A system for anchoring submarine pipelines by forming a continuous anchor having the shape of a dumbbell tube and constructed from an elongated envelope of plastic filter material which is seamed at sea and filled with ballast during its installation at its final position on the sea bottom. Alternatively, the dumbbell tube may be formed and filled with ballast and be installed continuously and simultaneously with the installation of the pipe sections comprising the submarine pipeline.

14 Claims, 18 Drawing Figures
METHOD AND APPARATUS FOR A CONTINUOUS DUMBELL TUBE ANCHORING SYSTEM FOR SUBMARINE PIPELINES

BACKGROUND OF THE INVENTION

1. Field of the Invention
This invention relates to the forming and installing of an anchoring system for submarine pipelines beneath a body of water such as on the sea floor. There are presently many varied uses for submerged conduits or pipelines installed on the sea floor. These include off-shore supply piping for loading ships such as slurry carriers for loading of tankers and the like and for off-shore gas and oil well delivery systems. However, various problems have occurred relative to the installation and maintenance of these underwater pipeline systems. Because of the natural forces of ocean currents and wave action which are normally transmitted to the bottom of the sea in shallow waters, it is necessary to secure or anchor underwater pipeline systems sufficiently in order to prevent scouring or eroding of the pipeline system by these natural forces.

2. Description of the Prior Art
Systems presently being employed for anchoring underwater pipelines include weightings the pipeline down with a concrete jacket and utilizing discrete components such as anchoring pilings and clamps located at spaced locations along the pipeline to prevent lateral movement. However, these prior art anchoring systems are vulnerable to the undermining of the sea bed caused by the interaction of the natural current forces with the pipe such that the bottom material is eventually eroded away adjacent to the pipe, thereby causing scouring of the support means by the flowing of water beneath it. A further disadvantage of the prior art systems is the necessity for the services of divers who must actually work on location on the ocean bottom in order to install these known systems.

Another system for anchoring submerged conduits and pipelines and which comprises a basic improvement over heretofore known systems is disclosed by the Keith U.S. Pat. application Ser. No. 273,447, filed July 20, 1972. This latter system comprises a means for anchoring submerged conduits or pipelines wherein an elongated, flexible envelope is partially filled with a non-soluble particulate matter. The structure of the envelope defines a pair of laterally disposed lobes such that the envelope assumes a dumbbell shape in cross section. The central portion of the envelope comprises a web that is disposed over the conduit so that the lobes of the dumbbell will lie on either side of the submerged pipeline. As such, the particulate matter serves to weigh down or ballast each side of the envelope and causes the web portion to anchor the interposed section of piping. The subject matter of the instant invention comprises an improvement in the form of a method and apparatus for continuously forming and installing the basic anchoring system disclosed by this latter application.

SUMMARY AND OBJECTS OF THE INVENTION

It is therefore an object of the present invention to provide a method and apparatus for forming and installing an anchoring system for submerged conduits or pipelines which will overcome the inherent limitations and disadvantages of the known prior art systems.

It is another object of the present invention to provide an anchoring system for submerged pipelines such that the system will be resistant to the natural forces of ocean currents and wave actions as well as severe weather conditions.

It is still another object of the present invention to provide an anchoring system of the aforementioned character having an effective high weight characteristic and an economical cost per unit length factor.

It is still a further object of the present invention to provide a method and apparatus for continuously forming and installing an anchoring system of the above character along a submerged conduit or pipeline system.

Another object of the present invention is to provide a method of forming and installing an anchoring system of the above character such that the system can be installed simultaneously and continuously with the installation of the pipeline.

It is yet another object of the present invention to provide an anchoring system which requires no drilling and placement of anchor pilings as are presently necessary with the known systems.

