MINE DISPOSAL HANDBOOK

PART IV

GERMAN UNDERWATER ORDNANCE

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MARCH 1, 1945

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MINE DISPOSAL HANDBOOK

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CHAPTER I

GERMAN INFLUENCE MINES

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Type	German Designation	Nature	Laid By		Case Mat'l.	Shape	Dimensions	
			Primary	Secondary			Diam.	Length
GA		Ground	Aircraft Parachute	Surface Craft	Al	Cylindrical	26"	5'8"
GA*		"	"	"	"	"	"	"
GB		"	"	"	"	"	"	8'8"
GC_1	LMB	"	"	"	"	"	"	"
GC_2	"	"	Surface Craft		"	"	"	7'6"
GD	LMA	"	Aircraft Parachute	Surface Craft	"	"	"	5'8"
GE		"	"		"	"	"	"
GG_1	BM 1000	"	Aircraft		Manganese Steel	Bomb Shaped	"	6'4"
GG_2	"	"	"		"	"	"	6'7"
GG_3	"	"	"		"	"	"	6'1"
GH	RMA	"	Surface Craft		Al	Hemispherical	50"	3'3" (height)
GI	RMB	"	"		Wood	Cuboidal	3'5" x 3'1 1/2" x 3'10"	
GN	TMC	"	Submarine	Surface Craft	Al	Cylindrical	21"	11' 1 1/2"
GO_1	EMF	Moored	"		"	Spherical	46"	
GO_2	"	"	Surface Craft		"	"	44"	
GO_3	"	"	"		"	"	46"	
GP	LMF	"	Aircraft Parachute	Surface Craft	"	Torpedo Shaped	26"	7'8"
GS	TMB	Ground	Submarine	"	"	Cylindrical	21"	7'7"
GT	TMA	Moored	"	"	"	Torpedo Shaped	"	9' 3 1/2"

Type	Main Wt. (lbs.)	Charge How Fitted	Wt. in Air (lbs.)	Bomb Fuze	Clock Fitted	Firing Units Found	Firing Units Possibly Fitted	Case Depths (ft.) Min.	Case Depths (ft.) Max.	Remarks
GA	676	Cast	1173	24 A	Mk II hydrostatic.	M Mk I		15	120'	Obsolete - six anti-rolling horns on nose.
GA*	"	"	"	"	"	"		"	"	"
GB	1536	"	2175	24 A 34 A	Mk I hydrostatic.	M Mk I, II		"	180	"
GC_1	"	"	"	34 A, A*, B	Mk I, II III, IV, IVa, V hydrostatic. Mk I RAM.	M Mk II series, IV, IVa A Mk I, II, III, VI, AM Mk I MP Mk I		"	180	
GC_2	"	"	2076	34 A, A*, B or none	"	"		"	"	
GD	676	"	1173	34 A, A*	"	M Mk II series, IV, IVa	A Mk I, II III, IV AM Mk I MP Mk I	"	120	Obsolescent
GE	"	"	"	34 A	Mk II hydrostatic.	None				Booby trap only - 3 PSE's - only two laid.
GG_1	1600	"	2060	157/3	None	M Mk V, VI, VIII IX, A Mk IV, V AP Mk I		24	180	Delay bomb firing in shallow water.
GG_2	"	"	"	"	"	AM Mk II		15	"	"
GG_3	"	"	"	"	Mk II RAM	AP Mk I	M Mk V, VI, VIII, IX, A Mk IV, V	24	"	"
GH		Block fitted	2700	None	Not known	None	M Mk II	15	"	Has been used as a controlled mine.
GI	1935 Variable	Cast	2285	None	"	M Mk II series		"	200	"
GN	2000	"	2360	"	Mk III special hydrostatic. 60-day SDM.	M Mk III A Mk III	A Mk VI AM Mk I	"	"	Has been used as sabotage mine.
GO_1	750	Block fitted	1331	"	Mk IIIa special hydrostatic. 60-day SDM 12-hr testing.	M Mk IVa		42	120	Offensive-laid by 1600 ton submarine minelayer.
GO_2	"	"	1270	"	"	M Mk IVa		15		Offensive
GO_3	"	"	"	"	Mk IIIa special hydrostatic. 12-hour testing	"		"		Defensive
GP	612	Cast	1035	"	Mk IIIa and V hydrostatic. 12-hour testing	"	A Mk I, II, III, VI	54	114	Has been used as a controlled mine for demolition. Moored from end; floats horizontally.
GS	1220	"	1540	"	Mk III special hydrostatic. 60-day SDM	M Mk III A Mk III	A Mk VI AM Mk I	15		Has been used as a sabotage mine.
GT	475	"	874	"	Mk II, III Special hydrostatic.	M Mk VII		48	114	Moored from end; floats horizontally.

Table 1 - German Influence Mines

Type	Found in Mine Type	Firing Mechanism	Direction of firing	A.L.A.	A/C Feature	P.D.M.	R.A.M.	Sensitivity (mg.)	Time to Fire	Remarks
M Mk I	GA, GA* GB	Needle	One way Red or Blue	None	Pendulum	None	None	50-80	1 1/2-3	Hand set latitude adjustment -
M Mk II	GB, GC_1 GD	"	"	Mechanical	"	"	"	20-30	2 1/2-3	Obsolete
M Mk III	GS, GN	"	"	"	"	6-place Item #1	"	"	2 1/2-3	"
M Mk II Revised	GC_1, GC_2, GD, GH, GI	"	One way Red or Blue	"	"	"	6-day	10-20	2 1/2-3	One found with R.I.M. Obsolescent.
M Mk IV	GC_1, GC_2, GD	"	Bi-polar, Red or Blue	Magnetic	None	None	None	20-40	less than one sec.	Obsolete
M Mk IVa	GC_1, GG GP	"	"	"	"	15-place Item #3	6-day	20-30	"	
M MkV	GC_1	"	One way Red or Blue	Electromagnetic	None necessary	None	None	20-35	3-4	Only two found. Obsolete.
M Mk VI	GG_1	"	"	"	"	3-place Item #4	"	"	5-7	Obsolete
M Mk VII	GT	"	"	Mechanical	Inertia switch	None	"	30-40	3-4	Counter balance system to counteract wave motion. Obsolete.
M Mk VIII	GG_1	"	"	Electromagnetic	None necessary	10-place Item #5	"	15-30	5-7	Obsolescent
M Mk IX	GG_1	"	Bi-polar, Red or Blue	Electromagnetic	"	9-place Item #6	"	15-25	3-4	

Table 2 - German Magnetic Firing Units

Type	Found in Mine Type	Type Microphone Used	A/C Period	P.D.M.	R.A.M.	Firing Frequencies (C.P.S.)	Firing Sensitivities (dynes per sq. cm.)	Time to Fire	Remarks
A Mk I	GC_1, GC_2	Cantilever	12 sec.	None	6-day	175-325 700-1100	30-50 @250 cps 100-150	1 1/2-3	Only one found. Obsolete
A Mk II	GC_1, GC_2	Cantilever	80 sec.	"	"	175-325 700-1100	30-50 @250 cps 100-150	1 1/2-3	Obsolete
A Mk III	GC_1, GC_2, GS, GN	"	"	12-place Item #2	"	175-325	30-50 @250 cps	1 1/2-3	
A Mk IV	GG_1	"	Duration of noise	10-place Item #8	None			1/2	Obsolescent
A Mk V	GG_1	"	Duration of noise plus 15 sec.	10-place Item #9	"			1/2 10 max.	Anti-sweep circuit.
A Mk VI	GC_1, GC_2	"	Duration of noise	12-place Item #2	6-day	88 238	650 800	3-3 1/2	Anti-mine-sweeper unit. Insensitive microphone.

Table 3 - German Accoustic Firing Units

Type	Found in Mine Type	Arming Mech.	Magnetic: Direction Arming	Magnetic: P.D.M.	Magnetic: R.A.M.	Magnetic: Sensitivity (mg.)	Acoustic: Microphone	Acoustic: P.D.M.	Acoustic: Firing Frequencies (cps)	Acoustic: Firing Sensitivity (dynes per sq. cm.)	Acoustic: Time to Fire	Acoustic: Time Active (Sec.)	Acoustic: Time to Fire (sec)
AM Mk I	GC_1, GC_2, GS GN	M Mk II Revised	One way, Red or Blue	12-place Item #2	6-day	3-9	Cantilever		175-325	30-50 150 250 cps	1/2-1 sec	45	3-4
AM Mk II	GC_2	M Mk IX	Bipolar, Red and Blue		None	12-15	Diaphragm	9-place Item #7				40	

Table 4 - German Magnetic-Acoustic Firing Units

Type	Found in Mine Type	Direction Pressure Charge	Pressure: Type Mech.	Pressure: Nominal Sensitivity (in. of water)	Pressure: Time to fire (sec.)	Other Unit Used: Unit Combined With	Other Unit Used: Variation in Normal Characteristic	Other Unit Used: A/C Feature	Combination: If "P" Unit operates first, other unit may operate to fire	Combination: If other unit operates first, "P" unit may operate to fire	Combination: P.D.M.	Combination: R.A.M.
AP Mk I	GC_1, GC_3	Negative (Decrease)	Integrating	2 1/2	7	A Mk V	Does not have anti-sweep characteristic. Acts like A Mk IV	Same as A Mk IV	Within 45 seconds after "P" actuation	Only at completion of "A" actuation.	10-place	80-hour
MP Mk I	GC_1	Negative (Decrease)	Non-Integrating	2 1/2	9	M Mk II Revised	Sensitivity 5 mg. Red only	See M Mk II Revised.	Only at completion of "P" actuation.	Within 25 seconds after "M" actuation	None	6-day

Table 5 - German Pressure-Operated Firing Units

Type	Found in Mine Type	Actuated By	Firing Principle	Delay Arming	Factors Determining Method of Operation	Nature and Amount of Delay Operation	Remarks
24 A	GA, GA*	Inertia	Percussion	10 sec. clockwork	Choice by pilot	Pyrotechnic delay	Pilot makes choice, whether mine or bomb. If lanyard is not pulled, bomb fuze is dormant.
34 A	GB, GC_1, GD	Inertia	Percussion	5 sec. clockwork	Setting of fuze and hydrostatic pressure.	21 sec. clockwork	"A" setting: Fires with delay after impact, unless under 15' water pressure. Fires if pressure is released.
							"B" setting: Becomes safe under 15' water pressure.
				None	Setting of bomb fuze	26 sec. clockwork	"C" setting: Aerial burst - not a design feature and never used.
34 A*	GC_1, GD	Inertia	Percussion	9 sec. clockwork	See 34A	17 sec. clockwork	Modification of 34A to give longer safe arming period, to allow parachute to open.
				None	Setting of bomb fuze	26 sec. clockwork	See 34A.
34 B	GC_1	Inertia	Percussion	7 sec. clockwork	Hydrostatic pressure	25 sec. clockwork	Modified 34A. "A" setting only.
				None	See 34A	32 sec. clockwork	See 34A.
157/3	GC_1, GC_2, GC_3	Inertia	Electrical	0.013 sec. electrical	Deceleration 200 g or more	None, instantaneous	Inertia bolt switch.
		Vibration	Electrical	None	Deceleration 20 g or more	None, instantaneous	Vibratory "trembler" switches. Close master switch in mine firing unit.

Table 6 - Bomb Fuzes used in German Aircraft Mines

Hydrostatic Arming Clocks

Type	Operating Depth (ft)	Time Limits	Switches	Delay Starting	Plates Used	Remarks
Mk I	15	17 min.	a-g 5 1/2 min. b-c 17 min. (b-h) (2 min.)	Soluble plugs	Type #5	Requires continuous hydrostatic pressure.
Mk II	15	17 min.	"	None	Types #1,3,7	"
Mk III	15	1/2-6 hours 1/2-6 days	a-g, b-c end of set period e-f 18 min. after a-g, b-c	None	Types #1,3,7	Once started, runs down.
Mk IIIa	15	"	"	None	Types #1,3,6	Once started, runs to end of set period.
Mk IV	15	"	"	None	Type #2	Once started, runs down.
Mk IVa	15	"	"	None	Type #2	Same as Mk IIIa.
Mk V	15	"	"	None	Types #2,4	Requires continuous hydrostatic pressure. Stops at end of set period.

Clock Starter Plates

Type	Type of Spindle	Anti-Recovery Switch	Locking Balls	Other Fittings
#1	Short	None	None	None
#2	"	Yes	"	"
#3	Long	"	"	Hole in spindle for safety pin.
#4	"	None	"	"
#5	"	"	"	Hole in spindle for safety pin. T-connection for soluble plug use.
O	"	"	Held by mooring spindle.	Soluble plug on surface laid type; non-return detent on submarine type.
S	"	"	Held by cap and safety bar.	Soluble plug may be fitted to cap.
T	"	"	Held by cap and lever system.	Non-return detent locks spindle in when depressed.

Other Clocks

Type	Used for	Time Limits	Switches	Purpose
6-day	RAM, RIM in GC, GD, GS, GN	0-6 days	1-2 4-5 } at end of set period	Delay arming, inerting (Influence Mines)
80-day	SDM, RIM (RAM) in GC, GS, GN	1-80 days	D E (7-10) Close at end of 24 min. F (8-9) A (2-5) B C E (7-10) Open F (8-9) Close at end of set period or if clock fails.	Scuttling (Moored Mines) Inerting (Ground Mines) (Possibly delay arming)
12-hour	Testing in GC, GP	1-12 hours	H-6-4 and 5-1-2 H-6 closed until end of set period when 6-4 closes. 5-1 closed unless heater I is energized, in which case 1-2 closes.	Testing clock to determine whether or not mine is properly laid.
80-hour	RAM in GC	0-80 hours	Master switch closed at end of set period.	Delay arming for GC only.

Table 7 - Clocks and Clock Accessories used in German Mines

Item	Type (Mark)	Units Fitted to	Units Possibly Fitted to	Mine Found in	Setting	Interval (sec)	Remarks
1	Clock-work (Mk I) (Z.K.)	M Mk II Rev. M Mk III	M Mk VII	GC_1, GD, GS	6 Max.	45	Obsolete
2	Clock-work (Mk II (Z.K. II)	A Mk III A Mk II AM Mk I	A Mk II	GC	12 Max.	120	
3	Clock-work	M Mk IVa		GC, GD, GO, GP	15 Max.	85-115	Mechanism built integral with M Mk IVa unit. May possibly be re-actuated after 60% of interval.
4	Fuse Delay Switch	M Mk VI		GC_1	3	50-60	Obsolete
5	Fuse Delay Switch	M Mk VIII		GC_1	10 Max.	30-50	Completely variable as required. Number of stages selected by inserting switches as desired.
6	Fuse Delay Switch	M Mk IX		GC_2	9 Max.	45-60	
7	Fuse Delay Switch	AM Mk II		GC_3	9 Max.	30-50	
8	Fuse Delay Switch	A Mk IV		GC_1	10 Max.	55-70	
9	Fuse Delay Switch	A Mk V AP Mk I		GC_2, GC_3	10 Max.	70-90	

Table 8 - German Period Delay Mechanisms

Parachute Number	Used with Mine Type	Number of Shrouds	Dimensions of Panel			Length Shrouds	Remarks
			Top (in)	Bottom (in)	Sides (in)		
I	GC_1	28	7	33	96	18'6"	
II	GD	24	7	33	73	No data available	
III	GD	24	6 1/2	35	72	No data available	
IV	GC_1	32	5	34	11'9"	25'	Parallel Lattic Type.
V	GC_1	16	No data available	No data available	No data available	No data available	Barber-Pole type. 18 cords to each loop of 2 shrouds.
VI	GC_2	10	No data available	No data available	No data available	No data available	Small parachute. Drogue only.

Table 9 - Parachutes used with German Mines

Type	Found Fitted to	In Mine Type	Firing Principle	Fires When	Armed By	Location of Safety Plug
PSE Mk I	Tail door	GC, GD	Electrical	Tail door is removed.	Safety pin	Looking forward, 24° clockwise from top center line: 6" forward of joint.
PSE Mk Ia	Mechanism plate	GT	"	Mech. plate is removed or mine is separated.	Safety pin	Under screw on mech. plate, 180 degrees from bowden wire channel.
PSE Mk II	Firing device	GC_1, GC_2	Photo-electric	Light falls on photo-electric cells.	Firing device arming	None
PSE Mk III	Tail door	GC, GD	Percussion	Tail door is removed.	Safety pin	Looking forward, 20 1/2° clockwise from top center line; on flange.
PSE Mk IV	Firing device	GC_3	Galvanic	Moisture enters firing device.	Firing device arming	None
Zus-40	Under bomb fuze	GC (GC_1,GD)	Percussion	Bomb fuze is withdrawn 0.6 inches.	Impact	"
Hydrostatic switch	Clock plate of hydrostatic clock Mk IV, IVa, V.	GC, GD, GP	Electrical	Hydrostatic pressure falls below 15 feet.	Firing device arming	"
"	Firing device	GC_1, GC_2	"	Hydrostatic pressure falls below 24 feet.	"	"
		GC_3	"	Hydrostatic pressure falls below 15 feet.	"	"
Clock work bomb fuze 34 A 34 B		GC_1, GD	Percussion	"	Impact	"

Table 10 - PSE and other Anti-Recovery Devices found in German Mines

Introduction

1. German influence mines exist in so many varieties that few generalizations can be drawn with respect to the mines as a group. Most of them can be and have been fitted with a variety of firing units upon which the mines' operational characteristics are dependent. The various individual characteristics of the mine assemblies, firing units and other associated fittings are shown in tabular form on the preceding pages. Detailed information on the operation of each firing unit will follow. Only two pertinent generalizations can be drawn as follows:

   (a) All mine cases are made of non-magnetic material.

   (b) All mine cases to date have contained Hexanite charges, either block-fitted or cast.

2. It is not possible to definitely establish maximum and minimum effective depths for employment of influence mines because of the large number of variables involved. However, the following generalizations may be drawn:

   (a) Moored influence mines

      (1) Minimum case depths are generally dependent on the minimum depths at which the hydrostatic arming devices will operate

      (2) Maximum case depths are generally dependent on the maximum depths at which the hydrostatic depth-taking devices will moor the case properly.

      (3) Maximum depths of moored mine assemblies (i.e. maximum anchor depths) are generally the sum of the maximum case depth and the maximum length of mooring cable.

      (4) In the case of mines in which separation of case and anchor takes place on the bottom, the maximum laying depth will be dependent on the crushing depth of the case and fittings.

   (b) Ground influence mines

      (1) Minimum depths are dependent on the minimum depths at which hydrostatic arming devices will operate.

      (2) Maximum depths are dependent on the crushing strength of the case and fittings. (This consideration is generally pertinent only for anti-submarine purposes.)

   (c) In addition to the above-mentioned structural considerations, maximum effective depths are dependent upon:

      (1) The distance from a ship at which detonation of the mine will result in effective damage to the ship. This is dependent on the relation between the power of the explosive charge and the structural strength of the ship.

   (d) Despite the variables involved, it appears that a reasonably constant relationship exists between the weight and type of explosive charge and the maximum effective depth against typical surface craft. If the explosive charge is Hexanite, this relationship is approximately as follows:

Weight of Charge (pounds)	Maximum Effective Depth (fathoms)
700	20
1200	25
1500-1600	30
2000	35

3. Hydrostatic arming clocks are fitted to almost all German influence mines and represent a danger to mine disposal personnel particularly because of the anti-recovery switches which may be fitted. These switches are designed to close upon release of hydrostatic pressure after the clock has been subjected to initial arming pressure, although they may be closed by shock or impact even if the mine has never entered the water. Before attempting to render safe a mine whose clock is ticking, gag the clock as follows:

   (a) Insert a piece of phosphor-bronze wire through the water entry hole in the clock plate and make sure that it comes out the other side.

   (b) Twist the ends of the wire securely together.

Introduction (Cont'd.)

4. Two exceptions to the procedure described in Par. 3 above are as follows:

   (a) The clocks fitted to Mines Type GO, GT, GS and GN are inaccessible, cannot be gagged and need not be gagged.

   (b) Clocks fitted with extended pistons (See Table # 7) cannot be gagged because of structural peculiarities. When dealing with mines fitted with these clocks, the procedure to be followed will depend on the local situation. If practicable, wait a period of six days before attempting to deal with it. The clock will then have completed its maximum arming period and the anti-recovery switch, if operative, will have fired the mine. If, however, RMS is necessary, it should be undertaken immediately with the intent of completely disarming the mine before the clock completes its delay period. It must be emphasized that this last procedure is extremely dangerous and should be undertaken only in extreme emergency.

5. The following precautions should generally be observed when dealing with mines of this type:

   (a) Do not attempt RMS unless absolutely necessary.

   (b) Observe accoustic procedure as follows:

      (1) Keep all necessary noise to a minimum.

      (2) Make no noise lasting longer than one second, or as in the case of Mine Type GC, one half second.

      (3) Allow a three second interval between each interval of sound.

   (c) Allow no movement of magnetic material near the mine.

   (d) Do not move or jar the mine except from a safe distance.

   (e) Observe all case markings carefully for clues as to the type of firing unit fitted.

   (f) Remove all fittings from a safe distance whenever feasible. Prior to removal of such fittings as cover plates etc., test for spring pressure or unnatural stiffness which might indicate the presence of a booby trap.

   (g) Do not, except in extreme emergency, raise any ground mine from underwater without first gagging the bomb fuze (if fitted) and the clock. Use remote control lifting gear for this operation.

   (h) Observe all precautions listed in Part I, Chapter 1 with regard to diving on influence mines.

Influence Firing Devices

Introduction

1. German influence firing devices (units) are designated by the Allies with a letter prefix and a mark number. The prefix indicates the type of firing influence or influences employed as: M-magnetic, A-acoustic, AM-magnetic-acoustic, AP-acoustic-pressure and MP-magnetic-pressure. The mark number indicates the individual unit, the numbers being assigned in sequence of recovery with little attention paid to the design of the particular unit.

2. A brief chronology and classification of the various unit types and individual units follows below. A detailed description of the operation of each unit circuit together with various unit accessories follows thereafter.

Magnetic Units

1. Magnetic units are all of the needle type and operate on the vertical component of the magnetic field of the earth or other magnetic body. These units are herein subdivided according to the type of automatic latitude adjustment (A.L.A.) which each employs and thus fall into three groups as follows:

   (a) Mechanical A.L.A. - includes M Mark II (obsolete), M Mark III (obsolete), M Mark II(revised) and M Mark VII. Units in this group are subsequent developments of the obsolete M Mark I which was designed with no provision for A.L.A. All are unipolar and may be set to fire on either RED or BLUE actuations. The M Mark II, III and II(revised) are commonly referred to as the M Mark II group and are designed for use in submarine, surface craft and aircraft-parachute-laid ground mines. They cannot be used in moored mines because of the pendulum-type anticountermining device fitted. M Mark I, a needle-type unit without A.L.A., was the basic unit. M Mark II differs from it by the incorporation of an A.L.A., making possible more sensitive settings than were practicable with M Mark I. M Mark II(revised) and M Mark III contain the further refinement of a trip switch for use during A.L.A. to help eliminate premature firing. The trip switch in M Mark II (revised) is a refinement over M Mark III in that it does not operate as the pre-set sensitivity is applied during A.L.A. unless the needle is stuck on its firing contact. In addition, M Mark III is mounted in a smaller ring to permit its use in 21" diameter mine cases. M Mark VII is designed for use in moored mines, this being made possible by the incorporation of a needle counterpoise system which counteracts wave motion and natural disturbances. It has been used only in mines laid by submarine or surface craft.

   (b) Magnetic A.L.A. - includes M Mark IV (obsolete) and M Mark IVa. Units in this group contain an armature-type, vertically-pivoted needle and represent an improvement over the M Mark II group in that they are more compact, incorporate bi-polar firing and can be made in mass production. No anticountermining device is fitted and the units fire more readily due to motion. Nevertheless, these units have been used with considerable success in moored and ground mines laid by submarine, surface craft and by aircraft with parachute. M Mark IVa incorporates a special, 15-place mechanical P.D.M. as an integral part of the unit.

   (c) Electromagnetic A.L.A. - includes M Mark V (obsolete), M Mark VI (obsolete), M Mark VIII and M Mark IX. Units in this group contain an armature-type, horizontally-pivoted needle, are especially sturdy in construction and are made with a minimum of moving parts, being designed for aircraft laying without parachute. All except M Mark IX are unipolar and may be set to fire on either RED or BLUE actuations. M Mark V is the basic unit and M Mark VI and VIII are modified by the addition of specially-designed electrical P.D.M.'s. M Mark IX is essentially a bipolar M Mark VIII.

Acoustic Units

1. All acoustic units use the carbon-button type of microphone which requires constant battery power to remain alive. Thus the life of the unit depends largely on the life of its microphone batteries. The microphones are of the resonant, cantilever type and use the mine case as a diaphragm. The units use rectified signal current for all phases of operation, no vacuum tubes being fitted to date. Each unit is fitted with an anticountermining device designed to render the unit passive if the sound level rises too rapidly. The units fall into two basic groups, depending on the number of relays used, as follows:

(a) Two-Relay Type - includes A Mark I(obsolete), A Mark II (obsolete) A Mark III and A Mark VI. Units in this group are designed for use in ground mines laid by submarine, surface craft and by aircraft with parachute. A Mark I is the basic unit and A Mark II is the same except that the microphone is provided with its own separate battery to give longer effective life. In addition, the anticountermining feature is altered slightly to make it more positive. A Mark III differs from A Mark II in that it is fitted with a filter which renders it more selective to firing frequencies and it may be fitted with a mechanical P.D.M. A Mark VI is a special modification of A Mark III, designed as an antisweeper unit, employing a long firing delay and an insensitive microphone. Although an additional relay is used in this unit, it is functionally a two-relay type.

(b) Three-Relay Type - includes A Mark IV (obsolete) and A Mark V. Units in this group are especially sturdy in construction and are made with a minimum of moving parts, being designed for aircraft laying without parachute. The two units are nearly identical although certain wiring differences create slightly different operational characteristics. A Mark V differs from A Mark IV as follows:

(1) Its microphone circuit is more sensitive and efficient.

(2) It is not fitted with a frequency filter.

(3) It requires a pre-determined rate of sound level increase which is limited both by maximum rate and, unlike any other German acoustic unit, minimum rate as well. This in itself constitutes an anti-sweep circuit.

Magnetic-Acoustic Units

1. Magnetic-acoustic units overcome the short-life weakness of the acoustic units in that they are magnetically armed and acoustically fired. The acoustic component does not draw on the microphone batteries until a magnetic actuation has been recorded and then only for a short period. In addition, these units present a more difficult problem for minesweepers. Each unit is composed of a standard-type magnetic unit (slightly modified) designed to arm a special acoustic component which employs a vacuum tube amplifier suited to the combination. The magnetic component selected determines the way in which the complete unit will be employed. AM Mark I is armed by M Mark II (revised) and AM Mark II, by M Mark IX.

Pressure-Operated Units

1. Pressure-operated units consist of a pressure component in combination with another influence-operated component. Two types of pressure-operated units have been used as follows:

(a) Integrating Type - AP Mark I. AP Mark I is a combination of a pressure detecting device, fitted with an integrating circuit, used with a slightly modified A Mark V unit. It is classified as an integrating type of circuit due to its property of registering cumulatively a series of short pressure pulses, provided the pulses occur frequently enough, with the result that a series of pressure pulses of less than the designed length may cause actuation in the same manner as one pulse of the designed length. This feature, a definite fault in design, tends to decrease the difficulty of sweeping.

(b) Non-Integrating Type - MP Mark I. MP Mark I is a combination of essentially the same pressure detecting device employed with AP Mark I, fitted with a non-integrating circuit and used with a slightly modified M Mark II(revised) unit. It is classified as a non-integrating type of circuit due to its property of totally disregarding pressure pulses other than those of at least the designed length. This arrangement is a considerable improvement over the integrating type making the development of countermeasures much more difficult.

2. The influence-operated component used in combination with the pressure component determines the way in which the complete unit may be employed.

Influence Units

General

1. In connection with the following description of German influence unit circuits, it should be borne in mind that these units exist in a large number of slightly varying forms. One of the most common variations appears to be in the delay arming clocks fitted (See Table #6), resulting in minor variations in the delay arming cycle, but having no effect on the basic operation of the unit. The following descriptions attempt to present typical assemblies as they have been found, particularly in so far as the delay arming clocks are concerned and make no attempt to enumerate the large number of variations which are possible.

M Mark II Unit Circuit - Operation

Arming

1. 5 1/2 minutes after the six-day clock starts, a-g closes and b-c closes 11 1/2 minutes later. B then blows L, unlocking the needle and starting A.L.A. Upon completion of A.L.A., S_2 closes and B blows K, allowing the preset sensitivity to be applied to the unit. As the preset sensitivity is applied, S_2 opens and, upon completion of this operation, S_1 closes. The unit is now alive.

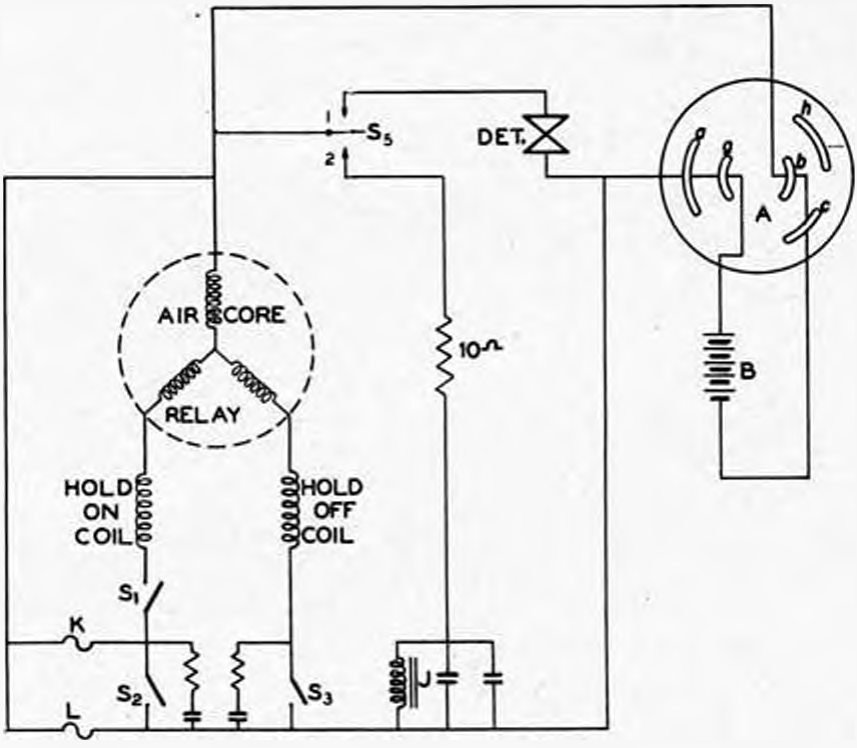
Normal Firing

1. A firing actuation closes S_5. This energizes the hold-on coil and the relay, closing S_5 to contact #1 and completing the circuit through the detonator.

Normal Anticountermining

1. A countermining shock closes S_3. This energizes the hold-off coil and the relay, closing S_5 to contact #2. The unit remains passive until S_3 settles down.

2. A countermining shock during A.L.A. closes S_3. The hold-off coil and relay operate as above, energizing J which holds the A.L.A. arm inoperative until S_3 settles down.



A - CLOCK (HYDROSTATIC)
B - BATTERY - 15 VOLTS
K - AUTOMATIC SETTING FUSE (ALA)
L - MAGNET RELEASE FUSE (ALA)
J - ELECTROMAGNET
S_1 - SENSITIVITY SETTING SWITCH
S_2 - NEEDLE SWITCH
S_3 - PENDULUM SWITCH
S_5 - AIR CORE RELAY SWITCH

Fig. 1 - E Mk. II Unit Circuit and Key

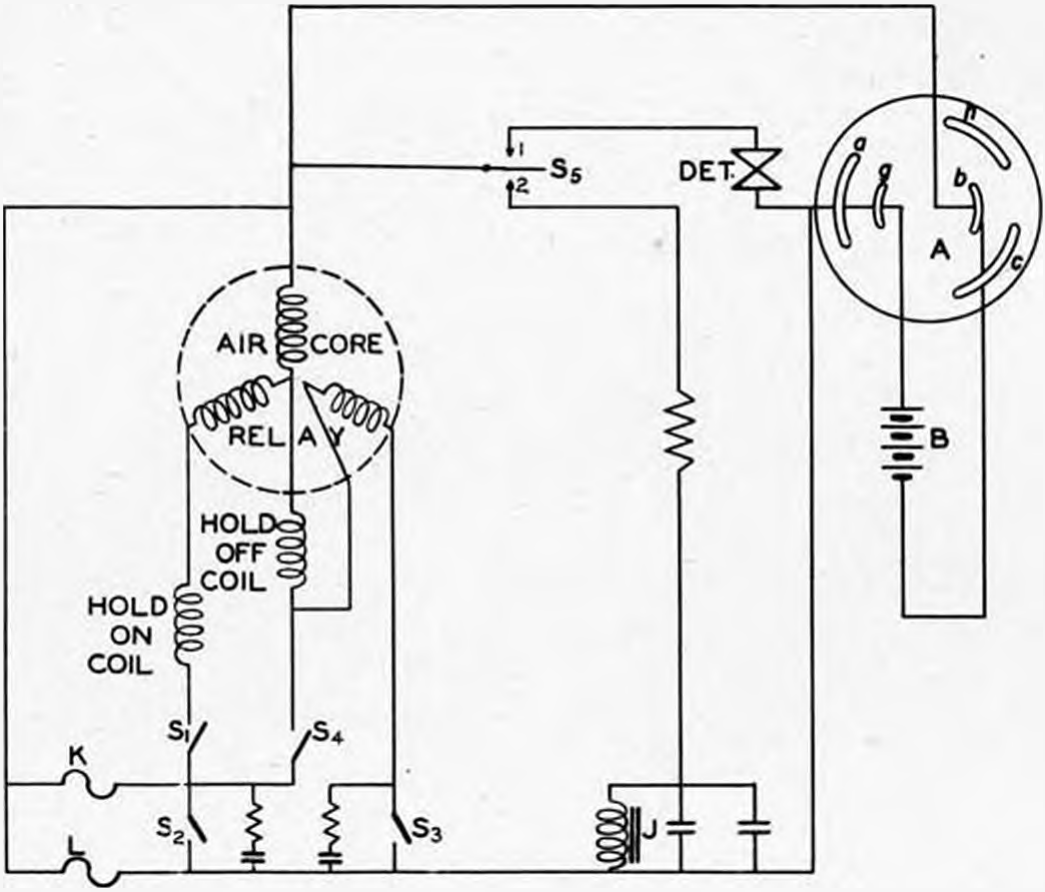
M Mark II(revised) Unit Circuit - Operation

Arming

1. Same as M Mark II except that if S_2 does not open properly as the preset sensitivity is applied, the A.L.A. arm momentarily closes S_1, completing the circuit through the hold-off coil and S_2, opening S_2.

Normal Firing and Anticountermining

1. Same as M Mark II.



A - CLOCK (HYDROSTATIC)
B - BATTERY - 15 VOLTS
K - AUTOMATIC SETTING FUSE (ALA)
L - MAGNET RELEASE FUSE (ALA)
J - ELECTROMAGNET
S_1 - SENSITIVITY SETTING SWITCH
S_2 - NEEDLE SWITCH
S_3 - PENDULUM SWITCH
S_4 - TRIP SWITCH
S_5 - AIR CORE RELAY SWITCH

Fig. 2 - M Mk. II (revised) Unit Circuit and Key

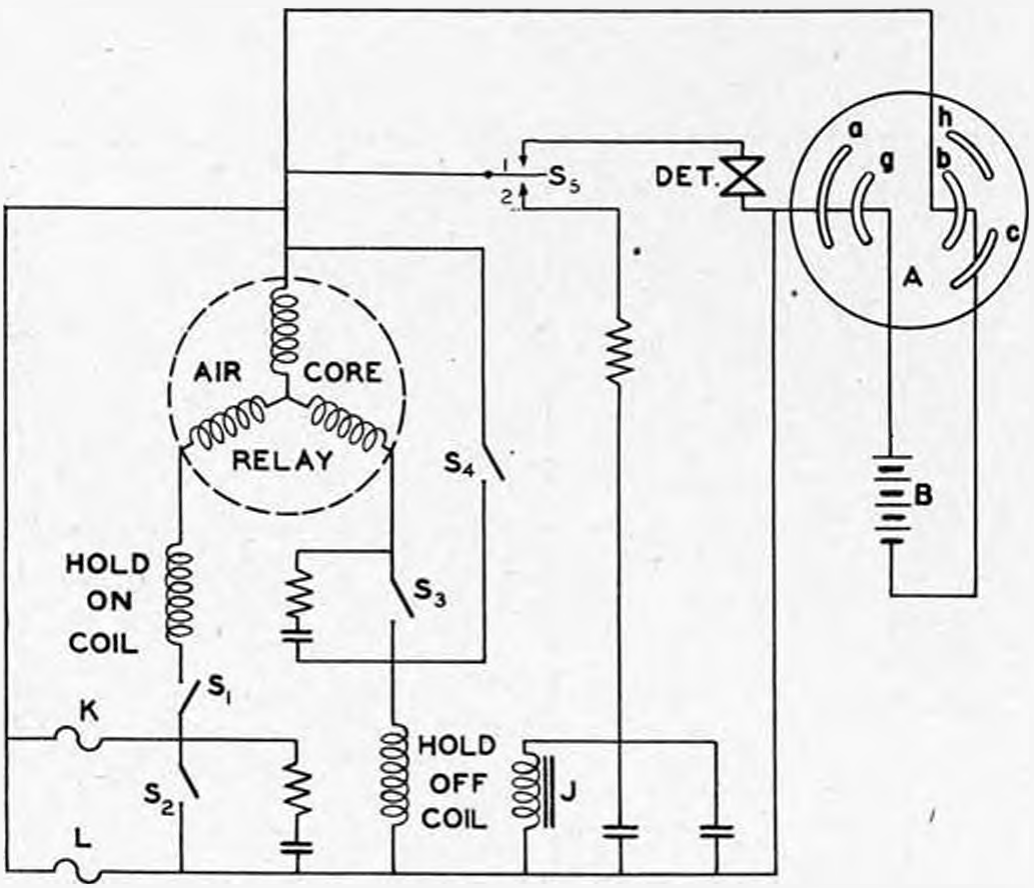
M Mark III Unit Circuit - Operation

Arming

1. Same as M Mark II except that as the preset sensitivity is applied, S_5 closes momentarily even if S_2 has opened properly, the purpose being to make doubly sure that S_2 is open at the completion of the operation.

Normal Firing and Anticountermining

1. Same as M Mark II.



A - CLOCK (HYDROSTATIC)
B - BATTERY - 15 VOLTS
K - AUTOMATIC SETTING FUSE (ALA)
L - MAGNET RELEASE FUSE (ALA)
J - ELECTROMAGNET
S_1 - SENSITIVITY SETTING SWITCH
S_2 - NEEDLE SWITCH
S_3 - PENDULUM SWITCH
S_4 - TRIP SWITCH
S_5 - AIR CORE RELAY SWITCH

Fig. 3 - M Mk. III Unit Circuit and Key

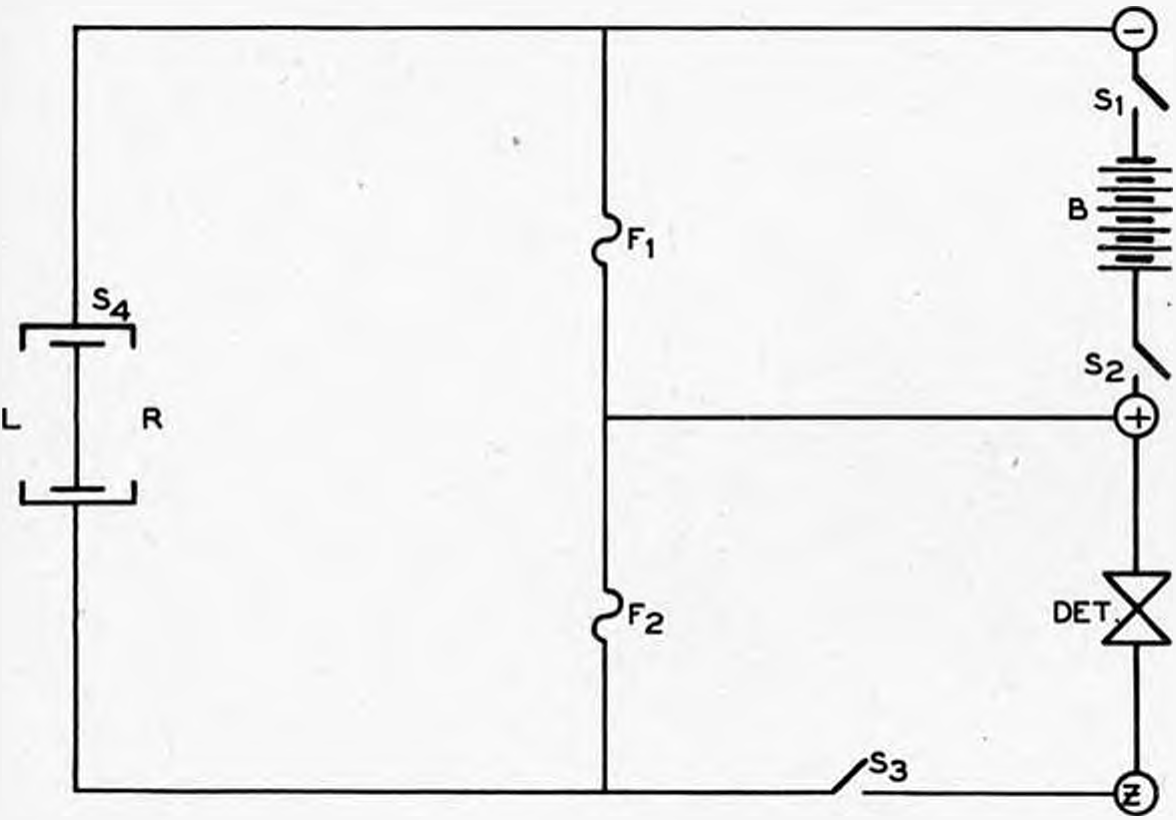
M Mark IV Unit Circuit - Operation

Arming

1. When the hydrostatic clock runs off its delay period, S_1 and S_2 close, blowing fuse #1. This releases a clock escapement and starts A.L.A. S_4 makes and breaks during A.L.A., blowing fuse #2. Upon completion of A.L.A., S_3 closes and the unit is alive.

Normal Firing

1. A RED or BLUE actuation closes S_4 to the proper contact, completing the circuit through the detonator.



B - BATTERY 9 VOLTS
F_1 FUSE
F_2 FUSE
S_1 HYDROSTATIC CLOCK SWITCH
S_2 HYDROSTATIC CLOCK SWITCH
S_3 CAM SWITCH
S_4 NEEDLE SWITCH

Fig. 4 - M Mk. IV Unit Circuit and Key

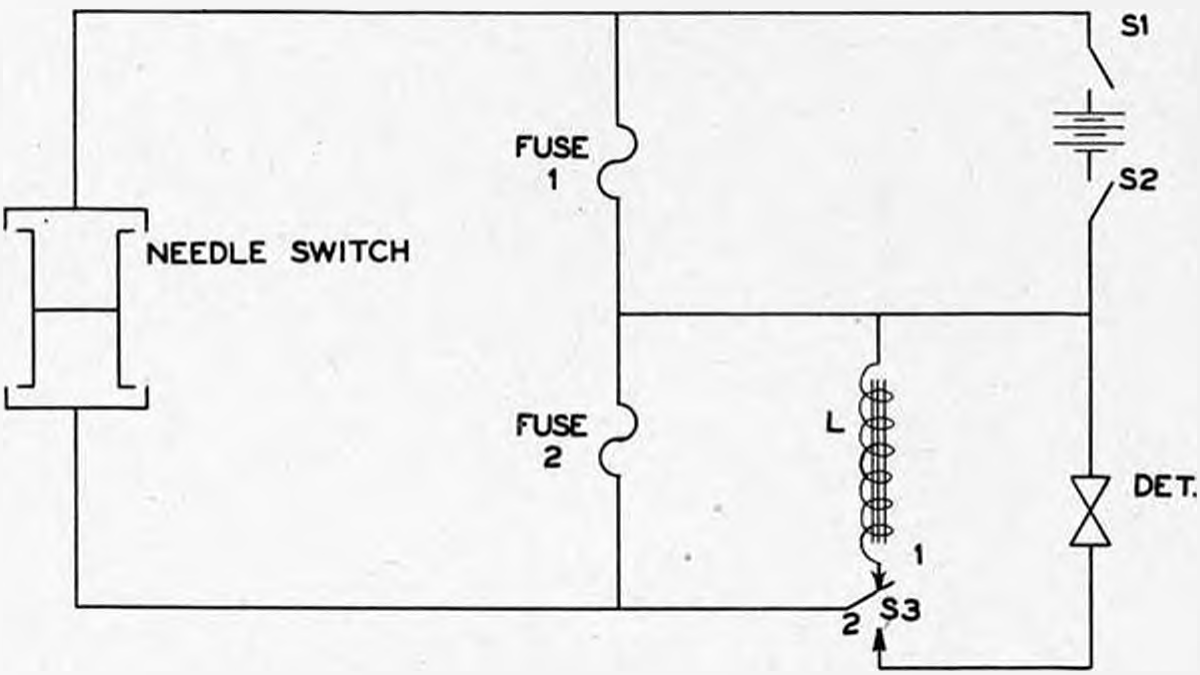
M Mark IVa Unit Circuit - Operation

Arming

1. When the hydrostatic clock runs off its delay period, S_1 and S_2 close, blowing fuse #1. This releases a clock escapement and starts A.L.A. During A.L.A. the needle switch closes, blowing fuse #2 and energizing L. When fuse #2 blows, the needle switch reopens and L is deenergized. Upon completion of the P.D.M. cycle, the unit returns to normal. After a maximum of 14 "blind" actuations, S_3 changes from contact #1 to contact #2, cutting out the P.D.M. and putting the detonator in the circuit.

Normal Firing

1. An additional RED or BLUE actuation closes the needle switch, completing the circuit through the detonator.



S1 S2- CLOCK SWITCHES.
S3- P.D.M. SWITCH.
L- P.D.M. SOLENOID.

Fig. 5 - M Mk. IVa Unit Circuit and Key

K Mark V Unit Circuit - Operation

Arming

1. When the mine is dropped, action of the Rheinmetall fuze closes the master switch F. The thermostatic clapper switch A is normally closed at temperatures above 32°F. If the mine reaches a depth of 24 ft. or more, the hydrostatic switch G closes to contact #2 and the battery BB energizes fuse delay switch B through fuse W. Upon completion of its delay period, B shorts its heater coil and W blows due to the increased current in the circuit. Battery current is then applied to the magnetic firing circuit.

2. Switch K is normally closed to contact #2 due to the BLUE field of a local magnet. When current energizes coil S, this magnet is depermed by rapid making and breaking of contact #2 until K no longer tends to close to contact #2. Thermistor M then heats until fuse R blows and isolates the A.L.A. circuit. The unit is now alive.

Delay Action Bomb Firing

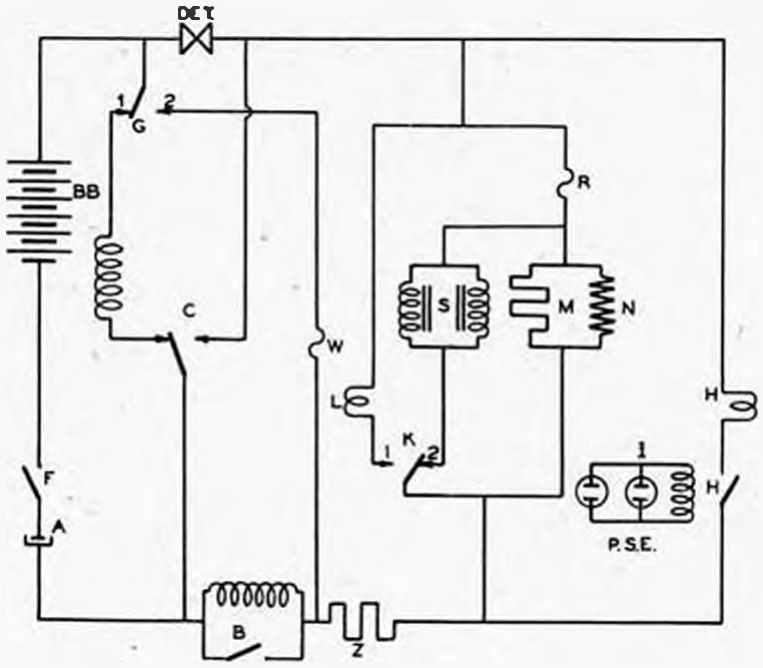
1. If the mine does not reach a depth of 24 ft., G remains on contact #1 and BB energizes C. Upon completion of its delay period, C switches over, completing the circuit through the detonator.

Normal Firing

1. A RED actuation closes K to contact #1, completing a circuit through the detonator, hold-on coil L and thermistor Z. When Z has heated sufficiently, L holds K on contact #1 and a current increase to 1/4 ampere fires the detonator.

P.S.E. Firing

1. The unit is fitted with two photo-electric cells designed to be energized upon exposure to light. The resultant current operates relay H, completing a circuit through H, Z and the detonator. The detonator will fire as above when Z heats sufficiently.



A	CLAPPER SWITCH	K	NEEDLE SWITCH
B	FUSE DELAY SWITCH	L	HOLD-ON COIL FOR K
BB	BATTERY 15 VOLT	M	THERMISTOR
C	FUSE DELAY SWITCH	N	RESISTOR
F	MASTER SWITCH	R	FUSE
G	HYDROSTATIC SWITCH	S	LATITUDE ADJUSTMENT COILS
H	PHOTOCELL RELAY AND HOLD-ON	W	FUSE
I	PHOTOCELL	Z	THERMISTOR

Fig. 6 - K Mk. V Unit Circuit and Key

M Mark VI Unit Circuit - Operation

Arming

1. Same as M Mark V.

Delay Action Bomb Firing

1. Same as M Mark V.

Normal Firing with P.D.M.

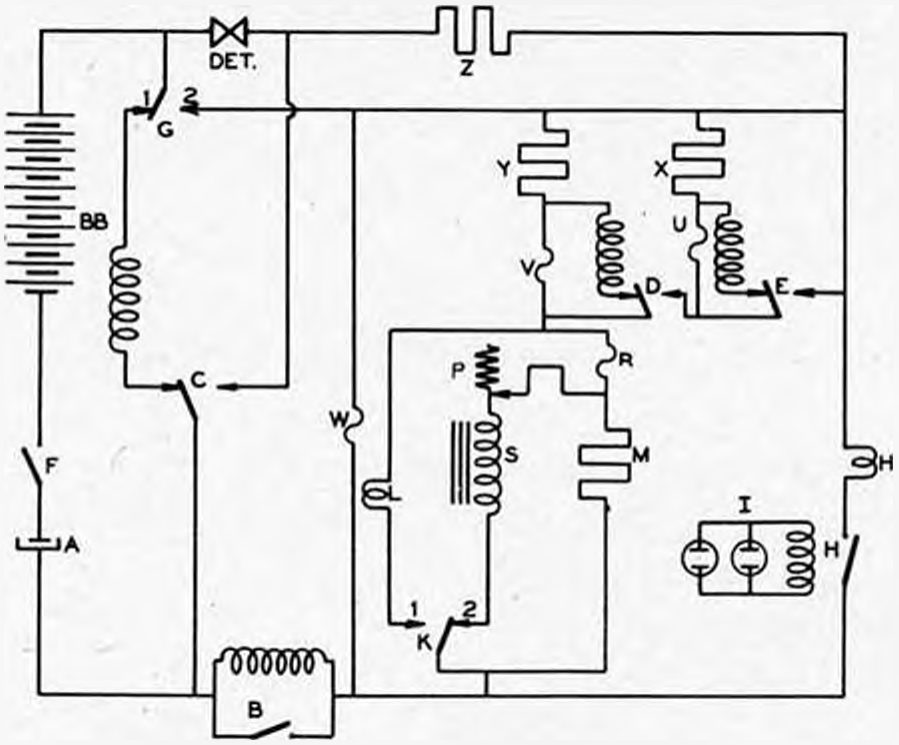
1. A RED actuation closes K to contact #1, completing a circuit through thermistor Y, fuse V and hold-on coil L. As Y heats, L holds K on its contact and V blows, energizing fuse delay switch D. Upon completion of its delay period, D switches over, completing a circuit through thermistor X and fuse U. X, being cold, cannot pass enough current to operate L and the circuit returns to normal.

2. A second RED actuation causes repetition of the above, with X heating, U blowing and fuse delay switch E switching in the detonator and thermistor Z. Z, being cold, cannot pass enough current to operate L and the circuit again returns to normal.

3. A third RED actuation completes the circuit through Z, L and the detonator which fires when the current rises to 1/4 ampere.

P.S.E. Firing

1. Same as M Mark V.



A CLAPPER SWITCH
B FUSE DELAY SWITCH
BB BATTERY 15 VOLT
C FUSE DELAY SWITCH
D " " "
E " " "
F MASTER SWITCH
G HYDROSTATIC SWITCH
H PHOTOCELL RELAY AND HOLD-ON
I PHOTOCELL
K NEEDLE SWITCH
L HOLD-ON COIL FOR K
M THERMISTOR
P RESISTOR
R FUSE
S LATITUDE ADJUSTMENT COILS
U FUSE
V "
W "
X THERMISTOR
Y "
Z "

Fig. 7 - M Mk. VI Unit Circuit and Key

M Mark VII Unit Circuit - Operation

Arming

1. When the hydrostatic clock runs off its delay setting, a-g and b-c close, blowing the detonator release fuse and starting A.L.A. which is performed as in M Mark II. The M Mark VII differs from M Mark II as follows:

   (a) Firing current passes directly through the needle switch.

   (b) The anticountermining device is of a different type.

   (c) The needle switch consists of eight flat needles mounted on a horizontal shaft with the needle edges in the vertical plane. The shaft is reverse-geared to a counterbalance system of weights and lever arms so that the moments of inertia of the needles and counterbalance systems are equal and opposite. The above change in construction permits the unit to tilt as much as 45° from the vertical without closing the needle switch. The net result of this modification, then, is that the opposing inertia moments prevent the unit from firing from shock or tilting whereas the needles may depress and close the needle switch upon receipt of a firing actuation without affecting the counterbalance system.

Normal Firing

1. A firing actuation closes the needle switch, operating the hold-on coil and completing the circuit through the detonator.

Normal Anticountermining

1. A countermining shock opens the inertia-operated, clockwork-type anticountermining switch which is normally closed. When the switch opens, it winds a small clockwork escapement and the circuit is broken until the escapement runs down in 3-10 seconds, varying directly with the intensity of the shock.

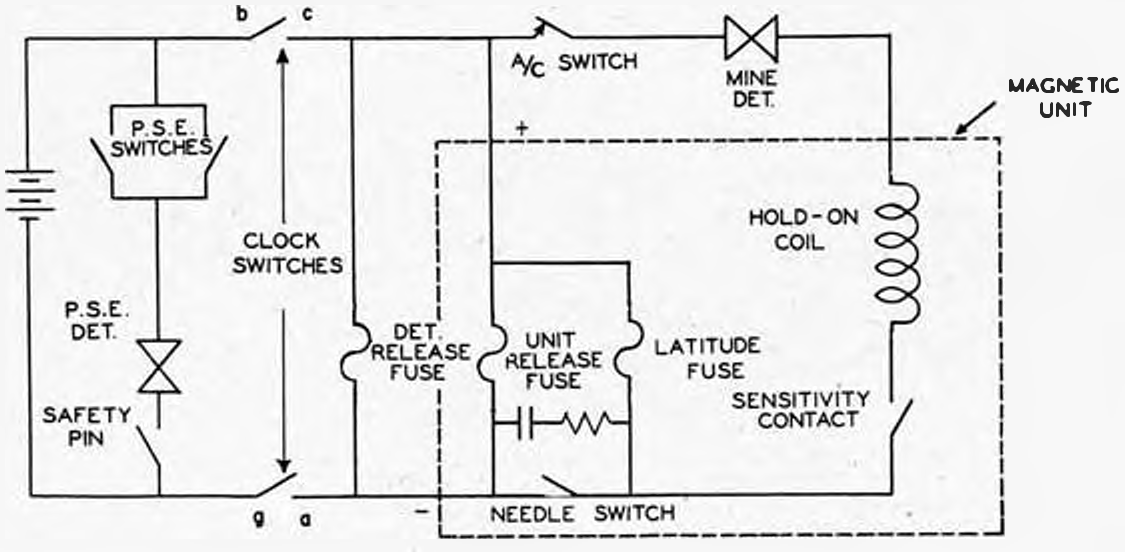


Fig. 8 - M Mk. VII Unit Circuit and Key

M Mark VIII Unit Circuit - Operation

Arming

1. When the mine is dropped, action of the Rheinmetall fuze closes the master switch F. The thermostatic clapper switch A is normally closed at temperatures above 32°F. If the mine reaches a depth of 24 ft. or more, the hydrostatic switch G closes to contact #2 and the battery energizes fuse delay switches B, D and E in that order. Upon completion of the delay period of E, battery current starts A.L.A. in the magnetic unit through the by-pass fuse of fuse delay switch #1 and thermistor Y. Upon completion of A.L.A., as in M Mark V fuse R will have blown and K will be just clear of contact #2.

Delay Action Bomb Firing

1. Same as M Mark V.

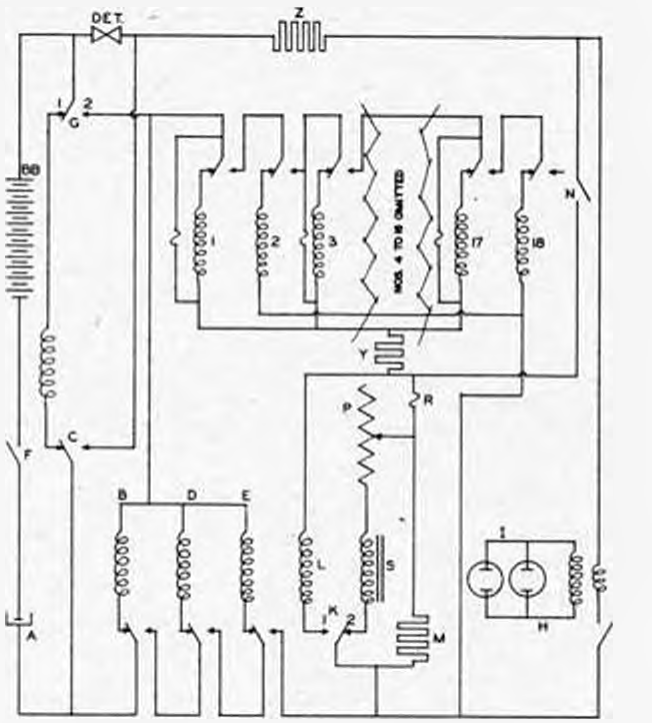
Normal Firing with P.D.M.

1. A RED actuation closes K to contact #1, completing a circuit from the battery through the by-pass fuse of fuse delay switch #1, thermistor Y and hold-on coil L. When Y heats sufficiently, L holds K on its contact, the by-pass fuse blows and switch #1 is energized. Upon completion of its delay period, switch #1 switches over, breaking the hold-on circuit, allowing L, Y and K to return to normal and cutting in switch #2 which passes current through a by-pass. Upon completion of its delay period, switch #2 switches over, cutting in switch #3. After a maximum of nine "blind" actuations, switches #17 and #18 will have operated, closing switch N and putting the detonator in the firing circuit.

2. A final RED actuation completes a circuit L, N, thermistor Z and the detonator. When Z has heated sufficiently, L holds K on its contact and a current increase to 1/4 ampere fires the detonator.

P.S.E. Firing

1. Photo-electric cells may be fitted as in the M Mark V.



A	CLAPPER SWITCH	L	HOLD-ON COIL FOR K
B	SWITCH-40 SEC. FUSE DELAY	S	LATITUDE ADJUSTMENT COILS
BB	BATTERY 15-VOLT	M	THERMISTOR
C	FUSE DELAY SWITCH	N	FUSE DELAY SWITCH
D	" " "	P	RESISTOR
E	" " "	R	FUSE
F	MASTER SWITCH	Y	THERMISTOR 5 TO 8 SEC.
G	HYDROSTATIC SWITCH	Z	" 2 TO 5 SEC.
H	PHOTOCELL RELAY AND HOLD-ON	1-3-5-7-SWITCHES 27 SEC FUSE DELAY	
I	PHOTOCELL	2-4-6-8- " " 7 " " "	
K	SWITCH-MAG UNIT RELAY		

Fig. 9 - M Mk. VIII Unit Circuit and Key

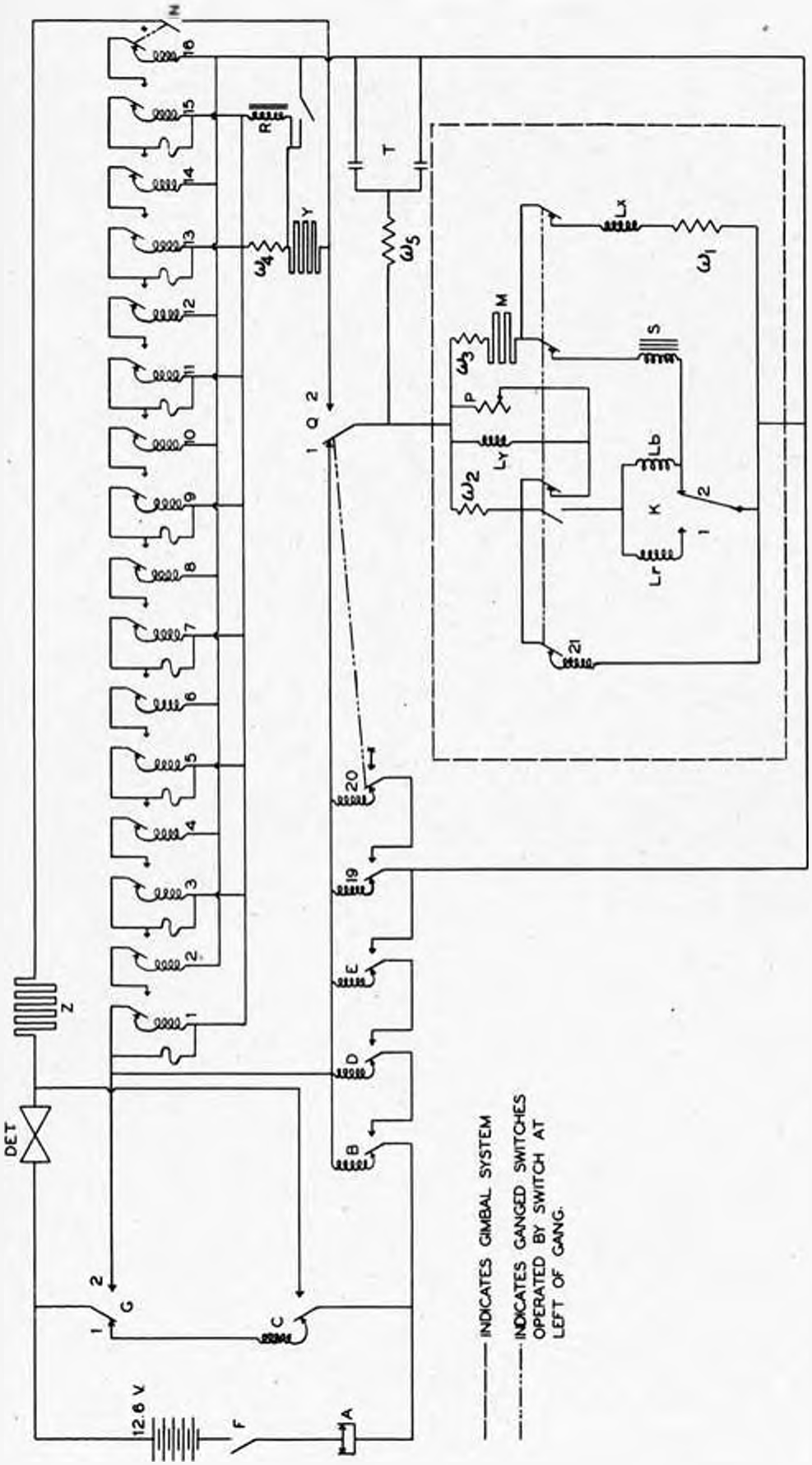


Fig. 10 - M Mk. IX Unit Circuit

M Mark IX Unit Circuit - Operation

Arming

1. When the mine is dropped, action of the Rheinmetall fuze closes the Master Switch F. The thermostatic clapper switch A is normally closed at temperatures above 32°F. If the mine reaches a depth of 24 ft. or more, the hydrostatic switch G closes to contact #2 and fuse delay switches B, D and E are energized in that order. Upon completion of the delay period of E:

   (a) Battery current energizes the gimbal system in which fuse delay switch #21 controls four circuits in addition to its own. Battery current energizes coil S which deperms its own magnetic core to a point where switch K is just clear of contact #2. All the current in this parallel circuit now flows through L_r which provides an increasing RED field due to heating of thermistor M. This assures that K does not remake contact #2 and further deperm S. During the above operation, L_y has been introducing a BLUE field roughly equivalent to the unit sensitivity. The strength of the L_y field is adjustable by varying P. When switch #21 switches over after completion of A.L.A., it breaks its own circuit, isolates S, breaks the circuit to L_x, and breaks the circuit to the compensating coil L_y and P so that K goes to equilibrium between the two contacts.

   (b) Battery current energizes switches #19 and #20 in that order. Upon completion of its delay period, #20 switches over to a blank contact and mechanically switches Q from contact #1 to contact #2, putting the bi-polar gimbal unit in the P.D.M. circuit.

Delay Action Bomb Firing

1. Same as M Mark V.

Normal Firing with P.D.M.

1. A RED or BLUE actuation closes K to the appropriate contact and battery current heats thermistor Y until it passes sufficient current to operate hold-on coil L_r or L_b. When the current reaches 100 ma., the by-pass fuse on fuse delay switch #1 blows and the fuse delay switch then carries the total current. The increasing current operates relay R which provides its own holding current through a lead which by-passes the gimbal portion of the unit. Hold-on current for K is then reduced to a point where K opens. Upon completion of its delay period, switch #1 switches over, de-energizing R which then returns to normal and cutting in switch #2. Upon completion of its delay period, switch #2 switches over and the unit returns to normal.

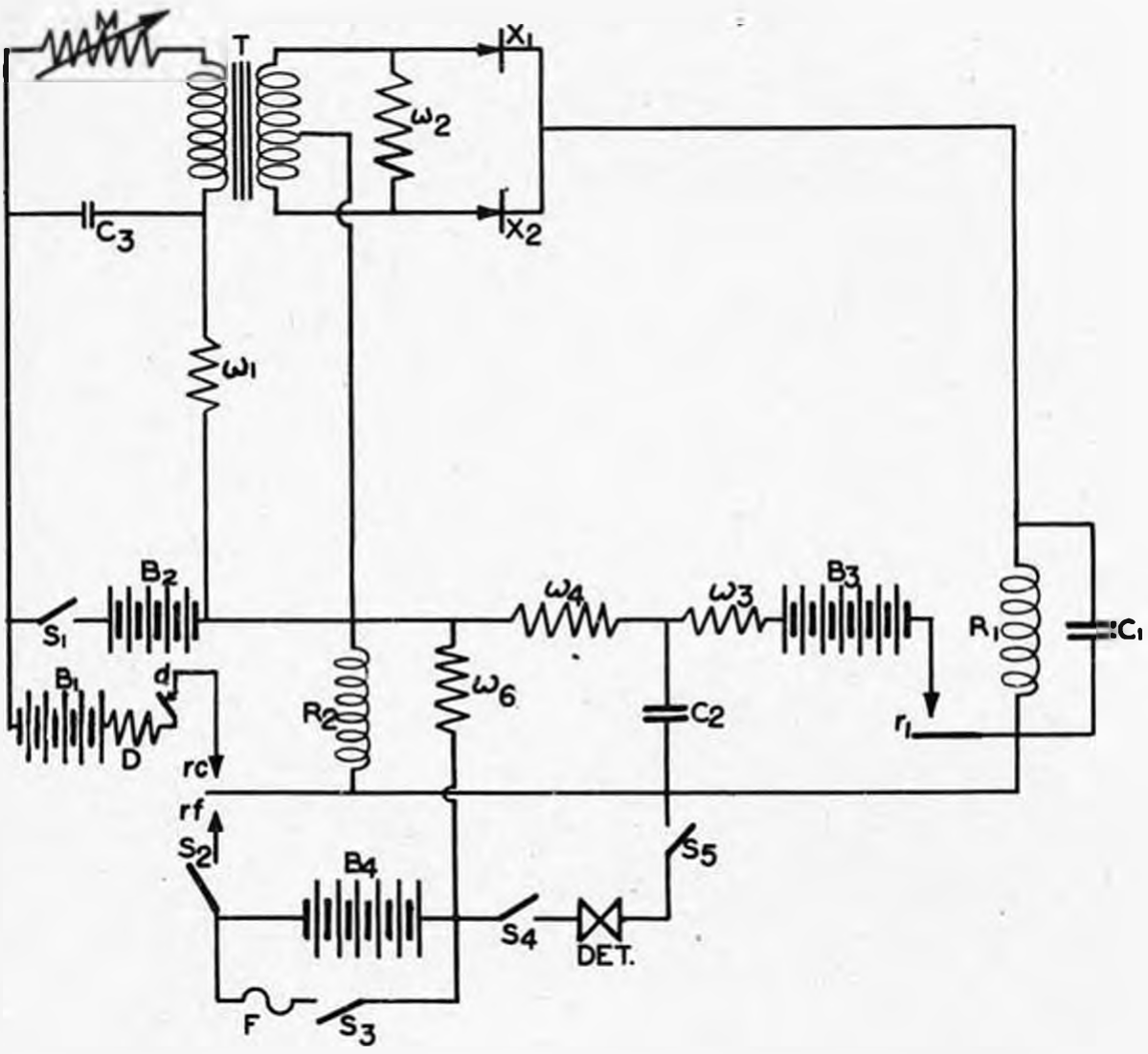
2. After a maximum of eight "blind" actuations, switch #16 closes switch N, completing the circuit through the detonator and thermistor Z. A final actuation fires the detonator as in M Mark VIII.

P.S.E. Firing

1. Photo-electric cells may be fitted as in M Mark V.

A - CLAPPER SWITCH
B,C,D,E - FUSE DELAY SWITCH
F - MASTER SWITCH
G - HYDROSTATIC SWITCH
K - NEEDLE SWITCH
L_r - RED HOLD-ON COIL
L_b - BLUE HOLD-ON COIL
L_x - AUXILIARY COIL
L_y - COMPENSATING COIL
M,Y,Z - THERMISTORS
N - SWITCH OPERATED BY FUSE DELAY SW. #18
P - POTENTIOMETER
Q - SWITCH OPERATED BY FUSE DELAY SW #20
R - SOLENOID RELAY
S - LATITUDE ADJUSTER COIL
T - CONDENSERS
w_1, w_2, w_3, w_4, w_5 - RESISTORS
#1 - #18 - P.D.M. FUSE DELAY SWITCHES
#19 #20 - DELAY ARMING FUSE DELAY SWITCHES
#21 - A.L.A. FUSE DELAY SWITCH

Fig. 11 - Key for M Mk. IX Unit Circuit



B_1	9 VOLTS
B_2	9 VOLTS
B_3	15 VOLTS
B_4	9 VOLTS
C_1	280 MICROFARADS
C_2	330 MICROFARADS
C_3	10 MICROFARADS
W_1	25 OHMS
W_2	3000 OHMS
W_3	5000 OHMS
W_4	5000 OHMS
W_5	1000 OHMS

F	FUSE TO START DELAY CLOCK
S_1 S_2	SWITCHES CLOSED BY DELAY CLOCK
S_3	TRANSIENT CONTACT ON HYDR. CLOCK
S_4	HYDROSTATIC CLOCK SWITCH (a-g)
S_5	HYDROSTATIC CLOCK SWITCH (b-c)
T	MICROPHONE TRANSFORMER
M	MICROPHONE
X_1	COPPER OXIDE RECTIFIER
X2	COPPER OXIDE RECTIFIER
R_1	RELAY-SENSITIVITY 116 MICROAMPS TO r_1
R_2	RELAY-SENSITIVITY 440 MICROAMPS TO r_c 1110 MICROAMPS TO r_f
D	THERMAL DELAY HEATER
d	THERMAL DELAY SWITCH

Fig. 12 - A Mk. I Unit Circuit and Key

A Mark I Unit Circuit - Operation

Arming

1. Two minutes after the hydrostatic clock starts, s_3 closes, blowing fuse F and starting the delay clock. When the hydrostatic clock runs off its delay period, (17 minutes) s_4 and s_5 close, putting the detonator in the circuit. When the delay clock runs off its period (6 days max.), s_1 and s_2 close and the unit is alive.

Normal Firing

1. When sound impinges on the microphone, the change in microphone resistance will appear as current variations on the primary of transformer T and as alternating signal current on the secondary of T. The signal current is then rectified by rectifiers X_1 and X_2 with direct current then flowing from the secondary through two relays in series, the first, R_1 being more sensitive than the second, R_2.

2. If the sound is of suitable intensity for normal firing, the current flowing through R_1 and R_2 will not be strong enough to operate R_2. If the sound persists long enough to charge C_1, R_1 closes to r_1. B_3 now sends current through R_2 which opposes and is stronger than the induced current from the secondary of T. The direction of this current is such that R_2 closes to contact r_f, putting the detonator across B_4.

Normal Anticountermining

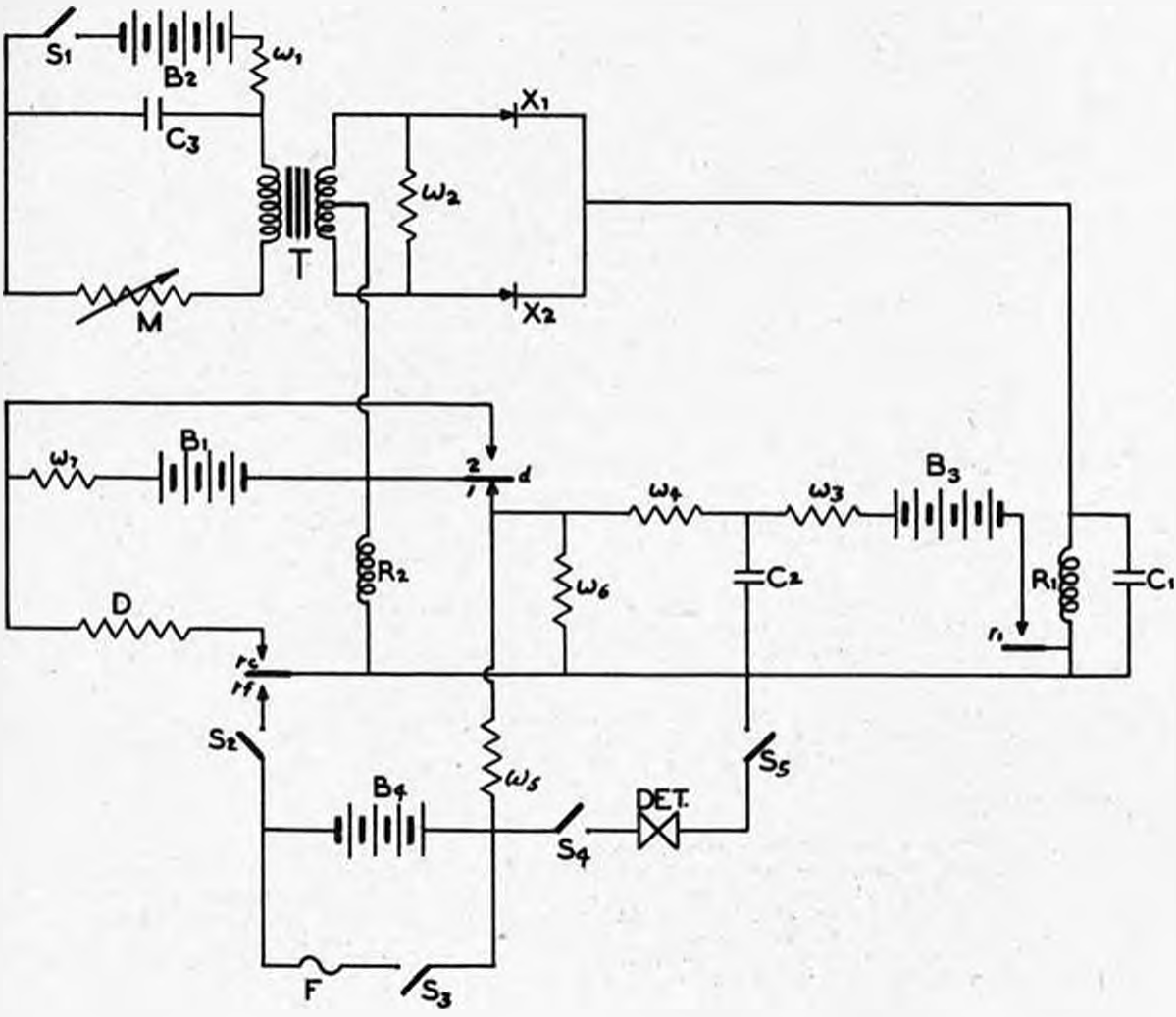
1. A loud sound which produces a strong current through R_1 and R_2 tends to operate both relays. Because of the delay in R_1 occasioned by C_1, R_2 operates first and, because of the direction of the actuating current, closes to r_o.

2. B_1 and B_2 then apply a locking voltage, preventing R_1 from operating, blocking further current from the secondary of T and keeping R_2 closed to r_o. This condition persists until thermal delay heater D heats and opens its switch d after about 12 seconds.

3. R_2 then opens, d closes and the unit returns to normal. If frequent anticountermining shocks are received, D will heat to the point where the unit's inert period may be as short as three seconds.

Intermediate State

1. A sound which builds up uniformly and rapidly to a point of considerable intensity may produce a current which is strong enough, after R_1 operates, to cancel out the current from B_3 which would ordinarily close R_2 to r_f. R_2 would not then close to either contact and the unit would neither fire nor be rendered passive. If such a signal ceased abruptly, R_1 would open although the unit would probably fire due to discharge from C_2 through R_2 which would close to r_f.



B1 - 15 VOLTS
B2 - 9 VOLTS
B3 - 15 VOLTS
B4 - 9 VOLTS
C1 - 315 MICROFARADS
C2 - 365 MICROFARADS
C3 - 10 MICROFARADS
W1 - 25 OHMS
W2 - 5000 OHMS
W3 - 5000 OHMS
W4 - 5000 OHMS
W5 - 1000 OHMS
W6 - 5000 OHMS
W7 - 20 OHMS

S1.S2 SWITCHES CLOSED BY DELAY CLOCK
S3 TRANSIENT CONTACT ON HYDR. CLOCK
S4 HYDROSTATIC CLOCK SWITCH (a-g)
S5 HYDROSTATIC CLOCK SWITCH (b-c)
T MICROPHONE TRANSFORMER
D THERMAL DELAY HEATER - 100 OHMS
F FUSE
R1 RELAY - SENSITIVITY 123 MICROAMPS TO r1
R2 RELAY - SENSITIVITY 700 MICROAMPS TO rc
975 MICROAMPS TO rf
M MICROPHONE
X1 COPPER OXIDE RECTIFIER
X2 COPPER OXIDE RECTIFER

Fig. 13 - A Mk. II Unit Circuit and Key

A Mark II Unit Circuit - Operation

Arming and Normal Firing

1. Same as A Mark I.

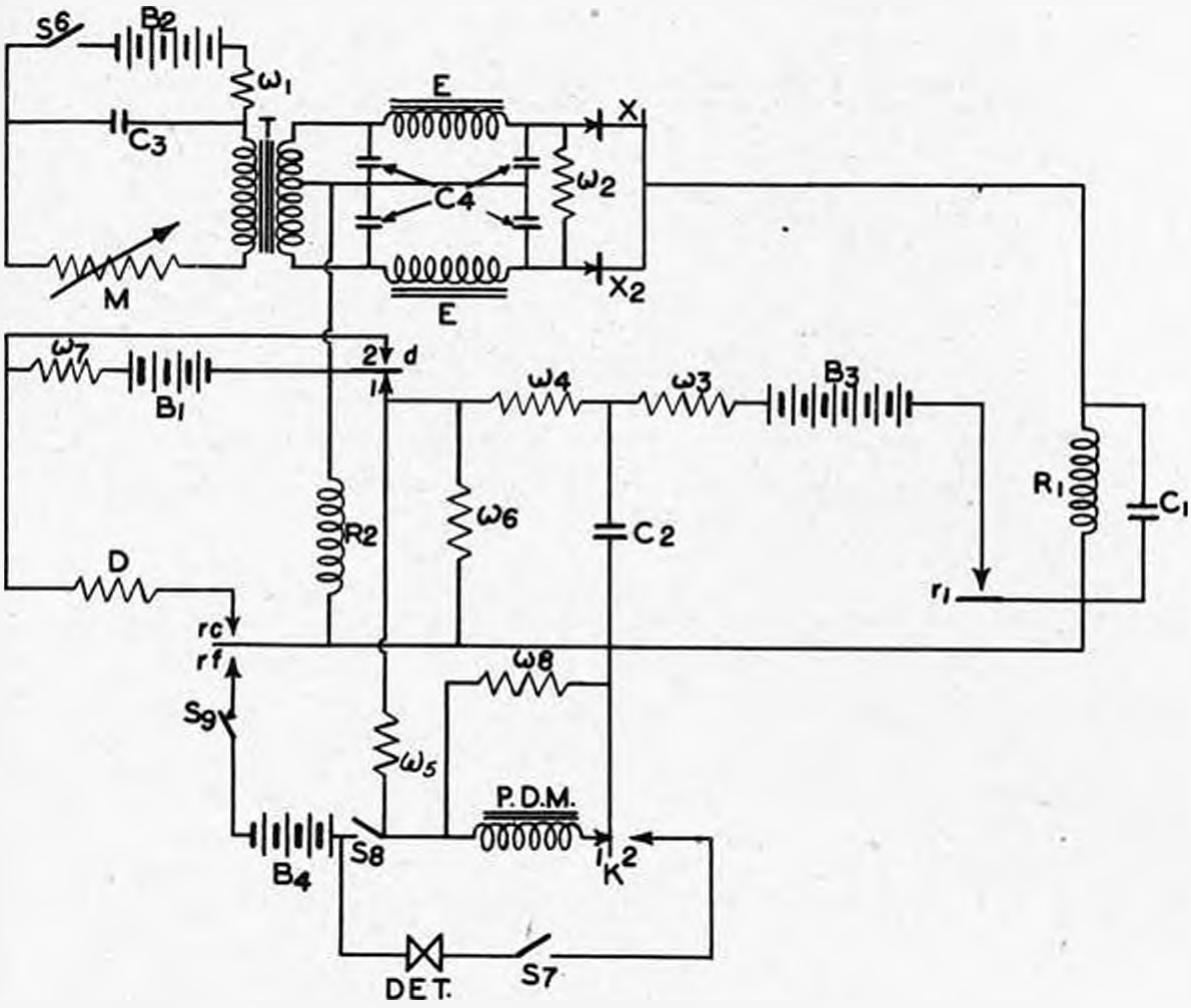
Normal Anticountermining

1. A loud sound which produces a strong current through both R_1 and R_2 tends to operate both relays. However, because of the delay in R_1 occasioned by C_1, R_2 will close to r_c first, imposing a blocking potential from B_1 across the secondary, thereby holding R_1 open.

2. With R_2 closed to r_c, the circuit from B_1 through D is completed and the thermal delay switch D starts to heat. After about 35 seconds, d_1 is broken and the contact starts to move toward d_2 which makes in about 30 seconds.

3. When contact d_2 is closed, B_1 is shorted through W_2, hold-on current through R_2 is reduced to a small amount and r_c opens. Since the circuit from B_1 through D is then broken, D begins to cool and the thermal delay switch starts moving back from d_2 to d_1, requiring about 15 seconds (total period of cycle is 80 seconds).

Note: The unit is not alive until the thermal delay switch returns to d_1 because, although the blocking potential is removed from the secondary upon opening of R_2, even if a signal causes R_1 to close, there is no circuit from B_1 through R_2, and R_2 cannot, therefore, be moved to its firing contact r_f.



B_1 - 15 VOLTS	S_6 SWITCH-CLOSES AT END OF DELAY (a-g)
B_2 - 9 VOLTS	S_7 SWITCH-CLOSES AT END OF DELAY (b-c)
B_3 - 15 VOLTS	S_8 SWITCH-CLOSES SHORTLY AFTER S_6 AND S_7 (e-f)
B_4 - 9 VOLTS	S_9 SWITCH ON P.D.M.
C_1 - 315 MICROFARADS	K SWITCH ON P.D.M. (STAYS ON 1 UNTIL RUN OFF)
C_2 - 365 MICROFARADS	D THERMAL DELAY HEATER-100 OHMS
C_3 - 10 MICROFARADS	E FILTER CHOKES
C_4 - 0.6 MICROFARADS	M MICROPHONE
W_1 - 25 OHMS	T MICROPHONE TRANSFORMER
W_2 - 5000 OHMS	R_1 RELAY-SENSITIVITY 123 MICROAMPS TO r_1
W_3 - 5000 OHMS	R_2 RELAY-SENSITIVITY 700 MICROAMPS TO r_c
W_4 - 5000 OHMS	975 MICROAMPS TO r_f
W_5 - 1000 OHMS	X_1 COPPER OXIDE RECTIFIER
W_6 - 5000 OHMS	X_2 COPPER OXIDE RECTIFIER
W_7 - 20 OHMS	
W_8 - 100 OHMS	

Fig. 14 - A Mk. III Unit Circuit and Key

A Mark III Unit Circuit - Operation

Arming

1. At the end of its preset period, the hydrostatic clock closes switches S_6, S_7 and S_8.

Normal Firing

1. Same as A Mark I and II except that the incorporation of an extra choke condenser filter (E-C_4) eliminates signal currents of 700-1000 cps. frequency, thereby making the unit more selective as to the frequencies of sound which will cause normal firing or anticountermining.

Normal Anticountermining

1. Same as A Mark I and II except as noted above.

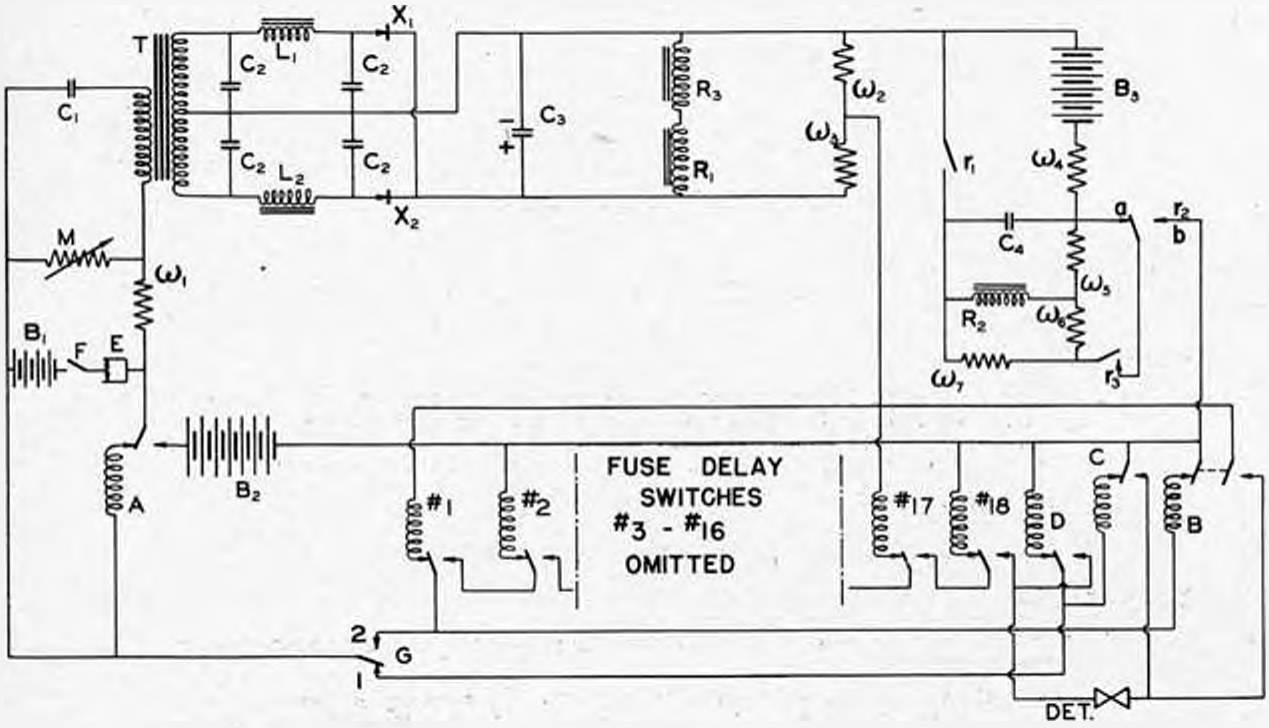
P.D.M. Action

1. In addition, a twelve-place P.D.M. may be fitted which operates as follows:

   (a) When a firing impulse closes R_2 to r_f, battery B_4 puts hold-on current through R_2 by means of W_c. The P.D.M. solenoid is also energized by B_4 through K_1 and the P.D.M. clockwork starts.

   (b) When S_9 breaks, R_2 hold-on current is broken and the P.D.M. solenoid is de-energized. The circuit then remains dormant until the P.D.M. interval is run off and S_9 recloses. When the final "blind" actuation is run off, K_1 breaks and K_2 makes, putting the detonator in the circuit.

   (c) Detailed operation of the P.D.M. is the same as that of the standard P.D.M. described on Page 56. S_9 corresponds to P-Q, K_1 R-S and K_2 to S-T in Fig.



A.B.C.D - FUSE DELAY SWITCHES
B_1 - BATTERY - 3 VOLTS
B_2 - " - 7.5 VOLTS
C_1 - CONDENSER - 240. MFD. - ELECTROLYTIC
C_2 - " - 0.5 "
C_3 - " - 100. " - ELECTROLYTIC
C_4 - " - " " - "
E - THERMOSTATIC SWITCH (CLOSED AT >23 F AND <95 F)
F - MASTER SWITCH
G - HYDROSTATIC SWITCH (24 FT)
L_1L_2 - FILTER CHOKES
M - CARBON MICROPHONE
R_1 - RELAY (INITIATING) - 500Ω r_1 - R_1 CONTACT
R_2 - " (TIMING) - 50Ω r_2 - R_2 "
R_3 - " (FIRING) - 250Ω r_3 - R_3 "
T - MICROPHONE TRANSFORMER
X_1X_2 - COPPER OXIDE RECTIFIERS
#1 - #18 - P.D.M FUSE DELAY SWITCHES
ω_1 - 10Ω
ω_2 - 5Ω
ω_3 - 2000Ω
ω_4 - 5000Ω
ω_5 - 5000Ω
ω_6 - 200Ω
ω_7 - 5Ω

Fig. 15 - A Mk. IV Unit Circuit and Key

A Mark IV Unit Circuit - Operation

Arming

1. When the mine is dropped, action of the Rheinmetall fuze closes Master Switch F. Since the thermostatic switch E is normally closed at temperatures between 23° and 95°F, B_1 energizes the microphone M through w_1 and fuse delay switch A. Upon completion of its delay period, A switches over, putting B_2 in series with B_1 with respect to all parts of the circuit except the microphone circuit.

2. If the mine reaches a depth of 24 ft. or more, hydrostatic switch G closes to contact #2 and, upon completion of the operations described in Par. 1 above, B_1 and B_2 energize fuse delay switch B. Upon completion of its delay period, B switches over, cuts itself out and puts the detonator in the circuit.

Delay Action Bomb Firing

1. If the mine does not reach a depth of 24 ft., the hydrostatic switch remains on contact #1 and, upon completion of the operations described in Par. 1 above, B_1 and B_2 energize switches C and D in parallel. Upon completion of their respective delay periods, C and D switch over, putting the detonator across the batteries.

Normal Firing with P.D.M.

1. When sound impinges on the microphone, the change in microphone resistance appears as current variations on the primary of transformer T and as alternating signal current on the secondary of T. The signal current is filtered by L_1, L_2 and C_2, rectified by X_1 and X_2 with direct current then flowing through R_1 and R_3, charging C_3. R_1 is more sensitive than R_3, the sound level at which R_1 operates being the initiating level and the level at which R_3 operates being the firing level.

