

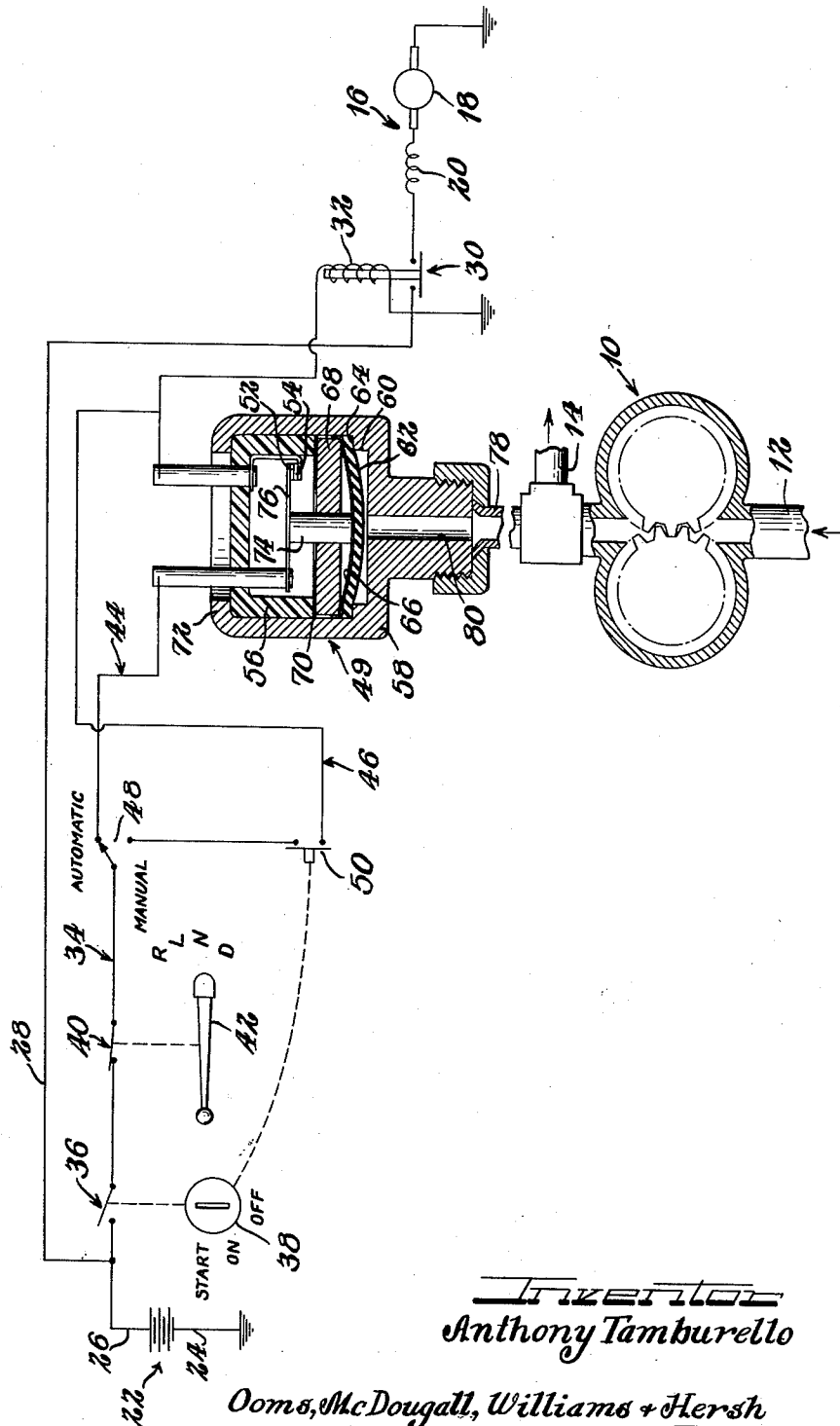
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AUTOMATIC ENGINE STARTING DEVICE

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AUTOMATIC ENGINE STARTING DEVICE

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This invention relates to internal combustion engines, particularly as applied to automotive vehicles, and pertains more specifically to electrically operable apparatus for starting such engines.

One principal object of the present invention is to provide a new and improved device for automatically restarting an engine after it has been inadvertently stalled.

A further object is to provide a new and improved device of the foregoing character which will automatically start the engine upon actuation of a manually operable master switch which also controls the energization of the ignition circuit.

Another object is to provide a new and improved engine restarting device which is applicable to an engine equipped with an automatic transmission and is arranged so that the engine will not be restarted until the automatic transmission is shifted into neutral position.

It is a further object to provide a new and improved automatic restarting device which is equipped with a manually operable selector switch adapted to cut out the automatic control so that the starting of the engine may be controlled manually, if desired.

Further objects and advantages of the invention will appear from the following description, taken with the accompanying drawing, in which the single figure is a schematic representation of an automotive engine arrangement equipped with an automatic starting device constituting an illustrative embodiment of the invention.

