United States Patent

Francois

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[54] **MUNITION**

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[51] **Int. Cl.**.....**F41f 1/00**

[58] **Field of Search**....89/1.5, 1, 1.806, 1.817, 1.818; 244/137; 42/1, 1 F, 1.816

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Attorney—Waters, Roditi, Schwartz & Nissen

[57] **ABSTRACT**

A munition comprising a plurality of missiles disposed in axially aligned adjoining relation in a tube. A firing system is provided for firing the missiles one after the other at a high firing rate. Safety means ensure that a missile cannot be fired before the missile immediately preceding it is fired.

1 Claim, 8 Drawing Figures

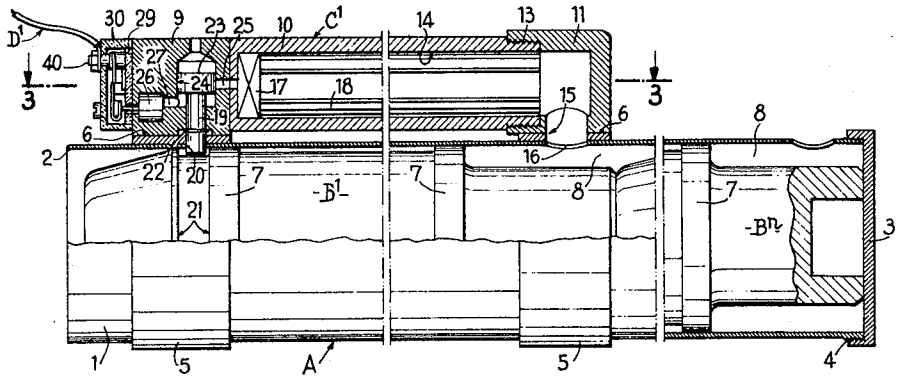
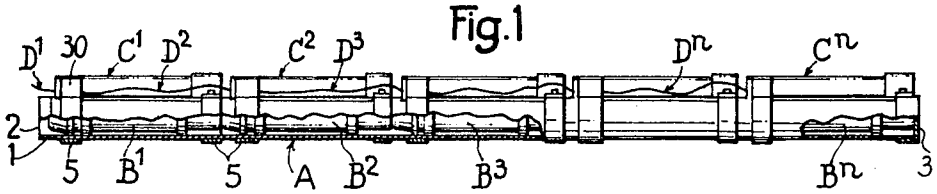


Fig.1



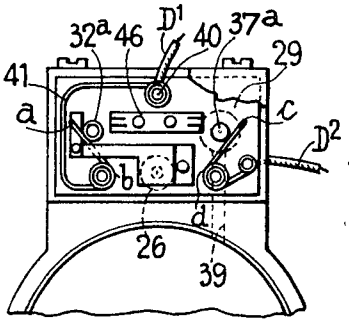
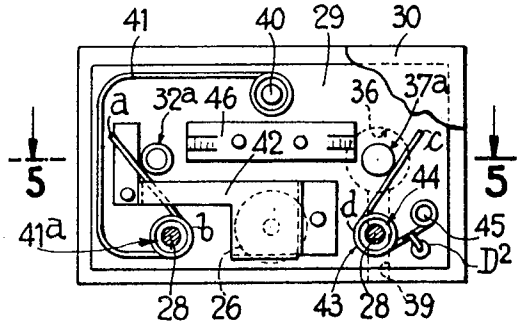


