when a surface pressure is to be applied or relieved. Although FIG. 1 shows the case that the surface pressure applying member 12 is attached to the opening/closing metal frame 2, it may be mounted to the sleeve 3a or the sliding metal frame 3.

The following description is now provided about the operation for applying or relieving the surface pressure, with reference to FIG. 4.

A refractory replacement work for the sliding gate nozzle device is performed while a molten metal vessel (not shown) is tilted 90° . To be more specific, in FIG. 4, the rod 4a side (direction B side) is raised vertically upward with respect to the plane of the paper. In the replacement work, the opening/closing metal frame 2 is opened and a fresh plate brick such as fixed plate 5 or slide plate 6 is set to the fixed metal frame 1 or the sliding metal frame 3. Thereafter, the metal frame 2 is closed and the rod 4a is attached to the metal frame 3.

Just after closing of the opening/closing metal frame 2, the surface pressure applying member 12 and an auxiliary block 13 are fitted in the opening 2b and the surface pressure blocks 9 are brought into a disengaged state, as shown in FIG. 4(a).

Then, the metal frame 2 is moved in direction A to the position of advance limit V (see FIG. 1). The auxiliary block 13 functions to prevent the sliding metal frame 3 from falling in direction A and becoming incapable of being connected to the rod 4a at the time of replacing the fixed plate 5 or the sliding plate 6 while raising the direction B side upward with respect to the plane of the paper. The auxiliary block 13 also functions to move the metal frame 2 in direction A for this replacement.

In this state, if the rod 4a is driven to move only the sliding metal frame 3 in direction B, the sleeve 3a of the metal frame 3 presses the surface 15 through the surface pressure applying member 12, so that the opening/closing metal frame 2 moves in direction B. This movement stops upon abutment of the brackets 2a of the metal frame 2 with the brackets 1b located on the rod 4a side of the fixed metal frame 1. Now, the state of components is as shown in FIG. 4(b), in which the metal frame 2 reaches the position of retreat limit W (see FIG. 1). At this time, the toggle pins of the fixed metal

frame 1 pushes the springs disposed within the spring chambers of the opening/closing metal frame 2, so that a surface pressure is applied.

After the surface pressure is applied thereon, the surface pressure blocks 9 are turned and installed between the brackets 1b and 1c to prevent movement of the metal frame 2 and thereby prevent relief of the surface pressure during operation. The brackets 1b attached to the fixed metal frame 1 are designed to have a strength high enough to prevent deformation thereof because a very large force is exerted thereon to stop movement of the metal frame 2 during application of the surface pressure.

After the mounting of the surface pressure blocks 9, the sliding metal frame 3 is moved a little in direction A to remove both surface pressure applying member 12 and auxiliary block 13 from the opening 2b. Otherwise, the presence of both components would make it impossible to ensure the stroke ST1.

Thus, according to the present invention, by presence of the surface pressure applying member 12, the opening/closing metal frame 2 assumes the position of retreat limit W ahead of the position of retreat limit Y of the sliding metal frame 3. When the opening of the lower nozzle 10 mounted on the sliding metal frame 3 and the opening 5a in the fixed plate 5 of the fixed metal frame 1 are displaced from each other and even when the position of the sliding metal frame 3 is changed in the longitudinal direction to correct such displacement, the application of the surface pressure is not affected at all because the retreat limit position of the opening/closing metal frame 2 does not change. For the same reason, no influence is exerted on the application of the surface pressure even when a play is created in the stroke ST1 due to a long-term use of the device and consequent wear of a connection in the drive system and even when the resulting displacement of the retreat limit position of the sliding metal frame 3 is corrected.

The operation for relieving the surface pressure is performed while tilting the molten metal vessel (not shown) 90° as is the case with application of the surface pressure as follows ;

After the end of casting, the sliding metal frame 3 assumes its advance limit position X (see FIG. 1), i.e., as shown in the state of FIG. 4(c), to isolate the opening of the lower nozzle 10 mounted on the sliding metal frame 3 and the opening 5a formed in the fixed plate 5 of the fixed metal frame 1 from each other.

