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V. McNAIR
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NEW YORK
NOSTRAND COMPANY
EIGHT WARREN STREET
1920

HANDBOOK

FOR

NAVAL OFFICERS

AN AID TO EXAMINATIONS FOR PROMOTION

BY

FREDERICK V. McNAIR
COMMANDER UNITED STATES NAVY

ILLUSTRATED

NEW YORK
D. VAN NOSTRAND COMPANY
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FOREWORD

THIS book was written by a Naval Officer for Naval Officers, and compiled from the practical service experience both of the author and numerous other officers. Written in the form of descriptions and practical problems with the solutions of their successful accomplishments. No claim is made that these are the *best* methods, or that improvements can not be made in them, but that the situations which frequently face a naval officer have been successfully met by the methods described.

No attempt was made to cover completely the subjects of Seamanship, Navigation, Strategy, Ordnance, and International and Military Law, Steam and Electricity, included in the book. But such subjects as the improved turbine installation in a modern battleship, one of our latest range finders, the Standard radio installation in service use, the handling of heavy weights by purchases and tackles, have been selected with the view of giving the reader a working knowledge of Navy Material under his [illegible] that will prepare an officer for mo[illegible]led study of [illegible] or prepare him for a suitable a[illegible] Examina[illegible]motion to the grades of Ensign [illegible]nt-Com[illegible]

[illegible] is [illegible] this [illegible] be of special value for [illegible] Of[illegible]lifying for permanent appointments, officers of State Reserve organizations (who will make but a short annual cruise), and also officers intending to qualify for commissions with Shipping Board vessels, who must necessarily have some knowledge of International and Military Law.

F. V. McNair,
Commander, U.S.N.

June, 1920.

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HANDBOOK FOR NAVAL OFFICERS

SEAMANSHIP

ANCHORING AND MOORING

Anchoring a ship consists in securing her in a fixed position in open water by a single anchor, said position usually determined by two bearings to place her in exact berth as assigned by fleet or squadron anchorage plan. Ordinarily, in anchoring, a ship uses five times the length of chain as there is depth of water.

Mooring a ship secures her in assigned berth in open water by the use of two anchors—ship being middled between the anchors, usually with 45–60 fathoms on each chain so that she is held with her bow approximately stationary on the line between them. The term further defines securing the ship to dock or pier by lines and chains, which is Navy Yard practice; and describes also making ship fast to buoy, either at the bow alone, or, to buoys ahead and astern, which is common practice in most European ports owing to limited harbor space.

In mooring in open water with two anchors, a straight moor consists in stopping ship dead in water, dropping first anchor under foot and backing engines, veering chain as the anchor will take it until double the amount of chain of the intended mooring length is out, when the second anchor is dropped, whereupon the ship is given headway, heaving in on the first chain and veering on the second until ship is middled between the two anchors. The *second* method of mooring in open water is known as the "flying moor," and is preferred, as being more expeditious and "smarter." In this maneuver the ship stands up to anchorage at reduced speed, dropping first anchor just before arriving at berth, veering chain roundly, and, after passing upstream of berth, dropping second anchor, upon which the ship is given sternboard to assigned berth. While going astern, heave in on first chain and veer on second anchor chain until ship is middled in proper position. Care must be taken in handling engines not to put excessive strain on anchor chains or to break the anchor out of the bottom. In case of chain tending across the stem, use of engines and rudder relieves the strain of the nip in the chain. (Points to be watched are vessel's speed, handling engines, not snubbing too soon or too violently, and that you have sufficient boiler power " up your sleeve " to back **hard** if necessary.)

A vessel moored will head in any direction, swinging about her own stem as a pivot.

The advantages of mooring are that a vessel takes up little space in swinging and that she cannot foul her anchors by dragging the bight of the chain over them.

The disadvantages of mooring are that a vessel must often ride to an open span if gale comes up from any direction athwart the line of anchors, in which case the tension on the cables will be out of proportion to that utilized in holding the ship. If vessel moors without putting on mooring swivel, trouble from foul hawse results.

MOORING GEAR

A mooring swivel is larger and heavier than the ordinary swivel with two links and shackles attached to **each** of its parts (4 links and 4 shackles). Shackled upon chain cables just forward of stem so that the parts or cables leading from hawse pipes are connected to inner shackles and parts leading to anchors are secured to outer shackles. As ship swings, swivel keeps chain clear. Mooring swivel is always put on cup up (rounded part to hawse pipe), so that oil will stay in swivel cup.

Mooring swivel may be put on **outside** the hawse (hawse pipe not large enough to take swivel) or **inside** the hawse on deck (ships have large enough hawse pipe to take swivel and several parts of chain). Naturally the latter is more convenient.

In unshackling and shifting chain cables for any purpose such as putting on mooring swivel or clearing a foul hawse, the following gear is used:

1. **Clear hawse pendant**=Six fathoms open link chain of metal one-half the diameter of cable with which it is to be used. Outer end of this chain fitted with slip or pelican hook; inner end fitted with shackle and thimble to which is spliced a tail of wire rope 30 fathoms long.

2. **Dip rope**=Six fathoms open link chain not exceeding one-inch diameter. Outer end fitted with enlarged link and sister hooks; inner end fitted with enlarged link and thimble to which is spliced 30 fathoms of flexible wire rope of circumference three times diameter of chain to which it is tailed.

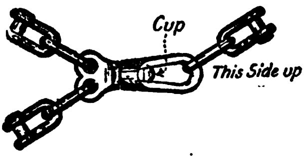
3. **Preventer hawser**=Manila line or 4″ wire line above or below slip hook of clear hawse pendant to prevent loss of cable in case of clear hawse pendant parting.

4. **Hook rope**=4″ manila for easing out cable, when it is unshackled.

5. Deck tackles, purchases, chain hooks, straps, unshackling tools, bitts, and controller, used as required.

If swivel cannot be put on either cable inside, wait until nearly slack water, and put on lee cable first as follows: Veer shackle outside, secure cable by clear hawse pendant over the bow, lower mooring swivel over bow to men on stage or in boat. Unshackle lee chain and put on mooring swivel. When ship swings to tide, this old lee chain becomes riding chain. The new lee cable is then secured below shackle by clear hawse pendant and preventer hawser. Cable unshackled and end leading from anchor shackled to mooring swivel by men working in boat as before. Lead dip rope around from **sheet** hawse pipe of new riding (weather) side and hook to link of ship end of disconnected lee cable, haul around bow, and shackle to inboard end of mooring swivel. Secure.

If hawse pipe is big enough to take shackle and chains, heave in on riding (weather) cable, secure cable by controller forward of shackle, also using deck stoppers. Unshackle riding cable and put mooring swivel in place. Put clear hawse pendant on lee cable and heave taut. Also place preventer hawser on lee cable. Pass dip rope out through riding hawse pipe, bring in lee hawse pipe, and make fast to lee cable just forward of shackle. Unshackle lee chain inside of hawse pipe, ease out lee chain with hook rope and haul around to riding side by dip rope. Shackle lee chain to forward end of mooring swivel. Veer riding chain until swivel is outside hawse pipe.



Sketch a mooring swivel, tell where used and which end is up.

Cup end is always up, or pointing toward ship, hence away from anchor, to maintain oil in cup for swivel.

How anchor a ship in 30 fathoms of water? How is bower chain secured when lying to single anchor?

To drop an anchor from billboard in 30 fathoms would probably mean a lost chain, therefore, connect up wildcat with shaft then walk back anchor engine until anchor is on, or nearly on, the bottom. Disconnect and set up brake. Have slight headway on ship then veer to prescribed scope, being careful not to veer chain on top of the anchor. Chain is secured by passing deck stoppers, slacking friction brake so that deck stoppers catch all the strain, then set up on brake again.

MARTIN'S MOORING BOARD

Martin's mooring and maneuvering board is a blank form of any convenient size for use on bridge in graphically solving quickly an anchorage.

It may be made on a sheet of paper or card board and consists of ten equidistant concentric circles, the outer one of which is graduated in both quarter points and degrees. Distances between circles may be taken as any desired unit such as 100 yards, one mile, etc. Radial lines are drawn from center to each compass point. Board is 20 inches square divided into 100 squares by tangents to every second circle. Sides of squares are double the distance between circles.

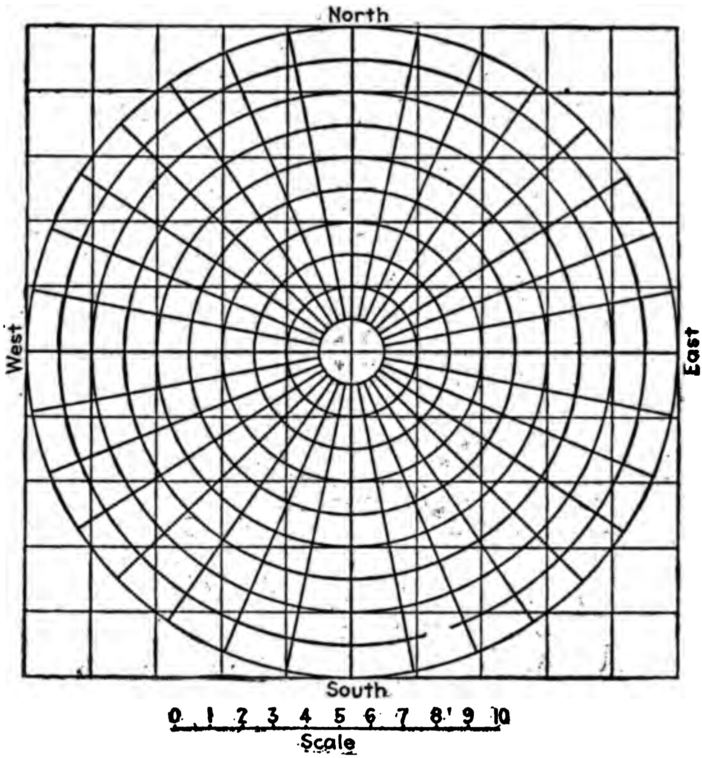
If the board is so constructed that the circular part will revolve, leaving the outer part of the blank form fixed, it is then known as a tactical board.

As this board is a marked blank chart, it is excellent for rapid plotting in anchoring on a ship already anchored (in center of board) or in a vessel assuming a new position on flag with fleet under way.

Diagram is particularly useful in laying out buoys where accurate position is required.

It is usual to signal bearings and distances of anchors as being taken from the foremast of the vessel at anchor

Fifty yards is allowed as distance from stem to foremast.



Mooring to a buoy means to secure to a buoy with bower chain and shackle, same having been unshackled previously from anchor; but as a matter of convenience, the ship secures first temporarily with heavy wire and shackle after which plenty of time is available to secure with chain which is unwieldy to handle with strong tide running.

The custom of establishing permanent mooring buoys for light cruisers and destroyers, which obtains in European ports, is now being adopted in our own ports, as exampled at Charleston and New Orleans. Such practice is even more mandatory in United States ports than abroad, owing to strong tides and heavy ice in winter in most of our Atlantic ports. Irrespective of the fact that light cruisers and destroyers were never intended to anchor in open roadsteads or exposed anchorages for long periods due to the fact that such anchorages submit these vessels to dragging with consequent shifting of berths, thereby effecting unnecessary wear and tear on the ground tackle and broken rest for the personnel. The advantages are evident —in that such moorings utilize all the limited space of a harbor; secure not only the safety of the ship but also that of neighbor shipping; and insures ships of a class being grouped together for administrative purposes and adjacent to a common landing place for stores and liberty parties.

Ground tackle comprises all the gear pertaining to the handling of anchors and chains, and, in some classes of ships, the hoisting in of boats; such gear includes—clear hawse outfit, shackles, swivels, devil's claw (for helping a refractory shackle over the wildcat), tackles, purchases, stoppers, slip hooks, chain hooks, anchor davits with falls, controller, etc.

Bringing Ship to Anchor.—When standing into port, have sea lashings removed from both bower anchors and same ready for letting go before entering the channel, notifying the officer of the fo'c'sle which anchor will probably be used first. Call all hands by bugle or use the watch on deck, calling the latter by word thru bosun's mate of watch.

The order for letting go is always preceded by, " Stand clear of starboard (port) chain," and sometimes by, " Stream the buoy," meaning to throw over the marker buoy of the anchor. Anchors are buoyed to show their location; buoy rope being made fast to the crown of the anchor. These buoys—green for starboard and red for port—are said to " Watch the anchor," so that if anchor chain parts, the anchor may be relocated and recovered. Any buoy is said to " Watch " when it floats on the surface of the water, but frequently in a strong tideway the buoy tows under and does not watch. " Bleed the buoy " means to drain a metal buoy which no longer watches from lack of positive buoyancy as a result of leaky seams.

When anchorage is reached, by cutting in on cross bearings, order: "**Let go starboard (port) anchor.**"

The officer in charge should be previously informed of the amount of chain to be veered, as "45-fathom shackle at the water's edge" or "60-fathom shackle at the hawse pipe,"—depth of water obtainable from chart prior to arrival at anchorage. Report is then received from the officer in charge of fo'c'sle that chain has been secured with stoppers, controller, brake, or method used, after which "**pipe down**" may be sounded, engines secured, steering gear secured, and the decks cleared up. As the anchor hits the water, a short blast is sounded on the whistle and the ensign and jack are mast-headed; simultaneously, the boatbooms go out and the gangways down, likewise the captain's speed boat is lowered on one side and a ship's power boat is lowered on the other. No one leaves the ship before the captain, who, if he has no official visit to pay, signifies such to be the case, and the mail orderly is immediately sent ashore or to flagship for mail. Anyone leaving the ship presupposes the fact that pratique has been obtained from quarantine, if required, and that the customs regulations have been fulfilled.

Getting Underway.—Preliminaries are the reverse of coming to anchor. In addition the regulations require that prior to commencing a voyage, the crew shall be drilled at fire, collision, and abandon ship quarters. On departure from base or home yard, three months' dry and ten days' fresh provisions are usually laid in, and all heads of departments assure themselves that their departments have a sufficient supply of spares and expendable stores on hand.

When the order is received from the Captain or Executive, the order is passed "**all hands up anchor.**" The Executive Officer takes the deck and orders "**heave round**" when signal of execution is made from the flagship. As the chain comes in the following reports are made to the bridge from the fo'c'sle:

"**Short stay, sir,**" made just before chain becomes perpendicular;

"**Up and down, sir,**" made when chain is perpendicular;

"**Anchor's away, sir,**" when movement of chain shows anchor to have broken ground;

"**Anchor's in sight, sir,**" when anchor ring breaks surface;

"**Clear anchor, sir,**" when anchor shows above water and there are no turns of chain around shank or stock.

The anchor davit fall is then hooked in the balance link of the anchor by sending a man over the side with a bowline around him and the anchor landed on the billboard, "**surging**" sufficient chain to allow the anchor fall to take charge. In a housing anchor the shank is hauled up snug in the hawse pipe, and, in both cases the anchor is got ready for letting go and the fact so reported. Immediately after getting underway, a muster is made to account for any absentees. Both anchors are kept ready for letting go until clear of the port or channel after which they are secured for sea. This latter must be done promptly as a heavy ground swell may be encountered outside which is dangerous to men working on the fo'c'sle.

"**Tend of Chain.**"—A chain is said to tend or grow in a certain direction when it points or leads from the hawse pipe in that direction, which is reported to the bridge in degrees relative to the keel, either by word of mouth or by holding the arm out in the direction that the chain tends. The amount of chain out may be reported by holding up tin disks appropriately marked. In heaving in engines and rudder should be maneuvered to assist capstan and anchor engine to bring chain home.

"**Backing an Anchor.**"—When the holding ground is poor, an anchor may be backed by another, which is accomplished by taking several turns around the riding chain with the chain of the anchor it is intended to let go, then veering on riding chain and letting go second anchor so that chain of second anchor will slip down along riding chain. A quick and usually effective method of checking dragging is to veer easily on riding chain, then to drop a second anchor under foot.

"**Ready for Letting Go.**"—An anchor is ready for letting go when, (1) Housed in hawse pipe, or (2) with a billboard anchor, when the wildcat is unlocked from shaft and controller free; brakeband on.

"**Let Go.**"—When the order is given, ease up on brakeband until the weight of the anchor causes the chain to veer to required scope, snubbing the chain slowly by means of the brake. Never allow excessive strain on chain. If anchor is on billboard, trip releasing bar with brake slack and snub as desired by brake pressure. In deep water, lift anchor clear of billboard with anchor davit, then walk back falls until anchor hangs under foot, from which position anchor may be eased to bottom by brake—letting an anchor go by the run in deep water will result in a lost anchor and chain.

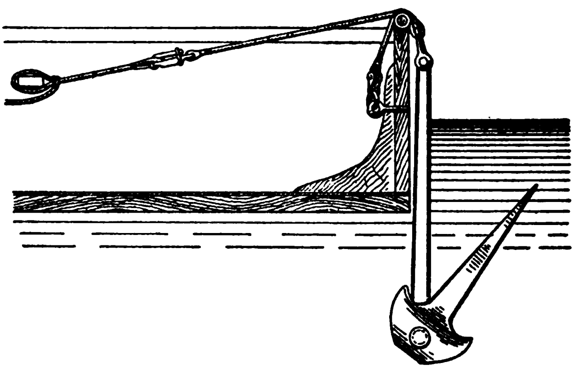
"**Secure Chain.**"—After veering chain to desired scope, heave taut on brakeband (wildcat still unlocked) and pass deck and slip stoppers after which brake may be released, allowing riding strain to be taken up by stoppers. Secure anchor engine.

"**Veer Chain (Emergency).**"—See chain locker clear. Cast off deck and slip stoppers and set up on brake if chain pays out too rapidly. If time permits, veer easily, as surging chain roundly and bringing her to all standing will probably break the anchor out.

"**Heave Round.**"—Preparatory to heaving in, steam is put on anchor engine, chain-tierers in chain lockers, set up on brakeband, take off all stoppers, lock wildcat with shaft, then release brake, see controller block down (if one is used), and have deck hose ready for washing chain as it comes in. At the order, start capstan and as chain comes in have blacksmith test each link with hammer. In case shackle refuses to pass wildcat, use devil's claw on link forward of wildcat and carry tail line to drum of winch, thereby assisting wildcat.

Show clearly, by sketch, how to hang a kedge anchor over the stern of a boat by means of a strap and toggle.

Sketch shows standing part of anchor strap secured to ring bolt or hoisting in links of motor sailer.



Releasing part of strap with slip hook and shackle may be of wire or 3-inch manila. Other end from slip hook may be secured to eye bolt in boat or turns taken in tandem around two or three thwarts—kedge assumed to be 600–700 pounds.

In connection with carrying out anchors, state what each end of the following named pieces of gear is made fast to, and give the use of each: (1) Buoy Rope, (2) Hauling line, (3) Weighing line, (4) Belly strap.

Buoy Rope.—One end fast to weighing line, and one end fast to buoy. Used to hold the buoy and for recovering the weighing line.

2. **Hauling Line.**—One end fast to ring of anchor and one end fast to winch or capstan on ship. Used to haul the ship toward the anchor.

3. **Weighing Line.**—One end fast to crown of anchor, one end fast to buoy rope. Used for weighing the anchor.

4. **Belly Strap.**—Ends fastened together after passing around boat. Used for hanging the anchor to, under the boat.

How is a modern anchor of the housing type stowed and secured for sea?

Shank stows inside hawse pipe with flukes flat against ship side, well above water line. Secured by slip stopper, friction brake, and extra deck stopper.

How let go and how is chain secured when riding at single anchor?

Having removed deck stopper, let go by knocking clear link of slip stopper, or, take off all stoppers and let go by using friction brake. Ride with wildcat unlocked, friction brake on and lashed, and deck stoppers secured.

Describe the make-up and marking of a chain cable for a battleship.

1. Bending shackle.
2. 5-fathom shot ⅛ inch larger than cable with swivel near end.
3. 40-fathom shot with shackle.
4. Successive 15-fathom shots, each with shackle to bring cable to 150-180 fathoms length.

Marked at:

15 fathoms with 1 white link.

30 fathoms with 2 white links.

45 fathoms with third studded link each side of shackle painted white with three turns wire around stud.

60 fathoms with fourth studded link each side shackle painted white with four turns wire around stud.

75 fathoms with fifth studded link painted white with five turns wire around studs.

Where is chain cable stowed and how is bitterend made fast? How is cable stowed when heaving in?

Chain is tiered or faked down as it comes into compartments below berth deck, the chain running from one end of the compartment to the other. This work is done by men detailed as chain tierers, using chain hooks, hook ropes, and tackles. The bitterend or inboard end of the chain is secured to a heavy ring bolt in the bulkhead by a slip hook. Modern battleships have deep, narrow chain lockers, which prevent kinking of chain hence do away with the necessity of chain tierers.

Describe how to handle ship and chain in making a flying moor, 45 fathoms on each chain, up to the time of putting on mooring swivel.

Reduce speed to 5 knots. Let go first anchor, then back engines with two-thirds power. Don't snub chain with brakeband until 45 fathoms have been veered. Regulate engines to check headway when 90 fathoms are out, so as to bring her up with moderately taut chain. Let go second anchor. Back both engines strongly enough to prevent ship being caught athwart the current. Veer roundly on second anchor chain and heave in on first chain until both 45-fathom shackles are inside the hawse pipes ready for putting on mooring swivel.

Discuss mooring a battleship to a dock.

Lines, etc., used for mooring a ship to a dock.

The following terms are used in the Service on board ship in referring to lines holding a vessel alongside a dock:

Bow-line	Bow fast,	Bow springs,	Spring fasts.
Stern-line,	Stern fast,	Quarter springs,	Breast fasts.

On some ships springs and breast are referred to by numbers, as 1, 2, 3 and 4 springs or breasts.

The correct terms are:

Forward springs, lead forward.

After springs, lead aft.

Breast lines, lead at right angles to the keel line of the ship.

After forecastle springs and **after quarterdeck springs** lead aft, and check the ship when going ahead, and hold her in place.

Forward forecastle springs and **forward quarterdeck springs** lead forward, and check the ship when going aft, and hold her in place.

Forward breasts and **after breasts** are used to haul the ship broadside to the dock and hold her there.

The ends of hawsers are made fast on the dock to **bollards, piles, ring bolts,** or **cleats.**

Hawsers are secured on board ship to **bitts** and lead through **chocks** to give them a fair lead.

Bow-lines; may be wire, manila, or chain, lead through the bow towing chock or through the warping chock on the forecastle and made fast to piles or bollards on the dock well ahead of the ship, used to haul the ship ahead and hold her there.

Stern-line; may be wire, manila, or chain, lead through stern towing chock or quarter chock on the quarterdeck, lead well aft on the dock and made fast to piles or bollards, used to haul the ship aft, and hold her there.

Forward forecastle spring; lead through chock anywhere on the forecastle between bridge and stem, leads forward, checks ship when going astern and holds her in place.

After forecastle spring; lead through chock anywhere on the forecastle between the stem and bridge, leads aft, checks ship when going ahead and holds her in place.

Forward quarterdeck spring; through any chock on the quarterdeck between the after turret and stern, leads forward, checks ship when going astern, and holds her in place.

After quarterdeck spring; through any chock on the quarterdeck between the stern and after turret, leads aft, checks ship when going ahead, and holds her in place.

Forward breast; through any chock on the forecastle between bow and bridge, lead at right angles to the keel line of the ship.

After breast; through any chock on the quarterdeck between the after turret and stern, lead at right angles to the ship's keel line, both breasts are used to haul the ship broadside to the dock and hold her in place.

If a large battleship moored to a dock should have breasts and springs out between forecastle and quarterdeck, they would be called: **Forward waist breast, after waist breast, forward waist spring** and **after waist spring.**

Spur shores; to hold a ship clear of a dock, they are wooden spars, from 30 to 50 feet in length with a mean diameter of about 20 inches, fitted at one end (the inner or shore end) with **trucks,** and a **half chock** (for the **heel chain**) and **ring bolts** and at the outer or ship end with three ring bolts for the lashing to secure it to the ship's side.

Spur shore shoes; made of planks from three to four inches thick and 2½ to 3½ feet square, hollowed a little on one side in which rests the outer end of the **spur shore**, and fitted with ring bolts to lash it to the ship's side with.

Thrum mat; to protect the ship's side, placed between the **spur shore shoe** and ship's side. (NOTE: In unarmored ships be careful to place the spur shore shoe on the ship's side where a frame will take up the pressure of the spur shore, otherwise the plates may be crushed in).

Spur shore heel chains; made fast to **bollards** or **cleats** on the dock, on each side of the spur shore, the bight is placed in the **half chock** at the heel of the spur shore, they keep the spur shore in place after the ship is shoved off as far as desired from the dock.

Camels; are rectangular floats built of wood, anywhere in size from 20×10×2 ft., to 40×20×4 ft., are usually fitted with hemp or manila puddings or dolphins at the corners, the camels float between the ship and the dock, rising and falling with the tide; and take the place of **spur shores**, in keeping the ship clear of the dock.

Floating spars; are used in some Navy Yards in the same manner as **camels**. (Spars are good only for vessels of the auxiliary class which have no projections about the side.)

Brow; are portable wooden bridges hoisted on board from the dock; communication is had with the shore and the ship over the **brow**, they are from 20 to 60 feet in length and from 4 to 8 feet wide, fitted with trucks at both ends and in the middle.

Chocks; are made of metal and fitted to the ship's rail or over the water ways, to give a fair lead to hawsers. (Chocks have horns, a base, and are secured with bolts that run through them.)

Bitts; on board ship are made of metal, to them hawsers are secured when laying alongside of a dock.

Bollards; are upright wooden or iron posts on the dock to which a vessel's lines are secured to when alongside a dock. (Some docks are fitted with **cleats** and **ring bolts**, an old smooth bore gun sunk in a dock with the muzzle half up is called a bollard.)

Cleats; of iron, are fitted on board ship, and on docks for securing lines to. (Cleats have horns, a base and bolts are run through them to secure with.)

Ring bolts; to make a mooring hawser fast to a ring bolt, put chafing gear on the end of the line, take a round turn and two half hitches. To double the mooring at a ring bolt, shove the bight of the line through the ring and shove a toggle through the bight.

Mooring staples; large iron staples fitted to the ship's side, about four or five feet above the water line; mooring chains found at most Navy Yard docks are rove through them and sometimes take the place of the manila springs and breasts which are taken in and reeled up, to protect them from the weather and chafe.

Piles; large spars, driven into the bottom of a river or bay, at the corners of docks; ship's mooring hawsers are made fast to them.

High tide; moor taut, have all lines taut (with low dock).

Low tide; moor slack, and allow for the rise of the tide.

Bow towing chock; largest pair of chocks over the stem in the bows, on the forecastle.

After or stern **towing chock**; two large round chocks over the stern on the quarterdeck.

Hawsers; that lead down to a dock at an acute angle to a bollard or pile without a **norman,** should be secured with one-half round turn and two half hitches, otherwise when the strain comes on the hawser, the end would slip off, as would be the case with a bowline or an eye in the end of the hawser.

18,000- TO 32,000-TON BATTLESHIP

Going into Port. Getting Ready to go Alongside of a Dock

On the forecastle, faked down clear for running:

1 Bow line, 9-in. manila or 5-in. wire hawser.
1 Spring, 6- or 7-in. manila hawser. (The two ends become the fore and after forecastle springs.)
1 Breast, 5- or 6-in. manila hawser.
6 Heaving lines.
4 Cork fenders.

On the quarterdeck, faked down clear for running:

1 8-in. manila or 2 4½-in. wire hawser, for stern line.
1 Spring, 7-in. manila hawser. (The two ends become the **fore and** after quarterdeck springs.)
1 Breast, 5- or 6-in. manila hawser.
6 Heaving lines.
4 Cork fenders. Four cork fenders **are also** kept handy on the super-structure or in the waist, in case they should be required amidships.

See that all is clear on the side going towards the dock.

After the ship is placed alongside the dock, and temporarily made fast with her manila lines, the **brows** are gotten on board and secured, the bow and stern lines are replaced by wire hawsers (unless they were used in the first place) and all **springs** and **breasts** are doubled up, and chafing gear placed around the lines in wake of all chocks, string pieces, and other places where they are liable to become chafed. If there are plenty of good mooring chains on the dock, they are rove off through the **mooring staples**, or taken up through the **chocks** on the rail and secured to the **bitts**, using **hook ropes** to get them through the **mooring staples** or on deck, being careful to have **check hook ropes** on the chains when hauling them through the staples or on board, otherwise they might take charge and run overboard or hurt someone (the mooring chains through the forward mooring staples are called the forward fore-castle **spring chain, after forecastle spring chain and forward breast chain,** the names are the same if they are taken on the deck. The chains through the after mooring staple are called the **forward quarterdeck spring chain, after quarterdeck spring chain, and after breast chain**).

Mats are then slung on the side where the **spur shores** are to rest against the **spur shore shoes,** and on the mats the **spur shore shoes** are secured, the outer end of the spur shores are then hauled up and placed in the **score** of the shoes and secured, the **spur shore heel chains** are then taken around the heel and placed in the half chock on top of the spur shore; the ends of the chains hauled **taut** with tackles, and when the ship is as far from the dock as desired the heel chains are secured either to **cleats, bollards, ring bolts,**

on the string pieces, or in some cases taken over the string pieces and secured to the under piling of the dock.

In case spur shores are not provided, **camels** are floated (two or three) between the ship and the dock, to keep the ship clear of the dock.

At all Navy Yards **tugs** bring the ship close enough to the dock to allow of throwing the heaving lines to the men stationed on the dock to receive the lines, they then haul the lines onto the dock and belay the ends to the **bollards, cleats,** or **piles.**

If there are no tugs available, boats are lowered, and the lines run to the dock, and the ends secured to the bollard sor piles.

Making Preparations to Leave the Dock

All lines are **singled, spring** and **breast chains,** unbent and hauled on the dock, where they are neatly **faked down** alongside the bollards, **spur shores** and **brows** are hauled ashore and laid in line with the string pieces, or fore and aft with the ship well clear from the ends of the dock, **fenders** are gotten ready for use fore and aft for the tugs, and to fend off on the side toward the dock where needed.

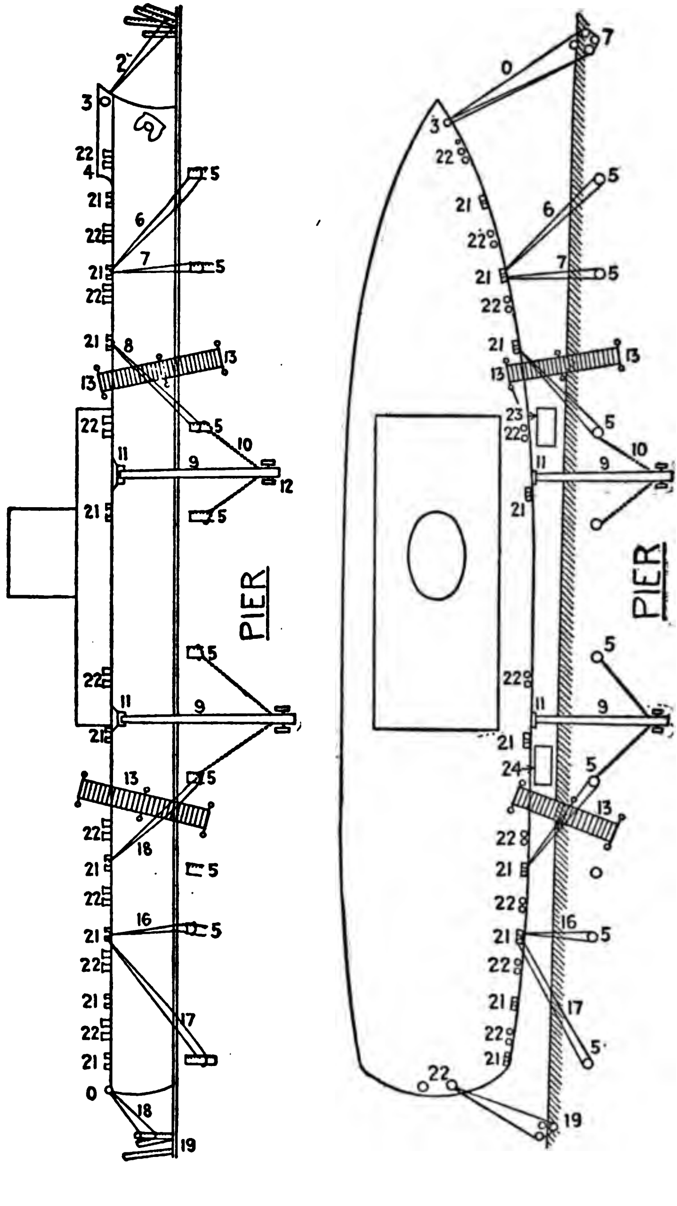
When clear of the dock all hawsers that are wet must be dried before reeling them up. (Never allow a hawser, manila or wire to be **stowed away** wet.)

An O. O. D. being relieved, would say to his relief: " The ship is secured to No. 2 dock with **forecastle** and **quarterdeck fore** and **aft spring** and **breast chains** rove through the **mooring staples** on the ship's side, a 5-inch wire **bow line** three parts, a 4½-inch **wire stern** line four parts, and has two **spur shores** to keep her away from the dock, and the forward and after brows are on board." (Or.)

" The ship is secured at No. 5 dock with a 5-inch wire **bow line,** an 8-inch manila forecastle fore and aft spring and breast, a 7-inch manila fore and **aft quarterdeck spring** and 6-inch manila **after breast,** well parcelled at the **chocks** and on the dock, a wire 4½-inch stern line, and has two **camels** alongside to keep her off, and two brows aboard."

TERMS USED WHEN MOORED OR MOORING TO A DOCK

After spring.
After breast.
Astern.
Bitts.
Bitt.
Base.
Bollard.
Brow.
Breasts.
Bow-line.
Bow.
Bowline.
Brow trucks.
Belay.
Bight of hawser.
Breast chains.
Chafing gear.
Check.
Cleat.
Chock.
Chains.
Camel.
Check hook rope.
Cork fenders.
Dock.
Double a line.
Doubled, the lines are.
Dolphin.
Eye, in hawser.
Fairlead.
Floating spars.
Fenders.
Fend off.
Faked down.
Forward springs.
Forward breasts.
Gear.
Hawsers.
Haul.
Heave.
Horns, of cleats and chocks.
Heel chain.
Hove.
Heaving lines.
Hook rope.
Lashed.
Lashing.
Low tide.
Mooring staples.
Moored.
Mooring.
Mooring chains.
Manila lines.
Manila hawsers.
Moor slack.
Moor taut.
Mat.
Norman.
Parcel.
Puddings.
Quarter chock.
Quarterdeck springs.
Quarterdeck bitts.
Round turn.
Ring bolt.
Rove.
Reel up.
Reeled up.
Singled.
String piece.
Spring chain.
Spur shore.
Shoe.
Stern chock.
Springs.
Stern lines.
Spur shore trucks.
Secure.
Stern.
Slack.
Stem.
Spars.
Stow away.
Staples, mooring.
Towing chock.
Toggle.
Trucks, spur shore and brow.
Tide.
Taut.
Thrum mat.
Veer.
Wire hawsers.
Warp, ahead and astern.
Warping ship.
Warped around.
Wind.
Waist springs.
Waist breasts.


PIER
PIER

Battleship moored at a dock.

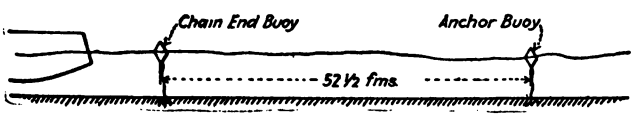
1. Piles.
2. Bow-line.
3. Bow, or towing chock.
4. Warping chock.
5. Bollards.
6. Forward forecastle spring.
7. Forward breast.
8. After forecastle spring.
9. Spur shore.
10. Spur shore heel chains.
11. Spur shore shoe, mat is placed between shoe and side.
12. Spur shore trucks.
13. Gangways or Brows.
14. Brow trucks.
15. Forward quarterdeck spring.
16. After breast.
17. After quarterdeck spring.
18. Stern line.
19. Piles.
20. Stern, or towing chocks.
21. Chocks.
22. Bitts.
23. Forward camel.
24. After camel.

NOTE.—Forward springs lead forward: after springs lead aft; breasts lead broadside to the ship.

Executive of the "Florida" moored in Hampton Roads, 10 fathoms water. Chain parts at 15 fathoms in heaving in. What do? How recover? Tide slack and you are alone?

Send down diver (Seaman Gunner) with 4-inch manila line. Bend on line and heave in on deck winch till end of chain is in sight. Shackle to parted chain, heave in, and by anchor davit bring up on deck.

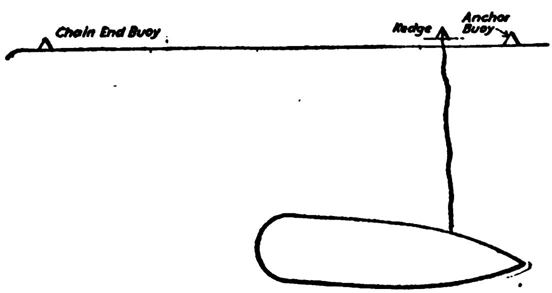
Another method with longer length of chain lost is:



In the autumn of 1911 the "Michigan" lost port anchor and 52½ fathoms chain in 22 fathoms water (too deep for a diver). The anchor buoy watched the position of the anchor; another buoy was immediately dropped and marked the position of the end of parted chain thus:

A kedge anchor was adopted as a grapnel, a long spar being lashed to the stock to ensure keeping the fluke down by preventing the kedge from tumbling during dragging. A 10-inch hawser was used as a dragging line.

The ship was maneuvered so as to place her stem properly for dragging the kedge over the line marked by the buoys.



The kedge was carried out over the stern of a cutter and let go beyond the range marked by the buoys. By heaving in on the hawser the chain was grappled by the kedge, and its bight hove up to the port hawser pipe, the end recovered and shackled, and the port bower hove up. One of the reasons why this anchor was recovered was because the length of lost chain was more than twice the depth of water.

BLOCKS, TACKLES, SHEERS, AND ROPE

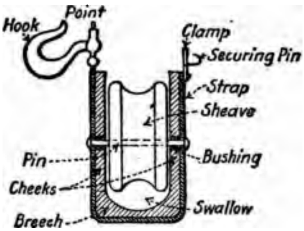
A block is a pulley or wheel enclosed in a case or shell made up of several parts and is used to pass a rope through for the appliance of power. Blocks are of wood or metal and are designated by their number of pulleys or sheaves, such as single block, double block, or treble block. They are also designated by diameter from top or head to bottom or breech, such as a 10-inch single block. The casing or shell of the block is made of two cheeks or side pieces, a breech at bottom, and head at top. The sheave is supported by a metal pin, which rests in bushings in the cheeks, and are in some cases supplied with ball bearings. Bearings in patent blocks greatly reduce loss of power by friction which in common blocks is usually 10 per cent. The space through which the rope passes between breech and sheave is known as the swallow. Blocks commonly used in service at present are (1) Snatch blocks which are single blocks with head and iron strap cut away, so as to be opened and closed by means of an iron clamp, thus allowing the bight of a rope to be "snatched."

The weakest part of a block is the swivel hook at head of block, which will give way first under heavy strain and for that reason is "moused" with wire or rope seizing from point of hook to back. "Mousing" also prevents hook of block jumping clear of deck bolt when tackle jumps or surges.

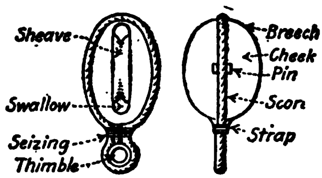
A **tackle** is a device for multiplying lifting or hauling power applied and consists of several blocks assembled with a rope or ropes. Usually one end of a rope is secured to one block and passes through the sheave of a second block and so on in succession reeves thru as many sheaves as there are in the block or blocks, leading from the last sheave as the hauling part to which power is applied. For each sheave there is a loss of 10 per cent of power owing to friction. One block of the tackle is secured to beam, bulkhead, or deck bolt, and is known as the fixed block, while the other, hooked on to the weight is known as the movable block. It is the movable block which supplies the increase in power, which is multiplied as many times as there are parts of rope at the movable block.

A pair of **sheers** consists of two spars or booms lashed together strongly at one end after the spars are laid side by side. The lashed ends, known as sheer head, are raised by means of guy ropes, and in doing so the free ends of the spars or sheer legs are spread apart and stepped in wooden rests called shoes or slippers, which prevent the heels of the sheer legs from slipping. Sheers are used for lifting very heavy weights, the threefold or fourfold purchase being secured at the sheer head lashing.

Sketch a block and name all parts; when is a snatch block used? Sketch a rope-strapped block.

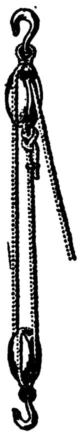


Snatch Block, Iron Strapped.

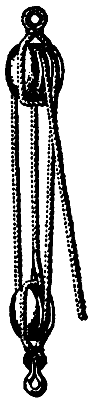


Rope. Strapped Block.

A snatch block is always a single block and has an iron strap across the breech, which may be opened by a releasing clamp, which permits snatching the bight of the hauling part of a line, thus saving the reeving of the end through the swallow and hauling the entire length of line through the swallow to take in slack of hauling part. Snatch blocks are used to give boat falls or hauling part of whips a fair lead.



Gun Tackle.

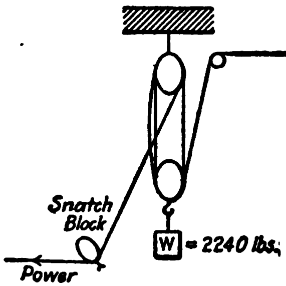


Luff Tackle.

Make line sketches of the following tackles and give the relation of power to weight, allowing for friction, when used to best advantage: (1) *Gun tackle purchase,* (2) *Luff tackle.*

Gun tackle. Hauling part from moving block $\frac{P}{W}=\frac{12}{30}$. Luff tackle hauling part from moving block $\frac{P}{W}=\frac{13}{40}$.

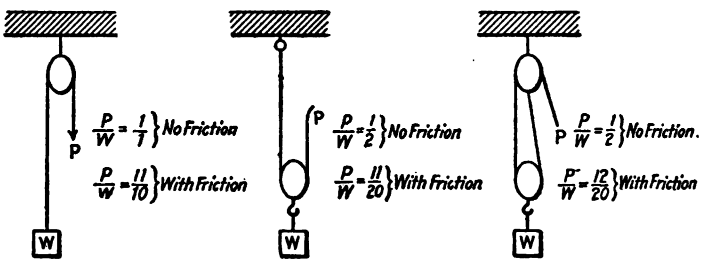
How many men, each pulling 75 pounds, would it take to hoist a 2-ton Navy life boat using a snatch block on each hauling part for a fair lead?



For one end of boat $\frac{P}{W}=\frac{15}{40}$ or $\frac{P}{2240}=\frac{15}{40}$ $P=840$ pounds. For both ends of the boat $P=1680$. Number of men equals $\frac{1680}{75}$. Number of men equals 22.4 or 23 men.

Five sheaves = 50 per cent added weight for friction 2240 + 1120 = 3360 lbs. total weight. W divided into 4 parts $=\frac{3360}{4}=840$. Each man pulls 75 pounds $=\frac{840}{75}=11.2$ men or 22.4 men for both ends. Total = 23 men #.

Sketch the following tackles, state in each case for what used and the relation of power to weight, including friction: (a) single whip, (b) runner, (c) gun tackle.



a. Single Whip. b. Runner. c. Gun Tackle.

Find the weight that may be lifted by a 7-inch manila line rove as a threefold purchase, the hauling part leading from the upper block through a snatch block on deck. What is the effect of applying a load suddenly on a rope?

$$L = \frac{C^2}{15}\text{tons} = \frac{49}{15} = 3.27 \text{ tons}$$

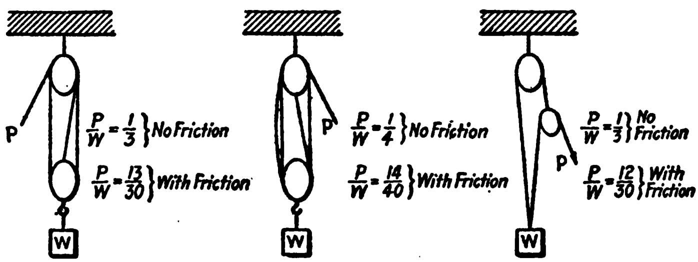
$$\underline{6} \text{ parts at movable block.}$$

$$19.62 \text{ tons} = \text{total } W \text{ including friction.}$$

$$\therefore \ 7 \text{ sheaves } \frac{10}{17} \times 19.62 = 11.54 \text{ tons \# actual } W \text{ lifted.}$$

Load is doubled by sudden application.

Sketch the following tackles, state in each case for what used and the relation of power to weight, including friction: (a) luff, (b) twofold purchase, (c) Spanish burton.



Luff. Twofold. Spanish Burton.

Find the safe load for a 5-inch wire line.

$$L = \frac{C^2}{2.5} = \frac{25}{2.5} = 10 \text{ tons \#.}$$

What is the object of mousing the hook?

Increases strength of hook, which is necessary, as most accidents occur at the hook of a fall or purchase through the hook straightening out, and also prevents the strap or shackle jumping out of the hook, when the fall or purchase jumps, which is caused by hauling end slipping on the winch.

Required to hoist 14-inch shell weighing 1375 pounds from handling room using a luff tackle. What size manila rope will be required for the tackle?

C = circumference-inches.

L = safe load-pounds.

Luff tackle—hauling part from upper block 3 sheaves—friction 30 per cent.

∴ dead weight = 1375 + 412.5 = 1787.5 pounds.

$\frac{P}{W}=\frac{1}{3}$. ∴ maximum tension $=\frac{1787.5}{3}=595.83$ pounds.

$$C=\sqrt{\frac{L}{150}}.$$

$$=\sqrt{\frac{595.83}{150}}=\sqrt{3.972}.$$

$C=2''$ nearly *Ans.*

You wish to lift a weight of 4000 pounds with a twofold purchase, hauling part leading from upper block, what power is required to lift it?

There are 4 parts at movable block.

4000 pounds to be lifted and 4 sheaves to increase weight.

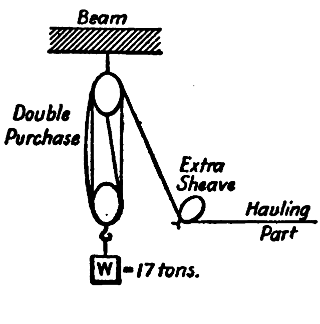
Ten per cent friction for 1 sheave = 400, and, for 4 sheaves = 1600 pounds.

Total weight = 4000 + 1600 = 5600 pounds to lift.

$$P : W = 1 : 4 \quad \therefore \quad P=\frac{5600}{4}=1400 \text{ pounds } \textit{Ans.}$$

$$P : 5600 = 1 : 4.$$

Find the size of rope necessary in hoisting in a 17-ton speed boat, rope rove, as a double purchase and lead from the upper block through an extra sheave as a fair leader?



5 sheaves = 50 per cent extra weight friction.

17 tons + 8.5 tons = 25.5 tons. Total WT.

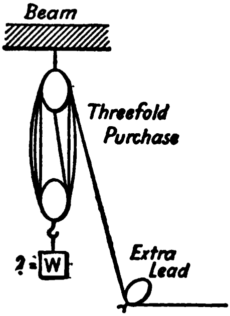
4 parts rope at movable block.

$\frac{25}{4} = 6.4$ tons on each part.

$C = \sqrt{L \times 15} = \sqrt{6.4 \times 15} = \sqrt{96} = 10$-inch rope #.

What is the breaking stress of an 8-inch wire line?

Breaking stress $= C^2 \times 2.5$ tons $= 64 \times 2.5 = 160$ tons #.



Find the weight that may be lifted by a 6½-inch manila fall rove as a threefold purchase, the fall of which leads from the upper block through an extra leader on deck.

$$L = \frac{C^2}{15} = \frac{(6.5)^2}{15}.$$

$$L = 2.82 \text{ tons.}$$

There are six parts rope $6 \times 2.82 = 16.92$ tons.

(Total weight including friction.)

There are 7 sheaves.

Hence $\frac{10}{10+7} \times 16.92 = 11.54$ tons #.

Find the safe load for a 6-inch manila line.

$$L = \frac{C^2}{15} = \frac{36}{15} = 2.4 \text{ tons \#.}$$

Find the safe load for a 6-inch wire line.

$$L = \frac{C^2}{2.5} = \frac{36}{2.5} = 14.4 \text{ tons \#.}$$

Find the breaking stress of a 6-inch manila line.

Breaking stress $= \frac{C^2}{2.5} = \frac{36}{2.5} = 14.4$ tons #.

A weight of 1 ton is to be lifted with a threefold purchase, the hauling part comes from the upper block lead through a snatch block on deck—what size manila fall is necessary?

	2240
7 sheaves = 70 per cent for friction =	1568 pounds.
Total weight =	3808.

Six parts of purchase $\frac{1}{6} \times 3808 = 634.67$.

Load $= L =$ on each part.

