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Patron: HIS MAJESTY THE KING. President: SIR WILLIAM CRAWFORD CURRIE.

Deck Machinery, with Particular Reference to Latest Developments.

Read by T. S. BROWN.

On Tuesday, December 11th, 1945, at 5.30 p.m. at 85, Minories, E.C.3.

Chairman: W. LYNN NELSON, O.B.E. (Chairman of Council).

Synopsis.

The steam cargo winches usually fitted in steamships with their derricks and rigging are considered, together with the arrangements adopted for dealing with heavy derrick cargo, utilising the ordinary cargo winch, together with block and tackle.

The loads and speeds usually provided for are dealt with; comparisons of steam consumption are made, and the steam saving obtained by adopting more efficient types of winches with machine cut gearing running in oil baths is given. A further development is dealt with, in the form of the totally enclosed splash lubricated steam cargo winch having a very high efficiency and low steam consumption.

The design of the drums, the fastening of the wires, and the behaviour of the runner for both warping and whipping are dealt with.

The steam anchor windlass, including anchoring and mooring conditions, hawse pipes, and chain lockers are discussed, together with the mooring requirements at the after end of the ship.

The steam cargo winch, in conjunction with swinging and topping derricks, and the use of dual purpose winches under the control of one winchman, as usually adopted for steam coasters are discussed.

For motor ships (cargo vessels and liners), the highly efficient totally enclosed electrically driven cargo winch is considered; comparisons are made with steam winch outfits, particularly regarding the losses in the transmitting of steam as compared with electrical transmission.

Maintenance of both steam and electric winches is discussed, various makes and systems of control with their advantages being dealt with.

The electrically driven anchor windlass with its mooring requirements is considered, together with the controls, including drum, contractor, booster, Ward Leonard, constant current and A.C. supply. The transmission cable runs are described, including the usual tree system and ring main.

In writing this Paper, the author knows that marine engineers are conversant with the most modern types of deck machinery, including anchor gears, mooring gears and cargo winches, both steam and electrically driven, for passenger and cargo liners, as well as coasters.

Attention is drawn to the development of high efficiency deck machinery, of which various types and makes are commented upon.

Systems of electric supply and control are touched upon, it being appreciated that each of such subjects requires a paper to itself. Comparison, however, is made which, it is trusted, will be helpful.

The Steam Windlass for Anchors and Mooring.

The weight of the anchors, and the size of the chain cable are decided by the Classification Society to meet the requirements for the size and class of the vessel. The power of the windlass must be at least sufficient for heaving the weight of two anchors, each with 30 fathoms of iron cable together. With this power available, the windlass must also be able to exert all its strain in one cable at a time, for breaking out and heaving one anchor. This strain is equal to the weight of one anchor and 85 fathoms of cable. The speed of heaving the anchors and cables is usually 40ft. per minute.

The steam pressure at the windlass, when working, is usually 100lb./sq. in., and the back pressure in the exhaust line at the windlass should not be more than 25lb./sq. in.

The windlass usually has two warping ends for docking and mooring services. The full load strain in the hawser should not be less than 1 ton for every 1,000 tons displacement of vessel. The speed of haul with full load strain is approximately 150ft./min., half load at 1½ times full load speed, and slack at double full load speed, having stalling strain ranging up to 1½ times the full load strain.

The steam engine control provides an infinitely variable speed within this range, including creep, both under strain and slack conditions, the slow heavy strain being necessary for housing the anchor. This speed control characteristic governs the paying out of the anchors when this is necessary, preventing the anchors from taking charge and racing the engine.

The stalling characteristic of the steam engine windlass provides the heavy strain necessary for breaking out anchors, and for moving the ship in close waters against wind and tide.

The pull in the anchor cables and hawser is at the windlass. The strain available in the cables between the ship and the anchor is reduced by the friction in the hawse pipe, usually varying between 25 per cent. and 33 per cent.

The windlass may be worked with safety with 1½ times the normal working steam pressure, and is capable of withstanding the boiler pressure. The windlass is usually arranged for working with saturated steam, with flat valves and differential reversing valve, the engine taking the steam for the full stroke of the pistons.

The windlass structure must be massive to withstand the riding strains, the gearing being steel, with square shaft drives.

The cable holders usually have five snugs and are a machine pattern production. There is a cable holder pattern for every $\frac{1}{16}$th of an inch in the diameter of the cable so as to provide the necessary grip for common links, end links and shackles.

Cable holders are usually made of tough, high tensile semi-steel. For steel cables, steel cable holders are recommended. The cable holders are independent, being free for "letting go" the anchor under the control of the brake. The brake is powerful enough to stop the anchor which has been dropped at full speed. While it is possible with the very powerful brakes fitted to pull up the anchor suddenly when running out at full speed, it is very bad practice to do this, as the tendency is then for the cables to ride over the cable holder snugs and severely damage the tips of the snugs. Although the brake is powerful enough to take the strain in the cable when the ship is riding at anchor, it is not advisable to allow this, and it is much better practice to fit cable stoppers to take these riding strains and to relieve the windlass structure from the same. The bow stoppers are massive, and are designed for taking the riding strains

ANCHOR CABLES.

Diameter of Iron Cables.	Equivalent Diameter of Steel Cables.	Length of Ship's Cable in Fathoms.	Weight of Ship's Iron Cable in Cwts.	Weight of Ship's Steel Cable in Cwts.	Saving in Weight using Steel Cables.
11/16″		120	29		
¾″		120	34½		
13/16″		135	45¾		
⅞″		165	64¼		
15/16″		165	74½		
1″		165	84		
1 1/16″		165	95¼		
1⅛″		195	126¼		
1 3/16″		195	141		
1¼″		210	168		
1 5/16″		210	185½		
1⅜″		210	203		
1 7/16″		210	222¼		
1½″	1 5/16″	210	242	185½	56½
1 9/16″	1⅜″	240	298½	231½	67
1⅝″	1 7/16″	240	319¼	254¼	65
1 11/16″	1 7/16″	240	344½	254¼	90¼
1¾″	1½″	240	370½	276½	94
1 13/16″	1 9/16″	240	397¾	298¾	99
1⅞″	1⅝″	240	425¼	319¼	106
1 15/16″	1 11/16″	270	511¼	387¼	124
2″	1¾″	270	538¾	414¾	124
2 1/16″	1 13/16″	270	573½	449½	124
2⅛″	1 13/16″	270	608½	449½	159
2 3/16″	1⅞″	270	645¾	484¾	161
2¼″	1 15/16″	270	682¼	511¼	171
2 5/16″	2″	270	720¾	539¾	181
2⅜″	2 1/16″	300	844¼	637¼	207
2 7/16″	2⅛″	300	890¼	676¼	214
2½″	2 3/16″	300	940	718	222
2 9/16″	2¼″	300	989	757	232
2⅝″	2¼″	330	1143	861	282
2 11/16″	2 5/16″	330	1200	881	319
2¾″	2⅜″	330	1258	928	330
2 13/16″	2 7/16″	330	1317	979	338
2⅞″	2½″	330	1378	1034	344
2 15/16″	2 9/16″	330	1440	1088	352
3″	2⅝″	330	1503	1144	359
3 1/16″	2 11/16″	330	1568	1200	368
3⅛″	2¾″	330	1634	1258	376
3 3/16″	2¾″	330	1701	1258	443
3¼″	2 13/16″	330	1769	1317	452
3 5/16″	2⅞″	330	1839	1379	460
3⅜″	2 15/16″	330	1910	1440	470
3 7/16″	3″	330	1983	1503	480
3½″	3 1/16″	330	2057	1568	489

FIG. 1.

up to the breaking strength of the cable.

Anchor cables have been, and still are, made of cable iron. Anchor cables of a steel known as "Tayco" now form the outfit for many ships, and are smaller than the iron cables for the same size of ship. *Figure 1* gives size and weight for iron cable and corresponding steel cable.

With the "Tayco" cable increased strain is exerted in the anchor chain, because the diameter of the cable holder is smaller than it would be for the corresponding iron cable. This increased strain is approximately 15 per cent. Consequently, due to this and the fact that the "Tayco" chains are not so heavy as the iron, the windlass can pick up the weight equal to two anchors and two 50 fathoms lengths of "Tayco" cable, as compared with two anchors and two 30 fathoms lengths of iron cable. Similarly, dealing with one anchor, the windlass can pick up one anchor and 135 fathoms of "Tayco" cables as compared with one anchor and 85 fathoms of iron cable.

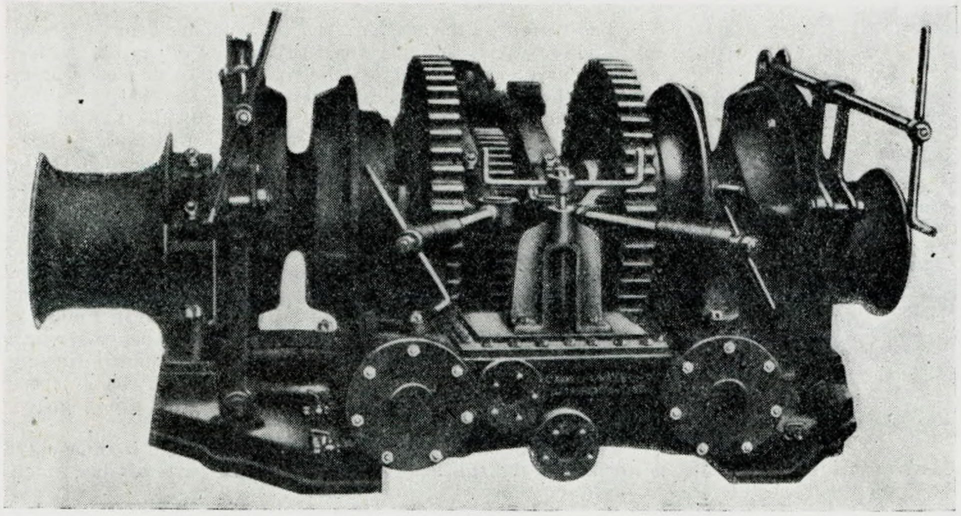


FIG. 2.

Figure 2 shows the steam windlass, looking forward. All the controls for engine, cable holder clutch gear, and brakes are arranged on the aft side, within easy reach.

The cables should have a clear lead to the hawse pipes, and there are no fittings which the whipping cable can damage. All superfluous clutch gears and operating fittings which usually rust up have been eliminated. Cable holders must be ready and free for "letting go" the anchors in any emergency.

It is essential that the cable holders particularly, and the windlass generally, which is exposed to the worst conditions, be kept well lubricated. Hand gear is usually supplied with the windlass for handling cables in dock. Smooth or whelped warping ends are provided for both surging and fleeting, the whelps arranged well rounded, so that they do not damage the hawser.

Warping ends must be of large diameter and length, suitable for at least four or five turns of "Manila", with smooth action surging curve and deep outer lip to prevent the rope being forced over the end. The warping ends must be of very hard white iron to restrict as far as possible the cutting action of the wire hawser when surging, but no matter what special material the warp ends are made of, if surging becomes excessive, it will always cause cutting and destruction of the warp ends. Smooth warping ends are usually fitted.

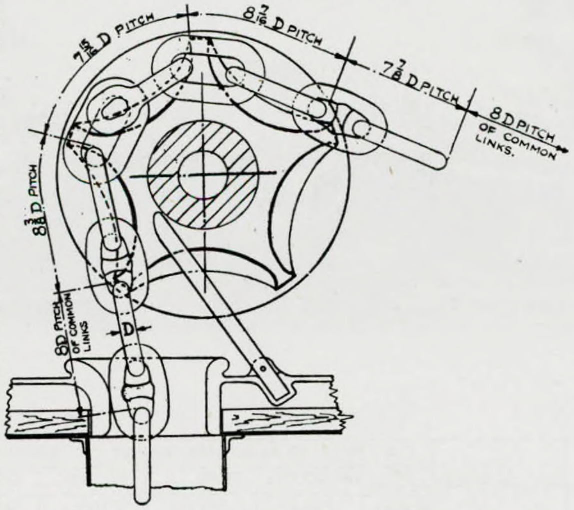
For several years, special windlasses have been made to withstand safely the breaking strength of the cables, with brakes powerful enough to hold the cables up to the breaking strength, the power of the windlass being sufficient to raise both anchors with all the cable out. This class of windlass has been found to be necessary in ships which anchor in deep water and are exposed to sudden changes in the weather.

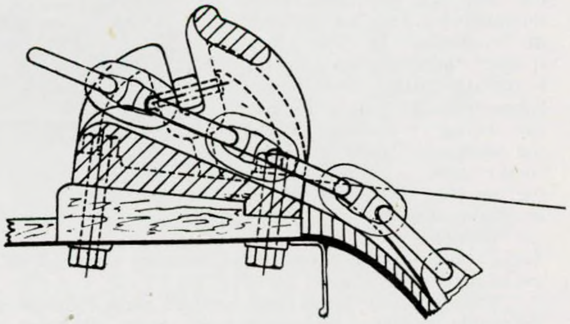
The position of the cable lockers in the ship is very important, if the windlass gear is to work satisfactorily in all respects.

Figure 3 shows the amount of grip of the chain by the cable holder, and to ensure this grip, it is essential to have tail end weight of the cable from the windlass down to the locker well below. It is necessary for the lockers to be below the main deck, with a chain locker pipe for controlling the lashing cable when "letting go". Ships have been built with lockers immediately under the windlass with the result that the cables jump, both when heaving and "letting go". The position of the cable locker is particularly stressed for the attention of owners, builders and Classification Societies.

In the Merchant Navy anchor cables are made up in 15 fathom lengths, usually coupled together by a bolt type of shackle necessitating special size extreme end links, and second end links, on either side of the shackle. The bolt type shackle can be easily disconnected in any emergency for slipping the anchor.

The design of the windlass cable holder must accommodate the





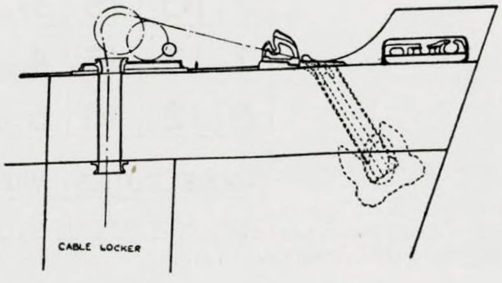


FIG. 3.—*Cable arrangements.*

pitch of common links as well as the different pitches over the shackle connections, also shown in *Figure 3.*

When the lugless type of shackle is used, the pitch of the chains throughout the cable is constant, and the cable holder can be a tighter fit with less slip and wear.

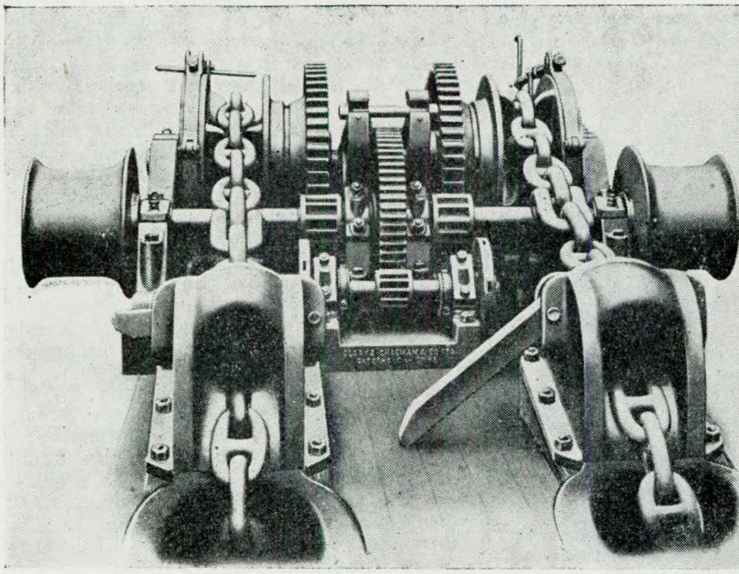


FIG. 4.

To eliminate the wear and tear at the hawse pipes and to reduce the frictional nip which has the effect of decreasing the effective strain in the cable between the ship and the anchor, the hawse pipe should be lipped so as to provide a continuous and easy race for the cable links, as shown in *Figure 4,* which also shows the "Woodeson" self holding and automatic release, tunnel headed bow stopper. The latter controls the whip in the cable when the anchors are "let go" out of control. In this bow stopper there are no working parts to rust, or require lubrication, a simple locking bar being provided. When the anchor is home, an extra "make fast" is provided by the devil's claw and screw, or Blake stopper.

Figure 5 shows the anchor gear of the Naval type, with the engine totally enclosed and running in oil.

The mooring heads can be used independently of the cable holders, making a very snug arrangement. To suit certain conditions the engine and driving gear can be arranged on the deck below. This leaves only the capstan heads and cable holders on the forecastle deck.

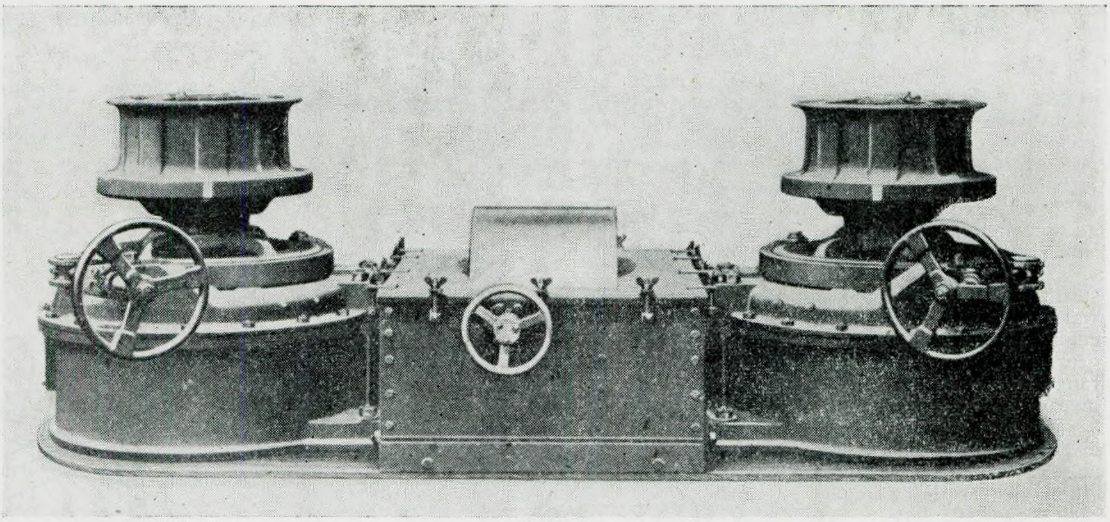


FIG. 5.

The Steam Driven Cargo Winch.

