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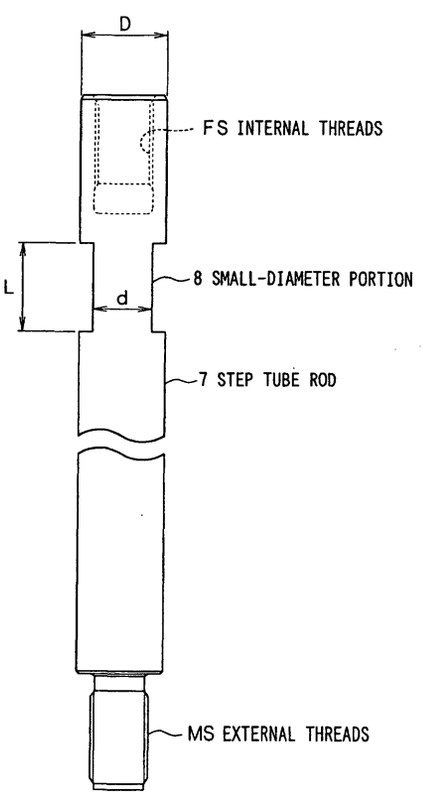
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(54) STEP TUBE ROD, AND DRILLING MACHINE

(57) In the present invention, in a drill rod for a boring machine, a rod outside diameter is large so as to be approximately equal to a bore diameter, external threads are provided at one end and internal threads are provided at the other end, and at least one small-diameter portion is formed near an internally threaded portion. This step tube rod can reduce a bore bend.

Also, for the boring machine using this step tube rod, the drill rod can be positioned easily, so that the connection and recovery work can be performed efficiently and safely.

FIG. 2



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Description

Technical Field

[0001] The present invention relates to a step tube rod and a boring machine using the step tube rod as a drill rod.

Background Art

[0002] A boring machine such as a hydraulic crawler drill and a fan cut drill is provided with a rock drill mounted on a. guide shell. A drill rod is insertedly mounted in the rock drill, and a bit is installed at the tip end of the drill rod. Thereby, a blow and rotation are transmitted from the rock drill to the bit via the drill rod, and the rock drill is fed, whereby a rock-bed is bored.

[0003] For example, in the case where the boring machine is a hydraulic crawler drill 11 as shown in Figure 8, a boom 14 is provided on a carriage 13 provided with a track frame 12 so as to be turnable and tiltable. At the distal end of the boom 14 is supported a guide shell 16 mounted with a rock drill 15 so as to be capable of tilting and swinging. The rock drill 15 is insertedly mounted with a drill rod 1 connected by a sleeve 2, and at the tip end of the drill rod 1 is installed a bit 3 having an outside diameter approximately equal to a bore diameter Dh.

[0004] The rock drill 15 has a blowing mechanism, a rotating mechanism, and a flushing mechanism (not shown). The rock drill 15 is moved longitudinally by a feed force given by a feed motor 17 provided on the guide shell 16, and transmits a blow and rotation to the bit 3 via the drill rod 1, whereby a rock-bed R is bored. Also, the flushing mechanism supplies compressed air to the tip end of the drill rod 1 to discharge cuttings. In the tip end portion of the guide shell 16, a hood 18 is provided to cover the bore and to collect cuttings.

[0005] In the case where the bore length is great, a plurality of drill rods 1 are connected successively at the time of boring work. The supply and connection of the drill rods 1 and the separation and recovery of the drill rods 1 after the boring work is finished are carried out mechanically by using a rod changer 19.

[0006] In the case where the connection and recovery of the drill rod 1 are carried out, the drill rod 1 must be clamped so that the central axis of the drill rod 1 is fixed when the drill rod 1 is connected or separated, so that a rod clamping device 4 is provided in the vicinity of the tip end portion of the guide shell 16.

[0007] The general drill rod 1 used for the above-described hydraulic crawler drill 11 has a hexagonal or circular external shape and has a predetermined size of 51 mm, 45 mm, 38 mm, etc. in outside diameter according to the size of connecting screw (T51 screw, T45 screw, T38 screw, etc.). This outside diameter is considerably smaller than the bore diameter Dh.

[0008] The drill rod 1 is available in two types: an MM rod 1A provided with external threads MS at both ends as shown in Figure 9(a), and an MF rod 1B which is provided with external threads MS at one end and the other end of which has a larger diameter and is provided with internal threads FS on the inside as shown in Figure 9 (b). When the MM rod 1A is used, it is connected via a sleeve 2, and when the MF rod 1B is used, the external threads MS and the internal threads FS are engaged directly with each other.

[0009] As shown in Figures 10 and 11, the rod clamping device 4 is constructed so that the drill rod 1 having a particular diameter is clamped by a pair of clamps 5 pivotally supported by pins 6 so as to be capable of being opened and closed. On the internal surface of the clamp 5, a large-diameter portion 5L and a small-diameter portion 5S are formed. When the MM rod 1A is used, the large-diameter portion 5L holds a portion of the sleeve 2, and when the MF rod 1B is used, the large-diameter portion 5L holds an internally threaded portion 1BL having a larger diameter.

[0010] This rod clamping device 4 not only clamps the sleeve 2 so as to prevent the rotation of the sleeve 2, but also easily positions the drill rod 1 by a diameter difference between the large-diameter portion 5L and the small-diameter portion 5S of the clamp 5.

[0011] Also, for a fan cut drill, a down-the-hole drill, and the like, a tube rod 1C as shown in Figure 9 (c) has been devised and used. This tube rod 1C is provided with external threads MS at one end and internal threads FS at the other end, and has a larger outside diameter than the MM rod 1A and the MF rod 1B, and the outside diameter of the tube rod 1C is approximately equal to the bore diameter. Therefore, a bore bend at the time when a long hole is bored is reduced, and the cuttings discharge efficiency can be improved.

[0012] When such a tube rod 1C is used, a rod clamping device 40 as shown in Figures 12 and 13 is provided for the fan cut drill, and a double clamp type rod clamping device 50 as shown in Figures 14 and 15 is provided for the down-the-hole drill.

[0013] The rod clamping device 40 shown in Figures 12 and 13 is constructed so that the drill rod 1 having a particular diameter is clamped by a pair of clamps 45 pivotally supported by pins 46 so as to be capable of being opened and closed. The inside diameter of the clamp 45 is constant, and there is formed no diameter difference.

[0014] The rod clamping device 50 shown in Figures 14 and 15 is constructed so that clamps 55 are opened and closed by right and left clamping cylinders 56, by which the drill rod 1 having a particular diameter is clamped. The inside diameter of the clamp 55 is constant, and there is formed no diameter difference.

[0015] If the tube rod 1C is used as the drill rod 1 to reduce a bore bend, since a rod clamping device of a type such that the clamp 45, 55 has no diameter difference as in the rod clamping device 40 shown in Figure 12 and the rod clamping device 50 shown in Figure 14 is used, the positioning of the drill rod 1 is unstable, so

that the work time increases significantly, and also danger in the connection and recovery work for drill rod increases.

[0016] Further, for the hydraulic crawler drill 11, if the tube rod 1C is used as the drill rod 1, the rod clamping device 4 shown in Figure 10 cannot be used as it is, and the function of the generally mounted rod changer 19 cannot be fulfilled.

[0017] The present invention has been made to solve the above problems with a boring machine, and accordingly an object thereof is to provide a step tube rod which can reduce a bore bend and in which the conventional rod clamping device and rod changer can be used as they are, and the positioning of drill rod is easy to perform, so that connection and recovery work can be performed efficiently and safely, and a boring machine using this step tube rod.

Disclosure of Invention

[0018] A step tube rod in accordance with the present invention is constructed so that in a drill rod for a boring machine, a rod outside diameter is large so as to be approximately equal to a bore diameter, external threads are provided at one end and internal threads are provided at the other end, and at least one small-diameter portion is formed near an internally threaded portion.

