Nov. 10, 1970 J. J. NASH 3,539,955

INTERVALOMETER

Filed Dec. 31, 1968

4 Sheets-Sheet 1

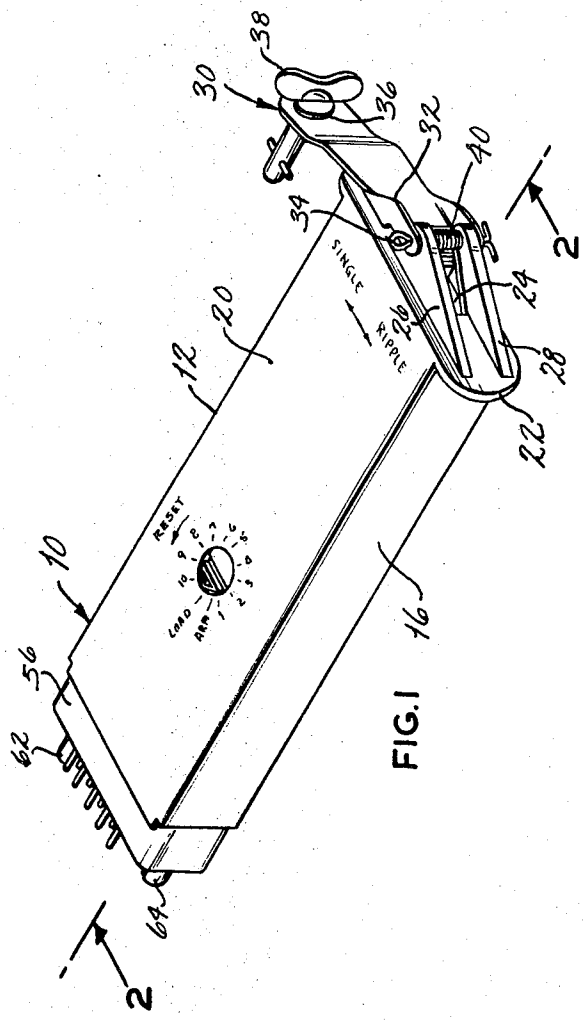


FIG. 1

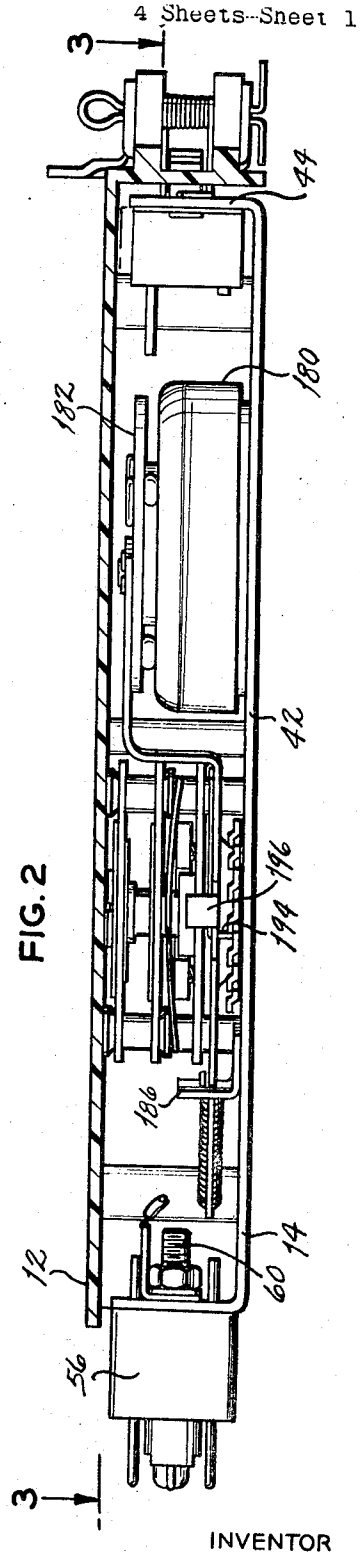


FIG. 2

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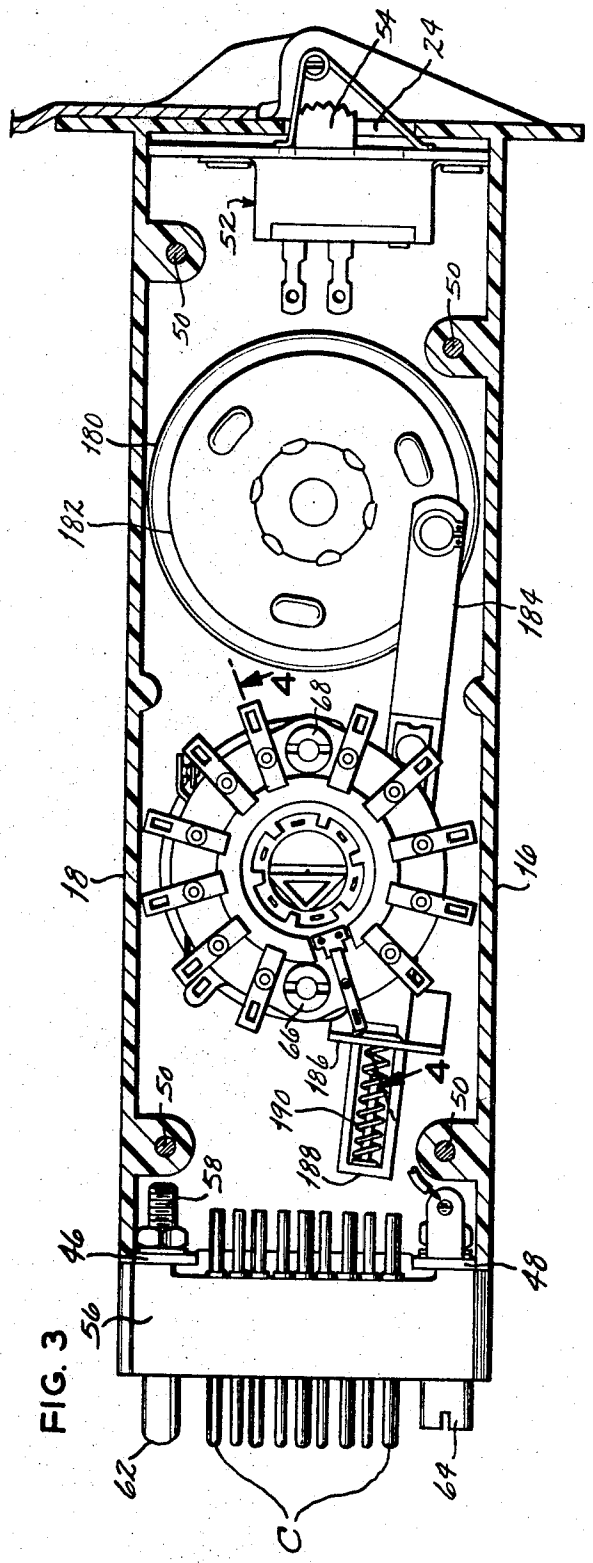