2. When the sound reaches the initiating level, R_1 closes r_1, causing B_3 to start charging C_4. After 1/2 second, C_4 will be sufficiently charged to operate R_2, thereby breaking r_2a and making r_2b. If the sound then reaches the firing level, R_3 closes r_3, completing a circuit from B_1 and B_2 through fuse delay switch #1, w_2, r_1, w_7, r_3 and r_2b. Potential drop through w_2 holds R_1 and R_3 operative and, since r_1 is held closed, B_3 holds R_2 operative.

3. Upon completion of its delay period, switch #1 switches over, cutting in switch #2 and by-passing the holding circuit which, if the sound has ceased, allows the circuit to return to normal. Upon completion of its delay period, switch #2 switches over, cutting in switch #3 and the circuit is normally alive again. After a maximum of nine "blind" actuations, switches #17 and #18 operate, putting the detonator in the firing circuit and an additional firing actuation will fire the detonator.

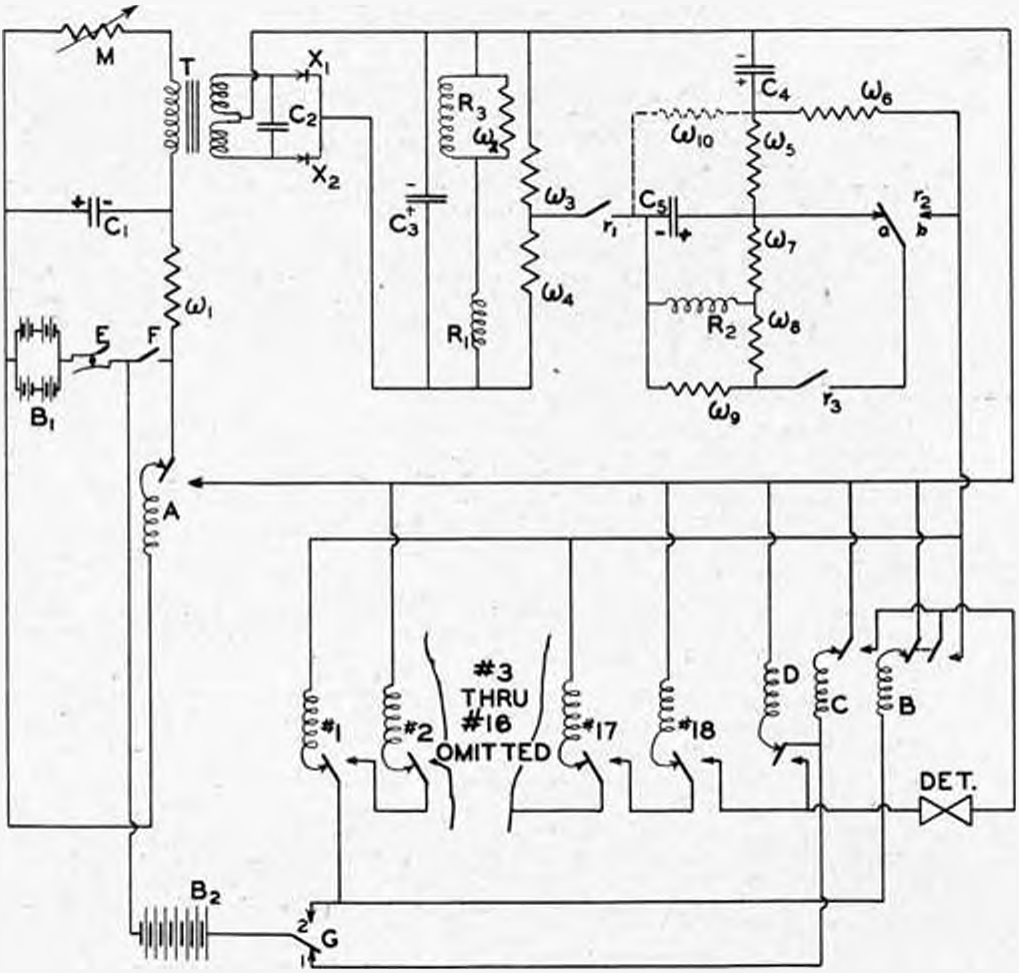
Normal Anticountermining

1. If at any time during the life of the unit, the relays operate in such a sequence that R_3 operates before R_2, the unit is rendered passive for the duration of the sound which causes the condition. If the sound reaches the firing level within 1/2 second after r_1 closes, R_3 will close r_3, making an almost direct short across C_4 via r_2a. R_2 then cannot operate.

2. If the sound then drops below the initiating level, all relays return to normal. If the sound drops below the firing level, but not below the initiating level, and then rises to the firing level after a 1/2 second delay, the unit will fire normally.

P.S.E. Firing

1. Photo-electric cells may be fitted as in M Mark V.



A,B,C,D - FUSE DELAY SWITCHES
E - THERMOSTATIC SWITCH (CLOSED AT >23°F AND <95°F)
F - MASTER SWITCH
G - HYDROSTATIC SWITCH (24 FT.)
B_1 - 3 VOLTS
B_2 - 10 "
C_1 - CONDENSER - 240 MFD. - ELECTROLYTIC
C_2 - " - 0.2 MFD.
C_3 - " - 100 " - ELECTROLYTIC
C_4 - " - " " - "
C_5 - " - " " - "
M - CARBON MICROPHONE
R_1 - RELAY (INITIATING) r_1 - R_1 CONTACT
R_2 - " (TIMING) r_2 - R_2 "
R_3 - " (FIRING) r_3 - R_3 "
T - MICROPHONE TRANSFORMER
X_1, X_2 - COPPER OXIDE RECTIFIERS
#1 - #18 - P.D.M. FUSE DELAY SWITCHES
ω_1 - 10 Ω
ω_2 - 3,000 Ω
ω_3 - 5 Ω
ω_4 - 10,000 Ω
ω_5 - 15,000 Ω
ω_6 - 01 Ω
ω_7 - 15,000 Ω
ω_8 - 5,000 Ω
ω_9 - 5. Ω

Fig. 16 - A Mk. V Unit Circuit and Key

A Mark V Unit Circuit - Operation

Arming

1. When the mine is dropped, action of the Rheinmetall fuze closes the Master Switch F. Since the thermostatic switch E is normally closed between temperatures of 23° and 95°F, B_1 energizes the microphone M through w_1 and fuse delay switch A. Upon completion of its delay period, A switches over, putting B_2 in the circuit.

2. If the mine reaches a depth of 24 ft. or more, hydrostatic switch G closes to contact #2 and, upon completion of the operations described in Par. 1 above, B_2 energizes fuse delay switch B. Upon completion of its delay period, B switches over, cuts itself out and puts the detonator in the circuit. B_2 charges C_4 after a 15 second delay due to the resistance of w_6.

Delay Action Bomb Firing

1. Same as A Mark IV except that all current is supplied by B_2.

Normal Firing with P.D.M.

1. When sound impinges on the microphone, the change in microphone resistance appears as current variations on the primary of the transformer T and as alternating signal current on the secondary of T. The signal current is rectified by X_1 and X_2 with direct current then flowing through R_1 and R_3, charging C_3. R_1 is more sensitive than R_3, the sound level at which R_1 operates being the initiating level and the level at which R_3 operates being the firing level.

2. When the sound reaches the initiating level, R_1 closes r_1, causing C_4 to start charging C_5 in an attempt to operate R_2. After 1/2 second, C_5 will be sufficiently charged to operate R_2, thereby breaking r_2a and making r_2b. If the sound then reaches the firing level before C_4 and C_5 discharge (10 sec.), R_3 closes r_3, completing a circuit through fuse delay switch #1, r_2b, r_3, w_8, r_1 and w_3. Potential drop through w_3 holds R_1 and R_2 operative and, since r_1 is held closed, C_4 and C_5 hold R_2 operative.

3. Upon completion of its delay period, switch #1 switches over, cutting in switch #2 and by-passing the holding circuit which, if the sound has ceased, allows the circuit to return to normal. Upon completion of its delay period, switch #2 switches over, cutting in switch #3 and the circuit is normally alive again. After a maximum of nine "blind" actuations, switches #17 and #18 operate, putting the detonator in the firing circuit and an additional actuation will fire the detonator.

Normal Anticountermining

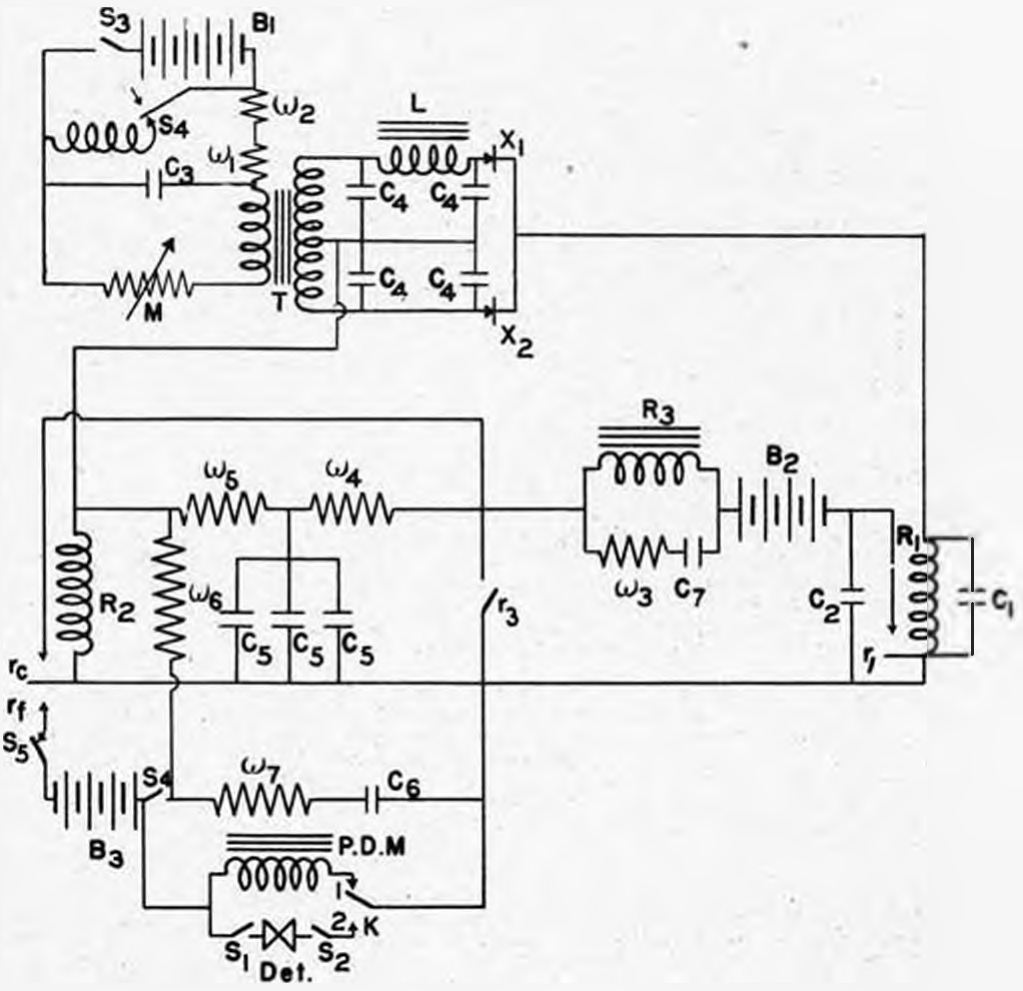
1. Normal anticountermining may occur in one of two ways as follows:

   (a) If the sound level rises too fast, the unit will be rendered passive in the same manner as the A Mark IV except that if the sound ceases or drops below the firing level, the unit will not again be normally alive for a period of 15 seconds maximum.

   (b) If the sound level rises too slowly after reaching the initiating level, C_4 and C_5 may discharge to the point where they will no longer hold r_2b closed. In such a case, r_2a will again close after a 10 second delay and the unit will not again be normally alive for a period of 15 seconds or until B_2 can recharge C_4 through w_6.

P.S.E. Firing

1. Photo-electric cells may be fitted as in M Mark V.



B_1	-	Battery	-	9 volts		ω_1	- 20 ~
B_2	-	"	-	15 "		ω_2	- 100 ~
B_3	-	"	-	9 "		ω_3	- 3000 ~
C_1	-	Condenser	-	300 microfarads		ω_4	- 5000 ~
C_2	-	"	-	365 "		ω_5	- 6000 ~
C_3	-	"	-	10 "		ω_6	- 1000 ~
C_4	-	"	-	.6 "	(each)	ω_7	- 20 ~
C_5	-	"	-	240 "			
C_6	-	"	-	100 "			
C_7	-	"	-	100 "			
K	-	PDM changeover switch					
L	-	Filter Choke					
M	-	Microphone (coarse)					
R_1	-	Relay - 50 Microamps sensitivity				r_1	- R_1 contact
R_2	-	Relay -				r_c, r_f	- R_2 contacts
R_3	-	Relay -				r_3	- R_3 contact
T	-	Microphone Transformer					
S_1, S_2	-	Clock Switches (a-g , b-c)					
S_3	-	Clock Switch (e-f)					
S_4	-	Fuse Delay Switch (30 sec.)					
S_5	-	PDM switch (normally closed)					
X_1, X_2	-	Copper Oxide Rectifiers					

Fig. 17 - A Mk. VI Unit Circuit and Key

A Mark VI Unit Circuit - Operation

Arming

1. When the hydrostatic clock completes its delay period, s_1 and s_2 close, putting the detonator into the circuit. Eighteen minutes later, s_3 closes and B_1 energizes fuse delay switch S_4 and the microphone M. Upon completion of its delay period, S_4 switches over, cutting out its heater, putting full battery current on the microphone and closing an extra contact of S_4 which arms the holding circuit of B_3 on R_2.

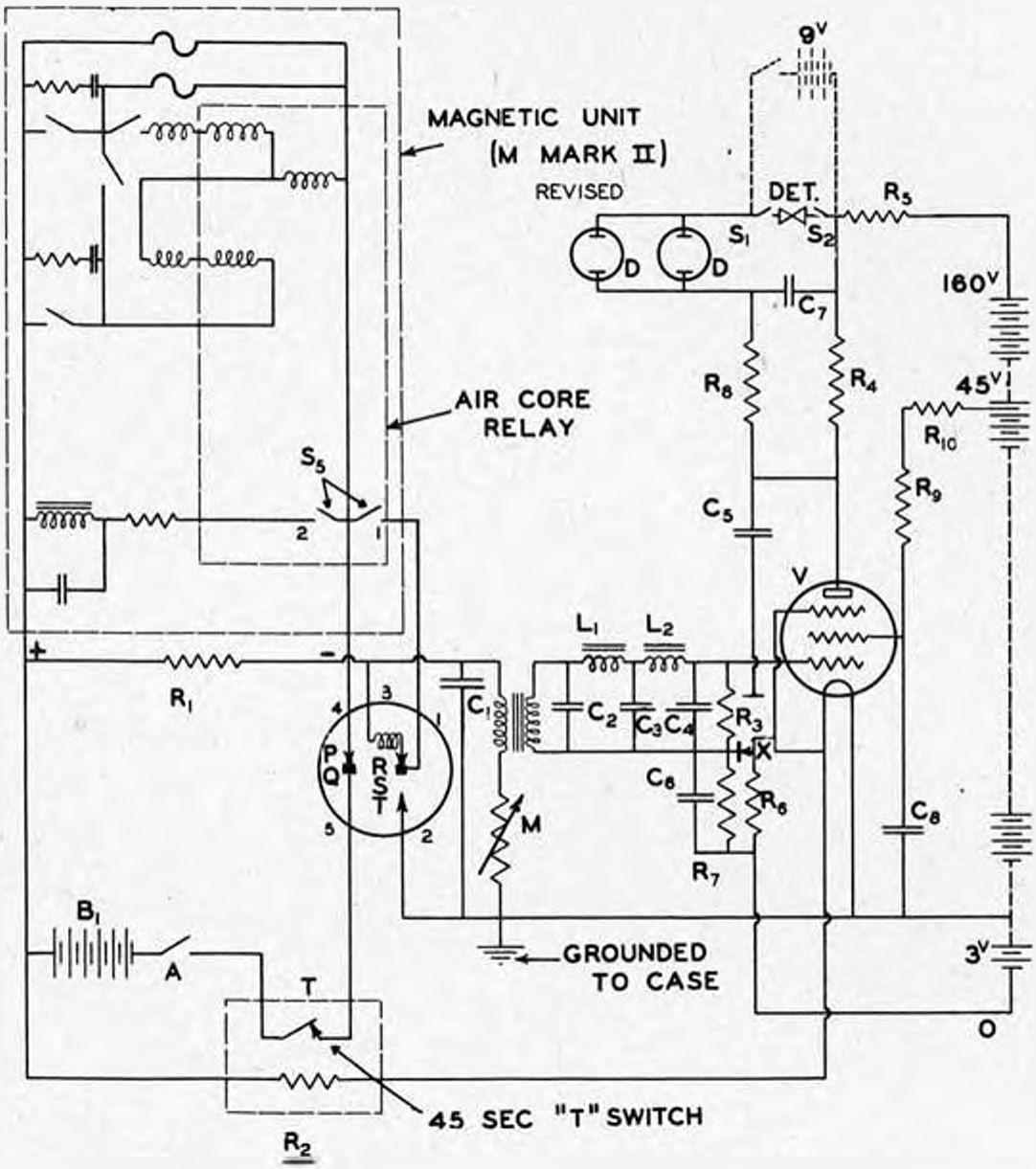
Normal Firing with P.D.M.

1. When sound impinges upon the microphone, it causes resistance variations which appear as alternating current upon the secondary of transformer T. This current is filtered and rectified in a manner similar to that employed in the A Mark III with the intensity of the rectified current directly variable with the intensity of the sound. An insensitive microphone is used so that the amount of current through the relay coils will be small compared to that produced in the A Mark III.
2. Since R_1 is more sensitive than R_2, normal sound of the type produced by an approaching minesweeper will operate R_1 but R_2 will not operate until the sweeper is fairly close. When R_1 closes, it completes a circuit through R_3, w_4, w_5 and R_2. Due to the high resistance of the circuit, R_3 does not operate.

3. If the sound persists for 3-3 1/2 seconds, however, C_5 charges sufficiently to let R_2 close to r_f, whereupon B_3 energizes a holding circuit through w_6 and the P.D.M. solenoid. During the P.D.M. cycle, S_5 breaks, de-energizing the holding circuit. After a maximum of 11 "blind" actuations, switch K breaks contact #1 and makes contact #2 and an additional firing actuation will fire the mine.

Normal Anticountermining

1. If the sound impinging on the microphone is of a very high intensity, such as might be produced by an underwater explosion, both R_1 and R_2 operate. R_2, however, closes to r_c so that the circuit from B_2 through R_3 is one of very low resistance. R_3 operates, closing r_3 which provides a self-holding current for R_3 through r_4, thus preventing C_5 from charging and R_2 from closing to r_f. This condition will persist until the sound level drops below that necessary to keep R_1 operative. At this point, R_3 is restored to normal and the unit is alive to normal actuation.



A	-	a-g	
S_1	-	b-c	
S_2	-	e-f	
B	-	BATTERY 15 VOLTS	
S_5	-	MAGNETIC UNIT SWITCH	
T	-	TIME DELAY SWITCH	
V	-	VACUUM TUBE AMPLIFIER	
DD	-	NEON TUBES	
L_1 L_2	-	FILTER CHOKES	
X	-	COPPER OXIDE RECTIFIER	
C_1	-	100. MICROFARADS	
C_2	-	0.02 MICROFARADS	
C_3	-	0.05 "	
C_4	-	0.02 "	
C_5	-	0.01 "	
C_6	-	0.5 "	
C_7	-	0.25 "	
C_8	-	4.0 "	

R_1	-	300.	OHMS
R_2	-	200.	" HEATER
R_3	-	0.1	MEGOHMS
R_4	-	0.06	"
R_5	-	5.5	KILOHMS
R_6	-	0.3	MEGOHMS
R_7	-	1.5	"
R_8	-	1.5	"
R_9	-	1.0	"
R_{10}	-	6000.	OHMS

Fig. 18 - Mk. I Unit Circuit and Key

Magnetic-Acoustic Firing Units

General

1. AM Mark I - consists of a constantly active magnetic component, an acoustic component and a twelve-place P.D.M. When the magnetic component is actuated, it steps off stages on the P.D.M. and, when the final "blind" actuation is run off, operates as if the P.D.M. were not fitted as follows:

   (a) A magnetic actuation operates the magnetic component which, instead of firing the detonator, energizes the microphone circuit, vacuum tube amplifier and "T" switch heater. The acoustic component is then active and if a sound of proper frequency, intensity and duration impinges on the microphone, it is transformed into an electric signal, passes through a filter circuit which eliminates undesirable frequencies and then to the energized vacuum tube amplifier and the detonator.

   (b) If, after the acoustic component is energized, no proper sound impinges on the microphone, the "T" switch opens after 45 sec., due to its heater, and cuts off the energizing current from the microphone, amplifier and its own heater and breaks the holding circuit in the magnetic component. The entire unit then returns to normal.

2. AM Mark II - consists of a constantly active magnetic, bi-polar component, an acoustic component, a nine place P.D.M. and a galvanic P.S.E. Its operation differs from that of the AM Mark I in that the P.D.M. "blind" actuations are run off by actuation of both the acoustic and magnetic components together rather than by actuation of the magnetic component alone; i.e. when the magnetic component is actuated, it immediately puts the acoustic component in the circuit and when sound impinges on the microphone, the P.D.M. advances one step. If acoustic actuation does not occur within 40 sec. after magnetic actuation, the "T" switch returns the entire unit to normal as in AM Mark I. Excessive moisture or humidity in the unit will operate a galvanic P.S.E. and fire the detonator after a short delay.

AM Mark I Unit Circuit - Operation

Arming with P.D.M.

1. When the hydrostatic clock runs off its delay period, switches A and S_1 close. When A closes, B_1 blows the magnet clamp fuse in the magnetic component, starting normal A.L.A., resulting in a constantly-alive magnetic component. Eighteen minutes later S_2 closes, putting the detonator into the firing circuit.

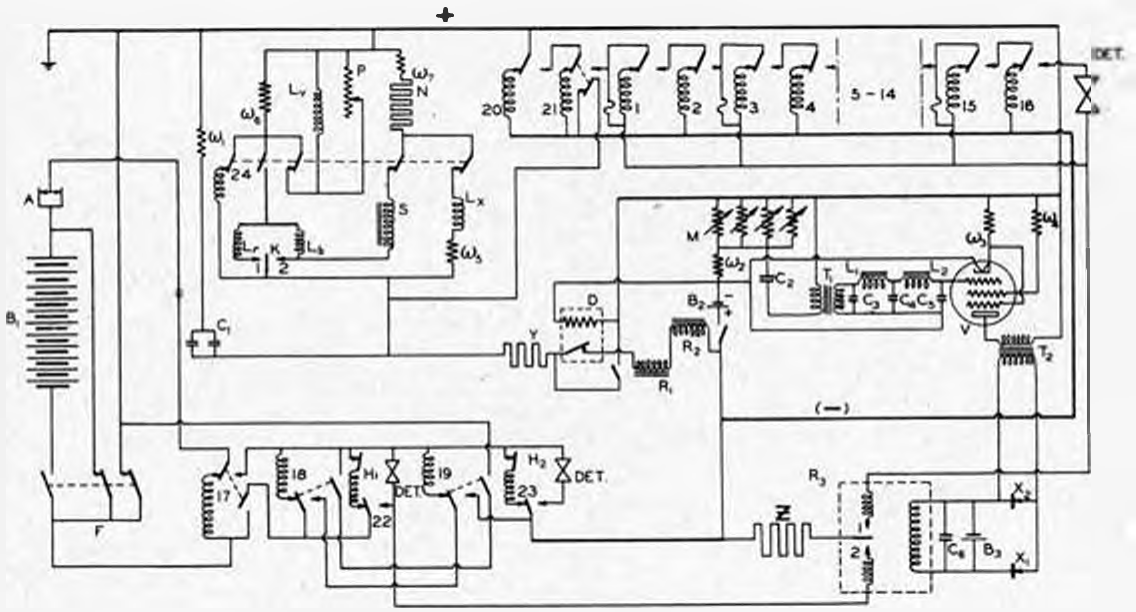
2. A magnetic actuation closes S_6 to contact #1, energizing the hold-on circuit. B_1 energizes the P.D.M. solenoid through contact R-S. P-Q breaks after each blind actuation to break the magnetic hold-on and allow the needle to recover. When the final "blind" actuation has run off, R-S breaks and S-T makes and the unit then acts as if no P.D.M. had been fitted.

Normal Firing

1. A magnetic actuation then causes current to flow through the microphone (M), the filament of the vacuum tube V, and R_2, the "T" switch heater. If no firing actuation impinges on the microphone within 45 seconds, the bi-metallic "T" switch opens, breaking the circuit to all the energized components, including the magnetic component hold-on, and the entire unit returns to normal.

2. If sound impinges on the microphone, current variations appear on the transformer coils, pass through the filter and appear on the grid of the vacuum tube V. Potential variations on the grid are amplified in V and are partially fed back to the grid circuit by C_5. Due to the half-wave rectifying action of X, the potential at the grid end of R_7 becomes more and more positive, resulting in a larger current through V and R_4 as the sound persists and increases.

3. Current through R_4 causes a voltage drop across R_4 which charges C_7 with a delay due to Rg. When C_7 is charged to a potential of 110 volts, the neon tubes DD break down and conduct current and the detonator fires.



A - THERMOSTATIC SWITCH - (CLOSED AT > 23°F & < 95°F)
B_1 - BATTERY - 13.5 VOLTS
B_2 - " - 1.5 "
B_3 - SEA BATTERY - (PSE MARK IX) FORMED BY MOISTURE IN UNIT.
C_1 - CONDENSER - MFD.
C_2 - " - "
C_3 - " - "
C_4 - " - "
C_5 - " - "
C_6 - " - "
D - THERMAL DELAY SWITCH & HEATER (40 SEC.)
F - MASTER SWITCH
H_1,H_2 - HYDROSTATIC SWITCH - (CLOSED AT < 15 FT.)
K - NEEDLE SWITCH
L_1,L_2 - FILTER CHOKES
L_x - AUXILIARY COIL
L_y - COMPENSATING COIL
M - MICROPHONES (4)
N,Y,Z - THERMISTORS
P - POTENTIOMETER
R_1,R_2 - SOLENOID RELAYS
R_3 - SENSITIVE RELAY
S - LATITUDE ADJUSTER COIL
T_1 - MICROPHONE TRANSFORMER
T_2 - OUTPUT TRANSFORMER
V - VACUUM TUBE (PENTODE)
ω_1 - RESISTOR
ω_2 "
ω_3 "
ω_4 "
ω_5 "
ω_6 "
ω_7 "
X_1 - COPPER OXIDE RECTIFIER
X_2 - " " " (INEFFICIENT)
#1 - #16 - PDM FUSE DELAY SWITCHES
#17 - #21 - DELAY ARMING FUSE DELAY SWITCHES
#22, #23 - DELAY BOMB FIRING FUSE DELAY SWITCHES.

Fig. 19 - AM Mk. II Unit Circuit and Key

Arming

1. When the mine is dropped, action of the Rheinmetall fuze closes the Master Switch F, making one contact and breaking two. Thermostatic switch A is normally closed at temperatures between 23° and 95°F. B_1 energizes fuse delay switch #17 which, upon completion of its delay period, cuts in fuse delay switches #18 and #22. Hydrostatic switches H_1 and H_2 open when the mine reaches a depth of 15 ft. or more. Upon completion of its delay period, switch #18 switches over, cutting in switch #19 which, upon completion of its delay period, connects the battery to the main positive and negative terminals of the unit.

2. The magnetic component (N Mark IX unit slightly modified) then goes through A.L.A., upon the completion of which the only parts of the magnetic component remaining in the circuit are w_6, L_T or L_b, and K. During A.L.A., switches #20 and #21 operate, switching in the P.D.M. fuse delay switches and breaking the negative return contact to the magnetic component.

Delay Action Bomb Firing

1. Two different methods of accomplishing delay action bomb firing may be employed as follows:

   (a) If the mine does not reach a depth of 15 ft., H_1 remains closed and when fuse delay switch #22 switches over, a detonator is put across the battery and the mine fires.

   (b) If the mine does not reach a depth of 15 ft., H_2 also remains closed. When fuse delay switch #19 switches over and connects the battery to the positive and negative leads of the unit, switch #23 will operate and fire the mine if H_2 has not opened. (H_2 is provided to allow an alternative method of delay bomb firing in case H_1 does not operate properly.)

Normal Firing with P.D.M.

1. A RED or BLUE actuation will close K to contact #1 or #2, respectively, and current will then pass from the main positive lead through w_6, L_T or L_b, K, thermistor Y, the normally-closed contact of thermal delay switch D and the operating coils of relays R_1 and R_2. When Y has heated sufficiently, the hold-on coil will operate and R_1 and R_2 close. Closing of R_1 provides a self-holding circuit for R_1 and R_2 through the contact of D. Closing of R_2 energizes the heater of D, energizes the four microphones K through w_2 and energizes the vacuum tube filament through w_3. The self-holding circuit of R_1 and R_2 shunts out the needle system, reducing the hold-on current to such a low level that K breaks its contacts and Y cools. The main circuit through R_1 and R_2 will persist until D breaks its contact due to heating action.
2. If sound impinges on the microphone before D breaks its contact, the change in microphone resistance appears as current variations in transformer T_1 and passes through the filter circuit to the control grid of pentode V. This vacuum tube amplifies the signal which then appears as current variations on transformer T_2. The output of T_2 is fed to the operating coil of sensitive relay R_3. Since the rectifier X_1 allows current to pass only in the direction of its allow and since the current output from T_2 is alternating, X_1 passes current half the time to the operating coil of R_3 with a slight delay due to C_4. Rectifier X_2 acts as an overload feature to by-pass heavy currents. The signal current from T_2 and X_1 closes R_3 to contact #1.

3. When R_3 closes to contact #1, a circuit is completed from (+) through the by-passing fuse of fuse delay switch #1, the holding coil of R_3 and thermistor Z to (-). If the sound persists long enough, Z heats and passes enough current to operate the holding coil, the by-pass fuse blows, and fuse delay switch #1 carries the total load until completion of its delay period when it switches over to switch #2, thereby cutting out the holding circuit and allowing R_3 and Z to return to normal. Before switch #2 completes its delay period, D breaks its contact, cutting out R_1 and R_2 holding circuit, its own heater current, the microphone current and the vacuum tube current. When switch #2 switches over to #3, the entire unit is again normal and ready for re-actuation. A maximum of eight "blind" actuations operates switches #15 and #16, putting the detonator in the circuit and an additional magnetic-acoustic actuation fires the mine.

P.S.E. Firing

1. If water or excessive moisture enters the unit, a cell is formed between two dissimilar metals. Current will flow through the operating coil of R_3 in such a direction that R_3 closes to contact #2, making a complete circuit from (+) through the closed contacts of switches #18 and #19, a detonator, the R_3 holding coil and Z to (-). When Z has heated sufficiently, the current holds the relay closed and the mine fires.

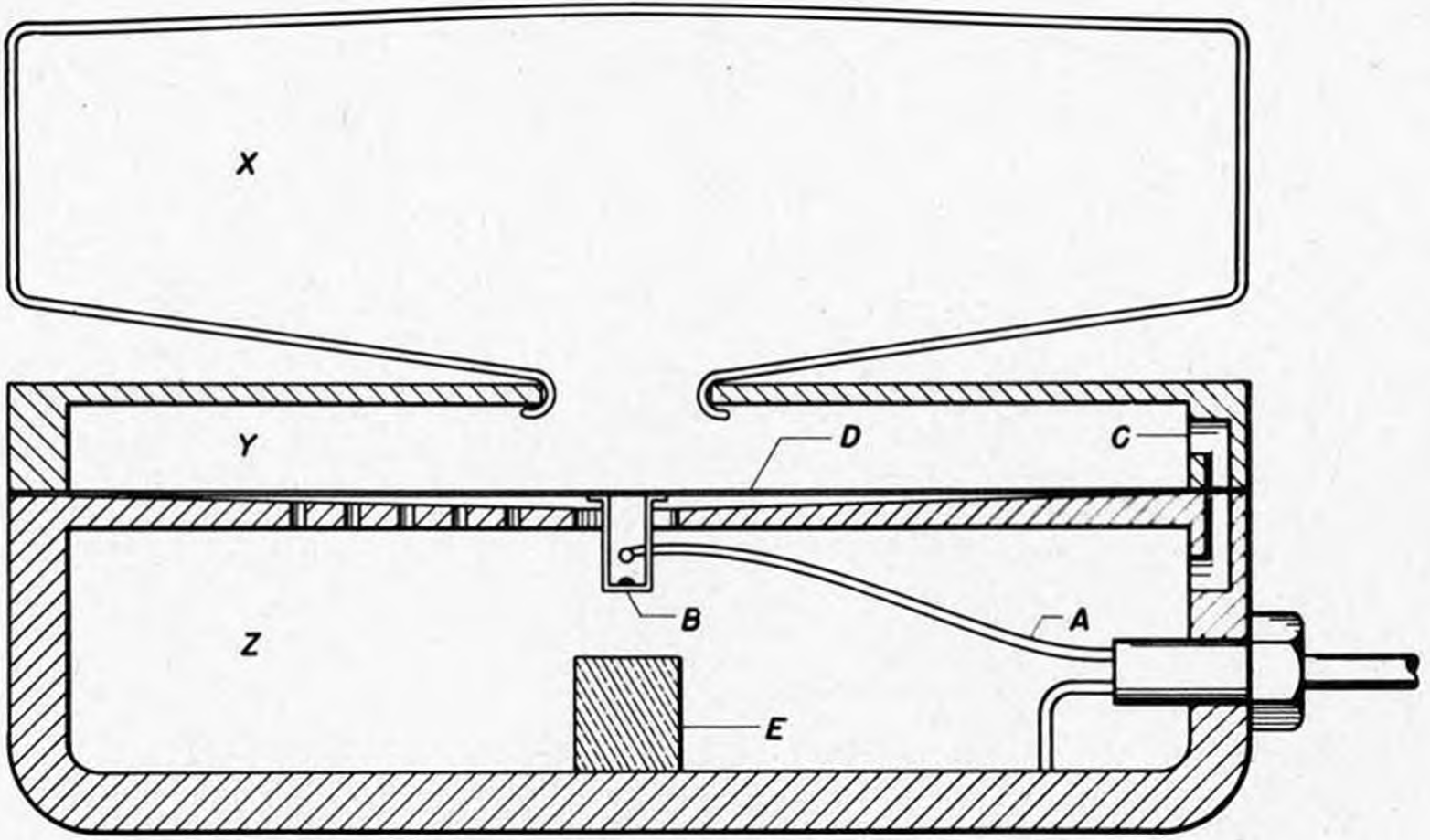


Fig. 20 - Pressure Detecting Device

A - Fixed Contact (Adjustable)
B - Moving Contact
C - Constriction
D - Diaphragm
E - Dessicator
X - Variable Volume
Y - Front Volume
Z - Back Volume

Pressure Detecting Device

General

1. The pressure component which the Germans have successfully combined with their acoustic and magnetic firing units consists essentially of a pressure detecting device which detects and operates on negative pressure differentials; an associated electrical circuit is controlled by the device. When a negative pressure differential is detected by the device, a switch contact is made for the duration of the detected differential, provided that the actuation falls within the design limits of the device.

2. The operational characteristics of the two types of pressure components are controlled, with the exception of sensitivity, by the arrangement and constants of the electrical circuits associated with each. These constants determine the period of circuit closure required to record an actuation and also determine whether the pressure component will be of the integrating or non-integrating type. Indirectly, they also determine the degree to which such disturbing effects as wave motion will effect the pressure component.

3. The pressure detecting device serves as the detecting mechanism of the pressure component of firing units which employ pressure firing. It has been used to date only in combination with units operating by other influences as follows:

   (a) In Mine Type GG in combination with a modified A Mark V unit, the complete assembly being designated GG/AP Mark I, and the firing unit, AP Mark I.

   (b) In Mine Type GC in combination with a modified M Mark II(revised) unit, the complete assembly being designated GC/MP Mark I, and the firing unit, MP Mark I.

Description

1. The pressure detecting device consists of three volume tanks, X, Y and Z, of which only X is variable. Y and Z, although separated by diaphragm D, are connected through constriction C. The overall unit consists of a machined aluminum casting surmounted by a collapsible rubber bag. Volume Y serves only as a connecting link between X and the diaphragm. Z is entirely closed except for the constriction C which is filled with adjustable, fibrous material (not shown on drawing). This serves as a variable resistance and regulates, within limits, the passage of air through the constriction.

2. D is backed up, except for a small circular area in the center, by aluminum reinforcing which forms part of the main casting. The surface of the casting is well machined and is bored with five small holes which prevent the diaphragm from sticking due to a possible vacuum seal.

3. The switch consists of two contacts, one fixed and one movable. The movable contact consists of a stirrup mounted on the center of the diaphragm inside Z. The fixed contact is mounted as indicated in the drawing, and is adjustable. Leads from the two contacts are taken out of the device through a packing gland by a double-conductor cable, pass through another packing gland into the main body of the mine case (as in GC) or the firing unit (as in GG).

4. It should be noted that the accompanying drawing of the pressure detecting device is schematic in nature and omits some of the refinements present in the actual device.

Operation

1. When the mine is dropped, it sinks rapidly to the bottom with a resulting rapid increase in hydrostatic pressure head, proportional to the depth of water. This pressure is transferred to X which is compressed thereby. Compression of X creates a pressure differential between Y and Z, causing the diaphragm to move inward toward Z and opening the switch wider than usual. The pressure differential leaks off through C and, when it has been reduced to zero, D and the fixed contact resume normal condition and contact gap. (0.007").

2. Any negative pressure differential on X, equal to about 2 1/2" of water, will cause X to expand and allow the contact to close, provided that the change in pressure occurs quickly enough. Pressure differentials caused by natural causes such as tides and seiches occur over periods too long to be effective due to the fact that C allows the pressure to equalize without expanding the diaphragm sufficiently to make contact. However, a large pressure differential caused by action of a ship, or even by a large wave or swell, will affect the diaphragm sufficiently to close the contact since C cannot equalize the pressure rapidly enough. From this point on, the associated electrical circuits of the pressure component govern further operation with the pressure detecting device serving only to close its switch for the duration of the pressure differential.

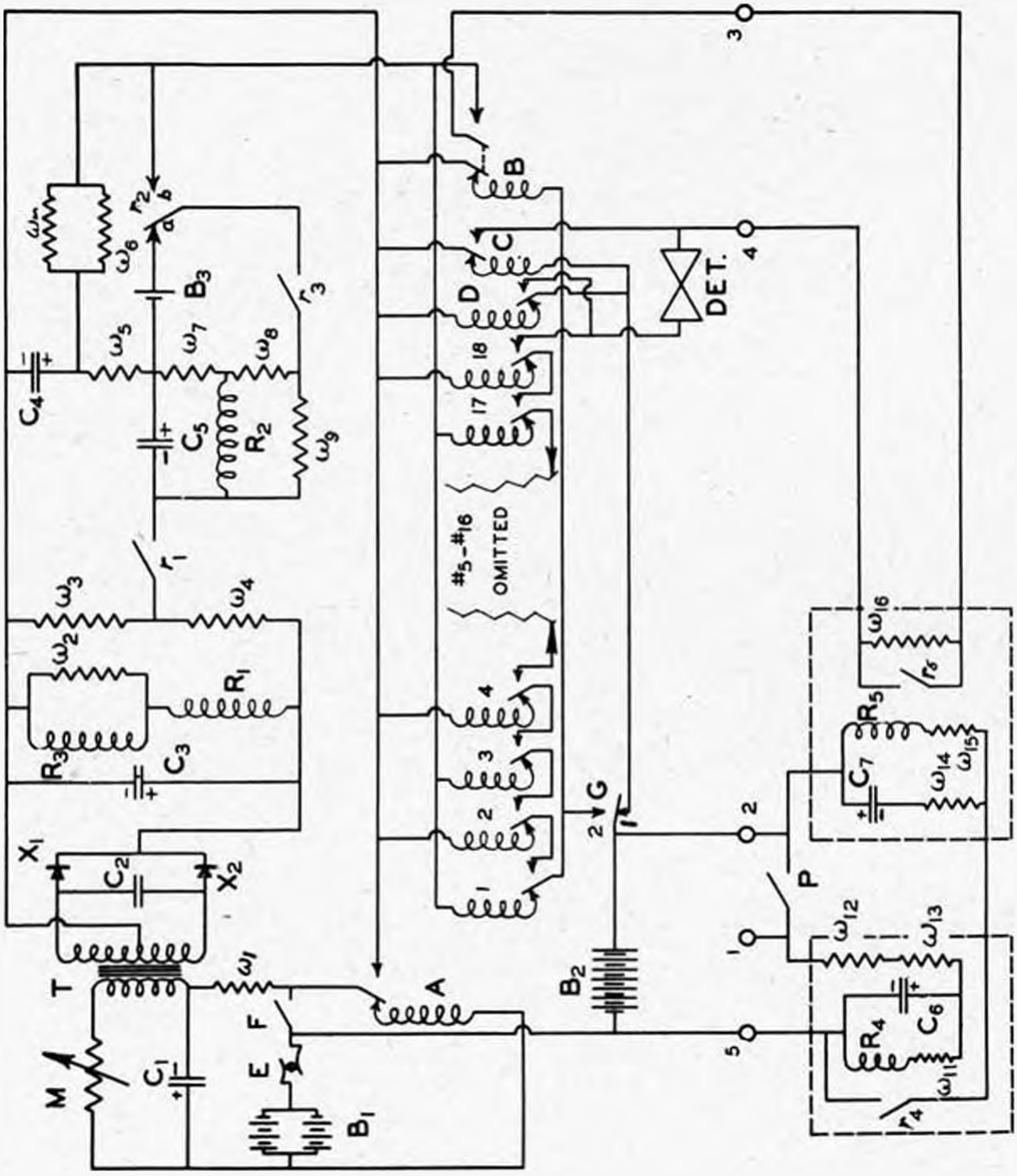


Fig. 20a - AP Mk. I Unit Circuit

AP Mark I Unit Circuit - Operation

General

1. The acoustic component of AP Mark I, A Mark V, is transformed into an acoustic-pressure unit by the addition of a pressure detecting device and its associated relays R_1 and R_2. It is further modified by the addition of w_{10} which changes its normal anticountermining action so that it operates more like an A Mark IV than an A Mark V. Addition of w_{10} reduces the resistance of the charging circuit from B_2 to C_4. There will therefore be no discharging of C_4 and C_5 if the sound does not rise rapidly from initiating level to firing level.

2. After the unit is armed, both the acoustic and pressure components are continuously alive. "Blind" P.D.M. actuations (9 max.) are run off by the acoustic component only and, upon completion of the P.D.M. actuations, the unit is receptive to acoustic-pressure firing.

Acoustic Actuation

1. An acoustic firing actuation operates R_1, R_2 and R_3 in order, closing them to contacts r_1, r_2b and r_3 respectively. This completes the circuit from B_2 through the three contacts above, through w_3, w_9, w_{16}, and the detonator. The addition of w_{16} to the A Mark V circuit raises its resistance to a point where the current flow is not sufficient to fire the detonator nor to hold the relays closed. If the sound falls off, the circuit and relays return to normal.

Pressure Actuation

1. A decrease in hydrostatic pressure closes pressure switch P. This causes B_2 to start charging C_6 through w_{12} and w_{13} in an attempt to operate R_4 through w_{11}. If P remains closed for a sufficient period, r_4 makes and B_2 charges C_7 through w_{14} in an attempt to operate R_5 through w_{15}. If r_5 makes, it shorts w_{16} and reduces the resistance of the detonator circuit, leaving the unit receptive to acoustic firing.

Combination Actuation

1. If acoustic actuation occurs first, the sound must be maintained at firing level until pressure actuation is complete. In this case, the closing of r_5 by actuation of the pressure component, allows the acoustic unit to fire the detonator.

2. If pressure actuation occurs first, acoustic actuation may reach completion at any time thereafter up to 45 seconds, because, after P opens, the charge on C_6 and C_7 keeps r_5 made until the charge drains off.

Integrating Firing Feature

1. The pressure component is designed to register an actuation if P is closed continuously for a period of seven seconds. This interval, however, may be somewhat decreased if C_6 and C_7 are partially charged at the time of actuation since the arrangement and constants of the circuit do not permit rapid condenser discharge. If the condensers are partially charged by a P switch closure of less than seven seconds duration and if, before the charge leaks off, another P switch closure occurs, it is possible for additional closures, none of which may be seven seconds long, to register a complete actuation. Such an actuation is, of course, dependent upon the short-interval closures occurring close together. This effect may be produced by wave action under certain conditions and thereby cause the pressure component to be continuously actuated. If this occurs, the unit is, in effect, a straight acoustic unit.

MP Mark I Unit Circuit - Operation

General

1. The magnetic component of MP Mark I is an M Mark II(revised) unit modified as in AM Mark I for increased sensitivity. It is fitted with a thermal delay switch as in AM Mark I which determines the interval after magnetic actuation during which pressure actuation may fire the mine.

Arming

1. When the hydrostatic clock runs off its delay setting, a-g and b-c close. B then charges C through w_3 and the closed contact (4-5) of R_1. When C is charged, R_2 operates, breaking 4-5 and making 4-3, thereby removing the detonator from the circuit. Eighteen minutes later, a-f closes, the magnetic component goes through A.L.A. and is armed.

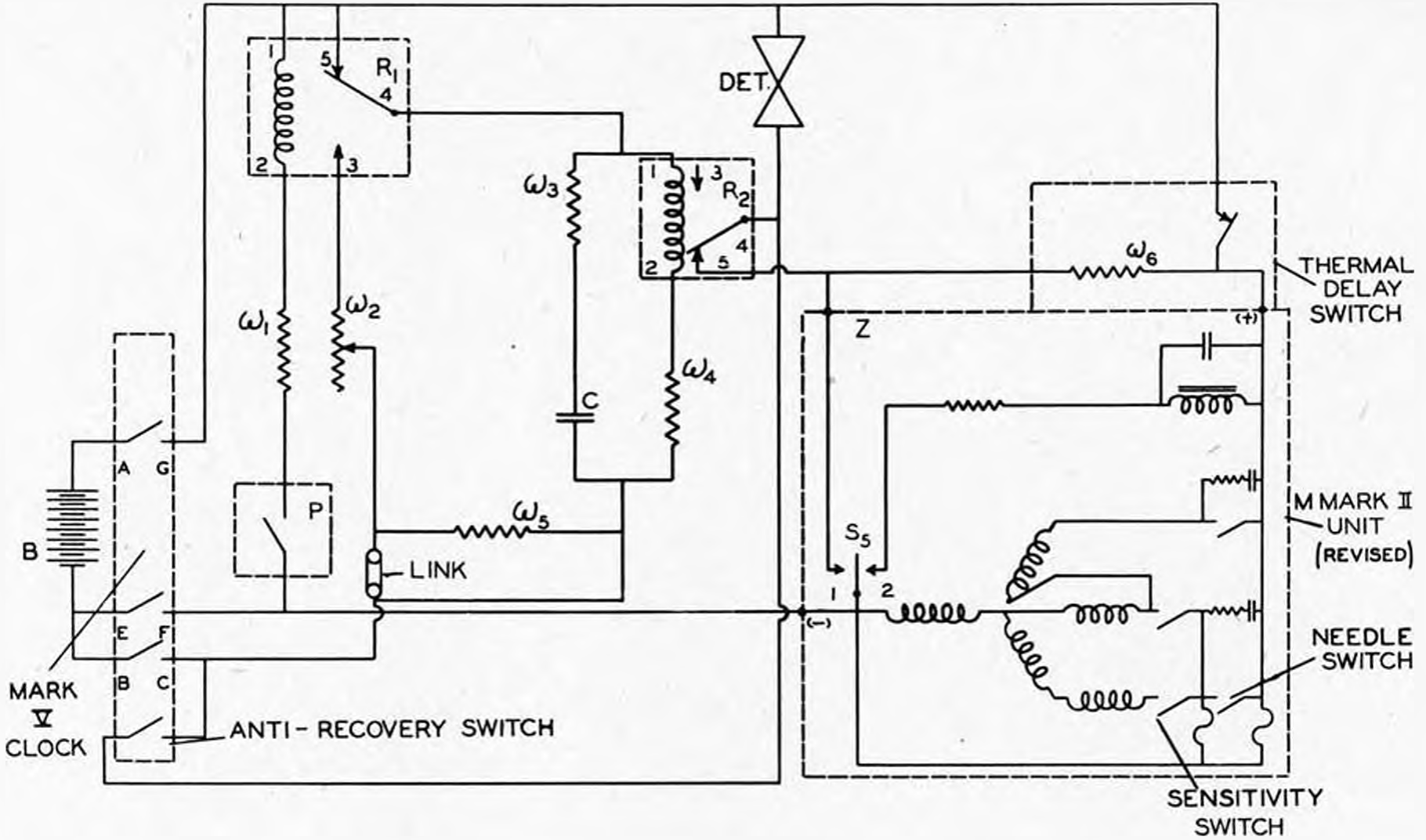


Fig. 21 - MF Mk. I Unit Circuit and Key

Magnetic Actuation

1. Actuation of the magnetic component closes the needle switch and operates the air core relay, thereby closing S_4 to contact #1. Hold-on current and thermal delay switch heater current pass through the normally-closed contact of the thermal delay switch. This condition persists until the thermal delay switch opens, breaking magnetic hold-on and heater current. The magnetic component then returns to normal.

Pressure Actuation

1. A decrease in hydrostatic pressure closes pressure switch P. This causes B to energize R_1, breaking 4-5 and making 4-3. Battery current to C is thereby cut off, causing C to discharge through w_1 and R_2. When C has discharged sufficiently, it no longer holds 4-5 open. The foregoing constitutes a single pressure actuation for which nine seconds continuous closure of P is required.

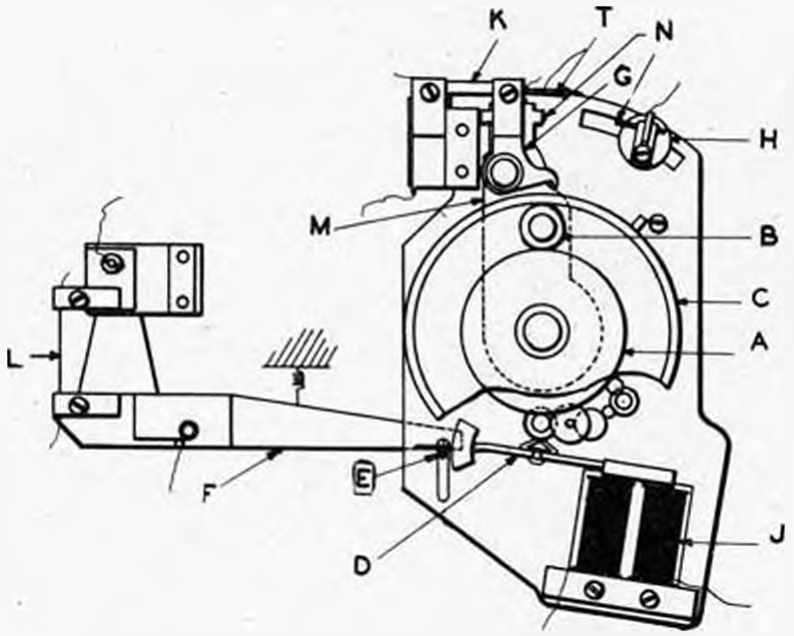
Combination Actuation

1. If magnetic actuation occurs first, pressure actuation may be completed at any time within 25 seconds thereafter. At the end of the 25 second period, the thermal delay switch breaks the magnetic circuit. Pressure actuation within the 25-second interval causes contact 4-5 of R_2 to make, firing the detonator through contact #1 of S_5.

2. If pressure actuation occurs first, P must be held closed until the magnetic actuation is complete if the detonator is to fire. Otherwise, opening P deenergizes R_1, recharging C and thereby opening 4-5 which takes the detonator out of the firing circuit.

Non-Integrating Firing Feature

1. The pressure component is designed to register an actuation if P is closed continuously for a period of nine seconds. This interval is not subject to decrease due to partially-charged condensers as is the case in AP Mark I. In the MP Mark I unit, the arrangement and constants of the circuit allow C to recharge fully through w_1 if P opens for 1/4 seconds or more. This feature is due primarily to the low resistance of w_1 and the lack of delay on R_1. The pressure component, then, is unlikely to be seriously affected by natural causes such as waves and swells.



A	GEAR TRAIN	H	SENSITIVITY SETTING STOP
B	" "	J	ELECTROMAGNET
C	" "	K	SENSITIVITY SETTING FUSE
D	ESCAPEMENT LEVER	L	MAGNET RELEASE FUSE
E	ESCAPEMENT LEVER CLAMPING ARM	M	PAWL ARM
F	MAGNET RELEASE LEVER	N	CONTACTS
G	PAWL	T	TRIP SWITCH

Fig. 22 - Mechanical ALA, Side View, with Key

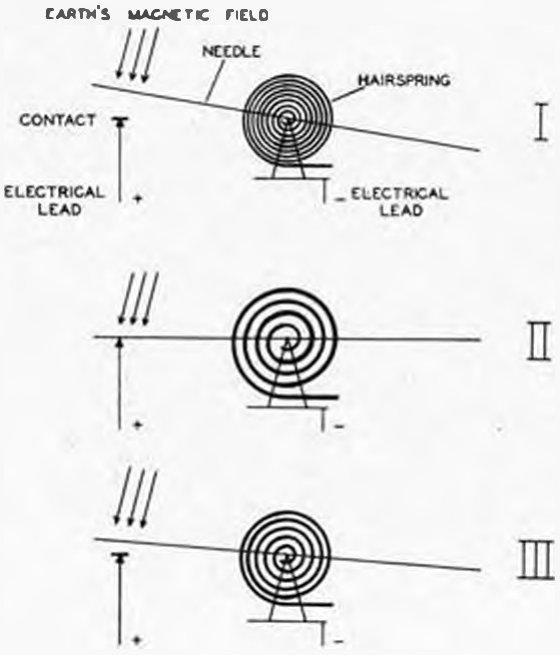


Fig. 23 - Schematic Explanation of Mechanical ALA Operation

A.L.A. - Automatic Latitude Adjustment Devices

Mechanical A.L.A. - Operation

1. When the hydrostatic clock completes its delay period, fuse L blows, seating the needle on its knife edges. Rotation of F allows E to rotate on its pivot and the A.L.A. clockwork starts to run. Oscillation of escapement lever D drives C in a clockwise direction, with M and G being restrained by fuse K. Clockwise rotation of C drives B counterclockwise and, since A is geared to B, A rotates clockwise. Counterclockwise rotation of A decreases tension on the needle hair-spring to which A is attached.

2. When hair-spring tension on the needle axis decreases so that the forces acting on the needle are equal and opposite to the force of the earth's magnetic field, the needle makes its contacts, blowing fuse K. When K blows, a small hair-spring rotates C until it engages A. Blowing of K also releases M allowing the pawl to lock the gear system. Since C is still rotating clockwise, the entire assembly consisting of A, B, C, G and M rotates clockwise. This puts tension back on the needle spring and opens the needle contacts. To assure that the needle contacts open at this point, rotation of M closes switch T momentarily, thereby energizing the hold-off circuit.

3. The assembly rotates as noted above until M comes up against H, the distance traveled by M before contacting H determining the amount of hair-spring tension on the needle and thereby the sensitivity setting of the unit. If at any time during the above process a countermining shock is received, closure of the pendulum switch energizes J which holds D inoperative until the pendulum switch reopens.

Magnetic A.L.A.

1. This mechanism consists primarily of two permalloy rods, offset and made into pole pieces with a magnetized spider or disc on a vertically oriented pivot between them (See Fig. 25). Fig. 25 shows the adjusting magnets D and D_1 which are fitted to concentric shafts. Rotation of these magnets is controlled by the clockwork escapement (Fig. 24).

2. Prior to operation, fuse #1 holds the lower arm against spring tension and the arm in turn holds the spring-loaded V-clip arm in at the top. Fuse #2 also holds a spring-loaded arm in the upright position. The needle extension arm lies between two sets of fixed contacts, so oriented that it tends to rotate toward the contact and hold-on magnet (L) on the left side. This is due to the vertical earth's field which is fed to the needle arm through the vertical pole pieces.

3. When F_1 blows, the A.L.A. escapement starts and the V-clip moves to mid-position; i.e. it restrains the needle extension arm on the Red (left) side only. The escapement rotates magnet D and, in so doing, introduces a constantly increasing component of its field into the pole pieces around the needle body. This component is Blue and tends to counteract the earth's field.

4. When a point of equilibrium between the two magnetic fields is reached, the needle extension no longer bears against the V-clip and, since the escapement continues to run, an excess Blue field is brought to bear on the needle, carrying it over to the Blue (right) contact. When contact is made, F_2 blows and the following operations are performed almost simultaneously:

   (a) The spring-loaded arm (Par. #2 above) is released and flies to its limit stop (Fig. 24).

   (b) The A.L.A. escapement stops and magnet D stops rotating. D_1 is rotated by the spring-loaded arm a sufficient amount to remove the excess blue magnetic field on the needle.

   (c) The resetting clamp points BB. are freed and fly apart due to the action of the spring which pulls AA_1 together and snaps the needle extension arm to the center.

5. The needle is now in mechanical and magnetic equilibrium. Rotation of the resetting cam is controlled by a separate escapement in the M Mark IV unit and by the PDM assembly in the M Mark IVa. This rotation will separate clamp points CC_1 and thus free the needle arm by spreading of AA_1.

Electromagnetic A.L.A.

1. The needle consists of an aluminum drum, mounted horizontally and fitted with a magnetic belt which is magnetized diametrically. It is placed between two sets of vertical pole pieces which conduct the vertical component of the earth's field through the needle. The needle G thus tends to rotate counterclockwise due to the Red field effect.

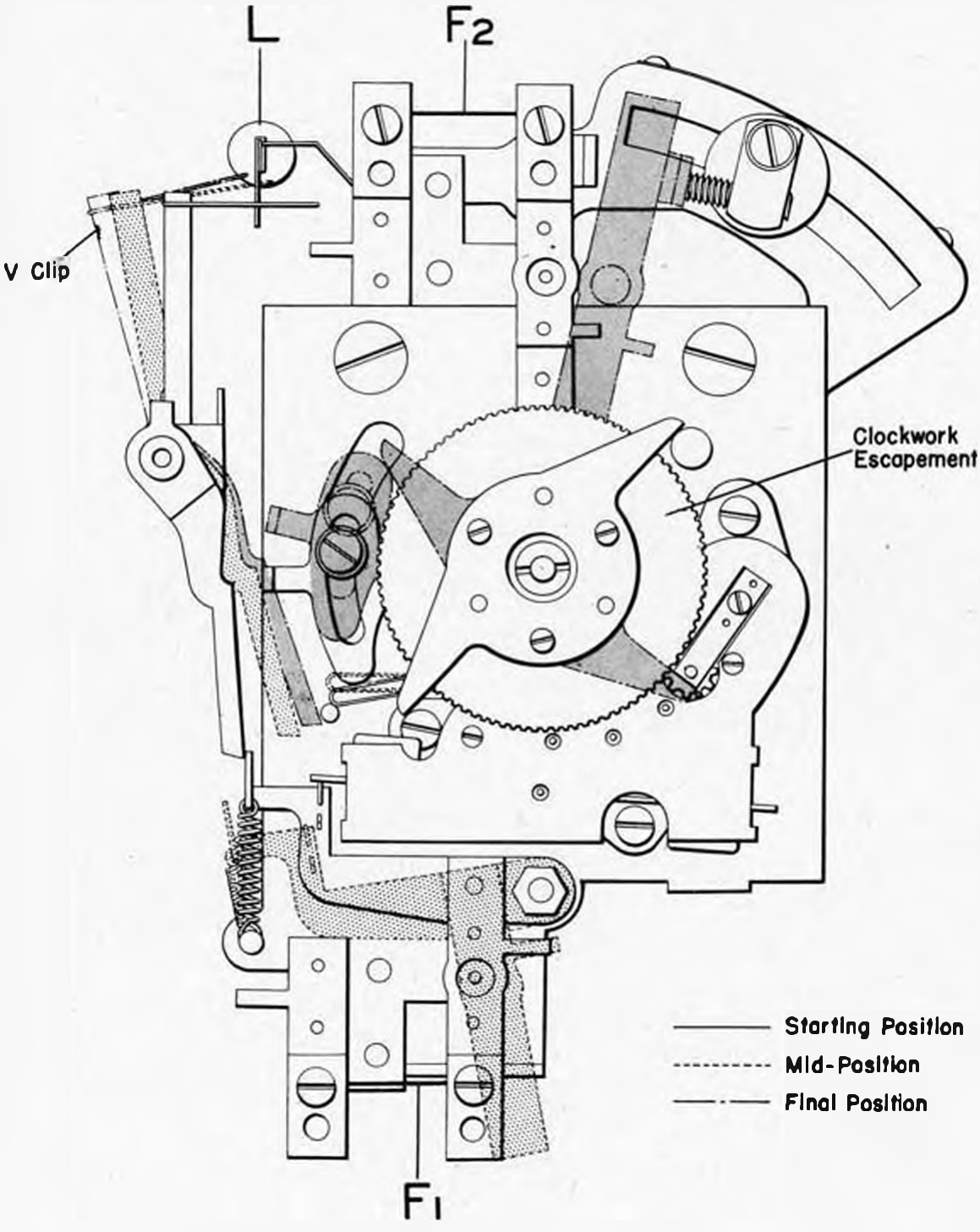
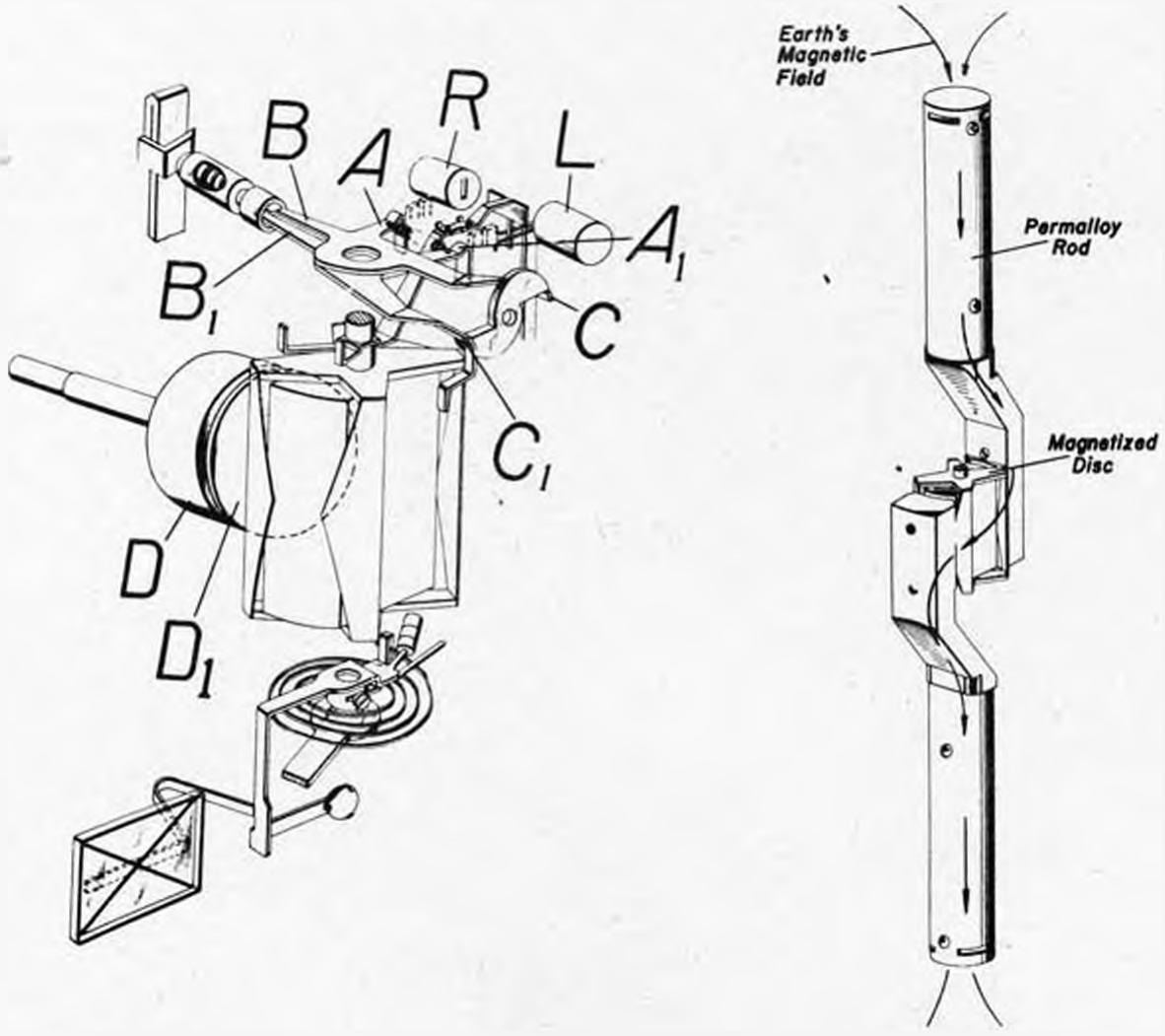
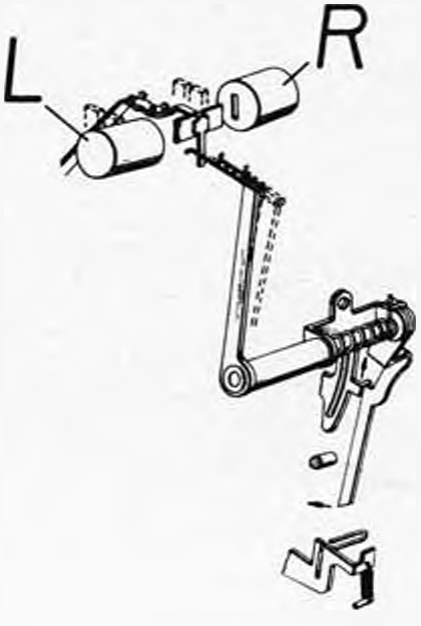


Fig. 24 - Magnetic ALA, Elevation View, showing Clockwork Escapement and Needle Arrangement



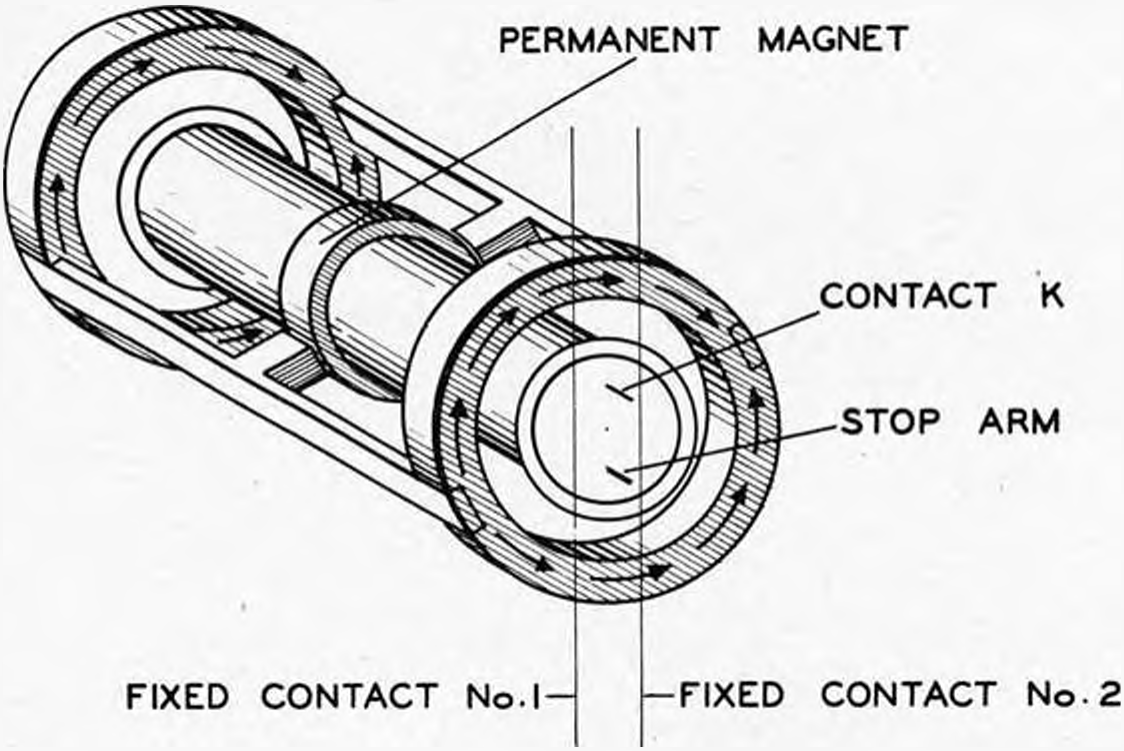


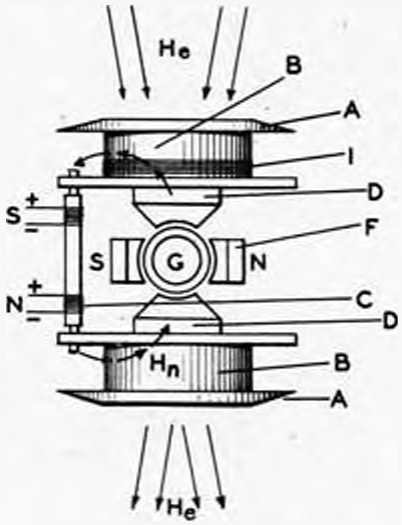
KEY TO OPERATING POSITION

——— Starting Position
- - - - - - Mid-Position
——·—— Final Position

AA_1, BB_1, CC_1 - Resetting Clamp Fingers
D - Disc Magnet (A.L.A.)
D_1 - Disc Magnet (Compensating)
F_1 - Fuse #1
F_2 - Fuse #2
L - Hold-on Magnet (Left)
R - Hold-on Magnet (Right)

Fig. 25 - Magnetic ALA, Component Parts





A CAPS (SOFT IRON)
B INTENSIFIERS (SOFT IRON)
C LOCAL MAGNET
D POLE PIECES
E PERMANENT MAGNET CORE
F SEPARATE POLE PIECES (RING)
G MAGNETIC DRUM
H EARTH'S MAGNETIC FIELD
H FIELD OF MAGNET
I HOLD-ON COIL

Fig. 26 - Electromagnetic AA, Component Parts

A.L.A. - Automatic Latitude Adjustment Devices (Cont'd.)

2. A separate local magnet J, wound with a coil, is also fitted to the unit. Its polarity is such that it puts out a Blue magnetic field which tends to rotate the needle clockwise. This Blue field is stronger than the earth's field and, as a result, the needle rotates clockwise to its limit stop.

3. A contact K is mounted on the drum and two vertical wires are placed in such a position that clockwise or counterclockwise rotation of the drum causes K to make contact #2 or #1 respectively. Thus, contact #1 becomes the Red contact and contact #2, the Blue contact and since the field of the local magnet is stronger than that of the earth, the needle will make contact K2 when the mine is laid.

4. When the unit is energized by the battery, current through fuse R energizes the latitude adjuster coil S and thermistor M. S is wound on the local magnet and is energized so that the field produced will be opposite to that of its core (i.e. the local magnet). The field produced by energizing S is strong enough to overcome the Blue field of the local magnet, causing the needle to break contact K2, thereby breaking the electromagnetic field of S. Since the residual magnetism of the local magnet is strong enough to swing the needle back again, contact K2 is again made and S reenergized.

5. This pulsing, or deperming, continues until the residual magnetism of the local magnet is no longer capable of making switch K2. This process is assisted by the heating of thermistor M whose decreasing resistance allows it to pass more current, thereby decreasing the pulsing current through S.

6. When the needle breaks K2 for the last time, M heats enough to pass 50 milliamperes, thereby blowing fuse R and isolating the A.L.A. from the circuit. The firing unit is now rendered active and receptive to a Red actuation. This device is used with M Mark V and modifications thereof.

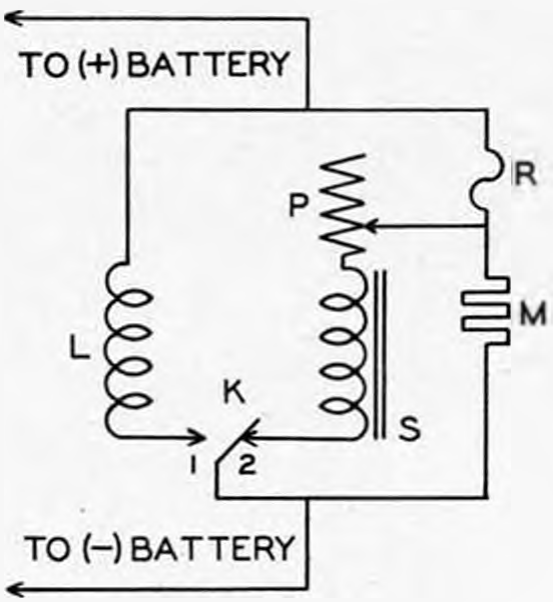


Fig. 27 - Electromagnetic ALA Circuit

Special Clocks

RAM - Rendering Active Mechanism (Arming Clock)

1. The hydrostatic clock switch a-g closes after a 5 1/2 minute delay, causing battery B to blow fuse F, starting the arming clock which may be set for any period up to six days.

2. The hydrostatic clock switch b-c closes after 17 minutes and, when the arming clock runs off its set period, it closes the switch 1-2, putting battery voltage on the firing unit and rendering it active. Used with M Mark II units and Mark I or II hydrostatic clocks.

RIM - Rendering Inert Mechanism (Scuttling Clock)

1. The hydrostatic clock switch a-g closes after a 5 1/2 second delay. Battery B blows fuse F starting the scuttling clock which may be set for any period up to six days.

2. The hydrostatic clock switch b-c closes after 17 minutes and, when the scuttling clock runs off its set period, it closes a switch which puts a direct short across the battery and rendering the mine inert. Used with M Mark II units and Mark I or II hydrostatic clocks.

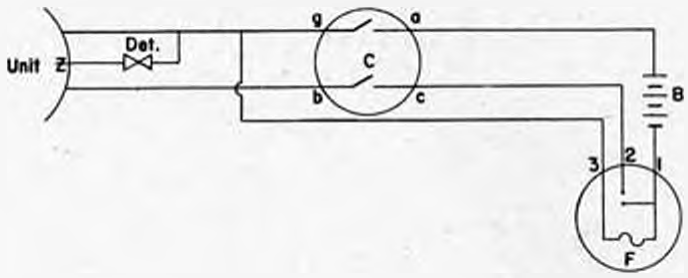


Fig. 27a - RAM Circuit

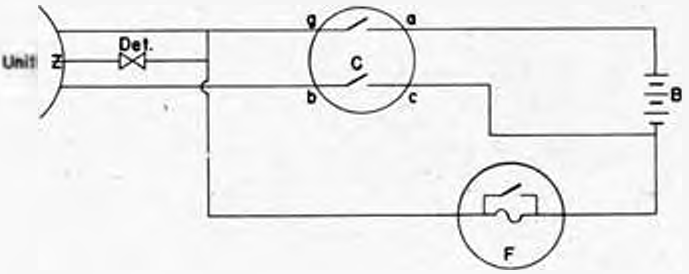
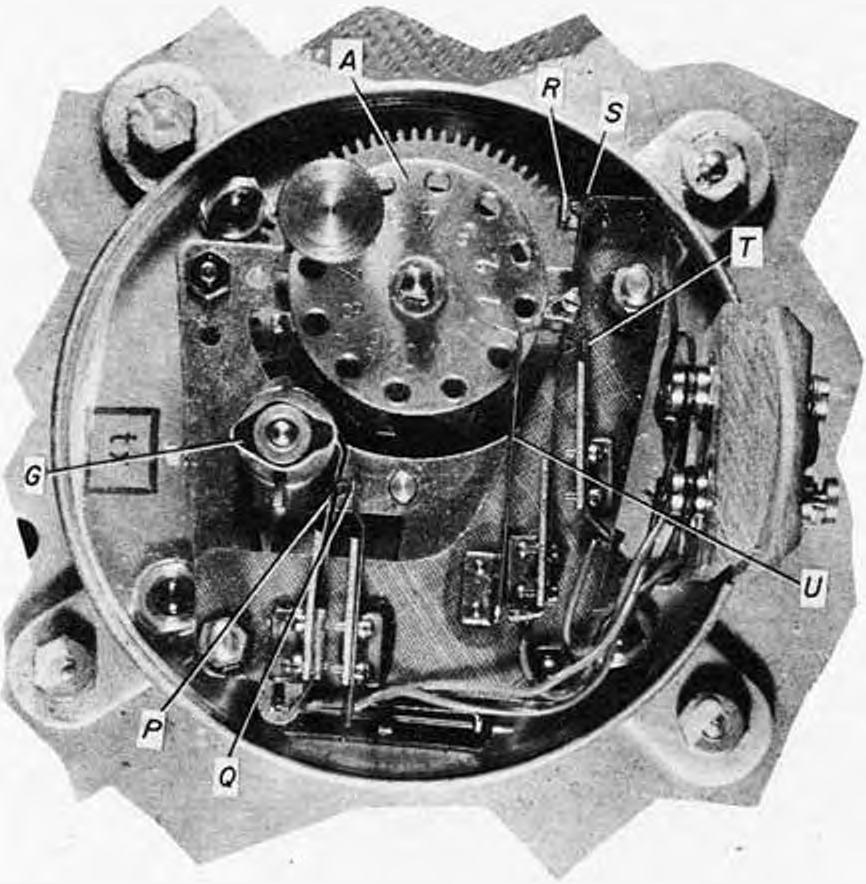
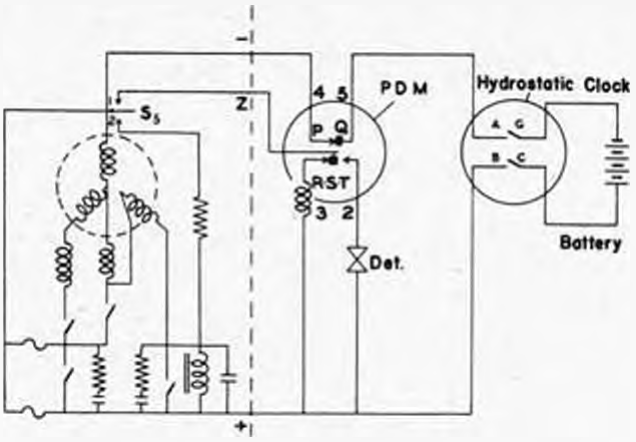


Fig. 27b - RIM Circuit





A- PDM Wheel
B- Battery
C- Clock- hydrostatic
G- PDM Cam
a-g, b-c -Hydrostatic Clock Switches
R-S-T- PDM Changeover Switch
P-Q- PDM De-energizing Switch
U- Cam Spring

Fig. 28 - Mechanical PDM with Circuit and Key

P.D.M. - Period Delay Mechanisms

Mechanical P.D.M.

1. The unit and P.D.M. are rendered active when the hydrostatic clock switches close. A magnetic actuation closes the needle switch and the air core relay closes S_r to contact #1 and energizes the P.D.M. solenoid through contacts R-S. The solenoid releases wheel G and the P.D.M. clockwork.

   (a) In the twelve-place P.D.M., G rotates one revolution while A rotates 1/12 of a revolution clockwise.

   (b) In the six place P.D.M., G rotates one revolution while A rotates 1/6 of a revolution clockwise.

2. After 11 seconds of rotation, G allows P-Q to break, de-energizing the unit hold-on coil and the P.D.M. solenoid. After 120 (45) seconds, P-Q remakes and the wheel stops.

3. A movable pin with a flanged collar may be put in any setting hole, and is indicated as being in hole #6 in the accompanying photograph. In the case illustrated, five actuations of the P.D.M. would cause the flanged collar to bear against the U-bend in the spring contact S, causing it to break contact with R and make with T. This substitutes the detonator for the P.D.M. solenoid in the circuit.

4. The six-place P.D.M. is used with M Mark II units and has a 45 second operating period per "blind" actuation. The twelve-place P.D.M. is used with A Mark III and AM Mark I units and has a 120 second operating period per "blind" actuation.

Electrical P.D.M. - Fuse Delay Switch

1. The accompanying diagram shows a typical fuse delay switch type P.D.M. set to "3". If an actuation is registered on the unit detector, current from the battery flows through fuse delay switch #1 although in some cases a by-pass fuse is used to reduce the resistance of the circuit to a value low enough to allow rapid holding in the detecting circuit. After a short delay period, switch #1 switches over, cutting out its own heater coil, opening the holding circuit and passing all current through switch #2 for a period long enough to allow the detecting circuit to recover.

2. When switch #2 operates, it puts switch #3 in the circuit and the unit is alive again. As this process is repeated, switches #3 and #4 operate in a like manner with a third actuation firing the detonator. P.D.M's of this type may have as many settings as can be fitted to the unit's P.D.M. terminal board with the P.D.M. setting of any unit being determined as follows:

   (a) $x = 2n - 2$, where x = the number of fuse delay switches and n = the P.D.M. setting.

3. This device is used with Mine Type GG.

P.D.M. for use with M Mark IVa Unit

1. This mechanism consists of a planetary gear train driven by a small escapement. The escapement is tripped by an electro-magnetically-operated detent which, upon actuation, releases the notched wheel I. Wheel A is the main clockwork drive and, upon release of I, rotates the system. Since I can only rotate 180° before the detent falls into the next notch, and since the gear ratio between A and H is 4:1, A will rotate counterclockwise 45°, carrying the indicator wheel G with it. G is connected to A by means of a small shaft K.

2. Rotation of the resetting cam J resets the needle switch and then frees it. Since B and its shaft are fixed to each other and to the unit, C and D rotate about it, being free on shaft K. Their rotation is 45° clockwise since B and C have the same gear ratio. Since D and E are geared in a ratio of 1:2 and since D is rotated 45° counterclockwise, E rotates 22 1/2° clockwise relative to D or 22 1/2° counterclockwise absolute. Since E drives F, F rotates in the same direction as G at half the speed. The net result, then, is that F rotates one division or step in the direction of decreasing numbers for each stage of P.D.M.

3. When the final P.D.M. setting is run off, rotation of G brings stud Q around behind the free arm L and, at the point where the dial indicator is at the zero position, causes it to force down lever M. This changes the switch contact from N-O to O-P, cutting out the electromagnet and putting the detonator in the circuit.

4. Due to the fact that the escapement drive spring runs down during P.D.M. operation, the dead interval on the unit is extended from 85 seconds to 115 seconds in the last blind stage of P.D.M.

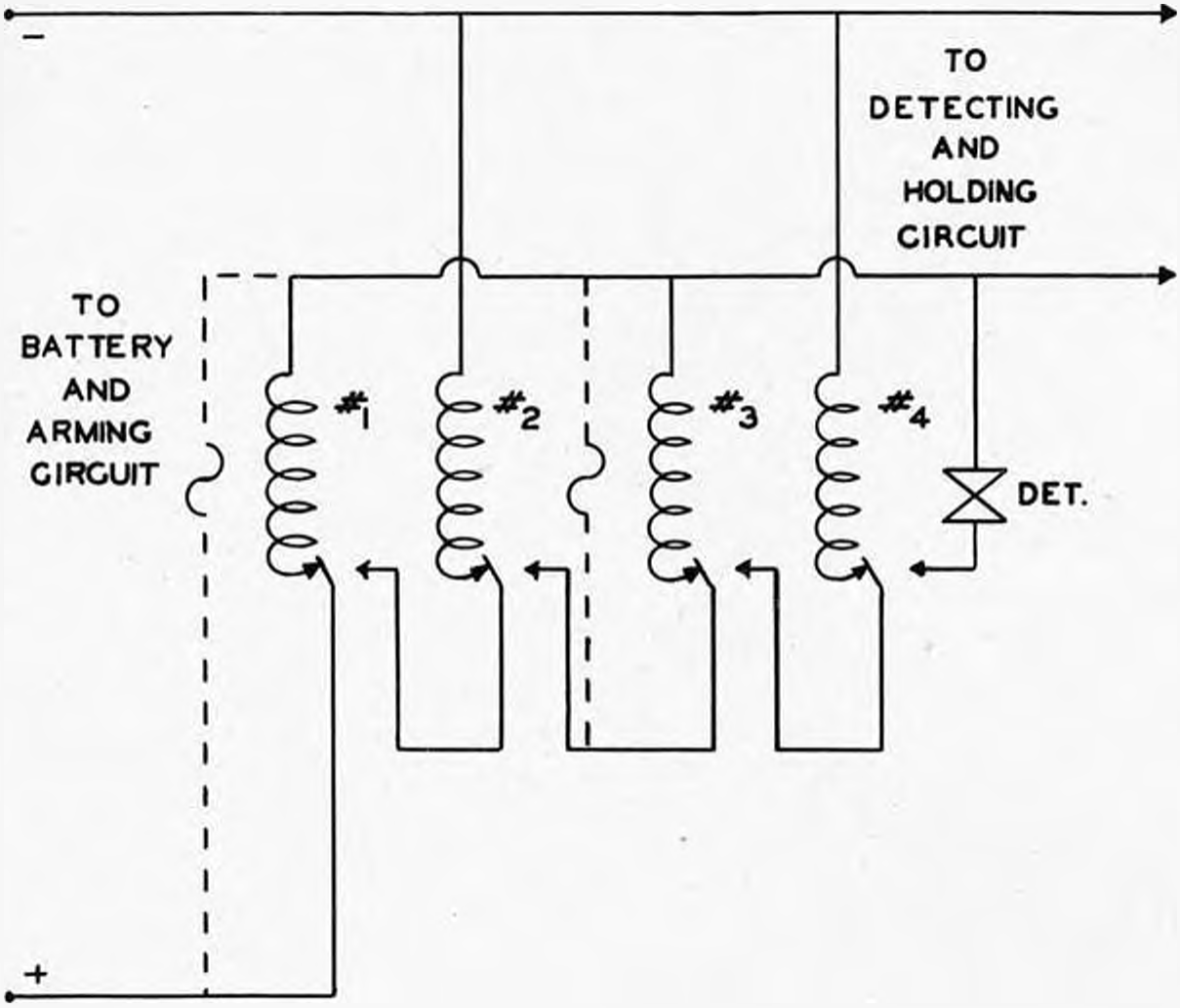


Fig. 29 - Electrical FDS (Fuse Delay Switch) Circuit

A, B, C, D, E, H	-	Gear Train
F	-	Indicating Pointer
G	-	Numbered Indicating Disc
I	-	Release Wheel
J	-	Resetting Clamp Cam
K	-	Shaft
L	-	Free Arm
M	-	Lever
N, O, P	-	Switch Contacts
Q	-	Stud

Fig. 30 - Key for Fig. 31

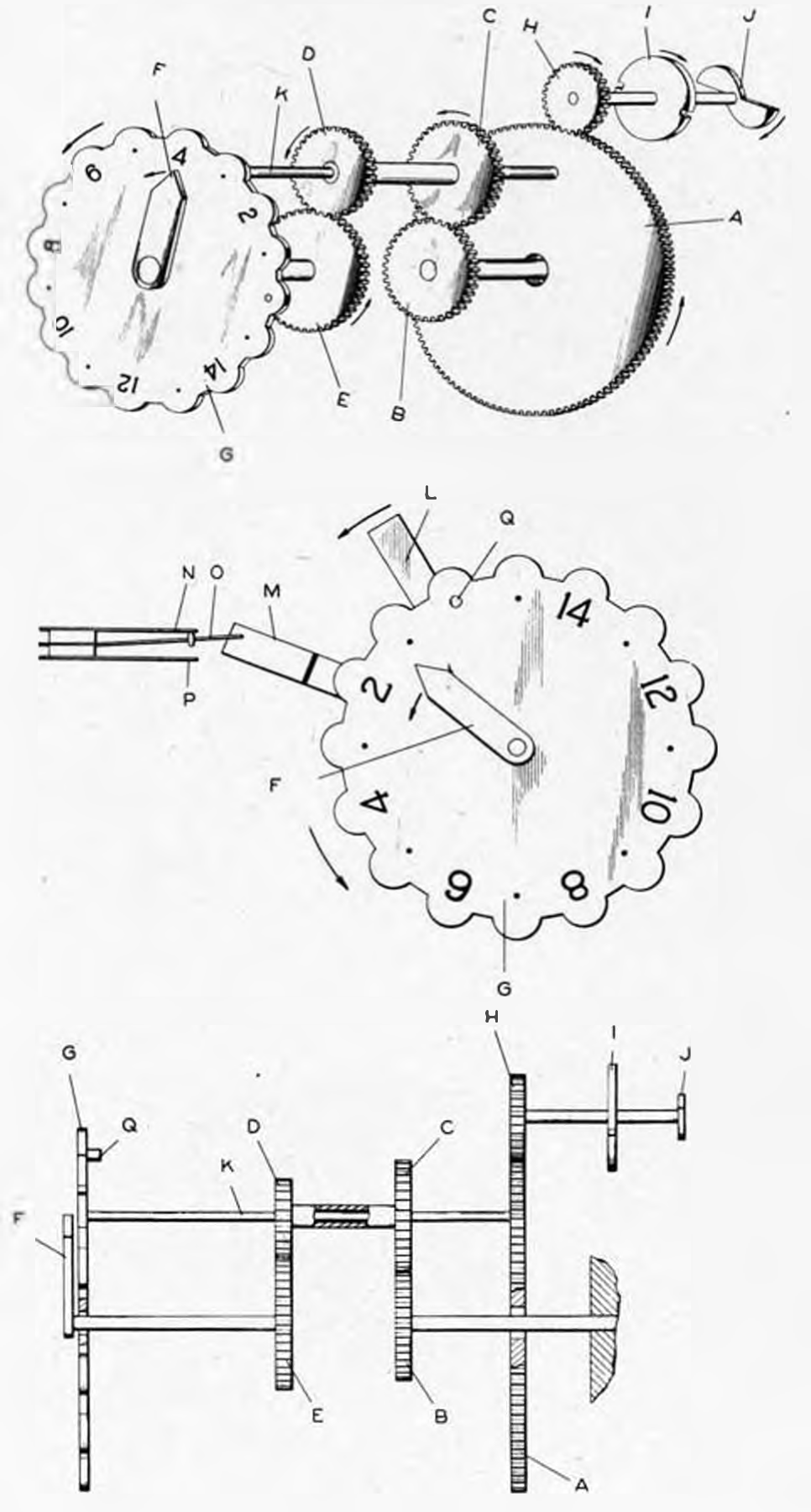


Fig. 31 - PDM used with M Mark IVa Unit
(see Fig. 30 for key)

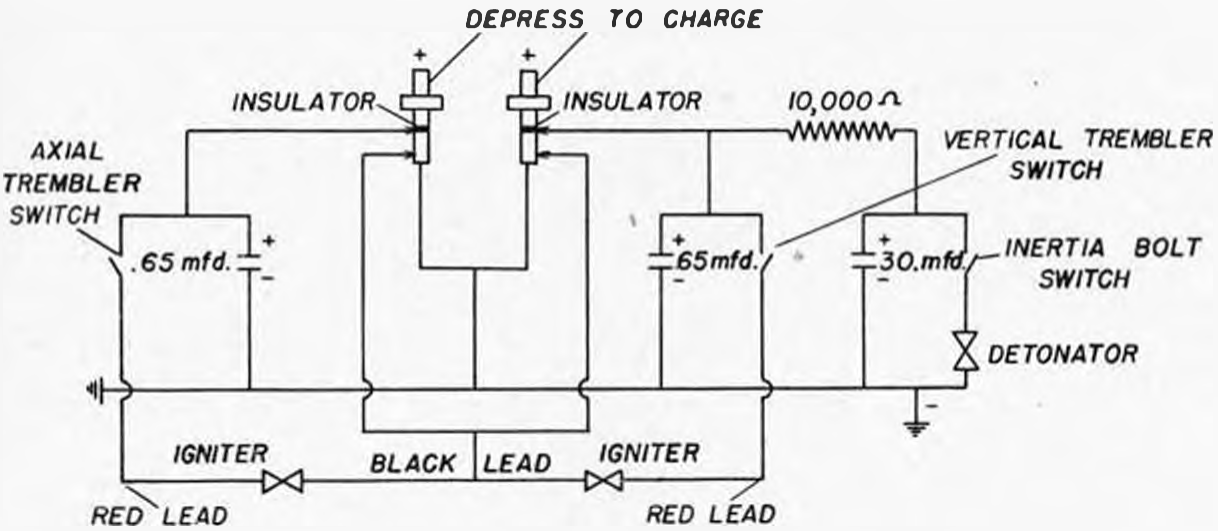


Fig. 32 - Rheinmetall Fuze Circuit

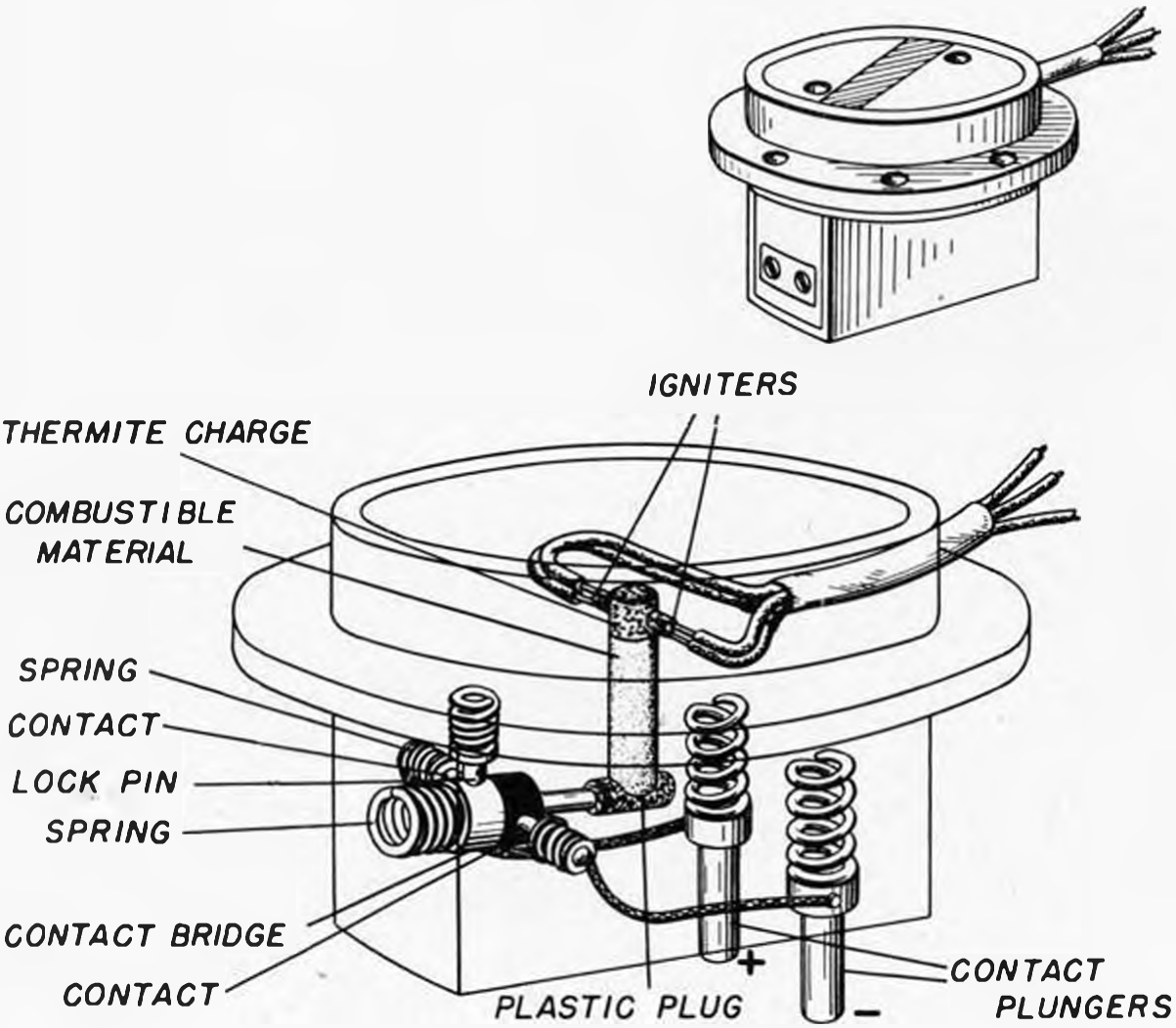


Fig. 33 - Mine Type CC, Master Switch

Special Accessories Used With Mine Type CC

Rheinmetall Bomb Fuze - Type 157/3

1. While the mine is being carried by the laying aircraft, the two spring-loaded charging plungers are depressed. As the mine is released and starts to drop, a potential of 180 volts is applied to the plungers which act as a positive terminal, the fuze body being the negative terminal. When the mine clears the plane, the plungers spring up and arm the fuze firing circuit.

