June 20, 1967 G. MARCONI 3,326,003

METHOD OF FORMING GROUND CUT-OFF WALL

Filed Jan. 19, 1961 2 Sheets-Sheet 1

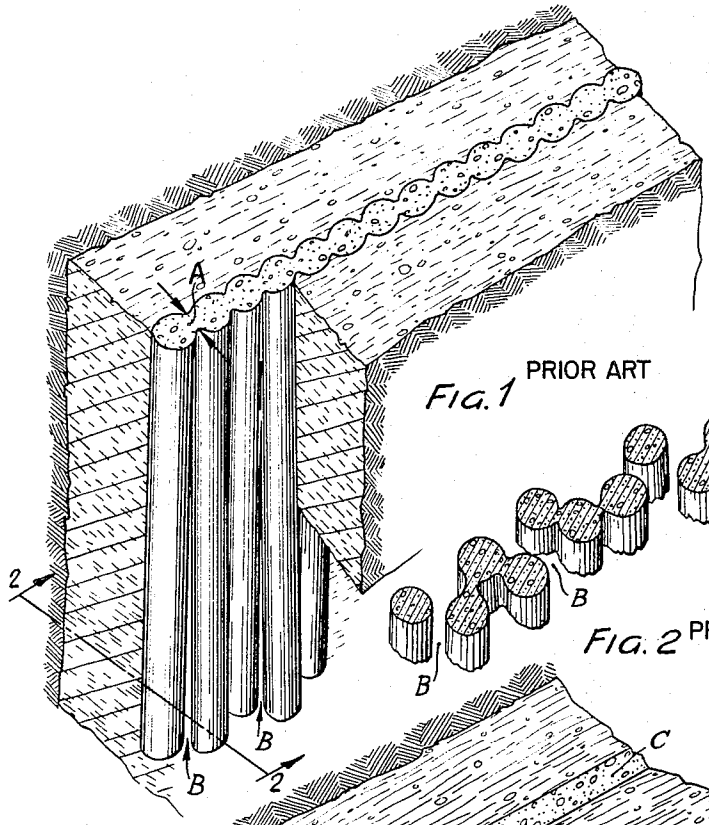


FIG. 1 PRIOR ART

FIG. 2 PRIOR ART

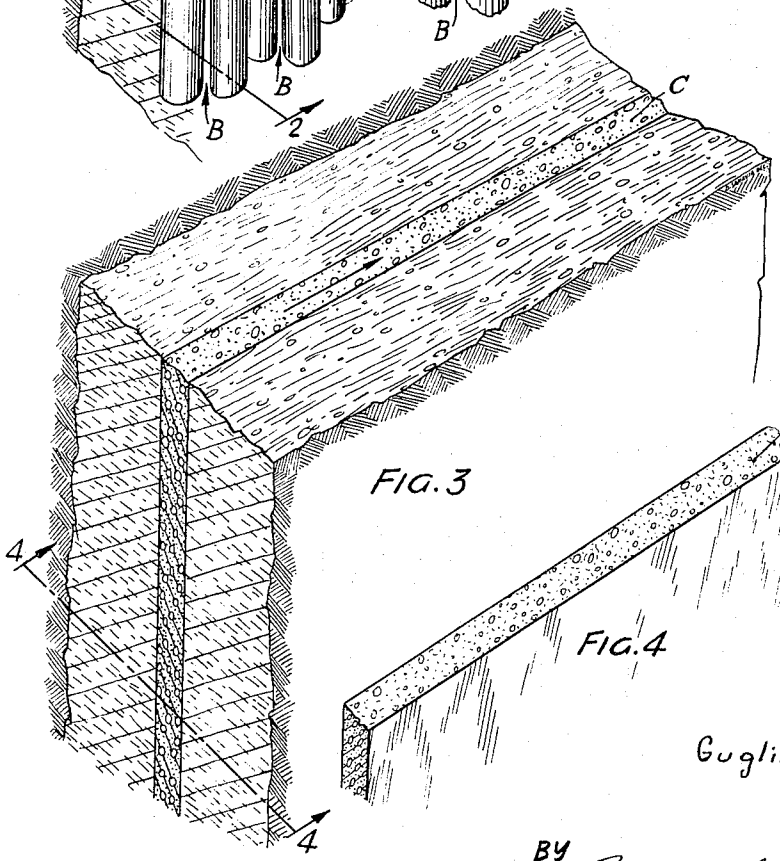


FIG. 3

FIG. 4

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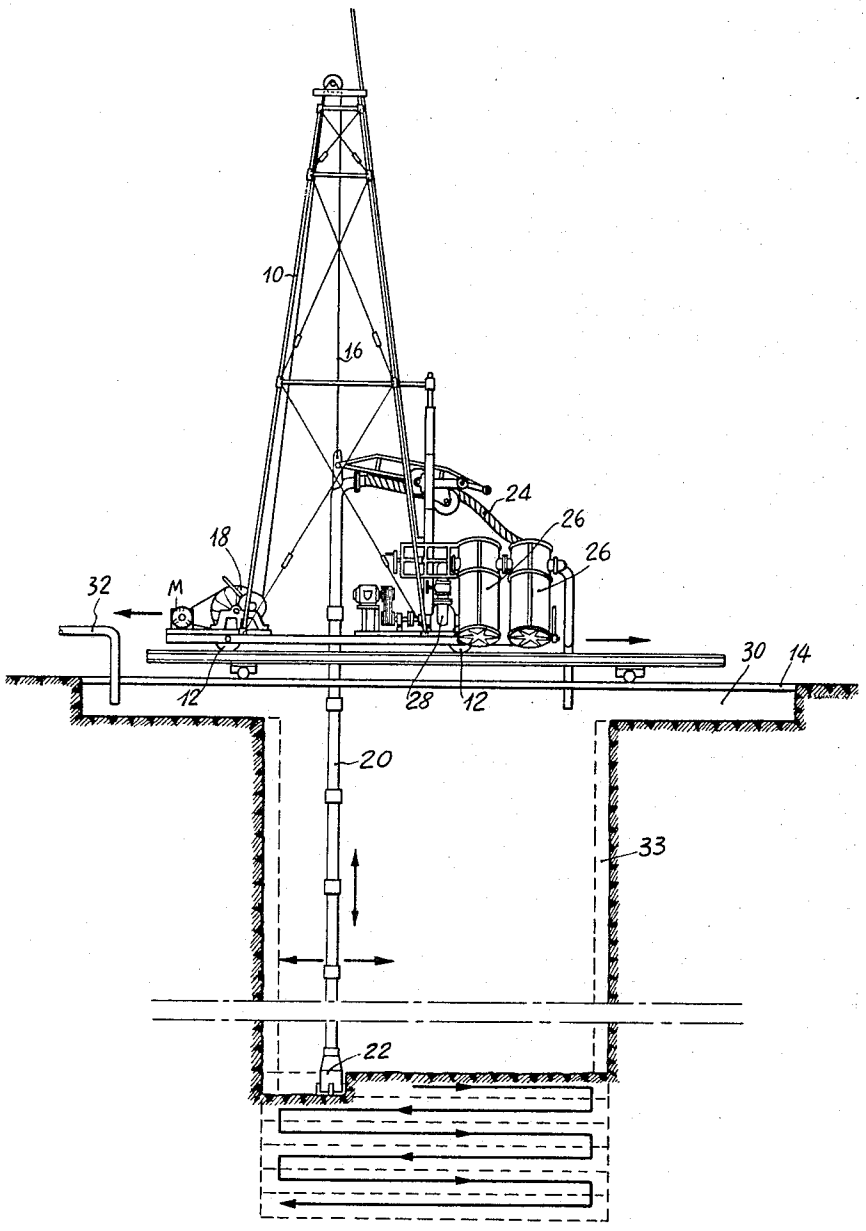


FIG. 5

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METHOD OF FORMING GROUND CUT-OFF WALL

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2 Claims. (Cl. 61—35)

This invention relates to the process for constructing a wall and, in particular to the forming of a wall in the ground. This application is a continuation-in-part of my application Ser. No. 414,447, filed Mar. 5, 1954, now abandoned.

Ground walls are constructed for various reasons, as for extending a dam into the adjoining bank to increase the length of the seepage path around the ends of the dam, for forming water-tight panels below the banks of a canal to prevent seepage, for stopping the seepage of ground water into excavations extending beneath the ground water table, for isolating springs to prevent both water loss and pollution, for forming retaining walls prior to making an excavation, for forming walls for docks, basins and canals, and for forming retaining walls for preventing earth slides. In these cases, long and narrow walls are desired, such as can be obtained by the use of metal sheet piling. When a wall of cheaper and more durable material is desired, concrete is used, with the wall being formed of a plurality of adjoined cylindrical piles. These piles (FIG. 1) are either pre-cast and driven