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(54) **Tap hole drilling machine**

Stichlochbohrmaschine

Machine de forage de trou de coulée

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**Description**

The present invention relates to a tap hole drilling machine for making a tap hole at a blast furnace.

A tap hole drilling machine is a machine for making a tap hole at the furnace wall made from refractory materials, which holds a drill rod, drill metal bar or bit drill, gives impacts, revolutions and feeding (forwarding) to the drill, thereby making a hole, or gives reversed impacts, revolution and back-feeding (retreating) to the drill after the completion of the hole, thereby withdrawing the drill and making a tap hole.

A schematic structural view of a conventional tap hole drilling machine is shown in Fig.16, where a drill rod 1 is held by a drifter 2 and a drill support (tip end support) 3 and given impacts and revolutions by the drifter 2 to make a hole at the tap hole furnace wall 4, as shown in Fig. 15. Numeral 5 is the tap hole and 23 is a trough. The drifter 2 is suspended below and along a guide channel (guide cell) 6 and moves forwards or backwards through a chain 8 linked to a feeding air motor 7 mounted on the guide channel 6 and the drifter 2 and chain wheels 9 by driving of the feeding air motor 7. As shown in Fig. 16, a hacker 10 is provided at the tip end of the guide channel 6 and engaged with a hacker hook 11 fixed at the tap hole furnace wall 4 to position the guide channel 6 and support the counter-force from the tap hole furnace wall 4 during the drilling. In the case shown in Fig. 15, the hacker 10 is rotatably engaged with the hacker hook 11. Numeral 24 is a heat-preventing plate provided at the tip end of the guide channel 6.

A unit for re-treating the tap hole drilling machine, supports the guide channel 6, and moves it between the drilling position and the retreat position. A suspender arm 12 is pivotally moved by a suspender air cylinder 13, and suspends the guide channel 6 linked through a pin 14. A front arm 15 is linked to through a pin 16 at its both ends and is pivotally moved according to the movement of the suspender arm 12 to maintain the inclination of the guide channel 6. The front arm 15 is also pivotally moved by an air cylinder 17 for engaging or disengaging the hacker 10 with the hacker hook 11. The foregoing members 12 to 17 are mounted on a suspender frame 18 and integrated.

A rotary beam 19 is linked to a bearing supported by a post 20 through a shaft at one end and is rotatable by a rotating motor, and is also linked to the suspender frame 18 through a shaft at the other end. Thus, the tap hole-drilling machine body can be rotated by rotation of the rotary beam 19. A stopper 21 stops the rotation of the rotary beam 19 to the drilling position and positions the suspender frame 18. A synchronizing beam 22 rotates according to the rotation of the rotary beam 19 to determine the inclination of the tap hole-drilling machine body on (from) the horizontal plane during the rotation.

Problems of the tap hole drilling machine have been successively so far raised and prompt solution of the problems are in keen demand.

One problem is due to use of a compressed air-driving type in the tap hole drilling machine, using compressed air as a driving source, since the tap hole drilling machine is subjected to high temperature molten iron and slag splashed from the tap hole of a blast furnace when the tap hole is made by the tap hole drilling machine and receives the heat of radiation of the hot molten iron from the underside, and it has been deemed impossible to use an oil hydraulic driving system with a combustible oil.

As to the tap hole drilling machine, technique of facilitating the operating control, as disclosed in Japanese Patent Application Kokai (Laid-open) No. 63-62807, and technique of using a hydraulic jack as a driving source for moving a tap hole drilling machine from the retreat position to the drilling position, as disclosed in Japanese Patent Application Kokai (Laid-open) No. 54-158310 are known as prior art, but they are all directed to tap hole drilling machines using compressed air as a driving source for the drifter, and no disclosure has been made of a tap hole drilling machine using an oil hydraulic system as a driving source for the drifter.

Since all the conventional tap hole drilling machines are driven by compressed air having such a low pressure as 7 to 10 kg/cm<sup>2</sup>, there has been such a problem that higher power required for the drilling due to filling of mud strong enough to meet a higher furnace inside pressure of a blast furnace cannot be satisfied. In order to increase the power, the drilling machine must be made large in scale or the driving source pressure must be increased. For the larger scale of the drilling machine, there is a dimensional restriction by the surrounding furnace facility. For the higher driving source pressure there is a technical difficulty due to the use of compressed air. Thus, no essential solution of the problem has been found yet.

Furthermore, there is a strict time restriction to the tap hole drilling at a blast furnace. Failure to make a tap hole, when required, leads to a danger for a serious accident. That is, molten iron is continuously formed in the blast furnace, and when there is a delay in making a tap hole, the amount of accumulated molten iron is increased in the blast furnace and the accumulated molten iron reaches the tuyere for air blowing. This leads to a serious accident accompanied by an inevitable tuyere damage or a channelling the blast furnace, resulting in deterioration of blast furnace operation, and thus should be avoided. The larger the scale of a blast furnace, the higher the molten iron production rate. Thus, the time restriction to the tap hole drilling will be more strict. For example, the molten iron production rate in a large scale blast furnace is about 10 tons/min, and in order to securely drill a tap hole by a tap hole drilling machine short of power, various types of drilling operation techniques have been so far applied.

One of them is a metallic rod withdrawal method for making a tap hole, which comprises filling mud into an open

tap hole under pressure by a mud gun, thereby closing the tap hole, driving a metallic rod through the filled mud into the furnace by a tap hole drilling machine before the filled mud is solidified by firing, and withdrawing the metallic rod also by the tap hole drilling machine when molten metal is discharged from the blast furnace. With the metallic rod withdrawal method for making a tap hole it is considered easy to make a tap hole by a tap hole drilling machine short of power, but another problem also appears in that case, because the metallic rod is driven even into the blast furnace in advance, and the metallic rod in the furnace is heated by the molten metal therein, and when the metallic rod is withdrawn, the metallic rod is broken at some length to leave the forward part of the broken metallic rod remaining within the tap hole. In such a case, no molten iron can be discharged from the blast furnace, and thus the remaining forward part of the broken metallic rod must be melted by an oxygen gas introduced from a lance. That is, when the metallic rod is broken even in the metallic rod withdrawal method, an excess time is required for melting the remaining forward part of the broken metallic rod by an oxygen gas, and thus the metallic rod withdrawal method cannot be regarded as a satisfactory technique for securely making a tap hole under a strict time control.

The technique disclosed in Japanese Patent Application Kokai (Laid-open) No. 54-158310 is based on use of a hydraulic jack as a driving source for moving a tap hole drilling machine from a retreat position to a drilling position, and is not obviously directed to an increase in the drilling power.

Many other techniques have been proposed but nothing has been disclosed of securely making a tap hole without utilizing an oxygen gas at the same time.

Another problem is a failure of efficient tap hole drilling operation by a tap hole drilling machine due to deformation or bending of a drill (rod), and attempts have been so far proposed to prevent such a failure. For example, Japanese Utility Model Publication No. 54-32981 discloses provision at the tip end of a guide channel (a unit for supporting a tap hole drill rod), which comprises a guide plate for guiding the tap hole drill rod freely in the vertical direction, a dropoff-preventing member fixed to the guide plate or guide channel, an engagement member with the dropoff-preventing member and a tap hole drilling rod support pin inserted movably into the opening at the bottom end of the guide plate. The unit for supporting a tap hole drill rod can prevent a center-off deformation of the rod between the fired mud to be drilled at the tap hole drilling operation and the drifter as a power source due to a compression load in the longitudinal direction at the tap hole drilling operation by restricting the rod at the tip end of the guide channel to some extent.

The proposed support of the rod at the tip end of the guide channel is effective, but such a circulation phenomenon that the rod tip end moves around to make a circle appears when the rod tip end is contact with the fired mud right after the start of tap hole drilling operation, and the proposed unit cannot suppress the circulation motion in the vertical direction. Furthermore, the use of the support pin requires manual labor near the tap hole drilling machine. Furthermore, since hot molten iron (at about 1,500°C) is discharged through the tap hole at the completion of the tap hole drilling operation, and since the unit for supporting the tap hole rod is of a fixed type, there is a high possibility for damaging the unit by melting.

Other problem is the linearity of guide channel in the tap hole drilling machine. That is, a drill is set to the required tap hole drilling position before the tap hole drilling operation, and in order to transfer the power from the drilling machine to the tip end of the drill securely during the tap hole drilling operation, it is the premise that the guide channel has a linearity. Deteriorating factors for the linearity are mechanical deformation due to the drilling counterforce at the drilling and thermal deformation due to the high temperature atmosphere around the tap hole of a blast furnace. The former factor can be well eliminated by designing to increase the cross-sectional rigidity of the guide channel, and the latter factor is eliminated by the conventional procedure for maintaining the linearity, that is, by cooling with compressed air. The cooling procedure is to cool the guide channel by passing compressed air for the drilling machine or for this cooling purpose through the hollow chamber formed along the guide channel from the rear end to the tip end. However, the air cooling of the guide channel alone is not sufficient, because in case of the above-mentioned metallic rod withdrawal method for making a tap hole which comprises driving a metallic rod into an unfired mud filled in the tap hole by a mud gun after the completion of the closing operation of the tap hole of a blast furnace, thereby making the metallic rod for an advance hole remain in the mud, and withdrawing the metallic rod at the next discharge of molten iron, (which can be also called a withdrawal tap-hole-drilling method or a prehole-preparing type tap-hole-drilling method), the guide channel is exposed to a very hot atmosphere due to the heat of radiation, etc. from the molten iron and slags remaining in the trough below the tap hole drilling machine (because the surface temperature of the remaining molten iron and slags is about 800°C) right after the completion of the molten iron discharge operation, and undergoes thermal deformation (curving deformation in the longitudinal direction mainly due to the heating of the bottom side), and thus the air cooling alone is not sufficient.

The metallic rod withdrawal method has been used owing to improvements of muds endurable for discharge of molten iron for a prolonged run so far made to reduce the run number of molten iron discharge, which largely contributes to a decrease in the production cost of molten iron. That is, improvement of muds has increased the mud strength, but, in the conventional case of making a tap hole by a bit rod during the drilling operation, more operating time has been required for the necessary discharge of molten iron, giving a large influence on the blast furnace operation. Thus, a metallic rod has been driven into the unfired mud to make an advance hole through the mud, before the mud has

not had a sufficient strength.

However, in the case of the metallic rod withdrawal method, the guide channel undergoes thermal deformation only with air cooling and the linearity of the guide channel cannot be maintained. That is, the power of the drilling machine cannot be completely transferred to the tip end of the drill, resulting in the prolongation of tap hole drilling operation. Furthermore, the thermal deformation remains permanent and it is difficult to set the tap hole drilling machine to the tap hole drilling position. Thus, its adjustment requires additional time as a demerit. A new step for preventing such thermal deformation is in keen demand.

In the tap hole drilling operation according to the present invention with a bit rod without driving a metallic rod in advance, a drilling machine with increased power based on oil hydraulic driving is used, and thus thermal deformation (deflection) of the guide channel must be prevented to a maximum.

A further problem is the positioning of the front part of the guide channel 6 for supporting the drill 1 at the tap hole drilling position by the hacker 10 and the hook 11 in the tap hole drilling machine 2 mentioned before, referring to Figs. 15 and 16, and positioning of the rear part of the guide channel 6 by the unit for retreating the tap hole drilling machine, resulting in a failure to vertically and horizontally move the center of the drill 1.

Japanese Patent Application Kokai (Laid-open) No. 54-158310 discloses a technique capable of providing an ideal track for moving a tap hole drilling machine from the retreat position to the tap hole drilling position, where the positioning adjustment of the tap hole drilling position is carried out by a pulling screw, as is obviously different from the tap hole centering made easily by remote control in this invention.