2. The fuze has two functions as follows:

   (a) If the mine strikes a hard surface producing a deceleration of over 200g, an inertia bolt switch closes, firing the instantaneous detonator.

   (b) If the mine strikes a surface producing a deceleration of between 20 and 200g, one or both of two vibrating "trembler" switches closes, discharging the condenser through an electric igniter in the Master Switch.

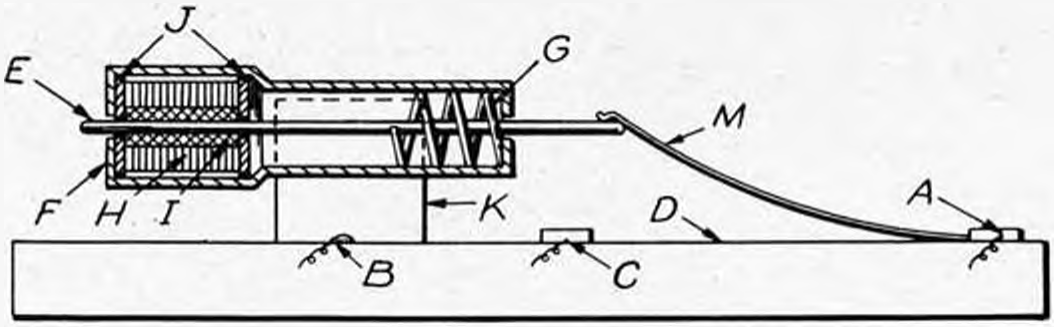
Master Switch

1. The master switch is a positive-locking, single pole, single throw type, the body of which contains two spring-loaded contact plungers which bear against a contact block inside the firing device. Each of these plungers in turn is connected to an additional spring-loaded contact plunger which bears against an insulated portion of the contact bridge plunger.

2. When the Rheinmetall fuze discharges through one or both of the switch igniters, a thermit cartridge ignites. This in turn ignites combustible material inside the switch, and the resulting heat melts a plastic plug which holds the contact bridge open. Spring tension then forces the contact bridge plunger into the molten plug, thereby bridging the two side contact plungers and closing a switch in the firing circuit. A spring-loaded detent holds the contact bridge plunger in the closed position.

Fuse Delay Switch

1. This switch is an electrically-operated delay type used in conjunction with delay bomb firing and PDM operation in this mine. It consists of a small, cylindrical shell F mounted in a fuse clip K on an insulating board D. A circuit is made from A to B through the spring copper strip M down the spring-loaded spindle E which is held in place by the adhesive action of a soft solder plug I. The circuit continues from the spindle into the heater coil H and out through the shell F. At the end of a heating period predetermined by the basic switch design, the solder melts and spring G forces spindle E to the left, thus breaking the circuit from A to B and making a circuit from A to C through the conducting strip M.



A, B, C - CONTACTS
D - INSULATING BOARD
E - SPRING LOADED SPINDLE
F - SWITCH SHELL
G - SPRING
H - HEATER COIL
I - SOLDER
J - HEATER COIL END BLOCKS
K - SWITCH CLIP
M - SPRING COPPER STRIP

Fig. 34 - Fuse Delay Switch

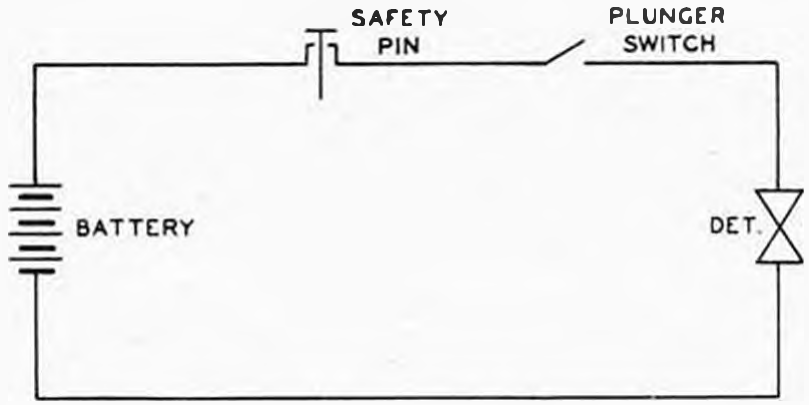


Fig. 35 - Mk. I PSE Circuit

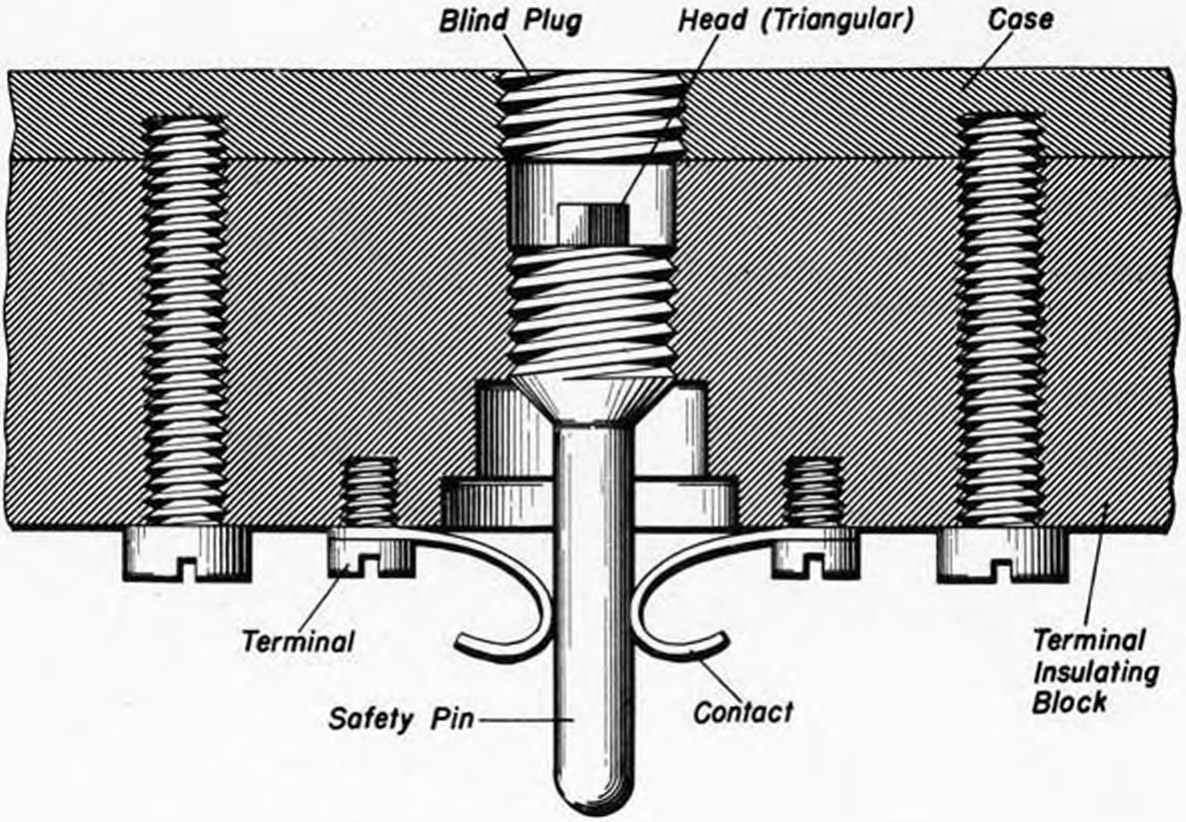


Fig. 36 - Mk. I PSE Safety Pin Arrangement

P.S.E. - Prevent Stripping Equipment

1. Various devices of this type, commonly called "booby traps", have been used by the Germans to preserve the security of their mine assemblies. They are ordinarily fitted as case accessories, designed to prevent access to the interior of the case at the most obvious points of entry such as cover plates and tail doors. However, as shown below, they may be incorporated as unit accessories or as integral parts of the unit.

2. Mark I P.S.E. (used with Mines Type GC and GD)

   (a) This device consists of a plunger switch which is held open when the tail door or mechanism plate to which it is attached is in its normal position, i.e., mine completely assembled. If an attempt is made to remove the mechanism plate or tail door, the spring-loaded plunger is released during removal and completes a circuit from the main mine battery through a special P.S.E. detonator, firing a small two pound charge.

   (b) The device is armed prior to launching by inserting a safety pin which closes a break in the P.S.E. circuit. This pin is inserted in the mine case through a plug hole, 135° from the top center line, 6" forward of the tail door flange. If the P.S.E. is fitted to the case, this hole will be present, although filled and painted over so as not to be obvious.

3. Mark Ia P.S.E. (used with Mine Type GT)

   (a) This device is essentially the same as the Mark I although it is rigged so as to operate if the mechanism plate is removed or if the case is separated at the flange. It is armed in the same manner as the Mark I, the safety pin being inserted underneath a screw on the mechanism plate, 180° from the bowden wire channel.

4. Mark II P.S.E. (used with Mine Type GC)

   (a) This device consists of two photo-electric cells, mounted on either side of the firing unit, which, when exposed to light, operate a relay and close the unit firing circuit, firing the main charge. The device becomes armed when the firing unit arms. It may be fitted to any Mine Type GC which is fitted with a firing unit which incorporates M Mark V or subsequent modifications thereof. The presence or absence of this device cannot be determined from an examination of the exterior of the mine case.

5. Mark III P.S.E. (used with Mines Type GC and GD)

   (a) This device consists of a spring-loaded firing pin which is held by two lock balls when the tail door or mechanism plate to which it is attached is in its normal position, i.e., mine completely assembled. If an attempt is made to remove the tail door or mechanism plate, movement of a spring-loaded spindle allows the lock balls to move into a recess, releasing the spring-loaded firing pin to impinge on a special P.S.E. detonator, firing a two pound charge.

   (b) The device is armed prior to launching by removal of a safety pin which leaves the firing pin restrained only by the lock balls. The safety pin is removed from the mine case through a plug which is located, 90° from the top center line on the flange.

6. Mark IV P.S.E. (used with AM Mark II unit in Mine Type GC)

   (a) This device consists of two wires, made of dissimilar metals, which are coated with a salt and laid side by side in a small trough. If humidity or moisture enter the trough, the salt dissolves, creating a small battery cell. The cell operates a sensitive relay, completing a circuit from the main mine battery to a special P.S.E. detonator, firing the main charge.

   (b) The device becomes armed when the firing unit arms and has only been found fitted to AM Mark II in Mine Type GC. The presence or absence of this device cannot be determined from an examination of the exterior of the mine case.

7. ZUS-40 Anti-Withdrawal Device

   (a) This device consists of a spring-loaded firing pin which is designed to be released when the accessory under which it is fitted is removed. When the mine is dropped, impact with the surface causes a lock ball to fall away, leaving the firing pin restrained only by its extension arm as shown in the accompanying drawings. If the accessory is withdrawn 0.76, the extension arm moves clear of the body of the accessory, releasing the firing pin to impinge on a special detonator, firing the main charge.

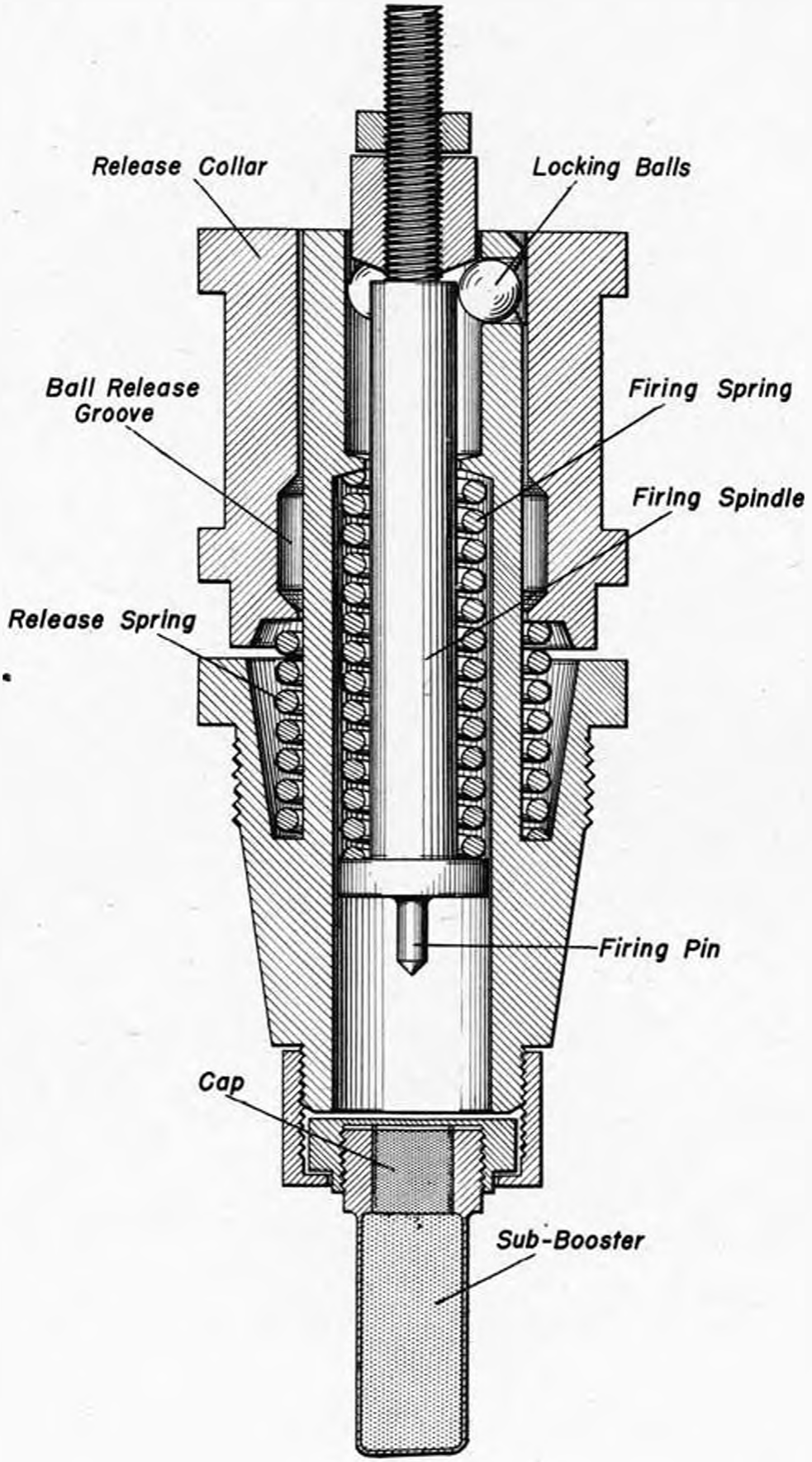


Fig. 37 - Mk. III PSE, Sectional View

P.S.E. - Prevent Stripping Equipment (Cont'd.)

(b) This device was originally designed to be fitted under bomb fuzes and its use in mines is thereby restricted, by its basic design, to Mines Type GC, GD and GQ, the only mines which have contained bomb fuzes. It should be noted however that this device may be used under any fitting the physical construction of which would permit effective operation.

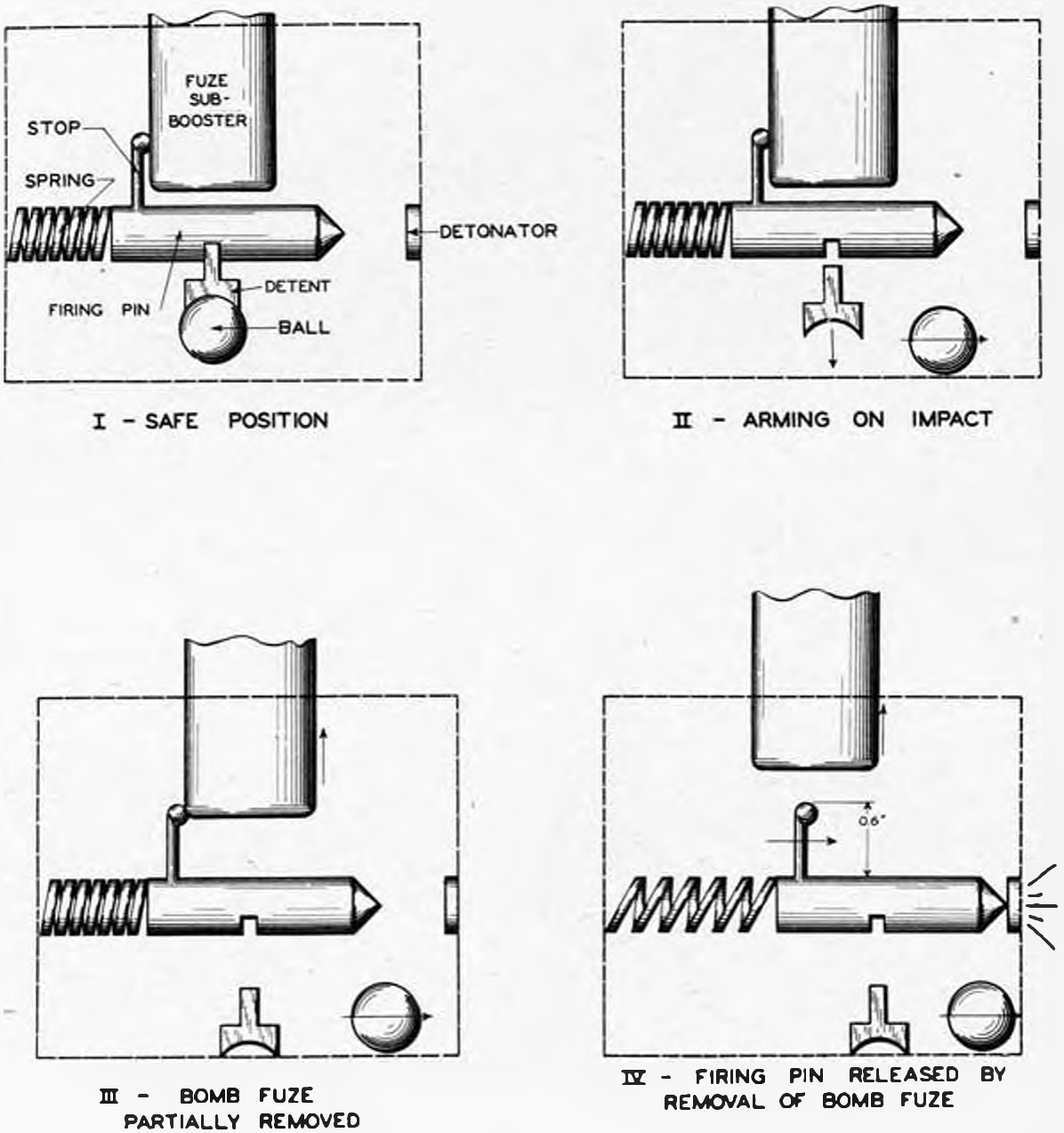


Fig. 38 - ZUS-40 Anti-Withdrawal Device

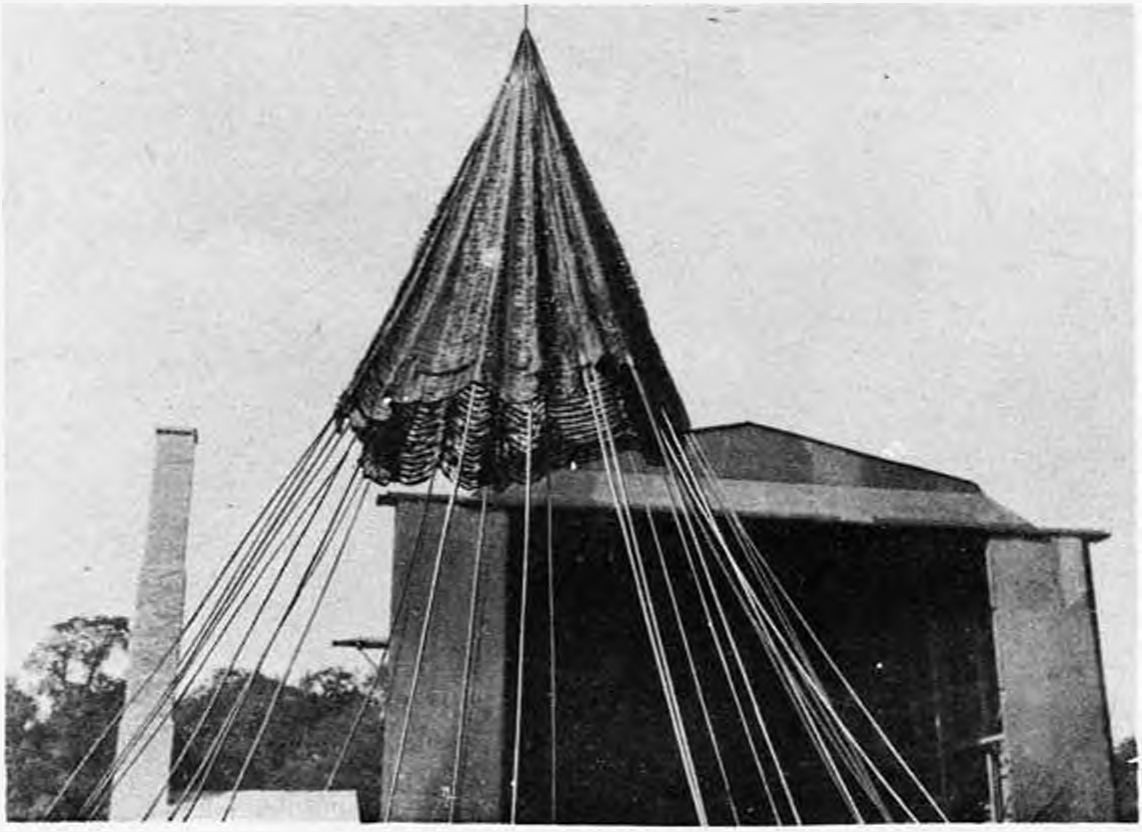


Fig. 39 - Lattice-Type Parachute (Parallel Lattice)

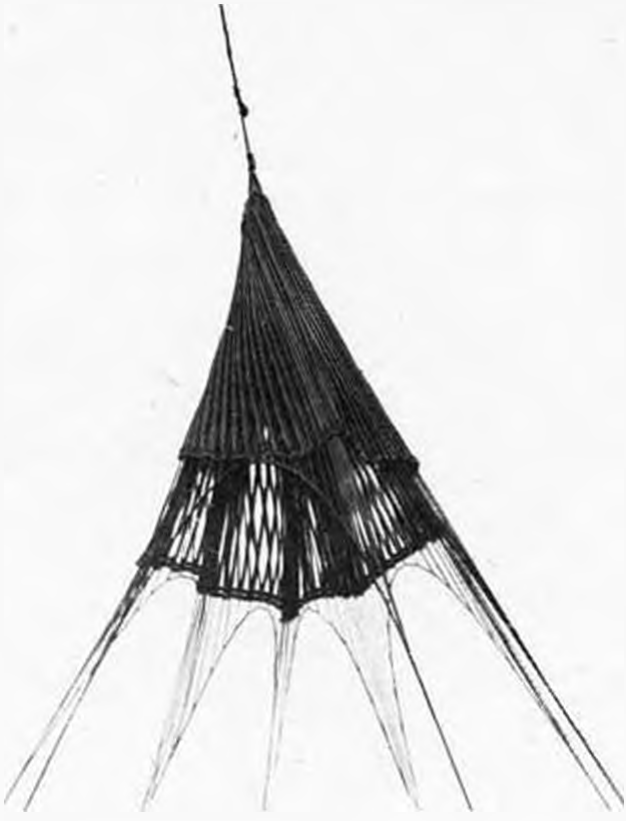


Fig. 40 - Lattice-Type Parachute (Barber Pole Type)

German Mine Parachutes

1. A knowledge of the various types of German parachutes is often useful in identifying mines which have accidentally been dropped on land. Although the mine may be completely buried, the parachute often is left on the surface and, since each type is distinctive and is ordinarily used with but one type of mine, an examination of the parachute may prove extremely valuable.

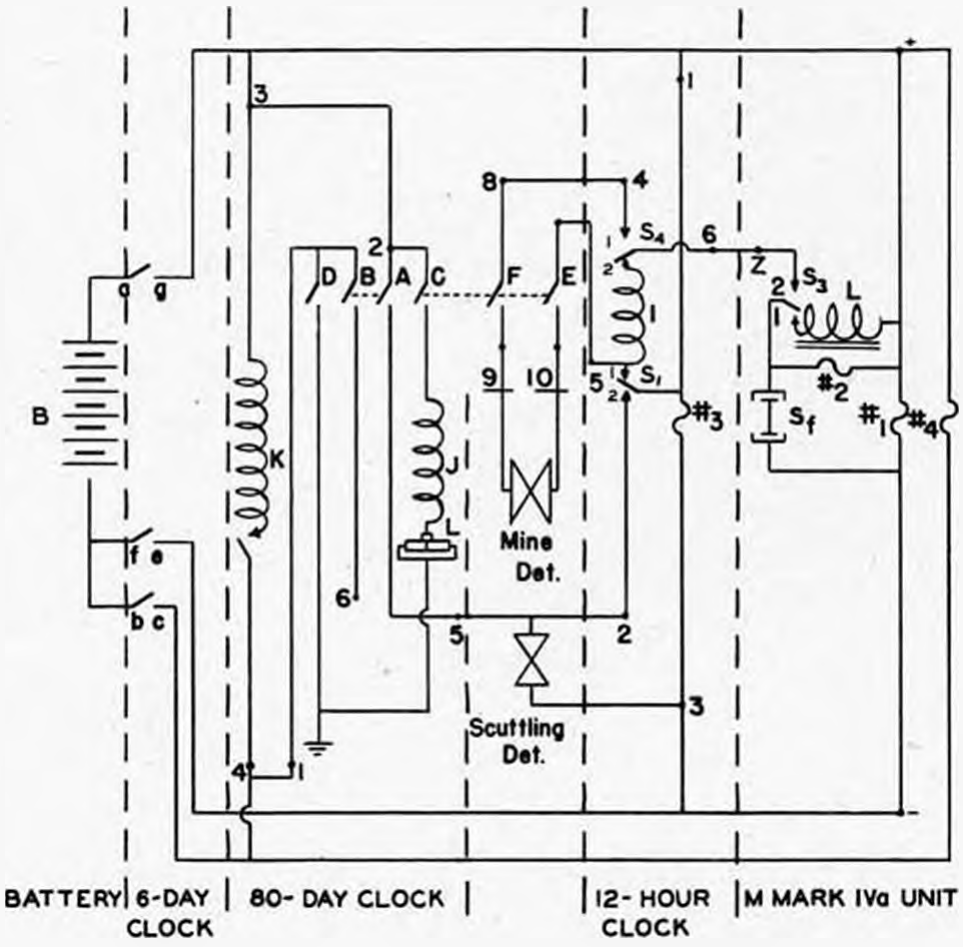
2. Two main types of parachutes are employed:

   (a) The canopy type - this parachute closely resembles the standard type aviator's parachute.

   (b) The lattice type - this parachute differs from the canopy type in that the canopy which catches the air and slows the mine's descent is not solid but is composed of a lattice work design. The various lattice work strips may run parallel to the edge of the parachute (parallel lattice type) or may be set in a manner similar to the stripes on a barber pole (barber pole type). The latter type apparently causes the mine to spin during descent, thereby permitting greater accuracy in laying.

3. The third type of parachute used is in reality a small drogue. Although it may serve to lessen the rate of descent through the air, it is believed that its primary purpose is to slow the mine's descent through the water. All available data with respect to these parachutes will be found in Table # 9.

Fig. 41 - Canopy-Type Parachute



I - 12 - HOUR CLOCK FUSE DELAY SWITCH
J - 80 - DAY CLOCK FUSE DELAY SWITCH
K - 80 - DAY CLOCK FUSE DELAY STARTING DEVICE

Fig. 42 - Mine Type GO, Testing Circuit

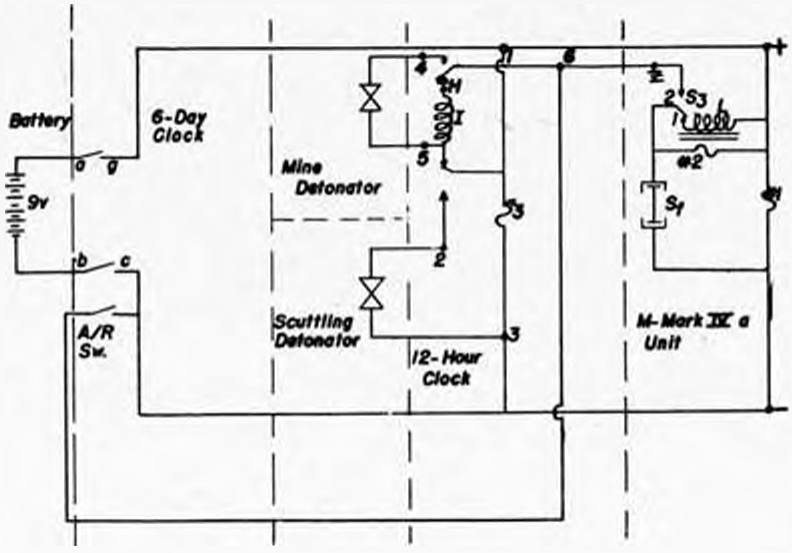


Fig. 43 - Mine Type GP, Testing Circuit

Special Mine Circuits

Mine Type GO Testing Circuit - Operation

1. When the hydrostatic clock runs off its delay period, switches a-g and b-c close, causing the battery to blow fuse #4 and operate the fuse delay device K.

   (a) Blowing of fuse #4 releases the lower portion of the M Mark IVa unit and leaves the unit swinging freely from its upper gimbal and spring suspension.

   (b) Operation of K throws the release arm which starts the 80-day clock and, simultaneously, operates a switch which cuts K out of the circuit.

2. Eighteen minutes after a-g and b-c close, e-f closes, causing the battery to blow fuses #1 and #3.

   (a) Blowing of fuse #1 starts the A.L.A. During A.L.A. operation, fuse #2 blows, and the unit is rendered alive.

   (b) Blowing of fuse #3 starts the twelve-hour clock, thereby starting the unit testing cycle. During the period set on this clock, if unsatisfactory laying conditions, such as excessive currents or wave motion, should fire the unit, the small scuttling charge is detonated.

3. Twenty four minutes after the 80-day clock starts, switches C, D, E and F close.

   (a) C and D render the clock-failure scuttling device active. This device includes fuse delay switch J and slip-ring assembly L.

   (b) E and F connect the main mine detonator to the testing circuit.

4. When the M Mark IVa unit is rendered active, it is receptive to blind actuations. If magnetic actuation occurs or if the mine is tilted sufficiently, the needle switch S_6 closes, energizing L and stepping off one place on the P.D.M. setting (15 maximum). If this occurs a number of times equal to the P.D.M. setting, switch S_3 closes to contact #2. Upon receipt of another actuation, S_6 closes, energizing the fuse delay switch I of the 12-hour clock, provided that all these actuations occur within the set period of the clock. When I is energized, contact #1 of S_4 breaks after ten seconds and contact #2 of S_4 is made, the battery fires the scuttling charge and the mine sinks. If these actuations do not occur within the period of the twelve-hour clock, S_4 changes over from contact #2 to contact #1 when the clock runs off. The scuttling detonator is then cut out of the circuit and the main mine detonator is put in.

5. If the mine does not fire normally within the set period on the 80-day clock, the clock opens C, E and F, removing the detonator from the firing circuit and disarming the clock-failure scuttling device, and A and B close, firing the scuttling charge.

6. If the 80-day clock should fail at any time during its run after C, D, E and F close, a contact is made in the slip-ring assembly L, causing the battery to energize J. After a ten-second delay, J moves a cam which closes A and B as in Par. #5 above and the scuttling charge fires.

Mine Type GP Testing Circuit - Operation

1. Differs from the Mine Type GO as follows:

   (a) No 80-day clock is fitted.

   (b) An anti-recovery switch is fitted to the hydrostatic clock which, at any time after a-g and b-c close, fires the scuttling charge or the main mine charge upon release of hydrostatic pressure. If hydrostatic pressure is released during the period of the twelve-hour clock, the scuttling charge is fired and if pressure is released after the period of the twelve hour clock, the main charge is fired.

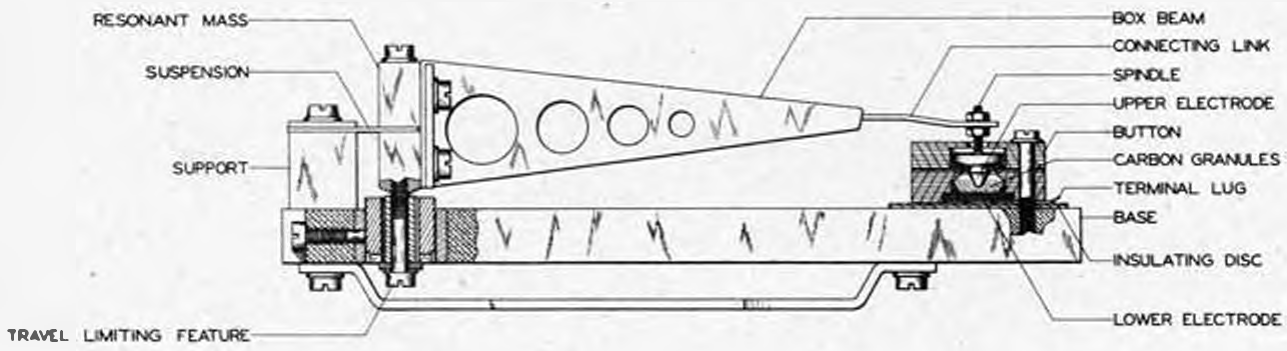


Fig. 44 - Cantilever Microphone

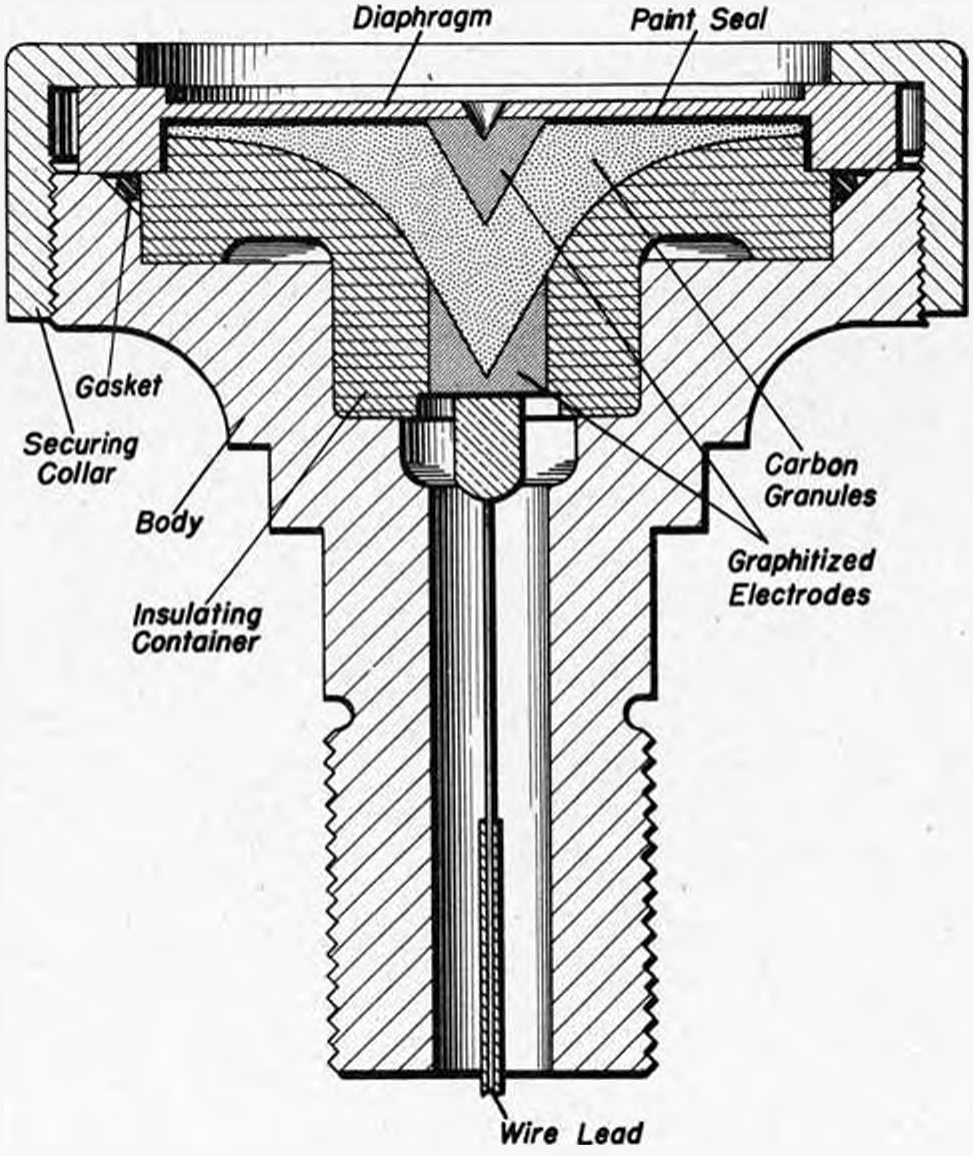


Fig. 45 - Diaphragm Microphone

Cantilever Microphone

General

1. This microphone is used with all acoustic and acoustic combination units except the AM Mark II. It is a carbon button type and acts electrically like a variable resistor the resistance of which varies directly with the vibration to which it is subjected.

Description

1. The microphone consists of an aluminum base rigidly attached to the mine case which acts as a diaphragm. The button (resistor element) and an upright support are rigidly secured to the base. An amplifying box beam and a resonant mass are attached to the support by means of a steel suspension piece. Only two leads are necessary; one each to lower and upper electrodes. The resistance element consists of carbon granules between two graphitized electrodes, one of which is fixed and the other, movable. In order to be active, the microphone must be energized constantly by battery current.

Operation

1. Vibration causes the resonant mass to oscillate according to the frequency and amplitude of the sound with the light box-beam amplifying this movement. The box beam also causes oscillation on the part of the upper electrode of the resistive element to which it is attached by means of a brass connecting link and spindle.

2. The elastic granules are thereby compressed and expanded, and since their resistance is a function of the amount of surface they present to each other, the resistance of the element is varied by sound vibration.

3. In most cases, the resonant frequency is about 250 cps.

Diaphragm Microphone

General

1. This microphone has been found used only in conjunction with the AM Mark II unit and has been found wired in parallel in groups of four. Its general operation is the same as that of the cantilever microphone.

Description

1. The microphone consists of a conical aluminum fitting covered at the base by a steel diaphragm which is held by a steel keep ring. The resistive element consists of two graphitized conical electrodes; one fixed to the diaphragm and one held in the body of the microphone in an insulating bakelite block. The space between the bakelite block and the diaphragm is filled with carbon granules and the inner surface of the diaphragm is painted so that only the electrode surface comes in contact with the granules.

2. The microphone is exposed to the water and is attached to the firing unit by a threaded portion on its apex and is secured by a nut. Only two leads are necessary; one to the electrode in the insulated block and the other to the diaphragm through a ground connection.

Operation

1. The microphone operates in much the same manner as the cantilever type. Its resonant frequency is about 250 cps., its sensitivity varying inversely with the depth of water due to increasing pressure on the diaphragm at greater depths.

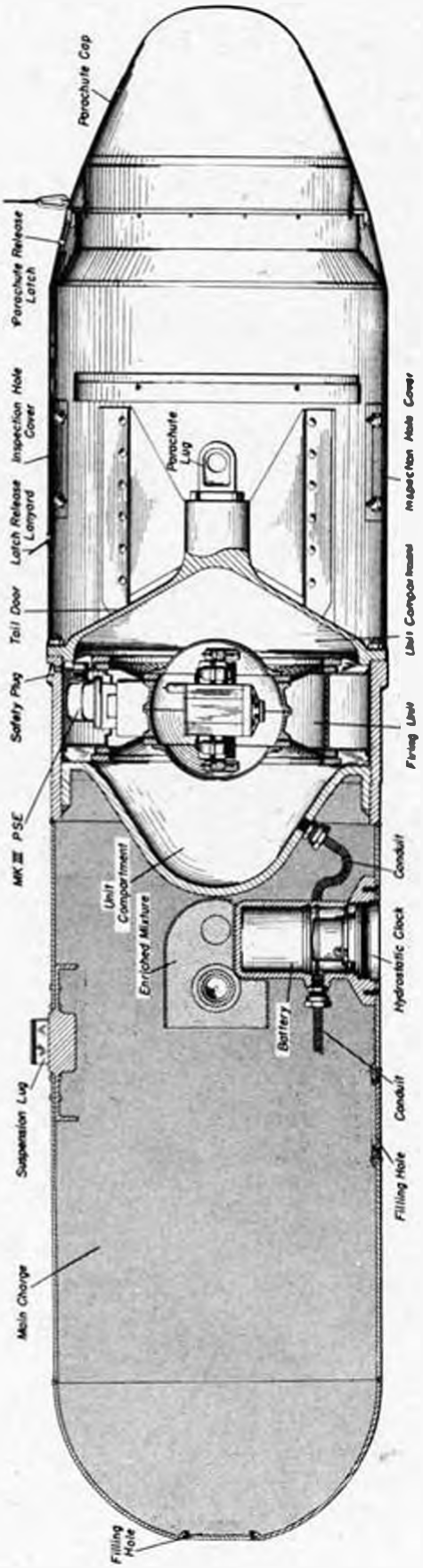


Fig. 46 - Mine Type CC, Sectional View

Mine Type GC[1] (GC[2])

General

1. Ground, influence mine, laid by aircraft with parachute. Magnetic needle, acoustic, magnetic-acoustic or magnetic-pressure firing.

2. German designation, "LMB".

3. Offensive mine, for use against surface craft.

Description

1. Case

Shape	Cylindrical, with hemispherical nose and tapered tail.
Color	Dark green or black.
Material	Aluminum
Diameter	26"
Length	
Overall	9'9 1/2"
Case	5'8 1/2"
Tail door	19"
Parachute housing	2'11 1/2"
Parachute cap	13 1/2"
Charge	1535 lbs. cast Hexanite.
Total weight in air	2175 lbs.

2. External fittings

Suspension lug	On top center line, 3'5" abaft the nose.
Parachute lug	Inside parachute housing, on center of tail door.
Booster release mechanism	4" diam., 270° from top center line, 3'8" abaft the nose, secured by keep ring.
Hydrostatic clock	6" diam., 180° from top center line, 4' abaft the nose, secured by keep ring.
Detonator Cover Plate	4 1/2" diam., 90° from top center line, 3'8" abaft the nose, secured by four screws.
Bomb fuze	3" diam., 270° from top center line 4'1" abaft the nose, secured by keep ring.
Filling hole covers	Four, 6" diam. One, in center of nose. One, 180° from top center line, 2'11" abaft the nose. Two, 135° and 225° respectively from top center line, 4'1" abaft the nose, each secured by four screws.
Inspection hole covers	Two, 7" x 9". One on top center line, 21" from other end. One 180° from top center line, 21" from other end; each secured by four lock-screws.
Parachute release latch	1/2" diam., on top center line, 2'2" from after end.
Ejecting plungers	Six, 1/2" diam., equally spaced on after end.

3. In some cases the Mine Type GC[1] has been fitted with an additional clockwork bomb fuse to reduce the possibility of a mine being found unexploded on land. The additional bomb fuze is mounted in place of the booster release mechanism and the booster is permanently housed over the detonator. The bomb fuze is mounted in an adapter tube which is screwed in the pocket in place of the booster release mechanism and

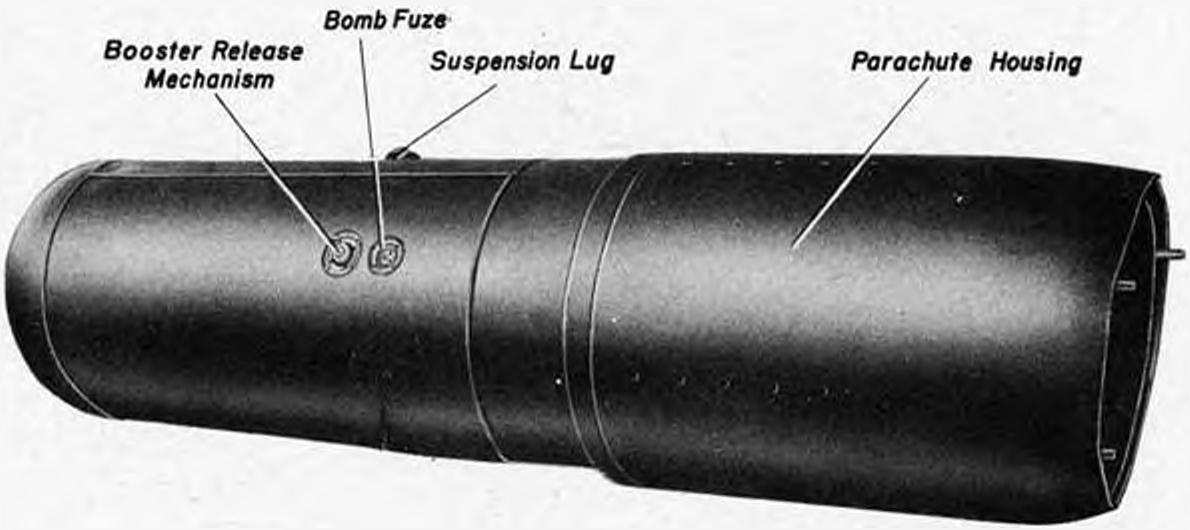


Fig. 47 - Mine Type CC[1]

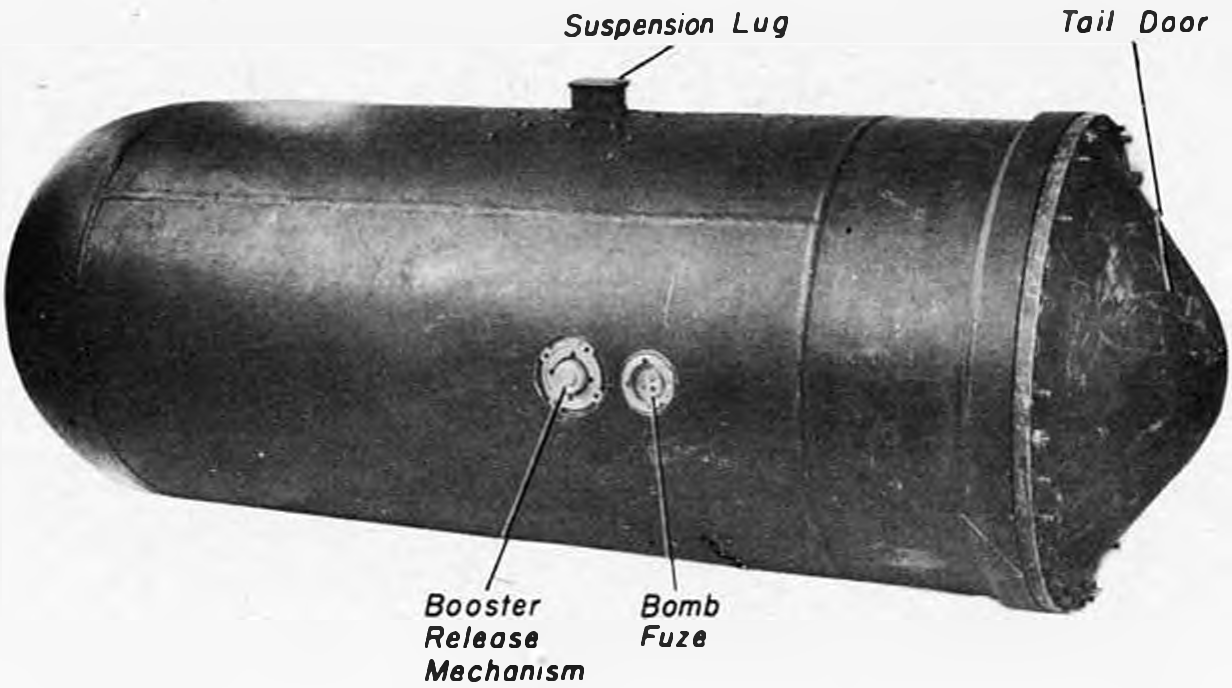


Fig. 48 - Mine Type CC[2]

Mine Type GC^1 (GC^2) (Cont'd.)

spring. The remaining space is filled with booster pellets and wooden blocks.

4. Mine Type GC^2, a surface-craft-laid model of GC^1, differs from GC^1 as follows:

(a) It is not fitted with a parachute housing or parachute lug.

(b) Its after end is rounded rather than tapered.

(c) It may not be fitted with a bomb fuse. If the fuze is fitted, it will probably be inoperative.

(d) Other significant features are as follows:

(1)	Total weight in air	2076 lbs.
(2)	Length	
	Overall	7'4"
	Tail door	7 1/2"
	Case	5'8 1/2"

Operation

1. (a) When the mine is dropped, two lanyards are pulled performing the following arming functions:

(1) One lanyard releases the parachute cap latch and the cap then serves as a pilot chute. When the main chute is fully streamed, the cap falls away.

(2) The second lanyard, a split type, removes the bomb fuze safety pin and the booster release mechanism safety fork. Removal of the safety pin allows the bomb fuze to arm after a short safety interval controlled by clockwork. Removal of the safety fork allows the booster to house over the detonator.

(b) Upon impact with any surface, the bomb fuze clockwork starts again and, after a 17 second delay, the bomb fuze fires the mine unless it has reached a depth of 15 ft. or more. Upon reaching this depth, the bomb fuze is again rendered passive and may or may not become active again if the mine is raised, depending on the fuze fitted (See Table 6).

(c) Dissolution of a soluble plug (may not be fitted) allows water pressure to depress the clock spindle at a depth of 15 ft., starting the clock. The clock runs off its delay setting and the firing unit begins its arming cycle. Dissolution of a soluble plug releases the parachute.

(d) GC^2 operates in the same manner as GC^1 except that no parachute is fitted and the bomb fuze, if fitted, will probably have the safety pin still in place.

2. See Table #1 for possible firing units fitted. In some cases the mine has been rigged as a shallow water depth bomb by replacing the hydrostatic clock with a hydrostatic switch which operates at a depth of 50 ft. and by plugging the bomb fuze so that it cannot be rendered passive by hydrostatic pressure.

3. No self-disarming devices are fitted.

Precautions

1. See Introduction.

2. Do not remove the tail door of the mine. It is possible that either the Mark I or Mark III P.S.E. will be fitted thereto.

RMS

1. If the clock is running, gag it.

2. Gag the bomb fuze(s) as follows:

(a) Type 34A or 34A* using threepenny bit type gag.

(1) Remove the hydrostatic cover screw and cover.

(2) Insert the gag pin in the water entry hole.

(3) Insert the threaded spindle in the hole and screw down as far as possible without forcing.

(4) Screw on the gag protective cylinder.

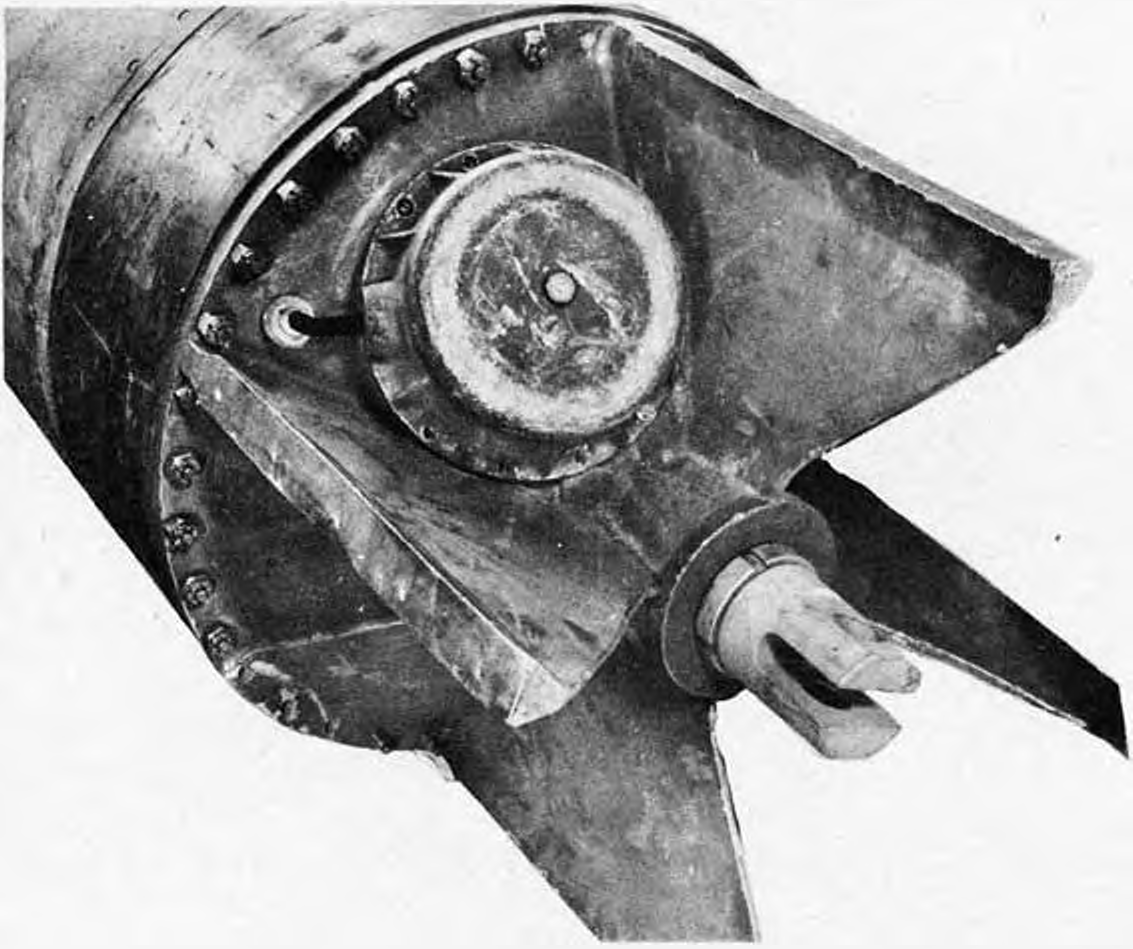


Fig. 49 - Mine Type CC[1], End View Showing Pressure-Detecting Device

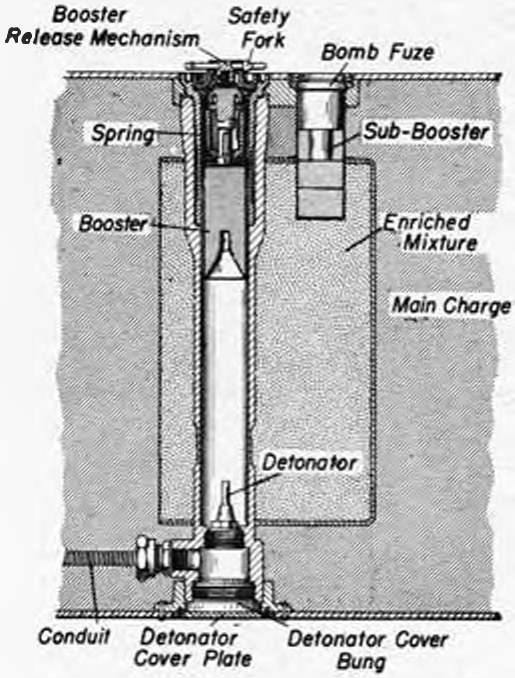


Fig. 50 - Mine Type CC, Detonator-Booster Assembly

Mine Type GC^1 (GC^2) (Cont'd.)

(b) Type 34B using British mechanical gag.

(1) Cock the gag.

(2) Remove the cap screw which covers the clockwork release pin in the bomb fuze.

(3) Screw the gag into the hole.

(4) Push the gag plunger in as far as it will go.

3. Remove the bomb fuze(s) as follows:

(a) Loosen the keep ring two complete turns and test for ZUS-40. If spring pressure or unnatural stiffness is detected, tighten the keep ring and proceed with step #4 below. Otherwise, proceed as indicated immediately below.

(b) Remove the keep ring, taking precautions against the bomb fuze falling out.

(c) Attach a length of white line to the gag protective cylinder or gag and, from a safe distance, withdraw the bomb fuze. Use an even, steady pull.

(d) Remove the sub-booster from the bomb fuze.

4. Remove the detonator as follows:

(a) Remove the detonator cover plate.

(b) Remove the plastic detonator cover bung.

(c) Cut and tape each lead separately, being especially careful not to short or ground any lead to the mine case.

(d) Remove the detonator.

5. Remove the booster as follows:

(a) Remove the keep ring using one thumb to hold in the booster release mechanism.

(b) Allow the booster release spring to expand sufficiently to obtain a firm grip on it. Remove the booster release mechanism and spring with a single quick motion.

(c) Insert the booster removal tool and remove the booster.

6. Remove the hydrostatic clock as follows:

(a) Loosen the keep ring two full turns and test for spring pressure. If detected, tighten the keep ring and cease operations on the clock. Otherwise, remove the keep ring, taking precautions against the clock falling out.

(b) Remove the clock.

(c) Cut and tape each lead separately.

(d) Remove the locking ring and battery or relay pack.

7. Dispose of all explosive elements including the picric acid pellets in bomb fuze pocket.

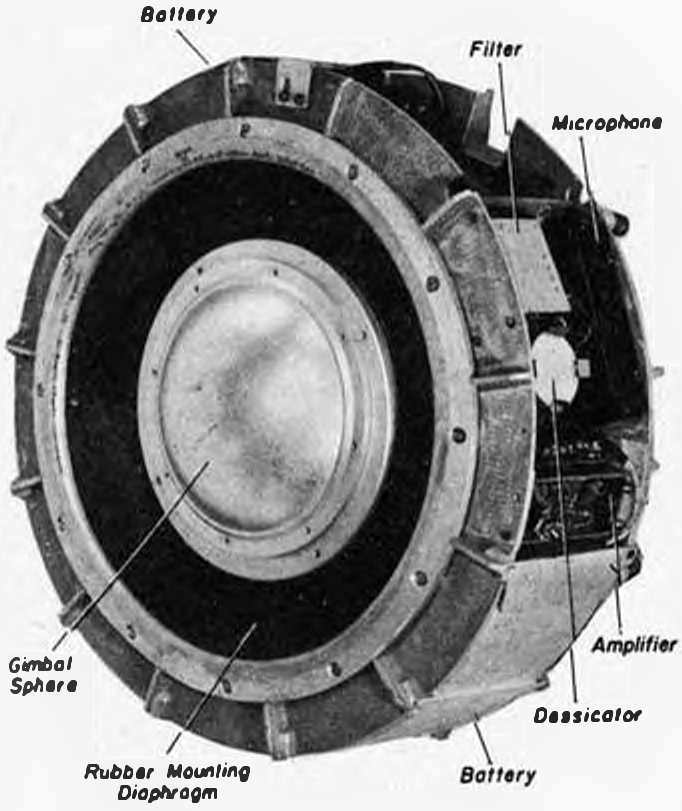


Fig. 51 - AK Mk. I Unit as fitted to Mine Type GC

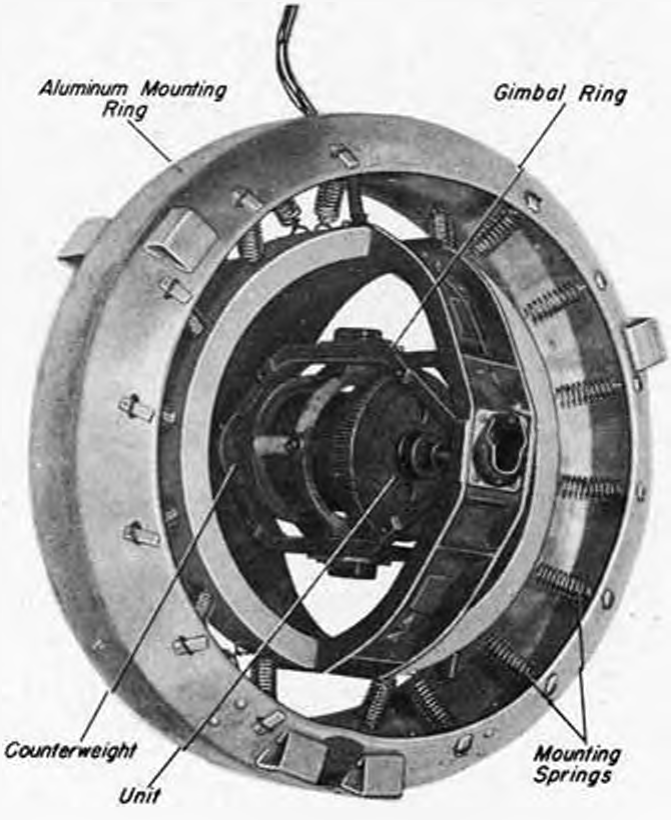


Fig. 52 - K Mk. IVa Unit as Fitted to Mines Types GC or GY

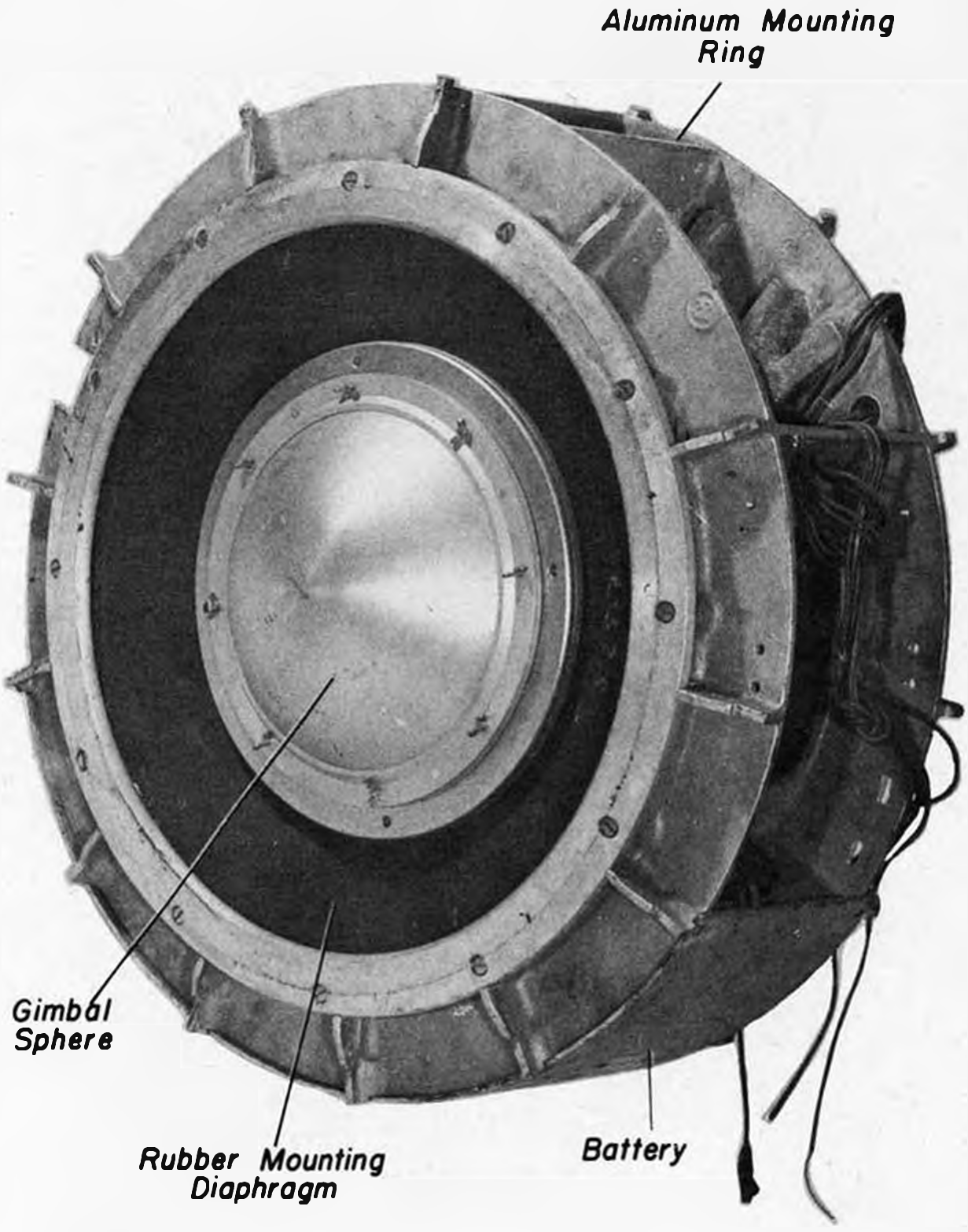


Fig. 53 - M Mk. II (revised) Unit as fitted to Mines Types CC and CD

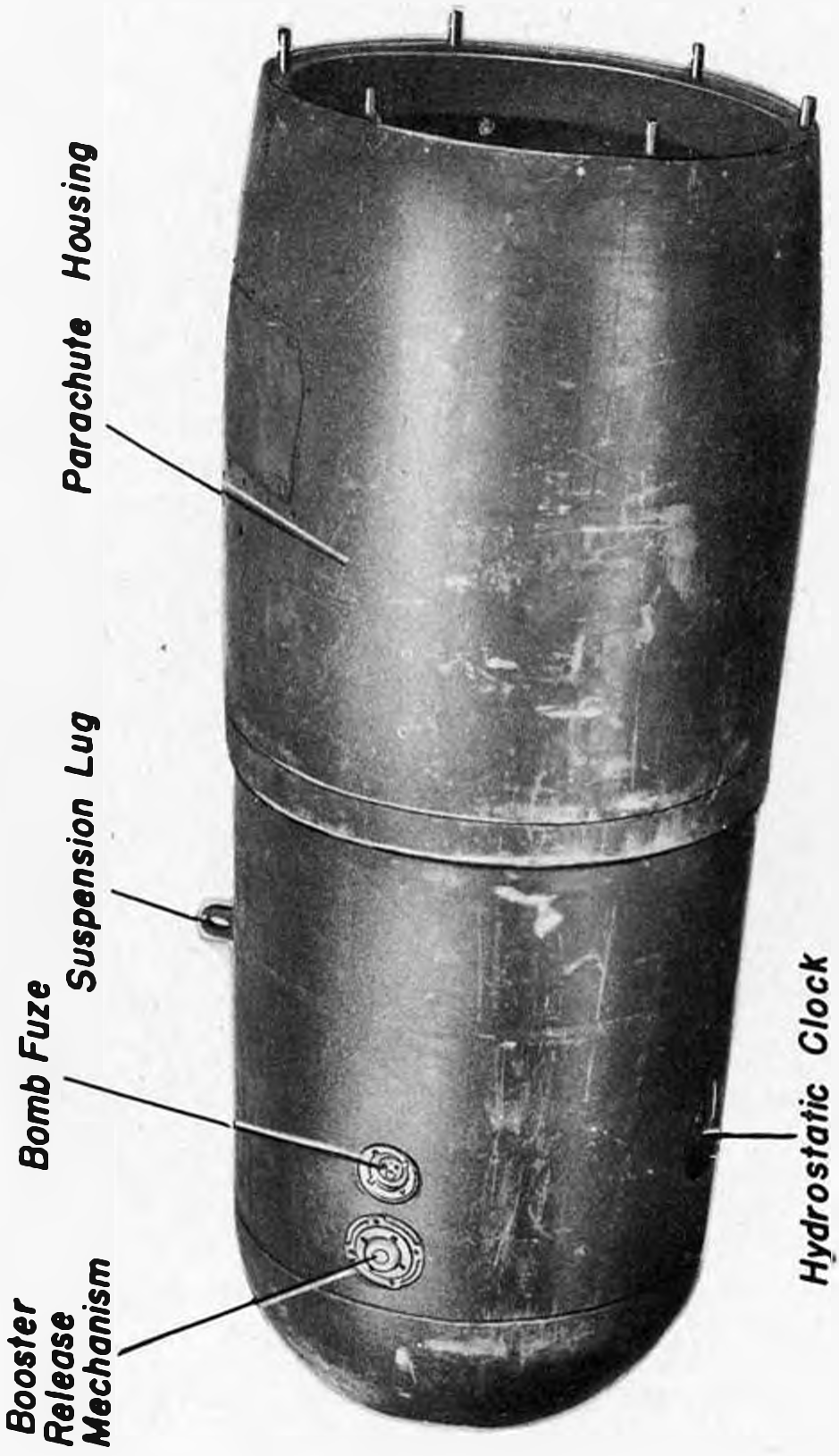


Fig. 54 - Mine Type CD

Mine Type GD

General

1. Ground, influence mine, laid by aircraft with parachute. Found to date with magnetic needle firing only although it may be fitted with the same firing units as Mine Type GC.

2. German designation, "[illegible]".

3. This mine is a smaller model of Mine Type GC and is now considered obsolete.

Description

1. Case

Shape	Cylindrical, with hemispherical nose and tapered tail.
Color	Dark green or black.
Material	Aluminum
Diameter	26"
Length	
Overall	6'9 1/2"
Case	3'4 1/2"
Parachute housing	2'3 1/2"
Tail door	19"
Parachute cap	13 1/2"
Charge	674 lbs. cast Hexanite.
Total weight in air	875 lbs.

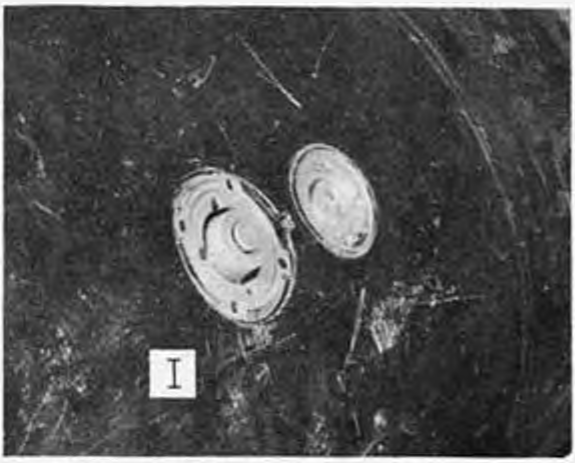
2. External fittings

Suspension lug	On top center line, 24" abaft the nose.
Parachute lug	Inside parachute housing, on center of tail door.
Booster release mechanism	4" diam., 270° from top center line, 15 1/2" abaft the nose, secured by keep ring.
Hydrostatic clock	6" diam., 180° from top center line, 18 1/2" abaft the nose, secured by keep ring.
Detonator cover plate	4 1/2" diam., 90° from top center line, 15 1/2" abaft the nose, secured by keep ring.
Bomb fuze	3" diam., 270° from top center line, 20 1/2" abaft the nose, secured by keep ring.
Filling hole covers	Three, 6" diam.; one in center of nose; two, 135° and 225° respectively from top center line, 19" abaft the nose. Each secured by four screws.
Inspection hole covers	Two, 7" x 9"; on top center line and 180° from top center line respectively, 12 1/2" from after end. Each secured by four screws.
Parachute release latch	1/2" diam., on top center line, 22" from after end.
Ejecting plungers	Six, 1/2" diam., equally spaced on after end.

Operation

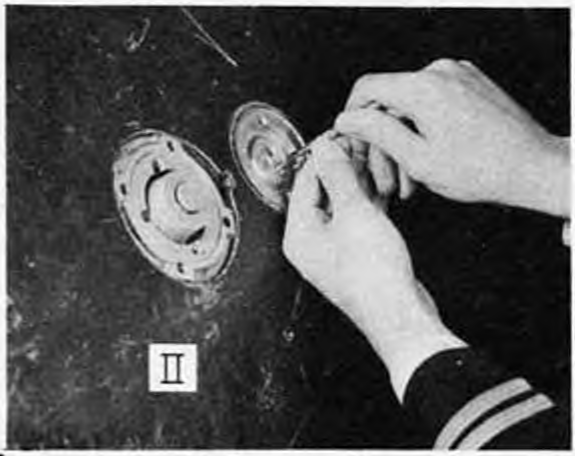
1. Same as Mine Type GC[1] except as follows:

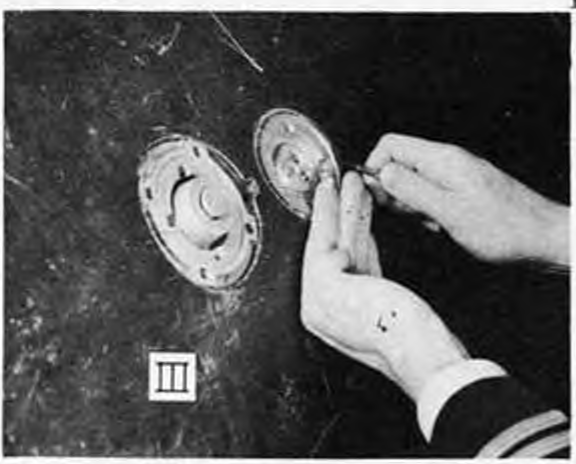
   (a) It has never been known to be fitted with acoustic or magnetic-acoustic units.



Fuze in place

Removing cap screw





Cap screw removed

Cocking gag

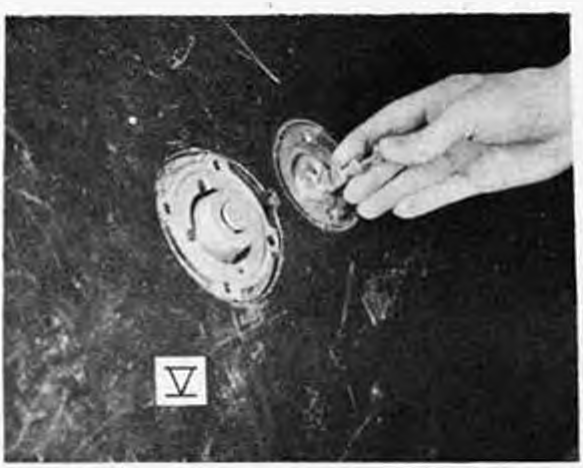
Mine Type GD (Cont'd.)

(b) It has never been known to be rigged as a depth bomb.

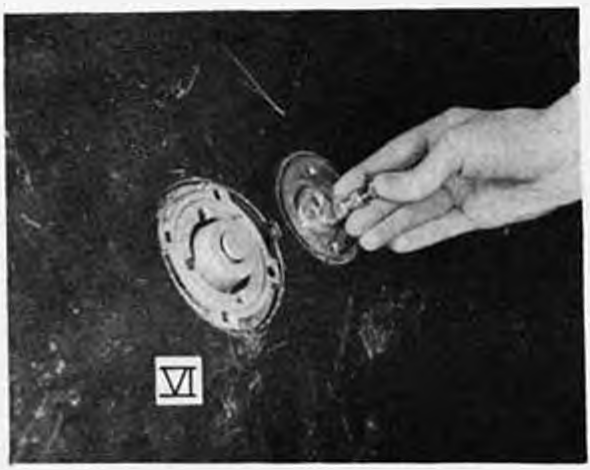
(c) It has never been known to be fitted with two bomb fuzes.

Precautions and RMS

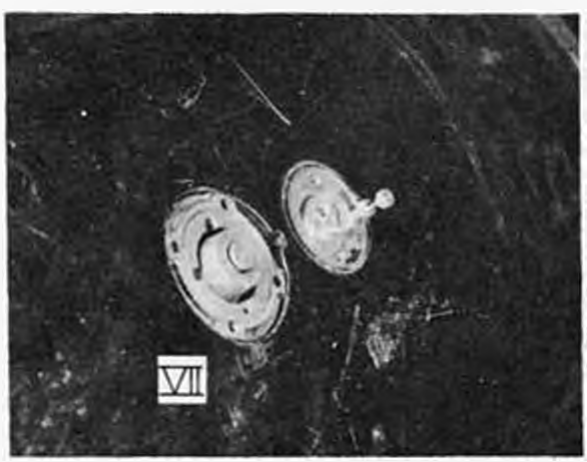
1. Same as Mine Type GC[1].



Gag in position



Plunger depressed



Fuze gagged

Fig. 55 - Use of British Mechanical Gag to gag 14B Bomb Fuze

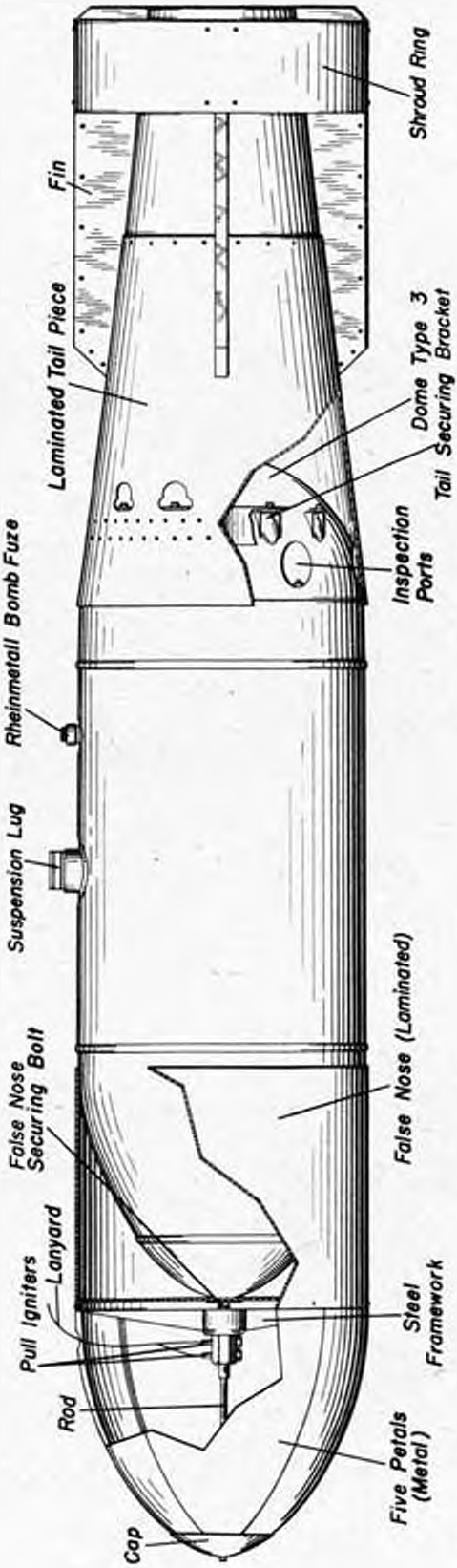


Fig. 56 -Mine Type GC with Cap, False Nose and Tail

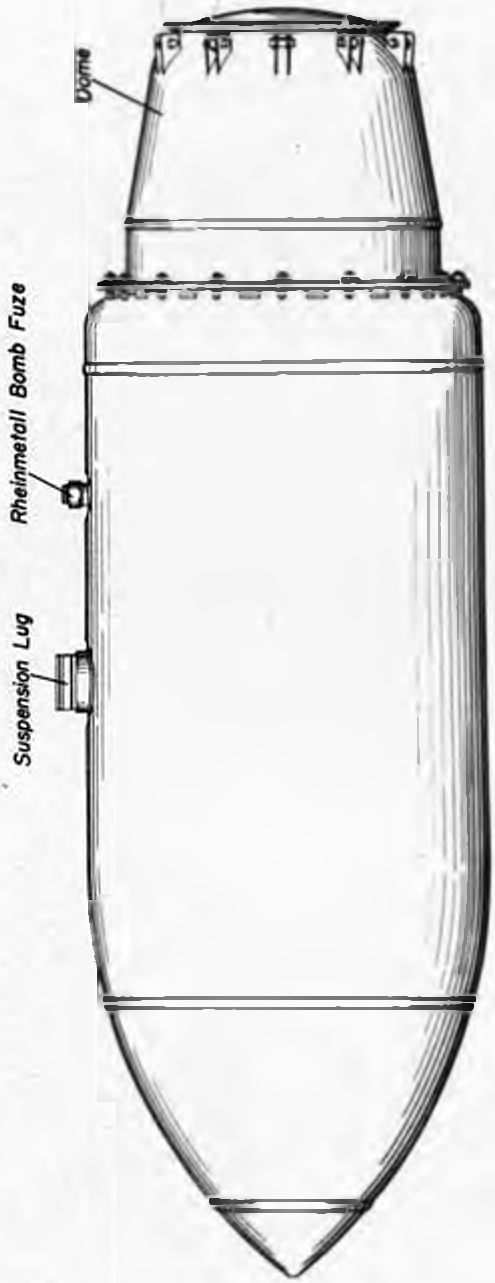


Fig. 57 - Mine Type GC

Mine Type GG^1 (GG^2, GG^3 and GG^4)

General

1. Ground, influence mine, laid by aircraft. Magnetic needle, acoustic, magnetic-acoustic or acoustic-pressure firing.

2. German designation, "B: 1000".

3. Offensive mine, for use against surface craft.

Description

1. Case

Shape	Cylindrical, with ogival nose and truncated cone dome on tail. Fitted with break-off tail section. Possibly fitted with false nose.
Color	Buff or light blue.
Material	Manganese steel
Diameter	26"
Length	
Overall	10'6 1/2"
Case	5'
Dome (Type #1)	16"
False nose	
Ogival section	23"
Cylindrical section	20"
Tail section	3'7 1/2"
Charge	1600 lbs. cast Hexanite with picric acid booster.
Total weight in air	2169 lbs.

2. External fittings

Rheinmetall bomb fuze	3" diam., on top center line, 4'2 1/2" abaft the nose.
Suspension lug	On top center line, 3'0" abaft the nose.
Dome (Type #1)	Secured to after end of case by 10 studs (see below).

3. Mine Type GG^2 differs from Mine Type GG^1 as follows:

   (a) It is fitted with Dome Type #2 (see below).

   (b) Its case length, including dome, is 6'7" and its total weight in air is 2126 lbs.

   (c) It is laid with a drogue or small parachute, the tail section being omitted. The false nose may also be omitted.

4. Mine Type GG^3 differs from Mine Type GG^1 as follows:

   (a) It is fitted with Dome Type #3 (see below).

   (b) Its case length, including dome, is 6'1" and its total weight in air is 2173 lbs.

5. Mine Type GG^4 (tentative desig.) differs from Mine Type GG^1 as follows:

   (a) It is fitted with Dome Type #4 (tentative desig.) (see below).

   (b) Its case length, including dome, is 6'7" and its total weight in air is 2126 lbs.

   (c) No complete mines of this type have been recovered, although single domes have been found. It has been reported to be a surface-laid version of GG^2 but evidence is not sufficiently conclusive to warrant any definite assumptions.

6. The four types of domes are as follows:

   (a) Type #1 - a truncated cone, rounded at its after end and fitted with a flange at its forward end. It is 26" in diameter at the flange, 20" in maximum diameter on the conical section and 16"

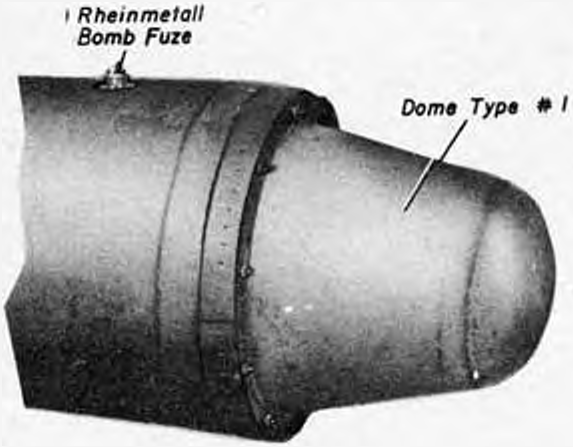


Fig. 58 - Mine Type GG, Dome Type #1

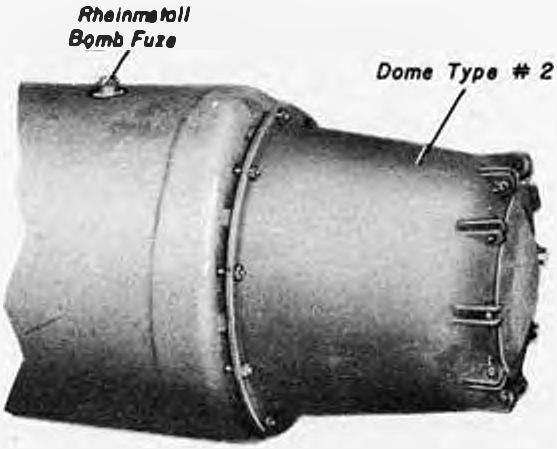


Fig. 59 - Mine Type GG, Dome Type #2

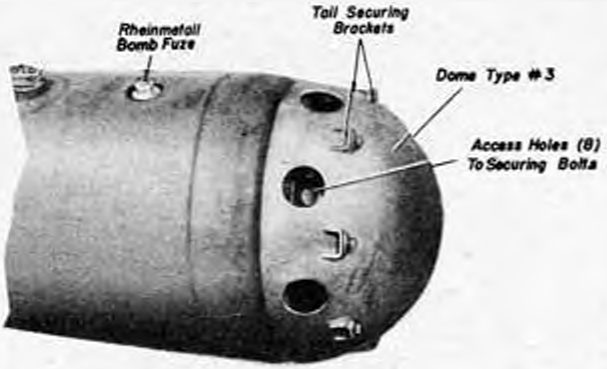


Fig. 60 - Mine Type GG, Dome #3

Fig. 61 - Mine Type GG, Dome #4

Mine Type GG[1] (GG[2], GG[3] and GG[4]) (Cont'd.)

long. It is secured to the charge case by 10 studs. Magnetic needle, acoustic, or acoustic-pressure units may be fitted.

(b) Type #2 - a truncated cone with a cylindrical base, rounded at its after end and fitted with a flange at its forward end. It is 26" in diameter at the flange, 19" in maximum diameter on the conical section and 19" long. It is secured to the charge case by 10 studs. Ten equally-spaced drogue securing lugs are fitted around the after end of the dome and a metal ring, 8" in diameter, is welded to this end. Magnetic needle, acoustic or acoustic-pressure units may be fitted.

(c) Type #3 - a hemisphere, 26" in diameter, fitted with eight holes, 3 1/4" in diameter, around its periphery. These holes give access to the eight studs which secure the dome to the charge case. It is fitted with eight equally-spaced brackets for securing the tail section. Only magnetic-acoustic units may be fitted.

(d) Type #4 - a truncated cone with a cylindrical base, rounded at its after end and fitted with a flange at its forward end. It is 26" in diameter at the flange, 19" in maximum diameter on the conical section and 19" long. It is secured to the charge case by 10 studs. Magnetic needle, acoustic or acoustic-pressure units may be fitted.

7. The two types of laminated paper break-off tail sections are as follows:

(a) GG[1] - consists of a truncated cone fitted with four radial fins enclosed in a shroud ring secured to the dome by rivets. None has been recovered.

(b) GG[3] - consists of a truncated cone with radial fins and shroud ring as on GG[4]. The section is 4'8" long, 25" in diameter at its forward end and 13" in diameter at its after end. The shroud ring is 8" long and 25" in diameter. Eight equally-spaced holes give access to the bolts which secure the section to the dome.

8. The false nose fitted to GG mines is composed of two parts as follows:

(a) A cylindrical, laminated paper section, 20" long and 26" in diameter, open at its after end and drilled with a hole through the longitudinal axis of the forward end. This hole receives a securing rod, the after end of which is secured to a threaded recess in the charge case.

(b) A steel ogival section, 23" long and 26" in diameter consisting of six, overlapping, petal-shaped pieces held together at their forward and after ends respectively by a small nose cap and a steel ring. One petal is drilled with a 1" hole to allow passage of an arming wire to two small delay detonators on the charge case. This section is secured to the plastic afterbody by six screws. The securing rod, which also passes through the longitudinal axis of this section, secures at its forward end to the small nose cap and serves to attach both the forward section and afterbody to the charge case.

9. Markings found on the mine case may be of assistance in identifying the type of unit fitted. The markings, consisting of a letter followed by three numbers, may be found in any one of three places: adjacent to the carrying lug, on the nose, or on the dome. The letter prefix determines the type of influence firing and the numbers, the specific unit. Examples are as follows:

(a) M 101 - M Mark VIII
M 103 - M Mark IX
A 105 - A Mark V
MA 101 - AM Mark II
AD 104 - AP Mark I
AD 104b - AP Mark I with 80 hour RAM.

Operation

1. When the mine is dropped, the Rheinmetall fuze condenser receives a charge and a split lanyard attached to the false nose is pulled, thereby igniting the two small delay detonators on the charge case. After a short delay, the delay detonators fire, driving the securing rod forward and thereby removing the small nose cap from the forward end of the false nose. Air travel then forces the petals outward and they fall away (GG[2] employs standard parachute laying). Upon impact with a surface, the Rheinmetall bomb fuze operates as follows:

(a) If the rate of deceleration is 20-200g, as in the case of impact with a soft surface such as water or loose earth, the trembler switches close, firing the igniters in the master switch. If the mine does not reach a depth of 24' within 90 seconds (15 ft. in 105 sec. for GG[3]), the mine will fire as a delay action bomb.

