



Thomas Smith (M.I.N.A.)

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Practical Iron Shipbuilding

Keels. - In boring keel-bars, be particular to have the top row of rivet-holes marked no lower down than is necessary to make a good and close fit of the garboard strake at the top row of holes; and on no account weaken the keel bar by having the lower row of holes bored too low down; at the same time, care must be taken to have a distance equal to the diameter of rivets between the lower edge of upper row and upper edge of bottom row; *i. e.* a distance of two diameters between the centre lines of the top and bottom rows. In marking off the holes, attention should be paid to having them properly divided; that is to say, having the upper rivet exactly between the two lower rivets.

Fig. I.



Make the length of scarfs of keel-bars at least ten times the thickness of keel-bar. Lloyd's Rules give only eight times, but this is too little to make a substantial connection.

Before commencing to drill the scarfs, have them drawn perfectly close, and see that the ends are brought together, and are a good fit.

It is not necessary to drill more than three holes in scarfs for *stitching*, and these should be on top part, so as not to weaken the keel-bar more than necessary.

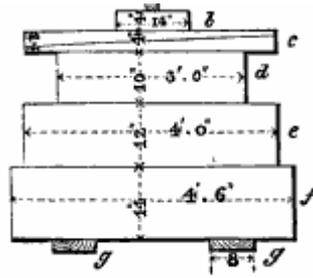
The upper side of scarf should be caulked before the frames are laid across keel and the under side after the keel-plates are riveted.

The butts of the garboard strake must be spaced so as to be well clear of the butts of keel-bar; say at least 30 inches, when practicable, and with care this distance can generally be given.

Have the position of all frames marked on the keel with a centre punch before any of the frames are laid across; this will save a deal of unnecessary trouble.

See that the keel-bars are properly shored, straightened on top edge, and got quite fair previous to laying any frames over them. Attention must also be paid to fairing the keel fore and aft by a line, after the frames are up in place, before commencing to fit any of the garboard strake on.

It is important to keep the keel a reasonable height from the ground, so as to allow room for the workmen to get under the vessel's bottom without being too much confined; otherwise they cannot make good work of the riveting and caulking. In settling this point you must bear in mind – if the vessel has a flat floor the blocks must be laid higher.



a. Keel. b. Cap Piece of Oak. c. Gluts or Wedges. d. Redpine. e. Redpine. f. Redpine. g. Slabs.

Let the keel-blocks be spaced about 7 feet 6 inches apart, and have a double block between, say every second and third block, alternately. This will allow for shifting any blocks that may be necessary to get at the work without fear of the vessel settling down. Have the three or four last blocks laid on fore and aft logs, as the vessel will be certain to sink at after end, if anywhere.

Fig. 2 shows height and dimension for keel-blocks, suitable for vessels of the usual run.

It is well to have the keel riveted as soon as possible to prevent dirt or any rubbish getting down between the keel and garboard strake.

Flat-Plate Keels. - If for a vessel building to class at Lloyd's, the breadth and thickness must be as follows: - In vessels of 500 tons and under, 2 feet wide; from 500 to 1000 tons, 2 feet 6 inches wide; 1000 tons and upwards, 3 feet wide. The thickness of plates in all cases to be not less than one and a half times the thickness of the garboard strake. The foregoing rule gives a good scantling for such keels, and I would recommend it to be adhered to in all cases.

It is desirable in flat-plate keels that the butts of the garboard strake should be clear of the butts of keel-plates at least two spaces of frames on both the port and starboard sides; and for this reason, the keel-plates should be made in such lengths as will suit this; also see that the butts of the keel-plates are fair between two frames, as this is necessary to facilitate the putting on of the butt-straps.

In all cases it is recommended to treble-rivet the butts of keel-plate, making the butt-straps as wide as can be got in between the flange of the frame angle-irons and heel-pieces on next frame.

Stern-Posts and Stern-Frames. - In a screw steamer, care must be taken in boring any holes about the boss that may be required, and this should be done previous to putting the frame up in place. Mark off the lead of these holes so that they may be bored in the proper direction, and thereby have a proper divide on the inside of the boss.

Particular attention should be paid to taking out any twist that may be in the stern-frame when it comes from the forge, and be careful to see that the bosses on both outer and inner post lead fair fore and aft.

In the upper portion of stern-posts it is only necessary to have one row of rivets for the rudder trunk. Some builders and inspectors prefer to put two rows, but it is only waste of time doing so.

In the riveting of bosses, it is absolutely necessary to have the countersink bored out a sufficient depth, so that when the engineers have done boring and fitting in the stern-tube, there will be plenty of countersink left to hold the rivets secure.

In putting in the boss-rivets it is a good plan to cool them at the points, so that the heads may thereby be well tightened up.

Bear in mind that it will save trouble and make better workmanship if you arrange the plating so that a strake will cover the boss.

Make the scarf of your stern-post always on the port side, and do not have the length of the knee or keel portion to exceed 10 feet 6 inches, as that length is about as great as can be conveniently taken on ordinary trucks, if the post has to come by railway from the forge.