The usual sizes of winches are :—

3 tons With engine cylinders 6″ diameter × 10″ stroke.
3½ tons ,, ,, , 7″ ,, 10″ ,,
4 tons ,, ,, ,, 7″ ,, 12″ ,,
5 tons ,, ,, ,, 8″ ,, 12″ ,,

The duty of these winches is given in the table, *Figure 6.*

SIZE OF WINCH.	DIA. OF CENTRE BARREL.	DUTY FROM CENTRE BARREL OR WARPING END.				DUTY FROM 11" DIA. WHIPPING DRUMS.	
		IN DOUBLE GEAR.		IN SINGLE GEAR.			
		PULL	SPEED.	PULL.	SPEED.	PULL.	SPEED.
6"x 10"	14"	3 TONS.	55 FT/MIN.	25 CWTS.	135 FT/MIN.	15 CWTS.	250 FT/MIN.
7"x 10"	16"	3½ TONS.	60 FT/MIN.	30 CWTS.	150 FT/MIN.	20 CWTS.	250 FT/MIN.
7"x 12"	16"	4 TONS.	60 FT/MIN.	35 CWTS.	140 FT/MIN.	23 CWTS.	255 FT/MIN.
8"x 12"	16"	5 TONS.	60 FT/MIN.	45 CWTS.	140 FT/MIN.	30 CWTS.	255 FT/MIN.

ABOVE DUTIES WITH A STEAM PRESSURE OF 80 LBS./SQ. INCH.

LIGHT HOOK SPEED IS APPROXIMATELY DOUBLE FULL LOAD SPEED IN EACH CASE.

FIG. 6.—*Standard steam cargo winch duties.*

The winches are usually arranged with centre barrel, two whips and warping ends. Light cargo can be handled with the four whips, the engine running continuously in one direction. The derricks are usually rigged in union purchase.

The winch should be placed as near to the hatch, and as far from the goose neck as practicable, so as to obtain the best lead for the cargo runner. The centre drum should be kept as short as practicable so that the wire may be wound on regularly. The angle of the wire lead from the drum should not exceed 5° maximum from the square line passing from the goose neck to the barrel mid-way between the flanges.

Figure 7 shows the "make fast" of the wire on the centre barrel which is pocketed within the flange, and the following turns of wire are not damaged as when over-riding the barrel hook.

The design of the warping end or whipping drum is shown in *Figure 8;* it is suitable for hoisting and lowering, with a fleeting curve extending across the waist to provide easy fleeting of the whip for light loads. In addition the warp end has deep flanges and effective surging curves for the hawser for moving the ship. The warping ends are fitted with a hook bolt for making fast the wire for hoisting the derrick. The winch centre barrel is usually fitted with a foot brake, to meet the requirements of certain Port Authorities, but is not essential for handling cargo, because the load can be suspended and lowered with the engine under control.

Steam consumption can be reduced by raising the efficiency of the winch transmission, providing gears with machine cut teeth running in totally enclosed oil baths, as shown in *Figure 9.* The steam consumption can be further reduced when the winch is arranged with its engines and gears totally enclosed running in oil, as shown in *Figure 10.* It is arranged with change speed spur gear, so that only one pinion and wheel are engaged, providing a silent drive.

The foot brake is enclosed with the engine, and is sufficiently powerful for the full load. All the working parts of this winch

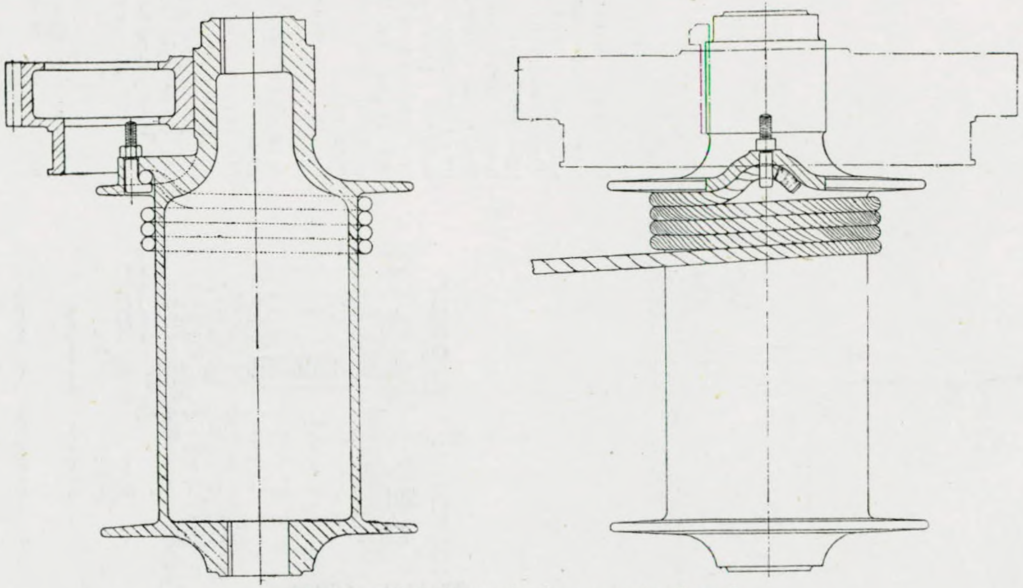


FIG. 7.—*Make fast of wire on centre barrel.*

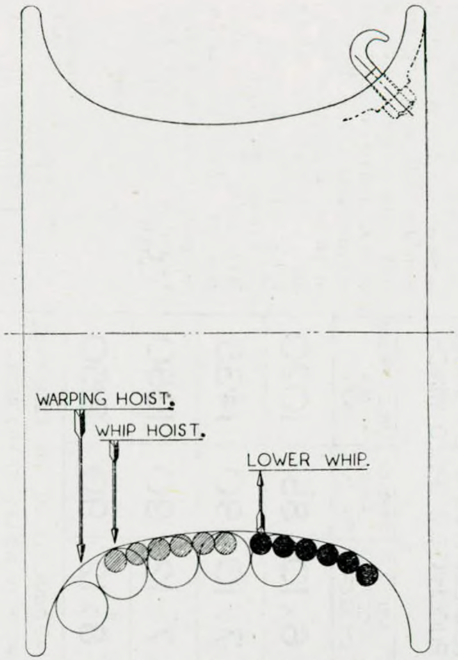


FIG. 8.—*Design of winch warping end suitable for warping and whipping duties with shallow curve waist for fleeting whip, and steep surging curved flanges for warping.*

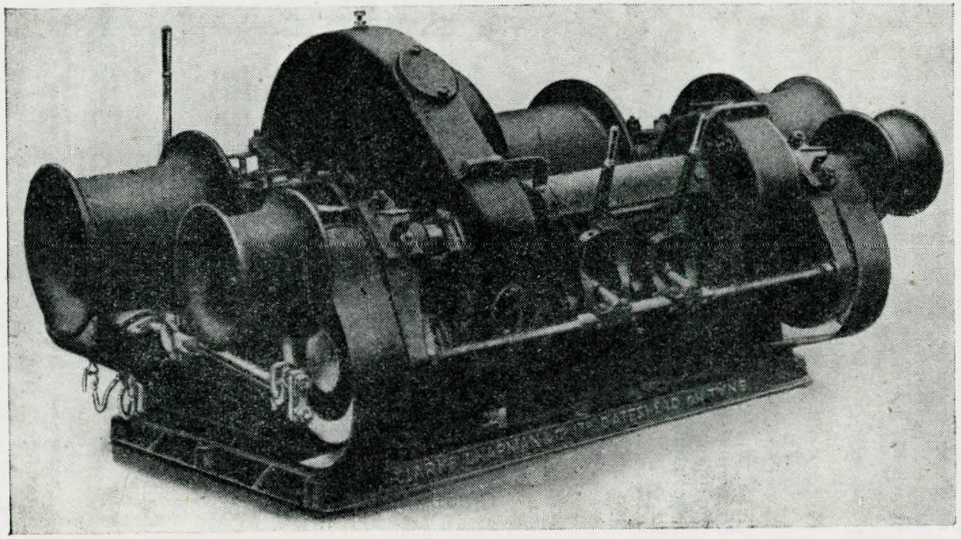


FIG. 9.

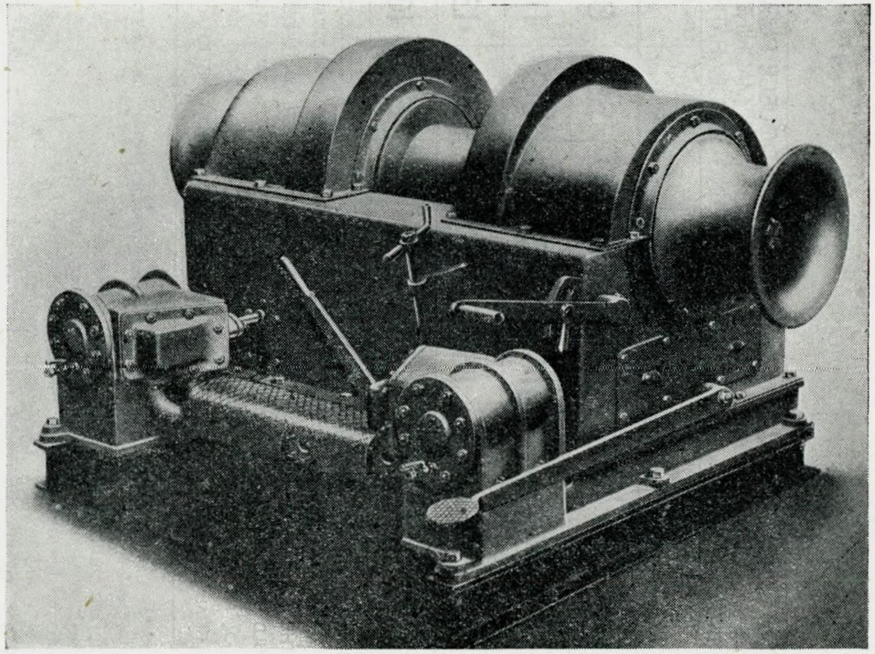
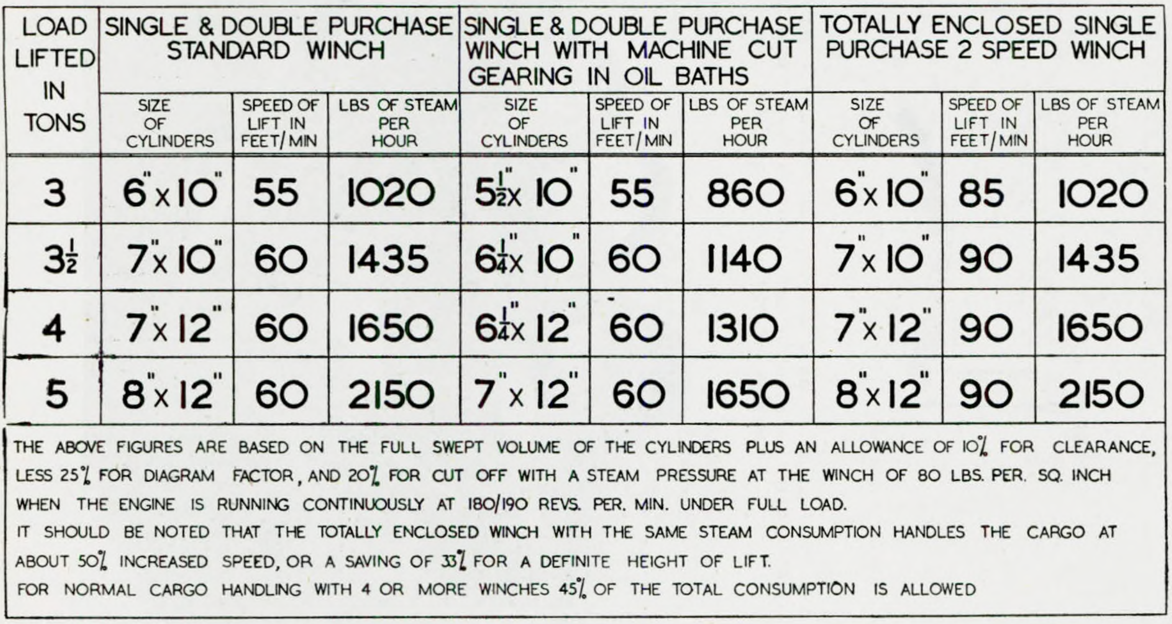


FIG. 10.



LOAD LIFTED IN TONS	SINGLE & DOUBLE PURCHASE STANDARD WINCH			SINGLE & DOUBLE PURCHASE WINCH WITH MACHINE CUT GEARING IN OIL BATHS			TOTALLY ENCLOSED SINGLE PURCHASE 2 SPEED WINCH		
	SIZE OF CYLINDERS	SPEED OF LIFT IN FEET/MIN	LBS OF STEAM PER HOUR	SIZE OF CYLINDERS	SPEED OF LIFT IN FEET/MIN	LBS OF STEAM PER HOUR	SIZE OF CYLINDERS	SPEED OF LIFT IN FEET/MIN	LBS OF STEAM PER HOUR
3	6" x 10"	55	1020	5½" x 10"	55	860	6" x 10"	85	1020
3½	7" x 10"	60	1435	6¼" x 10"	60	1140	7" x 10"	90	1435
4	7" x 12"	60	1650	6¼" x 12"	60	1310	7" x 12"	90	1650
5	8" x 12"	60	2150	7" x 12"	60	1650	8" x 12"	90	2150

THE ABOVE FIGURES ARE BASED ON THE FULL SWEPT VOLUME OF THE CYLINDERS PLUS AN ALLOWANCE OF 10% FOR CLEARANCE, LESS 25% FOR DIAGRAM FACTOR, AND 20% FOR CUT OFF WITH A STEAM PRESSURE AT THE WINCH OF 80 LBS. PER. SQ. INCH WHEN THE ENGINE IS RUNNING CONTINUOUSLY AT 180/190 REVS. PER. MIN. UNDER FULL LOAD.

IT SHOULD BE NOTED THAT THE TOTALLY ENCLOSED WINCH WITH THE SAME STEAM CONSUMPTION HANDLES THE CARGO AT ABOUT 50% INCREASED SPEED, OR A SAVING OF 33% FOR A DEFINITE HEIGHT OF LIFT.

FOR NORMAL CARGO HANDLING WITH 4 OR MORE WINCHES 45% OF THE TOTAL CONSUMPTION IS ALLOWED

FIG. 11.—*Comparative steam consumption.*

are splash lubricated. Inspection doors are provided so that adjustments can be made to the top and bottom ends, engine shaft bearings, eccentrics and brake. The steam and exhaust pipes are led snugly round the winch casing and are protected from the weather, the steam and exhaust branches being placed for a neat and easy connection by the builders.

The engine control lever is arranged for lifting when "hoisting" and depressing when "lowering", with the stop valve handle in a handy position. This arrangement is suitable for a seated winch man, where the Dock Regulations call for this, viz. Australia and New Zealand.

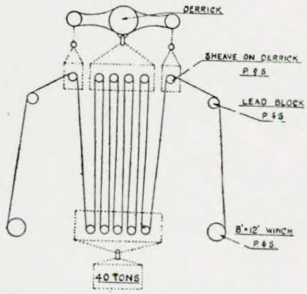
The comparative steam consumption of the foregoing winches is shown in *Figure 11.*

Regarding the most economical steam consumption, link motion reversing gear is much more economical in use than some types of winches which use ordinary differential reversing gear similar to that used on steam windlasses and capstans. Direct acting winches, without gears, are still more efficient with a further reduction in steam consumption. The drum is arranged on the crank shaft, and is suitable for lifting loads up to 2 tons at 250ft./min., and slack up to 500ft./min. This is a silent type of winch, but having no gears it requires a large engine with cylinders 12in. diameter × 10in. stroke, and is more expensive than the standard winch. These winches have been very satisfactory in service, the maintenance costs being considerably reduced. They can be arranged with the engine totally enclosed and running in oil.

It is recommended that winches should have :—

(1) Forged manganese bronze piston rods and valve spindles.

(2) Heavy type balanced valve gear.



DIAGRAMMATIC ARRANGEMENT OF BLOCKS

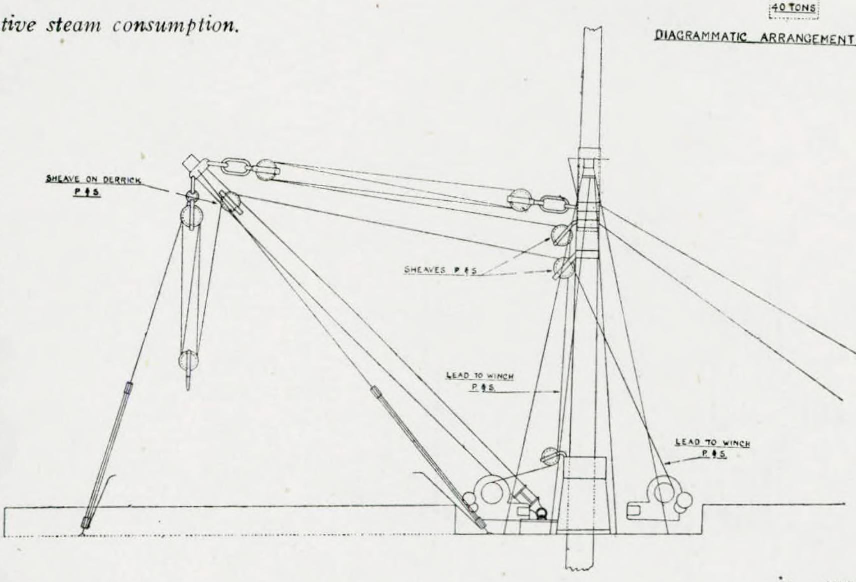


FIG. 12.—*Heavy derrick arrangement with two winches hoisting and two winches topping.*

