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STARTING AND IGNITION SYSTEM

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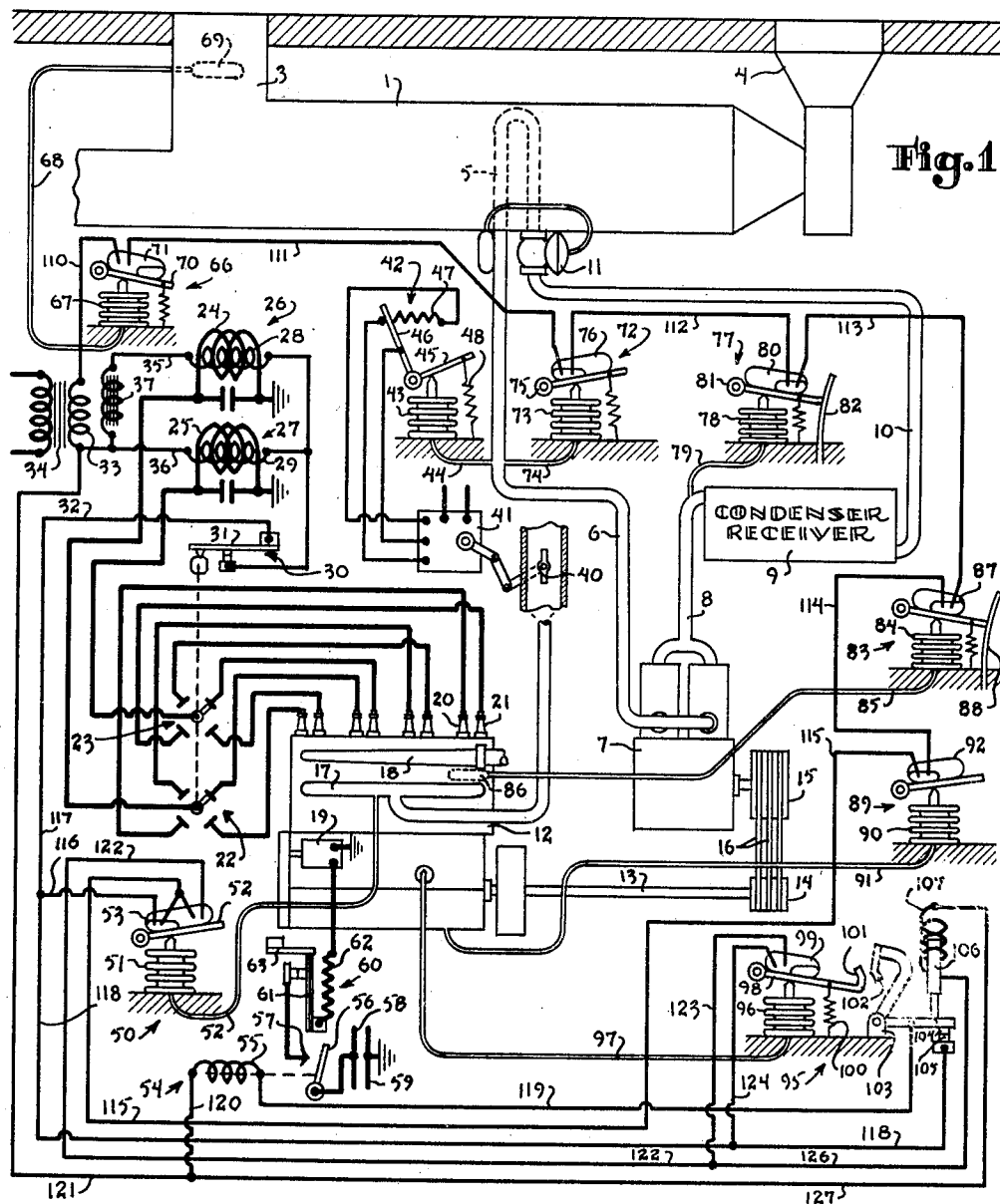


