March 15, 1960 H. WIENANDS 2,928,468

METHOD FOR BORING WELLS

Filed March 22, 1955 6 Sheets-Sheet 1

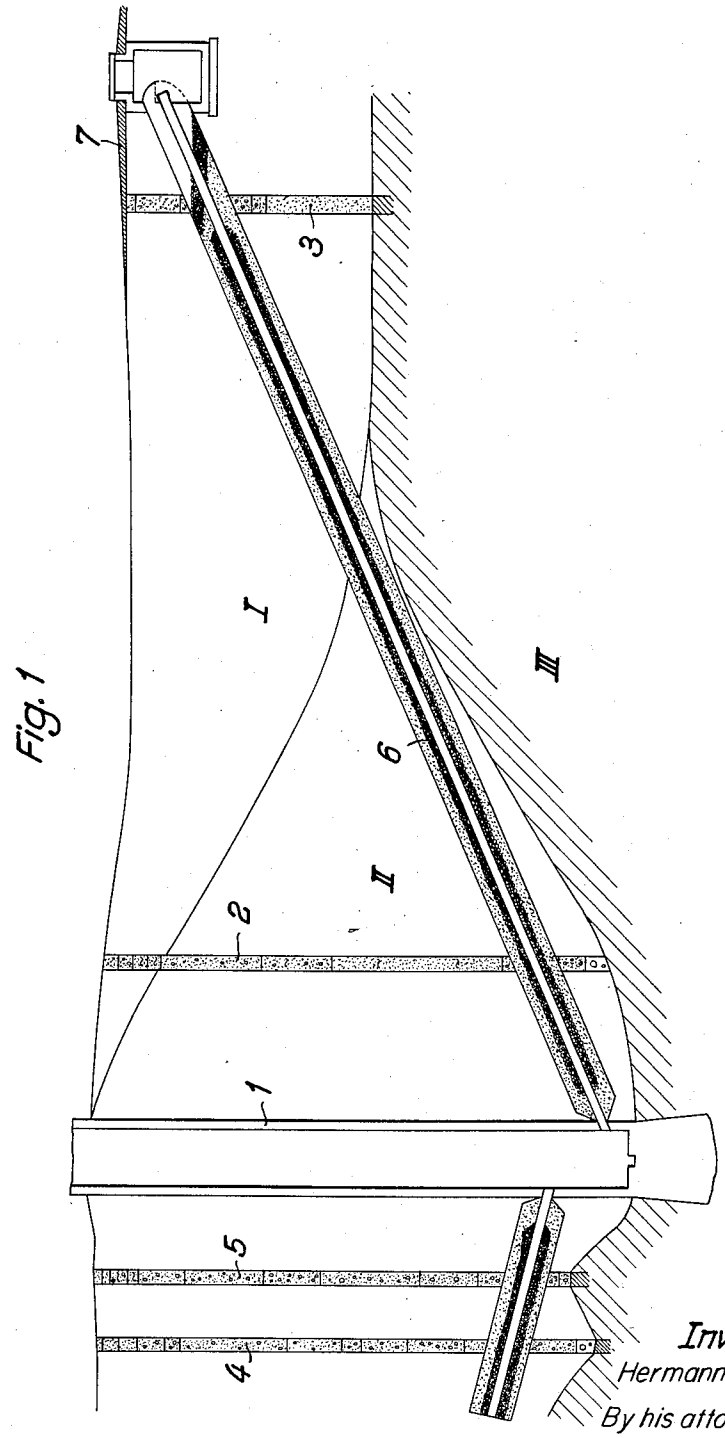


Fig. 1

