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BATTERY ISOLATING SWITCH SUITABLE FOR USE WITH INTERNAL COMBUSTION ENGINES

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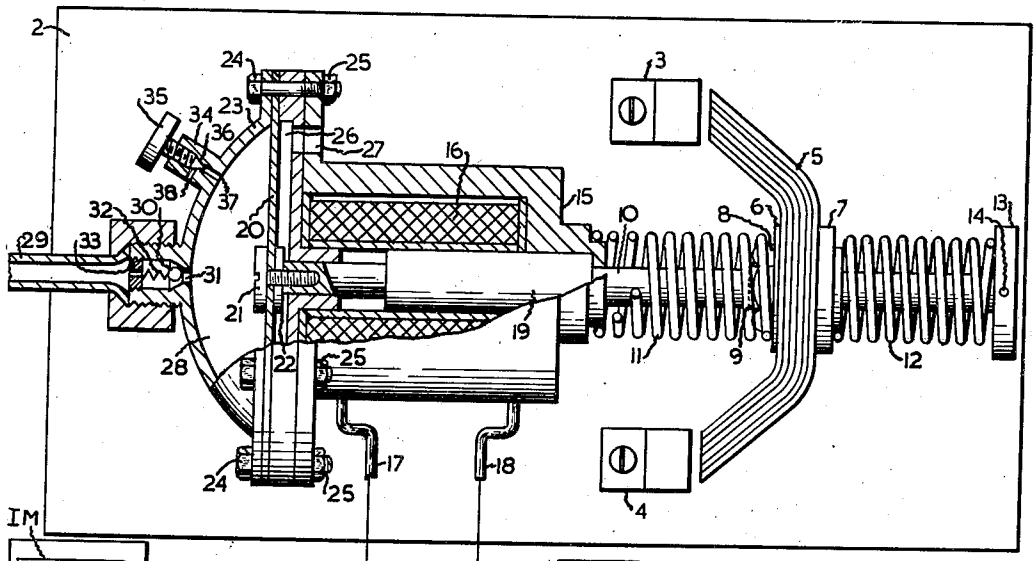



Fig I

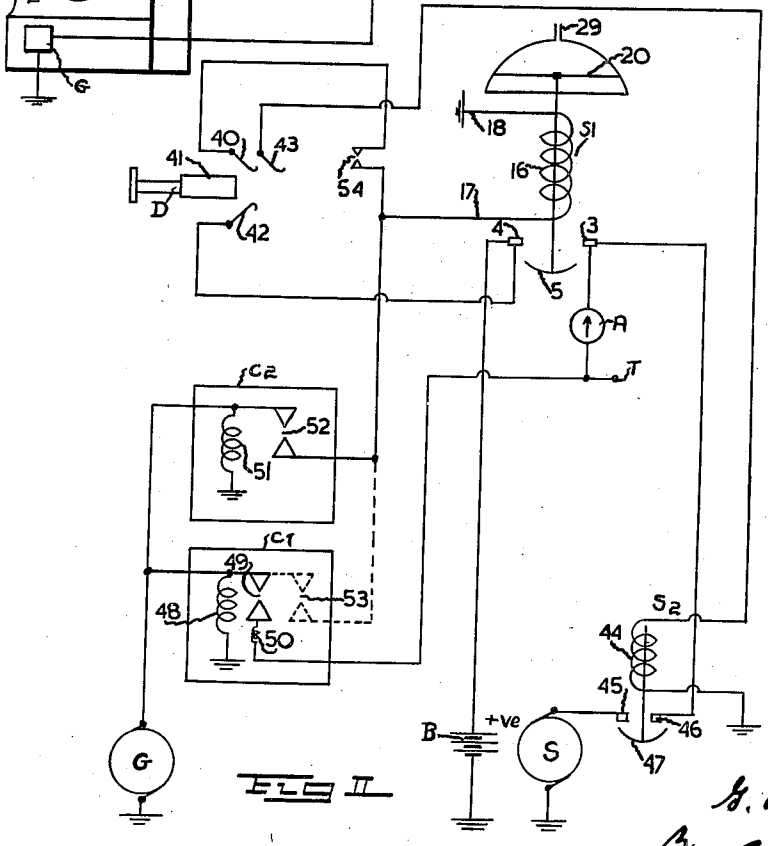



Fig II

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## BATTERY ISOLATING SWITCH SUITABLE FOR USE WITH INTERNAL COMBUSTION ENGINES