$L = C^2 \times 150$ pounds.

$$C = \sqrt{\frac{L}{150}} = \sqrt{\frac{635}{150}} = \sqrt{4.24} = 2.''06 \ \#$$

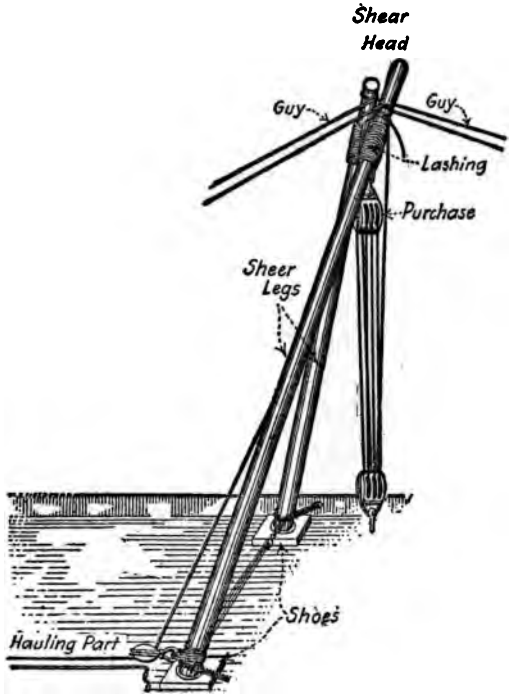
Find the safe thrust for a coaling boom 12 inches in diameter, 15 feet long.

$$\text{Safe thrust} = \frac{4R^4}{L^2} = \frac{4 \times 6^4}{17^2} = \frac{5184}{289} = 17.9 + \text{tons} \ \#.$$

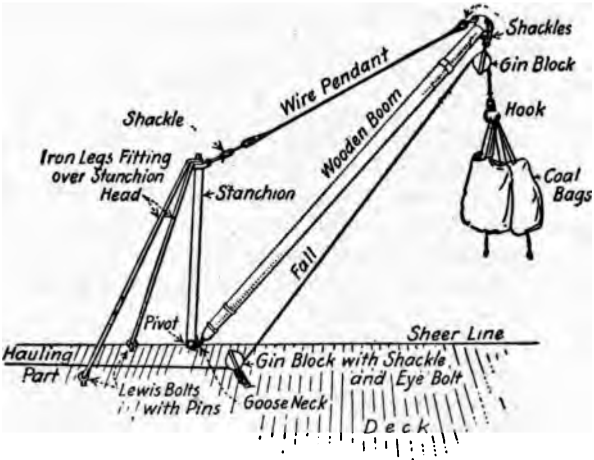
Sketch the method of rigging sheers and purchase for handling heavy weights through hatches on board ship, naming the parts and describing how to pass sheer head lashing.

Heavy three or fourfold purchase hooked or shackled in wire strap passed around sheer head lashing.

Lashing passed while legs are alongside each other, then legs spread, which tautens lashing.



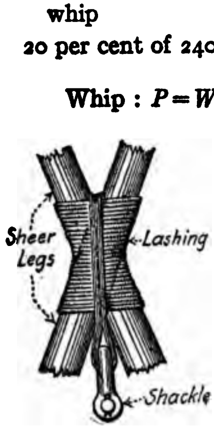
Sketch the coaling boom rigged for hoisting coal from a lighter and find out what size manila line would be needed as a coaling whip to hoist three 800-pound bags at once.



3×800-pound bags = 2400 pounds. There are 2 sheaves in coaling whip

20 per cent of 2400 = 480. Total $W = 2400 + 480 = 2880$ pounds.

$$\text{Whip}: P = W. \quad C = \sqrt{\frac{L}{150}} = \sqrt{\frac{288}{15}} = \sqrt{19.2} = 4.''4 \ \#.$$



Show by sketch sheer head lashing.

Spars for sheer legs laid side by side on deck. Lashing passed around pair of spars with ordinary close round turns, then when sheers are spread lashing will tauten and unexpended end of lashing is passed around cross of sheers vertically, which helps tighten the lashing and forms a grommet to support shackle into which the upper or fixed block of the tackle is hooked.

Describe care and preservation of wire rope. What is the chip log and how is it used?

Kept on a reel. Gone over monthly with raw linseed. If not to be used for a long time, painted with equal parts of linseed and lamp black. If wire rope is to be under water sometime, saturate rope with a boiling solution of equal parts Stockholm tar and fresh slaked lime. Galvanizing is the best preservative.

What knots should be used for:

(a) Bending on a boat anchor? (b) Taking another boat in tow? (c) Hoisting a spar to the top?

(a) Fisherman's bend and a half hitch.

(b) Round turn and two half hitches.

(c) Rolling hitch and a half hitch or timber hitch and half hitch.

To what use is hemp rope put aboard ship? manila?

Hemp is used for standing rigging and heaviest running rigging.

Manila is used for rigging, purchases and miscellaneous purposes.

Give steps in the manufacture of manila rope explaining what prevents it from unlaying.

How is rope designated as to size and length?

What are the advantages of hemp core in wire rope?

In the manufacture of rope, the original fibers are twisted together into threads or **yarns** and these into **strands**. A number of strands are twisted into a rope and several ropes may be combined to form a cable. Yarns right handed, strands left handed, rope right handed and cables left handed. This prevents unlaying. Above may be reversed. Twisting weakens about cne-third but adds to elasticity.

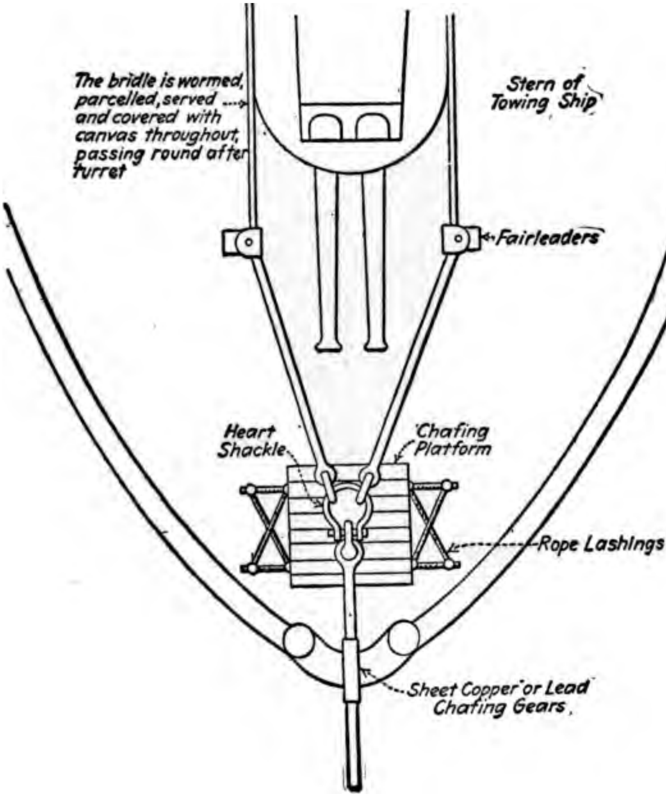
(1) By its circumference in inches. (2) In fathoms.

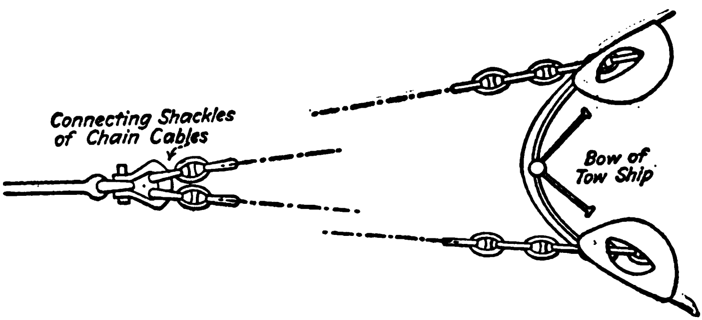
(1) Increases flexibility. (2) Holds lubricant. (3) Forms cushion. (4) Prevents distortion.

INSTRUCTIONS FOR HANDLING TOWING GEAR
GENERAL NOTES

Length of Towing Hawser: 150 Fathoms Type "AA" Steel Wire Rope

1. Vessels of 22,000 tons' displacement and under are fitted with 6¼-inch cir. (2-inch diameter) hawser; those above 22,000 tons with 6¾-inch cir. (2¼-inch diameter) wire rope.


The bridle is wormed, parcelled, served and covered with canvas throughout, passing round after turret
Stern of Towing Ship
Fairleaders
Heart Shackle
Chafing Platform
Rope Lashings
Sheet Copper or Lead Chafing Gears.


Connecting Shackles of Chain Cables
Bow of Tow Ship

2. **Directions for the Towing Ship.**—Take position well astern and to windward of the other vessel, pass a 3-inch manila line from bow to stern outside of all, on the leeward side, coil one end of the line on the forecastle, bring the other end in through the chock, this after end is bent to a 6-inch manila hawser which should be faked on deck clear for running, the other end of the hawser to be bent to the towing hawser which is shackled to the towing bridle, and is also faked on deck aft, for veering bight by bight, stopper the bights by 1-inch manila rope, made fast to the side bitts or cleats.

3. **Directions on the Towed Ship.**—Unshackle the two bower chains at the 5-fathom shackle, after each anchor has been secured in the hawse pipe by two-chain stoppers on each 5-fathom shot. Lead the chains through the chocks, bring back and shackle to the end of the towing hawser, which should be faked on the windward side of the forecastle for veering bight by bight, stoppering the bights by 1-inch manila rope. Bend a 3-inch manila line to a spar or buoy which, when put overboard, will probably float to windward. Signal position of spar to the towing ship which should steam slowly up from behind, pick up spar and bend the spar line to the 3-inch line on its forecastle. The towed ship will then haul in the spar line, also the 3-inch line, the manila hawser, and the towing hawser of the towing ship, shackle the two towing hawsers together and pay out slowly until both hawsers are out, veer the bower chains to about 45 fathoms, set up brake bands on wild cats and also secure chains by chain stoppers.

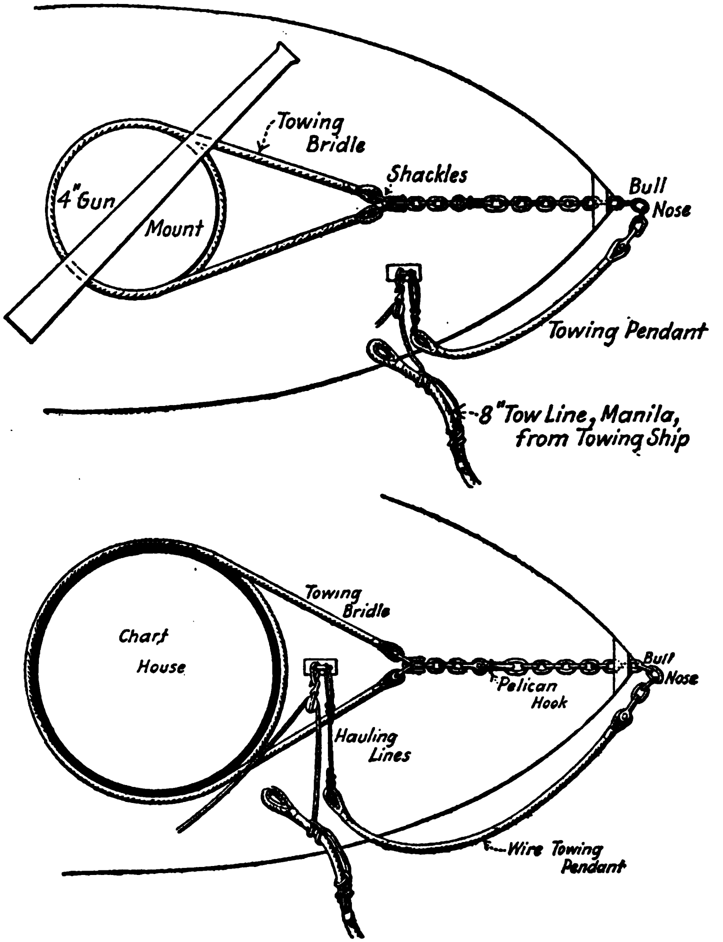
4. **The Towing Ship Should Steam Ahead Slowly.**—Care being taken to put strain on the hawsers very slowly until towed ship has headway.

Towing speed in smooth sea should not exceed 6 knots; in a rough sea about 3½ knots.

5. **To Release the Tow-lines.**—The towed ship should take in its hawsers first, using two winches and two 6-inch manila hawsers, bending them alternately to the hawser and stoppering the bights. When all in, make fast 6-inch manila hawser from towing vessel to its towline, unshackle and ease away, the towing ship to take in both hawsers and its 3-inch manila line.

Show by sketch the method of securing line on a destroyer for towing, naming on the sketch the gear used.

With a battleship towing a destroyer (*a*) *What sizes and lengths of hawsers are used in make-up of tow line?* (*b*) *What is meant by keeping vessels " in step," and how is this done?* (*c*) *If it becomes necessary for towing vessel to back her engines what risks does she run and what should tow do?* (*d*) *How let go of tow line?*



Small Coastal Destroyer.

(*a*) Full length of 8- or 10-inch manila and 5- or 6-inch wire hawsers.

(*b*) To use such a length of line that both ships will meet waves together, allowing length of tow line to be a multiple of wave length of sea so that ships will take wave crests together.

(*c*) Fouling towing hawser in screws. Steersman be ready to sheer out, so as to throw stern away from tow line.

(*d*) Trip pelican hook at stern of towing vessel.

In towing alongside what lines are used and where on tug are they made fast?

Bow and quarter spring made fast in bow of tug, from tug to tow.

Breast fast from stern of tug to tow.

In case sharp turn is to be made where would tug secure and why?

On inboard quarter which is side towards turn, because, when it becomes necessary to back to make the turn the greater leverage is obtained.

In the case of a vessel stranded what are the objections to backing off when aground on a rocky bottom, soft bottom, or with single screw ship? If the vessel cannot be backed off what is the most urgent step to take? When anchoring to seaward is possible, how can another vessel best render immediate assistance?

Liable to tear larger hole in bottom, filling condensers with sand, backing single screw steamer may slew her stern around and put her broadside to the beach.

Get out an anchor or kedge and get a good strain on line from this.

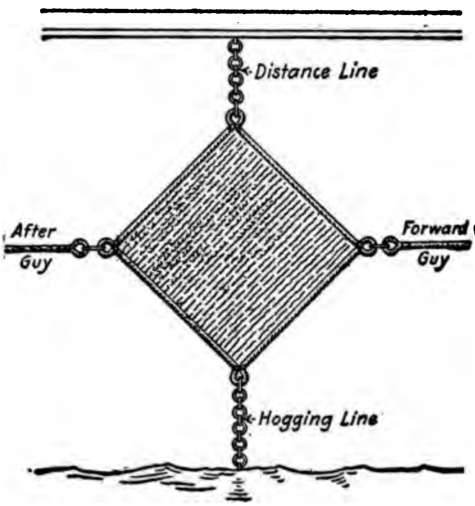
A is aground, *B* goes to assistance. *B* drops anchor at a distance from *A* not exceeding her available scope and goes ahead and veers with left rudder getting as close as practicable to *A*. Transfer *A*'s starboard bower anchor to *B*'s port bow. Run a good hawser between the ships. *B* heaves in; *A* veers on starboard chain. *B* lets go *A*'s anchor when nearly all scope is out. *A* now heaves in on her windlass; *B* heaves in on the line with her winch, and on her cable with her windlass and goes ahead on her engines.

COLLISION MAT

Collision mats are used to stop the inflow of water in case a vessel's bottom should be injured in collision or otherwise. They are carried by all of our vessels of war, and regular drills are held to familiarize the crew with their use.

In the United States Navy there are five sizes as follows:

No. 1.	Twelve feet square	For ships
No. 2.	Ten feet square	For ships
No. 3.	Eight feet square	For ships
No. 4.	Six feet by four feet	For torpedo boats
No. 5.	Four feet by three feet	For torpedo boats



One thickness of canvas of the collision mat is usually **thrummed** and the thrummed side is placed toward the skin of the ship.

The mat is hauled out by the lines as shown in the sketch.

The **hogging line** of wire rope tailed with chain is shackled to the lower corner of the mat, passes under the keel and is manned inboard on the opposite side of the ship. The hogging line is passed under the keel by means of the **dip rope or dipping line.**

This is a small manila or hemp rope with a middle section of chain to make it sink quickly. The bight is passed over the stem and the ends carried aft on both sides until abreast the point of collision, when one end of the dip rope is made fast to the hogging line. It is customary in some ships at collision call to start a dip rope from aft as well as from forward and use whichever arrives first.

The **distance** or **lowering** line is usually of wire rope tailed with chain and is shackled to the upper corner of the mat. This line is usually marked in fathoms and feet so that by consulting a blue print, the mat can be lowered to any specified distance below the water line.

The forward and after corners of the mat are hauled out by the **forward and after guys.** These are usually of 4-inch manila and are secured to the mat by shackles. These lines should be long so that they can be led well forward and aft and get a good spread on the mat.

The Regulations forbid hogging lines or chains to be rigged permanently on account of causing deterioration to ship's bottom.

HANDLING OF SHIPS AND TACTICAL DATA

No attempt has been made to discuss making docks, landings, or buoys, which must differ radically with individual ships and with same ship under different conditions of trim, wind, and tide, to say nothing of eddy currents peculiar to certain localities. Ship handling can best be learned by observation and experience. Never fail to note how another man makes a landing and reason out how you would make it under like conditions from an estimate of the maneuvering space, shipping, wind, tide, trim of ship, safety factor of the dock and adjoining docks, and practicability of making a quick "get-a-way," if required to do so.

In the following short discussion and problems, an endeavor is made to show cases of handling or maneuvering ship in open sea and employment of lines around piers and docks, which many officers moving ships or shifting berths, fail to utilize to full advantage.

As regards tactical data, no officer can handle his ship intelligently till he has found out her capabilities by "trial and error," so that at first available opportunity the tactical diameter, turning circle, backing powers, and behavior under one engine should be determined in smooth water with ship trimmed to about half load.

The captain's note book should contain notes of the action of the ship under varying conditions of wind, sea, and trim.

Discuss "lying to" under various conditions, large and small ship.

The **conventional** way of handling a steamer, when weather is too heavy to hold course, is to bring her up until she has sea on the bow and to hold her there by engines and rudder, assisted by available sail to steady her. In this position, most steamers fall off, hence considerable power must be used to maintain steerage way. This necessity causes pounding and strain to hull and engines with the danger of shipping heavy seas, also the danger of a broken shaft from propeller racing. This method of "lying to" has been handed down from the days of bluff bowed sailing ships and steamers with sail power. The advantage of the method is that a vessel is not blown several hundred miles out of her course down to leeward.

The usual method of "lying to" with the modern type of steamer or man-of-war is to let her take her own position, which is stern or quarter to sea, owing to the drag of her propeller and deep draft aft, or else, to run slowly before the sea. In this position she will roll freely and easily, and drift off to leeward. If rolling becomes dangerous, a slight change of course with propellers turning over slowly will correct roll.

In running before a sea, there is always danger of "pooping," but this can largely be averted by regulation of speed. If oil is used along weather side and astern, the wake can be converted into an "oil slick" and all danger of seas breaking on board will be prevented. As regards speed, the universal rule is that "the lower the speed at which she is run, the easier she will be."

What is a sea anchor? How made? How used?

A **sea-anchor** is frequently used to great effect with smaller vessels. This anchor may be of the regulation type usually carried, consisting of a canvas cone stretched on light wrought iron spreaders. The base of the cone is finished off with a wire rope grommet to which is attached the riding manila cable. This drag when thrown over the stern greatly assists the natural drag of the propeller and permits the stern to ride easily up into the sea.

For hauling in the sea-anchor a tripping line is attached to the apex of the cone for spilling the water out of it. In case no regular sea-anchor is provided, one can easily be improvised by lashing a couple of spars together and attaching a manila span to ends of spars, making riding cable fast to apex of span.

The use of sea-anchor for holding head to sea has not been successful as the drag of the propellers acts against the drag of the anchor with the result that vessel probably rides in trough of sea.

Describe the use of the barometer in forecasting weather with use of weather charts.

Reference maps or charts for each month of the year are issued which show the prevailing winds: anti-cyclonic and cyclonic. Anti-cyclonic winds are winds radiating out from a center and is a descending spiral current, causing an area of high barometer. Cyclonic winds (not to be confused with term cyclone as applied to a storm), are ascending currents surrounded by an inflowing current of air of greater or less intensity, which may become of such concentrated character as to become what is generally termed a "cyclone." These areas are marked by low barometer readings. Anti-cyclonic and cyclonic areas are spoken of as "highs" and "lows." In the Northern hemisphere, the direction of the wind in lows (cyclonic) is anti-clockwise, whereas in the Southern hemisphere, wind direction in lows is clockwise. Wind direction for "highs" is just the opposite to "lows" in each hemisphere.

Black curves on weather charts are "isobars," or curves of equal barometric pressures.

From a study of weather maps, any unusual atmospheric condition can at once be detected by the barometer. As a check on the barometer, an attached thermometer gives temperature readings. Weather maps show lines of equal temperature, called "isotherms."

Relative pressures in adjoining areas are determined by the amount of difference in the reading of the barometer for a given distance and are called "barometric gradients." Velocity of winds depend on these relative pressure.

The normal pressure at any given place may be expected to show the regular daily fluctuation or "barometric tide."

The Weather Bureau in U. S. is under the authority of the U. S. Department of Agriculture, who publish weather maps and are responsible for sending out storm warnings.

As an early indication of a distant storm, an abnormal rise of the barometer is usual. On approach of storm, barometer begins to fall slowly and later falls more rapidly and unsteadily.

Give rules for maneuvering a ship in a hurricane in Northern Hemisphere.

Heave-to on starboard tack to note shift of wind, or with wind on starboard bow of steamer.

Wind hauls to right.	Right or dangerous semicircle.	Run close hauled on starboard tack. When obliged to lie to, do so on starboard tack.
Wind hauls to left.	Left or manageable semicircle.	Run with wind on starboard quarter. If obliged to lie to do so on port tack.
Wind continues steady.	In path of storm.	Run with wind on starboard quarter and keep this compass course. If obliged to lie to, do so on the tack on which wind and sea will haul aft.

Explain reasons for circulation of wind in a "low" in Northern and in Southern Hemispheres.

As the wind comes from places in Northern or Southern latitudes to the equatorial regions, it reaches in succession localities whose linear velocity (of rotation) is less than its own which was imparted to it by the velocity of the locality of its origin. The wind thus affected seems, to an observer on the earth, to lag behind the earth in its rotation, or in other words, to acquire an easterly component, and consequently to be deflected to the right in the Northern hemisphere, and to the left in Southern latitudes. Conversely the wind from the equatorial regions moving to the north, acquires a westerly component and is deflected to the right, while if moving to the south acquires a westerly component and is deflected to the left.

Use of Oil.—The action of oil is not only to prevent the breaking of waves, but to a great extent to prevent them from forming. Even in a surf, oil greatly reduces the violence of waves though it cannot prevent them forming on shoals. Any oil will give good results, but animal and vegetable are best. Fairly thick and heavy oils are better than lighter ones. Oil of turpentine is probably best of all. Mineral oils are least effective. Where oil has thickened with cold temperatures, it may be thinned with petroleum. (Soap suds has a strong effect in preventing the formation of waves, but does not keep them from breaking when formed.)

Any method of spreading the oil, which produces steady even flow, may be used. A convenient way is to fill closet bowls with oakum and oil or to suspend a can with drip into bowls. Another method is to fill a canvas bag with oakum and oil and punch bag full of holes with a sail needle. Tow bags over the side.

If rapid flow is desired, a hose with oil suction can be played in the scuppers, or in emergency oil can be thrown over the side.

In crossing a bar, where a healthy oil flow is required for a short time, a hose may be trailed over the bow.

It should be noted that the rate of oil spreading is slow in comparison with the speed a vessel drifts, thus a ship with engines stopped can make slick to windward but not to leeward.

Oil is of particular value in towing.

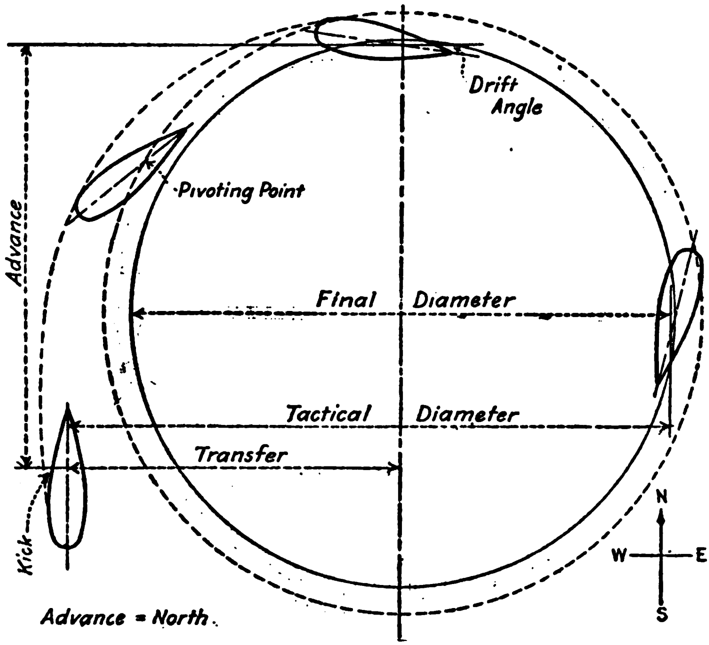
The amount of oil required is small. Vessels have ridden out a gale on the use of ten gallons.

Sketch a turning circle, showing what is meant by Advance, Transfer, Tactical Diameter, Final Diameter, Kick and Drift Angle.

Inner circle shows course described by pivoting point, which is near foremast.

Outer circle is course described by stern in swinging off from pivoting point.

Difference of circles shows kick or side-wipe of ship.



Standard tactical diameter, prescribed for all ships when turning at speed 12 knots.

Standard rudder is rudder angle necessary for ship to make tactical diameter at 12 knots.

Standard one-half rudder is rudder angle necessary for ship to make prescribed tactical diameter larger than standard at 12 knots.

Pivoting Point.—The point about which the ship appears to turn to an observer on board the ship.

Kick.—The throw of the stern to leeward when turning.

Advance.—The distance covered parallel to the original course from the time of putting the rudder over until the ship has turned through eight points.

Drift Angle.—The angle between the keel line of the ship and the tangent to the turning circle after this angle becomes steady.

What effect does speed have on the space in which a vessel will turn and on the time of turning?

Does not affect space but decreases time in which ship turns.

When rudder is put over suddenly which moves, the stern or the bow?

Stern, because pivoting point is near foremast, causing long arm which is from pivot to stern to swing out.

How to avoid a buoy suddenly picked up about a ship's length and a half ahead?

Left full rudder, then when buoy is abreast stem right full rudder.

With way on, ahead or astern, single screw ship, does ship obey her rudder with reference to motion of screw or of ship?

With reference to the way in which the screw is moving.

How does the length of a ship affect advance? How does speed affect advance?

Advance increases with the length of a ship, both absolutely and relatively. Speed does not affect advance materially.

Provided the same power is used in backing as in going ahead, about how many ship's lengths will a ship going full speed, rudder amidships, forge ahead after the engines are reversed to full speed astern?

About four lengths.

What is the most effective method of avoiding a reef suddenly discovered ahead?

Put rudder, " Right Full " (in right-handed single screw ship) and as head begins to swing decidedly to right, reverse engines full speed and shift rudder.

How does the wind affect the steering of a ship going astern? Why?

Ship tends to back her stern into the wind. On account of usually greater draft aft, greater area exposed to wind forward and the screw acting as a drag.

In a right-handed, single screw steamer which is the easier side to put alongside the dock? State the reason briefly.

Port Side.—Because it normally backs stern to port.

State the factors which are considered as entering into the steering of steamers.

1. The ordinary direct influence of the rudder.

2. The screw current which we shall find to be made up of two distinct parts.

3. The force exerted by the revolving blades of the screw to drive the stern to one side or the other by their direct sidewise pressure upon the water.

4. The wake current.

With a right-handed single screw steamer, how make a landing with a fair tide, starboard side to dock?

Preparations must be made to get out a stern line promptly and the vessel should be brought abreast her berth (or a little astern of it), with a slight cant of the head outward. This will prevent danger of current catching her stern on the inside and sweeping her off while the line is being made fast. The effect of bow spring would be to throw the stern off, while a stern spring brings her bodily alongside.

With out-turning twin-screw vessel moored starboard side to dock how prepare and get clear of dock—no wind or tide?

Single all lines.

Let go as many as can be spared.

Let go all permanent fasts and chains.

Clear away spur shores.

Station men by remaining lines.

Take all care to keep screws clear of dock.

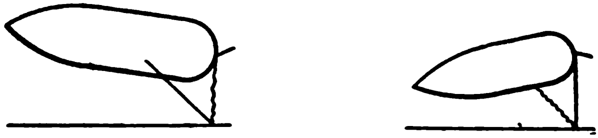
Go ahead slow on port screw with right rudder and with spring; bring bow into dock, which throws stern to port. With stern clear of dock, back starboard (or both engines), taking care not to "side-wipe" dock with bow as vessel backs off.

A ship coming into port suddenly sights a buoy about 1½ ship's length ahead, how miss it and save damage to screws?

"Right full" rudder to clear bow, then "left full" to clear stern, or vice versa, so that red buoy is left to starboard and black buoy to port.

Explain with the help of a sketch how to work a ship into the dock with the aid of a stern breast and a stern spring, by shifting the rudder and keeping the engines going ahead slow.

Go ahead, right rudder. Stern swings in on spring and slacks breast, as in Fig. 1. When canted as much as is thought necessary take in slack of breast and secure same, then shift rudder and bow comes in slacking spring. When bow is in far enough take in slack of spring and secure same. Repeat as necessary.



Describe the procedure or placing a ship in dry dock, assuming that all preparations have been made up to and including the flooding of the dock. What is done while in dock?

Haul ship into dock by means of lines until position is fixed by means of marks on side of dock. Place caisson and pump out. Have ship carefully secured so as not to permit motion in a fore and aft or athwartship direction. Place wale shores. Correct any list as ascertained by careful measurement. When ship's keel touches aft be careful to prevent any listing. Set up on wale shores by means of wedges when keel is resting on blocks along its entire length. Haul out bilge blocks. Pump out.

In the case of a twin-screw steamer (out-turning screws) (a) how turn to starboard from rest without gathering headway? (b) With ship going ahead and it becomes necessary to back both screws, how ensure ship's head turning to starboard? (c) In how many lengths can ship be stopped with rudder amidships?

(*a*) Rudder kept amidships. Port screw going ahead at slower speed than the starboard screw is backing—for reason that it takes less power to drive ship ahead than astern. Result should be: Ship turns on her heel, but takes longer than if going ahead on both screws.

(*b*) Right rudder will insure head turning to starboard. (Screws in this case reduce, but do not reverse, the normal effect of the rudder.)

(*c*) Four to five lengths.

With twin-screw ship moving ahead at fair speed: (a) How *turn vessel with out-turning screws to starboard in quickest time with small turning circle? (b) Same for vessel with in-turning screws?*

(*a*) Back starboard engine full and use right full rudder. Put rudder over first then ring up engine-room indicator.

(*b*) Right full rudder. Back port engine full, keep starboard engine going ahead until ship loses headway, then stop port engine, and complete turn with rudder and starboard engine going ahead. (Reason for backing port engine is that with in-turning screws, the stern is pulled **towards** the backing screw.)

Anchored in column inverted order, ships lying to flood tide, signal is made to cast to starboard and stand out in column natural order. You are O. O. D. of second ship. State what orders you would give to the wheel and to engines to arrive at standard distance astern of the flagship and when you would give them. Sketch the maneuver.

" All engines ahead one-third speed " when guide is two points abaft the beam. " All engines ahead standard " when guide is abeam. At about same time right standard rudder new course 30°; when about 10° of the new course rudder amidships and then meet her in time to come to the new course **steady**. The turn is through 30°. At the proper time to fall in astern of the guide left standard rudder new course. Meet her, steady as before. The guide obliques out one-half distance then resumes course to the front. Sketch as given in pamphlet.

Steaming in column in a fog, standard distance, course 15°, speed 10 knots, signal is made and executed for head of column to change course to the right 45°. You are O. O. D. of the third ship, state what orders you would give to the wheel to execute the maneuver and when you would give them.

When I heard the blast of the ship ahead showing that she had put her rudder over, I would start a stop watch, and at the end of 1′ 18″ I would give the order **right standard half rudder** new course 60. When heading 40 **rudder amidships.** When heading 50 **meet her**; when on 60 **steady.** Towing spar of ship ahead should be in sight just forward of my stem.

Steaming in line of bearing 45° on Flagship's quarter, your distance is correct, but you are considerably ahead of the bearing. What would you do to arrive at proper distance on the bearing?

Head towards guide and reduce speed a little in order to be at the proper distance when on bearing. Watch bearing carefully in order to resume standard speed in time. Do not decrease speed more than 3 knots.

Steaming in line, speed 12 knots, you are on the bearing, but you are 50 yards inside of distance. How would you correct your distance and remain on the bearing?

Increase speed and head away from guide 5° for about 2½'.

Fleet in column, one ship breaks down. What does she do?

Even numbered ships sheer out to port, and odd to starboard, unless impracticable to do otherwise.

When vessels are cruising in formation, define the duties of different vessels at " Man overboard," by day, by night.

By day.—Break " Breakdown " half mast, steer to starboard or port, according to number in column is odd or even, change course 10. Lower lee life boat.

By Night.—Make " Engine stopped " and fire signal gun. When man is picked up, make " Affirmative."

Fleet cruising in thick weather. What are the duties of the various ships at the signal " Form for fog"?

With or without Signal, position buoy is put over. Length of towline in column is 10 yards less than standard distance. Searchlight on buoy in column. In line (day light) searchlight on forward bridge, and at night, searchlight on after bridge, or main mast, to keep light out of O. O. D.'s eyes.

Two ships are directed by signal to interchange positions in the formation. Discuss the procedure of each vessel when in line, when in column.

Rules road apply.

Column, leading ship steer to starboard, rear to port. Take position.

In line (or line of bearing), left ship having other on starboard side shall pass astern.

As Officer of the Deck what do if weather gets thick concerning the following: (a) Assisting ship astern to keep position? (b) Sounding fog signals with and without way on? (c) Readiness of signal gun. (d) You desire to change course to port to follow the flagship.

(*a*) Put over position buoy and turn search light on it; towing spar should be 10 yards less than standard distance from bow of towing ship.

(*b*) Follow rules of road, one prolonged blast in succession, two prolonged blasts—one second interval.

(*c*) Signal gun and man standing by ready sunset to sunrise and during foggy weather.

(*d*) Blow two short blasts when you put your rudder over.

BOATS

Boats at present used in the Navy consist of speed boats, used for barges, gigs, and officers, which are high-powered gas-engine boats; large, heavy motor sailers, engined with Navy Standard gas engine, used for carrying liberty parties and stores of all kinds. These boats run from 50 feet up as carried by battleships and from 24 feet up as carried by small ships. Whaleboats (no power) are carried by all vessels from battleships to destroyers as life boats—large ships carry two and small ships one. As the purpose implies, they are excellent sea boats in open sea and will stand far more weather than any square-sterned motor sailer.

Dinghys and **wherries,** which are small four- or two-oared boats without power and are used for market boats, exercise, or any handy purpose, complete the list of boats now carried by modern ships.

The principal parts of the rigging are:

Foremast.
Mainmast.
Boom.
Yard, Fore.
Yard, Main.
Masthead Band.
Mast Sheave.
Mast Traveler.
Halyard Cleat.
Eyebolt Foremast.
Sheet and Toplift Band.
Ensign Halyard Cleat.
Ensign Halyard Eye.
Ferrule.
Shroud.
Shroud Whip.
Halyard.
Fore Sheet.
Main Sheet.
Topping Lift.
Grommet.
Yard Swing.
Block (on Shroud).
Fore Sail.
Main Sail.
Roping.
Lacing.
Eyelets.
Reel Points.

In boat sailing:

What is the universal safety rule?

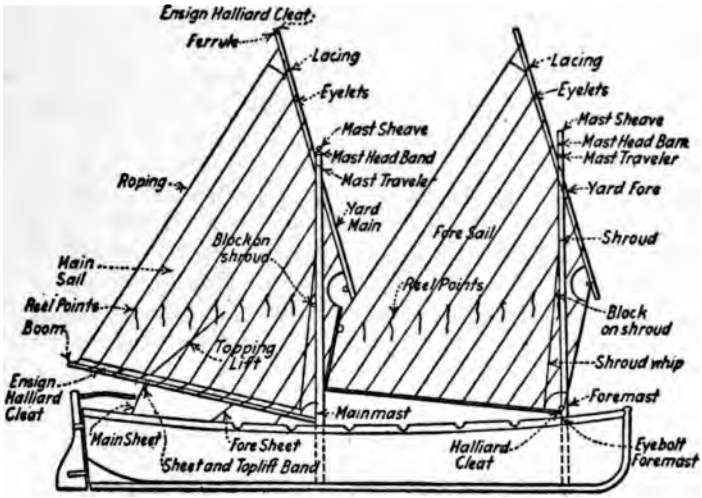
When on the wind, what tiller should a boat carry, how should the sails be kept?

When is it time to reef?

When on the wind, what do in a moderate squall?

Never belay a sheet.

Slight weather tiller. Sails should be kept with a good full, not trimmed too flat, and fore leech barely lifting.



Navy Lug Rig.

When boat begins to take water

Luff enough to shake but not spill the sails. Ease off sheets if necessary.

Give the orders for tacking a Navy lug rigged cutter and tell when these orders would be given and what is done.

" Ready about "—given as a warning. Haul main boom amidships. Put tiller down slowly.

" Let go fore sheet "—when foresail ceases to draw. Dip foresail without lowering halyards.

" Shift over main sheet "—when wind is ahead. Dip mainsail without lowering halyards.

" Haul aft fore sheet "—as soon as it will draw.

" Haul aft main sheet "—when well around on new tack

As Officer of the Watch what instructions would you give a green life buoy lookout on quarterdeck stationed at two life buoys, as to:

Which buoy to let go.

How to let go.

When to let go.

Duty after buoys have been dropped?

When life buoy watch sees man, drop buoy on same side after man is abreast buoy station.

When life buoy watch does not see man, drop buoy on opposite side to which people run, when it is judged man is abreast buoy station.

Pull toggle and kick buoy if it sticks

After man is abreast buoy station.

Keep man in sight. If there are two buoy watches, one may go up in after rigging.

You are in charge of a cutter called away as running boat to carry officers to another ship, in daylight, good weather, what orders would you give and when would you give them from the time you are told to take charge until the boat is alongside the other ship ready for the officers to disembark?

" Shove off "—when officers are seated in stern sheets and officer of deck has given his orders.

" Let fall "—when boat is clear of gangway.

" Give way together "—immediately after " let fall."

" In bow "—when just astern of ship to be visited.

" Way enough "—when about three boat lengths from gangway.

Stroke oar gives " Toss." Bow oars and inboard stroke check way of boat and hold her in to gangway.

In " pulling by numbers " describe what is done at the various numbers.

One.—Deep blades in water perpendicular to surface and put weight of body on the oar, arms and back remaining straight, drive with legs against stretcher until they are straightened out and the body is $22\frac{1}{2}^\circ$ past the perpendicular. Body then remains stationary, while the arms bring the oar home to the body.

Two.—Deep the arms until the blade is clear of the water.

Three.—Turn the wrists by dropping them, bringing the knuckles up and feather the oar.

Four.—Shoot the arms out sharply and swing the body slowly forward to the position of "Stand by."

What are the requirements with regard to readiness of life boats:—When at sea? When in port?

What are the duties of the Officer of the Deck with regard to life boats and crew at the beginning of every watch?

Boat at davits, griped in, falls clear, detaching apparatus clear, steering oar shipped in crutch, oars fitted with trailing lines, rowlocks shipped and fitted with lanyards, plug in, sea painter half-hitched around forward thwart, life lines bent to spar, life jackets in boat, lantern filled and trimmed (and at night lighted), and all other articles of the boat equipment in the boat and ready for use, with two days' water and provisions for the crew. In port one or both lifeboats shall be kept ready for immediate use from sunset until colors the next morning. Hence when there is no suitable boat in the water ready for immediate use, one boat for this purpose must be kept ready for instant use. Owing to handiness a dinghy is used in port in good weather and are required to carry only port equipment.

Keep boat on each side best adapted ready for lowering as a life boat. Coxswain muster lifeboat's crew abreast boat at beginning of each watch; inspect both life boats; and report same to officer of watch, as ready for lowering.

How tack a Navy cutter with sea on weather bow? In a fresh breeze how wear a lug rigged cutter?

Take advantage of smooth water, ease down the tiller, haul main boom amidships gradually and keep foresail drawing as long as possible; as jib begins to shiver ease off jib sheet. When foresail ceases to draw let go fore sheet. When wind is ahead shift over main sheet; when stem of boat has passed the wind haul aft the fore and jib sheets. Weights should be shifted forward as the tiller is put down and shifted aft on the new lee side as she starts to pay off on the new tack.

Put tiller up. Ease off main sheet. When wind is abaft beam ease off fore and jib sheets; as wind draws aft haul in main sheet; and when aft, up mainsail. As wind comes on new quarter shift over sheets, down mainsail; haul aft fore and jib sheets as she comes by the wind.

Ship riding to wind and tide, how bring lug rigged whaleboat alongside port gangway?

Approach from her beam, heading a little above gangway. When about three boat lengths from the gangway down jib and foresail. When at proper distance hard down, haul main boom amidships then down mainsail when the boat is alongside gangway.

In case of man overboard (a) what is the immediate danger and what should the Officer of the Deck do to minimize it? (b) With smooth or moderate sea at what speed of ship may life boat be lowered in safety? (c) Under what conditions should ship make whole turn before lowering boat? (d) In smooth weather in fog what is the best method of finding the man?

(*a*) Man getting caught in propellers; throw stern away from man by putting rudder over towards him.

(*b*) Five knots.

(*c*) Wind and sea abaft beam.

(*d*) Stop and send boat back along opposite course. Avoid changing position while boat is away.

You are in charge of a steamer making a duty trip, what salutes would you render and cause to be rendered under the following circumstances:

(a) You pass your Commanding Officer in a boat with pennant flying.

(b) You pass the Division Commander (Rear Admiral) in a boat in uniform no flag flying.

(*a*) Stop engines and salute with hand.

(*b*) Salute with hand.

In charge of life boat in rough weather how approach wreck for the purpose of removing people on board? What are the attendant dangers?

Pull up to stern of wreck from leeward and get line to wreck. Face crew about on thwarts and pull away at right angles to keel line to keep clear.

Wreckage alongside liable to wreck boat, wreck drifts fast therefore it may be impossible to get away from lee side, if boat once gets frozen to ship's side.—Carry two five- or ten-gallon tins of oil ready for quick use.

RULES OF ROADS

Name the three most important sets of rules that have to do with preventing collisions, and give the authority for each set?

International Rules.—International agreement.

Inland Rules.—Act of Congress.

Pilot Rules.—Promulgation of Board of Supervising Inspectors of Steam Vessels.

What is the difference between the after range light of a steam vessel as permitted by International Rules and as required by Inland Rules? What is the interval between fog signals for steam vessels under way as designated by International Rules? As designated by Inland Rules?

International Rules.—After range light shows through twenty points, from dead ahead ten points on each side. Inland Rules.—Light shows all around horizon.

International Rules interval, two minutes. Inland Rules interval, one minute.

Give the parts of the International and Inland Rules of the Road regarding "Steam vessels meeting" which differ?

In International Rules, it is obligatory for vessels meeting end on to pass to starboard (port side to port side), which is the law of the sea known as the "Law of Port Helm" (right rudder). In Inland Rules, vessels meeting end on, but with their courses so far on the starboard of each other as not to endanger a collision may pass to port (to the left), signifying this intention by two short blasts.

What are "Cross Signals" as defined by Pilot Rules? What is said as to the use of "Cross Signals"? Under Pilot Rules what is the "Danger Signal"? What is the first procedure for each of two approaching steam vessels when the danger signal is sounded by either?

Answering one whistle with two or answering two whistles with one.

Their use is forbidden.

The danger signal consists of several short and rapid blasts of the steam whistle, not less than four.

The engines of both vessels shall be stopped and backed until the headway of the steamers has fully been checked.

Cruising in Chesapeake Bay, near the entrance, you sight the following mentioned lights. What do you infer as to the vessels displaying them: (1) *Four white lights vertically arranged with red and green below.* (2) *Two white lights, one vertically over the other.* (3) *White light, while near it and lower, are four red lights vertically arranged.* (4) *A red light over a white light?*

1. Towing vessel with more than one tow, length of towline exceeding 600 feet, heading toward you.

2. Steamer which you are overtaking.

3. Dredge indicating that you are to pass on the side with the reds.

4. Vessel trawling, dredging or fishing (Inland) steam trawler (Internat.).

You are Officer of the Deck of the "Wyoming," under way at night, heading North, wind S. E. by E. You sight a green light two points on the port bow whose bearing does not change. What would you do? Assuming that a sailing vessel can lie within four points, what are the possible headings of the vessel whose lights are sighted?

Turn so as to pass astern of her, leaving her on your starboard hand.

Possible headings—Northeast to East by North.

Give the classification of motor boats. Draw a plan diagram showing lights carried by classes two and three.

Class 1. Less than 26 feet in length.

Class 2. 26 feet or over and less than 40 feet in length.

Class 3. 40 feet or over and not more than 65 feet in length.

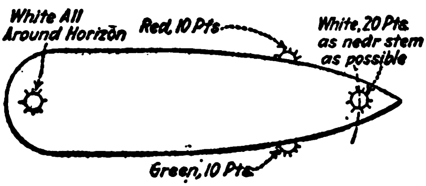
Give briefly the steering and sailing rules to prevent collisions at sea: (*a*) *Sailing vessels.* (*b*) *Steam vessels.* (*c*) *What is meant by sailing vessels?* (*d*) *By steam vessels?* (*e*) *When is a vessel under way?* (*f*) *When not under way?* (*g*) *What sound signals are used* *by vessels in sight of each other? (h) What are distress signals? When and how made?*

1. When two vessels under sail are approaching one another so as to involve risk of collision, one of them shall keep out of the way of the other, as follows:

(*a*) A vessel which is running free shall keep out of the way of a vessel which is close hauled.

(*b*) A vessel which is close hauled on the port tack shall keep out of the way of a vessel which is close hauled on the starboard tack.

(*c*) When both are running free, with the wind on different sides, the vessel which has the wind on the port side shall keep out of the way of the other.



(*d*) When both are running free, with the wind on the same side, the vessel which is to the windward shall keep out of the way of the vessel which is to leeward.

(*e*) A vessel which has the wind aft shall keep out of the way of the other.

Law of port helm—right rudder obtains.

Steam vessel with steam vessel on starboard bow gives way.

A steam vessel is any vessel propelled by machinery.

Every steam vessel under sail alone shall be considered a sailing vessel.

" Under way " within meaning of rules means not at anchor or made fast to shore or aground.

Every boat which is directed to keep out of the way of another boat shall, if the circumstances of the case admit, avoid passing ahead of the other.

Every boat under power which is directed by these rules to keep out of the way of another boat shall, on approaching her, if necessary, slacken her speed or stop or reverse.

Every boat, whether under power, oars, or sail, when overtaking any other shall keep out of the way of the overtaken boat.

Any boat under power approaching another which is in sight of her shall indicate what course she intends to take by the following signals on her whistle:

One short blast to mean, "I am directing my course to starboard."

Two short blasts to mean, "I am directing my course to port."

Three short blasts to mean, "My engines are going at full speed astern."

Distress signals are:

Day:

1. Gun or explosive.
2. International "N. C."
3. Distance signal square flag with ball shape above or below.
4. Continuous sounding on fog horn.

Night:

1. Gun or other explosives.
2. Flames from burning tar barrel or oil.
3. Rockets (any color) at short intervals.
4. Continuous sounding on fog horn.

How would you recognize following vessels at night: Steam vessel towing 3 vessels (long tow)?

Red and green side lights.

Three bright white lights on fore, visible 20 points—6 feet apart—lowest 14 feet above hull—visible 5 miles.

May carry small steering light aft but not visible forward of beam. Might carry range light.

Steam vessel underway but not under command?

Side lights if making way through water.

Two red lights on fore—visible all around—6 feet apart—visible 2 miles.

Steam pilot vessel in U. S. waters under way on station?

Side lights.

White light at fore visible all around horizon 5 miles.

Red light visible all around for 2 miles—8 feet vertically below white light.

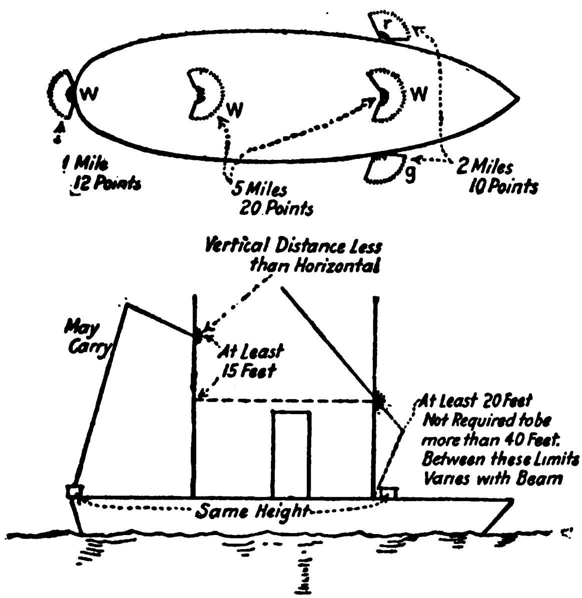
Flare up aft at intervals not to exceed 15 minutes.

Steam vessel being towed?

Side lights only.

May carry small white light aft for next to steer by—not to show forward of beam.

Show by sketches (plan and elevation) the lights required to be carried and which may be carried by a sea-going steamer. International rules, showing color, range, arc of visibility and relative position of all lights?



On a steamer at sea in a fog you hear one blast of a whistle one point on your starboard bow, what action take to comply with rules of road?

Stop engines. Determine exact bearing, by hydrophones if carried. Proceed with caution until past her. It is a steamer under way with way upon her.

O. O. D. of a steamer going up a narrow channel. There is a steamer ahead of you proceeding in the same direction. You wish to pass her. What will you do? Which side pass on, what signals give and what should she do?

Wait for a straight stretch of water. Blow two short blasts signifying intention to pass to port. When steamer ahead answers with two short blasts, signifying permission granted, and sheers out to starboard, pass her to port, keeping to center of channel, but allowing sufficient distance between ships so as to avoid screw current.

