TORPEDOES AND TORPEDO WARFARE

[ILLUSTRATED]

BY

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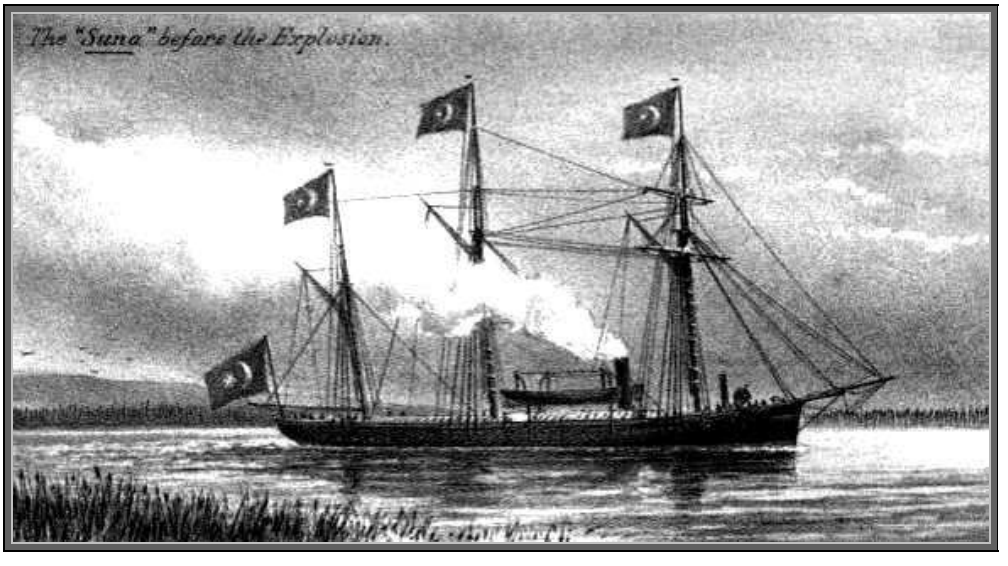
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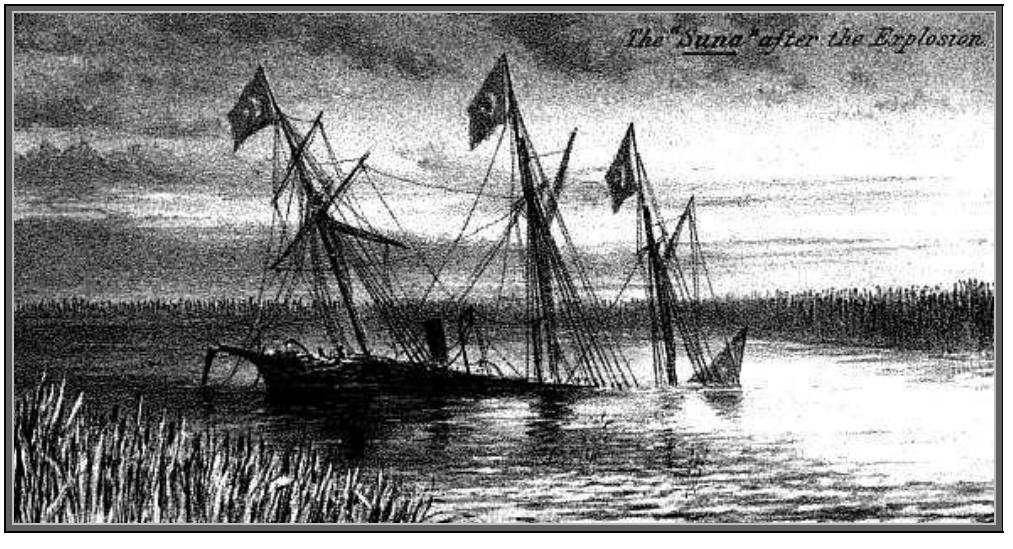
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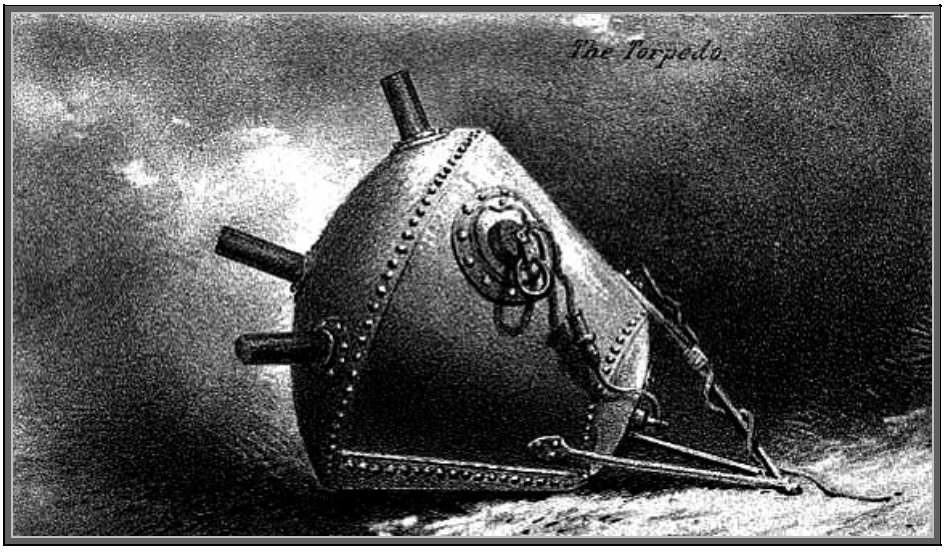
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THE earliest record we have of the employment of an infernal machine at all resembling the torpedo of the present day, was in 1585 at the siege of Antwerp. Here by means of certain small vessels, drifted down the stream, in each of which was placed a magazine of gunpowder, to be fired either by a trigger, or a combination of levers and clockwork, an Italian engineer, Lambelli, succeeded in demolishing a bridge that the enemy had formed over the Scheldt.

(Early History of the Torpedoes)







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TORPEDOES AND TORPEDO WARFARE:

CONTAINING A COMPLETE AND CONCISE ACCOUNT OF THE RISE AND PROGRESS OF SUBMARINE WARFARE;

ALSO A DETAILED DESCRIPTION OF ALL MATTERS APPERTAINING THERETO, INCLUDING THE LATEST IMPROVEMENTS.

BY

C. W. SLEEMAN, ES., LATE LIEUT. R.N., AND LATE COMMANDER IMPERIAL OTTOMAN NAVY.

WITH FIFTY-SEVEN FULL-PAGE ILLUSTRATIONS, DIAGRAMS, WOODCUTS, &C.

Preface

In the following pages the Author has endeavoured to supply a want, viz. a comprehensive work on Torpedo Warfare, brought down to the latest date.

The information has been obtained while practically engaged in torpedo work at home and abroad, and from the study of the principal books which have already appeared on the subject, and to the authors of which he would now beg to express his acknowledgments, viz.: "Submarine Warfare," by Lieut.-Commander Barnes, U.S.N.; "Notes on Torpedoes," by Major Stotherd, R.E.; "Art of War in Europe," by General Delafield, U.S.A.; "Life of Fulton," by C. D. Colden; "Torpedo War," by R. Fulton; "Armsmear," by H. Barnard; "Treatise on Coast Defence," by Colonel Von Scheliha; Professional Papers of the Royal Engineers; "The Engineering"; "The Engineer"; "Scientific American"; "Iron"; &c., &c.

The Author is also desirous of thanking the following gentlemen, to whom he is indebted for much of the valuable information contained herein:—

London, 1879.

Chapter I: The Early History of the Torpedo — Remarks On the Existing State of Torpedo Warfare

THE earliest record we have of the employment of an infernal machine at all resembling the torpedo of the present day, was in 1585 at the siege of Antwerp. Here by means of certain small vessels, drifted down the stream, in each of which was placed a magazine of gunpowder, to be fired either by a trigger, or a combination of levers and clockwork, an Italian engineer, Lambelli, succeeded in demolishing a bridge that the enemy had formed over the Scheldt.

So successful was this first attempt, and so tremendous was the effect produced on the spectators, by the explosion of one of these torpedoes, that further investigation of this new mode of Naval warfare was at once instituted.

But it was not until some two hundred years after that any real progress was effected, though numerous attempts were made during this period, to destroy vessels by means of sub-marine infernal machines.

It was owing to the fact, that the condition which is now considered as essential in torpedo warfare, viz., that the charge must be submerged, was then entirely ignored, that so long a standstill occurred in this new art of making war.

Captain Bushnell, the Inventor of Torpedoes.—To Captain David Bushnell, of Connecticut, in 1775, is most certainly due the credit of inventing torpedoes, or as he termed them submarine magazines. For he first proved practically that a charge of gunpowder could be fired under water, which is incontestably the essence of submarine warfare.

