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Serial No. 9

2

Command and Staff Class, June, 1946

NAVAL MINES

STAFF PRESENTATION

NAVAL WAR COLLEGE
Newport, R.I.
16 January, 1946

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This presentation was delivered separately to three groups of ten student officers each in Room 102, Luce Hall, 16 Jan 1946. One hour and a half was planned, but in each case, including the movie and recess, the time amounted to nearly two hours. Student participation was encouraged. A cut down form of three films on minesweeping (N.W.C. #24, 27 and 28) was used totalling 15 minutes. No outline was passed out before the presentation, but a rather detailed digest was issued afterwards to aid retention.

NAVAL MINES

The subject of MINES naturally divides itself into mine construction, mine countermeasures and mine laying. This morning we will briefly consider the principle features of mine construction; I will say something about countermeasures other than sweeping, then show a short movie on minesweeping, and finally say a little about aerial, surface and subsurface minelaying.

Although I don't pretend that this is a technical talk, yet discussion of a few of the details of mine construction is necessary. Without some knowledge of the various firing mechanisms, the variety of settings than can be made on them, and so forth, it is difficult to arrive at a basic understanding of mine warfare.

The unique characteristic of the mine as opposed to the gun, torpedo and bomb is that it is laid in the expected path of the enemy, usually well before the enemy gets there; generally the minelayer can retire before the target gets anywhere near.

The Naval Mine as distinguished from the land mine is a mine laid in water. Its targets are ships or boats. This does not mean that only the Navy handles the Naval mine. The Army can and does use it, and very effectively, as we shall see.

Some parts of a mine are common to all mines, such as the case, that is the mine itself, the explosive, generally TNT or torpex, a combination of TNT and aluminum powder, and the firing mechanism which fires the mine.

Other parts of a mine are present or absent depending on the use to which the mine is put, such as the anchor, for moored mines, or the antennae, sometimes used to increase the actuation range of contact mines.

Mines may be classified in a number of ways. They can be differentiated by their position.

TURN CHART

Ground mines rest on the bottom and can usually not be effective in water deeper than 150 feet.

Moored mines ride below the surface and are held in place by an anchor and cable. Anchor depth is limited only by the length of cable, and modern materials have made possible very long and slender yet strong cables. Most moored mining is done in depths less than 100 fathoms.

The Rising mine is a combination of the ground and moored mines. It has an anchor but when laid starts out as a ground mine resting on the bottom with the anchor. A timing device releases the case after a predetermined interval so that it rises to the length of its cable and becomes a moored mine. This makes sweeping more difficult.

Drifting mines are neither ground nor moored but float on or just below the surface, some at a constant depth and some oscillating in depth. They are, of course, at the mercy of tides and currents and a provision of International Law requires that such a mine be self destructive within one hour after the layer loses control of it. Needless to say, this provision has not always been honored.

The Tidal mine is a special type of drifting mine that is set to rise and float during the flood tide and to sink and rest on the bottom during the ebb. It is adaptable to mining enemy harbors without risking the minelayers too close to the intended minefield.

The sabotage mine is simply an explosive charge that is attached to the hull of a ship by a diver or from a small boat.

Mines may also be differentiated as to their types of firing mechanisms:

TURN CHART

Contact mines require physical contact between the target and the mine or its antennae. If the vessel strikes the mine itself it may move a pre-set trigger which closes a switch and fires the mine. Or the impact may break a bulb containing an acid which then flows into the cell of a battery to act as an electrolyte and closes a circuit that fires the mine.

If the vessel strikes the antennae, the steel of the ship and a copper plate outside the mine serve as electrodes and the sea water serves as an electrolyte and the mine is fired.

Influence mines do not depend on physical contact for actuation. The influence of the ship whether it be magnetic, acoustic, pressure or a combination of influences, is used to actuate the firing mechanism. The practical use of ships' influences to fire mines is new with this war and characterizes most of present day offensive mine warfare. We will examine these influences in some detail.