Under this state, the sliding metal frame 3 moves a little in direction B and stops, then the surface pressure applying member 12 and the auxiliary block 13 are disposed at predetermined positions of the opening 2b, as shown in FIG. 4(b). Thereafter, the sliding metal frame 3 is moved in direction B, allowing the sleeve 3a to come into abutment against the surface pressure applying member 12 to again create a

state in which the brackets 2a of the opening/closing metal frame 2 are pushed against the brackets 1b located on the rod 4a side of the fixed metal frame 1. In this state, the surface pressure blocks 9 are turned and disengaged from between the brackets 1c and 2a.

After the disengagement of the surface pressure blocks 9, the sliding metal frame 3 is moved in direction A. As a result, the sleeve 3a pushes the auxiliary block 13 positioned on the side opposite to the surface pressure blocks 9 and moves the opening/closing metal frame 2 to the A-side. Consequently, the pressing force of the springs mounted in the opening/closing metal frame 2 is released to relieve the surface pressure and a return is made to the state of FIG. 4(a).

Although the above description is of the case where the surface pressure is applied at the position of retreat limit W of the opening/closing metal frame 2, the present invention can be practiced also in the case where the surface pressure is applied at the position of advance limit V of the metal frame 2.

What is claimed is:

1. A sliding gate nozzle device comprising:

a fixed metal frame;

an opening/closing metal frame movable with respect to said fixed metal frame;

a sliding metal frame disposed between said fixed metal frame and said opening/closing metal frame and slidable up to a limit position; and

a surface pressure applying mechanism which presses said opening/closing metal frame against said fixed metal frame when the opening/closing metal frame is moved to a surface pressure applying position,

characterized in that:

said opening/closing metal frame is co-moved with said sliding metal frame; and

a surface pressure applying member which prevents said sliding metal frame from reaching said limit position when said opening/closing metal frame reached said surface pressure applying position is disposed removably between the opening/closing metal frame and the sliding metal frame.

2. A sliding gate nozzle device comprising:

a fixed metal frame;

an opening/closing metal frame having an opening and slidable with respect to said fixed metal frame;

a sliding metal frame disposed slidably between said fixed metal frame and said opening/closing metal frame; and

a surface pressure applying mechanism which presses said opening/closing metal frame against said fixed metal frame when the opening/closing metal frame moved to a surface pressure applying position,

characterized in that:

a sleeve is provided on said sliding metal frame, said sleeve being fitted in said opening to move said opening/closing metal frame through the opening; and

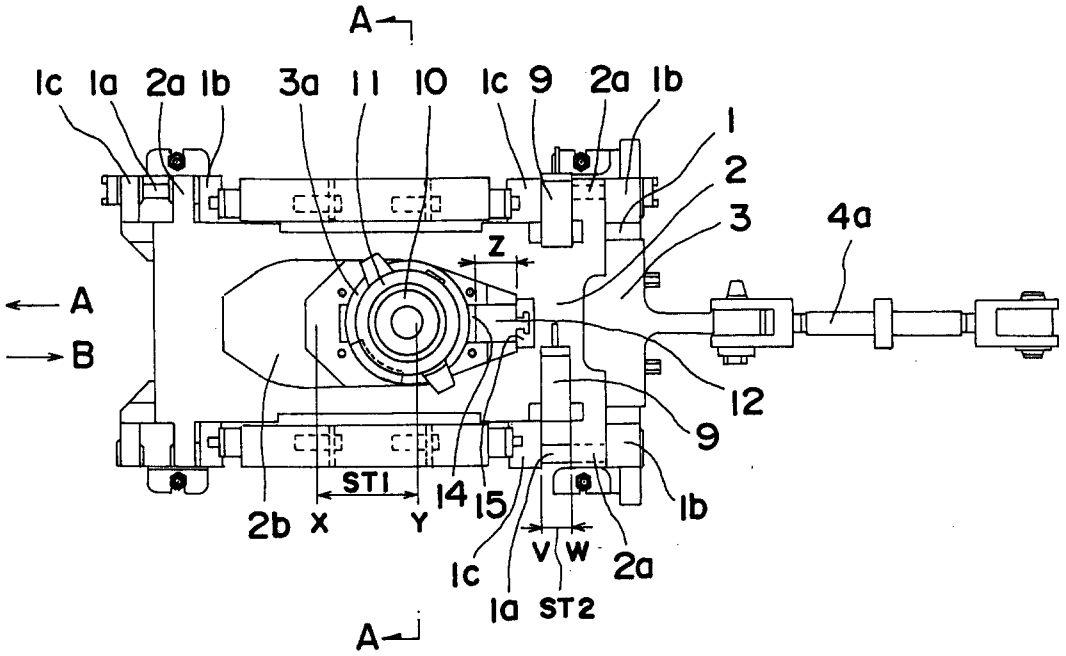
a surface pressure applying member having a predetermined effective size is mounted removably between said sleeve and an end face of said opening.

