

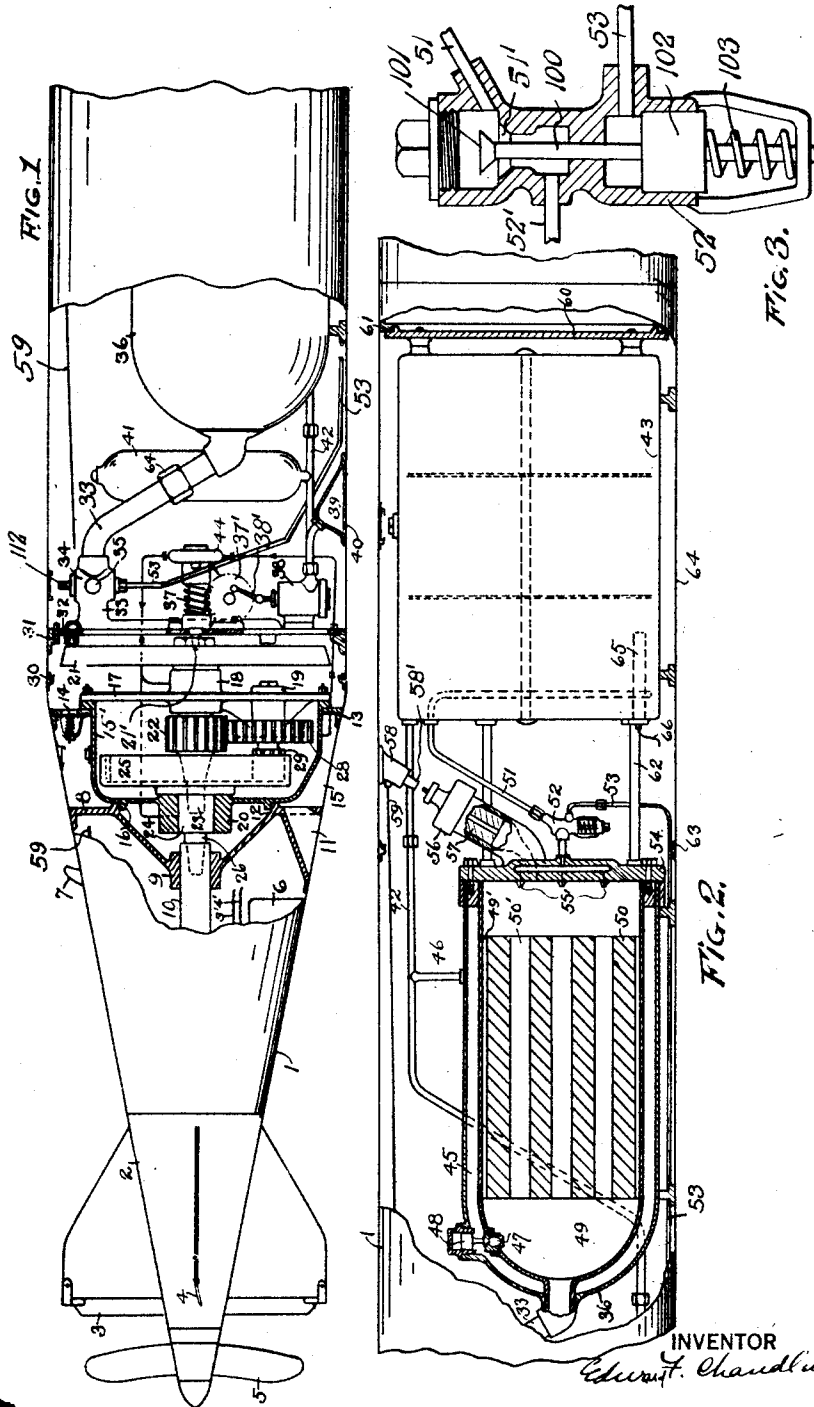
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TORPEDO

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INVENTOR

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TORPEDO.

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This invention has for its object to effect improvements in turbine installation so as to make them specially suitable for the propulsion of automotors such as torpedoes, where it is desired to have a simple plant working from stored energy of such a nature that the torpedo is independent of auxiliary apparatus such as air or gas compressing machinery. The invention consists in a motor or turbine installation adapted to utilize a given store of energy without the employment of oxygen other than that contained in said store in a more efficient manner than has heretofore been possible by any known means.