First of all the magnetic influence of a ship:

As you know, the earth is a giant magnet and since ships lie in its magnetic field, they become magnetized themselves and acquire magnetic fields of their own. Magnetic mines in one way or another are fired by the magnetic change caused by the approach of a ship's magnetic field.

The needle type magnetic mine when laid is so adjusted that it is neutral to the flow of the earth's magnetism as it is at the particular spot where the mine is laid. When a ship passes over the mine its magnetic field disturbs this equilibrum and a circuit is closed that fires the mine.

On 45-2164

Here the needle is resting between and not touching either of two stops, above and below it. When the ship represented by the bar, approaches close enough the needle will be moved up or down touching one of the stops and completing a circuit that can detonate the mine.

Off 45-2164 and On 45-2165

The coil magnetic mechanism, on the other hand, depends not on the movement of a needle but on the generation of an electric current in a coil induced by the approach of a ship's magnetic field. This current closes a circuit which fires the mine. And, another thing, the generation of this current depends not only on the size of the ship's magnetic field but also on its rate of approach. This adds the factor of target speed to a mine's selectivity.

Off 45-2165

Another type of influence mine is the Acoustic mine which makes use of a ship's noises. The three main sources of sound in a ship are:

1. Main and auxiliary engines
2. Propellers
3. Hull vibration

In general the propeller is responsible for most of the sound above 6000 cps. Below this frequency there is an appreciable contribution from the engine room which is transmitted thru the hull from most of the after part of the vessel. This noise is greatest from vessels powered by steam turbines through gear reductions, less in the case of Diesel engines, still less for gasoline engines, and hardly noticeable in ships powered by reciprocating steam engines.

The propellers produce low frequency vibrations due to the intense pressure on the blades and high frequency vibrations due to the bursting of small bubbles of water vapor formed by the blades.

The very low frequency vibrations of a ship are caused by the hull itself in accordance with its natural period of vibration.

The wave form of an acoustic signal is complex; however the rate of increase in average signal amplitude ranges from the comparatively slow rate characteristic of normal ship sounds to the rapid rate more characteristic of countermining shocks. This factor makes possible the use of circuits which enable the mechanism to differentiate between a normal ship sound and a countermining signal.

Further, the low frequency components of a ship's sound are rapidly attenuated with distance - that is, these low frequency components are intense only in the immediate vicinity of a ship. In general, they are localized in the region below and immediately adjacent to the hull of a ship (within about 200 feet). Therefore, the use in a mine of a firing mechanism which is sensitive only to the low frequency components of a ship's sound increases the probability that a target ship which actuates the mine will sustain severe or sinking damage.

In normal firing operations the acoustic pressure waves set up underwater by a ship mechanically stress the crystal element of a microphone to produce an electrical signal whose wave form is almost the same as that of the ship's sound. This is amplified and the desired low frequency component selected and further amplified, eventually actuating the mine.

A recent type of influence mine is the Pressure Mine. The Pressure Mine is actuated by the pressure field of a moving ship. There is a continuous flow of water from the bow to the stern of a moving ship: the forward part of the ship continually displaces new water and an equal amount is required at the after part to refill the displacement volume after the ship has passed. This water flow which is measureable at considerable distances from the moving ship, creates variations in the pressures which normally exist at various depths in the water. These variations are used to open a pressure switch of the firing mechanism.

Of course tides and waves by themselves also create variations in pressure and it is usual, therefore, to incorporate magnetic or acoustic firing mechanisms as well as the pressure mechanism in a pressure mine.

The advantage of the pressure device is that its sensitivity can be regulated so that the variation in water pressure of a small vessel such as a mine sweeper will not influence it.

Combinations of firing devices can be installed in the same mine requiring either simultaneous actuation or successive actuation of a set pattern, and the problem of the minesweeper becomes more and more difficult as the complexity of the mine increases.

The Observation mine works on an entirely different principle. This requires a switch to be thrown in a control station located ashore. It is used to defend coasts and harbors, very often by the Army. The positions of the mines and the target ship are plotted and when it is determined that the ship is within lethal range of the mine, the mine is exploded.

