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MULTI-NOZZLE JET PROPULSION UNITS

Filed March 18, 1963

6535

x 6527

FIG. 1

FIG. 2

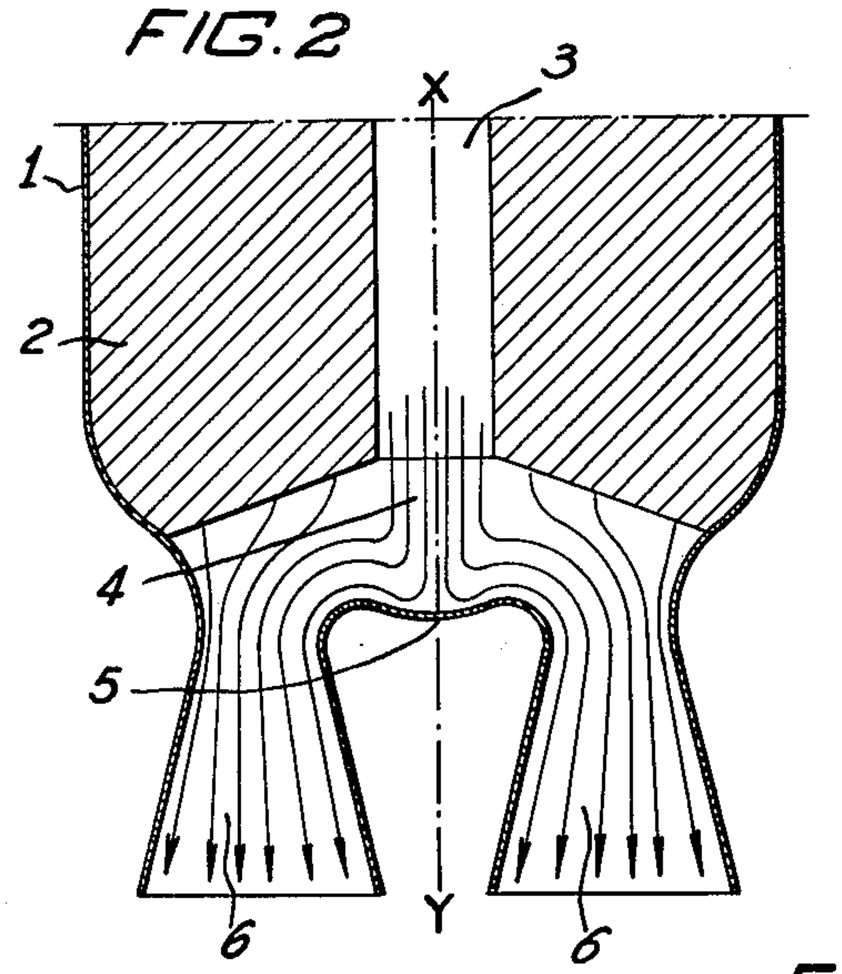


FIG. 4

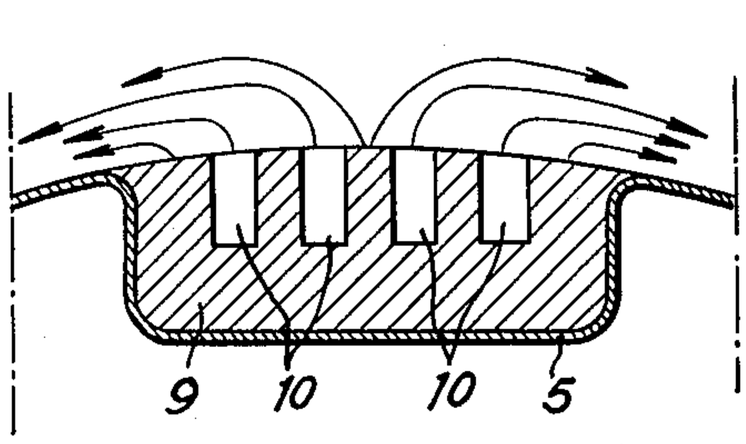
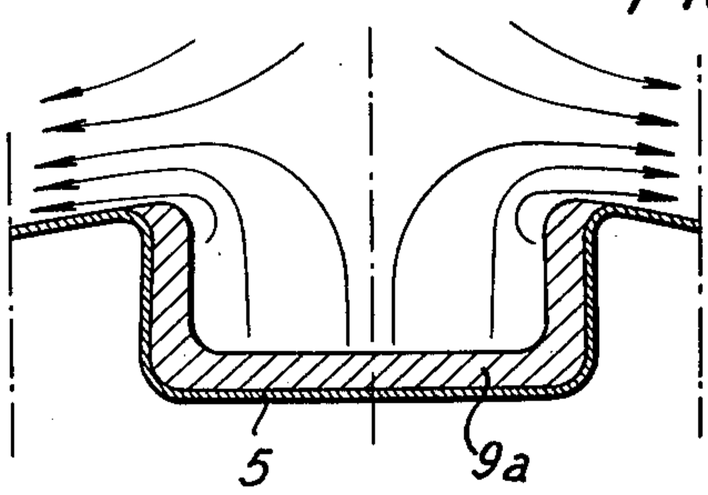