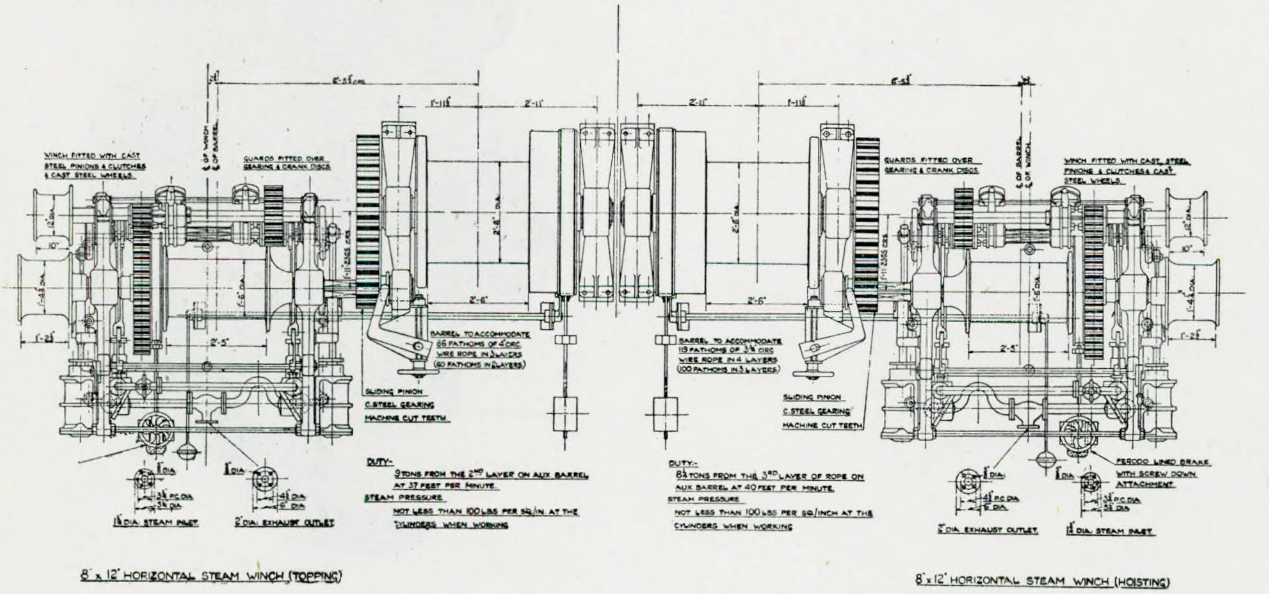


FIG. 13.—*Steam winches for 50 ton derrick at mainmast.*

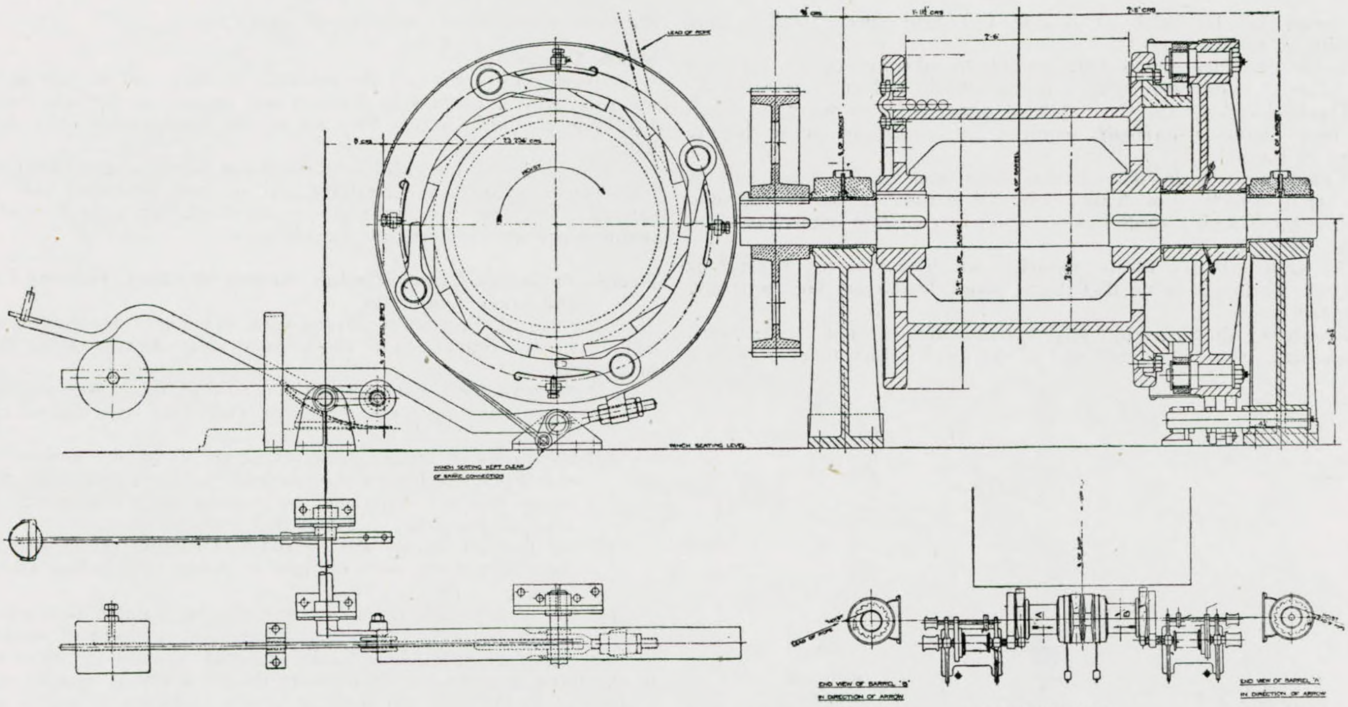


FIG. 14.—*Automatic safety brake.*

(3) Steel pinions and clutches.
the extra first cost being money well spent.

Heavy Derricks.

Loads up to 20 tons can be lifted through 5 part tackle by a single winch exerting a strain of 5 tons in the wire with a block efficiency of 80 per cent. For a height of lift of, say, 50 feet, the length of wire reeled on the drum would be 250 feet—say, two layers, a similar winch with tackle being used for the topping.

Loads up to 40 tons can be lifted through 10 part tackle by two standard 5 ton winches, with an endless rope led from the two centre barrels, as shown in *Figure 12.* The block efficiency remains 80 per cent. so long as the two winches are working together, because the middle pulley is stationary for all practical purposes.

For the 50ft. height of lift, each barrel will take 250 feet of wire as before, a similar pair of winches and tackle being used for the topping.

For both the 20 tons and the 40 tons with their tackle, the speed of hoist is the same. This practice does not require special winch gear, but necessitates a special "rig up" and reeving of the block and tackle. This arrangement is not provided with any safety measure in the event of the winch gears breaking while handling the load. To provide for this safety means and to avoid taking off the usual cargo runners from the centre barrels, an auxiliary barrel is arranged geared to the standard winch, and on this barrel the heavy derrick wire can be permanently stowed. One winch with an auxiliary barrel is used for the cargo purchase, and another for the topping. See *Figure 13.*

The winches are arranged at the mast on the opposite side to the derrick so that the wires lead direct from the barrels up the mast, thus permitting port and starboard swinging of the load. With these long wire leads to the masthead, the wires reel on the auxiliary barrel satisfactorily. This is the arrangement usually adopted when dealing with 30, 40, 50 and 80 ton derricks, and is one that can be recommended.

When the winches are dealing with normal cargo, the auxiliary barrels are disconnected by sliding out the pinion, the barrel being self spragged.

The auxiliary drums are fitted with free wheel self holding automatic safety brakes as shown in *Figure 14.*

Another arrangement for dealing with heavy derrick loads is two winches coupled together with a middle line geared drum unit, one pair of winches being used for hoisting and another pair for topping. With this arrangement the power from the two winch engines is used for the purchase and the topping. When winches are coupled in this way, the heavy derrick load must be controlled through a master valve, which makes it necessary to have one man on each winch and a third on the master valve.

When dealing with loads of over 100 tons on the more usual type of cargo vessels, two pairs of coupled winches with two middle line units worked with the endless rope with suitable tackle are used, the derrick in this case being fixed for topping.

Derricks are usually hoisted into position with the warping end, there being a lazy span wire with chain and shackle for making fast to a cleat on the deck. Sometimes the winches are fitted with a lazy span drum with brake and clutch.

The warping winch is the same type as the cargo winch, usually without a centre barrel. It should be powerful enough to exert a strain in the hawser of one ton for every 1,000 tons displacement

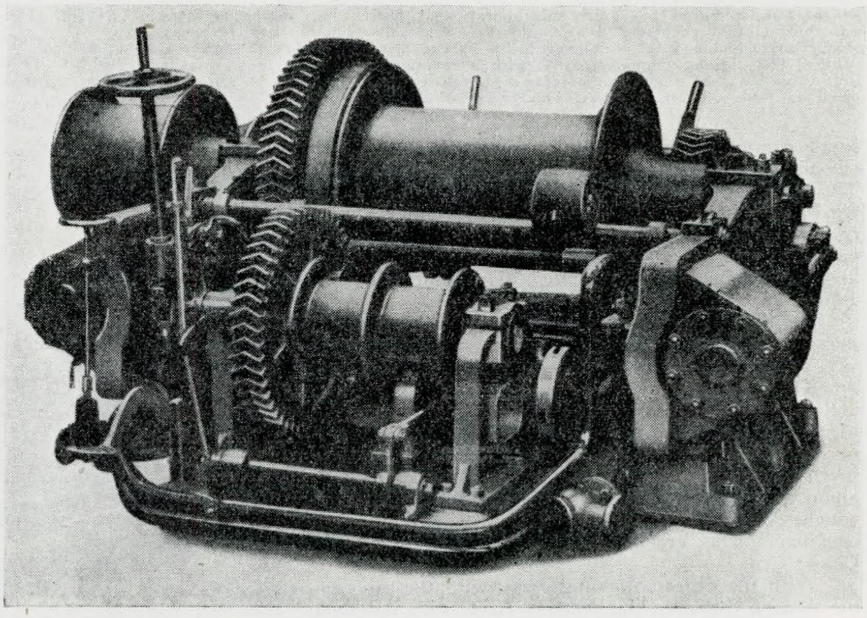


FIG. 15.

and bring in the slack at double full load speed, stalling and straining as required.

Large diameter drums long enough to take five or six turns of the "Manila", with deep surging flanges inside and out, are essential.

Heavy brackets for the extended drums of this warping winch with large diameter shafts are required for standing up to the surging strains of the ship.

Emergency steering barrels are often fitted on the extensions of the warping winch. For dealing with the stream anchor, the warping winch is fitted with a cable holder, which is complete with clutch and brake.

As an alternative to the mooring winch, a warping capstan is fitted, the advantage being that it can take a load from both port and starboard.

Figure 15 shows a combined hoisting and slewing steam winch for coasters, arranged at each end of the hatch, which together with a single derrick on the middle line, under the control of one man, can hoist, slew and lower the load rapidly. The winch is self-contained on one bedplate, provided with a hoisting winch in the usual way complete with its own engine, and also a slewing winch with its own engine. This derrick system with combined hoisting and slewing winch is indicated diagrammatically in *Figure 16.*

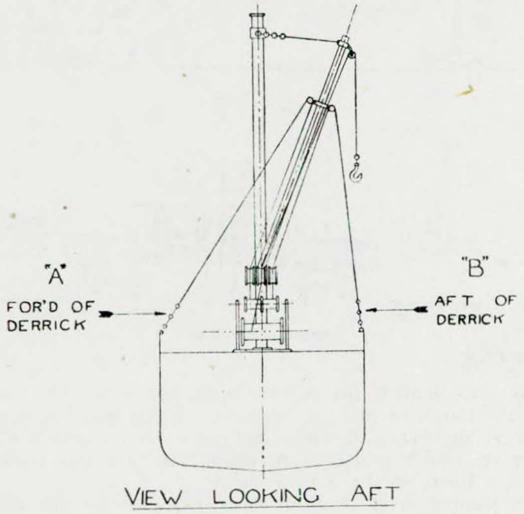


FIG. 16.—*Standard derrick system with combined lifting and slewing winch.*

(Diagrammatic).

Height of anchorage at ship's rails should be same height as sheaves.

With this system the derrick topping wire is fixed directly vertical over the heel of the derrick, and the *slewing inboard and outboard is done by means of steam power,* thus dispensing entirely with manual labour for pulling the derrick over *and only one man is required for operating.*

The winch is fitted with a small engine for working a divided barrel placed behind the usual lifting barrel, this small barrel being the one that is used for slewing the derrick.

Each barrel is driven by a separate pair of cylinders so that there are no clutches to engage and disengage, the reversing levers and stop valves being all that are required to control all operations. The lifting engine is fitted with link motion reversing gear, and the stop valve handle and reversing handle are combined in one lever by a special arrangement with universal joints. The slewing engine is fitted with a reversing valve, acting also as a stop valve, so that there are only two operating levers required to work the winch and *one man can therefore easily control all operations.*

For starboard slewing make fast "A" is aft of the derrick and "B" is forward.

The leading of the guys is very important.

The combination of the engine reversing lever and the steam stop valve, which is one of the features of the uni-control on the hoisting and slewing winches, is applicable to the ordinary steam hoisting winches when placed side by side and used in conjunction with union purchase derricks. The controls for both winches are brought to a position for operating by one man. This arrangement is only used in certain Lines.

With the object of doing away with the guys on the slewing derricks, the derricks have been arranged with crosstrees, which makes the derrick free for swinging port and starboard without having to change the position of the guy wires on the ship's rail.

Steam Cranes.

Steam deck cranes of the hoisting, slewing and derricking type are used with advantage in coasters and vessels on special runs, but to obtain the best results they should be manipulated by a skilled driver.

The foregoing has dealt with the steam windlass and cargo handling winches which have rendered and are still rendering very good service. The first cost makes them attractive, but running cost and maintenance are matters for consideration.

Electrically Driven Cargo Winches, Anchor Windlass, Mooring Gears, and other Auxiliaries.

The use of electrically driven deck machinery for motor ships has been the practice for many years, for the reasons undermentioned :—

(1) they are very efficient and the cost of the power consumed when handling cargo compares favourably with that of steam winches ;

(2) the losses in transmission of power from the generator to the winch are less in the electrically driven gear than in the steam driven. This will be obvious when the question of condensation, etc. is taken into consideration ;

(3) the cost of supply cables and distribution boxes compares very favourably with the cost of steam distribution arrangements ;

(4) the supply cable requires practically no maintenance, whereas steam and exhaust pipes require a fair amount of attention.

The electric winch, being totally enclosed, maintains a clean deck. In the latest practice, the electrically driven winch is usually worm geared, totally enclosed and silent, as shown in *Figure 17,* and is made in sizes giving from two to seven tons pull direct off the centre barrel. It will be seen that the winch is a smooth line construction, being watertight mechanically and electrically.

The flanges of the centre drum, as well as the warping ends, are completely shrouded with rope guards so that the runner cannot spring over the flanges and become jammed. The winch has no fittings on the hatch side, thus allowing the winch to be fitted close up to the hatch, and providing a long lead to the goose neck.

The winch is constructed so that it can be completely dismantled mechanically without disturbing the electrical equipment, or vice versa. A seat is arranged for the winchman which can be made adjustable if desired, with controls conveniently placed, affording a commanding view of the hatch.

The winch is arranged with two whipping warping ends. Oil ring bearings are arranged for the worm and barrel shafts and ball bearing for the worm thrust, efficient circulation of lubricant being thereby provided.

The mechanical efficiency of this winch is approximately 80 per cent., and the efficiency of the motor is approximately 85 per cent., varying slightly with the size.

An electric winch including the power transmission is certainly more efficient than a steam winch, due to losses in steam pipes and other causes which do not occur with the electric winch. On this score alone the electric winch is being more generally adopted than

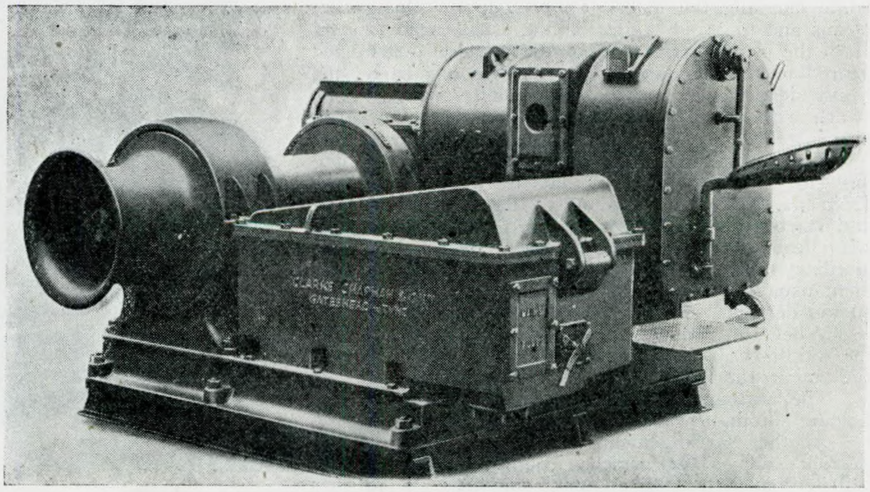


FIG. 17.

previously.

The electrical equipment is suitable for the ship's supply, which is usually 220 volts d.c. The winch is powered for the full load of, say, five tons at 100ft./min. with a predominantly series characteristic for lifting lesser loads at higher speeds. When the load falls to 2½ tons, it is automatically hoisted at 200ft./min., with lesser loads at correspondingly higher speeds, reaching a light hook speed of 450ft./min.

This handling of cargo is brought under the control of a simple lever with five steps for hoist. There is only one step for lowering, so that whether it is the light hook or the full load, no mistake can be made. This simple control is practically proof against being mishandled. The light hook is lowered at 450ft./min., whilst loads above one ton go down at the electrically controlled speed of 250ft./min. This electrically controlled lowering eases the wear and tear on the brakes considerably, thus keeping a cool temperature. Further, the winch is provided with an independent foot brake so that "inching" out of cargo, without snatch or wrench, is obtained. The winch will stall and strain when required, dragging out awkward cargo. The foot brake will easily handle full load, and will enable it to be landed at a creeping speed.

When hoisting the load, the control can be thrown over to the full step, and while the acceleration is rapid, it is automatically protected against heavy current surges by the specially designed contactor gear.

The winch is also fitted with a magnetic brake powerful enough to bring to rest the full load running down at full speed, when the control lever is brought to the "off" position. In the event of failure of supply, the brake automatically goes on and the winch will not start again until the lever has been first brought back to the "off" position, which is protection against accident.

The armature is built to withstand safely any speed which may be obtained when handling cargo. The winch being automatically controlled when loaded, and fitted with a limiting shunt winding in the field to prevent excessive speed when lifting light hook, the necessity of a centrifugal brake is eliminated.

Further, centrifugal brakes are not recommended due to the constant attention and adjustments necessary, and, in fact, with well designed control gear this type of brake is superfluous.

The five ton winch, lifting the full load at 100ft./min., can be fitted with a switch to exert its full power with a three ton load, lifting this at 170ft./min. With this switch in the "three ton" position the 1½ ton load is lifted at 340ft./min., which makes for a much higher cargo handling speed for the more usual lighter loads.

The foot brake pedal can be fitted with a switch which is so arranged that when the foot brake is applied during motoring, the whole of the starting resistance is inserted in the motor circuit irrespective of the control position, thereby limiting the current to 60 per cent. of the full load current. The torque is also reduced proportionately, but it remains high enough to prevent the heaviest cargo slipping back. This feature also enables dragging out the cargo inch by inch.

When the foot pedal is released the winch accelerates and lifts or lowers the load at the speed corresponding to the controller position.

Whilst the resistances are designed to withstand the heating due to the 60 per cent. full load current for a considerable period, standing on the foot brake causes unnecessary waste of energy, and should therefore be discouraged as far as possible.

Magnetic Brake.

The magnetic brake is of the spring loaded caliper type, arranged in a watertight and dust-proof housing bolted to the back end of the motor. It is completely isolated from the motor, so that the dust from the brake linings cannot penetrate the motor windings. It is fitted with self-accommodating lined shoes with generous bearing surface.

This improved type of brake is so designed that it does not require any adjustment throughout the life of the linings; this is a great advance upon other forms of brakes, which require constant attention due to wear. With the latest and most up to date type of caliper brake, and the winch running, the shoes are clear of the brake sheave, and consequently no heat is generated, there being no rubbing or even brushing of the surfaces.

