May 14, 1957 C. VEDER 2,791,886

METHOD FOR THE CONSTRUCTION OF A CUT-OFF WALL

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FIG. 1

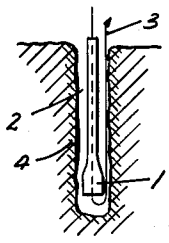


FIG. 2

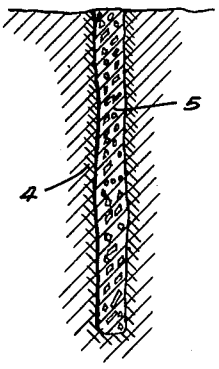


FIG. 3

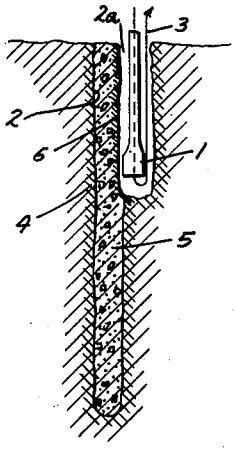
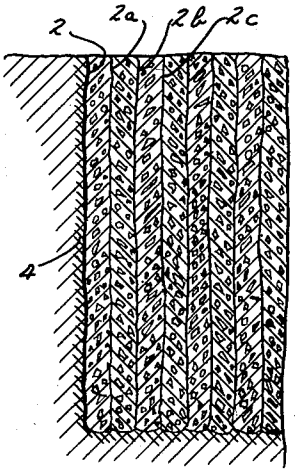


FIG. 4



INVENTOR.
CHRISTIAN VEDER

BY

ATTORNEY

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FIG. 5

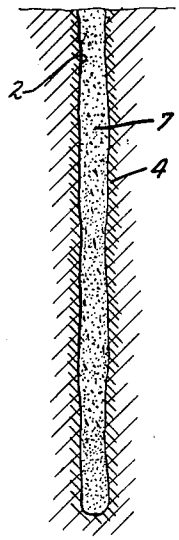


FIG. 6

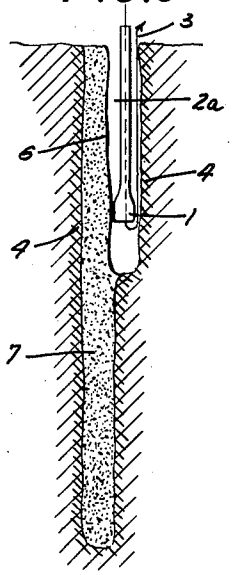
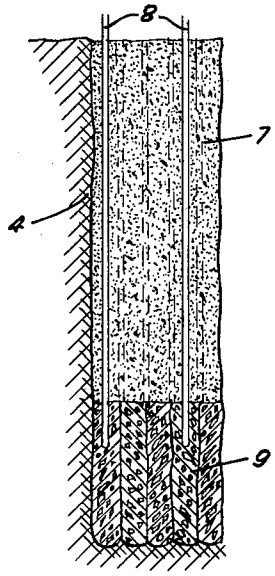


FIG. 7



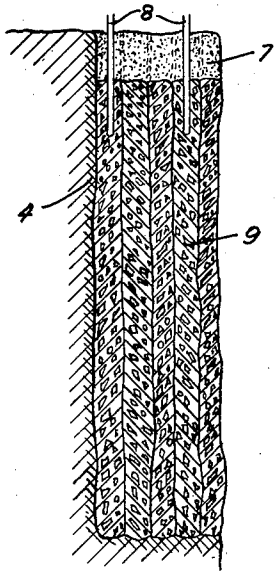


FIG. 8

FIG. 9

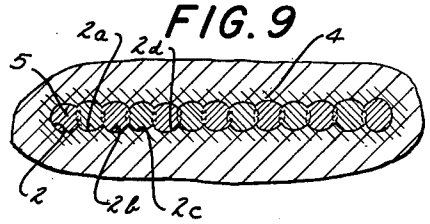


FIG. 10

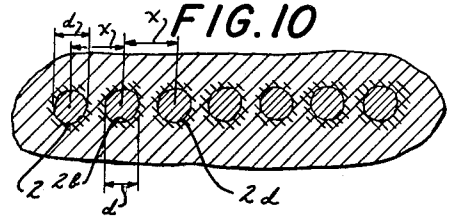
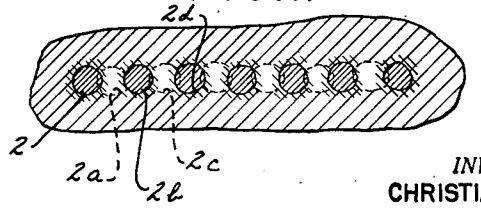


FIG. 11



INVENTOR.
CHRISTIAN VEDER

BY

ATTORNEY

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2,791,886

METHOD FOR THE CONSTRUCTION OF A CUT-OFF WALL

Christian Veder, Milan, Italy, assignor to I. C. O. S. Impresa Costruzioni Opere Specializzate, Milan, Italy

Application November 22, 1950, Serial No. 196,978

Claims priority, application Italy May 30, 1950

7 Claims. (Cl. 61—31)

This invention relates to cut-off walls and more particularly to a method for the construction of a cut-off wall.

