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**Description**

This invention relates to an anchor comprising a fluke, a twin shank which is fixedly connected to the fluke and is V-shaped in end view whereby the shank legs, which are each of a wide flat shape, lie in planes which have their intersecting line at the shank top at the anchor shackle eye diverging rearwardly from the fluke axis, and rear stabilizers in the form of upstanding inclined ear plates at the side corners at the rear end of the fluke.

In a prior anchor of this type, which is disclosed in Dutch patent application 7115016, the shank legs, of plate shape, have their horizontal describing lines, considered in each intersecting horizontal plane, diverging to the rear at a substantial angle, which has the disadvantage that, considered in projection perpendicular to the direction in which the fluke penetrates into the soil, they present a substantial surface area offering much resistance which impedes the deep penetration.

Moreover, the stabilizer ear plates of said prior anchor are upwardly and rearwardly inclined, which causes the soil flow at the trailing rear end of the fluke to pass above it tending to force this trailing end down so that in reaction the fluke tip at the leading front end of the fluke would be tipped up each time, and as a result the fluke would penetrate hobblingly on an unsteady only superficial course which could hardly extend to any substantial depth so that an increase of the holding power of the anchor by a deep penetration cannot be realized with the prior anchor.

All said disadvantages are obviated with the anchor of the present invention.

The invention provides an anchor wherein the planes in which the shank legs lie, have their intersecting line substantially parallel to or slightly diverging rearwardly from the fluke axis, and wherein the diverging angle of the shank legs, considered in each intersecting horizontal plane, is in the range of 0° to 9°, so that a tunnel passage of substantially constant or slightly increasing cross-sectional area is defined between the shank legs above the fluke, through which, when penetrating, the soil is to be displaced glidingly, whereby, to keep the anchor on its penetrating course, the stabilizer ear plates are upwardly inclined in the forward direction at an angle with respect to the plane of the fluke.

When the anchor penetrates, the soil can glidingly pass through the tunnel defined between the shank legs, which offers only little passage resistance. Particularly also at the top, just below the anchor shackle eye where the shank legs meet, the soil may now readily pass whereas with said prior anchor at that location an effect strongly impeding penetration occurs, since there the intersecting line between the shank legs, where they meet, does not extend parallel to the fluke but is directed at an angle causing much resistance.

The tunnel passage between the shank legs of the anchor of the present invention is quite unobstructed indeed and the purpose of the aspect that it may have a slight divergence of a few degrees to the rear, as outlined, is to avoid clogging as the soil has a tendency when passing through the tunnel under some pressure to break up in smaller particles which occupy more space, which increasing space is made available by the slight divergence.

The penetrating course of the anchor is effectively maintained by the stabilizer ear plates at the rear side corners of the fluke, each standing at a forwardly and upwardly opening vertical angle $\alpha$ so that the soil flow passes down below it thus giving uplift to maintain the penetration on a steady course, as well as offering little resistance to the penetration which can extend to a substantial depth to deeply bury the anchor so as to highly promote its holding capacity. Preferably the angle $\alpha$ at which the stabilizer ear plates stand with respect to the fluke and parallel to the fluke axis is from 15° to 55°, dependent upon the type of soil, while the angle $\beta$ at which the stabilizer ear plates are inclined perpendicular to the fluke axis is from 0° to 38°. This form of stabilizer presents a proper stabilizing action but much less resistance than the stabilizers used in the prior anchor which are placed at an angle opening upwardly and rearwardly with respect to the fluke.

The anchor can be used in practically any type of soil as preferably the shank is detachable and adjustable at angles from 28° to 50° for hard and soft soil.

As a matter of interest it is observed that in Dutch patent application 7608728 a prior anchor type is disclosed, having a twin shank with its shank legs having substantially diverging lines of intersection with horizontal planes offering much resistance and impeding an unobstructed tunneled flow of soil. In the Dutch patent 168768 issued upon this Dutch application the shank legs are drawn as being convergent to the rear, but again presenting a substantial surface area in projection perpendicular to the direction in which the fluke penetrates, with much resistance to impede the deep penetration.

The invention is described in more detail in the following specification with reference to the drawing wherein illustrative embodiments of the invention are represented.