Stems. - The mould for bending the stem too should be made off the inside line of stem, and if it is not turned before the scarfs of keel-bars are cut and finished, it is well to measure the total length of the keel on the blocks, and contract or increase the length of the stem-bar as the case may require to make up the exact length. Do not drill any holes in stem until it is turned to shape, and be careful to have the scarf on the right side to agree with forward length of keel-bar.

In forging stem-bars have the fore-side shaped to a flat half-round, and see that there is no twist in the bar.

Rudder-Frames. - Should you make the rudder forging in scantling, according to Lloyd's, bear in mind that if for a spardeck snip, or vessel with full poop and fore-castle, the diameter of the rudder-head must be in accordance with the dimension given for the gross tonnage, and not the tonnage under main deck.

Attention should be paid to having the rudder-pintles all in a fair line. Have a steel washer for the pintle at heel of rudder to work on. It is always the best plan to make the rudder to unship, and the space for unshipping at each pintle should be about one inch deeper than the length of the pintle.

In a screw vessel attention should be paid to keeping the pintles clear of the bracket on the after-post for outside shaft bearing.

In rudder forging for vessels of from 200 to 500 tons, have a stay across centre of rudder from rudder-post to bow ; and in vessels over that tonnage, two stays; width of stays about 3½ inches. The stays may either be made with the forging or of cast-iron fitted in. The space between the plates of rudder should be filled in with either wood or Portland cement. Thickness of rudder-plates need in no case exceed ¼ inch; and it makes the most substantial work to have the rudderplates snap riveted.

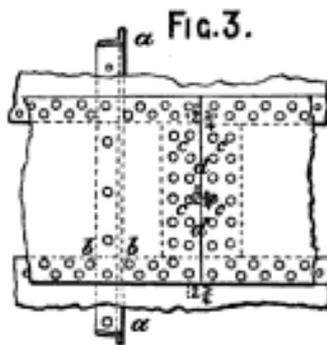
Rudder-bands. - Pay particular attention to see that the centre of pintles are correctly set off before boring same, by striking a line up centres, to see if these are in a line and that the back is straight and fair; this applies also to the sternpost. See that the rudder-trunk is made of sufficient size to allow the

rudderstock to be got up easily, say from 8 to 9 inches internal diameter for a 4 to 5 inch rudder-post; other diameters to be in like proportion. Attention should be paid to having the ruddertrunk and angle-iron binding the foot of trunk to outside plating a good fit, and the bottom carefully caulked.

Rudderstops. - The proper angle for a rudder to travel is 42 degrees on each side of centre line of ship, and the stoppers should be made to suit this. Be particular to have the stops made strong enough and well secured to sternpost. The rudder working easily is a matter of great importance, and requires particular attention in the lining-off and putting in place.

Angle-iron Frames. - Previous to putting any work on the bars, have them examined to see that there are no cracks or blemishes, as angle-bars are constantly sent from the Ironworks without care being taken to see if they are sound.

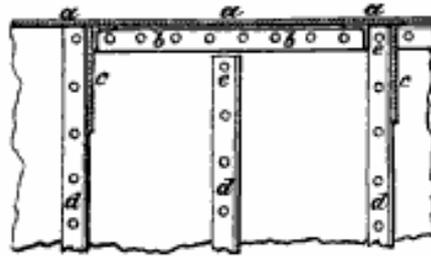
In punching the frames, see that the holes are properly divided; and as an example, for double-riveted laps with $\frac{3}{4}$ -inch rivets, have the top hole $4\frac{1}{2}$ inches from upper edge of lap, or $6\frac{1}{2}$ inches from centre of lap, and the lower hole $3\frac{3}{4}$ inches from lower edge of lap, or 6 inches from centre of lap, on plate mark on the mould on board. Fig. 3 shows the proper spacing of rivets for double-riveted laps with $\frac{3}{4}$ -inch rivets.



a Frame. b Rivets to be as close to frame as head of rivet will permit. c Chain-riveting at butts to have the holes punched opposite each other. d Butt-straps to be fitted as close as possible between laps of outside stakes.

In single laps have a hole punched $5\frac{1}{2}$ inches each side of centre of lap, the lap being $2\frac{3}{4}$ inches. Divide the spacing of holes for rivets between one lap of plates and the next, as near to eight times the diameter of the rivet as you possibly can arrange.

In frames that run up to form sides of poop, forecastle, or bridge, have those with no beam on, cut off low enough to allow the lug-pieces for securing stringer-plate to shell to run from beam to beam. Fig. 4. A hole should be punched in head of the frames that are cut short for lug-pieces passing, about 3 inches down; but it is best not to put this in until the vessel is framed and faired.



a a, Poop-deck Stringer-plate. b b, Lug. c c, Beam-knees.

Fig. 4: d. Frames. e. This hole to be made after the plating is on.

In frames that step on the knee of sternpost or stem, do not neglect to have them cut to the proper thickness to allow the plating to come on.

The heel of frames bearing on keel should be carefully cut and finished, so as to butt close together, and the bearing not to be greater in width than the thickness of keel, otherwise a proper job will not be made of the garboard strake.

