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DEVICE FOR ADJUSTING THE RANGE OF A MISSILE

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Fig. 1

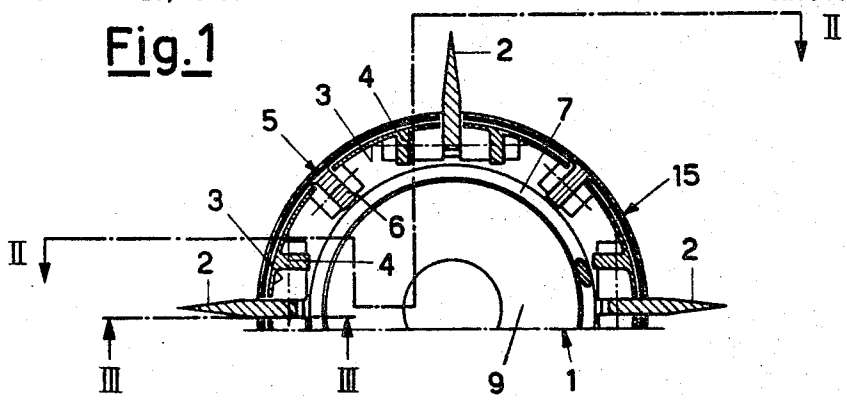
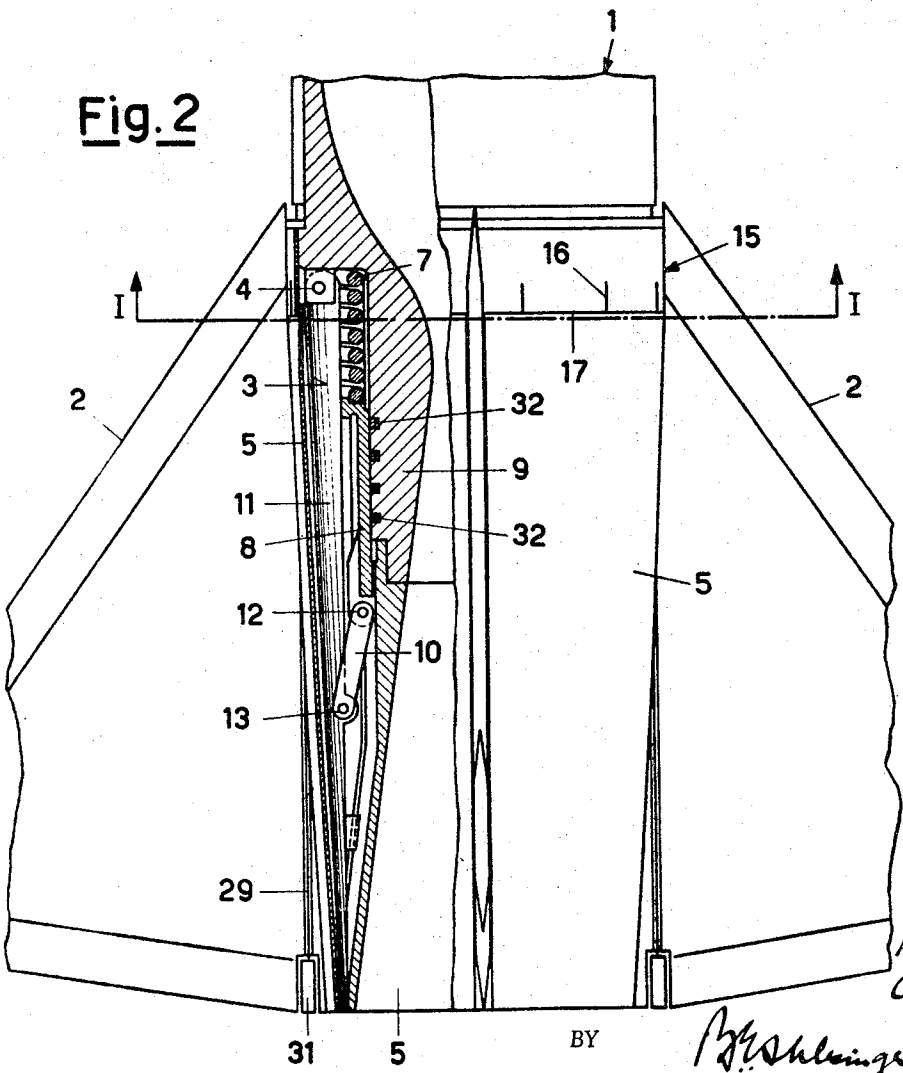


