United States Patent

Duc et al.

[15] **3,681,927**

[45] **Aug. 8, 1972**

[54] **DEVICE FOR LAYING SUBMARINE CABLES AND PIPES IN AREAS COVERED WITH ICE**

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[22] Filed: **Aug. 18, 1970**

[21] Appl. No.: **64,704**

[30] **Foreign Application Priority Data**

Aug. 18, 1969 France.....6928309

[52] **U.S. Cl.** **61/72.1**, 30/140, 61/1, 61/72.3, 299/14

[51] **Int. Cl.** **F16l 1/00**, F25c 5/02

[58] **Field of Search**.....61/72.1, 72.3, 36 A, 1; 299/14; 30/140

[56] **References Cited**

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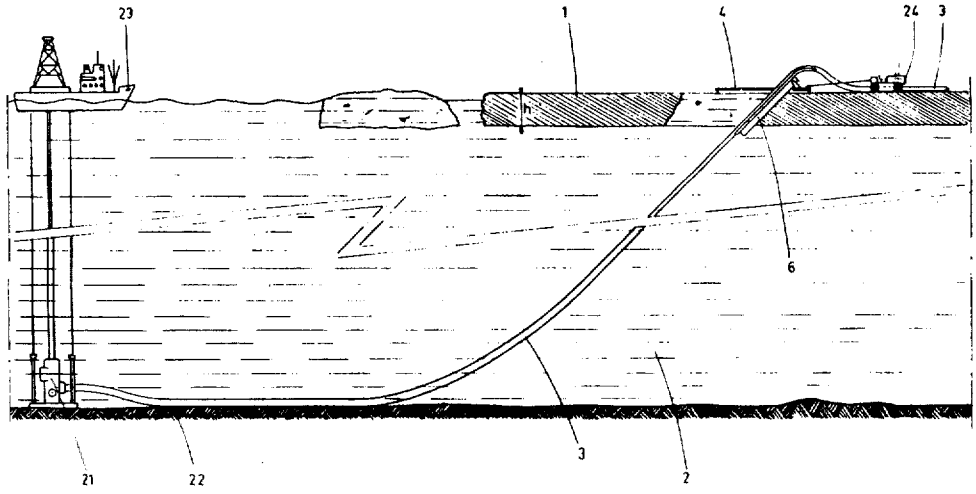
[57] **ABSTRACT**

Device for laying submarine pipes and cables in bodies of water covered with ice including a slide bar mounted at an angle to the vertical on a platform capable of being displaced along the surface of the ice, the slide bar extending below the platform by a distance greater than the thickness of the ice and including a plurality of burners capable of heating a wall of the slide bar positioned for contact with the ice.

