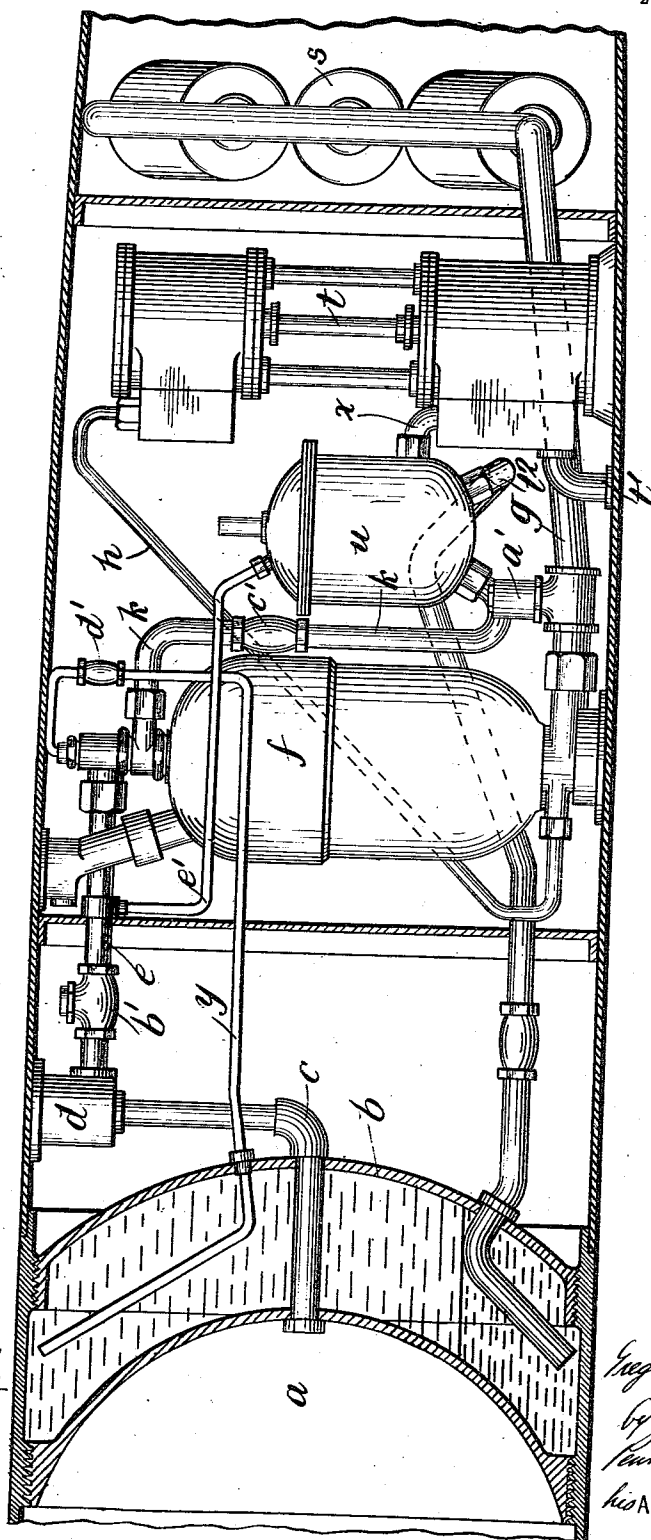


Fig. 1.



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G. C. DAVISON.
 APPARATUS FOR GENERATING MOTIVE FLUID FOR AUTOMOBILE TORPEDOES.
 APPLICATION FILED MAR. 29, 1909.
 1,036,080. Patented Aug. 20, 1912.
 2 SHEETS—SHEET 2.

