H. MAXIM.

AUTOMOBILE TORPEDO.

APPLICATION FILED OCT. 4, 1899.

937,217.

Patented Oct. 19, 1909.

4 SHEETS—SHEET 1.

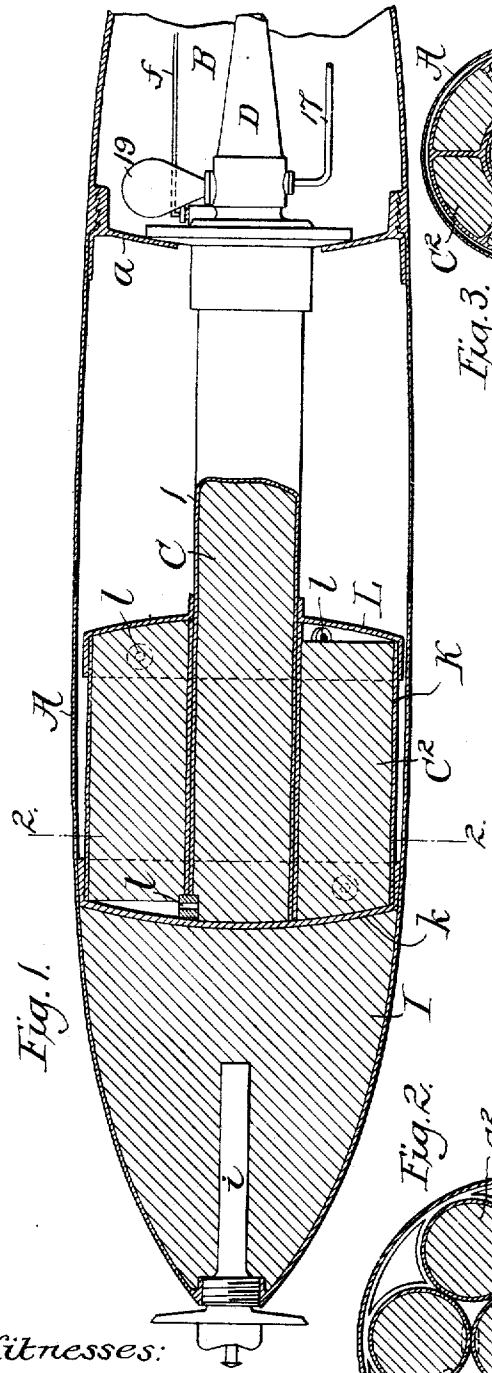

Fig. 1.

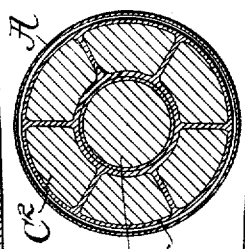

Fig. 3.

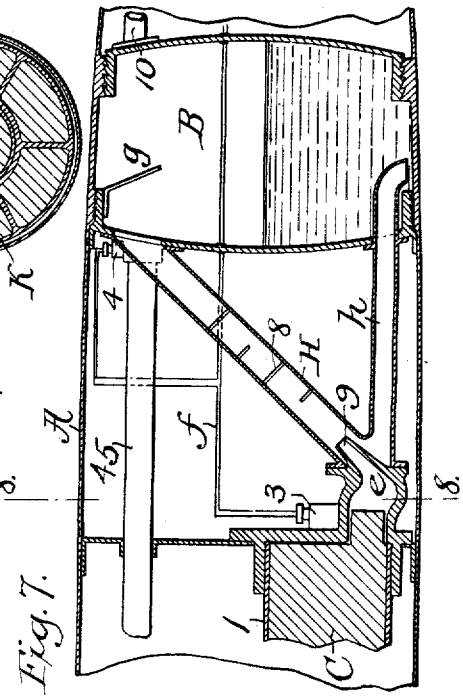

Fig. 7.

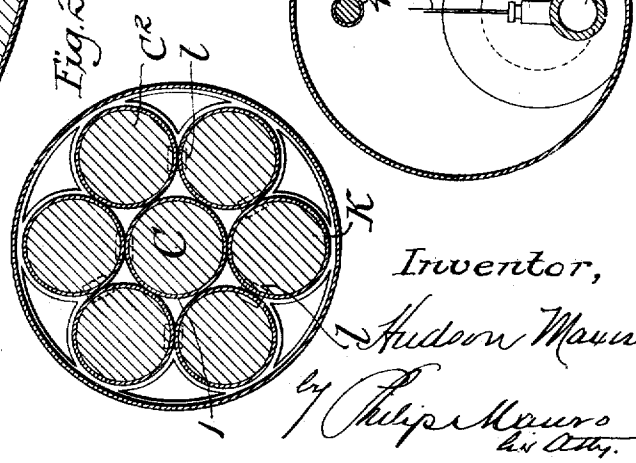

Fig. 2.

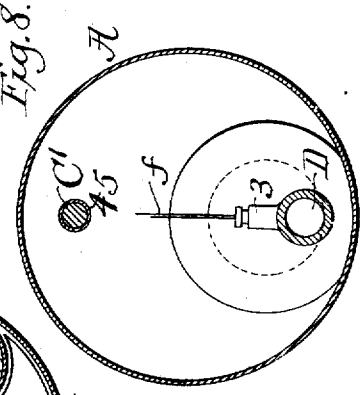

Fig. 8.