One aspect of great importance about influence mines is that they can be rigged with counting devices that count off a set number of actuations or "Looks", as they are called, before the mine is actually fired. This makes sweeping very difficult since many passes are necessary by minesweepers

before they can be sure that a suspected field is swept. This delays enemy shipping as long as possible which is one of the main purposes of a mine field. And even then the field may not be clear if the sweeper has not swept for the correct combination of mines.

To go one step further, purely to illustrate how complicated these things can get, more than one "look" may be required to register one count on the mine's counter. The Mark 26 Mod 1 mine for example, employs a two-look device which requires two looks within 102 seconds of each other to register one count, and the counter can be set for one to eight counts before actually exploding the mine. In addition, the two looks may be of random polarity or may be required to be of opposite polarity. In the latter case when the first look is received the mechanism starts stepping off the 102 seconds and is said to "remember the polarity of the first look." A count won't be registered unless a second look of opposite polarity is received within the 102 seconds. These devices are all calculated to make sweeping difficult and to aid in setting the mine so that it will damage the particular kind of ship you are after.

The question of the accessories on a mine is a big one and we will only touch on it.

On 44-2047

Here is a sectional view of a Mark 25 mine. Please notice the clock delay mechanism, the clock starter and the extender.

The clock delay mechanism is an attachment by which the arming of the mine can be delayed for a considerable period - even up to 100 days. In addition after a set time it can sterilize the mine by breaking a circuit. This latter capability is very important to permit the refreshment of mine fields by surface minelayers or submarines and is proving very important to us now that we are using waters in which we have earlier laid mines.

The clock starter which starts the clock delay mechanism is an additional safety factor delaying the commencement of the arming cycle by hydrostatic devices and solube washers.

The extender contains the primer and when the mine is laid, the extender is in a position withdrawn from the booster. After a hydrostatic device registers a depth of at least 16 feet, the primer will be extended into the booster upon the dissolution of a soluble washer. This permits the minelayer to carry the mine safely and gives it an opportunity to clear the minefield before the mines are armed.

Off 44-2047

All these items we have been discussing are only a few of the considerations that confront a mining officer with respect to the choice and setting of his mines or, if he is a minesweeper, with respect to the choice and setting of his sweep gear. You will not be surprised, I am sure, to see this complex diagram of the wiring in a Mark 25 mine.

On 46-485

Off 46-485

There is not time to show slides of all the various types of U.S. mines. Suffice it to say that altogether BuOrd has developed mines up to Mark 46, most of which have several modifications each, making well over 100 different mines in all. Some of these are freaks designed to perform very special purposes. Others have become obsolete as the newer types have been released.

Most important are Mks. 25 Mod 0, 26 Mod 1, 36 and 18 which are magnetic induction mines. The Mks. 13 Mod. 6 and 25 Mod 1 which are acoustic mines. The Mk. 25 Mod 2 which is a combination induction pressure mine; and the Mk. 6 and Mk. 10 which are moored contact mines.

That's a total of 8 principal mines used.

Let's take a short stretch in place.

Getting on to Countermeasures, there are many wartime defensive measures other than sweeping although sweeping is by far the most important.

Moored mines will not usually be found in depths over 100 fathoms; however, it is possible to lay them in almost any depth. Therefore ships should remain outside the 100 fathom and preferably the 300 fathom curve wherever practical to do so.

Ships should stream paravanes wherever traversing mineable waters.

Make certain that ship is well degaussed and that proper current settings are maintained at all times.

Use the lowest speed consistent with operations required. The coil type magnetic mine, as we have seen, is dependent on the rate of change of the magnetic field. Also, low speed will have much less effect on a pressure type mine, and it will usually permit greater opportunity to spot mines.

In areas where it is known moored mines are not present, ships should remain in depths of over 25 fathoms as, in general, 25 fathoms is the maximum effective lethal depth for ground mines and there will definitely be no damage in 40 fathoms or over.

Always pass through areas of suspected moored mines at times of maximum current. The dip produced by a current of as little as 1 ½ knots will cause a mine moored in 50 fathoms of water to be deepened by as much as 20 or 30 feet.

Vessels equipped with sonar gear should echo range. Rows of moored mines can frequently be discovered and recognized by this means.

