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Marion et al.

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[54] FLOATING TORCHER WITH PERMEABLE GAS CONDUIT FOR UNDERWATER OIL FIELDS

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[52] **U.S. Cl.**.....**431/202,** 9/8.3 R

[51] **Int. Cl.**.....**F23d 13/20**

[58] **Field of Search**.....431/202; 9/8.3

[56] **References Cited**

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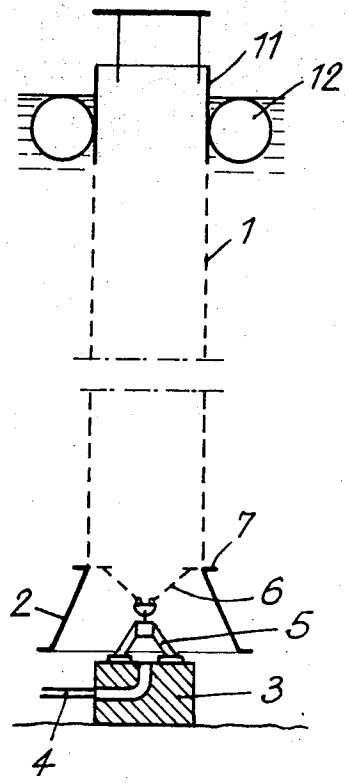
[57] **ABSTRACT**

A torch assembly for burning gases collected at the head of an underwater well which incorporates a thin permeable conduit made from lightweight, inexpensive material for conducting the gases to the water surface. One end of the conduit is secured to a hood placed above the gas outlet and anchored to the ocean bottom and the other end is attached to a chimney structure mounted on a float. The float structure includes regulating means for separating the gas from the water and for assuring a continuous flow and combustion of the gas.

