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Genini et al.

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[54] **FLARE FOR BURNING GAS**

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** **431/202**; 9/8.3; 61/46.5

[51] **Int. Cl.**[2] **F23D 13/20**

[58] **Field of Search** 431/202; 9/8.3; 61/46.5

[56] **References Cited**

UNITED STATES PATENTS

2,894,269	7/1959	Dodge	431/202 X
3,652,196	3/1972	Orieux et al.	431/202
3,666,395	5/1972	Kubasta	431/202

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[57] **ABSTRACT**

Flare for burning by-product gas comprises caisson and means for holding said caisson in a partially immersed position.

9 Claims, 8 Drawing Figures

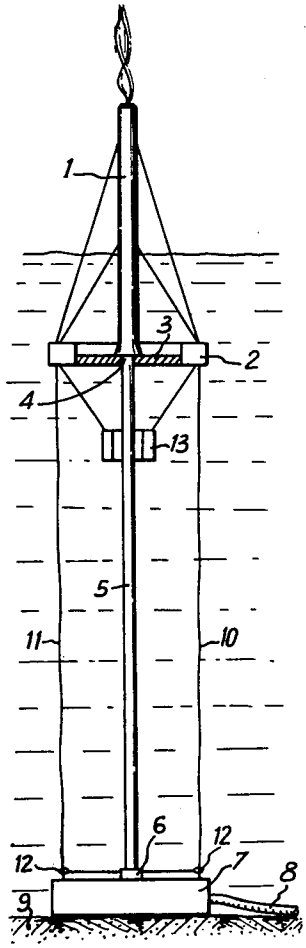


Fig: 1

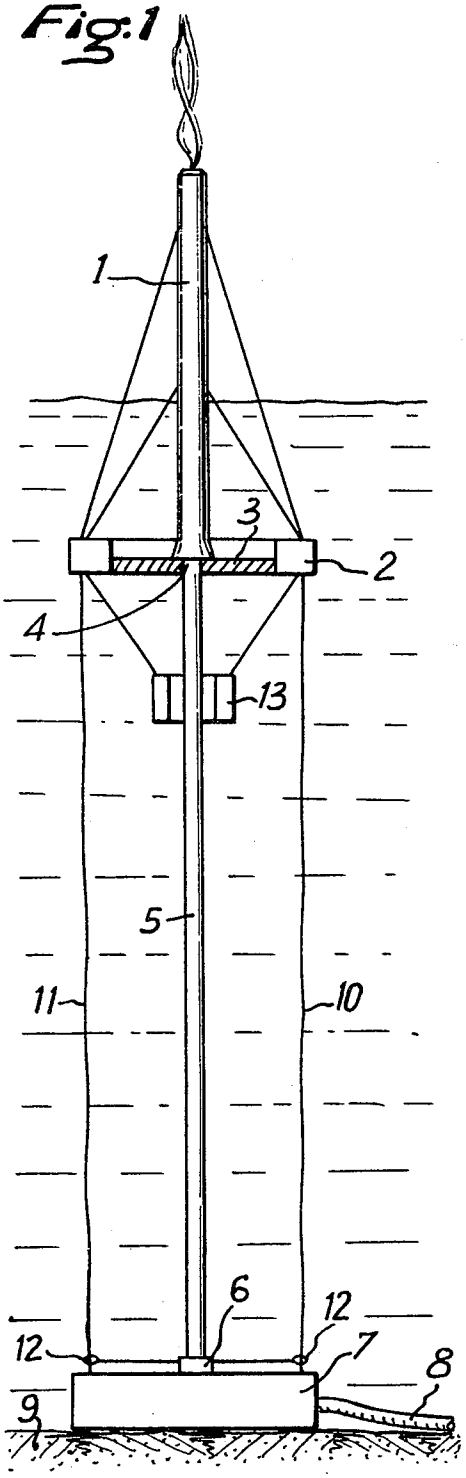


Fig: 2

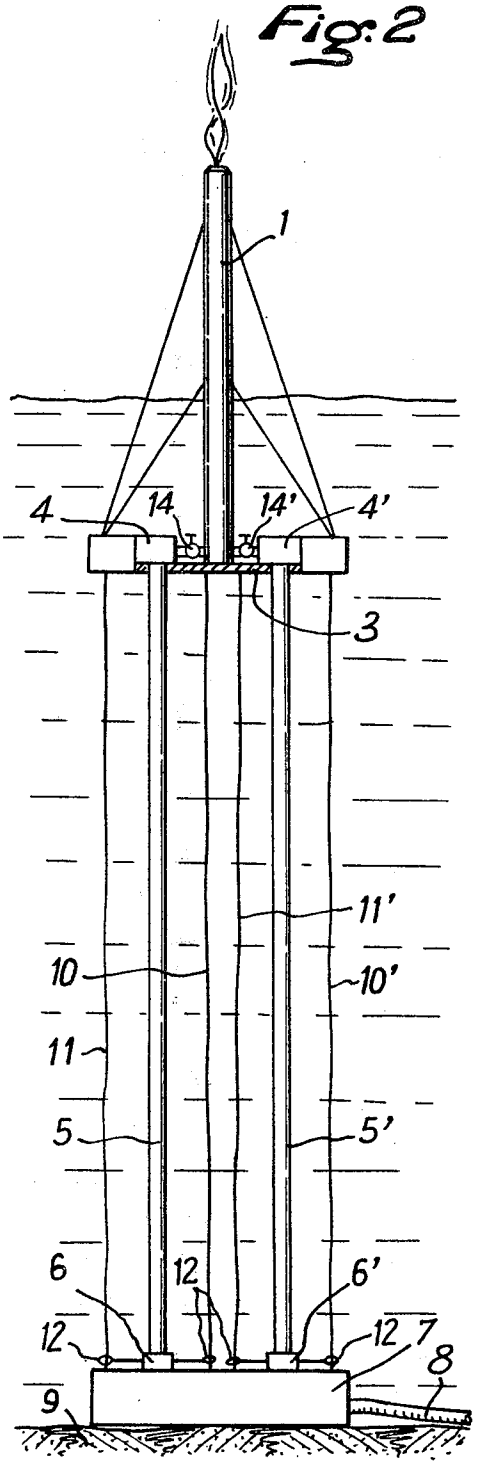


Fig:3

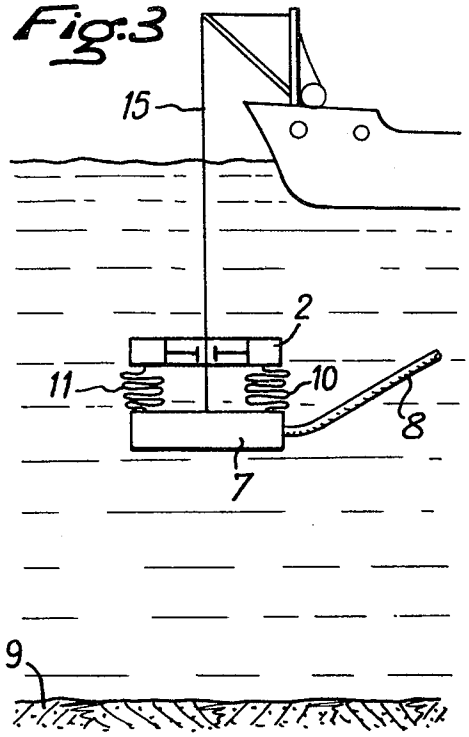


