

Report of Survey for Repairs, &c., of Engines and Boilers.

(Received at London Office

MON. 18 DEC. 1922

Date of writing Report *Nov 22* When handed in at Local Office *Nov 22* Port of *Seattle Wash*
 No. in Reg. Book. Survey held at *Bremerton Wash* Date, First Survey *Dec 13* Last Survey *Nov 14* 1922
 on the Machinery of the *Wood, Iron or Steel* *T.S. Empress of Australia* (No. of Visits *10*)
 Tonnage { Gross *2,486* Vessel built at *Seattle* By whom *Vancouver A.C.* When *1914*
 Net *1,792*
 Registered Horse Power *1,792* Engines made at *Do.* By whom *Do.* When *1914*
 No. of Main Boilers *1* Boilers, when made (Main) *1914* (Donkey)
 No. of Donkey Boilers *1* Owners *Canadian Pacific Railway Co.* Port *London* Voyage *Orient*
 Steam Pressure in Main Boilers *220* If Surveyed Afloat or in Dry Dock *Port*
 in Donkey Boilers *220* (State name of Dock) *Bremerton Navy Yard*

Particulars of Classification (which must be inserted precisely as in Register Book & Supplements).

CHARACTER, X for Special Survey, Date of last Survey and of Periodical Surveys
S. S. Ham. No. 222
105 N. 1-522
(Class. Exempted)
with full trial
FP at 110°E
VT 800
75 N 5.22

Last Report No. *Port*

Particulars of Examination and Repairs (if any)

Periodical Surveys, when held, must be reported in detail and serially in the terms of the Rules. State clearly the cause of Repairs, if any, and, in detail, the nature and extent of Examinations and subsequent Repairs. Repairs on account of Damage (the cause of which must be stated) should be separated from Repairs due to other causes; and besides being detailed in the body of the report, should be briefly summarised at the end of the report. State also the dates and initials of any letters respecting this case.

In damage cases where the Surveyor has not made a special damage report he is required to state whether he offered his services for this purpose, and why they were declined? Was a damage report made by anyone else? If so, by whom?

Did the Surveyor personally go inside each Main Boiler separately and make a thorough examination at this time?

Do. " " Donkey " " " "

If this was not done, state for what reasons?

And what parts of the Boilers could not be thus thoroughly examined?

Also what special means, in the absence of internal examination, were adopted by the Surveyor to assure himself of the thorough efficiency of those parts of each Boiler?

Did the Surveyor examine the Safety Valves of the Main Boiler?

To what pressure were they afterwards adjusted under steam?

Did the Surveyor examine the Safety Valves of Donkey Boiler?

To what pressure were they afterwards adjusted under steam?

Did the Surveyor examine all the manholes, doors and their fastenings of the Main Boilers?

and of the Donkey Boiler?

Did the Surveyor examine the drain plugs of the Main Boilers?

and of the Donkey Boiler?

Did the Surveyor examine all the mountings of the Main Boilers?

and of the Donkey Boiler?

Has screw shaft now been drawn and examined?

Is it fitted with continuous liner?

Is an approved appliance fitted at the after end of the shaft to permit of it being efficiently lubricated?

Has shaft now been changed? If so, state reasons

Has the shaft now fitted new?

Has it a continuous liner?

Is an approved appliance fitted at the after end of the shaft to permit of it being efficiently lubricated?

State the distance between lignum vitae or bearing metal of stern bush and top of after bearing of screw shaft?

If the Survey is not complete state what arrangements have been made for its completion and what remains to be done?

Survey for Repair to Rotor of Port Main Turbine.

It is stated that the vessel sailed from Vancouver B.C.

Sept. 28th 1922. bound for Yokohama. & reported all well. until 4.46pm Sept 30th when Port Main Turbine without any warning whatsoever developed several severe vibrations which were felt most effectively over the entire vessel. Steam was immediately shut off. & turbine brought to rest. Proceeded slowly with S.P. Engine while investigating trouble to Port Engine & after finding turbine could not be further used, decided to return to Vancouver B.C. At 8.54pm proceeded at half speed with S.P. Engine & at 9pm Full Speed arriving at Vancouver B.C. 6.25am Oct 4th 22.

As the Engineering facilities at Vancouver B.C. were not equal to the requirements, the vessel proceeded to Bremerton for Repair. Oct 11th 1922.

OVER

General Observations, Opinion, and Recommendation:—

(State clearly what alteration, if any, is suggested to be made in the existing classification of the vessel's machinery in the Register Book, consequent upon this survey, and also any alteration required to be made in the records of the vessel's machinery, boilers, working pressures, &c.; thus, for example, B.S. 9,11, B.M.S. 9,11, or L.M.C. 9,11, 140 lb., E.D., &c.)

