

Description

This invention relates to a shield tunneling machine for excavating a tunnel and, more particularly, to a shield tunneling machine for excavating a tunnel while excavating the tunnel face with a cutter head provided with two types of bits.

Generally, a shield tunneling machine for excavating a tunnel by use of pressurized muddy water or clear water while preventing collapse of the tunnel face has mounted on a cutter head either a plurality of cutter bits used for excavating a soft layer like a clay layer or a plurality of roller bits used for excavating a hard layer like a bedrock layer.

However, when the machine provided with said cutter bits excavates the hard layer, the cutter bits are damaged by the tunnel face and when the machine provided with said roller bits excavates the soft layer the efficiency of operation is degraded. Thus, the general machine provided with only one type of bits can excavate only one of soft and hard layers according to the type of bits mounted on the cutter head.

Some excavating machines having the cutter head provided with a plurality of cutter bits and a plurality of roller bits are known. However, in these well-known machines the respective cutter bits and roller bits are fixed to the cutter head so that clay, mud, etc. are attached to the roller bits in excavating the soft layer and thus disadvantageously the roller bits hinder the excavating operation and the cutter bits are damaged in excavating the hard layer.

An object of the present invention is to provide a shield tunneling machine which can be used to excavate either of soft and hard layers and in which in spite of the provision of the cutter bits and the roller bits the roller bits do not hinder the excavating operation in excavating the soft layer and the cutter bits are not damaged in excavating the hard layer.

The shield tunneling machine according to the present invention comprises a tubular shield body, a partition wall provided in the shield body, a rotary shaft rotatably supported by the partition wall and extending along the longitudinal axis of said shield body, a cutter head disposed on the front end of the rotary shaft and including a first cutter provided with a plurality of cutter bits for excavating soft layers and a second cutter provided with a plurality of roller bits for excavating hard layers, a mechanism for rotating said cutter head through said rotary shaft and a mechanism for moving straight forward and backward one of said first and second cutters relative to the other.

According to the present invention, a mechanism is provided in which the cutter bits and roller bits are mounted respectively on the first and second cutters and one of both cutters is moved straight forward and backward relative to the other, so that one of said cutter bits and roller bits can be projected and the other can be retreated for excavation according to the geology of said face.

Thus, the shield tunneling machine can be used for excavating either of soft and hard layers, the foundation having soft and alternatively, hard layers. Further, the roller bits do not hinder the excavating operation in excavating the soft layer and the cutter bits are not damaged in excavating the hard layer.

The other objects and features of the present invention will become apparent from the following description of preferred embodiments of the invention with reference to the accompanying drawings.

Fig. 1 is a longitudinal sectional view showing an embodiment of a shield tunneling machine according to the present invention;

Fig. 2 is a left side view showing said machine shown in Fig. 1; and

Fig. 3 is a longitudinal sectional view showing a different embodiment of the shield tunneling machine according to the present invention.

A shield tunneling machine 10 shown in Figs. 1 and 2 comprises wall member 14 and partition wall 16 provided in a tubular shield body 12 and crossing same respectively. The wall member 14 is spaced apart rearward from the partition wall 16 to define a muck chamber 18. A hollow rotary shaft 20 extending longitudinally through the center portion of the shield body 12 is rotatably supported by the wall member 14 and the partition wall 16.

A cutter head 22 is disposed on the front end of the rotary shaft 20, and provided with a first cutter 24 and a second cutter 26.

The first cutter 24 comprises a boss 28 fitted onto the front end of the rotary shaft 20 and fixed to same by a set of screws (not shown) and a circular face plate 30 provided on the front end of the boss 28.

On the center portion of the front surface of the face plate 30 are mounted a plurality of center bits 32. The face plate 30 is provided with a plurality of slits 34 (two shown in an embodiment) extending radially on an outer periphery of said center portion. To both opposed sides of the slit 34 are fixed a plurality of cutter bits 36. To the back of the face plate 30 are fixed a plurality of scrapers 38 (four shown in the embodiment) for scooping muck received in a space between the face plate 30 and the partition wall 16 through the slits 34 as the face plate 30 is rotated. The face plate 30 is also provided between the slits 34 with a plurality of openings lined up radially. The respective openings are referred to as window holes 48 for roller bits 44 which will be later described.