Fig.6

Fig.4



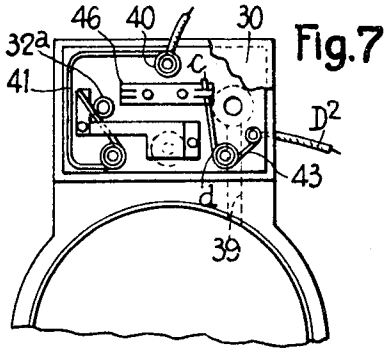


Fig.7

Fig.5

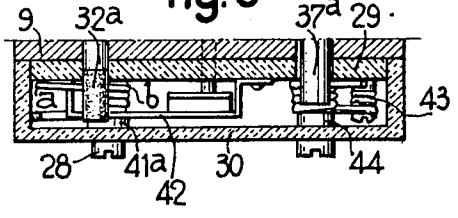


Fig.8

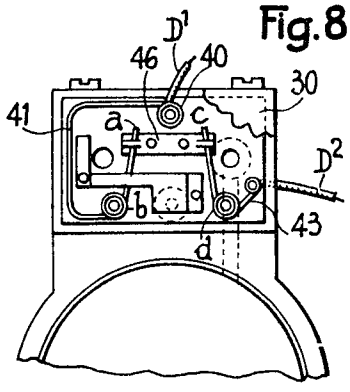


Fig. 2

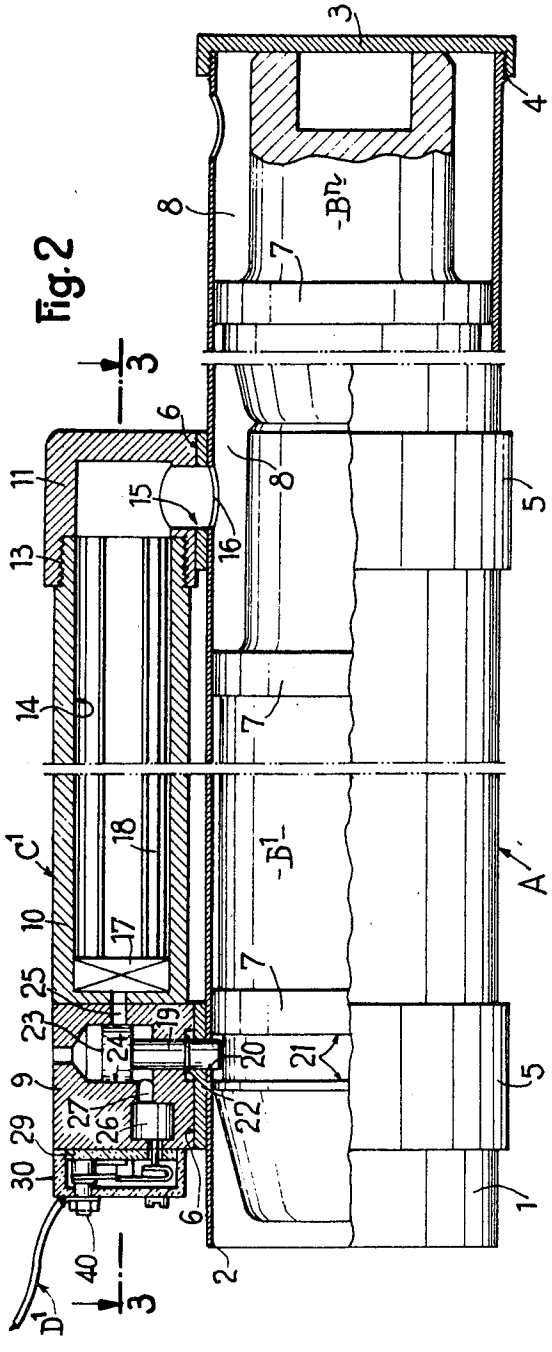

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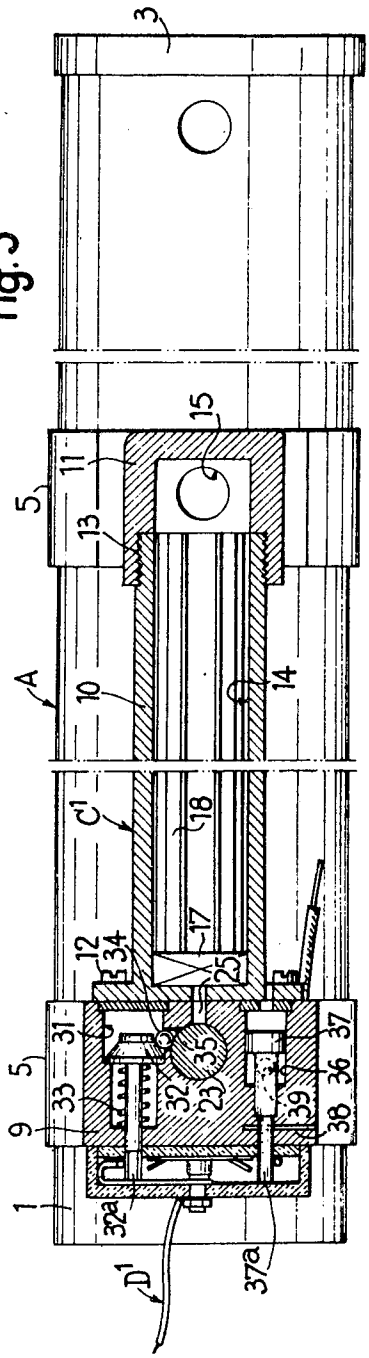
Fig. 3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MUNITION

The present invention provides an improved munition comprising a series of missiles disposed one behind the other and means for firing them in succession one by one.

Such a munition has many advantages over munitions having a single missile and in particular the following: increased rate of fire due to avoidance of the reloading operation, reduction in the transverse size of the arms or groups of arms adapted to fire a large number of missiles, improved ratio between the fired mass (missiles) and the immobile mass (arm) for a given rate of fire.

The number of missiles that is is possible to fire by means of this multi-missile munition is in fact merely limited by the permissible overall length which depends on the column or stack of missiles. It will be understood that the structure and shape of the missile should be such that the latter is unaffected by the effects of the powder gases, namely the pressure, thrust and temperature.

In an embodiment of the invention, the multi-missile munition comprises a metal tube which is open at one end and provided with an end wall at the other, and in which the missiles are disposed, the missile which was the first introduced in the tube bearing against said end wall, the other missiles bearing against one another and forming, at the rear of each missile, an annular chamber, firing means fixed on the tube and comprising as many missile-propelling gas-producing means as there are missiles, each gas-producing means comprising a powder charge and an igniting device and