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(12) # EUROPEAN PATENT APPLICATION

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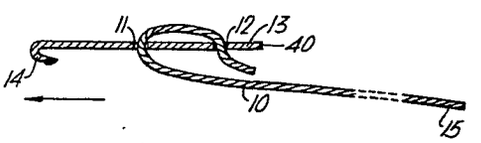
(54) **Staking or anchoring objects to the ground.**

(57) The object is connected to one end (13) of a flexible line (10), engaging either the other end (15) of the line (10) or an anchoring member (13 or 50) attached to the other end (15) of the line with a mechanical driving tool (16, 17, 18), forcibly driving the tool (16, 17, 18) into the ground until a predetermined length of the line (10) is embedded below ground level, disengaging the tool (16, 17, 18) from the line (10) or from the anchoring member (13 or 50), and extracting the tool (16, 17, 18) from the ground.



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IMPROVEMENTS RELATING TO THE STAKING OR ANCHORING OF OBJECTS TO THE GROUND

A known method of preventing erosion of the sea-bed around the feet of structures such as oil rigs is to plant a bed of artificial reeds or fronds around the feet. Such beds can also be planted in coastal waters to prevent erosion of the coast by creating artificial sandbank barriers, or by stabilising existing sandbanks.

In general the fronds or reeds are first secured at spaced intervals to a matting, and this matting is then staked to the sea-bed. However, the matting is expensive, and a further problem with this system has been that of underwater currents producing vortices around the edges of the matting which progressively erode the sand from beneath the matting. The matting can then be subjected to a considerable lifting force which is difficult to control and which may eventually overcome the retention force of the stakes.

A similar problem arises when staking anti-erosion matting to the beds or banks of canals.

In this case the constant down draw of water as ships pass up and down the canal can produce considerable viscous drag on the matting. Conventional methods of staking the matting using stakes or piles manufactured from wood, plastics or metal provide a limited retention force which is not always sufficient to counter this drag.

Higher retention forces can be obtained by using screw anchors but these are difficult to insert and at least in certain soils can be pulled out of the ground if a lifting force is applied directly along the line of the screw.

In accordance with the present invention there is provided a method of staking or anchoring an object to the ground characterized in that the method comprises connecting the object to one end of a flexible line, engaging the other end of the line with a mechanical driving tool, forcibly driving the tool into the ground until a predetermined length of the line is embedded below ground level, disengaging the tool from the line, and extracting the tool from the ground.

By means of the invention, artificial fronds may be anchored individually in the sea-bed without the need for matting. The invention is also capable of

achieving higher retention forces than conventional stakes, piles or screw anchors, and is therefore of wide application.

In its simplest form the anchor line may comprise a synthetic web or strap which is bent, folded, looped or otherwise deformed at one end to provide a tool-engaging surface. The tool-engaging surface may be formed, for example, by knotting the end of the web or strap to provide a cup or loop which not only receives the driving tool but also acts as a ground anchor for the anchor line. This can provide a retention force in the region of 150 kilogrammes, which is adequate for anchoring a single frond. If the web or strap includes thermoplastic or thermosetting materials, the cup or loop can be completed by bonding together overlapping portions of the web or strap using heat and pressure. Similarly, a single end loop can be divided into two equal loops projecting either side of the line, and each of these two side loops can then be compressed and bonded by applying heat and pressure to provide a pair of wing flaps.

To achieve higher retention forces, however, the end of the anchor line is provided with at least one anchoring member at least a portion of which is

pivotable between a first position offering minimum resistance to movement of the line through the ground and a second position transverse to the first position. The anchoring member is then maintained in its first position while being driven into the ground, but is automatically rotated to its second position as soon as the tool is removed and a lifting force is applied to the line. The anchoring member may comprise, for example, a separate plate attached to the end of the line and provided with a tool-engaging surface. For higher retention forces it may comprise a stake having at least one pair of opposed blades, each blade being pivotable between a first closed position lying generally parallel to the stake and a second open position extending outwardly from the stake.

The other end of the anchor line can be secured to the object being staked by means of a tie-knot or in any other convenient manner. In this case, when secured to an object such as a frond, the line may be driven sufficiently into the ground for the tie-knot to provide an additional anchoring effect just below the surface of the sea-bed.

The driving tool will generally include an elongate shaft with a shaped head for engaging

the tool-engaging surface and for penetrating the ground.

The driving force may be applied, for example, by a pneumatic or hydraulic hammer, or it may be applied manually. In the latter case, penetration of the driving tool into the ground is preferably facilitated by directing a jet of pressurized liquid into the ground in advance of the driving tool. In particular, the pressurized liquid may be fed through the driving tool itself and ejected from nozzles provided in the head of the tool.

