H.M.S. *LION* AT THE DOGGER BANK.

The following is an account of the damage which particularly affected the engine room department which was caused by German shell fire, together with the steps taken to clear the ship of water after the action and subsequent alterations and additions carried out as the result of experience in this action.

About an hour after the engagement commenced an 11-in. shell ex *Seydlitz* penetrated the armour in way of the Engineer's Workshop which surrounded " X " turret. The shell wrecked a lathe and drilling machine and was thereby deflected upwards through the deck and ultimately came to rest on the hatchway without exploding.

The hole made in the ship's side was a few feet above the normal water line, but owing to the speed of the ship and the consequent wave formation it was frequently submerged, resulting in the flooding of the workshop in spite of the efforts of the repair parties. The leak stoppers were quite inadequate to deal with the size of hole made.

Due to the earths which developed on the ring main owing to flooding No. 1 and 2 Dynamos soon afterward became overloaded and came " off the board," but the electrical repair parties maintained an adequate supply of light to the machinery compartments until the close of the action and even then limited emergency lighting was soon made available.

The next hit was forward, near the submerged flat and was also near the water line; this resulted in the flat and some adjacent compartments being flooded and was thus the origin of the events which led up to the access of salt water to the whole of the boilers some considerable time afterwards as will be explained later.

Almost simultaneously the ship was struck heavily on the port side in the neighbourhood of the forward bulkhead of the forward boiler room. This resulted in the flooding of compartments in the vicinity, caused the ship to take a slight list to port and slight trim by the head and put No. 2 dynamo permanently out of action.

The next serious hit occurred in the bakery, which was situated above the condenser rooms; the shell burst very well and large pieces passed down through the armour bars in the ventilation trunk leading to the port condenser room, and one piece about 6 in. × 4 in. × 2 in. went through the eduction bend into the Port Inner Condenser.

This splinter fortunately expended its force on the large steel framework to which the condenser testing doors are secured when required and then fell harmlessly on to the tubes where it was

subsequently found. The opening in the eduction pipe produced a noticeable fall in the vacuum on the port side.

The hit which resulted in the ship being reduced to half-power occurred soon after and was effected by shells bursting under water against the ship's side in the vicinity of the forward bulkhead of the port engine room.

The result was to blow in the inner and outer bottoms outside the feed tank and to cause the side armour to be driven into the slope of the armour deck.

The ship section at this station was somewhat as shown in the figure and the drawing indicates diagrammatically (1) the displaced inner bottom, (2) an angle from the inner bottom which curled over and swept away a few rivets in the inner wall of the feed tank, and (3) the buckled main air pump discharge pipe.

It was extremely fortunate that the damage in the case of (2) and (3) was not more extensive since if many rivets in the vertical joint of the wall of the feed tank had been sheared the wall might have given way and if the air pump discharge pipe had been fractured it would have presented a difficult problem to have prevented the ingress of sea-water.

As a result of the impact such fittings as gauge boards, clocks, telegraph, etc., were thrown from the wall of the feed tank, but the steam exhaust and hydraulic pipes, which were situated high up in the angle formed by the wall and the deck overhead and also the ring main were undisturbed. *See* footnote (*a*).

The immediate consequences of the damage were that the condensate from the port engines was being pumped into the sea and that " B," " D " and " F " boilers were being fed with salt water.

The valve on the cross connection pipe between the feed tanks, from which pipe " A " boilers took their suction, was immediately shut thus preventing access of salt water to the starboard feed tank, the bridge was informed the port engines eased and " B," " D " and " F " boiler rooms directed to draw fires as soon as possible and in the meanwhile take their feed from their reserve tanks.

It was judged undesirable to feed the boilers with salt water while their fires were heavy.

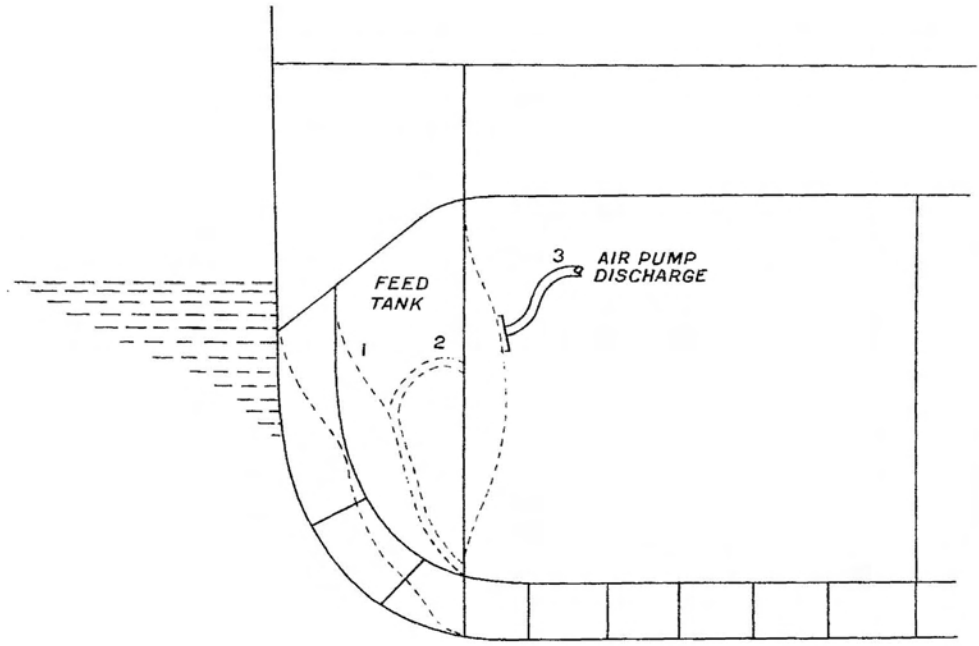
As a result of this damage the ship's list increased to something of the order of 10°. *See* footnote (*b*).

