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[54] **SAFETY LOCKOUT IGNITION SYSTEM**
7 Claims, 1 Drawing Fig.

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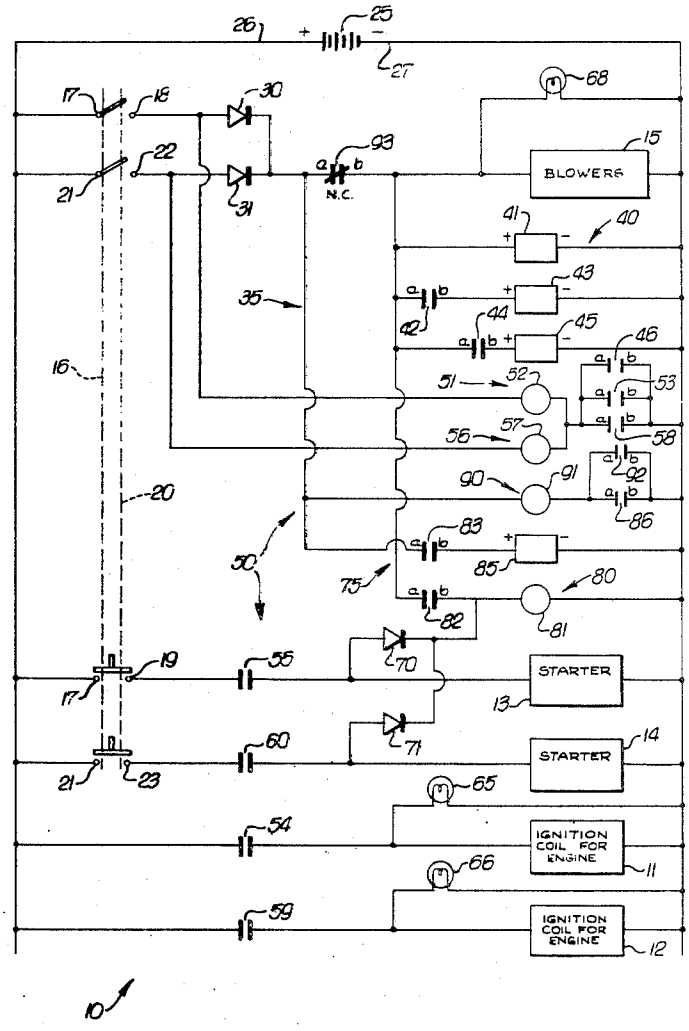
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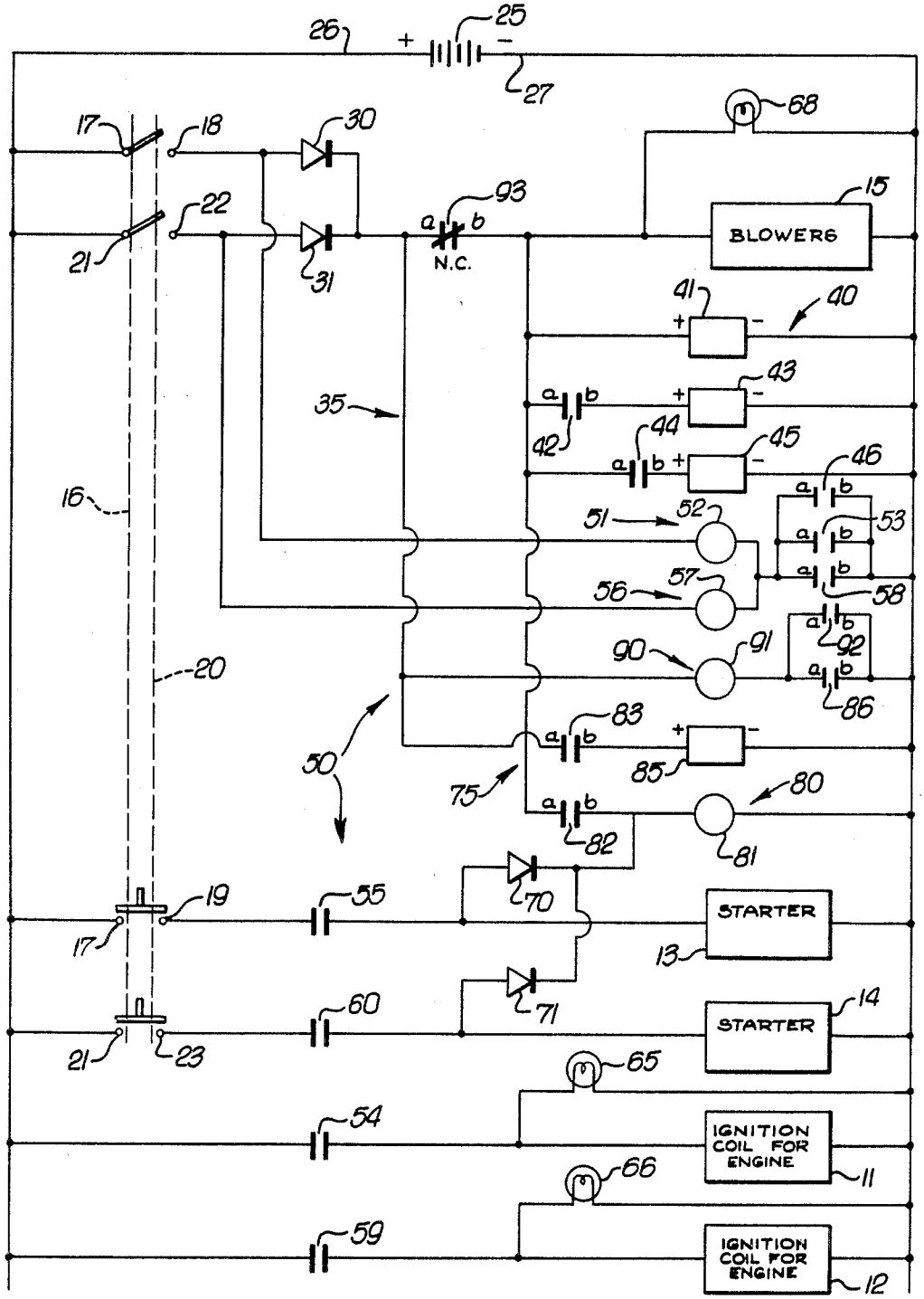
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ABSTRACT: An ignition switch for a powerboat having an ignition terminal connected to blowers for exhausting the engine compartment of fumes and to time-delay relays in series, in turn connected to a latching relay between a battery and an engine, and between the start terminal of the ignition switch and a starter, to prevent the engine from being started until the blowers have operated a preselected time duration to clear the engine compartment of dangerous fumes which might have collected therein. A control latching relay energized by the starter energizes a shutoff time-delay relay after a second predetermined time duration from starting, to open the normally closed contacts of a shutoff latching relay halting the operation of the blowers after the blowers have cleared the engine compartment of any fumes that might have accumulated therein during the starting of the engine.