My invention provides a simple, inexpensive and highly efficient torpedo capable of carrying a larger charge of explosive for a greater distance than at present possible with a given size of weapon. By doing away with the heavy and expensive compressed air or gas flask and by the other improvements and arrangements herein disclosed as one embodiment of my inventive idea, I provide a torpedo adapted to be built in great quantities if necessary, in plants not specially developed or equipped for the purpose, which during war time is highly desirable and important. It is an important advantage of my invention that the power plant employed is safe to handle up to the moment the weapon is fired whereas at present the large compressed air or gas flask is more dangerous when charged to 2200 lbs. per sq. inch, than the loaded warhead.

For the purpose of my invention, I preferably employ a solid combustible substance or compound, pressed, molded or otherwise formed into a suitable shape. Preferably this substance is not self-combustible but is adapted to interact exothermically with another body or substance introduced at the reaction spot. Obviously the bodies which are adapted to interact exothermically may be in the solid or liquid state. A combustible may be employed in the solid state and a combustion supporter be supplied thereto during the interaction, which is a liquid and in which the combustion supporting medium is carried in a chemically rather than a mechanically compressed state. An example of such a liquid is tetra-nitro-

methane which is an active oxidizing agent carrying also other elements (nitrogen and carbon) which are valuable in the development of a motive fluid. Carbon in the form of ground and compressed charcoal mixed with some suitable material (sugar, etc.) properly treated as by heating and/or adding a small quantity of water so that a briquette may be formed, may be employed as the combustible. I preferably employ a mixture of carbon, sugar and aluminum, the proportions of which may be widely varied, although a mixture of 2:1:1 respectively (by weight) has been found to give good results. It is desirable that the charge does not melt and lose its shape, also the metallic agent if employed should not produce troublesome slagging, it naturally being preferred that all or most of the charge be consumed during the action, the products of combustion preferably passing off as volatile matter. It would be within the scope of my idea to include in the mixture fluxes or other agents tending to improve the heating value or burning quality of the mixture as well as its other characteristics. By this system I am enabled to carry a large quantity of fuel in a comparatively small space, and at the same time greatly simplify the motive fluid generating apparatus. Further, what will be recognized as an important improvement over previously proposed schemes is the fact that at all time the functions of the apparatus are subject to complete control, the combustion rate depending upon the rate of feed of one of the interacting bodies and the temperature control being governed by the quantity of fluid or material inert with respect to the combustion, supplied thereto. Further objects and advantages of my inventive idea will be apparent to those versed in this art as the following specification is read in conjunction with the drawing herewith, it being understood that the drawing is intended for illustrative purposes only and not in a limiting sense.

In the drawing Fig. 1, is the aft end of a torpedo the shell of which is partly broken away to show part of one embodiment of my invention. Fig. 2, is a continuation of Fig. 1 illustrating the rest of the embodiment. Fig. 3 is a detail cross sec-