3. A sliding gate nozzle device according to claim 2, wherein the effective size of said surface pressure applying member is longer than the gap between said sleeve and said opening when said opening/closing metal frame is in said surface pressure applying position and when said sliding metal frame has been moved to a maximum in the

surface pressure applying direction.

4. A sliding gate nozzle device according to any of claims 1 to 3, wherein said surface pressure applying mechanism is a biasing force applying means disposed between said fixed metal frame and said opening/closing metal frame.

FIG. 1


A
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1
2
3
4a
Z
A
B
12
9
ST1
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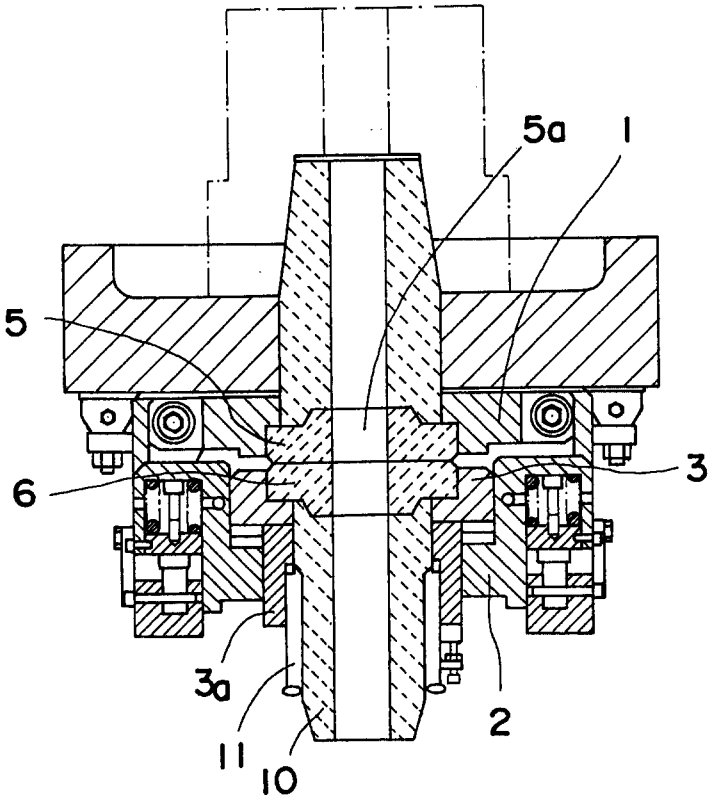
1b
2b X Y
V W
2a
1c
1a ST2
A

FIG. 2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5
3
6
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2
11
10

FIG. 3(a)