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7 Claims. (Cl. 123—146.5)

The present invention relates to battery isolating switches suitable for use with internal combustion engines mounted on a vehicle to serve as a source of power for propelling the vehicle in cases where an electrical battery is associated with the engine for supplying current to electrically operated parts provided on the vehicle. The battery may be employed for supplying current to electrically operated parts which are essential to the running of the engine e. g. to the coil ignition system for supplying ignition sparks in cases where the engine is a spark ignition internal combustion engine and/or for supplying current to parts which are not essential to the running of the engine e. g. to electric lamps and accessory parts such as indicators for traffic signalling.

The invention is especially applicable to motor vehicles driven by spark ignition internal combustion engines of the kind which employ an induction coil for generating the ignition sparks. The primary winding of the induction coil is generally connected in series with the battery by means of an ignition switch on the dashboard. If this ignition switch is inadvertently left closed when the car is placed out of use for several hours the battery will gradually discharge, possibly to such an extent as to be ineffective for starting the engine when the car is next required for use. A similar thing occurs if other parts of the electrical system are left switched on, for example parking lights. An object of the invention is to overcome this disadvantage by providing an automatic battery isolating switch i. e. a switch which will come into operation automatically subsequent upon the stoppage of the engine and will disconnect the battery from those circuits which may inadvertently be left switched on (except special circuits, such as circuits to radio sets, which it may be desirable to operate when the car is stationary), and from any other circuits which it is desired to isolate.

An embodiment of the invention will now be described, by way of example, reference being made to the accompanying drawing comprising Figures I and II, in which

Figure I shows partly in section and partly in elevation, the construction of a battery isolating switch according to the invention and suitable for use on a motor vehicle arranged to be driven by an internal combustion engine, whilst

Figure II shows a circuit arrangement including a battery isolating switch according to Figure I.

In Figure I, 2 is a mounting plate for a battery isolating switch provided with electrical terminals 3 and 4 arranged to be bridged by a laminated contact arm 5 which is clamped between a washer 6 and a collar 7, both of insulating material, and a nut 8 which engages a threaded extension 9 of collar 7 passing through the contact arm 5 and washer 6. The assembly 5, 6, 7, 8, 9 is slidably mounted on a rod 10 between two helical springs 11 and 12. The helical spring 12 abuts at one end against the collar 7 and at its other end against a collar 13 secured at the free end of the rod 10 by a pin 14. The other helical spring 11 abuts at one end against the washer 6 and at the other end against a casing 15 which contains an electromagnetic coil 16 terminating in leads 17 and 18.

The rod 10 passes along the axis of coil 16 and is provided, in the vicinity of coil 16, with a sleeve 19 of magnetic material such as soft iron so that when the coil 16 is energised by current flowing through it, the sleeve 19 and rod 10 will be drawn into the magnetic field against the compression of the helical springs 11 and 12. The end of rod 10 on the opposite side of sleeve 19 from the contact arm 5 is clamped to the middle of a flexible diaphragm 20, which may be of rubber, by means of a screw 21 and washer 22. The diaphragm 20 is clamped around its periphery between the casing 15 and a cover 23 by bolts 24 and nuts 25 to form on one side of diaphragm 20 a chamber 26 which communicates with the atmosphere through a breathing hole 27, and on the other side of the diaphragm a suction chamber 28 which communicates with a pipe 29 which may be connected to the induction manifold IM of an internal combustion engine E. Interposed between the pipe 29 and the chamber 28 there is a ball 30 held in place against an aperture 31 by a spring 32 and an apertured disc 33 to act as a ball valve and thus to prevent loss of vacuum in the suction chamber 28 due to gradual leakage through pipe 29 when the engine E stops running or if the engine E back-fires. The suction chamber 28 is also provided with a boss 34 internally threaded at its outer end to receive a tapered screw 35 the pointed end of which seats in a seating 36 which is provided at the upper end of a passage 37 leading to the suction chamber 28 and communicates with a passage 38 of small diameter leading to the atmosphere. The device 34—38 forms an adjustable valve by means of which the suction chamber 28 may be caused to act as a pneumatic delay device with an adjustable time period.