The tap hole position of a blast furnace changes with the operating time, and is defined by the outside surface of the tap hole furnace wall in the furnace radial direction and also by the center of the track of mud gun nozzle pressed on the outside surface of the tap hole furnace wall in the vertical and horizontal directions. When the mud gun nozzle is pressed onto the outside surface of the tap hole furnace wall to fill mud into the tap hole by a mud gun, it is necessary to keep the outside surface of the tap hole furnace wall smooth to avoid mud leakage. In order to keep the outside surface of the tap hole furnace wall smooth, the outside surface of the furnace wall is chamfered or scraped or refractory materials are additionally provided thereto, whereby the outside surface position of the tap hole furnace wall is continuously adjusted in the furnace radial direction. The mud gun is moved from the retreat position to the nozzle-pressing position by revolution and tilting motions in such a manner that the nozzle tip end can trace a certain track. The center of the pressing nozzle track also moves in the vertical and horizontal directions by an influence of the movement of the position of the pressed outside surface of the tap hole furnace wall in the furnace radial direction.

It is a problem that the center of the drill cannot be moved in the vertical and horizontal directions in the tap hole drilling machine to meet the movement of the tap hole with the operating time, as mentioned above. For example, when the drill is largely decentered and the drilled tap hole is deviated from the track of the pressing mud gun nozzle outwardly, mud leakage takes place at the filling of mud into the tap hole by the mud gun, resulting in a failure to close the tap hole.

This problem has been solved actually at the site by moving the drill support (tip end support) 3 in the vertical and horizontal directions to move the center of the drill tip end in these directions, thereby centering of the tap hole. This method can conduct the tap hole centering at the outside surface of the tap hole furnace wall, but still has another problem, because the movement of the drill support 3 in the vertical and horizontal directions leads to decentering between the guide channel center and the drill support center. The center of the drill support tip end depends on the center of the drill support, whereas the center of the drill rear end depends on the drifter. Since the drifter moves along the guide channel, a center deviation angle between the drill rod and the guide channel is increased with the drifter movement. That is, the curved drill rod is inserted into the furnace wall, and furthermore the rod curve angle is increased at the final stage of drilling. When impacts and revolution are given to the curved drill rod to transfer the impact force and rotary force to the bit at the drill rod tip end, thereby making a tap hole at the tap hole furnace wall, obviously the drill rod is bent and the drilling capacity is lowered. Actually, failures to make a tap hole have been encountered.

EP-A-0 379 018 describes a process and an apparatus for opening a tap hole of a furnace by pulling out a rod which is secured in the hardened material of the tap hole. In particular, a coupling means is pushed on the end of the rod and the rod is pulled outward by means of a grip attached to a hydraulic cylinder. There is also provided a working tool which is driven by a pneumatic or hydraulic fluid.

LU-A-74398 shows a blast furnace tap hole drilling apparatus which is mounted so as to be movable between a tap hole drilling position and a retract position. There is provided a drilling machine with a bar. Only the revolution and advancing mode of the drilling machine can be driven by hydraulic or pneumatic fluid.

It is the object of the present invention to provide a tap hole drilling machine with a sufficient power to securely make a tap hole, the tap hole drilling machine being particularly resistant to high temperatures.

This object is achieved with a tap hole drilling machine according to claim 1.

An advantage of the present invention is that no oxygen gas in the making of a tap hole is used and to provide a tap hole drilling machine with a member for restricting and supporting a drill rod at the guide channel tip end, capable of increasing a restriction force for preventing deformation or curving of the drill rod, carrying out a remote controlled

operation, and retreating the member for restricting and supporting the drill rod, thereby preventing contact with molten iron discharged at the opening of a tap hole and preventing the molting loss.

5 Another advantage of the present invention is to provide a tap hole drilling machine in a structure capable of preventing thermal deformation of the guide channel even under a drilling operation of high thermal load, thereby securing the linearity of the guide channel necessary for transmitting a power of the drill to the tip end of the drill rod securely.

Another advantage of the present invention is to provide a tap hole drilling machine capable of readily centering the tap hole by a remote control, thereby, preventing mud leakage when the tap hole is filled with mud by a mud gun and preventing a failure to make a tap hole due to the curving of the drill rod at the making of the tap hole, and thereby effectively and securely conducting the molten iron discharge operation.

10 According to a first aspect of the present invention, there is provided a tap hole drilling machine for giving impacts and revolutions to a drill rod supported by a drifter movable forwards or backwards along a guide channel by a feed motor provided at the rear end of the guide channel, thereby making a tap hole at a blast furnace wall, characterized by using an oil hydraulic driving in any or all of impacts, revolutions or reversed impacts by the drifter, providing an oil hydraulic unit as a driving source at a position far from the tap hole drilling machine, connecting an oil hydraulic piping between the oil hydraulic unit and the tap hole drilling machine, using a non-inflammable oil as a hydraulic fluid, enclosing the drifter with a heat-resistant cover and subjecting the inside of the heat-resistant cover to forced cooling.

15 When a tap hole is made by a tap hole drilling machine, the tap hole drilling machine is splashed with high temperature molten iron and slags gushed from the tap hole of a blast furnace or exposed is the heat of radiation of the molten iron from the bottom side. To meet these severe service conditions, the oil hydraulic unit as a driving source is provided at a position far from the tap hole drilling machine, and an oil hydraulic pipe is used to connect the oil hydraulic unit to the tap hole drilling machine. A non-inflammable oil is used as a hydraulic fluid and the drifter is enclosed with a heat-resistant cover, while the inside of the heat-resistant cover is subjected to forced cooling.

20 The drifter of an oil hydraulic driven, tap hole drilling machine has a structure based on that of an oil hydraulic rock drill generally used in the fields of civil engineering, mining and quarrying, where the impact force is intensified by enlarging the piston diameter and a reversed impact system is additionally provided, and such a non-inflammable oil such as water glycol, etc. is used as a hydraulic fluid. As packing and O-ring materials, nitrile rubber (NBR rubber) suitable for water glycol is used. As accumulator diaphragm materials special rubber, whose durability has been confirmed by the immersion test such as Vulcarsuper (trademark of a product made by Japan Vulcar K.K., Japan) is used.

25 The heat-resistant cover for protecting the drifter is made of a steel plate to shield the splashed molten iron and slags, and preferably is lined with a heat-resistant plate, and encloses the drifter, while the inside of the heat-resistant cover is further subjected to forced cooling. Forced cooling is most effectively conducted by passing cooling air through the inside of the heat-resistant cover. A water cooled jacket can be provided at the inside surface of the heat-resistant cover at the same time. The oil hydraulic pipe (hose) is of pressure resistance and heat resistance.

30 The drilling power (energy) of the present oil hydraulic driven, tap hole drilling machine can attain such a power distribution ratio of impact force : reversed impact force : revolution force = 1.7:1.2:3.0 on the basis of the power of a compressed air driven tap hole drilling machine being unity (1). Comparative data of the drilling power is given in the following Table 1.

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Table 1

	Oil hydraulic driven, tap hole drilling machine		Compressed air driven, tap hole drilling machine		Maximum capacity ratio A/B
	Driving source pressure (kg/cm <sup>2</sup> )	Maximum capacity A (kg-m)	Driving force pressure (kg/cm <sup>2</sup> )	Maximum capacity B (kg-m)	
Impact	140	54	7	32	1.7
Reversed impact	140	32	7	26	1.2
Revolutions	140	80	7	27	3.0

Drifter protective actions of the heat-resistant cover enclosing the drifter and forced cooling air for the inside of the heat-resistant cover are effective for preventing intrusion of high temperature molten metal and slags into the heat-resistant cover and for shielding the heat of radiation of the molten iron and slags from the bottom side. As a result, the temperature of the drifter itself can be kept as low as the room temperature and the packing and O-ring rubber of the drifter can be prevented from earlier deterioration, and also the hydraulic oil such as water glycol can be prevented from earlier deterioration. A risk of ignition and combustion of the the hydraulic oil can be completely eliminated.

The present tap hole drilling machine according to the first aspect of the present invention, when further provided with means according to a second, a third and/or a fourth aspect of the present invention as given below, can be more stabilized and brought into more preferable modes of embodiment.

According to a second aspect of the present invention, there is provided a tap hole drilling machine, further characterized by a unit for restricting and supporting, which comprises a dividable block divided into at least two portions that restricts a drill rod in the circumferential direction and has a thickness of 10 mm or more and a dividable ring plate for supporting the block, the dividable ring plate being connected to a driving cylinder through a lever, thereby allowing the dividable ring plate to be opening or closing-free in a direction of a right angle to the longitudinal direction of the guide channel and the drill rod to be restricted or released from restriction through the dividable block.

In the second aspect of the present invention, the circulation phenomenon of the drill rod tip end right after the start of the drilling operation can be controlled to suppression by restricting the drill rod in the circumferential direction. Since the dividable block is made of steel, the effect to stably support the drill rod is small, if the thickness of the block is less than 10 mm, and thus the block must have a thickness of 10 mm or more and must be preferably in a thickness range of 50 to 100 mm.

Division of the dividable block into at least two portions facilitates insertion of the drill rod into the block, and further supporting (restriction) or releasing of the drill rod by the block.

The dividable ring plate for supporting the dividable block must be opened or closed by a pneumatic or oil hydraulic driven cylinder through a lever, whereby the dividable ring plate can be used by changing the open position to the closed position when the drill rod is mounted on the tap hole drilling machine, and by changing the closed position to the open position to release the restriction and retreat the rod support from the tap front when the drilling operation is advanced and the drill rod is no more circulated, and thus the unit for restricting and supporting the drill rod can be protected from the splashed molten iron and slags gushed from the tap hole just after the drilling operation and there is no fear of melting loss at all.

The driving cylinder system can conduct an easy remote controlled operation by a wireless operation, etc., where an operator conducting the opening or closing operation can conduct the operation from a position far from the tap hole drilling machine.

According to a third aspect of the present invention, in a guide channel 6 of a tap hole drilling machine for making a tap hole at a blast furnace, it is characterized by a hollow chamber extending from the rear end to the tip end of the guide channel and vice versa along the guide channel of the drilling machine, and an inlet and an outlet for cooling water to and from the hollow chamber being provided at the rear end of the guide channel, whereby the guide channel is made a water-cooled guide channel.

In most cases, use of water is avoided from the viewpoint of a risk of explosion due to contact of high temperature molten products with water near the blast furnace tap hole. In the present invention, hoses or pipings for supplying and discharging water are merely provided at the rear end of the guide channel without any risk of explosion.

Generally, the heat transfer by air cooling is a few hundred Kcal/m<sup>2</sup>h, whereas that by water cooling a few thousand Kcal/m<sup>2</sup>h, which is about 10 times the cooling capacity of the former, and thus the superiority of water cooling is quite apparent therefrom. Thermal deformation (deflection) of the guide channel can be prevented to a maximum by water cooling, and thus the restricted setting time of a tap hole drilling machine and the capacity of the drifter can be fully utilized, leading to further shortening of the drilling operation time and consequently to reduction in the operator's labor load under the hot circumferences.

According to a fourth aspect of the present invention, there is provided a system which comprises a tap hole drilling machine body for giving impacts and revolutions to a drill rod supported by a drifter while feeding the drifter forwards along a guide channel by a feed motor provided at the rear end of the guide channel, thereby making a tap hole at a blast furnace wall, and a unit for retreating the tap hole drilling machine, which comprises a suspender arm, a forearm, a rotary beam and a synchronizing beam for holding the tap hole drilling machine body and moving the body between a drilling position and a retreat position, wherein a remote controlled stretching-contracting mechanism and a remote controlled locking mechanism are provided in parallel in each of either the suspender arm or the forearm and the synchronizing beam, and a hacker provided on the guide channel is given a freedom in the vertical and horizontal movements, thereby readily conducting the tap hole centering of the tap hole drilling machine by remote controlled operation.

It is desirable from the viewpoint of smallness in the size of units and secureness of the function that the remote controlled stretching-contracting mechanism is an electrically driven cylinder as a stretching-contracting actuator (driv-

ing means or working member) and the remote controlled locking mechanism is an electromagnetic brake provided in the electrically driven cylinder for fixing the actuated electrically driven cylinder.

The hacker can be given a freedom in the vertical and horizontal movements by using a hacker in such a structure that the hacker is made of a plate with a notch of a sufficient vertical allowance for engagement with a horizontally provided round bar of hook, the hook being in such a structure as to support the horizontally provided round bar by steel side plates at both ends of the round bar, and also with a sufficient horizontal allowance for the spade between the side steel plates, as shown in Fig. 13.

