

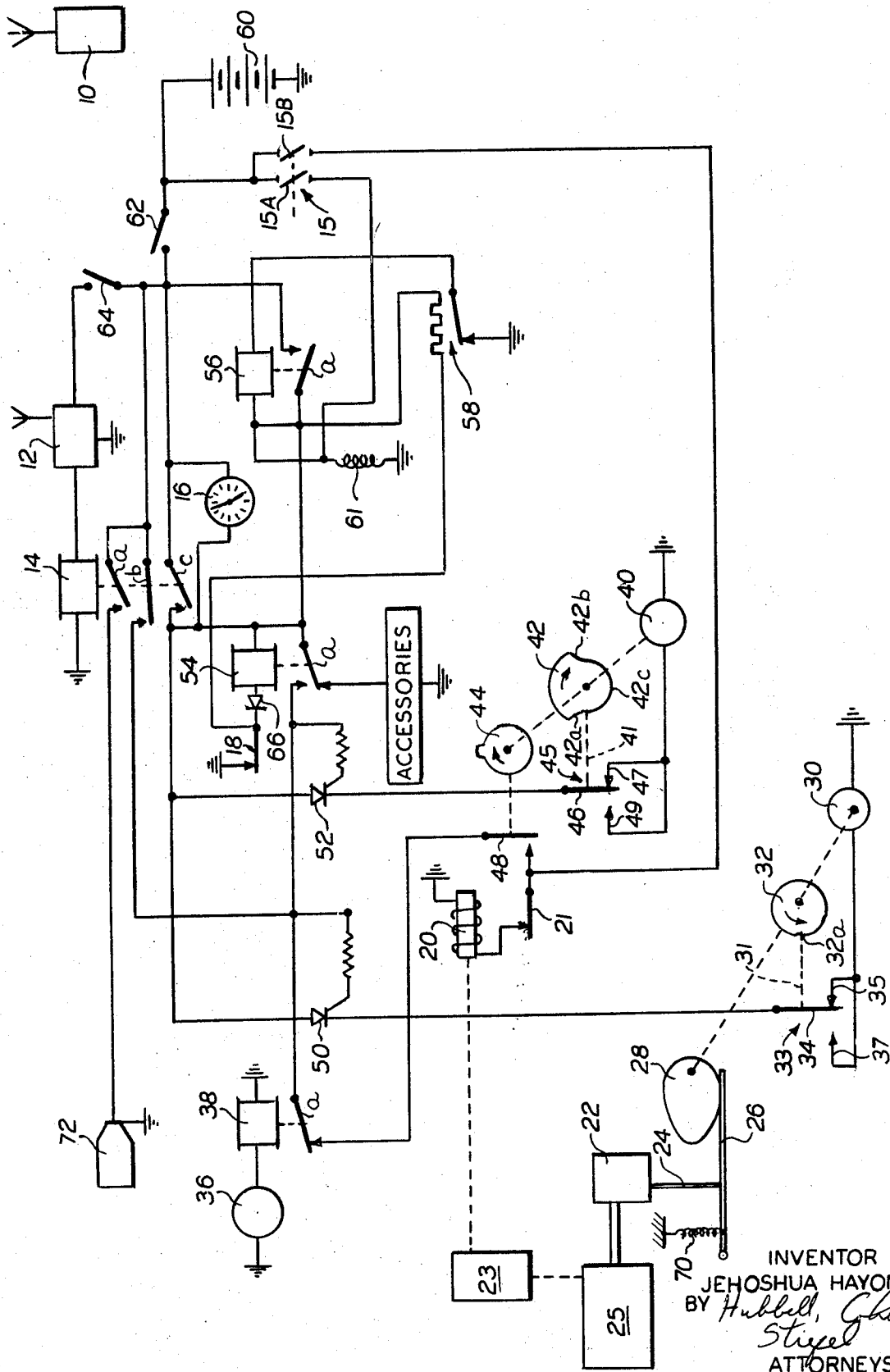
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AUXILIARY MEANS FOR STARTING INTERNAL COMBUSTION ENGINES

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AUXILIARY MEANS FOR STARTING INTERNAL COMBUSTION ENGINES

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ABSTRACT OF THE DISCLOSURE

An auxiliary mechanism for starting an automobile without the need for a driver to be present, the actuation of the auxiliary mechanism being effected by a remote radio transmitter, by time controlled means or otherwise, wherein once actuation is effected an auxiliary energizing circuit is established for the ignition coil of the automobile and a motor driven cam means is set into operation to operate the engine throttle and to energize the starter solenoid whereby to start the engine.

