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(54) UNDERWATER OILFIELD PRODUCTION EQUIPMENT

(71) We,ENTREPRISE D'EQUIPEMENTS MECANIQUES ET HYDRAULIQUES E.M.H., a body corporate organised under the laws of France, of 29, rue de l'Abreuvoir, 92100 Boulogne, France, do hereby declare the invention, for which we 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 production equipment for oil-fields at sea using off-shore platforms.

Its aim is, by means of a number of arrangements to be used together or separately, to substantially reduce the investment cost of low output fields and to make them workable.

It consists, according to one of these arrangements, in using a production platform, particularly of the type anchored to the bed of the drilling field and, for example, of the type hinged at the base, which platform comprises an oil and gas separator and which is combined with a flare which appears at a suitable distance from the axis of the platform, this flare being carried by a floating support turning into the wind while being connected by at least one hinged arm to a rotatable element, particularly a rotating head of the platform.

The production platform can be connected by pipeline to an assembly of a storage and loading platform, particularly with a base anchored to the sea-bed and forming a storage reservoir, and at least one column hinged to this base, which column comprises equipment for loading oil tankers, such as described in U.K. specification 1449103 and application No. 45549/76 serial No. 1555346.

The above-mentioned production column may be associated with a number of wells distributed about its base or else said wells may be drilled from its base. There are also provided systems of valves and manifolds suitable for directing the crude oil towards the separator, then the separated oil towards the storage and loading column.

Certain other arrangements, which are preferably used at the same time, will be explicitly mentioned hereafter.

The invention will be further described by way of example with reference to the accompanying drawings, wherein:

Figure 1 shows schematically in perspective an oil production installation;

Figures 2 and *3* show separately, on a larger scale, the structure supporting the flare in said installation; and

Figure 4 illustrates in perspective the base of a modified production column of the type shown in Figure 1.

Referring to Figure 1; the installation comprises a number of wells which are drilled from a mobile platform or from a drilling ship or in any other way, these wells being equipped with their usual accessories, such as protection casings, safety valves etc; their upper part forming the well-head 1. A manifold device 2, in combination with groups of valves and piping, collects the production of the wells, these valves being housed on the sea bottom or on the production column which will be described. The production column is formed by a hinged column 3, mounted through a universal joint 4 to a base 5, with ballast reservoirs 6 and at least one float 7 maintaining by hydrostatic thrust the substantially vertical position, said column being equipped moreover with a gas and oil separating system 8 to which the crude oil enters through a pipe 9 and from which it leaves, refined, by a pipe 10 going downwards from the column to convey the refined petroleum, or oil, towards the storing and loading equipment.

Fed by a pipeline 12, forming a continuation to pipe 10, the storing and loading

equipment is formed bya base 13 anchored to the sea-bed, serving as storage reservoir and of any desired size, and a loading platform constructed in the form of a column 14 hinged by universal joint at 21 and equipped with means for mooring ships 15, with a rotatable head 16 and a boom 17 for carrying loading tubes 18, as for example described in patent specification No. 1449103. Pumps 19 and valves 20 are provided for taking the oil from the reservoir-base 13 at will, or for stocking it therein.

A flare 11 for burning the gas leaving the separator is constructed in such a way that it is located at some distance from the production column (e.g. 100 to 200 m), while being carried by a floating structure 23 capable of turning into the wind, this structure being connected to the platform so as to be able to rotate thereabout, and for this reason the platform is equipped with a rotatable head 22 on which is hinged an arm connecting this head to said structure.

Referring also to Figures 2 and 3; the floating structure 23, carrying at one end flare 11, is formed advantageously by an assembly having a generally square or triangular or other section, of suitably cross-braced tubes, such a structure being insensitive to the effects of swell. It is connected to rotating head 22 by at least one arm 24, itself formed by tubes, which is hinged at one end to head 22 about a horizontal axis A-A, and at the other end is hinged to structure 23 about another horizontal axis B-B. The dimensions of the tubes of structure 23 will be calculated so that the water line is substantially half-way up the vertical section, as shown in Figure 3. The tubes in question could possibly be used for conveying gas, but it seems preferable for safety reasons to use separate piping such as 25 whose end on the column side is connected to the output tube of the separator by means of rotating joints schematically shown at 26, 27.

