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DRAINAGE METHOD AND DEVICE

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Fig. 1

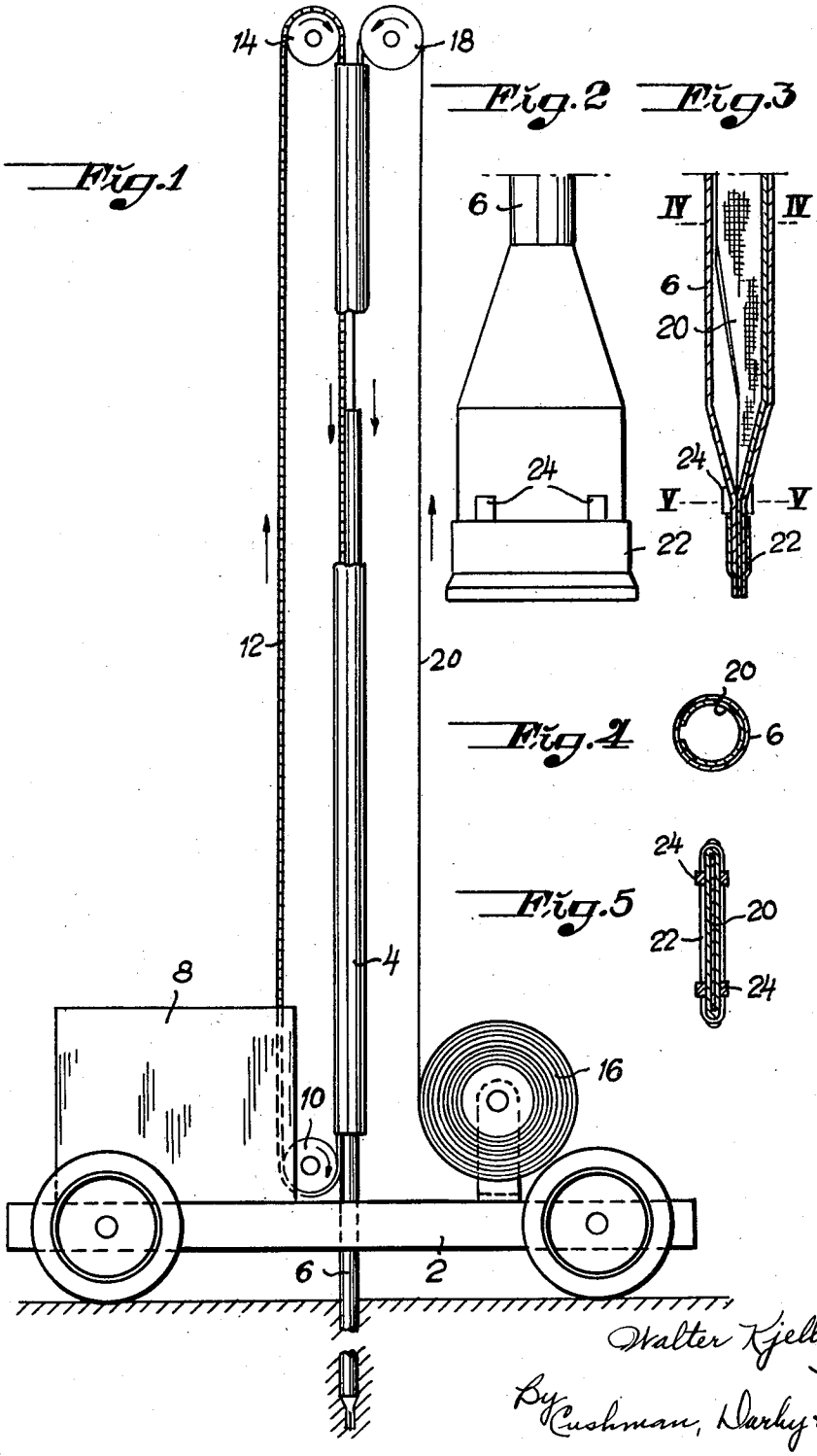

Fig. 2

Fig. 3

Fig. 4

Fig. 5

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DRAINAGE METHOD AND DEVICE

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6 Claims. (Cl. 61—11)

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This invention relates to a method and means for accelerating the consolidation of clay-ground or other soil.

