July 25, 1961 A. M. FEILER 2,993,461

EMBEDMENT ANCHOR

Filed Feb. 24, 1959 3 Sheets-Sheet 1

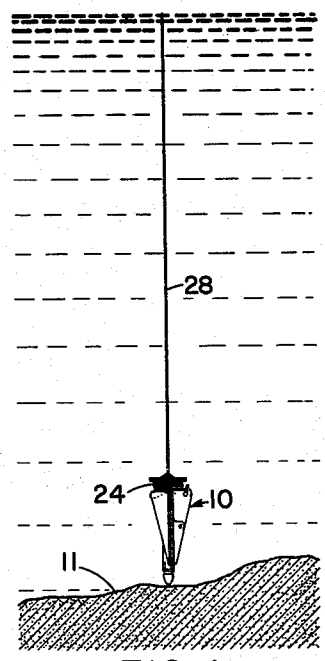


FIG. 1

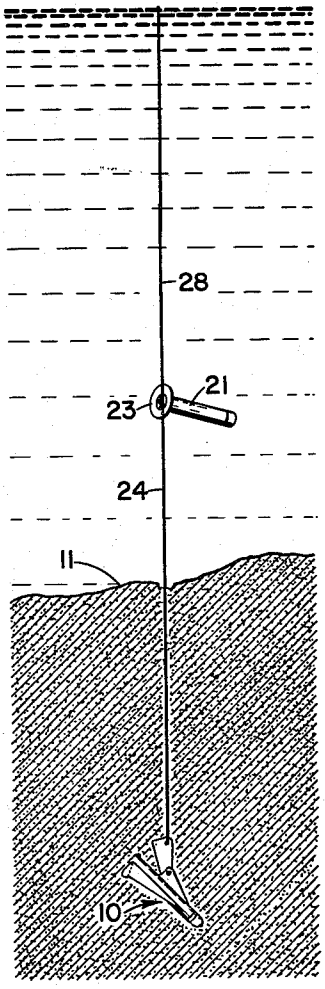


FIG. 2

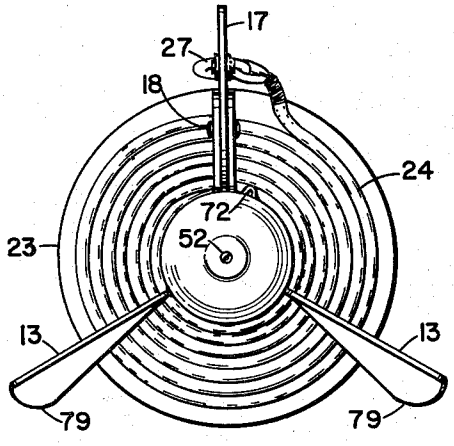


FIG. 5

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July 25, 1961 A. M. FEILER 2,993,461

