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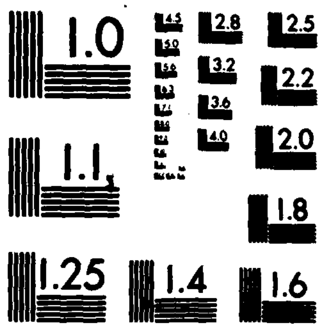

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AUTHOR: HANS-KRISTIAN BERGER

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MINE DEPLOYMENT AND OPERATIONAL MEANS

[Fregattenkapitän Hans-Kristian Berger: Soldat und Technik, D 6323 E, Vol. 2, Feb. 1983, pp. 68 - 71; German)

This series of articles is intended to make the reader familiar with /68
mine warfare as an integral component of naval warfare. In the following discussion this objective of mine laying as a component of mine warfare will be further elaborated.

For this purpose the attempt will be made primarily to show on the basis of characteristic features, capabilities and limitations of the mine weapon. In addition, the intent is to provide an impression of the collateral conditions and the expenditure and the disadvantages. Technical details will in this context be accorded less attention. Similarly, tactical details or even operational "scenarios" are of secondary importance for the purpose of this article.

FEATURES OF THE MINE

The often cited lack of ease in discussing mine use is caused to a large extent by the fact that the mine has been designated as a "weapon" for a long time, but that the basic example, which is associated in the subconsciousness, of the functional chains of all other weapons - Carrier connect until firing - target assignment - firing - movement to the target - ignition in/on target - does not apply. The basic example of the mine - transport to firing point - waiting - target acquisition - ignition triggering by the target - can be easily understood, when the main components of the mine are considered, which in principle remain unchanged to the present:

- Ignition systems. which react to mechanical contact or physical radiations of a ship.
- The explosive.
- Additional tactical equipment.

The basic model lacks the dynamic component and the human decision making process ends a long time before the firing, i.e., the psychological "point of not retu:n". These aspects are discussed more comprehensively in the section "Mine Deployment". It should be noted here that mines unlike all other weapons mines are not designed primarily for a direct attack on a target or to defend against an object. They are moreover intended to constitute such a threat for ships in an area of the sea, that the enemy insofar as possible will not use such an area or is forced to accept severe losses. However, it should be noted at this point that blocking areas of the sea with mines on a permanent basis is illusory.

The characteristic feature of the mine is therefore its action to change geography. In order to make the capabilities and limitations comprehensible and to exploit them, first the main components will be described in greater detail. Then a summary of the most important features follows as a transition to the section Mine Deployment.

THE IGNITION SYSYEMS

Contact Ignition

The direct contact between ship and mine is required. Because of the contact the so called "horns" on the mine casing are bent, which either act directly as a switch for the ignition current or contain the acid containers of an electrolytic fuze. This oldest type of ignition can be in moored anchor mines, in which the main components are contained in a floating container, which is held at the desired site by an anchor. The length of the mooring anchor (chain or wire) determines at what level the container is below the surface of the water and therefore as well what ships according to draft can be engaged. The principal advantage of these moored anchor mines with contact ignition is their relative degree of independence of the water depth. Today depths of ca. 1,000 m can be used. The most serious disadvantage is the very small threatened area. Expressed in other terms: The radius of the circle around the mine into which the ship has to come in order to trigger the ignition system sufficiently is extremely small. This radius is designated for all mines by the term "response zone". The "damage zone" of the ship is directly associated with this performance parameter of the mine. It is the radius of the circle around the ship in which the mine must detonate, in order to render damage. In the ideal situation both parameters should be of the same magnitude, in order to exploit the threatened area fully and to prevent detonations without damage effects, so called wasted ignitions. Both values depend essentially upon the /6

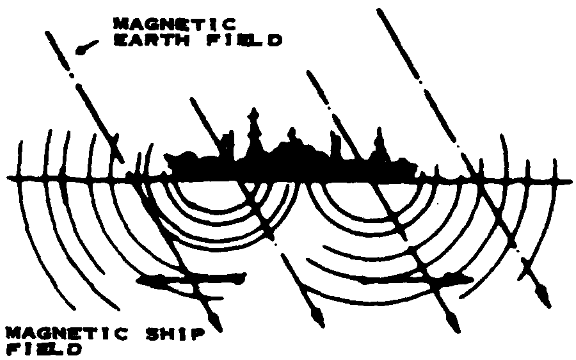

Fig. 1: Graphic illustration of the change of the earth magnetic field by the magnetic ship field.

the ignition system and the charge of the mine, the resistance and the size and the physical characteristics of the ship and upon the water depth. This mutual relationship is even more apparent in mines with remote ignition systems.

