MARINE EXPERT TELLS WHY TITANIC SANK

H. H. Brown, Well Known Writer on Engineering, Believes Forward Holds Filled.

ENGINE ROOM FLOODED TOO

Evidence Seems to Show That Two or More Adjoining Bulkheads Were Ripped Out.

In an article prepared for THE SUN on the causes of the sinking of the Titanic H. H. Brown, editor of *International Marine Engineering*, has the following to say:

Whenever two adjacent compartments in the hull of a large passenger steamship like the Titanic are filled with water by the piercing of the skin of the ship or the failure of a bulkhead the ship is in a critical condition and if a third compartment should be filled the ship is practically doomed to sink.

Modern passenger steamships, regardless of size, are designed so that if two compartments are flooded there will be sufficient reserve buoyancy to keep the ship afloat, and if the damage is confined to this space it is expected that the ship will be safe. Even a third compartment might be filled and still the ship would float, provided the flooded compartments are not adjacent.

While serious collisions are considered as a very remote possibility, yet they are always taken into most careful consideration by ship designers, and every precaution is taken to strengthen the hull at the place where the effect of the collision is most likely to be felt, that is, at or near the bow of the ship.

Thus the hull of a large ship is subdivided into watertight compartments by transverse bulkheads extending from the double bottom to the strength deck of the ship, which is always far above the load water line. In the case of the Titanic this was the upper deck. These compartments are of such size that if any part of the outer skin or shell of the ship is pierced the water will be confined by the bulkheads to that compartment. Whenever, however, the shell is pierced on the side of the ship above the double bottom at the place where a watertight bulkhead is located both the compartment forward of the bulkhead and that one aft will be flooded. The safety of the ship therefore depends upon the subdivision of hull and the strength and tightness of the bulkheads which form this subdivision.

On the Titanic, which was 882 feet inches long over all, 92 feet 6 inches beam, with a load draught of 34 feet 6 inches and a displacement of 60,000 tons, the ship being propelled by engines developing 46,000 horse-power, the hull was subdivided and reenforced in the following manner: First there is the double bottom which extends the full length of the ship from the stem to the stern. This is 5 feet 3 inches deep and is increased to 6 feet 3 inches depth in the engine room. The space between the inner bottom and the outer bottom of the ship is minutely subdivided on the cellular system into separate watertight tanks. The entire double bottom is subdivided into four compartments transversely by a watertight centre keelson and watertight longitudinals on each side 30 feet from the centre line, the subdivision being completed in the usual maner by transverse watertight floors. Besides the continuous tank girders there were five intercostal tank girders amidships on each side of the centre keelson and additional girders are fitted under the engine rooms.

From the double bottom to the upper deck, as shown on the drawing, the hull is divided by fifteen transverse watertight bulkheads. The first of these is located about 1-20th the length of the ship from the stem, or a little over 40 feet. It is called the forward collision bulkhead, and as the hull is narrow at this point the area of the bulkhead is small compared to the bulkheads amidships, so that it can be built with sufficient strength to withstand the water pressure in case the entire bow is torn off in collision.

Aft of the collision bulkhead there are three cargo holds each 50 feet long. The bulkheads in the holds are further reenforced by the steel decks, of which there are seven in the first hold and six in all the other cargo holds. Amidships the space is broken up by the propelling machinery and here there are only five decks in each hold.

Aft the forward cargo holds are six boiler rooms, each of which except the after one, which is next the engine room, is 57 feet long. There are twenty-nine boilers in all, having a total of 159 furnaces. The boilers in the forward boiler rooms are arranged side by side athwartships, five in each room. These boilers are double ended, 15 feet 9 inches in diameter and 20 feet long, supplying steam at 215 pounds pressure under natural draught. In the after boiler room there are five single ended boilers of the same diameter but only 11 feet 9 inches jong. These boilers are used for running auxiliary machinery while the ship is in port as well as for the general steam supply when the ship is at sea.

The coal bunkers are arranged athwartships between the boiler rooms, and the watertight bulkheads which separate the boiler rooms are located in the centre of the bunkers separating the supply of coal to each boiler room. Passageway is provided between the boiler rooms through alleyways where the watertight bulkheads are carried to the coal bunker bulkheads, and there are located watertight doors which can be automatically closed from the bridge.