tional view in elevation of an automatic governing valve inserted between the storage tank and the generator. In the form of apparatus herein shown as suitable for carrying my invention into effect 1, is a torpedo body having a suitable tail 2, carrying horizontal steering rudders 3, and depth steering rudders 4, suitably controlled from means within the torpedo, as by a gyroscope and a depth gear respectively. Preferably I provide a single propeller 5, though any other means may be employed. When using a single propeller, which is more efficient than two in tandem, I employ suitable means to counteract the tendency of the torpedo to roll, such as the keel weight 6. A suitable starting latch is indicated at 7, same being so associated with the apparatus as to initiate any desired function or functions before or during launching such as starting the generator, unlocking the gyro, etc. Secured within the torpedo, is a suitable bulkhead 8, having an aligning support or bearing 9 for the propeller shaft 10, and one or more exhaust openings to the sea 11, ranged about its periphery and an annular supporting ring 12. Forward of bulkhead 8, is a bolting ring 13, secured within the body and provided with suitable self-closing valves 14, adapted to permit the engine to exhaust to the sea through the ports 11, and to prevent water, which enters the space 15, from entering the motor chamber. Adapted to be bolted to the ring 13, is a gear carrying casing 15', having an annular ring 16, adapted to be supported, by ring 12, thereby rigidly securing the gear casing within the torpedo, though but one bolting ring is employed. A suitable cover plate 17, having a bearing 18, and a stud supporting boss 19, is adapted to close the gear casing, the rear bearing 20, being carried by said casing. 21, is the turbine rotor which preferably is keyed to a spindle running in the bearing 18, and having a pinion 22, and a journal end 23, borne by the hollow shaft 24, of the internal gear 25, carried by bearing 20. 26, is an extending clutch member integral with the gear shaft 24, which is adapted to engage the propeller shaft 10, for driving same, when the turbine is inserted into the torpedo. Suitably carried, as upon a journal stud secured in boss 19, is a gear 28, in mesh with pinion 22, and carrying a pinion 29, meshing with the internal gear 25, by this arrangement the propeller 5 and the large gear 25, is driven in the opposite direction to the turbine rotor, thus tending to balance the moments about the axis of the torpedo to prevent heeling. The after body is connected to the forward section by a suitable joint means 30, whereby when the torpedo is separated, the motor or turbine is accessible and easily removable. Forward of this joint, is a bolting ring to which the

nozzle carrying spider is secured. Preferably I arrange three nozzles (having one or more jets each) 120° apart, all supplied from a main pipe 33, in any suitable manner. A suitable fluid supply regulating valve 34, preferably adjustable from the outside of the torpedo, may be employed in the delivery pipe 33, having an adjustable blow-off valve 35. This valve has the object of regulating the flow of the motive fluid from the generator to the nozzles, and to this end it may be operated by means of square stem 112 to open more or less the passage for said motive fluid. The blow-off valve 35 may be of any suitable type and merely provides a means for relieving the pressure when said pressure should become excessive. An internal combustion generator 36, supplies energy to the turbine. 44 designates a suitable pump employed as an oil circulator whereby oil placed in the gear casing is delivered to the bearings 18 and 20 and returned. Said pump is shown co-axial with and driven by turbine rotor 21, to which it is connected by means of shaft 21' carried in bearings on a suitable bracket bolted to the spider 32. Said shaft carries a worm 37, in mesh with a worm wheel 37', which operates a pump 38 by means of a connection 38'.

Said pump 38 may be of any suitable type and in the embodiment shown, is adapted to draw water from the sea through the intake 39, having a removable grating or other suitable means 40, to exclude sea weeds, and so forth. Water delivered by the pump 38, is supplied to the generator 36 and the tank 43 by means of the pipe 42.

The generator 36, is preferably constructed with two concentric shells between which is an annular water space 45, to which water is delivered by the branch 46 of the pipe 42. Water, preferably in the form of steam, is admitted to the combustion space 49, by suitable inlets, as 47 normally closed by a suitable valve 48, preventing flooding of the generator before combustion has actually started, causing operation of the pump by the turbine. Said valve is adapted to be opened by pressure in the space 45, owing to the fact that part 48 of the valve has a larger diameter than the valve proper as shown. The valve is normally set in its closed position and may also open if the pressure should be developed within the generator without any counterpressure being developed in space 45; but in this case, the pressure existing within the generator would prevent the water from entering through inlet 47. The water will only enter through inlet 47 when the pressure within space 45 is sufficient to overcome the pressure within the generator. However, the pressure within space 45, is a function of the pressure within the generator, since pump 38 will

