Feb. 25, 1964 G. WYSER 3,122,058

SYSTEMS COMPRISING A CLUSTER OF ROCKETS CARRIED BY A LAUNCHING MACHINE

Filed Feb. 27, 1961 2 Sheets-Sheet 1

Fig. 1.

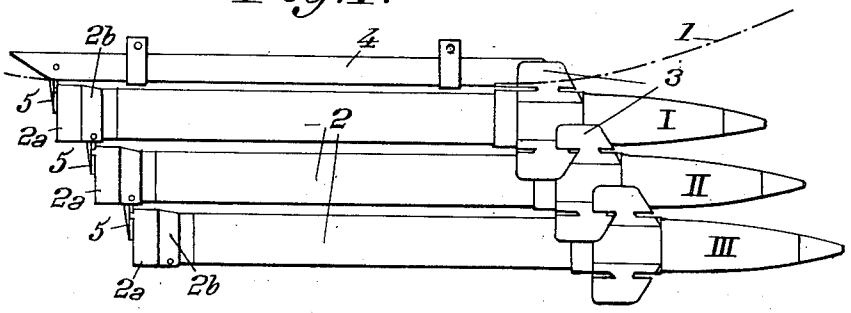

Fig. 2.

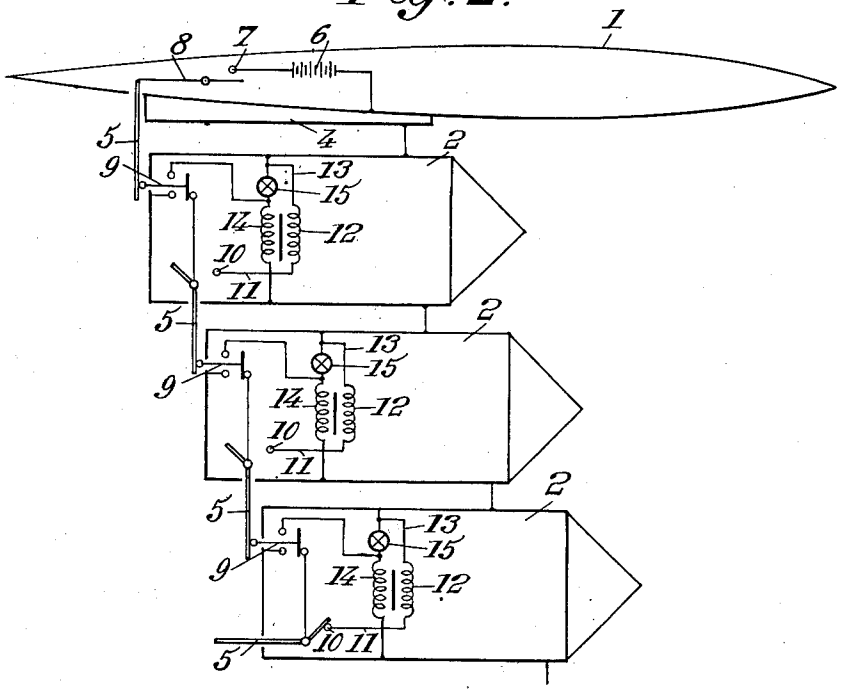

Fig. 3.

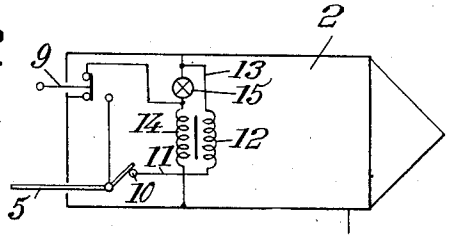

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Fig. 4.