Aft of the boiler rooms is the largest compartment in the ship, which is the main engine room, containing two sets of four cylinder triple expansion reciprocating engines taking high pressure steam direct from the boilers and driving the wing propellers. Aft of this engine room is a smaller engine room containing the Parsons turbine, which drives the centre shaft by using the exhaust steam from the reciprocating engines. The turbine room is only fifty-four feet long. Most of the auxiliary machinery, including condensers and pumps, are located in the main engine rooms, but in the compartment aft the turbine room are the principal electric generating sets, which consist of four 400 kilowatt engines and dynamos having a collective output of 16,000 amperes at 100 volts. Besides this electric plant there are two auxiliary 30-kilowatt engines and dynamos, situated on a platform in the engine casing at the saloon deck level, well above the water line, so that in the event of flooding the main electric plant lighting and power could be obtained from the auxiliary plant, a circumstance which probably accounts for the fact that the ship was kept lighted until she sank.

Aft the machinery space are two other cargo holds. Thus in the subdivision of the vessel over one-half of the length of the ship amidships, where the width is greatest, is divided into the largest compartments, in which are contained all the power for operating the ship.

The subdivision of the part of the ship forward of the boiler space, where it is expected that most of the damage from a collision would occur, is reenforced in addition to the ordinary frames and bulkheads by longitudinal girders at each deck level (there being six decks at this point); the transverse deck beams, which were of channel section 10 inches deep, are placed according to the spacing of the frames and secured thereto by efficient brackets. At the deck levels there are four longitudinal girders which extend the whole length of the ship, except in the machinery space, where special girders are provided of a sectional area equivalent to the four girders in the other parts of the ship. These girders are suitably supported by stanchions and columns. Thus these longitudinal girders, besides supporting the decks, furnish support against deflection of the transverse watertight bulkheads which separate the compartments.

The fifteen transverse watertight bulkheads extend from the double bottom to the upper deck at the forward end of the ship, and from the double bottom to the saloon deck at the after end of the ship, so that all the bulkheads extend far above the load water line and give a considerable margin for the emersion of the ship by the flooding of the compartments.

There are nine decks in the ship named from the bottom upward, orlop, lower, middle, upper, saloon, shelter, bridge, promenade and boat. Two of these decks are above the moulded structure of the ship and therefore add nothing to the strength of the hull, the entire superstructure being of light construction and provided with expansion joints amidships to obviate stresses in the superstructure.

From this description of the hull of the Titanic it is evident that the framing longitudinal keelsons, girders, decks, bulkheads and shell plating were of exceptional strength. Notwithstanding this, however, the shell plating itself is, of course, comparatively thin and cannot withstand a heavy blow at one point without being torn apart like paper or crushed.

From the most authentic reports from the survivors of the disaster the ship was struck on the starboard quarter forward of the machinery space, probably between bulkheads two and three, by the submerged part of an iceberg, and as the vessel's course had been changed to avoid the collision the blow was probably a glancing one of sufficient force to crush or split the plates either above or near the bilge, and as the vessel passed the iceberg the skin of the ship was pierced in several places for some distance aft, probably as far as the engine room. If this is what happened, two or three of the large compartments from the forward cargo holds aft to the engine room began to fill with water.

From the fact that there was no heavy jar felt in the vessel from the collision, the crushing of the shell plates or opening of the riveted seams in about this position was probably all the damage that was done to the hull by the collision.

Immediately after the collision the engines were stopped and the watertight doors in the watertight bulkheads between the various holds were closed. In this condition a ship would be as safe as it would be possible to make it in such a damaged condition; but with openings, whether large or small, into the watertight compartments it would take only a short time to fill the compartments which had been pierced to the height of the water line. Filling the compartments in this manner would reduce the buoyancy of the vessel and cause it to sink and change the trim.

Whether a ship will sink or not if two or more of the holds are filled with water depends upon the reserve buoyancy or the buoyancy of the upper part of the hull; that is, from the low water line to the upper strength deck; that the forward holds and probably one or more of the boiler rooms were filled with water is indicated by the fact that the trim of the ship was altered and she came down by the bow. The alteration of trim is a very important matter and particularly it it causes a loss of displacement at the bow, as would be the case if any of the forward compartments of the Titanic were flooded. Loss of displacement at the bow causes a greater immersion of the forward part of the vessel and also leaves the stern out of the water. Therefore loss of displacement at the bow means that there will also be a loss of displacement at the stern because that part of the hull is lifted out of the water.

