Dec. 29, 1959 R. J. JOHNSON 2,918,751

REACTION PROPULSION TOY

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FIG. 1

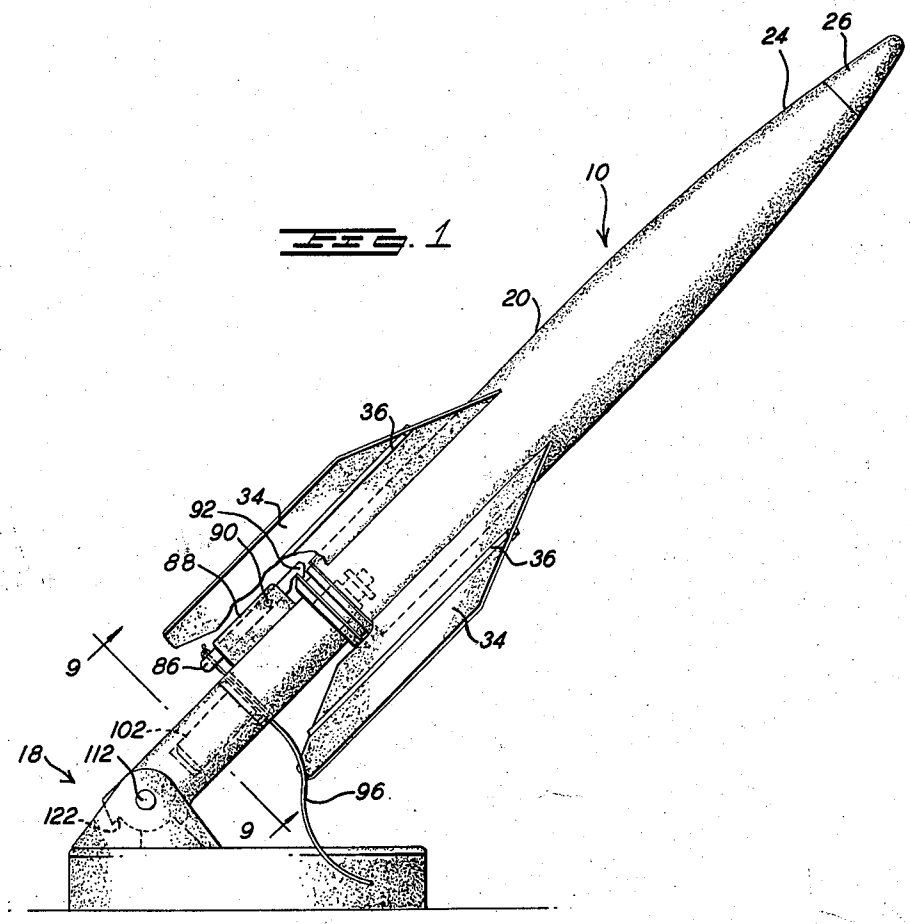
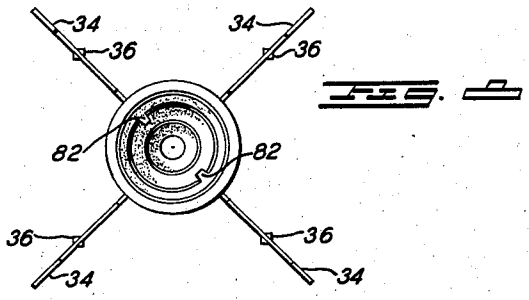