As O. O. D. you sight on your port bow the following lights: A vertical display of three lights, red, white, red, under these a green light. What kind of vessel have you sighted?

A cable ship on station laying cable which is standing across your bow.

Is it necessary or required by the Rules of the Road to show anchor lights when (a) moored at a dock or, (b) in a dry dock?

A vessel " moored at a dock " must be considered under the law as " made fast to the shore." She is therefore not " under way." If not " under way," under the law, and surrounded by water, she must come under the provisions requiring the anchor lights. (*b*) No, she is on dry land.

Detailed as signal officer on a ship just commissioned. Your force consists of sixteen men and one chief quartermaster. Arrange your watch list, torpedo defense station and general quarters station for your force.

Four watches; each watch has one first class, one second class, one third-class and one fourth-class. Chief quartermaster on the bridge at 7:00 A. M., getting under way, anchoring, during evolutions or tactical drills, during signal drills and at other times presence required; in charge and responsible for condition of bridge and all signal gear. In taking message first class receives fourth-class records, second- and third-class check. In case of two messages at the same time, first class receives one- and fourth-class records; second class receives one and third-class records. Variations from this are permitted only when all signalmen become expert. Torpedo defense stations and general quarters: One first class in conning tower with the captain. Signal officer and half the force at the battle signal station; other half at captain's reserve station with chief quartermaster. Varies for ships.

In entering a Navy Yard when is Senior Officer's pennant hauled down?

When the Commanding Officer is no longer the Senior Officer afloat at the Navy Yard. (The Commandant of the Yard is not afloat, though his flag is flying on board the receiving ship.)

What replaces steaming lights in case there is trouble with them?

Regulations require oil lights to be ready at hand, be sure they are when you take the deck at night, and that they were tested at sunset.

What are the usual steps taken after the ship has been placed in dry dock?

Scraping, brushing, washing, removing all blisters, avoid removing paint unnecessarily. Apply two coats of anti-corrosive and one coat of anti-fouling paint, generally. Work to be done by ship's force.

What is "Boot topping"?

Originally the operation of scraping the scale off the ship near the surface of the water and applying a mixture of tallow, sulphur and rosin. Now used to apply to the strip along the water line and more often to the special paint used on this particular part of the ship.

What to look for when inspecting a compartment?

The general neatness of everything. Cleanliness especially in corners and behind and underneath chests, etc., rusting, blisters in paint (generally rust underneath).

How determine speed of vessel without use of patent log?

(1) By revolutions, (2) by bearings (fixed points such as lighthouses or light vessels), (3) by soundings.

In taking a sounding with a sounding machine over the stern of a vessel, describe: How to prepare gear and detail crew?

How to run out wire including precautions?

How to reel in?

How to obtain depth of water and character of bottom?

Crew consists of two men and quartermaster, latter in charge. Quartermaster sees machine ready, index at zero, sees finger pin provided, lead armed with tallow, examines tube either clear or colored and places in guard cylinder. One man known as brakesman takes post at starboard side of machine—other known as leadsman takes post beside fair lead. Brakesman puts on handles securely, leadsman takes lead to fair lead armed. Brakesman sees catch on preventing arm from turning, turns handle for winding in, thus putting brakes on and calls "brakeon." Leadsman then lets down sinker with jerk until it hangs on rope. Pay out until sinker hangs free and then put brake on.

Quartermaster gives word "let go." Brakesman turns handle in direction for paying out until drum rotates freely. Holds handle in one hand, and presses on wire finger pin. Brakesman watches counter and if no bottom before 250 on index, applies brakes gradually so as to stop before 300. When wire slackens, he turns handle for hauling in until brake is lightened and wire stopped going out. Avoid kinks.

Brakesman and leadsman both wind in—latter guide wire with one hand. Heave until index shows 5 fathoms and then haul in very slowly. Leadsman steadies link and cord over fair lead, winding slowly, until sinker can be reached and taken on board.

Quartermaster examines lead arming for character of bottom, takes out tube and places alongside scale showing depths in fathoms—using clear and colored tubes. Records sounding in sounding book.

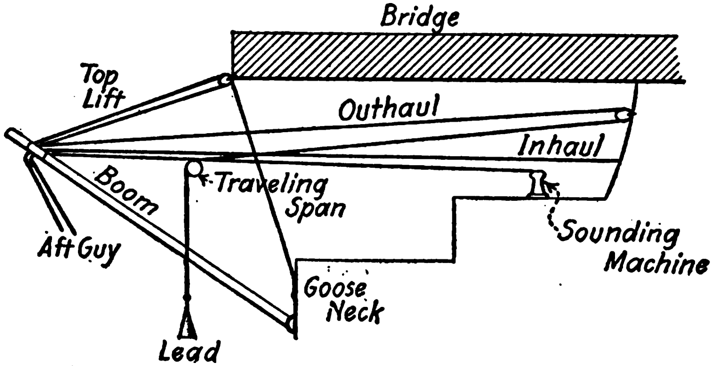
Describe depth recorder for taking soundings.

Water pressure on a diaphragm forces a piston, connected to diaphragm by piston rod, up a small cylinder. As the piston rod moves, a small marker slides over a scale on the piston rod—motion of the marker with the piston rod being prevented as the marker comes up against cylinder lips. When recorder is brought to surface, the tension of a spiral spring attached to the diaphragm, returns the diaphragm, piston rod, and piston "to battery." Friction between marker and piston rod causes marker to remain at point on scale of greatest depth.

Sketch a method of rigging boom or spar for taking soundings from the bridge or upper deck.

On board a battleship cruising in squadron at sea with colors hoisted give in detail what would be done at sunset

Turn on white main truck light with flagship also side lights and masthead and stern lights. Lower speed cones and colors, and lookout lays down from aloft. Station deck lookouts. Coxswain of the life boats reports boat ready. Have oil stand by lights ready and have them screened and muster crew.



You hear a signal faintly through the starboard receiver of a submarine signal apparatus, how determine its bearing?

Head towards sound and note heading when last heard. Then get heading when heard on other bow; half difference gives the bearing. Or bring it to maximum in one receiver and bearing is 90° from compass course.

Enumerate four methods of determining speed of ship through the water.

(1) Chip log. (2) Patent log. (3) Revolutions of screw. (4) Nicholson log.

UNIFORM SYSTEM OF BUOYAGE IN UNITED STATES WATERS

1. In coming from seaward, red buoys mark the starboard or right-hand side of the channel, and black buoys the port or left side. "Red—right—returning."

2. Dangers and obstructions which may be passed on either

side are marked by buoys with black and red horizontal stripes and may be left on either hand.

3. Buoys indicating the fairway are marked with black and white vertical stripes and should be passed close to.

4. Sunken wrecks are marked by the red and black obstruction buoys described in paragraph 2. In foreign countries green buoys are frequently used to mark sunken wrecks.

5. Quarantine buoys are yellow.

6. As white buoys have no special significance they are frequently used for special purposes not connected with navigation, such as limits of harbor anchorage.

7. The starboard and port buoys are numbered from the seaward end of the channel, the black bearing the odd and the red the even numbers.

8. Perches with bells, cages, etc., will, when placed on buoys, be turning points, the color and number indicating on which side they shall be passed.

Due to storms, hurricanes, and ice, the absolute position of buoys, as shown by chart, cannot be relied upon. This is particularly true off the coast of Florida and Gulf of Mexico, where buoys are frequently carried away.

BRITISH BUOYAGE

Owing to low visibility and fogs, primary importance in picking up buoys around the British Islands is *not* attached to their *color*, but to their *shapes*.

Shapes adopted by the Admiralty, as passed on entering from Seaward, are: (1) Cone (Nun) on Starboard hand, painted whole colors (usually red); (2) Flat topped (can) on Port hand, painted parti-colored, such as checkered black and white or checkered red and white (Liverpool Channel, cans are solid black); (3) Dome-shaped (Spherical) on ends of middle ground shoals, painted with horizontal white stripes; (4) Pillar buoys, with tall central structure on flat base, mark special positions, such as bells, whistles, or gas; (5) Spar buoys show only a mast above water and may be any color.]

Buoys are numbered from Seaward, odd and even, and frequently have a letter after the numeral to distinguish the channel.

All light vessels are painted red, with white name letters, and have a red nun watch buoy anchored near them.

NAVIGATION

State duties of navigator as specified in the U. S. N. R. (omitting Ordnance duties).

Head of Navigation Department and senior to all Watch and Division Officers.

Care and order of steering gear, and of compartments containing steering gear.

Care and order of conning tower, chart house. Navigation storerooms, Navigation instruments and aids and apparatus. (Such as sounding machines, sextants, Navigation binoculars, hand leads, patent log.)

Previous to entering pilot waters, study charts, sailing directions, and local pilot rules.

Direct course of ship in pilot waters. Notify officer of deck or captain when ship is running into danger, and advise safe course.

Perform duties with or without a pilot.

Correct all charts; sailing directions; light, buoy and beacon lists to date.

Report all hydrographic surveys made to Department.

Reports errors of position in longitude and latitude of places on charts to Department.

Make tidal observations at all places visited where observations have not been recorded.

Keep Navigation note book as official record. Forward to Department at end of cruise.

Sighting Land and Aids to Navigation.—The Officer of Deck must report to Navigator and log, when at sea, the time sighted and bearing of all aids to navigation. Also time of losing sight of a light.

"At 1:05 sighted Cape Charles light house, bearing 270° p. s. c. distant about 15 miles."

"At 7:50 passed derelict schooner, "J. B. Paler," dismasted and awash, Lat. 38° 40″ North, Long. 78° 00″ West."

"At 6:10 lost sight of Cape May's light, bearing 182° p. s. c.

Soundings.—Log all soundings when taken with deep-sea machine, also log depth, bottom and reading of patent log.

"Took soundings every hour as follows: 1:00, 59 fathoms, fine gray sand; 2:00, 63 fathoms, sand, broken shell; 3:00, 65 fathoms, mud; 4:00, 70 fathoms, broken shell."

Give rules for care of chronometers aboard ship. What chronometer records are kept by the Navigator? Describe all common methods of determining chronometer error by astronomical observations.

Permanent position of chronometer box near center of motion of ship, and as free from shock from guns and engines as possible. Location free from big temperature change and removed from vertical iron. Box to be lined with baize cloth, having separate compartment for each chronometer. Box covered with outer baize cloth to exclude moisture. Place chronometers with XII mark in same position.

For transportation short distances, clamp gimbals, and carry by hand; for express allow chronometer to run down; dismount and cork balance.

A chronometer **record book** showing error of chronometer, which is difference between time indicated and time to which it is referred, as G. M. T. Gains or losses of error will give **daily rate.**

Temperature curve to show effect of varying temperature on chronometer rate.

(*a*) Observatory method as by transit.

(*b*) Time signals.

(*c*) Observations—Single, double and equal altitudes.

Transit method is noting time of transit by chronometer of a heavenly body across each wire of a transit instrument well adjusted in meridian. Mean of these times, reduced to time of meridian passage by applying proper corrections in case middle wire is not exactly in meridian, will give the chronometer time of transit.

Time Signal.—In important seaports, black time ball hoisted in prominent position and dropped by electricity at given instant, which is found in sailing directions or local papers. Difference between chronometer face and the L. M. T. of fall is error on

L. M. T., from which error on G. M. T. is found by applying longitude.

In U. S. time signals sent out at noon daily except Sundays and holidays by the Naval Observatory to various cities and by government wireless stations to vessels at sea.

Observations, Single Altitudes.—With sextant and artificial horizon at a place of known Latitude and Longitude, the Navigator takes a series of altitudes of sun or star when body is seen near or on the prime vertical, noting time of each observation. Using an approximate chronometer correction, an approximate G. M. T. of observation is obtained, the declination of the body is taken out and the altitude reduced to true altitude of the center. The Navigator then has **h**, **d**, and **L** from which to find the body's hour angle.

Double Altitudes.—Instead of relying on altitudes on one side of meridian, observe same body on both sides of meridian at about the same time. Error on chronometer having been found from each set, the mean is taken as correct error.

Equal Altitudes.—If a heavenly body is observed at a given altitude on one side of the meridian, and, again, at the same altitude on the other side of the meridian, the chronometer times of each observation being noted, the mean of the two, or middle chronometer time, will be time of transit, provided declination has not changed. Difference between C. T. of transit and actual time, found independently, will be chronometer error on that particular time.

Give duties of Navigator according to Navy regulations (except ordnance) while commissioning and fitting out.

When fitting out, navigating officer shall make careful inspection of parts of ship confided to his care; of the steering apparatus in general, except the steam steering engine, and of everything connected with the navigation outfit of the ship. Should he discover any defects or deficiencies, he shall immediately make a detailed written report thereof to the commanding officer.

State duties of the Navigator as specified in the U. S. Navy Regulations on approaching land entering port:

Know ship's position.

Know time high water of port.

Soundings hand lead and machine to determine fix, if foggy.

Advise officer of deck and captain if course is dangerous

Pilot does not relieve Navigator of responsibility or of duties.

Describe all usual methods of determining the deviation of the standard compass and how compensate it by the starboard angle method. What advantage can be gained by observations of compass error made in the magnetic equator?

Reciprocal bearing method available when ship is in smooth water and compasses free from disturbing influences except ship's own magnetism and earth.

Observer sent ashore with compass mounted on tripod to location visible from ship and free from local magnetism.

Ship is swung or warped so that standard compass is steady on each bearing on which observations are to be taken. By whistle or other signal, mutual bearings are taken from ship and shore, as vessel is steadied on the various headings. Note times of observations. Shore station signal result of each observation so as to check inconsistencies, which will prevent swinging again.

The bearing of the standard **from** the shore compass, **reversed,** is the correct magnetic bearing of the shore compass from the standard. Make table and list deviations.

Distant bearing method is used when ship is anchored in harbor under ordinary conditions. Select object about ten miles away, so that when ship swings the parallax will be *nil*. (Method may also be used at sea with ship circling, using mountain peak 50 to 100 miles away.) Observe bearings on headings required. The difference between the bearings on the various headings and the magnetic bearing of the object, taken from chart or from the mean of four or more compass bearings on equidistant compass headings will give the deviation.

Celestial Body (azimuth).—Take bearing when body is near horizon, noting time by watch and correcting to G. M. T. With longitude and time, find hour angle. With latitude, body's declination, and the hour angle at time compass bearing was taken, pick out corresponding true bearings from azimuth tables. Compare with observed bearings. Make out deviation table.

Ranges.—Ranges whose magnetic bearings are known are laid down and their data published in Coast Survey pamphlet. When steaming across these ranges on various headings, compass bearings of range are taken.

Compare observed bearings with given magnetic bearings. Make out deviation table.

By obtaining observed deviations on eight or more headings, a curve may be faired through said points on a Napier diagram and deviation on any heading picked off the diagram.

Apply deviation by thumb rule—true—right—east.

Deviations due to sub-permanent (depends on ship's head in building) and to transient magnetism induced in vertical soft iron, measured from ship's head around to right (0—360°) is known as the starboard angle and is denoted by alpha.

The starboard angle is corrected by what is known as a Flinder's bar, which consists of a bundle of soft iron rods ¼" diameter by 36" in length so that at a fixed distance in front or in rear of standard compass, the intensity of its induced force may be varied as desired by increasing or decreasing the number of rods in bundle.

Advantage of observed compass error in magnetic equator is that after careful compensation, the force causing semicircular being there due to sub-permanent alone, should be entirely neutralized by magnets. Then if on change of magnetic latitude, a Flinders bar be placed to correct any semicircular that appears, the compensation will be general for existing conditions.

Koch Method Compensation.—Regardless of its magnetic bearing, if a distant object can be brought to bear the same by compass for all headings, that compass will be accurately compensated. By this method a bearing of a distant object is first taken by the compass to be corrected with the ship steadied on north by this compass. The ship is then headed south by compass and a bearing of the same object taken. The athwartship magnets are raised and lowered until the bearing of distant object is halfway between the two bearings observed on north and south, respectively. There should then remain no deviation on south except the real constant deviation, which it is desired to leave uncompensated. Compensation is completed on east and west and then on one of the intercardinal points by causing the distant object to bear the same as on the south. Sun may be used as distant object, allowing for change of bearing.

In practical compensation, the order of correction is:

1. Place quadrantal correctors by estimate.
2. Correct semicircular deviation.
3. Correct quadrantal deviation.
4. Swing ship for residual deviations.

Heeling corrector may be placed at any time after the semicircular and quadrantal errors are corrected.

A Flinders bar can be put in place only after observations in two latitudes.

Give a detailed account of the duties at sea of a Navigator of a vessel of war from daylight to 8:00 P. M. *of one day (fair weather).*

The routine of a day's work at sea consists in working the dead reckoning, an A. M. time sight and azimuth taken when sun is in most favorable position, a meridian altitude of sun (or when cloudy) a sight taken as near meridian as possible, and a P. M. time sight and azimuth. This is minimum amount of work and should only be omitted on account of cloudy weather.

The Navigator reports ship's position at 8 A. M., Noon, and 8 P. M.

Noon report includes:

1. Lat. and Long. by D. R. at noon.
2. Lat. and Long. by observation at noon.
3. Course and distance made good.
4. Set and drift of current.
5. Deviation of compass (Azimuth on course at A. M. sight).
6. Course and distance to destination.

To obtain these:

1. Find D. R. positions at time of A. M. sight for Longitude and at noon by sight for Long. and at noon by working the traverse from the previous noon.

2. Find an A. M. line of position by either the chord or tangent method and the deviation of compass when sun is favorable situated. Plot this line on Mercator Chart and find graphically its intersection with another line, if possible.

3. Find noon latitude by meridian altitude of sun or by a reduction to the meridian; or bring up to noon by a $\phi'' \phi'$.

4. Take difference between Lat. by observation and by D. R. at noon, and mark north or south as the former is to northward or

southward of latter. (Discrepancy usually considered due to current.)

5. Run noon Lat. back to time of sight, correcting backwards for both the run from sight to noon and the proportion of current in latitude for that time. Result will be true latitude of time of sight.

Find longitude by observation at time of sight by finding the position point of the line corresponding to the true latitude at time of sight.

6. Difference between longitude by observation and by D. R. at time of A. M. sight is discrepancy usually considered due to current. Value being from noon preceding day (departure) to time of A. M. observation. Marked E. or W.

7. Run longitude by observation at time of sight up to noon by applying run in longitude from time of sight to noon, and also current in longitude for the same time. Result will be longitude by observation at noon.

8. Course and distance from noon position previous day (departure) to noon position by observation arrived at, will be course and distance made good.

9. Course and distance from noon position arrived at by D. R. to that by observation will be set and drift of current.

10. Course and distance from noon position by observation arrived at to point of destination by middle latitude or Mercator sailing, will be course and distance by that sailing to destination.

Star sight work is clean, sharp work and not only checks the ordinary A. M. and P. M. lines, but gives an observation, when sun is clouded later. Only caution necessary is that a distant horizon is obtained, as a doubtful sight is worse than none at all.

How are the following obtained: Index error of sextant. Chronometer error. Chronometer rate, error of patent log? How are they marked? How used?

Index error obtained by:

Bring direct and reflected image of a star into coincidence; I. C. is numerically equal to reading, plus if right and negative if left of zero.

Horizon, direct and reflected brought into coincidence.

Measure sun's apparent diameter by bringing upper and lower

limb tangent to horizon. Add the two algebraic readings and divide by two. I. C. will be + or − according to thumb rule "when it's on, it's off, when it's off, it's on."

Chronometer error and **rate** given above.

Error of P. L. is determined by experiment under varying conditions of speed, draft, and foul bottom. Check repeatedly with runs by observation and by revolutions of screw. Varying length of log line from register to rotator will adjust small error.

P. L. not accurate at low speeds, nor in a head or following sea.

If required to report the position at noon obtained from A. M. sight and meridian altitude of the sun, what data would you prepare in note book in order to do so on the sun's dipping? Explain different methods of preparing Meridian Altitude Constant.

Watch time of local apparent noon. (Reason: observe meridian altitude by time rather than dip for sake of accuracy.)

Noon longitude obtained by running A. M. longitude up to noon. (Reason: to correct declination taken from N. A.)

Approximate meridian altitude); to correct for parallax and refraction. (Approximate meridian altitude determined from declination and approximate latitude.)

Lat. = Zenith dist. + Dec. (general formula).
= 90° − True Alt. + Dec.
= 90 − (Observed Alt. + Corr.) + Dec.
= (90 + Dec. − Corr.) − Observed Alt.
Thus (90 + Dec. − Corr.) = Constant prepared.

Lat. and Zenith distance combined algebraically.
Plane of meridian of position o.
NS = horizon.
P = elevated pole.
QQ_1 = equator.
Lat. = z + d (general equation).

(Latitude of place is angular distance north or south of equator measured on the meridian.)

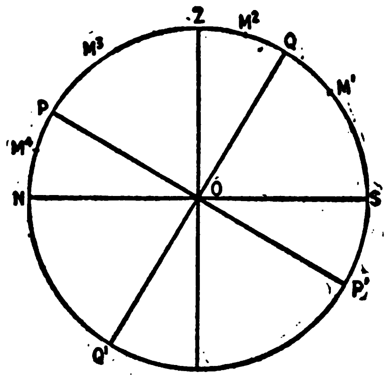
Cases.—(Correction taken plus.)

1. Lat. and Dec., opposite names, as (M^1):
   Lat. = +90 − Dec. − Corr. − Obs. Alt.
   Hence **constant** = (90 − Dec. − Corr.).
2. Lat. and Dec., same name, Lat. greater, as (M^2):

Lat. = 90 + Dec. − Corr. − Obs. Alt.
Hence **constant** = (90 + Dec. − Corr.).

3. Lat. and Dec., same name, Dec. greater, as (M^3):
Lat. = −90 + Dec. + Corr. + Obs. Alt.
Hence **constant** = −90 + Dec. = Corr.

4. Lat. and Dec., same name, lower transit, as (M^4):
Lat = +90 − Dec. + Corr. + Obs. Alt.
Hence **constant** = +90 − Dec. + Corr.



What are the advantages of an efficient submarine signal system over a system projecting sound through air?

The Nantucket light ship has a radio outfit, also a submarine bell; you are in a fog on a vessel fitted with a radio outfit and pick up the light ship's submarine bell signal. How would you fix position?

(1) Greater reliability, (2) greater distance, (3) can obtain fix.

Experiment has demonstrated that sound conveyed through atmosphere is very uncertain as to intensity and deceptive as to bearing.

The submarine bell is not affected by atmospheric conditions. Through agency of the microphones (one starboard and one port side) of a vessel's submarine bell receiving set, the bearing of a light ship eight miles distant has been determined within half a point.

When radio stations (light ships) equipped with submarine bell, send out simultaneously radio and bell signal, distance from sending station can be found by noting elapsed interval between time of arrival of radio and sound, and multiplying interval expressed in seconds by velocity per second of sound in water. By determining distance of light ship at different ship positions between which course and distance are known. Position of vessel can be found closely.

Explain the adjustment of a sextant at sea.

The index and horizon glasses must be perpendicular, and the line of sight parallel to the plane of the limb.

Adjustment of the **index mirror** consists in making reflecting surface of mirror perpendicular to plane of sextant. Set index near middle of arc. Place eye nearly in plane of sextant and close to index mirror, observe if direct and reflected image form continuous arc. If reflected image droops, glass leans backward. If reflected image rises, glass leans forward. Adjustment made by screws at back of mirror.

Adjustment horizon mirror consists in making reflecting surface of mirror perpendicular to plane of sextant. Index mirror having been adjusted, any one position showing horizon glass parallel to index glass, proves horizon mirror perpendicular to plane of sextant. Test with star or horizon. If reflected image of star passes over direct image, no adjustment; if passing to one side adjust by screws attached.

In using horizon, hold sextant vertical and bring direct and reflected horizon in coincidence. Incline sextant to make small angle with horizon; if images are still in coincidence the mirrors are parallel, if not, adjust.

Adjustment telescope so that line of sight is parallel to plane of sextant. Screw in telescope with cross wires and turn tube till cross wires are parallel to plane of instrument. Select two objects with angular distance of not less than 90°. Bring reflected image of one into coincidence with direct image of other at the inner wire, then by altering position of instrument make objects appear on other wire. If contact still remains perfect, then axis of telescope is correct, but if objects lap, adjust by screws of the ring into which telescope is screwed.

What is meant by the characteristics of a light? Explain the difference between a revolving light and a flashing light. Explain the difference between the expressions "Visibility of a light" and "Circle of visibility." How would you determine definitely on sighting it that you had not approached closer than the radius of the circle of visibility?

By **character** of light is meant the special characteristics of various light houses, light vessels, and light buoys, in order that confusion may be avoided in sighting a light. Character includes magnitude or order of light (range), color type of light, such as fixed, flashing, revolving, etc., also the duration and number of flashes or revolutions per time interval.

A **revolving light** appears and gradually increases to full effect, then gradually decreases to eclipse.

A **flashing light** shows a single flash at regular intervals.

A **fixed** shows a continuous steady light.

An **alternating** shows lights of different colors (generally red and white), alternating at equal intervals without any intervening eclipse.

The **period** of a flashing light is the time required to go through the full set of changes in the light.

The word "visible," when applied to lights shall mean visible on a dark night with a clear atmosphere.

The distances given in most buoy and light lists at which lights may be seen in clear weather are computed in **nautical** miles for a height of observer's eye of 15 feet above the water level.

The limit of visibility is the distance a light may be seen on a dark night with a clear atmosphere. (The Navigator strikes in his limit of visibility circles on the chart for lights to be passed during the night.)

The circle of visibility is a circle or that sector of a circle (usually plotted on chart) that a light may be seen by a vessel approaching from seaward, clear of all intervening obstructions. On account of time interval of light, a vessel may sight light inside circle of visibility. Navigator may determine this by going to low position (below 15 feet if possible), also by cross bearings or by doubling angle on bow for short run depending on course.

All lights are to be considered white unless otherwise stated.

What arrangements are made on board ship for obtaining speeds and depth of water? How does the Navigator insure correct results?

Patent log (usually taffrail) consists of a register with worm and gears attached to rail of vessel from which leads length of line far enough astern to clear wake and screw currents. Line had a rotator attached to it, which turns as ship goes ahead and registers speed on dial face of register.

Nicholson log is a variation of taffrail log. Water pressure acting through a hole in bottom of ship shows speed on hydraulic speed indicator in chart house.

Chip log used by sailing vessels consists of sector of wood (chip), which, with length of line attached marked in knots and tenths is thrown overboard and allowed to run out during the emptying of a sand glass of 28″ or 14″ period.

Ground log is used by sailing vessels in place of chip log and consists of a lead or weight with measured line attached. The lead is allowed to land on bottom, hence the name. Used only in shallow water. Advantage over chip log is that it gives true speed irrespective of current and trend of line gives course made good.

On steam vessels speeds are checked over runs of known distance between two lights, also by revolutions.

Depth of water is determined by the following three methods:

By hand lead on soundings.

By deep sea lead when no sounding machine is available.

By sounding machine, consisting of a 50-pound lead armed with tallow in cupped bottom of lead to pick up sample of bottom. Fine flexible wire attached to lead and is unreeled from a wooden drum which is braked when sufficient line is out. Above the lead is a metallic case to take a glass tube sealed at top and coated inside with chemical or with granulated substance. Water will be forced up in glass tube according to depth and may be measured when recorded with graduated scale.

A table worked out for various speeds of vessel supplies a constant to be subtracted from the length of wire unreeled—thus correcting the extra wire paid out through angular trend of sounding line due to ship's advance.

Speeds can be checked by distance made good from **observations** or by runs over known distances in piloting.

Depths can be checked by chart depths and character of bottom.

Landfalls are made in a fog by a line of soundings taken at regular time intervals, maintaining uniform speed of ship.

What is a bench mark? What relation does the bench mark bear to the gauge? How would you run in a shore line in a harbor survey? Describe methods of observing tides in hydrographic surveys. Define the terms used in connection with tides and tidal observations.

The plinth (block serving as base), the water table of a building, or base of a monument are proper **benches.** When these are not available, use a substantial rock. When a bench is made on shore, it should be marked by a circle of 2″ or 3″ diameter with a cross in center indicating the reference point.

Tides are subject to such irregular variations from winds and river outflows that a long series of observations are necessary to fix a natural plane.

Planes of reference are the planes to which soundings and tidal data are referred. As planes differ with charts, it is necessary to take note on chart which plane is used. Four planes of reference are used: (1) mean low water, (2) mean low water springs, (3) mean low water springs, and (4) the harmonic or Indian tide plane.

In measuring tides, the reference point or bench mark is used as a zero to run over the levelings from this point to the gauge. The Stoff gauge is the simplest device for measuring heights of tides from the leveling of the bench mark to the tide gauge

The ordinary chip log is frequently used to observe tidal rates in such places as Mississippi River. The chip is sometimes replaced by a weighted pole.

What is meant by vulgar or common establishment of a port and from what data is it determined? To what plane are soundings on charts referred and how is that plane determined?

The vulgar or common establishment (**establishment**) of a port is the interval between the moon's meridian passage of the place and the time of the next succeeding high water, as observed on the days when the moon is at full and change.

The corrected **establishment** is the average of all high water lunitidal intervals for at least a lunar month.

Range of tide is the difference in height between low water and high water.

To run in a shore line in a harbor survey, select base line with two signal points at least 1000 feet apart—the longer the less error in survey—measuring base line by direct measure of steel tape or, if shore line trends inward, by measuring two auxiliary intersecting lines from extremities of base line and solving triangle for length of base by having two sides and included (measured) angle. Points between base extremities on shore line may then be plotted in by plotted sextant angles using the three-point problem. By means of determined points, a curve of the shore line may be faired through said points.

SURVEYING

How measure a base line in a harbor survey? How locate signals when shores are so precipitous as to prevent direct measurement of base?

What considerations should control in selection of base lines of survey? How measure it? How determine its true azimuth and astronomical position and how plot it on sheet? How locate on sheet a station of the survey?

What records are made in boats and how are they used? State in general terms how you would make a running survey.

As above stated a base line is selected, using two prominent points at extremities with signals. Measure base line by steel tape or chain. If base line is broken solve by triangle as stated above. Select points as stations for main triangulation which will mark in outline of whole area to be surveyed. Points selected must be prominent, well conditioned as regards angles, and close enough together to afford accurate plotting for the intermediate stations of the secondary triangulation. Great care must be taken in establishing points of main triangulation, angles being taken with a theodolite or transit and observed with telescope direct and reversed. If sextant is used, the mean of a number of observations should be used.

Points of secondary triangulation are located by angles from main triangulation stations. These angles having less dependent on them need not be repeated.

Astronomical work of survey consists in determination of correct longitude and latitude of point within the survey area and of the true direction of some other point from the observation point, thus furnishing an original from which all positions and directions can be determined

The **plane table**, with telemeter and stadia, affords the best method of plotting topography.

The **hydrographic** features being the most important object of the survey, great care must be devoted to this part of the work. Soundings are run in one or more series of parallel lines, direction and spacing depending on survey. One series usually runs normal to the general trend of shore line, while second series runs perpendicular to first. A check is obtained on soundings by running a third series diagonal to first two. As depth of water increases, interval between lines may be increased. Lines are run usually by boat. Positions located by angles at beginning of each line, at each change of course, and at frequent intervals. Soundings between positions are plotted by time intervals. Positions are determined by (1) two sextant angles, (2) two theodolite angles, and (3) one sextant and one theodolite.

Boat also keeps **record** of soundings with time of each (for tidal corrections), the depth, the character of bottom, and such data as may be required to locate the position.

As use of lead does not always show pinnacle obstructions in soundings, a **wire drag** is used. The drag consists of a horizontal member, known as the bottom wire, which is a steel line of 50-foot sections shackled and swiveled, supported at each terminal from an 80-pound buoy by a chain stirrup line. Smaller buoys with steel cable stirrups support line at intermediate points. Towing bridles are attached at terminals and to prevent drag sagging back through pull on bridles, a lead weight of 165 pounds is suspended from each terminal stirrup. Two towing launches with 200-foot towing lines are usually used. A pinnacle is spotted when the line of buoys take a V-shape; also registered by a spring balance on towing boat. Average speed of towing about 1½ knots. Average area covered about 1½ square miles per working day.

Tidal observations for surveys are made as described above under **bench marks**.

A **running survey** is a superficial examination of coast line or water area in which soundings and shore positions are determined as ship steams along coast, stopping only at intervals to fix her position. Ship starts from known position and steams along coast at convenient distance, keeping account of course and distance by compass and patent log. Ship stops at intervals to fix her position and intervening dead reckoning is reconciled for current. If shore party is used, their duty is to unmistakably mark prominent objects.

ICEBERGS

What precautions in Navigating should be taken when a ship is supposed to be in the vicinity of icebergs?

Slow to half speed.
Listen in on submarine bell.
Station extra lookouts close to water and aloft.
Close water-tight doors.
Rig out all boats (if passenger vessel).
Watch radio for news of bergs.
Speak passing vessels for information.
Change course if considered necessary.

Region of ice is 40–50 N. Lat. and 40–55 W. Long. in Atlantic Ocean. April, May and June are usually worst months.

Current information comes from ice patrols and passing vessels, and is issued at large to ships by Notices to Mariners (weekly), Pilot Chart (monthly), and pamphlet on North Atlantic Ice Patrol.

Signs of the ice in proximity are: ice blink, cracking or breaking (sounds like breakers), absence of swell in fresh breeze means land or ice to windward, appearance of seals or flocks of murre, temperature of air falls on leeward side, and approach of calf ice in curve line—parent berg is on concave side of line of calf ice.

GYROSCOPE

State in brief and general terms the principle of the Gyro compass. Where would you install a master Gyro compass and by what means can its reading be indicated in any part of the ship?

What are the advantages of a Gyro compass with respect to steadiness, reliability, adaptability and flexibility of location, accuracy, safety of installation, recording feature?

Gyro compass consists of rapidly spinning rotor usually driven by a three-phase alternating current of electricity at a rate of about 20,000 revolutions per minute, and so suspended that it automatically places its axis in the direction of the geographical meridian and permits the reading of ship heading unaffected by any magnetic influence from a graduated compass card. From the "master compass," situated in compartment below and behind armor, electrical connections are made to "repeating compasses" on bridge, conning tower, and spotter's top, so that ship's true heading may be read at any station.

Action of Gyro compass conforms to Loncault's law that "a spinning body tends to swing around so as to place its axis parallel to the axis of any impressed force, and so that its direction of rotation is same as that of impressed forces." Small corrections, depending on latitude, course, and speed, can be applied to compass readings from reference table supplied.

After gyro is started, the oscillations to either side of the meridian are not effectually damped for about an hour and a half. With marked change of course, gyro does not settle down for several minutes. These are drawbacks for its use as a battle compass. On the other hand it gives true bearings in battle and the "master compass" is not only behind armor, but no amount of gunfire changing the magnetism will affect it.

Recent (1920) installations in new destroyers have given excellent results, but master gyro must be "set" for 5 knot changes of speed, as it will not read correctly for 25 knots speed if set for standard speed of 25 knots.

PILOTING

Discuss piloting. Describe all useful fixes.

Piloting is the art of conducting a vessel in channels and harbors and along coasts, where landmarks and aids to navigation are available for fixing the position, and where the depth of water and dangers to navigation are such to require a constant watch to be kept upon the vessel's course.

A **fix** is a definitely determined position of a ship, obtained by any of the following methods, through the agency of bearings taken on prominent, permanent objects located on a chart, such as a lighthouse, prominent bluff, mountain peak, radio tower, tangent to a headland, etc. Such points as light ships and buoys should not be depended upon absolutely in obtaining fixes, as either may have dragged from its normal position.

Describe different kinds of fixes in coasting on soundings when only one landmark can be recognized. When two or more can be made out, and when land can be made out but no mark recognized.

Methods of fixing position are:

1. Cross bearings of two known objects. Ship on course and even keel. Pelorus set with standard compass. Take simultaneous bearings of two known objects about 90° apart. Apply variation correction and plot on chart by magnetic rose. Intersection is ship's position.

2. Bearing and distance of a known object. Obtain bearing of single permanent object, apply correction, and plot as above. Determine distance by range-finder (nearly all vessels fitted with navigational 1-meter base range-finder on bridge) and with this distance and line of bearing, strike in position. If the height of object is known, stadimeter may be used, instead of range-finder. Latter will be more accurate if it has been adjusted and checked over a known range.

3. Bearing of a known object and angle between two known objects. Not much used as conditions permit cross bearings to be taken.

Take bearing of object by compass or pelorus, and observe the angle between two other known objects by sextant. Lay off the angle on three-arm protractor and swing it (keeping legs or lines over the two objects) until it passes over the line of bearing, which intersection defines position.

4. Two bearings of a known object separated by an interval of time with the run during that interval. Take careful bearing and at same time read patent log, then after running a convenient distance take a second bearing of same object and again read the log. The difference in reading gives the intervening run. When running at known steady speed, time interval between bearings will give distance run.

Cases of this method are (1) Doubling the angle on the bow, and (2) bow and beam.

5. Sextant angles between three known objects. Three objects on chart are selected and angles measured by sextant (apply I. C.) between the center of one and each of the others. Preferably there should be two observers. Plot position by three arm protractor. Set right and left angles on the instrument, then move over chart until the three beveled edges pass respectively and simultaneously through the three objects. Center of instrument will make position of ship. Prick on chart. This is practically the same as the three point problem used in surveying.

Define and explain utility of danger bearings and danger angles, horizontal and vertical, single and double. How use record of soundings in coasting?

When wishing to clear sunken danger at any desired distance, the Navigator uses what is known as the **danger angle**—either **horizontal** or **vertical.**

By **horizontal danger** angle, two objects on shore of good angular distance are selected in vicinity of a sunken rock. In order to pass outside of said rock, take the middle point of the danger as a center and the given distance it is desired to pass from this center as a radius and describe a circle. Then pass a circle through the two fixed points on shore and tangent to the seaward side of circle around rock. Second circle drawn by trial and error. Draw lines from the points ashore to the point of tangency of the two circles. Measure angle included between these two lines on chart and set the sextant for that angle. The angle subtended by the two points on shore at this point of tangency will be the same at any point on the circle running through the two points and this point of tangency and it is this angle for which the sextant has been set; therefore as long as the angle subtended by the two points ashore is not greater than that for which the sextant is set, the ship is outside the danger arc.

Why keep a mark abeam in rounding? How steer an arc course in rounding a light without fixes and be sure that the course itself does not decrease the initial distance?

A mark is kept abeam in rounding a light so as not to decrease the initial distance from said light when it first came abeam.

To steer an arc course around a light and so maintain the initial distance abeam, change course half a point or 5° towards light when it first comes abeam. This draws light half a point forward of beam. When light again comes abeam, change course again half a point towards light and again wait until it comes abeam. Continue changing course by half points towards light as it repeatedly comes abeam. This procedure will maintain initial distance from light when same was first abeam.

The **vertical danger** angle is exactly the same principle except that only one object is used and the vertical height of said object known, hence by setting the sextant for the angle subtended by the height of the known object at the required distance it is desired to pass said object, the ship may always be kept outside that distance.

The above are examples of **single** danger angles. **Double** dangers are the same except that a ship desires to pass outside of one rock and inside of a second rock further seaward, in which case the method used previously (either horizontal or vertical) is solved for each rock, which will give each a danger angle or two (double) danger angles.

A **danger bearing** is one that is within a danger sector shown from a lighthouse (usually red light, if the light is white), meaning that approach within that sector is dangerous.

Describe different methods of finding the distance of a ship from a navigational mark and distance at which she will pass it on a given course, drawing on. How use $\frac{7}{3}$ and $\frac{7}{10}$ rules?

Doubling Angle and Bow.—Take angular distance on bow of fixed object. Run on same course, till angle of object on bow is double first angle. Read patent log. Distance run is distance ship is from point observed at second position. Diagram will show isosceles triangle.

Bow and beam is same thing. Angles usually used are two point to four point. If bearings are taken at two points and four points, **seven tenths** (.7) of the run between bearings will be the distance vessel will pass abeam of the observed point. This is the **seven-tenths** rule.

When first bearing is 26½° from ahead and the second bearing 45°, the distance run between bearings is the distance the object will be passed abeam. This is the 26½° rule.

If bearings be taken at 22½° and 26½°, seven-thirds of the run between the two will be the distance the vessel will pass abeam.

On anchoring record and plot position by bearings on **permanent** objects so as to be certain the berth is safe.

Case in point as regards **permanent** object is:

A destroyer anchored Lynnhaven Roads. Could not establish fix by bearing on Cape Charles Lt. because battleship anchored in line of sight blanketed the lighthouse. Navigator took bearing on buoy as one bearing of his fix. Gale during night. Damage to destroyer's screws. Court of Inquiry held that fix established by a buoy was **not** a fix, as buoy might have dragged, hence possibly destroyer might have been anchored inshore of plotted anchorage and might have grounded when she started dragging. Don't do it!

PROBLEMS IN NAVIGATION

Given the following deviations of a ship's **standard** compass:

Ship's Head (psc)	Deviation	Ship's Head (psc)	Deviation
0° 00′	5° 17′ W	180° 00′	5° 26′ E
45 00	15 25 E	225 00	10 21 W
90 00	21 43 E	270 00	21 52 W
135 00	17 19 E	315 00	22 53 W

Find: (1) *the approximate coefficients,*

(2) *the exact coefficients to four decimal places, and* ∝ (*the starboard angle*).

(1) Ship's Head (psc)	(2) Deviation +E −W	(3) Ship's Head (psc)	(4) Deviation +E −W	(5) Half Sun	(6) Half Sun Change Sign of 4	(7) Computation, *B*		(8) Computation, *C*	
0° 00′	+ 5° 17′	180° 00′	+ 5° 26′	+0° 04′.5	− 5° 21′.5	0	0° 00′.0	1	− 5° 21′.5
45 00	+15 25	225 00	−10 21	+2 32.0	+12 53.0	S_2	+ 9 06.5	S_2	+ 9 06.5
90 00	+21 43	270 00	−21 52	−0 04.5	+21 47.5	1	+21 47.5	0	0 00
135 00	+17 19	315 00	−22 53	−2 47	+20 06	S_2	+14 13.0	$-S_2$	−14 13
					Sum+terms		+45° 07′		+ 9° 06′.5
					Sum−terms		− 0 00		−19 34.5
					Divisor		2)+45° 07′		2)−10° 28′
							B = +22° 33.5′		*C* = −5 14°

(9) Upper Half of (5)	(10) Lower Half of (5)	(11) Half Sum (9) and (10)	(12) Half Sum (9) (10), Chan. Sign (10)	(13) Computation, D		(14) Computation, E	
+0° 04′.5	−0° 04′.5	0° 00′	+0° 04′.5	0	0° 00′	1	+0° 04′.5
+2 32	−2 47.0	−0 07.5	+2 39.5	1	+2 39.5	0	0 00

	(11)		(13)		(14)
Sum+terms	+0 00		+2 39.5		+0 04.5
Sum−terms	−0 07.5		0 00		0 00
Divisor	2)−0 07.5	Divisor	1)+2 39.5		1)+0 04.5
#	A=−0 03¾		D=+2 39.5	E=	+0 04.5 #

Angles $A=-0^\circ\ 3\tfrac{3}{4}$, $B=+22^\circ\ 33'.5$, $C=-5^\circ\ 14'$, $D=+2^\circ\ 39'.5$, $E=+0^\circ\ 04'.5$
Sines −.00109, +.35363, −0.9121, +.004638, +.00131
Versines +.07652, +.00416, +.00108.

$A'=-.00109$ #

$B'=+.3263[1+.02319+.00638-.00104]+\tfrac{1}{2}(-).09121\times(+).00131=+.39451$ #

$C'=-.091=1[1-.02319+.00035-.0191]3+\tfrac{1}{2}(+).38363\times(+).00131=-.08713$ #

$D'=+.04638[1+.00036]=+.04640$ #

$E'=+.00131-(-).00044\times(+).04638=+.00135$ #

$$\alpha=\tan^{-1}\frac{-.0871}{+.3945}=347^\circ\ 32'\ 45''\ \#\ (\tan=.22054)\ \#$$

The following exact coefficients of a ship's **steering** compass having been found, viz.:

A′=O, B′=(+) .4121, C′= (−) .1114, D′= (+) .0612, E′= (−) .0071.

Took vibrations with a horizontal needle, ship's head (psc) 232°, deviation 12° 30′ W; time of ten vibrations on shore, T=21.17″; time of ten vibrations on board, $T'=27.41''$.

Find lambda.

$B'=+.4121$	$\zeta'=.\ 232^\circ$	$\zeta=219^\circ\ 30'$ cos −.77162, sin −.6
$C'=-.1114$	$x=-12\ \ 30'$	$2\zeta=79\ \ 00$ cos +.19031, sin +.98163
$D=+.0612$	$\zeta=\ 219\ \ 30$	$\delta=-\ 12\ \ 30$ cos +.97630
$E'=-.0071$	$2\zeta=\ 79\ \ 00$	

$$\frac{H'}{H}=\frac{T^2}{T'^2}=\left(\frac{21.17}{27.41}\right)^2=\frac{448.17}{751.31}=.59651$$

$$\lambda=\frac{.59651\times.97630}{\left\{\begin{array}{l}1+(+).4121\times(-).77162-(-),104\times(-).63608\\ +(+).0612\times(+).19081-(-).0071\times(+).98163\end{array}\right\}}=-9247\ \#$$

About 6 P. M., Dec. 4, 1915, at sea, Long. 64° 24′ W, observed the *a Ursae Minoris (Polaris) for Latitude as follows: W 5h 58′

42″, C—W 4h 24′ 28″, Chro. fast 6′ 14″ *'s Sext. h 38° 42′ 20″ Ht. of eye 46 feet, I. C. (+) 2′ 00″.

Find: (1) *L. S. T.*, (2) **'s H. A. stating whether star is east or west of Meridian*, (3) *Latitude by observation. Use Nautical Almanac Method.*

W	5h 08′ 42″		Obs. L	38	42′ 20″
C-W	4 24′ 28″		Cor.	—	5 53
C	10h 23′ 10″		h	38	36′ 27″
CE	6 14	for t	Cor. Tab I		52 20
GMT	10h 16′ 56″	Dec. 4	Lat	37	44′ 07″ N
			*RA +24 hrs. from N.A.		25h 29′ 12″
RAMO	16 48 52 .54		LST	22	49 33 .9
Cor	1 41 .4				
GST	3h 07′ 29″.94		*HA —	2h	39′ 18″.1 (East) #
GST	3h 07′ 29″.94		I C.		+2′ 00″
Long.	4 17 36 .00	W	D		−6 40
			V.		−1 13
LST	22h 44′ 53″.94	#	Cor.		−5′ 53″

At sea, Dec. 4, 1915, about 11 A. M., Approx. Lat. 44° S. Long. 78° 42′ W, observed the Sun, bearing northerly, as follows: W 10h 59′ 40″, C—W 5h 24′ 22″, Chro. fast 3′ 59″ ☉ 66° 14′ 00″, Ht. of eye 46 feet, I. O. (+) 2′ 00″.

Find Lat. by φ″ φ′ method.

W	10h 59′ 45″	LAT	−25h 15′ 14″.3			Obs. L	66° 14′ 00″
C-W	5 24 22	t	− 0 44 7			Cor.	+ 11 14
		t	−11° 11 25 .5	H.D.	−.988		
C	4h 24′ 02″			t	+4½	h	66 25′ 14″
∵ CE	3 59 for t	Eqt.	10 03″.63			C.D	+16 15.6
		Cor.	— 4. 33	Cor.	−4.33	I. c.	+ 2 00
GMT	4 20 03 Dec. 4					D.	− 6 40
ET	+ 9 59 .3	ET	9 59 .3				
GAT	4 30 02 .3	Dec.	22° 08′ 25″.7	H.D.	+21.02	P & V.	— 0 21 .8
λ	5 14 48 .0 W	Cor.	+ 1 31 .1 S	t	+ 4½		
						Cor.	+11 14
LAT	23 15 14.3	d	2 92 57	SCor.	+91.09		
h	66° 25′ 14″						
d	22 09 57 S	tan	9.61 001	Sin	9.96 213		
t	−11 11 25	sin	10.00 834	Cosin	10.42 333		
φ″	−22 33 09			Sin	9.58 380		
φ′	−21 18 11	tan	9.61 835				
				Cosin	9.96 926		
LAT	43 51 20 S #						

At sea, Dec. 4, 1915, from A. M. sights run up, the Navigator's predicted noon position is Lat. 26° 14′ N, Long. 89° 42′ W. The ship is steaming on course 195° psc. Var. 6° E. Dev. 2° W, at speed of 19 knots, C—W 5h 53′ 40″ Chro. fast 4′ 10″.

(*a*) *Find the Watch Time of L. A. N, at expected noon position.*

(*b*) *Find the Constant for use in a reduction to meridian sight taken 10′ before L. A. N. such that when the Sextant Altitude at that observation is properly applied to it, the result will give the Latitude at L. A. N.*

(Do not disregard the change in **Latitude** in the interval between sight and L. A. N.)

Height of eye 46 feet, I. C. (+) 2′ 00″.

(*a*)

Gat of LAN 5h 58′ 48″ Dec. 4		Eqt. 10′ 03.″8
Eqt. — 9 57 .8	C.T. 5h 53′ 00″.2	Cor. — 6
	C–W 5 53 40	
GMT of LAN 4 58 50.2 Dec. 4		ET 9 57. 8
CE 4 10 for *t*	W.T. 11 59 20 ∦	H.D. — .998
		λ + 6
CT of LAN 5 53 00 .2		
		Cor. — 5. 988

(*b*)

Dec. 22 08′ 22″.25	H.D. +21.03 S.D. +16′ 15″.6	Course Error Course
Cor. 2 06 .1	λ 6 I.c. + 2 00	psc True
		195° +4° 199°
d 22 10 28 .35	Cor. +126.2 D + 2 40	Dist. run 3.17 mi.
90 00 00	Approx. P & V — 0 58.5	
		1 = 3 mi. S
67 49 32	Lat 26 14′ N Cor. +10 37	$\Delta_0 ht^2$ 3 36
C — 17 13	*d* 22 10 $\Delta_0 h$ = 2.16	Cor. 10 37
	Z 48 24 N $\Delta_0 ht^2$ = 3′ 36″	
K = 67 32 19 ∦	*h* 41 36	C = +17′ 13″

Dec. 4, 1915, about 7 P. M., Lat. 38° 30′ N and Long. 75° 30′ W. W 6h 59′ 19″ C—W 5h 04′ 15″, Chro. fast 1′ 25″.

