MORE ABOUT JET PROPULSION

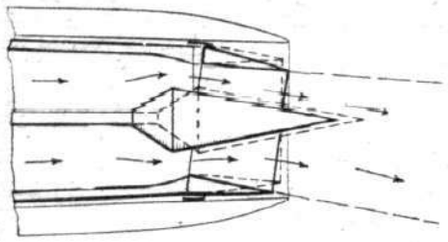


Diagram showing the method of regulating the propulsive jet and the possible arrangement for swivelling the discharge nozzle to assist manœuvring.

tests at the Guidonia Research Laboratory.

Doubtless the flight had been well publicised in advance, but as the experimental Caproni monoplane passed over cities en route, interest was particularly aroused by the unusual character of the noise created by the machine. This would be largely explained by the absence of the usual airscrew whirr.

When, as *Flight* has already recorded, the Campini machine was first flown in 1940 at the Forlanini airdrome and remained in the air ten minutes, Italian engineers were jubilant at the demonstration of their technical success. This was understandable in view of the experiments known to be proceeding in several countries. It was at once proclaimed to the world that this successful flight was the prelude to a revolution in the design of power units and aircraft.

Differences in Layout

From a close examination of new views of the Caproni-Campini aircraft, the first illustration of which appeared in *Flight* of December 4th, 1941, it is clear that the only opening for the admission of air is a circular duct in the nose, and the only discharge nozzle is in the tail of the fuselage. Thus the scheme departs materially from the original layout which had a pressure cabin in the nose and admitted air *via* a peripheral duct at the point of maximum pressure on the fuselage.

This feature and the method of adjusting the peripheral duct to meet conditions at sub-sonic and super-sonic speeds may be seen in the line drawing in the issue referred to. Recent pictures of the new design would apparently confirm that Campini's original suggestion of controlling the characteristics of the jet by means of a longitudinally adjustable, double-conical member mounted coaxially in the discharge nozzle, has been retained.

The diagram shows the general principles of this device. As the conical member, under the control of the pilot, is adjusted axially, the cross-sectional area of the nozzle aperture is varied in much the same manner as a tapered needle may be employed to alter the effective area of a carburettor jet. Although there is no specific information available on this point, it would also seem possible by means of this device to adjust the discharge nozzle to either a convergent or a divergent contour. If this is actually so it would become possible in some degree to regulate the terminal pressure of the jet and also the terminal velocity. The point of the conical member will be seen actually projecting beyond the discharge orifice in the side elevation of the machine.

The original design proposed the use of a universally swivelling discharge nozzle in order to impart direction to the jet, as also shown in the diagram. Externally there is no evidence of this being employed on the latest design, which is provided with the conventional elevators and rudder. However, within the not inconsiderable girth of the tail end of the fuselage it is conceivable that the swivelling mechanism is completely enclosed by the external skin. At present-day speeds in flight it is doubtful if facility to give direction to the jet is a feature of importance, but probably it would be of assistance in manœuvring the machine on the ground. It must be remembered that there is no airscrew slipstream for the rudder on a jet-propelled machine of this type.

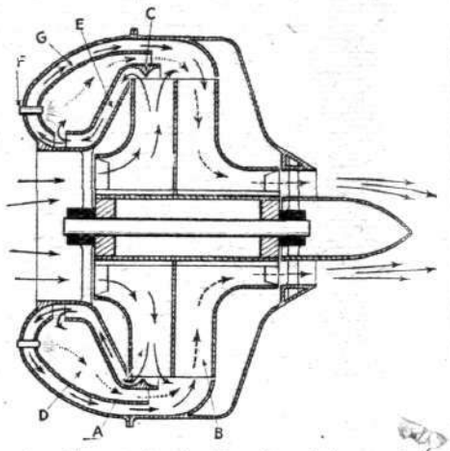
In referring to the girth of the fuselage it would seem that the cross-sectional dimension would be at least 6ft. diameter, as the engine, which is presumed to be a radial type, is approximately 4ft. in diameter. In general, the fuselage is of rocket shape and the structure, and also that of the wings and tail planes, is of duralumin. Wing roots appear to be unusually generously proportioned. This may be accounted for by the need for all structural attachments to be arranged externally in order to leave the interior of the fuselage unobstructed for the main air duct.

The same reasoning may provide an explanation for the peculiar bulge below the fuselage from which the tail wheel is supported. Furthermore, this necessity to keep the interior of the fuselage clear may have been the dominant factor leading to the adoption of the unusually low position of the main wing.

It will be seen from the illustrations that the wing passes completely below the fuselage and it is possible that the centre section is utilised to house the main fuel tanks.

A New German Design

In the meantime some details have reached us of a further German scheme of jet propulsion, sponsored this time by none other than the firm of Ernst Heinkel. The designer Herr Max Hahn, of Seestadt Rostock, has



A self-contained, all-rotary jet propulsion unit recently patented by the German firm of Ernst Heinkel.

evolved what appears to be a simple and compact unit embodying a turbine and compressor in combination. The main feature of the design will be appreciated from the diagram.

In a circular casing having an axial air intake at the front and coaxial discharge orifice at the rear, a shaft is mounted in two bearings supported on spiders. On this shaft is a single rotor which is divided to form a box-type blower impeller A and a boxed turbine wheel B. Air drawn into the unit through the forward central aperture leaves the impeller at its periphery and the stream is here divided by a projecting guide C on the enshrouding wall of the annular combustion chamber D.

The main supply is diverted to the rear to the turbine wheel, whilst a smaller portion passes along passage E between the main casing and the combustion chamber wall. At the point of smallest diameter, surrounding the intake aperture, this portion of the airstream is again divided. Part enters chamber D into which fuel is injected by nozzles F and burnt to furnish additional heat for the final jet. The remainder continues around the combustion chamber in space G and joins the initial airstream and the effluent from the combustion chamber to form a common stream which expands through the turbine and furnishes the motive power for rotating the blower. The annular discharge from the turbine wheel is a high velocity, rearwardly directed jet, the reaction of which furnishes the propulsive effort.

By passing a portion of the airstream completely round the combustion chamber this is effectively insulated and heat from the chamber is not completely lost by radiation to the atmosphere but is largely carried off by the air to perform useful work in expansion through the turbine.

Previous articles on jet propulsion have appeared in issues of "Flight" dated Aug. 28th, Sept. 11th, Sept. 25th, Oct. 9th and Dec. 4th, 1941.