

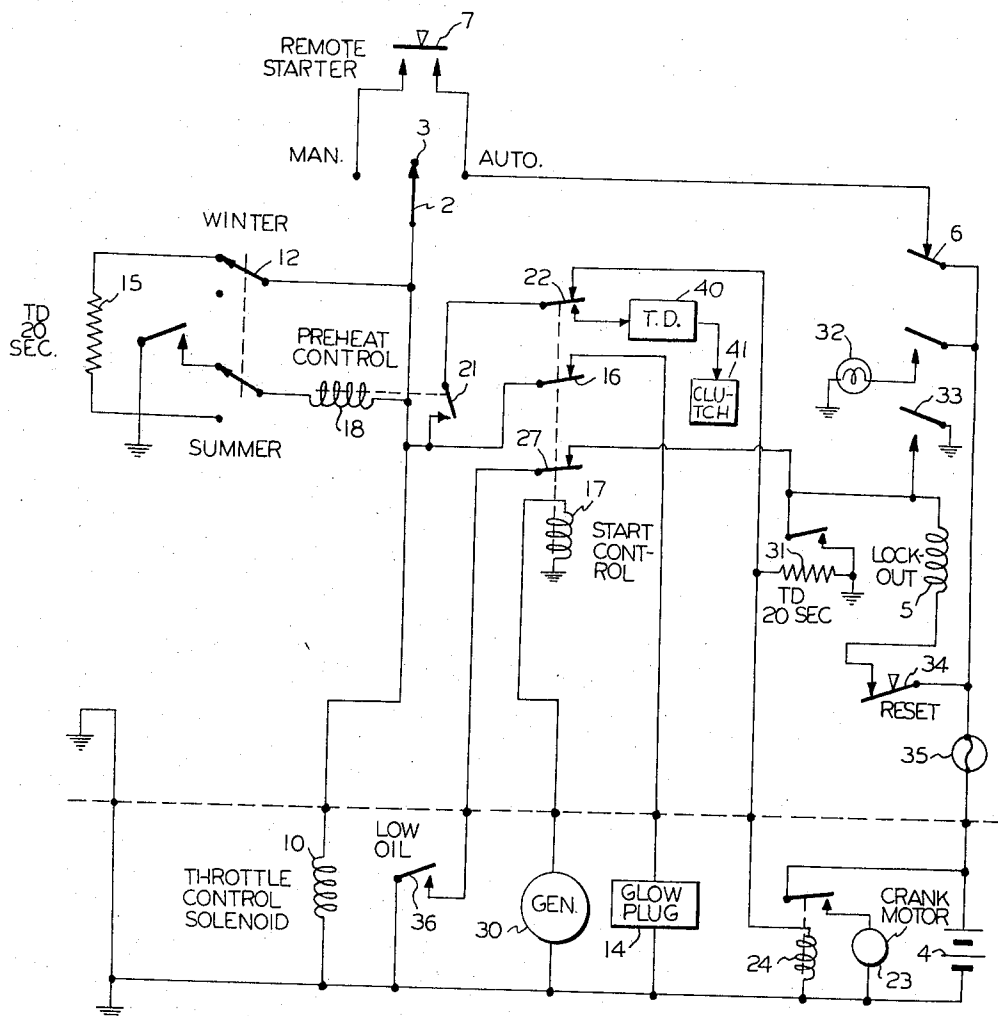
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SUMMER-WINTER AUTOMATIC DIESEL STARTING CONTROL

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SUMMER-WINTER AUTOMATIC DIESEL STARTING CONTROL

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ABSTRACT OF THE DISCLOSURE

An electrical control system for starting diesel motors automatically is disclosed. There are provisions for cranking the motor while energizing glow plugs from either manual or automatic control positions in either summer or winter hookups. A winter pre-heat condition occurring for some twenty seconds before cranking can occur is bypassed for summer operation. Cranking is terminated when the generator voltage is sufficient to lock out the start controls. Safety provisions are made to lock out the starter circuits if not started after a time delay of twenty seconds or so and to prevent starting if the oil is low. The lock out circuit may be reset for another starting cycle after it locks out, and without lock out it will re-cycle automatically and restart the motor should it stop when in automatic control.

This invention relates to automatic starting and preheating control for diesel engines, particularly of those types used for refrigeration or auxiliary power in transit in trucks or railway cars, wherein an engine may be automatically started without operator control should it stop en-route, yet provided with safety features that prevent damage or malfeasance.

Several features are desirable in the starting of diesel engines by automatic controls. The sequence of operations should be such that changes in temperature, such as incurred in winter and summer do not inhibit starting. Furthermore, safety precautions should be available in the event that the engine has low oil or does not start normally when cranked. All of these features should reside in a simple system which is adaptable to conventional engines with a minimum of installation points, and which utilizes conventional engine components for operation. Provisions should also be made for manual override controls in the event the normal automatic sequence fails.

It is therefore a general object of the invention to provide improved automatic starting controls for diesel engines compatible with the foregoing features.

Another object of the invention is to provide starting control sequences in an electrical control system which protect the diesel engines from damage.

A still further object of the invention is to provide automatic starting systems for diesel engines operable under a variety of conditions and temperatures.

These and further objects and features of the invention reside in an electrical relay control system provided by the invention, wherein either automatic or manual control can be selected to activate the starter. In winter operation the engine glow plug is preheated before the starter is cranked. The system is disengaged by generator output controls when properly started. Also when it fails to start properly after a reasonable time, a lock out protective circuit is actuated.

