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TRANSLATION

THE HEAT BARRIER

By

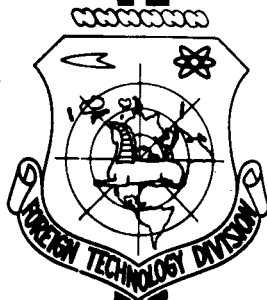
V. L'Vov

FOREIGN TECHNOLOGY DIVISION

AIR FORCE SYSTEMS COMMAND

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UNEDITED ROUGH DRAFT TRANSLATION

THE HEAT BARRIER

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THE HEAT BARRIER

By V. L'Vov

Dear Editor: Some years ago, our aircraft surmounted the "sound barrier". Recently, I heard about a new obstacle in the way of the designers: the "heat barrier". What is this? V. Avleyeva.

Moscow.

Rub your hand rapidly on the smooth surface of a table. You will, at once, feel your fingers becoming warm. Even now, students of the fifth and sixth grades know that during friction, heat is precipitated. But, for a person who is not familiar with physics, it is difficult to believe that the very air, which cools the face of a fast moving cyclist or ruffles the hair of a train passenger when he protrudes out the window of the moving train, can also melt the most heat-resistant metals.

This is the way it happens: While a great amount of heat can be precipitated by air friction, it is therefore a matter of the velocity of the body moving through air. A flight at speeds less than the speed of sound does not cause any significant heating on the aircraft. But let us assume that, instead of an aircraft, a rocket is flying with a speed five times greater than the speed of sound. If the nose of this rocket is made of aluminum it will begin to melt. Let us increase the speed. Now it is moving at six times the speed of sound. The nose is made of steel. Yet, in spite of this, a spray of melted metal will begin to fly off the nose. Due to the tremendous speed, the oncoming air will wash off the liquid steel in the same way that a turbulent mountain stream erodes its banks.

It is theoretically possible to calculate that during a speed ten times the speed of sound, the temperature of the air on the surface of a flying body will be

about 5-6 thousand degrees. During such enormous speeds, all known materials will evaporate like water splashed on a hot plate. How, then, can a space rocket achieve acceleration without being incinerated by air friction?

It is not difficult to realize that the density of the atmosphere is not the same everywhere. The lower layers lying close to the surface of the earth are dense and they create a greater resistance to flight, greater friction, and as a result a greater temperature.

At an altitude of 10 kilometers the heat flows heating the aircraft covering of a craft flying at a speed two and a half times greater than the speed of sound, is half as much as on the surface of the earth, and at an altitude of eighteen kilometers, it is even 10 times less. At an altitude of more than 200 kilometers the heat is already so low that it can be compared to the radiant energy which may be obtained by a flying craft from the sun and the earth. And if you still consider that during flight a rocket picks up speed gradually and it passes the denser layers of the atmosphere with comparatively low speeds, then it becomes clear that in the flight of a space rocket it will not be overheated during the time of the flight. The fight with heat in a rocket or satellite returning to earth is significantly more complicated. Here the space ship approaches the dense layers of the atmosphere at a tremendous speed.

The simplest way is to make our craft from materials capable of enduring a high temperature, and protecting the vitally important instrument compartments with a heat-resistant barrier.

Another way is the creation of a special cooling system using either liquid fuel or water as a coolant. The so-called porous cooling is an interesting new method. In this the liquid is poured through small pores or holes in the shell of the flying craft onto its incandescent surface. In evaporating, it covers this surface with a thin film of vapor which preserves the metal from melting.

A method of protecting the craft in which melting...is permitted, seems quite

unusual.

In this instance the metal almost melts, but the melting is "planned"--as the designer planned. This is its own kind of "compromise" with the heat barrier.

Low altitudes and high speeds is an area in which large forces enter and which little by little will give way before the harmonious pressure of our science and technology.

V. L'...

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