The brake sheave is fixed to the back end of the armature spindle and is dynamically balanced with the armature, so that it is free from vibration. The twin brake magnet has a powerful and snappy pull with ample reserve for releasing the brake when the linings are practically worn out. This brake magnet is so wound that it is practically instantaneous in action, as an initial surge of current is allowed to pass through the winding.

With the latest type of brake windings the magnet coils are kept extremely cool when the brake is off, and a continuous rating is provided. In the event of failure of supply when hoisting the load, this brake automatically goes on and the load is held suspended. The load can be lowered under control by a simple hand release provided for opening the caliper brake.

The magnetic and foot brakes are very accessible. By removing one door, new lined shoes can be readily fitted; these should be in-

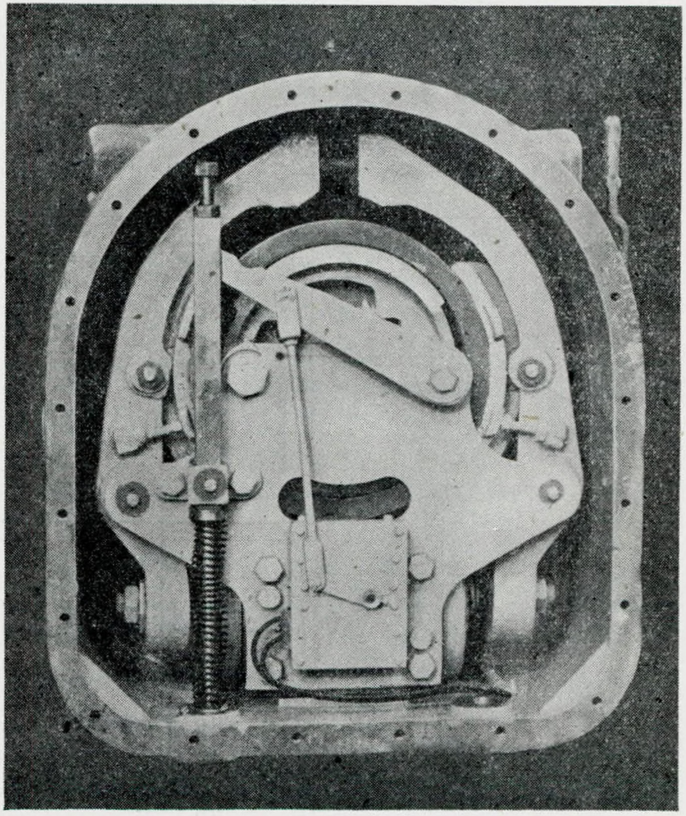


FIG. 18.—*Magnetic brake.*

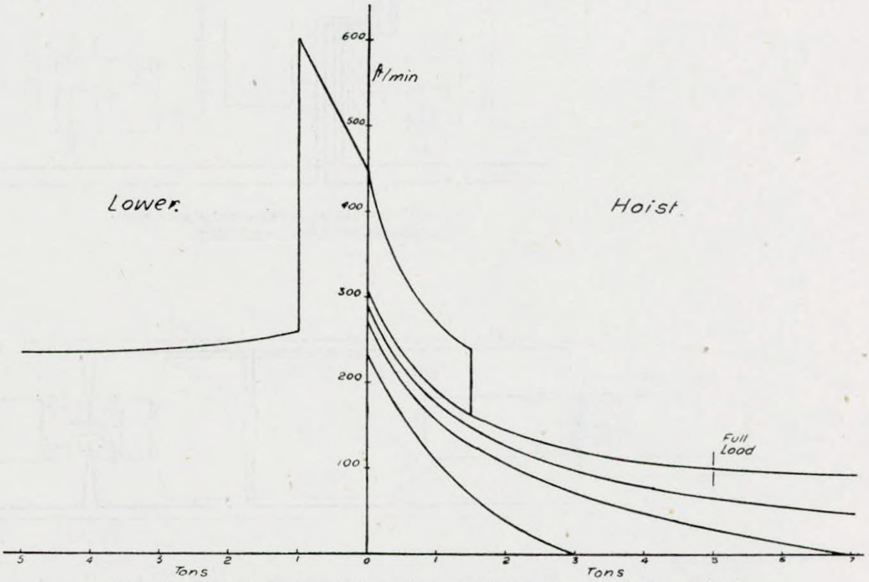


FIG. 19.—*Hoisting and lowering performance of 5 ton winch.*

cluded in the spares. The brake magnet, being separate from the brake rubbing surfaces, is not in any way affected by the temperature of the brake. The brake magnet is very accessible and can be easily fitted with new coils if required. This magnetic brake is shown in *Figure 18*. It will be seen that the separate and independent foot brake is of the internal expanding type, fitted in the same brake housing, and so arranged that no adjustment is required throughout the life of its linings.

Figure 19 shows the typical five ton winch load speed curve for both hoisting and lowering.

The hoisting control follows conventional lines. There are four resistance steps, the first two steps arranged for stalling current of 60 and 140 per cent. respectively. The contactors controlling third and fourth steps are fitted with current lock-out. This allows a high rate of acceleration without overload, and limits the starting current peaks to a safe value irrespective of the weight of the load or the skill of the operator. The control lever can be pulled straight in the last step position safely.

The fifth step is a series diverter step under control of a load discriminator, and is usually arranged to lift half load at twice full load speed. There is one step for lowering, the loads of one ton and above being power controlled to the speed of approximately 250ft./min., allowing the light hook to go down at a speed of approximately 450ft./min.

Figure 20 shows the extent of the current consumed.

The winchman is prevented from changing from "hoist" to "lower" or from "lower" to "hoist" whilst the armature is revolving by the use of back e.m.f. catches fitted to the controller. The lever is stopped in the "off" position, the magnetic brake going on making the action snappy.

This winch is not a one way winch, it being provided with a reversing isolating switch, which can be operated externally at the winch. The contactor gear is arranged on a frame, dropped into a watertight casing fitted with a hinged door. It is self-contained on the winch.

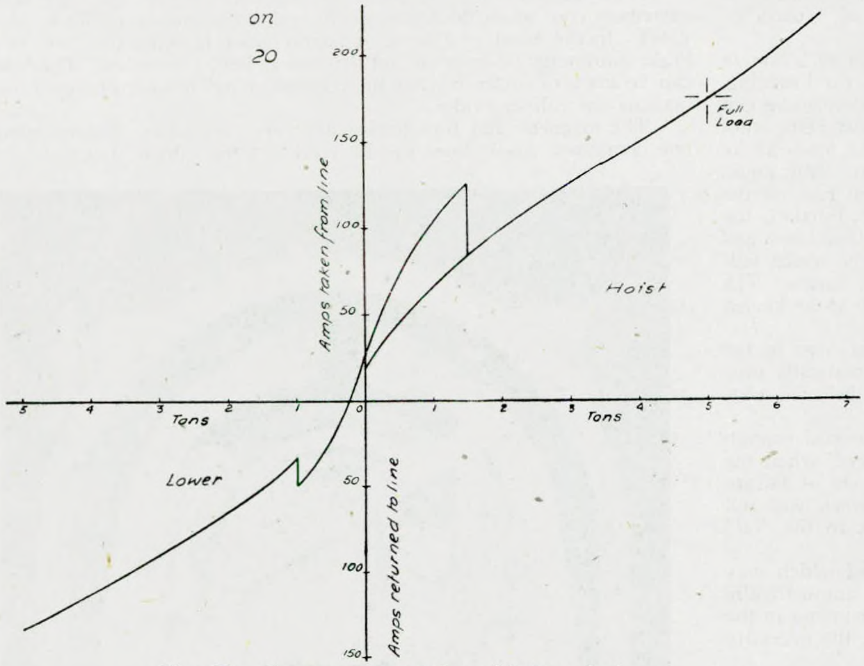


FIG. 20.—*Current consumption of 5 ton winch.*

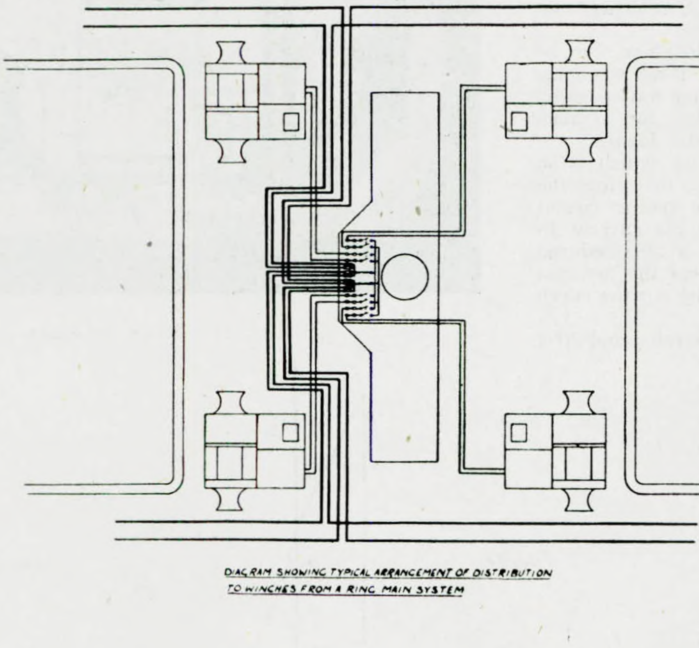


DIAGRAM SHOWING TYPICAL ARRANGEMENT OF DISTRIBUTION TO WINCHES FROM A RING MAIN SYSTEM

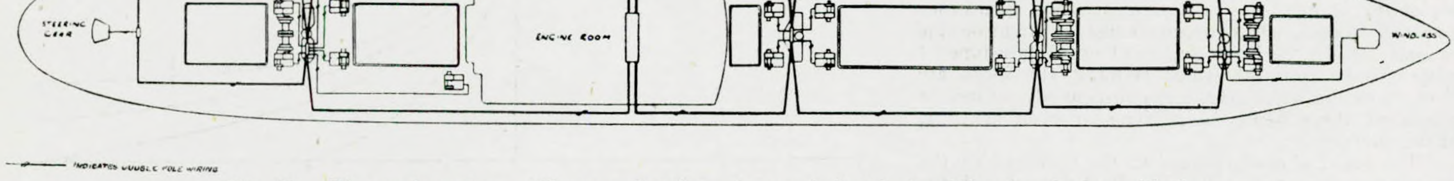


FIG. 21.—*Ring main system. Diagram showing scheme of electrical cabling for deck auxiliaries.*

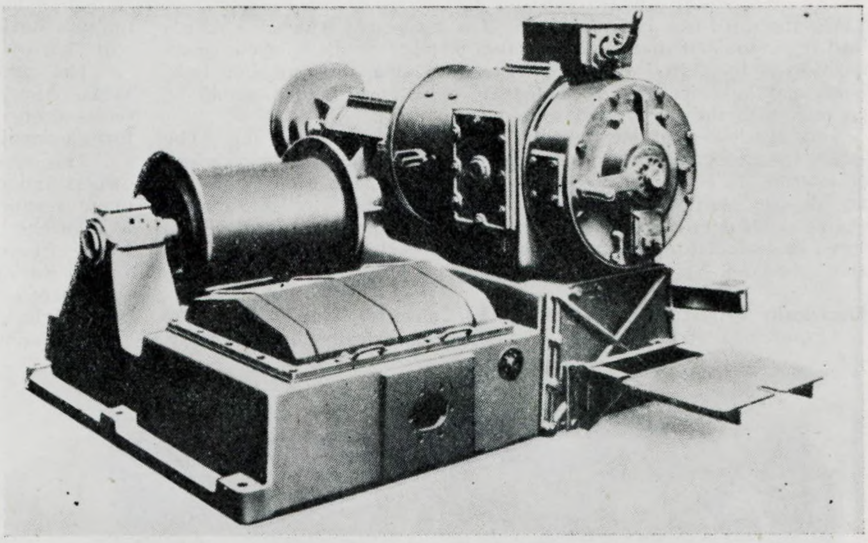


Fig. 22.

In a separate watertight compartment is fitted the rustless, unbreakable resistance, which is rated for taking first step stalling current for 15/20 minutes safely. It is of very high grade material and will safely withstand the temperature, meeting Lloyds' requirements. The indestructible resistance connections are easily disconnected from the leads, and the resistance can be withdrawn readily. There are no perishable connections in the resistance box.

The winch, including the electrical equipment, is amply rated for working in the tropics, there being no ventilators. In the past, ventilators were considered to be necessary, but when left open, or not shut tightly after closing down the winch, they allowed water to enter, with consequent damage.

The motor is rated for a temperature rise not exceeding 90° F. on all day working with loads up to half full load at the rate of 45 lifts per hour. The brake shunts have the same rating as the motor.

Condensation is inevitable in a totally enclosed winch when a hot and a hard day's work is followed by a chilly night. A warming element is provided so that the air is kept above condensation level, and the contactor gear, including the fine wire coils, is protected. As a further protection against condensation, the contactor box can be fitted with a perforated canister of silica-gel, or chloride of lime, which has the capacity of absorbing moisture equal to its weight.

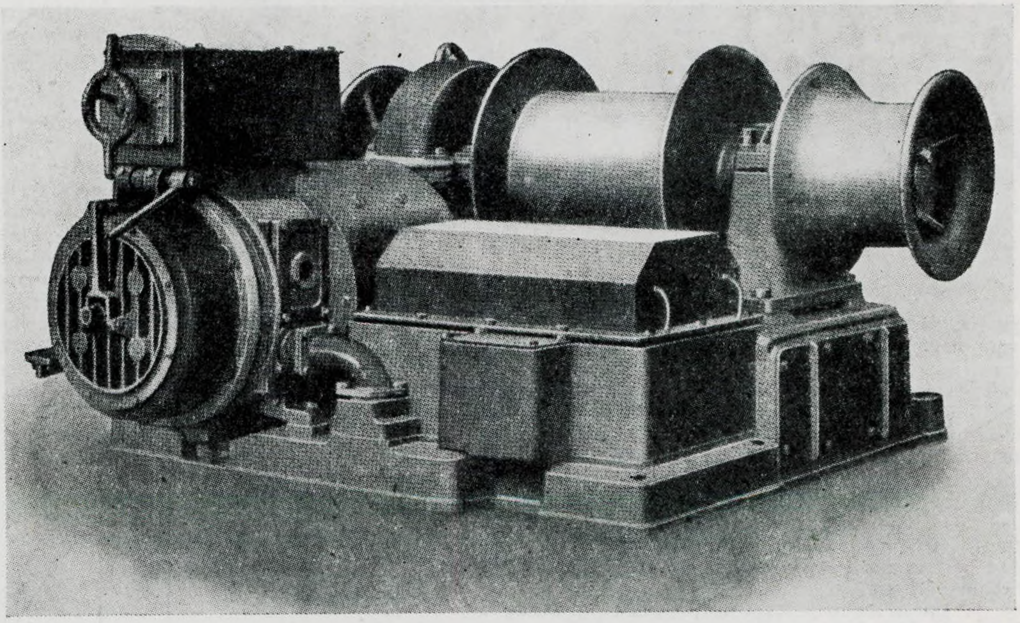


Fig. 23.

The winch is arranged with very accessible terminal connections for the incoming cables, which can be made without opening the contactor casing lid.

The winch can be arranged suitable for the ring main, but the link boxes are not usually arranged in the winch. *Figure 21* shows the typical layout of mast, derricks, hatches and winches with the usual ring main leads, distributing boxes, switches, etc. The advantage is that if any section of the ring main fails it can be isolated without affecting the winch, and further, if any winch fails, it can be isolated at the link box.

Preference is sometimes shown for winches with the contactor gear and resistances arranged in mast houses, the master controller only being arranged on the winch. This arrangement necessitates the wiring of the winch from the master controller to the mast house equipment and back to the motor, and is, therefore, not self-contained.

The contactor gear arranged in mast houses, is sometimes considered more accessible for adjustments, but care must be taken to keep it watertight and ventilated.

Figure 22 shows a similar type of winch of another make.

Figure 23 is another example of the self-contained ship's cargo winch.

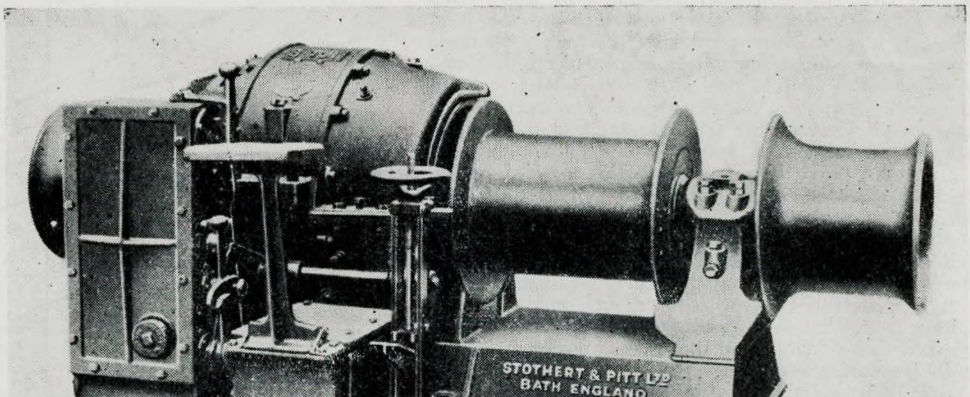


Fig. 24.

Figure 24 shows the co-axial electrically driven winch, which is direct coupled to the cargo barrel on winches for dealing with loads up to two tons, but is geared for winches dealing with higher loads.

This winch is arranged with a comparatively slow speed motor and regenerative control. In this type the contactor gear is usually arranged in the mast house.

The control of this winch is carefully thought out. In the "off" position the armature and the series winding form a loop for dynamic braking. As there is no magnetic brake, heavy loads are not held suspended, but will creep down unless the foot brake is applied. On the hoist side the first is an armature diverter step for creep speeds on all loads. The second is a resistance step, whilst the third is a "full on" step. On the geared winches a speed-load regulator actuated by the reaction member of the epicyclic gearing diverts the series winding on the third step, thus enabling light loads and light hook to be lifted at higher speeds than would be possible with the undiverted compound motor.

On the lowering side the first is a rheostatic braking step. The winch has no starting torque on this step, thus only heavy loads can be lowered. The second and third are potentiometer steps with full and diverted series fields respectively. As on the hoist side on the geared winches, the amount of diversion is under the control of the speed load regulator, allowing high speed of operation with light loads and light hook.

Electrically Driven Cargo Winch of the Converter Type.

Figure 25 shows the self-contained electrically driven worm geared cargo winch of the converter type, the converter being a single unit machine. The converter is a combined motor generator. Its construction is similar to the usual d.c. machines, but it is fitted with independent sets of brushes for the motor and the generator.

