Jan. 31, 1967 KEIJI MAEDA 3,300,987

APPARATUS FOR INSTALLING CARDBOARD WICK DRAIN

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FIG. 1

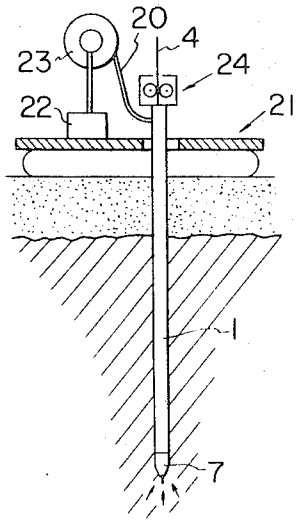


FIG. 2

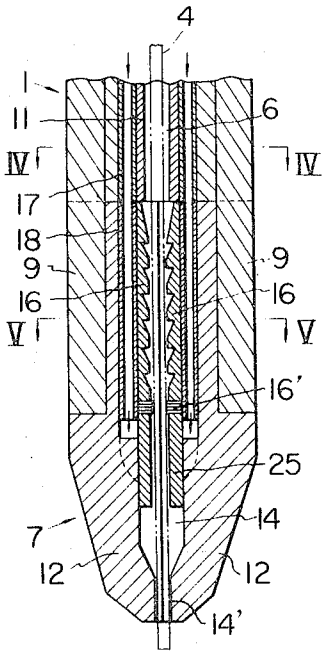
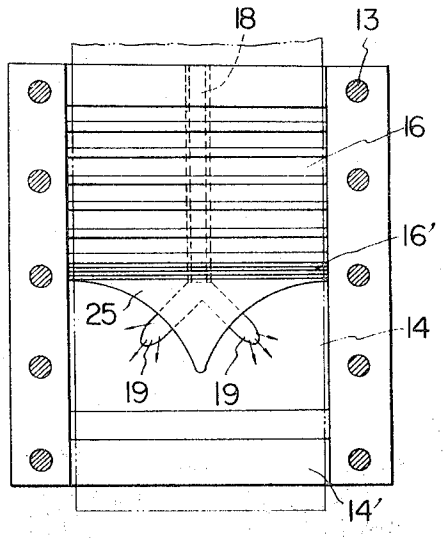


FIG. 3



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FIG. 4

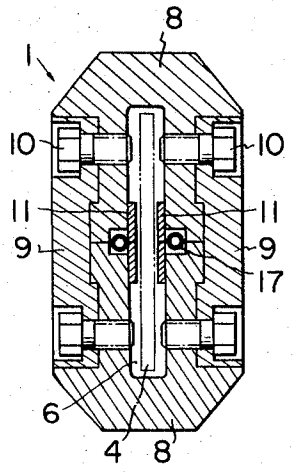


FIG. 5

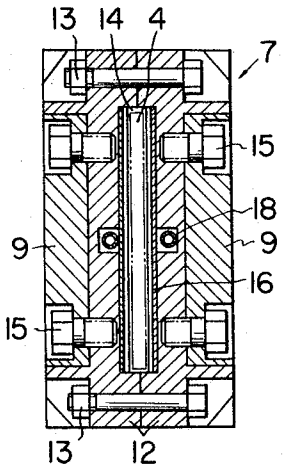


FIG. 7
PRIOR ART

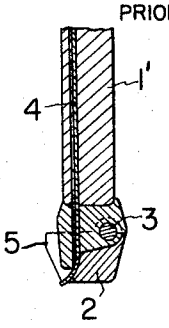


FIG. 6

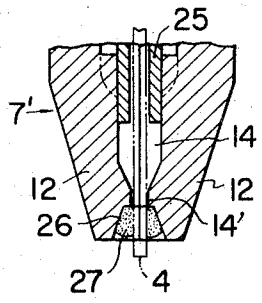


FIG. 9

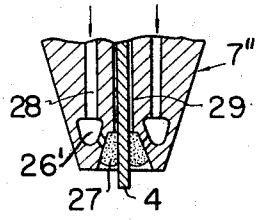
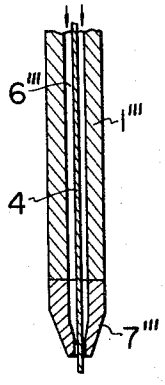


FIG. 8
PRIOR ART



INVENTOR.

BY

United States Patent Office

3,300,987

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3,300,987
APPARATUS FOR INSTALLING CARDBOARD WICK DRAIN

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Claims priority, application Japan, Nov. 18, 1963, 38/61,982
2 Claims. (Cl. 61—63)

The present invention relates to an apparatus for driving a cardboard wick in the cardboard-drain process which is known as a consolidation process for fine-grained soils.

An object of the present invention is to provide an apparatus for driving a cardboard wick in the cardboard-drain process into a thixotropic muddy soil (in the condition of paste, slurry, colloid, etc.) of high water content.

