Description

The present invention relates to an apparatus for and a method of thrusting a shield for use in tunneling, and more particularly to an apparatus according to the preamble of claim 1 and according to the preamble of claim 9, respectively.

Such an apparatus and such a method are known from EP-A-0 060 124, wherein a head attached to the leading end of the pipe to be laid underground is caused to move in vibratory movement while a propelling force is exerted on the rear end of the pipe to obtain penetration of the earth by the pipe. As the magnitude of the vibration depends on the nature of the earth, this magnitude has to be measured all time. Subsequently, the propelling force has to be varied in order to keep the head from being stuck in the ground. It might happen, however, that the apparatus is blocked by stone material. As the apparatus does not comprise any means for mining the ground, deblocking and further penetration of the apparatus can be obtained only by applying respectively high vibration and propelling forces. And this entails the use of large-size vibration and propulsion systems. Also, the control or adjustment of the thrusting direction of such an apparatus is difficult.

Also known is a pipe jacking method, shown in US-A-No. 4,311,411, according to which a shield is provided at the foremost part of a pipe to be thrusted and the ground is bored by the operation of an excavator attached to the shield, then by the subsequent operation of a hydraulic thrust jack disposed behind the pipe a thrust is exerted on the shield and the pipes, so that the shield and the pipes are thrusted into the bored portion of the ground. The above excavator is disposed rotatably in the front portion of the shield and is driven by a drive unit disposed behind a partition wall extending across the interior of the shield. During operation of the excavator, the cut surface of the ground or the tunnel face is maintained in a stable condition by being pressurized with pressurized water, sludge, etc.

Such preboring of the ground by the excavator diminishes the thrust resistance of the succeeding pipes, but since the pipes undergo an earth pressure acting on their circumference, the thrust resistance increases with adding of pipes required as the pipe thrusting proceeds and hence with increase of the overall length of pipes to be thrusted. Therefore, the above thrust jack must be large-sized enough to produce a large thrust. The foregoing earth pressure not only is an obstacle to the thrusting of a pipe, but also continues to act on the circumference of the pipes after embedded in the ground and impedes a stable maintenance of the pipes.

On the other hand, the excavator for excavating the ground which covers the front of the shield requires a large-sized drive unit capable of producing a large driving torque for driving its rotary cutter head. This drive unit must be disposed within the shield, but in the case of a shield having a small outside diameter, e.g., 300 mm or so, there is no room for mounting therein a large-sized drive unit.

Accordingly, it is an object of the present invention to diminish the thrust resistance of a shield and the succeeding pipe or pipes induced by earth pressure, thereby reducing the required thrust and attaining a permanent stability of the pipe embedded.

It is an object of the present invention to furtheron attain the reduction in size of a drive unit for driving a boring rotary head attached to a shield, thereby attaining a further reduction in size of the shield and hence permitting the application of pipes of smaller diameters.

This object is attained in an apparatus characterized by the features of claim 1 and in a method characterized by the features of claim 9.

This invention is based on the concept that a part or the whole of earth and sand which cover the front of a shield is thrusted away radially of the shield by means of a rotary head causing an eccentric motion, thereby forming a volumetric change in part of the ground which surrounds the shield, that is, forming a consolidated self-support zone in the ground.

The shield thrusting method of the present invention is characterized in that a conical or frustoconical rotary head supported by a crank shaft or an eccentrically disposed straight shaft at the front portion of a shield body is allowed to undergo an eccentric motion by driving the crank shaft and allowed to consolidate the ground, and in that a thrust is exerted on the shield body during such operation of the rotary head.

The shield thrusting apparatus of the present invention basically includes a crank shaft having one end supported rotatably by a partition wall extending across the interior of the shield body and connected to a drive mechanism behind the partition wall and the other end extending in front of the partition wall; a conical or frustoconical rotary head supported rotatably by the other end of the crank shaft; and a hydraulic means positioned behind the shield body for imparting a thrust to the shield body.

