

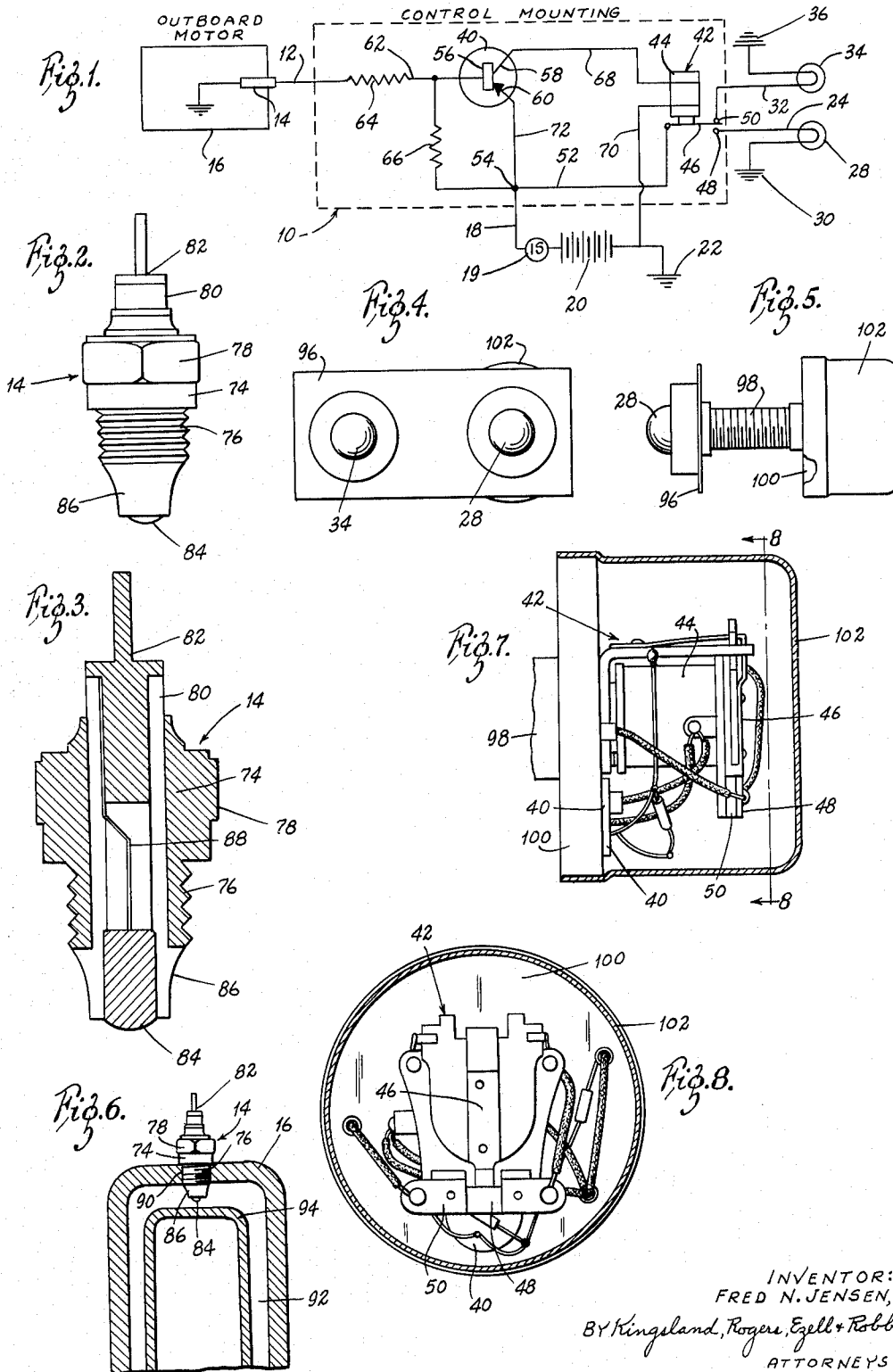
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SAFETY SIGNALING SYSTEM FOR MARINE ENGINE COOLING SYSTEMS

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## SAFETY SIGNALING SYSTEM FOR MARINE ENGINE COOLING SYSTEMS

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This invention relates to improvements in signaling systems for internal combustion engines with a liquid cooling system. Although it is not limited to internal combustion engines, it is particularly useful with marine engines, inboards and outboards, due to the hazards they encounter, and are subject to, when in use.