Figure 1 is a perspective schematic view of the new anchor with V-shaped twin shank, in which particularly the good passage of the soil at penetration of the anchor is illustrated;

Figure 2a—f show some applicable stabilizer configurations;

Figure 3a, b show a stabilizer, the position of which can be adjusted by means of a sensor;

Figure 4a—e show the even better penetration of an anchor with a precutter relative to the anchor without precutter as illustrated in Figure 4f;

Figure 5a—e are schematic views of a number of anchors, based on the novel principle, whereas Figure 5f clearly shows the penetration soil tunnel through the anchor of Figure 5a; and

In Figure 1 an anchor 1 with V-shaped twin shank is illustrated, the shank legs 2, 2 of which are positioned at an angle to be determined, dependent upon the type of soil, with respect to the fluke 3, which angle is approximately 28° for hard soil and approximately 50° for soft soil.

The invention relates to the position in which the shank legs 2, 2 are placed with respect to each other on the fluke 3, which position is chosen so that when digging-in the soil experiences little resistance and passes slidingly between the shank legs as through a tunnel, as depicted in Figure 1 with the passing lump of soil 4, so that the anchor 1 can penetrate deeply into the ground. To that end the shank legs 2, 2 are situated in planes 5, 5 which have an intersecting line 7 parallel to the fluke axis 6, which intersecting line 7 is partially imaginary, at 7', but at the location of the anchor eye 8, where the shank legs 2, 2, meet at the top, is also partially real, as indicated by 7". Thus the soil 4 can readily pass slidingly between the shank legs 2, 2 as far as the top, whereas in the prior anchors with V-shaped twin shank, particularly at the top where the shank legs at their meeting point cause an impeding effect, during penetration a high resistance was experienced so that a deep penetration could not be reached.

A ruling requirement for the position of the shank legs 2, 2 is therefore to be defined so that the line 9 of each of the shank legs, parallel to the fluke 3, considered in projection on the fluke, averaged along the height of the shank, makes an angle of no more than 0° + 9° with the fluke axis 6, which angle preferably decreases from below to above, but reckoned along the height of the shank can also be fully or partially constant. Above 30% of the shank height reckoned from the fluke it is anyway better to satisfy the requirement and to remain within the limit value of from 0° up to 9° as the soil 4 can in fact more readily pass the wider passage between the shank legs 2, 2 near the bottom than through the narrow passage near the top, i.e. under the anchor eye 8, where the anchor shackle 10 is hooked through, and where in the prior anchors with V-shaped twin shank a strong impeding action, exerting much resistance, is always developed.

It is observed that the holding force of the novel anchor is defined by the product of the fluke surface area and the penetration. The penetration is a third power root function of the holding force and therefore quite strongly influences the holding force.

Contrary thereto, in the known anchor as described in the foregoing, it is intended that the shank legs should also provide a holding force so that penetration is strongly counteracted and the overall holding force cannot be optimal.

The anchor 1 as illustrated in Figure 1 has stabilizers 11, 11 at the rear corners of the fluke 3, which due to their arrangement and plate structure offer practically no obstruction against penetration but give the anchor at the rear lower side an uplift, so that the penetration position is maintained as long as possible.

In Figure 1 an outwardly and forwardly inclined stabilizer 11 is represented which, measured parallel to the fluke axis, is inclined with respect to the fluke 3 at an angle α of 15°—55° and perpendicular to the fluke axis at an angle β of 0°—38°.

Figure 2a—f show suitable stabilizers 11 and 11' which are also arranged at the stated angles α and β. The outwardly and forwardly upwardly extending inclined position of the stabilizer 11 or 11' appears to be more satisfactory than the rearwardly bent-back inclined position which is used in the aforementioned known anchor.

The stabilizer (which due to its arrangement and its plate structure gives practically no obstruction against penetration) also gives the anchor an uplift at the rear lower side so that the penetration position is maintained as long as possible.

A small adjustable obstruction surface, mounted transversely on the fluke between the shank legs, can suddenly stop the anchor when reaching the desired holding force.

The stabilizer can be constructed in various ways. In Figure 2a the section ABCD of the fluke is tipped up about the axis AB at an angle α in plane ABEF, thus giving an upwardly directed force in the side, and thereby stability.

If the anchor is pulled away obliquely, for instance in the direction AF as indicated in Figure 2a, then the pyramid $ACEE_1$ in Figure 2b will be filled with soil, thus forming a proper surface to restore the stability of the anchor. This fillable section $ACEE_1$ is replaced in Figure 2b by a plate $ACE_1$. The stabilizer 11 of Figure 2c will not be more effective than that of Figure 2b as $ACE_1$ does not add stability in the direction of penetration.