The inside flange of angle-iron frame should be punched so as to suit size of the reverse frame, and care should be taken to see that the holes are so punched as to take the centre of flange of reverse frame.

It is necessary to see that the heel-pieces are quite fair with under-side of frames, and that they bear true on the keel. One or two holes only should be punched in the frames, for the beam-knee, prior to putting up the frames.

Length of beam-knee is measured square off, and the holes should be divided round the sweep, the centre of lower hole placed about 2 inches from lower edge of knee. Fig. 5.

Do not have the upper hole in head of frame for upper rivet in beam-knee punched until the frames of vessel are all faired and sheered, as in case the beam requires to be lifted or lowered, it spoils the hole, and as this rivet passes through the angle-iron on beam it is necessary the hole should be true to make good work. The same rule applies to the bottom hole in beam-knee, as it looks very unworkmanlike to see a blind hole there.

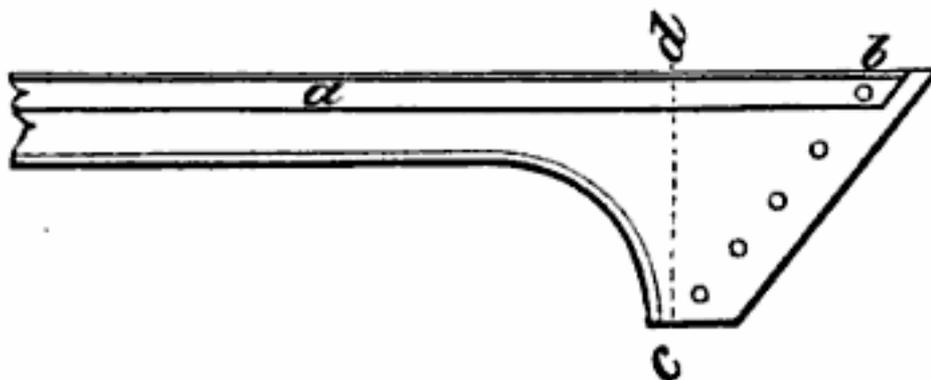


Fig. 5: a. Reverse Iron. b. This hole punched to take reverse bar on beam.
c d. This measurement at right angles to top of beam—not obliquely.

The double frames at the bulkheads should be punched for rivets 4 inches centre to centre, and should be chipped at both edges previous to hoisting up in place, otherwise difficulty will be found in making a tight job of the caulking.

If the vessel has a sheerstrake with jump joints, see that the holes punched in frames are clear of the lap of both the inside and outside sheerstrake.

Reverse Frames.—The frames with no beams on to have the reverse bars running up to main-deck height, and these to butt in centre of floor, having heel-pieces of angle-iron on opposite side of floor top, of sufficient size to form top flange for keelson-fastenings.

Short reverse frames to run up to upper turn of bilge; but if there is a spirketting plate on 'tween-deck stringer, then the short reverse frames should run up to top of said plate.

Butts of the short reverse frames should be about 4 feet each side of centre-line, alternately on the starboard and port side; but should these butts come in the way of boiler or other keelsons, the distance must be altered to suit.

Holes should not be punched in reverse frames in way of floor-ends, unless there is a clear space of three-quarters-of-an inch from outside of rivet-hole to lower edge of reverse frame (Fig. 6).

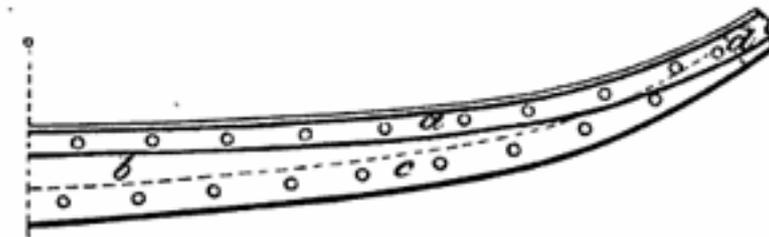


Fig. 6: a. Reverse Bar. b. Floor. c. Frame. d. Rivet this flush, and let Reverse Bar lie over it.

The reverse frames across the floor-tops at ends of vessel will require to be bevelled to suit the rise of floors and make a fair seat for the centre keelson. These bevels can best be taken when the vessel is ribanded and shored up.

See that the butts of the reverse frames are quite close and fair to each other. Accuracy of the workmanship adds greatly to the strength in all parts of an iron vessel.

The reverse frames must fit well over the floor-ends, and see that the floor-ends are thinned down to suit this.

The double reverse frame on floor-top should be neatly fitted on. Get a straight-edge, to see that it is fair, and attend to having all the scarphing or lug pieces riveted close to floorplates.

Angle-irons on Beams. - The holes must be punched to suit width of deck-planks; the centre should be marked on the beam and have two template battens made for marking the holes for punching in the angle-irons, so that they are equally spaced and divided. The holes for the fore-and-aft tie-plates and stringer-plates

should also be set off on these battens and the holes marked and punched accordingly. Holes for tie-plates and stringer must be punched to suit the diameter of rivets intended to be used, and those for the deck-plank to suit size of deck screws or bolts.