Submarine Boat.—To Captain Bushnell is also due the credit of first devizing a submarine boat for the purpose of conveying his magazines to the bottom of hostile ships and there exploding them.

Drifting Torpedoes.—Another plan of his for destroying vessels, was that of connecting two of his infernal machines together by means of a line, and throwing them into the water, allowing the current to carry them across the bows of the attacked ship.

Mode of Ignition.—The ignition of his magazines was generally effected by means of clockwork, which, when set in motion, would run for some time before exploding the machines, thus enabling the operators to get clear of the explosion.

Captain Bushnell's few attempts to destroy our ships off the American coast in 1776 and 1777, with his submarine boat, and his drifting torpedoes were all attended with failure, a result generally experienced, where new inventions are for the first time subjected to the test of actual service.

Robert Fulton.—Robert Fulton, an American, following in his footsteps, some twenty years after, revived the subject of submarine warfare, which during that interval seems to have been entirely forgotten.

A resident in France, in 1797, he is found during that year making various experiments on the Seine with a machine which he had constructed, and by which he designed "to impart to carcasses of gunpowder a progressive motion under water, to a certain point, and there explode them."[A]

Fulton's Failures.—Though these first essays of his resulted in failure, Fulton thoroughly believed in the efficacy of his schemes, and we find him, during that and succeeding years, vainly importunating the French and Dutch Governments, to grant him aid and support in carrying out experiments with his new inventions, whereby he might perfect them, and thus ensure to whichever government acceded to his views, the total destruction of their enemy's fleets.

Bonaparte aids Fulton.—Though holding out such favourable terms, it was not until 1800, when Bonaparte became First Consul, that Fulton's solicitations were successful, and that money was granted him to carry out a series of experiments.

In the following year (1801), under Bonaparte's immediate patronage, Fulton carried out various and numerous experiments in the harbour of Brest, principally with a submarine boat devised by him (named the *Nautilus*), subsequently to his invention of submarine carcasses as a means of approaching a ship and fixing one of his infernal machines beneath her, unbeknown to the crew of the attacked ship.

First Vessel destroyed by Torpedoes.—In August, 1801, Fulton completely destroyed a small vessel in Brest harbour by means of one of his submarine bombs, then called by him for the first time, torpedoes, containing some twenty pounds of gunpowder. This is the first vessel known to have been sunk by a submarine mine.

Bonaparte's patronage withdrawn.—Notwithstanding the apparent success, and enormous power of Fulton's projects, on account of a failure on his part to destroy one of the English Channel fleet, at the end of 1801, Bonaparte at once withdrew his support and aid.

Disgusted with this treatment, and having been previously pressed by some of England's most influential men, to bring his projects to that country, so that the English might reap the benefit of his wonderful schemes, Fulton left France, and arrived in London, in May, 1804.

Pitt supports Fulton.—Mr. Pitt, then Prime Minister, was much struck with Fulton's various schemes of submarine warfare, and after examining one of his infernal machines, or torpedoes, exclaimed, "that if introduced into practice, it could not fail to annihilate all military marines."[B]

Though having secured the approval of Mr. Pitt, and a few other members of the Government, he was quite unable to induce the English to accept his schemes in toto, and at once employ them in the Naval service.

Twice Fulton attempted to destroy French men-of-war, lying in the harbour of Boulogne, by means of his drifting torpedoes, but each time he failed, owing as he then explained, and which afterwards proved to be the case, to the simple

mistake of having made his machines specifically heavier than water, thus preventing the current from carrying them under a vessel's bottom.

Destruction of the "Dorothea."—Though in each of the above-mentioned attempts Fulton succeeded in exploding his machines, and though on the 15th October, 1805, in the presence of a numerous company of Naval and other scientific men, he completely demolished a stout brig, the *Dorothea*, off Walmer Castle, by means of his drifting torpedoes, similar to those employed by him at Boulogne, but considerably improved, still the English Government refused to have anything further to do with him or his schemes.

England, at that time, being mistress of the seas, it was clearly her interest to make the world believe that Fulton's schemes were impracticable and absurd.

Earl St. Vincent, in a conversation with Fulton, told him in very strong language, "that Pitt was a fool for encouraging a mode of warfare, which, if successful, would wrest the trident from those who then claimed to bear it, as the sceptre of supremacy on the ocean."[C]

Wearied with incessant applications and neglect, and with failures, not with his inventions, but in inducing governments to accept them, he left England in 1806, and returned to his native country.

Application to Congress for Help.—Arrived there, he lost no time in solicitating aid from Congress to enable him to carry out experiments with his torpedoes and submarine boats, practice alone in his opinion being necessary to develop the extraordinary powers of his invention, as an auxiliary to harbour defence.

By incessant applications to his government, and by circulating his torpedo book[D] among the members, in which he had given detailed accounts of all his previous experiments in France and England, and elaborate plans for rendering American harbours, etc., invulnerable to British attack, a Commission was appointed to inquire into and practically test the value of these schemes.

They were as follows:—

1.—*Drifting Torpedoes.*—Two torpedoes connected by a line floated in the tide at a certain depth, and suffered to drift across the bows of the vessel to be attacked; the coupling line being arrested by the ship's cable would cause the torpedoes to be forced under her bottom; this plan is represented and will be readily understood by Fig. 3.

2.—*Harpoon Torpedo.*—A torpedo attached to one end of a line, the other part to a harpoon, which was to be fired into the bows of the doomed vessel from a piece of ordnance mounted in the bows of a boat, specially constructed for the purpose; the line being fixed to the vessel by the harpoon, the current, if the vessel were at anchor, or her progress if underweigh, would carry the torpedo under her bottom. Fig. 2 represents this type of Fulton's submarine infernal machine.

3.—*Spar Torpedo.*—A torpedo attached to a spar suspended by a swivel from the bowsprit of a torpedo boat, so nearly balanced, that a man could easily depress, or elevate the torpedo with one hand, whilst with the other he pulled a trigger and exploded it.

4.—*Block Ship.*—Block ships, that is vessels from 50 to 100 tons, constructed with sides impervious to cannon shot, and decks made impenetrable to musket shot. A spar torpedo *a, a, a*, to be carried on each bow and quarter Fig. 4 represents this curious craft.

Stationary Mines.—Stationary buoyant torpedoes for harbour defence, to be fired by means of levers attached to triggers. This kind of mine is shown Fig. 1.

5.—*Cable Cutters.*—Cable cutters, that is submarine guns discharging a sharp piece of iron in the shape of a crescent, with sufficient force to cut through ship's cables, or other obstructions.[E]

Practical Experiments.—Various and exhaustive experiments were carried out in the presence of the Commissioners, tending generally to impress them with a favourable view of Fulton's many projects.

As a final test, the sloop *Argus* was ordered, under the superintendence of Commodore Rodgers, to whom Fulton had previously explained his mode of

attack, to be prepared to repel all attempts made against her by Fulton, with his torpedoes.

Defence of the "Argus."—Though repeated attempts were made, none were successful, owing to the energetic, though somewhat exaggerated manner in which the defence of the sloop had been carried out. She was surrounded by numerous spars lashed together, nets down to the ground, grappling irons, heavy pieces of metal suspended from the yard arms ready to be dropped into any boat that came beneath them, scythes fitted to long spars for the purpose of mowing off the heads of any who might be rash enough to get within range of them.

As Robert Fulton very justly remarked, "a system, then only in its infancy, which compelled a hostile vessel to guard herself by such extraordinary means could not fail of becoming a most important mode of warfare."

