Jan. 8, 1957 R. A. ROBERT 2,776,622

DEVICE FOR ATTACHING AUXILIARY ROCKETS TO A FLYING MACHINE

Filed May 27, 1948 3 Sheets-Sheet 1

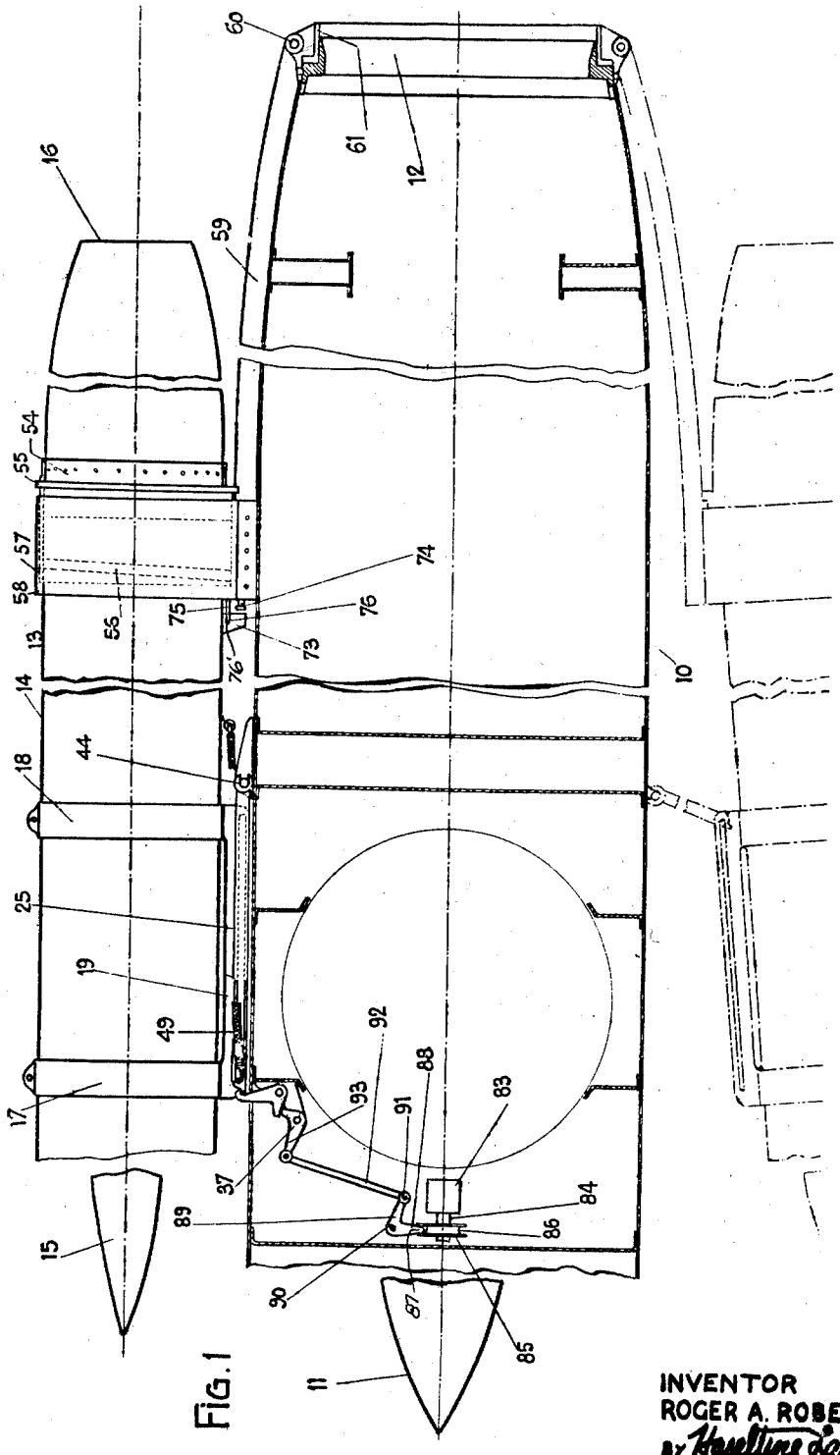


FIG. 1

