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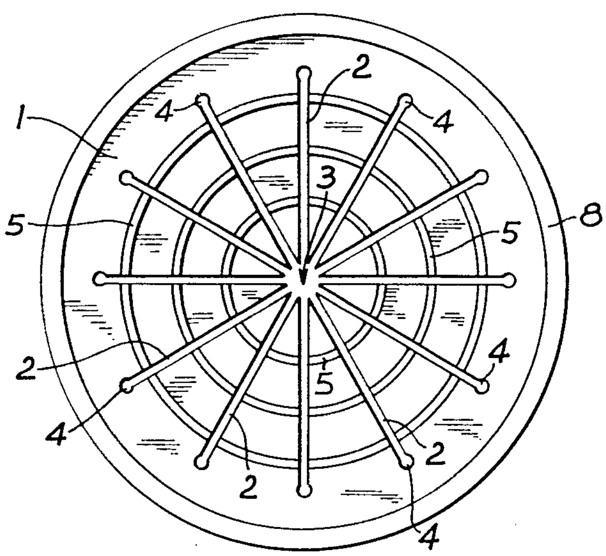
(54) Geotechnical device.

(57) A geotechnical device, which among other purposes is useful for sampling soil or rock in percussive boring or rotary drilling operations, comprises a one-piece, normally flat member (1) of resilient material, having a continuous circular circumference and having at least one projection extending from said circumference towards or beyond its centre. In one preferred form the device comprises a circular disc (1) of resilient material, having at least three radial cuts or slots (2) extending from the centre of the disc towards its circumference and having one or more concentric ribs (5) between the centre (3) of the disc and the radially outer limit (4) of the cuts or slots (2).



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GEOTECHNICAL DEVICE

The present invention is a device having a wide range of applications in the field of geotechnology. In particular, it is of value as a fitting associated with the drilling string in percussive boring and rotary drilling operations, especially for sampling soil or rock cores.

When hollow cutting shoes or bits are used in boring or drilling to obtain soil or rock samples for the purpose of establishing the nature of a soil or rock succession, the removal of a sample from its underground location is an unreliable operation, depending upon frictional retention of the sample within the cutting shoe or bit. In a significant percentage of borings or drillings, when the drill string is withdrawn to the surface it is discovered that no sample has been retained. One aim of my invention is therefore to provide a device by means of which a positive pick-up of samples is achieved.

The geotechnical device according to my invention comprises a one-piece, normally flat member of resilient material, having a continuous circular circumference and having at least one projection extending from said circumference towards or beyond its centre.

The device may be made of a wide range of different materials, including the resilient synthetic plastics materials such as polypropylene and polyurethane, and natural and synthetic rubber. The particularly preferred material is a polyurethane having a Shore Hardness of 45 to 95. This material represents the best balance in practice between the various factors of price, resilience, strength and durability.

The device may take a variety of forms. Thus it may be in the form of a flat annulus with a single integral projection extending towards or beyond the centre of the annulus or it may be an annulus with two or more projections. The projection or projections may be parallel-sided or may be segments extending only a part of theway or all of the way towards the centre of the device. When the projection or projections are in the form of segments, they preferably individually enclose an angle of not more than 120 degrees.

Preferably, each projection has at least one transverse rib, which is intended to impart additional strength to the projection and which may also serve a further function described hereinafter.

The diameter of the device will depend upon the specific purpose for which it is to be used but, in the case of its use for boring or drilling, is determined by the inside diameter of the body of the cutter; in such a case, the overall diameter of the device preferably exceeds that inside diameter by a small amount. Typically, the device will be between about 1 cm. and about 2 metres in diameter, especially between about 5 cm. and about 40 cm., for example about 12.5 cm. in diameter.

The thickness of the device depends upon its diameter, the length of the projections, the material of which it is made and the purpose for which it is to be used, among other factors. In general, the smaller its diameter and the shorter the projections, the thinner it can be. Typically, the device may be 1.5 mm to 6.0 mm. or more in thickness, which thickness may in turn be effectively increased by ribs of height between 0.5 and 1.5 mm.