communicating with one of the annular chambers, the firing devices comprising therebetween a safety actuating means which corresponds to a pyrotechnic logic and is so arranged that the powder charges are ignited in succession one after the other, the powder charge of a given missile being ignited only after the missile immediately preceding it has been launched.

As will be understood, the tube constitutes both a case and firing chamber, that is to say, it is capable of withstanding the pressure of the launching gases with no need for support afforded by the wall of the chamber of an arm.

Before firing, the end wall of the tube is applied against the breech of the arm so that the successive thrusts produced by firing the missiles are transmitted to this breech through the column of missiles and this end wall of the tube.

The length of the tube containing the missiles is:

either limited to the length of the stack of missiles, in which case a launching passage or track must extend the munition,

or extends sufficiently beyond the end missile so that the tube itself constitutes the firing barrel, in which case the munition performs the functions of a case and an arm.

Advantageously, but not exclusively, the igniting devices, which are actuated one after the other, are electric and supplied irrespective of the number of the missiles of the munition, through a single conductor connected to a firing station.

Consequently, if this conductor is permanently connected across a voltage, the munition fires all the missiles in succession at a rate which can be very high. On the other hand, if the current is distributed in the form of brief pulses, separated by an interval of time, each pulse causes a separate and single firing only of one missile at a time.

Further features and advantages of the invention will be apparent from the ensuing description with reference to the accompanying drawings.

