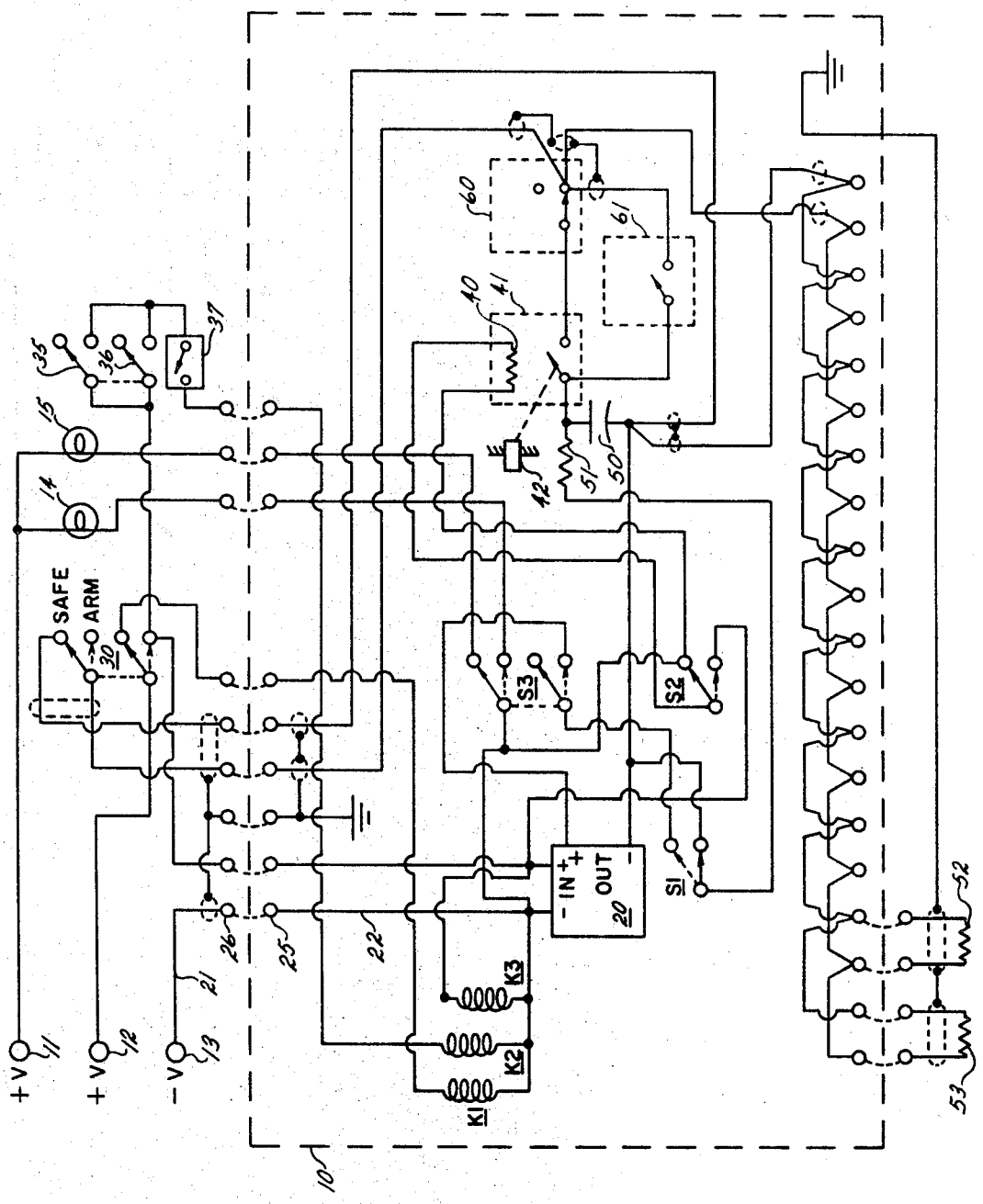
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DESTRUCTION ACTUATION CIRCUIT

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DESTRUCTION ACTUATION CIRCUIT

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The present invention relates to circuits for actuating a destructive device and more particularly, to a circuit for imposing predetermined conditions on a decision to destroy a vehicle carrying a destructor.

In a variety of applications, it is both desirable and necessary to insure the total destruction of a device upon the simultaneous happening of predetermined conditions. The most obvious of such applications are the destruction of a missile and the destruction of a craft, manned or unmanned, about to descend on an area where great damage could be done or where it would be undesirable to permit the contents of the craft to fall into the hands of the occupants of the area.

