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GB 1313818
GB 1304701
GB 769863
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(54) **Improvements in or relating to earth-boring apparatus for taking soil samples**

(57) A rotatable drill tube is connected via a hollow shaft 19 and a transmission to a laterally arranged driving motor. The drill tube coupled to the hollow shaft 19 contains an upwardly withdrawable linkage 37 with a sleeve-like probe 36 which is borne on a shoulder 34 of the drill tube and which receives a plastics material sleeve e.g. 5 or 35 open at both ends and acting as sample containers. It is thus possible to take samples by charges without uncoupling the motor or lifting the drill tube. The plastics material sleeve 5, 35 comprises a thin-gauge foil which, after withdrawal, is closed off by means of attachable caps 8. The empty thin-gauge sleeve may be pressed more or less flat for storage and carriage purposes; for this purpose, it is appropriately pre-folded along numerous generatrixes 6. Telescopic drill tubes which may be coupled to the motor 23 consecutively allow of sample taking down to several metres of drilling depth.

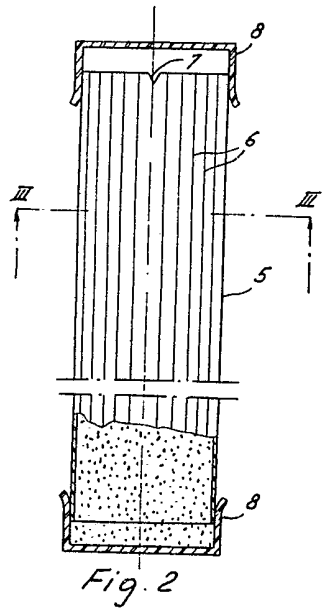

Fig. 2

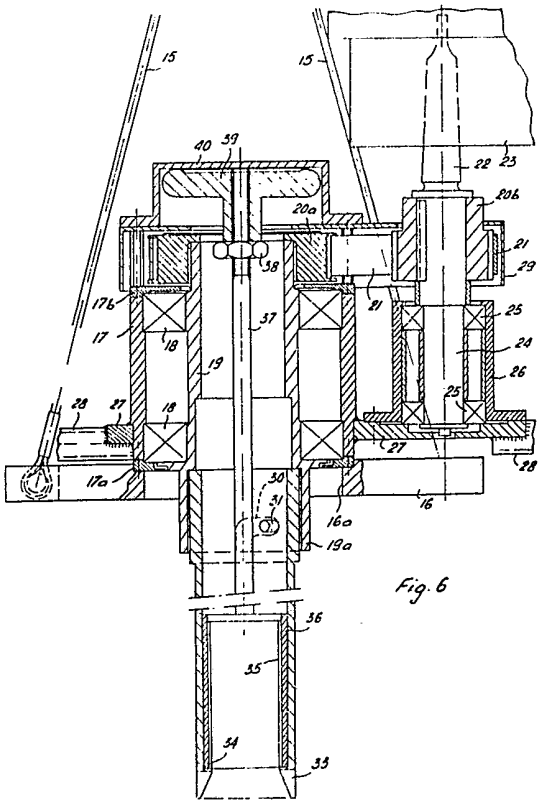

Fig. 6

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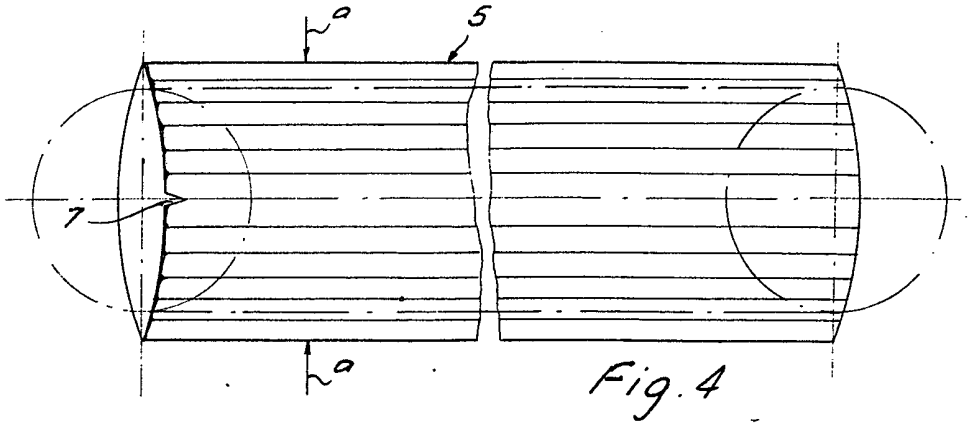