In the drawings:

FIG. **1** is a diagrammatic elevational view, with a part cut away, of a munition according to the invention;

FIG. **2** is a half axial sectional view and half elevational view of the two end portions of this munition and shows the first missile, the corresponding firing means, the repetition of the missile and associated firing means, the required number of times constituting the desired multi-missile munition, and the tail end of the last missile bearing against the end wall;

FIG. **3** is a corresponding plan view partly in section taken along line **3—3** of FIG. **2**;

FIG. **4** is an end elevational view, with the transparent cover removed, of the igniting device of a missile, this device being on a scale larger than that of FIGS. **2** and **3**;

FIG. **5** is a sectional view taken along line **5—5** of FIG. **4**, and

FIGS. **6–8** are diagrammatic views, on a reduced scale, of this igniting device in three successive positions.

DESCRIPTION

Reference will first be made to FIG. **1** which is an assembly view of the munition. The munition comprises the combination of a tube A, *n* number of missiles B^1, B^2, . . . B^n disposed one behind the other in the tube A and *n* number of firing devices C^1, C^2, . . . C^n, which produce propelling gases, are electrically ignited and fixed to the outside of the tube A for firing the missiles one by one, starting with the missile B^1 and ending with missile B^n, merely by the supply of electric ignition current through a single conductor D^1 which is, at one end, connected to a firing station (not shown) and, at the other end, connected to the first device C^1, the other devices being connected in series by conductor sections D^2, D^3, . . . D^n.

The tube A comprises (FIGS. **2** and **3**) a tube proper **1**, open at its forward end **2** and closed at its rear end by a transverse end wall **3** secured to the tube by a screwthread **4**. The tube **1** is surrounded locally by binding collars **5** which are fixed by adhesion, welding or other means and include plane faces **6** which constitute supports for the exterior firing devices C^1, . . . C^n.

Each missile B^1, . . . B^n is of any known type, depending on its function. The last missile B^n bears against the end wall **3**, whereas each of the other missiles bears against the missile located immediately behind. Each of them is provided with rings or flanges **7** for guiding the missile in the tube **1** and these flanges define annular chambers **8** between adjacent missiles.

Each device C^1 . . . C^n comprises three units or blocks **9**, **10** and **11** interconnected as by screws **12** (FIG. **3**) and a screwthread **13**.

The unit **9** constitutes a control unit and is connected to the elongated unit **10** defining a chamber **14** which is capable of withstanding high pressure and communicates with an orifice **15** which constitutes a nozzle

formed in the unit **11** and communicates with the interior of the tube **1** in the region of the tail end of the corresponding missile (B^1 for example) and in front of the following missile (B^2), in the annular chamber **8**, by way of an aperture **16** formed in the tube **1**.

Located in a chamber **14** of the unit **10** is an igniting relay **17** followed by the powder charge element or elements **18** known per se, whose combustion at relatively high pressure affords, after expansion by way of the nozzle **15**, all or a part of the gases for expelling the corresponding missile (if desired, an additional or complementary charge can in fact be provided in the chamber **8**). The powder element or elements **18** can be held stationary before and during combustion by any known means (not shown).

Slidable in the unit **9** is a locking means **19** for maintaining the corresponding missile (for example missile B^1) at rest. This locking means extends through an aperture **20** in the tube **1** into a recess **21** or blind hole formed in the body of the missile. It is held in this position by means affording a limited force of reaction, for example a resiliently yieldable split ring **22**. The locking means has a head **23** which is slidable in a fluid-tight manner in a cylindrical cavity **24** and constitutes a piston and closing element. At rest, this head closes an aperture **25** which connects the cylinder **24** to the relay **17**.

An electrically ignited primer detonator of fuze **26** is disposed in the unit **9**. The gases it produces are admitted by way of an aperture **27** below the head **23** of the locking means **19** and causes the latter to overcome the retaining action exerted by the resiliently yieldable split ring **22** and move a distance which corresponds to the release of the missile and to the unmasking of the aperture **25** leading to the relay **17** and powder charge **18**.

Secured in the front part of the unit **9** by screws **28** (FIGS. **4** and **5**) or other means, is an electric connecting box, preferably of moulded insulating material. It comprises a plate **29** and a preferably transparent hollow cover **30**.

