

THE VOITH-SCHNEIDER PROPELLOR

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BRITISH INTELLIGENCE OBJECTIVES
SUB-COMMITTEE

THE VOITH-SCHNEIDER PROPELLER

Reported by

E. C. GOLDSWORTHY

Target No. 29/49

BRITISH INTELLIGENCE OBJECTIVES SUB-COMMITTEE

32, Bryanston Square, London, W.1.

CONTROL COMMISSION FOR GERMANY
(BRITISH ELEMENT)

COMBINED INTELLIGENCE OBJECTIVES SUB-COMMITTEE

REPORT ON VOITH-SCHNEIDER PROPELLER

BY E. C. GOLDSWORTHY (CIVILIAN OFFICER)

1. INTRODUCTION

The following Report is based on the information obtained from a visit to the Works of Messrs. J. M. Voith, Heidenheim/Brenz from the 24th July to the 31st July inclusive. Target Evaluation Report prepared and handed to C.I.O.S. Headquarters, Frankfurt, on the 2nd August.

2. DESCRIPTION OF TARGET

The Voith-Schneider Propeller was introduced as a method of ship's propulsion in 1930. Its particular characteristic is that it can give variable directional thrust as well as variable pitch. Rudders and steering gear are not, therefore, required and the propeller is uni-rotational and at constant speed under any condition of load.

It was being increasingly used throughout the world for mercantile work before the war and was standard for the German Navy's "R" boats. It is used with steam diesel, diesel-electric and turbo-electric power plants up to powers of 2,200 h.p. per shaft.

3. MANUFACTURE

The propeller was manufactured only by J. M. Voith in their Works at Heidenheim/Brenz, Germany, and St Poelten, Austria. All design work was done at Heidenheim/Brenz, together with research work in their flume and cavitation tanks. The Heidenheim and St. Poelten factories are now respectively in the American and Russian Zones.

rough spare blades and for the material and fabrication of a special frame to transport the propellers.

5. DEVELOPMENTS AND IMPROVEMENTS IN CONSTRUCTION

The improvements in standard propellers during the war have been few owing to the necessity to concentrate on production. The following standardisation or alterations have been made since 1939:-

- (1) The elimination of leather packings on the blade shafts and the introduction of a double packing of synthetic rubber.
- (2) The changeover from carbon packings on the main stuffing box to synthetic rubber. This has necessitated the two lower synthetic rubber rings being lubricated and cooled by salt water. The upper single ring is sufficiently lubricated and cooled by splash oil from the gear wheel.
- (3) The standardisation on needle roller bearings for the blade shafts. These are the new type produced by Deutsche Kugellagerfabric, Leipzig which have three sets of short needles spaced between long needles.
- (4) The substitution of a stainless steel runner wheel by a rolled on plate consisting of approximately one-half stainless steel and one-half mild steel, the stainless steel side in contact with the water. I understand that this rolled on plate has been highly satisfactory.

6. RESEARCH

Construction

Practically no research work has been done on the construction of the propeller during the war, concentration being placed on production of the existing standard propeller and repair work. The only exception has been an experiment with one "R" boat type propeller to get a higher pitch. One complete new runner wheel with the necessary link motion was made, but it was unsuccessful partly due to the lack of space in the runner wheel to effect the greater movement and because of the heavy

vibration set up when under test. To bring into being propellers with the higher pitch will necessitate major re-design.

Theoretical

The following work has been done to determine the effect of using higher pitches than the present maximum of approximately 0.72:-

- (1) Model propellers were made at Heidenheim of various sizes, together with the necessary dies capable of giving a pitch from 0.60 to 0.90.
- (2) Propeller efficiency tests were carried out in the Heidenheim flume tank and eventually permission was granted by the German Naval Authorities for propulsion efficiency tests to be carried out at Wageningen Tank in Holland.
- (3) The following tests were carried out at Wageningen in 1943/44 using the model of the "Patria" obtained from the Hamburg Tank:-
 - (a) Tank tests with the best screws designed by Wageningen to check the results obtained by Hamburg.
 - (b) Tests with the "Patria" model with stern lines altered according to designs from Heidenheim to suit Voith-Schneider propellers At 17 knots the following results were obtained:-

					<u>Screw</u>	<u>V.S.P.</u>
Pitch	..	..	..	..		0.82
R.P.M.	..	..	..	..	108.6	42.8
Propulsion efficiency	..	..	..	..	0.715	0.610
Scale effect, Reynolds Number	..	..	..	..	1.85 x 105	0.66 x 105

	<u>Screw</u>	<u>V.S.P.</u>
This resulted in a propulsion efficiency of the full size ship of	0.742	0.721
The resistance of the two ships was e.h.p	6105	e.h.p 5664
With mechanical losses assumed to be 3% for the large V.S.Propellers H.P. required	8130	7600

These results were considered encouraging.

7. TYPES OF PROPELLERS FITTED SINCE 1939

Production was concentrated on the standard "R" boat propeller 900 b.h.p. type 14.F/87 the propellers being made at both Heidenheim/Brenze and St. Poelten, Austria. No other orders were taken with the exception of a few propellers for large floating cranes.

Records available show that nearly 400 propellers were ordered between the beginning of 1939 and the middle of 1945 for "R" boats and that R.150 was the last with Voith-Schneider Propellers to go on trials. The propellers for R.401 to R.418 had been delivered but no indication is shown that the vessels have run trials.

For every 10 ships fitted there would appear to be about 4 spare propellers - 2 port and 2 starboard.

8. SPECIAL TYPES

(1) Aircraft Carrier "Graf Zeppelin"

This vessel was fitted with two Voith-Schneider propellers for steering purposes, these being considered necessary for the ship when going through the Kiel Canal or other narrow channels.