It will be seen that the drawing illustrates an automotive engine of the type including a pump 10, operable by the engine, for developing fluid pressure during normal engine operation. The pump 10 may serve to develop lubricant pressure for lubrication of the engine or a transmission connected thereto, or may develop hydraulic pressure for carrying out various control functions. The illustrated pump 10 has an inlet conduit 12 for receiving oil or other fluid and an outlet conduit 14 adapted to carry the oil to the engine bearings or other components requiring fluid pressure.

An electric starter motor 16 is provided to crank the engine, the illustrated motor 16 being of a conventional type including an armature 18 and a field winding 20 connected in series. One side of the starter motor is grounded to the metallic body or frame of the engine, the frame serving as a return path for the electric current. The starter motor 16 is adapted to be energized by an electric storage battery 22 having grounded and ungrounded terminals 24 and 26. An energizing circuit 28 extends between the ungrounded terminal 26 of the battery and the starter motor 16. It will be seen that a normally open relay switch 30 is connected in series with the starter motor circuit 28. Closure of the switch 30 is effective to complete the circuit 28 and energize the starter motor.

A solenoid or relay winding 32 is provided to close the relay switch 30, one side of the relay winding being grounded. The other side of the relay winding 32 is con-

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nected in a control circuit 34 which extends to the ungrounded terminal 26 of the battery 22. A manually operable, normally open master switch 36 is in series with the control circuit 34. The master switch 36 may be arranged to be operated by the ignition lock 38 of the engine. In fact, the master switch 36 may constitute the master ignition switch of the engine. In the common manner, the ignition lock 38 is provided with "off," "on" and "start" positions. In the "off" position, the master switch 36 is open, but it may be turned on by shifting the ignition lock to the "on" position. The "start" position is of use only when the automatic starting device is cut out, in the manner to be described presently. It should be noted that the master switch remains closed when the ignition lock is shifted to the "start" position.

In the illustrated arrangement, a safety switch 40 is connected in series with the master switch 36. The safety switch is operable by a selector lever 42 which also serves to control an automatic transmission connected to the engine. In the common manner, the selector lever 42 has driving, neutral, low and reverse positions. The arrangement is such that the switch 40 is open except when the selector lever 42 is in the neutral position. In this way, the lever must be moved to the neutral position before the engine can be cranked by an electric starter motor. This arrangement prevents undesired movement of the vehicle when the engine is being started.

Two branches 44 and 46 are provided in the control circuit 34. Each branch returns to the relay winding 32. A single pole double throw switch 48 is arranged so that either of the branches may be switched into the control circuit. To provide for automatic engine restarting, an automatic control switch 49 is connected in series with the branch 44. The branch 46 provides for manual control over the starting of the engine. Thus, a normally open manually operable switch 50 is connected in series with the branch 46. The switch 50 may be coupled mechanically to the ignition lock 38 so as to be closed when the ignition lock is shifted to the "start" position.

The automatic control switch 49 is arranged to be operated in response to fluid pressure developed by the pump 10. In the illustrated embodiment, the automatic switch 49 comprises a pair of normally closed contacts 52 and 54 mounted on an insulating block 56 which is received in a housing 58. A pressure chamber 60 is defined in one end of the housing 58. One wall of the pressure chamber 60 is formed by a flexible sealing disk 62 of synthetic rubber or other similar rubberlike material. The circular outer edge of the disk 62 is seated against the shoulder 64 formed in the housing 58. Above the sealing disk 62 is a flexible, resilient diaphragm 66 made of metal or some other suitable material. It will be seen that the diaphragm 66 is formed so as to be slightly convex downwardly. The diaphragm is adapted to be flexed upwardly by fluid pressure in the chamber 60. When the pressure is lost, the diaphragm returns downwardly by its own inherent resilience. Above the diaphragm, metal and fiber washers 68 and 70 are interposed as spacers between the diaphragm 66 and the insulating block 56. The upper end of the housing 58 has a portion 72 which is crimped or otherwise formed inwardly so as to define flange means retaining the insulating block 56 securely against the fiber spacer 70. An operating connection is provided between the diaphragm 66 and the contact 52 by means of an insulating pin or shaft 74, extending between the diaphragm and a spring arm 76 which supports the contact 52, the spacers 68 and 70 being axially apertured so that the pin 74 may pass there-through.

