SHIELDED TUNNELING CONSTRUCTION METHOD USING ELONGATION CONVEYOR

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates, in general, to a shielded tunneling construction method using an elongation conveyor and, more particularly, to a shielded tunneling construction method using an elongation conveyor, in which excavated soil, which is produced by an excavating means, is conveyed by a conveyor belt unit.

Description of the Related Art

In the related art, a shielded tunneling construction method that excavates a base rock as well as earth/sand and ejects them to the ground includes the steps of: excavating the base, which is one of base rock and earth/sand, using an excavating means; conveying the base rock and the earth/sand using a screw conveyor means; crushing the base rock that has been conveyed by the screw conveyor means into scraps using a rock-crushing means; conveying the scraps and the earth/sand through a pressure-feed pipe using a pressure-feed pump; and sorting the scraps and the earth and soil that have been conveyed according to the sizes of particles using a scrap-

sorting means. The step of excavating is carried out by crushing the base rock using the rotational force of a cutter head, which is provided with a disc cutter, the disc cutter adapted to excavate the base rock.

However, since the shielded tunneling construction method of the related art conveys the crushed soil (i.e. the rock and the earth/sand) to the ground using the pressure-feed pump and the pressure-feed pipe, there are drawbacks in that a separate rock-crushing means is further required, and in that it is troublesome, for example, to sort the scraps and mix them with water.

SUMMARY OF THE INVENTION

Accordingly, the present invention has been made keeping in mind the above problems occurring in the related art, and the present invention is intended to propose a shielded tunneling construction method using an elongation conveyor, in which crushed soil that has been produced by an excavating means is conveyed by a conveyor belt unit so that it can be conveyed without having to be additionally machined, in which the length of the conveyor belt is elongated by an elongating means such that it corresponds to the movement of the excavating means and a carriage, so that the crushed soil can be continuously conveyed and the excavating means can

continuously excavate a tunnel, and the direction in which the conveyor belt proceeds is changed by a direction-changing unit such that the positions of a vertical conveyor means, which conveys the crushed soil to the ground, and an elongating means can be freely selected.

In order to achieve the above object, according to one aspect of the present invention, there is provided a shielded tunneling construction method using an elongation conveyor including the steps of: forming a vertical advancing tunnel and a vertical arrival tunnel; excavating a tunnel from a bottom of the vertical advancing tunnel to a bottom of the vertical arrival; conveying excavated soil that has been produced by an excavating means when the tunnels are being excavated to the vertical advancing tunnel; ejecting the excavated soil from the vertical advancing tunnel to the ground using a vertical carrier; and continuously installing segments on excavated areas of the tunnel that has been formed by the excavating means, thereby completing the tunnel. A screw conveying means supplies the excavated soil that has been produced by the excavating means to a conveyor belt, and the conveyor belt conveys the excavated soil to the vertical carrier.

The conveyor belt includes a first conveyor belt unit, which is disposed between the screw conveying means and a carriage to supply the excavated soil that has been supplied from the screw conveying means to the second conveyor belt

unit, a second conveyor belt unit, which is disposed above the carriage to carry the excavated soil that has been supplied from the first conveyor belt unit to a third conveyor belt unit, wherein the third conveyor belt unit, which has a return pulley, is mounted on the carriage, and carries the excavated soil that has been supplied from the second conveyor belt unit to the vertical carrier.

The third conveyor belt unit has a return belt section of a belt, the return belt circulating between a return pulley and a drive pulley. An elongating means is disposed on the return belt section, such that the belt, which is stored in the elongating means, is drawn by a same amount as an increase in the distance between the drive pulley and the return pulley, which is caused by an advancement of the carriage. This consequently increases the length of the belt that circulates between the return pulley and the drive pulley, and a direction-changing means is disposed between the elongating means and the return pulley. Consequently, it is not required for the drive pulley to be positioned collinearly with the return pulley, and it is possible to freely set the positions of the elongating means and the vertical carrier.