FIG. 3

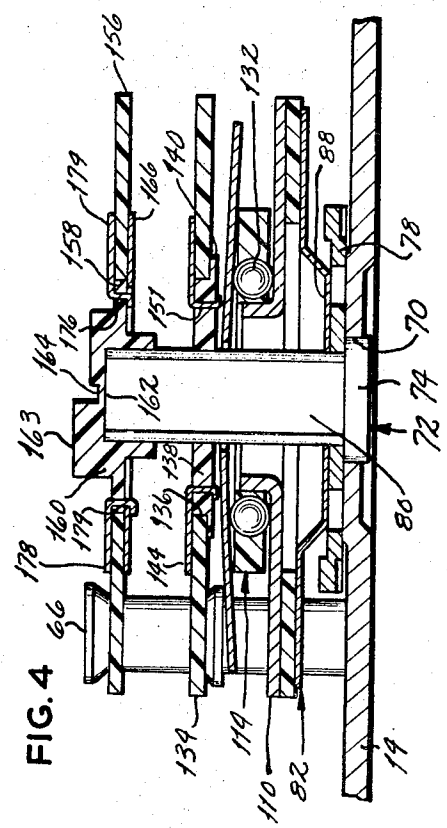


FIG. 4

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FIG. 5

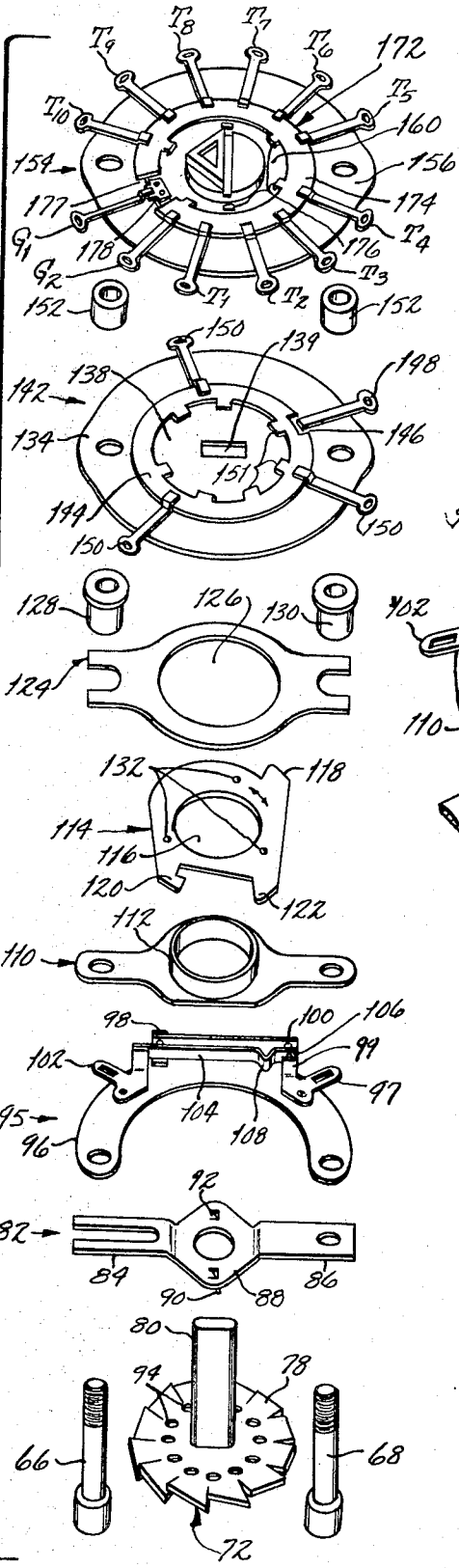


FIG. 6

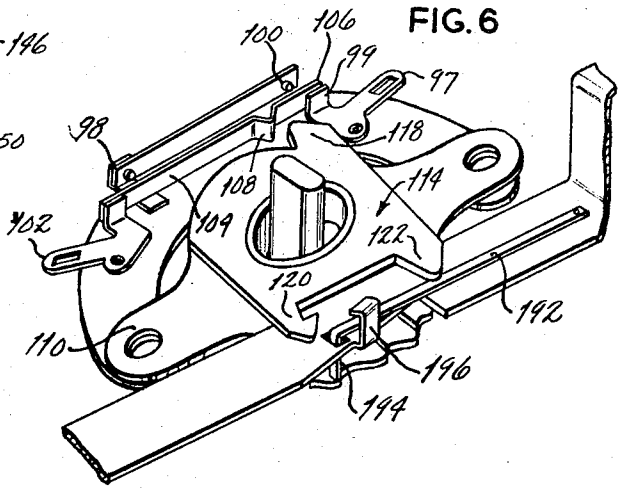
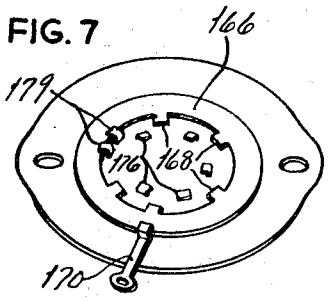