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DEVICE FOR ATTACHING AUXILIARY ROCKETS TO A FLYING MACHINE

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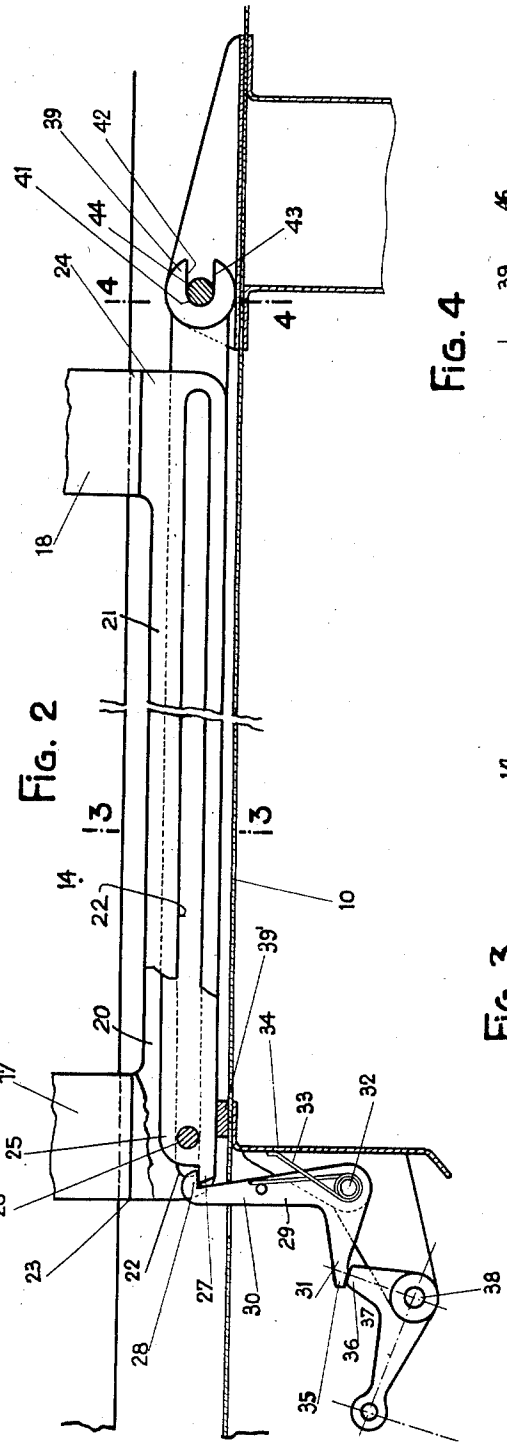