Such a structure is subjected by the sea, even in the case of storms, to much less heavy stress than a normal boat. It will be noted that the swinging movement of the hinged column will be braked by the movements of this structure in the water and the result of this will be, in connecting arm 24 and its joints, stresses which remain small, whereas they could become very great if flare 11 had the shape and the mass of a boat of the same length (the solution of a support comprising a boat hull not however being excluded).

In Figure 4 is shown another embodiment of the installation in which the well-heads are fixed through base 5 of the production column, in the case where this base has large dimensions (50 to 100 m per side). In this case, the base alone is installed first of all and the wells are drilled at the positions provided therefor by means of a mobile platform of a known type carrying drilling equipment and using the technique of deflected wells so as to attain the full volume of the oil-field. After the wells are finished and fitted with their control members, the hinged production column is installed and the oil collecting piping connected between the base and the column. The advantage of this embodiment is that it becomes possible, by using simple and economical equipment carried by the column, to carry out on and inside the well-heads all maintenance work which may prove necessary.

In this connection the column will be able to comprise all service means for control and possible loading of the well-heads and/or their accessories (valves etc.) in accordance with the arrangements described in U.K. patent application No. 23989/77 serial No. 1581373 (corresponding to U.S. specification 4119145).

The foregoing arrangements enable the different essential members to be concentrated on the platforms; consequent reduction of construction costs, even for platforms in deep water (e.g. 100 to 200 m); the production of several days to be readily stocked when bad weather prevents an oil tanker from coming to take it away, base 13 and the production column being able to have a large capacity; and a better supervision of the different parts of the whole.

WHAT WE CLAIM IS:

1. Production equipment for oil-fields at sea, with a production platform having a column connected to a base anchored to the sea bed, in combination with a floating flare located at a distance, for the combustion of gas extracted from the oil, wherein said flare is carried by a floating arm structure which turns into the wind and is connected to a rotating head of the column by a hinged support.

2. Production equipment according to claim 1, with a production column connected at its base to a plurality of wells, comprising an oil and gas separator, a flare disposed at a distance for evacuating the gases, and wherein the refined oil goes down to the base to be conveyed towards a storage reservoir located at a distance and anchored to the sea bed, this reservoir belonging to a loading platform.

3. Production equipment according to claim 1 or claim 2, wherein the production platform has a column hinged by a universal joint to a base serving as storage reservoir.

4. Production equipment according to claim 1 or claim 2, in connection with a plurality of wells, wherein there is provided the combination of a platform whose base on the sea-bed is constructed in the form of a storage reservoir, the wells emerging

therethrough.

5. Construction equipment according to any one of the preceding claims, wherein the floating support for the flare is formed by an assembly of cross-braced tubular arms forming floats.

6. Production equipment according to any one of the preceding claims, wherein the floating support is hingedly connected to arms themselves hinged to the head of the platform.

7. A flare stack assembly for an underwater oil-field comprising a buoyant arm structure pivoted to a member adapted to be fixed or moored relative to the seabed, the arm structure carrying a flare stack adjacent its outer end.

8. Production equipment for underwater oil-fields substantially as hereinbefore described with reference to Figures 1 to 3 of the accompanying drawings.

9. Production equipment for underwater oil-fields substantially as hereinbefore described with reference to Figure 4 of the accompanying drawings.