FIG. 7



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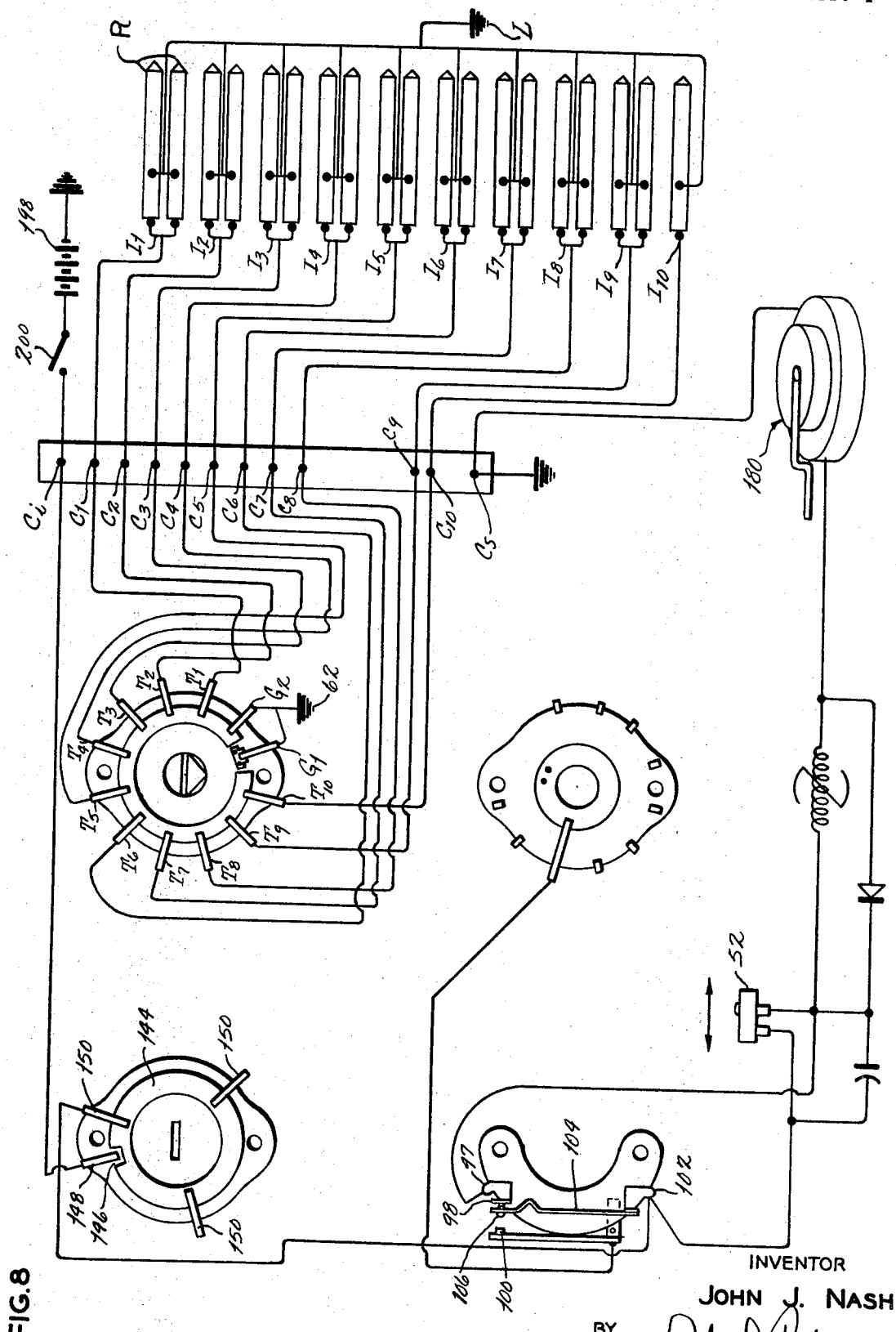


FIG.8

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3,539,955

INTERVALOMETER

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Int. Cl. H01h 51/08
U.S. Cl. 335—138 15 Claims

ABSTRACT OF THE DISCLOSURE

An intervalometer comprises a connector means adapted to be electrically connected to a source of electricity, a solenoid in electrical connection with the connector means, a plurality of output terminals, a distributor tab adapted to move to each of the output terminals, and switch means between the connector means and the distributor tab. The switch means is movable from an open position wherein the distributor tab is electrically disconnected from the connector means to a closed position wherein the distributor tab is electrically connected to the connector means. Mechanism responsive to the actuation of the solenoid is adapted to cause the switch to move to its closed position and to cause the distributor tab to move to each of the output terminals. Biasing means yieldably maintains the switch in its open position so that the distributor tab and the output terminals are electrically disconnected from the connector means whenever the solenoid is deactivated.

This invention relates to intervalometers and more particularly to intervalometers adapted for use on rocket launchers.

Rocket launchers used by U.S. military forces are comprised of a bundle of cylindrical tubes which slidably receive rockets and which are suspended beneath aircraft. The rockets are fired by the introduction of electrical current to an ignition cap at the rear end of each rocket. The electricity is introduced from a power source through an intervalometer which directs the current to each ignition cap of each rocket one at a time. Intervalometers in the present state of the art are adapted to be set for single firing and ripple firing. In single firing the intervalometer directs current to one rocket each time the airplane pilot closes a switch in the cockpit. In ripple firing the intervalometer is initially actuated by the closing of the switch in the cockpit and then it automatically causes the rockets to fire one at a time in successive order until they are all fired.

