

CONSTRUCTION OF M.V. "KOOJARRA"

REX C. ELLIS (MEMBER)

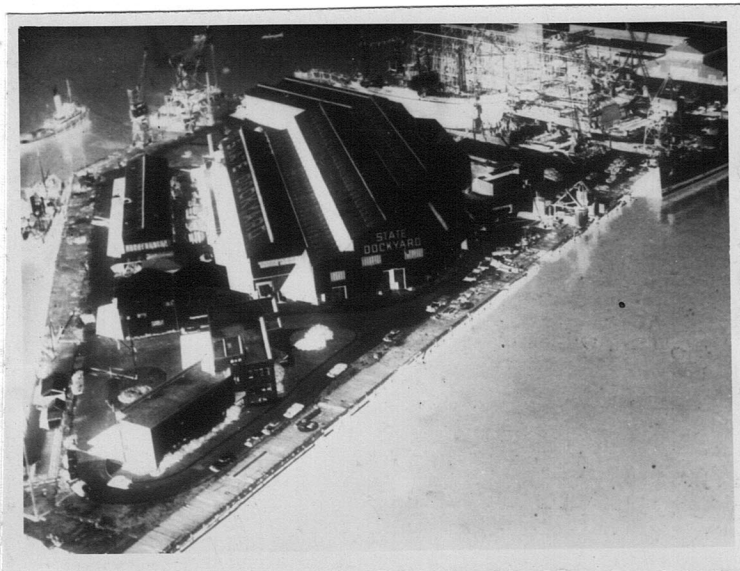
The principal particulars already given do not suggest that this is a ship of gigantic proportions, nor do they give the impression that there is anything unusual about its construction and outfit. However, the facts are that within the comparatively minor dimensions of the hull are embodied all the most modern services and appointments usually found on a much larger ship.

Working drawings were prepared with a view to utilizing to the fullest extent the Dockyard's modern welding, burning and handling facilities and block and panel prefabrication construction methods.

The ship was constructed on the prefabricated "unit" system, the units being depicted on the drawings as "panels" or "blocks" in accordance with a predetermined production schedule based on the availability of automatic and manual welding facilities and crane power at site of prefabrication.

The working drawings for shipyard use, necessarily embody a great deal more information than is the case of the orthodox built riveted ship. Apart from the multiplicity of welding notes the drawings show clearly the limits of the sections to be prefabricated the weights and in cases of irregular sections the position of the centre of gravity for lifting purposes.

It will no doubt be of interest to many to have an idea of the layout of the Dockyard where this vessel was constructed. It is also proposed to briefly describe the standard practice employed by the Dockyard in the prefabrication of ships hulls up to the laying of the keel as the construction of "Koojarra" falls within this category.



The main ship construction shops are grouped around the Building Berths and are conveniently situated to permit the most economical flow and mechanical handling of materials one to another, from the steel storage yard and to the prefabrication and assembly areas and the Building Berths. The aerial photograph (1) shows the Mould Loft, Steel Construction Shops and Steel Storage Yard at right, whilst on the immediate left of the Building Berths the Shipwrights and Painters and Dockers shops are located. Further to the left are the various Engineering shops and the Administrative Building.

The "unit" system assists considerably in the ordering, racking and intake of material for fabrication and contributes greatly to efficient interlocking of Loft work, marking off and assembly processes.

Loftwork has changed considerably with the introduction of prefabrication methods. The amount of templating has been greatly reduced but other information such as buttock and waterline battens applicable to the various prefabricated sections is supplied to facilitate the fairing of panels on the skids prior to erection on the Building Berth.

A special scribe of the bottom section is also supplied and fitted to the tracing table of a large "Nova Rex" gas profiling machine which has been equipped with two cutting heads and an extended table.



Scribe boards on which the lines have been adjusted for kerf are fastened to the tracing table of the profile cutter and by means of a manual tracing control, Port and Starboard floor plates are cut to shape simultaneously.

