F. M. LEAVITT.

HEATER FOR AUTOMOBILE TORPEDOES.

APPLICATION FILED DEC. 23, 1911.

**1,022,486.** Patented Apr. 9, 1912.

*Fig. 1.*

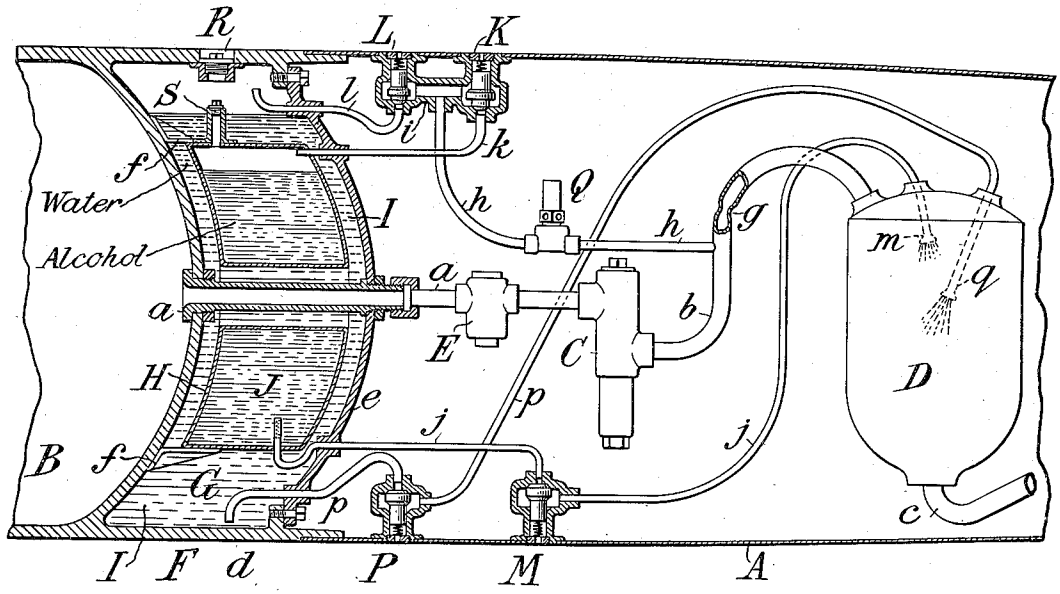



*Fig. 2.*

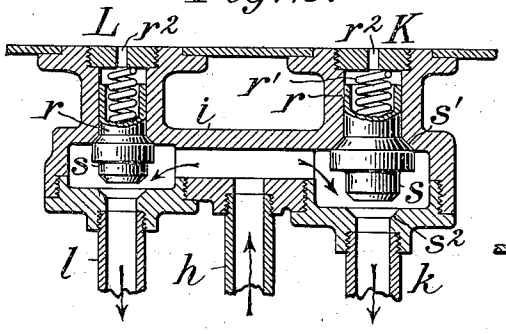



*Fig. 3.*

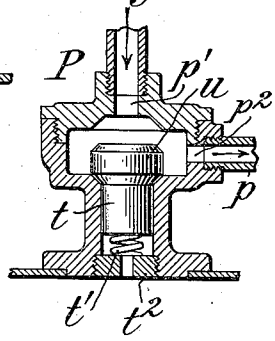



*Fig. 4.*

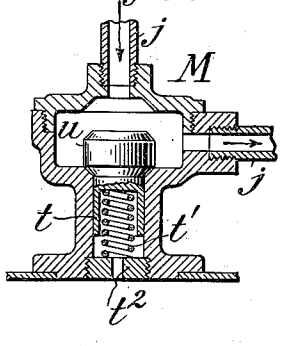
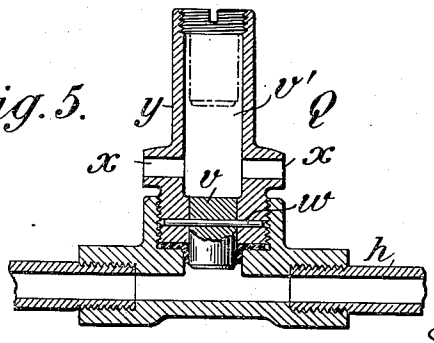



*Fig. 5.*

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# UNITED STATES PATENT OFFICE.

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## HEATER FOR AUTOMOBILE TORPEDOES.

1,022,486. Specification of Letters Patent. Patented Apr. 9, 1912.

Application filed December 23, 1911. Serial No. 667,531.