If conditions are suitable, moored mines can readily be located by planes on A/S patrol. Pilots should always be briefed to watch for them in mineable waters.

Vigilant lookouts located as high as possible can frequently spot moored and drifting mines.

On 43-305

Many of you have seen these pretty objects either cut loose by paravanes or adrift because of defective cables or because they had been set adrift by the Japs in well chartered currents.

On 46-307

Off Slide

Keep within the limits of designated swept channels and swept areas. It may seem needless to mention this precaution but most of our ships mined have been those which disregarded it.

Another countermeasure to mines is countermining.

Mines are delicate instruments and sometimes can be exploded by dropping depth charges in their vicinity. To counter this in turn stabilizers and circuit breakers are installed in mines and mine fields are laid with a calculated spacing between mines so that when one is exploded the whole field won't go up.

In order effectively to defend against mines you have to know details of the construction of the mines themselves. Before England in 1939 could develop successful countermeasures to the magnetic mine that Germany then brought out as its first secret weapon, one of these mines had to be recovered and taken apart. How this was done is a thrilling story in itself, but it was done and slowly and painfully England began developing the countermeasures that saved her. Before Germany got into full swing on the magnetic mining campaign successful sweep methods had been devised and German's big chance was gone. If she had waited until enough mines and

aerial minelayers had been accumulated and then gone all out suddenly, she might have won the war at once.

Many clever devices have been used to prevent recovery and stripping: hydrostats to explode mines when they are raised into shallow water, booby traps to explode mines when a nut is turned, light sensitivity mechanisms to explode the mine when inside parts are exposed -- and so the struggle of measure and countermeasure goes on.

Allied to this is the operation of our underwater demolition squads that have done such gallant work on landing beaches.

Passing to the subject of minelaying, consider now the various types of minelayers.

Mines may be laid by surface, submarine or airborne minelayers.

Large CM's like the Terror here shown were used early

On 44-828

in the war to lay defensive mine fields, as at Casablanca. They can carry a large cargo of mines, upwards of a thousand, but their speed is too low for most tactical mining and they have recently been used to service other minelayers.

On 46-303

The converted four-stack destroyers of the type here shown were faster and could carry about eighty mines but their limitiations in fuel capacity have at times been a disadvantage. However, they did great work in the Solomons early in the war.

On 45-839

As an improvement in our DM's some of our 2200-ton Sumner type destroyers were converted into the so called Aaron Ward class of DMs. Their fuel capacity is greater than that of the ODD's and they carry more mines. Notice the mines installed on tracks on the afterdeck.

On 46-483

The Aaron Ward itself incidentally was hit by six Kamikaze's on 3 May 1945 at Okinawa. It was of this vessel that Admiral

On 45-484

Nimitz said "we all admire a ship that can't be licked."

On 44-2051

Here's a Jap minelayer after damage.

Off 44-2051

Motor Torpedo Boats can carry mines by replacing torpedoes with them. Of course, their range and carrying capacity are small. Soluble washers usually have to be replaced by wooden washers until the very moment of laying the mines.

Beginning with the Mark 10, a pre-war design, most mines have been of a cylindrical shape to facilitate launching from the torpedo tubes of submarines or the bomb bays of planes as well as from the decks of surface layers.

A sub can carry usually two mines for every torpedo, but since only one mine can be launched from a tube at a time, one was to be removed before launching, if two are kept in a tube.

Almost all planes can carry at least one mine:

46-853

A convenient rule of thumb is that mines are usually in the vicinity of one thousand pounds in weight or two thousand pounds and can be carried by planes that can carry one thousand and two thousand pound bombs.

You will notice on the slide that the patrol planes, PBY, PB4Y, PB2Y and PBM have a good capacity and that the B29 can carry about 15 mines of one thousand pounds and 8 of the two thousand pounds.

Airborne mines have the interesting feature of a set of arming wires running from the pilot to the mine's parachute, nose fuse and sterilizer. This enables the pilot by holding on to some wires and letting others go at the time of dropping the mine, to use it either as a bomb, or as a mine or to let it go as a dud when he wants to jettison it.