REMOTE IGNITION SYSTEMS

Current remote ignition systems respond to the magnetic field of a ship, to its acoustic radiation and to its pressure field. These ship signatures can be used individually or in any combination for target acquisition, target identification and for ignition time determination. According to the signatures used by the ignition (firing) system, remote firing mines are designated as magnetic, acoustic, pressure or combination mines. They can be designed as moored anchor mines or as ground mines anchored on the sea floor by their own weight. Remote firing mines contain the most modern technology up to the microprocessor, in order to exploit the immense multiplicity of parameters of ship signatures, the environment and the tactical considerations as well as mine countermeasures.

Theoretically a remote ignition system can be designed today in such /68
a manner, so that it reacts only to field characteristics of a particular
ship or class of ships. If the characteristic feature of the mine is
considered, the the capability must be demanded of the mine to react to
the spectrum of the ship types, which the enemy will presumably use in /69
the area to be threatened. Remote firing systems will therefore have
to be set to one or more "target ships", i.e., the representatives of
the ship classes.

In reference to the capabilities and limitations of the mines it should be noted for the individual ignition (firing) systems:

MAGNETIC MINES

The firing (ignition) systems can exploit the change of the earth magnetic field by a ship field according to strength and/or by time to generate the firing signal, as well as the measurement of the ship field levels and their changes. Ship fields have according to the size, design, material and cargo differentiated field strengths and field strength changes, which decrease with the distance from the ship. The ignition (firing) system can according to its measuring sensitivity can detect a ship and in further measuring processes the change of distance.

From the pre-selectable minimum measuring values it can determine both the target ship and a good firing time. Good in this context means that the firing occurs within the damage radius. Aside from the fact that

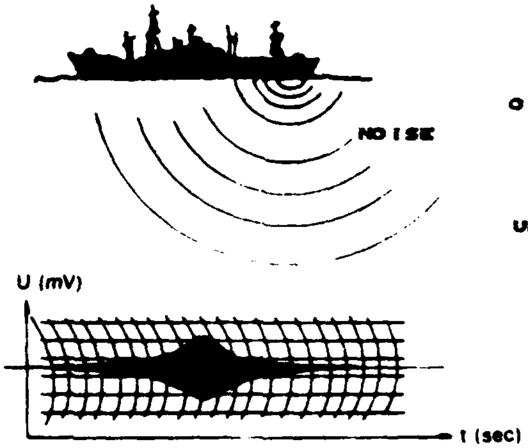

FIG. 2: ACOUSTIC RADIATION OF A SHIP UNDER WAY

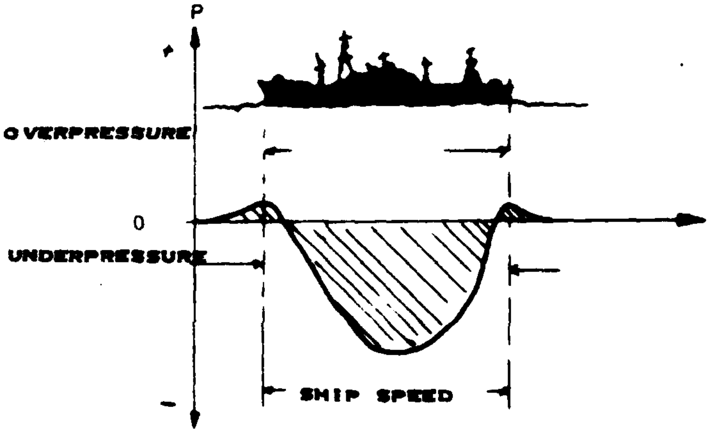

FIG. 3: THE PRESSURE CHANGE ON THE SEA BOTTOM CAUSED BY PASAGE OF A SHIP.

frequently several target ships are to be threatened, the ship fields themselves do not provide an excessively precise measurement values for a target identification and firing point determination. Magnetic mines therefore have a relatively high risk of wasted ignitions. The strength of the magnetic fields decreases with distance in such a manner that the mine can receive adequate signals in general only up to a water depth of 60 meters. In addition they can be neuralized with relative easy by mine counter-measures.