FIG. 2



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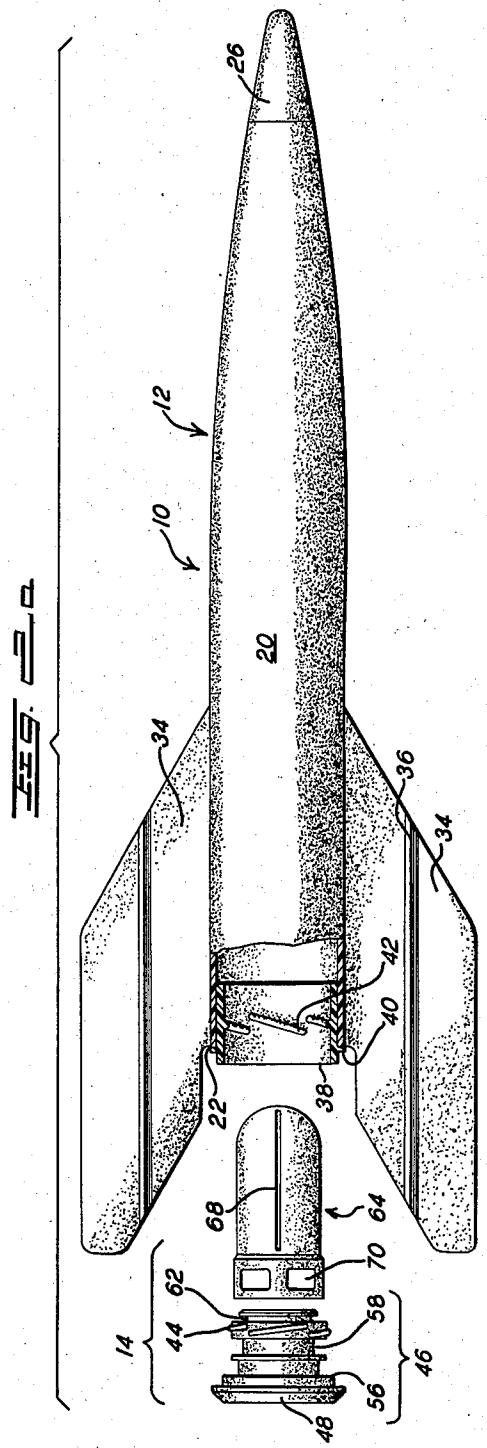