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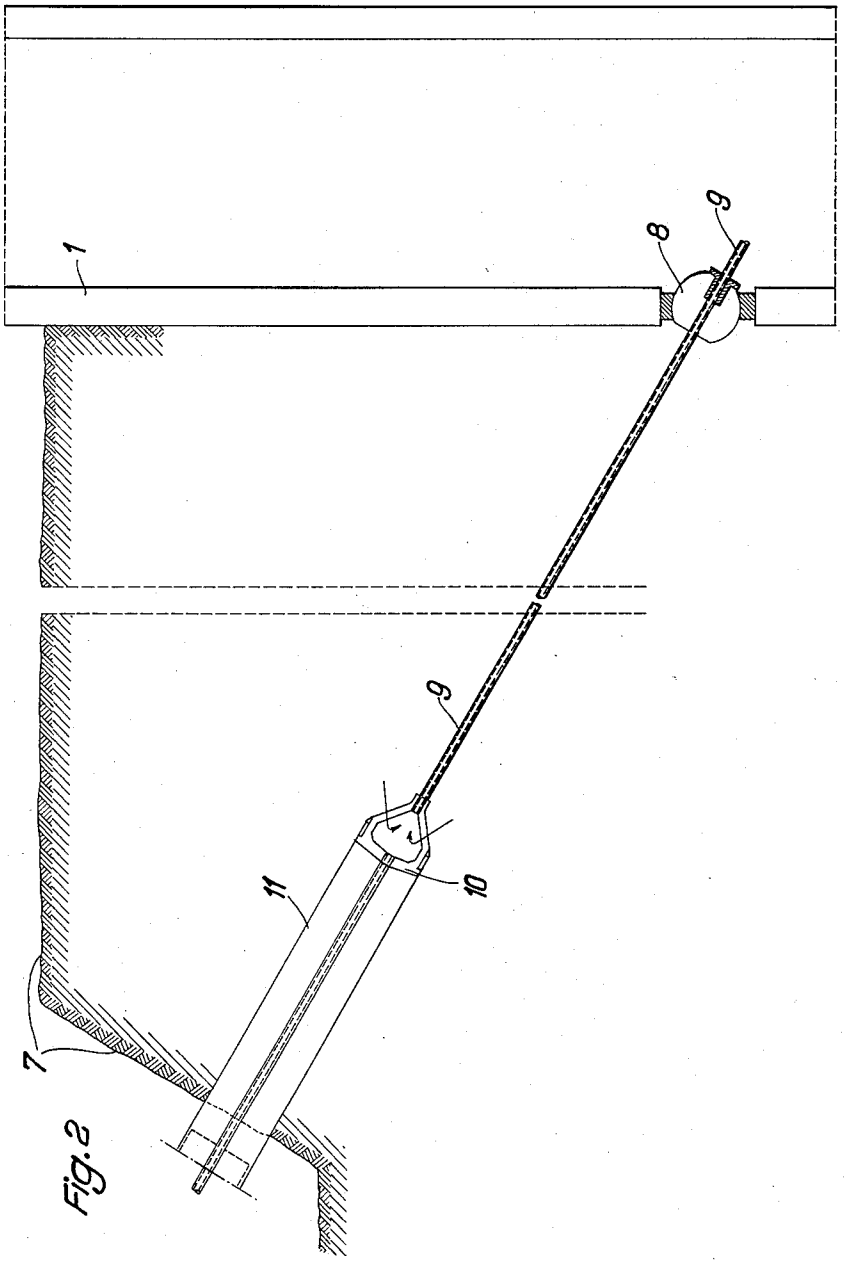


Fig. 2

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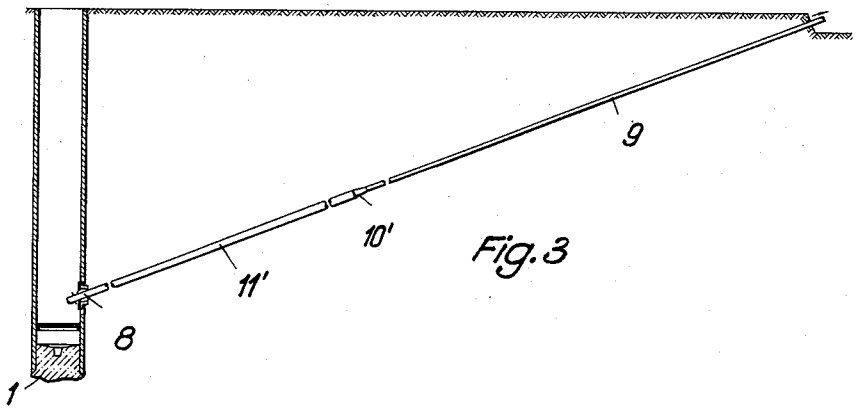


