ARCHIVE

THE BUILDING OF HYDROCONIC SHIPS IN ADELAIDE

By

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THE BUILDING OF HYDROCONIC SHIPS IN ADELAIDE

BACKGROUND.

Adelaide Ship Construction Limited was formed in July, 1957, for the purpose of constructing small steel vessels for which it was felt that there was a demand in Australia. The interested parties were The Adelaide Steamship Co. Ltd. and Seawork Ltd., the principal U.K. licensees for the Hydroconic form of ship construction.

Seawork Ltd. act as managing agents for their associated shipyards in Britain, namely :-

P.K. Harris & Sons Ltd., also P.K. Harris (Shipbuilders) Ltd., Appledore, North Devon.
T. Mitchison Ltd., Gateshead-on-Tyne.

These yards, together with Seawork Ltd. and Messrs. Burness, Corlett & Partners Ltd., form a part of the Burness Group, the principals being Messrs. James Burness & Sons Ltd., who, in addition to their shipbuilding interests, control a well-known British travel agency, a trawling company, a shipping line, mining, etc. James Burness & Sons Ltd. have been established in the City of London for over a century but have only recently turned their interests to shipbuilding.

In addition to the above yards controlled by Seawork, there are many other associated shipbuilding companies which hold a Hydroconic licence. The ones known are listed :-

Dorset Lake Shipyard Ltd., Dorset.
Atlantic Shipbuilding Co. Ltd., Newport, Mon.
Thames Launch Works Ltd., Middlesex.
Charrington Gardner Locket (London) Ltd., Kent.
Empresa Nacional Elcano de la Marina Mercante, Spain.
Hudson Engineering Co., Canada.
Sprostons Ltd., British Guiana.
African Marine & General Engineering Co. Ltd., Mombasa.
Mazagon Dock Private Ltd., India.
Tans Metaalconstructiea N.V., Holland.
Companhia Uniao Fabril, Portugal.
Adelaide Ship Construction Ltd., Australia.

In addition to these, similar associations exist in New Zealand and the U.S.A.

The design work for each of these yards is carried out by Messrs. Burness, Corlett & Partners Ltd. of Basingstoke, England, who are probably the largest firm of Naval Architects in Europe today.

Their design staff numbers approx. 30, apart from the Board, being headed by the Chief Engineer and the Naval Architects, who are responsible to the Board for the advisory and design activities of the firm. All work is carried out under the personal supervision of the Managing Director and the General Manager, and the Naval Architects and Chief Engineer are directly responsible for its detailed execution by themselves, by Assistant Naval Architects and by Ship Draughtsmen.

The drawing offices are organised under a Chief Draughtsman, who is one of the Naval Architects. The other Naval Architects do not have the same administrative responsibilities and are free to devote their energies to the specialised problems arising in the course of design work.

All of the normal establishment of four Naval Architects and the Chief Engineer have all been drawn from various shipyards in Britain and have an impressive academic record. Some have had experience at the National Physical Laboratory and are holders of various prizes for Naval Architecture, others have held the position of Superintendent of a trawling company and Manager of the maintenance facilities; have been University lecturers in Naval Architecture; ship surveyor with M.O.T.; or assistant shipyard managers, while two hold qualifications of Ph.D.

Burness, Corlett & Partners Ltd. was established in 1952 and up to the end of 1959 had been responsible for the design of 135 vessels which had completed building. They carry out consultive work for various shipping lines including the British India Steam Navigation Co. Ltd., Saguenay Shipping Ltd., Booker Bros. (Liverpool) Ltd., also for Government agencies such as the British Transport Commission and the Department of Fisheries, Government of Quebec. Contracts are carried out for such shipyards as Ateliers et Chantiers de la Seine Maritime, for Harbour Trusts including the Manchester Ship Canal Co. and the Dover Harbour Board, also for various independent ship operators. Design work for a number of small yards throughout the world is also an important activity. The firm also acts as technical and management consultants to the Pakistan Industrial Development Corporation in connection with their Khulna and Narayanganj shipyards.

MARKET IN AUSTRALIA.

As stated in the opening paragraph, it was felt that there was a demand in Australia for the construction of small steel craft. The prime interest in such craft centred on tugs as it was apparent that a replacement programme was essential and to date Adelaide Ship Construction has been wholly engaged on the construction of these, but we are also eager to build small cargo vessels, punts, barges, fishing vessels etc., as it is realised that in time we will overtake the present lag in replacements. However, as we all realise, Australia is quickly expanding and small ports are now becoming more important as they become centres for the export and import of various products. As these ports attract more vessels, as happens when tankers are required to supply oil companies storage tanks, it is found that tugs automatically follow. Two examples of this are at Albany in Western Australia and Portland in Victoria, for both of which ports we are now building small tugs.

The following table setting out the details of the various tugs building and in service throughout Australia will be of interest to those who are concerned with the building, maintenance or operation of this class of vessel. It will readily be seen that there remain many tugs which should be due for replacement, but it cannot be taken for granted that this will be in the immediate future, as to replace a tug these days can only be done at considerable expense. This is not so much due to the cost of the shipbuilders labour but to the cost of the materials, particularly the main machinery, and due to ships having become larger, particularly tankers, when a tug is replaced it is usually by one of greater size and power in order to handle the larger vessels, which automatically calls for greater expenditure.

In Table I following, the various tugs in Australia are listed with brief details concerning them, the details being correct so far as it has been possible to ascertain, but except for recently built tugs, few of them should be accepted without further checking.

Regarding the dimensions, the figures shown for breadth are in most cases the extreme breadth as given in Lloyd's Register.

The bollard pulls shown will no doubt provide a source of argument and it is emphasised that these have been recorded in good faith.

The two tugs on order for the Department of the Army have not been included in this list as they may not be used in the main ports.

* Indicates those tugs which are of Hydroconic design.

TABLE I – PARTICULARS OF TUGS

NAME	EX	REG.	BUILT	LENGTH B.P.	LENGTH O.A.	BREADTH	DEPTH	TONNAGE GROSS	TONNAGE NETT	H.P.	BUNKER CAPACITY		PULL
NEW SOUTH WALES													
Waratah Tug & Salvage Co.Pty.Ltd.													
ST. KITTS	UCO	Syd.	1919	135.0	143.0	29.0	16.0	386	1	1200 IHP	Coal	250	17
WARANG		Syd.	1936	95.0	102.7	25.0	12.9	230	7	570 IHP	Coal	50	11
WONGA		Syd.	1949	95.0	103.3	25.0	12.9	233	–	1000 IHP	Coal	50	14
WOONA		Syd.	1954	105.0	114.3	30.0	14.0	294	–	1200 IHP	Oil	118	18
*WOOREE		Syd.	1958	95.0	106.2	28.0	13.4	210	–	1040 BHP	Diesel	47	18
*WARILLA		Syd.	1959	95.0	106.2	28.0	13.4	208	–	1040 BHP	Diesel	28.5	18.1
*WILLARA (Building)		Syd.	1962	95.0	106.2	28.0	15.0			1360 BHP	Diesel		
Wallace Tugs Pty. Ltd.													
BUSTLER		Syd.	1917	75.0	80.5	16.6	9.4	74	–	256 IHP	Coal	9	
*KURNELL		Syd.	1959	95.0	106.2	28.0	13.4	208	–	1040 BHP	Diesel	28.5	17.1
J. Fenwick & Co. Pty. Ltd.													
HEROIC	EPIC	Syd.	1909	124.1	131.0	24.3	14.0	268	2	1100 IHP	Coal	100	
HEROINE		Syd.	1909	115.0	122.7	23.6	12.6	207	3	900 IHP	Coal	78	
HEROS	ST. ERTH	Syd.	1919	135.0	140.0	29.0	16.2	382	2	1200 IHP	Oil	55	
HIMMA	EMPIRE PAT	Syd.	1942	105.0	111.7	26.6	13.0	274	–	850 IHP	Oil	88	
LEVERET		Syd.	1892	100.4	105.0	19.9	11.5	146	12	450 IHP	Coal	50	
LINDFIELD	ST. CLAUDE	Syd.	1920	135.0	140.0	29.0	16.1	384	1	1200 IHP	Coal	240	
*SYDNEY COVE		Syd.	1956	104.2	115.6	30.0	13.1	245	9	1440 BHP	Diesel	100	22.0
*SIRIUS COVE		Syd.	1958	88.3	98.0	26.0	12.5	165	–	1100 BHP	Diesel		16.0
FARM COVE	PARMELIA) Being		1939	120.5	128.5	31.1	14.0	350 approx.		1250 BHP	Diesel	57	
MANLY COVE	COCKBURN) Converted		1938	120.5	128.5	31.1	14.0	350 approx.		1250 BHP	Diesel	57	
Maritime Services Board of N.S.W.													
BORAY		Syd.	1947	93.9	98.9	21.2				510 BHP	Diesel		
BOAMBILLY		Syd.	1947	93.9	98.9	21.2				510 BHP	Diesel		
BURROWAREE		Syd.	1947	93.9	98.9	21.2				510 BHP	Diesel		
N.S.W. Public Works Dept.													
BEN SHORTBRIDGE			1954	99.0	105.0	21.2	10.5	146	–		Oil	29	
H.F. SEARLE			1950	93.7	99.7	21.2	10.5	139	14		Diesel	21	

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VICTORIA													
Melbourne													
BATMAN (Huddart Parker)		Melb.	1954	125.5	138.8	33.5	17.3	432	59	1380 IHP	Oil		24.0
HOWARD SMITH (Howard Smith)		Melb.	1952	126.75	137.0	32.2	17.3	496	39	1380 IHP	Oil	132	24.0
JAMES PATTERSON (Jas. Patterson)		Melb.	1902	124.0	131.6	24.1	13.9	247	6		Coal	97	
KEERA (Melb. S.S. Co.)		Melb.	1926	80.3	85.6	19.3	10.2	100	18		Coal	24	
TOORONGA (Melb. S.S. Co.)		Melb.	1922		115.0	27.2	13.2	246	–		Coal	100	
*WALUMBA (Huddart Parker)		Melb.	1960	106.75	115.0	30.9	14.15	245	8	1310 BHP	Diesel	120	19.6
*YORK SYME (Aust. & Melb. S.S. Co.)		Melb.	1961	87.8	95.0	23.5	12.0	161	–	1080 BHP	Diesel	21	14.0
VIGOROUS (Melb. Harbour Trust)		Melb.	1946		99.9	21.3		132	33		Diesel	27	
Geelong													
GEELONG (Geelong Harbour Trust)		Geelong	1955	104.0	110.0	29.2	13.2	262	–	1310 BHP	Diesel		
SPENCER NALL " " "		Geelong	1955	104.0	110.0	28.1	13.2	262	–	1310 BHP	Diesel		
VICTOR " " "	EMILY NICHOLSON EMPIRE BEN	Melb.	1943	105.0	113.4	26.7	13.5	242	–	1150 IHP	Coal	100	
H.A. LUMB " " "		Geelong	1943	78.0	85.0	23.8	10.5	153	64		Diesel		
E.J. FAIRNIE " " "		Melb.	1943	74.0		20.0	9.1	98	35		Diesel		
Portland													
*TREWALLA (Portland Harbor Trust)	Building	Portland	1961	67.2	72.5	19.7	9.5			660 BHP	Diesel	13.1	
QUEENSLAND													
Brisbane													
CARLOCK		Bris.	1929	121.5	127.6	27.0	14.2	301	–	1050 IHP	Coal	119	
CORINGA	EMPIRE PEGGY	Bris.	1945	105.0	114.0	30.0	13.5	259	–	1100 IHP	Oil	94	
FEARLESS	ABQAIQ III	Bris.	1945	105.0	113.5	30.0	13.5	249	–	1000 IHP	Oil	95	
FORCEFUL		Bris.	1925	115.9	121.0	27.0	14.1	288	1	1050 IHP	Coal	103	
Townsville (Harbour Board)													
LALOR	EMPIRE MINOTAUR	Towns.	1942	105.0	112.1	27.0	12.5	233	2		Oil		

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TASMANIA												
Hobart												
SWIFTNESS	FISHGUARD, PLOVER		1920		98.4	22.3	10.1	146	1		Diesel	
Launceston (Harbour Board)												
JAMES WALLACE (Not Working)			1924		109.0	23.7		188	36		Oil	
SOUTH AUSTRALIA												
Port Adelaide (Ritch & Smith Ltd.)												
TUSKER		Pt.Ade.	1958	120.0	130.0	33.5	14.75	393.4	Nil	1600 BHP	Diesel 128	24½+
WOONDA		Pt.Ade.	1915	125.3	129.0	25.3	14.0	309.0	Nil	1120 IHP	Coal 165	17½
YELTA		Pt.Ade.	1949	95.0	103.3	26.7	12.9	233.48	Nil	1000 IHP	Oil 60	13½
FOREMOST		Pt.Ade.	1926	105.0	114.7	27.0	12.5	244.34	12.47	850 IHP	Coal 115	13
GEORGE DINSDALE		Pt.Ade.	1913	90.0	95.3	18.2	8.42	105	Nil	400 IHP	Coal 40	4½
*BUILDERS NO. 11 (Building)		Pt.Ade.	1962	95.0	106.2	26.5	14.8			1184 SHP	Diesel 50	
Port Pirie (Ritch & Smith Ltd.)												
YACKA		Pt.Ade.	1926	90.0	95.5	22.1	10.0	117.72	2.28	550 IHP	Coal 48	9
*TENACIOUS		Pt.Ade.	1961	87.8	95.0	23.5	12.0	164	Nil	900 BHP	Diesel 21	10.8
South Australian Harbors Board												
TANCRED		Syd.	1943	135.5	143.0	33.0	14.5	505	203		Diesel Elect.	
PRICE		World	War II		75.7	18.0	9.7			220 BHP	Diesel	

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WESTERN AUSTRALIA												
Fremantle												
The Adelaide Steamship Co. Ltd.												
YUNA	EMPIRE WINNIE ZEALANDIA	Melb.	1944	136.0	143.1	30.1	16.0	479	29	1275 IHP	Oil 330	
The Adelaide Steamship Co. Ltd. & The Swan River Shipping Co. Ltd.												
WILGA	EMPIRE NAN METINDA II BANBURY CROSS		1945	105.0	113.0	30.0	13.5	256	Nil	1089 IHP	Oil 95	
*WALANA		Frem.	1960	95.0	105.0	26.5	13.4	217	Nil	1040 BHP	Diesel 35.2	17.9
The Swan River Shipping Co. Ltd.												
WYOLA			1912	126.0	132.9	24.8	14.0	306	7	1100 IHP	Coal 98	
Kwinana												
B.P. Australia Ltd.												
B.P. COCKBURN		Frem.	1959	125.0	137.4	31.0	14.5	419		1500 BHP	Diesel	22½
B.P. PARMELIA		Frem.	1959	125.0	137.4	31.0	14.5	419		1500 BHP	Diesel	20½
Albany												
The Adelaide Steamship Co. Ltd. & The Swan River Shipping Co. Ltd.												
*KALGAN		Frem.	1961	67.2	72.5	19.7	9.5			660 BHP	Diesel 13.1	

HISTORY OF THE SHIPYARD.

It was decided to set up this shipyard on a 5-acre site known as "Fletcher's Slip", situated in the Port Adelaide suburb of Birkenhead. Fletcher had started a slipway on Kangaroo Island, but for reasons unknown transferred it to Port Adelaide. It is not known when he set up this yard, the first reference that can be found being on a plan dated 1875, on which a small slipway is shown as "old" with a bigger slipway being shown as "new", from which it is assumed that the yard is about 100 years old. Fletcher also intended to build a dry dock on an adjacent site, but this proved to be impracticable from an engineering point of view, this area now being used for the berthing of vessels owned by The South Australian Harbors Board.

The buildings originally erected had the usual machines and facilities of a shipyard carrying out ship repairs and at the time our re-building was commenced, these original machines still existed. This site, similar to various other adjacent boat-building yards, is on S.A.H.B. property, Fletcher's Slip being adjacent to the Harbors Board Glanville Dockyard.

Fletcher's Slip was taken over by the S.A.H.B. on 1/1/1917, being leased to The Adelaide Steamship Co. Ltd. on 1/4/1920. The Adelaide Co. used the main slipway for maintenance of vessels in the Port, administering this function as a separate entity called Port Adelaide Slipway, which comes under the direct control of the management of their main maintenance shop in Port Adelaide, which is commonly known as "Port Engineering" Workshops of The Adelaide Steamship Co. Ltd., these workshops at that time being solely engaged on maintenance work of the Adelaide Co.'s fleet and associated shipping interests in this port.

The yard is now leased in our own name from the S.A.H.B., it being the normal practice for all waterfront property in Port Adelaide and other South Australian ports to be vested in the S.A.H.B.

Reconstruction of the shipyard by Adelaide Ship Construction Ltd. started on the 10th January, 1958, involving the re-roofing and, in most cases, the re-flooring of all the existing shops and offices, together with the construction of a new fabrication shop for use by the boilermakers, the extension of portion of the existing main building to form a workmen's canteen with drawing office above, and the provision of the other normal requirements of a shipyard.

Before these buildings had been completed, quantities of steel had been delivered, which it was necessary to stow in the street outside the yard, by means of a mobile crane, as it was impossible to enter the yard with a truck or stow plates in any part. The reconstruction of the yard was substantially completed by end March 1958, but prior to this shipbuilding had commenced and the keel of the first vessel was laid on 20th May, 1958.

DESCRIPTION OF THE SHIPYARD.

A brief description of the yard and the various shops follows. Referring to Fig. No. 1, the various shops are identified by letters and described in the same order in the text.

(A) Ground Floor of Main Office Block

(i) Purchasing and Timekeeper's Office.
This is one large office which houses the Purchasing Officer, Assistant to Purchasing Office, Stock Clerk and Timekeeper, who are all staff members.

(ii) First Aid Room.
This is in the hands of a qualified St. John's Ambulance man. This room also contains the equipment controlling the automatic internal 'phones, also the master clock and associated watchman's equipment. This necessitates the room being used after normal working hours by the watchmen, of which there are normally three, working three shifts.

(iii) Workmen's Locker Room.
Sufficient lockers are available to give each workman his own lock-up locker, all being grouped in the one room.

(iv) Workmen's Shower Room, Washplaces and Toilets.
These are adjacent to the locker room, with hot water always available at wash basins and showers, and generally constructed to a high standard.

(v) Workmen's Canteen.
This allows sufficient room to seat all employees, with a shop at one end, for which the equipment is supplied by the firm, but stocked and run by a private person. Automatic cigarette and soft drink vending machines are installed, together with a cold drinking water unit.

(B) First Floor of Main Office Block

This contains offices for the following, together with other spaces as listed :-

(i) General Manager.
(ii) Shipyard Manager.
(iii) Asst. to Shipyard Manager; Technical Assistant.
(iv) Engineer Manager; Asst. to Engineer Manager.
(v) Secretary.
(vi) General Office - 4 shorthand-typistes; 1 telephoniste.
(vii) Cost Office - 1 cost clerk; 1 machine operator.
(viii) Drawing Office - Chief Draughtsman; 9 Draughtsmen; 1 tracer; 1 junior girl.
(ix) Staff Lunch Room.
(x) Washplaces and Toilets.
(xi) Strong Room.
(xii) Girls' Rest Room.
(xiii) Hot Water Tank Room.

(C) Mould Loft

This area measures 85ft. x 35ft., the floor being of T & G Kauri, secret nailed boards being 2½in. face x 1¼" thick, diagonally laid, which has shown no movement since laying. The body plan is always scrieved on tempered masonite, being taken up and stored against future requirements after completion of a vessel. The smaller vessels are faired in one length but usually it is necessary for lines to be put down in two portions, full size, since contracted lines are not used.

Advantage was taken of heavy timbers in the roof construction to build a platform on which to store templates, while a further platform was hung from the roof along one wall. Template timber is also stored on these areas.

With the number of tugs already built the number of templates became rather too numerous and templates for the first vessels have now been stored in a nearby store.

Methods now in use have cut down greatly the amount of templates required, but for the initial start in the yard it was necessary to adopt the customary shipyard practices. Wherever possible use is made of steel strip, template paper and masonite, but the greatest advantage has been the use of a scrieve board for direct cutting of the steel floors by the "Meser" burning machine in the Fabrication Shop. This has required that the scrieve board be duplicated in the lower portion up to tank top level. It is not possible to place all frame lines on the one scrieve due to the inability of the man on the Meser machine to quickly differentiate between frame lines scrieved close together, so the scrieve for the machine is placed on about four different boards, use being made of coloured paints. Present methods have resulted in the use of timber being cut to a minimum, this being reflected in the material costs for more recent vessels, which are now reduced to almost one quarter of the original costs.

The vessels are 100% lofted but in some instances we do check the templates at ship before fabrication, this being thought necessary however only at the extreme forward end of the lowermost shell where it joins the stem bar, and then not because of any loft inaccuracy, but to allow for any discrepancy in the forming of the stem bar.

(D) Store

The store is divided into two main areas, with smaller stores positioned at the end of the larger area, one for the small gear and spares which come with the main machinery, the other for electricians' cables.

The total area available in the store measures 84ft. x 35ft., a total of 2,940 sq.feet.

Steel shelving is used throughout, being positioned along all the available wall space. In addition, the centre of the floor in the smaller store is covered with racks and in the main store a further rack is placed on one side to take valves, flanges, etc., for plumbers use.

Since a good proportion of our equipment must be imported and as deliveries are protracted in many instances, we find it most necessary to order materials well ahead. Normally we have at least four vessels in hand at a time for which materials must be held in store and consequently the store areas are taken up with a variety of equipment.

The value of goods which are carried as stock, excluding steel, timber and paint, usually amounts to about £25,000. Where possible, equipment is ordered in against a ship and costed directly against it, so that the above value represents items such as welding rods, bolts, electrical switches and other items, amounting in all to over 4,000 different items listed in the stock records.

It is found preferable to order valves etc. in against stock, since they cannot be bought 'off the shelf' and it is necessary to have drawings done and approved prior to knowing the exact requirements, which leaves insufficient time for detail ordering. When information is known the valves etc. are identified and moved out of the main store into a sub-store, from which the foreman plumber can draw them as required. They are charged out when moved out of the store and by this means we find that accurate costing is possible and the least trouble caused by crediting at the completion of a vessel, as well as the least amount of confusion caused by men drawing wrong valves.