Located in a closed bore **31** (FIG. **3**) in the unit **9** is a valve element **32** which is biased by a calibrated spring **33** and retained in the illustrated position by a ball **34** which bears against the lateral face of the head **23** of the locking means **19**. For this purpose, the ball **34** is movable through a transverse aperture **35** having a diameter slightly greater than that of the ball. The valve element **32** terminates in an insulated stem 32^a which extends into the electric connecting box (**29,30**) which it completely closes.

Movable in another parallel bore **36** in the unit or block **9** and located on the other side of the locking means (**19–23**) is a piston **37** which is maintained in the illustrated position by a shearable pin **38**. An insulated stem 37^a of this piston extends into the box (**29, 30**) which it also completely closes. An aperture **39** (FIGS. **3,4** and **6** to **8**), formed in the tube **1** and in the body of the unit **9**, communicates with the bore **36** and allows the gases expelling the corresponding missile to arrive behind the head of the piston **37** and shift it to the right from the position shown in FIG. **3**, provided of course that the pressure of the gases is equal to or higher than the pressure required for shearing the pin **38**.

Each electric connecting box comprises a terminal **40** (FIGS. **2,4,6,7** and **8**) to which is connected, in respect of the gas producer C^1, the conductor D^1 (FIGS. **1,2** and **3**) and, in respect of the other gas-producing devices, the corresponding conductor section $D^2, D^3 \ldots D^n$.

A spring **41** is centered on a stud 41^a carried by the plate **29**, and one of its ends is connected to the fixed terminal **40** whereas a branch *ab* (FIG. **4**) at its other end tends, owing to the effect of resilience, to move from left to right (as viewed in FIG. **4**) but is prevented from doing so by the fact that it bears against the insulated stem 32^a of the valve element **32**, this stem completely closing the box **30**. The branch *ab* of the spring therefore cannot move so long as the valve element **32** is in its position of rest shown in FIG. **2**. This branch *ab* of the spring is then in contact with a trigger guard plate **42** which is electrically associated with the stud of the electric primer of detonator **26** the body of which is earthed.

Another spring **43**, also centered on a stud **44** of the plate **29**, has one end secured at **45**. One of the conductors $D^2, D^3 \ldots D^n$ is connected to this end and to the terminal **40** of the following device $C^2, C^3 \ldots C^n$. The free branch *cd* at the other end of the spring tends, owing to the effect of resilience, to move from right to left (as viewed in FIG. **4**) but is prevented from doing so by the fact that it bears against the uninsulated stem 37^a of the piston **37** (FIG. **4**). This piston stem completely closes the box **30** and the branch *cd* of the spring is prevented from moving so long as the piston **37** is in its position of rest (FIG. **3**).

Between the branches *ab* and *cd* of the springs **41** and **43** in a fixed waiting position is a metal connecting member **46** which is fixed to the plate **29** and adapted to receive the ends of the two springs when they have been released, as shown in FIG. **8**. At rest, there are therefore two breaks or interruptions in series in the supply circuit between the portions D^1, D^2 or D^2, D^3 of the conductor: an upper break (*ab*,**46**) depending on the position of the spring **41** and a lower break (**46**, cd) depending on the position of the spring **43**.

In other words, each housing comprises two contactors **42**, *ab*, **46**; **46**, *cd*, 37^a, whose positions (*ab*, **42** or *ab*,**46** and *cd*, **46** or *cd*, 37^a) are governed by the positions of the respective moving elements, namely the valve element **32** and the piston **37**, these contactors being, for example, in series in the position *ab*, **46**, *cd*.

OPERATION

Before explaining this operation, the following preliminary remarks will be made:

The firing safety of the described munition is afforded by mutually actuated current transfer or transmitting devices contained in the boxes **29, 30** and constituting a pyrotechnic logic, a certain sequence of operations (explained hereinafter) being necessary for firing a missile. The correctness of this sequence is checked by the transfer device pertaining to said missile before allowing the firing of the following missile. The single conductor D^1 which supplies current to the munition is, as explained hereinbefore, connected to the means controlling and supervising the first missile B^1. The electric connection from one device C to the other is in readiness for operation. Upon the normal fir-

ing of each missile, the transfer is established and the connection advances by a device C. The firing current therefore passes in series through the already-operated devices C for supplying current to the following device.

