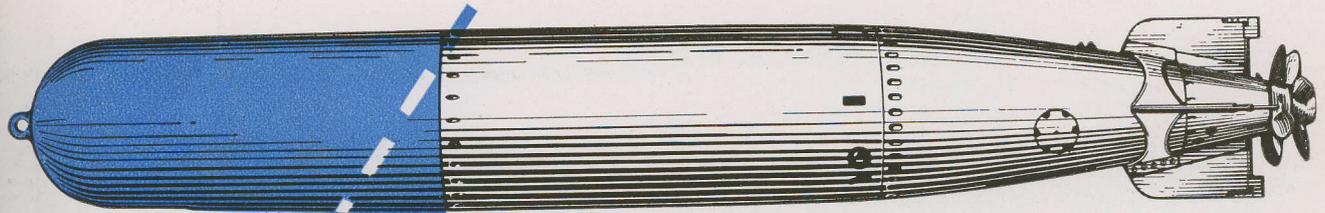


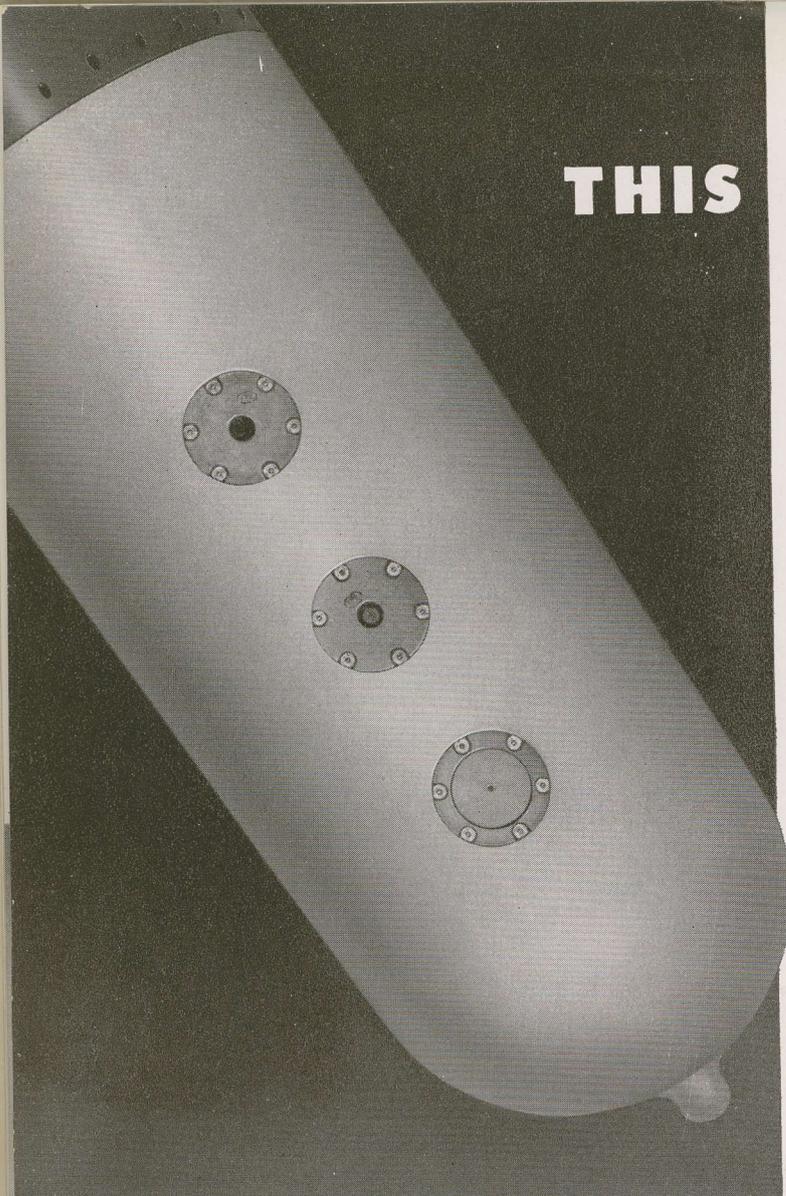
CHAPTER 1

EXERCISE
HEAD



General Description	14	Water Discharge Valve	20
How Modifications Differ . .	15	Relief Valve	20
How Exercise Head Works . .	14	Torpedo Headlight, Torch . .	21
Mark 26-2 Exercise Head Detail	16	Parts and Tools	22
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THIS IS A MARK 26-2



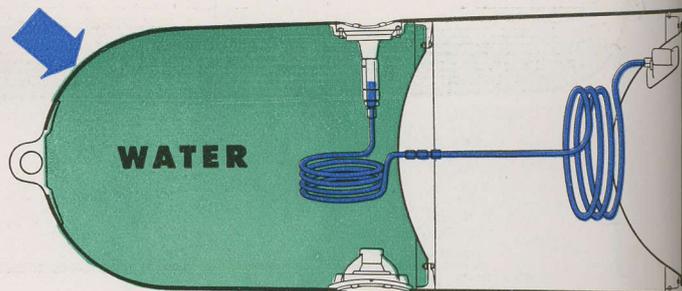
A complete torpedo, ready for war and for its function of destroying enemy vessels, is one which mounts an explosive-laden War Head. Once launched, a torpedo so equipped either finds its target and is destroyed with it, or sinks to the bottom of the sea when its fuel is exhausted and it no longer has forward momentum. Thus it can neither fall into enemy hands for study nor become a floating menace to navigation.

Obviously, a torpedo mounting a War Head cannot be given test runs nor used in target exercises, and so the Exercise Head has been developed to replace the War Head for test and practice runs. This Head consists primarily of a shell of the same thickness of metal and the same outward appearance and dimensions as the War Head. It is strengthened internally by means of metal rings, and at the nose, in the case of the Mark 26-2 Exercise Head, by a lattice-work of steel resembling a basket. In the newest Marks, the metal of the nose or dome section is materially thickened to resist crushing or denting.

HOW IT WORKS

The illustrations to the right show in cross-section how the Exercise Head's two basic functions are performed: (a) the carrying of sufficient water ballast or weight, to permit exercise runs with torpedoes of the same total weight and balance as torpedoes equipped with war heads, and (b) the automatic replacing of the water ballast with air to provide sufficient buoyancy for the torpedo to surface at the end of a run, so that it may be recovered for re-use. The manner in which this is done is shown diagrammatically at the right.

14



READY FOR RUN

The forward compartment is filled with sea water sufficient to make the total weight of the Exercise Head equal to that of a War Head. At start of run, Air Flask air pressure of 2800 pounds, feeding through Air Release Pipe, holds Air Releasing Valve against its seat, preventing passage of air into forward compartment of Exercise Head. *Air Releasing Valve operates by spring pressure against REDUCED AIR PRESSURE.*

EXERCISE HEAD

The Exercise Head shell is fitted with transverse bulkheads to form two compartments. The forward compartment may be filled with sea water, the weight of which brings the total weight of the Exercise Head to that of a War Head carrying its full charge of TNT and standard Exploder. A torpedo mounting an Exercise Head may thus be sent through an exercise run weighted and balanced to exactly

simulate a torpedo ready for war.

However, if the Exercise Head retained its water ballast at the end of a run, the torpedo would sink and be lost; the Exercise Head is therefore equipped with devices which automatically drive out the water ballast at the end of a run, replacing it with air which supplies the buoyancy necessary to keep the torpedo afloat until recovered.

ESSENTIAL DIFFERENCES

IN EXISTING AND PENDING EXERCISE HEADS

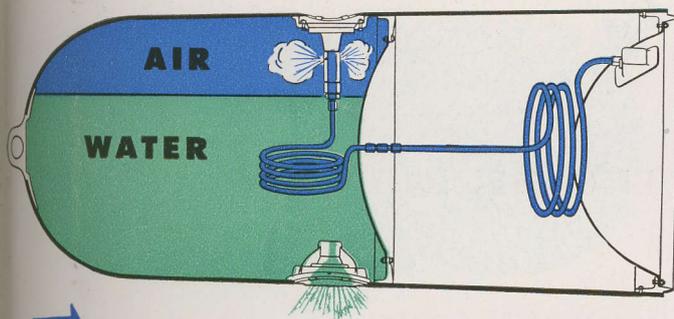
MARK 26: Has hand-cocked air releasing mechanism. Does not have headlight case; does have torch pot directly aft of the air releasing mechanism.

MARK 26-1: Earlier examples may have hand-cocked air releasing mechanism; later types have the self-cocking mechanism. Has torch pot and headlight case which is located directly forward of air releasing mechanism.

MARK 26-2: Headlight case, air releasing mech-

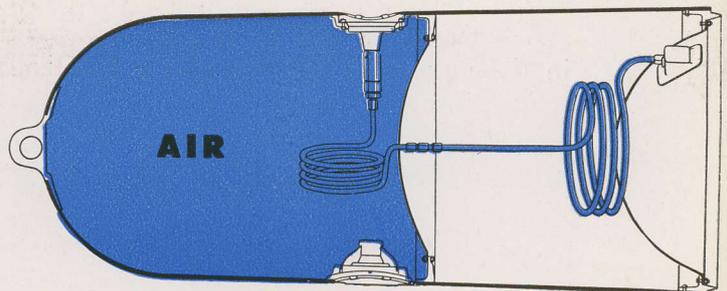
anism (self-cocking), and torch pot as in Mark 26-1. Nose reinforcement is supplied by steel lattice spider or "bird cage." Lead ballast is located aft of this cage, making necessary re-location of drain plug from directly forward of the water discharge valve to its after side and slightly to the right of center.

MARKS 26-3 AND 4: These are chiefly distinguished by a thickened cross-section through the shell at the dome. Not in production at time this manual was prepared.



AS FLASK PRESSURE REDUCES

When the torpedo nears the end of an exercise run, and the air pressure in the Air Flask reduces to a predetermined level (approximately 500 pounds), the Air Releasing Valve spring opens the valve, permitting the flask air to enter the forward compartment. This builds up sufficient pressure in forward compartment to open the Water Release Valve at bottom of Exercise Head and allow the water in the compartment to be expelled.



ALL WATER EXPELLED

Air continues to flow from the Air Flask through the Air Releasing Valve until all water is expelled from the Exercise Head and has been replaced by air. When the Air Flask air pressure has reduced to the point where it can no longer overcome the tension of the Water Release Valve spring, this valve closes. The Exercise Head is then entirely air-filled and sufficiently buoyant to cause the torpedo to surface.



FORWARD BULKHEAD

Reinforced by welded-on strengthening ring, through which pass screws sweated in place. Bulkhead seats on rubber gasket against forward side of bulkhead ring. Note "flats" on opposite sides of bulkhead's outer circumference; these permit bulkhead to pass through slots cut in inner circumference of the forward bulkhead ring.



AIR CONNECTION

Through forward bulkhead ring. Note pipe connection lock which swivels on bolt through main thickness of ring; nipple brazed to after air pipe; lock nut anchoring nipple against copper washer on after side of ring; nut holding forward pipe to nipple.

FORWARD BULKHEAD RING

A heavy, cast ring welded to head shell and designed to hold against strain imposed by abrupt release of air pressure, through air releasing valve, when water is blown from forward compartment (Page 15). Note slots through which "flats" on forward bulkhead may be passed; also pipe connection lock. (View shows after side.)



EXERCISE HEAD STRUCTURE DIMENSIONS & WEIGHTS

The Exercise Head Shell is of sheet steel, rolled and butt-welded to form a cylinder which tapers slightly from its after end to the point where a hemispherical or bowl-shaped nose stamping is butt-welded in place. A bronze nose piece is riveted and welded to the shell at the forward end, with a towing eye drilled through the boss forming the extreme forward portion of the nose piece. A steel joint ring is riveted and welded in place at the after end of the head shell, with 26 holes drilled into it at an angle and tapped to receive the joint screws which connect head to the air flask. Entire head shell is cadmium plated to prevent corrosion.

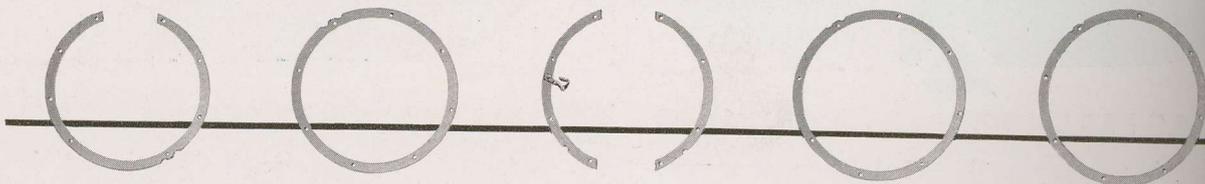
Length, Forward End of Nose Piece to Joint Line, All Marks	53.99"
Diameter at Joint Line, All Marks	22.42"
Weight Mark 26-1 Exercise Head, Empty	321.0 lb.
Weight Mark 26-1 Water Ballast	312.0 lb.
Weight Mark 26-1 Exercise Head, Ready to Run	633.0±3 lb.
Weight Mark 26-2 Exercise Head, Empty	338.0 lb.
Weight Mark 26-2 Water Ballast	287.0 lb.
Weight Mark 26-2 Exercise Head, Ready to Run	625.0±3 lb.