The store is worked by three men, comprising a head storeman, one other who does mainly clerical work and a third who is employed about 25% of his time as a driver. Two other storemen are employed in the yard but they do not work in this main store, one being wholly employed on steel, the other on paints and timber.

Double doors are provided for direct access to the adjacent street, also double doors open into the yard.

(E) Riggers Shop

A small riggers shop is provided under the roof of the winch house. Two experienced riggers are employed, one an ex-seaman employed on tugs, the other an ex-foreman from a British yard. These two do all rigging work necessary and form portion of the deck crew when we take vessels on trials, but do not manufacture the large rope bow fenders, which are made by The Adelaide Steamship Co. Ltd., who manufacture them in their main Riggers Loft in Port Adelaide.

The greater part of the ropes and wires which are used in the yard or on which work is to be carried out for vessels, are stored adjacent to the riggers shop, under cover of the roof of the winch house.

(F) Small Sections Store

All the smaller steel sections are kept in a rack 30ft. long, which is the maximum length to which sections are ordered. This has an end area of about 60sq.ft., fitted with solid doors.

(F1) Foremen's Offices

Offices for the foreman boilermaker, plumber and fitter are built above the small sections rack, on the same level as the floor of the winch house.

(G) Valve Store
(H) Pipe Store

Both the valve store and pipe store at one time were water tanks incorporated in the foundation of the winch shed but were abandoned when water was laid on many years ago.

Each has a length of 33 feet by a cross section of 80 sq.feet. As well as valves, the valve store also has a rack for non-ferrous small gauge pipes, while in the pipe store we are able to rack the majority of the steel piping for use by plumbers, any sizes which are too large or heavy being racked outside.

(I) Slipway Winch Shed

This is an open ended shop, the roof of which serves also as a roof for other smaller buildings.

(J) Patent Slipway

This slipway was modernised in 1958/9. The whole of the lower end was repiled, necessitating the erection of a caisson across the end of the slipway, while the midway, which was carried on pitch pine logs, was replaced in concrete.

The original steam winch, which had been in use since the early 1880's, was replaced by a modern electric winch supplied by Vickers-Hoskins of Perth. This winch is capable of handling vessels up to 1500 tons with the wires as arranged at present, but if the wires are doubled up, it can operate up to the maximum of about 2000 tons.

The slipway is the largest in Port Adelaide, or in South Australia, and in the absence of a graving or floating dock is used by the majority of the locally based vessels.

(K) Port Engineering Trades Lunch Room, etc.

A separate lunch room is provided for use by the Port Engineering Trades - that is fitters, plumbers and joiners. This is at the rear of the winch house on the top level, while below the lunch room are the toilets, wash room and locker room for their use.

(L) Electrical Sub-station

This was built by E.T.S.A. - the Electricity Trust of South Australia - and is capable of handling a load of 300 KVA.

(M) Maintenance Fitters Shop

The shipyard carries two maintenance fitters in a separate shop which also houses the following :-

Main Switchboard. This is adjacent to the sub-station and distributes all light and power by means of pyrotenax cables in underground ducts.

Air Compressor. There are two air compressors installed, the older one being a Broomwade with a capacity of 300 cu.ft./min., which is now kept as a standby machine. Recently a second machine, with a capacity of 300 cu.ft./min. has been installed, both being coupled to an inter-cooler and to the air reservoir and if necessary both may be used simultaneously.

Hicycle Generator. This supplies power on a three-phase circuit of 200 cycles at 125 volts, which permits a speed for portable tool rotors of 12,000 R.P.M. and permits tools to work at full load with only a 10% slip. Various drills and grinders are powered by Hicycle.

(N) Plumbers Shop

This shop measures approx. 45ft. x 40ft., with the pipe bending machine installed in an open area outside the shop. The following equipment is installed in this shop :-

One electro-hydraulic pipe bender of up to 4in. pipe capacity.
One oil furnace, having a maximum capacity of 6in. bore pipes, used in conjunction with a winch, bending slab and swinging jib.
One power saw, having a 6in. bore capacity.
One screwing machine, which takes a maximum of 4in. pipes or 2in. bolts.
One grindstone.
Two portable welding machines.

It is the practice now to sketch all pipes at the ship and bend in the shop, on the machine where possible. It is very seldom that 'sets' are lifted at the ship.

The foreman plumber works in close association with the plumbing draughtsman, who at one time was the plumber foreman, and now carries out all ordering and progressing in addition to his drafting duties.

(O) Electricians Shop

All electrical installation work is carried out by the shipyard, including the design and construction of switchboards. Normal yard maintenance work is carried out but no work such as re-winding of motors is attempted. The shop has an area of 37ft. x 31ft. and contains the following equipment :-

One steel surface table on which switchboards are built.
One drilling machine.
An electrical test board.
Various meters, punches, guillotines, straight edges, vices, stocks and dies, pistol drills and similar equipment are available.

A photograph of a typical deadfront switchboard, as built in the yard, in this case for our Ship No. 5, is shown in Fig. No. 4.

(P) Fitters Shop

This shop is used for small machine work which is preferably done in the yard rather than send work to the main shop at Port Engineering.

It is used to store equipment such as boring gear used for stern gear and for the rudder gear.

In addition to fitters' benches, the following machines are installed :-

One lathe with 8in. centres, gap out 12in. centres.
One pedestal drill with $1\frac{1}{4}$" chuck.
One 12in. grinder.
One pedestal drill with $\frac{1}{2}$in. chuck.

(Q) Port Slipway Sheds

These sheds are used by the men employed by Port Slipway and engaged on the work associated with the slipping of vessels. These employees comprise an experienced foreman, together with a shipwright and 8 painters and dockers, other casual P. & D. labour being picked up as required.

Facilities for washing, toilets, storerooms, messroom, etc. for this separate functioning portion of the parent company, are provided in this area.

(R) Fabrication Shop

This shop is the keystone of the yard and is the only one that can be said to be 100% new, all other shops having been rebuilt from existing buildings. This shop has a covered area of 4,800 sq.ft., with a travelling electric crane of 3-ton capacity. The tracks extend out either end of the shop, at one end spanning the area in which the majority of the steel plates are stored, while at the other is an area on which various assemblies such as aft end units, wheel-houses, funnels, etc. are prefabricated.

The shop is composed of four bays, marking off and burning tables covering the first two bays at the end of the shop adjacent to the steel stockyard. The next bay is kept clear and used mainly for the stacking of steel after it is cut to shape. On one side of this bay is a small bending slab and on the other side, a drilling machine and grinder. The fourth bay has raised skids over its entire area, being plated in on top and used for the preparation of deck and bulkhead panels and similar flat fabrications.

The principal items of equipment used by boilermakers in this shop and elsewhere in the yard are given in some detail as they will, no doubt, be of greater interest :-

1 - Plate rolls - to handle plate up to 11ft. long x 5/8in. thick. These rolls existed when the yard was rebuilt and were motorised by the shipyard. Plates which are too large for these rolls, amounting to four, sometimes six, per ship, are rolled by our men on larger rolls elsewhere in Adelaide.
1 - Finlay V.150 Hydraulic Press with a capacity of 150 ton.
1 - Meser "Statosec" burning machine with a length of track to permit burning a plate up to 20ft. long x 4ft. width, operating from a template or scrieve on an adjacent table. Fig. No. 5 shows a photograph of this machine. At the time of reading we will have received for this machine an automatic height sensing device, which will make unnecessary the adjustment of the cutting head to suit plate irregularities. This is one of the few machines of this make in Australia and the only such height sensing device.
1 - 48" Comweld profiling machine.
1 - Radial drill, to drill up to 1¼in. diameter hole.
1 - Double ended grinder with 15in. wheels.
1 - P.S.L. straight line burning machine.
3 - "Quicky" burning machines.
1 - "Via-vac" vacuum clamping machine, of ½-ton capacity. This machine is used for the rapid lining up of plates for tacking and for pulling stiffeners into contact with plates without the use of welded lugs.
5 - Swinging beams each with a trolley and 1-ton capacity chain block.
1 - 3-ton electric overhead travelling gantry crane.
2 - Bending slabs, principally used for fabrications such as rudders.
10 - Air cooled E.M.F. welding chokes, each of capacity 350 amps.
1 - Transformer for above chokes.
18 - Oil cooled Murex welding chokes, each of capacity 400 amps.
3 - Transformers for above.
6 - Single operator Murex welding machines, each of capacity 400 amps.
1 - Lincoln D.C. 750 amp. welding generator, used primarily for 'groove-arc' gouging.

Enquiries are in hand for an automatic welding machine at present.

(S) Fabrication Area

An area of 60ft. x 30ft. has been built at the top end of the patent slipway on which 'ring-frames' are fabricated. Due to the declivity of the slipway and the various uphaul and downhaul wires for the cradle, it was necessary to build an elevated area to protect the wires and provide a level working area. This area has been plated with steel plates, tacked together, and has had a criss-cross pattern of waterlines and buttocks struck in and marked on the plates. This enables three ring frames to be set up at the one time and the lines used to accurately set up the frames before welding. The normal output from one squad on this job is two ring frames completed per day. A squad comprises a plater, a helper and a welder, the plater often being an apprentice.

Should it ever be necessary this area can be quickly dismantled and the top area of the slipway used as a building area for a further vessel. This is unlikely, however, as at present four vessels can be built simultaneously on the existing berths, but would be used if vessels were already on the regular building berths and a quick building was necessary.

(T) Steel Storage Area

At present steel is delivered from wharves by semi-trailer and backed in under the shop crane adjacent to the steel storage area. We find that we might have in excess of one hundred tons arrive on the one day, with trailers waiting, then we can unload at other points with either of the other yard cranes.

All plates are ordered in a standard length of 20 feet, all heavy sections in lengths of 30 feet. This makes racking of steel much easier and neater, and the use of standard length plates does not give a great deal of waste as might be expected. All plans are drawn with this standard length in mind and we find now that we have about a 10% wastage on the gross steel of a vessel. When our first vessel was built, due to the fact that we had no offcuts to use, this figure was up to 17%. Since then, however, it has progressively improved and by slightly altering our methods to suit the Meser machine and our more recent methods of construction, it is anticipated that this wastage will be down to 8%.

It is not found possible to hold all the steel plates in the vertical racks and plates of a standard size may be stacked one on top of the other in an area adjacent to the shop until the racks have become depleted. With a good proportion of our work it is not necessary for the plates to go through the shop for marking and burning, since they are formed into panels by welding and cut to size on the skids.

In the past it has been proven to be essential that we carry good steel stocks, due to the inability of the manufacturers to supply large quantities at short notice, but this position is now improving. This question of the amount of steel stock to be carried will always be controversial - cost outlay, availability, storage space, etc., being known factors on the one hand, while on the other we must balance the possibility of being able to fulfil an order at short notice and so obtain a job which otherwise might have been placed elsewhere.

For our class of work, it is necessary to have supplies to hand of at least 1,000 tons, which is the equivalent of about one year's usage and sufficient for the construction of vessels which are on order.

(U) Port Slipway Office

This is not used by our Company but required for use of the staff concerned with the working of the patent slipway.

Shipwrights Shop

This shop front is covered with wire mesh sliding panels allowing material to be handled on to the machines.

The machines installed in this shop are :-

1 - 36in. Bandsaw, capable of cutting up to 12in. deep and 35in. wide.
1 - Thicknesser, cutting 20in. wide x 7in. thick.
1 - Circular saw, 24in. blade, cuts up to 9in. thick.

(U1). First Floor - Joiners Shop and Offices

This shop is used principally for assembly of the larger units of the furniture for which the setting-out and machining is done in the Port Engineering Workshops.

In addition to the foreman joiner's office, there is a storeroom for stowing offcuts of Laminex and Formica, also a store in which hardware and fittings are stored.

Also in this area is an office which is kept for the use of any owners representative standing by while a vessel is building, or for the use of the ships officers who stand by over the trial to delivery period.

(V) Paint Store

The storing and issuing of all paints,and the necessary clerical work, is from this store, while small paint jobs, also signwriting, are carried out inside.

The paint trades, that is, painters & dockers and professional painters, each has its own chargehand, the chargehand pro. painter being a skilled signwriter. Both trades are under the control of the foreman shipwright.

All paints are ordered in as stock, but are marked as reserved for a certain ship. This helps to ensure accurate costing and recording of quantities for various types of vessels, which supplies accurate information for following vessels. The quantity of paint normally carried in store varies but is of the order of £1,200.

Paint spray machines are used where practicable, three different types being available :-

(i) An "Arnold" high pressure unit.
(ii) An "Arnold" low pressure unit.
(iii) A "Devilbiss" airless spray unit.

The airless spray equipment is of particular worth, being used to spray the prime and undercoats in compartments before any fitting out is done, but of more interest, it is used for painting the external shell. Using this equipment one man is able to cover the same ground in one day as five men are able to by hand brushing.

(W) Timber Store

Prior to commencing building a quantity of timber was brought from interstate by Port Engineering, this being sufficient for our first five vessels. We now order the timber ourselves and, similarly with other materials, always endeavour to buy in our home State, all else being equal, otherwise interstate and finally overseas.

Suitable timbers present quite a problem and recently we sought quotations throughout Australia in an endeavour to find the best solution on the basis of cost, suitability for working, suitability for shipwork furniture, availability of stocks, etc. This led us to either Australian Oak or Jarrah, but for our first five vessels we used Queensland Maple and the following four used Tasmanian Myrtle. All have their good points and it appears that the choice of the most suitable timber is one that could be changed over the years.

The store is convenient to the woodworking trades and enables the one storeman to handle both paint and timber. This store is racked for the full height, which permits ample room for our requirements.

(X) Gas and Oxygen Store

This is referred to elsewhere.

(Y) Building Berths

There are two main building berths, referred to as Nos. 1 and 2, but each is capable of building two vessels simultaneously, and we refer to the 'top' and 'bottom' of each berth. This enables us to build four vessels simultaneously, each of an overall length of about 105ft. These berths could take three smaller vessels on each, although this has not yet been necessary. The berths are referred to as being able to take a vessel of a length of 220ft. and if we had to, we could go to a limit of about 300ft., but this would mean restricting our mobile crane to the eastern side of the berths. Again, it would be possible to build a vessel with a beam up to about 63ft., which would span the two berths.

These building berths are on top of the smaller of the old Fletcher slipways and at times we have struck the bluestone of which the slipway was built. A general view of the berths is shown in Fig. No. 6.

The piling at the end of the berths has been so arranged that a vessel, or vessels, can be positioned anywhere on the slipway. Piles were driven on to a substantial limestone ledge and the final structure can take large way end pressures.

Measuring the berth from a datum point on a cable duct which is on the edge of a bituminised area, the declivity of the first 100ft. is such that there is a fall of 12in. This means that the top of the berth is on the normal ground level in the yard. After the drop of 12in., the declivity of the ground is 5/8in. per foot for a length of 91ft., then a declivity at the lower end of 7/8in. per foot, for a length of 90ft. This ensures that the top 100ft. of the berth is almost always dry, even with tides up to 11 feet high, while the drop at the lower end (7/8in. declivity) permits a greater depth of water over the way ends. This also enables the groundways to be kept parallel to the ground and bear directly on the logs positioned in the berth over the lower portion, in the cases where the groundways are set at 7/8in. declivity, as has been the case in four launchings to date.

The normal tide height experienced is 5 or 6 feet but a tide of 9 feet is quite normal, occurring regularly particularly in the middle of the year. At Christmas there is a strange lack of such height tides for several months, the highest ones occurring from 4 a.m. to 6 a.m., which, needless to say, is rather an unwelcome time.

With unusual circumstances, tides rise much higher than 9 feet and since building started we have had at least six tides of a height of 12 feet, and one record one of 13ft. 3in., which completely covered the yard and carried keel blocks out of the front gate, entered stores and offices on the ground floor, damaging stocks, also damaging motors on the crane.

When building the berths we were fortunate to be able to purchase quantities of timber which had been used in a viaduct carrying trams to Henley Beach and recently demolished. The principal timbers were 30 feet long, and had a cross section 16in. x 10in., all being of ironbark, well aged and impregnated with tar. These were ideal for the use envisaged and they were sunk level with the slipway ground line every 10 feet down the building berths. On top of these similar timbers were laid longitudinally, on the centre of the berths, the space between being used as a drain into which tanks could be emptied, steel tubes 15in. diameter being split into three longitudinal parts to form this drain.

These timbers are of such a strength that they will carry the weights of any vessels we would be likely to build.

Staging planks are of oregon 12in. x 3in. of a uniform length of 20ft., but some longer ones are used, 24ft. in length, across the ends of the vessels.

Uprights were fabricated from both channels and tubes, of lengths of either 22ft. or 30ft., so constructed as to form a ladder on each side for the maximum accessibility. Spawls are of 4in. x 2in. channels and of length to allow three stage planks to be placed on them. To secure the bottom of these uprights concrete blocks were poured with steel channels flush with the top and integral with the blocks, spaced at 16ft. centres throughout to suit 20ft. length planks. The uprights have a flat plate on the bottom, 4ft. x 3ft., and the edges of these plates are welded to the channels in the concrete blocks. The length of these blocks is such that the uprights may be moved in and out to suit a ship of any beam.

(Z) Fitting Out Wharf and Basin

While our first ship was building it was necessary for us to build a fitting out wharf. A length of wharf of 80ft. was built with piles driven further out in line with the wharf edge so that vessels up to 150ft. could lay, and if necessary further piles could be driven to suit greater lengths. The depth of water was such that at low tides the vessel fitting out sat on the bottom, but as this was of mud and the vessel had a good flat of bottom without a great rise of floor, this proved quite practicable. The disadvantage of this was felt at times of trials when it was necessary to take the vessel out on a high tide before trials and remain at another wharf until after completion of trials. Subsequent dredging, however, has given us a depth of at least 12 feet below L.W.O.S.T. for a length out to the channel and a width more than wide enough to carry two ships. This basin is at the end of the launching ways so that the depth of water at launching is about 21 feet, since we always look for a 9ft. tide.

This basin was finally completed at Christmas 1960 and has proved to be quite practicable to date, as no silting up has occurred and no dropping in of the surrounding river bed.

The fitting out wharf was constructed using the 30ft. timbers which we purchased, being used for piles and the supporting structure, the planking being of jarrah, and is able to carry either or both of the two yard cranes.

General

Since most of the buildings and the roadway which formed the path of the crane track were existing, the best possible use had to be made of the existing facilities. Reference to Fig. No. 1 shows that the Jules Weitz electric tower crane is able to service most parts of the yard. This crane is of French manufacture and was the only one of its type in Australia when purchased. It is designed for high stressing and there is considerable deflection of the end of the jib when under load, which does not appeal to our authorities.

When the necessity arose for a second crane we had built locally, to our specification, a mobile crane capable of a maximum lift of 4 tons and a lift of 1½ tons at 50ft. radius, with pneumatic tires and without the necessity of using jacks under the chassis to take the lift specified. This is the only crane that has been constructed to this design and to date has given very satisfactory service, being able to go into any part of the yard and has been taken part way down the building berths. A photograph of this crane is shown in Fig. No. 2.

All services such as water, compressed air, oxygen, handi-gas, power, etc., are distributed in ducts throughout the yard. In one duct are the electrical services for domestic and welding power, lighting, hicycle power, internal telephones and watchman's patrol check points, while the second duct carries water, air, oxygen and handi-gas, this duct being sand filled so that any possible gas leak will not be able to work along the duct and form a dangerous pocket.

In the fabrication shop services are led to the burning tables, profiling machines and to points on the shop columns. Along both sides of the building berth area the services terminate in boxes spaced about every 40 or 50 feet so that there is a good coverage to any point on a vessel building. Some boxes are twice the capacity of others, while some carry a plug-in point for a large welding transformer. A photograph of a maximum size box is shown in Fig. No. 3. The various items of equipment as marked are listed below :-

A - 1 - 150 amp. switch and plug for welding transformer.
B - 2 - 60 amp. switch and plug for single operator welders.
C - 6 - Hicycle plugs.
D - 2 - 240 Volts switches.
E - 3 - Fuse banks.
F - Internal type telephone.
G - 2 - Double oxygen connections.
H - 2 - Double handi-gas connections.
J - 4 - Compressed air connections.

Until recently acetylene was used in the yard, being supplied from a bank of 8 bottles coupled together, with a second bank in reserve. We have now swung over to "Handi-Gas", it being considered to be cheaper and more efficient.

Oxygen is supplied in crates of 9 bottles, totalling approx. 2,100 cu.ft. We normally have four crates in position at the one time and our average usage is 6 crates per week. Over the 12 months ending 30/6/61 our usage of oxygen was approx. 290 crates, that is, approx. 609,000 cu.ft. Our requirements have been such that by the time this is read we will have had installed a liquid oxygen plant. We have been paying a reduced price on the basis of using liquid since the end of 1960, but have had to wait for equipment to be received from Britain, it being one of the first to be installed in South Australia.

