

June 21, 1932.

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1,863,732

SYSTEM OF AND MEANS FOR RAISING SUBMERGED VESSELS

Filed April 10, 1931

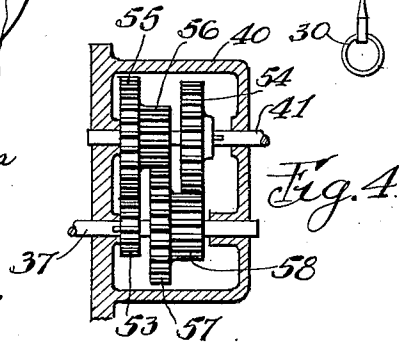
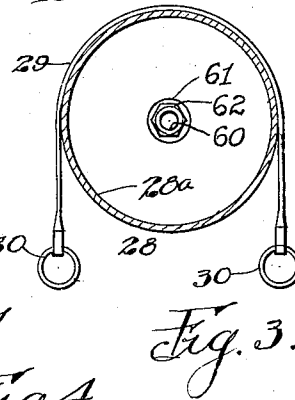
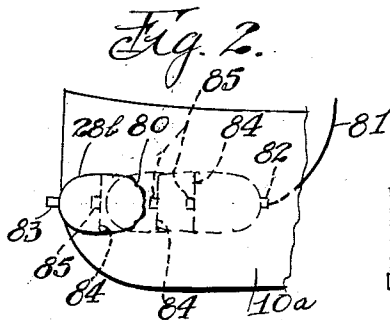
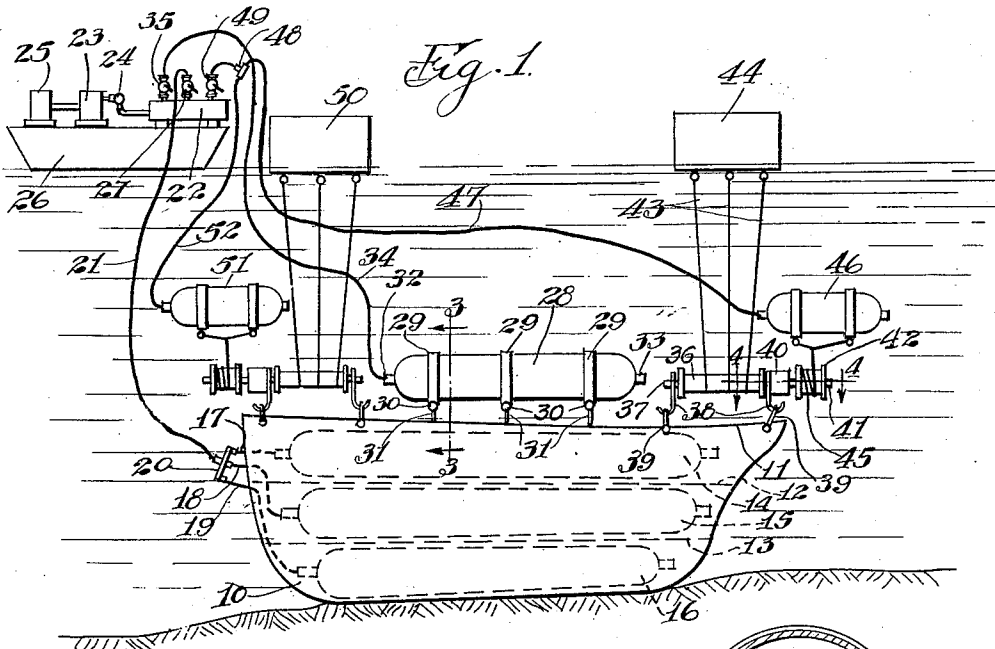


Fig. 5.