Further, the shield thrusting apparatus of the present invention includes an eccentric collar supported rotatably by a partition wall extending across the interior of the shield body, the eccentric collar being connected to a first drive mechanism; a crank shaft or an eccentrically disposed straight shaft connected to a second drive mechanism; a rotary head supported by the other end of the crank shaft or the straight shaft; and a hydraulic means positioned behind the shield body for imparting a thrust to the shield body, in which the crank shaft or the straight shaft itself is allowed to undergo an eccentric motion with respect to the shield body by the operation of the first drive mechanism and this eccentric motion is performed intermittently to form an appropriate extra space around the shield body, thereby facilitating the control or adjustment of the thrusting direction of the shield.

The features of the present invention will become more apparent from the following description of embodiments of the invention which are illustrated in the accompanying drawings.

Fig. 1 is a longitudinal sectional view of an apparatus according to an embodiment of the present invention;

Figs. 2 and 3 are partial longitudinal view and a front view, respectively, showing a modification of a rotary head;

Figs. 4 and 5 are a partial longitudinal sectional view and a plan view, respectively, showing a further example of a rotary head;

Fig. 6 is a longitudinal sectional view of an apparatus according to another embodiment of the present invention; and

Fig. 7 is a transverse sectional view taken along line 7-7 in Fig. 6.

Referring first to Fig. 1, there is shown a shield thrusting apparatus 10 embodying the invention, which includes a conical rotary head 14 supported at the front portion of a shield body 12 and a hydraulic thrust jack (not shown) of a structure known per se for exerting a thrust on both the shield body and a concrete pipe 16 contiguous to the rear portion of the shield body. The shield body 12 is provided with a partition wall 18 extending across the interior of the shield body, with a drive mechanism 20 for the rotary head 14 being supported by the partition wall 18.

The drive mechanism 20 includes a crank shaft 22 and a motor 26 connected to the crank shaft through a reduction gear 24. A shaft portion 22a on one end side of the crank shaft 22 is supported through a bearing 28 mounted to the partition wall 18 and is keyed to an output shaft 24a of the reduction gear 24. On the other hand, a shaft portion 22b on the other end side of the crank shaft 22 supports the rotary head 14 rotatably through a bearing 30 which is mounted to the rotary head together with an agitator plate 29. The crank shaft 22 has an amount of eccentricity corresponding to "e" (shown in Fig. 1) between its shaft portions 22a and 22b. The crank shaft 22 shown in the drawings is a single overhung solid crank shaft.

A pair of pipes 32 and 34 constitute means for discharging mined material from the forward zone of the partition wall 18 to the backward zone of the partition wall 18 and are attached to the partition wall 18 in lower positions of the wall so as to be open toward the front of the partition wall. The pipe 32 is a liquid feed pipe for feeding liquid such as fresh or muddy water ahead of the partition wall 18, while the pipe 34 is a liquid discharge pipe for discharging surplus water contained in the ground and muck together with the liquid fed.

Upon operation of the motor 26, the crank shaft 22 is rotated, so that the rotary head 14 undergoes an eccentric motion and comes into an intermittent contact with the ground. During this eccentric motion, the rotary head 14 exerts an urging force on the ground and at the same time receives a reaction force from the ground, so that it rotates by itself. The ground with the urging force exerted thereon is pressurized as a whole in the diametrical direction of the shield, which direction is attributable to the shape of the rotary head and the thrust acting from the rear, and the thus pressurized ground portion forms a consolidated zone 33 which surrounds the shield. The formation of the consolidated zone 33 is effective in diminishing the thrust resistance of the shield and reducing the earth pressure against the embedded pipe, thereby attaining stabilization of the pipe.

Where the ground is weak or soft, there will be little discharge of muck, but pore water present between soil particles will be separated upon consolidation of the ground and discharged through the liquid discharge pipe 34. In the case where the ground is hard or of a non-compressible nature such as rock bed, muck is formed by a squeezing or crushing action of the rotary head 14 and it is discharged through the discharge pipe 34.