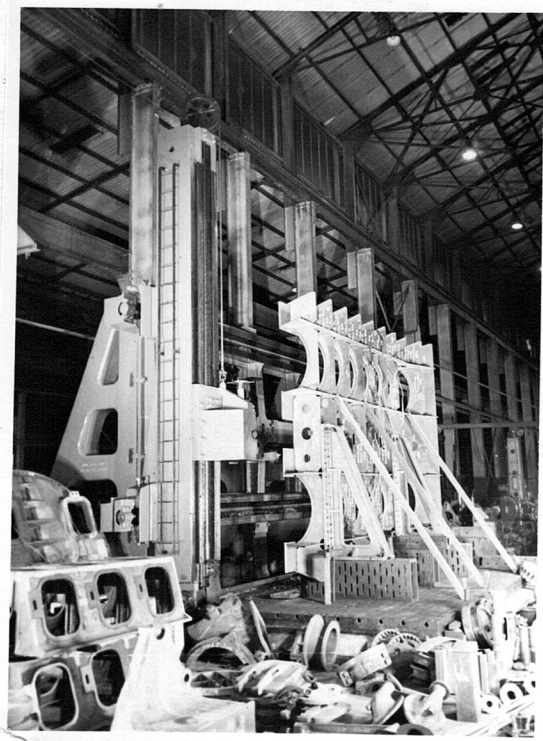
Intercostals, Beam Knees, Brackets and other similar components of which there are a considerable number of the same dimensions are cut to shape on the same machine but in this case a steel template is used and a magnetic tracer is fitted to the tracing control.



Sections including Double Bottoms, Bulkheads, Decks, Masts, Engine Seatings, Stern Frame etc., to the full capacity of the cranes are completed in this shop ready for erection

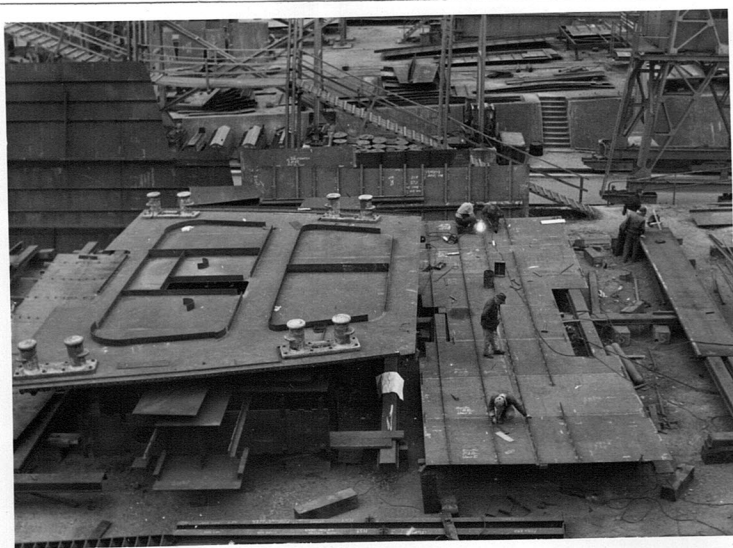


on the Building Berth.



Bulkhead stiffeners are slightly cambered and Deck beams over cambered before being welded to the plating so that they will respectively finish straight and with the correct camber after welding.

The welding sequence is such that each component being assembled into a full section is positioned to enable most welds to be made in the downhand position. Extensive use is made of the "Hidden Arc" process which eliminates to a great extent the necessity of veeing the plate edges.