MARK 26-2 EXERCISE HEAD DETAIL

On these two pages appear the fittings of the Mark 26-2 Exercise Head, positioned as they are found in the head shell and re-pictured out of and away from the shell to provide a clear idea of their general appearance, construction and function. Note that the re-inforcing spider in the nose of the shell, and the lead ballast weight just aft of it, are not shown separately.

The units forming the spider may be disassembled to permit repair of a crushed-in head, but this is a job requiring base workshop facilities and should not ordinarily be attempted on board ship. The lead ballast weight can also be removed, but this likewise should be done at a base; if removed, it must be replaced in the shell in its exact original position.

EXERCISE HEAD STRENGTHENING RINGS



Number 1 Strengthening Ring (numbering from fore to aft) is split at the top to accommodate the headlight flange. All rings are of steel, cadmium plated to resist corrosion by sea water.

Number 2 Ring is solid, and is located between headlight flange and air releasing valve flange. Strengthening rings are bolted to clips, which in turn are welded to inner surface of head shell.

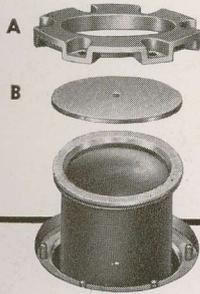
Number 3 Ring splits into two semi-circular pieces of equal size, which are fitted on a line with the centers of air releasing and water discharge valve flanges. Note pipe clip.

Number 4 Ring is solid and is positioned just aft of the torch case flange. Strengthening rings increase slightly in size from fore to aft to conform to the taper of the head shell.

Number 5 Ring is positioned midway between Number 4 Ring and joint ring. Strengthening rings, with spider, forward bulkhead ring and joint ring, stiffen head shell against crushing.

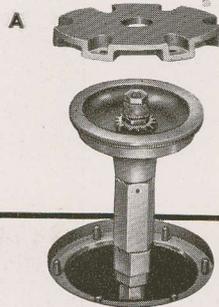
TORPEDO HEADLIGHT

This is inserted in forward flange on top-side of exercise head for night practice. (See P. 21 for construction detail.) When fitted into head, protective cover plate B is removed; underside of rim at top of headlight body is machined to form a close fit against the seat of the flange, against which it is held by cover A.



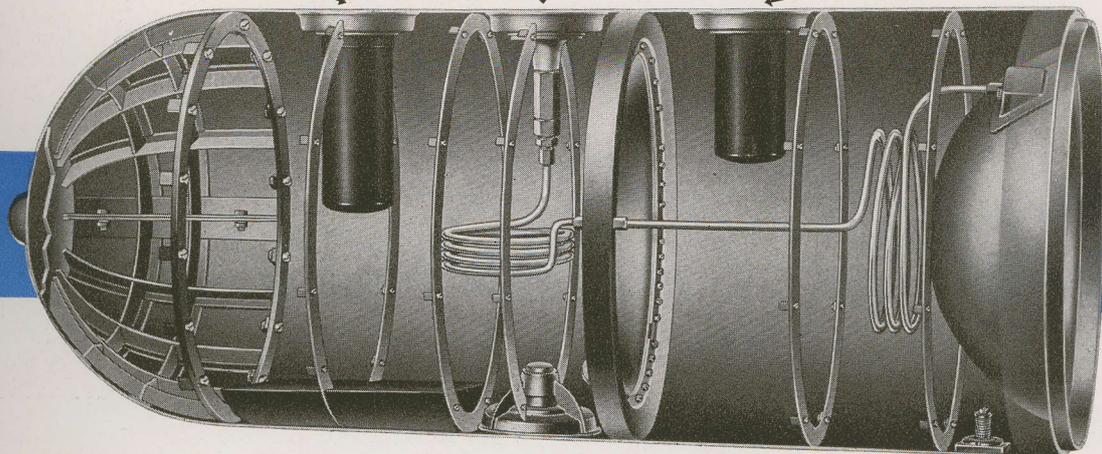
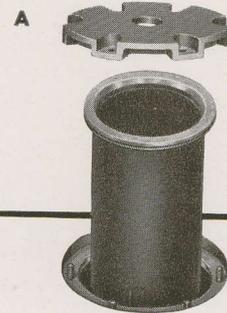
AIR RELEASING VALVE

Shown pulled out of central of three top-side flanges to indicate manner in which it may be removed from head for overhaul or repair. Central hole in cover A permits insertion of tool for turning adjusting nut (see P. 18). Angular seat on under side of valve body seats in flange and is held to water-tight fit by cover A.



TORPEDO TORCH CASE

Case for torpedo torch seats in after topside flange and receives torch for daytime practise runs. (See P. 21 for torch details.) Case and torch (if fitted) are held in place by cover A, which is interchangeable with cover for air releasing valve. Torch case remains permanently in place to seal flange opening.



DRAIN PLUG

Located on bottom center line in Mark 26 and 26-1 exercise heads, forward of water release valve; in Mark 26-2 head, plug is on after side of water discharge valve and to right of center.



AFTER BULKHEAD AIR PIPE CONNECTION

Through pad riveted and sweated to convex face of after bulkhead. Note pipe connection lock, nipple and washer on forward side of pad; lock nut and nut holding pipe from air flask against nipple on after side of pad.



WATER DISCHARGE VALVE

Centrally located in valve body fitted to exercise head on bottom center line, and centrally fore to aft. (See P. 20 for detailed description.) Valve opens under water pressure induced by admission of air to forward compartment as shown on Page 14, causing discharge of water ballast from exercise head.

RELIEF VALVE

Located on bottom side of after compartment, close to joint ring—on center line. Opens outboard to vent any pressure built up in after compartment due to leaks in air line from air flask to forward compartment.

STRENGTHENING RING CLIPS

All clips toe forward and are welded to shell; rings are bolted to them with nut forward and tightened against lock washers; bolt has slotted head as shown. Clips are cadmium plated.

AFTER BULKHEAD

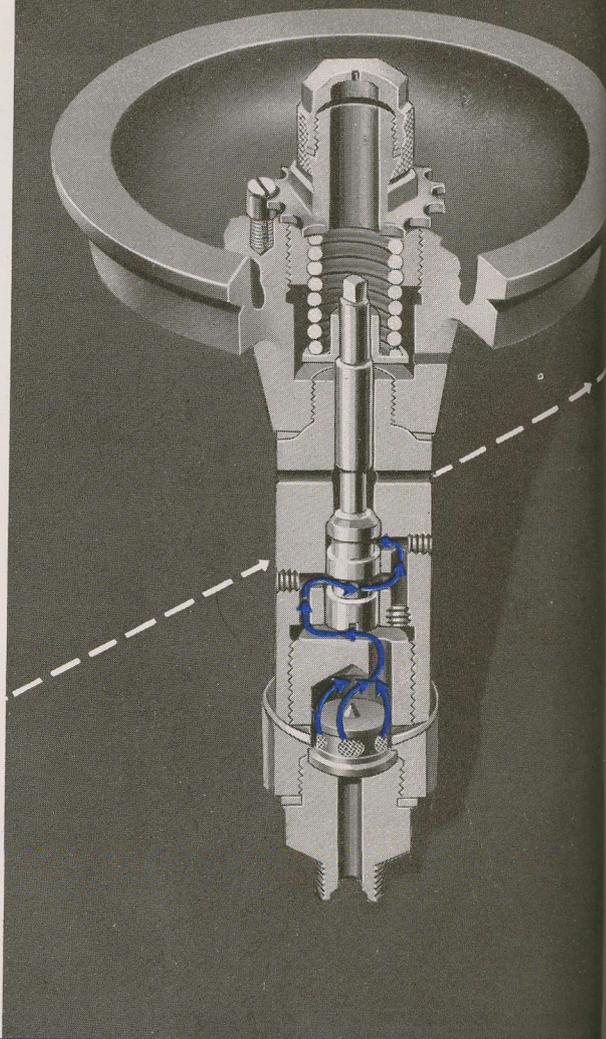
Seats against after side of joint ring on rubber gasket, with convex side facing forward. Note position of pad through which air pipe connection between air flask and forward bulkhead passes; it is always installed the same.

THE AIR RELEASING MECHANISM

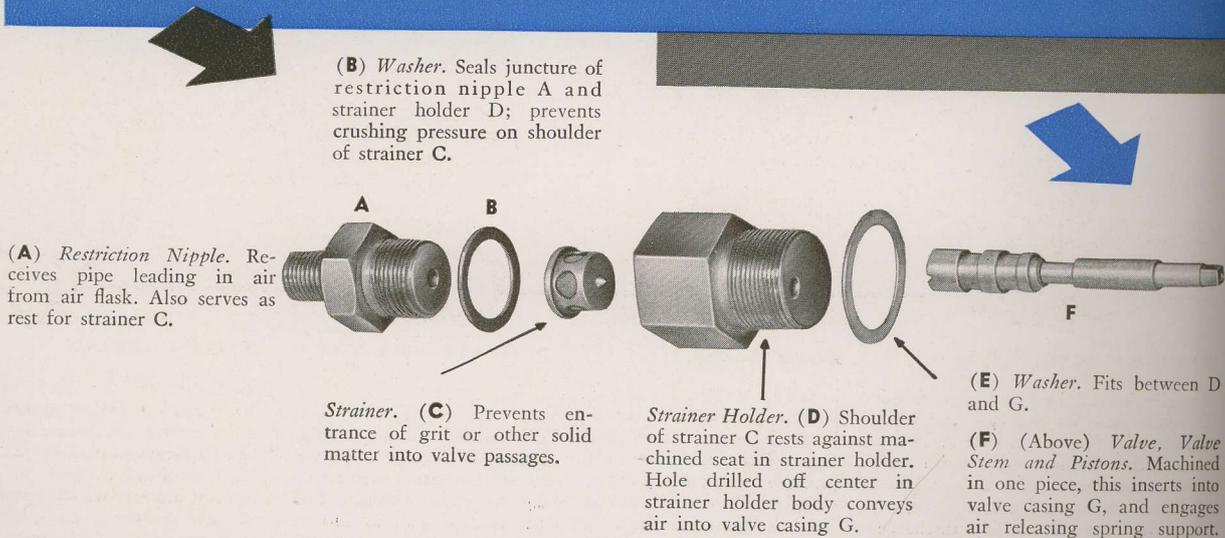
Working portion of this mechanism is the adjustable air releasing valve at right, which operates by *falling* rather than increasing air pressure. Valve may be set so air releasing spring will expand against pressure ranging from 600 pounds down to 400 pounds, releasing air flask air into forward compartment of exercise head, where it will expel the water ballast and give the torpedo sufficient buoyancy to surface.

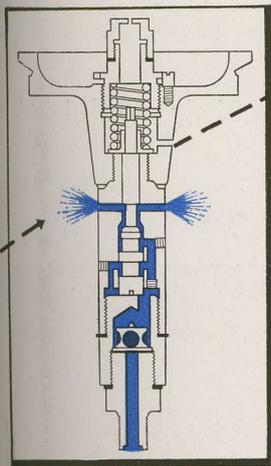
MARK 3 SELF COCKING AIR RELEASE VALVE in Cocked Position

Air from air flask at 2800 pounds pressure has been let into air pipe, from which it passes through strainer, striking lower piston and driving it with upper piston, valve and valve stem upward. Air continues past lower piston exerting further force against upper piston. Action is instantaneous and forces valve against seat, compressing air releasing spring and sealing mechanism against passage of air beyond valve.



MARK 3 AIR RELEASING VALVE



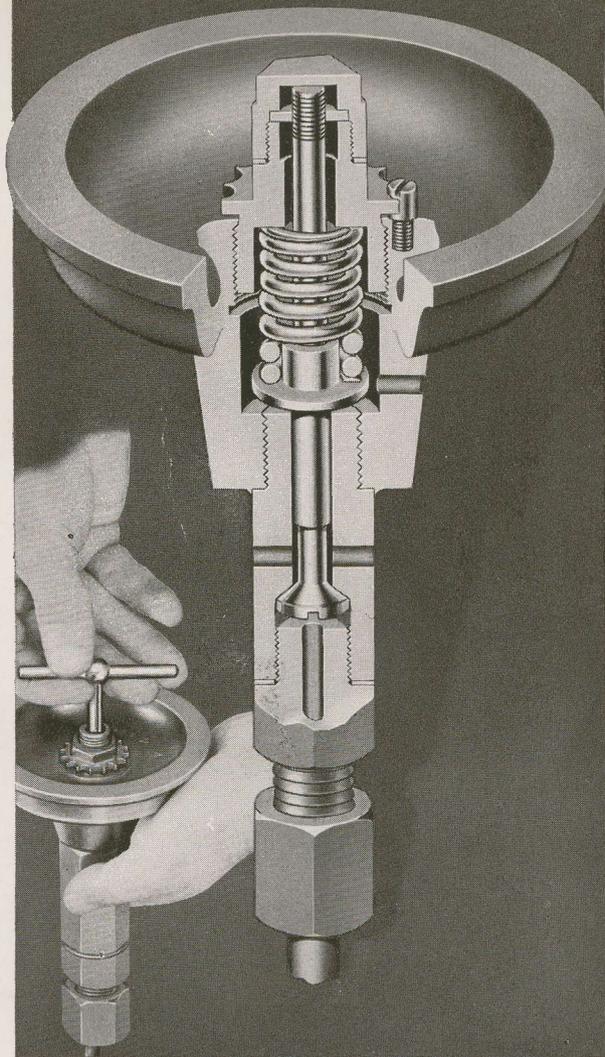


**MARK 3 AIR
RELEASE VALVE in
Operating Position**

Air flask pressure having fallen to that at which air releasing spring is set, the spring expands against air releasing spring support, forcing valve stem downward and opening valve to allow air to pass through escape ports. Valve mechanism remains in open position after air is completely exhausted from air flask, until re-cocked after air flask is recharged and air at full flask pressure is re-admitted to air releasing valve, automatically cocking it.