EMBEDMENT ANCHOR

Filed Feb. 24, 1959 3 Sheets-Sheet 2

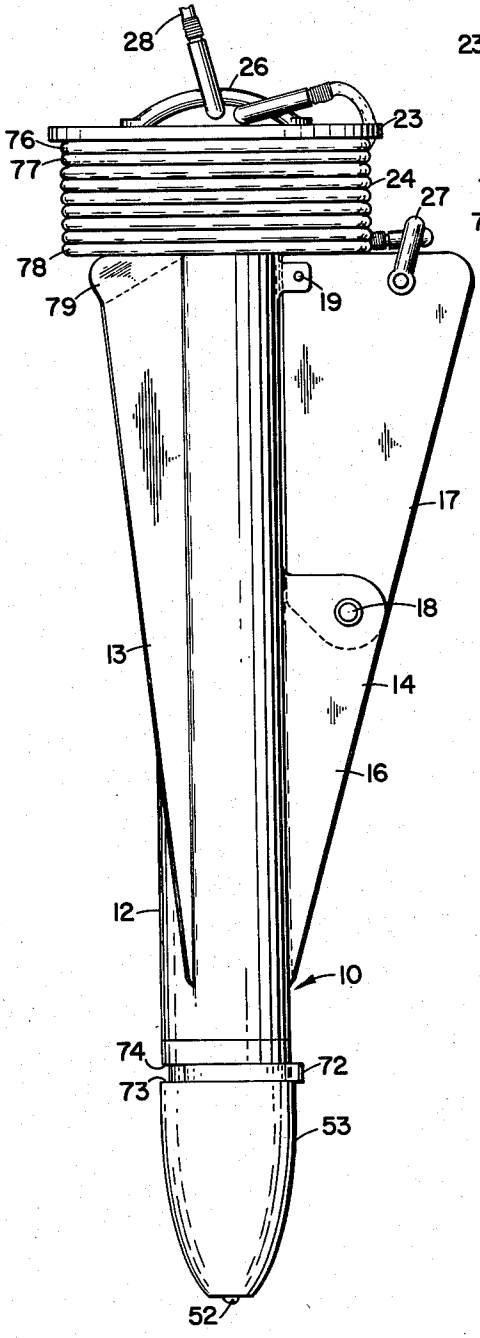


FIG. 3

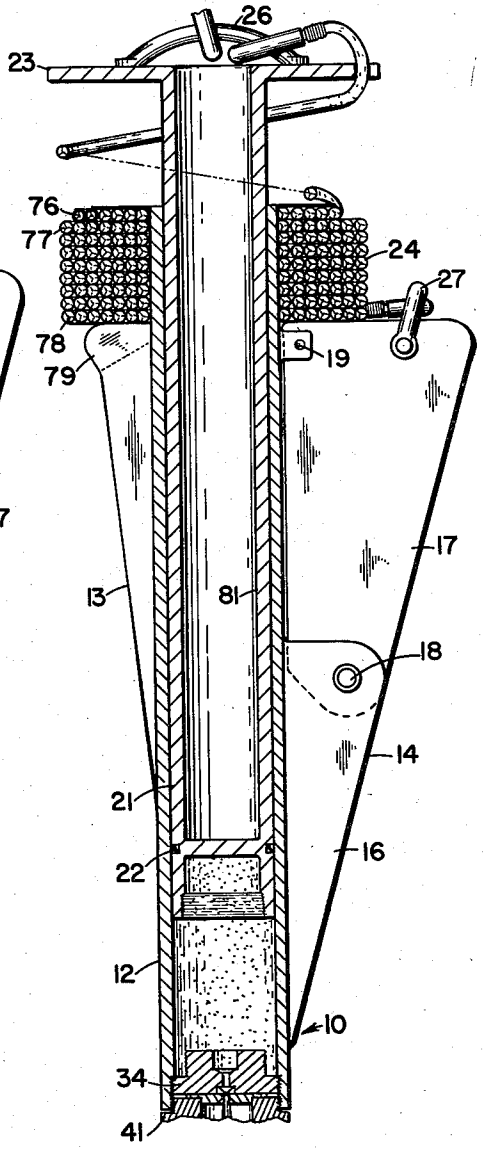


FIG. 4

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EMBEDMENT ANCHOR

Filed Feb. 24, 1959 3 Sheets-Sheet 3

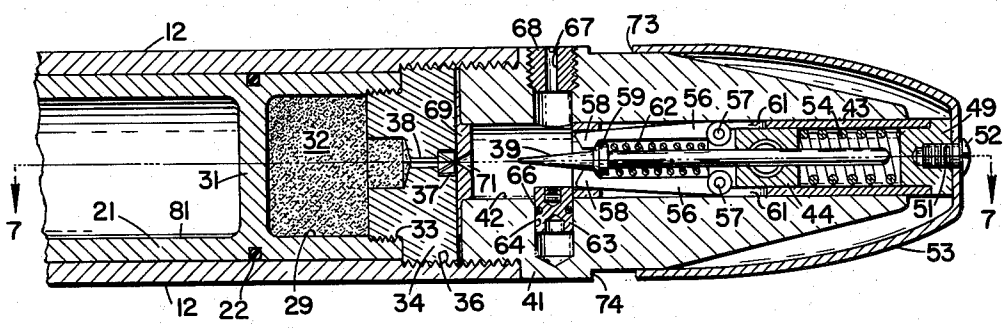


FIG. 6

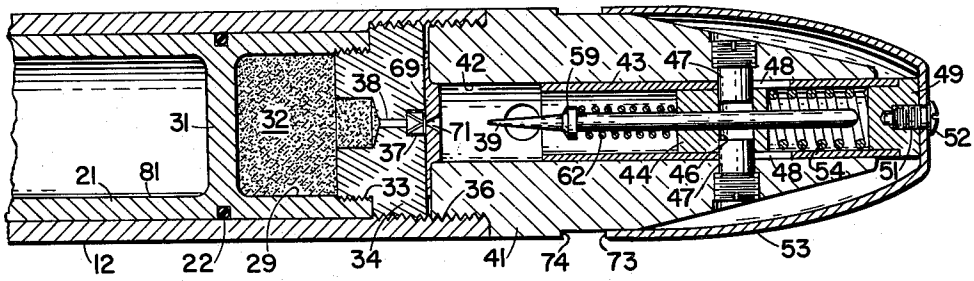


FIG. 7

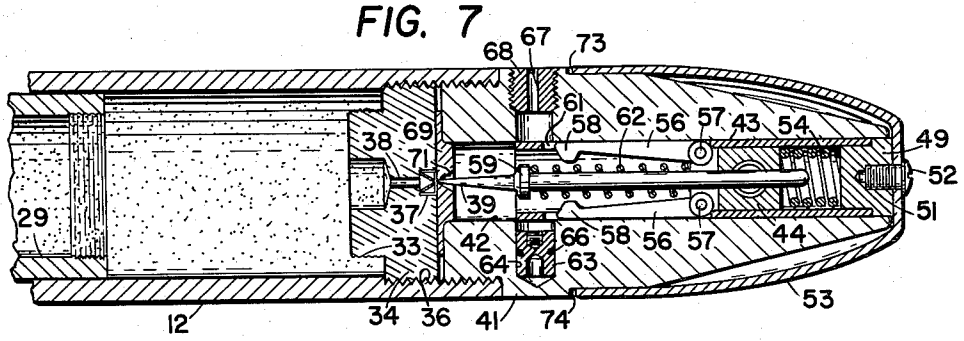


FIG. 8

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United States Patent Office 2,993,461 Patented July 25, 1961

2,993,461

EMBEDMENT ANCHOR

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Filed Feb. 24, 1958, Ser. No. 795,066
11 Claims. (Cl. 114—206)

This invention relates to anchors and more particularly to an embedment anchor in which an explosive charge is used to drive the anchor into the earth or ground at the bottom of the ocean or the like so that the anchor has a high holding power.

It is an important object of this invention to provide a new and improved embedment anchor containing its own propulsion means.

It is another object of this invention to provide an embedment anchor having explosive propulsion means in combination with ignition means which prevents ignition until the anchor has reached a predetermined water depth.

It is another object of this invention to provide an embedment anchor having an explosive propulsion in combination with means which provides maximum utilization of the propulsion energy.

It is still another object of this invention to provide a new and improved embedment anchor having a coil of cable on the anchor which prevents strains from being transmitted through the main anchor cable during the embedment operation.

Further objects and advantages will appear from the following description and drawings, wherein:

FIGURE 1 is a schematic illustration of the anchor showing the anchor as it engages the bottom of a body of water before ignition of the embedment propulsion charge;