By use of azimuth tables find:

(*a*) *True bearing of *a Aquilae (Altair).*

(*b*) *True bearing of *b Orionis (Rigel).*

	Altair		Altair
W 6h 59′ 10″	*RA 19h 46′ 38″.17	Y.D. +2.927	Base 101° 56′
C–W 5 04 15	Cor. + 2 .72	*t* + .93	Cor. for *t* 43.4
C 0 03 25	*RA 19 46 40 .89	Cor. +2.722	*d* + 18.6
CE 1 25 for *t*	*Dec. 8 38 34 .8 N	Y.D. +9.37	L + 16.5
GMT 12 02 00 Dec. 4	Cor. + 8 .7 N	*t* + .93	ZN 101 48.1
RAMO 16 48 52 .54	*d* 8 38 43 .5 N	Cor. +8.71	= 258 12′
Cor. 1 58 .6			

GST	4	52	51	.14
λ	5	02	00	W
LST	23	50	51″	.1
AltRA	19	46	40	.9
AltHA	4	04	10	
LST	23	50	51	.1
RigRA	5	10	29	.8
RigHA	18	40	21	
Cor.	5	19	39	

Riegel								
*RA	5h	10′	27″	.13		Y.D.	+2.882	
Cor.	+		2	.68		*t*	+ .93	
RA	5	10	29	.81		Cor.	+2.68	
Dec.	8	17	56	.4	S	Y.D.	+4.3	
Cor.			4.	0	N	*t*	+ .93	
d	8	17	52	.4	S	Cor.	+3.99	

Riegel		
Base	102	28′
Cor. for *t*		03 .3
d	+	13.5
L	+	01.
Z	102	47′

Given the following data from a set of bearings of a distant distant object, ship swinging with a short scope of chain:

Ship's Head p.s.c.	Bearing dist. obj. p.s.c.	Head p. steer c.
0°	223° 30′	350° 30′
45	186 30	46 30
90	154 30	106 30
135	154 00	164 00
180	168 00	214 00
225	188 30	250 30
270	209 30	279 30
315	227 30	308 00

Find the Deviations of both compasses on the given headings.

Bear	psc	Mag. Bear.	Standard Deviation		Stand. Head.	Mag. Head.		Steer Head		Steer Deviation	
223	30		−34°	30′	0	325°	30′	350°	30′	−25°	00′
186	30		+ 2	30	45	47	30	40	30	+ 1	00
54	30		+34	30	90	124	30	106	30	+18	00
54	00		+35	00	135	170	00	164	00	+ 6	00
68	00		+21	00	180	201	00	214	00	−13	00
88	30		+ 0	30	225	225	30	250	30	−25	00
209	30		−20	30	270	249	30	279	30	−30	00
27	30		−38	30	315	276	30	308	00		30
12	00		$							$	
89	00										

Given the following data from a set of simultaneous reciprocal bearings on eight equidistant headings:

Ship's Head p.s.c.	Bearing of Shore Compass p.s.c.	Bearing of Standard Comp. per Shore Comp.
0°	20° 30′	194° 15′
45	15 00	189 00
90	18 00	187 00
135	16 30	185 30
180	259 00	89 45
225	246 10	87 55
270	6 20	197 20
315	18 45	195 45

Find Deviations of Compass on given headings.

Head p.s.c.	Bearing Stand. from Shore	Bearing from Shore Reversed	Bearing Shore p.s.c.	Stand. Deviation
0°	194° 15′	14° 15′	20° 30′	− 6° 15′
45	189 00	9 00	15 00	− 6 00
90	187 00	7 00	18 00	−11 00
135	185 30	5 30	16 30	−11 00
180	89 45	269 45	259 00	+10 45
225	87 55	267 55	246 10	+21 45
270	197 20	17 20	6 20	+11 00
315	195 45	15 45	18 45	− 3 00

Given the following Deviation table of an uncompensated standard compass, find the values of A, B, C, D and E (the approximate coefficients) as per first page of Form N, Eq. 10, page 34, Compass Manual:

Ship's Head p.s.c.	Dev.	Ship's Head p.s.c.	Dev.
0°	10° 48′ W	180°	6° 49′ E
45	18 31 E	225	12 44 E
90	16 01 E	270	13 10 W
135	1 31 E	315	31 39 W

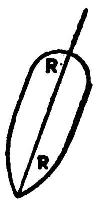
What was the probable approximate direction (quadrant) of ship's head when building?

Tell how to compensate this compass on Heads West, South and Southwest, showing by sketch in each case how the magnets or spheres should be placed.

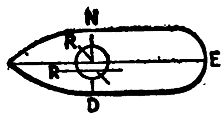
1	2	3	4	5	6		7		8
0	−10° 48′	180	+ 6° 49′	− 1° 59′.8	− 8° 48′.5	0	0° 00′	1	− 8° 48′.5
45	+18 31	225	+12 44	+15 37 .5	+ 2 53 .5	S_2	+ 2 02	S_2	02 .0
90	+16 01	270	−13 10	+ 1 25 .5	+14 35 .5	1	+14 35 .5	0	0 00
135	+ 1 31	315	−31 39	−15 04 .0	+16 35 .0	S_2	+11 44 .0	S_2	−11 44 .0

Sum +terms	+28 21.5	+ 2 02
Sum −terms	− 0 00	−20 32.5
	2) +28 21.5	2) −18 30.5
	B = +14° 11′	C = −9° 15′

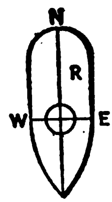
9	10	11	12		13		14
− 1° 59′.5	+ 1° 25′.5	−0° 17′	− 1° 42′.5	0	0° 00	1	−1° 42.′5
+15 37 .5	−15 04 .4	+0 17	+15 20 .8	1	+15 20 .8	0	0 00
		A = 0 00			D = 415 21′		E = −1° 42′



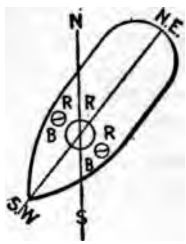
Ship head when built S.W. quad (about 200)



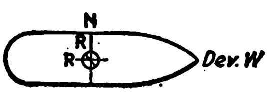
B Magnets red ends forward

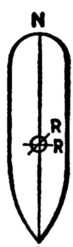


C Magnets red ends to port



Move Spheres Closer





A ship was swung on 16 equidistant headings per gyro compass, which reads true, beginning at North. On each of these headings, the ship's head per uncompensated magnetic compass was noted as shown below:

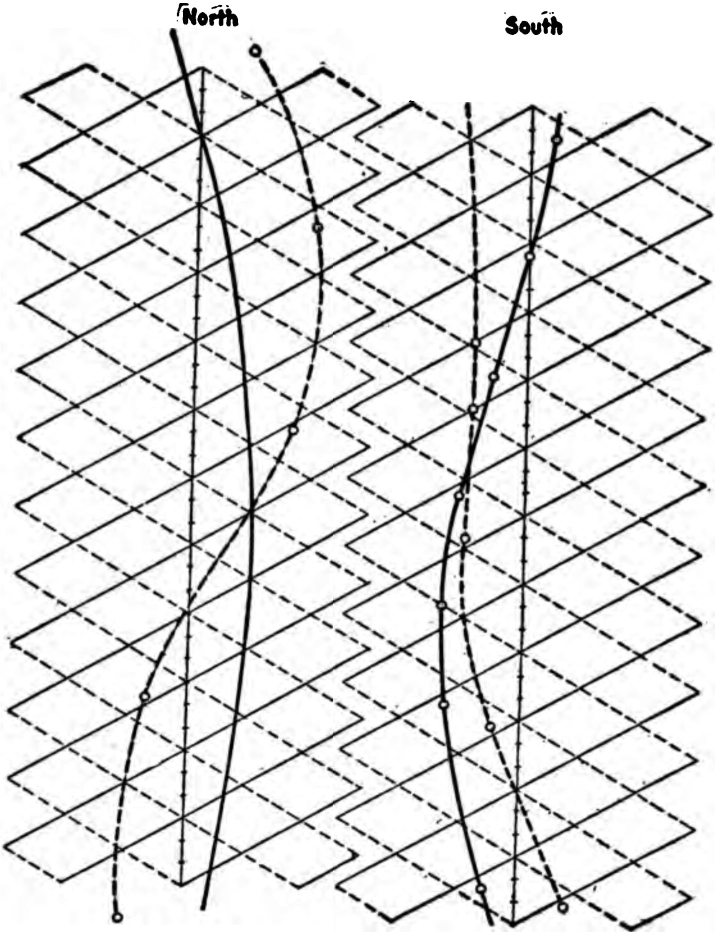
Ship's Head Per Gyro	Ship's Head Per Check	Ship's Head Per Gyro	Ship's Head Per Check
0° 00′	12° 00′	180° 00′	180° 00′
22 30′	27 30	202 30	213 00
45 00′	45 00	225 00	244 00
67 30′	64 00	247 30	274 00
90 00′	84 30	270 00	300 00
112 30′	107 00	292 30	321 00
135 00′	132 00	315 00	339 00
157 30′	158 00	337 30	355 30

From the above data, if the Variation is 10° West, find the Deviation of Check Compass and, by use of Napier Diagram make a Deviation Table for use with the Check Compass on 8 equidistant headings beginning at North.

True Head	Check Head	Error	Dev.	True Head	Check Head	Error	Dev.	Check Head	Check Dev.
0	12° 00′	−12° 00′	− 2° 00′	180°	184° 00′	− 4° 00′	+ 6° 00′	45	− 6° 30′
22.5	27 30	5 00	+ 5 00	202 .5	213 00	−10 30	− 0 30′	45	+10 00
45	45 00	0 00	+10 00	205	244 00	−19 00	− 9 00	90	+16 00
67.5	64 00	+ 3 30	+13 30	247 .5	274 00	−25 30	−16 30	135	+13 00
90	84 30	+ 5 30	+15 30	170	300 00	−30 00	−20 00	150	+ 7 00
112.5	107 00	+ 5 30	+15 30	292.5	321 00	−28 30	−18 30	225	− 4 00
135	132 00	+ 3 00	+13 00	315	369 00	−24 00	−14 00	270	−15 30
157.5	158 00	− 0 30	+ 9 30	337 .5	335 30	−18 00	− 8 00	315	−19 30
									#

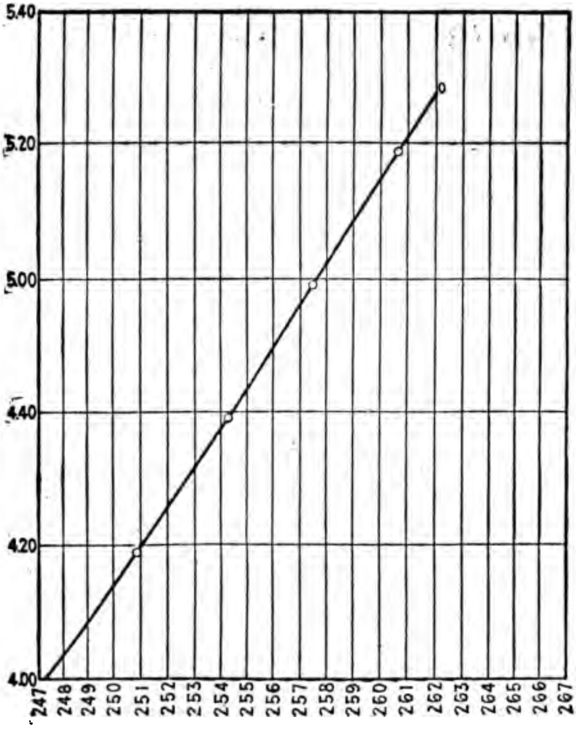
In preparation for swinging ship off the coast, the Navigator prepared the following data:

L. A. T.	O's True Bear by Az. Tables	L. A. T.	O's True Bear by Az. Tables
4h 00′	N 112° 44′ W	5h 00′	N 102° 31′ W
4 20	N 109 11 W	5 20	N 99 21 W
4 40	N 105 47 W	5 40	N 96 14 W


North
South

Then in swinging ship the following data was obtained:

Ship's Head p.s.c.	Watch Time	Bear of O p.s.c.	Head per Steer c.
0°	4h 29′ 18″	259° 10′	349°
45	4 35 20	257 40	19
90	4 41 19	261 15	66
135	4 47 21	265 15	143
180	4 53 20	265 10	195
225	4 59 18	264 40	239
270	5 05 18	267 10	284
315	5 11 20	269 00	321



The watch was 5′ 20″ fast on L. A. T.

The approximate value of the Variation from Chart was 9° 00′ W.

1. *Construct a curve of the sun's true bearings for the L. A. T. given.*

2. *By use of this curve and the observed bearings of sun (psc) and assuming A = O, find the compass error, variation and deviation of standard compass as per form on page 82 Compass Manual.*

3. *Find the Deviations of the Steering Compass on given headings (psc), plot curve of deviations for steering compass and make a Deviation Table for this (Steering) compass on 8 equidistant headings beginning at North.*

LAT	True Bear	Zn
4:00	N 112° 44′ W	247° 16′
4:20	N 109 11 W	250 49
4:40	N 105 47 W	254 13
5:00	N 102 31 W	257 29
5:20	N 99 21 W	260 39
5:40	N 96 14 W	263 46

Stand. Error	Var.	Stand. Dev.
− 7° 35′		+1° 00′
− 5 05		+3 30
− 7 40		+1 00
−10 40		−2 00
− 9 35	−8° 37′	−1 00
− 8 10		+0 30
− 9 40		−1 00
−10 30		−1 50

W. T.	Error of Watch	L.A.T.	p.s.c. Bear	True Bearing from Curve	Error of Standard
4h 29′ 18″	W fast 5° 20″.	4h 23′ 58″	259° 15′	251° 35′	− 7° 35′
4 35 20		4 30 00	257 40	252 35	− 5 05
4 41 19		4 35 59	261 15	253 35	− 7 40
4 47 21		4 42 01	265 15	254 35	−10 40
4 53 20		4 48 00	265 10	255 35	− 9 35
4 59 18		4 53 58	266 40	256 30	− 8 10
5 05 18		4 59 58	267 10	257 30	− 9 40
5 11 20		5 06 00	269 00	258 30	−10 30

8) −65° 55′

− 8° 37′

p.s.c. Head	Mag. Head	Steer Head	Steer Deviation	Steering Head	Steering Dev.
0°	1° 00′	349°	+12° 00′	0°	+22°
45	48 00	19	+29 30	45	+30
90	91 00	66	+25 00	90	+15
135	133 00	143	−10 00	135	− 7
180	179 00	195	−16 00	180	−17
125	225 30	239	−13 30	225	−13
270	269 00	284	−15 00	270	−15
315	313 10	321	− 7 50	315	−11

NOTE.—Construct both curves of deviation (called for in the two previous problems) on same Napier Diagram supplied; but, to avoid confusion, plot curve for one continous line and curve for the other in dotted or broken line.

A ship fitting out at the Norfolk Navy Yard is to have her compasses corrected outside the entrance of Chesapeake Bay during the afternoon of March 4, 1916. Arrangements have been made so that the ship will be ready to begin work at 3:20 P. M. by 75th Meridian mean time. The locality selected for the observations and compensation is Lat. 37° 30′ N, Long. 75° 15′ W, and the Variation at that place is 5° 40′ W.

1. If the compass work will require one and one-half (1½) hours and begins at 3:40 P. M. (75th Meridian mean time), *find the L. M. T. of the middle instant of the compass work at the place of observation.*

2. *Find the Declination of the Sun, Equation of Time and L. A. T. of the middle instant of the compass work.*

3. Using the Latitude and Variation given above and assuming the Declination to be constant at its value for the middle instant, *find the Magnetic bearing of Sun at the following L. A. T.'s.:*

3:20, 3:40, 4:00, 4:20, 4:40, 5:00.

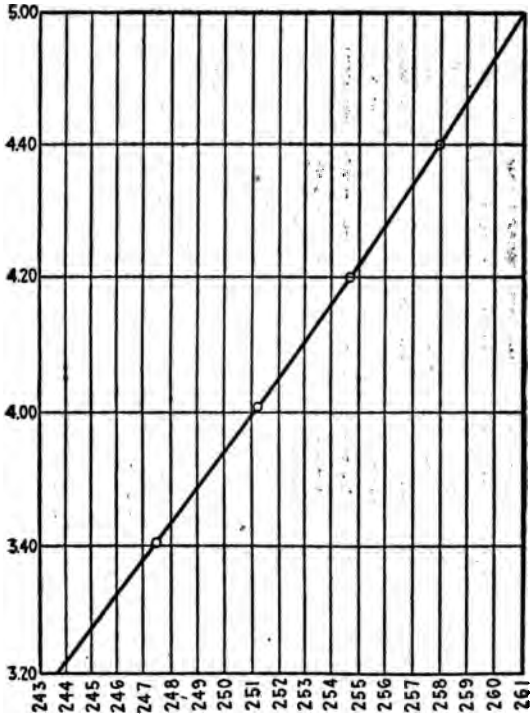
4. If the watch is correct on 75th Meridian mean time, *find the Watch Times corresponding to the L. A. T.'s in* (3). *Using Equation of Time for middle instant.*

5. *Construct curve of Magnetic Azimuths of Sun, using azimuths and times found in* (3).

6. If when heading South Magnetic the heading per standard compass is noted to be 187°, *tell what correctors to use and how to place them.*

7. If ship's head is then placed on East Magnetic and heading per standard compass is noted to be 95°, *tell what correctors to use and how to place them.*

8. When watch reads 4:20, *tell definitely how to place ship's head on 135° Magnetic by use of pelorus and curve of azimuths found in* (4).



9. If when ship's head is on 135° Magnetic (the spheres having been approximately placed in preliminary compensation) the head per standard compass is noted to be 133°, *tell definitely what to do to compensate.*

10. At 4:50 by watch the Sun bore 258° p. s. c. and ship's head was 35° p. s. c. At the same time the ship's head by other compasses was noted as follows:

Head by Steering Compass = 38°
Head by Top Compass = 47°

Find the Deviation of the three compasses on the given headings.

Begins	3h	40′	00″	75th M.T.	G.M.T.	9h	25′	00″	Mar. 4	Dec. 6 18′.1			
½ Inter.		45	00		Long	5	01	00	W	azimuths			
Mid. Int.	4	25	00	75th M.T.	L.M.T.	4	24	00	Mar. 4	(1) # Cor. for d	+0° 14′		
Long.	5	00	00	W	Eqt.	−	11	48.9		(2) # " " L	+0 17.3		
G.M.T.	9	25	00	Mar. 4									
					LAT	4	12	11.6	Mar. 4	(2) # Const. Cor.	+0° 32′		

L.A.T.	Z			True Zn		Z Mag.		
3:20N	120	06′	W	237	54′	243	34′	
3:40N	118	11	W	241	49	247	29	
4:00N	111	30	W	245	30	251	10	
4:20N	111	00	W	249	00	254	40	(3)
4:40N	107	40	W	252	20	258	00	
5:00N	104	28	W	255	32	261	12	#

W	4h	25′	00″	(75th M.T.)
L.A.T	4	12	12	
Error +		12	48	on L.A.T

LATS	Watch Times		
3:20	3h	32′	45″
:40	3	52	48
4:00	4	12	48
:20	4	32	48
:40	4	52	48
5:00	5	12	48

#

6. Use " C " correctors, red ends to starboard.

7. Use " B " correctors, red ends aft.

8. When watch reads 4:20 LAT = 4h 7′ 12″. Sun's Mag. Bear = 252°.5. Set pelorus dial to 135°.

Set pelorus vanes to 252° 30′.

Maneuver ship so that sun will be seen through vanes at 4:20.

9. Separate balls farther. Too much attraction at present.

(10) Watch time 4:50 = L.A.T 4h 37′ 12″, Mag. Bear. 257 30′

Bearing Mag.	257	30′	
" psc.	258	00	
Standard Dev. =	0	30	#
" Head	45	00	
Mag. Head	44	30	

Magnetic Head	44	30′	
Steering Head	38	00	
Steering Dev.	+ 0	30	#
Magnetic Head	44	30	
Top "	47	00	
Top. Dev.	− 2	30	#

At Noon, Friday, February 18, 1916, the position of a ship making passage from Panama to Melbourne, Australia, was:

Latitude 29° 58′ 00″ S, Longitude 176° 35′ 00″ W.

She sailed thence on a course 240° p. s. c. Dev. 4° W, Var. 10° 61′ E, at knots until about 7 A. M. next day (crossing the 180th meridian during the night) when the sun was observed as follows: Watch 6h 59′ 52″ C—W 0h 07′ 20″ Chro. fast 6′ 22″ ⊙ 14° 30′ 00″, I. C. (+) 1′ 00″. Height of eye 40 feet. Bearing of sun at time of sight 90° p. s. c.

She then continued same true course and speed until Local Apparent Noon when the meridian altitude of sun's lower limb was observed to be: ⊙ 68° 55′ 00″, same I. C. and Ht. of eye as at forenoon sight.

Find:

D. R. Position at time of sight.

Day of Week and Month, Civil Date, of A. M. sight.

Line of Position (St. Hilaire) and Long. factor "F."

Long. by observation corresponding to D. R. Lat.

Compass error.

Interval to L. A. N.

How set watch to be correct at L. A. N. and remaining error.

D. R. Position at L. A. N.

True Position at L. A. N.

Set and Drift of Current.

psc. Course	Var.	Dev.	Course	Dist.	S	W	Lat. 29° 58′ 00″ S	Long. 176° 35′ 00″ W
240	+10	−4	246′	304	1237	2777	l 2 03 42	5 24 00 W
Mid.Lat. 31° S			D = 324′ W				Lat. 32 01 42 S #	Long. 178 01 00 W

W 6 59′ 52″			
C–W 0 07 20	Dev. 11 32′.5 S	14 30′ 00″	Tab. 46 +6′ 15″
	Eqt. 14 04	Cor. + 7 27	Cor. +0 12
C 7 07 12			i.c. +1 00
CC — 6 22		h 14 37 27	
			Cor. +7 27
GMT 7 00 50	Feb. 19		
Et — 14 04	t (−) 5h 21′ 10″	1 hav. 9.61876	
	l 32 01 42 S	cos 9.92828	
GAT 6 46 46	d 11 32 30 S	cos 9.99113	
Long. 11 52 4	E		
		1 hav 9.53817	Nhav .34527
LAT 18 38 50	Feb. 19		Nhav .03163
	L–d 20 29 12		

Sunday Feb. 20
6–38–50 A. M. #

F = 10f #

D = 26.4 E

Z 75 44 50
h 14 15 10
h 14 37 27 #

a 2 22 17 toward Z$_N$

Base S 84° 53′ E Nhav .37690
Cor. + 0 15

Z S 85 08 E
Z$_N$ 94 52 #

Cor. for t – 0 09
d + 0 24
L 0 00

Cor. + 0 15

8 A.M. D.R. λ 178° 01′ 00″ E
D 26 24 E

8 A.M. Obs. λ 17 27 248 E #

Z$_N$ 14° 52′
Bear psc. 90 00

Error 4 52 E

Current in Long. for 19 hrs. = 26′.4 E = 1′ 45′.6
Current in Long. per hr 1′.39 E

t for D.R. λ at 8 A.M. 5h 21′ 10″
Cor. for cur. in Long. – 1 45.0

t for obs. λ at 8 A.M. 5 19 24.4

True Course	Run p.h.	S	W	D
246°	16	6.5	14′.6	17′.3 W

Westings per hr. 17′.3 – 1.39 = 15.9

$$\text{Interval to noon } \frac{319.4 \times 15}{884.1} = 5.419 \text{ hr.} = 5h\ 25'\ 09''.4$$ #

Watch at sight	Interval at noon	Watch at noon	Set watch back
6h 59′ 52″	+5h 25′ 08″	= 12h 25′ 00″	25 mins. and it will be correct at noon

Int. to noon 5.419h, Dist. run 86.7 mi.

Course	Dist.	S	W	D
246°	86.7	35.3	79.2	93.7 W

Westings per hr. 15.9′ W
Int. to Noon 5.419 hrs.

Westings to noon 26 12 W
Obs. 8 A.M. λ 178 27 24 E

Cor. to noon DRL 177 01 12 E
= 11h 48′

8 AM DRL 32° 01′ 42″ S
l 35 18 S

Noon DRL 32° 37′ 00″ S

λ 178° 01′ 00″ E #
D 1 33 42 W

λ 176 27 18 E

Tab. 46 + 9′ 29″
Cor. + 0 12
l.c. + 1 00

Corr. + 10 41

Dev. 11 27′.9 S

☉ 68° 55′ 00″
Cor. + 10 41

h 69 05 41
s 20 54 19 S
d 11 27 54 S

Lat 32° 22′ 13″ S #

True Noon Lat 32° 22′ 13″ S
D.R. Noon Lat 32 37 00 S

l 14 47 N
.10f D 1 29 E
True noon Long. 177° 02′ 41″ E
D.R. " " 176 27 18 E
D 35 23 E
p = 29.9 min. E

Long. Cor. to noon DR LAT 177° 01′ 12″ E
For Noon True Lat – D 1 29 E

True noon Long. 177° 02′ 41″ E #

l = 14.8 N P = 29.9 E
From Table 2
Set 64° # Drift 1.36 mi. per hr.

At noon, February 11, 1916, the position of a ship making passage from San Francisco to Tasmania was Lat. 35° 53′ S, Long. 169° 10′ E. She steamed thence on course 230° p. s. c. Var. 10 E., Dev. 2° E, at 15 knots until about 7:00 next morning, when the sun was observed as follows:

For Line of Position (Saint Hilaire formula): Watch 7h 00′ 37″ C—W 1h 02′ 31″ Chro. fast -′ 12″, $\odot$ 16° 28′ 00″, I. C. (+) 1′ 00″, Height of eye 40 feet.

For Compass Deviation: Watch 7h 05′ 30″, Bearing of sun 83° p. s. c., Variation 10° E.

The ship then continued same speed and true course until near noon sights for Latitude. Due to clouds no sight of sun was obtained until after Local Apparent Noon when the sun was observed at the instant its hour angle was exactly 10′ West of the meridian and the altitude of $\odot$ was 65° 00′ 00″. Same I. C. and Height of eye as at A. M. sight.

Find:

D. R. Position at A. M. sight.

A. M. Line of Position and Long. factor "F."

Long. by observation corresponding to D. R. Lat.

Compass Deviation.

Interval from A. M. sight to L. A. N. and how set watch to be correct at L. A. N.

D. R. Position at L. A. N.

Constant to which, if the meridian altitude had been observed, it could have been applied to obtain the Lat. at L. A. N.

True Lat. and Long. at L. A. N.

psc. Course	Var.	Dev.	True Course	Dist.	S	W				
230	+10	+2	242	285	133	E251.6	L_1	35° 53′ 00″ S	γ_1	164° 10′ 00″ E
							l	2 13 48 S	D	5 15 06 W
Mid. Lat. 37° S			D = 315.1 W				L_2	38 06 48 S	γ_2	163 54 54 E

GMT 7h 00′ 37″	Dec. 14 15′.2 S	$\underline{\odot}$ 16° 28′ 00″	Tab. 46 +6′ 42″
C-W 1 02 31	Eq. t 14 24.1	Cor. + 7 57	Cor. +0 15
			l.c. +1 00
C 8 03 08		h 16 35 57	
CC — 5 12			Corr. +7 57
GMT 7 67 56	Feb. 11 t 5 20 48.5	1 hav. 9.61796	
ET — 14 24.1	L 38 06 48.5	cos. 9.89586	
	d 14 15 12.5	cos. 9.98642	

GAT 7 43 31.9
λ 10 55 39.6
LAT 18 39 11.5
t = −5 20 48.5

F = .12f #

☉

1−d 23 51 36
−Z 73 38 10
h 16 21 50
h 16 35 57

a 14 07 toward #
#

1 hav. 9.50024

Base S 84 48′ E Nhav. .31640
Cor — .18 Nhav. .04273

Z S 84 30 E Nhav. .35913
ZN 95 30

True Z

Cor. for t −0 07
d −0 13
L +0 02

Cor. −0 18

Watch at sight 7h 00′ 37″ True Z at sight 93° 30′ 94° 46′
Watch at Az. 7 05 30 Cor for 4′ 53″ −44 Comp. Z 83 00

Elapsed Time 4 53 True Z at Az. 94 46 Error 11° 46′ E
Var. 10 00 E #

D 1 46 E

D − 18′ E 8 A.M. D.R. Long 163° 54′ 54″ E + D 18′ E − 8 A.M. Obs.
λ 164° 12′ 54″ E

Current in Long. for 19 hrs. = 18′ E = 1′ 12″ t for DR. λ at 8 A.M.
(−) 5h 20′ 48″.5
" " " per hr. 947′ E Cor. for cur. in Long. −1 12
t for obs. λ at 8 A. M. −5 19 36.5

True Course	p.h. run	W	E	D
242	15	7.0	13.2	16.83E

Westings per hr. 16.83′ − .95′ = 15′.88 W

Int. at noon $\frac{319.6 \times 15}{884.12}$ = 5.4224 hrs. = 5h 25′ 20″ #

Watch at sight, 7h 00′ 37″ Interval at noon, +5h 25′ 20″ Watch at noon, = 12h 25′ 57″ Set watch back 26′ and it will then be 3″ slow. #

Int. to noon 4.4224h. Dist. run 81¾ mi. 8 A.M. DRL 38° 06′ 48″ S

Course	Dist.	S	W	D
242	81¾	38.2	71.8	91.6 W

1 38 12 S

Noon DRL 38 45 00 S #

λ 163° 54′ 54″
D 1 31 36

λ 162 23 18 #

8 A.M. obs. Long. 164° 12′ 54″ E 90° 00′ 00″ 90° 00′ 00″ Tab. 46 + 9′ 25″
D 1 26 07 W d 14 11 00 S d 14 11 00 Cor. + 0 15
l.c. + 1 00

Approx. Noon λ 162 46 47 E 104 11 00 104 11 00
= 10h 51′ 18″ L 38 45 00 S Cor +10 40 Cor. +10 40

Declination 14° 11′ S h 65 26 00 K = 104 00 20 #

δh = 3″.57	⊙	65°	00′	00″		
δht² = 5″57	Cor. +		10	40		
Run per hour in	⊙	65	10	40		
Lat = 7′ S	Δδht²		5	57		
Run in 10′ =	h	65	16	37		
1′ 10″ S.	Z	24	43	23	S	
	d	14	11	00	S	
At 12:10 PM	Lat	38	54	23	S	
Run in Lat.		—	1	10		
True Noon Lat.		38	53	13	S	#
DR " Lat		38	45	00	S	
l			8	13	S	

Westings per hour			15′.88	
Interval to noon			5.4224	
Westings to noon	1°	26′	07″	
Obs. 8 A.M. Long.	164	12	54	
Long. con. to noon DRL	162	46	47	
For South. set D =			59	
True noon Long.	162	45	48	#

February 25, 1916, the Noon Position of a ship making passage from the English Channel to Charleston, S. C., was:

Latitude 37° 25′ 00″ N, Longitude 63° 16′ 00″ W.

She steamed thence at 12 knots on course 262° p. s. c. Dev. 3° E, Var. 14° W, until 5:15 next morning when sights were taken as follows:

Leonis (Regulus), bearing Westerly, Watch 5h 14′ 52″, observed alt. of * 15° 06′ 00″.

Scorpii (Antares), bearing Southerly and Easterly, Watch 5h 15′ 04″, obs. alt. of * 26° 18′ 00″.

In each case, C—W 4h 29′ 05″. Chro. fast 2′ 40″. Height of eye 40 feet, I. C. (+) 1′ 00″.

Neglecting the ship's run between the two sights, find the Line of Position (St. Hilaire method) from each observation; and, by construction of necessary part of Mercator's Chart, plot lines and find the ship's position. Limits of Mercator chart: Latitudes 36° 10′ *N to* 30° 30′ *N, Longitudes* 67° 10′ *to* 67° 50′ W.

Scale: 1 division = 1′ of Longitude.

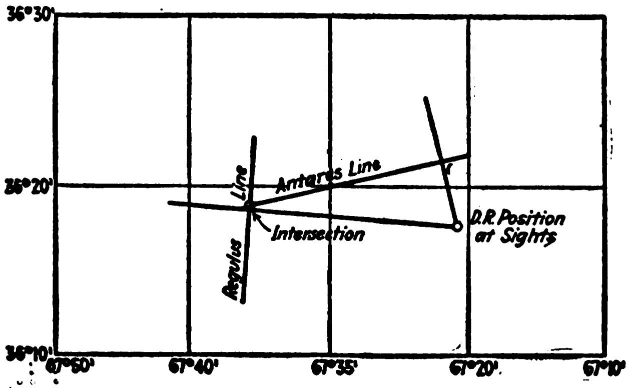
psc. Course	Dev.	Var.	True Course	Dist.	S	W	Lat 37° 25′ 00″ N	Long. 63° 16′ 00″
262°	+3	−14	251	207	67.4	195.7	l 1 07 24 S	at D 4 04 30
Mid L = t 36° 51′		D = 244′.5 W					Lat 36 17 36 N 5.15	Long 67 20 30

W 5h 14″ 52″	*Dec. 12° 22′ 30″ N	⊙	14° 06′ 00″	Tab.	46 − 10′ 10″
C—W 4 29 05		Cor.	9 00	I.c.	+ 1 00
C 9 43 57		h₁	13 57 00	Cor.	− 9 00

CC — 2 40				
GMT 21 41 17 Feb. 25	t 5h 27′ 38″.8	1hav 9.63311		
2 4 29 22 W	L 36° 17′ 30″ N	Cos. 9.90633		
	d 12 22 30 N	Cos. 9.98979		
LMT 17 11 55 Feb. 25	⊙			
Ramo 22 16 06.8	L−d 23 55 06	1hav 9.52923	N hav .33825	
Cor 3 33.8	Z 76 15 15	Base N 84° 31′ W	N hav .04299	
	h 13 44 45	Cor 5		
LST 15 31 35.6	h1 13 57 00 ⋕		N hav .38119	
*RA 10 03 56.8		Z N 84 36 W	Cor in t +0 20′	
	a 12 15 toward	Zn 275 24 ⋕	d −0 19	
*HA +5 27 38.8			L +0 04	
			Cor. +0 00	

W 5h 15′ 04″	*Dec. 26 14′ 59″ S	⊙ 26 18′ 00″	Tab.	46 −8′ 08″
C−W 4 29 05		Cor — 7 08	l.c.	+1 00
C 9 44 09		h1 26 10 52	Cor.	−7 08
CC — 2 40				

GMT 21 41 29 Feb. 25	t 0h 52′ 29″	1hav. 8.11572	
λ 4 29 22	L 36 17 36 N	Cos. 9.90633	
	d 26 14 54 S	Cos. 9.95273	
LMT 17 12 07	⊙		
Ramo 22 16 16.8	L−d 62 32 30	1hav 7.97478	N hav .00944
Cor. 3 33.9	Z 63 45 15	Base 12° 36′	N hav .26945
	h 26 14 45	Cor +32 Cor for	N hav .27889
LST 15 31 47.7	h1 26 10 52 ⋕	Sup Z 13 08	t +0 37′
*RA 16 24 16.8			d −0 03
	a 3 53 away	Zn 166 52 ⋕	L −0 02
*HA 23 07 31			Cor +0 32
t = −0 52 29			



L_1 36° 10′ N	M_1 2316.5		Intersection.
L_2 36° 20′ N	M_2 2328.9	Lat.	36° 18′ 00″ N
L_3 36° 30′ N	M_3 2341.3	Long.	67° 35′ 40″ W #

(*a*) Bearing of ⊙'s center 287° psc and 291° by Azimuth Tables. *Find Dev. and Comp. Error.* (*Var.* 12° *E.*)

(*b*) Bearing of ⊙'s center 93° psc and 88° True, Var. 8° W. *Find Dev. and Comp. Error.*

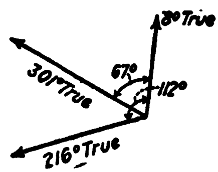
(*c*) True Course 175°, Dev. 4° E. Var. 12° W. *Find Magnetic Course and Comp. Course.*

(*d*) Comp. Course 355°, Dev. 1° W. Var. 14° E. *Find Magnetic Course and True Course.*

(*e*) Magnetic Course 300°, Dev. 3° E, Var. 12° W. *Find True Course and Comp. Course.*

(*a*) True 291°	(*b*) 88°	(*c*) True 175°	(*d*) Comp. 355°	(*e*) Mag. 300°
psc 287	93	Var. −12	Dev. −1	Dev. +3
Error +4 #	−5 #	Mag. 187 #	Mag. 354 #	psc 297 #
Var. +12	−8	Dev. +4	Var. +14	
Dev. −8 #	+3	psc 183 #	True 8 #	Var. 12° True 288°

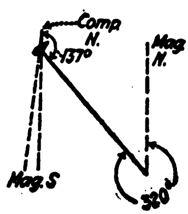
From a ship on course 264° psc, Var. 12° W, Dev. 4° E, a light bears 16° psc. The ship then changes course to NW psc, on which heading the Dev. is 2° W. *What was the relative bearing of the light before change of course? What is the Comp. bearing and relative bearing of light after change of course? How much was ship's head changed?*



2 pts. or 22° abaft stb. beam # 22° psc #.

2 pts or 23° ford stb. beam #. Changed 45° to right #.

In determining the Deviation of Compass on heading 30° in a locality where the Var. is 4° W, the bearing of the shore compass by the ship's standard compass is 137°. At the same instant the bearing of the standard compass on the ship from the shore compass is 320° *Find Dev. of Standard Compass on heading* 30°.

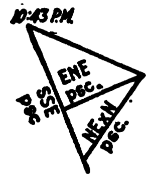


Bearing of shore from ship 140° Mag.

" " " " " 137 Mag.

Dev. 3° #.

A ship steaming at 15 knots on Course SSE psc, Var. ½ point E, Dev. ¼ point W, observes a light bearing ESE psc at 10:43 P. M. At 11:09 P. M. the same light bore ENE psc. What was the distance and true bearing of the light at 11:09. If the ship continued on same course and speed when will the light bear NE by N?



26″ at 15 knots 6½ miles #.

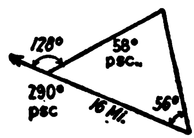
Bear psc ENE, error ¼ pt. E, true bearing ENE ¼ E #.

From Table 5A multiplier a beam is 1.50.

$\frac{6.5}{1.5}$=4⅓′ 4⅓×4=17⅓′. Time of NE×N bear 11h 26′ 20″ #.

A ship steaming at 12 *knots on Course* 290° *psc. Var.* 14° *W, Dev.* 2° *E, observes a light bearing* 346° *psc at* 11:42 P. M. *At* 1:02 A. M. *the same light bore* 58° *psc.*

What was the distance of light when abeam and at time of second bearing?

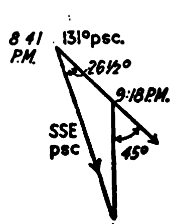


340° Dist. run 16 miles.

psc 16×.69 (multiplier abeam)=11.04 miles #.

16×.87 (multiplier 2d bear.)=13.92 miles #.

(*a*) A ship stems at 12 knots on Course 131° psc, Var. 10° W, Dev. 2° W. At 8:41 P. M. a light-house bears SSE psc. At 9:18 P. M. the same light bore 176° psc. *At what distance and time will the light be passed abeam? What was its distance and true bearing at* 9:18 P. M.?



37″ run at 12 knots=7.4 miles abeam #.

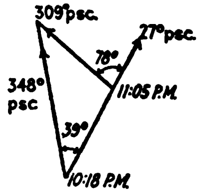
9:18 P. M.+37′=9:55 P. M. #.

1.41 (multiplier 2d bear) ×7.4=10:43 miles #.

At 9:18 comp. bear 176°, var.−10° Dev. 2°.

True bearing 9:18, 164° #.

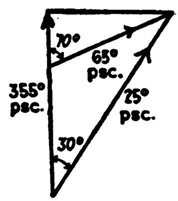
(*b*) A ship steaming at 12 knots on Course 27° psc, Var. 4° E, Dev. 5° W, observes a light bearing, 348° psc, at 10:18 P. M. At 11:05 P. M. the same light is observed to bear 309° psc. *What was the distance and true bearing of the light at the second bearing?*



In 47″ ship goes 9.4 miles #.
Comp. bear 309°. Var. +4°, Dev. −5°.
True bearing 308° #.

Solve the following question graphically without the use of table or computation. Scale: 1 inch = 4 miles.

A ship steaming at 12 knots on Course 355° psc observes a lighthouse bearing 25° psc. At 9:13 A. M., at 9:53 A. M., the lighthouse bears 65° psc. *What is the distance of the light-house at the time of second bearing and what will be its distance when abeam?*



Dist. at 2d bearing 6.2 miles #.
Distance abeam 5.8 miles #.

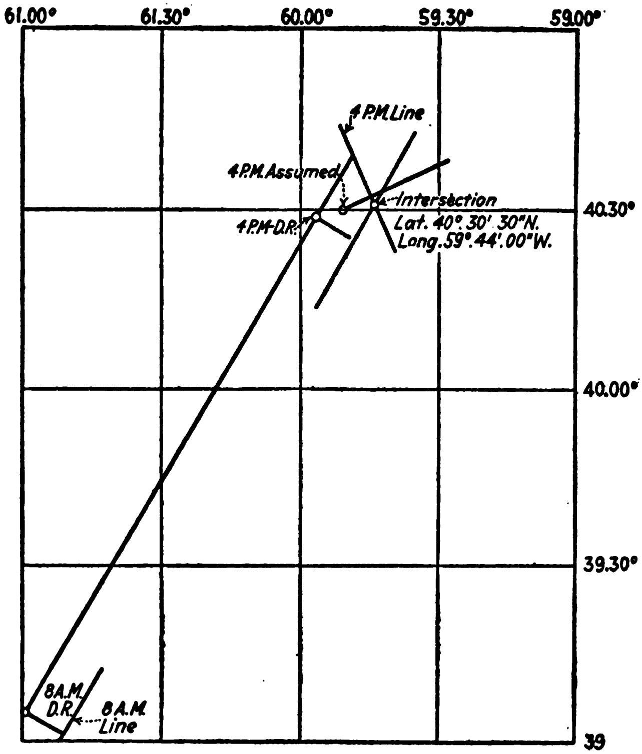
Construct a Mercator Chart showing degree and thirty-minute parallels and meridians covering 2° of Longitude, 61° W, to 59° W, between Latitudes 39° N and 41° N. Let twenty squares of the cross-section paper in the practical work-book equal 1° of Longitude.

At 8 A. M., October 2, 1915, the D. R. position of a ship was Lat. 39° 05′ N. Long. 60° 59′ W. Observed sextant altitude ⊙ at this time, 22° 12′ 30″. Height of eye 40 feet. I. C. (−) 1′ 30″. Computed altitude of sun's center for given D. R. position 22° 11′ 00″. True bearing of sun 120°. *Plot line of position on Mercator Chart*

From 8 A. M. ran 96 miles to about 4 P. M. on course 34° psc. Var. 6° W, Dev. 2° E, then took observation of sun. *Plot course of ship carry forward A. M. line of position to time of P. M. sight on chart neglecting current.*

Obs. Alt. $\underline{\odot}$	22°	12′	30″
I.C. −		1	30
D. −		6	12
P. & R. −		2	14
S.D. +		16	01
True Alt. $\underline{\odot}$	22°	18′	35″
Computed h	22	11	00

a = 7′ 35″ toward ⊙ at 8 A. M.



L.A.T	Mer. Parts	Mer. Difs.
39′ 30″	2530.2	38.6
39 30	2568.8	77.4
40 00	2607.6	116.6
40 30	2646.8	156.0
41 00	2686.2	

Data for P. M. sight: Sextant altitude ⊙ 19° 51′ 20″, height of eye 40 feet, I. C. (−) 1′ 30″. Watch time 4h 00′ 30″ C—W 3h 46′ 57″, Chro. Error 1′ 03″ slow. True azimuth 247°. *Using assumed position Lat. 40° 30′ N, Long. 59° 51′ W, work a Marc St. Hilaire sight (haversine, cosine formula).*

Plot the line of position so found on chart and pick off from chart the intersection of A. M. line carried forward for run and the P. M. line.

W = 4h 00′ 30″	Eq. t 10′ 21″.2	H.D. +.798	⊙ 19° 51′ 20″
C−W 3 46 57	Cor + 6 .2	t + 78	I.C. − 1 30
			I − 6 12
C 7 47 27	E. t 10 27 .4	6384	p+v − 2 32
CE 1 03 slow		5586	S.D. + 16 0
GMT 7 48 30 Oct. 2	Dec. 3. 15′ 20″.7 S	+62244	h 19 57 07
Long 3 59 24 W	Cor 7 34 .3 S	H.D. 5° 8′ 2″.5	
	d 3 22 55 .0 S	t + 78	
LMT 3 49 06		46600	
Eq. t + 10 27.4		4.775	
LAT 3 59 33.4		−454350	

t 3h 59′ 35″.4	L haver 9.39648	
L 40° 30′ 00″ N	L cos 9.88105	
d 3 22 55 S	L cos 9.99924	
⊙		
L − d 43 52 55	L haver 9.27677	N haver .18913
Z 69 58 10		N haver .13969
h 20 01 20	Z = 247°	
⊖ 19 57 67		N haver .32874
a 4 43 = 4.7 miles away from Sun (See intersection on chart).		

On a ship swinging to a short scope of chain, bearings of a distant object (per standard compass) and headings per standard and steering compasses were observed as follows:

Head p.s.c.	Bear of Dist. Object p.s.c.	Head per Steering Comp.
0°	25°	18°
45	27	63
90	40	102
135	46	139
180	39	172
225	31	190
270	28	248
315	28	329

Find the Deviations of the Standard and the Steering Compasses on the headings given.

Head psc.	Bearing psc.	Dev.	Stand.	Head Mag.	Head Steer.	Dev. Steer
0°	25°	Mag Bear 33°	+ 8	8°	18°	−10
45	27		+ 6	51	63	−12
90	40		− 7	82	102	−19
135	46		−13 *	122	139	−17 *
180	39		− 6	174	172	+ 2
225	31		+ 2	227	199	+28
270	28		+ 5	275	248	+27
315	28		+ 5	320	329	− 9

At sea, May 20, 1916, P. M.: Latitude 37° 20′ N, Long. 51° 50′ W; C—W 3h 24′ 28″, Chronometer slow 4′ 10″; while swinging ship for compass deviations, data were obtained on four equidistant compass headings as follows:

Head p.s.c.	Watch	Bearing Sun p.s.c.	Bearing Sun True
0°	4h 51′ 56″	282°	?
90	....	282	278° 20′
180	....	264	279 10
270	....	267	280 00

Assuming the constant Deviation (" A ") to be zero, find the Compass Errors, Variation by observation, and Deviation on the headings given.

W	4h	51′	56″	Lat 37 20′ N		
C−W	3	24	28	Dec. 20 02 .6 N		
C	8	16	24			
CC	+	4	10			
GMT	8	20	34	May 20		
E t	4	3	37.8			
GAT	8	24	11.8	Z_N = 277 25′ #		
Long	3	27	20 W			
LAT	4	56	52			

Head psc.	Bear psc.	Bear true	Error	Dev.
0°	282°	277° 25′	− 4° 35′	− 9° 34′
90	282	278 20	− 3 40	− 8 39
180	264	279 10	+15 10	+10 11
270	267	280 00	+13 00	+ 8 01
			19 55	
Observed Variation			+ 4 59 E	#

Briefly tell how to place correctors of semi-circular deviation to compensate on headings 90° and 180°.

Fore and aft correctors. Red ends aft #.

Deviation easterly athwartships correctors, red ends to port #.

At sea, May 20, 1916, about 4 A. M.: Position by D. R. Latitude 35° 20′ 00″ N, Long. 70° 05′ 00″ W; observed the * α Bootis (Arcturus) for line of position as follows:

Watch 4h 00′ 15″ C—W 4h 27′ 12″, Chronometer slow 2′ 20″ *'s obs. h 17° 50′, I.C. (+) 1′ 00″, Height of eye 40 feet.

Find the Line of Position by St. Hilaire formula; the Longitude Factor " F " and Longitude by observation corresponding to D. R. Latitude.

W 4h 00′ 15″	*RA 14h 11′ 51″.9	Obs. h 17 50′ 00″	Tab. 46 −9′ 12″				
C−W 4 27 12	*Dec +19 36.′9	Cor. − 8 12	I.c. +1 00				
C 8 27 27		h 17 41 48	Cor −8 12				
CC + 2 20							

GMT 20 29 57 May 19	t 5h 28′ 13″.6	= l ihav 9.63437	
RAMO 3 47 19 .4	L 35 20′ 00″ N	= l icos 9.91158	
Cor 3 22 .1	d 19 36 54 N	= l icos 9.97404	
	⊙	= l ihav 9.51999	
GST 0 20 26 .5	L−d 15 43′ 06″		Nhav .33112
Long 4 40 20 W	Z 72 31 10		Nhav .01869
LST 19 40 06 .5	h 17 28 50		
*RA 14 11 52.9	h_1 17 41 48		Nhav .34981
	a 13 00 toward		From Tables
*HA 5 25 13 .6			Z = 252 00′ #
F = .26f #			

		D. R. Long 70 05′ 00″ W
	Lat 35 20′	D 16 18 W
p = 13.3 mi		
D = 16 .3 W.	Long Cor. to D.R. Lat	70 21′ 18″ W #

May 20, 1916, A. M.: As part of a Day's Work, a navigator found his 8 A. M. D. R. position run up from noon yesterday to be Lat. 38° 35′ N. Long. 71° 24′ W. The A. M. sight taken when the watch read 7h 59′ 50″, C—W 4h 22′ 18″, Chronometer slow 4′ 10″, I. C. (+) 0′ 40″; height of eye 40 feet, after being worked out, showed that the Longitude by observation corresponding to the D. R. Latitude was 71° 04′ and the Longitude Factor was .1 the sun bearing Northeasterly. From A. M. sight the ship steamed at 15 knots on Course 323° (true) until L. A. N. At L. A. N. the altitude of the sun's lower limb bearing southerly was observed to be 70° 14′ 45″, same I. C. and height of eye as at A. M. sight.