ACOUSTIC MINES

The noise generated by ships is propagated basically in spherical form and consists of a multiplicity of frequencies of differentiated acoustic strength. The firing (ignition) system uses microphones for target acquisition and tests for target identification and firing time determination whether or not the characristic frequency/strength combinations to be expected from the target ship are contained in the acoustic spectrum. The detection range of acoustic mines is greater than of magnetic mines; target identification and firing time determination are more precise. Acoustic mines are however easier to deceive and neutralize by counter-measures.

PRESSURE MINES

As in the wave track along a ship it can easily be "read", moving ships generate over- and underpressures, which are differentiated primarily on the basis of ship form, size and speed and seaway conditions from the surrounding feield. The firing system exploits the underpressure signature for target acquisition, target identification and firing time determination. The detection range is in general considerably less than in acoustic and magnetic mines. However, this has a positive effect upon the firing time determination. Because of the considerable dependence of the signature upon the speed and size of the ship, the target ship spectrum is narrower and the firing system can often be confused by very slow ship movement. However, this is compensated by the fact that pressure mines today can only be combatted by minehunting units.

COMBINATION MINES

Two or each of the remote firing systems mentioned above are used. The principal objective is to exploit the imdividual strengths of the three components for target acquisition, firing time determination and resistance to mine countermeasures and to compensate the weaknesses of the particular systems.

THE CHARGE

Solid explosives are used, which as in all weapons are constantly being improved in order to increase the efficiency per unit of weight. For the mine explosive the density is also of special importance, because the majority of the space and weight percentage is contained in this component. Therefore the density impacts directly upon the required shipping area and therfore upon the number of minelaying units and their size. The weight saving impacts directly upon the design of the minelaying units or the suitability and transport capability of platforms, which are not designed as minelaying units. For example, the airplane can be cited.

If a contact mine is ignited, the charge acts very much like any other explosive charge; i.e., the ship is damaged primarily by destruction of parts in the immediate vicinity of the detonation point - such as, for example, rudder, keel or ship hull. Finally, a local damage occurs, whose results can of course cause the total loss of the ship.

In the case of a ground mine, the action occurs only in very shallow water. With increasing water depth the primary action derives from the gas bubble, which is generated by the detonation and which is propagated against the water "insulation medium". To state this in a more

simplified manner, the ship is struck after the first shock wave /69
transmitted by the water by overpressure and underpressure waves /70
which alternate very rapidly. The main effects are distortions and torsions which result in breakage of braces, lines, systems, frames or the keel. The probability of a total loss is considerably greater than in the case of a contact mine

THE AUXILIARY SYSTEMS

These components are also generally designated as tactical devices and are intended on the one hand to reduce the lack of non-influencing sensitivity and on the other hand to increase the resistance to mine countermeasures.

Clockworks are used for the first purpose, with which the arming time is pre-set. Circuits integrated into the firing system are used for the second purpose, which makes a multple generation of the response signals a predication for triggering the firing signal. Therefore, several target ships or mine countermeasures devices must pass over the response radius of the mine. In this battle of the mine technique and tactics against the countermeasures technology, the following article will not be anticipated.

COMMON FEATURES

▼ From the characteristics if the mine types described and their relationships to the target ships common characteristics result for all mines, which are the basis for understanding the deployment of mines:

▼ The action of changing geography distinguishes the mine from all other conventional weapons.

The relations between ship and mine limit the response range which can be obtained today to ca. 80 m. It results from this that ground mines can be employed against surface units only up to this water depth and that mines can consitute a real threat only when they are deployed in large numbers. The object of any evaluation is the effectiveness of a minefield and not the individual mine.

FIG. 4: MINE TRANSPORT

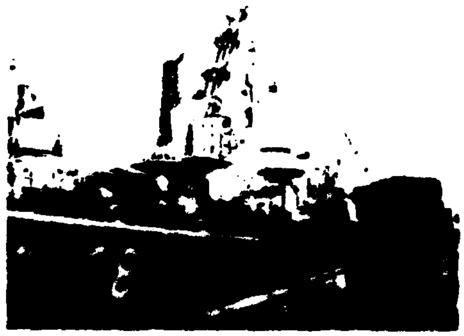

FIG.5: LOADING ON MINE TRANSPORT

FIG. 8: UNDERWAY FOR MINELAYING

FIG.9: SM-SHIP WITH MINE LOAD

▼ Mine can be combatted directly only by special mine countermeasures ships. /70

▼ Mines are not resistant to mine countermeasures.