Fig. 4

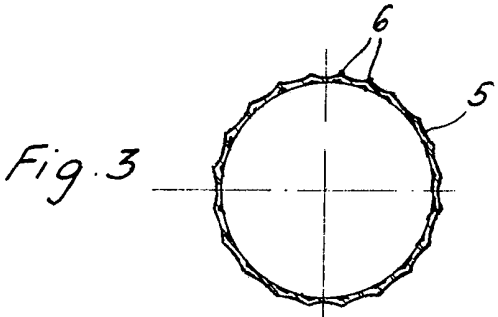

Fig. 3

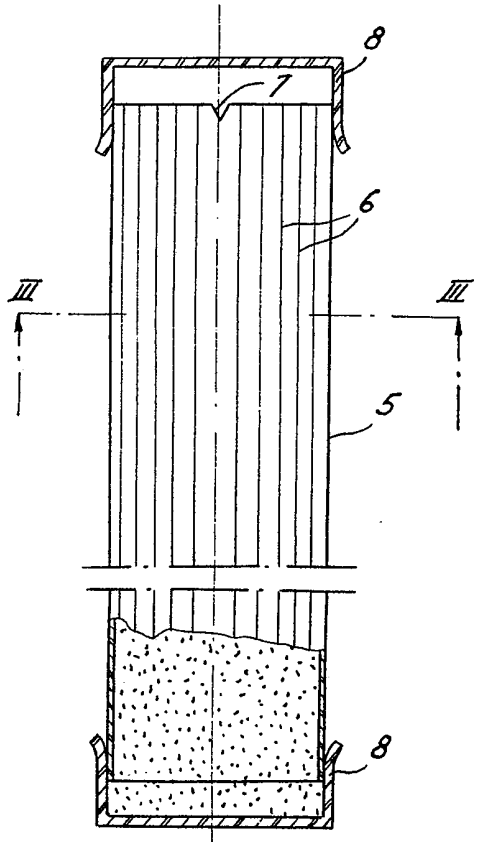

Fig. 2

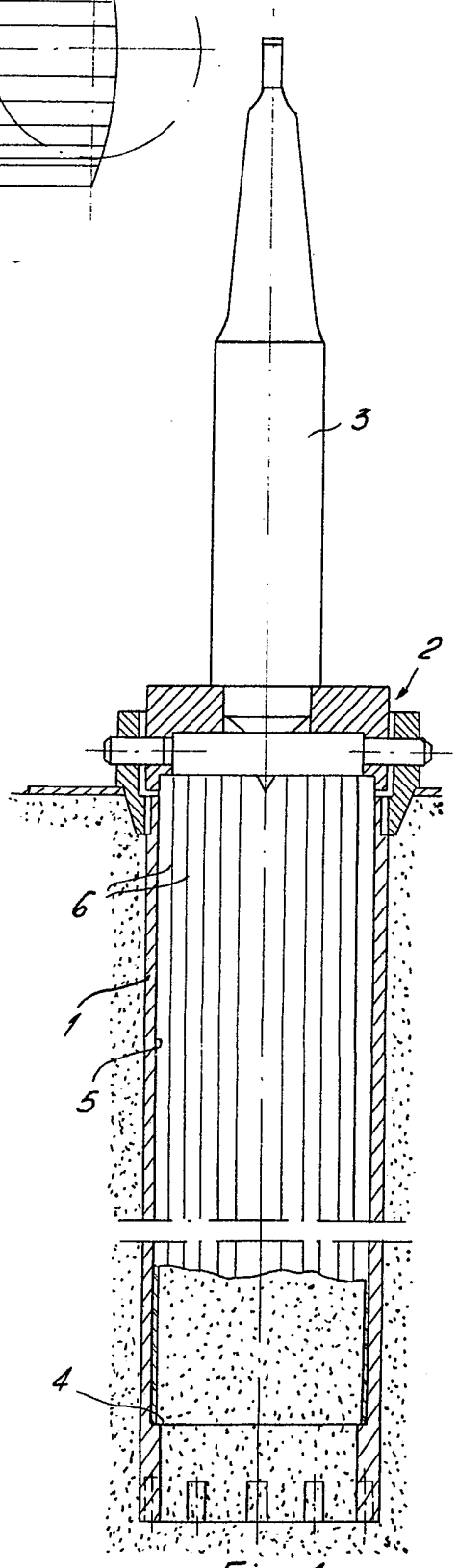