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SAFETY LOCKOUT IGNITION SYSTEM

BACKGROUND OF THE INVENTION

This invention relates to ignition systems and more particularly to a safety lockout ignition system for preventing explosions in the engine compartments of vehicles such as powerboats.

In vehicles powered by combustion engines and particularly in boats powered by such engines, there is always the danger of fire and explosion from the accumulation of gasoline or other combustible vapors from the engine. This danger is particularly present in vehicles such as powerboats where the engine compartment containing the engine is usually closed and located in the lowest part of the boat. In these closed compartments, an explosive mixture of gasoline, diesel or other fumes can accumulate due to leaks in fuel lines, leaks in fuel tanks or evaporation of gasoline from the carburetor. With the engine compartment closed, these fumes are trapped until a spark is provided to ignite such fumes. In the starting of the engine, electricity must be supplied to the ignition coil, the distributor points of the engine, and to the brushes of the starter motor all of which may produce sparking during operation thereof which may ignite any combustible fumes in the engine compartment to cause a fire or explosion.

Because of the danger of such fires or explosions, the engine compartments of powerboats are conventionally provided with blowers for exhausting any combustible fumes therein before an attempt is made to start the engine. These blowers may be electrically driven but need not themselves be within the engine compartment as long as they are in fluid communication therewith so that the blower motors do not present the problem of sparking found in the starter and the engine.

Conventionally, a separate blower switch is provided to energize the blower and a warning plate is put over the ignition switch, stating "CAUTION, Before starting engines turn on blowers for five (5) minutes." The plate reminds the operator to run the blowers for 5 minutes to remove any fumes that might be contained in the engine compartment before attempting to start the engine. Conventionally, no lockout device is provided between the blower switch and the ignition switch so that the boat operator is free to disregard this warning if he so desires and start the engine without ever having operated the blowers to clear the engine compartment of fumes. If the operator is so careless as to follow such a course, the spark created while starting the engine may cause the accumulated combustible fumes in the closed engine compartment to ignite and explode completely destroying the boat and surely seriously injuring those aboard.

SUMMARY OF THE INVENTION

It is therefore a primary object of this invention to provide a safety ignition system which automatically energizes the engine compartment blower for a selected predetermined time duration before the operator can energize and start the engine.

It is an object of this invention to provide a novel way of eliminating any possibility of explosion due to the energizing of either the engine or the starter by the operator before the blower has cleared the engine compartment of any combustible fumes therein.

It is another object of this invention to provide a safety ignition system where the energized blower continues to operate for a second predetermined time duration after the engine has been started to clear the engine compartment of any fumes accumulated during starting and to prevent the accumulation thereof.

Other and additional objects of this invention are to provide a safety ignition system including an electrical time-delay switch means which delays the energizing of the engine and of the starter for a selected predetermined time duration while blowers clear the engine compartment of any combustible fumes, to provide a time-delay unit not easily corroded by salt water, to provide a time-delay unit made up of a multiplicity of time-delay relays connected in a series so that the failure of one time-delay relay does not eliminate the predetermined time duration completely but only shortens it, to provide indicating means indicating that the blowers and engine are energized, to provide a safety ignition system which upon being moved to the off position cannot start the engine until after the blowers have been energized for the selected predetermined time duration, to provide a safety ignition system which may be used with multiple ignition switches and multiple engines, to provide a safety ignition system which is readily adaptable to be used with existing ignition switches and existing engines and starters in a powerboat, and to provide a safety ignition system which cannot be defeated by the operator of a powerboat to start the engine until after the engine compartment blower has been energized for a preselected time duration to remove any combustible fumes in the compartment.

Generally, the safety ignition lockout system of the present invention is adapted for use in a boat having an engine compartment housing an engine and an electric starter, the compartment being vented by an electrically controlled blower for removing combustible fumes from the compartment, and includes an ignition switch electrically connected to blowers and to an electrical time-delay switch means, delaying the energizing of the engine and the starter until the blower has been energized a preselected time duration, to clear the engine compartment of any possible combustible fumes therein. The safety ignition system also includes a shutoff electrical time-delay switch means permitting the blower to continue operating for a second preselected time duration after starting the engine to clear the engine compartment of any fumes that might accumulate from the engine during starting thereof before the switch means shuts off the blowers.

BRIEF DESCRIPTION OF THE DRAWING

The FIGURE shows an exemplary schematic diagram for the safety lockout ignition system of this invention for use with a vehicle such as a powerboat.

DETAILED DESCRIPTION

The safety lockout ignition system according to this invention is for use with a vehicle such as a power boat and is generally indicated at **10**. The preferred embodiment of the safety lockout ignition system **10** is shown in the FIGURE for use with a vehicle having a dual-engine drive. However, this ignition system **10** may be used with a single engine or three or more engines by the provision of suitable diodes as will be obvious to those skilled in the art.

