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APPARATUS FOR SHUTTING DOWN ENGINES ON OCCURRENCE
OF CERTAIN FAILURES
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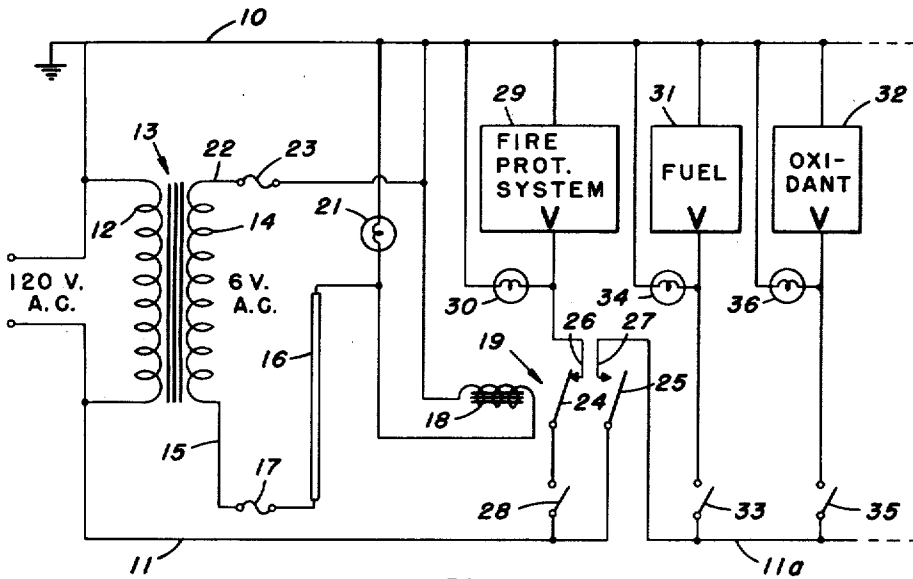


Fig. 1

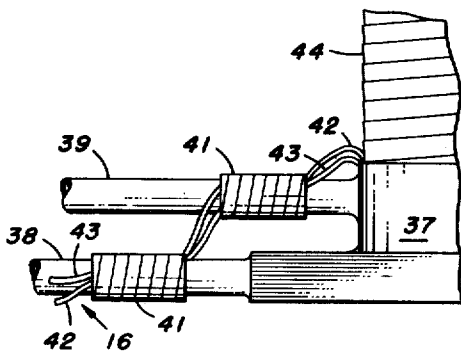


Fig. 2

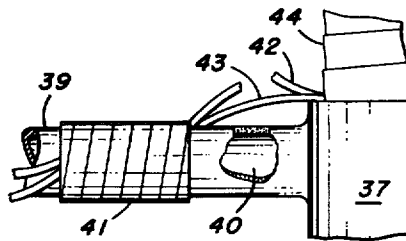


Fig. 3

INVENTOR
HOWARD W. DOUGLASS

BY *H. Schmitt*
R. J. Tompkins
ATTORNEYS

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APPARATUS FOR SHUTTING DOWN ENGINES ON OCCURRENCE OF CERTAIN FAILURES

Howard W. Douglass, Berea, Ohio

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10 Claims. (Cl. 169-2)

(Granted under Title 35, U. S. Code (1952), sec. 266)

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

The present invention relates to an apparatus and system for shutting down engines when certain types of failures occur therein and for protecting such engines against damage incidental to such failures. More particularly the invention relates to an apparatus and system for shutting down immediately and for protecting from damage jet propulsion engines on occurrence of certain failures therein or in any of the elements contained therein.

In testing jet propulsion engines, particularly those using high-energy propellants, frequent burn-outs occur which result in serious destruction of test equipment. These burn-outs are difficult to avoid in the experimental development of engines for which the demand is for ever increasing performance. Under such conditions failure of parts because of excessive stress, high pressures and excessive heat are common occurrences.

Heretofore, when burn-outs occurred in such engines, the damage rapidly advanced to complete destruction of the engine before an operator could detect the failure and close the valves necessary to shut off the fuel and oxidant supply to stop the engine, and operate fire extinguishing equipment.

An object of the present invention is to provide a new and improved system for closing down an engine which is simple in operation.