14 Claims, 8 Drawing Figures



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SHEET 1 OF 3

FIG. 1

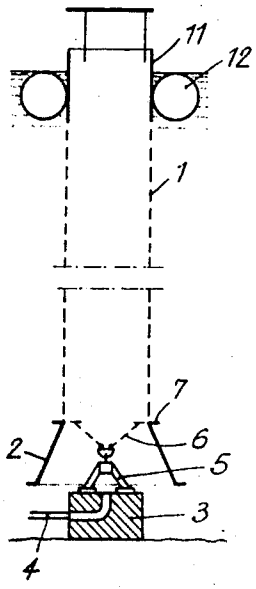

FIG. 2a

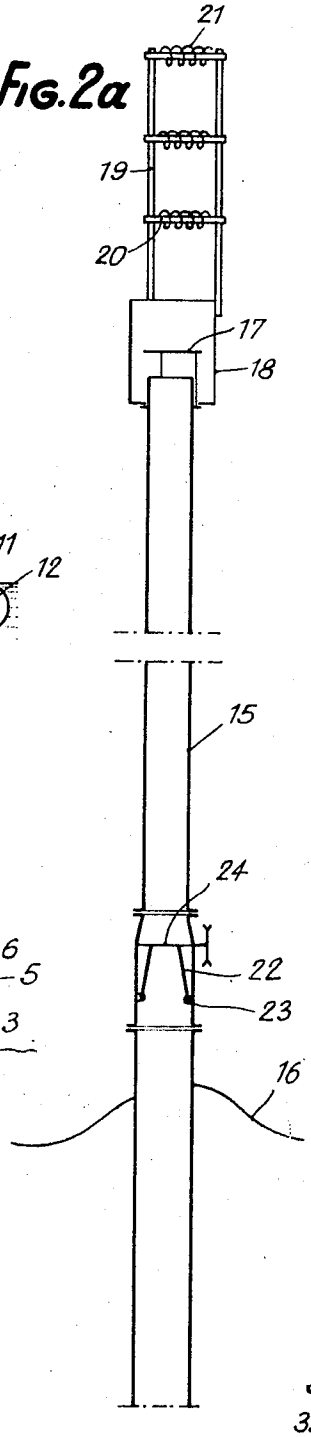

FIG. 2b

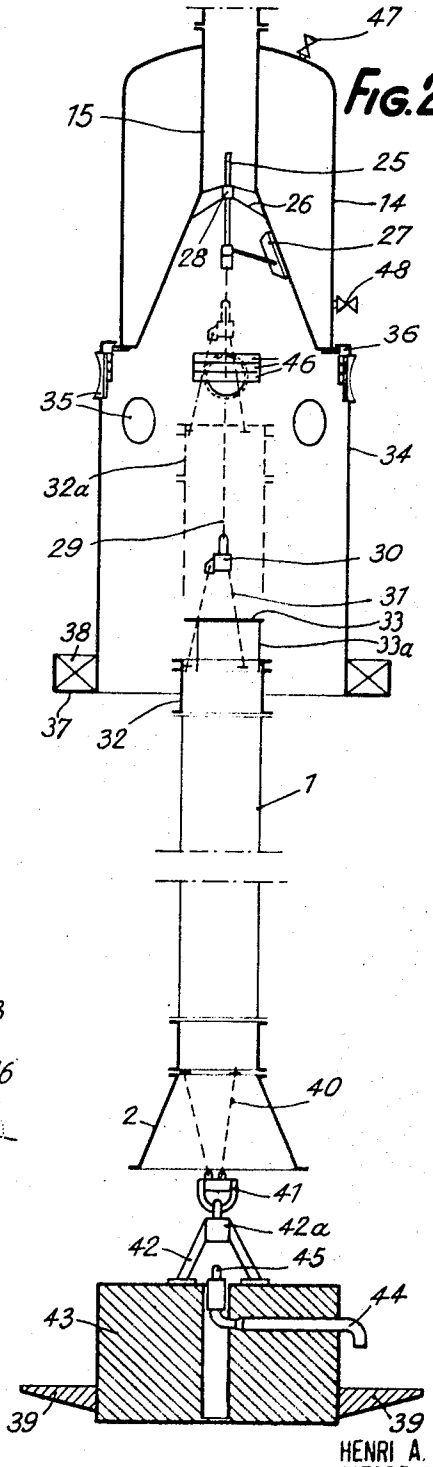

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FIG. 3

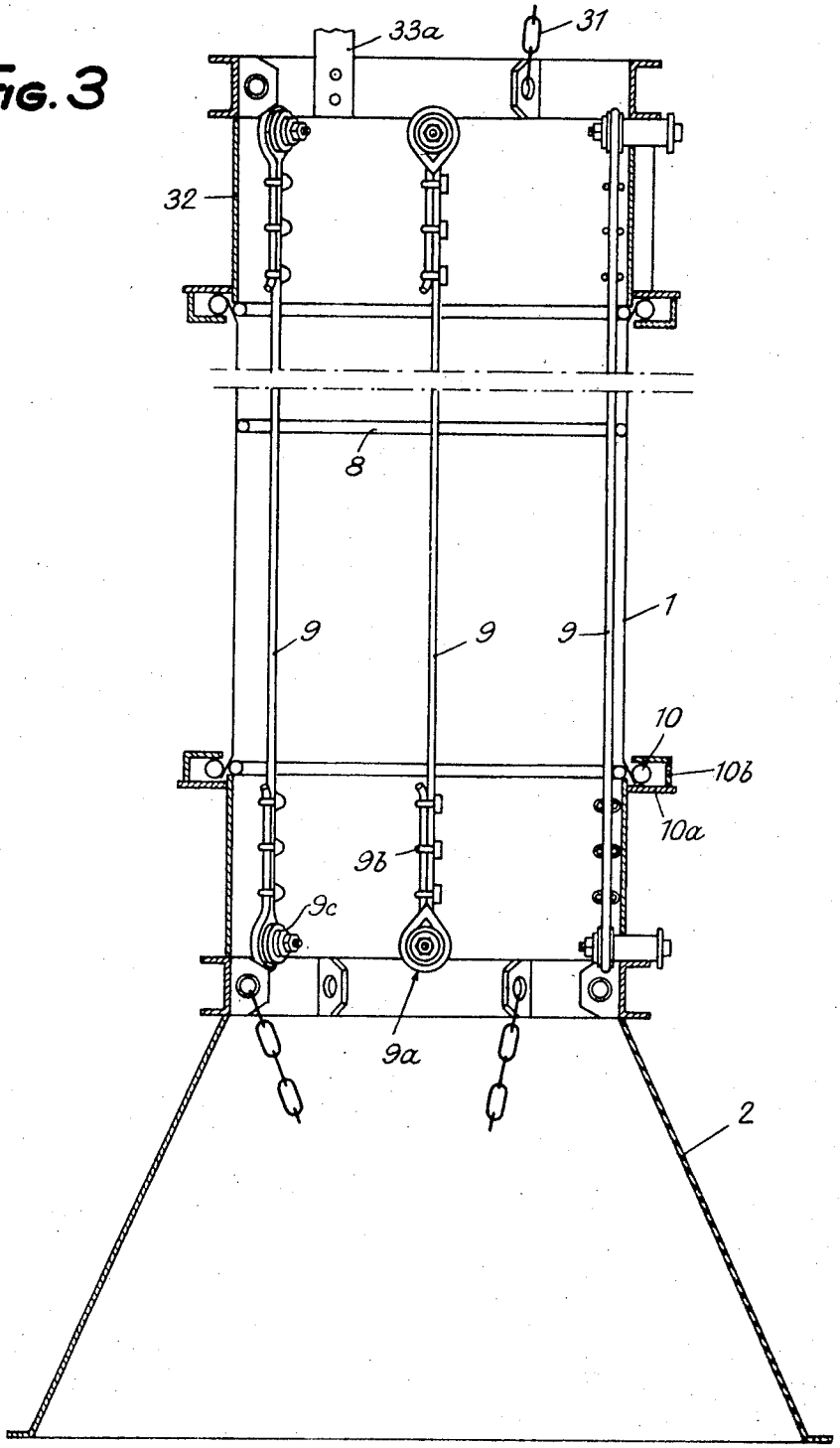


FIG. 5

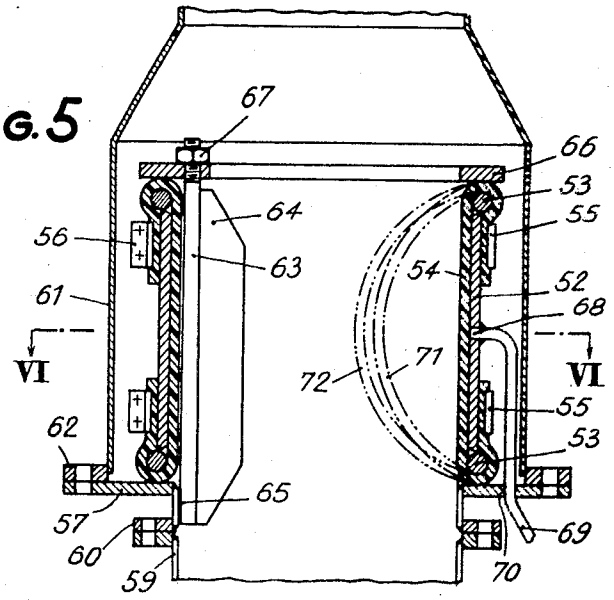


FIG. 4

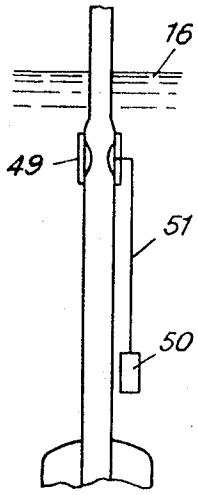


FIG. 6

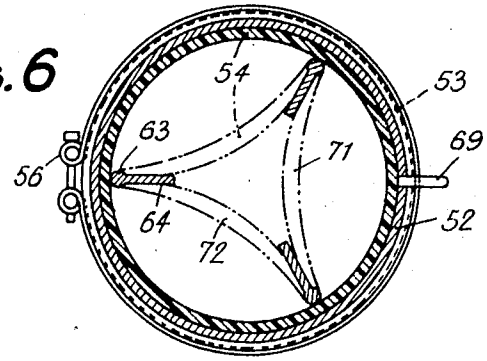
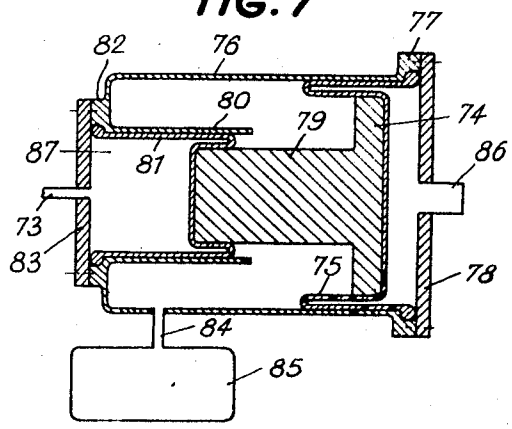


FIG. 7



FLOATING TORCHER WITH PERMEABLE GAS CONDUIT FOR UNDERWATER OIL FIELDS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a standard torch lamp for the combustion, on the surface, of gases collected at the head of an underwater well or at the output of an underwater installation.

2. Description of the Prior Art

The prior art for conducting gases through a pipeline, from a deep underwater zone to the water surface, in order to be burned, required the use of a metal pipe which would resist marine corrosion attack and was capable of withstanding the heavy pressures due to the pressure of the water on the outside, or, the pressure exerted by the gas from inside the pipeline. The placement of such a pipeline became a particularly delicate operation the moment the depth exceeded several scores of meters and the cost increased rapidly, in a prohibitive fashion, when the well head approaches a depth of about 100 meters.

The gas can be diffused through any kind of apparatus arranged at the ocean bottom, but this solution, which can be employed only at very shallow depths, entails the inconvenience of producing a flame that is unstable in bad weather and the extinction of which may involve risk of major accidents.

