Feb. 2, 1960 R. J. FISSEL 2,923,089

MULTI-STAGE PROJECTILE

Filed May 12, 1958

Fig.1

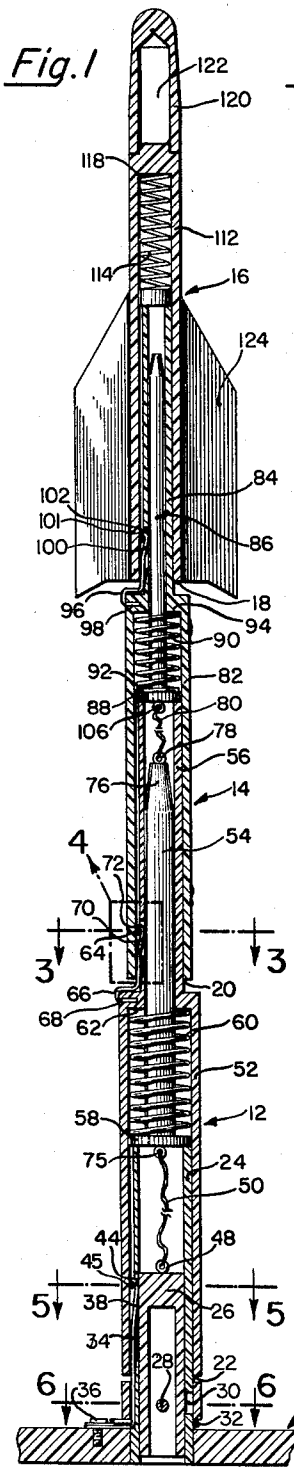


Fig.2

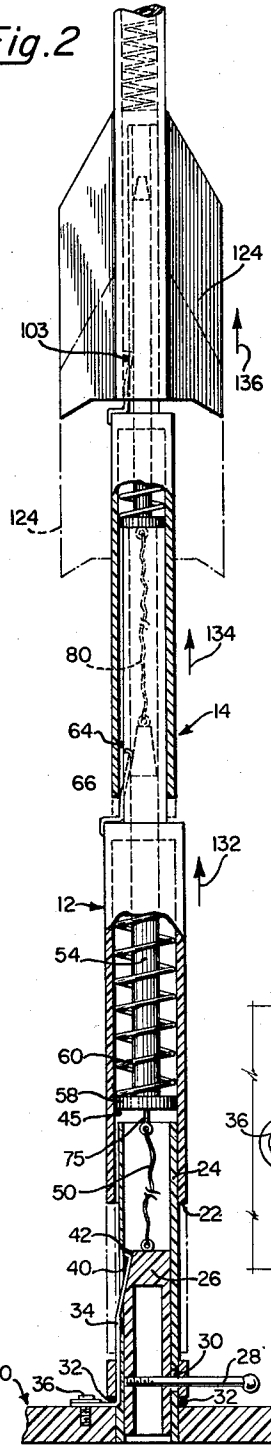


Fig.3

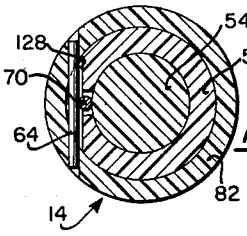


Fig.4

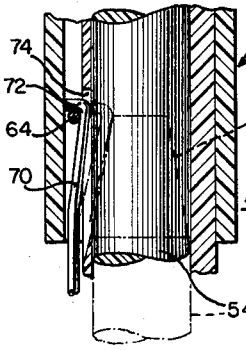


Fig.5

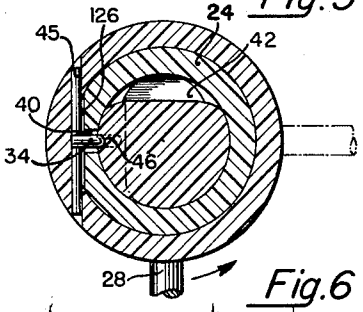
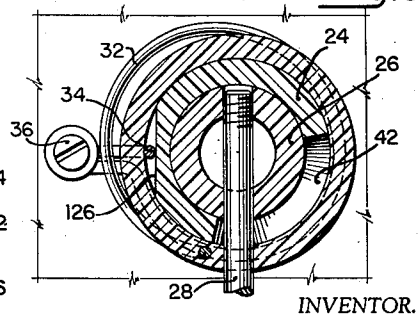


Fig.6



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MULTI-STAGE PROJECTILE

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5 Claims. (Cl. 46—74)

This invention relates to a multiple unit projectile and more particularly, although not necessarily exclusively to a multi-stage spring actuated rocket assembly.