In a particularly preferred form of my device, it comprises a circular disc of resilient material, having at least three radial cuts extending from the centre of the disc towards its circumference, and having one or more concentric ribs lying between the centre of the disc and the radially outer limit of said radial cuts. The number of radial cuts in the disc is preferably at least four, but advantageously is higher than this and may be as high as fortyeight, for example. Particularly good results are obtained when the number of cuts is between about six and about twentyfour. In one preferred form, the disc has twelve radial cuts. It will be understood that the effect of the cuts is to divide the disc into a like number of flexible, resilient segments, joined together at their circumference.

Although I have used the word "cuts" to describe the radial features which separate the disc segments, I would explain that it is not necessary that those features be formed by cutting. One convenient way of making the disc is by molding, in which case the "cuts" are an integral feature of the disc.

The cuts preferably extend a major proportion of the distance from the centre of the disc to its circumference, that is they are preferably at least 50 per cent of the disc radius in length. More preferably, they are equal to between 65 and 90 per cent of the disc radius.

The disc, as stated, has one or more concentric ribs lying between the disc centre and the radially outer limit of the radial cuts. The number of such ribs is determined by various factors including the thickness of the disc, the strength and flexibility of the disc material and the diameter of the disc. Typically, between two and thirty or more such ribs, especially between two and ten ribs, are provided.

The ribs may be of any desired cross-sectional profile since as indicated one of their fuctions is to impart strength to the projection or projections. Thus they may be of rounded or angular profile. However, it has been found to be particularly advantageous if the ribs are of inwardly-inclined saw-tooth profile, that is if each rib cross-section is in the shape of an inverted "V", with the point thereof generally towards the centre of the disc or other circular device.

The operation of the disc is rendered much more effective if means are provided to hold its outer edge. For example, if the edge of the disc is clamped between annular metal members, distortion of the disc in use is limited to those areas, namely the flexible segments, where it is desired that it should occur. In a preferred form of my invention, the edge of the disc is held between abutting surfaces or a pair of axially aligned cylindrical members. Alternatively, in another form of my invention, the edge of the disc is provided with one or more upstanding projections, which engage in a complementary recess in the cutter body or shoe or bit and thereby retain the disc against distortion.

In use of my invention, the flexible segments distort to allow a body, for example a cylindrical sample of soil or rock, to pass axially through the disc but the resilience of the disc material ensures that the segments close in on the sides of the body or, in the case of a body of finite length, behind the body. Movement of the body in the reverse direction is rendered very difficult by the resilience of the segments and the disc therefore acts in the manner of a one-way valve. This effect is significantly enhanced if the ribs are of saw-tooth section as described above. By virtue of this effect, in the case of a sample of soil or clay for example, the material is retained positively within the cutting shoe or bit and is not, as has heretofore been the case, dependent upon friction against the inside of the shoe or bit to ensure its retention.

The sample-retaining effect of the device according to my invention may be further enhanced by using two or more such devices in axially-aligned series. Thus, in the case of an elongated sample, the sample is thereby gripped at two or more points along its length. Furthermore, in the case of a typical layered sample, the layering is securely retained undisturbed.

In a further form of my invention, the sample-retaining device (or devices) is fitted over a ball-race. In this way, the disc may rotate or remain stationary as may be appropriate to the circumstances. Thus, in the case of rotary drilling, when the sample has been taken and is subsequently to be withdrawn, the disc may remain still while the drill itself is rotated during the withdrawing step.

As yet a further optional feature of my invention, when the device is in use for percussive boring for example, a "chute" may be formed within the upper end of the cutter body so as to divert material which passes through the cutter out at an angle through an aperture in the side of the cutter body. In this way, a layered sample entering the body through the cutting head may pass continuously through the body and out through the side aperture, preserving discontinuities in the stratum.

My invention will now be further described with reference to the accompanying drawings, in which:-

Fig. 1 is a plan view from below of a disc according to my invention; and

Fig. 2 is a sectional view of the disc of Fig. 1, retained in position in a cutting head.

