March 8, 1932. J. G. STEIN 1,848,581

METHOD OF RAISING SUNKEN SHIPS

Filed Jan. 3, 1931

FIG. 1.

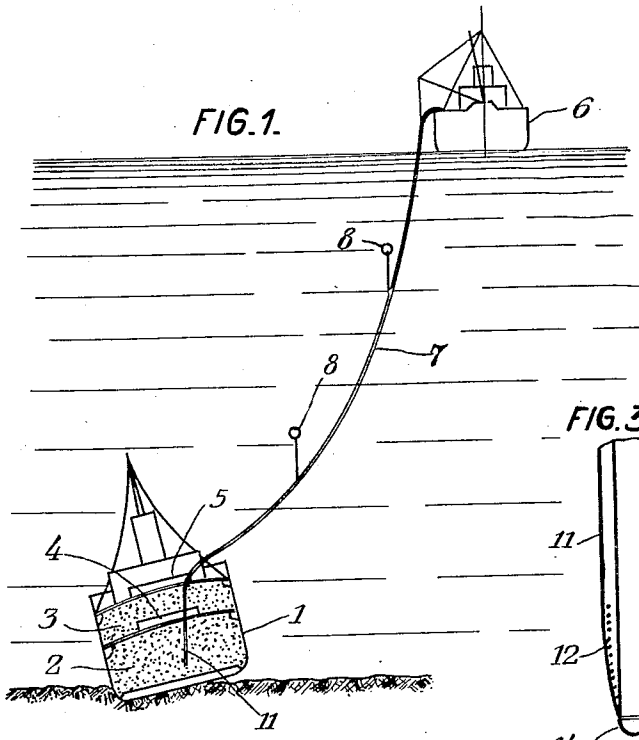



FIG. 2.




FIG. 3.

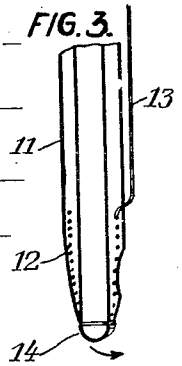



FIG. 4.

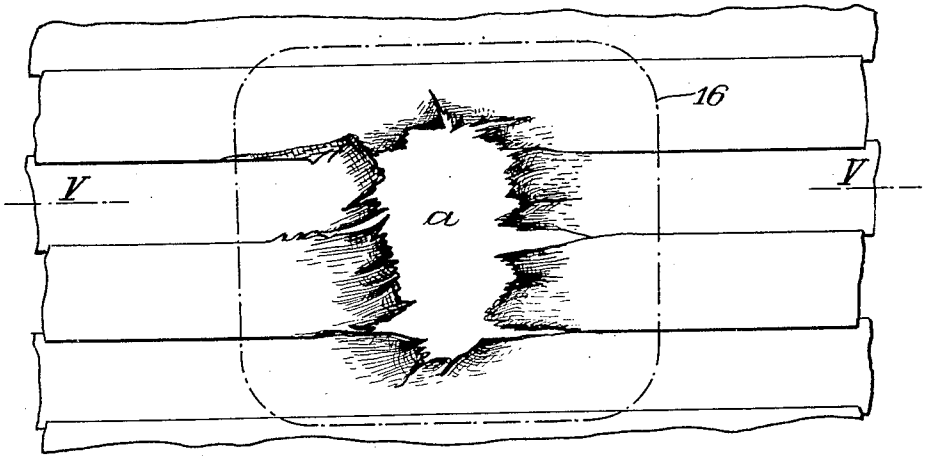
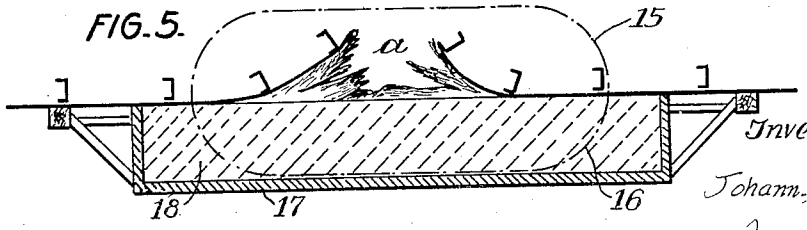



FIG. 5.




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# UNITED STATES PATENT OFFICE

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## METHOD OF RAISING SUNKEN SHIPS

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The salvage of sunken ships has so far been effected in such a manner, that the sunken ship was raised step by step by a certain amount with the aid of hoisting devices or salvage vessels equal to the lift required to raise the sunken ship when pumping out water ballast therefrom. In many cases the sunken ship will be tight except at the point where it sprung a leak and it will, therefore, be possible, after previously closing up the leak to expel the water from the ship by introducing compressed air or by pumping the water out of the hull. This method, however, requires the parts adjoining the leak to be comparatively smooth and tight or, in other words, that the outer planking or plating at this point be in comparatively good condition. It will, furthermore, be necessary, that at the point from where the ship is to be raised, there is no current or, at least, no current worth speaking of, so as to render it possible for the divers to properly attach the tightening medium to the point, where the leak is situated and to securely fix it to the hull about the leak. In connection therewith, very considerable difficulties will be encountered in trying to so fit this tightening medium against the hull below the sea level as to propely close up the leak.

The method in accordance with the present invention renders it possible, on the one hand, to raise a sunken ship also in that case, in which the ship has been damaged by breaking in different points whilst sinking. The method on the other hand, renders it possible to tighten or close up a leak even if the surrounding parts of the leak are not particularly smooth and if there is a current at the point where the ship is located.

