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TITLE OF THE INVENTION

BORING MACHINE

BACKGROUND OF THE INVENTION

5 The present invention relates to a boring machine
for water pipes or the like.

10 In a conventional method for attaching a branch
pipe on a water pipe, a saddle snap tap comprising a
snap tap is attached to a main water pipe, and boring
is carried out with the lower end part of a boring
machine fixed to the saddle snap tap. There are
various boring machines. For example, in a boring
machine disclosed in Japanese Utility Model Application
KOKOKU Publication No. 6-45284, components such as a
motor, a main shaft, a feed screw, and the like are
15 arranged in parallel to restrict the entire height to
be low so that the boring machine can be easily handled.

20 However, in the feed mechanism based on screwing,
a cutter is fed by one pitch as a feed handle is
rotated by one turn. To move the cutter for boring a
hole to a boring position, the feed handle must be
rotated by number of turns. It is thus not easy to
move the cutter. In addition, a longer time is
required to move the cutter. Further, since the screw
type feed mechanism is adopted, a thrust reaction force
25 which is transmitted to the feed handle during cutting
is deviated by the lead angle of the screw. It is
therefore difficult for the operator to feel the

cutting state through the feed handle. Consequently,
the cutter is easily locked so that it is not easy to
cope with locking. Hence, the screw type feed
mechanism is hardly adopted as a feed mechanism for
5 conventional well-known drilling machines.

There is another feed mechanism based on a rack
and a pinion of a drilling machine or the like, in
place of the screw type feed mechanism. In this
mechanism, however, the rack moves relative to the
10 pinion. Therefore, where a pinion is fixed in a
central portion, a space for containing a rack is
required in consideration of motion of the rack. As a
result, there is a problem that the main body is
elongated more than required.

15 Further, in a currently used method of boring into
a water pipe, a saddle snap tap is used, and a saddle
fixing nut incorporated in a boring machine body is
used with a screw at an upper part of the saddle snap
tap, to fixing them by screwing. This method hence has
20 following drawbacks. That is, the screw of the saddle
fixing nut which fixes the boring machine body to the
saddle snap tap is a right hand screw, and the cutter
rotates in a right-hand direction. Therefore, if the
cutter is locked due to cutting resistance in process
25 of boring, the reaction force in the circumferential
direction, which the cutter receives, acts in the
counterclockwise direction in which the nut is loosened.

At this time, the electric drill acts to transmit further torque to the cutter, so that a force acts on the fixed right hand screw in the direction (counterclockwise direction) in which this screw is loosened. Consequently, the saddle fixing nut of the boring machine body which has been fixed to the saddle snap tap is loosened, resulting in a problem that the boring machine body is swung.

To avoid this problem, in the boring machine disclosed in the above-mentioned publication No. 6-45284, when the cutter attached to the main shaft bites into a main pipe and is thereby locked and stopped, the motor shaft and the pinion are disconnected from each other to absorb shock of the stop, and rotation of the motor is continued so that the motor is prevented from seizure damages. However, since a clutch is provided, problems occur not only in that the structure is complicated but also in that increases of the weight and costs are invited or so.

At the portion where the cutter and the shaft used for the boring machine are attached to each other, the following drawback occurs. That is, the cutter used for the boring machine is fixed to the shaft by a right hand screw, and therefore, a surface where a spanner is to be set is provided on the cutter so that the cutter can be easily detached from the shaft.

Meanwhile, a surface where a spanner is to be set

is not provided on the shaft of the above-mentioned boring machine. This surface is not provided on the shaft because the minimum boring capability of the boring machine covers a saddle snap tap for branching
5 of a nominal diameter of 20, and the inner diameter of the saddle snap tap is about 21 mm. Therefore, the shaft of the boring machine cannot be larger than the inner diameter of the saddle snap tap, and a screw thread for fixing the cutter is formed on the inner
10 circumference of the shaft. Consequently, if a surface for setting a spanner is formed on the outer circumference of the shaft, the thickness of the shaft is thinned too much, so that such a surface cannot be provided at the distal end part of the shaft. In
15 addition, since boring is carried out on a water pipe without shutting off water, it is necessary to prevent running water from entering into the machine. The circumferential surface of the shaft is sealed by a seal member provided in the side of the member (saddle
20 bracket) which supporting the shaft. Therefore, if a surface for setting a spanner is formed on the outer circumferential part of the shaft, the seal member may not be caught by the surface when the cutter is lifted up to the upper end part. In addition, a valve is
25 provided in the saddle snap tap, and the distal end of the cutter may not interfere with the valve when the cutter is lifted up to the upper end part. If it

interferes, the valve cannot be closed, so that running water is emitted due to the inner pressure when the boring machine body is detached from the saddle snap tap. Consequently, the boring machine body cannot be detached from the saddle snap tap in this case.