[0019] The step tube rod may also be constructed so that a rod outside diameter is large so as to be approximately equal to a bore diameter, external threads are provided at both ends so that the rods are connected via a sleeve, and at least one small-diameter portion is formed near an externally threaded portion.

[0020] The above-described step tube rod can reduce a bore bend at the time of boring because the outside diameter thereof is large so as to be approximately equal to the bore diameter.

[0021] Also, the small-diameter portion is formed near the internally threaded portion for the step tube rod provided with the external threads at one end and the internal threads at the other end or near the externally threaded portion for the step tube rod provided with the external threads at both ends and connected via the sleeve. Therefore, for the boring machine, the step tube rod can be used as a drill rod merely by slightly modifying the conventional rod clamping device.

[0022] For the boring machine using the step tube rod as a drill rod, the drill rod can be positioned easily, so that the connection and recovery work can be performed efficiently and safely.

[0023] Feigned striking for loosening a screw of the connected step tube rod is performed after the completion of boring. However, when screw loosening is insufficient, feigned striking is performed in a state in which the step tube rod is fixed to the rod clamping device.

[0024] Therefore, for the step tube rodprovidedwith the external threads at one end and the internal threads at the other end, it is preferable that the small-diameter portion has an outside diameter which is 90% or less of the rod outside diameter and has a length which is 50% or more of the rod outside diameter.

[0025] Also, for the step tube rod provided with the external threads at both ends and connected via the sleeve, it is preferable that the small-diameter portion has an outside diameter which is 90% or less of the sleeve outside diameter and has a length which is 50% or more of the sleeve outside diameter.

[0026] For the boring machine, in addition to the case where the step tube rod is used for all drill rods, the step tube rod may be used only for the tip-end drill rod. Even in the case where the step tube rod is used only for the tip-end drill rod, a bore bend at the time of boring can be reduced as compared with the case where the conventional drill rod is used.

Brief Description of Drawings

[0027]

Figure 1 is a side view of a hydraulic crawler drill using a step tube rod in accordance with the present invention as a drill rod;

Figure 2 is a construction view of a step tube rod in accordance with one embodiment of the present invention;

Figure 3 is an explanatory view showing a state in which a step tube rod is guided by a rod guide;

Figure 4 is an explanatory view showing a state in which a step tube rod is clamped by a rod clamping device;

Figure 5 is a construction view of a step tube rod in accordance with another embodiment of the present invention;

Figure 6 is an explanatory view showing a state in which a step tube rod is clamped by a rod clamping device;

Figure 7 is a construction view of a step tube rod in accordance with other embodiments of the present invention;

Figure 8 is a side view of a hydraulic crawler drill using a conventional drill rod;

Figure 9 is a construction view of conventional drill rods;

Figure 10 is a construction view of a rod clamping device for a conventional hydraulic crawler drill;

Figure 11 is an explanatory view showing a state in which a conventional drill rod is clamped by a rod clamping device;

Figure 12 is a construction view of a rod clamping device for a conventional fan cut drill;

Figure 13 is a sectional view taken along the line A-A of Figure 12;

Figure 14 is a construction view of a rod clamping device for a conventional down-the-hole drill; and

Figure 15 is a sectional view taken along the line B-B of Figure 14.

Best Mode for Carrying out the Invention

[0028] Figure 1 is a side view of a hydraulic crawler drill using a step tube rod in accordance with the present invention as a drill rod, Figure 2 is a construction view of a step tube rod in accordance with one embodiment of the present invention, Figure 3 is an explanatory view showing a state in which the step tube rod is guided by a rod guide, and Figure 4 is an explanatory view showing a state in which the step tube rod is clamped by a rod clamping device.

[0029] The construction of a hydraulic crawler drill 10 shown in Figure 1 is basically the same as that of the conventional hydraulic crawler drill 11 shown in Figure 8. Therefore, description is given by applying the same reference numeral to the same element.

[0030] In this hydraulic crawler drill 10 as well, a boom 14 is provided on a carriage 13 provided with a track frame 12 so as to be turnable and tiltable. At the distal end of the boom 14 is supported a guide shell 16 mounted with a rock drill 15 so as to be capable of tilting and swinging. The rock drill 15 is insertedly mounted with a connected step tube rod 7 as a drill rod, and at the tip end of the step tube rod 7 is installed a bit 3 having an outside diameter approximately equal to a bore diameter Dh.

[0031] The rock drill 15 has a blowing mechanism, a rotating mechanism, and a flushing mechanism (not shown). The rock drill 15 is moved longitudinally by a feed force given by a feed motor 17 provided on the guide shell 16, and transmits a blow and rotation to the bit 3 via the step tube rod 7, whereby a rock-bed R is bored. Also, the flushing mechanism supplies compressed air to the tip end of the step tube rod 7 to discharge cuttings. In the tip end portion of the guide shell 16, a hood 18 is provided to cover the bore and to collect cuttings.

[0032] In the case where the bore length is great, a plurality of step tube rods 7 are connected successively at the time of boring work. The supply and connection of the step tube rods 7 and the separation and recovery of the step tube rods 7 after the boringwork is finished are carriedoutmechanically by using a rod changer 19.

[0033] In the case where the connection and recovery of the step tube rod 7 are carried out, the step tube rod 7 must be clamped so that the central axis of the step tube rod 7 is fixed when the step tube rod 7 is connected or separated, so that a rod clamping device 4 is provided in the vicinity of the tip end portion of the guide shell 16.

[0034] Also, in front of the rod clamping device 4, there is provided a rod guide 9 which holds the step tube rod 7 in the center to guide it when clamping by the rod clamping device 4 is released and boring is performed.

[0035] The step tube rod 7 has a large rod outside diameter D that is approximately equal to the bore diameter Dh, and is provided with external threads MS at one end and internal threads FS at the other end. The step tube rods 7 are connected by directly engaging the external threads MS with the internal threads FS. Also, a small-diameter portion 8 is formed near an internally threaded portion.

[0036] The small-diameter portion 8 is formed so that the outside diameter d thereof is 90% or less of the rod outside diameter D and the length L thereof is 50% or more of the rod outside diameter D, that is,

$$d \leq 0.9D,$$

and

$$L \geq 0.5D.$$

[0037] When boring is performed, as shown in Figure 3, the step tube rod 7 is guided by the rod guide 9 and is held in the center of the guide shell 16.

[0038] At the time of connection and recovery work, as shown in Figure 4, the step tube rod 7 is clamped by the rod clamping device 4 provided on the guide shell 16 of the hydraulic crawler drill 10.

[0039] The rod clamping device 4 is provided with a pair of clamps 5 pivotally supported by pins 6 so as to be capable of being opened and closed. On the internal surface of the clamp 5, a large-diameter portion 5L and a small-diameter portion 5S are formed, and the large-diameter portion 5L holds the internally threaded portion of the step tube rod 7.

[0040] Therefore, the step tube rod 7 is clamped by the rod clamping device 4 so as to be prevented from rotating, and is positioned by a diameter difference between the large-diameter portion 5L and the small-diameter portion 5S of the clamp 5.

[0041] Since the step tube rod 7 has the large outside diameter D approximately equal to the bore diameter Dh, a bore bend occurring at the time of boring is reduced. Also, since the small-diameter portion 8 is formed at the outer periphery near the internally threaded portion, for the hydraulic crawler drill 10, the step tube rod 7 can be used as a drill rod merely by slightly modifying the conventional rod clamping device.

[0042] For the hydraulic crawler drill 10 using the step tube rod 7 as a drill rod, the step tube rod 7 can be positioned easily, so that the connection and recovery work can be performed efficiently and safely.

[0043] Since the outside diameter d of the small-diameter portion 8 is 90% or less of the rod outside diameter D and the length L thereof is 50% or more of the rod outside diameter D, when screw loosening is insufficient, feigned striking can be performed without trouble in a state in which the step tube rod 7 is fixed to the rod clamping device 4.

