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BY A. P. C.

H. TAILLEFERRE

MARINE POWER PLANTS

Filed June 19, 1939

Serial No.
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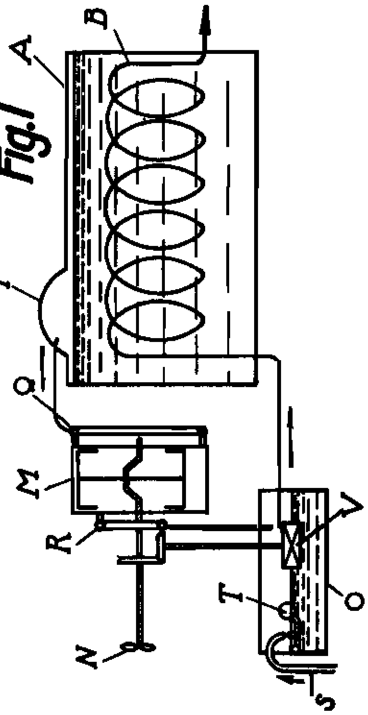

Fig.1

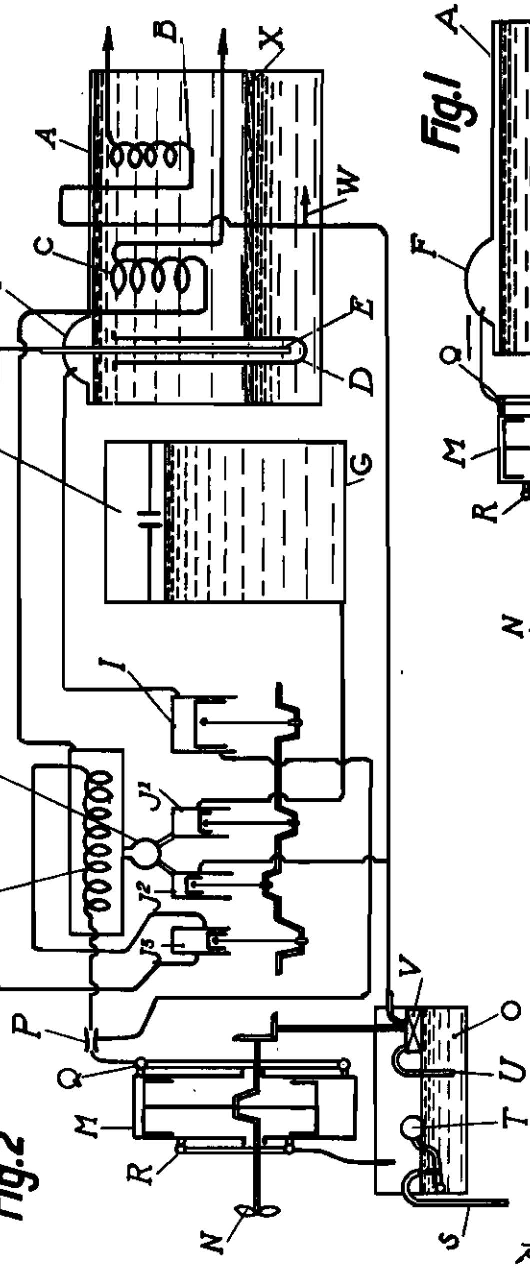

Fig.2

Inventor,
H. Tailleferre

By: Glascock Downing & Seebold
Attys.

