The present invention has for its object a pleasure submersible boat comprising a watertight cabin provided with operating members for controlling its immersion and its reascension to the surface, and a safety device constituted on the one hand by a float located at least partially above the water surface and on the other hand by at least one deformable parallelogram connecting the watertight cabin to said float. This safety device comprises a ballast mechanically connected to the float and also connected to the deformable parallelogram so that an angular displacement of the parallelogram out of its rest position causes simultaneously the immersion of the watertight cabin and a displacement of the ballast upward and toward the buoyancy thrust of the watertight cabin. In this manner, the buoyancy thrust is counter-balanced by the weight of the ballast.

The attached drawing illustrates schematically and by way of example one embodiment of the pleasure submersible boat according to the invention.

FIG. 1 is a side view of the submersible, certain parts being removed and others seen in cross section.

FIG. 2 is a plan view of the submersible boat, again with certain parts removed and others seen in cross section.

FIG. 3 is a partial view showing particularly the position of the ballast and of the deformable parallelograms when the cabin is floating on the water, certain parts being omitted and others broken away.

FIG. 4 shows the position of the ballast and of the deformable parallelograms just before the beginning of the immersion of the watertight cabin.

FIG. 5 shows the position of the ballast and of the deformable parallelograms when the watertight cabin is immersed at its maximum depth.

In the embodiment shown, the pleasure submersible boat comprises a watertight cabin 1 and a safety device constituted by a float 2 and two deformable parallelograms connecting the watertight cabin 1 to the float 2.

The watertight cabin houses a compartment 3 provided with two ventilating pipes 4 for the ventilation of the compartment, a mirror 9 is disposed at the vicinity of the aperture of each of these ventilating pipes enabling the passengers to see outside of the cabin, the view being reflected by the mirrors 8 in the ventilating pipes 7. These ventilating pipes 7 thus also serve as periscopes enabling the passengers to guide the submersible when the cabin is immersed.

The float 2 is constituted by a float divided into several watertight compartments, and when seen from above it has the general shape of a U.

Each of the lateral parts of the float 2 is constituted by a sharpened body 13 extending forward beyond a central part 9 and having a greater height than the central part 9.

The rear part of the submersible, constituted by the middle portion 9 of the U of the float 2, has a large, approximately rectangular, surface. A longitudinal cross section through said rear part 9 of the float shows that its thickness increases toward the rear. This central rear part 9 carries the propulsion means constituted by a water wheel 10 driven in rotation by an electric actuating motor M1 housed in a compartment 11. This motor M1 is a reversible D.C. motor which is mechanically connected to the water wheel 10 by means of pulleys and a belt B1. A battery P2, mounted in one of the bodies 13, energizes motor M4 through a conductor L1 which connects with a reversing switch controlled by one of the levers 6. The part 9 also carries steering means constituted by a rudder 12 driven in its angular displacements by an electric motor M5, not shown, also disposed inside the compartment 11. Motor M5 is identical to motor M4 and is controlled in the same manner. It is mechanically drivingly connected by means of a shaft S2 and bevel gears to the axle of rudder 12.

Further, this rear central part 9 carries the immersion means constituted by a third reversible D.C. motor M6, also housed in the compartment 11, driving two winches T disposed in the vicinity of the lateral sides of part 9. The motor M6 is mechanically drivingly connected through a gear reducer G including an electromagnetic brake to a shaft S1 driving the drums of both winches T. This motor is energized from another battery P3 mounted in the other body 13 through a conductor L1. Motor M6 is controlled in the same way as motor M5, by a second reversing switch coupled to the other lever 6.

Each of these three parts (9, 13) of the float 2 is divided into watertight compartments in order to increase the security of the submersible. In fact, it is possible for the float 2 to be damaged and even perforated, in the event of a collision with another boat, for example. Under these conditions, only one of the watertight compartments fills with water and the others still provide sufficient buoyancy to ensure the floating of the submersible on the water surface.

Further, the buoyancy of this float 2 is sufficient to support the total weight of the submersible even if, due to an accident, the cabin is entirely filled with water. This confers a practically total working security to the submersible, which is naturally necessary for such pleasure boats intended to be hired on public beaches.

In the embodiment shown the watertight cabin 1 is mechanically connected to the float 2 by means of two deformable parallelograms disposed on either side of said cabin and between the two bodies 13 of the float 2.