Fig. 1

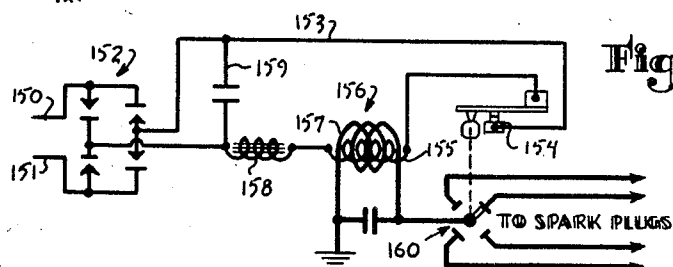


Fig. 2

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UNITED STATES PATENT OFFICE

2,222,568

STARTING AND IGNITION SYSTEM

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Application July 25, 1938, Serial No. 221,158

11 Claims. (Cl. 290—38)

This invention relates to internal combustion engines and is more particularly concerned with the provision of an automatic starting and ignition system for stationary internal combustion installations.

In internal combustion engine installations, it has been usual practice to utilize low voltage direct current as obtained from a storage battery for operating the starting and ignition system of the engine. This practice for mobile installations such as in automobiles, or railroad car refrigeration systems is quite necessary, for in such cases there is no other suitable source of electricity. However, in stationary gas engine installations such as for air conditioning systems or building power plants, this practice is not desirable, as a source of electricity is already available, and the storage battery and generator increase the initial cost and maintenance of the system above what it would be if this equipment were eliminated. However, the drawback to utilizing the usual alternating current service line for ignition purposes is that if the breaker points open when the current is reversing, or in other words at zero value, no spark will occur, and the engine will miss.

It is an object of this invention to provide an ignition system for internal combustion engines which permits the use of the usual alternating current supply for the ignition system, and which eliminates missing of the engine due to the fluctuating characteristics of the alternating current.

Another object of this invention is the provision of an automatic starting and ignition system for an internal combustion engine which is adapted to utilize the usual alternating current supply for furnishing power to the starting motor, and for energizing the ignition system.

A further object is the provision of an automatic starting and ignition system which is adapted to stop the engine automatically upon failure in oil pressure, and to prevent restarting of the engine after such occurrence until reset by an attendant.

Still another object lies in the provision of an automatic starting and ignition system which permits operation of the starting motor for only a limited period of time, thereby causing the starting motor to be deenergized automatically if the engine fails to start within a reasonable period of time.

Other objects of this invention will become apparent from the following description and the appended claims.

For a full disclosure of my invention, reference is made to the following detailed description and to the accompany drawing in which:

Figure 1 illustrates diagrammatically an application of a preferred form of my starting and ignition system as applied to an internal combustion engine driven air conditioning system, and in which

Figure 2 illustrates a modified form of ignition system.

Referring to Figure 1, reference character 1 indicates a conditioning chamber connected by a return duct 3 and a discharge duct 4 to a space being conditioned. Within this chamber is a cooling coil 5 which is connected by a discharge line 6 to the inlet of a compressor 7. The discharge of the compressor 7 is connected by a discharge line 8 to a condenser-receiver 9, the latter being connected by a liquid line 10 to the expansion valve 11 at the inlet of the cooling coil 5. The cooling coil 5, compressor 7, condenser-receiver 9, and expansion valve 11 form a conventional type compression refrigeration system and no further explanation of this system is necessary.

The compressor 7 is driven by means of an internal combustion engine generally indicated as 12. This internal combustion engine is connected to the compressor 7 by means of a drive shaft 13 and pulleys 14 and 15 over which run belts 16. This engine may be of any suitable form including an intake manifold 17, an exhaust manifold 18, and an alternating current starting motor 19. In accordance with my invention, this engine is provided with two separate sets of spark plugs 20 and 21, there being one plug of each set for each cylinder. These two sets of spark plugs are separately connected to individual distributors 22 and 23, respectively, and the rotors of these distributors are connected to the secondaries 24 and 25 of separate spark coils 26 and 27, these spark coils including primary coils 28 and 29. A common set of breaker points 30 is provided for the two ignition systems. The contact 31 of these breaker points is connected to a wire 32 which leads through the various controls from the secondary 33 of a step-down transformer 34 as will be presently described. The other contact of the breaker points is connected to the primary coils 28 and 29 of the spark coils 26 and 27 as shown. The other ends of these primary coils are connected in parallel by wires 35 and 36 to the transformer secondary 33. An important part of this ignition system is the provision of an inductance coil 37

in series with one of the primaries of the spark coils 26 and 27.

