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Letson et al.

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[45] Aug. 13, 1974

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[54] **AIRCRAFT EMERGENCY WARNING SYSTEM**

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[73] Assignee: **Pacific Communications, Inc.**, Santa Ana, Calif.

[22] Filed: **June 19, 1972**

[21] Appl. No.: **263,873**

[52] **U.S. Cl.** ..... **325/115**, 200/61.45 M

[51] **Int. Cl.** **H04b 1/02**

[58] **Field of Search** ..... 325/115, 111, 119, 185, 325/187; 200/61.08, 61.45 R, 61.53, 61.45 M; 335/164, 151, 153, 205; 343/705

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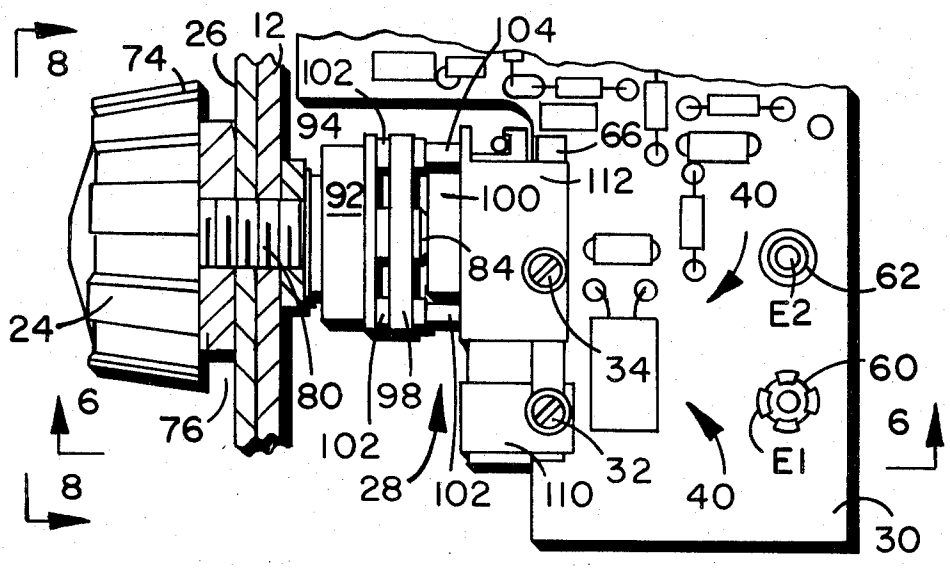
Primary Examiner—Benedict V. Safourek
Attorney, Agent, or Firm—George F. Bethel

[57] **ABSTRACT**

An aircraft emergency warning system comprising a radio signal generator having an integral power source, such as a battery, and an antenna for sending said signal. The signal is initiated by a switch which operates manually or upon "G" forces being exerted thereon, such as those forces encountered in a crash of an aircraft in which the emergency system is implaced.

The emergency system can be integrally tested by a "test means" in the form of the signal being "effectuated" and operating a test light. When the system is armed, a crash causes "G" forces during the crash to turn on the warning system through the switch. The switch comprises a relay which is closed by a first magnet. The first magnet has its forces normally shunted through an armature. Upon crash the armature is latched by a second magnet which holds it in place, causing said first magnet to close the relay which completes a circuit for issuing an emergency signal.