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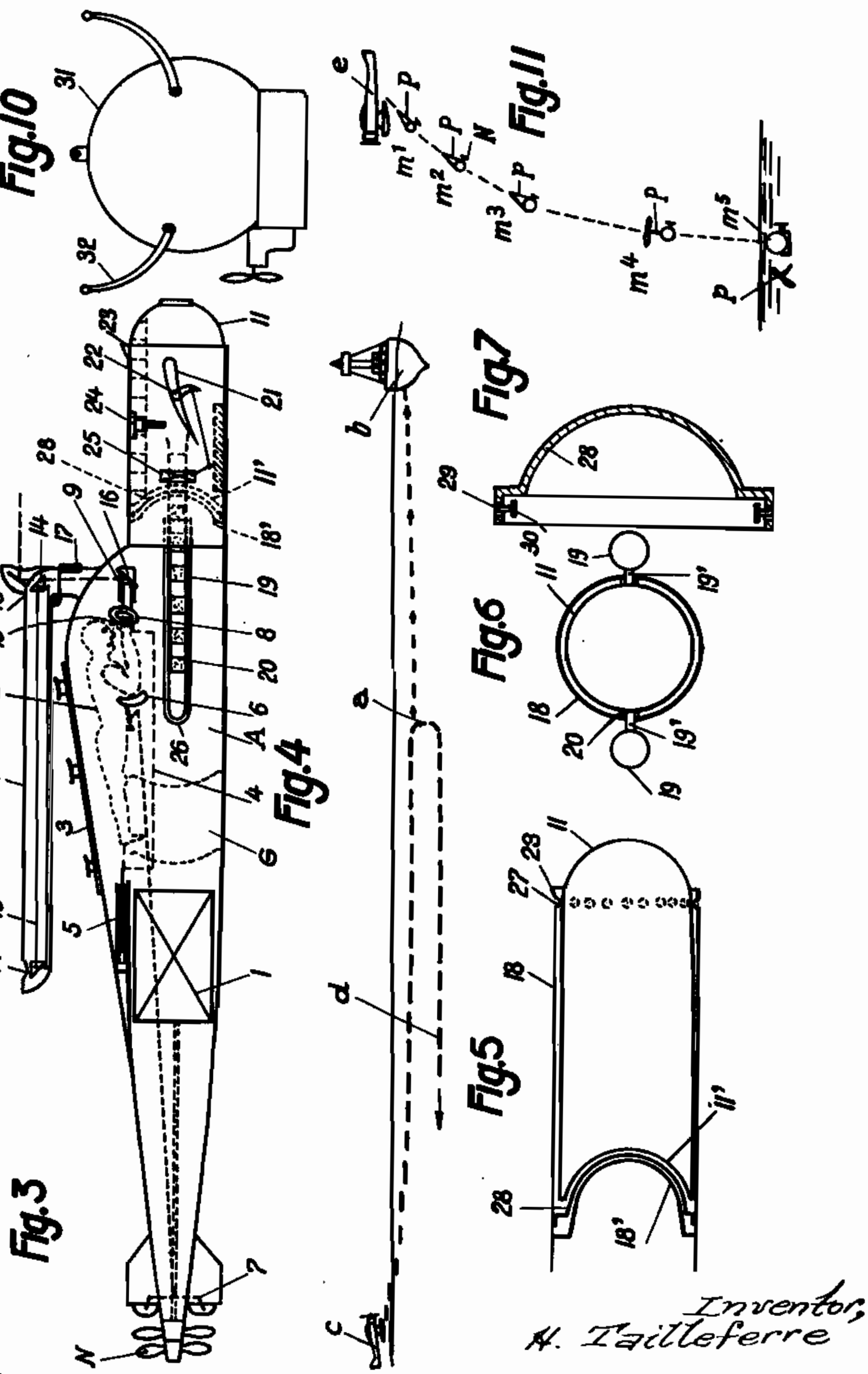

