Aug. 15, 1961 D. S. MUZZEY, JR 2,996,006

ANTI-SUBMARINE MINE

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FIG.1.

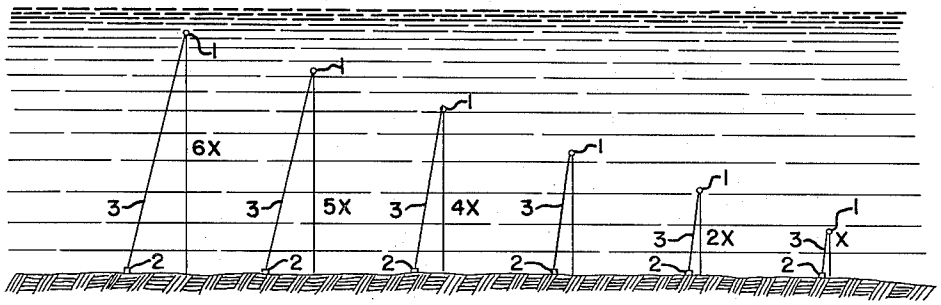


FIG.2.

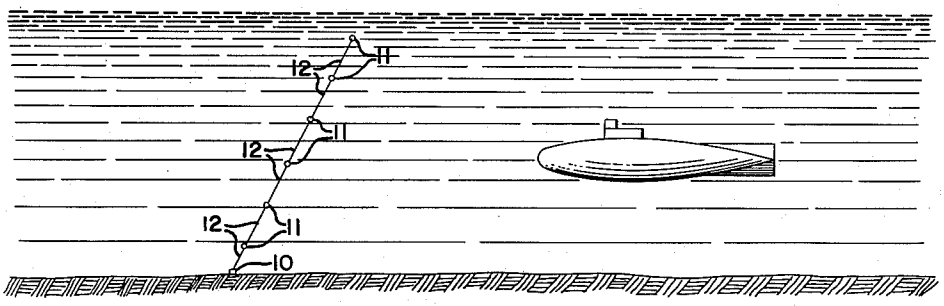


FIG.5.

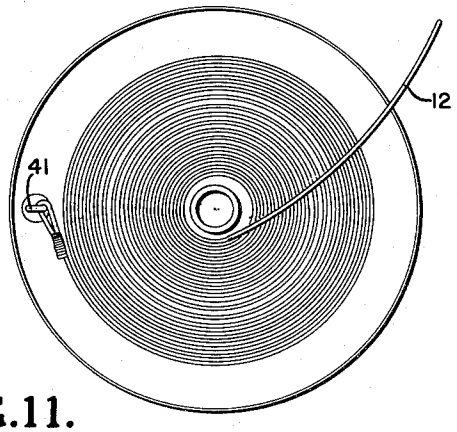


FIG.10.

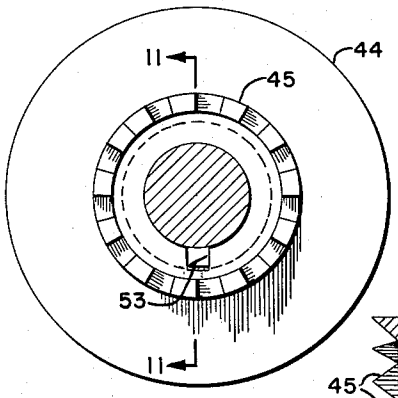
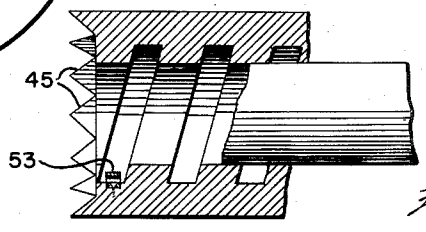


FIG.11.



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FIG.3.

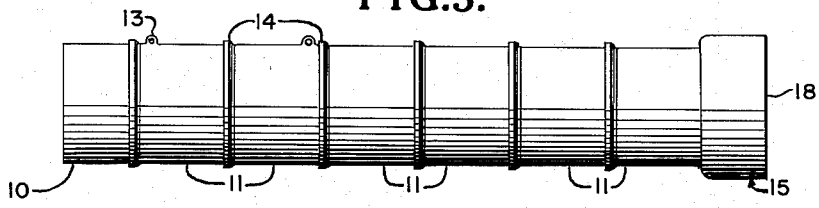


FIG.6.

