SECTION 9

FURTHER DEVELOPMENTS

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11 FUEL INJECTION SYSTEMS. DEVELOPMENT OF WANKEL ENGINES TO USE FUELS OTHER THAN PETROL

The majority of Wankel engines now available have been designed to operate on petrol. Petrol engines are not acceptable for civil passenger carrying hovercraft and the opportunity to exploit this new source of cheap power plant, which in most other respects seems specially suitable for hovercraft, will depend on its conversion to use fuels other than petrol.

The experimental work already undertaken by several groups using fuel injection systems of various kinds gives promise that a simple conversion may be practical so long as spark ignition is retained without major redesign of the engine. Unfortunately, much of the work so far has been done either on piston engines or the smaller Wankel type engines. The exception to this was the work done by Curtiss-Wright but their engines unfortunately are not in production. Daimler-Benz, who already use fuel injection in their M 950 engine, have not themselves experimented with fuels other than petrol in this engine but expressed the view that conversion would probably be practical with relatively small changes in the design of the combustion chamber.

There appears to be a need to combine the ideas and initiative of the small British research groups working in this field with one of the companies building the larger Wankel type engines to investigate the use of their fuel injection systems.

12 APEX SEALS

Work on apex seals and on compatible materials and finishes for the inner surface of the rotor housing will continue indefinitely in the same way as piston ring and cylinder bore development has continued since the earliest days of the reciprocating piston engine. One particularly interesting current development is the work of the B.S.A. Group Research Centre on apex seals in silicon nitride. This material offers superior low friction characteristics, and a considerable reduction in wear compared with the ferrous seals used by NSU and Daimler-Benz, or with the carbon seals used by Toyo Kogyo. Since overhaul life is inversely proportional to seal wear, other things being equal, and since the material of B.S.A.'s seals appears to be compatible with that of the housing bore used by NSU and Daimler-Benz, this is an important development and should be encouraged.

13 COUPLING ENGINES TOGETHER

Because of the limited power range of existing Wankel engines in production there is a need to consider coupling or grouping engines to provide bigger power units. Where engines are available to be bought off the shelf, as with NSU or Fichtel & Sachs, the work

of developing a coupling arrangement can be undertaken independently of the manufacturer. With engines such as Daimler-Benz, however, which are themselves under development, the only possibility of developing coupled engines would be with the co-operation of the manufacturers. The potential market for coupled engine units includes light aircraft, which would be a far bigger market than hovercraft.*

9.3.1 Daimler-Benz M 950

The twin engine installation of these engines in the CC-7 hovercraft could be proved in rig tests which the discussions held so far suggest might be arranged in the University at Stuttgart. It would probably need the active support of the German government to arrange the release of engines from the Daimler-Benz development batch and their assistance in the test programme. Provided this could be achieved the prospect following successful rig tests is that upwards of £15,000 might be saved on the power plant costs of the CC-7. A weight penalty of 740 lb would be more than offset by a 30% increase in available power (limited by the existing gearbox and fans), and 26% saving in specific fuel consumption. Advantage could be taken of the existence of the twin engine rig to develop and prove the operation of the engine with fuels other than petrol.

The application of the Daimler-Benz M 950 engine to the propulsion of the HM2 would not require specific development of the engine, apart from its conversion to operate on high flash point fuel. It would involve considerable, though generally simplifying changes, however, in the power plant layout in the craft.

9.3.2 NSU KKM 612

Arrangements could be made to buy these engines in standard form from the makers and a coupled installation of the type proposed for the fans of the HM2 could be built and tested here. Alternatively, though this would probably be unacceptably heavy with existing engines, a group of four engines geared together as in 7.3 could be considered for the power plant of the CC-7. The conversion of the basic engine to run on high flash point fuel could be investigated in bench tests of a single engine and then incorporated, if successful, in the rig programme. NSU have stated, however, that they themselves would be unwilling to take part in any development of their engine at this stage.

9.3.3 B.S.A. Small Twin Rotor Engine

The B.S.A. twin rotor engine has been developed using some standard Fichtel & Sachs parts. Specially adapted for air cooling, it is potentially very suitable for small hovercraft use, either as a single unit or with several engines coupled to a single shaft. The licensing situation would need to be regularised before it could be put into production; if this situation were

* It has been estimated that the annual demand for aero engines in the 100–500 bhp range could reach 30,000 units by 1978. Most of these would be sold in the U.S.A. and it would be necessary to work with an American manufacturer, such as

cleared up, B.S.A. might welcome support for the adaptation of the engine to hovercraft duties and the development of coupled units.

For small hovercraft there could also be some interest in developing a water cooled version of the B.S.A. engine. The replacement of the cooling fins by a water jacket on the two parts concerned would reduce the overall size of the engine to the point where it would be little larger than the hub of the propeller it would drive. The radiator could be located away from the engine, possibly forming part of the pylon. The B.S.A. Group Research Centre would not carry out such development in the normal way as their main interest is in a power unit for motorcycles, but they have said they would be willing to do such work if it were sponsored.

3.4 USE OF LIGHT ALLOYS

Perhaps the most important development in progress at present concerns the replacement of cast iron rotors by light alloy parts, which means, by implication, a weight saving of practically twice the weight difference between the two types of rotor, in single rotor engines, because weight is also saved on the balance weight.