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Description

The invention starts from a process for laying out a covering over a structure laid under water or a strip of ground lying under water, the covering being so formed that filling material from a surface craft is controllably introduced under pressure into a flexible casing lying directly over the structure or the strip of ground.

In the British patent specification No. 1 585 170, a process for forming concrete structures for underwater pipelines is described. A flexible casing in the form of a bag of a length of about 4.5 m and a width of about 3.5 m is laid under or over the pipeline laid on the sea-bed. By means of a flexible pressure pipe, one end of which is fastened to a concrete-preparing installation and the other end to a collecting pipe of the bag, liquid concrete under pressure is controllably introduced into the bag. The bag filled with liquid concrete takes on a swollen shape which adapts itself to the round surface of the pipeline, after which the concrete sets.

In this process, the pipelines cannot be uninterruptedly covered by means of individual bags and thus not be sufficiently protected. Through water currents, through weighing of dropped anchors, etc., the individual bags can be rolled off, whereby the pipeline is laid bare.

This disadvantage is supposed to be eliminated by the process for providing a protective arrangement for structures lying on the sea-bed, particularly pipelines, according to DE-A-2 814 381. Here the surface craft is equipped with a device for forming a concrete ribbon. The concrete ribbon is led down to the sea-bed and laid over the pipeline laid out in advance. The concrete ribbon, which also comprises reinforcement nets, is encased by a cloth or a film. The ribbon running off the surface craft extends obliquely down through the water to the pipeline, according to which it accommodates itself. In this way a uniformly rounded-off, uninterruptedly running concrete shell is produced over the pipeline.

In this process the concrete ribbon is continuously laid out over the pipeline by the surface craft while the concrete is still plastic. During the laying-out of the concrete ribbon, however, the latter cannot be laid out exactly over the pipeline, particularly at greater depths; with the inexact laying-out it can also slip off the pipeline. In order to prevent this, the

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laying-out must be uninterruptedly monitored by divers, which entails considerable costs.

In the German laid-open specification 2 922 410 a process for embedding a cable situated at the bottom of a body of water is described. For this purpose an embedding vehicle movable, particularly drivable, on the bottom of the body of water is used, which contains a pilot arrangement bearing a guide relation to the cable to be embedded. The embedding vehicle is pulled by an associated accompanying ship by means of a tow-rope.

By means of this embedding vehicle, however, the cable laid on the bottom of the body of water is not covered over with a stable covering.

In US-A-3 779 027 a process for laying-out a covering over an undersea pipeline is described. A web of material is led off out of its storage facility and reformed into a shape closed in cross-section by bringing-together of its longitudinal edges. These process steps are carried out on the accompanying boat, thus above water. The casing is then let down onto the pipeline laid on the sea-bed and filled with filling material via a pressure pipe introduced into the casing. The inlet end of the pressure pipe communicates with the accompanying boat. The casing thereupon assumes in cross-section a two-lobed dumb-bell shape which is set astride on the pipeline.

The two-lobed dumb-bell shape of the covering made in this process is disadvantageous, however, in the sense that both the crown of the covering without filling material and also the top of the pipeline which is covered only by the web of material without filling material can easily be damaged. Moreover, the course of laying-out must be monitored by divers.

The invention indicated in patent claim 1 is based on the problem of proposing a process for laying-out a covering over a structure laid under water or over a strip of ground lying under water and providing a device for carrying out the process, which process can be carried out precisely, without loss of time, and without monitoring of the course of laying-out by the divers. Also the work on board the surface craft shall be substantially facilitated and the personnel on the surface craft reduced. Through the kind of laid-out covering adapting itself to the shape of the structure, a lasting protection against mechanical damaging both of the structure or the strip of

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ground and also of the covering itself shall be attained.

The solution of these problems is achieved through the features of the characterization of patent claim 1 and of the characterization of patent claim 5.

The device may have a, in the direction of travel of the chassis, front slide for opening a slide fastener running along the entire length of the casing and a rear slide for closing the slide fastener. The two slides are fastened to the chassis at such a distance from one another which corresponds to the length of the opening in the case.