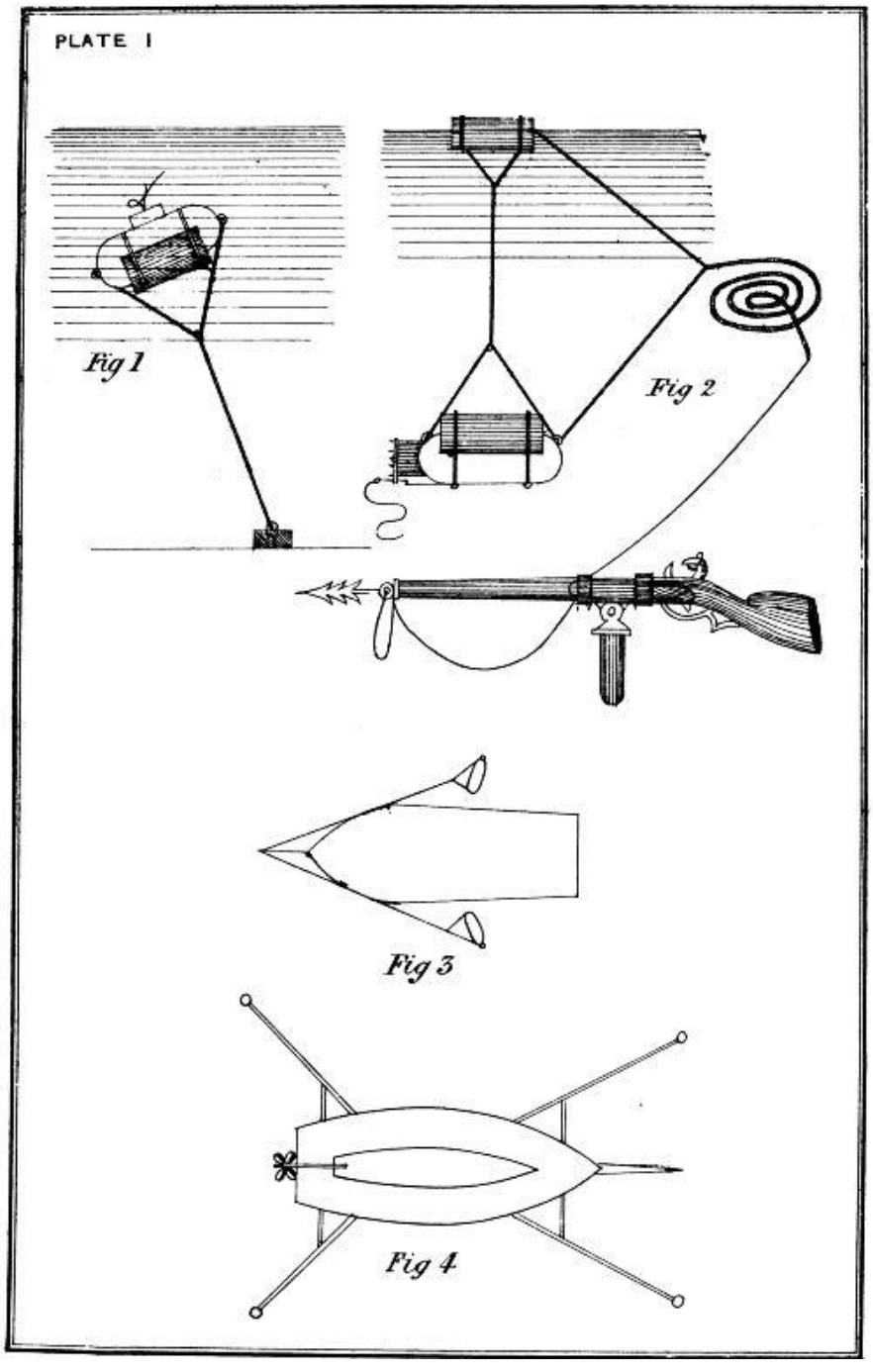
Three of the Commissioners reported as favourably as could be expected, considering its infancy, on the practical value of Fulton's scheme of torpedo warfare.

Congress refuse aid.—But on the strength of Commodore Rodgers's report, which was as unfair and prejudiced, as the others were fair and unprejudiced, Congress refused Fulton any further aid, or to countenance any further experiments that he might still feel inclined to prosecute.

Though undeterred by this fresh instance of neglect, and still having a firm belief in the efficacy of his various torpedo projects, yet other important matters connected with the improvement of the steam engine occupied his whole time and prevented him from making any further experiments with his submarine inventions.

Mode of Firing, 1829.—Up to 1829, that is to say for nearly sixty years after the invention of torpedoes, mechanical means only were employed to effect the ignition of the torpedo charges, such as levers, clockwork, and triggers pulled by hand; with such crude means of exploding them, it is not extraordinary to find, that all the attempts made to destroy hostile ships, resulted in failure.

Fulton's Torpedoes



Briefly reviewing the history of the torpedo during its first period of existence, viz., from Captain Bushnell's invention of submarine magazines in 1775, down to the introduction of electricity, as a means of exploding submarine mines, by Colonel Colt, in 1829, we find that due to the unwearied exertions, and numerous experiments carried out by Captain Bushnell, Mr. R. Fulton and others, the following very important principles in the art of torpedo warfare were fully proved:—

1.—That a charge of gunpowder could be exploded under water.

2.—That any vessel could be sunk by a torpedo, provided only the charge were large enough.

3.—That it was possible to construct a boat which could be navigated, and remain for several hours under water, without detriment to her crew.

4.—That a ship at anchor could be destroyed, by means of drifting torpedoes, or by a submarine or ordinary boat, armed with a spar torpedo.

5.—That a vessel underweigh could be destroyed by means of stationary submarine mines, and by the harpoon torpedo.

These principles, which at the time were fully admitted, laid the foundations of the systems of torpedo warfare, that are at the present day in vogue, all over the world.

Second Epoch.—The second epoch in the life of the torpedo dates from 1829, when Colonel Colt, then a mere lad, commenced experiments with his submarine battery.

Colt's Experiments.—His first public essay, was on the 4th June, 1842, when he exploded a case of powder in New York harbour, while himself standing at a great distance off.

Having by numerous successful experiments satisfactorily proved that vessels at anchor could be sunk by means of his electrical mines, Colonel Colt engaged to destroy a vessel underweigh by similar means, which feat he successfully accomplished on 13th April, 1844.

Colt's Electric Cable.—The electric cable as used by Colonel Colt, was insulated by cotton yarn, soaked in a solution of asphaltum and beeswax, and the whole enclosed in a metal case.

Colt's Reflector.—On examining Colt's papers after his death, one was found illustrating one of his many devices for effecting the explosion of a submarine mine at the proper instant.

Description of Reflector.—One set of conducting wires from all the mines is permanently attached to a single pole of a very powerful firing battery, the other wires lead to metal points which are attached to marks on a chart of the channel in front of the operator and which marks correspond with the actual positions of the mines in the channel. A reflector, is arranged to throw the image of a hostile vessel on the chart, and as this image passes over either of the wire terminations on it, the operator with the other battery wire, completes the circuit, and explodes the torpedo, over which by her image thrown on the chart, the vessel is supposed to be at that precise moment.[F] In his experiment with a vessel under weigh, Colt had probably taken the precaution of laying down several circles of mines, and thus aided by cross staffs, ensured the experiment being a success.

With regard to the invention of the word torpedo, for submarine infernal machines, Dr. Barnard in his life of Colt says, "that Fulton used the word torpedo, probably on account of its power of stunning or making torpid, and that a long way through the water,—in so naming it, he buildeth better than he knew, for Colt's torpedoes being fired by electricity may with special fitness take its name from the electric eel."[G]

Theoretical Knowledge.—Though many opportunities have occurred during the last thirty-five years for practically testing the effectiveness of torpedoes when employed on actual service, especially during the American Civil War (1861-65) and the late Turco-Russian War (1877-78), yet in so far as the offensive and electrical portion of submarine warfare is concerned, our knowledge of them is still principally theoretically.

Failure of Offensive Torpedoes.—The manipulation of the ordinary spar or outrigger torpedo boats, and of the various automatic torpedoes, appears simple enough, when practice is made with those submarine weapons during peace time, also the results of such practice is without doubt uniformly successful, yet when the crucial test of actual service is applied, as was the case during the war of 1877, with the Whitehead and spar torpedoes, then a succession of failures had to be recorded.[H]

The cause of this want of success in war-time with offensive torpedoes, lies in the fact, that during peace time the experiments and practice carried out with them, are done so, under the most favourable circumstances, that is to say in daylight, and the nerves of the operators not in that high state of tension, which would be the case, were they attacking a man-of-war on a pitch dark night, whose exact position cannot be known, and from whose guns at any moment a sheet of fire may be belched forth, and a storm of shot and bullets be poured on them, whilst on actual service, this would in nine out of ten instances be the case.

Some uncertainty must and will always exist in offensive torpedo operations when carried out in actual war, where, as in this case, the success of the enterprise depends almost wholly on the state of a man's nerves, yet this defect, a want of certainty, may to a considerable extent be eradicated were means to be found of carrying out in time of peace, a systematic practice of this branch of torpedo warfare, under circumstances similar to those experienced in war time, and this is not only possible, but practicable.

Moral Effect of Torpedoes.—We now come to the moral effect of torpedoes, which is undoubtedly the very essence of the vast power of these terrible engines of war. Each successive war that has occurred, in which the torpedo has taken a part, since Captain Bushnell's futile attempt in 1775 to destroy our fleet by drifting numerous kegs charged with gunpowder down the Delawarre, teem with proofs of the great worth of torpedoes in this respect alone.

That such a dread of them should and always will be met with in future Naval wars, at times creating a regular torpedo scare or funk, is not

extraordinary, when it is remembered that these submarine weapons of the present day, are capable of sinking the finest ironclad afloat, and of launching into eternity without a moment's warning or preparation, whole ships' crews.

