April 23, 1946. W. W. FARR 2,398,928

REACTION PROPULSION DEVICE

Filed Feb. 1, 1944

FIG. 1

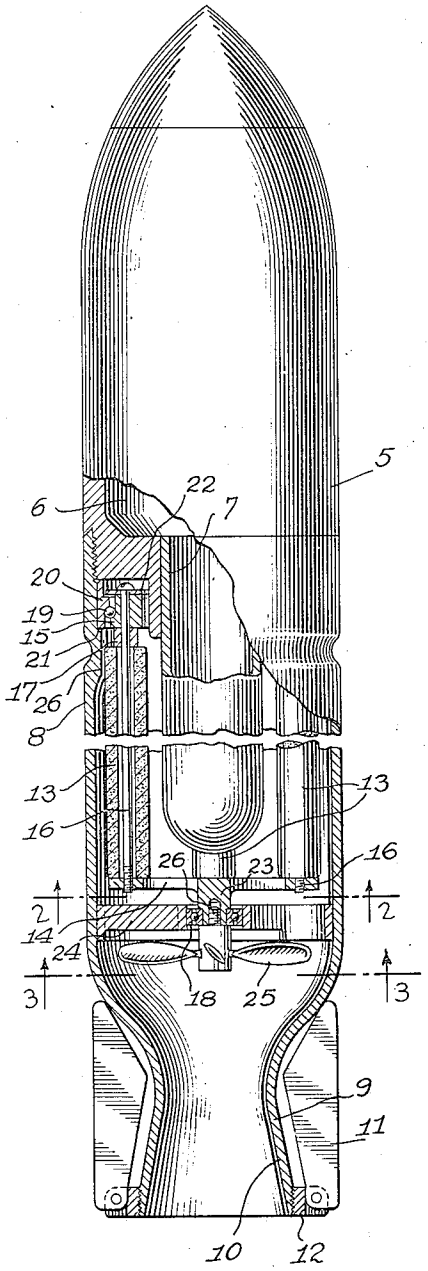
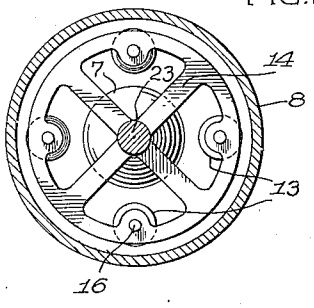



FIG. 2



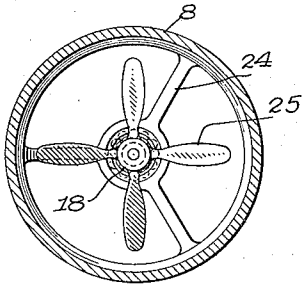




FIG. 3

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## REACTION PROPULSION DEVICE

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2 Claims. (Cl. 102—49)

This invention relates to projectiles and other devices of the reaction propulsion type.

One type of device of this character embodies a tubular casing carried by the trailing end of the projectile proper and having its rearward end contoured to define an axially opening Venturi passage, the propelling charge, usually in the form of a slow burning powder or other suitable material, being suitably supported within the casing in advance of the Venturi passage. Propulsion is produced by the exhaust of the gases, resulting from the burning of the charge, through the Venturi passage under pressure.

It has been ascertained that in a device of this character, the gases flowing through the Venturi passage may shift to one side from coaxial relation therewith with the result that the projectile will deviate from desired true flight.

One of the objects of the present invention is to provide a reaction propulsion device with means tending to minimize shifting of the axis of the gas flow from coaxial relation with the discharge passage.

Another object is to provide a reaction propulsion device with means whereby the pressure developing charge may rotate during burning of the charge to not only minimize shifting of the exhausting gases from an off-center position but also to provide for mass balance in the event of uneven burning of the charge.

With the above and other objects in view, which will be apparent from the following description to those skilled in the art to which the invention appertains, the present invention consists in certain features of construction and combinations of parts to be hereinafter described in detail with reference to the accompanying drawing, and then claimed.

In the drawing which illustrates a suitable embodiment of the invention:

Figure 1 is a side elevation of a projectile, partially in section, showing the rotating arrangement of the present invention; and

Figures 2 and 3 are transverse sections taken respectively on lines 2—2 and 3—3 of Figure 1.