*To all whom it may concern:*

Be it known that I, FRANK M. LEAVITT, a citizen of the United States, residing in Smithtown, in the county of Suffolk and State of New York, have invented certain new and useful Improvements in Heaters for Automobile Torpedoes, of which the following is a specification.

This invention relates to automobile torpedoes which are provided with means for heating the stored compressed air during its flow from the reservoir or air flask to the heater or engine, the effect of which heating is to increase the power or energy derivable from the compressed air, and thereby to drive the torpedo either at higher speed or for a greater distance or both. Such heaters are technically called "superheaters".

The invention further relates to such torpedoes in which the power is further augmented by the spraying of water into the heater, which water is thereby vaporized so that the resulting steam more or less superheated commingles with the compressed air and augments the supply of elastic motive fluid. In order to provide for such introduction into the heater of both liquid fuel and water, it is necessary that these be forced from their storage tanks under substantially equal pressures. The high pressure required involves the use of strong tanks which add considerably to the weight or specific gravity of the torpedo, and to give them the desired capacity involves difficulty in arranging them within the constricted space available in the shell or hull of the torpedo.

The present invention aims to obviate these disadvantages. To this end it provides for storing both the water and liquid fuel in a single vessel or container of adequate strength, wherein they are separated by a thin partition which is protected from strain by exactly equalizing the pressures within the water and fuel compartments on opposite sides of such partition. Such single container may occupy the entire cross section of the torpedo immediately adjacent the air flask, or it may be otherwise arranged to attain the desired compactness. Preferably the two compartments are formed by an inner tank or receptacle of thin metal, the walls of which separate the water compartment exterior to this vessel from the fuel compartment within it; or the water may be placed within it and the fuel outside of it as desired.

The accompanying drawings show the preferred embodiment of the invention.

Figure 1 is a longitudinal section of a portion of a torpedo. Figs. 2, 3, 4 and 5 are respectively vertical mid-sections of the several valves forming part of the apparatus on a larger scale.

Referring to the drawings, let A indicate the shell or hull of the torpedo and B the reservoir or flask of compressed air. From this flask an outlet pipe *a* leads to a pressure reducing valve C by which the air pressure in the flask is reduced to a lower and uniform pressure. From the low pressure side of this valve leads a pipe *b* which extends to the heater or superheater D, and from the latter a pipe *c* leads to the engine (not shown) which is commonly a turbine, and by which the screw propellers are driven in the well-known manner. At some suitable point in the pipe or passage *a* is introduced a starting valve E which may be of any known construction, and whereby the air is admitted to the heater and engine at the instant of launching the torpedo.

According to the present invention a strong container F is provided for inclosing the water and liquid fuel. This is conveniently formed by extending the outer walls of the air flask B in the form of a cylindrical wall *d* having a flange to which is securely attached a disk or head *e*. A chamber G formed within this container F is sub-divided into two compartments by a partition H of comparatively thin metal, such as metal sheet or plate, which is preferably constructed in the form of an annular vessel having a central opening for the free passage through it of the pipe *a* and which is supported within the container F in any suitable manner, as by brackets *f f*. The partition or vessel H thus divides the chamber G into two compartments, an outer compartment I, and an inner compartment J. In the construction shown the outer compartment I is designed to hold water and the inner compartment J to hold alcohol or other combustible fluid; but this arrangement may be reversed by suitably altering the respective pipe connections which will be described.

In the reduced pressure pipe *b* is formed a slight contraction or choking *g* and be-

tween this and the reducing valve C a branch *h* leads to a valve shell *i* where the duct branches and leads to two valves K and L. From the valve K a pipe *k* leads to the fuel tank or compartment J. From the valve L a pipe *l* leads into the water space or compartment I. From the bottom of the fuel compartment J there leads a pipe *j* in which is introduced a check valve M, and which pipe *j* leads thence to a fuel nozzle *m* through which fuel is sprayed or otherwise introduced into the heater. From the bottom of the water compartment I leads a pipe *p* in which is introduced a check valve P, whence the pipe *p* extends to the heater D and terminates in a spray nozzle *q* for introducing water.