According to embodiments of the present invention, in the shielded tunneling construction method using an elongation conveyor, the crushed soil that has been produced by the excavating means is conveyed by the conveyor belt unit so that

it can be conveyed without having to be additionally machined. The length of the conveyor belt is elongated by the elongating means such that it corresponds to the movement of the excavating means and a carriage, so that the crushed soil can be continuously conveyed and the excavating means can continuously excavate a tunnel. The direction in which the conveyor belt proceeds is changed by the direction-changing unit such that the positions in which the vertical conveyor means, which conveys the crushed soil to the ground, and the elongating means can be freely selected.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and other advantages of the present invention will be more clearly understood from the following detailed description when taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a schematic view showing a shielded tunneling construction method using an elongation conveyor according to an embodiment of the present invention;

FIG. 2 is an enlarged side elevation view showing a shielded tunneling apparatus using the elongation conveyor shown in FIG. 1;

FIG. 3 is a top plan view showing an example in which a elongating means and a direction-changing means are mounted on

the shielded tunneling apparatus, such that the position of the elongating means and the vertical carrier are set by the direction-changing means;

FIG. 4 is a schematic view showing an example in which the elongating means is mounted on the third conveyor belt;

FIG. 5 is an enlarged side elevation view of the elongating means;

FIG. 6 is a schematic view of the first direction-changing means; and

FIG. 7 is a schematic view of the second direction-changing means.

DETAILED DESCRIPTION OF THE INVENTION

Reference will now be made in greater detail to a preferred embodiment of the invention, an example of which is illustrated in the accompanying drawings. Wherever possible, the same reference numerals will be used throughout the drawings and the description to refer to the same or like parts.

Referring to FIG. 1, in general, a shielded tunneling construction method includes the steps of forming a vertical advancing tunnel 110 and a vertical arrival tunnel 120 and excavating a tunnel 130 from the bottom of the vertical advancing tunnel 110 to the bottom of the vertical arrival

tunnel 120. Here, the tunnel 130 is completed by conveying excavated soil that has been produced by an excavating means 10 while the tunnel is being excavated to the vertical advancing tunnel 110, ejecting the excavated soil from the vertical advancing tunnel 110 to the ground using a vertical carrier 90, and then continuously installing segments 140 on the excavated areas of the tunnel 130 that has been formed by the excavating means 10.

In the shielded tunneling construction method of this embodiment as described above, a screw conveying means 20 supplies the excavated soil that has been produced by the excavating means 10 to a conveyor belt C, which in turn conveys the excavated soil to the vertical carrier 90.

Referring to FIG. 2, the conveyor belt C includes first to third conveyor belt units 40, 50 and 60. The first conveyor belt unit 40 is disposed between the screw conveying means 20 and a carriage 30 to supply the excavated soil that has been supplied from the screw conveying means 20 to the second conveyor belt unit 50. The second conveyor belt unit 50 is disposed above the carriage 30 to carry the excavated soil that has been supplied from the first conveyor belt unit 40 to the third conveyor belt unit 60. The third conveyor belt unit 60 has a return pulley 61, which is mounted on the carriage 30. The third conveyor belt unit 60 carries the excavated soil that has been supplied from the second conveyor belt unit 50 to the

vertical carrier 90.

Referring to FIG. 3 to FIG. 5, in the third conveyor belt unit 60, a return belt section 63a of a belt 63 circulates between a return pulley 61 and a drive pulley 62. An elongating means 70 is disposed on the return belt section 63a. Thus, the belt, which is stored in the elongating means 70, is drawn by the same amount as the increase in the distance L1 between the drive pulley 62 and the return pulley 61, which is caused by the advancement (i.e. the movement in the direction of the arrow 35) of the carriage 30, thereby increasing the length of the belt 63 that circulates between the return pulley 61 and the drive pulley 62. A direction-changing means 80 is disposed between the elongating means 70 and the return pulley 61. Consequently, it is not required for the drive pulley 62 to be positioned collinearly with the return pulley 61, and it is possible to freely set the positions of the elongating means 70 and the vertical carrier 90.