SUMMARY OF THE INVENTION

The primary purpose of this invention is to provide an economical standard torch lamp for the conducting of the gas collected at the head of an underwater oil well to the surface and the combustion thereof, characterized by the fact that the torch lamp utilizes a buoy resting on the bottom below the water surface, which is equipped with a gas diffuser, a water-permeable casing whose lower portion is connected to said buoy, and a float connected to the upper portion of the casing, said float incorporating an interior passage for channeling the gas conducted through the casing and having a funnel mounted on the top thereof above the water surface for the combustion of the gas.

Since the casing or sheath is permeable, it is obvious that the pressures between the inside and the outside environments tend to balance each other and there will be no forces that would tend to deform the casing. It is thus possible to utilize a sheet of woven polyester, for example, as material for the light and deformable body of the buoy.

In addition to this first advantage, a second advantage is represented by the fact that the gas, in the course of its rise to the surface, has a very slight tendency, if any, to pass through the walls of the casing or sheath, in spite of their permeability, thereby enabling the casing or sheath to constitute a preferred route of the gas which, by virtue of this fact, is channeled up to the combustion opening where it is burned.

Such a system offers the advantage of being simple, economical, light, and easy to install. In order to prevent too great a variation in the movement of the floating portion, the float can be connected to three tables oriented at an angle of 120° apart, for example, and suitably anchored.

When the underwater well is situated in a region subjected to the swell of the sea or to powerful waves which might extinguish the flame, another benefit is obtained from the fact that the casing or sheath is attached to the buoy in order to keep the float below the surface of the water so as to make it invulnerable to the action of the waves. The upper metallic portion is extended upwardly by means of a pipe or funnel to form a chimney, where the height of the opening above the surface of the water is sufficient to prevent its immersion, even in heavy seas. Furthermore, in order to recapture a certain volume of gas which might eventually filter through the permeable casing a recovery hood is provided on the upper portion of the casing.

Another purpose of the invention is to provide a standard torch lamp of the type indicated, whose permeable casing ends at a point several meters below the surface of the water, said casing being connected, at its upper portion, to a completely submerged float which incorporates a central tubular passage for the placement of a pipe or chimney whose upper opening, which is situated several meters above the water surface, serves for the evacuation and combustion of the gas conducted by said casing, and the lower portion of said chimney is in the shape of a hood surrounding the upper portion of the casing. As a result, regardless of the weather conditions on the water surface, the frame cannot be submerged and there is no reason to fear a danger of explosion, since the gases, which might escape from the casing, accumulate under the hood and are evacuated through the chimney along with the gases that have not been diffused outside through the casing.

Another object of this invention is to provide a standard torch lamp of the type mentioned above, incorporating, in the portion of the chimney between the float and the water surface, a diaphragm with an adjustable opening and, in the upper portion of the casing, a horizontal plate which breaks up the rising energy of the water that is moved along with the gas. The purpose of such a combination is to prevent the frame from becoming unstable as a result of the water being moved upwardly along by the gases. The horizontal plate, arranged at the top of the casing, in effect enables a first decantation of the water to be obtained and the gases to escape into the chimney after having gone around this plate. Furthermore, by providing a diaphragm with an adjustable opening, a certain volume of gas can be accumulated in the hood situated above the casing. This prevents any continuous or discontinuous movement of the water in the chimney.

As the torch lamp is put in place, the diaphragm of the chimney is closed, so that any water that might eventually be moved along with the gases will fall back into the hood. The gases will accumulate progressively in the chimney and will push the water to the bottom of the hood. It then suffices to adjust the opening of the diaphragm to make sure that the gases will escape only in very small volume from the bottom of the hood.

Another objective of the invention is to provide a torch lamp of the type mentioned above, further incorporating a skirt that extends the outside wall of the float and is connected to the periphery of the hood. The advantage of such a construction resides in the fact that it increases the inertia of the system and that it avoids any abrupt variations in the attitude of the float and of the chimney.

Another purpose of the invention is to provide a torch lamp of the type mentioned above, in which the upper end of the permeable casing is connected, by means of chains, to a swivel-hook which is attached to the upper portion of the hood in the axis of the chimney, the upper portion of the skirt being equipped with a series of openings, enabling the average level of the water-gas separation surface to be stabilized at a predetermined height inside the skirt, and the center of the passage of the system to be moved into the vicinity of the point of attachment of the casing.

The presence of openings in the upper portion of the wall of the skirt thus enables the water-gas separation level to be stabilized. The surplus gas escapes progressively from the openings instead of escaping abruptly and by jolts at the bottom of the skirt. Furthermore, the lateral forces due to the current and the swell of the sea, undergone by the chimney-float-skirt assembly, is taken up by the casing as close as possible to the point of application of their resultant force. These efforts thus impart only a slight tilt to the chimney. There is, therefore, no need to keep the assembly in place by means of anchor cables, and the casing, attached to the buoy, constitutes the only anchoring device.