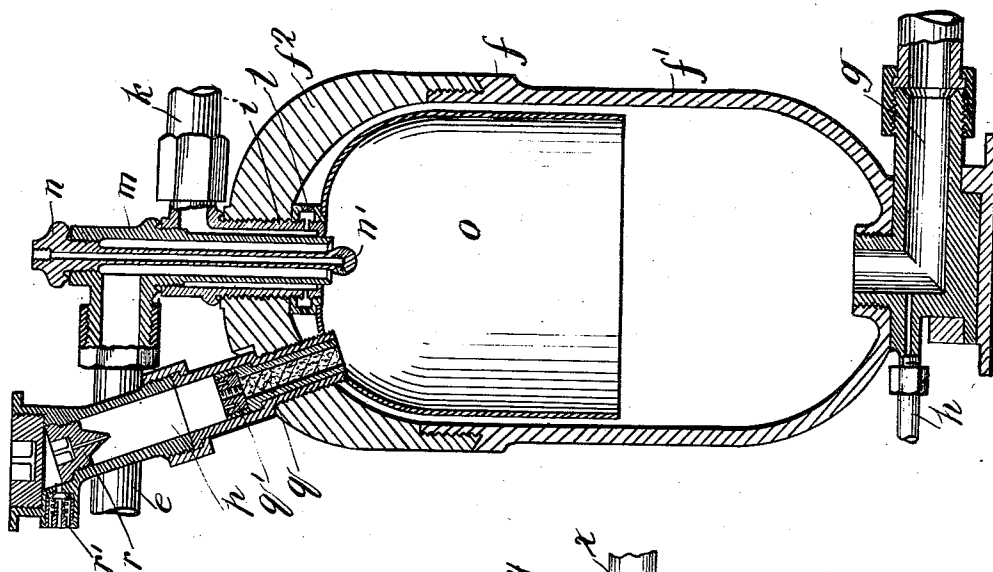


Fig. 2.

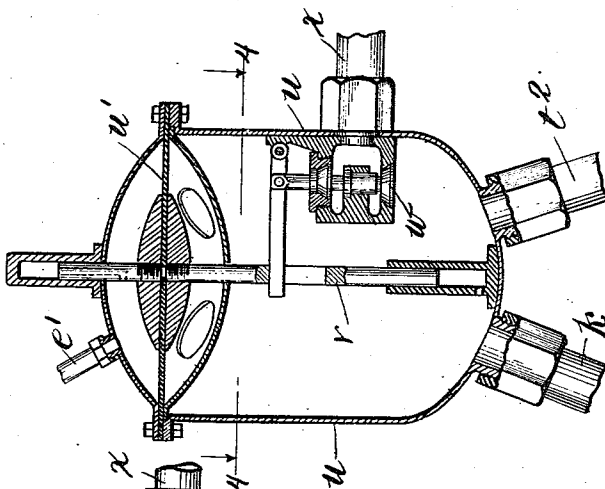


Fig. 3.

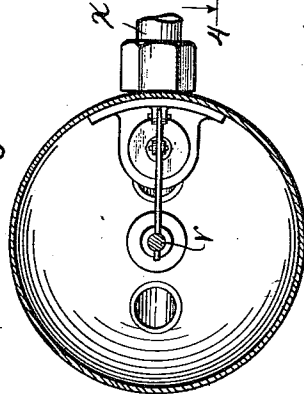


Fig. 4.

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APPARATUS FOR GENERATING MOTIVE FLUID FOR AUTOMOBILE TORPEDOES.

1,036,080.

Specification of Letters Patent.

Patented Aug. 20, 1912.

Application filed March 29, 1909. Serial No. 486,455.

To all whom it may concern:

Be it known that I, GREGORY C. DAVISON, a citizen of the United States, residing at Quincy, in the county of Norfolk, State of Massachusetts, have invented certain new and useful Improvements in Apparatus for Generating Motive Fluid for Automobile Torpedoes; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

In the operation of automobile (or self-propelled) torpedoes, it would be of great advantage to substitute for the compressed air commonly used as a motive fluid, a motive fluid derived by burning a suitable fuel with compressed air or oxygen and then injecting into the highly heated products of combustion a quantity of water, whereby the water is converted into steam, adding to the volume of the fluid and reducing its temperature. In this way there may be formed a motive fluid under extremely high pressure and at moderate temperature, which is admirably adapted to the operation of the light, high-speed, powerful engines which are used on such torpedoes; and a very high degree of efficiency of energy transformation may be secured; provided an apparatus can be devised which is of the requisite simplicity in construction and regulation, so that it may be used without danger and with the assurance that it will be in operative condition whenever it may be called upon to do its work.