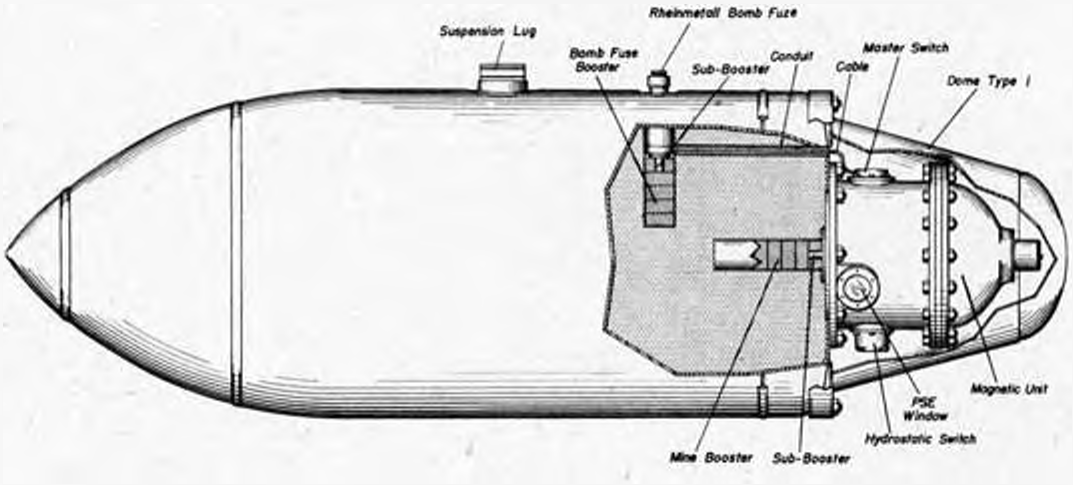


Fig. 62 - Mine Type GC fitted with Magnetic Unit, Sectional View

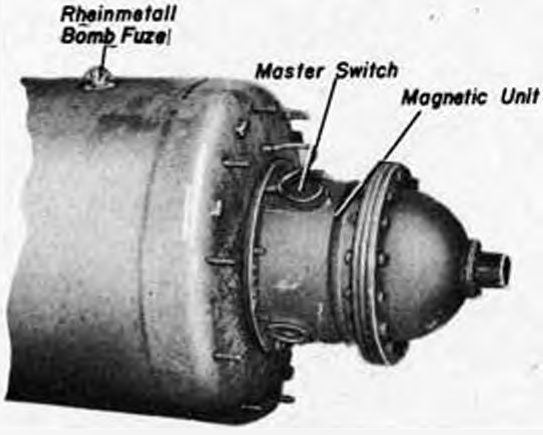


Fig. 63 - Mine Type GC fitted with Magnetic Unit

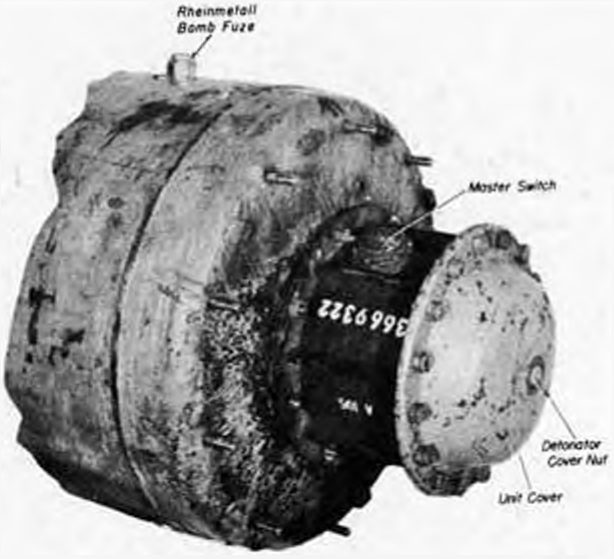


Fig. 64 - Mine Type GC Fitted With Acoustic Unit

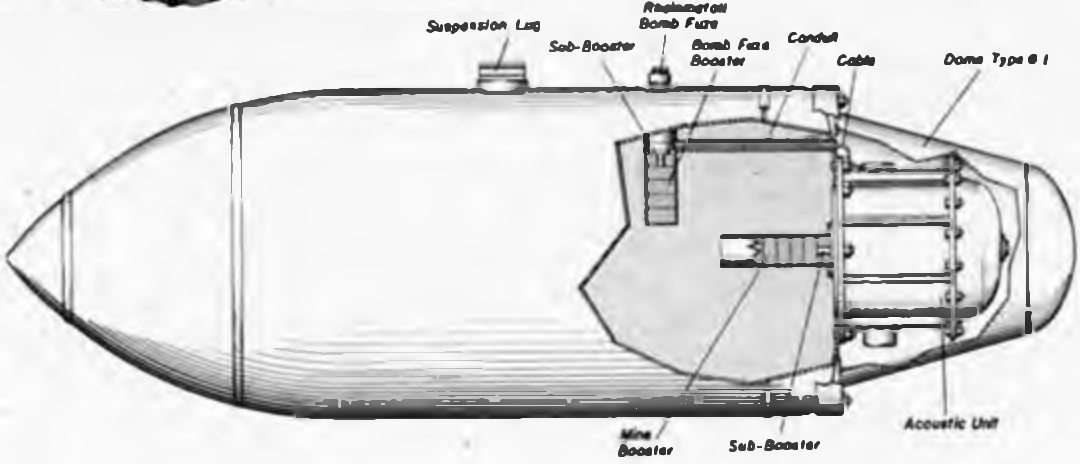


Fig. 65 - Mine Type GC Fitted With Acoustic Unit, Sectional View

Mine Type GG[1] (GG[2], GG[3] and GG[4]) (Cont'd.)

If the mine does reach the proper depth within the appointed time, the firing unit is put into the circuit and starts its arming cycle.

(b) If the rate of deceleration is greater than 200g, as in the case of impact with a hard surface such as concrete or rock, the mine fires as an instantaneous bomb.

2. See Table #1 for possible firing units fitted.

3. No self-disarming devices are fitted.

Precautions

1. See Introduction.

2. Make every effort to identify the unit fitted before proceding with RUS.

3. If the mine is found underwater, it should be raised only by remote lifting gear due to the fact that the delay action bomb firing may be reactuated when the mine is raised to a depth less than 24 ft. See Par. 1 (a) of Operation.

4. Do not expose a unit not definitely established as other than magnetic to light, due to the possibility that the Mark II P.S.E. may be fitted.

5. Do not allow moisture or high humidity to enter an AK Mark II unit due to the presence of the Mark IV P.S.E.

6. If the firing unit has not been definitely established as other than acoustic, observe special acoustic procedure as follows:

(a) Keep all necessary noise to a minimum.

(b) Make no noise lasting longer than one-half second.

(c) Allow a three-second interval between each interval of sound.

7. Be particularly cautious when dealing with a mine of this type which appears to be damaged. Such mines have been known to be active due to dents depressing the hydrostatic switch.

8. Russian reports state that ZUS-40 has been found beneath the Rheinmetall bomb fuze. Due precautions should be taken.

RUS

1. Remove the dome as follows:

(a) Remove all but two of the securing nuts.

(b) Remove the two remaining securing nuts in darkness.

(c) Remove the dome, observing all precautions.

2. Identify the firing unit fitted (Par. 9 of Description) and follow the procedure prescribed for the appropriate unit (Par. 7-10 below).

3. After removing the unit from the mine, remove the booster by unscrewing the eight bolts which secure it to the unit.

4. Unscrew the sub-booster from the booster.

5. Remove the Rheinmetall bomb fuze.

6. Dispose of all explosive elements including the picric acid pellets from the bomb fuze pocket.

7. Procedure A - Magnetic Unit

(a) Remove the master switch in darkness as follows:

(1) Remove the six securing screws.

(2) Lift out the switch.

(3) Cover the hole with a watertight plug.

(4) Slit the cable to the Rheinmetall fuze; cut and tape each lead separately.

(b) Remove the unit from the mine as follows:

(1) Remove the eight nuts which secure the unit to the case.

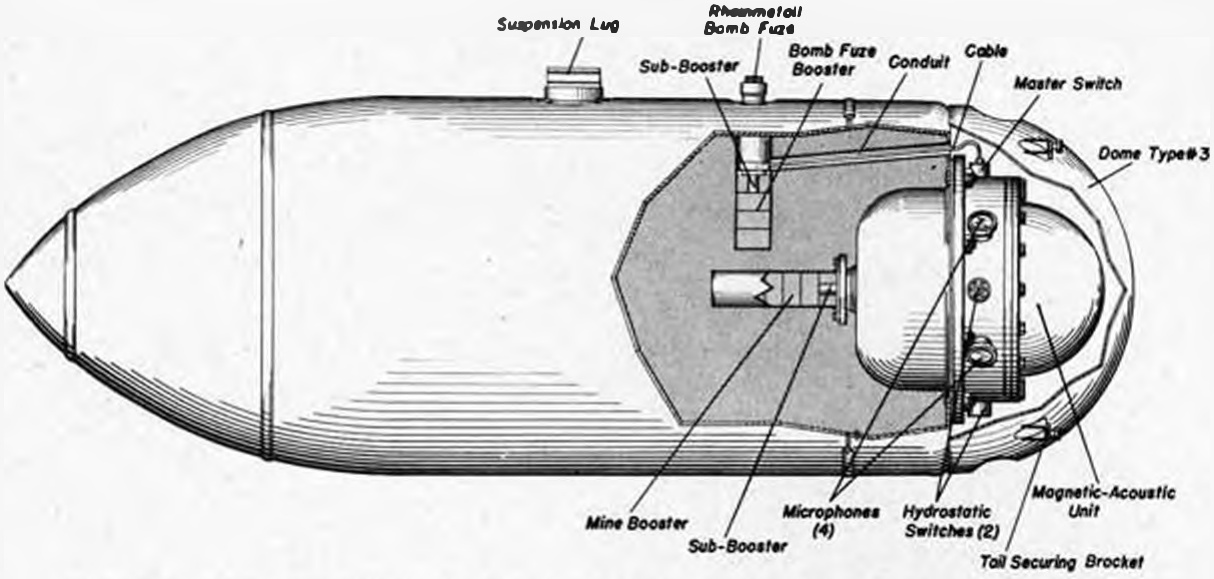


Fig. 66 - Mine Type CG fitted with Acoustic Magnetic Unit, Sectional View

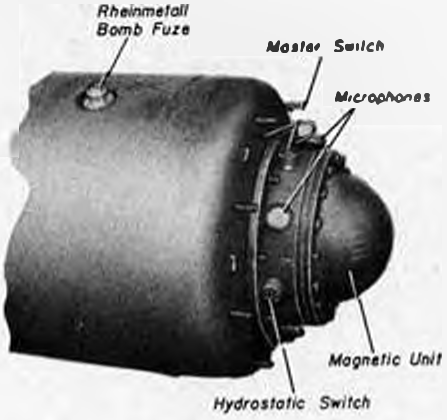


Fig. 67 - Mine Type CG fitted with Acoustic Magnetic Unit

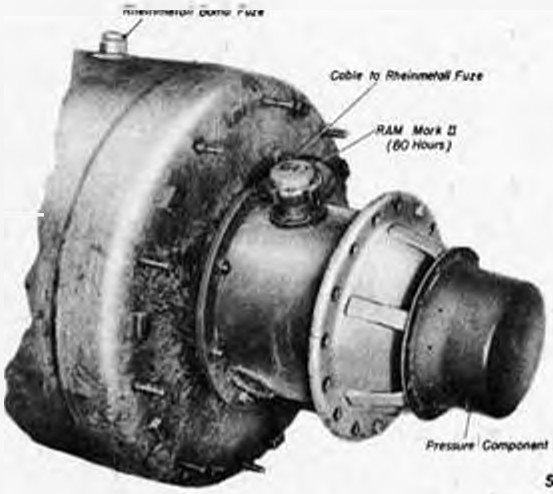


Fig. 68 - Mine Type CG fitted with Acoustic Pressure Unit

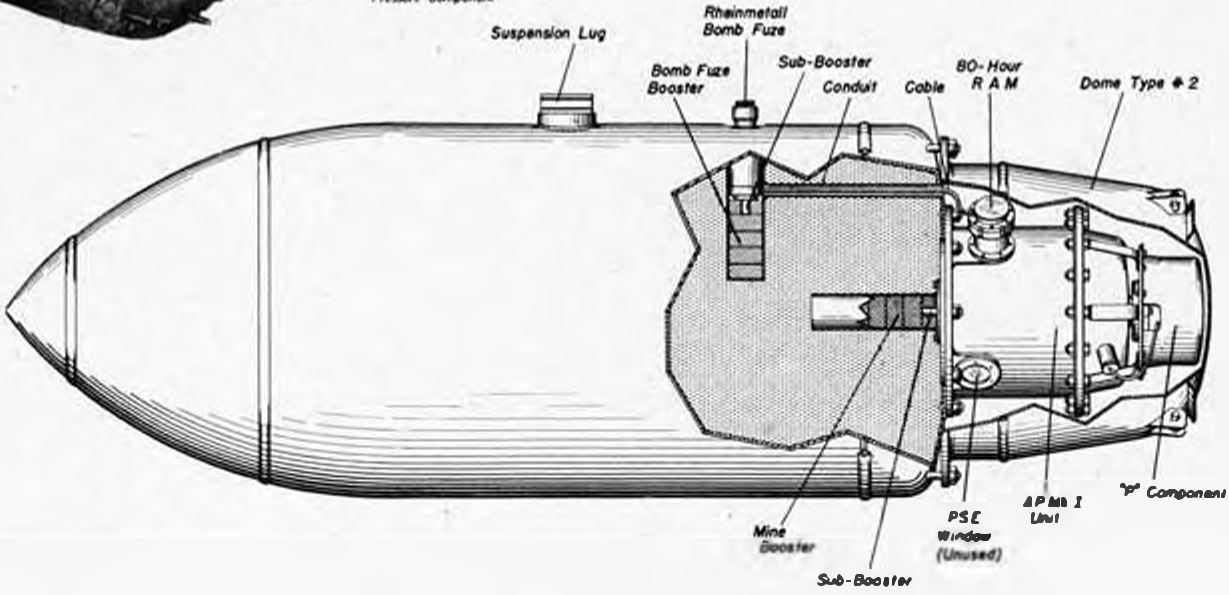


Fig. 69 - Mine Type CG fitted with Acoustic Pressure Unit, Sectional View

Mine Type GG^1 (GG^2, GG^3 and GG^4) (Cont'd.)

(2) Withdraw the unit carefully.

8. Procedure B - Acoustic Unit

(a) Remove the detonator as follows:

(1) Remove the nut in the center of the unit cover.

(2) Remove the detonator carrier by pulling on its spring with a small wire hook or other suitable tool.

(b) Remove the master switch as follows:

(1) Remove the six securing screws.

(2) Lift out the switch.

(3) Cut and tape separately each lead under the master switch.

(4) Cover the hole with a watertight plug.

(5) Slit the cable to the Rheinmetall fuze; cut and tape each lead separately.

(c) Remove the unit as in Procedure A above.

9. Procedure C - Acoustic-Pressure Unit

(a) Slit the double-conductor cable from the pressure unit to the acoustic unit; cut and tape each lead separately.

(b) Remove the master switch as in Procedure B above.

(c) Remove the unit as in Procedure A above.

10. Procedure D - Magnetic-Acoustic Unit

(a) Remove the magnetic sphere as follows:

(1) Remove the eight long bolts from the flange of the unit hemisphere. These bolts are located between the fittings on the unit frame.

(2) Separate the unit sphere from the unit frame. It may be necessary to pry it loose.

(b) Cut and tape separately the five leads which extend from the P.D.M. board to the detonator.

(c) Slit the cable from the Rheinmetall fuze to the master switch; cut and tape each lead separately.

(d) Remove the unit as in Procedure A above.

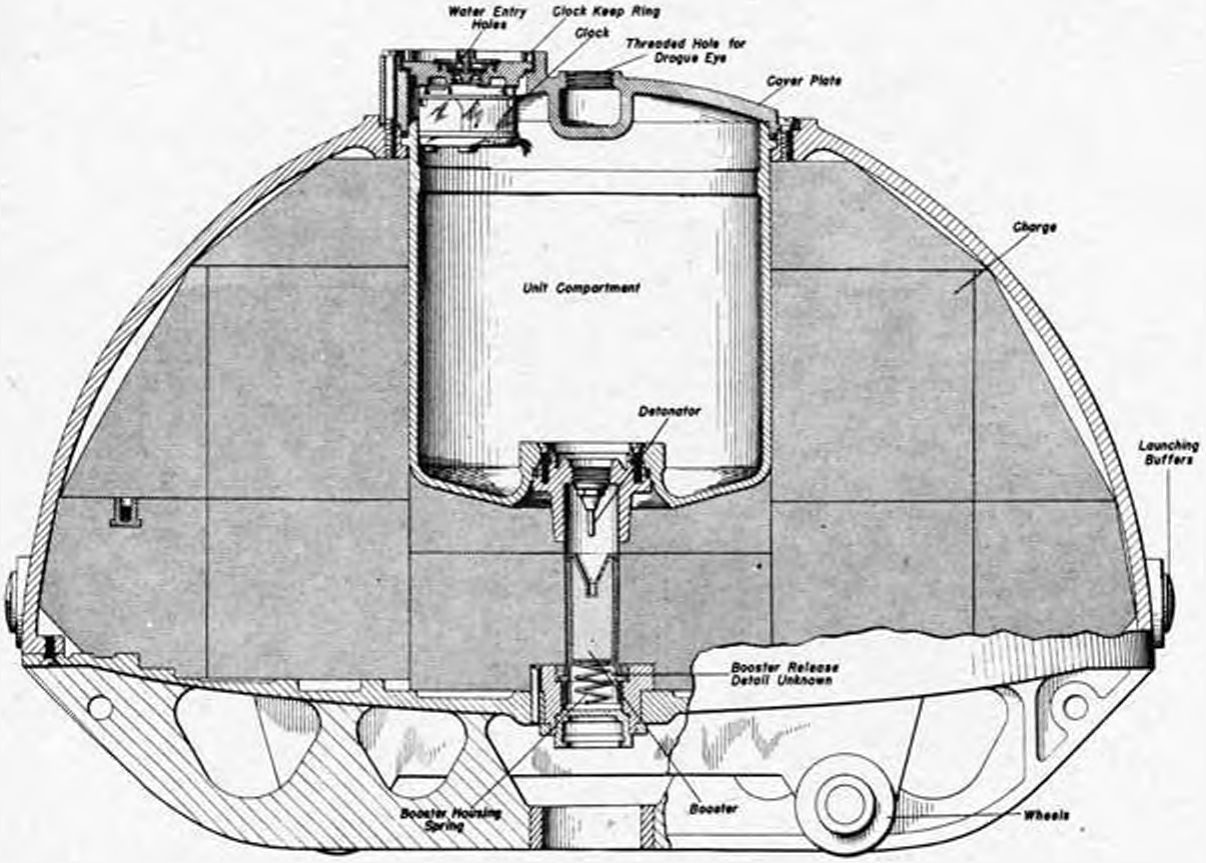


Fig. 70 - Mine Type GH, Sectional View

Fig. 71 - Mine Type GH

Mine Type GH

General

1. Ground, magnetic needle mine, laid by surface craft.
2. German designation, "RMA".
3. Defensive mine, for use against surface craft. May be used as a controlled mine.

Description

1. Case

Shape	Hemispherical. Supported by four-wheeled truck.
Color	Dark blue
Material	Aluminum
Diameter	50"
Height	39"
Charge	1200 lbs. block-fitted Hexanite.
Total weight in air	2700 lbs.

2. External fittings

Cover plate	18 3/4" diam., on top center of case, flush type, secured by 18 screws.
Drogue eye	Screwed into center of cover plate.
Hydrostatic clock	6" diam., 4" from drogue eye, secured by keep ring.
Inspection plug	1" diam., 12" from center of cover plate, screwed into case.
Launching buffers	Two pairs on bottom edge of hemisphere, 180° apart. The buffers in each pair are 18" apart.
Booster cover plate	4 1/4" diam., screwed into bottom center of case.

Operation

1. When the mine is launched, water pressure operates the booster release mechanism and, at a depth of 15 ft., depresses the clock spindle, starting the clock. The clock runs off its delay setting and the firing unit begins its arming cycle.
2. See Table #1 for possible firing units fitted.
3. No self-disarming devices are fitted.

Precautions

1. Since the mine may be rigged as a controlled mine, examine it carefully for a firing cable leading through a stuffing box where the hydrostatic clock is normally fitted to the cover plate. If none is observed, the mine must be assumed to be fitted with an influence firing unit.
2. No attempt should be made to remove the detonator in the field since it is sealed in place and may fire if handled roughly.

RMS

1. Remove the clock as in Mine Type GC.
2. Remove the booster cover plate and spring.
3. Remove the booster as in Mine Type GC.
4. Dispose of booster and charge, leaving the detonator in place.

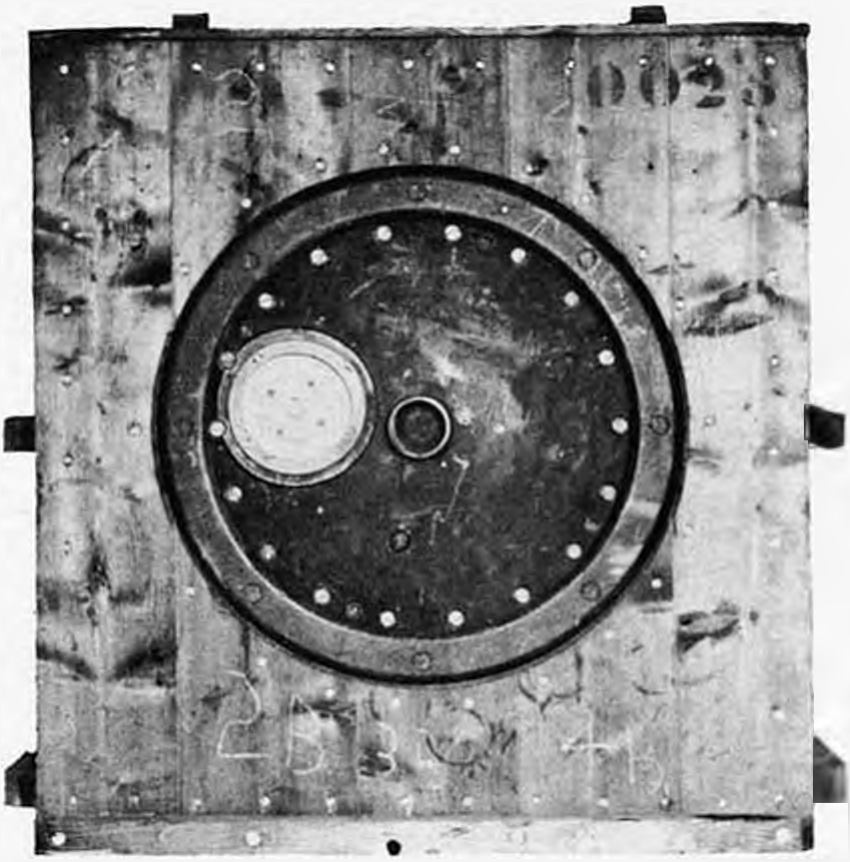


Fig. 72 - Mine Type GI

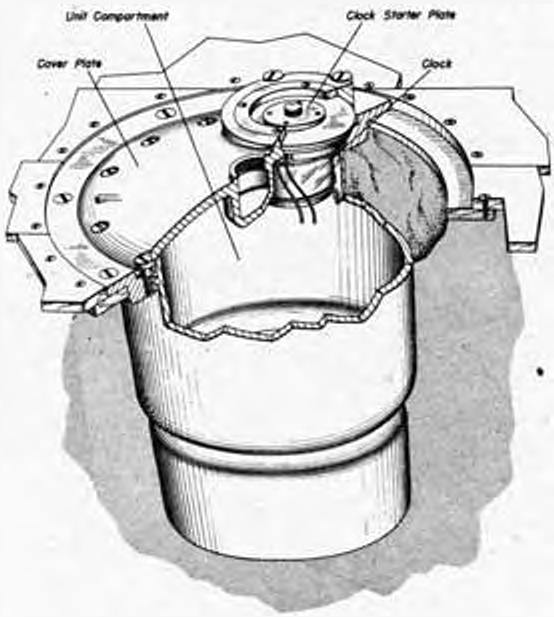


Fig. 73 - Mine Type GI Unit Compartment, Sectional View

Mine Type GI

General

1. Ground, magnetic needle mine, laid by surface craft.
2. German designation, "REH".
3. Defensive mine, for use against surface craft. May be used as a controlled mine.

Description

1. Case

Shape	Cuboidal. Supported by four-wheeled truck.
Color	Brown
Material	Wood
Length	3'5"
Width	3'1 1/2"
Height	3'10"
Charge	1935 lbs. cast Hexanite.
Total weight in air	2285 lbs. approx.

2. External fittings

Cover plate	18 3/4" diam., flush type, on side of case, secured by 18 screws.
Drogue eye	Screwed to center of cover plate. Consists of eye bolt, housing and space for soluble plug.
Booster cover plate	3" diam., aluminum, in center of side of case opposite cover plate.
Hydrostatic clock	6" diam., 4" from drogue eye, secured by keep ring.

3. The mine has been found with the cover plate on top and with varying weights of charge. It is believed that the exact dimensions of the case, weight of charge and other details will vary at the discretion of the local Mining Officer and will be limited only by his ingenuity and the type and amount of materials available.

Operation

1. When the mine is launched, it is oriented by a drogue during descent. Water pressure operates the booster release mechanism and, at a depth of 15 ft., depresses the clock spindle, starting the clock. The clock runs off its delay setting and the firing unit begins its arming cycle. Dissolution of a soluble plug releases the drogue.
2. See Table #1 for possible firing units fitted.
3. No self-disarming devices are fitted.

Precautions and RES

1. Same as Mine Type GH.

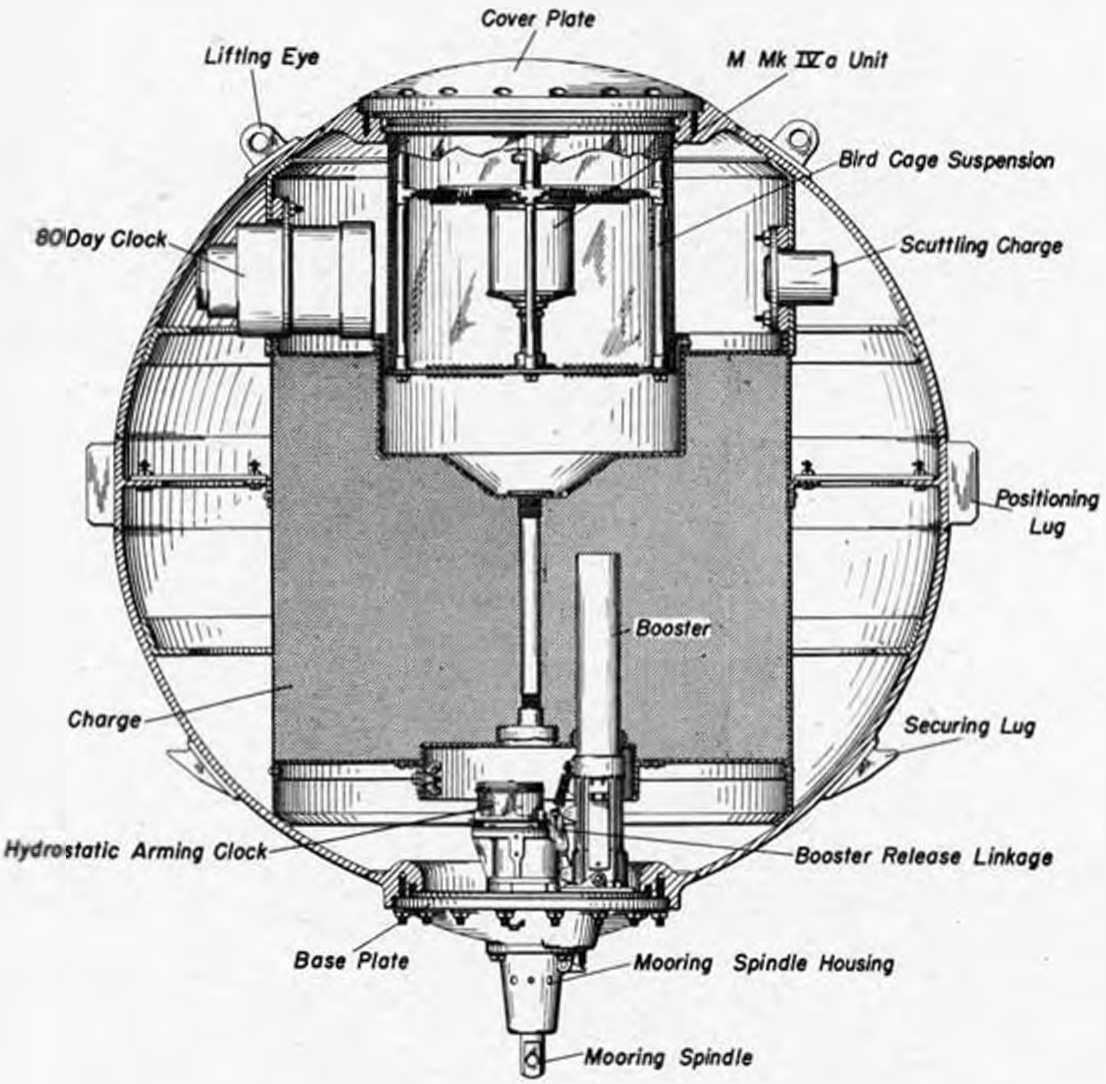


Fig. 74 - Mine Type GO^1, Sectional View

Fig. 75 - Mine Type GO^1

Mine Type GO[1] (GO[2] and GO[3])

General

1. Moored, magnetic needle mine, laid by submarine.
2. German designation, "EMF".
3. Offensive or defensive mine for use in maximum depth of water of 1445 ft. against surface craft.

Description

1. Case

Shape	Two hemispheres, joined by a 5" cylindrical mid-section.
Color	Dark green
Material	Aluminum.
Diameter	46"
Length	56"
Charge	750 lbs. block-fitted Hexanite.
Total weight in air	1290 lbs.

2. External fittings

Cover plate	19" diam., in center of upper hemisphere, flush type, secured by 18 bolts.
Base plate	15" diam., in center of lower hemisphere, lap-fitted, secured by 18 studs. Fitted with straight-shank mooring spindle and detonator strongback.
Lifting eyes	Two, 180° apart on upper hemisphere, 24 1/2" from center.
Anchor securing lugs	Three, angular-shaped, 120° apart on lower hemisphere, 29 1/2" from center.
Positioning lugs	Two, fin-shaped, 180° apart on cylindrical mid-section.

3. Mine Type GO[2] differs from Mine Type GO[1] as follows:

(a) Its case is designed for surface laying and is therefore of lighter construction; for use in maximum depth of water of 1650 ft.

(b) The base plate fitted, although similar to that fitted to GO[1], differs in that a soluble washer and a "V-Z" switch are fitted. The function of the latter is not known.

(c) Its case differs as follows:

(1)	Shape	Two hemispheres, joined by a 2-5" cylindrical mid-section.
(2)	Color	Light blue
(3)	Diameter	45"
(4)	Length	50" (approx.)
(5)	Charge	700 lbs. block-fitted Hexanite.
(6)	Total weight in air	1270 lbs.

(d) External fittings differ as follows:

(1)	Lifting eyes	Two, 60° apart on upper hemisphere, 20 1/2" from center.
(2)	Anchor securing lugs	Three, hook shaped; two on lower hemisphere, 160° apart, 11 1/2" from center; one on upper hemisphere, 28 1/2" from center.

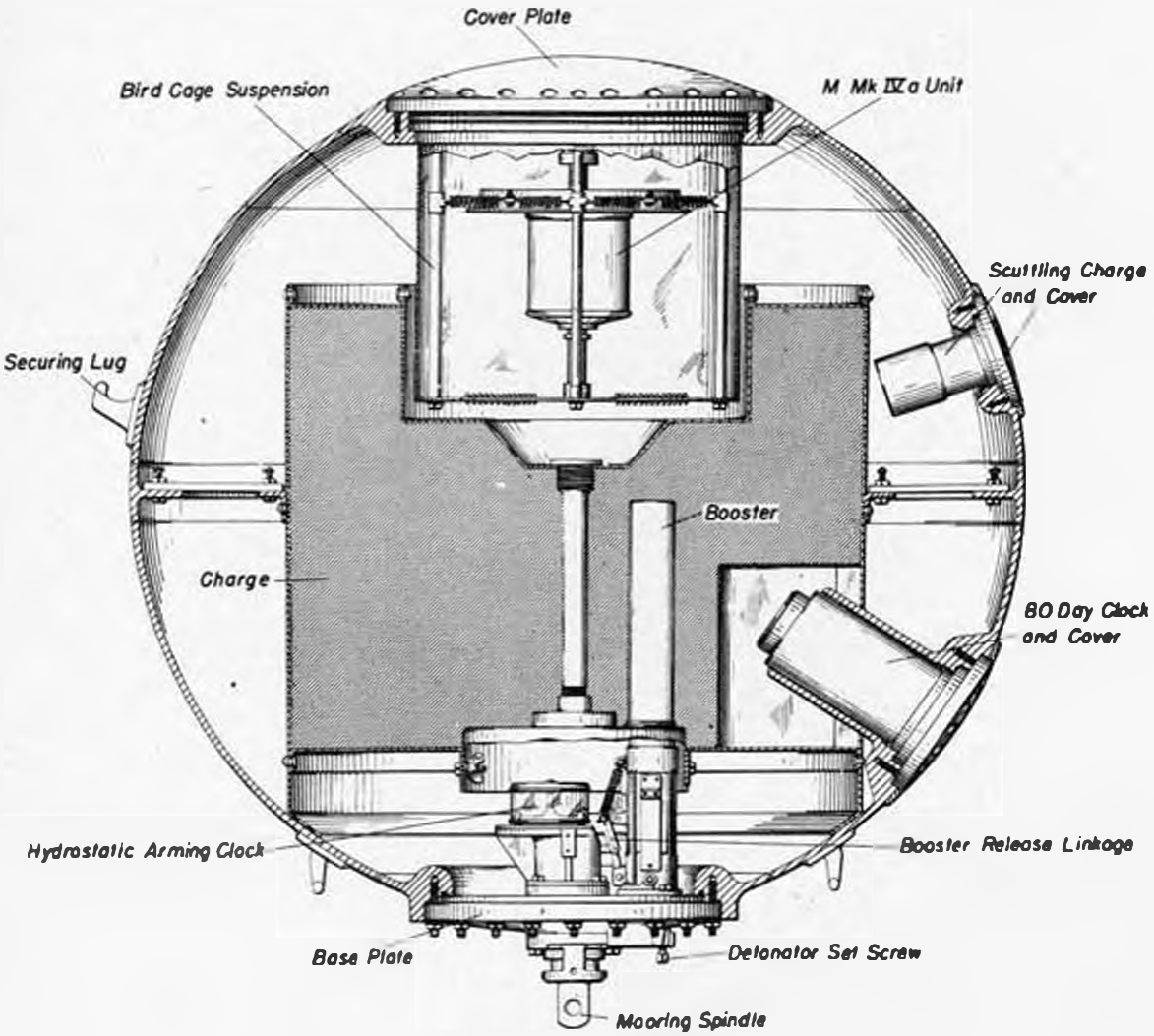


Fig. 76 - Mine Type GO^2, Sectional View

Fig. 77 - Mine Type GO^2

Mine Type GO^1 (GO^2 and GO^3) (Cont'd.)

(3)	Flooder plate	6" diam., on upper hemisphere, 28 1/2" from center, secured by 10 bolts.
(4)	80-day clock cover plate	8" diam., on lower hemisphere, in line with flooder plate, 2; 1/2" from center, secured by 10 bolts.

4. Mine Type GO^3 differs from Mine Type GO^2 as follows:

   (a) Its case is spherical, consisting of two hemispheres welded together.

   (b) Its flooder plate is located 26 1/2" from the center of the upper hemisphere. No 80-day clock cover plate is fitted, nor is there any other provision for fitting an 80-day clock.

Operation

1. Mine takes depth by loose-sight hydrostat system (GO^2 and GO^3, by plummet). Mooring tension pulls out the mooring spindle, tripping the booster release lever and releasing the locking balls from the clock-starting spindle. Water pressure depresses the clock spindle at a depth of 15 ft., starting the clock. The clock runs off its delay period and the unit starts its testing cycle (See Introduction for detailed operational analysis).

2. See Table #1 for possible firing units fitted.

3. The only self-disarming device is the 80-day clock which is designed to scuttle the mine if the clock stops at any time prior to completion of its set period or upon completion of its set period.

Precautions

1. See Introduction.

2. Do not tamper with the "V-Z" switch.

3. Note that the mine, if found floating, is extremely dangerous because of the fact that very slight motion is sufficient to fire the unit. This may either fire the main charge or the scuttling charge, depending on how much of the arming process has been completed.

EOS

1. Remove the detonator and booster as prescribed in the Introduction to Part IV, Chapter II.

2. Remove the base plate.

3. Cut and tape each lead separately, starting with the two yellow leads from the scuttling charge to the 12-hour testing clock.

4. Remove the scuttling charge as follows:

   (a) GO^1

      (1) Remove the cover plate.

      (2) Remove the firing unit and its bird-cage suspension.

      (3) Remove the scuttling charge from its securing bracket.

   (b) GO^2 and GO^3

      (1) Remove the flooder plate.

      (2) Unscrew the scuttling charge.

5. Dispose of all explosive elements.

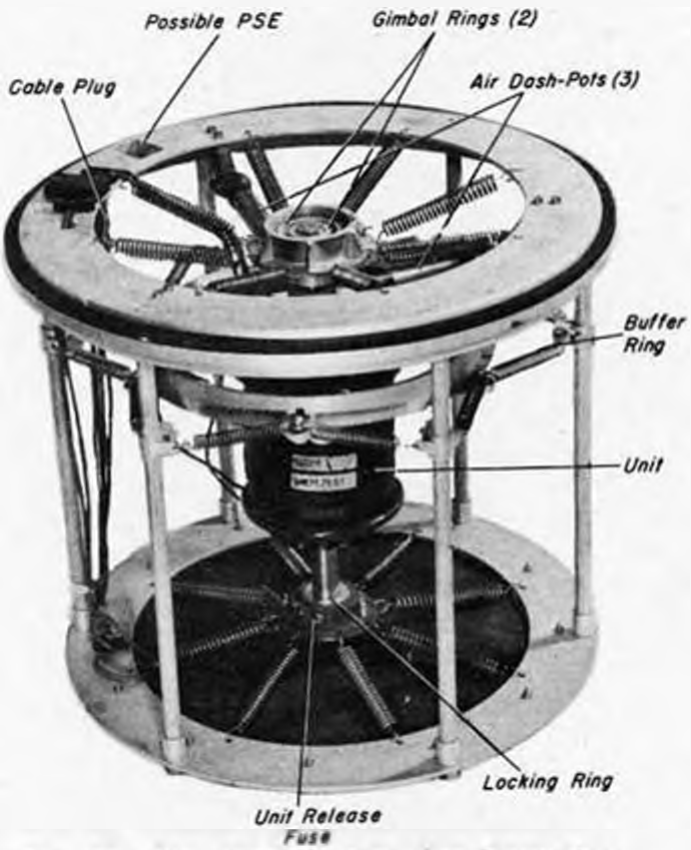


Fig. 78 - Mine Type GO, Bird Cage Suspension

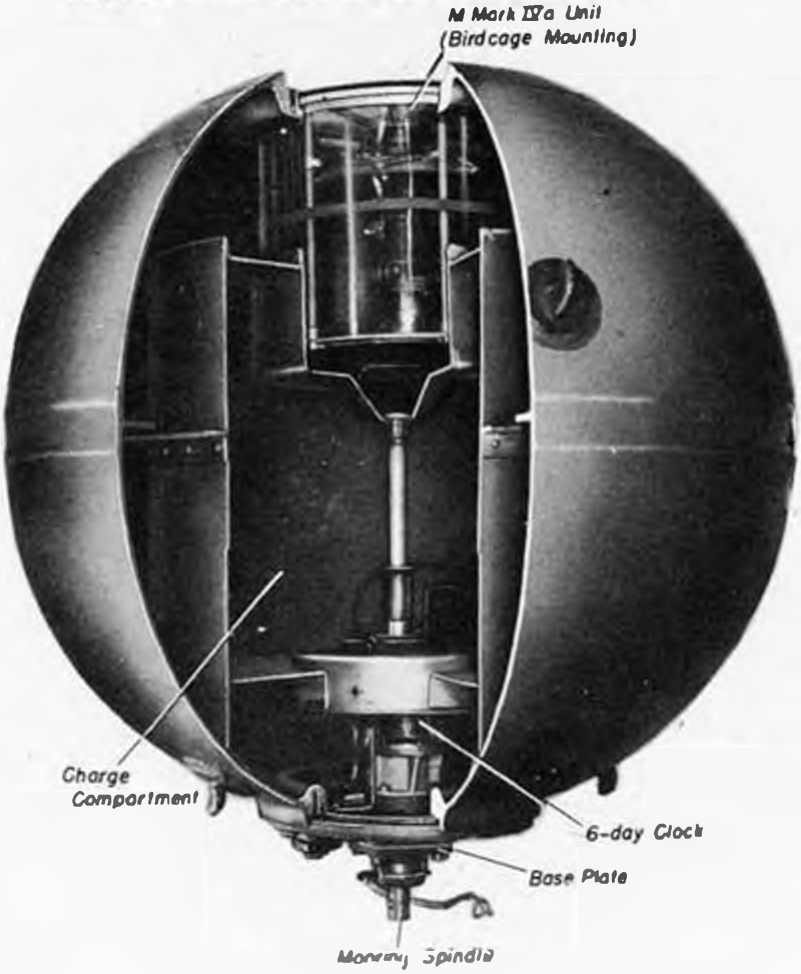


Fig. 79 - Mine Type GO, Cutaway View

Fig. 80 - Mine Type GC[1] on Anchor

Fig. 81 - Mine Type GC[1] Floating

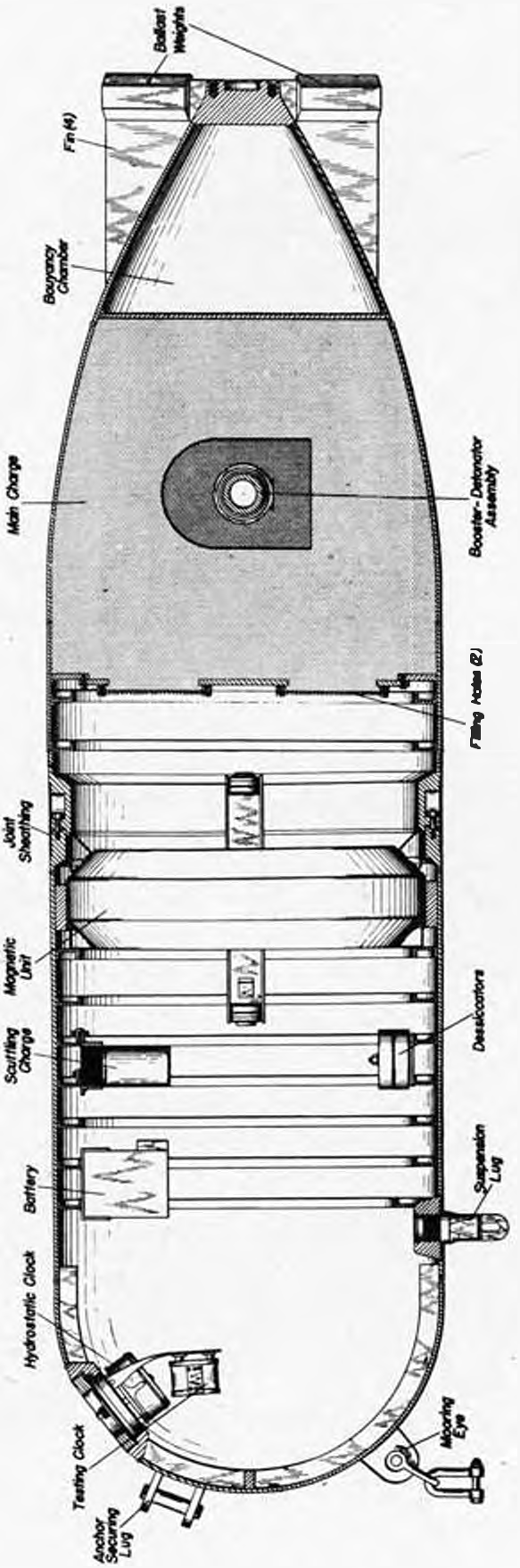


Fig. 82 - Mine Type GP, Sectional View

Mine Type GP

General

1. Moored, influence mine, laid by aircraft with parachute. Found to date with needle firing only although it may be fitted with the same firing units as Mine Type GC.

2. German designation, "LMF".

3. Offensive mine, for use against surface craft.

Description

1. Case

Shape	Cylindrical, with hemispherical nose and tapered, finned tail.
Color	Black
Material	Aluminum.
Diameter	26"
Length	
Overall	7'8"
Forward section	3'6"
After section	4'2"
After buoyancy chamber	2'7"
Charge	612 lbs. cast Hexanite.
Total weight in air	1035 lbs.

2. External fittings

Hydrostatic clock	6" diam., on nose, 11" from center, secured by keep ring.
Detonator cover plate	4" diam., 270° from top center line, 2'5" from after end, screwed to case.
Booster release mechanism	4" diam., 90° from top center line, 2'4" from after end, secured by keep ring.
Anchor securing lugs	Three, 120° apart, 8" from center of nose.
Mooring eye	On nose, 8" from center.
Suspension lug	180° from top center line, 10" abaft the nose.
Joining flange	3'6" abaft the nose, fitted with 36 evenly spaced stud holes. Covered by two sections of semicircular sheathing, 2" wide.
Anchor positioning lugs	Three, 105°, 195° and 345° respectively from top center line, 17" from center of nose.
Ballast weights	Six; one on end of each fin; one near end of each lower fin.
Fins	Four; 45°, 135°, 225° and 315° from top center line, at after end. 2'5" long, 10" wide.

Operation

1. When the mine is dropped, a safety fork is removed from the booster release mechanism, allowing the booster to house over the detonator. As the mine separates from its anchor, a pin is withdrawn from the hydrostatic clock. The mine then takes depth by loose-bight hydrostat system. Water pressure depresses the clock spindle at a depth of 15 ft., starting the clock. The clock runs off its delay period and the firing unit begins its testing cycle (See Introduction for detailed operational analysis).

2. See Table #1 for possible firing units fitted.

3. No self-disarming devices are fitted.

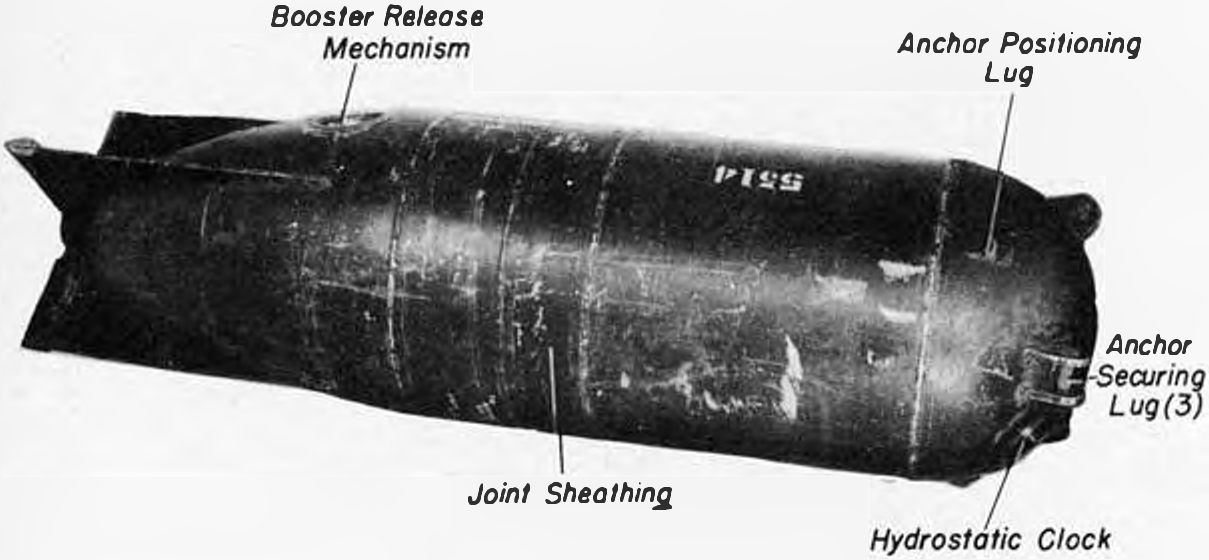


Fig. 83 - Mine Type GP

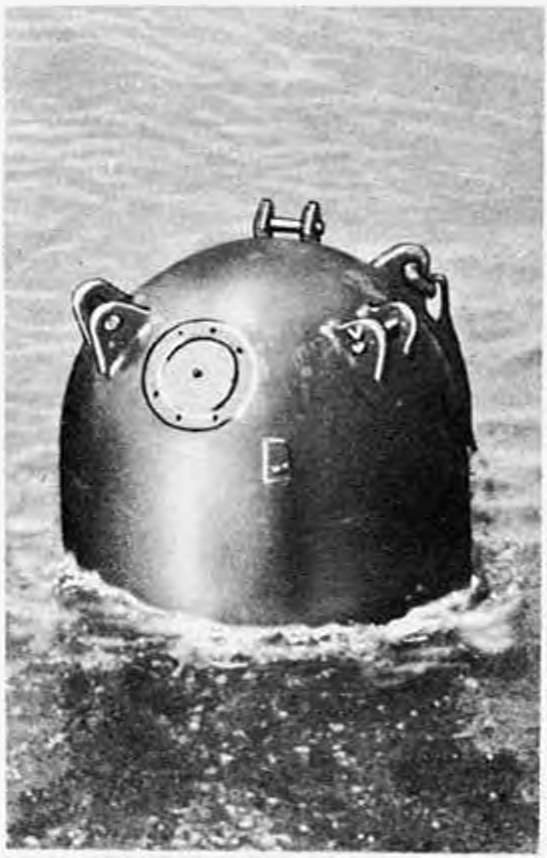


Fig. 84 - Mine Type GP, Floating

Mine Type GP (Cont'd.)

Precautions

1. See Introduction.
2. Stay clear of the forward buoyancy chamber as far as possible during R & S. A small scuttling charge is fitted thereto.
3. Note that the mine, if found floating, is extremely dangerous because of the fact that very slight motion is sufficient to fire the unit which may either fire the main charge or the scuttling charge, depending on how much of the arming process has been completed.
4. Although no booby traps have ever been encountered with this mine, it should be borne in mind that the piano wire booby trap fitted to Mine Type GT could easily be rigged to prevent separation of the case at the flange.

R & S

1. Remove the detonator as follows:
   (a) Remove the detonator cover plate.
   (b) Cut and tape each lead separately.
   (c) Using a pin spanner or other suitable tool, remove the detonator holder.
2. Remove the booster release mechanism and booster as in Mine Type GC.
3. Remove the clock as in Mine Type GC. This mine may be fitted with an additional 12-hour clock which is secured beneath the standard arming clock. Both clocks should come out together.
4. Unplug the battery. If this is impracticable, cut and tape separately each lead to the battery.
5. Slit the clock cable; cut and tape each lead separately.
6. Inspect the interior of the forward section through the clock pocket. If nothing unusual is observed, remove the aluminum band and the nuts in the joining flange.
7. Separate the case at the flange.
8. Remove the firing unit.
9. Cut and tape separately each lead to the scuttling charge.
10. Loosen the four bolts and remove the scuttling charge.
11. Dispose of all explosive elements.

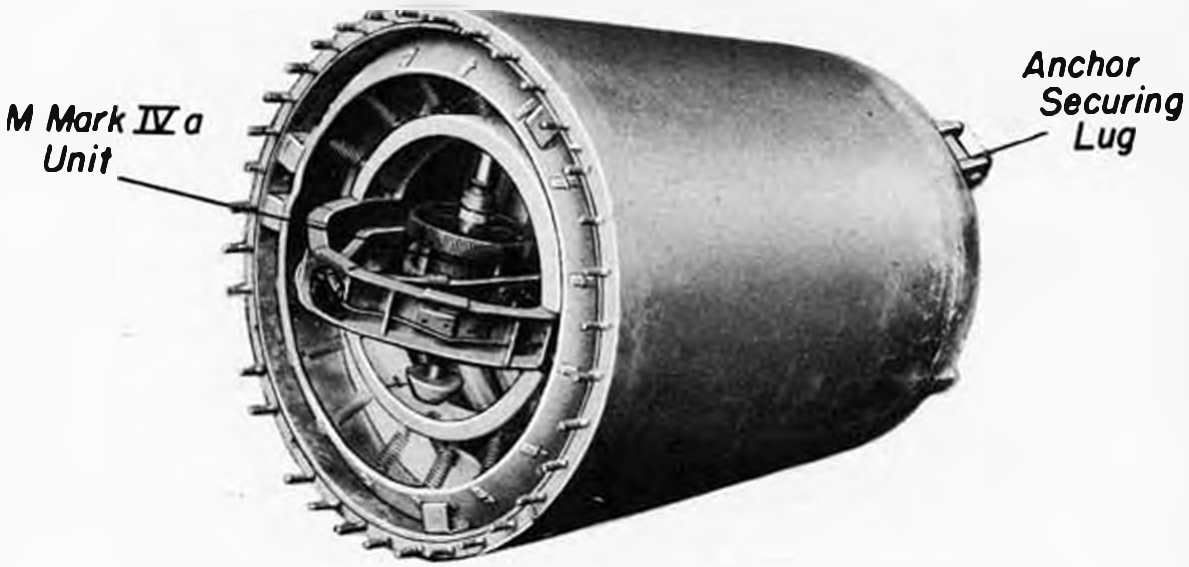


Fig. 85 - M Mk. IVa Unit as fitted to Forward Section of Mine Type GC

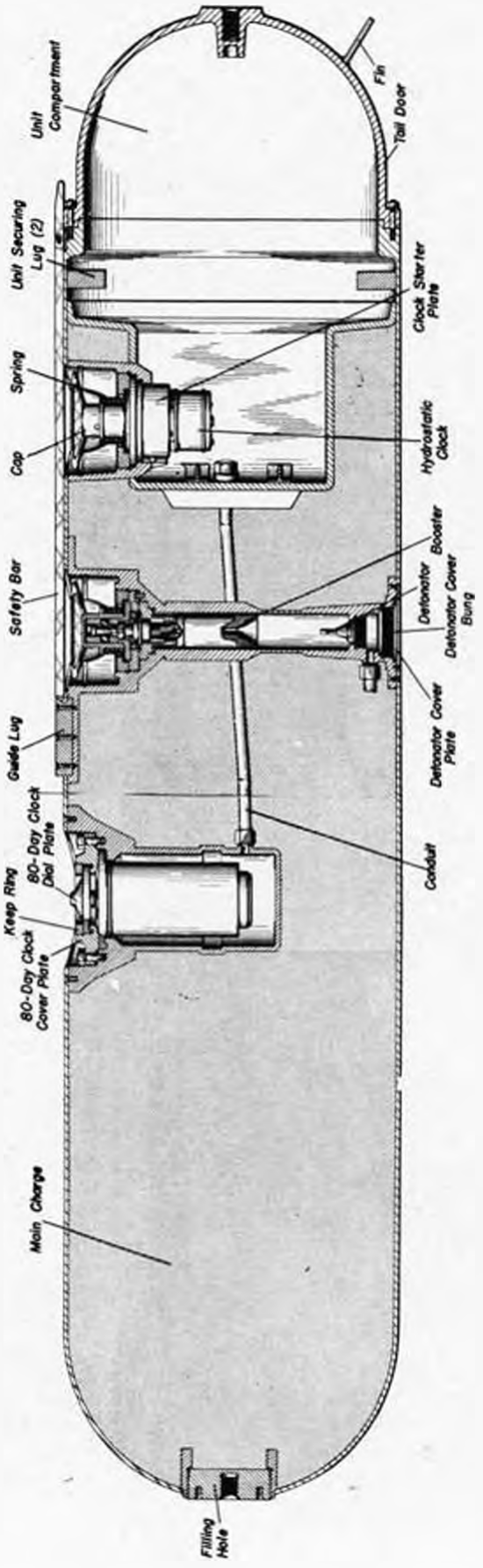


Fig. 86 - Mine Type Gd, Sectional View

Mine Type GS (GN)

General

1. Ground, influence mine, laid by submarine. Magnetic needle, acoustic or magnetic-acoustic firing.

2. German designation, "TMB".

3. Offensive mine, for use against surface craft.

Description

1. Case

Shape	Cylindrical, with hemispherical ends. Deflecting fin on tail door.
Color	Black or buff
Material	Aluminum.
Diameter	21"
Length	
Overall	7'7 1/2"
Case	6'6"
Tail door	13 1/2"
Charge	1221 lbs. cast Hexanite.
Total weight in air	1540 lbs.

2. External fittings

Positioning lug	On top center line, 3'9 1/2" abaft the nose.
Hydrostatic clock	6" diam., on top center line, 5' 6 1/2" abaft the nose, secured by keep ring.
Booster release mechanism	4" diam., on top center line, 4'5" abaft the nose, secured by keep ring.
80-day clock cover plate	8" diam., on top center line, 3'2" abaft the nose, secured by keep ring.
Detonator cover plate	4 3/4" diam., 180° from top center line, 4'6 1/2" abaft the nose, secured by keep ring.
Filling holes	Two; one, 5" diam., threaded to nose; one, 6" diam., 90° from top center line, 4' 6 1/2" abaft the nose; secured by four screws.
Safety bar clamp	On top center line at after end.

3. Mine Type GN differs from Mine Type GS as follows:

   (a) Its German designation is, "TMC".

   (b) It is 11'1 1/2" long overall, carries a charge of 2000 lbs. and weights 2300 lbs.

   (c) It is fitted with extra filling holes due to the larger charge although all essential fittings are positioned identically measured from the tail.

Operation

1. When the mine is launched, a spring-loaded safety bar is released from the top center line of the case, thereby unlocking the hydrostatic clock and booster release mechanism. Water pressure depresses the clock spindle and operates the booster release mechanism, respectively, at a depth of 15 ft., starting the clock and allowing the booster to house over the detonator. The clock runs off its delay setting and the firing unit begins its arming cycle.

2. See Table #1 for possible firing units fitted.

3. The only self-disarming device is the 80-day clock which may be fitted to sterilize the mine at the end of its set period by shorting out the battery.

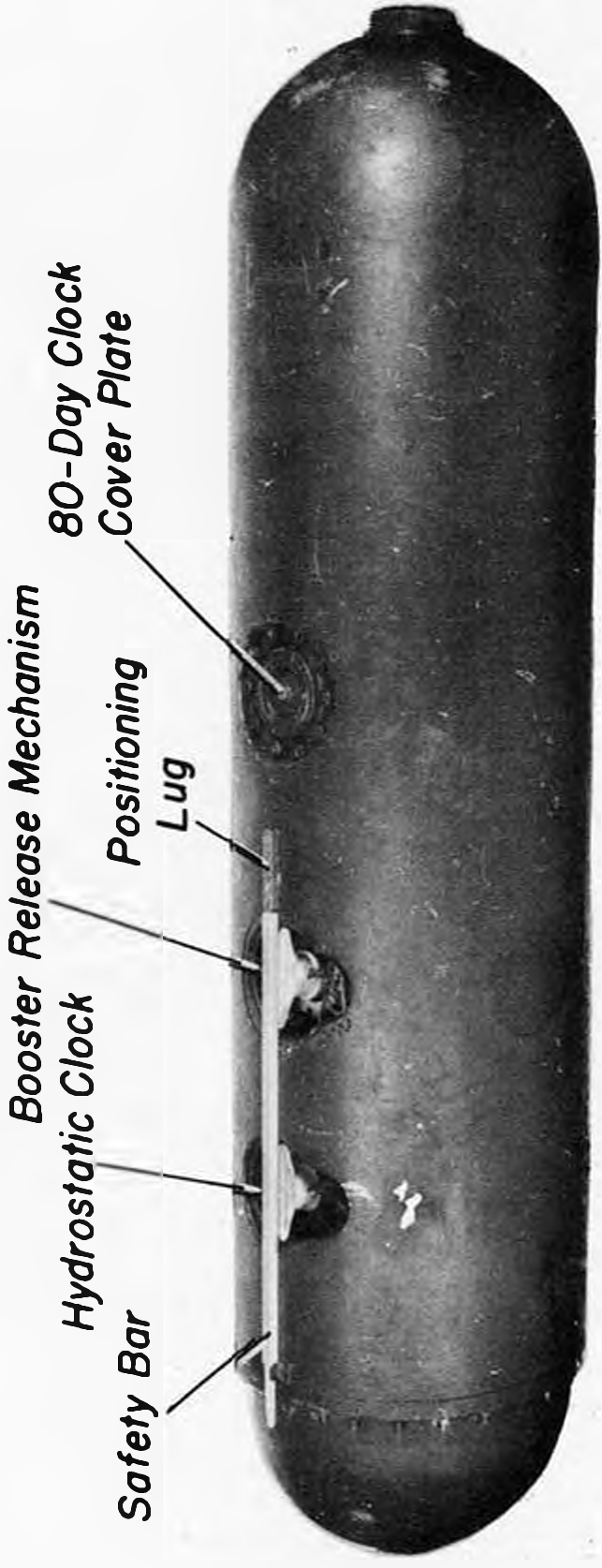


Fig. 87 - Mine Type G3

Mine Type GS (GN) (Cont'd.)

Precautions

1. See Introduction.
2. Do not remove the tail door of the mine. It is possible that either the Mark I or Mark III P.S.E. will be fitted thereto.

RNS

1. Remove the detonator, booster and clock as in Mine Type GC.
2. Remove the 60-day clock as follows:
   (a) Remove the keep ring.
   (b) Remove the bolts or nuts securing the clock dial cover.
   (c) Remove the clock (if fitted).
3. Dispose of detonator, booster and charge.

Fig. 88 - Mine Type GN

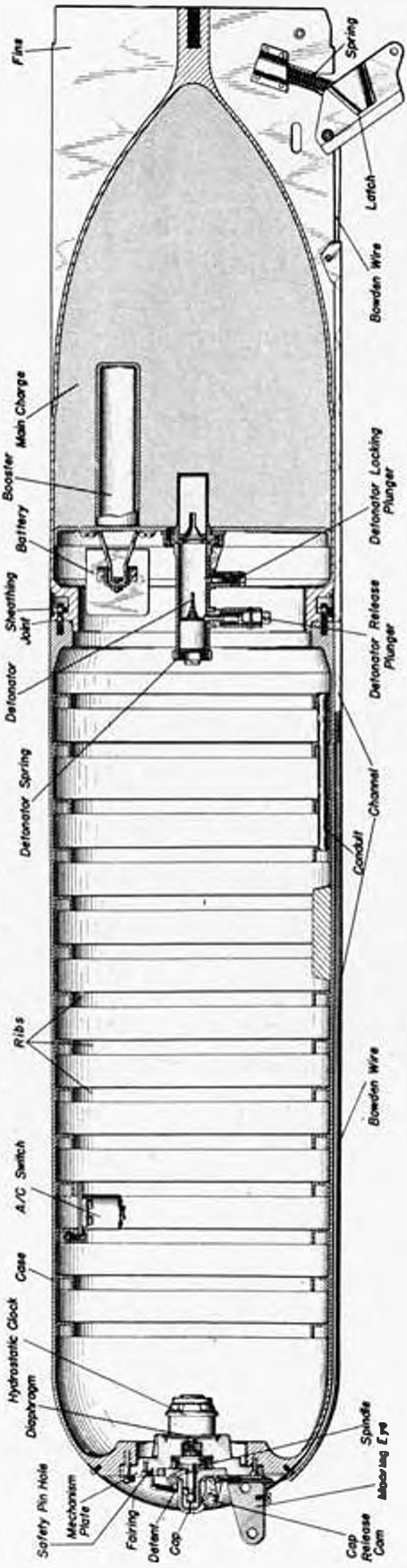


Fig. 89 - Mine Type CT, Sectional View

Mine Type GT

General

1. Moored, magnetic needle mine, laid by submarine.

2. German designation, "TMA".

3. Offensive mine, for use in maximum depth of water of 850 ft. against surface craft.

Descrpption

1. Case

Shape	Cylindrical, with hemispherical nose and tapered, finned tail.
Color	Black or dark green.
Material	Aluminum.
Diameter	21"
Length	9'3 1/2"
Charge	475 lbs. cast Hexanite.
Total weight in air	874 lbs.

2. External fittings

Bowden wire channel	180° from top center line, extends full length of case.
Positioning lugs	Five, on nose, 30°, 120°, 210°, 270°, and 300° respectively from top center line, 7" from center.
Securing lugs	Two, on nose, 90° and 270° respectively from top center line, 7" from center.
Mechanism plate	11" diam., on nose, secured by 15 studs. Covered by fairing, 16" diam., which is cut-away to permit access to the mooring eye and securing lugs.
Safety latch	On lower fin, in line with bowden wire channel, spring-loaded, controls bowden wire.
Joining flange	5'6" abaft the nose, covered by two sections of semicircular sheathing, 2" wide.
Fins	Four; 0°, 90°, 180° and 270° from top center line, at after end; 2'4" long, 9" wide.

3. When the mine is fitted with the Mark Ia P.S.E., a painted band, 4" long, may be present on the case at the joint between the case and tail section. As this marking is made with water soluble paint, it rarely will serve as a positive indication of the presence or absence of a P.S.E.

Operation

1. When the mine is launched, the safety latch springs out, pulling the bowden wire. This unlocks the spindle of a hydrostatic clock. Water pressure depresses the clock spindle at a depth of 15 ft., starting the clock. The clock spindle, once depressed, is locked in. The clock runs off its delay setting, allowing the detonator to house in the booster, and the firing unit begins its arming cycle.

2. See Table #1 for possible firing units fitted.

3. No self-disarming devices are fitted.

Precautions

1. Do not remove the mechanism plate or attempt to separate the case and tail sections. These points of entry to the case may be guarded by a P.S.E.

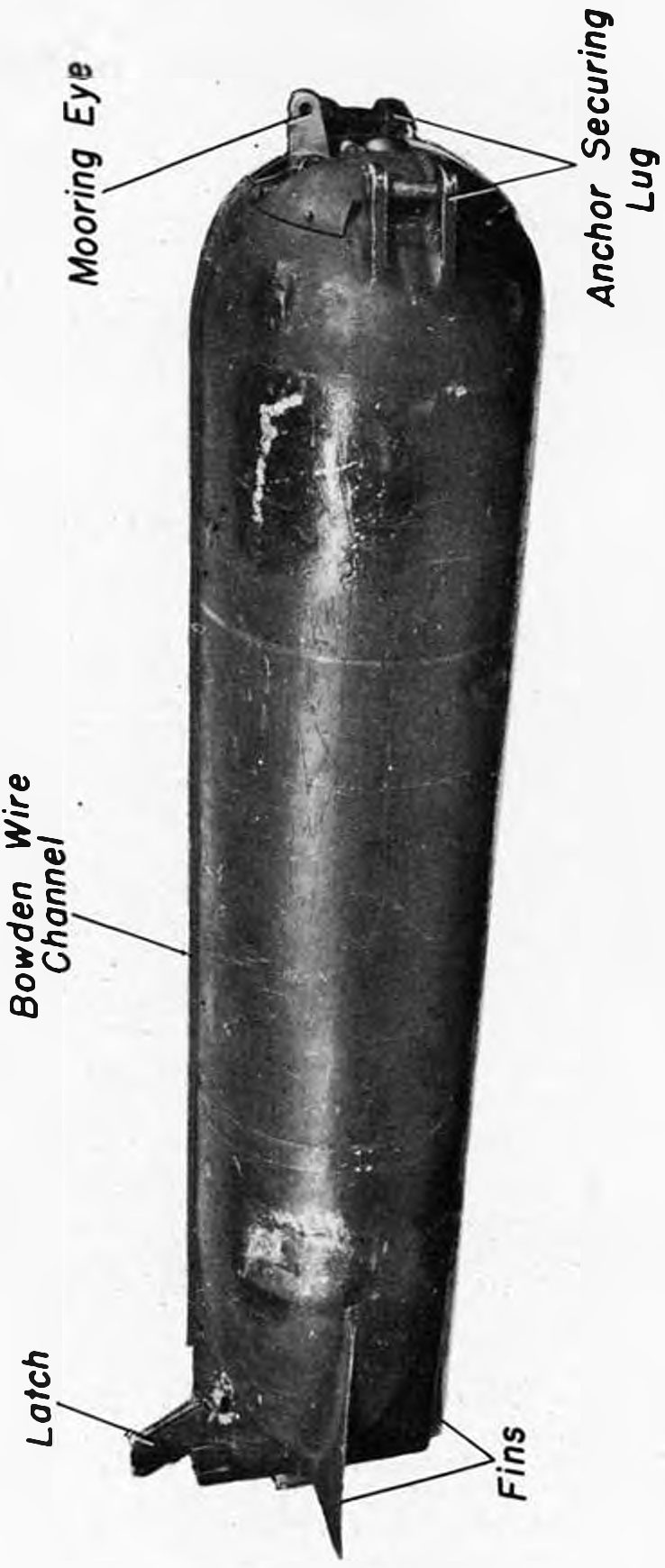


Fig. 90 - Mine Type CT

Mine Type CT (Cont'd.)

2. Do not attempt RMS by disassembly until after determining, as prescribed below, whether or not a P.S.E. is fitted.

RMS

1. Cut a hole approximately 4" in diameter in the mine case 8" abaft the nose and 160° from the bowden wire channel, looking from aft forward. If a P.S.E. is fitted, the following fittings will be visible:

   (a) Two P.S.E. switches mounted on a bracket directly under the hole. Each switch has two wire leads which run to

   (b) A special P.S.E. terminal strip mounted on a bracket above the clock. If no P.S.E. is fitted, proceed with step 3.

2. Cut the four P.S.E. switch leads and cut the slack wire lanyard to the smaller P.S.E. switch. Do not cut any taut wires.

3. Slit the blue clock cable; cut and tape each lead separately.

4. Carefully inspect the inside of the mechanism plate for P.S.E. fittings. If none are observed, remove the mechanism plate and inspect the interior.

5. Cut three small inspection holes in the case, 120° apart, just forward of the joining flange and inspect the surface of the joint carefully.

6. If no P.S.E. fittings are observed, separate the two sections of the case.

7. Remove the detonator release mechanism and separate the detonator and booster.

8. Remove the firing unit and separate the P.S.E. detonator, (if fitted) from its charge.

9. Dispose of all explosive elements.

Fig. 91 - Mine Type CT, Floating

MINE DISPOSAL HANDBOOK

PART IV

GERMAN UNDERWATER ORDNANCE

. . . . . .

CHAPTER 2

GERMAN CONTACT MINES

MARCH 1, 1945

CONFIDENTIAL

Designation	How Fired	Laid By	Type Base Plate	Diameter (in)	Length (in)	Type and Wt. of Charge (lbs)	Total Wt. (lbs)	Remarks
GJ^1, GJ^2 GJ^3	Chem. Horn	S/C	None	15	15	25 - approx.	65	
GK	Chem. Horn	S/C	None	47	47	162 - Hexanite	2090	
GL	Contact Antenna	Hand	None	15	81	25 - TNT	76	
GL-P	"	Hand	None	17 3/4	66 1/4	44 - TNT	66	
GM	Le Clanche-cell Horn	A/C or S/C	Special	26	44	120 - Hexanite	380	
GQ	Chem. Horn	S/C	Type D	29 1/4	29 1/4	88 - Hexanite	350	
GR	Chem. and Switch Horns	S/C	Type E	33 1/2	33 1/2	90 - Hexanite	420	
GU	Chem. Horn	S/C or Sub	None	34	46	360 - Hexanite	870	
GV	Chem. Horn	S/C	Type C	40	40	330 - Hexanite	775	Addition of electrode plate and antenna connector in place of cover plate differentiates from GX*. May have 80-day clock and flooder.
GV*	Chem. Horn	S/C	Type C	46	48 1/2	660 - Hexanite	1390	Addition of GV antenna fittings, differentiates from GY*.
GW	Chem. Horns	S/C	None	34	34	150 - Hexanite or TNT	375	
GX	Chem. Horn	S/C	Types A & B (obsolete) C (service)	40	40	330 - Hexanite	775	
GX*	Chem. Horn	S/C	Type C	40	40	330 - Hexanite	775	Addition of cover plate flooder and 80-day clock differentiates from GX.
GY	Chem. Horn	S/C	Types A & B (obsolete) C (service)	46	48 1/2	660 - Hexanite	1390	
GY*	Chem. Horn	S/C	Type C	46	48 1/2	660 - Hexanite	1390	Differs from GY as GX* differs from GX.
GZ	Chem. and Switch Horns	S/C	Type D	32	32	66 - Hexanite	350	

Table 1 - German Contact Mines

Introduction

1. The generalities drawn herein apply only to moored, contact mines. Each ground or drifting contact mine will be covered separately in the body of this chapter.

2. All German, moored, contact mines are spherical or have cases consisting of two hemispheres joined by a cylindrical mid-section. The cases are of mild steel, vary in diameter from 26" to 46" and are loaded either with cast or block-fitted Hexanite. Chemical and switch horns are employed, either singly or in combination.

3. Mines of this type usually depend on mooring tension for arming and disarming, these processes being controlled through the mooring spindle on the base plate. To date, five different types or base plates have been recovered and are arbitrarily designated Types A, B, C, D and E. The base plate fitted to Mine Type GM, a special type, is not considered here. General characteristics, common to all five types, are given below:

   (a) All base plates are fitted with straight-shank mooring spindles which are withdrawn by mooring tension against tension of a coil spring mounted on the inside of the base plate.

      (1) The withdrawn or retracted condition can be determined by checking the alignment of the respective safety pin holes in the mooring spindle and the mooring spindle boss.

         (i) If the holes are aligned the spindle has retracted.

         (ii) If the holes are not aligned the spindle is fully or partly withdrawn.

      (2) Withdrawal of the mooring spindle performs the following functions:

         (i) It trips the booster release lever.

         (ii) It arms the SDM.

         (iii) It closes the mooring safety switch.

   (b) The booster release lever is mounted in the booster tube and is connected, by means of a mechanical linkage, to the mooring spindle. The lever holds the booster in the "Safe" position above the detonator until the mooring spindle is withdrawn, at which time the lever is tripped and the booster is freed to drop over the detonator.

   (c) The SDM may be either an electrochemical internal horn (often referred to as the "eighth horn") used in the Type C base plate, or a rotary, two-position switch used in the Type B or D base plates.

      (1) The horn-type SDM is mounted in a casting secured to the inside of the base plate by four bolts. Its operation is controlled by a mechanical linkage connected to the mooring spindle. Withdrawal of the spindle allows a cocking pin to move to the armed position and retraction of the spindle pivots the cocking pin, and releases a spring-loaded firing pin which shatters the electrolyte ampoule. The electrolyte then runs into a battery energizing it and producing a momentary current sufficient to fire the detonator and main charge, if the SDM is in the firing circuit.

      (2) The switch-type SDM is mounted on a bracket on the inner end of the mooring spindle and is connected to the base plate by a mechanical linkage. Withdrawal of the spindle carries a small pin into position behind a cam. Retraction of the spindle carries the cam back with the pin and closes the switch.

   (d) The various base plates use the following types of mooring safety switches:

      (1) With base plate Type A - a switch consisting of four contacts, two of which are mounted on the mooring spindle and two on the mooring spindle housing. Withdrawal of the spindle makes the contacts, arming the horn circuit. Retraction of the spindle breaks the contacts, disarming the horn circuit.

Table 2 - Standard German Base Plates

Base Plate	Where Used	Diameter (in)	Material	Mooring Spindle Delay	Type of Booster Tube	SDM	How Secured	Location of "A-E" Switch	Remarks
Type A	GX and GY	15	Gunmetal	Two oil dash pots	8 1/2" long, open at top.	Chemical horn mounted in top of mooring spindle tube	Secured by 20 bolts	135° from booster tube	Considered obsolete
Type B	GX and GY	15	Steel	Two oil dash pots	18" long, closed at top.	Rotary two position switch	Secured by 19 bolts	135° from booster tube	Considered obsolescent
Type C	GX and GY	15	Steel	Soluble plug	18" long, closed at top.	Chemical horn mounted beside mooring spindle	Secured by 20 bolts	90° from booster tube	Fitted with lower antenna gland 180° from booster tube. Gland blanked off with a hexagonal cap if no antenna is fitted.
Type D	GZ	11 1/2	Steel	Two oil dash pots	15" long, closed at top.	Rotary two position switch	Secured by 19 bolts	135° from booster tube	
Type E	GR	11 1/2	Steel	Soluble plug	15" long, closed at top.	None	Secured by 18 bolts	90° from booster tube	Fitted with Tombac firing device gland, 180° from "A-E" switch and with mooring spindle locking detent, 180° from booster tube.

(Introduction, Cont'd.)

(2) With base plates Types B and D - a two-position rotary switch mounted on a bracket on the mooring spindle and connected to the base plate by a mechanical linkage. Withdrawal of the mooring spindle closes the switch, arming the horn circuit. Retraction of the spindle opens the switch, disarming the horn circuit.

(3) With base plate Type C - a switch consisting of two main parts: a cylindrical, bakelite housing mounted on the base plate and enclosing the inner end of the mooring spindle; two bakelite-covered brass cylinders mounted one above the other on the inner end of the mooring spindle. The latter are fitted with brass contact pieces and the former with spring-loaded contacts. Withdrawal of the spindle pulls down the two cylinders with respect to the housing so that the contact pieces make their respective contacts, arming the horn and SDM circuits. Retraction of the spindle breaks the upper set of contacts, disarming the horn circuit. The lower set is in the SDM circuit and remains closed, being locked by a spring-loaded detent.

(4) With base plate Type E - a switch consisting of eight contacts, four of which are mounted on a cross-head on the mooring spindle and four on the mooring spindle housing. Withdrawal of the spindle makes the contacts, arming the horn circuit. Retraction of the spindle breaks the contacts, disarming the horn circuit. However, the mooring spindle is designed to lock in the "out" position.

(e) A detonator carrier is fitted in a well located externally on the base plate beside the mooring spindle and is held in place by a strongback and a single set screw. The screw fits into a boss on the detonator carrier and is secured by a "U" pin which fits into an annular groove on the set screw. Two spring-loaded contacts are mounted on the inside of the base plate, extending vertically upward and then bending at an angle of 90° to enter the booster tube. These contacts make similar contacts on the detonator carrier when it is inserted in the booster tube.

(f) A spindle which controls an internal, two-position rotary switch is mounted at either 90° or 135° from the detonator carrier. A red arrow is stamped on its face to indicate the switch setting and the letters "A" and "E" are stamped on the part of the base plate adjoining. This switch is in the circuit of the SDM except in base plate Type E where it is in the circuit of the "tombac" anti-sweep device. If the arrow points to "A" (painted white), the switch is open and the SDM or "tombac" is not in the circuit. If the arrow points to "E" (painted red), the SDM or "tombac" is in the circuit and both should operate as designed.

(g) A soluble plug holder may be found alongside the mooring spindle, secured by a strongback. A black, plastic disc, about 1/2" in diameter, is fitted in the strongback. Withdrawal of the mooring spindle upon dissolution of the soluble plug pushes this disc out of the strongback. Note that the presence or absence of this disc provides a positive means of determining whether or not the mine has ever armed.

(h) In some cases, the following additional base plate fittings may be found:

(1) A gland for connecting a lower antenna or "tombac" anti-sweep device.

(2) A slotted screw plug for applying a circuit tester.

(i) See Table No. 2 for further base plate details and dimensions.

4. The following procedure should be employed to remove detonators and boosters from mines which take base plates of the type described above:

(a) Unscrew the set screw in the center of the detonator carrier strongback until the seal is broken and the detonator carrier starts to withdraw.

(b) Pull out the "U" pin.

(c) Remove the set screw and swing the strongback clear.

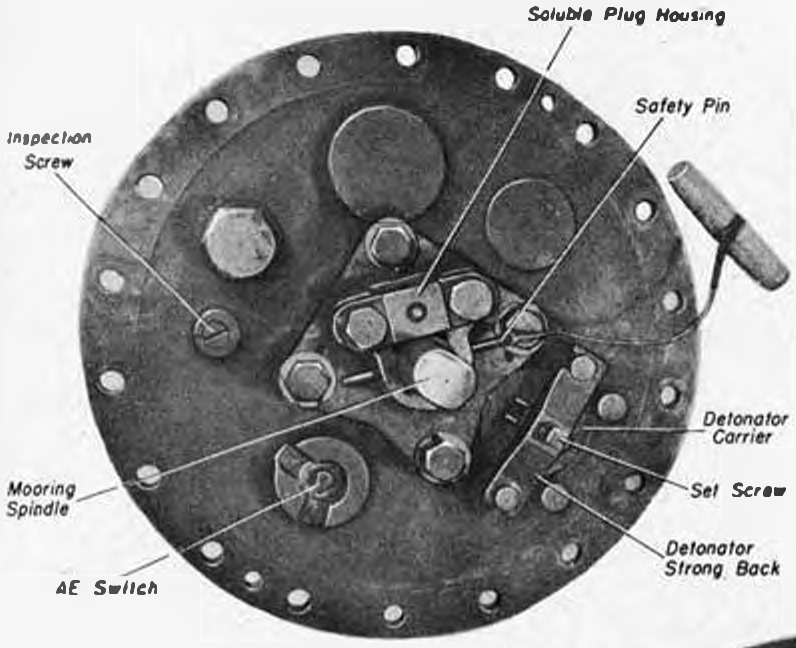


Fig. 1 - Base Plate Type C

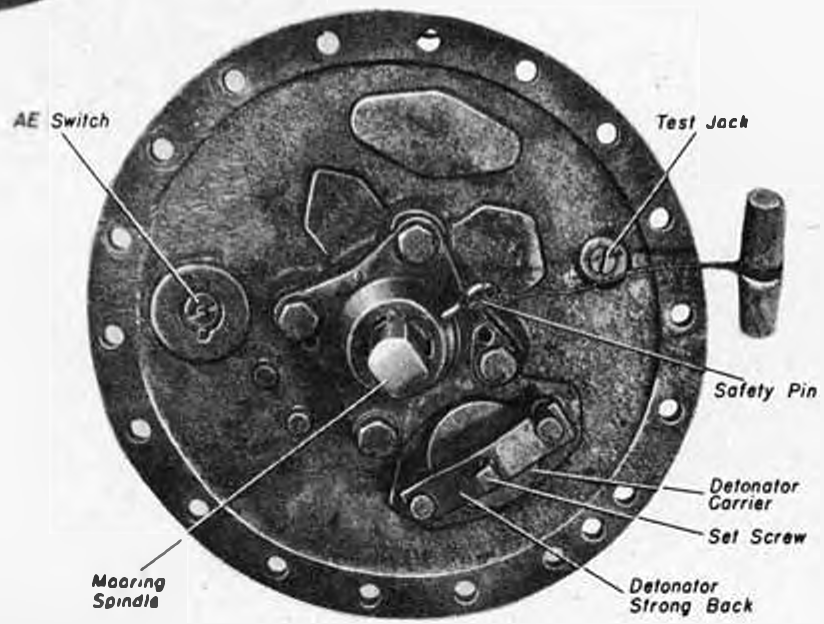


Fig. 2 - Base Plate Type D

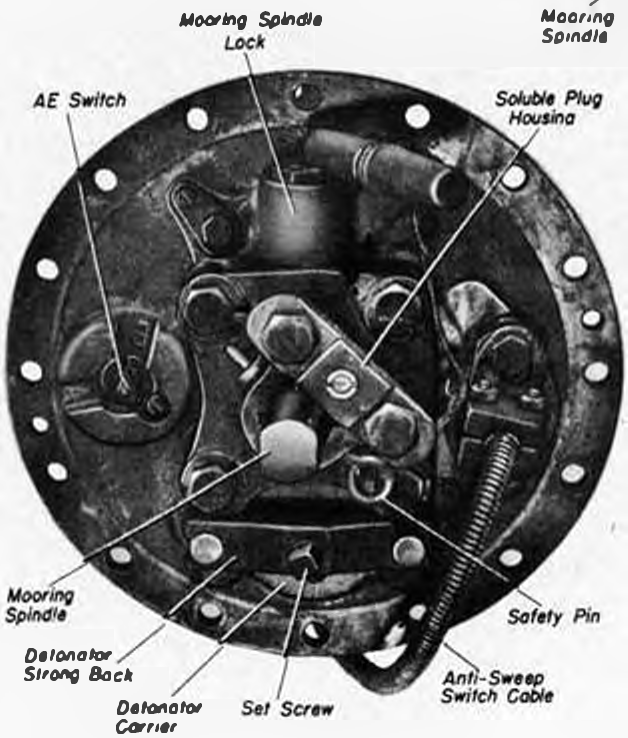


Fig. 3 - Base Plate Type E

(Introduction, Cont'd.)

(d) Remove the detonator carrier.

(e) Press in the two spring-loaded contacts and remove the booster. If such a procedure is impractical, remove the base plate and then remove the booster.

5. The following general precautions should be observed when dealing with all German contact mines:

(a) Do not bend or damage the horns.

(b) Keep clear of all antennae, snag lines or "tombac" anti-sweep devices which may be fitted.

(c) Do not move or jar the mine except from a safe distance.

(d) Keep clear of all flooder plates until the position of the mooring spindle has been determined. All flooder devices are rendered inoperative upon retraction of the mooring spindle.

(e) Check the mooring spindle and "A-E" switch. Do not attempt RMS except in extreme emergency:

(1) If the mooring spindle is withdrawn and a safety pin cannot be inserted in the hole provided.

(2) If the "A-E" switch is set on "E".

