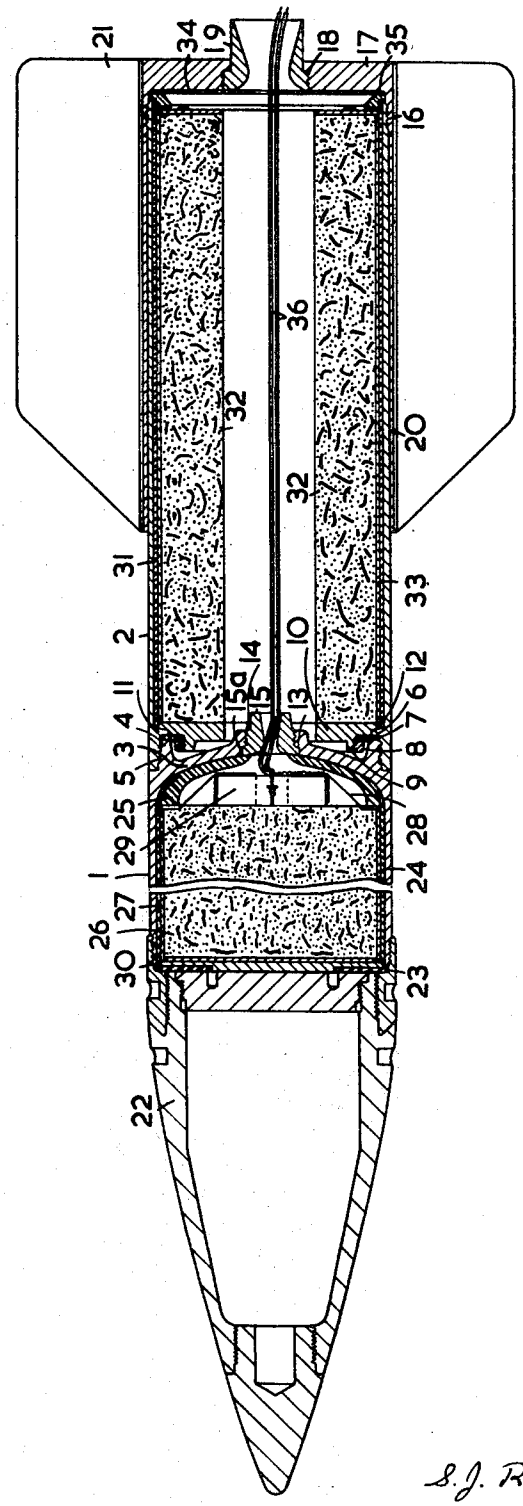
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ROCKETWISE PROPELLED PROJECTILES

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ROCKETWISE PROPELLED PROJECTILES

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In the provisional specification of co-pending patent application No. 24,024/57 there is described an unguided rocketwise propelled projectile in which the motor is arranged to propel this projectile at a substantially constant speed which is such that the drag does not reach an excessive value, and in one example of such an arrangement described in that specification, the projectile is provided with two charges arranged concentrically one within the other. One of these charges is the main charge which initially propels the projectile a certain distance and is termed a "booster charge" and the other charge is arranged to sustain the projectile in flight after the booster charge ceases to function and is termed a "sustainer charge." These charges are described as arranged to burn independently of each other, the outer charge, in the example described constituting the booster charge and being tubular and inhibited upon its outer face so that it will burn over the whole of its inner face and this burning will continue radially outwards. The inner charge constitutes the sustainer charge and in the example referred to, is described as being carried in a tube which is of somewhat less external diameter than the internal diameter of the outer charge, so that a tubular passage is formed between the inner charge carrying tube and the outer charge.

In the construction just described, the outer or rear end of the annular passage between the booster charge and the tube carrying the sustainer charge is closed by a plate which has in it a series of perforations spaced equally apart and at a constant radius from the central axis of the projectile and each of these perforations is provided with a short rearwardly directed nozzle through which will exhaust gas from the booster charge. The centre of the place has a single perforation which communicates with the tube carrying the sustainer charge and has a short rearwardly projecting nozzle through which this charge exhausts.

Although constructions having no discardable parts present advantages, they by no means achieve good accuracy of flight. In the above described example of construction, for instance, there is a tendency for the hot gases exhausting from the booster charge to erode unevenly the off-centre nozzles and this may give rise to unequal thrusts from these nozzles and considerable inaccuracies of flight in a non-rotating projectile. The effect can be minimised by orientating the nozzles so that the line of action of the thrust passes through the centre of gravity of the projectile, but the construction presents some production difficulties.

