

[54] **EMBEDDING CABLELIKE MEMBERS**

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[51] Int. Cl. **F16I 1/00, E02f 5/02**

[58] Field of Search **61/72.4, 72.1; 37/61, 62**

[56] **References Cited**

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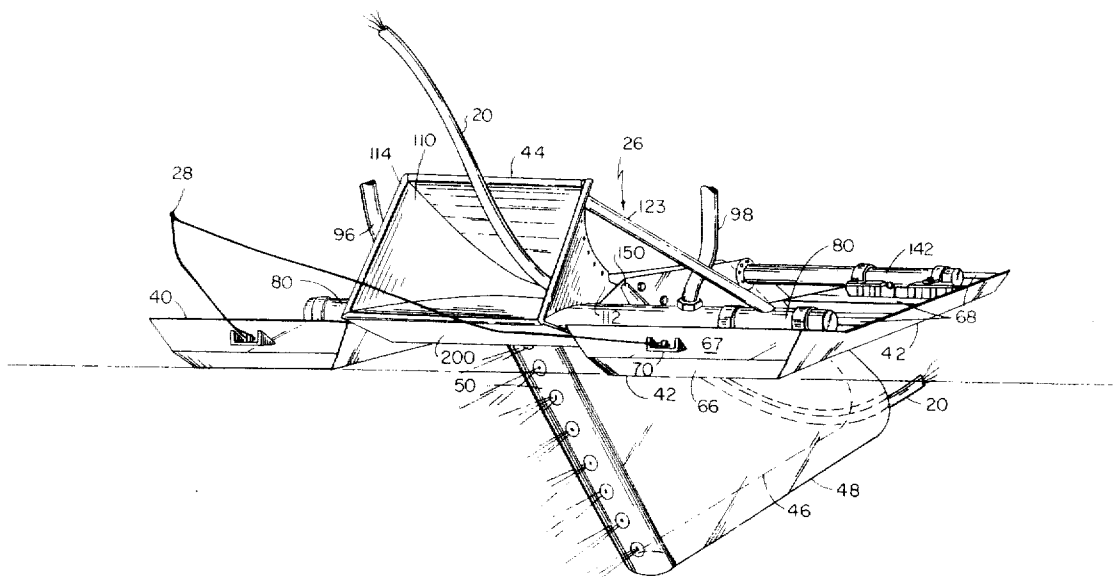
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[57] **ABSTRACT**

Cable embedment with apparatus comprising a water bed contacting support assembly, an entrance guide having a longitudinal axis, a depressor extending generally along a continuation of the axis rearward of the entrance, a jet assembly extending beneath the depressor, and, connected to the jet assembly, a source of fluid under pressure for creating a jet flow at a flow rate sufficiently high and a pressure sufficiently low to temporarily liquify water bed soil in the path of the cable without substantial permanent soil displacement.