11 Claims, 18 Drawing Figures



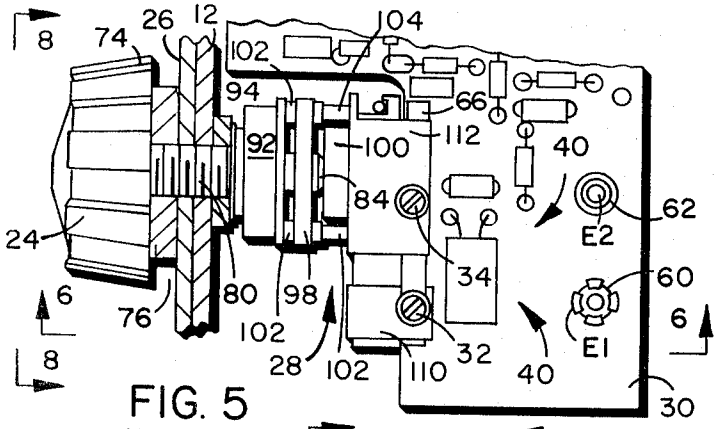


FIG. 5

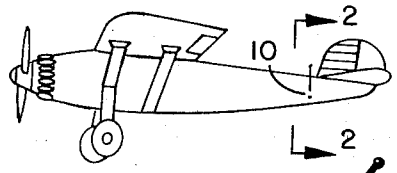


FIG. 1

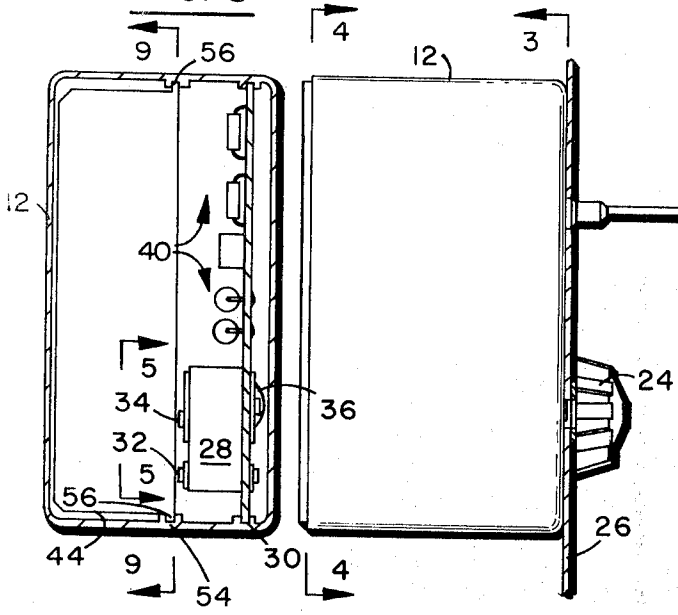


FIG. 4

FIG. 2

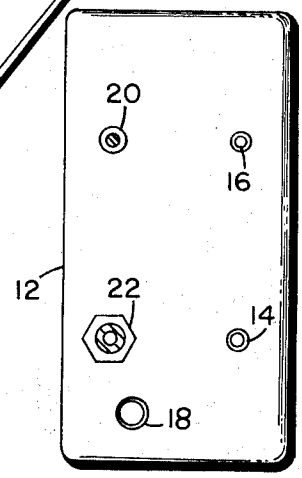


FIG. 3

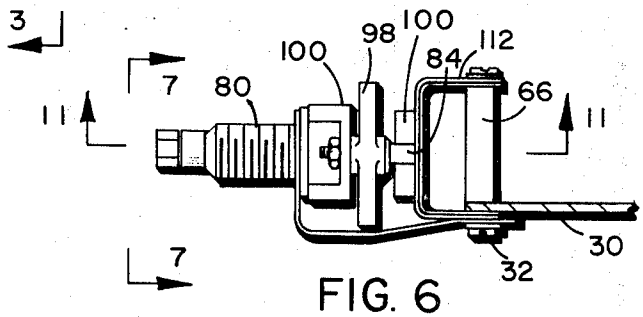


FIG. 6

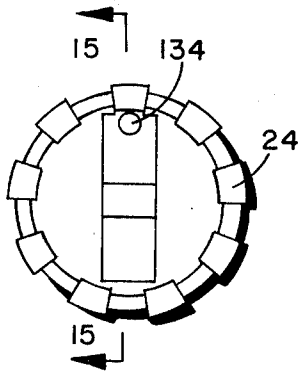


FIG. 8

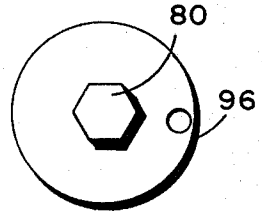


FIG. 7

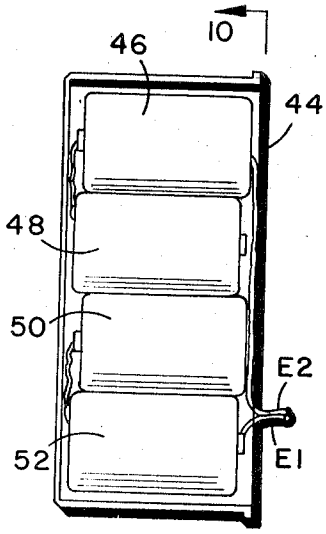


FIG. 9

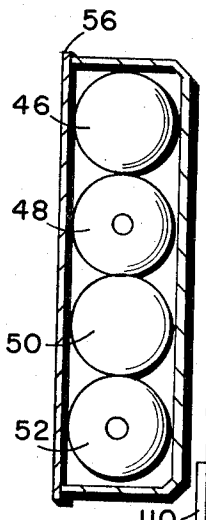


FIG. 10

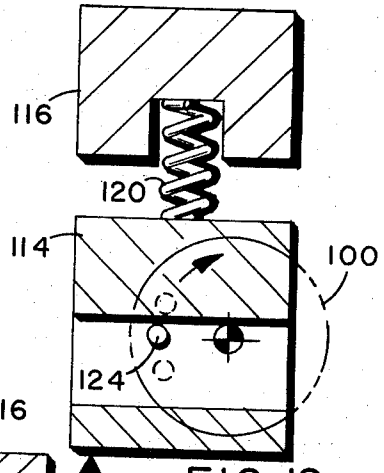


FIG. 12

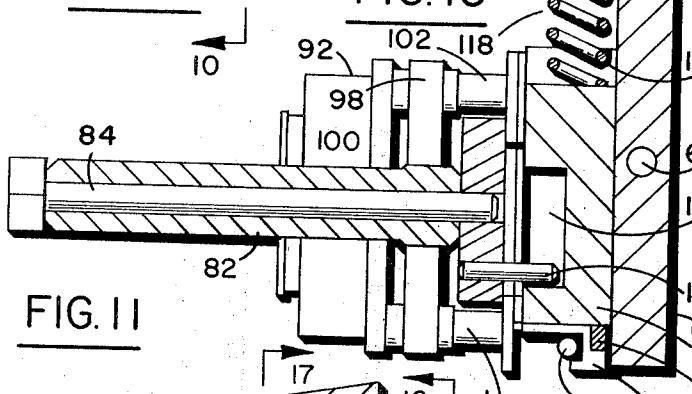


FIG. 11

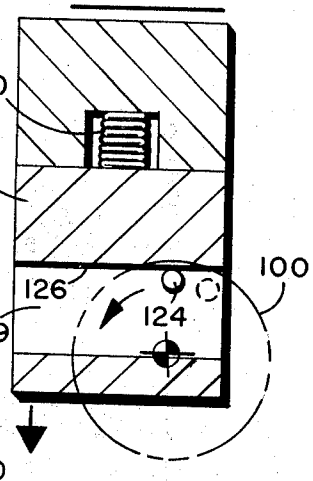


FIG. 13

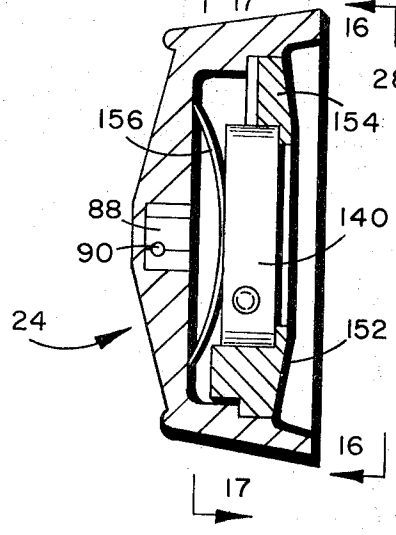


FIG. 15

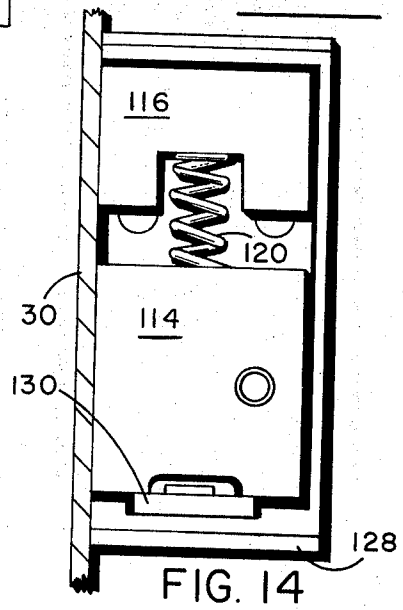


FIG. 14

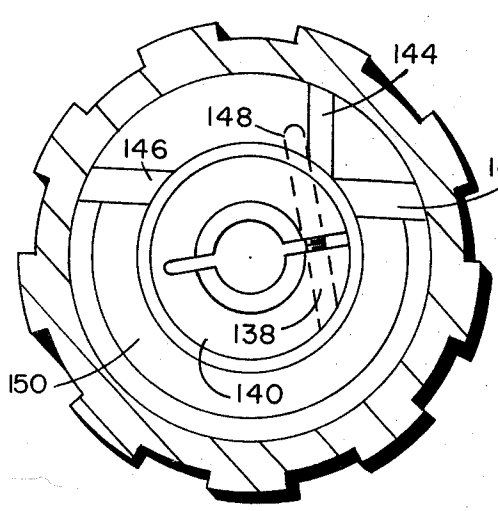


FIG. 17

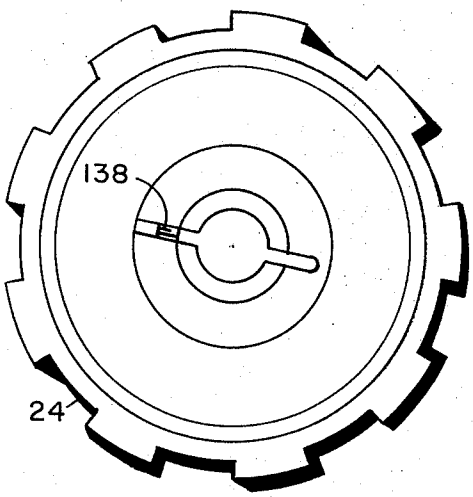


FIG. 16

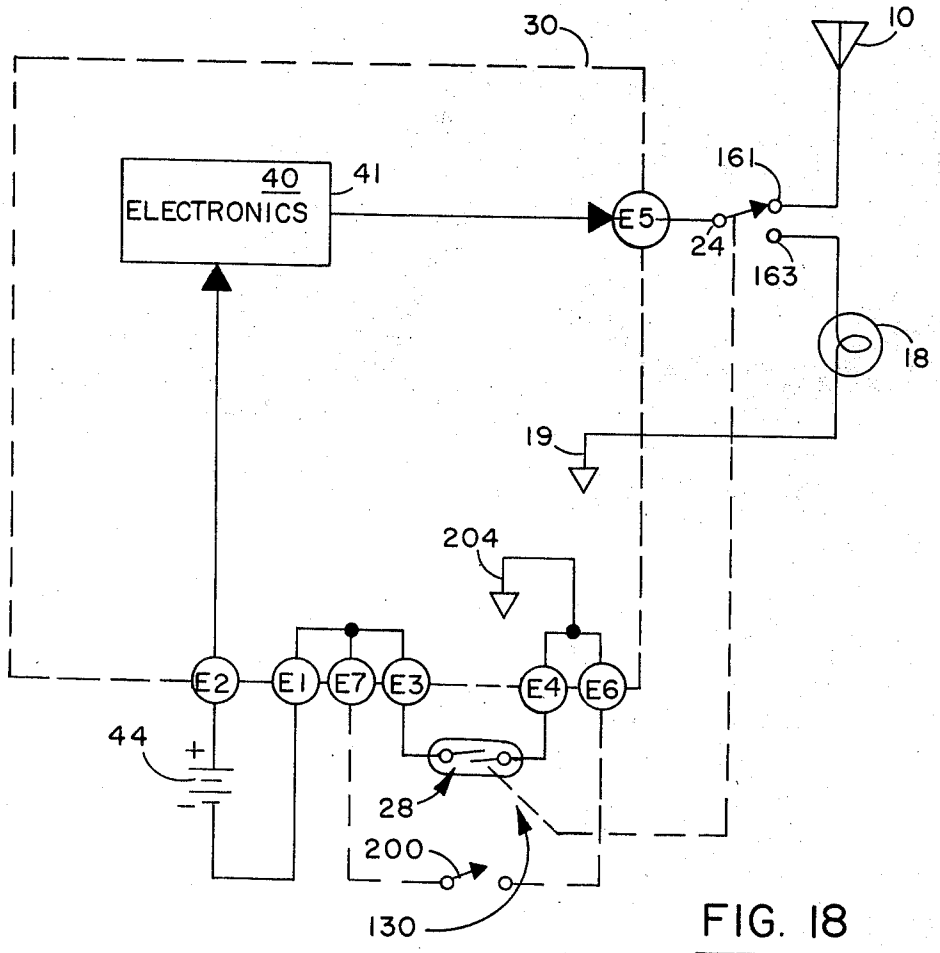


FIG. 18

AIRCRAFT EMERGENCY WARNING SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The field of this invention lies within the emergency signal warning art, specifically as it relates to aircraft which are in distress or which have crashed.

2. The Prior Art

