

# AIR CONDITIONING IN H.M.S. BULWARK

BY

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'The main engines look after themselves : 'tis only the domestics that require your attention'. Such were the words of wisdom offered me many years ago by one more experienced than I and, although such a statement is not wholly true, it does bear some relation to fact. In addition to boats, the supply of ice and water, especially in hot climates, is the criterion on which the assessment of the Engineering Department is based by most of the ships company. Another has now been installed in *Bulwark* in the form of a 4-million B.T.U. air conditioning plant, which serves all accommodation spaces not served by the original vacuum plant. The chilled water systems of both plants can be cross-connected if required.

The acquisition of a plant of such large capacity, and the time available in which to fit it, presented some problems, however, and resulted finally in the supply of a new centrifugal compressor, double helical gearing and a Bellis and Morcom turbine ; two sea water pumps were once used for the ship's catapult machinery and the two chilled water pumps had also seen service elsewhere. The new condenser and heat exchanger, like the compressor, were made by York Shipley and the gearing by Brown. The turbine once drove a turbo generator in *Ranpura*. The refrigerating side of the plant is similar to that fitted in Kuwait hospital and some of the sky scrapers of New York.

All of this equipment was installed in what had been the port catapult pump room, well below the waterline ; there was some concern as to whether the undocking date, planned some eight months earlier, could be maintained, but trials ashore of each individual piece of machinery were completed and the large

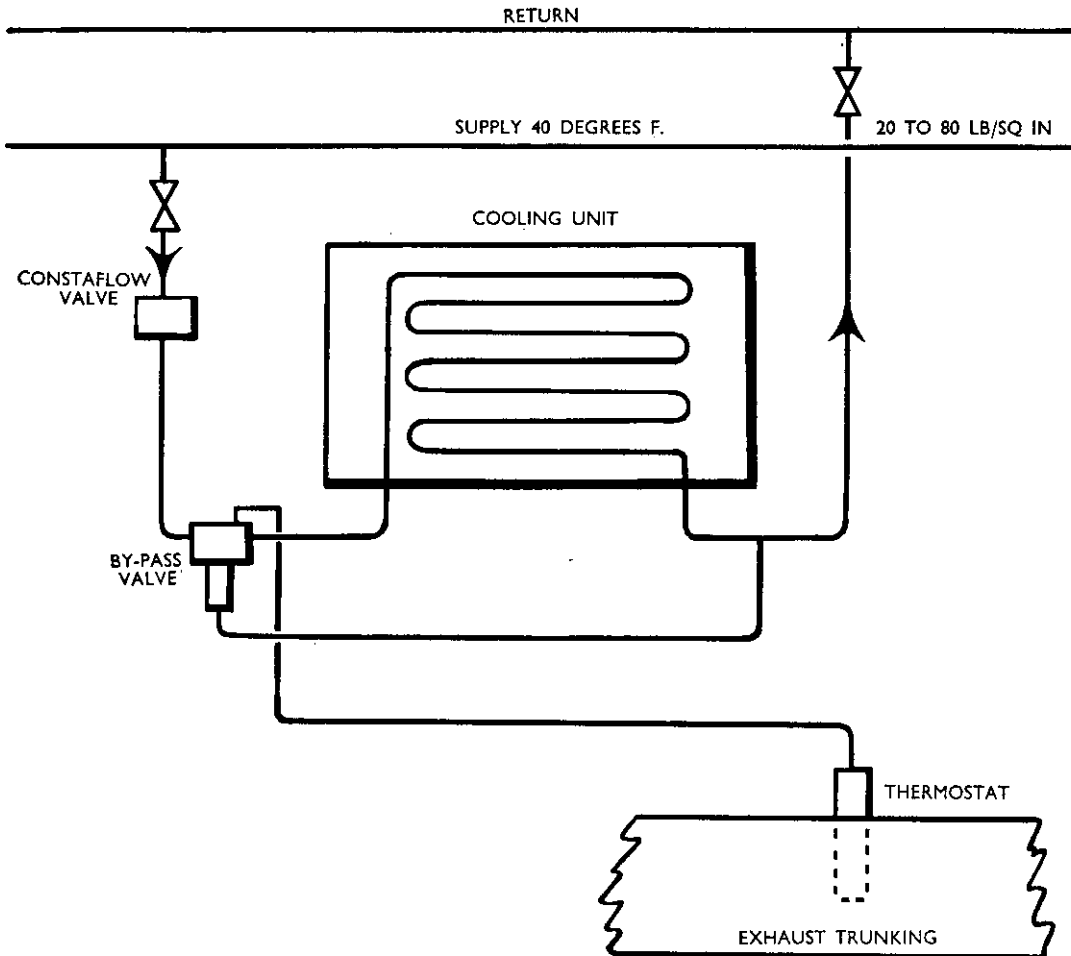


FIG. 1—TYPICAL LAYOUT OF COOLING UNIT

hole in the ship's side through which they were passed was plated over one day before the dock was flooded.

