July 22, 1958 C. RÈ ET AL 2,844,073

LAUNCHING DEVICE

Filed April 16, 1954 3 Sheets-Sheet 1

Fig. 1.

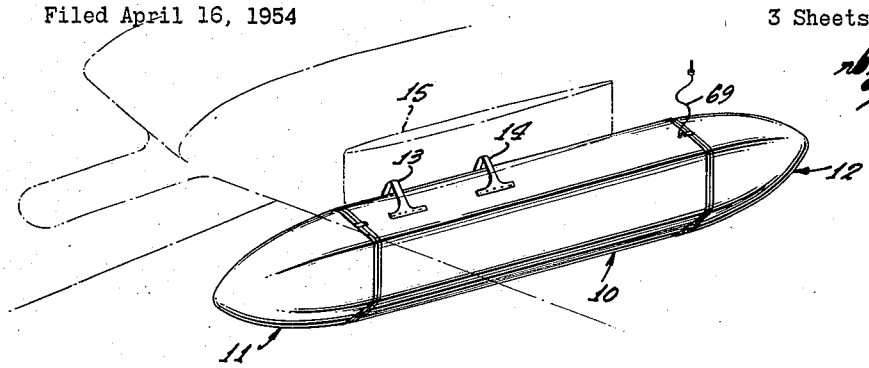

Fig. 2.

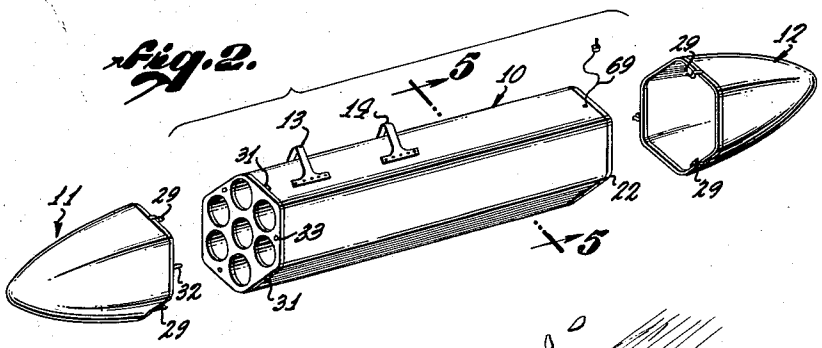

Fig. 4.

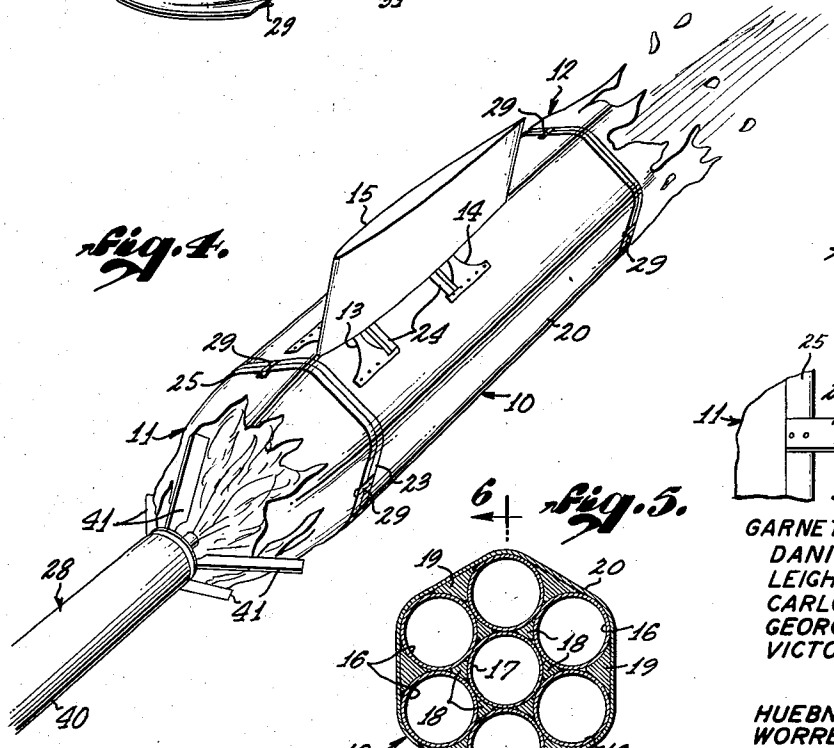

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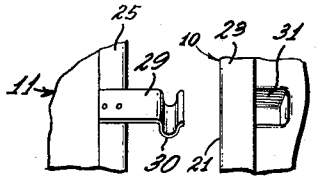
Fig. 5.