Fig. 2

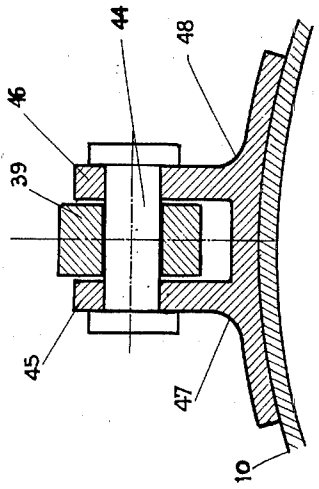


Fig. 4

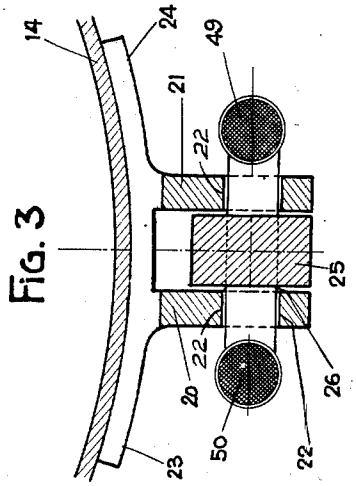


Fig. 3

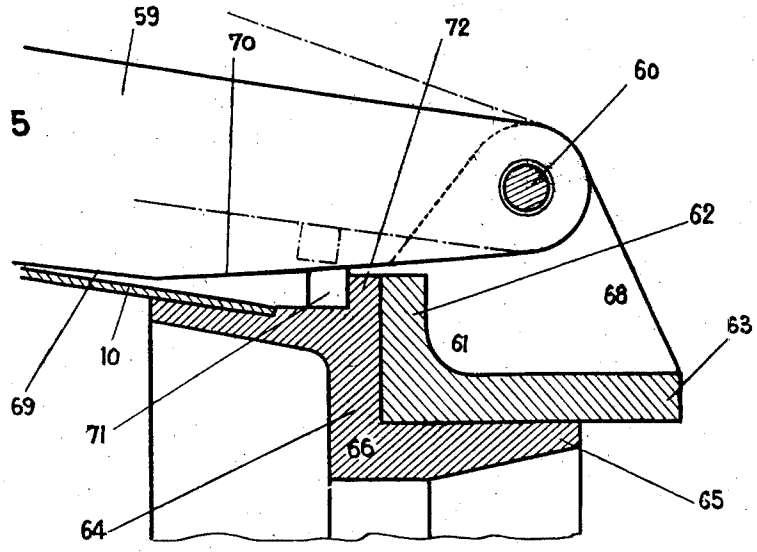
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FIG. 5



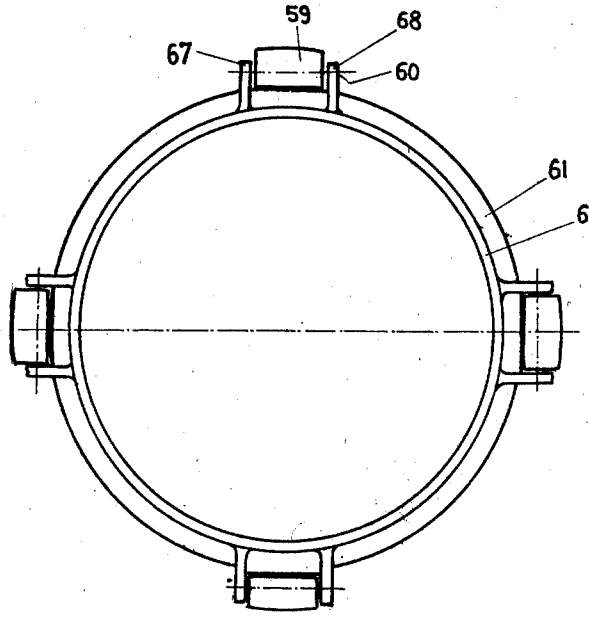
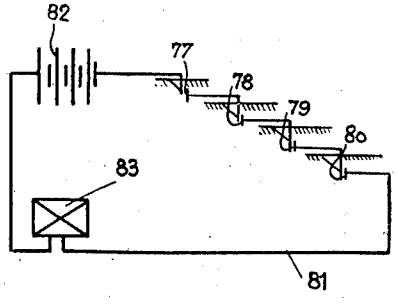


FIG. 6

FIG. 7



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United States Patent Office 2,776,622 Patented Jan. 8, 1957

2,776,622

DEVICE FOR ATTACHING AUXILIARY ROCKETS TO A FLYING MACHINE

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Application May 27, 1948, Serial No. 29,564

Claims priority, application France May 27, 1947

13 Claims. (Cl. 102—49)

It is known that in flying machines, guided missiles and the like, auxiliary propulsive means are sometimes used with the purpose of imparting to the machine, at the start thereof, a high rate of acceleration in order very rapidly to bring it to its normal speed, which is thereafter maintained by means of the main propulsive or drive unit of the machine.

The auxiliary propulsive or drive means ordinarily used are rockets, which are adapted to be automatically cast off or released so soon as they no longer develop any thrust. Now, the time during which such rockets are actually operative may vary as from one rocket to another, so that they are not as a rule cast off simultaneously. As a result, towards the end of the period of auxiliary drive, dissymmetrical effects occur which are liable to alter in an unpredictable manner the path of flight of the missile, and this is detrimental to the accuracy in firing.

It has been suggested to direct the propulsive actions of each of said rockets towards the center of gravity of the missile as a whole, so that the termination of the propulsive action of one or more of the auxiliary rockets should not introduce any disturbing torque.

Such a palliative remedy however is not sufficient, since it does not do away with the aerodynamical dissymmetry which occurs whenever the rockets are not cast off simultaneously.

The invention has for its object to provide a device for attaching and casting off auxiliary propulsive units to and from a flying machine, in particular a guided missile designed to convey an explosive charge towards a target, which will eliminate the above drawbacks.

It is an object of the invention to provide an attaching means for auxiliary drive units, of the rocket type, enabling all of the auxiliary rockets to be simultaneously cast off, after they have developed their full propulsive effect and regardless of the actual duration of the effective propulsive period supplied by each of them.