BACKGROUND OF THE INVENTION

Field of the invention

The present invention relates to an apparatus separate and apart from the normal manually actuatable apparatus for starting an internal combustion engine which auxiliary apparatus is designed to either start the internal combustion engine at a predetermined time or upon reception of radio signal, or the like.

SUMMARY

The present invention finds its major utility in connection with automobile engines although it may be employed with other internal combustion engines. The auxiliary starting mechanism includes an actuating means, switching means responsive to the actuating means, cam motor means controlled by the switching means, and driving cams which control the throttle and the starter solenoid of the engine. Upon actuation of the auxiliary starting mechanism, the switching means will close to energize the ignition coil and the cam motor means, whereby to operate the cams that control the engine throttle and starter solenoid to start the engine. Means are provided for discontinuing the operation of the auxiliary starting means upon the engine starting and also for discontinuing the operation of the auxiliary starting means should be the auxiliary starting means fail to operate to start the engine within a pre-determined time interval.

BRIEF DESCRIPTION OF THE DRAWING

The single figure is a diagrammatic view of the normal and auxiliary mechanisms for starting an internal combustion engine.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawing in detail, the mechanism diagrammatically illustrated therein includes a normal starting means for an internal combustion engine 25 and the novel auxiliary starting mechanism of the present invention. The internal combustion engine 25, as is customary, includes a carburetor 22 which controls the supply of fuel and air to the engine and the mixture thereof. Also included is a starter 23 which is actuated by a starter solenoid 20. In addition, the conventional ignition coil 61 is included.

The normal manner of starting engine 25 is by the operation of a key operated switch 15 having an ignition coil contact 15A and a starter solenoid contact 15B. In normal starting, the key actuated switch 15 is operated

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first to close contacts 15A and 15B whereby to establish energizing circuits for the ignition coil 61 and the starter solenoid 20. The driver depresses the gasoline pedal to feed fuel to the engine and to set the automatic choke. Upon the motor starting, the ignition key is permitted to turn a sufficient amount to open contact 15B while keeping contact 15A closed, whereby to discontinue starter operation and to keep the ignition coil 61 energized. This is the conventional manner for starting most internal combustion engines.

The present invention is directed to a mechanism providing auxiliary means for starting the engine without the driver present. The auxiliary means utilizes many of the conventional components of the internal combustion engine including those already mentioned plus the standard generator or alternator 36, a gear safety switch 21 which is closed when the transmission is in its neutral and park positions and is open at other times, and an oil pressure switch 18 which is normally closed but which is opened upon oil pressure achieving a pre-determined level only achievable upon operation of the engine 25.

As shown herein the auxiliary means for starting the engine includes two actuating means, a timer switch 16 and a radio transmitter 10-receiver 12. However, one or the other of these two separate and distinct means may be employed separately although preferably both are included. The timer switch 16 is a conventional clock switch having a pair of normally open contacts which close for a brief time interval at a pre-determined hour of the day.

The auxiliary starting mechanism also includes a first cam motor 30 that rotates a pair of cams 28 and 32, the cam 28 being connected to the throttle of the engine through a pivotal lever 26 and a link 24 moved thereby. In addition, a second cam motor 40 is included for rotating a pair of cams 42 and 44, the cam 44 being adapted to control during auxiliary starting the starter solenoid 20. The cam motors 30 and 40 are controlled in part by a pair of silicon control rectifiers 50 and 52 which in turn are controlled by an oil pressure relay 54 and an ignition relay 56. The auxiliary apparatus also includes a repeater relay 38 for the generator or alternator 36, a radio receiver repeater relay 14, a thermal time delay relay 58, a manually operable master switch 62, a manually operable receiver switch 64 and the conventional automobile battery 60 which, as shown in the drawing, serves to energize the entire apparatus.

Let it first be assumed that the device is to be controlled by the clock switch 16, which, as already noted, has an internal electrical contact that is normally open but which briefly closes upon a predetermined hour being reached. With the clock switch open the entire device is deenergized. In the deenergized condition it will be seen that the oil pressure switch 18 is closed, and the master switch 62 is closed. However, relays 54 and 56 will be deenergized whereby to open their front contacts and to cause the back contact *a* of the relay 54 to be closed. However, this will have no effect on the operation of the circuit at this time since the clock switch itself is open. In addition, both silicon control rectifiers 50 and 52 will be non-conductive and deenergized whereby to cause the cam motors 30 and 40 to be deenergized in the condition shown in the figure wherein the switches 34 and 46 are in their normal conditions, the switch 48 is at its normally open condition and the throttle is in a nonactuated condition. In addition, with the entire device off and the engine not running the generator 36 will not be operating and the relay 38 will thereby be deenergized whereby to close its back contact *a* to condition certain circuits to be hereinafter traced for operation.

