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71 Applicant: **Toyo Construction Co.,Ltd.**
1,Koraibashi 5 chome Higashi-ku
Osaka-shi Osaka-fu(JP)

(72) Inventor: Mitsuse, Masanori c/o Toyo Construction Co. Ltd.

**1, Koraibashi 5-chome Higashi-ku
Osaka-shi Osaka-fu(JP)**

**1, Koraibashi 5-chome Higashi-ku
Osaka-shi Osaka-fu(JP)**

**1, Koraibashi 5-chome Higashi-ku
Osaka-shi Osaka-fu(JP)**

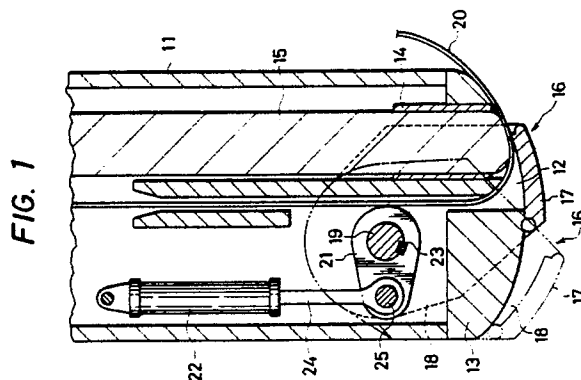
Inventor: **Goto, Seiichi c/o Toyo Construction Co. Ltd.**

**1, Koraibashi 5-chome Higashi-ku
Osaka-shi Osaka-fu(JP)**

74 Representative: **Kreutz, Karl-Jürgen**
Patentanwalt Dipl.-Ing. Karl Jürgen Kreutz
Osterwaldstrasse 149
D-8000 München 40(DE)

⑤4 Drain material holding apparatus for board drain process.

57) Disclosed is a drain material holding apparatus for use to carry out a board drain method, in which a pushing rod is inserted into a hollow mandrel provided with an openable/closable cover attached on its lower end so that a drain material can be grasped between the openable/closable cover and an end surface of the pushing rod when the openable/closable cover is rotated in the direction to close a drain material insertion through hole formed in the mandrel.



DRAIN MATERIAL HOLDING APPARATUS FOR BOARD DRAIN PROCESS

BACKGROUND OF THE INVENTION

(Field of the Invention)

The present invention relates to a drain material holding apparatus for use in a soil improving method, and particularly in a board drain method.

(Description of the Prior Art)

The board drain method includes the steps of: inserting a drain material composed of paper fibers (paper drain material), a drain material composed of high molecular compounds such as polyvinyl chloride, polypropylene, etc., or a plastic material, into a hollow mandrel; driving the drain material into the ground together with the mandrel; pulling only the mandrel out of the ground; and draining interstitial water contained in the ground through the drain material left in the ground so as to strengthen the ground. In such a board drain method as described above, however, there occur serious problems how to drive the drain material into the ground together with the mandrel and how to separate the drain material from the mandrel so as to leave the drain material in the ground, and therefore in order to solve the problems, various trials have been effected.

Figs.4(a) through 4(c) show specific examples of the trials. For example, in the case shown in Fig.4(a), a folding shoe member 4 is attached on the lower end portion of a drain material 3 in the vicinity of a drain material insertion through hole 2 formed in the lower end of a mandrel 1 to thereby leave the drain material 3 within the ground by utilizing resistance of the shoe member 4 after the drain material 3 has been driven into the ground together with the mandrel 1: in the case shown in Fig.4(b), an inverted T-shaped shoe member 5 (a corn-shaped member) is attached on the lower end of a drain material 3 to thereby leave the drain material 3 within the ground by utilizing resistance of the shoe member 5 similarly to the foregoing case: and in the case shown in Fig.4(c), a drain material 3 is partially bent along the outer peripheral surface of a mandrel 1 into a U-shaped form so that the drain material 3 can be driven into and left within the ground by resistance of the drain material itself.

In the foregoing conventional driving apparatuses as shown in Figs.4(a) and 4(b), there have been such disadvantages that not only the necessity of such a consumptive special shoe

member 4 or 5 requires an excess cost for producing the special shoe member 4 or 5, but it takes a long time for attaching the shoe member 4 or 5 onto the drain material 3 to thereby reduce the execution efficiency. In the driving apparatus shown in Fig.4(c), on the other hand, there have been such disadvantages that there is a possibility of break of the drain material 3 due its resistance against the ground when the drain material 3 is driven into the ground, and that earth and sand enter the mandrel 1 through the drain material insertion through hole 2 it becomes necessary to perform a troublesome operation for removing the earth and sand.