Advantageously the casing with filling material is formed at the end of the table facing the structure or the strip of ground. For this purpose two wings fixed laterally to the launching portion of the table are advantageously used, which wings are hydraulically or pneumatically swivellable-out to all sides.

The invention is elucidated in more detail below with the aid of the drawings, by way of example.

Fig. 1 shows a perspective view of the device according to the invention which is being towed over a structure at the bottom of a body of water by a surface craft,

Fig. 2 shows a longitudinal section of the device according to Fig. 1 lying over a structure at the bottom of the body of water,

Fig. 3 shows a top plan view of the device according to Fig. 2, but without the two slides of the slide fastener,

Fig. 4 shows a view of the device according to Fig. 2 in the direction of the arrow B,

Fig. 5 shows a partial view of the device with a storage facility of the casing in the form of a container which is partially represented in section,

Fig. 6 shows a partial view in section of the opening in the casing and of the fixing of the outlet end of the pressure pipe,

Fig. 7 shows a partial top plan view of the casing according to Fig. 6,

Fig. 8 shows a top plan view of the launching portion of the table with wings disposed swivellably on it,



Fig. 9 shows a view of the launching portion of the table according to Fig. 8,

Fig. 10 shows a cross-section through the pipeline with laid-out covering which extends under the structure.

Fig. 11 shows a partial longitudinal section of an embodiment lying on the bottom of the body of water over a structure, having a guide piece of S-shaped cross-section for the longitudinal edges of the web of material and a stapler for stapling the same together,

Fig. 12 shows a top plan view in section along the line XII-XII of Fig. 11,

Fig. 13 shows a top plan view of still another embodiment in which the web of material is opened to form an opening,

Fig. 14 shows a partial section along the line XIV-XIV of Fig. 12, in which the reinforcement bulges of the longitudinal edges of the web of material are formed channel-shaped,

Fig. 15 shows a similar section as in Fig. 14, the reinforcement bulges being formed flat,

Fig. 16 shows a section along the line XVI-XVI of Fig. 12,

Fig. 17 shows a section along the line XVII-XVII of Fig. 12,

Fig. 18 shows a partial view in section of the opening in the casing, and of the attachment of the outlet end of the pressure pipe, and

Fig. 19 shows a partial top plan view of the casing according to Fig. 18.

In order to protect a structure laid on the bed of a sea, lake, river, or canal, such as oil or gas pipeline or electric or telephone cables, from scouring by water currents or damage e.g. by wrecks, ship anchors, or fishing nets, a covering is laid-out over the same.

The embodiment of the device serving this purpose represented in Figures 1 to 7 is towed in the direction of the arrow A on a tow-rope 19 and remotely controlled by a surface craft 18. The device comprises a chassis 1 which is movable directly over the structure 13 laid under water. The chassis 1 contains two sidewalls 17a, 17b which are connected to one another by cross-struts 15 and provided with runners 12 which slide on the bottom 20 of

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the body of water. The cross-struts 15 pass above the structure 13.

Instead of the structure 13, a strip of ground lying under water can also be covered up with covering by means of the device. It is also conceivable that the chassis 1, instead of being towed on a towline by a surface craft, is equipped with self-propulsion.

Between the two sidewalls 17a, 17b disposed at a distance from one another a reel 3 is disposed rotatably about a horizontal axis X. On the reel 3 a casing 6 in the form of an elongated, flat folded tube is wound. The reel 3 is removably disposed in the sidewalls of the chassis 1; it has flanges 25 which run in bearings 14.

In the direction of travel of the chassis 1 behind the reel 3 a table 2 is accommodated in the same, which extends downwardly inclined from the reel 3 up to the structure 13. The table 2 is fixed in the two sidewalls 17a, 17b of the chassis 1. The table 2 consists of two parts, a laying portion 2a and a launching portion 2b jointly connected to the laying portion 2a, on the one hand, and resting upon the structure 13 or the strip of ground, on the other hand. The angle of slope of the table 2 to the bottom 20 of the body of water amounts to about 30 degrees.