Another purpose of the invention is to provide a torch lamp of this type where the stability thereof is further improved by surrounding the lower portion of the skirt with a counterweight so as to lower the center of gravity. The existence of the skirt not only provides benefits by increasing the inertia of

the system but also by maintaining the center of gravity very much below the center of thrust.

Another object of the invention is to provide a torch lamp of the above type, providing further, a device for the control of the degree of opening of said diaphragm, by utilizing a pilot device connected to the control device and submerged in the vicinity of the float in order to respond to the variations in water pressure, so that any increase in water pressure, is detected by said pilot device, which, in turn, furnishes a servomotion which brings about a reduction in the opening of the diaphragm, while a reduction in the pressure inversely brings about an increase in the opening of the diaphragm. This setup enables the effects of pressure variations due to a heavy swell as well as the resonance phenomena possible in the course of repeated cycles of pressure variations to be avoided, effects which involve the risk of causing untimely reentry of water into the chimney, thus extinguishing the flame.

By way of example, if the crest of the swell passes perpendicularly to the system, the pressure increase detected in depth enables the decrease in the opening of the diaphragm to be automatically controlled, so that the water level, which would have a tendency to rise in order to reach the chimney, is immediately pushed back down by the counterpressure of the gas which increases by virtue of the decrease in the opening of the diaphragm.

Another purpose of the invention is to provide a torch lamp of the above type, incorporating, in its upper portion, an anti-splash tap-nozzle, surrounded by a wind-break, said wind-break supporting an assembly carrying iron wires constituting hot points for instantaneous re-lighting. The anti-splash nozzle is installed at the top of the chimney and enables any projection of water capable of still being moved along in small quantity by the gases to be blocked. The anti-splash nozzle is surrounded by a wind-break and the base of the flame whose upper portion constantly heats the iron wires arranged on the carrier assembly is stabilized. As a result, if the flame should be extinguished, the gases reaching the wires, which are still hot, are once again spontaneously ignited.

Another object of the invention is to provide a torch lamp in which each end of the casing is attached by means of a clamp to a rigid cylindrical piece, a series of cables being extended inside the casing between the fixation attachment mounted on each of said cylindrical pieces. It is thus possible to use flexible casings with very little thickness, since the traction effort, exerted by the float, is supported by the cables. These casings thus can be several hundred meters long.

Finally, an economical, stable, and highly reliable and safe torch lamp is provided, which will resist the swell and bad weather, and is capable of collecting the gases coming from an underground well at unusual depths, in excess of several hundred meters.

Other features and advantages will emerge from the following description, presented here with reference to the attached drawings which, by way of a nonrestrictive example, illustrate one way of making the floating standard torch lamp.

BRIEF DESCRIPTION OF DRAWINGS

In the drawings:

FIG. **1** is a schematic representation, in cross section, of a floating torch lamp after installation;

FIGS. **2***a* and **2***b* are, respectively, cross section views of the upper and lower portions of one and the same torch lamp, especially adapted to resist the effects of the swell;

FIG. **3** is an axial cross section of the conduit of the standard lamps in FIGS. **1** and **2***b*, for channeling the collected gases toward the surface;

FIG. **4** is a schematic elevation view of a torch lamp equipped with an automatic gas-flow rate regulating device;

FIG. **5** is an axial cross section view of the automatic gas-flow regulating device of FIG. **4**;

FIG. **6** is a cross section view along section VI—VI in FIG. **5**, and

FIG. **7** is an axial cross section view of the automatic control for the gas-flow regulating device.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The torch lamp, illustrated in a schematic form in FIG. **1**, may be used in calm water. This torch lamp is made up essentially of a permeable casing **1**, shown in greater detail in FIG. **3**, the chief characteristic of which is that it is light in weight. Furthermore, the casing must resist the ocean water and the hydrocarbons, as well as the attacks from the marine flora. The material used for making the casing may, for example, be neoprene, a polyester, a polyethylene, or any other material capable of constituting a permeable structure and, especially a woven sheet, for example.

The lower end of the casing has a hood **2** which catches the gases coming out of a nozzle placed inside an anchoring post **3** on the bottom below the water surface. This anchoring post, which serves as a buoy for the assembly, receives the gases to be burned through pipeline **4** and, in its upper portion, includes an attachment tripod **5**.

Hood **2** is provided with three retaining chains **6** which are connected, by means of a link, to a screw-eye, mounted in the center of tripod **5**. The upper portion of the hood is provided with an attachment clamp shown schematically at **7**, making it possible to attach the permeable casing.

FIG. **3** is a detail view of the structure of the casing. The latter may be a woven polyester sheet **1**, kept open by metal circles or bands **8**, attached by any suitable means, either to the sheet, by screws through the sheet, for example, or by a plurality of cables **9** attached to hood **2**, with the help of cable end clamps, for example. The attachment of each cable may involve the use of a core eyelet **9***a*, attached to the wall of hood **2** by means of a pipe welded upon the wall and on which the eyelet is engaged. It is held in place by a washer and a bolt **9***c*. The cable passes into the neck of the eyelet, and its free end is flanged and kept tightly clamped together with galvanized stirrups or straps which are held together by a series of cap screws **9***b*.

