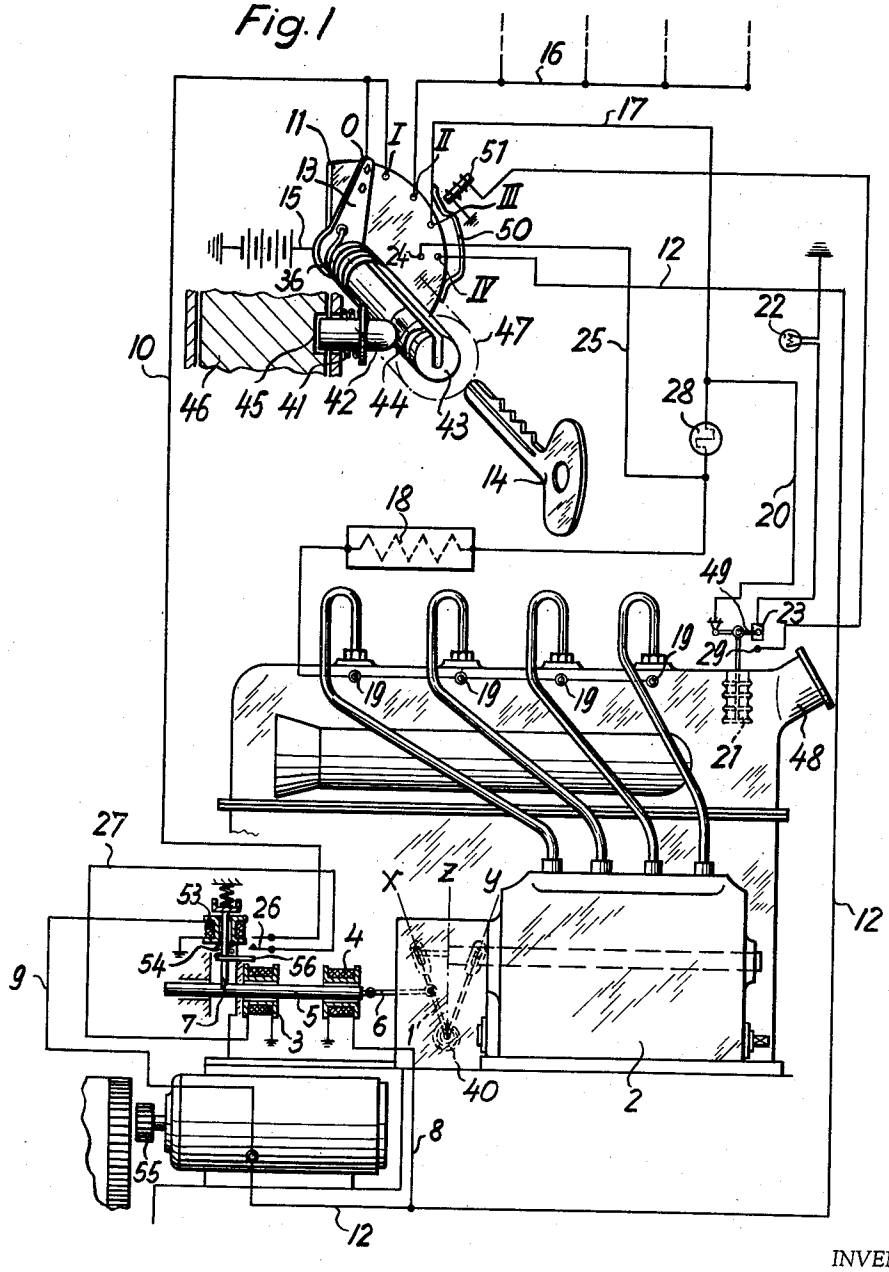
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STARTING MECHANISM FOR DIESEL ENGINE WITH INCANDESCENT HEATING MEANS

