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CAR STARTER

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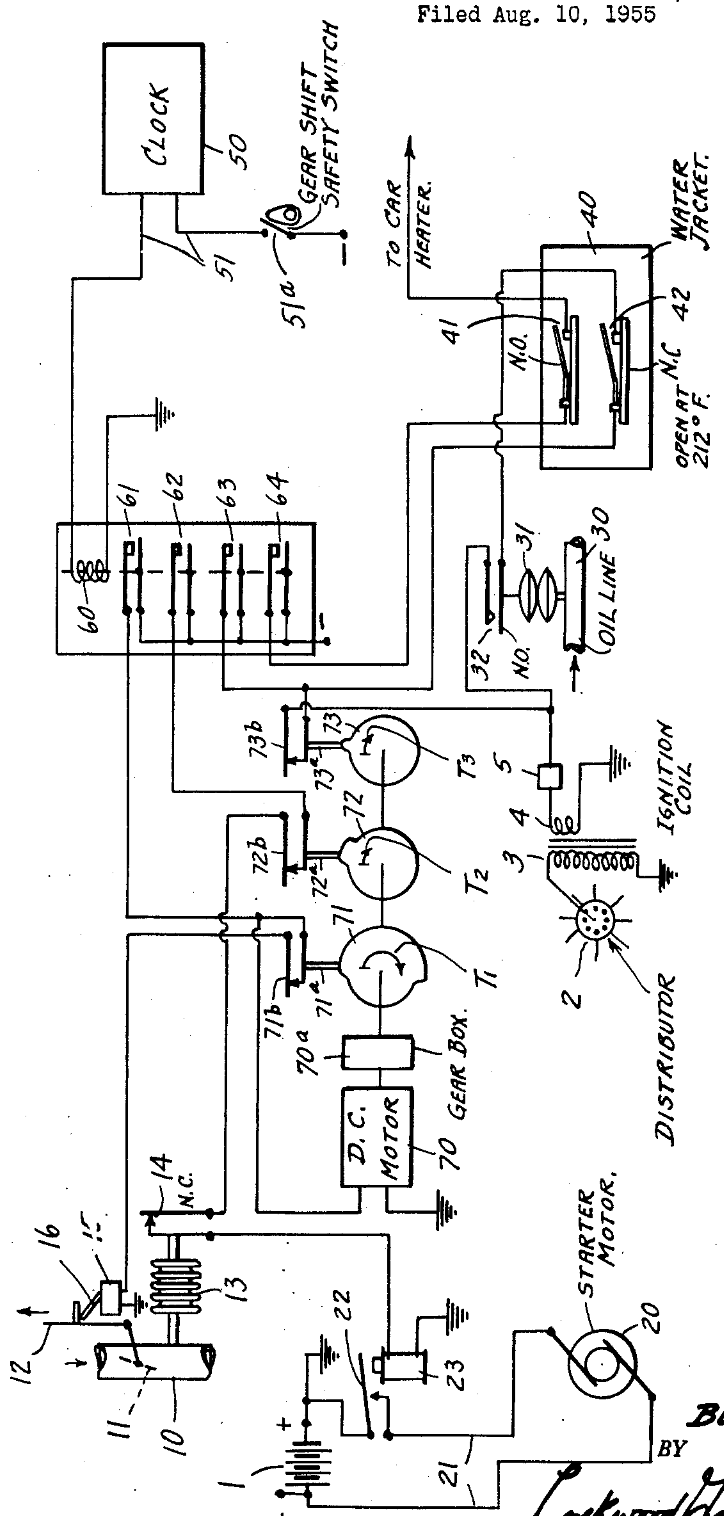

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1

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This invention relates to starter systems for internal combustion engines and is particularly directed to means for starting unattended engines.

Systems have been proposed heretofore for starting automobile engines at a predetermined future time and which are unattended. A clock controlled switch can quite conveniently be set to close circuits for initiating the starting cycle at any selected hour in the future. After the initiation of the starting cycle several automatic functions must be performed if a successful system is to be expected. For example, the starter motor, the ignition system and the throttle at the carburetor must be activated simultaneously, and in case of the failure of the engine to start, the starting motor and ignition circuit must be positively interrupted within a relatively short period of time after the beginning of the starting cycle. In systems heretofore, interruption of the various battery circuits was not positively controlled thus making the primary battery vulnerable to serious overload and rapid discharge. Obviously, a discharged battery is ineffective in starting the motor and yet may produce sufficient current to create a fire hazard.

The object of this invention is a starter system for internal combustion engines in which the circuits to the starting motor, to the ignition system and to the throttle are positively time-controlled.

Other objects of this invention will appear by referring to a specific embodiment thereof described in the following specification and shown in the accompanying drawing in which the single figure diagrammatically shows the important circuit elements of the system.