In operation, on the launching of the torpedo compressed air is admitted through the starting valve E to the reducing valve C, and flows thence through the heater to the engine; compressed air under the reduced pressure flows through the pipe *h* and divides at *i*, and, opening the valves K and L, flows through the pipes *k* and *l* into the respective fuel and water compartments, and thereby exerts a pressure upon the fuel and water whereby the fuel is ejected through the pipe *j* to the heater and the water is ejected through the pipe *p* to the heater. The pressure available for thus forcing out the fuel and water is that due to the difference in pressures on opposite sides of the constriction *g*, this pressure being sufficient to cause a uniform and moderate but sufficient flow of both fuel and water during the entire time which the run of the torpedo should take. A suitable igniter (not shown) automatically ignites the fuel upon its first admission to the heater, so that a fierce combustion is maintained in the heater, whereby the air circulating through it is heated to a high degree and the spray of water is converted into steam; the commingling steam, air and gases flow thence to the engine or turbine in a volume so increased as to notably augment the power developed thereby.

In order that thin metal may be used for the partition H, thereby economizing weight and space, it is essential that an exact balance of pressures on opposite sides of this partition should be attained. For this purpose the pressure introduced by the pipe *h* to the branch pipes *k* and *l* must be kept precisely equal. The valves K and L must therefore be so constructed as to be opened and held open without varying the pressure transmitted to the air in branch pipes *k* and *l*. Likewise the check valves M and P must interpose equal resistances to the outflow of the fuel and water through the pipes *j* and *p*.

The function of the check valves M and P is to prevent any outflow of water or fuel to the heater prior to the turning on of compressed air at the instant of launching. The valves K and L are to prevent any possible back-flow of water or fuel into the pipes *h* and *b*, such as might occur in handling of the torpedo prior to launching in case it were rolled over. Each of these four valves therefore is held closed by a spring of sufficient strength to prevent any such flow of liquid through the valves by reason merely of the weight of the liquid and unaccompanied by the exercise of the force of compressed air. Ordinary spring-closed check-valves might be used for these purposes, but would be subject to the disadvantage that the fluid in forcing its way through the valve would unseat the valve against the pressure of the spring, and hence would itself suffer a loss in pressure proportionate to the stress of the spring; so that if the springs of the respective water and fuel valves were of unequal strength or exerted unequal strains against their valves, this would cause an inequality in the pressures in the water and fuel compartments, which being multiplied in proportion as the area of the partition H exceeds that of each valve seat might readily generate a total pressure such as would burst or collapse the thin partition H. To prevent this result, which would destroy the advantage of the present invention, the respective valves are especially constructed in a manner which will be more evident from a consideration of the detailed Figs. 2, 3 and 4.

Referring to Fig. 2 which shows the safety or inlet valves to the water and fuel compartments, it will be seen that each valve comprises a valve shell (these being conveniently formed as one) formed with a valve chamber and a cylindrical chamber, and with a moving part or valve proper having a cylindrical plunger *r* which fits as a piston in the cylindrical chamber of the shell, and having a valve head *s* which seats in opposite positions, being adapted both to an upper seat *s'* in the shell and to a lower seat $s^2$, which latter forms the outlet opening. The plunger *r* is hollow and receives within it a spring *r'* which presses the valve initially against its outlet seat $s^2$. The respective seats are of unequal size, the valve head *s* being larger where it fits the upper seat than where it fits the lower seat. The outer area of the lower seating surface is less than the area of transverse section of the plunger *r*. When air pressure is admitted to the branch duct *i* it acts against the differential area thus formed, and lifts the valve against the pressure of its spring until stopped by the valve head coming against the upper seat *s'*, in which position the pressure holds it, leaving a free opening through the outlet. The space above the plunger *r* is in free communication with the

exterior medium (air or water) by means of a vent $r^2$. Hence the valve is held open by the difference in pressure between the compressed air in pipes $k$ and $l$ and the much lower pressure of the surrounding air or water with which the vent $r^2$ communicates. The seating of the valve against the seat $s'$ prevents leakage of compressed air after the first opening movement. Both valves K and L thus remain open during the entire run of the torpedo, as shown in Fig. 2, and the stress of the valve springs $r'$ however unequal has no effect to derange the equality of pressure communicated through the pipes $k$ and $l$.

The check valves P and M, Figs. 3 and 4, being practically alike one description will serve for both. These valves are in effect an inversion of the valves K and L but with the omission of the differential feature and a transposition of the positions of the inlet and outlet ports. Taking the valve P for example (Fig. 3), its moving part has a plunger $t$ moving in a cylindrical cavity in the valve shell, and a head $u$ which when pressed up by a spring $t'$ beneath closes the inlet $p'$ in pipe $p$. On being pressed down by the flow of fluid under pressure, the valve head seats against the lower seat, and thus prevents leakage past the valve. The spring chamber communicates through a vent $t^2$ with the outer medium, so that so long as the fluid continues to flow under pressure the function of the spring is suppressed, and the valve held open, leaving a clear passage from the inlet $p'$ to the outlet $p^2$.