9 Claims, 6 Drawing Figures



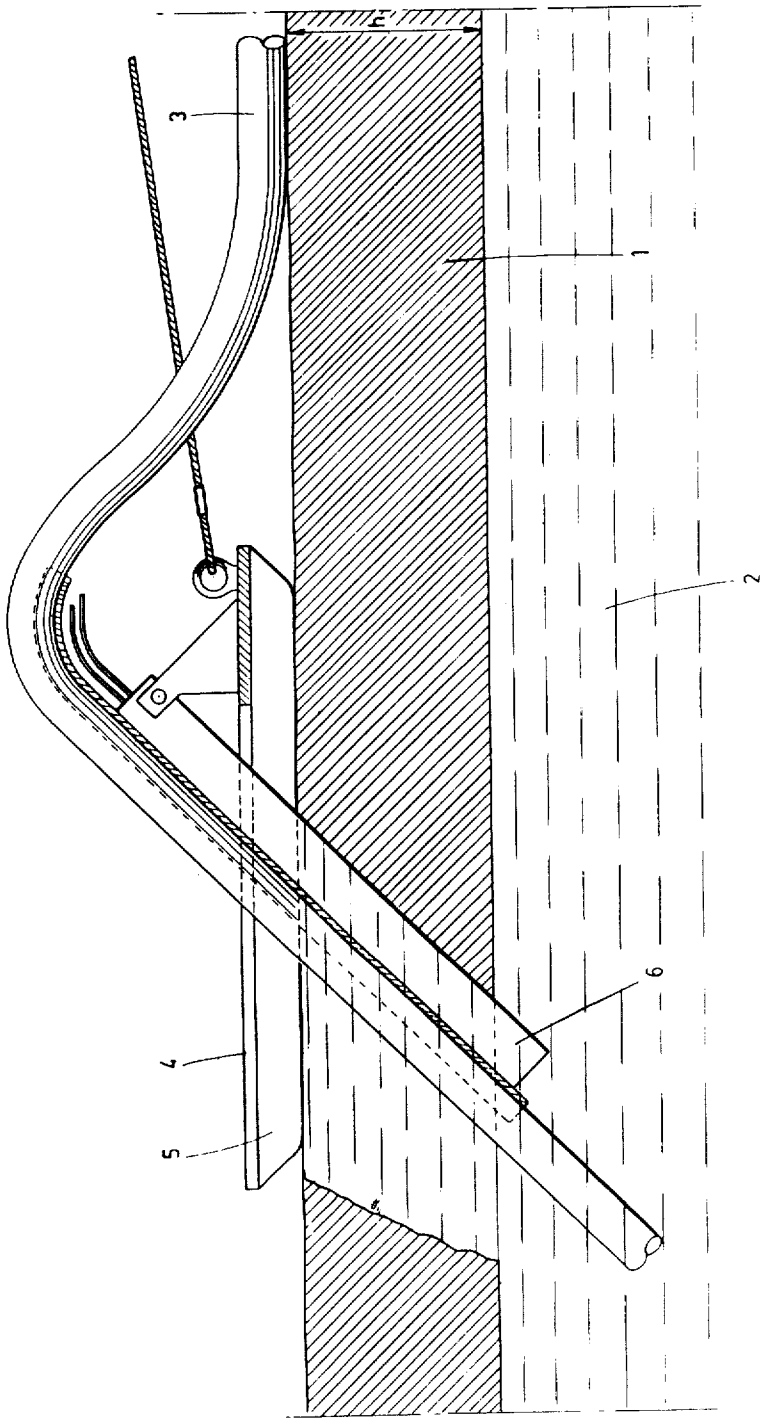


FIG.1

FIG. 2

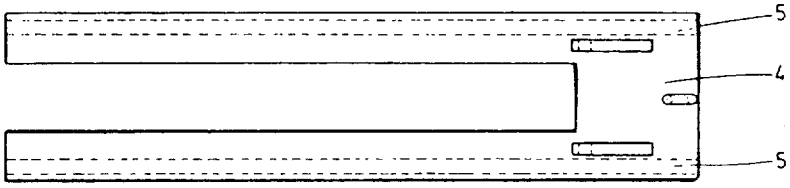


FIG. 3

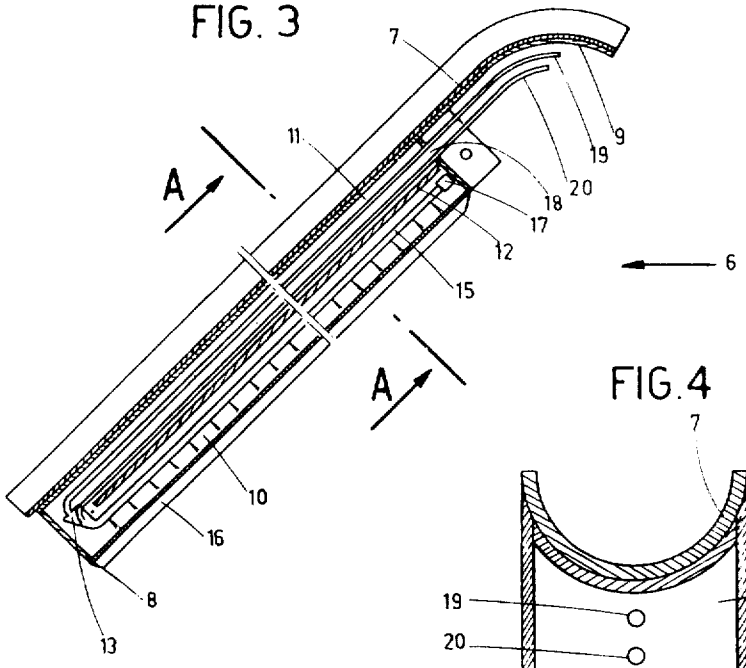