Holes should not be punched nearer to beam-ends on top flange of angle-iron on beam than about 6 or 7 inches, in case they should not come fair with the stringer angle-iron holes. These holes are best drilled through top flange of beam angle-iron, after the stringer is put on, the holes, of course, being previously punched in the stringer-plate.

One angle-iron only on beam to run out to beam-end, and to take a rivet through angle-iron on beam-knee and frame. (Fig. 7)

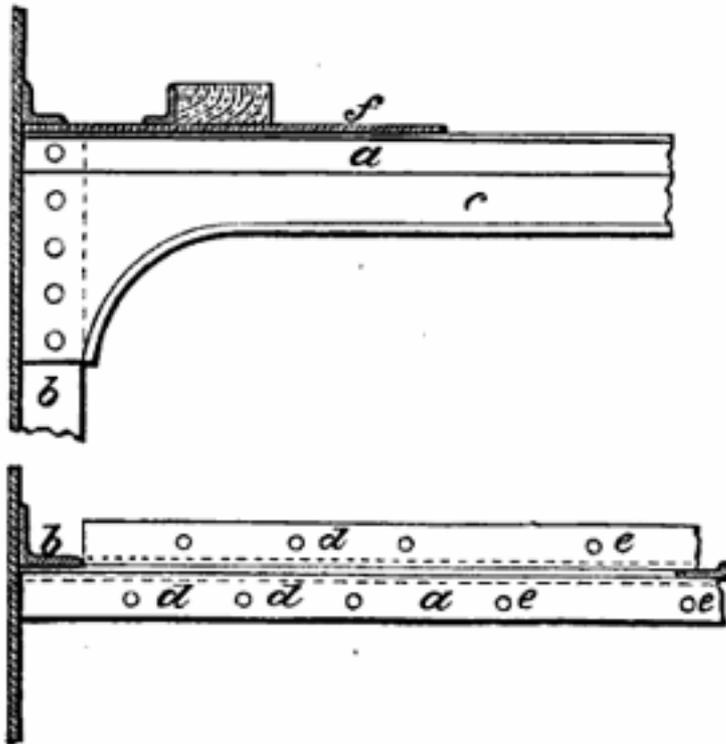


Fig 7: a. Reverse Bar on Beam. b. Frame. c. Beam. d. Rivets for Stringer-plate, 6" or 7" apart.. e e. Ditto for Deck-plank twice the width of plank. f. Stringer-plate.

The holes for riveting stringer-plate to angle-iron on beams should be about eight times the diameter of the rivets apart.

Attention should be paid to see that the angle-irons on beams are properly levelled at each end, so as to give a true seat on which to rivet the stringer-plates.

Floor-plates. - Floors should be twice the height above keel at floor-ends that they are at centre-line, and should be parallel to base-line athwartships, as far as practicable. Floor-plates at ends to be the width of inside flange of angle-iron frames.

See that the floor-ends are neatly thinned down, so that the reverse-frames fit over fair and close.

Floor-plates should be sheared half-an-inch less than the shape of frames.

The floor-ends where they have been thinned down for reverse frames should be chipped flush with the frame, both inside and out, previous to keelson or shell plating going on.

Limber-holes should be cut so as to clear frames, heel-pieces, lug-pieces for keelsons, intercostals, &c.

At the extreme ends of vessel, the floor-plates should be increased in depth to say twice the depth of floors amidships, or until they measure say 2 feet across the top, from outside to outside of frame.

Floor-plate for the transom-frame should be put on the depth of the knuckle, so that the stern timbers are sufficiently secured.

Main-deck Stringer. - In the case of an inside sheerstrake going up only to underside of main-deck stringer-plate, the holes in said stringer for the angle-iron bar will require punching the thickness of the inside sheerstrake nearer the outer edge of stringer-plate, so as to catch the centre of the bar. Fig. 8.

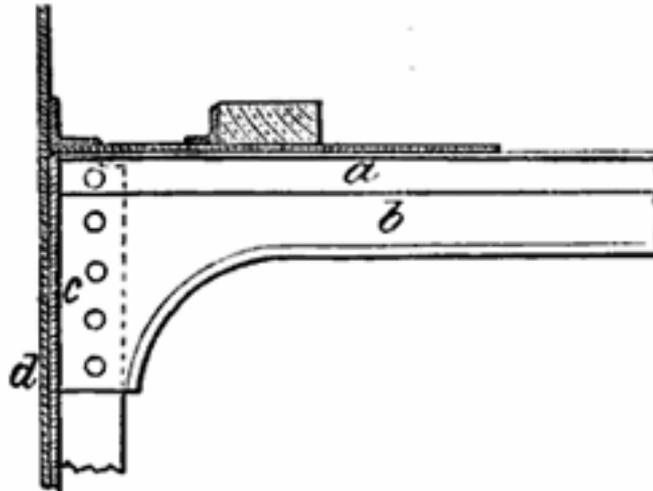


Fig. 8: a. Reverse Bar. b. Beam. c. Inside Sheerstrake. d. Outside Sheerstrake

Should the inside sheerstrake not run up above the main-deck stringer-plate, see that the stringer projects over the frames the full thickness of the inside sheerstrake.