At its lower end, the casing **1** is folded around a toric pipe **10**. In order to guarantee good attachment, the portion of the casing thus folded is surrounded by a band of neoprene having a certain thickness and the tube **10**, thus covered, is placed on a clamp **10***a*, against which the assembly is retained by means of a section steel piece **10***b* which is maintained against said assembly by means of a plurality of bolts, which are tightened to obtain an assembled structure.

An identical attachment of cables **9** and casing **1** is provided for their connection to the torch lamp buoy, which is made up of chimney **11**, seen in FIG. **1**, and buoy **12**. Three cables, arranged 120° apart, make it possible to anchor the system.

The traction exerted by buoy **12** on the buoy constituting the anchor post **3**, which is filled with concrete or with chains for this purpose and which may be sunk into sand impregnated with oil, is transmitted by cables **9**, FIG. **3**, and does not in any way put any stress on the permeable casing **1**. In this, an economical, sturdy, easily transportable and particularly quickly installed torch lamp is obtained.

When it is desired to burn the gases in a place where a swell manifests itself, the characteristics of the above-mentioned torch are improved by replacing the surface buoy **12** with a float submerged at a depth of several meters, as shown at **14** in FIG. **2***b*.

This float has a central opening, permitting the passage of chimney **15**, whose conical lower portion forms a hood for the channeling of the gases and whose upper portion, seen in FIG. **2***a*, emerged several meters above the water surface **16**, escapes the highest swell and serves as a burner.

A horizontal plate **17**, surrounded by wind-break **18**, enables the last quantities of water moved along by the gas to be eliminated. A fixture, made up of three vertical rods **19**, distributed symmetrically above wind-break **18**, supports bars **20**, to which are attached iron wires **21**. The heat released by

the flame is sufficient to rapidly bring the bulk of the wires **21** to a temperature which will spontaneously re-ignite the gases, if the flame has, in some way, been accidentally put out. The bulk or mass of wires **21** is also designed to be sufficient to store a volume of heat sufficient so that one simple dash of water, reaching the flame, will not prevent the gases from re-igniting because of possible excessive cooling of the wires.

In the non-submerged portion of chimney **15** and in the vicinity of the water surface level **16**, a diaphragm made up of two plates **22** pivoting around an axis **23** is provided. The upper ends of these plates may be moved more or less closer to each other with the help of an adjusting screw **24**, cooperating with a connecting mechanism, not shown here, in order to obtain a more or less large passageway for the gases.

A threaded rod **25**, shown in FIG. **2***b*, held in the axis of the lower portion of the chimney with the help of small bars **26**, attached to tabs **27**, passes into screw **28** and helps tighten a chain **29** which carries a swivel **30**, to which are connected the shackles of three chains **31**, connected to a rigid cylindrical piece **32**, to which are attached cables **9**, in FIG. **3**, and casing **1**.

Rigid cylindrical piece **32** carries the supports **33***a* of a plate **33**, seen in FIG. **2***b*, serving to break up the gas jet coming from the casing and to start the separation of the gas and the water that is brought along. A skirt **34**, incorporating in its upper portion, openings **35**, is connected to the lower portion of the hood of the chimney and to the periphery of the float by a clamp **36**. The skirt **34** has, at its base, a rim **37** which is filled with a ballast weight **38**.

The lower hood **2** of casing **1** is connected by three chains **40** to the lugs of a ring **41** attached to a screw-eye **42***a* of a tripod **42** attached to caisson **43**. This caisson **43** has a connecting pipe **44** for the entry of the gases and a nozzle **45**. It is made heavy with the help of chains or any other kind of weight, such as concrete, scrap iron, etc., as in the case of the torch lamp in FIG. **1**.

The continuous operation of the torch lamp is guaranteed by creating a gas buffer in the hood at the top of skirt **34**. Normally, the gas coming out of nozzle **45**, shown in FIG. **2***b*, is collected in hood **2** and is channelled from there into casing **1**. The water that penetrates into the interior of the casing, as well as the gas, run into plate **33** and are diverted outwardly toward the interior wall of skirt **34**. The gas escapes through chimney **15** while most of the water remains in skirt **34**. However, if the water flow-rate is great because of the depths or if the upper portion of the casing is too close to the lower portion of the chimney, as shown by the dotted lines **32***a*, the water is moved to the top of the chimney and there is a risk that the water might definitely extinguish the flame, in spite of anti-splash tap-nozzle **17** and wires **21**.