The torpedoes existing at the present day have, without doubt, reached a very high degree of excellence, in so far as their construction, fuzes, cables, &c., both electrically and mechanically, is concerned, but much has yet to be done to develop their actual effectiveness.

The result of the numerous and exhaustive experiments that have of late years been carried out by England, America, and Europe prove that the necessary distances between stationary submarine mines are by far greater than those within which the explosions are effective.

Therefore it will be found necessary to supplement those submarine harbour defences, by automatic torpedoes that can be controlled and directed from the shore, as well as by specially constructed torpedo boats.

Automatic Arrangements.—And to ensure certainty, which is the desideratum in torpedo warfare, circuit closers, or other automatic arrangements for exploding the submarine mines, must be employed, as the system of firing them by judgment is not at all a sure one.

Ship Defence.—The problem, which occupies the attention of Naval and other scientific men, at the present day, is how best to enable a ship to guard herself against attacks from the fish and other automatic torpedoes, and this without in any way impairing her efficiency as a man-of-war.

The means of such defence, should most certainly be inherent in the vessel herself, outward methods, such as nets, booms, etc., are to great extent impracticable, besides one of the above mentioned torpedoes, being caught by such obstructions would, on exploding, most probably destroy them, thus leaving the vessel undefended against further attacks.

Mechanical Mines.—Several ingenious methods have of late been devised for the purpose of obviating one of the principal defects common to all kinds of mechanical submarine mines, the most efficient and practical of which will be found fully described in the following pages, viz., the great danger attendant on

the mooring of such mines; but as yet, no really practical mode of rendering mechanical mines safe, after they have once been moored and put in action, has been discovered, were such to be devised, a very difficult and extremely important problem of defensive torpedo warfare would be solved.

Electrical Mines.—In regard to electrical submarine mines, much has been done by torpedoists in general to simplify this otherwise somewhat complicated branch of defensive torpedo warfare, by adopting the platinum wire fuze, in the place of the high tension one, by the employment of Leclanché firing batteries, by the simplification of the circuit closer, and discarding the use of a circuit breaker, by altering the form of torpedo case, and whenever possible by enclosing the circuit closer in the submarine mine.

The necessity of a very elaborate system of testing should, if possible, be overcome, for a system of submarine mines that requires the numerous and various tests that are at the present day employed, to enable those in charge of them to know for certain that when wanted the mines will explode, cannot be considered as adaptable to actual service. It must be remembered that the safety of many ports, etc., will in future wars depend almost entirely on the practical efficiency of electrical and mechanical mines. As yet, in actual war, little or no experience has been gained of the real value of a mode of coast defence by electrical mines, excepting from a moral point of view, though in this particular they have most undoubtedly been proved to be exceedingly effective.

A submarine mine much wanted on active service, is one that can be carried on board ships, capable of being fitted for use at a moment's notice, and of being easily and rapidly placed in position by the ordinary boats of a man-of-war. It should be a self-acting electrical mine, with the circuit closing apparatus enclosed in the torpedo case, and capable of carrying about 100 lbs. of guncotton. This form of mine would be found extremely useful to secure the entrance to a harbour, etc., where ships might happen to be anchored for the night, or which might have been wrested from the enemy, etc.

They should be capable of being placed in position and picked up again, in the shortest possible space of time.

Offensive Torpedoes.—Coming to the question of offensive torpedoes there still seems to be a great difference of opinion as to the real value of the Whitehead fish torpedo, and this point will never be finally settled until that weapon has been more thoroughly tested on actual service; from a specially built torpedo boat, by which is meant a Thornycroft or Yarrow craft, the spar torpedo would seem to be the most effective weapon. Torpedo vessels for the special purpose of experimenting with the Whitehead torpedo have been built by England, America, and several continental governments, so that we may soon hope to get some more decided opinion as to the utility of that weapon. When manipulated from the shore, or large ships, the Lay torpedo boat, if only its speed be increased will prove an exceedingly effective submarine weapon, for the purposes of offence, active defence, or clearing harbours, etc., of mines, in fact, it may be more truly said of this weapon, than of the Whitehead, "that it can do everything but speak." Captain Harvey has greatly improved his towing torpedo, but it is still a somewhat complicated and difficult weapon to manipulate by ordinary persons, that is, those not specially trained for the work.

Drifting torpedoes under certain circumstances should prove invaluable, but little or no improvement has been effected in this direction. Submarine boats have also remained *in statu quo*, though for the purpose of clearing an enemy's harbour of mines, it seems impossible to devise any better method.

Electric lights are now universally adopted for use on board ship, and will play a very important part in the defence of ships against torpedo attacks in future wars. Glancing back on what has been effected in the matter of improving the system of torpedo warfare in all its branches during the last few years, with the exception of the vast improvements in the form and construction of steam torpedo boats, their engines, etc., very little has been done, owing principally to the want of that practical knowledge which unfortunately can only be gained from their employment in actual war.

The late Turco-Russian war afforded a splendid opportunity for applying the crucial test of actual service to both the offensive and defensive branches of torpedo warfare, yet little or no light was thrown on the somewhat shadowy subject of submarine warfare. The present struggle between Peru and Chili

may furnish some experience, but it will not be very satisfactory, as hardly any knowledge of manipulating torpedoes is possessed by either side.

Footnones

[A] C. D. Colden's "Life of Fulton."

[B] C. D. Colden's "Life of Fulton."

[C] C. D. Colden's "Life of Fulton."

[D] "Torpedo Warfare," by R. Fulton, 1810.

[E] C. D. Colden's "Life of Fulton."

[F] Johnston's Cyclopædia.

[G] Armsmear.

[H] See Chapter VII.

Chapter II: Defensive Torpedo Warfare — Mechanical Mines — Mechanical Fuzes — Mooring Mechanical Mines

BY defensive torpedo warfare is meant the protection of harbours, rivers, etc., by means of various descriptions of torpedoes moored beneath the surface of the water.

Submarine, or sea mine, is the term that has been generally adopted to designate this particular species of torpedo.

Submarine Mines.—Defence in Future Wars.—The very conspicuous part played by submarine mines, in the many wars that have taken place since the introduction of the torpedo as a legitimate mode of Naval warfare, when their manipulation was comparatively little understood, and construction very imperfect, proves that, with the experience so gained, and the vast improvements that have been, and are daily being effected, in all that appertains to the art of torpedo warfare, the protection of harbours, etc., will in future wars depend in a great measure on the adoption of a systematic and extensive employment of submarine mines.

The utility and power of this mode of coast defence has been fully exemplified in actual war, more especially during the Franco-German war (1870-1) and the late Turco-Russian war (1877-8).

Torpedoes in the Franco-German War.—In the former instance, the superiority of the French over the Germans, in the matter of ships, was more than neutralised, by the use on the part of the latter of electrical, mechanical, and dummy mines for the protection of their harbours, etc. In regard to the utility of the latter, it is on record that a certain German port was entirely defended by dummy mines, the Burgomaster of that place having been unable to obtain men to place the active mechanical ones in position, owing to the numerous and serious accidents that had previously occurred in other German

ports at the commencement of the war, in mooring the latter kind of submarine mine.

The effect, so far as keeping the French fleet at a distance was concerned, was precisely the same, as though active instead of dummy mines had been employed, thus still further proving the vast moral power possessed by torpedoes.

Torpedoes in the Russo-Turkish War.—In the war of 1877, the Turks, though possessing a powerful fleet in the Black Sea and flotilla on the Danube, made little or no use of their superiority over the Russians in this respect. They failed to even attempt to destroy the bridges formed by the Russians over the Danube, nor did they make any attempt to capture Poti, re-take Kustendje, or to create diversions on the Russian coast in the Black Sea. Had the latter service alone been effectually carried out, by which means, a large force of the enemy would have been held in check, immense help would have been afforded to the Ottoman armies in Europe and Asia. Again, during the whole of the war, the Russian port of Odessa was never sighted, and Sebastopol only once by the Ottoman fleet.

Cause of Failure of the Ottoman Fleet.—The cause of this repeated neglect on the part of the Turkish fleet may be traced almost entirely to the assumption (which in nine out of ten cases was an erroneous one) on the part of the Naval Pashas and Beys that every Russian harbour, etc., was a mass of submarine mines, and this in several instances extending many miles to seaward.

So also, some of the many failures experienced by the Russians in their numerous boat torpedo boat attacks, were due in a great measure to an erroneous supposition on the part of the captain of the Russian steamer, *Constantine* (employed to convoy the torpedo boats), that the Turks had defended the entrance, to a distance of some miles to seaward, of their harbours, etc., and thus the torpedo boats were dispatched to the attack some miles off the entrance, causing them, owing to the darkness, to enter the harbour in which the Turkish vessels were lying, in a very straggling manner. And to a similar reason the failure of the Russians to capture Sulina, in the

attack made on that place in October, 1877, was principally owing to their not daring to send their Popoffkas to attack from the sea.