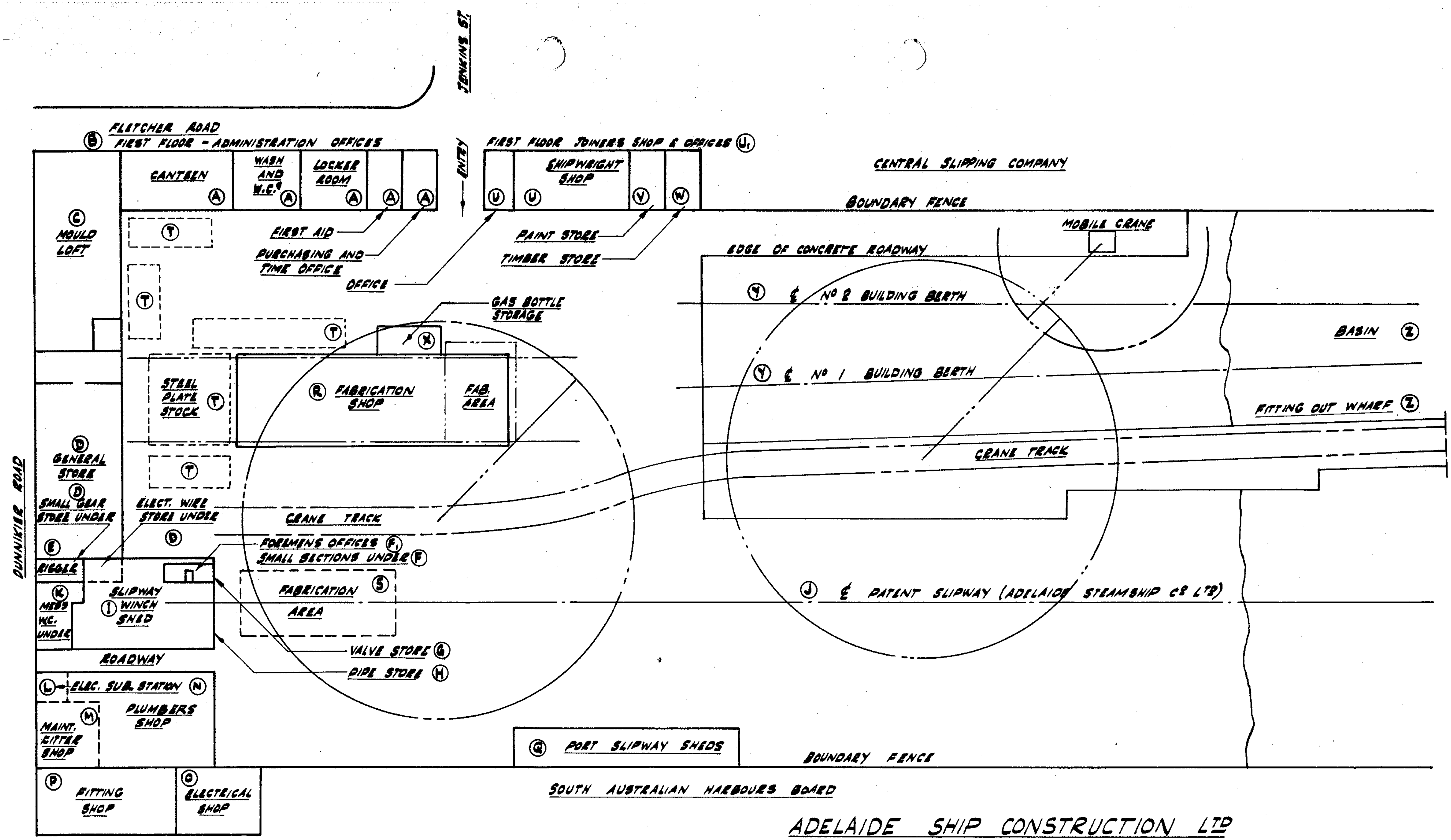
The distribution piping system for gas and oxygen was designed by C.I.G. (S.A.) Pty. Ltd. and even with the long run to the end of the fitting out wharf it has proved satisfactory.

Approximately 50% of the exposed ground in the yard, excluding the building berths, is of concrete. The remainder is of bitumen over substantial ballast but this was not designed to cope with our mobile crane when it was put down and will require to be replaced with concrete before long.

On our western boundary we have a vacant area owned by The South Australian Harbors Board, while on our eastern boundary is a firm who do some steel repair work, having the second largest slip in the port, and also build small wooden boats. Further to the east are other boatbuilding firms, while further to the west is the Glanville Dockyard, which is the main base for the maintenance of all ships owned by the S.A.H.B. This is quite an extensive area with good facilities, including a 60 ton floating crane, which is utilised to lift our imported main machinery from the holds of ships and again to place it in position on our vessels. We have found all these firms to be most co-operative and at times we have made use of certain of their facilities.

We have watchmen at the yard on a 'round-the-clock' basis, in conjunction with a system which entails clocking various points at times which cannot be plotted to predetermine when a round must be made. Should a point not be clocked or the system interfered with in any way, an alarm is sounded.

All time recording is done by means of clocks at the main entrance, controlled by a master time clock, which also operates the electric whistle for stopping and starting and controls various clocks positioned throughout the Yard and Offices. The cards are used to record the employee's times of arrival and departure for payment of wages, and in addition he fills in a daily time docket giving details of the work on which he is engaged, for costing purposes.



ADELAIDE SHIP CONSTRUCTION LTD
LAYOUT OF YARD
FIGURE No 1

SCALE 1" = 50 FEET

Fig.2

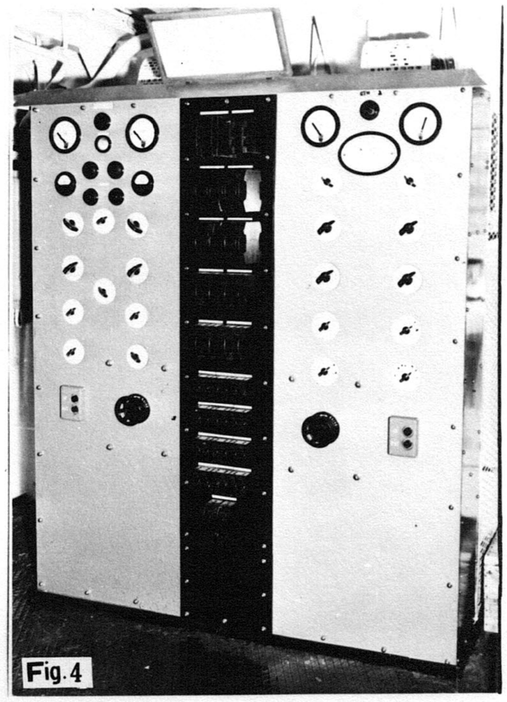


Fig.4

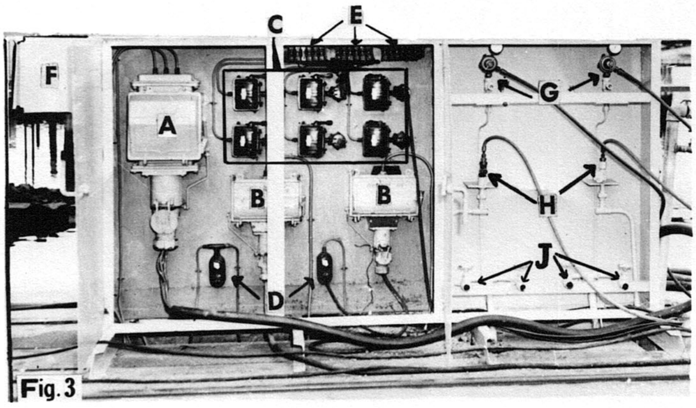


Fig.3

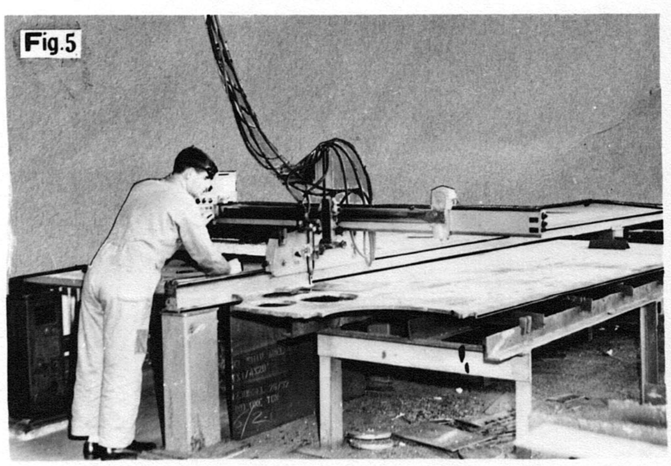


Fig.5

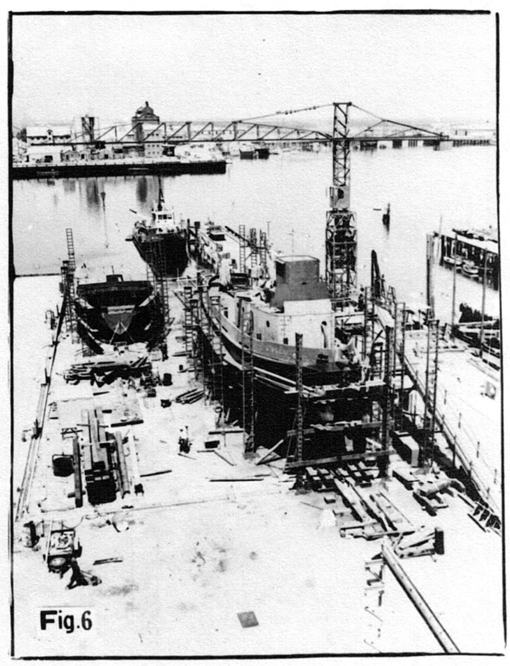


Fig.6

PERSONNEL.

For various reasons, labour for some trades is supplied wholly by our associates and main sub-contractors, the Port Adelaide Workshops of The Adelaide Steamship Co. Ltd., commonly referred to as "Port Engineering". These men are in the fitting, plumbing and joinery trades. They each have their own foreman, who is a staff member of the above Company, but in all cases they answer directly to the management of Adelaide Ship Construction Ltd. so far as instructions for the carrying out of their work are concerned. This came about primarily because facilities already existed for each of these trades at Port Engineering.

In the case of the fitters, a few machinists are employed in the fitters shop at the shipyard, on work which is found to be more conveniently carried out at the yard, the balance of the heavy class work being done by Port Engineering in their own shop. In addition to the great majority of the machine work, heavy blacksmithing and foundry work are also done on our behalf.

The joiners were originally divided into two sections, one being employed at the shipyard on the ships building, the other working in the Port Engineering workshops on the manufacturing of furniture, the men being interchangeable. This has now altered somewhat, for the sake of convenience, all men now working at the shipyard, with the exception of a machine man and setter-out, so permitting greater mobility of all the joiners, labour being divided between ship and shop as necessary.

The plumbing work now is all carried out at our yard, where facilities are better than they are in the Port Engineering workshop.

The men working in the Port Engineering workshop do not come under our direction in any way, being employed solely on a sub-contract basis, but their man hours are recorded against our costing system, similarly to their fellow employees who actually work at the shipyard.

The shipyard does not carry out any ship repair work whatsoever, even on the vessels owned by the associated companies, all this work being carried out by the Port Engineering workshops, which retain some tradesmen at all times for such work.

At present the total numbers of men actually working at the shipyard are as follows, the machinists, blacksmith, moulders, etc., employed wholly within the Port Engineering workshops being disregarded, their work being on a part time basis only :-

Boilermakers -		
Platers and markers off	18	
Caulkers, burners, drillers	6	
Welders	22	
Apprentices	10	
Ironworkers	12	
Shipwrights	15	
Apprentice Shipwrights	6	
Electricians	7	
Apprentice Electricians	2	
Painters & Dockers	13	
Professional Painters	3	
Storemen	5	
Miscellaneous	12	
Total Adelaide Ship Construction employees	131	131

Total Adelaide Ship Construction employees		131
Plumbers	11	
Apprentice Plumbers	2	
Plumbers Assistants	8	
Fitters	14	
Apprentice Fitters	2	
Fitters Assistants	6	
Joiners	7	
Apprentice Joiners	2	
Total Port Engineering Workshops employees	52	52
Ship Construction Management, Staff and Foremen	22	
Drawing Office Staff	11	
Port Engineering Foremen	3	
Total	36	36
GRAND TOTAL		219

The Staff employed by Adelaide Ship Construction Ltd. is as follows :-

General Manager - who is responsible for the overall administration of the Company.

Shipyard Manager - responsible generally for the integration of all work, and particularly for the Hull Departments and the Naval Architectural duties, as well as the preparation of new designs, specifications and estimates.

Asst. to Shipyard Manager - responsible for the carrying out of all work by Hull departments and the co-ordination of those departments with Engine and Electrical departments, checks drawings for constructional methods, requisitions materials.

Technical Assistant - acts as assistant in the office to the Shipyard Manager. He checks costing, prepares material specifications, records all man hour and cost data, prepares information for estimates.

Engineer Manager - responsible for the technical aspects of the Engineering and Electrical departments, also the preparation of material specifications, ship specifications and Engineering and Electrical department estimates.

Asst. to Engineer Manager - responsible for the specifying of materials for the Electrical department, carrying out of the work of Engineering and Electrical departments at the ship.

Secretary - responsible as the Public Officer of the firm and as Accountant. Responsible for all clerical work and staff and the preparation of cost data.

General Office - comprises 4 stenographers and a telephoniste. A senior stenographer carries out detail work for the Shipyard Manager.

Cost Office - comprises a senior clerk who carries out accountancy duties; a female machine operator; a clerical assistant who also carries out some duties in the Purchasing Office.

Purchasing Office - comprises 1 purchasing officer, 1 assistant and 1 stock clerk.

Timekeeper - 1 clerk.

Drawing Office - is headed by the Chief Draughtsman, who has the following staff :

3 senior ship draughtsmen.
2 junior ship draughtsmen.
2 senior engine draughtsmen, one of whom is largely on pipe work.
1 senior pipe draughtsman.
1 senior electrical draughtsman, also capable as an engine draughtsman if so required.
1 tracer.
1 junior girl on printing, filing drawings, etc.

Foremen - 1 shipwright foreman.
1 boilermaker foreman.
1 electrical foreman.

Staff members employed by Port Engineering but working full time for us are the -

fitter foreman.
plumber foreman.
joiner foreman.

The shipwright foreman, who is an experienced loftsman, has control of the following trades :-

mould loft.
shipwrights.
painters & dockers.
professional painters.
storemen and most miscellaneous.

He has under his control a chargehand loftsman, chargehand shipwright for the shipwrights' work, chargehand painter & docker and chargehand professional painter. In addition there are three liners off, one of whom is used in the Loft when necessary and another used as a chargehand if the number of ships warrants same.

The boilermaker foreman has control of boilermakers and ironworkers and has with him a chargehand welder, a chargehand plater in the shop and a second chargehand on the ships building and fitting out.

Other foremen, that is, electrician, plumber, fitter and joiner, each have a chargehand.

SUB-CONTRACTORS.

In addition to the main sub-contractor, that is, The Adelaide Steamship Co. Ltd. Port Engineering Workshops, the following are the principal items which are subcontracted :-

Ventilation trunking.
Laying of tiles and terrazzo.
Laying of floor coverings and underlays.
Upholstery and soft furnishings.
Pipe insulation.

ESTIMATING.

Sufficient data has now been accumulated for tugs, that given a brief outline of the owners requirements for the vessel and knowing at least the ship dimensions and type of machinery to be installed, a rough price can be given 'off the cuff'. This, however, is only for a first indication to the owner and is always followed up with a detailed estimate, which, however, is not normally done until a General Arrangement and Specification have been roughed out and agreed upon with the owners. It is the responsibility of the Shipyard and Engineer Managers to prepare this information.

All estimating is done for labour in man hours, being estimated against items in the Cost List but not normally against trades. In the case of a new type vessel, however, knowing the average break-up of man hours into trades, an estimate may be done in terms of trades in conjunction with the various foremen. This trade estimate is then cross-checked against that done against cost items.

PRICE RECORDS.

In addition to the recording of data for ships built, a record is also kept of quoted prices for all types of equipment which it is possible to obtain, irrespective of whether they were sought or are applicable to any prticular ship. While this does not replace the calling for quotations when a tender is being prepared, it does provide reasonably accurate information should a price for a vessel be required at short notice, in which case it may not be practicable to wait for a firm quotation, particularly from overseas suppliers.

All this price data is recorded against the relevant cost number and comparisons can be made immediately between different types or manufacturers of equipment. This is invaluable when a specification is being discussed with a prospective owner, as it is possible to decide immediately on the equipment required in most cases.

MANHOUR RECORDS.

To assist in estimating, also for the control of work, detail manhour records are kept, both for our own employees and for those employed on our work by Port Engineering. The Port Engineering records include all work done in their Shops on work such as shaft turning, castings, patternmaking, heavy blacksmithing, etc., as well as the hours expended by their employees in our yard.

These manhours are recorded weekly against each number in the Cost List, each number being split up into trades. Totals are given against numbers and also against trades, providing a cross check. The total hours against each number are summarised weekly in a separate report, together with the resultant labour cost and material cost for each item. These are totalled and the payroll tax and overhead added, so giving the cost incurred to date, which gives an immediate check on how that particular vessel stands. This is of particular use as it enables the possibility of a profit, or loss, to be quickly ascertained should directors enquire.

Table II following gives the percentage break-up of the final hours of several of our vessels. The various vessels may be identified from a table elsewhere. In our detailed records the various trades are further divided into tradesmen and apprentices and in the case of the boilermakers are further split up into platers; welders; caulkers, drillers and burners; and apprentices.

TABLE II - PERCENTAGE BREAK-UP OF MANHOURS INTO TRADES

Adelaide Ship Construction Trades

	Ship 3	Ship 5	Ship 7	Ship 8
Boilermakers	28.1%	26.8%	25.9%	27.3%
Ironworkers	8.1%	7.7%	7.1%	7.6%
Shipwrights	10.9%	11.0%	11.5%	12.6%
Professional Painters	1.5%	1.5%	1.6%	1.2%
Painters & Dockers	6.9%	7.0%	6.2%	6.1%
Electricians	4.3%	4.7%	4.8%	4.6%
Storemen, Crane Drivers & Miscellaneous	3.3%	4.0%	4.0%	3.9%
Draughtsmen	7.3%	5.3%	7.1%	5.9%
	70.4%	68.0%	68.2%	69.2%

Port Engineering Trades

	Ship 3	Ship 5	Ship 7	Ship 8
Plumbers	7.0%	7.1%	7.5%	7.2%
Fitters & Turners	9.8%	11.0%	10.6%	9.7%
Ironworkers	6.5%	7.1%	6.8%	6.0%
Joiners	5.9%	6.4%	6.6%	7.4%
Boilermaker, Wood Machinist, Pattern Maker, Moulder, Blacksmith, etc.	0.4%	0.4%	0.3%	0.5%
	29.6%	32.0%	31.8%	30.8%

These ratios will vary for different types, scantlings, and sizes of tugs, but may be taken as fairly representative of our manhour split-up for modern diesel tugs of about 90 - 110ft. in length. It must be remembered that union conditions, trade demarcations, degree of sub-contracting and the extent of purchasing of 'bought-in' items will vary in other yards from the conditions applying at our yard, with consequent effect on the ratios.

It is interesting to see that the values agree closely and where there is any great difference, for example, as appears in the case of draughtsmen, there is a logical reason. In this case Ship 5 was the third vessel with this class of hull and had the benefit that the drawings for the previous two similar vessels served as guidance, while Ships 3 and 7 were both of a totally different type, and were the first of their respective class. In the case where two vessels are of similar hull form and are put through the yard together, it is the practice to split the manhours and costs over those two vessels. This applies to loft work as well as draughtsmen.

Again, for Ship 3, the boilermakers' hours appear high, explained by the fact that the scantlings were somewhat lighter than the other two vessels, also since they had a complicated tank arrangement. After allowing for this there would be a tendency for the percentage to drop on later vessels, since the boilermakers had become more experienced and methods have been improved to a greater degree in this trade.

While the above Table II gives the percentage break-up of manhours in terms of the various trades on these vessels, it is of interest to check how the hours for the same vessels compare on a basis of cost items, which is shown in Table III.

Naturally it is not possible to list all items and for brevity the comparison will be made in terms of the main groups of our Cost List, which are :-

A. Section 1 - Hull Structural.
B. Section 2 - Hull Fitting Out, Piping, etc.
C. Section 3 - Machinery, Machinery Piping.
D. Section 4 - Electrical.
E. Section 5 - General - Loft Work, Drawing Office, Launching, Transport, Cranes, Storemen, etc.

TABLE III - PERCENTAGE BREAK-UP OF MANHOURS INTO COST SECTIONS

		Ship 3	Ship 5	Ship 7	Ship 8
A.	Hull Structural	26.8%	26.8%	25.5%	27.2%
B.	Hull Fitting Out	29.4%	29.9%	30.8%	30.8%
C.	Machinery	18.8%	19.3%	17.4%	17.4%
D.	Electrical	4.4%	4.9%	5.1%	4.8%
E.	General	20.6%	19.1%	21.2%	19.8%

It is not possible to compare this split-up with the previous one in Table II, with the exception of the Electrical Department. In this split-up into departments in Table III it will be seen that the percentage is slightly higher than in the trade split-up, since the hours of other trades "in attendance" on electricians have been added in against the Electrical Department.

A further comparison which may be of interest is of the cost of labour as against the cost of materials, given in Table IV. This must be considered in general terms only, as one owner may require a cheap vessel so far as equipment is concerned, while another will require dependability at any cost and specify various items of equipment for "stand-by" purposes. Again, the biggest single item of expenditure is the main machinery and this varies greatly in cost between different ships, depending on -

(i) whether a fluid, or other type, coupling is required.
(ii) the horsepower required, which in turn depends on speed and pull required.
(iii) the manufacturer specified, this being perhaps to standardize with other vessels in the fleet; of such a size to permit more accommodation; for the lowest cost; for the owner's personal preference; etc.

Despite the variation in this machinery cost and the cost of other equipment, it will be seen that the proportion is reasonably constant.

TABLE IV - PERCENTAGE BREAK-UP INTO LABOUR AND MATERIAL

	£'s Labour	£'s Material
Ship 3	32.7%	67.3%
Ship 5	33.6%	66.4%
Ship 7	36.5%	63.5%
Ship 8	33.2%	66.8%

Over the period in which these vessels were built there have been marginal and basic wage rises, which have affected these proportions. Scantlings of the vessels will also affect them, as also do the various points referred to above; also the amount of overtime worked, amount of lost time; yard facilities etc., but I think that it can be taken as a rough guide that -

"The Cost of Labour is Half the Cost of Material."

Of course these figures do not include Overhead, Payroll Tax, Profit, etc.

On examining the figures in Table IV it is of interest to find that the proportion of labour is greater in the smaller ship, but further investigation might prove that this had been caused by the higher wage rates in the more recent ship, which increases always tend to increase labour costs faster than the cost of equipment. Again it could be caused by increased efficiency in purchasing, or, most likely, a combination of all these reasons.

Any person would be ill-advised to use these proportions for estimating purposes in their own yard, however, since our conditions are different to those of any other yard as regards the amount of work which is subcontracted.