It is the object of the present invention to provide an apparatus suitable for that purpose, and the particular nature and principles of operation of the means employed to that end will be understood from a consideration of the following description and the accompanying drawings.

In the drawings, Figure 1 is a central vertical section of a portion of a torpedo showing the apparatus of my invention in elevation. Fig. 2 is a central vertical section of the generator in which the motive fluid is produced; Fig. 3 is a central vertical section of the regulator, and Fig. 4 is a sectional plan of the same on the line 4—4 of Fig. 3.

The oxygen-carrier, preferably air or oxygen, under pressure, is contained in a tank *a*, which, in the construction illustrated, is formed by partitioning off a portion of the

body of the torpedo in the customary way; and the fuel is contained in a tank *b*, which is likewise formed by partitioning off a portion of the body of the torpedo. A take-off pipe *c* leads from the tank *a* to and through reducing valve *d*, which is of the type commonly used in torpedoes of this class and is adapted to be opened automatically when the torpedo is launched. From here the oxygen-carrier flows at a reduced pressure through the pipe *e* to the generator *f*, within which it is intended that the mixed fuel and oxygen-carrier shall be burned, and charged with water vapor. The construction of the generator *f* will be understood from Fig. 2, from which it will be seen that the generator comprises a strong cylindrical tank with rounded ends made in two parts *f'* and *f''*. The lower portion *f'* has tapped into it at the bottom the take-off pipe *g* leading to the engine, and the take-off pipe *h* of considerably smaller capacity leading to the pump. The upper part *f''* of the generator has tapped into it centrally at the top the compound nozzle. This nozzle comprises an outer threaded sleeve *i*, into which the water pipe *k* leads, and which terminates within the cylinder in a spraying-head *l*, having spray-holes adapted to discharge the water tangentially against the upper end of the cylinder to set up a circumferential or whirling motion; an intermediate sleeve *m* with which is connected the pipe *e* containing the oxygen-carrier; and a central nozzle *n* for the fuel, said nozzle *n* terminating in a rounded head *n'* having spray-holes as shown. Secured to the water spray-head *l* and separating the water spray from the fuel and oxygen-carrier is the dome-shaped hood *o* extending well down into the body of the cylinder, the object of the hood being to prevent the injection of water into the mixed fuel and oxygen-carrier before the combustion is complete. It will be understood that the water sprayed from the head *l* will flow down over the heated hood *o* and the water vapor will mix with the products of combustion in the lower portion of the generating chamber. For starting combustion within the generator I provide a device which is automatically actuated as soon as the oxygen-carrier under pressure is admitted into the generating chamber. For this purpose, I have adopted a known construction of ignition device and have so lo-

cated it that it is in communication with the generating chamber at the upper portion of the hood *o* in proximity to the compound nozzle. This device comprises a receptacle *p*, in which slides a fuse carrier containing an ignition fuse *q* and carrying a percussion cap *q'*, and capable of sliding up the bore of the receptacle *p* into contact with the firing projection *r*. This firing projection has a central passage for the escape of the air within receptacle *p* when the ignition fuse rises therein, such air passing through the central passage in firing projection *r* and through the spring-pressed check-valve *r'*. Upon admission of the oxygen-carrier under pressure to the generating chamber *f* through the pipe *e* and sleeve *m* the fuse-carrier is forced up the bore of receptacle *p* until percussion cap *q'* strikes firing projection *r* and the fuse is ignited. A slow burning fuse is preferably used so that the combustible mixture which has formed in the generating chamber will surely be ignited. The manner in which the fuel and water are fed to the generating chamber will be further described hereafter.