Fig. 1

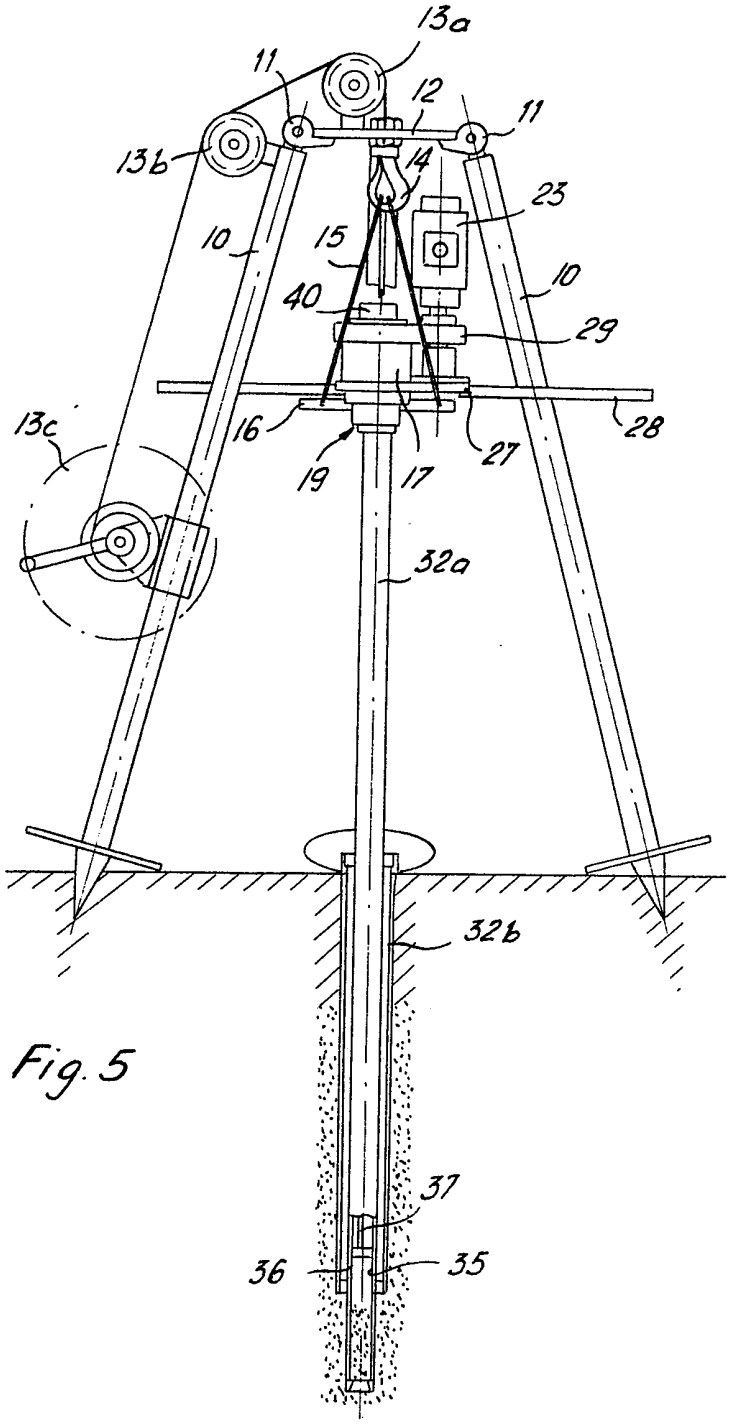
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Fig. 5