MATERIAL SPECIFICATIONS.

We consider it essential to prepare Material Specifications for the great majority of the materials purchased for vessels. Initially these were done in a brief manner but we found, in many instances, that we were not receiving the equipment we thought, and in the case of imported equipment there was no time then available for correcting this. This led us to be most meticulous with such specifications, particularly for an item such as a Main Engine, and we know that this system has paid off.

Such a specification is issued to all persons concerned with either its fitting, costing, drawing etc. and serves also for progressing purposes.

These specifications are numbered in the approximate order in which the materials should be ordered for a ship, and in the case of a repeat, or similar vessel, are invaluable since this becomes almost an automatic operation.

Prices are shown on these specifications and these also prove of great help when an estimate is being prepared.

All such specifications are the responsibility of the Shipyard and Engineer Managers, who either prepare or sight all such. This is only a matter of form for small items but is found to be essential with the larger items of equipment, as these persons have been responsible for the estimate, the ship specification and the preliminary general arrangement and know the exact requirements of the owner since, in most instances, the contract has been discussed between them. A great deal of the preparation of these specifications is done by the assistants to the respective Managers.

ORDERING.

When the Material Specification is drafted it is passed through to the ordering department with a requisition attached. It is checked for conditions of supply, details added regarding order number, etc., then typed and issued. In the case of equipment from overseas, these orders and specifications are passed to our associates in the U.K., Seawork Ltd., who pass them to the suppliers, retaining one copy, which supplies the information to enable them to carry out progressing in the U.K. on our behalf.

COSTING.

On receipt of invoice, the ordering department checks and extends same, marks the relevant cost number, obtainable from the requisition, and adjusts the stock records. Before payment is made invoices are sighted by the Managers, since some instructions to act do go out without a requisition and authority is required before payment will be made. One such instance is in the ordering by 'phone of tugs to move vessels, perhaps at short notice, when a written order is impractical.

The cost clerk posts items to the cost ledgers. It should be mentioned here, that invoices, when certified, are immediately entered in a Purchases Book, which is posted frequently. This means that the cost accounts are far more up to date than if the posting were done from cash book several weeks after receipt of goods.

Allocation of Wages and Manhour Compilation

Every workman fills in daily a daily time docket showing details of his day's work. These dockets are initialled by foreman and handed to the timekeeper. These dockets provide the information from which a weekly summary is compiled showing cost of each item of each ship and the hours worked on each cost item. The summary also shows "trade" hours as well as "manhours" for each item.

Cost Accounts

The cost accounts are compiled by accounting machine and consist of material and labour cards for each section of a ship, sub-total cards and a total card. The purpose of this is shown hereunder :-

Item Cards	Sub-total Cards	Total Card
Material cards (say) 1 - 300	Total material	Total Cost
Labour cards (say) 1 - 300	Total labour Overhead Payroll tax	

Item Cards

These show labour cost, manhours, trade hours and material for each section of ship.

Sub-total Cards

These show total of labour etc. posted each week to the various items.

Overhead is calculated weekly and posted to the overhead card.

Payroll tax is kept separate from wages and appears on payroll tax card.

Total Card

This contains the total of labour, material, payroll tax and overhead.

The above method provides fully detailed progressive costs of any part of a ship, progressive totals of labour, material, overhead and payroll tax, as well as the weekly total cost.

As all data required for the system is derived from daily time dockets, and the ordering of and invoices for material, it is important that these sources of information are carefully watched.

STANDARDS.

The introduction of "standards" has proved to be of the greatest possible benefit. At present these standard foolscap size drawings are in use for the outfit trades only, there still remaining many to be drawn when the opportunity arises. In due course, it is intended to apply the same methods to structural drawings. The number of standards in use at present is approximately 300, but some trades such as painting, plumbing, electrical, and engineering, have not been touched as yet and it is estimated that several times this number must still be prepared for outfitting trades.

The basis for using these standards is to prepare a large scale "weather deck fittings" drawing showing every item possible with the number of the relevant standard added, there often being a choice of three or even four standards for the one item; for example - tow beams. A further drawing is done for the "Accommodation" and these two drawings permit the majority of the work for the hull department fitting out trades to be covered. They do not, however, replace fitting out plans such as "Boat Arrangement", which will be peculiar to each ship, and requires to be submitted to the Navigation Department for approval.

These standards drawings also aid the estimating of quantities, the ordering of fittings, for use by subcontractors for manufacture of equipment, for the calling of quotations, as well as their prime purpose of standardising yard practice.

Needless to say, the issue of these is strictly controlled and the replacing of superseded details is essential.

SHIPBUILDING METHODS.

Construction

To date a "ring frame" method has been used on all ships with the exception of Ship No. 4, which was small and light and more suitable for panel construction. The name "ring frame" is self-descriptive, these frame rings being completely welded on the skids with all beam, floor, and bracket connections welded downhand and the slots for longitudinal members almost cut through, the mouths being left closed for burning out at the ship so as to prevent distortion whilst lifting into position. Even where the deck beams are not continuous, due to casing or hatch openings, the ring frames are constructed as a continuous ring in order to maintain transverse rigidity, the unwanted section of beam being left until virtually all the main structures have been erected and welded.

The Drawing Office develops the details to make construction almost entirely self-jigging, which requires that principals should be rigid in the transverse plane, which suits this ring frame method. To obtain the maximum advantage it is necessary to have a good proportion of the component parts of the structure ready alongside the berth before erection commences.

A gate template is usually made from the scrieve board for each body, the frame lines thereon being transferred on to the steel plates of the fabrication area, then the ring frames set down on those lines, tacked and then finally welded. A typical ring frame is illustrated in Fig. 7.

Large prefabricated units are not constructed due to the limiting crane capacity of 3 tons. However, bulkheads are always prefabricated, as also are deck panels without the beams, also shell panels on the flat of side without frames attached. The stern is always built as a unit from the forward bulkhead of the steering gear compartment, as also is the wheelhouse, funnel structure and portions of the superstructure where practicable.

When building the hull the procedure is that the bar keel is firstly laid, the bottom shell then being positioned on tops of planks which have been blocked up transversely to the approximate height of the shell. On top of this a key bulkhead, around amidships, usually the forward machinery space bulkhead, is erected and plumbed. It is normal practice for all our vessels to be built with frames vertical. Key ring frames spaced about four frame spaces apart are then erected forward and aft of this key bulkhead, held together at the top by spacing pieces. These frames are faired and the topside shell panels then positioned and the whole faired to form a unit. Ring frames forward of the machinery bulkhead are then erected, followed by any centreline bulkhead in this region. The remainder of the ring frames in the section aft of the machinery bulkhead are then completed, following which the main engine girders are erected complete with their rider plates. Any tank top plating in the engine room is then erected, together with the tank margin. Deck panels are now used to tie the whole unit together.

It is now possible to progress the ship either forward or aft of this centre section. Normally work progresses at the aft end to permit the heavy work in way of the stern frame and stern tube to be completed to permit boring out for the shafting to be completed prior to launching.

When progressing the forward end the stem bar is stood up, the bottom shell positioned, key ring frames positioned together with the fore peak bulkhead, following which the side shell is carried forward to this bulkhead. The remaining ring frames are then dropped in and also any fore and aft bulkheads or part transverse bulkheads.

Usually the tank top plating requires to be shipped through the deck beams and the tank top beams may require to be left portable. Deck girders are positioned, deck panels dropped on, followed by the bottom shell plates until finally the hull is complete up to the stem bar. At the forward end small shell plates may be left off for access, as also is the shell plating between the chines, but the shell is completed at the top sides to permit anchor recesses to be progressed and so enable the fore peak tank to be tested.

A similar procedure is adopted at the aft end, a process of erecting key ring frames and bulkheads, fairing them, adding the top shell, dropping in remaining ring frames, adding the deck, followed by the remainder of the shell.

Typical stages in construction by this method are shown in Figs. Nos. 8, 9, 10 and 11.

This method permits us to construct the hull of a vessel of approx. 100ft. length, up to the launching stage, in about 5 months, but if the vessel is fully manned up it would be possible to reduce this to 3 months, as was recently demonstrated by our associates in Great Britain.

The methods used in the case of twin screw tugs become a little more complicated in the aft end region, and reference may be made to the Paper "Design, Construction and Operation of a Class of Twin Screw Tugs" for further details.

The method described above was adopted when the yard commenced, being the method in use by our associates in Britain. It must be realised that the greater majority of our workmen were not skilled steel shipbuilders and those that had had shipbuilding experience were not acquainted with small ship construction in most cases. Once a certain method had been adopted we were loath to depart from it as the men have become skilled with this particular method. Recently, however, the position was again considered as it appeared that our forward programme would be such that we must attempt quicker and more efficient construction to be able to complete a greater number of vessels annually with the same work force. We do not wish to increase this work force greatly at present, due to the limitations with our locker and toilet facilities and seating space in the mess room, but, if necessary, steps will be taken to make other arrangements in this regard.

Our various technical staff are fully conversant with the advantages and disadvantages of the various methods of construction, such as panelling or unit methods, having had experience of these at other yards in Australia and overseas.

On the larger of the vessels now building, which at the time of reading this Paper should be approaching the launching stage, we have partly adopted panelling methods, by this means reducing the amount of positional welding and permitting the use of automatic welding machines, which to date have been considered to be unwarranted. This method employs a combination of flat plate panels, sub-assemblies and ring frames, the various steps being as follows :-

The bottom shell is constructed in panels but without stiffening members.

The side shell amidships over the half length is panelled complete with frames.

The main deck is panelled, panels being broken at the centreline where the straight line camber is knuckled, panels being complete with beams.

The tank top in the machinery space and also the tank top forward are built as panels, then the floors etc. erected on this panel as a base and welded in the downhand position, so that the tanks are erected as units, being welded to the bottom shell at the berth.

Ring frames are still used at the forward and aft ends.

The extreme aft end in way of the steering gear compartment is built as a unit.

The skeg, which extends from almost amidships to the propeller post is built as a unit.

At the forward and aft ends, in way of the ring frames, the shell plating is erected as a bare panel.

The strake between the two chine bars will be erected plate by plate, as also will be the lowermost shell at the extreme forward end, as it is necessary to leave these off as long as possible for convenient access and to suit the welding in the restricted tanks.

A further variation to the method of construction was used on our Ship No. 4 in which the framing at the forward end, where the shell is developed as portion of a cone, was run diagonally from the keel. Since the shell was a true part of the cone it was possible to arrange these dioframes so that they were straight and no shaping of frames was required, the method resulting in a very strong structure in association with the relatively light plating on this vessel.

This method is illustrated in Fig. 12.

Welding

After consideration of the various ships built to date, we find that in vessels with normal scantlings that an approximate quantity of 1,000 feet of rod is used per net ton of steel built into the ship. This figure is regularly reducing, in the case of the first vessels it being almost 1,100 feet but now is below 1,000. This is caused partly by a movement from using 10 gauge to 8 gauge and partly from the use of better welding methods.

The main usage is in 8 gauge rods, the quantity being approximately three times that of 6 gauge; our work not necessitating the size fillets obtainable with a 6 gauge rod. The amount of 8 gauge rod used is very roughly 50% of the total quantity for the ship.

Our figures do not show our growing use of vertical welding in the downhand direction, which is being used for our Ships Nos. 6 and 10, which are still building. We consider these rods give a much greater speed of weld deposit and in addition give a very smooth, somewhat concave, fillet and in so doing eliminate the possibility of undercutting, which was much more prevalent with vertical welding in the upward direction.

We have no preference for any single welding rod manufacturer, buying the rods which we consider the most efficient. For our earlier vessels we used 'A' type rods from one manufacturer, changed to 'B' type rods from another manufacturer, have now changed back to 'A' rods, and it could be that we will swing again to 'B' rods before long.

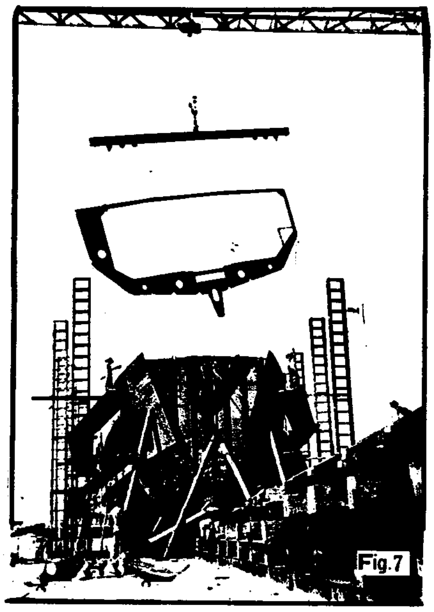


Fig.7

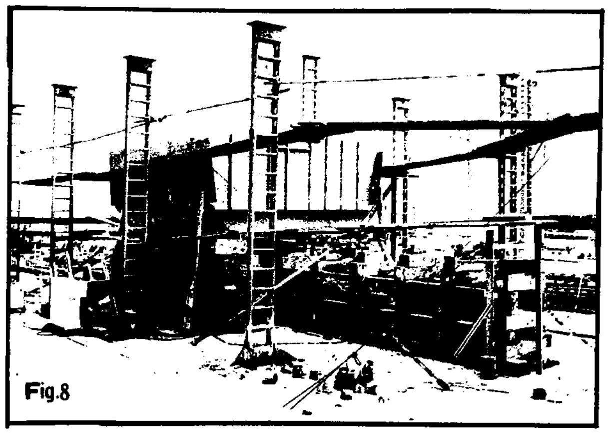


Fig.8

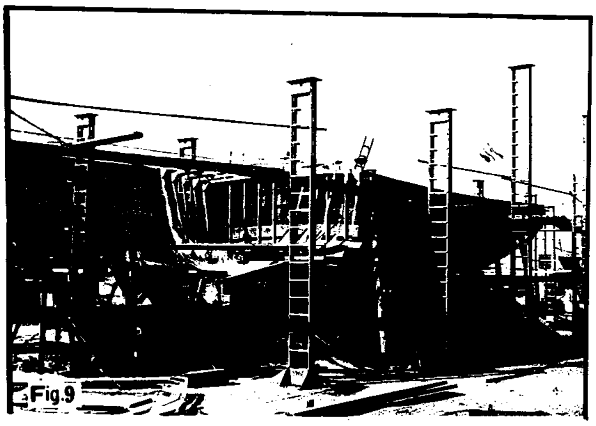


Fig.9

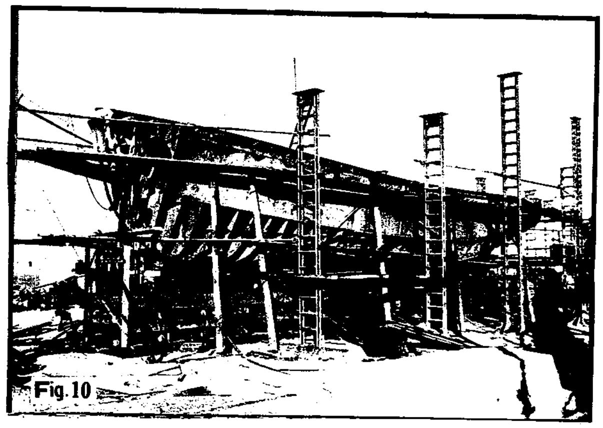


Fig.10

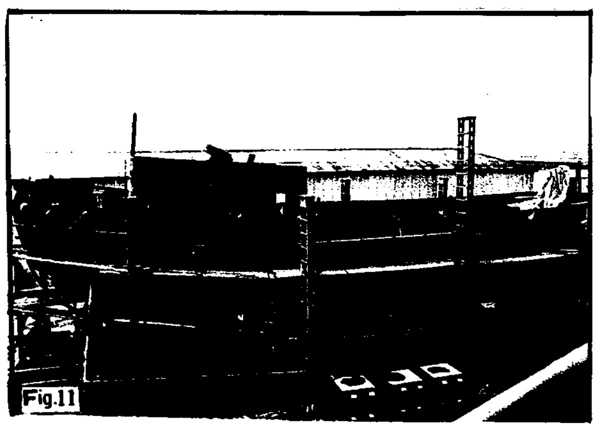


Fig.11

Fig.12

LAUNCHING

Launching information of the various vessels may be of interest, being set out in some detail in Table No. V, while a typical launching arrangement is shown in Fig. 13.

The obvious comment will be on the fact that launchings are carried out with a very small, even a negative, moment against tipping. This is principally caused by the hull form of the Hydroconic vessels, the very flat run up aft affording very small buoyancy. Such a condition was somewhat disturbing when first encountered, but now is not given a thought. As will be seen, Ship No. 2 had a tipping moment of 1300 ft.tons, brought about by the lack of tide which failed to reach the anticipated height by 6in.

For each launching the wax used has been Esso Basekote T.S.D. 646 with the lubricant Esso Slidecote 4. We have been able to retain the majority of the T.S.D. 646 on the ways between launchings, patching where necessary.

In the case of a large type tug built on the top of a berth, as was Ship No. 2, the maximum speed during the launch rose to 13 m.p.h., the dynamic effect of this being some safeguard in the event of any tipping moment.

The typical launching arrangement in Fig. No. 13 shows the arrangement as for our Ship 6, which arrangement we consider to be quite orthodox.

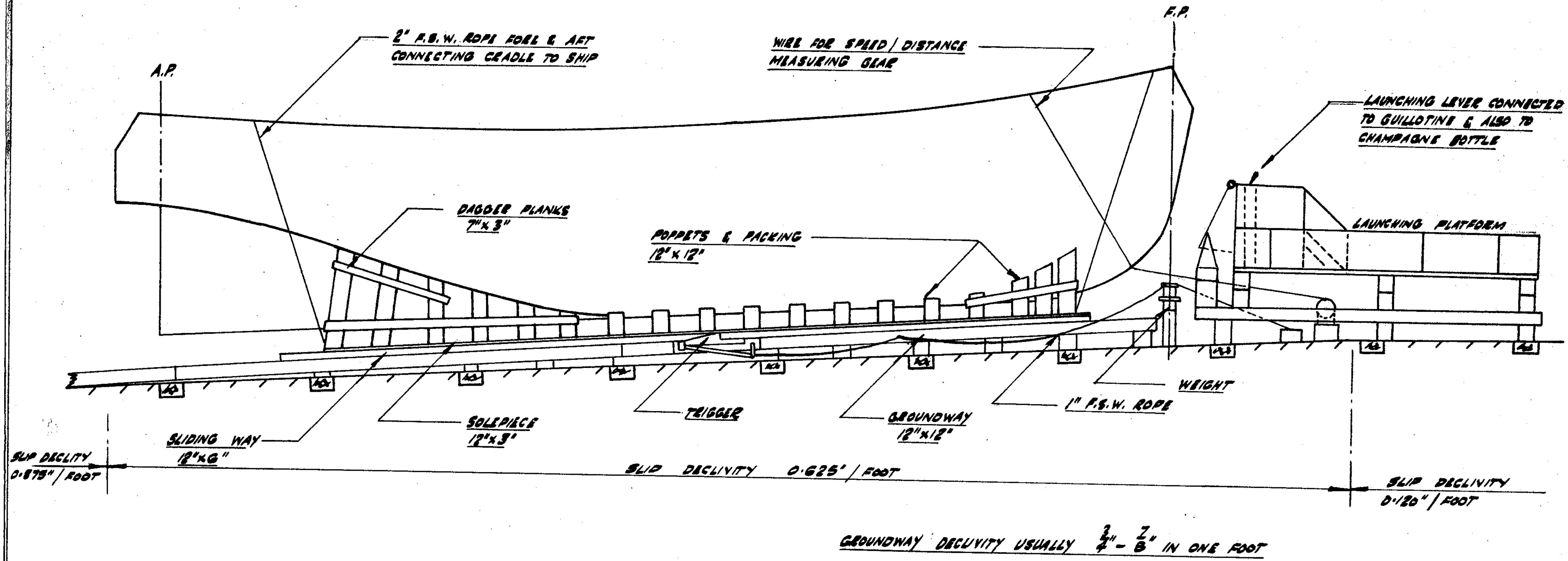
Several methods have been used to calculate the time/distance curve of the vessels during the launching. One method which was of particular interest but required more attention than usual to set up entails the use of a camera. Two squares were set up on the front of the wheelhouse at a distance apart of 16 feet. These squares had a white centre 12 in. square surrounded by a black border 6 in. wide to give a board on either side 2 ft. square. A movie camera was set up at a fixed distance forward of these points and the camera was set running prior to the ship commencing to move. A clock was suspended in the foreground with a sweep second hand, so that when the vessel started to move instantaneous records were recorded of time and the position of ship down the ways. When the film was developed the film frames were picked out at certain regular time intervals and the distance between the two fixed squares was accurately measured by means of a microscope. Knowing the details of the lens, it was then comparatively simple to calculate the distance these fixed points were from the camera and so the distance was able to be computed. This method proved to be amazingly accurate and had the benefit that it gave a definite record which could be run through at any time should there have been any accident during the launching.

More recently a pen type drum recorder has been used, operated by a steel piano wire attached to the ship. This is set up under the launching platform and also gives a very accurate record, recording the vibration when the guillotine cuts the trigger ropes nearby. This equipment was made up by the members of the staff of the School of Mechanical Engineering of the University of Adelaide at quite some expense and we now ask the University to take the records at every launch. This they are pleased to do, sending down two of their senior staff, the completed records being available within the next week or so.

ADELAIDE SHIP CONSTRUCTION LTD.

