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Luque

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[54] **ARTIFICIAL SEAWEED CUT FROM CONTINUOUS BAND**

[75] Inventor: **Rafael Fernandez Luque,** Rijswijk, Netherlands

[73] Assignee: **Shell Oil Company,** New York, N.Y.

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[52] **U.S. Cl.** ..... **61/3,** 61/72.1, 61/72.3, 114/.5 R

[51] **Int. Cl.** **E02b 3/04**

[58] **Field of Search** 61/3, 4, 1, 37, 38; 114/.5

[56] **References Cited**

UNITED STATES PATENTS

3,590,585 7/1971 DeWinter 61/3

3,745,771 7/1973 Rhodes et al. ..... 61/3 X

FOREIGN PATENTS OR APPLICATIONS

445,372 6/1927 Germany 61/37

Primary Examiner—Jacob Shapiro

Attorney, Agent, or Firm—Tom M. Moran

[57] **ABSTRACT**

This invention relates to a process for preparing artificial seaweed at the site where the seaweed is to be dropped into a body of water by (a) forming a continuous band of flexible, buoyant, synthetic polymer strands, (b) securing anchoring bodies transversely to the length of the polymer band at intervals along the length of the band, and (c) cutting the band between successive anchoring bodies. The invention also includes apparatus for carrying out the process.