From the grounds described above, the surface for setting a spanner to detach the cutter is not provided on the shaft in the conventional boring machine. As a result, the cutting reaction is applied in the direction in which the cutter is tightened during cutting, since the cutter rotates in the clockwise direction during boring. A problem hence arises in that, when the cutter is locked due to an excessive load, the cutter cannot be easily detached from the shaft. If a surface for setting a spanner is formed on the shaft in consideration of the above problem, the whole length of the body is elongated, and the boring machine body cannot be compact.

As a method of detaching a locked cutter in the conventional boring machine, a spanner is set on the surface of the cutter for setting a spanner, and an instantaneous impact is made on the spanner with use of inertial resistance from the shaft to the motor, to detach the cutter. In this method, there can be a problem in that transmission components from the shaft to the motor may be damaged. If the cutter cannot be detached upon the impact, a pipe wrench or the like

must then be fixed to the outer circumference of the shaft, to detach the cutter, so that the outer circumference of the shaft is damaged and the member sealing the outer circumference of the shaft is also
5 damaged. Consequently, a problem arises in that service water enters into the boring machine body during boring.

BRIEF SUMMARY OF THE INVENTION

The present invention has an object of solving the
10 problems described above, by providing a novel boring machine which adopts a cutter feed mechanism using a chain, rope, belt, or the like in place of a cutter feed mechanism based on screwing, and which prevents a right hand screw fixing the boring body from rotating
15 in a loosening direction (counterclockwise direction) even when the cutter is locked during boring.

The present invention also has an object of solving the above problems, by providing a mechanism capable of easily detaching the cutter even when the
20 cutter is locked on the shaft.

According to the present invention, there is provided a boring machine for boring a hole in a work piece, comprising a body which can be attached to the work piece, and a motor fixed to the body. The boring
25 machine further comprises: a hollow spindle rotatably held on the body and rotated by the motor; a shaft provided movably in the hollow spindle, having a cutter

capable of boring a hole in the work piece, and rotated together with the hollow spindle; and a cutter feed mechanism provided adjacent to the hollow spindle in the body, for moving the cutter in directions in which the cutter moves close to and apart from the work piece. The cutter feed mechanism includes transmission means having at least one of a chain, rope, and belt, and two wheels between which the transmission means is wound around.

10 Since the cutter feed mechanism in according to this boring machine has a transmission means having at least one of a chain, rope, and a belt, and two wheels between which the transmission means is wound around, the cutter can be fed at a very high speed compared with a conventional cutter feed mechanism based on screwing. Therefore, the cutter can be moved rapidly and easily to a desired position without rotating a feed handle for a number of times, so that the time required for moving the cutter can be shortened.

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20 Further, the boring machine body can be downsized, compared with a feed mechanism having a rack and a pinion.

 Preferably, the cutter feed mechanism has a holder installed on an outer circumferential surface of the hollow spindle such that the holder is movable along an axial direction of the hollow spindle, the holder is fixed to the transmission means and the shaft, and the

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shaft can be moved along the axial direction by rotating one of the wheels.

Also preferably, the boring machine comprises a brake device for preventing the transmission means from moving against operator's intention. Advantageously, the brake device is provided on a handle shaft for rotating and driving the one of the wheels.

Also preferably, the body can be fixed to a saddle snap tap attached to the work piece and has anti-reverse means for preventing the body from rotating relatively to the saddle snap tap. Preferably, the anti-reverse means has a belt. In this case, it is possible to avoid the problem that the boring machine body is swung about during boring.

Also preferably, a collar is inserted between the cutter and the shaft, and the collar has a plurality of flat surfaces on which a spanner can be engaged. In this case, in case where the cutter is strongly fixed by an excessive load or the like, the cutter can be easily detached from the shaft. Therefore, any force does not act on drive-force transmission components from the shaft to the motor when the cutter is detached. Thus, it is possible to prevent damages when detaching the cutter. Further, it is not necessary to grip directly the shaft by means of a tool such as a pipe wrench or the like, so that the outer circumferential surface of the shaft is prevented from damages. When

boring a hole in a water pipe, service water does not enter into the boring machine body.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

The accompanying drawings, which are incorporated
5 in and constitute a part of the specification,
illustrate presently preferred embodiments of the
invention, and together with the general description
given above and the detailed description of the
preferred embodiments given below, serve to explain the
10 principles of the invention.