Reference is made to the schematic circuit diagram of the drawing for a more detailed description of the invention.

Those elements connected below the dotted line are part of the diesel engine and a remotely located control con-

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sole may thus be connected simply with the engine by an appropriate electrical cable.

Starting control in either manual or automatic mode is effected by starter control switch arm 2, having a center rest off position 3. In control positions the switch arm 2 is energized from battery 4 whenever the lock out relay 5 has contact set 6 closed. In manual operation, the remote start switch 7 must be closed to energize switch arm 2 and this typically could be a key switch for the diesel engine. Energization of switch arm 2 causes the throttle control solenoid 10 to be energized to place the engine in running condition, and thus the engine may be turned off by throttle control either by opening remote start switch 7 in the manual mode or by moving switch arm 2 from automatic to off position 3.

In order to provide for changes in starting conditions at low temperatures a winter-summer switch 12 is provided, which can either be a thermally responsive automatic switch or a manually set toggle switch. The former is preferable since warm days can occur in winter and also it may be made responsive to engine temperature so that if the engine is started while warm, the summer position prevails. In essence, the winter hookup provides for a preheating of the glowplug 14, for a predetermined time such as twenty seconds. This time delay is produced in the time delay relay 15 comprising a heater and bimetallic switch, for example, so that it automatically resets itself whenever the resistance-heater element is deenergized.

In the winter operation mode therefore, as shown by the position of switch 12, the battery 4 is connected to the heater element of time delay relay 15 and the throttle control solenoid 10 by the starter control switch arm 2. In this respect glowplug 14 is also energized through closed contact set 16 of the start control relay 17. Then after the twenty second typical delay, the preheat control relay 18 is operated by time delay switch set 19. This results in closing contact set 21, which through closed contact set 22 of the start control relay 17 serves to operate the crank motor 23 by medium of the usual starter relay 24 of the diesel engine. Thus, the engine is cranked after a predetermined time delay when the glowplug is preheated unless the temperature is warm enough for summer operation without preheating. In this mode, the switch 12 bypasses the time delay relay 15 and operates the preheat control relay 18 as soon as the starter control switch arm is connected to battery 4, to simultaneously crank the motor and energize the glowplug 14.

After the engine starts and comes up to the speed set by the throttle control solenoid 10, a speed sensitive switch may be provided, such as comprised by generator 30 which energizes start control relay 17 to disengage the crank motor 23 and the glowplug 14.

However, should the engine fail to start after a reasonable predetermined cranking time such as twenty seconds set by a further time delay relay 31 of the type described, the lockout relay 5 is energized to open power control contact set 6 and light the alarm lamp 32. It is latched into lockout position by contact set 33 until manual reset switch 34 opens the holding circuit through fuse 35 and battery 4.

An alternate lockout protection circuit is provided such as in the event oil is low in the engine, the temperature is high, etc., as signaled by warning switch 36. In this case, when the start control relay 17 closes contact set 37, the lockout relay 5 is energized. This arrangement therefore provides for a continuous oil monitoring control that will shut down the motor at any time the oil alarm switch 36 is closed after the engine is started.

A further safety control feature is afforded by additional time delay device 40 which serves to engage a power clutch 41 to load down the motor only after a predetermined time of normal running speed.

Accordingly, it is seen that a simplified control system provides for not only a versatile all-temperature starting control with automatic sequencing, but also for cooperative interlocks to prevent engine damage or excessive cranking. Manual sequencing by means of remote start switch 7 requires that the switch be closed as long as the engine should run. As long as starter control switch arm 2 is energized, the engine will restart automatically (or lock out if it fails to start) after the voltage of generator 30 expires to disengage the contacts of start control relay 17.

Accordingly, an improved diesel engine start control system is provided for which features of novelty are defined in the appended claims representative of the spirit and nature of the invention.

What is claimed is:

1. A control system for starting a diesel motor with a cranking motor, a glowplug preheater and a generator comprising in combination, a starter control switch, means operable by said control switch to establish a predetermined throttle position on said motor and to energize said glowplug, winter-summer control means providing selective control of a predetermined time delay period in only the winter control position, means operable in conjunction with said starter control switch and said winter-summer control means to engage said cranking motor whereby preheating of the glowplug occurs for said predetermined time delay period for winter control, means controlled by motor speed when the motor is started and running at the speed determined by said throttle position disengaging said starting crank, and lockout means including a second time delay device with a predetermined

period for inactivating the starter control system should the engine not start within said predetermined period.

2. A system as defined in claim 1 including a warning switch in said engine wherein interlock means is interconnected with said warning switch to operate said lockout means.

3. A system as defined in claim 2 wherein said interlock means requires simultaneous operation of both said warning switch and said means operable to engage said cranking motor.

4. A system as defined in claim 1 wherein the lockout means comprises a latching relay normally unenergized and connected with said second time delay device for operation after expiration of said predetermined period.

5. A system as defined in claim 3 wherein the second time delay device is a thermally responsive bimetal switch, thereby automatically resetting itself when the cranking motor is disengaged.

6. A system as defined in claim 1, including an additional time delay device energized by said control system, and clutch means controlling a power load on said motor responsive after a predetermined time established by the additional time delay.

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