HOT AIR

BY

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The whole reason for having a Reserve Fleet Staff can be summed up in the words ' cleaner and drier ships '. The problem of cleanliness is well understood by most officers and the ships are inspected often enough to ensure that they really are clean. The white bilges have the virtue of showing up any dirt that may be present in the machinery spaces.

White bilges also show up any faults in the external dryness, but one is still left with an assortment of Class I ' whited sepulchres '. The internal dryness of the steam lines, fresh water systems and firemains provide many problems. It is, or was, often difficult to find any evidence that these systems had ever been dried out, though they usually had, of course, been drained—but that is not the same thing at all. There was, however, some positive evidence that drying out had been neglected. A *Battle* Class destroyer which was taken out of Class 1 Reserve in order to attend the Review in 1953, reported that the rust and scale coming over with the steam had made all the governors fail. These governors continued to give trouble in spite of frequent stripping and cleaning.

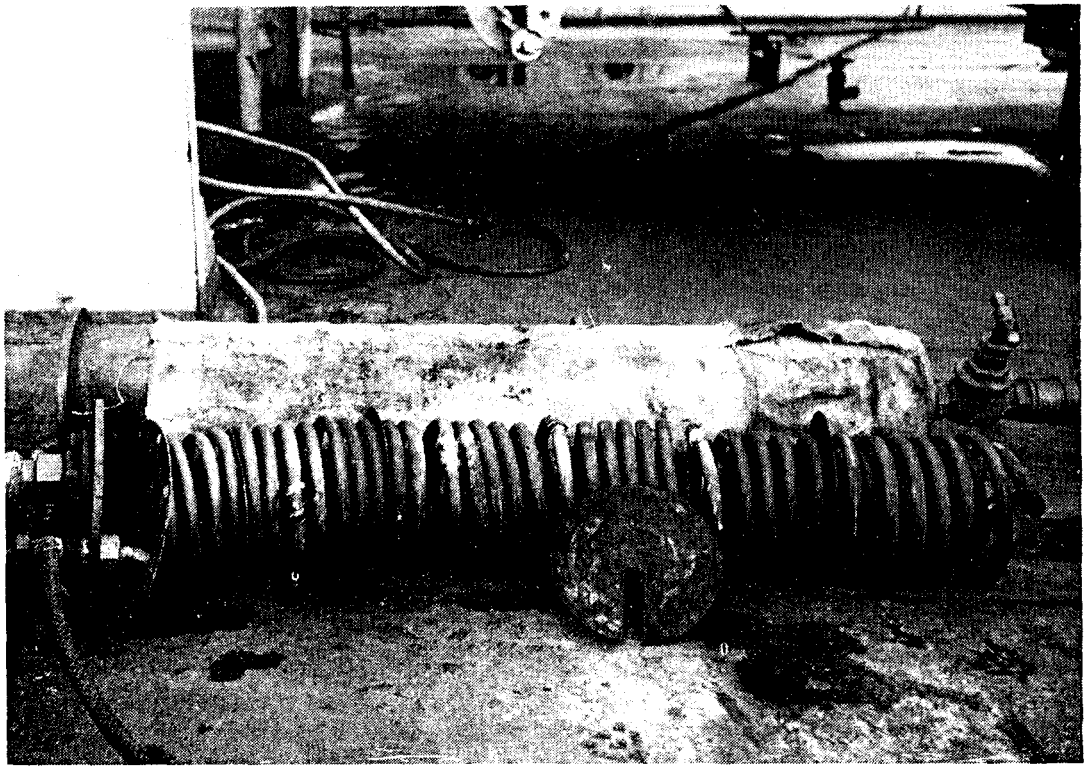
The only part of the machinery that had been really well dried out in the past was the boilers. Normal internal cleaning dried the drums and the steam generating tubes. The superheater tubes had been dried out with low pressure air which was passed through a spiral steel coil inside a brick lined tube of about 12 inches external diameter. The air was heated to about 350 F. by means of a quart blow lamp. Each superheater tube had the air blown through it for about 40 minutes. On completion of this drying out, the tubes were tested for dampness before the boiler was closed up in the E.C.L. state.