Fig:4

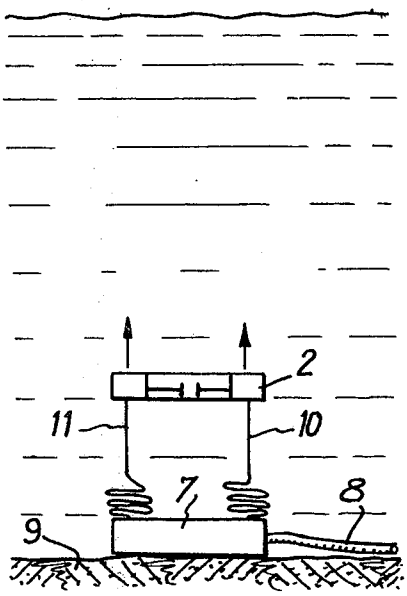


Fig:5

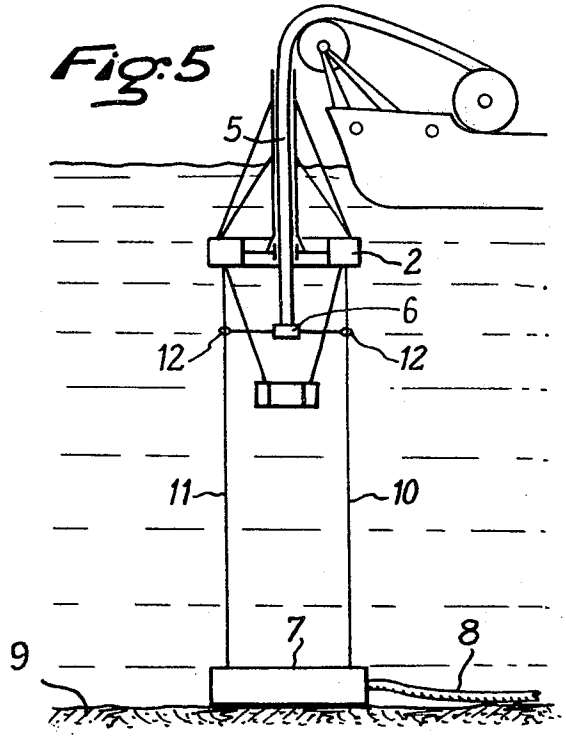


Fig: 6

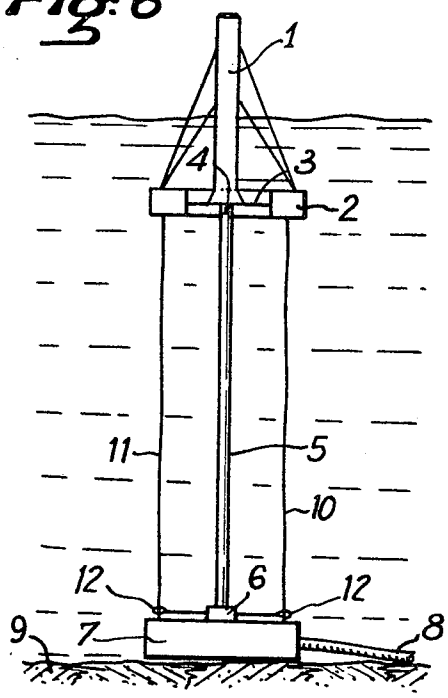


Fig: 7

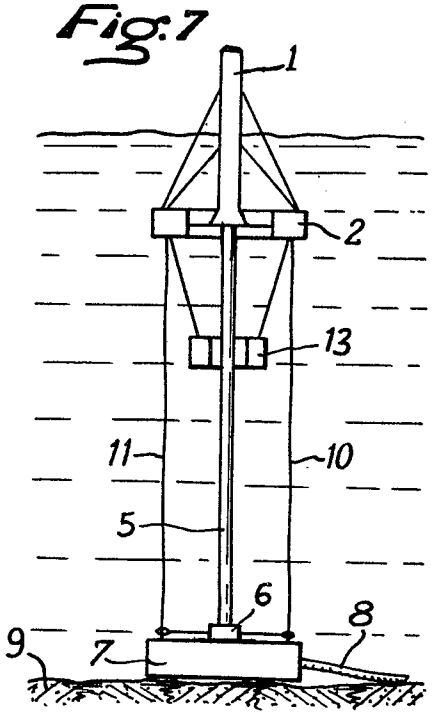
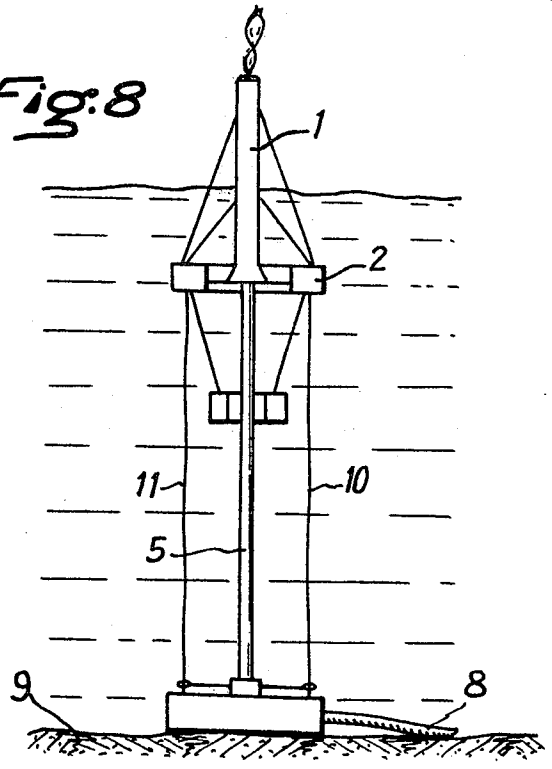


Fig: 8



FLARE FOR BURNING GAS

In the exploitation of oil fields it is frequently necessary to provide a flare for burning the gas after it has been separated from the oil.