Fig. 3.



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LAUNCHING DEVICE

Filed April 16, 1954 3 Sheets-Sheet 2

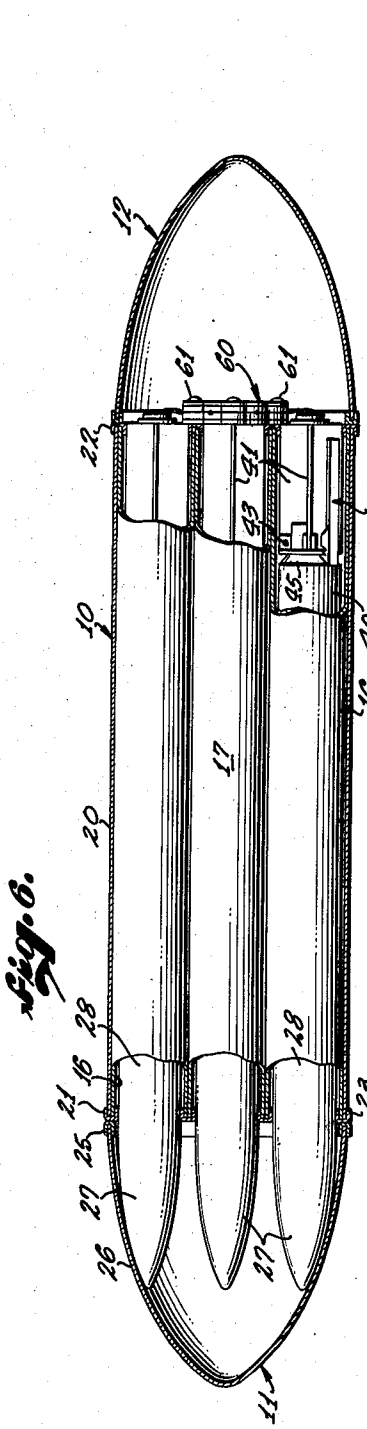

Fig. 6.

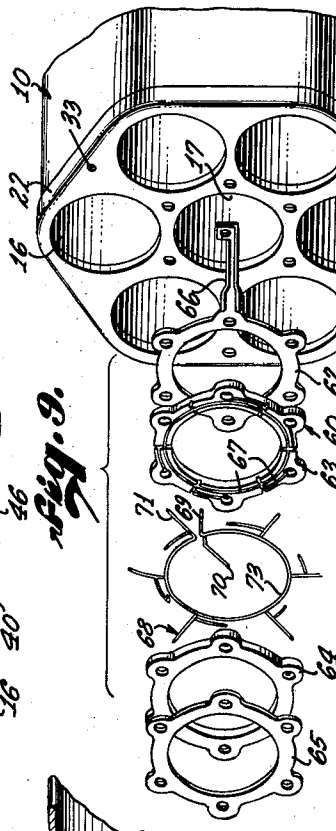

Fig. 9.

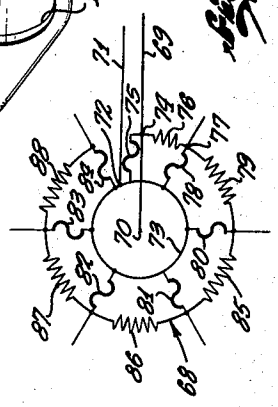

Fig. 10.

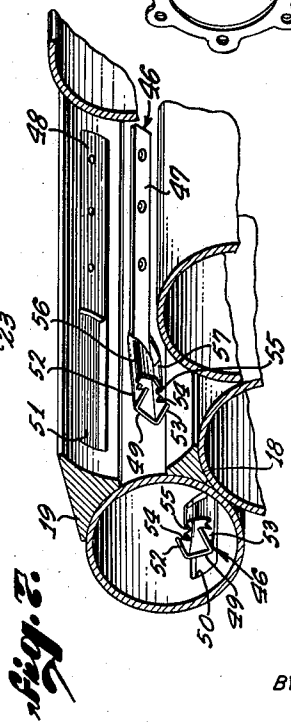

Fig. 7.