From the description thus far, it should be apparent that when the breaker points 30 are closed, assuming that the various controls are in position for closing the ignition circuit, the primary coils 28 and 29 of the spark coils will be energized. At this time, there will be reversal in current flow through each of the primaries due to the alternating current supply. However, no current will flow through the secondary of each coil for the reason that the impedance in circuit with the secondary of the coil will be higher than can be bridged by the potential across the secondary of each coil due to transformer action. In other words, the step-up in voltage due to plain transformer action of the spark coils will not be sufficient to cause a spark to occur across the spark gaps of the spark plugs. Upon abrupt opening of the breaker points 31, however, the abrupt change in current flow will be sufficient to cause a spark to occur in each ignition system.

At this time, it should be pointed out that if the breaker points should open at the instant of zero current flow through either the spark coil 26 or 27 there will be no spark from that particular coil. By the interposing of the inductance 37 in series with the spark coil 26, the current flow through this coil is caused to lag substantially 90° in phase behind the current flow through the spark coil 27. Due to this 90° displacement in current flow through the two spark coils, it will be apparent that a time will never exist when there is no current flow through at least one spark coil.

Consequently, upon opening of the breaker points 30, there will be a spark produced either by the coil 26 or by the coil 27 or both. Due to the complete separation of the primaries of the two spark coils, each coil having its own distributor and set of spark plugs, there will always be a spark provided at the appropriate time for each cylinder. My novel ignition system therefore permits the use of alternating current and avoids any chance of missing due to the engine requiring spark at the periods of zero current flow in the alternating current system. This arrangement, therefore, provides for the elimination of a direct current supply, consequently eliminating the necessity of using storage batteries or converters for operating the engine.

The engine 12 may be controlled in any suitable manner during its periods of operation. I have illustrated this engine as being controlled in a manner to maintain a constant evaporator or suction pressure within the refrigeration system. For this purpose the throttle valve 40 for the engine is positioned by means of a proportioning motor 41 which is controlled by means of a suction pressure controller 42. The proportioning motor 41 may be of any suitable type and preferably may be of the type shown and described in Patent No. 2,028,110, issued to Daniel G. Taylor on January 14, 1936. This type of motor is adapted to be controlled by means of a potentiometer controller and will assume intermediate positions corresponding to the position of the potentiometer slider upon its resistance.

Referring to the suction pressure controller 42, this controller may consist of a bellows 43 connected by a tube 44 to the suction line 6. This bellows may actuate a bell-crank lever having an actuating arm 45 and a control arm 46 which cooperates with the resistance 47 to form a control potentiometer. The arm 45 may be biased against the bellows 43 by means of a spring 48.

When the suction pressure is above a predetermined value, the bellows 43 will be expanded for causing the arm 46 to engage the left-hand end of resistance 47 and this will cause the motor 41 to assume a position wherein the throttle valve 40 is wide open. As the suction pressure decreases, the bellows 43 will collapse, this causing travel of the arm 46 to the right across resistance 47 and this will cause the motor to 41 to close the valve 40 an amount proportionate to the travel of the slider across the resistance. By this arrangement, the engine speed will be varied from a maximum to a minimum for maintaining the suction pressure within the control range of the controller 42. This control of the engine speed in accordance with suction pressure will cause the engine speed to be increased as the load upon the system increases and to be decreased as the load decreases.

Reference character 50 indicates a manifold pressure controller for controlling the starting motor 19. This controller may consist of a bellows 51 connected by a tube 52 to the intake manifold 17. The bellows 51 actuates a pivoted mercury switch carrier 52 which carries a double-pole type of mercury switch 53. This controller 50 may be so designed as to assume the position shown wherein the left-hand electrodes of the mercury switch 53 are bridged when the engine is out of operation. When the engine starts, however, the intake manifold pressure will be reduced below atmospheric pressure and this will cause collapsing of the bellows 51 for tilting the mercury switch 53 in a manner to unbridge the left-hand electrodes and bridge the right-hand electrodes.