Fig. 2



INVENTOR
Alessandro Cafissi

BY B. H. Schlesinger
ATTORNEY

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Fig. 3

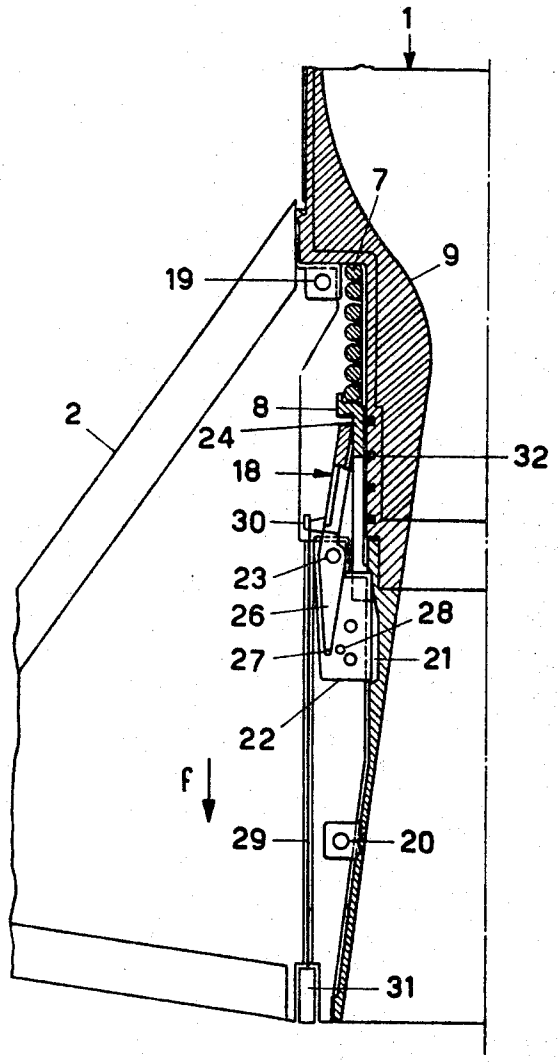
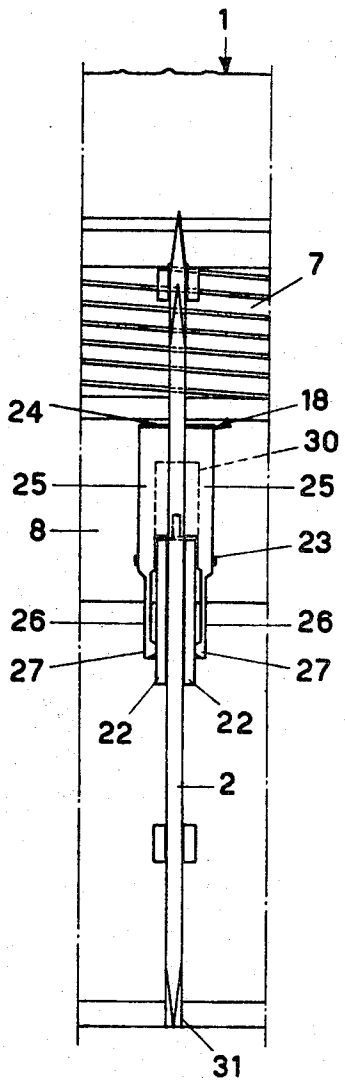