Known prior art devices of the aforedescribed category have for the most part been single stage units in which the energy required for launching or catapulting has been variously derived from explosive charges, compressed air or a spring. In each instance, however, with the possible exception of weapons of war, the apparatus has generally taken the form of a single unitary assembly utilizing either a base structure for housing the launching mechanisms or consists of a device wherein the propulsion apparatus is housed within the rocket assembly itself.

In order to produce sufficient force or power to launch a device of the foregoing self-propelled type into the air, a relatively large diameter stiff spring is used or where overall body length is of slight consideration a long narrow relatively flexible coiled spring is employed. Those rocket assemblies wherein the air borne unit is separable from the propulsion unit, generally utilize a platform structure which also acts as a housing for the required power plant. Such latter propulsion means may consist of a compressed air pump, reservoir and trigger mechanism, or, a relatively large coiled spring and a release mechanism, or in some instances the combination of a spring and air actuated device. Some known rocket projectiles combine a coiled spring housed within the rocket assembly with a coiled spring contained within a base supporting structure on or into which the assembled rocket is initially loaded.

In any case, the motive force whether spring, explosive charge or compressed fluid, i.e., air or gas, is limited by the initial size of either or both the rocket device and the launching mechanism. This latter power limitation can be circumvented somewhat by increasing the number of spring coils, lengthening and/or stiffening the springs, increasing air pressure etc. Such methods however, are relatively unsatisfactory and have resulted generally in apparatus which is bulky, cumbersome and unwieldly to handle.

It is an important object therefore of the present invention to provide a multi-stage rocket assembly which overcomes the foregoing difficulties in a new and unusual manner.

Still another object of the present invention is to provide an improved multi-stage rocket assembly having relatively few parts which is simple and economical to fabricate and assemble.

A still further object of this invention is to provide a multi-stage rocket assembly capable of automatically launching one or more stages, as desired.

An additional object of the invention is to provide a multi-unit projectile having a plurality of separable, interconnected portions, each portion being separated from the next adjacent portion under the combined acceleration provided from a self contained power unit and the forward thrust of the previous stage or unit.

Another object of this invention is to provide a multiple unit projectile whose component units automatically separate in flight, release of each unit being triggered by means of an individual latch which is carried in each of the units making up the rocket assembly.

A preferred embodiment of the multi-stage projectile constructed in accordance with the teaching of the present invention comprises a plurality of sub assemblies or stages which are telescopically slidably assembled together and disposed upon a projectile supporting-launching structure or base. Each stage is self propelled by means of a coiled spring which is or may be housed externally or internally of the stages, or both, if desired. Each stage is provided with a latch-release mechanism adapted to engage the next preceding unit or stage. The base or launching pad is provided, in addition to its own latch-reelase mechanism, with a trigger device adapted to release all of the stages substantially simultaneously, at will. Launching of the releasably connected stages from the base actuates each latch-release mechanism whereupon the final free flight stage becomes airborne.

Other objects and advantages of the present invention will be apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

Fig. 1 is a sectional view in side elevation of the assembled multi-stage projectile of the present invention;

Fig. 2 is a view similar to Fig. 1 but showing the stages slightly separated as they would appear immediately after launching;

Fig. 3 is a detail view taken along line 3—3 of Fig. 1;

Fig. 4 is a partial section detail within the dotted outline 4 of Fig. 1 showing the latch-release mechanism of the present invention;

Fig. 5 is a detail sectional view of the latching mechanism of the invention, the view being taken along the line 5—5 of Fig. 1; and

Fig. 6 is a sectional view taken along the line 6—6 of Fig. 1 illustrating the trigger launching mechanism of the invention.

Construction

Referring first to Fig. 1, a preferred embodiment of an assembled multi-stage projectile constructed according to the present invention is seen to comprise four main parts, units or stages as follows: launching base **10**, a first movable stage **12**, a second movable stage **14** and a third or final free flight stage **16**. Only three movable stages are shown in the present embodiment, however, it is to be understood that any number of stages may be used with this invention, the number of stages being limited by the desired size and handling ease of the final assembly.

The launching pad, hereinafter referred to as the base **10**, is or may be fabricated from any suitable material having sufficient rigidity to withstand the initial surge of pressure developed at the instant of release of the three movable stages.

With the exception of the base **10**, the three stages **12**, **14** and **16** are substantially similar in construction, certain exceptions being noted hereinafter. Each stage is fabricated from suitable light weight material having sufficient rigidity to be formed or shaped into a hollow cylinder or tube, for example, as shown. The shape is a matter of choice.