In Figure 2d AC is shifted to $A_1C$, thus achieving $A_1A_2E_1C$. In practice this is refined by shifting shaded surfaces to $A_1B_1E_1C$ as illustrated in the stabilizer 11' in Figure 2e and also in Figure 1. All the described shapes are stabilizing, the plate being bent-up forwardly about the fluke edge $A_1C$. A stabilization surface bent-down about AC as shown in Figure 2f can also provide the required uplift on the lower side.

Figure 3 shows a form of stabilizer 11" adapted to pivot about the fluke edge 12 and dirigible by a sensor-operated actuation element 13. The sensor 13 is adapted to be controlled by a force or motion in the pulling line 14 to adjust the position of the stabilizer 11" which is pivoted on the fluke 3, and thus exert more or less resistance and thereby control the developed holding force. The tensile force in line 14 can then be limited to prevent rupture of the line.

The illustrated stabilizer 11" has at the leading side an uplift promoting edge as indicated in Figure 3a with a detailed sectional view.

Until now stabilizers were always fixedly provided with respect to the pivotal fluke.

The action of stabilizers in general is that they give resistance at penetration. This means that if the anchor tends to rotate along the longitudinal axis, the stabilizer which has the greatest penetra-

tion will also meet the greatest upwardly directed force so that the anchor will be balanced again.

The stabilizers are often round and give great resistance against penetration, thus causing considerable loss in holding force, since a deeply penetrated anchor gives the greatest holding force.

The invention tends to provide a stabilizer which causes as little resistance as possible when penetrating and which in the condition that the anchor gets in a continuous slip, gives as little resistance as possible.

An additional advantage is that the stabilizer (like the aileron of an aircraft wing) tends to direct the total fluke downwardly so that the penetration movement will again be maintained as long as possible.

If the stabilizer were mounted on the fluke at a greater angle, it can be said that thereby the penetration resistance would be increased, for the pressure which the stabilizer exerts downwardly on the soil, may increase infinitely, as the soil cannot move away downwardly.

It is thus possible to control the penetration depth, and thereby the holding force, by increasing or decreasing the angle of the stabilizer.

Greater penetration, greater holding force demands as small an angle of the stabilizer as possible.

Less penetration, less holding force is achieved by means of a greater angle of the stabilizer.

The angle of the stabilizer may be influenced by means of a:

i. a) hydraulic cylinder,
b) air-operated cylinder,
c) wedge either or not pushed in or out hydraulically or by means of air,
d) electric motor;

the media mentioned under i) can be controlled

ii. a) by a strain gauge in the anchor shackle,
b) by a pressure plate on the fluke,
c) by a lever which is pushed back-over,
d) radiographically or
e) during positioning and pulling-in the anchor from a ship by electric operation.

The great advantage of such holding force adjustment is that the chain (which has a price that is a multiple of the price of the anchor) instead of having a safety factor of two, can be used at a much lower safety factor, since at a preset load the anchor will slip, which will thus provide a quite considerable saving in preventing breakage and loss of the chain.

Furthermore at a maximum required holding force the stabilizer can be positioned so that no resistance at all is experienced when penetrating, but now a sensor mechanism will have to be built in, which responds to rotation. Thus if the anchor rises at the left wing, the angle of the right-hand stabilizer will have to be increased and upon reaching balance the minimum angle is reset.

Slip can also be controlled since the wedge of soil between the fluke and the shank, remains substantially the same in cross-section; thus a relatively small obstruction may stop the entire wedge movement, so the holding force is suddenly increased and the slip — i.e. the forward movement of the anchor — will stop.

An obstruction plate can be influenced by the above factors i. *a* through *c* and ii. *a* through *c* as well as by an auxiliary anchor rearwardly of the anchor which activates the obstruction plate through a wire when the maximum slip is reached.

Figure 4a—e show an anchor 1 with a precutter 15 and give an illustration of the deeper penetration action which is exerted, as compared to an anchor without precutter as illustrated in Figure 4f.

Figure 4a and 4b show the anchor 1 and the precutter 15 collapsed when raised, and Figure 4c through 4e show the unfolding and digging-in. Due to the precutter 15 in Figure 4e a deeper final penetration position is reached than the anchor without precutter (Figure) 4f can achieve.

The precutter 15 consists of a knife-shaped forerunner with a streamline plate 16 arranged at its rear, which enhances the onflow to the anchor shackle 10.

By the use of a precutter the holding force can be doubled.