FIG. 1 is a schematic cross-sectional view showing
a boring machine according to a preferred embodiment of
the present invention, attached to a saddle snap tap;

FIG. 2 is an enlarged cross-sectional view showing
15 a part of the boring machine shown in FIG. 1;

FIG. 3 is a side view showing the boring machine
shown in FIG. 1, partially cut away; and

FIGS. 4A and 4B are views respectively showing
installation states of cutters at distal end parts of
20 shafts of a boring machine according to the present
invention and a conventional machine.

DETAILED DESCRIPTION OF THE INVENTION

In FIG. 1, the present boring machine comprises a
shaft 2 contained in a boring machine body 1, a hollow
25 spindle 3 for slidably guiding up and down the shaft 2,
a cutter 4 fixed to the distal end of the shaft 2, a
chain drive mechanism 5 as a cutter feed mechanism for

moving up and down the shaft 2 relative to the spindle 3, and a motor 6 for applying torque to the shaft 2 and hollow spindle 3. The boring machine is fixed through an attachment 53 by a saddle fixing nut 8 provided in
5 the side of the boring machine with respect to a saddle snap tap 7 fixed to a water pipe. The fixing nut 8 is formed as a right hand screw.

In FIG. 2, the lower end of the shaft 2 is rotatably supported on a saddle bracket 11 fixed to the
10 lower end of a gear box cover attached to the boring machine body 1 by a hexagonal socket head bolt 10, by a needle bearing 12. The saddle fixing nut 8 for attaching the boring machine to the saddle snap tap 7 through the attachment is attached to the saddle
15 bracket 11. The saddle fixing nut 8 is incorporated in the saddle bracket 11 such that the nut 8 moves up and down, and a seal ring 13 and a dust seal 14 are attached to the saddle bracket 11 and the inner circumferential surface of the shaft 2.

20 A shaft guide 15 is attached to the upper end of the shaft 2, and both ends of the shaft guide 15 penetrate the longitudinally extending elongated groove 3a of the spindle 3 (detailed structure will be described later) in the radial direction and are
25 incorporated in the pin guide 16 without looseness. Also, the shaft guide 15 it self is incorporated in the upper end part of the shaft 2 without looseness and is

fixed to the shaft 2 by a stopper ring 17.

An end portion of a pin 18 penetrating the shaft 2 in the diametric direction is secured to the pin guide 16. The pin guide 16 can slide on the outer
5 circumferential surface of the hollow spindle 3, and a pin cover 19 is assembled on the outer circumference of the pin guide 16. Ball bearings 20 are press fitted in the upper and lower sides of the pin guide 16. The pin guide 16, pin 18, pin cover 19, and ball bearings 20
10 are assembled in the chain holder 21 attached to be slidable on the outer circumferential surface of the spindle 3, and are fixed by a stopper ring 22. In this manner, the shaft 2 and the spindle 3 can integrally rotate about the axis inside the chain holder 21.

15 In addition, the hollow spindle 3 contains the shaft 2, and two elongated grooves 3a are provided to be symmetrical to the central axis. The shaft guide 15 and the pin are assembled in the elongated grooves 3a such that they cannot rotate but can slide up and down.
20 The lower end of the shaft 2 is slidably held in the hollow spindle 3 through a bush 23.

The upper end of the spindle 3 is rotatably attached to a body cover 1a by the needle bearing 24 and a thrust bearing 25. The lower end of the hollow
25 spindle 3 is rotatably attached to the gear box cover attached to the boring machine body 1.

The chain holder 21 is fixed to a chain 5a forming

a part of the chain drive mechanism 5, and the chain 5a is wound around two sprocket wheels 27 and 28 provided in the upper and lower sides in the boring machine body 1. In FIG. 3, the sprocket wheel 27 provided in the upper side is attached to a sprocket shaft 29 by a key 30, and a gear 32 is rotatably attached to the sprocket shaft 29 by the key 33 such that the gear 32 is provided at a predetermined interval from the sprocket wheel 27 by a spacer 31. The gear 32 is engaged with a gear 35 formed on the handle shaft 34 rotatably held on the boring machine body 1. A handle 36 is attached to the handle shaft 34. An O-ring 37 is assembled on the handle shaft 34. A spring 38, flat washer 39, friction disk 40, a brake disk 41, and flat washer 42 are assembled on the handle shaft 34 positioned in the boring machine body 1. The shaft is secured to the boring machine body 1 by a hexagonal nut 43.

The sprocket wheel 28 provided in the lower side is attached rotatably to a sprocket shaft 44 attached to the boring machine body 1 by a bush 45.