18 Claims, 11 Drawing Figures



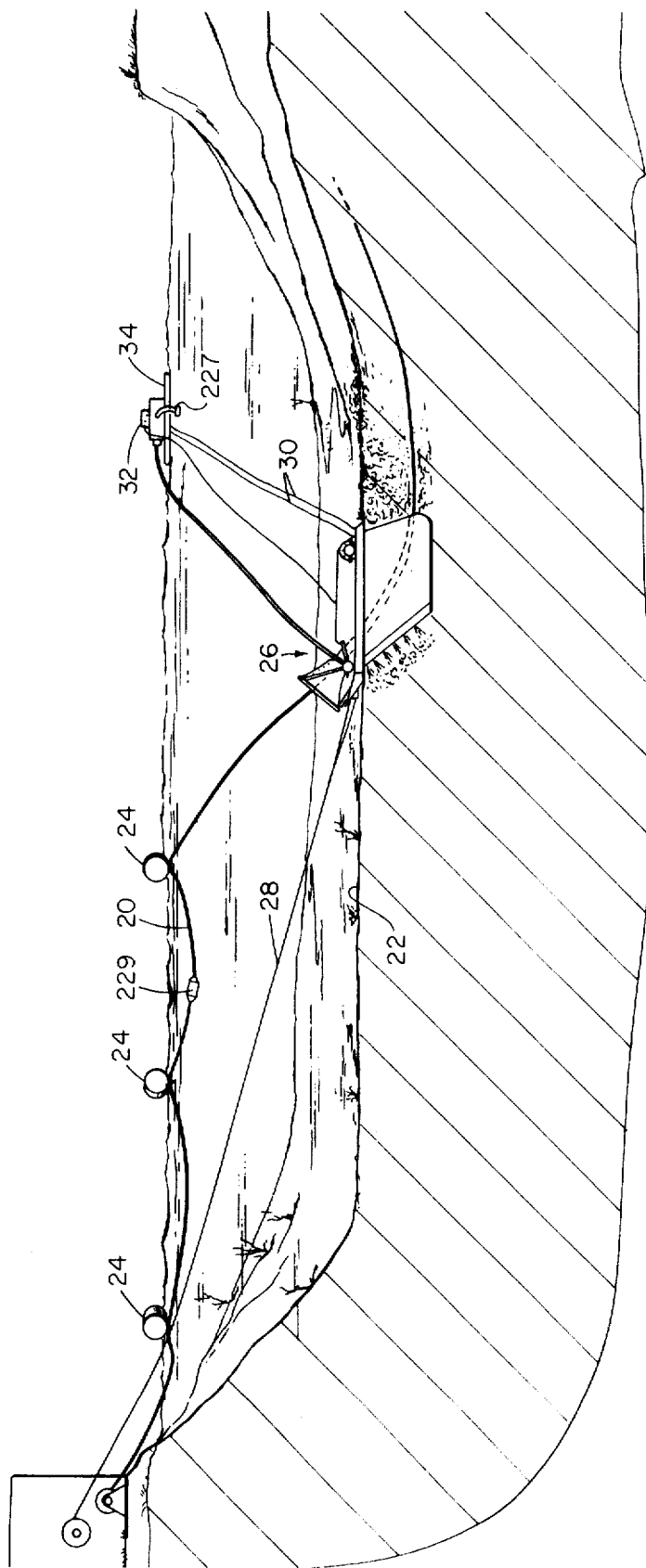
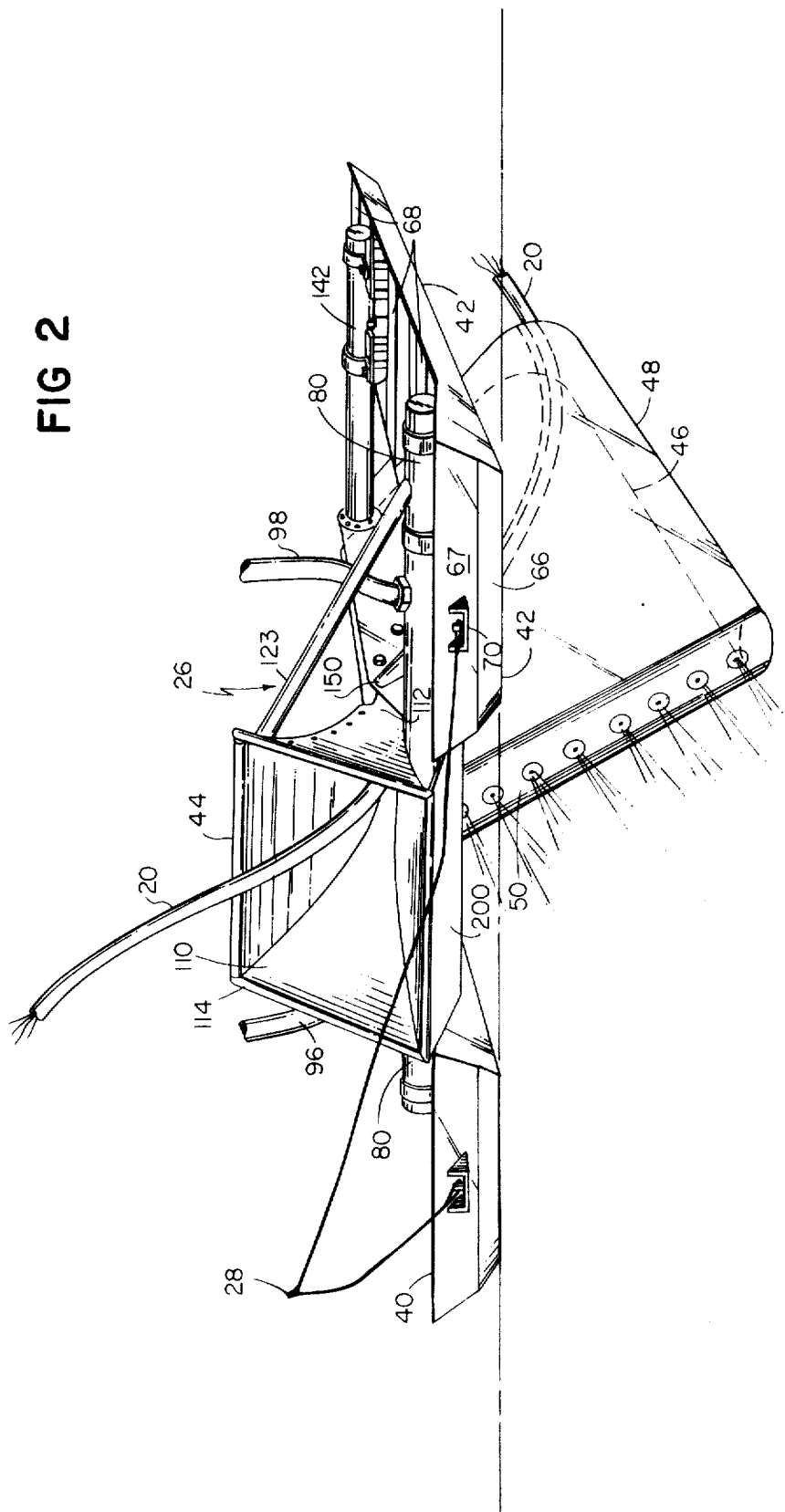
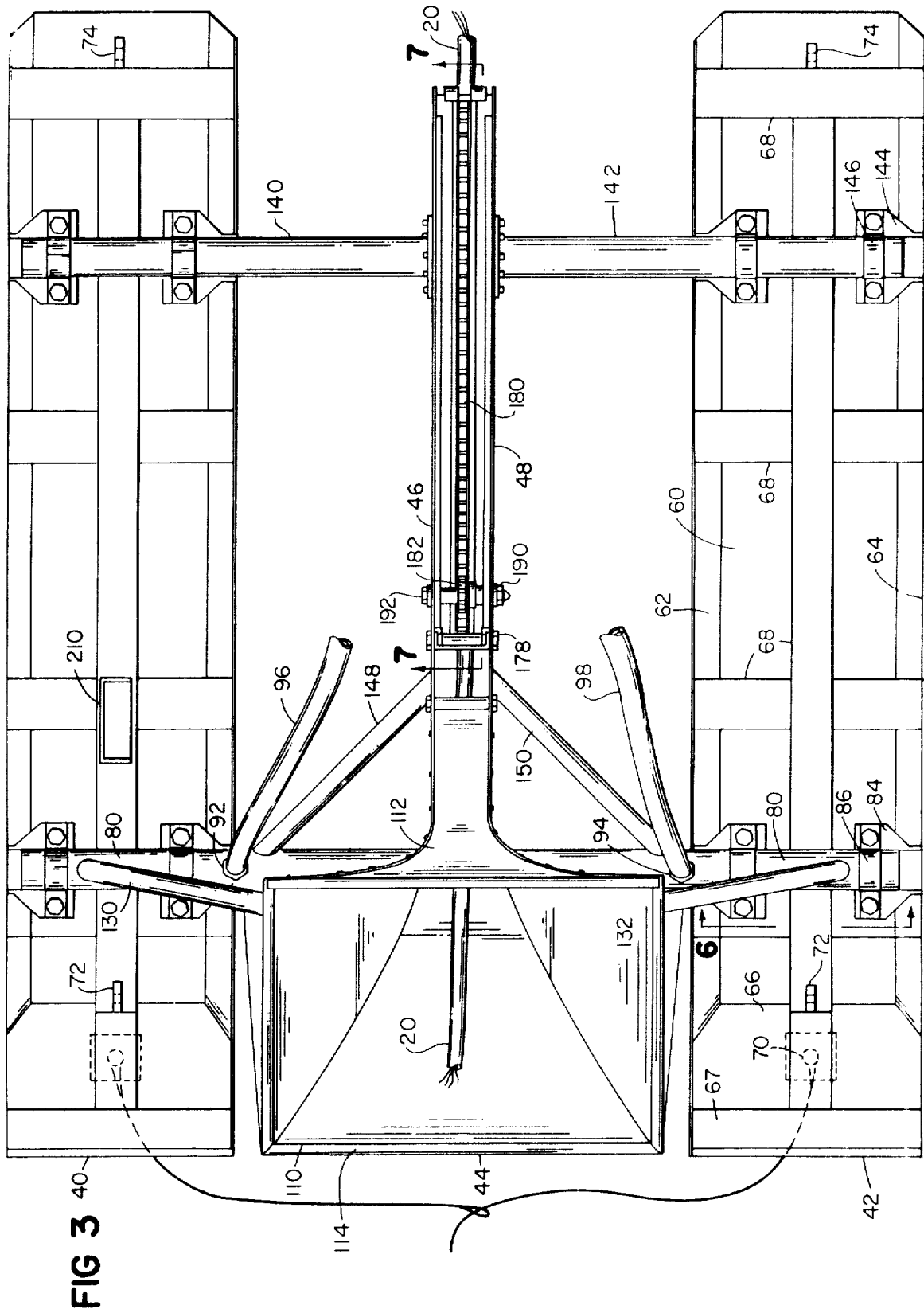
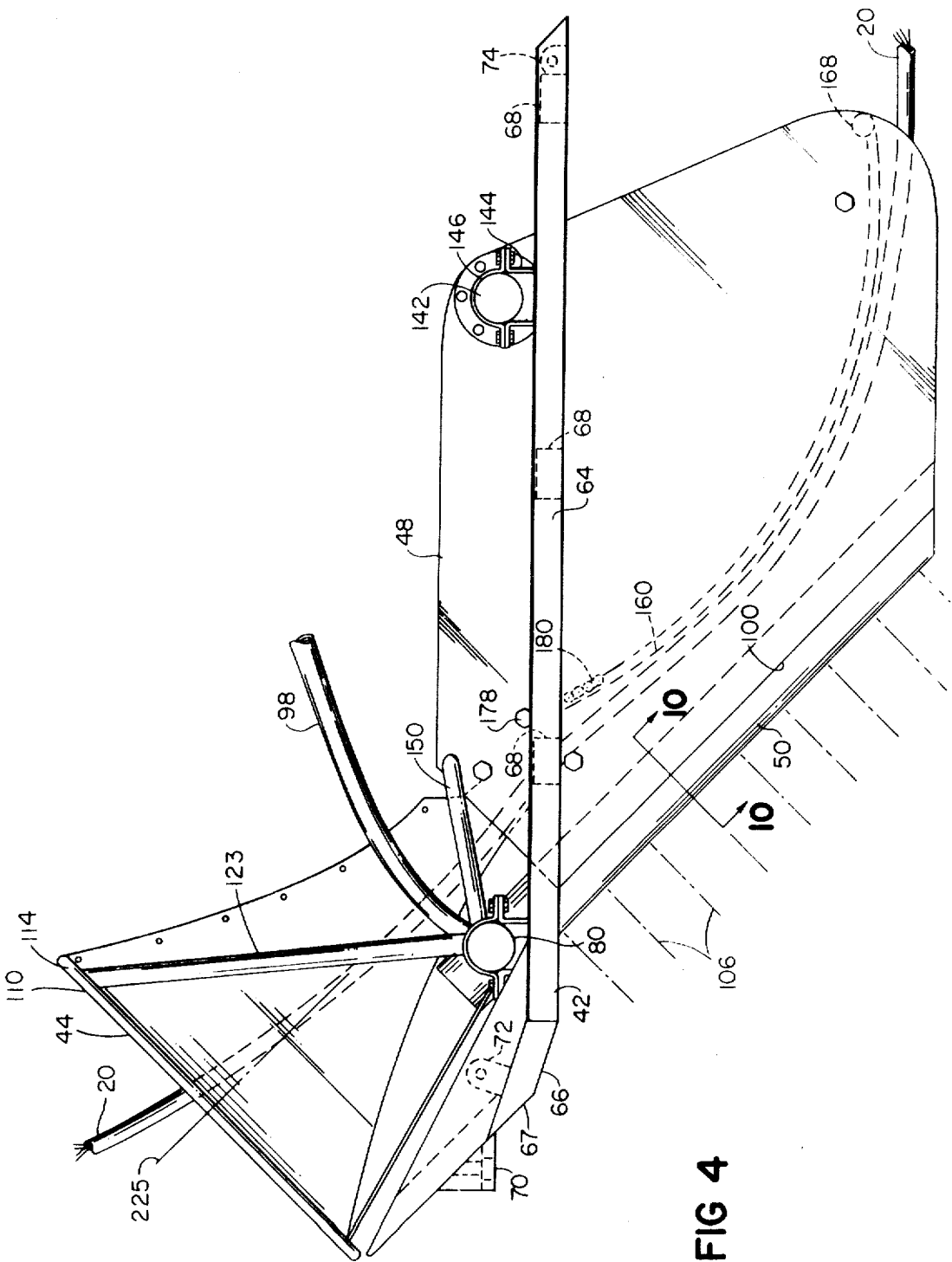