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4 SHEETS—SHEET 2.

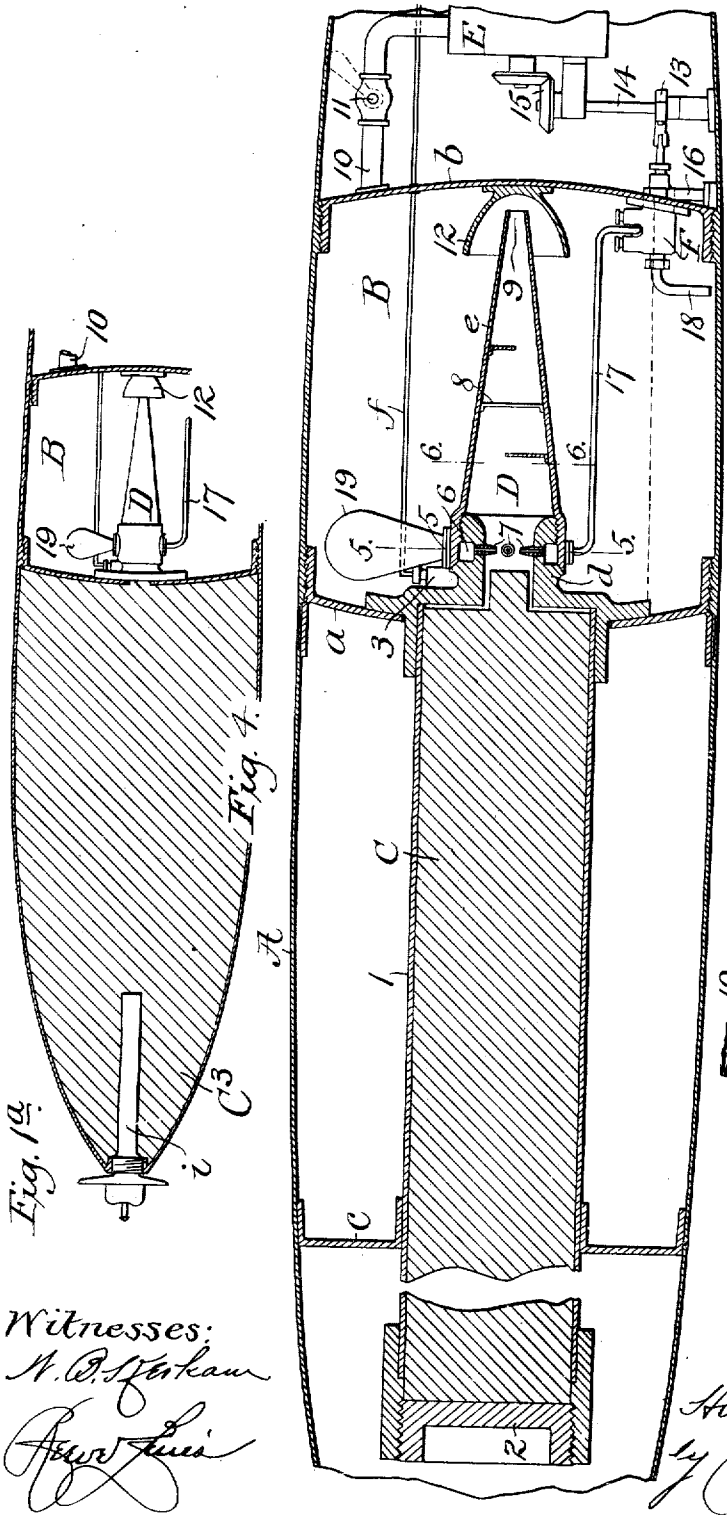


Fig. 1a.

Fig. 4.

Fig. 6.

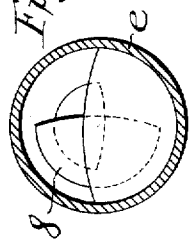
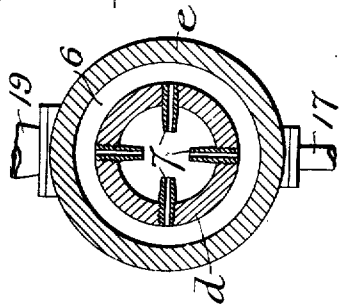


Fig. 5.