Another object is to provide a new and improved system for shutting down a jet propulsion engine which is operated quickly and reliably when a failure occurs.

Still another object is to provide a new and improved system for protecting a jet propulsion engine from substantial damage on failure of certain elements thereof.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

Fig. 1 is an electrical diagram showing an embodiment of the system of the present invention;

Fig. 2 is a view in elevation of a portion of an engine and showing the burnout wire used with the present invention; and

Fig. 3 is an enlarged view in elevation of a portion of Fig. 2 and showing the wire severed by a burnout or failure of an element.

Referring more particularly to the drawings, wherein like numerals indicate like parts throughout the several views, the diagram of Fig. 1 shows a typical circuit, suitable for the purpose wherein a pair of conductors 10 and 11 are connected to a source of alternating current. The primary winding 12 of a step-down transformer 13 is connected to conductors 10 and 11. The secondary winding 14 has a low voltage output such, for example, as 6 volts A. C. A conductor 15 connects one side of secondary winding 14 to a burnout wire 16, an electric fuse 17 being

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interposed in conductor 15, between secondary winding 14 and burnout wire 16. The other side of burnout wire 16 is connected to the winding 18 of a relay 19. Winding 18 is connected to the other side of a secondary winding 14 through a conductor 22 and a second fuse 23. A pilot lamp 21 is also connected between burnout wire 16 and the secondary winding 14 of transformer 13 by means of conductor 22 through conductor 10 in order to indicate when the low voltage circuit is energized.

The burnout wire 16 may be any suitable insulated wire which will burn away or break when an engine failure occurs, thus opening the low voltage circuit. Fuses 17 and 23 will open the circuit in the event that the insulation of wire 16 melts, grounding the circuit, but the wire fails to break.

Relay 19 is provided with a pair of switch arms 24 and 25. Arm 24 is normally closed when the relay 19 is deenergized, while switch arm 25 is normally open, under the same condition. When coil 18 of the relay 19 is energized, arm 24 breaks a circuit through a contact 26, while arm 25 closes a circuit through a contact 27 and a conductor 11a.

The circuit for contact 26 and arm 24 comprises a manual switch 28 connected between arm 24 and conductor 11, and a fire protection system 29 connected between conductor 10 and contact 26. System 29 may include a source of carbon dioxide or other suitable fire extinguishing material and a solenoid operated valve (not shown) for maintaining the system in shut-off condition until a break occurs in the low voltage circuit. A pilot light 30 is connected between contact 26 and conductor 10.

Arm 25 of the relay 19 controls the flow of 120 volt current from conductor 11 to a fuel shut-off valve 31 and an oxidant shut-off valve 32. The solenoid operated fuel valve 31 is connected to conductor 11a through a manual switch 33 while the other side is connected to conductor 10. A pilot light 34 is connected between switch 33 and conductor 10 to indicate when the fuel valve circuit is energized.

The solenoid operated oxidant valve 32 is connected to conductor 11a through manual switch 35 and to conductor 10 on the other side thereof. A pilot light 36 is connected between switch 35 and conductor 10 to indicate when the oxidant valve circuit is energized.

It is, of course, understood that other electrically controlled means may also be connected between conductors 10 and 11a in the manner of the valves 31 and 32 and controlled by switch arm 25 of relay 19.

As shown in Figs. 2 and 3, the burnout wire 16 may be taped to various danger points of the engine or the accessories thereof indicated at 37. A pair of conduits 38 and 39 which may be fuel or oxidant supply lines, are shown leading into the device 37 and wire 16 is shown taped thereto as at 41. The wire 16 may be looped back on itself to provide outgoing and return leads 42 and 43 at each danger point. The wire 16 may be led from the circuit of Fig. 1 to each danger point in succession and back to the circuit. The wire 16 may also be wrapped around and taped to the entire casing of the engine or casings of accessories attached thereto, as shown at 44.

