THE SALVAGING OF THE GREEK SHIP CAPTANTONIS

BY

COMMANDER T. P. IRWIN, R.N., A.M.I.MECH.E., M.I.MAR.E.

On Sunday 2nd December, 1962, H.M.S. *Rothesay* (Captain B. C. G. Place V.C., D.S.C., R.N.) was on passage from Aden to Massawa. On passing Perim Island about noon the Greek cargo ship *Captantonis* was seen aground, and it was established subsequently that she had grounded at 0500 that morning while steaming at her full speed of 14 knots.

The *Captantonis* is a 5-year old German built ship owned by Naftilos of about 10,000 tons displacement and was carrying a cargo of some 12,000 tons of iron ore. Her overall length is 540 feet and she is powered with a 6,000 h.p. unblown Diesel engine. Her steering gear is of particular interest being a Ward Leonard system driving a pump which discharges to a cylinder fitted over the rudder head. On the rudder pintle are formed three vanes and three vanes are fitted to the fixed cylinder. Displacement of fluid to the areas between the vanes causes the rudder head to turn in the desired direction. The plant is simple and quiet in operation.

The ship was fortunate in the actual site of her grounding on a sand/coral bank since a slight deviation would have brought her either into a rocky cliff or on to a reef. She was aground forward on her starboard side for about 300 feet and about 90 feet on her port side, but there was plenty of water aft.

Draughts before grounding were 27 feet forward and 29 feet aft. After grounding she was drawing 35 feet aft and the waterline was at 22 ft 9 ins. forward. There was a force 5 wind blowing for almost the entire operation and the tide ran between $1\frac{1}{4}$ and nearly 4 knots. The sea bed in the vicinity was a poor holding ground for anchors and was littered with old wires, probably a legacy from the days when the island was a coaling station ; fouled anchors were common during the course of the salvage operation.

The first attempt at towing was made on the 2nd of December, H.M.S. *Rothesay* towing from the bow. The tow was a 4-in. E.S.F.S.W.R. led from the *Captantonis*' stern to the frigate's port cable with two shackles veered. The pull started at 1600, the engines being worked up to 5,360 total shaft horse power (108 revolutions) and kept at this power for an hour. Thereafter the power was reduced to sufficient to keep the tow taut and ship to wind and tide prior to another attempt during the night. At about 2010 the tow was slipped, H.M.S. *Rothesay* having swung into a dangerous position making it necessary to get into safer water. Some 476 engine orders were received during the period of preparation, attempt and aftermath of the tow.

No guidance could be found on any limitations imposed by the prolonged running astern of Y.100 machinery. At this time the following auxiliary machinery was out of action :—

Port turbo blower
Port extraction pump
Port boiler auxiliary superheated stop valve, a joint having 'blown'
Starboard F.F.O. heater
Starboard F.F.O. service pump.

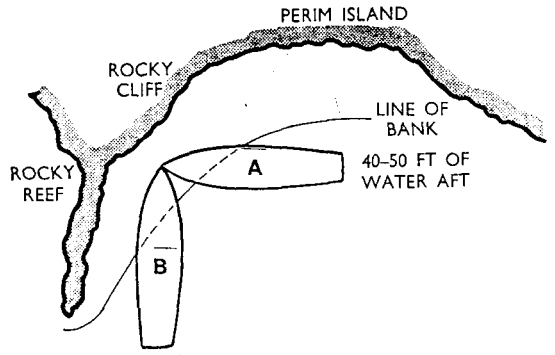

FIG. 7—A—ORIGINAL POSITION OF CAPTANTONIS
B—POSITION AFTER BREAKING OUT.

The power was thus limited. When revolutions had reached 108 astern the starboard blower was running at 5,000 r.p.m. and the extraction pump discharge pressure had fallen by 10—12 lb/sq in. below its normal pressure at lower powers.