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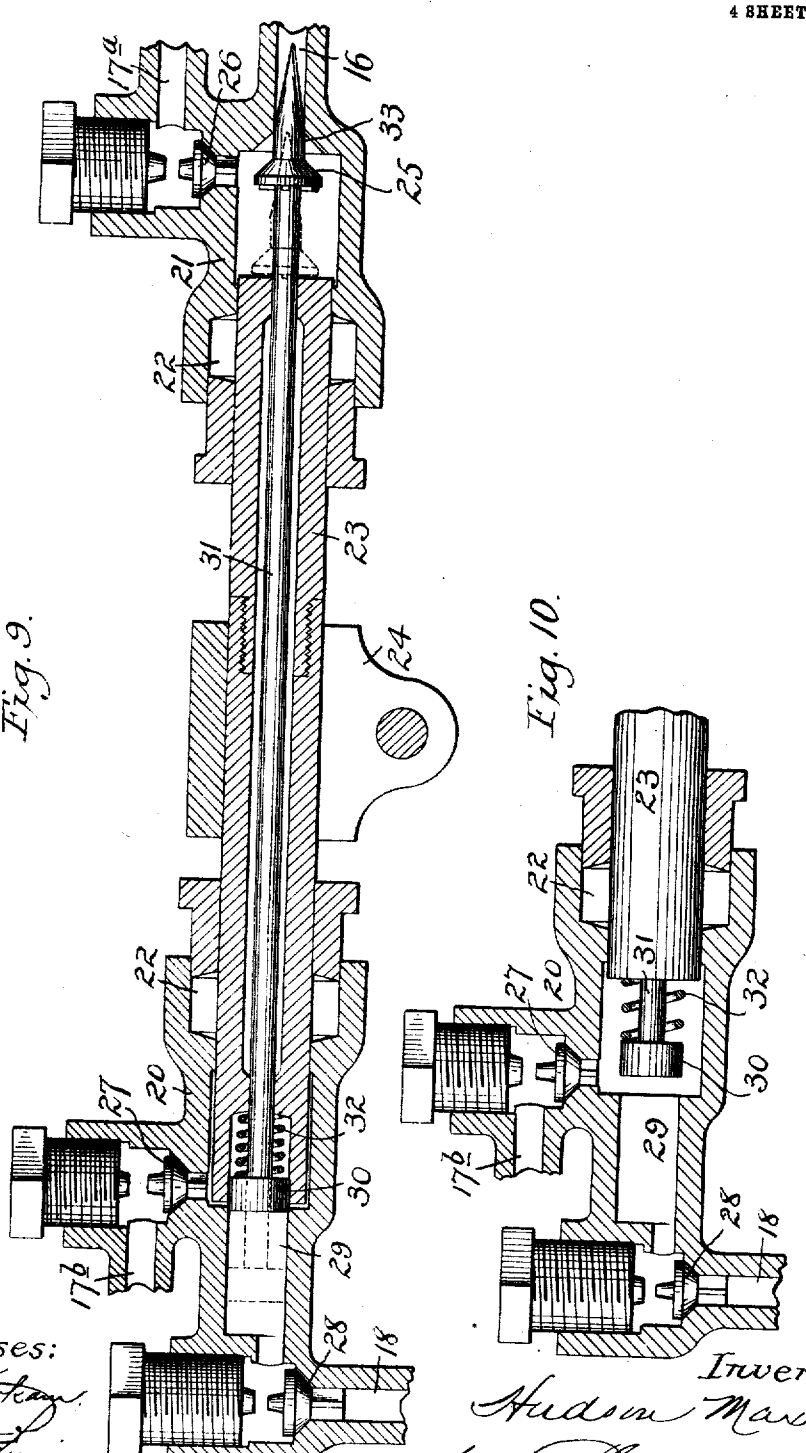
4 SHEETS—SHEET 3.



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AUTOMOBILE TORPEDO.

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937,217. Patented Oct. 19, 1909.

4 SHEETS—SHEET 4.

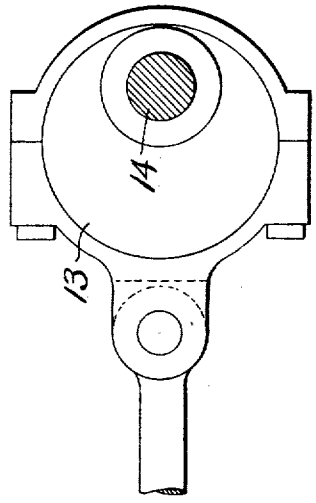


Fig. 11.

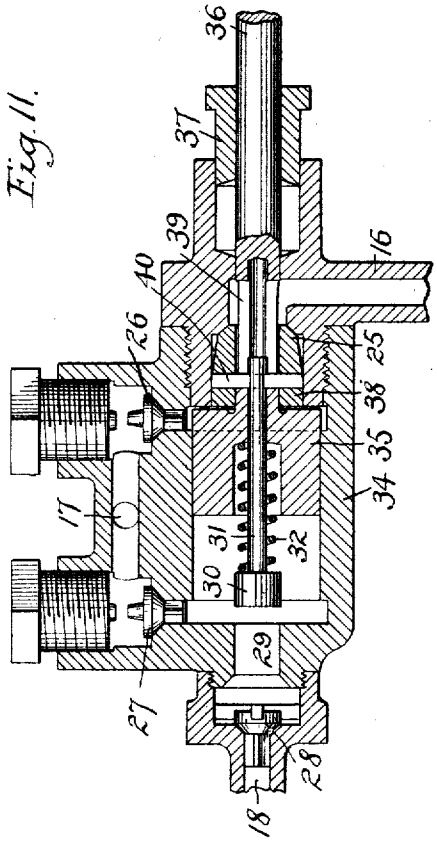
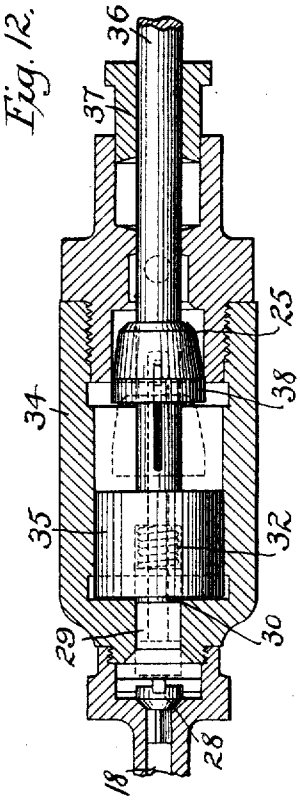