As each missile is retained or held stationary, at rest, by the locking means (19–23) so that there is no accidental movement thereof consequent to any disturbing forces, the sequence of operations must therefore include the prior withdrawal of this locking means before any production of missile-expelling gas. The sequence of operations must therefore be the following:

a. Firing of the electric primer of fuze 26.

b. Withdrawal of the locking means (19–23).

c. Ignition of the powder 18 and production of gases under pressure for expulsion of the missile.

d. Start of the movement of the missile.

e. Emergence of the missile from the tube A and drop in pressure.

This sequence of operations requires a certain period of time. When the firing of the multi-missile munition must conform to spaced pulses, it will be understood that the interval between these pulses must include this period of time. If the firing current is permanent, this period of time in fact determines the rate of fire.

The operation for each sequence of operations is the following:

a. The ignition of the primer or fuze 26.

The current arrives at the terminal 40 (FIGS. 4 and 6) and supplies the primer 26, through the spring 41 and by way of the plate 42 which is in contact with the branch *ab* of the spring. The primer is ignited and produces a corresponding gas pressure.

b. Withdrawal of the locking means (19–23).

The gases from the primer arrive behind the head 23 of this locking means (FIG. 2). The pressure overcomes the retaining action which the ring 22 exerts on the locking means and said locking means moves and releases the corresponding missile and simultaneously uncovers the aperture 35, in which the ball 34 (FIG. 3) is located, and the aperture 25 leading to the relay 17 and to the powder charge 18. The ball 34 no longer bears against the head 23 of the locking means 19.

Notwithstanding the release of this ball 34 which maintains it in position, the valve element 32 remains applied against its seating in its initial position owing to the pressure of the gases of the primer (this pressure is indeed transmitted immediately through the aperture 35 in which the ball 34 is disposed with clearance) and the pressure of the gases of the powder charge 18.

c. Ignition of the powder charge and production of the missile-expelling pressure.

The gases of the primer pass through the aperture 25, after having withdrawn the locking means (19–23), and ignite the relay 17 which, in turn, ignites the powder charge. This pressure ensures that the valve element 32 is still maintained in its initial position.

Meanwhile, the gases of the powder charge enter, by way of the nozzle 15, the tube 1 and create therein the missile-expelling pressure in the region of the chamber 8 behind the missile to be launched.

d. Start of the movement of the missile.

The missile, such as missile B^1, which is urged forward by the effect of the gases which bear against the forward part of the following missile, such as missile B^2, starts to move. After having travelled a given distance, it uncovers the aperture 39 and the missile-expelling pressure is transmitted, by way of this aperture, behind the head of the piston 37 (FIG. 3). If the pressure has the required magnitude, this piston, which is biased by the gases, causes the pin 38 to be sheared. This piston moves and its stem is withdrawn from the box 29, 30 and releases the branch *cd* of the spring 43 which extends and applies itself against the connecting member 46. The aforementioned lower break or switch (46–*cd*) in the conductor is closed and the box 29, 30 is in the condition shown in FIG. 7. On the other hand, if the pressure does not have the required magnitude or if the powder charge does not ignite, the pin 38 remains unsheared and the lower break or switch (46–*cd*) remains open and prevents any transfer of current to the following device C. This is an essential safety precaution. The firing then ceases.

e. Emergence of the missile from the tube and drop in pressure.

When the missile leaves the barrel of the arm, the missile-expelling pressure suddenly drops. The drop in pressure occurs in the unit 9 in the region of the valve element 32 by way of the communication between the tube 1 and the valve element (nozzle 15, chamber 14, aperture 25, aperture 35 containing the ball 34, etc.).