FIG. 4

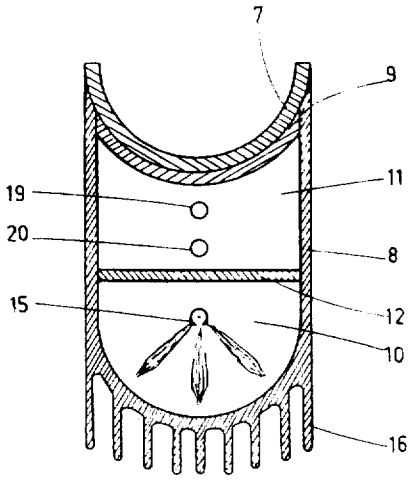


FIG.5

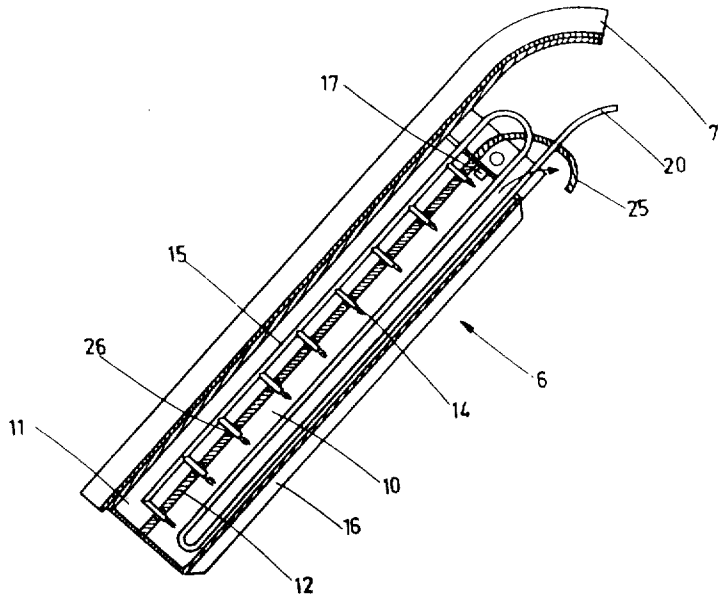
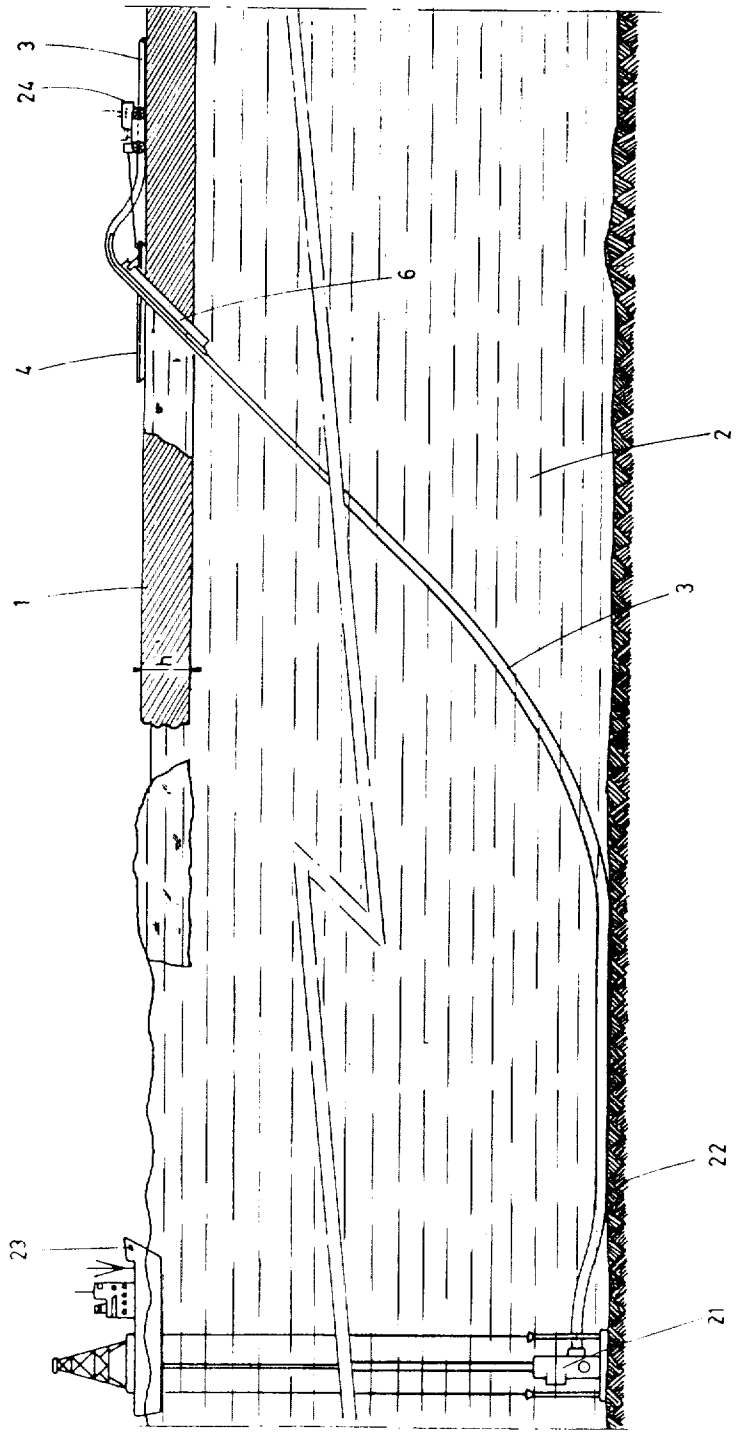