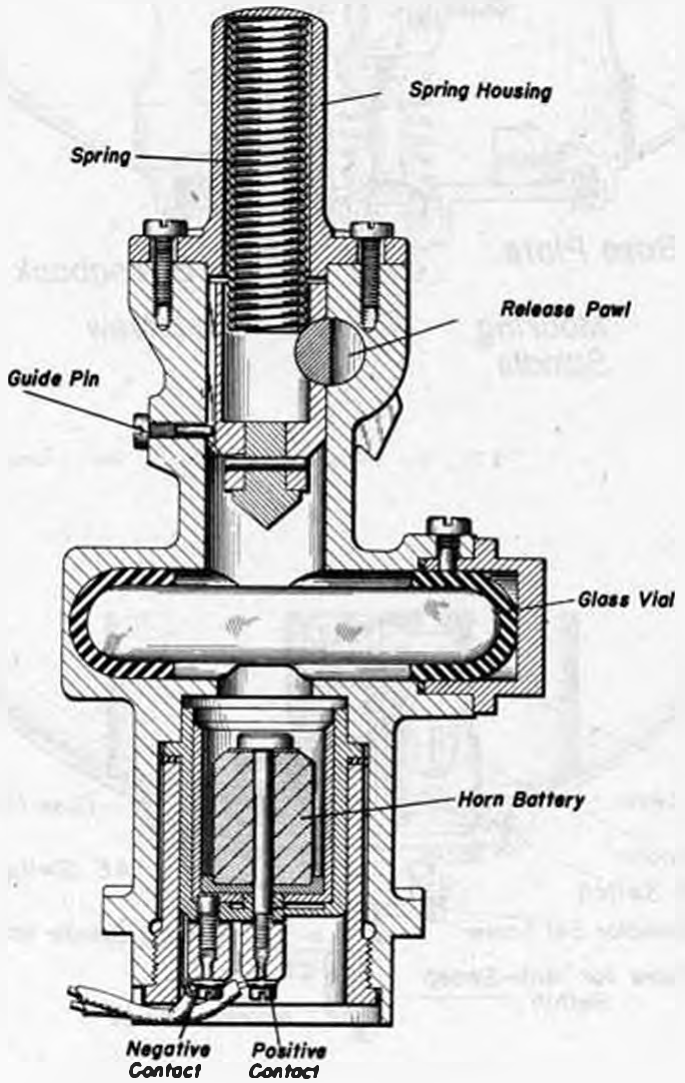


Fig. 4 - Electrochemical SDM ("eighth horn")

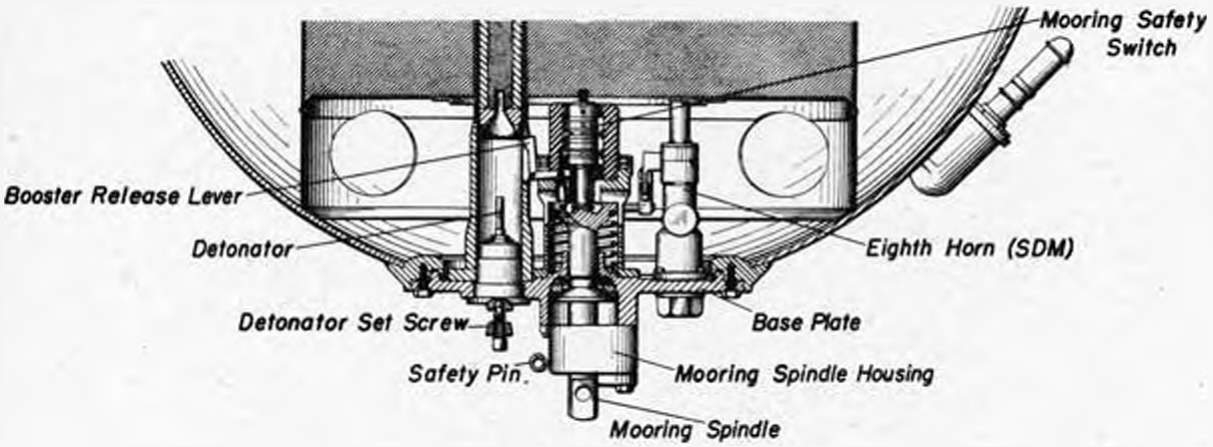


Fig. 5 - Base Plate Type C, Sectional View

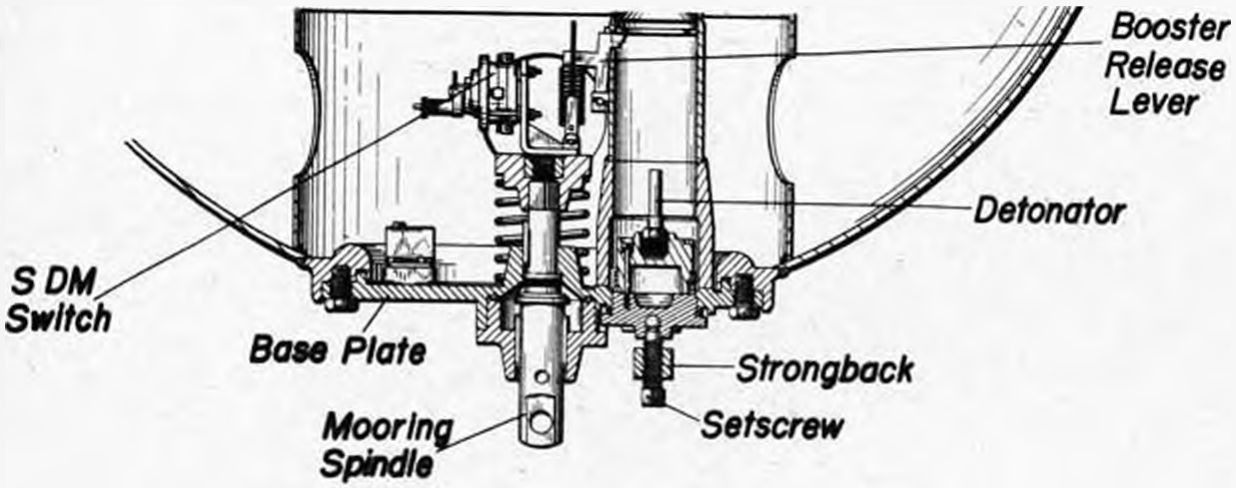


Fig. 6 - Base Plate Type D, Sectional View

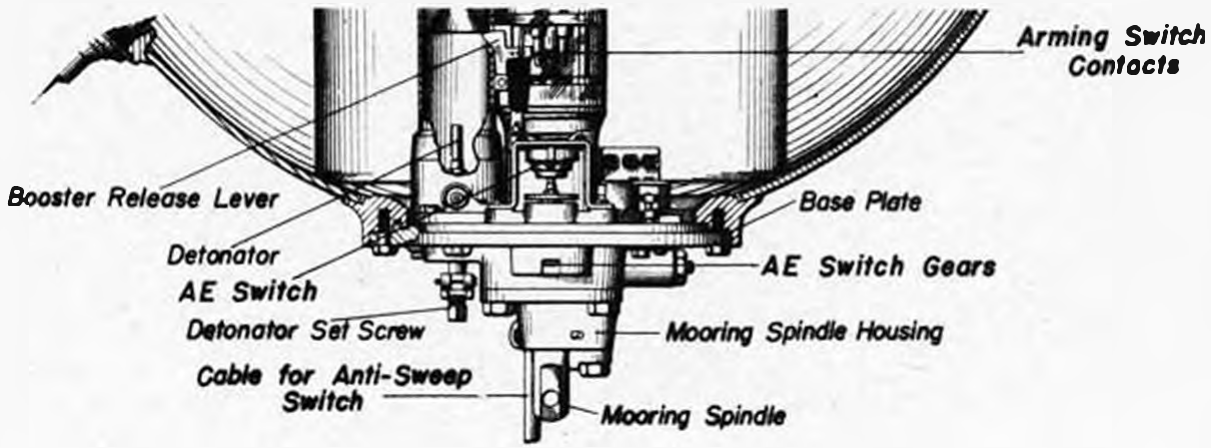


Fig. 7 - Base Plate Type E, Sectional View

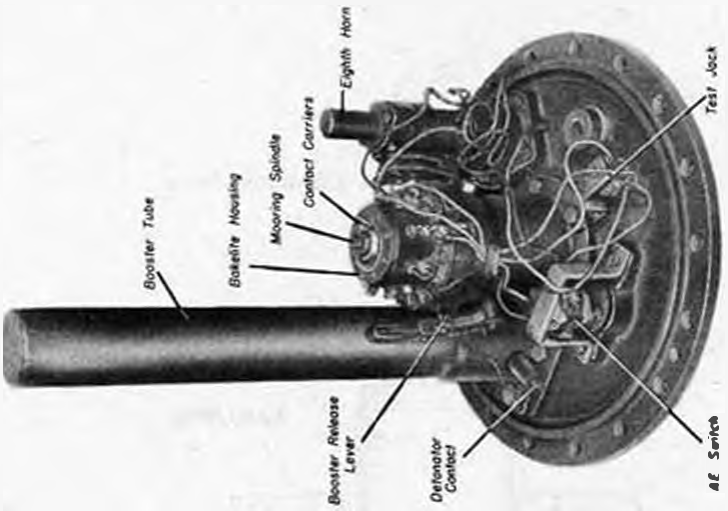


Fig. 8 - Base Plate Type C, Top View

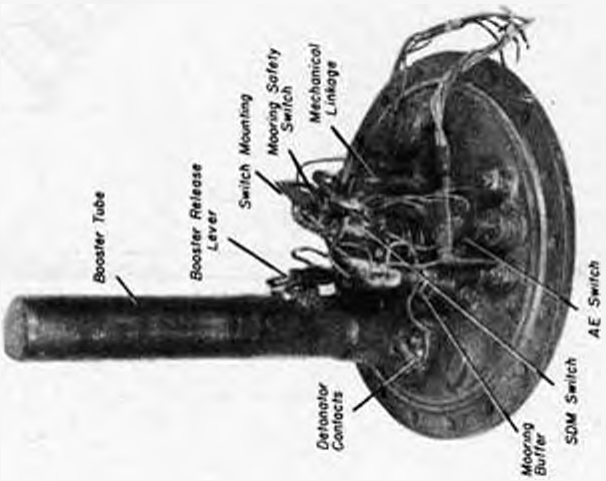


Fig. 9 - Base Plate Type D, Top View

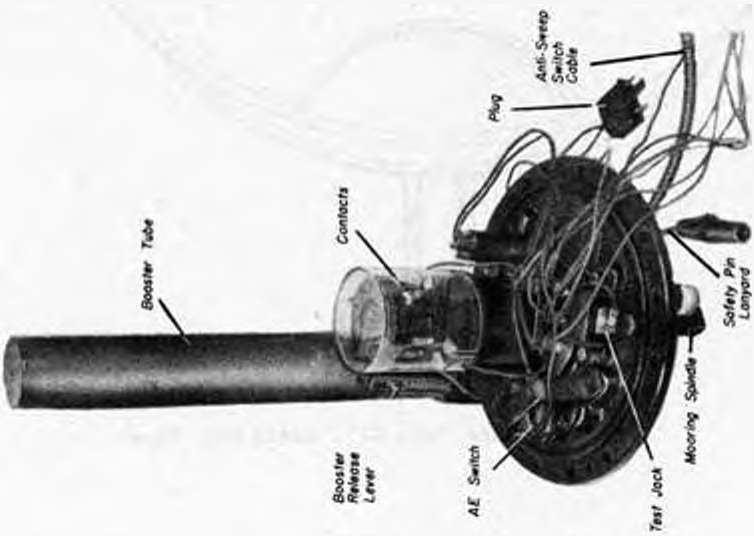
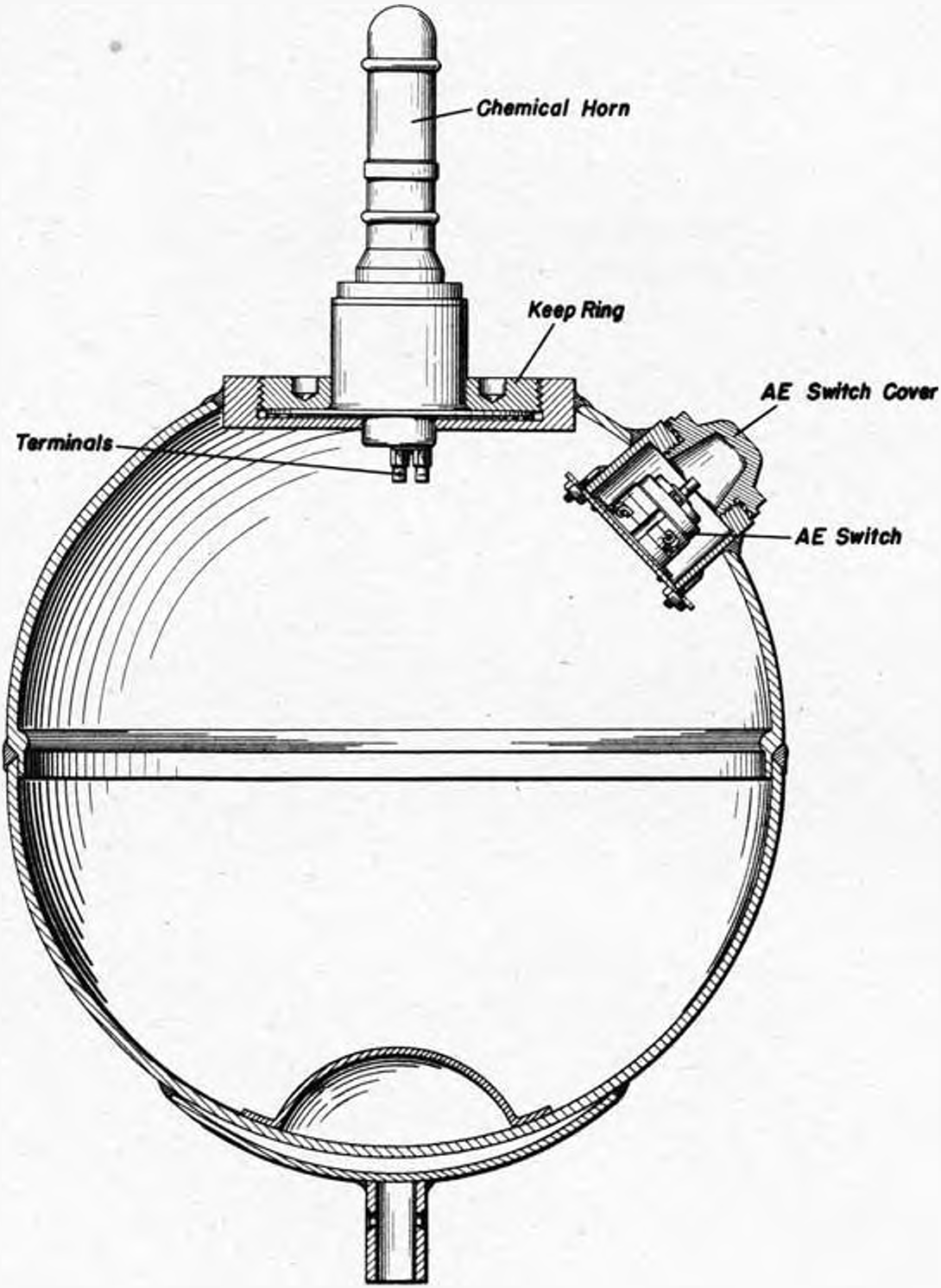


Fig. 10 - Base Plate Type E, Top View


Chemical Horn
Keep Ring
AE Switch Cover
Terminals
AE Switch

Mine Type GJ[1] (GJ[2] and GJ[3])

General

1. Moored or ground, contact, chemical horn mine, laid by surface craft.

2. German designation unknown.

3. Defensive mine for use in shallow water. May also be used as an anti-vehicular land mine on beaches or as a demolition charge. When used as a land mine, it is buried in the sand in a manner similar to the Types JE and JG mines.

Description

1. Case

Shape	Elliptical
Color	Black
Material	Steel
Diameter	15"
Charge	25 lbs. approx.
Total weight in air	65 lbs. approx.

2. External fittings

Horn	One, on top center of case, secured by keep ring.
Base plate	In center of lower hemisphere.
Pockets	Four, staggered around upper hemisphere; three blank, fourth contains "A-E switch.
Lifting eyes	Two, 180° apart on upper hemisphere.

3. Mine Type GJ[2] differs from Mine Type GJ[1] as follows:

   (a) It is fitted with two horns on its upper hemisphere, 180° apart, 90° from pad eyes. No horn is fitted to the top center of the case.

   (b) It has not been found fitted with an "A-E" switch.

4. Mine Type GJ[3] differs from Mine Type GJ[1] as follows:

   (a) It is fitted with neither "A-E" switch nor horns and is believed to be used as a demolition charge, possibly in conjunction with a delay clock.

   (b) It has a booster tube to take standard diameter detonator and booster.

Operation

1. Because no complete mines of this type have been recovered, information is not available as to the manner of depth-taking and mooring, the function of the "A-E" switch, or the method of housing the detonator.

2. Standard chemical horn firing.

3. No self-disarming devices are fitted.

Precautions

1. Due to the lack of information regarding this mine and the possibility of its being used as a delayed action demolition charge, no attempt should be made to render it safe except in extreme emergency.

RMS (tentative)

1. GJ[1]

   (a) Remove the chemical horn keep ring.

Fig. 12 - Mine Type GJ[1]

(Mine Type GJ^1 (GJ^2 and GJ^3), Cont'd.)

(b) Remove the horn assembly; cut and tape each lead separately.

(c) Remove the detonator.

(d) Remove the booster.

(e) Dispose of detonator, booster and charge.

2. GJ^2

(a) Remove the cover plate.

(b) Cut and tape separately all leads to the detonator and horns.

(c) Remove the detonator.

(d) Remove the booster.

(e) Dispose of detonator, booster and charge.

3. GJ^3

(a) None known.

Fig. 13 - Mine Type GJ^2

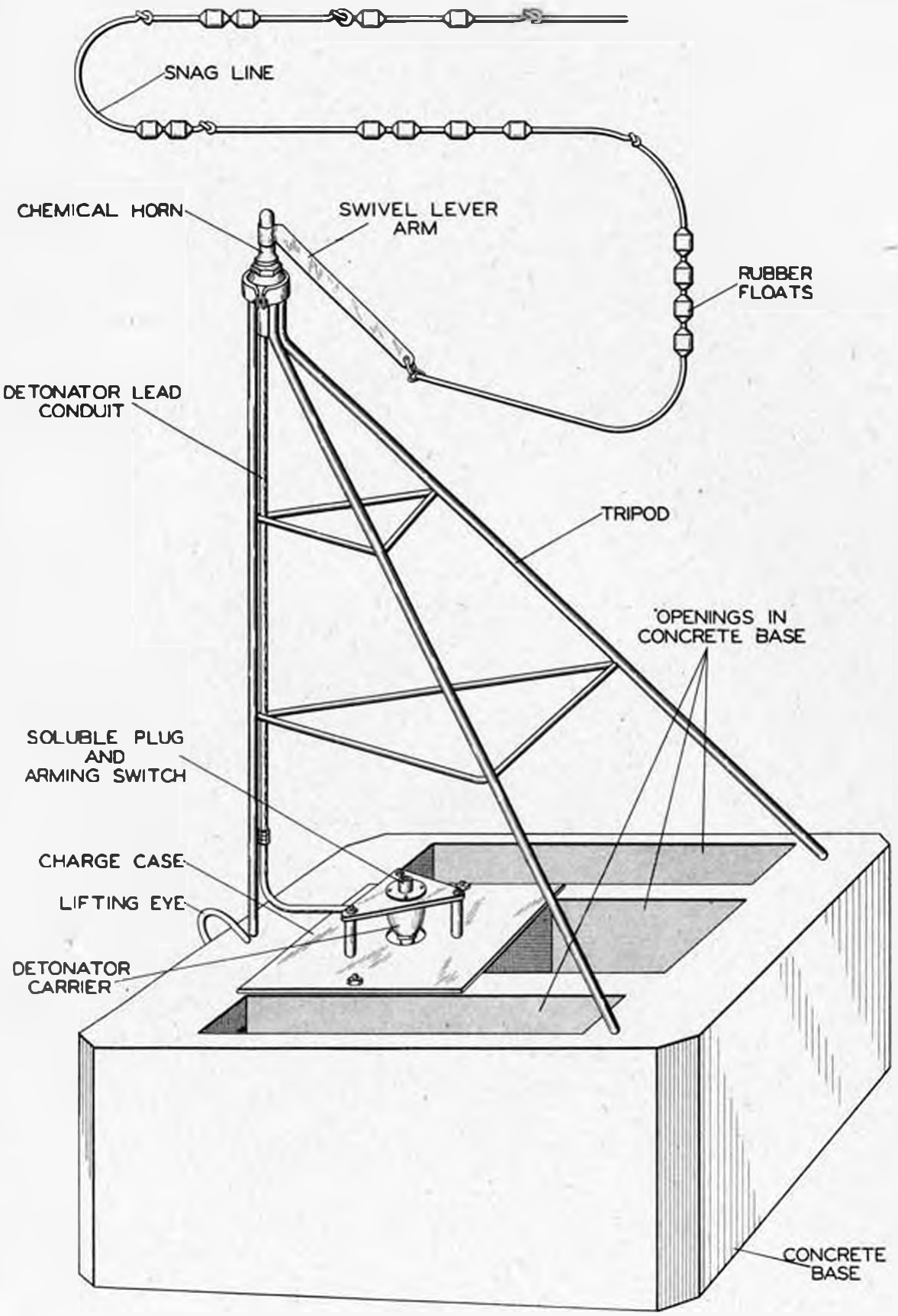


Fig. 14 - Mine Type GK, Elevation

Mine Type CK

General

1. Ground, contact, chemical horn mine, laid by surface craft. Usually fitted with snag line.

2. German designation, "KMA".

3. Anti-invasion mine, for use in maximum depth of water of 30 ft. against landing craft.

Description

1. Base

Shape	Rectangular, recessed concrete block, fitted with steel tripod 5'6" high on top.
Color	White or gray (unpainted).
Material	Concrete
Length	47"
Width	47"
Height	
Base	20" approx.
Overall	88"
Charge	162 lbs. cast Hexanite.
Total weight in air	2090 lbs. approx.

2. External fittings

Horn	One, on top of tripod.
Charge container	16 1/2" x 15 3/4" x 10 3/4", mounted in base. Fitted with cover, secured by two studs.
Detonator and booster housing	Plastic framework 6½" long, 2¾ diam., on cover of charge container. Contains opening inside for detonator leads.
Detonator lead conduit	Extends from horn battery to detonator and booster housing; married to forward leg of tripod.
Swivel lever arm (for use with snag line)	Mounted on horn.
Lifting eyes	Three; one forward on base below forward leg of tripod; two aft on base.
Soluble plug gear and arming switch	On top of detonator and booster housing.

Operation

1. Dissolution of the soluble plug permits the spring-loaded arming switch to close and arm the mine.

2. Standard chemical horn firing, either by direct contact or by tension on the snag line.

3. No self-disarming devices are fitted.

Precautions

1. Do not remove the chemical horn underwater before breaking the arming switch.

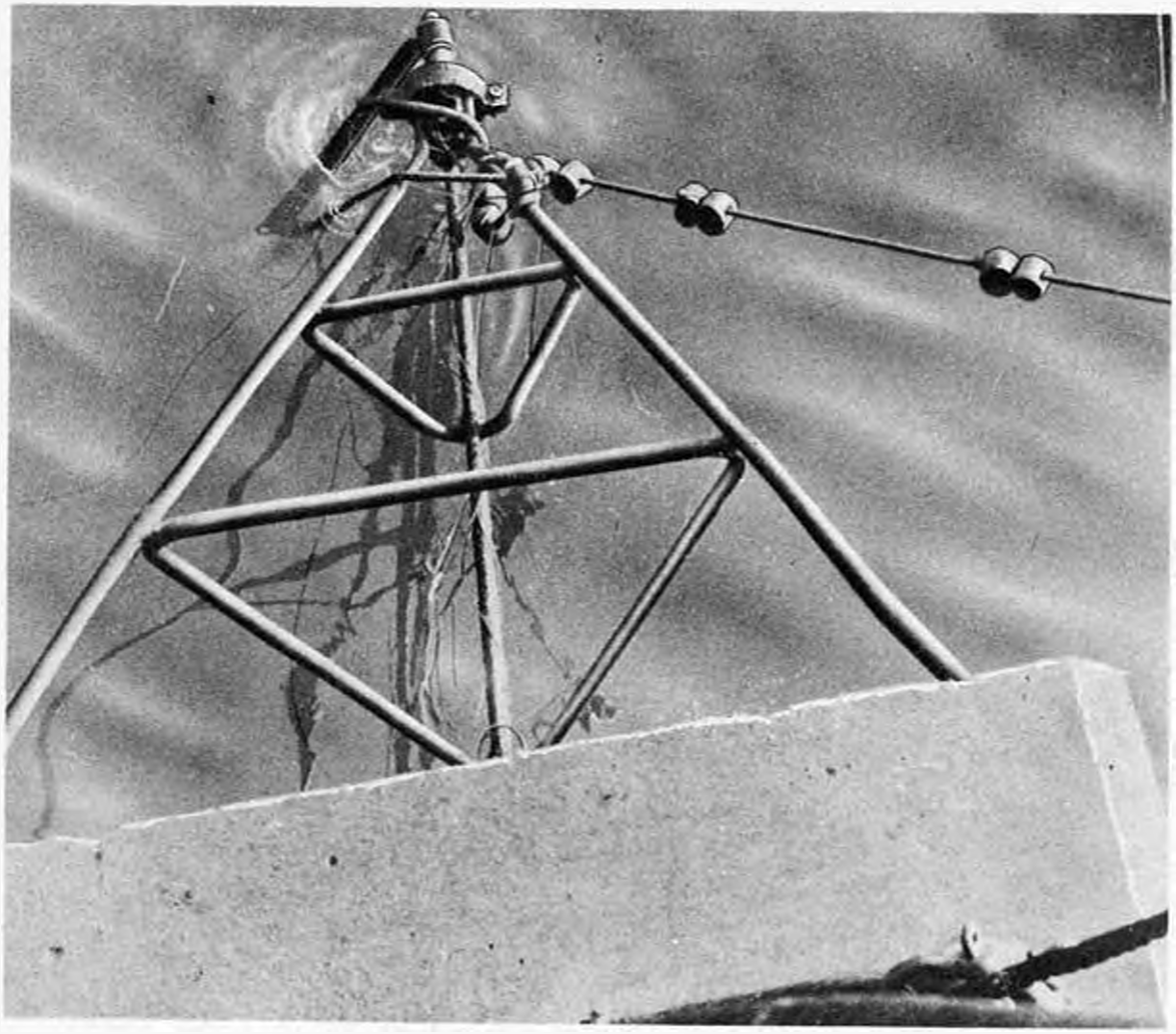


Fig. 15 - Mine Type CK

(Mine Type GK, Cont'd.)

RMS

1. Remove the knurled nut inside the soluble plug cage.
2. Screw special RMS tool (Fig. 16) onto threaded spindle and screw all the way home, thus withdrawing the spindle gently and breaking the arming switch.
3. If the mine is underwater, raise it to the surface and dispose of detonator, booster and charge.

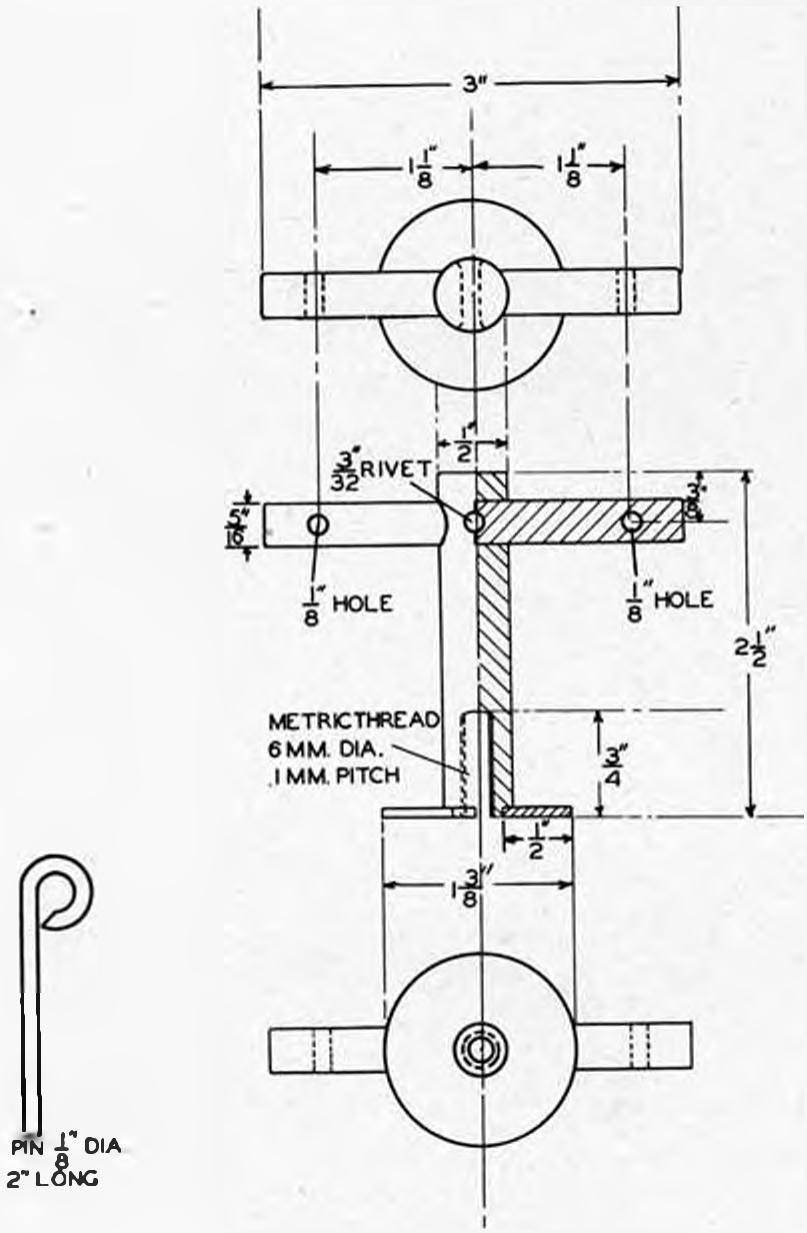


Fig. 16 - RMS Tool for Mine Type GK

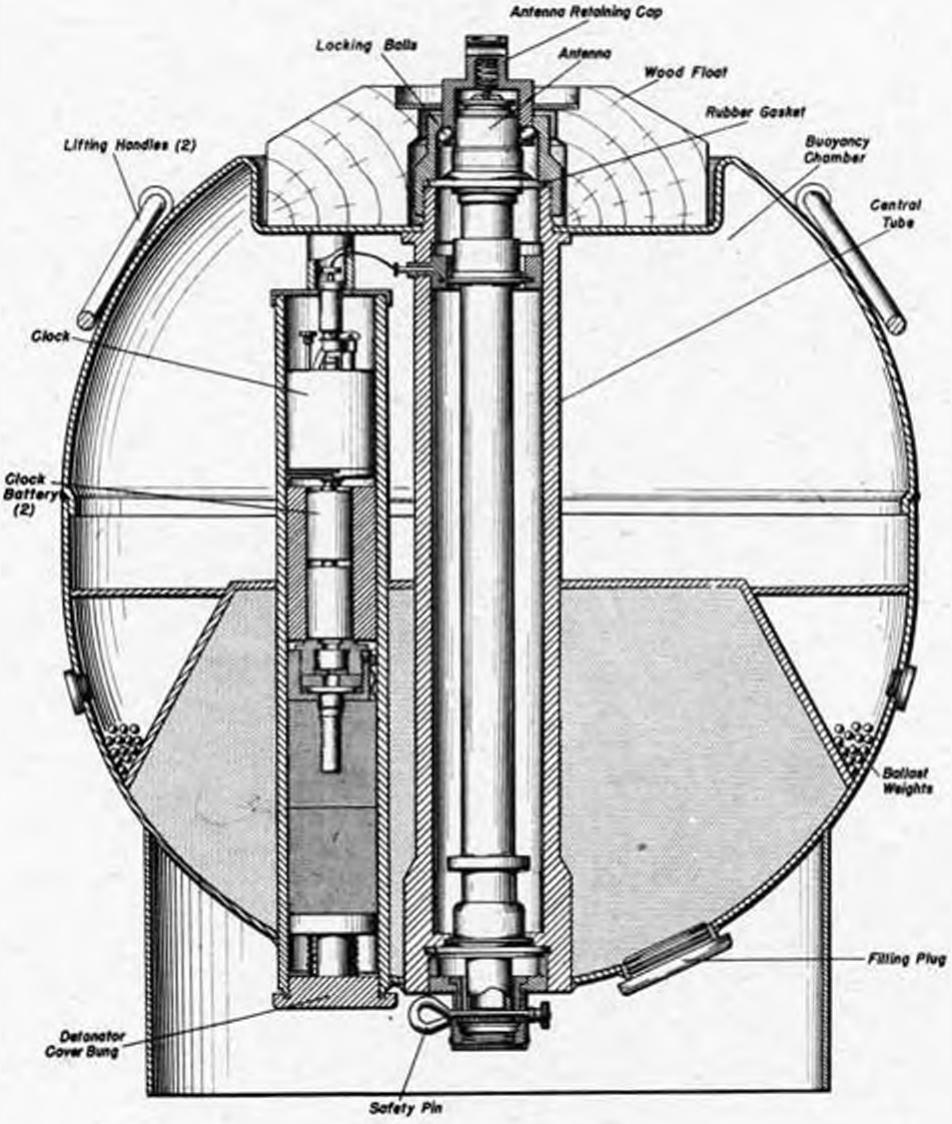


Fig. 17 - Mine Type CL, Sectional View

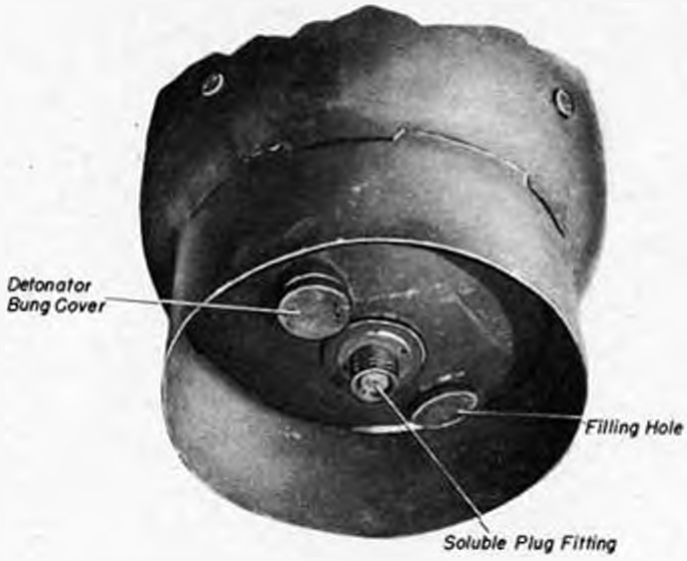


Fig. 18 - Mine Type CL, Bottom

Mine Type CL

General

1. Drifting, contact antenna-switch mine, laid manually.

2. German designation, "K. Tr. Mi. 41".

3. Offensive mine, for use in rivers and harbors against bridges, dams, docks etc. Normal depth of case when drifting is one foot.

Description

1. Case

Shape	Oval, with 4.5 skirt around base. Antenna protrudes from top center of case.
Color	Dark green
Material	Steel
Diameter	15"
Length Overall (includes antenna) Case	 6'9" 18"
Charge	25 lbs. cast TNT.
Total weight in air	76 lbs.

2. External fittings

Antenna	5'3" long, brass, fitted to top of case. Consists of five telescopic, spring-loaded sections. Fitted with four snag wires at top.
Detonator cover bung	2 1/8" diam., 2 3/4" from center of bottom of mine.
Filling plug	Screwed into base, 2 1/8" diam., 3 1/2" from center.
Wood float	7?4 diam., recessed into top center of case prior to laying. Free to rise and fall on lower section of antenna after mine is armed.
Soluble plug fitting	In base of antenna housing.

Operation

1. A safety pin is withdrawn from the base of the antenna prior to launching. When the mine is launched, dissolution of the soluble plug allows the lower section of the antenna to be forced downward, releasing locking balls and the antenna retaining cap, and allowing the antenna to extend to its full length. The wooden float takes position depending on the buoyancy of the mine which is then fully armed.

2. Mine fires when the antenna is bent in any direction against its internal contact ring. A self-destroying clock with a maximum period of six hours may be fitted.

3. No self-disarming devices are fitted.

Precautions

1. Never attempt RMS by disassembly.

2. Do not approach the mine unless absolutely necessary because the clock may fire the charge at any time.

3. Although no RMS procedure can be recommended, the following countermeasures are suggested:

   (a) If found floating, sink or explode by gunfire.

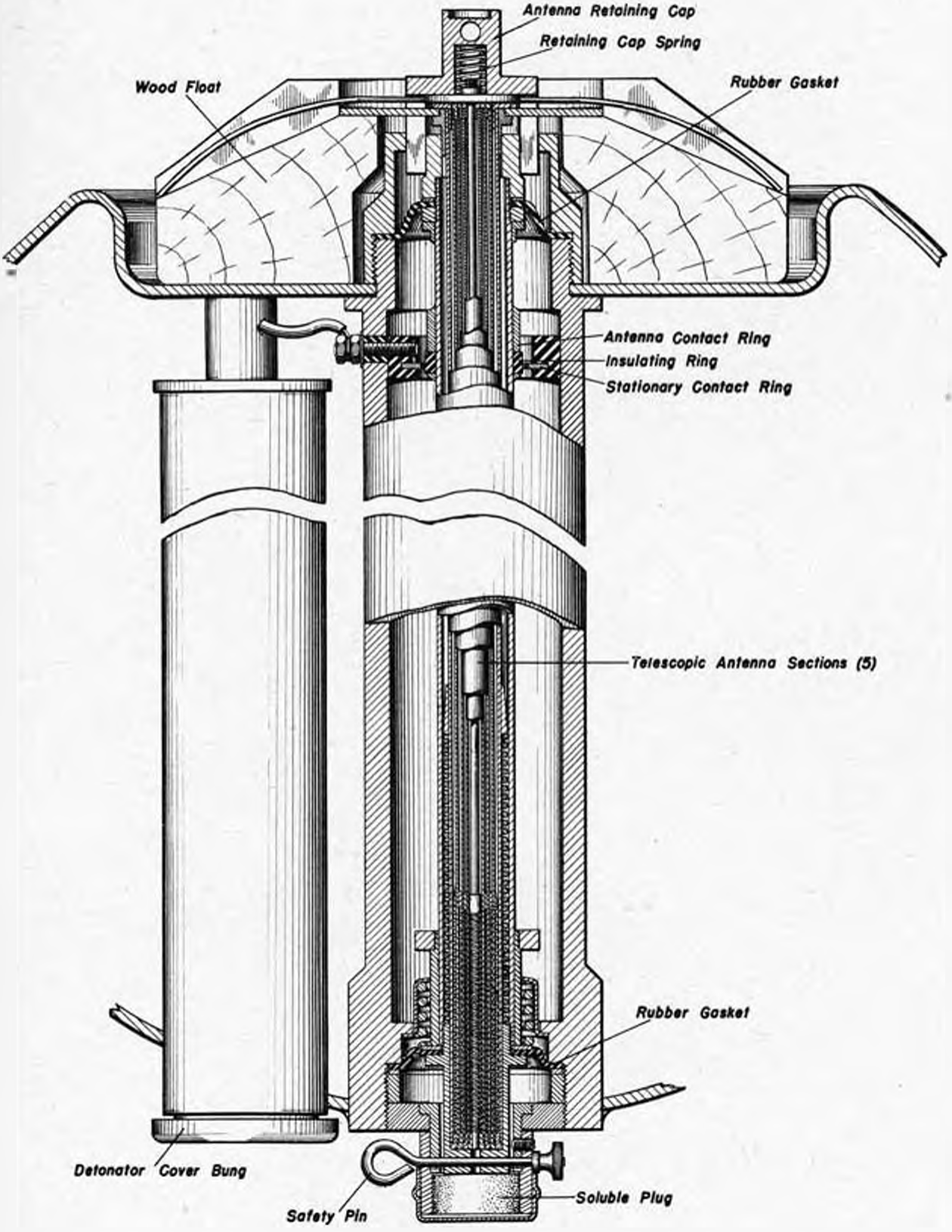


Fig. 19 - Mine Type GL. Antenna Housing and Release Gear, Sectional View

(Mine Type GL, Cont'd.)

(b) If found beached, haul a charge into position from a safe distance with all personnel taking cover and countermine.

RMS

1. No RMS procedure has been developed.

Fig. 20 - Mine Type GL

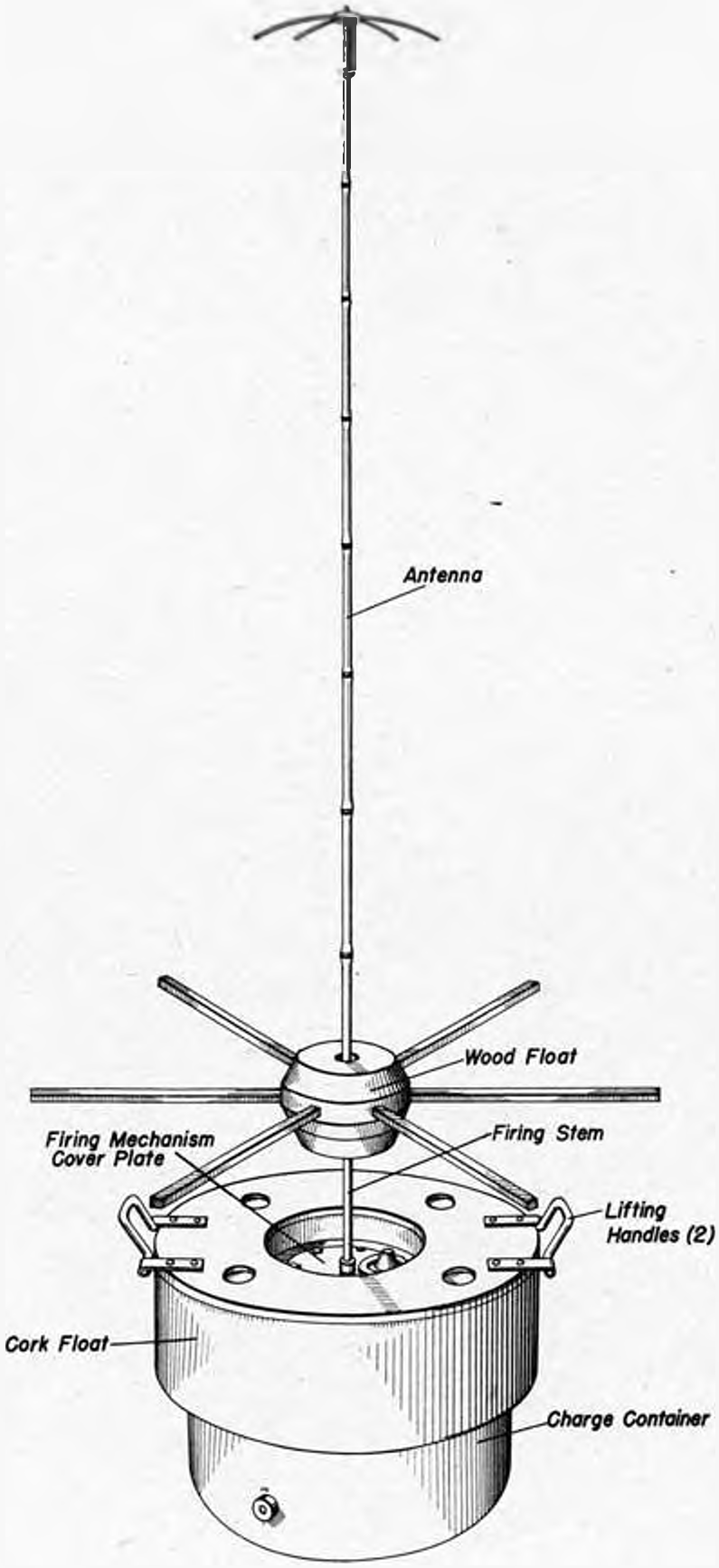


Fig. 22 - Mine Type GL-P, Elevation View

Mine Type GL-P

General

1. Same as Mine Type GL except that the German designation is not known.

Description

1. Case

Shape	Cylindrical with antenna protruding from top center of case.
Color	Green or brown
Material	Wood
Diameter	17 3/4"
Length	6 1/4"
Charge	44 lbs. TNT with Tetryl booster.
Total weight in air	66 lbs.

2. External fittings

Antenna	4 1/2 ft. long, bamboo or hazelwood, fitted to top of metal firing stem on top center of case.
Firing mechanism cover plate	Threaded into well on top center of charge container.
Wood float	Secured to firing stem, fitted with six wooden contact arms, each 13" long.
Lifting handles	Two, 180° apart, on top edge of case.

Operation

1. Mine is armed by a ten-minute arming clock in the firing mechanism.
2. Mine fires by percussion upon impact. The arming clock is believed to be fitted with a self-destroying featur which will explode the charge after a maximum delay period of six hours.
3. No self-disarming devices are fitted.

Precautions and RMS

1. Same as Mine Type GL.

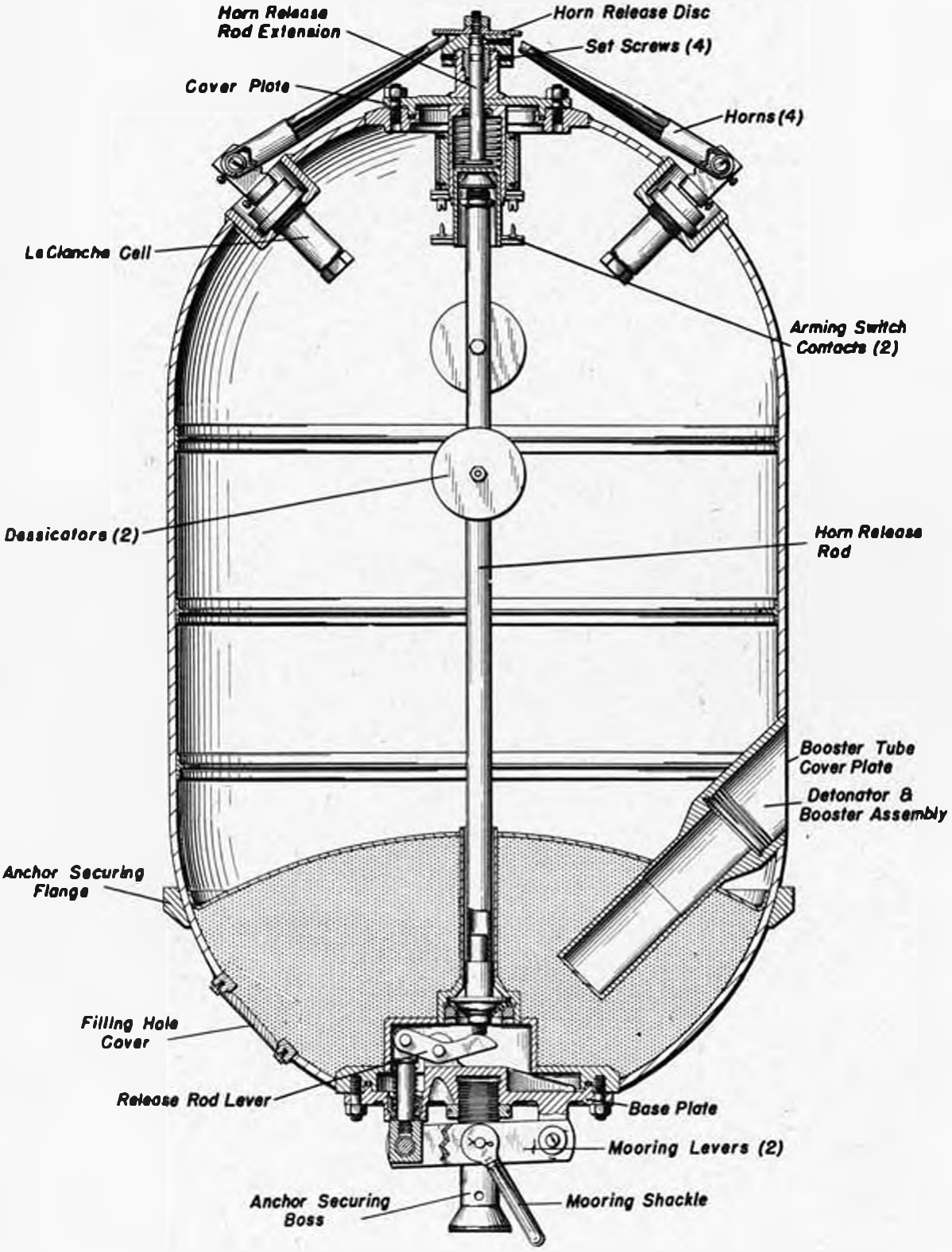


Fig. 23 - Mine Type GM, Sectional View

Mine Type C/!

General

1. Moored, contact, Le Clanche cell horn mine, laid by aircraft or surface craft.

2. German designation, "EMC".

3. Offensive or defensive mine, for use in maximum depth of water of 450 ft. against surface craft.

Description

1. Case

Shape	Two hemispheres, joined by a 22" cylindrical mid-section.
Color	Dark gray
Material	Steel
Diameter	26"
Length	44"
Charge	120 lbs. cast Hexanite
Total weight in air	380 lbs.

2. External fittings

Horns	Four, equally spaced around upper hemisphere, 11" from center.
Cover plate	8" diam., in center of upper hemisphere, flush type, secured by eight bolts.
Base plate	11" diam., in center of lower hemisphere, flush type, secured by 16 bolts. Fitted with mooring lever and anchor securing boss.
Horn release disc	2 3/4" diam., 1 3/8" above center of cover plate.
Booster cover plate	Oval-shaped, on cylindrical mid-section, 2 1/4" from anchor securing flanges, secured by set screw.
Filling hole cover	4 1/4" diam., on lower hemisphere, 10 1/2" from center, secured by four bolts.

Operation

1. Mine takes depth by hydrostat. Mooring tension pulls out the mooring spindle against spring tension on the inside of the base plate. Withdrawal of the mooring spindle forces a catch upward, thereby actuating a horn release rod which extends through the longitudinal axis of the case to the cover plate. Movement of this rod forces the horn release disc upward, allowing the horns to snap out and lock in the "out" position, and closes the arming switch on the wiring panel. The mine is now armed.

2. When a horn is bent, a brass tube at the base of the horn breaks, allowing sea water to enter a Le Clanche cell under the horn, energizing it and producing a current sufficient to fire the detonator.

3. The only self-disarming device is the arming switch which is designed to disarm the mine by opening the firing circuit upon release of mooring tension.

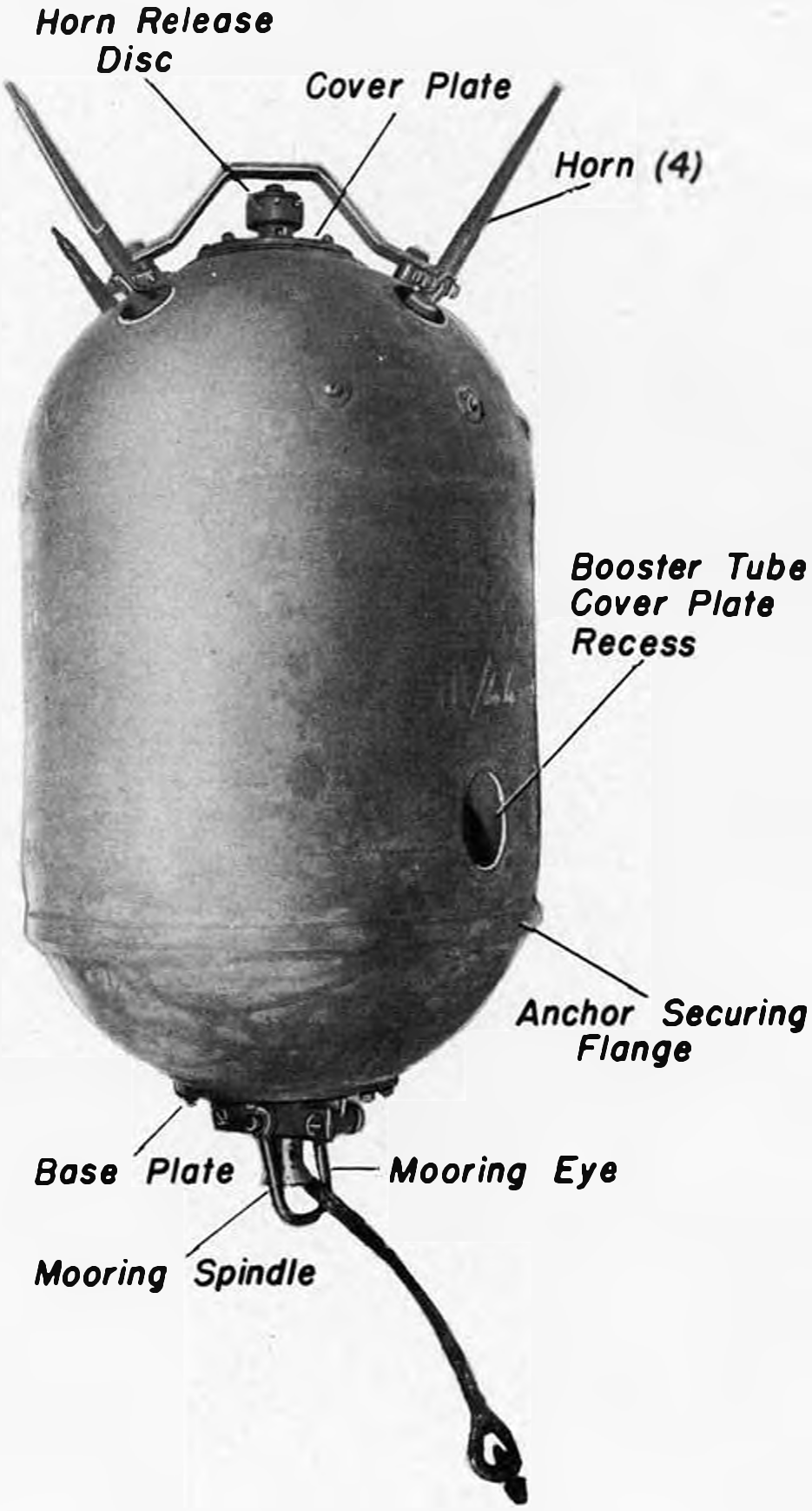


Fig. 24 - Mine Type G

(Mine Type GM Cont'd.)

Precautions

1. Note that the detonator and booster are permanently married and that the horns are of a particularly sensitive type.

2. The fact that the mooring spindle has retracted is not a positive indication that the firing circuit is open because of the possibility of malfunction of the horn release rod assembly.

RMS

1. Remove the booster tube cover plate and the detonator cover keep ring beneath.

2. Remove the detonator cover and bakelite spacer.

3. Cut and tape each detonator lead separately.

4. Remove the detonator and booster.

5. Remove the cover plate and cut and tape separately each lead to the arming switch.

6. Dispose of detonator, booster and charge.

Fig. 25 - Mine Type GM, Floating

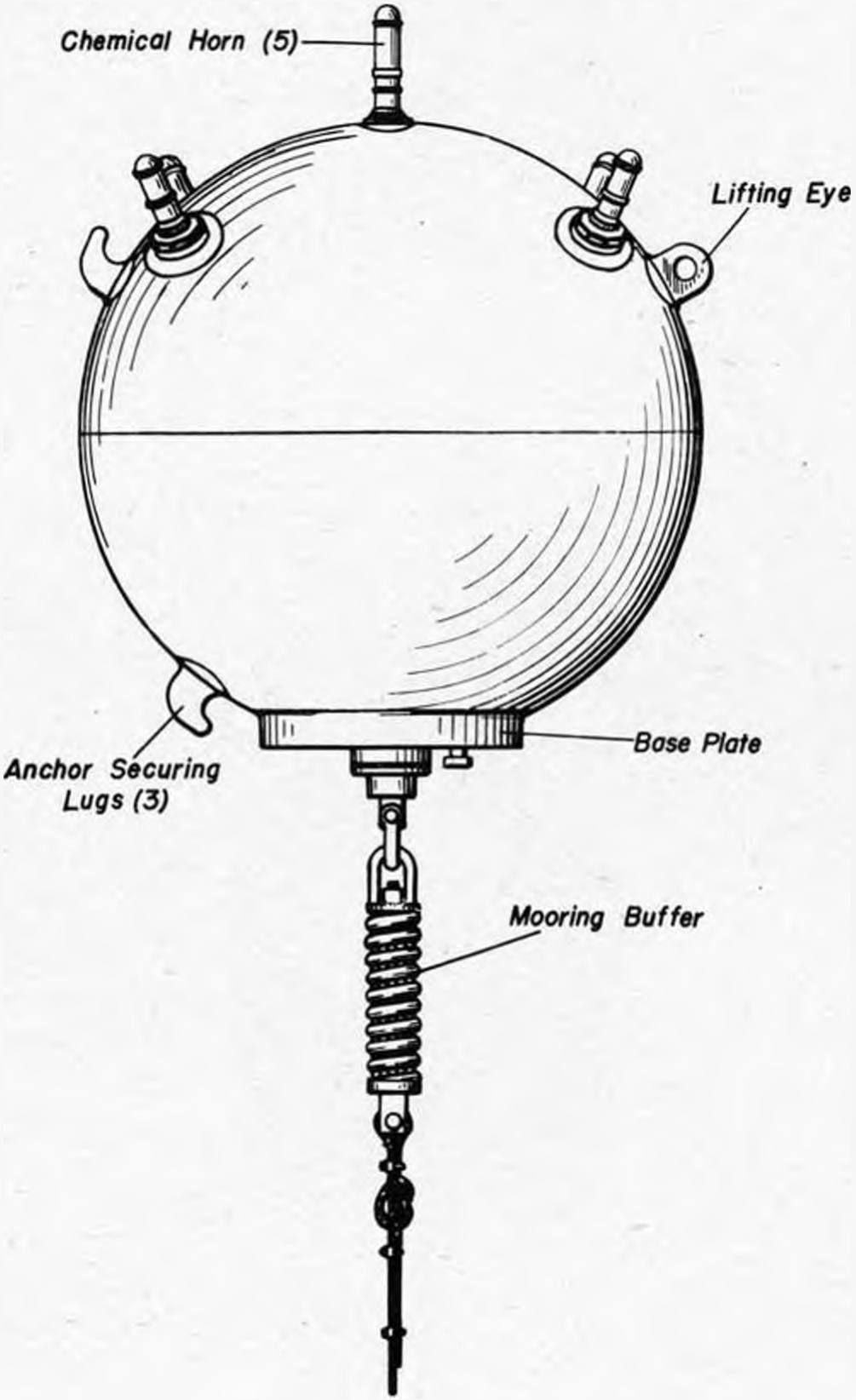


Fig. 26 - Mine Type GQ, Elevation

Mine Type [illegible]

General

1. Moored, contact, chemical horn mine, laid by surface craft.
2. German designation, "FMC."
3. Offensive mine, for use in maximum depth of water of 470 ft. against surface craft.

Description

1. Case

Shape	Spherical
Color	Black
Material	Steel
Diameter	29.25
Charge	88 lbs. block-fitted Hexanite.
Total weight in air	350 lbs. approx.

2. External fittings

Horns	Five; one, in center of upper hemisphere; four, equally spaced around upper hemisphere.
Base plate	Type D (modified). See Par. #1 below.
Anchor securing lugs	Three; one on upper hemisphere, two on lower hemisphere.
Lifting eye	On upper hemisphere

Operation

1. Mine takes depth by plummet. Mooring tension pulls out the mooring spindle, closing the mooring safety switch and the "A-2" switch, tripping the booster release lever and the mine is armed. The "A-2" switch in this case serves only to open or close a switch in the horn circuit.
2. Standard chemical horn firing.
3. The only self-disarming device is the mooring safety switch which is designed to disarm the mine by opening the firing circuit upon release of mooring tension.

Precautions

1. See Introduction.

RMS

1. Remove the detonator and booster (see Introduction).
2. Remove the base plate; cut and tape each lead separately.
3. Dispose of detonator, booster and charge.

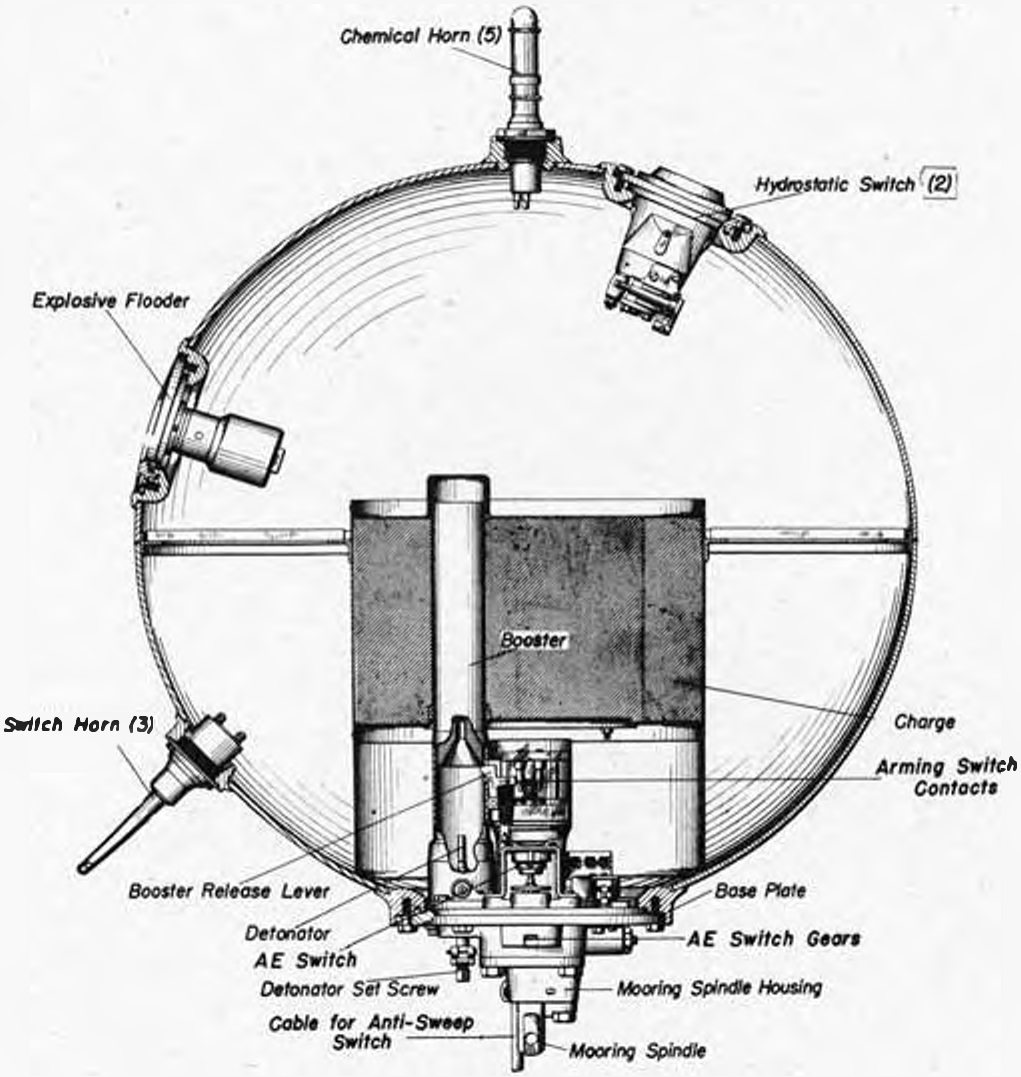


Fig. 27 - Mine Type GR, Sectional View

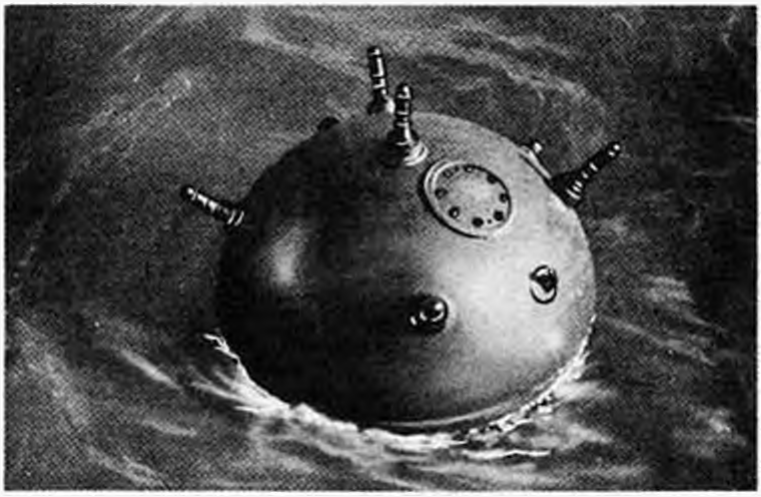


Fig. 28 - Mine Type GR, Floating

Mine Type GR

General

1. Moored, contact, chemical and switch horn mine, laid by surface craft. May be fitted with snag line.

2. German designation, "UMB".

3. Offensive or defensive mine, for use in maximum depth of water of 500 ft. against surface craft. Maximum depth of case when moored is 110 ft.

Description

1. Case

Shape	Spherical
Color	Black
Material	Steel
Diameter	3375
Charge	90 lbs. block-fitted Hexanite.
Total weight in air	420 lbs.

2. External fittings

Horns	Eight: one, chemical, in center of upper hemisphere; four, chemical, equally spaced around upper hemisphere, 17" from center; three, switch, equally spaced around lower hemisphere, 17" from center.
Base plate	Standard type E.
Hydrostatic switch covers	Two; 675 diam.; one, 785 from center of upper hemisphere; one, 17" from center of lower hemisphere.
Explosive flooder cover	675 diam., 23" from center of upper hemisphere.
Securing lugs	Three; one, 20" from center of upper hemisphere; two, 20° apart 12" from center of lower hemisphere.
Snag line (optional)	79 ft. long, secured to center of three ft. length of wire connecting two switch horns. When the mine is so rigged, the chemical horn directly above is blanked off.

3. (a) The hydrostatic scuttling switch on the upper hemisphere is an anti-shallow-plant hydrostat which controls a double-pole switch, normally made to one of its contacts. The hydrostat may be set to any one of four depths; 0, 5, 10 or 15 meters. If, upon laying, the mine moors at a depth shallower than that set on the hydrostat, the explosive flooder will fire upon closure of the mooring safety switch. If the mine moors correctly, (i.e. at a depth greater than that set on the hydrostat) the switch changes over to the other contact, permanently breaking the flooder circuit.

(b) The hydrostatic arming switch on the lower hemisphere is designed to open or close the firing circuit when the mine rises above or descends below a depth of six feet. A glycerine-filled dashpot delays the action of the switch for a period of 20 seconds. A screw plug, fitted to the center of the switch cover, is painted white when the switch is rigged to operate as described above. If the plug is painted red, however, it indicates that the switch has

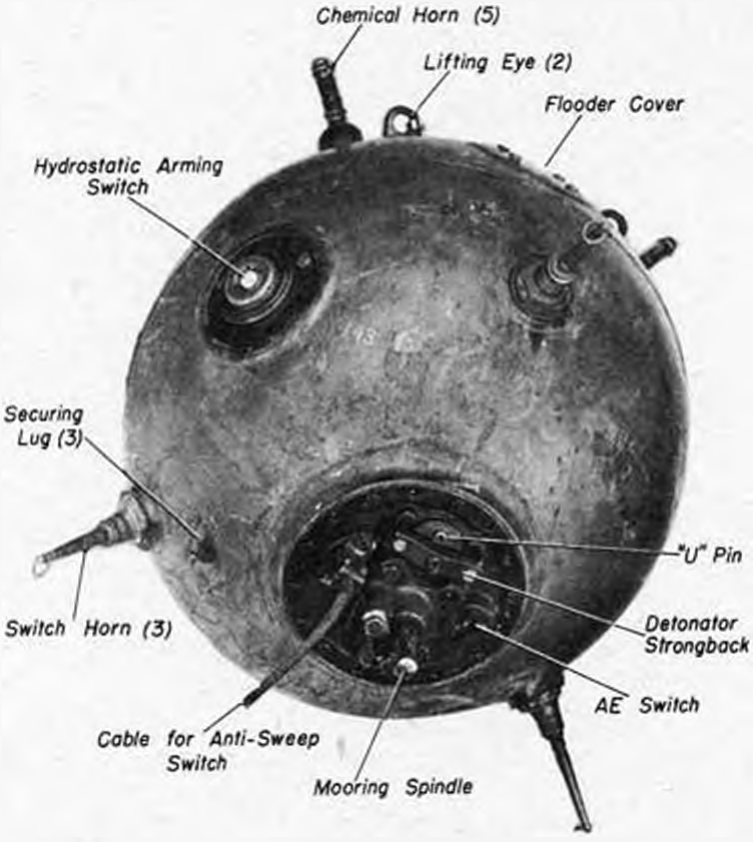


Fig. 29 - Mine Type GR

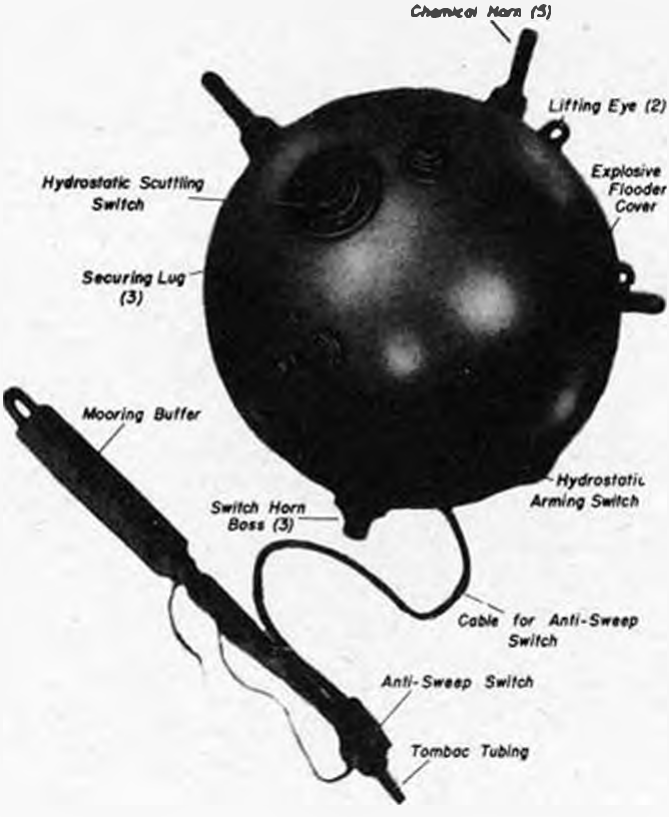


Fig. 30 - Mine Type GR

(Mine Type GR, Cont'd.)

been closed during assembly, being held in that position by a special extension arm added to the screw plug. In this case, the switch will not open under any circumstances.

Operation

1. Mine takes depth by plummet. The hydrostatic switch closes in six feet of water (if red screw plug is fitted, switch is permanently closed) and, if the mine moors at a depth greater than that set on the anti-shallow-plant hydrostatic switch, the flooder circuit is broken (see Par. 3 (a) above). Dissolution of a soluble plug allows mooring tension to pull out the mooring spindle, closing the mooring safety switch, and tripping the booster release lever and the mine is armed. A spring-loaded detent is usually fitted to lock the mooring spindle out.

2. Standard chemical or switch horn firing. An additional firing method may be incorporated by fitting a "tombac" anti-sweep tubing to the mooring cable. Upward movement of this tubing along the mooring cable, such as might be caused by a sweep wire contacting it, will close a switch on the tubing and fire the main charge. Mines fitted with snag lines will not normally be fitted with the "tombac" anti-sweep device nor the locking detent on the mooring spindle.

3. The mooring safety switch is designed to disarm the mine by opening the firing circuit upon release of mooring tension except when the detent is fitted (see Par. 1 above). The hydrostatic arming switch is also designed to break the firing circuit if fitted with a white screw plug (see Par. 3 (a) of Description).

Precautions

1. If any horn is bent or damaged, and if the screw plug in the hydrostatic arming switch is painted red, do not attempt RMS except in extreme emergency.

RMS

1. Remove the detonator and booster (see Introduction).

2. Remove the base plate; cut and tape each lead separately.

3. Remove the flooder plate and charge (if fitted).

4. Dispose of all explosive elements.

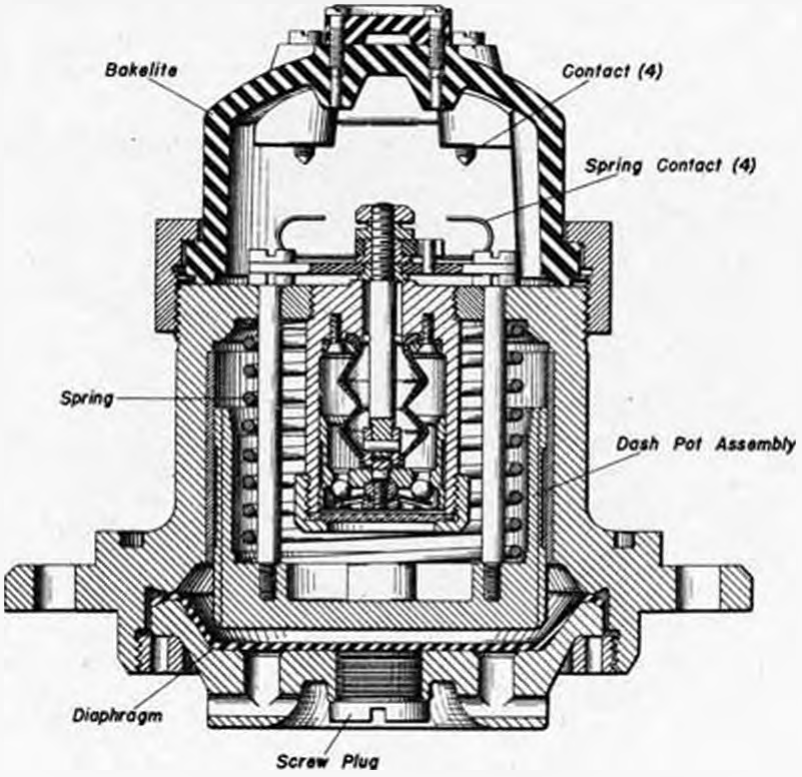


Fig. 31 - Mine Type GR, Hydrostatic Arming Switch, Sectional View

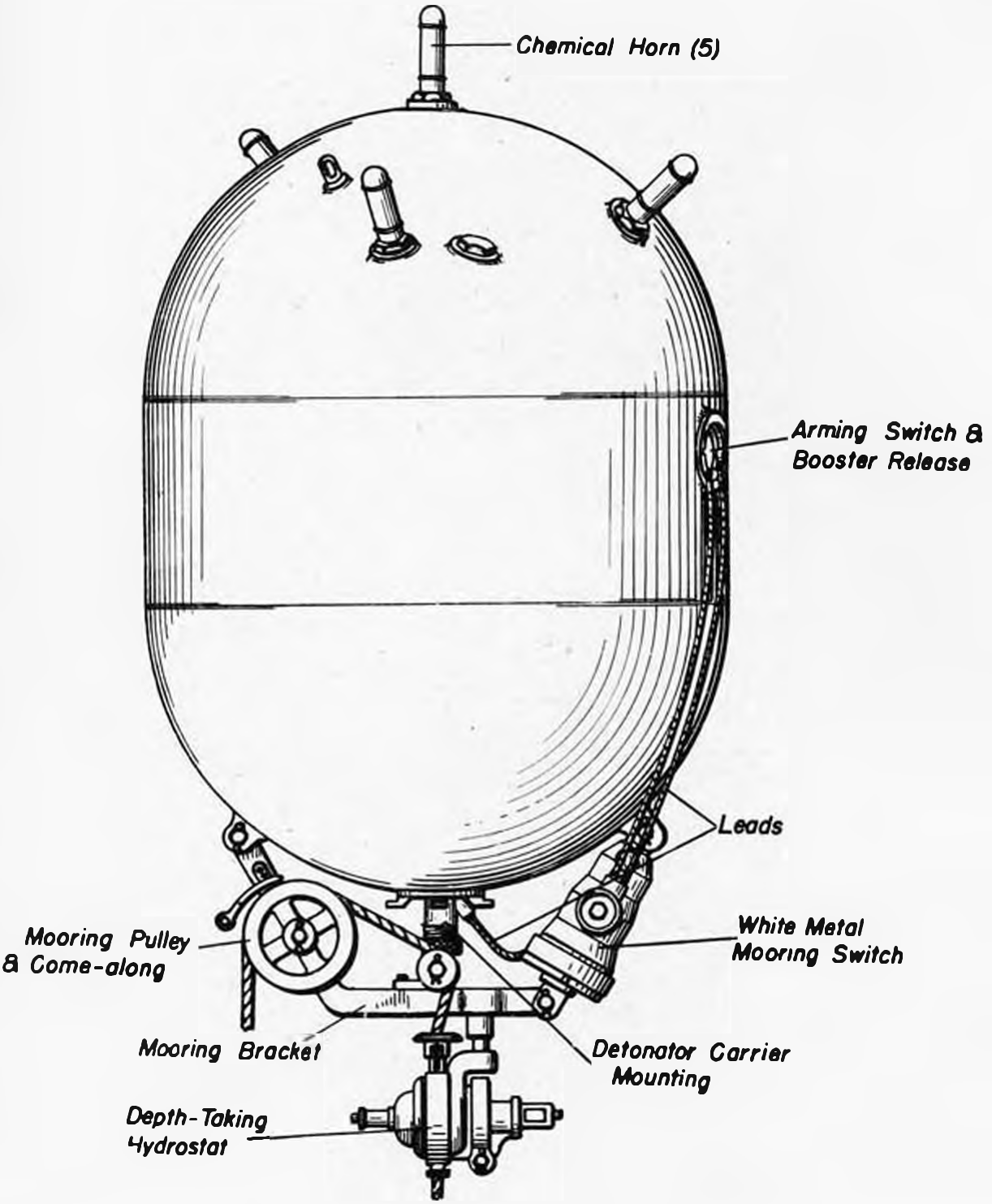


Fig. 32 - Mine Type CU.

Mine Type CU

General

1. Moored, contact, chemical horn mine, laid by surface craft or submarines.

2. German designation, "KMA".

3. Offensive or defensive mine.

Description

1. Case

Shape	Two hemispheres, joined by a 12" cylindrical mid-section.
Color	Black
Material	Steel
Diameter	34"
Length	46"
Charge	360 lbs. block-fitted Hexanite.
Total weight in air	870 lbs. approx.

2. External fittings

Horns	Five; one in center of upper hemisphere; four, equally spaced around upper hemisphere.
Arming switch and booster release	On mid-section, secured by keep ring.
Detonator carrier mounting	In bottom center of case.
Mooring bracket and white metal mooring switch	Bolted to two lugs on lower hemisphere.
Mooring pulley and "come-along"	Attached to extension of mooring bracket.
Depth taking hydrostat	Bolted to extension on mooring bracket.

3. Two pair of electrical leads extend from the white metal mooring switch, one set to the detonator carrier, the other to the arming switch.

Operation

1. Mine takes depth by hydrostat. Separation of the anchor and case withdraws a safety pin from the arming switch and booster release, making the circuit from the horn batteries to the detonator and allowing the booster to drop over the detonator. Mooring tension extends the spindle of the white metal mooring switch, arming the circuit of the internal horn to arm the mine.

2. Standard chemical horn firing.

3. Early models of this mine were fitted with the same type of self-disarming device used by the Mine Type JA. (See Part VI, Chapter I.) However, the white metal mooring switch has been added to later models and is designed to shatter an internal horn and fire the mine upon release of mooring tension. It is possible that the "come-along" safety device might be fitted in conjunction with the white metal mooring switch to disarm the mine if the mooring switch failed to operate as designed, but no mines, so rigged, have been recovered.

Precautions

1. Never move the mine until the leads from the white metal mooring switch have been cut and taped.

(Mine Type CU, Cont'd.)

2. Bear in mind that the white metal mooring switch is designed to fire the mine charge upon release of mooring tension. Therefore, any mine of this type found floating or beached should have fired and may fire at any time.

RMS

1. Cut and tape separately each lead from the white metal switch to the detonator carrier.
2. Cut and tape separately each lead from the white metal switch to the arming switch.
3. Remove the detonator.
4. Remove the arming switch keep ring and the arming switch.
5. Unscrew the knurled cap from the top of the booster tube.
6. Unscrew the booster release mechanism wing nut, press back the catch, and remove the booster from the base of the mine.
7. Dispose of detonator, booster and charge.

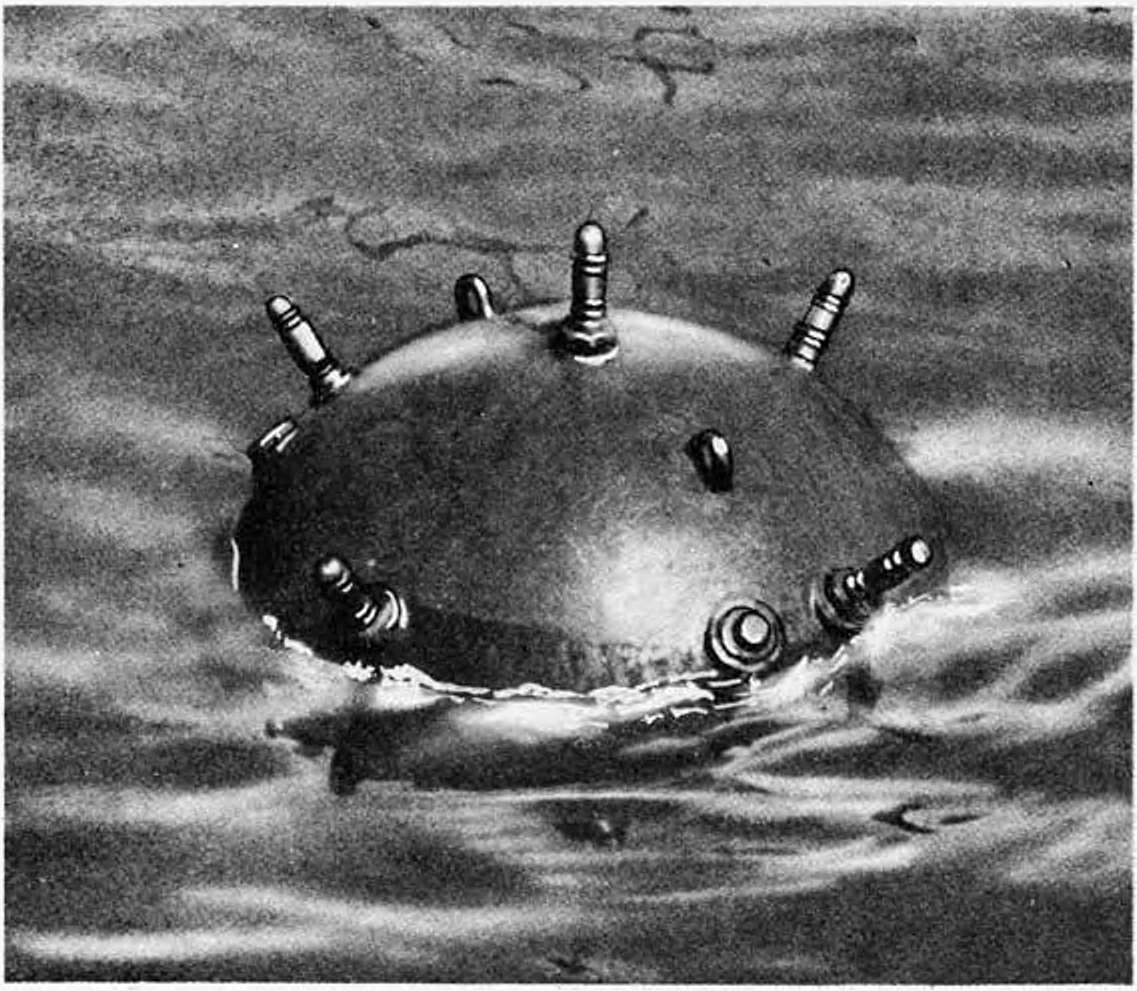


Fig. 33a - Mine Type CU, Floating

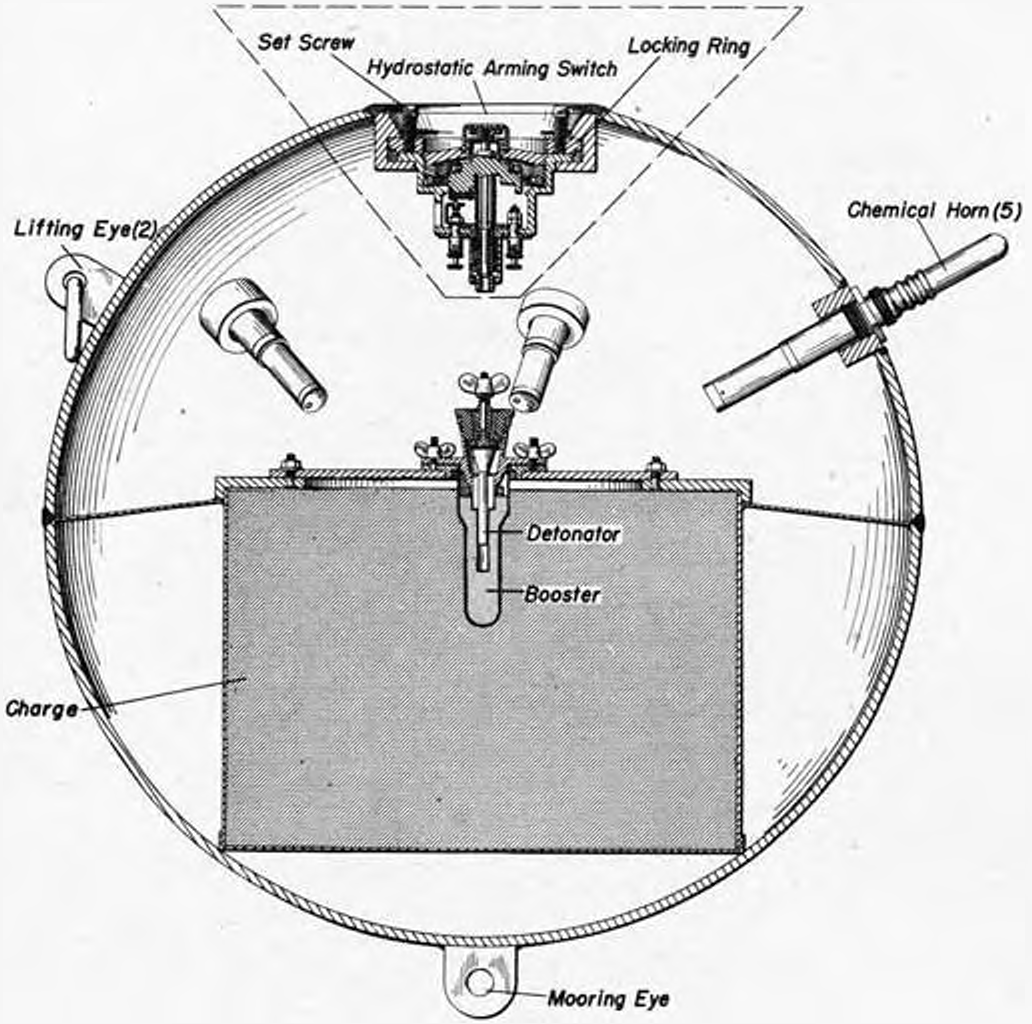


Fig. 34 - Mine Type GW, Sectional View

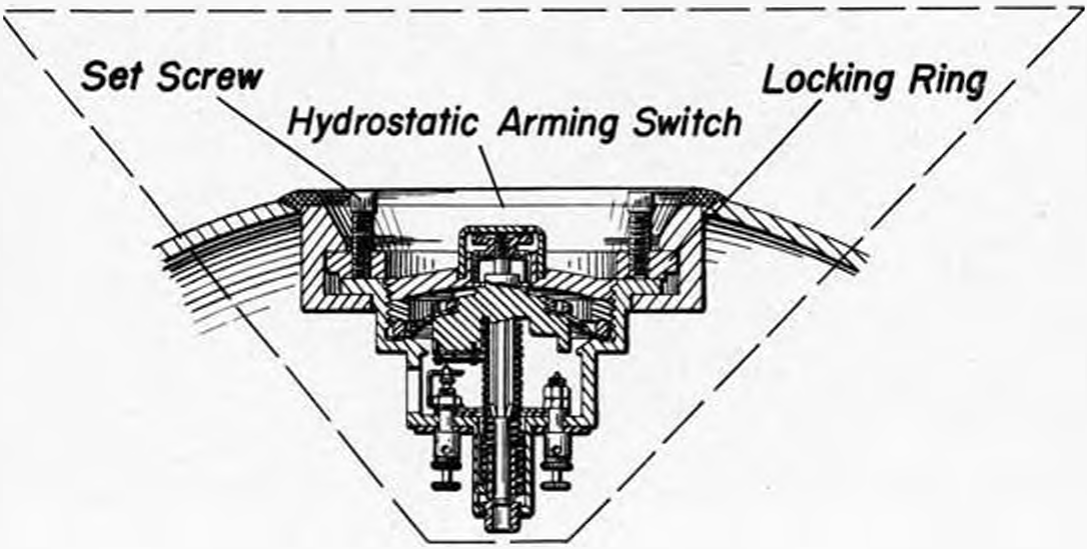


Fig. 35 - Mine Type GW, Hydrostatic Arming Switch

Mine Type GW

General

1. Moored, contact, chemical horn mine, laid by surface craft.
2. German designation unknown.
3. Defensive mine, for use in maximum depth of water of 300 ft. against surface craft.

Description

1. Case

Shape	Spherical
Color	Dark gray
Material	Steel
Diameter	34"
Charge	150 lbs. cast TNT or Hexanite.
Total weight in air	375 lbs. approx.

2. External fittings

Horns	Five, equally spaced around upper hemisphere, 15° from center.
Hydrostatic switch	7?5 diam., in pocket in center of upper hemisphere, secured by locking ring with four set screws.
Lifting eyes	Two, 180° apart, 19" from center of upper hemisphere. Fitted with lifting rings.
Mooring eye	In center of lower hemisphere.

Operation

1. Mine takes depth by plummet. Dissolution of a soluble plug allows water pressure to depress the spindle of the hydrostatic switch, closing the firing circuit and the mine is armed.
2. Standard chemical horn firing.
3. The only self-disarming device is the hydrostatic switch which is designed to disarm the mine by opening the firing circuit upon release of hydrostatic pressure.

Precautions

1. Note that the detonator and booster are permanently married.

RMS

1. Loosen the four set screws in the hydrostatic switch locking ring.
2. Break the bayonet joint and remove the locking ring.
3. Remove the hydrostatic switch; cut and tape all leads separately.
4. Remove the detonator and booster.
5. Dispose of detonator, booster and charge.

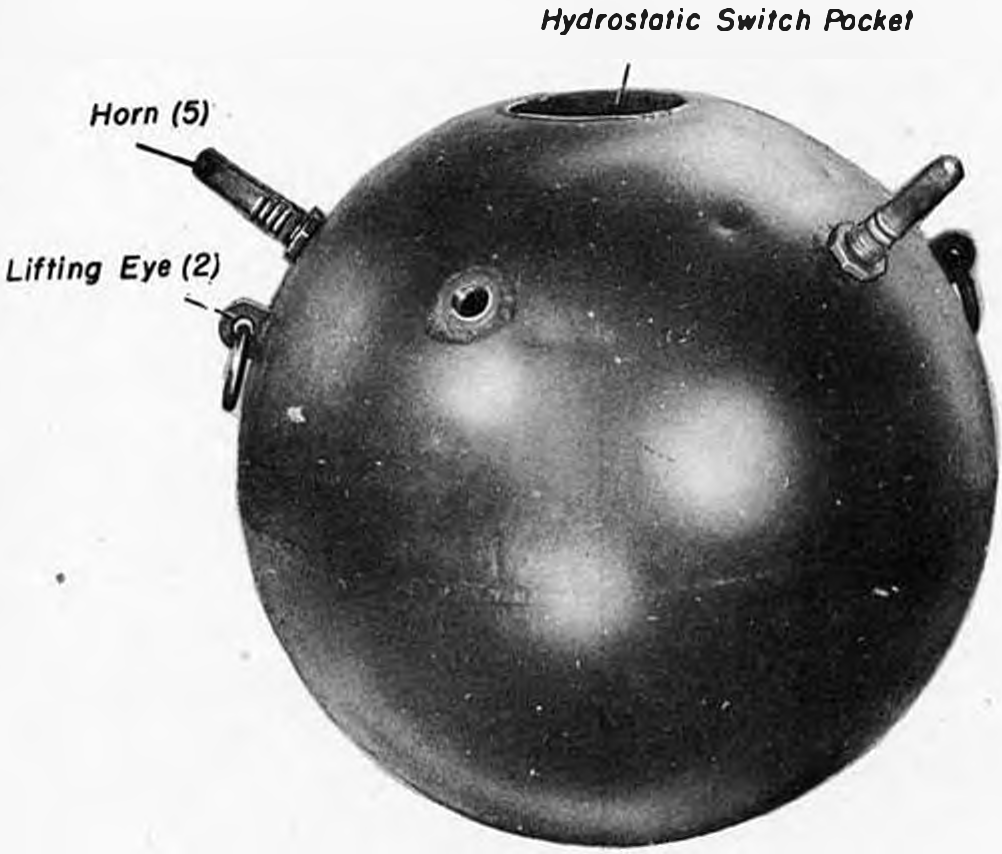


Fig. 36 - Mine Type OW

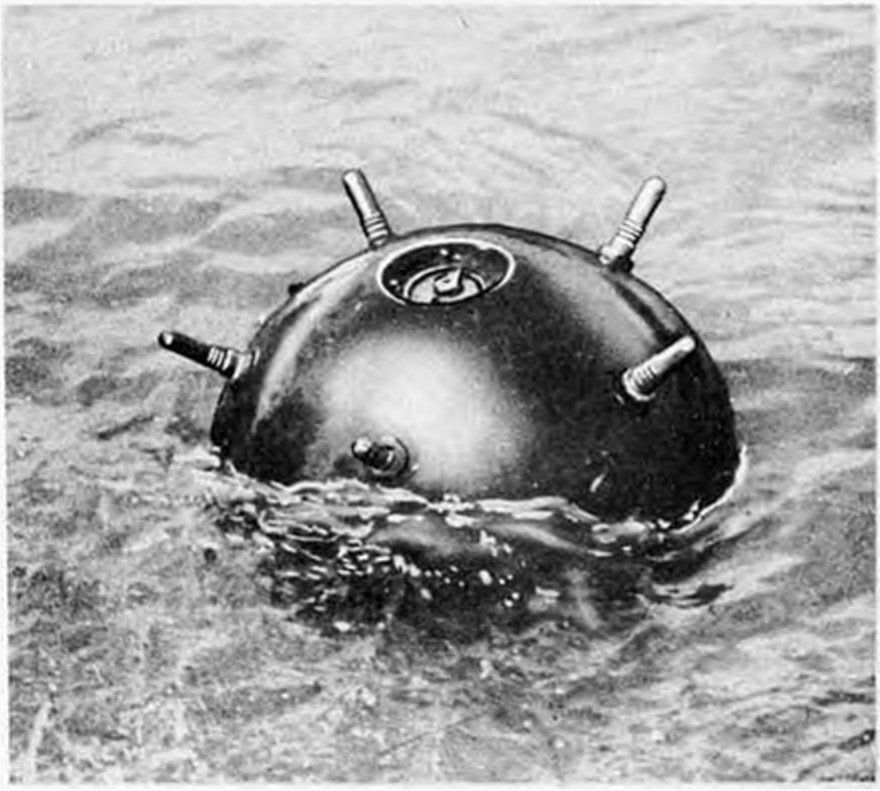


Fig. 37 - Mine Type OW, Floating

Mine Type GX (GX* GV)

General

1. Moored, contact, chemical horn mine, laid by surface craft.

2. German designation, "EMD".

3. Offensive or defensive mine, for use in maximum depth of water of 1700 ft.

Description

1. Case

Shape	Spherical
Color	Black
Material	Steel
Diameter	40"
Charge	330 lbs. block-fitted Hexanite.
Total weight in air	775 lbs. approx.

2. External fittings

Horns	Five; one in center of cover plate; four equally spaced around upper hemisphere, 20" from center.
Cover plate	7?5 diam., in center of upper hemisphere, flush type, secured by 10 bolts.
Base plate	Standard Type C.
Lifting eyes	Two, 16?5 apart, 22?5 from center of upper hemisphere.
Securing lugs	Five; one 22?5 from center of upper hemisphere; one 31" from center of lower hemisphere; three, staggered, 12" from center of lower hemisphere.

3. Mine Type GX* differs from Mine Type GX as follows:

   (a) It is fitted with an additional small cover plate, 6?5 diam., equidistant from the lifting eyes and 25" from the center of the upper hemisphere. Under this plate is a threaded boss which may take an explosive flooder. When the flooder is fitted, the horn on the cover plate is blanked off with a small plate, beneath which is an 80-day clock.

4. Mine Type GV differs from Mine Type GX* as follows:

   (a) Its German designation is, "EMD mit antennenzundung".

   (b) It is fitted with an upper antenna.

   (c) No horn is fitted to its cover plate. An electrode plate mounted on a plastic cover plate replaces the cover plate fitted to Mine Type GX*. The plastic cover plate is secured to the case by 10 bolts. An upper antenna connector is fitted to the plastic cover plate, 1/2" from the center. The 80-day clock and flooder may be fitted as in Mine Type GX*.

Operation

1. Mine takes depth by plummet. Mooring tension pulls out the mooring spindle, which closes the mooring safety switch, trips the booster release lever and arms the mine.