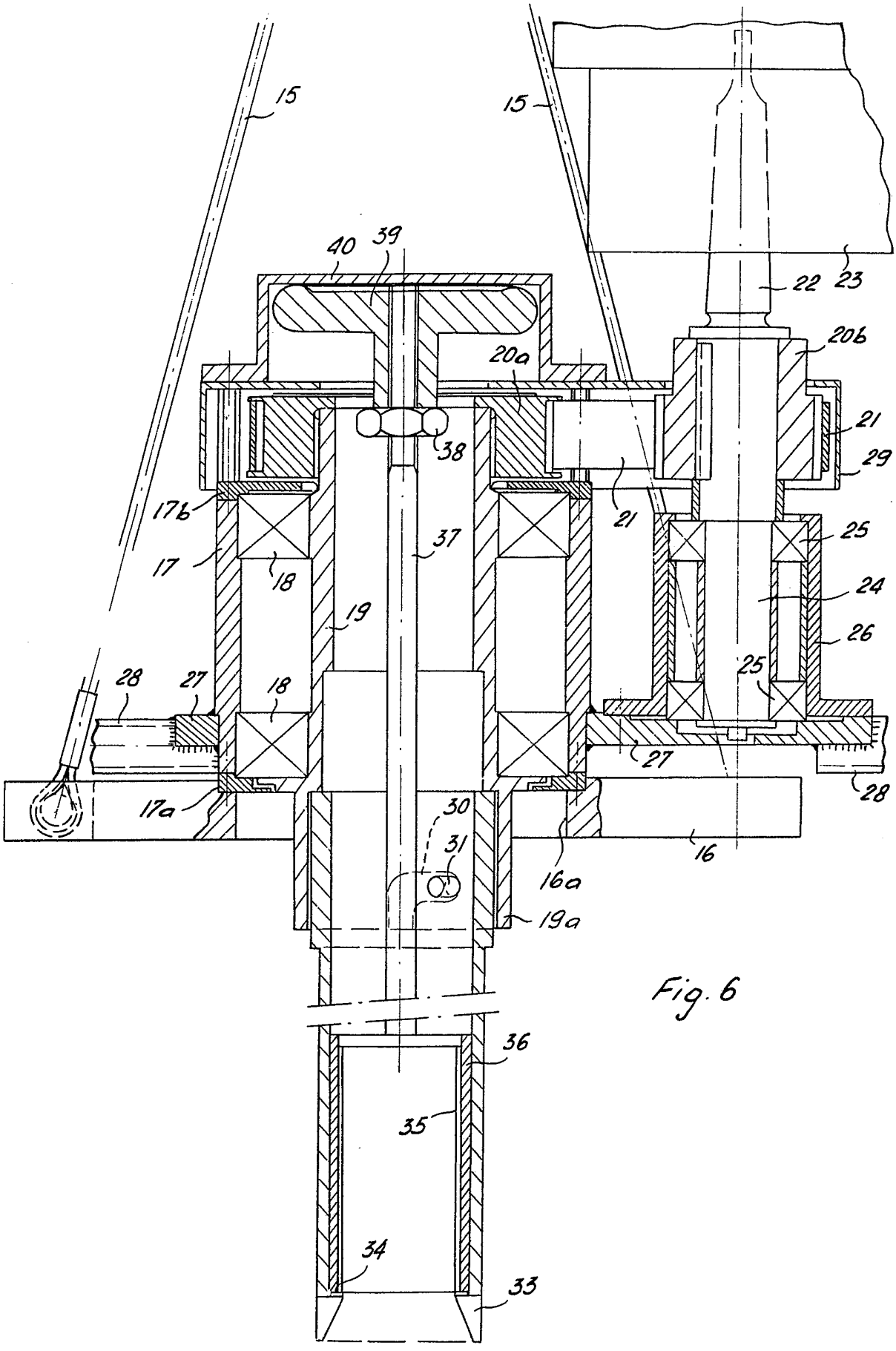
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Fig. 6

SPECIFICATION

Improvements in or relating to earth-boring apparatus for taking soil samples

The present invention relates to earth-boring apparatus for taking soil samples, of the kind having a rotatable boring tube carrying an annular bit and comprising a stepped recess for receiving an exchangeable plastics material sleeve to act as a soil-sample container. Hereinafter such apparatus will be referred to as "of the kind described".