It is another object of the invention that throughout the full period in which the rockets are connected with the machine, including the casting-off stage, the rockets should remain symmetrically positioned with respect to the machine, thus allowing the predetermined trajectory thereof to be faithfully followed.

Another object of the invention is to provide for a safe and simple release of all of the auxiliary rockets after the explosive charge thereof has been burnt up.

It is a further object of the invention to positively avoid that the rockets, both during and after the release thereof, might contact the main body of the machine, thereby modifying its path of light.

It is yet another object of the invention to provide a flying machine (such as a guided missile) which, after the auxiliary drive rockets have been released therefrom, will not present any projection liable to increase its drag, and one in which the liftdrag ratio will be as high as in a similar machine free of any auxiliary drive units.

In the ensuing description given merely by way of

example reference is made to the accompanying drawings wherein:

Fig. 1 is a general view in elevation, partly in cross section, of an embodiment of my invention;

Fig. 2 is an enlarged view in elevation and partly in section of the latching device;

Fig. 3 is a cross-section on a still further enlarged scale on the line 3—3 of Fig. 2;

Fig. 4 is a cross-section on line 4—4 of Fig. 2, but on a larger scale;

Fig. 5 is a sectional view on an enlarged scale of the rear end of the machine;

Fig. 6 is a front view on a smaller scale of the rear outlet of the machine;

Fig. 7 is an electric wiring diagram.

The flying machine shown includes a fair-shaped main body or fuselage **10** (Fig. 1) having a tapered or ogee-shaped front portion or nose **11** and carrying the supporting surface or surfaces (not shown for greater clearness in the drawing). It contains in particular the main drive unit the propulsive jet of which issues from the rear jet outlet **12** of the machine.

Along the body **10** of the machine a number of auxiliary drive units such as rockets **13** are arranged, e. g. four in number, uniformly spaced around the machine, the angular spacing thereof in the example shown being 90°.

Each of the rockets **13** includes a fair-shaped body **14** with a tapered front portion or nose **15**, and a propulsive jet adapted to issue from the rear jet outlet **16**.

According to the invention each of the rockets **13** is so connected with the machine that, in being cast off therefrom, it is first adapted to be released at its front end, so as to pivot about its rear connection with the body of the machine, the final casting off being accomplished only as the center axis of the rocket forms with the center axis of the machine an angle greater than a predetermined value.

The body **14** of the rocket has attached thereto forwardly of its mid-portion and in spaced relationship to each other a pair of collars or rings **17** and **18**. Between said collars and rigidly connected thereto within the gap defined between the rocket body **14** and the main body **10** of the missile there is a slideway or slotted member **19**. The latter comprises a pair of side flanges **20** and **21** (see Figs. 2 and 3) each of which has a straight slot **22** formed therein, the rigid connection between the slideway and the collars **17** and **18** being effected through a pair of arcuate flanges **23** and **24** formed at the ends of the slideway. Between the side flanges **20** and **21** there is arranged a bar **25** which at the front thereof and projecting from each of its faces mounts a pair of pins **26** each adapted to engage the related slot **22**.

The front end of the bar **25** forms a nose **27** with which is adapted to co-operate a complementary nose **28** of a latch member **29** comprising a bell-crank lever **30—31** pivotally mounted on a pin **32**. A spring **33** bearing at one end against a thrust plate **34** rigid with the body **10** and exerting its action against the bell-crank lever arm **30** continually urges the nose **28** away from the nose **27**. Except in the casting-off periods this action is prevented through abutment of the end **35** of the arm **31** against the end **36** of a lever **37** pivotally mounted on a shaft **38**. Contact engagement between the planar faces of the noses **27** and **28** is maintained by the resilient action of a small block **39'**, of rubber or the like, clamped during assembly between the bar **25** and the fuselage **10**.

The bar **25** is rearwardly extended beyond the collar **18**. It terminates in a head **39** (Figs. 3 and 4) formed with a wide cut-out **40** including a semi-circular portion **41** and two straight portions **42** and **43** parallel or substantially parallel with the side edges of the bar. The head **39** co-operates with a stop-pin **44** having a

diameter corresponding with that of the semi-circular portion of the cut-out, so as to allow rotation of the head **39** therein. The pin or rod **44** is secured between the side flanges **45** and **46** of angle sections **47** and **48** rigid with the fuselage **10**. A pair of extensible rubber cords **49** and **50** or similar resilient means are interposed between the pins **26** and the related rocket **13**.