The second cutter 26 comprises a boss 40 fitted onto the front end of the rotary shaft 20 and supported movably forward and backward along a slide key (not shown) and a plurality of spokes 42 (two in the shown embodiment) extending radially outward from the boss 40. The respective spokes 42 are disposed behind the face plate 30. A plurality of roller bits 44 are supported rotatably in brackets 46. The respective brackets 46 are disposed on the spoke 42 such that the roller bits 44 can move forward and backward of the face plate 30 through said window holes 48.

The cutter head 22 is rotated by a rotary mechanism 50 disposed on the rear end of the rotary shaft 20. The rotary mechanism 50 comprises a reversible motor 52, a reduction gear 54 connected to the output shaft of the motor, a gear 56 mounted on the output shaft of said gear 54 and a large gear 58 meshing with the gear 56. The motor 52 and the reduction gear 54 are mounted on a gear case 60 fixed to the wall member 14 by screws (not shown), and the large gear 58 is mounted on the rear end of the rotary shaft 20.

The machine 10 further comprises a straight movement mechanism 62 for moving the second cutter 26 of the cutter head 22 to move straight forward and backward relative to the first cutter 24. The mechanism 62 comprises two pneumatic or hydraulic cylinders 64 mounted on the gear case 60, a connecting arm 68 for interconnecting piston rods 66 of both cylinders 64, a slide shaft 70 disposed in a hollow portion 20a extending axially through the rotary shaft 20, a plurality of link rods 72 extending longitudinally through the boss 28 of the first cutter 24 and a link piece 74 for interconnecting the front ends of the respective link rods 72. The rear ends of the respective link rods 72 are connected to the boss 40 of the second cutter 26. The rear end of the slide shaft 70 is rotatably connected to the connecting arm 68 through a plurality of thrust bearings 76 and the front end is connected to the link piece 74.

On the upper portion of the partition wall 16 is formed an opening 78. At the opening 78 is disposed a lid 80 hinged to the partition wall 16. The lid 80 is pivotably connected through an arm 86 to a piston rod 84 of a pneumatic or hydraulic cylinder 82 mounted on the wall member 14 and closes normally the opening 78 by means of the cylinder 82. However, when the pressure of muck received in a space between the partition wall 16 and the cutter head 22 exceeds the pressure set to the cylinder 82, the lid 80 is pivoted to the partition wall 14 against the pressure of the cylinder 82 to open the opening 78 for flowing the muck into the muck chamber 18.

In the muck chamber 18 are disposed a rotor 88 and a stator 90 constituting a crusher for crushing relatively large gravel entering the muck chamber 18. The rotor 88 is mounted on the rotary shaft 20 and the stator 90 below the rotor 88 is mounted on the partition wall 16. High pressure water is sent into said muck chamber 18 through a water supply pipe 92 and the supplied water is discharged from muck chamber 18 to the rear portion of the shield body 12 through a drain pipe 94 together with the muck in the muck chamber 18.

The shield body 12 is advanced by a plurality of hydraulic jacks 98 utilizing segments 96 as reaction bodies. In a space formed between the shield body 12 and the segment 96 by the advance of the shield body 12 new segments are disposed.

In the excavation, the machine 10 transmits the rotation of the motor 52 of the rotary mechanism 50 to the rotary shaft 20 through the reduction gear 54, gear 56 and large gear 58 and further transmits rotation from the rotary shaft 20 to the

bosses 28, 40 of the first and second cutters 24, 26 for rotating the cutter head 22. Thus, said face is excavated by the cutter bits 36 or roller bits 44. The muck enters into said chamber in front of the partition wall 16 through the slits 34 in the face plate 30, flows into the muck chamber 18 through the opening 78 in the partition wall 16 and is then discharged from the muck chamber 18 through the drain pipe 94 together with water.

In operation of the machine 10, when the piston rod 66 in the cylinder 64 of the straight movement mechanism 62 is projected, the slide shaft 70 is moved right as viewed in Fig. 1 relative to the rotary shaft 20 so that the spokes 42 are moved similarly right and are spaced apart from the face plate 30 rearward. As a result, the roller bits 44 are retreated rearward of the face plate 30, i.e., behind the cutter bits 36. On the contrary to the above mentioned, when the piston rods 66 retreat into the cylinders 64, the slide shaft 70 is moved left as viewed in Fig. 1 relative to the rotary shaft 20. Thus, the spokes 42 are moved similarly left to approach the face plate 30. As a result, the roller bits 44 are projected forward through the window holes 48 in the face plate 30, i.e., more forward than the cutter bits 36 fixed to the face plate 26.