After drawing out of the line all went well for some time with the ship steaming on the starboard engines and trailing the port ones.

(*a*) Sluice valves were subsequently fitted at the junction of the air pump discharge pipe with the wall of the feed tank.

(*b*) The air pump discharge pipes were subsequently cross-connected and the feed suctions modified so that all boiler rooms could obtain a suction from either feed tank.

To face page 3.



152,127/4 8433, 1600, 10/32.

Malby & Sons, Lith.

The first symptom of trouble was that the starboard feed tank commenced to overflow, which subsequently proved to be due to salt water obtaining access to the auxiliary exhaust system through the damaged capstan engine exhaust pipe where it passed through the submerged torpedo flat.

Where this pipe entered the forward boiler room it was provided with a spring loaded non-return valve opening towards the condenser end of the system, the object being to prevent the escape of steam from the exhaust system should the latter be damaged in one of the outside machinery spaces, but it could not, of course, prevent the passage of water the reverse way.

As the closed exhaust steam was going partly to the starboard main turbines and the remainder to the auxiliary condensers, all air pump discharges showed salt when tested.

About this time the bunkers in the starboard after boiler room (" G ") were reported to contain water.

This was difficult to account for as they were on the disengaged side and it appeared that some damage, the cause of which was at present unknown, had occurred here and that sea water was obtaining access to the starboard feed tanks as well.

Subsequent examination showed that this was not the case, but that the access of salt water to the feed system was entirely through the capstan exhaust pipe.

The damage to " G " bunkers, etc., was caused by some "overs" bursting just under the water outside " G " boiler room.

This explained what had up till then been somewhat of a mystery. During the action a severe shock was felt in " G " boiler room, where all the electric lights were extinguished, although it is interesting to note that the oil lamps on the boiler gauge glasses were unaffected. The sudden darkness was accompanied by the roar of escaping steam, the cause of which was difficult to discover, but which was ultimately found to be caused by safety valves having been jerked off their seats and remaining stuck open.

A further disconcerting phenomenon was that certain of the reserve feed tanks in the boiler rooms commenced to overflow with salt water through the sounding pipes. This was ultimately traced, not to a damaged outer bottom as might reasonably be expected, but to fractured steam heater drains situated in flooded bath rooms, allowing water to pass in through them.

The valves on these pipes were fitted with non-return discs to prevent water going in the reverse direction if the outer bottom was pierced, but not until then was the other possibility foreseen. *See* footnote (*c*).

As the whole machinery system was becoming salted up it was decided that the ship should be taken in tow by *Indomitable* in

---

(*c*) Subsequently these and all similar valves were shut on going to action stations.

order to avoid steaming the boilers on salt water feed more than was necessary for providing steam for dynamos and pumps, although it would have been possible to have steamed the ship at slow speed and the engines were in fact used to bring the ship to anchor on arrival at Queensferry.

The source of the major trouble was discovered more or less by accident as the spring-loaded valve on the capstan exhaust steam pipe was seen to open, stay open a little while and then close. This intermittent action was no doubt due to local fluctuations in the exhaust pressure as nearby pumps were started and stopped and was complicated by the admission of the initial small quantity of sea water acting as a local jet condenser at this the far end of the exhaust system. *See* footnote (*d*).

So far as clearing the ship of water was concerned, it was observed that if the list to port could be reduced, certain shell holes would come above the water line. Flooding the starboard wing compartments did, in fact bring the shell holes into the space above the submerged flat and also the hole into the workshop above water. This enabled many spaces which had been flooded from above to be cleared of water by the ships pumps. As certain of the 50-ton electrically-driven pumps were in compartments which were flooded various devices such as sluicing and syphoning were resorted to while the hand pump was found useful.

As a result the forward part of the ship, except where actually open to the sea, was practically cleared of water by the time the ship arrived at Queensferry.

Subsequently the boilers were carefully cleaned and the whole of the machinery was opened out (other than the main turbine covers being lifted). The most striking feature was the extensive rusting which had taken place in the cylinders, etc., of the auxiliary machinery in the comparatively short period.

(*d*) All ships were provided with means of gagging the spring loaded capstan engine exhaust valve and it was gagged immediately the capstan engine was finished with on proceeding to sea.