F. M. LEAVITT.

EXPLODER.

APPLICATION FILED NOV. 29, 1911.

Patented July 29, 1913.

**1,068,594.**

*Fig. 1.*

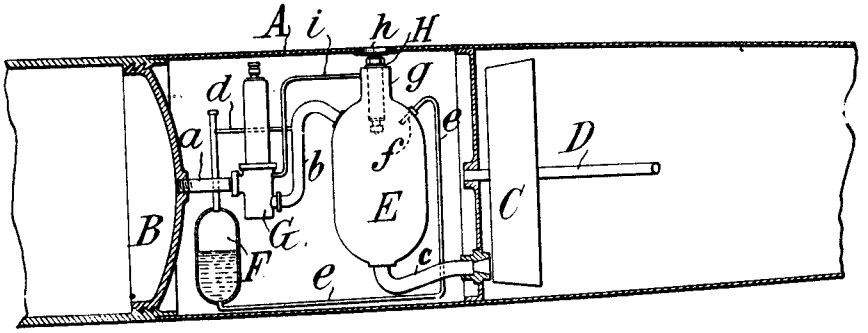



*Fig. 2.*

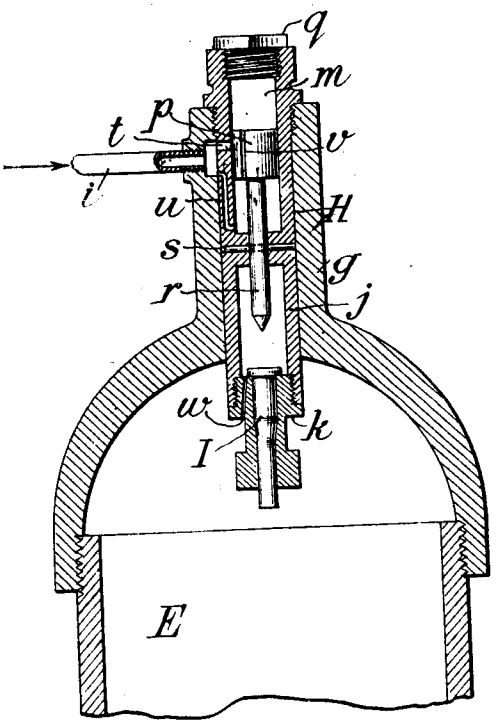
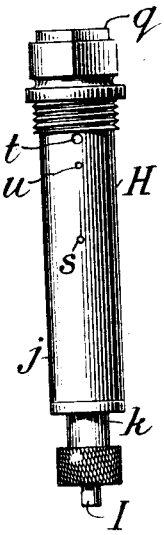



*Fig. 3.*




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# UNITED STATES PATENT OFFICE.

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## EXPLODER.

1,068,594. Specification of Letters Patent. Patented July 29, 1913.

Application filed November 29, 1911. Serial No. 662,988.

*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 Exploders, of which the following is a specification.

This invention relates to exploders operated by a fluid under pressure.

The invention has been primarily designed and adapted for use in automobile torpedoes as a means for igniting the fuel in the heater (technically called the "superheater") for heating the compressed air in its passage from the air flask or compressed air reservoir to the turbine or other motor engine. In such heaters the ignition of the fuel must be accomplished during or consequent upon the launching of the torpedo. The launching operation opens the throttle valve, which admits compressed air to the engine, and consequently starts the engine and propellers revolving, which in an overwater launch results in bringing the propellers into action while the torpedo is moving through the air and before it enters the water. It is desirable that the increased energy imparted to the air by heating it be made effective at as nearly the instant of submersion as possible. The feeding of alcohol or other liquid fuel which is sprayed into the heater, commences also consequent upon the launching operation, being commonly performed by the forcing in of the fuel under air pressure, which pressure results from the opening of the throttle valve. The ignition is commonly effected by means of a cartridge the cap of which is exploded automatically in or consequent upon the act of launching, and to delay the ignition it is customary to use a cartridge of smokeless powder, which burns slowly enough to prolong the ignition for a certain time. It is necessary to delay the igniting effect until the infeed of liquid fuel to the heater shall have been started and has become adequate, as otherwise the ignition might fail.

The present invention provides an exploder which instead of acting immediately upon the turning on of fluid pressure, has a delayed action such that the explosion is deferred for an appreciable or predetermined time after the admission of fluid pressure. As applied to a torpedo the delayed action may amount to from one-quarter second (or less) to one second (or more), being sufficient to certainly give time for the infeed of liquid fuel to have become so far started as to insure that the fuel shall have reached the heater, and that a continuous inflow of the fluid shall thereafter be maintained.