In FIG. 2, a first gear 47 is attached to the pipe spindle 3 by a key 46, and this first gear 47 is connected to an output shaft 49 through a reduction gear train 48. By driving the motor 6, the pipe spindle 3 can be rotated through the reduction gear train 48. Note that a different reduction mechanism such as a driving belt or the like can be adopted in

place of the gear train.

In FIG. 1, the saddle snap tap 7 is fixed to a water pipe 50 by a bolt 51 and a nut 52. The boring machine body 1 is fixed to the saddle snap tap 7 by the right-handed saddle fixing nut 8, and an attachment 53. An anti-reverse belt 54 is attached, as a means for preventing reversal movement, to the boring machine body 1. A hook 55 of the anti-reverse belt 54 is engaged in an eyenut 56 screwed on a thread formed at the distal end of the bolt for fixing the saddle snap tap 7 to the water pipe. The anti-reverse belt 54 is attached such that a tension acts in a direction opposite to a loosening direction of the boring machine, i.e., opposite to the direction in which the saddle fixing nut 8 is loosened. Of course, any other modified forms can be adopted for the anti-reverse belt 54, the eyenut 56, and the like as long as they can prevent rotation of the boring machine.

The operation of the boring machine having a structure described above will now be explained.

The boring machine body 1, in which the cutter 4 is attached to the shaft 2, is secured to the saddle snap tap 7 attached to the water pipe 50 by the saddle fixing nut 8 and the attachment 53, and the anti-reverse belt 54 is engaged on the eyenut 55 of the saddle snap tap 7 and held under tension.

The motor 6 is driven to rotate the first gear 47

through the reduction gear train 48 and further to rotate the hollow spindle 3. As the hollow spindle 3 rotates, the shaft 2, fixed to the spindle 3 in a manner that the shaft cannot be relatively rotated, is rotated, and the cutter 4 which is attached to the distal end of the shaft 2 rotates. In this state, the handle 36 is rotated to rotate the gear 35 formed on the handle shaft 34. Thus, the gear 32 engaged with the gear 35 is rotated to rotate the sprocket shaft 29. As the sprocket shaft 29 rotates, the sprocket 27 rotates so that the chain 5a wound around the sprockets 27 and 28 is moved. As the chain 5a moves, the chain holder 21 attached to the chain 5a moves downward along the outer circumference of the pipe spindle 3 which is rotating. At this time, the pin 18 incorporated in the chain holder 21 moves sliding along the elongated grooves 3a formed in the pipe spindle 3, so that the shaft 2 through which the pin penetrates moves downward. As a result, a hole is bored in the water pipe 50 by the cutter 4 attached to the lower end of the shaft 2. At the time of boring, a thrust force is applied to the ball bearing 21 and the pin guide 16 within the chain holder 21, in the direction in which the cutter 4 is fed, since the chain 5a is connected to the chain holder 21. The pin 18 is incorporated in the pin guide 16 and the shaft 2, so that a thrust force is applied by the pin 18 to the shaft 2 in the direction in which

the cutter is fed. The pin 18 moves along the elongated grooves 3a of the pipe spindle 3, and the shaft 2 moves forward the cutter 4.

When the cutter 4 is fed as described above and
5 the top of the cutter 4 reaches the inner surface of the water pipe 50, a water pressure is applied to the inside of the water pipe 50, so that running water is emitted from the water pipe. The emitted water flows out into the branch hole branched from the saddle snap
10 tap. Not a little remaining pressure exists inside the saddle snap tap 7, and the cross-section of the shaft 2 serves as a pressure receive surface for receiving the remaining pressure, so that the force acts in the direction in which the shaft 2 is pushed back. As the
15 shaft 2 is pushed back, the handle shaft 34 rotates reversely. Therefore, the cutter 4 is not pushed back or the handle shaft 34 does not rotate reversely, even if a remaining pressure is applied to the cross-section of the shaft 2, as the handle shaft 34 is braked by
20 friction between the friction disk 40 fixed to the boring machine body 1 and the brake disk 41 fixed to the shaft 34.

In addition, the anti-reverse belt 54 is attached to the boring machine body 1, and the hook 55 of the
25 anti-reverse belt 54 is engaged in the eyenut 56 screwed in the thread formed at the distal end of the bolt 51 for fixing the saddle snap tap 7 to the water

pipe 50. Also, the anti-reverse belt 54 is attached in a state that a tension force which acts in the direction opposite to the loosening direction of the boring machine acts. Therefore, even if a force acts
5 on the fixed right hand screw in the loosening direction (in the counterclockwise direction), it is possible to avoid a problem, that the boring machine body 1 is swung, owing to the function of the anti-reverse belt 54.

