Dec. 17, 1963 V. D. ESTES 3,114,317

MODEL ROCKET

Filed July 5, 1960

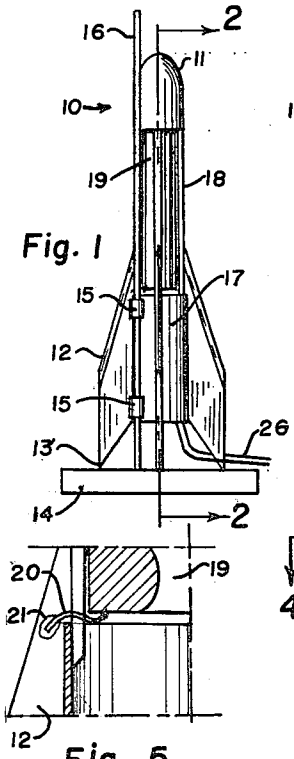

Fig. 1

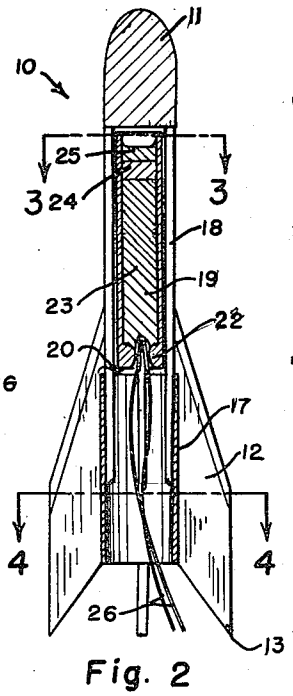

Fig. 2

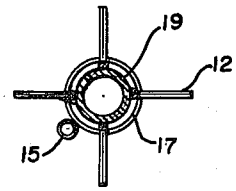

Fig. 3

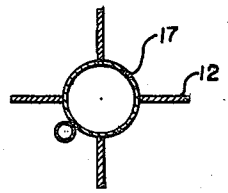

Fig. 4

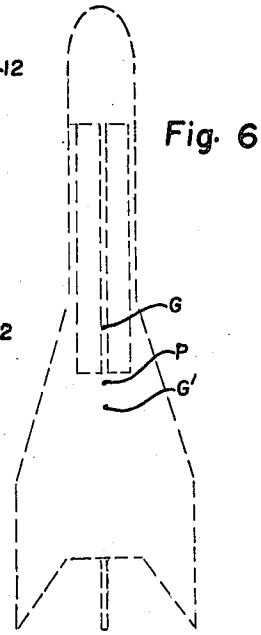

Fig. 6

Fig. 5

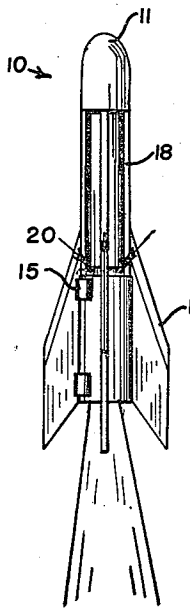

Fig. 7

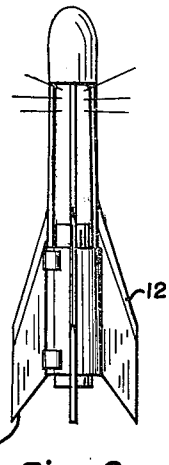

Fig. 8

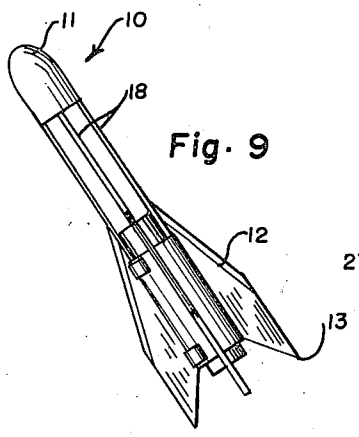

Fig. 9

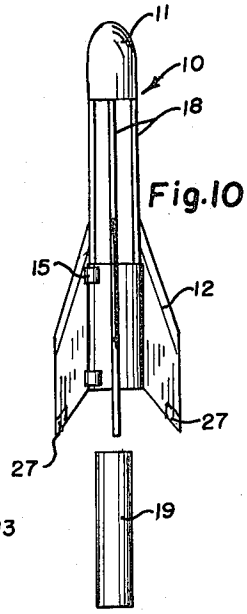

Fig. 10

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MODEL ROCKET

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This invention relates to rockets and more particularly to operative model rockets which fly much in the same manner as do prototype units, a primary object of the invention being to provide a novel and improved model rocket which is especially adapted to fly to an extensive height and to then be recovered for reuse.