The above-described action of the rotary head 14 supported by the driven crank shaft will be easily understood by recalling an internal gear type planetary reduction gear and by likening the action of an internal gear to the ground and that of a planetary gear to the rotary head. In this case, the rotary head corresponding to the planetary gear causes its transfer torque to be developed by virtue of a frictional force acting between the rotary head and the ground, and causes the resulting torque reaction to be borne by the shield body 12. Therefore, even if a small-sized reduction gear is used as the reduction gear 24 disposed between the crank shaft 22 and the motor 26 and the crank shaft is rotated at high speed and small torque, it is possible to develop a large torque according to the nature of the ground. As a result, it becomes possible to dispose a small-sized drive mechanism within a shield of a small diameter not having a large space, and this is extremely advantageous in realizing a shield having as small a diameter as possible.

The foregoing intermittent contact between the rotary head and the ground which occurs during the eccentric motion of the rotary head 14 is a contact of the rotary head with the ground in a linear portion extending from the tip end 14a of the rotary head to the rear end along the surface thereof. In order to enhance the squeezing or crushing action of the rotary head during such contact, it is advantageous to provide many chips or bits on a conical face plate 14b of the rotary head 14. Alternatively, convex and concave portions extending radially from the tip end 14a of the rotary head 14 may be provided in an alternately continuous manner in the form of a bevel gear.

The rotary head 14 illustrated in Figs. 2 and 3 has a generally frustoconical shape and is provided in its front surface as a vertical surface with slits 36 and 38 which are paired in the diametrical direction. Projecting forward from those slits are a

large number of bits 44 attached to support members 40 and 42. Further, on the conical surface contiguous to the front surface is formed a saw tooth-like rugged portion 46 with convexes and concaves extending alternatively in the circumferential direction. The mucks formed by excavation with the bits 44 are sent backward through the slits 36 and 38 and collected to the lower portion of the partition wall 18 under the action of the agitator plate 29, then conveyed further backward through the discharge pipe 34. During the eccentric motion of the rotary head, the rugged portion 46 on the conical peripheral surface compresses the ground and at the same time exerts an effective squeezing or crushing force thereon.

The rotary head illustrated in Figs. 4 and 5 has four slits 38 formed in the conical face plate 14b and extending crosswise from the tip end 14a. Within each of the slits 38 are provided plural limit pieces or restrictors 48 at predetermined intervals for limiting the size of muck taken in therethrough. Further, on the conical face plate 14b is provided a rugged portion 46 extending from the tip end 14a radially backward. In place of the conical face plate illustrated. a plurality of spokes may be arranged at predetermined intervals on the conical plane of the generally conical rotary head, and in this case the aforementioned limit pieces are disposed at predetermined intervals between the spokes and a multitude of chips and/or bits are provided on the spokes.

Referring now to Figs. 6 and 7, there is illustrated another embodiment of the present invention, in which a large number of bits 44 are provided on spokes 50 which are arranged at predetermined intervals in the circumferential direction and there is provided a mechanism 52 whereby a shaft 22 (a crank shaft in the example shown) which supports the rotary head 14 is allowed to perform an eccentric motion with respect to the central axis of the shield body for forming an extra space. This eccentric motion mechanism 52 includes an eccentric collar 56 which is supported by the partition wall 18 through a bearing 54 and a sleeve 58 which is disposed in the eccentric collar 56. The mechanism 52 further includes a drive mechanism provided with a motor 60 and a reduction gear 62 whereby the eccentric collar 56 is driven and rotated through engagement of a gear 66 formed on the outer periphery of a flange 64 of the eccentric collar 56 with a gear 68 mounted on an output shaft of the reduction gear 62.