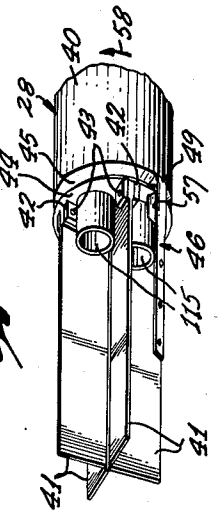

Fig. 8.

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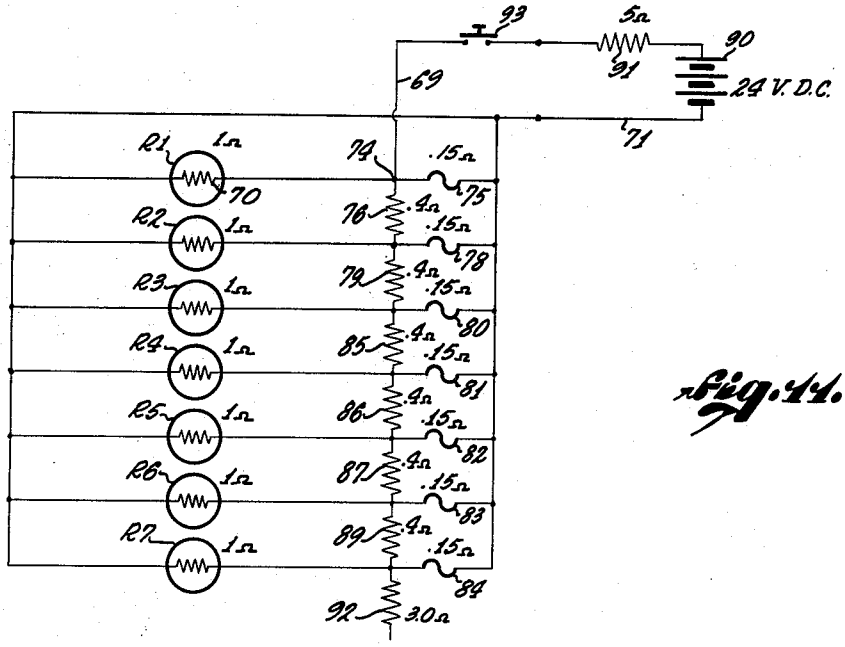

Fig. 11.

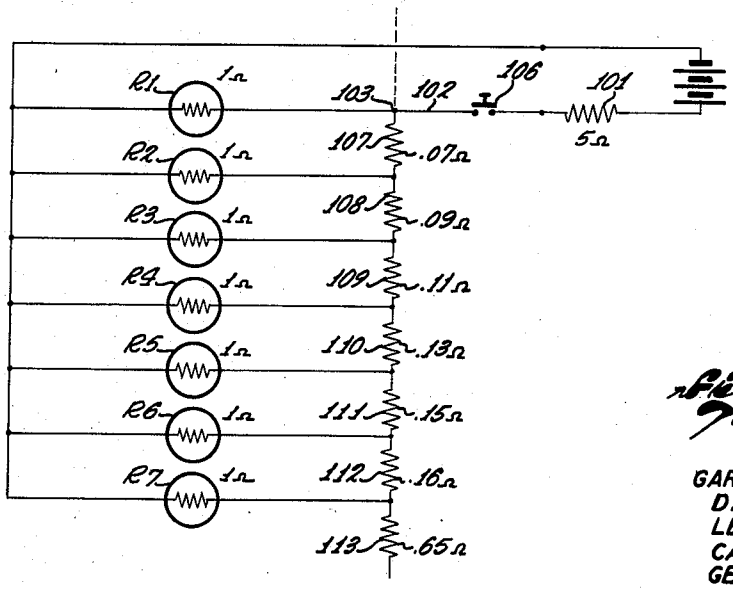

Fig. 12.

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2,844,073

LAUNCHING DEVICE

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Application April 16, 1954, Serial No. 423,618

6 Claims. (Cl. 89—1.7)

The invention relates to military weapons and has particular reference to a launching device by means of which a plurality of missiles in the nature of rockets can be launched simultaneously and preferably in close sequence one after the other in a manner known generally as ripple fire. The launching device is one designed to be carried by aircraft or other vehicles by use of racks or pylons.

Since the employment of rockets as missiles to be launched from airplanes has become prevalent, a variety of devices have been constructed to facilitate the launching of missiles of this kind. Practice has dictated that launchers be capable of launching a series of such rockets with each aiming of the launcher. Increased accuracy has been found possible of attainment when the rockets are launched in a rapid sequence, one shortly in advance of the other, so that the rockets stream from the launcher in a continuous stream until the last rocket has been loosed.