Referring to FIG. 5, in the elongating means 70, a plurality of pulleys 71 are rotatably arranged in the form of stairs on a first belt storage 72, and a plurality of pulleys 73 are arranged rotatably arranged in the form of stairs on a second belt storage 74. The first and second belt storages 72 and 74 are disposed on rails 75 such that they face each other and are spaced apart from each other. The belt 63 is drawn to the first belt storage 72 and the second belt storage 74 by

wire-pulling units 76 and 77. This can consequently prevent the interval L2 between the first belt storage 72 and the second belt storage 74 is abruptly reduced by the wire-pulling units 76 and 77. The belt 63 that has passed through the drive pulley 62 (see FIG. 3) is supplied through a first pulley 71a, which is disposed in the lowermost portion of the first belt storage 72, to a first pulley 73a of the second belt storage 74, and is then supplied from the first pulley 73a of the second belt storage 74 to a second pulley 71b of the first belt storage 72. In this fashion, the belt 63 passes through the pulleys 71 of the first belt storage 72 and the pulleys 73 of the second belt storage 74 along a serpentine path. After sequentially passing through a final pulley 71n, which is in the uppermost portion of the first belt storage 72, and a final pulley 73a, which is in the uppermost portion of the second belt storage 74, the belt 63 is supplied to the return pulley 61 of the third conveyor belt unit 60.

As such, the belt 63 is stored by passing through the pulleys 71 of the first belt storage 72 and the pulleys 73 of the second belt storage 74 along the serpentine path. When the pulling force F1 of the return pulley 61 of the third conveyor belt unit 60, which is caused by the advancement of the carriage 30, exceeds the drawing force F2+F3 of the wire-pulling units 76 and 77, the interval L2 between the first belt storage 72 and the second belt storage 74 is decreased by the

pulling force of the returning pulley 61 of the third conveyor belt unit 60. The length of the belt 63 is then increased toward the return pulley 61 of the third conveyor belt unit 60 by the same amount as the decrease in the interval between the first belt storage 72 and the second belt storage 74.

In the wire-pulling means 76, a frame 76b is configured such that it can be moved forward and backward by a cylinder 76b, a plurality of movable pulleys 76c and a plurality of fixed pulleys 76d are mounted on the frame 76b, and a wire 76e is wound on the pulleys 76c and 76d in a serpentine pattern. One end of the wire 76e is connected to the first belt storage 72.

Referring to FIG. 3 again, the direction-changing means 80 is divided into a first direction-changing means 81 and a second direction-changing means 87. The first direction-changing means 81 changes the direction of a carrier belt section 63b of the belt 63 of the third conveyor belt unit 60, in which the carrier belt section 63b carries the excavated soil. The second direction-changing means 87 changes the direction of the return belt section 63a of the belt 63 of the third conveyor belt unit 60, in which the return belt section 63a is fed to the return pulley 62.

Referring to FIG. 6, in the first direction-changing means 81, the direction in which the carrier belt section 63b proceeds (hereinafter, referred to as the "proceeding

direction") is changed to the inverse direction by a first pulley 82. The direction in which the carrier belt section 63b, which is changed to the inverse direction by the first pulley 82, proceeds is bent downward by a second pulley 83. The carrier belt section 63b is bent again to the proceeding direction by a third pulley 84, which is disposed below the second pulley 83. The proceeding direction of the carrier belt section 63b is then bent upwards by a fourth pulley 85, which is disposed parallel to the third pulley 84. A fifth pulley 86 is disposed between the first and fourth pulleys 82 and 85, and is oriented at an angle of 90° with respect to the fourth pulley 85, such that the carrier belt section 63b that has passed through the fourth pulley 85 is twisted 90° when it reaches the fifth pulley 86. When the carrier belt section 63 passes through the fifth pulley 86, it proceeds in the direction that is changed 90° with respect to the direction in which it was first proceeding toward the first pulley 82. Consequently, the excavated soil 5 that has been conveyed to the first pulley 82 by the carrier belt 63b is dropped to the carrier belt section 63b, which passes through the fifth pulley 86, so that the direction in which the excavated soil is conveyed is changed to a different direction.

Referring to FIG. 7, the second direction-changing means 87 serves to change the direction of the return belt section 63a. A sixth pulley 88 and a seventh pulley 89 are arranged up

and down and oriented at an angle of 90° with respect to each other, such that the return belt section 63a that passes through the sixth pulley 88 and the seventh pulley 89 is twisted 90°, thereby changing the direction in which it proceeds.

