

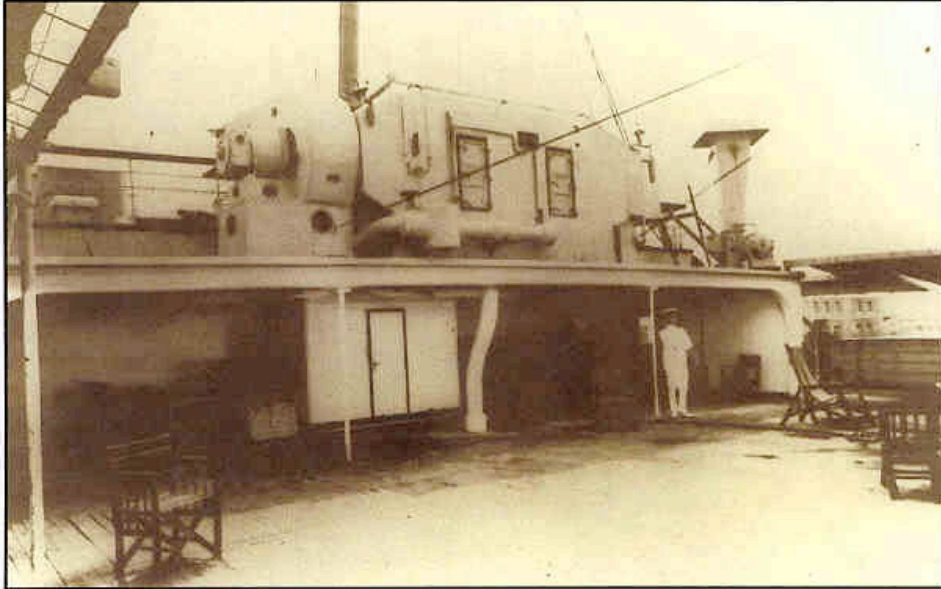
3.5 MARINE AIR CONDITIONING

The artificial ventilation of ships can be traced back to the use of bellows in the 1740s by Sir Martin Triewald in Sweden and then by the Rev Stephen Hales in England. It has been reported that Dr John Gorrie of Florida attempted to use his cold air machine for shipboard refrigeration around 1873 but was unsuccessful. Whether or not this was for space cooling is unclear. Refrigeration on ships was initially used to keep cargoes of meat chilled on long voyages. This was attempted from about 1875, but the first real success is usually attributed to the system on the SS "Strathleven" in 1880, using a Bell-Colman cold air machine [11/175]. From the 1890s, elaborate mechanical ventilation systems came into use for passenger comfort. In 1908, the Thermotank Ventilating Company of Glasgow provided elaborate heating and ventilating systems on the "Lusitania" and "Mauretania" [11/527]. Similar systems became commonplace on new luxury liners.

Early in 1924, Willis Carrier adapted his centrifugal refrigerating machine for use in the engine room of the American Navy warship USS "Arkanas". As a precaution, in a confined space, he intended the use of trichloroethylene as the refrigerant, rather than dielene. This was approved by the Navy and the machine was duly built, but the Navy decided it should be installed in the USS "Wyoming." This special 2-stage unit of 95 TR, installed in late 1925, became the first ship equipped with a centrifugal refrigerating machine. But Willis Carrier wanted a more suitable refrigerant and in 1926 he filed patent claims using methylene chloride as a refrigerant, and gave it the name "Carrene." This refrigerant doubled the cooling capacity of the existing centrifugal (doubling the horsepower also) and greatly improved its competitiveness against reciprocating machines [FAC, 74-5]

In 1930, C L Sainty and Archie Heard of CEC sailed back from the States carrying the drawings for the first air conditioning installation to be made in a passenger liner, the MV "Victoria" of the Lloyd-Triestino line. The system included full air conditioning for the dining saloons and six luxury cabins. The cabins were treated by means of local units (which would later be called induction units), supplied by small, high velocity conditioned fresh air ducts -a forerunner of the Carrier Weathermaster system [11/538].

After the "Victoria" CEC was engaged with a long sequence of ships in which the public rooms were all fully air conditioned, together with a few luxury cabins. These included the "Orion" (1935, Orient Line, 23,350 tons, 665 ft long) and "Orcades" (Orient Line); the "Strathmore," "Stratheden," and "Strathallan" (all P & O); and the "Normandie" (1935, French Line, 79,280 tons, 1028 ft). The "Normandie" was the first liner, air conditioned in 1936, to be fitted by CEC with a centrifugal refrigeration machine [11/538]. This was a 5-stage compressor with Carrene-1 as the refrigerant, rated at 174 TR driven by a 225 hp DC variable speed motor and gears. (In 1935, a 140 TR Carrier centrifugal had been installed on the "Koan Maru" for the Imperial Railway Steamship Company of Japan) [11/534].



