POOL OF DOMESTIC REFRIGERATING EQUIPMENT

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(Ship Department)

With increased emphasis in recent years on improving the domestic amenities for sea-going personnel, the Ship Department of the MOD have assembled a range of approved units which are available for fitting in existing ships by A and A action and in ships building as initial fit.

These units are accounted for and supported differently from other fitted equipments in that they are not catalogued and complete units, or spares, cannot therefore be obtained through the Naval Stores organization or from the SPDC. In general, they are commercial units which have been proven by trial or experience to be suitable for use in H.M. ships. The design is, therefore, liable to minor changes (without reference to the MOD) as the new year's models are introduced. In a limited number of cases where the manufacturers have been willing to co-operate, the designs have been modified to suit MOD requirements, particularly in respect of electrical power supplies.

A Pool of complete units, primarily intended as a replacement service, and 'first outfits' of onboard spares is financed and maintained by the Ship Department, and the equipment is stored in the various Admiralty Machinery Depots for convenience of accounting and issuing. A small number of selected units are held also at Singapore ANZUC Naval Base.

The existence of this Pool, together with instructions on the procedure for obtaining replacement units, has been promulgated in DCI 1128/70. Contrary to the instructions contained in the DCI, a number of demands are still being forwarded to the SPDC and to SNSO.s in the Home bases. This indicates either that the DCI is ambiguous or that information contained therein, referring to demands for replacement units, is not being recorded by personnel responsible for raising demands. This article again draws attention to the existance of this DCI, to the service provided by the Ship Department and describes in more detail the equipment concerned. Spare gear for these units is provided on initial issue; replacement items should be demanded from the Ship Department, not Devonport Dockyard, contrary to the instructions in DCI 1128/70 which will be amended at reissue.

The majority of these units are powered by hermetically-sealed commercial refrigeration units connected to sealed evaporator systems, expansion taking place in a capilliary tube. Ship's staff should not attempt to carry out repairs to this type of refrigerant system as special facilities are required to dehydrate, purge and re-charge to the required standard: a complete spare cabinet should be ordered. Spares kits for these units contain only minor electrical and cabinet spares.

A small number of cabinets are fitted with hermetically-sealed motor/compressor units connected by flanged or screwed connections to permit replacement of sub-assemblies, re-charging of dryers, and fitting of a dehydration/charging connection. These systems are generally not suitable for onboard replacement