FIGURE 2 is a view similar to FIGURE 1 illustrating the position the anchor assumes after it is embedded in the ocean bottom;

FIGURE 3 is a side elevation of the preferred structure according to this invention;

FIGURE 4 is a longitudinal section illustrating the internal structure of the anchor;

FIGURE 5 is an end view of the anchor;

FIGURE 6 is an enlarged fragmentary view of the firing mechanism illustrating the positions the elements assume before the anchor is lowered into the water;

FIGURE 7 is a fragmentary section taken along 7—7 of FIGURE 6; and,

FIGURE 8 is a view similar to FIGURE 6 showing the positions of the elements of the firing mechanism when it operates to ignite the propellant charge.

An embedment anchor according to this invention includes a propulsion means operable to embed the anchor in the bottom of a body of water and has the advantage of providing large anchoring forces with a relatively lightweight structure. The anchor is provided with safety means to insure that the propelling charge used to embed the anchor is not ignited before the anchor is lowered to a predetermined depth in the water. It also has a firing mechanism which is insensitive to water pressure so that it will only ignite the propelling charge upon engagement of the anchor with the ocean bottom.

In FIGURES 1 and 2, the operation of the anchor is schematically shown. When the anchor **10** engages the ocean bottom **11**, the firing mechanism explained in detail below is operated to ignite the propelling charge. This drives the anchor into the ocean bottom **11** as shown in FIGURE 2. The connection of the anchor cable to the anchor body is arranged so that any force tending to withdraw the anchor turns the anchor to a position approaching a perpendicular relative to the line of thrust on the anchor cable so that the side area of the anchor is available to resist its removal rather than the relatively small

end area. This also prevents the removal of the anchor up through the hole created during its embedment.

