PATENT SPECIFICATION

(11) 1356259

1356259

(21) Application No. 40976/70 (22) Filed 26 Aug. 1970
(23) Complete Specification filed 23 Aug. 1971
(44) Complete Specification published 12 June 1974
(51) International Classification B63B 21/26
(51) Index at acceptance
B7S 31A1 31E 31F

(19)



(54) ANCHORS

(71) I, PETER BRUCE, of British nationality, of 10 Torphichen Place, Edinburgh EH3 8DU, Scotland, Great Britain, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to an anchor for mooring an object to a mooring bed; for example, for mooring a vessel or other floating body such as a drilling rig to the sea bed; the anchor being substantially symmetrically disposed about a fore-and-aft plane orientated substantially vertically in a working burial attitude of the anchor and including: at least one burial surface located on at least one fluke member which in a final working burial attitude of the anchor is inclined relative to the horizontal to be penetrable into the mooring bed whereby forces are developed by the burial surface to cause burial of the anchor; and a shank member adapted at a foremost extremity to form a cable attachment point and linked to the fluke member such that the cable attachment point is located substantially in the said plane of symmetry and spaced therein from the fluke member. Such an anchor is hereinafter referred to as an anchor if the type aforesaid.

By the expression "working burial attitude" is meant that attitude of the anchor wherein the fore-and-aft plane of symmetry of the anchor is vertical and the burial fluke member lies below the shank member and is inclined to the horizontal whereby horizontal movement of the anchor in a particulate mooring bed causes the fluke member to produce burial forces tending to bury the anchor.

The word "cable" used hereinafter includes wire hawser, chain cable, natural or synthetic fibre rope and the like.

By the term "centre of pressure" on a body as used hereinafter is means the point of action of the resultant of all thrusts on the body.

It is known that the greater the depth of penetration of an anchor below the surface of a mooring bed, the greater the pull on the cable it will resist. To utilise this fact, an anchor will advantageously have the following characteristics: (1) orientating to a ground engaging working burial attitude on being cast on the mooring bed surface and dragged by its cable, if the initial attitude on the bed is not a working burial attitude: (2) penetrating through the surface of the mooring bed while remaining stable in a burial attitude: and (3) remaining stable while fully buried and penetrating deeply below the mooring bed surface.

An object of the present invention is to provide anchors which are stable when dragged in the working burial attitude and which are capable of developing high holding pulls.

According to one aspect of the present invention, an anchor of the type aforesaid includes at least one elongate transverse member attached to the shank member and/or fluke member and having two elongate surfaces substantially curved lengthwise and disposed one at each side of the said plane of symmetry of the anchor, said elongate surfaces together being symmetrical about the said plane of symmetry, and arranged such that a point moving on a medial line of one of said elongate surfaces can increase in separation from the cable attachment point while simultaneously decreasing in separation from the centre of area of the fluke member whereby when a portion of an elongate surface is in penetrative engagement with the mooring bed and the anchor is dragged over and relative thereto by a pull in the cable, forces are generated between the elongate member and the mooring bed which roll the anchor to a final working burial attitude wherein the fluke member engages the mooring bed, the arrangement being such that when the anchor is on the mooring bed and not already lying fluke member downwards in a final working burial attitude a substantially horizontal pull from the cable tends to tilt the anchor to bring a

[Price 25p]

Price 33p

portion of the said elongate surface into engagement with the mooring bed.

According to a second aspect of the present invention an anchor of the type aforeside includes at least one elongate transverse member providing two stabilizing surfaces disposed one at each side of the said plane of symmetry of the anchor, the shank being attached to the rear of the fluke member and said stabilizing surfaces together being symmetrical about the said plane of symmetry such that the resultant force vector produced by the stabilizing surface lying at either side of the said plane of symmetry due to undisturned relative movement of the mooring bed material incident at an angle to the stabilizing surface lies on a straight line which intersects the said plane of symmetry at a point aft and above a straight line containing the cable attachment point and the centre of area of the fluke member when the anchor is in a final working burial attitude whereby any rotation of the anchor about the said straight line through the cable attachment point due to a disturbing force arising when the stabilizing surfaces are buried causes an inequality between the magnitude of the resultant force vectors produced by the stabilizing surfaces and so causes a turning moment to be established about the said straight line containing the cable attachment point acting in a direction in opposition to the direction of the rotation caused by the disturbing force.