Upon the switch in the timer switch 16 being closed, a first energizing circuit for the oil pressure relay 54 will

be established which circuit may be traced from ground, through the battery 60, through the closed main switch 62, through the timer switch 16, through the winding of relay 54, through diode 66, and through normally closed oil pressure switch 18, back to ground. Upon this circuit being established the oil pressure relay will pick up to thereby open its back contact and close its front contact *a*. In addition, upon the timer switch 16 closing its contact, an energizing circuit will be established for the ignition coil relay 56 which circuit may be traced from ground, through battery 60, through main switch 62, through timer switch 16, through the winding of ignition relay 56, and over the normally closed back contact of the thermal control relay 58 to ground. This will cause the ignition coil relay 56 to pick up whereby to close its front contact *a* and thereby provide a stick circuit around timer switch 16 which will reopen after a brief instant. In addition, upon the timer switch 16 closing, energy will be supplied through the ignition coil 61 of the engine over a circuit which may be traced from ground, through battery 60, through master switch 62, through timer switch 16, and to the ignition coil back to ground. After timer switch 16 reopens, this circuit is maintained by front contact *a* of ignition coil relay 56. The establishment of the ignition coil circuit will, of course, condition the car for ignition when other conditions necessary therefore are achieved as will be described hereinafter.

The picking up of the two relays 54 and 56 will establish an energizing circuit for the two silicon controlled rectifiers 50 and 52. For example, the anode-cathode of silicon controlled rectifier 50 is energized by a circuit which may be traced from ground, through battery 60, over master switch 62, over the front contact *a* of the ignition coil relay 56, across the anode and cathode of the silicon controlled rectifier 50, over contact points 34-35 of a cam controlled switch 33, through the cam motor 30 to ground. In addition, the anode-cathode of the silicon controlled rectifier 52 is energized by a circuit which may be traced from ground, through battery 60, over master switch 62, over front contact *a* of the ignition coil relay 56, across the anode and cathode of silicon controlled rectifier 52, over points 46-47 of a cam controlled switch 45, and through the cam motor 40, to ground. As is well known to those skilled in the art of silicon controlled rectifiers, the mere application of potential across the anode and cathode of such a device will not cause conduction therethrough. A firing potential must be applied to the control element of a silicon controlled rectifier. Such a firing potential is applied to the control elements of both silicon controlled rectifiers upon the picking up of the oil pressure relay 54 and the ignition coil relay 56 by a circuit which may be traced from ground, through battery 60, over the master switch 62, over the front contact *a* of the ignition coil relay 56, and over front contact *a* of the relay 54 to the control elements of both silicon controlled rectifiers 50 and 52, whereby to cause these two devices to conduct and thereby complete the energizing circuits for the cam motors 30 and 40.

The cam controlled switches 33 and 44 are preferably of the over-centering type. Such switches are well known in the art and operate in such a way that as the operating member (not shown) thereof is moved from one extreme position to another extreme position, the movable switch member remains in engagement with one fixed point until the operating member has been moved a predetermined distance whereupon an internal toggle-like mechanism will snap the movable switch member out of engagement with said one fixed point and into engagement with the other fixed point.

Upon cam motor 30 being energized, it will commence rotating cam 32 which will immediately cause the low portion 32*a* of the cam to move out of engagement with the cam follower 31 whereby to move the cam follower to the left as viewed in the drawing to operate the movable operating member of switch 33. At a certain point in the movement of the movable operating member of

switch 33 movable switch member 34 will snap out of engagement with contact or point 35 and into engagement with contact or point 37, whereupon to establish a second energizing circuit for the cam motor 30 which is identical to the previously traced energizing circuit for cam motor 30 save for the substitution of switch contacts 34-37 for switch contacts 34-35. Further, upon the establishment of this second energizing circuit the SCR 50 will immediately recommence conduction as the establishment of this second energization circuit constitutes an establishment of an identical second anode-cathode energizing circuit for SCR 50 and the control electrode of SCR 50 remains energized over its previously traced energizing circuit. Thus, cam motor 30 will continue operating to move cams 32 and 28 through a full cycle of operation.