Referring to the starting motor control, reference character 54 indicates a relay having a coil 55 which operates through a suitable armature a switch arm 56 which cooperates with a contact 57. When the relay coil 55 is energized, the switch arm 56 will engage the contact 57, while when the coil is deenergized, the switch arm 56 will disengage contact 57 as shown. The switch arm 56 is connected to a line wire 58, the other line wire 59 being grounded as shown. The contact 57 in turn is connected to a cut-out device 60 and this device in turn is connected to starting motor 19. This cut-out device includes a bimetallic element 61 which is subjected to the influence of a heating element 62 which is connected in series with the starting motor 19. This bimetallic element 61 controls a pair of contacts in series with the starting motor circuit. When the bimetallic element 61 is cool, it will assume the position shown wherein the contacts are closed for completing a circuit to the starting motor. Thus whenever the relay coil 55 is energized, a circuit will be completed from the line wire 58 through switch arm 56, the contacts of the cut-out 60 and the resistance 62 to the starting motor 19. This will cause rotation of the starting motor for starting the engine. Simultaneously, with the energizing of the starting motor 19, the heating element 62 will be energized, this slowly heating the bimetallic element 61. If the engine fails to start within a predetermined period of time, this element will become heated sufficiently for opening the contacts of the cut-out 60, thereby deenergizing the starting motor 19. The bimetallic element 61 at this time may be prevented from returning to its original position by means of a clip 63. The arrangement just described therefore will permit operation of the starting motor for a predetermined period of

time. If the engine fails to start within this period of time, the cut-out 60 will open the starting motor circuit and the starting motor will be prevented from operating until this device is manually reset.

Reference character 66 indicates a space thermostat which may be utilized for starting and stopping the engine in accordance with space temperature. This thermostat may be of any desired type and is shown as comprising a bellows 67 which is connected by a capillary tube 68 to a control bulb 69 located within the return air duct 3. This bellows, tube, and bulb are charged with a suitable volatile fill for causing the pressure within bellows 67 to vary with changes in return air temperature. The bellows 67 may actuate a mercury switch carrier 70 which carries mercury switch 71. When the space temperature is sufficiently low as to require no cooling, the bellows 67 will be collapsed for causing the switch 71 to be tilted for unbridging its electrodes. However, when the space temperature rises to a value requiring cooling, the bellows 67 will expand for tilting the switch 71 to closed position.

Reference character 72 indicates a low limit suction pressure controller for stopping the engine if the suction pressure within coil 5 should become too low. This controller may comprise a bellows 73 connected by a tube 74 to the suction line 6. This bellows may actuate a mercury switch carrier 75 carrying a mercury switch 76. So long as the suction pressure is above a predetermined value, the mercury switch 76 will be closed as shown. However, under light load conditions, if the suction pressure should fall too low with the engine operating at its lowest speed, the bellows 73 will collapse for causing tilting of the switch 76 to open position.

Reference character 77 indicates a high pressure cut-out which may consist of a bellows 78 connected by a tube 79 to the high pressure line 8. The bellows 78 may actuate a mercury switch 80 which is mounted upon a pivoted carrier 81. So long as the head pressure is not excessive, the bellows 78 will be collapsed sufficiently to cause the switch 80 to be tilted for bridging its contacts. However, if the head pressure should become excessive due, for instance, to failure in cooling water supply, the bellows 78 will expand for tilting switch 80 to open position. The switch 80 may then be held in this open position by means of a clip 82 for preventing further operation of the system until this device has been manually reset.

If desired, an engine temperature controller 83 may be utilized for stopping the engine whenever its temperature becomes excessive. This controller may consist of a bellows 84 connected by a tube 85 to a control bulb 86 located within the engine water jacket. The bellows 84 may actuate a mercury switch 87. So long as the engine temperature is not excessive, the bellows 83 will be collapsed for causing the switch 87 to be closed as shown. When the engine temperature becomes excessive, however, the bellows 84 will expand for tilting the switch 87 to open position for stopping the engine. This switch may then be held in open position by means of a clip 88 for preventing engine operation until this device has been manually reset.

Also if desired, an oil level responsive controller 89 may be utilized for preventing operation of the engine if the oil level becomes too low. This controller may take the form of a float actuated

switch, or if desired may consist of a pressure type controller including a bellows 90 which is attached by a tube 91 to the bottom of the engine crank case. When the oil level is at a predetermined value, it will cause a pressure to exist within bellows 90 which is sufficient to tilt the mercury switch 92 to closed position. However, when the oil level is too low, the pressure within the bellows 90 will be insufficient to cause closure of the switch 92.