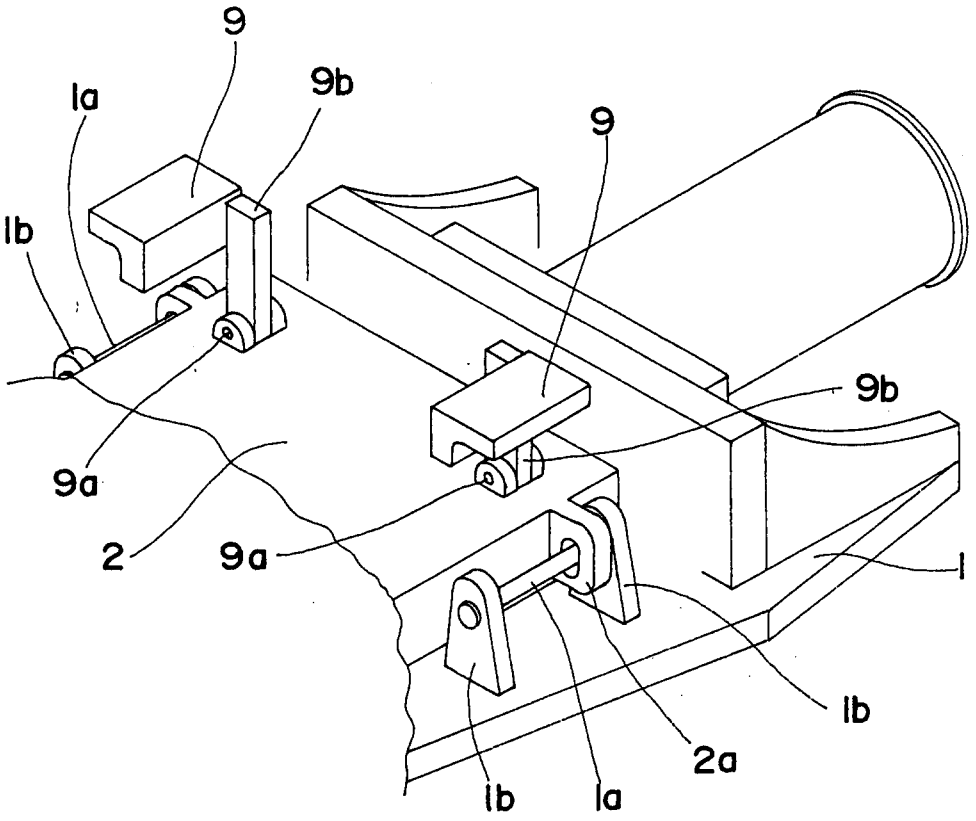


FIG. 3(b)

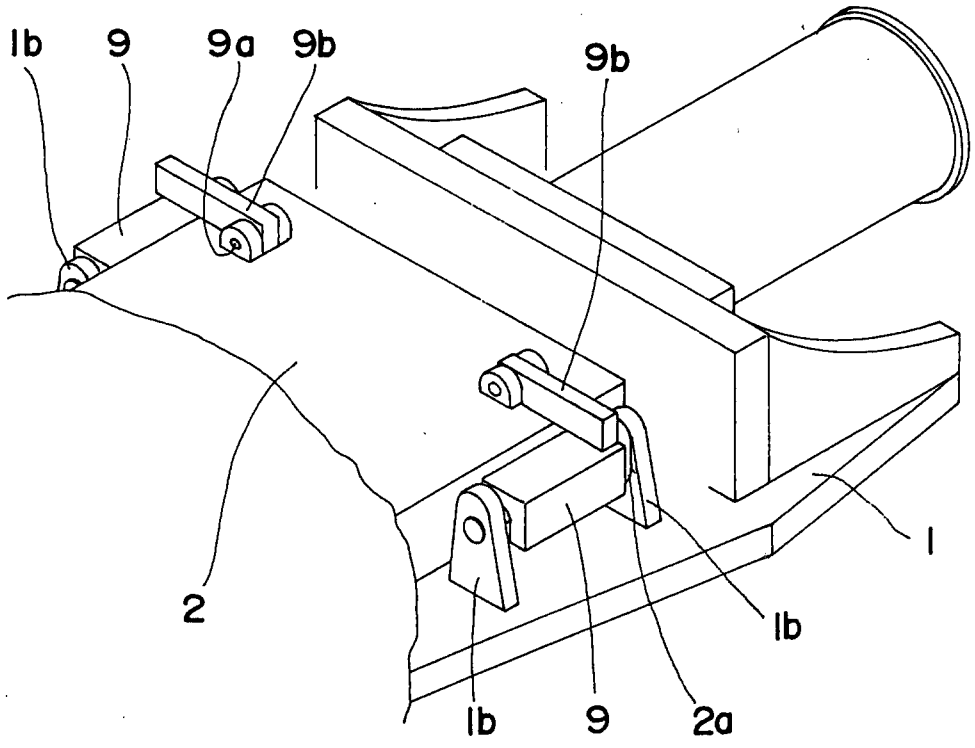


FIG. 4(a)