In order to eliminate the movement of water up to the upper end of the chimney, the opening of the diaphragm is reduced to a minimum with the help of control screw **24** so as to accumulate the gases in the chimney. The gas pressure then progressively pushes the water level to the base of the chimney and then into the skirt. The moment the gas escapes from the skirt through openings **35**, the diaphragm is opened so that the water level will be stabilized and maintained at the top of these openings. The gas-flow rate at openings **35** can be further reduced by more or less closing off these openings with the help of plates, such as those at **46**.

In the case of depths which are reached relatively easily by divers, the buoy **43** is lowered and attached at the desired place, and the casing **1** is lowered and placed down on the bottom. A diver then attaches the chains **40**, which are attached to the lower metal hood **2**, to the ears of ring **41** of screw-eye **42***a* of tripod **42**.

Float **14**, with skirt **34** and its chimney **15**, is placed in the water after it has been weighted by filling it partly with water. For this purpose, the float is equipped with two valves **47** and **48**. When the weight is made slightly greater, compressed air is introduced into float **14** through valve **47**, and the assembly is lowered into a reclining position, by the side of the end of the casing. A diver then connects the swivel **30**, attached to portion **32** supporting the casing by chains **31** to chain **29** of the float. As valve **48** is slowly opened, the compressed air in the float drives out the water. When the float begins to rise from the bottom, all the diver has to do is to close valve **48** again. The diver can place the casing **1** under slight tension by continuing the emptying of the float by means of the renewed opening of valve **48**. The length of chain **29**, connecting the float to the connection piece **32** of the casing, may thus be regulated if necessary with the help of shackles and with the help of threaded rod **25**.

When the effects of the swell are particularly noticeable, the diaphragm of chimney **15** is equipped with a control member **49**, seen in FIG. **4**, for bringing about more or less opening of the diaphragm as a function of the pressure prevailing in the vicinity of the float. For this purpose, a pilot device **50** which responds to the water pressure variations due to the swell is used. Member **49** is connected to device **50** by connection link **51**.

Since the water has a tendency to rise in the chimney when the level **16** of the water surface rises, it is a good idea to reduce the opening of the diaphragm so that the gas pressure will balance the pressure exerted by the water inside the skirt. Members **49** and **50** may be any kind of control mechanism that will perform the desired function. It will be understood that the devices shown in FIGS. **5–7** are given here only by way of example.

Instead of controlling the spacing of plates **22** by control device **49**, an inflatable ring-shaped chamber, positioned within the chimney can be used on a diaphragm. This chamber consists of a cylindrical metal clip **52**, shown in FIG. **5**, having two toroidal rings **53** welded to its ends. A rubber membrane **54**, whose ends are turned back toward the toroids **53**, is held by two collars **55**, fastened at **56** by bolting.

A support piece **57** serves to attach the assembly to the lower portion **59** of the chimney by means of clamp **60** and to the upper portion **61** by means of clamp **62**.

Three rods **63**, stiffened by pieces **64** are welded at **65** and are threaded in their upper portions in order to hold in place rubber membrane **54** with the help of clamp **66** and nuts **67**.

A passage **68**, from which branches off a pipe **69**, transverses piece **57** at **70** in a sealed manner, and serves to feed an inflating fluid. A space is provided between rods **63** and membrane **54** in order to permit the passage of the inflating fluid. In FIG. **6**, which shows the cross section VI—VI in FIG. **5** along a plane perpendicular to the axis of the chimney, two positions of membrane **54** are illustrated, one of them being **71**, when the pressure of the inflating fluid has a certain value, the other one being **72** when the pressure of the fluid has a greater value.

Tube **69** is connected to connection piece **73** of pilot device **50**, shown in FIG. **7**, in the form of a simple membrane jack which is used as a pressure multiplier. The device essentially involves a piston **74**, bearing membrane **75**. The latter is kept attached to the jacket **76** with the help of a flange made up of the membrane and engaged between clamp **77** and yoke **78**, attached to the clamp by bolting.

Piston **74** includes a second piston **79**, which has a smaller diameter and which slides in a jacket **80**, pushing against membrane **81**. The edge of this membrane is held tightly between clamp **82** and yoke **83**.

The space between jacket **76** and pistons **74** and **79** is kept practically at constant pressure and at a pressure equal to atmospheric pressure by connecting the volume thus defined to an additional enclosure **85** by means of a conduit **84**.

The pilot device, connected by conduit **69** to the chamber included between membrane **54** and clip **52** in FIG. **5**, is placed in the ocean in the vicinity of the float and constitutes one body with the torch, so that the pressure of the water, penetrating through opening **86** of yoke **78**, in FIG. **7**, into the space between yoke **78** and membrane **75**, acts upon piston **74**, pushing membrane **75** back, thus moving the piston **79** which has the smaller diameter.