These two parallelograms are identical and each comprises a first arm 14 pivoted on a shaft 15, one extremity of which is fast with the inside lateral wall 16 of one of the bodies 13 of the float 2 and on a triangular fixing plate 17 rigidly connected to the cabin 1. The second arm 18 of each of these deformable parallelograms is pivoted both to a stud 19 rigidly fixed on the inside wall 16 and to the triangular fixing plate 17. These two arms 14 and
18 are parallel so that the distance between the shaft 15 and the stud 19 is equal to the distance separating the pivoting points of these arms on the fixing plate 17.

One arm of each deformable parallelogram, in the embodiment shown the arm 18, is extended beyond its pivot point on the float 3 by a lever arm 20. In the example shown, the arm 20 is L-shaped with its free extremity 21 connected by means of a connecting member 22 to the free extremity 21 of the lever arm 20 of the other deformable parallelogram. The lever arm 20 is also connected by means of a reinforcing member 23 to the extremity of the corresponding arm 18, pivoted on the fixing plate 17. A cross piece 24 further connects the arm 18 and the reinforcing member 23 of each deformable parallelogram.

The arm 18, the lever arm 20, the reinforcing member 23 and the cross piece 24 of each deformable parallelogram constitute a triangulated system which is very rigid and which is able to withstand great forces.

The pleasure submersible boat according to the invention is further provided with a ballast mechanically connected to the float and also to the deformable parallelograms. This ballast is constituted in the embodiment shown by a water tank 25 of sufficient size to contain a water volume corresponding approximately to the weight of a water volume approximately equal to the volume of the watertight cabin diminished from the value of the maximum working load, that is of the weight of two average persons, in order for its weight to compensate for the upwardly directed buoyancy thrust of the cabin when it is immersed.

This water tank 25 presents an approximately rectangular shape and is provided with two apertures 27, 28 in its lower face 26 located respectively near the opposed lateral edges of said lower face 26. This water tank 25 is freely pivoted around a shaft 29 disposed near the lower face 26 of said water tank and extending transversely through it. This shaft 29 is placed out of the transverse symmetry plane of the water tank so that this tank tends to pivot in the direction of the arrow f around shaft 29 under the action of its own weight.

In a rest position, that is to say when the cabin is not immersed, the water tank 25 is empty and at least a large part of it is situated above the water surface.

The water tank 25 comprises two abutment members 30 disposed near each extremity of the shaft 29 and rigidly fixed on each lateral wall adjacent to the longitudinal edge of the lower face 26.

This water tank is disposed between the two bodies 13 of the float 2 near its front extremity and symmetrically disposed with respect to the longitudinal symmetry plane of the submersible. Each of the ends of the shaft 29 is pivoted on one extremity of a lever 31 itself pivoted at an intermediate point on the shaft 15.

In the rest position, corresponding to the state of the submersible in which the watertight cabin is not immersed, the levers 31 are locked in their angular position with respect to the bodies 13 by means of hooks 32 provided in the free end of blade springs 33 which are connected at their other extremities to the internal faces of the body 13 respectively. In this locked position, the levers 31 make an angle approximately equal to 45° with respect to the horizontal.

For that rest position, the free end of the arm 36 fast with the levers 31 respectively and disposed at a right angle with respect to them near their extremity which is pivoted on the shaft 29 rests on an abutment 37 rigidly fixed on the arms 18 of the deformable parallelograms at the place of their articulation on the bodies 13 of the float 2.

Sectors 34 are pivoted on the shaft 29 between the water tank 25 and each of the levers 31. Each of these sectors 34 is connected to this shaft 29 by a helical spring 35 tending to maintain it in a rest position illustrated at FIG. 3.

Each of these sectors 34 carries a radial lug 39 cooperating, in the rest position shown in FIG. 3, with one of the abutment members 30 carried by the water tank.

The central spring 35 tends to maintain the water tank against the action of gravity in its horizontal rest position defined by the bearing faces 40, carried by the arms 41 rigidly fixed on the arms 18 of the deformable parallelograms respectively, against which the abutment members 30 of the water tank are resting.

Each of its periphery is also provided with a groove 42 terminated at one extremity by a fixing member 43. Further a cam 44 is disposed on the external face of each sector 34 and serves a purpose which will be described later on.

The extremity 45 of each lever 31 is connected by means of a crank shaft 45 to a support 47 rigidly fixed on the arm 18 of the corresponding deformable parallelogram between its pivoting points on the float and on the fixing plate 17. The distance separating the support 47 from the stud 19 is greater than that separating the extremity 45 of the lever 31 from the shaft 15.