Fig. 3

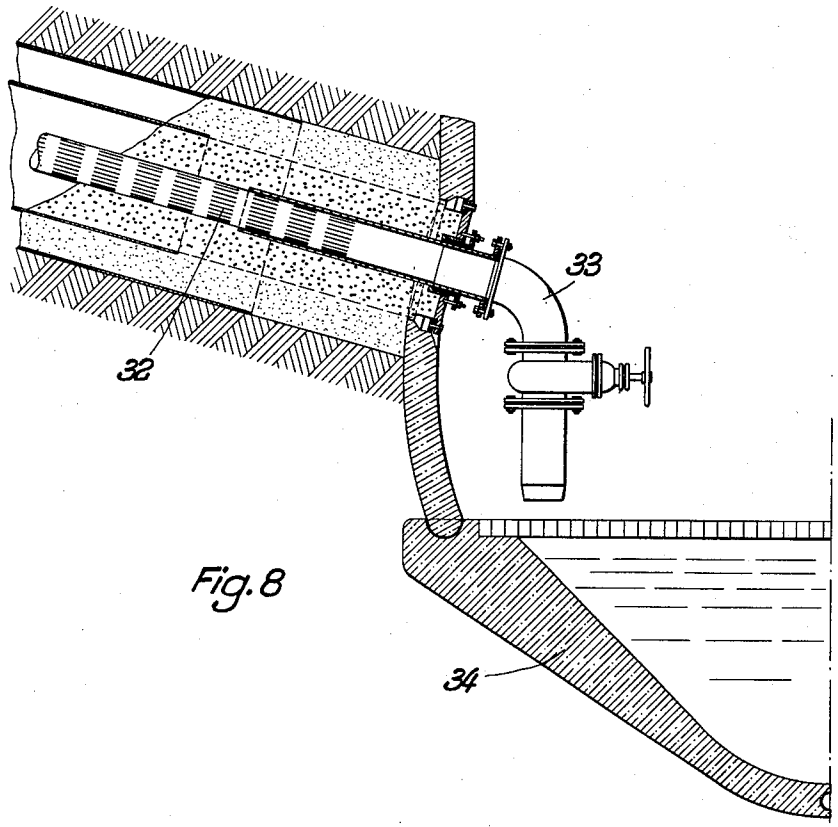


Fig. 8

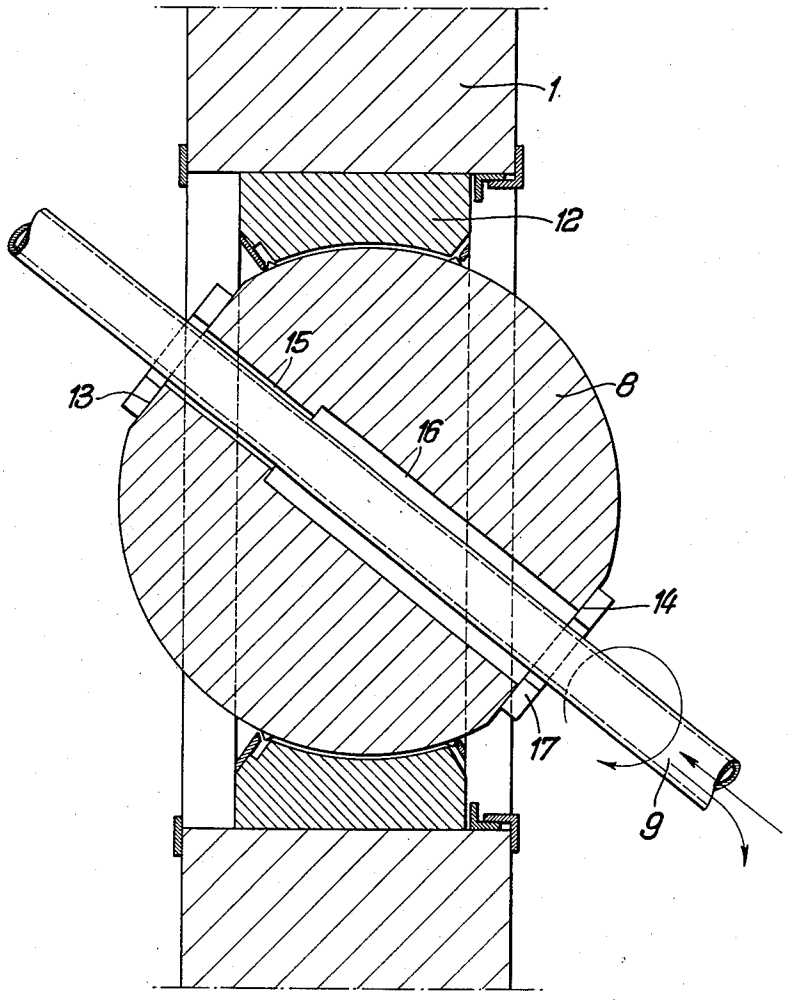
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March 15, 1960 H. WIENANDS 2,928,468