Inasmuch as these launchers are customarily carried on the wings of the airplane, it has been found highly advantageous to construct the launchers of such material that the launchers can be jettisoned after the rockets have been fired so as to permit the airplane to return to the base clean.

Launchers heretofore designed have been of metallic construction but even when attempted to be made of relatively light-weight metals and of generally light-weight construction they have nevertheless been designed, manufactured and used as relatively expensive permanent equipment.

It is therefore among the objects of the invention to provide a new and improved inexpensive, disposable rocket launching device which is dependable to the extent required of such weapons.

Another object of the invention is to provide a new and improved disposable rocket launching device which is constructed of exceptionally inexpensive and expendable material in the nature of paper, plastics, cellulose, and like material, while at the same time having built into the launcher sufficient strength and rigidity to be carried aloft under virtually all conditions which might be encountered in warfare of the sort to which it is adapted.

Another object of the invention is to provide a new and improved inexpensive, disposable rocket launching device which can, if need be, be employed as a means of shipping rockets, the device having removable fairings both fore and aft which can be attached to the main body of the device after it is in place on an airplane, thereby to streamline the device for effective flying, the streamlined fairings being frangible to the extent that they are readily broken open when the rockets are fired.

Still another object of the invention is to provide a new and improved launching device for a plurality of rockets which include a detent or catch device capable of firmly holding the rockets in their respective locations until they are fired with force sufficient to overcome the detent but which detent is so constructed that it can be easily released manually in the event it might become necessary to unload the rockets without their being fired.

Still another object of the invention is to provide a new and improved electric actuated firing mechanism which is very accurately timed to fire a series of rockets in a predetermined sequence, commonly identified as ripple firing, the electric mechanism being compact, accurate, dependable, operable in response to a relatively low current, and so arranged that it can be located compactly adjacent the aft ends of the rockets without increasing or otherwise burdening the rocket mountings.

With these and other objects in view, the invention consists in the construction, arrangement and combination of the various parts of the device whereby the objects contemplated are attained, as hereinafter set forth, pointed out in the appended claims and illustrated in the accompanying drawings.

In the drawings:

Figure 1 is a perspective view of the rocket launching device shown in the position it would have when attached to the underside of an airplane wing.

Figure 2 is an exploded view of the device in perspective showing the fore and aft fairings removed.

Figure 3 is a fragmentary view showing a snap or detent adapted to hold the fairings in place.

Figure 4 is a perspective view of the device as it would appear when a rocket has been fired and is leaving the device.

Figure 5 is a cross-sectional view taken on the line 5—5 of Figure 2.

Figure 6 is a longitudinal sectional view taken on the line 6—6 of Figure 5.

Figure 7 is a fragmentary perspective view of the aft end of the device showing the structure and location of the rocket detents.

Figure 8 is a rear or aft end perspective view of one of the rockets.

Figure 9 is an exploded view showing the construction of the electrical actuated firing mechanism.

Figure 10 is a schematic view of the wiring circuit in one of its forms.

Figure 11 is a wiring diagram applicable to the schematic representation of Figure 10 in which representative values are shown.

Figure 12 is a wiring diagram of another form of the electrical circuit adapted to the firing of the rockets.

In an embodiment chosen to illustrate the invention there is shown a launching device comprising a body **10** having a fore fairing **11** and an aft fairing **12**. In Figure 1 the body is shown assembled with the fairings and occupying the position it would have with hangers **13** and **14** attached to a bomb rack or pylon **15**.

The body construction is illustrated more particularly in Figures 2, 5 and 6. As there shown it is constructed of a plurality of paper tubes **16**, six in number in the modification shown, grouped about a central tube **17** of similar construction. It has been found advantageous to construct the paper tubes of spirally wrapped paper and preferably coated on both the inside and the outside with a tough plastic film, which film may be any one of a number of commercially available plastic materials which can be applied by customary coating processes.