Plot roughly the D. R. Position and Line of Position.

Find the interval from A. M. sight to L. A. Noon.

Find the true Noon Position.

§ Long. Cor. 8 a.m. D.R Long 71 24′
to Long. Cor to 8 a.m. DR Lat 71 04′

Interval
254.32×15 = 4.2892 = 4h 17′ 21″ §

889.4 D]
Change in Long 8 a.m. to L.A.N.

Lat current in λ 20 hrs. 20 E
current in λ per hr. 1 E

−W	7h	59′	50″	
C−W	4	22	18	
C	0	22	08	
CC	+	4	10	
GMT	0	26	18	May 20
Et	+	3	38.9	
GAT	0	29	56.9	
Long	4	44	16	W(obs.)
LAT	19	45	40.9	
t	4	14	19.1	
⊙	70°	14′	45″	
Cor	+	9	59	(Tab. 46)
h	70	25	44	S
Z	20	00	42	N
d	20	00	42	N
Lat	39	35	58	at Noon F = .1, D = 57″ W

Course run per hr N W D
323 15 12 9 11.6 W
hav = 39°

Change in Long p.h. = 10′.6 W

8 a.m. DRL	38	35′	00″	N
•		51	28	N
Noon DRL	39	26	28	N
True noon L	39	35	58	N
DR noon L	39	26	28	N
l		9	30	N

4.29h × 10.6′ W = 45′ 28″
8 a.m. obs. λ 71 04 00″

Long. Cor to noon DRL
71 49′ 28″ W
4h 47′ 18″

λ Cor. to DRL	71°	49′	28″	W
D			57	W
True Noon λ	71	50	25	

STRATEGY AND TACTICS

"**Strategy** shows the best way leading to the battle; it tells **where** and **when** one ought to fight." (Includes policy and diplomacy, preceding a declaration of war, which may have no apparent direct bearing on declaration.)

"**Tactics** teaches how to use the different arms in fighting; it tells **how** one ought to fight."

War is the combination of the two, but is based primarily on "plans devised in accordance with reasoned principles," hence **strategy.**

In other words, **strategy** is summed up in foreseeing and preparing for every eventuality (diplomacy, material, personnel, logistics) that ability, work and patience can accomplish, whereas **tactics** (in **contact** with enemy), means "to come up with, to engage, to **destroy.**"

An example of **strategy** is a planned building program of various types of war vessels, covering a limited period of years, to meet the emergencies that that nation will have to face due to its foreign policy.

An example of **tactics** is a thorough indoctrination of personnel under the most able **leader** of men, as long as he **is** able. **(There are no generalities**—a commander-in-chief must know the capabilities (details) of his command, before he is either able to take up the strategy or psychology of his duties.)

"When war is begun, strategy shows when it is to be carried on, and tactics, how to conduct it so as to defeat the enemy."

Strategy is taught by study of the past (which is the only way that the future can be judged) and is best exampled by observation. (Actual practice and War College.)

Tactics, as regards the ship, is largely a question of personal study and "trial and error," looking for such characteristics as concentration of gun fire on various bearings, steaming radius, and mobility, and visibility.

A **fleet** is composed of:

1. Main Body = Dreadnoughts.
2. Screen = Battle Cruisers.
3. Destroyers = First Attack.
4. Submarines (sea-going) = Second Attack.
5. Train = Auxiliaries.
6. Mine Layers and Mine Sweepers = Third Attack.

The **object** of dreadnoughts is to render the final decision. The **object** of a battle cruiser is that of a fast wing to harry enemy main body on day of decision, but more than that to screen own main body from enemy and to drive in enemy screen so that enemy main body must needs take battle formation (prepared for immediate action), whereas own main body may cruise in any formation and select time of attack.

The **object** of destroyers is to annihilate enemy main body before same arrives own main body. For this reasonable desire, two or three nights should be available before the main action. (Steaming radius of modern destroyer with reduced gearing about 6,000 miles at 15 knots, carrying 6 to 8 torpedoes, with re-loads.)

The **object** of sea-going submarines is to accompany fleet. Attack enemy main body night before main body action or day of main body action. (If destroyer and submarine flotillas are properly **indoctrinated,** main body question should be comparatively simple on day of final decision.)

The **object** of sea-going submarines is to finish on the day of battle what the destroyers have failed to do.

The object of the **train** is to supply the fleet with its needs, away from a fixed base. In other words, it makes the fleet **mobile,** or makes it a **fleet.**

The **mine laying** and **mine sweeping** unit is more or less an offensive-defensive unit.

In U. S. Navy, functions of destroyers are: (1) attack (initial proper function), (2) scouting and screening (see battle cruisers), (3) escort duty, mine laying, and mine sweeping.

Darrieus speaking of Suffren's campaign in India said: "To be able to carry on a war to the death, the French fleet had to have what is nowadays called a *point d'appui*, and has always been a base of operations."

The necessity of a base of operations is well shown in modern times by the diary of Count Von Spee:

" This everlasting worry about coal, with not a single base to turn to, is disgusting. Once the supply goes out entirely, it's all over.

" After the long voyage through the tropics we have now come into a very cool climate, and there is lack of warm clothing. For the crews, however, especially the stokers, it is a great relief.

" In a sea fight, I think, the tasks of the sailor and stoker are considerably more difficult than those of the infantryman and artillery soldier. Patriotic, inspiring enthusiasm means much more to the soldier, particularly in attacks, than it does to the sea fighter. With us all sentiment and feeling take a back seat and cool, calculating reason is the watchword. The naval officer's task, unlike that of the leaders on land, is to keep his men cool.

" Apart from the officers the man who plays the most important part in a naval battle and who has the claim to the lion's share of victory is the man who removes the general disturbances which, during the battle influence the floating and moving capacity of the ship."

A naval surgeon tells of his last meeting with Count Von Spee, off Valparaiso, whence the Count's squadron steamed to the Falkland Isles. He says:

" Our visit on board the flagship lasted two hours. When we parted Admiral Von Spee remarked: 'Perhaps we will not meet again.' He added that he had a certain premonition that some day he would share the fate of the British who were shortly before sent to the bottom by him.

" 'You must not forget, doctor,' he said, 'that I am absolutely without home or base. I cannot go to Germany, and we have no other safe port anywhere in the world. I must rove about the seas and do as much damage as I can until our ammunition is spent or until a superior enemy squadron gets me. But it will cost them some heavy sacrifices before they dispose of me.' "

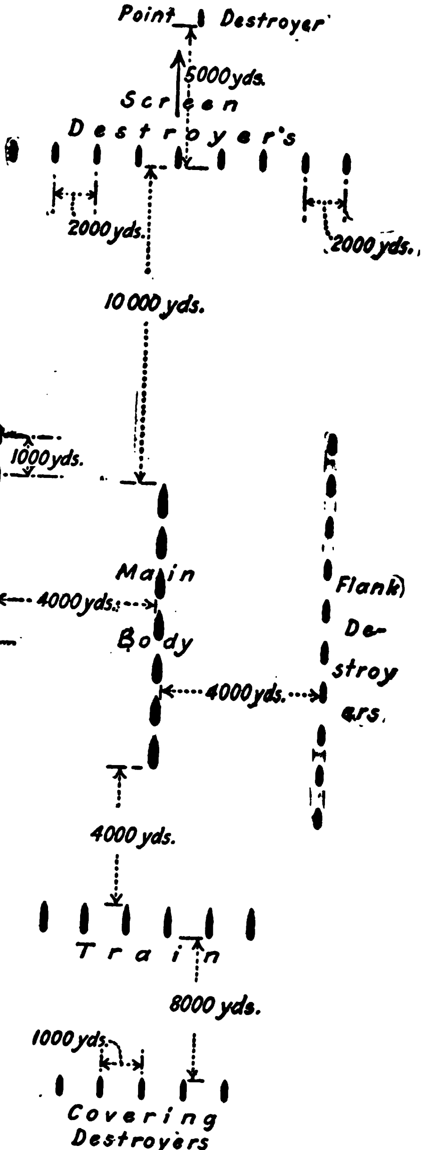
Synopsis of Jutland.—That the British attacked battleships with battle cruisers and armored cruisers is their own affair. They doubtless had what they considered sufficient reasons for doing so; but we may rest assured that this was done with the full knowledge of the probable nature of the sacrifice, and not with the idea that these vessels are a match for battleships; and if the conditions as to visibility had been better the sacrifice might well have been justified by success in engaging with the German main fleet. At all events, battle cruisers proved that in case of necessity they can fight a **delaying action** against battleships with reasonable chances of success.

There is nothing, however, in the incidents of the fight to justify any argument against the necessity for battle cruisers. When for any reason they are deliberately put against battleships they must expect to suffer in proportion to the relatively small number of their guns and the relative lightness of their armor. It is the same with all other types of vessels. If in this battle it had been considered to launch flotillas of unsupported destroyers against the enemy's battleships in daylight, and half of them had been destroyed, there would doubtless have been some arguments in opposition to building any more destroyers—and these arguments would have been precisely as sound as the popular arguments now current as a result of the sinking of the three British battle cruisers.

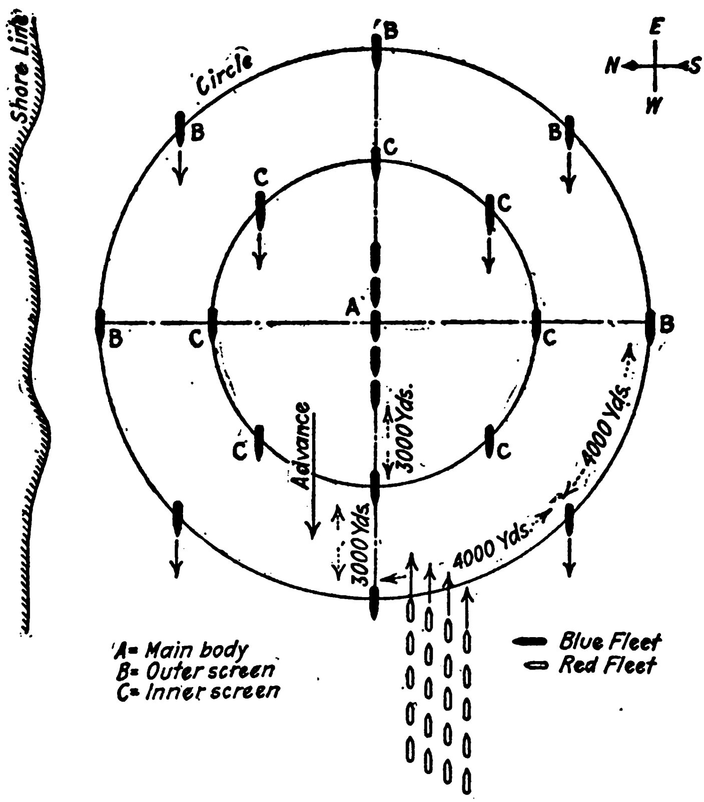
Indoctrination.—The thorough imbuing in subordinates of the battle plans and method of action of the leader. Drilled into subordinates in **preparation** for action, hence in time of peace.

" A wise leader, who has made known to his subordinates the main purpose in view and the general plan of action, will leave to their provision and supervision, in so far as possible, all details of the operations to be undertaken, thus availing himself of the opportunity to cultivate in them, initiative and decision of character. Such action on the part of their leader will not fail to inspire the commanders of the detachments to greater effort, through the confidence displayed in their ability to cope with such situations as may arise in the immediate vicinity of their respective commands."

Doctrine is **not written**, but is a bond of mutual understanding governing the application of principles to circumstances—a forwarding of the general plan, gained by **conference, observation,** and **common sense.** Use your initiative and help out your " next astern."



Fleet Screen for Cruising.



Advance enemy = Westward, speed 12 knots.

Destroyer attack in column divisions in echelon on apex enemy advance.

SMOKE SCREEN

This subject is worthy of the most careful investigation by trial and error as being of inestimable value as a maneuver on the day of action.

The value and utility of a smoke screen cannot be fully appreciated until it has actually been seen in action. The characteristics and advantages of a smoke screen are briefly: (1) Lay an impenetrable blanket on the ocean, (2) screen two miles long laid in four minutes (destroyers making 1,000 yards a minute), (3) density hardly weakened at all in five miles (10,000 yards), roll down to leeward, (4) no preparation necessary and can be made at a moment's notice, (5) can be made best with "dead" boilers, hence does not affect speed of destroyers under two steaming boilers (24 knots).

Its utility can probably be best described by orders issued relating to it, which were and are **orders of fact.**

"1. Searchers use smoke only after having concentrated in groups and **during an attack from windward** of enemy; or when withdrawing from an attack from either to windward or leeward of enemy." (Double purpose of attack and protection.)

"After withdrawing from attack keep clear of Reserve Division. This is for the purpose of determining the utility of smoke in protecting attackers from gun fire."

TO MAKE A SMOKE SCREEN

Destroyer: Normand Boilers, Bureau type burners, 8 to a boiler, or Thornycroft with 14 burners running on 4 (all boilers, smokeless, at about 25 knots, using three-fourths of burners. Orders to make smoke screen.

Slow down blowers to reduce air pressure and volume. Heavy black smoke is made in burning oil by insufficient air.

Cut out oil heaters. Cold oil makes smoke more readily than hot oil.

Increase oil pressure, use all burners if all were not used at first. Wing burners make smoke more readily than center. Increasing oil pressure will probably make the center of combustion not in the center of the boiler, but nearer the back wall, or perhaps on it, causing greater smoke.

In brief, increase oil and decrease air, this will cause heavy black smoke, use cold oil and all burners. Air must not be reduced so that there is danger of flare backs, or blowers must not be stopped, but kept turning over.

In laying smoke screens the speed of ship and force and direction of wind are important.

(1) *How repel an attack by aeroplane, single ship, (2) in fleet?*

A single ship will probably not be accompanied by her own seaplanes, but as modern battleships carry two small planes, these should be launched immediately for a counter attack on enemy seaplanes. Battleship immediately takes up zigzag on sighting strange plane and raises steam to full boiler power preparatory to rapid changes in speed. If destroyer escort is present, destroyers open well out on the flanks prepared to establish cross fire on enemy planes, as favorite method of attack is for planes to approach head on, dipping at the last moment to bomb her adversary. Battleship should establish zone fire with her own battery as far as practicable.

In case of fleet attack by enemy planes, the best defense is a counter attack by own escorting NC boats. A scout plane well in advance of fleet will warn fleet of enemy approach by radio. Fleet should "spread" immediately by divisions, raising steam as they do so, take up zigzag, and prepare to take up zone fire by divisions with anti-aircraft guns on previously arranged plan. Destroyer screen open well out on flanks by divisions prepared to take up crossfire, while van destroyer divisions proceed at full speed in direction of enemy planes and endeavor to intercept same with attack following and supporting our own seaplanes.

State the general disposition of a fleet in blockading a fortified harbor. What effect has radio, submarines and mines on blockading?

Wide semi-circle during daylight, out of range and sight. Close in at sunset. Picket boats close in at night supported by destroyers.

Radio of no effect for prolonged message on account of interference.

Enemy submarines would widen blockade and keep same moving back and forth, likewise increase pickets.

Enemy mines should be swept by mine sweeping division or destroyers—no effect. Mine sweepers used early morning and at twilight.

State the principle which governs the development of maximum gunfire.

Keep your line of bearing normal to bearing of enemy's center.

ORDNANCE

Explosives Usually Found on Board a First-class Battleship, and Their Use, Stowage, and Special Precautions to be Taken in Caring for Them

Notes.—(1) The list of special precautions does not include the ordinary items of care, such as care in handling, avoidance of unnecessary handling, avoidance of exposure to sun's rays, etc., such as are necessary with all explosives.

(2) The special precautions enumerated below in regard to the different explosives mentioned are as now given in the Naval Instructions and other official publications.

Explosive	Use	Stowage	Precautions
Smokeless powder.	In guns as a propellant.	Magazines and fixed ammunition rooms. For different calibers to be stowed in different magazines. Not to be stowed in same magazine with black powder (except ignition charges). Small arms ammunition to be stowed by itself. Fixed ammunition in cases containing primers to be stowed by itself in separate magazines.	Magazines to be always kept below 100° F.; not to habitually run above 95°, and to be kept below 90° if possible. Impure air and excessive ether fumes to be blown out of magazines. All containers of powder to be kept air tight. **Daily Test.**—Visual of violet paper and samples; and inspection of charges for local heating. **Fortnightly Test.**—Visual examination of one or more charges of each index. **Monthly Test.**—65.5° C. surveillance test on indexes giving 30 to 39 days. **Monthly Test.**—65.5° C. surveillance test on all indexes that give a test of less then 30 days.

Explosive	Use	Stowage	Precautions
			Bi-Monthly Test.—65.5° C. surveillance test on all indexes that give a test of 30 to 39 days. **Quarterly Test.**—65.5° C. surveillance test on all indexes that give a test of 40 to 59 days. **Semi-Annual Test**—65.5° C. surveillance test on all indexes that give a test of 60 days or more.
Black powder.	Saluting, signal, and fog guns.	In tanks in separate magazine by itself; sufficient quantity for signal and fog purposes to be kept on deck when underway in formation.	No special precautions.
Black powder.	Bursting charges for shell, etc.	Stowed in shell in shell-rooms and in fixed ammunition rooms.	No special precautions.
Black powder.	Ignition charges.	Made up as part of charges and of course stowed with them.	No special precautions.
Explosive "D."	Bursting charges for armor piercing shell.	Stowed in shell in shell-rooms and in fixed ammunition rooms.	No special precautions.

Explosive	Use	Stowage	Precautions
Gun primers.	For firing guns.	For breech loading guns in small arms magazine or fixed ammunition room. For fixed ammunition they are in place in cartridge cases.	No special precautions.
Fuses and tracers.	For exploding projectiles, and for tracing flight.	In shell and of course stowed with them; spares stowed in small arms magazine or fixed ammunition room.	No special precautions.
Dry guncotton primers.	Primers for torpedo war heads and mines.	In special cases on bulkheads, etc., in compartments as high up as possible, never below water line. No two to be within 10 feet of each other; no detonators to be near. To be in dry, cool place. Not to be near guns, galley fires, steam coils, etc.	Keep cool and dry. **Weekly Inspection.**—Visual of litmus paper and primers. **Monthly Inspection.**—Visual of litmus paper and primers; change litmus paper.
Wet guncotton primers.	To dry out to make spare dry primers.	Either in wet guncotton room or in cases located like those for dry primers.	Same as for war heads, etc.
Wet guncotton.	Torpedo war heads and mine charges.	In war heads and mine charge cases in special wet guncotton room constructed for the purpose.	**Quarterly Inspection.**—Weigh all charges and make up and loss of moisture by weight.

Explosive	Use	Stowage	Precaution
			Annual Inspection.—Same as quarterly. The instructions say that "at all shore magazines and **as far as possible** on board ship, samples will be taken from packages that have been loaded one year and given heat test," but this is not possible with the charges usually furnished ships.
Detonators and exploders.	For exploding torpedo war heads and mine charges.	In the special boxes provided, either in the tops or under them, or under the upper bridge; never near any other explosive.	No special precautions, except keep out of sun.
Private ammunition.	Use of officers; shot gun charges, etc.	In the proper magazine according to its character. It must never be left in the stateroom, etc., of the owner.	No special precautions.
Very's stars, rockets, etc.	Signals.	In boxes under upper bridge and around chart house; never in storerooms, etc., below.	No special precautions.

In addition to the above-mentioned explosives, there will soon be issued trinitrotoluol charges for war heads and mine charges, as a substitute for guncotton. No special precautions are necessary in the care of this explosive.

For full details as to the care, inspection, etc., of explosives, consult Chapter 26, Naval Instructions, 1913, and the various other official publications covering the subject.

MANUFACTURE OF SMOKELESS POWDER

The type of cotton used varies with price, amount on market, etc. At present, 1916, Massasoit short fiber cotton is used largely for great gun powder. This cotton is purified by boiling with caustic soda before picking.

The reason for picking is that the mass of cotton must be loosened as much as possible, as a lump will cause the whole to ignite when being nitrated.

It must be dried as moisture has same effect.

In drying 100° C. is now used, and the final moisture is usually less than 1 per cent.

Process of manufacture is summarized as follows:

Picking = to grind and remove foreign matter.

Drying = dried 8 hours at 105° C. to reduce moisture from between 4 and 6 per cent to 2½ per cent.

Nitrating = 30 pounds of cotton immersed in H_2SO_4, HNO_3 and oxides for 20 minutes. Weight when dry, after wringing, increased to 41 pounds of nitrated cotton or pyro.

Drowning = to remove free acids.

Boiling = 1000 pounds of pyro boiled 40 hours at 100° C. and washed five times to further remove free acids.

Pulping = 1025 pounds of pyro, or 25 wringer charges, to one pulper charge. Ground from 8 to 12 hours in contact with water to break up tubular cotton fibers. Water baled off through baler.

Poaching = 3075 pounds (three pulping charges) of dry pyro for one poaching charge. Boiled 12 hours at 100° C., and water charged five times. Washed ½ hour and drained 1 hour 10 times.

Testing = sample of pyro is chemically tested by heat test in laboratory.

Wringing = pyro is wrung in cotton-towel-lined wringers.

Dehydrating = charge of pyro submitted to pressure of 200 pounds per square inch to force out water. Alcohol then forced through charge under 75 pounds pressure until water is forced out. Charge then caked by 3000 pounds pressure maintained from one to three minutes.

Mixing = 100 pounds of dehydrated pyro in a charge. First ground by knives for 10 minutes. Ether, alcohol, and diphenylamine added, and charge again mixed for 30 minutes. Diphenylamine is previously placed in the ether in the proper amount which is equal, by weight, to .45 per cent of the dry pyro, or to .4 per cent of the finished powder. Now a plastic mass of nitro-cellulose. Taken out into three cans.

Note.—Diphenylamine, a basic compound, is a pale yellow, solid, soluble in alcohol, benzene or ether. It is obtained by heating aniline with aniline hydrochloride at 250° to 260° C. It absorbs nitrous vapors readily, thus preventing an accumulation of vapors, the pressure of which would tend to generate more. Powder is thus rendered indefinitely stable.

Pressing = pressure of 1000 to 2000 pounds applied, cakes are forced through 3/32-inch holes in strainer press. Thence to blocking-press, where it is again caked. Then forced through die press, from which it emerges of the desired diameter, with seven holes in the rod. The rod is cut into grains of the desired length. After cutting, the grains are hand sorted—an expensive process—and irregular, distorted and otherwise defective grains are removed.

Solvent recovery = Powder submitted to hot air for 96 hours at temperature of 30° C. to 39° C. Loses 30 per cent of its weight in volatiles. These volatiles are recovered by condensation.

Drying = green powder dries from 2 to 2½ months at air temperature. Then dried at 40° C. from 2 to 4 months.

Airing = left 24 hours in the blending house to absorb a normal amount of moisture from the air.

Blending = 100,000 pounds of powder in one blending charge (4″ and above) and 50,000 pounds (3″ and below). Blended to get all the powder of one index of an even mixture, so that any two bags of equal weight will give the same initial velocity under similar conditions.

Boxing and Weighing = placed in air-tight boxes, weighed, marked and stored ready for shipment.

What draws the line between cellulose of high and low nitration? At what percentage of nitration does this occur?

Guncotton is of several varieties, depending upon the degree of nitration the cellulose attains in the process of manufacture. A fairly sharp dividing line may be drawn between the grades of "high and low nitration" in that the latter are soluble in a mixture of ether and alcohol at ordinary temperatures, while the former are not. This division occurs when the percentage of nitrogen amounts to 12.75; above that point guncotton is insoluble. Guncotton containing less than 12.75 per cent nitrogen may be perfectly dissolved into a jelly substance, which, after the solvent is evaporated off, becomes a hard, tough mass. In this condition, it burns regularly in parallel layers without smoke; it may be pressed into any desired shape, and it cannot be detonated. This material, pressed into grains of the required form constitutes the U. S. Navy smokeless powder.

A clear distinction must be made between guncotton **proper**, which is used as a high explosive and that from which smokeless powder is manufactured. Nitration is stopped at bi-nitro for the guncotton that is to be used for smokeless powder.

Smokeless powder is now used for all purposes in the Navy except for saluting charges, ignition charges, and bursting charges. The form now issued for all guns is a singly-perforated or multi-perforated (7 holes) cylinder.

THE MANUFACTURE OF GUNCOTTON

Cotton.—Guncotton is generally made from unspun cotton waste, which is usually supplied in a purified state. A purification is necessary for the reason that the raw fiber has a thin coating of vegetable wax, giving it a waterproof character that hinders saturation by solutions. To remove this wax and other impurities the cotton is scoured by boiling with caustic soda and soda ash, which decomposes the wax and impurities into soluble substances that are removed by washing. In another washing bleaching powder is added to improve the color. Several boilings in clean water are now given in order to remove all the purifying materials and salts, after which the cotton is dried, compressed into bales, which are covered with heavy paper wrappers to protect them from dirt, and is then shipped to the manufacturer.

Picking and Drying Cotton.—The cotton when received is filled with knots and rolls being badly tangled from the purification treatment. In order that the nitrating acid may have ready access to every part of the fiber these tangles must be loosened, and this is done by passing the cotton through the picker, when it passes between two horizontal cylinders rotating in opposite directions both armed with teeth, and over a large wooden-toothed drum. The cotton is thus untangled and separated into small fluffy wads. The cotton is then dried at a temperature of 200° to 230° F. for 8 hours in the final drying room, at the end of which time it contains on an average about .5 per cent of moisture. Drying completed, the cotton is weighed into small lots the size of which has been designated specifically as being suitable for obtaining the proper degree of nitration with the quantity of acids to be used. These charges are then placed in air-tight containers.

Nitration.—The cotton then goes to the nitrating house. The acid mixture is approximately by weight one part of nitric to three parts sulphuric. The nitration or dipping is performed in a covered crock or jar made of stoneware and glazed inside and out. The mixed acid is run into this crock from an acid measure or receiver, and small cylindrical cast-iron vessel of 3½ gallons capacity. The top of this receiver is closed by a flange in the shape of a saucer having in its center a short 2-inch pipe into which dips a smaller pipe connected with the acid tanks. The base of the receiver is hemispherical with a discharge pipe fitted with a shut-off to convey the acid to the nitrating crock. In the nitration the mixed acid is run into this receiver through the pipe in the top until it overflows and shows clear without froth in the receiver top, this overflow being caught by the saucer-like top and run off through a pipe in the side. The weighed charge of the dried cotton is then thrown into a box supported on a wooden stand just above the nitrating crock. The cotton is now forked through an opening in the base of the cotton box into the crock being thoroughly and rapidly worked into the acid which at the same time is running in from the acid measure until the measure is emptied. The crock is now covered and carried to the cooling troughs being there kept cool by running water for 20 to 24 hours. This process is called "digesting." All this period the cotton and acids are working upon each other, the heat of the action being kept low by the water in the troughs. The building in which this process is under way is full of the biting fumes of the mixed acids. The sulphuric acid takes care of the water in the cotton thus maintaining the nitric acid at full strength while it is saturating the cellulose structures of the cotton. At the end of this period the crocks are emptied into an acid centrifugal wringer and the acids wrung out, they being piped to the "spent" acid tanks from which they are used again in the manufacture, being brought to required strength by "fortifying" acids. From the wringer, the guncotton, for the cotton has now become such in an unpurified state, is thrown into a long wooden water-filled trough, from which it is taken to the boiling tubs.

Purification.—After washing several times in clean water, the guncotton is boiled for a total of about 50 hours with several changes of water. It then goes to the pulper. To pulp the guncotton to the required state of fineness requires from 8 to 12 hours, the guncotton being continually washed during the process. The guncotton is then run into the poachers, boiled with and without soda several times and in several waters and finally washed with many changes of water.

Test.—On the completion of these washings a sample is taken to the laboratory and tested for stability and nitrogen content. Its nitrogen content must be between 13.15 per cent and 13.45 per cent. Its stability must be such that it, without sign of decomposition, stands a potassium iodide starch paper test at 65.5° C. for 35 minutes plus, and a litmus paper test at 135° C. for 30 minutes plus, and at this latter temperature must not explode under 5 hours. If stability is unsatisfactory the guncotton is given further purification treatment in the poachers.

Pressing.—If tests are satisfactory, the guncotton is emptied into the "stuff" chests, from whence it is drawn as required, given a preliminary pressing, and then the final pressing by which it is formed into the different shaped blocks required.

TRINITROTOLUOL, TRINITROTOLUENE, TNT, TOLUOL, OR TROTYL

Historical.—This substance has been adopted as the standard high explosive for torpedoes and mines by several countries, notably Germany, England (1911), France, Italy, Spain, Brazil, and Turkey.

Its first practical application was in Germany, where it is called Trotyl.

Present use of TNT in U. S. Navy:

(*a*) For charges in Mines Mark III and IV.

(*b*) For primer charges in Mines Mark III and IV.

(*c*) Practically all primer charges in Mines Mark II.

(*d*) All new construction torpedoes (Charge and primer).

Notes.—The mine charge for the Mark III and IV mines is made in cast form. The density being 1.5.

The primer charge for Mark II, III, and IV mines are made up of granulated TNT. The density being 1.0. The primer weight equals 2 per cent of the charge.

The war head charge of all torpedoes now under construction will be made up of cast TNT.

The primer charge of all torpedoes now under construction will be made up of granulated TNT.

The weight of primer for a 300-pound war head charge is 5 pounds.

Up to the present it has not been possible to replace the dry guncotton primers, in old torpedoes, with granulated TNT, as the primer case has not sufficient capacity to hold enough TNT to detonate the wet guncotton charge.

The dry granular TNT priming charge for torpedoes and mines is put up in a brass container of about .04" in thickness.

Properties.—The excellent properties of this substance may be summarized as follows:

(*a*) Chemical stability.

(*b*) Lack of chemical attraction.

(*c*) Safety and innocuousness during manipulation.

(*d*) Non-hygroscopicity and absence of fire risks.

(*e*) Insusceptibility to shock and blow (*f*) Its explosive force is 4 per cent less than that of Explosive "D," 10 per cent less than that of picric acid and 50 to 75 per cent greater than wet cotton charge.

General Description.—Trinitrotoluol is obtained by step-up nitration of toluene or toluol and dinitrotoluol according to known methods.

Toluene is a liquid substance, colorless, boiling at 110° C., which is obtained from the distillation of coal tar. It was discovered in 1838.

In order to obtain the highest purity, the trinitrotoluol is finally dissolved and recrystallized, yielding an end product free from impurities and low-grade nitro bodies.

Appearance.—It is a fine, yellowish crystalline powder when in granulated or compressed state, which changes to a deep brown when cast. Trinitrotoluol is non-acid in reaction, non-poisonous during manipulation and does not stain.

Non-vaporous.—During casting, no vapors are given off and no froth is formed. This renders the operation of filling war heads and mine charges less troublesome than does guncotton.

Stability.—Trinitrotoluol is a perfectly stable body, and neither exposure to the atmosphere nor contact with metals will affect it.

Melting Point.—The melting point of chemically pure trinitrotoluol lies between 80° C. and 80.6° C., according to the methods employed.

Absorption of Water.—It is non-hygroscopic and practically insoluble in cool water. Either in compressed or cast state it is equally impermeable to water; consequently it does not lose its aptitude of explosion through absorption.

Preservation.—No special means of preservation are, therefore, necessary either during storage or when filled in war heads or mine charge cases, but unprotected charges would, if immersed in water for any length of time be subject to the corrosion and weed growth of the sea, like any other submerged body.

Inflammability.—Under normal conditions trinitrotoluol is but slightly inflammable. When flame is applied to a mass of the explosive it melts, takes fire, and burns quietly with a heavy black smoke. Its aptitude of detonation is highest for the granulated, somewhat lower for compressed and the lowest for the cast material. For this reason a granulated or compressed charge is used for completely detonating charges of the cast material. Its ignition point is 180° C.

Detonation.—Electric or percussion detonators are used to detonate trinitrotoluol. A 60-grain detonator is required and issued.

Precautions.—No special precautions are necessary in the care of this explosive. Its chemical stability is unlimited. Atmospheric conditions have no influence on the charges, and they can be kept in any kind of magazine or storeroom.

High Temperature.—The only disadvantage of high temperature is in the expanding of the container of the charge, causing it to lose its adherence. This results in a loss of military value of the container. A temperature of 113° F. as a maximum should be the standard practice.

Exposure to Water.—In case of the flooding of storerooms or magazines, the trinitrotoluol charges suffer no loss of their explosive power, even if months under water.

Storage.—TNT should **not** be stored with smokeless powder or other explosives, but should be stored by itself in a separate magazine.

Tests.—No special tests of TNT, as stored aboard ship, are required.

(Those interested further are referred to Proceedings of the Naval Institute, No. 146.)

MANUFACTURE OF FORGINGS

Preparation of Charge in Furnace.

Melting and Reduction by Heat of Such Chemical Constituents as may be in Excess.—Carbon color tests every half hour during heat; physical and chemical tests as soon as charge is melted.

Rectification of Chemical Composition after Melting, by the addition of such elements as may be lacking; and the addition of material to produce the proper quantity and quality of slag.

Casting of the Ingot.—Either plain or corrugated.

Taking Samples during Pouring.—Chemical and heat tests.

Cooling of Ingot.—Either plain or under Whitworth process of fluid compression.

Removal of Ingot from Mold.—Numbering of ingot.

Annealing.

Removal of Discards.

Rough Boring, if ingot is to be hollow forged.

Cutting of Ingot, if it is to be forged in more than one piece.

Marking of Ingot and of Its Parts with identification marks.

Inspection for piping, blow holes, and other defects.

Forging, under either hammer or press.

Inspection of Forging Records.

Annealing.

Machining of Forging.

Inspection of Forging for cracks, piping, or other defects.

Tempering.

Annealing.

Test for Straightness, and strengthening **if necessary.**

Reannealing, if heated for tempering.

Test for Physical Properties.

Acceptance of Forging if Satisfactory.

CONSTRUCTION OF GUNS FROM FORGINGS

Receipt and Assignment of Forgings.

Setting the Forging in the Lathe.

Rough Turning.

Rough Boring.

Test by Balance Rod; several times during boring.

Bore Searching.

Star Gauging.

Building Up the Gun.

(*a*) **First Assemblage.**—Rough turned, finish bored jacket shrunk over rough bored, finish turned tube.

(*b*) **Successive Assemblages.**—Finish bored, rough turned hoops shrunk on over finish turned, rough bored tube, or finish turned jacket or hoops.

Finish Boring.

Chambering.

Bore Searching and Star Gauging.
Rifling.
Star Gauging and Bore Searching.
Finish Turning.
Determination of Droop.
Chasing Thread for Screw Box Collar.
Lapping.
Fitting Breech Mechanism.
Milling Key Way.
Putting on Yoke.
Balancing for Center of Gravity.
Weighing.
Final Factory Inspection and Marking.
Proving Ground Test; proof firing.
Relapping, Bore Searching, and Star Gauging
Final Acceptance, and issue to the service.

Some of the minor processes in the construction of the gun from the forgings, such as the determination of the droop, milling the key way, etc., do not necessarily always come in the exact order given above, as they may be done at any time during the work that is convenient and at which the state of the work will permit. The order given above is a satisfactory one, however, and should be memorized as a standard.

Inspection, bore searching, star gauging, checking measurements, etc., are rigidly and continuously continued throughout all stages of manufacture, as may be appropriate, although only enumerated at certain important stages in the above list.

The Basic Principle of Gun Design.—No fiber in the gun must be strained beyond the elastic limit of the metal of the cylinder.

This principle is strictly adhered to in the construction of guns built up wholly of steel forgings. In the construction of wire-wound guns the tube is, in some constructions, purposely compressed beyond its elastic limit by the pressure exerted upon it by the wire. In our built-up guns, the elastic limit for tension and for compression must never be exceeded.

At present the designer of a large gun is concerned only with the longitudinal strength in a **state of rest to resist droop**; for the reason that, if it is great enough to resist droop, there will be a large surplus of strength so far as longitudinal rupture is concerned.

The **principle of initial tensions** used for gun construction in U. S. Navy consists in giving to the exterior portions of the gun a certain initial tension, gradually decreasing toward the interior, and giving to the interior parts a certain normal state of compression by the grip of the outer cylinders.

Shrinkage obtains this result.

Name and tell of whom composed, the four essentials that determine battle efficiency.

Name all the stations for battle of a fire-control party on board a modern battleship. (Battery and ship.)

1. Ship Control.
2. Fire Control
3. Torpedo Control
4. Communication

Ship Control.........	Captain—1st Battle Station. Executive—2d Battle Station. Navigator—Conning Tower of Bridge. 1st Lieut.—Central Control Station.
Fire Control..........	Captain. Chief Fire Control—Conning Tower or Fire Control Station. Assistant Fire Control—As designated. Spotters—Fore Top, Main Top, Low Station. Plotting Room Operators. Sub-stations. Range-finder Party.
Torpedo Control......	Torpedo Control Officer—Bridge. Plotting Room Operator. Torpedo Crews.
Communication Party..	Communication Officer. Signal Officer. Quartermasters. Radio Force.

Executive Officer in lee of No. 2 turret to take command when 1st Battle Station in Conning Tower or on Bridge are shot away.

Ship control. **Gunnery Officer** in conning tower or fire control station to direct fire of ship of chief fire control officer.

Chief Spotter in force of main top to spot fall of 12" or 14" guns and in direct communication with plotting room and chief fire control officer.

Plotting Board Operators in direct communication with Captain, Chief Fire Control, Chief Spotter, Range Finder, and Substations with **Jack Board** in same room or next compartment. To spot course and speed of enemy by (1) Range Spot method and (2) Range Clocks or Projector, and by these methods passing out 30-second positions to the Battery via Sub-stations and to torpedo control officer.

Describe and define the usual terms used in fire control of naval gunnery.

Initial Sight-bar range is range at which sights are set from calculation or estimation. Use of range tables for deviation from standard conditions will give a correction which, if applied to the actual range obtained, should put the first shot or salvo on the target.

Deflection indicates the reading of that scale on the sight whereby the lateral movement of the projectile is regulated. Scale is graduated for the speed of target in knots. Initial deflection is calculated from range tables for existing conditions or by trial and error.

Salvo = Two or more guns fired on prearranged signal.

Shorts = Shots that fall between target and ship.

Overs = Shots that fall beyond target.

Slick = The base of splash made when projectile strikes water and the horizontal streak seen on surface after splash subsides.

Fork = Firing two or three shots of same caliber nearly simultaneously at different sight bar ranges with the object of having one shell short and another over—the approximate range then being the mean of the two sight bar ranges used.

Dispersion is the deviation of each shell from the mean point of impact of the salvo.

Danger space is the interval of space between the point of fall and the gun, such that the target, if situated at any point within said space, will be hit.

Twenty-five per cent of shorts will give maximum number of hits.

What are casualty drills and what is their purpose?

Casualty drills are the putting out of action through accident or gunfire of certain units of the ship's material or personnel and are for the purpose of testing, developing, and perfecting the flexibility and elasticity of the fire control and ship control systems. As an example, " Foremast shot away," in which case Chief Spotter is eliminated from high station and it becomes duty of maintop spotter to maintain fire by his spots, also devolves on ship-control party to clear away wreckage of foremast.

What are searchlight control stations in torpedo defense?

Searchlights are most efficiently controlled at stations below the searchlights and above the battery. Control officer forward or abaft the searchlight beam obtains best results. The usual stations are in the cage masts and on forward bridge fitted with both telephones and voice tubes. Both distant control and hand control are used.

Battleship (3-caliber type) approaching single enemy. Give procedure of fire control.

Plot enemy line in plotting room by range finder party. Determine moment when actual range will be 18,000 yards, by rate of change on clocks, altering course and speed if necessary. Apply ballistic corrections and use Farnsworth range corrector to determine initial sight bar range and deflection for 12″ range shot. Fire 12″ ranging shot when actual range is 18,000 yards. Obtain 12″ fork at once using three or four range shots if necessary. Open with 12″ salvo as soon as fork from range shot was obtained. Hold 8″ and intermediate salvos until actual range has decreased to 12,000 yards, then open with 8″ salvo using separate spotter for each caliber. Use high stations for spotters.

Name two types of air compressor, enumerating six parts of each and give cause of air from atmosphere to accumulator.

1. MK XIV electric driven four-stage compression delivering 30 cubic feet of air per hour at 2500 pounds pressure per square inch.

2. MK XVII steam-driven four-stage compression delivering 20 cubic feet air per hour at 3000 pounds per square inch.

The function of air compressors is to compress and store high pressure air in accumulators for purpose of charging torpedo air flasks and to store low pressure air in barks or accumulators for use in gas ejecting system on guns.

Six parts for Electric driven.	1 compound wound direct current 50 H. P. motor. 4 air cylinders with pistons. 1 circulating pump. 4 air-cooling coils. 1 oil pump. 2 separators.
Six parts for Steam driven.............	2 double acting steam pistons with valves. 4 single acting air pistons. 1 circulating pump. 2 oil pumps. 4 air-cooling coils. 2 separators.

Air enters compressor through "hurricane" or intake valve at bottom of first stage cylinder, passes through inlet valves on cylinder is compressed to 50 pounds, discharged through first stage discharge valves to air reservoir, passes through first stage cooling coil to separator to second stage valve chamber, through second stage inlet valve compressed to 230 pounds, then discharged to second cooling coil, through to third stage valve chamber, through inlet and discharge valves after being compressed to 875 pounds, so to third stage cooling coil to fourth stage valve chamber, through fourth stage inlet and discharge valve, having been compressed to 2500 pounds, then through after cooler to after separator through by-pass valve to accumulator where it is stored at original intake temperature.

Accumulators are seamless drawn steel bottles with copper liners used for storage of high pressure air at normal intake temperature. They are usually connected up in batteries of ten bottles and are fitted with separators, air cocks, by-pass, high pressure air lines, and strainers.

The great difficulty experienced in service use of all small, high speed air compressors (chargers) is that of wear, with constant renewals, and of leaks.

For parent ships and tenders, excellent results have been obtained by large steam compressors making only about sixty revolutions per minute, as exampled by the type manufactured by the Norwalk Iron Co. This type compressor will charge all accumulators of submarines of recent type from 0–2500 pounds pressure in about 2 hours.

ADJUSTMENTS, WHITEHEAD TORPEDO, MARK V

Adjustments and Tests for Exercise Run.

I. **Preliminary:**

Use uniform pressure of air through stop valve.

1. Inspect exercise head.
2. Fill oil cups.
3. Set reducer.
4. Install dummy gyro.
5. Close stop valve.
6. Charge air flask.
7. Test retarding gear.
8. Inspect rudder bearings.
9. Test immersion mechanism.
10. Test distance gear.
11. Place and test gyro.
12. Test fuel supply.
13. See sinking lever set at float.
14. Examine drain plugs.
15. Examine engine valve.

II. **Just before Firing:**

1. Slush torpedo and enter in tube.
2. Roll torpedo through 180°.
3. Verify setting of reducer.
4. Fill engine oil cup.
5. Blow out gyro line and install gyro.
6. See starting lever forward.
7. Wind gyro.
8. Install gyro door.

9. Roll torpedo through 90° and fill reducing valve oil cup.
10. Roll torpedo to upright position.
11. Charge torpedo.
12. Fill oil cups.
13. Set distance gear.
14. Verify setting of locking gear for duration.
15. Set depth index.
16. Fill fuel flask.
17. Set starting lever forward and open stop valve
18. Inspect fuse holder.
19. Open fuel feed.
20. Up water tripper and load torpedo in tube.
21. Check up position of water tripper.
22. Off propeller lock and set at "10 o'clock."
23. Close tube door and check down position of tube tripping latch.

III. Upon Recovery, after Firing:

In Boat.

1. Keep clear of starting lever and tail.
2. Close stop valve.
3. Put on nose and tail lines (propeller lock).

Aboard.

4. Close fuel feed valve.
5. Turn over propellers by hand.
6. Remove fuse and inspect.
7. Roll torpedo through 180°. Inspect oil in oil cups and in engine valve.
8. Fill engine oil cups.
9. Remove and inspect gyro.
10. Run engine.
11. Remove drain plugs.

Name the five functions demanded of every automobile torpedo.

Explosive charge detonated against target.

Storage of power.

Application of power to propel torpedo at accurate speed.

Maintaining torpedo at set depth.

Steering torpedo in vertical plane or desired course.

Name sections of Whitehead Torpedo with units contained by each section.

War Head...........	War nose (net cutter). Detonator. Dry primer. Charge (wet guncotton or TNT).
Air Flask............	Forward bulkhead removable. Flash drain.
Immersion Chamber...	Pendulum. Hydrostatic piston. Main air line. Drain or transportation screw.
Afterbody............	Main engine and reducing valve. Superheating system. Depth engine. Gyro. Horizontal and vertical steering lines.
Tail..................	Intermediate gears. Horizontal and vertical steering connections. Horizontal and vertical rudders. Propellers and tail shaft.

Sections are secured together by joint screws with exception of immersion chamber which is sweated and riveted to after end of air flask.

What is range, weight of charge (war head), and weight of torpedo ready for war shot of modern torpedo?

			Range, Yards.	Weight of charge, Pounds.	Wt. of torpedo ready for war shot Pounds.
Whitehead	MK	V......	4,000	200	1,452
B. L.	MK	III......	3,500	180	1,900
B. L.	MK	VII......	7,500	200	1,540
B. L.	MK	VIII......	10,000	317	2,760
B. L.	MK	IX......	7,000	215	2,040
B. L.	MK	X......	5,000	400	2,077

What is a war head? Describe the standard MK V war nose.

A sheet copper hemispherical head carrying an explosive charge of wet guncotton or TNT is supplied each torpedo and is known as the war head. The explosive of future war heads will be TNT, which poured in the war head in a liquid state forms a casting.

A war nose screwed in the forward end of the war head acts as the detonating agent of the charge. On contact with target at a minimum of six knots' speed, the firing pin of war nose explodes three Winchester caps, igniting a small powder charge which drives the detonator firing pin on through Winchester caps, which explode the detonator of fulminate of mercury. Said detonator explodes the dry guncotton primer placed axially in the war head, which in turn explodes the charge of wet guncotton. Safety on the war nose previous to firing is obtained by a pin locking the rotation of the war nose fan, whose spindle holds war nose firing pin away from Winchester caps in this locked position. On firing torpedo, water pressure (obtained at 18 knots' speed) on releasing plate forces lock pin to rear. Allows fan to rotate, running fan spindle far enough forward after seven turns to permit free action of war nose firing pin, when torpedo strikes target.

Give transmission of energy in Whitehead Torpedo.

Air flask = Storage compressed air.

Stop valve = Preventing air loss when flask is charged.

Main valve = Automatic starting torpedo.

Reducing valve = Reducing flask pressure to constant engine pressure.

Superheating system = Increasing cold air volume thereby increasing range and speed.

Engine = Conversion of energy into mechanical power.

Main and after propeller shafts = Translating energy from engine to propellers.

Intermediate gears = For delivering opposite revolutionary motion to propellers.

Propellers = Deliver driving power to torpedo.

What is the purpose of a torpedo reducing valve? How regulate the pressure?

A reducing valve is interposed between the air flask and main engine of a torpedo to reduce flask pressure (Whitehead = 2150) to working pressure (about 450 pounds)—this for the purpose of economy, hence increased range. The principle of the reducing valve is that of unequal pressures on the two sides of the valve whose top and bottom areas vary with the opening or throttling of said valve. Valve held off its seat by heavy spring whose tension is regulated by a "2000–4000 yard" plug or by a "range" plug (adjustment = trial and error). Thus the reducing valve lifts and throttles the entire run down the range. The reduced (engine side) air pressure instead of remaining approximately 450 pounds, varies from 400 to 600 pounds, with consequent irregular speed and loss of economy. Tests with a double reducer (hooked up in tandem) have given consistent results of range in pressure from 25–30 pounds.

Describe depth control of torpedo.

A **pendulum** moving freely in fore and aft line is connected by rods to horizontal rudders. Roughly, dive inclination or rise inclination of longitudinal axis of torpedo will give consequent rise or dive rudder.

Beneath the pendulum is a piston subject to water pressure and connected by rods to pendulum. This **hydrostatic piston** is set by spring pressure to have no effect (mid position) on pendulum at a certain depth. Should torpedo be running **level** above or below this set depth, movement out or in of piston will result in movement on pendulum, hence on horizontal rudders, tending to bring torpedo to its proper depth.

Depth engine, consisting of a small cylinder and piston with central valve operated by air pressure is located in the steering line between the pendulum and horizontal rudders for the purpose of damping violent pendulum movement.

Note.—Pendulum and hydrostatic piston in Whitehead and early Mark B. L. torpedoes were located in immersion chamber. In latest Mark B. L. they are located in afterbody in conjunction with gyro mechanism.

