# FLOAT CONTROL OF REFRIGERANT.

Most of the cooling machinery installations of the methyl chloride and freon types fitted on H.M. ships operate on the dry expansion system. With this system the evaporator is of the coil type (or consists of the cold room cooling coils in direct expansion systems) and the refrigerant as it passes through the coil is gradually evaporated from liquid to vapour, the proportion of liquid becoming less and less as it passes through.

If the regulating valve is correctly set, all the liquid has been evaporated and the vapour is dry or slightly superheated as it leaves the evaporator coil and passes to the compressor suction. The amount of liquid admitted to the evaporator is very critical. If the regulator is opened too much, liquid is carried over to the compressor and if not opened wide enough only a part of the evaporator surface is used. The thermostatic regulator usually fitted automatically controls the admission of the liquid refrigerant by reference to the degree of superheat in the vapour leaving the evaporator.

Some of the later vessels, however, are fitted with methyl chloride and freon machinery operating with a flooded shell and tube type evaporator. This evaporator is somewhat similar to a fire-tube boiler. The liquid refrigerant lies in the evaporator shell, surrounding the tubes through which the brine circulates. Sufficient liquid must be admitted to the evaporator through the regulating valve to maintain the liquid level high enough to cover the tubes, but not so high as to cause priming. Such installations are usually fitted with an automatic regulator in the form of a "high pressure float valve." This functions on the same principle as a steam trap, the liquid from the condenser draining to the float chamber. As the liquid from the condenser accumulates in the float chamber it raises the float and the liquid is allowed to pass into the evaporator. With this form of control the liquid level in the evaporator depends upon the amount of refrigerant in the system. If refrigerant is lost by leakage, more must be charged into the system to raise the level. The liquid level, however, is not critical; little difference in performance is observed with a liquid level an inch or so above the top of the tube bank or an inch or so below.

## CONTAMINATION OF FEED TANKS.

Trials of a new destroyer were recently delayed for 24 hours through salt entering the feed system via an electric salinometer drain. After passing through the salinity cell the sample of made water from the distiller was led to the main feed tank. In this ship, however, a T piece on the salinometer drain line also carried a connection to bilge which was controlled by a two-way cock. At some period shortly before leaving for trials the evaporator primed, and the salinometer drain allowed the contaminated water to pass to the main feed tank.

Carelessness on the part of the attendant in not switching over to bilge when priming took place was the reason given for the accident.

## A DEFECTIVE DRAIN COOLER.

Persistent contamination of feed water in a destroyer was traced to a Buckley and Taylor drain cooler which, under test, had revealed no leakage. It was found that the two long studs screwed into the tube plate for securing the cover were badly "necked" by corrosion and, while they were tight under test, were, when pulled by tightening on to the cover, moved sufficiently in the threaded portion in the tube plate to cause severe leakage. These studs are of mild steel and pass through bosses on the inside of the cover. The corrosion was caused by the omission of the annular joint between the cover bosses and the tube plate.

When the studs were withdrawn for renewal it was found that they were riveted over on the inside of the tube plate and the new studs, though a tight fit in the thread, continued to leak on tightening with the cover in position. Efforts are being made to remedy this by fitting studs with a shoulder biting into the tube plate and enlarging the cover holes, rather than removing the tube plate and riveting over. The cooler, in the meantime, was used under pressure conditions to maintain feed water purity.

## PRESSURE CHARGING OF DIESEL ENGINES.

In recent years considerable advances have been made with the supercharging of diesel engines, and as there is a tendency to regard the Buchi system as a system of supercharging, attention should be drawn to the paper, "Notes on the Buchi System," by Mr. H. O. Walker, recently presented to the North-East Coast Institution, in which the author refers throughout his paper to the system developed by Dr. Alfred Buchi, of Winterthur, Switzerland, as a system of pressure charging, emphasising the fact that pressure charging must not be confused in any way with the supercharging which, he suggests, involves the pre-compression of the air prior to its entering the cylinder. In the Buchi system, of course, the air is compressed, although only to a figure slightly above atmospheric pressure, so that it is really a difference of degree rather than of kind.

There is, however, another difference between the two systems to which the author draws attention. It is well known that in the four-stroke cycle the exhaust stroke of the piston does not result in all the products of combustion being swept out of the cylinder, and as a consequence the cylinder is not fully charged with air during the following suction stroke. If the charging air is compressed before it enters the cylinder, not only is a greater weight of air delivered to the cylinder, but the incoming air can be made to scavenge the cylinder, driving out the burnt gases which would otherwise remain after the completion of the exhaust stroke and at the same time cooling the cylinder. This, the author states, is the object of the Buchi system, the charging air pressure being raised only a few pounds per square inch above atmospheric pressure, so that the maximum pressure in the cylinder following combustion is not unduly raised, neither is the maximum temperature. Thus, no attempt is made to boost up the engine by the use of high maximum pressures; this, it is suggested, being a procedure which is not acceptable to the majority of diesel engine builders. Nevertheless, pressure charging results in an increase of engine power by 50 per cent. or more as compared with the output of a normally aspirated engine, a typical indicator diagram showing a maximum pressure in the region of 650 lb. per sq. in. with a mean indicated pressure of 137 lb. per sq. in., the brake mean effective pressure being 117 lb. per sq. in.

## WEAR DOWN OF *LIGNUM VITÆ* BEARINGS.

Trouble has recently been experienced by the rapid wear of *lignum vitæ* bearings in "A" bracket bushes. The cause of this is not yet clear, but may to a certain extent be due to the difficulty in obtaining high quality *lignum vitæ*, combined with the large amount of running done in tropical waters. It is also possible that marine coralline growth may form between the shaft and bush during even comparatively short spells in harbour.