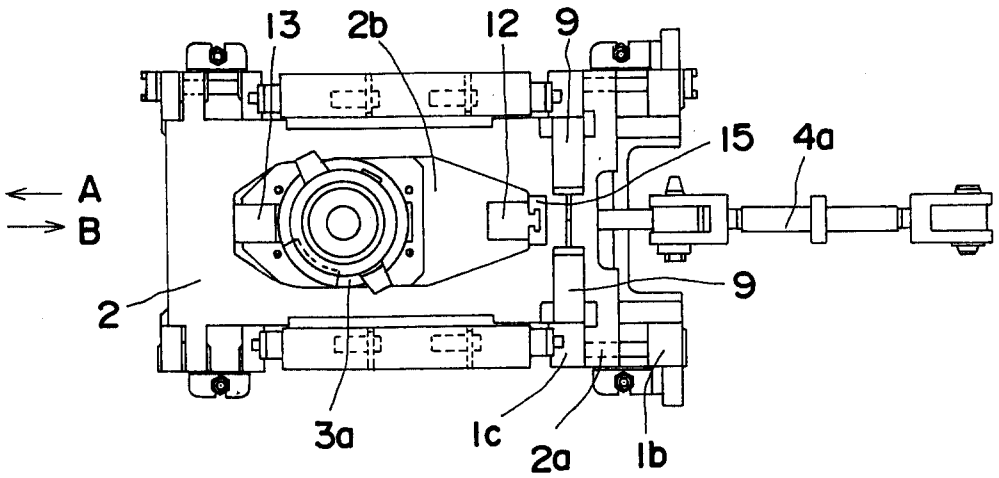


FIG. 4(b)

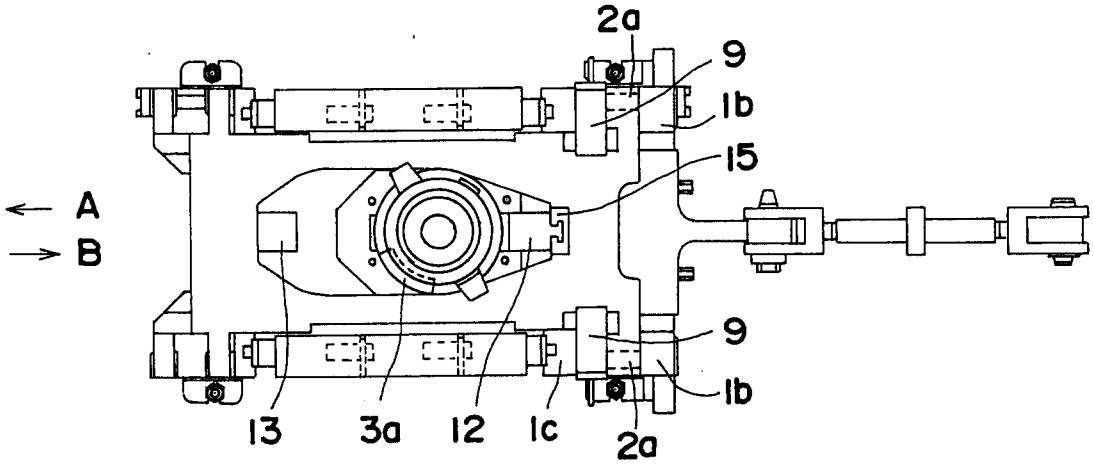


FIG. 4(c)