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Fig. 4



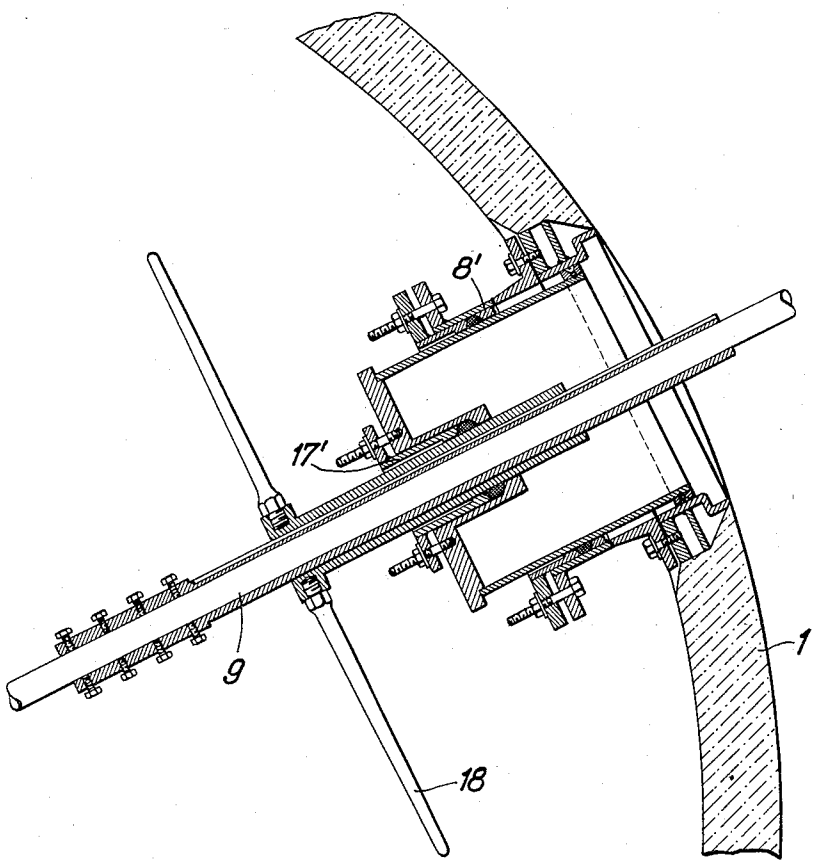
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METHOD FOR BORING WELLS