The anchoring method and apparatus of the present invention are adapted to be utilized in a manner which will continuously anchor the conduit or pipeline system that has been submerged into position on the ocean floor. The material used for forming the elongated tube having a dumbbell cross section is provided in roll form having the proper width. The material is fed around a form having a final tube inside diameter and is sealed. The particulate matter forming the ballast is then fed through a pipe inside the form and to the distribution points along the ocean floor. The sealed tube is fed to the sea bottom on the outside of the pipe conveying the particulate matter such that, as the loading system is continuously advanced, the particulate ballast material is deposited on both sides of the submerged pipeline, thereby filling the tube with the desired amount of ballast material and producing the dumbbell or double lobe configuration. Alternatively, as the pipeline is being laid in sections, the dumbbell envelope tube can be placed directly on the sections during the laying thereof with the roll of tube material being provided adjacent the pipe laying ship. The tube material is formed and sealed on the ship and proceeds to the ocean floor as a part of the pipeline being laid. The ballast material is then introduced into the tube to form the dumbbell shape at the ocean floor as the pipeline is placed in its final position. At the completion of the installation by either method, the envelope tube can then be closed by utilizing clamps installed by a driver. However, weights could also be used by attaching them to the end of the tube after it has passed through the seamer mechanism so that they can effectively close the end of the tube when they reach the ocean floor.

BRIEF DESCRIPTION OF THE DRAWINGS
These and other objects and features of the instant invention will become apparent from the following description and claims when taken in conjunction with the accompanying drawings wherein:

FIG. 1 is a plan view of a first embodiment of the continuous anchoring system forming apparatus of the present invention;
FIG. 2 is a side elevation view of the anchoring system forming apparatus of FIG. 1;
FIG. 3 is an enlarged fragmentary plan view of the dumbbell tube forming and filling area of the anchor system forming apparatus as viewed on the line 3—3 of FIG. 2.

FIG. 4 is a side elevation view of the apparatus of FIG. 3.

FIG. 5 is an enlarged fragmentary horizontal sectional view taken along the line 5—5 of FIG. 2.

FIG. 6 is a fragmentary side elevational view as seen along the line 6—6 of FIG. 5.

FIG. 7 is an enlarged fragmentary transverse sectional view taken along the line 7—7 of FIG. 5.

FIG. 8 is an enlarged transverse sectional view taken along the line 8—8 of FIG. 5.

FIG. 9 is a plan view of a second embodiment of the apparatus for forming and installing the anchoring system of the present invention;

FIG. 10 is a side elevation view of the apparatus of FIG. 9.

FIG. 11 is an enlarged fragmentary plan view taken along the line 11—11 of FIG. 10.

FIG. 12 is an enlarged fragmentary elevational view taken on the line 12—12 of FIG. 9.

FIG. 13 is a fragmentary side elevation view of the anchoring system being installed by the apparatus of the second embodiment;

FIG. 14 is a transverse sectional view taken along the line 14—14 of FIG. 13;

FIG. 15 is a transverse sectional view taken along the line 15—15 of FIG. 13;

FIG. 16 is a plan view of FIG. 13;

FIG. 17 is a transverse sectional view of an alternate form of an anchoring system formed and installed by the apparatus of the second embodiment;

FIG. 18 is a transverse sectional view showing the apparatus utilized to form and install the anchoring system of FIG. 17.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGS. 1—4 of the drawings, there is depicted an apparatus 1 of the present invention for forming and installing an anchoring system for a submerged submarine pipeline. A sea going vessel 3 which may be in the form of a barge or the like, includes a compartment 5 for storing a ballast material 6 utilized in forming the anchoring system. This latter material may comprise any suitable weighty particulate material such as sand, cement or concrete and the like. The preferred ballast material is iron sand or titaniferous magnetite beach sand.

Secured to the barge 3 is a support framing 7 upon which is supported a roller spool 9 of a substantially flat web material 11 which is used for forming the elongated tubular envelope that contains the ballast material. The web 11 may be porous and permeable or impermeable, depending upon the type of ballast material 6 being used. Preferably, the material making up the web 11 may be a porous woven plastic fabric which is resistant to the natural eroding and deteriorating factors of the water environment. The dispensing of the web 11 from roller spool 9 is effected by means of a pair of material feed rollers 13 which are power driven by means of a variable speed motor 15.