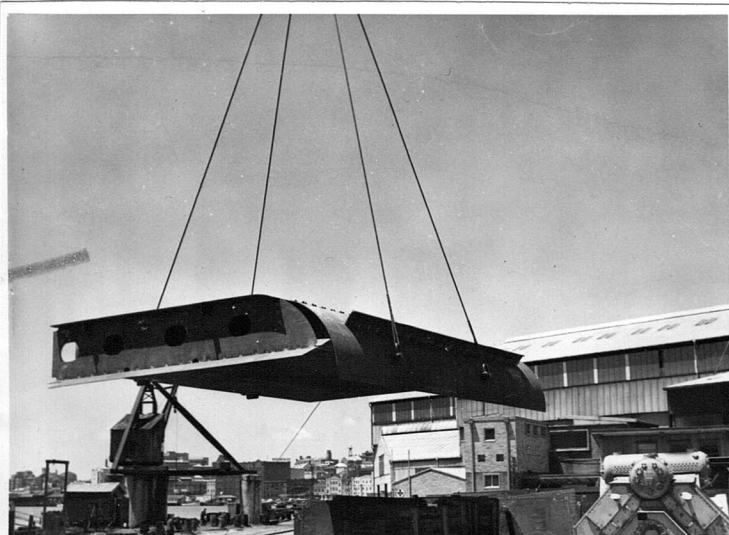
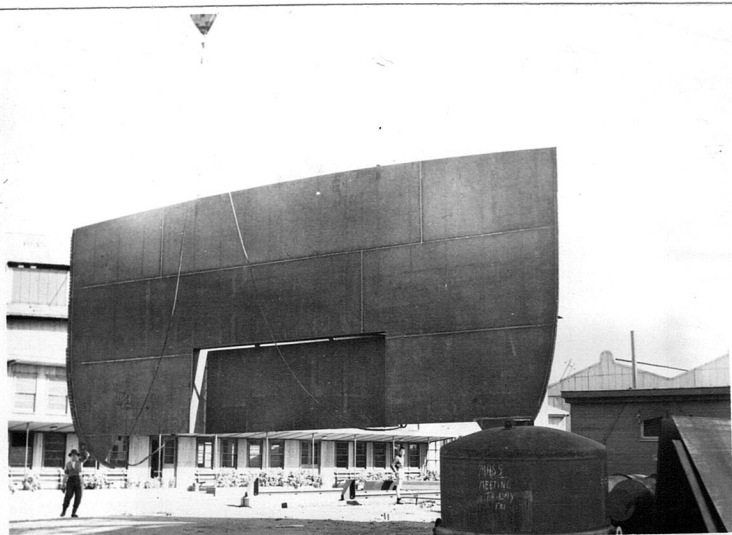


In the course of assembling Double Bottom Units, all pipes, bulkhead pieces, manhole covers etc. are fitted. The deck sections including hatch sides, bulwarks various coaming plates etc. are completely fitted with Bollards, fairleads, mooring pipes and all rigging fittings. Masts and Derrick Posts are completed in all respects and finished painted before they are taken from the shop.

The primary objects of proceeding to this degree of completion before erection were to perform welding under conditions most conducive to economy and efficiency, to minimise the number of welds in situ on the Building Berth and thus eliminate locked in stresses, to considerably reduce confined space work in tanks and to obviate the necessity of the erection and continual movement of complete rows of staging inside and outside the ship on the Building Berth. The procedure adopted has however also expedited the fitting out and painting of the ship generally.

The well formed spacious roads conveniently disposed between the various shops and alongside each Building Berth facilitate the transportation of completed sections by jinker from the main fabrication shop to the sub-assembly areas or direct to the Building Berth.

"Koojarra" was constructed on No. 4 Building Berth which is 520 ft. long and 75 ft. wide. Three travelling cranes of 5 tons, 6 tons and 45 tons capacity serve the Building Berth and the adjacent assembly and prefabrication areas.



The 45 tons travelling crane has an auxiliary hoist which in conjunction with the main hoist enables large sections to be turned over without the aid of another crane and as the turning process is performed in mid-air the necessity of providing turning pits to accommodate projections is obviated.



Complete Bow and Stern Units, side shell panels and double bottom units etc. which are beyond the capacity of the shop cranes are prefabricated on the assembly areas within reach of the 45 tons travelling crane. The final assembly and welding together of smaller components prior to erection on the Building Berths is also carried out.

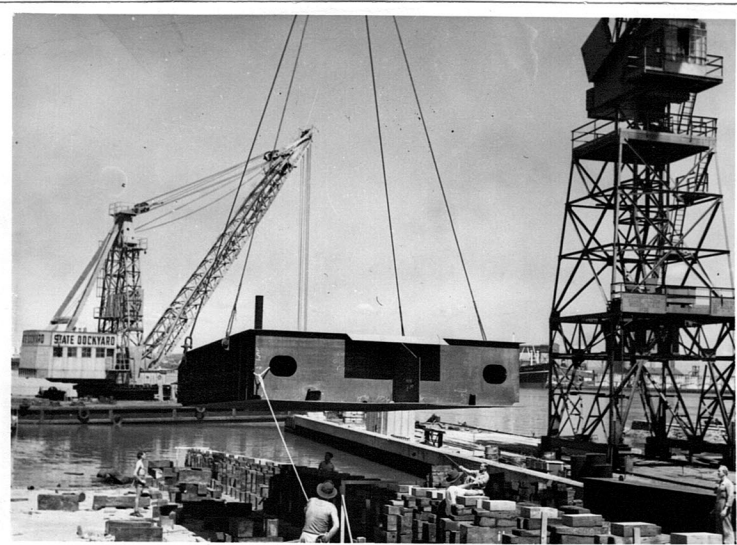
As no suitable sections are obtainable in this country for welded main frames, bulb angles are used and these members are riveted to the shell plating. The riveting however is completed on the assembly area.