A supple non resistent member, for example a wire- rope 48, is connected at one of its ends to the fixing member 43 of each sector 34. The wire rope is disposed in its groove 42 and wound around a pulley 49 pivoted on the corresponding shaft 15, then around a pulley 50 pivoted on the extremity 41 of the corresponding body 13, then around a pulley 51 pivoted on the fore part of the corresponding body 13 and is fixed at its other extremity on the corresponding winch T. This wire-rope is always, regardless of the position of the watertight cabin, situated in its greatest part out of the water. In fact only the portion of this wire-rope wound around the sectors 34 is in rest position of the submersible, located in the water.

The described pleasure submersible boat operates as follows:

In order to immerse the watertight cabin 1 of the submersible from its rest position shown in FIGS. 1 to 3, the operator, that is the passenger, actuates the third electric motor by means of one of the levers 6 disposed in the cabin 1 causing the driving of the winches T in such a direction that the wire-ropes 48 are wound on said winches.

The winding of these wire-ropes 48 on the corresponding winch T causes an angular displacement of the sectors 34 against the action of the helical springs 35. The water tank 25, which tends to tilt by its own weight in the direction of the arrow f, follows this angular movement, the abutment members 30 resting on the radial lugs 39 of the sectors 34. During this angular displacement, the aperture 28 of the water tank 25 is located under water whereas the aperture 27 is situated above the water surface. In this manner, when the angular displacement of the sectors 34 and thus of the water tank 25 reaches approximately 180° (FIG. 4), at least a great part of the water tank is located under the water surface, and therefore it becomes filled with water, its two apertures 27 and 28 being directed upwardly. This water tank cannot empty itself and constitutes from that moment the ballast intended to counterbalance the buoyancy thrust due to the immersion of the watertight cabin.

When the helical springs are completely tightened by a subsequent angular displacement of the sectors 34, the cam 44 carried by the lateral face of each sector 34 pulls the corresponding blade spring 33 toward the body 13 and unlocks the levers 31 which are then free to pivot around the shaft 15. Then simultaneously, the frontal face of the cam 44 rests on the edge of the corresponding lever 31. From then on no further relative angular displacement in the direction of the arrow f can occur between the sectors 34 and the corresponding levers 31.
The subsequent winding of the wire-rope 48 on their respective winch T causes, through traction on the free extremity 21 of the lever arm 20 of each deformable parallellogram, pivoting movement in the direction of the arrow / by the arms 18 of these parallellograms around the studs 19 out of their rest position. This angular displacement of the parallellograms, through a similar angular displacement of the arm 14 of each deformable parallellogram around the shaft 15, which produces the immersion of the watertight cabin 1, said cabin remaining parallel to itself during this displacement thanks to the action of the deformable parallellograms.

The lever 47 rigidly fixed to the arm 18 drives during the rotation of this arm 18, the corresponding lever 31 in rotation around the shaft 15 by means of the crank shaft 46.

This rotation of the levers 31 around the shafts 15 in the direction of the arrow / causes an upward displacement of the shaft 29 and thus of the water tank 25.

As the cabin 1 is immersed, the water tank, that is the ballast, is partially raised over the water surface in order to counterbalance the buoyancy thrust caused by the immersion of the cabin.

The configuration of the mechanical linkage between the levers 31 and the arms 18 is such, thanks to the ratio existing between the diameters of the arms 18, that the displacement of the lever 31 with respect to the arm 18 on the other hand, that the speed of the displacement of the ballast in the vertical direction, for a uniform angular speed of the arms 18, is quick at first until the cabin is immersed then slow during the whole stroke of said cabin effectuated under water. In this way the ballast 25 is rapidly raised above the water surface at the beginning of the rotation of the arms 18, corresponding to the immersion of the cabin 1, in order to immediately counterbalance the buoyancy thrust due to the immersion of the cabin. Then, during the subsequent angular displacement of the arms 18, corresponding to the lowering of the cabin to the desired depth, the water tank is practically not raised, the value of the buoyancy thrust exerted by the immersed cabin remaining practically constant. On the contrary, during this second phase of the immersion of the watertight cabin, the ballast 25 is forwardly displaced, practically parallelly to the water surface, in such a manner as to come closer to the vertical line along which the buoyancy thrust of the cabin is exerted.

The angular displacement of the arms 18 is followed (FIG. 5) until the moment when the cabin reaches its deepest position for which the arms 18 and 14 of the deformable parallellograms still form a certain angle with a direction normal to the water surface. In this position, the cabin 1 is located approximately under the water tank 25 which is located between the ventilating pipes 7. At this moment an end stroke switch is mounted on the winch T, stops motor M₂ and causes simultaneously the actuating of an electromagnetic brake immobilizing the drums of the winches T in their angular position. It is in fact necessary to provide a brake since if the tension of the wire-rope 48 is slackened the cabin comes back to the surface through the combined action of the gravity of the ballast and of the buoyancy thrust due to the immersion of the cabin, the parallellograms being not quite vertical.