After the switch has been operated (in a manner which will be described later) to cause the

contact arm 5 to bridge terminals 3 and 4, and the engine E has started, a difference in pressure is set up between the chambers 26 and 28 due to the suction in the induction manifold IM and causes the centre of the diaphragm 20 to be pressed in by atmospheric pressure towards the suction chamber 28, whereby the switch is held in its closed position with the contact arm 5 bridging the terminals 3, 4. The contact arm 5 is also held in this operated position due to current, for example current from an electrical generator G driven by the engine E, flowing through coil 16 via leads 17, 18 and causing it to exert an attractive force on the magnetic sleeve 19. When the engine is stopped, current ceases to flow through coil 16 and the pressure in suction chamber 28 begins to rise due to air leaking in through passages 38 and 37. The diaphragm 20 slowly restores to its rest position and after an interval depending upon the setting of screw 35, the contact arm 5 moves out of contact with terminals 3 and 4. Due to the provision of springs 11 and 12, an appreciable movement of the rod 10 towards its rest position may take place before the contact arm leaves terminals 3 and 4, thereby permitting a more accurate setting of the delay period.

Figure II indicates the manner in which a battery isolating switch according to Figure I may be connected in the electrical circuit of a motor vehicle which includes an internal combustion engine for propelling the vehicle, a battery B for supplying current to the electrical components of the vehicle (including a starter S for starting the engine) and a generator G arranged to be driven by the engine for the purpose of charging the battery B. S1 indicates diagrammatically a switch according to Figure I whilst S2 is a solenoid switch of standard type which is included in most starting systems for closing the circuit of the starter S. C1 is a cut-out connected in the battery charging circuit in the normal manner. D is a dash-board starting switch which is fitted with three contact springs instead of the two normally provided (the added contact spring is indicated by the reference 40). A is the ammeter normally provided for indicating the total current (apart from the starting current) flowing to or from the battery B.

The dash-board switch D is provided with a contact member 41 at the end of the switch plunger, which connects together contact springs 40 and 42 when the plunger is depressed, thereby causing current to flow from the positive terminal of battery B, over terminal 4, contact springs 42 and 40, lead 17, through coil 16, and over lead 18 to earth (neglecting contacts 54 for the time being). Switch S1 thereupon operates and bridges terminals 3 and 4 by the contact arm 5. A circuit is thereby completed from the positive terminal of battery B via ammeter A to terminal T from which positive leads run to the ignition coil, electric lamps and other electrical components. The lead to the ignition coil will, as usual, include an ignition switch which is closed before operating the starter. When the plunger of the dash-board switch D is further depressed, springs 40, 42 and 43 become connected together, the circuit of coil 16 is thereby maintained, and a circuit is completed over spring 43 for the coil 44 of switch S2. Switch S2 thereupon operates and bridges terminals 45 and 46 with its contact arm 47, thereby causing current to flow through the windings of starter S which thereupon rotates the engine. When the engine commences to run, the suction set up in the suction chamber of switch S1 serves to hold the contact arm 5 in firm contact with contacts 3 and 4. Switch D is allowed to return to its normal off-position when the engine has started, thereby opening the circuit of coil 16 at spring 40 so that no current now flows through coil 16 until the engine revolutions increase sufficiently as explained later.

The voltage of generator G increases with the engine speed until at a certain voltage the current flowing through the shunt coil 48 of the cut-out C1 has risen sufficiently to cause the cut-out contacts 49 to close, whereupon a circuit is completed from generator G to terminal T which is connected to the ignition and lighting circuits and is extended via ammeter A and terminals 3, 4 bridged by contact arm 5 to complete the charging circuit for the battery B. The current flowing through the series coil 50 of the cut-out C1 assists in holding contacts 49 firmly closed.