From the generating chamber the products of combustion are led, on the one hand, through the pipe *g* to the engines *s*, and on the other hand, through the pipe *h* to the pump *t*. This pump is connected with the water at *t'*, and with the regulator *u* at *x*. The construction of this regulator will be understood from Figs. 3 and 4, from which it will be seen that it comprises a casing divided into an upper and lower chamber by a flexible diaphragm *u'*, which diaphragm carries an adjustable slotted stem *v* actuating the double-seated balanced valve *w*, which controls the inlet passage from the pipe *x* leading from the delivery side of the pump. Into the lower portion of the lower chamber of the regulator is also tapped the outlet pipe *t''* leading to the lower portion of the fuel tank *b* and the outlet pipe *k* leading to the water nozzle. Into the upper part of the regulator above the flexible diaphragm is tapped the pipe *e'* branching from the pipe *e* and containing the oxygen-carrier under pressure. From the upper part of the fuel tank *b* there extends to the fuel nozzle *n*, a fuel pipe *y*.

With this construction and arrangement of parts the pressure of the oxygen-carrier in the pipe *e* on the low pressure side of the reducing valve *d* controls absolutely the pressure on the fuel and the pressure on the water supply to the generating chamber, so that the oxygen-carrier, the fuel and the water are fed always at a predetermined pressure to the generating chamber, and if, for any reason, the supply of oxygen-carrier is cut off or exhausted, the supply of fuel and water to the generating chamber will cease at once, while, as long as there is

a supply of oxygen-carrier under pressure and the flow of water into the regulator chamber is not interrupted, the supply of fuel and water to the generating chamber will continue under proper control. Furthermore, by this arrangement the fuel in the fuel tank, as it is withdrawn, is replaced by water, which, of course, remains at the bottom of the tank. This prevents a possibility of the admission of air or oxygen into the fuel tank and the formation therein of an explosive mixture. But a single pump is necessary to feed both the fuel and the water and it is made certain that the fuel and the water will be fed under the same pressure and will both be controlled by the pressure of the oxygen-carrier. This dependence of the fuel supply upon the water supply, and their mutual dependence upon the single pump and the pressure of the oxygen-carrier, is of further advantage in that it is impossible that the water supply should be stopped and the fuel supply continued, thereby creating unduly high temperatures in the generating chamber and engine. Furthermore, it will be observed, the arrangement is such, that if, for any reason, such as the breaking down of the water pump, the flow of water into the regulator chamber is interrupted, the supply of fuel will immediately cease, thus bringing the combustion to an end and preventing unduly high temperatures; but, nevertheless, the air or oxygen under pressure will continue to flow from the storage tank through the combustion chamber to the engine, and the torpedo will continue to be driven until the supply of oxygen-carrier under pressure is exhausted.

The operation of the system as a whole is as follows: When the torpedo is launched the valve *d* is opened automatically and the oxygen-carrier at the predetermined pressure is admitted to the upper portion of the generating chamber through the pipe *m*. The pressure thus produced in the generating chamber forces the fuse-carrier up the bore of receptacle *p* against the firing projection and ignites the fuse. The fuse contains a slow burning composition preferably one which will burn for several seconds, and before it is burned out, the pump, actuated initially by the oxygen-carrier passing through pipe *h*, will force fuel through the nozzle *n* into the generator, there forming an explosive or combustible mixture which will be ignited by the fuse. At the same time, or substantially the same time, that the fuel is admitted, jets of water will be thrown with a circumferential or whirling motion from the sprayer head *l* into the space between the hood *o* and the body of the generator, and as the hood heats up and the hot products of combustion accumulate the water will be vaporized and

mixed with the products of combustion, but by reason of the interposition of the hood *o* the combustion will be complete before the mixture takes place so that the water cannot interfere with the combustion. The mixed products of combustion and water vapor in the lower portion of the generator pass through the pipe *g* to the engine and through the pipe *h* to the pump.