The reel 3 can be replaced by a container 26 insertable in a holding frame 31, in which container the flat-laid casing in folds lying against one another is accommodated (see Fig. 5).

The casing 6 is provided along its entire length with a slide fastener 9. The, in the direction of travel of the chassis 1, front side 7 of the slide fastener 9 is fixed to a, in the direction of travel, cross-pipe 21 lying in front of the front slide 7, whereas the, in the direction of travel of the chassis 1, rear slide 8 of the slide fastener 9 is fixed to a cross-bar 11 with shuttle 11a lying, in the direction of travel, in front of the rear slide 8. The cross-pipe 21 as well as the cross-bar 11 are fixed to the two sidewalls 17a, 17b of the chassis 1. By 18 a plate disposed under the slides 7, 8 is designated.

Through the cross-bar 11 the outlet end 4b, consisting of a metal pipe, of a pressure pipe 4, made of flexible material, for plastic concrete 5 is led through. The inlet end 4a of the pressure pipe 4 communicates with the surface craft 18. Provided for on the surface craft 18 is a non-depicted



cement-preparing plant from which plastic concrete is introduced under pressure into the pressure pipe 4 passing from the surface craft 18 through the water to the chassis 1.

By means of the slides 7, 8 the casing 6 is uninterruptedly opened and reclosed along its entire length during its unwinding from the reel 3. Thus there is formed in the casing 6 an opening remaining the same in its form because the distance of the front 7 and the rear 8 slides from one another always remains the same. The outlet end 4b of the pressure pipe 4 is led through the opening 10 and opens out in the interior of the casing 6. The plastic concrete 5 is controllably injected into the casing via the pressure pipe 4 from the surface craft 18.

In the embodiment of the device depicted in Figs. 11 and 12 a web of material in flat form is wound on the reel 3 instead of the casing 6. For this purpose the width of the reel 3 must be about twice as great as that of the reel 3 according to the embodiment represented in Figs. 1 to 7. The longitudinal edges of the web 6 of material are formed as channel-shaped reinforcement bulges 35 (see Fig. 14) or as flat reinforcement bulges 35 (see Fig. 15). Other shapes of these reinforcement bulges, such as V-shape, are also imaginable.

As is apparent from Fig. 12, no opening is formed in the casing in this embodiment. The longitudinal edges of the web 6 of material are bound together during the unwinding of the web of material by a guide piece 32, S-shaped in cross-section, which is fixed to a support 36 that is in turn held fast to the chassis 1, in such a way that the longitudinal edges come to be over one another, after which they are bound together. In this embodiment the outlet end 4b of the pressure pipe 4 opens out only in the, in cross-section, closed form (casing) of the web of material produced by longitudinal edges connected together.

In the embodiment according to Fig. 13, the web of material is wound on the reel 3 so that its longitudinal edges are partially folded over one another. These longitudinal edges can also be detachably connected to one another. During unwinding of the web of material, the longitudinal edges of the same are guided about an opening part 36' of the support 36, whereby an opening 10 remaining the same in its form is produced in the web 6 of

material. The longitudinal edges of the web of material are then so led together again by means of the guide piece 32, S-shaped in cross-section, that they lie over one another and are connected together in order to form a shape closed in cross-section. The pressure pipe 4 for the plastic concrete 5 is led through the opening part 36' of the support 36 and the opening 10, its outlet end 4b opening out in the interior of the casing 6.

In order to connect the longitudinal edges of the web of material fast together in the embodiments according to Figs. 12 and 13, a stapler 33 with a staple magazine 34 is provided for on the support 36. Through the hydraulic or pneumatic operation of the stapler 33 the longitudinal edges of the web of material lying one over another are stapled together into a casing by means of the staples. How the longitudinal edges of the web of material are tightly connected by the staples 37 is visible from Fig. 16. Depicted in Fig. 17 is the guide piece 32 S-shaped in cross-section, which is intended for both embodiments according to Figs. 12 and 13.