An additional cut-out C2 is connected between generator G and lead 17 so that coil 16 will be energised by current from the generator G when coil 51 of the cut-out C2 becomes sufficiently energised to close contacts 52. It will be noted that contacts 52 are open while the engine is being started, so that battery B is prevented from discharging through generator G in a circuit extending over terminal 4 and contact springs 42 and 40. Instead of providing cut-out C2, the same effect may be obtained by providing additional contacts 53 in cut-out C1 in the position shown.

As long as the engine is running normally, the battery isolating switch S1 is maintained operated both by the suction created in the suction chamber 28 from the induction manifold due to the movement of the pistons of the engine and by the current flowing through coil 16 due to the rotation of the generator by the engine. Should the suction decrease due to the throttle of the engine being widely opened, the switch S1 would be maintained operated by the magnetic pull exerted by coil 16 on the magnetic sleeve 19; conversely if the speed of the engine should fall to such an extent that coil 16 is no longer energised, the switch S1 would be maintained operated by increased suction from the induction manifold. The delay period of the switch S1 is adjusted at the screw valve 35 (Figure I) to a suitable value, which in any case is made sufficiently long to prevent the switch S1 isolating the battery due to momentary stoppages of the engine, for example due to the engine stalling in traffic.

Arrangements may also be provided for closing and/or opening the battery isolating switch by separate controls from those described, for example it may be closed by means of a separate circuit including a dry battery or by a hand operated vacuum pump or by a hand operated lever with spring control acting on the rod 10. It is advantageous to provide a hand control for opening the battery isolating switch as it will then serve as an emergency control if a short-circuit should accidentally develop in normal use of the vehicle; in this case it is not necessary to provide a switch in the ignition circuit because the engine can be stopped by the hand control opening the battery isolating switch.

It is also advantageous to provide a lock switch in the initial energising circuit of the battery isolating switch S1 as indicated at 54 in Figure II. After the switch S1 has been closed and the engine has been started, the lock switch 54 may

be opened without causing the engine to stop. If the engine is stopped for a period which is less than the delay period of the battery isolating switch S1 for example at a traffic signal, it may be restarted without touching the lock switch 54 because battery B will still be connected to contact 46 via the switch arm 5 and terminals 3, 4. If, however, the engine is allowed to stop for a period which is greater than the delay period of the battery isolating switch S1 for example by parking the vehicle in the street for an extended period, the battery isolating switch will open and disconnect battery B from contact 46 on the switch S2 with the result that the engine can now no longer be started by an unauthorised person depressing the switch D but only by a person having a key suitable for closing the lock switch 54.

In cases in which no starter is provided, the starting switch D and the switch S2 will be omitted; the switch S1 will then be operated initially due to suction set up in the induction manifold during the process of starting the engine by hand. It will then be held operated both by suction from the induction manifold and by current flowing through coil 16 as already explained.

In the case of vehicles provided with a foot pedal for controlling a starter of the pre-meshing type so that the starter pinion engages the fly wheel before current is supplied to the starter, the switch D would be arranged to be operated by the foot pedal.

Instead of the pipe 29 being connected to the induction manifold of the engine it may be connected to any other chamber of the vehicle mechanism, the pressure in which is reduced (or increased, provided that slight modifications are made to the switch construction) below (or above) the pressure of the atmosphere when the engine is started. For example, in the case of a vehicle driven by a compression ignition engine and provided with vacuum assisted brakes, the pipe 29 may be connected to the exhausting chamber of the exhauster which is driven by the engine.

I claim:

1. An automatic battery isolating switch comprising battery isolating contacts, a movable rod for closing and opening said contacts and including a magnetic portion, an electromagnetic coil adjacent to said magnetic portion, a flexible diaphragm attached at its centre to said rod and held stationary at its periphery, a pneumatic chamber of which said diaphragm forms a wall, and an adjustable leakage valve fitted to said chamber.