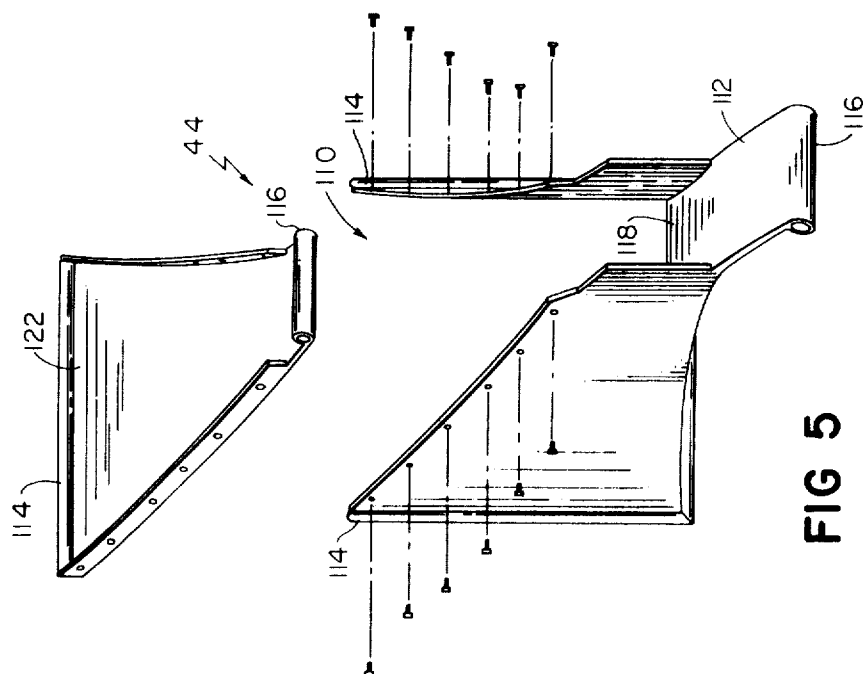
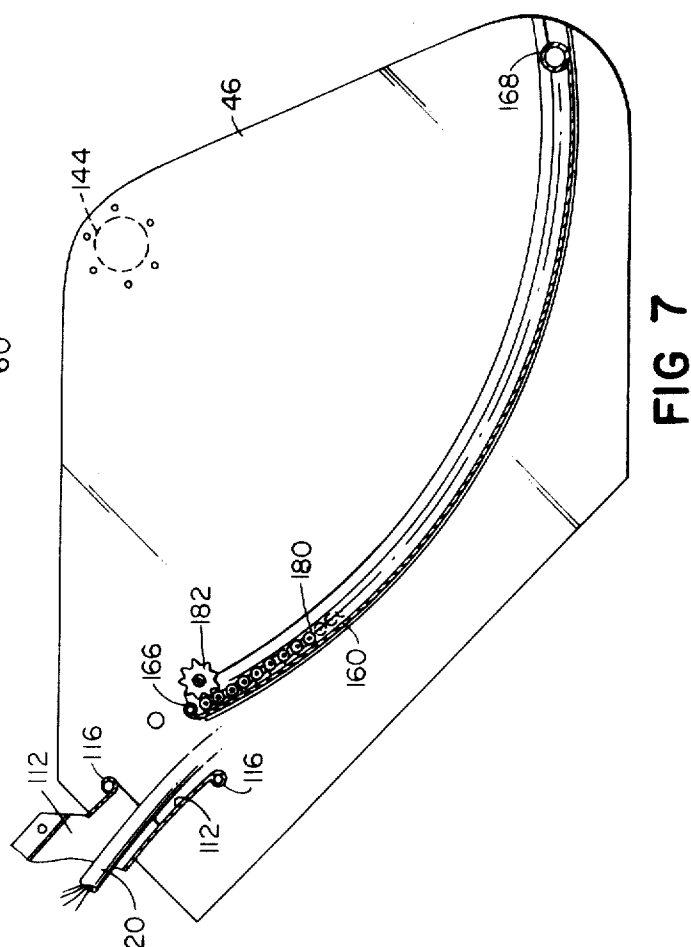
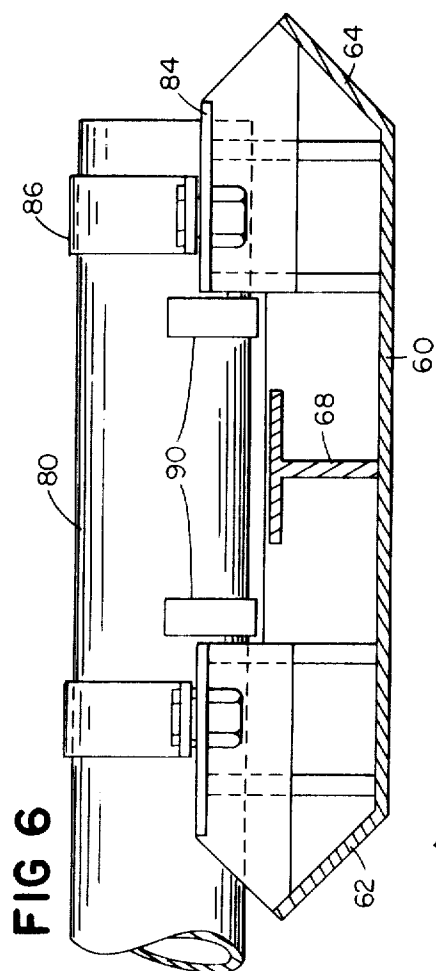
FIG. 1