SUMMARY OF THE INVENTION

An object of the present invention is therefore to solve the foregoing problems in the prior art.

Another object of the present invention is to provide a drain material holding apparatus in which it is possible to efficiently surely drive a drain material into and surely leave within the ground.

To attain the above objects, according to an aspect of the present invention, a drain material holding apparatus for use in a board drain method comprises a hollow mandrel having a drain material insertion through hole formed in its lower end, a pushing rod inserted in the mandrel so as to be movable relative to the mandrel, and an openable/closable cover rotatably attached to a lower end portion of the mandrel for opening/closing the drain material insertion through hole and for grasping a drain material in cooperation with the pushing rod when the drain material insertion through hole is closed.

In the thus arranged drain material holding apparatus for use in a board drain method, according to the present invention, the pushing rod is inserted in the mandrel so as to be movable relative to the latter, and the openable/closable cover is provided at the lower end portion of the mandrel for opening/closing the drain material insertion hole and for grasping the drain material in cooperation with the pushing rod, whereby it is possible to hold a drain material during a period where the drain material is being driven into the ground. Accordingly, there is such an effect that a drain material can be surely driven into the ground. Further, after the drain material has been driven, the pushing rod is moved relative to the mandrel to thereby make it possible to push the drain material into the ground so as not to cause the drain material to move upward together with the mandrel, and therefore

there is such an effect that the drain material can be surely left within the ground. Moreover, it is possible to drive a drain material into the ground without employing such consumption parts as used in the conventional apparatus, and therefore excess work for providing the consumption parts can be omitted, so that there is such an effect that drain-material driving efficiency can be improved.

The present invention will be apparent from the following detailed description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a sectional view showing the main structure of the drain material holding apparatus for carrying out a board drain method, according to the present invention;

Fig. 2 is a front view of the same;

Figs. 3(a) through 3(d) are diagrams for explaining the drain material holding state of the drain material holding apparatus according to the present invention in the order of steps; and

Figs. 4(a) through 4(c) are diagram for explaining the drain material holding state in the conventional drain material holding apparatus for carrying out a board drain method.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the accompanying drawings, an embodiment according to the present invention will be described hereunder.

In Figs. 1 and 2, a hollow mandrel 11 has a flatly formed lower end portion, and a bottom plate 13 is connected to mandrel 11 at the lower end thereof. The bottom plate 13 is formed therein with a drain material insertion through hole 12 at a position biased from the center thereof. A bush 14 rectangular in cross section is vertically fixedly attached to the bottom plate 13 so as to occupy one side portion of the drain material insertion through hole 12, one end portion of a plate-like pushing rod 15 being slidably fitted in the bush 14. The pushing rod 15 is supported at its upper end portion by driving means (not shown) so as to be movable relative to the mandrel 11 and normally positioned so as to make the lower end thereof substantially coincide with the lower end of the mandrel 11.

Further, the lower end portion of the mandrel 11 is provided with an openable/closable cover 16 rotatably attached thereto. The openable/closable cover 16 is constituted by a cover body 17 disposed below the bottom plate 13 of the mandrel

11, a supporting plate 18 extending along the outer peripheral surface of the mandrel 11 from the opposite sides of the cover body 17, and a shaft 19 rotatably horizontally suspended by the mandrel 11 for connecting the supporting plate 18 integrally with the mandrel 11, so that the cover body 17 is rotated with the fulcrum shaft 19 so as to open/close the drain material insertion through hole 12, and so as to grasp a drain material 20 between the forward end portion of the cover body 17 and the pushing rod 15 in the state where the drain material insertion through hole 12 is closed by the cover body 17.

The shaft 19 is connected through a pair of connection arms 21 to a cylinder 22 suspended in the mandrel 11. Each of the connection arms 21 has one end fixedly attached to the shaft 19 by a key 23 and the other end rotatably attached to a piston rod 24 of the cylinder 22 by a pin 25. When the cylinder 22 is actuated to cause the piston rod 24 to retreat from the state shown in Fig. 1, the connection arms 21 are rotated clockwise to rotate the openable/closable cover 16 clockwise to thereby cause the cover body 17 to open the drain material insertion through hole 12.