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1581372 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

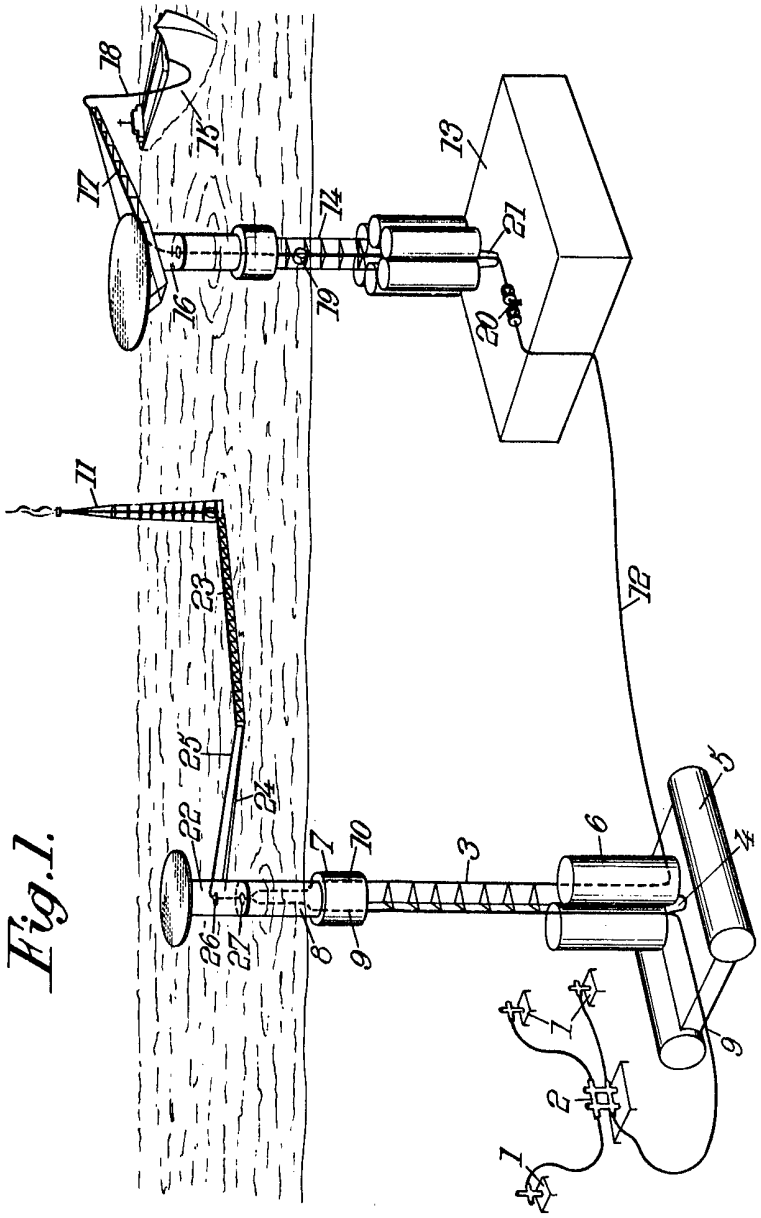

Fig.1.

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Sheet 2

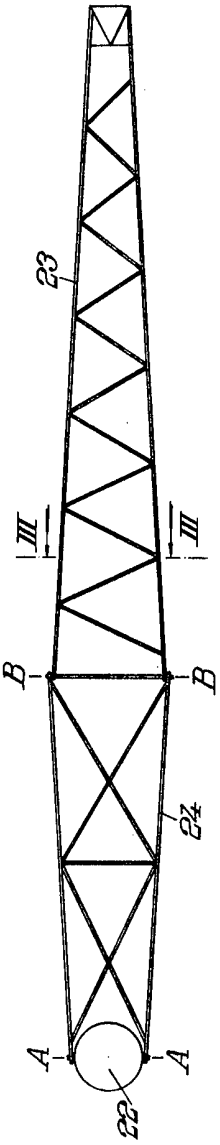

Fig.2.

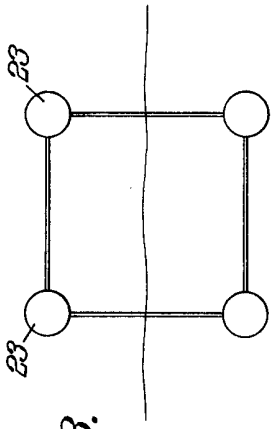

Fig.3.

1581372 COMPLETE SPECIFICATION

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Sheet 3

Fig. 4.