A shaft portion 22a of the eccentric shaft is received rotatably in the sleeve 58 and it is keyed at an end portion thereof to an output shaft of a reduction gear 24 which is connected to a motor 26. The sleeve 58 has a flange 70 and a bracket 72 integral with the flange. One end of a rocker arm 74 extending in the transverse direction of the shield body is pivotally connected to the bracket 72 through a pin 76, while the other end of the rocker arm 74 is pivotally connected through a pin 80 to a bracket 78 which is mounted to the shield body 12. Under the action of the rocker arm 74 the sleeve 58 performs an eccentric motion in accordance with the rotation of the eccentric collar 56, but its rotation about its own axis is prevented.

If the eccentric collar 56 is rotated at least once or rotated angularly during rotation of the crank shaft 22, the driven shaft itself which supports the rotary head 14 performs an eccentric motion about the axis of the shield body 12. Therefore, if the shaft portion on the reduction gear side of the driven shaft is held in the eccentric position when the driven shaft is a crank shaft or if the entirety of the driven shaft is held in the eccentric position when the driven shaft is an eccentrically disposed straight shaft, then by selecting the outside diameter of the rotary head suitably according to the diameter of the shield body, there can be formed an extra space having desired diameter and length throughout the overall circumference of the shield body or over a certain angular range, thereby permitting control of the thrusting direction of the shield body. The number of revolutions of the eccentric collar 56 can be set at about one twentieth of that of the crank shaft. Further, by controlling the operation of the drive mechanism 52, the rotation of the eccentric collar can be done continuously or intermittently according to the control for a desired shield thrusting direction.

An extra space for permitting the above-described thrusting direction control by the eccentric motion mechanism may be formed not only by a rotary head supported on a crank shaft but also by a rotary cutter fixedly supported on a straight shaft which is rotatably supported in a position eccentric to the axis of a shield.

Claims

1. An apparatus for thrusting a shield (12) for use in tunneling comprising:

a shield body (12) having a partition wall (18) extending across the interior of the shield body (12);

a rotary shaft (22) having one end portion (22a) supported rotatably by the partition wall (18) extending across the interior of the shield body (12);

a drive mechanism (20) connected to the shaft (22) and being positioned behind the partition wall (18); and

a hydraulic means for imparting a thrust to the shield body (12), the hydraulic means being positioned behind the shield body (12); characterized by

an eccentric collar (56) supported rotatably by the partition wall (18) and supporting the shaft (22) for an eccentric motion of the shaft (22);

a conical rotary head (14) supported rotatably by an opposite end portion (22b) of the shaft (22); and

means (32, 34) for discharging mined material from the forward zone of the partition wall (18) to the backward zone thereof.

2. An apparatus according to claim 1, characterized in that said discharging means (32, 34) includes a liquid feed pipe (32) and a liquid

large number of bits 44 attached to support members 40 and 42. Further, on the conical surface contiguous to the front surface is formed a saw tooth-like rugged portion 46 with convexes and concaves extending alternatively in the circumferential direction. The mucks formed by excavation with the bits 44 are sent backward through the slits 36 and 38 and collected to the lower portion of the partition wall 18 under the action of the agitator plate 29, then conveyed further backward through the discharge pipe 34. During the eccentric motion of the rotary head, the rugged portion 46 on the conical peripheral surface compresses the ground and at the same time exerts an effective squeezing or crushing force thereon.

The rotary head illustrated in Figs. 4 and 5 has four slits 38 formed in the conical face plate 14b and extending crosswise from the tip end 14a. Within each of the slits 38 are provided plural limit pieces or restrictors 48 at predetermined intervals for limiting the size of muck taken in therethrough. Further, on the conical face plate 14b is provided a rugged portion 46 extending from the tip end 14a radially backward. In place of the conical face plate illustrated. a plurality of spokes may be arranged at predetermined intervals on the conical plane of the generally conical rotary head, and in this case the aforementioned limit pieces are disposed at predetermined intervals between the spokes and a multitude of chips and/or bits are provided on the spokes.