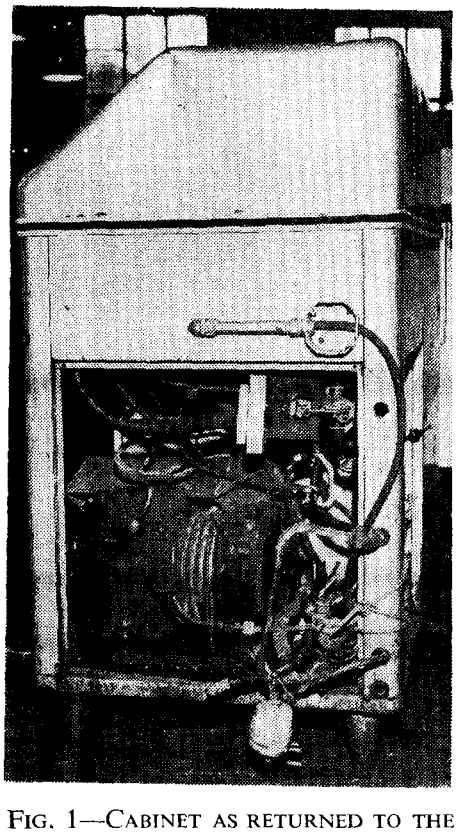

FIG. 1—CABINET AS RETURNED TO THE MANUFACTURER

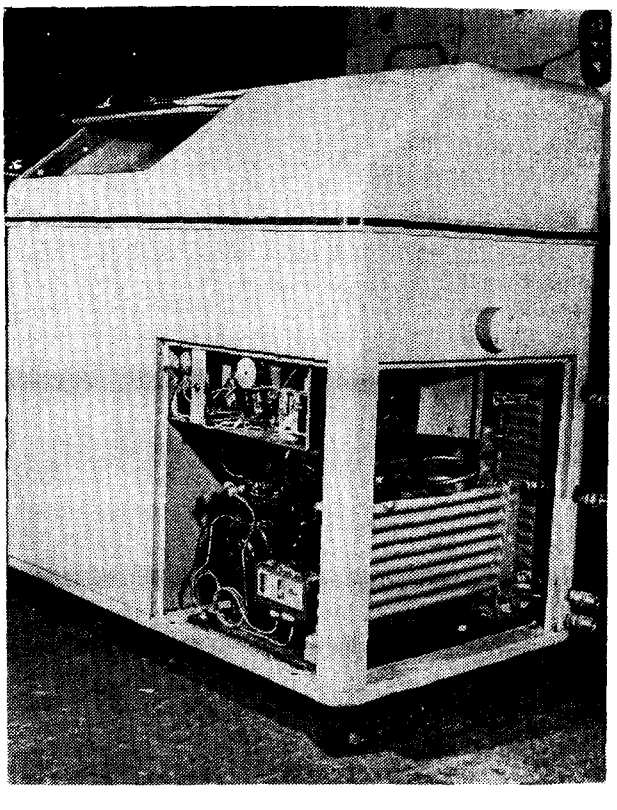

FIG. 2—THE CABINET SHOWN IN FIG. 1 AFTER REPAIR

of the motor/compressor as failure of this unit will distribute debris around the refrigerant circuit and meticulous flushing procedures, which can only be undertaken in suitable workshops ashore, are essential to restore the standard of system cleanliness required.

All d.c. and the larger a.c. cabinets are fitted with 'open-type' compressors driven by separate motors, expansion valves being fitted in lieu of capilliary tubing. The onboard spare gear outfits for these cabinets contain compressor and circuit component spares (as well as the electrical spares) to permit repair by ship's staff of the complete refrigeration system including the compressor.

A repair organization has been set up through which defective units are returned to the manufacturer for restoration to 'As New' condition; the decision as to whether to repair or to 'dispose to the best advantage of the Crown' is taken individually depending upon the age, defect condition, and initial cost of the item. Removal from the ship and packaging for transport should be undertaken with the greatest care bearing in mind that any damage caused during this process will add substantially to the repair costs. An example, by no means an isolated case, of how not to return a cabinet is illustrated in FIG. 1. FIG. 2 illustrates the restored condition.

In the equipment descriptions which follow, the approximate current purchase price has been included to indicate the value involved; this, when multiplied by several hundred units issued each year, summates to a considerable amount of the taxpayer's money. Unnecessary and extensive damage which can result from inexpert fault diagnosis and packing can necessitate writing off a cabinet which would otherwise have been suitable for repair. Domestic automatic refrigerators in general fleet usage have been patternized and are not therefore included in the Pool: details of these DARs have been promulgated in DCI T592/72.

The issue of domestic refrigeration units for first fitting in other than new construction vessels can only be made against an approved A and A initiated on a Class basis by the appropriate Warship Design Section of the Ship Department. This does not preclude individual ships raising A and A proposals through their administrative authorities if it is considered that substantial advantage would accrue from the fitting of such domestic 'goodies'.

Ice Cube Machines

In the past, the bulk demand for ice has been met by slabs frozen in the ice tank of the main refrigeration plant supplemented by ice cubes from DARs for bar use and for individual drinks. The task of breaking up the ice slabs into a convenient size and the humping of heavy ice pails was accepted as a necessary inconvenience, as were the occasional wisps of sacking in the lime juice and contamination of the wardroom gin with brine.

At one time, it was considered necessary to provide a base load for the refrigeration plant to avoid rapid cycling when the required room temperatures had been achieved. This base load was provided by the ice tank. With the introduction of hot gas bypass techniques, continuous running plant became possible and it was no longer necessary to fit an ice tank.