The principal features of this invention may be summarized in three aspects. First of all the system provides an instant, visual warning of malfunction of the cooling system due to interruption of circulation, although audible signals may also be used. As is known, the cooling systems of marine engines, and particularly outboard engines, have a forced coolant circulation, forced through the engine cooling system by means of a pump which is subject to wear and breakage. The cooling system's intake lines are subject to clogging, mud, sand, or picking up of any foreign matter, all of which interrupts the circulation through the cooling system. Upon failure of the coolant pump, or clogging of the intake lines, in such failures, the coolant level is lowered from the top, or highest part, of the cooling system. The top or highest part of the cooling system is the location of a specially designed sensor with a contacting electrode. This is very important in the operation of this device, as upon lowering of coolant in the system, an electrical coolant contact with the sensor electrode is broken, and immediately upon being broken, a visible warning signal indicating failure in the engine cooling system warns of this malfunction before serious damage to the engine occurs. Unlike devices that depend on heat to operate, this device operates on coolant contact, before damaging heat occurs.

Secondly, the system provides warning that the ignition switch is left on, with the engine not in use, when this occurs due to operator's negligence or otherwise. Some marine engines are stopped by retarding the throttle, some by their own accord due to mechanical difficulties. When this occurs, failure to turn the ignition switch off with the engine not in use, can be very damaging to the electrical system, battery drain, burned points, overheated resistors, etc. Due to the design and operation of this device, the sensor, with its contacting electrode, located in the top or highest part of the engine's cooling system, warns of this condition when the ignition switch is left on with the engine not in use. Also, should the engine stop for any reason, other than by turning off the ignition switch, coolant circulation is stopped, coolant level is lowered in the engine cooling system which causes breaking of contact with the sensor element with its contacting electrode. This in turn activates a warning signal to warn that the ignition is left on.

Thirdly, the system warns of signal system malfunction, loose or broken wires, bulbs burned out or broken. This invention is so designed that each time the ignition switch is turned on, there must be a red light. When there is no red light, with the ignition on, the operator will check the bulb or search for loose or broken wires. In proper system operation, when the ignition is on, the red light comes on, the engine is started and coolant circulates through the engine cooling system. When the coolant reaches the top or highest part of the system where the sensor with its contacting electrode is located, the red light changes to green, indicating the system is full or coolant. Should the green light not appear with

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the red light out, the operator will be informed that he should check the bulb or search for loose or broken wires. Thus, at all times, with the ignition on, and the engine running, these must be a light to provide assurance of proper operation.

Another feature of this invention resides in the provision of the sensor element which is connected into the water jacket to place an electrode in contact with the water coolant to provide a ground. This sensor is connected to the signaling system. The sensor is specially constructed of a carbon electrode and a specially designed and configured Teflon insulating element which resists water adsorption or chemical damage due to polluted coolant water to prevent shorting out of the system. The sensor is quite rugged to withstand heavy duty operation and is simple to install.

As a consequence of the signaling system of this invention, and the provided sensor element, the operator will be warned by the red light of the signal system, should the ignition key be left on for any length of time without operation of the engine, should the engine stop for any reason other than turning off of the ignition key, and is further warned, should water circulation be stopped, or partially blocked. Due to the location of the sensor element in the water jacket, should clogging of the intake water occur, or a failure of the water pump occur, the operator is warned by the signal light before the engine overheats and before damage to the engine occurs, such that the operator can immediately turn the engine off and locate the source of the trouble or have any necessary repairs made. The operator is further warned of a weak or worn water pump, e.g., when the red light flicks on and off.

The above features are objects of this invention and further objects will appear in the detailed description which follows and will be otherwise apparent to those skilled in the art.

For the purpose of illustration of this invention, a preferred embodiment is shown in the drawings. It is to be understood that these drawings are for the purpose of example only, however, and that the invention is not limited thereto.

In the drawings:

FIGURE 1 is a schematic electrical diagram of the signaling system of this invention as connected to an outboard motor;

FIGURE 2 is a view in elevation of the sensor element employed in the invention;

FIGURE 3 is an enlarged view in vertical section showing the construction of the sensor element;

FIGURE 4 is a plan view showing the mounting of the signal lights;

FIGURE 5 is a view in side elevation taken from the right side of FIGURE 4 showing the mounting of the signal lights and the mounting of the elements employed in the circuit to the rear of the signal lights and protected by a dust cap;

FIGURE 6 is a view in section showing the mounting of the sensor element upon the water jacket of the outboard motor;

FIGURE 7 is an enlarged view showing the dust cap in section and the arrangement of the electrical components of the control system; and

FIGURE 8 is a further view in section taken on the line 8—8 of FIGURE 7.