2. Standard chemical horn firing.

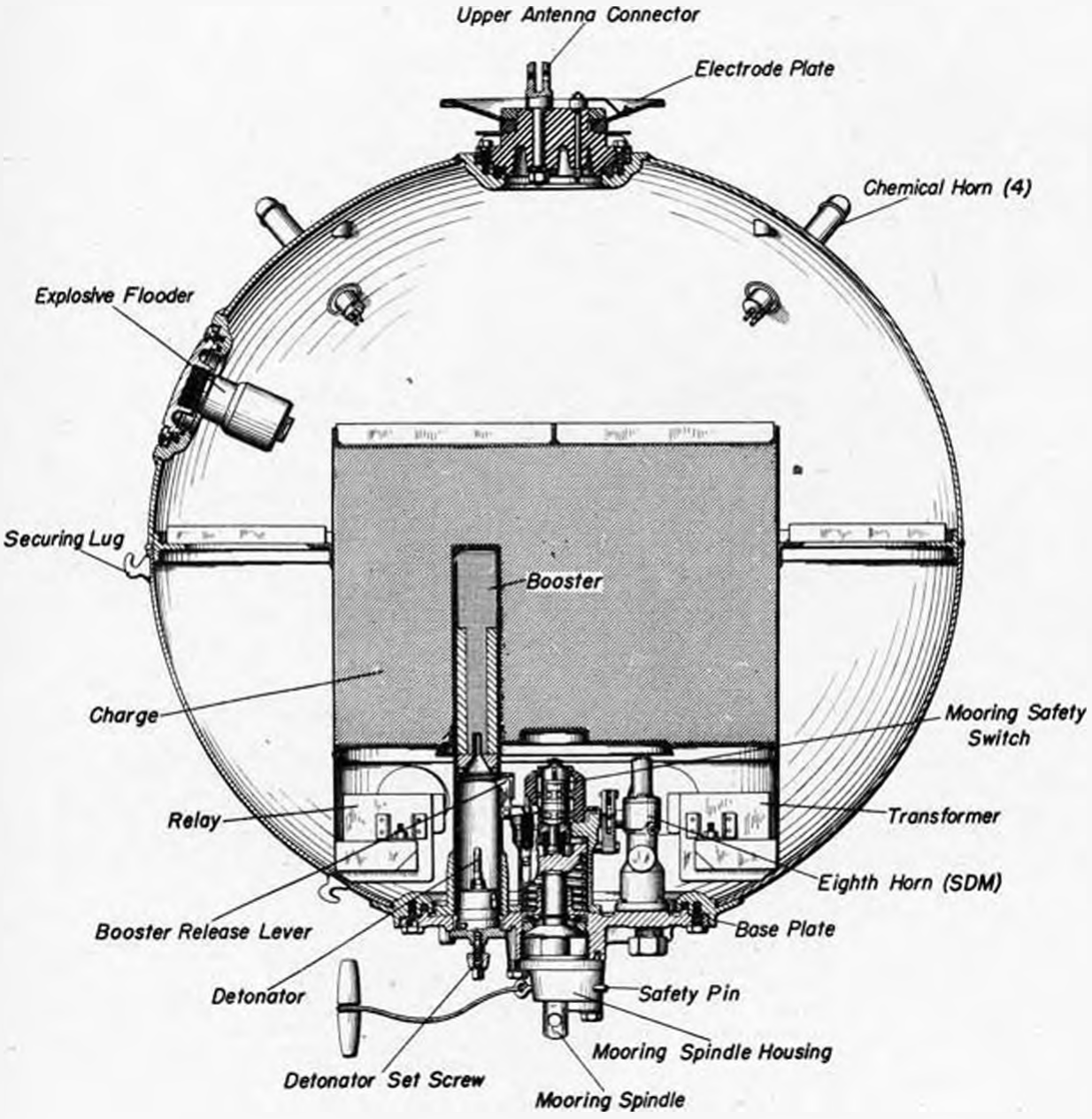


Fig. 38 - Mine Type CV, Sectional View

(Mine Type GX (GX* GV), Cont'd.)

3. The only self-disarming device is the mooring safety switch which is designed to disarm the mine by opening the firing circuit upon release of mooring tension. If the "A-E" switch is set to "E", however, the mine should fire upon release of mooring tension.

Precautions

1. See Introduction.

RMS

1. Remove the detonator and booster (see Introduction).
2. Remove the base plate; cut and tape each lead separately.
3. Remove the flooder plate and charge (if fitted).
4. Remove the cover plate and the 80-day clock (if fitted).
5. Dispose of all explosive elements.

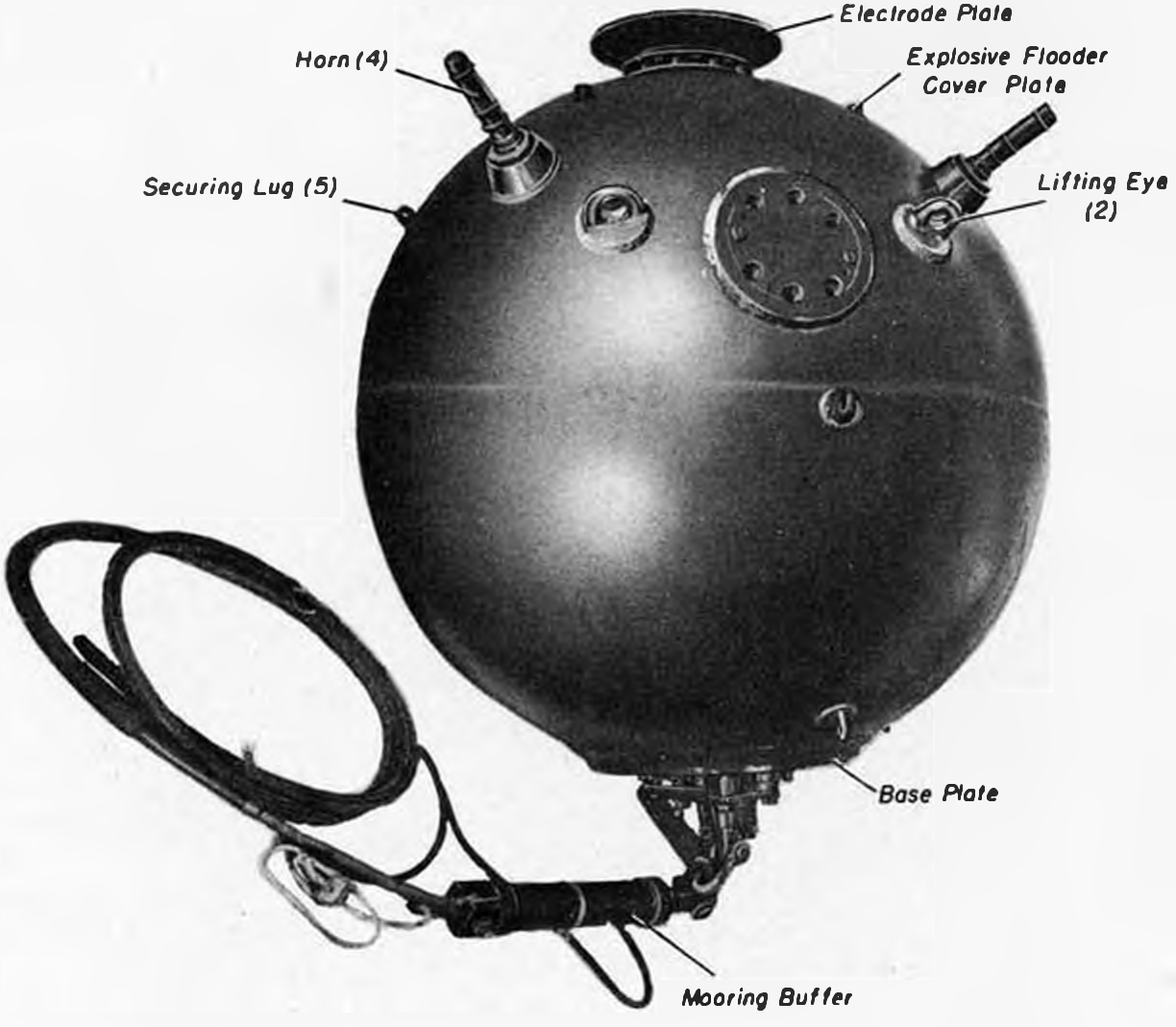


Fig. 39 - Mine Type GV

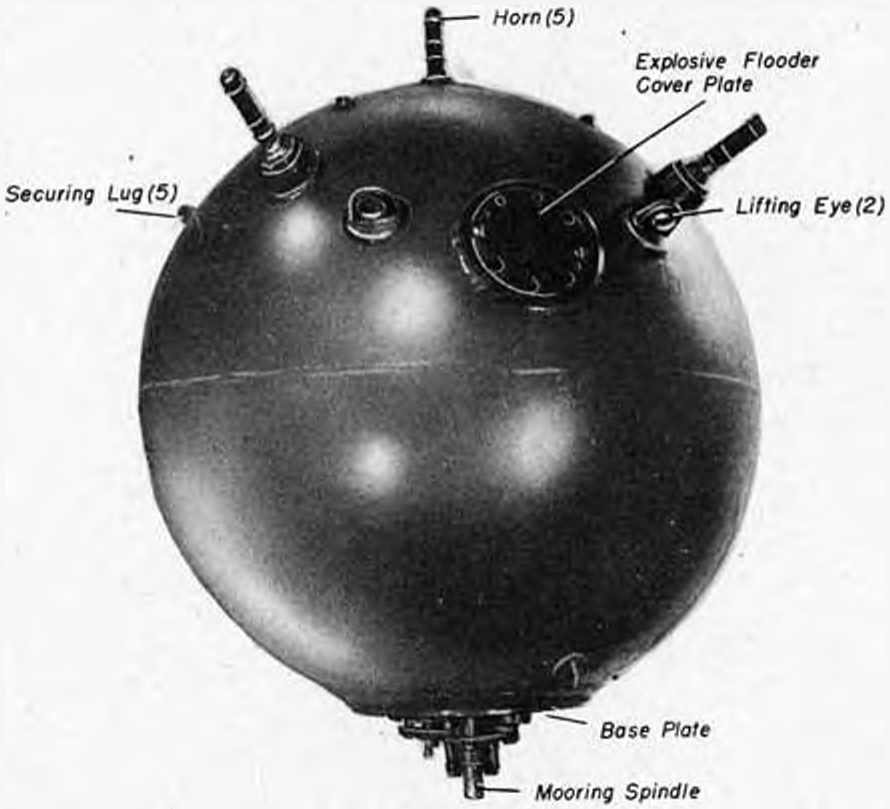


Fig. 40 - Mine Type CX*

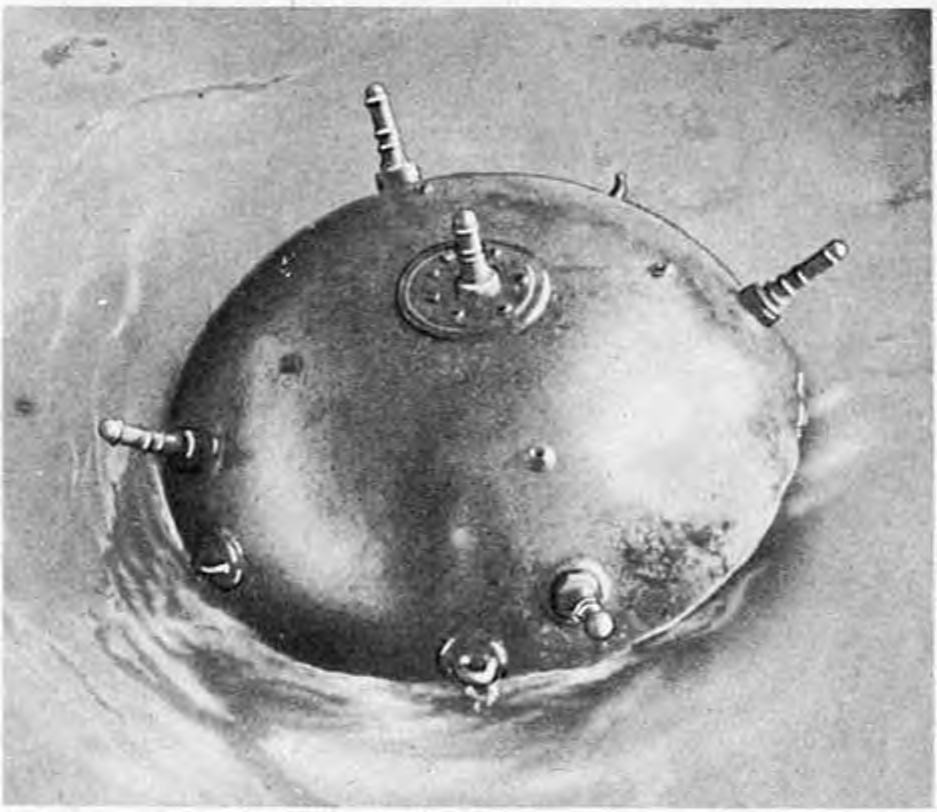


Fig. 41 - Mine Type CX*, Floating

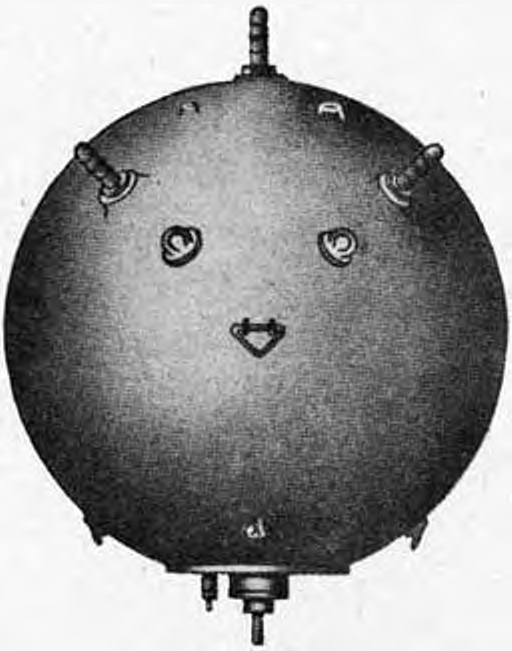


Fig. 42 - Mine Type GX.

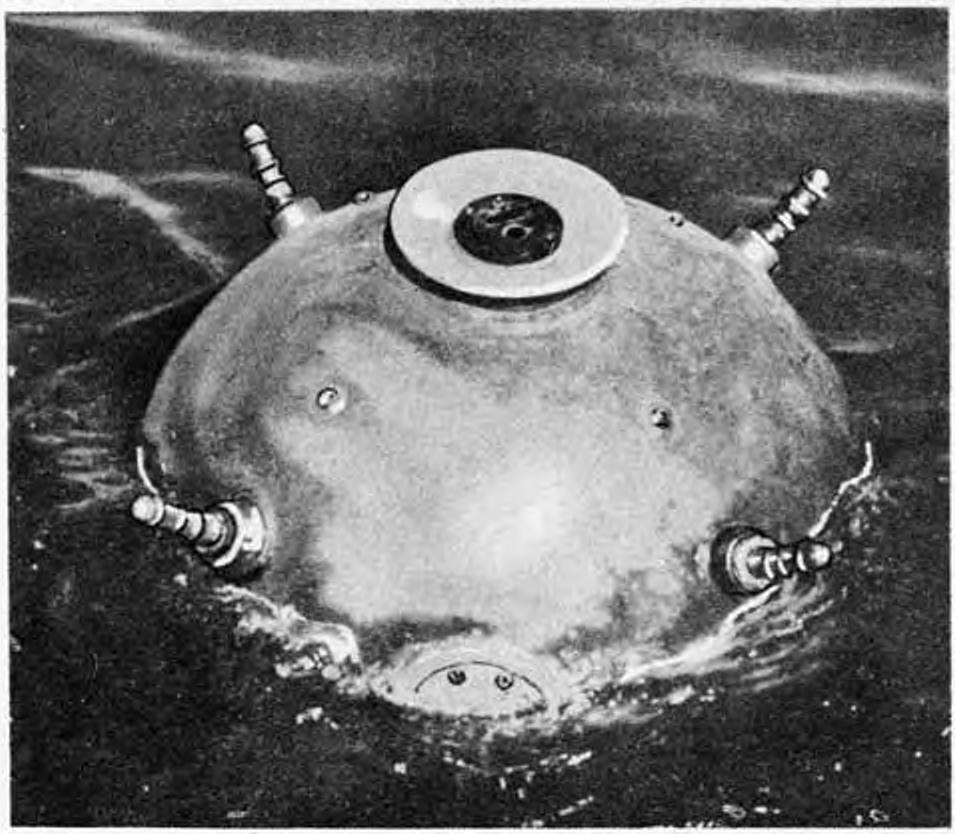


Fig. 43 - Mine Type GV, Floating

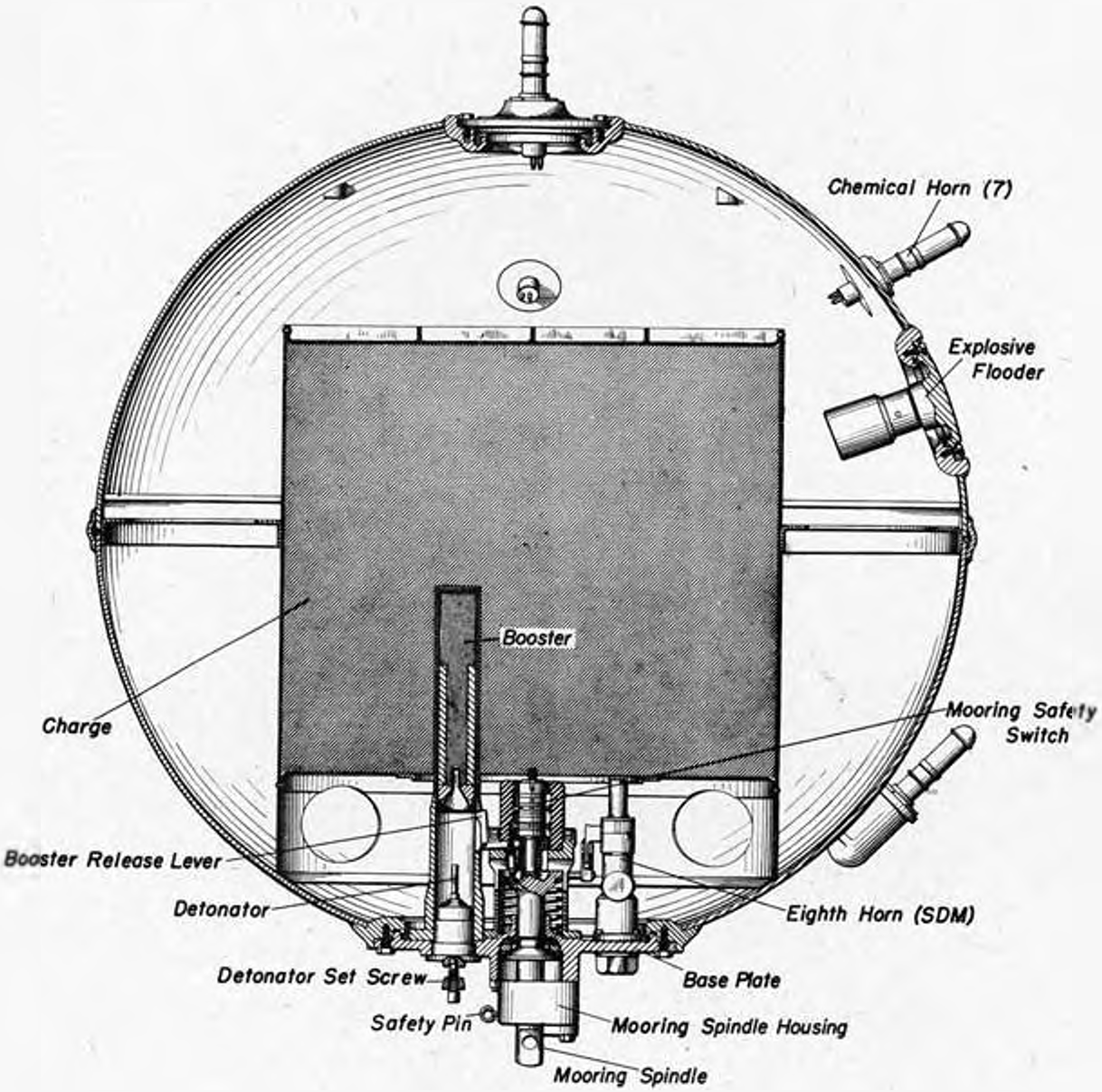


Fig. 44 - Mine Type GY*, Sectional View

Mine Type GY (GY*) (GV*)

General

1. Moored, contact, chemical horn mine, laid by surface craft.

2. German designation, "EMC".

3. Offensive or defensive mine, for use in maximum depth of water of 1700 ft. Maximum depth of case when moored is 100 ft.

Description

1. Case

Shape	Two hemispheres, joined by a 2" cylindrical mid-section.
Color	Black
Material	Steel
Diameter	46"
Length	48"5
Charge	660 lbs. block-fitted Hexanite.
Total weight in air	1390 lbs.

2. External fittings

Horns	Seven: one in center of cover plate; four equally spaced around upper hemisphere, 22" from center; two, on brackets, 39" apart, 17" from center of lower hemisphere.
Cover plate	7 1/2" diam., in center of upper hemisphere, flush type, secured by 10 bolts.
Base plate	Standard type C.
Lifting eyes	Two, 19" apart, 22" from center of upper hemisphere.

3. This mine has been found rigged as follows:

   (a) All lower horns blanked off.

   (b) The horn on the cover plate replaced by a plate fitted with an eye to which was attached a 10 ft. wire pendant and an elliptical float.

   (c) The spring omitted from the base plate resulting in permanent closure of the mooring safety switch upon planting.

   (d) Concrete ballast poured around the charge case to reduce the buoyancy.

   (e) A metal, ring-shaped weight, weighing 236 lbs., secured to the mooring cable.

   (f) An R.A.M. clock fitted inside the base plate, the clock being started by turning the "A-S" switch to "E".

   (g) A "tombac" anti-sweep device fitted to the mooring cable (see Mine Type GR).

4. Mine Type GY* differs from Mine Type GY as follows:

   (a) It is fitted with an additional small cover plate, 6"5 diam., equidistant from the lifting eyes and 28" from the center of the upper hemisphere. Under this plate is a threaded boss which may be fitted with an explosive flooder.

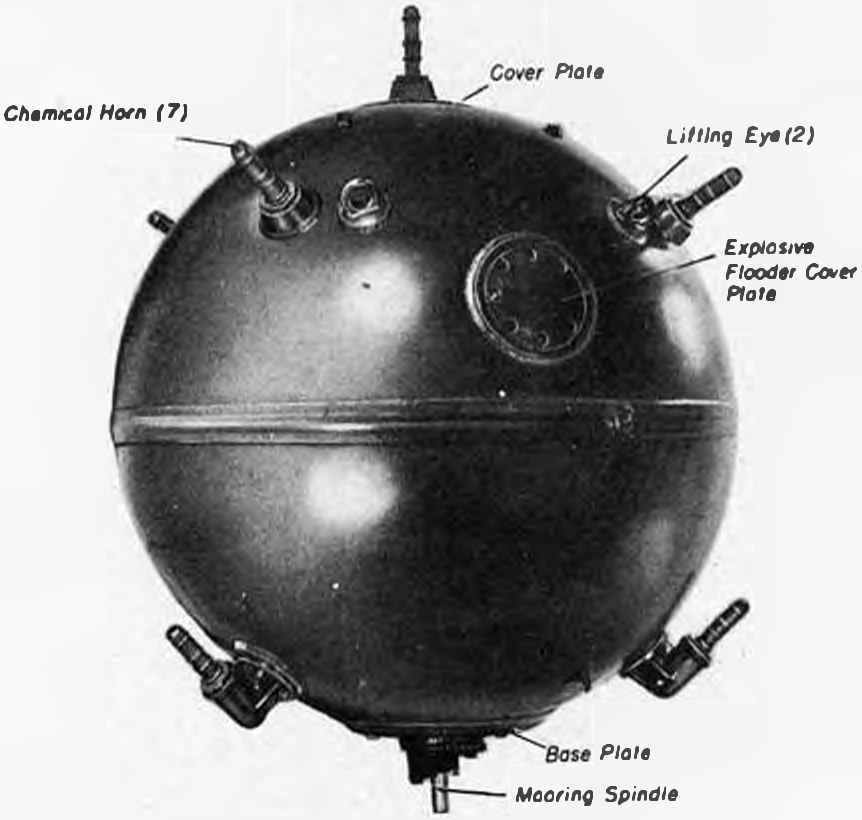


Fig. 45 - Mine Type GY*

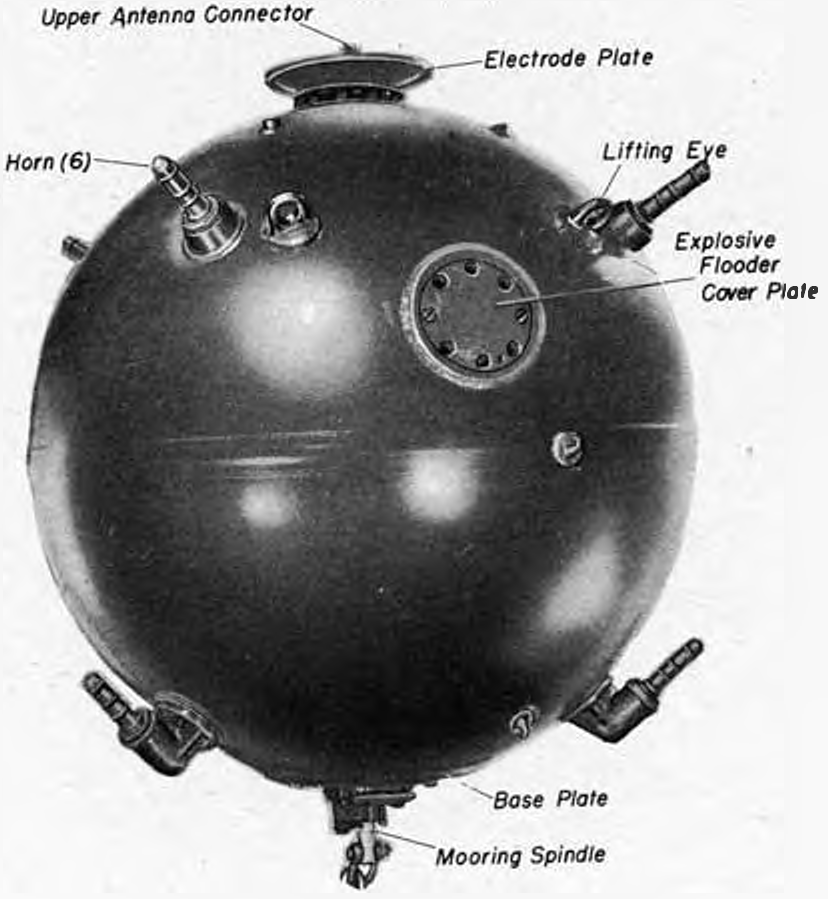


Fig. 46 - Mine Type GV*

(Mine Type GY (GY*) (GV*), Cont'd.)

5. Mine Type GV* differs from Mine Type GY* in that it is fitted with the antenna attachments used with Mine Type GV. Its German designation is, "EMC mit antennenzundung".

Operation

1. Mine takes depth by plummet. Mooring tension pulls out the mooring spindle, closing the mooring safety switch, tripping the booster release lever and the mine is armed.

2. Standard chemical horn firing.

3. The only self-disarming device is the mooring safety switch which is designed to disarm the mine by opening the firing circuit upon release of mooring tension. If the "A-E" switch is set on "E", however, the mine should fire upon release of mooring tension.

Precautions

1. If the mine is rigged as in Par. #3 of Description above, it will never disarm and is therefore especially dangerous if found floating or in the surf.

RMS

1. Same as Mine Type GX.

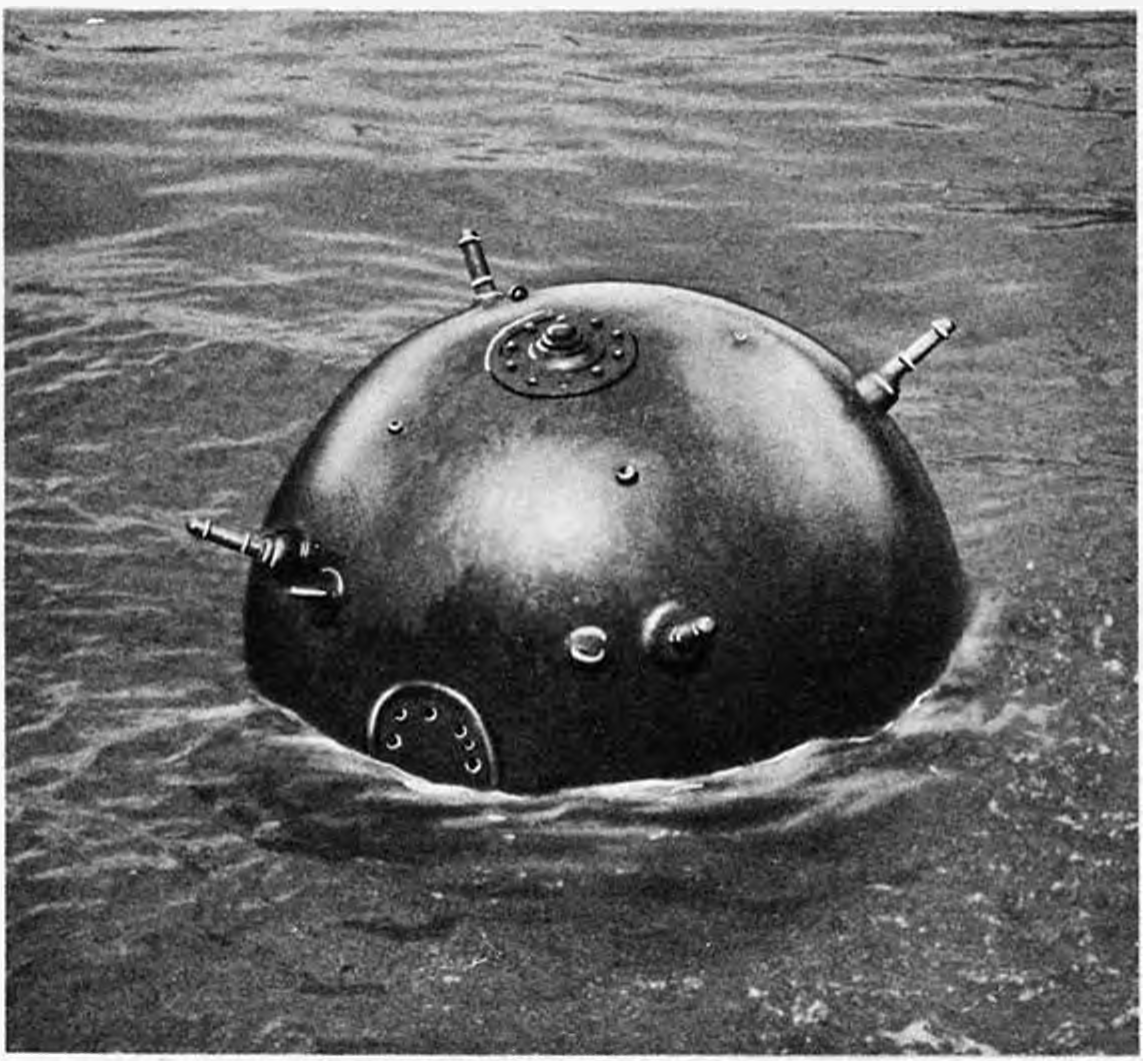


Fig. 47 - Mine Type GY, Floating

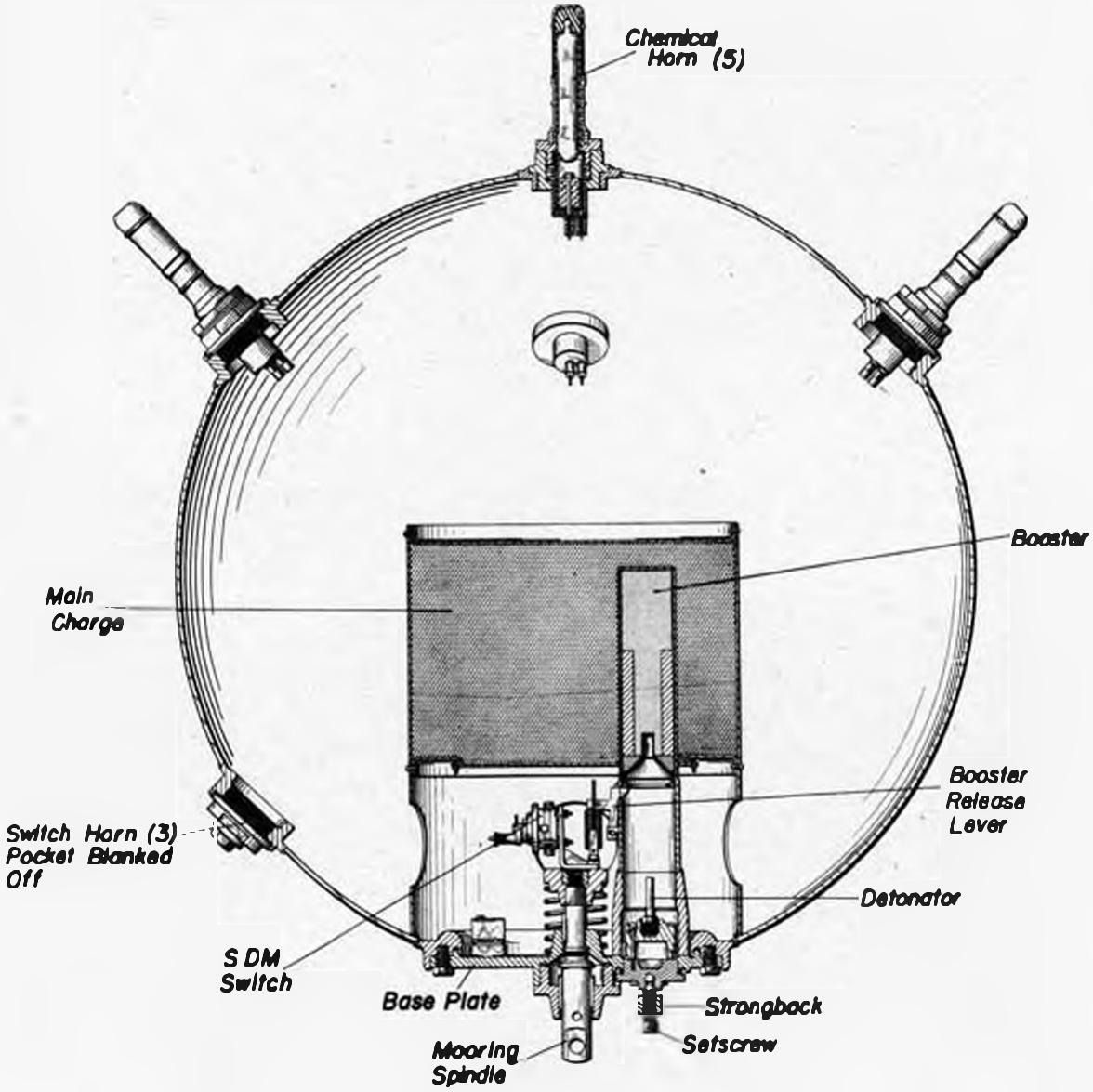


Fig. 48 - Mine Type GZ, Sectional View

Mine Type C2

General

1. Moored, contact, chemical and switch horn mine, laid by surface craft.
2. German designation, "UMA".
3. Defensive mine, for use in maximum depth of water of 350 ft.

Description

1. Case

Shape	Spherical
Color	Black
Material	Steel
Diameter	32"
Charge	66 lbs. block-fitted Hexanite.
Total weight in air	350 lbs. approx.

2. External fittings

Horns	Eight: one chemical, in center of upper hemisphere; four, chemical, equally spaced around upper hemisphere, 15 1/2" from center; three, switch, equally spaced around lower hemisphere, 17" from center.
Base plate	Standard Type D.
Lifting eye	One, 19" from center of upper hemisphere.
Lifting lug	One, 180° from lifting eye, 19" from center of upper hemisphere.

3. This mine has been found rigged as follows:
   (a) The entire case surface camouflaged with green and white paint.
   (b) All switch horns blanked off and the "A-Z" switch and switch horn battery omitted.
   (c) A metal, ring-shaped weight, weighing 194 lbs., secured to the mooring cable which may prevent the mooring spindle from retracting upon release of mooring tension.

Operation

1. Mine takes depth by plummet. Mooring tension pulls out the mooring spindle, closing the mooring safety switch, tripping the booster release lever and the mine is armed.
2. Standard chemical or switch horn firing.
3. The only self-disarming device is the mooring safety switch which is designed to disarm the mine by opening the firing circuit upon release of mooring tension. If the "A-Z" switch is set on "Z", however, the mine should fire upon release of mooring tension.

Precautions

1. If the mine is rigged as in Par. 3 of Description above, it probably will never disarm and is therefore especially dangerous if found floating or in the surf.

RMS

1. Remove the detonator and booster (see Introduction).
2. Remove the base plate; cut and tape each lead separately.
3. Dispose of detonator, booster and charge.

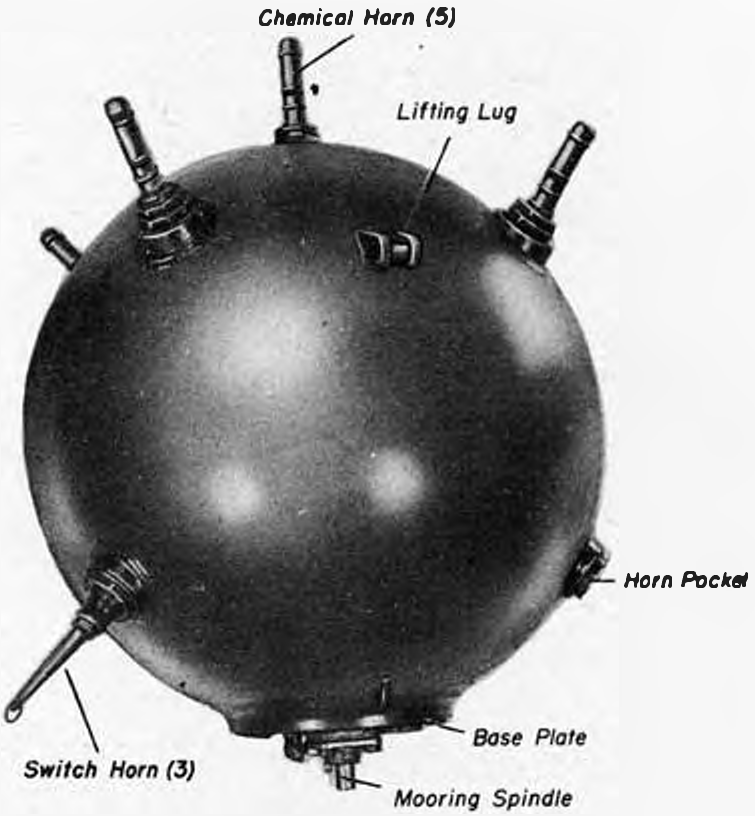


Fig. 49 - Mine Type GZ

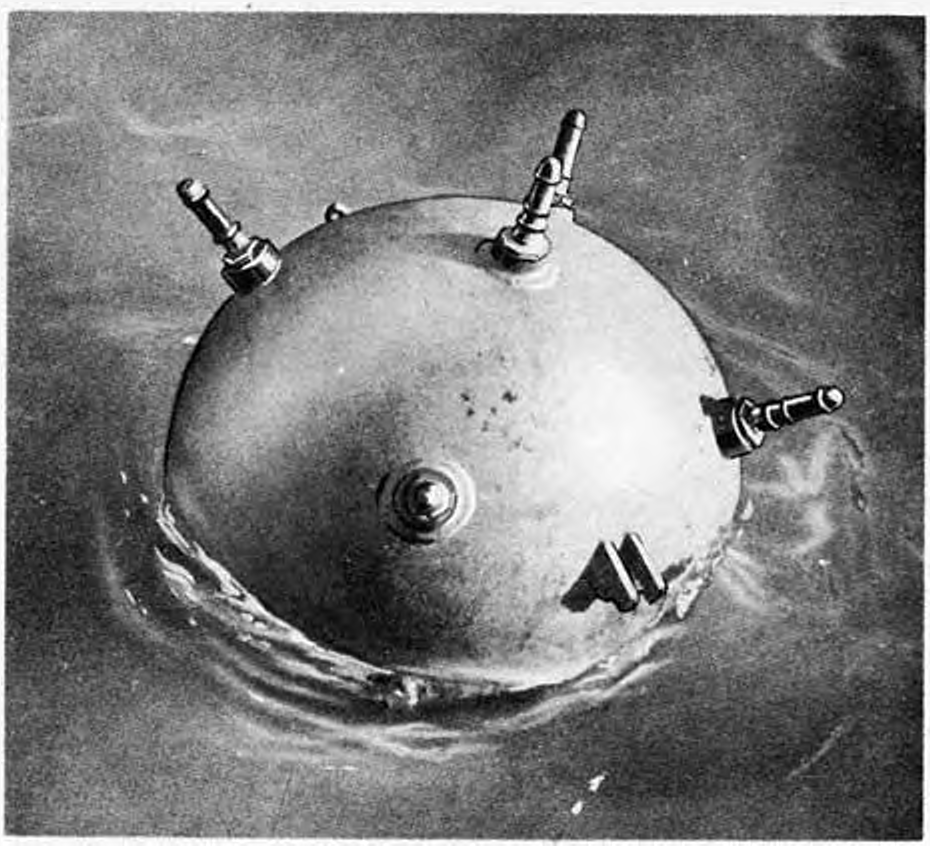


Fig. 50 - Mine Type GZ, Floating

MINE DISPOSAL HANDBOOK

Torpedoes

PART IV

GERMAN UNDERWATER ORDNANCE

. . . . . .

CHAPTER 3

GERMAN TORPEDOES

MARCH 1, 1945

Type	Length (in)	Diameter (in)	Location Pocket	Dimensions Exploder Pocket			Exploder Used	Material	Torpedo Used With	Markings	Provision for Securing Exploder
				Depth (in)	Diameter Inner (in)	Diameter Outer (in)					
Ka	46	21	Nose	22 1/2	4 1/4	7 1/2	P1-1 G7A-AZ G7A-MZ	Steel	T1, T2	Ka	4 holding screws
Kb	46	21	Nose	29	5 1/2	7 1/2	P1-2, P1-2c	Bronze	T3	Kb, S18 or S2	4 holding screws
Kc	46	21	Nose	9 1/2	5 1/2	8 1/2	P1-3	Steel	T1	Kc, S1/S2 or S2	6 screw holes
Kc1	46	21	Nose	16 1/2	5 1/2	8 1/2	P1-3	"	T1	Kc1, S2	"
Ke1	41	21	Top center line	13	3 1/2		P1-4c	"	T5	Ke1, S2	3 screw holes
Ke	41	21	Top center line	13	3 1/2		P1-4c	"	T5	Ke, S1/S2	"
F5b (Shallow Pocket)	49	18	Nose	7 1/4	4	6	F5S	"	F5b	None	Threads for keep ring
F5b (Deep Pocket)	49	18	Nose	19	4	6	F5S (?)	Bronze	F5b	"	"
GK2	49	18	(1) Nose (2) Top center line	(1) 7 (2) 16 1/2	(1) 3 3/4 (2) 2 1/4	(1) 5 3/4 (2) 3 1/2	(1) P142a (2) SIC Activator	Steel	Aircraft	GK2	(1) Threads for keep ring (2) Screw holes
GK3	49	18	Nose	11	3 3/4	5 3/4	P142a(e1)	"	"	GK3	Threads for keep ring

Table 1 - German Torpedo Warheads

Exploder	How Fired	Warhead Location	Arming Range(m)	No. of Whiskers	Warhead Known Used In	Remarks
Pi-1	Impact	Nose	150 or 300	4	Ka	
Pi-1c	"	"	"	None	Ka	
Pi-2	Impact Magnetic	"	"	4	Kb	
Pi-2c	"	"	"	None	Kb	
Pi-3	"	"	"	4	Kc	
Pi-4c	Inertia Magnetic	Top	Not known	None	Ke Kel	
Pi42s	Inertia	Nose	"	"	GK2	
Pi42s(el)	Inertia Magnetic	"	"	"	GK3	
F.5.S.	Impact	"	"	4	"F5B"	
G7A-A2	"	"	150 or 300	4	Ka	Obsolete
G7A-M2	Impact Magnetic	"	"	4	Ka	Obsolete

Table 2 - German Torpedo Exploders

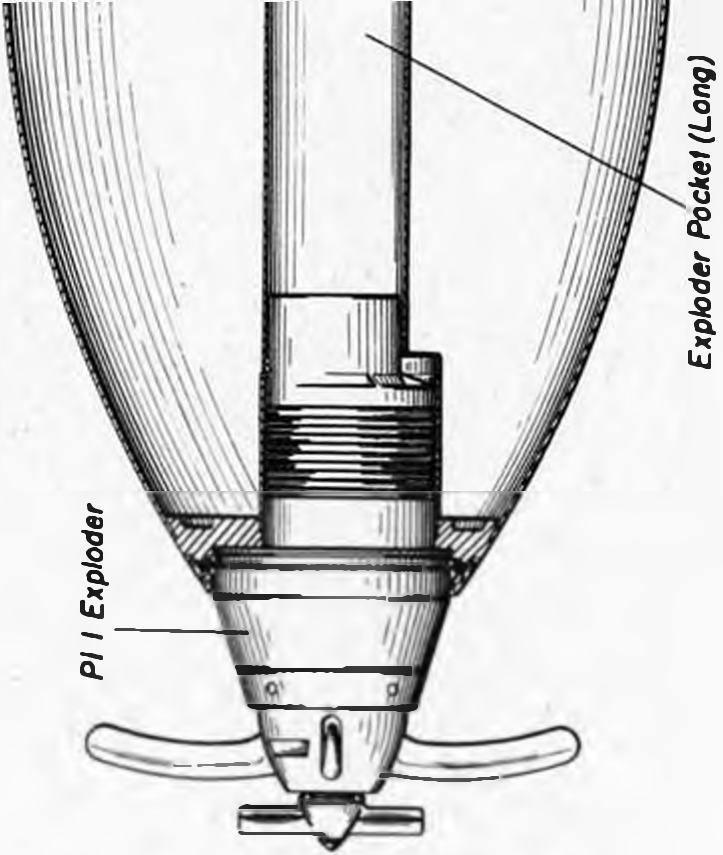
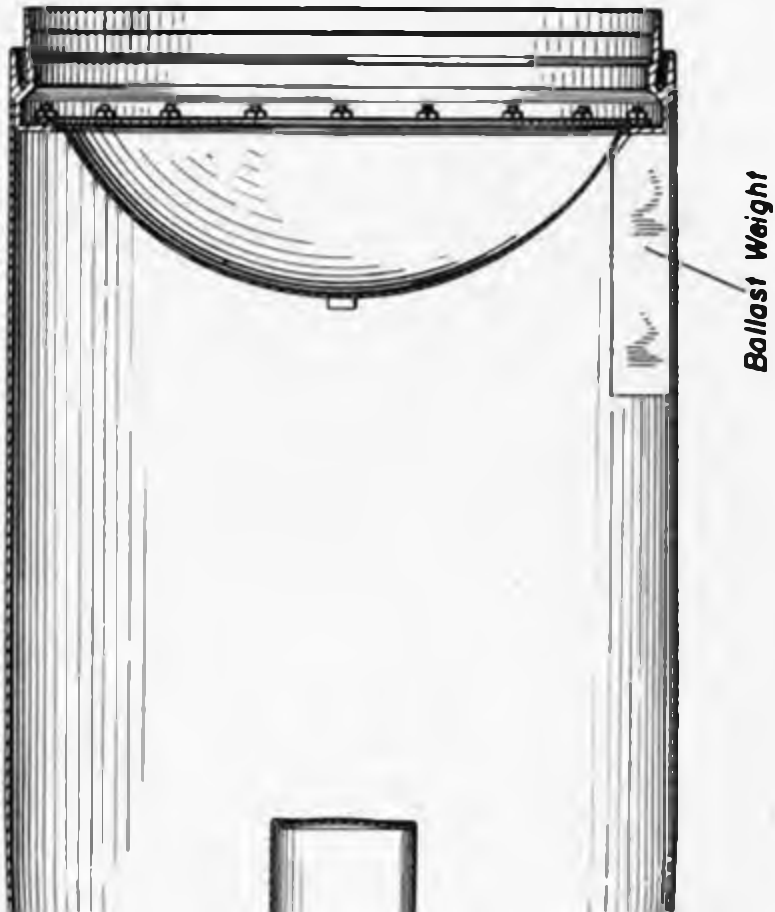


Fig. 1 - Ka Warhead, Sectional View


Ballast Weight

Introduction

1. The torpedoes of the German Navy and Luftwaffe are 21" (53.3 cm) and 18" (45 cm) in diameter respectively and represent some of the most advanced stages of torpedo development now in service. All aircraft-launched torpedoes are air-driven, while all the submarine-launched torpedoes, except T-1 which is air-driven, utilize electric drive.

2. These torpedoes incorporate many intricate mechanisms which provide for eccentric tracking, homing on acoustic actuations and other actions of a similarly complex nature. Detailed information on the various torpedoes will not be presented here. This chapter will deal in detail with warheads and exploders only.

German Warheads

General

1. The accompanying table gives pertinent data with regard to all German warheads concerning which comprehensive information is available. It is possible for the various warheads to be used with many different torpedoes in various combinations. For this reason, and because the German policy with respect to use of warheads with torpedoes is not definitely known in all cases, the column headed, "Torpedoes Used With", lists only those torpedoes with which the warhead may definitely be assumed to be used, the information being verified either by recovery or reliable intelligence sources.

2. As noted in the table, the warhead designation is marked in black or grayish-white paint near the nose, along with various combinations of numerals with the letter "S". The significance of the latter is not known. In addition to these markings, many warheads contain a small, bronze plate on the warhead shell near the nose. This plate contains the warhead serial number and other data. A discussion of the various special fittings and accessories on and in the warheads follows below.

Kb Warhead

1. External

   (a) Four screw holes, 9" abaft the nose, for securing the after ends of net cutters.

   (b) Four single-lead jacks alongside the exploder pocket for receiving corresponding plugs on the exploder.

2. Internal

   (a) A conduit, containing an electric cable, extends from the jacks to a battery connection projecting through the after bulkhead of the warhead.

Kc Warhead

1. External

   (a) Four single-lead jacks alongside the exploder pocket as on Kb.

2. Internal - the following fittings are located between the after bulkhead of the warhead and the charge bulkhead:

   (a) Two detecting coils, 4 1/2" in diameter, slightly forward of the after bulkhead on the top and bottom center lines, respectively.

   (b) An amplifier unit on the starboard side and a battery on the port side.

   (c) An air pressure switch on the charge bulkhead.

   (d) A junction box on the charge bulkhead.

   (e) Cables and leads as follows:

      (1) A cable from each coil to the junction box.

      (2) A cable from the junction box to the amplifier.

      (3) A cable from the battery to the amplifier.

      (4) A cable from the amplifier to the air pressure switch.

      (5) A cable from the air pressure switch to the jack plugs.

      (6) An air pressure line from the air pressure switch to a hole in the after bulkhead flange.

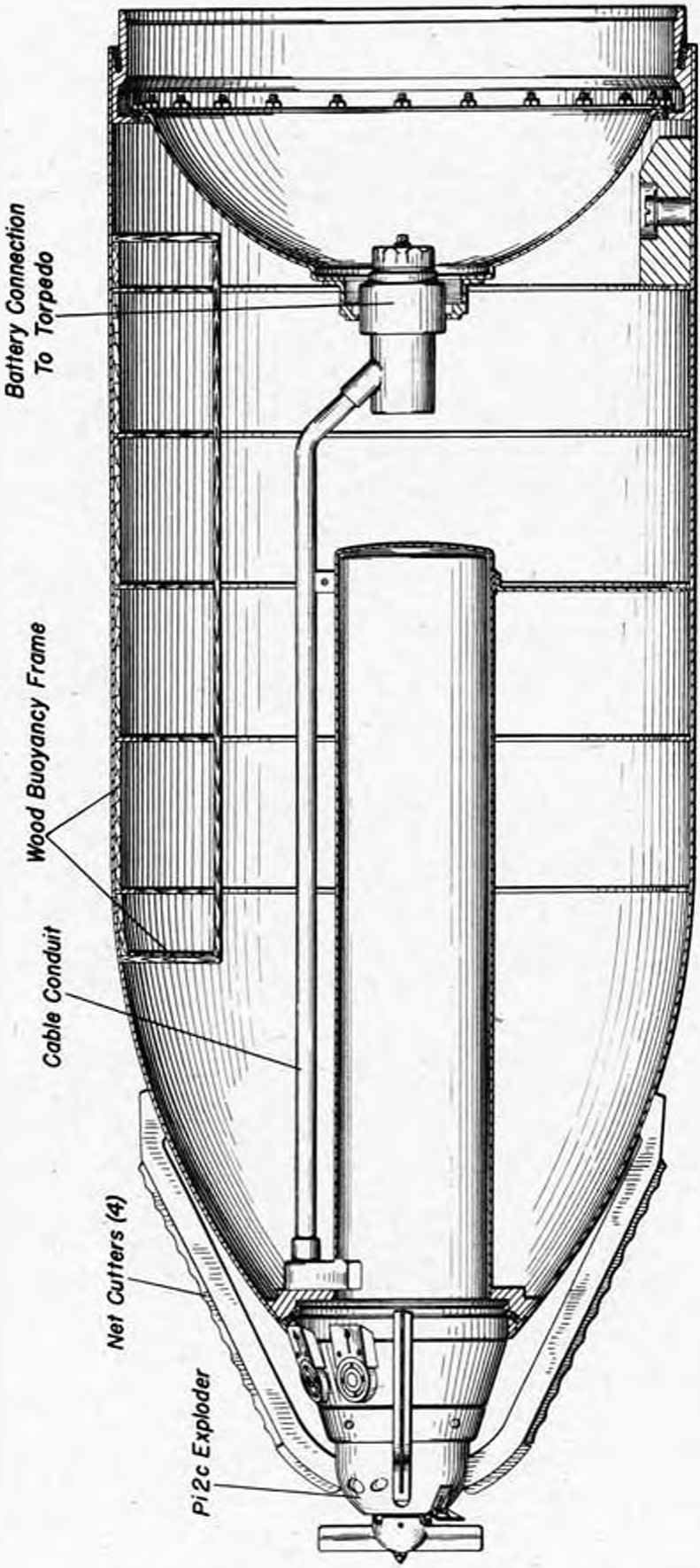


Fig. 2 - Kb Warhead, Sectional View

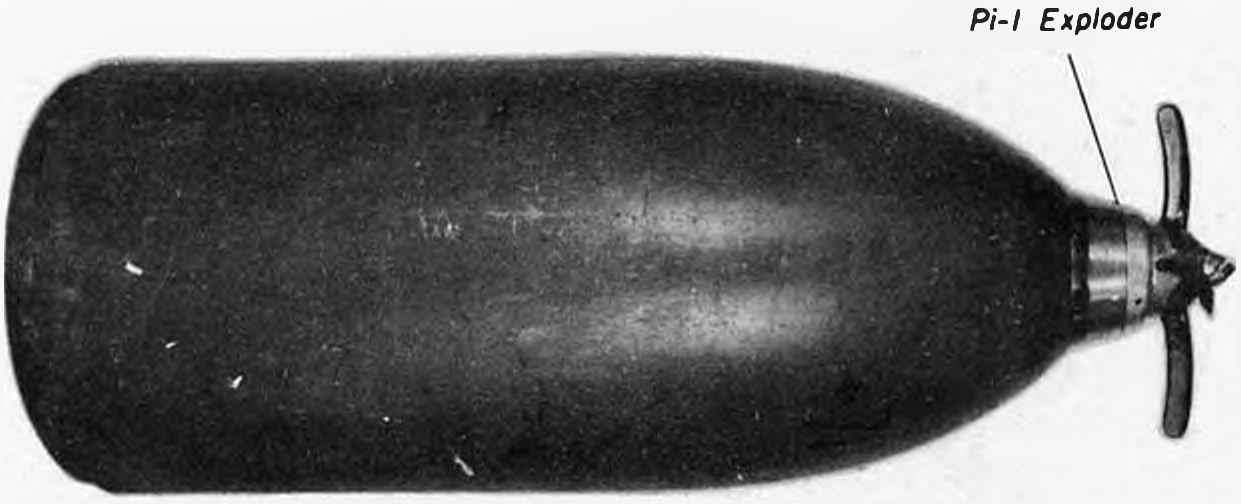


Fig. 3 - Ka Warhead

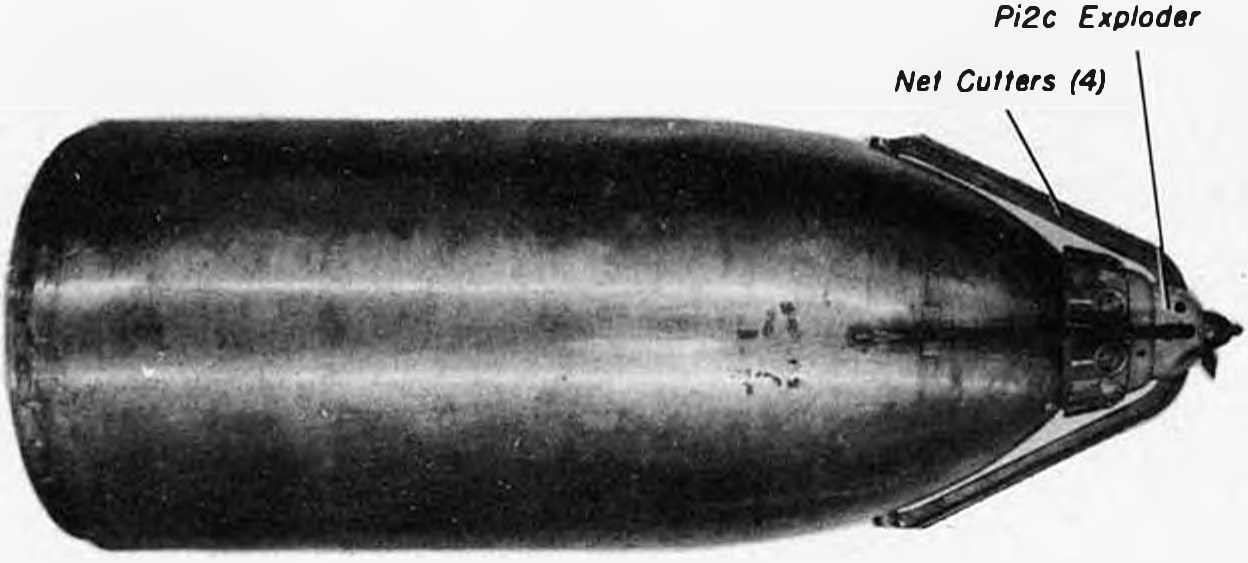


Fig. 4 - Kb Warhead

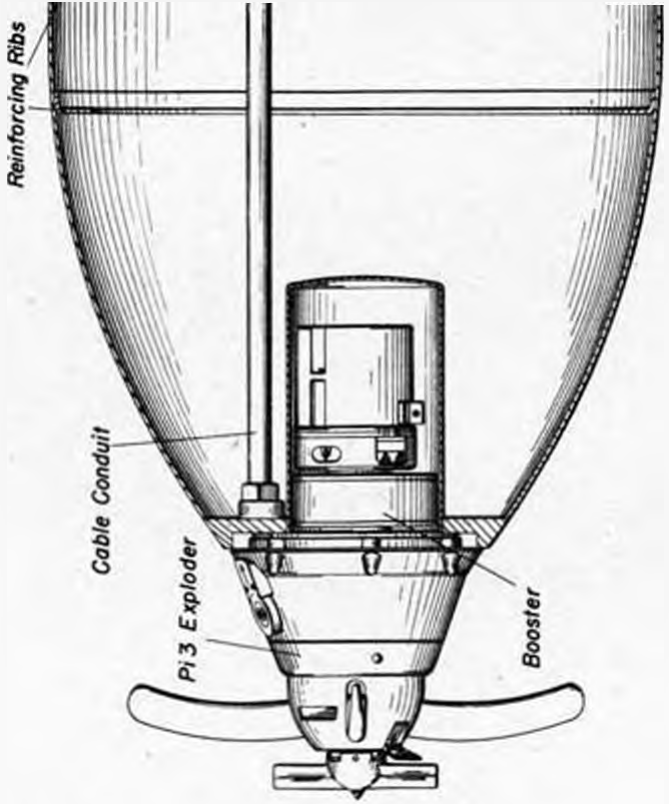
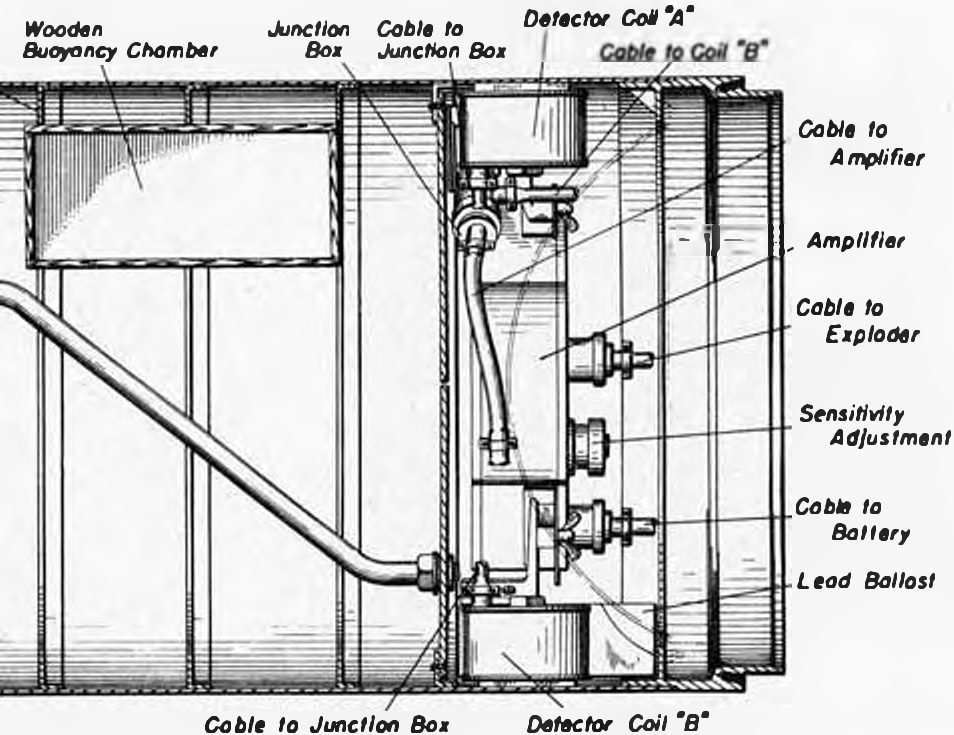


Fig. 5 - Kc Warhead, Sectional View


Wooden Buoyancy Chamber
Junction Box
Cable to Junction Box
Detector Coil "A"
Cable to Coil "B"
Cable to Amplifier
Amplifier
Cable to Exploder
Sensitivity Adjustment
Cable to Battery
Lead Ballast
Cable to Junction Box
Detector Coil "B"

German Warheads (Cont'd.)

Kc1 Warhead

1. This warhead differs from Kc as follows:

   (a) Its exploder pocket is deeper.

   (b) It is fitted with screw holes for securing net cutters, placed as on Kb.

Ke1 Warhead

1. External - this warhead differs from all others recovered in that it does not comprise the nose section of the torpedo to which it is fitted, additional torpedo control gear being fitted forward of the warhead. Fittings are as follows:

   (a) Two cover plates, 10 3/4" in diameter and secured by 16 bolts, on the top and bottom center lines, respectively, 7" abaft the forward edge.

   (b) An impeller trough, 3" long and 1 1/2" wide, next to the exploder pocket.

2. Internal

   (a) Two detector coils mounted under the respective cover plates.

   (b) A junction box on the flange to which the after bulkhead secures.

   (c) A spring-loaded pin protruding through the bottom of the impeller trough

   (d) A solenoid around the bottom of the spring-loaded pin.

   (e) An activator coil around the exploder pocket.

   (f) A plug on the forward bulkhead.

   (g) Cables as follows:

      (1) One from the junction box to the solenoid.

      (2) One from the junction box to the activator coil.

      (3) One from the junction box to a thin cavity along the after edge of the exploder pocket.

      (4) One from a hole in the after bulkhead flange through a conduit to the plug on the forward bulkhead.

      (5) One from a hole in the after bulkhead flange to each detector coil.

      (6) Two from holes in the after bulkhead flange to the junction box.

Ke Warhead

1. This warhead is very similar to the Ke1, the main difference being that only one detector coil is fitted.

F5b Warhead

1. This warhead's German designation and the pistol ordinarily used with it are not definitely known, although an F.5.S. pistol may be fitted to the shallow pocket model. The warhead is arbitrarily designated, "F5b", because it is known to be used with the torpedo so designated. No special fittings are incorporated in either the shallow or deep pocket model.

GK2 Warhead

1. External

   (a) An SIC activator pocket 3 7/8" in diameter, on the top center line, 20 1/2" from the after edge.

   (b) A pin fitted with a cross arm on top is mounted on each side of the activator pocket. A safety bar fitted with a spring and water flap is suspended between the pins prior to launching and serves to prevent the activator impeller from rotating.

2. Internal - this warhead is very similar internally to the Kc, differing as follows:

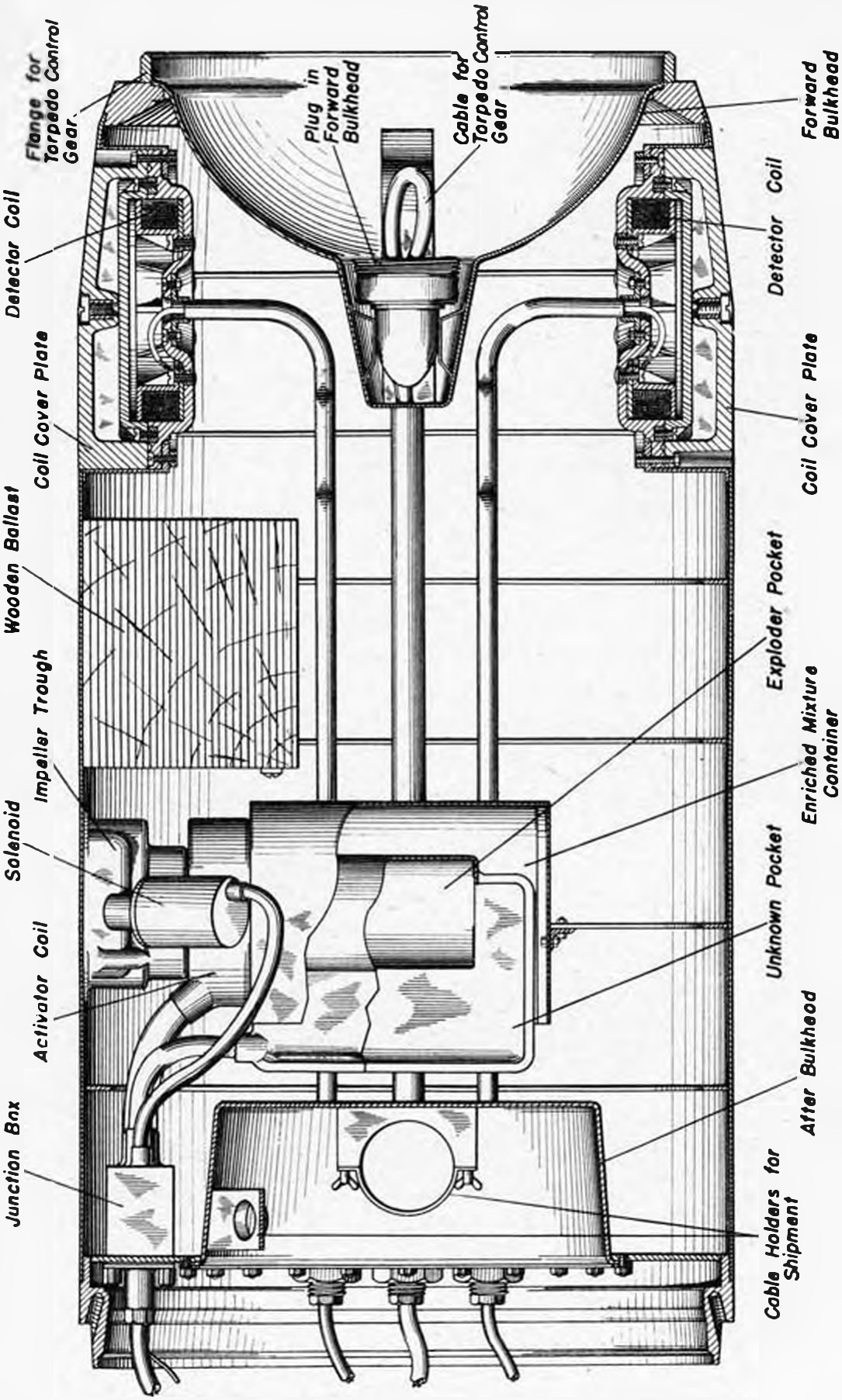


Fig. 6 - Kel Warhead, Sectional View

Fig. 7 - Kc Warhead

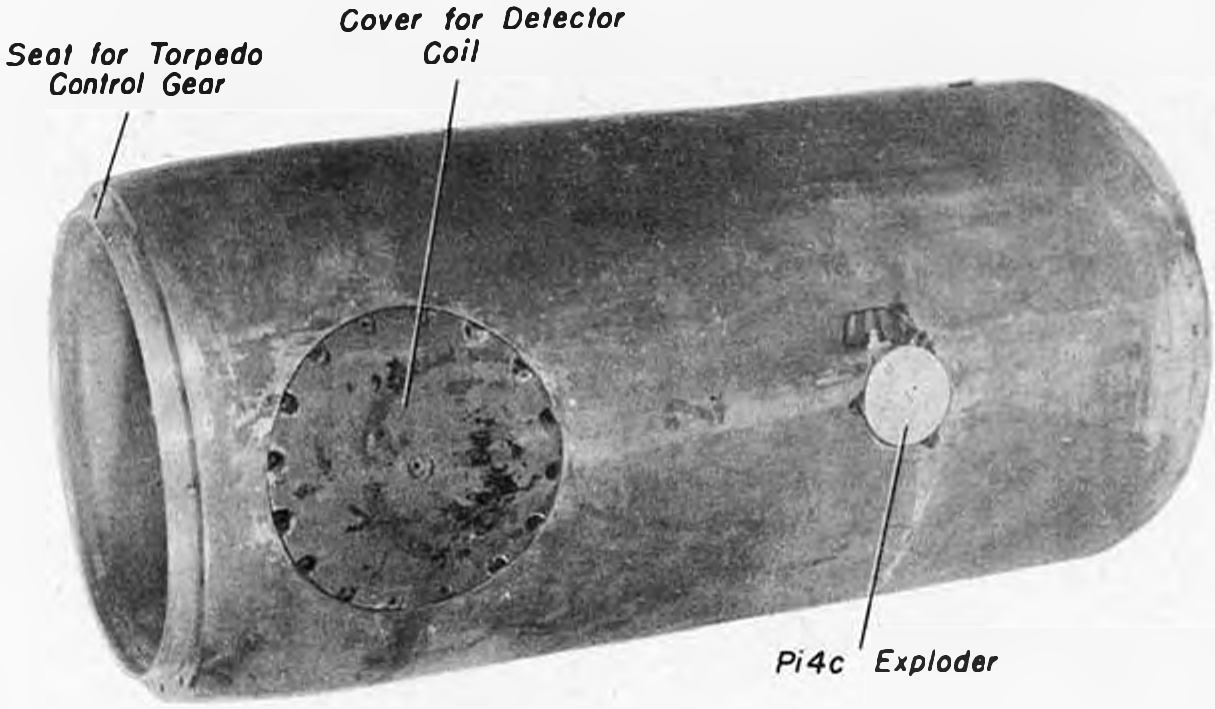


Fig. 8 - Kel Warhead

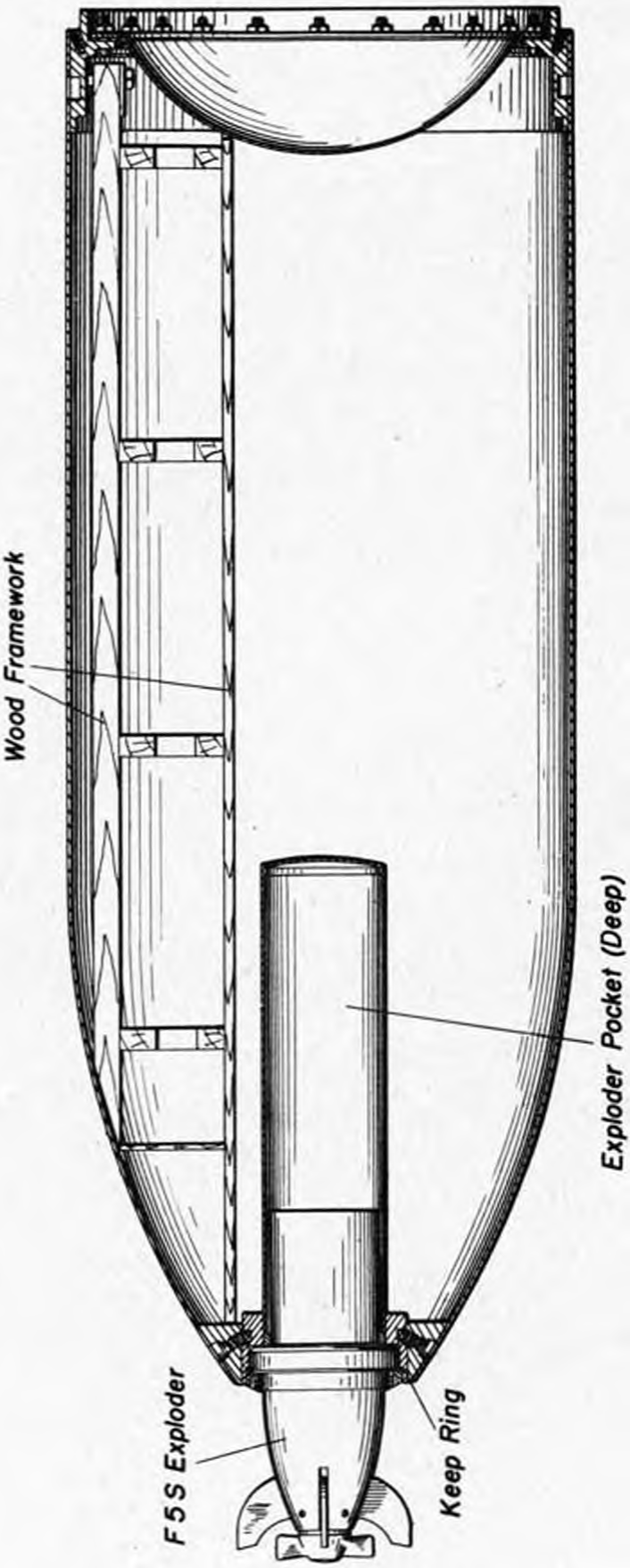


Fig. 9 - F5B Warhead, Sectional View

German Warheads (Cont'd.)

(a) No pressure lead, pressure switch or junction box is fitted.

(b) A test switch is fitted aft on the lower starboard side of the warhead shell.

(c) Cables lead from the test switch to each of the coils and to the amplifier; an additional cable extending from the amplifier to switches on the after side of the activator pocket.

GK3 Warhead

1. External

(a) The warhead differs from the GK2 in that no SIC activator or accessories are fitted.

2. Internal - this warhead is very similar internally to the Kc, differing as follows:

(a) No pressure lead or pressure switch is fitted.

(b) The cable from the amplifier extends to the after end of the exploder pocket, ending in a six-lead plug inside the pocket. The Pi42a(e1) exploder used with this warhead combines the functions of the SIC activator and the Pi42a exploder used with the GK2.

General Precautions

1. The following precautions should be generally observed when dealing with German torpedoes:

(a) Carefully secure the propellers with a length of chain or other suitable means before beginning disposal operations. The propellers are dangerous and may start to run at any time.

(b) Do not move or jar the torpedo except from a safe distance.

(c) Do not move or turn the exploder arming impellers.

(d) Avoid all unnecessary contact with any firing whiskers which may be fitted.

(e) Allow no movement of magnetic material near the torpedo until its exploder has positively been identified as employing other than magnetic firing.

2. Rendering safe German torpedoes involves disposing of the particular exploder which may be fitted. Consequently, the following describes briefly the operation of each exploder and gives the approved procedure for rendering it safe.

Fig. 10 - F5B Warhead

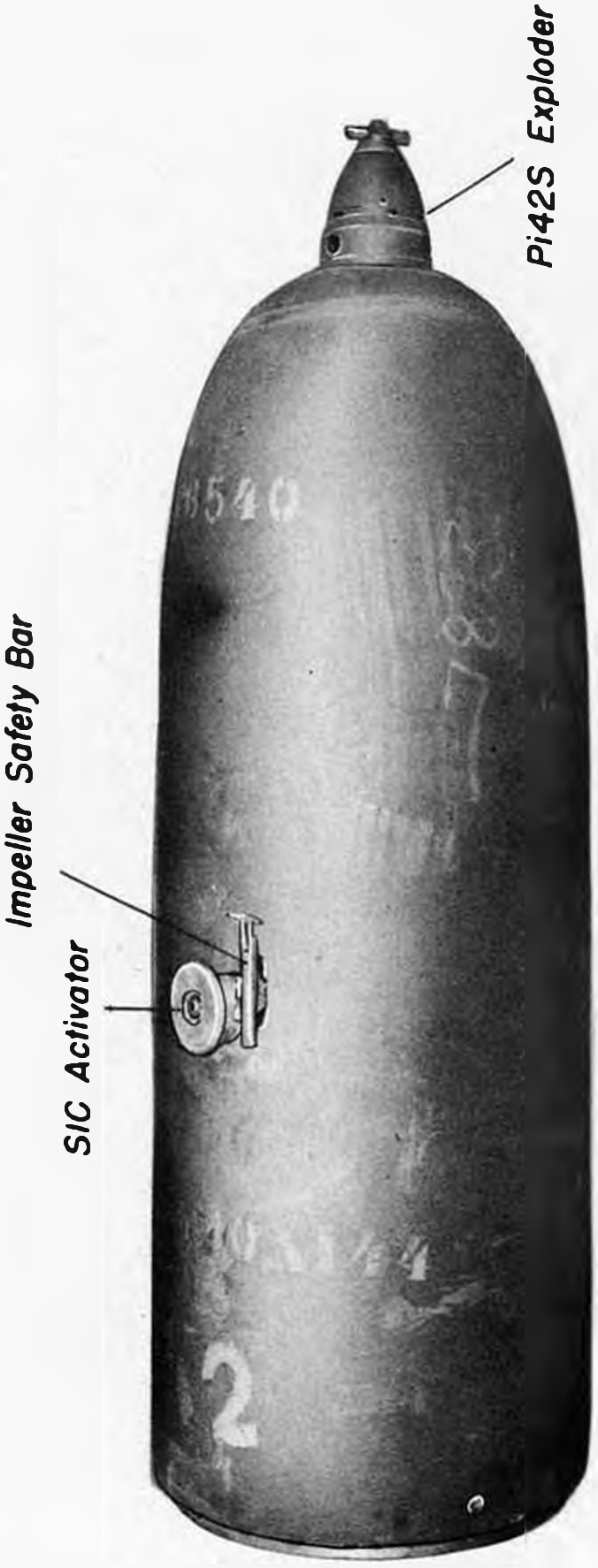


Fig. 11 - GK2 Warhead

Fig. 12 - GK3 Warhead

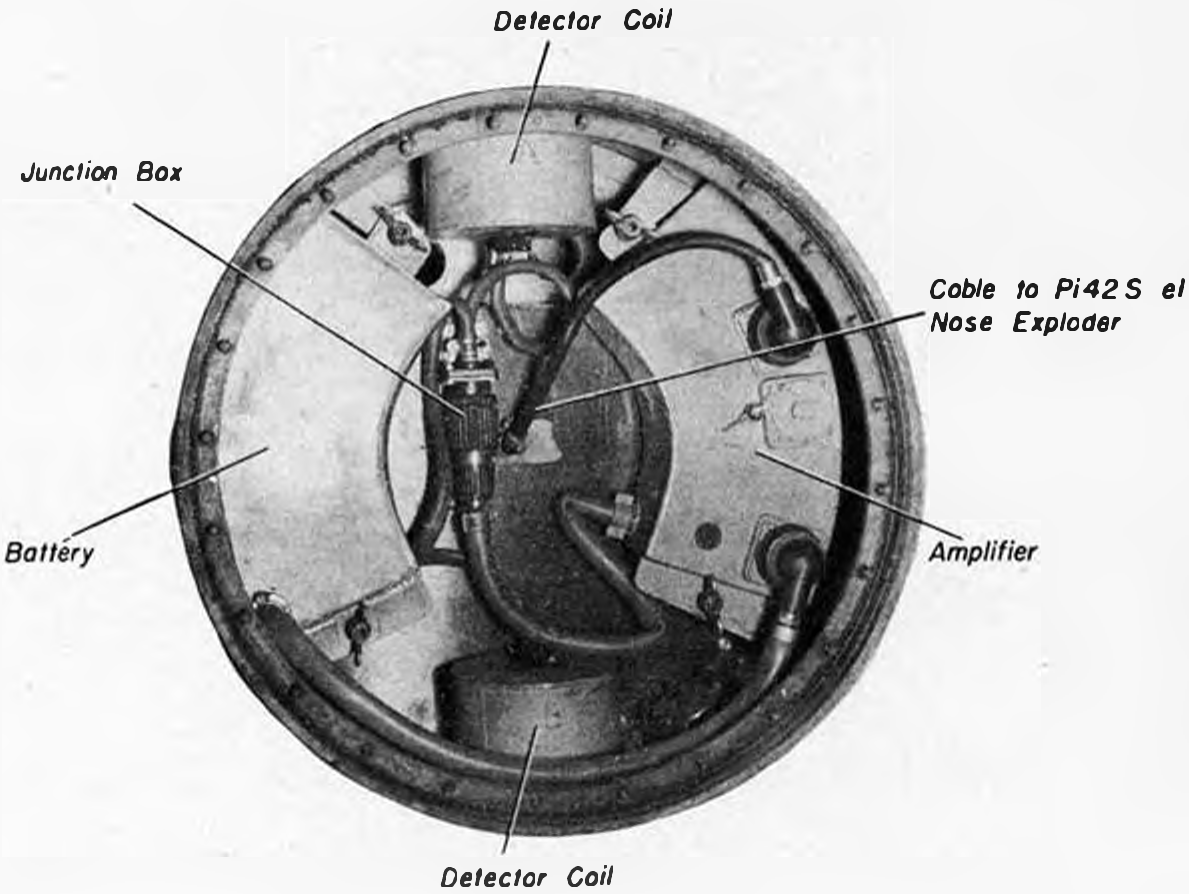


Fig. 13 - GK3 Warhead, After End View

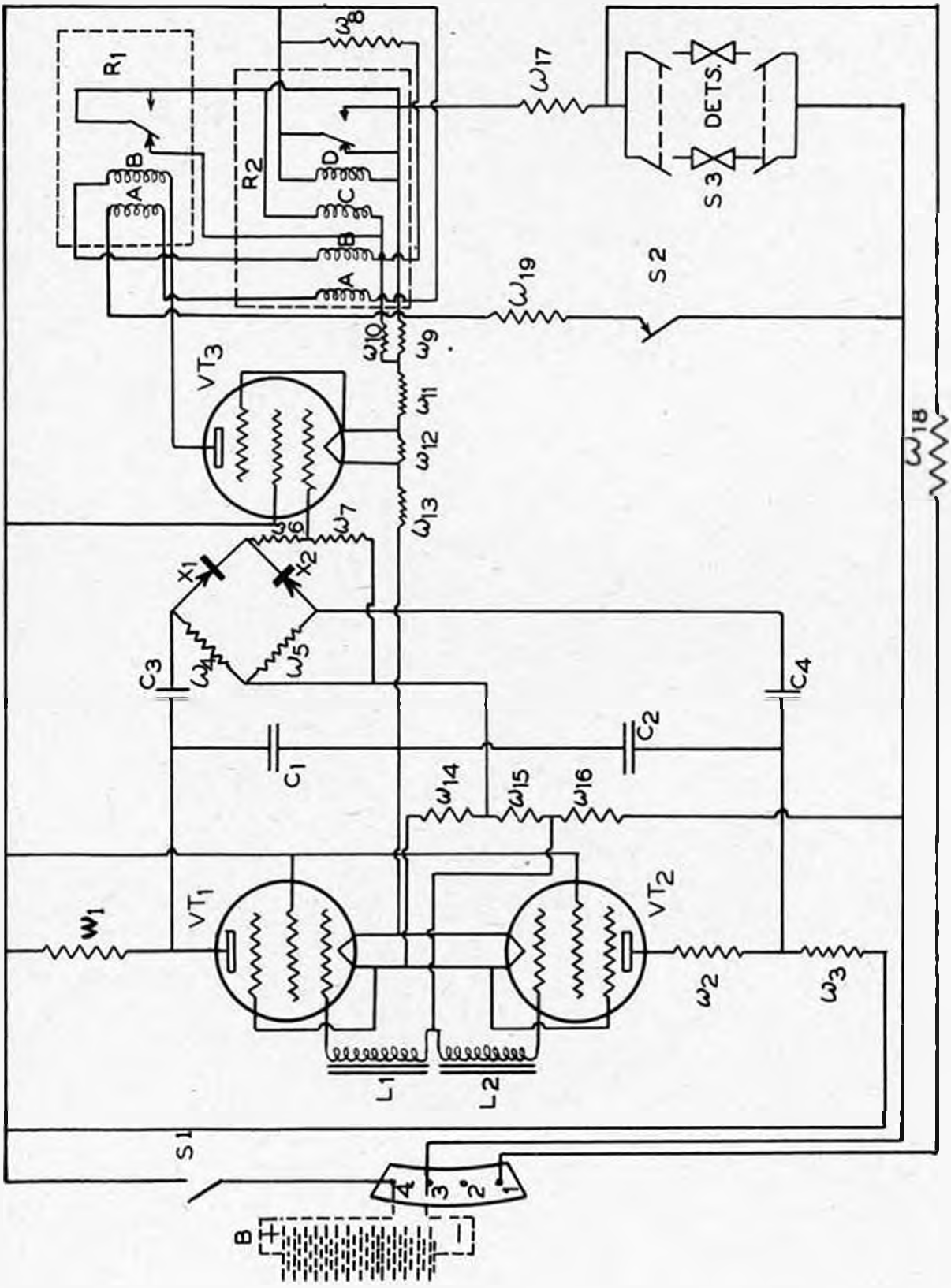


Fig. 14 - P1-2 and P1-2c Circuit Diagram

Pi-2 and Pi-2c Circuit - Operation

Arming

1. S_1 is closed manually prior to launching. When the torpedo is launched, B is put in the circuit and energizes the A coils of R_1 and R_2 through S_2 and w_{12}. The A coils reset the relays and, when the arming distance has been run off, S_2 breaks and S_3 makes, deenergizing the A coils and putting the electric detonators in the circuit.

Normal Firing

1. The firing circuit consists essentially of three vacuum tubes, a full-wave rectifier, two relays and two electric detonators. The relays are normally closed to one of their contacts due to magnetic hold-on. The relay coils in the accompanying diagram are drawn so that current flow "down" through a coil causes the relay contact to swing to the "left" and vice versa.

2. When arming is complete, VT_1, VT_2 and VT_3 are heated in the circuit which includes w_2 and w_{11}-w_{16}. The tubes are biased to pass a small amount of current when so energized. A change of magnetic field induces current in L_1 and L_2, affecting the grid potentials of VT_1 and VT_2 in opposite directions, causing changing plate currents in these tubes. Each tube then feeds an output pulse to the full-wave rectifier circuit through C_3 and C_4.

3. The rectified output produces a more positive potential on the grid of VT_3, causing it to pass more plate current through the B coils of R_1 and R_2. Coil R_1B is the operating coil of R_1 and R_2B, the restraining coil of R_2. Current travels "up" through R_1B and "down" through R_2B, closing R_1 to the right contact if the change in magnetic field is sufficient.

4. Operation of R_1 breaks the shunt on R_2C, the operating coil of R_2, allowing it to pass current. R_2C is then energized and opposes R_2B. When the magnetic field falls off to a point where VT_3 does not pass sufficient current through R_2B to oppose R_2C, R_2 breaks its left contact, opening the circuit through R_2C and breaking the shunt of the booster coil R_2D. R_2D then makes R_2 to the right-hand contact, putting the battery across the detonators in series with w_{17}. The circuit from contact #1 through w_{18} is a test circuit and is not used during a firing actuation.

B - BATTERY - 104 VOLTS
C_1, C_2, C_3, C_4, CONDENSERS 1 Mfd EACH
L_1 - SEARCH COIL 81,900 Ω
L_2 - SEARCH COIL 78,600 Ω
R_1 - RELAY #1
R_1A - RESETTING COIL
R_1B - OPERATING COIL
R_2 - RELAY #2
R_2A - RESETTING COIL
R_2B - RESTRAINING COIL
R_2C - OPERATING COIL
R_2D - BOOSTER COIL
S 1 - HAND-SET SWITCH ON PISTOL
S 2 - ARMING SWITCH
S 3 - DETONATOR PLUG CONTACTS
VT_1, VT_2, VT_3, - VACUUM TUBES

Fig. 15 - Pi-2 and Pi-2c Circuit Components

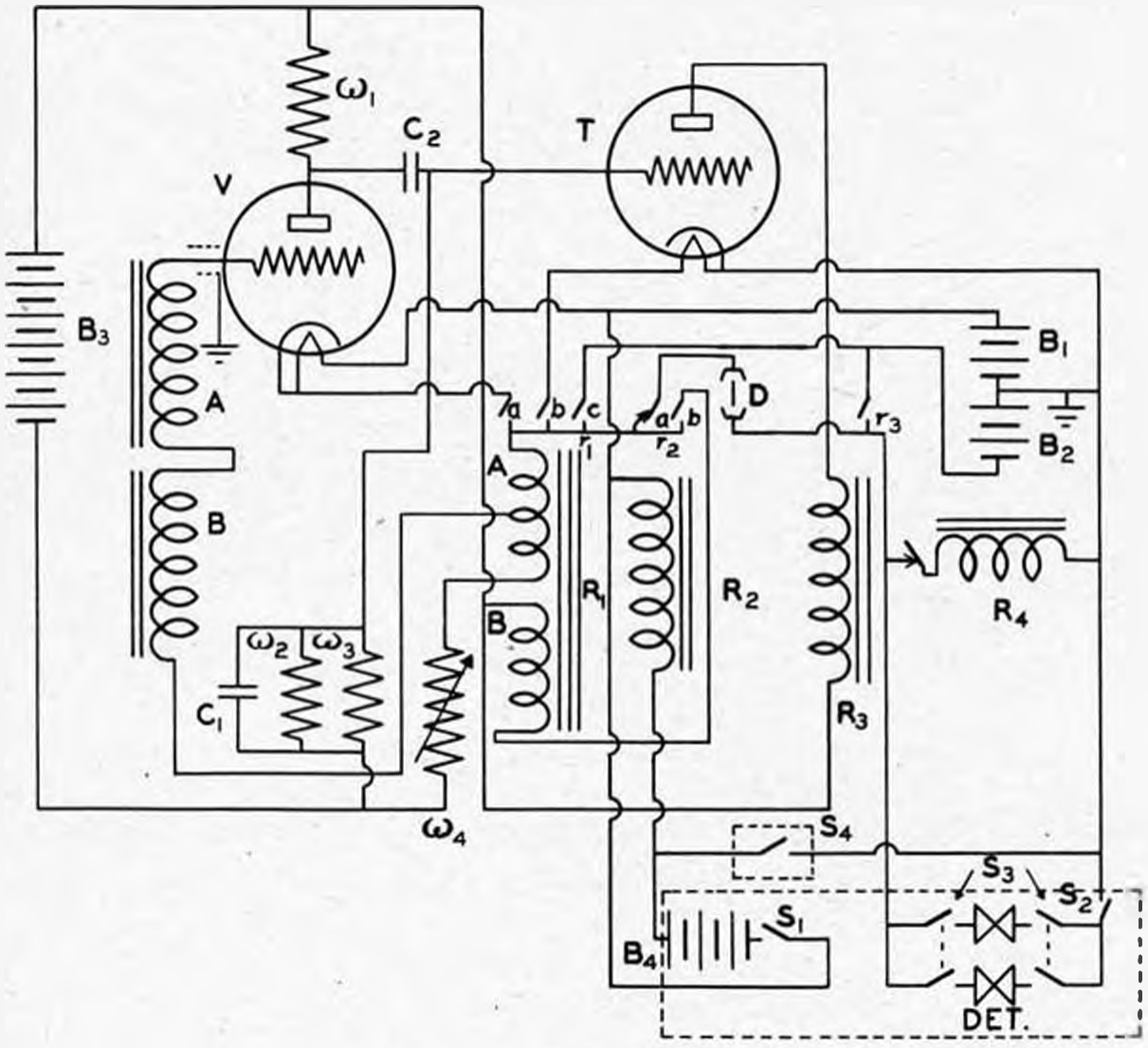


Fig. 16 - Pi-3 Circuit Diagram

Pi-3 Circuit - Operation

Arming

1. S_2 is closed manually prior to launching. When the torpedo has run a short distance, S_1 closes and B_4 energizes R_2, causing it to operate r_2. Operation of r_2 breaks r_2a and makes r_2b, putting B_3 across both coils of R_1 and across rheostat w_4. Operation of R_1 closes r_1, a, b, and c, causing B_1 and B_2 in series to heat the cathode of V_1 and B_2 to heat the cathode of T. When the arming distance has been run off, S_3 closes.

Normal Firing

1. A and B are wired in series and wound in opposite directions so that the motion of the torpedo through the earth's field produces no effect on either one. When the torpedo passes near a magnetic mass, the field around A and B is distorted in such a manner and at a sufficient rate to produce a potential between the grid of V and w_4 via R_1, the negative side of B_3. This varies the plate current of V in such a manner as to produce a DC pulse across w_4. Through the comparative coupling C_2, the pulse actuates the grid of T, allowing it to fire and make a complete circuit through B_3, R_3, the cathode of T, R_1A and w_4.