Attention was directed towards identifying a suitable self-contained ice cube machine with storage facilities and preferably air cooled to avoid the hazards of sea-water cooling systems. During 1970-1, a number of different designs were purchased and despatched to sea for trial but it became apparent that the commercially designed air-cooled units were unsuitable for the high ambient and fresh water temperatures at sea. FIG. 3 illustrates the effect of ambient conditions on output from similar cabinets when water cooled and when air cooled. The water-cooled type of machine maintains its output better over a wide range of ambient temperatures and may be preferred in certain cases to an air-cooled unit.

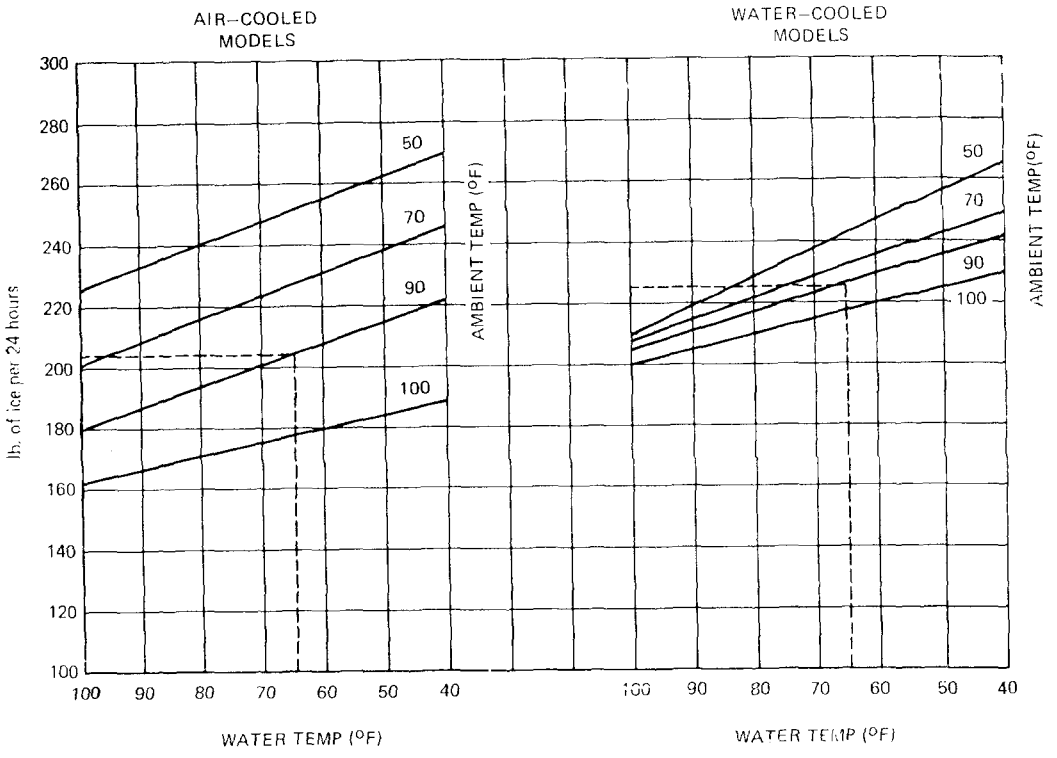

FIG. 3—ICE-MAKING CAPACITY—COMPARISON OF AIR COOLING AND WATER COOLING

The Scotsman 205 WJ machine, although water-cooled, was eventually selected as the standard unit on the grounds of reliability, satisfactory output at high ambient temperatures, and capacity to supply the daily requirements of large frigates and destroyers from a single machine. For smaller frigates where space is at a premium and the complement less, the Iceform Model K1 air-cooled machine was adopted in the absence of a competitive water-cooled unit and was modified to improve the output at high ambient temperatures.

With the introduction of senior rating's refreshment bars, a need arose for a small bar-type unit. The MK Refrigeration Ltd. model was selected as a result of a competitive tendering exercise to a MOD specification.