Referring to the FIGURE, the safety lockout ignition system **10** includes a first engine **11** and a second engine **12**, and first and second electrically operated starters, **13** and **14**, for the engines **11** and **12**, respectively. The engines **11** and **12** are located in an engine compartment of a vehicle such as a powerboat which will normally be closed. The engine compartment is provided with electrically controlled blowers **15** for exhausting the fumes that might collect in the engine compartment out into the open air. Normally, the blowers **15** will be driven by electric motors and if so, the blowers **15** should not be located in the engine compartment as sparks from the electric motors might ignite the fumes in the compartment. It is sufficient that the blowers be in fluid communication with the compartment to exhaust the fumes therein.

A first multiposition ignition switch **16** is shown schematically on the FIGURE and has, a common terminal **17**, an ON terminal **18**, and a START terminal **19**. A second multiposition ignition switch **20** is likewise shown schematically in the FIGURE and also includes a common terminal **21**, an ON terminal **22**, and a START terminal **23**. The ignition switches **16** and **20** are conventional three-position key-controlled switches with an OFF position, an ON position and a START

position. When ignition switch **16** is moved to the ON position, the contacts **17**, **18** are closed and when the switch is moved to the START position, the contacts **17**, **19** are additionally closed providing a conduction path from the power source to the relay contacts **55**; when switch **20** is moved to the ON position, the contacts **21**, **22** are closed and remained closed when the switch is moved to the START position whereupon contacts **21**, **23** will close to provide a current to relay contacts **60**, and, when such contacts are closed, to starter **14**. The switches **16** and **20** may also be conventional two-position key-controlled switches with OFF and ON positions and a separate pushbutton or similar switch for starting. Either type of ignition switch has an ON position and a START position and a common terminal and these terms as used herein refer to both types of switches.

A battery **25** has one pole **26**, arbitrarily picked as the positive pole thereof, connected to the common terminal of the ignition switches, **16** and **20**, and the other or negative pole **27** thereof conventionally grounded to the engines **11** and **12**, the starters **13** and **14** and the blowers **15**.

The safety ignition system **10** has an electrical time-delay switch means indicated generally at **35** for delaying the energizing of the engines **11** and **12** and delaying the energizing of the starters **13** and **14**, for a preselected time while the blowers **15** are energized to clear the engine compartment of any combustible fumes that might have accumulated therein. The safety lockout ignition system **10** also includes shutoff electrical time-delay switch means **75** which, in response to energizing either of the starters **13** or **14**, shuts off the blowers **15** and part of the electrical time-delay switch means **35** after a second preselected time duration so as to clear the engine compartment of any fumes that might have accumulated therein during starting.

Referring now specifically to the circuit shown in the FIGURE, the ON terminals **18** and **22** of the ignition switches **16** and **20** are each connected to the anode of ignition diodes **30** and **31**, respectively. The cathode of the ignition diodes **30** and **31** are connected to the positive side of the blowers **15**. Thus, moving either ignition switch **16** or **20** to the ON position will energize the blowers **15** to remove any combustible fumes from the engine compartment. The diodes **30** and **31** permit each ignition switch to function independently of the other.

The electrical time-delay switch means **35** includes a time-delay unit **40** and an energizing latching relay **50**. The time-delay unit **40** provides a time delay of 6 minutes between the moment of energizing of the blowers **15** and the energizing of the latching relay **50**. The time-delay unit **40** may be made up of a single time-delay relay but is preferably made up of three time-delay relays **41**, **43** and **45**, respectively. Conventionally, the time of delay recommended for clearing the engine compartment is 5 minutes so that if each relay **41**, **43** and **45** had a duration of 2 minutes, the total duration would be 6 minutes, which is more than ample time to clear the engine compartment of fumes.