Referring to FIGURES 3 through 5, the anchor **10** includes a tubular body **12** provided with two external fins **13**. A third fin **14** is formed by a fixed portion **16** and a hinged portion **17** connected to the fixed portion by a pivot **18**. The hinged portion **17** normally extends along the body **12** and is arranged to provide a continuing fin surface with the fixed portion **16**. A frangible pin **19** connects the rearward end of the hinged portion **17** to the body **12** to normally maintain the hinged portion **17** in the position shown in FIGURES 3 and 4 but fractures when a force is applied to the anchor cable to permit the hinged portion **17** to pivot to the position shown in FIGURE 2.

A tubular plunger **21** extends into the body **12** and is provided with a seal **22** which engages the inner wall of the tubular body **12** and prevents fluid leakage therebetween. The plunger **21** is formed with a radially extending flange **23** at its rearward end spaced from the rearward ends of the fins **13** and **14**. The rearward ends of the fins and the flange **23** co-operate to form opposed side walls between which is wound a short length of anchor cable **24**. The anchor cable **24** is fastened at one end to a cleat **26** and at the other end to a shackle **27** secured to the rearward end of the hinged portion **17**. An anchor cable **28** extending to the ship or device to be anchored is also connected to the cleat **26**. Prior to the ignition of the propulsion means, the piece of anchor cable **24** is carried by the anchor. During the embedment operation, however, the body **12** of the anchor is driven forward into the bottom and the plunger **21** remains substantially fixed in its position. The piece of anchor cable **24** provides a slack connection between the plunger **21** and the body **12** which unwinds as the body **12** embeds itself. This prevents unnecessary strains being placed on the main anchor cable **28** and also permits the free movement of the body **12** into the embedded position. The method used to wind the piece of anchor cable **24** is important to prevent fouling which could hinder the embedment of the body. The preferred method of winding the anchor cable **24** will be discussed in detail below.

Referring to FIGURES 6 through 8, the forward end of the plunger **21** is formed with a bore **29** terminating in a radial wall **31** which is filled with a propulsion charge **32**. The forward end of the tubular plunger is threaded at **33** onto a bulkhead **34** which is in turn mounted in the body **12** by means of threads **36**. A percussion detonator **37** is mounted in the forward face of the bulkhead **34** and is connected to the main charge **32** through a passage **38**. The detonator is detonated by a firing pin **39** and operates to ignite the charge **32**. This causes a rapid buildup in pressure against the plunger **21** which causes the threads **33** to be stripped permitting the body **12** to move to the right relative to the plunger **21**.

A nose member including a body **41** is provided to support the firing pin **39** and release it against the detonator when the anchor engages a solid such as the bottom of the ocean or the like. The nose member **41** is threaded into the forward end of the tubular body **12** and is formed with an axial bore **42** in which a latch tube **43** is axially movable. A latch block **44** positioned within the latch tube **43** is formed with a cross bore **46** into which projects opposed mounting pins **47** which are threaded into the nose member **41**. The latch tube **43** is formed with opposed elongated slots **48** through which the mounting pins **47** project; therefore, the latch block **44** is axially fixed in the body **41** and the latch tube is axially movable through a limited distance determined by the length of the slots **48**. An end member **49** is fastened in the outer end of the latch tube **43** by suitable means such as braising or welding and is formed with a threaded

bore 51 into which a screw 52 is threaded to mount a cup-shaped relatively thin walled nose piece 53. A spring 54 extends between the latch block 44 and the end member 49 resiliently urging the latch tube 43 to the right to the position shown in FIGURES 6 and 7 at which time the mounting pins 47 engage the rearward ends of the slots 48. The slots 48 are sized to permit movement of the latch tube 43 to the left when the anchor engages the ocean bottom.

A pair of opposed finger lock elements 56 are pivotally mounted on the latch block at 57 and are formed with locking projections 58 proportioned to engage a shoulder 59 on the firing pin 39 and secure the firing pin in the cocked position shown in FIGURES 6 and 7. The inner end of the latch tube 43 engages the finger lock elements and prevents radial movement thereof to release the firing pin 39 when the latch tube is in the forward position shown in FIGURE 6. Elongated slots 61 are formed in the latch tube 43 to receive each of the finger lock elements 56. However, the slots 61 do not extend to the left end of the latch tube 43 so that the finger lock elements are retained in their locked position until the latch tube moves to the left under the influence of engagement with the ocean bottom. A compression spring 62 extends between the shoulder 59 and the latch block 44 and urges the firing pin 39 into engagement with the locking projections 58.

