United States Patent

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[54] **STARTER SYSTEM FOR A DIESEL ENGINE**
12 Claims, 2 Drawing Figs.

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[50] **Field of Search** 123/142.5, 179H, 179B; 290/38, 2

[56] **References Cited**

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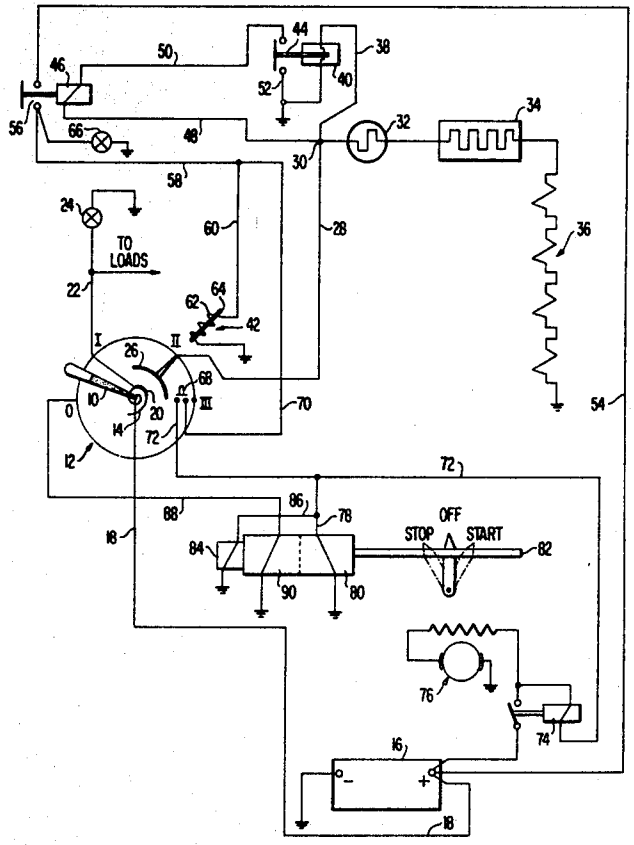
ABSTRACT: A starter installation for a Diesel engine provided with preliminary heating means, in which starting is controlled with the rotatable switch arm of a rotary switch; the switch arm is normally returned to its normal rest position and is prevented by a blocking means from reaching the starting position while the blocking means, in turn, is controlled by a heat-sensing device which senses the temperature of the engine.