Fig. 2a

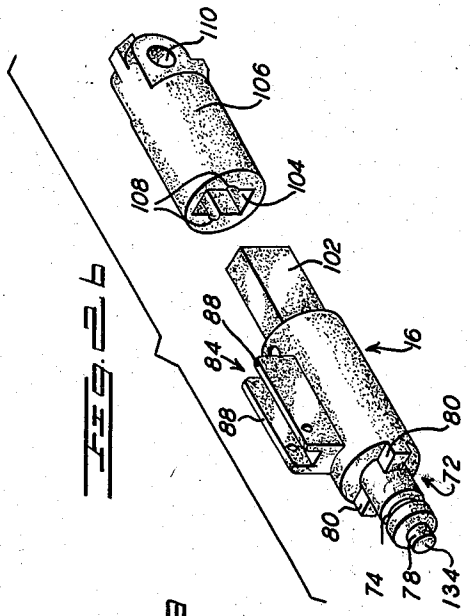

Fig. 2b

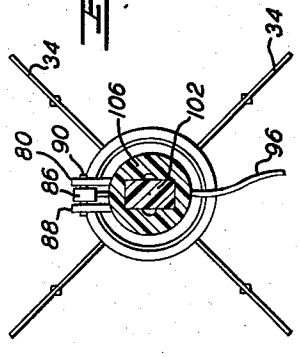

Fig. 3

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Fig. 3

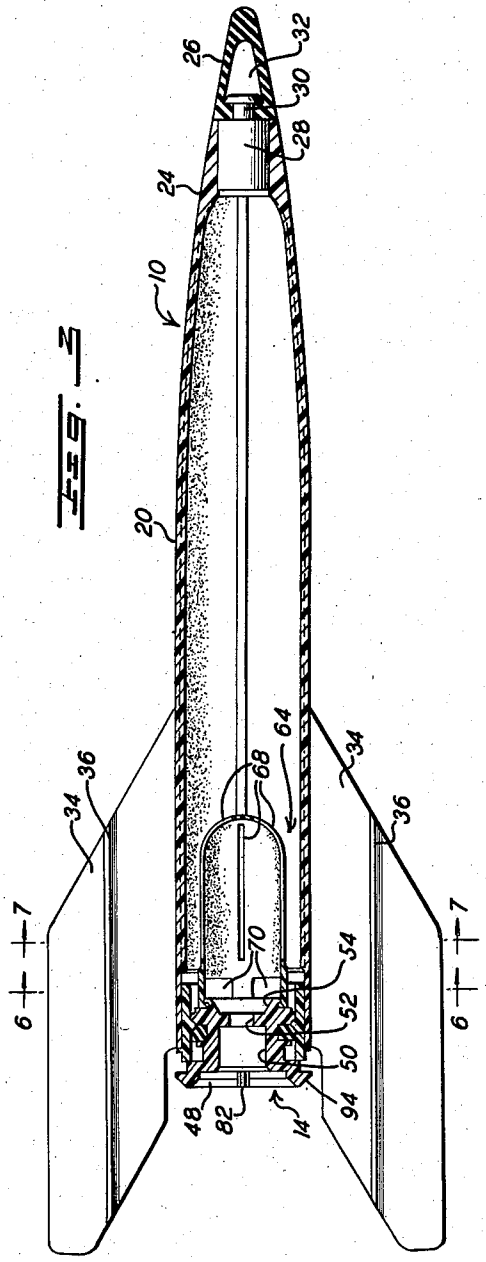

Fig. 7

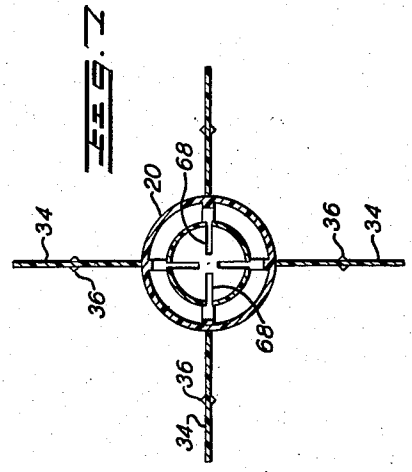

Fig. 8

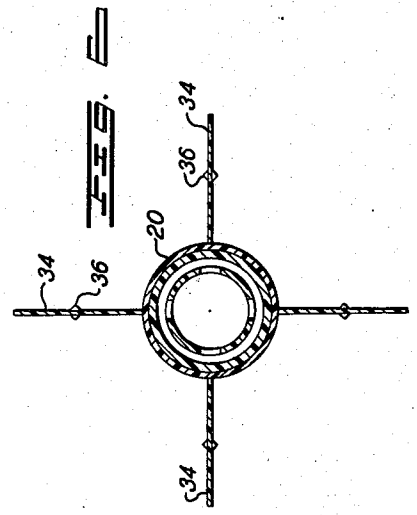

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FIG. 4

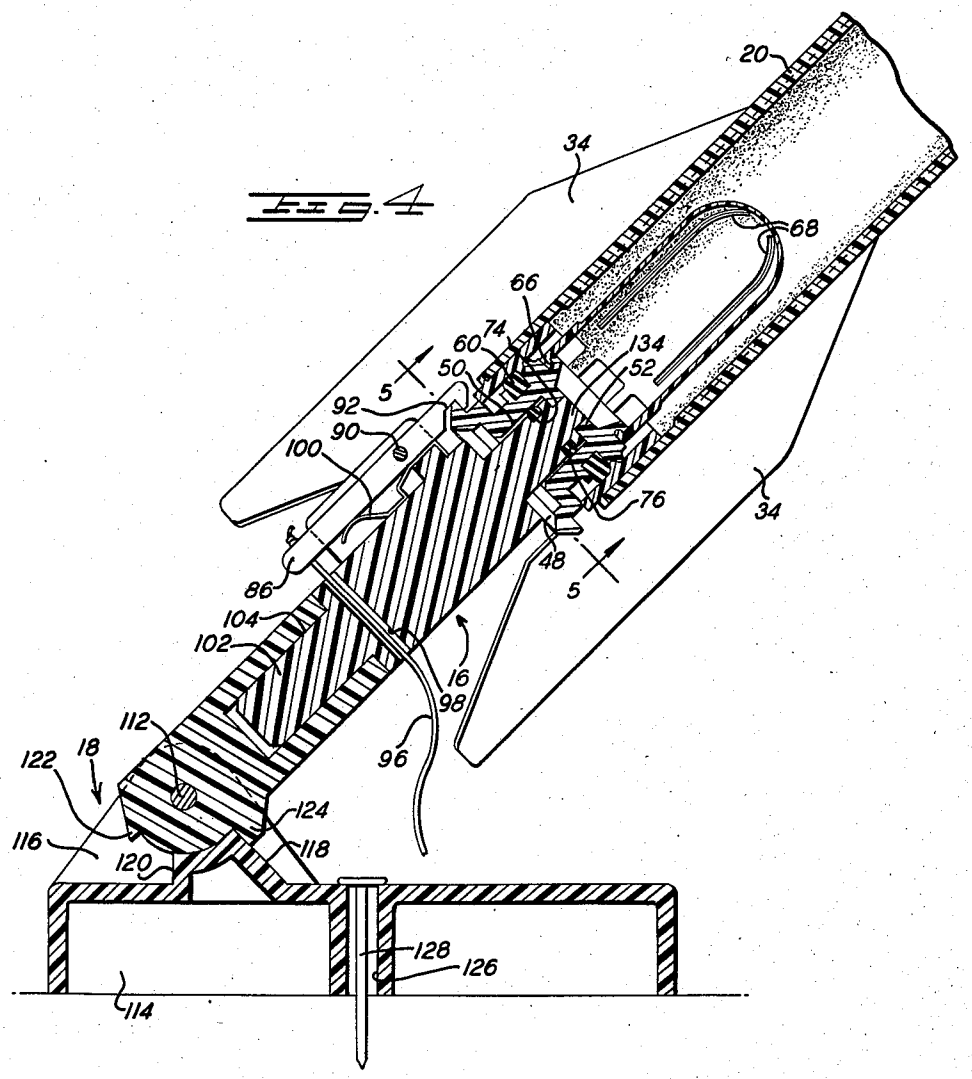
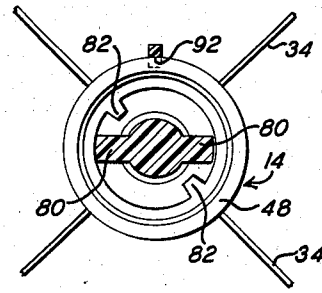