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Fig.9

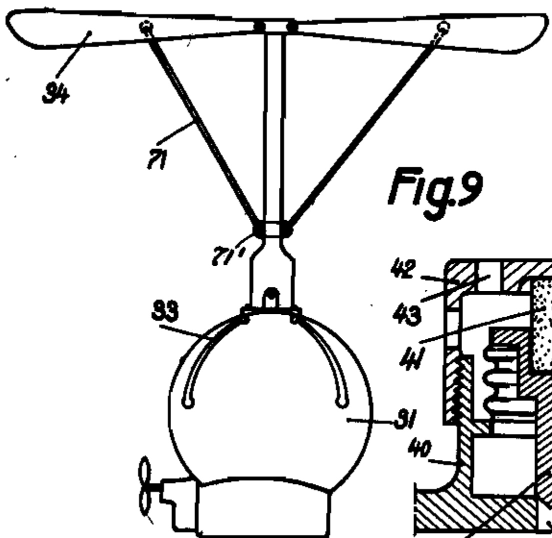


Fig.12

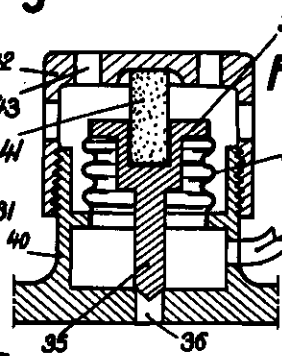


Fig.8

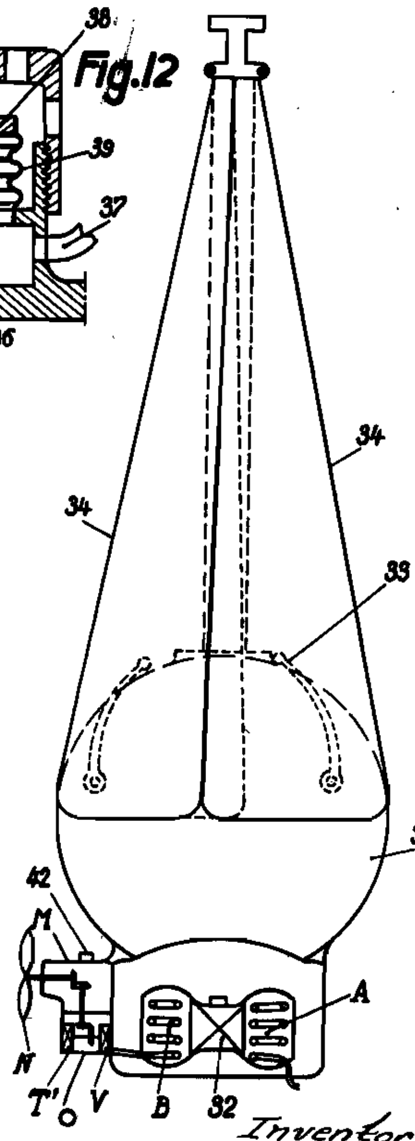
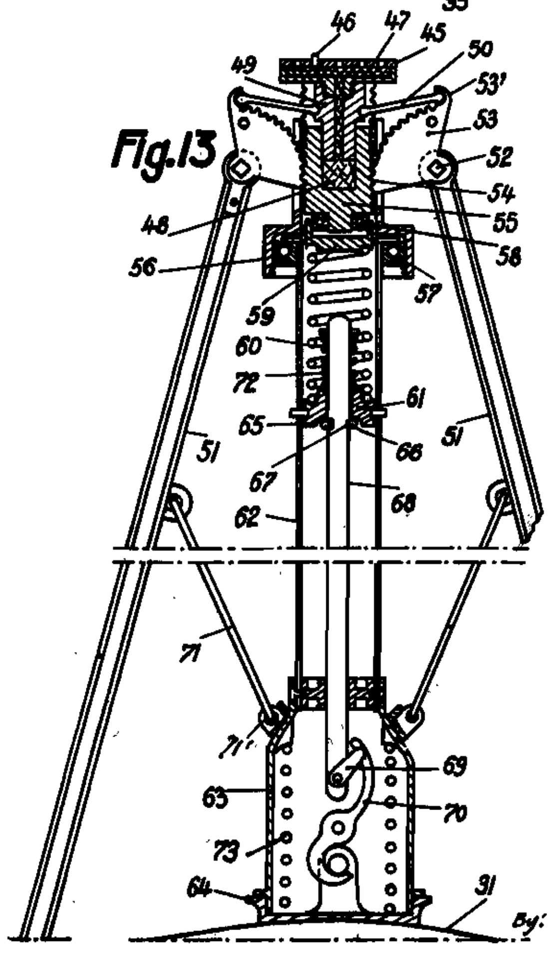


Fig.13



Inventor,
H. Tailleferre

By: Glascock Downing & Seebold
Attys.