TABLE V - LAUNCHING PARTICULARS

	Ship No. 1	Ship No. 2	Ship No. 3	Ship No. 5	Ship No. 6	Ship No. 7	Ship No. 8	Ship No. 10
Launching Weights - Vessel	171 Tons	173 Tons	190 Tons	176 Tons	71.2 Tons	125.4 Tons	125.8 Tons	73.5 Tons
Ballast	* 18 "	* 18 "	* 10 "	* 18 "	* 7.4 "	* 7.6 "	*10.7 "	* 7.4 "
Cradle	5 "	5 "	5 "	5 "	3.6 "	5.0 "	3.7 "	3.6 "
Total Launching Weight	194 "	196 "	205 "	199 "	82.2 "	138 "	140.2 "	84.5 "
Declivity of Keel - Ins. per foot	0.5625	0.5642	0.5714	0.564	0.5472	0.345	0.345	0.5472
Declivity of Groundways - Ins. per foot	0.875	0.6952	0.875	0.875	0.75	0.75	0.875	0.75
Length of Groundways (F.P. to A.E.W.)	182'-0"	292'-0"	190'-6"	191'-6"	168'-11¼"	278'-0"	186'-0"	270'-11¼"
Initial Force Down Ways	9.9 Tons	7 Tons	10.5 Tons	10.15 Tons	1.276 Tons	5.62 Tons	1.790 Tons	1.260 Tons
Coeff. Friction Grease (Sliding)	0.0022	0.037	0.01988	0.0202	0.0469 Ø	0.02975	0.02755	0.03565
" " " (Starting)	0.022	0.056	0.04784	0.05588	0.0608 Ø	0.03907	0.0599	0.04744
Length of Sliding Ways - Fore Poppet to After Poppet	70'-0"	70'-0"	73'-6"	70'-0"	48'-6"	64'-3"	63'-0"	48'-6"
Area of Bearing Surface - 2 Ways	134Sq.Ft.	134Sq.Ft.	141Sq.Ft.	134Sq.Ft.	96Sq.Ft.	123Sq.Ft.	118Sq.Ft.	96Sq.Ft.
Weight Per Sq.Ft. On Ways	1.45 Tons	1.29 Tons	1.45 Tons	1.31 Tons	-	1.12 Tons	1.188 Tons	0.879 Tons
C.G. of Ship From ⊗ (Without Cradle)	5.17' For'd	4.82' For'd	3.35' For'd	4.95' For'd	2.55' For'd	2.55' For'd	2.62' For'd	2.15' For'd
" " " " ⊗ (With Cradle)	5.19' For'd	4.85' For'd	3.54' For'd	4.28' For'd		2.42' For'd		
Sliding Ways Spread Cr. to Cr.	8'-11"	8'-11"	9'-11"	8'-11"	6'-8"	7'-11"	7'-11"	6'-8"
F.Poppet Aft of F.P.(To Cr.of Poppet)	11'-0"	11'-0"	12'-6"	11'-0"	6'-10"	10'-10"	10'-10"	6'-10"
Tide Above I.S.L.W.	8'-5"	8'-7"	8'-9"	8'-6"	11'-9"	8'-9"	7'-3½"	9'-1½"
Depth of Water Over Way Ends	7'-8"	6'-9½"	8'-1¾"	7'-8"	)Tide	7'-3"	6'-7½"	7'-9 5/8"
A.E.W. to F.P. When Ship Floats Off	23'-9"	25'-0"	52'-3"	23'-0"	)Abnormally	42'-0"	15'-4½"	51'-8¼"
Travel Before Lift of Stern	155'-3"	273'-3"	141'-9"	155'-0"	)High - No	236'-6"	149'-5"	216'-3 5/8"
Travel Before Ship Floats Off Ways	158'-3"	278'-0"	150'-9"	168'-6"	)Records	236'-0"	160'-7½"	219'-3"
Least Moment Against Tipping	250 Ft.Tons	-	300 Ft.Tons	300 Ft.Tons	)Possible.	-	-	490 Ft.Tons
Maximum Tipping Moment		1300Ft.Tons				200 Ft.Tons	210 Ft.Tons	
Drafts With Cradle Aft	8'-5"	8'-8"	8'-2"	8'-6½"	5'-7"	7'-3"	7'-3"	5'-7½"
For'd	5'-6"	5'-5"	4'-6"	5'-8½"	4'-2"	4'-7"	4'-8½"	4'-3½"
Without Cradle Aft	8'-6"	8'-9¼"	7'-11½"	8'-9"	5'-7"	7'-4½"	7'-5"	5'-9"
For'd	5'-6½"	5'-5¼"	4'-7"	5'-7"	4'-4"	4'-7½"	4'-9"	4'-4"
	* 18 Tons W.B. in Fore Peak.	* 18 Tons W.B. in Fore Peak.	* 10 Tons W.B. in Fore Peak.	* 18 Tons W.B. in Fore Peak.	* 7.4 Tons W.B. in Fore Peak. Ø Ship was in water.	* 7.5 Tons W.B. in Fore Peak.	*W.B. 7.6T. F.P., 3.1T. Chn.Locker. Ballast on Fore Deck.	* 7.4 Tons W.B. in Fore Peak.



ADELAIDE SHIP CONSTRUCTION LTD

FIG. 13 - TYPICAL LAUNCHING ARRANGEMENT

SCALE 1/8" = 1 FOOT

TRIALS.

The trials of all our vessels to date have been carried out with the same trials master in charge. This master is the Manager and Superintendent of the firm of tug owners in this port, prior to which he had considerable experience in Sydney and other New South Wales ports, together with the experience of several well-known salvage jobs. He was delivery master of what is regarded as the best salvage tug in Australia, which arrived from England in 1958, and by reason of his varied and extensive experience, is able to advise us on the ease of handling etc. of the various ships we have built. Any information given in this manner is borne in mind for future vessels and as a result we consider that the vessels we design are the best possible for the service intended.

It is the practice to carry out a fairly complete set of trials. Apart from the normal tests and making ready of equipment, which takes at least a fortnight before basin trials, the following sea trials are carried out :-

Anchor trials
Speed trials
Steering gear trials
Circle trials
Full speed astern trial
Stopping trial
Static bollard test
Hook tripping test
Deep-sea or oil consumption trial.

On the completion of the trials it is the practice to open up the main machinery, the vessel normally being handed over about 10 days after the completion of sea trials.

HYDROCONIC DESIGN.

Basic Considerations

The approach to Hydroconic design is centred on the propeller. The performance of a screw behind a normal tug hull is of lower efficiency than in open water, whether this be on the bollard or at low speeds, towing or running free. Normally, the centre of buoyancy of a tug is placed aft of amidships, and this entails a high thrust deduction which produces the lower "behind" towing efficiency (the efficiency of a propeller at zero speed of advance is, of course, zero). It was therefore taken for granted that the actual operating conditions of the propeller behind the hull must be as good and therefore moved the centre of buoyancy further forward, giving a very long easy run to the hull.

At the same time two further problems arose, namely, that such a form would "squat" at the higher speed length ratios and that air drawing, which is marked on some tugs, would be even more marked on such a form. The after sections were therefore considerably widened, which then gave sections which supplied complete coverage to the propeller and at the same time gave a feed of water to the propeller almost entirely on buttock lines, which gave a clear break away to the flow at the stern.

By suitably arranging the shape of these sections a dynamic lift at high speed length ratios was obtained, which enabled the squatting difficulty to be avoided, this being borne out many times by testing at the National Physical Laboratory, which proved the absence of squatting at any speed.

Propeller

Due to the shape of the after sections mentioned above, it is possible to fit a rather large propeller. Since the pull of a tug is lineally proportional to the propeller diameter, all other things being equal, this assists in obtaining a higher than normal bollard pull, as does the absence at the lower speeds of thrust deduction.

All propeller designs are carried out by Messrs. Burness, Corlett & Partners Ltd. and their success to date has been well borne out, better or comparable results having been obtained when compared with the results of the propeller manufacturing companies.

Hull Design

The Hydroconic form usually, but not invariably, embodies a double chine amidships, which disappears into a ship-shape bow forward. The hull is entirely developable and the well-known difficulty of obtaining the exactly correct position for chines forward is avoided completely by fitting developable but normal type bow sections.

Wide "V" forward sections are adopted with a relatively large angle of entrance and the water flow is encouraged more on the bow line than on the water line, which provides a flow beneath the hull as much as possible, which ensures a good feed to the long and fairly flat run aft into the propeller and stern gear.

The use of these wide "V" sections, as compared with sections of a vessel with a fine angle of entrance, show that an increase in breadth is necessary on the vessel with the fine angle of entrance because of the low waterplane inertia coefficient and to achieve the same stability as the vessel with the wide "V" sections, which offers some definite attraction in the Hydroconic form.

The hull is an individually distinct body with a skeg added, although, of course, the skeg is so constructed that it is an integral structural part of the hull. The effect of re-entrant corners upon the resistance is negligible. A great advantage of this stern is that an extremely uniform wake distribution can be produced, resulting in lack of vibration, high propeller efficiency and a good propulsive coefficient.

Careful consideration is given to water flow and all Hydroconic forms are so arranged that water flow does not cross the chines; diagonals approximately parallel to the chines being extremely smooth and easy. The shortest possible path is ensured thereby minimising the effect of form on skin friction, while the hull is rendered relatively less dependent of breadth and displacement length ratio.

During the last war it was shown by a number of investigators that in a straight line form, as opposed to the Hydroconic form, the resistance in propulsion characteristics are extremely sensitive to the position of the chine in the forward body, in the region of stations $9 - 9\frac{1}{2}$. It is possible to get good results, but only as a result of extensive tank testing involving the trial of a number of alternative positions.

N.P.L. tank tests show that the Hydroconic tug form is of low resistance by any tug standards and in association with a good propeller, has a high propulsive efficiency.

As mentioned previously, the hull is fully developable and the forward sections use the surfaces of various irregular, conical, or cylindrical bodies. Although described as a simplified form, the lines for vessels such as these are very difficult to evolve and the actual production of a completely developable form with satisfactory resistance, propulsion, steering, sea-keeping, etc., is much more difficult than producing a round bilge design of comparable quality. The form is defined very early in the design stage by the choice of development parameters and if these are not exactly right there is no freedom for fairing at a later stage. The detail definition of the form, therefore, in all respects must be decided on at an earlier stage than is normal in a ship and it is through much research, experiment and experience that excellent results have been obtained.

Rudder Forms

Most single screw Hydroconic tugs use the B.C.P. bulb rudder, which is a most efficient rudder having unusual characteristics. The principle of such a rudder is complicated; it is in effect a flapped hydro-foil, the flap acting to stimulate circulation over the forward part of the rudder, that is, the fixed post. If it were not for astern steering requirements, it would be satisfactory to fit a very large bulb post and a very small flap, but this is not practicable. The rudder has a characteristic of producing large lifting moments at small angles of helm and of having a relatively constant holding torque at any given speed when measured against the angle of helm.

The principal advantage is that contra-rudder characteristics are obtained, there being a definite forward component derived from the wake which helps the propulsive efficiency. In some tugs the increase in thrust produced has been as great as 10%, while the effect on free running characteristics, although smaller, is also noticeable.

In the case of the "Sydney Cove", over a range of about 800 to 1400 S.H.P. on the bollard, a more or less constant increment of thrust was obtained, the behind pull, in fact, being 1.6 tons higher than the calculated open water thrusts at these horsepowers.

This rudder, which was patented by our Consultants, is derived from wind tunnel results obtained from the Luftwaffe after the last war when their research records were made available to the Allies. Reference to Fig. No. 14 shows the rudder consists of a high thickness ratio streamlined bulb post with a flat plate rudder behind.

Manoeuvrability

The Hydroconic hull is extremely manoeuvrable either in single screw or twin screw form. The latest single screw hulls are built with a large sluice keel which assists in astern 'coasting' with the propeller at rest and the twin screw tugs are probably the most manoeuvrable at present built. This has been borne out by the N.P.L. reports, which confirm the following points :-

> "In ahead seas when steering ahead the course-keeping was good and the response to helm was rapid.
> When steering ahead in following seas the course-keeping was good and the stern lifted well to the seas without slamming.
> When turning the model laid beam on to the seas and turned either into the seas or away from them satisfactorily with no appreciable spray shipped even when turning into the seas.
> When backing into following seas the vessel backed slowly with satisfactory course-keeping and no tendency to slam or ship water."

In practice, with tugs in service, good reports have been received. With the longitudinal centre of flotation so far aft a tug tends to keep its stern on the water and its bow to lift. Due to the shape of the sections, bow movement, however, is heavily damped, with the net result that little or no water is shipped, the propeller does not kick out of the water, and in conjunction with the shape of the sections aft, there is no tendency to slam.

All single screw vessels built to date by Adelaide Ship Construction have been fitted with the rudder of the form previously described. A rudder angle of 35° is normally fitted, but it has been proven that at speed an angle of 27° is quite satisfactory. However, in tugs designed to work in the main Australian ports, we have found it advantageous to increase this rudder angle to 45°, as the maximum effect is required when the vessel is manoeuvring at very low speeds, say at 20 propeller r.p.m. With such an angle it is found that with a slight forward movement the vessel becomes quite manoeuvrable and when speed is increased with such an angle the vessel is very manoeuvrable and can turn easily in its own length. This point has proved so attractive to owners that it is intended to keep to this maximum angle for future vessels. At full speed trials have shown that with the angle of 45° a turning circle with a diameter of $2\frac{1}{2}$ times the vessel's length is normal. Fig. No. 15 shows such a plotted circle for our Ship No. 7, it being compared with the circle obtained at the normal rudder angle of 35°. It should be pointed out that at full speed it was not possible to put the helm over to the full angle of 45°. On Ship No. 8, of similar hull form, it was found on trials that at full power and with the helm 'hard-over', steering under power, the tactical diameter was 237ft. on the port circle and 248ft. on the starboard circle. At 35° helm these circle diameters were 251ft. and 254 ft. respectively.

Factors other than the design of the underwater hull affect the manoeuvrability, the principal one being the amount of windage and its centre of pressure, a factor of which tug owners are, or should be, acutely aware and design the superstructures of their vessels accordingly.

Again, we ensure that our tugs are manoeuvrable when on a line by correctly positioning the hook. Naturally this point varies with the type of hull but we have a percentage figure, measured aft of amidships, to the point of application of pull, which is never exceeded. A separate paper could be written on the advantages of various types of hooks but it is not proposed to discuss this further at present.

It will be found, almost without exception, that no single screw tug steers astern. Of course, there are exceptions, the tugs "Heros" and "Heroic", in service in Sydney Harbour, being cases in point. Hydroconic tugs cannot be excepted from this statement but it will be found that the great majority will run astern without deviation for some distance but they could not be said to answer the helm readily. However, if the owner specifies that he wishes his tug to steer astern, this can be done by a modification to the hull but without varying the Hydroconic form whatsoever. We have now built two vessels for such a purpose and in each case the owners have been delighted with the astern steering. Naturally, the performance in other directions could be expected to fall off, but again, any loss of efficiency in the ahead manoeuvrability has been more than compensated for by incorporating a rudder angle of 45°.

It was anticipated that there might be some reduction in stability, particularly with slack water in all tanks, but in practice it has been proven that the G.M. and range of stability has been entirely satisfactory, in fact, generally the stability standards used for Hydroconic tugs are much better than those normally provided by tug builders.

In the case of any twin screw Hydroconic tug it will be found that the astern steering is particularly good. Readers are referred to the paper by Messrs. Corlett, Venus and Gibson entitled "The Design, Construction, and Operation of a Class of Twin Screw Tugs" for details of the vessels designed for use on the Manchester Ship Canal.

Performance

The designs to the Hydroconic hull form, when carried through without undue restriction, can give pulls of the order of an average of 1.6 tow rope tons per hundred S.H.P. This has been proved beyond doubt and if a tug does not produce 1.6 tons per hundred S.H.P. on trials, it is considered to be deficient and is nearly always caused by the owner insisting on more horsepower than is economically suitable for a hull of the particular size, or alternatively, has specified propeller revolutions which are not the optimum for the size and horsepower of the tug.

These figures have been quoted for a single screw tug and in the case of a twin screw ship, a figure of 1.5 tons per hundred S.H.P. has been averaged. We are prepared to guarantee these performance figures against heavy penalties or even total rejection of the vessel.

It is possible to give a bollard pull of the order of 1.8 tons per hundred S.H.P. but this is only possible under ideal design conditions.

The quoting of bollard pull performance in a manner such as above has often been decried, usually by persons with no knowledge of the specialised field of tug design and construction. Their suggested method of better expressing the obtainable performance figures would be welcomed.

Naturally if a vessel be overpowered such figures cannot be quoted and to enable the designer to ascertain whether this is the case it is taken that it is not possible to achieve the normal minimum target for a single screw tug of 1.6 tons per 100 S.H.P. if the ratio $\frac{\text{S.H.P.}}{\text{Prop.D}^2}$ exceeds a limiting value dependent upon the hull form.

At times, due to unavoidable restrictions, the tug might be overpowered. A case in point is a tug now building in which the engine was uprated after ordering from 600 to 660 B.H.P., while at the same time the lightship weight had to be restricted to permit the vessel to be slipped on an existing slipway. It may be possible to achieve 9 - $9\frac{1}{2}$ tons but a figure above $8\frac{1}{2}$ tons could not be guaranteed. With a slightly larger tug the expected figure would be $10\frac{1}{2}$ and $9\frac{1}{2}$ tons could be guaranteed. With the smaller tug the largest propeller size is approximately 7ft. which gives a value for the above ratio of 12.75, while for the larger tug an 8ft. propeller could be fitted, giving a ratio of 9.8.

There are various ways in which this ratio of S.H.P./Prop. D^2 may be varied so that the resultant ratio required may be obtained. Firstly, power may be increased by running the engine at a slightly higher speed, this of course being dependent on the machinery manufacturers. Alternatively the propeller diameter may be increased by either increasing the draft aft if this is acceptable, or altering the aft end lines to accommodate a larger propeller while retaining the draft, such an alteration being possible in this type of hull by either of two methods.

The performance obtained on trials is always checked independently by our consultants, who have the experience of almost 100 tugs built to Hydroconic form. It must be stressed that Burness, Corlett & Partners Ltd. do not restrict their activities to such vessels alone as they are as well known for their work on normal form and large vessels. Any inaccuracy in obtained results is soon brought to notice since for any propeller there should be a constant relationship between pull and R.P.M. squared, this value being calculated from design charts. Any variation from the calculated figure immediately leads to a check on likely points. One experience to date has been excess slip in a fluid coupling, which could have been due to various reasons - wrong viscosity oil, high oil temperatures due to incorrect cooling, incomplete insertion of the scoop control, or various mechanical possibilities. In this case it was found that the scoop control had been incorrectly assembled and was not fully extended.

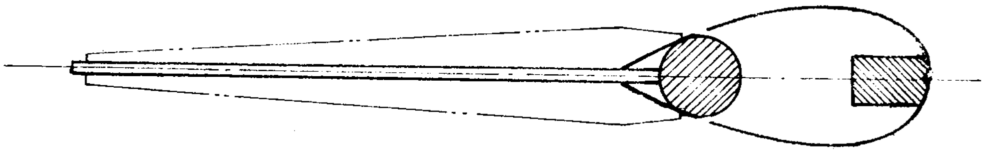
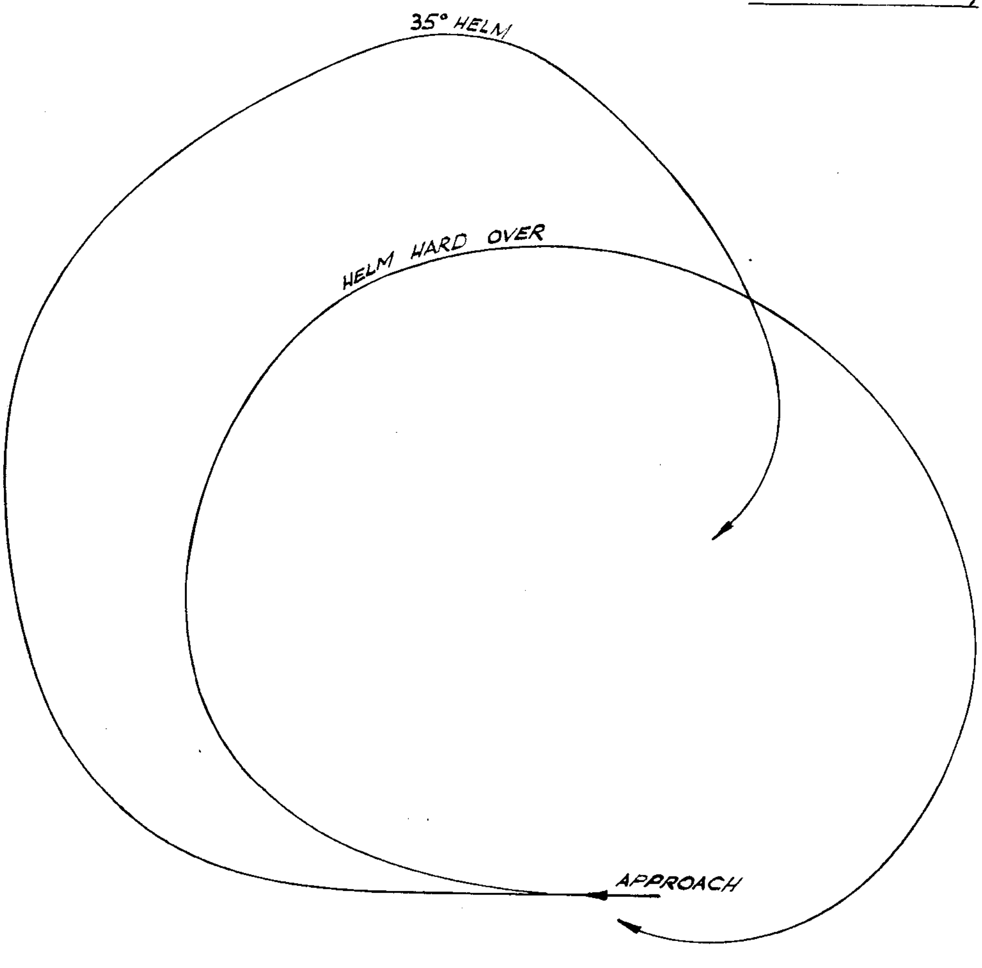


FIG. 14 B.C.P. BULB RUDDER

SHIP No. 7
TURNING CIRCLES
STARBOARD HELM – POWER STEERING
SPEED ON APPROACH COURSE 11 KNOTS
AVERAGE SHAFT REVS. 180 R.P.M.