In the conventional unit for retreating the tap hole drilling machine, the suspender arm 12 is pivotally moved by a suspender air cylinder 13 and suspends a guide channel 6 connected to the suspender arm 12 by a pin 14. The forearm 15 is connected to by a pin 16 at its both sides, and pivotally moved with the movement of the suspender arm 12 to select the inclination or tilting of the guide channel 6. The forearm 15 is also pivotally moved by another air cylinder 17 for hacker engagement or disengagement to engage or disengage the hacker 10 with or from a hook 11.

In Fig. 13 showing one embodiment of the present invention, the forearm 15 is made stretchable and contractable. A forearm 15 stretching-contracting mechanism 80 and a locking mechanism 81 for fixing the stretched or contracted state, both being remote controlled, are additionally provided on the forearm 15, and the hacker 10 provided on the guide channel 6 is given a freedom in the vertical and horizontal movements. By stretching or contracting the forearm 15 by the stretching-contracting mechanism, the guide channel 6 can be pivotally moved around the pin 14 to move the hacker 10 at the tip end of the guide channel 6 to a desired level and fix it by the locking mechanism 81. A drill support 3 provided at the tip end of the guide channel 6 moves together with the hacker 10 and thus its level can be set by moving the hacker 10 to a desired level and fixing it at that level. That is, the tap hole centering in the vertical direction of the tap hole drilling machine can be made by the present unit for tap hole centering.

In the conventional unit for tap hole centering, the synchronizing beam 22 is rotated with the rotation of the rotary beam to determine the horizontal inclination of the tap hole drilling machine body at the rotation (i.e. angle of the center line of the tap hole drilling machine in the longitudinal direction to the center line of a blast furnace in the horizontal direction). In the present invention as shown in Fig. 13, the synchronizing beam is made stretchable and contractable, and a remote controlled stretching-contractable mechanism 83 and a remote controllable locking mechanism 84 are additionally provided on the synchronizing beam 22, and the hacker provided on the guide channel 6 is given a freedom in the vertical and horizontal movements. By changing the length of the synchronizing beam 22 by the stretching-contracting mechanism, the inclination or tilting of the tap hole drilling machine body can be changed in the horizontal direction. At the tap hole-centered position obtained by changing the inclination or tilting of the tap hole drilling machine body in the horizontal direction, the stretched or contracted state of the stretching-contracting mechanism is fixed by the locking mechanism 84. That is, the tap hole-centering of the tap hole drilling machine can be made in the horizontal direction by the present unit for tap hole centering.

Tap hole centering operation of the present tap hole drilling machine provided with the unit for tap hole centering is carried out in the following procedure:

- 1) The tap hole drilling machine body provided with the drill rod 1 is moved from the retreat position to the drilling position by a unit for retreating the tap hole drilling machine to engage the hacker 10 with the hook 11.
- 2) The drifter 2 is advanced by the feed motor 7 to bring the tip end of the drill rod in contact with the tap hole furnace wall. Then, the operator visually inspects if there is a deviation of the drill rod tip end center from the center of the nozzle trace made by pressing the mud gun nozzle on the outside surface of the tap hole furnace wall.
- 3) When the operator finds it necessary to conduct tap hole centering, because there is a large deviation of the drill rod tip end center from the center of the mud gun nozzle trace upon the visual inspection, the operator conducts tap hole centering.
- 4) In the tap hole centering, the operator manipulates the operating switch provided near the tap hole to stretch or contract the electrically driven cylinder and conduct the tap hole centering in the vertical and horizontal directions. Delocking and relocking are automatically and sequentially carried out by the electromagnetic brake provided in the electrically driven cylinder.

In the foregoing, the stretching-contracting mechanism and the locking mechanism based on the electrically driven cylinder and the electromagnetic brake have been explained. An oilhydraulic cylinder with a locking function, for example, KBL locking actuator made by Kashima Tsusho K.K., Japan (Japanese Patent Application No. 3-234410) can be used in the present invention as these mechanisms.

The invention will now be further described in connection with the drawings.

Fig. 1 is a side view of the oil hydraulic driven tap hole drilling machine according to the first aspect of the present invention.

Fig. 2 is a schematic view showing a conceptual flow of oil hydraulic piping to a drifter 2 and from an oil hydraulic unit 25 shown in Fig. 1.

Fig. 3 (a) is a schematic, partially cross-sectional, enlarged side view of the drifter 2 shown in Fig. 1.

Fig. 3 (b) and Fig. 3 (c) are views showing the structure of a heat-resistant cover shown in Fig. 3 (a), where fig. 3 (b) is a cross-sectional view along the line A-A of Fig. 3 (a) and Fig. 3 (c) is a cross-sectional view along the line B-B of Fig. 3 (a).

Fig. 4 is a rear view of a unit 50 for restricting and supporting a drill rod in Fig. 1 according to the second aspect of the present invention, when the drill rod is restricted and supported.

Fig. 5 is a rear view of the unit 50 for restricting and supporting a drill rod, in Fig. 1, when the drill rod is in an open position of the unit.

Fig. 6 is a side view of a unit 50 for restricting and supporting a drill rod and a drill rod support 3 in Fig. 1, when the drill rod is restricted and supported.

Fig. 7 is a front view of the drill rod support 3 in Fig. 1, when the drill rod 1 is supported from the downside.

Fig. 8 is a front view of a unit 57 for restricting and passing the drill rod in Fig. 1 when the drill rod 1 is in a restricted and supported position or in an open position.

Fig. 9 is a side view of a tap hole drilling machine right before the start of the drilling operation according to the third aspect of the present invention.

Fig. 10 (a) and Fig. 10 (b) are views showing a hollow chamber formed in the guide channel, where Fig. 10 (a) is a cross-sectional partial view along the line corresponding to the line A-A of Fig. 9, and Fig. 10 (b) is a side view at the tip end (the rear end) corresponding to that of Fig. 9. Fig. 10 (c) is a cross-sectional partial view along the line corresponding to the line B-B of Fig. 10 (b).

Fig. 11 (a) and Fig. 11 (b) are cross-sectional views of another hollow chamber in the guide channel, where Fig. 11 (a) is a cross-sectional view along the line corresponding to the line A-A of Fig. 9 and Fig. 11 (b) is a side view at the tip end (the rear end) corresponding to that of Fig. 9.

Fig. 12 (a) and Fig. 12 (b) are cross-sectional views of other hollow chamber in the guide channel, where Fig. 12 (a) is a cross-sectional view along the line corresponding to the line A-A of Fig. 9 and Fig. 12 (b) is a side view at the tip end (the rear end) corresponding to that of Fig. 9.

Fig. 13 is a structural view showing the outline of a tap hole drilling machine according to the fourth aspect of the present invention.

Fig. 14 is an enlarged cross-sectional view along the line A-A of Fig. 13, showing that an electromagnetic cylinder 83 fixes a synchronizing beam 22 in a stretched or contracted state by a brake 84 provided in the electrically driven cylinder.

Fig. 15 is a side view of a conventional, compressed air driven tap hole drilling machine.

Fig. 16 is a structural view of the outline of the conventional tap hole drilling machine shown in Fig. 15.

#### EXAMPLE 1

One embodiment according to the first aspect of the present invention will be explained below.

Fig. 1 is a side view of the present oil hydraulic driven tap hole drilling machine, and Fig. 2 shows a conceptual flow of an oil hydraulic unit and an oil hydraulic piping.

A drill rod 1 is held by an oil hydraulic driven drifter 2 and given impacts and revolution or reversed impacts and revolutions by an oil hydraulic, reversed impact-giving machine 2a at the drifter 2 to make a tap hole 5 at a tap hole furnace wall 4. The drifter 2 is suspended below a guide channel 6 and moves forwards or backwards by a feed air motor 7 mounted on the guide channel 6 through a chain 8 connected between the motor 7 and the drifter 2 and linked between chain wheels 9.

As shown in Fig. 2, an oil hydraulic unit 25 comprises an oil tank 26 containing water glycol as a hydraulic fluid, oil hydraulic pumps 27, relief valves 28, and switch electromagnetic valves 29, and the oil hydraulic unit 25 is located at a position far from the drifter 2. Oil hydraulic pipings comprise steel pipes 30, flexible hoses 31 and a hose reel 32 and connect the switch electromagnetic valves 29 of the oil hydraulic unit 25 to the drifter 2 of the tap hole drilling machine. The hydraulic fluid under the pressure increased by the oil hydraulic unit 25 is led to the drifter 2 through hose reel 32 to drive the drifter 2 and then discharged into the oil hydraulic unit 25.

The structure of the present oil hydraulic driven, tap hole drilling machine is based on an oil hydraulic rock drill generally used in the fields of civil engineering, mining and quarrying, when the piston diameter is enlarged and the impact force is intensified and reversed impacts are additionally made applicable, and a non-inflammable oil such as water glycol, etc. is used as a hydraulic fluid.

As shown in Fig. 3, a heat-resistant cover 43 is made of a steel plate, and lined with an asbest plate 44 as a heat-insulating material, and forcedly cooled by air blowing, from air-blowing-off holes 46 of air pipings 45, whereby the oil hydraulic driven drifter 2 and flexible hoses 31 are protected against the surrounding heat. Numeral 47 is a water cooled jacket provided on the inside surface of the heat-resistant cover.

The drill rod 1 is a long rod provided with a bit as a cutting knife at the tip end of the rod, and when the unit 50 for

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restricting and supporting the drill rod is used, it supports the rod in the circumferential direction so precisely that the rod provided with a bit may not be bent or curved due to the impact force and revolution force given by the oil hydraulic driven drifter 2 with increased power as shown by data in the afore-mentioned Table 1. Further, the use of the unit 50 for restricting and supporting the drill rod and the unit 57 for restricting the passing drill rod is more preferable.

5 In this embodiment, an air motor is used as the feed motor, but an oil hydraulic motor can be used in place of the air motor.

10 In the following Table 2, actual drilling runs are shown, where the conventional compressed air driven, tap hole drilling machine had a withdrawal hole drilling rate of 97% and an oxygen gas-aided hole drilling rate of 30%, whereas the present oil hydraulic driven, tap hole drilling machine had a one-run hole drilling rate of 100% and an oxygen-aided hole drilling rate of 8%.

15 "Withdrawal" in Table 2 or the metallic rod withdrawal means for making a tap hole is a method for making a tap hole, wherein a metallic rod is driven up to the inside of the blast furnace before the mud is fired and cured, and then when the molten iron is discharged, the metallic rod is withdrawn by using a tap hole drilling machine, as afore-mentioned. "Normal one-run drilling" in Table 2 or the normal one-run drilling means for making a tap hole is a method for making a tap hole, wherein a drill rod provided a bit at its tip end is given impacts and revolutions by a drifter right before the molten iron-discharging operation, thereby making a tap hole at a stretch.

20 In Table 2, the oxygen-aided hole drilling conducted in the normal one-run hole drilling means such a case that, when it was completed to drill the mud at the blast furnace wall inside and the drill rod was withdrawn, the tip portion of the drill rod was cut on the way and retained in the mud in the blast furnace wall and thus the retained tip portion was molten by blowing an oxygen gas thereto.

25 By the adjustment, which will be explained later and the like, a one-run hole drilling rate of 100% and an oxygen-aided hole drilling rate of 0% can be expected.

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Table 2

Drilling mode	Present oil hydraulic driven, tap hole drilling machine		Conventional compressed air driven, tap hole drilling machine	
	Run number of normal drilling	Run number of oxygen-aided drilling used in the normal drilling	Run number of withdrawal drilling	Run number of oxygen-aided drilling used in the withdrawal drilling
Withdrawal	0	0	282	83
Normal one-run drilling	66	5	8	3
Total run	66	5	290	86
Rate %		8		30

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50 EXAMPLE 2

Another embodiment of the present invention according to the second aspect will be explained below, referring to Figs. 1 and 4 to 7. As already explained before, Fig. 1 shows the state that a tap hole drilling machine (drifter 2) of the present invention is provided above the trough 23 in front of the tap hole furnace wall 4 of a blast furnace. A unit 50 for restricting and supporting a drill rod 1 is provided at the tip end of the guide channel 6 of the tap hole drilling machine which is also supported by engagement of a hacker with a hook 11 provided on the furnace wall of the blast furnace.