Fig. 12.



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AUTOMOBILE TORPEDO.

937,217. Specification of Letters Patent. Patented Oct. 19, 1909.

Application filed October 4, 1899. Serial No. 732,563.

To all whom it may concern:

Be it known that I, HUDSON MAXIM, a citizen of the United States, resident of 891 Sterling place, Brooklyn, New York, have invented a new and useful Improvement in Automobile Torpedoes, which invention is fully set forth in the following specification.

My invention relates to torpedoes, and more particularly to that class of torpedoes which possess within themselves the means required for their propulsion, and known in the art as automobile torpedoes. Such torpedoes have, heretofore, been constructed with a reservoir for any suitable motive fluid, as compressed air, which fluid is utilized for driving a propeller. In order that such torpedo might have sufficient power stored in the reservoir to drive it at the desired speed or to the required distance, or both, it has heretofore been found necessary to construct the reservoir of such size as to occupy the greater portion of the space within the torpedo, thereby greatly restricting the space and weight to be utilized in carrying the explosive charge. In order to carry an explosive charge of even moderate efficiency, it has been found necessary to considerably encroach upon the space and weight needed for the motive apparatus, thereby greatly lessening the efficiency and accuracy of the torpedo.

The object of the present invention is to construct a torpedo which, within a shell of given proportions, shall be capable of carrying a much larger explosive charge than has heretofore been practicable and also be able to travel at a greater speed and for a greater distance than has heretofore been deemed possible in this class of torpedoes.

With this and other objects which will be hereinafter referred to, the invention consists in the method of producing a motor fluid by burning a body capable of supporting its own combustion and employing the products of combustion to heat a liquid which is simultaneously passed through a chamber with the products of combustion, the unevaporated portion of said liquid being again passed through said chamber where further evaporation takes place and the unevaporated portion of the liquid, with its contained heat, is again circulated through the chamber, and thus continuously to the end that the temperature of the products of combustion is lowered to a point where it will not be injurious to the motor of the torpedo and the heat is utilized for converting the liquid into steam which is mixed with the products of combustion to form the motor fluid.

The form of torpedo employed for practicing the present invention is one having a suitable chamber therein for a body of material capable of supporting its own combustion, and independent of the main explosive charge of the torpedo. Means are provided for igniting and controlling the combustion of this self-combustive body and for cooling the products of combustion and utilizing a portion of the heat thereof for evaporating a liquid, and of utilizing the evaporated liquid, together with the products of combustion for propelling the torpedo through the water. Such a torpedo is described in my application Serial No. 710,192 and my U. S. Patent No. 641,787, dated January 23d 1900.

In practicing the present invention there is provided means for circulating through the evaporating chamber of the torpedo a quantity of water or other liquid in excess of what can be evaporated during the time the liquid is subjected to the heat of the products of combustion under a given pressure, and for again taking up the excess of heated water and again circulating it through the evaporating chamber, and as the supply of water in the circulating apparatus becomes reduced, means are provided for taking in from the surrounding sea such a quantity of water as shall be necessary to supply that being evaporated. By this means it is necessary to carry only a very small quantity of water in the torpedo or even no water at all at the moment of starting the torpedo, thus eliminating a large amount of weight which may be utilized for increasing the propelling means or other suitable purposes.

Another object of the invention is to utilize the unburned self-combustible propelling compound, should there be any re-

maining when the torpedo strikes a target, as an auxiliary explosive body, or in addition to the main explosive charge; and as a further object the explosive charge of the torpedo may be utilized in part by its combustion as the propelling compound or material and the remaining portion be used as the main explosive body is exploded, fired or detonated when the torpedo reaches or strikes the target.