The standard blower had been fitted with new rotating elements in September after failure of the oil thrower ring which occurred before the ship reached Gibraltar on her way to Singapore. At the time of the failure, Admiralty had advised that 70 per cent power should be available on one blower. In the event, this towing attempt showed that at 5,000 r.p.m., (the tripping speed being 5,200 r.p.m.) the amount of oil being burnt under the boilers was only 55 per cent of full power consumption (6·7 tons per hour by sprayer output, 7 sprayers in all being in use at 500 lb/sq in.). The tripping speed setting of the blower was an unknown factor as, during trials after the new elements were fitted, a speed of above 5,000 r.p.m. could not be achieved. A setting was eventually made by estimate, the emergency gear having been set at a number of speeds in the 4—5,000 r.p.m. range to get a scale to allow an adjustment in excess of 5,000 r.p.m.

During the astern running all bearing temperatures remained normal but the turbine cylinder expanded a further $\frac{3}{32}$ in. Whenever a ' stop ' order was received the engines were carefully crept ahead. At one time one engine was ordered from astern to a substantial ahead power to keep the ship stern to wind and tide. When the tow had been slipped and the ship was steaming ahead the cylinder expansion rapidly fell back to its normal reading. It appears that this power plant is extremely flexible and astern operation presents no difficulties, but lack of specific guidance on this aspect caused some anxiety.

Another tow was passed on Monday 3rd December, this time from the quarterdeck, a 4-in. E.S.F.S.W.R. again being used. A coastal minesweeper, one of two which had come to assist, had tried to keep H.M.S. *Rothesay's* head into the wind, but was unsuccessful. The engines were worked up to 108 revolutions (7,500 s.h.p.) but the tow parted at this power.

Consideration was now given to the mathematics of the problem of shifting or moving cargo out of the casualty. It was apparent that a danger from hogging was present if weights were moved aft and in any event the amount which could be moved was limited. No knowledge was available on the sort of calculations involved in a ship of this size and type, the examples in Volume 3 of the *Seamanship Manual* deal with smaller ships.

The casualty's T.P.I. was established at 58 tons. When the M.C.T.1 in. was asked for the answer given was that 100 tons removed from forward raised the bow 6 in. and lowered the stern into the water by 3 in. From these figures it appeared that the M.C.T. 1 in. was about 6,700 tons-feet. This seemed a very high figure, but had to be accepted at its face value. It was subsequently shown to be about right as it indicated that 1,000—1,200 tons had to come out. The Master's estimate was 2,000 tons and the Marine Superintendent's (when he later arrived) about 1,000—2,000 tons.

Consideration was given to the actual salving of the cargo by the use of lighters and dhows from Aden. H.M.S. *Rothesay* returned to Aden on Tuesday 4th for consultation with the Flag Officer, Middle East, sailing for Perim on Wednesday 5th. At this time the casualty's Master was not prepared to unload.

Having obtained some basic figures about the unloading necessary to float

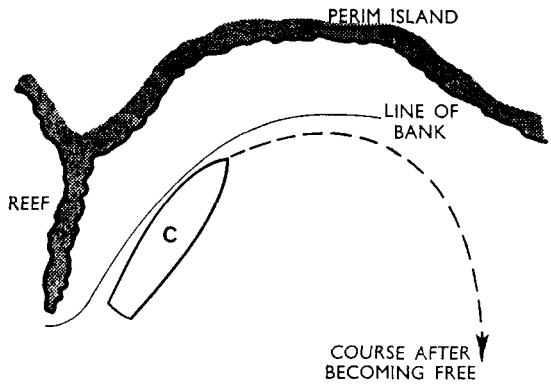

FIG. 2—C—POSITION AFTER UNLOADING AND SWINGING ON GROUND TACKLE

the ship, consideration was given to :—

(*a*) The effect of wind—but this was soon given up

(*b*) The question of what force was necessary to drag a ship off sand—also soon abandoned.