Apparatus of the kind described is referred to in Swiss Patent Specification No. 543,781. In this specification, a cylindrical plastics material sleeve is utilised, which has a fixedly inset base which is located at the top during the boring operation. The base is perforated to allow of the escape of the air trapped upon penetration of the sample core, and has a smooth wall. These smooth-walled sleeves closed off at one end by the base must have a comparatively thick wall in order to be sufficiently stable in shape during storage and carriage, and their space requirement is considerable. Cylindrical cover caps which are attachable are incorporated to close off the soil samples present in the sleeve; these cover caps also require comparatively great space during storage and carriage.

It is an object of the invention to remove or minimise these shortcomings in an uncomplicated manner.

Accordingly, the invention consists in earth-boring apparatus of the kind described wherein the sleeve is open at both ends and is formed from thin-gauge plastics material foil whereby it may be pressed flat temporarily for storage and carriage purposes and may be expanded again to a round cross-section upon being inserted into the drill pipe, and wherein two cover caps having tapering attachment skirts are provided to close off the open ends of the sleeve. The two cover caps may be identical, and advantageously a plurality of axially parallel fold lines is distributed evenly along the sleeve periphery, to give the sleeve a polygonal cross-section.

Such sleeves may be manufactured easily, e.g. by longitudinal folding of a flat pre-cut panel, rolling the same up and gluing or welding along an area of overlap. A sleeve envelope of this kind may be pressed more or less flat at two mutually diametrically opposed fold lines for carriage or storage purposes, and be opened out again into a round sleeve for use. The deformation or pronounced fold along two generatrixes produced by lightly pressing the same flat, may be smoothed again manually so that, upon being inserted into the drill tube, the sleeve automatically assumes the required round shape. The numerous fold lines furthermore establish a particular reinforcement of the sleeve, so that the latter may easily be produced from a slightly thinner foil than the existing smooth-walled sleeve. The two cover caps for the polygonal sleeve envelope are not placed over the sleeve ends until the sleeve envelope containing the soil sample is removed from the drill tube; they are appropriately lightly tapered which not only assures a firm seat on the sleeve envelope but also space-saving stacking by nesting the cover caps in each other for storage and carriage purposes.

Advantageously moreover the drilling operation may be carried out with several drill tubes passing telescopically one through another, sleeves of correspondingly smaller diameter being allocated to the innermost drill tube penetrating more deeply. It is thereby possible to take soil samples down to a depth of a few metres in sections corresponding to the sleeve length of approximately 25 ms; since it is precisely in such cases that a great number of sleeves is needed, the said polygonal sleeves which may be carried and stored in space-saving manner, and the cover caps co-ordinated with these, offer special advantages.

It was found that soil samples may be taken down to a drilling depth of up to several metres by means of earth-boring apparatus of this kind. In this connection, it proved to be particularly advantageous to construct the drill tube in a multisectional telescopic manner, the inner or innermost section, being that which is to be guided to the greatest depth, being located in the adjacent outer tube. This system presupposes however that the core sample sections packed into a corresponding number of sleeve envelopes by means of the external drill tube section are taken first, whereupon this empty external drill tube section is lowered again and then acts as a guide for the inner section with which the deeper soil samples may be taken in correspondingly narrower sample containers. It has now been observed that this method leads to perfect samples only if the withdrawal of the individual samples may be made whilst the drill tube remains in the ground. This is impossible in the case of this conventional positioning of the sample container direct on an inner shoulder formed by a step in the drill tube. This problem is also resolved in the apparatus described in that a cylinder can be inserted into the drill tube to receive the sample container and may be withdrawn from the tube independently of the latter for removal of the sample container by means of an upwardly extending linkage. A system of this kind intended for deeper bores is not only comparatively heavy as such, but also presupposes a comparatively powerful and thus weighty driving motor. In the case of the conventional positioning of the motor co-axially above the drill tube, the heavy motor must be dismantled every time a sample is taken. This problem is also resolved in the apparatus by arranging that the drill tube and the driving mechanism connectible thereto are carried by a saddle plate, the driving motor being situated beside a coupling head connected in co-axial alignment with the drill pipe, and the sample container being withdrawable from the drill pipe without separation between the coupling head and said pipe. This offers a quite substantial

reduction of the period needed to take samples to a greater depth amounting to several metres.