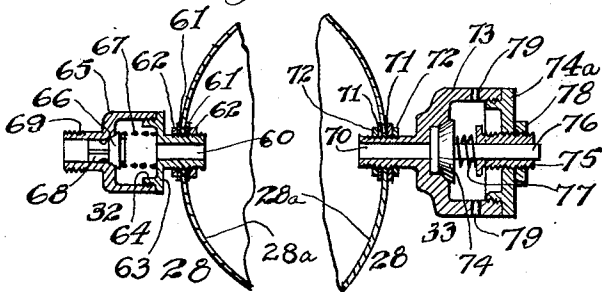


Fig. 6.

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SYSTEM OF AND MEANS FOR RAISING SUBMERGED VESSELS

Application filed April 10, 1931. Serial No. 523,998.

My invention relates to an improved system of and means for raising submerged vessels of different kinds, by the use of collapsible air bags which may be placed to advantage between the decks of the submerged vessel if desired, and above the submerged vessel after being secured in place, so that different ones of said bags may receive air supply in desired amounts and in desired sequence, to most effectively develop the lifting force required to raise the submerged hull. By my invention I also provide an improved construction of air bag for this purpose, and I also provide improved devices for holding the hull being raised, in upright position, so that it may be brought to the surface of the water by the inflated air bags without danger of turning over, and in a position to permit moving the raised hull to a repair dock with the certainty that the hull will remain in upright position and not cause trouble through turning over.

My invention will best be understood by reference to the accompanying drawing showing a preferred embodiment thereof, in which

Fig. 1 is a diagrammatic view illustrating a submerged hull with my improved apparatus placed therein and thereon, together with controlling mechanism for supplying the air as desired to different ones of the air bags for purposes of inflation,

Fig. 2 is a fragmentary view showing a part of a hull with one of my improved inflatable air bags used to temporarily close a collision opening in the hull,

Fig. 3 is a sectional view of one of the air bags shown in Fig. 1, to an enlarged scale, taken along the line 3—3,

Fig. 4 is a sectional view to an enlarged scale of a part of the devices shown in Fig. 1 taken along the line 4—4,

Fig. 5 is a longitudinal, sectional view through a check valve construction preferably employed at one end of each of the air bags, and

Fig. 6 is a longitudinal, sectional view through a pressure relief valve preferably

employed at the other end of each of the collapsible air bags.

Similar numerals refer to similar parts throughout the several views.

As illustrated diagrammatically in Fig. 1, I show at 10 a submerged hull, having decks 11, 12 and 13 between which air bags 14, 15 and 16 are shown, it being understood that, for example, the air bag 14 illustrates as many similar bags as can be conveniently placed side by side in the hull between the decks 11 and 12, and similarly for the air bags between the decks 12 and 13 and between the deck 13 and the bottom of the hull.

The bags are connected at one end as indicated at 17, 18 and 19 with air tubes or lines which may conveniently be connected with a pipe header 20, said header in turn being connected by another air tube or line 21 with a header 22 supplied with air under pressure from a pump 23 through a check valve 24, said pump being driven by any suitable power, for example an internal combustion engine 25, the header 22, pump 23 and engine 25 being indicated as carried by a boat 26 resting on the water in which the hull 10 is submerged. The air line 21 is preferably connected with the header 22 through a manually operable valve 27 by which air under pressure may be supplied to the air line 21 and in turn to the air lines 17, 18 and 19 and so to the air bags 14, 15 and 16 as desired. In addition to the air bags 14, 15, and 16, additional air bags may be secured to the hull above the deck 11 as illustrated by the air bag 28, which is similar in construction to the air bags 14, 15 and 16 and illustrates as many such air bags located above the deck 11 as may conveniently be used.