7 Claims, 3 Drawing Figures

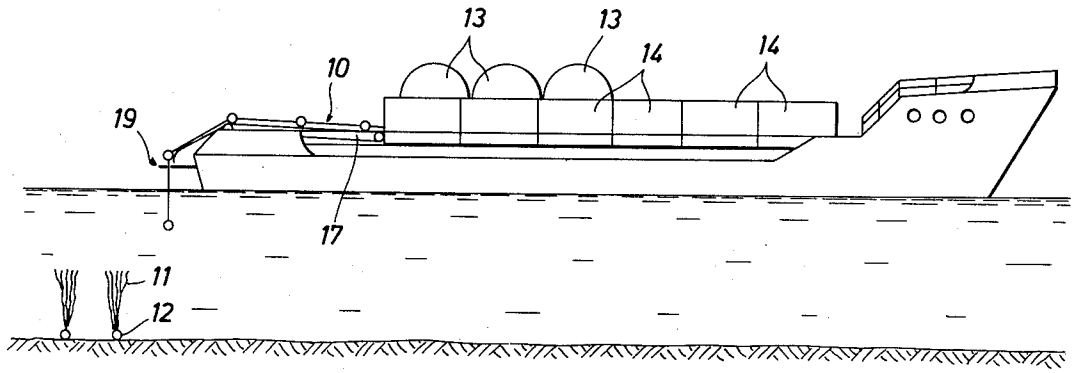


FIG. 1

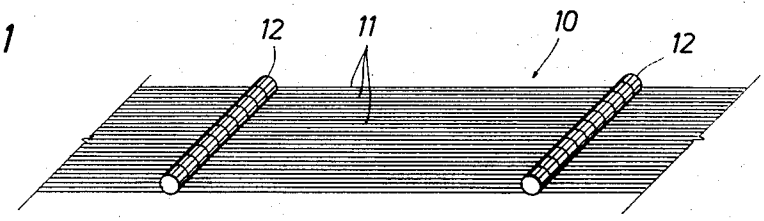


FIG. 2

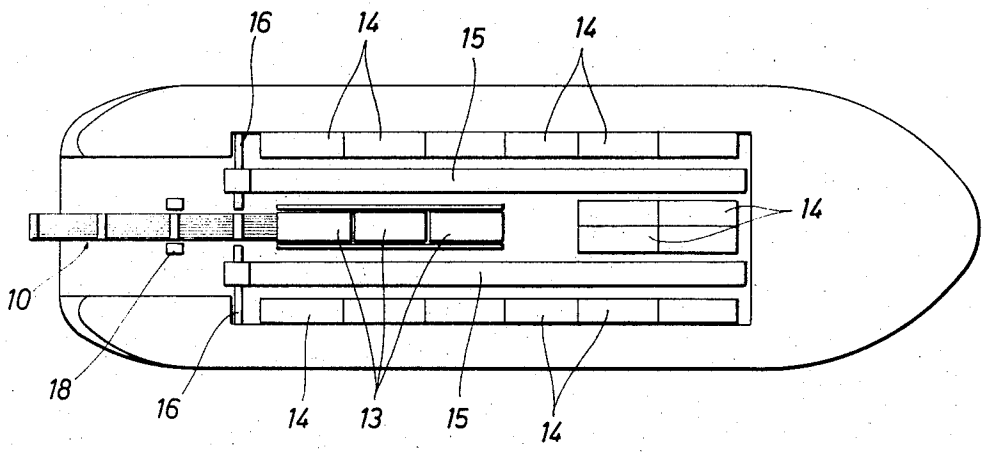
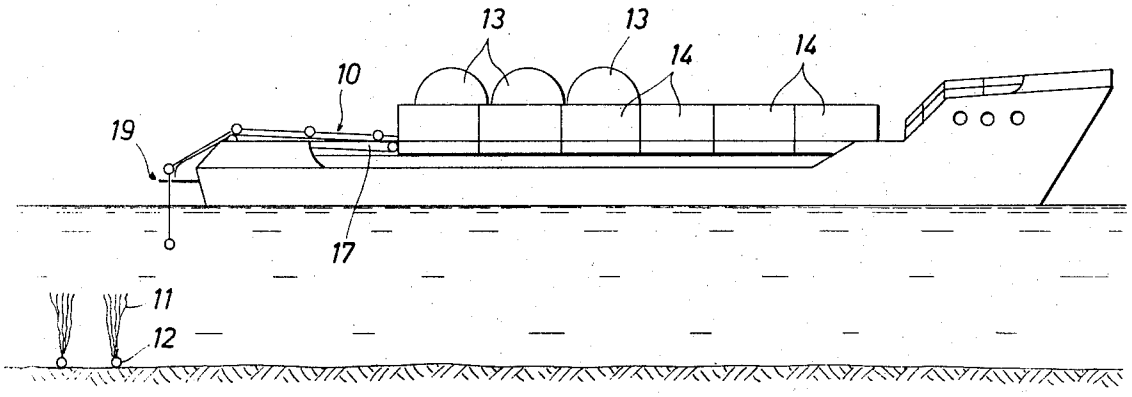


FIG. 3



ARTIFICIAL SEAWEED CUT FROM CONTINUOUS BAND

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention is directed to an improved process for making artificial seaweed, comprised of assemblages of buoyant, water resistent synthetic polymer strands and apparatus for making the seaweed. Such assemblages are useful as a means for influencing the migration of material at the bottom of bodies of water, as in combating coastal erosion.

2. Description of the Prior Art

As known heretofore and described, for example, in U.S. Pat. No. 3,299,640 to Nielsen, such a protective assemblage of artificial seaweed may consist of a wide screen formed by a large series of filamentary plastic elements or strands which are secured at one end to an anchoring means to be placed at the bottom of the sea. The strands have a lower density than water so that the screen formed of these elements will assume and retain an upright position in the water, thereby reducing currents in the surrounding water and promoting the deposition of sand or other solid materials entrained by the water. Erosion of sea-floors in coastal waters, which is sometimes a serious problem in the absence of sea vegetation, can thus be successfully combated not only at the shore of a body of water but also around structures erected on the sea-bottom, like landing-stages, piers, fixed drilling rigs, etc.

The filamentary elements known heretofore can be formed by a plurality of single or composite strands of a thermoplastic material. The strands may be solid material if the density of this material is less than that of water. It has also been proposed to use single hollow fibers closed at either end.

A preferred form of strands for use in artificial seaweed disclosed in U.S. Pat. No. 3,559,407 issued to Schuur Feb. 2, 1971 consists of elongated, flexible, buoyant strands, such as filaments or tapes having an open plexiform network structure surrounded with a substantially closed, thin-walled skin, such as are formed by extruding multicellular foam strands of a polyolefinic material having a density less than 300 g/l and subsequently stretching the strands in a ratio of at least 5:1. The strands are preferably made of polypropylene. In spite of the open internal structure of the elements, no substantial volume of water can penetrate into them because they have a relatively unbroken outer skin and because polypropylene is a non-water absorbent material. The air within the elements remains entrapped even under relatively high fluid pressures and continues to contribute greatly to the buoyancy of the elements.