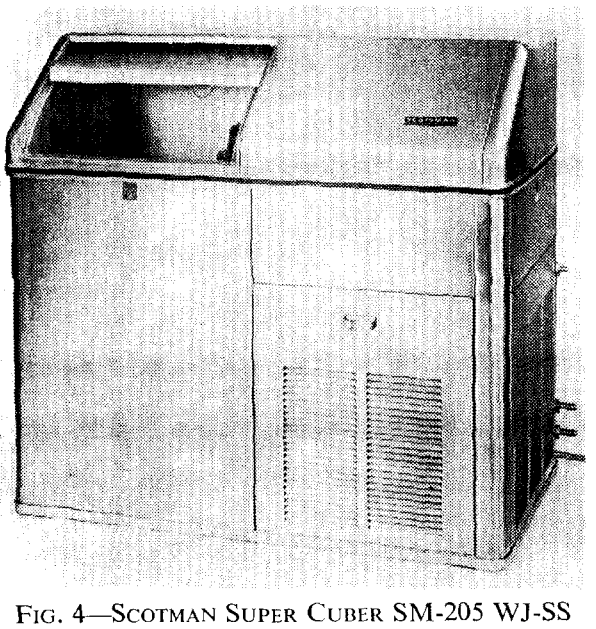

FIG. 4—SCOTMAN SUPER CUBER SM-205 WJ-SS

Scotsman Super Cuber SM-205WJ-SS (FIG. 4)

This is a water-cooled unit with an ouptut of approximately 220 lb. per 24 hours and has a storage facility of 150 lb. of compact ice cubes. It requires a 16-amp, 115-volt, single-phase, 60-cycle electrical supply and external services of sea-water supply and return and fresh water supply of not less than 20 p.s.i., and a drain.

The unit which is manufactured by King-Seeley Thermos Co. of Albert Lea, Minnesota, is shipped to Ernest West & Beynon Ltd. who fit a modified marine-type water-cooled condenser and sea-

water regulating valve, cupro-nickel piping and refrigerant circuit pressure gauges and charging facilities. The cost of the completed machine to the MOD is between £700 and £800.

Units currently in service, designated as SM-210 WJ-SS, were fitted with an open type of compressor, the type number being changed to 205 WJ with the introduction of a hermetically-sealed Copelaweld Refrigerant-12 compressor/motor. The cabinet which is free-standing on adjustable legs, weighs 385 lb. and has the following dimensions:

Height (with 6-in. legs)	45¼ in.
Width	44¼ in.
Depth	24½ in.

Ice is formed by spraying water vertically upwards from a rotating spray-bar into 102 inverted refrigerated cups mounted in a rubber platen, thus building up a layer of ice in the cups and eventually a solid cube. Excess water from the cube cups gravitates back into a reservoir and is recirculated through the spray bar. The freezing cycle is thermostatically controlled for approximately 20 to 25 minutes until the cubes are 75 per cent formed at which point a timer motor is started. Freezing continues for a furthur nine minutes at which time the freezing cycle is terminated and the harvest cycle initiated. Harvesting is achieved by flooding for a period of three minutes the rubber platen, in which the freezing cups are embedded, with warm water heated by the hot compressor discharge line. At the end of this period harvesting is complete; the released ice cubes which fall under gravity into the now empty reservoir are mechanically swept into the storage bin by the rotating spray-bar, and the refrigeration cycle is restarted. This unit is now the standard ice-cube machine for frigates, destroyers and larger vessels where it can be accommodated. As and As have been raised to fit these units in all such vessels not so fitted and deliveries are expected to commence early in 1973 and complete in the autumn of 1973.

Iceform Model Kl (FIG. 5)

This is an air-cooled unit with an output of 110 to 120 lb. per 24 hours and a storage capacity of 45 lb. of ice cubes. It requires a 13-amp, 115-volt, single-phase, 60-cycle electrical supply and a supply of fresh water and a drain.