CEC marine air conditioning plant on board "SS Victoria," 1930 [p-656].



Air conditioned Dining Saloon on "SS Victoria," 1930 [P-657].

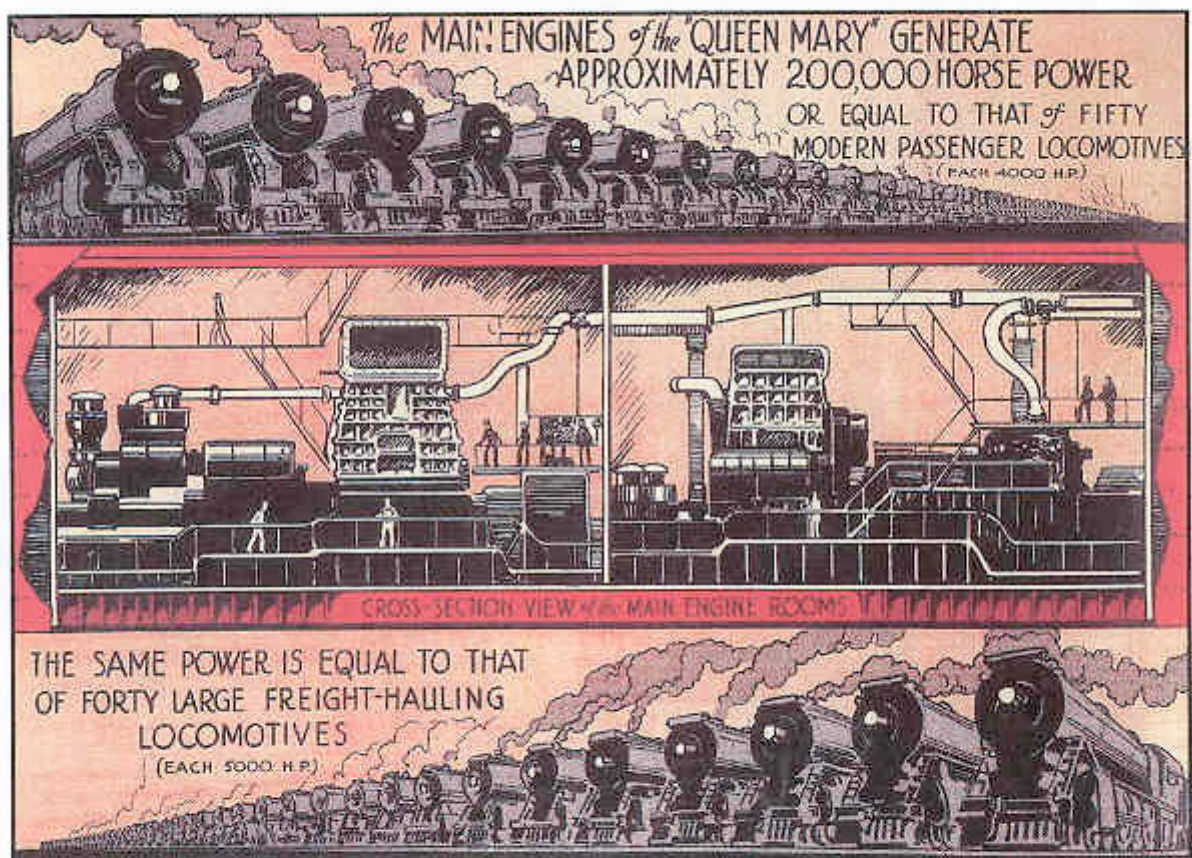
In 1936, CEC provided air conditioning for the RMS "Queen Mary" (Cunard White Star, 80,744 tons, 1018 ft). At this time air conditioning was limited to public spaces: the Main Dining Room, First Class Lounge, Tourist Dining Room and First Class Hairdresser's Shop. In 1938, the air conditioning for the "Nieuw Amsterdam" (Holland America Line, 36,287 tons, 758 ft) incorporated 2 x 175 TR centrifugal machines. A CEC listing of marine projects [6/502] shows that as the 1930s came to a close, the company was also involved with the RMS "Queen Elizabeth" and the second SS "Mauretania" (both for Cunard White Star), and with the MV "Dominion Monarch" (Shaw, Savill & Albion).

In the "Mauretania" (1939, 35,750 tons, 772 ft) six CEC plants served the Cabin Dining Room, Grand Hall, Tourist Dining Cabin, Tourist Lounge and Tourist Cinema. The biggest installation at this time was for the "Queen Elizabeth" (1940, 83,673 tons, 1031 ft). Twelve plants served the Public Rooms: Cabin Restaurant, Tourist Dining Saloon, Tourist Lounge, Cabin Smoke Room, Theatre, Salon, Cabin Lounge, Writing Room, Studio and Hairdressing Saloon.