In order that the paper tubes may be anchored in their proper positions, there are provided a series of spacer blocks **18**, preferably of wood, which are rounded to the same degree of curvature as the outside surfaces of the tubes, there being six such spacer blocks employed resting against the exterior of the central tube **17** at equally spaced intervals forming in effect a series of six cradles for reception of the surrounding tubes **16**. To further fix the positions of the tubes **16**, outer spacer

blocks 19 are provided rounded on their inner sides where they are applied against the exteriors of the tubes 16 and flat on the outer side so that a wrapping 20 around the exterior of all of the tubes is kept as smooth-surfaced as possible in its substantially hexagonal form. In some forms of the device it has been found advantageous to employ a large round paper or plastic tube for the exterior container encasing the small tube clustered as shown, even without the presence of spacer blocks or cradles.

To further assist in the proper placing and holding of the tubes 16 and 17 there is provided a fore bulkhead 21 and an aft bulkhead 22. These bulkheads are preferably made of metal, steel being exceptionally acceptable. The bulkheads are formed with flanged apertures corresponding to the paper tubes and a flange 23 extending around the perimeter serving as a means for determining the shape of the exterior of the body. Bulkheads 21 and 22 are similar to the extent that a description of one will suffice for both.

The hangers 13 and 14 are of a form heretofore found acceptable and in the embodiment herein disclosed are fastened to the body by means of screws passed through the wrapping 20 into the blocks 19 on either side of the uppermost of the tubes 16. When attached to the pylon 15 sway braces 24 may be employed when necessary.

The fore fairing 11 is made of frangible material which may be of papier mache, pasteboard or craftboard, styrene impregnated or coated similar to the paper tubes with a plastic film on the inside and outside and moreover painted especially on the outside so that the fairings conform to the body. To maintain the fairings in proper shape they are each provided with a reinforcing band 25 around the base which is crimped over the outside and inside surfaces of the fairing. The body of the fairing 26 has a projectile-like shape curved in a general way so as to match the curve of a head 27 of a rocket 28.

In order to secure the fairing in each case to the body, the fairing is provided with a series of three spring fasteners 29 (see Figure 3), each of the spring fasteners being designed so that a beaded end 30 is adapted to snap into an aperture 31 of the body immediately behind the flange 23. The reinforcing band may also be provided with a series of guide pins 32 adapted to fit into suitable holes 33 in the fore bulkhead at the edge to assist in the proper positioning of the fairing on the body. When the fairing is guided into position on the body by insertion of the guide pins into the holes, the fairing is pushed firmly until the beaded ends 30 fall into the apertures 31 at which time the fairing is hooked firmly in place. The fairing can, of course, be removed by springing the beaded ends 30 out of position.

The rockets 28 herein shown and described serve primarily to illustrate the utility of the launcher which is equally effective for various types of missiles.

The rockets 28 are identical and consist of a long cylindrical body 40 at the fore end of which is the head forming a continuation of the body and at the rear end of which is a series of four fins 41 as best shown in Figure 8, each fin having a mount 42 to which the fin is pivotally secured by means of a pin 43. In Figure 8 the fins are shown folded in in the position they would have when inserted in the tubes 16 and 17 as appearing in Figure 6. The rockets have a rear face 44 at the edge of which is an annular depression 45 of relatively shallow depth and having somewhat tapered walls.

For holding each rocket in place there is provided a spring-pressed detent 46 or detent latch, the form and mounting of which is perhaps best illustrated in Figures 7 and 8. Each detent is constructed of an elongated spring member 47, one portion of which is anchored to the adjacent outer block 19 by suitable screws, the block having a recess 48 for reception of the elongated spring member. At the aft end of the spring member is a detent head 49 which is adapted to be received in a hole 50 in the paper tube 16, or 17, the outer block 19 being recessed at 51 for reception of the head.

The head is normally bent inwardly toward the interior of the tube and is constructed with opposite longitudinally disposed flanges 52 and 53 having cut therein notches 54 and 55 so shaped that projections between notches may be received within the annular depression 45 which may be termed a detent groove. The flanges furthermore are provided respectively with bent-over portions 56 and 57 forming a smooth rounded cam-like exterior.

When the rocket is inserted fin or aft end first into the body and the tubes therein through the fore bulkhead, each rocket in turn is pushed into the tube until the projections on the head of the detent fall into the detent groove as illustrated in Figure 8. The spring force of the head of the detent is sufficient to anchor the rocket in place in its respective tube until the detent is overcome by the force of firing.

On occasions, however, it may become desirable to manually remove a rocket from its tube. This is accomplished by rotating the rocket in the direction of the arrow 58, for example. Rotation of the rocket will bring the next adjacent mount 42 into position against the near side bent-over portion and pressure of the amount on the bent-over portion will be sufficient to cam the head 46 of the detent out of detent position, after which the rocket may be freely withdrawn through the fore bulkhead.