An important feature of the present invention is the provision of an oil pressure safety controller which prevents operation of the engine upon failure in oil pressure until this device has been manually reset. Reference character 95 indicates generally a combination oil pressure safety controller and starting motor control switch. This device may consist of a bellows 96 which is attached by a tube 97 to the oil pressure line of the engine 12. The bellows 96 actuates a pivoted switch carrier 98 which carries a mercury switch 99. This switch carrier is also biased against the bellows 96 by a spring 100. In addition, the end of this switch carrier is formed to provide a catch 101 for cooperating with a latch device 102 carried by a bell-crank lever 103. One arm of this bell-crank lever carries a contact 104 which cooperates with a contact 105, these contacts being interposed in the starting motor circuit as will be described. The arm 104 also may be connected to an armature 106 of a solenoid having a coil 107. When the coil 107 is deenergized, the bell-crank lever 103 will assume the position shown wherein the contacts 104 and 105 are closed and wherein the latch 102 is out of reach of the catch member 101. However, when the coil 107 is energized, the bell-crank lever 103 will be rotated clockwise for opening contacts 104 and 105 and urging the latch 102 against the catch 101. At this time, if the oil pressure is at a proper value, the switch carrier 98 will assume a position above that shown and the catch 101 will not engage the latch 102. However, if the oil pressure should fail, the right-hand end of the switch carrier 98 will be pulled downwardly for allowing engagement of the catch 101 with the latch 102. This will prevent clockwise rotation of the bell-crank lever 103 for closing the contacts 104 and 105, and also will prevent upward movement of the switch carrier 98. The purpose of this device and of the other devices described will become apparent from the following statement of operation.

Operation

With the parts in the positions shown, the space temperature is satisfied as indicated by the mercury switch 71 of the thermostat 66 being open. At this time, the suction pressure is at a high value as indicated by the slider 46 of thermostat 42 engaging the left-hand end of resistance 47 and this has caused the motor 41 to shift the throttle valve 40 to wide open position. Also due to this high suction pressure, the low limit suction pressure controller 72 is satisfied as indicated by the mercury switch 76 being closed. Also at this time, the head pressure is not excessive, the engine temperature is not excessive, and the oil level is at a proper value as indicated by the mercury switches 80, 87 and 92 being closed. Due to the mercury switch 71 being open, the engine is out of operation and accordingly the mercury switch 53 of the controller 50 is positioned for bridging its left-hand electrodes, and the mercury switch 99 of the con-

troller 95 is tilted to open position due to the lack of oil pressure. The solenoid coil 107 is also deenergized, this causing the bell-crank lever 103 to be positioned for closing the contacts 104 and 105 and for moving the latch 102 from engaging relationship with the catch 101.

If the space temperature now rises to a value requiring cooling, the mercury switch 71 will be closed and this will complete a circuit for the ignition system as follows: transformer secondary 33, wire 110, mercury switch 71, wire 111, mercury switch 76, wire 112, mercury switch 80, wire 113, mercury switch 87, wire 114, mercury switch 92, wire 115, left-hand electrodes of mercury switch 53, wire 116, and wire 117 to the breaker points 30. Also a parallel circuit for energizing the starting motor 19 will be established from wire 116 through wire 118, contact 105, contact 104, wire 119, relay coil 55, wire 120, and wire 121 to the transformer secondary 33. The energization of relay coil 55 will energize the starting motor 19 as previously described. This will either cause starting of the engine or will cause rotation of the starting motor for a predetermined period of time, and will automatically stop the starting motor 19 if the engine fails to start within this time as previously described. Assuming that the engine is in proper condition and starts, the oil pressure will build up immediately thus causing the bellows 96 of the controller 95 to expand for closing the mercury switch 99 and for withdrawing the catch 101 from possible engagement with the latch 102. Also, the engine manifold pressure will decrease thereby causing tilting of the mercury switch 53 of controller 50 for unbridging its left-hand electrodes while bridging its right-hand electrodes. The unbridging of the left-hand electrodes will break the ignition circuit through wire 116 and will also break the energizing circuit for the relay coil 55. However, a new ignition circuit will be closed from wire 115, right-hand electrodes of mercury switch 53, wire 122, wire 123, mercury switch 99, wire 124, and wire 118 to wire 117. It will be noted that the oil pressure responsive switch 99 is now connected into the engine ignition circuit and will break the ignition circuit for stopping the engine if the oil pressure should fail. Simultaneously, with the establishing of this new ignition circuit through the mercury switch 99, the solenoid coil 107 will be energized as follows: from wire 122, wire 126, solenoid coil 107, wire 127, and wire 121 to transformer secondary 33. This energization of solenoid coil 107 will cause opening of contacts 104 and 105 for thereby preventing energization of the relay coil 55. This will prevent further energization of the starting motor until the contacts 104 and 105 are reengaged. At this time, if the oil pressure has assumed a proper value the latch 102 will merely abut the end of switch carrier 98 and consequently upon deenergization of the coil 107, the bellcrank lever 103 is free to return to its original position. However, if at this time the oil pressure has failed to assume a proper operating value, the latch 102 will engage the catch 101 for preventing return of the lever 103 to its normal position. This will prevent reenergization of the starting motor. Also if during operation of the engine the oil pressure fails, the bellows 96 will collapse, thus causing a downward movement of the right-hand end of switch carrier 98 and this will permit engagement of the catch 101 with the latch 102 for preventing energization of the starting motor or closure of the mercury switch 99.