	35° HELM	HELM HARD OVER
ADVANCE	234 FT.	158 FT.
TACTICAL DIAMETER	364 FT.	276 FT.
TIME TO COMPLETE CIRCLE	1M. 20s.	1M. 0s.
TIME TO PUT HELM OVER	3·2 SEC.	3·8 SEC

FIG. 15 TURNING CIRCLE
OF SHIP No 7



SHIPS BUILT AND ON ORDER

At the time of reading the following vessels have been completed :-

Ship No.	Name	Owners	Service
1	"Warilla"	Waratah Tug & Salvage Co.Pty.Ltd.	Sydney, N.S.W.
2	"Kurnell"	Wallace Tugs Pty. Ltd.	Sydney, N.S.W.
3	"Walumba"	Huddart Parker Ltd.	Melbourne, Vic.
4	"Nalta Yuki"	S.A. Highways & Local Government Department	River Murray, S.A.
5	"Walana"	The Swan River Shipping Co. Ltd. and The Adelaide Steamship Co. Ltd.	Fremantle, W.A.
6	"Kalgan"	The Adelaide Steamship Co. Ltd. and The Swan River Shipping Co. Ltd.	Albany, W.A.
7	"Tenacious"	Ritch & Smith Ltd.	Port Pirie, S.A.
8	"York Syme"	Melbourne Steamship Co. Ltd. and Australian Steamships Pty. Ltd.	Melbourne, Vic.

Work is in hand, or orders have been placed, for the following :-

9	"Willara"	Waratah Tug & Salvage Co.Pty.Ltd.	Sydney, N.S.W.
10	"Trewalla"	Portland Harbor Trust Commissioners	Portland, Vic.
11	-	Ritch & Smith Ltd.	Port Adelaide, S.A.
12	-	Department of the Army	-
13	-	Department of the Army	-

Arrangement drawings, photographs and details are appended of such of the above ships as can be given.

Negotiations are proceeding at present for the building of several other vessels and by the time this Paper is read we hope to be able to supply further details.

For those interested, these are as follows :-

Ship No.: 1

Name: "Warilla"

Owners: Waratah Tug & Salvage Co. Pty. Ltd., Sydney, New South Wales.

Service: Harbour duties in port of Sydney.

Fabrication Commenced 20/5/58; Launched 12/2/59; Handed Over 7/8/59.

Mld. Dimensions - L.O.A. 105'-0"; L.B.P. 95'-0"; B.Mld. 26'-6"; D.Mld. 13'-4¾"

Draft Aft: 14'-0"

Gross Tonnage: 208.5 Tons

Propeller Diam.: 10'-8"

Trials - Speed 11.9 Knots; Bollard Pull 18.1 Tons

Main Machinery: Engine National F4AUM8 supercharged uni-directional 4-stroke 8-cylinder diesel. Continuous rating 1040 B.H.P. @ 500 R.P.M.

Coupling Nil.

Gearbox M.W.D. reverse reduction M2WR5, stepped, 3.18 : 1 ratio.

Machinery directly manoeuvred from the wheelhouse by Bloctube controls.

Generators: 3 Ruston & Hornsby - 2 @ 25 K.W., 1 @ 10 K.W.

Electrical: 220V. D.C. with deadfront switchboard.
Emergency supply - 24V. batteries.

Outfit: Steering Gear Hand and power Donkin electro-hydraulic.

Capstan Thomas Reid electric, 3-ton.

Windlass Thomas Reid electric & hand to suit 1" cable.

Lifeboat Viking 16'-0" 13-person fibreglass.

Accommodation - Normal 5, Maximum 10.

Capacities - F.W. 119 Tons, O.F. 28 Tons.

General Description:
"Warilla" is Aboriginal for "Meeting place of the winds".

Accommodation on main deck for master, with galley, general mess, separate crew and officers washplaces.

Accommodation below main deck for remainder of crew, with a large store.

Accommodation is of the highest standard and is lined throughout with Formica panelling.

A "Seebeck" patent tow hook was fitted.

Classification - Lloyd's "+100A1 Tug" and to the Australian Navigation Act.

A Profile drawing of this vessel is shown in Fig. No. 16, and a Photograph in Fig. No. 26.

Ship No.: 2

Name: "Kurnell"

Owners: Wallace Tugs Pty. Ltd., Sydney, New South Wales.

Service: Harbour duties in port of Sydney.

Fabrication Commenced 20/8/58; Launched 22/5/59; Handed Over 20/11/59.

Mld. Dimensions - L.O.A. 105'-0"; L.B.P. 95'-0"; B.Mld. 26'-6";
D.Mld. 13'-4¾"

Draft Aft: 14'-0"

Gross Tonnage; 208.5 Tons

Propeller Diam.: 10'-8"

Trials - Speed 12 Knots; Bollard Pull 17.1 Tons

Main Machinery: Engine National F4AUM8 supercharged uni-directional 4-stroke 8-cylinder diesel. Continuous rating 1040 B.H.P. @ 500 R.P.M.

Coupling Nil.

Gearbox M.W.D. reverse reduction M2WH5, stepped, 3.18 : 1 ratio.

Machinery directly manoeuvred from the wheelhouse by Bloctube controls.

Generators: 3 Ruston & Hornsby - 2 @ 25 K.W., 1 @ 10 K.W.

Electrical: 220V. D.C. with deadfront switchboard.
Emergency supply - 24V. batteries.

Outfit: Steering Gear Hand and power Donkin electro-hydraulic.

Capstan Thomas Reid electric, 3-ton.

Windlass Thomas Reid electric & hand to suit 1" cable.

Lifeboat Viking 16'-0" 13-person fibreglass.

Accommodation - Normal 5, Maximum 10.

Capacities - F.W. 119 Tons, O.F. 28 Tons.

General Description:

"Kurnell" is named after Kurnell in New South Wales where Capt. Cook landed.

Accommodation on main deck for master, with separate crew and officers washplaces, galley, general mess.

Accommodation below main deck for remainder of crew, with a large store.

Accommodation is of the highest standard and is lined throughout with Formica panelling.

A "Seebeck" patent tow hook was fitted.

Classification - Lloyd's "+100A1 Tug" and to the Australian Navigation Act.

A Profile drawing of this vessel is shown in Fig. No. 16, and a Photograph in Fig. No. 27.

Ship No.: 3

Name: "Walumba"

Owners: Huddart Parker Ltd., Melbourne, Victoria.

Service: Harbour duties in port of Melbourne, salvage duties if necessary.

Fabrication Commenced 27/8/59; Launched 18/1/60; Handed Over 27/6/60.

Mld. Dimensions - L.O.A. 115'-0"; L.B.P. 106'-9"; B.Mld. 29'-4"; D.Mld. 14'-1¾".

Draft Aft: 14'-6"

Gross Tonnage: 269 Tons

Propeller Diam.: 11'-2"

Trials - Speed 11.75 Knots; Bollard Pull 19.9 Tons.

Main Machinery: Engine — British Polar M47M 2-stroke 7-cylinder reversible diesel. Continuous rating 1310 B.H.P. @ 300 R.P.M.

Coupling — Vulcan Sinclair SCD2 Size 70, scoop controlled.

Gearbox — M.W.D. M2WR8 co-axial reverse reduction with 2 : 1 ratio.

Machinery directly manoeuvred from the wheelhouse by Bloctube controls.

Generators: 3 Ruston & Hornsby - 2 @ 40 K.W., 1 @ 10 K.W.

Electrical: 220V. D.C. with deadfront switchboard. Emergency supply - 24V. batteries.

Outfit:	Steering Gear	Hand & power Donkin electro-hydraulic.
	Capstan	Thomas Reid electric, 3-ton.
	Windlass	Thomas Reid electric & hand to suit 1-1/16" cable.
	Lifeboat	Viking 17'-0" 16-person aluminium.
	Accommodation -	Normal 8, Maximum 16.
	Capacities -	F.W. 107 Tons, O.F. 120 Tons.

General Description:

"Walumba" is the Aboriginal word for "flying fox".

Accommodation is arranged on the main deck for master, engineer and mate, with separate messes for crew and officers and separate washplaces etc. for crew and officers, galley.

Provision below main deck for the rest of the crew, together with two small storerooms.

Accommodation is lined throughout with Formica.

Refrigerators and ranges are gas operated.

A spare tow hook is provided.

Classification - Lloyd's "+100A1 Tug" and to the Australian Navigation Act.

A Profile drawing of this vessel is shown in Fig. No. 17, and a Photograph in Fig. No. 28.

Ship No.: 4

Name: "Nalta Yuki"

Owners: S.A. Highways & Local Government Dept., Adelaide, South Aust.

Service: Towing vessel for use on the River Murray.

Fabrication Commenced 29/7/59; Launched 8/1/60; Handed Over 15/1/60.

Mld. Dimensions - L.O.A. 61'-2"; L.B.P. 60'-4"; B.Mld. 15'-0"; D.Mld. 5'-9".

Draft Aft: 2'-6"

Gross Tonnage: -

Propeller Diam.: 2 @ 2'-6"

Trials - Speed 9½ Knots; Bollard Pull 3 Tons.

Main Machinery: Engine — Matched pair of G.M. diesels, Type 6071E/6072E. Continuous rating 340 B.H.P. @ 1800 R.P.M.

Coupling — Nil.

Gearbox — G.M. inbuilt heavy duty hydraulic with 2 : 1 ratio.

Morse type engine controls were fitted to permit manoeuvring of engines from the bridge.

Generators: 1 Ruston & Hornsby - 2 K.W.

Electrical: 32V. D.C. single wire system. Switchboard by Dunlite.

Outfit: Steering Gear — Hand & power by B.M.I. Engineering.

Capstan — Nil.

Windlass — Simpson Lawrence hand type for 7/16" chain.

Lifeboat — Nil.

Accommodation - Normal 6, Maximum 6.

Capacities - F.W. 1 Ton, O.F. 3 Tons.

General Description:

"Nalta Yuki" is the Aboriginal word for "river boat".

This vessel was designed to tow two punts, each of 70 tons displacement, at 5 knots.

It is twin screw, each screw operating in a separate tunnel so as to restrict the draft to 2'-6".

Twin rudders were fitted and the vessel was highly manoeuvrable.

Forward the hull framing was by "dioframes".

A Profile drawing of this vessel is shown in Fig. No. 18, and a Photograph in Fig. No. 29.

Ship No.: 5

Name: "Walana"

Owners: The Swan River Shipping Co. Ltd. & The Adelaide Steamship Co.Ltd.

Service: Harbour duties in Fremantle and coastal towage.

Fabrication Commenced 27/11/59; Launched 8/7/60; Handed Over 5/12/60.

Mld. Dimensions - L.O.A. 105'-0"; L.B.P. 95'-0"; B.Mld. 26'-6"; D.Mld. 13'-4¾".

Draft Aft: 14'-0"

Gross Tonnage: 217 Tons

Propeller Diam.: 10'-8"

Trials - Speed 12 Knots; Bollard Pull 17.9 Tons.

Main Machinery:

Engine	National F4AUM8 supercharged uni-directional 4-stroke 8-cylinder diesel. Continuous rating 1040 B.H.P. @ 500 R.P.M.
Coupling	Vulcan Sinclair SCD52, scoop controlled.
Gearbox	M.W.D. reverse reduction M2WR5A, stepped; 3.25 : 1 ratio.

Machinery directly manoeuvred from the wheelhouse by Bloctube controls.

Generators: 2 Ruston & Hornsby - each 35 K.W.

Electrical: 220V. D.C. with deadfront switchboard.
Emergency supply - 24V. batteries.

Outfit:

Steering Gear	Hand & power Donkin electro-hydraulic.
Capstan	Thomas Reid electric, 3-ton.
Windlass	Thomas Reid electric & hand to suit 1" cable.
Lifeboat	Viking 16'-0" 13-person fibreglass.
Accommodation -	Normal 7, Maximum 12.
Capacities -	F.W. 112 Tons, O.F. 35 Tons.

General Description:

"Walana" is the Aboriginal word for "boomerang".

Accommodation arranged on the main deck for master and chief engineer, with separate messrooms for crew and officers, separate washplaces, etc. for crew and officers, galley.

Accommodation for all others arranged below the lower deck, together with a store.

Accommodation lined throughout with Formica.

This vessel is generally similar to Ships Nos. 1 and 2, but has greater accommodation to permit coastal towage and a fluid coupling was incorporated in the machinery.

The "Walana" was delivered in time for the berthing of the "Oriana" on her maiden voyage in December, 1960, being constructed for the handling of the new Orient liners.

Classification - Lloyd's "+100A1 Tug" and to Australian Navigation Act.

A Profile drawing of this vessel is shown in Fig. No. 19, and a Photograph in Fig. No. 30.

Ship No.: 6

Name: "Kalgan"

Owners: The Adelaide Steamship Co. Ltd. & The Swan River Shipping Co.Ltd.

Service: Harbour duties at Albany, Western Australia.

Fabrication Commenced 18/1/61; Launched 16/6/61; Handed Over Sept. '61.

Mld. Dimensions – L.O.A. 72'-6"; L.B.P. 67'-2"; B.Mld. 19'-8"; D.Mld. 9'-6".

Draft Aft: 9'-6"

Gross Tonnage: 75 Tons Approx.

Propeller Diam.: 7'-2"

Contract – Speed 10 Knots; Bollard Pull 9 Tons.

Main Machinery: Engine — Lister Blackstone uni-directional Type ERS8MGR diesel. Continuous rating 660 B.H.P. @ 750 R.P.M.

Coupling — Nil.

Gearbox — M.W.D. reverse reduction, stepped, with 3 : 1 ratio.

Machinery directly manoeuvred from the wheelhouse by Chadburn controls.

Generators: 2 Lister, each 12 K.W.

Electrical: 220V. D.C. with deadfront switchboard.
Emergency supply – 24V. batteries.

Outfit: Steering Gear — Hand & power Donkin electro-hydraulic with 40° rudder angle.

Capstan — Nil.

Windlass — Thomas Reid hand & power to suit 11/16" cable.

Lifeboat — Nil. One 8-man liferaft fitted in lieu.

Accommodation – Normal 4, Maximum 8.

Capacities – F.W. 32 Tons, O.F. 13 Tons.

General Description:

"Kalgan" is named after the coastal river which runs into the sea at Albany.

Accommodation – combined messroom, galley and combined washplaces etc. on the upper deck. All sleeping accommodation arranged below the main deck.

Classification – Lloyd's "+100A1 Tug" and to Regulations of the Western Australian Harbour & Light Department.

A Profile drawing of this vessel is shown in Fig. No. 20.

Ship No.: 7

Name: "Tenacious"

Owners: Ritch & Smith Ltd., Port Adelaide, South Australia.

Service: Ship handling work at Port Pirie, South Australia, and coastal towage.

Fabrication Commenced: 27/5/60; Launched 8/11/60; Handed Over 16/6/61.

Mld. Dimensions - L.O.A. 95'-0"; L.B.P. 87'-10"; B.Mld. 23'-6"; D.Mld. 12'-0".

Draft Aft: 11'-3"

Gross Tonnage: 164 Tons

Propeller Diam.: 9'-0"

Trials - Speed 11.9 Knots; Bollard Pull 10.8 Tons

Main Machinery: Engine — Ruston & Hornsby 5ATCM supercharged intercooled uni-directional diesel. Continuous rating 900 B.H.P. @ 500 R.P.M.

Coupling — Vulcan Sinclair SCD2 Size 52, scoop controlled.

Gearbox — M.W.D. reverse reduction M2WR5, stepped, ratio 2.5 : 1.

Machinery directly manoeuvred from the wheelhouse by Bloctube controls.

Generators: 2 Ruston & Hornsby, each of 30 K.W.

Electrical: 220V. D.C. with deadfront switchboard.
Emergency supply - 24V. batteries.

Outfit: Steering Gear — Hand & power Donkin electro-hydraulic with 45° rudder angle.

Capstan — Thomas Reid 2-ton below deck type.

Windlass — Thomas Reid electric & hand to suit 7/8" cable.

Lifeboat — Clausen 14'-6" fibreglass.

Accommodation - Normal 5, Maximum 8.

Capacities - F.W. 65½ Tons, O.F. 21 Tons.

General Description:

Accommodation was arranged for the master on the main deck, together with an officers messroom, galley and separate washplaces for crew and officers. The remainder of the sleeping space was arranged below the deck, together with the crew's mess.

Laminex linings throughout the accommodation.

A raised type wheelhouse was fitted to this vessel to provide the maximum vision over the top of barges when they were in the light condition.

This vessel had below the normal height bulwarks for the greater ease of handling of ropes.

Classification - Lloyd's "+100A1 Tug" and to Regulations of The South Australian Harbors Board.

A Profile drawing of this vessel is shown in Fig. No. 21, and a Photograph in Fig. No. 31.

Ship No.: 8

Name: "York Syme"

Owners: Melbourne Steamship Co. Ltd. & Australian Steamships Pty. Ltd.

Service: Harbour duties in Melbourne.

Fabrication Commenced 3/8/60; Launched 3/3/61; Handed Over 21/7/61.

Mld. Dimensions - L.O.A. 95'-0"; L.B.P. 87'-10"; B.Mld. 23'-6"; D.Mld. 12'-0".

Draft Aft: 11'-3"

Gross Tonnage: 161 Tons

Propeller Diam.: 9'-0"

Trials - Speed 11.9 Knots; Bollard Pull 14 Tons.

Main Machinery: Engine — Ruston & Hornsby 6ATCM supercharged intercooled uni-directional diesel. Continuous rating 1080 B.H.P. @ 500 R.P.M.

Coupling — Vulcan Sinclair SCD2 Size 52 with scoop control.

Gearbox — M.W.D. reverse reduction M2WR5A, stepped, 2.5 : 1 ratio.

Machinery directly manoeuvred from the wheelhouse by Bloctube controls.

Generators: 2 Ruston & Hornsby, each 35 K.W.

Electrical: 220V. D.C. with deadfront switchboard.
Emergency supply - 240V. A.C. available from shore supply.
- 24V. battery supply in engine room and entrances.

Outfit: Steering Gear — Hand & power Donkin electro-hydraulic with 45° rudder angle.

Capstan — Thomas Reid 3-ton electric.

Windlass — Thomas Reid electric & hand to suit 7/8" cable.

Lifeboat — Clausen 14'-6" fibreglass.

Accommodation - Normal 7, Maximum 10.

Capacities - F.W. 87 Tons, O.F. 22 Tons.

General Description:

"York Syme" is named after the Managing Director of Melbourne Steamship Co. Ltd.

Separate messrooms for the crew and officers, separate washplaces for crew and officers, also galley, are arranged on the main deck, all sleeping accommodation being arranged below the main deck.

Accommodation lined throughout with Formica.

On this vessel the lifeboat is stowed athwartships.

Two towing hooks are fitted, one of which is a spring type.

Classification - Lloyd's "+100A1 Tug" and to Regulations of the Marine Board of Victoria.

A Profile drawing of this vessel is shown in Fig. No. 22, and a Photograph in Fig. No. 32.

Ship No.: 9

Name: "Willara"

Owners: Waratah Tug & Salvage Co. Pty. Ltd., Sydney, New South Wales.

Service: Harbour duties in the port of Sydney and coastal towage.

Fabrication Commenced Aug. '61; Launched ; Handed Over .

Mld. Dimensions - L.O.A. 105'-0"; L.B.P. 95'-0"; B.Mld. 26'-8¼"; D.Mld. 15'-0".

Draft Aft: 14'-9" Approx.

Gross Tonnage: 230 Tons Approx.

Propeller Diam.: 11'-0".

Contract - Speed 12 Knots; Bollard Pull 17 Tons.

Main Machinery:	Engine	English Electric 12CSVM supercharged uni-directional "V" type diesel. Continuous rating 1360 B.H.P. @ 630 R.P.M.
	Coupling	Vulcan Sinclair Size SCD52 with scoop control.
	Gearbox	M.W.D. reverse reduction two speed co-axial.
Generators:		2 Ruston & Hornsby - 1 @ 50 K.W, 1 @ 30 K.W.
Electrical:		220V. D.C. with deadfront switchboard. Emergency supply - 24V. batteries.

Outfit:	Steering Gear	Hand & electric Hydrapilot, type HS 20 Super 'A' by A/S Frydenbo, Norway, with a 45° rudder angle.
	Capstan	Thomas Reid electric 3-ton.
	Windlass	Thomas Reid electric & hand suitable for 1" cable.
	Lifeboat	Viking 16'-0" aluminium, 14-person.
	Accommodation -	Normal 5, Maximum 14.
	Capacities -	F.W. 105 Tons, O.F. 52 Tons.

General Description:

"Willara" is the Aboriginal name for the district in Sydney called Woollahra.

Accommodation arranged on main deck for master, separate messrooms for crew and officers, separate washplaces for crew and officers, galley. All other accommodation, together with a store, below deck.

Lifeboat arranged athwartships.

Vessel is panelled throughout with Laminex.

A two speed gearbox has been provided to obtain both the maximum speed and the maximum bollard pull.

Hull is generally similar to that on Ships Nos. 1, 2 and 5, but the depth has been increased.

Classification - Lloyd's "+100A1 Tug" and to Australian Navigation Act.

A Profile drawing of this vessel is shown in Fig. No. 23.

Ship No.: 10

Name: "Trewalla"

Owners: Portland Harbor Trust Commissioners, Portland, Victoria.

Service: Harbour and pilotage duties at Portland, Victoria.

Fabrication Commenced 18/1/61; Launched 28/7/61; Handed Over

Mld. Dimensions - L.O.A. 72'-6"; L.B.P. 67'-2"; B.Mld. 19'-8"; D.Mld. 9'-6".

Draft Aft: 9'-6"

Gross Tonnage: 75 Tons Approx.

Propeller Diam.: 7'-2"

Contract - Speed 10 Knots; Bollard Pull 9 Tons

Main Machinery: Engine — Lister Blackstone uni-directional Type ERS8MGR diesel. Continuous rating 660 B.H.P. @ 750 R.P.M.

Coupling — Nil.

Gearbox — M.W.D. reverse reduction, stepped, with 3 : 1 ratio.

Machinery directly manoeuvred from the wheelhouse by Chadburn controls.

Generators: 2 Lister, each 12 K.W.

Electrical: 220V. D.C. with deadfront switchboard.
Emergency supply - 24V. batteries.

Outfit: Steering Gear — Hand & power Donkin electro-hydraulic with 40° rudder angle.

Capstan — Nil.