Embodiments of the present invention will now be described by way of example with reference to the accompanying drawings wherein:

Figs. 1 to 5 show perspective views of different embodiments of the present invention;

Fig. 6 shows schematically a side elevational view of the anchor of Fig. 1 and indicates the geometry of the anchor; and

Fig. 7 shows a schematic plan view of the anchor of Fig. 6.

Referring to Fig. 1, in one embodiment of the present invention, an anchor 1 for mooring a vessel to a mooring bed by a cable includes a shank 2 formed by an elongate bar of generally deep rectangular cross-section bent to form two limbs 2a, 2b, located in a plane of symmetry of the anchor vertically disposed when the anchor is in a final working burial attitude and a single burial fluke 3 of generally triangular or spade shape mounted on the shank 2 having a concave upwards burial surface. A foremost extremity of the bent shank has a circular hole 5 to facilitate attachment of the cable while the other extremity carries the fluke 3 disposed transverse to the plane of symmetry of the anchor. The inside edge of the bent shank 2 is chamfered to assist penetration of the shank 2 into the mooring bed. The line intersection between the working surface of the fluke and the plane of symmetry of the anchor forms an angle β (Fig. 6) with a line containing the centre of the cable attachment hole and the foremost point of the fluke in the range 45° to 75° (or most preferably in the range 60° to 70°). This angle is conveniently designated the "point angle".

The distance S separating the cable attachment hole centre from the foremost point of the burial fluke in the plane of symmetry is designated the "point span" of the anchor and will be used as a reference length hereinafter.

The limb 2a has a length L_1 of 0.90 S to 1.50 S with 1.32 S preferred and the limb 2b has a length L_2 of 0.40 S to 0.80 S with 0.60 S preferred, where both these ranges separation distance D_s between the centre of area C (Fig. 7) of the fluke 3 and the axis of the limb 2a is in the range 0.40 S to 0.80 S with 0.60 S preferred. The projected length P_L of the fluke 3 on the plane of symmetry of the anchor 1 is in the range 0.40 S to 0.80 S with 0.62 S preferred and the maximum width of the fluke 3 is 75 per cent of its said projected length. The angle α (Fig. 7) included between the foremost edges of the fluke 3 is in the range 40° to 80°.

A bar 4 of circular cross-section and forming a closed ellipse is attached to a point on the bottom surface of the fluke 3 situated adjacent to the centre of area C of the fluke 3 and encircles the fluke 3 and limb 2a with the major diameter of the ellipse lying in the plane of symmetry of the anchor. The plane containing the bar 4 is at right angles to the plane of symmetry of the anchor and intersects the axis of limb 2a aft of the cable attachment hole 5 and forms an angle θ in the range 15° to 40° with a straight line containing the centre of the cable attachment hole and the point of attachment of the bar 4 to the bottom surface of the fluke. The major diameter of the bar 4 is of length in the range 0.70 S to 1.30 S with 0.80 S preferred while the minor diameter is of length in the range of 70 to 100 per cent of the length of the major diameter. The cross-sectional diameter of the elongate elliptical bar is in the range 0.015 to .045 S.

In normal operation, the anchor is connected to a vessel by a cable of suitable length. The anchor is dropped onto the mooring bed where it can rest (a) with the point of fluke 3 and the foremost extremity of the shank 2 in contact with the mooring bed surface in a ground engaging attitude or (b) lying with one portion of the bar 4 and the foremost extremity of the shank 2 in contact with the mooring bed surface or (c) lying with one portion of the bar 4 and an aft portion of the shank 2 in contact with the mooring bed surface.

Burial of the anchor 1 occurs convention-

ally for attitude (a). When the anchor is dragged over the mooring bed in attitude (b) the centre of pressure on the ground engaged portion of the bar 4 moves along the bar and in particular substantially along the medial line of the bar to maximise its separation from the hole 5 and causes the anchor to roll on the bar 4 until attitude (a) and its consequence are achieved. When the anchor 1 is dragged over the mooring bed in attitude (c), the centre of pressure on the ground engaged portion of the bar 4 first acts as a tripping point over which the anchor 1 topples to adopt attitude (b) whence, on further dragging, attitude (a) is achieved with consequential burial of the anchor in the mooring bed.