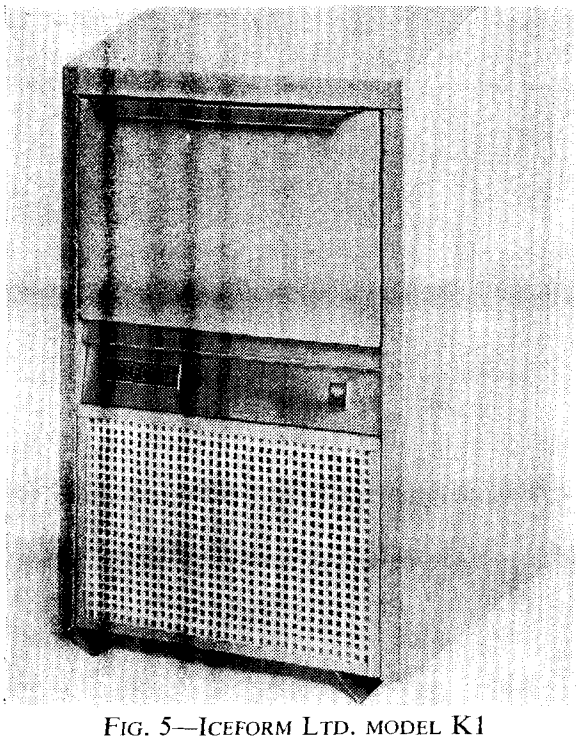

FIG. 5—ICEFORM LTD. MODEL K1

It is manufactured by Iceform Ltd. and modified by West and Beynon Ltd. to operate from a separate but associated transformer which converts the 115V a.c. ship's supply to 230V for which the cabinet was originally designed to suit the commercial market. The cost to the MOD for the modified cabinet is more than £600. During hot-box trials at the works of West and Beynon Ltd., it was observed that, as manufactured, the output decreased substantially at higher ambient temperatures necessitating the replacement of the ⅓ h.p. hermetically sealed compressor motor unit with one of ½ h.p.

The cabinet is free-standing on non-adjustable feet and is fitted

with bulkhead fixing brackets at the rear. The space required to install it is:

Height (including feet)	$31\frac{1}{2}$ in.
Width	$18\frac{1}{4}$ in.
Depth (including brackets)	$23\frac{1}{4}$ in.

and the cabinet weighs 105 lb.

The ice is formed in batches in a coaxial tubular coil, water circulating through the inner tube and Refrigerant 12 through the annulus. As ice builds up on the surface of the inner tube, the flow of water is progressively restricted until, at a predetermined flow, the refrigerant circuit is switched to pass hot refrigerant gas through the annulus thus releasing the ice in the tubular coil. The pressure of water passing through the ice tube is sufficient to expel the ice towards a deflector which snaps the ice into convenient lengths and deposits them into the storage bin. When the bin is full, a thermostat terminates the freezing and harvesting cycles, which are restarted automatically as the bin is depleted. The freezing cycle should extend over a period of seven to eight minutes producing some 13 ounces of ice. At present, these units are nominated for installation in the Type 21 frigates only.

Bar-Type Ice Cube Machine Mk 9T (FIG. 6)

This is an air-cooled unit with a capacity of 180 ice cubes every two hours. The unit operates on a 115-volt, single-phase, 60-cycle supply, no other services being required.

Manufactured by MK Refrigeration Limited, these machines cost over £60. The cabinet is suitable for mounting on a bar counter or on shelves behind or below the bar. The dimensions of the cabinet which weighs 70 lb. are:

Height	10 in.
Width	$25\frac{1}{2}$ in.
Depth	$13\frac{3}{4}$ in.

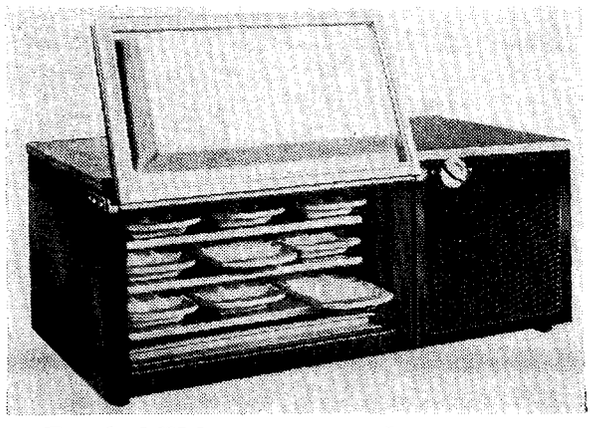

FIG. 6—MK REFRIGERATION LTD. BAR-TYPE ICE-CUBE MACHINE

In addition, an air space of at least two inches must be maintained at the rear of the unit to permit the required air flow both over the condenser and hermetically-sealed compressor/motor unit.