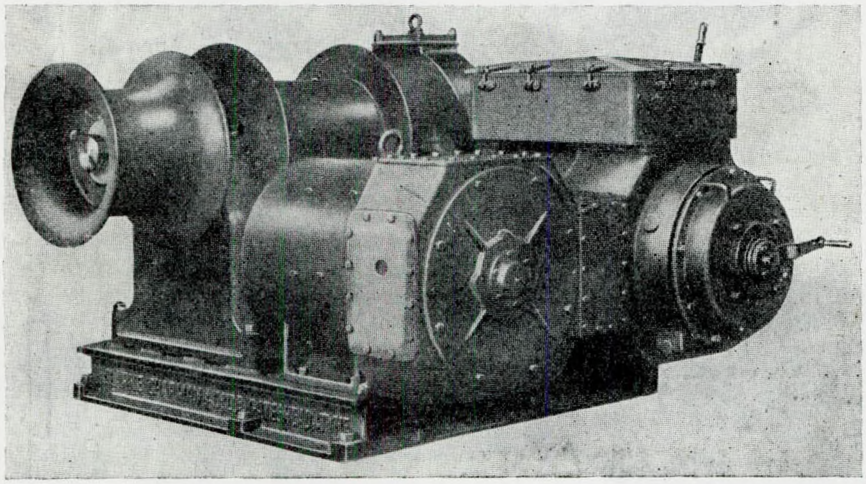


FIG. 25.

The converter "motor" receives the power from the ship's supply, usually 220 volts d.c.; the converter "generator" generates the current required by the winch motor, both the current and the voltage being regulated by the load on the winch. With the variable voltage supplied by the converter, the winch has practically an infinitely variable speed control for any load from light hook to full load. The performance of this winch for cargo handling is extremely good.

A simple control lever is provided, operating a face plate reversing potentiometer in the hoisting and lowering directions. By this regulation of the current supply from the converter generator to the driving motor, the winch will creep and inch up the light hook, tighten without snatch, lift the load with rapid acceleration, stop immediately and suspend the load, give over the load to the other derrick and pay out the slack when the load has been taken over by the other derrick, returning the light hook at high speed, all without the use of brakes.

A foot brake is not fitted to this type of winch, because there is no use for it; as a matter of fact, mechanical brakes of any kind are not required on this winch for cargo handling. A magnetic brake, however, is fitted so that in the event of supply failure the load will be automatically held in suspension.

The controller is very simple, including two push button controlled starting contactors with a small grid of starting resistance and the face plate potentiometer with regulating resistances.

This winch is instantaneously responsive to the control, there being no magnetic brake delay in swinging through the "off" position, from hoist to lower and vice versa, the action being smooth but the acceleration rapid. As the speed and load control is by voltage conversion through the converter and not through starting resistances, the consumption of this winch compared with that of the contactor winch shows a decided saving.

The converter system gives controlled lowering on all loads. When heavy loads are lowered, the converter "generator" receives energy from the winch motor and the converter "motor" returns current to the supply.

This winch has been proved to be extremely satisfactory both by owners and stevedores, but it is doubtful whether its complete automatic control over the well manipulated control of the contactor winch is sufficient justification for its increased cost of about 25 per cent. *Curve, Figure 26* shows the load speed characteristics of this winch for the various steps of hoisting and lowering.

There is no need to put the converter in a deckhouse, because it is sea tight as required by Lloyds.

The converter has a totally enclosed cooling system, circulating the air through the box bedplate with its large radiating surface.

These winches are particularly suitable for controlling at the hatch, it being unnecessary to arrange for foot brake connections.

Electrically Driven Cargo Winches Arranged for the Constant Current Supply.

The constant current system is ideal for severe duties like winch work, where the motors are subjected to frequent starting, stopping and reversing. The absence of starting losses—inevitable with the constant voltage system—and the fact that it has power controlled lowering, makes it an economical cargo handling arrangement.

The performance of the winches on the constant current system is at par with those of the variable voltage/variable current systems, such as the Ward Leonard, converter, booster, or reducer drives, and displays the same flexibility of control and excellence of manœuvrability. With this type of winch there is only one centralised generating plant. On the other hand, as the maximum approved voltage on this system for ship work is 650, the supply ring feeding the winches and, perhaps, other auxiliaries must carry considerable current, usually 200-300 amperes, and each motor supplied has to be constructed for this heavy current irrespective of its size.

The main current carrying parts, such as armature windings, commutators, switches, etc., become heavy current parts, robust, but large and costly.

Constant current can be generated by constant current generators,

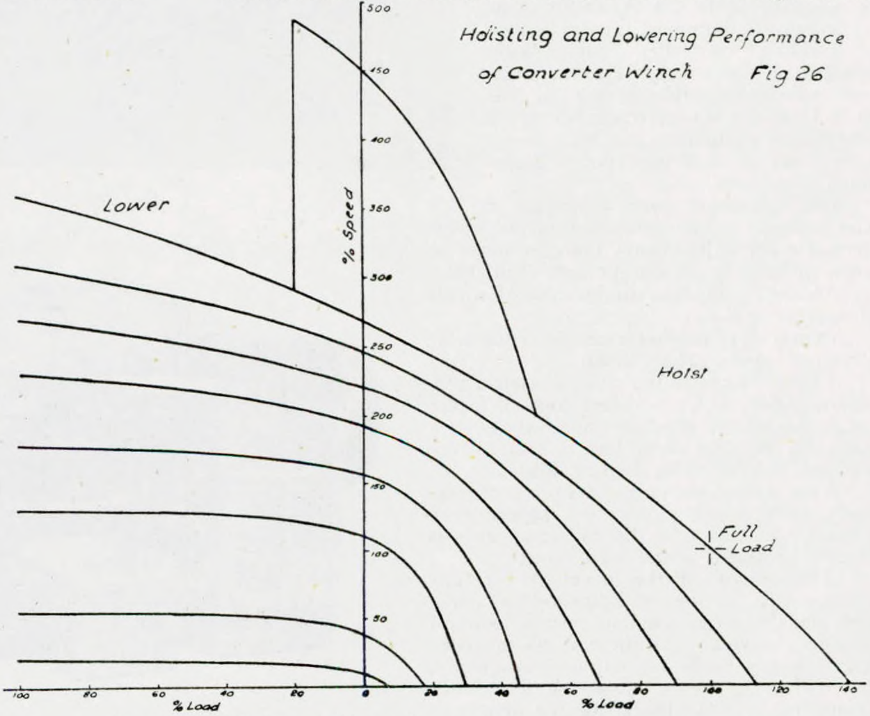


FIG. 26.—*Hoisting and lowering performance of converter winch.*

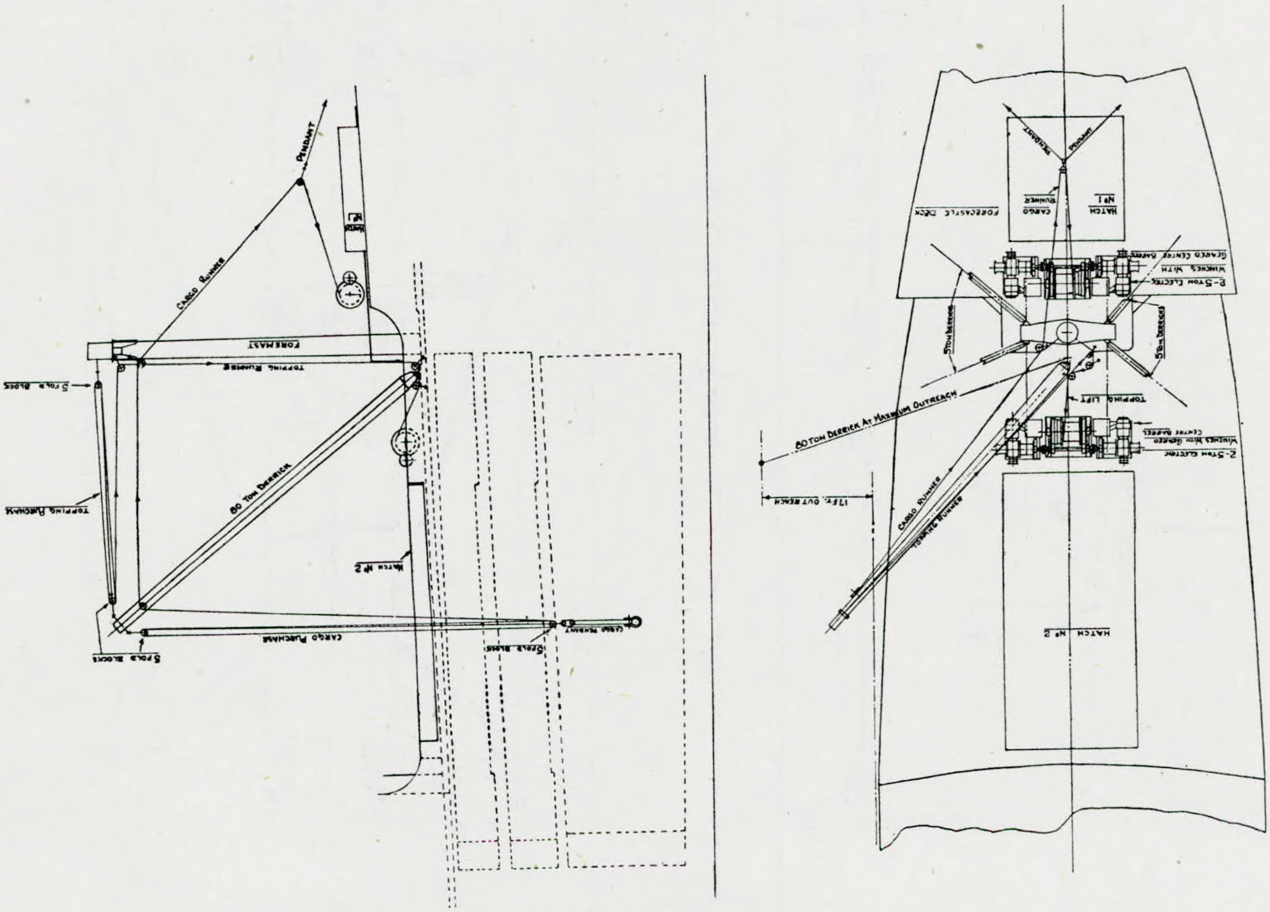


FIG. 27.—*80 ton derrick.* Two electric winches coupled for hoisting. Two electric winches coupled for topping.

usually coupled to an exciter, and can be driven by any prime mover. If a constant voltage d.c. supply is available, this can be converted into a constant current supply by the use of special converter units.

For the control of speed and torque the excitation of the constant current motors is varied by the winch operator, and the motors require either an auxiliary supply for their excitation, or such devices as exciters, or regulating motors coupled to the winch motor. This additional rotating machine adds considerably to the cost of the winch motor.

Heavy Derrick Work.

The various arrangements as described for steam winches in the early part of this Paper are applicable, generally, for the electrically driven outfit.

Figure 27 shows four cargo winches around the mast with heavy derrick. Each pair of winches is coupled to a middle line barrel, one middle line barrel being used for the heavy derrick hoisting purchase and the other middle line barrel for the topping purchase. The middle line barrels are uncoupled or unclutched when the winches are on usual cargo handling. The wire leads from the middle line barrels are not considered to be the best.

Figure 28 shows a pair of electrically driven cargo winches, each with auxiliary barrel, one for hoisting and one for topping quite independent. The long leads from the auxiliary drum up the mast allow the wires to reel with regularity. This rig-up allows the derrick to swing port and starboard.

Arrangement is made for the free wheel safety brake.

Figure 29 is an outline of a ship with three 120 ton derricks, each served by an electrically driven hoisting winch and independent topping winch. These winches have specially large drums arranged to take all the loaded wire in one layer. Automatic reversing spooling gear is provided for these winches on account of the large angle splay of the wires.

Figure 30 shows the electrically driven, totally enclosed, two speed spur geared cargo winch, arranged with mechanical change speed gearing. It is not self-contained.

A drum controller is usually supplied with this type of winch, together with resistance in a watertight case for placing beside the winch.

This type of winch, arranged for potentiometer control lowering, has been more or less adopted as standard on the Continent. If worked by unskilled winchmen, the controller contacts arc and are burnt and, further, if the controller is swung suddenly to the "full-on" position with a strain in the wire, the motor is severely overloaded. This winch does not compare with the automatically controlled types previously described.

A.C. Supply for Electrically Driven Cargo Winches.

The question is sometimes raised as to why a.c. supply is not used more in ships. Up to the present satisfactory control for load and speed has not been found comparable with the d.c. system. It will not respond to the creep required for light hook or give a load speed range and light hook 400/500ft./min. that we must have for cargo handling.

Power.

As regards the power supply to an outfit of electric winches, it is usual to allow for the diversity factor, as not all the winches are running at the same time, or hoisting under full load conditions. Lloyds specify the diversity factor in the case of cable and state that where there are six or more winches, the main cable supplying this group of winches need only be continuously rated for 33 per cent. of the combined full load current of all the motors. In practice, however, there is usually more generator capacity available for the winch load than this, as there is the usual port load, namely engine room auxiliary, lighting, sometimes heating and even cooking.

Electrically Driven Anchor Windlass.

Figure 31 shows the modern self-contained electrically driven anchor and mooring windlass with the watertight motor on the bed-

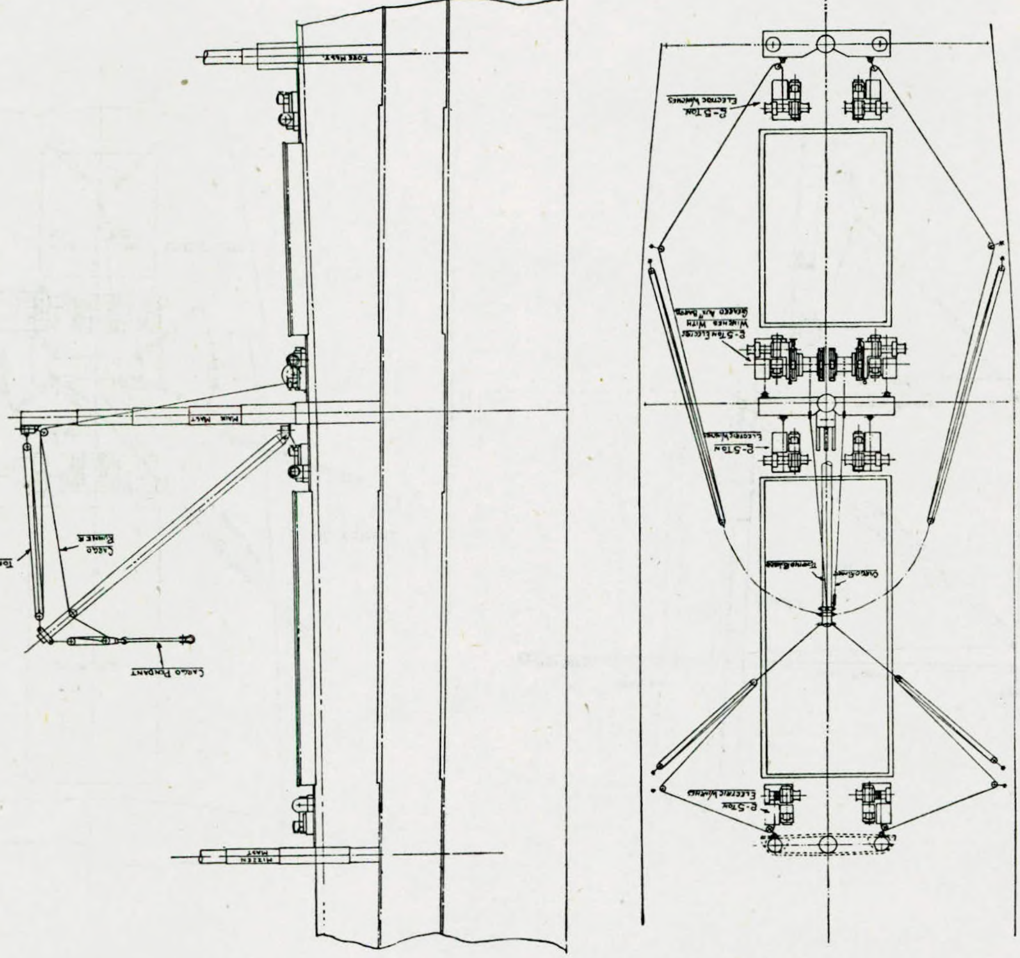


FIG. 28.—*50 ton derrick.* One 5 ton winch with auxiliary barrel for hoist. One 5 ton winch with auxiliary barrel for topping.