create more or less pressure according to the power exerted by the turbine rotor. Once this valve has been opened, it may remain open, since the pump being proportioned to deliver an amount of water to suit conditions in the generator, these in their turn controlling the speed of the turbine, and therefore of the pump, there is no danger of the generator being flooded after operation has been started. Neither is there any danger of the water or steam delivery being stopped by an increased pressure within the generator, since increased pressure means increased speed at the turbine end, and therefore increased pressure exerted by the pump. The various parts must of course be so proportioned, that the pressure of the pump delivery is always higher than the pressure in the generator, indirectly causing the operation of said pump. It will be understood that the water in the space 45, will absorb heat from the combustion space 49, and that some of this heat will be returned to the source thru the medium of the heated water or steam delivered by the inlet 47. 50 is the material with which another body is adapted to interact, to evolve heat, the said other body preferably being stored in the tank 43, and delivered by means of pipe 51, to the reaction point. The briquette of combustible substance 50, is preferably perforated as at 50' so as to allow the passage of gases thru the fuel block, to the combustion space, 49 by which means a relatively constant rate of burning is assured, with a substantially constant evolution of gas, as will be understood. Between the generator 36, and the storage tank 43, may be inserted in the pipe 51, a suitable automatic governing valve 52, controlled in any suitable manner, as by fluid pressure from the generator conveyed through the pipe 53 connected with the valve 34, (part of pipe 53 is not shown in the drawing). The valve 52, may be employed to reduce the supply of material through pipe 51, when the pressure in the generator reaches a certain value. This said valve may be of any well known type, suitable for the purpose. One form of valve 52, is shown in the enlarged sectional view Fig. 3, in which the fluid to be controlled enters the body by means of the inlet pipe 51, passes thru the normally open valve seat 51' and to the combustion chamber thru the delivery outlet 52'. The valve stem 100, is provided with a valve head 101, and with a piston 102. A spring 103, retains the valve in the open position. Fluid pressure entering the inlet 53, acts on the head of the piston 102, tending to draw the valve head 101, to the seat 51', thus restricting the flow of fluid to the combustion chamber as the said pressure increases, as will be understood. The generator combustion chamber is preferably closed by a suitable removable cover-

plate 54, having means 55, for distributing material delivered through pipe 51, as will be understood. A suitable ignition means, such as the pistol 56, is associated with the generator whereby combustion may be initiated. Preferably a charge 57, of slow burning, gas forming material is burned, whereby as the ignition is set up, an initial pressure is also established within the system for initiating the cycle, which obviously is subsequently maintained as long as the supply of exothermically interacting bodies last. From this it will be seen that normally, there need be no fluid under pressure in the system for initially driving the propelling apparatus, and hence the means for supplying the oxygen-carrier or the fuel as the case may be, to the combustion chamber. The pressure developed by the gases evolved by the combustion of the material 57 within the confined space, being utilized as a motive fluid for starting the cycle, in the preferred embodiment of the invention. A pistol firing means 58, is adapted to be actuated by the starting latch 7, or otherwise as desired, for instance by connecting said latch to the trigger of said pistol firing means by means of a connection 59, releasing the hammer 58' of said pistol firing means when the latch is thrown back at the time when the torpedo is fired. This means of starting the operation of the torpedo being well known a more detailed description is considered unnecessary. The tank 43, in the embodiment shown, is bolted to a bulkhead 60, which in turn is bolted to a ring 61, carried by the torpedo, also the tank, by means of distance rods 62, is bolted to the generator, so that a rigid unit is formed. By disconnecting bulkhead 60, from ring 61, and breaking the shell at the joint 63, which may be of any suitable detachable type, the section 64, of the shell may be removed forwardly, exposing the tank 43, obviously all parts being suitably designed to offer no obstruction. Breaking the shell at joint 30, and removing the afterbody, carrying the turbine, permits the section 64, as well as other connected parts to be reached through the spider 32, so that the said spider may be removed, preferably rearwardly and the generator, forwardly. Suitably associated with the storage tank 43, I preferably employ a heating means 65, which may be of any suitable type.

It will be noted that the water supply pipe 42, is shown as delivering water to the upper part of the tank 43, and that the outlet pipe 51, is adapted to deliver from the lower part of the said tank. This is an important feature made possible by the employment of a medium, such as tetra-nitromethane which is heavier than water and impervious thereto. By thus replacing one liquid by another a substantially constant