[0044] Figure 5 is a construction view of a step tube rod in accordance with another embodiment of the present invention, and Figure 6 is an explanatory view showing a state in which the step tube rod is clamped

by a rod clamping device.

[0045] This step tube rod 7 has a large rod outside diameter D that is approximately equal to the bore diameter Dh, and is provided with external threads MS at both ends. The step tube rods 7 are connected via a sleeve 2 provided with internal threads FS on the inside. The outside diameter Ds of the sleeve 2 is equal to the rod outside diameter D.

[0046] Also, a small-diameter portion 8 is formed near an externally threaded portion. The small-diameter portion 8 is formed so that the outside diameter d thereof is 90% or less of the sleeve outside diameter Ds and the length L thereof is 50% or more of the sleeve outside diameter Ds, that is,

$$d \leq 0.9Ds,$$

and

$$L \geq 0.5Ds.$$

[0047] The step tube rod 7 can be formed into shapes shown in Figures 7(a) and 7(b).

[0048] At the time of connection and recovery work, as shown in Figure 6, the step tube rod 7 is clamped by a rod clamping device 4 provided on a guide shell 16 of the hydraulic crawler drill 10.

[0049] The rod clamping device 4 is providedwith a pair of clamps 5 pivotally supported by pins 6 so as to be capable of being opened and closed. On the internal surface of the clamp 5, a large-diameter portion 5L and a small-diameter portion 5S are formed, and the large-diameter portion 5L holds a portion of the sleeve 2.

[0050] Therefore, the step tube rod 7 and the sleeve 2 are clamped by the rod clamping device 4 so as to be prevented from rotating, and are positioned by a diameter difference between the large-diameter portion 5L and the small-diameter portion 5S of the clamp 5.

[0051] Since the step tube rod 7 has the large outside diameter D approximately equal to the bore diameter Dh, a bore bend occurring at the time of boring is reduced. Also, since the small-diameter portion 8 is formed near an externally threaded portion, for the hydraulic crawler drill 10, the step tube rod 7 can be used as a drill rod merely by slightly modifying the conventional rod clamping device.

[0052] For the hydraulic crawler drill 10 using the step tube rod 7 as a drill rod, the step tube rod 7 can be positioned easily, so that the connection and recovery work can be performed efficiently and safely.

[0053] Since the outsidediameterdof the small-diameterportion 8 is 90% or less of the sleeve outside diameter Ds and the length L thereof is 50% or more of the sleeve outside diameter Ds, when screw loosening is insufficient, feigned striking can be performed without trouble in a state in which the step tube rod 7 is fixed to the rod clamping device 4.

[0054] For the hydraulic crawler drill 10, in addition to the case where the step tube rod 7 is used for all drill rods, the step tube rod 7 may be used only for the tip-end drill rod. Even in the case where the step tube rod 7 is used only for the tip-end drill rod, a bore bend at the time of boring can be reduced as compared with the case where the conventional drill rod 1 is used.

Industrial Applicability

[0055] As described above, for the step tube rod in accordance with the present invention, a bore bend at the time of boring can be reduced. Also, the small-diameter portion is formed near the internally threaded portion for the step tube rod provided with the external threads at one end and the internal threads at the other end or near the externally threaded portion for the step tube rod provided with the external threads at both ends and connected via the sleeve. Therefore, for this boring machine, the step tube rod can be used as a drill rod merely by slightly modifying the conventional rod clamping device.

[0056] For the boring machine using the step tube rod as a drill rod, the drill rod can be positioned easily, so that the connection and recovery work can be performed efficiently and safely.

Claims

1. A step tube rod **characterized in that** in a drill rod for a boring machine, a rod outside diameter is large so as to be approximately equal to a bore diameter, external threads are provided at one end and internal threads are provided at the other end, and at least one small-diameter portion is formed near an internally threaded portion.

2. The step tube rod according to claim 1, **characterized in that** the small-diameter portion has an outside diameter which is 90% or less of the rod outside diameter and has a length which is 50% or more of the rod outside diameter.

3. A step tube rod **characterized in that** in a drill rod for a boring machine, a rod outside diameter is large so as to be approximately equal to a bore diameter, external threads are provided at both ends so that the rods are connected via a sleeve, and at least one small-diameter portion is formed near an externally threaded portion.

4. The step tube rod according to claim 3, **characterized in that** the small-diameter portion has an outside diameter which is 90% or less of the sleeve outside diameter and has a length which is 50% or more of the sleeve outside diameter.