Besides the function of penetration, the precutter 15 fulfills yet another important task. Because the anchor 1 can readily be pulled out from the shackle 10, a chaser 17 can be successfully applied. To that end immediately ahead of the streamline plate 16 a recess 18 is made, in which the chaser 17 is caught to so exert a vertical force on the shackle 10 to break out the anchor. Now upon break-out of the anchor when the ship sails away, the anchor will tip from below against the precutter and lock the chaser (Figure 4a). The anchor will then move through the water upside down, with the precutter 15 between the two fluke tips, with the chain 14 or cable in stable condition. If the operating tugboat stops and the wire 19 (pennant wire) is paid out again while the chain is tensioned the anchor automatically arrives in the right starting position (Figure 4b ff.).

Figure 5a—e schematically represents a number of anchors according to the invention.

Figure 5a shows an anchor with shank legs which are detachable and adjustable at various angles with respect to the fluke, for hard and soft soil, respectively. For soft soil the lashing plates 20, 20 are removed, or another bolt row is used.

Figures 5b and c show a shank with wide shank legs 2, 2 of constant width on which one or more cable eyes 8 are arranged, and Figures 5d and e show an anchor 1 provided with one or more auxiliary flukes 21, 21 arranged on the shank 2, 2.

In Figure 5f the tunnel passage for the soil through the anchor of Figure 5a is depicted, which tunnel formation under the circumstances stands foremost for all the anchor embodiments as here represented.

**Claims**

1. An anchor comprising a fluke, a twin shank

which is fixedly connected to the fluke and is V-shaped in end view whereby the shank legs (2), which are each of a wide flat shape, lie in planes which have their intersecting line at the shank top at the anchor shackle eye (8) diverging rearwardly from the fluke axis, and rear stabilizers in the form of upstanding inclined ear plates (11) at the side corners at the rear end of the fluke, characterized in that the planes (5) in which the shank legs (2) lie, have their intersecting line (7, 7', 7") substantially parallel to or slightly diverging rearwardly from the fluke axis (6), and wherein the diverging angle of the shank legs (2), considered in each intersecting horizontal plane, is in the range of 0° to 9°, so that a tunnel passage of substantially constant or slightly increasing cross-sectional area is defined between the shank legs (2) above the fluke (3), through which, when penetrating, the soil (4) is to be displaced glidingly, whereby, to keep the anchor (1) on its penetrating course, the stabilizer ear plates (11) are upwardly inclined in the forward direction at an angle α with respect to the plane of the fluke.

2. An anchor according to claim 1, wherein the angle α at which the stabilizer ear plates (11) stand with respect to the fluke (3) and parallel to the fluke axis (6) is from 15° to 55°, dependent upon the type of soil (4), while the angle β at which the stabilizer ear plates (11) are inclined perpendicular to the fluke axis (6) is from 0° to 38°.

3. An anchor according to claim 1 or 2, wherein the shank (2) is detachable and adjustable at angles from 28° to 50° for hard and soft soil (4).

**Patentansprüche**

1. Ein Anker mit einer Flunke, einem Doppelt-schaft der fest mit der Flunke verbunden und in Endansicht V-förmig ist, wobei die Schaftschenkel (2) die je von einer breiten flachen Form sind, in Ebenen liegen, die ihre Schnittlinie am Schafttopp am Ankerschakenauge (8) rückwärts divergierend von der Flunkenachse haben, und mit rückwärtigen Stabilisatoren in der Form von hochstehenden geneigten Ohrplatten (11) an den Seitenecken am rückwärtigen Ende der Flunke, dadurch gekennzeichnet, dass die Schnittlinie (7, 7', 7") der Ebenen (5) in welchen die Schaftschenkel (2) liegen, im wesentlichen parallel ist zu oder einigermassen rückwärts divergiert von der Flunkenachse (6), und wobei der divergierende Winkel der Schaftschenkel (2), in jeder schneidenden Horizontalebene gesehen, im Bereich zwischen 0° und 9° liegt, sodass ein Tunneldurchgang von im wesentlichen konstanter oder einigermassen zunehmender Durchschnittsfläche zwischen den Schaftschenkeln (2) über die Flunke (3) begrenzt wird, wodurch beim Penetrieren die Erde (4) gleitend zu versetzen ist, wobei, damit der Anker (11) in seinem penetrierenden Kurs gehalten wird, die Stabilisatorohrplatten (11) in Vorwärtsrichtung aufwärts geneigt sind unter einem Winkel α bezüglich der Flunkenebene.