A primary source of direct current power such as a storage battery is shown at **1**. The ignition system of the conventional internal combustion engine comprises a distributor **2** for distributing successively high voltage ignition current to the several spark plugs. This high voltage is obtained from the secondary winding **3** coupled through an iron core to the low voltage winding **4** of the coil. The circuit breaker **5** is, as usual, connected in the low voltage side of the coil.

The fuel supply system of the engine includes an intake manifold **10** with a throttle valve such as the butterfly valve **11** rotationally controllable by the accelerator rod **12**. When the engine is idle the pressure in the intake manifold is near atmospheric pressure. When, however, the engine is running under light load and with the throttle nearly closed, the pressure in the manifold drops below atmospheric pressure. Thus, the bellows **13** can be made to respond to the manifold pressure and cause the normally closed contacts of switch **14** to open when the manifold pressure drops. At **15** is shown an electromagnet with an armature **16** for pushing on the accelerator rod to open the throttle. The third important element of the engine is its starter motor **20** which can be connected to the battery **1** through heavy current conductors **21** and through the relatively heavy contacts **22** of the starting relay. The primary circuit **23** of this relay is key and button controlled as is well-known in the art.

2

The usual electrical system of an automobile includes the battery **1** with one terminal solidly grounded. The positive terminal of the battery shown is grounded although the negative terminal could be grounded. The opposite terminal of the battery, usually termed the "hot" side, supplies current to the entire electrical system of the engine, single wires only being shown for the various circuits, the opposite side of the circuit being the framework of the automobile. Another important element of an internal combustion engine is an oil pump for supplying oil under pressure to the bearings and various moving parts of the engine. The pressure of oil in the line **30** connected to the oil pump will accordingly be zero when the engine is standing idle and rises to a predetermined level when the engine is running. According to an important feature of this invention, the oil pressure is employed by means of pressure bellows **31** to control the normally open contacts **32** of a pressure relay. Finally, the cooling system of the engine plays an important part in this invention. Where the engine is water cooled, the cooling media may be considered to flow in the water jacket diagrammatically shown at **40**. Normally open thermostatic switches **41** and normally closed thermostatic switches **42** are submerged in the cooling media of the engine such as water or are in intimate heat transfer contact with the water jacket.

The elements added to the conventional automobile engine according to this invention comprise the clock controlled switch **50**. Clock control switches are commercially obtainable which will open and/or close a circuit at pre-set times in the future. It is contemplated that the clock **50** will close the circuit represented by lines **51** at a pre-set hour and will open the circuit after a time lapse of, say, 15 minutes. Conductors **51** energize winding **60** of a multi-contact relay to close contacts **61**, **62**, **63** and **64** which normally stand open. One of each of the pairs of these contacts is connected in parallel and to the ungrounded side of the battery so that when relay winding **60** is energized all circuits are closed.

It is important that the starting circuit cannot be actuated unless the gearshift is in neutral. For this purpose switch **51***a*, operated by the gear shift lever, stands closed only when the gears are in neutral.

Contact 61 energizes the small direct current motor 70 so that motor 70 starts the instant the clock circuit is closed. Through a speed reduction gear box 70*a* the motor 70 drives discs 71, 72 and 73. These discs comprise time-controlled circuit closers and for the purpose of illustration are shown as cams, each with two cam levels. The cams have cam followers 71*a*, 72*a* and 73*a*, respectively, which will positively open or close switches 71*b*, 72*b* and 73*b*. For reasons which will more fully hereinafter appear, the cam rises of the three cams are of progressively different lengths. The speed of the motor driven shaft and the circumferential width of the cam rises (or commutator bars) are preferably adjusted so that switch 71*b* will remain closed approximately 1.5 minutes. This closing time is adjusted to the period desired for driving the engine at a warm-up speed. It has been found that the motor can most efficiently be brought to good operating temperature by alternately permitting the motor to idle and to run at about one-half speed. The temperature apparently rises with minimum wear on the motor by timing each period to about 1.5 minutes.

The cam rise time of cam 72, however, is shorter and in the example mentioned may be about 9 seconds. During this 9-second period, the starter motor is driven as will be explained. The time rise of the third cam **73** is preferably shorter than the cam rise of cam 72. In the example mentioned this cam rise and the close time of contacts **73***b* is 4.5 seconds. During this time the primary circuit of the ignition coil is closed and firing potentials are successively applied to the spark plugs of the engine.