Thus, the machine 10 can excavate bedrock layers by the roller bits 44 projected more forward than the cutter bits 36 so that the cutter bits 36 can be prevented from being damaged by the bedrock. On the contrary, since the roller bits 44 can be retreated behind the cutter bits 36, the roller bits 44 can be prevented from attachment of clay in excavating said soft layer. Thus, the machine 10 can be used for excavating each of the soft and hard layers and cope with the change in geology only by projecting or retreating the second cutter 26 relative to the first cutter 24 in the boundary of stratum so that when it is used particularly for the stratum having alternatively the soft and hard layers, the efficiency of excavating operation is remarkably improved compared with the shield tunneling machine having the cutter bits and roller bits fixed to the face plate.

A shield tunneling machine 10a shown in Fig. 3 is constructed similarly to the machine 10 shown in Figs. 1 and 2 except that a boss 28a of the first cutter 24 having said cutter bits (not shown) is supported movably forward and backward on the front end of the rotary shaft 20, the face plate 30 is connected directly to the front end of the slide shaft 70 and a boss 40a of the second cutter 26 provided with the roller bits 44 is fixed to the rotary shaft 20 by a screw 98. A straight movement mechanism 62a in the machine 10a is provided with two pneumatic or hydraulic cylinders 64 mounted on the gear case 60, a connecting arm 68 for interconnecting the piston rods 66 in both cylinders 64 and the slide shaft 70 disposed in the hollow portion 20a of the rotary shaft 20. The rear end of the slide shaft 70 is rotatably connected to the connecting arm 68 through a plurality of thrust bearings 76 and the front end is connected to the face plate 30.

In operation of the machine 10a, when the

piston rods 66 in the cylinders 64 of the straight movement mechanism 62 are projected, the cutter bits 36 retreat more than the roller bits 44. On the contrary, when the piston rods 66 in the cylinders 64 are retreated into the cylinders 64, the cutter bits 36 project forward more than the roller bits 44. Thus, since the first cutter 24 advances and retreats relative to the second cutter 26, the machine 10a can retreat and project the cutter bits 36 relative to the roller bits 44 in excavating said face of base rock and clay respectively. Therefore, it is possible to use the machine 10a for excavating each of soft and hard layers similarly to the embodiment shown in Figs. 1 and 2.

Claims

1. A shield tunneling machine comprising:
 - a tubular shield body (12);
 - a partition wall (16) provided in the shield body (12);
 - a rotary shaft (20) supported rotatably by the partition wall (16) and extending along the longitudinal axis of said shield body (12);
 - a cutter head (22) disposed on the front end of the rotary shaft (20) and including a first cutter (24) provided with a plurality of cutter bits (36) for excavating soft layers and a second cutter (26) provided with a plurality of roller bits (44) for excavating hard layers;
 - a mechanism (50) for rotating said cutter head (22) through said rotary shaft (20); and
 - a mechanism (62, 62a) for moving straight one of said first (24) and second (26) cutters forward and backward relative to the other to place them at a first position where one is projected more forward than the other and alternatively at a second position where one is retreated more backward than the other.
2. A shield tunneling machine as claimed in claim 1, wherein said first cutter (24) comprises a boss (28, 28a) fitted onto the front end of said rotary shaft and a face plate (30) provided on the front end of the boss and formed with a plurality of slits (34) extending radially, and said cutter bits (36) on the face plate are provided near said slits.
3. A shield tunneling machine as claimed in claim 1, wherein said second cutter (26) comprises a boss (40, 40a) fitted onto the front end of said rotary shaft and a plurality of spokes (42) extending radially outward from the boss, and said roller bits (44) are provided on said spokes.
4. A shield tunneling machine as claimed in claim 1, wherein said rotary mechanism (50) comprises a motor (52), a reduction gear (54) connected to the output shaft of the motor, a gear (56) connected to the reduction gear and a large gear (58) meshing with the gear and mounted on the rear end of said rotary shaft.
5. A shield tunneling machine as claimed in claim 1, wherein said straight movement mechanism (62, 62a) comprises a slide shaft (70) disposed in a hollow portion (20a) extending axially through said rotary shaft (20) and a means

(64, 66, 68, 76) for sliding the slide shaft forward and backward relative to said rotary shaft.

6. A shield tunneling machine as claimed in claim 1, wherein said first cutter (24) is mounted on the front end of said rotary shaft and said second cutter (26) is supported movably forward and backward on said rotary shaft and connected to said straight movement mechanism.