With the outbreak of World War II, the air conditioning of luxury liners gave way to the provision of air conditioning in the vital areas of warships, eg. radar rooms, with work on a variety of Light Fleet Cruisers, and air and sea rescue ships [11/538]. The CEC war-effort "at sea" extended to many non-air conditioning manufacturing activities: Catalina and Sunderland sea-plane refuelling craft, air-crew ferry vessels, marine fuel transfer pumping systems, and air-crew rescue buoys [11/541].

After the War, the first installation of marine air conditioning continued the pre-war pattern of applying these comfort facilities only to public spaces. In 1947, CEC provided air conditioning for the relatively small, first post-war Cunard White Star liner, the "Media" (13,350 tons, 531 ft). This was followed in 1948 by the "Parthia" with 3 plants serving the Dining Saloons, Lounge, Cinema, Cocktail Bar, Smoke Room, Long Gallery, Drawing Room and Writing Room.

16 CEC plants were installed in the "Caronia" (Cunard White Star, 34,200 tons, 715 ft), completed in 1949. These served the Aft Dining Saloon, Official's Dining Saloon, Theatre, Verandah Cafe, First Class Smoke Room, Library & Writing Room, Garden Lounge Bar, Cabin Lounge, Forward Restaurant & Private Dining Saloons, First Class Lounge, First Class Hairdressing Saloons, Cabin Smoke Room, Hospital General Wards, Operating Theatre, Infectious Wards, Cabin Hairdressing Saloon, Gynasium and Medicinal Bath Cubicals. Though the air conditioning was extensive, it did not extend to the Passenger Cabins.



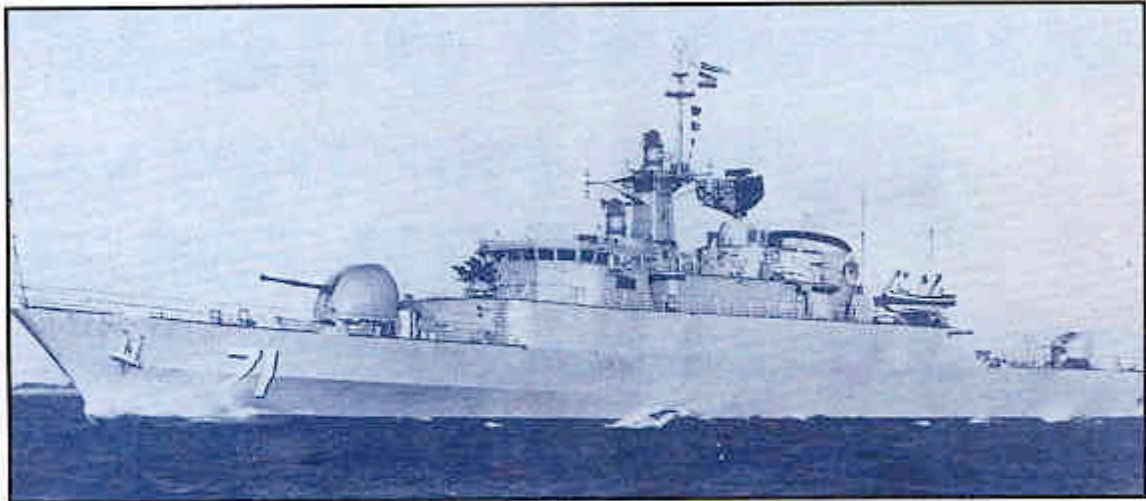
*Publicity drawing for the "RMS Queen Mary," 1936.
[from the Cunard "Book of Comparisons"].*

When C L Sainty resigned from the company, Groom decided to forgo future marine work and Heard recalls that CEC interests were more or less handed over to Winsor Engineering of Glasgow. However, when later, the Admiralty indicated they would like to keep CEC as a competitor to Thermotank, the position changed. Archie Heard was able to negotiate cost plus contracts for the new Hermes Class aircraft carriers ("Centaur," "Bulwark," "Albion" and "Hermes"). This resuscitated marine work leading to contracts for the "Empress of Canada" (1961, CPR Line, 27,300 tons, 650 ft), the "Northern Star" (1962, Shaw, Savill & Albion, 24,750 tons, 650 ft), and then the "QE2" (1968, Cunard, 65,850 tons, 963 ft). [11/538].