In order that the invention may be more clearly understood, reference will now be made to the accompanying drawings, which show one embodiment thereof by way of example and in which:—

Fig. 1 is an axial section of a drill tube with an inserted sample sleeve in the operating position,

Fig. 2 shows sample sleeve equipped with end caps, in axial section,

Fig. 3 is a cross-section along the line III—III of Fig. 2,

Fig. 4 shows a plan view, of a flattened empty sample sleeve of the kind shown in Figs. 1—3,

Fig. 5 shows a telescopic drill tube in the operating position, in sideview, and

Fig. 6 shows a detail from Fig. 5 in axial section and to an enlarged scale.

Referring now to the drawings, as shown in Fig. 1, a drill tube 1 fitted with hard metal cutters is connected via a coupling head 2, known per se, to the driving spindle 3 of an electric borer which is not illustrated. A sleeve 5 acting as a sample container rests on a bottom shoulder step 4. This sleeve is formed from comparatively thin foil of transparent plastics material. By virtue of a plurality of fold lines 6 extending along generatrixes, the sleeve periphery has a polygonal form largely approximating the cylindrical form. The one end rim of the sleeve 5 is provided with a marking notch 7. The fold lines 6 and the notch 7 may be produced during the same operation whilst cutting out the plane foil section arranged to form the sleeve. This sleeve 5 is provided with two caps 8 of identical shape, having taperingly flared skirts; the caps 8 serve the purpose of subsequently closing off the sleeve 5 containing the sample and removed from the drill tube 1, and are also made from a plastics material; their wall thickness is appreciably greater than that of the sleeve 5, however. The caps are appropriately made in different colours so that the top and bottom of the sample taken may be identified immediately. Since the two caps 8 are not pressed on to the sleeve 5 until after the sample is inserted into the latter, they may be stored and carried in space-saving form whilst nested one into another until the time of application. The sleeves 5 however, which have little morphological stability without the caps, because they are made from thin-gauge foil, may easily be pressed more or less flat by appropriate folding along two diametrical fold lines 6. The space they require for storage and carriage is thus very small. Before use, the sleeve 5 is restored to approximately round shape by light pressure on the fold lines (arrows *a* in Fig. 4) and smoothing of these fold lines if applicable. Since its periphery corresponds precisely to that of the drill tube volume, it adapts itself automatically to this cylindrical internal outline upon being inserted into the drill tube.

A particularly advantageous embodiment of a mechanism for removal by charges of soil samples down to greater depths, is shown in Figs. 5 and 6. The system comprises a three-legged frame. having legs 10 joined at the top, via rotatable pivot pins 11, to a bearing plate 12. The bearing plate 12 has a central opening and fitted to it is a cable pulley 13*a*, another cable pulley 13*b* and a cable drum 13*c* being secured on one of the three legs 10. The cable end projecting through the central opening of the bearing plate 12 carries a hook 14. The boring apparatus described in the following is suspended from this hood 14 by means of three cable loops 15. The cable loops 15 act on an anchoring plate 16 above whose central opening 16*a* the bottom delimiting ring 17*a* of a bearing case 17 is centred and carried. A hollow shaft 19 is journalled by means of ball bearings 18 in the case 17 comprising a delimiting ring 17*b* at the top. Above the delimiting ring 17*b*, the upper hollow shaft extremity bears a belt pulley 20*a* which is coupled via a belt 21 to a belt pulley 20*b*, which is borne on the transmission shaft 24 which is coupled via a taper 22 to the driving spindle of the borer 23. The transmission shaft 24 journalled in a case 26 by means of ball bearings 25 is arranged parallel to the hollow shaft 19; both bearing cases 17, 26 are mounted on a common saddle plate 27 which is provided with laterally projecting handles 28. The pulleys 20*a*, 20*b* and belt 21 forming a reduction gear are covered by a belt shield 29 secured on the case 17. In the connector pipe 19*a* projecting downwards through the anchoring plate 16 are present two angle slots 30 for engagement of driving pins 31 whereby the drill tube 32*a* in operation at the time is coupled to the hollow shaft 19 acting as a coupling head and consequently to the motor 23 via the transmission. In the present case, two telescopic drill tubes 32*a*, 32*b* are incorporated, the diametrically larger drill tube 32 already having described its drilling trajectory according to Fig. 5, and being disconnected from the hollow shaft 19 whilst temporarily remaining in the ground, whereas the inner drill tube 32*a* is shown in its operating position coupled to the hollow shaft 19. The two drill tubes are otherwise identical. Above their appropriately exchangeable annular bit 33, they have an internal shoulder 34 on which is supported a cylindrical probe 36. The sample container 35 which is open at both ends and in this case too is formed from a thin transparent plastics material foil, is inserted into this probe 36. As described with reference to Figs. 1 to 4, this sleeve 35 may also have a polygonal shape by pre-folding. In view of small wall thickness, it may however also be pressed more or less flat for storage and carriage purposes even without such fold lines, without incurring damage. The probe 36 containing the sample container 35 is fastened on an upwardly projecting rod 37 the upper extremity end of which projects beyond the belt shield 29 and is provided with a screw-thread and carries a handle 39 which is axially adjustable and fixable by means of a nut 38. This handle is covered by a cowling 40 which is removably secured on the case 17 together with the belt shield 29. This cowling 40 acts as a stop for the