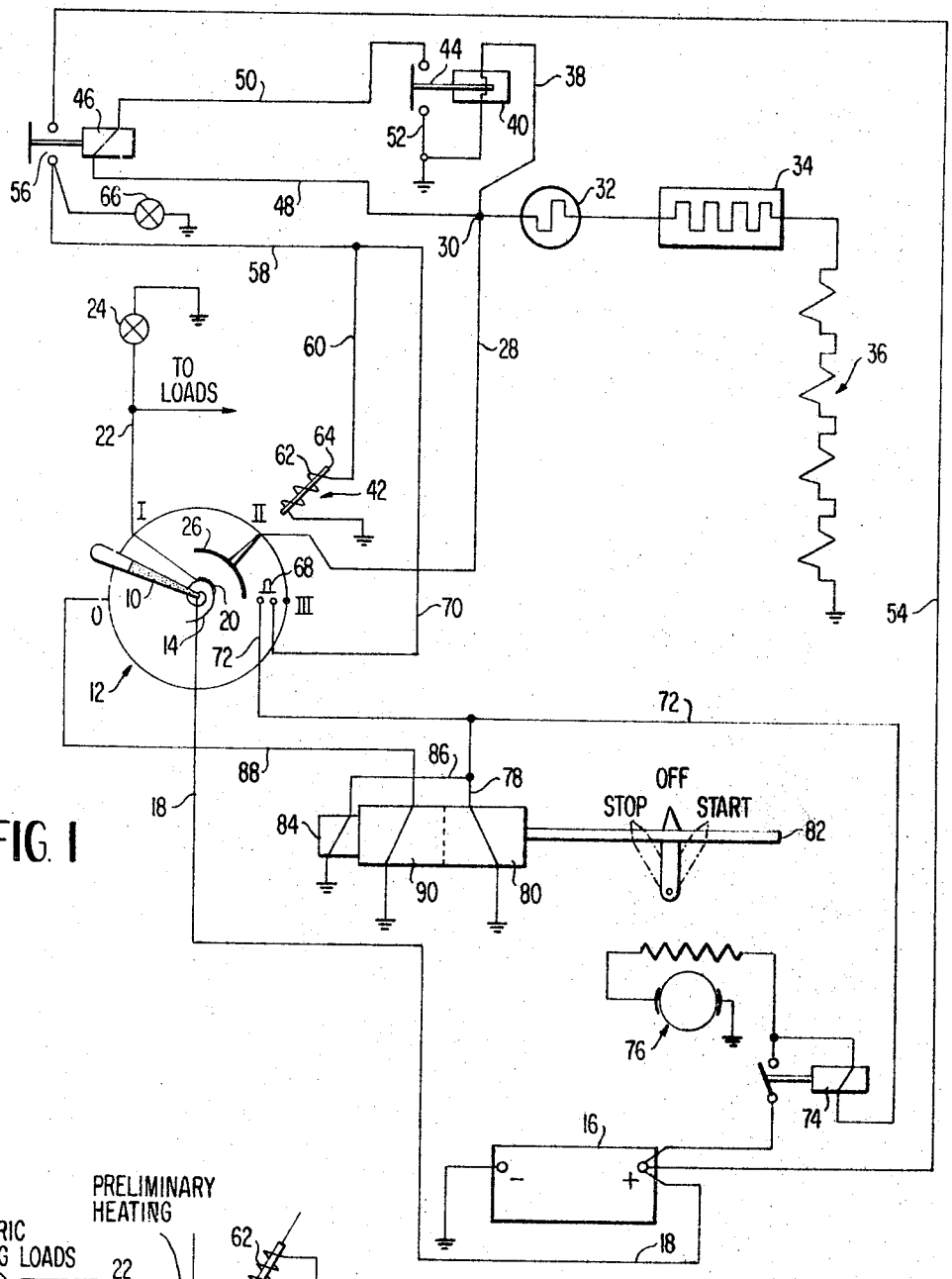


FIG. 1

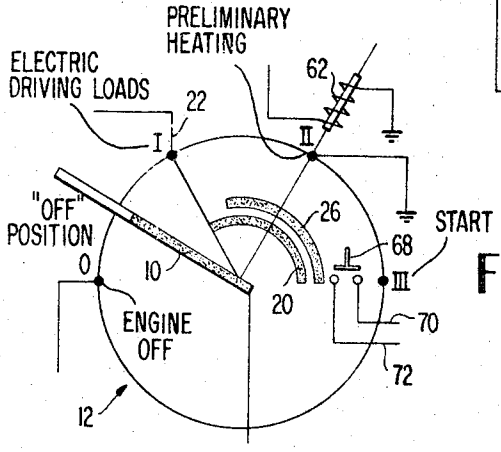


FIG. 2

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STARTER SYSTEM FOR A DIESEL ENGINE

BACKGROUND OF THE INVENTION

The present invention relates to a starter system for a diesel engine provided with a glow or incandescent device and including a manually operable rotary arm of a rotary switch which is forced back into its initial, normal rest position by means of a force storage means and which is adapted to be moved against such a force into a preliminary heating position and later on into a starting position from which it is adapted to be returned with the aid of a heat-sensing device sensing the engine temperature.

With a known, prior art starting installation of this type, one indicates with the aid of a control lamp whether or not the preliminary heating has been carried out for a sufficiently long time. When the control lamp becomes extinguished, it is an indication that one can now pass over from the preliminary heating to the starting. The switch arm has to be held manually in the preliminary heating position. On the other hand, it is also possible that a detent holds the switch arm in this position. However, one is able with this known starting installation, as customary ever since, to go at will from the preliminary heating to the starting independently of the function and operation of the heat-sensing device or of the control lamp. This means that starting is commenced uselessly and prematurely in haste or by unskilled persons so that the starting operation is delayed time-wise and also the battery is loaded more than is necessary (German Pat. No. 1,202,569).

SUMMARY OF THE INVENTION

It is the aim of the present invention to provide a starting system which prevents starting before preliminary heating has been carried out for a sufficiently long period of time.