Storm Valves, air escape pipes, cargo lashing rings and even spar ceilings are fitted to the shell panels before erection.



No jigs are used in fairing the shell panels, but a rather novel method of fairing by means of the erection and "winding in" of steel waterline offset battens has proved very successful.



The Keel or more correctly the midship double bottom unit was erected on the building berth on 11th November, 1954.

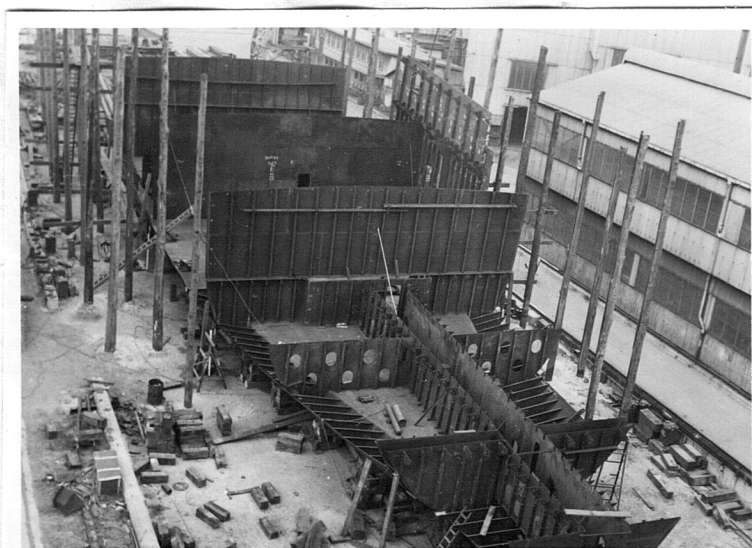


From then on prefabricated units were erected in a definite sequence, Port and Starboard units being positioned simultaneously and progressively from midships towards each end.



The general welding procedure was to commence at the centre and work towards the extremities of each unit: i.e., Welders were employed Port and Starboard and required to work towards the sides and ends simultaneously so that at all times in every direction welding was advanced towards a free end.

Employment of prefabrication methods reduced to a minimum the welding in situ and as by virtue of the welding sequence already described the only restraint on the joining welds was that due to a unit's own weight it is believed that "Locked In" stresses have been almost eliminated.



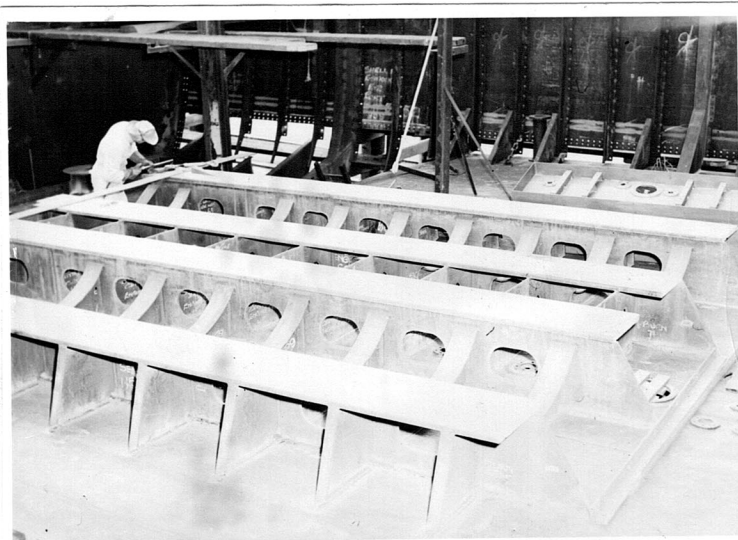
When the welding together of the double bottom units had been completed, Radiographic examination of important welds on the shell and inner bottom was carried out by the Standard Research Laboratories in accordance with the requirements of the Australian Shipbuilding Board.

A certain amount of shrinkage takes place with the welding together of the various sections, but it has been found to be uniform and no great difficulty is experienced in matching beam knees with frames, frames with bilge brackets etc.