In order to assist in examining this problem and to enable ships to forecast when docking will likely to be required in order to renew woods, the fitting of poker gauges has been authorised in ships fitted with *lignum vitæ* or white metal which is grease lubricated.

## HARDNESS TESTING WITH CALIBRATED FILES.

The subject is not new and there is nothing original in its application, being merely a modification of Moh's Scale of Hardness, but it is so simple that this means of hardness testing has been neglected in lieu of the more up-to-date scientific instruments. According to *Shop Notes*, issued by Bureau of Ships, U.S. Navy Department, hardness testing instruments are still lacking somewhat in their capacity to determine true surface hardness. There are also many shapes and surfaces upon which no hardness determination can be made; as, for example, the face of a gear tooth, especially near the root, or the bore surface of a hollow cylinder.

About four years ago several sets of files with hardnesses ranging from 36 Rockwell " C " to 67 Rockwell " C " (file hard) at intervals of approximately 3 points Rockwell " C " were made up at the Navy Yard, Washington. These files have been in constant use since that time and have given invaluable service in determining hardness on surfaces that would have been impossible by any other method.

No degree of accuracy is claimed for the results obtained, but with simple instructions an inexperienced operator can consistently determine hardness within $\pm 1$ point of the true Rockwell " C " hardness, which is satisfactory for commercial purposes. Hardened blocks of steel with varying degrees of hardness can be used as standards to enable the operator to check doubtful determinations. The surface being tested need not be badly marred by scratch testing because with very little experience an operator can determine by touch whether or not the file is gripping and the slight burr that is made can be readily stoned down. The only precaution necessary is to be assured that a sharp corner or point is always maintained which may be secured by breaking off the end of the file or by grinding.

Any type of file may be tempered for use, and either new or old files, but pillar files are most satisfactory, due to their smooth edges which facilitate making hardness determinations without resorting to grinding. The test is made by determining the softest file which will scratch the surface by starting with the hardest file first and working down the scale.

## CREOSOTE-PITCH MIXTURES.

With a view to conserving all available oil tanker space for the requirements of the services, it was decided shortly after the outbreak of war to request industrial users of imported petroleum fuel oils to replace them by home-produced fuel. To enable this to be done, the Petroleum Board, in conjunction with the coal industry, evolved a standard creosote-pitch mixture which has proved so successful that more than half a million tons are now being consumed annually, representing approximately two-fifths of the total amount of liquid fuel at present burnt in industry. According to a Fuel Efficiency Bulletin issued by the Ministry of Fuel and Power, creosote-pitch mixture is a coal-tar product made entirely from home-produced materials, the average ultimate analysis of which shows 89·86 per cent. carbon and 6·05 per cent. hydrogen, the gross calorific value being 16,500 B.Th.U. per lb., as compared with 18,900 for Pool fuel oil. The viscosity is 5,000 secs. Redwood No. 1 at 80° F., which decreases rapidly to 1,000–1,500 secs. at 100° F. and 100 secs. at 200° F., so that for pumping the recommended temperature is 80° to 90° F. The density is 1·1, which means that in the event of fire the flames can be blanketed by means of water. The pressure jet system is recommended for use with water-tube boilers, the steam-jet or low-pressure system being preferred for shell-type boilers. It is not suggested that a creosote-pitch mixture has been used for steam-raising purposes on board ship, but if it can be obtained at an economic price relative to imported fuel oil, the possibilities of its use might be worthy of investigation.

# REPAIRS BY WELDING.

Difficulties experienced in obtaining spares at short notice coupled with the limited time available for refit, has, during the past few years, led to the adoption of welding as a means of reclaiming large numbers of fractured or wasted machinery parts. The following repairs, representative of many carried out by M. E. D. Chatham, give some indication of the variety and scope of the work.

A typical example was the reconditioning of a number of main steam valves removed from *Vega*. These were of cast steel, the original castings being very defective and previously repaired by rivets and poor quality welding. One of the valves required five separate attempts before finally passing test owing to old defects appearing subsequent to each repair. The welds were made with Ironex electrodes. Two other examples of cast steel work were an auxiliary superheated steam valve with a diameter of approximately 8 in. from *Sussex* which had a new seat built up with Nicrex electrodes, and a cylinder head and jacket from *Tactician*, reinforced with the same material.

In the latter case, the abutting faces of the water jackets and cylinder head were so badly corroded that joints could not be made. The faces were machined down to clean metal and new landings built up. Nicrex rods, used in the last two cases quoted, are of the nickel chrome type and lay down a clean stainless quality steel with excellent wearing properties. Undercutting is non-existent and the rod lends itself to "spotting" for this reason.

Repairs to cast iron parts by the oxy-acetylene process have also been carried out. Since January, 1945, some 30 moderately sized cast iron welding jobs have been successfully undertaken by the dockyard staff. In the case of *Lune* a fire and bilge valve chest gland end was blown out. This was repaired by welding pieces (five in number) back into place. The valve chest was afterwards tested to a pressure of 250 lbs./sq. in. with satisfactory results.

Corrosion of cast aluminium parts provides, upon occasion, work for the welding shop. As a case in point, the main engine crankcase of the fire float *Frolic* was found to be badly corroded. The defective portions were cut out and patched using the electric arc process. Bronze welding is also carried out frequently, particularly the building up of eroded propeller blades by the electric arc method.

An interesting routine welding job carried out at Chatham dockyard is the reclaiming of I.C.E. valves by refacing with Stellite. Where the valves are badly pitted or burned on the edge the parts are reinforced with 3% nickel steel rods, subsequently machined and faced with Stellite. At the time of writing some 500 valves are due to be repaired in this manner.

In addition to those minor repairs the dockyard has carried out a number of large welding jobs, some of which it is hoped to describe and illustrate in subsequent issues.