**Mark 2 Air Releasing Mechanism
(Hand-Cocked Type)**

Mark 2 air releasing mechanism is old type, and while replaced in current exercise head production, may be encountered by torpedomen serving older type torpedoes. To cock Mark 2 valve, mechanism is withdrawn from the exercise head (while still attached to air pipe). Adjusting nut cap is removed and cocking tool is threaded into upper end of valve stem. (See inset illustration at right.) With the aid of cocking tool, valve is drawn against seat, where it is held manually while air from air flask is released into air pipe attached to mechanism. Otherwise the operation and adjustment of Mark 2 air releasing mechanism is the same as that of the Mark 3.



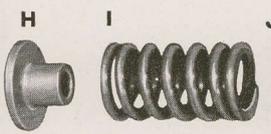
ING VALVE • PARTS AND ACCESSORIES

(G) *Valve Casing.* See large illustration on page 18 for interior construction. Upper and lower portions are screwed and sweated together and treated as a single unit.



NOTE: Beveled seat on underside of valve casing is undercut to hold gasket in alignment. Centering ring shoulders against flange preventing canting of valve.

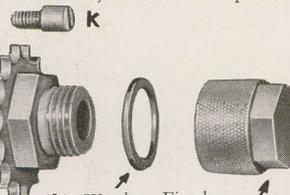
(J) *Adjusting Nut.* Turns to right or left to increase or decrease compression of air releasing spring K through pressure range from 600 pounds to 400 pounds.



(I) *Air Releasing Spring.* Compression type. May be installed with either end based on air releasing spring support.

(H) *Air Releasing Spring Support.* Flanged end rests against shoulder on valve stem F.

(K) *Adjusting Nut Lock Screw.* Must be backed out entirely before nut J can be turned, and replaced firmly when adjustment is completed.



(L) *Washer.* Fits between parts J and M.

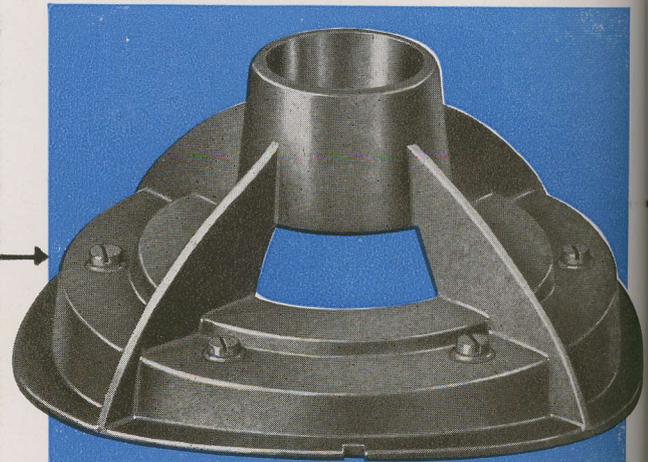
Adjusting Nut Cap. (M) Protects valve stem F from accidental handling or damage, and is vented to prevent banking up of any air which may pass valve stem.

THE WATER DISCHARGE VALVE

The water discharge valve is installed in the flange on the bottom side of the exercise head, on the center line and midway between the forward and after ends. It operates automatically under 400 or more pounds of pressure, opening outboard to discharge water ballast, and closes

when the ballast has been entirely expelled and the air pressure in the exercise head has dropped below the minimum poundage necessary to compress the valve thrust spring.

Water Discharge Valve Body. Riveted and sweated to head shell. If necessary to remove, must be re-sweated in place and given thorough test for leaks.



Water Discharge Valve Sleeve. Upper portion forms hollow guide stem and receives thrust spring.

Nut which threads to base of sleeve, holding leather seat in place.

Leather ring seat or washer. Seats against under side of valve body.

Phosphor bronze thrust spring.

Spring plate. Fastens to studs in flange.



AFTER COMPARTMENT RELIEF VALVE

Threads into valve body (top left) which is riveted and sweated to exercise head shell just forward of joint ring. It serves as both drain plug to drain off moisture and as a relief valve to vent air pressure which may leak from air pipe passing from after bulkhead to forward bulkhead ring. If air vents outboard through valve when flask pressure is released to air releasing valve, the condition must be corrected before head is used.

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THE HEADLIGHT

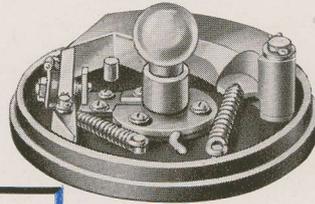
For use in night torpedo practise. Consists essentially of lens, reflector, inertia switch and eight flashlight batteries, assembled in brass case with heavy rim machined to seat in headlight flange on exercise head. Care must be taken to not only seat headlight firmly on rubber gasket but also to guard against leakage around lens.



Headlight cover with enlarged central opening.



Blank cover plate. Seals headlight flange when headlight is not fitted during run.



Inertia switch, closed or fired position. Headlight must be installed with inertia weight aft and in open or cocked position, as in main illustration.

TORPEDO TORCH

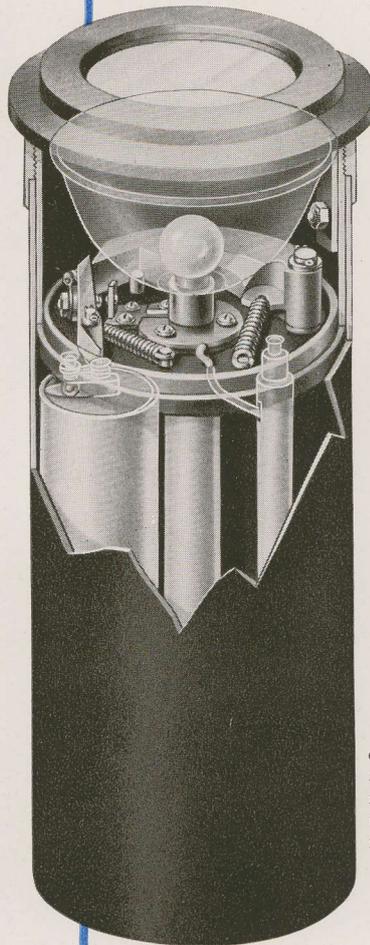
Torch case (below) installs in after flange of exercise head (top) and remains in place whether or not torch is installed. Rim at upper edge of case is machined to seat in flange and must be firmly in place on rubber washer. In daytime practise, torpedo torch case receives torch (right).



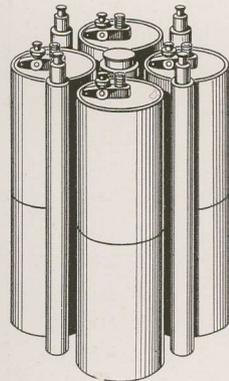
Torch contains chemical which creates smoke when mixed with water. Small hole in upper side is sealed with tin strip soft-soldered in place and with ring for removal.



Tin seal of torch must be removed just before installation of torch in case, and care taken to see that torch is in right-side-up position; also that torch is fitted down between indentations near case bottom. *Due to the possibility of setting fire to a plane, torches are not used in aircraft torpedoes.*



Headlight with case cut away to show detail of construction. Operation of inertia switch will be clear upon study. Inertia weight moves aft when torpedo is given forward motion, closing switch contacts.



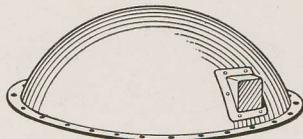
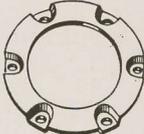
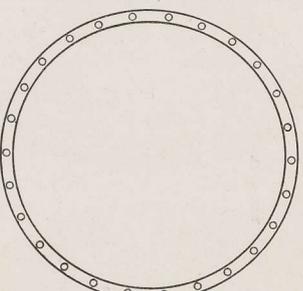
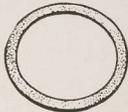
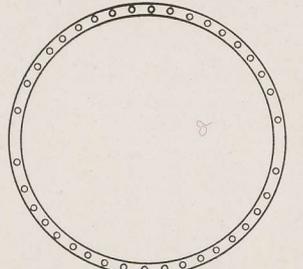
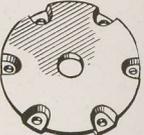
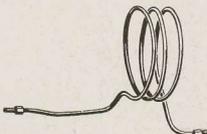
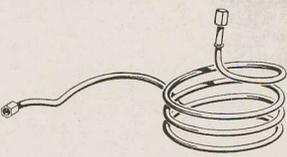
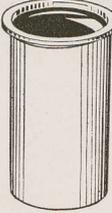
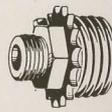
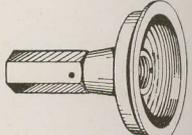
Wiring detail and location of batteries, spring contacts and wiring conduits. Care must be taken that all contacts are bright and free from corrosion.



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PARTS MARK 26-2 EXERCISE HEAD

KEY: SG—STOCK GROUP • SP—STOCK PART

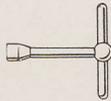
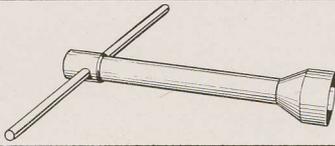
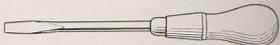
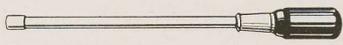
NUMBER OF PIECES		NUMBER OF PIECES	
AFTER BULKHEAD SG 2874		HEADLIGHT COVER SP 12784	
AFTER BULKHEAD GASKET SP 11606		FLANGE WASHER SP 933	
FORWARD BULKHEAD SG 3947		BLANK COVER SP 6347	
FORWARD BULKHEAD GASKET SP 10526		FLANGE COVER SP 11603	
AFTER AIR PIPE SG 2882		SPRING PLATE SP 11601	
FORWARD AIR PIPE SG 3948		ADJUSTING NUT CAP SP 8247	
TORCH CASE SP 2084 (RING) SP 2082 (CASE)		WASHER SP 8248	
		ADJUSTING NUT SP 13481	
		ADJUSTING NUT KEEP SCREW SP 8010	
		VALVE SPRING SP 9411	
		SPRING SUPPORT SP 9414	
		VALVE CASING SG 3875	

PARTS MARK 26-2 EXERCISE HEAD

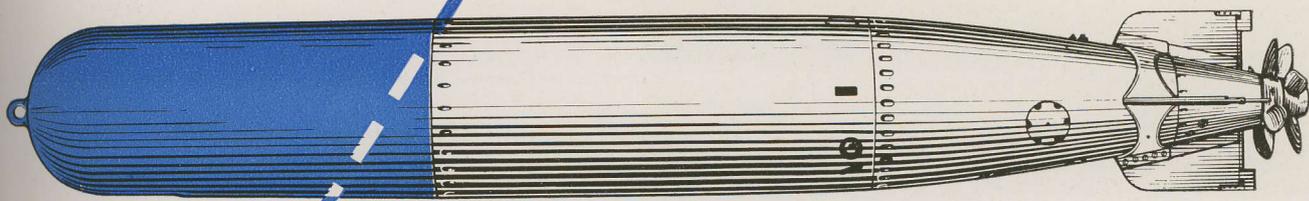
KEY: SG—STOCK GROUP • SP—STOCK PART

NUMBER OF PIECES		NUMBER OF PIECES	
1	AIR RELEASING VALVE SP 13482	1	WASHER SP 10167
1	WASHER SP 13485	1	VALVE SPRING SP 10164
1	STRAINER HOLDER SP 13483	1	WASHER SP 10166
1	STRAINER SG 3062	1	VALVE BODY SP 10162
1	WASHER SP 7080	1	WASHER SP 10165
1	CONNECTION NIPPLE SP 13484	1	VALVE SP 10163
1	WATER DISCHARGE VALVE FLANGE SP 11600	1	DRAIN PLUG SP 1508
1	VALVE NUT SP 7070	1	LOCK NUT (FORWARD PIPE CONNECTION) SP 11969
1	VALVE WASHER SP 10127	1	LOCK NUT (AFTER PIPE CONNECTION) SP 11970
1	WATER DISCHARGE VALVE SP 10126	2	WASHER SP 306
1	VALVE SPRING SP 10424	128	NUT SP 430
1	RELIEF VALVE FLANGE SP 10161	26	AIR FLASK JOINT SCREW SP 11910
1	RELIEF VALVE NUT SP 430		