At no time was any rigid restraint put on shrinkage, the cleats and dogs used for holding the butting surfaces together for welding being so arranged that the material was free to move along the direction of the weld and as there was always a free end in the direction normal to the weld movement was also unrestricted.

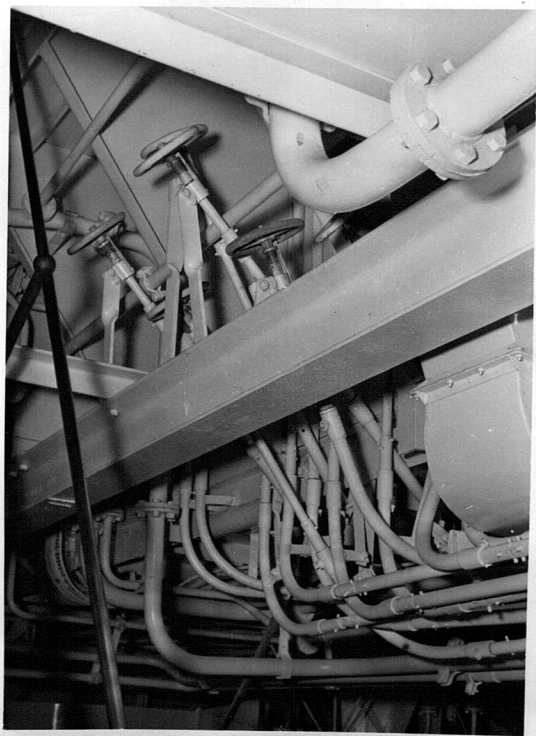
During erection and the subsequent welding together of the prefabricated units a systematic check was made of any resulting misalignment and in the few cases where it was found necessary it was rectified by slightly varying the welding sequence.



It was possible without varying the normal erection and welding procedure to finish the steelwork in way of the Engine Room and Refrigerated Holds quite early in the erection programme and thus enable a large labour force of outfitting trades to be employed in these areas.

Tank testing which is considerably expedited by the welded prefabrication methods employed was also at an advanced stage very early in the erection sequence.

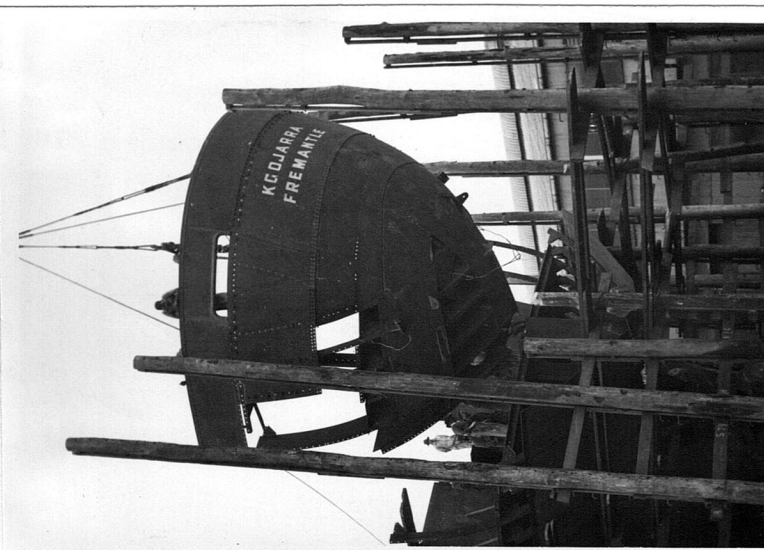
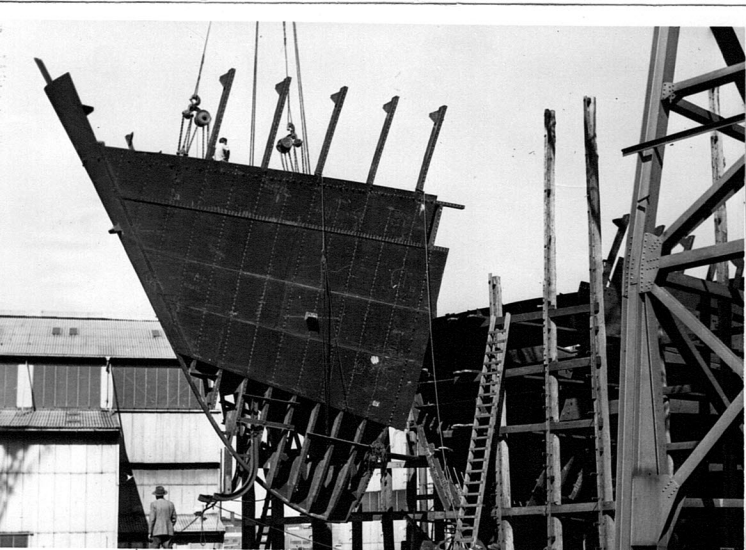
The insulation of the Refrigerated Holds has been the most complicated yet undertaken by the Dockyard. Three different insulating mediums were used in various places, the whole being bonded with hot bitumen for which a special thermostatically controlled electrically heated tank had to be devised.