The unit 50 for restricting and supporting a drill rod 1 supports and restricts the drill rod 1 during the drilling operation, and when the drilling is so advanced that the tip end of the drill rod is drilled into the mud and driven into the tap hole

5, and when any circulation movement of the tip end no more takes place, the restriction and supporting of the drill rod are released so that the drill rod can be retreated and protected against the splashing of the molten iron and slags gushed from the tap hole. In that case, the restriction and support of the drill rod can be more stabilized by providing a unit 57 for restricting the passing drill rod at the intermediate position of the drill rod, where the unit 57 can freely restrict and support the drill rod or release the restriction of the drill rod.

Figs. 4 and 5 are rear views of a unit 50 for restricting and supporting a drill rod, as viewed by facing the tap hole 5 as the foreground, where Fig. 4 shows the state of supporting the drill rod 1 and Fig. 5 shows the state of the drill rod in an open position.

Fig. 6 is an enlarged view of the tip end part of the tap hole drilling machine in Fig. 1 and shows the side view of the drill rod 1 in case that it is restricted and/or supported by the unit 50 and the drill support 3. A block 51 for restricting the drill rod 1 is dividable into two parts and a hole having a similar diameter to the outer diameter of the drill rod 1 can be formed at the center of the block 51. A ring plate 52, which can be divided into two parts, fixes the block 51 and is connected to a driving cylinder 54 through levers 53. In this embodiment an air cylinder is used as the driving cylinder 54, but can be an oil hydraulic cylinder. Numeral 55 is a support for the driving cylinder 54. The top ends of the ring plates 52 are pivotally movable fixed to the guide channel 6.

The driving cylinder 54 can be remote controlled, and the ring plate 52 can be opened or closed by the stretching or contracting motion of the driving cylinder 54 through the levers 53, thereby opening or closing the block 51. In an open state, the block parts and the ring plate parts can be freely gone up and down and the drill rod 1 is released from the restriction and supporting and retreated to the backside of a heat-resistant plate 24 provided at the tip end of the guide channel 6 and avoided molten loss due to the splashing of molten iron and slags. In fig. 4, the upper portions 52a of the ring plates 52 are put in recesses formed at the lower side flange of the guide channel 6.

Materials for the block 51 is iron or steel and the block has a thickness of 10 mm or more and a sufficient strength to restrict the drill rod 1. In this embodiment, the block 51 and the ring plate 52 are dividable into two parts, but may be divided to 3 or more parts.

In Fig. 6, numeral 3 is the side view of the drill rod support, and Fig. 7 is a cross-sectional view along the line A-A of Fig. 6 of the drill rod support 3. The drill rod support 3 supports the drill rod 1 at the downside and is used when the drill rod 1 is mounted on the drifter 2, the unit 50 for restricting and supporting the drill rod, and the unit 57 for restricting the passing drill rod. Number 58 is a driving cylinder and number 59 is a lever.

As shown in Figs. 1 and 8, performance for preventing the buckling of the drill rod can be more improved by providing at the intermediate position of the guide channel 6, a unit 57 for restricting the passing drill rod in addition to the drill rod support 3 and the unit 50 for restricting and supporting the drill rod 1, which unit 57 comprises a block dividable into an upper block part 60 and a lower block part 61, which restrict the drill rod in the circumferential direction, the upper block 60 being connected to a driving cylinder 63 through a lever 62, thereby making the block free of opening or closing in the direction of a right angle to the longitudinal direction of the guide channel 6, the unit 57 being fixed on a trolley 64 travelling along the guide channel 6.

### EXAMPLE 3

An embodiment according to the third aspect of the present invention will be explained below, referring to Figs 9 to 12.

Fig. 9 shows a tap hole drilling machine according to the present invention right before the start of drilling operation. The guide channel 6 of the tap hole drilling machine is set to the tap hole 5 at the blast furnace wall by the hacker 10 and supports 12 and 15. The drifter 2 and the drill rod (bit rod) 1 are suspended from the guide channel 6 and a tap hole is drilled through filled mud 70 up to the furnace inside by impacts, revolutions and feeding of the drill rod 1 given by the drifter 2. In case of prehole-preparing type tap-hole-drilling operation (advance drilling operation), thermal deformation of the guide channel 6 due to the expansion of the underside of the guide channel takes place owing to the heat from the molten iron and slags 71 remaining in the trough 23, whereby the hacker 10 is disengaged from the engagement position on the furnace wall or the forces given by the drifter 2 are not directly transferred to the tip end of the drill rod 1, resulting in prolonged drilling operation. In this embodiment, an inlet 72 and an outlet 73 for cooling water are provided at the rear end of the guide channel 6 to prevent the thermal deformation. That is, the thermal deformation is prevented by passing cooling water through a hollow chamber 74 extending from the rear end to the front end of the guide channel 6 and vice versa to cool the guide channel 6, thereby eliminating the thermal deformation.

Fig. 10 (a) shows the hollow chamber 74, and the inlet 72 and the outlet 73 for cooling water of Fig. 9 along the line A-A, and Fig. 10 (b) shows the tip end part of the guide channel 6 in Fig. 9. The hollow chamber 75 is at the water inlet side and the hollow chamber 76 is at the water outlet side. Since the guide channel 6 is provided with a drifter mounting bed 77 and a driving chain 8, and thus the hollow chamber 75 and 76 must be so provided as not to disturb the functions of these units. In this example, the hollow chambers 75 and 76 are provided at the lower outsides of the guide channel 6, respectively and are connected to each other at the tip end part through a connecting pipe 78. The

hollow chambers must be provided in the longitudinal direction of the guide channel 6 and may be at the insides of the guide channel 6, if the inside position may not interfere with other units. Cooling water can be supplied from the rear end and discharged from the tip end of the guide channel 6 or vice versa, but extension of the hose or piping for cooling water from the rear end part to the tip end part is required, a further problem appears in such provision or no better cooling efficiency is obtained.

Fig. 11 (a) and Fig. 11 (b) show hollow chambers 75 and 76 provided at the upper side and the lower side of the guide channel by separating the cooling water inlet side from the cooling water outlet side. In case of the system of these hollow chambers 75 and 76, a connecting pipe 78 at the tip end part is not needed.

Fig. 12 (a) and Fig. 12 (b) show a lower hollow chamber 75 at the inlet side and an upper hollow chamber 76 at the outlet side through the guide channel, separated by each other by a partition wall 79, whereby the cooling is intensified. In these systems as shown in Figs. 11 and 12, it is not necessary to provide a connection pipe at the tip end part of the guide channel 6.

#### EXAMPLE 4

An embodiment according to the fourth aspect of the present invention will be described below, referring to Figs. 13 and 14.

Fig. 13 is the structural view showing the outline of one embodiment of the present invention, where a drill rod 1 is supported by a drifter 2 and a drill rod support 3 and given impacts and revolutions by the drifter 2 to drill a tap hole at the tap hole furnace wall. The drifter 2 is suspended from a guide channel 6 to move forwards or backwards by a feed air motor 7 mounted on the guide channel 6 through a chain connected to the motor 7 and the drifter 2 and linked between chain wheels. A hacker 10 is provided at the tip end of the guide channel 6 and engaged with a hook 11 fixed at the tap hole furnace wall to support counterforces from the tap hole furnace wall during the drilling operation. In order to give the hacker 10 a freedom in the vertical and horizontal movements, the hacker 10 is in such a structure that the hacker 10 is made of a plate with a notch of sufficient vertical allowance for engagement with a horizontally provided round bar of hook 11, the hook 11 being in such a structure as to support the horizontally provided round bar by steel side plates at both ends of the round bar, and also with a sufficient horizontal allowance for the space between the side steel plates, as shown in Fig. 13.

A unit for retreating the tap hole drilling machine supports the guide channel 6 and moves it between the drilling position and the retreat position. The suspender arm (12) is pivotally moved by a suspender air cylinder 13 and suspends the guide channel 6 connected by a pin 14. The forearm 15 is connected by a pin 16 at both ends, and is pivotally moved according to the movement of the suspender arm 12 to select the inclination or tilting of the guide channel 6. Furthermore, the forearm 15 is pivotally moved by an air cylinder 17 to make engagement or disengagement of the hacker 10 with or from the hook 11. The forearm 15 is stretched or contracted and fixed by remote controlled, electrically driven cylinders 80 and brakes 81 provided in the electrically driven cylinders 80 to conduct tap hole centering of the tap hole drilling machine in the vertical directions. The members 12 to 17, 80 and 81 are incorporated and integrated into a suspender frame 18.

A rotary beam 19 is connected to a bearing supported by a post 20 through a shaft at one end and rotated by a rotary motor. The other end of the rotary beam 19 is connected to the suspender frame 18 through a shaft, and thus the tap hole drilling machine body can undergo rotary movement according to the rotary movement of the rotary beam 19. A stopper 21 stops the rotary movement of the rotary beam 19 at the drilling position and selects positioning of the suspender frame 18. A synchronizing beam 22 rotates according to the rotary movement of the rotary beam 19 and selects the inclination or tilting of the tap hole drilling machine from the horizontal direction during the rotary movement. The synchronizing beam 22 is provided with a remote controlled, electrically driven cylinder 83 and a brake 84 provided in the electrically driven cylinder 83 to give a freedom in the vertical and horizontal movements to the hacker 10 provided on the guide channel 6. That is, tap hole centering of the tap hole drilling machine in the horizontal direction can be carried out by changing the length of the synchronizing beam by the electrically driven cylinder 83 and fixing the length by the brake 84 provided in the electrically driven cylinder 83.

An oil hydraulic cylinder can be used in place of the electrically driven cylinder, and a mechanical locking member may be provided and actuated by applying an on-off oil hydraulic pressure to the mechanical locking member.

Fig. 14 shows the state of stretching or contracting the stretchable synchronizing beam 22 by the electrically driven cylinder 83 and fixing the stretched or contracted state by the brake 84 provided in the electrically driven cylinder 83.

#### Claims

1. A tap hole drilling machine, which comprises a tap hole drilling machine body for drilling a tap hole at a blast furnace wall by giving impacts and revolutions to a drill rod (1) supported by a drifter (2) while advancing the drifter (2)

along a guide channel (6) by a feed motor (7) provided at the rear end of the guide channel (6), wherein the drifter (2) is an oil hydraulic drifter (2) that produces the impacts and the revolutions by oil hydraulic driving, an oil hydraulic unit (25) as a driving source is provided at a position far from the tap hole drilling machine, the oil hydraulic unit (25) and the oil hydraulic drifter (2) are connected to each other through an oil hydraulic piping (30), and the oil hydraulic drifter (2) is enclosed with a heat-resistant cover (43), the heat-resistant cover being provided with a heat-preventing unit (45, 46) for forcedly cooling the inside of the heat-resistant cover (43).

2. A tap hole drilling machine according to Claim 1, wherein an apparatus for giving reversed impacts power to the drill rods supported by the drifter (2) is an oil hydraulic, reversed impacts-giving machine (2a), which is provided at the drifter (2) of said tap hole drilling machine.

3. A tap hole drilling machine according to Claim 1 or 2, wherein a hydraulic fluid for the oil hydraulic drifter is non-inflammable oil.

4. A tap hole drilling machine according to Claim 3, wherein the non-inflammable oil as a hydraulic fluid is water glycol.

5. A tap hole drilling machine according to any one of Claims 1 to 4, wherein an oil hydraulic unit (25) as a driving source is provided at a position far from the tap hole drilling machine, and a switch electromagnetic valve (29) of the oil hydraulic unit (25) is connected to the drifter of the tap hole drilling machine by an oil hydraulic piping (30).

6. A tap hole drilling machine according to any one of Claims 1 to 5, wherein there is provided a heat-preventing unit of the drifter (2), in which the drifter (2) is enclosed with the heat-resistant cover (43) made of iron plate, and a means (45, 46) for forcedly cooling by flowing cooling air in the inside of the heat-resistant cover (43) is provided.

7. A tap hole drilling machine according to Claim 6, wherein the heat-preventing unit (45, 46) for forcedly cooling the heat-resistant cover (43) is further provided with a water-cooled jacket (47) at the inside of the heat-resistant cover (43).