The propelling compound or body of self-combustive material, which may or may not form a part of the main explosive body, may be made of such a character that it may be burned in the manner already described for the production of motive power with perfect safety, and yet be capable of being detonated by the detonation or explosion of the main charge of the torpedo or by independent means. Such a compound may be made of, say, 80 per cent. nitro-glycerin, or thereabout, combined with 20 per cent. or thereabout, of guncotton of a suitable nitration, or of blended guncottons. Such a compound will burn with a greater rapidity under a given pressure, and will produce greater heat than one containing a lower percentage of nitro-glycerin, and I therefore burn this material under a lower pressure. A torpedo employing this modification of my invention, may be so constructed that the main bursting charge may be quietly burned away without explosion after consumption of the propelling charge, provided the torpedo does not strike the target and be thereby exploded. By this means, the torpedo would automatically render itself inert when its run was spent. Furthermore, when striking a target at short range, it is obvious that the main bursting charge would be greatly reinforced by utilization of the unburned remainder of the propelling charge, or that portion of the charge not consumed at the time of reaching or striking the target. The steam produced by the products of combustion by this invention may be freed from any small particles or globules of water, and the steam rendered dry by burning an independent body of self-combustive material and superheating the steam thereby before utilizing the same for driving the torpedo.

In practicing the invention, I preferably employ a pump of suitable construction for effecting the circulation of the water through the evaporating chamber, the pump being so constructed as to take water from the hot well of the circulating apparatus until the supply there becomes lowered so as to require additional water for evaporation, at which time the pump being so constructed, will automatically operate to draw in additional water from the surrounding sea, and just enough to supply the demand or that which is being evaporated in the evaporating chamber, thus automatically obtaining and regulating the supply of water to be evaporated. To effect this, the pump is preferably provided with means for trapping a small quantity of water which operates in such a way as to hold the sea valve closed until the water in the circulating chambers becomes lowered to such an extent that a certain quantity of steam enters the trap with the water, and which, being more compressible than water, allows the sea valve to be slightly opened and a small quantity of sea water to be pumped into the circulating chambers, and as the water in the circulating device becomes lower and lower, the valve is opened more and more, and in due proportion, so that the supply of water to the evaporating chamber when running remains practically constant, and only such an amount of cold water admitted as will be necessary to supply that which is evaporated. It is obvious that by this means a large amount of evaporating surface is presented by the water itself in the evaporation chamber and in its passage through the evaporating device, and that the said surface is proportionate to the rate at which the water is circulated, and that the evaporating chamber and evaporating device may be reduced to a minimum in size because all the heat necessary can be taken from the products of combustion simply by circulating such a quantity of water through and through the device as shall serve to effect the purpose. This is particularly valuable for this form of torpedo where it is desirable to carry as little weight as possible in evaporating devices or surfaces, and where it is desirable to carry as small a supply of water as possible.

The self-combustible compound is located in close proximity to the main explosive charge so as to be also detonated upon the explosion of the latter. The preferable method for carrying out this part of the invention is to place a large portion of the propelling compound, which is the last to be burned, directly in the rear of the main explosive charge. This portion of the compound consists preferably of a plurality of bars of propelling compound, so as to form a mass of explosive material much greater than that part of the main stick of propelling compound which can be readily detonated by the main body, means also being provided for igniting in succession such of the several parallel bars as may be required to continue the propulsion of the torpedo before the main charge is exploded.

Having now generally described the invention, a detail description thereof will be given, reference being had to the accompanying drawings, which illustrate a suitable apparatus for practicing the method which constitutes the invention, in which—

Figure 1 is a longitudinal section of a por-

tion of a torpedo containing apparatus for carrying out the present invention, Fig. 1ª. is a similar section showing a modified form, Fig. 2 is a cross section thereof on the line 2, 2 of Fig. 1. Fig. 3 is a similar section showing a modified form of propelling charge, or self-combustible, Fig. 4 is also a longitudinal section of a portion of a torpedo for practicing the present invention, Fig. 5 is a cross sectional view of the apparatus contained in the torpedo and on a line 5, 5 of Fig. 4. Fig. 6 is a similar section on the line 6, 6 of Fig. 4, Fig. 7 is a longitudinal sectional view of a modified form of an apparatus, Fig. 8 is a cross-section thereof on the line 8, 8 of Fig. 7, Fig. 9 is a longitudinal sectional view of one form of the pump which may be employed, Fig. 10 is a similar view partially in elevation, showing only one barrel of the pump with its operative parts in a different position, Fig. 11 is a longitudinal section of a preferred form of pump which is shown in elevation in Fig. 4, and Fig. 12 is a horizontal longitudinal section of the same form of pump with its operative parts in another position.

Only that part of a dirigible torpedo is shown which is necessary to fully show the apparatus employed in practicing the present invention, it being understood that the main explosive charge, buoyancy chamber, parts of the motor and the like, may be constructed and situated in any suitable manner known in the art. As no fixed motive gas under the great pressure heretofore used need be employed, the casing A is comparatively thin, but of sufficient strength to safely inclose a compressed fluid chamber B, between two transverse bulk heads, *a*, *b*, (see Fig. 4), the said chamber being adapted to support an internal pressure, say from 300 to 500 pounds per square inch. In the preferred form of apparatus, the chamber B, is first charged with air of sufficient pressure, say 300 pounds, to initially operate the motor E, to which it is connected by a conduit 10, controlled by a valve 11, the chamber B and pipe 10 together constituting a conduit leading from the combustion chamber D to the motor E.