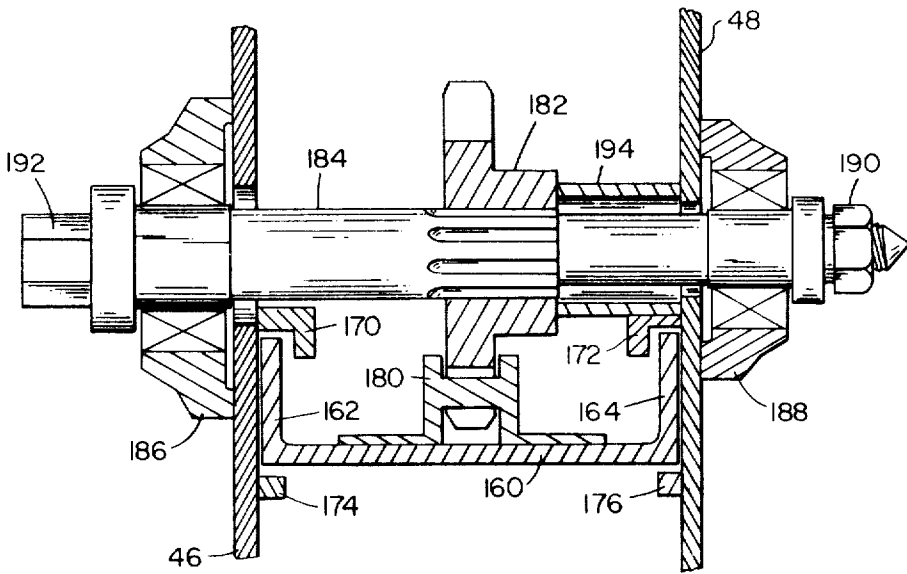
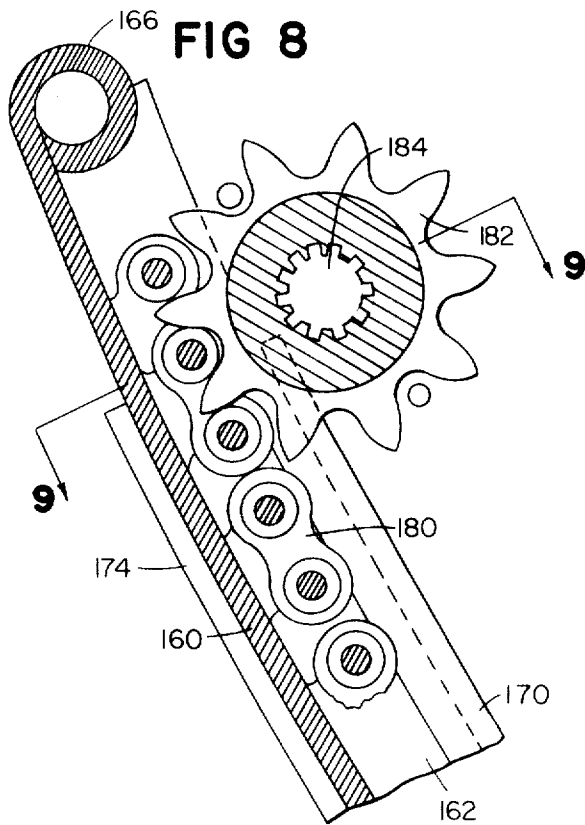
FIG 2