Clay-ground, which is loaded by a road embankment, is compressed while giving off water, and thus becomes more solid. On account of the low perviousness to water of the clay, this consolidation takes a long time. A consequence of this is that the settlements will go on for years or decades, causing irregularities and damages in the paving, which from time to time call for necessary repairs. Another result is that the above-mentioned increase of the solidity does not come to any use, inasmuch as the same sets in only by degrees and consequently does not aid in the first time toward preventing ground-ruptures or earth-slips.

Both of these drawbacks can be eliminated by an acceleration of the consolidation, so that the latter will for the greater part take place during the building time. This may be effected by means of a draining system provided in the clay, through which the water given off by the clay may find its way out rapidly and without meeting any appreciable resistance.

It is known for this purpose to arrange vertical drains in the ground, which consist of bore holes of a circular cross section and filled with sand. In order that a drain of this type shall permit of being made in a first-class manner, it must have a rather large diameter, generally amounting to about 20". For every drain, a great quantity of clay will thus have to be removed from the ground and a great quantity of sand carried right up to the bore hole to be filled into the same. The sand drain consequently involves a very high production cost, namely about 1:50 dollars per foot of drain length.

The object of my invention is to provide an improved drainage method and device by which the required work can be effected at highly reduced cost and time. The invention is hereinbelow more fully explained, reference being had to the accompanying drawing in which:

Fig. 1 is a diagrammatic total view of the arrangement; Figs. 2 and 3 show the end of a thrust pipe, with a drain inserted therein, in elevation and in longitudinal section, respectively; Fig. 4 shows a cross section on line IV—IV in Fig. 3; and Fig. 5 shows a cross section on line V—V in the same figure.

Theoretical and experimental investigations undertaken by myself have proved that the draining effect is influenced in a much higher degree by the mutual distance between the drains than by their diameter. The investigations have shown, furthermore, that a flat drain has a much greater effect than a round drain of the same

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cross-sectional area, provided that both drains possess great perviousness to water in the longitudinal direction. Thus it would be possible to attain the same effect as in the above-mentioned sparse system of circular sand drains of a large cross-sectional area with the use of a somewhat closer system of flat drains of a very small cross-sectional area and made from a material permitting a construction of the kind in consideration.

Accordingly, the present invention makes use of band-shaped drains from non-sized pasteboard of a width of, for instance, approximately 4" and a thickness of about ⅛". Such pasteboard drains are very cheap and easy to manufacture (the manufacturing cost is at present 3 cents per foot), to transport and to drive down into the ground. Although, in order to provide the same effect as the sand drains of 20", they must be located at a mutual distance about 25% less than that of said sand drains, the total cost of draining with pasteboard drains will only be about 15% of the total cost of draining with sand drains.

Instead of from pasteboard, the drains may be made from some other porous or fibrous and flexible or pliable material, such as jute fabric. Their suitable dimensions may in certain cases deviate considerably from the above statements. Generally, however, the width is expected to amount to something between 1" and 10" and the thickness to something between $\frac{1}{16}$" and 1". The length of the drain, that is to say the depth to which the draining is to take place, is believed to vary between 7' and 70'.

Referring to the drawing, 2 designates a low and stable four-wheel truck carrying a vertical pipe 4 by bracing means not shown, said pipe serving as a guide for the thrust pipe 6. Placed on the truck is a motor 8 driving a sprocket wheel 10 cooperating with a chain 12, which is stretched between the wheel 10 and a wheel 14, in a manner such that the same is caused to run within the guide pipe 4. The upper end of the thrust pipe is suitably secured to the chain 12, and the thrust pipe may thus be displaced up and down in the guide pipe by motive power. 16 is a supply roll of the drain material, which is delivered from the factory in the form of a very long integral band or web 20. From said roll, the band or web is supplied over a guide roller 18 at the upper end of the guide pipe into the latter and further into the thrust pipe, in which it continues down to the lower end thereof.

Arranged on the outside of the lower flat end portion of the thrust pipe is a sleeve 22 formed by a compressed piece of pipe, the lowermost portion of which has been pinched together upon

the threading of the band therethrough, so that the band is firmly secured to the same. 24 denotes supporting abutments having the sleeve 22 bearing thereon and serving to prevent jamming of the sleeve 22 onto the thrust pipe.