The self-combustible material employed for producing the heated products of combustion preferably consists of a nitro-compound, say a mixture of nitro-glycerin and pyroxylin or guncotton in suitable proportions. The compound is formed in the shape of a rod or bar C and placed centrally and longitudinally within a tube 1, extending from the forward bulkhead *a*, toward the forward end of the torpedo, and of such length as to contain sufficient combustible material to be consumed during a given period of time under a given pressure. The tube 1, may be charged with the combustible material at its forward end and sealed or otherwise closed as by a plug 2, and is preferably supported by the bulkhead *a*, and by one or more transverse partitions *c*.

The forward part of the torpedo casing A (see Fig. 1), is occupied by the main explosive charge I, provided with a suitable detonator *i*, and separated from the rear part of the torpedo by a partition *k*, which supports a plurality of circular tubes K, surrounding the central tube 1, carrying the main stick of self-combustible C and containing additional propelling material C^2, thus forming a mass of explosive material situated directly adjacent the main body I. The rear of the tubes K are united and secured to the tube 1 by a head L. The forward end of the tube 1, communicates with one of the tubes K, which communicates at its rear end with another tube and in like manner successively with the remaining tubes. Hence, when the stick C is consumed nearly to the bottom of its container, the flame of combustion is conveyed through an opening to a connected tube K, containing a stick C^2, and in like manner all the sticks C^2 are successively ignited and consumed. The opening between the tubes is preferably filled with a plug *l*, having a small central opening through which the igniting flash may pass and preferably made of self-combustible material which is rapidly consumed to allow free passage of the gases to the central tube 1.

The tubes K may have any suitable shape, but they are preferably placed as close together as possible, and may be made with radial sides so as to lie together in a close mass, in order to promote effective detonation by the main body of explosive (see Fig. 3.)

The modification shown in Fig. 1ª consists in forming the combustible material into a stick, rod, or mass C^3, of the entire width or diameter of the torpedo, and so as to conform to the shape of the interior of the casing. The mass is preferably burned under less pressure than when employing a smaller stick, in order to prevent the production of too great a quantity of gases from the larger burning area of the propelling material in this form. The combustible material may also be formed integrally with the main charge, as shown, so that should this torpedo not strike a target all the explosive material carried by it may be quietly and completely burned and the torpedo become inert.

Referring again to Figs. 1 and 4, the rear end of the tube 1, is held in the end of the combustion chamber or receptacle D, serving to connect the tube to the head *a*, and supporting an igniting device 3, connected with the wires *f*, and preferably constructed and operated as described in my application filed March 23, 1899, and Serial No. 710,192. Directly in front of the consuming end of the

stick of powder and in the path of the products of combustion therefrom, there is constructed a water injecting device, consisting of an annular channel 6, surrounding the combustion chamber and formed by a recess in the two parts *d*, *e*, of the combustion chamber. The channel or manifold communicates directly with a plurality of radial nozzles 7, which project into the combustion chamber for admitting water into the body of the products of combustion.

The rear part of the combustion chamber D, contains a device for mixing and thoroughly intermingling the gases and water, consisting of a plurality, say three, of successive transverse obstructions or blades 8, extending partially across the chamber and placed in alternating or in different positions circumferentially with respect to each other. After the hot gases have evaporated a portion of the water in the chamber *e*, they are ejected with the accompanying unevaporated water out of the nozzle 9, and deflected by a concave plate 12, backward into the chamber B, where the unevaporated water collects at the bottom and the gases of combustion and the steam pass through the conduit 10, to operate the motor E.

Upon the initial operation of the motor by the compressed air from the chamber B, the pump F, is actuated by an eccentric 13, upon a vertical shaft 14, which is revolved by any suitable power, preferably by the motor E, through a pair of beveled gears 15. Providing there is no liquid in the bottom of the chamber B, the pump will draw sea water through the pipe 16, open to the exterior of the torpedo and force the liquid through the conduit 17, into the manifold 6, already described. However, should there be water in the chamber B, either placed there before the operation of the machine or accumulated from the unevaporated water passing from the mixing chamber *e*, the pump will operate so as to partially or wholly stop the supply of water from the sea and to draw the supply of water for the combustion chamber from the chamber B, through the downwardly extending orifice or pipe 18. As soon as the water in the chamber B falls below the orifice of the pipe 18, and is nearly or wholly drawn from the chamber, the pump will then draw water from the sea as before described.

An air chamber or bulb 19, for moderating the intermittent action of the pump is carried by the combustion chamber and placed in communication with the manifold 5.

The structure of one form of pump, shown in Fig. 9, consists of two barrels 20, 21 separated a distance apart and each provided with stuffing boxes 22, and operated by a single plunger 23, which may be attached to a source of mechanical power by means of the collar 24. The barrel 21 is provided with an inlet non-return valve 25, controlling the pipe 16, communicating with the sea, and with an outlet non-return valve 26, in the pipe 17^a, communicating with the manifold. The other barrel 20, is also provided with an outlet non-return valve 27, controlling the pipe 17^b, which leads to the manifold, and is also provided with an inlet non-return valve 28, communicating with the hot well or chamber B, on the one hand, and on the other hand with a contracted portion of the barrel 20 or a trap 29, extending rearwardly from the main barrel and adapted to receive a piston 30, which is attached to a rod or spindle 31, extending longitudinally through the main plunger and carrying on its other end the sea inlet valve 25. The piston is also adapted to enter a recess in the end of the conduit and is provided with a spring 32, tending to keep the piston in its rearward position as shown in Fig. 10, and to also keep the sea valve in a position with respect to the plunger shown in dotted line in Fig. 9.