The known prior art related to aircraft systems utilized for sending a signal when an aircraft is in distress or has crashed does not incorporate an automatically responsive switch means to initiate the signal. Furthermore, the prior art does not incorporate a means for sending a signal indicating distress other than through the generally used radio frequencies of an aircraft. Thus, when an aircraft has crashed, and the radio system has been destroyed, there is no effective means to initiate a signal.

In some cases, signals have been initiated by emergency units that are carried inside the plane. Such units are not generally formed as integral signal units mounted in the aircraft, but are such that they can be utilized on a portable basis. Oftentimes the use of such portable signal means is not effectuated because the signal means are not carried with the aircraft, or are incapable of use after a crash. Furthermore, the occupants of an aircraft in distress or one which has crashed are often not capable of utilizing the signal means.

This invention specifically overcomes the deficiencies of the prior art by providing a cheap, economical signal means that is integrally structured and mounted within an aircraft. When an aircraft is in distress, the signal means can be operated to provide searchers with the position of where the aircraft in distress has crashed.

The signal system of this invention can be mounted after the aircraft has been in use over a period of time. Thus, the signal means does not need to be a piece of original equipment but can be mounted in the aircraft at any suitable time. This is particularly important in light of the fact that such a system does not exist, and there are numerous aircraft that should have such a system. Thus, the plight of many small aircraft owners in peril, or after a crash can now be signaled to a responsive search crew.

The means for arming or operating a signal means in the prior art by means of G-forces upon impact has never been provided for in a simple and effective manner. In most cases, a signal responsive to G-forces or impact is provided by a momentary closing of a switch or a contact means which effectively causes a circuit to set or reset itself in response thereto. As can be appreciated, the momentary switch function providing a latching is not as foolproof as a positive holding or switching function. This invention provides a positive holding or switching function without the requirement of electronic latching means. As can be appreciated, if a momentary contact is not made in an adequate manner, due to the equipment not having been operated for an extended period of time, the function of the emergency signal means will be completely obviated.