To prevent the accidental detonation of the charge 32 before the anchor is lowered into the water, a safety piston 63 is positioned in a cross bore 64 formed in the nose member 41. A resilient seal 66 mounted on the piston 63 provides sealing engagement with the walls of the bore 64 and sufficient friction to prevent its movement from the locked position of FIGURE 6 during the handling of the anchor. Prior to immersion, the piston 63 is positioned to engage the end of the latch tube and prevent its inward movement as shown in FIGURE 6. This prevents accidental firing of the charge 32. When the anchor is immersed, water flows into the bore 42 through a passage 67 formed in a plug 68 so that the inner end of the piston 63 is exposed to the pressure of the water. When the depth of the water produces a pressure on the piston 63 sufficiently large to overcome the friction, the piston moves toward the end of the cross bore 64 from the normal position shown in FIGURE 6 to the position shown in FIGURE 8. The piston 63 is proportioned so that when it is moved by the pressure of the water to the end of the bore 64, it is clear of the latch tube 43 and permits the latch tube to move to the left upon engagement of the anchor with the ocean bottom.

When the latch tube moves to the left, the slots 61 extend along the full length of the finger lock elements 56 as shown in FIGURE 8. At this time, the action of the spring 62 cams the finger lock elements outward and releases the firing pin 39. The firing pin 39 then moves to the left into engagement with the percussion detonator 37 and ignites the main propulsion charge 32. A guide member 69 is positioned adjacent to the percussion detonator 37 and is formed with a conical opening 71 which guides the end of the firing pin 39 as it approaches the percussion detonator 37 to insure proper contact. The rearward end of the firing pin 39 extends through the latch block 44 to provide general guiding support for the firing pin 39. However, the conical opening 71 provides precise guiding of the forward end of the firing pin to insure reliable operation.

A safety clip 72, shown in FIGURE 3, is positioned between the rearward end 73 of the nose piece 53 and a shoulder 74 to provide an additional safety device which prevents the movement of the latch tube 43 to the left during the handling of the anchor. This clip is removed before the anchor is used.

Referring again to FIGURES 3 and 4, the portion of the anchor cable 24 wrapped around the body 12 is wound in a series of radial coils each wound as a spiral so that it will not jam or bind as the body 12 moves away from the plunger 21. The upper end of the cable 24 is wound in a concentric manner or spiral down along the first row or coil 76 and then as a spiral out along the second radial coil 77. This is repeated until the last coil 78 is reached. The end of the body 12 extends through the coils of the cable 24 and tends to carry the cable off the end of the plunger 21 with the body as the body moves under the influence of the propelling charge. This helps to insure that the coils will not wrap around the plunger 21 which could cause drag to resist embedment of the anchor. The resistance of the water to the forward movement of the body 12 tends to throw the entire coil grouping off the rearward end of the body 12 as it clears the plunger 21 so the cable is free to unwind without any substantial resistance or tendency to foul. In addition, the spiral winding prevents fouling even if the coil does not remain on the body 12 until it clears the plunger 21.

The fin 14 is heavier than the fins 13 since it is subjected to anchor loads. Also, the attachment of the cable 24 provides additional resistance to movement which is applied to the body 12 at a point eccentric of the axis so it is necessary to bend the rearward portion 79 of the fins 13 to provide a symmetrical drag on the body 12. The deflection of the rearward portions 79 also assists in the insuring that the anchor moves to a position substantially perpendicular to the anchor cable 24 as shown in FIGURE 2 and prevents the removal of the anchor from the bottom 11 since they operate to turn the anchor when a force is exerted on the cable tending to remove the anchor.