10 In the pipe *g* between the generating chamber and the engine, I prefer to place a safety valve *a'*, and in the pipes *e*, *k* and *y* check-valves *b'*, *c'* and *d'* are interposed to prevent a back flow due to a sudden high pressure in the generator.

15 The above described arrangement of parts provides an operative system for automobile torpedoes which is simple, self-starting, self-regulating, and well protected against accidents.

20 What I claim is:—

1. In apparatus for generating motive fluid for automobile torpedoes, a generating chamber in which an oxygen-carrier and fuel are burned and the products of combustion mixed with water vapor, a tank for an oxygen-carrier under pressure, a water supply, a fuel supply, an auxiliary source of pressure for the water and fuel supply, a conduit leading from the oxygen-carrier tank to the combustion chamber, a second conduit through which the pressure of the oxygen-carrier is applied to regulate the pressure of the fuel and water supply, valve mechanism controlling said conduits, connections through which the fuel and water may freely pass under the pressure of the oxygen-carrier into the generating chamber, and a connection from the combustion chamber to the driving engine of the torpedo, whereby the flow of water and fuel feed to the generator depends at all times upon and is regulated by the pressure of the oxygen-carrier, but the flow of the oxygen-carrier is independent of the water and fuel supply.

2. In an automobile torpedo, motive fluid generating apparatus comprising a tank for storing an oxygen-carrier under pressure, a combustion chamber having an outlet conduit leading to the driving engine, and a conduit extending from the storage tank to the combustion chamber, the said elements constituting a power system in which the stored oxygen-carrier may flow from the storage tank through the combustion chamber to the engine to operate it; in combination with means for supplying a combustible and water to the combustion chamber, and means for discontinuing the combustible supply upon failure of the water supply, without interrupting the flow of oxygen-carrier to and through the combustion chamber and thence to the engine.

3. In apparatus for generating motive fluid for automobile torpedoes a tank for

storing an oxygen-carrier under pressure, a water pump, and a source of fuel supply, a combustion chamber, a supply conduit from the oxygen-carrier tank to the combustion chamber, a driving engine, a conduit from the combustion chamber to the engine, a conduit from the water pump to the combustion chamber, a conduit from the fuel supply to the combustion chamber and a connection through which the pressure on the water supply is applied to the fuel supply; substantially as described.

4. In apparatus for generating motive fluid for automobile torpedoes a tank for storing an oxygen-carrier under pressure, a water pump, and a source of fuel supply, a combustion chamber, a supply conduit from the oxygen-carrier tank to the combustion chamber, a driving engine, a conduit from the combustion chamber to the engine, a conduit from the water pump to the combustion chamber, a conduit from the fuel supply to the combustion chamber, a connection through which the pressure on the water supply is applied to the fuel supply, and a connection through which the pressure of the oxygen-carrier is applied to regulate the pressure of the fuel and water supply; substantially as described.

5. In apparatus for generating motive fluid for automobile torpedoes, a generating chamber in which an oxygen-carrier and fuel are burned and the products of combustion mixed with water vapor, a water supply and a fuel supply, means for injecting the water and fuel into the generating chamber, a supply of oxygen-carrier under pressure, and a regulator controlled by the pressure of the oxygen-carrier and controlling the water and fuel supply.

6. In apparatus for generating motive fluid for automobile torpedoes, a generating chamber in which an oxygen-carrier and fuel are burned and the products of combustion mixed with water vapor, a source of water supply under pressure for injecting water into the products of combustion, a fuel tank connected to the generating chamber, connections from the source of water supply to the fuel tank, a supply of oxygen-carrier under pressure, and a regulator controlled by the pressure of the oxygen-carrier for regulating the flow of water from the source of water supply to the generating chamber and fuel tank.