7. A shield tunneling machine as claimed in claim 1, wherein said first cutter (24) is supported movably forward and backward on said rotary shaft and connected to said straight movement mechanism and said second cutter (26) is mounted on said rotary shaft.

Patentansprüche

1. Schildvortriebstunnelmaschine mit
 - einem röhrenförmigen Schildkörper (12);
 - einem in dem Schildkörper (12) vorgesehenen Trennwand (16);
 - einer drehbar durch die Trennwand (16) getragenen und sich entlang der Längsachse des Schildkörpers (12) erstreckenden Drehwelle (20);
 - einem auf dem vorderen Ende der Drehwelle (20) angebrachten Schneidkopf (22) mit einer mit einer Mehrzahl von Schneidmeißeln (36) zum Graben von weichen Schichten versehenen ersten Schneidvorrichtung (24) und einer mit einer Mehrzahl von Rollenmeißeln (44) zum Graben von harten Schichten versehenen zweiten Schneidvorrichtung (26);
 - einem Mechanismus (50) zum Drehen des Schneidkopfes (22) durch die Drehwelle (20); und
 - einer Vorrichtung (62, 62a) zur geradlinigen Bewegung von einer der ersten (24) oder zweiten (26) Schneidvorrichtung vorwärts und rückwärts im Verhältnis zu der anderen, um sie in eine erste Stellung zu positionieren, in der die eine mehr nach vorn vorsteht, und alternativ in eine zweite Stellung, in der die eine mehr zurückgezogen ist als die andere.
2. Schildvortriebstunnelmaschine nach Anspruch 1, bei der die erste Schneidvorrichtung (24) eine auf das Vorderende der Drehwelle aufgepaßte Nabe (28, 28a) und eine auf dem Vorderende der Nabe vorgesehene und mit einer Mehrzahl von sich radial erstreckenden Schlitzten (34) gebildete Frontplatte (30) aufweist, wobei die Schneidmeißel (36) auf der Frontplatte in der Nähe der Schlitzte vorgesehen sind.
3. Schildvortriebstunnelmaschine nach Anspruch 1, bei der die zweite Schneideinrichtung (26) eine auf das Vorderende der Drehwelle aufgepaßte Nabe (40, 40a) und eine sich radial auswärts von der Nabe erstreckende Mehrzahl von Speichen (42) aufweist, wobei die Rollenmeißel (44) auf den Speichen vorgesehen sind.
4. Schildvortriebstunnelmaschine nach Anspruch 1, in der der Rotationsmechanismus (50) einen Motor (52), ein mit der Ausgangswelle des Motors verbundenes Untersetzungsgetriebe (54), ein mit dem Untersetzungsgetriebe verbundenes Zahnrad (56) und ein in das Zahnrad eingreifendes und auf dem hinteren Ende der

piston rods 66 in the cylinders 64 of the straight movement mechanism 62 are projected, the cutter bits 36 retreat more than the rollers bits 44. On the contrary, when the piston rods 66 in the cylinders 64 are retreated into the cylinders 64, the cutter bits 36 project forward more than the roller bits 44. Thus, since the first cutter 24 advances and retreats relative to the second cutter 26, the machine 10a can retreat and project the cutter bits 36 relative to the roller bits 44 in excavating said face of base rock and clay respectively. Therefore, it is possible to use the machine 10a for excavating each of soft and hard layers similarly to the embodiment shown in Figs. 1 and 2.