The method in accordance with the present invention is shown by way of example in the accompanying drawings, in which

Fig. 1 represents a cross sectional view of a sunken ship, as well as a view of a salvage ship,

Fig. 2 is a fragmentary longitudinal section partly in elevation of a portion of the conduit connecting the sunken ship with the salvage ship, on an enlarged scale,

Fig. 3 is a fragmentary longitudinal sectional view of the lower end of the same conduit with an additional auxiliary device associated therewith.

Fig. 4 a plan view of the leak of a ship on a somewhat enlarged scale,

Fig. 5 a cross section through Fig. 4 along the line V—V of Figure 4.

The method of raising sunken ships in accordance with the present invention essentially consists therein, that in or along the ship ice is artificially produced for the purpose of acting as a carrier or closing medium. In Fig. 1 the outside planking or plating is indicated by 1, whilst 2 and 3 represent the cargo holds, 4 and 5 the hatches appertaining thereto. Numeral 7 represents a conduit connecting the salvage vessel with the interior of the cargo holds 2, 3. In connection herewith the weight of the conduit is taken up or neutralized in a corresponding manner by means of buoys 8. In accordance with the present invention air, together with foam forming agents, as used, for the sake of example, in conjunction with the foam extinguishing process, is forced through this conduit into the water contained in the cargo hold, causing there the formation of foam in a corresponding manner. Subsequently liquid air is conveyed through the conduit into the cargo hold, thereby causing the water in the hold to freeze. The method may also be carried out in such a manner, that simultaneously with the introduction of liquid air, air and foam forming agents are forced into the water in the holds through another conduit, for the purpose of intensifying the formation of foam to the greatest possible extent. In this manner porous ice is gradually produced within the cargo holds which, as it is being produced, displaces part of the water from the interior of the ship's hull. To this end the hatches are appropriately loosened by the diver, so that it will be possible for the ice to expand without causing the hull to burst. Owing to the fact that the ice is porous, the danger of bursting of the hull has been rendered remote.

As conduits 7 single sections of tube headers 9 enveloped in a protective jacket 10 are preferably employed. The space between

the protective jacket and tube section is appropriately evacuated for the purpose of serving as insulation and to ensure, that the liquid air penetrates right into the interior of the ship In order to obviate the end 11 of the conduit 7, being enclosed by ice, freezing thereto, the end 11 may be provided with an electric resistance 12 to which is conducted an electric current by means of an appropriately armoured cable 13, thus heating the end 11 and thereby rendering a separation of the same from the ice possible. The outer point of the final section tube header is suitably fitted with a closing valve or a closing flap 14 being of a spring action type which ordinarily closes up the interior of the piping when lowering same down upon the wreck and only opens for the purpose of discharging the air or liquid air, when there is an excess pressure in said piping.

In Fig. 4 a leak in the outside planking or plating of a ship is indicated at *a*, such as may be caused by a collision, by the explosion of a mine or the like. With the aid of the method in accordance with the present invention it will be possible to produce a block of ice at the leak, as indicated at 15 in the interior of the ship or at 16 on the outside of the ship. The production of such a block of ice will only then be possible in conjunction with the method according to the present invention, if there is no current at this point. It will be especially appropriate, particularly if there is some current, to cover up the leak in the first instance by means of a kind of casing 17, within which a block of ice 18 is subsequently produced by means of the method in accordance with the present invention. This embodies the great advantage that the tightening cushions are not required, as they formerly were, to be made in one piece and to be subsequently placed in position over the leak, but that it will now be possible to place this casing in position over the leak successively in small sections. Such small sections may be placed in their proper position below the sea level with much greater ease and their employment will for that reason be possible, because a special tightening of the separate sections against each other will not be necessary owing to the fact, that the tightening up of the leak is effected by the block of ice within the casing.

I claim:

1. Method of raising sunken ships, consisting in displacing the water contained in the ship's hull by the artificial formation of ice and foam and reducing the weight of the ship by increasing the buoyancy.

2. Method of raising sunken ships, consisting in introducing into the ship's hull air, means for producing foam, and liquid air for the purpose of producing within the ship ice mixed with air and reducing the weight of the ship by increasing the buoyancy.

3. Method of raising sunken ships, consisting in producing artificial, very porous ice with the simultaneous formation of foam close to a leak in the outside plating of a ship and pumping the water out of the ship after closing up the leak.

4. Method of raising sunken ships, consisting in covering a leak in the outside plating of a ship by an externally provided cover, producing on the inside of the cover artificial, very porous ice with the simultaneous formation of foam and pumping the water out of the ship after tightly closing up the leak.

5. Method of raising sunken ships, consisting in producing artificial, very porous ice mixed with air and simultaneously forming foam close to a leak in the outside plating of a ship and pumping the water out of the ship after closing up the leak.

6. Method of raising sunken ships, consisting in covering a leak in the outside plating of a ship by an externally provided cover, producing on the inside of the cover artificial, very porous ice mixed with air while forming foam and pumping the water out of the ship after closing up the leak.

7. Method of raising sunken ships, consisting in covering a leak in the outside plating of a ship by an externally provided cover, producing on the inside of the cover artificial, very porous ice while forming foam and pumping the water out of the ship after tightly closing up the leak.

8. Method of raising sunken ships, consisting in covering a leak in the outside plating of a ship by an externally provided box-like cover, producing on the inside of the cover artificial, very porous ice mixed with air while forming foam and pumping the water out of the ship after tightly closing up the leak.

In testimony whereof I have affixed my signature.

JOHANN-GEORG STEIN.