This invention overcomes the momentary electronic latching problem by providing a positively latched "G" switch. Specifically, the invention incorporates a magnetic latch which maintains itself in position after G-forces or impact has been imparted against it. The magnetic latch constantly maintains a closure of the switch, such as a reed relay to provide positive ongoing functions. There is no momentary electronic latching or other problem associated with the invention, but rather a positive magnetic latch which maintains its contact after the G-forces have been of sufficient magnitude to cause the actuation features of the switch of this invention to function.

Some "G" switches have generally relied upon mechanical linkages which can sometimes improperly latch or lock, so the "G" switch will not funtion. This invention overcomes the deficiencies of the art by providing a positively latched switch by magnetic forces. The invention thus enables the arming or switch function to be provided in a positive magnetic manner without the requirement of mechanical linkages, seats, catches, or other unreliable machanical functions of the prior art.

In summation, this invention effectively overcomes the lack of an integral separately operating warning system for an aircraft which has crashed. Furthermore, it provides a novel "G" actuated switch.

SUMMARY OF THE INVENTION

In summation, this invention provides a new and novel warning system that puts out a distress signal of sufficient magnitude to be picked up by search crews upon actuation by G-forces such as those encountered in an aircraft crash.

More particularly, this invention comprises a radio distress signal means in a package that is integrally mounted into the aircraft. The package accommodates a transmitter, "G" switch and a battery source, with an appropriate antenna for broadcasting signals. The entire invention can be mounted in an aircraft either before or after manufacture, making the invention extremely useful for new as well as used aircraft.

In addition to the foregoing general functions, and novel aspects of this invention, the "G" switch or arming feature is provided by a novel switch. The "G" switch relies upon magnetic latching to overcome a spring force imposed on an armature. Upon movement of the armature to the magnetic latching means, a second magnet causes a reed relay to close thereby completeing a circuit to cause a radio signal to emanate from the remainder of the circuit. The "G" switch is extremely novel, inasmuch as it overcomes the latching and mechanical holding features of the prior art, whether they be electronic or mechanical. Thus, the "G" switch provides a positive magnetic latch which will reliably function upon impact.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be more clearly understood by reference to the description, taken in conjunction with the accompanying drawings wherein:

FIG. 1 is a view of an aircraft in which this invention has been mounted;

FIG. 2 is a view along lines 2—2 of FIG. 1 showing an elevation view of this invention through the skin of the aircraft;

FIG. 3 is a plan view along lines 3—3 of FIG. 2;

FIG. 4 is a sectional view along lines 4—4 of FIG. 2;

FIG. 5 is a fragmented cross sectional view along lines 5—5 of FIG. 4;

FIG. 6 is an end view along lines 6—6 of FIG. 5 which has been partially broken away;

FIG. 7 is a plan view along lines 7—7 of FIG. 6 showing the switch;

FIG. 8 is a plan view along lines 8—8 of FIG. 5 showing the knob of the switch;

FIG. 9 is a view along lines 9—9 of FIG. 4 showing the battery power supply;

FIG. 10 is a view along lines 10—10 of FIG. 9;

FIG. 11 is a view of the switch means along lines 11—11 of FIG. 6;

FIG. 12 is a view along lines 12—12 of FIG. 11;

FIG. 13 is an analogous view to FIG. 12 of the switch of this invention in its latched or on position;

FIG. 14 is a view along lines 14—14 of FIG. 11;

FIG. 15 is a sectional view along lines 15—15 of FIG. 8;

FIG. 16 is a view along lines 16—16 of FIG. 15;

FIG. 17 is a view along lines 17—17 of FIG. 15; and,

FIG. 18 is a schematic view of this invention showing the electrical functions thereof in schematic form.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

System and General Configuration

Looking specifically at FIG. 1, an aircraft is shown having an antenna 10. The antenna 10 is mounted as a part of this invention and protrudes from the skin of the aircraft. The proper location of this device is generally as far aft as possible while still allowing access thereto through the fuselage of the aircraft. The invention should be maintained at a minimum of 24 inches forward of the vertical stabilizer in order to avoid mechanical and electrical interference.

The invention can be more clearly seen in the remaining figures. Specifically, FIGS. 2, 3 and 4 show the outward configuration of the package or container which forms a portion of this invention. The package generally comprises a rectangular container 12 having a series of mounting holes 14 and 16. As can be seen in FIG. 3, the mounting holes 14 and 16 are facing upwardly and are such that the device can be mounted through the skin of an aircraft.

The container 12 has a test light 18 protruding therefrom, and an antenna receipt opening 20 where the antenna in FIG. 3 is shown in a sectioned manner. A switch for operating the invention is connected to the device by means of a nut or other suitable means 22. The connection means of the switch will be amplified as the explanation of the invention continues. As can be seen in FIGS. 2 and 3, a knob 24 protrudes exteriorly of the skin 26 of the aircraft.

