Antithermal shield for rockets with heat evacuation by infrared radiation reflection

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Abstract: *At high speed, the friction between the air mass and the rocket surface causes a local heating of over 1000 Celsius degrees. For the heat protection of the rocket, on its outside surface thermal shields are installed.*

Studying the Coanda effect, the fluid flow on solids surface, respectively, the author Ioan Rusu has discovered by simply researches that the Coanda effect could be /extended also to the fluid flow on discontinuous solids, namely, on solids provided with orifices. This phenomenon was named by the author, the expanded Coanda effect. Starting with this discovery, the author has invented a thermal shield, registered at The State Office for inventions and Trademarks OSIM, deposit F 2010 0153

This thermal shield:

- *is built as a covering rocket sheet with many orifices installed with a minimum space from the rocket body*
- *takes over the heat fluid generated by the frontal part of the rocket and avoids the direct contact between the heat fluid and the rocket body*
- *ensures the evacuation of the infrared radiation, generated by the heat fluid flowing over the shield because of the extended Coanda effect by reflection from the rocket body surface.*

Key Words: antithermal, thermal shield, Coanda effect

I. INTRODUCTION

The fluid flow, liquids and gases, on solids, follow the shape of the solids surface. This phenomenon was discovered by Henry Coanda and was named the Coanda effect (Figure 1).

Figure 1

By simply researches, the author Ioan Rusu discovers that the Coanda effect could be extended also to the fluid flow on discontinuous solids. Practically, it was demonstrate that on a solid surface with many orifices and at a special angle and minimum speed of a fluid, the fluid follows the apparent surface of solid as a continuous sheet (Figure 2, 3 and 4). Basically, it has been shown that, when a fluid flows at a certain angle and a minimum speed over a solid surface provided with many holes, the fluid will follow the solid surface like a continuous sheet.

Figure 2

Figure 3

Figure 4

Figure 3 shows that the fluid sheet follows the surface of the discontinuous solid on both sides. The phenomenon of the fluid flow on discontinuous solid surface as a continuous sheet was named by Ioan Rusu, the extended Coanda effect.

II. THE FLUID FLOW ON THE ROCKET SURFACE AND THEIR HEATING BY FRICTION

At high speeds, the friction between the fluid and solid surface of the rocket generates heating of both the fluid and solid body. At the impact of the solid surface with the air mass, the phenomenon of fluid flow on the solid surface by Coanda effect is generated.

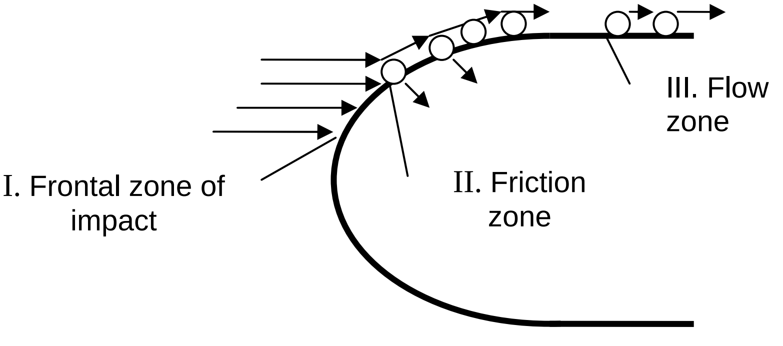

Figure 5

In zone I, of impact the air molecules start flowing on solid surface by Coanda effect. By friction, in zone II and also in zone III the heating of both the fluid and solid is generated by convection.

Built with a reflection surface of the rocket, a part of fluid and solid energy is radiated in space (Q *radiation*). The heat fluid is in contact with the rocket body and the heat is absorbed on the rocket body through conduction (Q *conduction*).

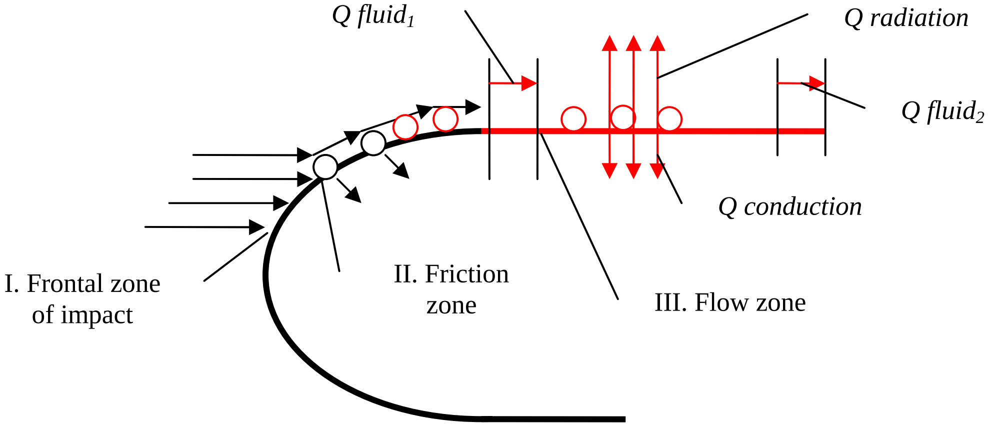

Figure 6

To determine the fluid mass $Qfluid_1$ (Figure 6) flowing on zone III in time t, the energy balance could be find using formula (1) and formula (2). At the start of the flow III, it is considered that the entire amount of heat is in the air mass.