2. Ein Anker nach Anspruch 1, wobei der Winkel α unter welchem die Stabilisatorohrplatten (11) bezüglich der Flunke (3) und parallel zur Flunkenachse (6) stehen, abhängig der Art von Erde (4), im Bereich von 15° zu 55° liegt, während der Winkel β unter welchem die Stabilisatorohrplatten (11) senkrecht zur Flunkenachse (6) geneigt sind, im Bereich von 0° bis 38° liegt.

3. Ein Anker nach Anspruch 1 oder 2, wobei der Schaft (2) lösbar und einstellbar ist unter Winkeln von 28° bis 50° für harte und weiche Erde (4).

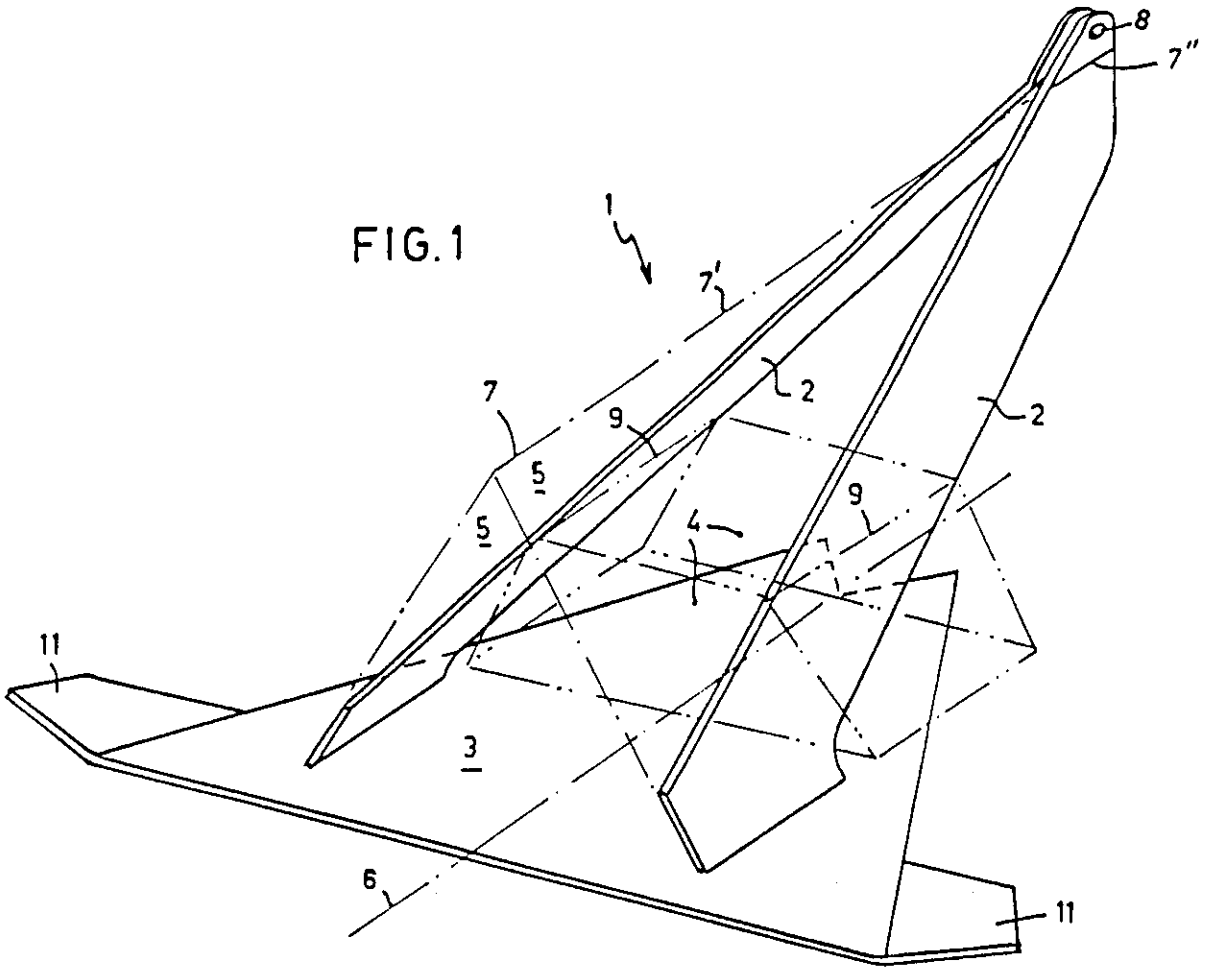
**Revendications**

1. Ancre comprenant une patte, une verge double raccordée de manière fixe à la patte et ayant une forme en V en vue de bout, si bien que les branches (2) de la verge qui ont chacune une forme large et plate, se trouvent dans des plans ayant une droite d'intersection à la partie supérieure de la verge au niveau de l'oeillet (8) de la manille de l'ancre divergeant vers l'arrière à partir de l'axe de la patte, et des stabilisateurs arrière sous forme de plaques (11) inclinées vers le haut, placées aux coins latéraux de l'extrémité arrière de la patte, caractérisée en ce que les plans (5) contenant les branches (2) de la verge ont leur intersection (7; 7', 7") sensiblement parallèle à l'axe (6) de la patte ou divergeant légèrement vers l'arrière à partir de cet axe, et l'angle de divergence des branches (2) de la verge, dans chaque plan horizontal d'intersection, est compris entre 0 et 9° si bien qu'un passage en forme de tunnel de section sensiblement constante ou légèrement croissante est délimité entre les branches (2) au-dessus de la patte (3), les matières du sol (4) se déplaçant en glissant dans ce tunnel lors de la pénétration si bien que les plaques stabilisatrices (11) sont inclinées vers le haut et vers l'avant suivant un angle α par rapport au plan de la patte de manière que l'ancre (1) soint maintenue sur sa trajectoire de pénétration.

2. Ancre selon la revendication 1, dans laquelle l'angle α des plaques stabilisatrices (11) par rapport à la patte (3) et parallèlement à l'axe (6) de la patte est compris entre 15 et 55° suicant la nature du sol (4), alors que l'angle β des plaques stabilisatrices (11) perpendiculairement à l'axe (6) de la patte est compris entre 0 et 38°.

3. Ancre selon l'une des revendications 1 et 2, dans laquelle la verge (2) est amovible et réglable à des angles compris entre 28 et 50° correspondant à un sol dur et à un sol tendre (4).