The antenna 10 is shown connected to the container at its attachment means 20. The container is shown having a switch mounting 28 on an electrical board 30, such as a printed circuit board. The switch mounting 28 is mounted by means of bolts or screws 32 and 34. A brass chassis strap going to ground 36 is provided. Components 40 are shown which serve the function of issuing the distress signal when required in an emergency situation for which this invention is designed. Specifically, components 40 form part of a radio signal transmitter which has a specific frequency.

Looking more particularly at FIGS. 9 and 10, a battery pack 44 is shown having batteries 46, 48, 50 and 52. The battery pack is the upper portion of the container and can be slide mounted into slots 54 within the container. As can be seen, a flange 56 of the battery pack slides interiorly of the slots 54.

Leads E-1 and E-2 emanate from the battery pack and lead to pin snaps 60 and 62 on the printed circuit board 30. The pin snaps 60 and 62 on the printed circuit board are effectively the connection points E-1 and E-2 shown in FIG. 18 which supply the power to the system at terminals E-3 and E-4.

The entire configuration of the container and the system is mounted with an instruction plate exterior to the aircraft skin to indicate the position of the knob 24 as well as other aspects of the operation of the invention.

"G" Switch and Arming Device

Looking more specifically at the remaining figures, the printed circuit board 30 is shown having clips 60 and 62 for receipt of the battery leads E-1 and E-2. The components 40 previously indicated and shown are provided on the circuit board for emitting a signal when the plane in which the device has been mounted has crashed, or the signal has been manually effectuated by manual articulation of the knob 24. The circuit board receives its power supply E-1 and E-2 and is on a duty cycle when the switch of this invention has been actuated. The switch is generally shown as the switch mounting 28 mounted by means of the bolts 32 and 34.

In order to mount the switch 28 to the PC board 30, the screws 32 and 34 are threaded through a pair of split blocks one of them being shown as block 66. The blocks have holes in them 68 and 70 which receive the screws 32 and 34. As can be seen in FIG. 6, the switch has been mounted on the board 30 by placing block 66 in overlying relationship thereto. However, the block 66 can be split so that the strapping which holds the switch in place can be used to grip two blocks which have been split rather than the single block 66.

Looking more specifically again at the entire device shown in FIG. 5, an elastomeric foam material 76 is placed around a portion of where the switch enters the skin 26 of the plane. A metal cup 74 holds the foam material in place so that the knob 24 can override the cup 74 to prevent moisture and other deleterious substances from leaking into the plane and damaging the switch or other portions of the invention.

The switch 28 has a stem 80 which seats within the knob 24. The stem 80 generally comprises an exterior portion 82 and an interior shaft portion 84 with a suitable flattened surface for seating within an opening 88 of the knob 24. An opening 88 is provided with a protuberance 90 in order to grip the stem 80.

The stem, as previously indicated, has an interior shaft portion 84 and an exterior portion 82. The two portions of the stem depend downwardly and are coupled with a switch detent mechanism 92 which indexes the switch and the respective switch locations. An O-ring is provided within an O-ring sealing means 94 to prevent the transmission of moisture through the switch.

A switch wiper, or rotatable contact 98 is provided and is attached to the interior shaft of the stem 84 in order to effectively change switch positions in accordance with the schematic showing of FIG. 18. The entire stem 84 is connected to a cam support means 100 which is shown in circular orientation in FIGS. 12 and

13 for operation of the switch. The switch wiper **98** and the cam support **100** are both supported by means of screws or pins **102** and **104** which provide support for the entire switch contact assembly and couple the different elements together.

The switch has a set of straps **110** and **112** which serve to hold the block **66** in a position for operation of the components of the switch. The straps **110** and **112** act as not only holding means, but also strap **110** serves as a magnetic shunt as will be explained. The entire assembly serves to hold an armature **114** and a magnet **116.** The armature and magnet are spaced in normal operation by an air gap **118.** A spring **120** is interposed between the armature **114** and the magnet **116.** The spring **120** serves to maintain the armature **114** in a position until it has been activated by G-forces.

The cam support **100** has a pin **124** which can be in the configuration of a roll pin placed therein. The roll pin **124** depends downwardly into a space **129** within the armature **114** for activation and movement thereof.

The armature **114** can be configured in any suitable means. The essential criteria is that the roll pin **124** actively pushes against a surface **126** of the armature for moving it in response to the rotational location of the cam support **100.** In effect, the roll pin **124** acts as a cam to move the armature **114** longitudinally toward and away from the magnet **116** in response to rotational movement of the knob **24.**

A reed relay **126** is shown within a carrier **128** which is part of the lower portion of the switch assembly **28.** The carrier **128** has a bar magnet **130** imbedded therein in adjacent relationship to the reed relay. The bar magnet **130** is suitably strong enough to close the contact of the reed relay when the armature **114** is displaced away from it. This is due to the fact that the magnetic lines of flux of the bar magnet **130** are shunted from the reed relay into the armature **114** until it is displaced. In other words, the field of the bar magnet **130** does not affect the reed relay until the armature **114** is displaced.