The embodiment of the device according to Figs. 18 and 19 fundamentally corresponds to the embodiment according to Figs. 6 and 7 with the exception that the, in the direction of travel of the chassis 1, front slide 7 of the slide fastener 9 has been omitted. The longitudinal edges of the web of material wound on the reel 3 are provided with slide fastener rows 9a which are not connected to one another. During unwinding of the web of material the two longitudinal edges open from one another because they are guided about the shuttle 11a of the cross-bar 11. Behind the shuttle 11a the two rows 9a of the slide fastener 9 are connected by means of the slide 8 in order to form a shape, closed in cross-section, of the casing 6. In this case the outlet end 4b of the pressure pipe 4 opens out, in the direction of travel of the chassis 1, behind the slide 8 in the interior of the casing 6.

Through the movement of the chassis 1 in the direction of travel (arrow A) and through the dead weight of the casing 6 filled with plastic concrete 5, the casing slides over the portions 2a, 2b of the table 2. At such time the plastic concrete 5 in the casing 6 is spread out uniformly on the laying portion 2a of the table 2. Through the spreading-out of the plastic concrete 5 on the laying portion 2a a uniform thickness of the casing 6 filled with

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the concrete 5 is produced.

The amount of plastic concrete 5 introduced into the casing 6 is monitored by a rubber roller 27, represented only schematically in Figures 2 and 3, with an indicator of the thickness of the casing 6. The casing 6 filled with concrete 5 then slides further over the launching portion 2b of the table 2 in the direction of the pipeline 13 or the strip of ground and is laid continuously over the same. Through the jointed connection of the launching portion 2b with the laying portion 2a of the table 2, it is achieved that the launching portion 2b, of which the run-out parts 2b' slide over the bottom of the water, can adapt to the irregularities of the bottom 20 of the water. Furthermore, the launching portion 2b ensures a uniform laying-out of the casing 6 with concrete 5 over the pipeline 13 even when the chassis 1 is not completely centred.

When the pipeline 13 is spaced from the ground-water bottom 20 and it is intended that the casing 6 with concrete 5 also be laid out at least partially under the pipeline 13, the casing 6 with concrete 5 is shaped at the end of the launching portion 2b of the table 2 facing the pipeline 13 or the strip of ground. For this purpose two wings 16a, 16b are provided for laterally on the launching portion 2b, which wings are swivellable out on all sides by means of hydraulic or pneumatic piston cylinders 22. The wings are mounted in bearings 23 fixed to supports 30. The wings 16a, 16b are materially reinforced and provided at their ends, by which the casing 6 with filling material 5 is operated, with rollers 24 with rubber cover. Through the pressing of the rollers 24 against the casing 6 with concrete 5 a shaping of the casing is achieved which is visible in Fig. 9. The piston cylinders 22 are swivellably disposed on a beam 29 which is fixed to the launching portion 2b from outside and proceeds as a bridge spaced from the launching portion 2b and transversely to its longitudinal axis.

The flat-folded web of material or casing 6 has an average length of 500 m and a width up to 10 m. The casing 6 filled with plastic concrete 5 has a thickness of about 10 cm. Upon the running-out of the stored-up, flat-laid casing 6, the reel 3 or the container 26 is taken off by means of a non-depicted crane from the chassis 1, and a new reel or container with the wound-up or stored-up casing is inserted in the chassis 1. Then the slides



7, 8 must be threaded into the slide fastener 9 after a partial unwinding or drawing-off of the flat-folded casing 6. This work as well as the introduction of the longitudinal edges into the guide piece 32, S-shaped in cross-section, must naturally be carried out by divers. In order to be able to check the exact laying-out of the covering from the surface craft 18, the device can be monitored by means of a television camera.

By means of the above-described device a covering can be laid out precisely and without loss of time over the pipeline laid on the bottom of the water or strip of ground lying under the water. The operating costs of such a device are substantially lower than with all known devices of this kind. The 500m-long casing can be laid out as a covering in 24 hours. In place of a slide fastener with two slides a separating and welding device can be used.