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Fig. 5



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METHOD FOR BORING WELLS

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Fig. 6

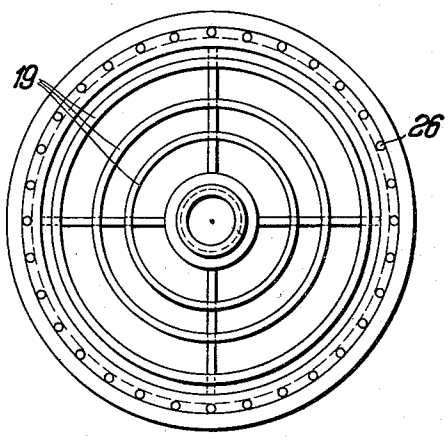
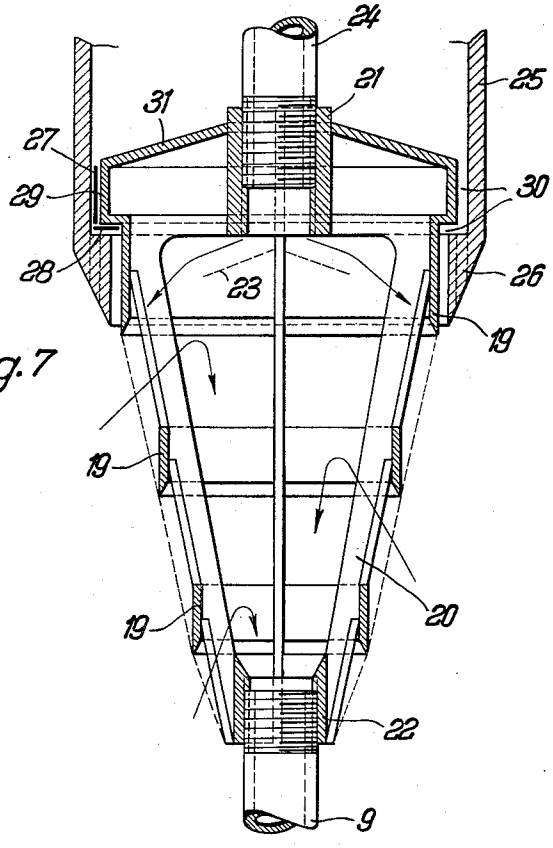


Fig. 7



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METHOD FOR BORING WELLS

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Application March 22, 1955, Serial No. 496,011

Claims priority, application Germany March 24, 1954

3 Claims. (Cl. 166—46)

The invention relates to a method of, and to appliances for, boring wells in which side bores are driven into the ground from a vertical shaft.

In known methods, such as that disclosed in U.S. Patent 2,550,408, issued April 24, 1951, side bores are driven into the earth horizontally from the shaft, i.e. at right-angles to the shaft wall. Bore tubes or apertured tubes are then introduced into the bore holes, likewise from the shaft, and these tubes serve for the installation of filter units and are withdrawn from the bore holes at the shaft end after the said filters have been fitted.

It is also known to drive bores into the earth for a few metres from the shaft in a slightly inclined direction.

However, these methods have the disadvantage that the vertical shaft must have a very large diameter, for example, a diameter of 5 metres, so that it is large enough for the necessary horizontally working appliances and machines for boring and flushing, for fitting and hauling the bore tubes, and for installing the filter, to be arranged therein. It is also a disadvantage that the lengths of the individual sections of the bore-rods and of the filters are restricted by the shaft diameter and may consequently only be about two metres long. As a further disadvantage, it is to be bore in mind that the material bored out always has to be removed from the bore holes in a direction opposite to the direction in which the bore tubes are fed and for this reason it is necessary to have special auxiliary means.

These disadvantages are obviated by the method according to the invention by the fact that the bores are driven from the lowermost part of the shaft in an inclined direction towards the ground surface.

A further feature of the invention consists in that the bores are driven to the surface of the ground by the use of a hollow bore-rod system, then second bore tubes having an increased diameter are connected to said bore-rod system and are introduced downwardly from the ground surface by withdrawing the bore-rod system, filter units are installed, and second bore tubes are withdrawn again in an upward direction from the ground surface.

The introduction of the second bore tubes into the upwardly inclined bores may be assisted by simultaneous thrust from the surface.

The angle at which the hollow bore-rod system is driven up to the surface of the ground in a manner known per se may be adjusted at will according to requirements, for example, by the use of a stuffing box which is fitted in the wall of the shaft and which is designed to correspond to the required boring angle, the hollow bore-rod system being driven into the earth through the said stuffing box. However, since then a separate stuffing box would be necessary for each boring angle, it is a further feature of the invention to use a shaft wall connector for the hollow bore-rod system, which connector is universally mounted in the lower end of the shaft wall and is sealed off against water. This arrangement permits both the adjustment of any desired boring angle, and also

a deviation of the bore-rod system to avoid any obstructions or fossils met during the boring operation by a suitable adjustment of the boring angle.