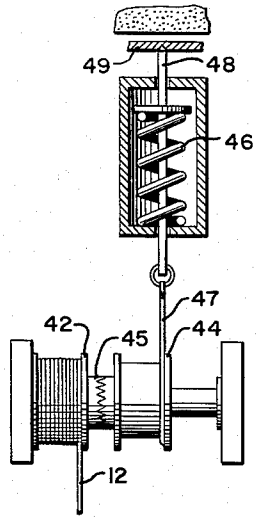


FIG.7.

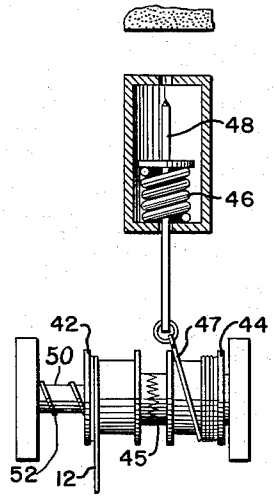


FIG.8.

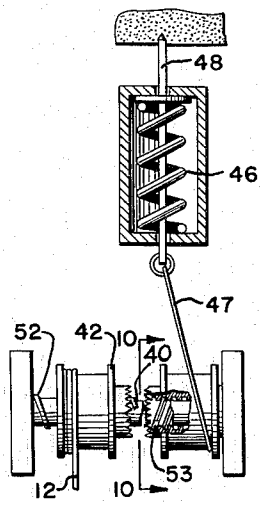
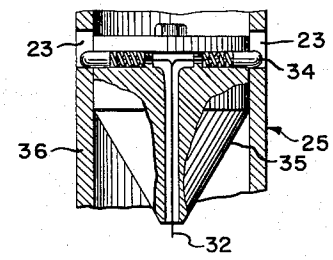


FIG.9.



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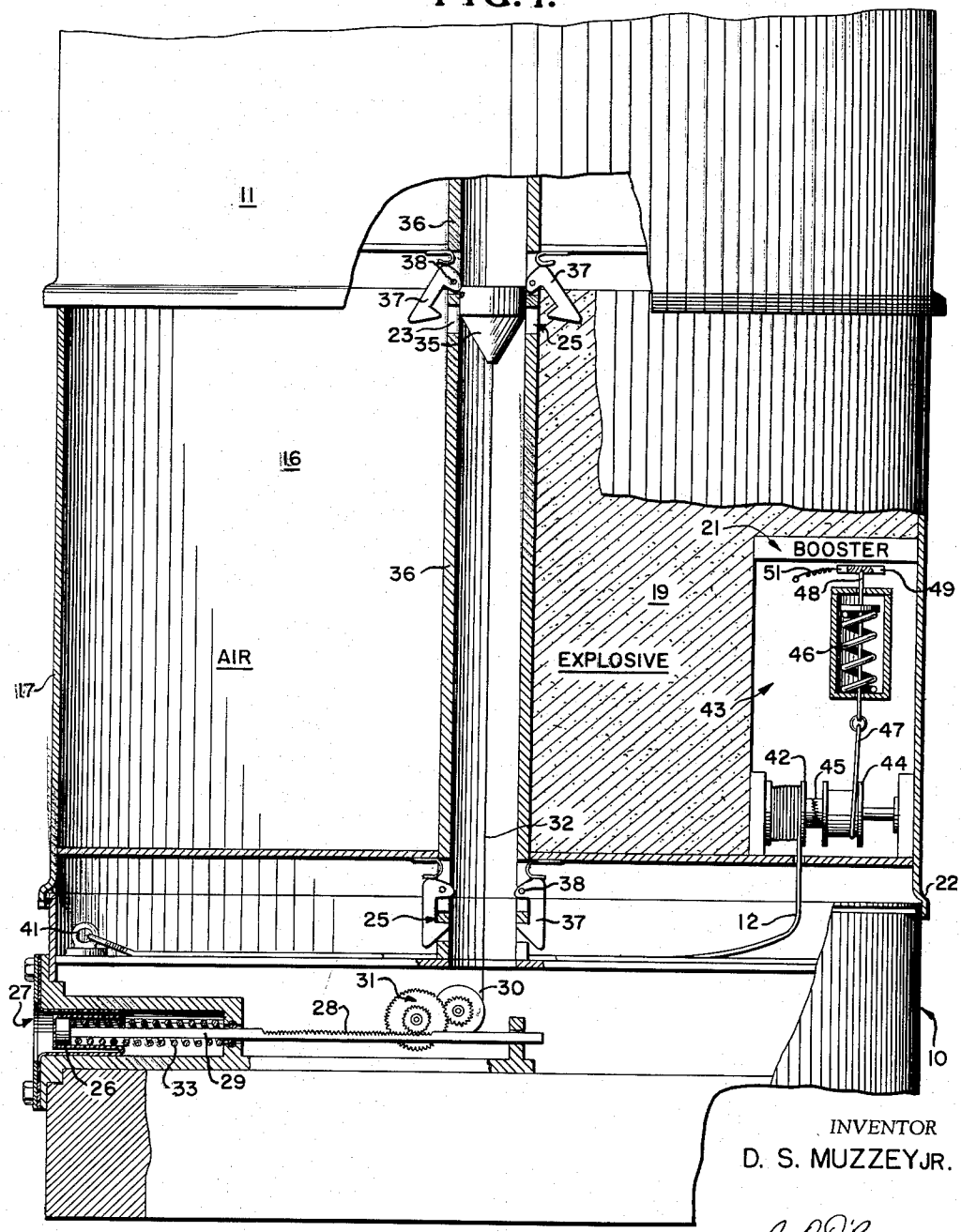
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FIG.4.