OFF SLIDE

The purposes of mining are various but, generally speaking, they are either defensive or offensive. Defensive when laid along our own coasts, and about our own harbors and anchorages; also when laid in narrow channels away from our own coasts with the purpose of keeping sea areas free of enemy men-of-war. Another defense purpose is to channelize own coastal shipping so that it is forced to concentrate in areas where it can be better defended.

Offensive mining has for its primary purpose, of course, the sinking of enemy ships. But a distinction may be made between attrition mining and closure mining.

Attrition mining is the continued mining of the enemy's shipping lanes, each mine field being planned to sink or damage only a few ships. Generally, attrition mining is carried on with the expectation that fairly effective countermeasures are in use against the mines. In addition to sinking enemy ships, a well carried out attrition mining campaign has other effects of almost equal importance.

It stimulates countermeasures. Defenses against mines, particularly against mines of varied types, laid more or less continuously in a variety of locations, are expensive and troublesome. Unless appreciable losses are to be risked sweeping must be done regularly even though no mines are present. Delays due to suspected mine fields are serious. It has been estimated that the total cost of countermeasures, including delays of shipping and diversion of traffic, was in the European theater four times the cost of the minelaying.

Closure mining has for its purpose the more or less complete stoppage of enemy vessels for a limited time. An early discovery of the field is expected but the field is planned to make the danger to the individual ship so high that prohibitive losses will result unless the enemy stops traffic through the mined area.

It may be expected that the enemy will take countermeasures to clear a channel so that the delay resulting from a single lay will necessarily be limited. Any attempts to close a port by surface or submarine layers would therefore be only temporarily successful. But if the mines are laid by aircraft, reconnaissance can indicate the channel being cleared and additional mines can be laid to maintain the danger of the field.

Many factors govern the planning of a minefield including the following:

Depth
Tides and current
Weather and waves
Bottom
Fouling
Transparency
Latitude
Characteristics of enemy traffic
Availability of his sweeps
Type and range of own minelayers
Sensitivity setting
Delays to be chosen
Types of mines to be used
Dimensions of the fields
Navigational aids
Defenses to be overcome
Diversion to be used
Possible interference with own operations
Notice to all hands of the field's location
Reconnaissance
Refreshment of the field, etc.

Since deep water mining requires moored mines and since moored mines with their anchors and cables are heavy in relation to the weight of explosive carried, most moored mining is done by surface craft rather than by air.

Here is an illustration of the laying of the old standard MK 6 moored mine.

USE COLORED CHART #1

On 46-806

And here is one of the newer surface-planted mines, the MK. 18, a ground magnetic induction mine. This mine carries the largest charge of any U.S. mine - 1350 lbs. of T.N.T.

Off 46-806

Offensive surface mining is usually done by more than one minelayer since it is likely to be in waters used or controlled by the enemy and the desire of the minelayers is to lay the mines quickly, and, if possible, secretly, and to get away safely.

Among the advantages of the surface layers are their good navigational facilities and their ability to operate in a close tactical formation.

A gallant and very effective surface mining campaign was conducted by some of our old converted four stackers in the Solomons.

On 46-902

Here's a slide of a mine field laid in Blackett Strait on the night of 6-7 May 1943 when the DMs, PREBLE, GAMBLE and BREESE, screened by the destroyer RADFORD, layed a three-row minefield.

The whole operation was conducted during darkness intensified by intermittent squalls. The executive officer of the RADFORD conned the entire force from the RADFORD CIC. Coast watches reported that within 48 hours combatant ships were sunk.

Off 44-910

A submarine can launch mines from bow or stern tubes or both but when launching a mine from a bow tube it must take care to move slowly enough to avoid striking the mine before it sinks and yet fast enough to clear a moored mine as it rises on its cable.

USE COLORED CHART #2

Here is a slide depicting a sub launching a Mark 10 moored, contact mine.

Early in the Pacific war our only offensive mining was conducted by submarines. They penetrated deep into enemy waters and laid mines along the shallow Chinese coast forcing Jap shipping into deeper water where it was more vulnerable to torpedo attack.