One of the chief points of usefulness of an extensive and systematic employment of submarine mines, will be to minimise the number of vessels necessary for the protection of harbours, etc., thus enabling a far larger number of ships to operate at sea against those of an enemy, this especially applies to countries like England and America possessing a large extent of seacoast, numerous harbours, rivers, etc., which it would be necessary to defend in the event of war.

Science of Torpedo Warfare.—The science of defensive torpedo warfare may be considered to consist of:—

1.—The arrangement of the mines in positions, such that it would not be possible for a hostile vessel attempting to force a passage into a harbour, etc., defended by such means, to pass more than one line of them, without coming within the destructive radius of some one or other of the remaining mines.

Note.—The difficulty of attaining the above effect, lies in the fact that the destructive radius of a submarine mine, is considerably less than the distance that must be maintained between them, to prevent injury by concussion to the cases, circuit closers, electric cables, etc., of such mines on the explosion of an adjacent one.

As an illustration of the above, take the case of a 500 lb. guncotton submarine mine. Now the destructive radius of a sea-mine is found by the formula R = [3rt](32 × C), where R is the destructive radius in feet of a mine moored at its most effective depth, and C is the charge (guncotton) in lbs.

In the above case R would be about 24 feet, which in so far as the actual destruction of a ship is concerned, may be taken as correct, but if injury to a vessel's engines, boilers, etc., be also taken into consideration, and as the vessel would most probably be underweigh on such an occasion, this would be a very vital and important consideration, R would under those circumstances be more than doubled. Now the necessary interval for safety between such mines,

according to torpedo authorities, is equal to 10 R, and should certainly be not less than 8 R, which in this case would give about 200 feet, therefore assuming the radius of destruction to be 50 feet, it is seen that there would be under those conditions a clear undefended space of about 100 feet between each couple of 500 lb. mines in the same line.

2.—The combined arrangement of submarine mines with forts and batteries, in such a manner, that every one of the former shall be well covered by the guns of the latter, and also that it would be impossible for an enemy's ships to get within effective range of the forts, or batteries, without moving over ground where mines were laid.

Note.—This applies to the defence of the more important harbours, etc., in which case the submarine mines (which would be chiefly electrical ones) would only act as auxiliaries to the land defences. To effectually carry out the above, there can be no question but that they who plan the forts, etc., should also plan the systems of submarine defence.

A harbour, river, etc., which it is necessary to protect by electrical submarine mines, etc., and where no land defences exist, should have its mines supported by a powerful ship or ships, as maybe thought desirable.

Success in Torpedo Warfare.—The two most important conditions essentially necessary to the successful employment of torpedoes, both offensive and defensive, are:—

- 1. Certainty of Action.
- 2. Simplicity of Manipulation.

Without the former this mode of Naval warfare is comparatively useless, while without the latter the former condition is rarely obtained, more especially in the case of offensive torpedoes.

Submarine mines are divided into separate classes, viz.:—

- 1. Mechanical Mines.
- 2. Electrical Mines.

Mechanical Mines.—By this description of submarine mines, is meant those whose charges are fired by mechanical means alone.

Mechanical Mines in the American Civil War.—During the civil war of America (1861-5), the Confederates depended almost entirely on mechanical submarine mines for the protection of their harbours, rivers, etc., and to this extensive use of such mines may be traced nearly the whole of the Federal disasters afloat.

In the principal wars that have subsequently occurred, though this form of submarine mine has been to a certain extent used, it has generally been only as an auxiliary to the more effective electrical torpedo, and owing to the deterrent effect produced by the numerous torpedo successes that characterised the American Civil War, on Naval Commanders, etc., few vessels have been destroyed by their means, the effect of the employment of defensive torpedoes having been almost wholly a moral one.

Mechanical Mines for Coast Defence.—The experience hitherto gained, with regard to the employment of mechanical mines for coast defence in actual war, proves that they will be found exceedingly valuable in the following positions:—

1.—In combination with booms or other obstructions placed in defence of narrow channels, etc., which are intended to be completely blocked up.

2.—In shallow water on the flanks of electrical mines.

3.—In protecting unfrequented bays, channels, etc., and a long line of seacoast, which may otherwise be entirely undefended.

Note.—In this latter instance, though the mines may not be covered by any guns, still they will be of great use, in so far, that being mechanical ones, they cannot be rendered useless by the process of cutting cables, etc., but must be destroyed, which in time of peace is a work of considerable labour and danger, and, therefore, would in the time of war, cause at the very least, serious delay to an enemy desirous of effecting a landing, etc., at a point so protected.

There are numerous objections against their employment, the principal ones being:—

1.—That they are all, more or less dangerous to place in position.

2.—That they cannot be tested when moored.

3.—That they are as dangerous to friend as to foe, when once placed in action.

4.—That an exploded, or known damaged mine cannot be replaced.

Note.—The above objections, especially 2 and 3, constitute without doubt very serious defects in a system of defence by mechanical mines, and in the case of purely mechanical ones, it seems almost impossible to eradicate any of them, though, notwithstanding, under the particular circumstance before-mentioned, these species of defensive torpedo will be found extremely useful.

The Advantages of Mechanical Mines.—They possess a few advantages, which are as follows:—

1.—They are comparatively cheap.

2.—They can be kept in store and ready for use at a moment's notice.

3.—They do not require specially trained men to manipulate them.

4.—Extempore ones can be easily and readily made.

Best Kinds of Mechanical Mines.—Among the very numerous and various kinds of mechanical submarine mines that have been devised the following may be considered as the most effective, and practicable of them all:—

- 1.—Frame Torpedoes.
- 2.—Buoyant Mines.

This includes:—

- *a.*—Barrel Mine.

- *b*.—Brook's Mine.
- 3.—Singer's Mine.
- 4.—McEvoy's Improved Mine.
- 5.—Extempore Mine.

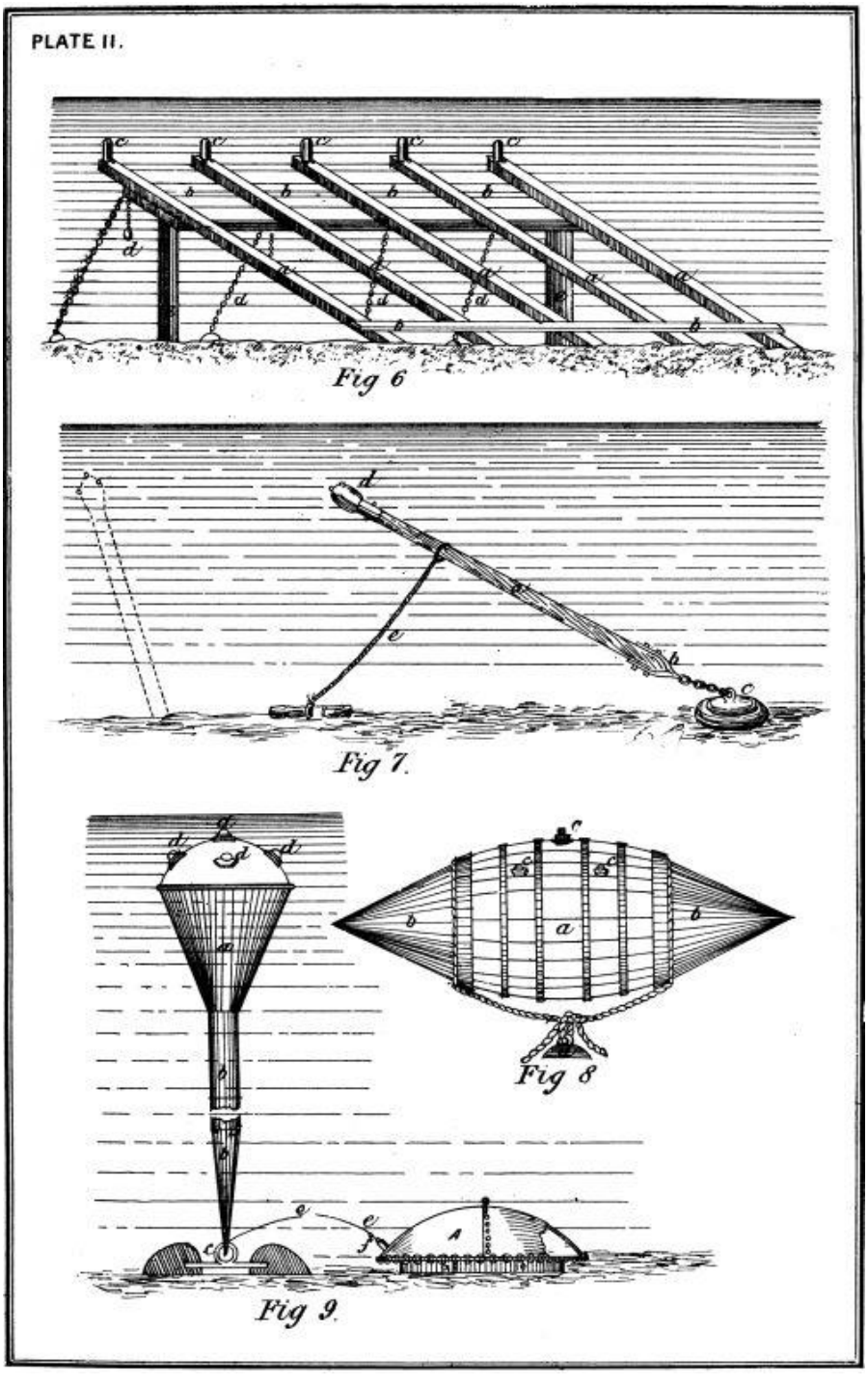
Frame Torpedoes.—This form of defensive mine is shown at Fig. 6. It consists of a frame work which is formed of four strong timbers *a*, *a*, *a*, *a*, these being kept parallel and only a few feet apart by means of cross timbers *b*, *b*. A cast-iron torpedo *c*, *c*, *c*, in the shape of a shell, is bolted to the head of each of the timbers *a*, *a*, *a*, containing about thirty pounds of fine grained gunpowder, and fitted with a percussion fuse, which is so placed that it would come into contact with a vessel striking against the framework, directly or not. One end of the frame is securely anchored, the other, that on which the torpedoes are fixed, is kept at its proper distance below the surface of the water by means of chains, *d*, *d*, and anchors. To prevent the frame from sinking when sodden with water, the uprights *e*, *e*, are provided.