into the soil or individual bore holes are made with the piles cast therein. Such a wall is not entirely satisfactory as the piles cannot be altogether joined to each other. (FIG. 2.) This difficulty is not altogether avoided by staggering the bore holes for the piles as bore holes are not all absolutely vertical. (FIG. 2.)

The object of this invention is to produce a process by which a long and narrow wall can be formed, said wall being of uniform cross-section. (FIGS. 3 and 4.)

In general, this and other objects are obtained by digging a long and narrow trench, with the width of the trench being too small to make the use of wood or metal shoring practical. As the trench is being dug, it is kept filled with liquid mud in order to keep the walls of the hole from collapsing. After a trench of the required length and depth is dug, it is filled with wall forming material, thereby displacing the liquid mud. After a wall panel has been formed, successive panels can be constructed in alignment with each other to make a wall of any desired length and curvature.

The means by which the objects of the invention are obtained are disclosed more fully with reference to the accompanying drawings, in which:

FIGURE 1 is a perspective view of a wall formed according to the prior art;

FIGURE 2 is a cross-sectional view generally on the line 2—2 of FIGURE 1;

FIGURE 3 is a perspective view of a wall formed according to this invention;

FIGURE 4 is a cross-sectional view generally on the line 4—4 of FIGURE 3; and

FIGURE 5 is a schematic view of an apparatus excavating a trench for a wall according to the process of this invention.