Meanwhile considerable activity had been going on elsewhere in the ship. Many thousands of square feet of bulkheads and deckheads were lagged or relagged with fibre glass sheeting ; the ventilation system was greatly modified and an additional 7,000 feet of trunking fitted, while the chilled water system slowly crept towards the forty-four cooling units and thirty space coolers being fitted in messdecks, flats and offices.

It will be appreciated that in addition to efficient lagging, effective air conditioning is dependent largely on five factors :—

- (a) The temperature of the chilled water
- (b) The size or capacity of the cooling unit
- (c) The rate of flow of chilled water through the cooling unit
- (d) A balance between all units on the same system
- (e) The flow of air across the coolers.

The compressor, running at 8,200 r.p.m. and using Arcton 11, which under N.T.P. conditions is a liquid, maintains a steady discharge temperature of the chilled water at 40 degrees F. This temperature remains constant despite the varying load on the system, by the operation of pre-rotating vanes fitted at the suction eye of the compressor. When the machine is stopped the vanes almost completely block off the orifice so reducing the starting torque, but when on load they are opened automatically by a small electric motor which is controlled by a thermostat in the chilled water discharge line. The chilled

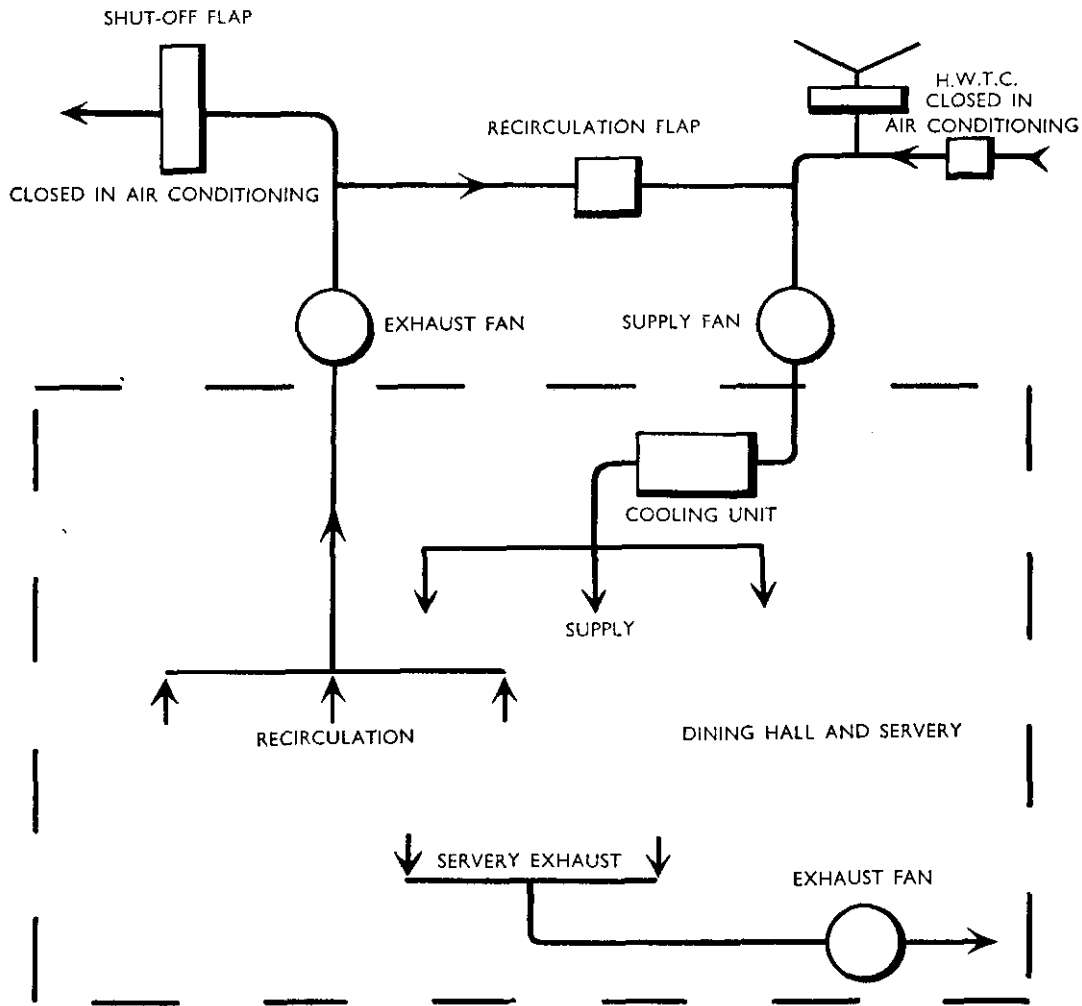


FIG. 2—TYPICAL EXAMPLE OF TRUNKING

water pump deals with 480 g.p.m. which returns to the evaporator at a temperature of 55 degrees F. The turbine and compressor are provided with automatic controls and cut-outs should failure of lubricating oil, chilled water pressure or refrigerant occur.

Cooling units, which are basically a cooling coil in the air supply trunking, are required to deal with compartments of various cubic capacities, and each unit has therefore been designed especially for the space it serves, bearing in mind the normal maximum number of persons, and hence the heat input, who occupy the space. Once the surface area of the cooling coil has been decided, the output of the unit will depend on a constant flow of chilled water through it.

Such a flow is achieved by the fitting of a Constaflow valve in the supply pipe to the cooler. This is a simple rubber seated valve which sits on a slightly bevelled seat fitted with a few narrow channels across its face. As the pressure in the system rises, the valve rubber is pressed into the channels so restricting the flow and ensuring that whatever the pressure, above a certain minimum, the actual quantity of water which can pass remains constant.

In order to maintain a constant temperature in any one compartment, a Spirax Sarco by-pass valve is fitted between the chilled water supply and return on each cooling unit. This valve is automatically controlled by a thermostat sited in the exhaust trunking. The thermostat is set at about 70 degrees F.—it is possible to adjust it a few degrees either way—and at temperatures above this