Fig. 4



INVENTOR

Alessandro Cafissi

BY

ATTORNEY

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Fig.5

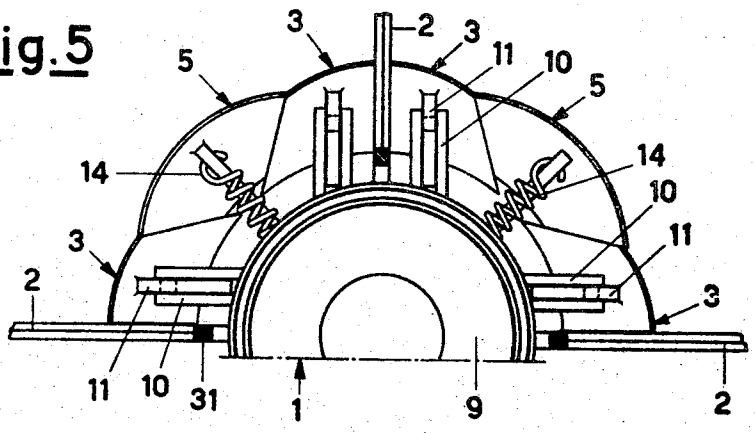
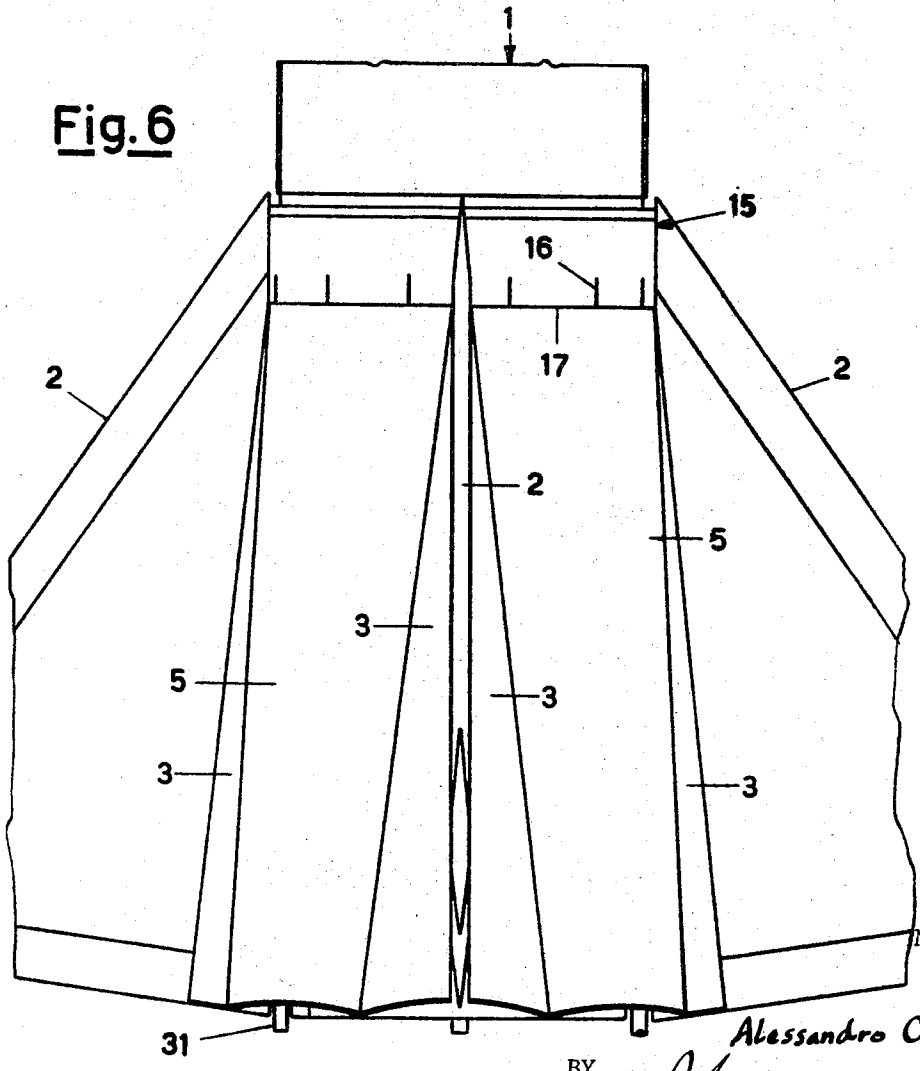