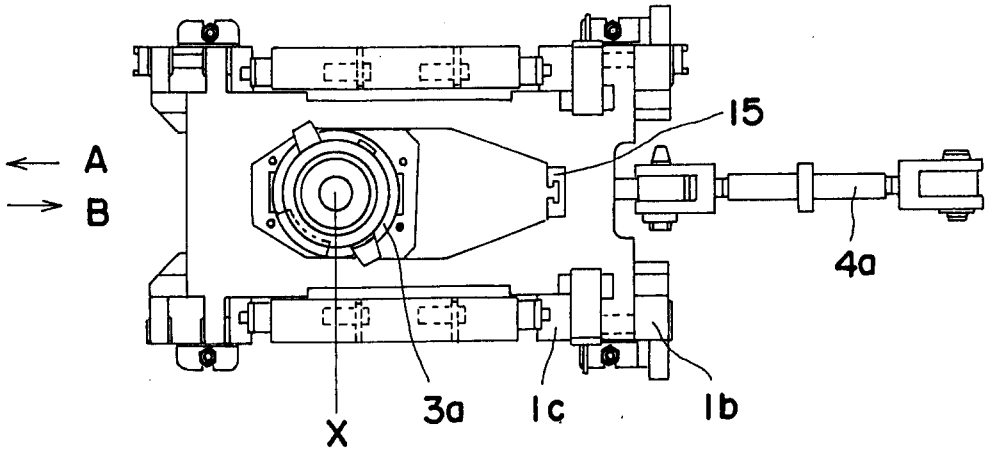
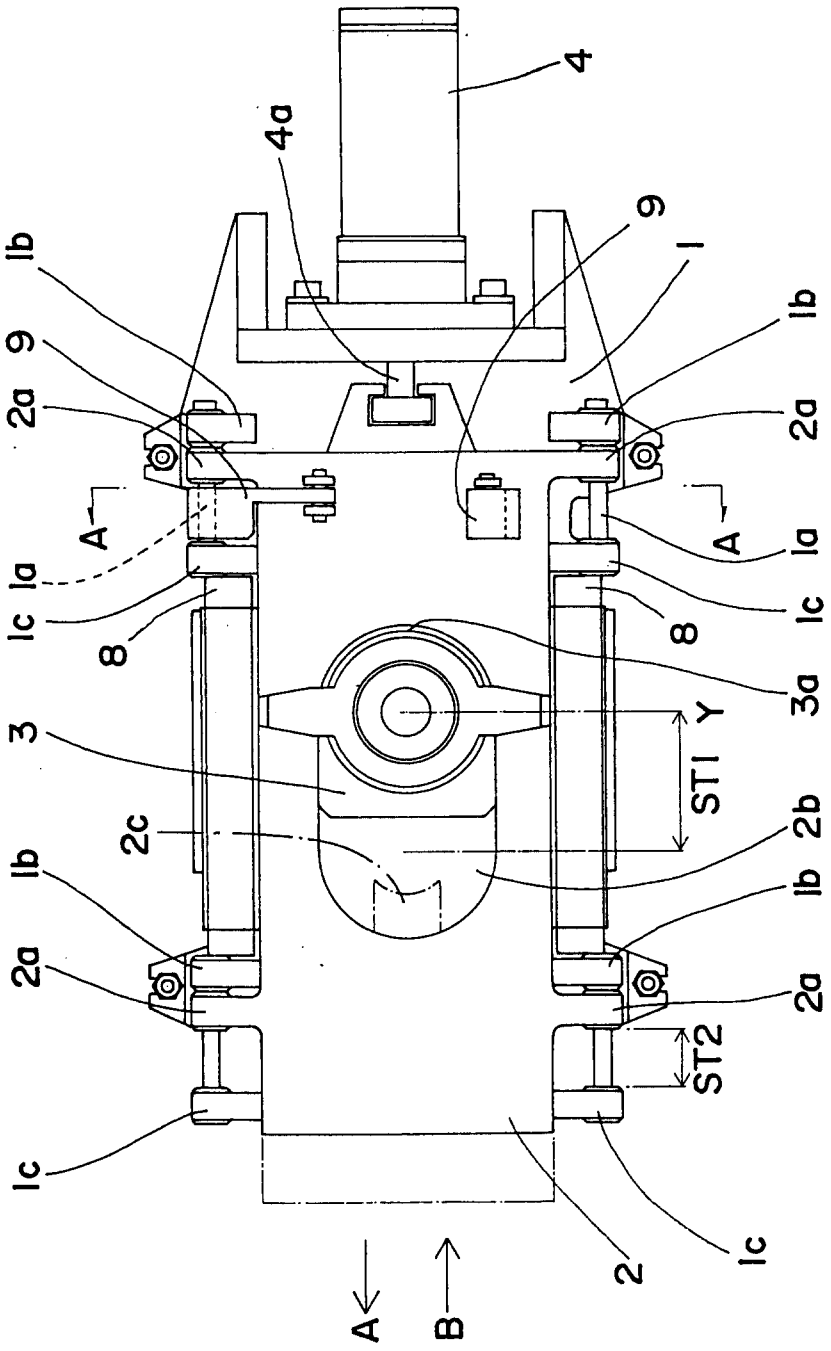


FIG. 5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9
2a
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ST2
1c
1c
2
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B