5. A boring machine **characterized by** using the step tube rod according to claim 1, 2, 3 or 4 as a drill rod.

6. The boring machine according to claim 5, **characterized by** using the step tube rod for a tip-end drill rod.

FIG. 1

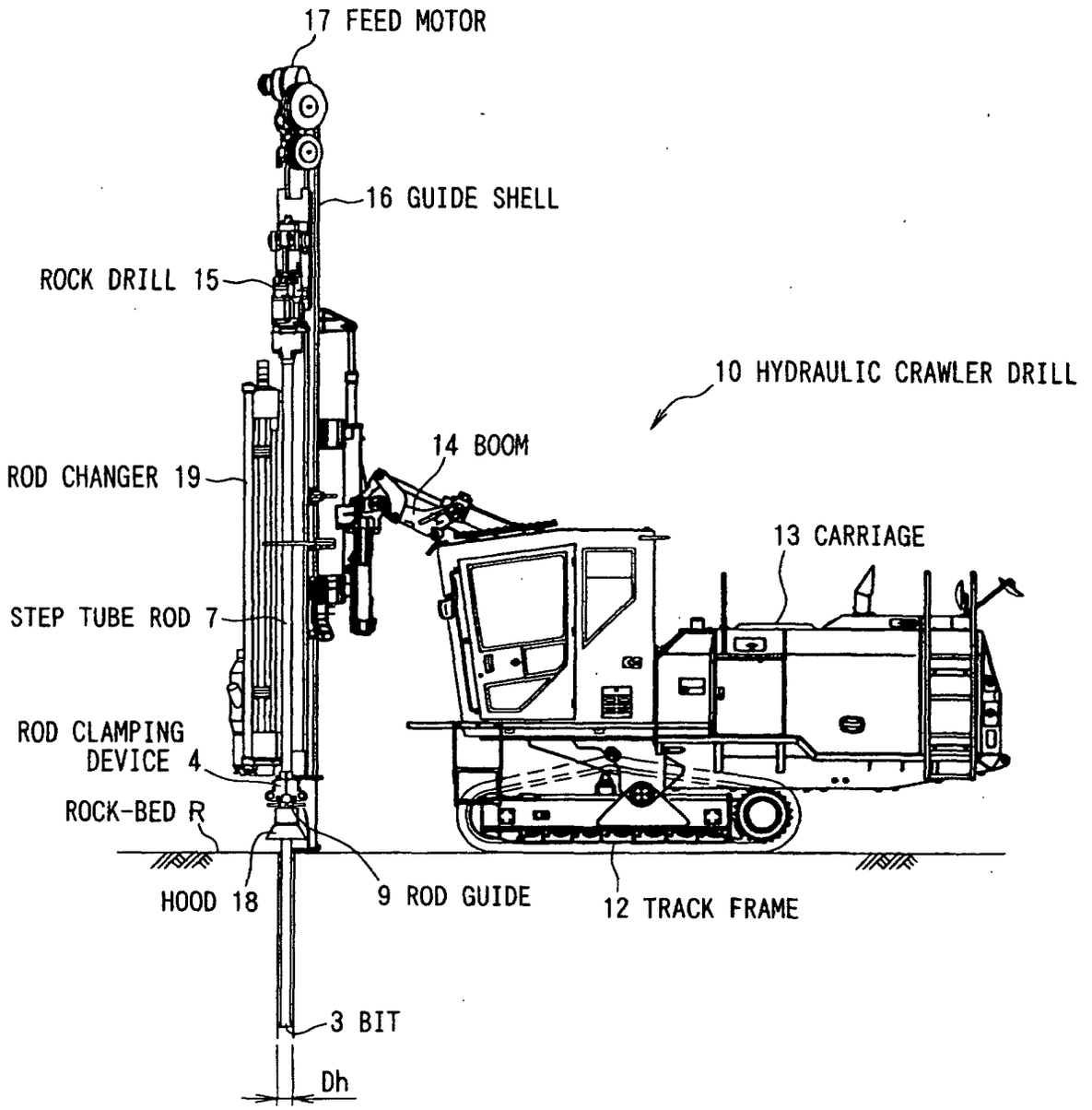
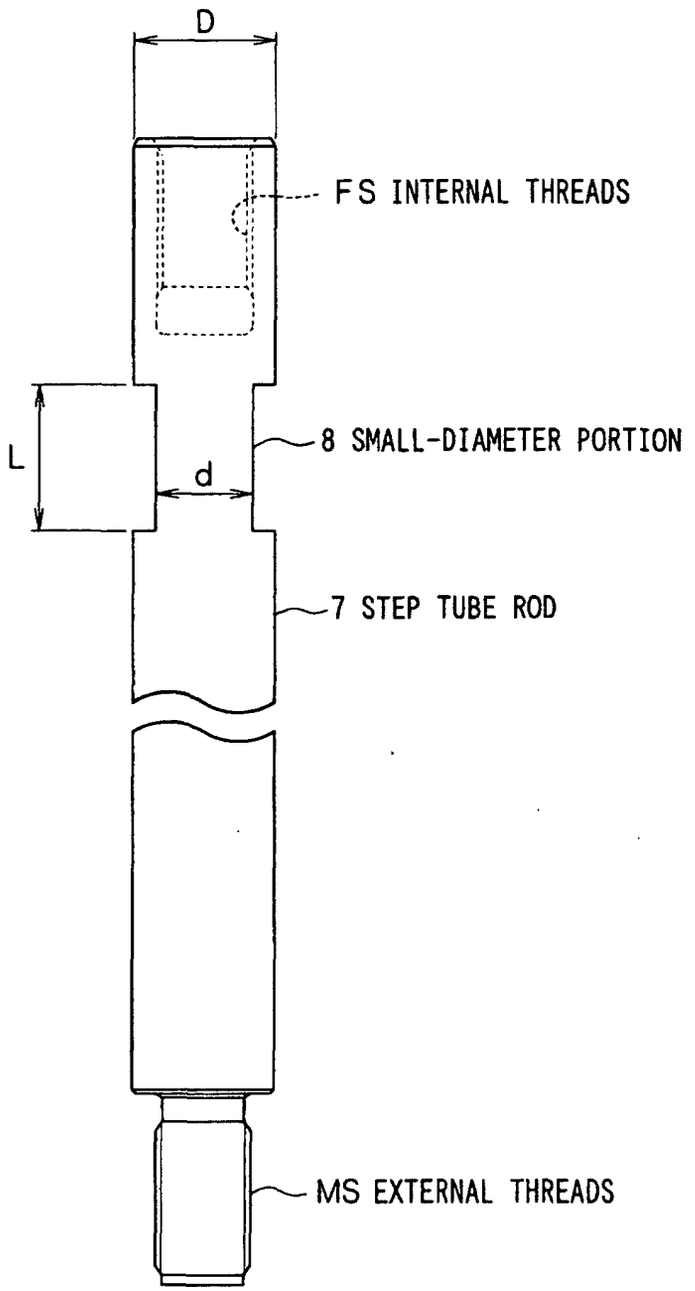

17 FEED MOTOR
16 GUIDE SHELL
ROCK DRILL 15
10 HYDRAULIC CRAWLER DRILL
14 BOOM
ROD CHANGER 19
13 CARRIAGE
STEP TUBE ROD 7
ROD CLAMPING DEVICE 4
ROCK-BED R
HOOD 18
9 ROD GUIDE
12 TRACK FRAME
3 BIT
Dh