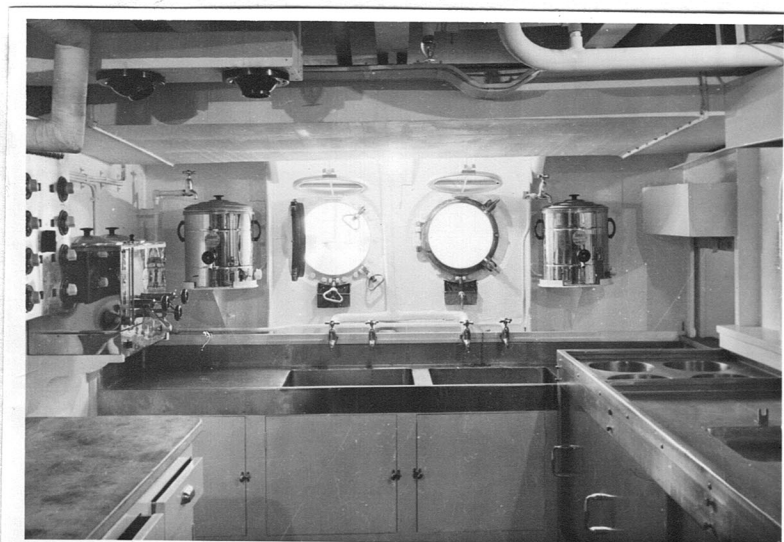
As the hull steelwork was being progressively erected considerable progress was made with the outfitting of the machinery spaces with its multiplicity of pipe lines, pumps, auxiliary generators and other auxiliary equipment.

After all eyeplates, lifting beams and other permanent fixtures had been located on the Deckhead of the Engine Room an immediate start was made with the Insulation and cladding as this would have been impossible after the electric cables, extended spindles and various ventilating ducts had been installed.

On an adjacent Building Berth the assembly of complete Bow and Stern Sections was proceeding so that these units would be ready for erection as scheduled.



Before the various divisional bulkheads between the Upper Deck and Bridge Deck were erected many items of equipment too large to be passed through passage ways and doorways had to be installed. These included such items as the Galley Range, Bain Marie, Bakers Oven, Domestic Refrigerators and Steering Gear etc.



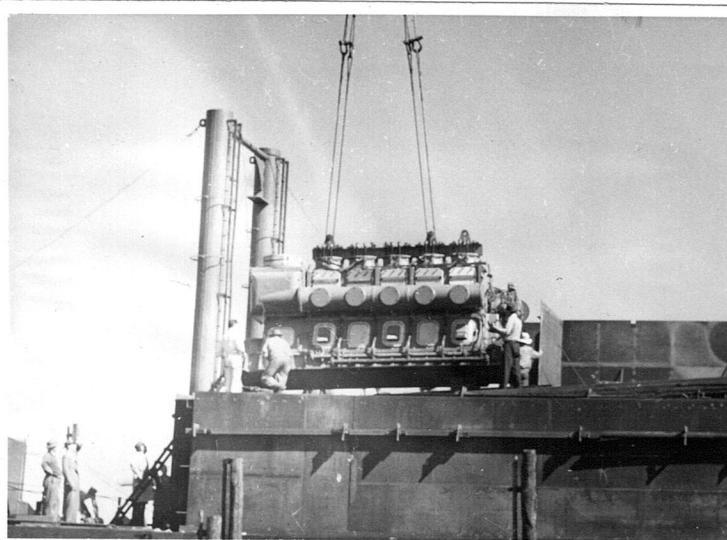
When the main steelwork had been erected a further radiographic examination was carried out of site welding subjected to high structural strains. Particular attention was given to cross welds.

Nearly 23 tons of electrode wire were deposited in the construction of the ship.