Claims

1. A shield tunneling machine comprising:
 - a tubular shield body (12);
 - a partition wall (16) provided in the shield body (12);
 - a rotary shaft (20) supported rotatably by the partition wall (16) and extending along the longitudinal axis of said shield body (12);
 - a cutter head (22) disposed on the front end of the rotary shaft (20) and including a first cutter (24) provided with a plurality of cutter bits (36) for excavating soft layers and a second cutter (26) provided with a plurality of roller bits (44) for excavating hard layers;
 - a mechanism (50) for rotating said cutter head (22) through said rotary shaft (20); and
 - a mechanism (62, 62a) for moving straight one of said first (24) and second (26) cutters forward and backward relative to the other to place them at a first position where one is projected more forward than the other and alternatively at a second position where one is retreated more backward than the other.
2. A shield tunneling machine as claimed in claim 1, wherein said first cutter (24) comprises a boss (28, 28a) fitted onto the front end of said rotary shaft and a face plate (30) provided on the front end of the boss and formed with a plurality of slits (34) extending radially, and said cutter bits (36) on the face plate are provided near said slits.
3. A shield tunneling machine as claimed in claim 1, wherein said second cutter (26) comprises a boss (40, 40a) fitted onto the front end of said rotary shaft and a plurality of spokes (42) extending radially outward from the boss, and said roller bits (44) are provided on said spokes.
4. A shield tunneling machine as claimed in claim 1, wherein said rotary mechanism (50) comprises a motor (52), a reduction gear (54) connected to the output shaft of the motor, a gear (56) connected to the reduction gear and a large gear (58) meshing with the gear and mounted on the rear end of said rotary shaft.
5. A shield tunneling machine as claimed in claim 1, wherein said straight movement mechanism (62, 62a) comprises a slide shaft (70) disposed in a hollow portion (20a) extending axially through said rotary shaft (20) and a means

(64, 66, 68, 76) for sliding the slide shaft forward and backward relative to said rotary shaft.

6. A shield tunneling machine as claimed in claim 1, wherein said first cutter (24) is mounted on the front end of said rotary shaft and said second cutter (26) is supported movably forward and backward on said rotary shaft and connected to said straight movement mechanism.

7. A shield tunneling machine as claimed in claim 1, wherein said first cutter (24) is supported movably forward and backward on said rotary shaft and connected to said straight movement mechanism and said second cutter (26) is mounted on said rotary shaft.

Patentansprüche

1. Schildvortriebstunnelmaschine mit einem röhrenförmigen Schildkörper (12); einem in dem Schildkörper (12) vorgesehenen Trennwand (16); einer drehbar durch die Trennwand (16) getragenen und sich entlang der Längsachse des Schildkörpers (12) erstreckenden Drehwelle (20); einem auf dem vorderen Ende der Drehwelle (20) angebrachten Schneidkopf (22) mit einer mit einer Mehrzahl von Schneidmeisseln (36) zum Graben von weichen Schichten versehenen ersten Schneidvorrichtung (24) und einer mit einer Mehrzahl von Rollenmeißeln (44) zum Graben von harten Schichten versehenen zweiten Schneidvorrichtung (26); einem Mechanismus (50) zum Drehen des Schneidkopfes (22) durch die Drehwelle (20); und einer Vorrichtung (62, 62a) zur geradlinigen Bewegung von einer der ersten (24) oder zweiten (26) Schneidvorrichtung vorwärts und rückwärts im Verhältnis zu der anderen, um sie in eine erste Stellung zu positionieren, in der die eine mehr nach vorn vorsteht, und alternativ in eine zweite Stellung, in der die eine mehr zurückgezogen ist als die andere.
2. Schildvortriebstunnelmaschine nach Anspruch 1, bei der die erste Schneidvorrichtung (24) eine auf das Vorderende der Drehwelle aufgepaßte Nabe (28, 28a) und eine auf dem Vorderende der Nabe vorgesehene und mit einer Mehrzahl von sich radial erstreckenden Schlitten (34) gebildete Frontplatte (30) aufweist, wobei die Schneidmeißel (36) auf der Frontplatte in der Nähe der Schlitten vorgesehen sind.
3. Schildvortriebstunnelmaschine nach Anspruch 1, bei der die zweite Schneideinrichtung (26) eine auf das Vorderende der Drehwelle aufgepaßte Nabe (40, 40a) und eine sich radial auswärts von der Nabe erstreckende Mehrzahl von Speichen (42) aufweist, wobei die Rollenmeißel (44) auf den Speichen vorgesehen sind.
4. Schildvortriebstunnelmaschine nach Anspruch 1, in der der Rotationsmechanismus (50) einen Motor (52), ein mit der Ausgangswelle des Motors verbundenes Untersetzungsgetriebe (54), ein mit dem Untersetzungsgetriebe verbundenes Zahnrad (56) und ein in das Zahnrad eingreifendes und auf dem hinteren Ende der



Rotationswelle angebrachtes großes Zahnrad (58) aufweist.

5. Schildvortriebstunnelmaschine nach Anspruch 1, in der die Vorrichtung (62, 62a) zur geradlinigen Bewegung eine in einem hohlen Abschnitt (20a) angebrachte, sich axial durch die Drehwelle (20) erstreckende Gleitwelle (70) und eine Vorrichtung (64, 66, 68, 76) zum Verschieben der Gleitwelle vorwärts und rückwärts relativ zu der Rotationswelle aufweist.