Attention should be paid to punching the holes in stringerplate for the angle-iron bar, to see that they are not punched with the same die as is used for the outside plating, no more countersink being required than is sufficient to keep the punch from choking, and the stringer-plates should be well sheared to form of side of vessel, or a bad bearing will be left for the gunwale angle-iron bars.

It is advisable to have the stringer-plates riveted to the beams, also the butt-straps riveted as soon as possible, and see that the butts come well clear of butts of sheerstrake.

Previous to commencing with main-deck stringer, see that the heads of frames and reverse frames are not higher than the beams.

Have all holes for the diagonal tie-plates in main-deck stringer-plates punched before putting in place. It is well in all cases to have the butts of main-deck stringers treble-chain riveted.

'Tween-deck Stringer. - Have all beams in and riveted before commencing to put in 'tween-deck stringers.

In vessels where the alternate reverse frames do not run up to height of hold-beams, see that holes are not punched in the vertical flange of stringer angle-iron, unless it is intended to rivet a lug-piece on the frame, for fastening the stringer angle-iron to the frames with no reverse bar running to that height.

In the after-peake, where there is a considerable flare in the sides of vessel, it is advisable to use a bar of larger dimensions for the stringer angle-iron, so as to get a good hole in the bar, not too near the edge, and thereby weaken it considerably. (Fig. 9.)

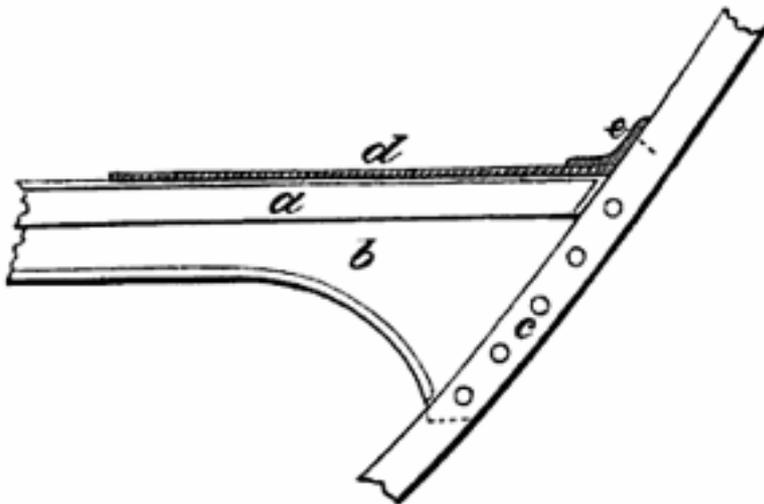


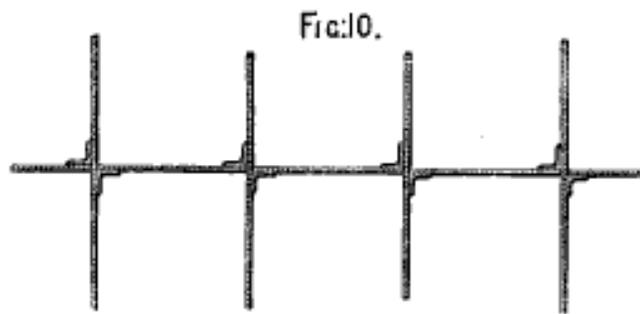
Fig. 9: a. Reverse Bar. b. Beam. c. Frame. d. Stringer-plate. e. Rivet must not be too near edge of angle-iron, nor too far down in its bosom.

Poop-deck Stringer.—In putting on poop and fore-castle deck stringers, have the stringer-plate sheared to come out to the outside edge of frames; so that when the fore-castle or poop plating goes on it will butt up against it.

Holes should be punched in edge of centre stringer-plate aft, for fastening plate, for taking rudder-trunk, and fixing stuffing-box round rudder-head to.

Wash-plates. - Do not put wash-plates between bulkheads and floor-plate on adjoining frames, so as to allow the water to get freely to the pumps.

Fitting-in wash-plates between floors may be done as shown in Fig. 10 ; but if they are required to serve as intercostal keelsons, four angle-irons at each floor will be necessary, and they must be made to fit close on.



Bilge-Keelsons, &c. - In putting on the lug-pieces for keelsons, see that they are quite fair with the edge of inside flange of angle-iron frame, and the fore-and-aft flange of reverse frame.

The lug-pieces should fit close against the frame angle-iron, and be well riveted thereto.

In keelsons formed of two angle-irons with a bulb-iron between allow between the angle-irons a quarter-of-an-inch extra, beyond the thickness of the bulb-iron, in marking off the holes for rivets in reverse frames and lug-pieces as far as the bulb-iron extends.

The lug-pieces for three frames forward and aft of the finish of bulb-iron between angles should not be punched, but drilled to suit a tapered slip neatly fitted between the two keelson angle-bars.

