TABLE II

Connecting Rod Stresses

	RPM	Inertial Stress
Connecting rod	6000	32,000 psi.
"	7000	43,000
"	8000	56,000
Bolts	6000	20,000
	7000	28,000
	8000	36,000

It is seen that the stresses in the bolts are appreciably lower than those in the main part of the connecting rod. However, the bolts have an additional stress due to the initial tightening which can increase the total stress significantly. Note that at 8000 RPM the stresses in the connecting rod are about one-half of the tensile strength, but are greater than the fatigue endurance limit. This means that running the engine momentarily at a high speed will cause internal structure changes in the metal which will manifest itself as a failure at some later time. The same will be true of the bolts if the sum of the tightening stress plus inertial stress exceeds the fatigue endurance limit.

Conclusions

By comparing the calculated stresses in Table II with the measured strengths of the connecting rod components in Table I, it is seen that the engine should operate indefinitely at speeds up to 7000 rpm. Speeds in excess of 7000 rpm cause the inertial stresses to exceed the fatigue endurance limit but not the tensile strength of the metal. This means that the parts would not fail immediately but could at some later time and at a lower stress level. There is no evidence of faulty materials or workmanship in this particular failure. The failure is attributed to delayed fatigue fracture.

SUMMARY

A broken connecting rod assembly was analyzed and compared with an intact assembly from a different cylinder in the same engine. It was concluded that the materials were not defective or inferior. The failure resulted from a delayed fatigue fracture.

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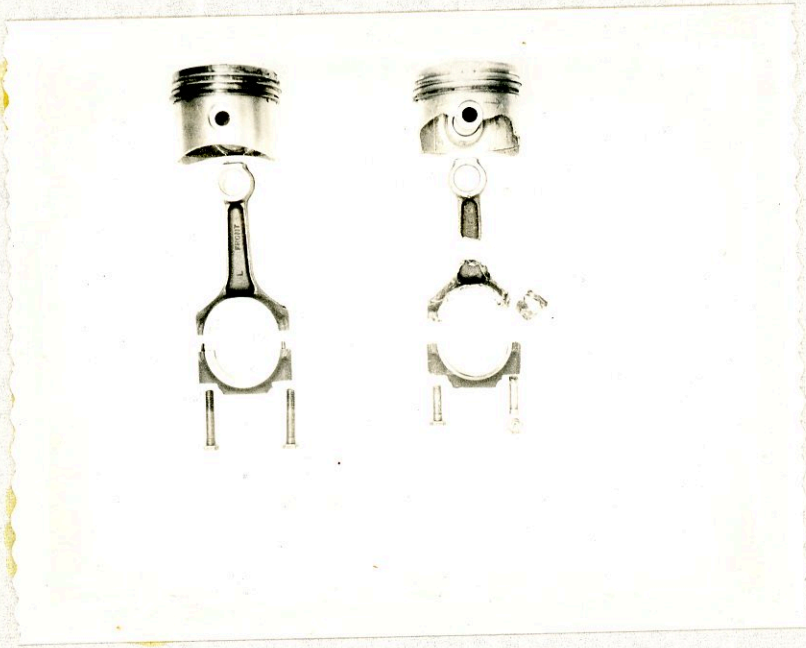

FIGURE I

The no. 4 and no.1 connecting rod assemblies from the Lotus Elan Engine.