By way of example only, an embodiment of the invention will now be described with reference to the accompanying drawings, in which:-

Fig. 1 is a cross-section through an anchoring assembly,

Fig. 2 is a plan view of the anchoring plate in the assembly of Fig. 1,

Fig. 3 is a side view of a driving tool for use with the assembly of Fig. 1,

Fig. 4 is a side view of a coupling for coupling the tool of Fig. 3 to a pneumatic hammer,

Fig. 5 is a sectional view on the line A-A of Fig. 4,

Fig. 6 is a side elevation view of one component of the coupling,

Fig. 7 is a diagrammatic plan view of an alternative driving tool for use with the assembly of Fig. 1,

Fig. 8 is a front elevational view of an alternative anchoring member providing a higher retention force, and

Fig. 9 is a side elevation of the anchoring member of Fig. 8

Referring first to Figs. 1 and 2, a flexible anchor line 10 in the form of a synthetic web or strap is threaded through the slots 11 and 12 of an anchor plate 13. The web or strap 10 may consist, for example, of a polyester fibre encased in alkathene.

The plate 13 includes a hook 14 which, in use, is engaged by a driving tool so that the plate 13 and strap 10 can be power driven into the ground (in the direction shown by the arrow) with the strap 10 lying substantially parallel to the plate 13 as shown in Fig. 1.

When the plate 13 and a length of the strap are embedded in the ground to a depth of between 1 and 3 metres (depending on the composition of the soil and the required retention force), the driving tool is extracted. If the strap 10 is then pulled in the reverse direction in an attempt to lift the plate 13 out of the ground, the reaction force on the end face 40 and the lifting force applied to the line combine to provide a moment tending to rotate

the plate anti-clockwise (as viewed in Fig. 1) until it eventually reaches a position transverse to the line. In this position the force required to pull the plate 13 out of the ground is substantially increased. It has been found that, with a 10 cm. plate, such a system can provide a retention force of up to 600 kilogrammes, this being greater than the tensile strength of the strap 10. Moreover, the full anchoring effect is obtained immediately the tool is removed, and there is virtually no reverse movement of the anchor strap once it has been anchored.

The free end 15 of the strap 10 is secured in any desired manner to the object being staked or anchored. This may be done either before or after the anchor plate 13 is driven into the ground. In particular, the end 15 may be secured to a single bundle of fronds when planting a bed of fronds in the sea-bed. Alternatively, the end 15 might be attached at spaced intervals to the wires or ropes threaded through the discrete blocks of a flexible concrete mat used for lining the banks of waterways, canals, embankments and shorelines. A particular advantage of the latter application is that the straps 10, when embedded in the bank, provide ties which reinforce and hold together the bank soil.

Moreover such mats are normally secured by means of screw anchors, the time required to secure each anchor being in the region of 10 to 15 mins. In contrast, the anchor of Fig. 1 can be secured in about 3 seconds.

The driving tool illustrated in Fig. 3 is for use with a pneumatic hammer. It consists of a solid metal rod 16 having a flattened end 17 which engages behind the hook 14 of the anchor plate 13 (Fig. 1). The other end of the rod 16 is formed with a square-section solid block 18. To secure the tool to the anvil of a pneumatic hammer, the block 18 is inserted into one end of the bore 19 of a box-section coupling member 20. The other end of the bore 19 receives the hammer anvil so that blows imparted to the anvil by a reciprocating hammer are transmitted to the block 18. The tool is retained in the coupling 20 by means of a retaining member 22 (Fig. 6) held in place by a split pin 21 (Fig. 5). For clarity, the retaining member 22 has been omitted from Fig. 5 but, as illustrated in Figs. 4 and 6, it consists of a cross-piece 24 connected to a pair of upstanding spaced apart pins 25 by a flat plate 23. The cross-piece 24 engages behind a pair of flanges 27 depending from the coupling member, while the two pins 25 receive

the rod 16 and locate behind the block 18 at the end of the rod.

The alternative driving tool illustrated in Fig. 7 consists simply of a hollow tube 30 with a handle 31 and with a cross-piece 32 containing three jet nozzles 33. Bracing struts 34 are also provided. In use, the cross-piece 32 engages behind the hook 14 of the anchor plate 13 (Fig. 1), and high pressure water is fed into the tube 30 from a high pressure line 35. The resulting jets of water emerge in the direction shown by the arrows and cut away the soil immediately in front of the anchor plate as the anchor plate is manually pushed into the ground by pressing on the handle 31.