The operation of the pump is as follows: On the reciprocation of the plunger the sea valve is caused to open both by the motion of the plunger and the pressure of the sea water. The water enters and is then forced by the backward stroke of the plunger through the outlet valve 26, to the manifold, it being seen that the valve 25 is returned to its seat by the pressure in the chamber B, operating through the valve 28 on the rod 31. This operation of the pump in the barrel 21 continues while the chamber B is empty of water, but when the unevaporated liquid from the mixing chamber *e*, collects in the bottom of the steam chamber and above the orifice of the pipe 18, the water is drawn into the trap 29, and the barrel 20. Upon the return stroke of the plunger the piston 30 barely enters the opening of the trap barrel, owing to the water contained therein, but the plunger continues its rearward stroke against the spring and forces the liquid in the main barrel past the valve 27, to the combustion chamber. As the piston is checked in its rearward movement the sea valve is not completely opened (see the position of parts shown in Fig. 9), owing to an extension 33, on the said valve, having a tapering end, which closely fits the pipe 16, and is of sufficient length and contour to open the said pipe only when the piston enters the trap 29 and gradually to a degree depending upon amount of water in the said trap. It will be seen that when no water is in the chamber B, the barrel 21, serves merely to pump gas to the combustion chamber which has no effect on the normal operation of the sea valve, owing to it being compressed in the trap 29 on the return stroke of the piston.

The preferred form of pump shown in Figs. 11 and 12, consists of a single barrel

34, containing a piston 35, upon the end of a piston rod 36, which passes through a stuffing box 37. The pump is provided with an inlet valve 28, situated in the steam chamber pipe 18, with a trap 29, in communication with the said valve and with a piston 30, controlled by a spring 32, and carried by a spindle 31, which extends through the main piston into a recess in the piston rod 36, on the other side thereof. In this instance the spindle is attached to the sea valve 25, by means of a transverse pin or cotter 40, extending through slots 39, formed in the piston rod. The extension 33, of the pump shown in Fig. 9 is replaced in the preferred form by a similar extension 38, surrounding the piston rod and carried on the inner side of the valve which is made integral with the said extension and also surrounds the piston rod. Outlet valves 26, and 27, are also provided in communication on one side respectively with each side of the main piston 35, and on the other side with the combustion chamber by means of the pipe 17. The operation of this form of pump is similar to that shown in Fig. 9, and may be readily understood by referring both to Figs. 11 and 12, which illustrates the operating parts respectively in different positions.

One feature of my invention consists in providing a neutralizer for the corrosive acid fumes in the products of combustion and for the acid set free by the action of said fumes upon the salts of the sea water which is drawn in to be evaporated. In accomplishing this part of the invention the initial charge of air in the chamber B may contain a suitable quantity of ammonia gas, or the chamber may contain an aqueous solution of a neutralizing substance, such as urea, ammonia gas, carbonate of ammonia, or other suitable alkalies. This solution is injected in the products of combustion through the pipe 18, and by the pump in a manner already described.

In operating the torpedo the valve 11 is first opened, the motor E, then begins to operate, owing to the compressed charge of air in the chamber B, the rod of powder is then ignited by the device 3, already mentioned and the pump simultaneously begins to force sea water into the combustion chamber, which is partially evaporated and thoroughly mixed with the gases of combustion in the chamber *e*, from whence it issues to the steam chamber B, ready to pass through the conduit 10, to the motor. While the water, steam and gases are momentarily in the chamber B, the unevaporated water falls to the bottom and is again forced to the combustion chamber to be evaporated. While the operation is thus proceeding the pump automatically and continuously or from time to time, as needed, forces additional sea water to replace that already evaporated, maintaining, however, an excess of water in the combustion chamber for the purpose already described.

In Figs. 7 and 8 is shown an apparatus for practicing the invention in which the pump is dispensed with and the steam chamber B made to contain sufficient water to carry out the operation of the propelling means. The required circulation of excess of water is attained by employing the orifice 9, of the combustion chamber *e*, as an injector to which water is supplied from the chamber B, through a conduit *h*, without force other than gravity and the pressure within the said chamber. The injected water is forced up the inclined mixing conduit H, provided with the obstructing blades 8, and opening into the chamber B opposite the deflector *g*. By this construction the water may be circulated in sufficient excess for the required purpose and until the water level in the chamber falls below the opening into the conduit *h*. In this case the stick C, and nozzle 9, are situated near the bottom of the torpedo casing so that the water from the chamber B may be lifted through the conduit *h* directly and more effectively by the force of the gases issuing from the nozzle.

Preferably a stick of self-combustible material C′ employed to superheat the steam in the chamber B, is contained in a tube 45 communicating with the said chamber and situated above the main stick C, (see Figs. 7 and 8). It is ignited by a device 4, similar to that already mentioned and connected to an electric generator by wires *f*.