The butts of angle-iron bars of keelsons should be so shifted as to be at least two spaces of frames clear of butts of other keelsons, and as far as practicable clear of butts of outside plating.

If the angle-irons for keelsons are 4 inches or more, the holes for rivets should be punched each side of the centre-line (Fig. 11).

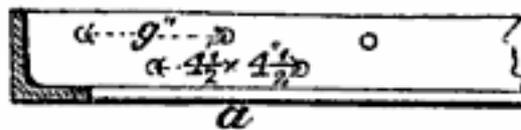


Fig. 11: a. In some cases, 5".

Athwartship flanges of bilge-keelson angle-irons in way of breasthooks should not be riveted till the breasthook-plate is in.

See that the breasthooks are got in as soon as possible, and that they are well fitted and securely riveted in place. A manhole should be cut in breasthooks where necessary.

Should the breasthooks or pointers aft in a screw-vessel not be high enough above the stern-tube, they should not be riveted until the boss for shaft is bored and finished, on account of leaving room for men fastening bolts, &c.

Have the position of bilge-keelsons carefully marked off on frames, and see that they are sheered fair.

It is advisable to keep the bilge-keelsons clear of ribbons as far as possible, in case the lug-pieces or reverse frames want any setting up.

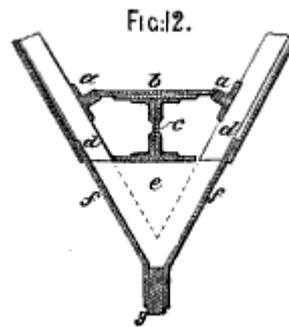


Fig. 12: a. Bilge-keelsons. b. Breasthook. c. Centre-keelson. d. Frame, e. Floor. f. Garboard Strake. g. Keel.

When practicable, have the height of lower bilge-keelsons at aft-peake bulkhead made to correspond with the height of top plate of centre keelson, so as to get a breasthook plate riveted between the bilge-keelson angle-irons and top of centre keelson (Fig. 12). This makes a good finish and a very secure fastening.

Bulkheads. - See that the bulkhead-frames are all chipped fair on edges, prior to putting up in place, so that the bulkhead plates can be properly caulked under the shelf-plates, stringers, &c.

The bulkhead-plates should be caulked outside between the frames, as well as both sides inside, and round the edges of the gravit-plates, for keelsons passing through, see that the gravit-plates are a good fit and neatly put on. The plates for gravits should be one-eighth of an inch thicker than the bulkhead-plates.

The beam angle-bars should be cut short on bulkheads, so that they lie in the bosom of the bar (see Fig. 13), and the angle-irons forming the beam on bulkhead should be not less than 3 inches deep, so that a good rivet may be got in through the head of the vertical angle-iron bar. The vertical bars should have a hole for a rivet punched through both side-frames and should be neatly joggled for it at foot. The same applies to both the reverse angle-irons on the top edge (see Fig. 14).

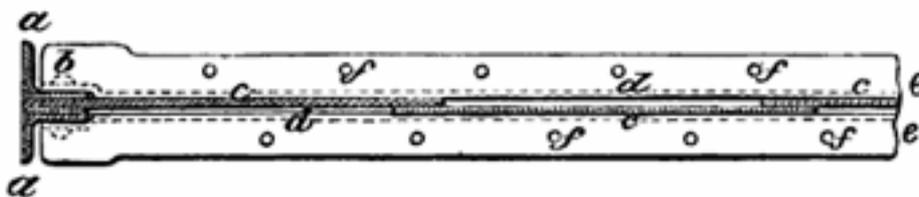


Fig. 13: a. Side-frame. b. These holes to be left blind, and riveted after the rest of bulkhead..
c. Bulkhead Plates. d. Slip to be set to curve of beam, and to equal angle-iron in depth.
e. The vertical flanges of these bars not to be less than 3' to get a good rivet in head of vertical bar. f. Holes to suit deck-planks.

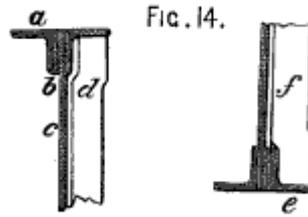


Fig. 14: a. Beam's Reverse Bar. b. Slip. c. Bulkhead-plate. d. Vertical Bar, to be properly joggled over. e. Side-frames. f. Vertical Bar.

In plating bulkheads, attention should be paid to see that the first plate is at right-angles with the keel; also see that the reverse angles forming the beam are not sagged down in centre or standing too high at centre or ends.

The fore and after peake bulkheads should be plated in the vessel, after the frames are faired, not from the mould, or board, in case the frames may not be the proper fit at the bottom. This applies more especially to vessels with flat-plate keels.

Attention should be paid to the fitting and punching of the gravit plates, to see that the holes are sufficiently close and regular, and that the plates are not made larger than necessary; as, if so, they cannot be caulked tight. It is also advisable to have a rivet as close as practicable to the hole for keelson-bars passing through the bulkhead (Fig 15).