The individual time-delay relays are of conventional design and may be solid-state time-delay relays. As an alternative to using solid-state the delay relays, thermal delay relays, timing motor switches, solid-state latching circuits, etc. could be used but the solid-state devices would have the advantage of resistance to salt water corrosion not found in mechanical latching devices.

The first time-delay relay **41** is connected from the cathode side of the diodes **30** and **31** to the ground pole **27** of the battery **25**. The first time-delay relay **41** has contacts **42** with contact **42***a* connected to the cathode of the ignition diodes **30** and **31**, and the other contact **42***b* connected through the second time-delay relay **43** to the ground pole **27** of the battery **25**. The second time-delay relay **43** has contacts **44** with contact **44***a* connected to the cathode of the ignition diodes **30** and **31** and the other contact **44***b* connected through the third time-delay relay **45** to the ground pole **27** of the battery **25**.

The third time-delay relay **45** has contacts **46** with contact **46***b* connected to the ground pole **27** of the battery **25**, and contact **46***a* connected to the ground side of the energizing latching relay **50**. The time-delay relays **41**, **43** and **45** are thus connected in series so that their individual time-delay duration is additive. The use of three time-delay relays in series rather than using one 6-minute time-delay relay lies in the safety feature that if one of the three time-delay relays **41**, **43** or **45** should fail and switch instantaneously, the other two may function properly giving a time delay of at least 4 minutes for the blower to exhaust the engine compartment, which should be sufficient, until the defective time-delay relay can be replaced to give the full 6 minutes.

The energizing latching relay **50** includes a first latching relay **51** and a second latching relay **56** for the first and second engines **11** and **12** and the first and second starters **13** and **14**, respectively. If only one engine and one starter were provided, there would be needed only one latching relay and if three were provided, three latching relays would be required etc.

Latching relay **51** has a coil **52** and latching relay **52** has a coil **57**, both of which have the ground side thereof connected to the contact **46***a* of time-delay relay **45**. The first and second latching relays also have latching contacts **53** and **58**, respectively, in parallel with the contacts **46** of the third time-delay relay **45**, between the ground side of the coils **52** and **57** and the ground pole **27** of the battery **25**. The other side of the coils **52** and **57** are connected to the ON terminals **18** and **22**, respectively, of ignition switches **16** and **20** so that upon the closing of the contacts **46** by the third time-delay relay **45** current will flow through the coils **52** and **57**. As current passes through the coils **52** and **57** the latching contacts **53** and **58** close to maintain the flow of current to the coils **52** and **57** even though the contacts **46** later open.

The latching relays **51** and **56** also contain ignition contacts **54** and **59** between the positive pole **26** of the battery **25** and the ignition coils of the engines **11** and **12**, and start contacts **55** and **60** between the START terminals **19** and **23** of the ignition switches **16** and **20** and the starters, **13** and **14**, respectively. As current passes through the coils **52** and **57**, these coils, besides closing the latching contacts **53** and **58**, also close the ignition contacts **54** and **59**, and start contacts **55** and **60**. The ignition coils of the engines **11** and **12** are therefore energized and the circuit between the START terminals **19** and **23** and the starters, **13** and **14**, is closed. Movement of the ignition switches **16** and **20** to the START position after the start circuit is closed permits starters **13** and **14** to start the engines **11** and **12**. Each ignition switch **16** and **20** will start only its engine **11** or **12** allowing each engine to run independently or both engines to be run together.

In order to indicate that the engine is energized and ready to be started, indicating lights **65** and **66** are provided in parallel with the engines **11** and **12**, respectively. The lights **65** and **66** will operate only when the ignition contacts **54** and **59** are close, indicating that the engines are energized and ready to be started so that the operator can move the ignition switches **16** and **20** to the START positions as desired.

Also, if desired, an indicating light **68** may be provided in a parallel with the blowers **15** to indicate that the blowers **15** are energized.