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ALIEN PROPERTY CUSTODIAN

POWER PLANT, IN PARTICULAR FOR THE MECHANICAL PROPULSION OF IMMERSED MACHINES, AND MACHINES EMBODYING SAID POWER PLANT

Henri Tailleferre, Paris, France; vested in the Alien Property Custodian

Application filed June 19, 1939

This invention has for its object a power plant which is intended in particular for propelling immersed machines such as submarines, torpedoes and submarine mines for example, in such a manner that nothing can reveal their presence.

Said plant is mainly characterized by the fact that, for actuating the engine or engines which drive the propeller or propellers of the immersed machine, a liquefied or optionally a solidified gas is used, which is automatically raised to its utilisation temperature by one or a plurality of exorthermic chemical reactions in which participates the liquid wherein the machine evolves, the gas which is utilized and also the agents which react together being furthermore such that the gaseous exhaust products of the engine or engines and likewise the products to be educed from the reaction or reactions are soluble in the liquid wherein the machine thus powered evolves.

As a result of the use of these liquefied gases and of the phenomena which ensue therefrom, the reserve of power that is stored up is considerably increased.

Thus, by way of example, an ordinary torpedo which has a reserve of 400 litres of air at 200 kg. per sq. cm. raised to the utilization temperature, viz. 500° C., has available about 224 cub. metres of gas brought down to atmospheric pressure, whereas the same machine equipped with the novel devices would have available a reserve of about 1.120 cub. metres. Furthermore, the storage vessels, instead of being subjected to a pressure of 200 kg. per sq. cm. would only be subjected to a pressure of about 30 kg. per sq. cm. This is a great advantage, since the saving of weight effected on the storage vessels can be used, either to increase the reserve of power, which also corresponds to an increase of range, or to increase the weight of the explosive charge.

It follows from the above figures that, under the present conditions, the range is multiplied by five, that is to say that for a normal torpedo of 550 mm. diameter, which has a range of about twelve kilometres, the range will be about sixty kilometres when said torpedo is equipped according to the invention.

Several embodiments of power plant according to the invention, and also of powered machines involving the application of same, are described hereinafter and diagrammatically illustrated in the accompanying drawings in which:

Fig. 1 shows a power plant in one of the simplest embodiments; and

Fig. 2 shows a more complex embodiment;

Fig. 3 is an overall view of an individual submarine of semi-directed torpedo, equipped with a power plant according to the invention;

Fig. 4 shows the evolutions of the individual submarine for battle;

Fig. 5 is a fragmentary view, in longitudinal axial section, showing a mounting detail of the war head of the individual submarine;

Fig. 6 is a transverse section of Fig. 5; and

Fig. 7 shows a detail of Fig. 5.

Fig. 8 is an elevational view of a mine which is made self-propelling by the application of a plant according to the invention, said mine being furthermore provided with a rotary fin device which is shown in its folded position in the manner in which it is arranged during the first phase of the fall of the machine;

Fig. 9 shows the machine with the fins developed, such as they are positioned for effecting the braking during the second phase of the fall;

Fig. 10 shows the mine after immersion;

Fig. 11 shows diagrammatically the successive modifications of the mine during the fall and after immersion;

Fig. 12 is a detail view in diametrical vertical section of the device for automatically starting the engine of the mine after immersion; and

Fig. 13 is a view in diametrical vertical section of the delayed release mechanism which, at the required instant, causes the fins to unfold for braking the fall.

Referring to the power plant shown in Fig. 1, A is a reservoir containing, for example, liquefied ammonia gas and provided with a heating coil B; F is a dome located at the upper part of the reservoir A for the take-off of the gaseous ammonia; M is an engine on the shaft of which is fixed the propeller N of the powered machine; O is a tank, hereinafter called absorber-heater.

The plant operates as follows:

The ammonia gas flows from the dome F to the inlet Q of the engine M and so actuates said engine, the exhaust gases of which flow from the exhaust pipe R into the absorber-heater O. Into this tank is introduced, through a pipe S which is controlled by a float valve T, the liquid in which the machine evolves, for example, sea-water. The solution of the ammonia gas in the water evolves heat and the hot ammoniacal water is driven, by a pump V actuated by the engine M, into the coil B and heats the liquid ammonia in the reservoir A; the ammoniacal water is then exhausted through the pipe into the sea.