(*c*) How much thrust was being developed by H.M.S. *Rothesay's* engines and what thrusts were normally developed anyway. The lack of information caused considerable concern.

The old B.R. 16 used to have some guidance on towing, but no similar hints could be found in any publication held on board. The thrust block drawing showed that 57 tons thrust per engine was expected at full power, but the safety margin was unknown and in any event there was no means of establishing the power being developed.

A shipwright artificer had a copy of *Theoretical Naval Architecture* by Attwood and Pengelly on board. In this book it states that a ' rule of thumb ' for tugs when towing is to divide the effective horse-power of the reciprocating engines by 100 to find the thrust in tons. The Captain said that he would go up to 160 revolutions at the next attempt. This is normally equivalent to 10,000 s.h.p. and dividing by 100 gives an expected thrust of 100 tons. However, it was expected that the thrusts would be higher in a turbine engined ship and when towing against an immoveable body. Once again the *Seamanship Manual* gave some information for tugs, stating that most tugs develop from between 10—15 tons thrust, while a few big tugs can exert a 70-ton thrust—for these reasons it is better to use a destroyer for getting grounded ships afloat, but no indication of thrusts to be expected are quoted.

On Friday 7th December, the Danish tug *Svitzer* joined the operation as a co-salvor and the Command Salvage Officer from Malta and the casualty's Marine Superintendent arrived. It was the intention at the next attempt for *Svitzer* to hold H.M.S. *Rothesay's* head into wind. It was thought that the resolved component of her thrust would act in conjunction with H.M.S. *Rothesay's* thrust along the towing wire thus providing a safety factor since the breaking strain of the rope would be reached before H.M.S. *Rothesay's* thrust reached that figure. (This proved not to be the case since the tug finished up by towing H.M.S. *Rothesay* at right angles).

A 6-in. E.S.F.S.W.R. belonging to *Svitzer* was passed to the Greek for the tow which was scheduled to take place from 0200—0500 on Saturday 8th, H.M.S. *Rothesay* to develop 10,000 s.h.p.

When this attempt was commenced, *Svitzer* first started towing H.M.S. *Rothesay* until the tow was taut. H.M.S. *Rothesay's* engines were then slowly increased in power. Before this stage was reached, once the tow had been successfully passed, it was necessary for H.M.S. *Rothesay* to keep into the wind with the tow attached. Many engine orders were received in the 10—20 r.p.m. range, but since the Chadburns do not go below 30 r.p.m., new scales had to be added in chinagraph on the turbometer glass fronts.

Torsionmeter readings were taken at each change in engine orders, revolutions being increased in steps of four. The Engineer Officer and his Deputy were to be seen sitting with slide rules and graph paper at the torsionmeter positions—