Intervalometers comprise a solenoid adapted to move a distributor mechanism leading to a plurality of output terminals to introduce electricity to them one at a time. The output terminals each are electrically connected to ignition terminals in electrical contact with the ignition caps of each rocket. As the distributor makes contact with each output terminal it introduces a jolt of electricity to each ignition terminal, thereby setting off the ignition caps and firing the rockets one at a time. The ignition terminals are usually metal contacts which engage the ignition caps of the rockets. They are insulated from the rocket launching tubes so that there will be no short circuiting of the circuit from the power source to the ignition cap of the rockets. Occasionally, however, the rocket launching tubes become bent or distorted and come in contact with the ignition terminals, thereby short circuiting the electrical circuit to the rocket ignition caps and preventing firing of the rocket in that particular tube. Short circuiting also occurs when the ignition terminals themselves become bent or damaged. When this happens not only does the rocket fail to fire, but the grounded ignition terminals short circuit the circuit from the power source to the solenoid of the intervalometer. As a result the intervalometer stops and does not complete its cycle to all of the terminals. For example, if the ignition terminal of the second rocket happens to be short circuited, the intervalometer will progress to that particular terminal and then will stop without completing the remainder of the cycle.

Among the several objects of the present invention may be noted the provision of an intervalometer which will step over any grounded output terminal and will progress on to the other terminals; the provision of an intervalometer wherein the power source is connected to the output terminals only after the solenoid is actuated; the provision of an intervalometer wherein the output terminals are all grounded except when fired to prevent the buildup of stray voltage and static electricity; the provision of an intervalometer which includes an interrupter switch which alternatively directs current to the solenoid and to the output terminals; the provision of an intervalometer wherein the circuit from the power source to the solenoid is isolated from the output terminals to prevent short circuiting when the output terminals are grounded; the provision of an intervalometer including a distributor mechanism and a grounding mechanism secured to the same rotating member to deliver electricity to individual output terminals while simultaneously grounding the remaining output terminals; and the provision of an intervalometer which is durable in use and economical to manufacture. Other objects and features will be in part apparent and in part pointed out hereinafter.

The invention accordingly comprises the constructions hereinafter described, the scope of the invention being indicated in the following claims.

In the accompanying drawings, in which one of various possible embodiments of the invention is illustrated,

FIG. 1 is a perspective view of the intervalometer;

FIG. 2 is a sectional view taken along line 2—2 of FIG. 1;

FIG. 3 is a sectional view taken along line 3—3 of FIG. 2;

FIG. 4 is an enlarged sectional view taken along line 4—4 of FIG. 3;

FIG. 5 is an exploded perspective view of the structure shown in FIG. 4;

FIG. 6 is a detailed perspective view of the interrupter mechanism;

FIG. 7 is a perspective view of the bottom surface of the upper wafer shown in FIG. 5; and

FIG. 8 is a schematic diagram of the electrical circuit showing the electrical interconnection of the various components of the intervalometer.

Corresponding reference characters indicate corresponding parts throughout the several views of the drawings.

Referring to the drawings, **10** designates a housing assembly having an upper housing **12** and a housing base **14**. Upper housing **12** includes three lateral sides **16**, **18**, **20**, and one end flange **22**. End flange **22** has a switch slot **24** forming communication between the outside of housing assembly **10** and the interior thereof. Two horizontal bracket lips **26**, **28**, extend from the exterior face of end flange **22**. A grounding tab **30** having a yoke portion **32** is secured to bracket lips **26**, **28**, by means of a cotter pin **34** extending vertically through the arms of yoke **32** and bracket lips **26**, **28**. Yoke **32** is permitted to pivot about the vertical axis created by cotter pin **34**. At the opposite end of grounding tab **30** from yoke **32** is an aperture **36** with a wing stud **38** extending therethrough. Wing stud **38**, grounding tab **30**, and cotter pin **34** are all constructed of material which is a good electrical conductor, the purpose of wing stud **38** being to make grounding connection with a conventional rocket launcher (not shown). A spring element **40**, also constructed of a good

electrical conducting material, is coiled about cotter pin **34** and has its opposite ends extending through switch slot **24** into the interior of upper housing **12**.

Housing base **14** consists of a bottom **42**, a first vertical end **44** adjacent end flange **22** of upper housing **12**, and two spaced apart vertical legs **46, 48**, on the end of housing base **14** opposite from first vertical end **44**. Housing base **14** is constructed of a material which is a good electrical conductor and is secured to upper housing **12** by screws **50**, as illustrated in FIG. 3. It should be noted that first end **44** is adjacent end flange **22**, but that spring element **40** is embraced therebetween. The result is that spring element **40** forms electrical connection between housing base **14** and grounding tab **30**. A slide switch **52** having a slide button **54** is secured to the inside of first end **44** with slide button **54** extending outwardly through an aperture in first end **44** and through switch slot **24** in end flange **22**. Thus slide button **54** may be moved from the outside of housing **10**. Slide button **54** is movable between a single fire position and a ripple fire position.

A connector member **56** is secured to housing base **14** by bolts **58, 60**, extending through vertical legs **46, 48**, of housing base **14**. Bolts **58, 60**, are constructed of a good electrical conducting material and extend through connector member **56** to form electrical connection with male guide pin **62** and female guide pin **64**, respectively. Guide pins **62, 64**, are ground-leads and are adapted to be connected by wires to a ground. Also extending through connector member **56** are a plurality of connector pins C. These connector pins C are shown schematically in FIG. 8 and include ten rocket connector pins C_1–C_{10}, an input connector pin C^i, and a solenoid connector pin C^s.

FIGS. 4 and 5 illustrate a deck assembly within housing **10**. Two vertical guide posts **66, 68**, are rigidly secured to housing base **14** and extend upwardly therefrom. A pivot aperture **70** extends through housing base **14** and is centered between guide posts **66, 68**. A movement member **72** is pivotally mounted within pivot aperture **70** and includes a bearing poriton **74** extending through aperture **70**, a ratchet wheel **78** directly above and adajacent to housing base **14**, and a vertically disposed center post **80** extending upwardly from ratchet wheel **78**. Center post **80** is rectangular in cross-section. A ratchet spring plate **82** having wings **84, 86**, on opposite sides of a bearing portion **88** is positioned over ratchet wheel **78** with guide posts **66, 68**, extending through apertures in wings **84, 86**, and center post **80** extending through an aperture in bearing portion **88**. Bearing portion **88** includes two downwardly projecting catch fingers **90, 92**, which bear against ratchet wheel **78**. Catch fingers **90, 92**, are adapted to be received yieldably within each of a plurality of apertures **94** arranged in a circular array in ratchet wheel **78**. Thus while ratchet wheel **78** may be turned by the application of a substantial torque thereto, fingers **90, 92**, tend to hold ratchet wheel **78** against rotational movement. In addition, because of the slanting position of fingers **90, 92**, ratchet wheel **78** can turn in only one direction. As ratchet wheel **78** rotates, fingers **90, 92**, snap in and out of apertures **94**, thereby causing ratchet wheel **78** to progress a step at a time.