According to the present invention the projectile motor comprises a casing, a booster charge within this casing, a sustainer charge, also within the casing, and a common outlet orifice or nozzle arranged axially of and at the rear of the casing, for the exit of the propulsive gases from both these charges.

Preferably the sustainer charge is disposed forwardly of the booster charge.

In a preferred construction according to the invention, the casing is divided, by a transverse partition, into two parts, the rear one of which contains the booster charge,

and the other the sustainer charge, and the partition is provided with an axial orifice or nozzle through which the gas from the sustaner charge will first pass into the rear part of the casing before exhausting through the coaxial orifice or nozzle at the rear end of the casing, through which last mentioned orifice or nozzle will also issue the gas from the booster charge. In this construction, the booster charge is so arranged and/or is of such shape as not to present any obstruction to the passage of the propulsive gases from the sustainer charge through the rear part of the motor casing, and it is not only found convenient to make the booster charge tubular for this purpose, but this shape enables it to be constrained to burn radially outward over its inner surface.

The sustainer charge, which must, of course, continue to burn after the booster charge has ceased burning, may be of such shape and so arranged within the casing that it will burn cigarettewise from its rear end.

For small boost-sustainer thrust ratios it is possible from the known arts to dispense with the forward chamber and nozzle and to burn the two propellants in a single chamber. The present technique permits of the attainment of higher boost-sustainer ratios at the cost of a drop in efficiency which increases as the ratio of boost to sustainer thrust increases and which results from the low stagnation pressure in the rear boost chamber. However, this drop in efficiency diminishes with increase in altitude, due to the reduced ambient pressure at high altitude and resultant increased rocket exhaust velocity.

An example of a rocket motor according to the invention will now be described with reference to the accompanying sectional drawing.

As shown in the drawing, the motor comprises a casing having a front portion **1** and a rear portion **2**.

Formed integral with the rear end of the front casing portion **1** is a domed wall **3**, the outer peripheral portion of which wall is provided with a rearwardly directed annular flange **4** provided upon its exterior with a screw-thread **5** on to which is screwed the interiorly screw-threaded forward end of the rear casing portion **2**.

Inside the forward end of the casing portion **2** is provided a flange **6**, between which and the rear end face of the flange **4** is compressed the outer peripheral portion of a sealing ring **7**, the inner peripheral portion of which is clamped by a ring **8** screwed on to a forwardly extending reduced portion **9** of a ring **10** having an intermediate portion **11** which fits within the flange **6** and is retained therein by a larger diameter portion **12** which abuts the rear face of the flange **6**.

The central part of the domed wall **3** is thickened and bored axially therethrough at **13**, the forward end portion of which bore **13** is plain and the part of said bore to the rear of this plane portion is of slightly reduced diameter and has formed in it a screw-thread **14** in to which is screwed, from the forward side of the domed wall **3**, a nozzle **15** having at its forward end portion an enlarged part **15***a* machined to fit within the plain forward portion of the bore **13**.

The exterior of the rear end of the casing portion **2** is machined to a reduced diameter and provided with a screw-thread **16** on to which is screwed a cap **17** which is centrally bored and provided with a screw-thread **18** to carry a nozzle **19**.

Carried upon the rear end of the casing portion **2** is a sleeve **20**, carrying fins **21**, against the rear end of which sleeve abuts the cap **17**.

Screwed on to the forward end of the front casing portion **1** is a war-head, indicated generally by **22**, between which and the forward edges of this casing portion is clamped a rubber ring **23**.

The front casing portion **1** is provided with a rubber

lining **24** which extends on to the peripheral portion of the domed end wall **3** on which is provided a lining **25** of material sold under the registered trademark Durestos.

Fitting within the front casing portion **1** is a sustainer charge **26** having an inhibitive coating **27** of ethyl cellulose and a rearwardly protruding tapered portion **28** into the rear face of which is inset an electrically operated igniter, indicated generally by **29**. Disposed between the rear end of the sustainer charge **26** and the war-head **22** is a disc **30** the peripheral portion of which is undercut so that its central portion fits into the rubber ring **23**, whilst its undercut portion clamps tightly against the rear face of this ring.

The rear casing portion **2** is also provided with a rubber lining, indicated by **31**, and fitting within this lined body portion is a tubular booster charge **32** having an exterior coating **33** of ethyl cellulose.