By means of this self-heating, the utilization temperature is very quickly reached.

Of course, instead of the float device T, a pump could be used, likewise actuated by the engine M.

In this operation, the sole elements involved are therefore, on the one hand the gas used for actuating the engine, and on the other hand the liquid, for example the sea-water, in which the machine equipped with the plant in question evolves.

In the embodiment of Fig. 2, in addition to the liquefied gas and the ambient liquid, another reacting agent is involved, in this case and for example, concentrated sulphuric anhydride or oleum.

In this figure, A is the reservoir containing liquefied ammonia gas and provided with heating coils B and C; D is a tube arranged in the reservoir in such a manner as to enable the liquid ammonia to be taken up by a pipe E dipping into the tube D. F is the dome which is located at the upper part of the reservoir A and serves for the take-off of the gaseous ammonia.

G is a reservoir of sulphuric anhydride (oleum), the upper part H of which forms an air chamber; I is an auxiliary piston engine, J^1, J^2, J^3 are three piston pumps actuated by the auxiliary engine I; K is a mixer connected to the pumps J^1, J^2; L is a superheater, M is the main engine, on the shaft of which is fixed the propeller N of the powered machine, O is the absorber-heater.

The operation is as follows:

The ammonia gas taken off at the dome F is conveyed to the auxiliary engine I which is set in motion and in turn actuates the three pumps J^1, J^2, J^3. The pump J^1 sucks sulphuric anhydride taken from the reservoir G and drives it into the mixer K into which, on the other hand, the pump J^2 delivers water obtained from the absorber-heater reservoir O.

The two liquids intermingle and produce an exothermic reaction, thereby enabling the liquid ammonia drawn into the tube E by the pump J^3 to be superheated in the boiler L. The ammonia issuing from the superheater L flows into a nozzle P of the Venturi type connected to the exhaust of the auxiliary engine I which causes a depression in the exhaust of the engine. The ammonia flows thence to the inlet Q of the main engine M which it actuates. The exhaust R of the engine M exhausts its gases into the absorber-heater O which is provided with a water inlet S controlled by a float valve T and with an outlet U for the heated ammoniacal water provided with a pump V. The ammonia dissolves in the water in the tank O and evolves heat; the hot ammoniacal awter is pumped by the pump J^2 so that in the mixer K it is converted into a solution of ammonium sulphate by exorthermic reaction with the oleum.

In order not to modify the ballistic coefficient of the machine, a quantity of liquid is introduced at the base of the reservoir A, equal in volume to that of the liquid ammonia used.

A portion of the ammoniacal water issuing from the absorber-heater O is used as substitution water at the lower part of the reservoir A wherein it is introduced through the tube W. The ammoniacal substitution water is separated from the ammonia in the reservoir A by an oil piston X or by any other means.

The excess of hot ammoniacal water is used, by passing it through the coil B, for heating the liquid ammonia stored in the reservoir A; said excess is then exhausted into the ambient medium.

Furthermore, after being used in the superheater L, the hot solution of ammonium sulphate is also used for heating the ammonia in the same tank A by circulating said solution in a coil C whence it is exhausted into the ambient medium.

As regards the machine shown in Figs. 3 to 7, said machine forms an individual submarine, the front head of which forms one or a plurality of compartments intended for introducing either torpedoes of reduced size owing to the short travel they will have to effect by their own means, or a single removable war head. Said machine is adapted to be guided by a pilot or by remote control and can travel at very high speed; at the most suitable firing distance, that is to say at the position shown at *a* in Fig. 4, its war head or the torpedoes is fired and finishes alone the last part of the travel to the target *b* while the body proper of the submarine turns right around and returns to its base (surface vessel or launch, hydroplane *c*, or fixed station), the whole of these journeys being effected entirely under water and without any trace at the surface. The dotted line *d* represents the return journey.