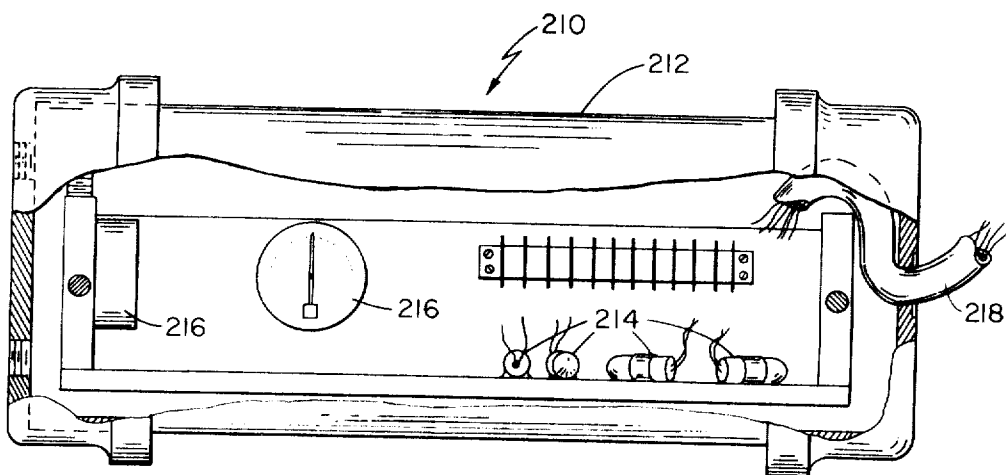
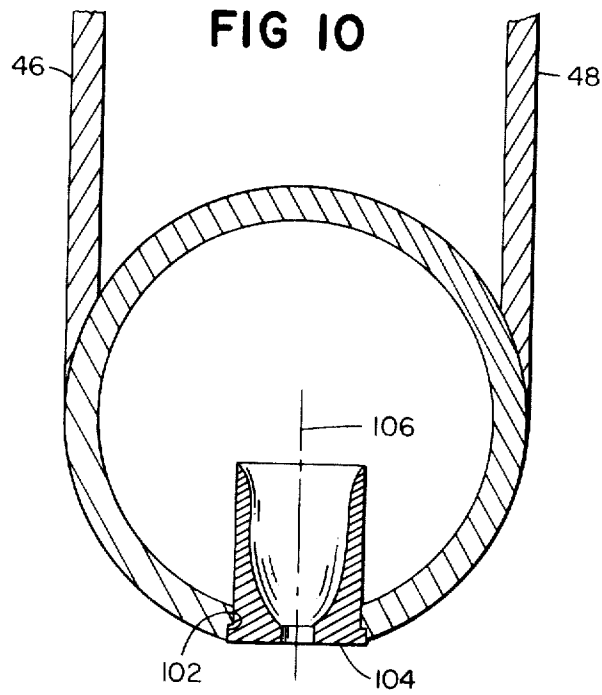












EMBEDDING CABLELIKE MEMBERS

This invention relates to embedding cablelike members under water.