A fluid carrying conduit 78 is connected between the outlet 14 of the oil pump 10 and a passage 80 extending

through the housing 58 into the pressure chamber 60. When the engine is running normally, lubricant pressure is developed in the outlet conduit 14. The conduit 78 transmits the fluid pressure to the pressure chamber 60, with the result that the diaphragm 66 is flexed upwardly so as to open the contacts 52 and 54. Thus, the relay winding 32 is disconnected from the battery 22, assuming that the selector switch 48 is in its automatic position so as to connect the branch 44 into the circuit 34. When the engine is inadvertently stalled, the engine oil pressure will be lost, with the result that the diaphragm 66 returns downwardly by its own resilience. Accordingly, the contacts 52 and 54 are closed by the resilience of the spring arm 76. This completes an energizing circuit from the battery 22 to the relay winding 32. The energizing circuit includes the master switch 36, the safety switch 40, the selector switch 48, together with the contacts 52 and 54. The relay winding 32 will be energized provided that the selector lever 42 of the automatic transmission is in its neutral position so as to close the safety switch 40. It is also necessary that the master switch 36 be in its closed position. This is normally the case when the engine is stalled inadvertently.

The energization of the relay winding 32 closes the relay switch 30 and thereby brings about energization of the starter motor 16. As a result, the engine is restarted. Such automatic restarting occurs whenever the engine oil pressure drops to zero due to inadvertent stalling of the engine, provided that the transmission selector lever 42 is shifted into its neutral position.

If it is desired to restart the engine under manual control, the selector switch 48 may be shifted to its manual position so as to cut out the automatic switch 49 and introduce the manual starter switch 50 into the control circuit 34. The switch 50 may then be operated by turning the ignition lock 38 to its "start" position. Here again, it is necessary to shift the transmission lever 42 to its neutral position in order to bring about energization of the starter motor. It will be seen that the switches 48 and 50 effectively bypass the automatic switch 49.

With the selector switch 48 in its automatic position, the engine is started initially by shifting the transmission lever 42 to neutral and turning the ignition lock 38 to its "on" position. With the engine out of operation, the oil pressure is zero and the automatic switch 49 is closed. Accordingly, moving the master switch 36 to its closed position completes the energizing circuit to the starter relay 32. It is not necessary to shift the ignition lock 38 to its "start" position. As soon as the engine starts, the oil pressure builds up and opens the automatic switch 49. This deenergizes the starter motor.

With the starting device of the present invention, the engine may be restarted in a minimum of time and with a minimum of effort when it is inadvertently stalled. The driver need only move the transmission selector lever to its neutral position to restart the engine. Although the neutral safety switch is desirable, those skilled in the art will understand that it may be omitted in some cases. It will also be understood that the automatic starting device is applicable to vehicles equipped with manually operable transmissions with or without a neutral safety switch. Of course, the clutch of such a vehicle should be disengaged or the transmission gears moved to their neutral position to facilitate the cranking of the engine and prevent undesired movement of the vehicle.

Various other modifications, alternative constructions and equivalents may be employed without departing from the true spirit and scope of the invention as exemplified

in the foregoing description and defined in the following claims:

I claim:

1. In an automotive vehicle having an automatic transmission provided with selector means for controlling operation thereof and connected to an engine equipped with an electric starter motor, an oil pump, and an electric battery, the combination comprising a starter motor circuit extending between said battery and said starter motor and including a normally open relay switch operable to energize said starter motor, a relay winding for actuating said relay switch, a control circuit extending between said battery and said relay winding and including a manually operable master switch in series with said control circuit, a safety switch in series with said master switch and connected to and operable by said selector means so as to be closed with said selector means in neutral position, a first branch circuit extending to said relay winding and including an automatic control switch in series with said first branch circuit, a second branch circuit extending to said relay winding and including a normally open manually closable switch, a single pole double throw selector switch connected to said branch circuits and in series with said control circuit for selectively switching either of said branch circuits into said control circuit to provide for either automatic or manual control over said relay winding, said automatic control switch having normally closed contacts, a pressure-responsive element for opening said contacts, means connecting said pressure-responsive element to said oil pump for actuating said contacts to open position in response to the development of oil pressure by said pump during normal engine operation, said automatic switch including resilient means for restoring said contacts to closed position in consequence of loss of oil pressure when said engine is stalled, said contacts thereupon being effective to energize said relay winding and thereby actuate said starter motor to restart said engine.

2. In an engine equipped with an electric starter motor, an oil pump, and an electric battery, the combination comprising a starter motor circuit extending between said battery and said starter motor and including a normally open relay switch operable to energize said starter motor, a relay winding for actuating said relay switch, a control circuit extending between said battery and said relay winding and including a manually operable master switch in series with said control circuit, a first branch circuit extending to said relay winding and including an automatic control switch in series with said first branch circuit, a second branch circuit extending to said relay winding and including a normally open manually closable switch for selectively switching either of said branch circuits into said control circuit to provide for either automatic or manual control over said relay winding, said automatic control switch having normally closed contacts, a pressure-responsive element for opening said contacts, means connecting said pressure-responsive element to said oil pump for actuating said contacts to open position in response to the development of oil pressure by said pump during normal engine operation, and resilient means for restoring said contacts to closed position in consequence of loss of oil pressure when said engine is stalled, said contacts thereupon being effective to energize said relay winding and thereby actuate said starter motor to restart said engine.

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