Starters **13** and **14** are each connected to the anode of a start diode **70** and **71**, respectively. The cathodes of the start diodes **70** and **71** are connected to the shutoff electrical time-delay switch means **75**. Again the purpose of diodes **70** and **71** is to permit each ignition switch to function independently of the others.

The shutoff electrical time-delay switch means **75** includes a control latching relay **80**, a shutoff time-delay relay **85** and a shutoff latching relay **90**.

The control latching relay **80** has one side of its coil **81** connected to the cathode of the start diodes **70** and **71** and the other side thereof connected to the ground pole **27** of the battery **25**. The control latching relay **80** has latching contacts **82** with contact **82***a* connected to the blowers **15** and contact **82***b*

connected to the one side of coil 81. The control latching relay 80 also has control contacts 83 with contact 83*a* connected to the blowers 15 and contact 83*b* connected to the shutoff time-delay relay 85. Upon energizing of either starter 13 or 14, the start diodes 70 and 71 pass current through the coil 81 of the control latching relay 80 to close latching contacts 82 and control contacts 83. The latching contacts 82 continue the flow of current through coil 81 to maintain the control contacts 83 closed although both the starters 13 and 14 are later shut off.

The shutoff time-delay relay 85 has one side connected to control contact 83*b* and the other side thereof connected to the ground pole 27 of the battery 25. The shutoff time-delay relay has contacts 86 with contact 86*b* connected to the ground pole 27 of the battery and contact 86*a* connected to the shutoff latching relay 90. The shutoff time-delay relay 85 is similar to the time-delay relays 31, 33, or 35 and may have a second preselected time delay, such as 2 minutes. If the shutoff time-delay relay has a preselected time duration of 2 minutes, then 2 minutes after the control contacts 63 are closed, the shutoff time-delay relay 85 closes the contacts 86 to energize the shutoff latching relay 90.

The shutoff latching relay 90 has a coil 91 connected between the contact 86*a* of the shutoff time-delay relay 85 and the cathode of the ignition diodes 30 and 31. The shutoff latching relay has latching contacts 92 in parallel with contacts 86 and normally closed shutoff contacts 93, with contacts 93 in the circuit between the cathode of the ignition diodes 30 and 31, and the blowers 15. The shutoff latching relay 90 is energized by the closing of contacts 86 to pass current through coil 91 closing latching contact 92 to maintain the current flow through the coil 91 and to open the normally closed shutoff contact 93 interrupting the circuit between the ignition switches 16 and 20 (through the ignition diodes 30 and 31) and the blowers 15 as well as between part of the electrical time-delay switch means 35, i.e., the time-delay unit 40, allowing the time-delay unit 46 to return to normal. The opening of the normally closed shutoff contact 93 also deenergizes the control latching relay 80 and the shutoff time-delay relay 85 to return the contacts therein to their normally open position. The engines 11 and 12 continue to run because the first and second latching relays 51 and 56 continue to have current flowing through their coils 52 and 57, which continues to hold the ignition contacts 54 and 59 and start contacts 55 and 60 closed.

The engines will continue to run until the ignition switches 16 or 20 are moved from the ON position to the OFF position, opening all of the circuits and returning all of the contacts to their normal positions. Once the ignition switches 16 and 20 have been moved to the OFF position, the engines 11 and 12 and the starters 13 and 14 cannot be reenergized without waiting the preselected time duration after the blowers 15 are energized as is provided by the safety ignition system 10.

In operation, the powerboat operator unlocks the ignition switches 16 and 20. The operator may then turn one or both of the ignition switches 16 or 20 to the ON position, energizing the blowers 15 and the blower-indicating light 68, and energizing the electrical time-delay switch means 35.

The energizing of the electrical time-delay switch means 35 actually energizes the first time-delay relay 41 of the time-delay unit 40. After the proper delay, the first time-delay relay 41 energizes the second time-delay relay 43 which after the proper delay energizes the third time-delay relay 45. The third time-delay relay 45 after the proper delay energizes, for example, latching relay 51 (assuming only switch 16 has been turned to the ON position) to energize the engines 11 and the indicating light 55 which corresponds to the ignition switch 16 which is closed. The energizing of the latching relay 51 also closes the respective circuit between the start terminal 19 and the starter 13.