This form of mechanical mine, which performs the double function of torpedo and obstruction, was much used by the Confederates, and found extremely useful, no passage was attempted to be forced by the Federals where these torpedoes were known to be placed.

Stake Torpedo.—Fig. 7 represents another form of the frame torpedo.

It consists of a piece of timber, *a*, its heels secured by a heavy metal shoe *b*, working in a universal joint in the mooring, *c*. At the head of the piece of timber is secured a torpedo *d*, containing about fifty pounds of gunpowder, and fitted with four or five sensitive fuzes. The proper angle of inclination is obtained by securing the upper end of the timber to an anchor as shown at *e*. As a proof of the efficiency of this species of mechanical mine, even though having been in position for a great length of time, the U.S. gunboat, *Jonquil*, was nearly destroyed whilst attempting to remove some similar torpedoes which had been in position for two years.

Frame Torpedoes, Buoyant Mechanical Mines



The Barrel Torpedo.—One description of this form of mechanical submarine mine is shown at Fig. 8. It consists of a barrel *a*, to the ends of which are attached two cones of pine *b*, *b*, for the purpose of preventing the current from turning the mine over.

To ensure its being watertight, pitch is poured into the interior through the bunghole, and the barrel rolled about, so that the inside may be evenly covered. The outside was also thoroughly coated with pitch. These mines usually contain about 100 lbs. of gunpowder, and are exploded by means of percussion or chemical fuzes (*c*, *c*, *c*,) generally five in number, screwed into sockets on each side and on the top of the bilge of the barrels. To keep them upright a weight *d* is hung below the mine.

This kind of mechanical mine was much used by the Confederates, and to some extent by the Turks in their late war with Russia.

They are cheap, convenient, and under certain circumstances very effective. One of the objections to their use is the difficulty of mooring them securely in strong currents, as otherwise they are very liable to shift their positions. Three Confederate vessels were "hoisted by their own petards," from this cause.[I]

Brook's Torpedo.—Another form of buoyant mechanical mine is represented at Fig. 9. It was designed for the express purpose of preventing its discovery by dragging, etc., by the enemy. It consists of the torpedo case *a*, formed of copper, which is attached to a spar *b*, the lower end of which is secured to an universal joint in its anchor *c*. Five percussion or chemical fuzes *d*, *d*, *d*, are screwed into the head of the copper case.

Turtle Torpedo.—To increase the danger and uncertainty of any attempt to remove this form of buoyant mine, a turtle torpedo *A*, is attached to it by a wire *e*. This torpedo contains about 100 lbs. of gunpowder, and is exploded by means of a friction primer which passes through a watertight joint *f*, and is attached to the wire *e*.

Whether this combination would prove effective, has yet to be seen, but the buoyant mine alone was considered one of the most dangerous used by the Confederates.

Singer's Mechanical Mine.—An elevation and section of this form of mechanical mine is shown at Fig. 10. It consists of an air chamber *a*, and a powder chamber *b*; in the latter is fixed a rod of iron *c*, one end of which rests in a cup formed in a lug *d*, where there is a screw by means of which the rod *c* may be screwed against the bottom of the torpedo case, on the interior. In the cup is placed the fulminating substance. A heavy cast iron cap *A B* rests upon the top of the case and is prevented from falling off by a low rim of tin, which enters an aperture in the cap as at *e*: a wire *f* connects this cap with a pin *g*, which keeps a plunger *h* at rest. The head of this plunger *h* is directly beneath the bottom of the rod *c*, within the case; by means of a spring *i*, directly the pin *g* is drawn out, which is done by a hostile vessel striking against the mine and knocking off the cap *A B*, the plunger *h* is forced against the bottom of the case and drives the rod *c* into the cup containing the fulminate, and so explodes the torpedo. The case of these mines, as used by the Confederates, was formed of tin, and they contained from 50 to 100 lbs. of powder. A safety pin *k* is provided to prevent a premature explosion due to the pin *g* being accidentally withdrawn.

This form of submarine mine was one of the most successful and most extensively employed of all, on the part of the Confederates.

Though no accidents are stated to have occurred in placing this mine in position, yet the fact of the iron rod *c* having to be fixed for action, and that close against the interior of the bottom of the case, before the charge of powder has been put in, is an element of great danger, for a comparatively slight blow beneath it, which might easily occur in transport, etc., would explode the torpedo prematurely.

McEvoy's Improved Singer's Mine.—To obviate this defect Captain McEvoy has designed an improved mode of ignition for Singer's mine. This is shown at Fig. 11. The form of case, and arrangement of heavy cap are similar to those in Singer's mine. The mode of ignition is as follows:—In the powder chamber *b* is fixed a friction fuze *f*, which by means of a piece of wire secured to a length of chain *k*, *k*, is connected with the heavy cast iron cap *A B*. The piece of wire passes through a diaphragm of thin metal *h*, which is soldered all around, thus forming a complete watertight joint. Premature explosion is

prevented by passing a link of the chain, through a slot in the bolt *c*, securing it there by a pin of bent wire *l*. The dotted line of chain *k*, *k*, shows its position during the process of mooring this form of Singer's torpedo. The manner of lowering this and also Singer's mine is shown at Fig. 12. A buoy *x*, is attached by means of a line, in the former case to the pin *l*, Fig. 12, in the latter case to the pin *k*, Fig. 10, the pulling out of either, sets their respective mines in action.