10 Next explanation will be made of an installation part of the cutter 4 and the shaft used in the boring machine, with reference to FIGS. 4A and 4B.

 The conventional cutter 4 used for the boring machine is fixed to the shaft 2 by a right hand screw,
15 and a spanner setting surface 4a is provided on the cutter, to detach the cutter. However, no spanner setting surface is formed on the shaft 2. Therefore, when the shaft 2 and the cutter 4 are locked, the cutter 4 cannot be easily detached from the shaft 2.

20 The present invention uses a collar 57 having a spanner setting surface. In FIG. 4A, the shaft is incorporated in the boring machine body 1 and slides in the rotating direction and the vertical direction. The collar 57 having a spanner setting surface is inserted
25 between the cutter 4 and the shaft 2 when the cutter 4 is attached to the shaft 2. The cutter 4 is fixed to the shaft 2 by screwing. In this manner, a force which

tightens the shaft 2 and the cutter 4 to each other
acts due to a cutting load which acts on the top of the
cutter 4. However, the collar 57 is fixedly secured to
the shaft 2 by the friction force. Therefore, the
5 collar 57 can be regarded as being integral with the
shaft 2, so it can be considered that a pseudo spanner
setting surface is formed on the shaft 2. As a result,
when the cutter is detached, tools such as spanners or
the like are set on the spanner setting surfaces of the
10 collar 57 and the cutter 4, and a force is applied in
an instant, holding both spanners. In this manner, the
cutter 4 can be detached easily from the shaft 2. If
the cutter 4 is detached with use of the collar 57
having a spanner setting surface, the (impact) force
15 applied when the cutter 4 is detached is not
transmitted to drive-force transmission components
including the shaft 2 up to the motor 6. Thus, drive-
force transmission components are prevented from
damages.

20 In the above, embodiments according to the present
invention have been explained. However, the pipe
spindle 3, the shaft 2, the state in which the shaft 2
and the boring machine body 1 are incorporated, and the
drive-force transmission mechanism between the motor 6
25 and the pipe spindle 3 are not limited to the
embodiments described above but another embodiment can
be adopted. Also, a drive mechanism using a belt, wire,

or the like can be used in place of the chain drive mechanism used as the cutter feed mechanism in the above embodiments.

Further, the present invention can be practiced in
5 other various modification forms without deviating from
the spirit or main features of the invention. Therefore,
the embodiments described above are merely simple
examples in all aspects, and limited interpretation
thereof should not be allowed. Accordingly, various
10 modifications may be made without departing from the
spirit or scope of the general inventive concept as
defined by the appended claims and their equivalents.

WHAT IS CLAIMED IS:

1. Boring machine for boring a hole in a work piece (50), comprising a body (1) which can be attached to the work piece, and a motor (6) fixed to the body,
5 characterized in that the machine further comprising:

a hollow spindle (3) rotatably held on the body (1) and rotated by the motor;

a shaft (2) provided movably in the hollow spindle, having a cutter (4) capable of boring a hole in the
10 work piece, and rotated together with the hollow spindle; and

a cutter feed mechanism (5) provided adjacent to the hollow spindle (3) in the body, for moving the cutter (4) in directions in which the cutter moves
15 close to and apart from the work piece (50), wherein

the cutter feed mechanism (5) includes transmission means (5a) having at least one of a chain, rope, and belt, and two wheels (28, 38) between which the transmission means is wound around.

20 2. The boring machine according to claim 1, characterized in that the cutter feed mechanism has a holder (21) mounted on an outer circumferential surface of the hollow spindle (3) such that the holder is movable along an axial direction of the hollow spindle,
25 the holder is fixed to the transmission means and the shaft (2), and the shaft can be moved along the axial direction by rotating one of the wheels (38).



3. The boring machine according to claim 1 or 2, characterized by further comprising a brake device (40, 41) for preventing the transmission means (5a) from moving against operator's intention.

5 4. The boring machine according to claim 3, characterized in that the brake device is provided on a handle shaft (34) for rotating and driving the one of the wheels (38).

10 5. The boring machine according to one of claims 1 to 4, characterized in that the body (1) can be fixed to a saddle snap tap (7) attached to the work piece (50) and has anti-reverse means (54, 55, 56) for preventing the body from rotating relatively to the saddle snap tap.

15 6. The boring machine according to one of claims 1 to 5, characterized in that the anti-reverse means has a belt.

20 7. The boring machine according to one of claims 1 to 6, characterized in that the work piece is a water pipe.

25 8. The boring machine according to one of claims 1 to 7, characterized in that a collar (57) is inserted between the cutter (4) and the shaft (2), and the collar has a plurality of flat surfaces on which a spanner can be engaged.