Referring to Fig. 2, in a second embodiment of the present invention, an anchor 1 for mooring a vessel to a mooring bed by a cable includes a shank 2 and fluke construction 3 as described for the first embodiment of the invention. However in this case the bar 4 is discontinuous and forms a semi-circle. The bar 4 is attached to a point on the bottom of the fluke 3 adjacent to the centre of area C of the fluke and curves around each side edge of the fluke 3 in the direction of the shank foremost limb 2a. The radius R (Fig. 2) of the curved bar is 0.30 to 0.65 S with 0.50 S preferred. In this case, the plane containing the bar intersects the axis of limb 2a fore and aft of the hole 5, with the angle θ between the plane of the bar 4 and the straight line containing the centre of hole 5 and the point of attachment of the elongate curved bar to the fluke in the range from 15° forward of the straight line to 60° aft of the straight line subject to the further limitation that the distance between a point on the curved bar 4 and the centre of hole 5 always increases as the point on the bar 4 moves along the bar towards the attachment point between the bar 4 and the fluke 3. A preferred angle for the plane containing the bar 4 is at 45° aft of the straight line containing the centre of hole 5 and the point of attachment of the bar 4 to the fluke 3.

The projection of the extremities of the elongate curved bar 4 onto the plane of symmetry of the anchor lies between the fluke 3 and the outside edge of the limb 2a and is separated from the outside edge of limb 2a by a distance in the range 0.105 to 0.405 to ensure that in an inverse attitude of the anchor with the upper edge of limb 2a lying on the mooring bed surface only one extremity of the bar 4 engages the mooring bed. This encourages immediate functioning of bar 4 to roll the anchor 1 over to bring the fluke 3 into engagement with the mooring bed. The extremities of the modified bar 4 are formed into points to facilitate penetration into the mooring bed.

When the anchor of Fig. 2 is dropped onto a mooring bed it can rest (a) in an attitude identical to attitude (a) of the anchor of Fig. 1 or (b) lying inverted with the outside edge of limb 2a and one extremity of bar 4 in contact with the mooring bed surface or (c) lying with rear portion of shank 2 and one extremity of bar 4 in contact with the mooring bed surface.

When the anchor is dragged over the mooring bed: in attitude (a), burial occurs conventionally; in attitude (b), one extremity of bar 4 penetrates into the mooring bed and the centre of pressure on the buried portion of bar 4 moves along bar 4 to maximise its separation from the centre of hole 5 whereby the anchor 1 is rolled over until attitude (a) and its consequence are achieved; in attitude (c), for a substantially horizontal pull on the cable, the extremity of bar 4 trips the anchor into attitude (b) whence attitude (a) and its consequence are achieved; in attitude (c), for a pull by a cable inclined at a large angle to the horizontal not exceeding 40° one extremity of bar 4 penetrates the mooring bed whereupon the centre of pressure moves as consequent to attitude (b) to roll the anchor over until fluke 3 engages the mooring bed whereupon burial occurs if a sufficient angle of fluke inclination to the horizontal is present.

In a third embodiment of the present invention shown in Fig. 3, an anchor 1 for mooring a vessel to a mooring bed by a cable includes a shank 2, fluke 3, and an elongate elliptical bar construction as described for the first embodiment but in this case the elliptical bar is attached to the outside edge of the limb 2a with the portion of the elliptical bar 4 between the fluke and the minor diameter of the ellipse removed.

The anchor of Fig. 3 operates in a substantially similar manner as that of Fig. 1, except that attitude (b) develops fully into attitude (a) only after fluke 3 engages the mooring bed and commences to bury the anchor.