In the drawings, the disc illustrated is made of polyurethane of Shore Hardness approximately 55 and is intended for use when drilling through relatively soft clay. For stiffer clay, material of Shore Hardness about 90 is preferred.

The disc, indicated by the numeral 1, has twelve radial cuts 2 which extend about 80 per cent of the distance from the centre of the disc towards its circumference. The disc centre is apertured at 3 and the radially outer ends of the cuts 2 each has a small circular hole 4 associated with it. Three concentric circular ribs 5 project from the underside of the disc 1 and intersect the cuts 2. The ribs 5 are of saw-tooth profile, as shown in Fig. 2, having a generally vertical face 5a nearer to the centre of the disc and an inclined face 5b further therefrom.

In use, the disc 1 is disposed between two axially aligned cylindrical members identified as the cutting shoe 6 and the cutter body 7 respectively. A peripheral shoulder 8 on the disc 1 seats in a correspondingly shaped recess 9 in the cutting shoe. The cutting shoe 6 has machined cutting faces 10 and 11 by means of which the drill cuts its way into the ground under exploration. The cutting shoe 6 and cutter body 7 are secured together by means of a quick-release square screw thread 12, the abutting faces of which are tapered to form a secondary locking mechanism. Thus, when the components 6 and 7 are screwed tightly together, the disc 1 is securely gripped at its edge and no major distortion is possible.

Clay entering the lower end of the cutting shoe through the aperture 13 pushes against the resilient disc 1 and passes through the disc into the main cutter body 7. The disc 1, aided by the ribs 5, effectively prevents the clay from leaving the cutter via the aperture 13 and thereby positive pick-up of a sample is assured.

My geotechnical device has been described above specifically in the context of clay cutting. However, it has numerous other geotechnical uses which derive chiefly from its one-way action. Using discs of different characteristics within the broad ranges specified above, it may be used for retrieving cores of soil in undisturbed condition and for recovering subterranean rock samples. It also offers the opportunity for recovering lost drilling tools from the bottom of deep drill-holes, in both on-shore and off-shore locations.

CLAIMS

1. A geotechnical device characterised in that it comprises a one-piece, normally flat member of resilient material, having a continuous circular circumference and having at least one projection extending from said circumference towards or beyond its centre.

2. A geotechnical device according to claim 1, characterised in that it is made of a synthetic plastics material or of natural or synthetic rubber.

3. A geotechnical device according to claim 2, characterised in that it is made of polypropylene or polyurethane.

4. A geotechnical device according to claim 3, characterised in that it is made of a polyurethane having a Shore Hardness of 45 to 95.

5. A geotechnical device according to any of the preceding claims, characterised in that it comprises a flat annulus with two or more projections.

6. A geotechnical device according to claim 5, characterised in that it comprises a circular disc having at least three radial cuts extending from the centre of the disc towards its circumference.

7. A geotechnical device according to claim 6, characterised by between about six and about twentyfour radial cuts.

8. A geotechnical device according to claim 6 or claim 7, characterised in that said cuts are each equal to between 65 and 90 per cent of the disc radius in length.

9. A geotechnical device according to any of the preceding claims, characterised by at least one transverse rib on each projection.

10. A geotechnical device according to claim 9, characterised by between two and thirty concentric ribs disposed between the centre of the device and the radially outer limit of the projections.

11. A geotechnical device according to claim 9 or claim 10, characterised in that the rib or ribs are of saw-tooth profile, inclined towards the centre of the device.

12. A geotechnical device according to any of the preceding claims, characterised in that it is clamped between annular metal members.

13. A geotechnical device according to claim 12, characterised in that the edge thereof is held between abutting surfaces of a pair of axially aligned cylindrical members.