Minelaying by aircraft differs from other forms of aerial assault in that the target is merely a spot in the water indistinguishable from any other spot. This means that a substitute aiming point has to be developed. The usual practice is to pick outstanding landmarks when dropping visually from low altitude. Using radar for mine laying involves selecting pin points from radar scope photographs.

In the selection of pin points the planned approaches should be over areas free of AA and search lights if possible. As soon as the pin point is reached a stop watch is started. At the end of the run-out the mine is released.

The accuracy obtained in pin point aiming is calculated

as 10% of the run-out distance. For this reason pin points close to the desired mine location should be chosen.

Also small errors in wind determination will cause large errors in mine location.

Aerial mining of course has been a big thing in the Pacific war. Most defensive mining has been done by surface craft but most offensive mining was done by air and it contributed greatly to the defeat of Japan.

In the Central Pacific, PBY5's and PB4Ys laid mines in the Marshalls and carrier planes mined Palau. Catalinas of the RAAF flying from Australia closed the ports of the East Indies time and time again.

From India the 10th Air Force closed the port of Rangoon and the 20th Bomber command reached as far as Singapore.

In China the 14th Air Force mined the coast of China, Thailand, Indo-China and Formosa and in 1945 B29s began their great mining offensive from the Marianas.

On 46-296

Beginning on 27 March, B29s of the 313th Bomb Wing, XXI Bomber Command, undertook to close by mining the Shimonoseki Straits, the Inland Sea, and important ports in the Japanese Empire.

On 46-385

This is a natural target. The straits are narrow and shallow and the Inland Sea is generally 30 fathoms or less in depth, ideal for aerial mine laying of magnetic and acoustic ground mines.

It is estimated that by mid June the Straits had been closed at least one third of the time and that throughout the Empire as many as 150 ships had hit mines. From photographs taken during the first two weeks after the minings of 27 and 30 March it appears that approximately 80 per cent of the vital flow of shipping through the Shimonoseki Straits was denied passage. Anchorages, in this region so vulnerable to bombing, were bulging with merchant and naval craft while minesweepers were furiously engaged in an effort to break this blockade.

The tactical importance of the program is revealed by the fact that the one task force, built around the Yamato, which the Japanese sent out to contest our attack on Okinawa, chose to sortie via Bungo Channel rather than via Shimonoseki Straits. The task force was sighted by our submarines and proceeded within easy range of our reconnaissance planes. While the overall Strategic plan was directed at merchant shipping, Tactical considerations loomed very large in the first raids, which greatly hampered the enemy in maneuvering his naval units.

On 46-486

I have here some figures showing the total U.S. mines laid during the war through July 1945 in the Pacific which may surprise you as much as they did me.

Off 46-486

SUMMARY

In this general discussion we have touched on Mine Construction, Mine Countermeasures and Minelaying.

Under Mine Construction we considered various firing mechanisms:

Contact
Magnetic needle
Magnetic induction
Acoustic
Pressure, and
Observation.

You also have become acquainted with a few mine accessories: the extender, clock delay mechanism, sterilizers, soluble washers, etc.

As far as countermeasures are concerned, first in importance is minesweeping, contact, magnetic and acoustic. Other measures are the paravane, degaussing, deperming, countermining, avoidance and recovery.

You have seen slides of our principle types of minelayers and have heard something of the problems of planning a mining sortie, together with examples of our surface and aerial mining campaigns.

In short you know that a mine is a highly intricate weapon, greatly developod during World War II, and requiring exact knowledge and careful planning to use it and to combat it.

Strategic blockade by mining has now come of age. It played a vital role in restricting the Jap's efforts to redeploy his forces and prevented him from utilizing fully his resources for the final phase of the war.