For even higher retention forces, as required for example when anchoring objects such as radio masts or mobile homes, the flexible anchor line may be attached to an anchoring member such as that illustrated in Figs. 8 and 9.

The anchoring member of Figs. 8 and 9 consists essentially of a stake 50 in the form of a solid metal bar pointed at one end. A pair of eyes 51 are welded to the stake for attachment to the flexible anchor line. In addition, a pair of opposed blades 52 are pivotably mounted on respective pins 53

extending between a pair of metal plates 54 welded to opposing faces of the stake. The blades 52 are curved and can pivot from the closed position shown in full outline in Fig. 8 to the open or extended position shown in dashed outline. When in their closed position, the blades are inclined at about 5^{o} to the stake and therefore offer minimum resistance to movement of the stake through the ground. The stake is preferably driven into the ground to a depth of at least 3 metres using an electrically controlled hydraulically actuated percussive hammer and a driving tool similar to that illustrated in Figs. 3 to 6 except that the blade 17 is replaced by a socket capable of receiving the top end of the stake 50.

CLAIMS:

1. A method of staking or anchoring an object to the ground characterized in that the method comprises connecting the object to one end of a flexible line, engaging the other end of the line with a mechanical driving tool, forcibly driving the tool into the ground until a predetermined length of the line is embedded below ground level, disengaging the tool from the line, and extracting the tool from the ground.

2. A method according to claim 1 in which the flexible line comprises a web or strap, the web or strap being bent, folded, looped or otherwise deformed at one end to provide a tool-engaging surface.

3. A method according to claim 2 in which the deformed end of the strap or web includes a cup or loop for receiving the driving tool.

4. A method of staking or anchoring an object to the ground characterized in that the method comprises connecting the object to one end of a flexible line; securing an anchoring member to the other end of the line, at least a portion of the anchoring member

being pivotable between a first position offering minimum resistance to movement of the member through the ground and a second position transverse to the first position; engaging the anchoring member with a mechanical driving tool, forcibly driving the tool into the ground with the anchoring member or the said portion of the anchoring member in its first position until a predetermined length of the line is embedded below ground level; disengaging the tool from the anchoring member; and extracting the tool from the ground; whereby a lifting force subsequently applied to the line rotates the anchoring member or the said portion of the anchoring member into its second position to resist extraction of the anchoring member from the ground.

5. A method according to claim 4 in which the anchoring member comprises a generally flat plate provided with a tool-engaging surface.

6. A method according to claim 5 in which the flexible line comprises a web or strap, and the plate includes a slot for receiving the web or strap.

7. A method according to claim 4 in which the anchoring member comprises a stake having at least

two opposing blades, each blade being pivotable between a closed position lying generally parallel to the stake and an open position extending outwardly from the stake.

8. An anchor for anchoring an object to the ground, the anchor comprising an anchoring device attached or formed at one end of a flexible anchor line, the device including a tool-engaging surface engageable with a tool for driving the device into the ground; and the arrangement being such that, in use, at least a portion of the device adopts a first orientation relative to the line when being driven into the ground and a second orientation when a lifting force is subsequently applied to the line, the first orientation offering less resistance to movement of the device through the ground than the second orientation.

9. An anchor for anchoring an object to the ground, the anchor comprising; an anchoring member attached to one end of a flexible anchor line, the anchoring

member being engageable with a driving tool for driving the member into the ground, and at least a portion of the anchoring member being pivotable between a first position offering minimum resistance to the passage of the anchoring member through the ground and a second position offering a substantially greater resistance, the arrangement being such that, in use, the member or the said portion of the member adopts its first position when being driven into the ground and is automatically pivoted to its second position when the member is embedded in the ground and a lifting force is applied to the anchor line.

10. An anchor according to claim 9 in which the anchoring member comprises a stake having at least one pair of opposed blades, each blade being pivotably mounted on the stake for movement between a closed position lying generally parallel to the stake and an open position extending outwardly from the stake.

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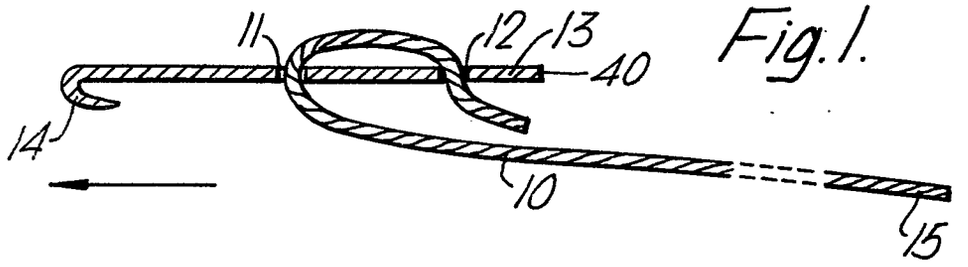

Fig. 1.