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Fig. 1




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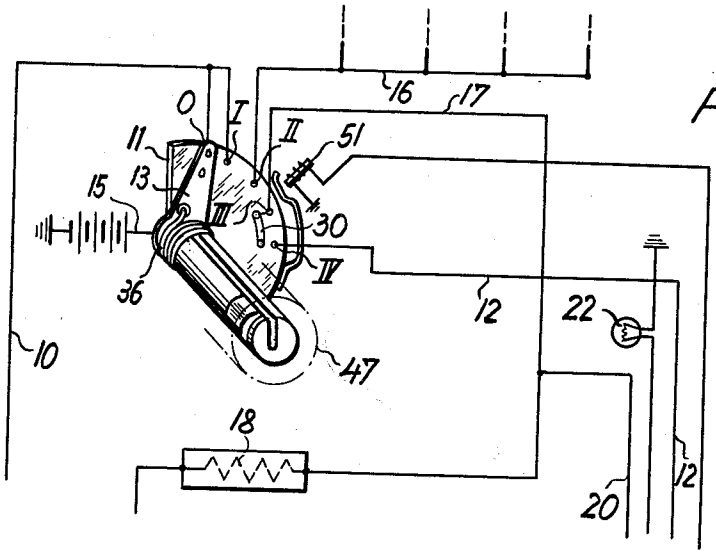



Fig. 2

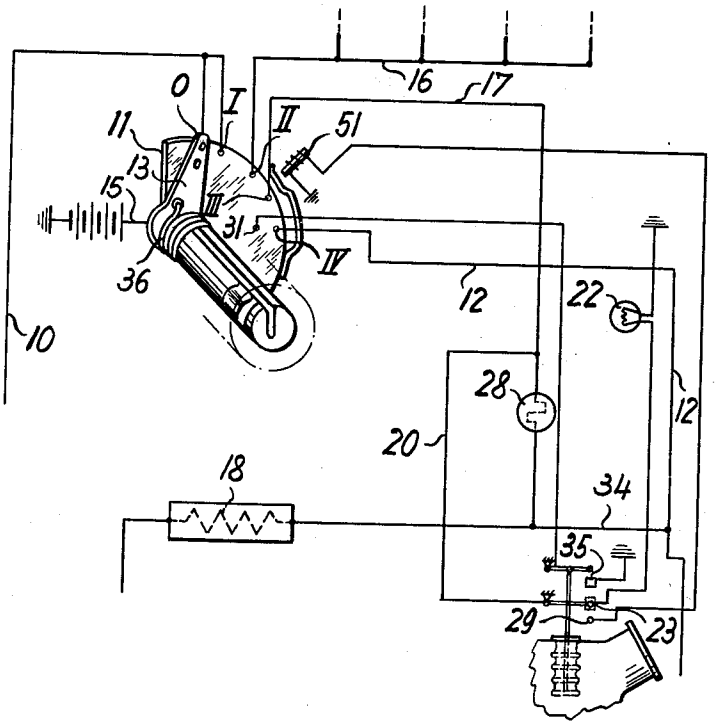



Fig. 3

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# STARTING MECHANISM FOR DIESEL ENGINE WITH INCANDESCENT HEATING MEANS

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The present invention relates to a starting mechanism for a diesel engine which is provided with incandescent heating means.

In the known types of such installations, the heater plug starting switch is mechanically connected to a control lever which acts upon the control rod of the fuel injection pump or directly upon the control rod, for example, by means of levers, rods, or by a Bowden cable. Such mechanical connecting means are often very difficult to apply and are subject to undesirable vibrations, an inaccurate and unreliable operation, and numerous other deficiencies.

it is an object of the present invention to overcome these disadvantages by providing an electric control of the fuel control element of the fuel injection pump and by combining the necessary electric contacts including the contacts for the heater plug installation and the starter on a common switch, and especially a switch of a steering-wheel lock. According to the invention, the injection pump is controlled by a pair of electromagnets, one of which moves the control element of the pump to its off position, while the other magnet moves the same control element to its starting position. The invention further provides that, when the mentioned control element of the injection pump is in its off position, the electric current of the control mechanism will be switched off automatically.