In Fig. 1 it can be seen that the three stages which are to be launched from the base **10** are each constructed so as to provide a portion which is capable of being telescopically interfitted with the next adjacent stage including the base upon which the assembled projectile is initially loaded. Each stage beginning with the free flight stage **16** to and including the stage **12**, consists of a

hollow tubular member of graduated and decreased diameter, as shown. The open end portion **18**, of member **16** is telescopically slidably received over the upper narrow reduced portion of member **14**. Likewise, the open end **20** of member **14** is slidably received over member **12**. Member **12** in turn has its open end **22** slidably received over the lowermost upstanding hollow cylindrical launching guide tube member **24** which is secured to the launching base **10**.

Launching base

As can be seen from Figs. 1 and 2, the launching base **10** comprises a supporting member such as a plate of any suitable rigid material e.g., wood, metal, plastic etc., to which is secured the aforementioned launching guide tube **24**. The specific choice of the various projectile parts is or may be determined on the basis of cost, weight, ease of handling and fabrication. A trigger shaft **26** is axially rotatable within the guide tube **24** and is controlled by means of a trigger handle **28** threadedly or otherwise secured thereto through the arcuately elongated slot **30** in the tube **24**. A coiled trigger return spring **32** biases the trigger handle **28** into an inoperative position, as will hereinafter be described. A trigger spring **34** of suitable resilient material is secured to the base plate **10** as by a screw **36**. The upstanding portion of the unsecured end of the trigger spring is inwardly bowed or bent as indicated by reference character **38** and is initially biased so as to project inwardly of the assembly through a slot **40**, Fig. 5, in the guide tube **24** so as to rest in its untensioned or relaxed condition against slanting cam surface **42** of Fig. 2 of the trigger shaft **26**. The terminal end of the trigger spring **34** is hook shaped as shown by reference character **44** for latching engagement with guide pin and trigger catch **44** disposed in stage one for a purpose to be described later on. Rotation of the trigger handle will cause the slanted cam surface **42** to move or cam the hook shaped spring end **44** outwardly through the slot **40**, Fig. 5, away from the guide tube to snap over the aforementioned pin **45**. A notch or recess in the upper end of the trigger shaft **26** permits the shaft **26** to be locked in place after rotation from the position of Fig. 1 to that of Fig. 2 cocking the mechanism as hereinafter described. The upper end of the trigger shaft **26** is also provided with an eyelet **48** or other similar means for attachment thereto of a cable **50** the purpose of which will appear more clearly hereinafter.

First stage

The first stage **12** comprises a hollow cylindrical projectile shell having an elongated portion **52** slidably receivable over the guide tube **24** of the launching base **10**. A cylindrical trigger or piston rod **54** slidable within the reduced upper portion compressing the first stage guide tube **56** is provided with a piston **58** of suitable material, such as Bakelite, at one end thereof. A piston return spring **60** provided with a prescribed slight initial compression surrounds the piston rod and is seated against and retained by the piston **58** at one end and the shoulder **62** of the opposite end of the first stage shell. A guide pin and trigger catch **64**, Fig. 4, projects through the guide tube **56** for a purpose to be described presently. The bottom surface of the piston **58** rests against guide pin **45** when the spring **60** is in its initially compressed or uncocked condition. The hook shaped end of trigger spring **34** in the base **10** engages pin **45** when the assembly is cocked as shown in Fig. 1 and as will become more apparent as the description proceeds. Secured to the shell, as shown at **68**, is a trigger spring **66** substantially identical to spring **34** in the launching base **10**. The free end of spring **66** including its inwardly bent or bowed portion **70** and the hooked end **72** projects inwardly of this shell through a slot **74**, Fig. 4, in the lower end of the guide tube **56** so as to rest when in its relaxed condition as shown in the dotted outline of Fig. 4. An eyelet **78** similar to eyelet **48** is secured to the frusto conical end **76** of the piston rod for the securement thereto of a cable **80** similar to cable **50**. Eyelet **75** on the piston **58** permits the cable **50** to join the launching guide tube **26** to the first stage for purposes to be explained later on.

It is apparent from the foregoing that telescopic compressive movement of the piston and piston rod, i.e., compressing spring **60**, as in cocking the assembly, will cause the frusto conical portion **76** to force the trigger spring **66** outwardly through the slot **74** causing the hook shaped end **72** to snap over the guide pin **64** locking the first stage to the launching base **10**.