Since the action of the bar 4 in all the above three embodiments results from the maximal migration of the centre of pressure on the portion of the bar 4 engaging the mooring bed from the hole 5, as a result of dragging the anchor over the mooring bed, it will be evident that the bar 4 will continue in this action until the whole of the bar 4 is buried beneath the mooring bed surface. Thus the bar 4 has two functions, namely: anchor orientation at the mooring bed surface, if the initial attitude has not already brought the fluke 3 into engagement with the mooring bed, and subsequent anchor roll stabilization in a final working burial attitude until the bar 4 is completely buried beneath the mooring bed surface.

Further, the bar 4 will continue to furnish a stabilization effect of reduced magnitude

during deep burial of the anchor 1 below the mooring bed surface in mooring beds wherein the bed material has an appreciable shear strength differential across those vertical intervals intercepted by the bar 4 while moving below the surface of the mooring bed.

To provide satisfactory roll stabilization in mooring beds where such shear strength differentials do not occur, as for example, in beds of saturated clay or very soft mud, a fourth embodiment (Fig. 4) of the present invention is provided wherein an anchor 1 for mooring a vessel to a mooring bed by a cable includes a shank 2, a fluke 3, and an elliptical bar 4 as described for the first embodiment but with the elliptical bar 4 attached to the fluke 3 at a point located aft of the foremost point of the fluke by a distance in the range 0.40 to 0.65 P_L (Fig. 6) and having portions in the form of two curved and tapering plates 6, 7 extending from a point on the bar adjacent an edge of the fluke to a point located approximately adjacent the minor diameter of the elliptical bar 4. The inside surfaces 9, 10 of the curved plates 6, 7, which surfaces constitute stabilizing surfaces of the anchor, lie in an upwardly concave surface of a circular cone axially located in the plane of symmetry of the anchor and convergent aft with a cone convergence angle in the range 0° to 15° with a preferred convergence angle of 5°. But the surface could be of cylindrical form. The maximum fore-and-aft width of each curved plate is adjacent an edge of the fluke and is in the range 0.20 P_L to 0.50 P_L (Fig. 6) with 0.46 P_L preferred. The foremost edge of each plate 6, 7 lies in close parallel alignment with the median line of the inside surface of the bar 4. For minimum roll resistance the surface of fluke 3 is also arranged to lie in a portion of the same circular conical surface as the inner surfaces of the curved plates 6, 7.

In operation of the anchor as shown in Fig. 4, in the event of a disturbance occurring when the anchor is buried in its working burial attitude causing the anchor to roll about its roll axis, which is a straight line containing the centre of hole 5 and the centre of area of fluke 3, one curved plate 6, 7 becomes displaced lower than the other plate and becomes subject to undisturbed relative movement of the mooring bed material over locations on its inner surface which are smaller angles of incidence than those occurring at corresponding locations on the inner surface of the other plate. The resultant force vector from the relatively downwards displaced plate therefore is smaller in magnitude than that from the upwards displaced plate. The moments of the resultant force vectors from the plates 6, 7 about the roll axis of the anchor 1 are consequently unbalanced and a net turning moment is present which acts in a direction such as to oppose the rolling of the anchor 1 and return the anchor to its original working burial attitude. Additionally, the anchor of Fig. 4 has the operational characteristics of the anchor of Fig. 1, the medial line 11 being indicated on the surfaces 9, 10 in Fig. 4.

In the modification shown in Fig. 5, the upper portion of bar 4 is dispensed with to leave solely the curved tapering plates 6, 7 whose dimensions and geometry correspond essentially with the plates 6, 7 of Fig. 4, the bar having a minor diameter in the range 0.80 S to 1.10 S.

However, the extremity portion of each plate 6, 7 departs from the said right circular conical surface such that the outermost half of the median line of the inner surface of each plate 6, 7 forms a straight line tangential to the outermost extremity of a partial ellipse lying in the said conical surface and formed by the innermost half of the said median line. The angle of convergence aft between these extremity portions of the plates 6, 7 measured in a plane parallel to the axis of the right circular conical surface and orthogonal to the plane of symmetry of the anchor increases progressively from the preferred 5° (or other angle from the range 0° to 15°) to an angle not exceeding 110° adjacent the points of the elongate curved plates. This assists the anchor to engage the mooring bed at large angles of inclination of the cable to the horizontal.