The launcher is provided with an ignition assembly mounted on the aft bulkhead, this assembly being contained essentially within a housing 60 to which it is attached by means of screws 61.

The housing, as illustrated in Figure 9, consists of a number of parallel elements consisting of a plate 62 lying immediately adjacent the bulkhead, an insulator plate 63, a second insulator plate 64, and a cover plate 65, all of these plates being held together by the same screws 61 already made reference to.

The plate 62 has a shield extension 66 extending laterally therefrom designed to provide a protection for wiring from the initial blast of the rockets and also to provide means for attachment of a ground connection.

The insulator plate 63 is illustrated as provided with suitable grooves 67 designed to match comparable grooves in the plate 64. These grooves are for reception of an ignition spider 68. It is the ignition spider which contains the means for ripple firing the rockets in accordance with a predetermined sequence.

The ignition spider is illustrated schematically in Figure 10 and in that modification consists of an electric circuit composed of a lead-in wire 69 adapted to connect to the rocket firing disc of the center rocket at the point 70. A ground wire 71 connected at the point 72 to a ground circuit 73 supplies the ground connection for all of the rockets including the center rocket.

At a point 74 the lead-in wire is connected in one direction to a fuse 75 which in turn is connected to the ground circuit 73. In another direction contact is made at the point 74 with a resistance 76. From the resistance 76 connections are made respectively at point 77 to a fuse 78 and a second resistance 79. Succeeding fuses are numbered 80, 81, 82, 83 and 84. Succeeding resistances are numbered 85, 86, 87 and 88. The lead-in wire 69 and ground wire 71 are designed to lie within the shield extension 66.

In the exploded view of Figure 9 the ignition spider, shown schematically in Figure 10, features the lead-in 69 as indicated, the ground wire 71 as also indicated, the ground circuit 73, and the fuses 75, 78, 80, etc., the resistances not being specifically illustrated in Figure 9. At the point 77, for example, and at corresponding succeeding points, connection is made to the respective rocket firing disc, the discs being illustrated at the points 70 in

Figure 6. A plug connection **89**, shown in Figure 1, is attached to the lead-in wire **69**, the plug being adapted for connection to the circuit in the airplane. For ready identification the firing mechanism may be referred to as an intervalometer directed to the launching of the missiles at predetermined intervals.

For a more complete explanation of the firing mechanism of the intervalometer reference is made to the wiring diagram of Figure 11. In that figure, for example, a source of power is illustrated as originating in a twenty-four volt battery **90**, although it will be appreciated that an A. C. circuit is as effective in this device as a D. C. circuit.

In the circuit illustrated a time delay resistance **91** may be employed if need be to compensate for the current characteristics of the source of power. The rockets are numbered in sequence in Figure 11 beginning with R1 indicating the center rocket and then respectively the surrounding six rockets R2, R3, R4, R5, R6 and R7.

Values are given to the various resistances and fuses by way of example as being values which are operable when subjected to the source of power of twenty-four volts. It will be noted that the internal firing resistance of a squib in the rocket in each instance is one ohm. Each of the seven fuses is provided with an identical resistance of .15 ohm. The resistances are each provided in the illustration with values of .4 ohm. For successful performance, however, there should be included a final resistance **92** having an arbitrary value greater than the sum of the previous six resistances, which value can be 3.0 ohms. The presence of the final resistance is made such that it is representative of what would be a continuation of the circuit, inasmuch as the resistances of the fuses and resistances preceding it in the circuit are balanced to take into consideration an aggregate resistance equal to the sum of the several resistances which follow. When the last rocket is to be fired for the timing to continue accurately, there should be a weighted resistance such as the resistance **92**.