It was decided to try to extend the internal drying to the steam pipes and exhaust lines throughout the ship. There were plenty of 2-inch air connections on the dockside and there was no real difficulty in obtaining the necessary hose. It was apparent that the only source of heat, likely to warm such a large volume of air, would be steam from a donkey boiler.

A few tentative enquiries about the chances of getting an oil fuel heater ' off the record ' met with no encouragement, so it was therefore decided to construct a suitable form of heat exchanger. The requirement was that the heater should be sufficiently light to be portable but, at the same time, sufficiently robust to withstand air or steam at a working pressure of 100 lb/sq in.

The construction of the outside shell was fairly easy because it was made from the largest available size of solid drawn tube that could be legitimately obtained from the dockyard. The first internal coil was of steel with baffles welded to it, but the results were not as good as had been expected. The steel coil was replaced by the maximum amount of $\frac{3}{4}$ in bore copper tube that could be got inside the shell. This was about 180 ft. Two smaller $\frac{3}{8}$ in. diameter coils were wound in a spiral that would pass inside the larger $\frac{3}{4}$ in coil. The performance was greatly improved but it was found that, if the air was opened wide, there was a tendency for the drain coils to become waterlogged.

The $\frac{3}{8}$ in diam coil was replaced by a shorter length of $\frac{1}{2}$ in diam coil and the number of baffles was increased from four to twelve. The photograph



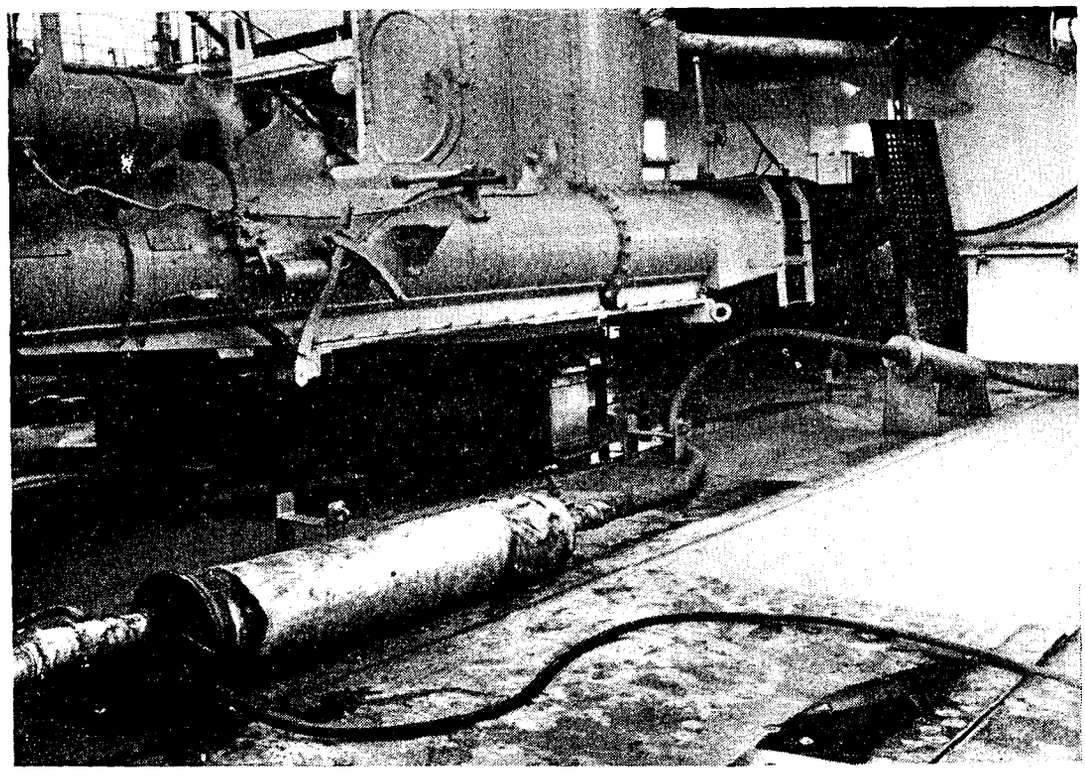
THE HEATING COILS AS ORIGINALLY FITTED

shows only four baffles and the $\frac{3}{4}$ in diam drain coil. The baffles are a neat fit in the casing and the slots are staggered so that the longest possible path for the air is provided. It may be seen that a water separator is also fitted in the circuit. This separator was of simple design with an internal slotted pipe and a quarter-inch drain hole at the lowest point. The leak past the drain is easily adjustable and, so far, there has been very little evidence of water coming over with the dockyard air.