The above-mentioned objects as well as the essential features and most important advantages of the present invention will become more clearly apparent from the following detailed description thereof, particularly when the same is read with reference to the accompanying drawings which in FIGURES 1 to 3 illustrate the circuit diagrams of three different embodiments of the invention.

FIGURE 1 shows the present invention incorporated in the electrical control system of a diesel engine.

FIGURE 2 shows a modification of the electrical circuits of FIGURE 1.

FIGURE 3 shows a modification of the electrical circuits of FIGURE 1.

In all three of these drawings, the fuel injection pump 2 is provided with a control lever 1 which may be shifted to an off-position $x$ and to a starting position $y$ either by a double electromagnet or two individual electromagnets 3 and 4, and which is normally maintained in the central position $z$ by a conventional spring 40. For shifting the control level 1 from one position to the other, it is connected by an arm 6 to a plunger-type armature 5 of magnets 3 and 4. One of these magnets, for example, magnet 53 as shown in FIGURE 1, is provided with an electromagnetic locking device 7. Magnets 3 and 4 and locking device 7 are connected by lines 8, 9, and 10 to a switch 11. Line 10 is connected to two contacts O and I of switch 11, while lines 8 and 9 are operatively connected to a common switch contact IV. Contacts O and I are combined with a steering-wheel lock conventionally controlled by a key 14 and in which the position O corresponds to the locking position, while the position I corresponds to a position in which the steering wheel is unlocked. Contact IV is connected to a line 12 which leads to a starter 55. The movable contact arm 13 on the rotatable member 43 receiving key 14 is constantly in circuit through a line 15 connected to a current source. A further contact II is connected to a line 16 which leads to the various points of normal current consumption of a motor vehicle. A further contact III of switch 11 is connected to a line 17 which leads to a resistance element 18 in series with the heater plugs 19 of the engine. A line 20 branches off line 17 and leads to a thermostatic time switch 49, 23 including a movable switch element 49 actuated by thermostat 21 controlled by the temperature of the cooling water in engine cylinder head 48, the element 49 in turn engaging or disengaging switch element 23 to control the current to a control light 22. According to the embodiment of the invention as shown in FIGURE 1, switch 11 is provided with a further contact 24 which is also engaged by contact arm 13 when the latter is turned to engage with contact IV so as also to connect the resistance element 18 into the circuit through a line 25. Locking device 7 contains a further switch 26 which in the closed position connects magnet 3 through a line 27 to line 10. This occurs as armature 5 is in a position in which it is shifting the control lever 1 of the injection pump 2 toward its starting position $y$. As shown in FIGURE 1 the locking device 7 comprises a detent member engageable in a corresponding recess in armature 5. The detent member is actuated by the armature of an electromagnet 53, the latter being in circuit with the line 9 previously referred to. Springs including spring 54 urge the armature into detent-engaging position. Carried by the armature is actuating member 56 which, when electromagnet 53 is energized, is effective to close switch 26, such closure being maintained as long as the end of the detent member is supported by the cylindrical portion of the armature during the movements thereof.



In the embodiments of the invention according to FIGURES 1 and 3, a heater- plug control light 28 is connected in series with the resistance element 18. In the embodiment according to FIGURE 1, line 17 is connected to a second thermostatic time switch 49, 29 which is controlled by the engine coolant and acts upon the control arm 13 of switch 11 in a manner hereafter described. FIGURE 2 further shows a contact segment 30 which is likewise adapted to be engaged by control arm 13 and extends from the switch position III to switch position IV. In the circuit arrangement according to FIGURE 3, control arm 13 of switch 11 is further adapted to engage with a second contact 31 closely adjacent to contact IV for connecting these contacts to each other in a manner similar to that of the FIGURE 1 structure. Contact 31 is connected by a line 33 to a switch 35 which together with switch 23 is controlled by the thermostat 21. Finally, the circuit arrangement according to FIGURE 3 also contains a connecting line 34 between line 12 which leads to the starter or between contact IV and the line which connects the heater-plug control light 28 and the resistance element 18. Control arm 13 and rotatable element 43 are acted upon by a return spring 36 which tends to swing control arm 13 back to its position II if this arm is moved in the clockwise direction beyond this position II. The switch mechanism is further designed so that switch 26 in the locking device 7 will be closed as soon as armature 5 is moved toward its right end position and control lever 1 of injection pump 2 is in its starting position $y$. The two magnets 3 and 4 are connected so that when magnet 3 is energized, it draws armature 5 toward the left as viewed in FIGURE 1, whereas when magnet 4 is energized, it pushes the armature toward the right.