▼ Mines cannot distinguish between friend and foe.

▼ The degree of tuning of a remote ignition (firing) system to a target ship depends upon the knowledge of the target ship signature, the water depth and the geophysical conditions.

MINE DEPLOYMENT

The term "mine deployment" is defined as the preparation and performance of minelaying operations. The wide range includes the operational planning and the materiel preparation and terminates with the return of the units involved in a minelaying operation. In the sense of the objective of this article this spectrum is reduced to the question: "What can be realized and what parametric conditions have to be considered?".

This is important, because the answering of this question is the key for the individual decision on the issue "What should be realized?" and therefore for the assignment into the entire tasking spectrum elaborated by Kapitän zur See Niemann in the first article for a navy.

If we again proceed from the effect of changing the geography, the the solution to the question begins with the clarification of what sea areas the enemy has to or wants to use and in what sections of these areas mines can be employed. If the last is easy to determine by looking at a sea chart and the operational values of the mines, then the first issue requires a considerable effort for the collection and evaluation of information both on the ecocomic conditions and for the military capabilities and intentions. If the expenditure for the required number of mines and their transport is added, then laying minefields is rapidly concentrated in those areas, where the shipping traffic has to be concentrated for economic and military reasons and/or because of the water depth.

These areas are primarily harbors and their approaches, straits and coastal areas, which are suitable for amphibious landings, therefore, areas which cannot be avoided. Mines will be used here insofar as possible in reference to natural barriers such as land and shallows, in the manner of a net, whose mesh size and durability cannot be calculated for the enemy. However, as well - because of the width or constriction or the water depths - minefields can realize their operational mission only one a one-sided basis or a network which is not referred to or associated with such barriers. Here they channelize the enemy shipping traffic and therefore create concentration areas for other naval weapons.

The effects of minefields can be summarized as follows:

▼ The materiel supply of the economy, of the population and of the armed forces can be interdicted up to temporary and local paralysis.

▼ The sorty of naval forces can be prevented, and in particular can be delayed or attenuated.

▼ The defense against amphibious landings can be continuously supported.

▼ The freedom of movement of naval forces can be restricted particularly by mining straits.

▼ The effectiveness of other naval weapons can be enhanced.

▼ Personnel and material can be diverted for the detection and eliminatio of the mine threat. This expenditure exceeds as a rule the expenditure required for mining by far, if the dependence upon sea supply or clearing protected minefields is of vital importance.

▼ The own freedom of action is restricted to a degree similar to that of the enemy.

Before we specifically address mine use and deployment in the FRG Navy, the expenditure has to be considered again. Obtaining information on the areas to be mined and the target ships have already been mentioned. Processing such information for planning a minefield - i.e., the question "How many mines of what type do I need in order to obtain a desired degree of threat?" to be answered - is not longer possible with manual calculation techniques. Therefore, computer-supported calculation programs must be developed. They also helpt to reduce the time required for the preparation of minelaying operation. /70

Time as a matter of fact exerts an decisive influence upon the expenditure. For setting the firing (ignition) systems and therefore the efficiency of the minefield or as well the number of mines required it is advantageous to have to make few assumptions in regard to the target ships and intentions of the enemy; i.e., to perform the minelaying operation as late as possible. Coincidental the restriction of the own freedom of action can be delayed. However, this is opposed by the significantly more critical risk that minefields which are used for the defense of our own coasts and waters must be realized to defend against attacks of the enemy. The expenditure for the protection of minelaying operations can exceed the costs for the mines and their transport considerably. /71

Therefore the attempt should be made to perform such mining operations as early as possible.

However, the correct conclusion from the characteristic feature of the mine imposes narrow limits om this operational requirement. In order to maintain the freedom of the high seas, international law condones minelaying before the outbreak of a war only:

- In the own territorial waters, insofar free transit is provided and

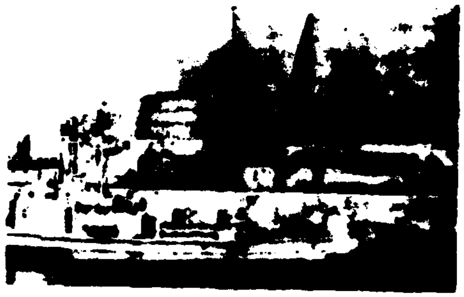

FIG. 6: MINE TRANSFER TO COASTAL MINELAYERS

FIG. 7: MINE TRANSFER AT ANCHOR

FIG. 10: MINEHUNTER SQUADRON AFTER COMPLETED EXERCISE ALONGSIDE TENDER.