$$Qfluid = Qfluid_1 \ (1)$$

In the flow area III the total heat of air mass is:

$$Qfluid = Qfluid_1 = Qfluid_2 + Qradiation + Qconduction \ (2)$$

$$Qfluid_1 > Qfluid_2 \ (3)$$

To avoid the heating of the rocket body, the following condition must be fulfilled:

$$Q\ conduction \qquad 0\ (4)\longrightarrow$$

III. ANTITHERMAL SHIELD FOR ROCKETS

To reduce the heat transfer through convection from the heated air mass to the body of rockets the direct contact of heated air mass with the surface of rockets should be avoided.

The thermal shield invented by Ioan Rusu, is built as a covering rocket sheet with many orifices installed with a minimum space *d* between the shield and the rocket body (Figure 7).

The infrared radiation reflected by the rocket body is transferred in the atmosphere through the shied orifices. Figure 8 shows the phenomenon of infrared radiation transfer.

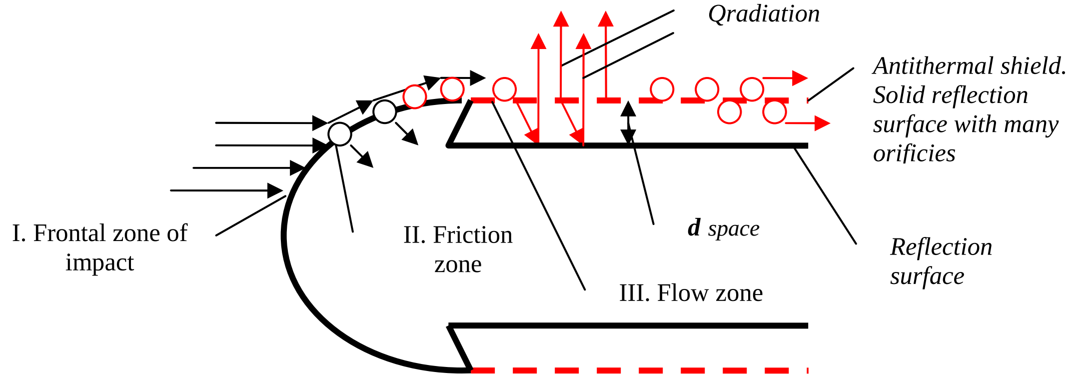

Figure 7

Figure 8

Using a thermal shield, the energy balance equations for determining the mass of fluid $Qfluid_1$, are shown in formula (5) and formula (6). At the start of the flow III, it is considered that the entire amount of heat is in the air mass.

$$Q\ fluid = Q\ fluid_1 \ (5)$$

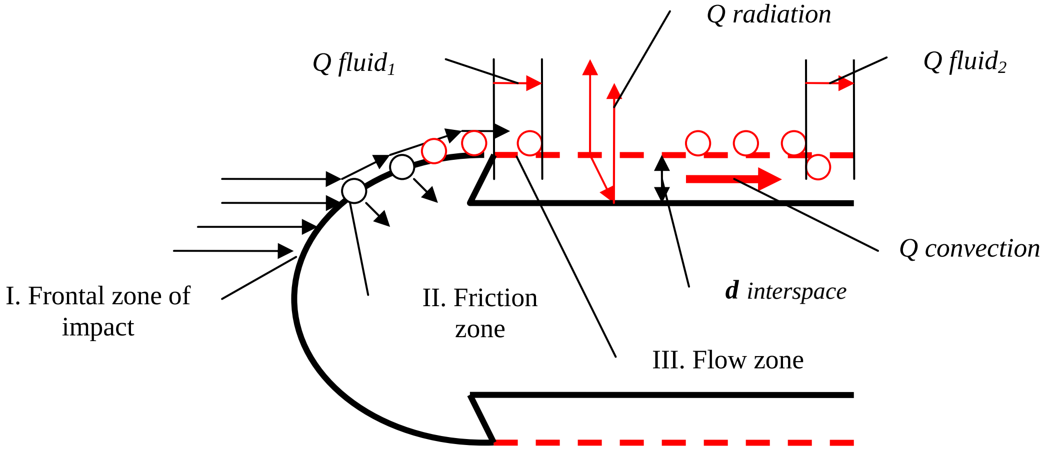

Figure 9

In the flow zone III, the total amount of heat the air mass is:

$$Q\ fluid = Q\ fluid_1 = Q\ fluid_2 + Q\ radiation + Q\ convection \quad (6)$$

Comparing the classical solution from figure 6, by using the thermal shield as shown in Figure 7 and Figure 9; the direct contact between the heated fluid and the solid surface is eliminated. In this way, the heat transfer by convection is limited.