Two principal factors are involved in the controlling of such destructor systems: reliability and controllability. In regard to reliability, such factors must be considered as the ability of the destructor to perform its task under the environment giving rise to the desirability of destroying the craft and the ability of the destructor system to initiate the destructive action.

In regard to controllability, it is necessary that the operator or operators in whom the decision is trusted to actuate the destructor system have the choice to determine the circumstances, within limits, under which the destructor system shall operate. A specific example would be the desire for the total destruction of certain secret equipment through the use of pyrotechnic devices. It is desirable that the destructor system, including the pyrotechnic destructors, cause the total destruction of the designated equipment upon a predetermined operator-initiated signal or upon certain other conditions such as impact; however, the prior art fails to teach a system that can overcome problems attending such destructor systems. For example, certain pyrotechnic devices do not efficiently operate at high altitudes; similarly, the prior art has relied on complex and expensive impact switch circuits for the actuation of destructor devices in order to obviate the difficulties arising through "contact bounce" attending the closing of the impact-actuated contacts.

The prior art has also failed to provide a destructor system that may be placed in a completely safe condition while nevertheless permitting the system to initiate a destruct even though the craft power system may fail.

It is therefore an object of the present invention to provide a destructor actuating circuit that will fire destructor devices upon the initiation of an operator and/or under certain predetermined conditions.

It is another object of the present invention to provide a destructor actuation circuit wherein a destructor may be actuated upon the impact of the craft carrying the destructor actuating circuit and wherein the destructor may be actuated by an operator only if the craft is within effective destructor altitudes.

It is a further object of the present invention to provide a destructor actuation circuit wherein contact bounce does not affect the actuation of destructors connected thereto.

It is still another object of the present invention to provide a destructor actuation circuit wherein a capacitor is charged or discharged in accordance with a switch position and wherein said capacitor will remain charged even though the craft electrical system may fail.

It is still another object of the present invention wherein an operator may initiate the actuation of a destructor and wherein an operator may override the previous decision.

These and other objects of the present invention will become apparent to those skilled in the art as the description thereof proceeds.

Briefly, in accordance with the embodiment chosen for illustration, a capacitor is charged from a capacitor charging device which, in turn, is powered by a potential source provided by the craft mounting the structure actuation circuit. A relay means is connected between the capacitor charging device and the capacitor wherein the contacts of the relay means have two mutually exclusive positions. The first of these positions provides a discharging circuit for the capacitor; whereas, the second of these positions connects the capacitor charging device across the capacitor.

A capacitor discharging circuit including a plurality of destructor actuation devices (such as bridge wires for the ignition of a pyrotechnic device) is connected in series with the capacitor and in series with a switch arrangement including an explosively actuated switch closable at the will of an operator. These switches also include a barometrically responsive switch that remains closed at those altitudes at which the destructor devices are effective and which opens at all other altitudes; further, an impact-responsive switch is provided that will close when a predetermined acceleration force is imparted thereto by the impact of the craft carrying the destructor actuation circuit.

The present invention may more readily be described by reference to the accompanying figure which schematically illustrates a destructor actuation circuit constructed in accordance with the teachings of the present invention.

Referring to the drawing, that portion of the circuit enclosed within the dashed box **10** may be mounted in any convenient location on the craft; similarly, the components within the box **10** may, to some extent, be separated for more convenient distribution throughout the craft. For convenience, the components mounted within the box **10** may be positioned to provide maximum efficiency for the impact switch (to be described) and other elements contained in the box. A power supply (not shown) provided by the craft mounting the circuit of the present invention may be connected at terminals **11**, **12** and **13**. The potential existing between terminals **12** and **13** may conveniently be termed the potential source since it is this potential that is utilized throughout the circuit excluding indicator lamps **14** and **15** which utilize the potential between terminals **11** and **13**. Since the potential existing between terminals **12** and **13** is necessarily a very low direct current potential, it is convenient to convert this potential to a higher direct current potential through the utilization of a converter **20**. Accordingly, the negative potential source terminal **13** is connected through conductors **21** and **22** to the negative input terminal of the converter **20**. It may be seen that continuity between conductors **21** and **22** is provided by terminals **25** and **26** mounted within and without respectively the box **10**. Since the interconnection of components mounted within the box **10** to components mounted without the box **10** are always accomplished through terminals such as those at **25** and **26**, it is felt unnecessary to refer to these terminals in the description that follows; however, the terminals are provided so that the components within the box **10** may readily be "unplugged" and conveniently removed. The positive terminal **12** of the potential source is connected to the positive input terminal of the converter **20** through a Safe-Arm switch **30**. The Safe-Arm switch **30** includes two ganged wiper contacts which, when in the arm position, connect the terminal **12** to the converter **20**. When

the Safe-Arm switch **30** is in the safe position, the positive side of the potential source connected to the terminal **12** is disconnected from the converter **20**. When the switch **30** is in the safe position, the positive side of the potential source connected to the terminal **12** is connected to a relay coil K1 which electromagnetically operates the relay switch contacts S1 and causes the wiper arm of the switch S1 to assume the position shown by the solid line. All of the switches indicated in the drawing are shown as they would appear with the Safe-Arm switch **30** in the position shown and with the potential source supplied to terminals **11**, **12** and **13** as previously indicated.