FIG.6



DEVICE FOR LAYING SUBMARINE CABLES AND PIPES IN AREAS COVERED WITH ICE

The present invention relates to the laying of submarine cables and pipes in areas covered with ice.

The pipes whose placement is carried out according to the present invention may be particularly designed for the transfer of oil originating from underwater deposit, and this particular example of one use of the present invention will be referred to hereinafter, although it will be apparent from this description that the invention is inherently applicable to other uses.

Up to now, the laying of submarine pipes and cables has been very difficult, if not altogether impossible, when the surface of the sea is covered with ice to a significant extent. The problem to be solved consists in easily obtaining a passage of the pipe or the cable through the ice.

The present invention proposes a device which makes it possible to obtain a passage for a pipe or a cable through the layer of ice covering the ocean, a lake, or a body of water, by locally bringing about a melting of the ice to permit the cable to pass through.

The device according to the present invention, which makes possible the placement or laying of submarine pipes or cables in areas or regions that are covered with ice, includes a platform which may be displaced at the surface of the layer of ice. It is characterized in that the platform comprises a slide bar inclined with respect to the surface of the ice and having, in the direction below the surface carrying or supporting this platform, a length greater than the thickness of the layer of ice. This slide bar is adapted to guide the pipe in the process of being laid and comprises a combustion chamber having at least one wall in contact with the ice so as to bring about the melting of the ice over a width sufficient to allow for the passage of this slide bar therethrough.

The present invention will be described in further detail hereinbelow in connection with the accompanying drawing which discloses, simply by way of example and without being limitative, one embodiment according to the present invention, and wherein:

FIG. 1 is a side sectional view schematically illustrating one embodiment of the device according to the present invention;

FIG. 2 is a top plan view of the platform shown in FIG. 1;

FIG. 3 is a longitudinal sectional view of the device which effects the local melting of the layer of ice;

FIG. 4 is a cross-sectional view taken along line A—A of FIG. 3;

FIG. 5 is a longitudinal sectional view of another embodiment of the device as proposed by the present invention; and

FIG. 6 illustrates schematically an example for the use of the device according to the present invention.

In FIG. 1, reference numeral 1 identifies a layer of ice having a thickness h and covering the surface of the ocean, or a lake, or body of water 2, at the bottom of which a pipe 3 must be deposited. This pipe has been previously unrolled and deposited on the surface of the ice 1 with the aid of any appropriate means known in the art, and essentially along a path vertically above the spot or place where it is intended to rest at the bottom of the ocean.

The device according to the present invention, which allows for the passage of the pipe 3 through the layer of ice 1, is made up of a platform 4 that is equipped with blocks or runners 5. This platform 4 shown in a top plan view in FIG. 2, has, for example, an essentially U-shaped configuration, and the spacing of the branches or arms thereof is greater than the diameter of the pipe 3. The blocks or runners 5 have a surface sufficient to allow the platform 4 to glide on the icy surface 1, and the width of the platform is sufficient to insure that it will remain flat to the surface on which it is supported during use in spite of the tipping forces which may be applied thereto.