▼ In parts of the high seas, insofar as it is required for protection against an immediately imminent attack. /71

Here reference will be made directly to the FRG Navy. National (FRG) law includes international law Our legislation also also specifies that the determinaticn from when and with whom we are at war and that an attack is imminent must be made by a political council. Therefore, the Navy may lay mines wherever only after the approval of the political leadership.

A look at the water depths in the Baltic Sea and The North Sea and the Baltic Approaches shows that in themain operational area of the (FRG) Navy mines can be laid anywhere. The geography of the Baltic Approaches makes it possible almost in an ideal manner to lay minefields in the narrow passages next to the coastlines. The close association of land and water however also indicates that minefields can only perform their defensive function so long as the control of the adjacent land (shore) is denied to the enemy. In addition, our mine deployment can result in an unavoidable system of "nets" only in close cooperation with Denmark.

If we consider that the control of the area of the Baltic Approaches in the event of a conflict is a prerequisite for the Warsaw Pact for access to the Atlantic and for us this control is a prerequisite for the protection of the vital reinforcement and supply transport lanes through the North Sea, then it is apparent that the emphasis of a mining operation of the (FRG) Navy must be directed to the Western Baltic and the Baltic Approaches. As opposed to this, the emphasis for the Warsaw Pact in our area can only be in the North Sea.

For the Baltic and its approaches, our mining operations compell the Warsaw Pact to maintain a large mine countermeasures capability.

The importance which the (FRG) Navy assigns to mining operations can be illustrated by the fact that from submarines to destroyers almost all units can deploy mines. This naturally also results from the fact that minelaying operations always require a relatively short period of time and that single-puprpose minelayers would not be fully utilized. In the vicinity of the enemy, however, the already mentioned factor of "time" makes it necessary to provide so many units for the primary mission of minelaying so that as required the most important minefields can be laid simultaneously. In this regard the principle of "small and many" is followed, so that even with losses sufficient numbers of mines can be laid. In addition, large units could not perform this mission in the shallow coastal areas and in the straits.

The technical proximity has the effect that these minelaying units of the (FRG) Navy are also equipped as mine countermeasures units. Included among these are the 21 fast coastal minesweepers of the SCHÜTZE Class and the 18 inshore minesweepers of the ARAIADNE and FRAUNELOB Classes. They are supplemented by the landing ships and supported by the two mine transport ships SACHSENWALD and STEIGERWALD. From these ships or the depots they take the mines and keep themselves ready for operations. Transfer and laying of the mines and cooperation with security units are frequently practised, because the correct positioning of the individual mines in the fields is of critical importance for their degree of efficiency and because speed and stealth are decisive for the ability to perform the minelaying operation.

There are several thousand mines in our depots; these are primarily US ground mines; there are also moored anchor mines manufactured in Germany for which the whole spectrum of ignition (firing) systems is available. They can be loaded on minelayers operationally in a short time. How the firing systems should be set can today be calculated with a computer-supported minefield planning program at Fleet Headquarters in Glücksburg. The capability of being able to deploy the available resources as required has been repeatedly tested and demonstrated.

PROSPECTS

The mine weapon of the (FRG) Navy is currently beginning a change of generation. The US mines are reaching the end of their operational lives. They are gradually being replaced by modern German developments. Beginning this year the Sea Mine G1 is being procured, which can be laid by submarine. Thereafter we will have the German-Danish Sea Mine SA1, which is intended for defense against landings on our coasts, followed by the Seegrundmine 80 (sea ground mine), which was also jointly developed with Denmark. In the developments the emphasis was directed towards eliminating the weak points of current mines, i.e.: reducing expenditure by easier maintenance and reducing the size of the components, time saving by more flexible setting capability of the firing systems and reduction of the wasted firings (ignitions) and the mine countermeasures vulnerability by utilizing the the most modern technology. Also, the end of the service life of the SCHÜTZE Class of coastal minesweepers, which have been in service since the beginning of the 1960's, can be anticipated. The development of a successor class has already been initiated.

Therefore it is being insured that the mine will continue to be capable of performing its role in the spectrum of missions of the (FRG) Navy. ◻