FIG. 2


D
FS INTERNAL THREADS
L
d
8 SMALL-DIAMETER PORTION
7 STEP TUBE ROD
MS EXTERNAL THREADS

F I G. 3

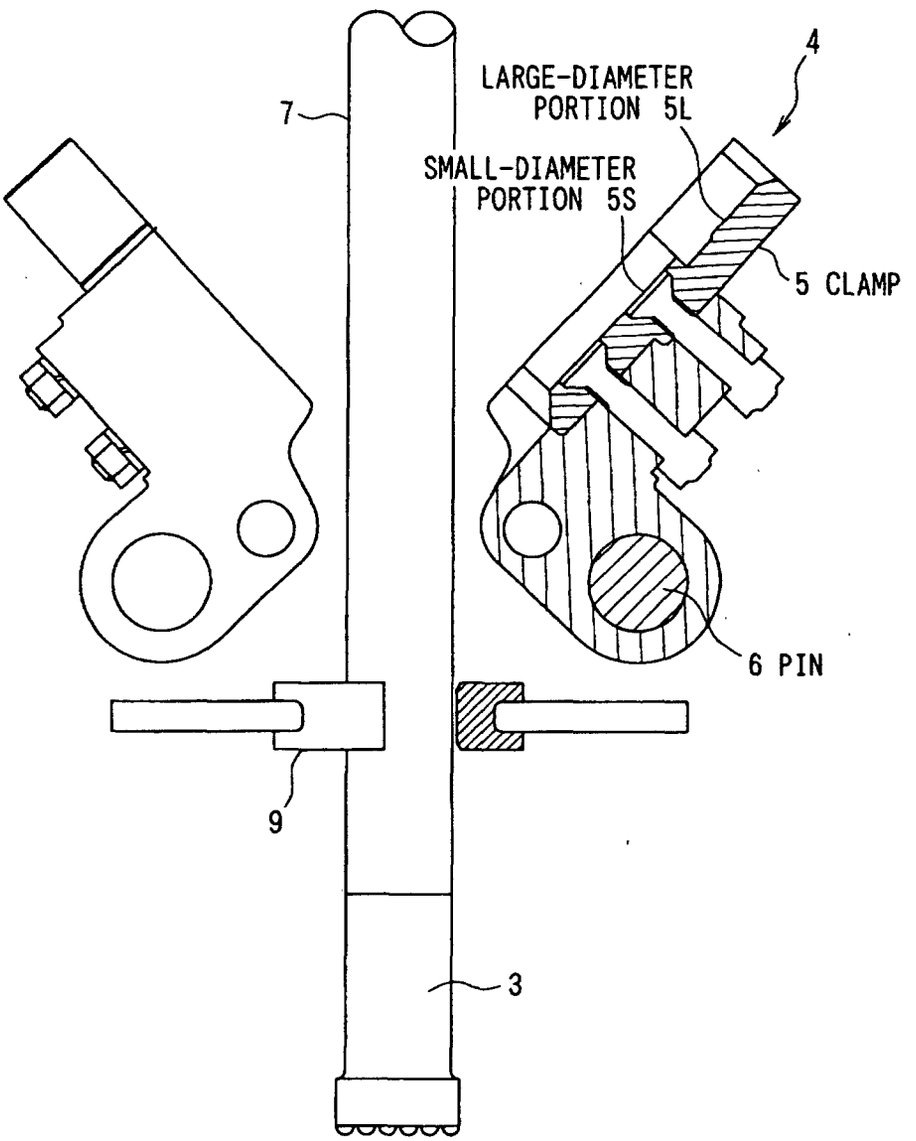

4
LARGE-DIAMETER
PORTION 5L
7
SMALL-DIAMETER
PORTION 5S
5 CLAMP
6 PIN
9
3

FIG. 4

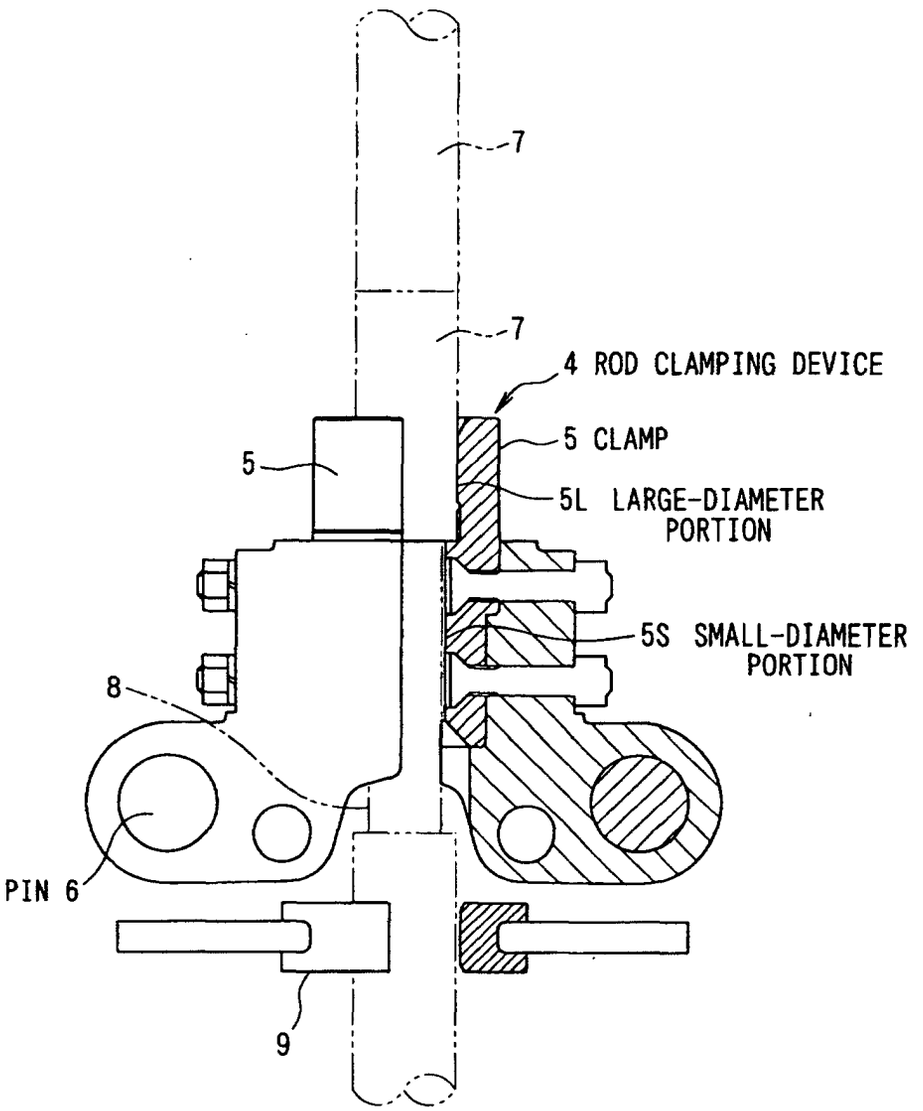

7
7
4 ROD CLAMPING DEVICE
5 CLAMP
5
5L LARGE-DIAMETER PORTION
5S SMALL-DIAMETER PORTION
8
PIN 6
9

FIG. 5

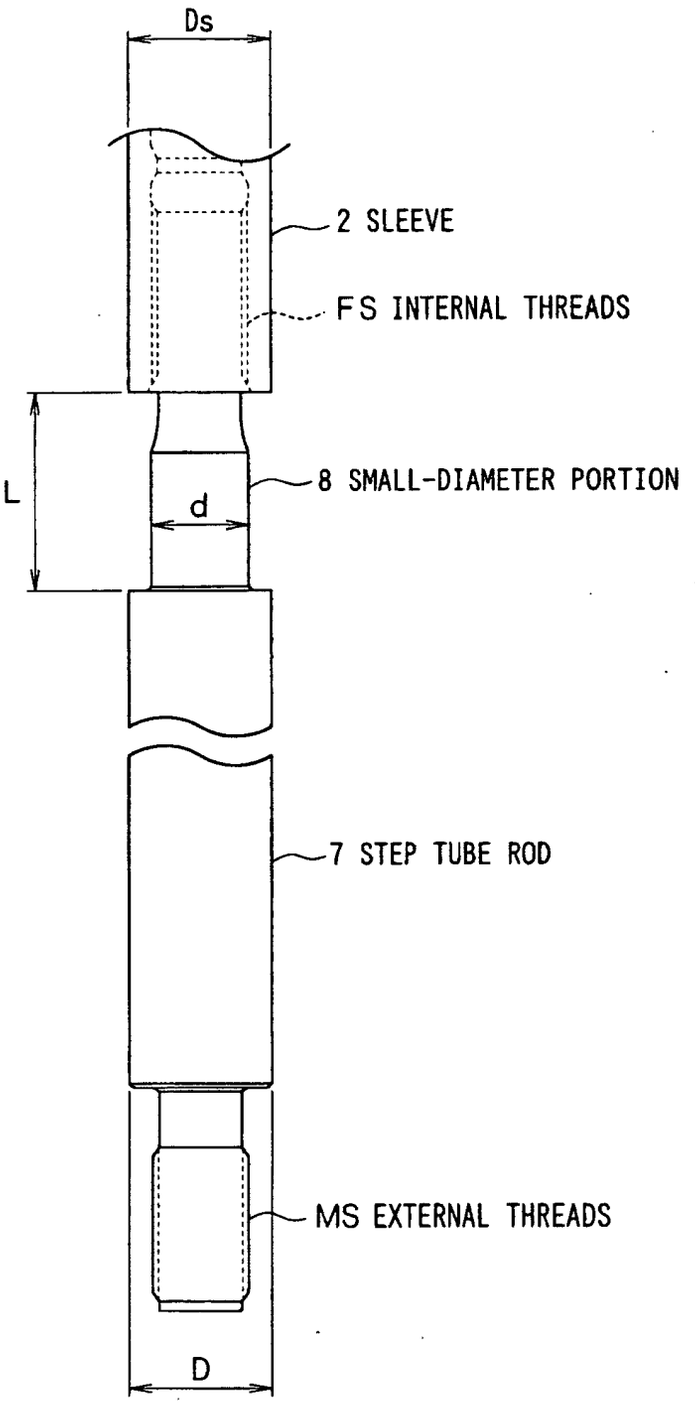

Ds
2 SLEEVE
FS INTERNAL THREADS
L
d