It is to be noticed that at the beginning of the immersion of the cabin, when it is not situated under the ballast, the combined action of the gravity of the ballast and of the buoyancy thrust of the cabin causes a torque tending to tilt backward the submersible, therefore the great part of the buoyancy (central part 9) of the float 2 is concentrated at the rear of the submersible so that a little tilting of the float in a direction against the arrow / enables to counterbalance this torque. This tilting torque becomes very low when the cabin is in its extreme position of immersion since the ballast is then situated practically above the cabin.

When the passenger or passengers want to come up again to the surface, they progressively free the electromagnetic brake by means of one of the levers 6, slackening thus the wire-rope 48 to allow the arms 18 and 14 to pivot in a direction against the arrow / under the action of the torque caused by the gravity of the ballast and the buoyancy thrust of the cabin. When the cabin is again out of the water (FIG. 4) the helical springs 35 cause the sectors 34 to pivot in a direction against the arrow / at first locking the levers 31 by means of the hooks 32 and then the driving of the water tank, the lugs 39 bearing on the abutment members 30.

During this rotation, the water tank empties to arrive at least in its rest position (FIG. 3) for which at least a great part of it is located above the water surface and for which its apertures 27, 28 are directed downwardly.

From this moment, the passengers may open the cover of the cabin 1 and get out. In rest position, the submersible is light, the ballast being practically nonexistent since the water tank is then empty, which greatly facilitates on the one hand its evolutions on the surface and on the other hand its handling on the land.

Finally the support 38 of the submersible not being locked, the relative displacement of the cabine or of the water tank with respect to the float 2 is possible, which also facilitates the handling of such a submersible.

The principal advantages of the described submersible with respect to the existing boats of this type are the following:

1. The combined action of the weight of the ballast and of the buoyancy thrust of the immersed cabin tends continuously to return the submersible to its rest position, that is to say with the cabin out of the water. This represents a supplementary security, in fact if during an accident the wire-rope 38 were cut, the cabin would then automatically reascend to the surface without any external aid.

2. In the rest position, all the mobile parts of the submersible (cabin, ballast, deformable parallellograms) are locked in position, thus hindering any relative displacement of these mobile parts. This facilitates greatly the handling of the submersible on the land.

3. The ballast is constituted by a water tank which is emptied in rest position of the submersible, enabling to realize a submersible with low draught when it is at the surface which facilitates greatly its evolutions and its handling by reducing its weight.

4. The filling of this ballast water tank happens automatically through its rotation of 180°, no filling means or draining means being necessary.

5. The water tank, located above the cabin when the latter is immersed, constitutes a protection for it as well as a sun shield for the passengers.

6. The U shape of the float 2 guarantees a good stability, while compensating, through a small backward tilting, for the torque due to the ballast and to the cabin at the beginning of its immersion.

7. The disposition of the wire ropes is such that they are practically entirely out of the water, which extends their useful life.

8. The special shape given to the arms 18 of the deformable parallellograms ensures a very great rigidity to the linkage float-cabin.

9. All the mechanical and electrical elements as well as the propulsion means, the immersion means and the steering means, are fixed on the float being thus very easy to manufacture and of a very easy maintenance as well as of a high efficiency.

One embodiment of the pleasure submersible boat has been described by means of non limiting example but it is to be understood that numerous variants could be foreseen without departing from the scope of the protection...
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7 claimed. For example the shape of the different constitutive parts of the submersible, the float, the cabin, the ballast and of the deformable parallelograms, could be different. Further in another variant the three electric motors could be replaced by only one motor and coupling devices. "The electric motor or motors could be in a variant replaced by an internal combustion engine for example.

In a further variant not shown, the float 2 could be filled with a cellular synthetic material that is to say a material comprising in its mass a multitude of closed and water tight spaces. The cellular synthetic materials are very light and practically speaking do not diminish the buoyancy of the float. Such a float filled with cellular synthetic material shows a very great security. In fact, its buoyancy is practically not affected in case of collision for example, since it is divided into an infinity of "watertight compartments," only some of which are ruptured during an accident.