Contact **71b** of cam **71** serially connects the voltage source through contact **61** to the throttle control solenoid **15** so that the throttle is kicked open by armature **16** of the solenoid and holds the throttle open throughout the cam rise time of cam **71**. If the cams turn at the rate of one revolution in 3 minutes and if the cam rise and cam fall are equal in circumferential length then the throttle will remain open 1.5 minutes and will remain closed 1.5 minutes. These time periods may, of course, be lengthened or shortened and may be proportioned as experience dictates for a particular engine to be started. In the closed position of the throttle the engine is appropriately adjusted to idle at its lowest speed. The throttle also is adjusted by its linkage to run at a warm-up speed in the neighborhood of one-half its top racing speed.

The contact **72b** closes substantially simultaneously with the closure of contact **71b** and serially connects the voltage source from contacts **62** through the normally closed contacts **14** to the solenoid **23** of the starting relay. When the motor starts, the pressure in the manifold **10** drops, the bellows **13** collapse and contacts **14** open, disengaging the starter relay winding **23**.

Contacts **73b** are also closed substantially simultaneously with the closure of contacts **71b** and **72b**. Contacts **73b** connect the voltage source at **63** to the ignition coil. The opening and closing of the circuit breaker points at **5** supply the necessary high voltage at the distributor and at the spark plugs. According to an important feature of this invention, the contacts **73b** are paralleled by a second circuit which maintains a closed ignition circuit after contacts **73b** open. This parallel circuit comprises the normally open contacts **32** of the pressure responsive relay coupled to the pressure oil line of the engine. When the engine starts, the oil line pressure closes contacts **32** through the response of the diaphragm **31** to the oil pressure. Such a parallel circuit takes over the control of the ignition circuit the instant the engine starts and the oil pressure rises and removes control of the ignition circuit from the time control switch **73b**. If the engine does not start, the ignition circuit control remains responsive to the time controlled cam and its switches.

In starting and running unattended engines it is desirable to incorporate reliable safety devices so that should the engine overheat it will shut down. For this purpose the normally closed thermostatic relay contacts **42**, submerged in the cooling medium of the engine, are connected in series with the ignition circuit. Conveniently, the contacts **42** are connected in series with the pressure responsive switch **32** as shown.

If it is desired that the car heater be started after the engine has reached a predetermined temperature, the normally open contacts **41** of the thermostatic relay are connected between the voltage source at contact **64** and the motor of the car heater (not shown).

In operation, the clock initiates all functions at a predetermined time when coil **60** is energized and all of the contacts **61**, **62**, **63** and **64** are pulled up. This starts D. C. motor **70** whereupon contacts **71b**, **72b** and **73b** are closed at the time of or shortly after initiation by the clock. The throttle opens in response to contacts **71b** and connected solenoid **15**, the ignition circuit is closed by **73b**, and the starter relay is closed by contacts **72b**. If the motor starts immediately, the starter motor relay is interrupted by the pressure responsive contacts **14** at the manifold, and the ignition circuit is transferred from **73b** to **32**. If the engine does not start within 9 seconds or within the time dictated by cam **72**, contact **72b** opens and interrupts the starter relay. 1.5 minutes thereafter, in the example mentioned, the starting cycle recommences, the throttle being opened, the starter relay being closed, and the ignition circuit being closed.

Many modifications may be made in this invention without departing from the spirit thereof as defined in the following claims.

What is claimed is:

1. A starter system for an engine having a fuel intake manifold with a throttle, a starter motor and an ignition coil, the system comprising a plurality of motor driven time-controlled circuit closers, said closers being arranged to close substantially simultaneously and to open at successively different times, means responsive to one closer for operating said throttle, means responsive to another closer for energizing said starting motor, and means responsive to still another closer for energizing said ignition coil.

2. In the system defined in claim 1, the last named means comprising a first circuit serially including the last mentioned closer, said ignition coil and a battery; and a normally open pressure responsive relay with contacts connected in parallel with the contacts of the last mentioned closer.

3. A starter system for an internal combustion engine having a battery, a starter motor, a starter relay with contacts between the battery and starter motor, an oil pressure pump, an intake manifold with a throttle, and an ignition coil; the system comprising three time-controlled circuit closers, means for closing the circuit closers substantially simultaneously and for holding the closers closed for different periods of time, a throttle controlling solenoid, a first closer being in serial circuit with said solenoid and battery, a second closer being in serial circuit with said starter relay, and a third closer being in serial circuit with said ignition coil.

4. The system of claim 3 further comprising a first pressure responsive switch associated with said manifold and with contacts serially in circuit with said starter relay.

5. The system of claim 3 further comprising a second pressure responsive switch associated with said oil pump and with contacts connected in parallel with the third mentioned closer.

6. A starter system for an engine having a fuel intake manifold with a throttle, a starter motor and an ignition coil, the system comprising a plurality of time-controlled circuit closers, said closers being arranged to close substantially simultaneously and to open at successively different times, means responsive to one closer for operating said throttle, means responsive to another closer for energizing said starting motor, and means responsive to still another closer for energizing said ignition coil.

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