Fig. 3 shows a failure of conduit 39 in which a hole 40 has been caused by excessive pressure therein or by the melting of metal because of high heat and permitting the leakage of fuel or oxidant therethrough. Lead 42 of wire 16 has been severed either by heat, fire, or explosive force, thus breaking the low voltage circuit passing therethrough. It is clear that wire 16 will break at any point of failure protected thereby. It is also to be noted that the single looped wire 16 comprising outgoing and return leads 42 and 43 may be trained over and secured to the various parts of the engine to protect the entire engine

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against fire and other damage as the result of failure of any part thereof.

In operation, the conductors 10 and 11 are connected to a suitable source of alternating current, such for example as 120 volts, and the manual switches 28, 33 and 35 are closed. Normally closed switch arm 24 is moved to the open position by relay winding 18, while normally open switch arm 25 is moved to the closed position by winding 18. Under this condition, the fire protection valve 29 is in closed position, while fuel valve 31 and oxidant valve 32 are open, thus permitting operation of the engine.

When a failure develops in the engine or the components thereof, protected by the system of the present invention, burnout wire 16 breaks or burns out in the area of failure. The low voltage circuit is deenergized by the breaking of wire 16 and winding 18 is also deenergized. Switch arms 24 and 25 are released by coil 18 to the normal positions thereof, i. e., the closed position for 24 and the open position for 25. In the foregoing position, arm 24 provides current to contact 26 thus energizing solenoid valve 29 to open. On opening valve 29, carbon dioxide or other fire extinguishing material is sprayed or otherwise applied to the engine thus extinguishing or preventing any fire caused by the failure.

Simultaneously with the closing of valve 29, switch arm 25 moves to the open position, thus opening the fuel valve and oxidant valve circuits. Fuel valve 31 and oxidant valve 32 close when the solenoids thereof are deenergized by opening of the circuits thereof. When valves 31 and 32 are closed, the fuel and oxidant supplies to the engine are shut off, thus stopping the engine and preventing further fire being caused by the fuel and oxidant.

From the foregoing, it is clear that there has been provided a protective system for jet propelled engines which prevents damage to such engines due to failures in the engine mechanism, fuel and oxidant conduits, or other components thereof. While the circuit has been described as being energized by 120 volts A. C., it may be adapted to other voltages where line voltage is not available, such as in an aircraft in flight.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A system for protecting jet propulsion engines from damage due to failures in danger points comprising, a source of electrical power, means for reducing the voltage of said power source, a low voltage circuit energized by said voltage reducing means, a higher voltage circuit energized directly by said power source, a relay coil connected in said low voltage circuit, a first switch normally biased to a closed position in said higher voltage circuit and movable to an open position by said relay coil when said coil is energized, a second switch normally biased to an open position in said higher voltage circuit and movable to a closed position by said relay coil when said coil is energized, a first solenoid operated valve connected to said first switch, said first valve being normally closed and energized to an open position when said relay coil is deenergized, a plurality of solenoid operated valves held in an open position by said second switch when said relay coil is energized and biased to a closed position when said relay coil is deenergized, and a burnout wire in said low voltage circuit positioned adjacent at least one danger point in said engine whereby said wire will be severed when a failure develops in the area of said danger point thereby to deenergize said low voltage circuit and said coil.

2. A system for protecting jet propulsion engines from damage due to failures in danger points comprising, a low voltage circuit, a higher voltage circuit, a relay coil connected in said low voltage circuit, a normally closed

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switch in said higher voltage circuit and movable to an open position when said coil is energized, a normally open switch in said higher voltage circuit and movable to a closed position when said coil is energized, a normally closed solenoid operated valve connected to said normally closed switch and movable to an open position when said relay coil is deenergized, a plurality of normally open solenoid valves movable to a closed position when said normally open switch is released to an open position as said relay coil is deenergized, and a burnout wire in said low voltage circuit positioned adjacent at least one danger point in said engine whereby said wire will be severed when a failure develops in the area of said danger point thereby to deenergize said low voltage circuit and said coil.

3. A system for protecting jet propulsion engines from damage due to failures in danger points comprising, a low voltage circuit, a higher voltage circuit, a relay having a coil, a normally open switch and a normally closed switch each connected in said higher voltage circuit, said coil being connected in said low voltage circuit whereby said normally open and normally closed switches are moved to the closed and open positions respectively by said coil when said low voltage circuit is energized, a normally open solenoid operated valve held closed by said normally closed switch and movable to open position when energized by the opening of said normally closed switch, and a normally closed valve held in open position by said normally open switch when closed and releasable to closed position when said normally open switch is released, and a burnout wire in said low voltage circuit positioned adjacent at least one danger point in said engine whereby said wire will be severed when a failure develops in the area of said danger point thereby to deenergize said low voltage circuit and said coil to release said switches to the normal positions thereof.