If the housing of the universal mounting were to be fixed in the wall of the shaft, the slope of the bore-rod system relative to the surface of the earth would be limited by the fact that the said system strikes against the outside wall of the shaft at a certain angle. In order to produce a steeper ascent of the bore-rod system towards the surface, it is proposed that the ball of the universally mounted shaft wall connector, which is arranged to be displaceable in the lower part of the shaft wall in a direction towards the earth, is flattened on two sides which are opposite one another, and the flattened sides are formed with two or more bores which are selectively employed for passing through the hollow bore-rod system. In order therefore to be able to bore towards the surface in a direction ascending as steeply as possible, the ball which is flattened on both sides is displaced outwardly to the maximum extent with the housing and the bore-rod linkage is guided through a bore permitting the largest possible boring angle.

The following particular description describes a number of appliances which serve for carrying into effect the process according to the invention.

In the drawings:

Figure 1 is a diagrammatic section through the top stratum of the ground, in order to make clear how the well installation is to be conceived.

Figure 2 diagrammatically illustrates the process and the appliances used therefor, this figure also being a section through the ground. Another form of the process is illustrated in a similar manner in Figure 3.

Figure 4 shows one particular embodiment of the shaft wall connector.

Figure 5 shows another form of the shaft wall connector with a hollow bore-rod system fitted therein.

Figures 6 and 7 are respectively a cross-section and a longitudinal section of a drilling unit.

Figure 8 repsesents a section of a completed well installation in the lower part of the shaft.

In Figure 1, I represents virgin diluvial valley sand, II a stratum consisting of coarse sand and gravel, and III a stratum of clay.

The well shaft is indicated at 1. It may be made by any conventional method for digging wells. The bores 2 and 3 are exploratory bores for testing the ground, and the bores 4 and 5 represent inspection bores. The collecting pipe for the ground water and the filter units are indicated at 6. For simplification, details of the filter units will not be described. Various conventional filter units may be employed, for example, those disclosed in U.S. Patents Nos. 2,126,575 or 2,383,496. As will be seen, the said collecting pipe and filter units 6 slope upwardly from the bottom end of the shaft 1 to the ground surface 7.

In Figure 2, with reference to which the process and some of the apparatus used are to be explained, the shaft is again indicated at 1 and the ground surface at 7.

Fitted in the lower part of the shaft wall 1 is a universally mounted connector 8 for the shaft wall, through which connector a hollow bore-rod system 9 is driven through the earth at an upward inclination to the surface 7.

After the hollow bore-rod system 9 has drilled through the earth as far as the surface 7 thereof, a bore tube shoe 10 is screwed from the said surface on to the hollow bore-rod system, the said shoe being connected on the other side to the bore tube 11. The introduction of the bore tube 11 (from top left to bottom right in the drawing) is effected by the use of a winch disposed

in the lower part of the shaft, the said winch not being illustrated. In addition, a ram (also not illustrated) may be provided on the earth's surface, the said ram assisting the introduction of the bore tube into the ground. It may be that the internal diameter of the hollow bore-rod system is not sufficient in all cases for the masses of earth displaced by the bore tube, as it is introduced, to be discharged downwardly therethrough, particularly if bore tubes of relatively large diameter are being laid. In such cases after the hollow bore-rod system has been driven up to the surface, the said system may be used for introducing an auxiliary sectional bore-rod from the shaft, and the bore tubes that serve for the installation of the filter units may be introduced into the upwardly inclined bores by connecting the tubes to the auxiliary sectional bore-rods and withdrawing the latter. The diameter of the auxiliary bore-rods should be smaller than that of the bore tubes and larger than that of the hollow bore-rod system. The diameter of the auxiliary sectional bore-rod system depends upon the amount of earth displaced by the bore tubes and is about 1/10 to about 1/6 of the diameter of the bore tubes (large main bore tubes).