Likewise, upon cam motor 40 becoming energized as just described, it will commence rotation with the cam follower 41 remaining in contact with the low portion 42*c* of cam 42 whereby to maintain the previously traced energizing circuit for the motor 40 established. At some point in the rotation of motor 40, the cam portion 42*b* will move into engagement with the cam follower 41 whereby to operate the movable operating member of switch 45 from one extreme position to another. At some point in the travel of said movable operating member, the internal switch mechanism will over-center to snap movable contact 46 out of engagement with switch point 47 and into engagement with switch point 49. This switch operation will establish a second energizing circuit for motor 40 identical to the previously traced energizing circuit save for the substitution of switch points 46-49 for switch points 46-47. This engagement of cam portion 42*b* is timed to occur before the high point of cam 44 operated switch 48 so that the engine has not yet started. This being the case, upon contact 46-49 being made motor 40 will be reenergized because SCR 52 will reconduct, as potential is still being supplied to the control electrode of SCR 52 over its previously traced energizing circuit.

The operation of the cam motor 30 will cause operation of the eccentric cam 28 whereby to pivot the lever 26 and thereby move vertically the link 24 that is connected to the carburetor throttle to open the throttle and thereby supply gasoline to the engine through the carburetor 22 and set the automatic choke. The cams 28 and 44 are preferably timed so that the cam 22 is operated to close the energizing circuit for the starter solenoid 20 at a point of time slightly past the point of maximum injection of fuel into the engine; that is, at a point after the high point of the eccentric cam 28 has rotated past the lever 26 and the lever is pivoting upwardly under the urging of the coil spring 70. This timing, although not critical, is preferable because it assures an adequate supply of fuel to the engine at the time that the starter is energized by the starter solenoid 20. The starter solenoid is energized by a circuit which may be traced from ground, through battery 60, over master switch 62, over front contact *a* of the ignition coil relay 56, over front contact *a* of oil pressure relay 54, over back contact *a* of generator repeater relay 38, over cam switch 48, over gear safety switch 21, and through the solenoid coil 20 to ground. Thus it will be seen that the solenoid coil 20 cannot be energized if the car is not in its neutral or parking position whereby to insure that the car will not commence moving upon being started either remotely or time controlled. It should be noted that cam 44 is shaped so that the period of energization of the starter solenoid 20 is comparatively brief whereby to reduce the drain on the battery per cycle of operation and to permit the battery to restore itself during the relatively long period that the starter solenoid is not energized.

With the ignition coil energized as previously described, and with an adequate supply of fuel having been provided by the automatic cam actuation of the carburetor 22

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as just described, upon the cam switch 48 being closed to energize the starter solenoid, the starter will operate and the engine will normally start.

Upon the engine starting two things will occur that will effect the apparatus shown in the figure. The first of these is that the generator 36 will commence generating whereby to energize relay 38 over a circuit which may be traced from ground, through generator 36, through winding of relay 38 and back to ground. This will cause relay 38 to pick up and open its normally closed back contact *a* whereby to deenergize the starter solenoid 20 and thereby discontinue starter operation which, as is well known, would seriously damage the starter once the engine has commenced operation. The second event that will occur upon the starting of the engine is the opening of the oil pressure switch 18 which, as previously noted, is a pressure responsive switch that is normally closed but is opened when oil pressure reaches a certain amount. Upon the oil pressure switch 18 opening, the oil pressure relay 54 will become deenergized due to the opening of its previously traced energizing circuit at the oil pressure switch 18. Upon this occurring the relay 54 will release whereby to open its front contact *a* and close its back contact *a*. The opening of front contact *a* of relay 54 will open the energizing circuit for the starter solenoid 20 at still another place and will also open the energizing circuits for the control element of silicon controlled rectifier 50 which circuit opening will have no effect on the conduction through the silicon controlled rectifier 50 since it is no longer under the control of the control element.

In like manner the control electrode of SCR 52 is also deenergized by the opening of front contact *a* of relay 54. With the two SCR's having their control electrodes deenergized, the energizing circuits for cam motors 30 and 40 are now conditioned to be opened by continued operation of the cam motors themselves. Thus, for example, let it be assumed that cam motor 30 is energized over its energizing circuit including the points 34 and 37. As the motor continues to operate when the low point 32*a* of the cam 32 engages the follower, the movable contact 34 will move between point 37 and point 35 and during its travel it will open the energizing circuit, whereby to discontinue conduction through SCR 50. Thus, motor 30 will become deenergized in the condition illustrated in the figure. Likewise, as cam motor 40 continues operating, since the portion of the cam 42 moving past the follower is one representing the transition from a high point to a low point as at 42*a* and 42*b* the movable contact member 46 will operate between switch point 49 and switch point 47, to cause a momentary interruption of the anode-cathode energizing circuit for SCR 52, whereby to cause the SCR 52 to discontinue conduction and thereby open the energizing circuit for the cam motor 40.