It is desirable that the seaweed, once installed under water, has its strands extending freely and independently, forming a kind of screen in the water. This structure could be obtained by securing the strands individually in side-by-side arrangement, rather than in groups or bundles fastened jointly at spaced locations. Unfortunately, individual attachment of the lower ends of the strands to anchoring means in a regularly spaced side-by-side relationship is complicated and expensive and is therefore unsatisfactory or unacceptable for commercial utilization since these articles are typically required in very large volumes to protect an extensive coastal area and hence require only low-cost, easy-to-produce materials.

Heretofore if the strands were attached to an anchoring device prior to deposition of the seaweed, a problem experienced during the transport, handling and laying of the seaweed on the bottom of the body of water to be protected was that the strands became easily entangled especially when the strands were relatively long, e.g. 1–3 yards long.

U.S. Pat. No. 3,590,585 issued to De Winter July 6, 1971 disclosed an artificial seaweed which partially overcame the entanglement problem. That patent describes a seaweed wherein the strands (which are all connected to an anchoring means) are interconnected at spaced intervals along their length by filaments of a water-decomposable material. While this invention solved the entanglement problem, it is not entirely satisfactory since the preparation involves the cumbersome step of weaving the water-decomposable material among the polymer strands either before or after the anchoring device is attached.

According to the process of this invention the difficulties of the prior art can be effectively overcome.

SUMMARY OF THE INVENTION

A process of producing artificial seaweed, comprising

a. forming a continuous band of at least one flexible, buoyant, synthetic polymer strand,

b. securing anchoring bodies to the band at intervals along the length of the band, and

c. cutting the band between successive anchoring bodies to form individual seaweed units each composed of an anchoring body and a suitable length of strand.

Preferrably the band comprises a plurality of strands, the anchoring bodies are elongated in form, and the anchoring bodies are secured transversely to the length of the band. The process is best performed on a seaweed laying vessel in the area where the seaweed is to be dropped, and after the anchoring body is secured, it is hung overboard and the band is cut between the suspended anchoring body and the succeeding anchoring body.

Thus, by using the process of this invention, the seaweed units can be produced in large quantities cheaply without entangling the strands of each of the seaweed units.

The apparatus of this invention for producing artificial seaweed on a sea-going vessel, comprises

a reel support for holding a storage reel,

a storage reel carrying a band of flexible, buoyant synthetic polymer strands.

a belt conveyor positioned to support said band of strands as it is unwound and to move said band from the storage reel,

a means to drive said conveyor,

a means for transversely securing anchoring bodies to the band at intervals along the unwound section thereof while the band is on said conveyor belt, and

a cutting device for cutting the unwound section of the band between successive anchoring bodies to form said individual seaweed units, the cutting device being positioned on the vessel so that upon cutting the seaweed units fall into the body of water in which the vessel is navigating.

PREFERRED EMBODIMENTS

The first step of the process of this invention is the formation of a continuous bond comprising at least one flexible, buoyant synthetic polymer strand. Generally the band will have a plurality of strands which can be in the form of filaments, tapes or strips. The strands are composed of a synthetic polymer having a density less than that of water, i.e., they are buoyant, and thus the strands will be upright in the water. Suitable synthetic polymers are polyethylene and polypropylene. Foamed and stretched polypropylene strands are not only strong and have low-density but are also flexible, and are therefore particularly suitable for application as seaweed strands. The strands made according to the disclosure of U.S. Pat. No. 3,559,407 to Schuur are especially useful in this regard and to the extent is pertinent, the disclosure of that patent is incorporated by reference herein.

After the band of strands to be used in the process of this invention is formed it usually advantageous to wind the bond on a storage reel to be stored for use in the future, at which time the band can be easily unwound before going on to the next step of the process.

After the band is formed (or after it is unwound from the reel), anchoring bodies are attached to the band at intervals along the length of the bond.

The anchoring bodies can be any type of weight material and of any suitable shape as long as the weight is sufficient to keep the seaweed anchored to the bottom of the body of water in which they are placed. Preferably, these bodies are of elongated shape, such as cylinders, and are secured to the band of seaweed strands so as to extend transversely of the band. Examples of suitable anchoring bodies are metal or concrete bars, or elongated bags filled with granular weight material such as sand, earth, slag or gravel. An anchoring body is permanently connected to the band by using a water proof adhesive or by wrapping the end of the band about the anchoring body and fusing the strands of the band together by heat or the action of a solvent or adhesive.