The end wall of the cap **17** is lined with a Durestos ring **34** and clamps on to a ring **35** which bears on the end of the booster charge **32**, so that this charge is clamped between this ring **35** and the aforesaid ring **10**, so that the bore of the booster charge constitutes an axial communication between the nozzles **15** and **19**. The wiring **36** from the igniter **29** is passed through nozzle **15**, thence through the bore of the booster charge **32** and out through the nozzle **19**.

When the igniter **29** is fired, it ignites the rear end of the sustainer charge **26**, the hot gases from which pass through the nozzle **15**, the tubular booster charge **32** and out through the nozzle **19**, but in passing through the booster charge they ignite this. The booster charge **32** burns rapidly outward from its bore and the hot gases from this, of course, also pass out through the nozzle **19**. The sustainer charge **26** burns cigarettewise from its rear end and at a considerably slower rate than the booster charge.

We claim:

1. A projectile motor having an axial line of symmetry comprising, a first tubular casing having a domed rearward wall, a rearwardly directed, detachable nozzle mounted axially in said domed wall, a first liner along the inner peripheral surface of said casing, said first liner extending along a substantial portion of the inner peripheral surface of said domed wall, a second liner having a thickness greater that that of said first liner and extending along the inner peripheral surface of said domed wall, to overlap a portion of the rearward end of said first liner, a solid cylindrical sustainer charge having an inhibitive coating in said first casing, a second tubular casing detachably engaged to the rearward end of said first casing, a liner extending along the inner peripheral surface of said second casing, a cylindrical inhibited booster charge in said second casing, said booster charge having an axial bore of constant diameter throughout its length and piercing said booster charge, a cylindrical cap detachably secured over the rearward end of said second casing, a series of stabilizing fins integral with said cap, a rearwardly directed detachable nozzle mounted axially in the rearward end of said cap, a warhead detachably secured to the forward end of said second casing and an igniter fixed to the rearward end of said sustainer charge.

2. A projectile motor comprisng a first tubular casing having a domed rearward wall, an externally threaded, annular flange integral with and extending rearwardly from said domed wall, a rearwardly directed, detachable nozzle mounted axially in said domed wall, a first liner extending along the inner peripheral surface of said first

casing and a portion of the inner peripheral surface of said domed wall, a second liner having a thickness greater than that of said first liner and extending along the inner peripheral surface of said domed wall to overlap a portion of the rearward end of said first liner, a solid cylindrical sustainer charge in said first casing, said sustainer charge having a rearwardly extending tapered portion, an inhibitive coating extending along the forward face and outer peripheral surface of said sustainer charge, a warhead threadably secured in axial alignment to the forward end of said first casing, a first sealing means disposed between said first casing and said warhead, a second cylindrical casing having an internally threaded forward portion for engagement with said external threaded portion on said flange on said domed wall whereby said second casing is in axial alignment with said first casing, said second casing having an externally threaded rearward portion, a booster charge in said second casing, said booster charge having an inhibitive coating extending along its peripheral and rearward surfaces, said booster charge having an axial bore of constant diameter piercing said booster charge, a third liner extending along the inner peripheral surface of said second casing, a spacing ring abutting the rearward end of said second casing, a tubular cap having an internally threaded rearward portion adjacent its rearward end for engagement with said rearwardly externally threaded portion on said second casing, a series of stabilizing fins carried by said cap, a rearwardly extending nozzle detachably secured axially in the rearward end of said cap, a retaining ring having a single central opening abutting the forward end of said second casing, said central opening having a diameter equal to said axial bore in said booster charge, a second sealing means carried by the forward face of said retaining ring for sealing between said retaining ring and said flange on said domed wall, and an igniter carried by said tapered portion of said sustainer charge.

3. A projectile motor as claimed in claim **2** wherein said second sealing means between said second casing and said flange on said domed wall comprises a first annular flange integral with the inner peripheral surface of said second casing and adjacent the rearward end of said internal threaded portion in said second casing, there being an annular enlarged portion on said retaining ring for abutment with said internal flange, a second externally threaded annular flange integral with and extending forwardly from said retainer ring, said last named flange having an outer diameter less than the outer diameter of said retainer ring, a sealing ring fitted about said second flange, and an internally threaded clamping ring adapted for threadable engagement on said second flange.

4. A projectile motor as claimed in claim **2** wherein said first sealing means betwen said first casing and said warhead comprises, a disc abutting the forward end of said first casing and covering the forward end of said sustaining charge, said disc having a peripheral undercut portion and a sealing ring snugly fitting said undercut portion.

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