8 SMALL-DIAMETER PORTION
7 STEP TUBE ROD
MS EXTERNAL THREADS
D

FIG. 6

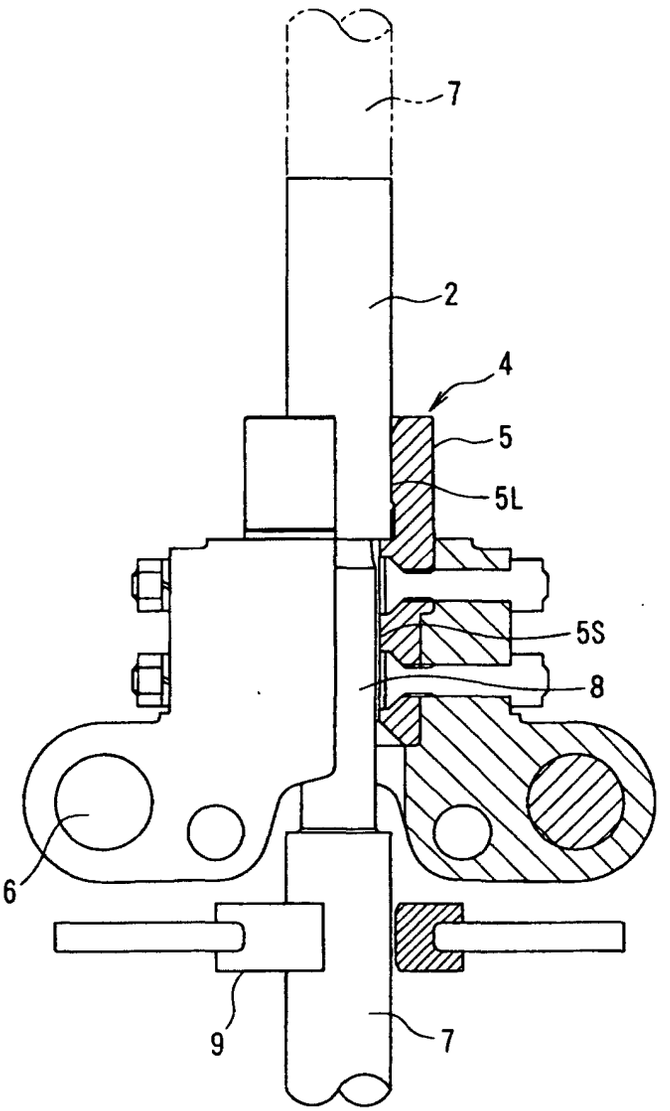


FIG. 7
(a)

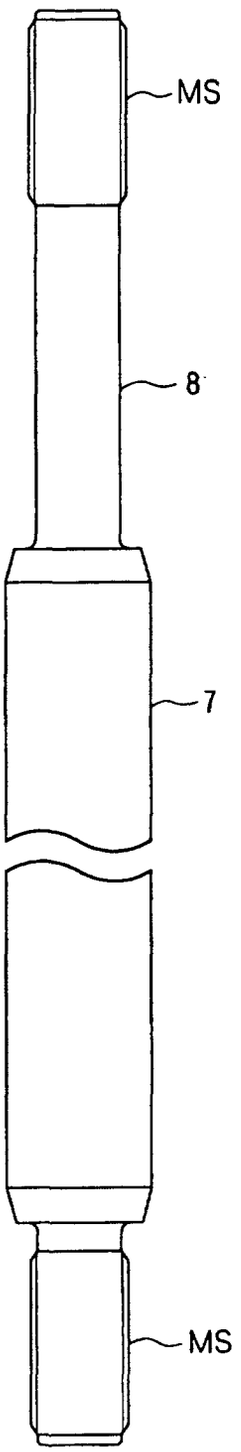


FIG. 7
(b)

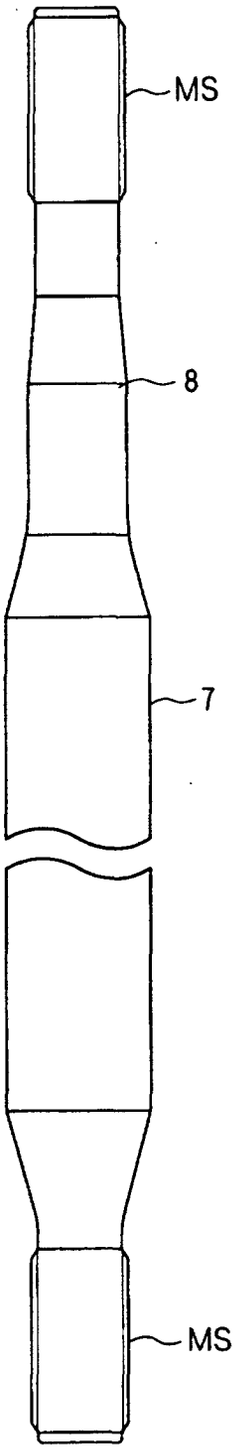


FIG. 8

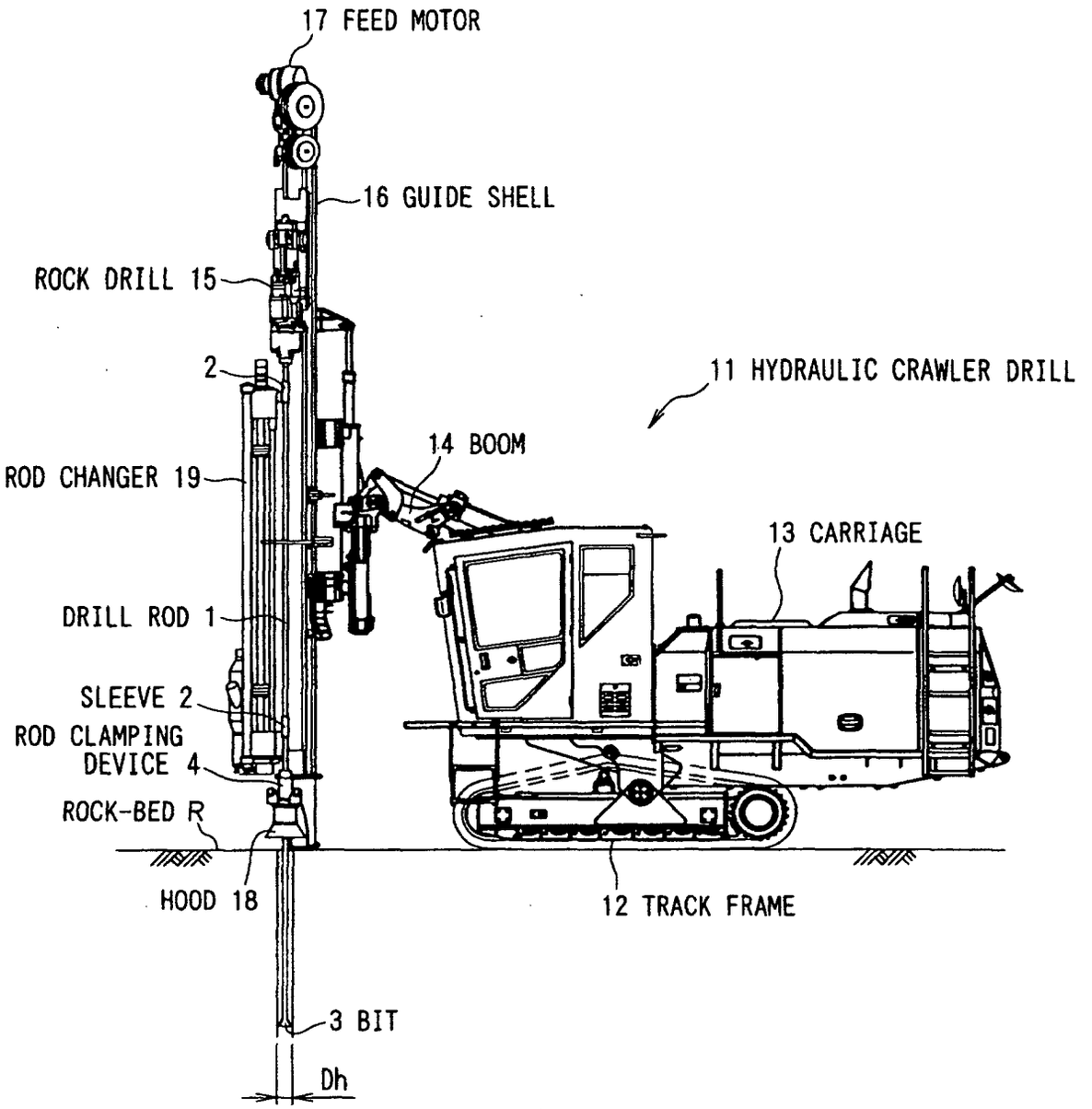

17 FEED MOTOR
16 GUIDE SHELL
ROCK DRILL 15
2
11 HYDRAULIC CRAWLER DRILL
14 BOOM
ROD CHANGER 19
13 CARRIAGE
DRILL ROD 1
SLEEVE 2
ROD CLAMPING DEVICE 4
ROCK-BED R
HOOD 18
12 TRACK FRAME
3 BIT
Dh