The invention permits the use of a vertical shaft which has a substantially smaller diameter than that of known horizontal wells, because it is no longer necessary to introduce into the shaft bore tube and filter units which take up a considerable amount of space. Moreover, it is possible for longer individual bore tube sections with a length of, for example, 5 metres to be introduced, whereby there is also obtained a reduction in working costs.

During the boring operation the materials which are drilled out may slide down through the hollow bore rods into the shaft, or be flushed away by flushing water or ground water. Therefore, it is no longer necessary to have separate auxiliary means for the removal thereof from the bore holes. By means of a steel cable or a steel rod which can be moved backwards and forwards and which is guided through the hollow bore-rod system, the sliding of the earth down the bore-rod system may be facilitated during the boring operation if, for example, the water supply is defective.

When the hollow bore-rod system has reached the required point at the surface, the bore-shoe on the bore-rod which has come to the surface is unscrewed and a specially constructed bore-shoe on the first section of the bore tube to be introduced into the ground is screwed on to the bore-rod, the said section being provided with a screw-threaded sleeve suitable therefor. The retraction of the bore-rod system with the bore tube connected thereto takes place at the same angle at which the bore-rod system had been driven towards the ground surface, for example, by means of a hydraulic winch disposed on the bottom of the shaft. At the same time, the bore tube may be pushed forward by a hydraulic ram set up on the ground surface. In order to accommodate this ram, the ground surface at this point may be sloped to correspond to the angle of introduction, so that the pressure is applied in the direction of the axis of the bore tube. The earth displaced by the bore tube shoe as the bore tube penetrates into the ground may be discharged through the said shoe in the same manner as during the boring operation and through the hollow bore-rod system into the lower part of the shaft. If the amount of ground water is insufficient, the earth may be washed away under pressure by a water-flushing device introduced through the bore tube into the said shoe, the flushing water advantageously being conveyed in circulation from the lower part of the shaft into said shoe again. In this manner, the bore tube which is composed in known manner of individual tube sections is drawn into the earth as far as the shaft wall connector. When the shoe of the bore tube has reached this point, the bore rod is unscrewed, the hydraulic ram and winch are dismantled and the lower end of the bore tube is sealed. The universally mounted connector may then also be dismantled.

The installation of the filter units in the bore-tube system is then carried out from the surface in a manner known per se, the said tube system being thereafter withdrawn again from the ground surface.

Another embodiment of the method according to the invention is described with reference to Figure 3.

As in the first embodiment, the hollow bore rod **9** with an internal diameter of about 0.1 m. is driven from the lower part of the shaft through the universally mounted shaft wall connector up to the surface. The lower end of the bore rod is then provided in the shaft with a bore-head **10'**, to which is connected an auxiliary sectional bore-rod **11'**, the individual sections of which have a length of about 1 to 2 metres and a diameter of about 0.2 to 0.4 m. This auxiliary bore-rod is drawn by means of a winch and the bore-rod system **9** from bottom left to top right in the drawing. In the drawing, the bore-head **10'** is shown about half way. When the auxiliary sectional bore-rod **11'** has been forced through to the surface of the ground, it is provided at the surface with a bore-shoe, such as is necessary for the bore-tube which is later to accommodate the filter units. This main bore tube is not shown in the drawing and has an internal diameter of, for example, 0.5 to 2.0 m. The introduction of this large bore tube is effected in the manner described above in a downward direction from the surface.

Figure 4 shows a particular form of a universally mounted shaft wall connector **8**. The latter is built in the shaft wall with a housing **12**. The surface of the ball is flattened on two sides at **13** and **14** and two bores **15** and **16** pass through the flattened surfaces and act as guides for the hollow bore-rod system **9**. The bore **15** corresponds to the diameter of the rod system **9**, while the bore **16** allows for the fitting of guide bushings and packings. A stuffing box is indicated at **17**.

Another embodiment of a shaft wall connector is shown in Figure 5. This connector **8'** is fixed in the shaft wall and permits the passage of the hollow bore-rod system **9** through a stuffing box **17'**. The ram for driving the hollow bore rod is indicated at **18**.

Figures 6 and 7 illustrate an appliance with which the bore tubes are introduced into the ground from the surface until they reach the lower part of the shaft.