The rollers 13 feed the web 11 to an envelope forming means which comprises a tube forming plate 17 and a tube form means 19. The sealing or seaming together of the edges of the web is effected by means of a well-known seaming means 21. This latter device may be in the form of a heating means for joining together the edges of the web 11 if plastic web material is being utilized. Alternatively, seaming means 21 may be in the form of any suitable apparatus for sewing, stapling or cementing the edges of the web 11 together such that a sufficiently strong joint is produced with lasting qualities for the water environment within which it will be ultimately placed.

Disposed coaxially in relationship with the tube form means 19 is a filler hose 23 which is preferably made of flexible material. The end of the filler hose 23 at this point is connected to a ballast fill line 25 which receives the ballast material from a ballast mixing tank 27 which may be provided with a pump (not shown) in its lower section. Ballast contained within tank 27 is conveyed thereto by means of a feed conveyor 29 which draws from the ballast supply 6 contained within compartment 5.

A formed and sealed tubular envelope 30 is passed downwardly to an ocean floor 31 on top of a submerged pipeline 33. As seen in FIG. 2, the flexible filler hose 23 is contained within the envelope 29 which has been formed therearound. To the end of the filler hose 23 at the ocean floor is secured a bifurcated or Y shaped flexible splitter hose 35. This latter member is depicted in FIGS. 5—7 wherein there is shown adjacent the base of the bifurcation of hose 35 a guide roller 37 which is adapted to ride in a guiding manner on top of the submerged pipeline 33. Also connected to the splitter hose 35 is a spreader bar 39 with guide rollers 41 secured thereto for contacting the lateral or side portions of the pipeline 33.

FIG. 8 shows the installed anchoring system over the submerged pipeline 33. The tubular envelope 30 containing the ballast material 6 assumes a double-lobe dumbbell shape which straddles the pipeline 33 and anchors same to the ocean floor 31.

Referring now to FIGS. 9 and 10, there is depicted a second embodiment of an apparatus for forming and installing the anchoring system of the present invention. In this embodiment, a barge or similar sea-going vessel in the form of a ship or the like that is adapted for carrying and laying a plurality of pipe sections 103 which, when joined together, make up a submerged pipeline 105. The barge 100 is provided with a compartment 107 for containing a ballast material 109. A feed conveyor 111 conveys the ballast material 109 to a ballast mixing tank 113. The latter tank may be provided with a pump (not shown) in its lower section. The ballast material is conveyed through a ballast fill line 115 to a filler hose 117.

The forming of the envelope portion of the anchor system by the apparatus of this second embodiment is shown in FIGS. 11 and 12. A roller spool 119 stores a roll of a substantially flat web material 121 utilized for forming an envelope 123 for containing the ballast material 109. The web 121 is dispensed from spool 119 by means of a pair of feed rollers 125 driven by a variable speed motor 127. The web 121 then passes around a tube forming plate 129 and is curved by a tube form means 131. A sealing or seaming means 133 is disposed above the tube form means 131 for seaming the edges of the web 121 together to form the envelope 123 in the same basic manner as outlined above for the first embodiment. As is evident in FIGS. 11 and 12, the pipe
sections 103 making up the submerged pipeline 105 are joined together and passed through a framework 135 supporting the web supply spool 119, tube form means 131 and seaming means 133. As seen in FIG. 12, the completed envelope 123 containing the filler hose 117 is draped over the joined pipe sections 103 being advanced to the ocean floor to form the submerged pipeline.

The other end of the filler hose 117 reaching down to the ocean floor is connected to a bifurcated or Y-shaped splitted hose 137 shown in FIGS. 13-16. As in the case of the first embodiment, the splitter hose 137 is provided with a brace or spreader bar 139 having attached thereto a guide roller 141 for guiding contact with the upper portion of the submerged pipeline 105.