FIG. 1 illustrates the platform 4 equipped with a device identified in a general manner by reference numeral 6. This device, which extends below the supporting or carrying surface of the platform 4, is inclined about an angle α with respect to the platform, and this angle may be adjustable if desired. This device 6, which will be further described in detail below, has a length sufficient to pass completely through the ice layer 1. By means of heating, the device 6 causes a melting of the ice and guides the pipe 3 into the opening thus formed in the layer of ice 1.

FIG. 3 shows an exemplary embodiment of the device 6. This device is composed of a slide bar 7 for guiding the pipe 3, and of a heating element 8 which encloses the external surface of the slide bar 7. A thermal protective layer 9 prevents any excessive heating of the slide bar 7. As illustrated in FIG. 4, the slide bar 7 has an arcuate cross section whose radius is at least equal to that of the pipe 3 and, in the longitudinal direction, it has a curvature which is at least equal to the minimum desireable radius of curvature of the pipe. The heating element 8 (FIGS. 3 and 4) comprises two internally disposed chambers 10 and 11 which are separated by means of a partition 12 but communicate with each other at the lower portion thereof through an orifice 13. The chamber 10 constitutes a combustion chamber whose wall is equipped with small cooling blades 16. Disposed within this combustion chamber is a row 15 of burners 14 supplied with a combustible substance, this row being provided with a device 17 for initiating the combustion, for example, an electrical device which may be of any known type.

After the combustion, the gases pass through the orifice 13 around the partition 12 into the chamber 11 and are discharged into the atmosphere through the opening 18 positioned in the wall at the upper part of this chamber. The air and the combustible fuel necessary for the combustion are furnished to the row 15 of burners by the conducts 19 and 20, respectively. Prior to their connection to the row 15 of burners, these pipes pass into the chamber 11 for the discharge of the burned gases in a manner such that the air and the combustible fuel are preheated by virtue of the exhaust gases.

The burners are of a conventional type and are chosen as a function of the combustible mixture which is being employed. The latter may either be crude oil, or preferably gas whose combustion releases a significant amount of calorific energy. The heat being produced is transmitted through the wall of the heating element 8 and the small blades 16 to the ice, and the melting of the latter is thus accomplished. A trench is

thus obtained in the ice layer (FIG. 1), permitting the passage of the pipe 3 which is immersed in proportion to the degree of advance of the platform 4.

FIG. 5 represents a modified embodiment of the device for melting the ice. In this embodiment, the combustion chamber 10 is put in direct communication with the atmosphere at the upper part thereof and a deflecting plate 25 which is integral with the device 6 directs the burnt gases toward the surface of the ice along the path indicated by the arrow.

The pipe 20 for the fuel supply is placed in the combustion chamber, and the speed of flow of the fuel is controlled such that the temperature of this pipe remains below a predetermined temperature, for example 100°.

The chamber 11 which, at the upper portion thereof, is in communication with the atmosphere serves as an air-supplying pipe and contains the row 15 of burners. The burners 14 which are secured to the row 15 terminate in the combustion chamber 10 through the orifices 26 of the partition 12, these orifices having a diameter sufficient to also provide for the passage of fresh air from the chamber 11 toward the chamber 10.

FIG. 6 illustrates schematically a non-limiting example for reducing to practice such a device as proposed by the present invention. An immersed head of an oil well 21 has been formed at the bottom 22 of the ocean 2 by a drilling boat 23. A pipe 3 for collecting hydrocarbons is secured at one of its ends to the shaft or well head 21 and so must be deposited on the bottom 22 of the ocean 2 which is covered at its surface with an ice layer 1 having a thickness h. This thickness is, for example, several meters.

The sections making up the pipe 3 stored on the ship 23 are deposited, for example, by means of a helicopter, on the surface of the ice 1 where they are assembled along a path substantially vertically the place where the pipe is intended to be immersed. One of the ends of the pipe is thereafter connected to the submarine well. The fuel supply pipe 20 is connected to a combustible reservoir by means of a flexible pipe which has not been shown in the figure. This reservoir may be situated on the ship 23 or may have been previously deposited in a specific place on the ice layer.