GYRO (Gyroscope)

A **gyro** is placed in a torpedo for the purpose of correcting horizontal deflection of the torpedo from the aimed course. The principle of the gyro is that a wheel or rotor (suspended freely by gim-

Put in fuel.
Advance fuel.
Note fuel tank full.
Put in water.
Put in tail packing (two guns full).
Put in double seal checks and soap.
Set depth index.
Set distance gear.
Verify speed screw, oil reducer (sperm oil).
Drain water out of air flask.
Turn torpedo 90° left to drain combustion flask.
Examine condition of pistol.
Put in pistol and fuse.
Verify all adjustments.
Examine tube ready for firing.
Note angle fire spindle disengaged, on zero. (Zero is 270 on port, 90 on starboard.)
Load torpedo in cover.
Open stop valve wide, remove starting lever safety stick.
Remove propeller lock.
Close and lock cover.
Report ready to flood

CHANGING FROM EXERCISE TO WAR SHOT

What changes make when torpedo is to be changed to a war shot?
Take out floating shaft to governor.
Set distance for 15 feet.
Set sinking attachment for sink, i.e., take out long screw and replace with short screw.
Put on war head and attachments.

STEPS TAKEN AFTER RECOVERY OF TORPEDO

Close stop valve.
Put on propeller lock.
Remove gyro.
Drain afterbody and tail.

Take air pressure in air flask.
Gauge amount of fuel, water, and oil.
Remove burned fuse; replace pistol plug.
Remove burned-out calcium pot.
Blow down torpedo.
Clean and oil shell of torpedo.
Take tension off all springs.
Seat starting piston and set distance index at zero.

ROUTINE UNDER WAR SERVICE. DAILY ROUTINE

Boost air in flask; insure no teat on wing nut.
Turn engine over about seven turns by hand.
Cut fuel and water plugs to insure compartments full, replace plugs.
Note oil pot full and oil tail bearings, oil reducer.
Exercise depth and regulator springs and reseat.
Relieve pressure in immersion chamber.
Inspect pistol and fuse and replace.
Work both steering engines and rudders by hand.
Exercise spinning mechanism; inspect gyro and replace.
Drain afterbody, and water out of air flask.

FORTNIGHTLY ROUTINE

Drain fuel and water.
Remove check valves, inspect, oil, replace, and test.
Exercise main engine by running with air.
Examine fuel and air strainer; oil air strainer.
Swing torpedo to exercise pendulum.
Work hydro piston in and out for exercise.
Inspect A. C. R. device, oil gyro, release impulse spring and reset.
Release and exercise firing spring of exploder.
Wipe off and grease up torpedo.

MONTHLY ROUTINE

Clean steering engines with gasoline and oil well.

QUARTERLY ROUTINE

Drain air flask of air and inspect interior of flask.
Drain and inspect interior of water compartment.
Weigh guncotton heads.

CARE UNDER WAR SERVICE—GENERAL NOTES

In cold weather have portable steam or electric heater surrounding water compartment, to prevent water freezing.

Do not use alcohol to prevent water freezing, as this gives too high a heat.

Be careful of ruining exploder when removing torpedo from tube; with care, the exploder can stay in torpedo while it is being withdrawn.

What overhauling is done to a torpedo of a destroyer while on war service?

No overhauling is done aboard ship; the torpedoes are overhauled on tender or base ashore by good mechanics or expert torpedo men.

What overhauling is done on the battleships and cruisers?

On the larger ships the torpedoes are overhauled when they are absolutely in need of it.

Will a torpedo need overhauling if it has not been fired for four of five months?

No; and not if laid up a year or more, if the torpedo gang is efficient and gives the torpedo its exercise as routine regulations call for.

BLISS-LEAVITT TORPEDOES

The essential point of difference between the B. L. and Whitehead torpedoes lies in the engine. Instead of air entering the valve chests of a four-cylinder reciprocating engine (as in the Whitehead) the main air line in the B. L. leads to two turbine wheels (Curtis type) which revolve in opposite directions at a ratio of about 7 to 4 and through the agency of balanced gear train transmit their energy to propeller shaft, bevel gears, and after shaft, so to propellers turning in opposite directions. (The balance gears were necessary to remove torque of vertical turbines.) In recent B. L. torpedoes the turbines are horizontal, revolve at same speed and are geared to inner and outer main shafts revolving in opposite directions. The increased range of later torpedoes is due to the fact that the flask air is not only superheated by fuel combustion but additionally by steam. Exhaust from turbines is carried off from engine compartment by exhaust pipes passing though afterbody bulkhead instead of through main shaft (Whitehead).

As above stated, the principle of the gyros used in the torpedoes is the same though construction is different.

Give the gist of the safety orders in regard to any ten of the following:

1. Naked lights in magazines.
2. Live ammunition for drill.
3. Watch plug face.
4. Opening breech during salvos.
5. Mushroom to be sponged.
6. Posting safety orders.
7. Precaution against unlocked plug.
8. Closing breech after loading.
9. Breech locked while primed.
10. Precautions with firing lanyards.
11. Precautions with cocked lock.
12. Cease firing.
13. Firing pin housed.
14. Priming.

1. Naked light never to be taken in any compartment containing explosives.

2. Never to be used for drill.

3. In cartridge case gun, except sliding wedge, plug not to be closed until front face of plug is seen to be normal.

4. Not to be opened.

5. Mushroom of breech-loading gun sponged after every shot.

6. Posted in convenient places and all members of crew to be instructed in them.

7. Take precautions that plug will not fire gun in swinging of block, before latter is rotated. Automatic functioning of lock should not be interfered with.

8. Close breech immediately after loading.

9. Breech shall never be opened with live primer in lock.

10. Lanyard shall not be hooked to trigger of lock until after breech is locked and gun primed. Hook lanyard just before cocking lock.

11. Keep breech locked.

12. At "cease firing," place gun in condition to prevent accidental firing by removing primer or cartridge case.

13. No cartridge case gun shall be fired unless firing pin is completely housed.

14. Priming a B. L. gun with breech open is forbidden.

Discuss outpost patrol and scouting duty.

An outpost patrol consists of (1) reserve, (2) support, and (3) outguards, in the order named from the main body towards the enemy. Its function is to secure a camp from surprise.

The **reserve** is the main body of the patrol and serves as a support for troops in front or as a rallying body. The **supports** constitute a supporting line for outguards and also furnish the outguards. The **outguards,** who are nearest the enemy, may be classified as **pickets, sentry squads,** and **cossack posts,** and are numbered from right to left.

A **picket** is a group of two or more squads and supplies ahead of it, sentinels, sentry squads, or cossack posts for observation.

A **sentry squad** is a squad posted in observation and furnishes a double sentinel.

A **cossack post** consists of four men in observation similar to sentry squad, but employs a single sentinel.

Duties of outposts are to remain concealed as much as possible, prevent enemy scouts obtaining information, checking enemy scouts if they advance, and warn main body of advance of large enemy force.

Duties of scouts on offensive are to search for and report enemy and report best available route for main body advance. Duties of scouts on defensive are to observe and report enemy advance and probable tactics.

Scouts should be selected for intelligence, observation, endurance, knowledge of language, etc. Their purpose is to observe and not to be observed.

Prepare for and plant a field of 12 naval defense mines. State what tests you would make, what boats use, how prepare boats, how manage them.

Rig sailing launch with 2×3-inch timbers placed athwartship with cleat at each end on underside to prevent slipping. Four 2-inch planks should be laid fore and aft over these timbers and spiked to them—two on each side of the boat, one flush with the gunnel and the other a foot from it. Make wire pennants with eye hanging over side of launch. Hang mine anchors alongside of boat from pennants secured to eyes by strap and toggle. Place mines along sides of boats on planks and chocked to prevent rolling with the tripod pointing outboard. Before attaching mooring bolt, test anchor by pulling mooring line. If pawl is not disengaged, lift distance weight a short distance and drop it. Mooring line should unreel evenly with brake set to necessitate 75-pound pull.

When mine is rigged, attach lanyard of anchor toggle to lower eye-bolt of mine. Place buoyant reel with mine leading wire between upper tripod legs. Place battery boxes in dinghy boxes connected with line equal to proposed mine interval. Secure another dinghy astern mine launch with battery box in dinghy trailing the first dinghy. Take all three boats in tow of power boat. Tow mine launch close to line of marker buoys previously laid out to indicate position of mine field. When abeam first buoy roll first mine over. When first mine is let go cast off dinghy with battery boxes. This boat tows reel of first mine at right angles to line of mines to position of second battery box. When second mine is let go, dinghy still in tow takes reel out to battery box boat, and returns to launch for reel of third mine. Battery box boat continues to pull on line parallel to mines and about 400 feet from it. Do not plant mines closer than 200 feet apart as explosion of one mine might destroy circuit breakers of neighboring mines.

Precaution.—Brighten legs of each detonator before installing. Test circuit with length of insulated wire bell magneto.

STANDARD 14-INCH LOADING DRILL

Turret Crew

Plugman.—Operates plug, wipes off mushroom, primers, operates plug light.

Carman—Operates hoist telegraph, dumps car.

Trayman.—Gun Captain at present, puts in and takes out loading tray, bore clear, receives powder from under gun and places powder on tray, assists in hand ramming.

Trayman.—Handles spanner tray, receives powder from under gun, places it on tray, assists in hand ramming.

Rammerman.—Operates powder rammer, assists in hand ramming.

Shellman.—Receives shell from car, steadies it on loading tray, assists in hand ramming.

Powderman.—Under gun, receives powder from trap, passes it to trayman.

Powderman.—Same.

Trap Powderman.—In trap, receives powder from scuttle, places it in trough, tips trap door and shoves powder through to under the gun.

Turret Captain.—Standing by right gun.

Gunner's Mate.—Standing by left gun.

Messenger.—(One only) in booth.

UPPER HANDLING ROOM

Upper Hoistman.—Operates hoist, helps handle shell.

Lower Hoistman.—Operates hoist, helps handle shell.

Shellman
Shellman } —Handle shell in upper handling room.
Shellman

Gunner's Mate.—In charge, voice tube, looks out for gear (one only).

LOWER HANDLING ROOM

Boatswain's Mate.—In charge (Junior officer in turret booth for fire-control).

Gunner's Mate.—Looks out for gear, sees proper powder index sent up.

Scuttle Powderman.—Operates powder scuttle to trap.

Upper Platform Powderman.—Handles powder, places it in scuttle.

Upper Platform Powderman.—Handles powder on upper powder platform, receives powder from No. 7 platform powderman or from conveyor.

Platform Powderman. (7)—Pass powder on platforms. (Not needed when using powder conveyor.)

Platform Powderman (6)	do.	do.
Platform Powderman (5)	"	"
Platform Powderman (4)	"	"
Platform Powderman (3)	"	"
Platform Powderman (2)	"	"
Platform Powderman (1)	"	"

Handling-room Powderman
Handling-room Powderman
Handling-room Powderman
Handling-room Powderman —Handle powder in lower handling room.

Magazine Powderman
Magazine Powderman
Magazine Powderman
Magazine Powderman —In magazines, open, tank, take out and pass powder.

Shellman
Shellman
Shellman
Shellman —Handle shell from handling rooms to lower hoist.

Messenger.—At voice tube in lower handling room (one only).

25-FOOT 4-INCH RANGE FINDER, MARK XIII-1

This range finder has a 25-foot 4-inch base and is designed for use in 14-inch turrets. It is of the single erect image coincidence type. Behind each end window of this instrument is a penta objective reflector, which turns the entering ray through an angle of 90°, and directs it down the length of the tube of the range finder. The penta reflector is used in this case because it possesses the quality of the "optical square"; that is to say, any ray of light which enters one side of the penta reflector is turned through exactly 90° and reflected out through the other side. This reflection of exactly 90° always takes place no matter how the reflector may be rotated. The entering rays having been reflected through 90° by the penta objective then pass through an optical system on each side exactly similar to that found in any good grade of telescope; that is to say, the systems consist of an objective lens, collective, etc., except that there is but one eyepiece for both systems. This eyepiece is located at about the middle of the range-finder tube. Rays of light having passed through these optical systems on the right and left side of the range finder both enter a common coincidence prism. This coincidence prism is so silvered that whereas the lower half of one ray is suppressed and the upper half is reflected into the eyepiece, the upper half of the other ray is suppressed and the lower half is reflected into the eyepiece. The observer, therefore, sees through the eyepiece single erect images but a field of view divided horizontally in the middle by a halving line. Objects appear divided in half by the line through the middle of the field. The two half images of an object are not exactly joined, except for objects at infinite distance; for objects at a finite distance the half images are displaced laterally, depending upon the distance the object observed is from the instrument. The nearer the object is to the range finder the greater lateral displacement there is between the two half images seen in the eyepiece. By introducing an optical wedge into the right-hand optical system of the range finder the half image which comes from the right end window can be moved at will by sliding the optical wedge lengthwise in the range finder. As this optical wedge consists of nothing but a piece of glass with two plain surfaces inclined at a known angle a scale can easily be computed and fixed to the wedge, so that ranges may be read immediately when coincidence has been accomplished by movement of the wedge. The marks on this scale are reflected by suitable prisms into the lower part of the eyepiece so that they are visible to the observer in the lower part of his field of view.

This range finder is also equipped with self-contained adjustment system. This consists of a small penta prism at each end of the range finder so mounted that by turning the knob underneath the range finder tube the small penta adjusting prism rotates into position in front of the penta objectives. With source of light windows in the middle part of the tube, light can be reflected by small right prisms into the internal adjusting system. The system then becomes a collimator with rays of light entering the penta objectives as if from an object at infinite distance. Adjustment can then be made for the infinity mark on the scale. The penta adjusting prisms can also be rotated through 90° and adjustment then made again for the infinity mark. Any difference between the two adjustments thus effected should be halved for the final setting of the instrument. This protects against any error creeping in due to a fault in the self-contained adjustment system.

The instruments are also adjusted for halving. The expansion of the range finder due to heat or to the difference of light entering the two end windows may cause some slight displacement of the optical systems. This displacement gives rise to the necessity for correcting for coincidence as above, and also for correcting for halving. Halving error exists when the two half images of any object in the field of view of the range finder do not come together to make a perfect complete image. There may appear to be a central portion suppressed, or the central portion may appear to be elongated. Turning the halving adjuster knob alters the position of the optical bar and the coincidence prism so that the halving error can be eliminated.

The optical bar, containing the coincidence prism, the right- and left-hand optical systems, and the measuring wedge, is hung on suspension wires stretched inside the tube between the end boxes. The end boxes contain the penta objective reflectors, the penta adjusting prisms, and the triple prisms which are part of the internal adjustment collimator system. The end boxes also contain the end box windows which should never be touched in service. The left-hand end box window is as near a true plain piece of glass as it is possible to make. The right-hand end box window is purposely ground slightly wedge shape and is provided with a substantial mechanism for rotating it. This, however, is purely a manufacturer's adjustment and must not be touched at all in service under any circumstances. The right-hand end box window of this instrument is to a range finder as the regulator is to a ship's chronometer—leave it alone.

This range finder is fitted with an astigmatizer, so that ranges may be taken on a light at night. There are also two eyepiece systems which give a choice of power of 15 or 28. These are operated by a knob on the tube of the range finder. Another knob marked "Amber, Clear and Dark," can be operated to introduce a light or dark ray filter, or none at all. The instrument is equipped with small electric light bulbs for illuminating the adjustment system. The operating wheel which moves the optical wedge and internal scale also rotates an outside scale and an electric asynchronous transmitter, so that the instrument can be connected to one or more Sperry Range Indicators. Ranges can therefore be simultaneously observed by (1) the operator (who sees the internal scale reflected into the lower part of his field of view); by (2) the turret officer (who sees the outside scale through a port in his booth); and (3) and (4) by one or more substation parties (who see Sperry Range Indicators).

METHOD OF OVERHAULING 5-INCH RECOIL CYLINDERS

Remove piston-rod nuts, block up under muzzle of gun with properly shaped block well vaselined. Block up breech of gun with running in truck, having gun slightly elevated. Haul gun in with chain fall, using another chain fall as a preventer. Drain cylinders, remove stuffing box lock nut, start stuffing box nut with wrench (after cylinder head), put on spring compressor and screw traveling block on end of piston rod, then unscrew stuffing box nut with compressor and remove tension from springs by operating screw shaft of compressor in proper direction. When tension is removed from springs, compressor may be unscrewed from piston rod and removed, after which springs, discs and piston may be hauled out to the rear.

Be careful of the threads on piston rods when removing spring compressor.

This type of mount is used on all of the late type dreadnaughts.

INTERNATIONAL LAW

What are the rules regarding telegraphic cables in time of war? What was done in the Spanish-American War?

Telegraphic cables between enemy points or between enemy territory and United States, interrupt. Telegraphic cables between enemy and neutral, interrupt within territorial limit of enemy. Telegraphic cables between neutrals inviolable.

(These rules apply to cables owned by states, individual, enemy, and neutral.)

British Government in Spanish-American War issued instructions that belligerent warships should not send cipher or messages to direct war operations. Belligerent war vessels could use for ordinary purposes or to narrate past operations for general publication. Consular officers have right of free communication with their governments whether plain or cipher.

By Hague Convention of 1907, a neutral power is not called upon to forbid or restrict the use on behalf of the belligerents of telegraph or telephone cables or of wireless telegraph apparatus belonging to it or to companies or private individuals.

By Hague Convention of 1907, belligerents are forbidden to erect on neutral territory a wireless telegraph station or other apparatus for the purpose of communicating with belligerent forces on land or sea.

In the European War of 1914–1917, the United States Government established censorship at all principal radio stations in the persons of naval officers to prevent unneutral use of said radio.

Define blockade.

Pacific blockade is a means short of war used by a stronger power against a weaker.

Military blockade is the blockade of enemy port, arsenal, base or fleet, where commerce does not exist.

Commercial blockade may be of enemy seaports or an entire coast, and is for the purpose of cutting off food supplies or vital imports.

A blockade must be notified by proclamation and by notification to neutral powers through diplomatic channels and to the local authorities of the blockaded port. A neutral power is not obliged to issue a proclamation of a blockade to its citizens, but it is customary to do so.

Authority to declare a blockade is vested in the head of a sovereign state or in the senior naval representative of said state at scene of operations.

Declaration of blockade specifies (1) date when blockade begins, (2) geographical limits, and (3) period within which neutrals may come out.

Renewal of blockade is notified neutral governments and local authorities in the same manner as original blockade is established, but a blockade is not raised if blockading is temporarily withdrawn through stress of weather.

A **de facto** blockade begins and ends with the actual establishment without notification; in which case neutrals attempting to enter the port are not subject to capture, but are simply warned off and an entry to that effect is entered in their log by an officer of the blockading force.

To be **effective**, that is to be recognized, blockade must be a fact.

Breach of blockade is entry or egress of port or an attempt to enter—limited within area of operations.

Irrespective of character of cargo or purported destination, a neutral vessel appearing off a blockaded port is liable to capture and condemnation if (1) evidence is conclusive that she has attempted an unneutral service, (2) avoids or resists search, and (3) presents fraudulent papers or is not supplied with necessary papers.

What circumstances would a neutral appearing off a blockaded port not be liable to violation of blockade?

(1) If bound for a non-blockaded port without absolute contraband of war, no matter what the ulterior destination of a vessel or of her cargo. (2) No knowledge of blockade through date of sailing being previous to that of blockade declaration.

Under what circumstances may a neutral enter a blockaded port?

Stress of weather, but vessel must communicate with blockade commander and bring cargo out intact.

Proper license from government of blockading state.

Neutral vessels may enter or depart with permission of blockade commander, but permission must be given impartially.

Can insurgents establish a blockade? What would be your action in case insurgents refused admission of American merchantmen to port?

Blockade is right of sovereign states or belligerent state. Insurgents are not accorded right of blockade. United States refused to recognize blockade of Rio by Brazilian insurgents.

What is the object of visit of search? Explain the right and how far it may be carried. Give duties of officer making search.

The exercise of right of search during war is conferred upon properly commissioned and authorized vessels of war. The object is to ascertain nationality; nature of cargo; and ports of departure and destination. Vessel may be seized and sent into U. S. port for action of courts if circumstances warrant or she may be released. The boarding officer wearing side-arms and accompanied by two men (armed or unarmed) makes known the reason of his visit and upon examination of ship's papers, either makes a prize of her or releases her; in latter case makes entry in her log that she has been searched. Boat crew in boarding may be armed or unarmed. Resistance to search involves condemnation of vessel as a prize.

What is meant by an effective blockade?

How is blockade ratified?

What specifications must be made in the declaration?

What is a breach of blockade and what is the penalty therefor?

One so invested as to create an evident danger to attempt entrance or egress.

By proclamation; by notification to authorities and consuls of ports blockaded; to government of neutral states, direct or to diplomatic representatives accredited to blockading government; by special notice to neutral vessel and by common notoriety.

Date of beginning of blockade; geographical limits of; and time allowed for neutral ships to come out.

Capture and confiscation of ship and cargo, unless the owner of goods can prove he did not know nor could have known, that vessel intended to violate the blockade.

Of what does the maritime territory of a state consist?

Ports, harbors, bays, and parts of sea enclosed by headlands belonging to same state.

Distance of a marine league along all coasts of the state.

Straits and sounds bounded on both sides of the territory of the same state.

What is meant by "the right of search"? Under what conditions may this right be exercised?

What is meant by "the right of approach"?

When is it permissible for a man-of-war to attack and capture a pirate within the maritime waters of another state?

Right of search is right of a belligerent war vessel to stop and search **any** merchant vessel, neutral or belligerent, on the high seas or in territorial waters of a belligerent, in time of war to determine her character, cargo and destination. Exercised in time of war by a duly commissioned vessel of war of a belligerent.

Right of approach is right of any war vessel to approach a merchantman on high seas in time of peace for purpose of observation and verification of flag and character—right given because of question of piracy and slave trade. Merchantman not required to heave to and no force used unless in case of slave trade or piracy.

In case of **hot pursuit** begun on high seas, but capture must be surrendered to that state for trial.

What is done to a vessel that resists visit and search?

Captured and condemned. Cargo treated as enemy cargo.

What papers must a merchant vessel carry?

1. **Register**—evidence of nationality.
2. **Muster roll**—list of officers and men.
3. **Log**—history of vessel.
4. **Manifest**—summary of bills of lading.
5. **Bill of lading**—receipt for the cargo.
6. **Charter party**—contract between owner and shipper.
7. **Shipping articles**—contract between master and seamen.
8. **Invoices**—nature of cargo.
9. **Bill of health**—shows port of destination.
10. **Clearance**—permission to sail.

Define contraband. Whose duty is it to prevent this trade and how is it prevented?

Give classification of contraband as proposed by Grotius?

Contraband trade is trade with a belligerent with the intent to supply him with military or naval supplies, equipments, instruments, arms or armaments. Prevented by the belligerents, by exercise of right of visit and search, capture, and confiscation after trial by prize court if at all possible.

1. Articles that are used solely for warlike purposes, such as guns, arms, warlike ammunition, etc.

2. Those that cannot be used for war purposes, as pictures, etc.

3. Those that may be used for either peaceful or warlike purposes, as money, food, etc.

When may a vessel carrying contraband be condemned?

If contraband reckoned by value, weight, volume, or freight forms more than half the cargo.

What circumstances would induce you to seize a merchant vessel in time of war and what would be your disposition of cargo, papers and crew?

Grounds for seizure:

Enemy merchant vessel.

Neutral carrying absolute contraband or conditional contraband documented to enemy or enemy agent.

Unneutral service.

Violation of blockade.

Suspicious action.

A neutral vessel carrying less than half of her cargo absolute contraband, hence not subject to condemnation, must be allowed to continue her voyage, if the master is willing to hand over the contraband to the captor, whose commander is at liberty to destroy said contraband. The master must give the captor certified copies of all relevant papers. The captor must enter the goods surrendered in log book of vessel stopped.

In case of destruction of neutral capture through military necessity, all persons on board must be placed in safety and all ship's papers and relevant documents must be retained and inventoried.

A captor who has destroyed a neutral vessel must establish the exceptional necessity of the destruction.

In the case of an unarmed merchantman at sea:

How would she be brought to?

How would she be searched?

What are the objects of the search?

Under what circumstances would she be seized?

Signal to heave to or fire a blank shot across her bow, followed by a solid shot, if necessary. If she does not heave to then fire a shot at her.

Send a boarding officer and crew alongside, arms in boat, officer side arms. Officer goes aboard with two men unarmed, unless immediate resistance expected. Officer makes known object of visit, examines papers, examines holds if not satisfied.

To ascertain nationality, port of departure, destination and nature of cargo.

If papers show vessel to be enemy vessel, carrying contraband, engaged in unneutral service or in violation of blockade. Also suspicious circumstances, such as far off course.

What are the duties of Commanding Officer making capture? (Revised Statutes, 4615.)

Secure documents of ship and cargo, including log book, letters and other papers found on board. Inventory same and seal them up. Send to prize court with a written statement that all papers are forwarded in condition found. Send Master, one or more officers, and any persons whose testimony may be of value, as witnesses before court. Prize, papers, and witnesses to be sent into port for adjudication under command of prize-master and crew. (Officer making visit of search to be appointed prize-master if possible.) In absence of instructions, direct prize to most convenient port. If any part of capture is in unfit condition to be sent to port, a survey shall be made and report of same forwarded to court. Property so surveyed, if not appropriated to government use, shall be sold and the proceeds deposited with the Assistant Treasurer of the United States most accessible to the court.

What are the duties of prize-master?

Bring prize into port directed (or nearest suitable port in case of necessity) within territorial jurisdiction for adjudication.

Deliver documents, papers, inventory, to prize commission and make affidavit that said papers are in same condition as when received.

Deliver witnesses to custody of a marshal.

Report to district-attorney all information in possession respecting prize.

Retain prize in custody under original colors until decision of prize court is rendered.

Destroy prize if in danger of recapture or if interfering with military operations.

Under what circumstances may a captured enemy merchant vessel be destroyed?

What proceedings are necessary before captured vessels, arms or munitions of war, may be destroyed or taken for the use of the U. S.? Describe the proceedings necessary in the case of captured merchantmen under ordinary circumstances.

Unseaworthiness; existence of an infectious disease on board, lack of prize crew; imminent danger of recapture; by Dec. Lon. when capture jeopardizes success of a military maneuver.

Surveyed, appraised and inventoried by competent and impartial persons. Result of above to be sent to prize court.

Prize sent in to nearest prize court of U. S.—in charge of prize crew—best send boarding officer. Ship intact—papers sealed at time of capture and in custody of prize-master—necessary witnesses—national colors of vessel seized remain her proper flag until decision of court is made.

Under what conditions may a transfer of flag be made after the outbreak of war?

When it is proved that transfer was not made to evade consequences to which enemy vessel is exposed.

Is the fact that the destination of a vessel is neutral conclusive evidence as to the destination of her cargo?

What is the doctrine of continuous voyage, and how is it applied by U. S. courts?

The doctrine of **continuous voyage** is that a cargo of vessel bound for a neutral port is conditional contraband unless said neutral port is established as not the final destination of said cargo. In other words, the fact is determined that on arrival at neutral port a reshipment of the cargo to enemy country is not purposed.

The Declaration of London (Art. 35) states that conditional contraband is not liable to capture, except when found on board a vessel bound for territory belonging to or occupied by the enemy, or for the armed forces of the enemy, and when it is not to be discharged in an intervening neutral port. The ship's papers are conclusive proof both as to the voyage on which the vessel is engaged and as to the port of discharge of the goods, unless she is found clearly out of her course indicated by papers, and unable to give adequate reasons to justify such deviation.

The wording of this article was to prevent conditional contraband being liable to capture if bound for other than enemy territory or in other words, preventing the application of continuous voyage to conditional contraband to neutral ports.

If the country at war has no seaboard, a cargo bound to enemy forces using an intervening seaport is liable to seizure, as the neutral port of destination in this case is construed to be an enemy port.

A neutral port of destination is not the conclusive proof of the destination of the cargo, the ship's papers are:

By the Declaration of London, the doctrine of continuous voyage (assumption that a cargo was intended for an enemy, though vessel was bound for a neutral port), was given up by U. S. with respect to blockade and the carriage of conditional contraband.

A vessel carrying contraband may be condemned if the contraband, reckoned either by value, weight, volume, or freight, forms more than half the cargo.

With us the tendency has been to limit the confiscation of the ship to cases where fraud or bad faith on the part of the master or owner was discovered.

In the World War, 1914-1917, Great Britain in Feb.-Mar., 1916, issued Order in Council abrogating the doctrine of continuous voyage as set forth in the Declaration of London.

What is right of asylum in legations, on board vessel of war, and on board merchant vessel? Cite instance of controversy.

The right of asylum is protection granted a political or criminal offender under the flag of one nation on the territory or territorial waters of another nation.

The privilege of immunity from local jurisdiction does not embrace the right of asylum for persons outside of a representative's diplomatic or personal household. (Instructions to Diplomatic Officers of U. S.)

The practice of granting immunity from arrest and asylum in legations and consulates is not in accordance with the rules of international law. Under the general rule of international law and courtesy it is considered wrong to afford asylum to a criminal or to a person charged with a crime against the state in whose friendly water a vessel of war happens to be for the time. If criminal of any kind succeeds in boarding a foreign vessel of war, he cannot be apprehended on board by the police or local authorities. The Commanding Officer has a right to judge whether the crime charged as non-political is so, or is only used as a pretext to prevent asylum being granted to a person in flight for his life on account of his political acts.

U. S. Navy Regs. The right of asylum for political or other refugees has no foundation in international law. In countries, however, where frequent insurrections occur, and constant instability of government exists, usage sanctions the granting of asylum; but even in the waters of such countries, officers should refuse all applications for asylum except when required by the interests of humanity in extreme or exceptional cases, such as the pursuit of a refugee by a mob. Officers must not directly or indirectly invite refugees to accept asylum.

Apart from acts affecting their internal order and discipline, and not disturbing the peace of the port, merchant vessels, as a rule, enjoy no exemption from the local jurisdiction. It is therefore generally laid down that they cannot grant asylum.

Case of controversy—Sotelo case.

The French steamer " L'Ocean " received on board at Valencia, Spain, Sotelo (a Spanish ex-minister), who was under prosecution for political offenses. Vessel put to sea without knowledge of the personality of the passengers and entered Alicante, Spain, where, during custom's inspections Sotelo was recognized, seized, and taken ashore. The captain protested against violation of flag and invoked the right of asylum. Diplomatic communications between Spain and France established that the conduct of authorities of Alicante were above reproach; that Sotelo surreptitiously at Valencia could be regularly seized at another port of the same country; and that the fact of " L'Ocean " having been on the high seas before entering Alicante did not alter the nature of the act done at the place of departure and prove at the place of arrival under the dominion of the same laws.

What are the prisoners of war and what persons may become so? What treatment are they entitled to? Is exchange obligatory? How is exchange made? Is it an offense for a prisoner to attempt to escape? Discuss parole.

Persons entitled to the consideration and privileges of **prisoners of war** are members of the army or navy of the enemy, both combatants and non-combatants, and the wounded and sick taken during operations or in hospitals. Civilians engaged in military or auxiliary duties are liable to be held as prisoners of war. Camp follower correspondents, and contractors, are subject to restraint and to treatment as prisoners of war if able to produce a certificate from the military authorities of the army they accompanied. Prisoners of war are in the power of the hostile government, but not in that of individuals or detachments which have captured them. They should be treated humanely and with regard due their rank. All personal property except military equipment remains the property of the prisoners. Prisoners of war cannot rightfully be required to furnish information of their own forces nor to assist the military operations of the enemy. Prisoners of war may be employed as laborers, but the labor shall have no connection with the war operations and shall be paid for at rates commensurate with the work performed. Prisoners of war should be exchanged without unreasonable delay, but exchange is not obligatory.

Conventions of exchange are called **cartels** and are drawn up to arrange conditions and scale of exchange. A cartel can be made between commanders-in-chief or government agents.

A cartel ship is a vessel employed to exchange prisoners. The cartel ship is neutralized by her office and is unarmed.

After conclusion of peace, prisoners of war shall be sent back to their country as soon as possible. Prisoners can be punished for attempt to escape. Escaped prisoners who are recaptured before regaining their army shall be amenable to punishment. Prisoners who have succeeded in escaping and are again made prisoners of war shall not be subject to punishment for previous escape.

The U. S. Army Field Regs. state that prisoners must be given to understand that any attempt to escape will draw fire.

Parole is a pledge to the effect that the prisoner will not bear arms against the government or armies of the captor during the pending war unless duly exchanged. A paroled prisoner may perform internal service such as recruiting or guarding stores in the interior.

No military person other than a commissioned officer can give a parole for himself or others. Paroles must be voluntary on both sides. A breach of parole is punished by deprivation of the rights of prisoners of war and further punishment by courts. A prisoner cannot be forced to accept his liberty on parole.

Who is authorized to send or admit communication by flag of truce afloat? To what immunity is the bearer entitled? Is it obligatory to receive or to cease firing on its approach?

Art. 4, U. S. Navy Regs., states that the only persons empowered to hold intercourse with an enemy are the President, the Secretary of the Navy, the Commander-in-Chief of the fleet, the commander of the squadron, or, in case of a vessel acting singly, the commanding officer. No specific mention is made of a flag of truce.

A flag of truce is a square white flag and is used for parley between opposing forces. International law extends its protection to any duly authorized person carrying it and to necessary accompanying persons. A vessel employed to arrange under a flag of truce for cessation of hostilities is called a cartel ship. Admission to opposing lines by party carrying this flag cannot be claimed as a right. The commander to whom flag is sent may give general notice to the other belligerent that he will not receive any flags of truce, or none within a certain period, or except at certain places; or he may warn off any particular flag of truce; but without such warning or notice, to fire upon a flag of truce or offer violence to bearer is an offense against the rules of war. A flag of truce being admitted precautions may be taken to prevent improper advantage being taken by the bearer. A bearer of the flag of truce is bound to act in good faith and should he abuse the confidence of the receiving force he may be tried for violation of the laws of war.

In 1827, the firing on an English boat bearing a flag of truce precipitated the battle of Navarino Bay, which resulted in the destruction of the Turkish fleet and in the independence of Greece.

Is it ever allowable to give no quarter? What is retaliation and when may it be resorted to?

By Hague Convention of 1907, it is especially forbidden to declare that no quarter will be given.

By Art. 368, Rules of Land Warfare (U. S., 1914).—All troops of the enemy known or discovered to give no quarter in general, or to any portion of the army, receive none.

Retaliation are acts resorted to by one belligerent against the enemy individuals or property for illegal acts of warfare committed by the other belligerent, for the purpose of enforcing future compliance with the recognized rules of civilized warfare.

An example of retaliation in the European War of 1914–1917 was the isolated confinement of certain British officers made prisoners by Germany as a reprisal for the reported similar confinement of German submarine officers captured by England.

Retaliation will only be resorted to as a means of protective retribution and only after careful inquiry into the real occurrence and the character of the misdeeds that may demand retribution. Reprisals should never be resorted to by individual soldiers, but solely under the direct orders of a commander.

What is the status of privateers?

The Declaration of Paris provided that "Privateering is and remains abolished."

The United States was not a signatory, hence is entitled to use privateers. A privateer pension fund is still existent in the Revised Statutes. The U. S. Naval War Code of 1900 recognizes privateers by including same in its definition of Naval Forces by the sentence, "The officers and men of all other armed vessels cruising against the enemy under lawful authority."

What are usages as to attack and siege of fortified places? Is any previous notice necessary or customary?

What is the usage as to the attack on unfortified towns or seaports?

Fortified places in time of war are liable at any time to attack or bombardment, the fact of its fortification justifies a surprise, and in time of war the non-combatants residing in such a place must be prepared to share its fortunes. Bombardment, assault, and siege are recognized as legitimate means of warfare, but their use is limited to defended places. The definition of a defended place is (1) a fortified place, (2) a town surrounded by detached forts, and (3) a place that is occupied by a military force or through which such force is passing. The American rule is that commanders inform the enemy of their intention to bombard a place so that the non-combatants may be removed before the bombardment commences. Surprise may be a necessity. The attack or bombardment by whatever means, of towns, villages, dwellings, or buildings, which are undefended is prohibited.

Captain of a ship in a foreign port, man commits an offense is arrested and is to be prosecuted ashore, what is your duty? He escapes to ship? He is taken from boat? What is your duty in each case?

Navy Regs.—If an officer or member of the crew while on shore commits an offense against the laws of the country, the local authorities have jurisdiction over such persons while they are on shore, and may cause them to be arrested while there, and to be punished in accordance with the laws of the foreign state. The commanding officer of the ship should at once be informed of the arrest and of the causes which lead to it so that either he, or the diplomatic or consular authorities of his government may procure the return of the persons accused to their own vessel or to observe the manner of trial. If the offenders, however, escape to their own vessel they cannot be apprehended by the local authorities, but the C. O. can if he sees fit, without the loss of dignity or prestige, surrender the offenders for trial and punishment by the local courts, or matters can be left to the usual diplomatic channels. If the offender is taken from the ship's boat, his release must at once be demanded and the matter reported through diplomatic channels. It is probable that an apology would be demanded by the government.

Navy Regs.—The commanding officer shall not permit any ship of the navy under his command to be searched by any person representing a foreign state, nor any of the officers or crew to be taken out of her, so long as he has the power to resist. If force is used it must be repelled. In ports where war or insurrection exists or threatens, the commanding officer of a ship shall always require the boats away from the ship to have some competent person in charge and shall see that the proper steps are taken to make their national character evident at all times. The boats of a ship of war will be regarded, in all matters concerning the rights, privileges, and comity of nations, as parts of the ship herself.

How is insurgent state recognized as having obtained belligerency by third powers and by parent states?

When a state recognizes an insurgent community as having attained the state of belligerency the recognition is generally made by a formal notification of neutrality, giving the date from which the state assumes the attitude of neutrality in the contest.

The parent state cannot be expected to proclaim recognition of an insurgent community as a belligerent. It acts naturally in an indirect manner, and its relations toward the insurgents must be judged by these acts. A proclamation or establishment of blockade, an exchange of prisoners, and the enforcement of the rules of war as to the carriage of contraband by neutrals, can be considered as manifest through indirect acts of recognition of belligerency by the parent state.

Give five conditions which a sovereign state must fill to be in standing as such.

1. A normal political community with common laws and customs.

2. A fixed territory within which this community lives.

3. A supreme government controlling within these boundaries.

4. The state must be independent of other states.

5. The state must be recognized as a sovereign state by other sovereign states.

What is meant by "de facto" government?

In order that insurgents may be recognized as a belligerent power, what three conditions are necessary?

A **de facto** government is a political organization, arising during a civil war, which has established itself by arms to such an extent that it can exercise sovereign powers.

1. Possession of part of the territory of the legitimate government

2. Organized a government of their own.

3. Conduct armed contention with the legitimate government according to the laws of war.

When abroad, what benefits does a citizen of a state enjoy as compared to an individual without nationality?

State five methods, generally recognized, for acquiring nationality through citizenship.

Give the naturalization requirements of the United States.

Protection of home state also individual when abroad. Protection to his property abroad when he is in his home state.

Birth, naturalization, revolution, cession, subjugation.

Applicant declares on oath before a court two years at least before his admission and after he has reached the age of 18 years, his intent to become a citizen. After 5 years of residence and within 7 years of first declaration, he may obtain citizenship by taking an oath of allegiance to the U. S. and of renunciation of his former country.

Why do states maintain legations in other states?

Why consular officials?

Give the grades of diplomatic representatives of the U. S.

As a means of intercourse with other sovereign states. A state cannot be a member of the family of nations if it has no provisions for such intercourse. Deal with diplomatic and broad questions of national policy and individuals rather than commercial interests.

To supervise and protect, in conformity with special treaties between the states and international law, the individual and national interests of his country and countrymen in accordance with regulations of his government and the other; no diplomatic functions—mostly commercial and maritime interests.

1. Ambassadors extraordinary and ministers plenipotentiary.

2. Envoys extraordinary and ministers plenipotentiary, special commissioners.

3. Ministers resident.

4. Chargé d'affaires.

What immunities are accorded an Ambassador by the state to which he is accredited?

Exemption from civil and commercial jurisdiction, from local police regulations, from custom duties and taxes, from religious regulations and from general exercise of authority over his household. These immunities extend to his official suite and immediate family.

You are in charge of a steam launch from U. S. S. "New Orleans" in harbor of Rio Janeiro, Brazil, and an enlisted man from your ship has assaulted a Brazilian while on liberty but escapes to your boat pursued by police. They attempt to take him from your boat. What action would you take?

Prevent his capture, by force if necessary.

Return him to the ship and report matter to the Commanding Officer.

A British subject murders a Frenchman on a U. S. merchant vessel on the high seas. What court has jurisdiction?

United States courts.

What is the modern doctrine as to treatment of enemy citizens residing in a state at the outbreak of war?

What is meant by the term " laws of war"?

Expulsion resorted to in extreme cases, the state being the judge. Unless special reasons exist, they should be allowed to remain so long as they don't give aid or information to own country. In absence of treaty stipulations, right to arrest no longer exists and right to expel should be used sparingly and only in great emergencies.

That branch of international law which prescribes the rights and obligations of belligerents, whether or not in arms, and of persons under military government or martial law, and persons simply resident or being upon the theater of war, and which authorize their trial and punishment when offenders.

Name five generally accepted duties of neutrals.

Under what circumstances are belligerent ships and crews interned?

1. To prevent belligerent acts in neutral territory.
2. To prevent passage of belligerents over neutral territory.
3. To prevent use of neutral ports as a base.
4. To prevent a hostile expedition from a neutral port.
5. To intern belligerents seeking refuge in a neutral country.

Interned, when they refuse to leave the neutral port at expiration of the time limit set by the neutral country.

What classes of enemy vessels are usually immune from capture or destruction in time of war?

What persons serving on vessels afloat are entitled to be made prisoners of war? How are these prisoners treated? What may be required of them as to labor?

Vessels engaged purely on charitable missions, scientific work or of explorations, hospital ships, cartel ships.

Members of armed Naval forces, auxiliary, combatants and non-combatants, sick and wounded taken during operations, and all persons officially attached to the fleets. Treated humane manner and with due regard to rank. Rationed and clothed same as corresponding of captor. Can be disciplined; made to work on civil works; not to work on military preparations.

In what branch or branches of the U. S. Government is the treaty making power vested?

What does the Constitution provide as to the manner in which treaties made by the U. S. shall be regarded in all the states of the Union?

What is the effect of war upon the treaties between two belligerents?

By Executive, by and with advice and consent of Senate. The House acts on financial part involved.

Are the supreme law of the land, all judges being bound by the provisions thereof, anything in the Constitution and laws of any state to the contrary notwithstanding.

Abrogated or suspended in general, except as to conduct of war; as to boundary lines of states concerned; treaties of cession and treaties of recognition.

What is the general object of war?

What forces comprise the Naval forces of a state?

What is the area of maritime warfare?

What legal proceedings are necessary in the case of a public vessel becoming a prize to an enemy man-of-war?

To procure the complete submission of the enemy at the earliest period with the least expenditure of life and property.

Officers and men of regular naval establishment.

Naval Reserve.

Naval militia and auxiliaries.

Officers and men of all other armed vessels cruising against enemy under lawful authority.

High seas and territorial waters of belligerents.

None.

State four ways in which a neutral ship may be guilty of unneutral services?

Are neutral vessels under neutral convoy exempt from search?

Which of the large nations fully ratified the Declaration of London?

Which three large nations first ratified the League of Nations and thereby made same effective.

1. Transmit or repeat certain messages or information to or for a belligerent.
2. Carry certain despatches for a belligerent.
3. Transport certain persons in the service of a belligerent.
4. Accompany naval or military force as auxiliaries.

Yes, by Declaration of London.

The U. S.

England, France, and Japan.

What was the "Trent" affair; what action was taken?

The English steamer "Trent" en route from Havana to St. Thomas was stopped by the U. S. SS. "San Jacinto" under Capt. Wilkes, and two Confederate agents—Mason and Slidell—were removed to the "San Jacinto" and taken to Boston. The offense according to Great Britain was that innocent voyage from one neutral port to another had been violated on the high sea. The U. S. surrendered Mason and Slidell to Great Britain on the grounds that these men should not rightfully have been separated from the ship, and that both ship and men should have been captured as contraband of war. England's reply was that the men were not agents, but were on an unofficial voyage and were not bearing despatches.

MILITARY LAW

Military Law is a branch of general law, is essentially ordained for the government of the military force of a state in peace and war, and administered in courts-martial or courts of inquiry.

During the occupation of territory of a foreign state, the law of the invested territory is automatically suspended and military law (the law of the investing body) becomes the law of the territory controlled.

Trial is: "The examination before a competent tribunal, according to the laws of the land, of the facts put in issue of a cause, for the purpose of determining such issue." (Bouvier.)

There are three naval courts-martial, which conduct a "trial" of an enlisted man of the Navy or Marine Corps, (1) general courts-martial, (2) summary courts-martial, and (3) deck courts.

Regulations define the punishments courts-martial may inflict.

General courts-martial may be convened by the President, by the Secretary of the Navy, by the Commander-in-Chief of a fleet or squadron, and by the Commanding Officer of any naval station beyond the continental limits of the United States.

A general courts-martial shall consist of not more than thirteen nor less than five commissioned officers as members; and as many officers, not exceeding thirteen, as can be convened without injury to the Service, shall be summoned on every such court. But in no case, where it can be avoided without injury to the Service, shall more than one-half, exclusive of the president, be junior to the officer to be tried. The senior officer shall always preside and the others shall take place according to their rank.

In detailing officers for a general courts-martial for the trial of a medical, pay, or marine officer it is deemed proper if the exigencies of the Service permit, that at least one-third of the court be composed of officers of the same corps as the person to be tried. No officer should be named in the precept as a member against whom either the judge advocate or the accused can reasonably object when called upon to exercise the privilege of challenge.

Does detachment relieve an officer from general court-martial duty?

No.

What are the duties of judge advocate general regarding: Before assembling of court? Examination of charges and specifications? Lists of witnesses? Summoning witnesses? Assisting accused? Record of proceedings? Administering oaths? Advice? Improper evidence? Can civilian witnesses be subpœnaed?

The judge advocate is responsible to the convening authority for the proper discharge of his duty. Upon being notified that a trial has been ordered, and having obtained all the papers, he will ascertain whether the accused has received a copy of the charges and specifications. He shall critically examine the charges and specifications in order to notify the court if there are any inaccuracies. He will be authorized by the court to correct manifest clerical errors. If material errors in the charges and specifications are discovered, they will be returned to the convening authority for amendment. The judge advocate will call upon the accused for a list of the witnesses he wants summoned and shall furnish the accused with a list of witnesses for the prosecution. The judge advocate shall not, except by order of the court, summon any witnesses at the expense of the United States, or any officer of the Navy or Marine Corps, unless satisfied that his testimony is material and necessary to the ends of justice.

If naval witnesses are required where expense of travel is involved, the judge advocate of a general court-martial convened within the limits of the United States will submit a list of such witnesses together with subpœnas to the Secretary of the Navy through the Judge Advocate General, explaining in his letter the testimony he expects to obtain from these witnesses. The convening authority approving, the subpœnas will be issued for their attendance.

In case a civilian witness refuses to attend, he will be paid or tendered the fees and mileage provided by law for such attendance, and if he then fails to respond a report of the circumstances will be made by the court to the United States District Attorney, whose duty it becomes to institute a prosecution against such witness for disobedience of the subpœna.

When the accused is without counsel the **judge advocate** will assist him both in and out of the court, as may be compatible, with his primary duty of conducting the prosecution. He will guard against even suggesting that the accused plead guilty.

Deliberations by the members on any matter will be conducted in closed court, the **judge advocate** also being required to withdraw; and the decision will be announced when the court is opened. Previous to leaving the court the parties will be permitted to submit their reasons for their contentions upon the point to be decided.

The finding and sentence must be in the handwriting of the **judge advocate** and there should be no erasures or interlineations in same. All the members and the judge advocate sign the record of the proceedings.

SUMMARY COURTS

What determines the time of meeting? Who summons witnesses? What limitations are put on summoning witnesses? How is a summons transmitted? When is a copy of specifications furnished accused? Who is the prosecutor? Who decides admissibility of evidence? What rules of evidence prevail? In questions of procedure what is followed? Can the court correct clerical errors in specification? What is said to accused's counsel? What does record contain regarding: Copy of specification? Challenge of members? Oaths to members and recorder? Oaths to witnesses? Accused as witness? Clearing of court. What is done in case of challenge? How is accused arrainged? What is proper order for introduction of evidence? How is testimony recorded? Suppose member or recorder be witness? When is his testimony taken? What is proper order for examining of witnesses? What is said as to reading over testimony? What warning is given witness? What is said as to accused as witness? When and how does recorder help accused? Who leaves when court is cleared? May conduct record of present enlistment be received as *evidence? What is said as to previous convictions? Regarding sentence of S. C. M. what is said as to: Limitations of punishment? Mixed sentences? Use of irons? Bread and water? Extra police duties? Incompetence? Reduction in rating? Loss of pay? Signatures? Who signs record of proceedings? What power has the convening authority? When is the sentence of bad conduct discharge carried into effect? What is said as to compelling civilian witnesses to attend and depositions?*

The summary court-martial is the next higher of the naval courts. It is different from the deck court in that it consists of three commissioned officers as members, and an officer as recorder. Any officer in the command, including a warrant officer, may be a recorder. The summary court-martial is ordered for the trial of enlisted men by the commander of a naval vessel, or commandant of a yard or station, or the commandant of a marine barracks. It is for the trial of offenses which the convening authority deems deserving of greater punishment than he is authorized to impose, or than may be adjudged by a deck court, but not sufficiently serious to require trial by general court-martial.

The senior member of the summary court-martial presides, preserves order and acts as the mouthpiece for the court. The recorder shall summon such witnesses as may be necessary for the prosecution and defense. He will not summon witnesses without written orders from the convening authority where there would be any expense to the Government involved for transportation or attendance fees. Summons to persons on board ship are sent through the executive officer and ashore through the officer of the day. According to custom in the command, it may be done orally or by memorandum.

The accused will be furnished with a copy of the specification, if possible, at least 24 hours before he is brought to trial. This period is not mandatory, but sufficient time should be given the accused to enable him to prepare his defense.