The ellipse of the median line of the inner halves of the plates 6, 7 intersects the plane of symmetry of the anchor 1 at a point on the upper surface of fluke 3 lying aft of the fluke point by a distance in the range 0.60 P_L to 0.85 P_L (Fig. 6). The straight line containing the centre of hole 5 and the intersection of the said median line ellipse with the plane of symmetry of the anchor forms an angle with the plane containing the ellipse in the range 10° to 30°. Each fore-and-aft cross-section of the plates 6, 7 and of the fluke 3 is generally wedge shaped with the sharp point foremost and having an included angle in the range 3° to 12° at the sharp foremost point.

Additionally, the angular space enclosed by the rearmost 40 per cent of the limb 2a and the uppermost 65 per cent of the limb 2b may contain a web 8 attached to the shank.

The anchor of Fig. 5 functions similarly as the anchor of Fig. 2 but with the additional function giving the roll stability of the anchor of Fig. 4. Rolling of the anchor 1 about the roll axis, which is the straight line containing the centre of hole 5 and the centre of area of fluke 3, due to a disturbance also causes the shank web 8 to be displaced from a normal working vertical orientation, and so become subjected to relative movement of the mooring bed material incident at an angle to one face of the shank web 8 whence a resultant

force vector is generated athwart the plane of symmetry of the anchor and passing aft and above the roll axis of the anchor.

The net turning moment due to the displaced plates 6, 7 acts together with the moment of the resultant force vector from the shank web 8 about the roll axis of the anchor 1 in a direction such as to oppose the rolling of the anchor 1 and to return the anchor to its original working burial attitude.

Modifications are of course possible. For example in the anchor of Fig. 1, the bar 4 could be attached to the shank 2.

WHAT I CLAIM IS:—

1. An anchor comprising a fluke member for penetration into a mooring bed to cause burial of the anchor, and a shank member for attachment to a cable at a point in the foremost extremity of the shank member and linked to the fluke member such that the cable attachment point is located substantially in a fore-and-aft plane of symmetry of the anchor and spaced therein from the fluke member, said plane of symmetry being orientated substantially vertically in a working burial attitude of the anchor, and at least one elongate transverse member attached to the shank member and/or fluke member and having two elongate surfaces substantially curved lengthwise and disposed one at each side of the said plane of symmetry of the anchor, said elongate surfaces together being symmetrical about the said plane of symmetry, and arranged such that a point moving on a medial line of one of said elongate surfaces can increase in separation from the cable attachment point while simultaneously decreasing in separation from the centre of area of the fluke member whereby when a portion of an elongate surface is in penetrative engagement with the mooring bed and the anchor is dragged over and relative thereto by a pull in the cable, forces are generated between the elongate member and the mooring bed which roll the anchor to a final working burial attitude wherein the fluke member engages the mooring bed, the arrangement being such that when the anchor is on the mooring bed and not already lying fluke member downwards in a final working burial attitude a substantially horizontal pull from the cable tends to tilt the anchor to bring a portion of the said elongate surface into engagement with the mooring bed.

2. An anchor according to claim 1, wherein the elongate member is a continuous member and the said elongate surfaces lengthwise form a closed curve.

3. An anchor according to claim 2, wherein the curve is substantially elliptical in shape.

4. An anchor according to claim 3, wherein the burial surface of the fluke member and the said elongate surfaces lie on a cylindrical surface or a conical surface, and are axially located in the plane of symmetry of the anchor whereby the fluke member burial surface is concave upwards in a final working burial attitude of the anchor.

5. An anchor according to claim 4, wherein the said surface containing the fluke member burial surface and the elongate surface is a conical surface having an angle of convergence aft in the range 0° to 15°.

6. An anchor according to claim 1, wherein the said transverse elongate surfaces lengthwise form an open curve having its extremities uppermost in a final working burial attitude of the anchor, the elongate member being attached to the fluke member.

7. An anchor according to claim 1, wherein the said elongate surfaces lengthwise form an open curve having its extremities lowermost in a final working burial attitude of the anchor, the elongate member being attached to an upper portion of the shank member.