Methods for the construction of watertight walls in the ground are already known, for example for the construction of cut-off walls, which eliminate the necessity of expensive draining and sealing operations during excavations, especially in alluvial grounds.

The processes used up to now consist either in inserting into the ground pre-fabricated elements, laterally inter-connected, or in drilling into the ground, by means of metallic boring tubes, a succession of bores placed adjacent each other, which bores are subsequently filled with cement and thus form a concrete cut-off wall or palisade. Alternatively, there may be inserted into these bores cement poles, pre-fabricated to define a particular shape or section, which poles establish a more intimate interlocking connection between the single elements of the palisade.

Walls so built do not, however, always ensure the desired watertightness. The reason for this is partly because it is difficult to obtain a perfect interlocking or interengagement of the single elements, partly because ordinary methods of drilling by means of boring tubes do not guarantee a perfect verticalness of the final wall, and partly because the manner in which the drilling is normally effected by the tubes disintegrates, loosens and possibly washes away the soil in the vicinity of the wall of the bores in such a way that supplementary injection operations are necessary in order to consolidate the wall and to fill in the empty spaces.

Anyway, in constructing a wall in accordance with known methods, a depth of about 20 metres only can be obtained, because beyond this depth the diameters of the boring tubes have to be made smaller, and consequently no interengagement of the individual elements is attained below this depth.

These drawbacks are avoided by building up the wall according to the present invention. A wall constructed in accordance with this invention consists of a series of substantially vertical cylindrical elements which intersect, interengage and adapt themselves to each other so as to form a single homogeneous mass. This is obtained by drilling a series of intersecting holes, preferably made with a rotary drill bit, which holes are filled on the spot with cement or the like material.

It is possible to build up such a watertight wall in two ways. The first one comprises drilling one or more holes in spaced relation, and then filling these holes with concrete made of a sufficiently slow setting cement, in order to be able to drill intermediate holes intersecting the partially set concrete poles already present in the first mentioned hole or holes without meeting with excessive resistance by these partially set poles, and in order that the concrete then filled into the intermediate holes may intimately bind itself to the concrete in the first mentioned holes.

The second embodiment of the method of building up the cut-off wall, which is also within the scope of the present invention, comprises the filling with gravel of one or more suitably spaced holes drilled into the ground, whereafter intermediate and adjacent holes are drilled, which latter intersect the first mentioned holes and are likewise filled with gravel, and finally injecting into the mass of gravel contained in all said holes a cement slurry that will transform the gravel into concrete.

In order that the invention may be better understood several embodiments of the inventive construction method are given in detail in the following description to be read with reference to the accompanying drawings that illustrate the two above cited methods as examples to which examples, however, the present invention is not limited.

In the drawings:

Fig. 1 is a vertical section of a first hole drilled into the ground with the drilling tool still in position;

Fig. 2 is a vertical section of the first element of the palisade or cut-off wall built according to the first method of construction;

Fig. 3 is a vertical section showing the building up of the second element, also according to the first method of construction;

Fig. 4 is a vertical section of a portion of the palisade or cut-off wall completed in conformity with the first method of construction;

Fig. 5 is a vertical section of a first element in the process of construction of the palisade or cut-off wall in conformity with the second method of construction;

Fig. 6 is a vertical section of a first element and of a portion of the hole for a second element of the palisade or cut-off wall according to the second method of construction;

Figs. 7 and 8 show in vertical section the beginning and the end of a further stage of construction of the palisade or cut-off wall according to the second method of construction;

Fig. 9 is a horizontal section of a completed cut-off wall constructed in accordance with any method according to the invention;

Fig. 10 is a horizontal section illustrating an intermediate step during the building-up of a cut-off wall according to the invention; and

Fig. 11 is a horizontal section illustrating a subsequent intermediate step during the building-up of a cut-off wall according to the invention.

As it appears from Fig. 1, a hole 2 is drilled into the ground, for both methods of construction, by means of a large rotary drill bit 1 having a bore in its centre through which a thick liquid is introduced into the hole 2 and caused to circulate upwards within the hole 2 in the direction of the arrow 3, in order to carry the material dug out from the bottom of the hole up to the surface and to obtain at the same time sealing and reinforcement of wall 4; as liquid for example a suspension of bentonite and water may be used.