2. When R_3 is energized, it makes r_3, putting B_2 across the detonators. The testing switch S_4 and the buzzer R_4 are parts of the original Italian SIC mechanism and are inoperative in this circuit.

Self-Destroying Feature

1. Pin D is incorporated if a self-destroying feature is desired. When the circuit is armed, B_4 energizes R_2 continuously until the unit fires or comes to rest without firing. In the latter case, B_4 eventually runs down, allowing R_2 to recover gradually. When this occurs, the shorting contacts of r_2 are closed at the same time. Since r_2b is closed, R_1 is still energized and r_1c is closed. If D is fitted, B_2 is then put across the detonators through r_1c, r_2a and D.

A - THERMOSTATIC SWITCH - (CLOSED AT > 23°F & < 95°F)
B_1 - BATTERY - 13.5 VOLTS
B_2 - " - 1.5 "
B_3 - SEA BATTERY - (PSE MARK IV) FORMED BY MOISTURE IN UNIT.
C_1 - CONDENSER - MFD.
C_2 - " - "
C_3 - " - "
C_4 - " - "
C_5 - " - "
C_6 - " - "
D - THERMAL DELAY SWITCH & HEATER (40 SEC.)
F - MASTER SWITCH
H_1H_2 - HYDROSTATIC SWITCH - (CLOSED AT < 15 FT.)
K - NEEDLE SWITCH
L_1L_2 - FILTER CHOKES
L_x - AUXILIARY COIL
L_y - COMPENSATING COIL
M - MICROPHONES (4)
N,Y,Z - THERMISTORS
P - POTENTIOMETER
R_1R_2 - SOLENOID RELAYS
R_3 - SENSITIVE RELAY
S - LATITUDE ADJUSTER COIL
T_1 - MICROPHONE TRANSFORMER
T_2 - OUTPUT TRANSFORMER
V - VACUUM TUBE (PENTODE)
ω_1 - RESISTOR
ω_2 "
ω_3 "
ω_4 "
ω_5 "
ω_6 "
ω_7 "
X_1 - COPPER OXIDE RECTIFIER
X_2 - " " " (INEFFICIENT)
#1 - #16 - PDM FUSE DELAY SWITCHES
#17 - #21 - DELAY ARMING FUSE DELAY SWITCHES
#22, #23 - DELAY BOMB FIRING FUSE DELAY SWITCHES -

Fig. 17 - Pi-3 Circuit Components

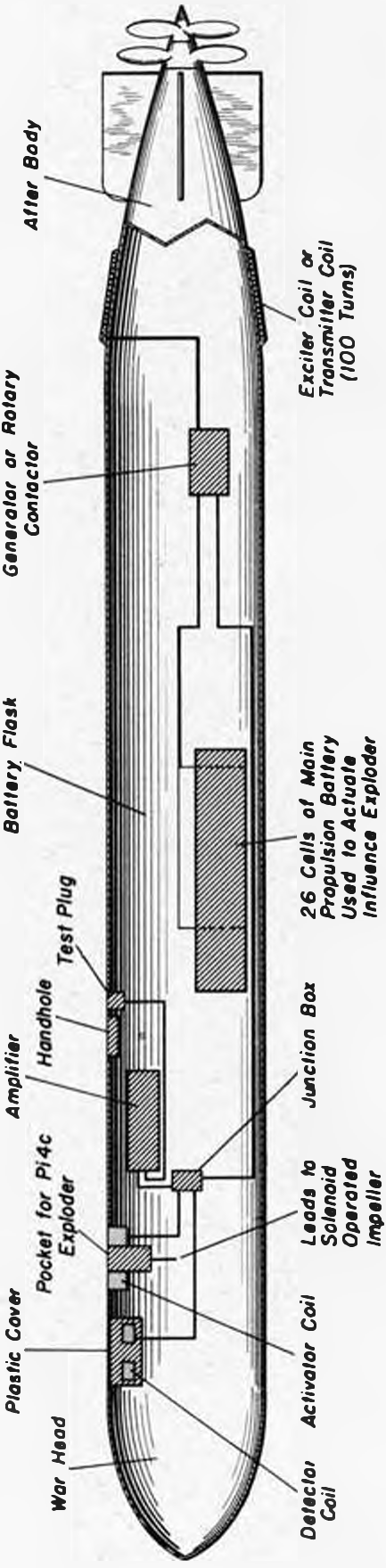


Fig. 18 - Pi-4c Influence Firing Assembly (Schematic)

Pi-4c Firing Device

1. This device is an electromagnetic, radiating type, influence firing mechanism, operating on the same basic principle as the U. S. Navy Ordnance Detector, Mark I (Part I, Chapter 2). A magnetic field is radiated by a transmitting coil around the tail of the torpedo. The coil receives A. C. power from a rotary contactor which in turn is supplied by the main torpedo propulsion batteries.

2. If the radiated signal is reflected by an electromagnetic discontinuity such as might be provided by a ship, the reflected signal is picked up by a detector coil or coils in the warhead. The coil transmits the signal to an amplifier which increases the signal current to a point where it is strong enough to operate two relays.

3. Closure of these relays puts battery current across the activator coil around the exploder pocket. When the activator coil is energized, it sets up a strong magnetic field, causing the main pendulum of the exploder to move forward and release the exploder firing pins.

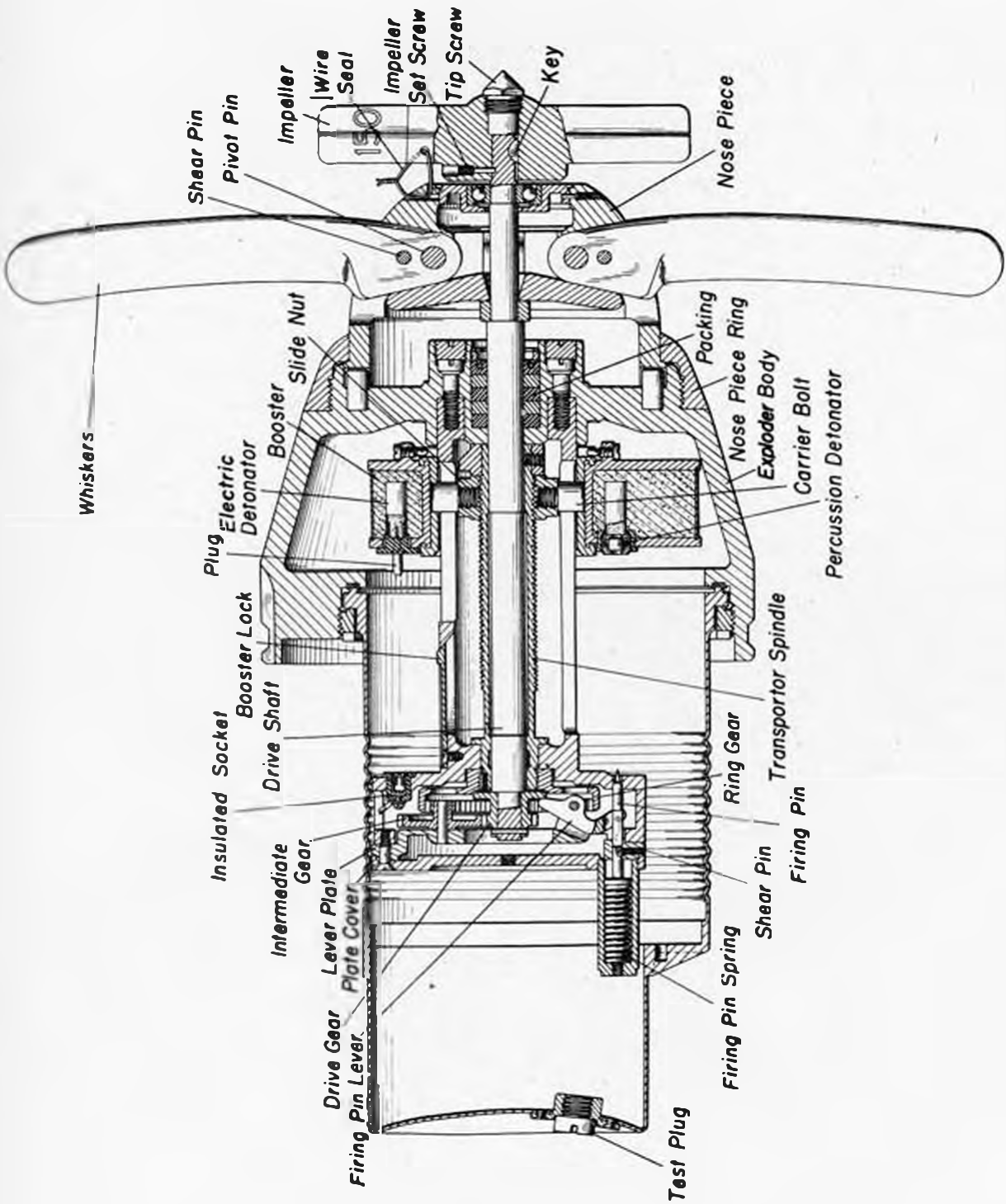


Fig. 19 - Pi-1 Exploder, Sectional View

Pi-1 (Pi-1c) Exploder

General

1. Impact, direct action type, fitted in nose pocket of 21" Ku warheads with T-1 und T-2 torpedoes; sometimes designated, "Pi-G7H".

Description

1. External

(a) The exploder is 17 1/2" long, 7" in maximum diameter, and is composed of the following main parts:

(1) A forward section, which protrudes 8 1/4" from the warhead, consisting of an exploder body, shaped like a truncated cone, to which is secured a rounded, cylindrical nose piece. Four curved whiskers protrude 5 3/4" from slots on the nose piece. A two-bladed impeller with a span of 5 1/2" is fitted to the center of the nose piece, being attached to the outer end of a drive shaft. A small, spring-loaded flap mounted on the side of the nose piece prevents impeller rotation prior to launching.

(2) An after section, consisting of a cylindrical steel canister, 8 1/2" long, is secured to the inner end of the exploder body. This canister houses the working parts of the exploder.

(b) Markings on the exploder body und nose piece are as follows:

(1) The letters Pi-1 or G7H stamped on the nose piece.

(2) The exploder serial number stamped on the exploder body, nose piece or whiskers.

(3) One impeller blade painted red or blue. If red, the number 150 is painted on the blade in white und if blue, the number 300, the respective numbers indicating the arming range in meters.

2. Internal

(a) The primary working parts of the exploder are as follows:

(1) A steel drive shaft which extends longitudinally through the exploder body.

(2) A firing pin housing which contains:

(i) A gear train which engages the after end of the drive shaft.

(ii) Four levers spaced radially around the after end of the drive shaft. Ordinarily, three of the levers are attached to firing pins, two of which are spring-loaded, and the fourth controls a small leaf switch. In some cases, however, all four levers are attached to firing pins, all of which are spring-loaded. A flange on the after end of the drive shaft bears against each lever.

(iii) Two female plug connections for electric detonators in the booster can.

(3) A hollow, threaded transporter spindle which encloses the drive shaft and engages the gear train at its after end.

(4) An annular booster can, secured around the transporter spindle, which contains two electric and either three or four percussion detonators.

(b) Each of the whiskers is pivoted at its inner end and bears on a shoulder on the forward end of the drive shaft.

3. Method of Mounting

(a) The exploder is slipped into the warhead and secured by four screws which pass through the warhead and engage a groove on the after part of the exploder body.

4. The Pi-1c differs from the Pi-1 as follows:

(a) No whiskers are fitted, net cutters usually being fitted in their place. No whisker shear pins are fitted nor is there any provision for them.

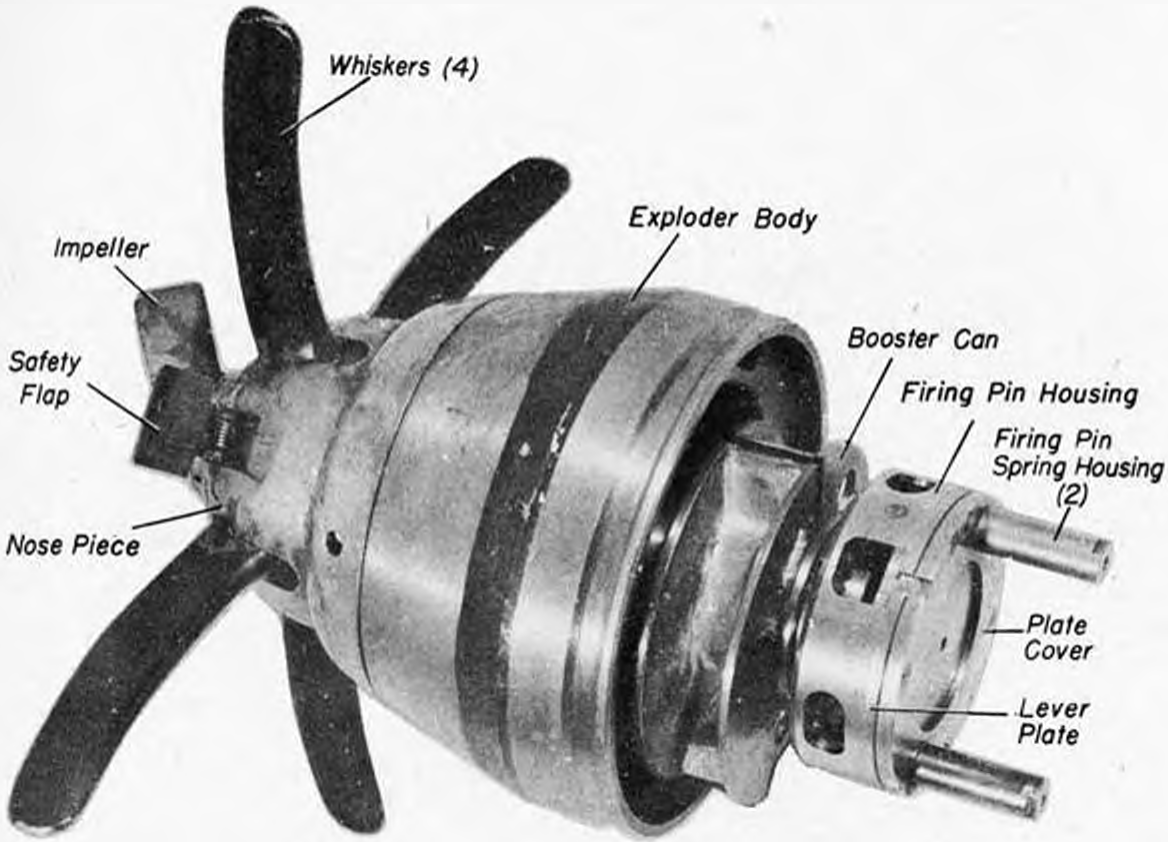


Fig. 20 - Pi-1 Exploder, Canister Removed

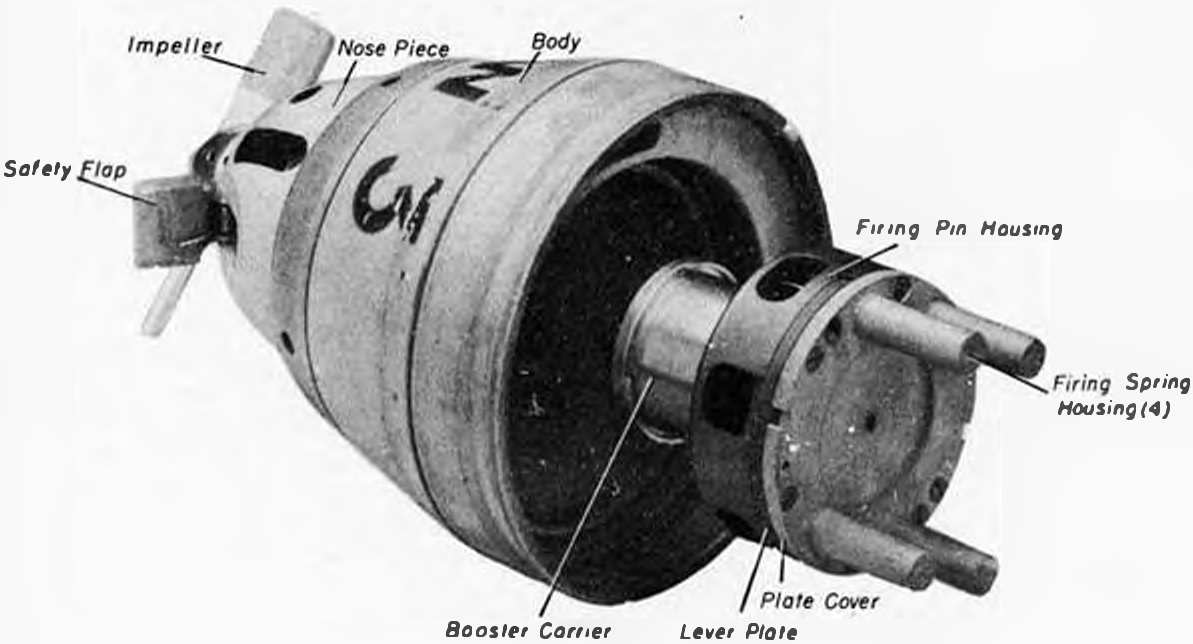


Fig. 21 - Pi-1c Exploder, Canister Removed

Pi-1 (Pi-1c) Exploder (Cont'd.)

(b) The letters Pi-1c are stamped on the nose piece.

(c) A modified, steel nose piece fitted abaft the impeller prevents the exploder from firing from a blow on the impeller unless the blow is of sufficient strength (5000 lbs. approx.) to force the steel tip screw through the impeller. The exploder design is such that it is believed to fire upon contact with a very hard surface but not upon contact with a torpedo net.

Operation

1. When the torpedo is launched, water travel shears a small wire attached to the impeller and nose piece and depresses the safety flap. Impeller rotation then turns the drive shaft clockwise, thereby rotating the transporter spindle counterclockwise through the gear train in the firing pin housing. Rotation of the transporter spindle moves the booster aft and, after a 150 or 300 meter run depending on the impeller fitted, the booster is adjacent to the firing pin housing. When the booster is in this position, the two electric detonators are plugged into their sockets and the percussion detonators are adjacent to the firing pins. At the end of its travel, the booster carrier disengages the threads of the transporter spindle and the booster locks in the armed position.

2. The exploder fires upon receipt of a blow on the whiskers or impeller as follows:

   (a) A blow on a whisker shears a large shear pin in the whisker and forces the drive shaft aft about 1/4". The flange on the after end of the drive shaft pivots the firing pin levers, breaking their shear pins and allowing the firing pins to impinge on the respective detonators. When the drive shaft moves aft, it also closes the leaf switch to the electric detonators.

   (b) A blow on the impeller shears two shear pins in the impeller seat forcing the drive shaft aft and firing the detonators as in (a) above.

Precautions

1. There is no means of determining the armed or unarmed condition of the exploder from an exterior examination.

Rendering Safe Procedure

1. Insert wedges abaft each whisker to prevent any movement.
2. Tape the impeller to the nose piece.
3. Remove the exploder securing screws.
4. From a safe distance, remove the exploder from the warhead.
5. Remove the keep ring which secures the canister to the exploder body.
6. Remove the canister.
7. Cut and tape separately the two leads from the battery to the electric detonator switch. These leads may not be fitted.
8. Remove the eight screws which secure the plate cover and lever plate to the firing pin housing.
9. Remove the plate cover and lift off the lever plate which carries the levers and firing pins.
10. Remove the two screws which secure the booster can to the booster carrier. These screws are forward of the booster can and are accessible only if the booster is in the armed condition. If the booster is in the unarmed position, rotate the large gear in the firing pin housing clockwise until the screws become accessible.
11. Depress the booster lock while rotating the large gear counterclockwise until the booster moves forward about 1/2". This forward motion unplugs the electric detonators.
12. Rotate the booster can and separate the booster from the booster carrier by breaking the bayonet joint. The booster will come off in two sections.
13. Remove the detonators from the booster.
14. Dispose of all explosive elements.

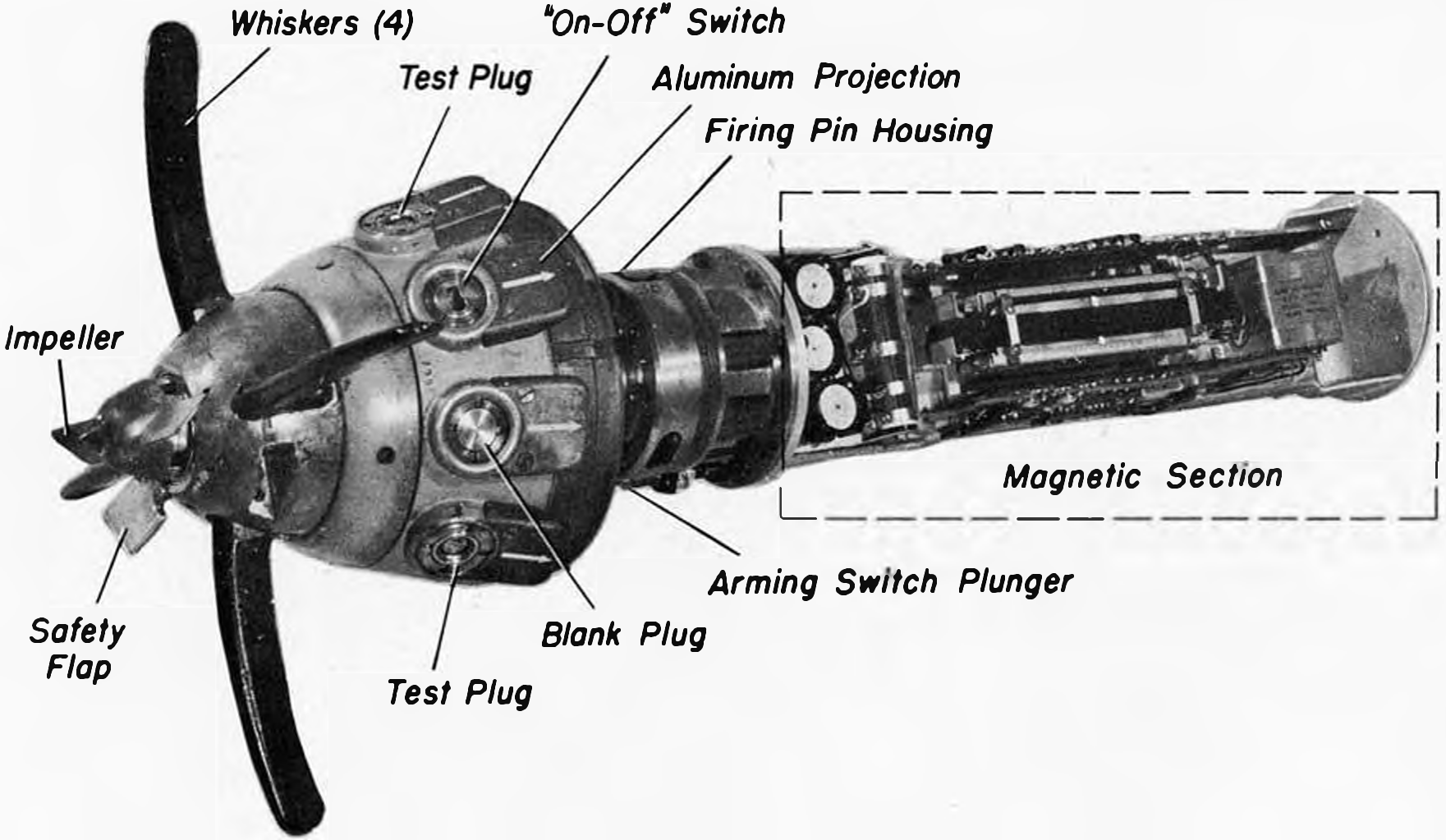


Fig. 22 - P1-2 Exploder

Pi-2 (Pi-2c) Exploder

General

1. Combination impact, direct action and magnetic induction type, fitted in nose pocket of 21" Kb warheads with T-3 torpedoes.

Description

1. External

   (a) The exploder is 3' long, 7" in maximum diameter, and is composed of the following main parts:

      (1) A forward section, which protrudes 8 1/4" from the warhead, consisting of an exploder body and nose piece very similar to the forward section of the Pi-1. The main difference consists of the presence of four, raised, brass plug fittings, each 1 1/2" in diameter, mounted radially on the forward end of the exploder body. Reading clockwise and looking aft, the fittings are: test plug for magnetic circuit; "on-off" switch for magnetic circuit; blank plug; test plug for magnetic circuit. Four jack plugs, fitted to the after part of the exploder body, fit into corresponding jacks alongside the exploder pocket.

      (2) An after section, consisting of a cylindrical steel canister, 28" long, is secured to the after end of the exploder body. This canister houses the mechanical and magnetic parts of the exploder. The extra length, as compared with the Pi-1, is necessary to accommodate the magnetic firing device.

   (b) Markings on the exploder body and nose piece are as follows:

      (1) Same as Pi-1 except that the letters Pi-2 are stamped on the nose piece.

2. Internal

   (a) The internal alignment of parts is similar to the Pi-1 except that a magnetic firing device has been added. This device consists, essentially, of a search coil, three vacuum tubes, two relays and a full-wave rectifier. The firing pin housing differs from that on the Pi-1 in that four percussion firing pins are fitted, three being spring-loaded.

3. Method of Mounting

   (a) Same as Pi-1.

4. The Pi-2c differs from the Pi-2 as follows:

   (a) It is designed for use with one-man, human torpedoes and possibly other torpedoes.

   (b) No whiskers nor whisker plate are fitted.

   (c) The nose piece is made of steel instead of brass.

   (d) The letters Pi-2c are stamped on the nose piece. The impact firing mechanism is similar to that in Pi-1c.

Operation

1. (a) Impact section

      (1) Same as Pi-1.

   (b) Magnetic section

      (1) As the booster can moves aft on the transporter spindle, the can depresses a plunger switch, arming the magnetic firing device.

2. (a) Impact section

      (1) Same as Pi-1

   (b) Magnetic section

      (1) Magnetic firing occurs when the firing device is subjected to a sufficient rate of change in the surrounding magnetic field to induce the proper current in the induction coil. This causes relays to close and place the detonators across the battery. See Introduction for detailed operational analysis.

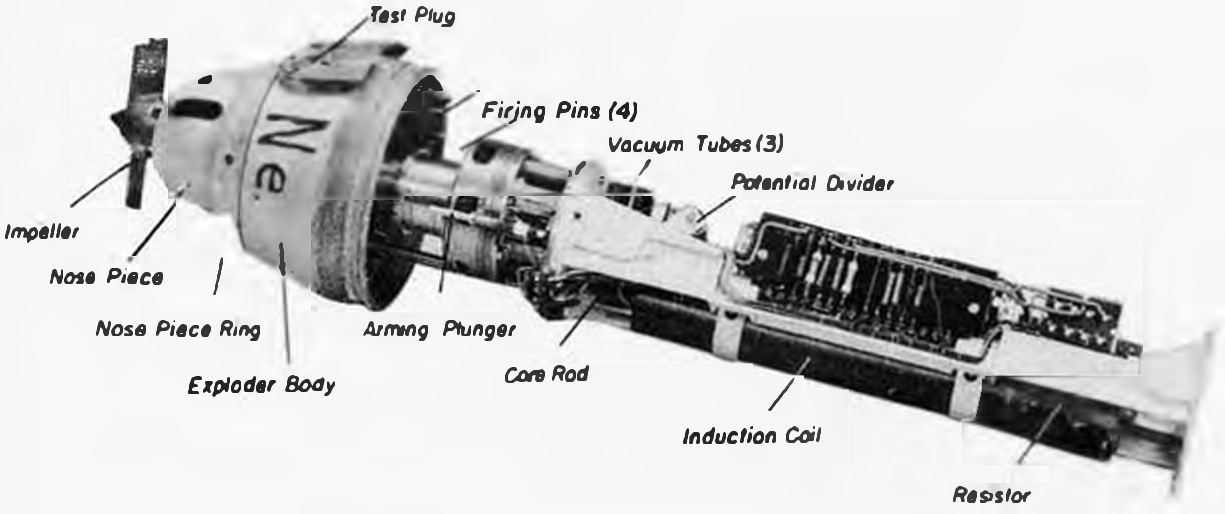


Fig. 23 - P1-2c Exploder

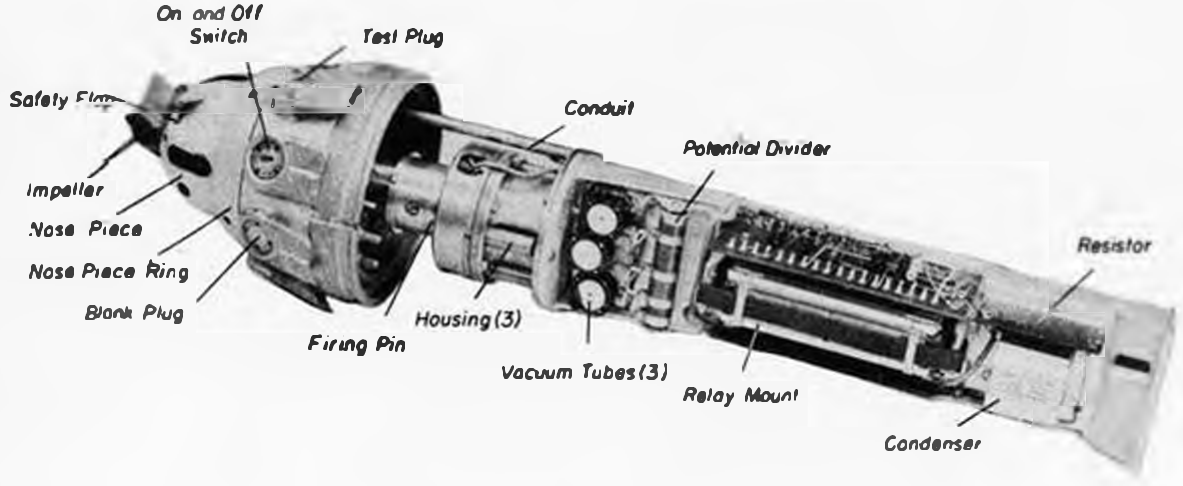


Fig. 24 - P1-2c Exploder

Pi-2 (Pi-2c) Exploder (Cont'd.)

Precautions

1. Note that there is no means of determining the armed or unarmed condition of the exploder from an exterior examination. The relative position of the "on-off" switch cannot be used for this purpose.

2. Note that the magnetic firing device may incorporate a self-destroying feature. Except in extreme emergency, wait at least 24 hours before attempting to render safe.

Rendering Safe Procedure

1. Remove the two securing screws which hold the small aluminum projection against the after edge of the "on-off" switch. Remove the projection.

2. Remove the outer keep ring which holds the switch in place.

3. Remove the inner keep ring.

4. Remove the switch. Be sure to remove the small plastic disc which contains the switch contacts on its bottom face. The magnetic section is now inoperative.

5. Insert wedges abaft each whisker to prevent any movement.

6. Tape the impeller to the nose piece.

7. Remove the exploder securing screws.

8. From a safe distance, remove the exploder from the warhead.

9. Remove the keep ring which secures the canister to the exploder body.

10. Remove the canister.

11. Separate the magnetic section frame from the firing pin housing by removing the six screws from the joint located about 21" forward of the after end of the frame. Cut and tape each lead separately.

12. Remove the two remaining screws which secure the plate cover to the lever plate.

13. Proceed with steps 9-14 as prescribed for Pi-1.

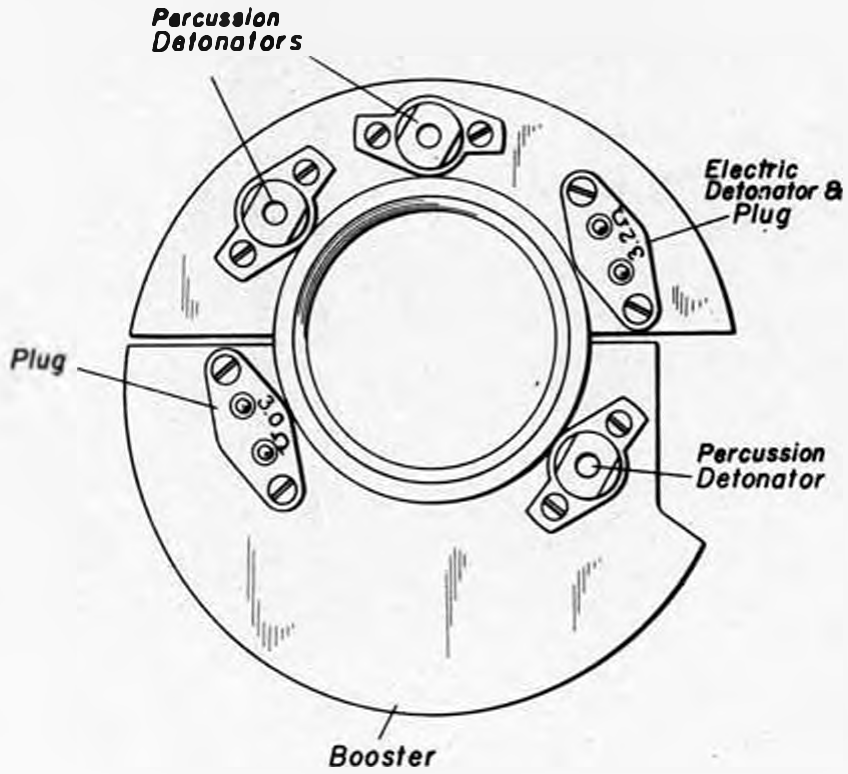


Fig. 25 - Pi-1 Booster, Elevation

Pi-3 Exploder

General

1. Combination impact, direct action and magnetic induction type, fitted in nose pocket of 21" Kc warheads with T-1 torpedoes.

Description

1. External

   (a) The exploder is 17" long, 8 3/4" in maximum diameter, and is composed of the following main parts:

      (1) A forward section, which protrudes 8 1/2" from the warhead, consisting of an exploder body and nose piece very similar to the forward section of the Pi-1 although the shape is somewhat modified. The main difference consists of the presence of two, raised, brass plug fittings, each 1 1/2" in diameter, mounted on the forward end of the exploder body. One fitting is the "on-off" switch fitted to the Pi-2 and the other, a test plug for the magnetic circuit. Four jack plugs, fitted to the after part of the exploder body, fit into corresponding jacks along side the exploder pocket.

      (2) An after section, consisting of a cylindrical steel canister, 9" long, is secured to the inner end of the exploder body. This canister contains the mechanical working parts of the exploder.

   (b) Markings on the exploder body and nose piece are as follows:

      (1) Same as Pi-1 except that the letters Pi-3 are stamped on the nose piece.

2. Internal

   (a) The internal alignment of mechanical parts is similar to the Pi-1 except that a 4.5 volt battery, enclosed in a cylindrical plastic container, is secured to the plate cover of the firing pin housing. The firing pin housing differs from that on the Pi-1 in that four percussion firing pins are fitted, two being spring-loaded. The magnetic firing device is located in the after end of the warhead.

3. Method of Mounting

   (a) The exploder is slipped into the warhead pocket and secured by six bolts which screw through the exploder body into the warhead.

Operation

1. (a) Impact section

      (1) Same as Pi-1.

   (b) Magnetic section

      (1) As the booster can moves aft on the transporter spindle, it releases a push button on the inside of the exploder body, arming the magnetic firing device.

2. (a) Impact section

      (1) Same as Pi-1.

   (b) Magnetic section

      (1) Magnetic firing occurs when the field put out by the magnetic firing device is disturbed by any object whose electrical conductivity differs from that of the surrounding medium. This field distortion is recorded on detector coils and amplified to a point where the resultant current is strong enough to close certain relays, putting a battery across the detonators.

Precautions

1. Same as Pi-2.

Rendering Safe Procedure

1. Remove the "off-on" switch as in Pi-2.

2. Insert wedges abaft each whisker to prevent any movement.

3. Tape the impeller to the nose piece.

Pi-3 Exploder (Cont'd.)

4. Using a 9/16" socket wrench or other suitable tool, remove the six exploder securing bolts.
5. From a safe distance, remove the exploder.
6. Remove the keep ring which secures the canister to the exploder body.
7. Remove the canister.
8. Slit the gray cable; cut and tape each lead separately.
9. Remove the two battery securing screws and remove the battery.
10. Proceed with steps 8-14 as in Pi-1.

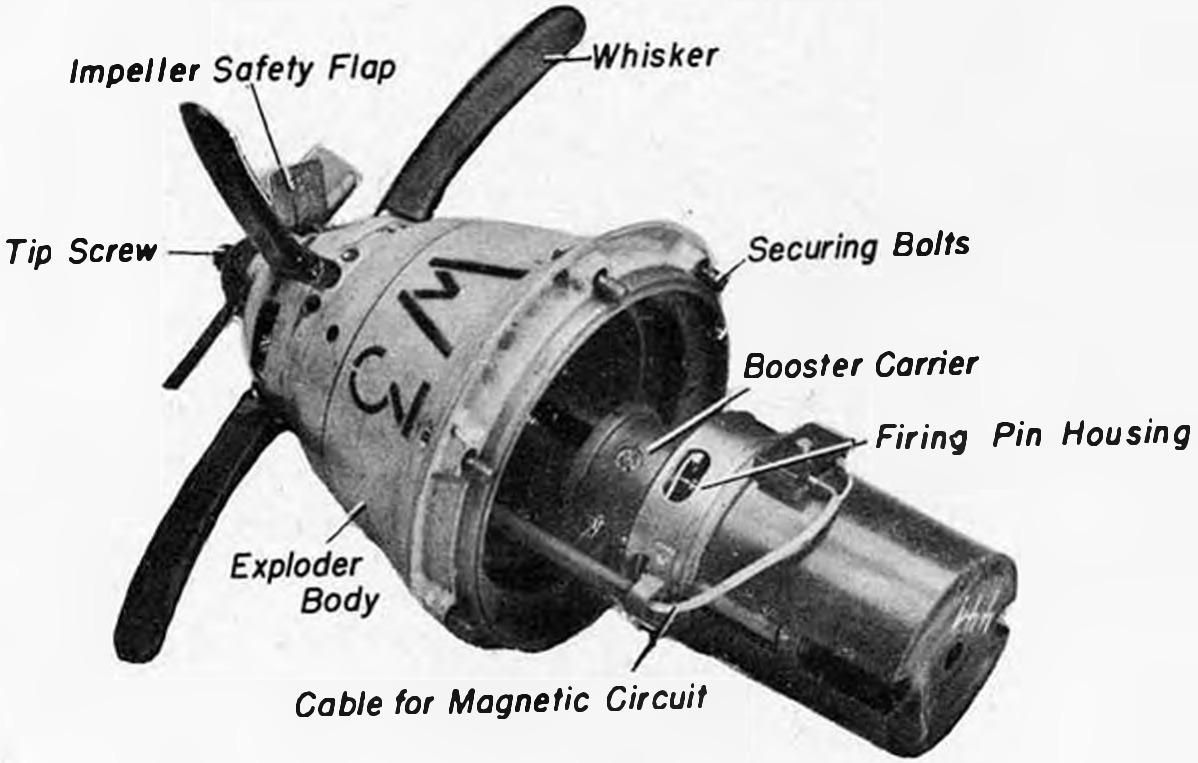


Fig. 26 - Pi-3 Exploder

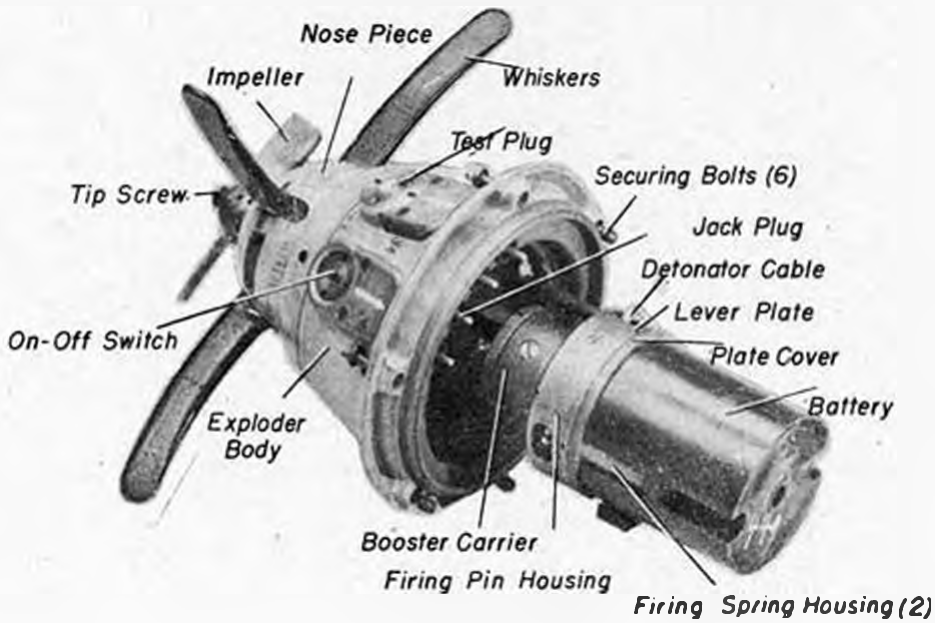


Fig. 27 - Pi-3 Exploder

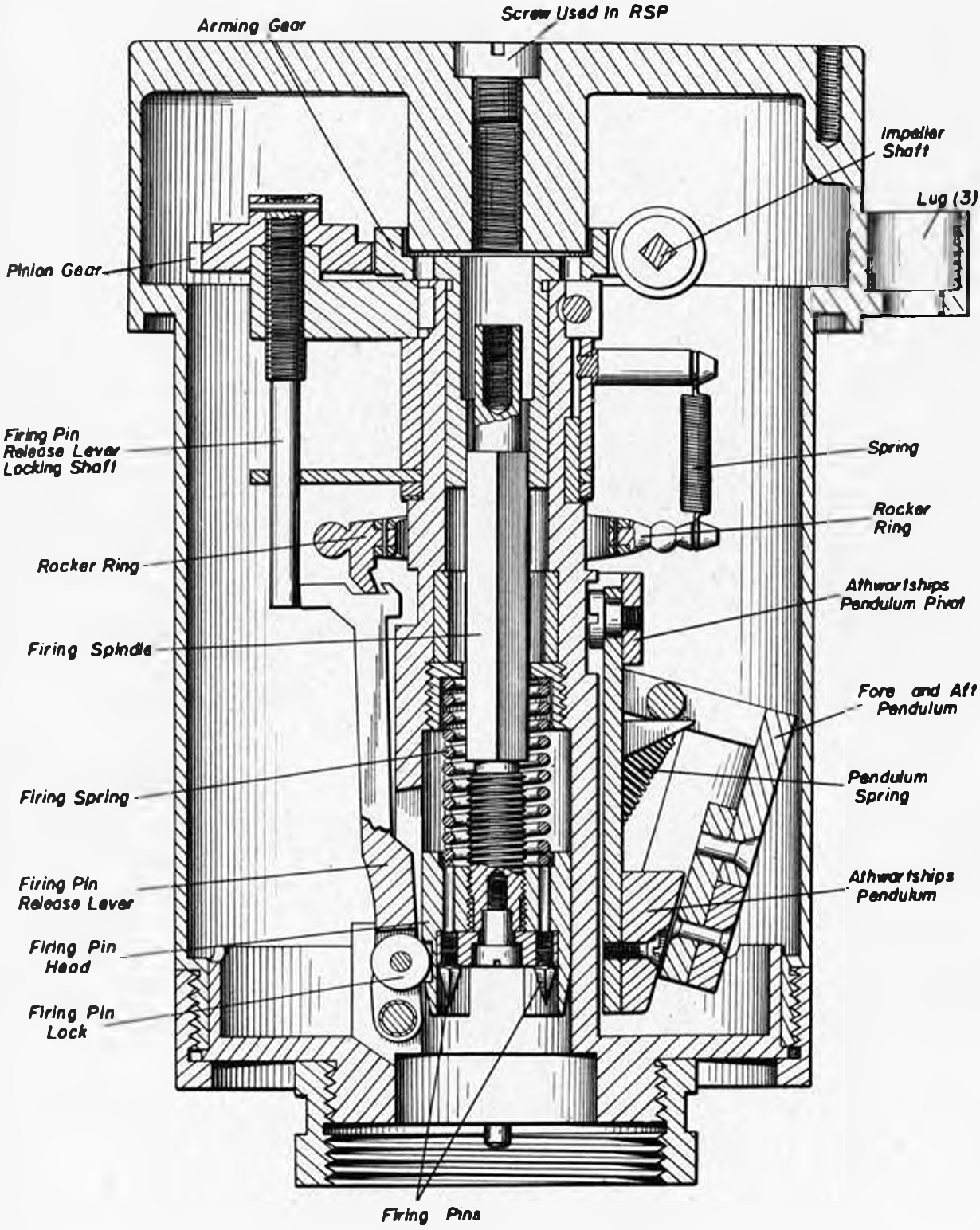


Fig. 28 - Pi-4c Exploder, Sectional View

Pi-4c Exploder

General

1. Combination impact-inertia, magnetic induction type, fitted in transverse pocket on top center line of 21" Ke und Kel warheads with T-5 torpedoes.

Description

1. External

(a) The exploder is cylindrical, 5 5/8" long and 3 7/8" in diameter, and is fitted on one side with a three-bladed, black, rubber impeller which rotates in an impeller trough adjoining the exploder pocket. A locking pin, withdrawn by a solenoid in the warhead when the motor starts, prevents impeller rotation prior to launching. The exploder serial number is stamped on the top face.

2. Internal

(a) The primary working parts of the exploder are as follows:

(1) A worm gear driven by the impeller.

(2) An arming gear mounted on the vertical axis.

(3) A spring-loaded firing pin spindle fitted with two firing pins.

(4) Two inertia-operated pendulums, one of which operates on fore and aft actuation and the other, athwartships actuation.

(5) A spring-loaded rocker ring controlled by the pendulums. This ring in turn controls the firing pin spindle release lever.

(6) A firing pin spindle release lever locking shaft and pinion gear.

(b) The magnetic firing device is mounted elsewhere in the warhead and torpedo body.

3. Method of Mounting

(a) The exploder is slipped into the warhead and is secured by three, square-headed bolts.

Operation

1. When the torpedo is launched, energization of a solenoid by the main propulsion battery removes the impeller lock. Impeller rotation then turns the arming gear and worm gear, moving the firing pin spindle down until, after about 250 impeller rotations, the firing pins are in the armed position and the square section of the firing pin spindle disengages the square hole in the arming gear. Rotation of the arming gear also turns the pinion gear on the release lever locking shaft and, since this shaft is threaded to the frame, rotation moves the shaft upward until it disengages the firing pin spindle release lever and the pinion gear disengages the arming gear. The inertia pendulum system is now armed.

2. (a) Impact section

(1) The exploder fires when subjected to an impact of 7g fore and aft, 4g athwartships and on appropriate rates of deceleration at angles in between. The pendulums swing in the direction of impact and a lever system lifts the rocker ring, releasing the firing pin spindle release lever. The firing pin spindle spring compressed in assembly, then forces the firing pin spindle release lever out and the firing pins are freed to impinge on the detonators.

(b) Magnetic section

(1) The exploder fires when a detector coil is energized. This results in a strong current through an activator coil around the exploder pocket, thereby making pole pieces of the steel-backed fore and aft pendulum and the steel exploder base. The pendulum moves forward to decrease the gap, tripping the lever system, and the exploder fires as above. For further details, see Introduction.

Precautions

1. Same as Pi-2.

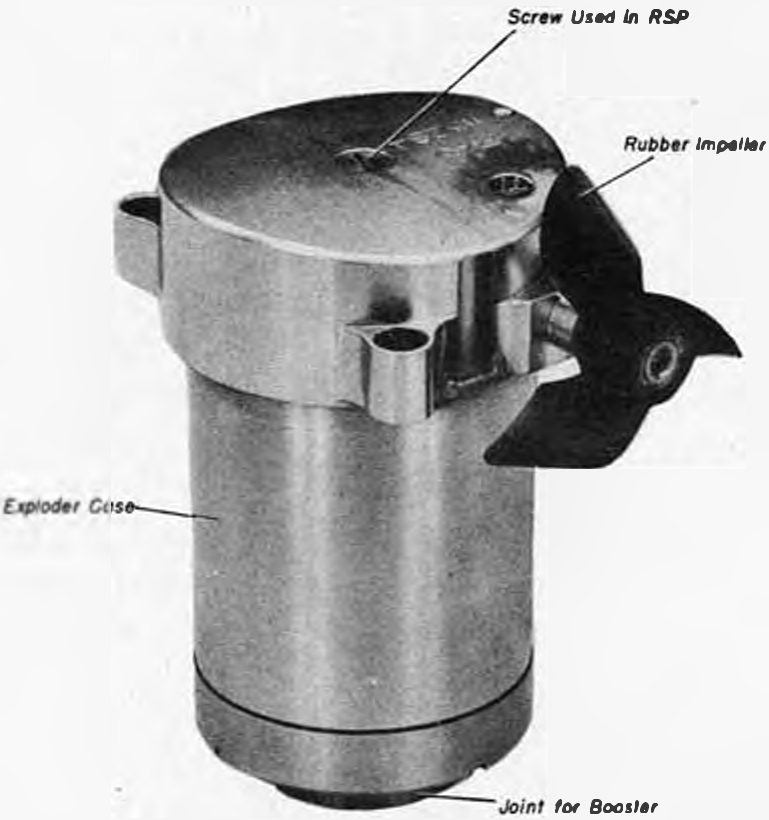


Fig. 29 - Pi-4c Exploder

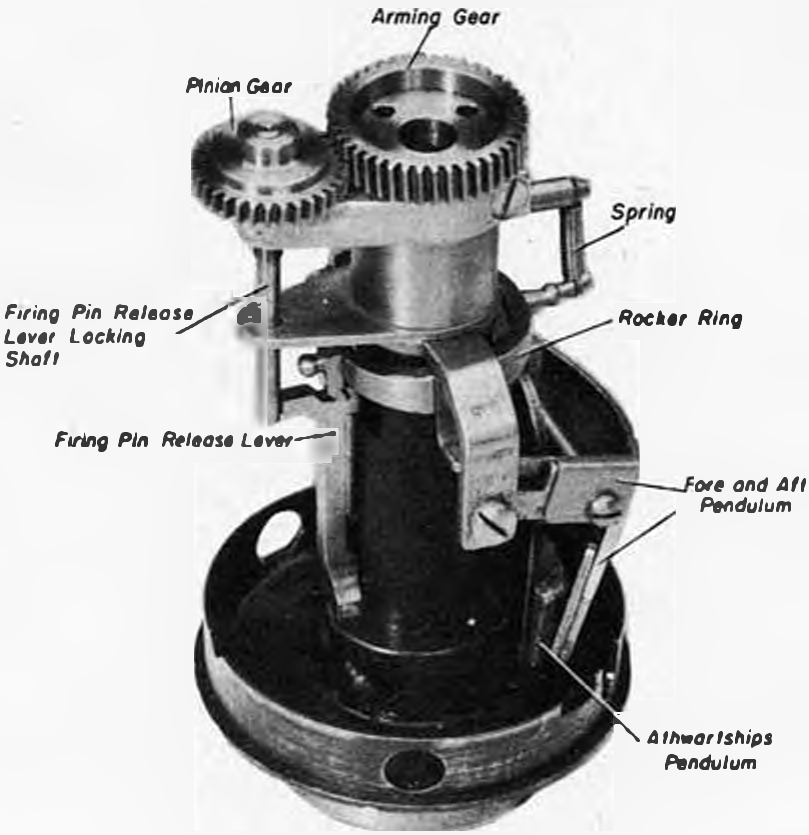


Fig. 30 - Pi-4c Exploder, Case Removed

Pi-4c Exploder (Cont'd.)

Rendering Safe Procedure

1. Remove the screw from the center of the top of the exploder.

2. Insert a special tool (Fig 30a) and screw it gently into the hole until it engages the threaded portion in the top of the firing pin spindle. Screw the knurled washer down until it bears against the exploder face. The firing pin spindle is now locked.

Note: Three exploders of a total of eighteen examined were not fitted with the screw in the center as above. The firing pin spindles of such exploders cannot be locked as prescribed and no attempt to render safe such exploders should be made except in extreme emergency. In such instances, proceed with steps 3 and 4 below. Upon removing the exploder from the warhead, destroy the exploder in situ without attempting disassembly. Exercise extreme caution to avoid jars or shocks.

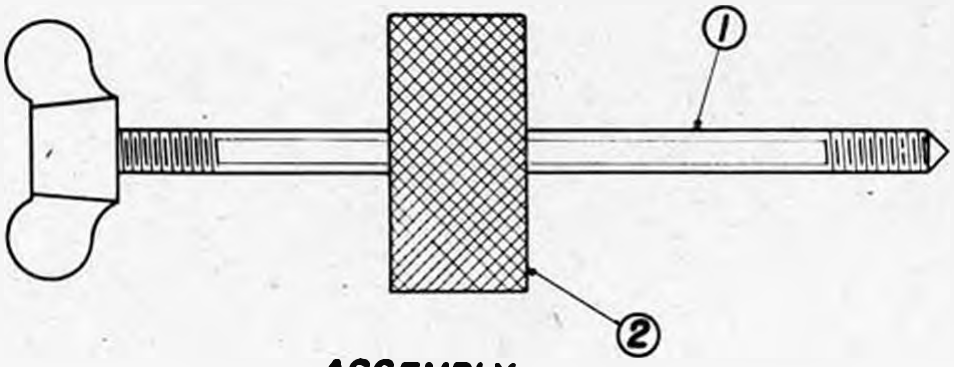
3. Remove the exploder securing bolts.

4. From a safe distance, remove the exploder from the warhead.

5. Remove the locking ring (left hand threads) and separate the booster from the exploder body.

6. Lift out the cylindrical detonator housing.

7. Dispose of all explosive elements.



ASSEMBLY

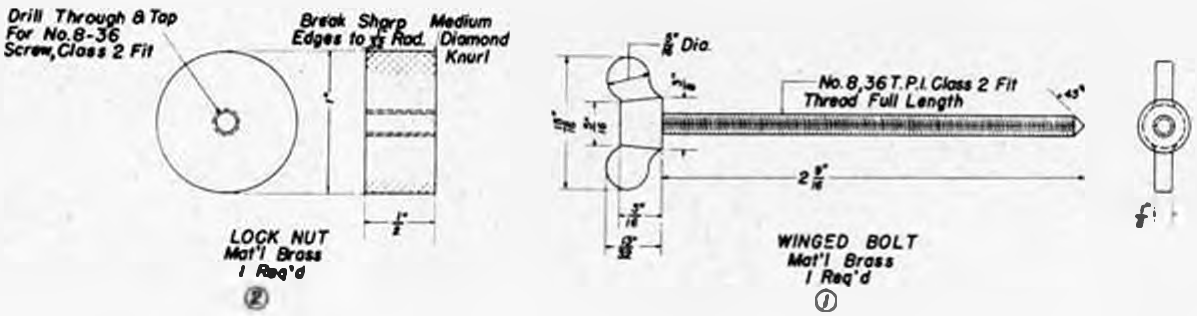


Fig. 30a - RSP Tool for Pi-4c Exploder

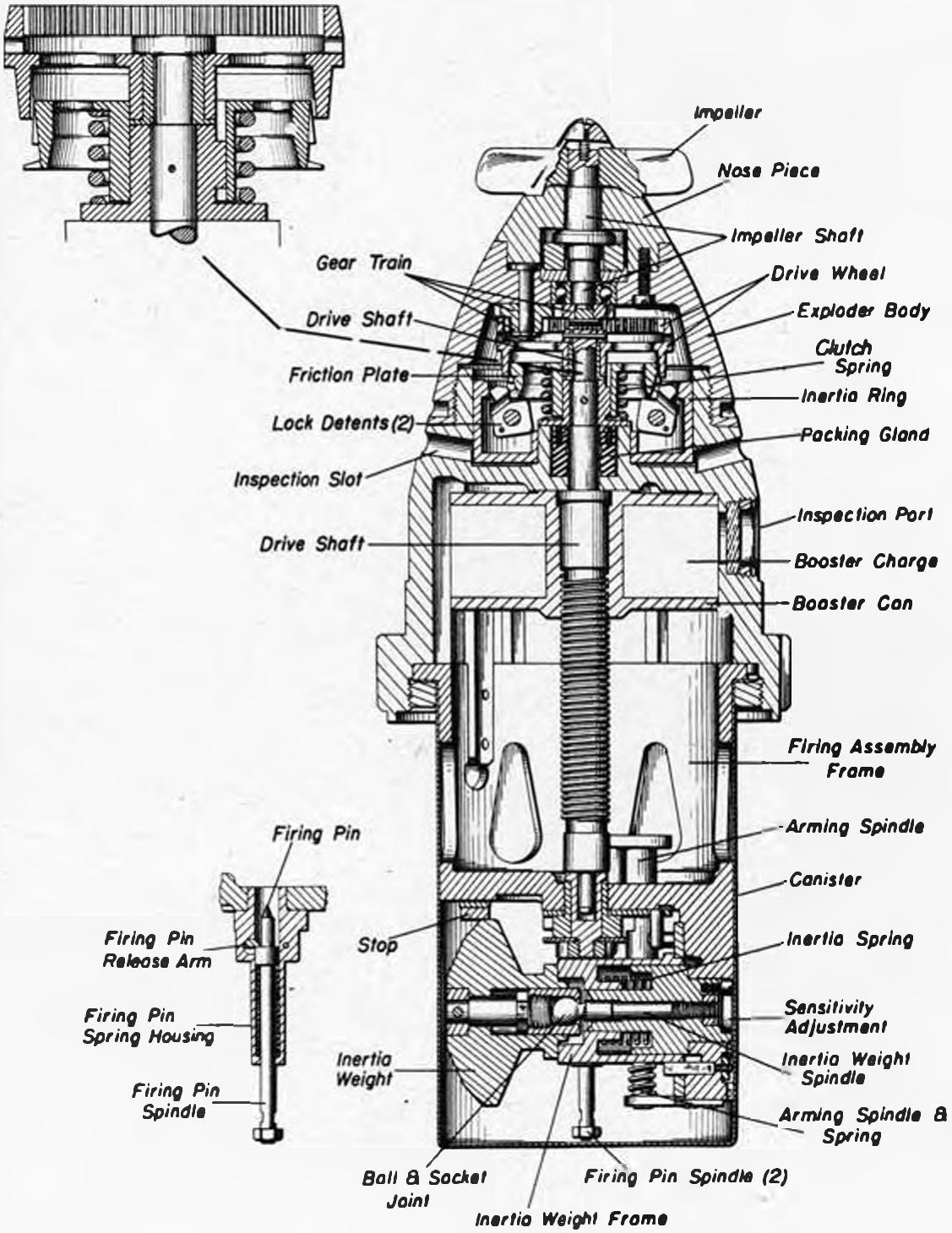


Fig. 31 - P142s Exploder, Sectional View

Pi42a Exploder

General

1. Impact-inertia type, fitted in nose pocket of 18" GK-2 warhead in aircraft-launched torpedoes.

Description

1. External

(a) The exploder is 12 3/4" long, 5 1/4" in maximum diameter, and is composed of the following main parts:

(1) A forward section, which protrudes 7" from the warhead, consisting of an exploder body and nose piece. A four-bladed impeller with a span of 2 3/4" is fitted to the center of the nose piece, being attached to the outer end of an impeller shaft. A small inspection port covered by a transparent plastic window, 1" in diameter, is fitted 5 1/2" aft the nose. No whiskers are fitted.

(2) An after section, consisting of a cylindrical steel canister, 6" long, is secured to the inner end of the exploder body. This canister houses the exploder firing mechanism.

2. Internal

(a) The primary working parts of the exploder, reading from fore to aft, are as follows:

(1) The impeller shaft, bearings, reduction gear train and drive wheel.

(2) An inertia-operated arming clutch mechanism, consisting of an inertia ring which, when in the unarmed position, holds two spring-loaded lock detents against the notched outer circumference of a spring-loaded friction plate.

(3) A threaded drive shaft to which the booster can is screwed and which is keyed to the friction plate. The booster can is prevented from rotating with the shaft by a projection attached to the firing assembly frame. This projection travels in one of two grooves on the circumference of the booster can. The booster is fitted with two percussion detonators.

(4) The inertia firing assembly, consisting of a cylindrical frame which contains the booster (when armed) and has the firing mechanism and spring-loaded firing pins mounted on its after face. The firing mechanism consists of the following parts:

(i) A wheel-shaped inertia weight, suspended from a transverse spindle by a ball and socket joint.

(ii) A spring-loaded arming spindle which determines the armed or unarmed condition of the inertia weight and firing pins.

(iii) An air dashpot which damps the inertia weight.

3. Method of Mounting

(a) The exploder is slipped into the warhead and is secured by a keep ring.

Operation

1. When the torpedo is launched from aircraft, the impeller idles until the torpedo hits the water, at which time the inertia ring in the clutch mechanism is driven forward, thus allowing the two lock detents to move outward and release the friction plate. The friction plate is then driven forward by the clutch spring, wedging the beveled outer edge of the friction plate into the ring on the drive wheel. Impeller rotation is then transmitted through the drive wheel and friction plate to the drive shaft, and the booster is carried aft to its armed position in the firing assembly frame. As the booster reaches the fully armed position, it forces the arming spindle aft, performing the following arming functions:

(a) It rotates a ring, thereby releasing the cylindrical inertia weight frame and moves a stop, unlocking the inertia weight.

(b) It unlocks the two spring-loaded firing pins.

2. The exploder fires upon receipt of a blow sufficient to displace the

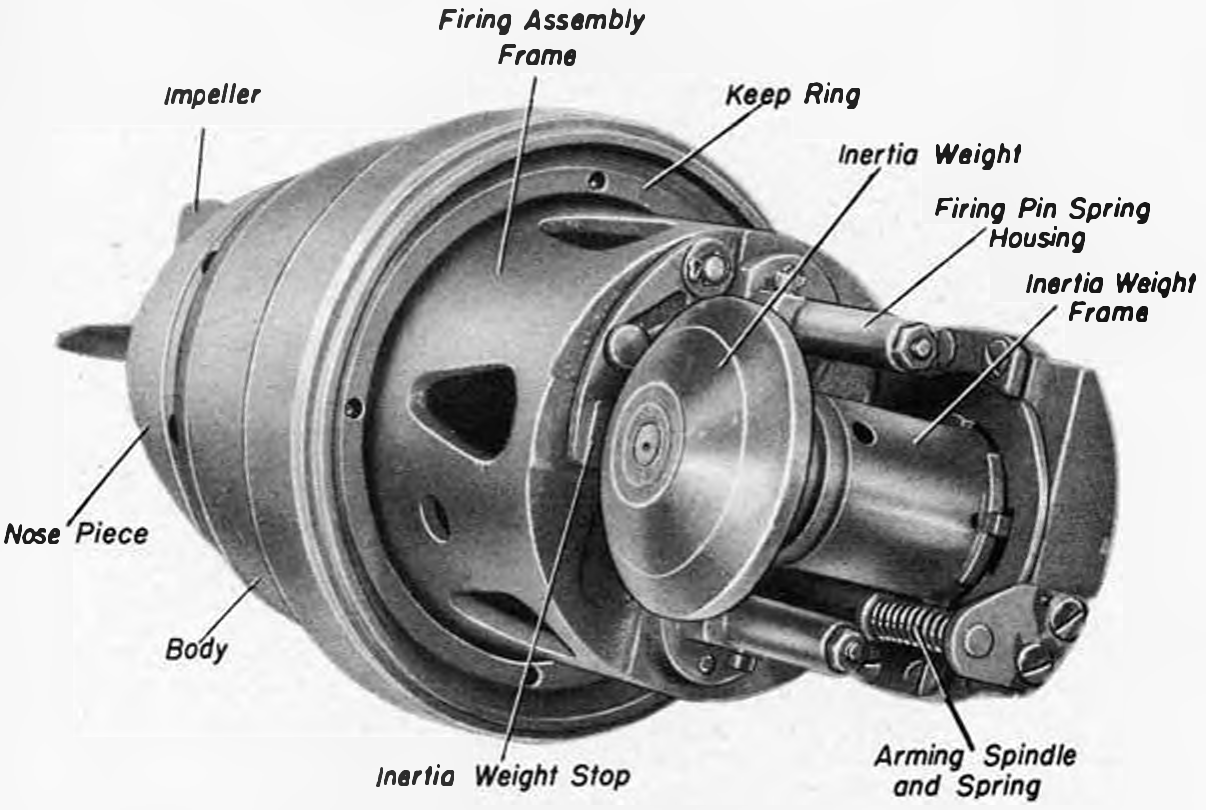


Fig. 32 - P142s Exploder, Canister Removed

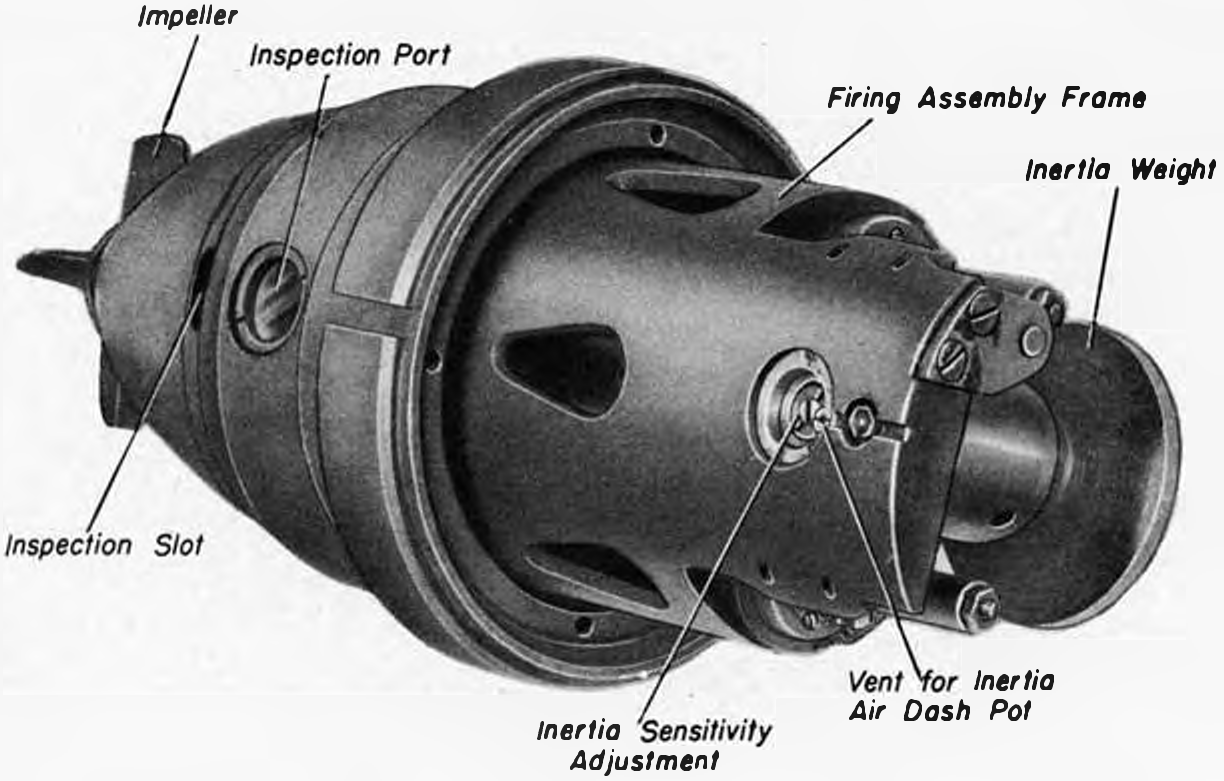


Fig. 33 - P142s Exploder, Canister Removed

Pi42s Exploder (Cont'd.)

inertia weight which, upon displacement, pushes its frame outward against the dashpot and a weak spring. A detent on the frame bears against a detent on a firing pin release arm, pivoting the arm and releasing the firing pins to impinge on the detonators.

Precautions

1. Note that this exploder is used in a warhead which also contains the SIC activator. Should it be necessary to render safe such a warhead, deal with the activator first if practicable. If the activator is not accessible without moving the torpedo, the exploder should be rendered safe first.

2. Note that the SIC magnetic firing device may incorporate a self-destroying feature. Except in extreme emergency, wait at least 24 hours before attempting to render safe.

3. Note that this exploder is exceptionally sensitive to shock or impact.

4. Check the inspection port.

   (a) If the booster can is visible, the exploder is unarmed.

   (b) If the booster can is not visible, the exploder must be assumed to be armed. Do not attempt to render safe an armed exploder of this type except in extreme emergency.

5. An additional possible means of checking the condition of the exploder is as follows:

   (a) If the inertia clutch mechanism has not operated, the white-painted inertia ring should nearly cover the inner opening of a 3/4" slot which perforates the exploder body about 1" forward of the inspection port. If the inertia ring has moved forward, only the after edge is visible, indicating that the clutch has operated. The booster is therefore probably in the armed position.

Rendering Safe Procedure

1. Tape the impeller to the exploder body.

2. Remove the keep ring which secures the exploder to the warhead.

3. From a safe distance, remove the exploder from the warhead, being sure to provide some suitable means for cushioning its fall.

Note: At this point, unless there is positive evidence that the exploder is not armed, it should be sandbagged and blown in situ. It is possible to carry out the remainder of the rendering safe procedure as prescribed on an armed exploder, but such action is so dangerous as to be prohibitive.

4. Remove the keep ring which secures the canister and firing assembly to the exploder body.

5. Remove the canister and firing assembly from the exploder body, thereby separating the firing pins and detonators.

6. Unscrew the booster can from the drive shaft.

7. Dispose of all explosive elements.

Fig. 34 - Pi.2s Exploder

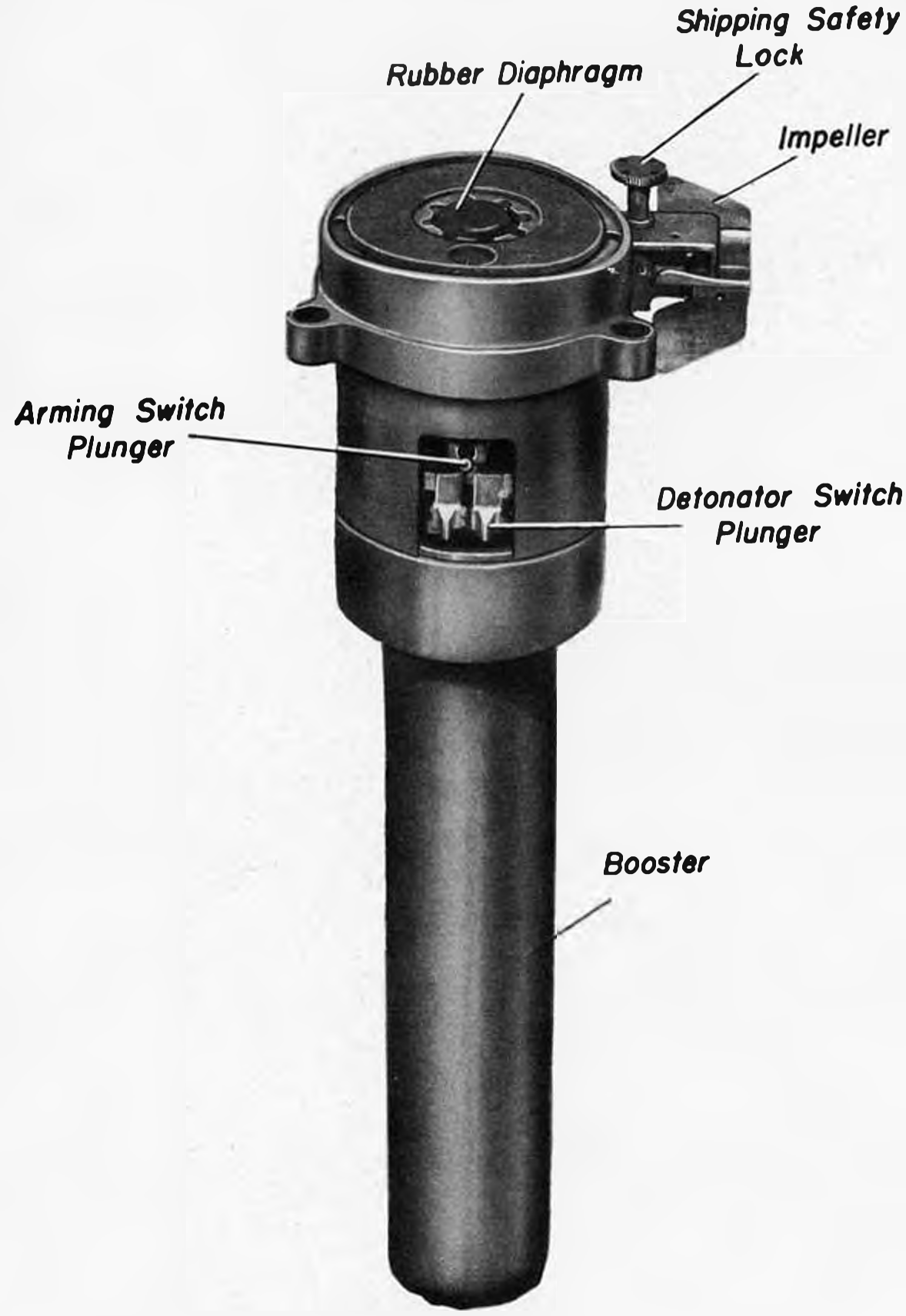


Fig. 35 - SIC Activator

SIC Activator

General

1. Impeller-driven arming device, fitted in transverse pocket on top center line of GK2 warheads with aircraft-launched torpedoes.

2. This device, although not an exploder in the usual sense, is treated in detail herein because it performs arming and firing functions ordinarily carried out by an exploder. It therefore must be dealt with in rendering safe the torpedo to which it is fitted. The Pi42s exploder is fitted in the same warhead but is independent of the SIC activator.

Description

1. External

   (a) The activator is 16" long, 3 7/8" in maximum diameter, and is composed of the following main parts:

      (1) An upper section, consisting of a cylindrical, brass housing 5" long, which encloses the main working parts of the device. A three-bladed impeller mounted on the end of an impeller shaft protrudes from the side of the housing and rotates in an impeller trough adjacent to the activator pocket. A safety bar, notched at each end and containing a spring and water flap, is suspended between two pins on the warhead and prevents impeller rotation prior to launching. A rubber diaphragm, 1" in diameter, is fitted to the center of the top cover and serves to keep the interior of the device watertight.

      (2) A lower section, contained in a cylindrical, brass housing, 11" long and 2 1/4" in diameter, which encloses the booster and detonators.

   (b) The upper and lower sections are joined by six bolts.

2. Internal

   (a) The main working parts of the activator are as follows:

      (1) The impeller and impeller shaft, the latter being fitted with a worm on its inner end which engages a spur gear.

      (2) A threaded arming spindle which engages internal threads of the spur gear. The top of the spindle is square and fits into a corresponding hole in the top cover under the rubber diaphragm. The lower end of the spindle is secured to a spindle extension.

      (3) Two lever systems, one of which controls an arming switch plunger while the other compresses the spring of the detonator switch plunger. The arming switch plunger, consisting of a brass pin mounted on a sliding frame, is held in the unarmed position by a spring clip which bears against the arming plunger lever system. The detonator switch plunger consists of two insulated, wedge-shaped contacts, each of which is fitted with an electrical lead below and an extension arm above. The leads go to the detonators and the extension arms rest against a leaf-spring, short-circuiting bridge when the detonator plunger switch is in the unarmed position.

3. Method of Mounting

   (a) The activator is slipped into the warhead pocket and secured by three bolts.

Operation

1. (a) When the torpedo is launched, the safety bar prevents impeller rotation during air travel. Upon impact with the water, pressure on the water flap forces the forward section of the safety bar aft against spring pressure until the bar is free and falls away. Impeller rotation then turns the worm and spur gears. The arming spindle, which is not free to rotate, rises up on the threads of the spur gear, carrying the spindle extension with it. As the spindle extension rises, it pivots a lever system against the spring clip, forcing the arming switch plunger aft and closing the arming switch which energizes the magnetic firing device located elsewhere in the warhead.

   (b) Upward motion of the spindle extension also compresses the detonator switch plunger spring. After the arming switch plunger operates, further upward motion of the spindle extension aligns a slot in the spindle extension with detents on the detonator switch plunger, allowing the plunger to snap aft by spring pressure and make its double contact. Aftwise movement of the plunger also

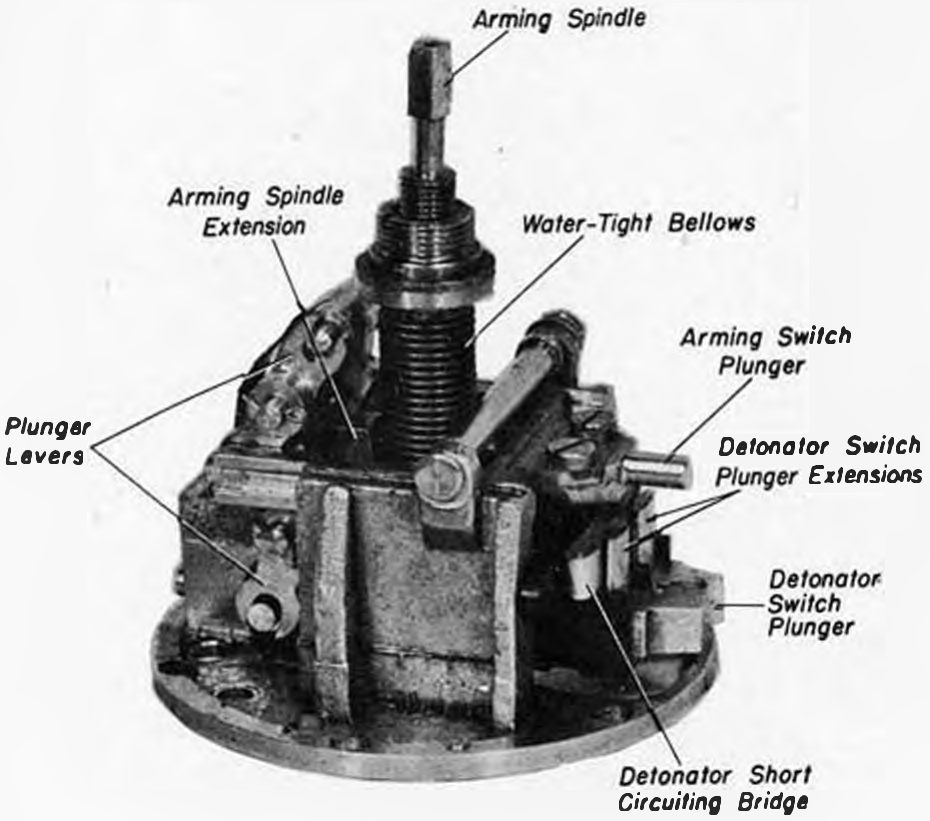


Fig. 36 - SIC Activator, Arming Assembly

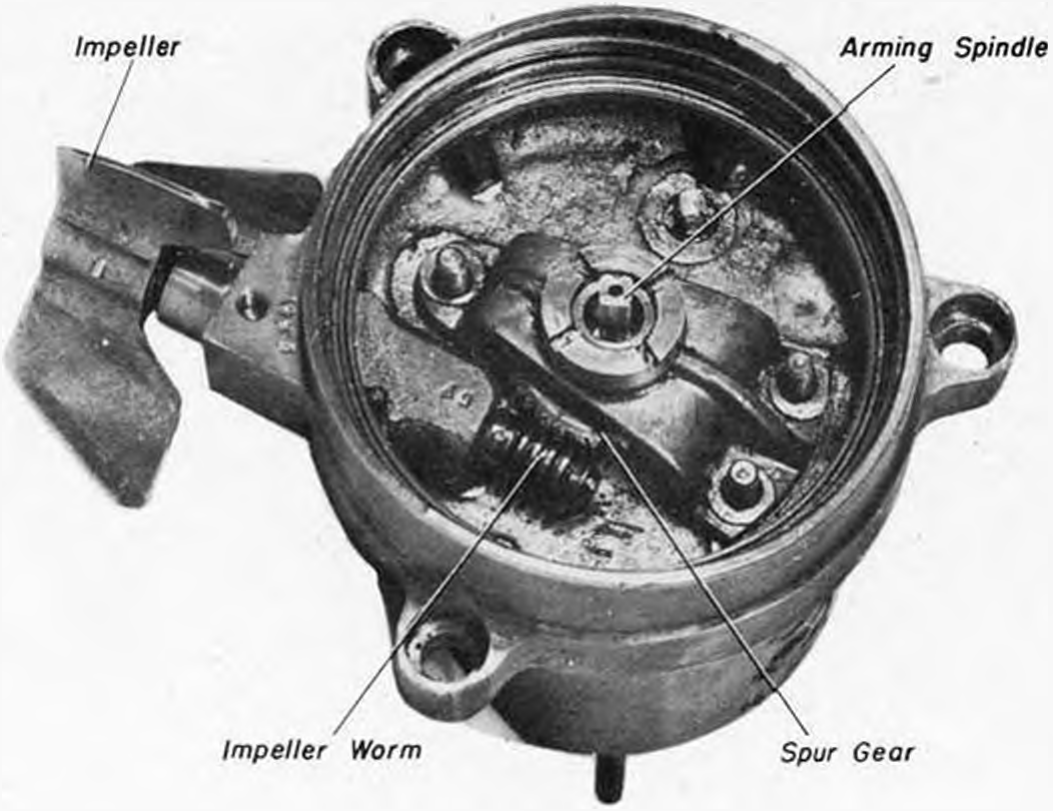


Fig. 37 - SIC Activator, Top Removed

SIC Activator (Cont'd.)

breaks contact with the short-circuiting bridge and the detonator circuit is armed.

(c) Continued impeller rotation moves the square top of the arming spindle upward out of the square hole in the top cover stretching the rubber diaphragm, at which point upward motion of the spindle ceases as it may now rotate freely.

2. The detonators fire when the detector coils in the magnetic firing device receive the proper signal and the amplifier completes the detonator circuit from the battery.

Precautions

1. Note that this activator is used in a warhead which also contains the P142s nose exploder. Should it be necessary to render safe a torpedo fitted with these devices, deal with the activator first if practicable. If the activator is not accessible without moving the torpedo, the exploder should be rendered safe first.

2. Note that the activator cannot be withdrawn from the warhead when in an armed condition.

3. The magnetic firing device may incorporate a self-destroying feature. Except in extreme emergency, wait at least 24 hours before attempting to render safe.

4. Check the condition of the activator as follows:

(a) Cut away the rubber diaphragm on the top cover.

(b) If the arming spindle projects more than 1/8" above the square hole, the magnetic firing device must be considered armed.

Rendering Safe Procedure

1. Unarmed

(a) Tape the impeller to the warhead shell.

(b) Remove the securing bolts.

(c) From a safe distance, remove the activator.

(d) Remove the six bolts and separate the upper and lower sections.

(e) Dispose of detonators and booster.

2. Armed

(a) Using the proper nitric acid solution (Part I, Chapter 7), cut a hole approximately 3" in diameter in the warhead shell, 3" abaft the after end of the activator pocket.

(b) Slit the buff colored, rubberized cable beneath the hole; cut and tape separately each of its four leads. The magnetic section is now inert.

Note: If the nose exploder in the warhead has not yet been removed, it should be dealt with at this point.

(c) Enlarge the hole until easy hand access is obtained.

(d) Remove the keep ring which secures the switch to the after side of the activator; remove the switch.

(e) Remove the keep ring which secures the top cover of the activator; remove the top cover.

(f) Reach in through the hole and push the detonator switch plunger forward while rotating the arming spindle clockwise. Continue until the switch plunger retracts to the unarmed position.

(g) The activator is now disarmed; proceed as in Par. 1 above.

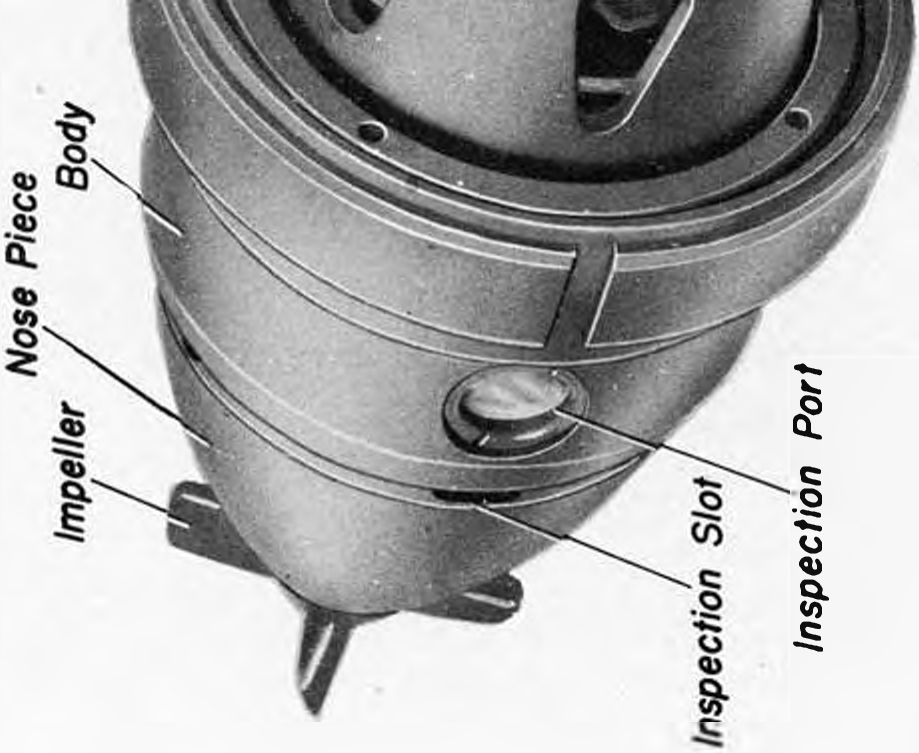
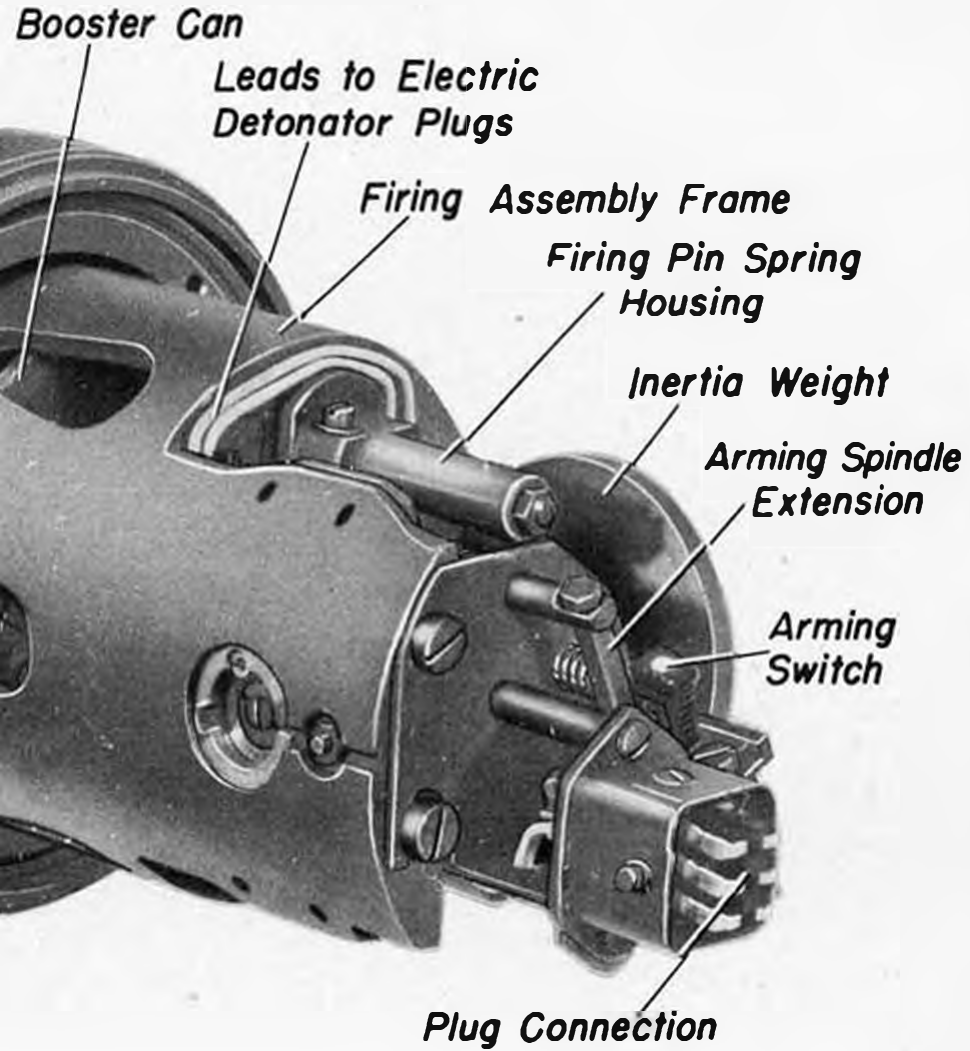


Fig. 38 - Pi42s(el) Exploder, Canister Removed



GERMAN TORPEDOES

P142s(el) Exploder

General

1. Combination impact-inertia exploder and SIC activator, fitted in nose pocket of 18" GK-3 warheads with aircraft-launched torpedoes.

Description

1. External

   (a) Same as P142s except that a six-lead plug connection projects through the after end of the canister.

2. Internal

   (a) Same as P142s except as follows:

      (1) Two electric detonators with male connections are added to the booster. These detonators plug to female connections on the firing assembly frame when the booster is in the armed position.

      (2) An electric, spring-loaded arming switch, containing one constant make and two make-break switches, is secured to the after end of the firing mechanism. One of the make-break switches has no leads fitted.

      (3) An extension is added to the after end of the arming spindle and serves to restrain the arming switch so that the operative make-break switch is open when the exploder is unarmed.

      (4) A small projection is added to the after end of the drive shaft and controls a small arm on the forward end of the arming spindle.

      (5) Leads from the plug connection as follows:

         (i) Four to the arming switch.

         (ii) Two to the electric detonators.

   (b) The magnetic firing device is located elsewhere in the warhead.

Operation

1. (a) Impact section

      (1) Same as P142s.

   (b) Magnetic section

      (1) The first revolution of the drive shaft causes the projection on its after end to come up against the arm on the forward end of the arming spindle, thereby rotating the spindle about 25°. This moves the extension on the after end of the arming spindle away from the arming switch, allowing the make-break switch to make and arm the magnetic circuit.

2. (a) Impact section

      (1) Same as P142s.

   (b) Magnetic section

      (1) Similar to P13.

Precautions

1. Bear in mind that the SIC magnetic firing device may incorporate a self-destroying feature. Except in extreme emergency, wait at least 24 hours before attempting to render safe.

2. Note that there is no means of differentiating this exploder from the P142s when it is mounted in the warhead. However, the P142s(el) is used with the GK3 warhead which does not contain the SIC activator on its top center line.

3. Note that this exploder is exceptionally sensitive to shock or impact.

4. Check the inspection port.

   (a) If the booster can is visible, the exploder is unarmed.

   (b) If the booster can is not visible, the exploder must be assumed to be armed. Do not attempt to render safe an armed exploder of this type except in extreme emergency.