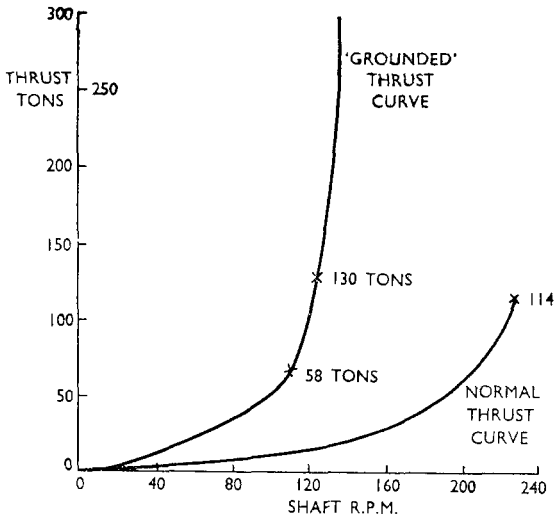

FIG. 3—THRUST (?)—R.P.M. CURVE

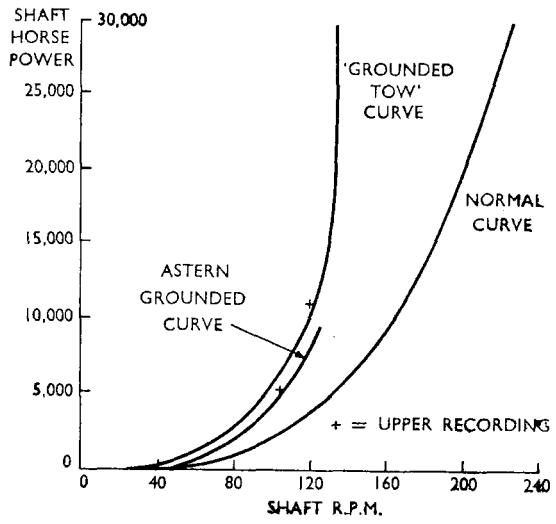

FIG. 4—S.H.P.—SHAFT R.P.M. CURVES

surely an unusual sight in the engine room of an H.M. ship in the middle watch!

At 120 revolutions, 10,700 s.h.p. was being developed. As the Captain was being informed that the limit had been reached, so the Salvage Officer in *Captantonis* radioed, 'Anything may happen'—and at that moment the tow parted! The casualty had been swung 30 degrees (and moved a further 10 degrees under her own engines).

Simultaneously with the tow parting, things happened very quickly below. The P.O.M(E). in the boiler room immediately had to take two sprayers off each boiler, leaving a $\frac{1}{2}$-size sprayer on each boiler. The sudden change in conditions demanded more water than the main feed pump could supply (with only one extraction pump in use for such a demand), and it speeded up and tripped. The reaction of the machinery to the rapidly changing conditions was surprisingly quick. Engine revolutions ordered were almost simultaneously reduced by the bridge and the auxiliary feed pump was able to cope satisfactorily.

Svitzer then passed a tow herself and was able to swing the Greek still further until the wind took charge and swung the ship a total of 120 degrees from its original position against the coral bank approach to the reef, but more of the ship was off the sand bank than where she originally grounded.

When daylight came it was felt that at last some facts might be available with regards to thrusts. The s.h.p.s obtained were plotted against the r.p.m. The slope of the curve is alarming. If the extension of the curve to maximum horse power is correct, then an increase of 10—12 revolutions increases the power developed from 10,000—30,000!

It was then possible to plot out thrusts against r.p.m. and s.h.p. using the breaking strain of the 4 and 6-inch wire ropes which parted, (the former 58 tons and the latter 129·6 tons). Once more considerable dangers appear to be present again if the extension to the curve is correct. It was also possible to make an estimated thrust curve for normal running, using the thrust block figures of 57 tons per block.

Other information began to come to light. Firstly the 'rule of thumb' for finding thrust by dividing s.h.p. by 100 does not apply when towing a grounded vessel at high powers. Secondly, when towing a 'free' vessel, the curves should fall between the 'grounded' tow curve and the 'normal' curve ; it may be possible to estimate the thrusts under free towing by the 'rule of thumb' figure

when the s.h.p. readings have been obtained, but the thrusts will depend upon the tow itself and prevailing weather conditions.

It was with a feeling of relief having some (though not very certain) facts available, that preparations for the tow, due to take place in the early hours of Sunday 9th, were made. The casualty was now in a position where she might come off. The Salvage Officer had said on arrival that, in theory, the ship would not come off without discharging cargo, but many odd things happened with grounded ships. It was a matter of considerable surprise to a lot of people that H.M.S. *Rothesay* could develop such a thrust.