In FIGURE 1 the schematic electrical diagram is shown and the major electrical components of this invention are contained within the control mounting 10. In addition, external to the components in the control mounting, are a lead 12, leading to sensor 14, mounted upon water jacket 16 of the outboard motor. A second lead 18 is connected externally from the control mount-

ing through ignition switch 19 to battery 20, which is grounded at 22. In addition, a third lead 24 is connected to a red warning lamp 28 grounded at 30. A fourth lead 32 is connected to a green normal operating condition lamp 34 which is grounded at 36.

The control mounting 10 contains as its main components a transistor 40 and electrical relay 42. The relay is composed of a coil 44 and an armature 46. The armature 46 is provided with two contacts, one being a normally closed contact 48 in the circuit to the red warning lamp 28, and the other being a normally open contact 50 leading to the green satisfactory operating condition lamp 34. A lead 52 connects the armature to junction point 54.

The transistor 40 is comprised of a base 56, a collector 58, and an emitter 60. The base 56 is connected by lead 62 to a resistor 64, which is connected to the aforementioned lead 12. Another resistor 66 is connected between the junction point 54 and the lead 62. The collector 58 is connected by lead 68 to the coil 44 and is grounded on the other side by lead 70 at ground 22. The emitter 60 is connected by lead 72 to the junction point 54.

The sensor 14, as best shown in FIGURES 2, 3 and 6, is composed of a brass base or body 74 which has a threaded portion 76 at the lower end so that it may be threaded within the tap hole of the water jacket casing 16. It has a hexagonal exterior 78 so that it may receive a wrench to be tightened into the tap hole. An integral Teflon insulating shell 80 is received within a bore of the sensor shell in a press-fitted relationship, and, in turn, receives a sensor post 82 constructed of brass. A carbon electrode 84 is press-fitted within the bottom of the Teflon shell 80. A conductor 88 connects the carbon electrode plug 84 with the sensor terminal post.

It is to be noted that Teflon is employed because of its very high degree of lack of water adsorption and resistance to salt water and chemicals present in polluted water which are prevalent in industrial waterways. Other synthetic resins, such as nylon, have some degree of water adsorption which contributes to malfunctioning in the sensor element which thereby shorts out to the metallic water jacket, such as to falsely indicate that the sensor is operating properly even though water has left the water cooling chamber 16. The configuration of the bottom portion 86 of the shell 80 is also to be noted as having a flaring and downwardly tapering configuration which avoids build-up of salt where used in salt water and other foreign matter which occurs in a cylindrical configuration. Due to this configuration the coolant water readily drips off the sensor when the engine is stopped, thereby minimizing the possibility of attack and seepage into the sensor between the insulating shell and the electrode plug.

The sensor element 14 is best shown connected to the water jacket 16 of a typical outboard engine in FIGURE 6. As there shown, it is seen that the threaded portion 76 of the sensor element is readily received within a tap hole 90. The carbon electrode plug is positioned in the top of the water cooling chamber 92, but spaced from the inside wall 94. By positioning at the top of the chamber, ready indicating of any malfunctioning of the water pump or partial draining of the water coolant is immediately indicated, as this is the first part of the jacket drained of water.

FIGURE 4 shows a mounting plate 96 for the mounting of the red safety light 28 and the green light 34. The plate 96 also receives a threaded and hollow mounting socket 98 which is connected at the back to a mounting plate 100 which receives the electrical components of the control mounting. A dust cap 102 acts to protect the components from any damage. The electrical components previously described in the control mounting 10 are simply mounted upon the mounting plate

100 and are readily available for any repair or checking of action by removal of the dust cap.

The arrangement of the electrical components in FIGURES 5, 7 and 8 shows the ready mounting upon the mounting plate 100. Thus, the electrical relay 42 is simply mounted upon the mounting plate as is the transistor 40. Likewise, the resistors 64 and 66 are simply connected into the circuit. The armature 46, adapted to make and break contact with contacts 48 and 50, are readily accessible once the dust cap 102 is removed, such that any required repair or maintenance is easily provided.