Fig.6



INVENTOR

Alessandro Cafissi

BY

ATTORNEY

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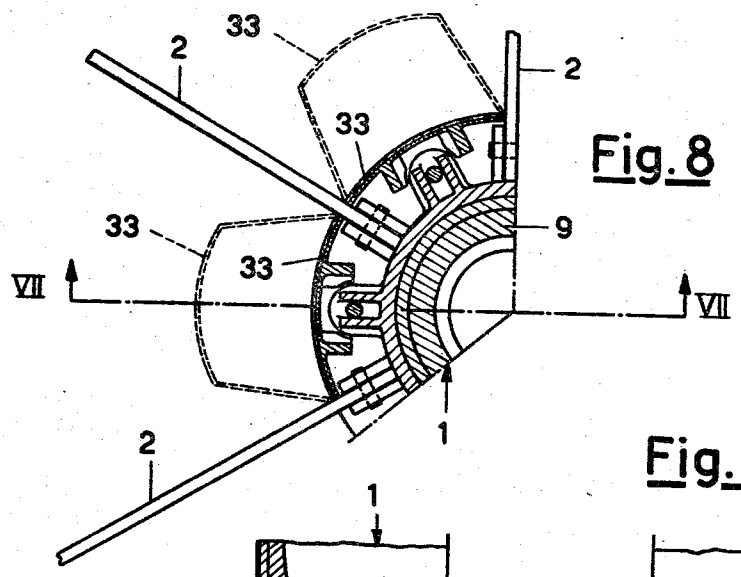


Fig. 8

Fig. 9

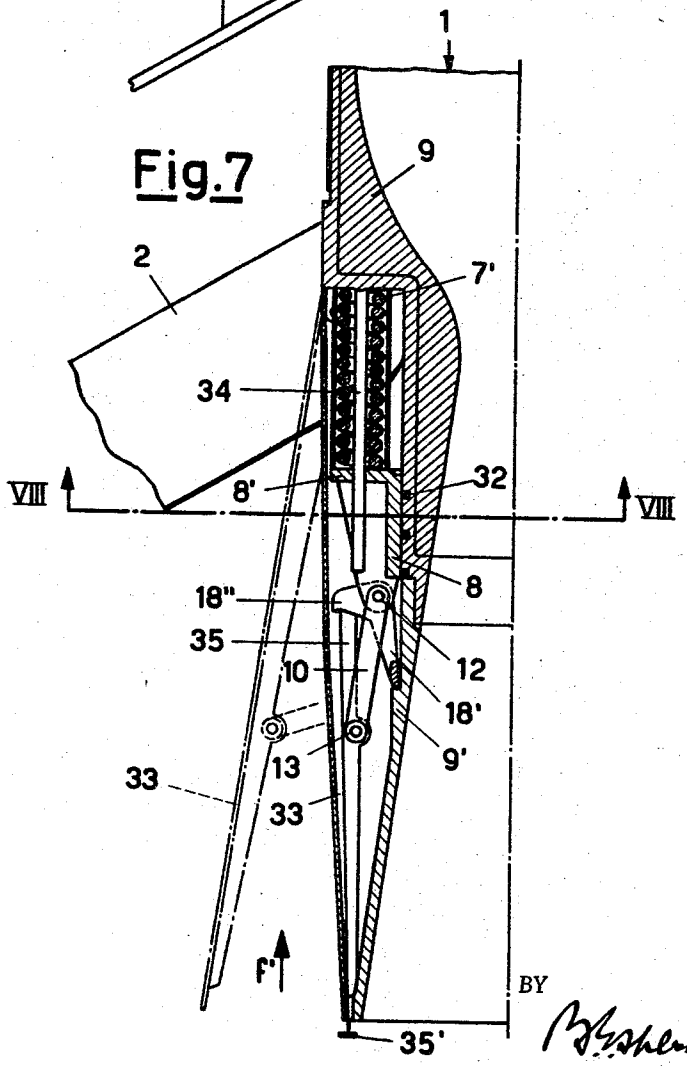
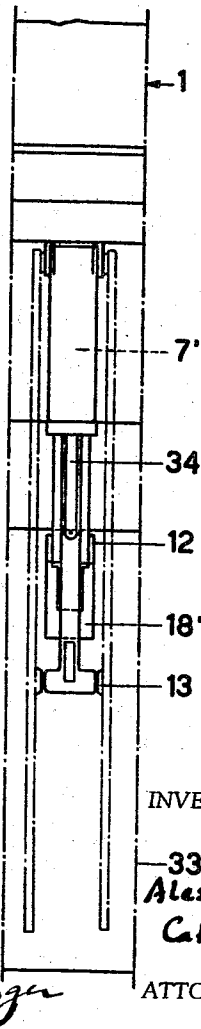