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2,996,006

ANTI-SUBMARINE MINE

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Filed Mar. 31, 1955, Ser. No. 498,459
4 Claims. (Cl. 102—11)
(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates to an improved method of mine field protection particularly against submarines and to a moored mine assembly for use against both surface vessels and submarines of a character which is more effective thereagainst than the mines of the usual mine laying pattern by which each mine of the mine field is attached to an individual anchor. The instant mine field utilizes fewer mines, and incorporates an aircraft launched mine of a character having a plurality of series arranged moored buoyant charges with firing mechanisms therein so disposed as to effectively cover or protect the entire depth of water within the effective area of the charges thereof.

More particularly, the instant invention relates to a mine assembly utilizing a single anchor and a plurality of short cylindrical case structures, each containing an explosive and means providing a buoyancy volume, with each case structure so interconnected by a cable arrangement that the plurality of mines are disposed at various preselected levels within the water and at predetermined spaced distances along the mooring cable.

In a preferred embodiment of the invention the entire assembly comprising the anchor and the series of explosive cases are assembled in a compact unit for mine laying from an aircraft in flight in which the assembly to be released is in the general shape of 2,000 pound aircraft carried mine. In prior systems for protecting an area against submarine attack it is necessary to employ a series of 2,000 lb. mines each on an individual anchor with a length of cable connected from the anchor to the mine such that the depth of the first mine with respect to the bottom would be, for example, 100 feet; the cable length on the second line which is spaced vertically 100 feet therefrom would be 200 feet; the third would be disposed 300 feet from the bottom and so on to the last of the group which would be a multiple of 100 feet plus of a length sufficient to provide for submergence of the mine, for example, 40 feet below the surface of the water, thereby to render the mine concealed from visual detection at the water surface. In such an arrangement, the mines carrying 300 lb. explosive charges are carefully spaced so as not to contact or entangle one another and it is customary to space the mines a distance of some 300 feet apart so that the explosion of one 300 lb. charge of a characteristic type of mine will not set off the others.

In deploying the mine of the instant invention in an underwater field to be mined the proposed segmented mine is launched as a unit from an aircraft and contains a charge in each of a plurality of buoyant cylindrical chambers of approximately 80 lbs. of high explosive. The spacing of individual charges is such that the entire string may go off when the firing mechanism of one of the mine cylinders is actuated; the entire length of the cable being interconnected to respective ones of the mine system thereby being adapted to act as a common actuator. This arrangement is effective if the submarine target bumps the cable, or one of the mines, hard enough so that slack develops in the cable after submarine movement away from the cable or mines, as the case may be.

The first mine above the point of contact of the cable will fire and with the passage of the shock wave through the water and/or resultant slacking of other sections of the cable may fire the other charges. The destructive effect on the target of this quick succession of explosions, for example, of a plurality of 80 lb. charges firing in a line is known to be much greater than that of a single 80 lb. charge.