#### OPERATION

The operation of the safety signal system of this invention is quite simple. As the operator turns on the ignition key 19 to close the switch, the normally closed contact 48 creates a circuit from the battery 20, through junction point 54, lead 52, the armature 46, the ignition switch, and the red light 28, which is grounded at 30. This indicates to the operator that the switch is on but that the cooling system is not operating.

As the engine is started, water is caused to circulate through the cooling space 92 and the cooling jacket 16. As this occurs, the electrode 84 is grounded through the water to the grounded engine jacket. In this condition the transistor 40 will conduct. The transistor passes current through the coil 44 of the relay to close the armature against the normally open contact 50. This causes the breaking of the circuit to the red light and the red light goes out, and, since the circuit is now made to the green light 34, this light will go on indicating satisfactory operation.

Should the water pump be damaged, or should the water intake be clogged, or for any other reason, should water not satisfactorily circulate through the chamber 92, the grounding condition will be removed when water leaves the top of the chamber. When this occurs, an opening is created in the circuit to the transistor causing the relay to return to its normal position, i.e., to close the contact 46 against the contact 48. This, of course, causes the green light to go out and the red light to return. Upon the indication of the red light, the operator will be informed of a malfunction and any necessary repair can be effected.

Accordingly, there has been provided a safety signaling system which can be employed by an outboard engine operator to insure that the cooling system is operating properly. The protection of the engine is thereby afforded immediately upon the indication of unsatisfactory operation of the cooling system. Through the provision of the sensor element, a very rugged and efficiently operating element has been provided. Likewise, through the arrangement of the mounting of the electrical components in the control mounting with the readily removable dust cap, easy repair and maintenance, should this be necessitated, is afforded.

Various changes and modifications may be made within this invention as will be readily apparent to those skilled in the art. Such changes and modifications are within the scope and teaching of this invention as defined by the claims appended hereto.

What is claimed is:

1. A signaling system for marine engines to indicate the condition of an electrical ignition system and a water coolant system employed in the engine, said system employing a first circuit operative when an ignition switch is turned on to energize a warning light to indicate that the ignition is on and that coolant is not being circulated through the coolant system, and a second circuit including a sensor element established by the circulation of water through the coolant system when in contact with the sensor element to provide a short circuiting ground to the engine, thereby energizing a relay to open the first circuit and establish a connection to a second light indicating satisfactory operation of said coolant system.

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2. A signaling system for marine engines to indicate the condition of an electrical ignition system and a water coolant system employed in the engine, said system employing a first circuit operative when an ignition switch is turned on to energize a warning light to indicate that the ignition is on and that coolant is not being circulated through the coolant system, and a second circuit including a sensor element and a transistor acting as a switch to conduct current, established by the circulation of water through the coolant system when in contact with the sensor element to provide a short circuiting ground to the engine, thereby energizing a relay to open the first circuit and establish a connection to a second light indicating satisfactory operation of said coolant system.

3. A signaling system for marine engines to indicate the condition of an electrical ignition system and a water coolant system employed in the engine, said system employing a first circuit operative when an ignition switch is turned on to energize a warning light to indicate that the ignition is on and that coolant is not being circulated through the coolant system, and a second circuit including a sensor element established by the circulation of water through the coolant system when in contact with the sensor element to provide a short circuiting ground to the engine, thereby energizing a relay to open the first circuit and establish a connection to a second light indicating satisfactory operation of said coolant system, said sensor comprising a brass body containing an insulated carbon electrode adapted to be inserted in the shell of a water jacket with the electrode in communication with the coolant inside said shell, said electrode being insulated from said shell by a Teflon insulating element characterized by its lack of water adsorption and resistance to attack by brine and other chemicals.

4. A signaling system for marine engines to indicate the condition of an electrical ignition system and a water coolant system employed in the engine, said system employing a first circuit operative when an ignition switch is turned on to energize a warning light to indicate that the ignition is on and that coolant is not being circulated through the coolant system, and a second circuit including a sensor element and a transistor acting as a switch to conduct current, established by the circulation of water through the coolant system when in contact with the sensor element to provide a short circuiting ground to the engine, thereby energizing a relay to open the first circuit and establish a connection to a second light indicating satisfactory operation of said coolant system, said signaling system containing as a separate mounting unit the relay and said transistor mounted upon a mounting plate and protected by a removable cap whereby the mounting unit may be simply connected to the ignition system of said marine engine as a unit.