FIG.1



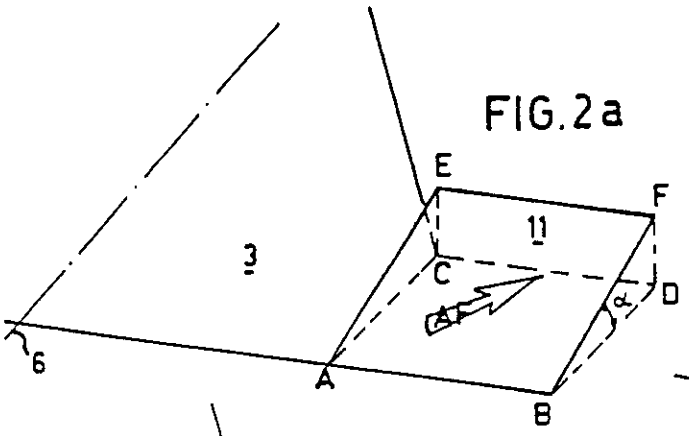



FIG. 2a

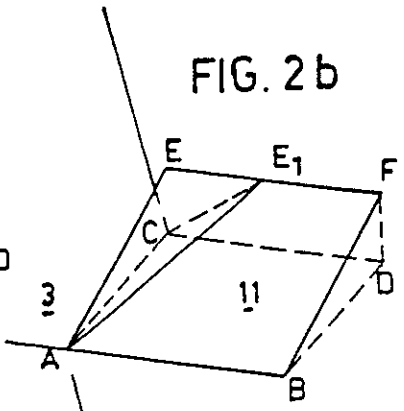



FIG. 2b

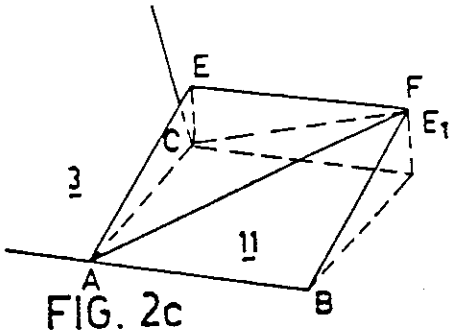



FIG. 2c

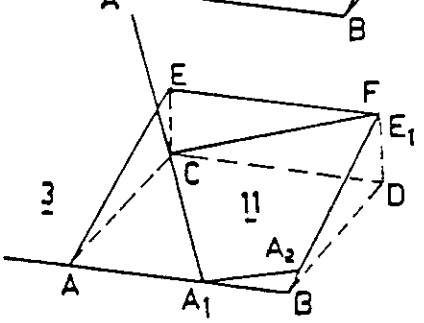



FIG. 2d

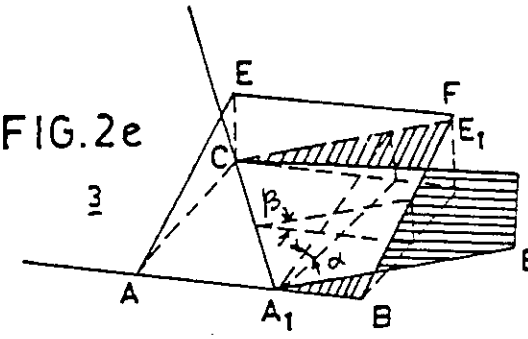



FIG. 2e

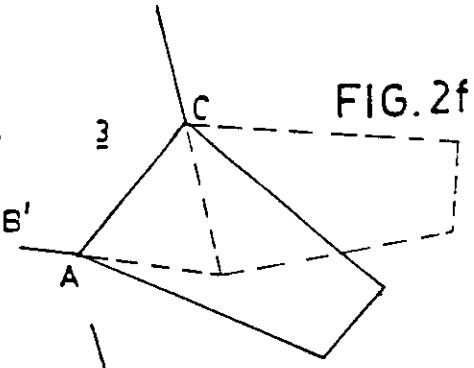



FIG. 2f

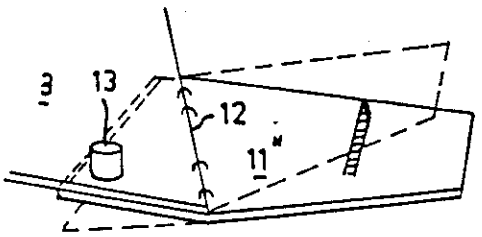