It is a feature of this invention to provide a moored mine which is more dangerous to submarines than the usual type embodying a single charge which is attached to an anchor individual thereto, and which improved mine structure comprises a series of interconnected moored buoyant charges with separate firing mechanisms in each of the charges to cover substantially the entire depth of water at one particular station against safe passage of a submarine therethrough.

It is one object of the invention to provide an improved aircraft laid mine for protecting a particular zone of water against safe passage of a submarine therethrough in which protection is uniform throughout the depth of the water, and in which the number of active elements in the mine system varies at various depths of submergence while being provided by a single mine assembly.

It is a further object to provide an improved mine in which an entire group of single mine cylinders is launched from an aircraft by a parachute and which upon entering the water functions in response to hydrostatic pressure to operate the mechanism therein to separate the various individual units from each other and from the anchor such that the whole assembly will moor as a chain of small buoyant mines spaced along a series of connected cables extending above the anchor.

In correlation with the immediately preceding object it is a further object to provide a mine arrangement whereby individual units of the chain of mines may be prevented from operating if the depth of water is insufficient to warrent use of the entire string of separate small mines.

A still further object of the invention resides in the provision of a mine comprising a series of separable explosive units in which compensation as to the number of explosive chambers which are disposed along a vertical line in the water is automatically adjustable after entry of the mine into the water for providing protection from depths varying, for example, from 100 to 600 feet and in which the entire string of mines is initially contained in a single package for launching from an aircraft in flight.

It is a further object to provide a mine system which reduces the total overall weight of mines required to protect a given area against submarines and in which a plurality of buoyant explosive charges, are disposed along a substantially vertical path in the water, and connected to a single anchor thus obviating the necessity for a plurality of anchors each individual to each of the explosive mines.

It is also an object to provide a more effective explosive effect in a mine field when a single unit or the cable of the mine is contacted by a submarine to provide a chain firing of elements of the instant mine without activating the firing mechanism of adjacent units of the same character and disposed at horizontal distances sufficient to render them substantially immune from anti-countermining explosion as the instant mine fires.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIG. 1 is a diagrammatic showing of the manner in which six mines of the prior art type such as 1500 lb.

moored mines containing a 300 lb. explosive charge would be arranged to provide protection at a needed depth along the path of travel of a submarine;

FIG. 2 is a view in elevation showing the manner in which a mine of the instant invention is deployed under water to provide similar initial protection to the same depth as provided by the six separate mines of FIG. 1;

FIG. 3 is an illustration of the manner in which a plurality of sections of the mine are initially disposed in alignment with a common mine anchor for the assembly and with a parachute pack prior to launching the mine from an aircraft;

FIG. 4 is an enlarged fragmentary view in elevation and partially broken away with part thereof in vertical section showing the hydrostatic pressure responsive means for depth selective release of the mine section and additionally showing other mechanisms for paying out cable between the individual cylindrical explosive charges of the assembly along with the latch details whereby the sections are separated from one another and the lowermost one thereof from the anchor after launching;

FIG. 5 is a plan view of one of the explosive cylinder units of FIG. 4 showing the manner in which the interconnecting cable between mines is disposed in a flanged recessed portion of the top thereof prior to mine laying;

FIG. 6 is a fragmentary view of parts of FIG. 4, and showing the firing pin actuating assembly for the booster charge in the safe position thereof;

FIG. 7 is a view of the firing pin actuating mechanism of FIG. 6 in the armed position thereof;

FIG. 8 is a diagrammatic view of the firing mechanism of FIG. 5 in the firing condition thereof;

FIG. 9 is a detail of the plug assembly which is actuated by the hydrostatic release mechanism for effective sequential separation of each mine cylinder from the locking arrangement with a mating portion of the next adjacent cylinder unit;

FIG. 10 is an enlarged fragmentary view of the drum of FIGS. 4 and 6 to 8 taken along the line **10**—**10** of FIG. 8 and showing certain mechanical details thereof; and

FIG. 11 is an enlarged fragmentary section of the drum assembly of FIGS. 4 and 6 to 8 taken along line **11**—**11** of FIG. 10.

Referring now to FIG. 1 there is a showing of a plurality of mines **1** as heretofore employed with each mine connected to an individual anchor **2** by cables **3** of various lengths as, for example, in increments of $x=100$ feet between 100 and 600 feet to provide protection of an underwear zone to a depth of 640 feet against a submarine passing therethrough.