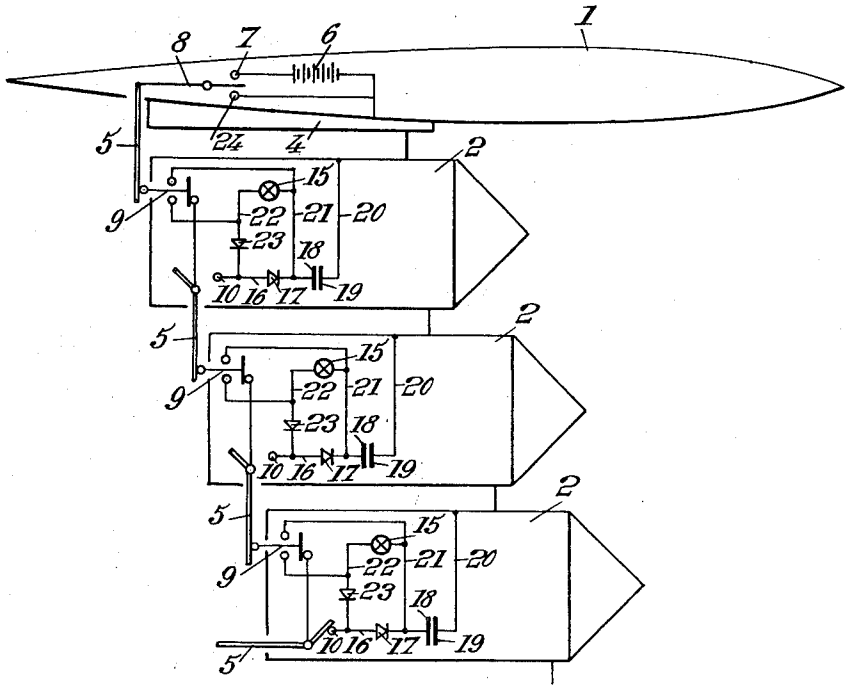
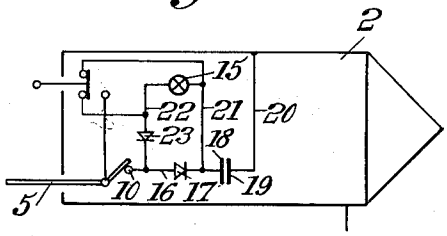


Fig. 5.



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3,122,058

SYSTEMS COMPRISING A CLUSTER OF ROCKETS CARRIED BY A LAUNCHING MACHINE

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6 Claims. (Cl. 89—1.7)

The present invention relates to systems comprising a cluster of several rockets supported in series by a launching machine such as an aircraft, the term "supported in series" meaning that every rocket is supported by another rocket to be fired immediately after it, with the exception of the last rocket to be fired, which is supported directly by the launching machine.

The object of this invention is to provide a system of this kind which is better adapted to meet the requirements of practice than those known up to this time, in particular to control of the firing of successive rockets.

In such systems, every rocket comprises on the one hand means forming, when the rockets are secured to one another, a continuous electric line extending through the series of rockets, from each of them to the next one and, on the other hand, an electric igniting device carried by each of the rockets and comprising an input terminal, means being provided for connecting this electric line with the input terminal of the igniting device of the first rocket to be launched, but keeping the respective input terminals of the igniting devices of the other rockets disconnected from said line.

According to the present invention, each of these igniting devices is arranged in such manner as to require, in order to cause its rocket to be fired, at least two predetermined successive variations of the voltage at its input terminal, control means being provided for producing said voltage variations through said electric line.

Preferred embodiments of the present invention will be hereinafter described, with reference to the appended drawings, given merely by way of example, and in which,

FIG. 1 is a diagrammatical view on a small scale of a cluster of three rockets suspended under the wing of an aircraft and to which the system according to the invention is to be applied.

FIG. 2 diagrammatically shows the three rockets and the electric ignition system according to a first embodiment of the invention.

FIG. 3 shows the electric igniting device of a rocket which is not suspended to another rocket.

FIGS. 4 and 5 are views similar to FIGS. 2 and 3 respectively but illustrating another embodiment of the invention.

The invention is concerned with a system of rockets suspended under the wing 1 of an aircraft. The systems according to the invention comprise the following elements:

Means for suspending to wing 1 the last rocket to be fired (rocket I), for suspending another rocket (II) to said rocket I, still another rocket (III) to said rocket II, and so on.

Means for conveying toward the first rocket to be launched an electric current passing through the other rockets without influencing them, and,

Means for preventing any risk of operation of the primer of each rocket before it has been inserted in the suspended cluster.

The above mentioned means may be of any suitable structure.

In the following description, it will be supposed by way of example that every rocket is mounted on the element by which it is to be supported (either a rocket

or a support 4 fixed to the wing 1 of an aircraft) in the manner described in U.S. Patent No. 2,968,222. In this construction, each of the rockets comprises a body 2, the rear portion 2*a* of which contains the nozzle through which escape the combustion gases of the propelling charge of the rocket.

Every rocket comprises, as shown by FIG. 1, a sliding tail unit 3 through which said rocket is suspended to the corresponding tail unit of the rocket located immediately above it, or, for the last rocket I, to a support 4 rigidly carried by wing 1. This tail unit 3 occupies, before the rocket is launched, a forward position where it acts both as a guide and as a support for the rocket body, the tail unit being carried along by said rocket body just when it is being launched and being then wedged against a frusto-conical bearing 2*b* provided near the rear end of body 2, where it remains during the flight of the rocket.

Each of the rockets, and also support 4, is provided with a pivotable flap 5 dimensioned and positioned in such manner that the flap 5 of a supporting rocket II, when it occupies its vertical downward position, extends across the propelling jet of the supported rocket III when it is fired, so as to be pushed back and retracted by this jet. The flap 5 carried by support 4 in turn extends across the jet of the top rocket I of the cluster when this rocket I is fired. Holding means of a known type are provided to permit the launching of a rocket only when the flap 5 extending behind its nozzle has been pushed back and retracted by the jet starting from this nozzle.

