COMPOSITION AND OPERATION MODE OF PROPULSION WITH TURBOJET ENGINE FOR M = 0 ... 4 SUPERSONIC AIRCRAFT

Shevchenko M. A.
National Aerospace University «Kharkiv Aviation Institute», Kharkiv

Choice of composition of power plant (PP) is a part of the complex integrated variational optimization task. Due to complexity of this task, it is advisable to simplify it by setting a flight profile and geometric shape of an aircraft. This formulation of the task allows finding an optimal composition and operating mode of the PP, the flight mode of the aircraft, under given conditions. It is advisable to simplify the solution search by dividing it into two levels. At the zero level stage, for selected aircraft and the PP composition, parameters of the cycle and air flow (which ensures take-off mode) G are selected. Takeoff gas temperature $T^*_{g_{t.max.}}$ is setting to maximum. High-speed characteristics (HSC) of turbojets are calculated. For selected aircraft and composition of the PP, a dependence of the aircraft resistance Q at the middle of the cruising flight section is determined. A cruising flight speed, from the equality of thrust P and resistance is determined. Pre-determined mass of fuel and PP. Fuel overhead due to take-off, taxiing, and climb are taken into account by the coefficients. Comparing of the total mass of fuel and PP at different $\pi^*_{c_{cr}}$ and $T^*_{g_{cr.}}$, pre-determined $\pi^*_{c_{opt.pr.}}$ and $T^*_{g_{opt.pr.}}$ which provide a minimum mass of fuel and PP and payload maximum mass. At the first level stage, in the region of $\pi^*_{c_{opt.pr.}}$ and $T^*_{g_{opt.pr.}}$, the final search of the optimal cycle parameters is carried out: for each π^*_c, near the $\pi^*_{c_{opt.pr.}}$ region, the required G is determined. The dimensions and mass of the PP and the HSC are calculated for a number of $T^*_{g_{cr.}}$ values; the differential equations of aircraft motion at the flight profile section which corresponds to the exit to the cruising mode at $T^*_{g_{t.max.}}$ are numerically solved; the differential equations of aircraft motion at the flight profile cruise section, for a number of values $T^*_{g_{cr.}}$ are numerically solved. The flight speed from the condition of equal P and Q is determined. Moreover, the lower $T^*_{g_{cr.}}$, the lower cruising speed, but the specific fuel consumption of the turbojet engine are smaller too. As a result of the calculation, the required fuel supply for a given flight profile is determined depending on $T^*_{g_{cr.}}$; for each value of π^*_c, the dependence of the total mass of fuel and PP as a function of $T^*_{g_{cr.}}$ is built. And $T^*_{g_{opt.}}$ at the cruise mode, in which this sum of masses is minimal, which ensures maximum payload is determined; comparing the total mass of fuel and PP at different π^*_c and $T^*_{g_{opt.}}$, $\pi^*_{c_{opt.}}$ that provides maximum mass of the payload is determined.Based on the approach described above, for the PP with turbojet, the operating mode of the PP and the aircraft flight modes along the given flight profile are determined.