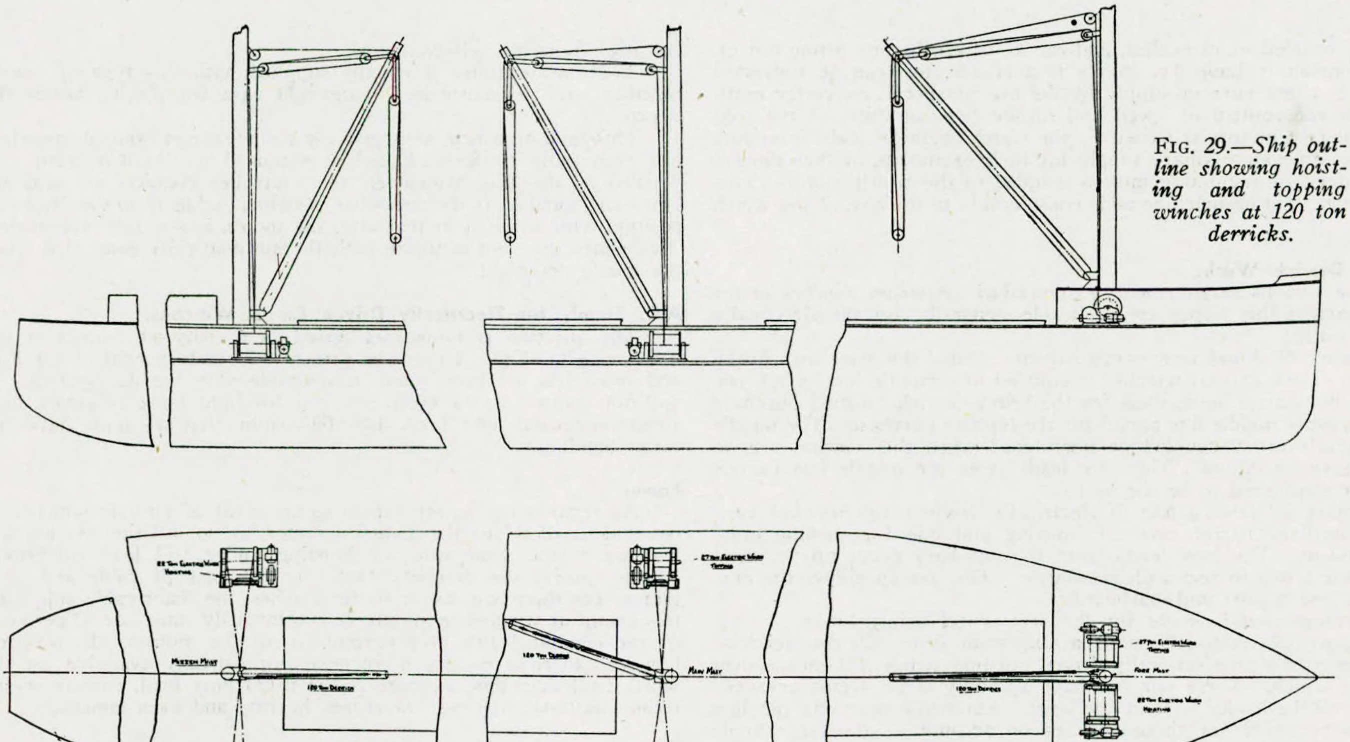


FIG. 29.—*Ship outline showing hoisting and topping winches at 120 ton derricks.*

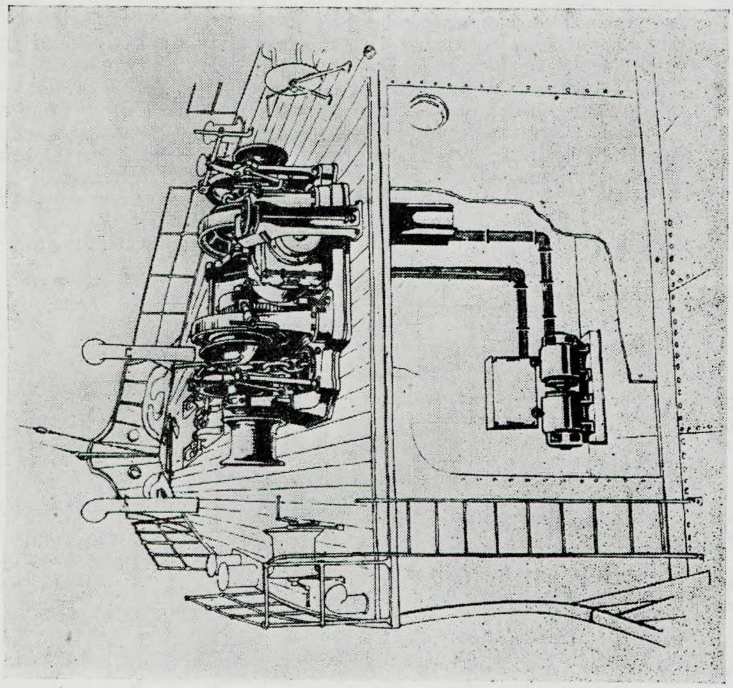


Fig. 32.—*Arrangement of booster control.*

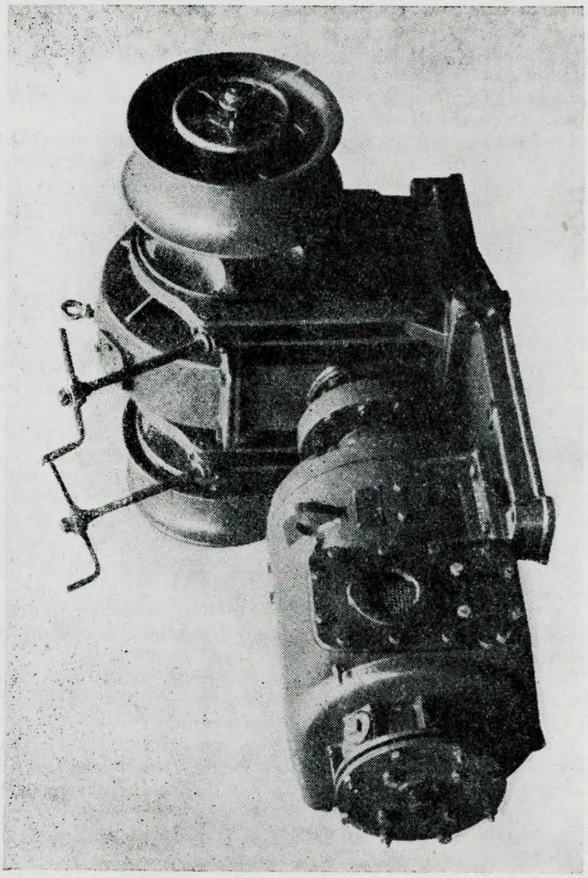


Fig. 33.

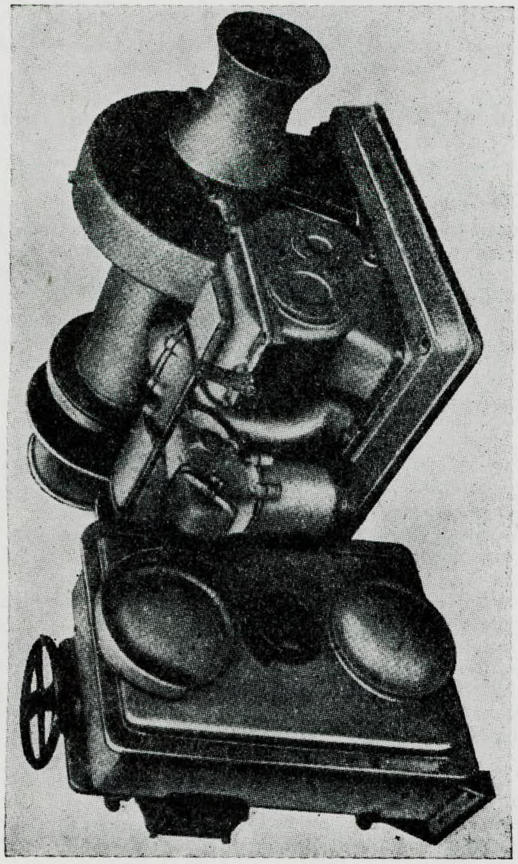


Fig. 30.

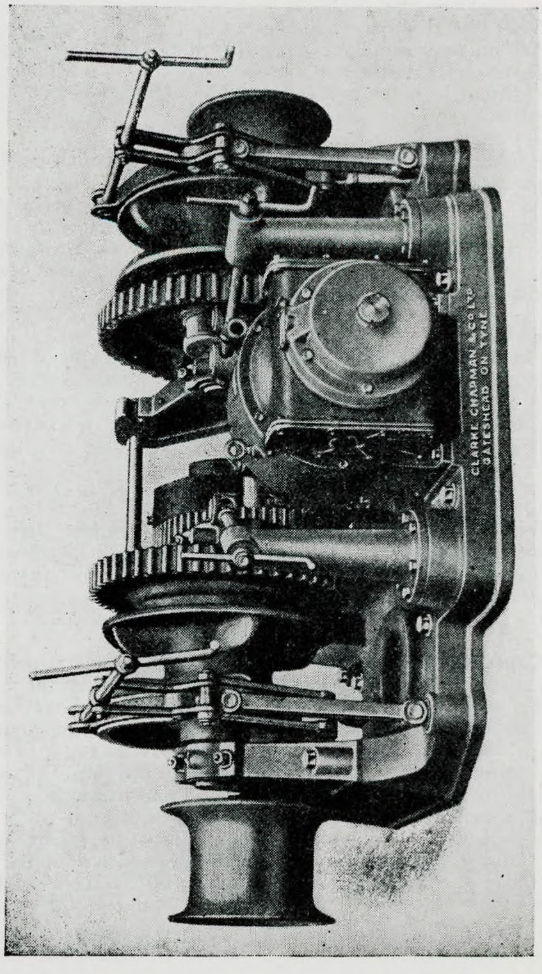


Fig. 31.

plate. Experience shows that the self-contained windlass is a satisfactory machine in every way.

The requirements for anchoring and mooring are provided for with the electrical drive, viz. :—

(1) breaking out anchors, taking the strain and overload;

(2) housing the anchors without shock, warping the ship with a stalling strain, creep with full load and dealing with the slack.

The windlass is protected from shock from the motor when housing the anchor suddenly, a totally enclosed, oil immersed, all metal slipping clutch being provided. Usually the anchors are "let go" under the control of the brake, but where in special cases the anchors are required to be lowered with power, some form of power controlled lowering should be provided to protect the armature.

While drum control for small windlasses and contactor gear for larger windlasses are satisfactory, neither of them provides for power controlled lowering of the anchors.

Electrically Driven Windlass with Booster Control.

For electrically driven anchor windlasses of sizes with cables over 2in. diameter, Ward Leonard booster control meets the arduous conditions of anchor and mooring work in a most satisfactory manner.

The windlass itself is self-contained with its driving motor in the usual way. The control is by a motor generator, called the booster.

The usual ship's supply of 220 volts is connected to the driving motor, the booster varying the voltage up to 440 maximum, or reducing it to nothing, thereby obtaining speed control.

The booster motor is usually in the range of one-third the power of the driving motor, and through the generator only deals with one-third of the power supply to the driving motor.

A watertight master controller is usually arranged at the windlass; the contactor panel is placed beside the motor generator on the deck below, thus incorporating all the protection required. *See Figure 32.* With this unique control we obtain practically an infinitely variable speed from slack to the full load and continuous stall.

When the strain yields the windlass automatically picks up the load, taking up the strain and accelerating to suit the conditions just like a steam engine.

The contactor panel includes :—

(a) starting contactors for the motor generator set,
(b) starting resistance,
(c) main contactor,
(d) torque limit relay,
(e) controlled lowering relay,

there being no main resistances other than the small starting grid for the push button controlled motor generator.

With the booster control the anchors can be payed out with the motor, overspeed being prevented by the characteristic of the circuit. Ward Leonard control meets the requirements in a similar manner to booster, but is more expensive, because the motor generator units are the same size as the main driving motor.

Motor Coasters.

Small coasters are sometimes fitted with diesel engine driven cargo winches, and meet the requirements within certain limits. The diesel engine is for all practical purposes a one speed, one direction unit, and has to be constantly running. This necessitates a friction clutch centre barrel, which is engaged for hoisting. The load is lowered by disengaging the clutch and controlling with the brake, the load going down by gravity. It is necessary to have a ponder ball for carrying down the light hook.

This type of winch has change speed gear for lifting half load at double speed, there being no speed range for the light hook.

On coasters, with diesel engine winches, the anchor windlass is operated by hand power, or by a transmission drive taken from the forward winch by chain or shafting, which is not satisfactory. Modern coasters are now being provided with electrically driven cargo winches, windlass and capstans.

Figure 33 shows a very compact electrically driven worm geared windlass with two independent cable holders and two warping ends for independent mooring.. It is self-contained and watertight.

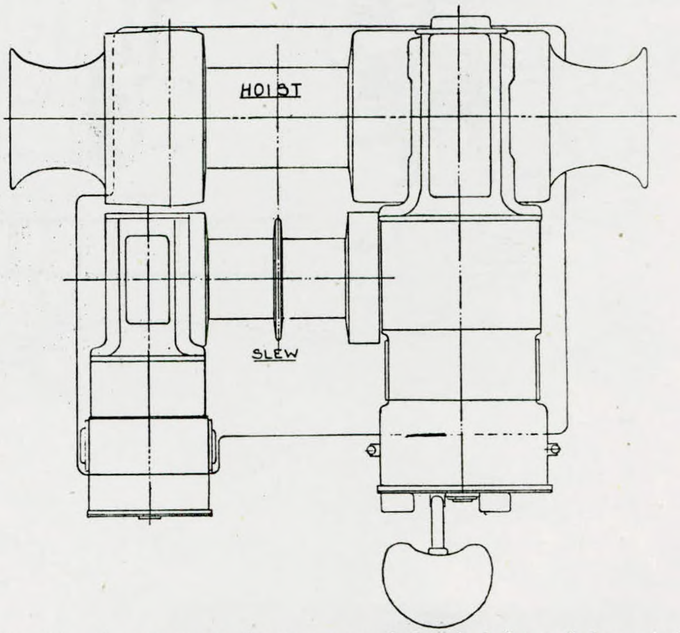


FIG. 34.—*Arrangement of worm geared electric hoist and slew winch.*

Figure 34 shows the electrically driven combined hoisting and slewing winch with two independent motors, which has proved very suitable for this type of ship.

Self-contained hoisting, slewing and derricking winches have three independent motors under the control of one winchman.

The Author wishes to thank marine superintendents, superintending engineers, electrical superintendents, and others, who have given so freely of their experience obtained with the handling of ships and cargoes, thereby influencing the design and construction which have been evolved to date. He is indebted to the makers of the machinery for their generous help. This Paper has only been made possible by the co-operation of his colleagues, who have assisted throughout.

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Discussion.

The **Chairman** said the meeting would agree that Mr. Brown had read his paper exceedingly well and had made the subject most interesting. He had given them a full measure of material for discussion. Mr. Brown desired to reply to each speaker's contribution as it was made, and his request had been granted.

Captain J. D. Elvish said that Mr. Brown, by raising the question of leads of heavy derricks, had pointed out what he considered to be the most satisfactory type. As one who had worked for many years with heavy derricks, Captain Elvish had found that their users were always forced to compromise between the needs of ordinary and heavy cargoes. In the 80 ton type used in his ship, two winches were coupled to a central barrel, and the single barrel was coupled to a single winch for a lighter load. They preferred the centre barrel for very heavy loads. That made the provision of an adequate lead very difficult. He had noticed that the lead in one of the illustrations was their standard type of lead for an 80 ton derrick ship. It was not a sailor-like job; it did not please the eye, but it worked. In another ship with 120 ton derricks they had had special winches working between decks, and independent 5 ton winches for the usual type of cargo; that was the ideal arrangement. It was now proposed to fit into the ships with which he was concerned the single type winch to a heavy barrel, for loads up to 50 tons and use approximately the same lead as that in the illustration, working No. 2 hatch from No. 1 winches. Again, however, they came up against the need to compromise, because the winch man would not be able to see what he was doing, and it might be necessary to employ an extra hatch man. Compromise, therefore, was necessary at every step they took. They found that they had to do things which they did not always like to do from the point of view of efficiency, merely because they were unable to do anything else.

The Author said he considered that what Captain Elvish had done was good for that particular arrangement.

In his ships the central barrel unit incorporated a gear reduction, which increased the strain in the lead from the barrel, obtaining 20 to 25 tons pull on the wire. With this heavy strain, the heavy load could be lifted with less tackle, and so had less wire to lead on to the middle line drum when hoisting. This arrangement required a less number of coils on the drum and was satisfactory.

He, however, considered it was better to have the 5 ton winch geared to an auxiliary barrel for hoisting and another winch with auxiliary barrel for the topping, even though it meant that with one winch engine hoisting, half speed was obtained.

Usually speed of hoist for heavy loads was not of the first importance, but the leads of the wires were vital, and with the two independent auxiliary barrelled winches placed at the aft side of No. 1 hatch, the leads from the drums to the mast head were direct and very satisfactory. If the winch man was standing at the back of the mast house and derrick table and could not see the load, remote control could be used, so that the winch man could be placed just where he was wanted.

Captain J. Isdale said he had had little experience of heavy load winches, but lately his Company had had a class of ship carrying 120 ton derricks of the kind that Mr. Brown had described. He could not think of a better arrangement than existed there, where they had independent controls. It worked very satisfactorily and quite smoothly. The ship was of the Empire Marshall class.

Captain J. P. Thomson said he had found Mr. Brown's paper very interesting indeed, particularly where it dealt with windlasses. The third illustration in his paper showed the spurling pipe under a windlass almost plumb with the after side of the cable lifter centre. He asked whether it would be possible to place the spurling pipe a little further underneath and thereby get a larger bearing surface for the cable, and the added security of the additional snug. His second point concerned the brake on the windlass. He asserted that anyone who walked along the dock side and looked at the brake on the windlass of any ship would find that the shodding on any strap was very much worn on the top and almost new underneath. This would indicate to most persons that the brake was not bearing evenly on the drum, and here was room for improvement.

Mr. Brown had made the further excellent point that the leads should have a fair run to the drum or warping end of the winch or windlass. Captain Thomson asked whether it was necessary to have a taper on the warp end of the winch or windlass. His Company had attempted to use the Admiralty net defence winches for warping purposes, and they fitted a taper piece on the shaft which answered the purpose, but he wanted to know whether a rule existed concerning it, and whether in Mr. Brown's opinion those winches which were used for the Admiralty net defence gear could be adapted in that way.

The Author replied that many years ago the common practice was to place the centre of the spurling pipe plumb and tangential with the chain circle centre line on the cable holder, the cables being gripped by two cable holder snugs. With this clear lead of cable, the anchor could be "let go" at excessive speed. When the brake was suddenly jammed on, the cables jumped the snugs, exposing the windlass to damage.

The position of the pipe had been moved forward, the effect being to put a drag upon the cable when "letting go", restricting the speed. The spurling pipe could with advantage be placed a little further forward, thereby obtaining the grip from three snugs, but the wear and tear on the spurling pipe called for special consideration.

In the "Naval type" shown in Fig. 5, the angle of embrace of the cable holder by the chain was about 180°.

As regards the shodding on the windlass brake strap being worn on the top and almost new underneath, if the brake strap was shod with wood or other friction fabric lining, and the weight of the whole brake gear was not "floated", excessive wear would take place on the top side, due to weight. Further, the heavy wear was usually to be found on the top half strap, even when its weight was balanced and unlined, because the top half was the heavy tension end of the strap. The grip upon the brake sheave on the end of the top half and consequent wear were further increased by the radial thrust through the bell crank fulcrum when screwing up the brake hard. The brake strap on the top side was thickened up to take the wear. A forged steel brake strap, "floated" and bearing direct on the metal brake sheave, was recommended. If brake strap lining was preferred, it should be of rolled manganese bronze.

As to whether it was necessary to have a taper on the warp end of the warping winch or windlass, the Author had found that the warp end for mooring purposes should have a slightly tapered waist, ¼in. on the diameter per 12in. length for hemp, or ½in. on the diameter per 12in. length for wire hawser.

If the soaking manilla or greasy wire hawser slipped down the taper, which was too steep, the rope did not grip.

The Admiralty Net Defence winches with parallel drum and square faced flange were in the Author's opinion unsuitable for use as mooring winches. They could be adapted by fitting warping ends with surging curve flange on the inboard side and large diameter lipped flanges on the outboard side to prevent the rope from slipping off.

Captain A. R. Martin suggested that the rather old fashioned method of having a barrel on the forecastle head geared to the windlass to take the purchase of the heavy derrick wire seemed to him to have a lot to commend it in giving a fair lead. He also pleaded for better control of the winches taking the guys for the 50 to 60 tons derricks. Many accidents were due to careless handling of the winches which controlled the two guys. He wondered whether a plan had even been considered of having some spring or buffer action to take up the difference between the man who should be heaving and the man who should be slacking. This became especially necessary when the ship took a list as the lift was first raised and afterwards when the derrick was being "topped". He wondered if any method existed of reducing the danger of the human element failing in this work.

The Author replied that the barrel abaft the windlass had been used for many years. It was satisfactory when arranged with a drum 20 to 24 inches diameter and six to eight feet long. It took its long lead to the foremast for the purchase, and reeled all its hoisting wire in one layer. There was no difficulty about the reeling because of the long lead. He considered that the man who had to work the windlass was right away from the load, and was under the control of someone signalling at a distance. The topping and slewing of the derrick would be controlled at the hatch.

