Patented Sept. 4, 1928. 1,683,085

UNITED STATES PATENT OFFICE.

HUDSON MAXIM, OF HOPATCONG BOROUGH, NEW JERSEY; LILIAN MAXIM EXECUTRIX OF SAID HUDSON MAXIM, DECEASED.

METHOD OF GENERATING MOTIVE FLUID.

No Drawing. Application filed February 23, 1921. Serial No. 447,176.

The object of the invention is mainly to provide a simpler, safer, more efficient and convenient method of utilizing a self-combustive or explosive fuel for the generation of energy for the propulsion of torpedoes than has heretofore been employed.

In carrying out the invention, I preferably employ for a self-combustive and explosive liquid fuel, nitroglycerin de-sensitized by dissolving in it a suitable de-sensitizing substance or by forming a solution of another explosive substance in it, such as tri-nitro-methyl-phenol, di-nitro-naphthalin, di-nitro-benzol, tri-nitro-toluene, or di-nitro-glycerin, or other suitable solid or liquid explosive substance or substances, and I may and sometimes do employ a solution in nitroglycerin of a suitable non-explosive combustible substance to de-sensitize the nitroglycerin, such, for example, as gum camphor, wood alcohol, acetone, mono-nitro-naphthalin or nitro-benzol, which latter two substances, although nitro compounds, still contain such a small percentage of combined oxygen as by themselves to be impractical or unsuitable as explosive compounds, either for the purpose of a self-combustive fuel for torpedoes or of a high explosive to reinforce the explosive blast of the warhead of the torpedo, as hereinafter described.

All of the above de-sensitizing agents further serve the purpose of materially lowering the freezing point of nitroglycerin.

I have found that when a sufficient percentage of a suitable de-sensitizing substance or combination of substances, such as those above enumerated, are employed effectually to de-sensitize the nitroglycerin and render it suitable as a liquid fuel for torpedoes, the freezing point of the nitroglycerin is thereby lowered below the freezing point of seawater, so that a torpedo containing such liquid fuel may remain immersed indefinitely in seawater in winter, in any climate, without freezing of the nitroglycerin or the crystallization of any of the nitroglycerin out of solution.

I preferably employ such a proportion of de-sensitizing matter as shall render the nitroglycerin incapable of detonation under the conditions in which it may be employed in the combustion chamber of a torpedo by the action of vaporization and inflammation for the generation of heat for the produtcion of the necessary gases or vapors at the required temperature to evaporate sufficient water to serve as an effective fuel for driving torpedoes, as hereinafter described, and still, I preferably employ so small or limited a percentage of the de-sensitizing agent or substance or substances as shall render any residual quantity of the fuel compound, in proximity to the warhead after a run of the torpedo, capable of being detonated by the detonation of the warhead of the torpedo, thereby permitting of the utilization of any residue of the self-combustive fuel to participate in and add to the force of the explosive blast of the warhead.

I have found gum camphor to be a very efficient de-sensitizer of nitroglycerin. Camphor has a very intense affinity for nitroglycerin, on account of the great solubility of camphor in nitroglycerin. The affinity of camphor for nitroglycerin is such that but very little camphor will evaporate from a solution of nitroglycerin even after long exposure, so that in the event of some of the liquid nitroglycerin fuel containing camphor being inadvertently spilled and exposed to the atmosphere, there will, after long exposure, remain in solution in the nitroglyerin the greater part of the camphor originally in solution, thereby effectually serving to prevent any quantity of the liquid for becoming sensitive and dangerous due to evaporation. Other more volatile solvents, such as acetone, wood alcohol and the like, may evaporate from the nitroglycerin, leaving the camphor. Furthermore, wood alcohol, acetone and the like, may be removed or washed out of the nitroglycerin with water, while it is very difficult to extract camphor from nitroglycerin with water, the camphor being, for all practical purposes, as insoluble in water as is nitroglycerin.