FIG. 5



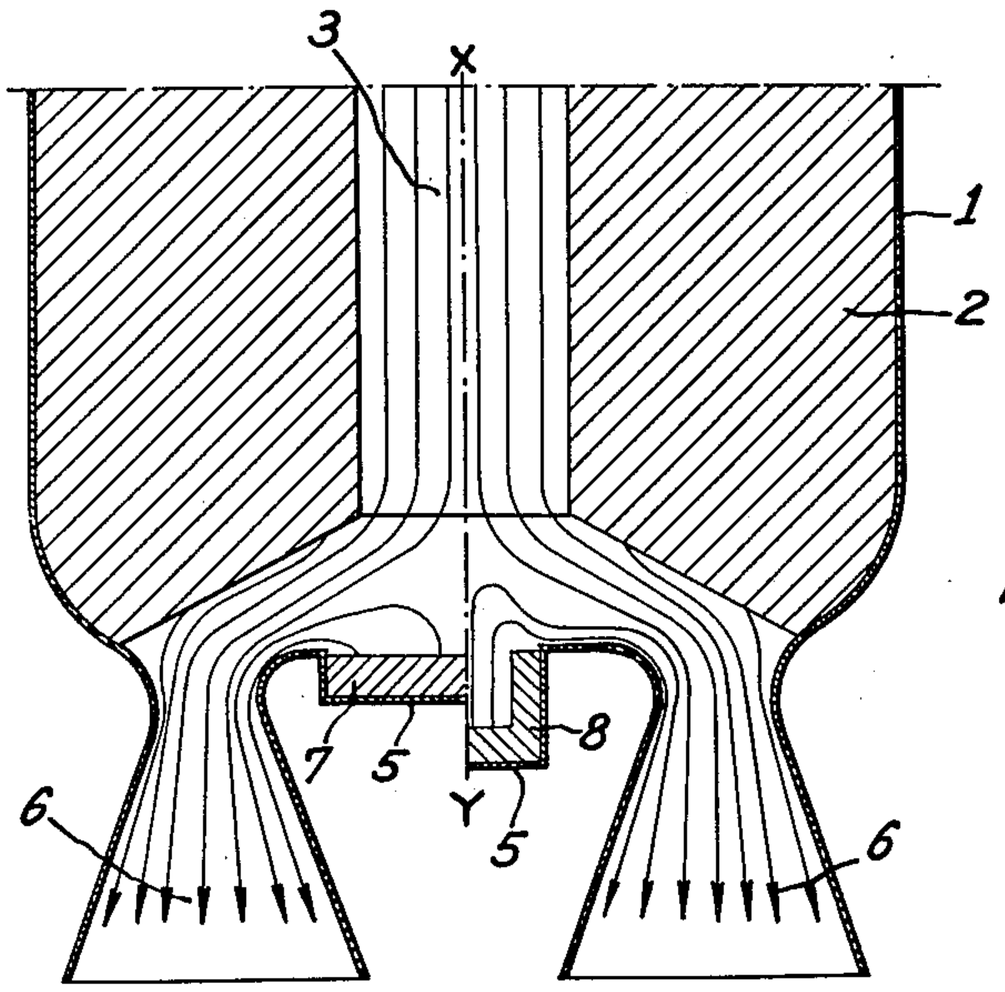


FIG. 3

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MULTI-NOZZLE JET PROPULSION UNITS

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3 Claims. (Cl. 60—35.6)

The present invention relates to a propulsion unit having a plurality of reaction propulsion nozzles which are offset relatively to the axis of the propulsion unit, and it is concerned more particularly with a powder-fuel rocket.

Multi-nozzle propulsion units have already been proposed more particularly for the guiding or control of the trajectory of various rockets. In the case of a powder-fuel rocket, the form of the powder block of the propulsion unit presents a considerable disadvantage: The combustion gases before they penetrate into the discharge nozzles are in the form of a dart which impinges against the rear end piece situated axially of the rocket, the latter not having a central discharge nozzle, with the result that, in order to avoid the premature destruction of this end piece, engineers feel obliged to reinforce its thermal protection considerably by making it very thick and consequently heavy in weight, without unfortunately deriving any benefit from this extra weight from the point of view of propulsion.