FIG. 6

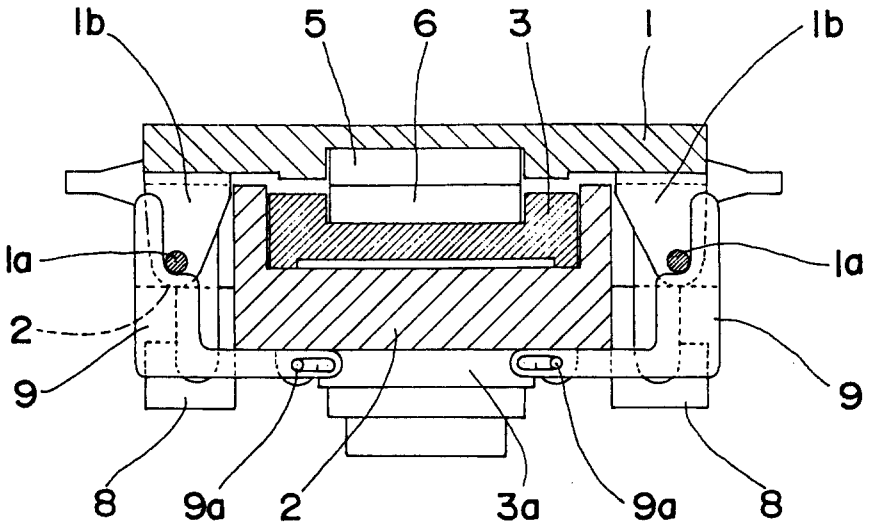


FIG. 8

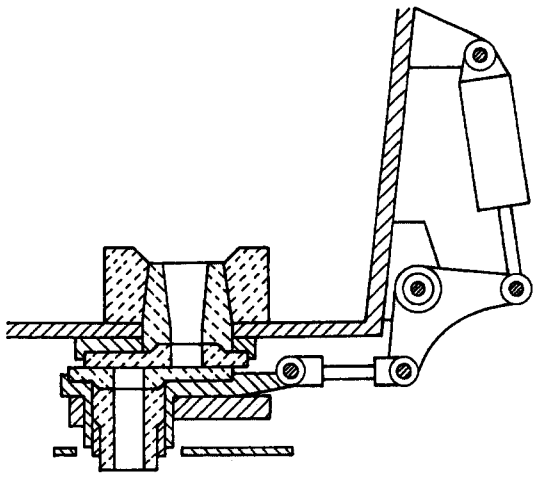


FIG. 7(a)