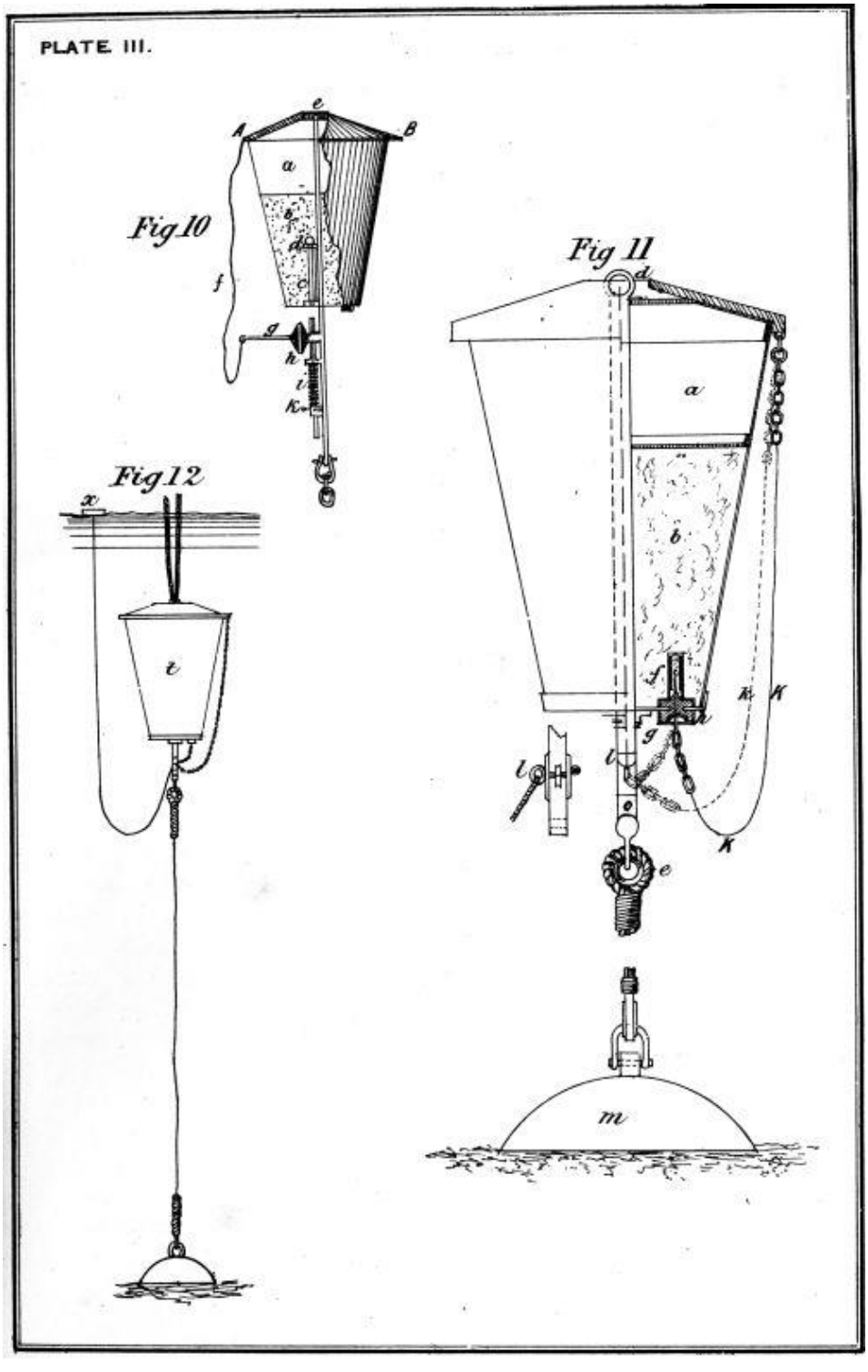
Singer's And Mevoy's Mechanical Mines

Mathieson's Cement Safety Plug.—In the place of the safety pin *l*, Fig. 11, employed by Captain McEvoy in his improved form of Singer's mine, Quartermaster-Sergeant Mathieson, late Royal Engineers, employs a plug or disc of soluble cement, so arranged that the action of the sea-water after the mine has been placed in position destroys the plug or disc, and so frees the chain which is connected with the fuze and the heavy cap of the torpedo. This plan does away with the necessity of using a buoy and line as shown in Fig. 12, and also affords ample time for the men engaged in mooring the mine to get far away before it is ready for action.

Mechanical Mine.—The extempore mechanical submarine mine, shown at Fig. 13, will be found to possess all the qualities which are necessary to a perfect mine of that description.

It is extremely simple, it can be readily and quickly made, all the materials of which it is constructed are at hand on board every man-of-war, and it is certain in its action.

It consists of a barrel *a*, which is thoroughly coated inside and out with hot pitch, etc., to make it watertight, a block of wood *b*, secured to the top of the cask *a*, and having a recess cut in it to receive a round shot *c*, also a hole through which a strop *d*, is passed, and another hole to receive a toggle *e*. At the bottom of the cask on the inside, is fixed a wooden frame work *f, f*, to the top of which two ordinary gun friction tubes are fixed *g*, *g*. A piece of wood *h*, is secured to the bottom of the cask on the outside, bored with two holes, one to receive a thin iron rod *i*, the other for the safety pin *k*.


PLATE III.
Fig 10
Fig 11
Fig 12
a
b
c
d
e
f
g
h
i
K
x
m

Wires *x*, *x*, secure the gun tubes *g*, *g*, to one end of the iron rod *i*, the other end of which is connected by means of a rope lanyard to the shot *c*. Weights are slung beneath the barrel to keep the mine upright. The principle of action of this form of mechanical mine is precisely similar to that of Captain McEvoy's improved Singer's mine, and need not, therefore, be described.

McEvoy's Mechanical Primer.—A sectional view of this apparatus is represented by Fig. 14. It consists of two brass tubes fitting accurately one within the other, of which *a*, *a*, is the inner one. To this inner tube are affixed two brass diaphragms *b*, *b*. A brass spindle *c*, carries a weight *d*, which is regulated by a spring, *e*. A locking rod, *f*, moves in a ball and socket joint at *g*. A hammer *h*, which is shown in Fig. 14, at full cock, is kept in that position by the rod *f*. A vessel, striking the mine, in which this apparatus is placed causes the weight, *d*, to cant over, allowing the rod, *f*, to be forced upwards by means of the spring *e*, and so frees the hammer *h*, which falls on a nipple *i*, on which is placed the percussion substance, and so explodes the mine.

McEvoy's Papier Maché Safety Plug.—To prevent a premature explosion during transport, etc., of a mine in which this apparatus is placed, a plug of papier maché, which is soluble in water, is inserted in the two spaces *p*, *p*, by which the spindle *c*, is prevented from moving to one side or the other. The use of a papier maché, instead of a cement plug for the purposes of safety, is a great improvement, as by the simple process of pressure, any period of time that it is necessary should elapse before the complete destruction of the plug, can be readily and certainly obtained, which when a cement plug, formed of different ingredients is used, is not always the case.

McEvoy's Mechanical Mines.—Captain McEvoy has also devised a plan, whereby a mechanical mine of the foregoing form may be placed in a state of safety, even after it has been rendered active. In the place of the aforesaid papier maché wad at *p*, Fig. 14, he uses a plunger which fits into the cavity *p*, of the heavy weight *d*. This plunger is always kept in a position clear of the weight by means of a spiral spring, unless it is desired to render the mine inactive when the plunger is forced into the aforesaid cavity and kept there by means of a pin inserted above it. Above this there is another plunger, acted on by a spiral spring sufficiently powerful to enable it to force the previous

mentioned plunger into the safety position; this upper plunger is rendered inactive by means of a pin. The mine being placed in position, that pin which is keeping the lower plunger inserted in the cavity *p*, of the weight *d*, is withdrawn and the mine rendered active. To the pin of the upper plunger is attached a line which is anchored some distance from the mine in a known position. Then to render the mine inactive for the purpose of picking it up, etc., it is only necessary to raise the aforesaid line, and draw out the pin of the upper plunger, which by means of the strong spiral spring will force the lower plunger into the safety position, and render the mine inactive.

Whether this invention is a practicable one or not, remains to be proved, but anyhow it is a step in the right direction.

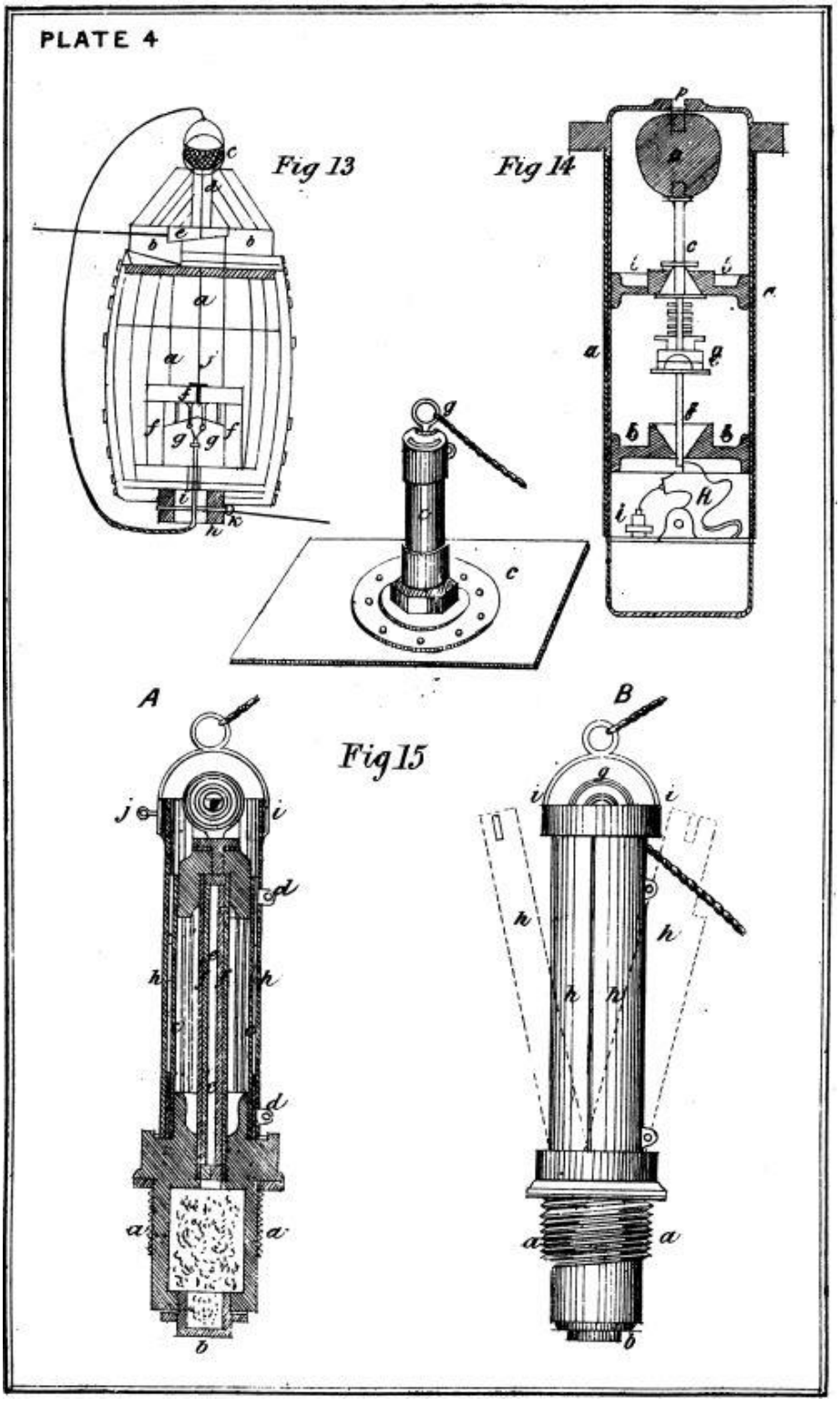
Extempore Mechanical Mine, Mechanical Primers