FIG. 3a

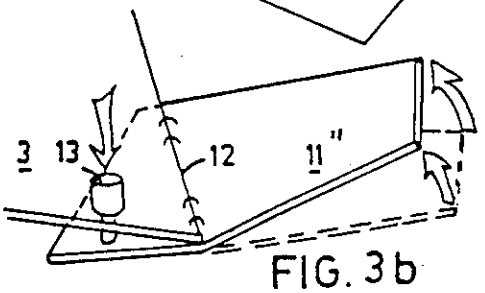



FIG. 3b

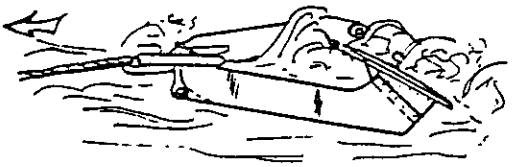


FIG. 4a

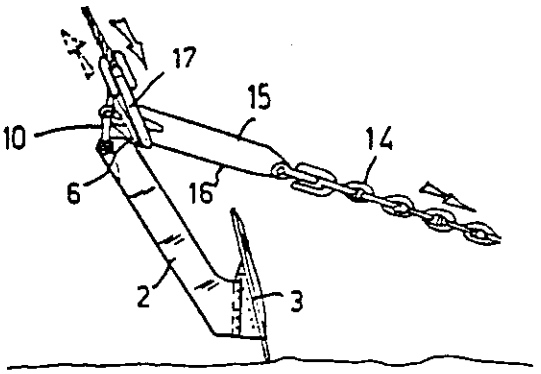



FIG. 4b

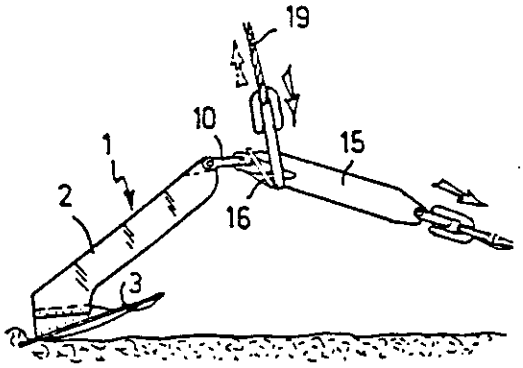



FIG. 4c

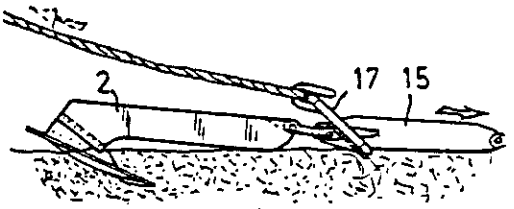



FIG. 4d

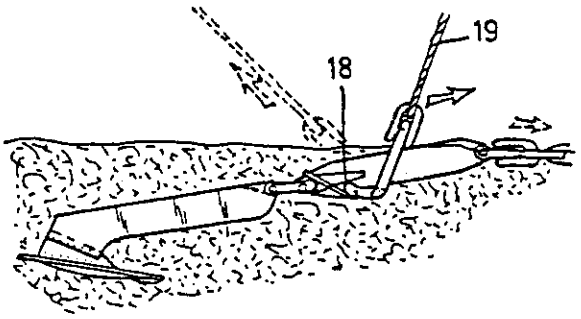



FIG. 4e

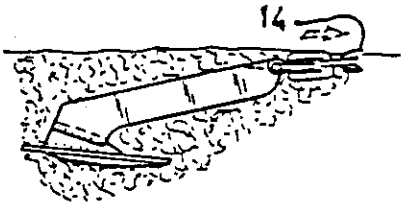