An interrupter switch **95** is mounted on a crescent-shaped dielectric interrupter deck **96** which has its crescent tips slidably received over guide posts **66, 68**, directly over and adjacent to ratchet spring plate **82**. Interrupter switch **95** includes a first fixed interrupter terminal **97** and a second fixed interrupter terminal **98**. First interrupter terminal **97** has a first fixed contact point **99**, and second fixed interrupter terminal **98** has a second fixed contact point **100**. A movable interrupter terminal **102** is also secured to interrupter deck **96** and has a spring arm **104** extending therefrom with a movable contact point **106** on its end between first and second fixed contact points **99, 100**. Spring arm **104** yieldably holds movable contact point **106** against first fixed contact point **99**. Also on spring arm **104** is a cam follower shoulder **108**. First fixed terminal **97**, second fixed terminal **98**, movable terminal **102**, spring arm **104**, and fixed and movable contact points **99, 100, 106**, are all made of a material which is a good electrical conductor.

Directly above interrupter deck **96**, a pivot plate **110** is slidably mounted on guide posts **66, 68**, which extend through apertures on its opposite sides. Pivot plate **110** includes a cylindrical pivot collar **112** extending upwardly therefrom with center post **80** extending upwardly through its interior. A cam **114** is rotatably received over pivot collar **112** by means of a center aperture **116**. Cam **114** includes a cam finger **118** on one side thereof and first and second drive lips **120, 122**, on opposite sides thereof. FIG. 6 illustrates the interrelationship of cam **114** and interrupter deck **96** when the components are assembled. Cam finger **118** abuts against cam follower shoulder **108** of spring arm **104**. Thus the rotation of cam **114** causes cam finger **118** to push against cam follower shoulder **108**, thereby pushing movable contact point **106** away from first fixed contact point **99**, and causing it to be moved into electrical contact with second fixed contact point **100**.

Directly above cam **114** is a top spring plate **124** which is slidably received over guide posts **66, 68**, and which has an aperture **126** in the center thereof with center post **80** extending upwardly therethrough. A pair of shims **128, 130**, are slidably received over guide posts **66, 68**, respectively, to help urge top spring plate **124** downwardly against cam **114**. Cam **114** has a plurality of ball bearings **132** which are sufficient in diameter to extend both above and below the upper and lower surfaces of cam **114** to allow cam **114** to move freely with respect to pivot plate **110** and top spring plate **124**.

Directly above shims **128, 130**, is a lower deck wafer **134** which has a center aperture **136** therein (FIG. 4). Rotatably received within center aperture **136** is a disk-shaped lower deck bearing **138** made of dielectric material and having a rectangular keyhole **139** therein for receiving center post **80** of movement member **72**. A flange **140** is provided on the bottom of lower deck bearing **138** and engages the lower surface of lower deck wafer **134** to limit the upward axial movement of lower deck bearing **138** within center aperture **136**. A solenoid control mechanism **142** is mounted on the upper surface of lower deck wafer **134** and includes a solenoid control ring **144** having a notch **146** therein, a power terminal **148**, and a plurality of solenoid terminals **150**. Solenoid control ring **144** is secured to the upper surface of lower deck bearing **138** by means of prongs **151** extending through lower deck bearing **138**. Flange **140** and solenoid control ring **144** embrace the opposite surfaces of lower deck wafer **134** so as to hold lower deck bearing **138** against axial movement within center aperture **136**. Power terminal **148** is secured to lower deck wafer **134** and is positioned so that it engages solenoid control ring **144** at all times except when notch **146** is adjacent it. When notch **146** is positioned adjacent power terminal **148** the electrical connection between solenoid control ring **144** and power terminal **148** is broken. Solenoid terminals **150**, however, extend inwardly toward the inner edge of solenoid control ring **144** a sufficient distance so that they are always in electrical contact with solenoid control ring **144** regardless of the position of notch **146**. Power terminal **148** is adapted to be connected to a power source and solenoid terminals **150** are adapted to be connected to a solenoid. Electrical current from power terminal **148** will be conducted through solenoid control ring **144** to solenoid terminals **150** as long as power terminal **148** is in electrical connection with solenoid control ring **144**. However, the circuit from the power source to solenoid terminals **150** can be broken by moving notch **146** adjacent power terminal **148**.

Slidably received on guide posts **66, 68**, directly above lower deck wafer **134** are two additional shims **152**. Slidably received over guide posts **66, 68**, directly above shims **152** is an upper deck assembly **154** which includes an

upper deck wafer **156** having a center aperture **158** therein. Rotatably received within center aperture **158** is a disc-shaped dielectric upper deck bearing **160** which includes a rectangular aperture **162** extending upwardly from its bottom surface and terminating short of its upper surface for receiving the extreme upper end of center post **80**. The top of upper deck bearing **160** is formed into the shape of a triangular pointer **163** and a screw driver slot **164** which are adapted to protrude through an aperture in upper housing **12** so that they are visible and accessible from outside housing **10** (FIG. 1).