Referring now to Figs. 6 and 7, there is illustrated another embodiment of the present invention, in which a large number of bits 44 are provided on spokes 50 which are arranged at predetermined intervals in the circumferential direction and there is provided a mechanism 52 whereby a shaft 22 (a crank shaft in the example shown) which supports the rotary head 14 is allowed to perform an eccentric motion with respect to the central axis of the shield body for forming an extra space. This eccentric motion mechanism 52 includes an eccentric collar 56 which is supported by the partition wall 18 through a bearing 54 and a sleeve 58 which is disposed in the eccentric collar 56. The mechanism 52 further includes a drive mechanism provided with a motor 60 and a reduction gear 62 whereby the eccentric collar 56 is driven and rotated through engagement of a gear 66 formed on the outer periphery of a flange 64 of the eccentric collar 56 with a gear 68 mounted on an output shaft of the reduction gear 62.

A shaft portion 22a of the eccentric shaft is received rotatably in the sleeve 58 and it is keyed at an end portion thereof to an output shaft of a reduction gear 24 which is connected to a motor 26. The sleeve 58 has a flange 70 and a bracket 72 integral with the flange. One end of a rocker arm 74 extending in the transverse direction of the shield body is pivotally connected to the bracket 72 through a pin 76, while the other end of the rocker arm 74 is pivotally connected through a pin 80 to a bracket 78 which is mounted to the shield body 12. Under the action of the rocker arm 74 the sleeve 58 performs an eccentric motion in accordance with the rotation of the eccentric collar 56, but its rotation about its own axis is prevented.

If the eccentric collar 56 is rotated at least once or rotated angularly during rotation of the crank shaft 22, the driven shaft itself which supports the rotary head 14 performs an eccentric motion about the axis of the shield body 12. Therefore, if the shaft portion on the reduction gear side of the driven shaft is held in the eccentric position when the driven shaft is a crank shaft or if the entirety of the driven shaft is held in the eccentric position when the driven shaft is an eccentrically disposed straight shaft, then by selecting the outside diameter of the rotary head suitably according to the diameter of the shield body, there can be formed an extra space having desired diameter and length throughout the overall circumference of the shield body or over a certain angular range, thereby permitting control of the thrusting direction of the shield body. The number of revolutions of the eccentric collar 56 can be set at about one twentieth of that of the crank shaft. Further, by controlling the operation of the drive mechanism 52, the rotation of the eccentric collar can be done continuously or intermittently according to the control for a desired shield thrusting direction.

An extra space for permitting the above-described thrusting direction control by the eccentric motion mechanism may be formed not only by a rotary head supported on a crank shaft but also by a rotary cutter fixedly supported on a straight shaft which is rotatably supported in a position eccentric to the axis of a shield.

Claims

1. An apparatus for thrusting a shield (12) for use in tunneling comprising:

a shield body (12) having a partition wall (18) extending across the interior of the shield body (12);

a rotary shaft (22) having one end portion (22a) supported rotatably by the partition wall (18) extending across the interior of the shield body (12);

a drive mechanism (20) connected to the shaft (22) and being positioned behind the partition wall (18); and

a hydraulic means for imparting a thrust to the shield body (12), the hydraulic means being positioned behind the shield body (12); characterized by

an eccentric collar (56) supported rotatably by the partition wall (18) and supporting the shaft (22) for an eccentric motion of the shaft (22);

a conical rotary head (14) supported rotatably by an opposite end portion (22b) of the shaft (22); and

means (32, 34) for discharging mined material from the forward zone of the partition wall (18) to the backward zone thereof.

2. An apparatus according to claim 1, characterized in that said discharging means (32, 34) includes a liquid feed pipe (32) and a liquid

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discharge pipe (34), both said pipes being supported by said partition wall (18) and each provided with an opening facing forwardly of said partition wall (18).

3. An apparatus according to claim 1 or 2, characterized in that said rotary head (14) has a closed front face.

4. An apparatus according to claim 3, characterized in that said rotary head (14) is provided with crushing chips on said front face thereof.