In the example illustrated it is assumed that a minimum of 0.5 ampere will be employed, although a current somewhere near half the average current of .05 and 1.5 amperes is more satisfactory in that it provides a greater margin of dependability. When contact is made as by means of a push button **93**, current is immediately connected to the rocket **R1**. The rocket, however, will be delayed in firing a small fraction of a second sufficient to have the current ignite the squib of the rocket. Current will be deflected to the rocket by the presence of the fuse **75** and resistance **76** and the respective circuits in which they are connected. Upon the burning out of the squib in the rocket, current will then follow the path of least resistance and burn out the fuse **75**. The resistance of the fuse **75** is made such that it will burn out at a predetermined time interval which may be .01 second or some other chosen interval. After the fuse **75** has burned out, current will flow through the resistance **76** to the point **77** where again the major proportion of the current will be deflected to the firing squib of the rocket **R2**. It will be apparent that the delay in the firing of the rocket R2 is a matter of time determined by the length of time required to burn out the fuse **75** plus the time required to ignite the squib in the rocket R2. Following the burning out of the squib in the rocket R2, current will then be deflected through the fuse **78** until that is burned out in a predetermined time interval, after which the current will then pass through the resistance **79** to the firing squib of rocket R3. This progress of current continues through all of the fuses and all of the resistances except the resistance **92**. Because of presence of the resistance **92**, the last two rockets **R6** and **R7** will be fired at the same precise time interval rather than almost simultaneously as might be the case should the resistance **92** be omitted. A regulated time interval of ripple firing is therefore assured and this interval can be very accurately controlled, at least sufficiently accurately for proper aiming and firing of the series of rockets by selection of fuses and resistances of properly balanced ohm value. Inasmuch as most rockets are built to a predetermined value of resistance in the firing squib, namely, approximately one ohm, the other values will be balanced accordingly.

In another more simplified form of the circuit illustrated in Figure 12, fuses have been dispensed with and the values of the resistances balance to compensate for exclusion of the fuses. Again in this circuit the resistance of the firing squibs in the rocket is assumed to be one ohm.

In the modified circuit a source of power **100** is fed through a resistance **101** here selected as a resistance of five ohms. The current follows a lead-in wire **102** until it reaches a point **103** where it is adapted to divide, part of the current continuing to the point **104** where it is connected to the firing squib of rocket **R1**. A ground circuit element **105'** is connected to a ground circuit **105**; a button **106** is designed to start the chain of firing.

In this form of the invention resistances **107**, **108**, **109**, **110**, **111** and **112** have gradually increasing values, those values being illustrated on the wiring diagram as .07 ohm increasing at increments of .02 ohm until the last resistance increment of .01 ohm. An end resistance **113** of .65 ohm is provided, that resistance being slightly less than the sum of all of the preceding six resistances. The value of the end resistance **113** is selected so as to be substantially the equivalent of a continuation of the circuit. This assures firing of the last rocket in the same predetermined sequence as those preceding it. This may perhaps be more readily appreciated when it is considered, for example, that the resistance of the rocket R2 will become one ohm after rocket R1 is out of the circuit, having been fired. There need also be a compensating factor for rocket R2 and succeeding rockets due to a portion of the current flowing into those rockets in quantities still insufficient to fire the respective rockets until the rocket immediately ahead of it in the circuit is fired.

Of further importance in this form of the circuit is the fact that the resistances **107**, **108**, etc., can be made to very small values, namely, in values of hundredths of an ohm increasing by increments of as little as .02 ohm. By keeping these values small, a great many rockets more than seven can be fired in the same accurate sequence by the same firing technique. The limit on the number of rockets thus fired runs into several hundred before resistance values become too high to be practical. At this point, however, additional rockets could be fired by running a lead-in wire **114** in a different direction to a new sequence of rockets. The time interval between the firing of rockets with a circuit of this kind can be accurately controlled to intervals in the neighborhood of .040 second or at intervals shorter or longer than such intervals. The time intervals can be further controlled to some degree by the value of the current impulse sent into the system through the button **100**.

It will therefore become apparent that a very accurate timing mechanism is possible by employment of extremely simple electrical structure and the use of fuse and resistance elements of elementary character, the values of which can be readily determined and employed. Ignition spiders can be made up following the scheme disclosed with a great degree of economy without sacrifice of accuracy and dependability of timing. Such ignition spiders are readily insertable in the ignition housing. Where it may be desired to fire at a different ripple sequence, ignition spiders having different sets of values can readily be replaced for those removed from the housing.

Upon the firing of the initial rocket, the blast at the tail ports **115** disintegrates the aft fairing **12** and as the rocket is propelled forward the nose **27** breaks through the fore fairing **11** at the center point under circumstances where the center rocket is fired first. As the rocket emerges from its tube, the fins **21** spring outwardly tearing open the remainder of the fairing **11** after which the

remaining rockets emerge from the body in the sequence predetermined by the ignition spider values. After the last rocket has been fired, the body and the fragmented fairings can be jettisoned in the customary manner.

