SECTION 10

CONCLUSIONS AND RECOMMENDATIONS

Several types of Wankel engine are now in full production and in regular use in a number of motor car designs and in a range of small equipment. All these engines are petrol driven and the maximum power they offer is 110 bhp. Larger engines up to 350 bhp are now in course of development or on test and these include diesel versions which are intended ultimately to have a multi-fuel capability. There are now more than twenty licensees and their number is increasing steadily.

In general, Wankel engines appear to offer a number of advantages in their favour for application as hovercraft power plant. They are smaller in bulk and lighter in weight than the corresponding piston engine, have about the same specific fuel consumption, are basically simpler, and simpler to service and their first cost should be about the same. Though not so small and light as the corresponding gas turbines they are very much cheaper in first cost and would generally have a lower specific fuel consumption, especially under part load. A further advantage compared with the conventional piston engine is that they may be brought up to full power more quickly and may be run for long periods at a high proportion of maximum power. They can also use lower grade petrol and lend themselves more readily to effective exhaust emission control.

One small British hovercraft, Hover-air's 'Hoverhawk', already uses 20 hp Wankel type engines (Fichtel & Sachs KM 914) as standard. B.S.A., though not holding a licence, are developing a twin rotor engine based on the same unit intended to develop 50 hp and aimed at the motorcycle market. If such an engine is developed successfully it might well find application in small hovercraft, most of which are presently underpowered.

Except in the smallest hovercraft it will be necessary to use Wankel engines which are adapted to burn high flash point fuels. Fortunately, this conversion, retaining spark ignition, promises to be not particularly difficult but development work will have to be done on the larger engines which will be needed. Up till now, much of this contributory work, using various types of fuel injection and ultrasonic atomisers, has been done in the U.K. but on piston engines or the smaller types of Wankel engine only. The manufacturers generally are taken up with the immediate motor car market and are unlikely to undertake such development work themselves. A specific programme of development aimed at the conversion of one of these larger engines to burn kerosene or other high flash point fuels, is required.

Larger power units which may be needed for hovercraft applications can be provided by grouping the engines and several possible arrangements are described. Of the particular installations examined, only the CC-7 requires coupled engines and twin Daimler-Benz M 950 engines are proposed. These will make available nearly 80% more power but some modifications of the existing fans and gearboxes will be required to exploit the whole of this increase. There would be a weight penalty of 740 lb which would be partly offset by reduced specific fuel consumption. The higher power available would make practicable an increase in craft

length and cabin size which would provide increased payload and more than compensate for the higher power plant weight. The estimated saving in first cost on the basic craft by fitting the Wankel engines is about £15,000.

The power requirements of the HM2, the other design considered for Wankel installations, can be met very conveniently by substituting two Daimler-Benz M 950 engines for the two diesel engines used for propulsion and two NSU KKM 612 engines for the single diesel used to drive the lift fans. The small weight and volume of the M 950 engine allows it to be installed in the craft sidewall in place of the V gearboxes and releases the space previously occupied by the propulsion diesels for extra passenger and luggage room. Even after allowing for the extra passengers and luggage there is a net reduction of 9% in craft all up weight. The change over to Wankel propulsion engines could provide a convenient opportunity to replace the conventional propellers with waterjets. The substitution of two KKM 612 engines for the lift diesel provides an additional 47 bhp and allows each fan to be separately driven so that half power is still available after a lift engine failure.

On the basis of the foregoing, the following recommendations are made:-

1. A range of practical designs of Wankel engines is available in production but development is rapid and the progress of the concept deserves to be kept under continuous review.

2. Greater attention should be paid in the U.K. to the emergence of the Wankel engine and its possibilities. A simple development such as that in hand on a 50 bhp engine at B.S.A. should be encouraged.

3. To enable Wankel engines to be used in larger hovercraft the work already started in the U.K. on fuel systems designed to use kerosene and other high flash point fuels should be reviewed and arrangements sought to have it applied to some of the larger Wankel engines. The NSU KKM 612 and the Daimler-Benz M 950 are specially recommended for this development.

4. Discussions should be held with the German Ministry of Defence on the possibilities of joint action to develop the Daimler-Benz M 950 engine for hovercraft applications.

5. A full design investigation should be undertaken into the conversion of the HM2 to Wankel engines including the incorporation of waterjet propulsion.