The operation of the three embodiments of the invention according to FIGURES 1 to 3 as described above is substantially alike. For the preheating operation control arm 13 is turned from the position O or I to the position III where it is arrested either by hand or by a stop member in the form of a spring detent member 50

of which the free end engages the end of arm 13 to yieldably hold the latter in position III. In this position III, the current flows through line 15, 13, 17, 28, and 18 to heater plugs 19 and at the same time through line 20 to the control light 22 and to the thermostatic time switch 21. Control light 22 is again switched off by time switch 21 as soon as the required heating time has expired which differs in accordance with the temperature of the cooling water. If after control light 22 has gone out, control arm 13 is not turned back by hand so that heater plugs 19 continue to heat, the second thermostatic time switch 49, 29 will then cause energization of an electromagnet 51, the free end of the spring detent member constituting an armature for the magnet. The energization of the magnet as controlled by switch 49, 29 is effective to relax the major pressure of detent member 50, the arm 13 then being returned by spring 36 to the position II after overcoming the resistance of detent member 50 in position III.

After the preheating operation has been completed, the engine is started. Control arm 13 is then moved, for example, from position II to position IV and is there arrested by hand. Arm 13 is then again acted upon by spring 36 which tends to swing it back to the position II. In position IV, the current flows first from terminal 15 through control arm 13, contact 24, line 25, and resistance element 18 to heater plugs 19 and, second, through contact IV via line 12 to the starter and, third, to electromagnet 53 of locking device 7 and magnet 4. Due to the flow of current to the electromagnet of locking device 7, the locking effect upon armature 5 is overcome and the latter is free to move in the axial direction so that the energized solenoid of magnet 4 can then draw the armature 5 toward the injection pump 2 and thereby shift the control lever 1 to its starting position *y*. Since the starter is connected to line 12, the engine will start to run. As soon as this occurs, the operator only needs to let go of key 14 and arm 13 will then swing back to position II under the action of spring 36.

For shuting off the engine, control arm 13 is moved to its O or I position in which the current flows from line 10 through the closed switch to magnet 3 with the result that armature 5 will now pull the control level 1 of injection pump 2 to its off-position. The return movement of armature 5 to detent-engaging postion also results in switch 26 being opened, so that the flow of current to magnet 3 is again interrupted. When completing its return movement armature 5 is mechanically arrested in this position by the locking device 7.

In the embodiment of the invention according to FIGURE 2, the heater-plug operation is maintained in switch position IV by contact segment 30 from which the current flows to heater plugs 19 through line 17. Since line 25 according to FIGURE 1 is omitted, there is no need for indicating the end of the heater-plug operation by means of a heater-plug control light 28. In this case, the indication by control light 22 will suffice. With this circuit arrangement it is only necessary to make the resistance element 18 of which a size that it will have the same electrical resistance as the heater-plug control light 28 together with the resistance element 18 according to FIGURE 1.