8. A tap hole drilling machine according to any one of Claims 1 to 7, wherein a unit (50) for restricting and supporting the drill rod (1), which comprises a dividable block (51) for restricting the drill rod (1) in the circumferential direction, a dividable ring plate (52) for supporting the block (51), a lever (53) connecting the ring plate (52) to a driving cylinder (54), thereby making the ring plate (52) freely open or closed in the direction of a right angle to the longitudinal direction of the guide channel (6) and the drill rod (1) restricted, in such a manner that the minimum clearance is left, or released from restriction through the block (51), is further provided at the tip end of the guide channel (6) besides the drill rod support (3).

9. A tap hole drilling machine according to any one of Claims 1 to 8, wherein a unit (57) for restricting the passing drill rod (1), which comprises a dividable block (60, 61) for restricting the drill rod (1) in the circumferential direction in such a manner that the minimum clearance left, the block (60, 61) being connected to a driving cylinder (63) through a lever (62), thereby making the block (60, 61) open or closed in the direction of a right angle to the longitudinal direction of the guide channel, the unit (57) for restricting the passing drill rod (1) being mounted on a trolley (64) travelling along the guide channel (6), is further provided at an intermediate position of the guide channel (6) besides the drill rod support (3) and the unit (50) for restricting and supporting the drill rod.

10. A tap hole drilling machine according to any one of Claims 1 to 7, wherein the unit (50), (57) for restricting and supporting the drill rod (1) is provided on the tip end and an intermediate position of the guide channel (6).

11. A tap hole drilling machine according to any one of Claims 1 to 10, wherein a hollow chamber (74) extending from the rear end to the front end of the guide channel (6) vice versa is provided and an inlet (72) and outlet (73) for cooling water are provided at the rear end of the guide channel (6), as connected to the hollow chamber (74), thereby making the guide channel (6) of water cooled type.

12. A tap hole drilling machine according to any one of claims 1 to 11, in which the unit (12, 15, 19, 22) for retreating the tap hole drilling machine comprises a suspender arm (12), a forearm (15), a rotary beam (19) and a synchronizing beam (22) for supporting the tap hole drilling machine body and moving the body between a drilling position and a retreat position, characterized in that one of the suspender arm (12) and the forearm (15) and the synchronizing beam (22) is stretchable or contractable, one of the stretchable or contractable suspender arm (12) and forearm (15) and the stretchable or contractable synchronizing beam (22) is provided with remote controlled stretch-

ing-contracting mechanism and locking mechanism, and the hacker (10) provided on the guide channel (6) is given a freedom in the vertical and horizontal movement, and thereby conducting tap hole centering.

- 5 13. A tap hole drilling machine according to Claim 12, wherein the stretching-contracting mechanism and the locking mechanism are driven by oil hydraulic cylinders (80, 83) with a locking mechanism (81, 84).

**Patentansprüche**

- 10 1. Stichlochbohrmaschine mit einem Stichlochbohrmaschinenkörper zum Bohren eines Stichlochs an einer Blashochofenwand, indem Schläge und Drehbewegungen an eine Bohrstange (1) abgegeben werden, die von einem Bohrhammer (2) gehalten wird, während sich der Bohrhammer (2) längs eines Führungskanals (6) mittels eines Vorschubmotors (7) bewegt, der an dem hinteren Ende des Führungskanals (6) angeordnet ist, wobei der Bohrhammer (2) ein ölhydraulischer Bohrhammer (2) ist, der die Schläge und die Drehbewegungen durch ölhydraulischen Antrieb erzeugt, eine ölhydraulische Einheit (25) als eine Antriebsquelle an einer Position weit weg von der Stichlochbohrmaschine angeordnet ist, die ölhydraulische Einheit (25) und der ölhydraulische Bohrhammer (2) über ein ölhydraulisches Leitungssystem (30) verbunden sind und der ölhydraulische Bohrhammer (2) von einer hitzebeständigen Abdeckung (43) eingeschlossen ist, wobei die hitzebeständige Abdeckung mit einer hitzeverhindernden Einheit (45, 46 zum Zwangskühlen der Innenseite des hitzebeständigen Abdeckung (43) versehen ist.
- 15 2. Stichlochbohrmaschine nach Anspruch 1, wobei eine Vorrichtung zum Abgeben von umgekehrter Schlagkraft auf die von dem Bohrhammer (2) gehaltene Bohrstange eine ölhydraulische Umkehrschläge-Abgabemaschine (2a) ist, welche an dem Bohrhammer (2) der Stichlochbohrmaschine angeordnet ist.
- 20 3. Stichlochbohrmaschine nach Anspruch 1 oder 2, wobei ein hydraulisches Fluid für den ölhydraulischen Bohrhammer nicht-brennbares Öl ist.
- 25 4. Stichlochbohrmaschine nach Anspruch 3, wobei das nichtbrennbare Öl als das hydraulische Öl Fluid Wasser-Glykol ist.
- 30 5. Stichlochbohrmaschine nach einem der Ansprüche 1 bis 4, wobei eine ölhydraulische Einheit (25) als eine Antriebsquelle an einer Position weit weg von der Stichlochbohrmaschine angeordnet ist und ein elektromagnetisches Schaltventil (29) der ölhydraulischen Einheit (25) mit dem Bohrhammer der Stichlochbohrmaschine über ein ölhydraulisches Leitungssystem (30) verbunden ist.
- 35 6. Stichlochbohrmaschine nach einem der Ansprüche 1 bis 5, wobei eine hitzeverhindernde Einheit des Bohrhammers (2) bereitgestellt ist, in welcher der Bohrhammer (2) mit der aus einer Eisenplatte hergestellten hitzebeständigen Abdeckung (43) eingeschlossen ist, und eine Einrichtung (45, 46) zum Zwangskühlen durch strömende Kühlluft im Inneren der hitzebeständigen Abdeckung (43) bereitgestellt ist.
- 40 7. Stichlochbohrmaschine nach Anspruch 6, wobei die hitzeverhindernde Einheit (45, 46) zum Zwangskühlen der hitzebeständigen Abdeckung (43) ferner mit einem wassergekühlten Mantel (47) am Inneren der hitzebeständigen Abdeckung (43) versehen ist.
- 45 8. Stichlochbohrmaschine nach einem der Ansprüche 1 bis 7, wobei eine Einheit (50) zum Zwangsführen und Unterstützen der Bohrstange (1), welche einen teilbaren Block (51) zum Zwangsführen der Bohrstange (1) in der Umfangsrichtung, eine teilbare Ringplatte (52) zum Unterstützen des Blocks (51), einen die Ringplatte (52) mit einem Antriebszylinder (54) verbindenden Hebel (53), wodurch die Ringplatte (52) in der Richtung eines rechten Winkels zu der Längsrichtung des Führungskanals (6) frei in einer Weise geöffnet oder geschlossen und die Bohrstange (1) zwangsgeführt wird, daß das minimale Spiel erhalten bleibt, oder von der Zwangsführung durch den Block (51) freigegeben wird, aufweist, zusätzlich an dem Vorderende des Führungskanals (6) neben der Bohrstangenunterstützung (3) bereitgestellt ist.
- 50 9. Stichlochbohrmaschine nach einem der Ansprüche 1 bis 8, wobei eine Einheit (57) zum Zwangsführen der durchlaufenden Bohrstange (1), welche einen teilbaren Block (60, 61) zum Zwangsführen der Bohrstange (1) in der Umfangsrichtung in der Weise aufweist, daß das minimale Spiel erhalten bleibt, wobei der Block (60, 61) über einen Hebel (62) mit einem Antriebszylinder (63) verbunden ist und dadurch den Block (60, 61) in der Richtung eines rechten Winkels zu der Längsrichtung des Führungskanals (6) geöffnet oder geschlossen werden kann, und
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die Einheit (57) zum Zwangsführen der durchlaufenden Bohrstange (1) auf einem entlang dem Führungskanal (6) fahrenden Wagen (64) montiert ist, ferner an einer Zwischenposition des Führungskanals (6) neben der Bohrstangenunterstützung (3) und der Einheit (50) zur Zwangsführung und Unterstützung der Bohrstange bereitgestellt ist.

- 5
10. Stichlochbohrmaschine nach einem der Ansprüche 1 bis 7, wobei die Einheit (50), (57) zum Zwangsführen und Unterstützen der Bohrstange (1) an dem Vorderende und an einer Zwischenposition des Führungskanals (6) bereitgestellt ist.
- 10
11. Stichlochbohrmaschine nach einem der Ansprüche 1 bis 10, wobei eine Hohlkammer (74), die sich von dem hinteren Ende zu dem vorderen Ende des Führungskanals (6) und umgekehrt erstreckt, bereitgestellt ist und ein Einlaß (72) und ein Auslaß (73) für Kühlwasser an dem hinteren Ende des Führungskanals (6) verbunden mit der Hohlkammer (74) bereitgestellt sind, wodurch sie den Führungskanal (6) zu einem wassergekühlten Führungskanal machen.
- 15
12. Stichlochbohrmaschine nach einem der Ansprüche 1 bis 11, in welcher die Einheit (12, 15, 19, 22) zum Zurückziehen der Stichlochbohrmaschine einen Aufhängerarm 12, einen Vorarm (15), einen Drehausleger (19) und einen Synchronausleger (22) zum Unterstützen des Stichlochbohrmaschinenkörpers und zum Bewegen des Körpers zwischen einer Bohrposition und einer zurückgezogenen Position aufweist, dadurch gekennzeichnet, daß einer von dem Aufhängerarm (12) und dem Vorarm (15) und dem Synchronausleger (22) streckbar oder kontrahierbar ist, einer von dem streckbaren oder kontrahierbaren Aufhängerarm (12) und dem Vorarm (15) und dem streckbaren oder kontrahierbaren Synchronausleger (22) mit einem ferngesteuerten Streck-Kontraktions-Mechanismus und Verriegelungsmechanismus versehen ist, und dem auf dem Führungskanal (6) angeordneten Haltebügel (10) ein vertikaler und horizontaler Bewegungsfreiheitsgrad gegeben ist, wodurch die Stichlochzentrierung ausgeführt wird.
- 20
- 25
13. Stichlochbohrmaschine nach Anspruch 12, wobei der StreckKontraktions-Mechanismus und der Verriegelungsmechanismus von ölhydraulischen Zylindern (80, 83) mit einem Verriegelungsmechanismus (81, 84) angetrieben werden.

30

### Revendications

- 35
1. Machine de forage de trou de coulée, comprenant un corps de machine de forage de trou de coulée pour forer un trou de coulée dans une paroi de haut fourneau en communiquant des chocs et un mouvement de rotation à une tige de forage (1) supportée par un entraîneur (2), tout en faisant avancer l'entraîneur (2) le long d'un canal de guidage (6) par un moteur d'alimentation (7) monté à l'extrémité arrière du canal de guidage (6), machine dans laquelle l'entraîneur (2) est un entraîneur hydraulique à huile (2) qui produit les chocs et le mouvement de rotation par un entraînement hydraulique à huile, un bloc hydraulique à huile (25) servant de source d'entraînement est placé dans une position éloignée de la machine de forage de trou de coulée, le bloc hydraulique à huile (25) et l'entraîneur hydraulique à huile (2) sont reliés l'un à l'autre par une tuyauterie hydraulique à huile (30), et l'entraîneur hydraulique à huile (2) est enfermé dans un capot résistant à la chaleur (43), ce capot résistant à la chaleur étant muni d'un bloc de protection contre la chaleur (45, 46) pour produire le refroidissement forcé de l'intérieur du capot résistant à la chaleur (43).
- 40
- 45
2. Machine de forage de trou de coulée selon la revendication 1, dans laquelle un appareil destiné à communiquer une puissance de chocs inversée à la tige de forage supportée par l'entraîneur (2), est une machine hydraulique à huile de fourniture de chocs inversés (2a) qui est montée dans l'entraîneur (2) de la machine de forage de trou de coulée.
- 50
3. Machine de forage de trou de coulée selon la revendication 1 ou 2, dans laquelle le fluide hydraulique destiné à l'entraîneur hydraulique à huile est une huile non inflammable.
- 55
4. Machine de forage de trou de coulée selon la revendication 3, dans laquelle l'huile non inflammable servant de fluide hydraulique est du glycol à l'eau.
5. Machine de forage de trou de coulée selon l'une quelconque des revendications 1 à 4, dans laquelle un bloc hydraulique à huile (25) servant de source d'entraînement est placé dans une position éloignée de la machine de forage de trou de coulée, et une soupape électromagnétique de commutation (29) du bloc hydraulique à huile (25)

est reliée à l'entraîneur de la machine de forage de trou de coulée par une tuyauterie hydraulique à huile (30).