In the limited space available the lining off and installation of the many services throughout the accommodation presented a major problem and necessitated the closest co-operation between the various trades.

Positions had to be found for hot and cold fresh water services, fire main and wash deck services, CO<sub>2</sub> and Grinnell Sprinkler piping system, Brine piping for Domestic Refrigeration, Iced Water lines, Electric lighting and Power Cables, Air conditioning ducts, Mechanical Ventilation, Natural ventilation, as well as the numerous scuppers and drains and filling, sounding and air pipes to the various tanks.



The Main Engines were installed on 8th December, 1955 and work in the square of the Engine Casing was thus enabled to progress.

The Launching arrangements were put in hand before the first unit was erected on the Building Berth.

It is the Shipyard's standard practice to lie the standing ways on the Berth before the steelwork is erected and thus avoid as far as possible the manhandling of these heavy timbers.

The oregon sliding ways (30" wide) were greased at the head of the Berth and moved down to their positions under the ship by means of temporary rollers fitted on the outside and timber skids under the Ribbands on the inside. This was done to reduce the thickness of packing on top of the ways.

"Koojarra" was named and launched by Mrs. H. C. Strickland, wife of the Minister for the North West and Shipping Western Australian Government on 14th January, 1956.

The launched weight was 1,832 (One thousand eight hundred and thirty-two) tons, mean static pressure on grease 1.72 tons per square foot and the ship moved down the ways at an average speed of 7 (seven) miles per hour on a declivity of 23/32" (twenty-three..thirty-seconds) per foot.

Extensive use was made of the Nelson Stud Welder in fitting out the ship. The fastening of wood grounds in Refrigeration and accommodation spaces, Teak Decking, Electric Cables, Ventilation Ducts and various pipes was considerably expedited by this method. The necessity of drilling and tapping or through bolting some 57,000 (fifty-seven thousand) holes was therefore eliminated. A considerable quantity of insulation was also fastened to bulkheads by means of this tool using insulation pins and speed clips. 22,000 (Twenty-two thousand) super feet of Teak was used in the wood decks and handrails. The decks after being payed were planed all over.

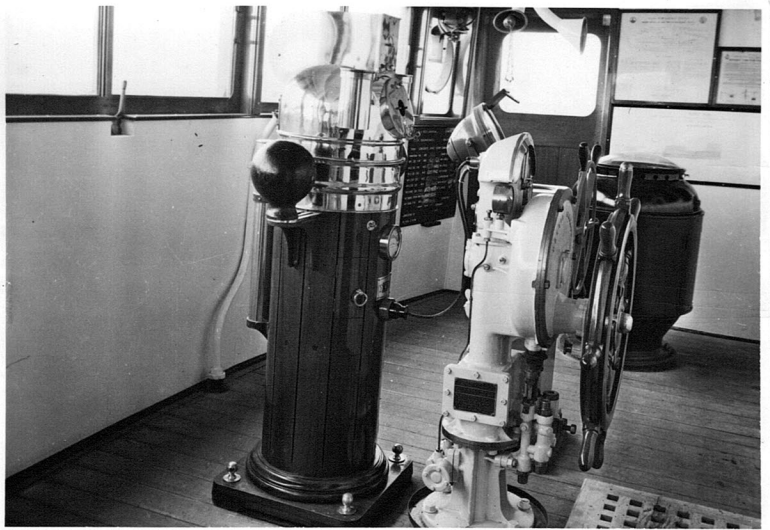


The Steel Decks throughout the crews, officers, and passengers accommodation and public rooms were covered with semtex fleximer underlay and overlaid respectively with Vynle Tiles, Sheet Rubber and Rubber Tiles.

As previously mentioned the air conditioning and ventilating ducts were of considerable proportions and their installation together with the many other services in the limited spaces available presented a major problem.

The Air Conditioning Ducts were in the main constructed of 16 gauge galvanized iron having monel-metal "Pop Riveted" and soldered joints. On completion the whole was insulated with "Onozote" stuck to the ducts with "Laminex Adhesive" and wrapped with insulating tape. The magnitude of this work may best be appreciated by the fact that some 13 (Thirteen) miles of industrial tape were required to cover the insulation.