The present invention relates to a flare of the semiimmersed type which is adapted to burn gas in installations for exploiting or treating oil beneath the sea or in fresh water of substantial depth.

The present invention relates to a semi-immersed flare which is mounted on a caisson which assures the flotation of the flare but is held beneath the water so as to shelter the flare from the effects of the wave action, with only the upper part of the flare remaining above the water.

The semi-immersed flare according to the invention has a particularly simple and economical construction and it may be put in place and maintained easily even when it is located in deep water.

The object of the present invention is to provide a new article of manufacture which consists of a semi-immersed flare characterized by the fact that the chimney of the flare is mounted on a caisson which is constantly immersed but which has a positive buoyancy and is connected to a base which is resting on the ocean floor through at least one flexible tube under tension. The caisson is also connected to the base by means of at least two anchoring and guiding cables which are normally sleek but which may be placed under tension in order to avoid tension on the flexible tube or tubes. These cables also make it possible to mount or replace flexible tube or tubes.

In accordance with the invention, the flexible tube or tubes used are preferably of the type comprising metallic reinforcing means which resist radial pressure and longitudinal tension and comprise at least one fluid tight sheath.

Advantageously the lower part of each flexible tube is provided with an automatic connector which permits the automatic connection of the lower part of the flexible tube to a connector mounted on the base. The connectors or connector mounted on the base themselves connected by other steps to the reservoir or to the place at which the gas to be burned in the flare is separated.

In a preferred embodiment of the invention the caisson comprises a device which makes it possible to ballast it, that is to say, to regulate its buoyancy to exert on the flexible tube or tubes any desired longitudinal tension.

In accordance with the particular emodiment of the invention, the balancing means is mounted on the lower part of the caisson in such a way as to hold it in a substantially horizontal position and thus avoid any possibility that the chimney of the flare will incline too greatly away from the vertical under the effect of the current or the wind.

In the simplest embodiment a semi-immersed flare comprises a single flexible tube which connects the caisson to the base.

In the more complex embodiments several parallel flexible tubes may be located between the caisson and the base which make it possible to insure that a larger volume of gas will flow toward the chimney. Moreover, it is possible to replace one of these tubes while the other continues to supply the flare.

The present invention also relates to a method of locating a flare of the type which has just been described in position, which method is characterized by the fact that: the assembly of the caisson and the base is formed and the cables serving for anchoring and guiding are coiled in a figure 8 on the base; the assembly comprising the base and the caisson are progressively immersed by known means; after having ballasted the base when it is located at the bottom of the sea, a certain buoyancy is imparted to the caisson which is liberated from the base so that it can rise until the cables serving to anchor and guide it are subjected to tension.

A preferably automatic connector is located beneath the caisson and connected to the cable which anchors it and guides it. The lower end of the flexible tube is attached to the connector; the flexible tube is immersed while permitting the connector to descend to the base; the upper end of the flexible tube is connected to the chimney of the flare and the lower end of the tube to the base; and the device regulating the tension on the cable is actuated to lengthen them and place the flexible tube under tension.

In a preferred embodiment of the invention, the connector which is located at the lower end of the flexible tube is an automatic connector which permits automatic engagement of the connector and the corresponding connector on the base.

By operating in this way it is possible to locate the base on the bottom without having to use divers working at the depth of the sea floor.

When it is desired to change or inspect the flexible tube, tension is exerted on the anchoring cable and the connector is liberated from the base which makes it possible to raise the tube upward after having removed the chimney from the flare.

The device according to the invention has the advantage of permitting the semi-immersed flare to be easily mounted and maintained under constant tension by the flexible tube which is a condition which is very favorable to its long life despite the movements to which it is subjected as a consequence of the agitation of the sea.