TOOLS FOR EXERCISE HEAD

NUMBER OF PIECES		NUMBER OF PIECES	
1	<p>JOINT SCREW SOCKET WRENCH NO. 49</p> 	1	<p>PIPE CONNECTION WRENCH NO. 141A</p> 
2	<p>BREAKING SCREW NO. 61</p> 	1	<p>UPPER AIR RELEASE VALVE NUT WRENCH NO. 451</p> 
1	<p>COCKING TOOL FOR MARK 2 AIR RELEASING MECHANISM NO. 441</p> 	1	<p>RELIEF VALVE SCREW DRIVER NO. 39</p> 
2	<p>RELIEF VALVE SOCKET WRENCH AND HANDLE NO. 391A (WRENCH NO. 215 (HANDLE)</p> 	1	<p>AIR RELEASING MECHANISM CALIBRATING SCREW DRIVER NO. 41</p> 
1	<p>SOCKET WRENCH FOR NO. 430 NUT NO. 48</p> 	1	<p>LOWER AIR RELEASE VALVE NUT WRENCH NO. 229</p> 

WAR HEAD



Mark 13 War Head	28	Arming and Firing	35
Mark 4-1 Exploder	30	Anti-countermining Device . . .	36
General Construction of Exploder	31	Detonator and Detonator Holder	38
Units on Exploder Base	32	Booster; Installing Exploder . .	39
Arming Gear and Trigger Mechanism	34	Parts and Tools	40
		Notes	44

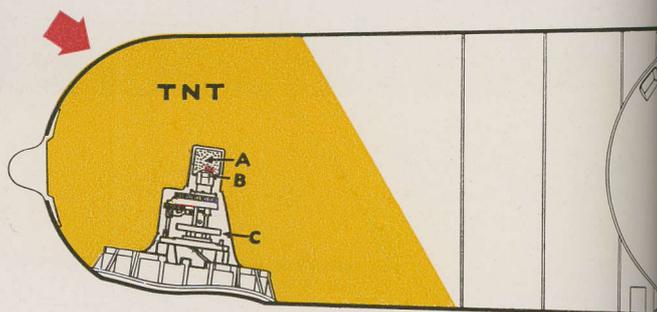
THIS IS A MARK 13

The War Head is the torpedo's reason for being—the vehicle for transporting and the means of exploding the TNT which, if the torpedo finds its mark, may sink an enemy battleship. The War Head itself is of comparatively simple design and construction. It consists of a steel shell identical in material and dimensions with the Exercise Head shell, fitted with a towing eye, strengthening rings, lead ballast block and a single bulkhead aft (see opposite page).

On the underside well forward is carried a flange into which may be fitted an Exploder which works on the inertia principle, much as does the searchlight for the Exercise Head. Normally the War Head, fitted with a protecting ring at the joint line, is stowed separately from the Exploder; in time of war when torpedoes may be kept in "fully ready" condition for weeks on end, a servicing routine must be rigidly followed. There is nothing facetious intended in the statement that a War Head may be used only once, and therefore *must* be kept in perfect operating condition.

HOW IT WORKS

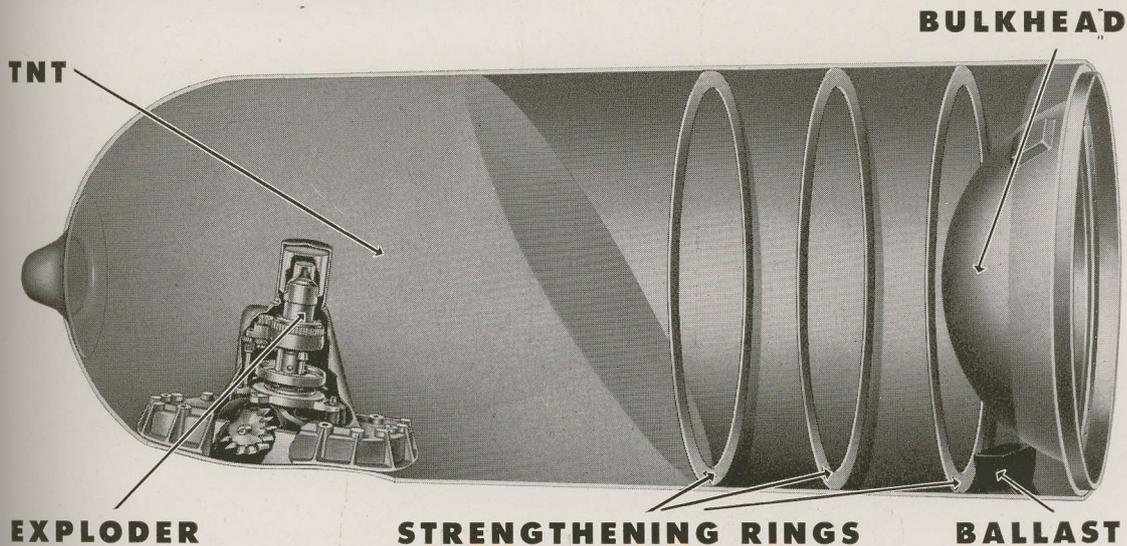
The illustrations to the right demonstrates in cross section the manner in which the Mark 13 or Mark 13-1 War Head, is armed and detonated. There is no marked structural difference between the Mark 13 and Mark 13-1 War Heads, incidentally; the former is loaded with 400 pounds of cast TNT and the latter with 600 pounds, but otherwise they appear and are serviced alike. TNT is the designation for trinitrotoluol, one of the most powerful and at the same time one of the most stable of explosives.



EXPLODER COCKED, UNARMED

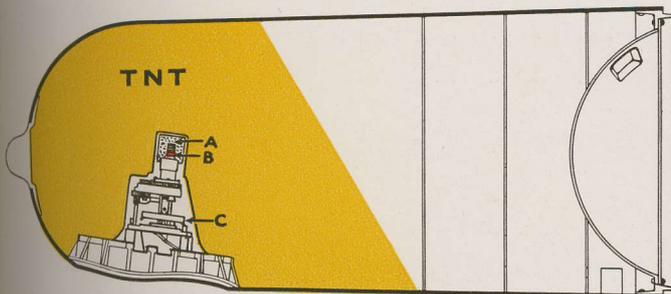
Mark 4-1 Exploder has been fitted, cocked but unarmed. Fulminate of mercury detonator charge (B) is therefore within safety chamber of Exploder; if accidentally fired, it should not detonate tetryl booster charge (A), nor the TNT charge. Position of firing ring (C) indicates cocked condition of Exploder. Heads for aircraft use are now being loaded with TORPEX.

WAR HEAD



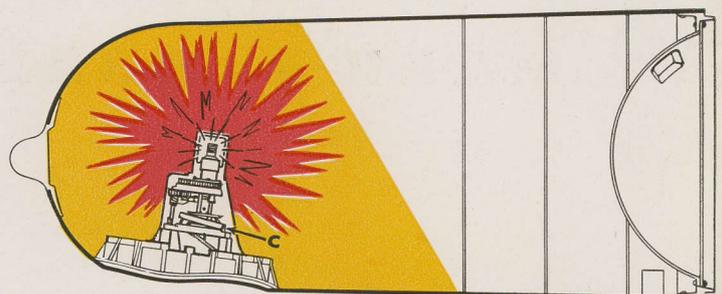
WAR HEAD DIMENSIONS, WEIGHTS, ETC.

Length, Forward End of Nosepiece to Joint Line, Marks 13 and 13-1	53.99"
Diameter at Joint Line, Marks 13 and 13-1	22.42"
Weight Empty, Less Explosives Charge and Exploder (Mark 13)	195.9 lb.
Weight Empty, Less Explosive Charge and Exploder (Mark 13-1)	202.5 lb.
Weight Explosive Charge, Mark 13	400 lb.
Weight Explosive Charge, Mark 13-1	600 lb.
Weight Loaded and with Exploder, Mark 13	625 lb.
Weight Loaded and with Exploder, Mark 13-1	836 lb.
Weight Lead Ballast, Marks 13 and 13-1	12 lb.



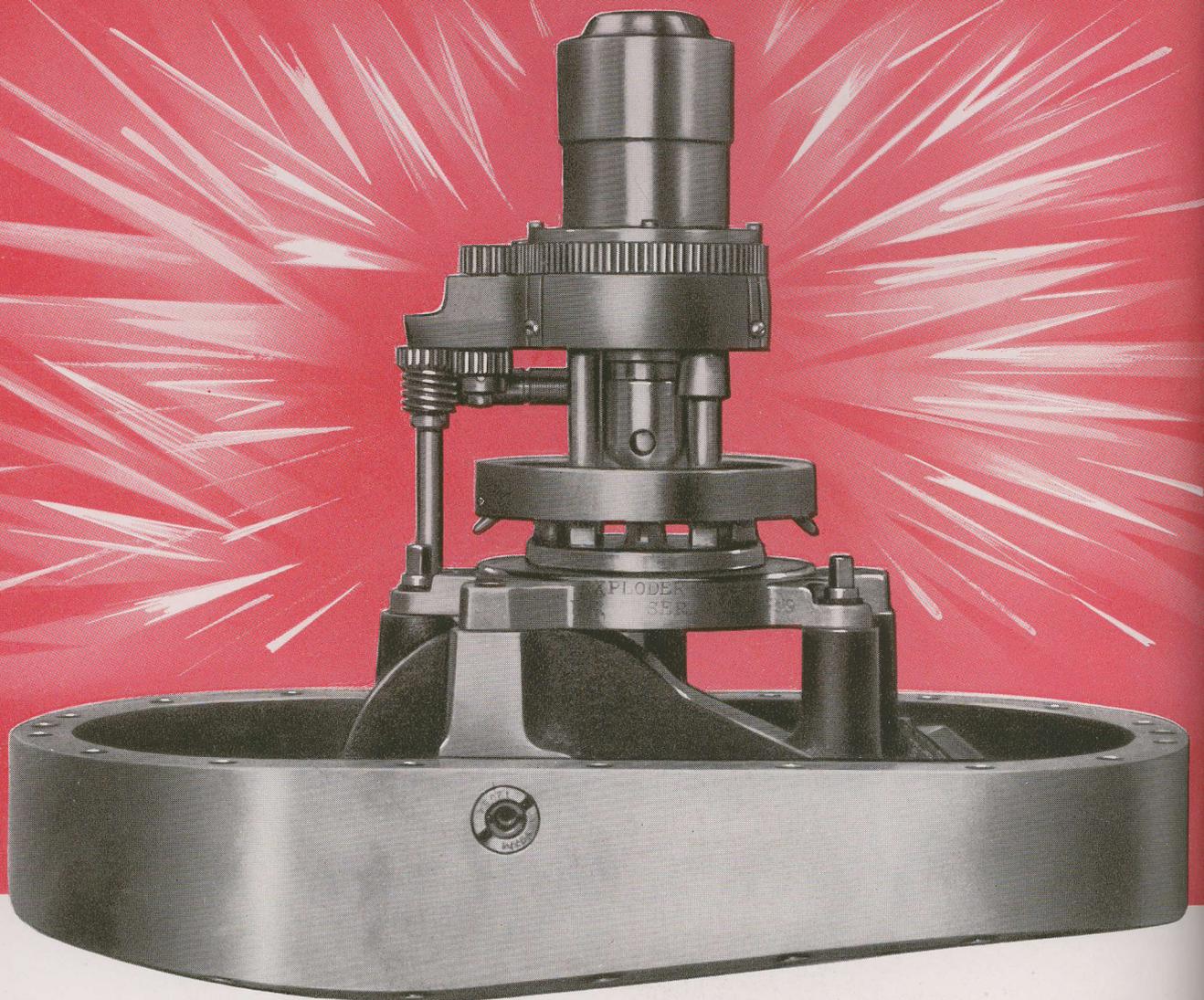
▶ EXPLODER COCKED, ARMED

Torpedo having been launched, flow of sea water through open channel in base has turned the impeller (see "paddle wheel" in base of exploder in large illustration above) a sufficient number of turns to raise the fulminate detonator (B) up out of the safety chamber into the recess in the booster charge container (A), at the same time fully compressing firing spring and releasing firing pin from safety balls.



▶ EXPLODER FIRED

Impact of the torpedo against its target has caused the firing ring (C) to be unseated by force of inertia. Through the process explained in the description of the exploder (beginning with page 30) the exploder is fired; the primer caps detonate the fulminate, the fulminate explodes the booster charge, and the booster charge explodes the main charge of TNT. The entire process is, of course, practically instantaneous.



MARK 4 MOD. 1 EXPLODER

Upon the performance of the mechanism displayed above depends the final success or failure of every war head-equipped torpedo which reaches its target. All the care and attention which may be given to the mechanisms which propel and guide the torpedo to its mark will be wasted if any lack of care or attention causes the exploder to malfunction.

Therefore, study carefully the following pages that describe the Mark 4 Mod. 1

exploder and don't profess to understand it until you actually do. The exploder is not as intricate as it at first appears to be; it is simply a device by which a war head is armed or made ready to fire, on impact, *after* it has been launched and is at a safe distance from its launching point, and by which the war head's explosive charge is detonated by the force of the torpedo's striking against its target or of *the target striking against the torpedo*.

GENERAL CONSTRUCTION OF EXPLODER

A MARK 2 BOOSTER. Container formed of thin sheet copper, holding charge of highly-compressed tetryl and constructed to fit down snugly over safety chamber C, as shown.

B MARK 7 DETONATOR HOLDER. (See page 38 for detailed description.) Shown in armed position, with flash holes clear of safety chamber. (See page 38 also for detail of detonator.)