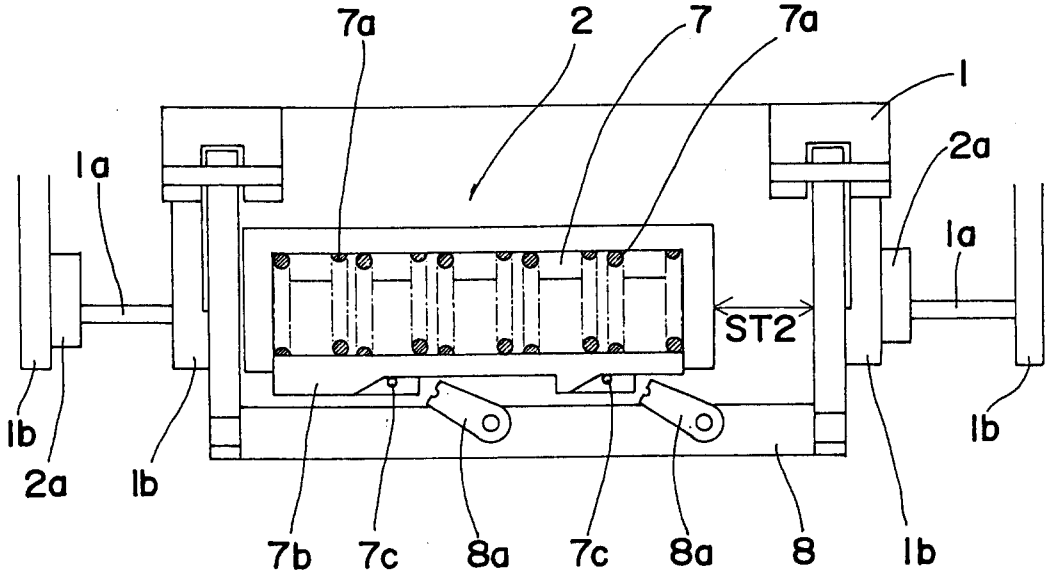
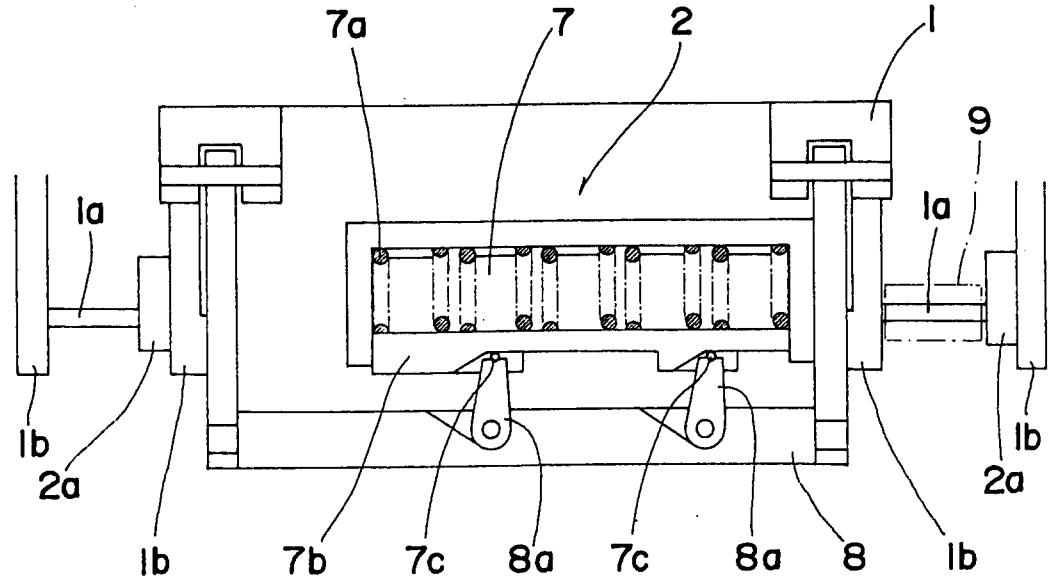
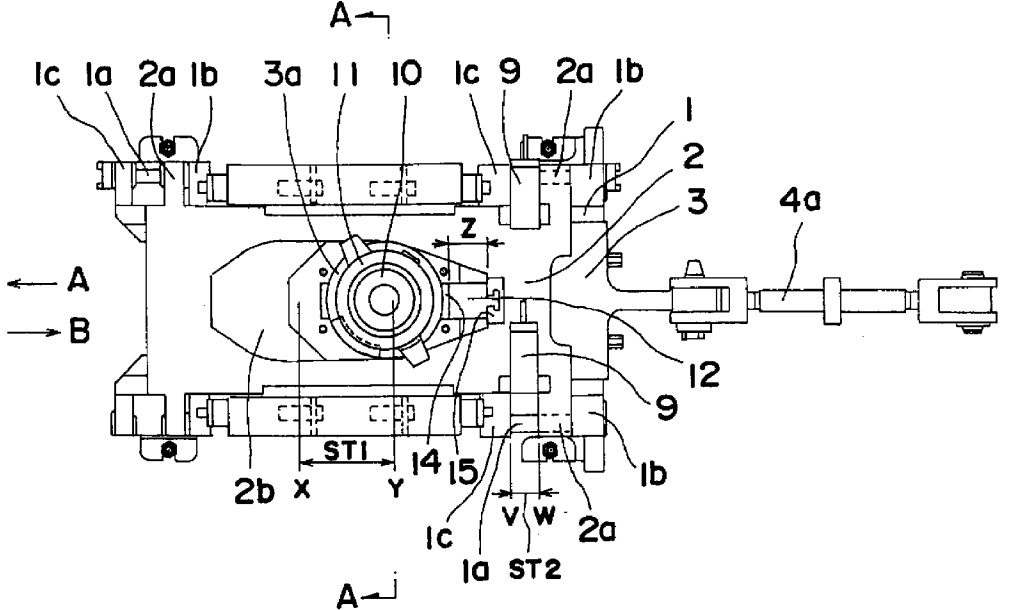

7a
2
7
7a
1
1a
2a
1a
ST2
1b
2a
1b
1b
7b
7c
8a
7c
8a
8
1b

FIG. 7(b)


7a
7
2
1
9
1a
1a
1b
2a
1b
2a
1b
7b
7c
8a
7c
8a
8
1b


A
1c
1a
2a
1b
3a
11
10
1c
9
2a
1b
1
2
3
4a
Z
A
B
12
9
ST1
2b
X
Y
14
15
1b
V
W
2a
1c
1a
ST2
A