There are two heat transfers between the thermal shield and the rocket surface:

1. Heat transfer through convection (*Q convection*) generated by the heat fluid flow in interspaces ***d***

2. Heat transfer through direct infrared radiation generated by shield and heat fluid flow over the orifice of shield

In case of heat transfer through convection (*Q convection*), because of the heat fluid flow over the shield due to *expanded/extended Coanda effect*, (see Figure 2, 3 and 4), outside and inside the shield, there are no important fluid mass contacting the rocket surface (see Figure 10). If increasing interspaces ***d***, the heat transfer through convection is much limited. The most important heat transfer from the heat fluid and the shield into atmosphere is by infrared radiation. An important part of infrared radiation contacts the rocket surface. Using the reflection surface, the rocket reflects the infrared radiation in atmosphere through shield orifices (Figure 7 and Figure 9).

The orifices size of thermal shield is in according/accordance with the mechanical resistance of the shield and must keep the rocket shape. Using orifices of much small size, a big fluid mass inside the shield is avoided through the *extended Coanda effect*. In this way the heat transfer through convection to rocket body is reduced.

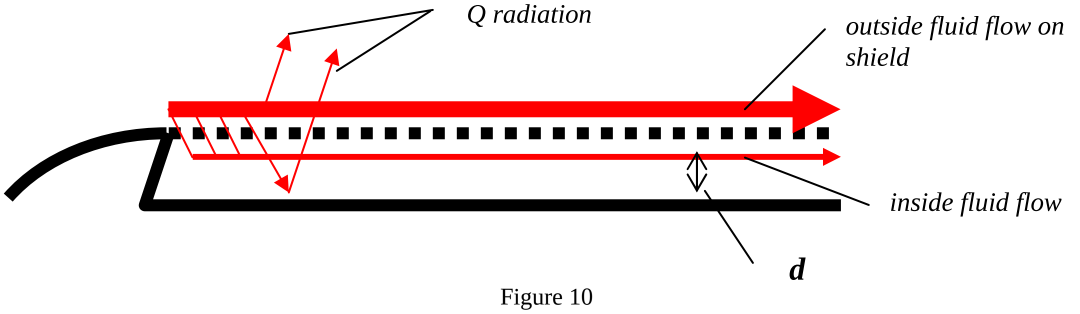

Figure 10

The thermal shield invented by Ioan Rusu, made of mechanical and thermal resistance metal, (over 2000-3000 ^{o}C), covers the surface of rockets with an interspaces ***d*** (Figure 11).

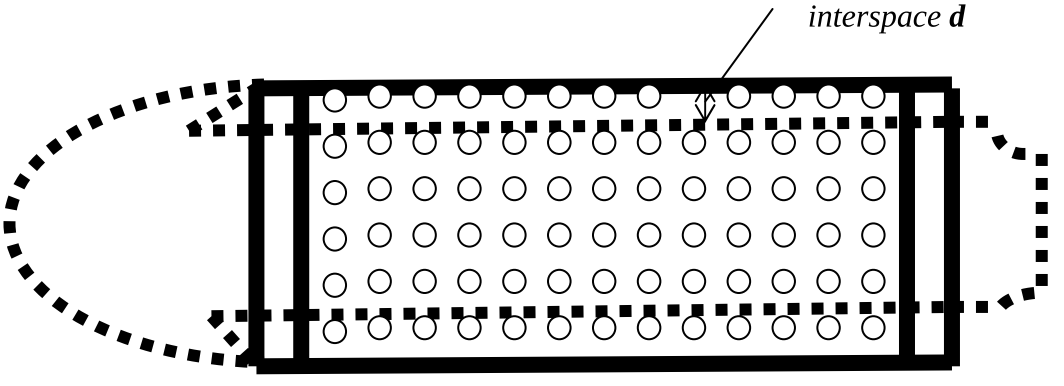

Figure 11

Using the thermal shield with strong mechanical resistance, the damage by antithermal slabs dislocation at high speed of air mass is avoided.

IV. CONCLUSION

Studying Coanda effect, namely the fluid flow on solids surface, the author has discovered by simply researches that Coanda effect could be expanded/extended also for fluid flow on discontinuous solids, on solids with orifices, respectively. This phenomenon was named by the author, *the expanded/extended Coanda effect.*

Using this discovery, Ioan Rusu invents a new generation of thermal shields for rockets and other flying objects working by reflection of the infrared radiation.

This thermal shield:

- is built as a covering rocket sheet with many orifices installed with a minimum space from the rocket body
- takes over the heat fluid generated by the rocket frontal part and avoid the direct contact between the heat fluid and the rocket body
- ensures the evacuation of the infrared radiation, generated by the heat fluid flowing on shield by expanded/extended Coanda effect through reflection from the rocket body surface

V. REFERENCES

[1] Ioan Rusu, “Thermal shield for rockets”, *The State Office for inventions and Trademarks OSIM Deposit f 2010 0153,* 2010