The windlass on the forecastle deck hoisted the load, while the winch at the derrick topped. The arrangement, in his opinion, did not compare with that of a couple of winches with independent auxiliary drums, one for hoisting and one for derricking, with a man on each winch in view of the load.

Regarding better control of winches taking the guys for the 50 to 60 ton derrick, and the suggestion of a spring or buffer action to take up the difference between the man who should be heaving and the man who should be slacking, the Author considered that the winch man hauling the slewing guy against load resistance had no difficulty, the other winch man giving out the restricting rope, keeping it just slack. When the ship corrected her list and the load tended to take charge, the winch man should put a check on his rope to control the swing of the derrick which had become alive.

Captain J. D. Elvish suggested that he might be able to help, as he had had plenty of experience in this kind of operation. It was not his custom to put guys on to the derrick, but to use one pair on the derrick to steady it when the lifting out of the hold was being done. After that he had guys on the lift. It had been found that the derrick would always follow the lift, whereas the lift would not always follow the derrick. If two men were stationed at opposite sides of the ship, a tremendous thrust might be brought to bear on the derrick; no one knew what the strain was, and an accident might quickly occur. If, however, the derrick was steadied for the lift coming up, and the lift was steadied afterwards, the derrick would always follow. No difficulty had been experienced with it. It was a product of experience.

Mr. T. S. Miles said that in a paper read before the American Institute of Electrical Engineers a light hook speed of 750ft. per minute was advocated, and it had been noted that an increase in the present British practice of 400 - 500ft. per minute had been suggested with the full load speed remaining at approximately 100ft. per minute. Would this higher speed be an improvement when with an ordinary three or five ton winch the lift was only about 40ft., and it was necessary to accelerate and de-accelerate within this distance? Any increase in the light hook speed must react on the braking whether electrical or mechanical.

With heavy lifts through blocks the usual difficulty was not raising the load but controlling it when lowering. On the performance curves, Figs. 19 - 20, it was noted that only one step of regenerative lowering was provided. Was this considered adequate and satisfactory from the point of view of switching and commutation, also control, especially with a fluctuating supply voltage which was almost inevitable when working cargo?

The Author said that a light hook speed of 750 feet per minute could be provided if required, but he doubted whether it had any advantage. The usual light hook speed obtained with electric winches was as fast as the cargo could be served. It seemed to him that no time was wasted, waiting for the light hook to come back. If the light hook speed were increased, one of the difficulties would be that a full load speed of 100 feet per minute and light hook speed of 750 feet per minute called for a 7½ to 1 range on the motor, which was undesirable from the point of view of design. He would therefore say that it was not required. In the controlling of loads being lowered on the heavy derrick with five ton winches, regenerative control was provided, and they had experienced no commutation trouble or other difficulty with it. It was a simple one step lowering winch. All loads of one ton and above in the wire direct from the barrel were lowered at a constant speed of about 250 feet per minute, light hook 450 feet per minute. The foot brake slowed down the load speed to inching when required for landing.

Mr. J. E. M. Payne (Member) said that the author was to be thanked for giving the meeting a great deal of technical information not readily accessible without considerable search in books of reference, and this data with its context would form a useful addition to the proceedings. The problem was a very difficult one when dealing with certain types of vessels, notably ships on regular runs between ports where shore crane facilities were ample and adequate. In such cases the cargo winches represented in a sense so much idle capital or rather a form of insurance against breakdowns in shore facilities. On a first view the answer seemed to be to fit the cheapest type of auxiliary, a problem which was not easily solved when all the factors were taken into consideration. Turning to Fig. 3, he considered that the spurling pipe should be spigotted into the deck fitting, providing a smooth entry for the cable without any ridge. The pipe should be preferably about 5° from the normal to prevent rattling of the pipe. From his experience he agreed that the chain locker should be as low down as possible. He had noticed cases in which the chain had actually surged over the gipsy through being too high up.

Fig. 5 raised an important point in this generic type where the drum axis was vertical—the design of the thrust ring under the rotating cable holders. In certain types the oil grooves were not adequate, and insufficient lead was provided in the oil ducts to lubricate the rotating spindle, the result being partial seizure. The grooves should have ample depth, say $\frac{3}{16}$", and should be located in such a manner as to ensure even feed over the thrust face, especially in wintry conditions when the viscosity of oil was high. He noticed that some makers employed grease lubrication and fitted grease nipples on deck fittings. This was not really satisfactory, because it was very difficult to prevent people from covering them with paint, and in cold weather stoppages were frequent. The oil holes were preferably situated in the centre of the spindles, and should be made of generous proportions and covered by an adequate cover plate, well shaped and of stout construction generally. Wing nuts should have strong lugs, for these machines were frequently overhauled under the worst of weather conditions.

Mr. Brown's statement on page 6 that steam winches acting directly on the drum shaft were more economical than geared winches seemed to call for elucidation. Other things being equal, a high speed steam engine coupled to the drum shaft through accurately cut gears running in an oil bath should, he would imagine, be more economical in steam consumption, because the mean temperature of the cylinder walls would be higher and the engine could probably be worked with a shorter cut-off. Of course, that advantage was partly offset by the fact that the cylinders would presumably be smaller and the ratio of cylinder radiating surface to the swept volume was an inverse function in general of the cylinder bore.

Fig. 15 presumably showed the cast helical gears of a very well known type of winch which gave very little trouble. When, however, machine cut gears were employed, their standard of accuracy became very important in relation to the thrust rings that located the pinions on the shaft, and such gears should be totally enclosed. Cases had arisen in which inaccurate helical gears which had been machine cut had been left uncovered, and the pinions had been located by thrust rings of relatively fine clearance—say 1/10,000 of an inch—and owing to the inaccuracy of the gears, undue mechanical pressure had come on to these thrust rings and caused a partial seizure. This had actually been a war experience. A standard to aim at was a clearance of, say, 1/30,000 on the thrust rings on the pinions, and on either side of the apex of the helix.

The statement on page 8 regarding the relative cost of cables and distribution boxes compared with steam distribution arrangements was interesting, but Mr. Payne imagined that the cost largely depended upon the type of ship, and also on the arrangement of decks, deck houses, and so forth. In support of his argument, it might be added that a prolific wastage of deck plating might be caused over a number of years by steam deck fittings. Such wastage was largely eliminated by the employment of electric winches using direct current. This was a pertinent factor in favour of the electric winch. Moreover, electric winches cost much less in maintenance than steam winches. Manufacturers could help a little by standardising much of the contactor gear and motors, because the spare armature, solenoids, contacts, etc., formed a heavy but essential item of capital cost. Shunt field coils and interpoles should be capable of being withdrawn without disturbance of the armature. The warming element mentioned on page 11 was a highly desirable feature. The Author, he noticed, dismissed the question of alternating current supply in few but apt and pertinent words. Mr. Payne supposed that the only advantage was the relatively low cost of the squirrel cage induction motor as against the inability to realise the torque characteristics of the series motor.

Returning to his first point concerning high initial cost, Mr. Payne asked whether modern hydraulic transmission motors of the rotary type fed from a common main with one master hydraulic unit would not compare favourably with other forms of machinery. As a matter of interest, approximately 80 man hours covered the annual cost of electrical maintenance, including annual overhaul, on a ship fitted with one windlass and one capstan of hydraulic electric type and two winches electrically driven and controlled by contactor gear, the ship operating on a six hour run in 24 hours. To this figure had to be added 160 man hours for the annual overhaul of the hydraulic units, which in general merely required opening up for inspection and reassembling, but no repairs.

The Author replied that the spurling pipes might be spigotted into the deck fitting, providing a smooth passage for the cable. The chain pipe in the windlass bedplate should not be enlarged, because the cable links would lash the cable holder flange and brake gear when "letting go".

The chain pipe between decks might be reduced, but they should have large diameter ball mouths at the lockers so as not to obstruct the passage of an uncontrolled lashing cable.

The larger chain pipe between decks acted as a controller of the cable in violent action.

Regarding the statement on page 6, direct acting winches without gears were more efficient than winches which were geared. It was obvious that, other things being equal, the power wasted in driving gearing in one winch was saved in the gearless winch.

Mr. R. Clarke agreed with the Author that when regenerative control was used brakes could be dispensed with, the load being controlled in the lowering direction electrically.

He noticed that the speed/load curve displayed on the screen showed two speeds only, one for full load and one for light loads, the lowest speed of approximately 250 feet per minute at full load. How did the Author propose to get crawling speeds at any load? He supposed by use of a foot brake. He asked did not the Author consider that it would be better to have more than one step on the lowering side? The control could then be arranged to give crawling speeds at various loads and the foot brake could be dispensed with. Further, it would then be possible to remotely control a winch, the operator being placed with full view of both hold and dock, it being then unnecessary to have more than one operator per winch.

The Author replied that only on the converter winch, mechanical brakes were not required for controlling the load, see page 12. In the contactor winch with electric braking, giving one speed for lowering all loads of about 1 ton and one speed for the light hook, the creep speed for any load or light hook was obtained with the foot brake. The foregoing was the most satisfactory arrangement for a contactor winch. Complete control over any load or light hook, lifting or lowering, at the winch or remote, without the use of brakes, was obtained electrically with the converter winch.

Mr. C. A. Day (Member) said that time after time when he had watched cargo being taken out of a ship he had observed the same sequence of events. First No. 1 winch started up and lifted the load clear of the deck, and No. 2 winch started shortly afterwards and chased it up. Then No. 1 stopped, and No. 2 carried the load across the deck. No. 1 then started to lower, and a short time afterwards No. 2 lowered. When cargo was being loaded, the same sequence was observed, but in reverse order. He suggested therefore that it was not beyond a designer's ingenuity to design and fit to electric winches, drum controllers which would pass the current from one winch to the other and vice versa, so that instead of employing three men, one man could carry out the whole operation with greater safety and with more efficiency. He would hold in his hand a switch with three buttons, one marked "inboard", one marked "outboard" and one to work an emergency stop, this switch being connected to the control panel by a long flexible lead. The operator would look down the hatch, and start off the sequence by pressing the "outboard" button. This would lift the cargo up and swing it over the ship's side on to the quay, where it would stop automatically. He would walk to the ship's side, see the unhooking of the sling and the hooking on of the empty sling, and carry it inboard and repeat the process back and forward, which would work quite automatically. He was sure this could be done, and that it would speed up the handling of cargo enormously. The details of the drum controllers could be arranged so that varying height of lift could be easily adjusted.

The Author said that Mr. Day's proposal was similar to what obtained in the hoisting and slewing winch operated by one winchman. Mr. Day had suggested a remote control carried by the winchman between the hatch and the side, the control incorporating an automatic setting for the lifts.

On the contactor winch the landing of loads and inching of light hook were controlled by the footbrake, which made the remote portable control a further problem. The proposal was more suitable for the converter winch, where the whole operation of the winch was controlled without the use of any brake.

Mr. Day, proposing a vote of thanks to the Author, said that the lecture had been in the nature of a marathon, for the discussion had been so long. Mr. Brown was therefore to be congratulated on having interested so many people so greatly.

Mr. W. R. Steele (Member) seconded the vote of thanks, which was carried with acclamation.

BY CORRESPONDENCE.

Mr. J. H. Anderson (Member): In these days of fuel economy it is surprising that Mr. Brown refers to a steam pressure of 100lb./sq. in. with an exhaust pressure of 25lb./sq. in. Some 30 years ago in a similar discussion I stated that "superheated steam could be used much more than it is, particularly where there are a lot of auxiliaries, steam winches, etc. to which the steam is conveyed a considerable distance". In the case of some winches it is difficult to know whether steam or hydraulics is the motive power. There is no doubt that if these scattered units were worked electrically there would be a great saving. Such small measures as returning all steam from winches, etc., also effectively protecting the pipes—both pressure and return—make quite a saving in the course of time. Mr. Brown's back pressure is very wasteful indeed; when working cargo these winches should be coupled to a condensing apparatus, thus reducing the back pressure to well below atmospheric pressure.

I am very much struck by the Author's illustrations of such a collection of the worst possible designs for wire rope leads. It seems to me that wire ropes are rigged up by persons who lack practice in their actual use. I had experience some 40 years ago with bad wire rope leads, and after making some common sense alterations we increased the average life of these wires by some 400 per cent., and kept this efficiency up ever since. Nearly all the Author's illustrations clearly show reverse bends, and in some there are several of these badly designed leads; these are bad enough when one is forced to use them, but in the diagrams I see no reason whatever why they were put in. The action of these reverse bends is similar to the bending of a wire almost double, then straightening out and bending it in the opposite direction; consequently the best of wire is overcome by fatigue and soon breaks, leaving one of those nasty places which is usually picked up when handling the rope.

As regards the working in and mooring of a vessel, I am glad of this opportunity to deprecate the bad leads for mooring purposes which exist aboard most ships; these are more or less survivals from the days when manilla or hemp ropes were the only ropes used as compared with wire ropes which are extensively used to-day. Within a dock where there is still water and no tide effect the matter is not serious, though improvements could be made; it is a very different matter in a tidal river such as the Thames, with a four knot tide and a rise and fall of some 18 feet, and where there are eddy currents and the effect of vessels of all sizes and speeds passing the wharf at which the vessel is being moored, sometimes with only a few inches of water under the loaded ship. At a particular wharf I have in mind, vessels up to 10,000 tons have been discharged, but the usual type is between 2,500 tons and 4,500 tons; they belong to various owners and some of the ships are better fitted from the mooring point of view than others. The usual ropes are used, i.e. head rope or ropes, a spring and a breast rope; similarly at the stern—stern rope or ropes, spring, and a breast rope.

Because of bad leads from winch to bollards, also because space on decks where these bollards are usually placed is required to place beams and hatches during discharge of cargo, the bollards are very rarely used, anyway near to the hatches, and consequently practically all ropes are secured on the forecastle head and poop of the vessel.

Vessels have to be moored and kept in an exact position as the discharging is done by day and night, and if this position were not kept there would be a risk of damage on deck by the high speed five ton loads being handled. The best way is to come alongside, secure the forward spring a bit short, keeping the engines going slow ahead so as to locate the ship by easing the spring to the position on heaving away with the head rope, then secure the breast rope and continue with the stern mooring. This sounds quite simple but is much different in practice.

Many vessels now have wire rope compressors through which the wire ropes are led to the windlass drum, the rope being secured by clamping down inside by screwing the compressor down; unfortunately these compressors are not numerous enough, and if only they were strong enough to hold the ship the above lead would be all that could be desired. If these compressors were supplied, thereby providing a fair lead for the springs, considerable time and heavy work would be saved.

Consider what happens in a vessel not fitted with compressors. Taking the Author's illustration Fig. 32 as an example, there the lead from the "pipe" to the winch drum is all right for heaving the head ropes, but these ropes have to be secured on the bollard on the port or starboard side, which means that a heavy strained rope (possibly a 4½in. wire rope) has to be temporarily secured by snotter chain, which may or may not hold the wire without slipping a certain distance; then the wire is slacked off the winch drum and manhandled over to the side bollard; this usually means a certain amount of additional slack being given to the mooring position, which may allow the tideway to get between the ship and the quay, causing difficulty in getting the wire back to the winch to repeat the performance of heaving alongside.

Regarding the spring, this is a more difficult position, as the leads are generally so bad that as a rule a series of snatch blocks have to be used to get any sort of job done; this is generally done by a messenger wire.

As a suggestion bollards could be put in a fair lead position after coming through a positive hawse hole (not a cleat or open pattern, which are unsafe for tidal work) a port and starboard roller of strong build in a direct line with the windlass drum; then wires from winch, around roller ahead, back through bollard and through hawse hole would give much advantage, the wire being snottered off at bollard as before; this would also allow for tightening up the turns on the bollard by winch drum.

None of this sort of mooring is nearly as effective as mooring by direct leads through compressors, particularly as ropes have often to be adjusted, either heaved in or slacked off owing to rise or fall of tide, or the discharge altering the draught of the ship. Wire ropes last much longer and are certainly much freer from kinks. With present-day shipping these wires very often have to bear the full strain of the winch when endeavouring to heave the ship alongside with ropes running over fixed fair leads of only a few inches radius, which practically ruins the wire the first time it is so used. I have seen the middle of a new wire after such use resemble a coiled steel spring for several fathoms.

Proper consideration of these points in connection with mooring, and other factors on deck would save considerable heavy manual work and incidentally reduce the idle time involved in turning round vessels alongside. I have many times noticed that the time taken in coming alongside and getting ready for discharge, added to the time taken for preparing to sail, exceeds that taken in the discharge of the whole cargo.

This refers to grabbing out of coal cargoes, which have many times been discharged under six hours; on one occasion the time occupied in discharging the cargo of 2,500 tons, including cleaning up the holds, was exactly 2½ hours.

I am sure that more attention given to these fair leads to prevent the misuse of winches and wire ropes would be well repaid.

The Author: Regarding high pressure superheated steam for the deck lines for windlass and winches, my experience is that on account of long leads, bends and valves, and the fact that the winches are often standing in between the lifts, the superheat in the steam at the boiler is lost; the steam at the winches and windlass, in fact, is not dry. For this reason superheated steam is not usually provided for deck machinery.

In any case the pipes must be effectively protected in order to prevent as far as possible the loss of heat from the steam.

As regards the exhaust pressure of 25lb./sq. in. being very wasteful, this is usually found on board to be much higher; very seldom is it less, even when the exhaust is coupled to a condenser. The cause of this 25lb. exhaust pressure is the long line of pipes, bends and valves.

The Author regrets that Mr. Anderson does not give examples of the wire rope leads which he has found to give the runners four times the length of life. The examples given in the paper are from modern practice, and, provided the sheaves are of large diameter, the rope service is generally satisfactory.

As regards the mooring of a vessel, the "make-fast" of the strained wire presents no difficulty to the usual deck hand. The wire is usually "snottered" on the fore side, after which the wire is "made fast" to the bollard.

Wire rope compressors meet the mooring conditions, but from the number that are fitted it would appear that they are not considered essential.

Mr. A. M. Bennett: In assessing the merits and demerits of steam and electric winches, it would be necessary to know the actual steam consumption of the former in service as the efficiency falls off much more rapidly than that of electric winches. Blow past piston rod and valve spindle packing is always a source of considerable wastage. Furthermore, for ships trading to cold climates the long hours of idling can be a most uneconomical factor. It would be interesting to have the Author's comments on this point.

The Author mentions that the modern electric winch has a seat for the winch man with a commanding view of the hatch, but would it not be better if the winch man had a commanding view of the hold? Why not place the seat on the motor to form a rostrum with the controls extended accordingly?

I am pleased to learn that the Author thinks the centrifugal brake is superfluous on the modern winch. It was always a source of trouble, and I always thought the number of brakes on this auxiliary was "over-egging the pudding". The method of limiting the current to 60 per cent. by the hand or foot brake is both simple and safe.

As there are five hoisting steps and only one lowering step, what are the characteristics of the winch when hoisting on the lowering mark side?

With the ring main system of current supply what protection is fitted to the motor? Are fuses fitted, or is the motor dependent entirely on overload cut-outs.