The plunger 21 is formed with an axially extending bore 81 which extends from the upper end to the radial wall 31. The immersion fills this bore and increases the reacting mass of the plunger to increase the thrust on the body 12 without requiring excessive dry weight in the anchor. The flange 23 also provides a resistance to movement of the plunger 21 in the water so that a more effective reacting device is provided. Because the body 12 must move a substantial distance before it separates from the inner end of the plunger 21, a substantial thrust energy is produced before the compressed gas is released by the separation. Also, since the reaction mass of the plunger 21 is substantially constant, the velocity of the anchor body 12 will be a function of the pressure of the ignited charge times the distance the body 12 moves before separation occurs. Since the thrust is maintained through a relatively long stroke until the body 12 separates completely from the plunger 21, an efficient operation is provided and high velocities are achieved.

In operation, the clip 72 is removed and the anchor is lowered into the water. As the anchor moves to greater depths, the piston 63 moves to the end of the bore 64 to completely arm the device. When the nose piece 53 engages the bottom, the latch tube 43 moves in a direction toward the anchor body 12 which releases the firing pin 39. The firing pin 39 then moves under the influence of the spring 62 against the detonator 37 and ignites the propelling charge 32. This shears the threads 33 and causes the anchor body 12 to be propelled into the ocean bottom. During the embedment of the anchor body 12, the coils of the anchor cable 24 unwind to prevent drag on the anchor body 12 and also to prevent the thrust from being absorbed by the main anchor cable 28. After the anchor is embedded in the ocean bottom, the plunger 21 is above the bottom and the force on the anchor cable 24 tending to pull the anchor body 12 out of the ocean bottom causes the frangible pin 19 to break. Therefore, the anchoring force is applied to the anchor body at the pivots 18 intermediate its ends. This produces a turning moment on the anchor body 12 which assists the deflected rearward portion 79 in causing the anchor body 12 to turn to a position substantially perpendicular to the line of thrust

on the anchor cable. This provides a maximum surface area to resist removal of the anchor. In actual practice, anchors according to this invention have been found to provide anchoring forces many times as great as normal anchors of similar weight. It is recognized that anchors of this type are normally not reusable but they are extremely desirable for use in rescue work where lightweight, dependable anchoring is necessary.

Although a preferred embodiment of this invention is illustrated, it will be realized that various modifications of the structural details may be made without departing from the mode of operation and the essence of the invention. Therefore, except insofar as they are claimed in the appended claims, structural details may be varied widely without modifying the mode of operation. Accordingly, the appended claims and not the aforesaid detailed description are determinative of the scope of the invention.

I claim:

1. An embedment anchor comprising a tubular body, an ignition mechanism on one end of said body, a hollow plunger telescoping into the other end of said body having an inner end adjacent said one end of said body and an outer end beyond said other end of said body, a chamber defined by said body and plunger the volume of which is increased by movement of said body away from said plunger for a distance substantially equal to the length of said body, and an explosive charge in said chamber ignitable by said ignition mechanism, ignition of said charge pressurizing said chamber and propelling said body away from said plunger.

2. An embedment anchor comprising a tubular body, an ignition mechanism on one end of said body, a hollow plunger telescoping into the other end of said body having an inner end adjacent said one end of said body and an outer end beyond said other end of said body, a connection between said plunger and body releasable in response to a predetermined force, a chamber defined by said body and plunger the volume of which is increased by movement of said body away from said plunger for a distance substantially equal to the length of said body, and an explosive charge in said chamber ignitable by said ignition mechanism, ignition of said charge pressurizing said chamber producing said predetermined force and propelling said body away from said plunger.

3. An embedment anchor comprising a tubular body, an ignition mechanism on one end of said body, a plunger telescoping into the other end of said body having an inner end adjacent said one end of said body and an outer end beyond said other end of said body, seal means between said body and plunger, a chamber defined by said body and plunger the volume of which is increased by movement of said body away from said plunger for a distance substantially equal to the length of said body, an explosive charge in said chamber ignitable by said ignition mechanism, ignition of said charge pressurizing said chamber and propelling said body away from said plunger, and cable means providing a slack connected between said plunger and body.

4. An embedment anchor comprising a tubular body, an ignition mechanism mounted on one end of said body, a tubular plunger telescoping into said body having an inner end substantially adjacent to said one end of said body and an outer end extending beyond the other end of said body, a wall closing said tubular plunger adjacent said inner end co-operating with said body and plunger to form a chamber the volume of which is increased by relative movement of said body away from said plunger through a distance substantially equal to the length of said body, a propulsion charge in said chamber ignitable by said ignition mechanism, said tubular plunger being adapted to receive water from said outer end to said wall, ignition of said charge pressurizing said chamber and propelling said body away from said plunger.