Referring to the accompanying drawing, the projectile shown for illustration includes a main body 5 having a chamber 6 therein for the explosive charge (not shown) a rearwardly extending burster tube 7, and a tubular casing 8 threaded to the rearward end of the main body 5 and having its trailing end 9 contoured to define an axially opening Venturi passage 10. Suitable stabilizing fins 11 are hinged to a ring 12 which is carried by the rearward or trailing end of the casing 8.

In accordance with the present invention, the propelling charge is in the form of a plurality of tubular sticks 13 of slow-burning powder or other suitable material. The sticks 13 are supported by a suitable cage which may comprise a rearward spider 14, a forward annular ring 15 and a plurality of rods 16 which extend through the ring 15 and the sticks 13 and are threaded into the spider 14, suitable spacers 17 being provided between the ring 15 and the adjacent ends of the sticks 13 to maintain the sticks rigid.

The cage, just described, is supported for free rotation by a rearward radial ball bearing unit 18 and a forward combined radial and thrust bearing. The outer surface of the ring 15 is shaped to form the inner race for the balls 19 of the forward bearing, the outer race 20 being clamped between the end of the main body 5 and an upset internal shoulder 21 formed in the casing 8. In order to prevent inadvertent disassembly of the forward bearing a plate 22 is secured to the forward face of the ring 15 by the rods 16.

The inner race of the rearward bearing unit is carried by a coaxial portion 23 of the spider 14 and the outer race thereof is carried by an annular spider 24 preferably having a tight fit with the inner wall of the casing 8.

The cage and powder sticks 13 supported thereby are thus freely rotatable within the casing 8.

In order to effect rotation of the cage, a suitable bladed element or fan 25 is provided between the spider 24 and the Venturi passage 10, the fan 25 having a threaded shank 26 threaded into the spider portion 23, as shown in Figure 1. The gases resulting from the burning of the charge sticks 13 are adapted to impinge against the blades of the fan 25 and thus cause rotation of the fan and the charge-supporting cage.

In the assembly of the arrangement described the spiders 14 and 24, bearing unit 18 and face 25 are assembled into the casing 8 as a unit prior to upsetting the portion 26 of the casing which forms the shoulder 21.

The forward bearing, including the ring 15, assembled with the rods 16 in place with the charge sticks 13 thereon, is then inserted into the open end of the casing 8 and thereafter the rods 16 are threaded into spider 14 to complete the assembly. This stage of the assembly is performed, of course, after the upsetting of the casing to provide the shoulder-forming portion 26. The casing then may be mounted on the main portion 5.

The arrangement of the present invention just described provides an effective means whereby incident to rotation of the charge sticks, the gases resulting from the burning of the sticks 13 will be caused to rotate during their passage through the pressure developing Venturi passage 16 and due to this rotation will have an axis of discharge which is coaxial with the Venturi passage. Thus, the tendency toward off-center discharge incident to uneven burning of the charge will be minimized. Also, by rotating the complete charge, the charge and supporting cage will have better balance or mass distribution, especially in the event of uneven burning of the charge, which will tend toward truer flight of the projectile.

While the arrangement of the present invention, has been described in connection with an explosive projectile, it is to be understood that it is equally applicable to other devices, such as for example chemical shells, flare devices, and the like.

It is to be understood that the structure shown has been selected for the purpose of illustration and that various changes may be made in the detailed construction and arrangement of parts without departing from the spirit and substance of the present invention, the scope of which is defined by the appended claims.

What is claimed is:

1. In a reaction propulsion device having a tubular casing closed at one end and having a coaxial pressure developing passage at its opposite end, a cage concentrically arranged within said casing for rotation relative to said casing, a plurality of elongated rod-like elements of combustible material carried by said cage in circumferentially spaced relation, and a fan member fixed to said cage adjacent said passage and adapted to be rotated by the products of combustion exhausting through said passage whereby to rotate said cage.

2. In a reaction propulsion device having a tubular casing closed at one end and having a pressure developing passage at its opposite end, a plurality of elongated elements of combustible material within said casing, a freely rotatable means within said casing supporting said combustible elements in circumferentially spaced relation, said rotatable means having an axis of rotation coaxial with said passage, spaced antifriction bearing means supported by said casing for rotatably supporting the opposite ends of said rotatable means, and a fan element within said casing coaxially fixed to said rotatable means adjacent said passage, said fan element being in the path of flow of the products of combustion of said combustible elements toward said passage.

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