THE NAVAL MINE

TITLE OF THE PRESENTATION

Given by Cdr. Allis

Date

LEFT SCREEN (FACING STAGE)			RIGHT SCREEN (FACING STAGE)		
Box No.	FILE No.	TITLE OF SLIDE	Box No.	FILE No.	TITLE OF SLIDE
			1	45-2164	Needle mechanism
			2	41-2165	Coil mechanism
					lights
			3	44-2047	Mk 25 section
			4	46-485	Mk 25 wiring
					lights
			5	46-305	JA adrift
			6	46-307	Floating JB
					lights
			7	44-828	Terror
			8	46-303	Gamble
			9	45-839	Aaron Ward
			10	46-483	Aaron Ward
			11	46-484	Aaron Ward
			12	44-2051	Jap layer
					BLANK
			13	46-853	Plane capacities
					lights
			14	46-806	Mk 18
					BLANK
			15	46-902	Blackett St.
					lights
			16	46-296	B29's

THE NAVAL MINE

TITLE OF THE PRESENTATION

Given by Cdr. Allis

Date

LEFT SCREEN (FACING STAGE)			RIGHT SCREEN (FACING STAGE)		
Box No.	File No.	TITLE OF SLIDE	Box No.	File No.	TITLE OF SLIDE
			17	46-385	Inland Sea
			18	46-486	Mines laid
					lights

Digest of Presentation on The Naval Mine

Naval War College, 16 January, 1946

Introduction

The subject of Naval Mines naturally divides itself into Mine Construction, Mine Countermeasures and Mine Laying.

Mine Construction

Some parts are common to all mines and some depend upon the use to which the mine is put.

By position mines are classified as Ground, Drifting, Moored or Sabotage.

By firing mechanisms mines are classified as Contact, Influence or Observation.

Contact mines depend for actuation on contact of the target with the mine, its antennae or its cable.

The general use of influence mines is new with this war, whether magnetic, acoustic or pressure or a combination of any of these.

The magnetic "needle" type mines depend for their actuation on the strength and direction of flow of the magnetic force of the target ship's field.

The magnetic "induction" type mines depend on the rate of the approach of the target ship's field to generate current in a coil.

Acoustic mines, upon receiving sounds on a diaphragm, select only the particular frequency typical of the intended target before amplifying it to cause actuation.

Pressure mines usually are combined with magnetic or acoustic devices so that mere pressure changes of waves and tides will not fire them..

Influence mines may be set to the sensitivity most likely to react to the intended target and to ignore others such as sweepers.

Also, influence mines have counting devices requiring a set number of actuations before the mines are fired. And, in addition, many such mines require that a set pattern of "looks" (of random or opposite polarity, for instance) be received within a fixed "live" period in order that one count may be recorded.

The observation mine is wired to a shore firing switch.

Accessories of mines, such as the clock delay mechanism, the clock starter and the extender, insure delayed arming and later sterilization, not only to protect mine layers but also to add to the complexity of minefields.

Countermeasures

Sweeping is most important.

Ship precautions include degaussing, deperming, paravanes, careful observation of depths and currents, and constant use in suspected areas of sonar, lookouts and planes.

Most mines are protected against countermining by stabilizers, circuit breakers and by proper spacing.

To defend against a mine it is desirable to know the details of the weapon. Anti-stripping devices make the work of the U.D.T. more dangerous.

Minelaying

Surface minelayers include the CM's, such as the Terror, which was not fast enough, the old DM's that played such a fine part in the Solomons despite their small fuel capacity, PT boats and the new Aaron Ward DMs.

Most mines are of a cylindrical design to permit launching from the torpedo tubes of a submarine or the bomb-bays of a plane. Planes that can carry 1000 lb or 2000 lb bombs can carry mines of these approximate weights.

The purposes of mining may be defensive or offensive, attrition or closure, to sink ships or compel countermeasures, or any or all of these.

Planning a minefield involves many factors including depth, tides and currents, weather, bottom, latitude, characteristics of enemy traffic; availability of his sweeps, type and range of own minelayers, sensitivity settings, delays to be chosen, mine types to be used, dimensions of fields, navigational aids, enemy defenses, diversion, possible interference with own operations, notice to all hands of fields location, reconnaissance, refreshment, etc.

Conclusion

The mine is a highly intricate weapon, greatly developed during World War II and requiring exact knowledge and careful planning to use it an to combat it.

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