FIG. 5



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REACTION PROPULSION TOY

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Application November 14, 1957, Serial No. 696,408

5 Claims. (Cl. 46—74)

This invention relates to a reaction propulsion toy and more particularly to a new and improved reaction propelled toy rocket and launching device therefor.

It is a particular object of this invention to provide a toy reaction propulsion rocket which simulates in appearance, operation and flight an actual ballistic missile without the inherent complexity of such devices.

It is a further object of the invention to provide such a device wherein the reaction propulsion engine thereof is of the cold discharge type thereby providing a safe amusement and educational device for children.

It is a further object of the present invention to provide such a toy that is relatively simple in construction and operation, that may be reused for plural flights by merely recharging the reaction engine and wherein the angle of flight and distance of operation may be varied within wide latitudes.

It is a further object to provide a novel reaction engine for a toy rocket wherein the internal pressures developed within the device are effectively maintained within the pressure limits of the construction material.

A further object is to develop such a device wherein the period of time required to develop operating pressures within the rocket is relatively short.

These and other objects and advantages are provided by a toy rocket which generally comprises an elongate hollow body portion having a closed forward end and an open rearward end, a reaction motor releasably mounted in the rearward end of the body portion, said motor including a ring having a Venturi passage extending therethrough, a basket releasably secured to the inner end of the reaction motor ring, said basket being provided with a plurality of slots extending through the side walls thereof, and launching means for the toy rocket including a peg, one end of said peg adapted to snugly engage the Venturi passage in said reaction motor, and latch means releasably holding the peg within the Venturi passage.

The novel features of the present invetion will be more apparent to those skilled in the art from the following detailed description of the invention in reference to the accompanying drawings wherein:

Fig. 1 is an elevational view of the improved reaction propulsion toy of the invention including its launching platform;

Fig. 2*a* is an exploded view in partial section of the missile and its motor components;

Fig. 2*b* is an exploded view of a portion of the launching mechanism for the missile shown in Fig. 1;

Fig. 3 is a longitudinal sectional view through the missile and its motor components;

Fig. 4 is an enlarged fragmentary sectional view through the assembled missile and launching platform therefor;

Fig. 5 is a section substantially on line 5—5 of Fig. 4;

Fig. 6 is a section substantially on line 6—6 of Fig. 3;

Fig. 7 is a section substantially on line 7—7 of Fig. 3;

Fig. 8 is an end view of the missile shown in Fig. 1; and

Fig. 9 is a section substantially on line 9—9 of Fig. 1.

Referring to the drawings the illustrated embodiment of the invention generally comprises a reaction propulsion rocket 10 which includes a body portion 12 having a reaction motor releasably secured therein and generally designated 14, rocket release mechanism 16 and launching structure 18. Each of these elements of the structure of the invention will be separately described hereinafter.

