



# Lloyd's Register of Shipping,

342, Argyle Street, Glasgow.

24th October, 1924.

DR. MONTGOMERIE.-

Reference

BROKEN CRANKSHAFT - M.V. "LAGARTO".

Agreeably with your instructions, I have made an investigation into the causes leading to the failure of this Forging and beg to submit my report.

The following is the history of the forging.

Makers of forging.- Dennystown Forge Co., Dumbarton, Feb., 1916.

Makers of Ingot ) D. Colville & Sons, Ltd., Motherwell  
S.M. Acid Steel )

Size & Weight ) 48" Octagonal, wide end up, hot top.  
of Ingot, etc., ) 29 tons 3 cwts.

Weight of Forging - 13 tons.

Machined by - Harland & Wolff, Ltd., Glasgow.

Finished size - Shown on tracing attached.

The forging was forged under a hydraulic press, the webs being left solid. The twisting or "setting through" of the webs was effected during the forging. After this "setting" operation, practically no further "work" was put upon the part.

The fracture occurred through the after web of number 3 crank and a careful examination of the fractured surfaces leads me to conclude that rupture first started on the inside of the web near to where this joins the journal. The fracture is of the detail type, step by step across the web, with considerable rubbing of the parts first to fracture - ending in a crystalline formation/

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formation indicating a sharp final breakage. It should be pointed out that perfectly normal material fractures in this manner. I am satisfied after careful examination, that no defect existed in the centre of the broken section and that ~~what~~ was ~~first~~ supposed to be a defect can be satisfactorily explained by a study of the circumstances leading to final rupture.

Chemical analysis from drillings taken in way of fracture was made by Messrs. Wm. Beardmore & Co., Ltd., Parkhead, acting for Messrs. The Dennystown Forge Co., the writer being permitted to see the results. The following figures - indicating a steel of suitable quality for the purpose intended - were obtained.

Carbon,	.32%
Manganese,	.76
Silicon,	.169
Sulphur	.040
Phosphorus,	.053.

Tensile and bend tests were made from material taken from the fractured web, the following figures being observed.

Maximum stress } Tons per sq.inch	32.6	32.0	32.6	32.6
Elongation % 2"	28	31	31	28.5
Reduction of area %	51.2	51.2	51.2	51.2
Cold Bend,	180°	180 °	180 °	180 ° signs of fracture.

It will be noted that the foregoing figures do not reveal any abnormal feature. The appearance of the test pieces - by the roughening of the skin - suggested a coarse structure, however. Izod impact test specimens were prepared and in this case the

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the results were not entirely satisfactory - the low average figure of 17 foot lbs. energy absorbed being obtained.

Overheating being suspected, the writer obtained various samples near to and away from the fracture for microscopical examination when it was seen that the material was overheated to a considerable extent. Micrographs have been prepared and these are included with this report.

### Conclusions.

I believe the overheating occurred during the operation of forging and that the annealing, probably carried out at too low a temperature, failed to restore the structure.

No exception can be taken to the size or weight of the ingot from which the forging was made, but, in my opinion, the method of manufacture is open to objection. In the operation of forging a high temperature is necessary and this tends to the production of an unsatisfactory structure. This structure can be restored by "work" (or less easily) by annealing. In the present case, after the twisting or "setting through" <sup>of</sup> the webs, further work is practically impossible. The chances, therefore, of the forging having - as shown in this instance - a grossly overheated structure, are not small. It has also to be pointed out that in the case of the crank of the solid type the grain of the material runs across the web and not as in the case of the built crank lengthwise with the web.

It will be appreciated that the satisfactory "working" of the parts of a crank of the built-up type is a comparatively simple matter and it is pleasing to learn that crankshafts of this/

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this type are now being specified.

The writer wishes to acknowledge the help received from Mr. Green of Messrs. Harland & Wolff, Ltd., Glasgow, and Mr. Arthur Wedgewood of Messrs. The Dennystown Forge Co., Dumbarton.

*Louis Phipps*



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