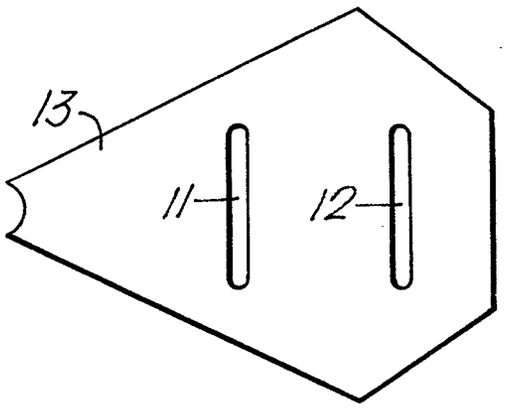

Fig. 2.

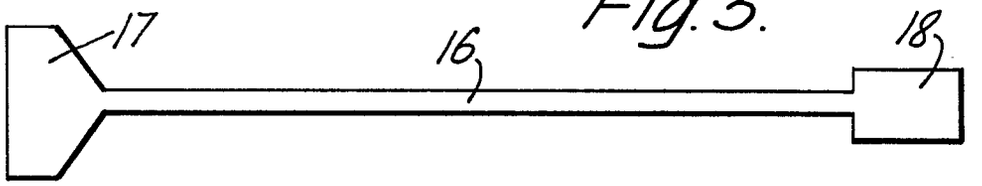

Fig. 3.

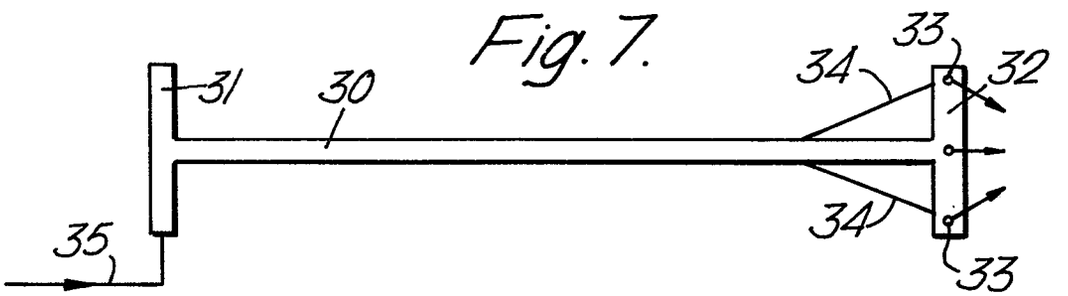

Fig. 7.

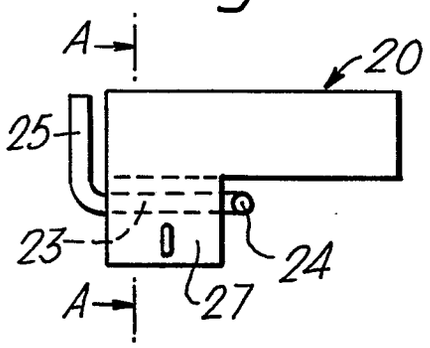

Fig. 4.

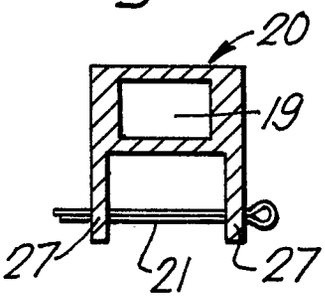

Fig. 5.

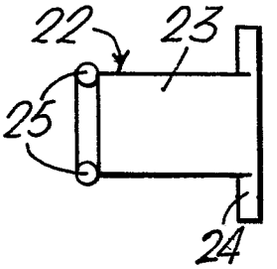

Fig. 6.

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Fig. 8.