The energizing of the light 65 informs the operator that the blowers 15 have operated for the preselected time duration, such as 6 minutes, to clear the engine compartment of any combustible fumes that might have accumulated therein, and informs him that he is now free to start the engine 11. If only the ignition switch 16 is on, that switch may be moved to the START position to start engine 11. However, the other switch 20 may be moved to the ON position and to the START position immediately energizing and starting the engine 12 without delay as the latching relay 56 closes automatically upon the subsequent movement of the switch 20 to the ON position.

The operator may now move either or both ignition switches 16 or 20 to the start position to energize the respective starters 13 and 14 to start the respective engines 11 and 12. The energizing of either starter 13 or 14 by the operator, energizes the shutoff electrical time-delay switch means 75. The energizing of the electrical time-delay switch means 75 actually energizes the control latching relay 80 to energize shutoff latching relay 85. The control latching relay 80 after once being energized, maintains the shutoff time-delay relay 85 energized although the respective engines 11 or 12 have been started and the operator has moved the respective ignition switch 16 or 20 to the START position back to the ON position.

After the second preselected time duration of 2 minutes, the shutoff time-delay relay 85 energizes shutoff latching relay 90 which opens normally closed shutoff contacts 93 to shutoff the blower 15 and the blower light 68. The extinguishing of blower light 68 tells the operator that the engine compartment is free of any combustible fumes that might have accumulated therein during starting, and that the blowers 15 have been shut off.

The opening of normally closed shutoff contact 93 also deenergizes the time-delay unit 40 including time-delay relays 41, 43 and 45, the control latching relays 80, and the shutoff time-delay relay 85, permitting them to return to the deenergized state while the engines are running, to prolong their life.

The energizing latching relays 50, i.e., first and second latching relays 51 and 56, maintain the engines 11 and 12 energized and closes the circuit between the start terminals 19 and 23 and the respective starters 12 and 13 as long as the respective ignition switch 16 or 20 is in the ON or START positions. This feature permits the operator, if an engine dies of if only one engine has been started, and the operator desires to start the other engine, to start it without delay of the safety ignition system 10. This feature also allows one engine to be shut off and restarted as needed to conserve fuel, or to alternate which engine is being run, as long as at least one engine is being run at all times.

When the operator desires to shut off the engines in the boat, he moves both ignition switches 16 and 20 to the off position, shutting off the engines 11 and 12. The movement of both ignition switches 16 and 20 to the off position deenergizes the energizing latching relays 50, i.e., latching relays 51 and 56 to open the ignition circuits, and deenergizes the shutoff latching relay, returning the contacts 93 to the normally closed position so as to require that any subsequent attempts to start the engines 11 or 12 will utilize the safety ignition system 10.

Thus, the safety ignition system according to this invention automatically energizes the blowers to clear the engine compartment of fumes while preventing the energizing of the engine or the starter for a preselected time duration thereafter to prevent any possibility of an explosion due to the presence of combustible fumes in the engine compartment, and continues the blowers operating for a second preselected time duration after the starting of the engines to clear the engine compartment of any fumes that might collect therein during starting.

I claim:

1. In a safety ignition lockout system for use in a powerboat, the boat having an engine compartment housing an engine, and an electric starter, said compartment being vented by an electrically controlled and driven blower, the ignition system including a battery, and an ON-OFF-START multiposition ignition switch with the common terminal thereof connected to one pole of a battery, and the engine, electric starter and elec-

trically driven blower connected to the other pole thereof, the improvement comprising:

time-delay switch means connected between said ignition switch and said engine, said electrical starter and said blower; said time-delay switch means permitting said electrical blower to be energized by said battery when said ignition switch is moved from the OFF to the ON position, and preventing said starter and said engine from being energized for a preselected time duration, said blower being energized for a period at least equal to said preselected time duration to remove combustible fumes from the engine compartment before the engine is energized and before the electrical starter is energized to start the engine and shutoff electrical time-delay switch means to shut off said blower upon expiration of a second preselected time duration after said engine is started.