In that connection, the present invention provides that the heat-sensing device is combined with a locking or blocking means which prevents a further rotation of the rotary arm into the starting position and that the heat-sensing device lifts the locking or blocking effect after a time period dependent on the engine temperature.

In the installation according to the present invention, the hitherto customary preliminary heating monitoring devices as well as also the control lamps or the like may be dispensed with. The starting with an installation of the present invention requires a minimum of attention on the part of the operating personnel. Nevertheless, starting operations are avoided with certainty which do not lead to the end result sought.

The simplest relation between the starting and the indication that the starting can be commenced with, is achieved by the provision of a locking or blocking means adapted to be locked and unlocked electromagnetically and of the control thereof by the contacts of a relay which is connected in the starter circuit.

According to a further feature and development of the present invention, the heat-sensing device is a slow acting bimetallic switch whose contacts are connected in the current supply or energizing circuit of the relay. It can be achieved thereby that by reason of its inertia or slow acting characteristic, the bimetallic switch continues to maintain the starting conditions for a short time, for example, 5 seconds. Hence, one does not need to start immediately when the switch arm has snapped back after its unlocking by means of the return force of the force storage device but instead a sufficient span of time is available therefor. The blocking or locking means is not applied, i.e., is not rendered effective within this period of time even if starting is not commenced with immediately.

With warm diesel engines whose operation is interrupted only shortly, it is not necessary to recommence with the preliminary heating if one desires to start. In such cases, one rotates the switch arm continuously and uninterruptedly from the position OFF into the position START. During this relative rapid pivotal movement, the locking or blocking means must not be engaged. The locking or blocking means has to be

deactivated, i.e., rendered ineffectual while the switch arm is moved. The deactivation operation has to be completed at least when the switch arm is in the position PRELIMINARY HEATING. In order that the locking or blocking means as well as the relay have become energized by this time, i.e., have pulled up at this moment, a first, relatively long contact segment is provided in the rotary switch which is connected with the preliminary heating device of the bimetallic switch.

It is advantageous if a second contact segment is provided in the rotary switch which is longer than the first contact segment in the return direction. It is then possible without preliminary heating or without starting to turn on the magnetic loads used when driving in that one rotates the switch arm only up to the section of the second contact segment which makes the difference in length to the first contact segment.

Accordingly, it is an object of the present invention to provide a starting installation for a diesel engine which eliminates by simple means the aforementioned shortcomings and drawbacks encountered with the prior art systems.

Another object of the present invention resides in a starting system for diesel engines which precludes useless starting attempts on the part of inexperienced persons.

A further object of the present invention resides in a starting installation of the type described above which precludes unnecessary time delays of the starting operation as well as minimizes unnecessary starting loads of the bar battery.

Still another object of the present invention resides in a starting installation for diesel engines which effectively prevents the premature starting of the engine before sufficient preliminary heating.

Another object of the present invention resides in a starting system in which a blocking effect prevents the starting of the engine in dependence on the engine temperature.

Still a further object of the present invention resides in a starting installation for diesel engines which is simple in construction, requires relatively few parts and dispenses with the need for monitoring devices or control lamps.

These and further objects, features and advantages of the present invention will become more obvious from the following description when taken in connection with the accompanying drawing which shows, for purposes of illustration only, one embodiment in accordance with the present invention, and wherein:

FIG. 1 is a schematic wiring diagram of a starting installation in accordance with the present invention; and

FIG. 2 is an enlarged schematic showing of the rotary switch of FIG. 1.

Referring now to the drawing wherein like reference numerals are used throughout the two views to designate like parts, the rotating arm 10 of a rotary switch generally designated by reference numeral 12 is at first in the illustrated neutral position at OFF during the operation of the starting installation. The rotary arm 10 is retained in this OFF position by a spiral spring 14 forming a force storage means, whose one end is secured at the rotary arm 10 and whose other end is secured at the housing (not shown) of the rotary switch 12. A deflection of the rotary arm 10 from this position in either direction produces a return force which is effective either in the clockwise or counterclockwise direction. In the position I, the positive terminal of a battery 16 is connected by way of a line 18, by way of the rotary arm 10 and by way of an inner conductive segment 20 with the line 22 which leads to the driving loads. A control lamp 24 is connected with the line 22 whose other terminal leads to the negative terminal of the battery 16 by way of the ground. One can ascertain with the aid of this control lamp 24 that the driving loads are turned on. If one further rotates the rotary arm 10 until it slides along an outer segment 26, then a positive voltage is applied to a line 28. The current flowing in the line 28 branches off at point 30 into a first branch which consists of the series connection of a conventional preliminary heating indicator or monitoring device 32, of a preliminary heating resistance 34 and of four