It will be understood that the air bags referred to may have any desired size and shape, depending upon the spaces in and purposes for which they are used. In practice I find it advantageous to use air bags of elongated form, since they fit into the available spaces in the hull to advantage, and are more easily handled than air bags of other form would be. The air bag 28 is illustrated as being provided with flat flexible bands 29, 29 secured to the outer surface of the bag 28,

and provided at their lower ends with rings 30 which are preferably of metal to facilitate securing the bands and bag to the hull 10 as indicated at 31. One end of the bag 28 carries a check valve as indicated diagrammatically at 32, and the other end of said bag is provided with a pressure relief valve as indicated diagrammatically at 33. The check valve 32 is connected with an air tube or line 34, connected in turn through a manually operable valve 35 with the header 22. It will be understood that all of the air bags employed are preferably equipped with check valves and pressure relief valves as described for the bag 28. The check valve in each case serves to retain in the corresponding bag, air that may have been pumped into it under pressure and the pressure relief valve serves to limit the air pressure produced in any bag to a predetermined amount, permitting excess air to escape from the bag through said valve, if the air pressure on the header 22 is in excess of the air pressure desired to be established in the air bag. In this way by suitably setting the pressure relief valves, a desired relation of air pressures in the several air bags may be effected, and a corresponding relation between the lifting effects of the several air bags may be established.

As a result of providing the air lines thus far described, with control valves 27 and 35, it will be observed that a means is employed for establishing a desired relation between the lifting effects of the air bags above the hull, and the lifting effect of the air bags in the hull, so that for example, the tendency may be at all times to maintain the hull in upright position during the raising of the same, by producing sufficient buoyant effect by means of the bags 28, to accomplish this result.

To further insure maintaining the hull in upright position during the raising of the same, I may employ additional devices as follows. At each end of the hull and above the deck 11, I show a first cable drum 36 mounted on a shaft 37 extending through supports 38, 38 which are conformed at their lower portions to facilitate connecting them with the hull 10 as indicated at 39, 39. The shaft 37 extends into a gear box 40 carried by one of the supports 38, 38 and from the gear box 40 a second shaft 41 extends to carry a second cable drum 42, the drums being rigidly secured to the shafts carrying them. The gear box 40 contains multiplying gears as and for a purpose to be described. The drum 36 has connected with it a plurality of cables 43 extending upwardly and secured at their upper ends to a floating tank 44. The drum 42 has secured to it a cable 45 extending upwardly and secured to an air bag 46 of the construction above described for the other air bags employed in my improved system. An air

tube or line 47 extends from the bag 46 to a pipe header 48 from which header an air tube extends to a manually operable valve 49 connected with the header 22. A similar drum mechanism is illustrated at the other end of the hull, similarly connected with a floating tank 50 and an air bag 51, the air bag 51 being connected by an air tube or line 52 with the header 48. In using the devices last described, the bags 46 and 51 in collapsed condition are located immediately above the corresponding drums and connected with said drums by the cables indicated, so that the cables are wound on the drums and the air bags cannot move upwardly relatively to the hull without turning said drums. At the same time, the cables from the other drums are in unwound condition as to said drums, and are sufficiently tight so that rotation of these drums will move the floating tanks downwardly and produce motion of them relatively to the hull 10. The gearing in the gear cases connects the drums of each set of controlling mechanism, so that rotation of either drum is possible only when accompanied by rotation of the other drum reversely, as far as the winding effect of the cables is concerned. That is to say, upward movement of the air bags relatively to the hull, will produce rotation of the corresponding drums, and this rotation which is accomplished by unwinding of the corresponding cables, produces rotation of the other drums in a direction to wind up their cables and thus move the tanks towards the hull.

Since the two sets of controlling mechanism illustrated, are identical, and each is preferably provided with the same construction of gear box and gears therein, it is necessary to describe but one of these gear box constructions, for example the construction of the gear box 40, which, as shown in horizontal, sectional view and to an enlarged scale in Fig. 4, provides bearings for the shafts 37 and 41, which shafts have rigidly secured to them in the gear box, a pinion 53 and a gear 54 respectively. The shaft 41 has mounted on it and freely revolvable thereon, a combined gear 55 and pinion 56, the gear 55 meshing with the pinion 53 and the pinion 56 meshing with the gear 57 of a second combined gear and pinion freely revolvable on the shaft 37, the pinion 58 of which meshes with the gear 54. From this construction, it will be observed that the shafts 41 and 37 are connected so that for any given amount of rotation of the shaft 41, the shaft 37 is rotated a greater amount. With this construction, when the air bags 46 and 51 are located in collapsed condition immediately above their cable drums, and the floating tanks 44 and 50 are connected with their drums as described, supplying air under pressure to the bags 46 and 51 produces a corresponding buoyant effect and rotation of the shafts 41,