When the switch **30** is in the arm position, positive potential source voltage is applied to a pair of firing switches **35** and **36**. These firing switches each independently, when closed, apply the positive potential of the terminal **12** through a suitable time delay **37** (when desired) to a relay coil K2. Energization of the relay coil K2 causes the relay switch S2 to assume the position indicated by dotted lines. This latter position results in the application of the potential source voltage to the bridge wire **40** of an explosively actuated switch **41**. The switch **41** may be a conventional squib-fired switch wherein an application of a suitable voltage to a bridge wire such as the wire **40** causes an explosive force to permanently close the switch. The switch **41** is provided with an alternate closing means shown schematically in the drawing as a manually operated push button **42** mechanically connected to the switch.

A relay coil K3 is connected across the input terminals of the converter **20**, and, when the Safe-Arm switch **30** is in the arm position to apply potential source voltage from terminals **12** and **13** to the converter **20**, the identical voltage is applied to the relay coil K3, thus causing relay switch S3 to assume the position shown by the dotted lines. The switch S3 is a dual-ganged wiper arm switch wherein the upper wiper arm may assume either of two positions in each of which a different one of the indicator lamps **14** or **15** will be ignited. The lower wiper arm of the switch S3, when in the position indicated by the dotted line, connects one of the terminals of the switch S1 to the positive output terminal of the converter **20**. The output of the converter **20** is utilized to charge a capacitor **50** which stores the charge necessary to ignite the actuator devices. The capacitor **50** is charged or discharged through a resistance **51** which may either be connected across the capacitor **50** (through the lower contact of switch S1) or in series with the capacitor and the output of the converter through the upper terminal of switch S1 and the lower terminal of switch S3.

When the capacitor **50** has been charged, it may either be discharged through the resistor **51** as previously indicated or may be utilized to provide the pulse for actuating destructor actuators such as bridge wires **52** and **53**. It may be noted that the bridge wires **52** and **53** represent only two of several such bridge wires that may be placed across the capacitor **50**; obviously, the ability of the capacitor to provide energy for the actuation of destructors would depend on the size of the capacitor as well as the number of destructor actuation devices requiring a pulse from the capacitor. A capacitor discharging system is provided including the previously described firing switch **41**; however, since the devices being utilized as destructors may not operate efficiently at high altitudes, a barometrically responsive switch **60** is connected in series with the switch **41**. The switch **60** is designed to be normally closed at altitudes below a predetermined altitude and to be normally open above the predetermined altitude. For a variety of pyrotechnic devices with which the present circuit is intended to be used, the barometrically responsive switch **60** may be designed to remain closed at altitudes below 20,000 feet. Thus, even though the firing switch **41** may be closed, either by closing switch **35** and **36** or by the manual impetus of push button **42**, the destructors (pyrotechnic devices) will only

be actuated below 20,000 feet. An impact-responsive switch **61** is connected in parallel with the switches **41** and **60**. The switch **61** is adjusted to close in response to predetermined acceleration forces such as those caused by impact of the craft with the ground or with another craft. The parallel connection of the impact switch **61** with the switches **41** and **60** provides an unusual advantage in that the impact switch may operate independently of other series-connected switches thereby alleviating problems caused by such switches as the barometric switch of contact bounce on impact. Thus, while the barometric switch **60** may yield unacceptable contact bounce (representing a discontinuity or transient in the discharge circuit of the capacitor through the destructor devices), the impact switch parallels the barometric switch obviating the difficulties caused by the latter. Since the probability of actuation of the impact switch at altitudes above the altitudes at which the destructors are effective is extremely unlikely, the paralleling of the barometric switch with the impact switch does not represent any significant disadvantage.