Fig. 7



INVENTOR
Alessandro Cafissi

BY B. Schlesinger

ATTORNEY

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3,343,767

DEVICE FOR ADJUSTING THE RANGE OF A MISSILE

Alessandro Cafissi, Brescia, Italy, assignor to Breda Meccanica Bresciana S.p.A., Brescia, Italy, a company of Italy

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Claims priority, application Italy, Feb. 18, 1965, 3,413/65, Patent 745,416
14 Claims. (Cl. 244—3.27)

ABSTRACT OF THE DISCLOSURE

For controlling the range of a rocket, hinged panels are mounted around the rocket between its fins, to swing out and aerodynamically brake the rocket. The panels are constantly urged outwardly by a spring-pressed ring, which slides axially on the rocket body. The amount of rearward movement of the ring determines the amount of outward swing of the panels. Stops of different lengths, which are adjusted prior to launching, determine the amount of rearward movement of the ring and therefore the range of the rocket. Split rings normally compressed by the spring-pressed ring prevent forward return movement of that ring when uncovered by the rearward movement thereof.

The present invention relates to a device for adjusting the range of missiles. The inventive device has for its object to allow that the aerodynamic drag of a missile be suitably caused to vary, to vary its range or throw without modifying the angle of fire, that is, without changing the angle of quadrant elevation of the launching ramp: thus, the inaccuracy of firing which is inherent in the low angles of fire is done away with. By adopting the inventive device, the launching ramp has a fixed angle of quadrant elevation, for example of about 45°; stated another way, the angle of fire is constant.

The inventive device essentially comprises aerodynamic braking means adapted to modify both the superpressure resistance and the bottom resistance of a missile. In other words, the inventive device comprises an aerodynamic brake, which is positioned astern of the missile and is adapted adjustably to increase the superpressure resistance and the bottom resistance, so as to cause the throw of the missile to be accordingly varied consistently with the distance at which the target to be struck is located.

The term "superpressure resistance" is intended herein to indicate the resistance to the pressure exerted on the sidewalls of the missile, due to the increased surface of the missile which is exposed to the atmosphere; "bottom resistance" is intended herein to designate the resistance to forward motion of the missile due to an increase of its main section, caused by the action of the aerodynamic brake.

The inventive device will be now described in more detail with reference to two embodiments thereof, namely for rockets having fixed and collapsible fins, respectively. Said two embodiments are given by way of example only and are in no wise intended as limitations inasmuch as constructional modifications are possible without departing from the scope of the invention. Said modifications and variations will be obvious for all those skilled in the art, in the light of the teachings of the present invention.

The exemplary embodiments aforementioned will be described with the aid of the accompanying drawings, wherein:

FIGURES 1 to 6 illustrate application of the invention to a rocket having fixed fins, the front portion of the rocket being omitted from the drawings for the sake of simplicity, since it is not pertinent to the present invention.

FIGURES 7 to 9 illustrate the application of the invention to a rocket having collapsible fins.

More detailedly:

FIGURE 1 is a fragmentary diagrammatic cross-sectional view taken along the line I—I of FIG. 2.

FIGURE 2 is a diagrammatical longitudinal cross-sectional view taken along the line II—II of FIG. 1.

FIGURE 3 is a diagrammatic longitudinal cross-sectional view taken along the line III—III of FIG. 1, in tangential relationship with the adjoining fin on the left of FIG. 1.

FIGURE 4 is a side elevational view of the constructional detail shown in FIG. 3.

FIGURE 5 is a fragmentary view, from beneath the rocket, of the inventive device in its working position.

FIGURE 6 is a side elevational view of the device shown in FIG. 5.