8. An anchor according to claim 6, wherein the projection of the extremities of the elongate member onto the plane of symmetry of the anchor lies between the fluke member and the uppermost edge of the shank member and is spaced from the shank member uppermost edge at least sufficiently to ensure that in an inverse attitude of the anchor, wherein the said uppermost edge of the shank member lies on the mooring bed surface, the anchor tilts naturally about the shank member so that initially only one extremity of the elongate member engages the mooring bed surface.

9. An anchor according to claim 6 or 8, wherein the elongate member lies sufficiently forward of the aftermost portion of the shank member adjacent to the fluke member to permit one or other of the extremities of the elongate surfaces on the elongate member to tilt naturally into engagement with the mooring bed surface when the anchor is hanging by the cable with the aftermost portion of the shank member adjacent to the fluke member bearing against the mooring bed surface so that rolling of the anchor to bring the fluke member into engagement with the mooring bed can occur when the anchor is dragged over the mooring bed surface at large angles of inclination of the cable to a horizontal plane.

10. An anchor comprising a fluke member for penetration into a mooring bed to cause burial of the anchor, and a shank member for attachment to a cable at a point in the foremost extremity of the shank member and linked to the fluke member such that the cable attachment point is located substantially in a plane of symmetry of the anchor and spaced therein from the fluke member, said plane of symmetry being orientated substantially vertically in a working burial attitude of the anchor, at least one elongate transverse member pro-

force vector is generated athwart the plane of symmetry of the anchor and passing aft and above the roll axis of the anchor.

The net turning moment due to the displaced plates 6, 7 acts together with the moment of the resultant force vector from the shank web 8 about the roll axis of the anchor 1 in a direction such as to oppose the rolling of the anchor 1 and to return the anchor to its original working burial attitude.

Modifications are of course possible. For example in the anchor of Fig. 1, the bar 4 could be attached to the shank 2.

WHAT I CLAIM IS:—

1. An anchor comprising a fluke member for penetration into a mooring bed to cause burial of the anchor, and a shank member for attachment to a cable at a point in the foremost extremity of the shank member and linked to the fluke member such that the cable attachment point is located substantially in a fore-and-aft plane of symmetry of the anchor and spaced therein from the fluke member, said plane of symmetry being orientated substantially vertically in a working burial attitude of the anchor, and at least one elongate transverse member attached to the shank member and/or fluke member and having two elongate surfaces substantially curved lengthwise and disposed one at each side of the said plane of symmetry of the anchor, said elongate surfaces together being symmetrical about the said plane of symmetry, and arranged such that a point moving on a medial line of one of said elongate surfaces can increase in separation from the cable attachment point while simultaneously decreasing in separation from the centre of area of the fluke member whereby when a portion of an elongate surface is in penetrative engagement with the mooring bed and the anchor is dragged over and relative thereto by a pull in the cable, forces are generated between the elongate member and the mooring bed which roll the anchor to a final working burial attitude wherein the fluke member engages the mooring bed, the arrangement being such that when the anchor is on the mooring bed and not already lying fluke member downwards in a final working burial attitude a substantially horizontal pull from the cable tends to tilt the anchor to bring a portion of the said elongate surface into engagement with the mooring bed.

2. An anchor according to claim 1, wherein the elongate member is a continuous member and the said elongate surfaces lengthwise form a closed curve.

3. An anchor according to claim 2, wherein the curve is substantially elliptical in shape.

4. An anchor according to claim 3, wherein the burial surface of the fluke member and the said elongate surfaces lie on a cylindrical surface or a conical surface, and are axially located in the plane of symmetry of the anchor whereby the fluke member burial surface is concave upwards in a final working burial attitude of the anchor.

5. An anchor according to claim 4, wherein the said surface containing the fluke member burial surface and the elongate surface is a conical surface having an angle of convergence aft in the range 0° to 15°.

6. An anchor according to claim 1, wherein the said transverse elongate surfaces lengthwise form an open curve having its extremities uppermost in a final working burial attitude of the anchor, the elongate member being attached to the fluke member.

7. An anchor according to claim 1, wherein the said elongate surfaces lengthwise form an open curve having its extremities lowermost in a final working burial attitude of the anchor, the elongate member being attached to an upper portion of the shank member.