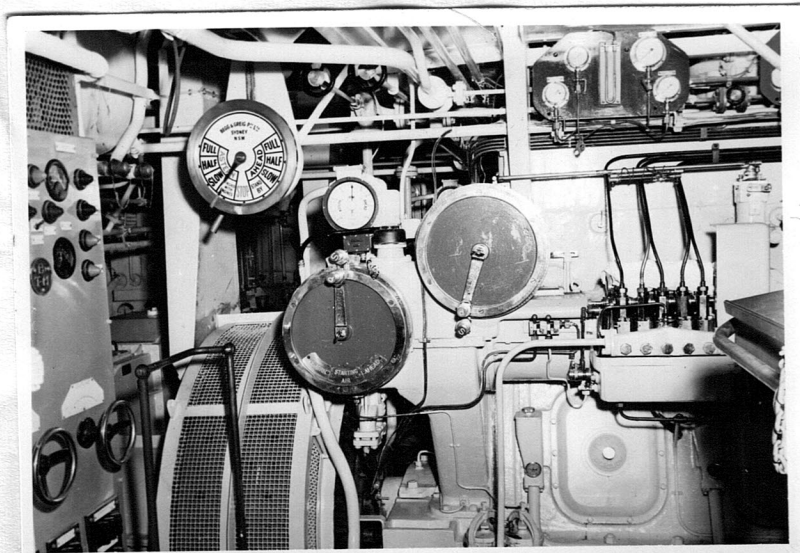




In addition to the usual electrically operated Engine Room Auxiliaries, Winches, Windlass and Galley equipment the ship has some modern aids to navigation in the form of Radar, Echo-sounding, Gyro Compass and Automatic Pilot and each stateroom is fitted with a microphone which is wired to the Ships Pantry and enables the passengers to speak to the Steward. The total length of cable used in the ship amounted to 19.5 miles.



Separate trials each of 72 (Seventy-two) hours duration were carried out on the Cargo and Domestic Refrigeration Plants, and the Air Conditioning and Mechanical Ventilation systems.



On completion of the testing of all the ships services, Cargo Gear, Windlass, Steering Eng., Auxiliaries and Fire Fighting Equipment, Basin trials of 8 hours continuous running were carried out.

The vessel was docked on 20th August, 1956. An inclining experiment was performed on 22nd August, and the compasses adjusted the same day.

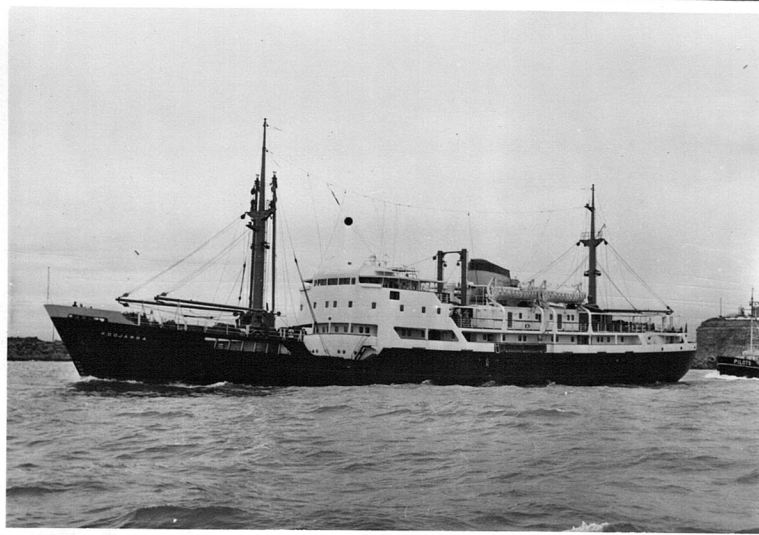


On 28th and 30th August, the vessel underwent Sea Trials. A mean speed of 12.75 knots was obtained with the main Engines developing 1,375 (One thousand three hundred and seventy-five) B.H.P. and the propeller revolutions being 130 (One hundred and thirty). The corresponding consumption figures were 0.428 lb./B.H.P./Hour.



"Koojarra" was formally handed over to the Australian Shipbuilding Board and then to the Western Australian State Shipping Service on 14th September, 1956.





After being loaded with Cargo "Koojarra" was subjected to a further Sea Trial of 24 hours duration on the successful completion of which she proceeded to Fremantle. "Koojarra" has now taken her place with the other units of the Western Australian State Shipping Service and it is hoped that this, the most modern "Little Big Ship" on the Australian Coast designed and built by Australians will serve Australia well.

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