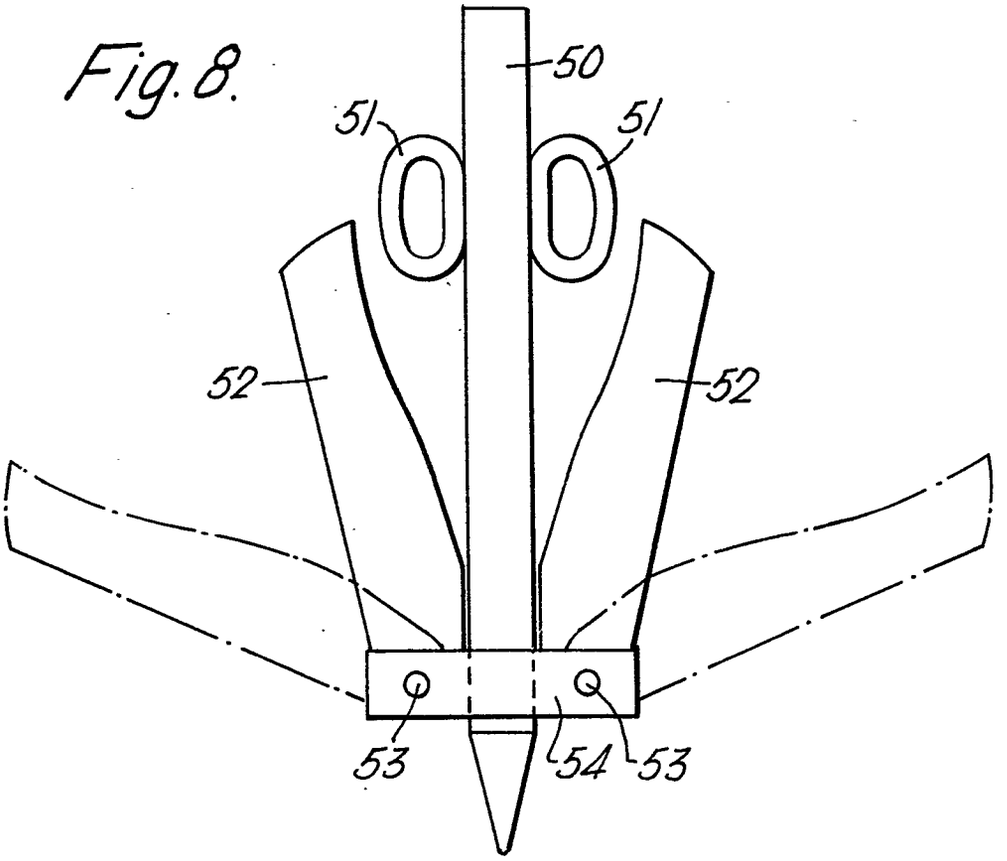
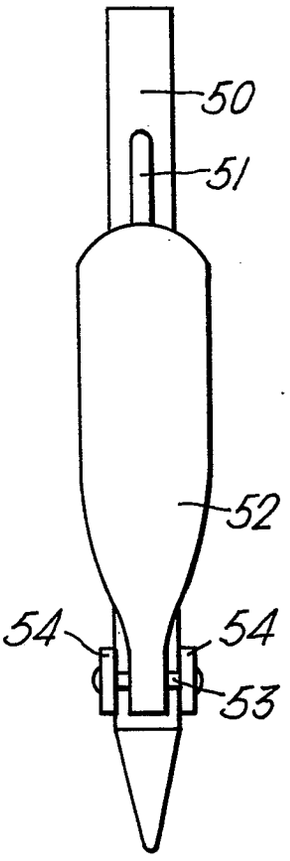


Fig. 9.



European Patent Office

EUROPEAN SEARCH REPORT

0046382
Application number
EP 81 30 3708

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
X	US - A - 2 340 447 (ALKEN) * page 1 - right-hand column, lines 15-50; page 2, left-hand column, lines 9-44, 56-61, 70-75; page 2, right-hand column, lines 1-10; figures 1,2,4,5,6 * --	1,2,3, 4,5,6, 7,8,9, 10
X	US - A - 4 003 169 (YOUNG) * column 2, lines 26-37, 60-68; column 3, lines 23-42; column 4, lines 5-24, 37-48; column 5, lines 46-60, 65-68; column 6, lines 1-11, 42-47; figures 1 to 5 * --	1,2,3, 4,5,6, 8,9
X	FR - A - 2 031 804 (MENARD) * page 2, lines 18-40; page 3, lines 1-21; figures 1 to 6 * --	1,4,5, 6,8,9
X	FR - A - 673 138 (TERZOLI) * page 1, lines 1-16, 45-62; page 2, lines 1-22; figures 1 to 4 * -----	1,4,5, 6,8,9

CLASSIFICATION OF THE APPLICATION (Int. Cl.³)

E 02 D 5/80

TECHNICAL FIELDS SEARCHED (Int. Cl.³)

E 02 D
E 04 H

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	04-11-1981	HUYMBE[illegible]

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