The heating element 8 brings about the melting of the ice, thereby allowing for the passage of the pipe 3 through the ice; the platform 4 is then displaced slowly on the ice with the aid of any appropriate means, for example, a vehicle 24, which allows for the passage of the pipe through the layer of ice.

It is understood that modifications may be applied to the present invention without departing from the spirit and scope thereof. It is possible, for example, to utilize as the combustible substance the crude petroleum furnished by the well or shaft head and stored on the ship 23. Instead of being hauled by a vehicle, the platform 4 itself may also be equipped with a driving motor mechanism. In addition, the wall of the combustion chamber which is in contact with the ice may have any shape or configuration that is adapted to create a good thermal exchange between the combustion chamber and the ice.

While we have shown and described two embodiments in accordance with the present invention, it is understood that the same is not limited thereto but is susceptible of numerous changes and modifications as known to a person skilled in the art, and we therefore do not wish to be limited to the details shown and described herein but intend to cover all such changes and modifications as are obvious to one or ordinary skill in the art.

We claim:

1. A device for laying submarine pipes and cables in areas covered with ice, comprising a platform capable of being displaced over the surface of a layer of ice, a slide bar mounted on said platform so as to be inclined with respect thereto, said guide bar extending below the carrying surface of said platform by a length greater than the thickness of the layer of ice and including guide means for guiding the pipe in the course of its being laid, and a combustion chamber forming part of said slide bar, at least a part of the external wall of said chamber forming a wall of said slide bar which is in contact with the ice and transmits thereto a quantity of heat sufficient to bring about the melting thereof over a width sufficient to effect the passage of said slide bar therethrough, wherein said combustion chamber contains a row of burners for burning fuel, an exhaust chamber for the exhaust of burnt fuel gases toward the atmosphere, and pipes for supplying said row of burners with a combustion-supporting medium and a combustible fuel, said pipes extending through said exhaust chamber to effect pre-heating of said combustion-supporting medium and said fuel.

2. A device according to claim 1, wherein said slide bar is mounted on said platform so that the inclination of said slide bar with respect to said platform is adjustable.

3. A device according to claim 1, wherein said external wall of said combustion chamber is equipped with small blades for contact with the ice.

4. A device according to claim 1, wherein said combustible fuel consists of at least one hydrocarbon.

5. A device according to claim 1, wherein said combustible fuel is crude petroleum.

6. A device according to claim 1, wherein said combustible fuel is gaseous.

7. A device according to claim 1, and further including deflecting means for directing the flow of exhaust gases at the outlet of said exhaust chamber toward the icy surface.

8. A device for laying submarine pipes and cables in areas covered with ice, comprising guide means for guiding a pipe along a path over the surface of a layer of ice and supporting means for supporting said guide means on the ice, said guide means extending below said supporting means by a distance greater than the thickness of the ice and including heating means for melting ice coming into contact with said guide means, wherein said heating means includes a combustion chamber having at least one burner therein and an exhaust chamber communicating with said combustion chamber for exhausting burned gases to the atmosphere, said exhaust chamber including deflecting means for directing the flow of exhaust gases at the outlet of said chamber toward the outer surface of said guide means capable of contacting the ice.

9. A device for laying submarine pipes and cables in areas covered with ice, comprising a platform capable of being displaced over the surface of a layer of ice, a

slide bar mounted on said platform so as to be inclined with respect thereto, said slide bar extending below the carrying surface of said platform by a length greater than the thickness of the layer of ice and including guide means for guiding the pipe in the course of its being laid, and a combustion chamber forming part of said slide bar, at least a part of the external wall of said chamber forming a wall of said slide bar which is in contact with the ice and transmits thereto a quantity of heat sufficient to bring about the melting thereof over a width sufficient to effect the passage of said slide bar therethrough, said combustion chamber communicating at the upper part thereof with the atmosphere, and further including deflecting means for directing the flow of exhaust gases at the outlet of said chamber toward the icy surface, said combustible fuel and said combustion-supporting medium being introduced into said combustion chamber through at least one orifice provided in the wall of said combustion chamber over a part of the wall which is not in contact with the ice.

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