In addition, the closing of the back contact *a* of oil pressure relay 54 will establish an energizing circuit for the automobile accessories such as, for example, the heater or the air conditioner depending upon which accessories are connected for operation. Such accessories energizing circuit may be traced from ground, through the battery 60, over the master switch 62, over front contact *a* of ignition coil relay 56, over the back contact *a* of oil pressure relay 54, and through whatever auto accessories are to be energized, to ground.

Means are included in the circuit of the figure for deenergizing the entire apparatus should there be a failure of the engine to start after a predetermined time interval. This means is the thermal time delay relay 58 and the circuitry associated therewith. Thus, it should be noted, that upon the timer switch 16 closing its contact at the predetermined hour, an energizing circuit is established for the heater of the thermal time delay relay 58 which circuit may be traced from ground, through battery 60, through master switch 62, through timer switch 16, through the heater of relay 58, and over oil pressure switch 18, to ground. The heater of relay 58 will com-

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mence heating and after an appropriate time interval of the order of thirty seconds to one minute, if the circuit is not opened by the operation of the oil pressure switch 18, which operation can only occur by the engine starting, the contact of the thermal time delay relay 58 will operate to an open condition whereby to open the energizing circuit for the ignition coil relay 56, whereby to cause the ignition coil relay 56 to release and thereby open the energizing circuits for the oil pressure relay 54, SCR's 50 and 52, and the cam motors 30 and 40. Thus, the entire mechanism will be returned to a deenergized condition and will be prevented from attempted restarts until the clock 16 is reset. This protective circuit is of course included to protect against a large number of repeated attempts to start the engine which repeated attempts will of course drain the battery 60 and finally run it down so that the car cannot be started. A study of the energizing circuit for thermal time delay relay 58 will indicate that upon the engine 25 starting to thereby open oil pressure switch 18 the energizing circuit for thermal time delay relay 58 will open whereby to discontinue its operation after engine start.

Let it be assumed that the engine does not start the first time when the clock 16 operates. The apparatus will go through the predetermined operation heretofore described but the engine will not start and accordingly the relay 38 will remain deenergized as the generator 36 has not commenced generating and the oil pressure switch 18 will remain closed as oil pressure has not been achieved. This being the case the energy will continue to be supplied to the control electrodes of the SCR's 50 and 52 over their previously traced energizing circuit including the battery 60, the master switch 62, the front contact *a* of ignition coil relay 56, the front contact *a* of oil pressure relay 54, to the control electrodes of the SCR's 50 and 52 in parallel. Thus the SCR's will remain conditioned to conduct to thereby continue to energize the cam motors 30 and 40. Hence, assuming that the engine has not started when the movable cam switch member 34 is operated from its left hand position as shown in the figure to its right hand position shown in the figure, notwithstanding the momentary interruption in the anode-cathode energizing circuit for SCR 50, upon the contact 34-35 being reestablished the energizing circuit for SCR 50 will be reestablished to continue energizing the cam motor 30. Similarly, the cam motor 40 will be energized whether or not the movable member 46 is in its left hand position or its right hand position although, of course, as it moves between these two extreme positions there will be slight interruption in the conduction of energy to the cam motor 40. However, the cams will continue to rotate whereby periodically to cause additional supply of gasoline to the engine through the cam 28 and an intermittent closing of the previously traced energizing circuit for the starter solenoid 20 whereby to energize the starter so as to reattempt to start the engine of the automobile. These reattempts will continue so long as the thermal time delay relay 58 has not operated to open its contact. Upon that happening, as previously described, the entire device will shut down to save the battery.

As shown in the figure, additional means for energizing the auxiliary engine starting apparatus of the figure are included although such inclusion is not necessary to the present invention. The additional means is the radio receiver 12 and its repeater relay 14 which are actuated by a remote transmitter 10. It should be understood that the apparatus will function without the inclusion of the radio receiver or, in the alternative, the radio receiver as will be described hereinafter, may be employed and the timer switch 16 may be deleted. In effect they are alternative devices and need not both be included in the present invention at the same time.