The rear portion of the rocket **13** has secured thereto a collar **54** formed with a circumferential flange **55**. The latter serves as a support for a coil spring **56** surrounding and spaced from the opposite portion of the body **14**. This spring is housed within a bushing **57** and its other end bears against a front circumferential flange **58** of said bushing. The bushing **57** is secured to one end of an arm **59** arranged adjacent to the rear portion of the fuselage **10** of the machine and the other or rear end of which is pivotally mounted around a pivot pin **60** on a circular flange **61**.

The flange **61** is formed with an angle-shaped cross section having two arms **62** and **63** (Fig. 5) respectively engaging the related arms **64** and **65** of a flange **66** rigid with the body **10**. The pivot pins **60** are arranged at the opposite ends of two diameters of the flange **61** extending at right angles to each other, each of said pins being mounted between two side flanges **67** and **68** (Fig. 6).

The face **69** of the arm **59** which lies opposite the body **10** carries towards its rear end a near-rectangular prismatic block **71** or similar projection co-operating with a bead **72** formed on the flange **66**.

The body **14** of each rocket immediately in front of the portion thereof surrounded by the bushing **57** carries a contact finger **73** adapted to co-operate with a complementary contact element **74** carried by the bushing **57**. Two projections **75** connected with the bushing **57** are arranged on both sides of the fingers **73**. They carry a shear-pin **76** extending through said finger through a bore **76'** of equal diameter.

The pairs of electric contacts **77**, **78**, **79** and **80** (Fig. 7) each formed by the co-operating contact elements **73** and **74** related to each of the rockets are connected in series in an electric circuit **81** supplied from a suitable source of current **82** such as a storage battery. In said circuit there is interposed the energizing means for an electrically operated jack **83** housed within the body (Fig. 1). The movable part **84** of said jack carries a grooved frame member **85** the groove **86** of which is engaged by rollers **87** each of which forms the termination of an arm **88** of a lever **89** rotatably mounted on a pin **90**. The outer end **91** of the opposite arm of said lever is connected through a link **92** with the arm **93** of the lever **37**.

The above-described attaching and releasing device operates as follows:

Prior to the starting of the machine or missile, each of the auxiliary rockets is positively maintained in its safety position by means of the pin **76** the shear-resistance of which is sufficient to prevent any displacement of the rocket with respect to the machine under the action of its own weight and of the spring **56**, thus preventing closure of the contacts **77—80**. Upon starting, and under the action of the thrust from the auxiliary rockets **13**, the shear-pins **76** are sheared and the rockets move slightly forward relatively to the main body **10** of the machine, against the action of the spring **56** already placed under compression. The rockets thus are caused to assume the position shown at the top of Fig. 1.

Throughout the full period they exert their propulsive action the auxiliary rockets retain an unchanged relative position with respect to the main body of the machine. The thrust is transmitted through the bushings **58** and the arms **59**. The construction of the rockets is such that in theory the combustion periods therein are the same. In practice however it very often happens that the propulsive actions of the rockets do not

terminate simultaneously. When the propulsive action of any one rocket ceases, the effect of the spring **56** relating to that rocket and of the air-drag becomes predominant and the rocket is caused slightly to recede rearwardly with respect to the main body of the machine. This movement is operative to close the corresponding electric contacts comprising elements **73—74**. It should be noted that it is after the four pairs of contacts **77** through **80** are closed that the electrically-operated jack **83** is actuated. So long as such is not the case the rockets remain latched with respect to the machine, since pivotal movement of the bar **25** is prevented due to the co-operation of the noses **27** and **28**; the thrust exerted by the rocket applies the arm **62** of the circular flange **61** against the arm **64** of flange **66**.

As the propulsive action of a rocket ceases, release of the flange **61** rearwardly is prevented through abutment of the prismatic element **71** against the bead **72** as long as the arm **59** has not swung through a predetermined angle. The arm is prevented from thus swinging because of the previous latching of the rocket which remains effective as long as the rockets have not all terminated their propulsive action.

Only when all of the rockets have stopped exerting their propulsive effect, the circuit **81** is closed and the electric jack **83** is actuated, thereby extending the projecting part of its movable element **84**.