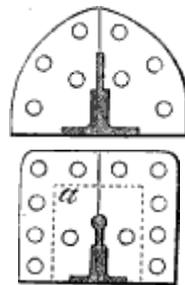


Fig. 15: Boiler keelsons in engine room.

Inside Sheerstrakes. - The butts of inside sheerstrake should be double-riveted through inside sheerstrake and butt strap; the row of rivets next butt of plate to be riveted flush before the outside sheerstrake is put on (Fig. 16).

If there is only one frame between the butts of outside and inside sheerstrake, see that the plates are butted fair in the centre, between frames. Same rule applies to the outside sheerstrake, so that there is a full frame space of shift between the butts of outside and inside sheerstrakes.

The holes for rivets in the gunwale angle-iron bars should not be punched with the same die as used for outside plating, on account of giving too much countersink.

In inside or ordinary sheerstrakes attention should be paid to seeing that the holes for the vertical flange of gunwale angleiron are punched the proper height, so that the holes may be fair in the centre of bar.

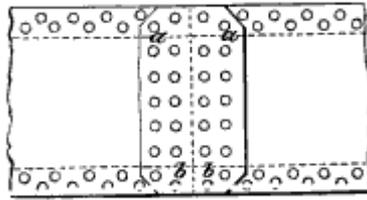


Fig. 16: a. These two rows, through inside and outside sheerstrakes and butt-strap, &c.
 b. These two rows through inside sheerstrake, and butt-straps, and riveted flush, before outside plate is put on.

Outside Sheerstrakes. - In outside sheerstrakes, make sure that the gunwale angle-iron bars on the top edge of sheerstrake are properly faired all fore and aft, as also the top edge of the sheerstrake itself. If possible, it is well that the gunwale angle-bar should be not less than 4 inches by 4 inches, as this width will give a better chance of making all fair holes.

Beams.—The beam-mould should be made the full breadth of the vessel, so that the total length of beam can be taken off and the correct bevel taken at both sides. The mould should be made the full depth of the beam-knees.

Have the bottom hole for rivet in the beam-knee punched, so as to allow an inch-and-a-half of iron from the under-side of rivet to bottom of knee.

Poop-Beams. - Have the poop-beams put up and bolted to the frames, but do not have them riveted until after the stringer plates and tie plates are all faired and riveted. This should be specially attended to, as it frequently occurs that if the beams are riveted first the knees get twisted, and set the beams up or down, as the case may be, making bad and unfair work of the stringer and tie plates.

To keep the poop-beams the proper spacing, it is a good plan to have a long plank, say in scantling, about 8 inches by 3 inches or 2½ inches, and have marked off on this plank the spacing of the beams, cutting out a notch for each beam; and when the beams are put up let them go into the notches, and have the plank shored up from main deck. By attending to this you will have all your beams equal distant and to one curve, which will add considerably to the appearance of- the cabin ceiling, &c.

Framing of Hatches, &c. - In making hatches, put in the fore and aft angle-iron bars first; have them made a good and neat fit; see that they are straight fore and aft, and then put in the bulb iron or plate for fore-and-aft carlings; seeing this is also a good fit.

An angle-iron bar, about 5 inches by 5 inches by ½ inch, cut in lengths to suit, and fitted in the corners of the hatches, makes a much better finish than to knee the bulb-iron or bend the plate-knee.

The beams that form the fore-and-aft ends of hatchways should have reverse angle-irons, not less than 3 inches deep, so that the holes in plate-knees may be punched to allow three quarters of an inch of iron from top of rivet hole to top of knee-plate (Fig. 17).

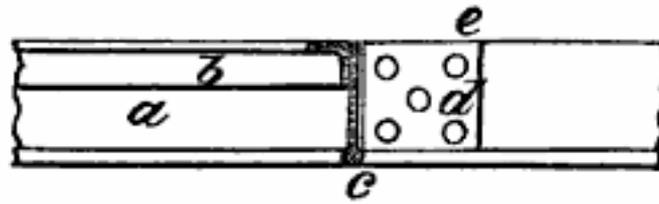


Fig. 17: a. Beam. b. Reverse Bar on beam. c. Fore and after d. Plate-knee, in corner of hatch, inside.
e. This rivet to be not less than $\frac{3}{4}$ from edge.

Outside Plating. - Attention should be paid to having the butts of the garboard strake clear of the scarphs in keel, and that the butts of the garboard plates have three frames between them from the starboard to the port side throughout (Fig. 18).

In order to have the butts of the outside plating a clear two spaces from the bulkheads, have the plates that come in wake of bulkheads a space of frames more in length than the average length of plating.

Have the sides of plates, with the Maker's stamp on, put to the outside of ship, so that the Surveyor may see it, on account of the classification.



Fig. 18: a. The butts of these go a frame further forward on starboard side (see f).
b. The butts of these do the same (see e). c. Butts (see f). d. Garboard Strake Butts (see e).

In the butts of bilge strakes, if the bilge is at all quick, the edges of the plates should be sheered with a slight curve.