handle 39 and thus allows of axial immobilisation of the rod 37 bearing on the drill tube shoulder 34 via the probe 36. The hollow shaft 19 and an opening aligned with it in the belt shield 29 are also so dimensioned that after removal of the cowling 40, the rod 37 together with the probe 36 and the soil sample received in the sample container 35 may be withdrawn upwards by means of the handle 40. A removal or uncoupling of the laterally positioned motor 23 from the hollow shaft 19 or the drill tube, is unnecessary to this end. Due to the application of a probe 36 separate from the drill pipe for reception of the sample container, the individual samples needed to reach the drilling depth obtainable with the drill tube in question may be withdrawn consecutively, without the drill tube having to be pulled up every time. The terminal portions of the samples taken in each case are thereby left wholly intact, so that a sample core undamaged throughout the drilling depth may be taken despite taking individual samples by charges. On the other hand, the borer unit as a whole may be raised by means of the cable hoist, so that the drill tube may be lifted out of the borehole whilst it rotates. Due to the perfectly centred suspension of the boring mechanism on the cable hoist or winch of the three-legged frame, the borehole wall is hardly damaged whilst doing so. Boreholes produced in this manner may consequently be utilised as permanent check bores, e.g. for monitoring ground water, by insertion of lining pipes corresponding to the drill tubes used.

CLAIMS

1. Earth-boring apparatus of the kind described, wherein the sleeve is open at both ends and is formed from thin-gauge plastics material foil whereby it may be pressed flat temporarily for storage and carriage purposes and may be expanded again to a round cross-section upon being inserted into the drill pipe, and wherein two cover caps having tapering attachment skirts are provided to close off the open ends of the sleeve.

2. Apparatus as claimed in claim 1, the sleeve exhibits a plurality of axially parallel fold lines evenly distributed along its periphery, whereby a polygonal cross-section is imparted to the sleeve.

3. Apparatus as claimed in claim 1 or 2, wherein a marking notch is provided at one end of the sleeve.

4. Apparatus as claimed in claim 1, 2 or 3 wherein the upper end of the drill tube is releasably connected to a hollow shaft acting as a coupling head, which is coupled via a transmission means to a driving motor positioned axially parallel with lateral spacing therefrom, the bearing case of the hollow shaft and the bearing case of the transmission shaft co-axial with respect to the motor spindle, being mounted on a common saddle plate.

5. Apparatus as claimed in claim 4, wherein at least two drill tubes passing one through another telescopically are incorporated for consecutive sample taking in different depth sections.

6. Apparatus as claimed in claim 4 or 5, wherein a cylindrical probe to receive the sample sleeve and which is withdrawable from the drill tube whilst the latter remains in the ground, by means of a linkage extending upwards through the drill tube and the hollow shaft, is supportable on an internal shoulder of the drill tube.

7. Apparatus as claimed in claim 6, wherein the upper end of the rod has a handle adjustable by means of a screw-thread, a removable cowling acting as a stop for the handle for the purpose of axial immobilisation of the probe on the drill tube shoulder.

8. Apparatus as claimed in claim 4, 5, 6 or 7, wherein the case of the hollow shaft is centrally supported with respect to the central opening of an anchor plate, which anchor plate is suspended from a hook of a cable winch by means of cable loops, said winch being carried on a three-legged frame.

9. Earth-boring apparatus substantially as hereinbefore described with reference to the accompanying drawings.

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