The Machinery of this vessel as far as is practicable is now in efficient condition & capable in my opinion to remain so (Class. contemplated) & that no Record of this Survey be made in Register Book.

Survey Fee (per Section 25) *\$80.00*
 Special Damage or Repair Fee (if any) *\$120.00*
 Travelling Expenses (if chargeable) *\$40.00*

Fees applied for *Nov 22*
 Received by me, *19*

C. V. Varte
 Engineer Surveyor to Lloyd's Register of Shipping.

Committee's Minute

Assigned

New York DEC 5 - 1922

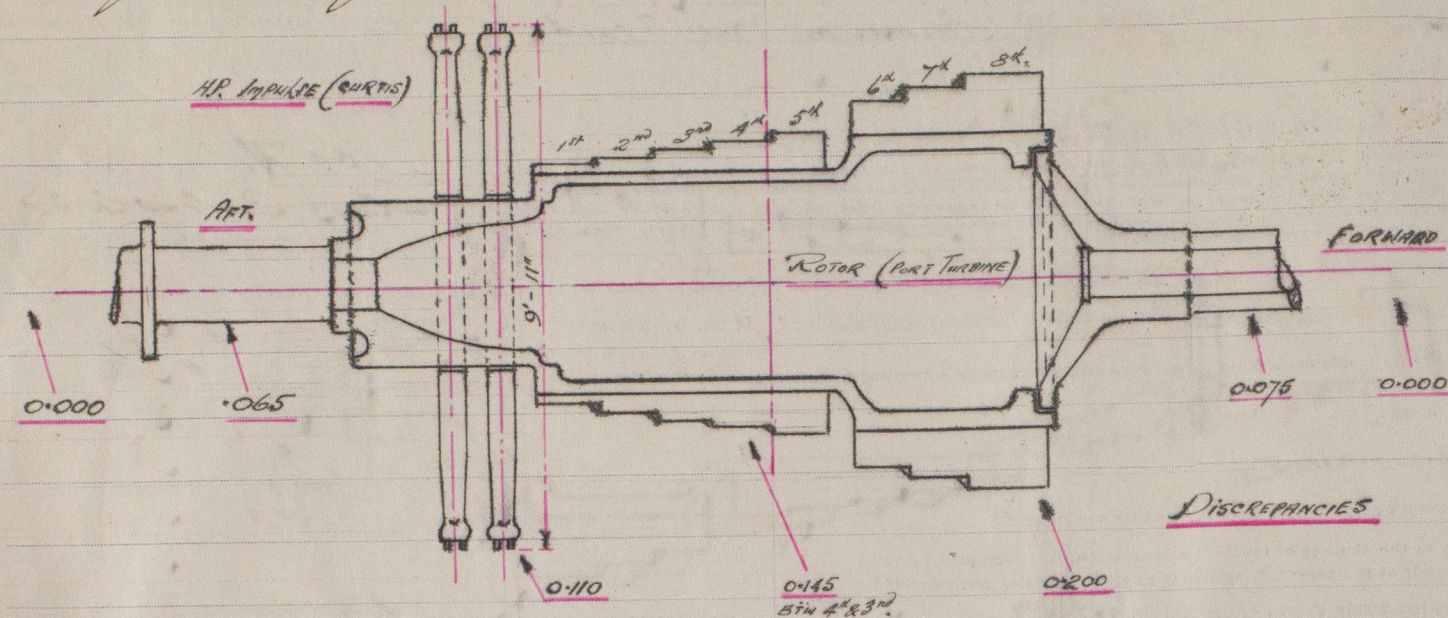
As now subject



© 2020

Lloyd's Register
 Foundation
 W1086-01123

(1) Examination:- The Turbine being dismantled of its Connections to Casing was removed & Rotor lifted & transported to Lath Machine Shop for Examination. A Micrometer Reading throughout was taken at various points to ascertain location of Rupture. The measurements were found as follows:-



The shearing on Rotor blades also stationary blades at the 7th & 8th stages was badly rubbed & blades corroded where same had been in contact, due to whip in Rotor at this point. The Forward & After labyrinth packing and Diaphragm seal were badly damaged & Evidence of contact was very noticeable at joints between Expansion blades in 4th 5th & 6th stages, decreasing gradually to 7th stage. A noticeable Rub was noted on periphery of the S.P. impulse wheel flanges at diaphragm steam seal fit. Upon completion of check the Rotor was taken from Lath Centres & Dismantled. The Forward & After sections of Shaft & the Two S.P. impulse wheels were removed leaving Rotor a separate unit. At Forward End seven securing studs were found corroded up to as to permit them being moved by hand. & under hammer test all but four were considered sound. The threads in studholes were found stripped & the Flange faces for approx 90° circumferentially were found oxidised in way of loose scale - defining poor contact of surfaces. The Forward securing flange face of Rotor was sprung .080" & after face .012" out of square with Shaft axis.