FIG. 9(a)

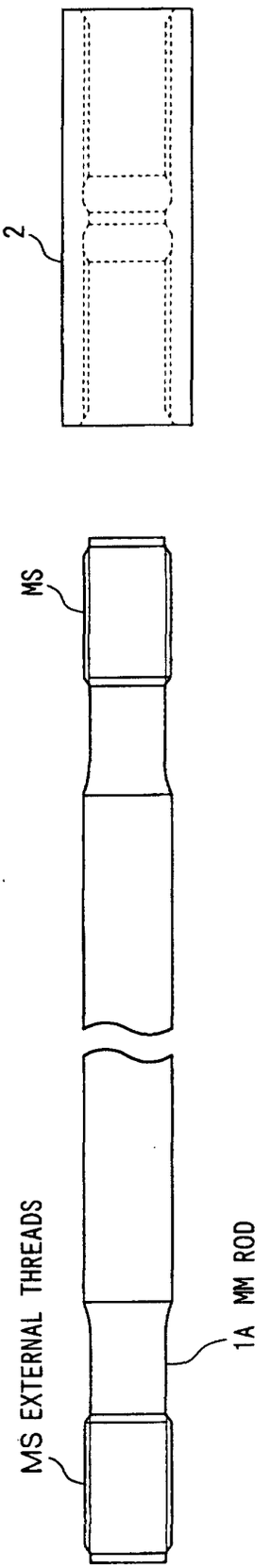


FIG. 9(b)

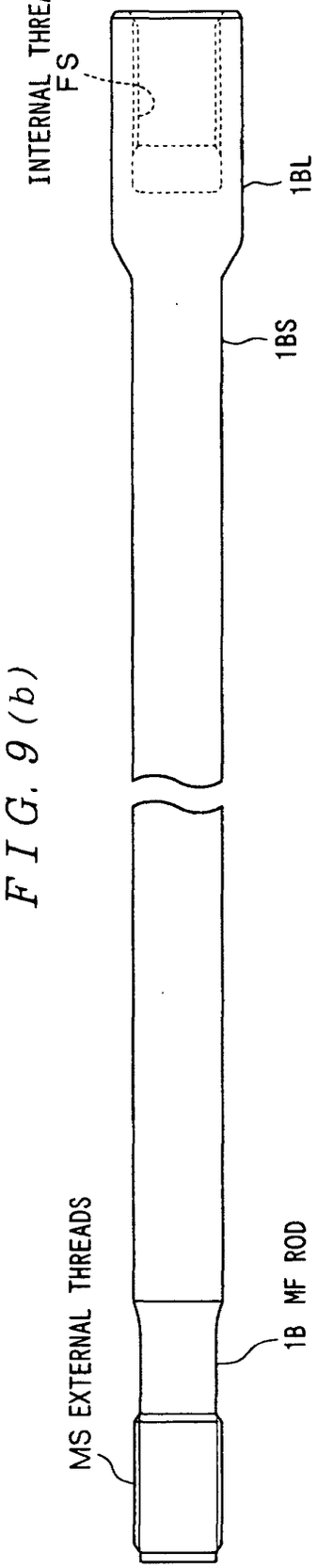
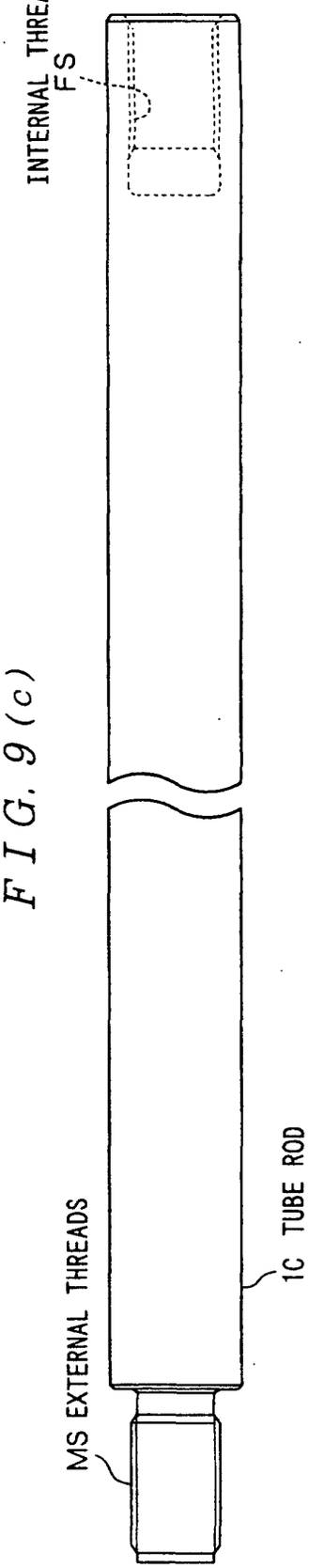


FIG. 9(c)