The novel machine ensures:

(*a*) an infinitely greater probability of hitting the target than do the present known torpedoes, both owing to its speed and to its guiding and its invisibility;

(*b*) a substantial economy with respect to the ordinary torpedo which is completely destroyed or lost, whereas in the present case, only the war head or the small torpedoes contained in the compartments are sacrificed for obtaining an infinitely more certain result, while the individual submarine can be re-equipped and used again.

In Fig. 3, the rectangle **1** diagrammatically represents the power plant which may for example be of the type shown in Fig. 2 and which actuates the propeller N. A is the ammonia reservoir and G the sulphuric anhydride reservoir.

In this figure, the machine is assumed to be guided by a pilot **2** who is located in a compartment adapted for this purpose and to which access can be had through a water-tight door **3**. The man is placed parallel with the longitudinal axis of the machine; a sliding base **4** on which he lies is provided with a dash-pot device **5** which is intended to absorb the negative or positive accelerations. Two elbow-rests **6**, which are connected by an appropriate device to the vertical rudder **7**, enable the horizontal trajectory of the machine to be modified; opposite each elbow-rest is provided a handle **8** which is also provided with a dash-pot device **9** and on which is arranged a release **10**. One of the releases, the left hand one for example, enables the pilot **2** to release the machine from its catch elements in the case in which it is carried, for example, by an aeroplane. The other release, that is to say the right hand one, is adapted in this case to cause the war head **11** or the torpedoes to be fired.

A periscope **12**, which can be folded down and is mounted with a knuckle-joint at **13**, enables the pilot to guide the machine towards the target. Said periscope has as an optical system a set of prisms **14** which are connected together by a system of connecting rods forming a hinged parallelogram **15** in such a manner that the prisms pivot in harmony when the periscope is raised or is folded down; it is furthermore provided with a mirror **16**. When inoperative, that is to say before immersion, the periscope is folded down horizontally as shown; as soon as the machine is immersed, the knuckle-joint **13** is released by a hydrostat **17** of known type which automatically unlocks the knuckle-joint, so that the periscope swings into the upright position.

Of course, the air necessary for the pilot to breathe is contained in a reservoir and may optionally be activated by the combustion of oxylith.

With regard to the war head 11 carrying the explosive material, said war head, which is located at the front of the machine, is simply fitted with a sliding fit in a firing tube 18. The end 11' of the war head is separated from the end 18' of the firing tube by a dummy end 28 of similar shape, which is mounted with a sliding fit in the tube 18.

Two rocket-tubes 18 secured to the war head 11 are fitted with a running fit in two tubes 28, like pistons in their cylinders, wherein 18 are the pistons and 28 the cylinders, said rocket-tubes 19—28 being arranged diametrically opposite and parallel with the generatrices of the machine, the projections 19' which connect the rocket-tubes 18 to the war head 11 passing through slots 28 forming slideways provided in the launching tube 18.

The end space left between each rocket-tube 19 and its tube 26 is supplied with a cartridge of powder, the firing of which is controlled by the pilot of the machine, or again by a take-off of compressed gas obtained from the pipe leading from the superheater to the main engine M.

According to the position of the centre of gravity of the projectile unit, that is to say of the war head 11 and of the rockets 19, two carrier planes 21 are arranged, the function of which is to sustain the war head 11 as soon as same has left the machine. In view of the fact that said war head has to be able to propel itself below a constant plane of water, the sustaining fins 21 are pivoted about a pin 22 so as to modify the value of the angle of incidence proportionally to the hydrostatic pressure and to a gyroscope acting simultaneously as a servo-motor on the system.

In order to obtain this operation, a part of the pressure of the liquid may be used which is taken up by means of a tube 23 fixed along the tube 18, and also the phenomenon of cavitation produced at the rear of the moving body by its own displacement.

The hydrostat 24 and the gyroscope, which are of known design and are used in existing torpedoes, therefore act as a servo-motor on a differential device 25, using the two above mentioned phenomena; said differential device is mechanically connected to the pivot pin of the sustaining fins 21.