2. On a motor vehicle, an engine, an electrical generator coupled to said engine, electrically operated components on said vehicle, a battery for supplying current to said components, a lead from said battery to said components, battery isolating contacts in said lead, an electromagnetic coil for controlling the closing of said contacts, a momentarily operable switch for initially completing a circuit to said coil from said battery, a circuit for subsequently energizing said coil from said generator for automatically maintaining said contacts closed during the running of the engine, and a delay device for maintaining said contacts closed for a predetermined interval after the stoppage of the engine.

3. On a motor vehicle, an engine, an electrical generator coupled to said engine, electrically operated components on said vehicle, a battery for supplying current to said components, a lead from said battery to said components, battery isolating contacts in said lead, an electromagnetic coil for controlling the closure of said contacts, a momentarily operable switch for initially completing a circuit to said coil from said battery, a circuit for subsequently energizing said coil from said generator for automatically maintaining said contacts closed during the running of the engine, a fluid pressure chamber in which a pressure change is set up due to the starting of the engine, means for permitting the pressure in said chamber to restore towards its original value upon the stoppage of the engine, and means for maintaining said contacts closed until the pressure in said chamber reaches a predetermined value during its restoration towards its original value.

4. On a motor vehicle, an engine, an electrical generator coupled to said engine, electrically operated components on said vehicle, a battery for supplying current to said components, a lead from said battery to said components, battery isolating contacts in said lead, an electromagnetic coil for controlling the closure of said contacts, a starting switch for initially connecting said coil to said battery for causing said coil to close said contacts, cut-out contacts which are closed only when the voltage of said generator reaches a predetermined value, a circuit including said cut-out contacts for subsequently energizing said coil from said generator for automatically maintaining said battery isolating contacts closed during the running of the engine, and a delay device for maintaining said battery isolating contacts closed during the running of the engine for a predetermined interval after the stoppage of the engine.

5. On a motor vehicle, an engine, an electrical generator coupled to said engine, electrically operated components on said vehicle, a battery for supplying current to said components, a lead from said battery to said components, battery isolating contacts in said lead, an electromagnetic coil for controlling the closure of said contacts, a starting switch for initially connecting said coil to said battery for causing said coil to close said contacts, cut-out contacts, a cut-out coil arranged to close said cut-out contacts for extending a charging circuit from said generator to said battery when the voltage of said generator reaches a predetermined voltage, additional cut-out contacts, a second cut-out coil arranged to close said additional cut-out contacts when the voltage of said generator reaches a predetermined value, a circuit including said generator, said additional cut-out contacts and said electromagnetic coil for subsequently energizing said electromagnetic coil from said generator for automatically maintaining said battery isolating contacts closed during the running of said engine, a fluid pressure chamber in which a pressure change is set up due to the starting of said engine, means for permitting the pressure in said chamber to restore towards its original value upon the stoppage of said engine, and means for maintaining said battery isolating contacts closed until the pressure in said chamber reaches a predetermined value during its restoration towards its original value.

6. On a motor vehicle, an engine, an electrical generator coupled to said engine, electrically operated components on the said vehicle, a battery supplying current to the said components, a lead from said battery to said components, battery isolating contacts in said lead, an electromagnetic coil for controlling the closing of the said contacts, a momentarily operable switch for initially

completing a circuit to said coil from said battery, a key actuated switch in said circuit, and a circuit for subsequently energizing said coil from said generator for automatically maintaining said contacts closed during the running of the engine.

7. On a motor vehicle, an engine, an electrical generator coupled to said engine, electrically operated components on said vehicle, a battery supplying current to said components, a lead from said battery to said components, battery isolating contacts in said lead, an electromagnetic coil for controlling the closing of said contacts, a momentarily operable switch for initially completing a circuit to said coil from said battery, a key actuated switch in said circuit, a circuit for subsequently energizing said coil from said generator for automatically maintaining said contacts closed during the running of the engine, and a delay device for maintaining said contacts closed for a predetermined interval after the stopping of the engine.

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