As preparations went ahead the following arrangements were made ' below ' for the big effort :—

(*a*) The port boiler was connected to the auxiliary superheated steam range, the joint being allowed to ' blow '

(*b*) The defective blower was run at idling speed (1,000 r.p.m.) with a mechanician standing by its controls. Two mechanics stood by with fire-fighting equipment in case a fire started from leaking lubricating oil, and with oil for replenishment

(*c*) A second P.O.M(E) closed up in the boiler room to tend the second boiler

(*d*) An E.R.A. and a P.O. electrician stood by in the Diesel generator compartment in case of power failure

(*e*) The defective extraction pump was run at idling speed with a mechanician standing by

(*f*) Watchkeepers were closed up in the tiller flat and main switchboard. A host of talent was available in the engine room.

Power was to be limited to 110 revolutions, with once again *Svitzer* holding H.M.S. *Rothesay's* head to wind. Once the tow was taken up, revolutions were increased to 108, giving 7,000 s.h.p. and the *Captantonis* swung from her position allowing the line of tow of *Svitzer*, H.M.S. *Rothesay* and *Captantonis* to be in one straight line for the first time. The total thrust therefore was in the order of 100 tons, but unfortunately the 6-in. towing wire had suffered considerable punishment and it began to strand so the tow had to be given up. by now it was clearly apparent that cargo would have to be discharged overboard, and no further towing was envisaged until this had been done.

With four years' Fleet Work-Study experience the Engineer Officer was a ' natural ' for considering the materials handling problem. It was agreed that, with the ship's new position and draughts, about 500 tons (at 45/- a ton) would need to be discharged. The casualty had no unloading year other than her derricks. Fortunately H.M.S. *Rothesay* had a small deck cargo of lubricating oils and five 45-gallon drums were soon made available, the tops removed, lifting holes cut some one-third from the top and welded round for strengthen ing. Other stand-by containers such as the bathing pools, to be fitted into cargo nets, were also shipped across. A large number of 45-gallon drums had previously been seen ashore, but when a party went for them it was found that a dhow had collected the empties the day before. Fortunately, again, the *Captantonis* also had some empty drums on board, apparently an unusual practice for them. It was the intention to try to strap four drums into a single unit to make the most of each derrick operation. This proved difficult, but finally a double unit was made to work successfully. Local Arab labour was arranged at 6/- per day per man, some 30 Arabs being due to arrive at 0700 on Monday 10th. Twenty in fact eventually arrived and were given their clocking-in cards.

The casualty's crew had started unloading on the Sunday afternoon and some worked during the night. By 0700 they were exhausted and the Arabs took over both numbers one and two holds, starting with great gusto. At this time

H.M.S. *Rothesay's* Daily Orders, in giving the routines to be worked each day, were prescribing ' Daily Towing Routine ' or ' Sunday Towing Routine ' During the Sunday the *Svitzer* laid out ground tackle from the Greek's bow and stern in order that she could hold herself off the bank as she was lightened.

At about 1030 on the Monday morning the after draught and forward water line gave an indication that a midship draught of about 32 feet would be needed for the vessel to float. A dip was taken and it was found to be 32 feet. At that moment the ship started to move on the forward ground tackle. Although it had been agreed all round that the next attempt would be made on the morning high water on Tuesday, the ship went against this agreement and the Salvage Officer's advice. Furthermore, they continued to use the ship's engine at full power, knowing the ship now to be grounded aft, against the strongest recommendations to cease. Several ' clunks ' were felt and heard aft. The stage was reached when the engine telegraphs were not used, orders being quietly passed by telephone to keep the Admiralty representatives on board in ignorance, but obviously the engine powers could be assessed from on deck. It is considered that the success of the whole operation was at this time being jeopardized since a failure could have put the ship into a worse plight and severely damaged the propeller. However the ship persisted and after about an hour (at 1145) she came off. She was steamed round to a sheltered anchorage where H.M.S. *Rothesay's* divers carried out an underwater examination. There was no damage, but the propeller blades were ' polished ' for 18 in., showing, indeed, how lucky the ship was.