conventional glow plugs 36. A further portion of the current flows from point 30 by way of a line 38—forming a second branch—to a bimetallic time switch 40 which is connected with its other terminal to ground, i.e., the negative terminal of the battery 16. The bimetallic switch 40 is disposed in the cooling water stream of the engine to be started. Prior to the application of the voltage, the bimetallic switch 40 was at the cooling water temperature. The current flowing through the bimetallic switch 40 now heats the same. If the cooling water was relatively cold, then the difference to its switching temperature is relatively great and it takes a relatively long time until this switching temperature of the bimetallic switch 40 is reached. The bimetallic switch 40 is traversed uninterruptedly by the current up to the switching point thereof since the rotating arm 10 is retained in the position II as well as also prevented against further rotation by a locking or blocking means 42 of any known conventional construction. Since such devices are known, per se, in the art and form no part of the present invention, a detailed description thereof is dispensed with herein. If the bimetallic switch 40 has reached its response temperature, then its working contact 44 closes and current flows through the relay 46 since the working contact 44 forms a loop closed by way of a line 48, the coil of the relay 46, a line 50, and a further line 52, which constitute a third branch relative to point 30. The bimetallic switch 40 is slow acting and still remains in its switch (closed) position for approximately 5 seconds, even when current no longer flows through the same. When the relay 46 is energized, current is able to flow through a control winding 62 for the blocking or locking means 42, by way of a line 54 and a now closed working contact 56, a line 48 and a line 60. The armature 64 of the winding 62 releases the locking or blocking means 42, i.e., renders the same ineffectual to retain the arm 10 and prevent the same from further rotation in the clockwise or counterclockwise direction. As a result thereof, the rotary arm 10 can snap back into its OFF position under the force of the spiral spring 20. This gives an indication to the operating person that the preliminary heating has been carried out for a sufficiently long time. Additionally, a control lamp 66 is provided which is connected in parallel to the winding 62 and whose illumination indicates that the preliminary heating has been carried out for a sufficiently long time. However, as such, the control light 66 and also the preliminary heating monitoring device 32 are not necessary for the safety of proper functioning and may be omitted without adverse effect. Even when the rotary arm 10 has now snapped back to its OFF position whereby the preliminary heating operation has been terminated, the working contact 44 of the bimetallic switch 40 remains closed nevertheless by reason of the slow-acting nature thereof. If the operating person now rotates the rotary arm 10 within the next 5 seconds in the clockwise direction up to the position III, then at first the relay 46 is again energized as soon as the rotary arm 10 reaches the segment 26 since the working contact 44 is still closed. Since the relay 46 is thus energized, current again flows through the winding 62 of the locking or blocking means 42 and the armature 64 renders the blocking means 42 ineffectual whereby one can rotate the rotary arm 10 to the position III without intermediate stoppage. In this III position, a bridge 68 is pressed down by the rotary arm 10 against end terminals of lines 70 and 72 whereby current is able to reach a magnetic switch 74 of a conventional starter generally designated by reference numeral 76 by way of the line 58, the line 70, and the line 72. As a result thereof, the engine is started. A further line 78 is connected with the line 72 which leads to an electromagnet 80 that actuates a control rack 82 which, in turn, displaces an injection pump (not shown) into its position of "increased quantity" necessary for the starting. In this position, the control rack 82 assumes its furthest right position. In this position, the control rack 82 not only comes under the effect of the electromagnet 80 but also under the effect of an unlocking magnet 84 which is connected by way of a line 86 connected with the line 78 and which has previously retained the control rack 82 in its furthest left position. The control rack 82 assumes this left end position when fuel is no longer to be supplied to the injection pump, i.e., when the diesel engine is to be turned off. If the starting operation has led to a successful starting, then the operating person releases again the rotary arm 10 so that the latter snaps back into its position OFF. In order to again turn off the engine, the rotary arm 10 is displaced into the O position. In this position, current flows by way of the line 18 and the rotary arm 10 to a line 88 with which is connected a stopping magnet 90 that pulls the control rack 82 completely toward the left, in which, as already mentioned, it is locked by the unlocking magnet 84. During the normal driving operation, the control rack 82 assumes its center position. In this position, the injection pump is conventionally controlled by the gas pedal.