The maximum length of the seaweed strands in the seaweed units is determined by the length of the interval between two successive anchoring bodies, which means that the length of the strands can be chosen as desired without restriction as to the maximum length. It is therefore possible to produce the seaweed units with strands having a length of, for example, three meters or longer. The use of such long strands permits a significant reduction in the installed total length of seaweed units per unit area of sea floor as compared with seaweed having strands of only two meters or less length. Since the costs of a seaweed project are for the major part formed by the installation costs, the longer seaweed strands permit a considerable saving in the total costs of the project for a similar or even better performance of the seaweed.

It is possible to supply the band of seaweed strands with transverse tubular anchoring socks adhesively or integrally attached thereto. These socks are to accommodate the anchoring bodies, and they also keep the seaweed strands together in the desired parallel arrangement. Therefore, the band does not contain "loose" strands which might become entangled. The strands become free at one end only at the moment that the band is cut between two successive anchoring bodies, and this moment can be postponed until the band of seaweed strands has been transported to the site above the area of application. By this cutting, no material is wasted.

The good accessibility of the transverse anchoring socks permits them to be filled easily with the anchoring bodies; if desired, from both ends of the sock. The installation of the seaweed can be carried out in a simple manner. For this purpose, the band with tubular socks is supplied wound on a storage reel on a seaweed laying vessel anchored above the area of intended seaweed application. A length of the band is unwound from the reel so that sand bags or other anchoring means can be inserted into the socks. The ends of the socks are then closed to lock the sand bags therein. The leading end of the unwound length of the band including the foremost sand-bag filled sock is hung overboard, and the band is cut between this sock and the next following sock, so that the cut-off portion, forming a seaweed unit with the plurality strands extending from the anchoring sock, drops to the sea floor. The whole operation can be carried out as a fully or as a step-wise continuous operation. An advantage is that the band of seaweed can be cut so that the formed units drop in the position they are required to assume underwater.

An example of the invention will be described with reference to the accompanying drawings, in which:

FIG. **1** shows a seaweed band as used in the present production method,

FIG. **2** is a plan view of a vessel for laying artificial seaweed, and

FIG. **3** is an elevation of the vessel of FIG. **2.**

In FIG. **1** a seaweed band **10** is shown as formed of a plurality of strands **11** extending lengthwise of the band in juxtaposed, parallel position. The strands are made of foamed and then stretched polypropylene material, being in the form of thin strips, a few millimetres wide, and having a density of 200 grammes per litre. Anchoring socks **12,** woven of the same material as the seaweed strands, are attached to or formed integrally with the seaweed band at regular intervals of three meters. The diameter of the socks **12** is 0.25 meter. The band **10** is factory-made on a weaving loom or otherwise, and is transported to the site of use wound on large reels. In this example, each reel is 3 meters in diameter and 1 meter wide, and contains a seaweed band 4200 meters long and 1 meter wide.

In FIGS. **2** and **3,** the seaweed laying vessel is shown with three such reels **13.** The vessel further carries 16 containers **14** filled each with 260 cylindrical sand bags of 1 meter length and 0.2 meter diameter. Each bag weighs 30 kg. The containers **14** are located alongside two belt conveyors **15.** Hydraulically operable pushing rods **16** are provided at the forward end of the conveyors **15** for pushing a sand bag carried by the conveyor belt into an anchoring sock of the seaweed band. A third belt conveyor **17** is provided for carrying the seaweed band unwound from the foremost reel **13** towards the aft of the deck. Along the belt conveyor **17,** a wire stapler **18** is placed for closing the ends of sand-bag filled anchoring socks **12.** An electric cutting device **19** is mounted at the back of the vessel for cutting the seaweed band into separate sections.

The vessel, when used for laying the seaweed, is shiftably anchored above the site of application. A length of the seaweed band is unwound from the foremost reel

13 and is moved forward on the belt conveyor 17. Sand-filled bags are taken from the containers 14 and placed at 3 meter intervals on the belt conveyors 15 which transport the bags towards the pushing rods 16. The equipment is operated so that at one moment a sand bag on each belt conveyor 15 is in aligned position between and with an anchoring sock 12 of the seaweed band and one of the pushing rods 16. At this moment, all three belt conveyors are stopped, and the pushing rods 16 are operated whereby a sand bag is fully inserted into the anchoring sock from either end thereof. The pushing rods are then retracted to their initial position, and the three belt conveyors are set in motion with synchronous speed until the belts have traversed a distance of 3 meters, whereupon they are once more stopped. In this position, the anchoring sock with inserted sand bags is located opposite the stapler 18 which is operated to close the ends of the sock with wire staples. At the same moment, another sand bag on each of the belt conveyors 15 is located between an empty anchoring sock and one of the pushing rods, whereupon the pushing rods are operated to push the sand bags into this anchoring sock.