In plating vessels attention should be paid not to put too much weight of plating on the top sides until the garboard bilge and bottom is all plated and riveted.

The holes for rivets in the lower edge of double riveting should be punched as near as possible to the edge of frame (Fig. 19), and spaced, say, for a 3-inch flange and 3/4-inch rivets, not more than 8 inches pitch.

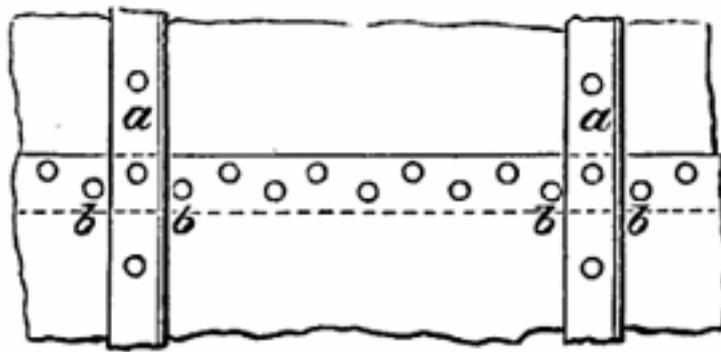


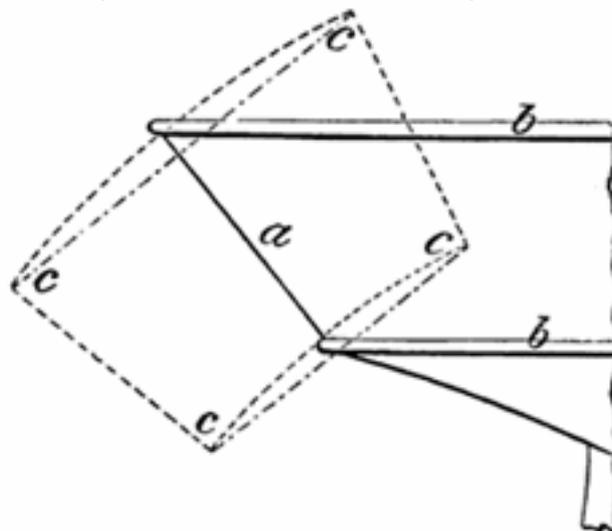
Fig. 19. a. Frames. b. Rivets next to frames to be as shown.

Have the inside strakes stitched at the butt straps and frames say about six rivets in each butt-strap and two in each frame, before putting on the outside strakes.

The filling-plates at the bulkheads at back of shell-plates should be at least the width of the fore-and-aft flange of the frame angle-iron longer than two spaces of frames, in the fore-and-aft peake bulkheads, the filling-plates will be about three inches longer on account of the set and bend.

In the plating round the knuckle of stern, see that the plates are kept up to the sheer-marks, and on no account have them below, and allow a clear inch-and-a-quarter from top of rivethole to the edge of plate.

In taking off the dimensions to order plates for going round the stern (supposing them to be of average size) an allowance of about five inches should be made beyond what the plate measures in the depth of the stern (Fig. 20).



Fig, 20: a. Centre of plate. b. Mouldings. c. Development of plate showing allowance.

In marking the rivet-holes for sheerstrakes aft, attention should be paid to having the holes for connecting the stringerplate to the shell of the vessel high enough up for the rivet-hole to come in the centre of the flange of the angle-iron (Fig. 21).

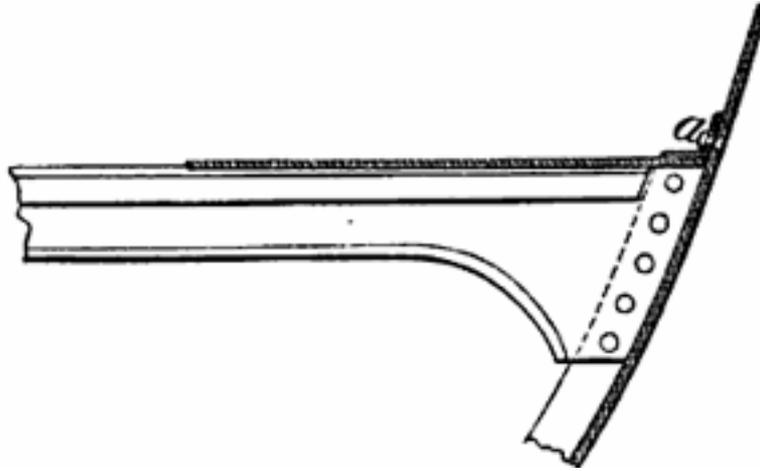


Fig. 21: a. See that this rivet is not too low in bosom of angle-iron.

In the plating of topgallant forecastles, the plate that is cut for the knightheads should project say about three inches beyond the knighthead bulkhead, and the rivets through the bulkhead should be flush on the forward side. The projection is to allow for bolting on the knee-brackets, &c.

Fig. 22 is a sketch showing a good arrangement of rivets in frames, heel-pieces, and butt-straps, of garboard-strake.

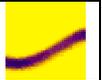


Fig.22.