To prevent the possibility of injury to the apparatus in case through some derangement of the pressure reducing valve C an abnormal pressure were admitted to the pipes $b$ and $h$ and to the heater D and engine, a safety valve Q is provided, being conveniently located in the pipe $h$. The construction of this valve is shown in Fig. 5. It comprises a valve shell having a transverse passage or cylinder in which is mounted a normally stationary plunger $v$. This is held in place by a shearing pin or key $w$, being a piece of wire of suitable metal introduced through coinciding holes in the shell and plunger. This pin is of strength such that it amply resists the normal pressure when the reducer is working properly; but when this pressure is abnormally increased the pin gives way, being sheared by the forcing outward of the plunger $v$, which then moves up into a chamber $v'$ (see dotted lines) and thus opens a free outlet for the air through openings $x$ $x$. In mechanical construction the valve shell is of two parts, the one $y$ screwing into the other and confining between them a cupped packing to prevent leakage around the plunger. The pin $w$ is put through a hole in the shell $y$ where it screws into the socket in the main shell, so that this socket prevents escape of the pin. This construction forms a very simple, compact and effective safety valve.

For filling the water and fuel compartments, plugs R and S are provided. These being in line, the smaller plug S is removed through the bushing of the plug R. The liquid fuel is then introduced through a funnel into the inner vessel, and the plug S then screwed home. Water is then introduced and the plug R screwed home.

This invention is susceptible of considerable structural modification without departing from its essential features. The specific shape and arrangement of parts shown although suitable are unimportant.

What I claim is:—

1. In a torpedo, a containing vessel divided by a partition into water and fuel compartments, a source of compressed air, and means for conducting compressed air under equal pressures into both compartments.

2. In a torpedo, a compressed air flask, a containing vessel formed against one end thereof, a partition therein dividing its interior into two compartments, and means for conducting compressed air under equal pressures into both compartments.

3. In a torpedo, a compressed air flask having its outer wall prolonged, a cover fitting against such prolonged wall to form a containing vessel, a partition dividing such vessel into two compartments, and means for conducting compressed air under equal pressures into both compartments.

4. In a torpedo, a containing vessel, a partition therein forming an inner vessel, and means for introducing compressed air under equal pressures into said containing vessel outside and inside of said inner vessel.

5. In a torpedo, a containing vessel, a partition therein dividing it into fuel and water compartments, means for introducing compressed air under equal pressures into both compartments, and a normally closed spring-pressed valve adapted to be opened on admission of pressure and adapted when opened to remain open against the stress of its spring, thereby avoiding back-pressure on the air due to the tension of the spring.

6. In a torpedo, a containing vessel, a partition therein dividing it into fuel and water compartments, means for introducing compressed air under equal pressures into both compartments, comprising a pipe branching into two pipes entering said compartments, and valves controlling said branch pipes to prevent back-flow.

7. In a torpedo, a containing vessel, a partition therein dividing it into fuel and water compartments, means for introducing compressed air under equal pressures into both compartments, pipes leading from the respective compartments, a heater into which

said pipes lead, and check valves in said pipes to prevent accidental flow.

8. In a torpedo, a containing vessel, a partition therein dividing it into fuel and water compartments, means for introducing compressed air under equal pressures into both compartments, and check valves in pipes communicating with said compartments comprising a plunger, a spring normally closing the valve, and a vent opening whereby when the valve is opened by the admission of pressure it remains open against the stress of the spring while such internal pressure continues.

9. In a torpedo, a containing vessel, a partition therein dividing it into fuel and water compartments, means for introducing compressed air under equal pressures into both compartments, comprising branch pipes and valves therein, each valve comprising a differential plunger, a spring pressing it closed against the outlet seat, and a vent, said outlet seat being of smaller area than said plunger, whereby by the admission of pressure the valve is opened and remains open while internal pressure continues.

10. In a torpedo, a compressed air reservoir, a reducing valve, a conduit leading from the reservoir to said valve, a reduced pressure conduit leading from said valve, and a safety valve communicating with the latter conduit, comprising a shell having a relief opening, a plunger closing said opening, and a shearing pin adapted to hold said plunger in place under normal pressures and to be sheared by an abnormal pressure.

In witness whereof, I have hereunto signed my name in the presence of two subscribing witnesses.

FRANK M. LEAVITT.

Witnesses:
E. A. MAIN,
F. C. FLADD.