The aircraft carries a source of current 6 adapted to be connected through a contact 7 with a line 8 connected to the flap 5 carried by support 4.

Every flap 5, when it occupies its vertical downward position behind the nozzle of a rocket, acts, in this rocket, upon a switch 9 which extends to the flap 5 of said rocket the electric line starting from element 8 flap 5 and extending through the rockets located above the one that is being considered.

Thus, from each rocket to the next one, this electric line extends as far as the flap 5 of the first rocket to be launched, which flap is arranged in such manner that, due to the fact that it has been retracted by the launching of the preceding rocket, it connects, in said first rocket to be launched, said electric line with the terminal 10 of the electric igniting device of this rocket.

Each of the flaps 5 will act in the same manner when it is retracted by the launching of the preceding rocket.

In such a system, every switch 9 is arranged in such manner that, when it is not depressed by a flap 5 (that is to say before the rocket is supported by another rocket, or by support 4) it short-circuits, as shown by FIGS. 3 and 5, the terminals of primer 15, so that this primer cannot be excited. The arrangement for this purpose is visible in FIGS. 3 and 5.

In prior systems of the kind above described the electric current fed through the line was a current for directly firing the first rocket to be launched. There was a risk of producing, by a single current impulse, an accidental launching of several rockets instead of a single one. This risk was due to the fact that the launching of a rocket immediately places the next rocket into condition for being launched, which occurred if the current flowing through the line was maintained a little too long.

According to the present invention, each of the igniting devices of the respective rockets is arranged in such manner as to require, in order to cause its rocket to be fired, at least two predetermined successive variations of the voltage at its input terminal, control means being provided for producing said voltage variations through said electric line.

Thus, when the first voltage variation takes place, the first rocket to be launched is merely prepared for launching whereas its launching only takes place when the second voltage variation is produced.

In these conditions, the next rocket which has not been "prepared" cannot be fired even if the current which has produced the launching of the first rocket, is maintained. To launch this second rocket, it is therefore necessary to produce once more the two successive voltage variations that are required.

For instance, the first voltage variation is produced by feeding current from the electric source to the igniting device input terminal through the line, this feed of current constituting the preliminary operation which places the igniting device of the rocket into a state such that the subsequent voltage variation causes the passage through the primer of said device of a current sufficient to cause its operation.

According to a first embodiment of the invention, illustrated by FIGS. 2 and 3, the preliminary operation consists in supplying current to the primary winding of an electric transformer, the next operation, i.e. the igniting operation proper consisting in cutting off this current so as to produce in the secondary winding of the transformer a current sufficient to operate the primer.

As shown by the drawing, terminal **10** is connected through a conductor **11** to one end of the primary winding **12** of a transformer, the other end of this primary winding being grounded through a conductor **13**, i.e. being connected to the metallic mass formed by the rocket bodies and the metal frame of the aircraft.

One of the ends of the secondary winding of said transformer is also grounded, whereas the other end of this secondary winding is connected to one of the terminals of primer **15**, the other of these terminals being themselves grounded.

With such an arrangement, when contact **7** is closed (preliminary operation), a current is made to flow through the circuit including the primary winding **12** of the transformer, the difference of potential produced across secondary winding **14** and applied on the primer being not sufficient to operate it, whereas when the electric contact is broken at **7** (igniting operation proper), the sudden current break produces a high difference of potential capable of operating the primer. Thus, the launching of the first rocket takes place only after this second operation and the next rocket can be launched only after two other successive operations have been performed.

According to a second embodiment, illustrated by FIGS. 4 and 5, the preliminary operation consists in charging a capacitor and the ignition proper is achieved by discharging this capacitor through the primer.

In this case, terminal **10** is connected through a conductor **16**, with the interposition of a rectifier **17** (for instance of the type making use of a semiconductor such as germanium or silicon), to one of the plates **18** of a capacitor the other plate **19** of which is grounded through a conductor **20**, rectifier **17** being disposed to prevent the flow of current from plate **18** toward terminal **10**.

Plate **18** is connected through conductor **21** to one of the terminals of primer **15**, the other terminal of this primer being connected to terminal **10** through a conductor **22** in which is inserted a second rectifier **23** arranged to prevent the flow of current from terminal **10** toward primer **15**.

The switch interposed between line **8** and contact **7** is arranged in such manner as to permit of connecting said line either with contact **7** and therefore source **6**, or with a grounded contact **24**.

Thus, the preliminary operation, which consists in connecting line **8** with source **6**, causes capacitor **18**, **19** to be charged, whereas the second operation connecting line **8** with contact **24** causes this capacitor to be discharged.