Another object of the invention is to provide a novel and improved reusable model rocket which is adapted to be propelled by a standard type of a replaceable fuel cartridge and which is adapted to advantageously use the bulk of such a cartridge to facilitate a properly directed upward flight and a retarded fall thereafter.

Another object of the invention is to provide a novel and improved reuseable model rocket which is constructed with safety objectives in mind to insure not only safety in the ignition and upward flight of the rocket but also safety when the rocket falls after its flight.

Yet another object of the invention is to provide a novel and improved reuseable model rocket which is propelled by a replaceable fuel cartridge and which is especially adapted to use the weight of this cartridge to cause the model rocket to fall, after reaching the peak of its ascension, in a safe predetermined manner and so prevent the model rocket from injuring anyone it might accidentally strike and also to prevent the model from being shattered or otherwise damaged whenever it strikes a pavement or like hard ground surface.

Yet other objects of the invention are to provide a novel and improved model rocket construction which is a simple, neat-appearing, low-cost, durable unit and is capable of flying to considerable heights with a predetermined charge of fuel.

With the foregoing and other objects in view, all of which more fully hereinafter appear, my invention comprises certain novel and improved constructions, combinations and arrangements of parts and elements as hereinafter described, defined in the appended claims, and illustrated in preferred embodiment in the accompanying drawing in which:

FIGURE 1 is a side elevational view of a model rocket constructed according to my invention as being mounted upon a launching pad.

FIGURE 2 is a longitudinal sectional view of the unit as taken from the indicated line 2—2 at FIG. 1, but on an enlarged scale.

FIGURE 3 is a transverse sectional view as taken from the indicated line 3—3 at FIG. 2.

FIGURE 4 is a transverse sectional view as taken from the indicated line 4—4 of FIG. 2.

FIGURE 5 is a fragmentary portion of the showing at FIG. 2 but on a greatly enlarged scale.

FIGURE 6 is a diagrammatic outline of the rocket body illustrating the location of the lateral center of pressure thereof and the center of gravity which is shifted in accordance with the principles of the invention.

FIGURE 7 is similar to FIG. 1, but showing the rocket as being in flight and with the pattern of the gases being diagrammatically indicated.

FIGURE 8 is similar to FIG. 7, but showing how a frontal explosion of the fuel cartridge forces it to shift its position and thereby change the center of gravity and with the pattern of the explosive gases being diagrammatically indicated.

FIGURE 9 is similar to FIG. 8, but showing the rocket in a typical position it will assume when falling.

FIGURE 10 is similar to FIG. 8, but showing another

manner in which the center of gravity of the rocket may be shifted by a frontal explosion of the fuel cartridge but where the explosive gases completely expel the fuel cartridge.

The development of lightweight operative model rockets is similar to the development of operative model airplanes in that model airplanes have been constructed along general lines of current types of prototype airplanes and fly in much the same manner as do their prototypes. However, because model rockets must be use powerful and sometimes explosive fuels, the same as prototype rockets, there is an element of danger for the amateur which does not exist in the building and flying of model airplanes. Several actual injuries and damage occurrences connected with the flying of rockets by amateurs have caused both advocates of model rocketry and civil authorities to impose restrictions upon the construction and flying of model rockets in order to promote safety.

In line with the above factors, most authorities permit model rockets to be of a type which is recoverable and reuseable, but insist that a standard type of factory-made fuel cartridge be used. Such cartridges can be loaded under controlled conditions for maximum safety in burning. Also, it is required that the light weight rockets fall after their upward flight at a reduced velocity. Under no circumstances should the rocket fall to the earth point first in the same manner as it flies when it rises. A rocket body is similar to an arrow in its flight. Even though it must be very light in weight to attain a substantial height in its flight, when a rocket falls point first with a minimum air resistance to retard its speed of all, it becomes a dangerous weapon. In the first place, the striking of a hard ground surface will shatter the necessarily lightly constructed body. Should it strike a person it is apt to do injury. A sidewise or backwards fall is preferred, for the rocket body is then able to take advantage of air resistance to retard its fall.

With these and other factors in view, the present invention was conceived and developed. The invention comprises in essence an improved model rocket body adapted to receive a standard type cylindrical rocket motor. The model rocket is especially balanced to fly in a proper manner during its upward flight, but it is also adapted to become unbalanced as the motor burns out and will fall in a sidewise or similar erratic manner. This will reduce the speed of the fall and minimize the possibility of damage or injury.