The appliance consists of annular members **19** which are provided with sharpened chisel edges and are held together by longitudinal ribs **20**. The upper end of each of the said longitudinal ribs is welded to a guide sleeve **21** and the lower end of each rib is welded to a guide sleeve **22**. Located inside the appliance is a conical deflecting plate **23** by means of which the stream of flushing water supplied through an upper pipe connection **24** is split up to form a cone of water which produces a washing movement between the longitudinal ribs. The connection **24** is also constructed as a hollow guide member. The tube to be drawn into the ground and not shown in the figures is provided with a bore-shoe **25**, which is provided at its lower end with holes **26**. Iron spacers **27** and **28** welded in the bore-shoe **25** serve as abutments for driver members **29** inserted into the said shoe and connected to the outermost annular member **19**, and produce spaces **30** through which water introduced from above into the tube can enter the ground as well as through the holes or bores **26**.

The operation of the appliance is as follows:

When the hollow bore-rods **9** forced through the ground have passed out through the surface, the tube to be drawn into the ground is inserted at this position and the appliance is guided into the tube by means of the hollow rod system **24**. The threaded guide sleeve **22** connected to the innermost annular cutter is then screwed on to the upper end of the hollow bore-rod system **9**. The hollow rod system **9** with the appliance fixed thereon

is then withdrawn, carrying the tube with it. At the same time, the tube may be driven in from the surface by means of a hydraulic ram. The earth displaced by the annular cutters passes inside the appliance and is discharged through the hollow rod system 9 in the direction of feed by means of flushing water supplied through the hollow pipe connection 24.

The number of annular cutters required and the spacing between them depend on the nature of the ground, it being expedient to use a large number of annular cutters spaced a short distance apart for fine sands and a smaller number of annular cutters with larger spacings for heavier ground. Moreover, the appliance may be open at its upper end or may be closed by cover 31, depending on the manner in which the flushing water is to be supplied. With sandy soil, it is preferable to use the open construction of the appliance, the flushing water being conducted into the appliance through the tube which is to be introduced. With loamy or clayey soil, on the other hand, it is advantageous to use a closed construction. In this case, the flushing water passes through the hollow guide rod 24 into the appliance, where it is guided by the deflecting or baffle plate 23 on to the longitudinal ribs and flushes away the loamy earth deposits which may adhere at these points.

Figure 8 is a sectional view showing the lower part of a filter installation 32 when completed, with a water discharge pipe 33 which delivers the water to the bottom 34 of the well shaft.

It will be apparent to those skilled in the art that the novel principles of the invention disclosed herein in connection with specific exemplifications thereof will suggest various other modifications and applications of the same.

It is accordingly desired that in construing the breadth of the appended claims they shall not be limited to the specific exemplifications of the invention described herein.

What I claim as my invention and desire to secure by Letters Patent of the United States is:

1. A method of producing a well having a vertical shaft and side bore holes containing filters, comprising

forming a well shaft in the earth in a substantially vertical direction, driving a small bore rod in an upwardly-slanting direction from the lower part of said shaft to the surface of the earth to form a side bore hole, attaching a bore tool of larger diameter than said bore rod on the upper end of said bore rod, pulling said bore tool down to the lower part of said shaft, by retracting said bore rod, to enlarge said bore hole, placing a filter in said enlarged bore hole, and retracting said larger bore tool to the surface of the earth.

2. The method claimed in claim 1, in which the bore tool is also pushed downwardly with pressure from the earth surface.

3. A method of producing a well having a vertical shaft and side bore holes containing filters, comprising forming a well shaft in the earth in a substantially vertical direction, driving a small bore rod in an upwardly slanting direction from the lower part of said shaft to the surface of the earth to form a side bore hole, attaching a bore tube of larger diameter than said bore rod and having a detachable shoe at its lower end, to the upper end of said bore rod by means of said shoe, pulling said bore tube down to the lower part of said shaft by retracting said bore rod to enlarge said bore hole, detaching said bore rod from said shoe, removing said shoe from said bore hole, placing a filter in said enlarged bore hole and retracting said bore tube to the surface of the earth.

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