FIGS. 17 and 18 show an alternate form of filling the envelope 123 by the apparatus of the second embodiment. As seen in FIG. 17, the envelope 123 completely encloses the joined pipe sections 103 as they are being laid to form the submerged pipeline 105. Also enclosed within envelope 123 is a single ballast fill line 143 that is supported by a bracing means 145 having a guide roller 147 associated therewith. By virtue of this alternate arrangement where in only a single fill line 143 is employed, the resulting anchoring system, as shown by FIG. 18, completely encloses the submerged pipeline 105.

MODE OF OPERATION

The basic mode of operation for the continuous forming and installing of the anchoring system of the present invention is basically the same for the two embodiments of the apparatus discussed above. The main difference being in the simultaneous laying of both the pipe and the anchoring system by the second embodiment whereas the first embodiment lays the anchoring system over the already submerged pipeline.

The system is initiated by drawing the web material from its supply spool by means of power driven feedrollars. The webbing is then passed around a tube forming plate and a tube form means wherein it is bent into a basic tubular envelope shape. The edges of the envelope are then sealed. The end of the envelope thus formed is clamped shut and pulled along the outside of the splitted section of the filler hose. The end of the envelope is then pulled forward a short distance for initial filling on its bottom in order to establish the necessary weight for placement over the submerged pipeline. The ballast material is then conveyed from the storage compartment to the mixing tank and through the fill line to the filler hose. As the ballast material is ejected out the bifurcated legs of the splitted hose, the latter is pulled through the continuously forming envelope by means of guide rollers contacting the top and side portions of the submerged pipeline. The envelope being draped over the submerged pipeline will fill with ballast material thereby forming two lobe sections having the shape of a dumbbell. The top section of the envelope is essentially in the form of a web which, by virtue of the weight of the ballast material contained in the lateral lobe sections, serves to weigh or anchor the submerged pipeline down upon the ocean floor.

In general, the ballast can be loaded into the tube in either a dry or wet state. Preferably, however, the ballast material is mixed with water to form a slurry and is transported in slurry form to the sea bottom, that is to say, to the end of the splitted hose. At its location of interjection, the ballast settles and is retained by the dumbbell tube, however, the supporting water flows out to the permeable fabric of the tube and through the holes between the tube fibers. In general, the fiber spacing of the material of which the tube is made is close enough to retain ballast, but allows the water to pass away.

While various particular structures are shown in illustrating the preferred embodiments of the present invention, it would be understood that many modifications and adaptations of the invention will occur to those skilled in the art to which it is directed. For example, the rollers in variable speed motor used for feeding the tube may or may not be necessary once operation has been started since the dumbbell tube will be held on the sea bottom by its own weight and, as the dispensing barge advances, the additional tubing will be pulled off the feed roll without the necessity for the assistance of the variable speed drive mechanism. Accordingly, the invention as disclosed here should be taken in a general sense as including such departures from the present disclosure as come within knowledge or customary practice in the art to which the invention pertains, and as may be applied to the essential features hereinafter set forth and fall within the scope of the invention or the limits of the appended claims.

1. An apparatus for continuously forming and installing an anchoring system for submerged pipelines comprising in combination: a storage means for containing a supply of ballast material; a tube material supply means; an envelope forming means for receiving material from the tube material supply means for forming an elongated tubular envelope therefrom for installation over the submerged pipeline; a distribution means for filling the tubular envelope with ballast material after the tubular envelope has been installed over the submerged pipeline; and a conveying means for conveying the ballast material from the storage means to the distribution means.

2. The apparatus of claim 1 wherein the distribution means includes a sea-going vessel.

3. The apparatus of claim 1 wherein the envelope forming means includes: a tube form means; and a seaming means for seaming the tube formed by the tube form means.