Referring more particularly to the drawing, the body 10 of the model rocket is typically elongate in form having a suitable nose structure 11 at its leading end and tail fins 12 at its trailing or rearward end. In preferred construction, the tail fins 12 taper outwardly and rearwardly to define supporting points 13 rearwardly of the trailing end of the body 10 to permit the model rocket to set upon a launching pad 14 in a suitable vertical position for initiating flight thereof. To supplement this supporting means for launching the rocket, the body 10 may also include suitable guide sleeves 15 which are threaded onto an upstanding launching stem 16.

The body 10 of the rocket is suitably divided into an open forward section and confined rear section, and the rear section is a short lightweight tubular shell 17 from which the tail fins 12 outstand. The shell 17 also carries within it a cage-like array of longitudinally extending spars 18 which extend forwardly to the shell to form the open forward section and these spars connect to the nose 11. These spars 18 are spaced circumferentially about and in spaced parallelism with the central longitudinal axis of the rocket with their inner edges forming cylindrical guideways through the body of the rocket.

These guideways are adapted to hold a cylindrical rocket motor 19 with a light frictional fit so that the motor

may be pushed to the forward end of the rocket body in position for use and it is contemplated that the length of this forward section is substantially the same length of the motor. A short lock-wire clip **20** is attached to one of the spar members as by a drop of glue **21** at a location adjacent to the base of the motor. It is directed inwardly as to assist in holding the motor in position. It may be operated in a resilient manner or it may be of malleable material which is easily bent to a desired shape.

The cylindrical rocket motor **19** is usually factory made and the size of such motor is standardized to a selected length and diameter. It is therefore, a simple matter to provide for a desired tightness of fit in the guideways formed by the longitudinal spars **18**. If desired, certain portions of these spars may be formed with an inward arch to a slight degree to flex outwardly when a motor is inserted to give a proper frictional fit. The type of motor used with the rocket includes a suitable nozzle **22** at its discharge end, and several powder charges within the body of the motor. The charges include first, a charge of propulsive powder **23** within the rocket body adjacent to the nozzle **22**, a delay charge **24** within the rocket motor near the forward end thereof which is adapted to ignite as the propulsive charge burns out, and an explosive charge **25** of powder adjacent to the front end of the rocket motor which is adapted to ignite as the delay charge burns out.

This explosive charge **25** which is used specially as hereinafter described, will eject gas at the front of the rocket motor, and is conventionally used in model rockets for ejecting parachutes and the like, after the rocket has reached its maximum elevation. A conventional fuse at the nozzle may be used to ignite the model rocket or, as illustrated, the ignition may be obtained with a resistance wire **26** which is inserted into the discharge nozzle of the model rocket.

In operation, the model rocket is loaded with a motor **19**, the wire **26** is set and the model is then mounted upon its launching pad, as indicated at FIGS. 1 and 2. A suitable electrical charge ignites the rocket motor and the effect of the jet blast from the rear end of the motor drives the unit upwardly to a substantial height before the propulsive charge **23** burns out. The construction of the tubular shell **17** wherein the longitudinal array of spars is set provides for an air inflow ring at the upper rim of the shell **17** as indicated by arrows at FIG. 7. This will supplement and increase the effectiveness of the reactive action of the propulsive gases of the jet issuing from the discharge orifice of the motor to increase the driving power of the motor to permit the model rocket to be driven to greater elevations than would otherwise be possible.

When the propulsive charge **23** has burnt out the model rocket will have attained a considerable speed and it will coast during the burning out of the delay charge **24**. As the rocket approaches the peak of its flight the explosive charge **25** at the front end of the rocket motor ignites. The force of this explosive charge displaces the wire retainer **20** holding the motor in its selected driving position at the forward end of the rocket body and the action of this explosive charge at the front end of the rocket motor drives the motor rearwardly in the rocket body with the excess force of the charge being released laterally through the opening of the rocket body between the spars and with the motor being positioned near the rearward end of the rocket as illustrated at FIGS. 8 and 9. The model rocket is then ready to fall to the earth.

In falling to the earth, it is essential that this model rocket fall at reduced speeds and even though the model rocket is very light in weight it is desirable and necessary to take full advantage of the air resistance encountered during the fall to keep the speed of the fall at a minimum. Thus, while proper flying action of the model rocket involves driving the rocket upwardly with the leading end point first as in the manner of the flight of an arrow, the

manner of fall must be otherwise and it is desired that the rocket fall in a sidewise position tumble or even fall backward as indicated at FIG. 9.