The advantages of this shielded tunneling construction method of this embodiment are that the belt of the third conveyor belt unit 60 can continuously convey the excavated soil by extending for the distance that the excavating means 10 and the carriage 30 have moved, so that the excavating means 10 can continuously excavate the tunnel, and the positions in which the vertical carrier 90 and the elongating means 70 can be freely selected by the direction-changing means 80.

Although the exemplary embodiments of the present invention have been described for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

WHAT IS CLAIMED IS:

1. A shielded tunneling construction method using an elongation conveyor comprising:

forming a vertical advancing tunnel and a vertical arrival tunnel;

excavating a tunnel from a bottom of the vertical advancing tunnel to a bottom of the vertical arrival;

conveying excavated soil that has been produced by an excavating means when the tunnels are being excavated to the vertical advancing tunnel;

ejecting the excavated soil from the vertical advancing tunnel to the ground using a vertical carrier; and

continuously installing segments on excavated areas of the tunnel that has been formed by the excavating means, thereby completing the tunnel,

wherein a screw conveying means supplies the excavated soil that has been produced by the excavating means to a conveyor belt, and the conveyor belt conveys the excavated soil to the vertical carrier,

wherein the conveyor belt includes a first conveyor belt unit, which is disposed between the screw conveying means and a carriage to supply the excavated soil that has been supplied from the screw conveying means to the second conveyor belt unit, a second conveyor belt unit, which is disposed above the

carriage to carry the excavated soil that has been supplied from the first conveyor belt unit to a third conveyor belt unit, wherein the third conveyor belt unit, which has a return pulley, is mounted on the carriage, and carries the excavated soil that has been supplied from the second conveyor belt unit to the vertical carrier,

wherein the third conveyor belt unit has a return belt section of a belt, the return belt circulating between a return pulley and a drive pulley, and an elongating means is disposed on the return belt section, such that the belt, which is stored in the elongating means, is drawn by a same amount as an increase in the distance between the drive pulley and the return pulley, which is caused by an advancement of the carriage, thereby increasing the length of the belt that circulates between the return pulley and the drive pulley, and a direction-changing means is disposed between the elongating means and the return pulley, and

wherein the direction-changing means includes a first direction-changing means, which changes the direction of a carrier belt section of the belt of the third conveyor belt unit, the carrier belt section carrying the excavated soil, and a second direction-changing means, which changes a direction of the return belt section of the belt of the third conveyor belt unit, the return belt section being fed to the return pulley.

2. The shielded tunneling construction method of claim 1, wherein the first direction-changing means includes a first pulley, which changes the direction in which the carrier belt section proceeds to an inverse direction, a second pulley, at which the direction in which the carrier belt section, which is changed to the inverse direction by the first pulley, proceeds is bent downward, a third pulley, which is disposed below the second pulley, such that the carrier belt section is bent again to the direction in which the carrier belt section proceeds, a fourth pulley, which is disposed parallel to the third pulley, such that the direction in which the carrier belt section proceeds is bent upwards, a fifth pulley, which is disposed between the first and fourth pulleys and is oriented at an angle of 90° with respect to the fourth pulley, such that the carrier belt section that has passed through the fourth pulley is twisted 90° when the carrier belt section reaches the fifth pulley, the direction in which the carrier belt section proceeds while passing through the fifth pulley is changed 90° with respect to the direction in which the carrier belt section proceeds toward the first pulley, whereby the excavated soil that has been conveyed to the first pulley by the carrier belt is dropped to the carrier belt section, which passes through the fifth pulley, so that the direction in which the excavated soil is conveyed is changed to a different direction.

3. The shielded tunneling construction method of claim 1, wherein the second direction-changing means is adapted to change the direction of the return belt section, and includes a sixth pulley and a seventh pulley, which are arranged up and down and oriented at an angle of 90° with respect to each other, such that the return belt section that passes through the sixth pulley and the seventh pulley is twisted 90°, thereby changing the direction in which the return belt section proceeds, whereby the drive pulley and the return pulley are not required to be collinear, and it becomes possible to freely set the positions of the elongating means and the vertical carrier.