d'splacement of the torpedo is maintained, and by so designing the apparatus, that the tank is at or near the center of gravity of the torpedo, the trim of the weapon is easily maintained by the automatic steering means, without offering undue resistance, (owing to the inclination of the rudders) to the passage of the torpedo through the water. Also the apparatus is greatly simplified but one pump being required. As previously set forth I preferably employ a combustion supporter in which the oxygen is chemically rather than mechanically compressed and in which a thermal diluent is not present in objectionable quantities. Nitroform perchlorate $(\text{NO}_2)_3\text{C.CLO}_3$ and tetra-nitromethane $\text{C}(\text{NO}_2)_4$ are examples of this type of body. If combustion is supported by liquid air or liquid oxygen none of the heat evolved is derived from the recombination of the air or oxygen itself whereas in my preferred case, part of the molecule combines with a fixed amount of available oxygen, releasing the nitrogen, as a gas. Take as an example tetra-nitro-methane interacting with carbon. The carbon in the molecule burns to CO_2 thereby consuming say $\frac{1}{4}$ of the available oxygen, and liberating its equivalent in heat. The nitrogen comes off as fixed nitrogen taking no part in this or subsequent reactions and the remaining $\frac{3}{4}$ of available oxygen may be utilized for the combustion of a hydrocarbon, carbohydrate, a metal or any substance or body which will liberate heat by oxidization. As will be understood the control of pressure and temperature may be governed by automatically regulating the supply of combustion supporter, thereby controlling the amount of heat generated in any given interval of time as for example by the control valve 52.

From the foregoing it will be apparent that I provide a novel method of self-regulation in a device of this kind, the pressure of the gases evolved in the generator being used to control the supply of the liquid contained in the storage tank, and also the supply of water delivered by the pump.

It will be understood, that the function of valve 34 is to regulate the speed of delivery of the motive fluid, assuming that an adjustment be necessary in view of different conditions created by different materials employed within the generator, and also in view of external factors, such as the temperature of the surrounding water, which are liable to affect the ultimate temperature and pressure of the motive fluid, or to otherwise influence the performance of the generator. When substantially standardized conditions should be created, however, especially in so far as concerning the nature of the materials employed, the ratio of liquid delivery to pressure, and the ratio of water delivery to speed, accordingly standardized

passages may be adopted for connecting the generator to the turbine, and the employment of a regulating valve, such as shown at 34, may be entirely omitted.

The operation of valve 52, as explained, is apparently open to the objection that when the delivery pressure of the pump increases (owing to the fact that increased speed in the motive fluid does not only mean increased speed in the turbine, but also increased force of the impact against the same), as well as the quantity of water delivered thereby, said increase in pressure is also transmitted to the liquid inside of tank 43; this being directly antagonistic to the action of valve 52, whose object is to diminish the supply of liquid to the generator, when the pressure in the generator increases.

This action, however, may obviously be counterbalanced by proper proportioning of the parts composing valve 52, providing for a preponderating action of the pressure against piston 102 as against the action of possible increases in pressure within tank 43.

It will be seen, I provide a weapon which is inexpensive to build, and easily operated and not liable to get out of order, also owing to the small space occupied by my propelling plant I am enabled to employ keel weights not permissible in other types of torpedoes, whereby I may use a single propeller with practical results.

I claim:

1. In a torpedo, a motive fluid generator, a combustible substance within the generator, storage space for a liquid combustion supporter, means for conveying liquid from said space to said generator, means for initiating a reaction between said substance and said liquid to evolve heat and means supplying water from the medium surrounding the torpedo to the reaction space and to the storage space, the water supplied to the said storage space displacing the said liquid therein and thereby forcing it into the generator.

2. A torpedo comprising a motive fluid generator, a motor, a storage space for a fluid oxygen carrier connected to said generator and a pump driven by the motor for delivering fluid from the medium surrounding the torpedo to the generator and to the said storage space.

3. In an automobile torpedo, a propelling motor, a generator for supplying a working fluid to the motor, storage space for a liquid combustion supporter, a conduit for conveying the combustion supporter from said space to the generator, means responsive to the pressure of the working fluid for controlling the delivery of said combustion supporter to the generator, and means operable by the motor for creating pressure in a liquid and for supplying said liquid under pressure to said storage space.

4. In an automotive torpedo, a propelling motor, a pressure generator having a closed combustion chamber, a solid fuel contained therein, means for delivering an oxygen bearing liquid to the fuel, means for delivering water from the medium surrounding the torpedo to the combustion chamber, and separate means for supplying initial heat for the purpose of promoting the chemical reaction between the liquid and the fuel.