- 5 6. Machine de forage de trou de coulée selon l'une quelconque des revendications 1 à 5, dans laquelle on utilise un bloc de protection de l'entraîneur (2) contre la chaleur, bloc dans lequel l'entraîneur (2) est enfermé dans un capot résistant à la chaleur (43) constitué par une plaque de fer, et l'on utilise également des moyens (45, 46) pour produire un refroidissement forcé en faisant circuler de l'air de refroidissement dans la partie intérieure du capot résistant à la chaleur (43).
- 10 7. Machine de forage de trou de coulée selon la revendication 6, dans laquelle le bloc de protection contre la chaleur (45, 46) destiné à produire le refroidissement forcé du capot résistant à la chaleur (43), est en outre muni d'une chemise refroidie à l'eau (47) à l'intérieur du capot résistant à la chaleur (43).
- 15 8. Machine de forage de trou de coulée selon l'une quelconque des revendications 1 à 7, dans laquelle un bloc (50) de limitation et de support de la tige de forage (1), comprenant un bloc divisible (51) pour limiter la tige de forage (1) dans la direction circonférentielle, une plaque de bague divisible (52) pour supporter le bloc (51), et un levier (53) reliant la plaque de bague (52) à un cylindre d'entraînement (54), de manière à permettre à la plaque de bague (52) de s'ouvrir et de se fermer librement dans la direction rectangulaire à la direction longitudinale du canal de guidage (6), et à la tige de forage (1) d'être limitée, de manière à conserver le jeu minimum, ou d'être libérée de sa limitation à travers le bloc (51), est en outre prévu à l'extrémité du bout du canal de guidage (6), en plus du support de tige de forage (3).
- 20 9. Machine de forage de trou de coulée selon l'une quelconque des revendications 1 à 8, dans laquelle un bloc (57) de limitation de la tige de forage (1) en cours de passage, comprenant un bloc divisible (60, 61) pour limiter la tige de forage (1) dans la direction circonférentielle de manière à laisser le jeu minimum, le bloc (60, 61) étant relié à un cylindre d'entraînement (63) par l'intermédiaire d'un levier (62) de manière à permettre au bloc (60, 61) de s'ouvrir ou de se fermer dans la direction rectangulaire à la direction longitudinale du canal de guidage (6), le bloc (57) de limitation de la tige de forage (1) en cours de passage étant monté sur un chariot (64) passant le long du canal de guidage (6), est en outre prévu dans une position intermédiaire du canal de guidage (6), en plus du support de tige de forage (3) et du bloc (50) de limitation et de support de la tige de forage.
- 25 30 10. Machine de forage de trou de coulée selon l'une quelconque des revendications 1 à 7, dans laquelle les blocs (50), (57) de limitation et de support de la tige de forage (1), sont prévus à l'extrémité du bout et dans une position intermédiaire du canal de guidage (6).
- 35 11. Machine de forage de trou de coulée selon l'une quelconque des revendications 1 à 10, dans laquelle on utilise une chambre creuse (74) s'étendant de l'extrémité arrière à l'extrémité avant du canal de guidage (6) et vice versa, tandis qu'un orifice d'entrée (72) et un orifice de sortie (73) pour de l'eau de refroidissement sont prévus à l'extrémité arrière du canal de guidage (6), en étant reliés à la chambre creuse (74), ce qui permet ainsi au canal de guidage (6) d'être de type à refroidissement à eau.
- 40 45 12. Machine de forage de trou de coulée selon l'une quelconque des revendications 1 à 11, dans laquelle le bloc (12, 15, 19, 22) de retrait de la machine de forage de trou de coulée, comprend un bras de suspension (12), un bras avant (15), une poutre rotative (19) et une poutre de synchronisation (22), pour supporter le corps de la machine de forage de trou de coulée et pour déplacer ce corps entre une position de forage et une position de retrait, caractérisée en ce que l'un ou l'autre du bras de suspension (12), du bras avant (15) et de la poutre de synchronisation (22), est étirable ou contractable, en ce que l'un ou l'autre du bras de suspension (12) et du bras avant (15) étirables ou contractables, et de la poutre de synchronisation (22) étirable ou contractable, est muni d'un mécanisme d'extension-contraction et d'un mécanisme de verrouillage commandés à distance, et en ce qu'on donne au croc (10) monté sur le canal de guidage (6) une liberté de mouvements dans les directions verticale et horizontale, pour effectuer ainsi le centrage du trou de coulée.
- 50 55 13. Machine de forage de trou de coulée selon la revendication 12, dans laquelle le mécanisme d'extension-contraction et le mécanisme de verrouillage sont entraînés par des cylindres hydrauliques à huile (80, 83) avec un mécanisme de verrouillage (81, 84).

FIG. 1

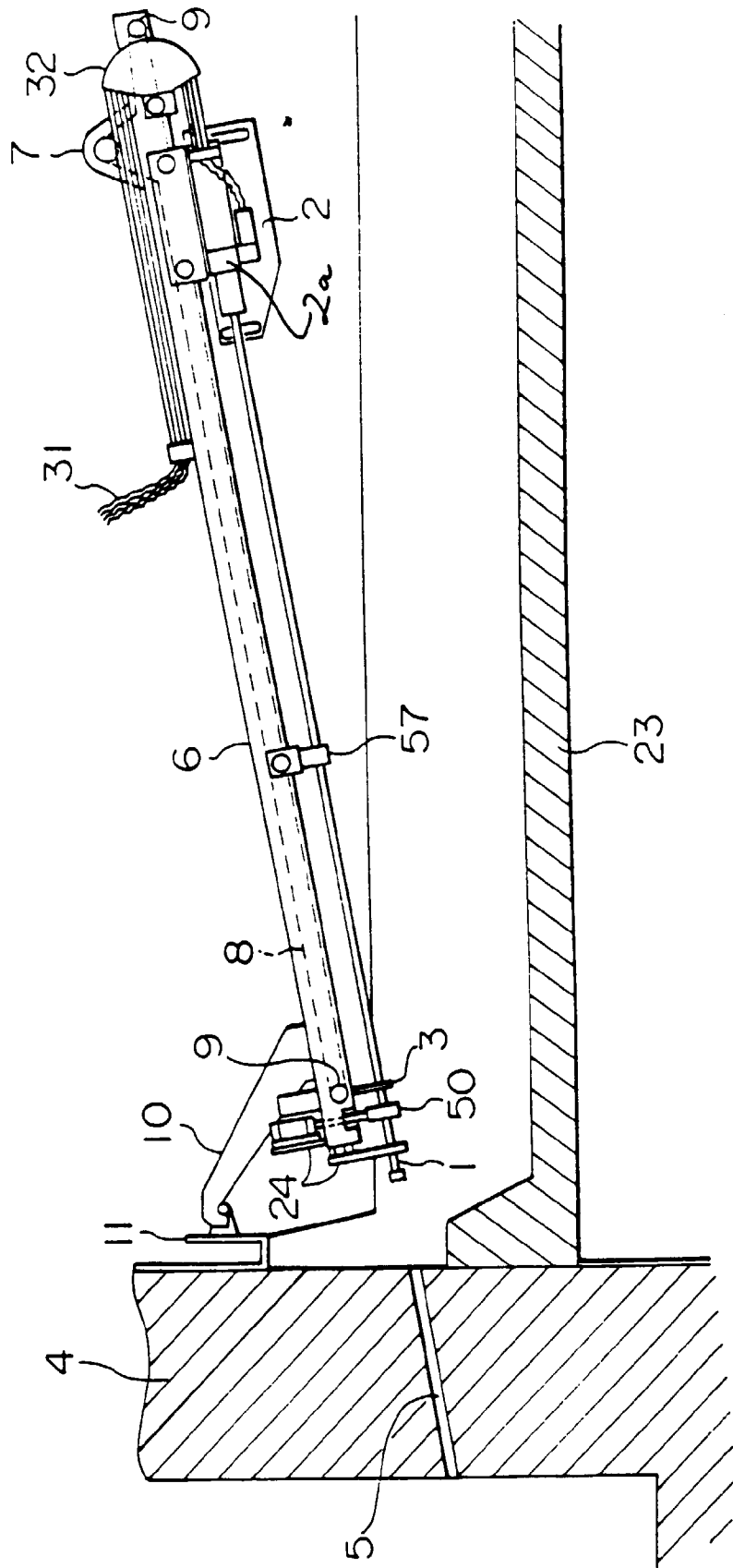


FIG. 2

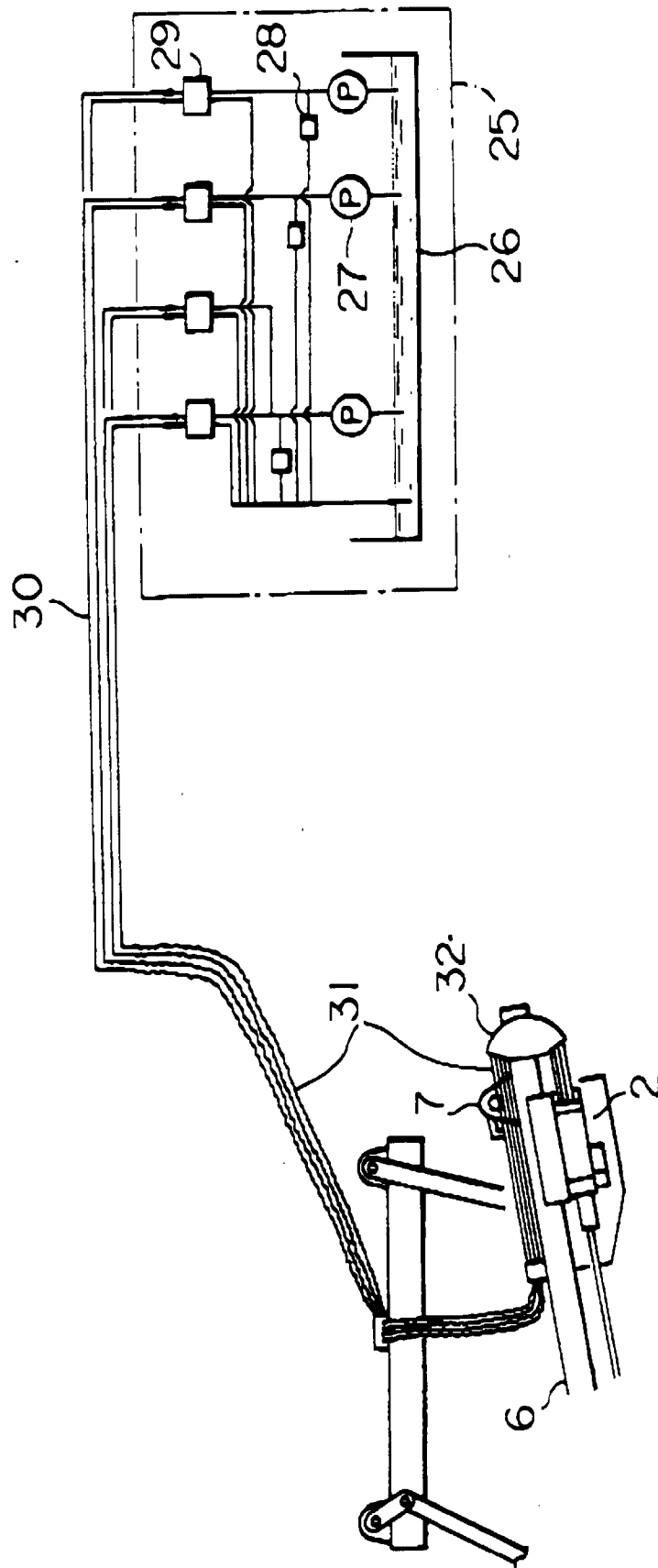


FIG. 3(a)