While we have herein shown and described our invention in what we have conceived to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope of our invention, which is not to be limited to the details disclosed herein but is to be accorded the full scope of the claims so as to embrace any and all equivalent devices.

Having described our invention herein, what we claim as new and desire to secure by Letters Patent is:

1. In a ripple firing multiple rocket launching device a body having a central rocket tube and a plurality of rocket tubes distributed circumferentially about the center, an aft bulkhead having tube apertures therein coinciding one with each said tube, a circuit holder adapted to be secured to the outside face of the bulkhead between the center tube and the circumferentially disposed tubes, said holder being split between forward and aft faces and having at least one adjacent face grooved for reception of a ripple firing wire circuit member, a ripple firing wire circuit member comprising a direct wire connection for the central rocket, a ground circuit for all said rockets, a series resistance circuit for all said rockets having a connection for each rocket, a separate series-connected resistance between each pair of adjacent connections, and a fused circuit between each connection and the ground including a fuse of lesser resistance than the adjacent resistance adapted to burn through at a predetermined time interval.

2. In an electric actuated ripple firing circuit for a series of rockets having resistance fired squibs therein of equal predetermined resistance values of a magnitude of about one ohm each, the combination of a source of electric power, a power line therefrom having a series of contacts for the respective squibs, a ground from each squib, fusible connections from the respective contacts to the ground, continuous series connected resistances between the respective contacts, said resistances having values increasing at progressive increments of a relatively small fraction of one ohm, and an end resistance greater than the sum of the resistance of the continuous resistances, the resistance value of said resistances being balanced with the current value and the resistance value of the squibs whereby each squib is ignited at successive equal intervals after the firing of the preceding squib when the circuit is closed to the source of electric power.

3. In an electric actuated ripple firing circuit for a series of rockets having resistance fired squibs therein of equal predetermined resistance values the combination of a source of electric power, a power line therefrom having a series of contacts with the respective squibs, a ground from each squib, fusible connections from the respective contacts to the ground of equivalent resistance values less than the resistance value of the squib, continuous series-connected resistances between the respective contacts, said resistances having equivalent values greater than the fusible connections, the resistance value of said fusible resistances being balanced with the current value from the source of electric power, the resistance value of the continuous resistances and the resistances of the squibs whereby the squibs are ignited at successive equal intervals when the circuit is closed to the source of electric power.

4. In an electric actuated ripple firing circuit for a series of rockets having resistance fired squibs therein of equal predetermined resistance values the combination of a source of electric power, a power line therefrom having a series of contact points for the respective squibs, a ground from each squib, fusible connections from the respective contact points to the ground of equivalent resistance values less than the resistance value of the squib, continuous series connected resistances between the respective contact points, said resistances having equivalent values greater than the fusible connections and less than the squibs, and an end resistance greater than the sum of the resistances of the fusible elements and continuous resistances, the resistance value of said fusible resistances being balanced with the current value from the source of electric power, the resistance value of the continuous resistances and the resistances of the squibs whereby the squibs are ignited at successive equal intervals when the circuit is closed to the source of electric power.

5. In a multiple rocket launching device comprising a body formed from a series of tubes adapted for reception of rockets having tail fin mounts and a detent element adjacent thereto the combination of a rocket detent means in each tube of lesser detent strength than the rocket when under power, said means comprising a spring member secured to the inside wall at the aft end of the tube, a head on the spring member free of direct attachment to the tube and bent resiliently inwardly toward the center of the tube, a longitudinally disposed flange adjacent the head having a rocket-engaging detent element complementary to the detent element on the respective rocket, a portion of said flange at the relative location of the tail fin mounts having a laterally bent cam face adapted for contact with and depression by one of said tail fin mounts upon rotation of said rocket for manual release of the rocket.

6. In an expendable multiple rocket launching device comprising a body formed from a series of tubes adapted for reception of rockets having tail fin mounts and an annular detent flange on each rocket adjacent the mounts the combination of a rocket detent means in each tube of lesser detent strength than the rocket when under power, said means comprising an elongated spring member secured at its outer end to the inside wall of the tube at the aft end of the tube, a head at the inside end of the spring member free from direct attachment to the tube and bent resiliently inwardly toward the center of the tube, longitudinally disposed flanges at the sides of the head each having a longitudinally spaced flange-engaging notch therein, portions of said flanges at the relative location of the tail fin mounts having laterally bent cam faces adapted for contact with and depression by said tail fin mounts upon rotation of said mounts for manual release of the rocket.

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