The present invention provides a hammer for striking the percussion cap of the cartridge, which hammer is operated by a piston or plunger (preferably formed integrally with the hammer), which piston moves in an air cylinder in such manner that when the air pressure is first admitted it causes the piston to execute a slow preliminary movement by reason of the restricted admission of air, which movement consumes sufficient time to accomplish the desired delay, whereupon the piston uncovers a larger admission opening whereby the compressed air is admitted behind it at such rate as to cause it to move at high velocity so that the hammer is caused to strike the requisite blow against the cap for accomplishing the ignition.

The preferred embodiment of my invention is shown in the accompanying drawings, wherein,—

Figure 1 is a longitudinal mid-section of a portion of the after body of an automobile torpedo showing the heater and its accessories in elevation; Fig. 2 is a vertical mid-section of the heater and exploder on a larger scale; Fig. 3 is an elevation of the exploder detached.

Referring to Fig. 1, A is the shell or hull of the torpedo; B is the air flask or compressed air reservoir; C is the turbine or other engine or motor which drives the propeller shaft D; E is the air heater; F is the fuel tank; G is a reducing valve, which may also be the starting valve.

Upon the opening of the starting valve, compressed air is admitted from the reservoir B through the pipe *a*, which pressure

is reduced by the reducing valve G, and the air then passes by pipe *b* to the heater E and thence by pipe *c* to the engine. Liquid fuel, such as gasolene or alcohol, is supplied in the tank F, and this receives air pressure through a pipe *d* by which the fuel is driven out through pipe *e* and sprayed into the heater through nozzle *f*. The details of these several apparatus are not shown, being well understood.

The exploder H to which the present invention pertains, is inserted in the heater E at any convenient location, as by introducing it through a neck *g* which may be formed at one end of the heater. It is desirably rendered accessible through a plug *h* in the torpedo shell A, whereby the exploder may be removed and replaced.

For operating the exploder, compressed air is admitted to it through any suitable air duct, as for example the pipe *i* (Fig. 1) which may connect with the valve G as shown, and thereby be put in communication with the source of air at high pressure; or any other connection may be made whereby when the compressed air is admitted to the heater air pressure is simultaneously admitted to the exploder.

The exploder comprises a shell *j* which at one end has a removable section *k* adapted to receive an ordinary blank cartridge I having the usual percussion cap; and which is formed internally with a chamber or cylinder *m* in which moves the piston or plunger *p*, this cylinder being closed by a plug *q*. The hammer or firing pin *r* is arranged to slide through a guide portion in the shell *j*, and when projected its pointed end strikes the cap. It is operated by the piston *p*, preferably by its being connected directly thereto or formed integrally therewith. The parts are shown in the initial or preparatory position. To hold them in this position any resistant means may be provided which is adapted to afford enough resistance to prevent accidental displacement of the piston and firing pin during handling. The means shown consists of a key *s* which consists of a small wire of copper or other suitable metal inserted through coinciding holes in the shell and firing pin, so that the firing pin can be displaced only by a pressure sufficient to shear this wire key.

As shown the piston stands initially in approximately the middle of its cylinder. In this position it blocks a direct air port *t* which communicates with the air inlet pipe *i*. Another air port *u*, however, is provided, which leads air from the air inlet to the other end of the cylinder *m*. This air duct is preferably a contracted duct. The piston is not made leak-tight, but is made a sufficiently free or loose fit with the cylinder to permit a slight leakage of air around it. If too tight to afford the requisite leakage, a small groove *v* may be formed upon the periphery of the piston through which air leakage may occur.

The operation may now be understood. The exploder being primed and in place in the heater with its parts in the position shown in Fig. 2, let us suppose that the torpedo is launched, by which operation compressed air is automatically admitted to the heater and engine. At the same instant compressed air is admitted through the pipe *i* to the exploder. The port *t* being closed this air can only enter the exploder through the end port *u*. Thus entering, it presses against the exposed annular surface of the forward end of the piston around the hammer *r*, and the pressure thus exerted against the piston is sufficient to instantly shear the pin *s*. The piston then moves rearwardly toward the plug *q*; since behind the piston there exists air at approximately atmospheric pressure only; this movement occurs quickly, and until the air which is behind the piston is compressed to the same pressure as that on the opposite side which impels the piston, whereupon the piston is stopped by the cushion thus afforded. For a moment it dwells in this position. Thereupon by leakage around the piston or through the groove *v* as the case may be, the equilibrium is disturbed by reason of the air acting upon the full area of the back of the piston, whereas on the front thereof it acts only on the annular area around the hammer *r* which acts as a piston rod. Consequently the pressure back of the piston preponderates, and the piston consequently moves forward, this movement occurring, however, at a rate which is determined by the rate of leakage past the piston. This slow movement occurs until the piston advances enough to uncover the direct port *t*, whereupon a comparatively unrestricted flow of air is admitted to the rear of the piston, and acting against the differential or unbalanced area thereof (being the area of the hammer *r*) the air thus admitted is effective to cause a quick and powerful movement of the piston and hammer, whereby the hammer is caused to strike a blow against the cartridge cap sufficient to insure its explosion. The delay occasioned by the backward and slow forward movements of the piston preceding its quick forward movement to strike the hammer blow, affords ample time after the admission of compressed air for the latter to institute the infeed of fuel to the heater. The ignition of the fuel by the flame blowing out from the cartridge is thus assured. Inasmuch as some leakage occurs around the hammer *r* where it has its sliding seat in the exploder shell,