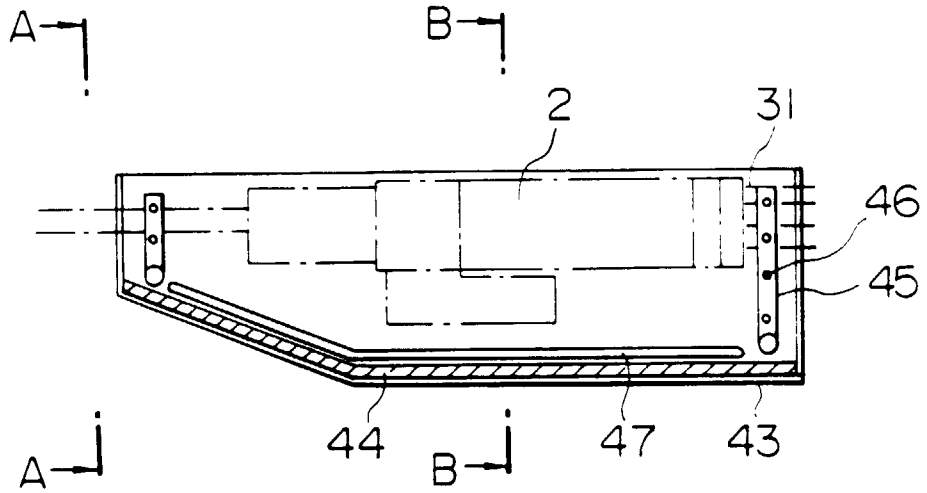


FIG. 3(b)

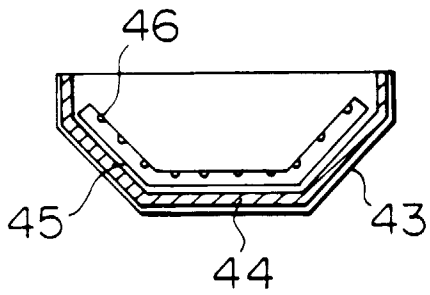


FIG. 3(c)

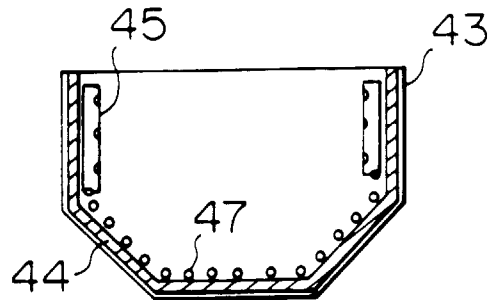


FIG. 4

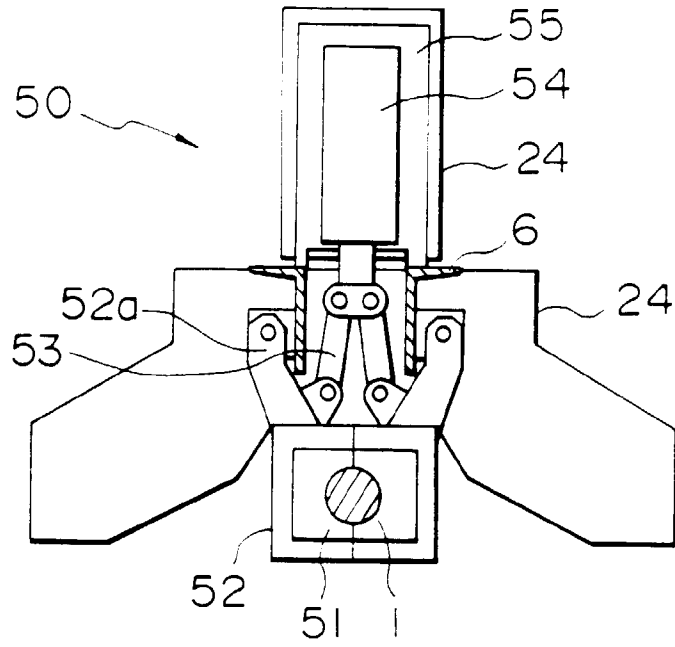


FIG. 5

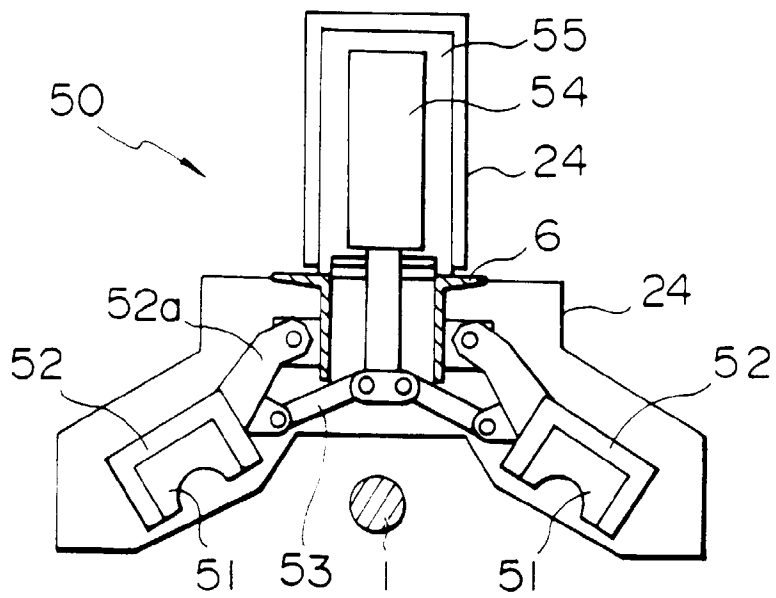




FIG. 8

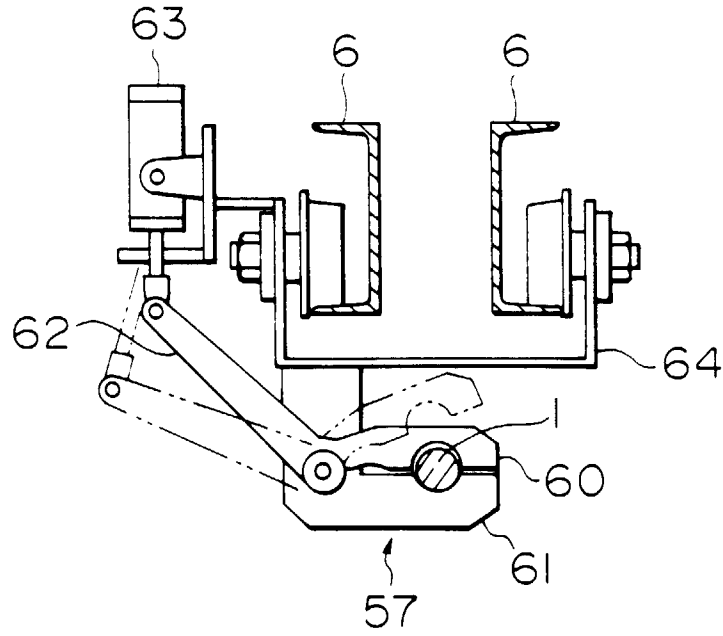


FIG. 9

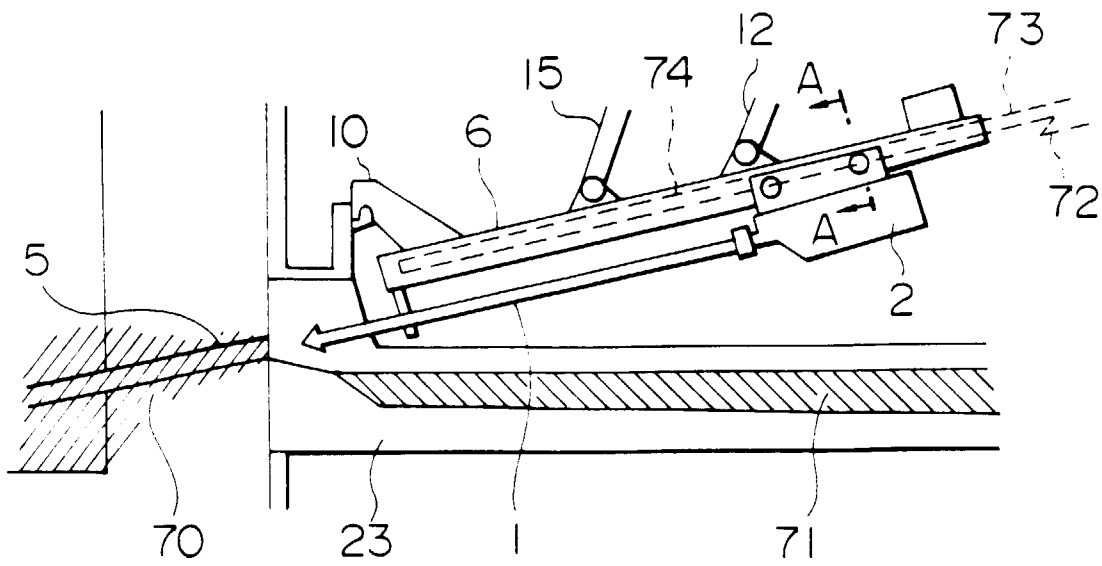


FIG.10(a) FIG.10(c)

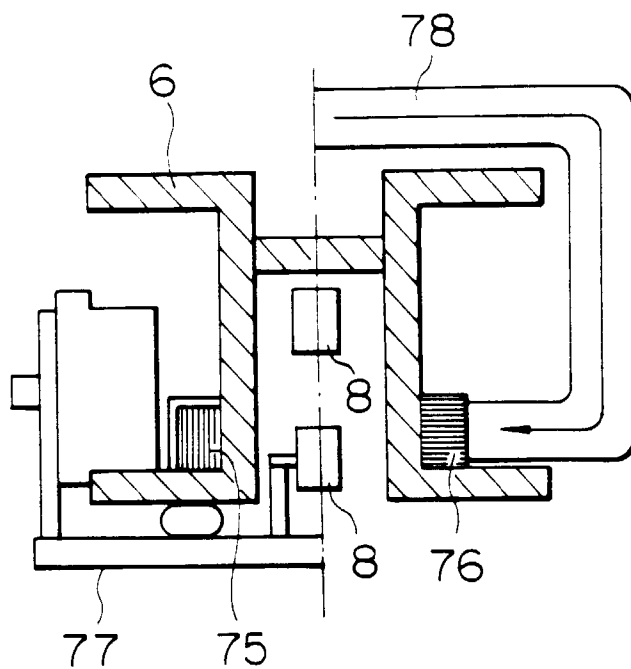


FIG. 10(b)

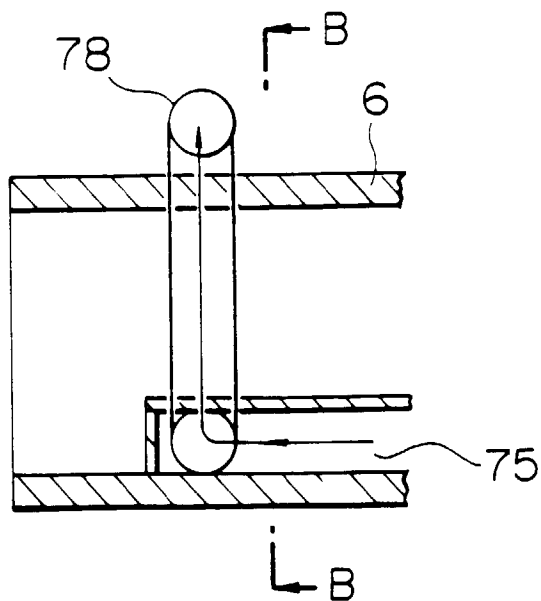


FIG. 11(a)

