

# PATENT SPECIFICATION

(11) 1 594 117

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(21) Application No. 46909/77 (22) Filed 10 Nov. 1977  
(31) Convention Application No.  
7 634 180 (32) Filed 12 Nov. 1976 in  
(33) France (FR)  
(44) Complete Specification published 30 July 1981  
(51) INT. CL.<sup>3</sup> E02B 15/04  
(52) Index at acceptance  
B7A AT



## (54) APPARATUS FOR COLLECTING POLLUTANTS ACCIDENTALLY SPILLED IN THE VICINITY OF THE SEA BED

(71) We, COFLEXIP, a French Body Corporate of 1 and 4, avenue de Bois Preau, 92500 – Rueil-Malmaison, France, do hereby declare the invention, for which we 5 pray that a Patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

The present invention relates to 10 apparatus for collecting a pollutant which is escaping into ambient water from a location adjacent to the water bed.

One of the sources of maritime pollution is oil which, by some accident has spilled or 15 escaped from a location adjacent to the sea bed, e.g. as a result of a tanker sinking. Such pollution can also result from pollutants leaking from a submerged pipeline, for example a pipeline carrying hydrocarbons 20 along the sea bed or can result from an uncontrolled escape of hydrocarbons from a well on the sea bed.

It has hitherto been difficult to recover 25 pollutants, particularly oil, accidentally spilled in this way in the sea. One solution previously proposed has been to seal the holes in the sunken tanker, pipeline or oil well by using divers. However, this solution is only practicable if the depth is relatively shallow.

30 The most frequently adopted solution is to permit the existing pollutant to rise to the surface and attack the thus formed solution with dispersing agents, wetting agents etc. This solution is not satisfactory because it 35 does not permit the total elimination of the pollution.

It is an object of the present invention to 40 provide apparatus for recovering a pollutant escaping from a source, irrespective of the depth of the submerged source and obviating the necessity of underwater activity by divers.

According to the present invention 45 apparatus for collecting a pollutant escaping from a source in the vicinity of the sea bed comprises a member which, in use, is of inverted funnel shape open at its base and suspended over the escaping pollutant, means for lowering the member in the said 50 position, at least one flexible riser pipe

adapted to support the member and the lower end of which communicates with the interior of the member and which is adapted to deliver the pollutant obtained from the interior of the member to storage means on 55 the surface of the water.

The flexible riser pipe or pipes used are 60 preferably of the type having metallic reinforcements which oppose radial compressive stresses and longitudinal tensile stresses, and have at least one sealing layer or casing. Flexible pipes of this type with a large diameter and considerable continuous length are marketed by the present applicants. 65

In a preferred arrangement the storage means can advantageously be in the form of a tanker, particularly an oil tanker having a mechanism for winding and unwinding the flexible riser pipe or pipes in order to permit 70 the submergence and raising of the funnel shaped member suspended on the riser pipe and pipes. Advantageously the tanker is equipped with separators for separating the pollutant from water which is also raised 75 with it.

The apparatus according to the invention 80 may comprise ballast on the funnel shaped member or on the flexible pipe or pipes in the vicinity of the said member.

The accumulation of buoyant pollutant 85 which naturally rises cause as a result of the hydrostatic pressure difference at the bottom of the pipe, an acceleration of the flow rate of the pollutant towards the surface in 85 the riser pipe or pipes.

In the case of great depths or for increasing the upward flow rate of the pollutant in the pipe or pipes it may be desirable to provide submerged pumping means such as 90 centrifugal pumps in stages, and air injection system or a jet provided in a caisson arranged in use to be below the surface of the water and above the funnel shaped member, whereby the pumping means suck 95 in the pollutants and deliver them to the surface.

The funnel-shaped member of the apparatus according to the invention can be a rigid structure, but preferably it is a fold- 100

able structure which can be submerged in the folded state and spread out following submergence to the requisite depth for use.

According to a preferred embodiment, 5 the funnel-shaped member has a skin made from flexible, waterproof material, for example a waterproof cloth made from polyester, polyethylene, neoprene or any other material which is waterproof or has 10 been rendered waterproof able to resist sea-water, hydrocarbons and other pollutants liable to be raised, as well as the attacks of marine flora.

In this embodiment, the funnel shaped 15 member has a plurality of reinforcement rods which can be spread out and radiate from the zone of connection between the member and the riser pipe or pipes. The free ends of the rods are advantageously connected by a flexible peripheral connecting member and the funnel shaped member has a plurality of floats and releasable retaining means for maintaining the member in the folded state during submergence, said 20 retaining means being released when the folded member reaches the desired depth which releases the reinforcement rods and permits the spreading out of said rods and of the flexible material jacket of said member 25 under the action of said floats. The opening of the jacket is interrupted when the peripheral connecting member is taut, the apparatus according to the invention then being ready to operate.

35 Other advantages and features of the invention can be gathered from reading the following description which relates to an embodiment of the invention given in exemplified and non-limitative manner, 40 with reference to the attached drawings, wherein show:

Fig 1 diagrammatically, an apparatus according to the invention in the position for use.

45 Fig 2 diagrammatically, the apparatus shown in Figure 1 during submergence.

Figure 1 shows an embodiment of the apparatus according to the invention for collecting oil escaping from an oil tanker 1 50 which has sunk onto the sea bed due to a shipwreck.

The apparatus according to the invention comprises a funnel-shaped member 2 constituted by a skin 3 made from a flexible 55 waterproof material, for example a polyester cloth, and a plurality of divergent reinforcement rods 4, made from a lightweight material such as an aluminium alloy, for example Duralumin (Registered Trade 60 Mark), or a plastics material which is able to resist the attacks of hydrocarbons and the influences of the maritime medium at the envisaged depths of use. For example, each of the reinforcement rods 4 is about 25 65 metres long. The reinforcement rods are

connected at their free ends by a flexible peripheral connecting member, for example a cable 5.