The entire device is mounted so that the internal stem **84** attached to the knob **24** can operate the camming pin **124** attached to the cam support **100.** The location of the knob **24** serves to move the camming pin **124** as shown in FIGS. **12** and **13** in the direction of the magnet **116** or the bar magnet **130.** Thus, the device can be tested as well as placed in a ready position to be armed upon impact, as will be explained in connection with the schematic circuit diagram.

Looking more particularly at the knob, an indicator **134** is shown on the knob. The knob **24** seats over the stem **84** extension as previously described and is provided with a screw **138** which is threaded into an inner circular area **140.** The screw is seated by means of passing along a groove **142** when the inner circular portion **140** is aligned so that the screw **138** can pass thereinto.

A second and third passage or grooves **144** and **146** are such that they allow an extension **148** of the screw to lodge into the grooves **144** and **146** for positioning the knob **24.** An interior ledge **150** is provided with an upper portion **152** and a lower portion **154.** A spring **156** in the form of a circular concave spring allowing the passage of the stem **84** therethrough serves to bias the inner circular portion **140.** The outer portion of the knob **24** can be depressed and moved in a rotational manner to cause a placing of the shaft and attendant switch contacts or waifer **98** in its proper location, in response to the placement of the extension of the screw **148** with respect to the grooves **144** and **146.** Thus, in effect, the extension of the screw **148** goes into the respective grooves **144** and **146** in the manner of a detent.

System Schematic

Looking more specifically at FIG. **18,** the circuit on the circuit board **30** is shown having a light **18** leading to ground **19.** A grounded battery source in the form of the battery pack **44** is shown having a grounded side E-**1** and a positive side E-**2.** The battery pack **44** is connected to the board **30** as previously mentioned by clips **60** and **62** for providing the respective battery supplies E-**1** and E-**2.** E-**3** and E-**4** represent the connections to the switch **28** shown in block form and which incorporates the reed switch **130.**

In the schematic showing, antenna **10** is shown for purposes of indicating an emanation of the signal from the transmitter **41** which is driven by a battery source **44.**

The outline of the box or transmitter **41** is formed with the series of components **40** therein which in effect is the radio signal generator or transmitter. The transmitter **41** operates the device so that a distress signal is issued when the "G" switch **28** of this invention is either manually or automatically tripped. The grooves **144** and **146** position the knob **24** to cause the switch contacts or waifer **98** to close to positions **161** or **163.** Positions **161** and **163** are respectively the armed and test positions for impact operation of the "G" switch **28.** When the "G" switch **28** is positioned at contact **163,** the reed relay **130** will function by the manual positioning to operate light **18** which is the test function. The light **18** operates by emanation of a signal from the circuitry **41.**

Thus, the two positions of the switch respectively shown as positions **161** and **163** provide automatic operation of the "G" switch on impact; or a manual test operation which turns on the light **18** to indicate the transmitter can put out the desired signal when the "G" switch operates on impact.

A remote switch **200** can be mounted away from the entire invention in container **12.** For instance, the switch **200** can be mounted in the cockpit of an airplane for activation by the pilot. In such an embodiment, the switch is mounted across terminals E-**7** and E-**6** to provide a fail-safe mode. With a ground **204** provided, the remote switch will not cause any grounded or shorted wires to create a malfunction of the "G" switch **28.**

The antenna **10** in the drawings has been shown mounted to the container **12.** However, the antanna **10** can be remotely mounted to any portion of the aircraft and connected to the switch **28** and container **12** by means of a remote lead. Furthermore, the battery power supply **44** can also be mounted in a remote location and connected to leads E-**1** and E-**2** by means of a remotely connected lead.

Operation of the Invention

In operation, the invention is provided with a power source from the battery pack **44** integrally included in container **12** or remotely mounted, so that a source of

power can be delivered to the signal generator **41.** The source should be maintained at a relatively reliable level and periodically inspected to determine whether it has sufficient power to operate the system.

In order to test whether or not the batteries are providing sufficient power and whether or not the system is operating, the knob **24** of the switch **28** can be rotated to position **163** of the schematic, i.e., FIG. **18.** The knob **24** has a spring return from either the off or test position **163.** Thus, the switch **28** cannot be accidentally activated.

When the switch **28** is depressed and rotated, or in other words, when the armature **114** has been pushed by the roll pin **124** in the direction of the magnet **116,** the bar magnet **130** causes a closure of the reed switch **126.** Thus, a capability of determining whether or not the system is operating is effectuated. In effect, the switch **28** is turned to position **163** of the schematic, and a signal is emanated from the circuitry. Specifically, the radio frequency signal generator emanates a signal which is of sufficient power to light the light **18** connected to a ground **19.** This light **18** shows that the switch is functioning as well as the circuitry of the generator **41** which emanates the radio frequency signal. Thus, the emanation of the signal when the switch is in position **163** is analogous to that which would be provided by the invention to the antanna **10** and shows that the system is operative.