In carrying the method according to the invention into effect the truck 2 is driven out on the ground to be treated, the thrust pipe being then pressed down to the requisite depth with the use of the motor 8 and chain 12. On account of the arrangement of the sleeve 22, the band drain is thus entrained and rolled off the roll 16. The direction of movement of the driving machinery is then reversed, and the thrust pipe is pulled up. The sleeve 22 is thus pulled off the end of the thrust pipe and retains the drain, so that the latter is caused in the pulling up of the thrust pipe to run out through the opening thereof, while another length of drain material will at the same time be introduced into the thrust pipe to be enclosed thereby at the upper end thereof. After the thrust pipe has been pulled up above ground, the band is severed, another sleeve 22 being then applied and secured by pinching to the band. The truck is then moved for a distance corresponding to the required drain distance, and the cycle is repeated, until the whole of the ground surface to be treated has been provided with drains. Under favourable circumstances, the machine can operate at a rate of one drain per minute.

The method above described for deep-draining with the use of band drains may be employed to prevent ground-ruptures and earth-slips and to render settlements harmless in most cases where a load is applied to loose ground, as in the building of roads, railroads, streets, aerodromes and earth-dams and in the arrangement of store-places, industrial sites, and so forth. In addition, the method may be used, in combination with temporary overloading, to prevent earth-slips in most cases where channels or other large pits are to be excavated in loose soil. The application of the method is of course not limited to clay-ground, but comprises all loose soil having a low perviousness to water, such as barren, mud, sludge and peat.

What I claim is:

1. A method of accelerating the consolidation of soil having a very low perviousness to water, for the purpose of improving the carrying capacity thereof and rendering the settlements therein harmless, comprising the steps of threading an elongated flexible and porous drain of rectangular cross section through a thrust pipe, clamping a collar to the lower end of said drain, driving said collar and said drain downwardly into the soil by means of said thrust pipe, and pulling up said thrust pipe, whereby said collar and said drain are permitted to remain in said soil.

2. Drainage apparatus comprising a thrust pipe, an elongated flexible and porous drain band of rectangular cross section extending through said thrust pipe, collar means secured to the lower end of said drain band, means at the lower end of said thrust pipe for engaging said collar means in driving relationship, and means for forcing said thrust pipe downwardly into the ground and pulling up said thrust pipe, whereby said collar means and said drain band are forced into the ground and permitted to remain there when said thrust pipe is pulled up.

3. Drainage apparatus comprising a carriage, a thrust pipe vertically mounted on said carriage, means for guidably supporting said thrust pipe, means for forcibly driving said thrust pipe downwardly into the ground and for pulling up said thrust pipe, means on said carriage for yieldably supporting an elongated drain band, and means for guiding said drain band to a point above the upper end of said thrust pipe when in up position and into said thrust pipe, the bottom end of said thrust pipe being adapted to support drain band engaging means when said thrust pipe is driven into the ground.

4. Drainage apparatus comprising a carriage, a thrust pipe vertically mounted on said carriage, means for guidably supporting said thrust pipe, means for forcibly driving said thrust pipe downwardly into the ground and for pulling up said thrust pipe, means on said carriage for rotatably supporting a roll of elongated flexible and porous drain band, and means for guiding said drain band to a point above the upper end of said thrust pipe when in up position and into said thrust pipe, the bottom end of said thrust pipe being flattened and including lugs for supporting means for engaging and guiding the end of said drain band when said thrust pipe is driven into the ground.

5. Drainage apparatus comprising a carriage, a thrust pipe vertically mounted on said carriage, means for guidably supporting said thrust pipe, means for forcibly driving said thrust pipe downwardly into the ground and for pulling up said thrust pipe, a supply of elongated drain band supported on said carriage, means for guiding said drain band to a point above the upper end of said thrust pipe when in up position and into said thrust pipe, said band extending to the upper end of said thrust pipe and downwardly therethrough, and means engaging the lower end of said drain band, said drain band engaging means being also engaged by said thrust pipe in driving relationship.

6. Drainage apparatus comprising a carriage, a thrust pipe vertically mounted on said carriage, means for guidably supporting said thrust pipe, means for forcibly driving said thrust pipe downwardly into the ground and for pulling up said thrust pipe, a roll of elongated flexible and porous drain band rotatably supported on said carriage, means for guiding said drain band to a point above the upper end of said thrust pipe when in up position and into said thrust pipe, said band extending to the upper end of said thrust pipe and downwardly therethrough, and collar means engaging the lower end of said drain band, the bottom end of said thrust pipe being flattened and including lugs, said collar means being also engaged by the lugs of said thrust pipe in driving relationship.

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