The "Empress of Canada" had Carrier Centrifugals and was the first liner to be fitted with the CEC "Marinair" high velocity, all-air, air conditioning system [11/525]. The "Northern Star" incorporated many refinements found advantageous during seven years of round the world service by her earlier sister ship "Southern Cross," and was air conditioned throughout by the CEC "Marinair" high velocity system. In addition to the 13- Public Rooms, air conditioning was provided for all passenger cabins as well as the accommodation of the officers and crew. CEC provided 67 separate air conditioning plants in conjunction with 3-electric motor-driven Carrier centrifugal water-chilling refrigeration machines of 1020 TR total capacity [11/R97]. Advertising by Carrier Ross Engineering indicates the establishment of a Marine Air Conditioning Division under their banner (although Haden were using the name CAC Marine for the same company in 1977), with a project listing from 1960 onwards through to 1985 [9/542]. This list includes HMS "Bulwark" (1960), HMS "Albion" (1961), "Empress of Canada," "Northern Star" and the "QE2" mentioned above. The great majority of the air conditioning work carried out by Carrier Ross over the next 25-year period was for Fast Patrol Boats for Vosper, later Vosper Thornycroft, for navies of countries all around the world. They also worked on a destroyer, numerous frigates and corvettes, as well as ammunition carriers and landing ships.

The air conditioning of the "QE" proved to be a difficult contract. Cunard favoured Thermotank, and were hesitant about the CEC "Marinair" high velocity air system which didn't use the traditional heating and cooling water valves for individual cabin control. They also expressed concern over service arrangements when in port. So CEC joined forces with Winsor Engineering to quote as joint venture. The first design for a liner, codenamed Q3, proved to be uneconomic.

At this stage CEC considered the chances of winning the contract for the modified ship Q4 to be poor. However, Carrier-Winsor came up with a new design concept, which they managed to keep secret from the competition. Their proposal was to concentrate all the major plant rooms on one deck. These centralised services, simplified maintenance and operation, released space to the interior designers, reduced weight at high level, and was cheaper. It secured the order. [11/539].



Mark V frigate with air conditioning by CEC [11/529, 2].



110 ft Patrol Craft with air conditioning by CEC [11/529, 2].



"RMS Queen Elizabeth 2," on speed trials off Arran, 1968 [p-658].

The details of the "QE2", its accommodation, the boilers, the air conditioning, and all of the complex mechanical and electrical systems that were necessary in a modern passenger liner at that time, have been described elsewhere ["Queen Elizabeth 2," *The Steam & Heating Engineer*, May & June 1969]. These articles record that Winsor was in fact the Winsor Engineering Division of Stone-Platt Scotland Ltd. The "Mainair" system as used provided a high velocity, constant volume single duct arrangement to distribute cooled air to terminal reheat units. Supply air was delivered through an acoustically treated diffuser developed for the "QE2" and called "Carmline." The centralisation of all the air conditioning plants on one deck reduced the total number required from a possible 75 to 34, allowing them to be accommodated in only 10 plant rooms on No.3 deck. The extract plants were located in 4 other plantrooms on the top deck. The total supply air volume totalled 518, 000 ft³/min. The cooling load was handled by 3 Carrier centrifugal machines with a total capacity of 2050 TR, each machine being driven through speed-increasing gears by a 700 hp motor.

Archie Heard described the completion and trials of the "QE2" as disastrous [11/540]. The workmen used the air conditioning ducts as receptacles for all kinds of rubbish. Even a large coil of one-inch rope had been jammed inside a chilled water main. The ship was still unfinished when the trials began and suffered from engine troubles. Carrier-Winsor had their own share of problems. The chilled water system kept draining itself, until it was discovered that someone had connected the sprinkler system into it. There was an initial unfavourable reaction to the air conditioning from Cunard who expected the usual draughts and noise, and had to be convinced all was working satisfactorily. However, these and the usual commissioning difficulties pale into insignificance compared with the boiler and turbine problems so widely reported by the media.

In 1970-1, Carrier Ross air conditioned eight SRN6 hovercrafts for a British Hovercraft order to Saudi Arabia. During the 1980s, air conditioning of hovercraft was carried out for owners in Mexico, Hong Kong, Singapore and Kuwait. Passenger vessels included the MV "Copenhagen" (1975, Nordline of Denmark), the "Stella Polaris" (1978, Kuwait National Hotels) and two passenger ferries (1984, Hong Kong Hi-Speed Ferries).

Another document [11/529] reveals that the P & O liner "Chusan" (built 1950, 24,200 tons, 673 ft) was converted to full air conditioning; that the "Copenhagen" was renamed "Odessa" and passed into Russian ownership; that the "Stella Polaris" was formerly the American cruise liner "Santa Paula" (built 1958 for Grace Line of New York, 15,350 tons, 584 ft) and was to be permanently berthed in Kuwait to be used as a hotel. Also upgraded by CEC in 1959 was the third "Himalaya" (built 1949, P & O, 27,955 tons) [11/527]. Both the "Chusan" and "Himalaya" had Carrier centrifugal refrigeration.