As shown in FIGURE 1, a plurality of piles, either pre-cast and driven or poured into bore holes, were used by the prior art to form a long and narrow wall in the sense of being a curtain, membrane, or diaphragm wall. In forming the individual piles, even though their upper ends A are joined together, the bore holes will drift apart so that the lower portions B of the piles are in some instances separated from each other. Obviously these spaces destroy the utility of the wall as a barrier against the seepage of water through the wall.

According to FIGURES 3 and 4, a wall C of uniform cross-section is formed according to this invention. This wall is constructed of individual panels of any desired length. Experience has shown that it is advisable to form a panel having a length and depth which can be formed in one day's working time, as a panel from 6 to 10 meters in length, depending upon the type of soil being excavated and the depth of the wall being constructed. The wall has a thickness of from 20 to 100 centimeters and can have a depth as great as from 50 to 100 meters. The extreme thinness of the wall means that the shoring of the trench or the hole being excavated is a practical impossibility. According to the process of this invention, the width of the excavation is substantially equal to the width or diameter of the tool used to dig the trench.

As shown in FIGURE 5, a digging rig **10** is mounted on wheels **12** for longitudinal movement on track **14**, the rig being self-propelled by a motor M. A hoisting cable **16** joined to a winch **18** suspends the pipe **20** having a cutting head **22** joined to its lower end. The upper end of pipe **20** is connected by a flexible tube **24** to one or the other of alternate mud separators **26**. A suction pump **28** is also connected to the separators **26**.

In the process of constructing a diaphragm wall, a shallow trench **30** is first excavated and filled with thixotropic drilling mud from an outside source, as through pipe **32**. A diaphragm wall panel is then excavated downwardly over a given length of the trench, as from 6 to 10 meters. This is done by vertically dropping the cutting head in an impact stroke to fracture and break the ground, then lifting the cutting head in the same vertical path. Suction pump **28** draws the liquid mud with the fractured ground fragments up through pipe **20** and deposits the material in either of the separators **26** from which the liquid mud is drained back into the trench. After the cutting head **22** has been raised, the rig **10** is moved longitudinally on the track **14** a distance not greater than the diameter of cutting head **22**, then the cutting head is dropped for another impact stroke, and the material removed as before. These impact strokes are continued over the length of the wall panel being formed and when the end is reached, the direction of the rig **10** is reversed so that a second cut is taken in a reverse direction in the trench. The cutting head is raised but slightly above the unexcavated bottom portion of the trench and drops, due to the weight of the head itself and the pipe **20**. Each impact stroke makes a very small cut in the bottom of the trench, the depth depending upon whether the ground is hard or soft. As the trench deepens, additional liquid mud is poured into the trench through pipe **32** to keep the trench full of liquid mud which prevents the walls of the trench from collapsing. After a trench of sufficient length and depth has been dug, joint forms **33** as indicated by the dotted lines in FIGURE 5, are inserted against the ends of the trench, and then the trench filled with wall forming material such as concrete; as the concrete is poured into the trench, the liquid mud is displaced and removed from the top of the trench. When the poured wall has solidified, adjoining panels can be dug. The joint forms **33** become exposed and are removed so that, when an adjacent panel is poured, it becomes joined to the previously formed panel.

By means of this process, a long and very narrow diaphragm wall can be quickly and cheaply constructed. In practice, it has been found advisable to construct a plurality of panels separated from each other by one panel space. After these panels have solidified, the intermediate alternate panel trenches can then be excavated. The

cutting head is not a rotating drill bit, but simply a vertical impact tool which digs somewhat in the nature of a hoe. The width of the trench and therefor of the wall panel formed is substantially equal to the diameter of the cutting head **22** and therefor can be as narrow as 20 centimeters or even less. All the panels formed are of uniform cross-section and the individual panels are joined to make an impervious wall of any desired length and curvature.

Having now described the means by which the objects of the invention are obtained,

I claim:

1. A method for constructing in the ground a vertical wall of long length and narrow width, the steps comprising forming a first wall panel section by digging a trench with a hollow percussion tool of the same width as the wall by moving the tool in successive vertical impact strokes while moving the tool between strokes longitudinally back and forth on the bottom of the trench along the length of the panel section to form a trench of the width of said tool, said trench being maintained with vertical sides as the trench deepens to a great depth, the dug material from the trench through said tool, constantly filling the trench with thixotropic drilling mud as the trench is dug without the sides of the trench being shored, pouring wall forming material into the mud-filled trench and thereby displacing the mud from the trench and forming the first wall panel section, and then extending the length of the wall by similarly forming trenches and panel sections joined, respectively, to each precedingly formed panel section.

2. A method as in claim **1**, further comprising vertically moving the tool into one impact stroke against the ground to loosen the ground material, removing the loosened and dug material by suction, lifting and moving said tool longitudinally a distance not greater than the width of said tool, and then successively repeating these steps.

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