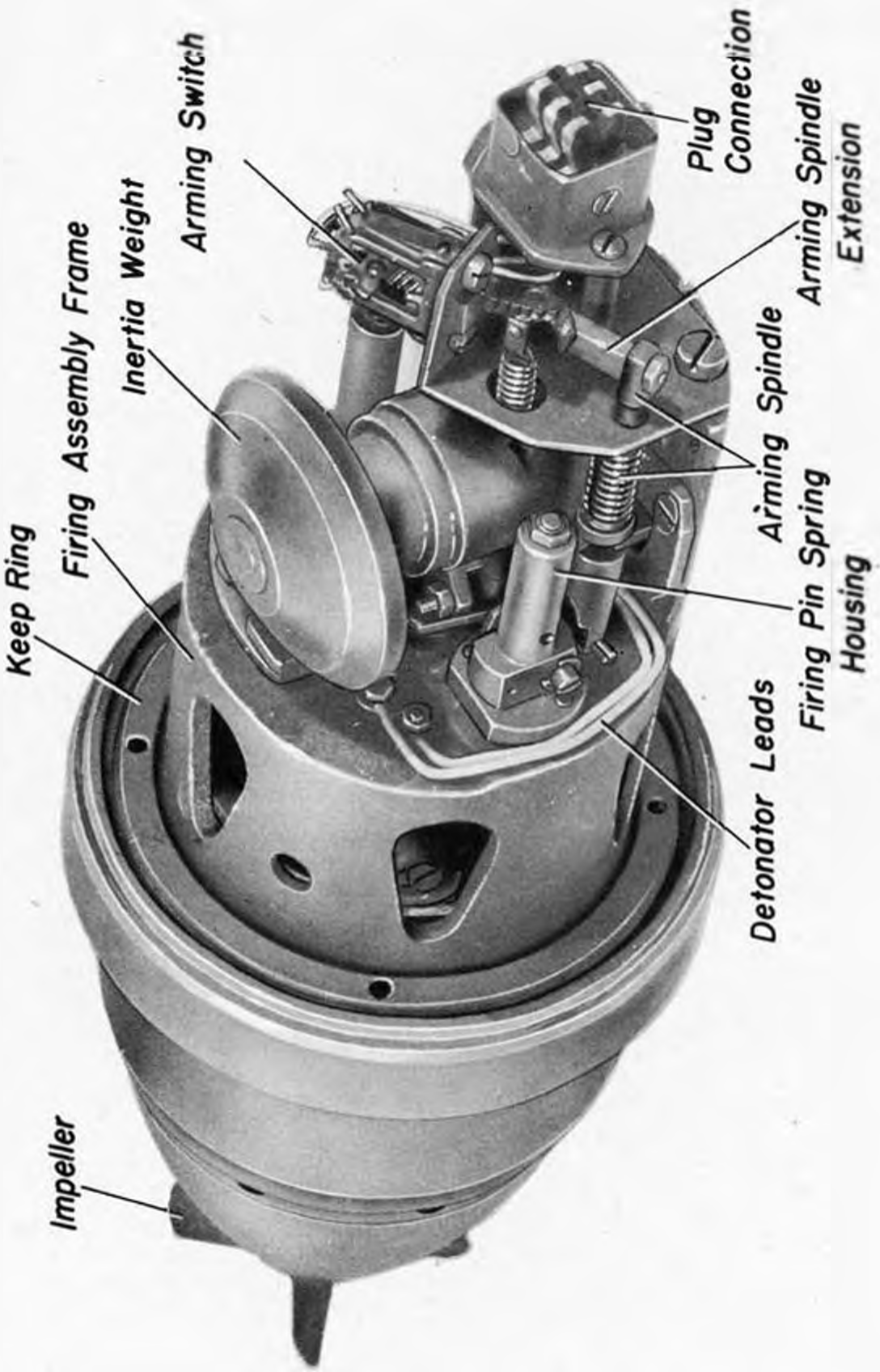


Fig. 39 - F142s(el) Exploder, Canister Removed

P142s(el) Exploder (Cont'd.)

5. An additional possible means of checking the condition of the exploder is as follows:

   (a) If the inertia clutch mechanism has not operated, the white-painted inertia ring should nearly cover the inner opening of a 3/4" slot which perforates the exploder body about 1" forward of the inspection port. If the inertia ring has moved forward, only the after edge is visible, indicating that the clutch has operated. The booster is probably in the armed position.

Rendering Safe Procedure

1. Same as P142s except as follows:

   (a) After removing the exploder from the warhead pocket, disconnect the plug on the after end from the cable in the warhead.

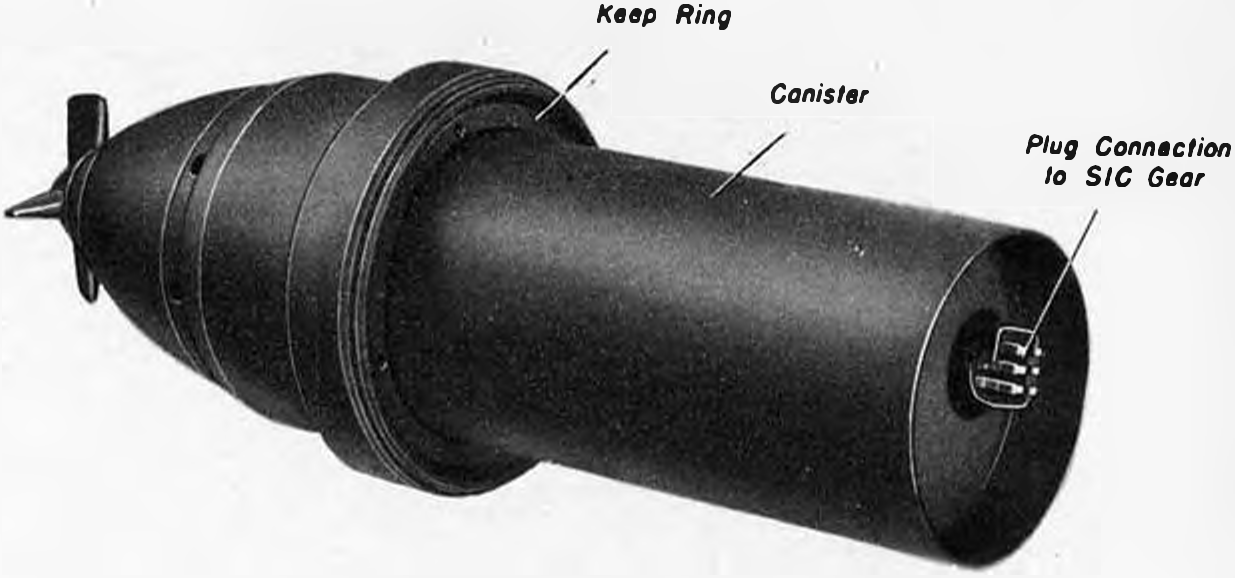


Fig. 40 - P142s(el) Exploder

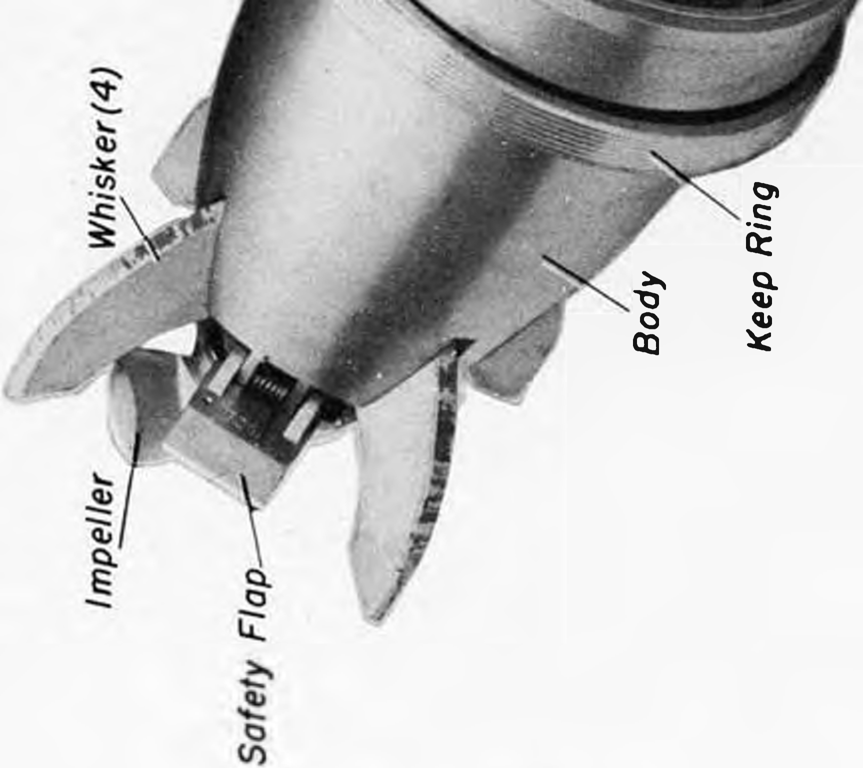


Fig. 41 - F5S Exploder


Drive Shaft
Firing Spring Housing (2)
Lever Cover Plate

F.5.S. Exploder

General

1. Impact, direct action type, fitted in nose pocket of 18" "F5B" warheads with F5B torpedoes.

Description

1. External

   (a) The exploder is 12 3/4" long, 4 1/2" in maximum diameter, and is composed of the following main parts:

      (1) A forward section, which protrudes 7" from the warhead, consisting of an ogival exploder body. Four curved whiskers, flat end type, protrude 2" from slots on the exploder body. The whiskers are in a single casting and do not operate independently as in Pi-1. A two-bladed impeller with a span of 3 1/2" is fitted to the center of the nose, being attached to the forward end of a drive shaft. A small spring-loaded flap, mounted on the side of the nose, prevents impeller rotation prior to launching.

      (2) An after section, consisting of a cylindrical steel canister 5 1/2" long, is secured to the inner end of the exploder body. This canister houses the working parts of the exploder.

   (b) Markings on the exploder body are as follows:

      (1) The letters F.5.S. stamped on the exploder body.

      (2) The exploder serial number stamped on the exploder body.

      (3) Scribe marks in green paint on both the exploder body and whiskers which, when aligned, indicate the unfired position of the whiskers.

2. Internal

   (a) The internal alignment of parts is similar to the Pi-1 although the firing mechanism is simpler in design. The booster can is mounted directly on a threaded drive shaft and is prevented from rotating with the shaft by two longitudinal projections, 180° apart, on the inside of the exploder body. These projections engage corresponding grooves on the outer circumference of the booster can. Only two firing pins are fitted and it is assumed that the booster can (none recovered) contains but two percussion detonators. The plate cover and lever plate fitted to the Pi-1 are combined into a single lever cover plate.

3. Method of Mounting

   (a) The exploder is slipped into the warhead and secured by a keep ring.

Operation

1. Similar to Pi-1 although the arming range is not known.

Precautions

1. See Introduction.

Rendering Safe Procedure

1. Insert wedges abaft each whisker to prevent any movement.
2. Tape the impeller to the nose piece.
3. Remove the exploder keep ring.
4. From a safe distance, remove the exploder from the warhead.
5. Remove the keep ring which secures the canister to the exploder body.
6. Remove the canister.
7. Remove the six screws which secure the lever cover plate to the firing pin housing and remove the lever cover plate.
8. Remove and dispose of all explosive elements as in Pi-1.

G7A-AZ Exploder

General

1. Impact, direct action type, fitted in nose pocket of 21" torpedoes. Believed to be obsolete.

Description

1. External

   (a) The exploder is 18 1/2" long, 7 1/2" in maximum diameter, and is composed of the following main parts:

      (1) A forward section which protrudes 9" from the warhead consisting of an exploder body and nose piece very similar to the forward section of the Pi-1. Four flat end, steel-tipped whiskers, made in a single casting, protrude 3" from slots in the nose piece. A two-bladed impeller with a span of 5 1/2" and variable pitch is fitted to the center of the nose piece, being attached to the forward end of a drive shaft. The variable pitch permits different arming range settings. All other external features are very similar to the Pi-1 except that the nose piece is slightly smaller in diameter.

      (2) An after section, consisting of a cylindrical steel canister 9" long, is secured to the inner end of the exploder body. The canister houses the main working parts of the exploder.

   (b) Markings on the exploder body and nose piece are as follows:

      (1) The letters G7A-AZ stamped on the nose piece.

2. Internal

   (a) Same as Pi-1 except as follows:

      (1) None of the firing pins is spring-loaded.

      (2) An electric switch is fitted inside and a battery is fitted to the after edge of the firing pin housing. These are used for electric firing on impact.

      (3) The booster charge is slightly smaller and the booster can contains four percussion detonators and two electric detonators.

3. Method of Mounting

   (a) Same as Pi-1.

Operation, Precautions and Rendering Safe Procedure

1. Same as Pi-1.

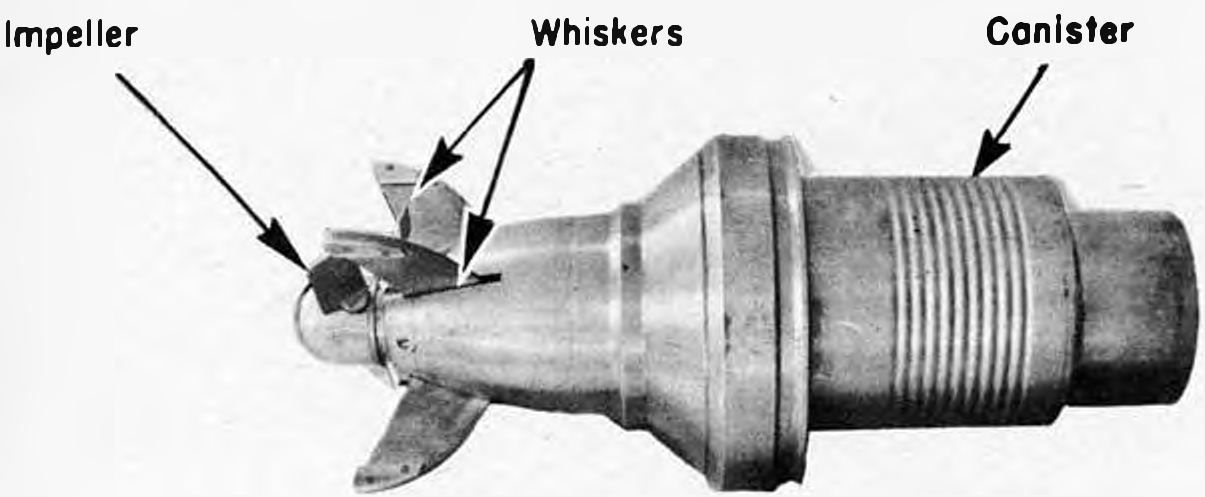


Fig. 42 - G7A-AZ Exploder

G7A-MZ Exploder

General

1. Combination impact, direct action and magnetic induction type, fitted in nose pocket in 21" torpedoes. Believed to be obsolete.

Description

1. External

   (a) The exploder is 28" long, 7 1/2" in maximum diameter, and is composed of the following main parts:

      (1) A forward section, which protrudes 9" from the warhead, consisting of an exploder body and nose piece very similar to the forward section of the G7A-AZ. The main difference consists of two concentric setting rings around the forward part of the exploder body. The forward ring, used for latitude adjustment, has a single letter setting, "A", and number setting from -5 to 16. When the exploder is set on "A", the magnetic firing device is inoperative. The after ring, used to adjust the arming range, has settings from 120 to 4000 meters.

      (2) An after section, consisting of a cylindrical steel canister, 19" long, is secured to the inner end of the exploder body. The canister houses the main working parts of the exploder.

   (b) Markings on the exploder body and nose piece are as follows:

      (a) The letters G7A-MZ stamped on the nose piece.

2. Internal

   (a) The primary working parts of the impact arming and firing sections are similar to those fitted to the G7A-AZ except that an arming range adjusting mechanism and clutch have been added and four firing pins are fitted. The following additional parts are added for magnetic firing:

      (1) A small, four-brush rotor.

      (2) A movable compensating magnet for latitude adjustment.

      (3) A battery relay and various magnets.

3. Method of Mounting

   (a) Same as Pi-1.

Operation

1. Safety range and latitude adjustments are made prior to launching. When the torpedo is launched, impeller rotation turns the drive shaft and generator rotor. After a variable period depending on the length of the arming range, the clutch operates, engaging the transporter spindle and the booster moves aft as in the Pi-1. The exploder is fully armed when the booster completes its travel.

2. (a) Impact section

      (1) Same as Pi-1.

   (b) Magnetic section

      (1) The exploder fires when a magnetic field surrounds the rotor, whereupon it generates a small current which operates a sensitive relay, putting the electric detonators across the battery.

Precautions and Rendering Safe Procedure

1. Same as Pi-1 except that step #8 of the rendering safe procedure should be changed as follows:

   (a) Remove the six screws which secure the lever plate, plate cover and magnetic firing device to the firing pin housing; remove the lever plate, plate cover and magnetic firing device.

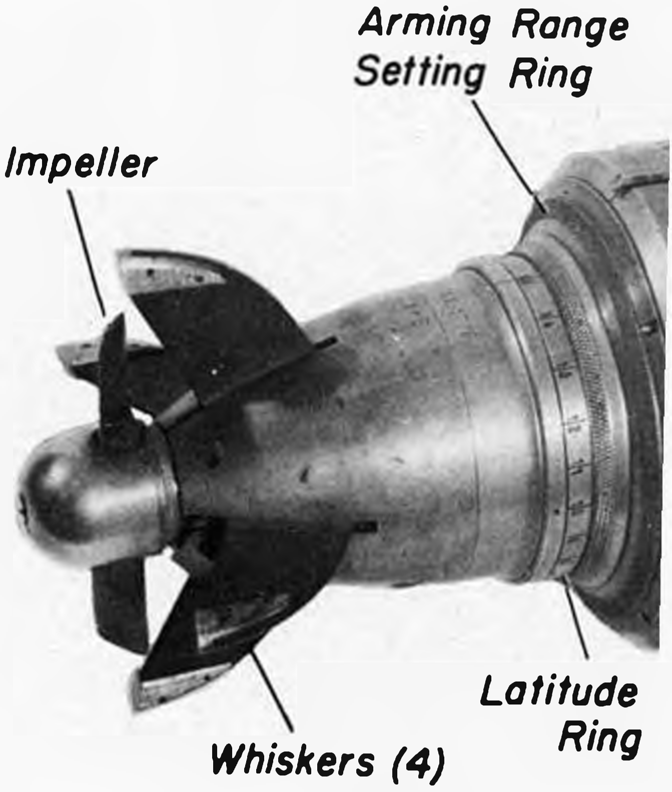
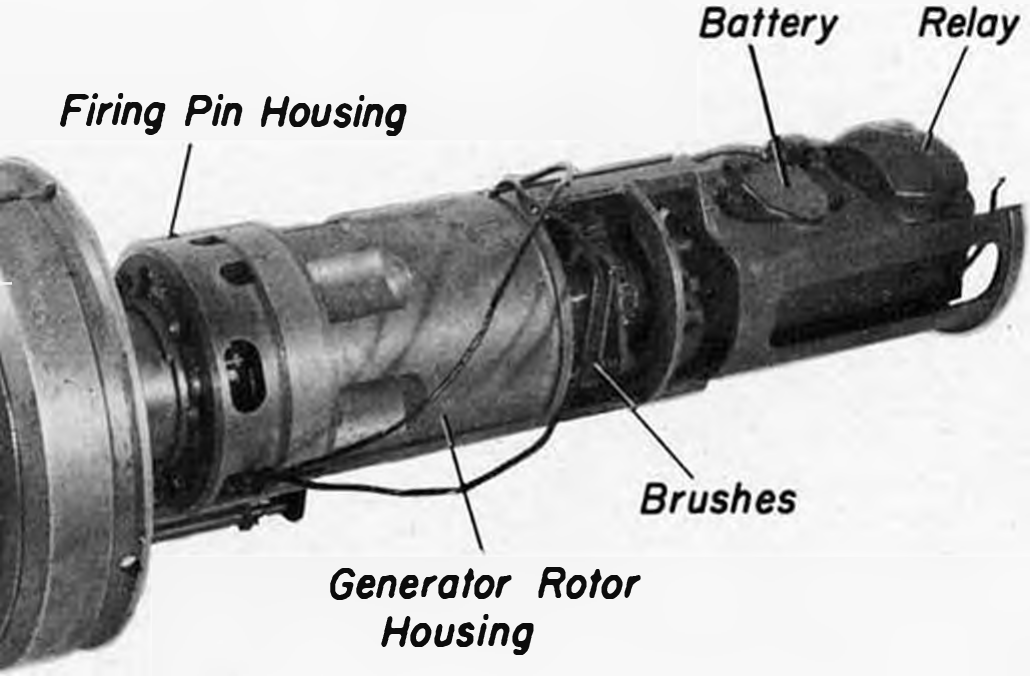


Fig. 63 - G7A-W2 Exploder


Battery
Relay
Firing Pin Housing
Brushes
Generator Rotor Housing
Setting

MINE DISPOSAL HANDBOOK

PART IV

GERMAN UNDERWATER ORDNANCE

. . . . . .

Depth Charges

CHAPTER 4

GERMAN DEPTH CHARGES

MARCH 1, 1945

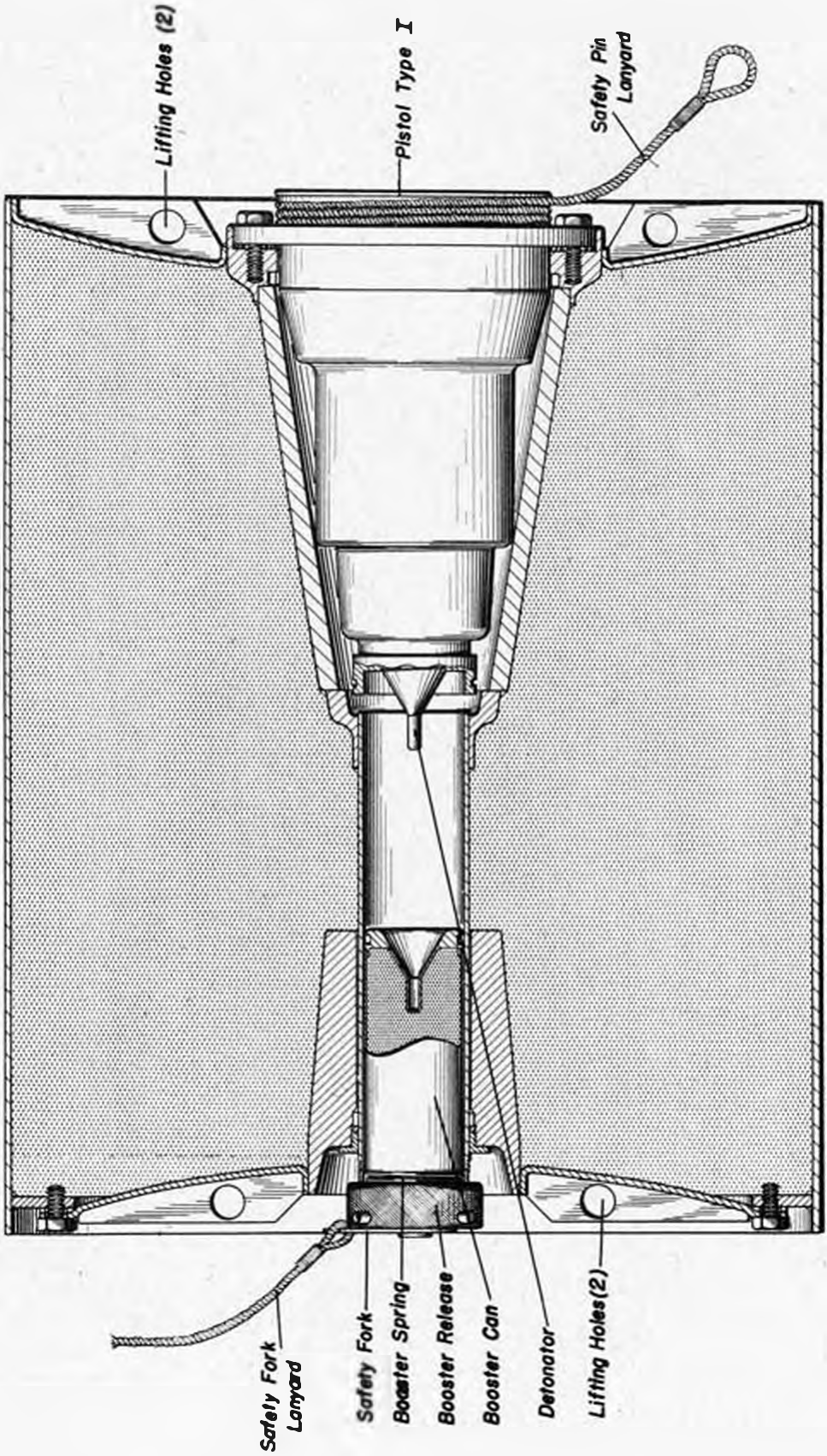


Fig. 1 - Depth Charge Type I, Sectional View

Introduction

1. Although only a single German depth charge case and four pistols have been recovered, it is believed that they are representative of German developments in this field. Recent intelligence reports indicate that at least three cases and six pistols are in common use, all the cases having the same dimensions and each of the pistols operating on the same basic principles as the recovered specimens. The Tactical Depth Charge, although not a depth charge in the usual sense, is included herein because of its similarity in appearance.

2. The pistols employed fire by means of a hydrostatically driven, clock-work firing device. Both pistols and charge cases are herein given arbitrary designations, the specific German designations not being known, although depth charges as a group are designated by the Germans as "WB" or "Wasser Bomben."

3. The following precautions should generally be observed when dealing with depth charges of this type:

   (a) Do not move or jar the charge except from a safe distance.

   (b) Do not move or rotate the depth setting dial while rendering safe.

   (c) If the charge is found underwater, raise it to the surface before rendering safe.

Depth Charge Type I

General

1. Launched by surface craft.

Description

1. Case

Shape	Cylindrical
Color	Black. Ends may be painted red or yellow.
Material	Steel
Diameter	
Case	17 1/2"
Central tube	
Booster end	2 1/4"
Pistol end	7 7/8"
Length	22 1/2"
Charge	300 lbs. approx.
Total weight in air	420 lbs. approx.
Weight of case less explosive	120 lbs.

2. External fittings

End plate	16 1/8" diam., secured by eight bolts, encloses booster end. Fitted with six radial stiffening ribs, two of which are drilled with 1" lifting holes.
Filling hole covers	Two, 4" diam., on end plate, 180° apart, secured by expanding rubber washers.

3. Standard accessories for case

   (a) Pistols - recovered with Type I. Type II, III and possibly others could be fitted.

   (b) Standard booster release and booster assembly.

Rendering Safe Procedure

1. Remove the pistol securing screws and break the pistol seal by screwing two of the screws into the extra holes in the pistol flange.

2. Remove the pistol from the central tube.

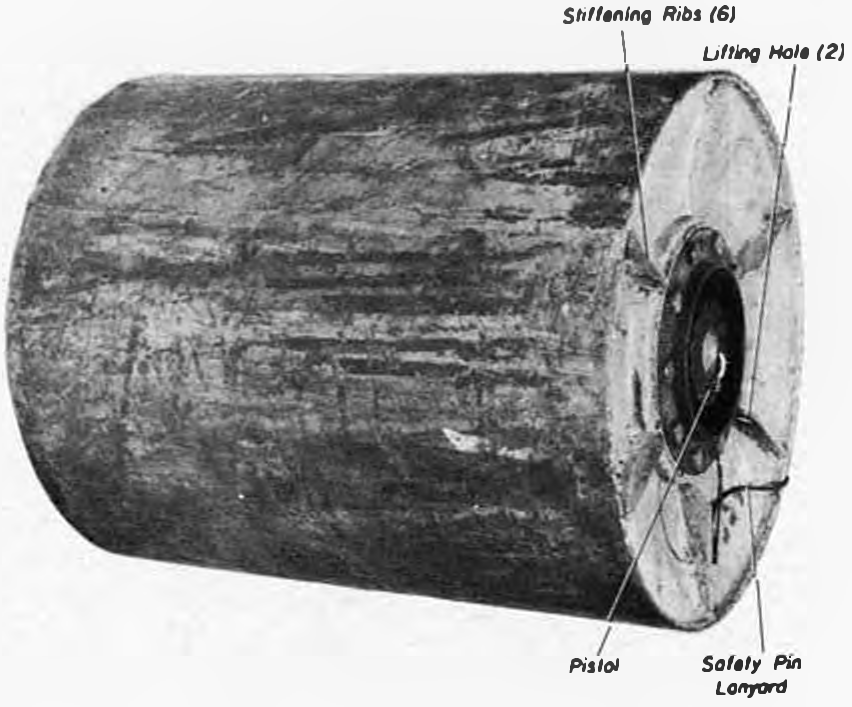


Fig. 2 - Depth Charge Type I, Pistol End

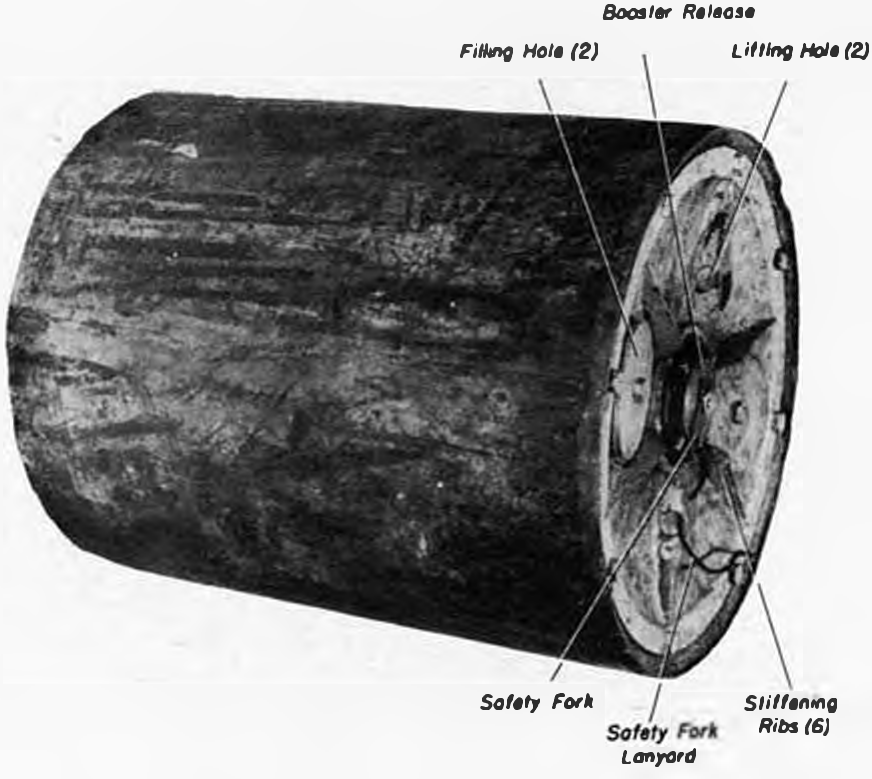


Fig. 3 - Depth Charge Type I, Booster End

Depth Charge Type I (Cont'd.)

3. If the booster can comes out with the pistol, separate it from the pistol after retracting the spring-loaded securing detents.

4. Unscrew the detonator from the pistol.

5. If the booster has not come out with the pistol, remove it and the booster release mechanism from the central tube.

6. Dispose of detonator, booster and charge.

Type II Pistol

General

1. Hydrostatic, clock-delay type, believed to be used in aircraft-launched depth charges.

Description

1. The pistol is 10 5/8" long, 7 3/4" diameter at its top flange and is shaped roughly like a tapered cylinder. The case consists of two main parts as follows:

   (a) An upper section, 7 3/8" long, 5 5/8" in maximum diameter, which houses the following parts:

      (1) A depth-setting dial and dial plate. Settings on the dial are 35, 60, 90, 120 (meters) and SAFE. The dial plate is removable and is used to make settings on the pistol, the small opening in the plate indicating setting.

      (2) A rubber diaphragm which controls a hydrostatic piston assembly and which is held in the safe position prior to launching by four lock balls. The lock balls are held by a spring-loaded locking ring. A small setting boss on the locking ring protrudes from the top face of the pistol and is used to rotate the locking ring into position against spring tension. Once in position, it is held by a safety pin.

      (3) A diaphragm spring and three housing springs which tend to hold the hydrostat in the "out" position.

      (4) A spring-loaded firing pin spindle, centrally located, which passes through a release collar. The spindle is held in the safe position by a small detent mounted thereon which bears against the release collar. The collar is fitted with a small keyway or groove which permits the detent on the firing pin spindle to pass through upon firing.

      (5) A driving rack, connected to the hydrostat assembly, which extends downward to engage the teeth of a pinion gear in the clockwork.

   (b) A lower section, 3 1/2" long and 3 1/4" in diameter, threads internally to the upper section. A cylindrical ring mounted on its lower end serves as a booster seat and is equipped with three small spring-loaded detents which lock the booster in place. The lower section contains the following parts:

      (1) A clockwork escapement geared to the release collar.

      (2) The lower end of the firing pin spindle.

      (3) The lower end of the driving rack.

      (4) The detonator and small percussion cap.

2. Method of Mounting

   (a) The pistol is secured to the case by ten body screws through the flange of its upper section. A round, cover plate, 5 7/8" in diameter, fits over the face of the upper section prior to launching.

Operation

1. (a) The cover plate is removed and the depth setting made before launching. To set the depth, the dial plate is grasped, depressed and rotated to the proper position indicated by white numerals on the dial which represent meters. Rotation of the dial plate rotates the firing pin spindle, varying the distance from the detent on the firing pin spindle to the keyway in the release collar.

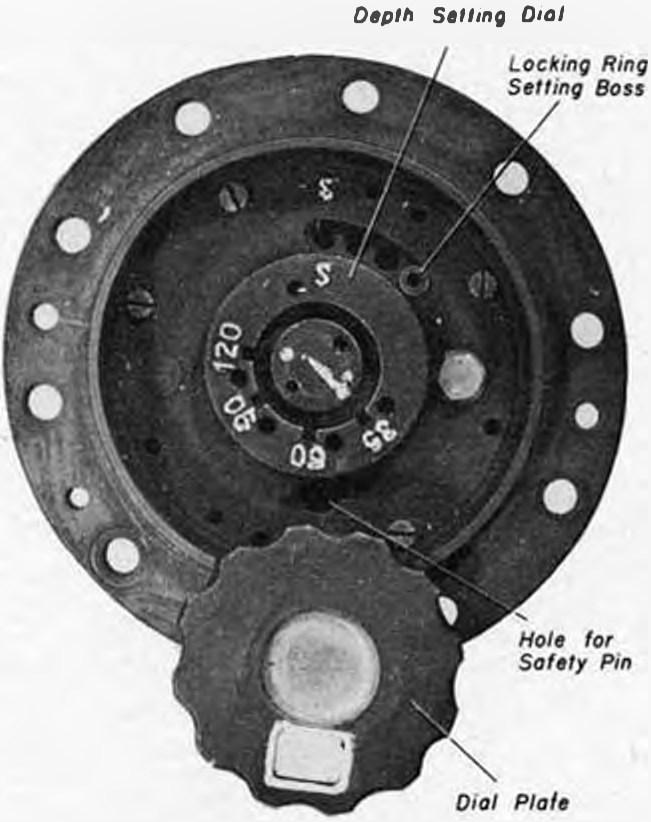


Fig. 4 - Depth Charge Pistol Type II

Fig. 5 - Depth Charge Pistol Type II, Top View

Type II Pistol (Cont'd.)

The greater the distance, the greater the depth setting since the clockwork must close the distance between the detent and keyway before firing can take place. Removal of the safety pin allows the spring-loaded locking ring to rotate about 45 degrees under the tension of the lock release spring, thereby releasing the lock balls and unlocking the diaphragm and hydrostatic piston.

(b) When the charge is launched, increasing hydrostatic pressure houses the booster over the detonator and depresses the hydrostatic piston against the tension of the three housing springs and diaphragm spring. Downward movement of the piston compresses the firing spring and depresses the driving rack, thereby driving the clock pinion gear. Operation of the clockwork rotates the release collar and, when the collar has rotated to the point where the firing pin spindle detent is in line with the keyway in the collar, the firing pin is freed to impinge on the detonator.

Type I Pistol

1. This pistol differs from the Type II as follows:

(a) Its depth settings are given both in meters, for firing depth, and in seconds, for time delay between launching and firing. The time delay figures are painted in red as follows: 5, 10, 15, 20, 26 and 33. The depth settings are painted in white, directly below the time settings, as follows: 15, 25, 35, 45, 60 and 75.

(b) The words "SEK" and "MET" are painted on the dial plate alongside the window on the depth setting dial.

Type III Pistol

1. This pistol, believed to be a surface-launched model of the Type II, differs from the Type II as follows:

(a) Settings on its depth-setting dial are 20, 35, 50, 70, 90 and 120 meters.

(b) The shape of the pistol body is modified slightly.

Type IV Pistol

1. This pistol, not recovered by U.S., is known to have settings of 20, 25, 55 and 90 (meters) but is believed to be otherwise identical to Type II.

Type V Pistol

1. This pistol, apparently an older model of the Type II, is very similar internally to the Type II. Its case construction however, differs radically as follows:

(a) Its securing flange is positioned about in the center of the case rather than at the top of the upper section. Provision is made for eight securing screws instead of ten.

(b) A 4 1/2" tubular extension is added to the lower section or clock housing to accommodate the firing pin shaft. A special flange is fitted to this extension for the booster, detonator and percussion cap mounted on the lower end of the extension. Depth settings are the same as Type II.

(c) No information is available as to the type of booster fitted or how it is secured.

Standard Booster and Booster Release Mechanism

Booster

1. The German depth charge booster is similar to that used in Mine Type GC. It consists of a cylindrical container, 5 1/4" long and 2 1/8" in diameter, with an 11/16" grooved stem on its outer end. The detonator envelope screws into and seals the inner end of the container. It is known to be used with the pistols, Type I, II, and III in the depth charge Type I.

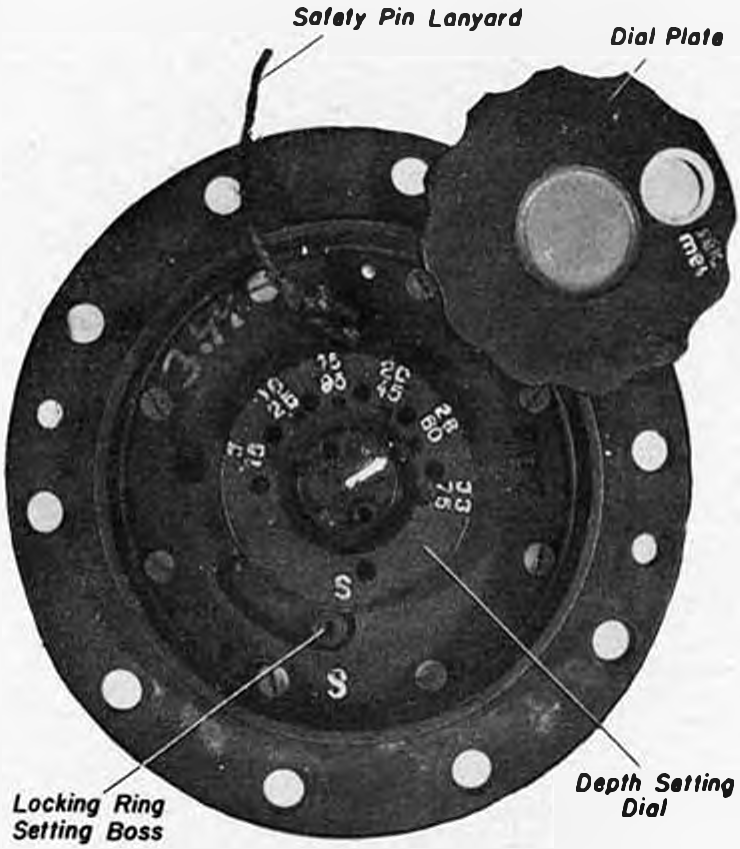


Fig. 6 - Depth Charge Pistol Type I

Fig. 7 - Depth Charge Pistol Type I, Top View

Fig. 8 - Depth Charge Pistol Type III

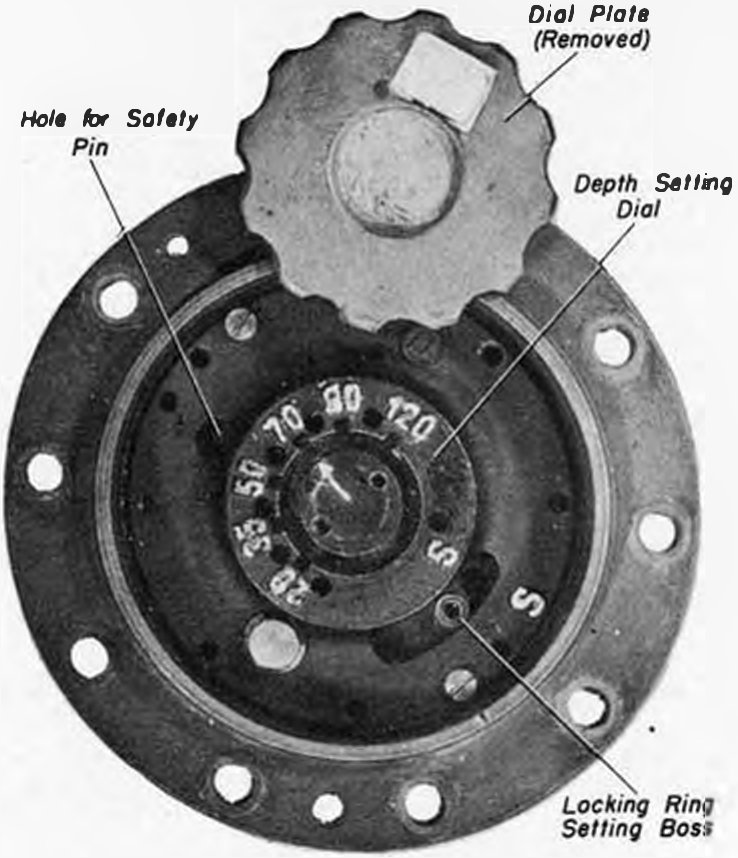


Fig. 9 - Depth Charge Pistol Type III, Top View

Fig. 10 - Depth Charge Pistol Type V

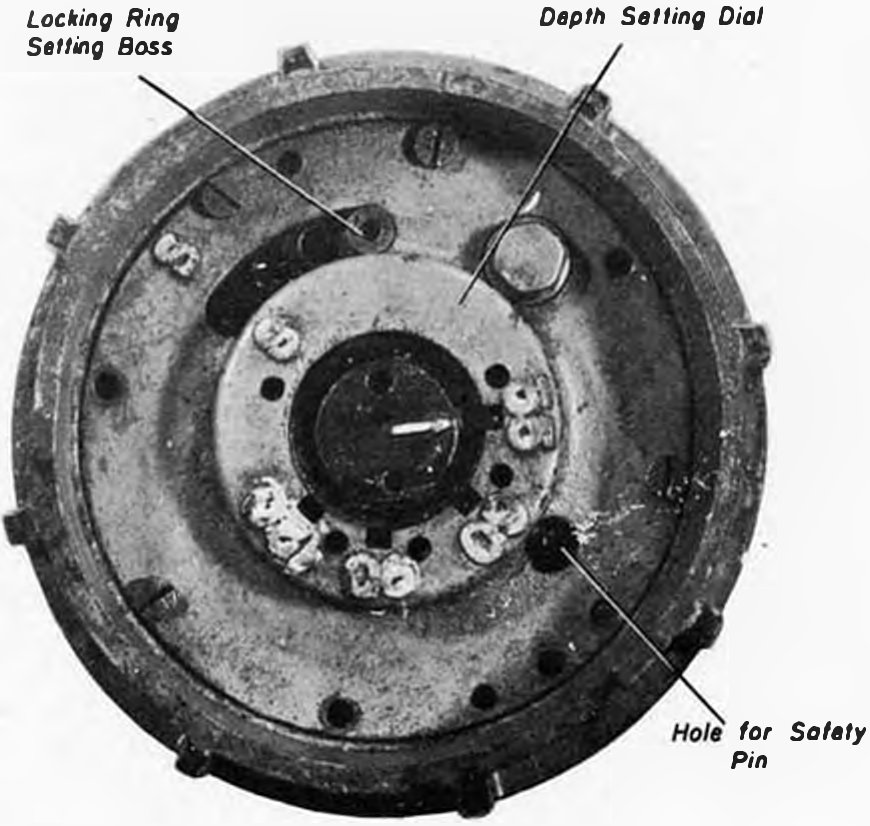


Fig. 11 - Depth Charge Pistol Type V, Top View

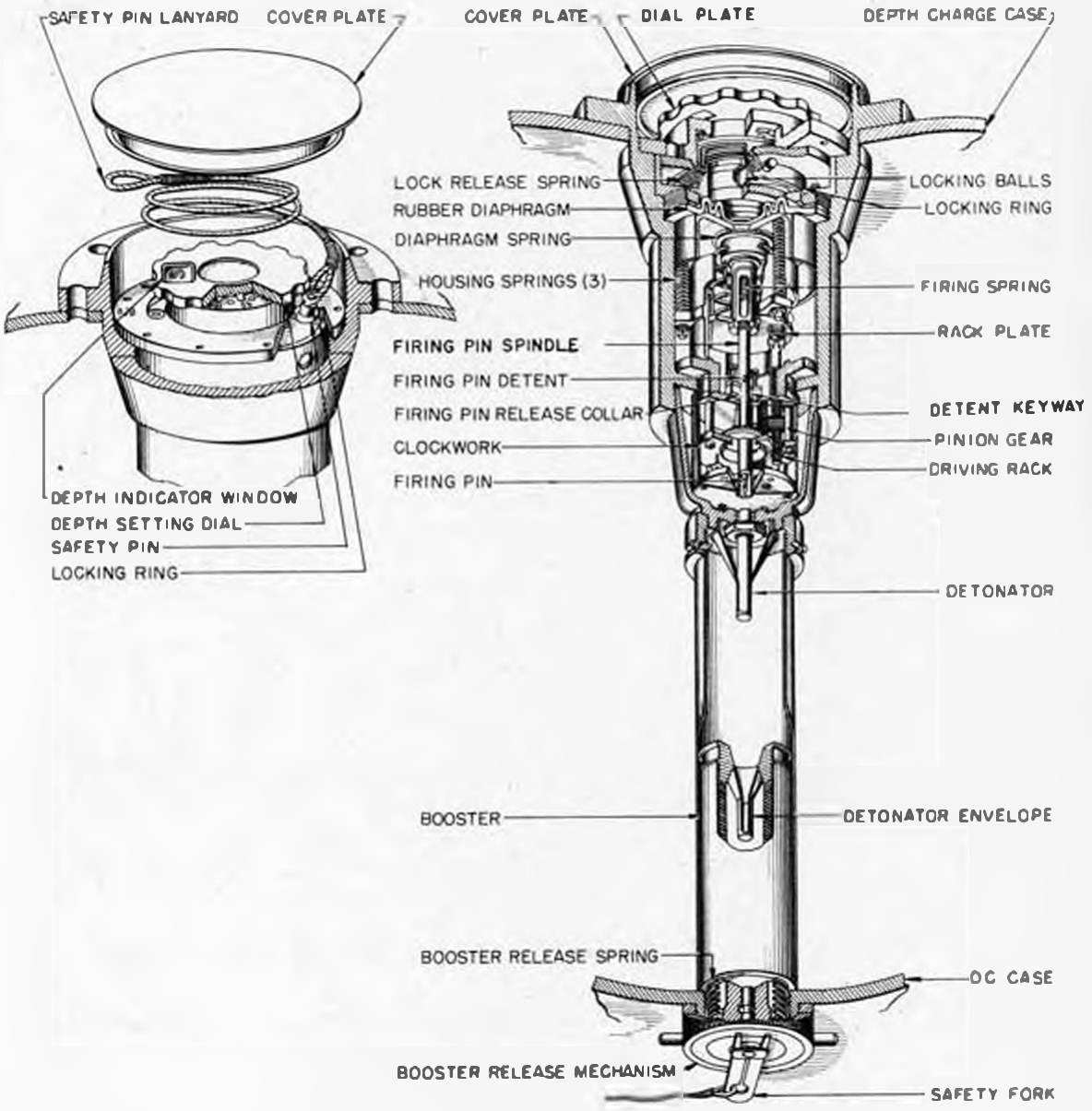


Fig. 12 - Depth Charge Pistol Type III, Sectional View

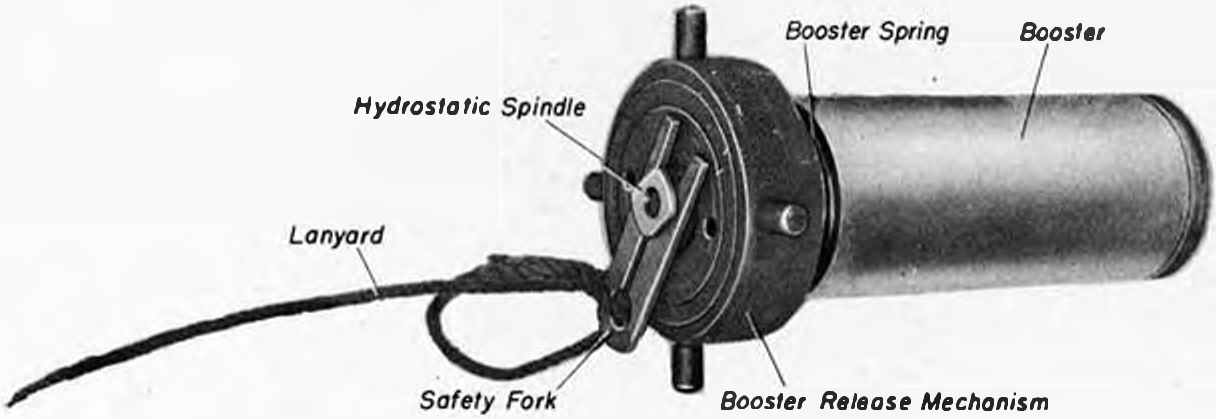


Fig. 13 - Depth Charge Booster Assembly

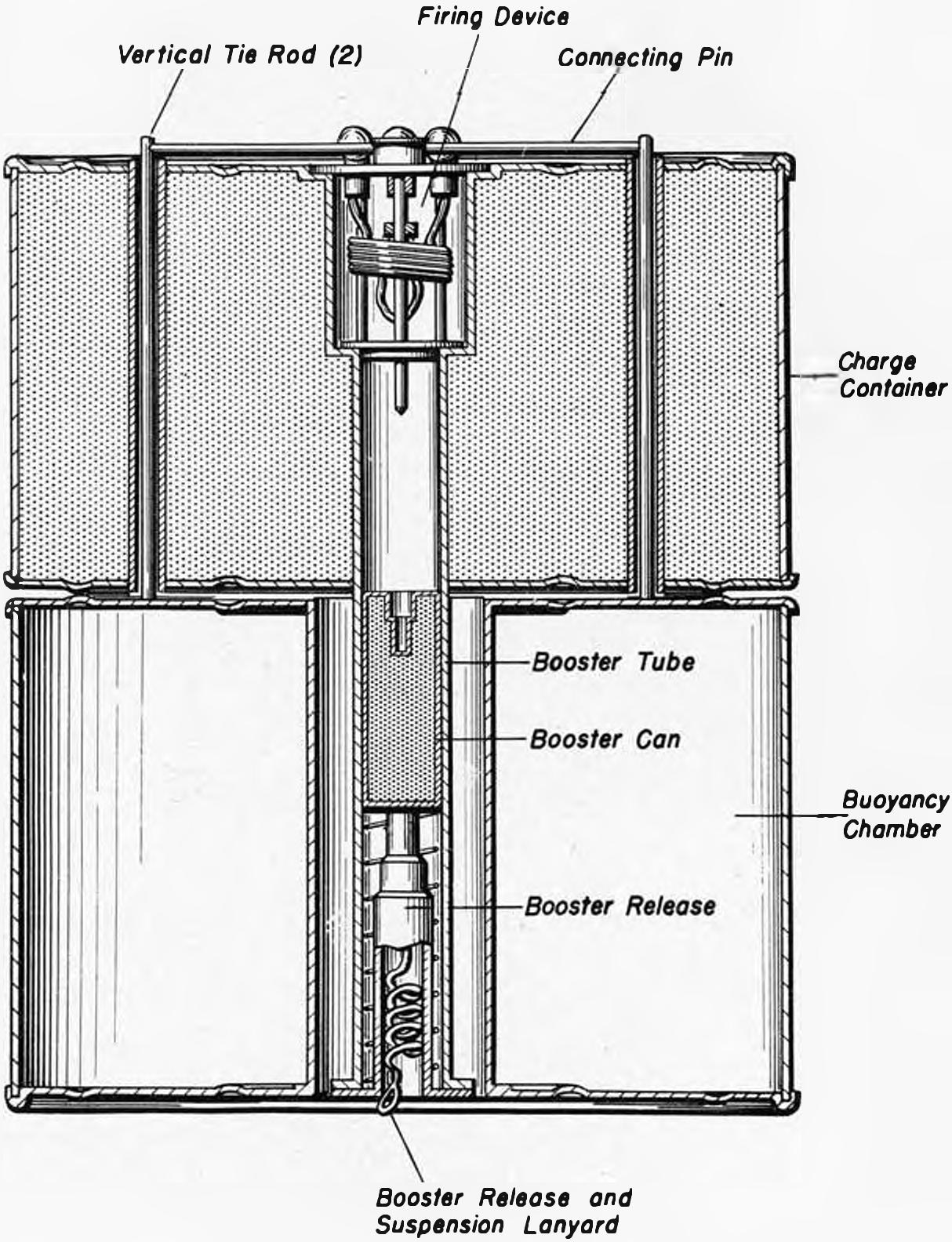


Fig. 14 - Tactical Depth Charge, Sectional View

Standard Booster and Booster Release Mechanism (Cont'd.)

Booster Release Mechanism

1. This device is a hydrostatically-actuated release mechanism housed in a cylindrical container, 3" in diameter and 1" long. The booster can stem fits into a recess on the inner side and is held by two locking detents. Hydrostatic pressure releases the detents and the booster is then housed over the detonator by spring pressure. The mechanism is locked prior to launching by a two-pronged safety fork.

2. This mechanism is used with the depth charge, Type 1 and probably with all depth charges which take the pistols Type I, II, and III.

German Tactical Depth Charge

General

1. Buoyant, tactical explosive charge, launched from surface craft.

2. German designation unknown.

3. Used defensively by surface craft to harass pursuing surface units. Designed to force pursuing ships to keep at a safe distance from the charges and thus give the pursued ship a tactical advantage.

Description

1. Case

Shape	Cylindrical
Material	Steel
Color	Gray-green
Diameter	18"
Length	22"
Charge	130 lbs. Hexanite (approx.)
Total weight in air	170 lbs. (approx.)

2. The charge is composed of five main parts as follows:

(a) The charge container - a cylinder, 10" long and 18" in diameter, fitted with a booster tube, 21 1/2" long, which protrudes 11 1/2" below the container. A 4 1/2" length of the upper part of the tube is 3" in diameter and serves as a firing device pocket. The lower part which houses the booster is 2 1/4" in diameter. Two smaller tubes, 1/2" in diameter, 180° apart and 4" from the central tube, pass longitudinally through the container. The arabic numerals 30, 50, 70 and 200 are stenciled in white or black around the top of the container. A transparent, protective covering is fitted over the stenciled numbers which evidently indicate the burning time in seconds for the four fuze delays of the firing device. Two filling holes, 2 1/2" in diameter, are located at the bottom of the container.

(b) The buoyancy chamber - a watertight cylinder, 12" long and 18" in diameter. Two vertical tie rods of the separating gear are secured to the top of the chamber and are so located as to fit into the 1/2" tubes in the charge container when the two sections are married. The chamber is fitted with a central tube, 4" in diameter, which houses the extension of the charge container booster tube when the two sections are married.

(c) The firing device - consists of a framework containing four pull igniters with connecting fuze delay cords, a separating detonator and a main detonator. The igniters are mounted on the top face in positions corresponding with the delay settings on the charge container. Each igniter is fitted with a short lanyard and is enclosed in a red, bulbous, protective cap. The four fuze delay cords are wound around the frame and terminate in a central junction box. An additional fuze train runs from the junction box to the separating detonator and a longer fuze extends downward to the main detonator.

(d) The separating gear - a simple system of connecting tie rods which secure the charge container to the buoyancy chamber and which, when the separating detonator fires, permit the charge container to drop free. The tie rods on the buoyancy chamber extend through the charge container and are secured at their upper ends by two connecting pins. One end of each pin engages a notch in its re-

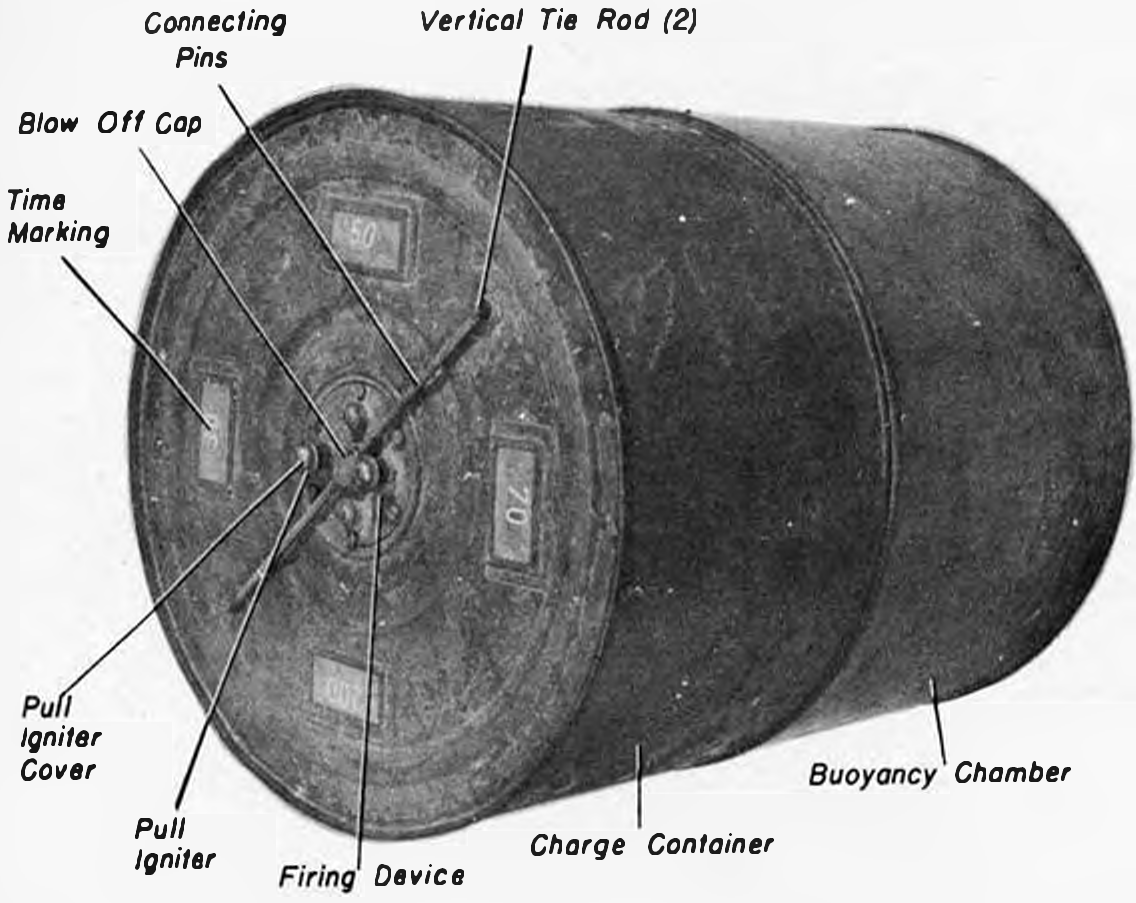


Fig. 15 - Tactical Depth Charge, Igniter End

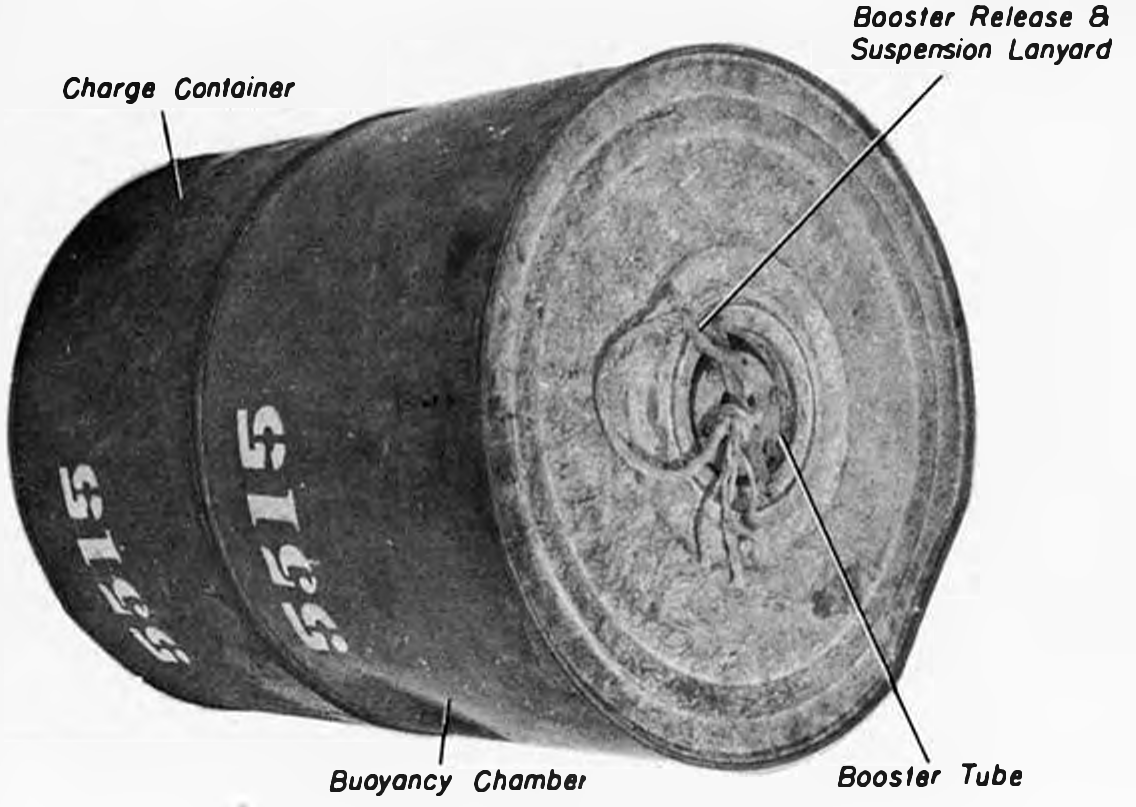


Fig. 16 - Tactical Depth Charge, Booster End

German Tactical Depth Charge (Cont'd.)

spective tie rod and the other ends of the two pins butt against each other at the center of the firing device and are secured thereto by a small, blow-off cap.

(e) The booster and booster release gear - the booster is similar to that fitted to Mine Type CC, being 4 3/4" long, 2 1/8" in diameter and fitted with a fork-shaped clip at one end. The booster release and spring are located at the bottom of the booster tube with the booster clip being locked to the release housing by the release rod. A booster release and suspension lanyard, believed to be about 6 1/2' long, is attached to the release rod at one end. Its other end is attached to a brace across the lower end of the buoyancy chamber central tube.

Operation

1. When the charge is launched, one of the four igniters is pulled, starting its appropriate fuze delay which burns while the charge remains on the surface. Shortly after the fuze burns to the junction box, the separating detonator fires, ripping loose the blow-off cap and allowing the connecting pins to drop free. The charge container is then released to drop to the end of the lanyard which, when it is pulled taut by the weight of the charge container, retracts the release rod and operates the booster release. The charge is now fully armed with the buoyancy chamber floating on the surface and the charge container below it at the end of the suspension lanyard.

2. After a short delay period (believed to be about 10 seconds) provided by the delay fuze from the junction box to the main detonator, the charge fires.

Precautions

1. Avoid all contact with the igniters, fuzes and booster lanyard.

2. If any of the igniter covers is missing, the charge may be in a dangerous condition and must be treated as a hangfire.

3. If the charge container and buoyancy chamber have separated, the detonator and booster are probably married.

Rendering Safe Procedure

1. Remove the six screws which secure the firing device to its pocket.

2. Remove the firing device.

3. Destroy the firing device. Do not attempt to remove fuzes and detonators.

4. Dispose of all explosive elements.

Fig. 17 - Tactical Depth Charge, Firing Device

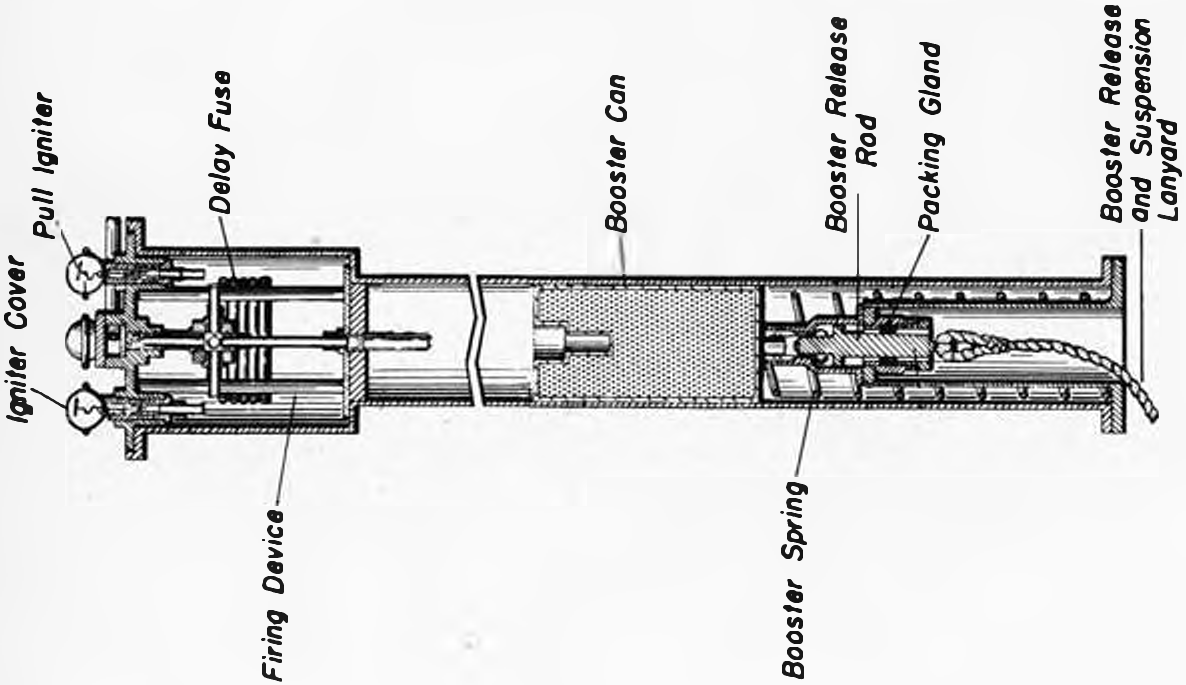
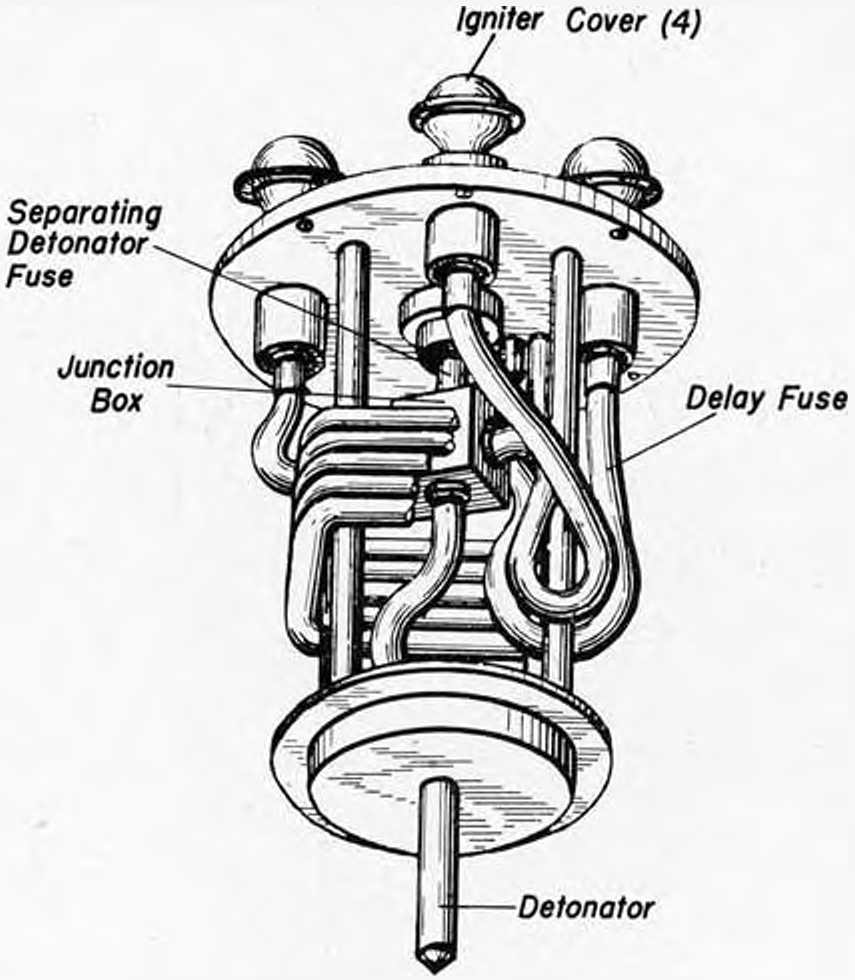


Fig. 18 - Tactical Depth Charge Accessories, Sectional View



GERMAN DEPTH CHARGES

MINE DISPOSAL HANDBOOK

PART IV

GERMAN UNDERWATER ORDNANCE

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Controlled Mines

CHAPTER 5

GERMAN CONTROLLED MINES

MARCH 1, 1945

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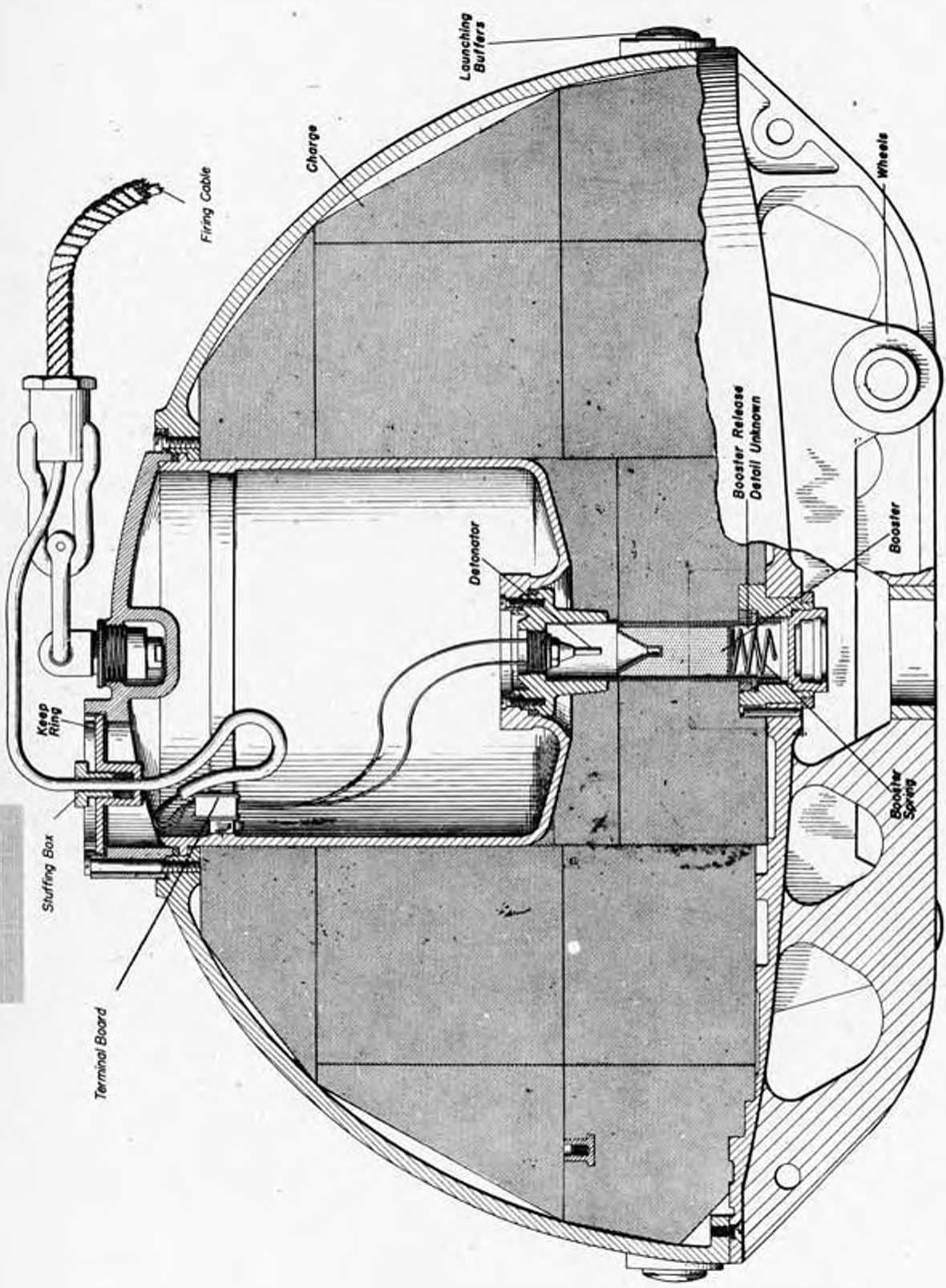

Fig. 1 - Mine Type GH, Sectional View

General

1. Although the Germans have made extensive use of various influence mines as prepared demolition charges, the only mines which are known to have been used underwater as tactical, controlled mines are the Mines Type GH and GI. This chapter incorporates all available information on the above controlled mine assemblies. Part IV, Chapter I, in which the mines are treated as influence mines, contains detailed information on the mine cases.

Controlled Mines Type GH and GI

Description

1. A firing cable is led into the case through a stuffing box which replaces the clock pocket in the influence-fired model of each mine. The cable used is a four-conductor type although, in the mines recovered to date, the two respective black and white conductors were twisted together, making the cable a double-conductor type.

2. The two conductors are attached to two upper terminals on the mine terminal board and the detonator leads, to the corresponding lower terminals. Two detonators and boosters are sometimes used, in which case the detonators are wired in parallel. A galvanized cable connector is used to stop the firing cable to a drogue eye on the cover plate.

Operation

1. Mine is armed manually prior to launching.

2. Mine is fired electrically by an observer.

3. No self-disarming devices are fitted.

RWS

1. Slit the firing cable; cut and tape each lead separately.

2. Remove the booster cover plate; remove the booster.

3. Dispose of booster and charge, leaving the detonator in place.

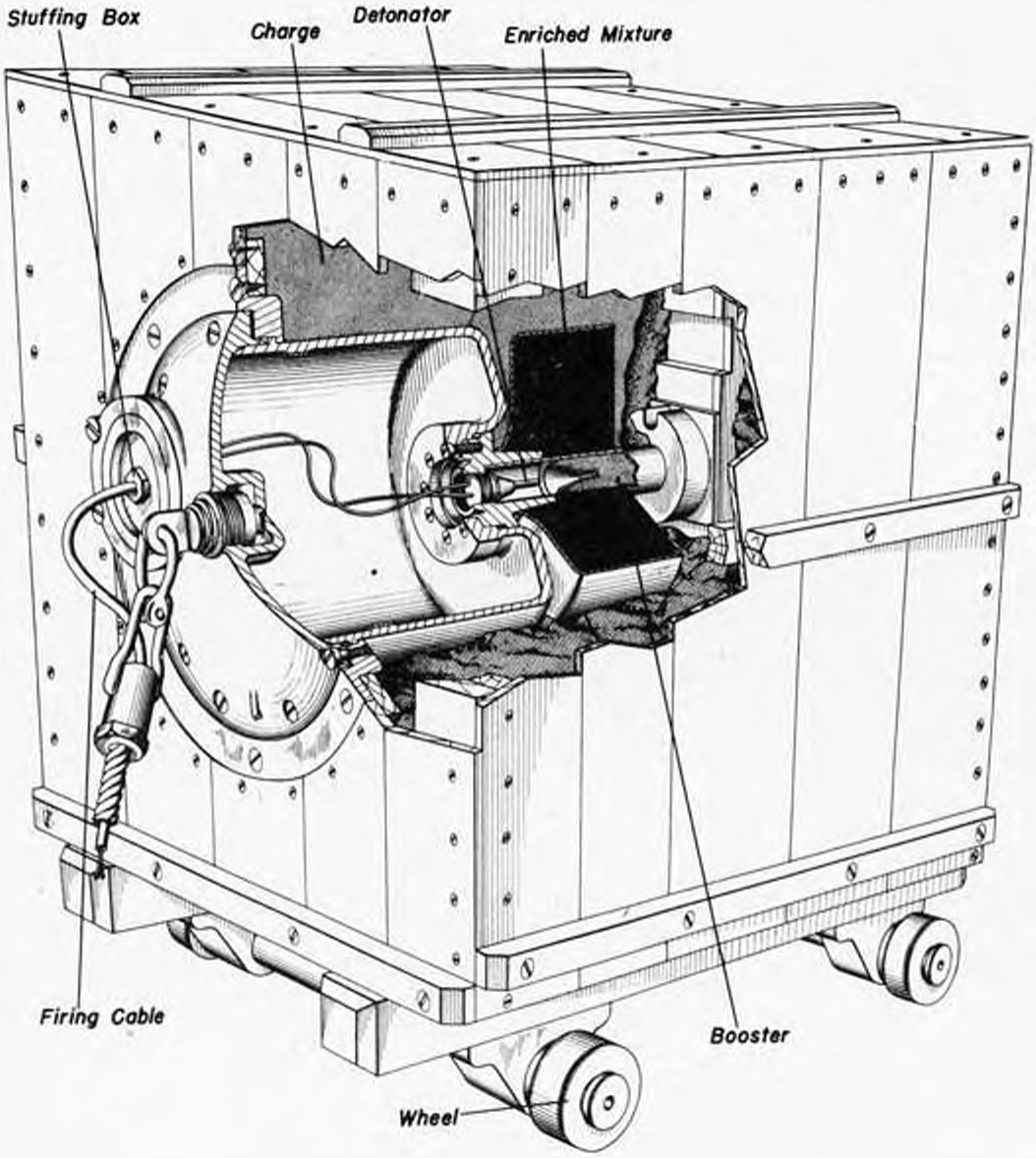

Fig. 2 - Mine Type GI, Sectional View

MINE DISPOSAL HANDBOOK

PART IV

GERMAN UNDERWATER ORDNANCE

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CHAPTER 6

GERMAN SWEEP OBSTRUCTORS

Sweep Obstructors

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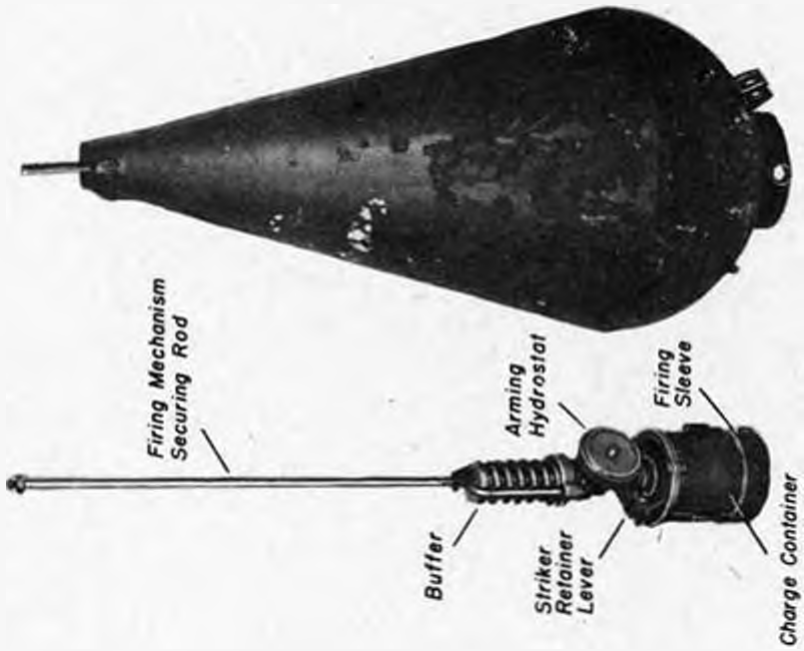

Fig. 1 - Explosive Conical Float Type 1.

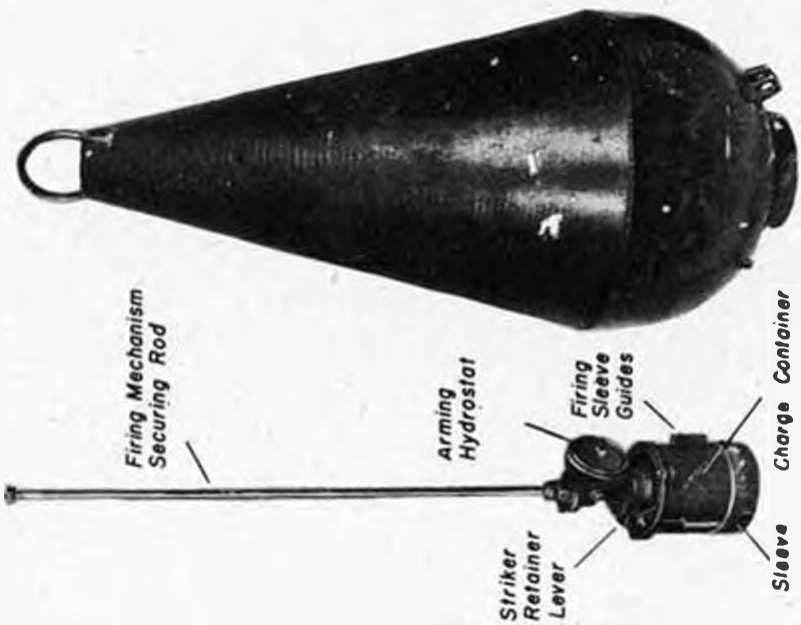

Fig. 2 - Explosive Conical Float Type 2.

Introduction

1. German sweep obstructors, laid in and around moored mine fields, are designed to cut sweep cables and prevent or hinder sweeping of the mine field. They may contain explosives or merely support mechanical cutters on their mooring cables. The various types of conical floats may be indistinguishable when found afloat.

German Explosive Conical Float Type 1 (Type 2)

General

1. Moored, conical float sweep obstructor, laid by surface craft.
2. German designation, "Sprengboje."
3. Defensive, anti-sweep device laid in and around moored mine fields. Maximum length of mooring cable is 360 feet.

Description

1. Case

Shape	Conical upper section welded to hemispherical lower section.
Color	Black
Material	Steel
Diameter	15"
Length	37"
Charge	1 lb. 13 oz.
Total weight in air	50 lbs. approx.

2. External fittings

Lifting eye	At top of conical section.
Securing lugs	Two, 180° apart on lower hemisphere.
Soluble plug fitting	Threaded into side of flange on lower hemisphere.
Firing assembly	In pocket in base, secured by vertical rod and nut at top of float. Firing sleeve contains hole for safety pin.

3. Type 2 differs from Type 1 as follows:
   (a) The base of the float contains no soluble plug fitting on flange.
   (b) The arming hydrostat locks in the armed position.
   (c) It is not fitted with an interlocking grip to release the float in case of firing failure.

Operation

1. Float takes depth by a fixed mooring cable (vertical cylinder anchor with cable stop pin). A stop pin is inserted aboard the laying vessel and determines the length of cable that will unwind from the cylinder. A hydrostat in the firing mechanism unlocks the spring-loaded firing pin in 7 feet of water. Dissolution of a soluble plug unlocks the firing sleeve and the firing mechanism is armed.
2. The spring-loaded firing pin is released by a rotating cam operated by a lever system connected to the firing sleeve. A sweep wire riding up the mooring cable will lift the firing sleeve, operating the lever. Thirty pounds pressure will operate the sleeve. If the explosive gear fails, further pressure will be exerted on the charge case. At about 200 lbs. pressure, a spring-loaded interlocking grip mounted above the hydrostat releases, dropping the mooring with charge still attached and freeing the float only.
3. The only self-disarming feature is a device which locks the firing pin when the float surfaces. This is extremely unreliable.

Fig. 3 - Static Conical Sweep Obstructor

German Explosive Conical Float Type 1 (Type 2) (Cont'd.)

Precautions

1. The float should not be moved or touched, due to the extremely sensitive firing mechanism. Countermine whenever possible.

2. Type 1, which is fitted with a soluble plug, may be rendered safe, as prescribed below, but only in extreme emergencies. Type 2, having no soluble plug, must always be rendered safe by means other than disassembly.

Rendering Safe Procedure (Type 1 only)

1. Insert a safety pin to hold the sleeve out; lash the pin in place.

2. Remove the cotter key and nut from the upper end of the float. From a safe distance withdraw the unit from base of float.

3. Back out the screw at the elbow joint between the sleeve and the firing pin.

4. Remove and lift off the keep ring and locking ring from around the edge of the charge.

5. Unscrew the charge from the firing pin unit, using gripes if necessary.

6. Remove the sub-booster from the firing pin unit. A small grub screw must be removed to do this. The detonator will come off with the sub-booster.

7. Remove the match cap by separating its holder from the firing pin unit.

8. The booster may now be removed from the charge and the firing pin unit broken down with safety.

9. Dispose of all explosive elements.

Static Conical Sweep Obstructor

General

1. Moored, conical float, laid by surface craft. Fitted with mechanical cutters on mooring cable.

2. Non-explosive, anti-sweep device, laid in and around moored mine fields.

Description

1. Float

Shape	Conical; resembles explosive conical floats, Type 1 and 2.
Color	Black
Material	Steel
Diameter (base)	19"
Length	44"

2. The float is moored to a concrete block, 33" x 27" x 28", which is surmounted by a steel drum, 33" high and 25" in diameter. The mooring cable (300 ft. max.) is fitted with four mechanical cutters. The uppermost cutter is attached two feet below the float and the others, at 4'3" intervals. Seven cone-shaped, steel beads are woven into the mooring cable between the float and the uppermost cutter.

Operation

1. A stop pin is inserted in the anchor prior to laying to adjust the depth setting. The float therefore takes depth by fixed mooring cable setting. Dissolution of a soluble plug releases the float from its anchor. The float then rises, pulling the cutters from brackets inside the drum and unreeling the cable.

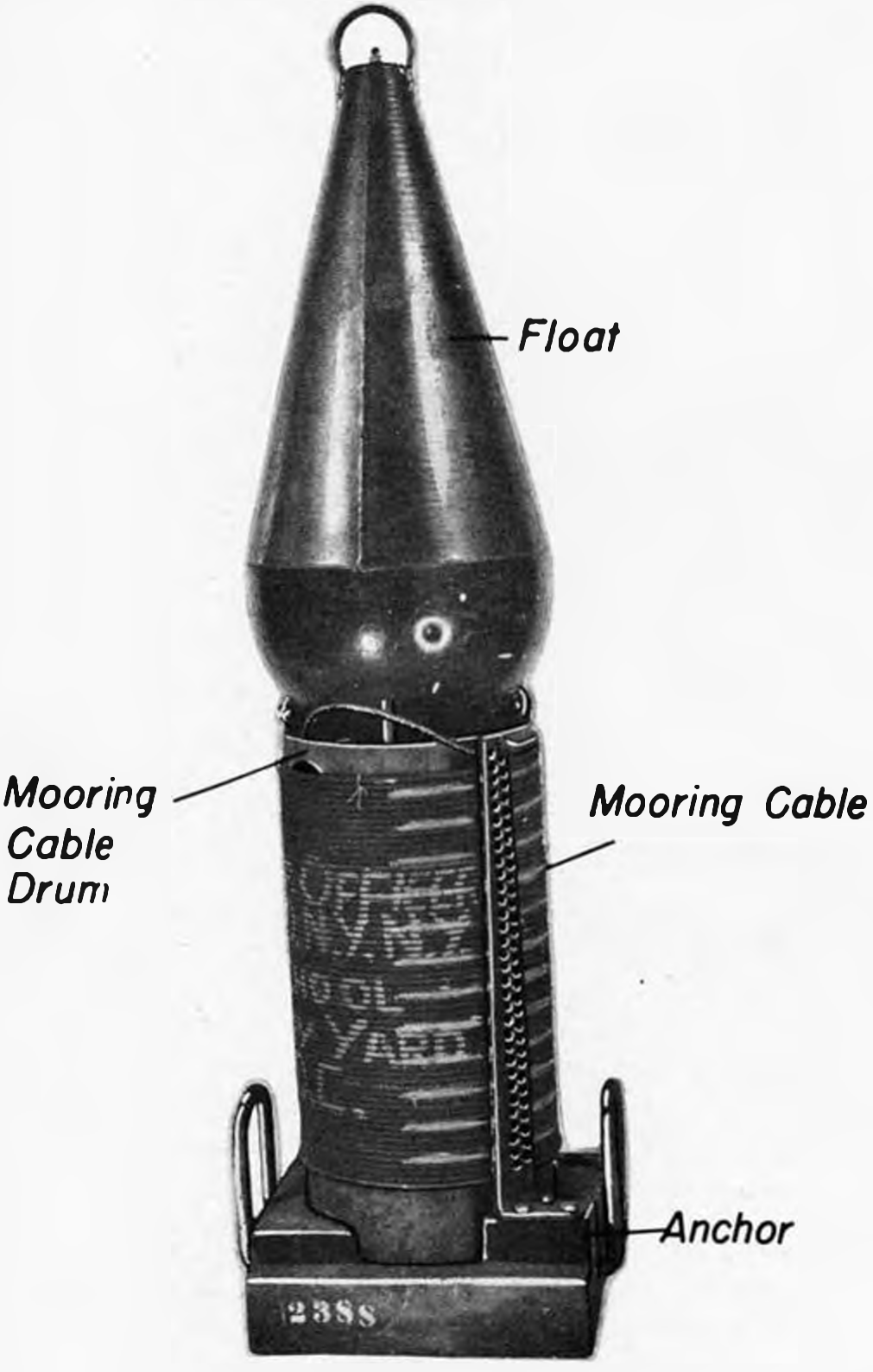

Fig. 4 - Explosive Conical Float, with Anchor

Aircraft-Laid Sweep Obstructor

General

1. The German aircraft-laid sweep obstructor is 8'5 1/2" long, 25 1/2" in maximum diameter and weighs 2021 lbs. When assembled for laying, it resembles very closely a Mine Type GG with tail fairings attached.

Description

1. Component parts are as follows:

   (a) The anchor - a steel cylinder with an ogival nose resembling the case of Mine Type GG. It is 62" long and weighs about 1000 lbs. Approximately 865 lbs. of cement are cast into the forward part, the after end of the casting being formed to provide (1) positioning seats for two cutters and (2) a mooring cable drum. The following fittings are bolted to the after end of the casting:

      (1) A wooden block which serves as a float seat.

      (2) A circular, cutaway rubber buffer pad which is believed to serve as a shock absorber upon impact.

   (b) The float - this component has the appearance of two cones welded together at their bases. It is 32" long overall, 21" in maximum diameter and has a positive buoyancy of about 65 lbs. The mooring cable is attached to a lug at one end.

   (c) The tail - consists of a truncated cone fitted with four radial fins which are enclosed by a shroud ring, 8" long and 25 1/2" in diameter. The conical section is 43 1/2" long, 25 1/2" in diameter at its forward end and 8" in diameter at its after end. The tail is attached to the after end of the anchor by eight bolts.

   (d) The cutters - these are standard German mechanical cutters, two in number, secured to the mooring cable three feet and nine feet respectively below the float.

   (e) The mooring cable - consists of a 125 ft. length of 5/8" steel wire. One end is attached to the float and the other end, to a short length of chain which in turn is attached to a bolt on the anchor case. The chain serves to prevent the mooring cable from parting due to chafing on the anchor. Prior to laying, the cable is wound around the cement casting in the anchor.

Operation

1. Impact with the water shears the tail. The buoyancy of its case and the expelling effect of the rubber buffer pad cause the float to rise toward the surface as the anchor sinks. As the anchor continues to sink, the entire length of mooring cable pays off the mooring drum and the float and cutters take depth according to the depth of the water.

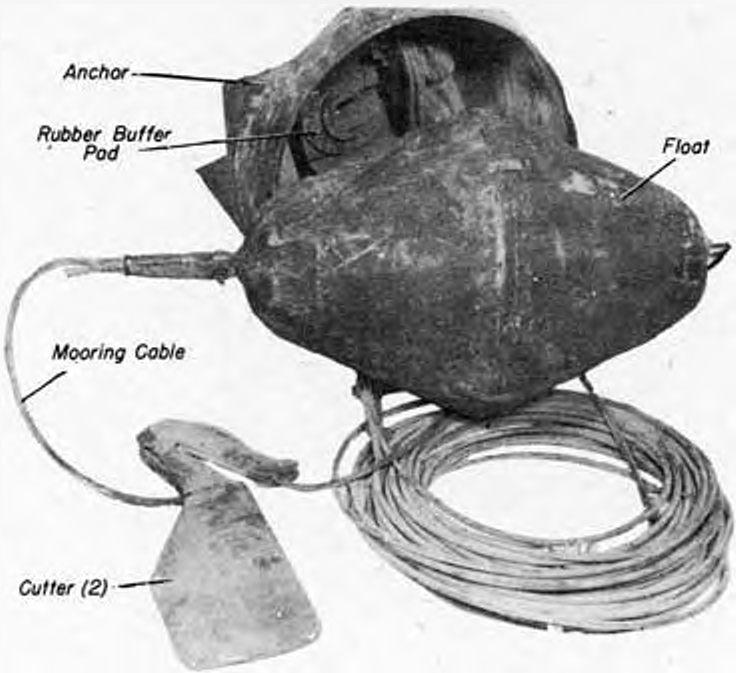

Fig. 5 - Aircraft-Laid Sweep Obstructor