5. A signaling system for marine engines to indicate the condition of an electrical ignition system and a water coolant system employed in the engine, said system employing a first circuit operative when an ignition switch is turned on to energize a warning light to indicate that the ignition is on and that coolant is not being circulated through the coolant system, and a second circuit including a sensor element and a transistor acting as a switch to conduct current, established by the circulation of water through the coolant system when in contact with the sensor element to provide a short circuiting ground to the engine, thereby energizing a relay to open the first circuit and establish a connection to a second light indicating satisfactory operation of said coolant system, said signaling system containing as a separate mounting unit the relay and said transistor mounted upon a mounting plate and protected by a removable cap whereby the mounting unit may be simply connected to the ignition system of said marine engine as a unit, said mounting plate being connected to a separate light mounting plate supporting the aforementioned lights whereby the lights, the relay, and the transistor may be installed as a unit.

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6. A signaling system for marine engines to indicate the condition of an electrical ignition system and a water coolant system employed in the engine, said system employing a first circuit operative when an ignition switch is turned on to energize a warning light to indicate that the ignition is on and that coolant is not being circulated through the coolant system, and a second circuit including a sensor element and a transistor acting as a switch to conduct current established by the circulation of water through the coolant system when in contact with the sensor element to provide a short circuiting ground to the engine, thereby energizing a relay to open the first circuit and establish a connection to a second light indicating satisfactory operation of said coolant system, said sensor comprising a brass body containing an insulated carbon electrode adapted to be inserted in the shell of a water jacket with the electrode in communication with the coolant inside said shell, said electrode being insulated from said shell by a Teflon insulating element characterized by its lack of water adsorption, said signaling system containing as a separate mounting unit the relay and said transistor mounted upon a mounting plate and protected by a removable cap whereby the mounting unit may be simply connected to the ignition system of said marine engine as a unit.

7. A signaling system for marine engines to indicate the condition of an electrical ignition system and a water coolant system employed in the engine, said system employing a first circuit operative when an ignition switch is turned on to energize a warning light to indicate that the ignition is on and that coolant is not being circulated through the coolant system, and a second circuit including a sensor element established by the circulation of water through the coolant system when in contact with the sensor element to provide a short circuiting ground to the engine, thereby energizing a relay to open the first circuit and establish a connection to a second light indicating satisfactory operation of said coolant system, said sensor comprising a brass body containing an insulated carbon electrode adapted to be inserted in the shell of a water jacket with the electrode in communication with the coolant inside said shell, said electrode being insulated from said shell by a Teflon insulating element characterized by its lack of water adsorption, said Teflon insulating element being in the form of a shell enclosing the electrode in exposed relation at one end and supported to the brass body at the other end, and a connector connecting said electrode with a mounting terminal at an opposite end of the brass body, and said Teflon insulating element shell having an exterior surface diverging generally from the exposed end of said electrode to adjacent the connection with said brass body.

8. A sensor element for use with marine engines to establish a shorting condition in a coolant jacket employed therein, said sensor comprising a brass body containing an insulated carbon electrode adapted to be inserted in the shell of a water jacket with the electrode in communication with the coolant inside said shell, said electrode being insulated from said shell by a Teflon insulating element characterized by its lack of water adsorption and resistance to chemical attack by brine and other chemicals, said Teflon shell serving to protect the electrode and being substantially flush with the end of the electrode.

9. A sensor element for use with marine engines to establish a shorting condition in a coolant jacket employed therein, said sensor comprising a brass body containing an insulated carbon electrode adapted to be inserted in the shell of a water jacket with the electrode in communication with the coolant inside said shell, said electrode being insulated from said shell by a Teflon insulating element characterized by its lack of water adsorption and resistance to chemical attack by brine and other chemicals, said Teflon insulating element being in the form of a shell enclosing the electrode in exposed

relation at one end and supported to the brass body at the other end and a connector connecting said electrode with a mounting terminal at an opposite end of the brass body, and said Teflon insulating element shell having an exterior surface diverging generally from the exposed end of said electrode to adjacent the connection with said brass body, said Teflon shell serving to protect the electrode and being substantially flush with the end of the electrode.

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