C SAFETY CHAMBER. Detonator holder when in unarmed position is carried within safety chamber; the force of any accidental discharge of the detonator will be confined within the chamber and not communicated to the booster.

D FIRING PIN. "T" shaped, with ends of cross-piece notched to fit guideposts F. Firing pin points on top of crosspiece locate directly under primer caps of detonator. Shank of firing pin rides in sleeve of top plate J.

E ARMING GEAR. When revolved by impeller mechanism arming gear rotates safety chamber C, causing detonator holder B to rise to armed position, at the same time elevating arming screw G to release safety balls K.

F GUIDE POSTS. These guide both detonator and firing pin on their upward course.

G ARMING SCREW. Threads on outer, upper circumference engage similar threads on inner face of arming gear E; when latter is revolved by impeller U and intermediate mechanism, arming screw rises until threads are clear, in which position it idles throughout run of torpedo, the "fingers" at its lower extremity having released the safety balls K.

H FIRING SPRING. Upper end seats in circular groove in underside of firing pin crosspiece; lower end seats on bottom of arming screw sleeve, (G).

I STOP BALLS AND SPRINGS. Eight in number, the stop balls are forced by the stop springs into groove at lower end of arming screw, arresting its upward motion when it has cleared the arming gear.

J TOP PLATE. Serves as carrier for firing pin, arming screw and arming gear, lower ball race with stop balls and as lower seat for firing spring. Lower sleeve of top plate contains safety balls by which exploder is held in unarmed position, and firing balls (not shown) which lock firing pin in armed position until mechanism is fired.

K SAFETY BALLS. Two in number, crimped into holes in lower top plate sleeve.

L FIRING BALLS. Three in number, likewise crimped into holes in same plane with safety balls.

M TRIGGER CAP. Grooved internally to receive firing balls when forced upwards by trigger plate P against resistance of trigger spring Q.

N TRIGGER SPRING. Seats in recess provided at inner bottom of trigger cap M, restraining trigger cap from upward movement until its tension is overcome by trigger plate.

O TRIGGER SPRING FOLLOWER. Provides guide and upper seat for trigger spring Q. Locates against inner shoulder of lower top plate sleeve.

P TRIGGER PLATE. Interposed between trigger cap and firing ring R.

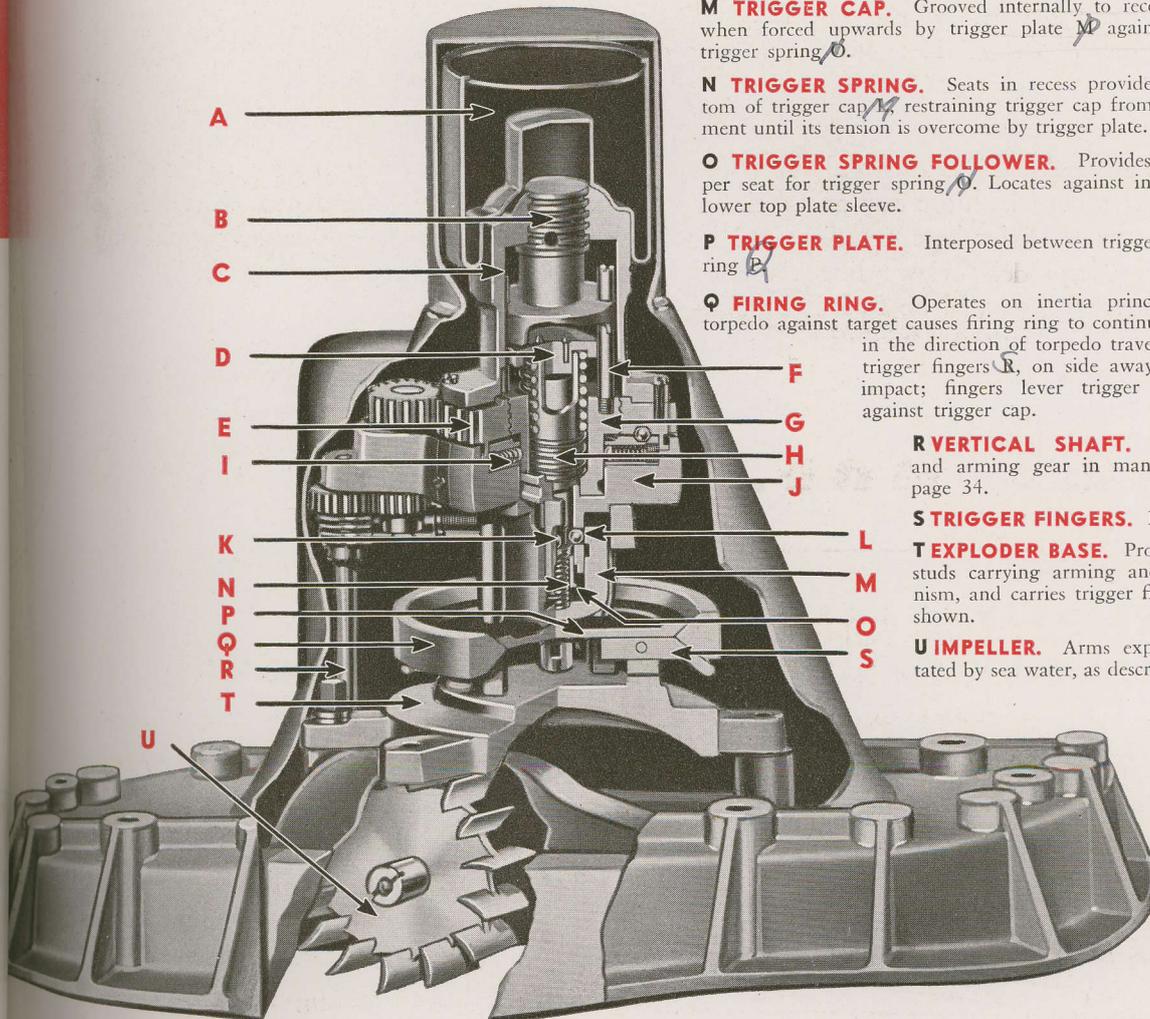
Q FIRING RING. Operates on inertia principle. Impact of torpedo against target causes firing ring to continue its movement in the direction of torpedo travel, forcing down trigger fingers R, on side away from point of impact; fingers lever trigger plate upwards against trigger cap.

R VERTICAL SHAFT. Links impeller and arming gear in manner detailed on page 34.

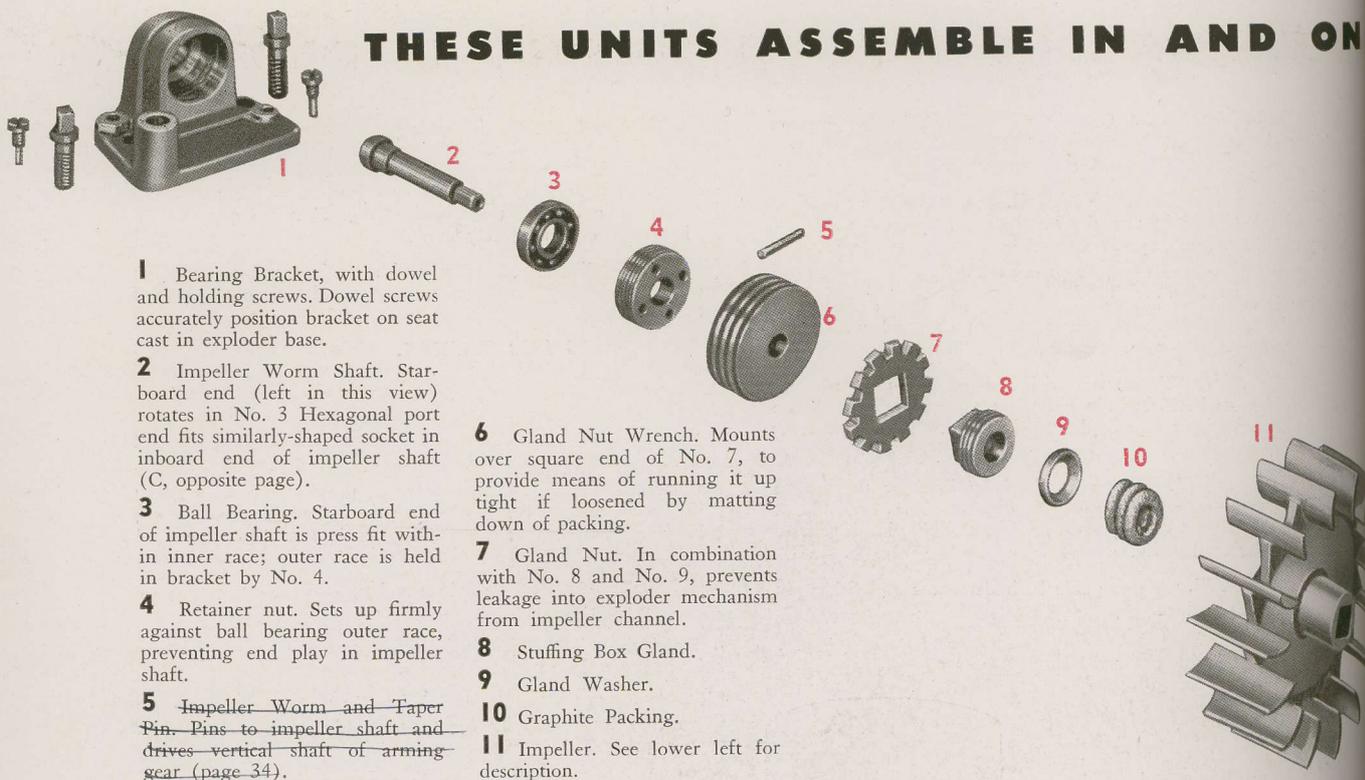
S TRIGGER FINGERS. Four in number.

T EXPLODER BASE. Provides mount for studs carrying arming and firing mechanism, and carries trigger fingers in lugs as shown.

U IMPELLER. Arms exploder when rotated by sea water, as described on page 32.



THESE UNITS ASSEMBLE IN AND ON



1 Bearing Bracket, with dowel and holding screws. Dowel screws accurately position bracket on seat cast in exploder base.

2 Impeller Worm Shaft. Starboard end (left in this view) rotates in No. 3 Hexagonal port end fits similarly-shaped socket in inboard end of impeller shaft (C, opposite page).

3 Ball Bearing. Starboard end of impeller shaft is press fit within inner race; outer race is held in bracket by No. 4.

4 Retainer nut. Sets up firmly against ball bearing outer race, preventing end play in impeller shaft.

5 Impeller Worm and Taper Pin. Pins to impeller shaft and drives vertical shaft of arming gear (page 34).

6 Gland Nut Wrench. Mounts over square end of No. 7, to provide means of running it up tight if loosened by matting down of packing.

7 Gland Nut. In combination with No. 8 and No. 9, prevents leakage into exploder mechanism from impeller channel.

8 Stuffing Box Gland.

9 Gland Washer.

10 Graphite Packing.

11 Impeller. See lower left for description.

On this and the opposite page, the units which are carried within or directly on the exploder base are displayed in disassembly. "Exploded" views like these of numerous mechanisms will be found throughout this Manual. They serve two purposes: (a) being photographic, they aid in ready identification of what they picture when the actual parts are handled; (b) being set up, as nearly as physically possible, in the normal relationship the parts of any mechanism bear to each other,

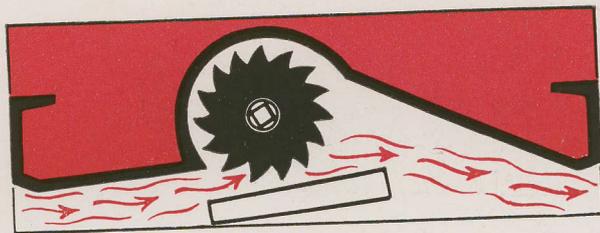
these exploded views supply a graphic guide to assembly and disassembly procedures. Anyone with any mechanical knack at all should experience no difficulty in putting together or taking apart any mechanism pictured in this Manual, with these exploded views for guidance.

In the case of the exploded views on these two pages, each assembly is positioned approximately opposite its location when in place on or within the exploder base, but in size is not in exact proportion to the base casting.