2. The improvement of claim 1 wherein said electrical time-delay switch means includes a plurality of time-delay relays connected in cascade, said time-delay relays having a time-delay duration which together equals the preselected time duration, whereby the failure of one of said time-delay relays shortens but does not eliminate the preselected time duration.

3. The improvement of claim 1 wherein said engine compartment housing includes an additional engine and electric starter within the same compartment and vented by said electrically controlled and driven blower, and said ignition system includes a second ON-OFF-START multiposition ignition switch for said second engine connected to said one battery pole and said engine, electric starter and electrically driven blower connected to the other pole thereof, said ignition system including means including a second time-delay switch means and additionally including means permitting immediate energizing of said second engine and electrical starter when the time-delay switch means for said first engine and starter has closed the ignition contacts and start contacts for said first engine although said second multiposition switch was not simultaneously moved to the ON position at the time said first engine multiposition switch was moved to the ON or START position.

4. In a safety lockout ignition system for use in a powerboat, the boat having an engine compartment housing an engine, an electric starter and an inlet of an electrically controlled and driven blower for removing combustible fumes from the compartment, the ignition system including a battery and an OFF-ON-START multiposition ignition switch connected to one pole of the battery, and the engine, electric starter, and electrically driven blower connected to the other pole of the battery, the improvement comprising:

electrical time-delay switch means connected between the ON position of the ignition switch and the other pole of the battery, said electrical time-delay switch means including normally open ignition contacts between the one pole of the battery and the engine, and having normally open start contacts between the START position of the ignition switch and the starter, said electrically controlled blower also being connected to the ON position of the ignition switch, said electrical time-delay switch means and said blower being energized by the movement of the ignition switch to the ON or START positions, said normally open contacts preventing said engine and said starter from being energized for a preselected time duration, after being energized, after the preselected time duration, the electrical time-delay switch means closing the ignition contacts to energize the engine, and closing the start contacts to permit the ignition switch in the START position to energize the electrical starter and start the engine after the blower has removed any combustible fumes from the engine compartment, and said electrical time-delay switch means including a time-delay relay unit connected between the ON position of the ignition switch and the other pole of the battery, and an energizing latching relay energized by the time-delay relay unit after being energized for the preselected time duration, said energizing latching relay upon being energized closing said ignition contacts and said start contacts.

5. The improvement as recited in claim 4 wherein the energizing latching relay includes latching contacts, said latching contacts maintaining the latching relay energized so as to maintain the ignition contacts and the start contacts closed until the ignition switch is moved to the OFF position.

6. The improvement of claim 4 additionally comprising shutoff electrical time-delay switch means including:

a control latching relay in parallel with said starter and energized as the starter is energized,

a shutoff time-delay relay energized and maintained energized by the control latching relay although the starter is shut off, and,

a shutoff latching relay energized by the shutoff time-delay relay a preselected time duration after the shutoff time-delay relay is energized, said shutoff latching relay being maintained energized and shutting off the time-delay unit, the control latching relay, the shutoff time-delay relay and the blowers as the engine runs after the blowers have cleared the engine compartment of any combustible fumes that might have accumulated therein during starting, said shutoff latching relay being deenergized by movement of the ignition switch to the OFF position.

7. The system as in claim 6 wherein two engines with respective starters and ignition switches are provided, each of said ignition switches being provided with a diode between the ON position thereof and the blowers and a respective ignition latching means is provided for each existing switch with a respective diode between the respective ignition latching relay and the control latching relay to permit a respective ignition switch to energize and start the respective engine independently of the other engine and still operate the safety ignition system.