The checking of Forward & After Shaft sections proved same to be within .003" perfect. In the After section a journal alignment variation of .011" was noted & that the labyrinth and packing cage fits on account of contact had increased their axial clearance to .080"

(2) Repairs:- The Forward & After securing flange faces of Rotor, turned true and labyrinth packing cages connected to Shaft for Relativity. The studholes in after flange retapped .085" larger & new nickel steel studs fitted. The stud holes

SEE Sheet No 2.

"EMPRESS of AUSTRALIA"

in Forward Flange Retapped & Carried Right through flange. A set of new Nickel Steel Collar Bolts fitted with Lock nuts on spot faced surfaces & some electrically welded to bolt & flange. A new set of after nuts specially made & fitted. The labyrinth fins of After Casing removed & replaced by new & three of shaft re-rolled to original form. New diaphragm seal packing made & fitted & all loose leading in to 4th & 8th stages of both casing & Rotor as noted, was secured & shrouding brazed or fused necessary. For Main bearing top & bottom brasses & after main bearing top brass removed checked & re-bored for alignment & the joint faces machined to reduce oil clearance to .025. also stops fitted in housings to reduce bearing lift to a fixed amount.

(3) Assembly & Balancing:- The Forward & After shaft sections together with impulse wheels secured in place & a thickness check taken between Lath Centres and Forward & After main journals, thrust collars, & After labyrinth steam seal fins all slightly reduced in diameter for correction. The Rotor was then placed in the Airiff Balancing Machine, arm weights adjusted and correct speed obtained. After several trial runs to obtain unbalanced points, same was arrived at for Forward end at 190° on Radius 28 3/8" with vibration .002" at flange face. At After end 124.5°, Radius 21 1/8" with vibration .003" located on periphery of lock nut of after impulse wheel. Weight calculations were then carried out to put Rotor in a Static & Dynamic balance. While this was being done the Forward shaft flange connection to Rotor was finally electrically secured circumferentially, a groove 1/2" deep & 3/8" wide having been previously machined at joint to accommodate same. (An identification for future purposes is made.) After several trial rotations & correction of weights Forward & After a final weight calculation was made & new plane lines established and Rotor finally balanced giving a vibrational reading at gauges of .003 which was recorded & accepted as final. Rotor was removed & installed in place about vessel.

(4) Steam Trials:- A steam trial was conducted at Dock under full working conditions with the Port & Star Turbines running alternately. The gauges registered over 900 Rev/min. The Trip gears were tried for relief & found to function satisfactorily. The Stoppage gears & Overhauls throughout worked efficiently giving no trouble.

Boilers:- The oil burning tanks & appliances of Back Boiler have been removed & replaced by the fitting of Teco-Hite oil fuel system & under operation were found to function very satisfactorily.

Empress of Australia.

Observation: As everything in the Machinery Dept. was reported normal, just previous to mishap which occurred without any warning, it is difficult to define the specific cause attributable to accident of Rotor.

A momentary water gulp (priming), loss of vacuum, defect in Tottinger Gear (Racing & momentary shock absorption & disturbance transmitted in turn to Steam unit) etc. have been advanced.

From the point of Rotor design we have a different view of things. Referring to sketch it will be observed that the Rotor is a large hollow steel Casting without any, or, in immediate interior strengthening, to span between journal supports being over 22 ft. (weight 2 1/2 tons).

In order for vessel to maintain anything like Canadian Pacific schedules, the Rotations of turbines Register well over 30,000 R.P.M. with a speed of over 30,000 f.p.m. at Suez Canal of Imbrosi wheel. The Michell Thrusts are reported to have always been uncertain, having to be continually watched due to Register Excess temperatures & under many & varied adjustments by the Trust. People themselves are still waiting.

Conclusion: Personally I consider, that due to the Design of Rotor to Rotations, should not exceed a Practical Working Speed of 750 R.P.M. Actual subsistence in strengthening in the initial Construction would have rectified same immensely as the Kinetic energy of Rotation would have been increased (as unlike to general make of propelling elements the machines always run in one direction, Reverse being accomplished at water gears) & there for a tendency to avoid & offset the arising of small discrepancies in grading from the propeller forward must be accomplished. Regarding Thrusts it would be very feasible to assume that the heating is due to movement of Relative Expansion under heat to which the Rotor of their peculiar design lend themselves. The heat distortion for the quality of steel can probably be attributable for the mishap. The Thrust arrangement of high temperatures are relatively, only not so markedly in line too.

OK