The nature, principle, and details of the invention will be best understood by reference to the following description taken in conjunction with the accompanying drawings in which like parts are designated by like reference characters, and in which:

FIG. 1 is a diagrammatic view, partly in section and partly in elevation, showing the general arrangement of one example of the apparatus for driving a cardboard wick according to the invention;

FIG. 2 is a framentary view in longitudinal section showing the lower part of a driving tube according to the invention and suitable for use in the apparatus shown in FIG. 1;

FIG. 3 is an elevational view partly in vertical section, showing only the mouth piece of the driving tube;

FIGS. 4 and 5 are cross-sectional views taken along the lines IV—IV and V—V in FIG. 2, respectively;

FIG. 6 is a fragmentary elevational view in longitudinal section showing the lower part of a drive tube mouth piece in another embodiment of the invention;

FIG. 7 is a fragmentary longitudinal sectional view of one type of conventional driving tube;

FIG. 8 is a fragmentary longitudinal sectional view of another type of conventional driving tube; and

FIG. 9 is a fragmentary longitudinal sectional view of a mouth piece serving to illustrate the advantages of the present invention.

In order to fully understand and appreciate the nature and utility of this invention, the following brief consideration of the prior art is believed to be necessary.

In the conventional apparatus for driving a cardboard wick in the cardboard-drain process, a mouth piece **2** capable of opening and closing movement is pivoted by pin **3** to the lower end of a driving tube **1** (FIG. 7). In operation the driving tube **1'** is driven into the ground while the bottom part of a cardboard wick **4** inserted into the driving tube **1'** is held by the mouth piece **2** by means of the pressure of soil acting on the lower surface of the mouth piece **2**. After the tube **1** has been inserted to a certain depth, the resistance of the soil acting on arm **5** projecting laterally from the mouth piece **2** exceeds the pressure acting on the bottom surface of the mouth piece since the lower soil is softer than the side soil. At this time the mouth piece is opened so that the driving tube **1'** is pulled up while the cardboard wick **4** is driven down at the same speed as that of the driving tube **1'** by means of a cardboard wick feeding device provided on the top of said driving tube **1'** with the wick **4** being thus left in the ground. However, in the case of driving the driving tube into muddy soil, the mouth piece **2** does not open when the driving tube is pulled out because the pressure of muddy water acts always on the lower surface of the mouth piece **2**, and the resistance force on the arm **5** is very small. Therefore, it has been impossible to drive a cardboard wick into the thixotropic muddy soil.

It is a specific object of the present invention to overcome the above described difficulty by providing means whereby, instead of the use of a mouth piece capable of opening and closing movement, compressed air is supplied into the cardboard wick insertion bore to prevent infiltration of muddy water thereinto and thereby eliminate the undesirable result such that the cardboard adheres to the driving tube due to adhesive material of the mud and is withdrawn together with the driving tube, whereby driving into the thixotropic muddy soil is made possible.

However, if the compressed air is supplied from above by utilizing a cardboard wick insertion bore **6'''** in the driving tube **1'''** as shown in FIG. 8, the air penetrates the cardboard wick **4** and flows out upward and downward through the inner longitudinal channels of the cardboard wick due to the great contact areas of the air with the cardboard wick. Moreover, in using built-up tpe driving tubes (this type of the driving tube is needed for convenience in transportation and cleaning of the cardboard wick insertion bore), a large quantity of air leaks and, accordingly, the capaicty of the air compressor must be quite large, with the result that this process is quite impractical. In addition, the air pressures on both sides of the cardboard wick will be unbalanced due to the leakages of air, whereby the cardboard wick will stick to the wall of the cardboard wick insertion bore so that it is impossible to feed the cardboard wick.

According to the present invention, for the solution of this problem, on the wall of the cardboard wick insertion bore and in the lower part of the driving tube there are arranged pressure reducing members which lightly contact the cardboard wick and shut off the lower cardboard wick insertion bore from the upper bore, with the compressed air being supplied to the lower cardboard wick insertion bore whereby muddy water is prevented from entering into the bore.

For a better undersstanding of this invention, reference is made to the following description of some embodiments thereof taken in connection with the accompanying drawings.

Referring first to FIGS. 1 through 5, reference numerals **1** and **7** designate respectively a driving tube and a mouth piece connected to the lower edge of the driving tube **1**. The driving tube **1** consists of two members **8**, **8** connected to coupling plates **9**, **9** by bolts **10**, whereby a cardboard wick insertion bore **6** is formed. Reference numeral **11** designates a cardboard wick supporting plate fixed to the wall of the cardboard wick insertion bore.

The mouth piece **7** consists of members **12**, **12** which are coupled by means of bolts and nuts **13**, with a nozzle **14'** being formed by narrowing the space between a insertion bore **14** and the cardboard wick **4**, and is connected to the lower part of driving tube **1** by bolts **15** on coupling plate **9**, **9**.