When the system is not to be tested, and the entire unit is to be armed for purposes of creating a distress signal upon actuation of the "G" switch, the switch is rotated to position **161.** In this position, the armature **114** causes the magnetic forces of the bar magnet **130** to be shunted into the armature.

In operation, the G-forces on the switch, such as during a crash, are of such a significant magnitude to cause movement of the armature **114** in the direction of the magnet **116.** This is due to G-forces on the armature overcoming the compressive forces of the spring **120.** In this manner, the armature **114** will then magnetically latch against the magnet **116** and be held in place thereby.

The strap **110** serves the function of a magnetic field adjusting shunt. The strap in effect shunts the field from the magnet **116** with respect to its longitudinal placement. In other words, the more forewardly the shunt strap **110** is placed of the magnet **110,** the greater the pull is exerted on armature **114.** The more the relative anterior placement of the shunt, the less magnetic force lines can emanate and pull on the armature **114.**

Thus, the position of the shunt strap **114** serves to calibrate the G-forces necessary to overcome the forces of spring **120.** This allows a calibration of the switch in a relatively exact manner with respect to the compressive forces of spring **120** as they operate against the magnetic forces of magnet **116** drawing armature **114** into a latching position.

At this moment in time, when the armature **114** is latched to magnet **116,** the device is placed in the on condition by virtue of the fact that the bar magnet **130** can effectively close the reed switch **126.** By closing the reed switch **126,** current is caused to flow in a manner whereby the signal generation means **41** emanates a signal through the switch terminal **161** to the antanna **10.** In this manner, a pre-established distress signal is emanated through the antenna **10** so that emergency signal recieivers of an aviation authority can pick up the signal and render aid. As can be appreciated, the signal can be of any frequency or duty cycle depending upon local or national needs.

It should be understood that other embodiments and alternatives of this invention can be utilized to effectuate the teachings and principles thereof. Specifically, different signal sources can be utilized as well as different components for switching the "G" switch into a test mode, operative mode, or manual mode. Furthermore, different latching means can be utilized having the same magnetic principles and different switching means other than the reed switch can be utilized. In addition thererto, as previously stated, the antenna **10,** container **12,** and battery power source **44** can all be mounted in remote positions from each other. Specifically, the foregoing elements can be packaged separately and connected by separate cables. Thus, this invention is only to be construed and defined in light of the following claims.

We claim:

1. An aircraft emergency radio signal system having an electrical power source means for generating and broadcasting a radio signal connected for operation by said electrical power source and, means to switch the radio signal means into an operative condition when G-forces have been encountered by the switching means above a pre-established level wherein the improvement is a switching means comprising:

a first magnet;

a movable armature;

a relay actuated by said first magnet which is shunted when the switch is in the open position through said armature being in proximate relationship thereto until said armature is moved by the pre-established G-forces; and,

a second magnet for latching said armature thereto upon the G-forces moving said armature into magnetically holding juxtaposition therewith.

2. The system as claimed in claim **1** further comprising:

spring means for biasing said armature in proximate relationship to said first magnet until "G" forces are encountered.

3. The system as claimed in claim **2** further comprising:

switching means to test the system by manually moving said armature from said first magnet.

4. The system as claimed in claim **3** further comprising:

a light for emitting a visual indication of the radio signal when said switch is in a test mode.

5. A "G" switch for conducting the flow of electrical current when said switch is subjected to a generally pre-established gravity force thereon comprising:

a reed relay;

a magnet which actuates said reed relay;

an armature for placement in juxtaposition to said magnet; and,

a second magnet for latching said armature thereto away from said first magnet after a pre-established G-force has moved said armature in the direction of said second magnet.

6. The switch as claimed in claim **5** further comprising:

spring biasing means for holding said armature in unlatched position of a suitable compressive strength

to hold it in proximate relationship to said first magnet until a pre-established G-force causes said armature to be latched to said second magnet.

7. The switch as claimed in claim **6** wherein said shunt comprises:

a shunt for shunting the magnetic forces of said second magnet in relation to the armature, adjustably located along said second magnet so that the latching effect of the magnetic forces of said second magnet on said armature can be adjusted by virtue of the shunt increasing or decreasing the amount of magnetic force of said second magnet on said amrature.

8. The switch as claimed in claim **7** further comprising:

a means for moving and holding said amature away from said first magnet.

9. The switch as claimed in claim **8** further comprising:

a stem;

a knob attached to said stem;

a cam surface on said stem of said switch which moves against a portion of the armature which forms a follower for said cam surface.

10. The switch as claimed in claim **9** in combination with a radio signal means comprising:

a source of electrical power; and,

radio signal producing means connected to said relay for operation by said power when said relay has been actuated.

11. The combination as claimed in claim **10** further comprising:

a light connected to said radio signal means which can be actuated when said switch is turned to a position for causing said radio signal to emanate; and,

means for connecting said relay to said light through the radio signal means.

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