5. In an automotive torpedo, a motor, a generator having a closed chamber, a combustible substance and a self-combustive substance associated with said chamber, a supply of oxygen containing fluid, a liquid thermal diluent, means for igniting the self-combustive substance to evolve heat and fluid pressure for forcing said oxygen containing fluid into the chamber and initiating a chemical reaction between the combustible substance and the fluid containing oxygen, and for feeding said liquid thermal diluent to the products of said combustion.

6. In an automotive torpedo, fluid pressure operated propelling means, a generator comprising a combustion chamber, a storage tank connected thereto, a supply of a liquid combustion element within said tank, and means for drawing water from the medium surrounding the torpedo and for delivering said water under pressure to said storage tank.

7. In an automotive torpedo, the combination, with a generator comprising a combustion chamber, a storage tank connected thereto, and a supply of liquid combustion element within said tank, of means for drawing water from the medium surrounding the torpedo and for delivering said water under pressure to said chamber, and to said storage tank.

8. In an automotive torpedo, the combination, with fluid pressure operated propelling means, a fluid generator comprising a combustion chamber, a receptacle connected thereto, and a supply of liquid combustion element within said receptacle, of means operated by said propelling means, adapted to draw water from the medium surrounding the torpedo and to deliver said water under pressure to said chamber, and to said receptacle.

9. In an automotive torpedo, fluid pressure operated propelling means, a fluid generator comprising a combustion chamber, a receptacle connected thereto, a supply of liquid combustion element within said receptacle, and a pump operated by said propelling means, adapted to draw water from the medium surrounding the torpedo and to deliver water under pressure to said chamber, and to said receptacle.

10. In an automotive torpedo, the combination, with a fluid generator comprising a

reaction chamber, a fluid reaction element, and a thermal diluent for the products of the reaction within said chamber, of a pump forcing said fluid reaction element and said thermal diluent to said chamber, and means controlled by the pressure of the fluid generated within said chamber, regulating the supply of said fluid reaction element and thermal diluent, to said chamber.

11. In an automotive torpedo, a fluid generator comprising a combustion chamber, a liquid combustion element a thermal diluent for the products of combustion within said chamber, a pump feeding said liquid combustion element and thermal diluent into said chamber, and means controlled by the pressure of the fluid generated within said chamber, regulating the relative supply of liquid combustion element and of thermal diluent, to said chamber.

12. In an automobile torpedo, a fluid generator comprising a combustion chamber, a receptacle connected thereto, a solid combustion element within said chamber, a liquid combustion element within said receptacle, a pump operated by the pressure of the fluid generated within said chamber, adapted to supply water to said chamber and to said receptacle, thereby forcing said liquid element from said receptacle into said chamber, and means controlled by the pressure of said fluid, regulating the supply of said liquid element to said chamber.

13. In an automobile torpedo, fluid pressure operated propelling means, a fluid generator comprising a combustion chamber, a receptacle connected to said chamber, a solid combustion element within said chamber, a liquid combustion element within said receptacle, a pump operated by said propelling means, adapted to supply water to said chamber and to said receptacle, thereby forcing said liquid element from said receptacle into said chamber, and means controlled by the pressure of the fluid generated within said chamber, regulating the supply of said liquid element to said chamber.

14. In an automotive torpedo, the combination, with a generator comprising a reaction chamber, of a receptacle connected to said chamber, a liquid reaction element heavier than water, within said receptacle, and means for feeding water from the medium surrounding the torpedo to the upper part of said receptacle.

15. In an automotive torpedo, a motor, a closed combustion chamber, a fuel within said chamber, a supply of oxygen bearing material, means for creating an initial pressure within said combustion chamber and for igniting said fuel, means actuated by said initial pressure forcing said oxygen bearing material into the combustion chamber and means automatically reducing the supply of oxygen bearing material as the

pressure within the combustion chamber increases.

16. In an automotive torpedo, the combination with a closed combustion chamber, 5 a body adapted to interact exothermically within said chamber, and another body adapted to promote said interaction, of means for creating an initial pressure in

said combustion chamber, and means for utilizing said initial pressure to force said 10 second mentioned body into the combustion chamber to promote said interaction.

In testimony whereof I hereunto affix my signature.

EDWARD F. CHANDLER.