The present equipment gives a full bore discharge of L.P. air from a two-inch hose at a temperature of about 190° F. There has been some trouble in getting steam when the heat exchanger is more than 100 ft away from the donkey boiler, and the best results have been obtained when solid drawn two-inch steel pipe is used for conveying the steam, and the amount of flexible steam pipe is reduced to a minimum.

Several ships have now been dried out with the equipment, which has shown itself adequate for large ships as well as for frigates. It is generally possible to get a pressure of about 50 lb/sq in. in the auxiliary steam line and a considerable amount of water is usually dislodged when the drains are opened wide. Within about ten minutes the air coming from the drain is dry and warm (140° F.). It is usually possible to have about four drains opened wide simultaneously. One day is sufficient to dry out the auxiliary steam lines to the machinery in the engine room of a small ship, a further day is required for the exhaust line, after which attention can be turned to the boiler rooms or the main steam systems. The whole of a small ship can be completed in about six days if steam is opened up punctually at 0800 each day and is left on until 1530.

It has not been easy to obtain very much precise data about the performance of the equipment, because most users have devoted all their energy to getting the job done, and have not been keen to leave the job to take readings from thermometers. Some results obtained include the following :—



THE STEAM PIPE DRYING EQUIPMENT

H.M.S. ' Helmsdale '

(*a*) Inlet temperature of air to ship. 180° F.

(*b*) Outlet temperature of four drains. 120° F.

(*c*) Time taken for engine room auxiliary steam system. 2½ hours.

(*d*) Pressure in ship's auxiliary steam system. 30 lb/sq in.

Remarks.—System had previously been drained by normal methods, but a considerable amount of extra water was dislodged by the air.

H.M.S. ' Knaresborough Castle '

(*a*) Inlet temperature of air to ship. 160° F.

(*b*) Outlet temperature of drains. 120° F.

(*c*) Time to warm furthest point in exhaust line. 2½ hours.
Time to warm furthest point in main steam line. 5 hours.

(*d*) Pressure in system not stated.

Remarks.—Hot air was kept for a total of 18 hours in the exhaust system and 20 hours in the main steam line.

H.M.S. ' Magicienne '

(*a*) Inlet temperature of air to ship. 170° F.

(*b*) Outlet temperature of drains. 130° F.

(*c*) Time to warm furthest point in auxiliary steam line. 1½ hours.

(*d*) Pressure of air in system 45 lb/sq in.

H.M.S. ' Enard Bay '

(*a*) Inlet temperature of air to ship. 200° F.

(*b*) Outlet temperature of drains. 160° F.

(*c*) Time taken to dry out auxiliary steam line in E.R.—3½ hours.
Time taken to dry out auxiliary steam line in B.R.—5 hours.
Time taken to dry out main steam line in E.R.—10 hours.

(*d*) No attempt was made to keep a pressure in the system : the covers of the throttle valves were removed in sequence so as to get a powerful rush of air through each pipe in turn.

Other ships which have been dried out are H.M.S. *Sluys*, H.M.S. *Camperdown* and H.M.S. *Euryalus*.Warm air has also been used to dry out the main steam pipes and the turbines of H.M.S. *Cadiz*, where sweating produced several buckets of water in the L.P. casing, the drains having been left shut. An attempt to heat the oil in two F.F.O. tanks of H.M.S. *Camperdown* was not successful, but enough information was gained to show that further trials might be successful. It was evident that it was just as easy to admit steam to the individual tank heating coils and lead the drains overboard. The small size of the heating steam leads and the length of the pipes (other than the portion in the tank) resulted in such a poor flow of air that the volume was insufficient to convey sufficient heat.

So far, all the engineer officers who have been offered the use of the steam pipe drying gear have been sceptical until they have tried it. They have all been convinced at the end of the job that the results fully justified the labour expended. There is little doubt that, of all the liquids and gases one has to use in the Engine-Room Department, by far the most agreeable is Hot Air.