The rotary switch 12 may be actuated by an ignition key in a similar manner as gasoline engines, whose associated ignition lock may simultaneously take care of the locking, for example, of the steering wheel. The section of the segment 26 disposed ahead of the position II in the clockwise direction should be as long as possible in order that a sufficiently long time is available to the relay 46 and to the armature 64 to attract so that the contact arm 10 can be rotated without any waiting period by way of the position II into the position III while the working contact 44 is still closed, i.e., when preliminary heating conditions are still in existence which lead to a starting. Of course, it is also possible that the operating person does not necessarily have to start when his or her dispositions have changed during the preliminary heating operation. It is then only necessary to permit the rotary arm 10 to snap back into its OFF position without pivoting the same again in the clockwise direction.

While we have shown and described only one embodiment in accordance with the present invention, it is understood that the same is not limited thereto but is susceptible of numerous changes and modifications as known to a person skilled in the art, and we therefore do not wish to be limited to the details shows shown and described herein but intend to cover all such changes and modifications as are encompassed by the scope of the appended claims;

We claim:

1. A starter installation for a diesel engine provided with a preliminary heating means, comprising rotary switch means including manually actuatable switch arm means, force storage means normally urging said switch arm means into its normal rest position and adapted to be displaced against such force into a preliminary heating position and subsequently thereto into a starter position, means including heat-sensing means sensing the engine temperature to enable return of said switch arm means from said preliminary heating position into its normal rest position, blocking means normally preventing further rotation of said arm means into the starting position, and connecting means operatively connecting said sensing means with said blocking means for rendering ineffectual the blocking means by said heat-sensing means after a time interval depending on the engine temperature.

2. An installation according to claim 1, wherein said blocking means is electromagnetically operable, a starter circuit, and control means including relay means having contact means in said starter circuit for controlling said blocking means.

3. An installation according to claim 2, wherein said blocking means is controlled by said contact means.

4. An installation according to claim 3, wherein said heat-sensing means includes a slow acting bimetallic switch means having contact means connected in the energizing circuit of said relay means.

5. A starter installation according to claim 4, wherein said rotary switch means includes a first relatively long contact segment for said rotary arm means which is connected with a heating means for the bimetallic switch means.

6. A starter installation according to claim 5, wherein said rotary switch means includes a second contact segment for said rotary arm means which is longer in the return direction that said first contact segment.

7. An installation according to claim 2, wherein said heat-sensing means includes a slow acting bimetallic switch means having contact means connected in the energizing circuit of said relay means.

8. A starter installation according to claim 7, wherein said rotary switch means includes a first relatively long contact segment for said rotary arm means which is connected with a heating means for the bimetallic switch means.

9. A starter installation according to claim 8, wherein said rotary switch means includes a second contact segment for said rotary arm means which is longer in the return direction than said first contact segment.

10. A starter installation for a diesel engine having a preliminary heating means, a rotary switch means including manually actuatable switch arm means having a normal rest position, a preliminary heating position and a starting position and normally seeking to return to its normal rest position, and heat-sensing means sensing the engine temperature, characterized in that a locking means is provided for said switch arm means normally preventing any further rotation of said switch arm means into the starting position and holding said switch arm means in said preliminary heating position when rotated from said normal rest position in the direction toward the starting position to energize said preliminary heating means for a predetermined time, and connecting means operatively connecting said heat-sensing means with said locking means to release the locking effect of said locking means by said heat-sensing means after said predetermined time which is dependent on the engine temperature.

11. An installation according to claim 10, characterized in that said connecting means includes means for rendering ineffectual the locking means for a certain period of time after completion of the required energization of said preliminary heating means.

12. An installation according to claim 10, characterized in that the preliminary heating of the preliminary heating means commences some time prior to said switch arm means reaching the preliminary heating position in its movement from the normal rest position toward the preliminary heating position.