Accordingly, the belt conveyors are operated periodically to move the belts over 3 meters, and during each stop two sand bags are inserted into an empty anchoring sock of the seaweed band by the pushing rods 16 whilst a sand-bag-filled anchoring sock is closed by the stapler 18. Thus the leading end of the seaweed band will comprise a section with at least two filled anchoring socks, and after this section has passed the belt conveyor 17 it hangs overboard in a vertical position at the aft of the deck. The seaweed band is then cut just underneath the second anchoring sock by the cutting device 19, whereby an individual seaweed unit is formed comprising one anchoring sock with seaweed strands. The seaweed units drops through the water in the position it is required to assume at the bottom of the sea. Therefore, there is little risk that ends of the seaweed strands would become trapped under the anchoring sock at the sea bottom. It will be clear that an individual seaweed unit is cut each time that the belt conveyors are stopped. With this procedure, the seaweed is laid at a rate of about one unit per 5 seconds. The 4200 units of the three reels 13 are therefore laid in about 7 hours, covering a seafloor area of about 8,400 m^2. During the seaweed laying operations, the vessel will be periodically shifted to drop the seaweed units at the desired location of the seafloor.

Although the invention has been described above with reference to sand-bag filled anchoring socks as the anchoring means for the seaweed, many other types of anchoring means may be chosen. For example, a complete anchoring device such as a concrete or metal bar may be attached to the seaweed band whilst the band is continuously or periodically advanced. If anchoring socks are used, these may suitably be arranged above the general plane of the seaweed band so that the empty socks will not tend to lay flat when the seaweed band is under tension and therefore will not obstruct the insertion of the sand bags. To further facilitate the insertion of the bags, sand bags may be used which are under vacuum. These bags are compact and rigid and behave like solid bars. Once inserted in the anchoring sock, the wall of the bag may be pierced to terminate the vacuum and the sand bag will regain its flexibility as is desired for adaptability to the contours of the sea floor.

We claim as our invention:

1. A process for producing artificial seaweed at the site where the seaweed is to be dropped into a body of water, comprising;
   a. forming a continuous band made up of a plurality of strands,
   b. securing elongated anchoring bodies transversely to the length of the band at intervals along the length of the band, said bodies or anchoring socks for said bodies being the only connections between said plurality of strands,
   c. cutting the band between the successive anchoring bodies as the continuous band is unwound from a storage reel at the site where the seaweed is to be dropped into the body of water to form individual seaweed units, each composed of an anchoring body and a plurality of strands extending therefrom.

2. The process of claim 1, wherein the anchoring bodies are sand-filled bags.

3. The process of claim 1 wherein the anchoring bodies are inserted in tubular socks attached to or integral with the band.

4. The process of claim 1 wherein the band is cut close to an anchoring body.

5. The process of claim 1, wherein the continuous band is unwound from a storage reel placed aboard a seaweed laying vessel, the anchoring bodies are secured to a part of the band unwound from the reel, and the band is cut to form the individual seaweed units which are immediately dropped overboard.

6. The process of claim 5, wherein the leading end of the unwound band including the foremost anchoring body is hung overboard the vessel, and the band is then cut between this anchoring body and the succeeding anchoring body.

7. Apparatus for producing artificial seaweed on a sea-going vessel, the apparatus comprising
   a reel support for holding a storage reel,
   a storage reel carrying a band of flexible, buoyant synthetic polymer strands,
   a belt conveyor positioned to support said band of strands as it is unwound and to move said band from the storage reel,
   a means to drive said conveyor,
   a means for transversely securing anchoring bodies to the band at intervals along the unwound section thereof while the band is on said conveyor belt, and
   a cutting device positioned on the boat at a point where the leading end of the unwound length of the band, having passed the belt conveyor, is hung overboard in a vertical position, said cutting device positioned relative to this leading end so that it cuts between the foremost anchoring body which is hung overboard and the next anchoring body so that upon cutting the individual seaweed unit is formed and falls into the body of water in which the vessel is navigating.

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