On the part of the bore wall between the insertion bore **14** of the mouth piece and the insertion bore **6** of the driving tube, there are attached a pressure reducing member consisting of a packing **16'** of rubber or other elastic material and a labyrinth packing **16** having a sawtooth-shaped cross section and a high efficiency of pressure reduction against leakage of air from below such portion. The packing **16'** and labyrinth packing **16** are in light contact with the cardboard wick **4**. Consequently, the upper and lower insertion bores **6** and **14** are separated from each other, and through air pipes **17** and **18** positioned in the driving tube **1** and the mouth piece **7** respectively, compressed air is fed into the insertion bore **14** via an opening **19**. The compressed air is fed into the air pipe **17**, through a flexible pipe **20** connected to the upper part of the driving tube from an air compressor **22** mounted on a driving machine. The flexible pipe **20** is wound on a hose reel **23** placed on a

mast (not shown) which supports the driving tube **1** in a manner permitting only its ascent and descent, whereby the flexible pipe is reeled in or out automatically according to the ascent or descent of the driving tube.

On the top of the driving tube **1**, there is arranged a cardboard wick feeding device **24** holding the cardboard wick **4** during the driving-down of the driving tube **1** and feeding the cardboard wick **4** downward at the same speed as that of the driving tube **1** when the tube **1** is raised. An air guide plate **25** is fixed to the mouth piece.

According to the above-mentioned construction, when the driving tube is driven into or raised from muddy soil, the compressed air fed into the bore **14** will leak very slightly into the upper insertion bore **6** due to the pressure reducing members. The leakage of air through the cardboard wick is also reduced due to the narrow surface of the carboard wick **4** in contact with the compressed air, whereby the compressed air in the insertion bore **14** is exhausted from the nozzle **14'** and this prevents infiltration of muddy water into the insertion bore **14**. Consequently, there is absolutely no possibility of the mud clogging the cardboard wick insertion bore and of upward movement of the cardboard wick together with the driving tube when the driving tube is removed, with the result that the cardboard wick can always be driven to uniform depths.

Another embodiment of the invention is shown in FIG. **6**. In this embodiment, the upper construction of the mouth piece **7'** is exactly the same as that shown in FIG. 2, but a concave part **26** of trapezoid cross section adapted to form a sand arch is provided on the lower surface of the mouth piece at the lower edge of the insertion bore **14**. By this construction, the driving tube is driven directly when there is a sand layer on the upper part of the muddy soil. In cases where there is no sand layer, or a sand layer of unsuitable character, sand is placed on the location where the operation is to be effected, and the driving tube is then driven whereby a sand arch **27** is formed by the driving pressure in the concave part **26** so that it is possible to prevent the infiltration of the muddy water into the bore **14**. In some cases, it may be necessary to add a slight amount of air pressure to the bore during the driving operation so as to increase the effect of preventing infiltration of the muddy water.

Accordingly, the compressed air may be fed into the bore **14** only when the driving tube is removed to exhaust the air from the nozzle **14'**, with the result that the sand arch **27** is blown away. Hence, the infiltration of muddy water into the bore **14** is prevented and the quantity of compressed air needed is reduced.

In this case, when the compressed air is exhausted into the concave part **26'** through passage **28** as shown in FIG. 9, the sand arch **27** is blown off, but the exhausted air causes the pressure in the lower part of the mouth piece **7** to become higher, and the exhausted air will infiltrate into insertion bore **29** together with the muddy water, whereby the cardboard wick driving efficiency is reduced due to the mud clogging the bore. Under these

circumstances, the compressed air must always be fed into the insertion bore **14**.

While the above description relates to the apparatus for driving a driving tube into the thixotropic muddy soil, it will be obvious that the embodiments mentioned above are applicable to the case of driving a driving tube into soft sea-bottom sediments through the water.

Essentially, this invention makes it possible to drive a cardboard wick for the cardboard-drain process into the thixotropic muddy soils, which operation heretofore has been considered to be impossible, and thereby contributes considerably to widening the scope of applications of the cardboard-drain process.

I claim:

1. An apparatus for driving a cardboard wick in the cardboard-drain process comprising a driving tube having therethrough a carboard wick insertion bore through which a cardboard wick is inserted, pressure reducing members attached to the inner wall of said insertion bore and adapted to contact lightly said cardboard wick, said pressure reducing members thereby functioning to partition said cardboard wick insertion bore into an upper bore and a lower bore, the lower part of said lower bore being formed as a nozzle by narrowing the space between said lower bore wall and said cardboard wick, and means adapted to supply compressed air into said lower bore during the driving operation, thereby to prevent infiltration of mud or water into said cardboard wick insertion bore.

2. An apparatus for driving a cardboard wick in the cardboard-drain process comprising a driving tube having therethrough a cardboard wick insertion bore through which a cardboard wick is inserted, said driving tube having on its lower end surface and at the lower end of said cardboard wick insertion bore a conical, outwardly diverging recess for forming a sand arch, said recess communicating at its inner end with said cardboard wick insertion bore, pressure reducing members attached to the inner wall of said cardboard wick insertion bore and adapted to contact lightly said cardboard wick, said pressure reducing members thereby functioning to partition said cardboard wick insertion bore into an upper bore and a lower bore, the lower part of said lower bore being formed as a nozzle by narrowing the space between said lower bore wall and said cardboard wick, and means to supply compressed air into said lower bore at the time of the driving tube withdrawal step in the driving operation, thereby to prevent infiltration of mud or water into said cardboard wick insertion bore.

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EARL J. WITMER, *Primary Examiner.*