THE SEA DRIVES THE IMPELLER

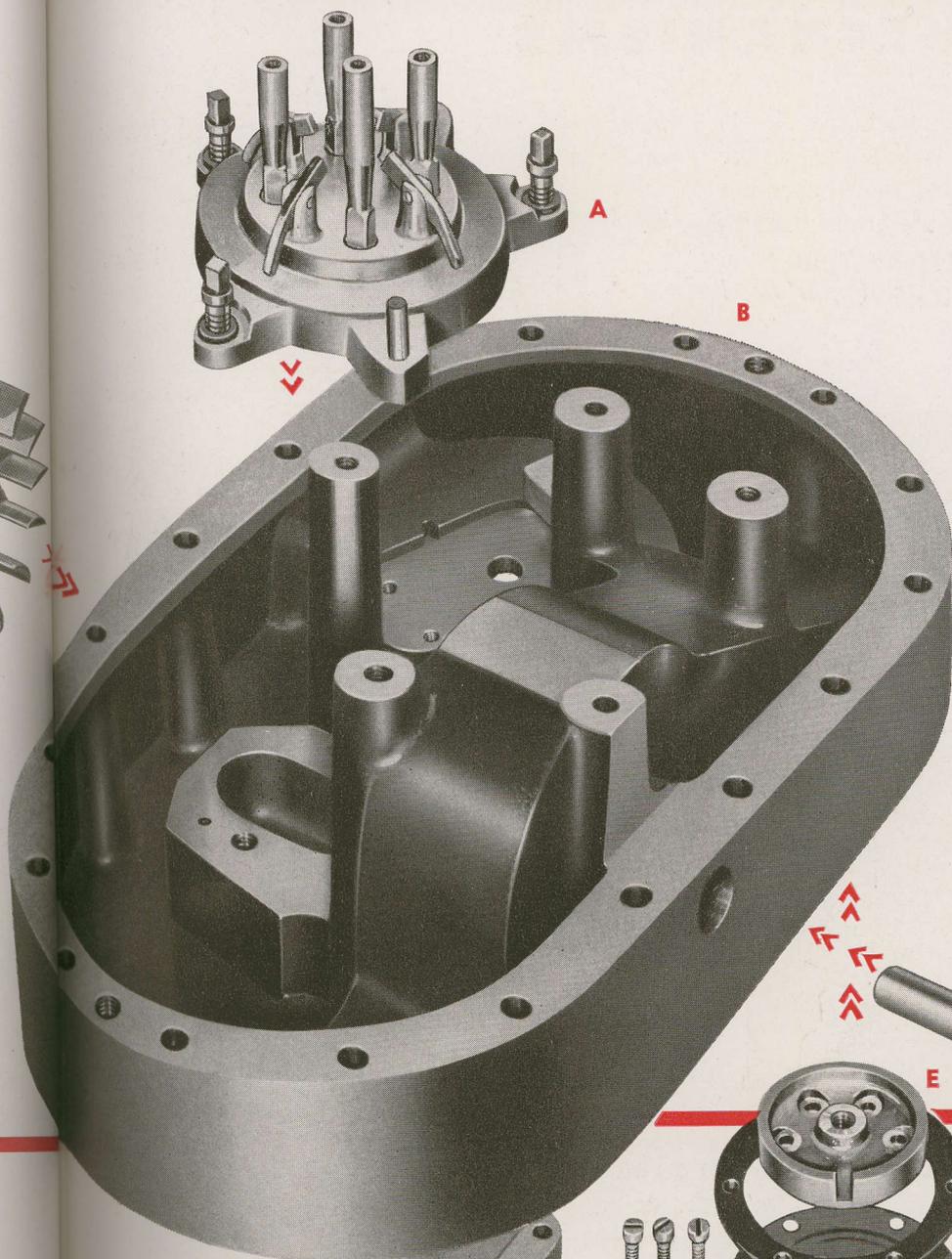
THE IMPELLER OPERATES AND ARMS THE EXPLODER

The impeller (*see No. 11 above*) has a square central hole which fits over the squared portion



of the impeller shaft (*No. 2 above*), so that when rotated by the sea as the torpedo passes through it (*see diagram at left*) the impeller revolves the impeller shaft, and with it the worm shaft and worm which meshes with worm wheel pinned to lower end of vertical drive shaft (*page 34*). The vertical shaft in turn drives the exploder's arming mechanism.

EXPLODER BASE PLATE



A Exploder Base, with Trigger Fingers in place. Mounts to base plate with holding screws and two dowels which assure accurate re-positioning following removal for any reason.

B Exploder Base Plate. Note five bosses for support of exploder mechanism, grouped around impeller channel; bosses for A.C.M. piston lever (see page 37) and bearing bracket (No. 1, page 32).

C Impeller Shaft. Slot at outboard end is for attachment of testing motor.

D Impeller Shaft Sleeve Nut. Prevents backing out of impeller shaft.

E A.C.M. Diaphragm Cap. See pages 36, 37 for detailed description of A.C.M. device.

F A.C.M. Diaphragm Gasket, large.

G A.C.M. Diaphragms. Two are fitted.

H A.C.M. Diaphragm Gasket, small.

Impeller Guard (above) with screws for fastening to under side of impeller channel. Both protect impeller blades and leads sea water to them.

I A.C.M. Diaphragm Plate.

J A.C.M. Diaphragm Ring.

K Holding Screws for A.C.M. Diaphragm Assembly.

L Test Plug Washer.

M Test Plug. Locates in lower side base plate just forward of diaphragm recess.

N Screws for diaphragm assembly.

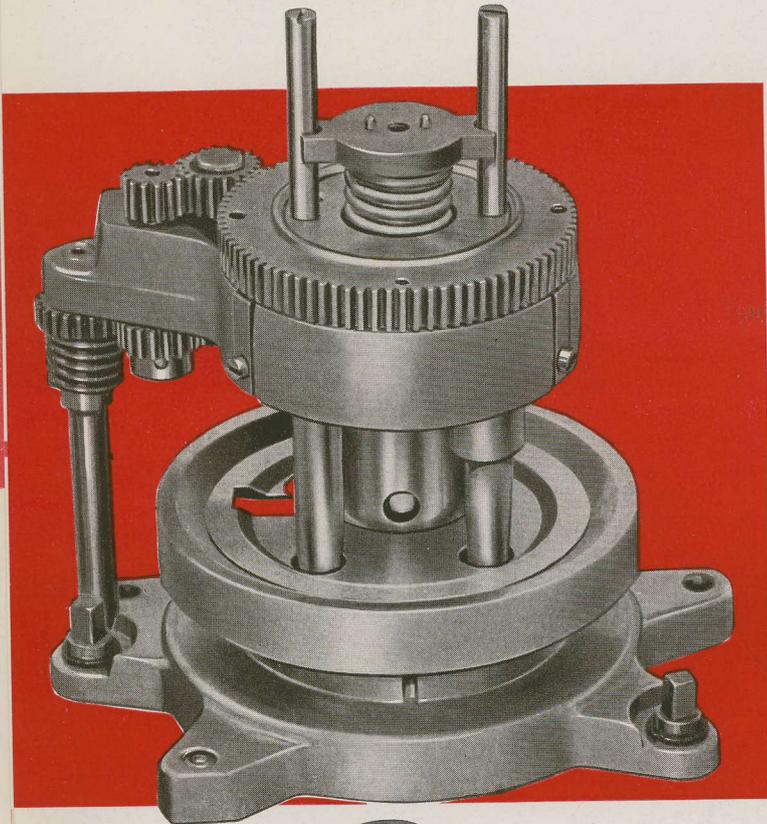
Paragraphs 5 to 11 should be changed to read as follows:

5. Taper Pin. Used to pin No. 6 to No. 2.
6. Worm. Drives vertical shaft (X on Page 34) of arming gear through worm wheel (Y on Page 34).
7. Gland Nut Wrench. Mounts over square end of No. 8 to provide means of running it up tight if loosened by matting down of No. 10.
- 7a. Lock Washer. Interposed between exploder base and No. 7 to lock wrench (No. 7) in place. (Not shown).
8. Gland Nut. In combination with No. 9 and No. 10, prevents leakage into exploder mechanism from impeller channel.
9. Gland.
10. Graphite Packing.
11. Impeller.

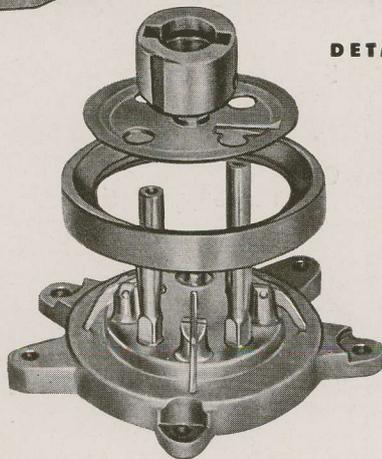
THE ARMING AND TRIGGER MECHANISMS

The arming and trigger mechanisms are closely related and assemble one above the other on the exploder base. It can also be said that the trigger mechanism assembles within the arming mechanism. Illustrations show (*large illustration*) the assembled mechanisms complete, (*right hand*

disassembly) the arming mechanism, and (*lower disassembly*) the trigger mechanism.

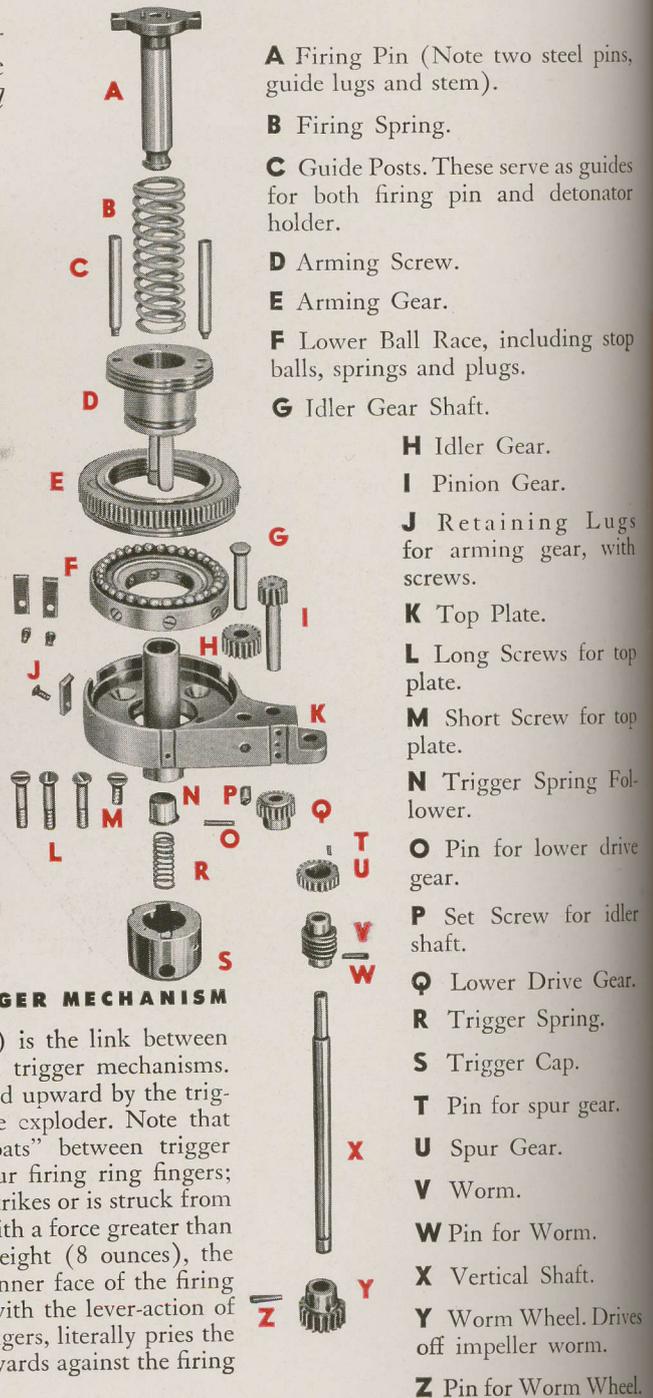


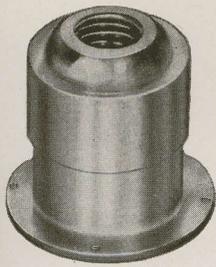
The arming of a torpedo is completed after approximately 780 turns of the impeller; the trigger mechanism will release upon impact of approximately 5 pounds' force.



DETAILS OF TRIGGER MECHANISM

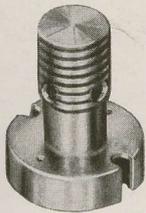
Trigger cap (S) is the link between the arming and trigger mechanisms. It must be forced upward by the trigger plate to fire exploder. Note that firing ring "floats" between trigger cap and the four firing ring fingers; when torpedo strikes or is struck from any direction with a force greater than six times its weight (8 ounces), the wedge-shaped inner face of the firing ring, coupled with the lever-action of one or more fingers, literally pries the firing plate upwards against the firing cap.





COMPLETING THE ASSEMBLY

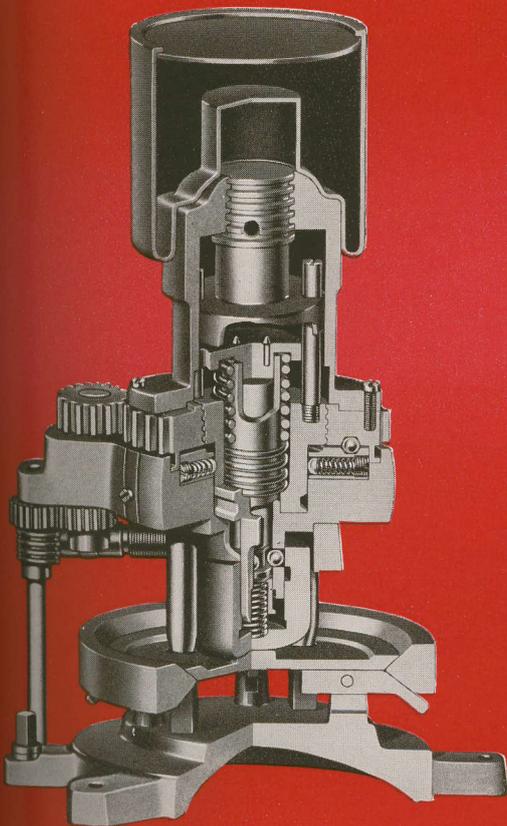
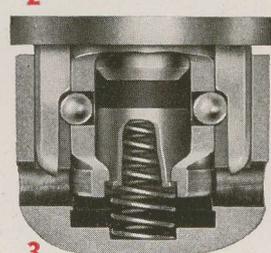
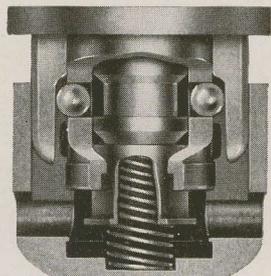
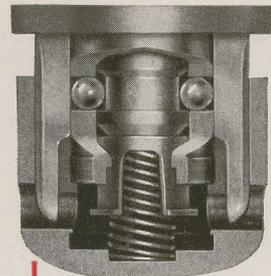
At left (top) is the Safety Chamber and (below) the Detonator Holder. The detonator holder threads into opening in top of safety chamber, which is then screwed to the upper surface of the arming gear to complete the assembly in large illustration on opposite page.