With the regenerative winch does the Author consider that there is a legitimate claim to an improved diversity factor?

It is difficult to agree with the Author when he states there is usually more generator capacity for the winches, than that allowed under the diversity factor, as there is the usual port load; but this supply cannot be tapped; surely the generating capacity should be constant ship load plus winch load?

It would be instructive to learn what progress has been made in prefabricated bedplates for windlasses and winches. It would seem that fabrication would be advantageous where severe temperature changes are experienced, to say nothing of the saving in weight.

It is gratifying to learn that in the modern design of electric winch the worm drive is placed over instead of under the whipping shaft. One of its distinct advantages is that the drum shaft is lower down, which enables the winch seatings to be correspondingly higher. One of the most difficult things to combat is the pockets formed by the seatings, which hold stagnant water. It is always impossible to place the seatings high enough to scale the deck plates properly, in fact, in my opinion, it would be helpful if winch designers could so design their winches that seatings could be raised even higher.

The Author: The actual consumption for the deck steam winches when handling cargo is given in Fig. 11, this being a fair average covering the losses due to condensation in the pipe lines and the blow past the glands.

The steam winches of ships sailing under Arctic conditions should be kept turning over and, if this is occasional, the loss is relatively unimportant, but if the vessels are running frequently under these conditions the losses must be taken into account.

Electric winches are to be recommended for Arctic conditions, as there are no standby losses and no possibility of freezing up and becoming ice bound, with consequent cracking of cylinders, valves, pipes, etc.

To seat the winch man on the top of the motor would certainly provide him with a better view of the hatch, but it would necessitate the controls being mounted above the motor. Having this rig-up placed above the winch motor presents gear which may become hitched with the handling of ropes and tarpaulins across the deck.

Hoisting on the lowering step would be very unusual, because the rope lead from the top of the cargo barrel to the goose neck is usually fixed for a one direction hoist, but if a mooring strain were taken on the warping end with a reversed rope, the winch would hoist the load at lower speeds. A change-over switch is provided at the winch for dealing with this reverse rope, so that the loads and speeds are characteristic of the usual hoisting and lowering as given in the curves.

With the ring main system of current supply or with the branch system, fuses are not a protection to the winch motor. The protection is provided by main contactors which are opened automatically by no-volt and overload relays in case of supply failure or overload.

In the winch arranged with electrical braking, the brake contactors also open in the case of supply failure or overload, and in the event of excessive speed, through the action of the excess volt relay. Fuses are always provided for the auxiliary circuits, i.e. the supply to the contactors and relays and for the drying lamp or heater circuit.

With the regenerative winch the Author does not consider an improved diversity factor is justified. There is usually more generative capacity for the winches than is allowed for under the diversity factor. The generator capacity is usually ample for the requirements at sea, plus the requirements of the winches using the diversity factor.

As the port demand upon the generators is less than at sea, a surplus is available should it be required for the winches.

Bedplates of electric winches are fabricated in steel, as are also the motor magnets and control gear casings. This practice of fabrication meets deck machinery requirements very satisfactorily, and is more suitable to meet Arctic conditions.

Further progress has been made in the direction of the all fabricated electric winch. Fabrication in steel construction for windlasses is progressing and will follow the winch practice.

Fabrication usually shows a saving in weight.

The Author agrees that everything is to be gained by placing the winches on high seatings, 21in. being very suitable to enable the seating and deck work to be conditioned. The winches, as designed, are suitable for placing on these high seatings and, incidentally, the winch man has a better view of the hatch.

Mr. T. W. C. Knowles (Member): At the risk of being thought very out of date, which in fact I am after isolation in internment, I should like to make reference to an item of deck machinery which has been fitted in a number of vessels in the past.

I refer to a cargo winch consisting of two barrels suitably located for use with widely spaced derricks and driven by a single electric motor arranged on the centreline with worm or bevel gearing. The motor ran constantly in one direction of rotation, and the control of the winch barrels was effected by means of two epicyclic gear trains with friction clutches to operate them.

It appears to me that this winch has much to commend it: electrically it is extremely simple, gives no surging "kicks" on the switchboard as the inertia of the motor serves to accelerate the load being lifted, provides very high light hook speeds particularly when lowering, and can have the mechanical controls for both barrels arranged for one operator when the derricks are being used with "union purchase". I would not advocate this winch for dealing with heavy lifts on account of the slight "jar" one gets when the automatic brake takes control, but I consider that it has many advantages for, say, coastal vessels. May I ask whether there have been any developments in the type of winch which I have described?

The Author: The cargo winch to which Mr. Knowles refers is arranged with the motor running continuously in one direction and having a plain series characteristic for load and speed with limit shunt. The control is by a simple starter; the drive is through worm gear, each drum being driven through epicyclic gear, and friction clutch. The hoisting drum is also provided with a brake for controlling the loads, which are all lowered under gravity.

With this double drum winch for operating two fixed derricks by one man, he has to control the hoisting of the load, transfer and lower by means of two clutch levers and two brake levers, which requires practice and skill, and it is doubtful whether this cargo handling arrangement would be worked in many ports.

It is a good winch, but necessitates perfect adjustment of the clutch and brake operating gear, which require constant attention.

It will be noted that when transferring the load across the deck with one barrel, it has to drag the other barrel round, because it receives no lowering power to itself.

As far as the Author knows, this winch has not been greatly favoured, even for coasters.

Mr. A. D. Bean (Member): I do not wish to appear superior, but I am a little confused by the free use of the word "strain" in the opening paragraphs. I always associate strain with deformation, and would be happier in reading "stress", "pull" or "load".

In the section on the steam windlass, the first statement is that the power required must be sufficient to heave two anchors, each with 30 fathoms of cable.

Later, the Author states that "the pull in the cable is at the windlass". "The strain available in the cables between the ship and the anchor is reduced by the friction in the hawse pipe, usually varying between 25 and 33 per cent.".

These two remarks require some explanation for, if we take the first, the windlass lifts the weight of two anchors each with its cable, whereas the second suggests that to this weight we must add 25 to 33 per cent. to overcome the friction in the hawse pipe. Surely the pull in the anchor cables and hawser is in the section between the ship and the anchor, this being the factor governing all the others, and to which would be added surging loads, checking loads, frictional loads, etc., to arrive at the power required in the windlass.

In my experience a ship always entered port with derricks up and all tackle in place, ready for loading or discharging, the cargo runner being attached to the barrel and wound on.

On many occasions it was found necessary to use the warp end on one or two winches, to handle ropes when going alongside, or when shifting ship in port, and it was an easy matter to throw out the clutch and prevent the barrel turning by using the brake while operating the winch for the warp end.

In the drawings and photographs shown by the Author, I notice that the clutch is no longer a feature of the modern winch; thus the warp end cannot be used as an independent unit and I would like to know if mates were consulted before the designs were modified, as I fear that the general utility of the winch has been impaired.

The Author: Academically Mr. Bean's definition of the word "strain" may be correct, but it appears to convey to the minds of engineers and seamen exactly what is meant much better than the word "stress".

The Author would respectfully draw the writer's attention to the clause in which he stated "the power of the windlass must be at least sufficient for heaving *the weight* of two anchors, each with 30 fathoms of iron cable". The strain in the cable between the hawse pipe and the anchor as exerted by the windlass is effectively reduced by the friction in the hawse pipe. Part of this friction is cancelled out by the weight of water displaced by the cable and anchors and, further, as stated in the paper, the windlass can deal with strains up to 1½ times the normal working strain.

When the ship enters port with derricks up and tackle rigged, and with the runners fixed to the cargo barrel, the cargo winches are not required for bringing the ship alongside, this being done by the windlass, poop winch and/or capstans.

In the Author's experience it has not been the practice to fit the cargo barrels on ships' deck winches with clutches with the object of getting independent warping. It is only the occasional ship's outfit that has this provision made.

Mr. G. T. Adams (Member): With regard to electric winches, the writer would like to place on record his appreciation of the readiness of the author's firm to co-operate with the winch user in order to produce cargo handling gear to give the greatest possible satisfaction to all concerned.

The design of this winch represents a distinct advance over earlier productions in many ways, and is an example of success achieved by close co-operation between users and manufacturers.

It is suggested that of recent years, whilst we tend to increase the speed of our ships between ports, we have done little to reduce the time the ship is delayed in port whilst handling cargo. Surely it is a better proposition for the shipowner to spend money on more rapid cargo handling gear than to go to the greater expense of fitting and running more powerful main engines. From the shipowner's point of view it is not the time taken to go from port A and to port B, but the time taken from the commencement of loading at Port A to the termination of discharge at Port B which determines the expenses of the voyage.

The Author says on page 8 that electric winch supply cables require practically no maintenance. Does he favour cables above the weather deck or below? Cables above and their casings undergo deterioration owing to exposure, whereas cables below are liable to damage by cargo handling and may give rise to or suffer damage from fire in the cargo space. The writer recalls one instance where it was possible to discharge cargo damaged by fire from a 'tween deck by means of the ship's own winches which had the supply cables led above the weather deck. Had these cables been below deck, this would have been impossible.

On the same page, the Author states that ball bearings are utilised for the worm thrust. The fitting of these bearings requires care. A race which is slack in its housing or on its shaft will give trouble sooner or later, and it is trouble which cannot be cured by fitting a new race. Positive means of locking the races in position should be insisted upon.

On page 13 the Author touches lightly on the subject of a.c. winches. It seems to some of us that this line of development should be actively pursued because lack of a satisfactory a.c. winch is the principal obstacle in the way of adoption of alternating current on board ships generally, and this would lead to substantial economies in the electrical equipment and maintenance of ships.

The Author: I favour the electric winch supply cables carried below the weather deck. If the cables are run in steel channels, fitted with cover plates, close up to the deck beams, they are protected to a certain extent from small fires.

The cables are varnished cambric, lead covered, steel wire armoured, protected with braiding and treated with heat resisting compound. The varnished cambric has an alternative V.I.R. rubber or paper insulated, as may be called for.

Cables led above the weather deck are not usual, except for tankers. If in the case of tankers, or where the cables are specified to be led above deck, they are run in galvanized steel pipes, or protected as described for the leads below the deck; this arrangement will be found satisfactory.

Regarding the ball thrust bearing, the outer race is held with an interference fit in the housing, the inner race being locked on the shaft and arranged to just float as required by the gunmetal bearings which carry the worm shaft.

With regard to the d.c. winches being an obstacle to the use of a.c. on ships, there is no simple answer. In my opinion it all depends on how important the deck auxiliaries are compared with the rest of the ship's electrical equipment.

If the deck auxiliaries constitute the main electrical equipment, the only other consideration being perhaps the lighting, then the choice will obviously be d.c. If, however, there are large demands on power for which a.c. is more suitable, it may be an advantage to install a.c. in the ship as the main supply. The winch problem may then be considered.

(1) To use a.c. motors for winches.

At present I know of no variable speed a.c. motor which will give comparable performance to the d.c. compound motor as regards starting torque, light load to full load speed ratio, and reliability.

The choice then is always between the variable speed a.c. motor with performance inferior to that of the d.c. motor, and a constant speed a.c. motor with mechanical speed torque control.

Hydraulic power transmission between the a.c. motor and winch does not meet cargo handling requirements satisfactorily, because it does not give the speed range from the hydraulic transmitter from full load speed to light hook speed. Further, hydraulic transmission absorbs power.

(2) To install an a.c./d.c. motor generator set and supply all the winches with d.c.

This can be a constant voltage or a constant current system, the winches being of the appropriate type.

(3) To provide a separate motor generator set for each winch on the Ward Leonard system.

(4) To use rectifiers for the deck auxiliaries, providing constant voltage d.c. for the winches.

No re-generation on this system would, of course, be permissible.

ADDITIONS TO THE LIBRARY.

Purchased.

Boiler-house Practice. By E. Pull, R.N.R., M.I.Mech.E., M.I.Mar.E., M.R.Soc.T. (Second Edition—revised and considerably enlarged). The Technical Press Ltd., Gloucester Road, Kingston Hill, Surrey, 1945, 278 pp., price 12s. 6d.

Scientific Societies in the United States. By Ralph S. Bates, Ph.D. New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd. 1945, 192 pp., excluding Bibliography and Index, price $3.50.

A full-scale account of the evolution of American scientific organizations, including the main national scientific societies, and the state, local, specialized and technological societies.

Modern Turbines. By L. E. Newman, A. Keller, J. M. Lyons, L. B. Wales. Edited by L. E. Newman. John Wiley & Sons, Inc., New York. Chapman & Hall, Ltd., London. (Second printing, July, 1944). 175 pp., 93 Figs., $5\frac{1}{2} \times 8\frac{5}{8}$, cloth, $2.50.

This exceedingly useful book gives information regarding the characteristics of steam turbines and generators. The author states that it is written for engineers who are concerned in the selection of the right turbine for a particular job, and on the whole it fulfils that purpose.

It gives much information of a general nature which should prove invaluable to the young engineer who, having had experience in the building of turbines, should, if he is keen, be turning his mind to enquiry as to the reasons why certain types of turbines are selected for specific jobs. It is written primarily for the operator and has a definite bias towards the purely power plant, but it is all so interesting that it should whet the appetite of the keen student for further and more detailed information.

The chapter on the Fundamentals of Steam Turbines is well written and explained. The sketches in this chapter should be of great help to the student. The concise section "Steam Turbines—Facts and Fallacies" will be informative and useful to many.

The authors state in regard to steam charts that "they are awe-inspiring to see, but their fearsome appearance belies their simplicity", and they proceed to explain the matter in very clear and simple terms.

The Generator is dealt with in a separate chapter; this has been a long felt want in most books of this type, and the student who reads this book can learn many useful things which are often omitted from text books written for the engineer.

This is altogether a thoroughly good book, well written, and one which will be a useful addition to the library of any young, and many older seagoing engineers.

The Atlantic System. By Forrest Davis. First published in the U.S.A. Published in Great Britain in 1943. George Allen & Unwin, Ltd., London, 308 pp., excluding Appendix, Bibliography and Index, 15s. net.

Great Britain and America *must* co-operate in the Atlantic. On that bedrock of policy, says Forrest Davis, is the surest foundation of complete collaboration in war and an indispensable condition of future peace. A community of interest has bound the self-governing peoples around the Atlantic basin, and this has led naturally to the concept of the Atlantic system, or the joint control through sea power, by Great Britain and America, of the great Atlantic area.

Forrest Davis, who is steeped in the writings of the great Mahan, has written nothing less than an historical brief for the Atlantic Charter. The history of the Atlantic system is the story of Anglo-American relations during the last half-century; the quarrels and misunderstandings; the forces operating both to attract and to repel; the "broad entente" existing between these strongheaded, individualized peoples. And it is only too clear now that joint control of the Atlantic constitutes the vital aspect of the major strategy of both nations. *The Atlantic System* is interpretative historical writing at its best, and provides admirable insight into the historical relationship and the community of interest of the two great English-speaking democracies.

Presented by the Publishers.

Ship to Shore. By William McFee. Faber & Faber Limited, 24, Russell Square, London, W.C.1, 1945, 380 pp., 10s. 6d. net.

Mr. G. K. Chesterton, on the occasion of his introduction to the illuminated advertisements in New York, agreed that they were a wonderful sight—to anyone unable to read. Most of the characters presented to us by Mr. McFee in his new book are, without making Mr. Chesterton's qualification, admirers of blatant illuminated advertisements and all the other vulgarities with which we were deluged in the days before austerity brought us one of its few blessings.

A Mediterranean cruise of a luxury liner in the palmy days of 1929 forms the background of the first half of the book. Expressing with little restraint libidos of more than usual unpleasantness, the mass of passengers whose acquaintance we make present a picture of garish, tedious futility.

Fortunately, the principal characters of the book—the married captain of the liner and a New York business girl passenger—are more inspiring, and persuade one that their liaison is of more emotional value than the other associations which take place on board.

The second half of the book, dealing with the complications that ensue when the captain seeks a divorce from his unattractive wife, the effect on his professional career, and the social forces which can be brought to bear on those who are not economically independent, will be found by many to be more readable than the earlier part of the book.

Mr. McFee's knowledge of ships and shipping makes the book of slightly more interest to marine engineers than it will be to the general reader. It is not a work than can be classified as significant literature, but many will find it pleasurable reading.

British Standards Institution.

PD 431 Amendment No. 1 to B.S. 163 Part 1 : 1943. Galvanized Steel Wire Strand for Signalling Purposes.

PD 437 Amendment No. 1 to B.S. 1041 : 1943. Code for Temperature Measurement.

MEMBERSHIP ELECTIONS.

CORRECTION.

In the list of elections under date 10th January, 1946, on page 163, the following are incorrectly shown as Associates. They were elected as Members on the date above-mentioned :—

Bernadine Thomas Eli Capewell, Lt.-Com'r.(E.), R.N.R.
John Meneck Cooper.
William Dey.
James Dobbie, D.S.C.
Edward Elliott.

Date of Election, 5th February, 1946.

Members.

Hugh Blackwood Alexander.
Henry Brain.
John Charles Budd.
Matthew Caldwell.
Stanley Francis Casley, Lieut.(E.), R.N.R.
Henry Iver Forman.
Joseph Edmund Hamer.
John David Hamilton.
James Henry Hargreaves.
Edward Alan Legg, Temp. Lieut.(E.), R.N.R.
George Edward Lemmon.
William Leonard McKaine.
William Hamilton Purdie.
George Hugh Reece.
W. A. Scott.
John Leslie Sedgwick.
Arthur Harold Short.
Alexander Walker.
John Waugh.
Gordon Whitfield Hedley.
Ronald James Hook.
John Robartes McDowell, B.Sc.
Percy Henry Martin.
Thomas O'Driscoll.
Donald Alexander Orr.
James Frederick Stephen, Sub. Lieut.(E.), R.N.V.R.
Thomas Norman Taylor.
Raymond Arthur Wright.

Associate Members.

John Alexander Gill.
Robert Mack, D.S.C., Lt.-Com'r.(E.), R.N.
Arthur Pitchers.

Associates.

Nelson Briggs.
Kenneth Pearson Campion.
Arpad Desiderius Farkas.
John Robert Fittes.
Cameron Gibb.
Cuthbert Hartley Gribble.

Graduates.

John Bell.
John Glidden Starr Campbell, Lieut.(E.), R.C.N.
Brian Patrick McConnell, Lieut.(E.), R.N.

Students.

Anthony St. Vincent George, Actg. Lieut.(E.), R.A.N.
Aidan Freear Lade, Actg. Lieut.(E.), R.A.N.
Frederick Miguel Shaw, Actg. Lieut.(E.), R.N.

Transfer from Associate to Member.

Charles Grant.
William Robertson Simpson.
James Joseph Tobin.

Transfer from Student to Graduate.

Gerald Guy Woodhouse-Adolphus.

PERSONAL.

W. H. KIRBY (Associate Member) has returned safely from internment in Japan.

EVELYN WOOD, B.Sc. (Member), has been appointed a Controller with the Control Commission for Germany.