The body portion 12 of the rocket includes an elongated shell 20 having an open rear end 22, and an inwardly tapered forward portion 24 carrying a resilient nose piece 26. As more clearly shown in Fig. 3 of the drawings, the nose piece 26 is secured to the forward end 24 of the shell of the rocket by a pin 28 secured in a bore in the nose. The pin 28 includes a forwardly projecting boss 30 which snaps into a recess 32 in the resilient nose piece 26.

At the rearward end of the body portion 20 the rocket is provided with a plurality of stabilizing fins 34 which may be formed as an integral part of the shell 20 or bonded thereto by welding, cementing or the like. On small toy rockets necessitating the employment of thin lightweight stabilizing fins 34, the fins may be provided with suitable ribs generally designated 36, preferably extending parallel to the direction of flight of the rocket to reduce the tendency of the fins to bend in flight which would reduce the accuracy of the flight of the toy.

In the preferred form of the invention, the body 20 and the fins 34, including the ribs 36, are cast of a tough plastic such as nylon or cellulose derivatives. Particularly satisfactory results have been obtained by using cellulose acetate-butyrate.

The rear end of the body of the rocket is provided with an adapter ring 38 having a shoulder 40 adapted to abut the peripheral edge of the rocket. The internal surface of the adapter ring 38 is conveniently provided with partial threads 42 adapted to mate with cooperating partial threads 44 carried on the external surface of the nozzle portion 46 of the motor 14.

The nozzle portion 46 of motor 14, as more clearly shown in Figs. 2*a*, 3 and 4, includes an outlet which communicates with a constricted opening 52 which, in turn, communicates with the interior of the rocket through bore 54. The bore 54, the constriction 52, the bore 50 and the outlet 48 cooperate to define a Venturi passage through which the "fuel" maintained under pressure in the body of the rocket issues during the flight of the rocket as to be more fully described hereinafter.

The external cylindrical surface of the nozzle 46 is provide with a shoulder 56 which abuts the extended edge of the motor retainer ring 38 when the cooperating threads 42 and 44 are fully engaged as shown in Figs. 3 and 4. The external surface of the nozzle is also provided with a peripheral groove 58 adapted to receive a conventional resilient O ring 60 which maintains a fluid type seal between the inner surface of the motor retainer ring 38 and the external surface of the nozzle 46 when the motor is in place in the rocket body. A further groove 62 is provided adjacent the most forward portion of the nozzle 46 which groove is adapted to receive a basket 64 provided with inwardly projecting elements 66 which snap into the groove 62 to maintain the basket 64 in axial extension from the nozzle 46 as more clearly shown in Fig. 4.

The basket 64 is adapted to receive the "fuel" or a portion thereof for pressurizing the rocket and is generally cylindrical in form and is provided with a plurality of longitudinally extending slots 68 which permit communication between the interior of the basket and

the interior of the rocket. The lower end of the basket **64** is also provided with a plurality of openings **70** of substantially larger size than the longitudinally extending slots **68** hereinbefore described.

The basket **64** and the nozzle **46** may also be conveniently molded from plastic, and very satisfactory results have been obtained by molding the parts from cellulose acetate-butyrate.

The release mechanism **16** for the rocket, as more clearly shown in Figs. 2*b* and 4, comprises a cylindrical standard or peg having a reduced cylindrical end portion **72** of a diameter slightly less than the bore **50** in the nozzle. Forwardly of the portion **72** of the standard is provided a peripheral groove **74** adapted to receive resilient ring **76**, Fig. 4, which provides a fluid tight seal between the outer surface of the standard **72** and the inner surface of the bore **50** of the nozzle.

Forwardly of the peripheral groove **74** is a further reduced extended end portion **78** having a diameter which snugly fits into the bore **52** of the constricted portion of the rocket nozzle. The standard **16** is also provided with a pair of radial bosses **80** which cooperate with a pair of bosses **82** projecting inwardly of the outlet ring **48** of the nozzle. The radial extension of the cooperating bosses **80** and **82** are such that when the reduced end portions **72** and **78** of the standard **16** are inserted into the bores **50** and **52** of the nozzle as shown in Fig. 4 the cooperating bosses **80** and **82** limit the extent of roation of the standard **16** within the bores of the nozzle whereby the motor may be screwed into and out of the motor retainer ring **38** by turning the standard **16**.