From the foregoing description it should be apparent that the various safety controllers 72, 77, 83, and 89 are always in circuit with the ignition system and consequently will prevent operation of the engine if either the engine condition or conditions within the refrigeration system are such that engine operation is not desirable. It should also be apparent that the mercury switch 99 of the oil pressure responsive device is placed out of the engine starting and ignition circuits when the engine is not in operation. However, when the engine is started, the mercury switch 99 is automatically inserted in the engine ignition circuit for thereby causing stopping of the engine upon failure in oil pressure. It should further be apparent that as long as the engine is running, the solenoid coil 107 will be energized thereby placing the latch 102 in position for engaging the catch 101 if the oil pressure fails to build up, or fails during engine operation, this action automatically holding the parts in position for preventing further engine operation until such parts are manually reset. It should also be apparent that when the engine is stopped either by opening the ignition circuit or by stalling, the solenoid coil 107 will be deenergized thus permitting the latch 102 to be withdrawn from operative relationship with the catch 101. Consequently at this time when the oil pressure falls, the latch 102 will not engage the catch 101 and the engine is free to be restarted. If the engine fails to start, the starting motor will after a predetermined period of time be deenergized by means of the automatic cut-out 60.

Referring to Figure 2, this figure shows a modified form of ignition system. In this figure, reference characters 150 and 151 indicate suitable alternating current line wires, these wires being connected to a rectifier 152. One load terminal of the rectifier 152 is connected by wire 153 to the breaker points 154 which in turn are connected to the primary coil 155 of a spark coil 156 having a high voltage secondary coil 157. The other terminal of the primary coil 155 is connected through an inductance coil 158 to the other load terminal of the rectifier. In addition, a condenser 159 is connected across the load terminals of the rectifier 152. The coil 158 and condenser 159 function in a manner to smooth out the direct current voltage wave in a manner understood in the art. The high voltage secondary coil 156 is connected to the distributor 160 and to the spark plugs in the usual manner. It will be understood that the rectifying means need not provide a smooth direct current flow, as a fluctuating current will be satisfactory due to the fact that the relatively slow changes in current flow through the primary coil 155 will not cause sufficient transformer action as to cause a spark to jump across the gaps of the spark plugs. This permits the use of a very inexpensive rectifying device. Upon the opening of the breaker points 154, however, the abrupt change in current flow will be sufficient to cause a spark to occur. Due to the action of coil 158 and condenser 159 in smoothing out the current flow, there will be no times at which the current flow is at zero value and consequently whenever the breaker points open there will have been sufficient current flow through the primary of the spark coil as to cause a spark.

From the foregoing, it will be apparent that my invention provides for the use of alternating current for operating the starting and ignition system of a stationary internal combustion en-

gine installation and further provides for safe operation of the engine, the engine being operated only when proper conditions for operation exist within the engine and within the refrigeration system actuated thereby. It will also be seen that my invention provides for preventing operation of the engine upon failure in oil pressure, while providing normal control of the engine if the engine stops from some other cause than oil pressure failure. While I have shown and described a preferred form of my invention, it will be apparent that many modifications and adaptations of the novel features and subcombinations of my invention will occur to those skilled in the art. I therefore desire to be limited only by the scope of the appended claims.