The improved arrangement of this invention will be apparent by reference to FIG. 2, in which a single unitary assembly of an anchor at **10** and a plurality of cylinders containing explosive charges **11** are spaced along a cable **12** to provide the same initial protection of the mined area upon passage of a submarine through the zone to be protected as that of the prior art system of FIG. 1.

Referring now to FIG. 3 there is shown thereon, a mine assembly indicated generally at **15** comprising a plurality of explosive chamber elements **11**, a common anchor **10**, a plurality of eye loops **13** and **14**, for handling of the mine and suspension thereof in the aircraft prior to launching, and a parachute pack at **18**. The structural details of the individual explosive units of the system are shown in greater detail in FIG. 4 wherein the buoyant chamber as provided at **16** between the outer casing **17** and the center column **36** is illustrated in accordance with a preferred embodiment of the invention. A high explosive chamber is provided at **19**, and the initiator, firing train and booster charge for firing are located as indicated generally at **21**. These elements are of a character well known in the art. The outer casing wall **17** of the cylinder element **11** is provided with an offset flange or bell portion at **22** to provide for a nesting relationship with the anchor or the periphery of the casing **17** of superposed cylinder elements **11** disposed thereover, as the case may be. The upper end of each of the cylinder walls **17** is provided with an elongated rim portion which is engaged by the inner wall of the bell portion **22** of the next succeeding mine section.

The individual units **11** are initially locked together along the column **36** and the lowermost unit is locked to the anchor. This locking of the units and anchor into a single unitary assembly is accomplished by a plurality of latches **37** which engage the column at aperture **23** of the latch assembly **25** which function in a manner which will become more apparent as the description proceeds.

The mine assembly of FIG. 3 is launched from an aircraft by release from the aircraft retaining structure at the hook eyes **13** and **14**. The parachute (not shown but contained in the pack **18**) brakes the fall of the mine, and helps to minimize the shock as the mine strikes the water. The parachute is subsequently disengaged from the mine assembly by a pack-container release mechanism, not shown, but of a conventional nature well known in the prior art.

As the mine assembly descends in the water, the pressure sensitive plunger **26** of the hydrostat assembly **27** of FIG. 4 which is spring loaded by coil spring **33** moves the rack **28** which may be attached to the piston rod **29** or integral therewith and provides rotary movement of the gear train indicated generally at **31**. This rotation is appled to a reel or drum **30** and functions to reel in cable **32** to effect an inward pull on the normally spring biased dogs **34**, FIG. 9, and release the plug **35** for longitudinal travel. This release is from an engagement by the dogs **34** with aperture **23**, at the top of the central column **36** of the uppermost mine cylinder and the pull of the cable **32** functions to move the plug **35** downwardly through the core element or column **36** until it engages the locking hooks **37** of the uppermost mine unit. Thereupon it causes the hooks **37** to be actuated outwardly about the pivot pins **38** to disengage the uppermost mine unit **11** from the attached relationship with the unit immediately therebelow. Since this unit is positively buoyant, the cylinder **11** travels upwardly and pays out the cable **12** disposed in the top of the cylinder below as shown in greater detail in FIG. 5. This cable is attached at one end to an eye **41**, FIG. 5, in the top of the mine section therebelow and the other end is in engagement with the reel **42** of the mine firing device indicated generally at **43**, FIG. 4.

As the uppermost mine section continues to travel upwardly the balance of the mine still attached to the anchor **10** is undergoing a subsequent downward movement. As the mine and the anchor assembly descend the hydrostatic pressure increases and causes the cable **32** to draw the plug **35** through the column **36** to effect release of latches **37** of additional units **11** until the anchor reaches the bottom of the body of water. As the upper mine cylinders rise due to the positive buoyancy thereof the slack in the cable **12** is taken up and this action causes rotation of the reels **42** with respect to the fixed shaft **50**. The shaft **50** is provided with threads **52**, FIGS. 7 and 8, which terminate at **40** as shown on FIG. 8. A section of cable **12** on the reel **42** is then payed out to rotate the driven part of the drum **44** through the tooth engagement therewith at **45**. This action moves the reels **42** and **44** to the right and compresses the spring **46** associated with firing pin **48**, by reeling in cable **47** onto drum **44**. This releases the firing pin **48**, attached to cable **47**, from the safety member **49** which is normally disposed within the path of travel thereof. This safety device **49** is pivoted away from the path of travel of the firing pin by a spring indicated diagrammatically at **51** in FIG. 4. As the mine and anchor assembly continues to descend, the increase in hydrostatic pressure produces additional rotation of the gear train **31** by movement of the

rack 28 on the piston rod 29 and reels up an additional amount of the cable 32 attached to the central plug 35. This effective shortening of the cable advances the plug 35 into actuating relationship with the next successive pair of hooks 37 and effects release of the next additional mine section 11.