The various contacts of switch 11 are, according to the invention, combined in a steering-wheel lock, and control arm 13 is actuated by a suitable turn of the key 14 of this lock. The steering wheel lock is of conventional construction comprising a locking bolt 42 which, in the position of rotatable switch actuating member 43 shown in FIGURE 1, is received at one end thereof in a recess 45 in steering column 46, thus locking the latter. Movement of the bolt into the recess is brought about by a cam 44 on member 43 engageable with the other end of bolt 42. Unlocking movement of the bolt out of the recess is caused by a spring 41 effective when member 43 is rotated by the key to move cam 44 away from bolt 42. The member 43 is supported in housing 47. The mere insertion of this key into the steering-wheel lock will not as yet produce any effect since switch 26 is then in the open position. When the key is turned to move control arm 13 to the position I, merely the steering-wheel lock will be actuated and the steering wheel will be unlocked. In position II, the normal points of current consumption of the motor vehicle are switched on, in position III the preheating is started, while in position IV the starter is also switched on.

Although the invention has been illustrated and described with reference to the preferred embodiments thereof, it should be understood that it is in no way limited to the details of such embodiments but is capable of numerous modifications within the scope of the appended claims:

What is claimed is:

1. A starting mechanism for a diesel engine having a starter, incandenscent heating means, a fuel injection pump, fuel control means on said pump, said fuel control means being movable to an off position and to a starting position and electric means for controlling said fuel control means comprising an electric control switch, said switch having a plurality of switch contacts in operative electrical connection with said incandescent means and a further switch contact in operative electrical connection with said starter, a current source and a movable control arm in circuit with said current source and adapted to engage with said plurality of switch contacts and with said further switch contact.

2. A starting mechanism as defined in claim 1 in which said electric means for controlling said fuel control means further comprise a pair of electromagnets, one of said electromagnets being adapted to move said fuel control means to said starting position, the other of said electromagnets being adapted to move said fuel control means to said off position, said one of said electromagnets having an operative electrical connection with said further switch contact, further switch contact means on said electric control switch engageable by said control arm, an electrical connection for connecting said further switch contact means and said other of said electromagnets, said electromagnets comprising means operatively connected to said fuel control means.

3. A starting mechanism as defined in claim 2, in which said electrical connection for connecting said further switch contact means and said other of said electromagnets comprises disengageable means effective to interrupt said last-mentioned connection.

4. A starting means as defined in claim 2, in which said electromagnets are disposed coaxially behind each other and said means operatively connected to said fuel control means comprises a plunger-type armature.

5. A starting mechanism as defined in claim 4, further comprising releasable locking means including mechanical means for arresting said armature in a position corresponding to said off position of said fuel control means and electrical means in operative electrical connection with said electric control switch for releasing said mechanical means.

6. A starting mechanism as defined in claim 5, in which said electric means for controlling said fuel control means further comprise a second switch for controlling the operation of said other of said electromagnets, said locking means, said electromagnets, and said second switch being structurally combined to form a unit so that, when said armature is moved toward a position in which said fuel control means is in said off position, said second switch will be opened and thereby interrupt the flow of current to said one of said electromagnets.

7. A starting mechanism as defined in claim 1, further comprising means for urging said control arm in a movement away from said plurality of contacts, releasable means for resisting said movement and means including at least one thermostatic time switch controlled by the temperature of a part of said engine for releasing said

releasable means when said incandescent means have been in operation for a predetermined time.

8. A starting mechanism as defined in claim 7, said further switch contact and said control arm comprising a starter switch, said means for urging said control arm being effective to disengage said control arm from said further switch contact to de-energize said starter.

9. A starting mechanism as defined in claim 1, further comprising a spring acting upon said control arm of said control switch and tending to return said control arm from a position in which said incandescent means are operated and to maintain said control arm in a position in engagement with one of the contacts of said control switch



which is adapted to be connected to the conventional current consuming means of a motor vehicle.

**References Cited** in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| 2,195,927 | Hurst et al. | Apr. 2, 1940 |
| 2,251,630 | Leeffler et al. | Aug. 5, 1941 |
| 2,679,837 | Tyler | June 1, 1954 |
| 2,850,001 | Jones | Sept. 2, 1958 |
| 2,864,357 | Howard | Dec. 16, 1958 |
| 2,945,484 | Scherenberg et al. | July 19, 1960 |
| 2,966,902 | Nallinger | Jan. 3. 1961 |