The *Captantonis*' engine was examined by H.M.S. *Rothesay's* Engineer Officer. When she was sitting on the bank with the engine stopped, there was a freely fluctuating crankshaft deflection of 0·004 in., (use of the engine at every high tide may have had some effect here.) With the engine turned by turning motors a deflection of 0.038 in. was seen. When the ship finally anchored there was no fluctuating deflection with the engine stopped, but when turning 0·013 in. was present. The maximum allowed is 0·006 in. There were signs of whitemetal in the sumps, but these pieces may well have come from the large-end bearing butts.

Re-assessing the total amount of cargo removed, taking the s.g. of iron ore as 3·5 for low grade ore, (iron ore has an s.g. of 5·2), it is thought as a conservative estimate that 400 tons were removed, of which about 200 tons was discharged by Arab labour. This figure agrees closely with the trim calculations.

It was a very satisfying sight to see *Captantonis* afloat again. It is considered that, although she finally came afloat under her own power and using ground tackle, the success of the operation was due to :—

(*a*) H.M.S. *Rothesay's* tow at 130 tons for two hours at 0300 on the 8th, breaking the casualty out of her original position

(*b*) Further turning by H.M.S. *Rothesay's* two-hour pull at 100 tons on the 9th

(*c*) *Svitzer's* laying of ground tackle and holding H.M.S. *Rothesay* to wind for pulls

(*d*) The naval organization of improvised gear, shovels (from Aden) and hire of Arab labour.

Cost

The most obvious Crown cost is fuel, 211 tons of F.F.O. were burnt during the operation, but this is less than would have been used had H.M.S. *Rothesay* carried out her original programme of visiting Massawa and acting as plane-guard for H.M.S. *Hermes.*

Conclusions

(*a*) There is little or no guidance on the running of Y.100 machinery at astern powers. The power plant seems very flexible and astern running seems to present no difficulties. Confirmation that there are virtually no limitations would be welcomed.

(*b*) There is no guidance on thrusts developed under these or under normal conditions. The information gathered in this operation may be useful and expert opinion on it would be welcomed. The Fleet requires to be informed about thrust problems to prevent a possible disaster.

(*c*) Information contained in the *Seamanship Manual* would be greatly enhanced with some typical examples relating to a ship of the size of the *Captantonis*.

(*d*) Slight variations in s.h.p. recorded for similar revolutions are probably due to varying towing conditions, e.g. *Svitzer's* position relative to H.M.S. *Rothesay*, weather and slight inaccuracies in the turbometer.

Tailpiece

The ship's original programme required her to replenish at sea from the R.F.A. *Olna*. On Saturday the 8th December, the *Olna* was sighted on her way south from Suez and the following signal was sent, ' Sorry I can't get away to RAS with you today, my tow won't let me '. In the afternoon of the 8th, while preparations for a further attempt were being made a tug was sighted on the horizon. Additional help was considered a possibility and she was signalled. She altered course towards, but turned out to be the Russian tug *Golovnoy*. At one stage she sent a rude signal in International Code, but perhaps in error.

On completion of the operation the ship sailed from Aden for Singapore ; a new deck cargo of oils was embarked. This cargo was really needed and not obtained, as the First Lieutenant alleged, just in case of another salvage job.

Comment by D.M.E.

The Y.100 machinery was designed to be flexible in operation, and this demonstration is most gratifying.

The main turbines are designed for a continuous astern power of 10,000 s.h.p. and first of class contractor's sea trials include one hour at this power. No reports of trouble have been received, and continuous running at this full power astern is considered to be perfectly safe.

There is a reasonable margin of safety on thrusts, and the more important criterion is that full power torque should not be exceeded. (See B.R.3000, Article 0308).

The limitation of 55 per cent boiler output imposed by the blower is noted with interest. It is possible that more sprayers at a lower fuel pressure would have produced more favourable conditions for the blower, that is a lower H and a higher Q for the same 5,000 r.p.m., and information on operating experience with one blower on two boilers from other ships would be welcomed by D.M.E.