Loss of buoyancy at the bow makes the situation critical, even if there is a large reserve buoyancy, because the distribution of stresses in the hull is greatly changed and greater stresses are produced in the upper members of the structure amidships; that is, in the upper decks, so that the strength of the sturcture will be affected and cause a break in the hull. Furthermore the continual sinking of the bow of the ship places additional stress on the watertight bulkheads just aft the last compartment that is flooded, causing possibly the breaking away of the bulkhead and the filling of the next compartment.

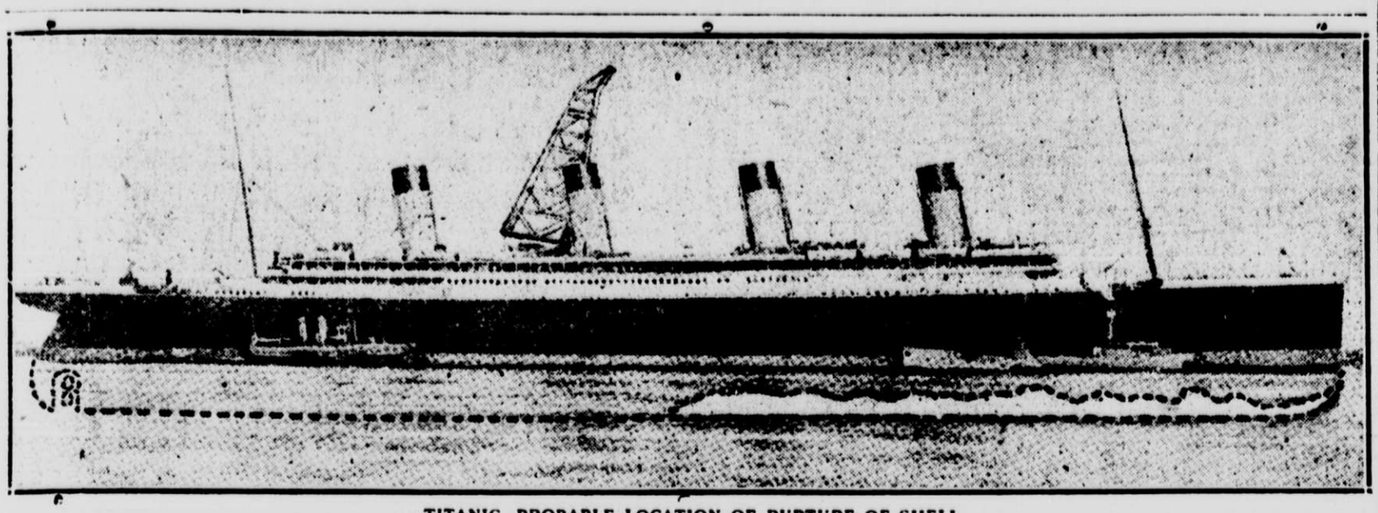
Apparently some such action took place in the Titanic if the somewhat indefinite accounts of the disaster represent the truth of conditions at that time. It seems to be understood that just before sinking the bow was almost totally immersed and the stern drawn out of the water, and that before the vessel finally sank she broke into two parts somewhere aft of the midship section. At this time some distinct crashes were heard, which have been attributed by some to the explosion of the boilers and consequent breaking of the ship. It is not probable, however, that the boilers, even if immersed in the water, would have exploded. The fires would simply have been extinguished and the steam pressure lowered. The type of boilers used in the Titanic are designed with such an ample factor of safety that cold water on the outside of the boilers would not be expected to cause a contraction of the steel boiler plates sufficiently to cause an explosion. The crashes heard were probably due to the giving away of a bulkhead and consequent rupture of the upper decks from the excessive strain due to the flooding of the next hold.

Whether the watertight doors which give communication between the various boiler rooms and engine rooms failed to close is as yet unknown. The doors were arranged on the drop system, each door being held in the open position by a friction clutch which could be instantly released by means of a powerful electro magnet controlled from the captain's bridge so that the captain could by simply moving an electric switch instantly close the doors throughout the vessel. Other means were also provided for closing the doors, by operating levers when connected to the friction clutch and by floats which are provided beneath the floor level, so that if water entered the compartment it would automatically lift the float and close the door if it had not already been dropped by the mechanism connected with the bridge.