Referring to Figs. 3(a) through 3(d), description will be made as to the operation of the thus arranged drain material holding apparatus according to the present invention. First, the mandrel 11 is mounted on a driving machine (not shown), and a feeding apparatus (not shown) is actuated to insert the drain material 20 into the mandrel 11. Then, as shown in Fig. 3(a), the cylinder 22 is actuated to rotate the openable/closable cover 16 in the direction to open the drain material insertion through hole 12, and the lower end of the pushing rod 15 is positioned so as to coincide with the lower end of the mandrel 11, one end of the drain material 20 being slightly projected from the lower end of the mandrel 11. Next, the cylinder 22 is operated to rotate the openable/closable cover 16 in the direction to close the drain material insertion through hole 12. At this time, as shown in Fig. 3(b), the drain material insertion through hole 12 is closed by the openable/closable cover 16 so that the drain material 20 is firmly grasped between the cover body 17 and the pushing rod 15 to be horizontally bent at its one end portion.

In this state, when the driving mechanism is actuated to drive the mandrel 11 into the ground, the drain material 20 is driven into the ground together with the mandrel 11 without being broken in the midway of the driving operation because the drain material 20 is firmly grasped between the pushing rod 15 and the openable/closable cover 16.

After the mandrel 11 has been driven to reach a predetermined depth, the cylinder 22 is operated again to rotate the openable/closable cover 16 in the direction to open the drain material insertion through hole 12 as shown in Fig.3(c), and then only the mandrel 11 is moved up. Thus, the pushing rod 15 is moved down relative to the mandrel 11 as shown in Fig.3(d). As a result, the drain material 20 is never moved up together with the mandrel 11 because the forward end portion of the drain material 20 is pushed into the ground. Thereafter, if the pushing rod 15 is pulled out of the ground, the drain material 20 is surely left in the ground.

Although only the mandrel 11 is pulled out of the ground after the driving operation in the foregoing embodiment, the present invention is not limited to this embodiment, but any modifications can be effected. For example, the pushing rod 15 may be moved down with the mandrel 11 held in the fixed state, or the pushing rod 15 may be moved down simultaneously with the moving up of the mandrel 11.

Claims

1. A drain material holding apparatus for use in a board drain method, comprising:
a hollow mandrel having a drain material insertion through hole formed in its lower end;
a pushing rod inserted in said mandrel so as to be movable relative to said mandrel; and
an openable/closable cover rotatably attached to a lower end portion of said mandrel for opening/closing said drain material insertion through hole and for grasping a drain material in cooperation with said pushing rod when said drain material insertion through hole is closed.

