Semi-Annual Status Report
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Radiation Heat Transfer

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The purpose of this report is to describe work which has been carried out under the subject grant during the period from April 1, 1961, to October 1, 1961. Technical supervision and guidance of the work was provided by Mr. Seymour Lieblein, Chief, Flow Physics Branch, NASA Lewis Research Center, Cleveland, Ohio.

Radiant Absorption Characteristics of Cavities

Analytical studies have been carried out to determine the absorption characteristics of various types of cavities with respect to radiant energy entering the cavity from the outside. Three different cavity shapes have thus far been considered: (a) a v-shaped groove, (b) a rectangular groove, and (c) a spherical enclosure open at the top. The final results have been phrased in terms of an apparent absorptivity, which is the ratio of the energy absorbed in the cavity to the total radiation entering the cavity. The apparent absorptivity depends on the size of the cavity, on the actual surface absorptivity, and in some cases, on some characteristic of the entering energy.

For the v-groove and the rectangular groove, the study was carried through for two general types of incoming energy: (a) radiation arriving in a parallel ray bundle, (b) radiation diffusely distributed in space. For each situation, absorption results have been obtained for cavity surfaces which are either diffuse reflectors or specular (mirror) reflectors. For the spherical enclosure, it was possible to obtain results for an arbitrary spacial distribution of the incoming energy, but this degree of generality was possible only for diffusely reflecting surfaces.

The absorption studies for the aforementioned cavities are complete, and the results are now available. Papers covering this work will be written.

Radiating Fins

At the request of Mr. Lieblein, a detailed analytical formulation of the heat transfer processes taking place in a general fin and tube space-vehicle radiator has been carried out. This formulation has been orally presented and later discussed with members of Mr. Lieblein's Branch. Several problem areas were delineated by the formulation and by the subsequent discussion.

Specific analytical consideration has been given to particular types of fin and tube radiators, for example, to a sandwich configuration in which the fins are the covers of the sandwich and the tubes are the meat. The equations governing the energy exchange by conduction and radiation have been formulated, and numerical work will be undertaken during the next phase of the project.

Radiation Characteristics of Honeycomb Surface

In connection with a space simulator being designed at the Lewis Research Center, it is desired to know the radiation characteristics of a honeycomb surface which will be used to cover the walls of the simulator chamber. An analytical model appropriate to a typical element of the honeycomb has been formulated, and the equations which govern the energy transfer by radiation and conduction have been written. Numerical solutions will be undertaken in the next phase of the project.

Experimental Studies

The hemispherical reflectivity of aluminum foil was measured at the request of Mr. Lieblein. A copy of a letter in which these tests are reported is attached.

An instrument has been under development for measuring the directional reflectivity of surfaces. Some of the features of the instrument are as follows:

A beam of black-body energy is directed at the test surface, the angle between the incident beam and the surface normal being arbitrarily variable. The energy reflected at a preselected angle is focused on a thermopile and recorded. The device is so arranged that energy reflected at any arbitrary angle can be measured. Various parts of the instrument have been fabricated, and it is expected that the test set-up will soon be completed.