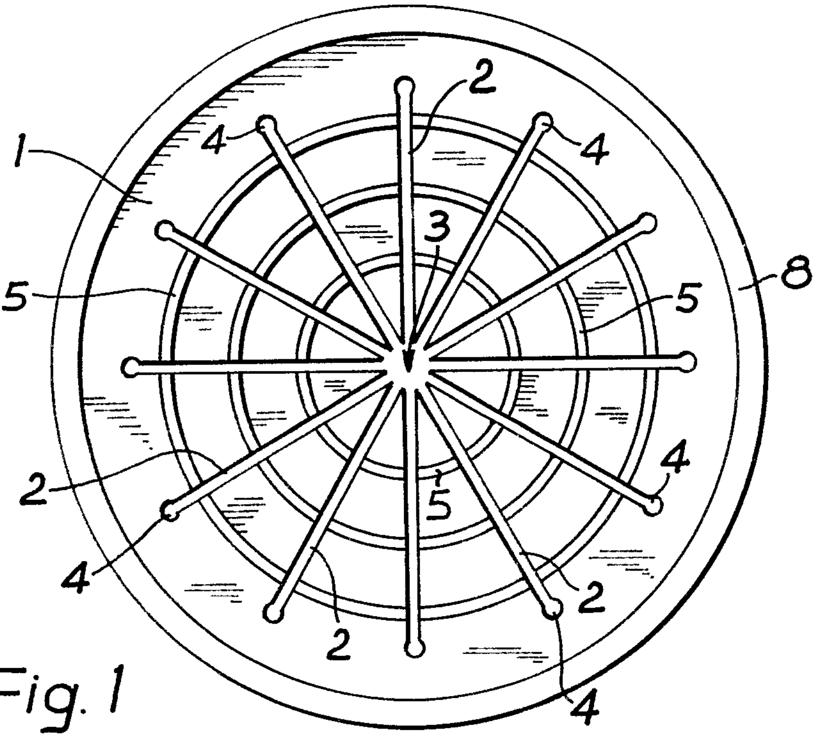

Fig. 1

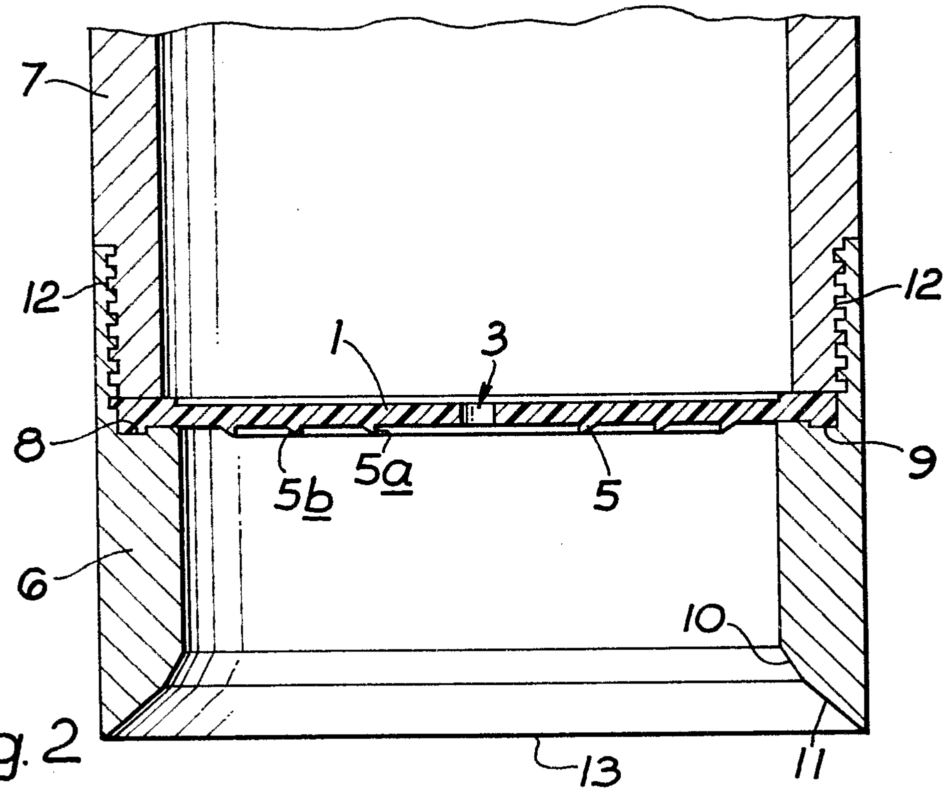

Fig. 2