The levers **89** then are simultaneously rocked, causing corresponding displacements of the links **92** and levers **93**; the ends **36** disengage the levers **29** and the latter, under the urge of the springs **33** retract the noses **28** from their position opposite the noses **27** of the bars **25**.

The action of the elastic cords **49** and **50** initiates the rocking movement of the bars **25** about the related pins **44**, and the opening-out or flaring movement of the rockets **13** with respect to the main body **10** thereafter mainly proceeds under the effect of the aerodynamic forces, as a result of the pivotal connection still remaining effective between the bars **25** and pins **44**. So long as the center axes of the rockets do not form with respect to the axis of the flying machine an angle in excess of a predetermined value, as illustrated by the position shown at the bottom of Fig. 1, the prismatic element **71** (Fig. 5) acts to prevent the flange **61** from slipping backwards with respect to the flange **66**. Beyond that position however the prismatic element **71** disengages the bead **72** and the whole assembly comprising the circular flange **61**, arms **59**, rockets **13**, collars **17** and **18**, slideways **19** and bars **25** is cast off. One or more parachutes, for instance one for each rocket unit, may be provided to allow said units to be ultimately reclaimed. At the time of release the rockets **13** are spaced sufficiently far away from the main body of the machine to avert any risk of their coming into contact with the latter. During the entire casting-off period the rockets remain symmetrically positioned with respect to the axis of the main body **10**, so that they do not interfere with the trajectory of the missile.

What I claim is:

1. Auxiliary propulsive device for a flying machine, which comprises a central collar, a plurality of rockets arranged in uniformly spaced relationship about and parallel with the axis of said collar, arms interposed between said collar and said rockets for supporting said rockets, and deformable resilient means deformable in the direction of said axis interposed between each rocket and its supporting arm.

2. In a flying machine, a central faired body, a plurality of auxiliary rockets arranged parallel with and along said body, and connecting means between said central body and said plurality of rockets comprising: a bearing rearwardly of and connected to said body, a collar surrounding said bearing, two cooperating abutment surfaces on said bearing and said collar respectively, and, associated with each rocket: an arm pivotally mounted

on said collar on a transversely extending pivot axis, a cup member laterally fixed on said arm on the outer side thereof, an aperture in said cup member adapted to allow one of said rockets to slidingly pass therethrough, an annulus secured on said auxiliary rocket, resilient means interposed between said cup member and said annulus, a first ring secured on said rocket forwardly of said annulus, a second ring secured on said rocket between said first ring and said annulus, a longitudinal rib integral with said rings and interposed therebetween, a longitudinal groove formed in said rib, a transversely extending projection integral with said faired body rearwardly of said rib, a bar longitudinally disposed between said faired body and the rocket, a two-tined fork at the end of said bar and cooperating with said projection, a pin integral with said bar at the opposite end thereof cooperating with said groove, resilient traction means interposed between said pin and said rocket and hookingly engaging said rocket at a point rearward of said projection, a nose on said bar, and a hook cooperating with said nose to block said bar, means for controlling retraction of said hooks with respect to said rockets, and comprising an electric motor within said central body, drive transmission means from said motor to said retraction controlling means, an electric feed circuit for said motor, switches in said circuit each comprising a contact element carried on a rocket and an opposite contact element carried on the corresponding annulus relating to said rocket, said contact elements adapted to cooperate together upon the action of said first named resilient means exceeding the opposing action of the propulsion jet of said rocket.

3. A flying machine which comprises a main rocket, a plurality of longitudinally extending auxiliary rockets spaced about said main rocket, connecting means between said main rocket and said auxiliary rockets resiliently deformable in a direction parallel with the common axial direction of said rockets, and frangible means rigidly connecting said main rocket with said auxiliary rockets and adapted to break upon exertion of the propulsive action of the auxiliary rockets.

4. In a flying machine, an elongated fair-shaped main body, a plurality of starting jet rockets arranged about said main body, a common support for said jet rockets removably mounted on the rear end of said body, means pivotally connecting said rockets to said support, latch means on said body and engaged with said jet rockets releasably securing said jet rockets and said support to said body, said jet rockets being supported for slight longitudinal movement relative to said body, resilient means urging said jet rockets longitudinally in a direction opposite to the direction they are moved by their propulsive action, and release means in said main body operated by longitudinal movement of said jet rockets when moved by said resilient means to release said latch means and free said jet rockets and said support to drop clear of said body when the propulsive action of all of said jet rockets has ended.