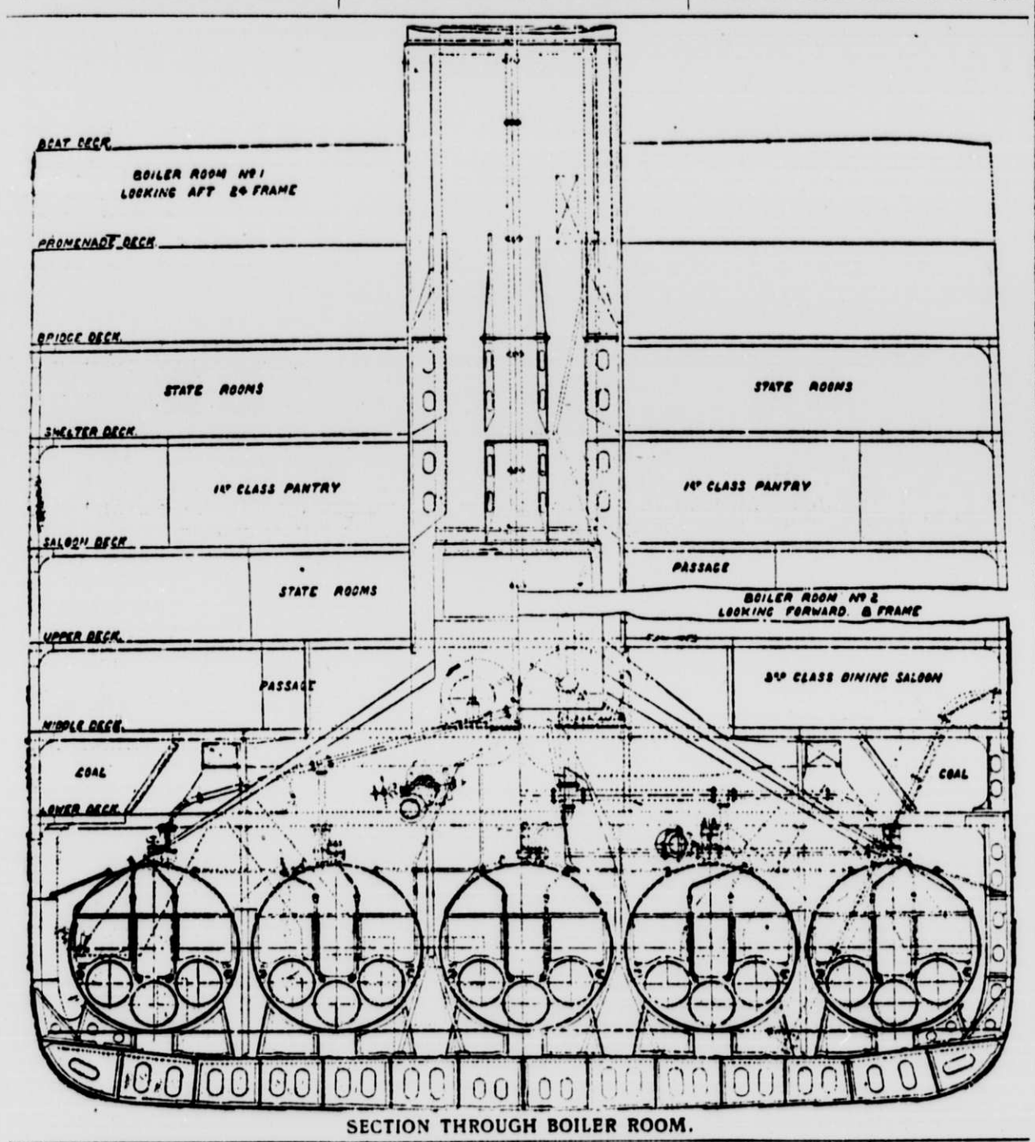
Watertight bulkheads are designed so that they are expected to withstand the pressure of the water if the compartment is filled. They are formed of horizontal strakes of plating braced by vertical stiffeners uniformly spaced across the width of the bulkhead. The stiffeners on bulkheads as large as those in the Titanic are constructed of a channel or I beam section and are secured by efficient brackets to the decks at the top and to the bottom of the ship. Double bounding angles are placed around the edge of the bulkhead and extend to the water line. All the seams are thoroughly calked and the bulkheads are supposed to be absolutely watertight and sufficiently strong to withstand the pressure of water when the compartment is filled. As a matter of fact, however, in merchant vessels there is no means of testing the strength and watertightness of the compartments, as the holds are too large to be filled with water, as is done in warships.