The operation of the circuit of the present invention may now be described. The present description may be broken into two functional portions. The first will be concerned with the arming of the destructor system through the utilization of the destructor acuation circuit, and the second will be concerned with the firing of the destructor devices through the utilization of the destructor actuation circuit. When the circuit is in the condition indicated by the solid lines of all of the switches, the system is considered to be on "safe." It will be noted that this safe condition presupposes the existence of a potential source (the supporting craft voltage system) being connected to the terminals **11**, **12** and **13**. Under these conditions, the Safe-Arm switch provides energization to the relay coil K1, thus causing the switch S1 to provide a discharging circuit for the capacitor **50** through the resistance **51**. In the event of a power failure, and the subsequent removal of voltage from the terminals **12** and **13**, the relay coil K1 will become de-energized and the switch S1 will assume the dotted position. It may be noted that in this position, a discharging circuit is not provided for the capacitor **50**; however, since no power exists at the terminals **12** and **13**, no charging current will be available to charge the capacitor **50**. This unique interaction of switches provides an unexpected advantage. Assuming that the switch **30** had been placed in the arm position, and assuming that the capacitor **50** had become charged, a subsequent power failure, such as may commonly occur if the craft is hit during combat, will nevertheless permit the capacitor to remain in the charged state and the switch S1 will not close to the discharge position. In this manner, the destructor actuation circuit of the present invention, once armed, will remain armed until it is placed in the safe condition by the operator. Under these conditions, destruct actuation may be accomplished by closure of the impact switch **61**. With the switch **30** in the safe position, switch S3 will be in the position shown and the indicator lamp **15** will be actuated to indicate that the system is on safe. When the switch **30** is moved to the arm position, relay coil K1 will become deenergized and the switch S1 will assume the position indicated by the dotted lines. Further, the converter **20** will have the potential source existing at the terminals **12** and **13** applied at the input thereof and the relay coil K3 will become energized. Energization of the relay coil K3 will cause the switch S3 to assume the position shown by the dotted lines. The switch S3 will therefore extinguish indicator lamp **15** and ignite indicator lamp **14** to indicate that the system is on "arm"; further, the switch S3 will now be placed in series with switch S1 and will provide a charging current to the capacitor **50**. The charged condition of the capacitor **50** will prevail until either the system is fired or the system is again placed on safe wherein the relay coil K1 will become energized, causing the switch

S1 to place the resistor 51 across the capacitor 50 and discharge the latter.

The second function to be described will be that concerning the actuation of a destructor device. Assuming that the circuit has been placed on "arm" and that the destructors are to be activated through the provision of a suitable pulse to the bridge wires 52 and 53 of the destructor devices, the switches 41, 60 and 61 must be operated under the conditions to be described. If the craft is below the maximum altitude determined by the barometrically responsive switch 60, the closing of switches 35 or 36 will cause the explosively actuated switch 41 to permanently close, thus discharging the capacitor 50 through the bridge wires 52 and 53; however, in the event that the barometrically responsive switch 60 is open, closing of switches 35 or 36 will close switch 41 but the capacitor 50 will not discharge until the proper altitude is reached when the barometrically responsive switch 60 closes. Alternatively if the circuit has been placed in the "arm" condition, an impact of the craft imparting suitable acceleration forces to the impact-responsive switch 61 will close the circuit to discharge the capacitor 50 through the bridge wires. The discharge of the capacitor through the impact-responsive switch will occur regardless of the position of the firing switch 41 or the barometrically responsive switch 60 and will thus obviate any difficulties that might otherwise have arisen caused by contact bounce of the barometric switch 60. The timing device 37 may be any conventional timing apparatus intended to close a suitable switch at the end of a predetermined time set by an operator. The timing device may be eliminated; however, in those instances where a craft is to be destroyed and it may be considered dangerous for the operator to be on board the craft at the instance of actuation of the destructors, then the timing device 37 may appropriately be set to close the firing switch circuit at the end of a predetermined time. The arrangement shown in the accompanying diagram provides another unique and unexpected advantage. In the event that it is decided to actuate the destructors and the firing switch 41 is actuated, the operator may reconsider his decision and override the actuation of the bridge wires 52 and 53 provided the barometric switch 60 is still open. The override may be accomplished simply by replacing the system on "safe" to thereby discharge the capacitor 50 through the resistor 51 and switch S1 before the capacitor discharges through the actuators. A similar override may be provided if the firing switch 41 is not yet actuated and the timer 37 has not completed the time interval to the destruct signal; during this interval, the override may similarly take place by placing the switch 30 in the safe position.