A primary object of the invention is to provide for embedding cable, conveniently and effectively at desired depth along the full length to be buried, with equipment that is light weight, easily transported, simple, inexpensive, efficient, and reliable in operation under all conditions and in various types of soil. Other objects are to avoid damage to the cable (e.g., from excessively sharp bending, from abrasion against the embedding mechanism, or from obstacles in the soil); to make possible accurate, monitored placement of the cable, with minimum disturbance to the marine environment (e.g., by limiting soil displacement); and to permit embedding of already laid cables, and cables with enlarged portions such as splice cases or amplifier housings; all with a minimum of equipment peripheral to the embedding mechanism itself (e.g., frequently without water surface vessels), and in a manner particularly suitable for burial under shallow water.

In general the invention features a water bed contacting support assembly, an entrance guide having a longitudinal axis, a depressor extending generally along a continuation of the axis rearward of the entrance, a jet assembly extending beneath the depressor, and, connected to the jet assembly, a source of fluid under pressure for creating a jet flow at a flow rate sufficiently high and a pressure sufficiently low to temporarily liquefy water bed soil in the path of the cable without substantial permanent soil displacement. In preferred embodiments the entrance guide is a bellmouth; the support assembly has a pair of runners generally parallel to the bellmouth axis; the flow rate is at least 500 gallons/minute and the pressure no more than 150 p.s.i.; the jet assembly includes a manifold pipe at 45° to the water bed providing bottom protection for the cable, the jet being in a plane including the bellmouth axis; the depressor is removably supported between a pair of cable-guiding plates spaced to allow entrance of the cable therebetween from above, the guide itself being a curved plate removal of which is facilitated by a sprocket wheel and chain drive, the sprocket wheel being mounted on a removable shaft between the plates; the bellmouth has a removable upper wall to allow entrance of the cable from above; an obstacle plate is secured beneath the bellmouth; the plates, bellmouth, and manifold are supported by the runners through bracing members, the manifold-bracing members being pipes that carry water to the manifold, the plates, bellmouth, runners, and manifold thereby being mutually supporting, with no independent framework that might block entrance of the cable into the device; the jet is through individual nozzles mounted in openings in the manifold, so that the nozzles can be changed for varying soil conditions; an attitude sensor is provided to signal the attitude of the runners with respect to the water bed and thereby monitor the embedding process; and the embedding device is towable from shore, and is provided with jet water under pressure from a separately floated pump in turn towed by the embedder.

Other objects, features, and advantages will appear from the following description of a preferred embodiment of the invention, taken together with the attached drawings, in which:

FIG. 1 is an overall diagrammatic view showing the cable embedder in operation;

FIG. 2 is a perspective view of the embedder;

FIG. 3 is a top plan view;

FIG. 4 is a side elevational view;

FIG. 5 is an exploded view of the bellmouth;

FIG. 6 is a sectional view taken along 6—6 of FIG. 3;

FIG. 7 is a sectional view taken along 7—7 of FIG. 3;

FIG. 8 is an enlarged view of a portion of FIG. 7;

FIG. 9 is a sectional view taken along 9—9 of FIG. 8;

FIG. 10 is a sectional view through the jet manifold; and

FIG. 11 is an elevational view broken away of the attitude sensor.

Referring to the drawings, the cable 20 (FIG. 1) to be buried in water bed 22 extends on floats 24 between shores,

passing through embedder 26 towed from shore through cable 28 and in turn towing, through cables 30, water pump 32 on float 34.

Embedder 26 (FIGS. 2-4) has two runners 40, 42 between which are supported bellmouth 44, vertical side plates 46, 48, and jet manifold 50.

Runner 42 (with which runner 40 is identical) has flat base 60, sloping sides 62, 64, forwardly angled toe plate 66, sloping mud plate 67 extending upwardly from plate 66, and internal stiffeners 68. Towing eye 70 and lifting eyes 72 and 74 are provided.

Support and flow pipe 80 is secured to runners 40 and 42 by brackets and tie bands (e.g., bracket 84 and tie band 86 on runner 42), extends transversely to the runners beneath bellmouth 44, and is connected to manifold 50 extending downwardly and rearwardly at 45° to base 60. Abutment guides 90 on pipe 80 (FIG. 6) cooperate with the pipe-supporting brackets to transversely locate the manifold. The ends of pipe 80 are capped, and water input connections 92, 94 are provided for flexible pipes 96, 98 carrying water from pump 32.

Manifold 50 is welded to the sloping edges 100 (FIG. 4) of plates 46, 48, and has a row of nine nozzle holes 102 (FIG. 10) in each of which is secured a replaceable nozzle 104 (¾-inch diameter flow passage) having a flow axis 106 in a plane parallel to and midway between plates 46 and 48 and at about 45° to the plane of runner base 60.

Bellmouth 44 has its top, bottom, and sides curved concave outwardly from a wide entrance 110 to a narrow neck 112. Fairing 114 at the mouth and 116 at the neck is provided to protect the cable. Top 122 is removable, and is bolted to the sides. Struts 130, 132 are secured between the sides of the bellmouth and pipe 80 for structural support. Neck 112 extends into the space between plates 46, 48 (FIG. 7).

Plates 46, 48 are held in place by support pipes 140, 142 which extend from the plates respectively to brackets and tie straps (e.g., 144, 146) on the runners (these pipes being transversely located in the same manner as pipe 80), and by struts 148, 150 which run between the plates and pipe 80.