Assuming the car owner desires to use the radio control actuation means, then the manual control switch 64 is closed (the closing having been effected by the owner

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prior to leaving the car) whereby to provide standby power for the radio receiver 12 over a circuit which may be traced from ground, through the battery 60, over master switch 62, and over manual switch 64, through the receiver to ground. Thus, the receiver is conditioned to operate upon the reception of a radio signal from the remote transmitter 10. Upon such a signal being received, the receiver will cause a signal to be put out to its repeater relay 14 whereby to cause repeater relay 14 to pick up and close its normally open front contacts *a*, *b* and *c*. Front contact *c* is in parallel with the timer switch 16 and functions in precisely the same manner as the timer switch. That is to say, upon the momentary closing of the front contact *c* of relay 14, an energizing circuit will be established for each of the oil pressure relay 54 and the ignition coil relay 56 which circuits are identical to the previously traced energizing circuit save for the substitution of the front contact *c* of relay 14 for the timer switch 16. The subsequent operation of the apparatus is precisely that heretofore described and an additional description is therefore deemed unnecessary.

However, additional features included in the remote control actuation will now be described in detail. Specifically, upon the relay 14 picking up as a result of the actuation of receiver 12, the front contact *a* of relay 14 will be momentarily closed whereby to establish an energizing circuit for the horn 72 which circuit may be traced from ground, through battery 60, through master switch 62, over front contact *a* of relay 14, and through the horn 72 to ground. This will cause the horn to operate whereby to give a sonic indication to the remote radio operator that the signal is being received and the apparatus of the figure is functioning. Of course, the duration of the horn operation is very brief and is dependent upon how long the radio signal from transmitter 10 is being transmitted. As soon as the signal from transmitter 10 is discontinued, the relay 14 will be deenergized whereby to open its front contact *a* and deenergize the horn 72 at the front contact *a* of relay 14.

The opening of front contact *c* of relay 14 will have no effect on the remainder of the apparatus as that contact is effectively bridged by front contact *a* of the ignition coil relay 56 as previously described in connection with the timer switch 16.

Once the engine has commenced operating by the radio actuated means as heretofore described, means are at hand within the apparatus already described for intermittently racing the engine by supplying it with additional motor fuel through the additional operation of the cam 28, whereby to assure a quick warm up and a continued operation of the car during the warm up period. This is achieved by additional actuations of the radio transmitter 10 after the engine has commenced operation. As previously noted, in an engine operating condition, the ignition coil relay 56 is energized and the oil pressure relay 54 is deenergized. Further, with the engine operating neither SCR 50 nor SCR 52 is conducting. In this described condition, let it be assumed that an additional radio signal is transmitted from transmitter 10 whereby to cause receiver 12 to operate and cause its repeater relay 14 to pick up. The horn 72 will operate as previously described. In addition, SCR 50 will be caused to fire by the application of a potential to its control electrode over a circuit which may be traced from ground, through battery 60, over master switch 62, and over front contact *b* of relay 14 to the control electrode of SCR 50, whereby to cause the SCR to conduct over its previously traced energizing circuit. With this occurring, motor 30 will commence operating and through the shaping of cam 32 will immediately operate movable switch member 34 out of engagement with contact 35 and into engagement with contact 37. This will occur before relay 14 has the opportunity of releasing to open the energizing circuit to the control electrode of SCR 50 prior to the establishment of the alternate anode-cathode circuit including the contacts 34-37. With this occurring

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the alternate energizing circuit for cam motor 30 will be closed whereby to take the cam 28 through one complete revolution to again increase the supply of fuel to the engine and cause it to race. At the conclusion of the operation, the movable contact 34 will move from switch point 37 to switch point 35 and during the interval of movement will open the anode-cathode circuit for SCR 50. Upon the closing of contact 34-35, the SCR will not re-fire as the control electrode is now deenergized at the open contact *b* of receiver repeater relay 14. Accordingly, it will not continue operating. However, if the owner of the vehicle desires to repeat the operation he may merely reactuate the transmitter 10 additional times which additional actuations will cause the cam motor 30 to go through one cycle of operation to race the engine while the remainder of the apparatus remains in the previously described condition. It will also be recognized that subsequent operations of the radio actuating means which will cause cam motor 30 to go through additional cycles may be employed to operate the automatic choke after engine warm-up to cause a leaner mixture to be supplied to the engine. This is desirable in the event that the driver, once having started his engine remotely, is detained and desires to adjust the setting of his automatic choke to reduce gasoline consumption.