5. An embedment anchor comprising a tubular body, an ignition mechanism mounted on one end of said body, a plunger telescoping into said body having an inner end substantially adjacent to said one end of said body and an outer end extending beyond the other end of said body, an outwardly extending flange on said outer end of said plunger, a wall closing said plunger adjacent said inner end co-operating with said body and plunger to form a chamber the volume of which is increased by relative movement of said body away from said plunger through a distance substantially equal to the length of said body, a propulsion charge in said chamber ignitable by said ignition mechanism, ignition of said charge pressurizing said chamber and propelling said body away from said plunger.

6. An embedment anchor comprising a tubular body, an ignition mechanism mounted on one end of said body, a tubular plunger telescoping into said body having an inner end substantially adjacent to said one end of said body and an outer end extending beyond the other end of said body, a wall closing said tubular plunger adjacent said inner end co-operating with said body and plunger to form a chamber the volume of which is increased by relative movement of said body away from said plunger through a distance substantially equal to the length of said body, a propulsion charge in said chamber ignitable by said ignition mechanism, said tubular plunger being adapted to receive water from said outer end to said wall, ignition of said charge pressurizing said chamber and propelling said body away from said plunger, and a cable coiled in a spiral around said anchor connected at one end to said plunger and at the other end to said body.

7. An anchor which embeds itself into the bottom of a lake or the like comprising a body, an ignition mechanism on one end of said body, a plunger in said body operating with said body to form a chamber the volume of which is increased by movement of said body away from said plunger, an explosive charge in said chamber ignitable by said ignition mechanism, said ignition mechanism including a latch member movable from a normal position by engagement with said bottom to an operated position in which said charge is ignited, and a piston normally in a position engaging said latch member preventing its movement to said operated position, said piston being movable by a predetermined pressure to an armed position clear of said latch member.

8. An anchor which embeds itself into the bottom of a lake or the like comprising a body, an ignition mechanism on one end of said body, a plunger in said body operating with said body to form a chamber the volume of which is increased by movement of said body away from said plunger, an explosive charge in said chamber ignitable by said ignition mechanism, said ignition mechanism including a latch member movable axially relative to said body by engagement with said bottom from a normal position to an operated position in which said charge is ignited, a cross bore in said ignition mechanism, and a piston in said cross bore normally in a position engaging said latch member preventing its movement to said operated position, said piston being movable by a predetermined pressure to an armed position clear of said latch member.

9. An embedment anchor comprising a tubular body, an ignition mechanism on one end of said body, a plunger telescoping into the other end of said body terminating at an inner end adjacent said one end, a chamber defined by said body and plunger the volume of which is increased by movement of said body away from said plunger, an explosive charge in said chamber ignitable by said ignition mechanism, ignition of said charge pressurizing said chamber and propelling said body away from said plunger, a plurality of radially extending fins symmetrically located around said body, and a cable connected at one end to said plunger and at the other end to one of said fins, the rearward ends of the other of said fins being deflected increasing their water resistance.

10. An embedment anchor comprising a tubular body, an ignition mechanism on one end of said body, a plunger telescoping into the other end of said body terminating at an inner end adjacent said one end, a chamber defined by said body and plunger the volume of which is increased by movement of said body away from said plunger, an explosive charge in said chamber ignitable by said ignition mechanism, ignition of said charge pressurizing said chamber and propelling said body away from said plunger, a plurality of radially extending fins symmetrically located around said body, one of said fins including a link pivoted to said body intermediate the ends of said body, and a cable connected at one end to said plunger and at the other end to said link, the rearward ends of the other of said fins being deflected to increase their water resistance.

11. An embedment anchor comprising a tubular body, an ignition mechanism on one end of said body, a plunger telescoping into the other end of said body terminating at an inner end adjacent said one end, a chamber defined by said body and plunger the volume of which is increased by movement of said body away from said plunger, an explosive charge in said chamber ignitable by said ignition mechanism, ignition of said charge pressurizing said chamber and propelling said body away from said plunger, a plurality of radially extending fins symmetrically located around said body each terminating at a rearward edge spaced from said other end of said body, a flange on outer end of said plunger, a cable wound in a spiral around said other end of said body between said flange and rearward edge of said fins, a first connection between one end of said cable and said plunger, and a second connection between the other end of said cable and one of said fins, the rearward ends of the other of said fins being deflected to increase their water resistance.

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