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FIG. 2

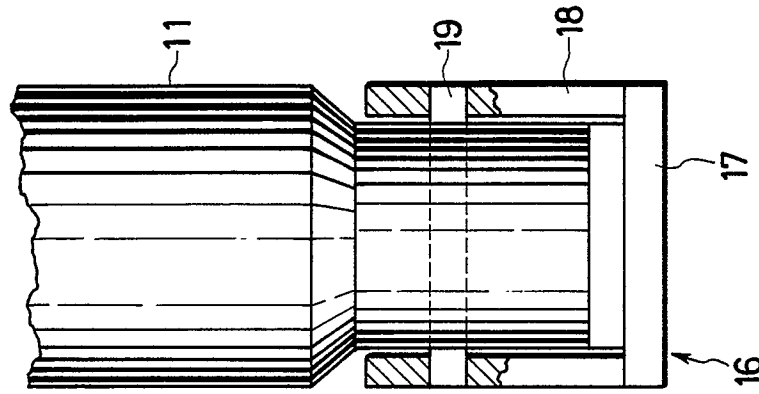


FIG. 1

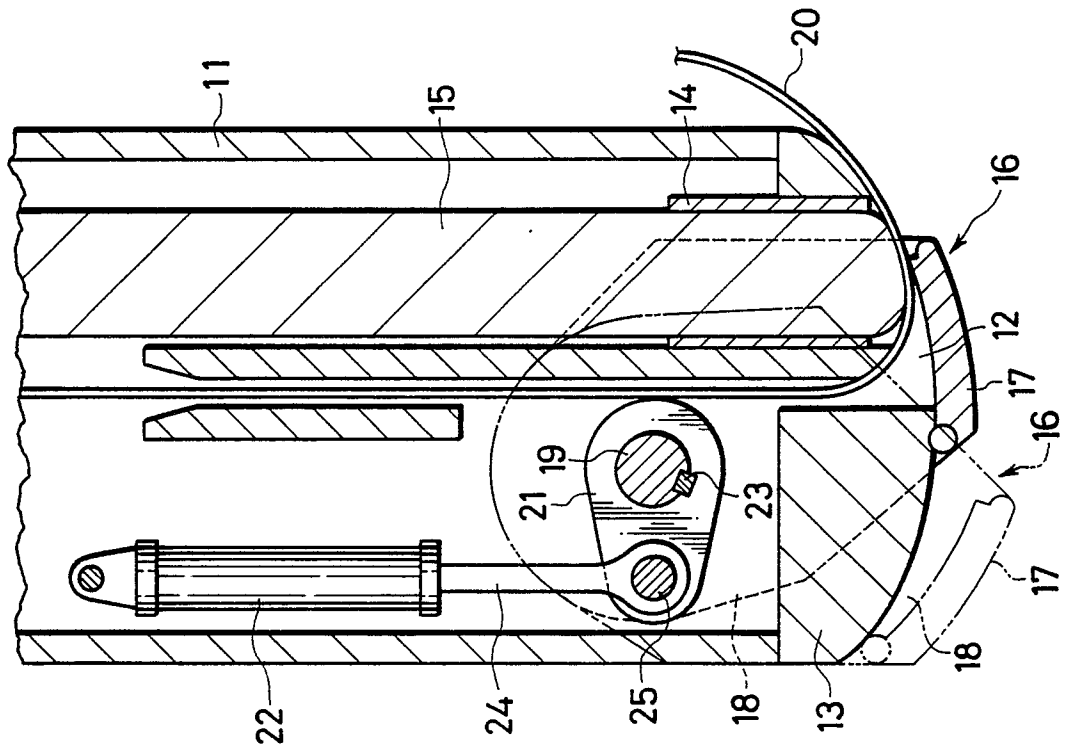


FIG. 3

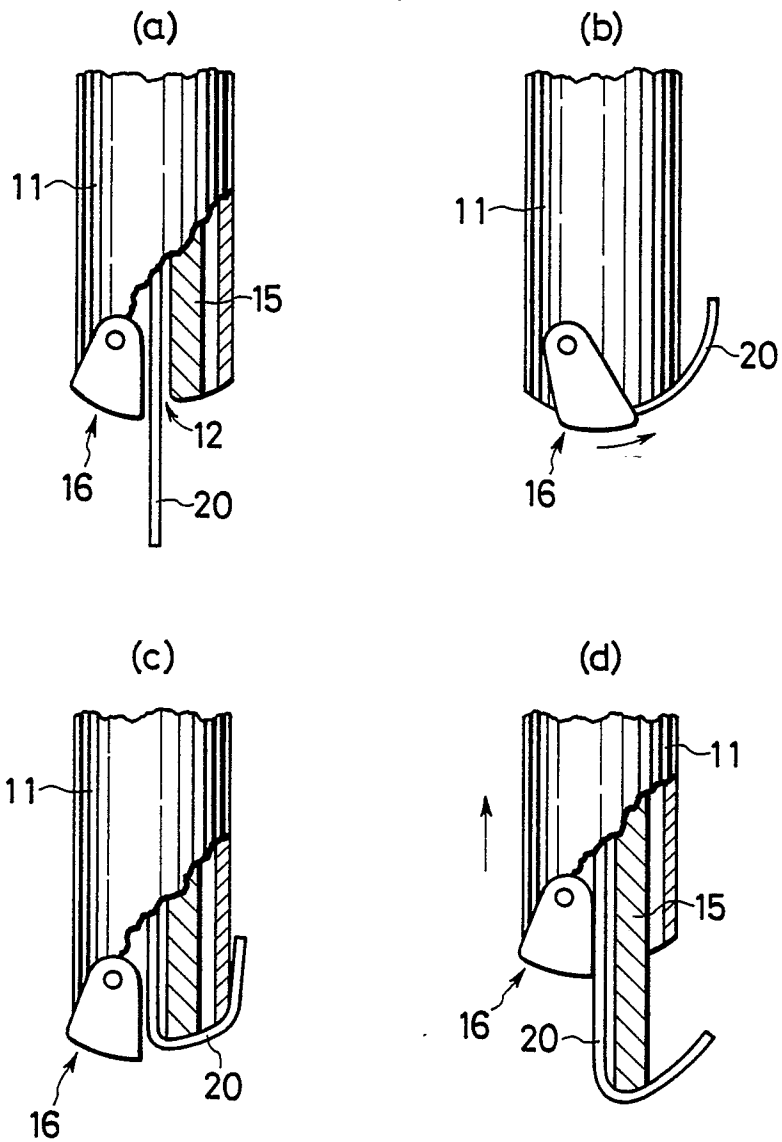


FIG. 4