which rotation is multiplied by the gearing described, and the greater rotation of the other drums of the controlling mechanism, moves the tanks 44 and 50 downwardly a correspondingly greater amount relatively to the hull 10, than the air bags 46 and 51 move upwardly relatively to said hull. By suitably proportioning the air bags 46 and 51 and the floating tanks 44 and 50, any desired amount of buoyant effect may be produced, which is exerted on the upper part of the hull, and by properly proportioning this buoyant effect relatively to the lifting effect of the air bags in the hull and secured to its upper deck, the hull will be maintained in upright position until the hull is brought to the surface of the water, or near enough to the surface so that it may be moved from one location to another to permit taking it to a suitable dock for repair. The valves 27, 35 and 49 form a convenient means for establishing a desired relation between the buoyant effects of the controlling mechanisms described, and of the air bags in and above the main deck of the hull.

As shown in Fig. 3, my improved air bag construction consists of a flexible envelope 28a of suitable material impervious to air, for example fabric impregnated or coated with a rubber compound, which envelope is preferably of circular cross section and of any convenient diameter depending upon the requirements of any particular case. The bands 29 are preferably flexible and may consist of suitable fabric secured to the outer surface of the envelope 28a around its upper half, the ends of each band preferably extending loosely downwardly to substantially the lower part of the envelope where they are securely attached to devices for convenient connection with the fastenings to the hull, these devices, for example, consisting of metal rings 30 as described.

In Fig. 5 I illustrate a construction of check valve 32 that may be employed with the air bags, consisting of an externally threaded tubular member 60 extending through the envelope 28a of the bag, preferably at one end, and held in place by washers 61, 61 which are pressed against the material of the envelope 28a by nuts 62, 62 threaded on said tubular member. The outer end of the tubular member is extended laterally to form a flange 63 having an externally threaded extension 64 co-axial with the tubular portion 60, and engaging internal threads in a metal housing 65 containing a valve member 66 held against its seat inside of the housing 65, by a spring 67, the spring 67 being sufficiently strong to hold the valve positively against its seat, but weak enough to permit the valve to yield readily under air pressure communicated to the outer end of the valve, to permit the air to pass into the envelope 28a without appreciable obstruction. The valve mem-

ber 66 carries a spider extension 68 which extends loosely into an externally threaded tubular portion 69 projecting away from the valve member, the threads of this projecting portion affording a convenient means for the connection of an air tube or line to the check valve to supply the envelope 28a with air under pressure. In this manner, air supplied to the envelope 28a is retained in it against back flow through the air line, in the event the pressure supplying the air line drops below the pressure in the air bag for any reason.

In Fig. 6 I illustrate a form of pressure relief valve 33 that may be employed with my air bag construction, consisting of an externally threaded tubular member 70 extending preferably through the end of the envelope 28a opposite to that carrying the check valve 32, the material of the envelope 28a being tightly held between washers 71, 71 by nuts 72, 72 threaded on said tubular member. Outside of the envelope 28a, the tubular member 70 extends laterally to form a housing 73 containing a valve member 74 pressing against a suitable seat in said housing. The outer end of the housing 73 is externally threaded to receive a correspondingly threaded extension from a disk 74a, which disk is internally threaded to engage corresponding external threads on a sleeve 75. The bore of the sleeve 75 receives with a sliding fit, the stem 76 of the valve member 74, to hold said valve member in alignment with its seat and guide it to and from its seat. A spring 77 is mounted on the valve stem 76 between the valve member 74 and the sleeve 75, and the sleeve 75 is held in desired position in the disk 74a by a clamping nut 78. Thus any desired compression may be given the spring 77 by turning the sleeve 75 and for any desired compression of the spring, the sleeve 75 may be locked by the nut 78, to maintain any desired adjustment of the spring, and the valve member 74 may thus be set to open for any desired air pressure in the envelope 28a. The housing 73 is provided with vent openings 79, 79 to permit air passing through the valve to escape from the housing 73. In this manner I provide a convenient construction for limiting the air pressure in each of the air bags to a predetermined amount, so that on the one hand the air bag may not be subjected to an air pressure greater than it is able to safely withstand, and on the other hand the air pressure may be limited to a desired amount relatively to the air pressures desired to be used in others of the air bags, according to the requirements of any particular case and the relative location of the several air bags.