Windlass — Thomas Reid hand & power to suit 11/16" cable.

Lifeboat — Clausen 14'-6" fibreglass.

Accommodation - Normal 4, Maximum 8.

Capacities - F.W. 32 Tons. O.F. 13 Tons.

General Description:

"Trewalla" is the name of a parish near Portland in Victoria, being a corruption of "Trawalla", Aboriginal for "wild water" or "much rain".

Accommodation - combined messroom, galley and combined washplaces etc. on the upper deck. All sleeping accommodation arranged below the main deck.

Classification - Lloyd's "+100A1 Tug" and to Regulations of the Marine Board of Victoria.

A Profile drawing of this vessel is shown in Fig. No. 20, with the exception that a lifeboat is stowed athwartships at the after end of the boat deck where it is inclined down.

Ship No.: 11

Name:

Owners: Ritch & Smith Ltd., Port Adelaide, South Australia.

Service: Harbour duties in Port Adelaide and coastal towage.

Fabrication Commenced ; Launched ; Handed Over .

Mld. Dimensions - L.O.A. 105'-0"; L.B.P. 95'-0"; B.Mld. 26'-6"; D.Mld. 14'-9$\frac{3}{4}$".

Draft Aft: 13'-6"

Gross Tonnage:

Propeller Diam.: 11'-0" Approx.

Contract - Speed 12.25 Knots; Bollard Pull 17.5 Tons.

Main Machinery: Engine — Ruston & Hornsby 7ATCM supercharged intercooled uni-directional diesel.

Coupling — Metalastic.

Gearbox — M.W.D. reverse reduction three speed M2WR5B, stepped.

Machinery directly manoeuvred from the wheelhouse.

Generators: 2 Ruston & Hornsby, each 35 K.W.

Electrical: 220V. D.C. with deadfront switchboard.
Emergency supply - 24V. batteries.

Outfit: Steering Gear — Hand & electric Hydrapilot, type HS 20 Super 'A' by A/S Frydenbo, Norway, with a 45° rudder angle.

Capstan — Thomas Reid electric 3-ton.

Windlass — Thomas Reid electric & hand suitable for 15/16" cable.

Lifeboat — Viking 16'-0" aluminium, 13 person.

Accommodation - Normal 5, Maximum 12.

Capacities - F.W. 110 Tons, O.F. 50 Tons.

General Description:

Accommodation arranged below the main deck for all officers and crew. Separate messrooms for officers and crew, together with galley, arranged on the main deck forward of the engine room casing. Separate washplaces etc. for officers and crew arranged abreast the engine casing on the main deck.

Lifeboat arranged athwartships.

Vessel panelled throughout with plastic faced plywood.

Maximum height of the wheelhouse has been arranged.

Special arrangements have been made regarding the mast etc. to permit reception in the ironstone area around this region of South Australia.

A three speed gearbox has been provided to obtain both the maximum speed and the maximum bollard pull, while permitting the vessel to manoeuvre on the minimum propeller revs. of 20. This arrangement has made the installation sufficiently flexible to enable the fluid type coupling to be deleted.

The hull is of the same length as that on Ships Nos. 1, 2, 5 & 9, but the lines have been varied.

Classification - Lloyd's "+100A1 Tug" and to Australian Navigation Act.

A Profile drawing of this vessel is shown in Fig. No. 24.

Ships Nos.: 12 & 13

Name:

Owners: Department of the Army, per the Australian Shipbuilding Board

Service:

Fabrication Commenced ; Launched ; Handed Over .

Mld. Dimensions – L.O.A. 60'-6"; L.B.P. 56'-0"; B.Mld. 16'-6"; D.Mld. 7'-0".

Draft Aft: 5'-9" Approx.

Gross Tonnage:

Propeller Diam.:

Contract – Speed 8 Knots; Bollard Pull 3½ Tons.

Main Machinery: Engine Twin, in-line G.M. geared diesels, Series 71, Models 12003C. Continuous rating 286 Delivered H.P. @ 400 Propeller R.P.M.

Coupling Nil.

Gearbox G.M. reverse reduction.

Generators: A diesel driven 3/5 K.W.

Electrical: 24V. D.C.

Outfit: Steering Gear Hand type.

Capstan Nil.

Windlass Hand type.

Lifeboat 8'-0" G.P. fibreglass dinghy and inflatable liferaft.

Accommodation – Normal , Maximum .

Capacities – F.W. , O.F. .

General Description:

These vessels are to the design of the Australian Shipbuilding Board, being of flat plate construction, but are not of Hydroconic design.

A Profile drawing of this vessel is shown in Fig. No. 25.

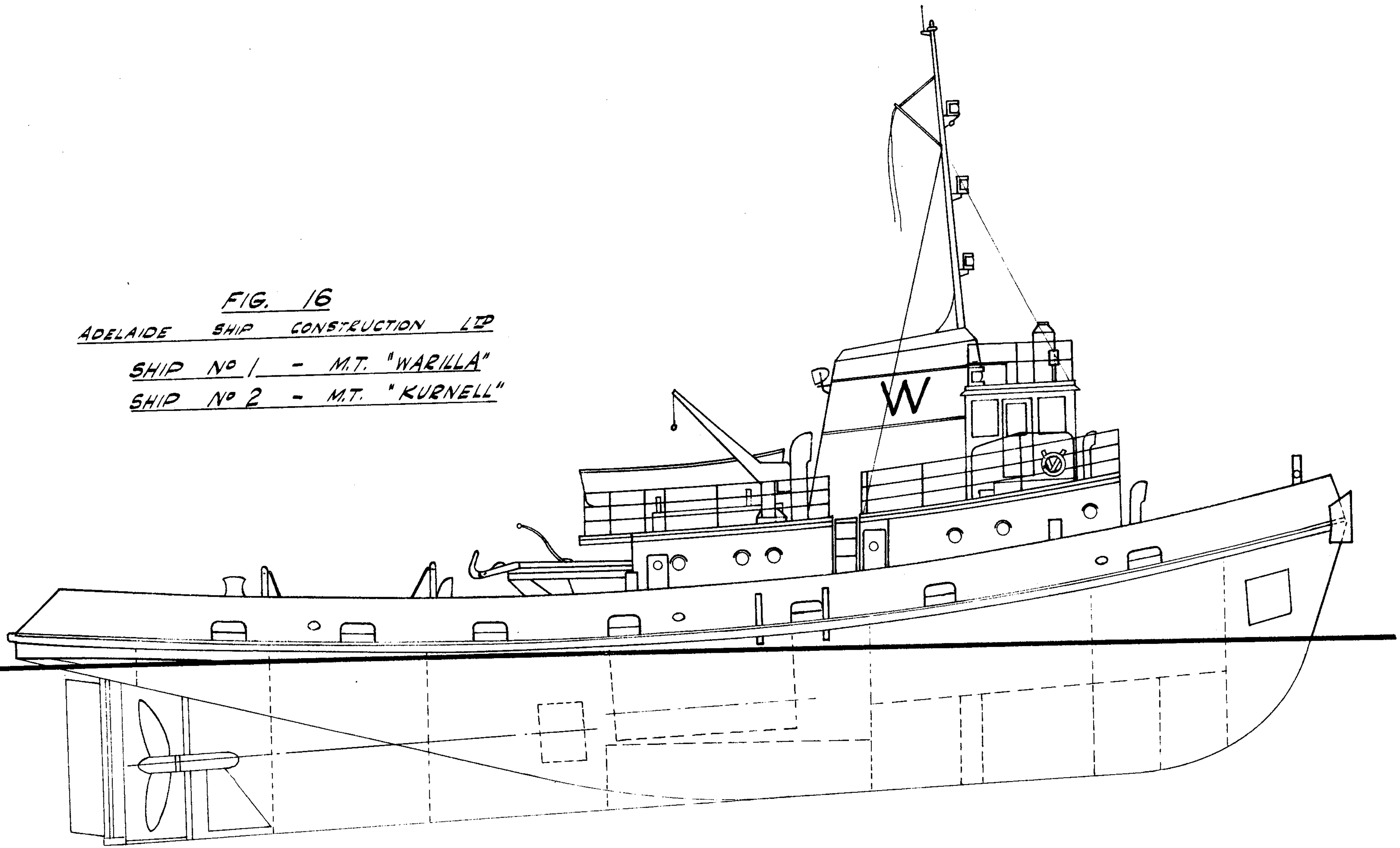


FIG. 16

ADELAIDE SHIP CONSTRUCTION LTD

SHIP No 1 - M.T. "WARILLA"

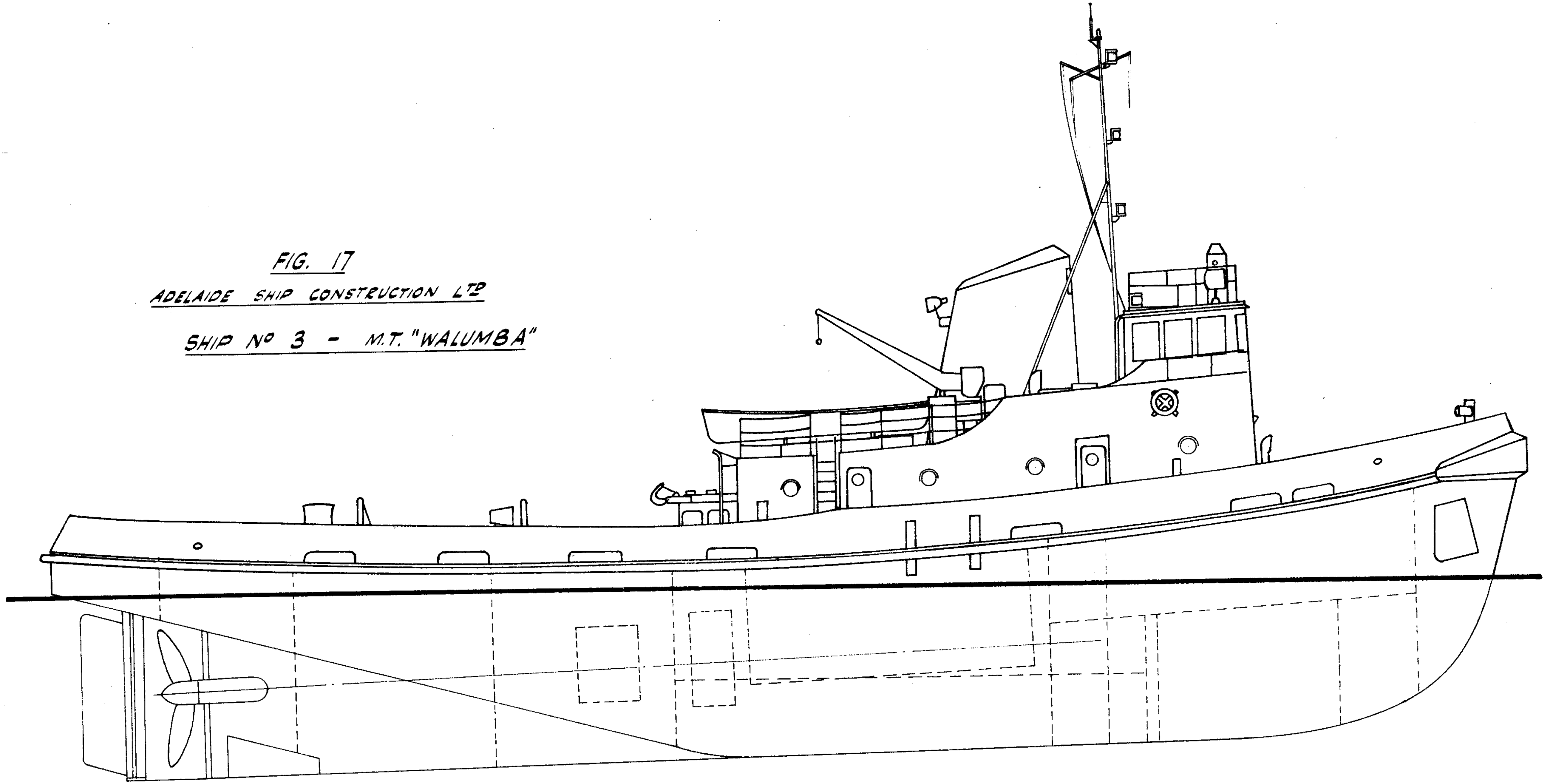
SHIP No 2 - M.T. "KURNELL"

B.E. 21-7-61.

FIG. 17

ADELAIDE SHIP CONSTRUCTION LTD

SHIP No 3 - M.T. "WALUMBA"

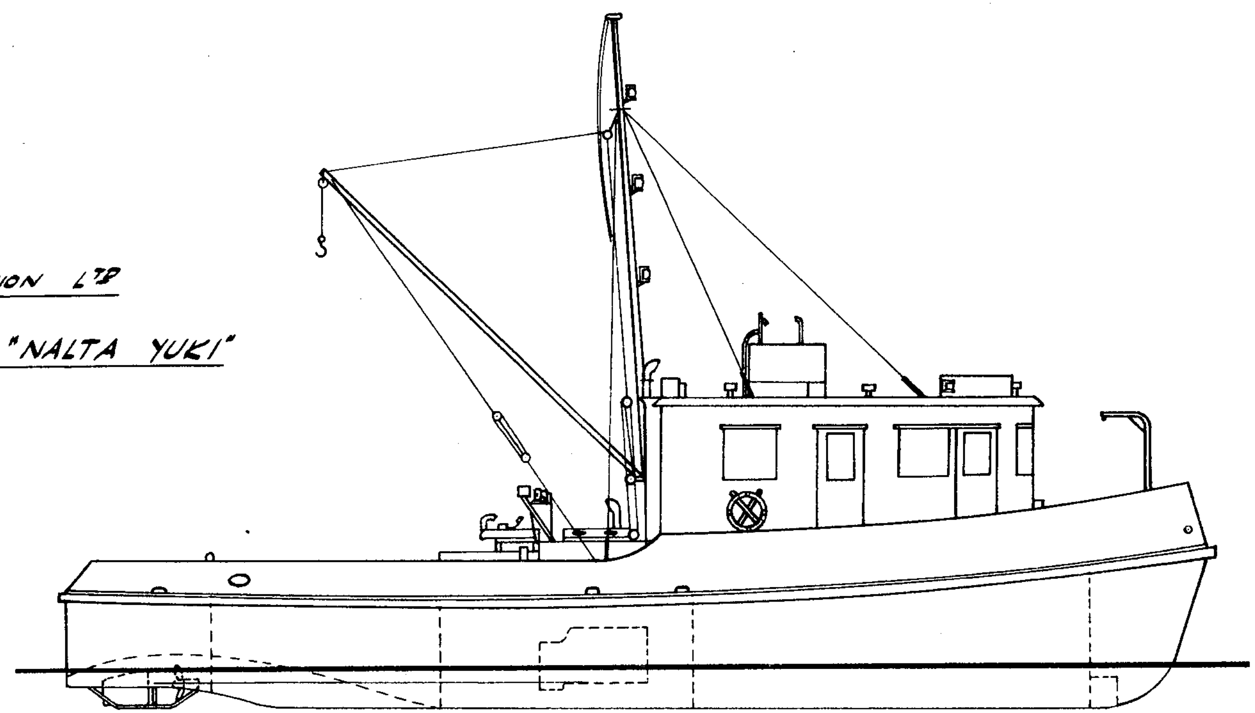


B.E. 24-7-61

FIG. 1B

ADELAIDE SHIP CONSTRUCTION L^{TD}

SHIP No 4 – "NALTA YUKI"

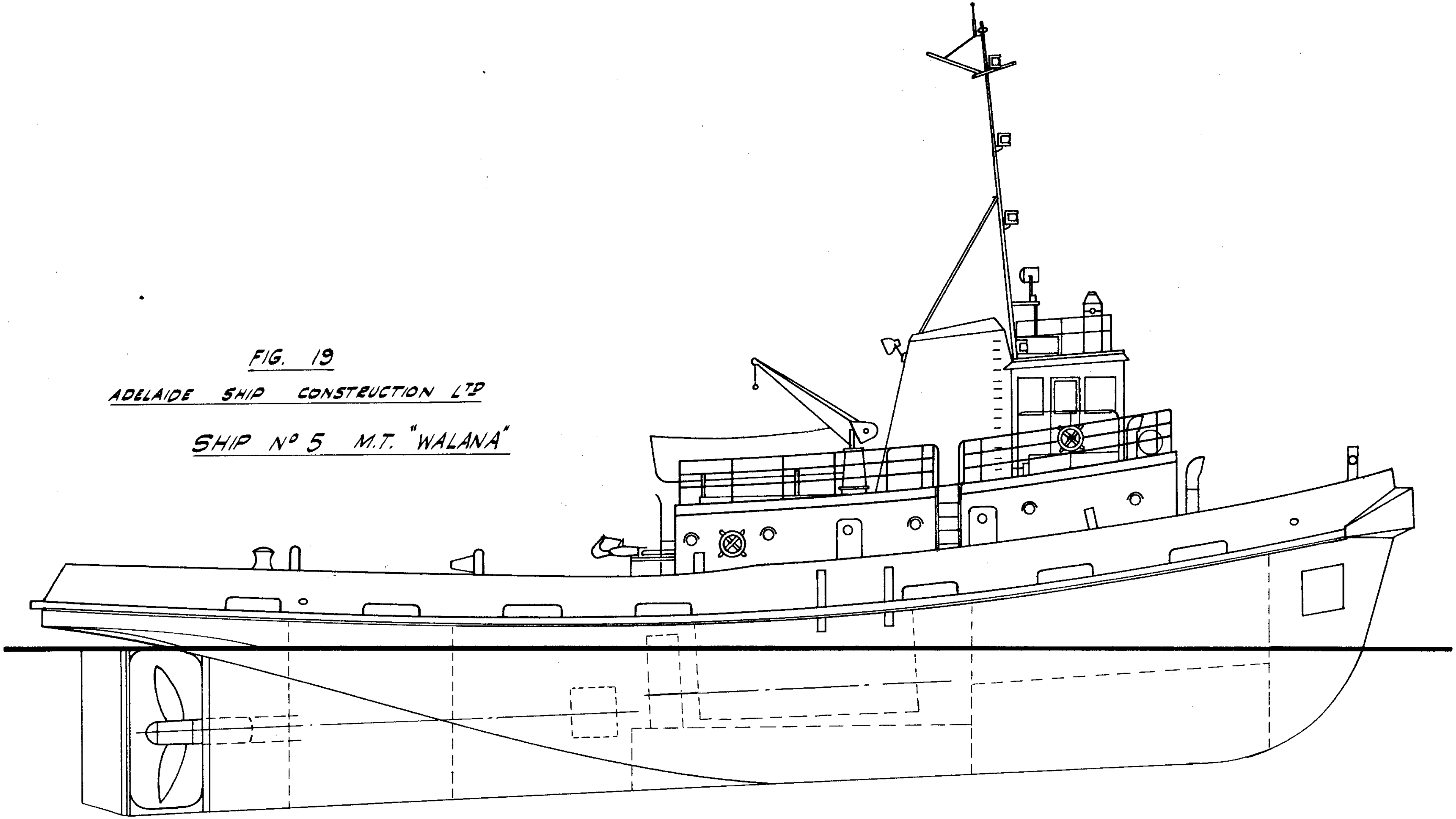


B.E. 27-7-61

FIG. 19

ADELAIDE SHIP CONSTRUCTION LTD

SHIP No 5 M.T. "WALANA"



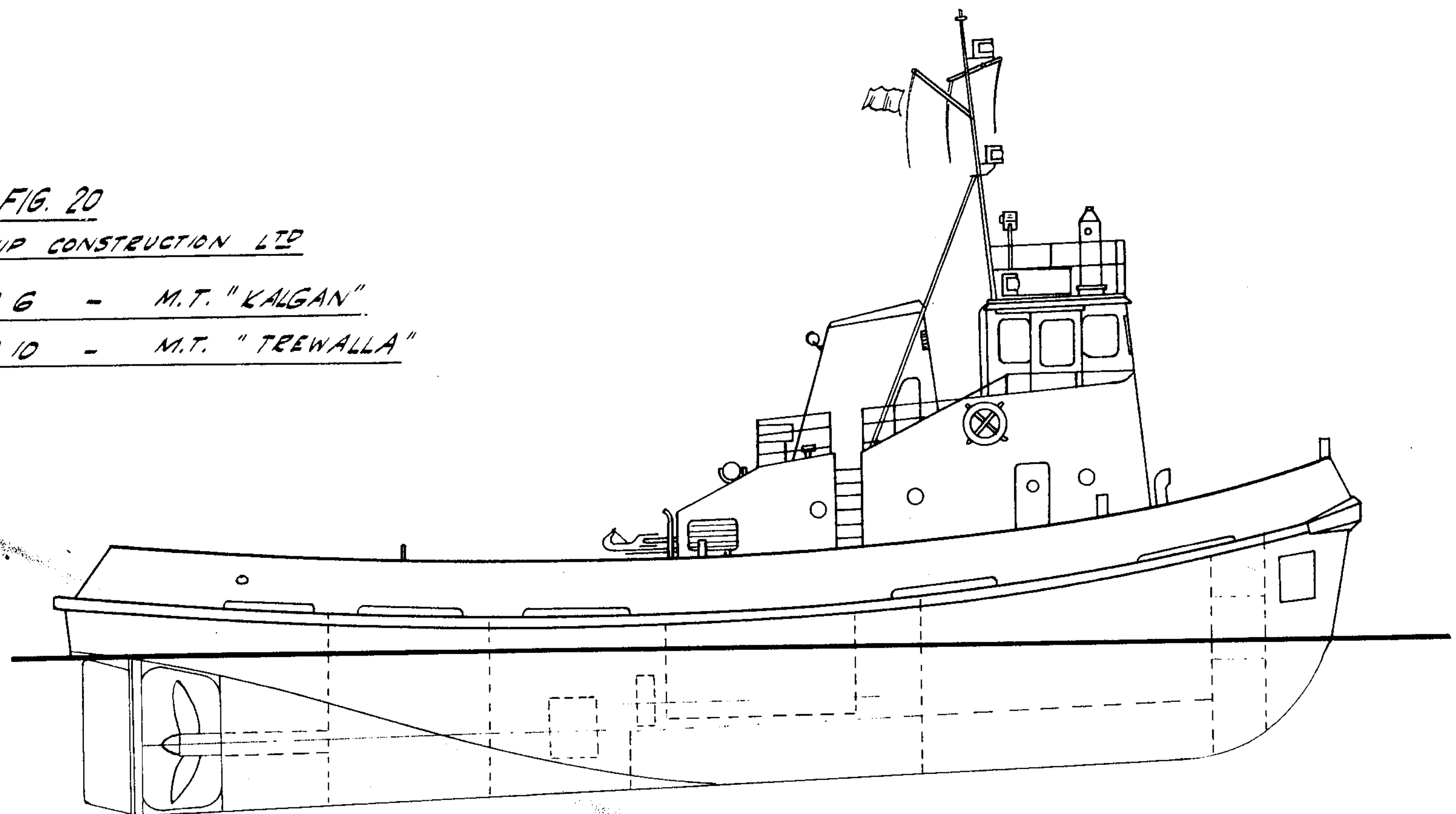
B.E. 1-8-61.