5. A flying machine according to claim 4, wherein said release means is electrically operated and comprises a member for releasing said latch means, a normally open switch for each of said jet rockets arranged to be closed when said jet rockets are moved by said resilient means, and a circuit connecting said member and said switches in series with a source of electric current to energize said member when all of said switches are closed.

6. In a flying machine, a faired body, a plurality of auxiliary jet rockets positioned about said body, a bearing ring mounted on the rear end of said body, a collar removably supported on said bearing ring, means connecting said jet rockets to said collar, cooperating abutments on said collar and said bearing ring to transmit the propulsive thrust of said jet rockets to said body, latch means on said body engaging said rockets and retaining said collar and rockets against rearward displacement relative to said body, and means on said body for releasing said latch means to free said rockets and collar to drop rearward off said body when all of said jet rockets have expended their propulsive thrust.

7. A missile, comprising a central body, a plurality of rockets uniformly spaced about the periphery of said body, a bearing ring mounted on said central body, a collar slidably positioned on said bearing ring, each of said rockets being connected to said collar, and cooperating abutments on said collar and said bearing ring for conveying the propulsive thrust of said rockets to said body; the connection of said rockets to said collar being a pivotal connection, and comprising latch means on said body forwardly of said bearing ring and engaged with said rockets holding them against free pivotal movement relative to said collar, and mechanism in said body for releasing said latch means freeing said rockets for pivotal movement relative to said body when the propulsive thrust of all of said rockets is expended.

8. A missile, comprising a central body, a plurality of rockets uniformly spaced about the periphery of said body, a bearing ring mounted on said central body, a collar slidably positioned on said bearing ring, each of said rockets being connected to said collar, and cooperating abutments on said collar and said bearing ring for conveying the propulsive thrust of said rockets to said body; said connection of said rockets to said collar comprising an arm extending from each of said rockets and pivotally connected at their ends remote from said rockets to said collar so that said rockets and arms may pivot radially outward about the pivoted ends of said arms, and a radially inwardly extended projection on each of said arms in abutting engagement with said bearing ring, said projections being of a length to clear said bearing ring as said arms pivot outward from said body to an angular position relative to said body to allow said rockets, arms and collar to drop safely from said body when said rockets have expended their propulsive thrust.

9. In a flying machine, a faired body, a plurality of rockets spaced evenly about said body, latch means on said body releasably engaging said rockets securing them to said body, an electrically operated release mechanism on said body and engaging said latch means for operating said latch means to release said rockets, and a control circuit for said release mechanism including a series connected normally open switch for each of said rockets to energize said release mechanism when said switches are closed, said rockets being supported for slight longitudinal movement in each direction parallel to the flight axis of said body, resilient means acting to move said rockets in a direction to close said switches when said rockets have expended their propulsive thrust.

10. A flying machine according to claim 9, comprising fragile connections between said rockets and their supports holding said rockets against the action of said resilient means preventing said switches from being accidentally closed and arranged to be broken when said rockets are moved against the action of said resilient means by their propulsive force.

11. A flying machine according to claim 4, comprising resilient means acting between said body and each of said rockets to pivot them radially outward when released by said latch means.

12. A flying machine, comprising a main rocket, a plurality of arms extended longitudinally of and spaced equally about said main rocket, said arms being pivotally attached at their rear ends on said main rocket, an auxiliary starting rocket carried by each of said arms, latch means on said main rocket engaging said starting rockets for releasably holding said arms and starting rockets in pivoted positions against the sides of said main rocket, and means on said main rocket controlled by said starting rockets when they have expended their propulsive thrust to release said latch means, said starting rockets being supported on said arms for slight sliding movement in a direction parallel to the flight axis of said main

rocket and resiliently moved in a direction opposite to the direction they are urged by the propulsive thrust of said starting rockets; said release means being electrically operated and comprising a normally open switch for each of said starting rockets arranged to be closed when said rockets are urged by said resilient means, and a circuit connecting in series all of said switches, said release means and a source of current for energizing said release means when all of said switches are closed.

13. A flying machine according to claim 12, wherein said starting rockets are normally held against being resiliently urged to close said switches by a frangible element connected between said starting rockets and said arms and arranged to be broken when said starting rockets are moved by their propulsive thrust.

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