In Fig. 2 I illustrate another use to which my improved air bag construction may be put, consisting of forming a temporary closure for a hole formed by accident in a hull. As illustrated in this figure, I show a hull 10a

having a hole 80 therein, through which hole an air bag 28b may be passed in collapsed condition, from the inside of the hull, after which the air bag may be inflated by supplying it with air under pressure through an air tube or line 81 from any convenient pumping mechanism. In this case, the check valve of the air bag is located at 82 and the pressure relief valve of the air bag is located at 83 outside of the hull, these valves being preferably of the construction above described. For this use, I preferably provide the air bag with transverse partitions 84 of flexible material impervious to air under pressure, these partitions being provided with pressure limiting valves 85 preferably of the construction above described, which pressure limiting valves are preferably adjusted for air pressures in the compartments between the partitions 84 successively greater from end to end of the air bag, to insure that the air bag shall be filled with air under pressure determined by the outermost pressure limiting valve that is effective at any time in retaining air under pressure in the air bag. In this manner, if the outermost compartment of the air bag is torn, the next pressure limiting valve operates to maintain the air bag in inflated condition, and so on for the others of the pressure limiting valves.

While I have shown my invention in the particular embodiment above described, it will be understood that I do not limit myself to this exact construction as I may employ equivalents known to the art at the time of the filing of this application without departing from the scope of the appended claims.

What I claim is:

1. In a system for raising submerged hulls, the combination of collapsible air bags for location in and upon and connection to a hull to be raised, check valves carried by said bags permitting air flow into the same and preventing air flow therefrom, pressure relief valves carried by said bags for limiting air pressure in said bags to predetermined amounts, devices for connection with said hull to maintain the same in upright position during its raising, air lines extending from said check valves, and pumping mechanism for forcing air under pressure through said air lines and said check valves into said bags, said devices comprising a floating tank, a submerged collapsible air bag, cable guiding mechanism connected with the upper part of said hull, cables extending from said tank and said submerged bag in opposed relation to said cable guiding mechanism, whereby upward movement of said submerged bag relatively to said hull produces downward movement of said tank relatively to said hull, and an air line extending from said submerged bag to said pumping mechanism to supply air under pressure to said submerged bag.

2. In a system for raising submerged hulls,

the combination of collapsible air bags for location in and upon and connection to a hull to be raised, check valves carried by said bags permitting air flow into the same and preventing air flow therefrom, pressure relief valves carried by said bags for limiting air pressure in said bags to predetermined amounts, devices for connection with said hull to maintain the same in upright position during its raising, air lines extending from said check valves, and pumping mechanism for forcing air under pressure through said air lines and said check valves into said bags, said devices comprising a floating tank, a submerged collapsible air bag, cable guiding mechanism connected with the upper part of said hull, cables extending from said tank and said submerged bag in opposed relation to said cable guiding mechanism, whereby upward movement of said submerged bag relatively to said hull produces downward movement of said tank relatively to said hull, and an air line extending from said submerged bag to said pumping mechanism to supply air under pressure to said submerged bag, said submerged bag having a check valve in its air line and also a pressure relief valve limiting air pressure therein to a predetermined amount.