I claim as my invention:

1. In an alternating current automatic starting and ignition system for an internal combustion engine, in combination, a starting motor for said engine, an ignition switch, a set of ignition breaker points for said engine, a pair of spark coils connected to said breaker points, phase displacing means interposed in circuit with one of said spark coils for causing the current flow through one coil to lag relatively to the other, a first distributor and spark plug set connected to one of said coils, a second distributor and spark plug set connected to the other of said coils, switching means responsive to operation of said engine, said switching means being associated with said ignition switch in a manner to energize said starting motor when said engine is not operating and said ignition switch is closed, while placing said starting motor out of operation whenever said engine is in operation, a switch interposed in series with said starting motor, a thermostatic element for actuating said last mentioned switch, and a heater in series with said last mentioned switch for influencing said thermostatic element in a manner to open said last mentioned switch when said starting motor operates a predetermined period of time.

2. In an alternating current automatic starting and ignition system for an internal combustion engine, in combination, a starting motor for said engine, an ignition switch, a set of ignition breaker points for said engine, a pair of spark coils connected to said breaker points, phase displacing means interposed in circuit with one of said spark coils for causing the current flow through one coil to lag relatively to the other, a first distributor and spark plug set connected to one of said coils, a second distributor and spark plug set connected to the other of said coils, switching means responsive to operation of said engine, said switching means being associated with said ignition switch in a manner to energize said starting motor when said engine is not operating and said ignition switch is closed, while placing said starting motor out of operation whenever said engine is in operation, an oil pressure responsive device for said engine, an oil pressure switch actuated by said oil pressure responsive device and connected in series with said ignition switch for cutting off the ignition when the oil pressure is low, means for short-circuiting said oil pressure switch when said starting motor is in operation, means controlled by said oil pressure responsive device and said switching means for preventing energization of said starting motor upon failure in oil pressure during operation of said engine, while permitting operation of said starting motor upon drop in oil pressure due to stopping of the en-

gine, a switch interposed in series with said starting motor, a thermostatic element for actuating said last mentioned switch, and a heater in series with said last mentioned switch for influencing said thermostatic element in a manner to open said last mentioned switch when said starting motor operates a predetermined period of time.

3. In an automatic starting and ignition system for an internal combustion engine, in combination, a starting motor for said engine, an ignition switch, switching means responsive to operation of said engine, said switching means being associated with said ignition switch in a manner to energize said starting motor when said engine is not operating and said ignition switch is closed, while placing said starting motor out of operation whenever said engine is in operation, an oil pressure responsive device for said engine, an oil pressure switch actuated by said oil pressure responsive device and connected in series with said ignition switch for cutting off the ignition when the oil pressure is low, means for short-circuiting said oil pressure switch when said starting motor is in operation, means controlled by said oil pressure responsive device and said switching means for preventing energization of said starting motor upon failure in oil pressure during operation of said engine, while permitting operation of said starting motor upon drop in oil pressure due to stopping of the engine, a switch interposed in series with said starting motor, a thermostatic element for actuating said last mentioned switch, and a heater in series with said last mentioned switch for influencing said thermostatic element in a manner to open said last mentioned switch when said starting motor operates a predetermined period of time.

4. In an automatic starting and ignition system for an internal combustion engine, in combination, a starting motor for said engine, an ignition switch, switching means responsive to operation of said engine, said switching means being associated with said ignition switch in a manner to energize said starting motor when said engine is not operating and said ignition switch is closed, while placing said starting motor out of operation whenever said engine is in operation, an oil pressure responsive device for said engine, an oil pressure switch actuated by said oil pressure responsive device and connected in series with said ignition switch for cutting off the ignition when the oil pressure is low, means for short-circuiting said oil pressure switch when said starting motor is in operation, and means controlled by said oil pressure responsive device and said switching means for preventing energization of said starting motor upon failure in oil pressure during operation of said engine, while permitting operation of said starting motor upon drop in oil pressure due to stopping of the engine.