I claim:

1. A pleasure submersible boat comprising a watertight cabin, operating members housed in said cabin for controlling said submersible boat, safety means including a float having at least partially above the water and at least one deformable parallelogram comprising two arms connecting said cabin to said float, submersible boat comprising further a lever arm fast with at least one of the arms of said deformable parallelogram and extending beyond the point at which said one parallelogram arm is pivoted on said float; at least one motor driven winch carrying a wire rope which cooperates with the free extremity of said lever arm to produce angular displacements of the deformable parallelogram with respect to said float; a ballast comprising a drainable water tank mechanically connected to said parallelogram and mounted on said float therewith, aperture in said water tank, rotation of said water tank by 180° away from its rest position causing the immersion of one of said apertures and the filling of said tank with water, the rotation of said water tank being controlled by means of said motor driven winch; the angular displacement of said deformable parallelogram out of its rest position, controlled by said motor driven winch, being effected against the combined action of said buoyancy thrust of said cabin and the weight of said ballast, said angular displacement causing the immersion of said cabin and the displacement of said ballast upward and toward the buoyancy thrust of said cabin to compensate said thrust.

2. A submersible pleasure boat as claimed in claim 1 in which the float has the general shape of a U, the ballast as well as part of the cabin being located between the two legs of said U-shaped float and mechanically connected to said float by means of two deformable parallelograms.

3. A submersible pleasure boat as claimed in claim 2 in which the water tank is, in the rest position of the boat, empty and located practically entirely above the water with its apertures directed downwardly, whereas when the said cabin is immersed the said water tank is located practically entirely under water with its apertures directed upwardly.

4. A submersible pleasure boat as claimed in claim 3 in which the mechanical linkage connecting the ballast to the deformable parallelogram comprises a shaft connecting said legs of said U-shaped float, one extremity of a first one of said arms of said parallelograms being journaled on said shaft, levers journaled on said shaft at a position such that their free ends are situated at different distances from said shaft, the short legs of said levers being mechanically connected to the second arm of said parallelograms, the long legs of said lever being connected together at their free extremities by means of a shaft, said water tank being journaled on said shaft, any uniform angular displacement of said parallelogram causing thereby a displacement of the ballast which is not uniform.

5. A submersible pleasure boat as claimed in claim 2 in which said water tank tends to rotate under the action of gravity, and spring means effective to maintain said water tank in rest position against which said water tank is journaled and disposed on either side of said water tank, said sectors being subjected to the force of said helical springs and comprising radial lugs and abutment members on said water tank engaging said radial lugs, said free extremity of said lever arm of said parallelogram bearing a roller, said wire rope of said winches passing over said roller and being attached to said sectors.

8. A submersible pleasure boat as claimed in claim 7 comprising further cams integral with said sectors for providing angular displacement thereof with respect to said parallelograms.

9. A submersible pleasure boat as claimed in claim 4, further comprising means for locking said parallelograms in their rest positions with respect to said float, said locking means comprising blade springs, each having one extremity which is fast with said float, hooks being provided on the free extremities of said blade springs to cooperate with the edges of said levers on which the water tank is journaled.

10. A submersible pleasure boat as claimed in claim 8, further comprising means for locking said parallelograms in their rest positions with respect to said float, said locking means comprising blade springs, each having one extremity which is fast with said float, hooks being provided on the free extremities of said blade springs to cooperate with the edges of said levers on which the water tank is journaled, said levers being cooperated with the edges of said levers on which the water tank is journaled.

11. A submersible pleasure boat as claimed in claim 8 in which the filling of said water tank takes place before each immersion of the cabin and the draining of said water tank takes place after each emersion thereof.

12. A submersible pleasure boat as claimed in claim 4 in which said water tank tends to rotate under the action of gravity, spring means effective to maintain said water tank in rest position against gravity, said motor driven winch controlling said spring means and in which said spring means are constituted by helical springs, sectors journaled on said shaft about which said water tank is journaled and disposed on either side of said water tank, said sectors being subjected to the force of said helical spring and comprising radial lugs, abutment members on said water tank cooperating with said radial lugs to subject said water tank to the action of said helical springs, said free extremity of said lever arm of said parallelogram supporting a roller, the said wire rope of said winches passing over said roller and being attached to said sectors, said sectors comprising further a cam limiting their angular displacements with respect to said parallelograms.

13. A submersible pleasure boat as claimed in claim 11 in which the water tank is journaled on a shaft connecting said lever arms of each of said parallelograms.

14. A submersible pleasure boat as claimed in claim 12 in which said float comprises several watertight compartments.

15. A submersible pleasure boat as claimed in claim 12, in which when the watertight cabin is in its extreme
position of immersion the longitudinal symmetry axis of the deformable parallelogram forms an angle with respect to a direction normal to the surface of the water, so that when the tension of the wire rope is slackened the watertight cabin reascends automatically to the surface under the combined action of the buoyancy thrust of the cabin and of the weight of the ballast.

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