ARMING AND FIRING

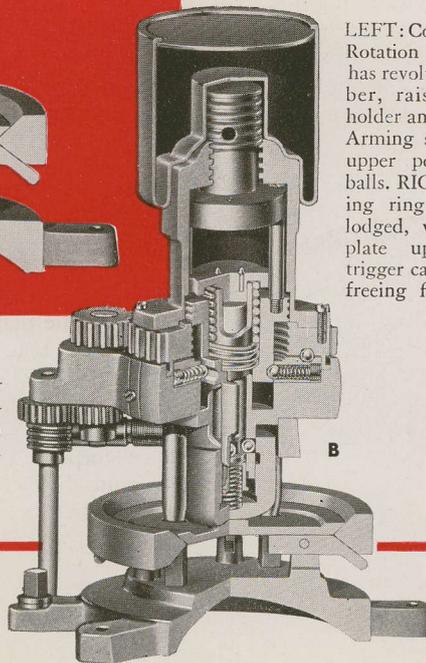
The arming and firing of the Mark 4-1 Exploder is basically controlled by the arrangement detailed in the three small illustrations at right (1, 2 and 3), which must be considered in direct relationship to the three larger illustrations at left and below (A, B and C). In 1 and A, the exploder is cocked and unarmed. The two fingers which extend downward from the arming screw are at their lowest point, locking the safety balls in the lower sleeve of the top plate into the groove at lower end of the firing pin stem (illustration 1). At the same time the three firing balls, also in the lower sleeve of the top plate and in the same plane as the

safety balls, are locked into the groove in the firing pin stem by the firing cap (illustration B), making it doubly impossible for the firing pin to be released. Illustration 2 and illustration B combine to show the condition of the mechanism when cocked and armed. Arming screw has risen and carried the fingers with it, freeing the safety balls from the firing pin groove (illustration 2). Firing balls, however, are still locked into the firing pin groove by the trigger cap. Illustration 3 and illustration B demonstrate the firing of the exploder. Safety balls are already clear of the firing pin (illustration 3) and movement of the trigger cap when forced upward by the trigger plate has freed the firing pin stem (illustration C). Firing spring then drives firing pins against caps in detonator holder.

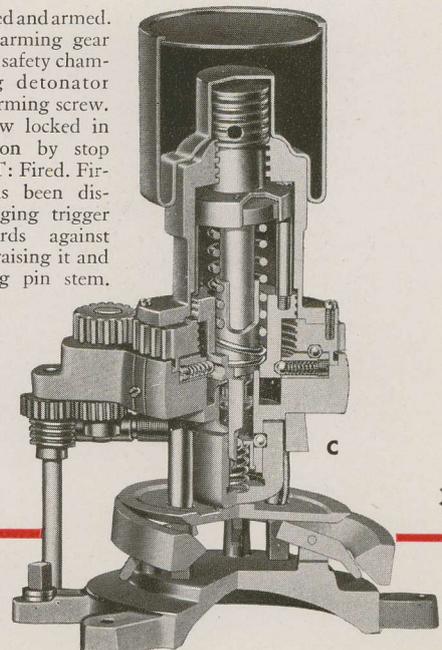


A

ABOVE: Cocked and unarmed. Detonator holder in safety chamber, arming screw in lowest position. Raising trigger cap cannot fire mechanism with safety balls locked into firing pin stem.



B

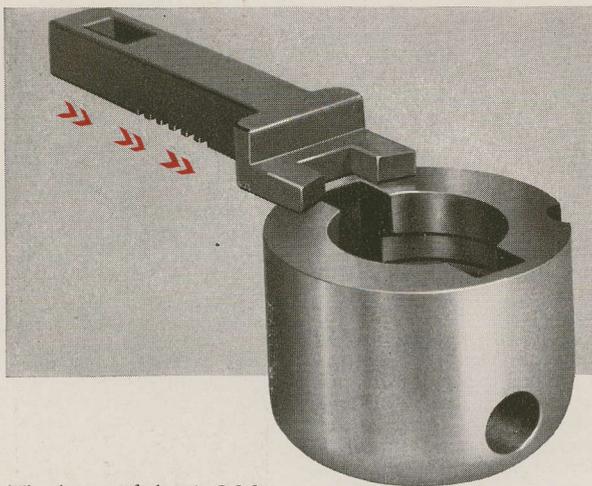
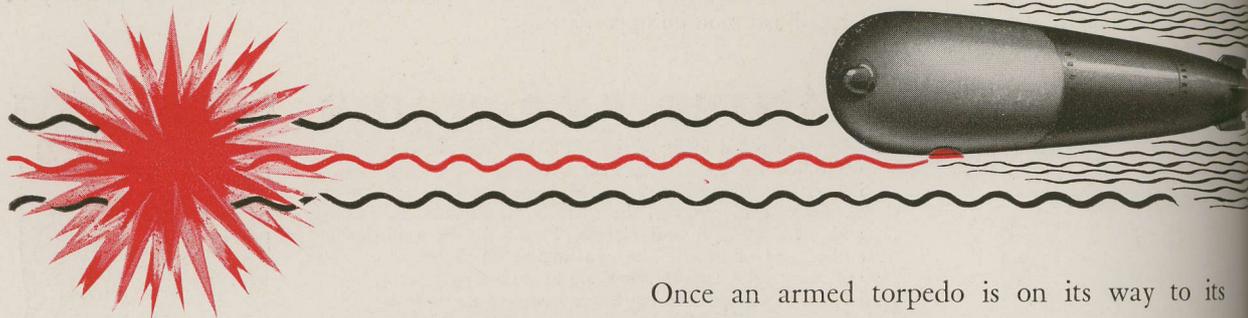


C

LEFT: Cocked and armed. Rotation of arming gear has revolved safety chamber, raising detonator holder and arming screw. Arming screw locked in upper position by stop balls. RIGHT: Fired. Firing ring has been dislodged, wedging trigger plate upwards against trigger cap, raising it and freeing firing pin stem.

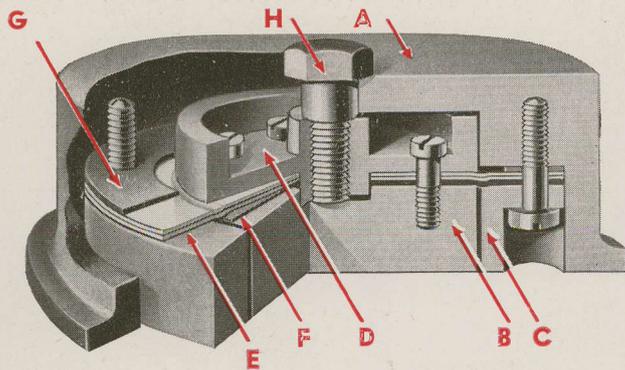
"A.C.M."

ANTI-COUNTERMINING DEVICE



The heart of the A.C.M. device is the locking rack shown above; the function of the A.C.M. mechanism is to cause the forked toe of the locking rack to bear against the top of the trigger cap, preventing it from rising and firing the exploder in the event of a nearby mine or depth charge explosion in the sea. The A.C.M. mechanism has the further function of allowing the locking rack toe to be withdrawn as soon as the danger of premature firing of the torpedo is over with.

Once an armed torpedo is on its way to its target, any blow striking it with approximately five pounds or more of force is sufficient to fire the exploder and destroy the torpedo before it reaches its objective. Because water cannot be compressed, it will transmit any violent disturbance, such as the explosion of a mine, depth charge or shell, for a considerable distance through its own substance. It is well known that the explosion of a stick of dynamite in water will kill fish scores of yards distant from the point of explosion. Hence it is easy to see that if a mine should explode even at some distance from an armed torpedo, sufficient force might be transmitted through the water to fire the torpedo, unless provision is made against this possibility. Such provision is made in the form of the anti-countermining, or "A.C.M." device.



The basic means of setting the A.C.M. mechanism in motion is the diaphragm assembly at left, consisting of diaphragm housing A, cap B, ring C, body D, copper diaphragm discs E, lower gasket F, upper gasket G and piston H. The inner portion of this assembly "floats" within the outer; any concussion near the torpedo forces the diaphragm assembly upwards, and with it the piston. See next page for further explanation.

NOTE: Parts are numbered from bottom of disassembly, and then from left to right. They should be studied with reference to assembled mechanism pictured directly below disassembled view.

1 Piston (see bottom of opposite page). When concussion forces diaphragm assembly upwards, piston thrusts against:

2 A.C.M. Lever. Flattened toe (left end as pictured) pivots under overhang in base plate, and is held in place by:

3 Lever Screw Pin.

4 Lever Guide and holding screws.

5 Push Rod. Seats in socket at free end of lever.

6 Push Rod Spring.

7 Locking Rack Bracket. Mounts on three short studs extending up from exploder base, being held down by three long screws inserted through holes in arms shaped to fit closely around trigger cap.

8 Locking Rack, with retainer strap and holding screws. Forked toe of rack straddles top plate retaining lug; teeth on under side of rack mesh with pinion 12.

9 Bell Crank. Converts upward thrust of push rod into horizontal movement by rack.

10 Bell Crank Torsion Spring.

11 Bell Crank Pin and cotter.

12 Spring Clutch Pinion.

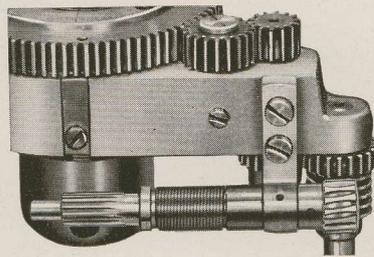
13 Clutch Spring.

14 Clutch Shaft.

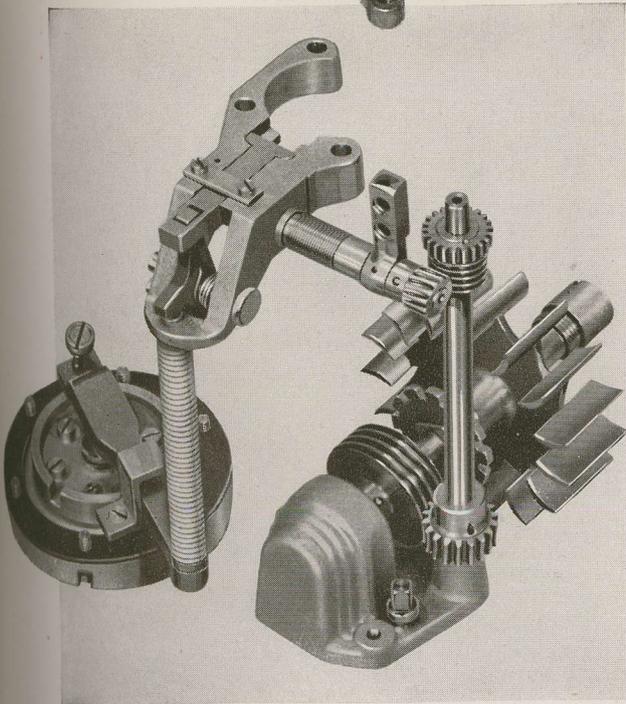
15 Clutch Shaft Bracket and holding screws.