FIGURE 7 is a longitudinal cross-sectional view, taken along the line VII—VII of FIG. 8, of a rocket having collapsible fins, to which the inventive device has been applied.

FIGURE 8 is a cross-sectional view taken along the line VIII—VIII of FIGURE 7, and

FIGURE 9 is a diagrammatical side elevational view corresponding to FIGURE 8.

Having now initially reference to FIGURES 1 to 6, which relate to the case of the inventive device being applied to a rocket **1**, fitted with fixed fins **2** which, in the example shown, are four in number, the inventive device comprises panels, hingeably rotatable between the fins **2** and means for their being opened, more or less widely as will be seen hereinafter. There are three panels in this embodiment disposed between every two fins more precisely, there are two panels **3**—**3** disposed at opposite sides, respectively, of each fin **2** to swing about a common hinge **4** having its axis perpendicular to the interposed fin **2**, so as to be opened in planes which are parallel to said interposed fin **2**, and there is a central intermediate panel **5**, which is angularly displaced by 45° from the two adjacent fins **2** and disposed between two of the panels **3**, and borne by a hinge **6**.

The panels **3** have a tendency, due to their own controls, to be opened, as will be seen later, whereas the panels **5** are more or less opened according to the higher or lesser degree of opening of the panels **3**, and have a tendency due to their respective controls, to rest constantly against the panels **3**, as will be appreciated hereinafter.

The side panels **3** have a tendency to open due to the presence of a compression spring **7** which acts upon a sleeve **8**: the latter can slide longitudinally on the Venturi-like body **9** of the rocket **1** and is connected to each panel **3** by means of a couple of links **10**. Said links are positioned on both sides of each rib **11**, and each link **10** is pivotally connected, as at **12**, to the sleeve **8** and, as at **13**, to the rib **11**.

Each central panel **5** is constantly urged against the adjoining panels **3** by a return spring **14** (FIG. 5).

The spring **7**, which is concentric with the body **9**, could however be replaced by as many springs as there are panels **3**, each spring acting upon its attendant panel **3** and arranged, rather than about the body **9**, with its own axis coincident with a point of the circumference of the sleeve **8**. Moreover, the side panels **3** could be arranged over the central panel **5**.

In the embodiment illustrated herein, the front edges of all the panels **3** and **5** are positioned under a ring **15** (FIG. 2) intended to overcome any possible discontinuities of the outer surface of the rocket. Said fillet **15**, however, has a set of slots **16** so that, when the panels **3** and **5** are in their active positions, that is, angularly

swung outwards, the lower edges 17 of the fillet 15 may make a resilient fit with the outer surfaces of the panels 3 and 5 in said working position.

To prevent the panels 3 and 5 from continuing to swing outwardly, upon reaching the preselected position, a set of pivotal jacks 18 (see FIGS. 3 and 4) having different lengths are provided. Each length of jack 18 corresponds to a specific angular amount of swing of the panels 3 and 5 and thus a different attitude of flight of the rocket 1.

To avoid uneven actions for each length of jacks, there should be at least two equal and diametrically opposed jacks: these could also be more than two, provided that they are angularly evenly spaced apart along the same circumference.

Inasmuch as the jacks, apart from their individual lengths, consist of substantially identical component parts, one jack only will be described herein, as applied in correspondence with one of the fins 2. Referring to FIGURES 3 and 4, the fin 2 is affixed to the body 9, as at 19 and 20: it is affixed also at 21 by means of a couple of plates 22 which protrude out of the body 9 and are rigid therewith.

The jack 18 is hinged to the plates 22 as at 23 and is U-shaped. Its upper edge is 24 and its side arms 25 extend downwardly with integral extensions 26. Each extension 26 terminates in an ear 27 facing the adjoining plate 22 and spaced a little distance apart therefrom. Each plate 22 has an indentation 28 at a radial distance 23–27 from center 23. The abutment jacks are controlled by ties 29: these are hooked at 30 (FIG. 3) to the jack 18 above the pivotal point 23 and are rigid at their lower ends with respective members 31. Each of these latter members is any member capable of longitudinally acting on the tie 29 such as a lever or, as in the example shown, a cylinder which can be remotely controlled when a rocket is to be launched.