a small duct *w* is provided in the section *k* to permit this leakage to escape: as otherwise it would accumulate and exert a pressure against the pointed end of the hammer. To again use the exploder, it is bodily unscrewed from its seat in the neck *g* of the heater, and the section *k* is unscrewed from it; the cartridge shell is then removed from this section and a new cartridge inserted. The hammer is restored to its original central position, and the shear key or wire is pushed out of its socket and replaced by a new key of suitable wire. The exploder is then screwed back into the neck of the heater and is ready for the next operation. By means of this construction of exploder a retardation of from one to two seconds, or even longer, can easily be obtained.

An important advantage of delaying the ignition is that in case of an over-water launch it prevents the racing of the engine. While the torpedo is being launched through the air its engine is started, and as the propellers encounter only the resistance of the air, they are liable to race; this racing however is not serious if the compressed air is admitted cold to the engine; but if the heater begins to act to heat the air before the torpedo enters the water, the energy of the air is so greatly increased as to cause serious and detrimental racing of the propellers. By delaying the ignition long enough to insure that the torpedo shall enter the water before any serious heating of the air shall commence, this practically overcomes the undue speeding or racing of the engine.

My invention is not limited to the construction shown, but may be modified to a greater or less extent without departing from its essential features which are set forth in the claims.

I claim as my invention:—

1. An exploder comprising a compressed air operated hammer having air ports for admitting compressed air to operate it, said ports adapted to admit primarily a minute flow of air to retard the preliminary movement of the hammer, and to admit subsequently a larger flow to impel the hammer forcibly to the firing position.

2. An exploder comprising a hammer and a pressure actuated piston for moving it, a casing for said piston having ports admitting first a minute flow of air to impart a slow preliminary movement to the piston, and subsequently a larger flow to impel the piston forcibly to the firing position.

3. An exploder comprising a shell formed with a cylindrical chamber, a piston moving in such chamber, a hammer actuated by said piston, and said shell having air ports the one adapted to admit a minute flow of air to cause a slow preliminary movement of the piston, and the other adapted to uncover at the end of such preliminary movement to admit a larger flow of air to impel the piston forcibly to the firing position.

4. An exploder comprising a casing formed with a piston chamber, a piston moving therein having a stem on one side passing out through the end of said chamber, and air ports entering said chamber the one admitting air on the front side of the piston to act against its lesser area, whereby the leakage of air to the opposite side of the piston causes the piston to execute a slow preliminary movement, and the other port adapted to be uncovered at the end of such preliminary movement to admit air freely to the rear side of the piston to impel it forcibly to the firing position.

5. An exploder comprising a casing formed with a piston chamber, a piston moving therein having a stem on its forward side passing out through the front end of said chamber, the piston initially occupying an intermediate position in said chamber, with resistant means for holding it in such position, and air ports entering said chamber, the one admitting air on the front side of the piston to act against its lesser area whereby when air pressure is turned on it overcomes the resistance of said resistant means and moves the piston backward, after which the leakage of air to the opposite side of the piston causes it to execute a slow preliminary forward movement, and the other port adapted to be uncovered at the end of such preliminary movement to admit air freely to the rear side of the piston to impel it forcibly to the firing position.

6. An exploder comprising a compressed air-operated hammer having means for admitting air to cause the hammer to execute an initial backward movement preliminary to its forward blow, whereby to delay the explosion.

7 An exploder comprising a pressure-actuated piston and a casing therefor having an air port uncovered by the piston in its movement, with a port admitting a restricted flow for causing a slow, preliminary movement, whereby to retard the action of the exploder.

8. An exploder comprising a pressure-actuated piston and a casing therefor having a larger and a smaller air port, the latter adapted to admit a minute flow to cause a slow, preliminary movement of the piston, and the former arranged to be uncovered by the piston at the end of such movement and thereupon to admit an augmented flow to impel the piston forcibly forward.

9. An exploder comprising a pressure-actuated piston and a casing therefor having a larger air port uncovered by the piston

during its movement, and restricted ports, the latter adapted to admit a minute flow in front of the piston to force it initially backward and subsequently behind the piston to force it forward with a slow, preliminary movement until it uncovers said larger port.

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

FRANK M. LEAVITT.

Witnesses:
H. C. SEAMAN,
JOHN D. MCINTYRE.