The physical factors which control the manner of the fall of this model rocket depend upon the location of the center of gravity with respect to the lateral center of pressure of the rocket body. The outline indicated at FIG. 6, locates the center of pressure P, the center of gravity G, with the motor in its initial position, and the center of gravity G' when the motor is driven to its rearward position. With the center of gravity ahead of the center of pressure the rocket will fly point first and such is the proper weight distribution for the rocket when it is flying upwardly. If the same condition is maintained at the termination of the flight, the rocket will actually arch itself over and fall downwardly point first. However, it was discovered and ascertained that if the center of gravity were shifted rearwardly and behind the center of pressure location as at the point G', the model rocket would not maintain its directed position of minimum air resistance but it would fall in a desired flatwise or erratic manner as indicated at FIG. 9. It is immediately apparent that the shifting of the rocket motor cartridge from the forward to the rear end of the model rocket is very simple and effective to accomplish this shift of weight. Other expedients, such as projecting a parachute, the blowing the rocket apart or the like in order to obtain a properly retarted fall in the interest of safety are not needed.

In the unit illustrated at FIG. 10, the friction of the spars or other motor holding means is adjusted so that the rocket motor is blown completely from the rocket body rather than being merely moved to the rear end thereof, and in such construction it is still possible to attain the desired shifting of the center of gravity by proportioning the model rocket in a manner which places the center of gravity to point G ahead of the center of pressure point P when the rocket motor is near the forward end of the body but shifting the center of gravity to point G' behind the center of pressure point P when the rocket motor is ejected from the body. To assure such balance suitable weighting means such as clips **27** may be located at the tip end of the tail.

I have now described my invention in considerable detail and it is immediately obvious that others skilled in the art can devise and build alternate and equivalent constructions which are nevertheless within the spirit and scope of my invention. Hence, I desire that my protection be limited not by the constructions illustrated and described, but only by the proper scope of the appended claims.

I claim:

1. A model rocket adapted to be driven by a model rocket unit motor of the type having a burnable propulsive charge at its discharge end and a small burnable explosive charge at its leading end adapted to be ignited after the propulsive charge is burnt out, and comprising in combination therewith:

(*a*) a hollow tubular body having a leading nose piece closing the leading end of the body and with the trailing end of the body being open to receive the unit motor;

(*b*) tail fins at the trailing end of the body;

(*c*) releasable holding means for normally holding the motor within the body near the forward end thereof as during the propulsive stage of its flight when the propulsive charge of the motor is burning and is being discharged from the trailing open end of the body, said releasable means being adapted to release the motor from its normal position near the forward end of the body and permit it to move towards the trailing open end of the body responsive to the pressure created by the burning of the explosive charge; and,

(*d*) a sidewall opening in the body at the forward end thereof adapted to release excess pressure created

by the burning of the explosive charge of the motor and thereby prevent the explosive charge from rupturing the body.

2. A model rocket adapted to be driven by a model rocket unit motor of cylindrical type having a burnable propulsive charge at its discharge end and a small burnable explosive charge at its leading end adapted to be ignited after the propulsive charge is burnt out, and comprising in combination therewith:

(*a*) a hollow tubular body having a leading nose piece closing the leading end of the body and with the trailing end of the body being open to receive the unit motor,

(*b*) tail fins at the trailing end of the body; and

(*c*) releasable holding means for normally holding the motor completely within the body near the forward end thereof as during the propulsive stage of its flight when the propulsive charge of the motor is burning and is being discharged from the trailing open end of the body, said releasable means being adapted to release the motor from its normal position near the forward end of the body and permit it to move towards the trailing end of the body responsive to the burning of the explosive charge:

wherein, the positioning and proportioning of said body and tail fins is such as to place the center of gravity of the model rocket and motor therein at a point forwardly of the rocket's center of pressure when the unit motor is normally positioned at the forward end of the rocket body and to place the center of gravity at a point rearwardly of the center of pressure when the motor is shifted rearwardly from the said normal forward position.

3. In the combination defined in claim 2, longitudinal

openings in a regular array about the leading end of said body adapted to release excess pressure created by the burning of the explosive charge of the motor and thereby permit the burning of the explosive charge to shift the motor rearwardly in the body without rupturing the body, and to effect such release in a balanced manner.

4. In the combination defined in claim 2, wherein said holding means includes guideways formed by a cage-like array of longitudinally extending spars at the forward end of the body.

5. In the combination defined in claim 2, wherein said holding means includes guideways formed by a cage-like array of longitudinally extending spars at the forward end of the body, said spars extending towards the rear of the body and means adapted to hold the motor at the rear end of the body in the embrace of said spars after it is shifted by said explosive charge.

6. In the combination defined in claim 2, wherein said holding means includes a yieldable finger adapted to be pushed aside whenever the explosive charge moves the motor rearwardly.

7. In the combination defined in claim 2, wherein the body structure and holding means includes guideways formed by a cage-like array of longitudinally extending spars encased within a body shell, said shell being positioned at the rearward section of the body with the spars extending forwardly therefrom to form an open section and provide for a booster air flow space between the shell and the unit motor carried within the spars.

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