Referring to FIGS. 4 and 7, a distributor ring **166** is operatively secured to the bottom surface of upper deck bearing **160** by means of prongs **168**. A distributor power terminal **170** is secured to the bottom surface of upper deck wafer **156** and is adapted to be continually in contact with distributor ring **166**. Distributor power terminal **170** is also in electrical connection with second fixed contact **100**. On the upper surface of upper deck bearing **160** (FIG. 5) is a grounding mechanism **172** which includes a circular grounding ring **174** secured to the upper surface of upper deck bearing **160** by prongs **176**. Grounding ring **174** includes a cutout portion or notch **177**. A distributor tab **178** is secured to upper deck bearing **160** in the space provided by notch **177** and includes connecting prongs **179** (FIG. 4), which extend downwardly through upper deck bearing **160** and are in contact with distributor ring **166**, thereby providing an electrical connection between distributor ring **166** and distributor tab **178**. Grounding ring **174** is insulated from distributor tab **178** and distributor ring **166** because its prongs **176** are embedded in the dielectric material of upper deck bearing **160**.

A plurality of output terminals T_1–T_{10} are arranged in a circular array and secured to the upper surface of upper deck wafer **156** so that they are in electrical contact with the outer edge of grounding ring **174**. Two grounding terminals G_1 and G_2 are also included in this circular array. Output terminals T_1–T_{10} are electrically connected to connector pins C_1–C_{10} which in turn lead to ignition terminals I_1–I_{10}, respectively, as illustrated in FIG. 8. Grounding terminals G_1 and G_2 are electrically connected either to guide pin **62** or guide pin **64** which are in turn adapted to be grounded so that grounding terminals G_1 and G_2 are always electrically grounded. Notch **177** of grounding ring **174** is of a width that disconnects one terminal at a time as grounding ring **174** rotates throughout one revolution. Thus, grounding ring **174** is in electrical connection with all but one of the output terminals T_1–T_{10} and grounding terminals G_1 and G_2. Because of this arrangement at least one of the grounding terminals G_1 and G_2 is always in electrical contact with grounding ring **174** and consequently all of the output terminals in contact with grounding ring **174** are grounded. Thus, grounding ring **174** grounds all of the output terminals while notch **177** breaks electrical connection between grounding ring **174** and each of the output terminals T_1–T_{10} one at a time. Because distributor tab **178** is positioned in the space provided by notch **177** it simultaneously makes electrical contact with the same terminal which is disconnected from grounding ring **174** by notch **177**. Thus, as upper deck bearing **160** rotates through one revolution, each of the output terminals is simultaneously disconnected from grounding ring **174** and connected to distributor tab **178** at one time.

When ratchet wheel **78** is rotated it also rotates center post **80**, lower deck bearing **138**, and upper deck bearing **160**. Solenoid control ring **144** rotates in unison with lower deck bearing **138**. Rotating with upper deck bearing **160** are distributor ring **166**, distributor tab **178**, and grounding ring **174**. The keying of center post **80** to lower deck bearing **138** and upper deck bearing **160** causes all these units to rotate in unison. The center apertures in the other components of the deck assembly are sufficiently large to permit free rotation of center post **80**.

Referring to FIGS. 2 and 3, a solenoid **180** is operatively secured to housing base **14** adjacent the previously described deck assembly. Solenoid **180** includes a solenoid rotor **182** which is adapted to rotate upon activation of solenoid **180**. A link or drive arm **184** is pivotally secured to solenoid rotor **182** at one of its ends and has the other of its ends slidably received through a slide bracket **186** which is operatively secured to housing base **14**. A spring stop **188** is on the end of drive arm **184** opposite solenoid rotor **182** and a coil spring **190** is positioned around drive arm **184** between spring stop **188** and slide bracket **186** to yieldably urge drive arm **184** to the left as viewed in FIG. 2. Slide bracket **186** holds drive arm **184** so that its intermediate portion is adjacent the deck assembly. An L-shaped spring **192** (FIG. 6) is operatively secured at one of its ends to drive arm **184** with a downwardly projecting pawl or drive finger **194** at its opposite end and extending downwardly through an aperture in drive arm **184** to engage the teeth of ratchet wheel **78** (FIG. 6). Drive arm **184** is also equipped with an upwardly projecting pawl or drive finger **196** which is disposed between drive lips **120**, **122**, of cam **114**. Thus, as viewed in FIG. 6, upon activation of solenoid **180** drive arm **184** is moved to the right, thereby causing downwardly projecting finger **194** to rotate ratchet wheel **78** in a counterclockwise direction and causing upwardly projecting drive finger **196** to engage drive lip **122** of cam **114** to rotate cam **114** in a counterclockwise direction. The rotation of cam **114** in a counterclockwise direction causes cam finger **118** to bear against cam follower shoulder **108**, thereby moving movable contact point **106** from first fixed contact point **99** to second fixed contact point **100**. Upon deactuation of solenoid **180**. drive arm **184** is returned to its original position by coil spring **190**. As spring **190** moves drive arm **184** to the left as viewed in FIGS. 2 and 6, upwardly projecting finger **196** strikes drive lip **120** and rotates cam **114** in a clockwise direction. This rotation permits spring arm **104** to move movable contact **106** back into electrical contact with first fixed contact, **99**.

Referring to the schematic drawing of FIG. 8, a plurality of pairs of rocket ignition terminals I_1–I_9 and a single rocket ignition terminal I_{10} are positioned adjacent nineteen rockets R. Rockets R are all grounded to the rocket launcher L as a result of their engagement with the rocket launching tubes in which they are placed. Each of the rocket ignition terminals I_1–I_{10} are electrically connected to connector pins C_1–C_{10} which are in turn electrically connected to output terminals T_1–T_{10}.

The method of operation is as follows: Triangular pointer **163** is manually positioned pointing to "load" which is marked on the outer surface of upper housing **12** as viewed in FIG. 1. In this position the various components are positioned as follows: Solenoid control ring **144** is positioned with its notch **146** adjacent power terminal **148**, thereby freeing power terminal **148** from electrical contact with solenoid control ring **144**. Distributor tab **178** and notch **177** of grounding ring **174** are positioned at grounding terminal G_1. In this position the outer peripheral edge of grounding ring **174** is in electrical contact with grounding terminal G_2 and with all of the output terminals T_1–T_{10}. Thus in the "load" position all of the ignition terminals I_1–I_{10} are grounded to drain off any stray voltage. Whenever the device is in the "load" position there is no danger of accidental firing caused by a voltage potential building up on any one of the ignition terminals I_1–I_{10}.

When the rocket launcher is to be prepared for firing, triangular pointer **163** is manually rotated to the position marked "arm" on the outer surface of housing **10** as viewed in FIG. 1. In this position solenoid control ring **144** is positioned with its notch **146** slightly counterclockwise with respect to power terminal **148**. Thus power terminal **148** is in electrical contact with solenoid control ring **144** and electrical connection from a power source **198** through input connector C_1 and power terminal **148**

into the system is prevented only by an operator switch **200** which is normally located in the cockpit of the airplane. In the "arm" position the distributor tab **178** and notch **177** are positioned adjacent grounding terminal G_2, thereby leaving distributor tab **178** free from electrical contact with any of the output terminals T_1–T_{10}, and maintaining all the output terminals T_1–T_{10} in electrical contact with grounding ring **174**.

Before the airplane takes off, slide switch **52** is positioned in either the single fire position or the ripple fire position. In the single fire position, slide switch **52** is closed, and in the ripple fire position it is open. The method of operation when the slide switch is in the ripple fire position is as follows: When the pilot wishes to fire a rocket he closes operator switch **200**, thereby completing an electrical circuit from power source **198** through operator switch **200**, through input connector pin C_i, through power terminal **148**, through solenoid control ring **144**, through solenoid terminal **150**, through movable terminal **102**, through spring arm **104**, through first fixed terminal **97**, through solenoid **180** to activate it, and through solenoid connector pin C_s which is connected to a ground.

The activation of solenoid **180** causes drive arm **184** to be moved to the right, causing downward projecting finger **194** to rotate ratchet wheel **78** and causing upward projecting finger **196** to meet drive lip **122** of cam **114**, thereby rotating cam **114**. The effect of this movement is that movable contact **106** is pushed out of electrical contact with first fixed contact point **99** during activation of solenoid **180**. However, because slide switch **52** is open, the movement of movable contact **106** away from first fixed contact **99** causes the circuit from the power source to solenoid **180** to be broken, thereby deactuating solenoid **180**. When solenoid **180** is deactuated drive arm **184** is again returned to its original position by coil spring **190**, thereby causing **114** to return to its original position, and permitting spring arm **104** to urge movable contact **106** back into electrical contact with first fixed contact **99**. Solenoid **180** is again actuated and the cycle repeats itself, solenoid **180** being actuated and deactuated alternatively. This alternative actuation and deactuation causes two movements.

The first movement is the reciprocal movement of movable contact **106** from a first position in electrical contact with first fixed contact **99** to a second position in electrical contact with second fixed contact **100**. This causes electric current to be alternatively directed first to solenoid **180** and next through distributor ring **166** and prongs **179** to distributor tab **178**. The second movement produced by solenoid **180** each time it is actuated is a stepwise rotary movement of ratchet wheel **78** caused by the reciprocation of drive arm **184** and downwardly projecting finger **194**. The stepwise rotation of ratchet wheel **78** causes distributor tab **178** to step around from one output terminal to another. The movement of movable contact **106** and distributor tab **178** is coordinated so that current is introduced to distributor tab **178** each time it moves into contact with another terminal. Thus as distributor tab **178** steps around it causes current to be introduced to each of the ignition terminals I_1–I_{10} so that the rockets will be fired one pair at a time. The stepping action automatically continues until solenoid control ring **144** returns to its original position and notch **146** causes power source **198** to be cut off from solenoid **180** permanently.

If slide switch **52** is in a closed position the breaking of electrical contact between movable contact point **106** and first fixed contact point **99** causes the electrical circuit to be diverted from movable terminal **102** through slide switch **52** to solenoid **180**, thereby maintaining solenoid **180** in an activated state and consequently maintaining movable contact point **106** in its second position away from first fixed contact point **99**. The only way to alternatively activate and deactivate solenoid **180** is to open and close operator switch **200**, thereby opening and cutting off power source **198** from the system. Thus a system is provided which permits the firing of rockets one at a time with each opening and closing of operator switch **200**.

This construction provides a result heretofore not obtained in intervalometers for rocket launchers. The output terminals T_1–T_{10} and the ignition terminals are never connected to power source **198** until after the actuation of solenoid **180**. Consequently they cannot short circuit the circuit between power source **198** and solenoid **180**. If, for example, ignition terminal I_3 were grounded, distributor tab **178** would move from output terminal T_2 to output terminal T_3, and would simultaneously introduce a jolt of electricity to output terminal T_3. The grounding of ignition terminal I_3 would prevent the firing of the third rocket, but it would not prevent distributor tab **178** from progressing further. Spring arm **104** instead would urge movable contact **106** into its first position where it is disconnected from distributor tab **178** and where it reestablishes the circuit from the power source to solenoid **180**. As a result solenoid **180** continues to be alternatively actuated and deactuated to cause distributor tab **178** to step on through its cycle, thereby firing all the remaining rockets.

Notch **177** in grounding ring **174** releases ignition terminals I_1–I_{10} from grounding contact one at a time simultaneously with the introduction of electrical current from power source **198** for firing. The gorunding mechanism causes all of ignition terminals I_1–I_{10} to be grounded at all times except during their intended firing. The grounding contact caused by grounding ring **174** prevents misfiring of ignition terminals I_1–I_{10} during the firing cycle and during the time that triangular pointer **178** is in either the "load" or "arm" position.

Another important feature of this invention is the provision of a housing which includes three avenues for grounding electrical current from the ground-leads formed by bolts **58, 60**. Grounding is accomplished by direct electrical connection of guide pins **62, 64**, with a conventional ground. Grounding is also accomplished from bolts **58, 60**, through housing base **14**, through the rocket launcher which engages housing base **14**, to the grounded airplane. The third avenue is from bolts **58, 60**, through housing base **14**, through spring element **40**, through grounding tab **30**, to the rocket launcher.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

What is claimed is:

1. An intervalometer comprising connector means adapted to be electrically connected to an electrical source of current; a solenoid in electrical connection with said connector means and adapted to be actuated by the introduction of electrical current, a plurality of output terminals; a distributor tab adapted to move to each of said output terminals to make electrical contact with said output terminals one at a time; switch means between said connector means and said distributor tab, said switch means being movable from an open position wherein said distributor tab is electrically disconnected from said connector means to a closed position wherein said distributor tab is electrically connected to said connector means; mechanism responsive to the actuation of said solenoid to cause said switch means to move to its closed position and to cause said distributor tab to move to each of said output terminals one at a time; and biasing means yieldably maintaining said switch in its open position so that said distributor tab and said output terminals are electrically disconnected from said connector means whenever said solenoid is deactuated.

2. The intervalometer of claim **1** wherein said switch means includes first and second fixed contacts and a movable contact, said movable contact being connected in series with said solenoid and said connector means, said movable contact being free from electrical contact with

said second fixed contact when said switch means is in its open position, said movable contact being in electrical contact with said second fixed contact when said switch means is in its closed position.

3. The intervalometer of claim 2 wherein said first fixed contact is in electrical connection with said solenoid; said movable contact engaging said first fixed contact when said switch means is in its open position.

4. The intervalometer of claim 1 wherein said plurality of output terminals are positioned in a circular array on a dielectric wafer and said distributor tab is rotatable to each of said output terminals.

5. An intervalometer comprising a dielectric wafer, a plurality of output terminals in circular array on said wafer; a grounding mechanism electrically connected to a ground and rotatably mounted on said wafer, said mechanism including a grounding portion in electrical contact with said output terminals and a circuit breaker means adapted to rotate to each of said output terminals one at a time to disconnect said output terminals from said grounding portion; a distributor tab rotatably mounted on said wafer and adapted to rotate to each of said output terminals in unison with said circuit breaker means so that their rotation causes each of said output terminals to be disconnected from said grounding portion and simultaneously to be connected to said distributor tab; means for introducing electrical current to said distributor tab from a power source so that electrical current will be conducted to the one of said output terminals in contact with said distributor tab; a prime mover adapted to be actuated by electrical current; and mechanism responsive to the actuation of said prime mover to cause said circuit breaker means and said distributor tab to rotate to each of said output terminals.

6. The intervalometer of claim 5 wherein said means for introducing electrical current to said distributor tab is a switch electrically connected to a connector means, said connector means being adapted to be connected to an electrical power source and said switch means being movable from an open position wherein said distributor tab is disconnected from said connector means to a closed position wherein said distributor tab is electrically connected to said connector means.

7. The intervalometer of claim 5 wherein said means for introducing electrical current to said distributor tab is an interrupter switch connected in series between said prime mover and a power source; said interrupter switch having a first position connecting said power source to said primer mover and a second position connecting said power source to said distributor tab.

8. The intervalometer of claim 7 wherein a biasing means yieldably holds said interrupter switch in its first position; said mechanism including means responsive to actuation of said prime mover to cause said interrupter switch to move to its second position.

9. The intervalometer of claim 5 wherein a bearing means is rotatably mounted on said wafer and said grounding mechanism, said distributor tab being secured to said bearing means.

10. An intervalometer comprising a stationary assembly including a dielectric wafer; a plurality of output terminals arranged in circular array on said wafer; a dielectric bearing rotatably mounted to said stationary assembly; a grounding mechanism mounted on said bearing and electrically connected to ground, said grounding mechanism being adapted to rotate with said bearing from an initial position wherein it is in electrical contact with all of said output terminals through a plurality of positions wherein it breaks electrical contact with each of said output terminals one at a time; a distributor tab mounted on said bearing and adapted to rotate therewith through a plurality of positions wherein it makes electrical contact with each of said output terminals; the relative position of said distributor tab and said grounding mechanism on said disk being such that each of said output terminals is simultaneously disconnected from said grounding mechanism and connected to said distributor tab; means for introducing electrical current to said distributor tab; and drive means for rotating said bearing.

11. An intervalometer comprising a plurality of output terminals; a distributor tab adapted to move to each of said output terminals one at a time; a prime mover adapted to be actuated by electrical current; an interrupter switch connected in series between said prime mover and a power source; said interrupter switch being movable from a first position connecting said power source to said prime mover to a second position connecting said power source to said distributor tab; biasing means yieldably holding said interrupter switch in its first position to prevent electrical connection between said power source and said distributor tab; and mechanism responsive to the actuation of said prime mover to cause said interrupter switch to move to its second position and to cause said distributor tab to move to each of said output terminals.

12. An intervalometer according to claim 11 wherein said interrupter switch includes two fixed contacts and a movable contact; said movable contact engaging one of said fixed contacts when said interrupter switch is in its first position and engaging the other of said fixed contacts when said interrupter switch is in its second position.

13. An intervalometer according to claim 12 wherein said biasing means is a spring arm and said movable contact is mounted on said spring arm.

14. An intervalometer according to claim 11 wherein said mechanism includes a link connected to and driven by said prime mover; said link including means for moving both said distributor tab and said interrupter switch in response to actuation of said prime mover.

15. An intervalometer according to claim 11 wherein said distributor tab is rotatable about a first axis and said mechanism includes a cam and a link; said cam being rotatable about said first axis and said link being drivingly connected to said prime mover; said link including means for engaging and moving said cam; and said cam being adapted to engage and move said switch.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,539,955 Dated November 10, 1970

Inventor(s) John J. Nash

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 3, line 32, "C^1" should read -- C_i --; same line, "C^S" should read -- C_s --; line 39, "poriton" should read -- portion --; line 40, "adajacent" should read -- adjacent --. Column 5, line 64, "at one time" should read -- one at a time --. Column 7, line 37, "causing 114" should read -- causing cam 114". Column 8, line 28, "gorunding" should read -- grounding --; line 54, "current," should read -- current; --.

SIGNED AND SEALED FEB 9 1971

(SEAL)
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