The funnel-shaped member 2 also has a plurality of floats 6. Funnel-shaped member 70 2 is suspended at the end of a flexible riser pipe 7 linking the inside of the funnel-shaped member 2 define by skin 3 with storage means at the water surface, for example located in an oil tanker 8. Oil 75 tanker 8 has a motor-driven reel 9 permitting the winding and unwinding of the flexible pipe 7 at the lower end of which is suspended the funnel-shaped member 2, whereby reel 9 is operated in per se known 80 manner in such a way that the end of flexible pipe 7 penetrates the boss of the reel, the latter being linked with ship-borne tanks by a pipeline 10. Not shown rotary sealing means are provided with respect to the connection of pipeline 10 to the boss of reel 9. Flow control means, diagrammatically indicated by a valve 11, can advantageously be provided on pipeline 10.

The apparatus according to the invention 90 advantageously has ballast 12 and, if appropriate, a caisson 13 on the flexible pipe 7. Caisson 13 has pumping means which accelerate the raising of the recovered pollutants into the funnel-shaped member 2 95 and their delivery to the surface ship 8. Caisson 13 is submerged and raised by conventional lifting means, such as a crane provided on ship 8. These lifting means also serve to submerge and raise onto the ship 100 the funnel-shaped member 2 in its folded position.

Fig 2 diagrammatically shows the apparatus according to the invention during submergence. Rods 4 and jacket 3 are 105 folded and are substantially an extension of the flexible pipe 7 being held together via a ring 14 which can be opened automatically or under the control of the surface ship when member 2 reaches the desired submergence depth. When ring 14 opens, the reinforcement rods 4 and jacket 3 unfold under the action of the floats 6 until they reach the position of use shown in Fig 1. The maximum opening of the funnel-shaped 115 member 2 is obtained when the peripheral connecting member 5 is taut, the length of said member 5 being determined in such a way that an apex angle of member 2 of for example approximately 120° is obtained. 120

Once the member 2 is spread out over the area of escape the pollutant, i.e. in the represented embodiment at the location of hole or holes in the sunken ship 1 or in other cases a damaged pipeline or a well head, the 125 pollutants are raised up to the surface ship 8. The ship can advantageously be equipped with separating means in order to recover the pollutants from the sea-water which has inevitably been raised with them. The sur- 130

face ship is equipped with conventional wreckage locating and marking means such as sonar, television, etc. In order to maintain the apparatus above the zone where the pollutant leaks have occurred, the surface ship 8 can be provided with per se known dynamic positioning means permitting it to maintain its position above the wreck 1, no matter what the stresses to which ship 8 is 10 subject.

Although the invention as been described in conjunction with a preferred embodiment, it is obviously not limited thereto and various modifications regarding shape and 15 materials can be made without passing beyond the scope of the invention.

In particular, although in the represented embodiment only a single flexible pipe has been used, it is possible to use a plurality of 20 such riser pipes connecting the submerged member 2 and the surface ship 8.

In the same way and without passing beyond the scope of the invention, it is possible to provide other means ensuring the 25 spreading out of the funnel-shaped member. In addition, it is possible to envisage a rigid funnel-shaped member 2 suspended on the flexible pipe or pipes.

**WHAT WE CLAIM IS:-**

30 1. Apparatus for collecting a pollutant escaping from a source in the vicinity of the sea bed comprising a member which in use is of inverted funnel shape open at its base and suspended over the escaping pollutants, 35 means for lowering the member into the said position, at least one flexible riser pipe adapted to support the member and the lower end of which communicates with the interior of the member and which is adapted 40 to deliver the pollutant obtained from the interior of the member to storage means on the surface of the water.

2. Apparatus as claimed in claim 1 in which the or each flexible pipe is of the type 45 having metallic reinforcements which oppose radial compressive stresses and longitudinal tensile stresses and one or more fluid tight layers.

3. Apparatus as claimed in claim 1 or 50 claim 2 in combination with storage means in the form of a tanker having a mechanism

for winding and unwinding the or each flexible pipe in order to permit the submergence and raising of the funnel-shaped member suspended on the pipe or pipes. 55

4. Apparatus as claimed in any one of the preceding claims including ballast on the funnel-shaped member or on the flexible pipe or pipes in the vicinity of the member.

5. Apparatus as claimed in any one of the preceding claims including pumping means provided in a caisson arranged in use to be below the surface of the water whereby the pumping means suck up the collected products into the funnel-shaped 65 member and deliver them to the surface.

6. An apparatus according to any one of the preceding claims, wherein the funnel-shaped member is a rigid structure.

7. An apparatus according to any one of the claims 1 to 5, wherein the funnel-shaped member is a foldable structure which can be submerged in the folded state and is then spread out after being submerged to the 70 requisite depth for use. 75

8. An apparatus according to claim 7, wherein the funnel-shaped member has a skin made from flexible waterproof material and a plurality of reinforcement rods which can be spread out and radiate out from the 80 connecting zone of said member to the said pipe or pipes.

9. An apparatus according to claim 8, wherein the end of the reinforcement rods are connected by a flexible peripheral connecting member, whilst the funnel-shaped member has a plurality of floats and releasable retaining means are provided for maintaining the member in the folded state during its submergence, the retaining means 90 being released when the member, in the folded state, has reached the requisite depth. 85

10. An apparatus substantially as described hereinbefore with reference to the 95 drawings.

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COMPLETE SPECIFICATION

1 SHEET

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