FIG. 20

ADELAIDE SHIP CONSTRUCTION LTD

SHIP Nº 6 - M.T. "KALGAN"

SHIP Nº 10 - M.T. "TREWALLA"



B.E. 2·8·61

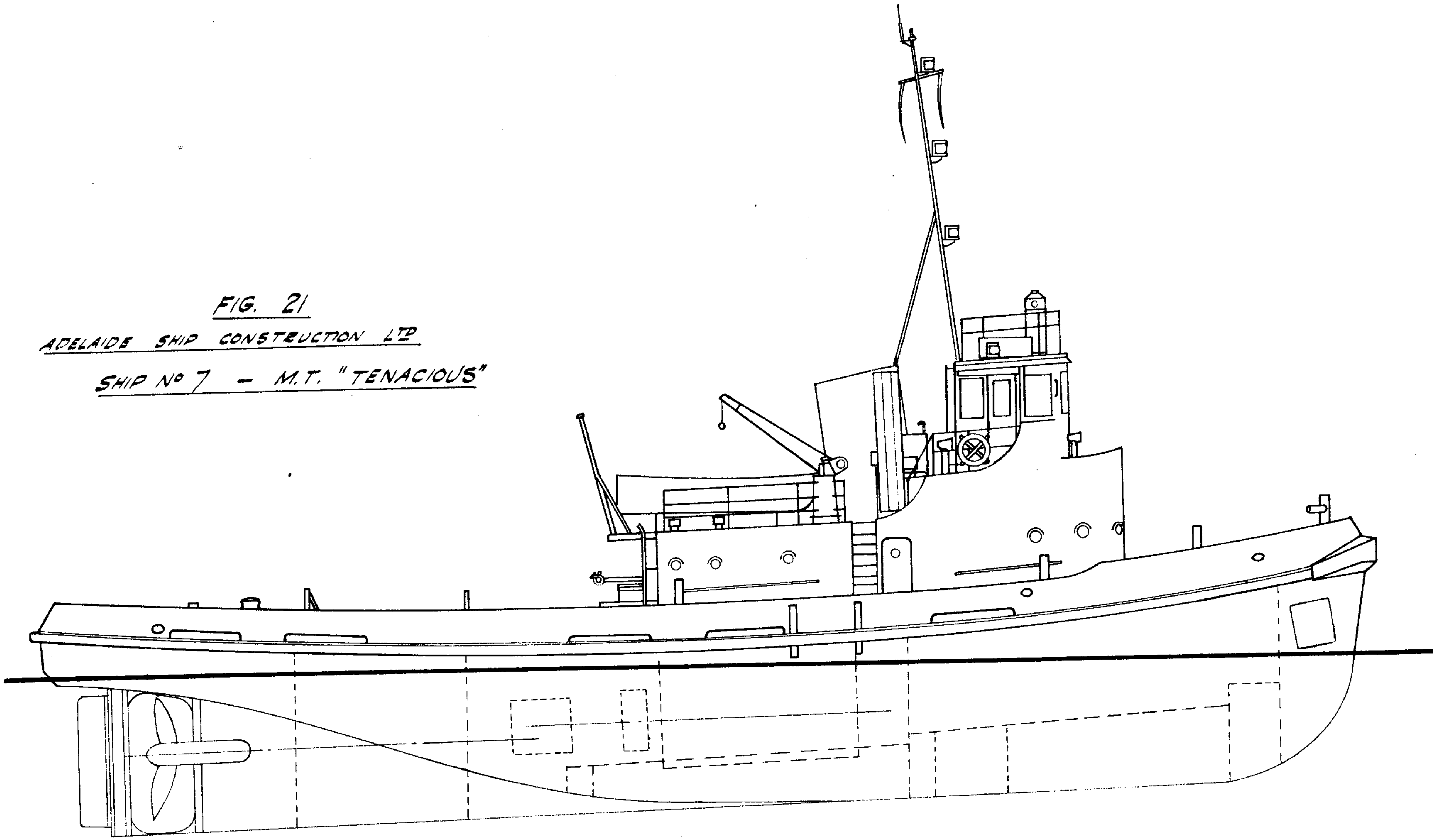


FIG. 21

ADELAIDE SHIP CONSTRUCTION LTD

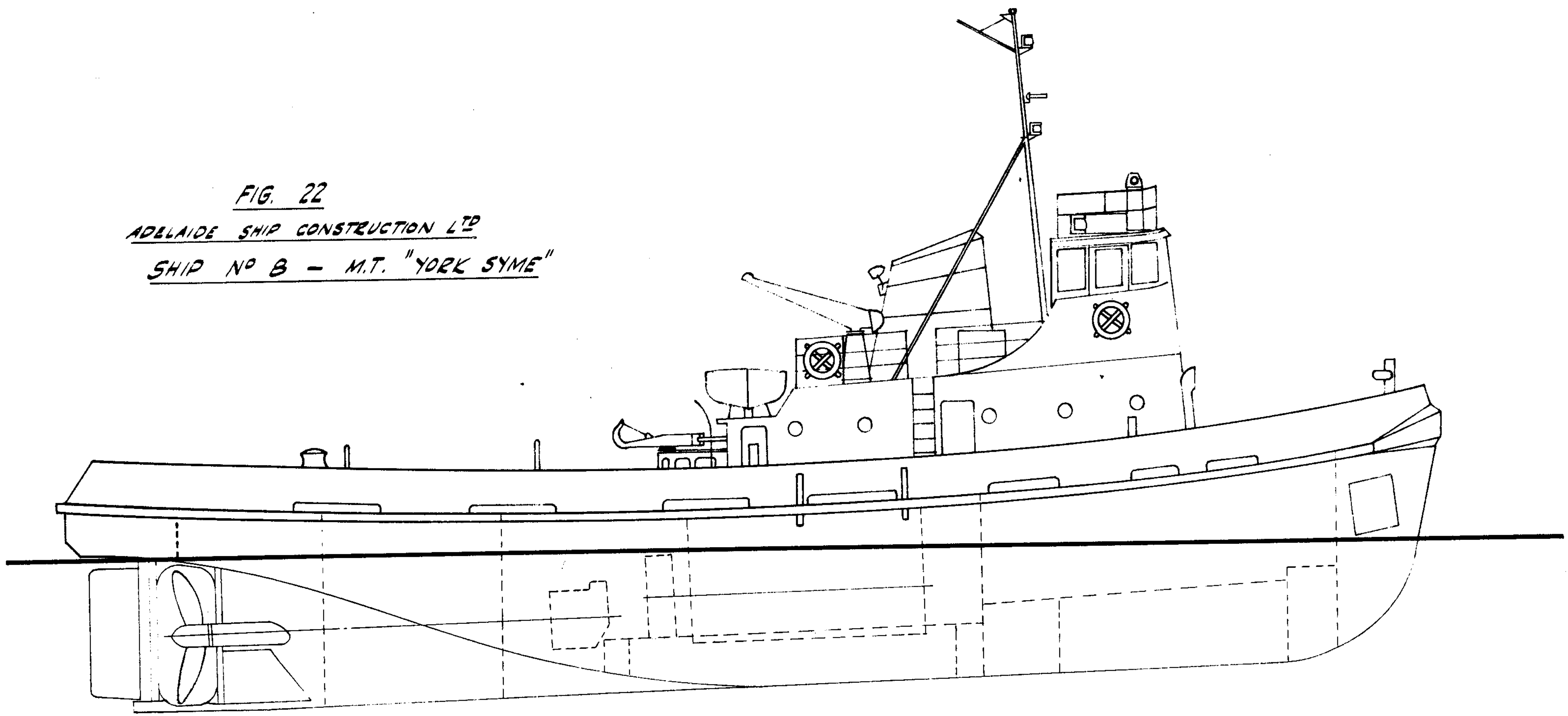
SHIP No 7 - M.T. "TENACIOUS"

B.E. 8·8·61

FIG. 22

ADELAIDE SHIP CONSTRUCTION LTD

SHIP No 8 – M.T. "YORK SYME"

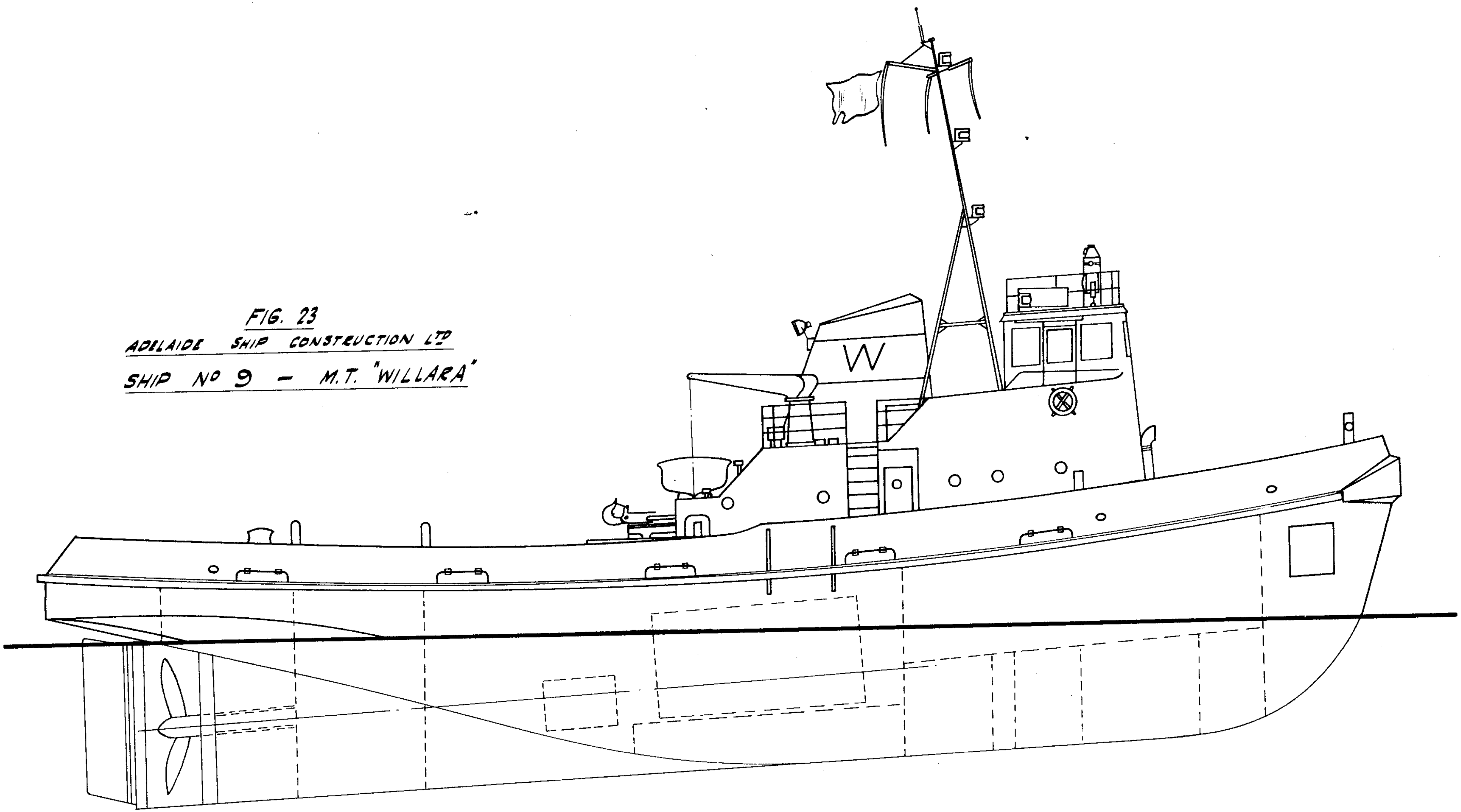


B.E. 9·8·61

FIG. 23

ADELAIDE SHIP CONSTRUCTION LTD

SHIP No 9 – M.T. "WILLARA"

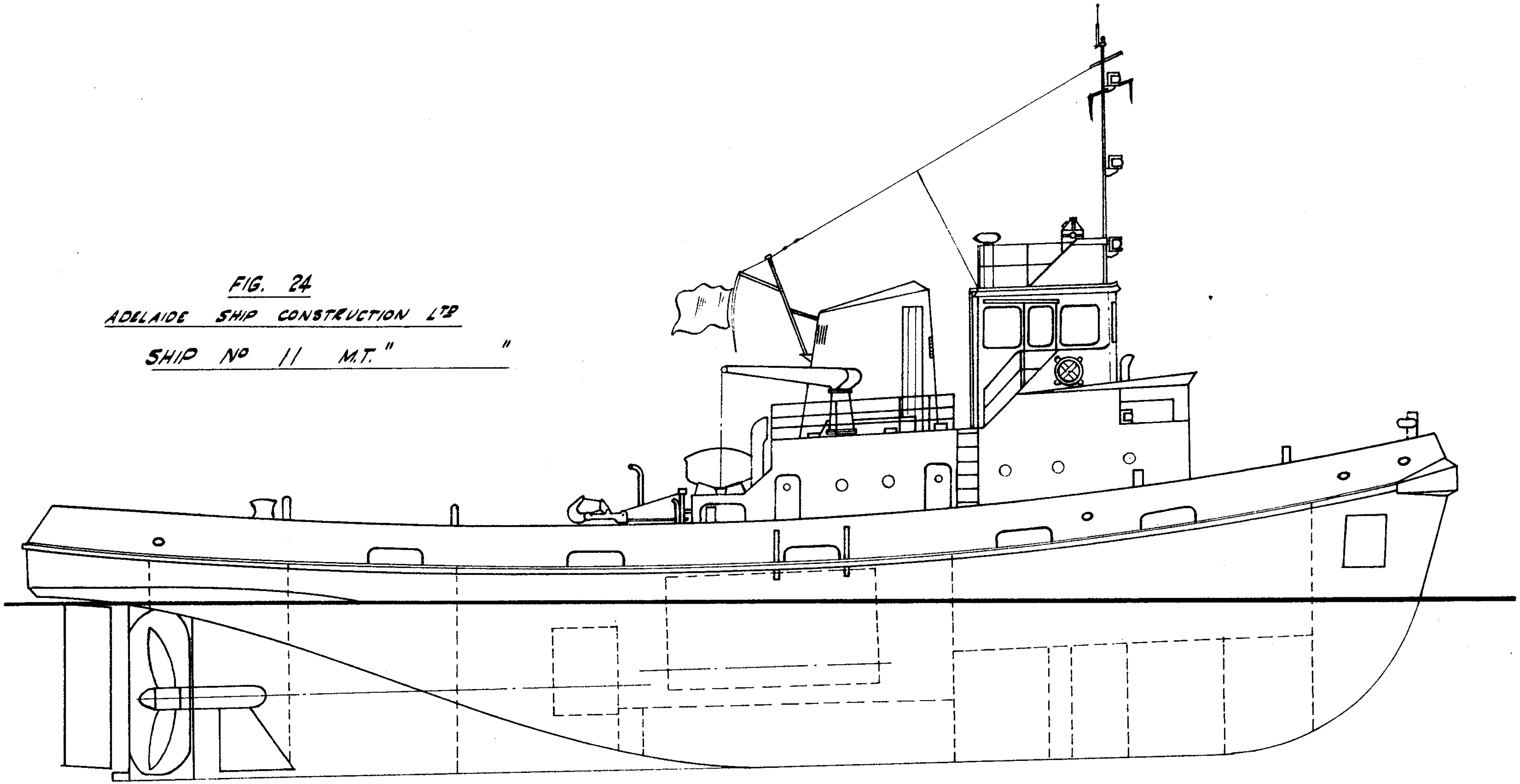


B.E. 3-8-61.

FIG. 24

ADELAIDE SHIP CONSTRUCTION LTD

SHIP No 11 M.T. " "

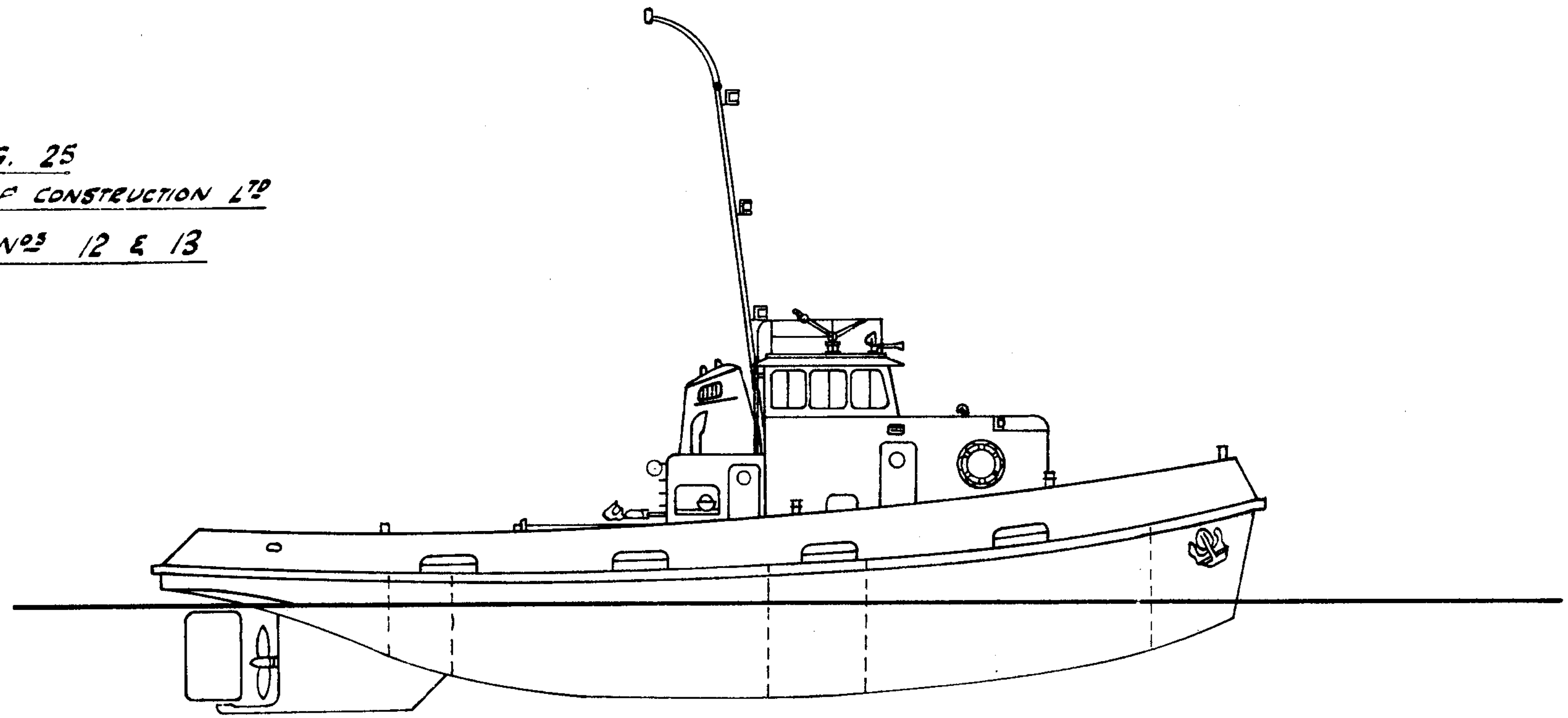


B.E. 4-8-61

FIG. 25

ADELAIDE SHIP CONSTRUCTION L^TD

SHIP N^OS 12 & 13



A.E. 9·8·61

Fig.26

Fig 27

Fig.28

Fig.29

Fig.30

Fig.31

Fig.32

CONCLUSION.

As yet we have received no major complaints regarding any of our vessels when in service. We always ask the delivery master or owners to report to us after the delivery voyage and to date we have had the services of one delivery master for several of our vessels, this master living in Adelaide and reporting to us after the delivery of each vessel.

To quote from the owners' report to us for Ship No. 7 :-

> "The Master was extremely pleased with the sea-keeping qualities of the tug, and apart from the extreme conditions encountered, he expressed complete satisfaction with the delivery voyage; when running before the sea, at a draft of 8'-0" and 10'-6", the decks were comparatively dry in the waist, dry enough to allow walking upon in ordinary shoes; when heading into a rough ahead sea only occasional water was shipped."

Regarding the report on this vessel in service we quote :-

> "At 20 revs. on the propeller "Tenacious" was able to keep station without "towing the ship", and proved to be extremely handy when on a tow line, and we emphasize extremely handy. The arrangement of the tow hook in practice to date has fulfilled our expectations."

We consider this to be representative of the comments from the various owners on the Hydroconic tugs we build and as a result of their satisfaction we now find we are being approached for repeat orders.

To permit us to keep abreast in developments in tug design and construction in other parts of the world, we make it our business to be supplied with information from various sources.

Prior to commencement of the shipyard the Shipyard Manager was sent to Great Britain and earlier this year the General Manager toured Britain, the Continent and the U.S.A., to obtain the latest information on methods and available equipment and to make contact with other builders, tug owners, tug operators and machinery builders. It is hoped that we will continue such visits, to be able to offer the best possible service to the owners for whom we build.

With such experience and due to the satisfaction we have already been able to give owners we confidently expect to be able to obtain orders for the greater proportion of the tugs required in Australia for many years to come.