The destructor actuation circuit of the present invention provides a reliable system operation wherein a destructor device or devices may be actuated through the utilization of a charge stored on a capacitor, thus giving rise to a rapid discharge time and obviating difficulties arising, for example, in contact bounce of a conventional impact-responsive switch. Prior art systems have frequently attempted to use storage devices such as batteries wherein the energy to be delivered to the destructor devices may require a length of time militating against the utilization of contacts exhibiting contact bounce. The charge stored on the capacitor 50 provides sufficient pulse peaks to obviate this difficulty. Further, the circuit of the present invention provides a unique means for overcoming system failure due to power failures of the craft electrical system while nevertheless providing a system that may be placed on safe with adequate assurance.

While the present invention has been described in terms of a specific embodiment and a specific circuit arrangement, it will be obvious to those skilled in the art that modifications may be made without departing from the spirit and scope of the invention.

We claim:

1. A destructor actuation circuit comprising: a capacitor; a potential source; a capacitor charging device conneted to said potential source and to said capacitor; a capacitor discharge circuit comprising:

(A) a first series circuit having connected in series:
  (1) a destructor actuation device responsive to a current therethrough for actuating a destructor;
  (2) said capacitor;
  (3) a normally open firing switch having contacts closable at the will of an operator;
  (4) a barometrically responsive switch having contacts normally closed at sea level and normally open at a predetermined height above sea level;

(B) and a second series circuit having connected in series:
  (1) said destructor actuation device;
  (2) said capacitor;
  (3) an impact-responsive switch having normally open contacts responsive to predetermined acceleration forces for closing.

2. A destructor actuation circuit as defined in claim 1 wherein said firing switch is an explosively actuated switch explosively closed at the will of an operator.

3. A destructor actuation circuit comprising: a capacitor; a potential source; a capacitor charging device connectable to said potential source; relay means connecting said capacitor charging device to said capacitor for charging and discharging said capacitor, said relay means including relay switches having, when said potential source is connected to said capacitor charging device, two mutually exclusive positions the first of which connects said capacitor charging device across said capacitor for charging the latter and the second of which completes an electrical circuit across said capacitor to discharge the latter; a capacitor discharge circuit comprising:

(A) a first series circuit having connected in series:
  (1) a destructor actuation device responsive to a current therethrough for actuating a destructor;
  (2) said capacitor;
  (3) a normally open firing switch having contacts closable at the will of an operator;
  (4) a barometrically responsive switch having contacts normally closed at sea level and normally open at a predetermined height above sea level;

(B) and a second series circuit having connected in series:
  (1) said destructor actuation device;
  (2) said capacitor;
  (3) an impact-responsive switch having normally open contacts responsive to predetermined acceleration forces for closing.

4. A destructor actuation circuit comprising: a capacitor; a potential source; a capacitor charging device connectable to said potential source; a resistor; relay means connecting said capacitor charging device to said capacitor for charging and discharging said capacitor, said relay means including relay switches having, when said potential source is connected to said capacitor charging device, two mutually exclusive positions the first of which connects said resistor in series with said capacitor and said capacitor charging device across said capacitor and resistor for charging the latter and the second of which connects said resistor across said capacitor to discharge the latter; a capacitor discharge circuit comprising:

(A) a first series circuit having connected in series:
  (1) a destructor actuation device responsive to a current therethrough for actuating a destructor;
  (2) said capacitor;
  (3) a normally open firing switch having contacts closable at the will of an operator;
  (4) a barometrically responsive switch having contacts normally closed at sea level and normally open at a predetermined height above sea level;

(B) and a second series circuit having connected in series:

(1) said destructor actuation device;

(2) said capacitor;

(3) an impact-responsive switch having normally open contacts responsive to predetermined acceleration forces for closing.

5. A destructor actuation circuit as defined in claim 3 wherein said relay switches are capable of only the first of said mutually exclusive positions when said potential source is not connected to said capacitor charging device.

6. A destructor actuation circuit as defined in claim 4 wherein said relay switches are capable of only the first of said mutually exclusive positions when said potential source is not connected to said capacitor charging device.

7. A destructor actuation circuit as defined in claim 3 wherein said firing switch is an explosively actuated switch explosively closed at the will of an operator.

8. A destructor actuator circuit as defined in claim 4 wherein said firing switch is an explosively actuated switch explosively closed at the will of an operator.

9. A destructor actuation circuit as defined in claim 3 wherein said relay switches are capable of only the first of said mutually exclusive positions when said potential source is not connected to said capacitor charging device, and wherein said firing switch is an explosively actuated switch explosively closed at the will of an operator.

10. A destructor actuation circuit as defined in claim 4 wherein said relay switches are capable of only the first of said mutually exclusive positions when said potential source is not connected to said capacitor charging device, and wherein said firing switch is an explosively actuated switch explosively closed at the will of an operator.

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