5. An apparatus according to claim 1 or 2, characterized in that said rotary head (14) has a plurality of convexes and concaves (46) extending radially from its tip end (14a), at least one slit (36, 38) formed in its conical surface (14b) and limit pieces (48) for limiting the size of muck received into said shield body (12) through said slit (36, 38), said limit pieces (48) being disposed in said slit (36, 38).

6. An apparatus according to claim 1 or 2, characterized in that said rotary head (14) has a plurality of spokes (50) disposed radially from its tip end (14a) and a plurality of bits (44) provided on each of said spokes (50).

7. An apparatus according to one of claims 1 to 6, characterized in that said eccentric collar (56) is connected to a first drive mechanism (52) and that said rotary shaft (22) is a crank shaft (22) connected to a second drive mechanism (20).

8. An apparatus according to one of claims 1 to 6, characterized in that said eccentric collar (56) is connected to a first drive mechanism (52) and that said rotary shaft (22) is a straight shaft (22) disposed in a position eccentric to the axis of said shield body (12) and connected to a second drive mechanism (20).

9. A method for thrusting a shield for use in tunneling, wherein a thrust is exerted on a shield body (12), characterized by the steps of:

causing a rotary head (14) provided at the front portion of the shield body (12) to perform an eccentric motion;

exerting said thrust on the shield body (12) during the eccentric motion of the rotary head (14); and

discharging the material mined by the rotary head (14) from a forward zone to a backward zone in the shield body (12).

10. A method according to claim 9, characterized by the steps of:

supporting said rotary head (14) by a crank shaft (22) at the front portion of said shield body (12), said rotary head (14) being a conical or frustoconical rotary head (14); and

driving said crank shaft (22) to cause an eccentric motion of said conical or frustoconical rotary head (14).

11. A method according to claim 9, characterized by the steps of:

supporting said rotary head (14) by a straight shaft (22), disposed in an eccentric collar (56), at the front portion of said shield body (12), said rotary head (14) being a conical or frustoconical rotary head (14); and

driving said straight shaft (22) and said eccentric collar (56) to cause an eccentric motion of said conical or frustoconical rotary head (14).

Patentansprüche

1. Vorrichtung für den Tunnelschildvortrieb mit:

einem Schildkörper (12), der eine sich durch das Innere des Schildkörpers (12) erstreckende Trennwand (18) aufweist;

einer Drehwelle (22), deren einer Endabschnitt (22a) drehbar von der sich durch das Innere des Schildkörpers (12) erstrekkenden Trennwand (18) getragen ist,

einem Antriebsmechanismus (20), der mit der Welle (22) verbunden ist und hinter der Trennwand (18) angeordnet ist; und

einer Hydraulikeinrichtung zum Ausüben eines Druckes auf den Schildkörper (12), wobei die Hydraulikeinrichtung hinter dem Schildkörper (12) angeordnet ist; gekennzeichnet durch

einen exzentrischen Bund (56), der drehbar von der Trennwand (18) getragen ist und die Welle (22) für eine exzentrische Bewegung der Welle (22) trägt;

einen konischen Drehkopf (14), der drehbar von einem entgegengesetzten Endabschnitt (22b) der Welle (22) getragen ist; und

einer Einrichtung (32, 34) zum Entleeren von abgebautem Material von dem Bereich vor der Trennwand (18) zu dem Bereich hinter der Trennwand (18).

2. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Entleerungseinrichtung (32, 34) ein Flüssigkeitszuführrohr (32) und ein Flüssigkeitsentleerungsrohr (34) aufweist, wobei beide Rohre von der Trennwand (18) getragen sind und jedes mit einer Öffnung versehen ist, die sich vor die Trennwand (18) öffnet.

3. Vorrichtung nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß der Drehkopf (14) eine geschlossene Frontfläche aufweist.

4. Vorrichtung nach Anspruch 3, dadurch gekennzeichnet, daß der Drehkopf (14) mit zermahlenden Meißeln an seiner Vorderfläche versehen ist.