3. In a system for raising submerged hulls, the combination of collapsible air bags for location in and upon and connection to a hull to be raised, check valves carried by said bags permitting air flow into the same and preventing air flow therefrom, pressure relief valves carried by said bags for limiting air pressure in said bags to predetermined amounts, devices for connection with said hull to maintain the same in upright position during its raising, air lines extending from said check valves, and pumping mechanism for forcing air under pressure through said air lines and said check valves into said bags, said devices comprising a floating tank, a submerged collapsible air bag, cable guiding mechanism connected with the upper part of said hull, cables extending from said tank and said submerged bag in opposed relation to said cable guiding mechanism, whereby upward movement of said submerged bag relatively to said hull produces downward movement of said tank relatively to said hull, and an air line extending from said submerged bag to said pumping mechanism to supply air under pressure to said submerged bag, said cable guiding mechanism comprising separate cable drums and multiplying gearing connecting said drums, whereby said relative movement of said submerged bag may be less than said relative movement of said tank.

4. An air bag for the purposes shown and described, consisting of the combination of an elongated flexible envelope of air impervious material, flexible flat bands extend-

ing around said envelope and secured thereto to facilitate securing said envelope to a hull, and a flexible partition of air impervious material extending laterally across the interior of said envelope and dividing its interior into compartments.

5 5. An air bag for the purposes shown and described, consisting of the combination of an elongated flexible envelope of air impervious material, a check valve connected with said envelope and comprising an air supply passage therefor, a pressure relief valve connected with said envelope for limiting air pressure in said envelope, a flexible partition of air impervious material extending laterally across the interior of said envelope and dividing its interior into compartments, and another pressure relief valve carried by said partition, said partition extending across said envelope interior between said check valve and said first mentioned pressure limiting valve.

10 6. In a system for raising submerged hulls, controlling devices comprising a floating tank, a submerged collapsible air bag, cable guiding mechanism connected with the upper part of said hull, cables extending from said tank and said submerged bag in opposed relation to said cable guiding mechanism, whereby upward movement of said submerged bag relatively to said hull produces downward movement of said tank relatively to said hull, and an air line extending from said submerged bag to supply air under pressure to said submerged bag.

30 7. In a system for raising submerged hulls, controlling devices comprising a floating tank, a submerged collapsible air bag, cable guiding mechanism connected with the upper part of said hull, cables extending from said tank and said submerged bag in opposed relation to said cable guiding mechanism, whereby upward movement of said submerged bag relatively to said hull produces downward movement of said tank relatively to said hull, and an air line extending from said submerged bag to supply air under pressure to said submerged bag, said submerged bag having a check valve in its air line and also a pressure relief valve limiting air pressure therein to a predetermined amount.

40 8. In a system for raising submerged hulls, controlling devices comprising a floating tank, a submerged collapsible air bag, cable guiding mechanism connected with the upper part of said hull, cables extending from said tank and said submerged bag in opposed relation to said cable guiding mechanism, whereby upward movement of said submerged bag relatively to said hull produces downward movement of said tank relatively to said hull, and an air line extending from said submerged bag to supply air under pressure to said submerged bag, said cable guiding mechanism comprising separate cable drums and

multiplying gearing connecting said drums, whereby said relative movement of said submerged bag may be less than said relative movement of said tank.

9. In a system for raising submerged hulls, controlling devices comprising a floating tank, a submerged collapsible air bag, cable guiding mechanism connected with the upper part of said hull, cables extending from said tank and said submerged bag in opposed relation to said cable guiding mechanism, whereby upward movement of said submerged bag relatively to said hull produces downward movement of said tank relatively to said hull, and an air line extending from said submerged bag to supply air under pressure to said submerged bag, said cable guiding mechanism comprising separate cable drums and multiplying gearing connecting said drums, whereby said relative movement of said submerged bag may be less than said relative movement of said tank, said submerged bag having a check valve in its air line and also a pressure relief valve limiting air pressure therein to a predetermined amount.

In witness whereof, I hereunto subscribe my name this 2nd day of April, A. D. 1931.

SEBASTIAN SCHWAGER.

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