When the missile range is to be adjusted, the sleeve 8 is thrust by the spring(s) 7, until it reaches those stays 29 which have such a length that the corresponding panels 3 and 5 may be opened as required to adjust the maximum desired throw of the missile. To this end, all the stays 29 which are longer than those intended to arrest the sleeve in the desired position should be made inactive. To achieve this, the members 31 of the jacks 18 to be made inactive are adjusted, so that the corresponding stay 29 is displaced in the direction of the arrow *f*. By so doing, the jacks will swing outwardly so as not to obstruct the fall of the sleeve 8, this latter being stopped by the jacks having the desired length. The thusly pivoted jacks will remain in their outwardly directed positions since the ears 27, owing to the resiliency of the arms 26, will leap over the respective indentations 28 to reach positions away from those shown in FIGURE 3, and will be held there by the engagement of the sleeve 8 with those jacks 18 that are in operative position.

To overcome an exceedingly high force for disengaging the jacks, that is to avoid an excessive strain on the stays 29 and the members 31, the panels 3 and 5, while within the launching tube (not shown), are laterally pressed so as to be slightly inclined inwardly as shown FIG. 2: thus, by means of the links 10, they thrust the sleeve 8 upwards against the force of the spring 7, so that the sleeve is slightly spaced from the jacks 18, as can be seen on FIG. 3.

To avoid, during the rocket's flight, the thrust induced by air pressure on the swung out panels 3 and 5 restoring said panels and the sleeve 8 to their starting positions, suitable resilient means 32 (such as for example, resilient rings similar to conventional piston rings for engines, as shown in FIG. 3, or resilient plungers) are provided for each adjustment position corresponding to a given length of one or more of the jacks 18. Said resilient means

32, by cooperating with the body 9 and the spring 7, oppose the backward movement of the sleeve 8.

As already outlined, FIGURES 7, 8 and 9 illustrate another possible application of the present invention, and more particularly a rocket 1 having collapsible fins 2. In these FIGURES 7, 8 and 9, parts similar to those already described in connection with the preceding figures, have like reference numerals. In the example shown, six fins 2 are provided and the panels are indicated by 33. There is a single panel 35 between every two adjacent fins 2. More than one panel, however, can be provided between two adjoining fins 2.

In this last instance, the opening of the panels is controlled by a set of individual springs 7', rather than by a single spring, the number of springs being consistent with the size and the use of the collapsible fins 2.

Each spring 7' is freely mounted on a stem 34, the spring 7' being compressed between the body 9 and the peripheral flange 8' of the sleeve 8. The stems 34 can freely pass through said flange 8'.

Moreover, the control of the opening of the panels 33 does not take place any longer by a stay but through a thrust imparted to the outer portion 35' of a rod 35 controlling a jack 18'.

The panel 33 is pivotally connected to the sleeve 8 by links 10, these latter being fulcrumed at 12 and 13. At 12 the jack 18' is also fulcrumed, which normally abuts against an abutment 9'. The jack 18' has a catch 18'' resting on the rod 35. Whenever it is desired, for adjusting the range, to unlock the intended jack(s), the end 35' of the associated rod 35 is moved in the direction of the arrow *f'*. Then, the catch 18'', and therewith also the jack 18', is disengaged from the abutment 9' and thus is freed from the sleeve 8 also.

Having now described in detail the device according to the invention, its operation can be summarized as follows:

As outlined above, the adjustment of the range of the rocket is obtained by varying, according to the distance from the target, the angle of swing of the panels 3 and 5 (or 33) when the rocket is to be launched. This variation is obtained as follows: before launching the rocket, one or more jacks 18 are mechanically or electrically controlled so as to allow the sleeve 8 to move downward (backward) a suitable distance consistent with the desired degree of opening of the panels forming the aerodynamic braking means. Since the jacks have different lengths, it is possible to select closely the backward movement of the sleeve 8, and thus the opening of the braking panels. These latter cannot be rotated outwardly until the rocket is in its launching ramp. Means for temporarily retaining the panels could however be provided, irrespective of the launching ramp.