The operation is as follows:

This machine, which is assimilable to a semi-guided torpedo, can be hooked under the fuselage of an aeroplane, for example, the hooking device being released by the pilot of the machine.

A fork system bearing on the vertical rudder of the machine, makes it possible, by means of a system of rods, to inform the pilot of the aeroplane of the exact course he should follow. As soon as the target is projected on to the telemetric mirror 16 of the periscope 12 of the pilot of the machine, the latter acts on the release of the left handle and thereby releases the machine from its hooking device.

On contact with the water and by means of a known device, the machine starts its propelling apparatus and at the same time the hydrostat 17 which locks the periscope 12 in the folded down position releases said periscope.

From this instant onwards, the machine thus piloted follows a navigational course in the direction of the target, which direction can be corrected according to the evolutions of said target, by means of the elbow-rests 8 which are available to the pilot and are connected to the controls of the machine in the manner of the so-called "scissors" device which is used in aeroplanes for controlling the ailerons. A depth correction is also provided by simultaneously operating the elbow-rests in the same direction, for the accidental case in which the gyroscope ensuring the depthwise stability of the machine might fail.

As soon as the target projected on to the telemetric mirror 18 appears in the circle of aim, the pilot fires the war head 11 by actuating his right handle 8; the rocket-tubes 19 secured to the head are driven out of the tubes 28 which are arranged on the machine proper. This driving is effected either by means of powder, or as stated above by means of ammonia gas; this sudden expansion eauses the percussion of a lighting fuse by means of inertia masses each arranged inside the rockets which become operative after a predetermined time, thereby ensuring the propulsion of the war head 11 towards the target. Stability is ensured during the travel, in the horizontal direction by means of two small compensated rudders fixed on the two rocket-tubes 18 and controlled by a gyroscope, and in the vertical direction by means of the hydrostat 24 acting through the intermediary of the hydrostatic relay on the sustaining fins 21 (variation of incidence).

When the war head 11 is fired, a depression occurs at the rear of its end 11' which causes the dummy end 28 to move forwards by sliding inside the tube 18 and take up the position originally occupied by the front part of the war head. The dummy end locks itself in this forward position by the engagement, in openings 27 (Fig. 5) provided in the tube 18, of fingers 29 (Fig. 7) which are urged by leaf springs 30 arranged inside the dummy end 28. Furthermore, the water penetrates into the tube 18 through the slots 20. In this manner the ballistic coefficient of the machine is not modified for the return journey after the war head has been fired.

Figs. 8 to 13 show the application of the invention to a submarine mine, thereby enabling a movement to be automatically imparted to the latter when it is immersed, so that it may be made to follow either a straight or a spiral course whereby the zone which is effectively swept forms a very vulnerable field for vessels which might be located in that zone.

The power plant, of the type for example of the one shown in Fig. 1, is lodged at the base of the mine 31; in Fig. 8 the reference letters A B M N O V designate the same members as in Fig. 1; T' designates a pump which, like the pump V, is driven by the engine M and ensures the supply of sea-water to the absorber-heater O; 32 designates an immersion control device of a type known per se which enables the mine to evolve vertically like a ludion and 33 the usual antennae (Fig. 10) or any other known firing devices which cause the mine to be fired by a known device when the antenna is struck by a ship or other like object.

For obtaining the automatic starting of the engine when the mine is immersed, a device is provided which, under the action of the sea-water, opens the supply of ammonia gas to the engine M.

Such a device has been shown in Fig. 12. In this figure, 35 is a needle valve controlling an orifice 36 through which the ammonia supplied by a pipe 37 can be introduced into the engine M; the head 38 of said needle valve rests, through the intermediary of a corrugated metal tube 39 welded to said head, on an inner flange of a bush 40 secured to the engine M; the upper part of the head 38 is recessed so as to serve as a housing for a block 41 of sea salt which is held by a clamping plug 42 screwed on the bush 40 and provided with holes 43 to enable the sea-water to act on the block 41. It will be readily understood that, when said block 41 is disintegrated by the sea-water, the needle valve 35 is lifted by the pressure of the ammonia gas and that of the corrugated tube 39 acting on the lower face of the head 36. Consequently, the ammonia is supplied to the engine M which starts operating.

