DEVICE FOR BORING WELLS IN THE GROUND

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The invention relates to a device for boring wells, vertical shafts, casing pits or the like in the ground by means of augers.

The present invention has for its object to provide an improved self-contained device capable of effecting borings of large cross section, such as are more and more frequently required for forming piles of large diameter (especially of one metre and more) and high bearing strength (especially 500 to 1000 metric tons or more) for the foundations of industrial premises or high buildings, where high concentrated loads are encountered.

According to the invention, the boring device includes at least one auger of any suitable type, which is coupled directly to a driving unit, so as to form an assembly adapted to be lowered into the ground and which is suspended from any suitable lifting device, the driving unit being connected through flexible channels to a source of power medium arranged at the surface of the ground, with means being provided to prevent rotational movement of the driving unit while permitting free longitudinal movement thereof through a limited stroke so that the weight of the driving unit bears on the auger to increase the effectiveness of the latter.

Thus, the device according to the invention is self-contained and not dependent upon mechanical power transmission means connecting it to the surface. Owing to this feature, the said device enables a boring to be sunk up to a theoretically unlimited depth and to carry out borings of much larger cross section, the useful power of the device being much greater than that of the usual devices. Moreover, it can be very conveniently and rapidly operated.

Other features and advantages of the invention will appear from the disclosure of a few examples of embodiment, given hereinafter with reference to the accompanying diagrammatic drawings, in which:

Figs. 1 and 2 are diagrammatic elevational views of two different positions of a device according to the invention, at work within a lining tube;

Fig. 3 is an elevational view, partly in axial section, drawn to a larger scale, of the said device;

Fig. 4 is a cross-sectional view according to line IV—IV of Fig. 3;

Fig. 5 is an axial section of an auger when opened;

Fig. 6 is an axial section of a different embodiment of an auger;

Fig. 7 is a cross-sectional view according to line VII—VII of Fig. 6;

Fig. 8 is an elevational view of another embodiment of the invention;

Fig. 9 is a fragmentary, horizontal section taken along the line IX—IX of Fig. 8;

Fig. 10 is an axial section taken along the line X—X of Fig. 9; and

Fig. 11 is an elevational view of still another embodiment of the invention.

In the example shown in Figs. 1—2, the device according to the invention is shown in operation in a lining tube which may be made as a unitary body or be formed of sections which are assembled as the sinking proceeds. The device includes a cutting tool or auger 2 which is caused to rotate by means of a driving unit 3, through an intervening reduction gear 4 which may be of the tooth wheel type. The driving unit is preferably an electric motor of the enclosed type, to which the current is fed through a flexible lead 3a.

In view of the fact that the motor is secured to the auger it is necessary to provide for clamping the frame of the motor against rotational displacement with respect to the tube 1, since, otherwise, the auger would not rotate. Such clamping should be carried out in such a way as to permit nevertheless the longitudinal displacement of the auger-and-motor unit with respect to the tube 1, which displacement should be at least equal to the boring stroke of the auger. Such clamping may be carried out in any convenient way. In Figs. 1—2, the clamping means are shown diagrammatically at 5. The engine is fitted in a cage 6 provided with an attachment member 7 for the suspension cable 8 which is operated from any lifting device. The cage is formed with at least one window 9 shaped like a slot and having engaged therein a radial projection of the clamping member 5. After the device has been lowered into the tube 1, the various components thereof assume the position shown in Fig. 1. As soon as the device rests upon the earth, the member 5 is clamped with respect to the tube and the motor is started, so as to impart a rotary motion to the tool 2, which bores the ground and descends into the latter, taking with it the reduction gear 4, the motor 3 and the cage 6, all connected therewith. The assembly then assumes the position shown in Fig. 2, the length of the slot 9 corresponding substantially to the stroke of the tool. The clamping means are then released, so that they can travel downwards along the slot, and the device is raised in order that the tank 31 of the auger 2 may be emptied and, thereafter, the cycle of steps resumed.

As shown in Fig. 3, the means 5 may comprise electromagnets provided in any desired number, e.g. two, three or four, the windings 10 of which are supported by a section of tube 11 slidably mounted upon a central member 12 of the cage 6. The electrical current is fed to the electromagnets by flexible leads, such as 10a and 10b. The outward movement of the armatures 13 brings about the clamping. Such movement may be caused by the windings attracting the armatures against the action of the return springs 14; however, such displacement may alternately be produced by the springs, which would be pressure springs in this instance, the clamping device being in such instance released through the armatures being attracted.