6. Schildvortriebstunnelmaschine nach Anspruch 1, in der die erste Schneidvorrichtung (24) auf dem vorderen Ende der Rotationswelle angebracht ist und die zweite Schneidvorrichtung (26) bewegbar vorwärts und rückwärts auf der Rotationswelle getragen ist und mit der Vorrichtung zur geradlinigen Bewegung verbunden ist.

7. Schildvortriebstunnelmaschine nach Anspruch 1, bei der die erste Schneidvorrichtung (24) bewegbar vorwärts und rückwärts auf der Drehwelle getragen ist und mit der Vorrichtung zur geradlinigen Bewegung verbunden ist, und bei der die zweite Schneidvorrichtung (26) auf der Drehwelle angebracht ist.

Revendications

1. Machine à forer les tunnels à bouclier, caractérisée en ce qu'elle comprend:

—un corps de bouclier tubulaire (12);
—une cloison (16) prévue dans le corps de bouclier (12);

—un arbre rotatif (20) supporté mobile en rotation par la cloison (16) et qui s'étend selon l'axe longitudinal dudit corps de bouclier (12);

—une tête fraiseuse (22) disposée sur l'extrémité avant de l'arbre rotatif (20) et comprenant une première fraise (24) munie d'une pluralité d'outils fixes (36) pour creuser dans les couches meubles, et une deuxième fraise (26) munie d'une pluralité d'outils à molette (44) pour creuser dans les couches dures;

—un mécanisme (50) servant à faire tourner ladite tête fraiseuse (22) par l'intermédiaire dudit arbre rotatif (20); et

—un mécanisme (62, 62a) servant à déplacer l'une desdites fraises, soit la première fraise (24) soit la deuxième fraise (26), en translation vers l'avant ou vers l'arrière par rapport à l'autre, pour placer ces fraises, soit dans une première position dans laquelle l'une est avancée plus loin que

l'autre et, en variante, dans une deuxième position dans laquelle cette fraise est rétractée plus en arrière que l'autre.

2. Machine à forer les tunnels à bouclier selon la revendication 1, caractérisée en ce que ladite première fraise (24) comprend un bossage (28, 28a) monté sur l'extrémité avant dudit arbre rotatif et un disque avant (30) prévu sur l'extrémité avant du bossage et muni d'une pluralité de fentes (34) qui s'étendent radialement, et lesdits outils fixes (36) portés par le disque avant sont prévus à proximité desdites fentes.

3. Machine à forer les tunnels à bouclier selon la revendication 1, caractérisée en ce que ladite deuxième fraise (26) comprend un bossage (40, 40a) monté sur l'extrémité avant dudit arbre rotatif, et une pluralité de rayons (42) qui s'étendent radialement vers l'extérieur à partir du bossage, lesdits outils à molettes (44) sont prévus sur lesdits rayons.

4. Machine à forer les tunnels à bouclier selon la revendication 1, caractérisée en ce que ledit mécanisme rotatif (50) comprend un moteur (52), un réducteur à engrenages (54) relié à l'arbre de sortie du moteur, un pignon (56) relié au réducteur à engrenage et une grande roue (58) qui engrène avec le pignon et est montée sur l'extrémité arrière dudit arbre rotatif.

5. Machine à forer les tunnels à bouclier selon la revendication 1, caractérisée en ce que ledit mécanisme de translation (62, 62a) comprend une barre coulissante (70) disposée dans une partie creuse (20a) qui s'étend axialement à travers ledit arbre rotatif (20), et des moyens (64, 66, 68, 76) servant à faire coulisser la barre coulissante vers l'avant et vers l'arrière par rapport audit arbre rotatif.

6. Machine à forer les tunnels à bouclier selon la revendication 1, caractérisée en ce que ladite première fraise (24) est montée sur l'extrémité avant dudit arbre rotatif et ladite deuxième fraise (26) est montée sur ledit arbre rotatif de façon à pouvoir se déplacer vers l'avant et vers l'arrière et est reliée audit mécanisme de translation.

7. Machine à forer les tunnels à bouclier selon la revendication 1, caractérisée en ce que ladite première fraise (24) est montée sur ledit arbre rotatif de façon à pouvoir avancer et reculer et est reliée audit mécanisme de translation et ladite deuxième fraise (26) est montée sur ledit arbre rotatif.



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