The standard **16** is also provided with an upstanding boss generally designated **84** which receives a latch pin **86**. The latch pin **86** is mounted between the flanges **88** of the boss **84** by a pivot pin **90**. The extended end of the latch pin **86** is provided with a cutout portion **92** adapted to be received about a flange **94** on the nozzle outlet **48**. The other extended end of the latch **86** is bored to receive a release cord **96** which passes through a bore **98** in the standard **16**. To complete the latch pin assembly a spring **100** is positioned between the flanges **88** of the boss **84** to urge the pivotally mounted latch pin **86** into latched engagement with the motor outlet nozzle ring **94**.

In the illustrated embodiment of the present invention the spring **100** for urging the latch member into engagement with the extended end of the rocket motor is of the leaf-type spring. However, coil springs or other suitable means for biasing the latch member may be employed without departing from the present invention.

The rearwardmost end of the standard **16** is reduced in cross-sectional area and preferably quadrangular in shape. The quadrangularly shaped end is adapted to be freely insertable in a corresponding quadrangular opening **104** in the rocket standard launching socket **106**. As more clearly shown in Fig. 2*b* and Fig. 9, the quadrangular opening **104** in the socket **106** is provided with one or more axially extending grooves **108** which grooves provide weep holes for liquid or air within the passage **104** to permit the free insertion thereinto of the end portion **102** of the peg **16**.

The lowermost end of the standard socket **106** is bored as at **110** to receive a pivot pin **112** whereby the standard socket **106** is pivotally mounted to the launching platform base member **114** between the upstanding flanges **116** carried thereby. The lowermost end of the standard socket **106** and the upstanding flanges **116** are provided with cooperating bosses **118**, **120**, **122** and **124** whereby the pivotal movement of the standard socket **106** upon the base member **114** is limited to a range of from about 90° to about 45° from horiozntal.

The base member **114** of the launching platform **18** is further provided with an axial bore **126** adapted to receive a pin **128** freely passed through the bore **126** and into the ground which aids in maintaining the launching platform **114** and its rocket mechanism in rocket launching position. The entire platform and its rocket also may be conveniently rotated about the pin **128** to vary the heading of the rocket.

The fuel for the rocket comprises a suitable acid preferably in the solid granular form, a gas generating compound and water. Very satisfactory results are obtainable with a fuel charge of citric or tartaric acid, a bicarbonate such as sodium bicarbonate and water. In operation of the rocket, the rocket is disassembled as shown in Fig. 2*a* of the illustrated embodiments of the invention. The basket **64** is then filled with a bicarbonate and an acid in granular form. Very satisfactory results are obtained when the basket is filled with 3 cc. of sodium-bicarbonate and 2.5 cc. of citric acid. The acid and bicarbonate charge is in the granular form with the size of the grains usually less than the width of the slots **68** in the basket adapted to receive the combined citric acid sodium bicarbonate charge of 5.5 cc. It will be appreciated that with a slot width of .04 inch and with the grain size of the acid-bicarbonate charge smaller than .04 inch that the charge would not normally remain in the basket. In order to contain the granular charge within the basket upon initial operation of the rocket the internal surface of the basket is wetted. When the dry citric acid and sodium bicarbonate is placed in the basket having its inner surface wetted the dry powders or grains form bridges across the slots preventing the remainder of the charge from passing through the slots.

The body of the rocket **12** is then filled with from about 25 to about 30 cc. of water where the rocket is about 7 inches in length and has a maximum internal diameter of about 1 inch and a total internal volume of about 75 cc.

The charged basket **64** is then snapped on to the nozzle mounting ring **62**, the release mechanism **16** is assembled to the motor as shown, for example in Fig. 4, with the latch bar **86** in engagement with the latch ring of the nozzle. The basket, nozzle and release mechanism is then assembled to the rocket body **12** so that the cooperating parted threads **42** and **44** are fully engaged and the shoulder **56** of the nozzle is in abutting relation to the peripheral edge **38** of the motor mount **22**.

The rocket is then inverted and the lowermost end **102** of the release mechanism **16** is inserted into the slot **104** of the standard socket **106**. As soon as the rocket assembly is inverted the water placed within the housing of the rocket comes in contact with the acid-bicarbonate charge within the basket. The substantial width of the plural slots **68** in the basket and the large openings **58** at the lowermost end of the basket permit very rapid reaction between the dry sodium bicarbonate and citric acid.