Warships are minutely subdivided into small compartments and before the ships are launched each compartment in turn is filled with water and all leakage stopped, and if any deflections of the bulkhead are apparent the construction is reenforced. The testing of watertight bulkheads in merchant vessels, however, consists simply of throwing a stream of water over the seams from a hose, which rarely gives any indication of the tightness of the seams. There is therefore some possibility that large bulkheads of the kind used in the Titanic might leak or "seep" water to a certain extent and that this, added to the deflection of the bulkheads from the pressure of the water in the compartment which had been flooded, might have led to the breaking away of a bulkhead.

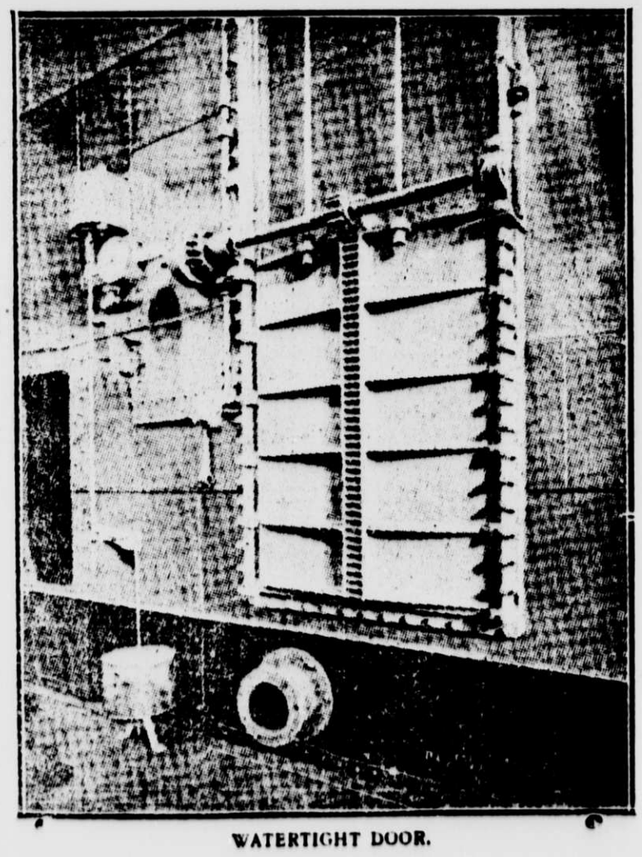
The position of the lifeboats is clearly shown on the drawings of the ship. They are located on the boat deck, which at the time the boats were launched was from sixty to seventy feet above the water with the vessel listed about five degrees to the starboard. It is probably the first time in history that in a vessel in such a condition it has been possible to launch all the lifeboats safely. That it has been done this time in the short space of fifteen minutes without serious mishap is due to the type of davits by which the boats were lowered. These davits, which are of the Welin type, permit swinging the lifeboat away from the side of the ship so that even if the vessel is listed the boats can be safely launched, without striking the side of the vessel. The davits were also so constructed that they were capable of handling twice the number of lifeboats the law demanded that the vessel should carry.



TITANIC, PROBABLE LOCATION OF RUPTURE OF SHELL.



SECTION THROUGH BOILER ROOM.



WATERTIGHT DOOR.

IT WAS W. F. HOYT.

Member of New York Firm Was Dying When Carpathia Came.

The printed lists of the survivors have contained the name of W. F. Host. It has been confirmed by cable from the Paris office of the White Star Line that the correct name should be W. F Hoyt. This has also been established beyond all doubt by the information and records furnished by the chief officer of the Carpathia.

Mr. Hoyt was dying when the lifeboat was picked up by the Carpathia and at 4 o'clock on Monday afternoon he was buried at sea, together with two other passengers who were found in the same condition.

His identity has been further established by personal effects taken from his clothing, consisting of a watch and chain, memorandum book, letters and pocketbook, which are now in the possession of the officials of the Cunard Steamship Line.

Mr. Hoyt was the junior member of the firm of Houghton, Lee & Hoyt, importers and makers of laces and curtains at 15 West Thirty fourth street.