By proceeding according to the first method of construction, one fills the first hole 2 with concrete 5 of slow setting quality (Fig. 2) and subsequently the second hole 2*a* (see Fig. 3) is drilled adjacently in a similar way. Along the line of intersection of the two holes an impermeable layer 6 is formed, which, if permitted to remain, would interrupt the continuity of the palisade; in order to avoid this drawback, this layer 6, that has formed itself in the line of contact with the concrete of the first element is washed away, using pure water instead of the thick liquid. The light sealing and reinforcing layer, however, that has been incorporated into the natural soil wall of the second hole 2*a* remains unchanged. By continuing this process any desired number of times, a completely watertight cut-off wall is obtained, as shown in the ver-

tical section of Fig. 4 and the horizontal section of Fig. 9, completely surrounded by an impermeable layer **4**.

It is obvious that the boring of the first element as well as of the following ones, which latter intersect with those already filled with concrete, may be carried out by means of metallic tubes instead of by rotary drill bits; one should take care that the metallic tubes are held in a perfect vertical position during the drilling operation.

By proceeding in accordance with the second method of construction, the first hole **2** is filled up with pure gravel **7** (Fig. 5), the second hole **2***a* (Fig. 6) being afterwards bored in the same way as shown for the first method of construction.

A compact palisade or cut-off wall is thus obtained which is formed by a mass of gravel **7** into which a slurry of cement is injected by means of small metallic pipes **8** which are pushed into the gravel down to the bottom of the palisade or cut-off wall and are afterwards pulled back gradually (Figs. 7 and 8), thus transforming the mass of gravel into a compact mass of concrete **9**.

The result of this is a compact palisade or cut-off wall as represented by Figs. 4 and 9. According to above description of both methods of construction the individual holes **2**, **2***a*, **2***b* . . . of the entire series of holes are drilled in consecutive order. It is obvious that one will not go out of the scope of the invention if the order of drilling the holes is modified; it might be advantageous, especially in order to accelerate the work, instead of drilling the holes consecutively, to make at first a series of spaced holes **2**, **2***b*, **2***d* . . . (Fig. 10) whose axes are at a distance *x* smaller than twice their diameter *d*, and to make afterwards a second series of spaced holes **2***a*, **2***c* . . . (Fig. 11), the axes of which are in the center between the axes of the first series of holes **2**, **2***b*, **2***d* . . . , in order to be able to work with several drillers at the same time.

What I claim is:

1. A method for the construction of a cut-off wall, comprising the steps of: drilling into the natural soil a series of vertical holes in such a way, that a first hole and a second hole of two adjacent holes are drilled at different times, spacing the vertical axes of adjacent holes of said series of holes from each other at a distance smaller than the sum of the radii of said adjacent holes whereby adjacent holes intersect each other, consolidating the wall of each hole and rendering same impervious to water by introducing into the hole a thickish liquid apt to gel, causing said thickish liquid to circulate for a predetermined time in each of said holes from the bottom towards the top whereby material loosened by the drilling is removed, filling the first hole of two adjacent holes with a slowly binding cementitious material and performing the subsequent drilling of the second hole of two adjacent holes while the cementitious material filled into said first hole is still in binding condition, removing excess thickish liquid and loosened material from each hole after the drilling thereof, washing off a layer of impermeable material formed by said thickish liquid at the intersection of adjacent holes on the surface of the incompletely bound cementitious material filled into the first hole of two adjacent holes, and filling thereafter cementitious material into the second hole of two adjacent holes.

2. A method for the construction of a cut-off wall as claimed in claim 1, wherein the holes of the series of holes are drilled in consecutive order.

3. A method for the construction of a cut-off wall as claimed in claim 1, wherein at first a first plurality of spaced holes is drilled and thereafter a second plurality of spaced holes is drilled, and wherein the drilling of said holes is carried out in such a manner that the axes of the holes of said second plurality of spaced holes are arranged in the center between the axes of the holes of said first plurality of spaced holes.

4. A method for the construction of a cut-off wall as claimed in claim 1, wherein after the circulation of said thickish liquid in the hole water is introduced into said hole for removing the excess thickish liquid and the loosened material and for washing off said layer of impermeable material.

5. A method for the construction of a cut-off wall as claimed in claim 1, wherein said thickish liquid is introduced into the hole during the drilling of the latter.

6. A method for the construction of a cut-off wall as claimed in claim 1, wherein the drilling of the holes is carried out by means of rotary drill bit means having an axial bore, and wherein said thickish liquid is introduced into the hole through said axial bore of the rotary drill bit means.

7. A method for the construction of a cut-off wall as claimed in claim 1, wherein a bentonite mud is used as said thickish liquid.

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