7. In apparatus for generating motive fluid for automobile torpedoes, a generating chamber in which an oxygen-carrier and fuel are burned and the products of combustion mixed with water vapor, a source of water supply under pressure for injecting water into the products of combustion, a fuel tank connected to the generating chamber, connections from the source of water supply to the fuel tank, a supply of oxygen-

carrier under pressure, and a regulator interposed in the connections from the source of water supply to the generating chamber and fuel tank for regulating the flow of water from the said source, said regulator comprising a casing, a flexible diaphragm dividing the casing into two chambers, with one of which chambers the inlet from the source of water supply and the outlet to the generating chamber and the fuel tank communicate, a valve connected to the diaphragm and controlling the inlet from the source of water supply, and connections for admitting the oxygen-carrier under pressure to the other chamber of the regulator casing.

8. In apparatus for generating motive fluid for automobile torpedoes, a generating chamber in which an oxygen-carrier and fuel are burned and the products of combustion mixed with water vapor, inlet devices for the fuel and oxygen-carrier, a dome-shaped hood about said devices, and a water spray-head arranged to spray water on the outside of said hood.

9. In apparatus for generating motive fluid for automobile torpedoes, a generating chamber in which an oxygen-carrier and fuel are burned and the products of combustion mixed with water vapor, inlet devices for the fuel and oxygen-carrier at the upper part of the generating chamber, a hood overhanging said inlet devices, and a water spray-head for directing jets of water on the outside of said hood.

10. In apparatus for generating motive fluid for automobile torpedoes, a generating chamber having a dome-shaped upper end and in which an oxygen-carrier and fuel are burned and the products of combustion mixed with water vapor, inlet devices for the fuel and oxygen-carrier at the upper part of the generating chamber, a hood overhanging said inlet devices and substantially conforming in shape to the dome-shaped upper end of the generating chamber and a centrally located water spray-head between the end of the chamber and the hood for directing jets of water on the outside of said hood.

11. In apparatus for generating motive fluid for automobile torpedoes, a tank for an oxygen-carrier under pressure, a fuel tank, a generating chamber, a regulator casing, a pump, and a fluid-operated motor, connections extending from the oxygen-carrier tank and from the fuel tank to the generating chamber, whereby the oxygen-carrier and fuel are admitted to the generating chamber to be burned therein, connections

extending from the generating chamber to the fluid actuated motor and to the pump, whereby the products of combustion are led to the motor and pump to actuate the same, connections extending from the pump to the regulator casing and from the regulator casing to the fuel tank and to the generating chamber, a branch connection extending from the oxygen-carrier connections to the regulator casing, and mechanism within the regulator casing and actuated by the pressure of the oxygen-carrier for controlling the inlet from the pump.

12. In apparatus for generating motive fluid for automobile torpedoes, a generating chamber in which an oxygen-carrier and fuel are burned and the products of combustion mixed with water vapor, a tank for an oxygen-carrier under pressure, a water supply, a fuel supply, a conduit leading from the oxygen-carrier tank to the combustion chamber, a second conduit through which the pressure of the oxygen-carrier is applied to the water supply, valve mechanism controlling said conduits, a conduit leading from the water supply to the fuel supply, and connections through which the fuel and water may freely pass under the pressure of the oxygen-carrier into the generating chamber, whereby the water and fuel feed to the generator, depends at all times upon the pressure of the oxygen-carrier, and the feed of fuel is dependent upon the pressure of the water supply.

13. In apparatus for generating motive fluid for automobile torpedoes, a generating chamber in which an oxygen-carrier and fuel are burned and the products of combustion mixed with water vapor, a tank for an oxygen-carrier under pressure, a conduit including a control valve through which the oxygen-carrier may pass to the generating chamber whenever the control valve is open, a water supply, a fuel supply, a second conduit likewise controlled by said valve and through which the pressure of the oxygen-carrier is applied to the fuel and water supply, and conduits through which the fuel and water may freely pass, under such pressure, into the generating chamber, whereby the water and fuel feed depends at all times upon the pressure of the oxygen-carrier.

In testimony whereof I affix my signature, in presence of two witnesses.

GREGORY CALDWELL DAVISON,

Witnesses:

F. L. BRAKE,
W. D. FESLER.