Abel's Mechanical Primer.—This is shown in section and elevation at Fig. 15 (A and B). *a*, *a*, is the powder chamber in which the priming charge is placed; *b* is a screw plug to close the chamber; *c* is a flexible india rubber tube; *d*, *d*, are screw bands; *e* is a glass tube containing oil of vitriol enclosed in a lead tube; *f* which contains the explosive mixture; *g*, an eye at the head of the primer to receive the firing line; *h*, *h* are segmental guards; *i* is the guard ring; and *j* the safety screw pin. This apparatus is screwed into a socket in the upper part of the torpedo case, as shown at Fig. 15 (C).

Mode of Action.—When placed in position, to render the primer ready for action, the guard ring, *i*, is pulled off, first having removed the safety pin *j*, when the segmental guards *h*, *h*, will fall away, leaving the india rubber tube *c*, *c*, exposed.

A sufficient strain being brought on the rope secured to the ring *g*, the lead tube *f* bends, causing the fracture of the glass tube *e*, thus igniting the priming charge and exploding the mine.

A submarine mine so fitted may be fired at will, by bringing a line, from the ring *g*, to the shore, or it may be made self-acting by connecting two of them together, etc.


PLATE 4
Fig 13
Fig 14
Fig 15
A
B

Percussion and Chemical Fuzes.—Many forms of this mode of mechanical ignition have been from time to time devised, of which the following are the most important ones:—

Sensitive Fuze.—It consists of an inner cylinder *a*, *a*, Fig. 15, of composition metal, 1-1/2" diameter, and 2-1/2" long, having a thread cut on its outside, and a bouching *b*, 2-1/4" diameter and 2" long with a sexagonal projection *c*, for applying a wrench, also with an external and internal thread. The upper end of the inner cylinder *a*, is solid for 1", and is perforated by three holes *d*, *d*, *d*, in each of which a percussion primer is placed *e*, *e*. A piece of thin, soft and well annealed copper *f* is soldered to the upper end of the bouching *b*, to keep moisture from the primers, and is so thin that a slight blow will crush without breaking it. A safety cap can be screwed on to the external thread above the projection *c*.

Rain's Detonating Composition.—The detonating composition employed in this and many other forms of percussion fuzes by the Confederates, etc., consisted of a combination of fulminate of mercury and ground glass, and was invented by, and is named after, General Rains, Chief of the Torpedo Bureau, at Richmond, during the Civil War (1861-5). So sensitive was this composition that seven pounds pressure, applied to the head of one of the primers, would explode it.

When required for use the internal cylinder *a*, containing the primers *e*, *e*, is screwed up until contact between them and the copper cap *f* is secured.

McEvoy's Percussion Fuze.—Fig. 16 represents a longitudinal section, full size, of the mechanical percussion fuze, used by Captain McEvoy in connection with his drifting torpedo, which latter will be hereafter described. *a* is a piece of metal, having an external and internal thread, and a projection *b*, to which is applied the spanner for screwing it into the torpedo case. This piece *a* is hollow at its upper end, and is closed by means of a thin copper dome *c*, which is soldered to it. Screwed into the piece *a* is the plug, or nipple *d*, with a hole through it from end to end, it is rammed full of mealed powder, and then a fine hole is drilled through the composition. A cavity *e* at the head of the plug, or nipple *d*, is filled with a fulminating substance. A spiral spring *f*, encircles

the plug *d*, on which a cap *g* rests; *h* is a needle in this cap. The action of this fuze will be readily understood from the plan of the fuze at Fig. 16. A safety cap is provided, which fits into the slots *i*, *i*, and is fixed there by means of a set screw.

Improved Form of Jacobi's fuze.—The section shown in Fig. 17 is an improved form of the chemical fuze, invented by Professor Jacobi, and used by the Russians in their land and sea mines during the Crimean war (1854-5). It consisted of a small glass tube *a*, containing sulphuric acid, enclosed in a lead cylinder *b*. A mixture of chlorate of potash and white sugar surrounds the tube and holds it in position; *c* is a primer filled with mealed powder in connection with the charge of the mine. The action of this fuze is as follows:—On a vessel striking against the lead cylinder *b*, it is crushed in, breaking the glass tube containing the sulphuric acid, and thus causes it (acid) to flow into the mixture of chlorate of potash and white sugar, producing fire, which by means of the primer *c*, passes into the charge, and explodes the mine.

Mechanical Fuzes

Defect of Chemical Fuze.—The defect of the chemical fuze just described is its slow rate of ignition when compared to gunpowder. This may be remedied by adding a small quantity of sulphuret of antimony or perro cyanide of potassium.

Both the Turks and the Germans employed, as a mode of ignition for their mechanical submarine mines, the chemical fuze described above, with but slight modifications in the shape of the lead cylinder and manner of fixing the fuze into the torpedo case.

Mechanical fuzes, both percussion and chemical, which require a blow to effect their ignition, are to a certain extent defective when applied to submarine mechanical mines (which are always buoyant ones) in so far that a hostile vessel passing over ground supposed to be defended by torpedoes of any description, would do so at as slow a rate of speed as it would be possible to proceed at, and would, under those circumstances, *push away* rather than strike a buoyant mine, with which she might come in contact.

PLATE V.

Fig 15a

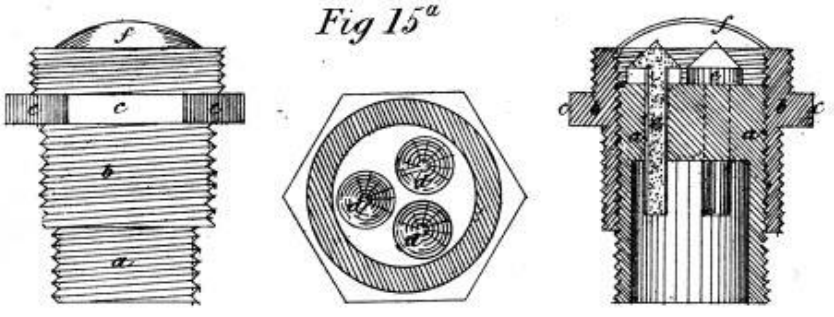


Fig 16

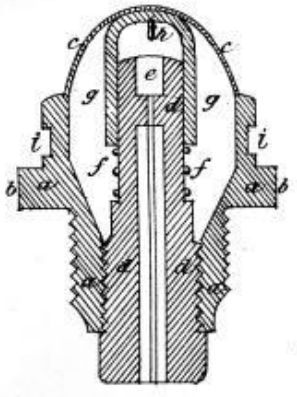


Fig 17

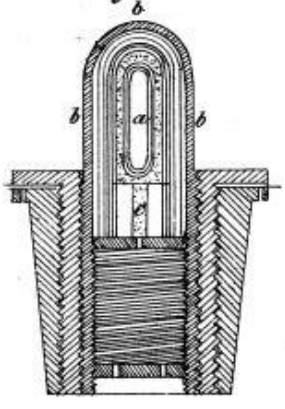


Fig 18