4. A system for protecting jet propulsion engines from damage due to failures in danger points comprising, a low voltage circuit having a relay coil therein, severable means in said low voltage circuit for opening said circuit when a failure develops in the area of said danger point, said means positioned adjacent at least one danger point in said engine, a higher voltage circuit, first circuit closing means in said higher voltage circuit held open when said relay coil is energized, second circuit closing means in said higher voltage circuit held closed when said relay coil is energized, first protection means connected to said first circuit closing means and activated when said low voltage circuit is opened, fuel shut-off means connected to said second circuit closing means and activated to shut off said fuel when said second circuit closing means is opened by the opening of said low voltage circuit.

5. Apparatus for protecting jet propulsion engines from damage due to failures in danger points comprising, means for activating a fire extinguishing system, means for shutting off the fuel and oxidant supply to said engine, and failure sensing means comprising an electrical system including a burnout wire positioned adjacent at least one danger point in said engine for activating said fire extinguishing system activating means and said fuel and oxidant shut-off means when a failure develops in said engine which severs said wire.

6. Apparatus for protecting jet propulsion engines from damage due to failures in danger points comprising, first solenoid operated valve means for activating a fire extinguisher system, second solenoid operated valve means for shutting off the fuel and oxidant supplies to said engine, and severable means positioned adjacent at least one danger point in said engine for causing operation of said valve means when a failure develops in the area of said danger point.

7. Apparatus for protecting jet propulsion engines from damage due to failures in danger points comprising, a first solenoid operated valve in a fire extinguisher system, a second solenoid operated valve for shutting off the fuel

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supply to said engine, a third solenoid operated valve for shutting off the oxidant supply to said engine, and failure sensing means comprising an electrical system including a burnout wire positioned adjacent at least one danger point for activating said first, second, and third valves when a failure develops in said engine.

8. Apparatus for protecting jet propulsion engines from damage due to failures in danger points comprising, a plurality of solenoid operated valves, means comprising an electrical system including a burnout wire positioned adjacent at least one danger point for sensing a failure in said engine, and circuit means initiated by said sensing means to operate said plurality of valves.

9. Apparatus for protecting jet propulsion engines from damage due to failures in danger points comprising, a plurality of damage prevention means, means comprising an electrical system including a burnout wire positioned adjacent at least one danger point for sensing a failure in said engine, and circuit means initiated by said sensing means to operate said plurality of damage prevention means.

10. A system for protecting jet propulsion engines from damage due to failures in danger points comprising, a source of electrical power, means for reducing the voltage of said power source, a low voltage circuit energized by said voltage reducing means, a higher voltage circuit energized directly by said power source, a relay coil connected in said low voltage circuit, a first switch normally biased

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to a closed position in said higher voltage circuit and movable to an open position by said relay coil when said coil is energized, a second switch normally biased to an open position in said higher voltage circuit and movable to a closed position by said relay coil when said coil is energized, a first solenoid operated valve connected to said first switch, said first valve being normally closed and energized to an open position when said relay coil is deenergized, a plurality of solenoid operated valves held in an open position by said second switch when said relay coil is energized and biased to a closed position when said relay coil is deenergized, an insulated burnout wire in said low voltage circuit positioned adjacent at least one danger point in said engine whereby said wire will burn out when a failure develops in the area of said danger point to thereby deenergize said coil, and fuse means in said low voltage circuit operable to interrupt said circuit and deenergize said coil in the event that the insulation of said wire melts, grounding the circuit but the wire does not break.

References Cited in the file of this patent

UNITED STATES PATENTS

1,840,986	Townsend	Jan. 12, 1932
2,566,235	Mathisen	Aug. 28, 1951
2,573,335	Hodgins et al.	Oct. 30, 1951
2,737,249	Pinkel et al.	Mar. 6, 1956