A curved cable depressing plate 160 (FIG. 4, 7-9) with side flanges 162, 164 and fairing 166, 168 is supported between plates 46 and 48 in tracks provided on the inner plate surfaces by upper guides 170, 172 and lower guides 174, 176, the depressor extending generally along a continuation of the longitudinal axis 225 (FIG. 4) of the bellmouth, to avoid sharp bending of the cable, and being locked in place by bolt 178 passing through plates 46 and 48 and fairing 166. A chain 180 is fixed to the upper surface of depressor 160. Sprocket wheel 182 is splined to shaft 184 journaled above the chain (wheel 182 being in mesh with the chain) in bearings 186, 188 carried respectively by plates 46, 48. Nut 190 holds the shaft in place, and hex head 192 is provided at the other end of the shaft, so that the shaft can be rotated with a wrench, thereby to rotate sprocket wheel 182. Spacer 194 locates wheel 182 on shaft 184. Depressor 160 extends to the rear edges of plates 46, 48, below the runners by the desired depth of burial.

Rock obstacle plate 200 (FIG. 2) is mounted under the bellmouth and slopes downwardly and rearwardly.

Attitude sensing assembly 210 (FIG. 11) is mounted on runner 40 (FIG. 3) on a shock pad. Inside sealed case 212 are mounted mercury tilt bottles 214 and pendulum potentiometers 216. Electrical cable 218 is connected at one end of casing 212 and provides for transmission of electrical signals to a remote indicator (not shown) or alarm. Potentiometers 216 are at zero position and bottles 214 are nonconducting when runners 40 and 42 are horizontal. When embedder 26 tilts, the potentiometers give a continuous attitude indication, and bottles 214 can be arranged to signal when a critical angle of tilt is exceeded.

In operation, cable 20 passes through and generally along axis 225 of bellmouth 44, and then between depressor 160 and manifold 50, all as the embedder is towed on runners 46, 48 from right to left as shown in FIG. 1. Pump 32 draws water

from over the side of float 34 through a suction pipe 227 and pumps it to pipe 80 through which it reaches nozzles 104 to produce jets in a vertical plane including axis 225. The water flow rate is 600 gallons/minute (preferred range is over 500 gallons/minute, with the practical minimum being about 300 gallons/minute) and the pressure drop across the nozzles is 100 p.s.i. (preferred range is 50-150 p.s.i., with the practical maximum being about 300 p.s.i.) to fluidize the soil between the runners into a water-soil slurry, without much permanent soil displacement, to allow passage of manifold 50 and plates 46, 48. Soil fluidization allows for efficient use of available power. The cable passes out the rear of the embedder in position below the surface of bed 22, and the fluidized soil settles back into place, effecting the embedment. Manifold 50 provides bottom protection for the cable.

Floats 24 are manually detached as they approach the bellmouth.

When a splice box 229 (FIG. 1) too big to pass through the embedder approaches, bellmouth top 122 and locking bolt 178 are removed, shaft 184 is rotated to drive depressor 160, through chain 180, up and out from between plates 46 and 48 (the final removal of the depressor being manual), and nut 190 is taken off to allow removal of shaft 184 and wheel 182. Cable 20 can now be lifted out of the embedder to allow passage of the splice box. During all this the jets are kept in operation so that soil fluidization will continue, enabling manual burial of the portion of the cable including the splice box. Removed parts are then replaced and normal procedure is resumed.

The procedure just described also allows an already laid cable to be inserted in the embedder at an intermediate point in the cable.

Sensor 210 allows determination of whether runners 40, 42, are flat on bed 22, as they should be for proper burial at the desired depth.

Plates 62, 64, and 67 on the runners prevent mud from covering the runners when they partially sink into the bed. Sinkage of the runners is reduced by the slope of plates 67.

Other embodiments will occur to those skilled in the art and are within the following claims.

What is claimed is:

1. Apparatus for embedding a cablelike member under water, comprising
 - a water bed contacting support assembly,
 - an entrance guide having a longitudinal axis,
 - a depressor extending generally along a continuation of said axis rearward of said entrance guide,
 - a jet assembly extending beneath said depressor, and, connected to said jet assembly,
 - a source of fluid under pressure for creating a jet flow at a flow rate sufficiently high and a pressure sufficiently low to temporarily liquefy water bed soil in the path of said member without substantial permanent soil displacement, said flow rate being at least 300 gallons/minute and said pressure being no more than 300 p.s.i.
2. The apparatus of claim 1 wherein said support assembly comprises a pair of runners extending generally parallel to said axis and said entrance guide is a bellmouth.
3. The apparatus of claim 1 wherein said flow rate is at least 500 gallons/minute and said pressure is no more than 150 p.s.i.
4. The apparatus of claim 1 wherein said jet assembly includes nozzles having axes arranged to be oblique to the water bed during operation.
5. The apparatus of claim 4 wherein said nozzle axes are arranged to be at 45° to said bed.
6. The apparatus of claim 1 wherein said jet assembly includes a manifold pipe extending beneath said depressor, and a pair of cable-guiding walls define with said depressor and said manifold pipe a passage for said member, said manifold pipe

providing bottom protection for said member.

7. The apparatus of claim 4 wherein said nozzle axes are in a plane including said longitudinal axis.

8. The apparatus of claim 1 wherein said depressor is supported between a pair of cable-guiding walls open at the top.

9. The apparatus of claim 8 wherein said depressor is a curved plate supported in tracks mounted on said walls, and a chain and sprocket wheel are respectively secured to said depressor and said walls to facilitate removal of said depressor.

10. The apparatus of claim 1 wherein said depressor extends below said support assembly by the desired depth of burial.

11. The apparatus of claim 9 wherein said sprocket wheel is mounted on a removable shaft between two plates providing said walls.

12. The apparatus of claim 8 wherein said entrance guide has a removable top to allow entrance of said member therein to from above.

13. The apparatus of claim 1 wherein an obstacle plate is obliquely secured below said guide.

14. The apparatus of claim 1 wherein said jet assembly includes a manifold pipe in which are mounted a plurality of replaceable nozzles.

15. The apparatus of claim 10 wherein an attitude sensor is provided to monitor the orientation of said support assembly, thereby to determine whether burial to the desired depth is being accomplished.