In the operation of this apparatus in a mine field, the firing of a first one of the charges of the instant mine occurs with a bumping of one of the mine sections by a passing vessel, or with the tensioning of the cable by a submarine passing in adjacency thereto. As the submarine engages the cable 12 of a charge unit cylinder 11 there occurs a slight tensioning of the cable 12 between two adjacent units 11 of the mine. Release of this additional tension or of buoyancy tension provides a reeling of cable 12 on spool 42. When spool 42 is rotated in a direction to reel in cable, it moves on the fixed threads 52 which are discontinuous at 40 to the left hand position thereof as shown in FIG. 8. This provides disengagement of the dog teeth at 45 since spool 44 is prevented from moving to the left by the non-return spring arrangement diagrammatically shown at 53, FIGS. 10 and 11 positioned in the bottom of the thread groove of drum 44 in a manner to prevent return of this threaded engagement after the first disengagement of the threads at 40.

When the reel 42 has moved a predetermined distance to the left as shown in FIG. 8 a disengagement occurs between the teeth of the left hand reel 42 and that of the right hand reel 44 thus permitting the firing pin to move upwardly to strike the initiator or detonator of the firing train indicated generally at 21 and subsequently fire the booster and explosive charges in the mine. With the firing of this charge, the adjacent mine units of this mine will probably also fire as the shock wave effects may pass from the first fired mine through the water or cable to release the firing pins of the other units. The removal of one mine unit from the chain may also sever the adjacent cable to provide a release of the firing cables of other mine units to further insure a chain of explosions from the individual charges.

Although the instant mechanism as shown represents a preferred embodiment of the mechanical structure of the firing system of the instant invention it is not intended to be limited thereto and certain modifications of the firing mechanism may be made without departing from the spirit or scope of the instant invention.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A multiple and separable submarine mine unit comprising in combination, a plurality of mine sections containing inertia firing means and explosive charges, a common anchor for said mine sections, means for releasably securing said sections and the anchor in end to end relation, hydrostatic means for operating said releasable securing means as the mine submerges to a preselected depth, a plurality of sections of cable interposed between said mine casings, each length of cable being secured at its ends to adjacent sections of the mine and adapted to secure said sections in spaced relation as the sections are released by the releasable securing means, and means operated by said cable for arming said mine sections in successive order as the cable sections are drawn taut after the mine sections are initially released.

2. An aircraft laid mine assembly comprising a plurality of separable explosive sections, a plurality of lengths of cable interposed between said mine sections, an explosive charge in each of said sections, a common anchor for said plurality of sections, means for releasably securing said sections and the anchor together in end to end relation, means responsive to hydrostatic pressure for releasing said releasable securing means for the said sections in sequential order with the number of mine sections being released being selected by said securing means to correspond in lengths of cable to the depth of submergence of said anchor, and firing means for each said sections of a character to be responsive to a change in the tension of the interconnecting cables subsequent to initial launching thereof.

3. An aircraft launched mine of the character described comprising a mine anchor and a plurality of bouyant explosive chambers of a character providing for assembly in a stacked semi-nested relationship to superpose over said anchor portion, comprising cable means for interconnecting individual ones of said mine units in a mutual relationship and for connecting with said anchor portion, means in each of said units for providing mine firing in response to a change in the tension of said cables, and means in said anchor responsive to hydrostatic pressure for deploying predetermined numbers of individual ones of said mine explosive units from said assembly in correlation with the depth of submergence of the anchor in a body of water.

4. An aircraft launched comprising an anchor and parachute pack disposed at opposite ends of said mine and a plurality of serially interconnected buoyant explosive members adapted for severable disassociation from the initially mutually stacked relationship thereof, means including a plurality of lengths of cable for interconnecting said explosive mine units, means in said anchor for selectively releasing in sequential order individual ones of said explosive units, means rendering said releasing means responsive to changes in hydrostatic pressure, and firing mean in each of said buoyant mine units for mine firing of individual ones thereof in response to a change in the tension of the interconnecting means after initial launching.

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