The recorder represents the Government in prosecuting the case. He should skirmish around before the trial, look up his evidence, decide how he had best introduce it to prove the specification, and endeavor to produce the best evidence of which the case is susceptible. He should, of course, offer only that evidence which is lawfully admissible, but if in doubt he submits it to the court, which decides whether it will be received or not.

For instance, if the accused is charged with absence over leave, the recorder will obtain witnesses to prove that accused had permission to be absent, that he did not return at the expiration of his liberty, that he continued absent from his station and duty with authority, covering the period, commencement and expiration, hour and day. If it is a case of absence without leave, the recorder must show that accused was absent from his ship or station and duty without proper authority, that he continued so absent, covering the period, commencement and expiration by hour and day.

The evidence must be relevant, that is, it must bear directly on the issue. An eye witness to an occurrence is a better witness than one who heard of the occurrence through another. As an example, an eye witness to an assault is a better witness than the doctor who treated the injured person, although the doctor's testimony could establish the extent of the injury and would corroborate the testimony of the eye witness. But the eye witness could testify that he personally witnessed the assault, and state circumstances which may enable the court to determine whether or not it was wilful, malicious, and without justifiable cause.

In a court-martial, the same as in other criminal courts, the burden of proof rests upon the government. The accused is presumed to be innocent until he is proven guilty. His guilt must be established beyond a "reasonable doubt." By "reasonable doubt" is intended not fanciful or ingenious doubt or conjecture, but substantial, honest, conscientious doubt, not removed by material evidence in the case. The meaning of the rule is that the proof must be such as to exclude, not the possibility of innocence, but every fair and natural hypothesis except that of guilt. "What is required is not absolute or mathematical, but a 'moral certainty.'"

The recorder is required to record the evidence as it is given, and under the direction of the court prepares the record. He must enter the finding and sentence in his own handwriting. In a trial by summary court-martial, either the accused or the recorder may object to a member or members, only one objection being heard at a time.

A valid objection might be that the member has taken part in a previous trial or inquiry, is a material witness, has shown personal hostility, or has expressed or formed an opinion. The challenged member is permitted to reply, and the court then decides whether or not to sustain the challenge. If the challenge is sustained, the convening authority is notified and he appoints a new member.

The witnesses before a summary court-martial before testifying are sworn by the senior member.

The members and recorder of the court are sworn before each separate trial.

The accused has a right to counsel to assist him and counsel may be detailed if he so requests. If the accused has no counsel the recorder will help him to prepare his defense, and permit nothing incriminating or prejudicial to his case to be introduced, executing this duty in such manner as may be compatible with his primary duty as prosecuting officer.

Evidence of previous convictions is introduced by the recorder after the finding is reached. Such evidence should relate only to the current enlistment of the accused. Before such evidence is received by the court, the presiding officer will ask whether there is any objection to its introduction, and if not, the recorder reads aloud in open court extracts from the log enlistment records, or descriptive books, general court-martial orders or any other evidence of previous convictions, certified copies of such extracts being appended to the record. Such extracts to be admissible must show that the previous convictions have been approved by the authorities necessary to give full effect to the sentence.

After the sentence of the court is entered on the record it must be signed by all the members and the recorder. If any of the members think the accused is entitled to clemency they may make a recommendation to that effect, which must be signed only by the members concurring in such recommendation.

The record of the court is then submitted to the convening authority and after his action it is submitted to the senior officer present, whose action is final, except for the paramount authority of the Secretary of the Navy in all cases. The sentence of a summary court-martial does not take effect until it is approved by the senior officer present.

The record may be returned to the court for revision of the finding or sentence, or for the correction of clerical errors. However, no new testimony may be introduced on the revision, the court being restricted to reviewing the evidence already taken. This does not apply to evidence of previous convictions, which may be introduced on the revision, if the accused has been acquitted by the original finding, which is changed by the court on revision.

The summary court-martial is dissolved by the authority that convened it, which may be done either orally or in writing.

As the summary court-martial is intended to try cases that are deemed to require a greater punishment than may be imposed by deck court, the limitations of punishments that this court is authorized to adjudge are naturally greater than those within the power of a deck court. Thus, a summary court-martial may adjudge bad conduct discharge, or confinement not to exceed two months or solitary confinement for 30 days, or reduction to the next inferior rating. Extra police duties and loss of pay not to exceed 3 months may be added to any of the above punishments. For instance, this court can impose a sentence of 30 days' solitary confinement and loss of 3 months' pay, stating the amount of pay to be forfeited and not the period of time. Three months' extra police duties could be added to this punishment; or the court could sentence a person to be reduced to the next inferior rating and to lose 3 months' pay to which extra police duties for 3 months might be added. This court is also authorized to adjudge a punishment of bad conduct, discharge and loss of 3 months' pay.

DECK COURT

Who may order a deck court? When should it be ordered? What is the composition of the Court? What are the limitations of punishment? Ordinarily of what rank should an officer be to do this duty? What is done when there is only one officer attached to a ship, station, etc.? Who may be ordered as recorder? What is done if accused object to being tried by deck court? What is the ordinary time limit between offense and trial? What is done regarding previous convictions? What procedure is followed by deck court? In a deck court are witnesses sworn? When may accused testify? What matter is *submitted to convening authority? What power has reviewing authority? What record of procedure is kept? To whom is result published? What is done in case of appeal? What is said as to civilian witnesses and depositions?*

The deck court is the lowest of the naval courts. It is a court composed of one commissioned officer for the trial of enlisted men for minor offenses. The deck court officer will not be below the rank of a lieutenant in the Navy or a captain in the Marine Corps, unless all the officers on duty with a command are below such rank, in which case the commanding officer acts as deck court officer. An ensign may be deck court officer if he is the commanding officer and there are no other officers of the required rank on duty in the command. The deck court may be ordered by a commandant of a yard or station, commanding officer of a ship or a commanding officer of marines or higher authority. The deck court officer cannot be a witness either for the prosecution or defense. The deck court cannot adjudge a punishment greater than 20 days' confinement or 20 days' solitary confinement, and 20 days' loss of pay. For instance, this court may award either of the above forms of confinement and loss of pay not to exceed 20 days. The deck court may sentence a petty officer to reduction to the next inferior rating. Extra police duties not to exceed 3 months may be added to any of the above punishments. This court cannot adjudge a sentence of discharge. The recorder of a deck court may be any person in the command. It is his duty to record the testimony. The deck court swears the recorder and witnesses, and examines witnesses. The accused to be tried by a deck court may have counsel and he may testify in his own behalf if he so requests. He is also permitted to make a statement not under oath. Before a man is brought to trial by deck court he signs a statement to the effect that he consents to such trial; if he coes not consent, the charge against him will be tried by summary court-martial. After the deck court has entered the finding and sentence, the record is sent to the convening authority for action. The convening authority may approve, disapprove, mitigate or remit a whole or part of the sentence. After action by the convening authority, the sentence, if approved, or mitigated, becomes effective and is published to the accused. The record, when completed, is sent by the convening authority to the Judge Advocate General. A man convicted by deck court has a right to take an appeal to the Secretary of the Navy within 30 days after his trial.

COURT OF INQUIRY

When in general is a court of inquiry ordered? In case of accident involving loss of life what is ascertained? Who may order a court of inquiry? What are the duties of the President? What are the duties of the Judge Advocate? In a court of inquiry when is the defendant introduced? What is he told? Is a court of inquiry an open court? Who acts as prosecutor? Are the accuser and defendant allowed counsel? Can a member be challenged? Has the defendant a right to be present at an investigation? Are witnesses sworn? What is the order of interrogation? Can civilian witnesses be made to appear? What are the rights of the defendant regarding testifying? May defendant decline to make a statement? May defender or accuser demand a copy of proceedings? What authenticates the proceedings? What is said as to disclosure of opinion by members?

An investigation by a court of inquiry is in no sense a trial of an accused person; its function is merely to inform the convening authority in a preliminary way as to the facts involved in the inquiry, and when directed, to recommend what further action, if any, should be taken.

Court of inquiry may be ordered by the President, Secretary of the Navy, or the commander of a fleet or squadron.

This court affords the best means of collecting, sifting, and methodizing information for the purpose of enabling the convening authority to decide upon the necessity and expediency of further proceedings. It is ordered in important cases where the facts are various and complicated, where there appears to be ground for suspecting criminality, or where crime has been committed or much blame incurred without any certainty on whom it ought chiefly to fall.

The court of inquiry is usually composed of three officers and a judge advocate. The senior member of the court is the president. Less than three officers may act as a court of inquiry, and such courts have in fact been composed of only one officer and a judge advocate.

It is the duty of the president to administer the oath to the judge advocate and the witnesses, to preserve order and decide upon matters relating to the routine of the business.

The judge advocate administers the oath or affirmation to the members. He keeps the record of the proceedings under the direction of the court, puts the questions to the witnesses, and assists the court in systematizing the information it may receive. The judge advocate and the president in conjunction authenticate the proceedings with their signatures.

The court in its investigation must ascertain and report whether or not any person in the naval service is responsible for the irregularity or other matter under investigation, and if so, whose was the fault or negligence, and the degree thereof. If the death of a person in the Navy is the subject matter of the investigation, it must report whether or not such death occurred in the line of duty, and whether or not it was the result of misconduct on the part of the deceased.

The accuser, if any, and the accused, are allowed to have counsel present during the investigation, to introduce evidence, and to cross-examine witnesses.

The court will decide, unless otherwise ordered, whether or not its proceedings will be conducted behind closed doors.

The defendant may be absent from the investigation if he prefers, unless ordered to be present.

The defendant, at his own request, may be allowed to testify as a witness.

Courts of inquiry are empowered to issue process to compel the attendance of civilian witnesses, the same as general courts-martial. They also have like authority to punish naval witnesses for contempt, and to cause proceedings to be instituted against civilian witnesses by the United States district attorney.

The examination of witnesses being finished, the parties before the court are permitted to address it, if they so desire, and present their contentions and arguments for the court's consideration.

The proceedings may be revised as often as the convening authority considers necessary. New evidence may be received at such revisions, if desirable.

After mature deliberations upon the testimony recorded during the inquiry, the court shall proceed to report the facts, and, if so directed, shall express its opinion on the merits of the case, and recommend such further action as deemed necessary.

The complete original copy of the court's proceedings, after action thereon by the reviewing authority, shall be forwarded direct to the Judge Advocate General.

BOARDS

Who can order board of investigation and what is its composition? What does a board of investigation report? Can a board of investigation ordinarily administer oaths? When is a board of inquest ordered? Who orders boards of inquest? What is the composition of board of inquest? Are members or witnesses sworn? What is reported by board of inquest?

Officers commanding shore stations and ships on detached service, not being empowered to order courts of inquiry, shall order a board of three officers to investigate any casualty, occurrence or transaction in regard to which the Department should be informed and may, when necessary, require an opinion on the merits of the case.

The board shall make a report in writing, stating fully, clearly and as concisely as possible all the facts of the case. The substance of such report should be entered in the journal of the station, or the log of the ship, as the case may be.

The parties to the investigation have the same right to introduce evidence, and cross-examine witnesses as the defendant in a court of inquiry.

Board of this kind will not take testimony under oath except in important cases in which expressly authorized by the convening authority to administer oaths to witnesses.

The senior member of the board presides, preserves order, etc. The recorder under the direction of the board records the proceedings and findings.

Boards of investigation may revise their proceedings as often as the convening authority may consider necessary. New evidence may be introduced in revision, and such additional investigation made as may be proper to fully inform the convening authority and the Department with reference to the matter under investigation.

Boards of investigation and courts of inquiry differ from courts-martial in that such board and courts of inquiry in revision may, as stated, receive new evidence and make further investigations, while courts-martial are restricted to a reconsideration of the evidence already recorded.

In cases of naval boards of investigation the original copy of the proceedings, signed by the members and approved by the convening authority, is forwarded by the latter to the Judge Advocate General direct, except in cases where the subject matter of the investigation relates to collisions, or other accidents to ships or their machinery, etc., in which cases the record is forwarded to the Bureau of Navigation.

BOARDS OF INQUEST

In all cases of death occurring in the Navy, as the result of an accident, or attended with unnatural or suspicious circumstances the senior officer present is required to order a board of inquest to assemble and investigate the matter.

Such boards must be composed of not less than three commissioned officers, of whom one at least shall be of the medical corps. Neither the members of the board nor any person to be examined shall be sworn.

The board must first proceed to the spot where the body is found, observe its position, examine into its condition, and note its surroundings, for the purpose of discovering if possible some evidence that may tend to throw light upon the matter. If the body has not been found, as often happens in the case of drowning, a board of inquest should not be ordered, or if ordered, would be without authority to proceed. In this respect the Navy Regulations with reference to boards of inquest are similar to the laws relating to coroners' inquests in civil life, that is to say, in order to hold an inquest it must be possible to view the body of the deceased, and without such a view being had, the inquest is not valid. In naval cases, the situation suggested may be met under the regulations by convening a board of investigation instead of a board of inquest.

After viewing the body, the board of inquest assembles in some convenient place and records all the evidence procurable relative to the manner in which the deceased met death.

The medical member is required, after careful examination of the body, to give his opinion as to the cause of the death.

If the body of the deceased shows wounds or bruises such as to indicate that he came to his death by violent means, it shall be the duty of the board to ascertain, if possible, all the circumstances connected with the death, and such information as may be required to draw up charges and specifications against the person or persons whom it accuses of causing the death.

In every case the board must state whether the deceased met his death in line of duty, and whether or not it was due to his misconduct.

The record of the proceedings is prepared by the recorder, signed by all the members and the recorder, and transmitted to the convening authority who takes the necessary action thereon, and transmits the record to the Bureau of Navigation, unless the convening authority is authorized to order a court of inquiry, in which event the record of the inquest is attached to and made a part of the precept convening a court of inquiry in the case.

NAVAL EXAMINING BOARD

Officers of the Navy, to be eligible for promotion, must pass such mental, moral, professional and physical examination as the Secretary of the Navy may from time to time prescribe.

The examining board must consist of not less than three officers senior in rank to the officer being examined. When practicable the members of the board must be selected from the corps to which the candidate belongs.

The senior member of the examining board acts as the president, preserves order, etc. The junior member is customarily designated to act as recorder. The recorder under the direction of the board records the proceedings and enters the findings and recommendation.

The candidate for promotion will be duly informed when and where he is to report for examination. He will of course report in uniform. The candidate will first be examined by the board of medical examiners and having qualified physically will report to the examining board for the balance of the examination.

If the candidate fails physically, the examination is suspended and the board completes its report and forwards same to the Judge Advocate General, the candidate being discharged from further attendance before the examining board pending action by the Department.

The candidate having been found physically qualified and finished his written examination, the board then considers all papers on file in his case, all matters of record relating to the service of the candidate in his present grade having been forwarded by the Department to the board for this purpose.

The board will assume that the candidate is qualified mentally and morally, unless there is reason for doubt on either head, in which case it must proceed to investigate these requisites.

Interrogatories may be sent by the board to any officer having knowledge of the facts, or such officer may if the exigencies of the service permit, be called upon to testify in person before the board.

Any officer whose case is to be acted upon by such examining board has the right to be present, if he so desires, and to submit a statement of his case under oath.

The onus of establishing professional fitness shall be held to rest entirely upon the officer under examination. It shall be obligatory for any member of the board to recommend the promotion of any officer until he is satisfied of the officer's entire mental, moral and professional fitness for promotion. The board, while careful not to do injustice to any officer regarding whom there is any doubt, shall take equal care to safeguard the honor and dignity of the service, recommending no officer for promotion as to whose fitness a doubt exists.

The examination of the candidate having been concluded he is discharged from further attendance.

The board then deliberates upon the evidence before it, decides upon its finding, the record of the examination is signed and forwarded to the Judge Advocate General.

If there is a minority opinion it is made a part of the record and signed by the minority member or members who will state the facts on which such opinion is based.

Any question of law arising before the board, and communications relating to its proceedings, must be submitted to the Judge Advocate General.

An examining board is dissolved by the authority that convened it.

RETIRING BOARDS

A retiring board consists of not more than nine or less than five commissioned officers, two-fifths of whom shall be members of the medical corps of the Navy. Said board, except the officers taken from the Medical Corps, shall be composed, as far as may be, of seniors in rank to the officer whose disability is the subject of inquiry.

A retiring board is authorized to inquire into and determine the facts touching the nature and the occasion of the disability of any officer whose case is duly referred to it by the Secretary of the Navy, and possesses such powers of a court-martial and of a court of inquiry as may be necessary.

The members of the board must be sworn in each case to discharge their duties honestly and impartially.

When a retiring board finds an officer incapacitated for active service, it must also find and report the cause which in its judgment produced his incapacity, and whether such cause was an incident of the service.

No officer of the Navy may be retired from active service for physical disability or wholly retired from the service without a full and fair hearing before a retiring board if he shall demand it.

No officer of the Navy shall be placed on the retired list because of misconduct; but instead must be brought to trial by court-martial for such misconduct.

The record of the proceedings and decision of the board in each must be transmitted to the Judge Advocate General.

INQUIRY INTO LOSS OR GROUNDING

In an inquiry into the loss or grounding of a ship what particulars are included regarding: Books, Chart, Courses and Distances run, Deviation. If land was made, Instructions observed. Separate working of reckoning. Attestation of reckoning, etc.

(1) Rough log; (2) Night order book; (3) Chart with plotted courses. (See **largest scale chart used.**) (4) Navigator's note book.

When an inquiry is made into the loss of a ship, what report is called for? What is then done?

Official report of C. O. regarding loss or disaster.

What two questions are put to the commanding officer in case of loss of ship?

Is report true statement? Any complaint against officer or man?

What question is put to other survivors in case of loss of ship?

Narrative correct or charges to make?

What duties of commanding officer in case of loss of ship with accounts, clothing, etc.

Report circumstances to Secretary of Navy as soon as possible. Repair with crew to nearest naval station; if, in foreign country, to fleet or squadron or to United States.

Give pay officer written order to open new accounts for survivors dating from date of disaster and crediting them with pay of their respective ratings.

Reports of loss of clothing and bedding forwarded to Secretary of the Navy, signed by divisional officers and Commanding Officers.

You are in command of vessel which collides with merchant vessel, causing injuries which involve damages, what would be procedure (1) *home port,* (2) *foreign port?*

In the event of a collision between a ship of the Navy and a merchant vessel, so serious, or under such circumstances as not to admit of immediate repair with the resources at hand, and therefore likely to involve damages, a board of three officers shall be ordered by the commander-in-chief or senior officer present to ascertain all the attendant circumstances, injuries received by the merchant vessel, probable amount of damages, and which of the ships is responsible for the accident; and the master of the merchant vessel concerned shall be notified of the time and place of meeting of the board and informed that the officers and men of his vessel will be given a hearing by the board, if such hearing is desired. The report shall be prepared in quadruplicate; one copy shall be forwarded without delay to the Navy Department, one retained by the commander-in-chief, one furnished to the commanding officer of the naval vessel concerned, and the remaining copy given to the master of the merchant vessel, provided that the officers and crew thereof who were witnesses to the collision shall have testified before the board. When repairs have been effected on the spot, a certificate of the fact shall be taken from the master of the merchant vessel and forwarded, through the commander-in-chief, to the Secretary of the Navy.

If not in the presence of a senior officer, the commanding officer of the ship shall order the board.

If the collision occurs in the waters of the United States, and results in the loss of life or damage to person or property, the commanding officer of the ship concerned shall inform the collector of the district in which it occurs, through the senior officer present, in accordance with the Act of June 20, 1874.

If the collision occurs in a foreign port, such measures shall be taken as may be required by the port regulations, and the captain of the port shall be informed should it be necessary.

Whenever, in consequence of injuries sustained in the waters of a foreign port by a United States vessel, as a result of a collision between it and a foreign merchant vessel, clearly the fault of the latter, it may become necessary or desirable, on the part of the commanding officer of the former or of the senior officer present, to libel the latter vessel, such libel proceedings shall be instituted in the name of the United States, and not in the name of such commanding officer or senior officer present. In all such cases it shall be the duty of the commanding officer concerned, or of the senior officer present, according to circumstances, immediately to inform the Department of his action.

Enumerate the duties of a Recorder of a Summary Court-martial, preliminary to the trial.

Specification examined for typographical errors, errors in spelling, errors in names, dates or facts and legal features.

Serve specification on accused. (Noted in log.)

Examine papers pertaining to case.

Examine proposed witnesses and accused.

Find statement accused wishes to make.

Final Preparation.—As it is necessary for him during the course of the trial to present to the court a statement of the pay of the accused per month and the amount due him on the date of the trial, he should obtain such statement from the pay officer prior to the trial. As it is also necessary to introduce evidence of previous convictions, if any, he should carefully examine the service record and prepare such evidence for presentation to the court. He should consult with the Executive Officer telling him the time and place of the trial indicated by the Senior Member with a view to seeing that the same does not conflict with the ship's routine or program, and should request that an orderly be detailed for the court. He should send notification to all witnesses as to the time and place of trial and as to the approximate time when they will be desired by the court. He should in ample time before trial request the Officer-of-the-deck to have the accused together with all witnesses sent to the court room. Just before trial he should see that the place of meeting is in readiness, that all papers pertaining to the case and the necessary books, such as Regulations, Rules of Procedure, Bible, etc., are in place and available for ready reference. He should assure himself that the orderly, the accused, and such witnesses are on hand and will be certain that everything is in readiness to proceed at the time previously set by the Senior Member.

In a trial by Summary Court-martial:

What is the status of an accused who voluntarily takes the witness stand in his own defense?

Same as any other witness.

At what stage is the accused permitted to submit a statement? Is this statement considered as evidence?

When all evidence is in. No.

At what stage of the trial is the recorder permitted to submit evidence of previous convictions and how is this done?

After finding and submitted from excerpt of enlistment record of **approved** sentences of previous convictions.

By whom is the arraignment of the accused made, and at what point in the trial?

By recorder after oaths are administered and specification read with no witnesses present.

EVIDENCE AND TESTIMONY

What is evidence? Kinds? When is hearsay evidence admitted? When opinions? Can a civilian testify before a military court? In what connection may a civilian act? What is said as to documentary evidence?

How is testimony corrected or amended? What warning is given witnesses? When may accused testify? Does failure of witness to testify create a presumption? Is a statement evidence? When is an opinion admissible as evidence? What is hearsay evidence and why objectionable? What exceptions to rule excluding hearsay evidence? What is the order of the introduction of evidence.

Evidence is that which is legally submitted to a competent tribunal as a means of ascertaining the truth of any alleged matter of fact under investigation before it.

Testimony is a declaration or affirmation made to establish some fact; such declaration made by a witness under oath. Testimony is a species of evidence. The subject of evidence may be divided up into four heads: Proof in general; admissibility of evidence; oral testimony; written evidence.

Rules of Evidence.—*What are rules of evidence and how did they come to be adopted?*

Rules of evidence are simply standards which have been adopted for testing the weight that may safely be given to particular testimony, or other evidence. It is not pretended that these rules will give mathematically correct results, nor that they will always insure absolute justice. But it is a fact that in the large majority of cases, if intelligently applied, they will greatly assist in arriving at the true facts which is necessary in order to come to a reasonably correct conclusion.

Rules of evidence are in some part also rules of law. That is, the people of a State have become convinced that it is absolutely necessary to enact certain rules into statute law, so that courts will be bound to follow them, whether the courts should approve of their application in particular cases or not. In general, such statutes have been enacted to protect those accused from abuse by the Government itself in conducting criminal prosecutions. As a striking example of such statutes, embodied into the organic law of the United States, I quote the following from the Constitution: "No person shall be convicted of treason, unless on the testimony of two witnesses to the same overt act, or on confession in open court."

This provision of the Constitution in regard to the necessity of having two witnesses to the same overt act is limited to the case of a prosecution for treason.

Another rule adopted from the English law, but which has since been modified in many jurisdictions, is the rule which prohibits husband and wife from testifying against one another or for one another. It was considered better for the body of the State to run the chance of justice failing in some particular cases rather than to take the chance of impairing that complete confidence which should, for the benefit of the State as a whole, exist in connection with the marital relation.

The Rules of Reason.—Rules of evidence which, in their application, require thought and the exercise of discretion. They are those with which the court has to deal in its capacity as a jury. More than any other one thing, an officer is dependent for success upon his ability to judge testimony, to weigh evidence. To have "common sense" is to have the ability to justly weigh evidence, and this "common sense" is acquired by knowledge and the practice of applying such knowledge to the particular cases as they arise.

Charles C. Moore, in the preface to his volumes "Moore on Facts," the only text book in existence devoted to the arguments on questions of facts as obtained from judicial authorities, states: "The late Mr. Justice Miller of the United States Supreme Court declared that the difficulties in determining questions of fact are greater and more common than those that occur in determining questions of law, and other judges have testified to the same experience. It is therefore eminently desired that aid should be sought by the triers of facts in all accessible sources where authentic advice is likely to be found." No man can in a lifetime, of his own experience, overcome the difficulties of determining the various questions of fact which he will be called upon to determine. It is well, therefore, as stated by Moore, to seek the aid that can be had by a knowledge of these rules that have been determined by the experience of others.

Admitted Facts.—In the most confusing cases, where the testimony is conflicting, you will generally find some one or more facts which are not at all doubtful, certain facts which are proved beyond any dispute or which are admitted to be true by both sides. Always start with these facts when you desire to arrive at the correct conclusion. Disregard all such testimony as conflicts with the admitted, undisputed facts.

Inclination to Give too much Weight to Testimony.—The ordinary jury, or court-martial, is always inclined to give too much weight to testimony. The careful weigher of evidence will always consider testimony in connection with every known or admitted fact. The mere fact that a witness is honest, with no intent nor interest to deceive, and that he makes his statements under oath does not bind us to believe everything or even anything he may state on the stand.

Superiority of Written Evidence to Oral Testimony.—It is notorious that a man's memory may change from day to day, but a document, if unaltered, relates the same story to-day as it did the day on which it was written. In courts-martial the "Report of Deserters Received on Board," is evidence of the return to naval authority of a deserter.

It should be remembered, however, that this rule should be applied in the light of all the surrounding circumstances, for the witness, if biased, might have suppressed some of the facts, or have colored some of the facts at the time of writing. Consider, therefore, carefully where written evidence is introduced if the writer had any interest in the case such as might have produced a bias in his mind.

All documentary evidence is offered in a public session of the court. For instance, should it be desired to introduce a letter to prove the hand writing of the accused, it must be offered in open court; thereupon the opposite party and the court have a right to inspect same, and to offer objections to its admission as evidence; party introducing it may reply; and the court then decides whether the document will be admitted and considered as part of the evidence, and if so, it is appended to the record as an exhibit, a note to that effect being made in the record of proceedings.

Suspicion.—Although probabilities are always to be considered, carefully guard against forming judgments upon mere suspicion.

Where husband and wife have been lost in the same marine disaster, the theory has been advanced that the man, being the stronger, would have naturally survived the longer. This question may be of importance in the matter of inheritance or of property left by will. However, to hold on such grounds that the husband survived the wife is to hold upon mere supposition and to render a decision entirely without evidence. It would, in fact, be no decision at all, but a guess or conjecture such as should have no place in the findings of a court-martial.

Reasonable Doubt.—No person has as yet defined " reasonable doubt " either to his own or any other person's complete satisfaction. The phrase was used to impress the fact that justice was the object to be attained, in criminal cases, but that, since it is impossible for a human mind to conceive pure justice, no more injustice should be perpetrated than the maintenance of the peace of the State demands. The State does not demand, on the contrary, it desires to avoid, so far as is possible with any administering of criminal law, that a single innocent person should ever suffer conviction and consequent undeserved punishment. The desire is to have employed the utmost human prudence in every case in administering punishments to individuals. " In all cases the positive testimony of an otherwise unimpeached witness can only be disregarded when its improbability of inconsistency furnishes a reasonable ground for doing so, and this improbability or inconsistency must appear from facts and circumstances disclosed by the evidence in the case. It cannot be arbitrarily disregarded by either court or jury, for reasons resting wholly in their own minds, and not based upon anything appearing at the trial."

Testimony as to Witnesses' Mental Process.—When an accused person charged with desertion testifies that he had no intent to abandon the service, the circumstances connected with his absence may have more weight as to his real intent than has his testimony.

Opinions—Expert Testimony.—Any intelligent witness may testify as to opinions which are themselves conclusions drawn from numerous facts within the daily observation and experience of intelligent persons.

Opinions of an **expert** in an art, trade, or profession, in which they have attained especial proficiency, may at the discretion of the court and under its direction, be given in evidence. The party who introduces expert witnesses must show that they are experts **in fact**.

In a collision case in admiralty, between the "Iberia" and the "Umbria," where the disaster happened in a dense fog, two experts of character and intelligence were called in behalf of the "Umbria," who testified that to put the "Umbria" at full speed, under the circumstances stated in the case, was a proper maneuver, and because no expert was called to the contrary it was urged to be an established fact in the case that it was proper to put the "Umbria" at full speed, and that all there was for the court to do was to say so. "But," said Judge Benedict, "this contention seems to render it necessary to report here that the opinion of experts, however intelligent and trustworthy, do not bind the conscience of the court." And further on he said: "I marvel to hear it contended that the law can be thus sworn away. No; the law stands that a vessel called to answer for damages shown to have arisen from her going full speed in a fog must be held liable, unless **facts** be proved which show to the court the existence of at least an apparent necessity to go full speed to avoid some immediate danger."

Observation.—The art of observation is one that is not very highly cultivated at the present time among civilized peoples. It is a very necessary accomplishment for service men, but one which will frequently be found lacking to an unexpected degree in witnesses. A man may have passed over a closed hatch, or around the same hatch when open, almost daily for a period of months during which he has served on the same ship, yet, when questioned on the witness stand, be totally unable to accurately describe, or recollect, its location. If he is otherwise an intelligent and upright witness, his lack of observation should not cause disbelief in such of his statements as are made from full recollection; but it is, of course, proper in weighing his testimony to take into consideration his ordinary lack of observation.

Credibility and Competency.—The question of the credibility of the testimony given by a witness is most important, for upon it rests the decision of the court. When the character for veracity of a witness has been shown to be bad—and whether this has been done or not is a matter within the sound judgment of the court—his testimony need not be wholly disregarded, but such credit given it as it appears to be entitled to receive.

A confirmed user of drug is not regarded as a credible witness. The general manner and bearing of a witness is an important consideration in weighing his testimony.

Competency should not be confounded with credibility. By law idiots, insane, intoxicated persons, young children and wives of accused persons are not competent to testify.

Exceptions may be taken to the competency of witnesses and, as a general rule, will be stated before the witness is shown; but at whatever stage of the trial the incompetency appears the court may rule that the witness is incompetent, and strike out and disregard the testimony already given. For instance, a party may object to a witness because of infancy, insanity, or drunkenness; also the wife of the accused may be objected to unless the case is one where the husband is charged with personal injury to his wife, in which event she is competent to testify.

In deciding questions of law as to the competency of witnesses and the admissibility of evidence, the members of courts-martial act in the capacity of judge; while in weighing the evidence they act in the capacity of jurors. In other words, members of courts-martial are judges of both the law and the facts, thus exercising the combined function of judge and jury in the civil courts.

As to the testimony of intoxicated persons, that is, persons who were intoxicated at the time of the occurrences which they attempt to relate, it is notorious that such testimony is unreliable, although it is admissible. While such testimony may, in cases be entitled to some weight, it should always be received with the greatest care and is easily overcome by proper testimony to the contrary. Evidence of the intoxication of a witness is always admissible to show to the court that he is not to be relied upon for a correct version of the facts at issue.

Interest.—It has been stated by a judge that the testimony of those on board a sailing vessel as to the strength and direction of the wind is entitled to more weight than that of others on board a steamship. Again, where a mate of a schooner testified that after coming to anchor he hove the lead and found the depth of water was 2½ fathoms, that he hove it but once, that he had no particular purpose in doing so, and he told no one at the time, the court remarked that it could be only regarded as a casual observation and could not be relied upon for perfect accuracy.

Statement of Reasons for Attention.—Witnesses who give reasons for the accuracy of their observations are to be preferred to those who merely state the fact to be so. Thus, testimony of the crew of a vessel that their light on the night of a collision was red, and nothing more, was easily overcome by the testimony of witnesses on the other vessel that the light was white, not red, and that the fact had been a matter of comment among them when the light was first observed.

In collision cases we should always weigh carefully the state of mind of the witness at the time of the collision, that is, whether he was excited or cool and collected. In the case just cited, the witness had not anticipated any great damage from the collision and had been cool and collected in his observations.

The Actor Rule.—The actor rule was well illustrated by Cicero in his speech for Archias, when he told the judges that he would prove conclusively that his client was enrolled as a citizen of Heraclea. " There is a man present," he said, " a most scrupulous and truthful man, Lucius Lucullus, who will tell you not that he thinks it, but that he knows it; not that he has heard it, but that he saw it; not even that he was present when it was done, but that he did it himself."

The rationale of the Actor Rule is that the chances of error are small when the witness tells you that he actually did, or said, something himself, providing you believe his memory is accurate and that he is without any interest which would tend to make him color his story.

Memory.—Just as the credibility of a witness may be attacked without criticising his veracity, so it is no argument as to the credibility of a witness to show that he is a man of excellent character, provided it is simply a question of the accuracy with which a witness remembers a transaction. The best of men may be deceived by their memories, and the most worthless characters may have excellent memories.

So far as the rules as to the weight of evidence are concerned, many of them can, necessarily, only be self-imposed restraints. Only the members of the court will know what really influenced their minds in arriving at findings of fact.

After all witnesses for the prosecution and defense have been heard, the accused will be permitted to submit a written statement or an oral argument. The judge advocate will be permitted to reply in like manner. The argument is supposed to bring out the salient points in the case, wide latitude being allowed both to the prosecution and the defense as to the statements they may make, provided of course that they are relevant to the issue.

Order of introducing witnesses to obtain evidence is:

1. Prosecution.
2. Defense.
3. Rebuttal.
4. Surrebuttal.

In command, to bring officers to trial by general court-martial, state procedure until case is before court.

If upon investigation the C. O. shall be satisfied that the charge is such as to call for judicial action, he may place the accused under suspension or in confinement, as the case may require, neither of which, however, shall be considered as a punishment.

When an offense has been committed by any person in the Naval Service which may involve his trial by general court-martial, he should, in general, be placed under suspension or in confinement, as the case may require, while awaiting action and pending a decision in the matter. When the competent officer has decided to have such person tried by a G. C. M. he shall cause charges and specifications against the offender to be prepared, and transmit a true copy of them, with an order for the arrest or confinement of the accused to the proper officer, who shall deliver such order to the accused, together with the copy of the charges and specifications, at the same time formally notifying him that he is under arrest, and, if an officer, shall receive his sword.

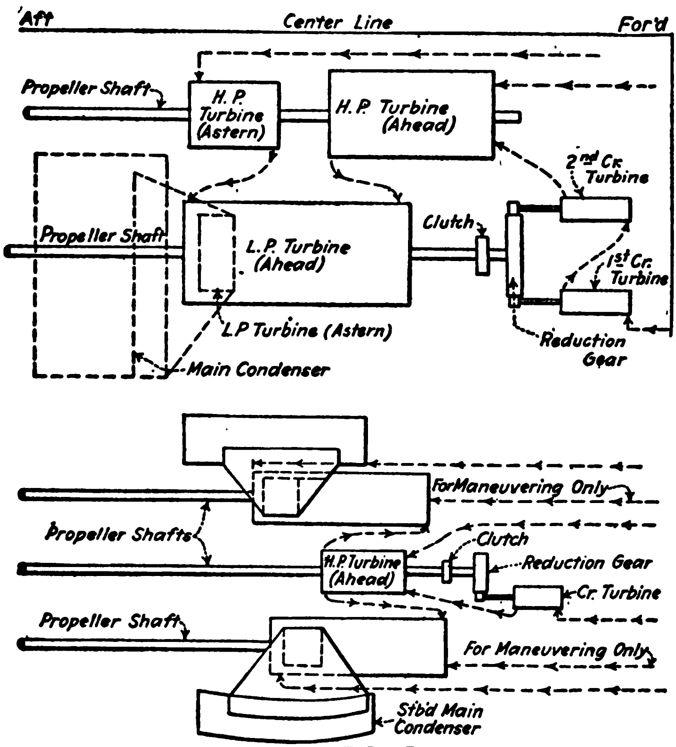
Ship going out of commmission at Navy Yard, give duties regarding delivery of orders detaching officers.

When a ship is to be placed out of commission, the orders detaching officers shall not be delivered until the vessels, supplies and equipment have all been landed or receipted for; the crew transferred or paid off; the ship ready to be turned over to the yard; and all regulations fully complied with.

STEAM

PARSONS' TURBINE

The Parsons Turbine embodies the principle of reaction compounding. The turbine consists of many rows of moving and fixed blades through which the steam expands continuously from entrance to exhaust. The mechanical parts are: Rotor to which are attached the moving blades; casing which surrounds the rotor and on the inner surface of which are attached the fixed blades; the bearings which support the rotor shaft and which are outside of but secured to the casing; the adjusting block outside of the casing, which is a small thrust block used to retain the rotor in a fixed plane of rotation to prevent moving and fixed blades touching; the dummy packing which is secured to the dummy piston (revolves with rotor) and to the dummy cylinder (fixed to the casing) to prevent steam leakage from the admission steam chest (ahead or astern turbine); shaft glands to prevent leakage of steam from the casing where the shaft passes through the casing (or to prevent air leakage depending on pressure in the casing). Steam admission is around the pull periphery. Each pair of rows of fixed and moving blades is called a stage; each set of blades of the same length is called an expansion. Speed reduction of turbine to meet the economical speed of propeller is accomplished by lengthening the turbine; or expressed more directly, by increasing the number of stages. This fact is illustrated by the addition of " cruising turbines " through which the steam flows before reaching the main H. P. turbines. To increase speed of rotation the cruising turbines are by-passed; and a still further increase of speed is accomplished by by-passing from one to three expansions in the H. P. turbine. The losses from increased number of stages are increased due to lengthening of steam path and thus increasing skin friction, and to increased tip leakage due to increased number of blade rows over which steam may leak. Reversal is accomplished in all U. S. Navy installations by an astern turbine installed in the L. P. ahead turbine under the main exhaust to the condenser; and in some cases by additional independent H. P. astern turbine direct connected to the same shaft as the main H. P. ahead turbine.



ARIZONA, (Stbd. E. R.) (Parsons.)

(H. P. ahead and I. P. astern turbines both exhaust to main condenser through main exhaust pipe.)

(L. P. ahead and L. P. astern turbines exhaust through main exhaust pipe into main condenser.)

CURTIS TURBINE

The Curtis turbine embodies the principle of pressure staging; and in the H. P. pressure stages (from one to five stages) the principle of velocity compounding. (Hence the term "pressure velocity compounded.") Expansion of steam takes place in fixed nozzles, there being a row of nozzles for each pressure stage. Each set of nozzles reduces the pressure of the steam to the amount of a portion of the entire expansion which takes place from entrance to exhaust. In a velocity compounded pressure stage, one to five rows of moving blades mounted on a wheel are used to absorb the velocity acquired by the steam due to its expansion in the nozzles of that stage. In pressure stages other than those velocity compounded, the velocity of the steam acquired in each set of nozzles is absorbed by only one row of moving blades. The moving blades of the pressure stages which are not velocity compounded are mounted on a drum, the forward end of which is closed for the purpose of balancing propeller thrust (the after end usually being subject to exhaust pressure only). The mechanical facts are: the rotor which consists of the velocity compounded pressure stage wheels and the drum secured to a shaft; the casing surrounding the rotor; the diaphragms which separate each two velocity compounded pressure stages; the moving blades attached to the wheels and the drum; the fixed or guide blades attached to the inner surface of the casing; the nozzles which are attached to the forward end of the casing in the first pressure stage to each diaphragm in each preceding velocity compounded pressure stage, and in the drum stages the guide blades form spaces which are in effect nozzles; the shaft glands which prevent steam leakage from the casing where the shaft passes through the casing; bushings which are secured to the diaphragms where the shaft passes through the diaphragms, to prevent steam leakage from one pressure stage to the next pressure stage; bearings which support the shaft and rotor and which are outside of and secured to the casing; adjusting block, which is the small thrust bearing used to keep the rotor in a fixed plane of rotation to prevent moving blades from touching the fixed or guide blades.

In destroyer installations the main ahead turbine is in one casing;

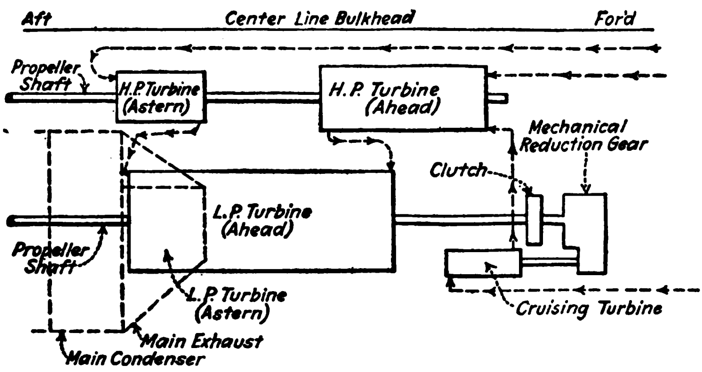
in battleship installations the main ahead turbine is divided into two parts, each in a casing of its own.

Reversal is accomplished by an astern turbine in the same casing as the L. P. ahead turbine, which is installed under the main exhaust pipe to the main condenser; and in some installations by an additional H. P. astern turbine which is independently connected to the same shaft as the H. P. ahead turbine.

The moving blades of the last velocity compounded pressure stage are secured to the forward end of the drum.

Speed reduction to meet economical propeller speeds is accomplished by velocity compounding (increasing the number of moving blade rows in the first few pressure stages); and by pressure staging (increasing the number of nozzle rows and the number of moving blade rows). This increase of blade rows increases the length of the steam path and losses are increased due to increase in skin friction.

The steam admission for velocity compounded pressure stage is only partially around the periphery, the increased volume of steam being allowed for by increasing the arc of admission for successive stages. The first and succeeding pressure stages not velocity compounded have full peripheral admission, the increased volume of steam being allowed for by increasing blade heights and in the last stages by increasing the blade spacing.



PENNSYLVANIA, (Stbd. E. R.) (Curtis.

Note.—Steam action: Parsons—expansion takes place throughout the length of the turbine in the fixed and moving blades.

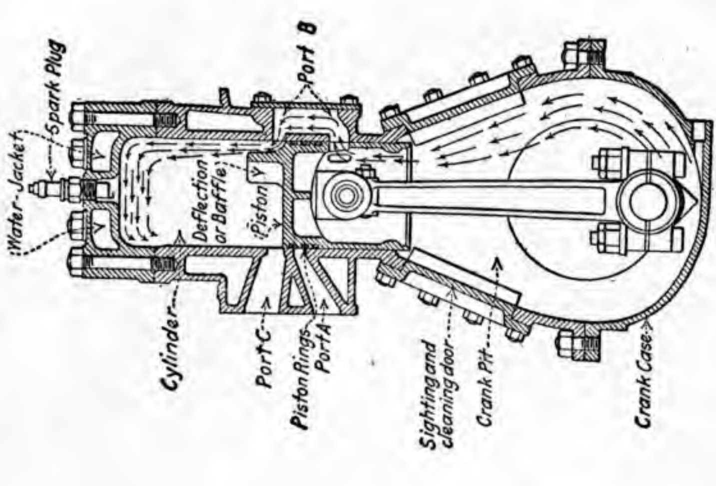
Curtis.—Expansion is wholly in steam nozzles (fixed).

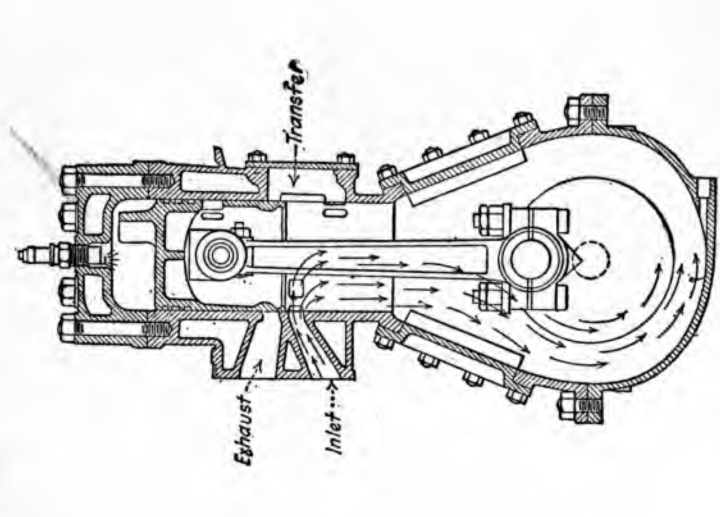
TWO-CYCLE ENGINE

The action of a two-cycle engine is as follows: Consider the piston at the top of its stroke with the combustible charge of gas compressed and ready for ignition. On the first stroke the charge in the combustion chamber is ignited and burned, and the resulting increased pressure forces the piston downward. At the beginning of this stroke, the enclosed crank case is full of a combustible mixture which has been previously drawn in and through ports " A," is compressed to about 4 or 5 pounds by the piston on its downstroke.. When near the bottom of the stroke, the top edge of the piston uncovers a series of ports " C " in the cylinder wall through which the burned gases escape into the exhaust pipe, the pressure in the cylinder dropping to about that of the atmosphere. Shortly after the exhaust ports have been uncovered, the piston still moving downward uncovers the transfer ports " B " in the cylinder wall, which are situated diametrically opposite the exhaust ports. The transfer ports are connected by a passage or by-pass through which the combustible mixture in the crank case flows into the cylinder. To prevent the incoming charge from passing directly across the cylinder and out of the exhaust ports (inlet and exhaust ports being open at the same time), the top of the piston is provided with a deflector or baffle plate, which directs the charge up to the top of the cylinder, thereby driving out the greater part of the burned gases remaining. On the second stroke the piston moves upward, first closing the transfer ports and shortly after the exhaust ports. The charge in the cylinder is compressed, and at the top of the stroke is ready for firing. During this stroke a new charge is drawn into the crank case.

By three-port method (used in the service engine) the charge is drawn from the carburetor into the crank case through ports " A " in the cylinder wall, located just below the exhaust ports, and are uncovered by the bottom edge of the piston when near the top of its stroke. No check valve is required.

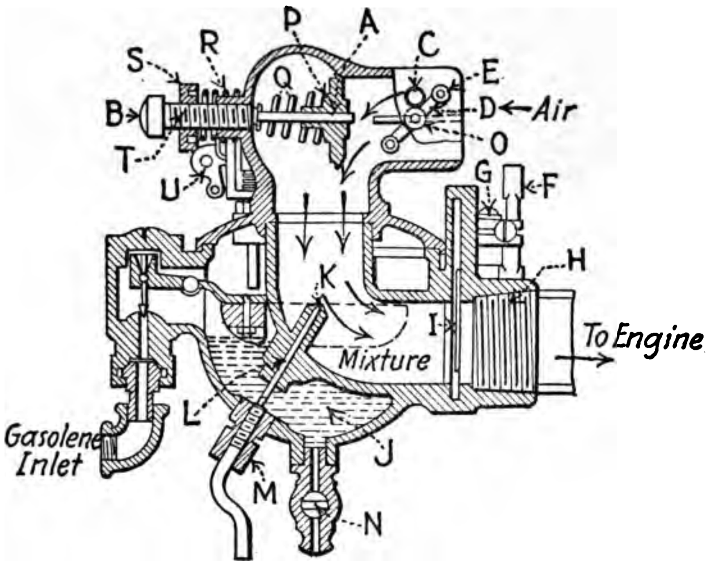
The illustrations show sectional views of a Schebler carburetor and a two-cycle engine. Before the gas is admitted to the engine the gasoline passes through a carburetor or vaporizor.


Water-Jacket
Spark Plug
Port B
Deflection or Baffle
Piston
Cylinder
Port C
Piston Rings
Port A
Sighting and cleaning door
Crank Pit
Crank Case


Transfer
Exhaust
Inlet

The parts of the carburetor are as follows:

A. Auxiliary air valve.
B. Air valve stem.
C. Starting lever spring.
D. Starting lever.
E. Air valve shutter.
F. Throttle lever.
G. Throttle lever stop.
H. Throttle valve.
I. Throttle valve disc.
J. Fuel bowl.
K. Spray nozzle.
L. Needle valve guide.
M. Packing nut.
N. Drain cock.
O. Air valve disc.
P. Air valve guide.
Q. Air valve spring.
R. Adjusting screw lock spring.
S. Adjusting screw lock nut.
T. Air valve adjusting screw.
U. Flushing lever.



Name the four strokes comprising the working cycle of a four-cycle gas engine. What takes place during each stroke? Does ignition take place before, or after the end of the compression stroke; state reason for this.

1. **Admission** = charge (mixture) of gas and air from carburetor is drawn into cylinder through inlet valve on down-stroke of piston.

2. **Compression** = charge admitted is compressed on up-stroke, thus generating heat and pressure.

3. **Ignition, explosion, expansion** = spark jumping across spark gap of plug screwed in top of cylinder ignites the charge. The instant of this spark is arranged for by the position in which a make and break circuit known as a "timer" or distributor is placed. The ignition spark which explodes the charge is made just before the completion of the compression stroke, which not only cushions the piston, but also gives the charge a chance to ignite and explode thoroughly before the piston has **started away** from the charge, thus insuring largest pressure for power stroke by saving waste of unburnt gases.

4. **Expulsion** = Just before completion of power stroke, exhaust valves open, and on the up-stroke, the burnt charge is forced out of cylinder.

In the four cycle, only one stroke exerts power in every two revolutions of the crank.

A six-cycled or scavenging engine never obtained commercial importance. In this type there is a third revolution of the piston used to admit a charge of pure air into the cylinder after the exhaust of burnt gases and subsequently expel it. By thus **scavenging** the combustion space, a greater economy of fuel consumption was expected but never realized.