4. The apparatus of claim 1 wherein the distribution means includes: a filler hose having one end connected to the conveying means for receiving the ballast material; and a Y-shaped splitter hose section connected to the other end of the filler hose for straddling the submerged pipe line and distributing the ballast material into the elongated tubular envelope.

5. The apparatus of claim 4 wherein the Y-shaped splitter hose section includes: a roller in guiding contact with the top portion of the submerged pipeline; and a spreader bar having secured thereto a plurality of rollers in guiding contact with the side portions of the submerged pipeline.

6. The apparatus of claim 1 wherein the tube material supply means includes: a roller spool means for storing and dispensing a roll of tube material; and a power-operated feed means for feeding the tube material from the roller spool means to the envelope forming means.

7. The apparatus of claim 1 wherein the conveying means includes: a feed conveyor; a ballast mixing tank for receiving ballast material fed by the feed conveyor;
and a ballast fill line for conveying the ballast from the mixing tank to the distribution means.

8. A method of continuously forming and installing an anchoring system for submerged pipelines comprising the steps of: shaping a substantially flat web of material into a tubular shape; seaming the edges of the tubular shaped web to form an elongated envelope; substantially continuously depositing the elongated envelope at least partially around the pipeline; and filling the deposited elongated envelope with ballast material.

9. The method of claim 8 wherein the elongated envelope has a central web portion and laterally extending lobe portions which define enclosing volumes for receiving the ballast material.

10. The method of claim 8 wherein the filling of the deposited envelope with ballast material is effected by means of a filling hose that is being continuously pulled through the envelope.

11. The method of claim 8 wherein the ballast material is a material selected from the group consisting of titaniferous magnetite beach sand and concrete.

12. The method of claim 8 including inserting the pipeline within the elongated envelope.

13. The method of claim 8 wherein the pipeline is laid simultaneously with the continuous depositing of the elongated envelope.

14. The method as in claim 8 further including the step of mixing the ballast material with a liquid to form a slurry thereof which is deposited in said elongated envelope.

* * * * *
It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the drawings, sheet 4, Figure 12, the reference numeral 117 should be 137. Sheet 6, Fig. 13, the reference numeral 117 should be 137, and the pair of numerals 18 with the accompanying arrows and dashed section line should be deleted; Fig. 14, the numeral 139 (lower occurrence) should be 137; Fig. 16, a dashed section line, with accompanying numerals 18 and arrows directed toward the right, should be drawn vertically across the left-hand portion of the figure midway between the numerals 105 and 190; Fig. 16, the numerals 105, 109, 117, 123, 137, 139 and 141 should be 105', 109', 117', 123', 137', 139' and 141', respectively; Fig. 17, the numerals 143 and 147 should be 117' and 141', respectively; Fig. 18, the numerals 105, 109 and 123 should be 105', 109' and 123', respectively.

In the specification, column 3, cancel line 31 and substitute --Fig. 16 is a fragmentary plan view of an alternate form of an anchoring system formed and installed by the apparatus of the second embodiment;--; cancel lines 32, 33 and 34 and substitute --Fig. 17 is a transverse sectional view through a portion of the system of Fig. 16 which extends upwardly toward the vessel;--; cancel lines 35, 36 and 37 and substitute --Fig. 18 is a transverse sectional view taken along the line 18-18 of Fig. 16--; Column 4, line 54 delete "filler" and substitute --bifurcated--; cancel "117" and substitute --137--. Column 5, line 5 cancel "117" and substitute --137--; cancel lines 9, 10 and 11 and substitute --The bifurcated or Y-shaped splitter hose 137 which reaches down to the ocean flow is shown in Figs. 13-15--; line 16, after "FIGS." insert --16--; lines 17, 18 and 21 cancel "123" and substitute --123--; line 19, cancel "103" and substitute --103--; lines 20 and 27 cancel "105" and substitute --105--; lines 22 and 25 cancel "143" and substitute --117--; line 23 cancel "147" and substitute --141--.

Signed and sealed this 11th day of March 1975.

(SEAL)

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks