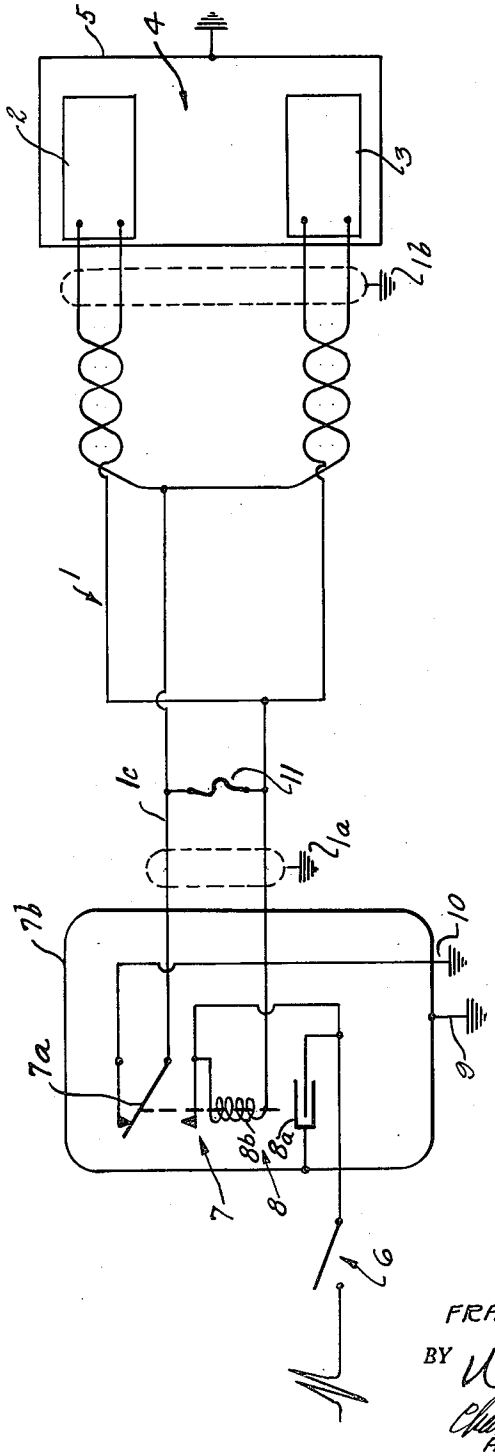
Jan. 30, 1962 F. M. JOHNSON 3,018,733

MULTIPURPOSE SAFETY FOR IGNITER CIRCUITS

Filed Aug. 31, 1956




INVENTOR.
FRANCIS M. JOHNSON
BY Wade Kroenty AND
Charles W. Wagner
ATTORNEYS

United States Patent Office

3,018,733

Patented Jan. 30, 1962



3,018,733

# MULTIPURPOSE SAFETY FOR IGNITER CIRCUITS

Francis M. Johnson, Dayton, Ohio, assignor to the United States of America as represented by the Secretary of the Air Force

Filed Aug. 31, 1956, Ser. No. 607,530
2 Claims. (Cl. 102—70.2)
(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the United States Government for governmental purposes without payment to me of any royalty thereon.

This invention relates to a destructor system in which an igniter or firing circuit is utilized to fire an explosive charge. More particularly, this invention relates to means for safetying said igniter circuit to prevent inadvertent or premature firing thereof.

The continued development of a variety of destructor systems as used on all aircraft and including particularly missiles has emphasized the necessity of simultaneous development of safety precautions to reduce or even eliminate serious accidents resulting in injuries and fatalities occurring as a result of premature or inadvertent firing of explosively operated aircraft components, as for example, the ejection of aircraft canopies and seats and destructor systems on missiles. The advent of electrically fired systems to replace the former gas actuated devices on aircraft has led to peculiar problems of safety. This is especially true where the firing system is utilized in connection with a guided missile instead of an aircraft component. In systems of this type, an extremely powerful main explosive shaped charge is employed and this charge is ignited or fired by one or more explosive squibs, blasting caps, or electric primers. In all electrically fired systems, then, it has been determined that premature or inadvertent firing of the igniter circuit setting-off, in turn, the igniter and main explosive charge may occur as a result of radiation, conducted noises, transient currents, spurious signals, static charges, magnetic couplings, stray currents, and other known and unknown phenomena. Since such igniter circuits are rather sensitive in nature, it becomes increasingly important that there is a corresponding development of safety means to prevent said premature firing.

It is an object of the invention, therefore, to provide a destructor or electrically initiated explosive system in which certain safety features are incorporated to prevent premature firing of the destructor system igniter circuit.

It is a further object of the invention to shield the igniter circuit which together with the incorporated additional safety features protect the circuit from inadvertent firing as a result of radiation, conducted noises, transient currents, spurious signals, static charges, magnetic couplings, stray currents, and other known and unknown phenomena.

A still further object of the invention resides in the provision of a by-pass circuit as a means of safetying the main igniter circuit.

Other objects and advantages of the invention will become apparent from the following description, taken in connection with the accompanying drawing in which the single view thereof represents a simple basic schematic illustration of the destructor system embodied in the invention.

The destructor system normally consists of two main sub-systems, the explosive or igniting unit system and the electrical firing circuit system. It is this latter sub-system with which the present invention is primarily concerned. It is sufficient to point out that the explosive unit system involves the selection of the specific type of igniter and main explosive charge to be utilized in



accordance with the desired objective. On the one hand, the explosive charge may be either the shaped charge of the guided missile, the explosive cartridge utilized in an airplane ejection seat, or some other type explosive charge. On the other hand, the igniting unit may be one or more explosive squibs, blasting caps, or electric primers. Whatever main explosive charge and igniter unit is selected, the important feature of the invention resides in the electrical firing or igniting circuit wherein certain safety features are incorporated to ensure against accidental or inadvertent firing of said igniter and main charge.

The igniter circuitry illustrated in the drawing is a representative circuit which may be modified to conform with a specific requirement without departing from the spirit of the invention.

As seen clearly in the single view of the drawing, the electrical sub-system, which forms the basis of the invention and which is schematically illustrated, includes an igniter or firing circuit **1**, a pair of igniters **2** and **3** in circuit therewith, and a main explosive charge **4** positioned between and in contact with said explosive squibs **2** and **3**. Said main explosive charge **4** and said igniters or squibs **2** and **3** are hermetically encased or sealed in the housing **5** to provide protection against outside environmental conditions. A 28 volt D.C. line under control of the main safety switch **6** supplies the primary power to said igniter circuit **1**. Said main safety switch **6** is shown in open position in the drawing. A standby 24 volt battery (not shown) may be utilized to automatically cut into said igniter circuit, should the primary power line fail. A relay **7** is positioned in said igniter circuit, as close as practicable to the igniters **2** and **3**. Said relay **7** includes a relay switch **7***a* which is operable to the closed position under action of a predetermined signal. It is only necessary to close the main safety switch **6** which conditions the firing circuit **1**, and then apply said predetermined signal to the relay **7**, at which point the relay switch **7***a* will close and current will flow to the igniters **2** and **3** to fire the latter and thereby explode the main explosive charge **4**. It is noted that said firing or igniter circuit **1** may be utilized to fire a variety of other elements or components, such as, the explosive bolt assembly used in the support of bombs or auxiliary wing tanks. The slight modification of the wiring circuitry that may be necessary for these various other elements or components would not involve any modification in the safety features which form the present invention.

The electrical sub-system described above involves the use of igniters or explosive squibs **2** and **3** which are normally fired by the igniter circuit **1** only when desired. Normally, it would be expected that so long as the main safety switch **6** is in the open position and no predetermined signal is received by the relay **7**, no current would flow in the circuitry and, therefore, there would be no danger of the squibs or igniters **2** and **3** and explosive charge **4** prematurely igniting and exploding at an inappropriate moment and thereby cause possible serious injury and even fatalities; however, it has been found that said igniters **2** and **3** are very sensitive in nature and may be inadvertently ignited or fired with currents in the range from 0.008 to 0.35 or more amperes. Furthermore, it has been determined that certain phenomena, as for example, conducted noises, transient currents, radiation, spurious signals, static charges, magnetic couplings, and stray currents, as well as other known and unknown phenomena have caused said premature firing of said igniters—an extremely dangerous and unsafe condition. For this reason, certain safety precautions hereinafter described have been incorporated in the firing circuit **1** to form the present invention and these precautions are designed to ensure that firing occurs only when it is desired.

One of the above-mentioned safety precautions involves shielding all wiring by the utilization of twisted shielded pair wire to protect said firing circuit from outside influences, as for example, radiation from a nearby radio antenna. The shielded portion thereof is grounded at 1*a* and 1*b*, as clearly illustrated in the drawing and at intermediate locations as necessary particularly for protection against radio frequencies (R.F.). A second safety precaution of the invention consists of the electric filter indicated generally at 8 and includes the capacitor 8*a* and the reactor 8*b* which reactor 8*b* constitutes the coil that operates the relay 7*a* when a predetermined signal is transmitted therethrough on closing of main switch 6. Said capacitor 8*a* is positioned between the main safety switch 6 and the reactor coil 8*b* on the input side of the relay switch 7*a* to protect the latter from its susceptibility to conducted noises effected by voltages setting up alternating currents or harmonics in the circuit which may cause said relay switch 7*a* to close and thereby prematurely fire the explosive charge 4. These harmonics, sometimes referred to as conducted noises, may be caused by static, close proximity of a magnetic field or even movement of the vehicle carrying the igniters, main explosive charge and associated electrical system itself as well as other phenomena impressing voltages in the wiring of the firing circuit which voltages result in alternating currents which may fire the circuit. In the instant case, therefore, the capacitor 8*a* is tuned to the reactor coil 8*b* and, as a result, said alternating currents or transients or conducted noises or harmonics are bypassed through said capacitor 8*a* to ground substantially preventing their transmission through the reactor coil 8*b* to operate the relay switch 7*a* and thus prematurely fire the circuit; however, once the main safety switch 6 is closed, direct current voltage of a predetermined amount is impressed on the firing circuit to fire igniters 2 and 3 in which event, capacitor 8*a* has little or no effect. In addition, the relay 7 and said relay switch 7*a* are enclosed in the shielded can 7*b* which provides protection against certain other phenomena, as for example, spurious signals which, likewise, may prematurely operate said switch 7*a* and thereby accidentally fire the circuitry. Said shielded can 7*b* and said relay switch 7*a* are grounded at 9 and 10, respectively. A 3 ampere quick-blow fuse 11 is incorporated in the firing circuit 1 as close as possible to the igniters 2 and 3. Said quick-blow fuse 11 acts as a shunt to form a by-pass circuit 1*c* with regard to residual or transient currents. A transient is, by definition, an impulse having a duration of no longer than 0.1 second and a repetition rate of no greater than 1 every 5 seconds; nevertheless, such a condition may fire the sensitive igniter as at 2 or 3 at an inappropriate moment. In the drawing, a quick-blow fuse as at 11 is illustrated; however, any shunt, minimum inductance, or any electrical equivalent of substantially similar characteristics may be substituted for the fuse 11 without departing from the spirit of the invention. The preferred shunt is the quick-blow fuse 11 which is connected across said igniters 2 and 3, and has a resistance of not over 0.6 ohm. Consequently, any residual or transient current that may be found in the igniter circuit is insufficient to blow the fuse 11 and will, therefore, flow therethrough to completely by-pass the igniters or squibs 2 and 3. When, however, it is desired to fire said igniters 2 and 3, normal current flow from the primary power source blows said quick-blow fuse 11 eliminating the by-pass circuit 1*c* formed thereby until a new fuse 11 is installed and thus permitting current to flow through the igniter circuit 1 to said igniters 2 and 3 to fire the latter and explode the main explosive charge 4.

To summarize the normal operation of the igniter circuit 1 embodied in the invention, the main safety switch 6 is closed to connect the igniter circuit 1 in circuit with the main power source (28 volt D.C. line), the relay switch 7 then closing on receiving a certain predetermined signal, the fuse 11 blows, and the circuit is completed to the explosive squibs 2 and 3 which then ignite to set off the explosive charge 4. If, however, the main safety switch has not been closed and the igniter circuit is nevertheless subjected to conducted noises, for example, the filter 8 will protect the relay switch 7*a* and the latter will not close to thereby prematurely fire the explosive squibs 2 and 3. Nor will premature firing occur as a result of transient currents since the latter will by-pass the explosive squibs 2 and 3 and return to ground as a result of the utilization of the quick-blow fuse 11 in the igniter circuitry. Furthermore, the relay switch 7*a* is enclosed in the shielded can 7*b* and all wiring consists of twisted shielded pair wire, thereby affording additional protection against premature firing as an additional safety feature.

It is therefore seen that the destructor system of the instant invention is compact and less complex in design, may be actuated either by a ground monitor or by automatic means in flight, and stresses safety in both ground handling and flight. Moreover, commercial parts may be interchangeable with standard military parts provided no alterations are required. Furthermore, no materials that are nutrients for fungi are used where it is practical to avoid them; however, due to the simplicity of the destructor system of the subject invention, it is a simple matter to treat with a fungicidal agent. In any event, the utilization of hermetically sealed inclosures eliminates the need for such treatment. Any metals utilized are of the corrosion resistant type and where low impedance bonding is involved, bonding surfaces are made free of all insulating finishes in order to provide a continuous low impedance electrical bond. In the event that dissimilar metals are utilized in intimate contact with each other, suitable protection is afforded against electrolytic corrosion. In addition, the igniters 2 and 3, tested and used in the present invention, have a minimum shelf life of three (3) years, can fire within a maximum of 50 milliseconds at 3.0 amperes and 28 volts, D.C., will not fire within a minimum of 60 seconds at 2.0 amperes and 28 volts, D.C., will not ignite when subjected to a 20 foot drop on concrete, have a heat resistance of 200° F. for 6 hours or 400° F. for 2 hours, and will not deteriorate when 0.1 ampere is induced into the igniter circuitry for the duration of 3 seconds, 3 times a day for 2 years.

The resistance of the complete assembly is a maximum of 3.0 ohms. The main safety switch 6 incorporated in the destructor or igniter circuit 1 is an inertial or other similar approved type to prevent inadvertent firing of the main explosive charge 4 prior to, and during, the launching phase. This allows for automatic positive arming of the destructor system after initial takeoff. Where a recoverable missile is utilized, means are provided to permit an "arm" or "disarm" function and, in addition, some means (telemetering or aural signals) of indicating the "arm" or "disarm" position of said destructor system. Said arming is automatically accomplished within ½ second by means of lanyard or umbilical attachment used as a triggering means. The destructor system of the present invention is adaptable for use with such an automatic arming means. The latter is not shown, however, since it forms no part of the present invention. Moreover, because of its simplicity, assembly and disassembly of said destructor system is accomplished without the use of special tools.

It is noted that the incorporation of the relay 7 and the filter 8 in the igniter circuitry 1 ensures that neither a steady voltage in excess of 50 millivolts or a transient in excess of 150 millivolts is present in said circuitry.

The destructor system of the instant invention, the details of which have been set forth in USAF Specification No. X–28663 written by the inventor, is used primarily to blast a missile into sections and thereby terminate its flight when there is either a guidance failure or when test installations or populated areas are

endangered. In addition, such a system as utilized with the igniter circuitry 1 assures destruction of the vehicle in the event of a tactical situation requiring the abandonment of a base. Furthermore, said destructor system may be used for other purposes, as for example, cutting of control cables and wires, fuel cut-off, and the severing or releasing of instrument-carrying sections.

Thus, a destructor system has been devised which is detonator safe, protects personnel during handling and launching from an accidental initiation, and yet is simple and effective in operation.

I claim:

1. A destructor system comprising a main charge, a pair of igniting units in contact with and on opposite sides of said main charge, a weatherproof casing housing said main charge and said igniting units, an electrical firing circuit for igniting said igniting units, a primary source of power, a main safety switch connecting said firing circuit to said primary source of power, said circuit having a relay switch positioned as near as mechanically feasible to said igniting units, said relay switch normally actuated by a predetermined signal to its closed position to fire said igniting units, and a plurality of safety features incorporated in said system to prevent inadvertent firing of said charge, said safety features consisting of a shield to protect said firing circuit from outside radiation, a filter consisting of a reactance normally operating said relay switch when energized by said primary source of power and a capacitance tuned thereto and electrically interconnected between a common connection of said main safety switch and said relay switch and ground to protect the latter from conducted noises induced by transients, and a quick-blow fuse connected across said pair of igniting units to form a by-pass circuit protecting



said units from transient currents imposed on said circuit from outside sources, said relay switch being enclosed in a shielded relay can to protect said switch from spurious signals.

2. In a destructor system having a main direct current power source under control of a main safety switch, a main explosive charge, a pair of igniter units adjacent said main explosive charge, a relay switch having a reactor coil controlling the operation thereof, a firing circuit between each of said pair of igniter units and the output of said relay switch, a main electrical circuit between said direct current power source and the input of said relay switch, at least one of said firing circuits being grounded, and a plurality of safety devices preventing premature firing of said igniter units, said plurality of safety devices including an electrical filter on the input side of said relay switch comprising a grounded capacitor tuned to the reactor coil of said relay switch between said reactor coil and said main safety switch bypassing to ground alternating currents set up by transients impressed on said main electrical circuit, a quick-blow fuse positioned between the firing circuits of said igniter circuits intermediate of said relay switch and said igniter units, and means protecting said electrical circuits from outside electrical disturbances, said means comprising shielding the wiring in said circuits from outside radiation.

**References Cited** in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| 1,858,969 | Ruhlemann | May 17, 1932 |
| 2,331,058 | Stick | Oct. 5, 1943 |
| 2,419,815 | Breeze | Apr. 29, 1947 |
| 2,545,474 | Kurland | Mar. 20, 1951 |
| 2,623,922 | Muffly | Dec. 30, 1952 |