8. An anchor according to claim 6, wherein the projection of the extremities of the elongate member onto the plane of symmetry of the anchor lies between the fluke member and the uppermost edge of the shank member and is spaced from the shank member uppermost edge at least sufficiently to ensure that in an inverse attitude of the anchor, wherein the said uppermost edge of the shank member lies on the mooring bed surface, the anchor tilts naturally about the shank member so that initially only one extremity of the elongate member engages the mooring bed surface.

9. An anchor according to claim 6 or 8, wherein the elongate member lies sufficiently forward of the aftermost portion of the shank member adjacent to the fluke member to permit one or other of the extremities of the elongate surfaces on the elongate member to tilt naturally into engagement with the mooring bed surface when the anchor is hanging by the cable with the aftermost portion of the shank member adjacent to the fluke member bearing against the mooring bed surface so that rolling of the anchor to bring the fluke member into engagement with the mooring bed can occur when the anchor is dragged over the mooring bed surface at large angles of inclination of the cable to a horizontal plane.

10. An anchor comprising a fluke member for penetration into a mooring bed to cause burial of the anchor, and a shank member for attachment to a cable at a point in the foremost extremity of the shank member and linked to the fluke member such that the cable attachment point is located substantially in a plane of symmetry of the anchor and spaced therein from the fluke member, said plane of symmetry being orientated substantially vertically in a working burial attitude of the anchor, at least one elongate transverse member pro-

viding two stabilizing surfaces disposed one at each side of the said plane of symmetry of the anchor, the shank being attached to the rear of the fluke member and said stabilizing surfaces together being symmetrical about the said plane of symmetry such that the resultant force vector produced by the stabilizing surface lying at either side of the said plane of symmetry due to undisturbed relative movement of the mooring bed material incident at an angle to the stabilizing surface lies on a straight line which intersects the said plane of symmetry at a point aft and above a straight line containing the cable attachment point and the centre of area of the fluke member when the anchor is in a final working burial attitude whereby any rotation of the anchor about the said straight line through the cable attachment point due to a disturbing force arising when the stabilizing surfaces are buried causes an inequality between the magnitude of the resultant force vectors produced by the stabilizing surfaces and so causes a turning moment to be established about the said straight line containing the cable attachment point acting in a direction in opposition to the direction of the rotation caused by the disturbing force.

11. An anchor according to claim 10, wherein the stabilizing surfaces are located on at least two members disposed at least one at each side of the said plane of symmetry, the members being joined to the fluke member and forming extension portions thereof extending from the side edges of the fluke member at each side of the said plane of symmetry of the anchor.

12. An anchor according to claim 10 or 11, wherein in a final working burial attitude of the anchor the stabilizing surfaces and the burial surface of the fluke member are located on a portion of a cylindrical surface or a conical surface which is concave upwards, and axially located in the said plane of symmetry of the anchor.

13. An anchor according to claim 12, wherein the said surface containing the fluke member burial surface and the stabilizing surfaces is conical and has an included angle of convergence aft in the range 0° to 15°.

14. An anchor according to claim 12 or 13, wherein an outer portion of each stabilizing surface departs from and lies substantially tangential to the said surface containing the fluke burial member surface.

15. An anchor according to claim 12 or 13, wherein the outer portions of the stabilizing surfaces depart from the said surface containing the fluke member burial surface such that line intercepts of the outer portions of the stabilizing surfaces with planes normal to the plane of symmetry and parallel to the axis of the surface containing the fluke member burial surface converge aft at angles progressively increasing as the intercepts move towards the outer extremities of the stabilizing surfaces to a maximum angle of convergence aft at the said extremities of up to 110°.

16. An anchor according to any one of the preceding claims, wherein the shank member includes a web portion providing two stabilizing surfaces substantially parallel to the said plane of symmetry of the anchor.

17. An anchor substantially as hereinbefore described with reference to Figs. 1, 6 and 7, or any one of Figs. 2 to 5 of the accompanying drawings.

FITZPATRICKS,
Chartered Patent Agents,
14—18 Cadogan Street,
Glasgow, G2 6QW.
and
Warwick House
Warwick Court,
London, WC1R 5DJ.

Printed for Her Majesty's Stationery Office, by the Courier Press, Leamington Spa, 1974.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