With the advantage ensuing from the fact that it is self-propelled, this mine, which is intended to be thrown by aeroplane, combines those ensuing from the fact that, throughout its drop from the aeroplane until approaches quite near the plane of the water, it retains its ballistic characteristics which are comparable to those of a normal bomb, whereas as soon as it penetrates into the water, it becomes a real submarine mine owing to the fact that it is released from the device which braked it in the second phase of its fall.

Fig. 11 shows the different phases of said fall; *e* designating the aeroplane, at m^1, m^2, m^3 is shown the appearance of the mine during its free fall, at m^4 its appearance when the braking device with rotary fins *p* with which it is provided has spread out and its fall is braked; m^5 shows the appearance of the mine after immersion when it is released from the detachable fin device *p*.

The detachable fin device forming the braking device is shown folded in Fig. 8 which corresponds to the first phase of the fall, that is to say the free fall; it is shown spread out in Fig. 9 which corresponds to the second phase of the fall, that is to say, the braked phase. 34 designates blades.

The delay release device for opening the fins is shown in detail in Fig. 13.

In this Figure, 45 is an artillery fuse, called a disc fuse provided with a known striker device 46, said device containing a Bickford fuse 47, or the like, which transmits its flame to a charge of powder 48. The fuse 45 is screwed on a sleeve 49, on which are pivoted connecting rods 50, the number of which corresponds to that of the supports 51 of the blades 34.

Each support 51 is pivoted on a shaft 52 carrying a toothed quadrant 53, on the end 53′ of which the head of the connecting rod 50 abuts. The toothed quadrant 53 meshes with a rack 54 provided on the periphery of a bush 55 about which is concentrically arranged an outer sleeve 56. The assembly thus obtained, and which forms a rotatable head, is mounted on ball bearings 57—58, so that it can effect a rotary movement about its vertical axis. On the ball bearing 57 is mounted an abutment 59 forming a shoulder for a coil spring 60 which bears, on the other hand, against the part 61, which is secured to a brace tube 62 connecting the movable head to a base 63, loosely fitted in a bush 64 secured to the mine 31.

In the part 61 is provided a groove 65 which enables balls 66, partially engaged in a groove 67 provided in the main rod 68, to be held stationary.

Said rod 68 is connected by a connecting rod 69 to a locking hook 70, to which is hooked the mine 31.

71 are shocks absorbing spring devices, secured on a rotating ring 71′, for braking the opening movement of the supports 51 of the blades 34.

When the powder 46 explodes, the fuse 45 is projected, and thus carries with it the whole of the movable part, as well as the connecting rods 60, thereby enabling the arms 51 supporting the blades to open, and to rotate about the vertical axis of fall, in the manner of a helicopter, which brakes the speed of fall of the mine. The head 53′ then bears on the upper part of the sleeve 56, which thus forms an abutment. Owing to the rotary movement of the blades about the pivot 52, the quadrants 53 cause the bush 55 to move downwards, until the instant when the collar 59 abuts against the upper part of the central rod 68 and thereby causes said rod to move downwards. At this instant the balls 66, which are lodged in the groove 65, are released and fall.

As soon as the mine touches the water, and owing to the lightening which ensues therefrom, the blades, which are urged on the one hand by the spring devices 71, and on the other hand by the main spring 60, eliminate the thrust previously exerted on the rod 68 by the collar 59. As the latter is no longer retained by the balls 66, it continues its upward movement under the action of the spring 72, thereby pulling the connecting rod 69 and causing the retaining hook or catch 70 to pivot; the spring 73 which is lodged in the base 63 of the brace tube 62 therefore drives the whole arrangement, and thus completely releases the mine 31 from its sustaining members.

It is, of course, understood that the invention is in no way limited to particular embodiments, and that without exceeding the scope of the invention, numerous modifications and improvements of detail can be conceived, as well as the use of means forming equivalents of those given by way of example.

HENRI TAILLEFERRE.