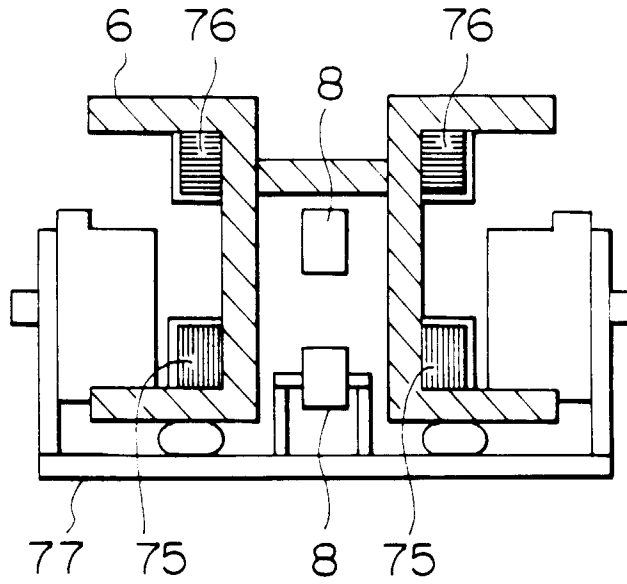


FIG. 11(b)

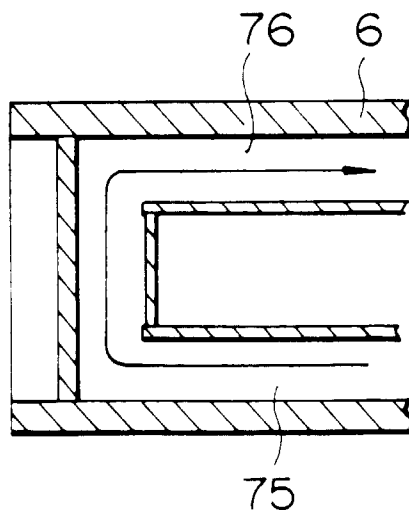


FIG. 12(a)

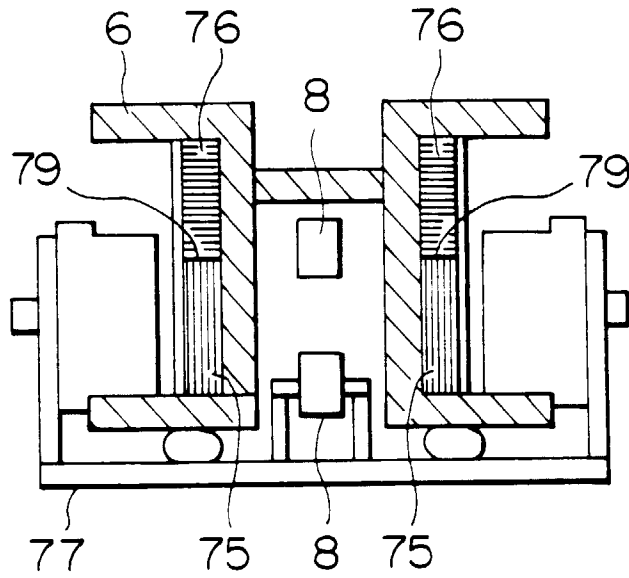


FIG. 12(b)

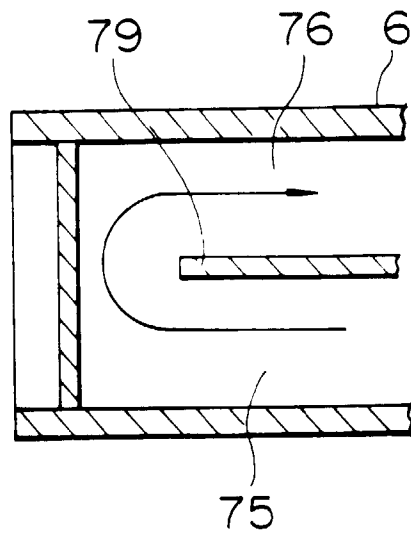


FIG. 13

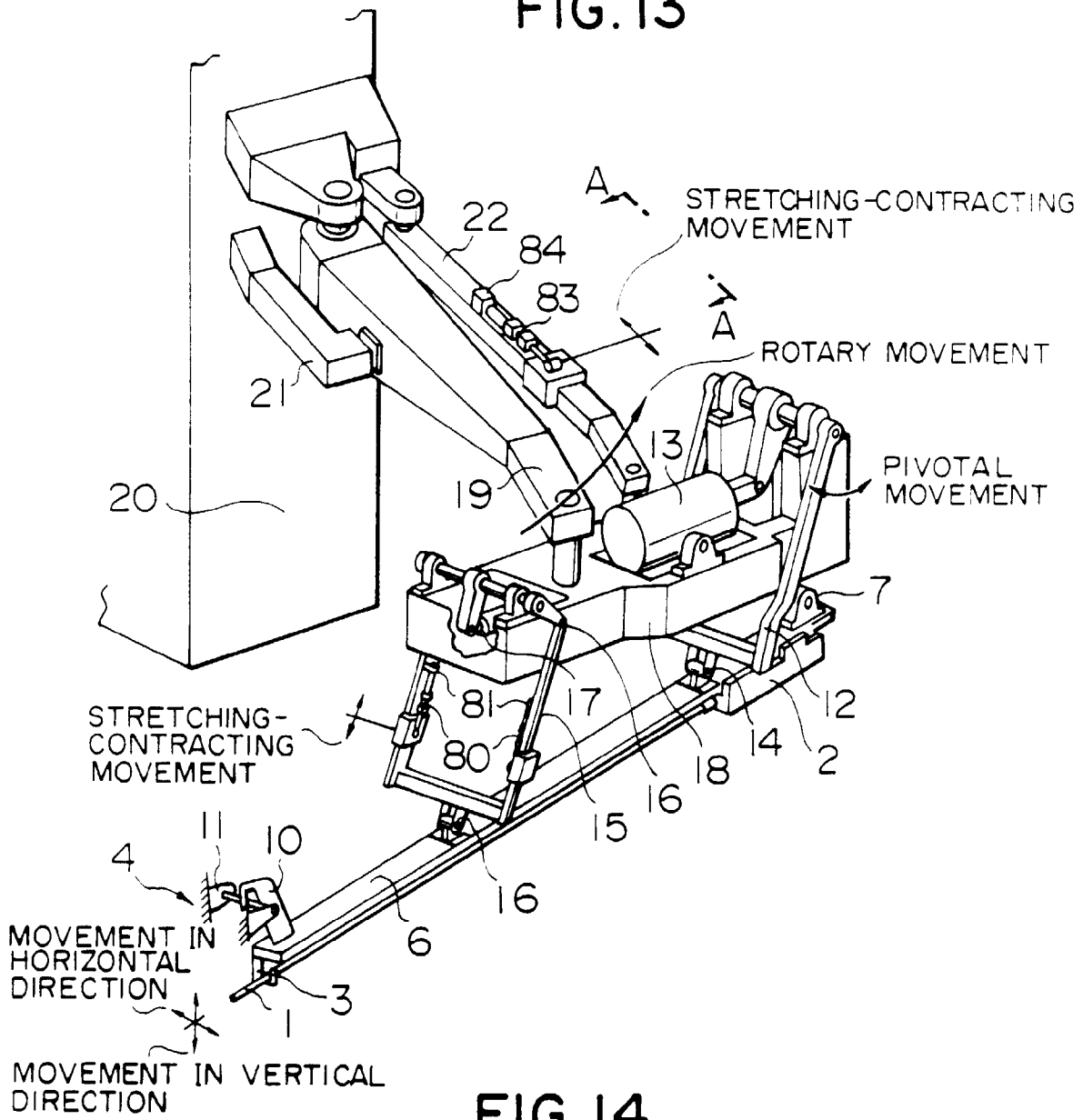


FIG. 14

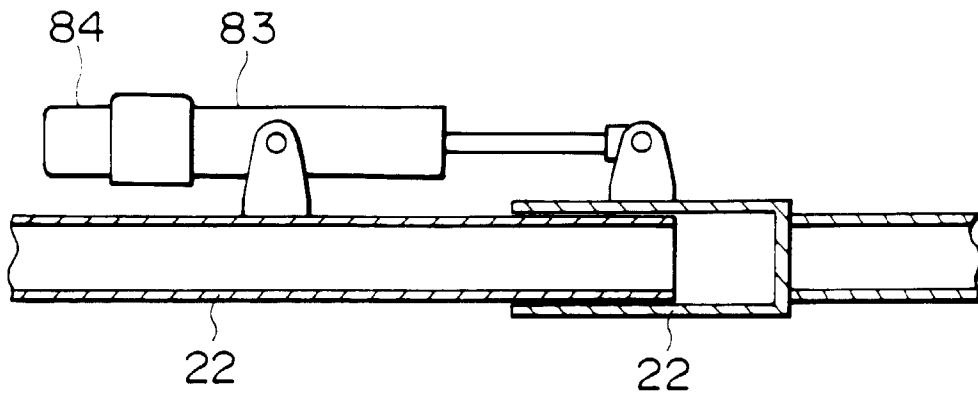


FIG. 15

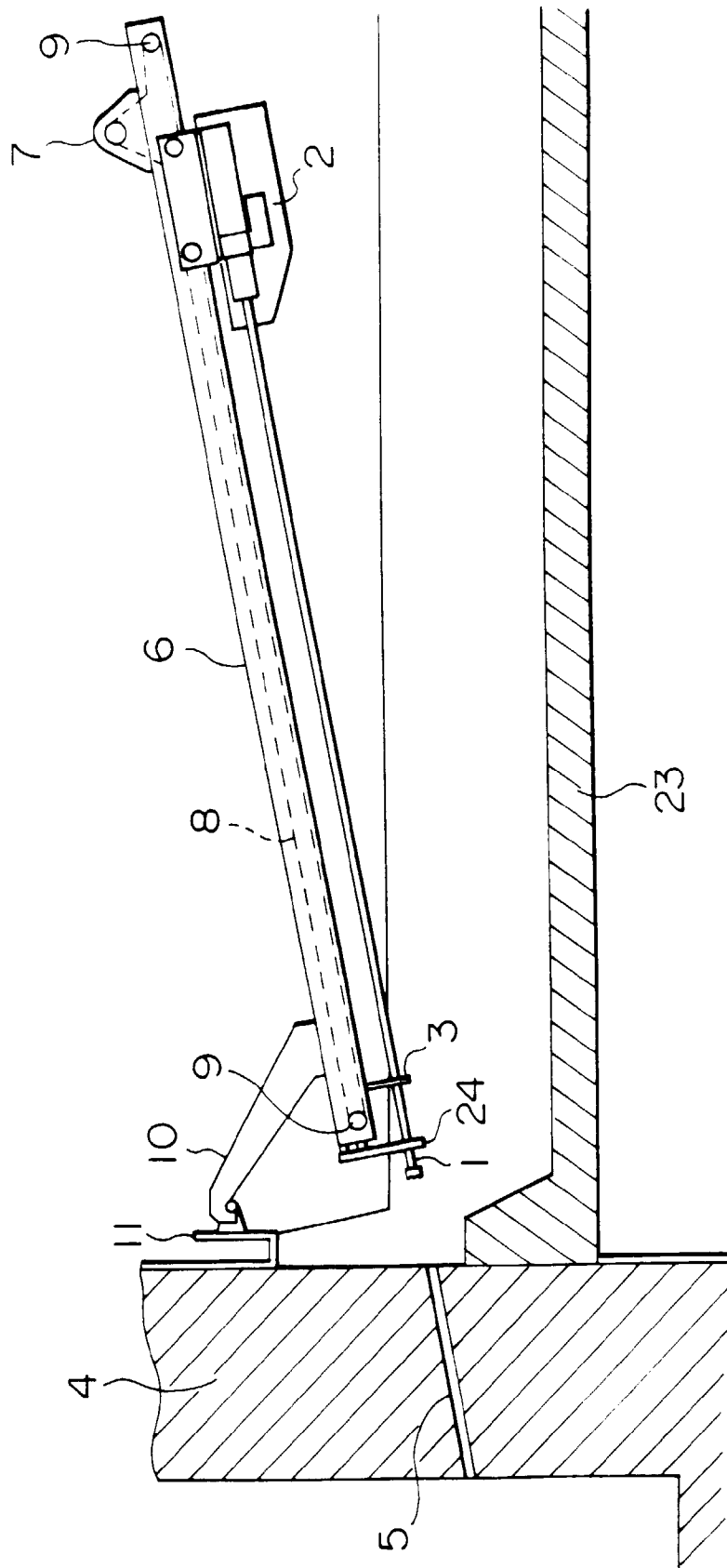


FIG. 16