In a second embodiment of the invention several flexible tubes are used which are located parallel to each other, each of which is equipped with anchoring and/or guiding cables which permit it to be located in place as indicated above.

In the embodiment which comprises several flexible tubes the upper ends of the tubes are connected to the chimney by vanes which make it possible to isolate certain tubes as bad.

In order that the invention may be better understood, several embodiments thereof will now be described purely by way of illustration and example with reference to the accompanying drawings, on which:

FIG. 1 schematically illustrates the first embodiment of the semi-immersed flare according to the invention;

FIG. 2 illustrates a second embodiment of the invention;

FIGS. 3–8 schematically illustrate the successive steps in mounting the semi-immersed flare according to FIG. 1.

FIG. 1 shows the chimney 1 of the flare resting on a caisson 2 which has, in the present case, an annular shape but may have a different shape without thereby departing from the basic principles of the invention.

At the level of the platform 3 of the caisson 2 the chimney 1 is connected to the upper part 4 of the flexible tube 5 which, thanks to the connector 6 located at its lower part, is connected to a connector (not shown) on the base 7.

This connector is connected to the tube which rests on the bottom of the sea 9.

Two cables 10 and 11 which may serve to anchor and/or guide are located between the caisson 2 and the base 7.

The drawings schematically show how the guide means 12 of the connector 6 are attached to the cables 10 and 11.

FIG. 1 shows the semi-immersed flare in its operating position. The flexible tube 1 is placed under tension by reason of the buoyancy of the caisson 2 while the anchoring and/or guiding cables 10 and 11 are shown slack. It is also possible to hold a slight tension on the cables, the torch being nevertheless anchored by the flexible tube.

The anchoring and/or guiding cables 10 and 11 are connected at their upper part to the caisson 2 by means of a device which makes it possible to vary their useful length in such a manner that by lengthening them the tube 1 is placed under tension, whereas by shortening them and placing them under tension, axial tension on the flexible tube 5 is relieved, the buoy then being anchored by the cables.

Such devices may consist, for example, of winches which wind and unwind the guiding cables 10 and 11 for a certain length or by hydraulic or pneumatic cylinders which move the point of attachment of the guiding cables 10 and 11 with respect to the caisson 2 or by any other conventional system.

It will be appreciated that under these conditions the flare subjected to the action of the waves and the flexible tube 5 is placed under tension by the buoyancy of the caisson 2 which is favorable to the strength and holding power of this flexible tube 5.

Moreover, the flexibility of the cable also permits the chimney to be displaced laterally even to tilt in response to the movement of the sea or the wind.

In the embodiment of FIG. 2 a ballasting means 13 is schematically represented mounted on the lower part of the caisson 2 so as to impart thereto a stability which tends to hold the chimney 1 vertical or at least to limit its inclination.

In the embodiment which is illustrated on FIG. 2, this figure shows the base 7 which is connected to the caisson 2 by four cables for anchoring or guiding purposes 10, 11, 10', 11' and by two flexible tubes 5 and 5'.

Each flexible tube is provided with a base 6, 6' mounted on the guide cables by guide means 12.

In this embodiment the heads 4 and 4' of the tube 5 and 5' are connected to the lower part of the chimney by vanes 14 and 14' which have been shown schematically.

The cables serving for anchoring and/or guiding purposes are in this case also provided with means for varying their length in order to permit them to keep under tension or relieve from tension the tubes 5 and 5'.

The valves 14 and 14' make it possible to isolate one of the tubes so as to repair or replace it.

It is obvious that, according to the invention, it is possible to make a semi-immersed flare comprising more than two tubes, preferably regularly distributed about the perihpery of the chimney of the flare.

A description of how the flare may be placed in position over a great depth will now be given, for example, a depth of several dozen or several hundreds of meters or more.

FIG. 3 schematically shows how the base 7, supporting the caisson 1 while the cables 10 and 11 are coiled in the form of a figure 8, is progressively immersed by means of a conventional device, for example, by means of a crane 15 equipped with antiramming means.

The duct 8 which is connected to the base may advantageously be already mounted thereon.

The assembly constituted by the base 7 and the caisson 10 is then progressively immersed until the base 7 rests on the sea floor 9.

When the base is fixed on the sea floor the caisson 2 is released, for example, by means of a telemetric control device. Before carrying out this operation and liberating the caisson 2 one may, if desired, ballast the caisson 7 either by filling it with water or by attaching thereto a heavy product which is sent down from the surface of the water through a tube.