The calibrated spring 33 shifts the valve element 32 as soon as the decreasing pressure can no longer maintain the valve element on its seating. The threshold value of operation is chosen very low. The insulated stem 32^a of the valve element moves away from the box 29–30 and releases the branch *ab* of the spring 41 which extends and applies itself against the connecting member 46. The aforementioned upper break or switch is in turn closed (FIG. 8).

The current is transmitted or transferred. The following pulse reaching the terminal 40 passes through the box by way of the two springs 41 and 43 which are electrically interconnected by the connecting member 46 and the conductor D^2, and reaches the following device C^2 where the same sequence recommences and so on up to the last device C^n of the munition.

It will be understood that the last device C^n and the associated electric connection box can be without the piston 37, the spring 43 and the output conductor, since no transfer of current has to be effected thereby. On the other hand, all the other parts are necessary.

The various safety precautions are afforded in the following manner.

A current pulse fed into the device C^1, C^2 . . . C^n of the munition can affect only the primer or fuze 26 of this device; the primer or fuze of the following device is earthed owing to the fact that the branch *cd* of the spring 43 bears against the uninsulated stem 37^a of the piston 37 (FIGS. 4 and 6). The same is true of the following devices C.

The primer 26 can only be ignited if the corresponding missile B is correctly locked in position. Indeed, if the locking means (19–23) is accidentally raised or withdrawn, the valve element 32 is no longer retained and, in moving, releases the branch *ab* of the spring 43 which leaves its contact with the plate 42. The primer can no longer be ignited. The aforementioned lower break (46–*cd*) prevents the electric pulse from reaching the following primer and the firing of the mu-

nition is interrupted. This is an indispensable safety precaution since the missile to be fired might have moved accidentally.

The shearable pin **38** guarantees a sufficient magnitude of the expelling pressure for firing the missile. The closing of the lower break or switch (**46**–*cd*) therefore cannot occur for an insufficient pressure which would be liable to result in the missile being left in the barrel of the arm. The same is true of the situation when the powder charge **18** does not ignite.

The closure of the upper break or switch (*ab*–**46**) cuts off the connection between the circuit and the ignited primer. Any short-circuiting of the latter, due to the combustion of the substances it contained, does not adversely affect the ignition of the following primers.

When both breaks or switches (*ab*–**46**; **46**–*cd*) are closed, the electric circuit is transferred or transmitted. Any subsequent movement of the valve element **32** or of the piston **37** under the possible action of the gases given off by the following devices C has no effect on the springs **41** and **43** which transfer or transmit the current.

Although a specific embodiment of the invention has been described, many modifications and changes may be made therein without departing from the scope of the invention.

The launching charges **18** may be corrected so as to adjust the initial speed of the missiles in accordance with the different lengths of travel through the tube A and possibly through the barrel of the firing arm.

Having now described my invention what I claim and desire to secure by Letters Patent is:

1. A munition comprising a metal tube having an open forward end and a closing wall at the other end, a plurality of missiles disposed in said tube in axially adjoining relationship to one another, whereby the rear end missile bears against said end wall, means defining at the rear end of each missile an annular chamber with said tube, a plurality of firing means each of which is associated respectively with one of said missiles, fixed laterally on said tube and provided with a missile propelling gas produced means, an igniting device and a chamber for receiving a powder charge, said munition further comprising a plurality of openings provided in said tube for putting respectively in communication corresponding ones of said annular chambers with said chambers of said firing means, and automatically withdrawable locking means engageable with each missile for holding the missile stationary in said tube before it is fired and means associated with said locking means for withdrawing said locking means just before firing the missile, said locking means being movable in the wall of the tube and said means associated with said locking means comprising a cylinder directly communicating with said igniting device and a piston slidable in said cylinder and connected to said locking means, said piston and cylinder constituting a slidable closing means between said igniting device and said powder charge, the arrangement being such that said locking means is withdrawn by the action of the gases of the igniting device before said gases of the igniting device come in contact with said powder charge.

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