I have found, furthermore, that by dissolving in nitroglycerin another explosive substance less sensitive than nitroglycerin, such as tri-nitro-methyl-phenol, or tri-nitro-toluene, di-nitro-naphthalin, di-nitro-benzol, or di-nitro-glycerin, the nitroglycerin is de-sensitized thereby, and the same purposes served as by the use of camphor, while the added explosive material, unlike a non-explosive combustible, is capable of contributing heat to the reaction of self-combustion of the liquid in the combustion chamber of the torpedo, but the employment of a small percentage of camphor in addition to such an ex-

plosive adds to its solubility in nitroglycerin.

Therefore, I may and sometimes do employ both an explosive and a non-explosive substance or substances for the purpose of desensitizing nitroglycerin, such, for example, as acetone or wood alcohol or both with di-nitro-glycerin, or I may employ, instead of di-nitro-glycerin, or in addition to di-nitro-glycerin, tri-nitro-toluene, di-nitro-benzol or tri-nitro-methyl-phenol or other suitable explosive material.

I some times employ a solution of acetylene gas in acetone dissolved in nitroglycerin, either with or without the addition of other de-sensitizing agents, the acetone serving the purpose of effecting more rapid action of vaporization and inflammation of the liquid fuel in the combustion chamber of the torpedo. Furthermore, acetylene being an endo-thermic body, it is capable of generating heat from its decomposition or dissociation in the combustion chamber of the torpedo sufficient to render its own gases of decomposition incandescent without oxygen, so that by its use I am enabled to add to the amount of heat generated, while at the same time I lessen the proportion of oxygen in the products of combustion, thereby rendering the gases of the products of combustion more reducing and less oxidizing than they otherwise would be, which is particularly advantageous if the combustion chamber be made of tungsten or an alloy rich in tungsten, or a baffle or enflaming plate of tungsten be employed upon which to play or jet the stream of liquid fuel into the combustion chamber, the high temperature of the tungsten rendering complete, efficient, constant and steady vaporization and inflammation of the liquid fuel. As tungsten at a high temperature is rapidly oxidized and destroyed in an oxidizing flame, the advantage of a reducing flame is obvious when tungsten is employed for the purpose above specified.

The initial vaporization and inflammation is preferably effected either by the employment of a pilot flame of a portion of the material burned in a jet of air or by a pilot igniter made of an explosive material, such as black gunpowder or of a combination of black gunpowder and smokeless powder, or of a smokeless powder like cordite, rich in nitro-glycerin.

After the initial vaporization and inflammation of the liquid fuel is effected, the pilot flame or means of ignition may be discontinued.

The heat evolved or generated by the inflammation or combustion of the self-combustive liquid will be sufficient to maintain at a very high temperature the baffle plate or vaporizing and enflaming plate against which the self-combustive fuel is projected or jetted in the combustion chamber of the torpedo. In the absence of such baffle plate, the heated walls of the chamber of the torpedo will serve the same purpose, the excess of heat in the products of combustion being absorbed by water admitted to the combustion chamber or into the stream of products of combustion in their escape from the combustion chamber, and by being forced by the flame blast through a suitable mixing or atomizing device or means whereby the water is practically instantly evaporated by the absorption of heat from the stream of products of combustion and the steam superheated to any desired temperature, which temperature at present employed is about 1100° F. at the nozzle.

What is claimed is:—

1. A liquid explosive for driving torpedoes consisting of a nitro compound of glycerine holding in solution gum camphor, and a combustible non-explosive material.

2. A liquid explosive for driving torpedoes consisting of a nitro compound of glycerine holding in solution gum camphor, acetylene gas, and a combustible non-explosive material.

3. A liquid explosive for driving torpedoes consisting of a nitro compound of glycerine holding in solution gum camphor, acetylene gas, acetone and a combustible non-explosive material.

In testimony whereof I have signed my name to this specification.

HUDSON MAXIM.