Second stage

Still referring to Figs. 1 and 2, the second stage **14** is seen to comprise a hollow cylindrical shell **82** having a reduced upper end portion forming a second stage guide tube **84**. A trigger or piston rod **86** carrying a piston **88** at one end thereof, is provided with a piston return spring **90** one end **92** of which abuts the inner surface of the piston while the opposite end of this spring abuts the shoulder **94** at the base of the guide tube **84**. A trigger spring **96** substantially identical to the springs **34** and **66** is secured to the shell **82** as at **98** while the upwardly extending inwardly bent portion **100** and the hook shaped end **101** thereof, projects through a slot **102** in the guide tube **84**. A guide pin and trigger catch **103** is disposed in the lower portion of stage three. The piston **88** rests against pin **64** when spring **90** is uncocked. As with the preceding stage compressive movement of the piston **88** and piston rod **86** as by mounting on this stage as on the preceeding stage will force the frusto conically shaped end **110** of the piston rod against the trigger spring **96** moving the hook shaped end **101** outwardly through a slot **102** within which it is disposed, to engage the pin **103** and latch this stage to the preceding lower stage. An eyelet **106** is or may be used for the attachment thereto of the cable **80** for a purpose presently to be explained.

Third, free flight stage

The third or final free flight stage **16** comprises a hollow cylindrical shell **112** carrying a launching spring **114** retained therein by means of the guide pin and trigger catch **103**, Fig. 2, at one end thereof and the end wall **118** of the shell at the opposite end.

Stage **116** is designed for free air flight and to this end it is provided with an aerodynamically shaped nose cone **120** which is or may be provided with a hollow chamber **122** for carrying a lowering parachute permitting the recovery of the stage without undue damage due to the shocks incurred during rapid descent or on contact with the earth's surface. Additionally, the third stage is or may be provided with a plurality of laterally projecting guidance surface members **124** forming air foils for greater sustained free flight and to prevent or reduce rotative or twisting motion after launching. Such guidance members can be fabricated integrally with the shell **112** or they may be secured thereto in any suitable and well known manner.

It may be desirable in some instances to load the nose cone chambers with a low velocity explosive charge in which case it is necessary to make provision for preventing any blow back from deleteriously effecting the mechanism within the central body portion of this stage as by fabricating the nose cone itself from light weight metal or similar material.

In order to provide for proper and accurate orientation of the various stages one with another, and with the launching base **10**, launching guide tube **24** and first and second stage guide tubes **56** and **84** are each provided with an elongated flat surface portion **126** and **128** respectively, extending the length of each guide tube. Only the flat surfaces of guide tubes **24** and **56** being shown in the drawing. Since each shell will matingly fit or be received over only one guide tube, the flat surfaces prevent any accidental misalignment of stages. In addition

since the flat surfaces are formed on the same sides of the guide tubes as that on which the trigger springs are each located, the possibility of failure of the trigger spring to latch with its mating guide pin is thus avoided.

Time delay is designed and built into the present invention and is or may be varied by means of the piston rods whose length may be altered or changed to suit the specific conditions desired. Delay may also be provided through the medium of individual orifices not shown, in the pistons **58**, **88** respectively. Each orifice is or may be provided with an adjustable air bleed screw, also not shown, so that a desired exact and measured amount of air can escape from the shells **12** and **14** during the expansive release of the springs **60** and **90**, respectively during launching.

In order to assure that the three stages when loaded and cocked onto the base will not be accidentally dislodged or slip into a release or launching condition, the upper surface portion of the base trigger shaft **26** is provided as before noted, with the notch or nick **46** into which the spring **34** will positively seat or engage.

Loading operation

With the base guide tube **24** disposed in a vertical position, e.g., as shown in Fig. 2, the first stage **12** is placed on guide tube **24** so that the guide pin and trigger catch **45** is in substantial alignment with the flat side **126** of the base guide tube **24** and the piston **58** in position to seat upon the upper end of the tube **24**. The second stage **14** is then telescopically slidably received on the guide tube **56** of the first stage **12** so that guide pin and trigger catch **64** are in alignment with the flat side **128** of the first stage guide tube **56**. The third or final stage **16** is placed on the guide tube **84** of the second stage so that guide pin and trigger catch **103** is in alignment with the flat side (not shown) of the second stage guide tube **84**. The three stages are now ready to be cocked. The third stage **16** is pressed downwardly until it bottoms on or abuts the next lower stage which causes the spring **114** to be compressed. As the third stage continues its downward movement the trigger catch pin **101** passes the plunger end **110** just prior to the trigger spring **96** which then rides along the conical part of the plunger to be pressed outwardly to latch over the pin **101**. With these two stages held together the third and second stages are pressed downwardly onto the first stage compressing each of the second and first stage springs **90** and **60** to thereby latch the stages together in the manner described for the latching of the third stage to the second stage.