Ice is manufactured in nine ice cube trays (as used in domestic refrigerators) enclosed in a refrigerated compartment sealed by a top-hinged insulated door. Tray filling and harvesting is carried out manually.

Dehumidifiers

A small number of space dehumidifiers which operate on the principle of cooling the air to below the dew-point by means of a domestic refrigeration unit, resulting in condensation on the evaporator coil, are maintained in the Pool. The use of these units is limited to special areas such as bedding stores where these are not air-conditioned and for dehumidification of small vessels or small compartments of larger vessels in 'Reserve'. Where massive dehumidification is required, regenerative-type units of greater capacity are provided, but these latter units are not held in the Pool.

Two units both operating on 115-volt, single-phase, 60-cycle supply have been standardized and are currently available.

Temperature Ltd. Temkon Dehumidifier Model DH2

This is a 15½-in. wide × 30½-in. high × 16-in. deep free-standing cabinet (weighing 120 lb.) mounted on castors with a water removal capacity of one to five pints per hour depending upon ambient temperature and humidity.

Westair Dynamics Ltd. Dehumidifier—Space No. Mk II/1

This is a 12⅜-in. wide × 11-in. high × 17-in. deep shelf-mounted cabinet weighing 65 lb. with a minimum water removal duty of 0.45 lb./hour.

At the request of DGST, this unit is being replaced by a Westair Dynamics Ltd. Type D50 KM of similar dimensions but with an improved minimum performance of 0.65 lb./hr for an 'all up' weight of 50 lb. The new unit will be patternized and available as a Naval Stores item.

Beer and Soft-drink Cooling Machines

In 1967, when the privilege of purchasing beer on repayment through the NAAFI was extended to junior ratings, commanding officers were invited to submit forms S1182 containing proposals for beer-cooling stores (or cooling cupboards). Up to that time these units had been purchased by NAAFI, the units being of 20 to 150-cu. ft. capacity manufactured by the Lightfoot Refrigeration Co. Ltd. These units were subsequently purchased by the MOD, who accepted responsibility for meeting future requirements. Because of their reliability, it was decided to standardize on the Lightfoot 20-cu. ft. capacity cabinet.

In 1970, when the daily rum issue was abolished and, by way of compensation, the beer allowance to junior ratings was increased, in order to meet the need for greater storage capacity approval was given to issue Lightfoot cabinets to ships not already so fitted. It was discovered, however, that the 20-cu. ft. cabinet being too large to pass through the standard door frame required considerable dismantling before it could be embarked in the majority of frigates. In October 1970, a new specification was prepared and issued for competitive tender to a number of firms who were known to manufacture this type of equipment. The resulting product was the 14-cu. ft. West and Beynon Cool Drinks Refrigerator, Verikold Type BC-20.

In 1971 on introduction of senior ratings refreshment bars, a requirement arose for a can-cooling shelf. In the interests of standardization it was decided to specify a single-shelf design powered by a self-contained refrigeration unit, multiples of this unit to be fitted according to the ship's complement. Again, competitive tendering was applied and resulted in the adoption of the MK Refrigeration model. Although the carriage of beer in kegs is approved by the MOD and stowages are included in the official bar designs, the provision of any associated cooling machinery is the responsibility of individual ships and is not included in the Pool.

Lightfoot 20-cu. ft. Beer Cooling Cabinet (FIG. 7)

This unit, manufactured by The Lightfoot Refrigeration Co. Ltd., is basically a large size single-door domestic refrigerator with the machinery compartment below the refrigerated storage compartment and has a duty of cooling 48 dozen 12-oz. cans of beer to a temperature of 52°F. The cabinet, which weighs 942 lb. and is secured to the deck by four built-in securing lugs, has the following dimensions:

Height	74¾ in.
Width	42⅝ in.
Depth	30⅝ in.