A type of internal combustion engine known as the "heavy oil engine" is now used in submarines. The main difference between the "gas" and the "oil" engines is the fact that there is no ignition spark in the oil engine, the heat of ignition being supplied by the rise in temperature generated by the compression of a charge of pure air, in which is injected a spray of oil, whose flash point is **comparatively** low.

What is an oil engine and how does it differ from other forms of internal combustion engines? Is it two or four cycle? Describe operation of an oil engine.

Briefly described, the engines offered are single acting, and work on the two-stroke cycle with combustion of the liquid fuel under constant pressure. This principle embraces certain fundamental advantages to be mentioned later which are not to be found in oil or gasoline engines working on the so-called Otto principle.

The cycle of this engine is as follows:

1. On the up-stroke of the piston, pure air is compressed in the working cylinder to a high pressure and thereby becomes heated to a temperature above the flash point of the fuel oil.

2. Shortly before the end of the up-stroke, a spray valve opens and fuel oil is, for a short time at the beginning of the down-stroke delivered into the cylinder and begins to burn immediately. This down-stroke is therefore the real working stroke. During the first part of it, combustion under constant pressure takes place, while afterwards, the products of the combustion work by expansion. At the end of this stroke, the burned gases are exhausted through ports uncovered by the piston, and by certain novel arrangements provided, the cylinders are scavenged and filled with pure air which is then again compressed and the cycle repeated. Attention is here invited to the fact that there is no loss of fuel due to scavenging such as occurs in the ordinary two-cycle gasoline engine, and therefore this two-cycle operation should under no circumstances be confused with the two-cycle engines generally known, using gasoline. As the scavenging is performed with pure air only, an excess of air can be employed since the efficiency of the engine is not affected to any considerable degree, if part of the scavenging air escapes through the exhaust ports. In this way the working cylinders are thoroughly cleaned of the products of combustion, and a high mean pressure is obtained. Notwithstanding this, the mean temperature of the cylinder is not so high as to endanger the reliability of the engine.

The two-cycle operation and high mean pressure give a large power output per unit of cylinder volume, and in consequence the space occupied by the engine and its weight are both small.

The working cylinders are water cooled and the pistons are cooled in a special manner which obviates any danger to lubrication in the event of leakage.

The fuel is injected into the cylinders by compressed air, supplied by a two-stage air compressor, driven by the crank shaft and furnished as an integral part of the engine. This compressor has a capacity in excess of the fuel injection requirements, the excess capacity is employed when necessary to make up the supply for starting and reversing.

The wrist pin, or gudgeon pin, is not located in the hot working cylinder as is the case with the usual trunk piston construction, but well below it in a cool place in the scavenging piston, which beside supplying the scavenging air, serves as a cross head, thus relieving the working piston of any side thrust.

The lubricating system is of a forced type throughout. It has been carefully worked out, gives perfect results and by dispensing with hand lubrication, minimizes attendance. Besides insuring constant and adequate lubrication, the system serves to cool the main, crank pin and wrist pin bearings, as the oil is used in a closed circuit and cooled by a suitable cooler.

The heat conditions have received careful consideration in the design so that certain features that have hitherto been obnoxious in internal combustion engines generally, have been entirely avoided. The absence of side thrust in the working cylinder, its effective cooling, the cooling of the piston and location and arrangement of the wrist pin, all contribute to this result. In addition, the principle on which the engine works involves less extremes of temperature than the Otto principle and thus lessens the original cause of trouble.

The control gear of the engine is conveniently located at its forward end. The operations of starting, stopping, reversing or changing speed are all accomplished by the simple movement of a single part, a hand lever in the case of small engines and a hand wheel for the larger sizes. The necessary gauges, speed indicators, etc., are grouped at this station, so that the operator has full knowledge of all conditions affecting the working of the engine.

Except in special cases, the engine is made up in six cylinder units, in which case no fly wheel is required. This gives good balance and freedom from vibration as well as a very uniform turning movement. The engine is thus a very steady and smooth-running one and will operate satisfactorily even under light loads and at slow speed.

Special precautions are taken in the design to prevent the escape into the engine room of fuel fumes or products of combustion, so that the air in the engine room remains sweet and cool, and free from any disagreeable odor. Complete combustion is obtained in the cylinders, so that the exhaust is not smoky and carbon deposits on the piston head or cylinder are avoided.

The scavenging and fuel valves are mounted in cages and thus may be readily removed for examination and ground in when required. Their removal gives access for inspection of the piston head and cylinder.

Finally it should be noted that this engine is entirely free from the shocks to which the ordinary Otto (Gas) cycle engine is subject, where the combustible mixture at a pressure of from 50 to 75 pounds, is exploded, with an instantaneous rise in pressure to 300 or 350 pounds. Such sudden shocks, occurring at each working stroke of each cylinder, subject all parts of the engine to rapidly recurring stresses fluctuating in valve and sign. The inevitable result is a short-lived engine, which, particularly in the larger sizes is subject to sudden breakdown, due to the failure of even the best material under constant vibratory stresses of unknown magnitude.

Durability and all around serviceability of these engines, which taken with their moderate weight small size and great economy of fuel, constitute their most important advantages.

The fuel consumption per horse-power varies slightly with the size and speed of the engine, being lowest for large and slow speed engines and a little higher for small and high-speed engines. A fair average fuel consumption is .5 pound per brake horse-power per hour. The average specific gravity of ordinary fuel oil is .89 equivalent to 7.4 pounds per gallon. The fuel consumption therefore amounts to .54 of a pint per horse-power. The average price of such oil is 3 cents a gallon, making an average fuel cost of 0.2 cents per brake horse-power hour.

Compare this with the cost of gasoline or steam power. With gasoline at 24 cents a gallon and an average consumption of one pint per horse-power hour, the cost is 30 cents or 15 times as great. With coal at $5.00 per ton and a consumption of 2 pounds per horse-power hour, the cost is 0.486 cent or about 2½ times as great. This comparison relates only to fuel cost; there are other important economies which will be mentioned later.

Larger sized engines must naturally be compared with steam plants. An analysis of the factors here indicate equality in only one respect, viz.: Item E, durability. The first cost of the oil engine installation will generally be slightly greater, but in all other respects it shows material superiority over the corresponding steam plant. In this case also the difference in fuel cost alone is sufficient to offset the greater first cost of the oil engine, but even if this were not the case, the saving in weight and space required for the machinery installation and fuel would make the oil installation the more economical. For similar service, there is a saving of the weight and space required for machinery and fuel of from 40 per cent to 50 per cent, which is immediately applicable to an increase in the dead weight carrying capacity, and cargo and passenger space. In other words, where the size of the ship remains constant, its gross carrying capacity increases and at the same time its running expense decreases. The ultimate economy thus affected is enormous, and may amount to as much as 20 per cent per annum on the capital value of the ship.

OIL-BURNING SYSTEM

U. S. S. Wadsworth

Boilers.—There are four oil-burning Normand water-tube boilers, arranged in pairs in two separate compartments. They are designed to run the entire machinery plant at full power, with an average air pressure in the fire rooms of about 5 inches of water.

Each boiler has an independent smoke pipe 20 feet high above the main deck.

Data for One Boiler.—Working pressure, pounds... 260

Number of furnaces	1
Furnace volume, cubic feet	520
Area through smoke pipe, square feet	19.2
$\frac{\text{Smoke-pipe area}}{\text{Furnace volume}}$	0.0368
Heating surface, square feet	5375
$\frac{\text{Heating surface}}{\text{Furnace volume}}$	10.34
Oil burners, number	12
Type	Modified Bureau of S. E.

External height, feet and inches	14–11 $\frac{7}{16}$
Width, feet and inches	16–02 $\frac{1}{16}$
Length, feet and inches	13–09 $\frac{1}{2}$
Tubes, outside diameter, inches	1 $\frac{1}{2}$–01 $\frac{1}{4}$
Thickness, inch	0.12–0.109
Number	116–1594
Downcomers, inside diameter, inches	10
Thickness, inch	0–$\frac{3}{8}$
Number	2
Drum, upper, number	1
Inside diameter, inches	44
Thickness, shell, inch	0–$\frac{11}{16}$
Tube sheet, inches	1–$\frac{3}{16}$
Lower, number	2
Inside diameter, inches	19
Thickness, shell inch	0–$\frac{7}{16}$
Tube sheet, inch	0–$\frac{3}{4}$
Diameter of main steam stop valve, inches	7
Auxiliary steam stop valve, inches	3
Safety valves (two duplex Ashton), ins.	4
Main and auxiliary feed, stop and check valves, ins.	3
Bottom-blow valves, inches	1 $\frac{1}{2}$
Surface-blow valves, inches	1 $\frac{1}{4}$

Fuel Oil System.—The fuel oil pumps and heaters are located in the fire-rooms.

The plant consists of two light-service pumps, four heavy-pressure service pumps, two oil heaters, and the oil-storage tanks in the forward and after holds, together with the necessary piping and fittings.

The booster pumps have suctions from all storage tanks and the deck connection for taking on oil, and discharge to all storage tanks, service-pumps' suctions and the deck connections.

The service pumps draw oil from the storage tanks and the booster pumps, discharges, and deliver it to the oil burners on the boilers, via the oil heaters or by-passes. The burners, twelve per boiler, of the slightly modified Bureau of Steam Engineering type, are mechanical atomizers.

A small hand oil pump is installed in each fire room for supplying oil to the burners when raising steam.

PUMPS AND CONNECTIONS U. S. S. "WADSWORTH"

Pumps.	*Type.*	In.	*Suction Pipes from*	In.	*Discharge Pipe to*
2 Main Air.	Twin, Vertical, Bucket, Single-acting Warren.	11	Condensers, Through Water Seal. Reserve Feed Tanks.	10	Feed Tank. 1 in each eng. room.
2 Aux. Circ. for Main Condensers.	Turbine-driven Centrifugal Worthington.	14	Sea.	14	Main Condenser. 1 in each eng. room.
		7	Bilge.		
2 Main Feed.	Vertical Piston, Double-acting, Single, Warren.	5½	Feed Suction Pipe and Reserve Feed Tanks.	4	Main Feed Discharge. In ford. eng. room.
		5½	Water Seal Cross-connecting Pipe.		
2 Aux. Feed.	Vertical Piston, Double-acting, Single, Warren.	5½	Feed Suction Pipe and Reserve Feed Tanks.	4	Aux. Feed.
		1½	Hose Connection.	1½	Hose Connection. 1 in each boiler room.
2 Fire and Bilge.	Vertical Piston, Double-acting, Single, Warren.	4	Sea.	2½	Fire Main.
		4	Drainage.	3½	Overboard.
		4	Bilge of same Compt.	2½	Distiller.
		1½	Hose Connection.	1½	Hose Connection. In after eng. room.
1 Fire and Bilge.	Vertical Piston, Double-acting, Single, Warren.	3	Sea.	2½	Fire Main.
		3¾	Drainage.	3½	Overboard.
		1½	Hose Connection.	1½	Hose Connection. In after boiler room.
1 Aux. Circ. for Aux. Condenser.	Electric-driven Centrifugal.	5	Sea.	5	Aux. Condenser. In ford. eng. room.

Pumps.	*Type.*	In.	*Suction Pipes from.*	In.	*Discharge Pipe to.*
1 Aux. Air.	Vertical Piston, Double-acting, Single, Warren.	4½	Aux. Condenser.	4	Feed Tank. In ford. eng. room.
1 Evaporat. Feed.	Vertical Piston, Double-acting, Single, Warren.	2	Sea.	1½	Evaporators. In after eng. room.
1 Distiller Fresh Wat.	Vertical Piston, Double-acting, Single, Warren.	1½	Dist. Circ. Disch.	2	Reserve Feed Tank.
		2½	Distiller Reservoir Tank	2	Ship's Tanks.
				2	Cofferdam.
				1¼	Main Feed Tank. In after eng. room.
1 Oil Cooler Circ.	Vertical Piston, Double-acting, Single, Warren.	3	Sea.	2½	Oil Cooler. Fire Main via Oil Cooler. In after eng. room.
2 Lubricating Oil.	Vertical Piston, Double-acting, Single, Warren.	3½	Lub. Oil Tank.	3	Bearings.
				1½	Settling Tanks via Forced Lub. System. In after eng. room.
4 Fuel Oil Service.	Vertical Piston, Double-acting, Single, Warren.	2½	Oil Storage Tanks.	2	Burners. 2 in each boiler compartment.
		2½	Booster Pump Disch.	2½	Service Pump Supply.
2 Fuel Oil Booster.	Vertical Piston, Double-Acting, Single, Warren.	3	Storage Tanks.	2½	Storage Tanks.
		3½	Deck-hose Connection.	2½	Deck-hose Connection. 1 in each boiler room.

Forced Draft Blowers.—Four forced draft blowers are installed, two in each fire room. The fans are of the Keith single-inlet type, mounted on vertical shafts in the base of the fire-room ventilators, from which the air supply is taken. Each fan is driven by a 24-inch vertical Terry steam turbine located immediately below the fan.

The fan data is:

Fan, diameter mean, inches	$41\frac{3}{4}$
Width over all, inches	$13\frac{7}{16}$
Number of blades	24
Diameter of inlet, inches	35
R. P. M. (designed)	1600

Evaporating and Distilling Apparatus. The distilling apparatus is installed in the after-engine room.

There are two evaporators and two distillers, with their accessories, arranged to operate in single or double effect. The plant has a combined nominal capacity of 5,400 gallons of water per 24 hours, with overload capacity 40 per cent in excess of the nominal capacity when plant is clean.

Main Condensers.—There is one main condenser or circular section in each engine room. They are of the curved-tube type, with the tubes expanded in both tube sheets.

Vacuum Augmenter.—A Parsons vacuum augmenter is provided for each main condenser, consisting of a small condenser of the curved-tube type, steam jet and water seal, all connected to the main condenser and air-pump suction piping in the usual manner.

Reduction Gear.—The reduction gears are after the Parsons' design. Each unit consists of two forged steel pinions, forged integral with their shafts, driving a main gear. The main gear is secured to its shaft by bolts, two collars being provided on the shaft for the purpose. It is of the built-up type, consisting of a forged-steel rim securely bolted to two steel-plate discs, forming a wheel, the whole being cross-braced by a cast-steel cone fitted between the discs and through bolted with the after disc to the rim and with the forward disc to its shaft collar. The gear and pinions have helical cut teeth. The pinion charts are direct connected to the turbines, the H. P. turbine driving the outboard pinion and the L. P.

turbine the inboard pinion. The gear shaft is coupled direct to the main shafting, and on its forward end is fitted the main thrust bearing, of the Kingsbury pivoted type. The gear box consists of a rigid cast-steel bedplate, supporting the bearings, thrust, etc., and securely bolted the foundations built in the vessel. The entire apparatus is enclosed in a sheet steel casing and provided with an elaborate system of forced lubrication for the shaft bearings and spray nozzles for the gear and pinions.

Shafting.—The starboard shafting is in three sections, consisting of one line shaft; one stern tube shaft and one propeller shaft. The port side has four sections, an additional section line shaft being necessary for extension to the forward engine room.

There are two stern tube and one strut bearings for each line of shafting. The bearings are lined with lignum vitae. The shafts are composition bushed at the bearings, and within the stern tubes are covered with a seamless drawn brass tube casing, shrunk on.

Each section of line shafting is supported by two spring bearings, white metal lined, of the self-oiling type.

The inboard coupling consists of a collar secured to the stern tube shaft by four keys. Forward of this collar are two thin half collars fitted into a groove turned in the end of the shaft, to prevent the shaft from backing out, the whole being through bolted to the coupling disc on the line shaft.

The outboard coupling is of the ordinary sleeve type secured to the shaft by four feathers and two cross keys each.

Propellers.—The propellers are three bladed. The port propeller is left hand and the starboard propeller is right hand. The blades and hubs are of manganese bronze and cast in one piece.

SMOKE PREVENTION

Running smokeless depends on perfect combustion in boilers. Such combustion depends on viscosity of oil, flash point of oil, and air supply for explosive mixture, which is supplied through the burners. (Type of burner—area of nozzle aperture—also affects smokeless running. Trial and error has practically eliminated various burners, resulting in service use of the Bureau type and *Schutte*-Koerting.)

Heater coils are installed in settling tanks, known as suction heaters, also the large pressure heaters. Oil heaters not only raise the temperature of fuel toward the flash point (combustion), but also reduce the viscosity of the fuel, which is particularly necessary with crude Mexican oils. (Mexican oil is considerably cheaper than Texas oil.) With bunker temperature of 80° F., oil heaters can practically be dispensed with.

Flash Point is that temperature at which inflammable gases begin to be given off from the oil in sufficient quantities to form an explosive mixture with the air present. Navy requirements in contracts is a flash point of 175° F.

ALLEN DENSE-AIR ICE MACHINE

Air ice machines produce cold by expansion, in an engine, of air which has previously been compressed by an air compressor and then cooled while under pressure.

The distinguishing feature of the Allen dense-air ice machine is: that it takes for compression not air of atmospheric pressure from the open atmosphere or from cooled chambers not air tight, but air of considerable pressure which is contained in the machine and in a system of pipes.

This air under pressure (generally 60 pounds) is taken in by an air-compressor and compressed to commonly 210 pounds. This heats up the air, storing in it such amount of heat as is the equivalent for the labor expended upon the compression. It is then passed through a copper pipe coil immersed in circulating water and this removes the heat to nearly the temperature of the water.

Then the air passes into the valve-chest of the expander, which is, in construction, a usual steam engine with a cut-off valve. The valves admit the highly compressed air upon the piston to a certain point of the stroke and then shut it off. The piston continues to travel to the end of the stroke, the air exerting pressure upon it (constantly diminishing, of course). This takes out of the air such a quantity of heat as the labor performed by the air, while expanding, requires for its performance.

The result is a very low temperature of the air at the end of the stroke. The return stroke of the piston pushes it out through thickly insulated pipes to such places as are to be refrigerated, viz.; the ice-making box, the meat chamber and the drinking-water butt. In all these the air is, of course, tightly inclosed in pipes or other strong apparatus, being under the original pressure at which it entered the compressor (60 pounds) and the cold is given out through the metallic surfaces.

ELECTRICITY

Define voltage, kilowatt, resistance, ground, torque.

Voltage is the electromotive force which impels an electric current through a conducting medium. It is proportional to the product of the current and the resistance.

Kilowatt is 1000 watts. One watt equals one volt times one ampere or is (10) ergs per second.

Resistance is the property of a matter to resist the flow of an electric current.

Ground is a spot of no insulation in an electric circuit permitting electric leakage to the ground. Two grounds, one on negative and one on positive leg of the circuit constitute a short circuit.

Torque is turning moment. It is the product of the force applied tangentially multiplied by the radius.

What are the international or legal units?

Resistance.—International ohm is resistance offered to a constant current of a column of mercury of one square millimeter cross section, and 106.3 centimeters long, at the temperature of melting ice.

Current.—International ampere is the unvarying current which when passed through a neutral solution of nitrate of silver, 15 per cent by weight in strength, will deposit pure silver at the rate of .001118 gram per second. The anode is pure silver; the cathode is platinum.

International Volt is the E. M. F. which will force an international ampere through an international ohm.

Define inductance of an electric circuit.

The unit of inductance is a **henry**, which is that induction which takes place when a rate of change of current of one ampere per second induces an E. M. F. of one volt.

Define alternating current, frequency, cycle, electric oscillation.

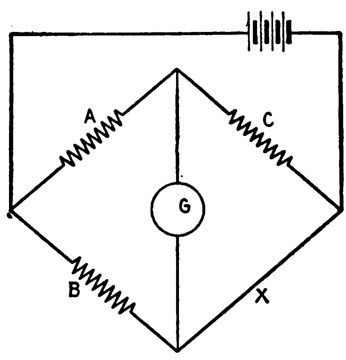
An A. C. current is one which periodically changes its direction of flow. A cycle is the operation of an A. C. in passing from a point in its value to the same point in the succeeding alternation flowing in the same direction. The frequency is the number of cycles per second. An electric oscillation is an A. C. of frequency 100,000 or over.

What is the theory of the galvanometer?

The mutual reaction of a magnet and a coil bearing a current.

Ammeters and voltmeters are D'Arsonval galvanometers in which the deflection of the needle varies directly as the strength of the current flowing. The only difference in their construction is in the relations of the resistance in the instrument and the current flowing. In an ammeter the instrument measures and indicates the current flowing, in a voltmeter the current is measured in the same way, but the scale indicates the drop of the potential through which the current flows (which is prop. to the current).

Draw diagram of Wheatstone bridge and explain its action. Where used on board ship?



The arms *ABC* are adjustable resistances. The arm *A* is the ohms that it is desired to measure. *G* is a galvanometer. A battery is connected as indicated. When the resistances by trial and error are brought to such a relation to each other that the galvanometer does not show a deflection, the following relation holds:

$$\frac{\text{Resistance } A}{\text{Resistance } B} = \frac{\text{Resistance } C}{\text{Resistance } X}$$

It is used in the electrical department to measure resistances, generally small ones, and insulation.

Describe a Leclanché cell.

This cell has carbon and zinc electrodes; the electrolyte is sal ammoniac; it has a depolarizer of manganese dioxide. A common form consists of a glass jar, in which fits a cylinder of carbon covered with a rubber plate. Through the plate the zinc rod sticks down into the solution and insulated from direct contact with the carbon. The depolarizer is formed in a layer on the inside of the carbon cylinder.

Describe briefly a cell of a secondary battery used in submarines.

The Edison Storage Cell.—Iron oxide and nickel hydrate, electrolyte is a solution of potassium hydroxide. The container is a tank of sheet steel nickel plated.

Negative plate (iron oxide). Twenty-four rectangular pockets supported in three horizontal rows in a grid. Pockets made of thin steel nickel plated and perforated with small holes. The positive plate (nickel hydrate) consists of tubes made of steel and filled with the nickel, thirty in number and carried in supporting frame. The positive and negative plates are assembled alternately, all connected to their proper pole.

The electrolyte solution is 21 per cent normal.

What is the rate of charge of storage battery?

600 amperes per hour usually the 8-hour rate.

Discuss the availability of electricity as compared with steam.

Ease of installation of wires compared to pipes.

Absence of leaky joints.

Freedom from heat in confined spaces.

Saving of power when machines are used intermittently.

Ease of operation.

What use is made of electrical appliances in the equipment of a modern war vessel? Why is not the metal of a ship's hull used as a return circuit?

Practically everything but the main engines and a limited number of auxiliary machinery. In the near future these will probably be electrical:

All lighting.
Searchlights.
All turret and gun machinery.
Air compressors.
Boat cranes.
Radio.
Deck winches.
Sanitary pump.
Fire control.
Capstan.
Steering engine.
Fire and engine telegraph.
Interior communication.
Ventilating and forced draft.
Machine power machine shop.
Galley.
Bake ovens.
Gyro compass.

On account of the stray field which is always present, shorts and grounds.

Discuss the advantages of A. C. and D. C. on board ship.

The chief advantage of A. C. is its ease of transmission over long distances, this is not necessary on board a ship. The A. C. motors are not capable of the varieties of speed and adjustment that is necessary on board; the D. C. however are. The A. C. motors are more rugged and harder to get out of order than D. C. Also A. C. do not depend for their efficiency upon cleanliness, D. C. do. The chief reason that D. C. is used is that in the present stage of development of A. C. machinery there is not the fine control and flexibility that is possible with the D. C.

Briefly give considerations that led to adoption of A. C. system in shore plants as (1) power plant, (2) transmission.

A. C. machinery simpler construction, usually less expensive. No commutators, hence, no trouble due to commutation. In case of induction motors no slip rings, no loss due to bad insulation; they can run under water in some cases; need not be cleaned.

Ease of transforming A. C. makes transmission at high tension and low current possible with comparatively small loss—small wires—economy. Transformers are inexpensive compared to motor generators.

What is a motor generator and where is it used on board ship?

A motor and a generator coupled together on the same shaft. Used where it is required to use a voltage materially higher or lower than the ship's voltage or to change to alternating current; in some turret gear, radio sending set, and interior communications.

What is a dynamotor, and where does it differ from a motor-generator?

A dynamotor consists of a motor and a generator windings on the same armature, using the same field, but having separate brushes, commutation (or slip rings in the case of A. C.), and armature windings. A motor-generator is two separate machines, coupled together mechanically.

Describe a compound generator.

A compound generator is one having two field windings; one shunt the other series. It is used to maintain a constant voltage with change of load.

What advantages has a compound-wound generator over a shunt-wound machine? What is meant by "over-compounded," why necessary and how accomplished?

A compound machine gives constant voltage with a varying load, a shunt-machine voltage varies inversely with the load. A machine is over compounded when the voltage along the line is higher than the machine voltage across the brush. Over compounding is resorted to when it is desired to transmit to a distant station, in order to account for the drop in the line. It is never useful in the vessels of the Navy, as the lines are all short.

Where use shunt motors aboard ship? Where series? Why?

Shunt (constant speed).	Series (variable speed).
blowers.	Boat cranes.
turret turning.	Deck winches.
" elevating.	Amm. hoists.

Because shunt motors run at almost constant speed regardless of the load. Series motors are not of constant speed, but they give a large starting torque.

What is meant by operating generators in parallel? How done?

By having two or more machines connected, like brushes to like mains on a circuit in such a way that each one does the same amount of work. This is accomplished by the use of an extra conductor called the equalizer, which connects to all the negati brushes, and insures the same field excitation for all machines, hence the same brush voltage. Prevents reversal of current in any machine.

The steps to connect up a second generator in parallel with one already running are: Warm up and start engine. Get up to normal speed. Close equalizer switch of machine already running. Vary field rheostat of second machine until machine builds up to a little more than line voltage. Close circuit breaker. Close equalizer. Close common negative. Close switches as required. Adjust field to make voltmeter read line voltage.

Give four types of D. C. motors in use on board ship.

Name.	*Used for.*	*Reason.*
Series.	Heavy starting slow speed work.	Large starting torque.
Shunt.	Constant speed work.	Speed remains constant under varying loads.
Differential compound.	Radio set.	Absolutely unvarying speed.
Cumulative compound.	Deck winch.	Starts as a series motor, and operates as a shunt motor at higher speeds.
Interpole motor.	Reversing direction.	No armature reaction or sparking.

Note.—In a differential motor the series and shunt-fields are wound in opposite direction, in a cumulative compound motor the series and shunt-field are wound in the same direction.

Give a brief summary of faults in generators and motors, with their causes, methods of detection and remedies.

GENERATOR AND MOTOR FAULTS

Fault.	*Cause.*	*Detected.*	*Remedy.*
Too high voltage.	Engine speed too high.	Voltmeter. Lamps too bright.	Slow engine. Move rest in shunt field of generator.
Low voltage.	Slow engine. Weak magnetism of generator. Brushes not properly set.	Voltmeter. Dim lamps. Motor fails to start.	Increase engine speed. Rock brushes.
Excessive current.	Too many lamps or motors on short circuit.	Ammeter. C. B. blows.	Reduce load. Locate leak.
Short circuit in armature.	Broken connection in arm.	Excessive current. Sparking. Heating of armature.	Locate Break.
Brush spark.	Not properly set. Excessive current. Poor brushes.	Sight.	Cut out load. Rock brushes. Clean and adjust brushes. Set brushes.
Motors low and high speed fail to start.	Too much load. Weak field friction. Brushes not set properly.	Sight.	Obvious.

What is meant by motor control and what systems are in use on board ship?

The operation of a device by which the motor is started, stopped, and its speed and direction of rotation controlled, may also include safety devices. Automatic rheostat, Ward-Leonard, Day and Panel.

What is the function of the starting box for motors and how is it constructed?

The starting box is designed primarily to prevent starting an armature current without a field. When the motor stops it automatically places all the resistance in the armature current so that it must be started in proper sequence again. It also has an automatic release in case the field is weakened below a safe amount. It also has an overload release.

It is constructed with a starting arm which first energizes the field, then gradually increases the current through the armature by means of cutting out the resistance as the arm moves across the box. This arm is held against a spring by the magnetism supplied to a small magnet by the field current. If the field fails the magnet lets go and the arm returns to starting position. The overload release is so connected that an overload of current will cause the no voltage magnet (as this thing is called) to let go.

Describe a dynamo room switchboard and its use.

In the modern battleship there are two dynamo rooms, each containing two 300 K. W. turbo-generators. In each dynamo room there is one switchboard with two panels (duplicate), one for each machine. The board itself is a plate of slate. The instruments found on the front are as follows, beginning at the top: Circuit-breaker, wattmeter, voltmeter, ammeter, shunt field rheostat handle, positive power switch, positive light switch, common negative switch, equalizer switch.

There are leads from the voltmeter of each board to a common calibrating voltmeter situated between them with a double pole double throw switch, so that reading from either machine can be gotten on this instrument. Behind the board is a vertical bus bar (positive) which connects through the positive switches mentioned above to the horizontal power and light buses. The common negative and equalizer buses are also horizontal and connect with the machine through their proper switches. There are also small leads from the brushes and terminals of the machine to the voltmeters and rheostats. In all cases the machine lead is on the hinge side of the switch and the line is on the knife side.

Name and describe the electrical equipment of a modern turret.

Training Motor (one spare).—A shunt motor of about 25 H. P. which operates a Waterbury tool gear which drives the turning shaft.

Elevating Motor.—One for each gun and a spare for each gun, each 15 H. P., also drives Waterbury tool gear connected to worm screw.

Ammunition Hoist.—Series motor, 5 H. P.

Rammer Motor.—Series motor, 3 H. P.

Plug Motor.—Small shunt motor.

Ventilating Motor.—Small shunt.

Lighting Circuits.—From battle circuit.

Firing Circuits.—Energy supplies by motor-generator "or" by storage battery. Switches in turret officer's booth allow guns to be cross connected for firing double barreled by either pointer.

Salvo Bells and Buzzers.—One over each pointer or separately.

Fire Control Telephones.—Sending and receiving set for turret officer and receiving set for sight-setters.

Range and Deflection Visuals.—One set for each sight-setter.

Turret Telltale.—Indicates danger zone of turret relative to other turrets, by showing position of own and adjacent turrets relative to center line of ship.

Danger Zone Alarm.—Warns danger of injury to other turrets or guns by means of Klaxon howler.

Individual Fire Control—When spotting for the individual turret by means of periscope, signal bells and lights to pointers operated from turret officer's booth.

Give one method of locating a short-circuited armature coil.

The bar of the affected coil would spark when passing the brushes. Bar to bar test. Consists simply in measuring the resistance of the insulation between successive bars of the armature. Large deflection locates the bar affected. No deflection *vice versa.*

What material is used to clean a commutator?

Coarse canvas, fine sand paper. Never emery cloth.

What are the purposes of a rheostat?

To vary the resistance in a circuit.

Water rheostats for the discharge submarine boat batteries are formed by use of ordinary barrel filled with water containing two iron plates for the terminals.

What is the purpose of an electric fuse?

To protect a circuit against excessive current by melting at a given value of current. They must give the protection claimed at their rated current, and should be so fitted as not to injure nearby fittings by dropping molten metal.

Give materials used for conduits in magazines and near compass.

Brass.

Discuss thermostats for use in magazines on board ship.

Used to indicate and cause an alarm to be given in case of dangerous rise of temperature in the magazine in which it is installed. The type for magazines is wholly inclosed for obvious reasons. The principle of operation is a break in a circuit which will be closed by the expansion of some metal when heated (mercury or some other metal). When heated to the necessary amount, then circuit will close, hence the bell or indicator or other device will register.

Discuss use of electrical, forced draft blowers.

The apparatus consists of a Cutler Hammer Automatic Starting Rheostat. The motors (shunt) and blowers are situated in the blower rooms or drum rooms, the starting, stopping, and speed is regulated by one small wheel in each fire room. No operation is necessary in the blower rooms, but there is provision in case of necessity to operate them there.

The controller is in a water-tight metallic box. The controller in the fire room is also enclosed, the only operation necessary for the water tender to start, operate and stop the blowers is to turn a small hand wheel.

How is power absorbed in electrically driven ships when backing, stopped, etc.?

This is not a logical question. However, there is a resistance such as is mentioned. The function of the resistance is to put resistance in series with the windings of the motors, which has the effect of giving the motors a large starting torque. The resistance actually does absorb a quantity of energy, but that is not its *raison d'être.*

What are some of the rules for the care and management of searchlights.

Care.—Keep direct rays of sun off mirror. Do not keep elevated for long, as hot particles of carbon fall on mirror and crack it. Keep draft off mirror after using. Keep mechanism well oiled. Remove glass doors before target practice.

Gear teeth and universal joints kept clean of rust and lightly oiled; before going on long sea run, give steel parts a coat of vaseline.

See drain holes in motor casing and bottom plate of lamp kept open.

Keep shutters of light clean and lubricated with mixture of oil and graphite. (Light will be needed quickly for signaling at sea.)

Mirror should be cleaned with alcohol and polished with chamois.

Keep paint free from all working parts.

Insulation tests to insure projector free from grounds should be made frequently. Grounds most likely to occur at (1) Double plug and receptacle. (2) Thermostat plug and receptacle. (3) Altitude and azimuth scale lights, and (4) Fuse box.

The new 24-inch high-powered searchlight AA will give excellent results with a little daily care.

Management.—Keep flame of arc in focus of mirror, if rays converge move lamp out, if they diverge move in, and when in focus the rays are parallel. If arc hisses and spatters, the carbons are too close together. Keep flame in center of carbons. If wart forms knock off by quick movement.

Destroyers experienced searchlight trouble battle practice (night) through lights going out entirely. Investigation showed that vibration at 25 knots caused irregular feed of carbons. Remedied by electrician standing at searchlight and tending feed.

What would cause flickering of lamps and how remedy?

Usually a bad connection, and probably the lamp is not screwed home. If all the lamps in the ship are affected the fault must be near the generator. In the old generators this was caused by faulty action of the engine due to governor; this is a very remote possibility with the turbo-generator. It may be due to a "high bar," which means that one of the commutator bars is higher than another causing the brushes to jump, hence varying the E. M. F.

Examine and correct all connections.

Examine commutator.

Examine engine.

What do you do if you get an arc or flame at the spark gap instead of a spark?

It is a sign that the capacity of the condenser is insufficient for the voltage. Either increase the capacity or better make the spark gap longer.

What current in amperes and volts is required for Navy searchlights? How is the required voltage obtained?

Depends on size of searchlight. Usually current of about 45–60 amperes and at a voltage of about 75–90 volts. Obtained by a resistance in series with the arc called a "ballast" resistance.

Under standard conditions on a modern destroyer, use of searchlight necessitates starting the second 10 K. W. machine.

State briefly the principle underlying the telephone.

The increase and decrease of intensity of an unbroken electric current. It is necessary that a current be caused to flow in a circuit and means provided that the waxing and waning of the current be made to conform to the sound waves produced by the voice. It is done as follows:

The complete elementary circuit consists of a transmitter, a receiver, a battery, and the wires (conductors). The transmitter consists of a hollow metallic box within which a piston fits. Between the piston and the sides of the box or cylinder are iron filings loosely packed, so that any slight movement of the piston will increase or decrease the density of the packed filings, hence increase or decrease the ability of the arrangement to transmit current. The diaphragm (hard rubber) receives the waves caused by the voice, the vibration of the diaphragm causes a changing resistance in the transmitter box, hence will cause an increase or decrease in the intensity of the current flowing. One terminal of the wire is on the piston, the other is on the box. The receiver consists of two permanent magnets, around which the wires are wound. By a well-known property of current to produce magnetism, the varying current in the wires, hence the windings of the poles, will cause a varying magnetism in the poles (magnets). Across the end of the poles is a diaphragm made of some magnetic material, so that the varying magnetism will cause it to vibrate. These vibrations are those heard in the receiver when close enough to the ear. The battery is self-explanatory. Any type of current producing apparatus may be substituted for it.

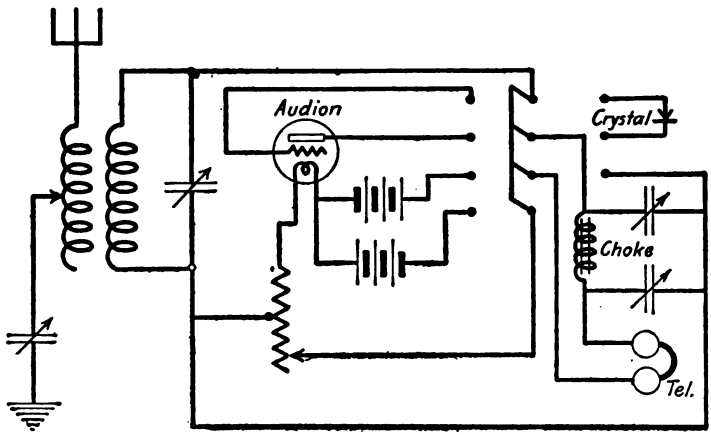
RADIO INSTALLATION

Receiving Sets.—All receivers now issued to ships are of the inductively type. Both the primary and secondary can be adjusted by means of variable inductances and capacities. There are no metallic connections between the two circuits. A schematic diagram of a typical receiver is shown below. For obvious reasons the Navy Department considers the greater part of our radio installations secret so a description must be very general.

Both crystal and valve detectors are used, instantaneous control being accomplished by means of a switch. In addition, in order to increase the strength of the receiving signals, amplifiers are used. There are two kinds: (1) Audio frequency amplifiers and (2) radio frequency amplifiers. The former, as its name implies, amplifies signals after they have been made audible by means of a detector and the latter amplifies them before they reach the detector. Either one or the other, or both can be used. The same receiver can be used for both spark and arc signals the adjustment of circuits being slightly different with the two types of signals.

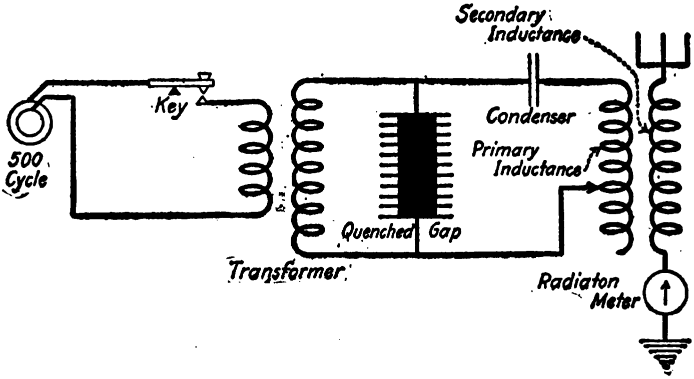
Transmitters.—In general the Navy uses three types of transmitters, (1) spark, (2) arc and (3) valve. Their rated capacities cannot be given but it is sufficient to say that the Spark Transmitter is used for medium distances, the Arc for long distances and the Valve for short range work. The Western Electric Radio Telephone, Type CW 936, which is installed on practically every ship in the Navy, is a good example of the Valve Transmitter. All our high-power Shore Stations (one exception) use the Arc. This form of transmitter comes in sizes from 2 kw. to 1000 kw. Shipping Board vessels are being equipped with the 2 kw. arc. This is the first instance of Arc Installation on a large scale on merchant vessels and the suggestion is made to those interested that if time for studying radio is limited give the Arc preference (as this type of transmitter is gradually replacing the Spark Type). The same holds true for receiving apparatus used in connection with arc and valve signals. Below are shown in schematic form the circuits of both an arc and spark transmitter.

Attention is called to the procedure for tuning both of these systems to certain wave lengths. With the spark it is necessary to tune both the primary and secondary circuits and of equal importance get the proper coupling between the two circuits.

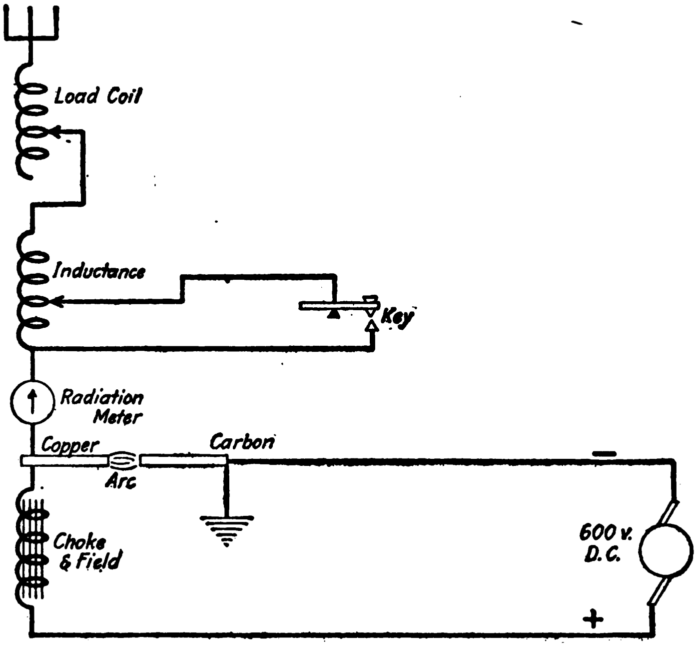


With the Arc it is only necessary to tune cne circuit. A brief description of the spark apparatus follows: The source of AC. supply is usually a 500-cycle 240-volt generator. The terminals of these are connected to the primary of a step up transformer through the transmitting key. The transformer steps up this voltage about 50 times, that is in the ratio primary volts 240 to secondary volts 12,000. Across the secondary is connected the quenched gap which is a series of silver-surfaced plates absolutely parallel. The Navy Standard Gap has large cooling flanges thus doing away with blower or fan. The number of gaps used depends on the power desired, but is about one unit (a unit being one plate) *per 1000* volts of the secondary of the transformer. Around the gap are connected the capacity and inductance in series. The capacity is made up of specially constructed mica condensers. These take the place of the Leyden jars used since Radio was first used in the Navy. The inductance is made of copper ribbon wound in pancake form on framework of insulated material. Variation of wave length is accomplished by varying either or both. We vary wave length by means of the inductance only. What is known as a "wave changing switch" does this to both the open and closed circuit simultaneously.

The hot wire ammeter in the antenna, or open circuit, indicates the amount of current in the antenna. Remember that this dia-



gram is schematic. The complete wiring diagram of a set as installed aboard ship, with relays, keys, safety devices, etc., is rather complicated. The same is true of the Arc Transmitter wiring circuit a description of which follows: The source of power supply for the arc is usually about 600 volts DC. (not AC.). This is connected to the terminals of the arc converter, the positive to the water-cooled copper tip (known as anode), the negative to the carbon tip (known as cathode). A choke coil and arc field coil is connected as shown. The former prevents the high-frequency oscillators, in the antenna, from going to the 600-volt generator and injuring it and the latter builds up a strong magnetic field across the arc to increase the current flow and stabilize the arc. The actual process of charging the antenna cannot be described briefly. This can be found in any number of books dealing with Radio. Obviously the key cannot be placed as in the spark circuit as the arc would break when the keys become opened. It is therefore hooked up in the manner shown by being connected around a portion of the inductance. Two wave lengths are thus radiated but the receiving operator has no difficulty in picking up the wave length, the actual signal is being sent on.



Describe briefly an Audion.

The present audion is a small vacuum tube containing three electrodes known as (1) filament, (2) grid and (3) plate. It can be used either as a detector, amplifier or transmitter. It is the most sensitive of detectors and has more uses, and is of more value than any other piece of Radio Apparatus.

Why not connect the telephone directly around the tuned secondary circuit?

The frequency of radio signals runs up in the thousands—too rapid changes for the diaphragm of the phone to operate.

What advantages has the valve detector over the crystal?

Every advantage but principally it can be used for all types of signals.

Why are inductively coupled receivers preferred to other types?

More efficient, more selective thereby cutting down interference trouble and atmospherics (known as " strays " or " static").

What is meant by " loose " and " close " coupling and when used?

Close coupling (in receiving) is used when it is desired to pick up signals whose wave length is not known. The closer the coupling the greater range of signal on different wave lengths can be heard. Therefore to cut out as many of these signals as possible loose coupling must be used. If primary and secondary are both tuned on close coupling both require retuning when coupling is loosened.

Do the remarks on coupling in connection with receiving apparatus apply to transmitting apparatus?

Yes; loose coupling is used when it is desired to cause the least amount of interference and tight coupling vice versa as for S. O. S. signals and interference with the enemy.

What is meant by a 500-cycle note?

The Navy Standard Spark Transmitters are 500 cycles or 1000 alternations per second. The spark gap breaks down at each alternation giving 1000 breaks per second. The average human ear is most sensitive to 900 to 1000 breaks per second.

What material is used to separate the individual gaps in a Quenched Gap?

Usually mica or fish paper.

How tune up an inductively coupled spark transmitter?

Using a wave meter, tune up the close circuit first, then the open or antenna circuit using as loose a coupling as possible. When tuned, tighten the coupling for maximum radiation as shown in hot wire ammeter, then loosen until radiation begins to drop. Then if the indicating instrument in the wave meter (wave meter of course being set) reads its maximum at that point you set it properly tuned.

What can happen if coupling is too close?

Gap may fail to quench properly and, two waves will be radiated and, as the receiving operator can only tune one, the energy in the other is lost.

Why is it that the higher the antenna is the greater the range of communication; all other things being the same?

The larger the capacity of an antenna the more current it will absorb, the nearer the ground the antenna is the larger its capacity but the range increases with its effective height which is the height to the center of the capacity.

What advantage has the Arc Transmitter over the spark?

Only one circuit is tuned, receivers and detecting apparatus more efficient for undamped signals, less interference, greater range and longer wave lengths obtainable.

What disadvantages?

Difficulty of getting the arc to work on short wave lengths.

Can undamped signals be heard in a crystal detector?

No.

Any special care required in building an antenna and furnishing a " ground " for a transmitting system?

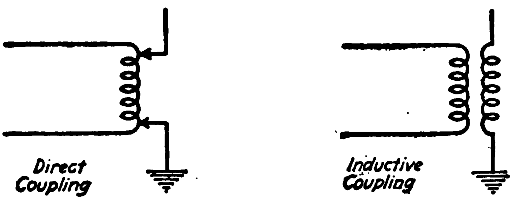
Much more than is usually taken. There should be no sharp points on the antenna. In connecting antenna to leading in insulator " biting " contacts should be used. In connecting it to ground never do it by connecting two smooth plates together. Roughen up the plates like a rasp.

Why not smooth surfaces?

Currents of the frequency used in Radio flow only on the skin of a conductor and it is almost impossible, practically, to have every point on both plates touch. But by roughing them up they bite into one another and a maximum contact is had.

What forms of coupling are used for radio and what are the advantages of each form?

Coupling is defined in two ways: It may be direct or inductive; or tight or loose as illustrated below.



Tight coupling is when the secondary of the transformer is inductively coupled to a great number of turns in the primary. Loose coupling is when it is not.

Tight coupling does not send a selective wave, and hence there is apt to be a large amount of interference either from other waves or from static. Its only use is in sending general information to a lot of other stations as in the case of the noon tick or S. O. S.

Loose coupling allows selective sending and receiving, cuts out interference.

Name and describe the types of spark gaps.

There is only one spark gap in general use at present, it is known as the quenched spark gap. It consists of several plates of copper placed parallel to one another and accurately machined. They are separated by hard rubber or mica gaskets. The plates are carried on a rod passing throughout the center of each plate and they are held rigidly together and the space between the plates is rendered air-tight by means of a screw and pressure nut on the end of the rod. The spark takes place between the plates, the dielectric medium being air. The current leads are taken to the spark gap by means of clips which are quickly changed by hand to include the desired number of gaps. The whole is cooled by means of a small fan directly below it.

Define tuning as used in radio telegraphy, how is it accomplished?

Tuning is defined between two circuits as that state when the product of their inductance by their capacity is equal, or in other words, they have the same wave length or same frequency.

It is accomplished by the use of a wave-meter by which either the wave length of a circuit may be measured or the wave length of an incoming wave may be measured.

How do you change from one wave length to another on any set with which you are familiar?

If you are familiar with one, state the answer; if not, roughly, the ratio of the inductance to the capacity will give the wave length, every operator has marks, etc., on his gear that will give him all the usual wave lengths used in the Navy, he simply sets his capacity and inductance to the proper points to give the wave length desired. If an unusual wave length is desired resort must be had to the wave meter and the set tuned to the new wave length.

If the ship's masts are destroyed how would you arrange to send radio signals?

Rig temporary antenna to the lower booms, well insulated, or rig them about the decks; they can also be rigged below decks, but their efficiency is impaired by the surrounding magnetic material. I have seen them rigged in the ammunition passage and still give good service at a range of about four miles, enough for tactical signals. Battleships are supplied with field radio sets which could be rigged from boat cranes and would give 50 miles.

What effect does increasing the height of the antenna have on the distance of transmittal of radio set?

Increases the capacity, hence the distance.

How can you tell if antenna is radiating?

Read ammeter in antenna circuit.

What special care is taken in making antenna joints, and why?

There is a high tension in the antenna, therefore any leak will interfere with the fire-control telephones, might cause injury, reduce the efficiency of the radio set.

Name two types of detectors and show how each is attached to the receiving circuit.

Crystalline audion.

What electrical qualities regulate the wave length?

Capacity and inductance.

State the periodic tests required by regulations.

The test required by the regulations for an electric plant are as follows:

Daily: Turn over all idle machinery, inspect for defects (log this).

Test each circuit for grounds (ground detector) (log).

Run each searchlight for a short time to drive moisture from carbons.

Weekly: Operate all auxiliary machinery. Each generator set should be run for at least 30 minutes each week (log). Test running on atmosphere. Test all emergency governors (turbos).

Quarterly: Complete insulation test of every circuit on the ship (log).

How are various circuits marked to distinguish them without tracing a lead?

All tagged with appropriate marks at each junction box.

What care of a battle circuit?

Free from grounds, good lamps, well protected below armor where possible, all dark slides, etc., in working order.

Defects of signal gear?

Grounds due to moisture, keep well painted.

Care of telephone board?

Keep clean, free from grounds, well fitting jacks and plugs.