POSITION	DRY BULB	WET BULB
Flight Deck	89	81
' E ' Dining Hall	83	76
' F ' Dining Hall	81	75
Juniors' Mess	78	71
Wardroom	82	73
Cabin	85	76

FIG. 3—TYPICAL FORENOON TEMPERATURES, ARABIAN SEA, JUNE, 1960

figure causes the by-pass valve to close, resulting in a maximum quantity of chilled water passing through the cooler.

These two valves therefore ensure that whatever position in the ship the cooling unit may be, either in the island structure or at the end of the system where pressure is likely to be lowest, each unit of the same capacity receives the same quantity of chilled water and that space temperatures remain constant within reasonable limits.

In small isolated spaces, such as offices and some cabins, a space cooler is provided. This again is basically a simple cooling coil with a fan impeller causing a flow of air to pass over it. The space cooler is not fitted in the ventilation trunking, and merely cools the air already within the compartment, the supply of fresh air being provided from the normal non-air conditioned ventilation system and adjusted by operation of the punkahs or baffles in the supply trunking.

In the case of the cooling units, the supply and exhaust ventilation trunkings are cross-connected, and by adjustment of flaps or covers, a percentage of cold air is recirculated with the fresh air being drawn in by the supply fan and so enables the plant and system to be reduced to an acceptable capacity and size. In most cases the surplus exhaust from air conditioned spaces is discharged through bathrooms, heads, pantries etc., so that these spaces too have a small measure of air conditioning.

The results achieved so far have overall been very satisfactory and an example is shown in FIG. 3. Without air conditioning the temperature within the ship is several degrees higher than on deck, but it will be seen that the system reduces the inside temperature and humidity well below the ambient.

In any such major modification there will always be some problems which in new construction can be avoided, and so it is in *Bulwark*. The exhausts from the main Diesel generators pass through air conditioned spaces and, although well lagged, the heat given off has a considerable and adverse effect ; heavy and continuous traffic through messdecks, causing swing doors to remain open for long periods has a similar result, while the ventilation in machinery spaces workshops and the laundry must be carefully balanced to prevent hot air being discharged into or cold air drawn from the messdecks above, for it is impracticable to keep hatches to these spaces closed. These are, however, comparatively minor points. The few days when the plant has not been in use have made it appreciated by all, and we are equally appreciative of the efforts of our predecessors and all those who were responsible for the supply and installation of our latest acquisition.