16 Clutch Worm Wheel.

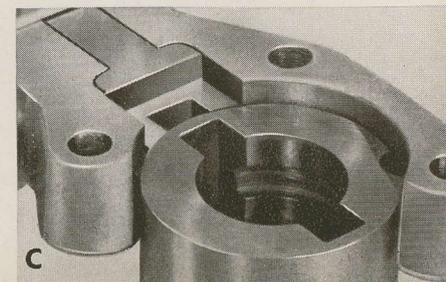
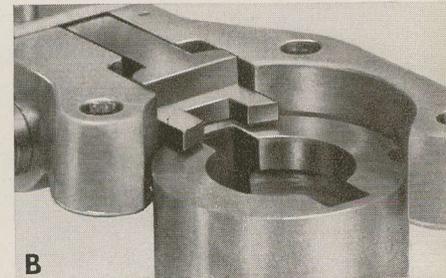
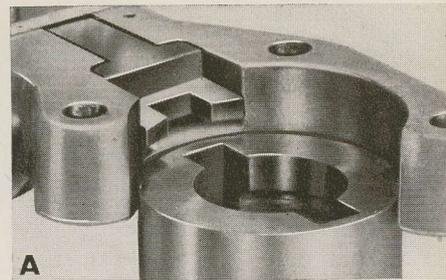
A. C. M. SPRING CLUTCH

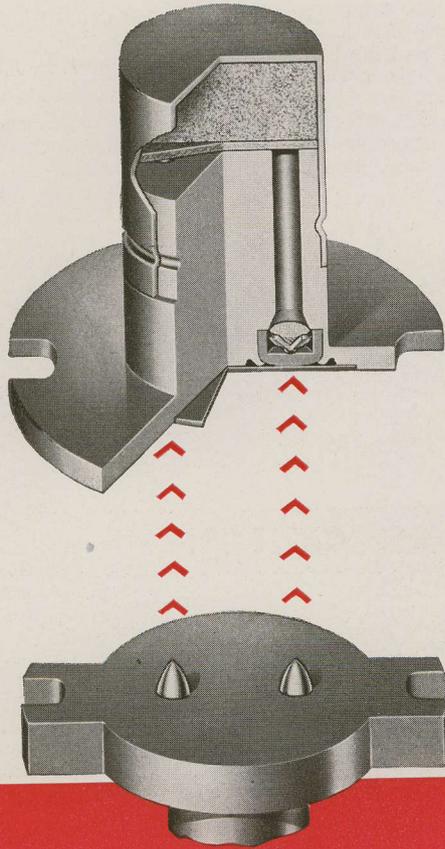


Permits locking rack to move into locking position, but prevents its withdrawal by any means other than the outward rotation of the clutch pinion, which is driven by the arming mechanism's vertical shaft through a worm, located just below spur gear which drives the arming mechanism proper.



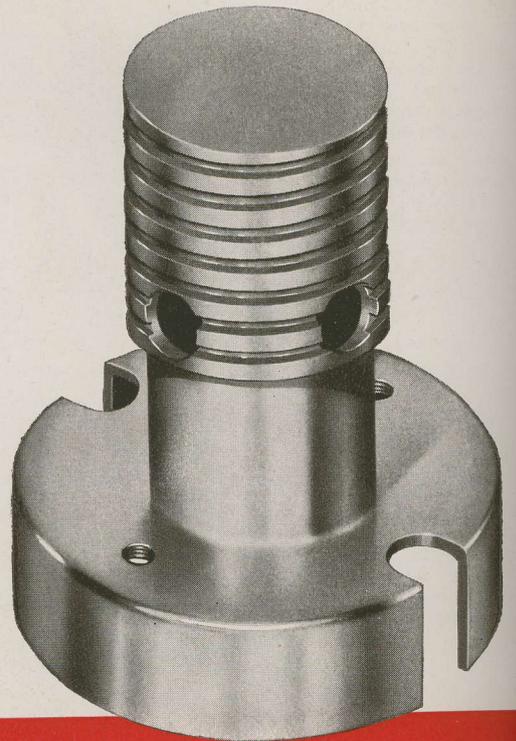
In **A** at right, locking rack is inoperative, being held out of engagement with trigger cap by bell crank torsion spring. In **B**, locking rack is in locked position; pressure wave caused by an explosion nearby has struck diaphragm assembly, causing locking rack to engage before firing ring of exploder mechanism can be dislodged. In **C**, spring clutch has allowed locking rack to be disengaged slowly (as protection against secondary pressure wave) and subsequent firing of exploder results in passage of trigger cap past locking rack toe.





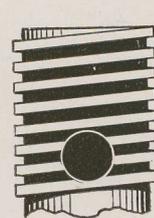
THE MARK 7 AND 8 DETONATOR

The general construction of these detonators is shown above; upper chamber of assembly contains fulminate of mercury detonating charge resting above a small ignition charge of guncotton. Primer caps at lower end of channels drilled through body of detonator receive impact of firing pins, igniting guncotton which in turn detonates fulminate. Detonator should be stored with holder (see next column) and safety chamber belonging to it. *NEVER ATTEMPT TO DISASSEMBLE DETONATORS FOR ANY REASON WHATEVER.* They are constructed to eliminate danger during handling, but should nevertheless be treated with respect at all times.



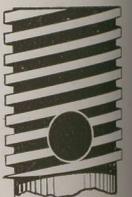
THE MARK 7 AND 8 DETONATOR HOLDER

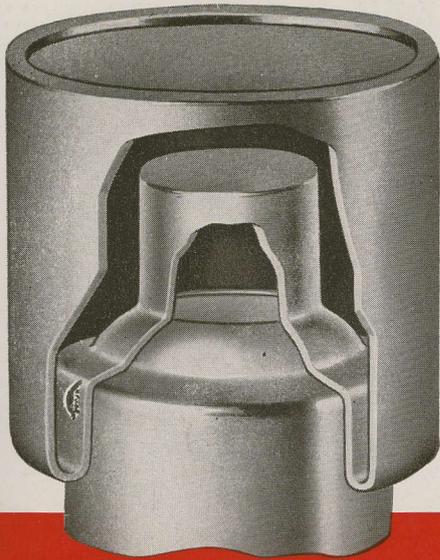
The Mark 7 and 8 detonator holders are identical in size and construction except for a difference in threading (see below). A line is scribed across the top end of each detonator holder and across the top of safety chambers; these must coincide when holder and safety chamber tops are flush together after assembly for a war shot, to assure alignment of firing pins with primer caps in detonator. When assembling detonators in holders and holders to guide posts, make certain there is no danger of binding during the arming process.



DOUBLE PITCH THREAD ON MARK 8 HOLDER

For assembly with correspondingly threaded safety chamber only. Mark 8 holder (right) goes into firing position in half the time, and hence half the distance, required by the Mark 7 holder (left).





THE MARK 2 BOOSTER

The Mark 2 booster is a copper container carrying 2 ounces of tetryl in the space between the double walls shown in cut-away form above (container is shown empty to make its construction clear). When booster is fitted into pocket at top of exploder casing, and safety chamber is in place as shown above, upper recess in booster will be properly aligned to receive detonator holder when exploder is armed.

GENERAL COMMENT CONCERNING EXPLODERS

Tetryl used in boosters is very nearly as stable as TNT, but it should nevertheless be handled with proper care. Never let familiarity with explosives of any kind breed contempt for them; they are as deadly when accidentally set off as when intentionally detonated.

Boosters are issued in individually sealed metal containers, which in turn are sealed, in lots of six, in metal boxes. Never break the seals of individual booster containers until and immediately before installation in war head for an actual war shot.

Exploder mechanisms are as delicately machined as any mechanism related to the Mark 13-1 Aerial Torpedo. Treat them accordingly; exploders which fail to fire may give the enemy just enough time to launch a torpedo against one of our vessels which may not miss or fail.



INSTALLING THE EXPLODER MECHANISM

Booster is fitted into pocket of exploder casing in war head. Base plate gasket is fitted in place and exploder mechanism then lowered into casing with holding screws as shown, care being taken to accurately fit safety chamber into recess in booster. Holding screws are then threaded down. A in illustration below is impeller guard, B is underside of A.C.M diaphragm assembly.



PARTS MARK 13 WAR HEAD MARK 4 MOD. 1 EXPLODER

KEY: SG—STOCK GROUP • SP—STOCK PART

NUMBER OF PIECES		NUMBER OF PIECES	
BULKHEAD SP 12052	1	DIAPHRAGM CAP SP 12067	1
BULKHEAD CASKET SP 11606	1	RUBBER GASKETS, SMALL SP 12069	1
AIR FLASK JOINT SCREW SP 11910	26	SCREW SP 2	8
BASE PLATE SP 12080	1	DIAPHRAGM GASKETS, LARGE SP 12070	1
BASE GASKET SP 12078	1	IMPELLER SP 11760	1
DIAPHRAGM RING SP 12081	1	IMPELLER SHAFT SP 12056	1
SCREWS SP 12089	6	IMPELLER NUT SP 12054	1
IMPELLER GUARD SP 12053	1	GRAPHITE PACKING (3 PIECES & 7 STRANDS) SP 11050	4
SCREWS SP 6497	1	STUFFING BOX GLAND SP 11049	1
PIN FOR DIAPHRAGM SP 12122	1	GLAND NUT SP 12549	1
DIAPHRAGM PLATE SP 12068	1	TEST PLUG WASHER SP 11051	1
DIAPHRAGMS SP 12073	2	TEST PLUG SP 11046	1
		PISTON SP 12071	1
		LEVER SP 12072	1
		LEVER SCREW SP 12090	1
		LEVER GUIDE SP 12066	1

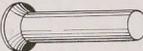
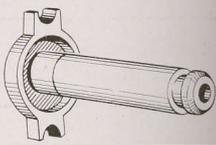
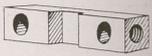
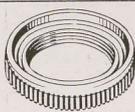
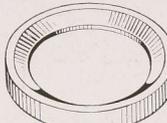
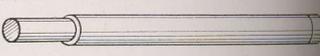
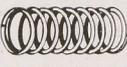
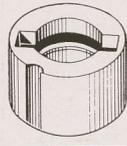
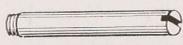
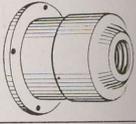
PARTS MARK 13 WAR HEAD MARK 4 MOD. 1 EXPLODER

KEY: SG—STOCK GROUP • SP—STOCK PART

NUMBER OF PIECES			NUMBER OF PIECES	
GUIDE SCREWS SP 120	2		BELL CRANK SP 12085	1
WORM SHAFT SP 12064	1		LOCKING RACK BRACKET SP 12099	1
BALL BEARING SP 11336	1		PIN SP 11532	2
BEARING BRACKET SP 12063	1		BELL CRANK PIN SP 12086	1
BALL BEARING RETAINER SP 12126	1		SPRING SP 12104	1
WORM SP 12065	1		COTTER PIN SP 475	1
TAPER PIN SP 12125	1		STRAP FOR LOCKING RACK SP 12575	1
GLAND NUT WRENCH SP 12569	1		TOP PLATE SP 12092	1
HOLDING SCREW SP 11020	20		3 LONG SCREWS SP 12088	3
SCREW DOWELS SP 12091	2		1 SHORT SCREW SP 11526	1
EXPLODER BASE SP 12079	1		CLUTCH BRACKET SP 21093	1
FINGERS SP 11481	4		SPRING CLUTCH SHAFT SP 12095	1
PINS FOR FINGERS SP 11528	4		SPRING SP 12103	1
STUD POST (LONG) SP 11484	1		PINION SP 12096	1
STUD POSTS (SHORT) SP 12097	3		WORM WHEEL SP 12100	1
LOCKING RACK, PLATE & 2 PINS SG 3647	1		IDLER GEAR SP 11501	1

PARTS MARK 13 WAR HEAD MARK 4 MOD. 1 EXPLODER

KEY: SG—STOCK GROUP • SP—STOCK PART

NUMBER OF PIECES			NUMBER OF PIECES		
1	IDLER SHAFT SP 11502		3	RETAINING LUGS SP 11517	
1	SET SCREW SP 11524		1	SCREWS FOR LUGS SP 11523	
1	PINION GEAR SP 11500		1	FIRING PIN, GUIDE & STEM SP 2007	
1	LOWER DRIVE GEAR SP 11499		1	FIRING SPRING SP 11520	
1	DOWEL PIN SP 12577		1	CAP FOR FIRING PINS SP 11553	
1	ARMING SCREW SP 11489		1	SCREWS FOR FIRING PIN CAP SP 11554	
1	ARMING GEAR SP 11487		1	WORM WHEEL SP 12131	
1	FIRING RING SP 11491		1	VERTICAL SHAFT SP 12136	
1	TRIGGER PLATE SP 11490		1	PIN FOR WORM WHEEL SP 11531	
13	STEEL BALLS SP 4676		1	WORM SP 12101	
1	TRIGGER CAP SPRING SP 11534		1	GEAR SP 12135	
1	TRIGGER CAP SP 11493		1	PIN SP 15626	
1	BRASS FOLLOWER SP 11516		2	DOWEL SP 11536	
1	LOWER BALL RACE SP 16800		1	PUSH ROD SP 12084	
8	SPRING SP 16799		1	SPRING FOR PUSH ROD SP 12102	
8	SCREW PLUG FOR SPRING AND BALL SP 11522		1	LOCK WASHERS FOR SQUARE HEAD SCREWS SP 12123	
28	GUIDE POSTS SP 11521		1	SAFETY CHAMBER SP 50448	
33	BRONZE BALLS SP 3277		1	DETONATOR HOLDER SP 50447	

TOOLS MARK 13 WAR HEAD MARK 4 MOD. 1 EXPLODER

NUMBER OF PIECES		NUMBER OF PIECES	
JOINT SCREW SOCKET WRENCH NO. 49	1	THICKNESS GAUGE WE 2	1
GENERAL USE SCREW DRIVER NO. 39	1	SCREW DRIVER NO. 37	1
GENERAL USE SCREW DRIVER NO. 41	1	HANDLE (FOR SCREW DRIVER NO. 37) NO. 38	1
SPRING CLIP MF-11	1	OPEN END WRENCH NO. 141-A	1
OPEN END WRENCH NO. 64	1	SCREW DRIVER NO. 40	1
COMBINATION PLIERS NO. 72	1	SPRING BALANCE NO. 98	1
LIFTING TOOL MF 2	2	GREASE GUN MF-1	1
		IMPELLER TEST TOOL MF 7	1