F I G. 10

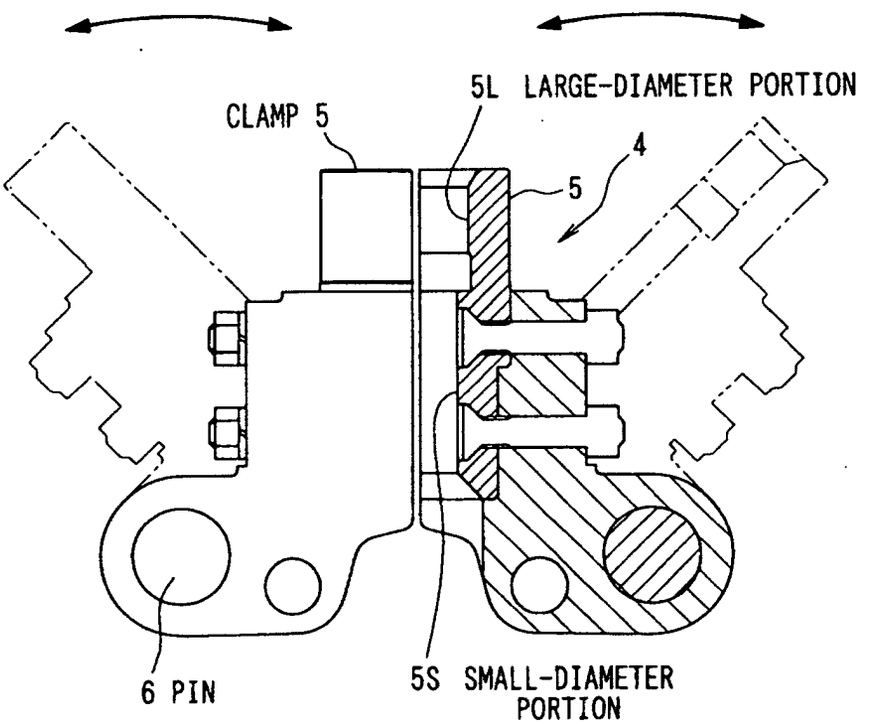

CLAMP 5
5L LARGE-DIAMETER PORTION
4
5
6 PIN
5S SMALL-DIAMETER PORTION

FIG. 11

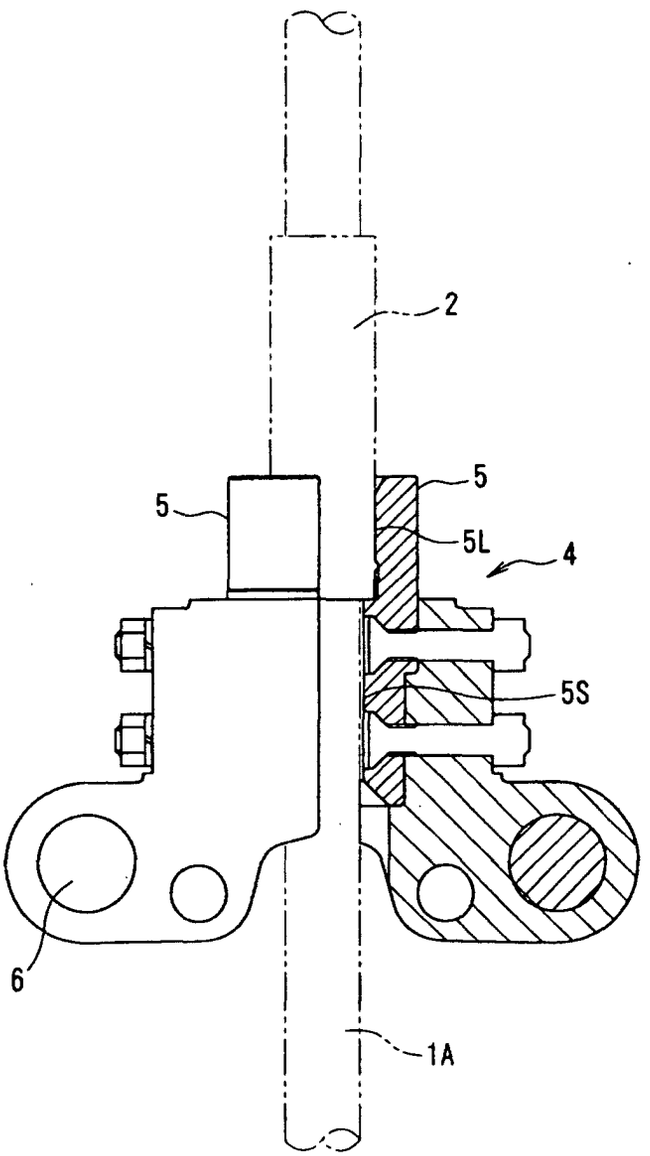


FIG. 12

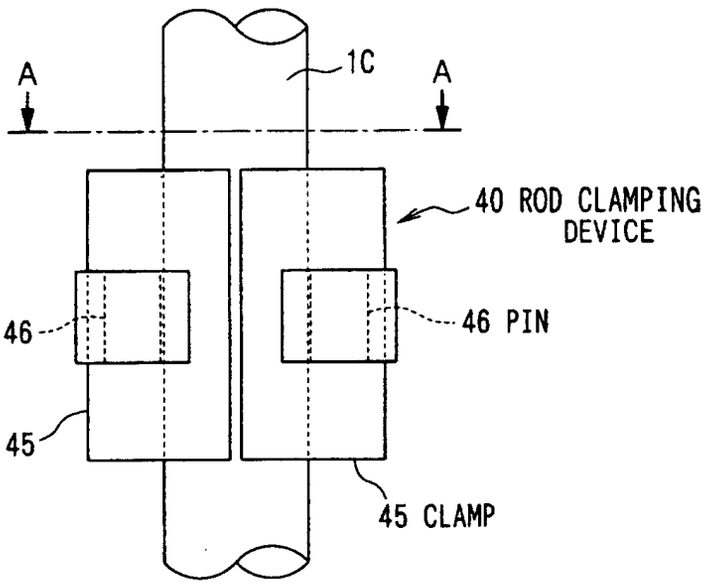

A
1C
A
40 ROD CLAMPING DEVICE
46
46 PIN
45
45 CLAMP

FIG. 13

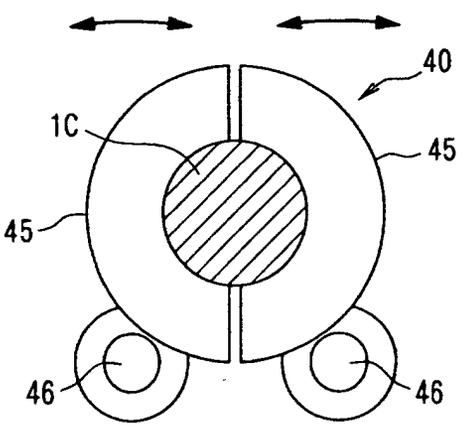

40
1C
45
45
46
46

FIG. 14

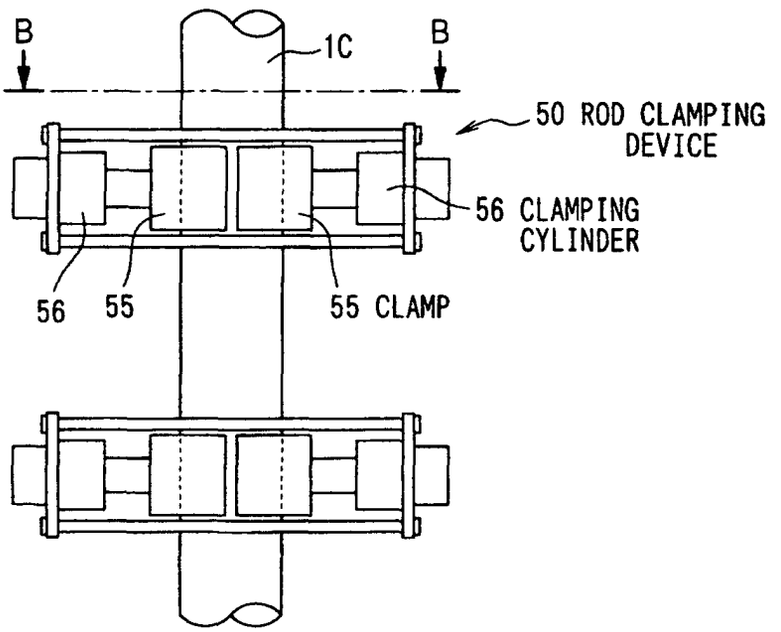
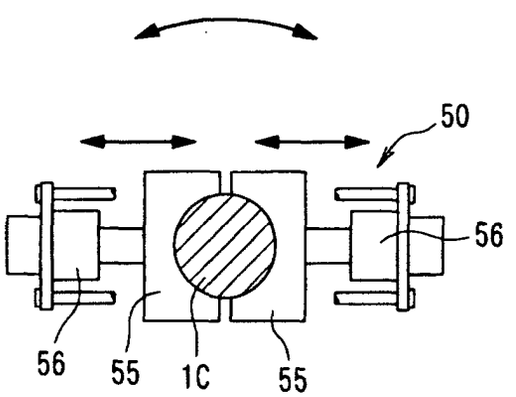

B
1C
B
50 ROD CLAMPING DEVICE
56 CLAMPING CYLINDER
56
55
55 CLAMP

FIG. 15


50
56
56
55
1C
55

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP02/04149

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] E21B17/042, 6/02, 19/24

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl[7] E21B17/042, 6/02, 19/24

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

Jitsuyo Shinan Koho	1922-1996	Toroku Jitsuyo Shinan Koho	1994-2002
Kokai Jitsuyo Shinan Koho	1971-2002	Jitsuyo Shinan Toroku Koho	1996-2002

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 126387/1983(Laid-open No. 36489/1985) (Daido Steel Co., Ltd.), 13 March, 1985 (13.03.85), Full text; all drawings (Family: none)	1,2,5 3,4,6
Y	US 4460202 A (Glenn G. Chance William Kovensky), 17 July, 1984 (17.07.84), Full text; all drawings & JP 57-108390 A & GB 2087950 A	1-6
Y	WO 93/04257 A2 (GD-AN-KER GmbH.), 04 March, 1993 (04.03.93), Full text; all drawings & JP 6-501072 A & US 5350024 A & DE 4127249 C	1-4

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
31 July, 2002 (31.07.02)	13 August, 2002 (13.08.02)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP02/04149

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 8-2223 Y2 (Kabushiki Kaisha Higuchi Giko), 24 January, 1996 (24.01.96), Full text; all drawings (Family: none)	1-4

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