The auger shown in Fig. 3 comprises a tank 32 secured onto the output shaft 15 of the reduction gear 4 and having its lower end closed by a hinged bottom 16 provided with a knife 17 arranged beside a window 18 through which the earth may enter the tank. Fig. 5 shows the bottom in its open position for emptying the auger. For large borings, it will be useful to employ an auger having a laterally protruding knife 19, as shown in Figs. 6—7.

Fig. 8 shows a construction approximately similar to the one described with reference to Figs. 1 and 3, but including an auger having a double laterally protruding knife. In order to ensure that the device is correctly centered, the same is provided with an annular projection 20 entering the tube 1 with a suitably small clearance.

Figs. 9—10 show the particulars of an electro-magnetic clamping arrangement. The movable armatures 13 terminate in wide shoes which provide a large contact surface with the tube 1.

The angular clamping may be provided by the mutual engagement of grooves and ribs, which may be provided
on the inside wall of the lining tube and on the frame of the boring assembly respectively, or vice-versa. Fig. 11 shows such a construction. The tube shows grooves 21 having engaged therein projectiles 21a, which may be provided upon the casing of the reduction gear and the tank of the auger in order to afford a better stability to the assembly. In this instance the cage 6 with the slot 9 is no more necessary, since the said projections can slide in the grooves 21 during the boring stroke of the device.

Where it is useful or necessary to effect a superficial breaking-up of the soil in the area to be acted upon by the auger, the invention provides that the boring device may be furnished with means for carrying out such breaking-up, e.g. by air blasts and/or water or other liquid sprays applied adjacent the bottom of the auger. The tubes necessary for producing the blasts or sprays are advantageously arranged around the auger. Use may, for instance, be made of a perforated tube 28 to which the fluid is supplied through a conduit 29 to which is connected a flexible pipe 30.

It will be understood that the invention is not restricted to the examples described and illustrated, which are subject to various modifications without departing from the spirit of the invention.

1. A device for boring vertical shafts in the ground, comprising a rotary cutting tool, a rotary driving unit directly coupled thereto to form an assembly adapted to be lowered into the ground, means for attaching the assembly to cablelike suspension means, flexible means for connecting the driving unit to a source of power medium arranged on the surface of the ground, a cage integral with the frame of the driving unit, longitudinal slots provided in said cage and having a length substantially corresponding to the stroke of the cutting tool, at least two electro-magnets each having a movable armature, and means connecting the electro-magnets to a source of electric current, each armature extending radially through one of said slots of the cage and being capable of being urged against the walls of the shaft being formed, thereby to retain the frame of the driving unit against rotary movement to the shaft while permitting a longitudinal movement of the assembly including the tool, driving unit and cage in the shaft through a distance at least equal to the operating stroke of the cutting tool.

2. A device for boring vertical shafts in the ground; said device comprising a rotary cutting tool, a rotary driving unit directly coupled to said tool and forming an assembly with the latter adapted to be lowered into the ground, means for attaching said assembly to cable-like suspension means, flexible means for supplying a power medium to said driving unit from a location on the surface of the ground, means for supplying said power medium to said driving unit from a location on the surface of the ground, a lining tube surrounding said assembly in sliding relationship therewith and adapted to be lowered with the assembly, means for attaching said assembly to cable-like suspension means for supplying a power medium to said driving unit from a location on the surface of the ground, said driving unit including a frame with respect to which said tool is rotated, a radially expansible clamping means adapted to be expanded against the inner surface of said lining tube, means supporting said clamping means on said frame, and permitting free longitudinal sliding movement of said clamping means through a limited stroke relative to said frame, means preventing rotational movement of said clamping means relative to said frame, and means adapted to be controlled from the surface of the ground and operative to selectively expand and contract said radially expansible means so that, when the latter are expanded against the surface of the shaft, rotation of said frame relative to the shaft is prevented, while said driving unit and tool are free to move longitudinally within the shaft through said limited stroke.

3. A device for boring vertical shafts in the ground; said device comprising a rotary cutting tool, a rotary driving unit directly coupled to said tool and forming an assembly with the latter adapted to be lowered into the

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