5. Vorrichtung nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß der Drehkopf (14) eine Mehrzahl von konvexen und konkaven Bereichen (46), die sich radial von seinem spitzen Ende (14a) erstreckt, mindestens einen Schlitz (36, 38), der in seiner konischen Oberfläche (14b) gebildet ist, und Begrenzungsstücke (48) zum Begrenzen der Größe des Abraums, der in dem Schildkörper (12) durch den Spalt (36, 38) aufgenommen wird, aufweist, wobei die Begrenzungsstücke (48) in dem Schlitz (36, 38) angebracht sind.

6. Vorrichtung nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß der Drehkopf (14) eine Mehrzahl von Speichen (50), die radial von seinem spitzen Ende (14a) angeordnet sind, und eine Mehrzahl von Spitzen (44), die jede auf den Speichen (50) vorgesehen sind, aufweist.

7. Vorrichtung nach einem der Ansprüche 1 bis 6, dadurch gekennzeichnet, daß der exzentrische

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Bund (56) mit einem ersten Antriebsmechanismus (52) verbunden ist und daß die Drehwelle (22) eine Kurbelwelle (22) ist, die mit einem zweiten Antriebsmechanismus (20) verbunden ist.

8. Vorrichtung nach einem der Ansprüche 1 bis 6, dadurch gekennzeichnet, daß der exzentrische Bund (56) mit einem ersten Antriebsmechanismus (52) verbunden ist und daß die Drehwelle (22) eine gerade Welle (22) ist, die in einer Position exzentrisch zu der Achse des Schildkörpers (12) angebracht ist und mit einem zweiten Antriebsmechanismus (20) verbunden ist.

9. Verfahren für einen Tunnelschildvortrieb, bei dem ein Druck auf einen Schildkörper (12) ausgeübt wird, gekennzeichnet durch die Schritte:

Bewirken der Durchführung einer exzentrischen Bewegung eines Drehkopfes (14), der an dem Vorderabschnitt des Schildkörpers (12) angebracht ist;

Ausüben des Druckes auf den Schildkörper (12) während der exzentrischen Bewegung des Drehkopfes (14); und

Entleeren des durch den Drehkopf (14) abgebauten Materiales von einem vorderen Bereich zu einem hinteren Bereich in dem Schildkörper (12).

10. Verfahren nach Anspruch 9, gekennzeichnet durch die Schritte:

Tragen des Drehkopfes (14) durch eine Kurbelwelle (22) an dem Vorderabschnitt des Schildkörpers (12), wobei der Drehkopf (14) ein konischer oder ein kegelstumpfartiger Drehkopf (14) ist; und

Antreiben der Kurbelwelle (22) zum Verursachen einer exzentrischen Bewegung des konischen oder kegelstumpfartigen Drehkopfes (14).

11. Verfahren nach Anspruch 9, gekennzeichnet durch die Schritte:

Tragen des Drehkopfes (14) durch eine gerade Welle (22), die in einem exzentrischen Bund (56) an den Vorderabschnitt des Schildkörpers (12) angeordnet ist, wobei der Drehkopf (14) ein konischer oder ein kegelstumpfartiger Drehkopf (14) ist, und

Antreiben der geraden Welle (22) und des exzentrischen Bundes (56) zum Verursachen einer exzentrischen Bewegung des konischen oder kegelstumpfartigen Drehkopfes (14).

Revendications

1. Appareil d'enfoncement d'un bouclier (12) pour le percement de tunnels comprenant:

- un corps de bouclier (12) présentant une paroi de séparation (18) s'étendant en travers de son intérieur;
- un arbre (22) dont un tronçon extrême (22a) tourillonne dans la paroi de séparation (18) s'étendant en travers de l'intérieur du corps de bouclier (12);
- un mécanisme moteur (20) relié à l'arbre (22) et placé derrière la paroi de séparation (18); et
- un moyen hydraulique destiné à imprimer une poussée au corps de bouclier (12), le moyen hydraulique étant placé derrière le corps de bouclier (12); appareil caractérisé par:
- un collier excentrique (56) tourillonnant dans la paroi de séparation (18) et supportant l'arbre (22) en vue d'un mouvement excentrique de celui-ci;
- une tête rotative conique (14) tourillonnant sur un tronçon extrême opposé (22b) de l'arbre (22); et
- un moyen (32, 34) pour évacuer les déblais depuis la zone avant de la paroi de séparation (18) jusqu'à la zone arrière de celle-ci.