16. The apparatus of claim 1 wherein said apparatus is towable from shore, and includes a separately floated and towed pump.

17. The apparatus of claim 1 wherein said support assembly comprises a pair of runners extending generally parallel to said axis and having sloping sides and a sloping front mud plate,

said jet assembly includes a manifold connected to said runners by a support pipe also acting as a conduit to carry water to said manifold,

said entrance guide is a bellmouth effectively supported by said runners and having a removable top,

said depressor is a curved plate slidable between a pair of spaced plates parallel to said axis,

said depressor and said manifold bounding a passage through which said member moves when said apparatus is in operation,

said manifold being at 45° to said water bed,

said depressor and said plates extending below said runners by the desired depth of burial, and

an obstacle plate is obliquely mounted below said bellmouth,

said bellmouth, plates, manifold, and runners being effectively mutually self-supporting, without independent framework to block entrance of said member into said device at an intermediate point of said member.

18. Apparatus for embedding a cablelike member under water comprising

a water bed contacting support assembly,

an entrance guide having a longitudinal axis,

a depressor extending generally along a continuation of said axis rearward of said entrance guide,

a jet assembly including a manifold pipe extending beneath

said depressor to provide bottom protection for said member,

said depressor being supported between a pair of cable-guiding plates, said depressor, manifold pipe, and plates defining a passage for said member,

said entrance guide having a removable top to allow entrance of said member thereinto from above, and, connected to said jet assembly,

a source of fluid under pressure for creating a jet flow against said water bed to allow burial of said member.

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REEXAMINATION CERTIFICATE (859th)
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Niederer [45] **Certificate Issued** **May 31, 1988**

[54] **EMBEDDING CABLELIKE MEMBERS**

[75] **Inventor:** Otto C. Niederer, Old Lyme, Conn.

[73] **Assignee:** Aqua-Tech, Inc., Norwick, Conn.

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[52] **U.S. Cl.** 405/159; 405/163;
405/171; 37/61

[58] **Field of Search** 405/154, 158, 163, 164,
405/168, 169

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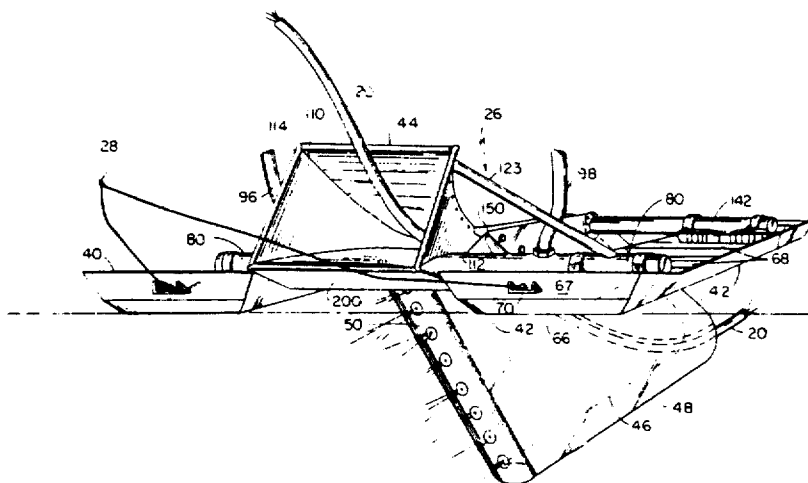
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Primary Examiner—Dennis L. Taylor

[57]

ABSTRACT

Cable embedment with apparatus comprising a water bed contacting support assembly, an entrance guide having a longitudinal axis, a depressor extending generally along a continuation of the axis rearward of the entrance, a jet assembly extending beneath the depressor, and, connected to the jet assembly, a source of fluid under pressure for creating a jet flow at a flow rate sufficiently high and a pressure sufficiently low to temporarily liquify water bed soil in the path of the cable without substantial permanent soil displacement.



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REEXAMINATION CERTIFICATE ISSUED UNDER 35 U.S.C. 307

THE PATENT IS HEREBY AMENDED AS
INDICATED BELOW.

Matter enclosed in heavy brackets **[]** appeared in the patent, but ~~has~~ been deleted and is no longer a part of the patent; matter printed in italics indicates additions made to the patent

AS A RESULT OF REEXAMINATION, IT HAS
BEEN DETERMINED THAT:

The patentability of claim 18 is confirmed.

Claims 1, 2, 4, 5, and 7-17 are cancelled.

Claims 3 and 6 are determined to be patentable as amended.

3. **[The apparatus of claim 1]** *Apparatus for embedding a cablelike member under water, comprising a water bed contacting support assembly, an entrance guide having a longitudinal axis, a depressor extending generally along a continuation of said axis rearward of said entrance guide,*

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a jet assembly extending beneath said depressor, and, connected to said jet assembly, a source of fluid under pressure for creating a jet flow at a flow rate sufficiently high and a pressure sufficiently low to temporarily liquefy water bed soil in the path of said member without substantial permanent soil displacement,

wherein said flow rate is at least 500 gallons/minute and said pressure is no more than 150 p.s.i.

6. **[The apparatus of claim 1]** *Apparatus for embedding a cablelike member under water, comprising a water bed contacting support assembly, an entrance guide having a longitudinal axis, a depressor extending generally along a continuation of said axis rearward of said entrance guide, a jet assembly extending beneath said depressor, and, connected to said jet assembly, a source of fluid under pressure for creating a jet flow at a flow rate sufficiently high and a pressure sufficiently low to temporarily liquefy water bed soil in the path of said member without substantial permanent soil displacement, said flow rate being at least 300 gallons/minute and said pressure being no more than 300 p.s.i.,*

wherein said jet assembly includes a manifold pipe extending beneath said depressor, and a pair of cable-guiding walls define with said depressor and said manifold pipe a passage for said member, said manifold pipe providing bottom protection for said member.

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