It has been found that with a rocket constructed as hereinabove described, the charge generates a pressure of about 85 pounds per square inch within the shell of the rocket in about 1 minute where the temperature of the water is from about 65° F. to about 72° F. After the lapse of about 1 minute the rocket may be launched. To launch the rocket, the cord **96** is pulled which rocks the latch bar **86** away from engagement with the flange **94** of the nozzle outlet. As soon as the latch is disengaged from the nozzle flange the pressure developed within the rocket body acting upon the surface **134** of the forward end of release mechanism **16** forces the rocket off the release mechanism and the carbon dioxide and water contained within the body of the rocket are forced through the reaction engine creating thrust which sends the rocket soaring into the air.

It has been discovered that with a rocket constructed as detailed in the above example containing from about 25 to about 30 cc. of water; having a fuel charge of about 3 cc. of sodium bicarbonate and 2.5 cc. of anhydrous

citric acid and with the rocket positioned at an angle of from about 55° to about 60° to the horizontal a rocket flight of about 150 feet will result. It has also been determined that in such a flight the rocket will travel at a maximum speed of from about 40 to 50 miles per hour.

From the foregoing description of this invention, it will be appreciated that the size and exact configuration of the rocket may be variously modified and that as the weight and size of the rocket is increased proportionate increases in the sodium bicarbonate-acid charge would be necessary in order to properly propel the device. Further, the amount of charge to be added to the basket may conveniently be in weight quantities. For example, if the total volume of the basket **64** is about 5.5 cc., the weight of sodium bicarbonate would be 2.5 grams and the weight of anhydrous citric acid would be 2.2 grams.

While enlarging or decreasing the overall size of the rocket and its motor will require larger or smaller quantities of bicarbonate-acid charge, the slot width **68** in the basket should be maintained substantially constant to insure adequate bridging during the initial operation of the device and also a rapid reaction to provide maximum pressure within the body of the missile in a relatively short period of time.

Where shorter reaction periods are desired to generate the rocket launching pressure with the body of the rocket, the acid portion of the charge may be dissolved in the water in the body of the rocket and only the granular sodium bicarbonate placed in the basket. When this procedure is employed, it is advantageous to provide the rocket of the example with a basket which will only contain, for example, 2.8 cc. or approximately 2.3 grams of sodium bicarbonate. The citric acid may then be added in excess directly to the body of the rocket as a solution containing approximately 3 grams of the acid. It has been found that by using 3 grams of citric acid dissolved in 25 cc. of water in the rocket body and with the basket containing 2.3 grams of granular sodium bicarbonate a pressure of about 95 pounds per square inch will be developed within the rocket in about one minute. Again, however, the developed pressure is maintained well below the bursting strength of the rocket body as the quantity of sodium bicarbonate is limited by the capacity of the basket.

Having described my invention in its preferred and modified forms, what is claimed is:

1. A toy rocket comprising an elongate hollow body portion having a closed forward end and an open rearward end, a reaction motor releasably mounted in the rearward end of the body portion, said motor including a ring having a passage extending therethrough, a basket releasably secured to the inner end of the reaction motor ring, said basket being provided with a plurality of slots extending through the side walls thereof, and launching means for the toy rocket including a peg, one end of said peg shaped to snugly engage the passage in said reaction motor, and latch means releasably holding the peg within the passage.

2. The invention defined in claim 1 wherein the slots extending through the side walls of the basket have a width of about .04 inch.

3. A toy rocket comprising an elongate hollow body portion having a pointed nose at the forward end and stabilizing fins at the rearward end, a reaction motor releasably mounted in the rearward end of the body portion, said motor comprising a ring forming a passage extending axially therethrough, a container for a granular gas forming composition releasably mounted to the forward end of said reaction motor ring, said basket having provided in the side walls thereof a plurality of slots, the width of said slots being about .04 inch, and launching means for said rocket including a peg, one end of said peg shaped to be snugly received in the passage in said motor ring, latch means releasably holding the peg within the passage, and a platform receiving the other end of said peg for holding said toy rocket in a launching position.

4. The invention defined in claim 3 wherein said other end of said peg is pivotally mounted to said platform whereby the launching angle of said rocket may be readily varied.

5. The invention defined in claim 1 including resilient sealing means carried by said peg to provide a substantially fluid tight seal between said peg and the passage in the motor ring.

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