2. Appareil selon la revendication 1, caractérisé en ce que ledit moyen d'évacuation (32, 34) comporte un tuyau d'amenée de liquide (32) et un tuyau d'évacuation de liquide (34), ces deux tuyaux étant supportés par ladite paroi de séparation (18) et chacun présentant une ouverture regardant vers l'avant de ladite paroi de séparation (18).

3. Appareil selon la revendication 1 ou 2, caractérisé en ce que ladite tête rotative (14) présente une face avant fermée.

4. Appareil selon la revendication 3, caractérisé en ce que ladite tête rotative (14) est munie de dents d'écrasement sur sa susdite face avant.

5. Appareil selon la revendication 1 ou 2, caractérisé en ce que ladite tête rotative (14) présente une série de convexités et concavités (46) rayonnant à partir de son extrémité de pointe (14a), au moins une fente (36, 38) ménagée dans sa surface conique (14b) et des pièces limitatives (48) destinées à limiter la grandeur des débris pénétrant à l'intérieur dudit corps de bouclier (12) à travers ladite fente (36, 38), lesdites pièces limitatives (48) étant disposées dans ladite fente (36, 38).

6. Appareil selon la revendication 1 ou 2, caractérisé en ce que ladite tête rotative (14) présente une série de rayons (50) rayonnant à partir de son extrémité de pointe (14a) et une série de coupoirs (44) prévus sur chacun desdits rayons (50).

7. Appareil selon l'une des revendications 1 à 6, caractérisé en ce que ledit collier excentrique (56) est relié à un premier mécanisme moteur (52) et que ledit arbre (22) est un vilebrequin (22) relié à un second mécanisme moteur (20).

8. Appareil selon l'une des revendications 1 à 6, caractérisé en ce que ledit collier excentrique (56) est relié à un premier mécanisme moteur (52) et en ce que ledit arbre (22) est un arbre rectiligne (22) situé en un emplacement excentrique à l'axe dudit corps de bouclier (12) et relié à un second mécanisme moteur (20).

9. Procédé d'enfoncement d'un bouclier pour percement de tunnels, dans lequel on exerce une poussée sur un corps de bouclier (12), caractérisé par les opérations consistant à:

- amener une tête rotative (14) prévue à la partie avant du corps de bouclier (12) à décrire un mouvement excentrique;
- exercer ladite poussée sur le corps de bouclier (12) pendant le mouvement excentrique de la tête rotative (14); et
- évacuer les déblais détachés par la tête rotative (14) d'une zone avant jusqu'à une zone arrière

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dans le corps de bouclier (12).

10. Procédé selon la revendication 9, caractérisé par les opérations consistant à:

- faire supporter ladite tête rotative (14) par un vilebrequin (22) à la partie avant dudit corps de bouclier (12), ladite tête rotative (14) étant une tête rotative conique ou tronconique (14); et
- entraîner ledit vilebrequin (22) pour provoquer un mouvement excentrique de ladite tête rotative conique ou tronconique (14).

11. Procédé selon la revendication 9, caractérisé par les opérations consistant à:

- faire supporter ladite tête rotative (14) par un arbre rectiligne (22), disposé dans un collier excentrique (56), à la partie avant dudit corps de bouclier (12), ladite tête rotative (14) étant une tête rotative conique ou tronconique (14); et
- entraîner ledit arbre rectiligne (22) et ledit collier excentrique (56) pour provoquer un mouvement excentrique de ladite tête rotative conique ou tronconique (14).

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