Thus, it will be seen that by radio control means or time control means or other means such as thermostatically controlled means, an automobile engine can be started without the driver present in the car to actuate the engine by the closing of the ignition switch and the operation of the starter. As already indicated, such auxiliary operation is extremely convenient, especially in cold weather to assure a driver that his car engine will be properly warmed up before he arrives to drive the car away. In addition, due to the operation of the accessories, the car engine will not only be warmed up as just indicated but the car cab itself will be heated in winter by the operation of a heater accessory or will be cooled in summer by operation of an air conditioner accessory. Likewise, the windshields could be defrosted and any other impediment to rapid driving away of the automobile can be removed by the operation of the accessories through their energization over the back contact *a* of oil pressure relay 54.

Moreover, the inclusion of the apparatus of the figure will not make the car any more tamper prone than it presently is as all of the circuitry can be integrated into one sealed box and no additional electrical leads will be exposed to thereby be accessible to auto thief or the like. If desired, the radio transmitter 10 and the radio receiver 12 can be arranged to transmit and to respond to a specific code. This will eliminate the possibility of someone with a broad band transmitter actuating the apparatus and thereby starting an automobile without authorization. Of course, in connection with all of these devices, one would expect the automobile owner to lock the doors of his automobile, whereby to prevent theft upon automatic or remote starting of the automobile. Thus, a simple auxiliary mechanism is provided for starting an automobile or other internal combustion engine either by radio, by time control or by other means which means may be remote controlled or time controlled or temperature controlled or otherwise controlled which means will automatically start the car upon a predetermined event occurring and, if it should fail to start the engine, will automatically shut itself off to protect the battery after a preselected time interval has passed.

The cams 28, 32, 42 and 44 may all be adjustably positioned on their respective cam shafts whereby the owner can secure the most desirable timing for his particular automobile. Moreover, cams may be replaceable with cams having slightly different contours whereby to alter the timing of events such as, for example, lengthening the period of time during each cycle of operation that the starter is energized should this prove to be necessary or desirable for a given automobile or, for example, changing the shape of cam 28 to provide for increased or re-

duced supply of gasoline during a given cycle of operation. It will also be obvious that rather than using replaceable cams for changing the timing of the apparatus, adjustable cams of well known type may be employed for this purpose.

Thus it will be seen that with the present invention an automobile owner can set his clock 16 to close the timer switch at a pre-selected hour in the morning slightly in advance of his usual departure time from home. The clock 16 will operate to start the automobile engine and to turn on the heater or the air conditioner, depending upon the season, whereby when the owner steps from his house and into his car, the car is ready to be driven away with the driver in comfortable surroundings. Alternatively the owner can actuate the automobile through radio transmitter 10 at any time of the day or night to accomplish the same highly desirable end.

It will be recognized that if radio actuated means are included, a single radio transmitter may be employed to actuate a number of internal combustion engines 25 having the auxiliary starting apparatus of the present invention. Thus for example a line of tanks can be started by one radio transmitter to permit such tanks to warm while their crews are preparing to enter the tanks. Similarly, a group of tractors on a farm, for example, may all be started with one radio transmitter.

As has already been pointed out in this description, the apparatus 10 need not include both radio actuation means and time controlled actuation means. Clearly, the invention is highly desirable if it includes one or the other of these actuating means as well as if it includes both of them.

While I have herein shown and described the preferred form of the present invention and have suggested various modifications therein, other changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of this invention.

What is claimed is:

1. In combination with an internal combustion engine including a starter, a starter solenoid for actuating said starter, fuel supply control means, and ignition means, normal means for energizing said ignition means, and normal means for energizing the starter solenoid; auxiliary means for starting said engine comprising:

an auxiliary actuator;

switching means having a non-operated condition and an operated condition;

means for operating said switching means to said operated condition upon operation of said auxiliary actuator;

an auxiliary means for energizing said ignition means including said switching means;

cam motor means, a first cam and a second cam, means for rotating said first and second cam in response to operation of said cam motor means;

linkage means connecting said first cam to said fuel supply control means for operating the latter in response to operation of the former;

a normally open first switch, means connected to said second cam for operating said first switch to a closed condition in response to rotation of said second cam;

energizing circuit means for said cam motor means including said switching means and being closed only when said switching means is in said operated condition; and

an auxiliary energizing circuit for said starter solenoid including said normally open switch and being closed only when said normally open switch is closed.