The cost is between £500 and £600.

The R12 air-cooled refrigerating unit is of the open type belt-driven by a separate 115-volt, single-phase, 60-cycle motor suitable for *in situ* repair of minor defects.

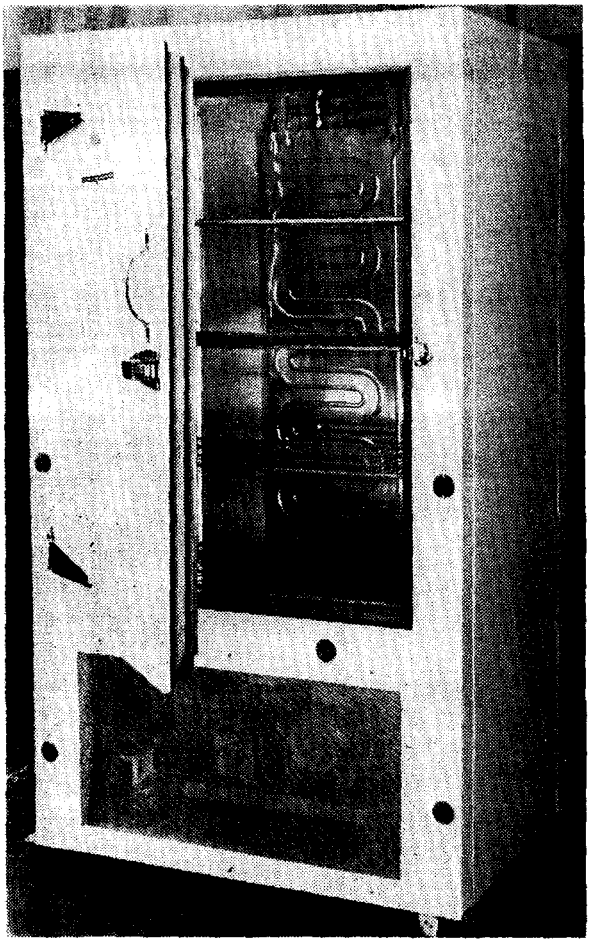

FIG. 7—LIGHTFOOT REFRIGERATION LTD. BEER-COOLING CABINET

A number of small Lightfoot cabinets originally supplied by the NAAFI were fitted in the early *Leander* Class; although described as of 20 cu. ft. capacity, they are in fact of nominal 10 cu. ft. capacity. As the West and Beynon units describe below provide a more economical use of the available space, the smaller Lightfoot cabinets will no longer be suppled from MOD resources.

As the average domestic automatic refrigerator will cool its contents to 40 to 42°F, beer should not be stored in DARs for extended periods; drinks cooled to this temperature can result in stomach chills, 50 to 55°F being considered the most suitable temperature.

West and Beynon Verikold Type BC-20 (FIG. 8)

This unit was specifically designed to meet naval requirements. The capacity is such as to provide cooling capacity for one day's issue of beer to the ship's company of a *Leander* Class frigate, and the overall dimensions were limited to enable the cabinet to be shipped through a standard watertight door. The refrigeration machinery is housed in a removable housing which forms the top of the cabinet and includes two fans for circulating air through the cabinet. The air inlet and outlet grills are formed in this casing and are tilted at 45 degrees to the horizontal to avoid blockage by unauthorized stowage of items on top of the cabinet. This also enables the cabinet to be installed close to the bulkhead. Complete replacement machinery units will be available as spare items eliminating the need to remove the complete cabinet in the event of a cooling unit failure with possible consequential damage to the casing

To eliminate the need to provide an external condensate drain, an internal transparent tube is fitted which simply requires unclipping and draining when full.

The hermetically-sealed air-cooled refrigeration system is designed to cool 40 dozen 12-oz. cans from 70° to 52°F in six hours in an ambient temperature