The apparatus herein shown and described is not claimed in this application, since the same will form the subject-matter of a separate application.

What is claimed is:—

1. The herein described process of evaporating a liquid and the production of a motive fluid, which consists in burning a body capable of supporting its own combustion, passing the products of combustion through a chamber, and passing a liquid through said chamber to heat the liquid and then again passing the unevaporated portion of the heated liquid through the same chamber.

2. The herein described process of producing a motive fluid, which consists in circulating products of combustion and a liquid through a chamber, evaporating a portion of the liquid and again passing the unevaporated liquid through the same chamber, to evaporate a further portion of the liquid.

3. The herein described process of producing a motive fluid for driving a torpedo, which consists in passing products of combustion of a self-combustive nitro-compound through a chamber and simultaneously passing through the said chamber a quantity of

water in excess of that capable of being evaporated by the heat of the products of combustion, and then again passing through the evaporating chamber the unevaporated liquid.

4. The herein described process of producing a motive fluid for the propulsion of automobile torpedoes, which consists in passing products of combustion of a self-combustive compound through a chamber, circulating water through the chamber to evaporate the water, and supplying water from the surrounding sea as fast as evaporated.

5. The herein described process for producing a motive fluid, consisting in burning a combustible body, passing an excess of water into the hot products of combustion, withdrawing the unevaporated water, and again passing the unevaporated water into the products of combustion.

6. The herein described process for producing a motive fluid, consisting in burning a combustible body, passing an excess of water into the hot products of combustion, circulating the unevaporated water through the products of combustion and supplying additional water to replace the evaporated water.

7. The herein described process of producing a motive fluid, for propelling a torpedo, which consists in evaporating water and then superheating the steam with the heat of the products of combustion of a body capable of supporting its own combustion and independently of the means for evaporating the water.

8. The herein described process of producing a motive fluid for driving a torpedo, which consists in evaporating water by the heat of the products of combustion of a body capable of supporting its own combustion and superheating the steam by the products of combustion of another such body.

9. The herein described process of producing a motive fluid and propelling a torpedo, which consists in burning a portion of the explosive charge of the torpedo for the production of motive power, and then detonating the unburned portion of the charge upon the striking of the torpedo upon the target.

10. The herein described process for producing a motor fluid for driving a torpedo, consisting in burning a self-combustible nitro-compound, evaporating sea water in the products of combustion of the said compound and supplying a neutralizer to the said gases and evaporated sea water to neutralize the acid produced by the reaction of the combustion gases upon the salt contained in the sea water.

11. The herein described process of producing a motor fluid which consists in burning a suitable self-combustible explosive and thereby creating a flame blast and then feeding a liquid into the path of the flame blast, whereby the flame blast acts to spray the liquid and the liquid absorbs heat from and reduces the temperature of the flame and the gases of combustion.

12. The herein described process of producing a motor fluid which consists in burning a self-combustible nitro-compound explosive and thereby creating a flame blast, and then feeding water into the path of the flame blast, whereby the flame blast acts to spray the water and the water acts to absorb heat from and reduce the temperature of the flame and the gases of combustion.

13. The herein described process of producing a motor fluid which consists in burning a suitable self-combustible explosive in a combustion chamber and feeding water into said chamber whereby the water is converted into steam the temperature of the gases lowered and said steam and gases mixed to form a motor fluid.

14. The process of producing motor fluid which consists in burning a self-combustible body, injecting a liquid into the path of the products of combustion whereby the products of combustion and the evaporated portion of said liquid are mixed to form a motor fluid, and then utilizing said motor fluid to inject the unevaporated portions of said liquid again into the path of the products of combustion.

15. The method of forming a motor fluid which consists in burning a self-combustible compound, passing the products of combustion through a manifold together with a liquid whereby a portion of said liquid is evaporated, utilizing the mixed products of combustion and the vapors of the liquid to operate a pump for again injecting the unevaporated portions of said liquid into the chamber where they are mixed with further products of combustion.

16. The process of forming a motor fluid which consists in burning a self-combustible body, pumping sea-water into the path of the products of combustion said water having been previously supplied with a neutralizer for the corrosive acid fumes in the products of combustion.

17. The method of producing motor fluid which consists in burning a self-combustible in a closed chamber, mixing the vapors of a liquid with said products of combustion and utilizing the power of the fluid thus obtained to continuously circulate the liquid through a mixing chamber with subsequent products of combustion.

18. The process which consists in burning a nitro-compound in a tube with its outlet arranged near an injector, directing sea water through said injector into the path of the said products, then carrying the products

of combustion and the vaporized water into a mixing chamber having baffle-plates or other mixing means whereby the said products and vapor are thoroughly mixed or commingled.

19. The combination with a torpedo, of a motor of the internal combustion type, receptacle means for fuel, a combustion chamber and means for introducing fluid from the immersing medium to the combustion chamber to augment the volume of working fluid obtained by the combustion of said fuel.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

HUDSON MAXIM.

Witnesses:
WILLIAM O. GANTZ,
WILLIAM C. MAXIM.