2. The auxiliary engine starting means of claim 1, further comprising means for detecting engine start including a contact having a normal condition when said engine is not operating and an operated condition when said engine is operating, time delay means having a contact with a normal condition and an operated condition which it as-

sumes a predetermined time interval after said time delay means is energized, an energizing circuit for said time delay means including said switching means and said contact of said engine start detecting means and closed when said switching means is in said operated condition and said contact of said engine start detecting means is in its normal condition.

3. The auxiliary engine starting means of claim 1, wherein said auxiliary actuator is a clock switch.

4. The auxiliary engine starting means of claim 1, wherein said auxiliary actuator is a radio receiver and a remote radio transmitter.

5. The auxiliary engine starting means of claim 1, further comprising means for detecting engine start including a contact having a normal condition when said engine is not operating and an operated condition when said engine is operating, and wherein said switching means comprises first and second relays, an energizing circuit for said first relay including said auxiliary actuator, a stick circuit for said first relay, a first energizing circuit for said second relay including said auxiliary actuator and said contact of said means for detecting said engine start and closed when said last mentioned contact is in its normal condition, and a second energizing circuit for said second relay controlled by said first relay and said last mentioned contact and closed when said first relay is energized and said last mentioned contact is in its normal condition, and wherein said auxiliary means for energizing said ignition means is a circuit controlled by said first relay and is closed when said first relay is energized.

6. The auxiliary engine starting means of claim 5, wherein said cam motor means includes first and second cam motors, said switching means further comprises first and second switching devices, said auxiliary starting means further comprises third and fourth cams for controlling the energization of said first and second cam motors, respectively, second and third switches each having two extreme closed positions and an intermediate open position, means operatively connecting said third cam to said second switch for operating said second switch between its two extreme positions in response to rotation of said third cam, means operatively connecting said fourth cam to said third switch for operating said third switch between its two extreme positions in response to rotation of said fourth cam, means connecting said first cam motor to said first and third cams for rotating said first and third cams in response to operation of said first cam motor, means connecting said second cam motor to said second and fourth cams for rotating said second and fourth cams in response to operation of said second cam motor, circuit means for rendering said first switching device conductive and for energizing said first cam motor controlled by said first and second relays and said second switch and closed when said first and second relays are energized and said second switch is in an extreme position, circuit means for maintaining said first switching device conductive and for energizing said first cam motor controlled by said first relay and said second switch and closed when said first relay is energized and said second switch is in an extreme position, circuit means for rendering said second switching device conductive and for energizing said second cam motor controlled by said first and second relays and said third switch and closed when said first and second relays are energized and said third switch is in an extreme position, circuit means for maintaining said second switching device conductive and for energizing said second cam motor controlled by said first relay and said third switch and closed when said first relay is energized and said third switch is in an extreme position.

7. The auxiliary engine starting means of claim 6, wherein said auxiliary actuator is a radio transmitter and receiver, and further comprising another circuit for rendering said first switching device conductive and for energizing said first cam motor controlled by said radio

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receiver and said second switch and closed when said radio receiver is receiving a signal from said transmitter and said second switch is in an extreme position.

8. The auxiliary engine starting means of claim 7, further comprising a horn, and an energizing circuit for said horn controlled by said radio receiver and closed when said receiver is receiving a signal from said transmitter.

9. The auxiliary engine starting means of claim 5, and time delay means for deactivating said auxiliary means for starting said engine, comprising time delay means including a normally closed contact which opens a predetermined time interval after said time delay means is energized, an energizing circuit for said time delay means controlled by said first relay and said contact of said engine start detecting means and closed when said first relay is energized and said contact of said engine start detecting means is in its normal condition, said stick circuit for said first relay including said contact of said time delay means.

10. The auxiliary engine starting means of claim 5, wherein said engine is the engine of an automobile having an accessory therein, and an energizing circuit for said accessory controlled by said first and second relays and closed when said first relay is energized and said second relay is deenergized.

11. The auxiliary engine starting means of claim 6, and time delay means for deactivating said auxiliary means for starting said engine, comprising time delay

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means including a normally closed contact which opens a predetermined time interval after said time delay means is energized, an energizing circuit for said time delay means controlled by said first relay and said contact of said engine start detecting means and closed when said first relay is energized and said contact of said engine start detecting means is in its normal condition, said stick circuit for said first relay including said contact of said time delay means.

12. The auxiliary engine starting means of claim 11, wherein said first and second cams are so shaped and relatively positioned as to cause said first cam to operate its associated linkage means to supply said engine with fuel prior to said second cam operating said first switch to its closed condition.

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