When the caisson 2 has reached its upper position, as may be seen in FIG. 5, the cables 10 and 11 are placed under tension by the buoyancy of the caisson 2.

The chimney is then mounted and this chimney 1 must be attached to the caisson 2 by stays or fixed to the caisson 2 by any suitable conventional means. The ballast 13 is added beneath the caisson but does not form an integral part of the caisson and the flare.

In one variation of the caisson 2 the ballast 13 and the chimney 1 are fixed to each other and rest on the base 7, to which they are connected by the cables serving for anchoring and guiding purposes and which are coiled on the base. In this case the caisson, the ballast, the chimney and the base are simultaneously and progressively immersed an then the assembly constituted by the caisson, the ballast and the chimney are raised toward the surface by uncoiling the cables, as has already been described.

The connector 6 is then located at the end of the tube 5 and this connector is attached to the cables 10 and 11 by guide means 12. By progressively unrolling the tube 5, the base, which is guided by the cables 10 and 11, is permitted to descend.

As shown on FIG. 5, the connector 6 is then attached to connecting means positioned on the base 7 and the connection may then be automatically effectuated without using divers. This may also be done manually when the depth of the water is not too great to permit easy work by a diver.

The upper part 4 of the tube 5 is then connected to an appropriate attaching device located on the platform 3 of the caisson 2. It then suffices to actuate the device for attaching the cables 10 and 11 to the caisson 2 so as to slightly lengthen these cables so as to place the tube 5 under tension, which has the effect of relieving the tension on the cables 10 and 11 or reducing the tension on the cables 10 and 11 if it is desired to retain a slight tension thereon. The flare is then ready to operate.

It will be readily understood that the tube 5 may be inspected or replaced by reversing this procedure, that is to say, by placing the cables 10 and 11 under tension while releasing the connector 6 from the base 7 and raising the tube.

It is also possible to proceed in the same way to inspect or replace the cables serving for anchoring or guiding purposes while the caisson is held by the tension of the flexible tube.

It will be seen that the positioning of the flare according to the invention as well as its maintenance can be carried out in a simple and economic manner.

In effect, most of the work carried out at the level of the caisson, that is to say, at a depth of immersion of the order of a dozen meters, is sufficient to protect the caisson from the action of the waves but nevertheless permits easy operation by divers.

The operations which must be carried out at the level of sea bottom may be entirely automatized, if that is necessary, and if the bottom is sufficiently deep so that work thereon is difficult. In the contrary case, the work at the level of the base may be simplified when it is possible to carry it out by submarine divers.

It will of course be appreciated that the embodiments which have been herein described have been given purely by way of illustration and example and may be modified as to detail without thereby departing from the basic principles of the invention.

What is claimed is:

1. In a flare comprising a chimney which is mounted on a caisson having a positive buoyancy connected to a base having a negative buoyancy and adapted to rest on the sea floor, the improvement comprising

first connecting means in the form of at least one flexible water-tight tube located between said caisson and said base,

second connecting means in the form of at least two cables positioned parallel to each other and connecting said caisson to said base, and

means for placing either of said connecting means under tension so as to relieve the tension on the other.

2. Flare as claimed in claim **1** in which the flexible water-tight tube comprises metallic reinforcements which resist radial tension and presure and longitudinal tension as well as at least one water-tight sheath.

3. Flare as claimed in claim **1** in which the lower part of said at least one flexible water-tight tube is provided with an automatic connector which permits it to be automatically connected to at least one connection on the base.

4. Flare as claimed in claim **3** in which the connector on the base is itself connected by other ducts to the reservoir, or to the point at which the gas to be burned in the torch is separated.

5. Flare as claimed in claim **1** in which the caisson comprises ballast holding means.

6. Flare as claimed in claim **1** in which at least one ballasting device is mounted on the lower part of the caisson.

7. Flare as claimed in claim **1** which comprises a single flexible tube which connects the caisson to the base.

8. Flare as claimed in claim **1** which comprises several flexible tubes which are positioned parallel to each other between the caisson and the base, each of which is accompanied by cables for anchoring and/or guiding it.

9. Flare as claimed in claim **8** in which the upper ends of the tube are connected to the chimney by vanes.

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