The present invention makes it possible to obviate this disadvantage, by arranging the rear end of the multi-nozzle propulsion unit in such a manner that hot gases are produced at this level and form an auxiliary flow which opposes the dart of hot gases discharged by the main combustion.

According to the invention, the rear end of the propulsion unit is covered with a layer of powder of sufficient thickness which in being consumed participates in propulsion but which as long as it is not entirely consumed, provides thermal protection for the aforesaid rear end.

The following description with reference to the accompanying drawings, which are given by way of non-limitative example, will make it easy to understand how the invention can be carried into effect, the features brought out either from the text or from the drawings being understood to form part of the said invention.

FIGURE 1 is an axial sectional view of a known multi-nozzle rocket.

FIGURE 2 shows the rear portion of this rocket on a larger scale.

FIGURE 3 is a diagrammatic view of the rear portion of the rocket according to the present invention, on two axial half-sections each representing one form of embodiment of the rocket end.

FIGURES 4 and 5 show a variant of the end in two different stages of operation of the rocket.

The known propulsion unit of FIGURES 1 and 2 comprises a rocket body **1** containing a block of powder **2** having a central duct **3** which conducts the combustion gases towards the rear of the rocket. These gases are in the form of a dart **4** which impinges on the rear end **5** of the rocket and then escape through discharge nozzles **6** which are offset relatively to the axis X–Y of the propulsion unit.

It will be seen from the flow lines that the hot gases impinge violently against the central end **5** and are considerably deflected before reaching the discharge nozzles **6**, passing along the surface of the end **5**. Very considerable thermal stressing ensues, which acts on the said end

and would rapidly destroy it if the said end were not effectively protected.

According to the present invention, this protection is provided by an auxiliary block of powder lining the rear central end of the rocket.

This auxiliary block may be of the frontal-combustion type, as shown at **7** in the left-hand portion of FIGURE 3, or of the central-combustion type as shown at **8** in the right-hand part of this figure. In the first case, a large combustion surface is obtained and this form of embodiment is advantageously applicable when a broad dart comes out of the central duct **3**, whereas the second form where an auxiliary dart of greater strength is emitted, is more suitable if the main dart is a narrow one.

The flow lines are shown in both cases in FIGURE 3. They show the greater action of the dart issuing from the central-combustion powder block **8** relatively to the flow issuing from the frontal-combustion powder block **7**.

The combustion speeds of the powder blocks **2** and **7** or **8** may be equal or different, slow or rapid. Choice will depend on the precise case in question. However, for the same configuration and the same kind of block of main powder **2** and central duct **3**, the powder constituting the secondary, central-combustion block **8** will be less rapid than that constituting the frontal-combustion block **7**.

In the modified form of embodiment of the secondary powder block **9** represented in FIGURES 4 and 5, combustion is "mixed," i.e. it is predominantly central at the beginning of combustion and frontal at the end of combustion.

Holes **10** formed in the powder block **9** increase the combustion surface and give a powerful flow at the beginning of combustion. This flow counteracts the dart coming from the main block at the moment when the said dart is itself at its most powerful.

When the powder has burned for a certain time, nothing remains between the initial holes and there is obtained a block **9***a* having a form which is shown diagrammatically in FIGURE 5. Combustion has become substantially frontal, and then therefore the intensity of the secondary dart is less strong, which, however, is quite suitable since in the meantime the central duct of the main block has widened and the speed of the gases issuing therefrom has consequently been reduced. Less power is required in order to counteract the gases from the main flow.

It will be apparent that modifications may be made to the form of embodiment which has just been described, more particularly by the substitution of equivalent technical means, without thereby departing from the scope of the present invention.

What we claim is:

1. A solid-propellant rocket comprising a generally cylindrical casing, a plurality of spaced nozzles having inlet ends communicating with the interior of said casing and offset relatively to the axis thereof, a central bottom closing portion extending generally transversely between said inlet ends and substantially centerd on said axis, a block of powder housed within said casing and shaped to substantially fill the same except for an axially extending space formed through said block and flared adjacent to and a little short of said nozzle inlet ends and bottom portion, said space being designed to afford unhindered passage to burning gases generated by the combustion of said block in the form of a tongue of flame directed toward said bottom portion, and a thermally-protective coating on the inner surface of said central bottom portion across the direct and unhindered path of said tongue of flame, said protective coating being made of a combustible material adapted to generate hot gases upon burning.

2. A rocket as claimed in claim 1, wherein the protective coating is made of an auxiliary block of powder designed to generate upon burning a flow of hot gases in a general initial direction substantially opposite to that of the tongue of flame whereby said flow of hot gases and said tongue of flame are mutually deflected toward the nozzles.

3. A rocket as claimed in claim 2, wherein the auxiliary block of powder is designed for burning in a first predominantly central type combustion phase and thereafter in a second predominantly frontal type combustion phase.

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