5. In an automatic starting system for an internal combustion engine, in combination, a starting motor, switching means for controlling said starting motor, means for moving said switching means to a position for deenergizing said starting motor when said engine is running, an oil pressure responsive device, and means actuated by said oil pressure responsive device for preventing movement of said switching means to a position for energizing said starting motor upon failure in oil pressure when said switch is in position for deenergizing said starting motor.

6. In an automatic starting system for an internal combustion engine, in combination, a starting motor, switching means associated with said starting motor in a manner to prevent operation of said starting motor when said switching means is in a first position, while permitting operation of said starting motor when said switching means is in a first position, while permitting operation of said starting motor when said switching means is in a second position, a controller responsive to operation and non-operation of said engine, an oil pressure responsive device, and means controlled conjointly by said oil pressure responsive device and said controller for maintaining said switching means in said second position upon drop in oil pressure while the engine is in operation.

7. In an automatic starting and ignition system for an internal combustion engine, in combination, a starting motor for said engine, an ignition circuit for said engine, an ignition switch for opening and closing said ignition circuit, a starter switch for controlling said starting motor, said switch preventing operation of said starting motor when in a first position, and permitting operation of said starting motor when in a second position, means for causing said starter switch to assume said first position when said ignition circuit is closed and said engine is in operation while causing said starter switch to assume said second position when said ignition circuit is open, an oil pressure responsive device, and means controlled conjointly by said oil pressure responsive device and said starter switch for maintaining said starter switch in said first position upon failure in oil pressure while said switch is in said first position.

8. In an automatic starting and ignition system for an internal combustion engine, in combination, a starting motor for said engine, a starter switch for controlling said starting motor, said switch preventing operation of said starting motor when in a first position, and permitting operation of said starting motor when in a second position, means for causing said starter switch to assume said first position when said engine is in operation while causing said starter switch to assume said second position when said engine is out of operation, an oil pressure responsive device, and latch means actuated by said oil pressure responsive device for engaging said starter switch and holding said starter switch in said first position upon a drop in oil pressure while said starter switch is in said first position, said latch means being arranged so as to clear said starter

switch when said starter switch is in said second position.

9. In an automatic control system for an internal combustion engine, in combination, an electrical starting and ignition system for said engine, an oil pressure responsive switching mechanism for controlling said electrical system, latch means for holding said oil pressure responsive switching mechanism in low oil pressure position upon its once assuming this position, and means actuated upon stopping of said engine for withdrawing said latch means from operative position, to thereby prevent latching of said oil pressure responsive switching mechanism when the drop in oil pressure results from stopping of the engine.

10. In an automatic control system for an internal combustion engine, in combination, control means for placing said engine into and out of operation, an oil pressure responsive device, a controller actuated by said oil pressure responsive device and movable from a first position to a second position upon fall in oil pressure from a value suitable for engine operation to a value too low for engine operation, said controller being associated with said control means in a manner for preventing engine operation when said controller is in said second position, means for locking said controller in said second position, and means for placing said locking means out of operation when the engine is stopped by other than said controller to thereby permit restarting of the engine when the stopping of the engine is not due to failure in oil pressure, while preventing restarting of the engine when the engine is stopped due to failure in oil pressure.

11. In an automatic control system for an internal combustion engine, in combination, control means for placing said engine into and out of operation, an oil pressure responsive device, a controller actuated by said oil pressure responsive device for controlling said control means in a manner tending to prevent engine operation when the oil pressure is below a predetermined value, locking means for preventing restarting of the engine upon stopping of said engine by said controller, and means for placing said locking means out of operation when the engine is stopped by other than said controller to thereby permit restarting of said engine when the stopping of the engine is not due to failure in oil pressure, while preventing the engine from restarting when the stopping of the engine is due to failure in oil pressure.

ALWIN B. NEWTON.

CERTIFICATE OF CORRECTION.

Patent No. 2,222,568.

November 19, 1940.

ALWIN B. NEWTON.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, second column, line 3, for the word "accompany" read --accompanying--; page 2, second column, line 9, strike out "to" first occurrence; page 6, first column, lines 6, 7, and 8, claim 6, strike out the words and comma "while permitting operation of said starting motor when said switching means is in a first position,"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 1st day of April, A. D. 1941.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.

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Signed and sealed this 1st day of April, A. D. 1941.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.