The pressure of the fluid contained in chamber **87** is transmitted directly to membrane **54**, in FIG. **5**, which is thus deformed as a function of the value of the pressure exerted upon piston **74**, decreasing or increasing, as the case may be, the surface of the passage cross section offered by the more or less pronounced spacing of the three lobes of membrane **54**, as can be seen by comparing lines **71** and **72**, in FIGS. **5** and **6**, which correspond to the positions of the membrane for two different pressures.

The output of the device can also be increased by reducing the pressure prevailing in enclosure **85**.

The pilot device in FIG. **7** is made in one body with the torch and any variation in the height of the water column to the right of the opening **86** is expressed by a movement of pistons **74** and **79** and, consequently, by a variation in the cross section of the diaphragm. Thus, when the floating-line level rises, the pressure inside the skirt increases, compressing the gases which then have a tendency to escape more rapidly while, at the same time, the water level inside the skirt tends to rise. However, the increase in the pressure of the fluid in chamber **87** brings about the transmission of a certain volume of fluid into the lobes of membrane **54** of the diaphragm, thus reducing the cross section of the passage for the gases.

It is obvious that many variations could be used here. For example, if low gas pressure is present, a simple, closed, deformable envelope, containing a liquid having a density less than that of water, could replace the jack shown in FIG. **7**.

Without going beyond the framework of this invention, the small volume of gas filtering through openings **35** could also be channeled so as to lead toward the flame of the torch.

Finally, the transport of the torch could be facilitated by making the skirt **34**, FIG. **2***b*, rest on the edges of an outwardly projecting piece **39**, adjoining caisson **43**.

What is claimed is:

1. A torch for the conduction and combustion of gas collected at the head of an underwater oil well, comprising, a buoy resting on the bottom of the ocean water, said buoy being equipped with a gas diffuser, a water-permeable casing whose lower portion is connected to said buoy and a float connected to the upper portion of the casing, said float including an inside passage for the channelling of the gas moved along by the casing and being surmounted by a funnel chimney for the combustion of gas.

2. A torch as in claim **1**, wherein the float is completely submerged several meters below the surface of the water, said chimney being extended by several meters above the water, the diameter of said chimney being smaller than that of the float.

3. A torch as in claim **1**, wherein the attachments of the ends of the casing to the float and to the buoy are made by three chains, said chains being connected by a swivel to a fastening attached in the axis of the float and through a fastening attached in the axis of the buoy.

4. A torch as in claim **3**, further comprising, a diaphragm having an adjustable opening located in the portion of said chimney situated above the surface of the water.

5. A torch as in claim **3**, wherein the base of said chimney traversing said float flares out in the form of a truncated cone, diverging downward, to serve as reception hood for the gases coming from the permeable casing.

6. A torch as in claim **5**, further comprising, a skirt which prolongs said float downward.

7. A torch as in claim **6**, wherein the upper portion of the wall of the skirt has a series of openings therein.

8. A torch as in claim **6**, wherein a ballast is contained in the lower portion of the skirt.

9. A torch as in claim **5**, wherein the upper end of the chimney is surmounted by a deflector for breaking up the gas jet, a wind-break for the protection of the base of the flame, and a support mounted on said wind-break to present to the flame a series of fires surrounded by iron wires, said float being prolonged downward by a skirt carrying a series of openings in its upper portion, the base of said chimney forming a hood and including a fastening system with adjustable height so as to adjust the point of application of the tension of said casing.

10. A torch, as in claim **8**, further comprising a means for controlling the degree of opening of said diaphragm, a pilot means connected to the control means and immersed in the vicinity of the float to respond to the water pressure variations, whereby, any increase in water pressure, detected by said pilot device, furnishes a servo-motion bringing about the decrease in the opening of the diaphragm, while a drop in the pressure inversely brings about an increase in the opening of the diaphragm.

11. A torch, as in claim **10**, wherein the diaphragm is comprised of three lobes of an elastic membrane situated inside a cylinder, the diaphragm being controlled by the introduction of an inflating fluid into the chamber delimited by said membrane and the cylinder, said introduction leading to the reduction of the interior space existing between the lobes and being produced by said immersed pilot device comprising a water pressure amplifier in the vicinity of the enclosure, the output of the amplifier being connected by a rigid conduit to said chamber delimited by the membrane and the cylinder.

12. A torch, as claimed in claim **1**, wherein said casing comprises, a metal portion at each of its ends to which it is connected by clamp means, said pieces supporting a series of fastenings between which are stretched cables supporting the stress engendered by said float and said buoy, a series of metal circular members having the same diameter as the casing, being fastened to the cables so as to keep said casing open.

13. A torch as in claim **12**, wherein the casing is made of woven polyester sheet.

14. A torch as in claim **12**, wherein the casing is made of woven polyethylene sheet.

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