The downward travel of stages **12**, **14** and **16** relative to the pistons **58** and **88** forces each of the frusto conical end portions **76** and **110** to engage and press outwardly the respective springs **66** and **96** with its respective hook shaped end portion **72** and **101**. Each portion **72** and **101** of each spring is thus permitted to snap over its associated guide pin **64** and **103**. Arcuate rotation of the trigger handle **28** through cam **42** presses the lower trigger spring **34** outwardly causing its hook shaped end **44** to snap over the guide pin **45** thus latching i.e., cocking the three stages together as a unitary but automatically separable assembly.

Firing

The trigger handle **28** which may be moved remotely or by hand as desired, is turned to its uncocked position, Fig. 2. As the handle turns, the trigger spring **34** springs back into the slot **40** in the side wall of the tube **24**. This action releases the hook shaped spring end **44** from the guide pin **45** causing the first stage **12** to be ejected under expansion of the stored energy of the piston return spring **60** which compressive force has now been released. This force launches the three stages **12**, **14** and **16** in the direction of the arrow **132**, substantially together. When the stage **12** has moved approximately 95° of its travel, it releases the trigger spring **66** and the second and third stages are launched together, arrow **134**.

When stage **14** has travelled for approximately 95° of its travel the trigger spring **96** is released from its guide pin **103** and the third stage is launched into free flight, arrow **136**. The third stage is aided in its upward movement by the additive force of its own launching spring **114** which was also under compression as earlier described but now released to propel the projectile outwardly away from the other stages.

The first and second stages are easily recoverable by means of the cables which may be used therewith. Suitable bright colors can be used to mark or identify the third stage to prevent its accidental loss after launching.

What is claimed is:

1. A multiple stage projectile of the character described comprising, a fixed base, a guide member upstanding from said base a first stage telescopically slidably mounted on said guide member, a second stage telescopically slidably mounted on said first stage, a third free flight stage telescopically slidably mounted on said second stage, means releasably securing together said second and third stages, means releasably securing said second stage to said first stage, means releasably securing said first stage to said base, self-propelling means in each stage, a trigger in said base operable to release said securing means to eject said first stage from said base by said propelling means, means disconnectibly releasing said second and third stages while in flight by the self propelling means within said stages acting upon said means securing said stages together.

2. A multiple stage projectile comprising, a fixed launching base, an upstanding guide member rising from said base, a first stage tube slidable on said member, a releasable latch connecting said tube to said base, means including a compression spring to eject said tube when said latch is released, means operable at will for releasing said latch to eject said tube by said spring, a second stage tube slidable on said first stage tube, a releasable latch connecting said tubes together, means actuated by the ejecting movement of said first stage to release said second stage latch, and means including a compression spring for ejecting the unlatched second stage from the first stage, whereby the two stages are successively ejected for free flight.

3. A multiple stage projectile according to claim 2, wherein third stage member is slidable on said second stage tube, a releasable latch connecting said third stage member to said second stage tube, means actuated by the ejecting movement of said second stage for releasing the latch of said third member, and means to propel the released third stage member.

4. A multiple stage projectile comprising a fixed base, a guide member rising from said base, a closed end first stage tube telescopically slidable on said member, a latch connecting said tube and said member in telescoped condition, a piston in said tube, a piston rod projecting through said closed end, a spring compressed between said piston and said end to eject said tube when said latch is released, trigger means in said base to release said latch, a second stage tube telescopically slidable on said first tube, a latch connecting said tubes in telescoped condition, and means controlled by said piston rod for releasing said second tube latch in response to the ejecting movement of said first stage tube.

5. A multiple stage projectile comprising a fixed launching base, an upstanding guide member rising from said base, a first stage tube telescopically slidable on said guide member, a second stage tube telescopically slidable on said first tube, a third stage tube telescopically slidable on said second tube, a releasable latch connecting said second tube with said first tube in telescoped condition, a releasable latch connecting said third tube with said second tube in telescoped condition, propelling means in each stage tube, means including rod carried

pistons respectively in said tubes for setting said propelling means, means carried by said pistons for successively releasing said latches by the propelled movement of said tubes, a latch connecting said first stage tube to said guide tube member, and trigger means to release said first stage latch to respond to the propelling means whereby the successive ejection of the second and third tubes releases the respective latches.

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