The propellers were placed in the fore and aft line well forward,

the drive being from electric motors through gears. The propeller size was 1600 mm. and the input 450 h.p. They were in separate closed compartments with facilities for raising the propellers, so having a clear line of hull when the ship was under normal power and controlled by stern rudders. These propellers were fitted but so far as is known the ship has never been to sea so that no results are available.

(2) Submarine Steering Propeller

The German Admiralty placed an order with J. K. Voith for one propeller 800 mm. blade orbit diameter, to be driven by a 100 h.p. electric motor, for installation in a 600-ton U-boat. The propeller was to be installed forward with the blades horizontal in a narrow compartment open to the sea in an athwartships direction to give steering effect when at low speeds or a turning moment when stopped. The propeller was subsequently fitted to the submarine U-118 X.P. which was stated to be 900 tons. Trials were carried out at Kiel in November, 1941 and although the desired thrust of 1000 kg. was obtained - which was considered sufficient for the smaller vessel - it was too low for the larger displacement boat. I understand no further work was done on this.

(3) Light Weight Propeller

The German Army Engineers decided in 1937 to experiment with a light tug for pontoon work. A Voith-Schneider propeller was ordered, type 12. F/60, to be driven by a 250 b.h.p. engine. The propeller was to be as light as possible and aluminium alloys were used for the following parts:-

- (a) Runner Wheel: Cast in Hydronalium HY.51.
- (b) Top Casing: Cast in Hydronalium HY.51.
- (c) Servo Motor Ends: Cast in Silumin.
- (d) Blade Pot Tops: Cast in Hydronalium HY.51.
- (e) Stuffing Box Housing: Cast in Silumin.

All other parts were of the usual materials - cast or forged steel and bronze. The propeller blades were 15 per cent chrome steel.

The weight of the complete propeller was about 1000 kg. whereas the normal propeller of this size would be about 2,200 kg.

The propeller was fitted and trials carried out on the Elbe in October, 1938, the vessel being in service some few months. The method was found satisfactory with the exception that the Servo motors which had been purposely designed smaller than normal to reduce weight were not man enough to hold the control column when under full thrust. During the war the propeller was returned to Heidenheim for fitting new and larger Servo motors, but work was stopped owing to pressure of production.

The propeller was examined in the Stores at Heidenheim and no signs of corrosion were noticed. Particular attention was paid to the light alloy runner wheel adjacent to the bronze plate surrounding the blade shaft and, although the clearance between the two materials was approximately only 1 mm. and the vessel had been working in semi-salt water, no corrosion was evident.

9. MATERIAL REMOVED

The attached document No.1 gives the drawings and miscellaneous material removed. Copies have been left with Messrs. J. M. Voith; Military Government Office, Heidenheim; G.2. Dept; Heidelberg; and C.I.O.S., Frankfurt.

10. EQUIPMENT REQUISITIONED

The attached document No.2., copies of which have been left with all authorities mentioned above, shows the material which has been requisitioned.

All this equipment is to the order of Messrs. Ferguson Bros. (Port Glasgow) Ltd., dated November, 1938, for which 50 per cent of the total cost has already been paid viz. £1206 0s. 0d. This propeller, equipment and spare parts are for a vessel which is already completed to the order of the Anglo-Iranian Oil Company (British Tanker Company Ltd.,) and which vessel is urgently needed for service.

Messrs. J. M. Voith are overhauling and testing the propeller and

this work should be completed by 1st October.

Instructions should be given for this material to be packed and despatched at the earliest possible moment direct to Messrs. Ferguson Bros. (Port Glasgow) Limited Port Glasgow.

SUMMARY OF PROPOSED ACTION

- (1) Obtain copies of sketches removed by Lieut. Wiers, U.S. Army, on 27th April.
- (2) Visit Wageningen Tank in Holland to check up on results of tank tests of propellers with higher pitch and to obtain one of the model propellers together with the requisite dies.
- (3) To give instructions to remove from Messrs. J. M. Voith, Heidenheim, all equipment specified in document No. 2 on completion of overhaul and ship to Messrs. Ferguson Bros., (Port Glasgow) Limited, Port Glasgow

(SGD.) E. C. GOLDSWORTHY.

31st August, 1945.

COPY

Document No. 1.

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To J. M. Voith

Heidenheim/Brenz

This is to certify that I have taken the following pursuant with authority from the above:-

- (1) Set of working drawings of the propeller. Type 18 S.
- (2) Set of working drawings of the propeller Type 16 F
- (3) Miscellaneous charts and sketches relating to design and efforts to increased pitch.
- (4) Certain drawings relating to the light alloy propeller, code-name "Pioboot".
- (5) General arrangement drawing showing the modern design of the R-boat propeller.

(Sgd.) E. C. GOLDSWORTHY.
Civilian Officer.

Heidenheim, 30th July 1945.

COPY

CONTROL COMMISSION FOR GERMANY
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Document No. 2.

COMBINED INTELLIGENCE OBJECTIVES SUB-COMMITTEE

To J. M. Voith.

Heidenheim/Brenz

By authority from the above the following material is ordered to be retained by J. M. Voith pending further instructions from appropriate authority:-

- (1) 1 Voith-Schneider-Propeller, code-name "Ferguson", type 18 S/60, No. 131.
- (2) Control apparatus
- (3) Voith pin-type coupling for 200 HP at 480 Rpm.
- (4) A quantity of spare parts including:-
 - 2 propeller blades
 - 6 blade roller bearings
 - 6 leather packing pieces and other small items.
- (5) Set of normal tools for dismantling, etc.
- (6) Set of necessary drawings for repair and overhaul together with instruction books.

(Sgd.) E. C. GOLDSWORTHY,
Civilian Officer.

Heidenheim, 30th July, 1945.

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