FIG. 4f

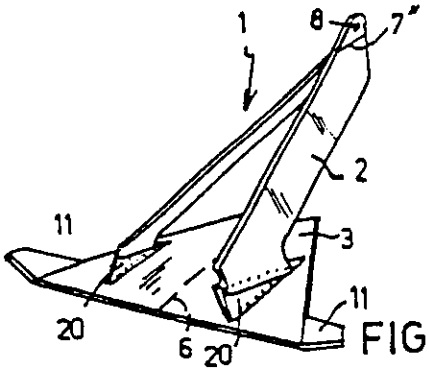



FIG.5a

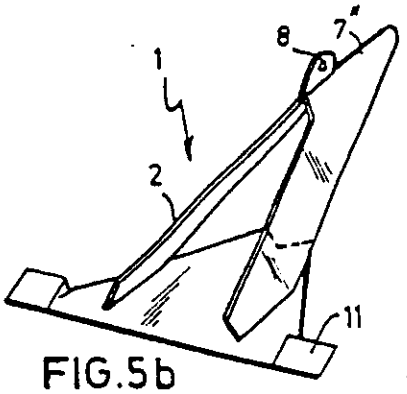



FIG.5b

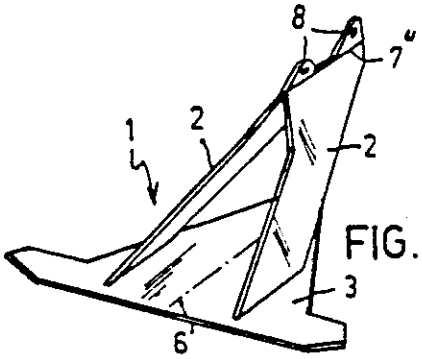



FIG.5c

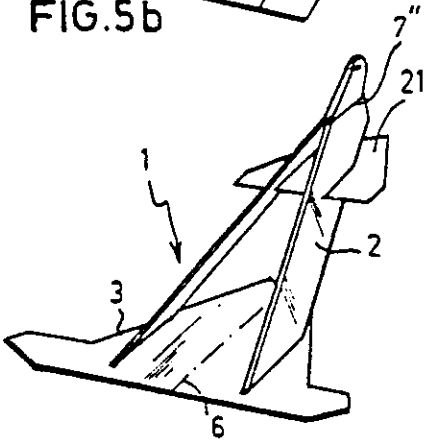



FIG.5d

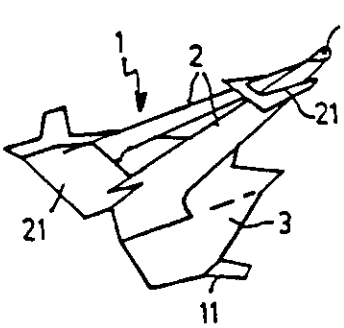



FIG.5e

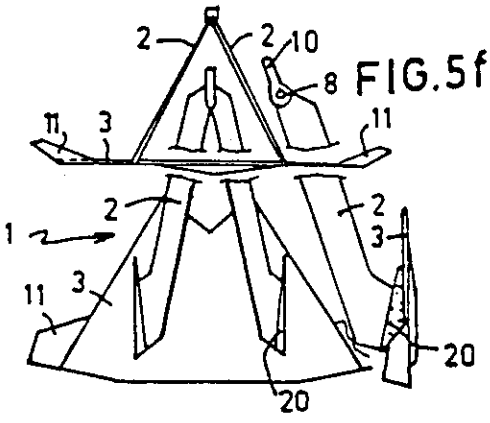



FIG.5f

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