As the rocket leaves the launching ramp, the spring 7 (or 7') suitably calculated for overcoming the drag and the inertial forces, urges the sleeve 8 against the jacks, causing the rotation of the links 10 and thus the swinging of the panels outward.

Thus, a surface is obtained which has virtually no discontinuity, as clearly appears in FIGS. 5 and 6 which relate to a rocket having four fixed fins 2. The situation is the same if the number of fins is different. The backward (rearward) movement of the sleeve 8 is hindered, as aforesaid, by the resilient rings (or plungers) 32 corresponding to the different positions occupied by the sleeve 8.

FIGURES 2 shows four resilient rings 32, since four positions have been provided for the braking panels, it being understood that, should additional adjustment positions for the several jacks be required an equal number of resilient rings will be provided.

While only two embodiments of the invention have been shown and described herein, of the inventive device, other modified forms are possible without departing from the scope of the invention.

I claim:

1. A rocket having a body and aerodynamic braking means for adjusting the range of the rocket comprising

a plurality of first panels, each hingedly connected at one end to said body to swing out from said body to a greater or lesser extent, thereby to control the amount of braking action on and the range of the rocket,

means constantly urging said first panels to swing outwardly of said body, and

means adjustable prior to launching of the rocket to predetermine the amount of outward swing of said first panels.

2. A rocket as claimed in claim 1, having a plurality of fins on said body adjacent the rear thereof and projecting outwardly therefrom and equiangularly spaced thereabout, said first panels being disposed between adjacent pairs of fins.

3. A rocket as claimed in claim 2, wherein said fins extend longitudinally of said body, and a pair of said first panels are disposed at opposite sides of each of said fins to extend also generally longitudinally of said body.

4. A rocket as claimed in claim 1, wherein a plurality of second panels are mounted on said body to pivot toward and from said body, the individual panels of said plurality of second panels being disposed between a pair of said first panels to overlap the outside faces of said pair of first panels, whereby said second panels move outwardly with said first panels, and means is provided constantly urging said second panels toward closed positions.

5. A rocket as claimed in claim 1, wherein resilient means constantly urge said first panels outwardly to open positions, and said adjustable means comprises a plurality of stops, one for each of said first panels and individually and separately adjustable to predetermine the outward swing of each first panel.

6. A rocket as claimed in claim 5, wherein said resilient means comprises a ring mounted coaxially of said body and slidable thereon in the direction of the axis of said body, and spring means surrounding said body and engaging said ring to press it rearwardly, said stops being disposable to limit the rearward movement of said ring to predetermine the outward swing of the first panels.

7. A rocket as claimed in claim 5, having means for adjusting said stops individually to non-operative position.

8. A rocket as claimed in claim 1, wherein means is provided for preventing return movement of said first panels to closed position.

9. A rocket as claimed in claim 6, wherein lock means is provided for preventing upward return movement of said ring after it has been moved rearwardly by said spring means.

10. A rocket as claimed in claim 9, wherein said lock means comprises a normally expanding resilient split ring surrounding said body and normally enclosed and compressed by the first-named ring, and operable when uncovered by rearward movement of said first-named ring to expand to act as a stop to prevent forward return movement of said first-named ring.

11. A rocket as claimed in claim 10, wherein there are a plurality of said split rings surrounding said body and spaced axially of said body from one another, the number of said split rings equalling the number of said fins.

12. A rocket as claimed in claim 4, wherein each first panel hinges about an axis perpendicular to the adjoining fin, and each of said second panels pivots about an axis perpendicular to the bisectrix of the axes of the adjacent pair of first panels.

13. A rocket as claimed in claim 1, wherein said fins are pivoted on said body to be collapsible, a first panel is provided between every two adjacent fins, and each first panel is pivotable in a plane passing through the longitudinal axis of the rocket and the bisectrix of the angle between two adjoining fins.

14. A rocket as claimed in claim 5, wherein different stops are of different lengths, and means is provided for individually moving the differet stops to inoperative position.

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BENJAMIN A. BORCHELT, *Primary Examiner.*

SAMUEL FEINBERG, *Examiner.*

V. R. PENDEGRASS, *Assistant Examiner.*