Of course, the switch intended to cooperate either with contact **7** (FIGS. 2 and 3) or alternately with this contact **7** and with grounding contact **24** (FIGS. 4 and 5) may be actuated in a suitable manner, either manually or automatically, so as to permit either to launch the rockets at any designed time intervals, or by bursts and generally in any suitable manner.

In a general manner, while I have, in the above description, disclosed what I deem to be practical and efficient embodiments of my invention, it should be well understood that I do not wish to be limited thereto as there might be changes made in the arrangement, disposition and form of the parts without departing from the principle of the present invention as comprehended within the scope of the accompanying claims.

What I claim is:

1. The combination of a launching support, at least two rockets, a first one and a second one, holding means carried by said support for detachably securing said second rocket to said support, holding means carried by said second rocket for detachably securing thereto said first rocket, an electric igniting device carried by each of said rockets, each of said igniting devices having two terminals, a first one and a second one, a source of electric current carried by said support, said source having two terminals, the second terminals of said igniting devices being electrically connected with one of said source terminals, means carried by said rockets, when they are assembled together, forming an electric line extending from said support and leading to the first terminal of the first rocket igniting device, said line being unconnected with the first terminal of the second rocket igniting device as long as said first rocket is secured to said second rocket, means carried by said second rocket for connecting the first terminal of the igniting device thereof to said electric line when said first rocket is detached from said second rocket, each of said igniting devices comprising a primer operable by a given electric current caused to flow therethrough and means for supplying this given current only in response to two predetermined successive variations of the voltage across the terminals of said last mentioned igniting device, and switch means on said support interposed between the other source terminal and said electric line for producing two such successive voltage variations for launching each of said rockets, successively, control of said switch means for the launching of said second rocket being independent of the control thereof for the launching of said first rocket although subsequent thereto.

2. The combination of a launching support, at least two rockets, a first one and a second one, holding means carried by said support for detachably securing said second rocket to said support, holding means carried by said second rocket for detachably securing thereto said first rocket, an electric igniting device carried by each of said rockets, each of said igniting devices having two terminals, a first one and a second one, a source of electric current carried by said support, said source having two terminals, the second terminals of said igniting devices being electrically connected with one of said source terminals, means carried by said rockets, when they are assembled together, forming an electric line extending from said support and leading to the first terminal of the first rocket igniting device, said line being unconnected with the first terminal of the second rocket igniting device as long as said first rocket is secured to said second rocket, means carried by said second rocket for connecting the first terminal of the igniting device thereof to said electric line when said first rocket is detached from said second rocket, each of said igniting devices comprising a primer operable by a given electric current caused to flow therethrough and means for supplying this given current only in response to two predetermined successive variations of the voltage across the terminals of said last mentioned igniting device, one of said variations being the feed of current from said source to said igniting device, and switch means on said support interposed between the other

source terminal and said electric line, said switch means being capable of occupying either a first position where it connects said last mentioned source terminal with said line to produce the first of said voltage variation or a second position where it produces the second of said voltage variation across the terminals of said device whereby the bringing of said switch means successively into said first and second positions causes the launching of one of said rockets, control of said switch means for the launching of said second rocket being independent of the control thereof for the launching of said first rocket although subsequent thereto.

3. A combination according to claim 2 wherein each of said igniting devices comprises a transformer having its secondary winding connected in series with said primer and its primary winding connected at one end with the first terminal of said igniting device and at its other end with the second terminal of said igniting device, said switch means being adapted to cut off said line from said source so as thus to produce the second voltage variation across the terminals of the igniting device.

4. A combination according to claim 2 wherein each of said igniting devices comprises a transformer having a primary winding and a secondary winding, said secondary winding and said primer being in series with each other, the whole of these two last mentioned elements being connected with the second terminal of said igniting device, and said primary winding being inserted in series between the two respective terminals of said igniting device, said switch means being adapted to cut off said line from said source so as thus to produce the second voltage variation across the terminals of the igniting device.

5. A combination according to claim 2 wherein each of said igniting devices comprises a capacitor, means responsive to the feed of current from said source to the first terminal of said igniting device for charging said capacitor, and means responsive to the grounding of said line for discharging said capacitor through said primer, this combination comprising a grounded contact on said support, said switch means being adapted to connect said line with said grounded contact.

6. A combination according to claim 2 wherein each of said igniting devices comprises a capacitor having two plates, unidirectional conducting means leading from the first terminal of said igniting device to one of the plates of said capacitor, the other plate of said capacitor being connected with the second terminal of said igniting device, an electric primer connected in shunt with said unidirectional conducting means, and rectifier means in series with said primer arranged to prevent the flow of current through said primer from said igniting device first terminal to said capacitor first plate, this combination comprising a grounded contact on said support, said switch means being adapted to connect said line with said grounded contact.

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