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AUTOMATIC AUTOMOBILE STARTING SYSTEM

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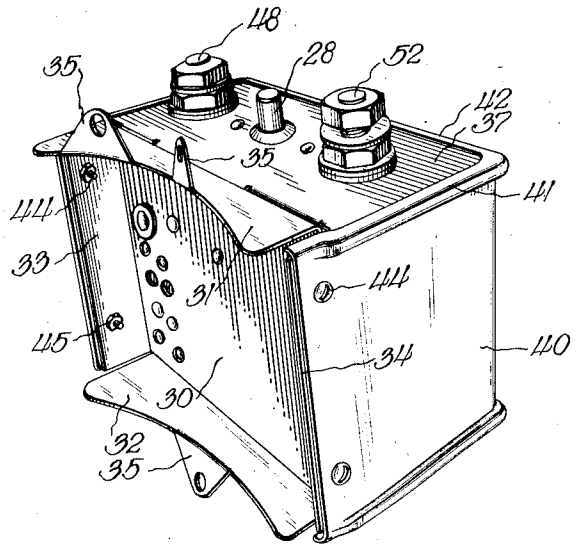


Fig. 1.

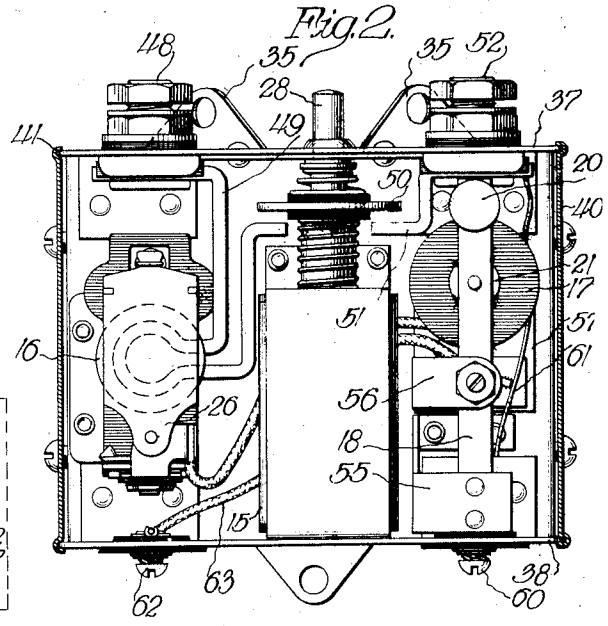


Fig. 2.

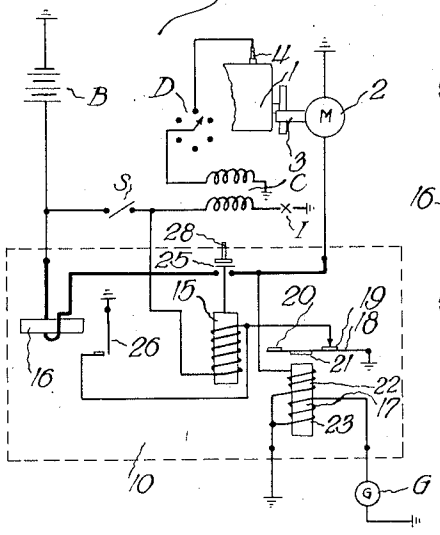


Fig. 3.

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AUTOMATIC AUTOMOBILE STARTING SYSTEM

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5 Claims. (Cl. 290—37)

The present invention relates in general to means for starting an internal combustion engine, particularly of an automobile, and is more particularly concerned with the automatic restarting of the engine should it stop during the normal use of the automobile.

It is an object of the present invention to provide a simple and reliable automatic restarting device which will be certain in its operation and so timed as to positively avoid any chance of jamming the usual starting mechanism controlled thereby.

The present invention, while for general application, is particularly useful in connection with the so called "free-wheeling" transmission. Such transmissions employ some sort of automatic arrangement, generally in the form of an overrunning clutch, for permitting the declutching of the engine to permit the car to travel under its inertia at a speed faster than that of the engine. During such time the engine idles and any stoppage of the engine may go unnoticed by the driver. After the car has decelerated sufficiently and the driver wishes to stop the deceleration, or to accelerate the car, he may find that the engine has stopped. To avoid such occurrences means have been provided for automatically restarting the driving engine when the same comes substantially to rest. Such restarting devices are generally dependent for their operation upon the drop in voltage of the usual electric generator that is driven by the internal combustion engine. As the engine slows down, the generator voltage decreases and finally becomes insufficient to maintain a hold-out relay operated. Upon release of this relay certain electrical circuits are brought into action for establishing a circuit to the starting motor for cranking the engine to restart the same. With the cranking or starting devices now in general use it is essential that the engine be at rest when an attempt is made to crank it. Since the voltage of the generator driven by the engine drops to a negligible value before the engine has come to rest, and therefore releases the hold-out relay that institutes the restarting operation, it is necessary that some means be provided for delaying the cranking action after the generator voltage has fallen to a low value. Vibrating reeds have been used for securing this delay. It is one of the objects of the present invention to provide an automatic restarter of the type employing a vibrating reed for producing the delay, said restarter being arranged so that the amount of delay that must be introduced by the vibrating reed is a minimum.

In the present invention a vibrating reed comprises the armature of the hold-out relay that is maintained in its operated position while the generator voltage is of any appreciable value. The relay is provided with an operating winding and a holding winding. The holding winding maintains the reed in its operated position until the internal combustion engine has almost come to rest. At that time the reed is released and vibrates for a short time. When the reed comes to rest it closes a circuit for instituting the restarting operation. The device of the present invention does not require that the reed be plucked in order to be set into vibration, hence it is not necessary to have any appreciable spring tension on the armature of the generator or hold-out relay. Since there is very little spring tension urging this armature to its released position, the armature will remain in its operated position until the generator voltage reaches an exceedingly small value. If the arrangement were such that the reed must be plucked to set up the vibration, it would be necessary to have some kind of a spring device for producing the plucking action when the relay is released. As the armature of the generator relay would be pulling against this spring device, it would release at a higher generator voltage than is necessary to hold the reed itself. As a result of the present arrangement the relay is not set into vibration until the engine is substantially at rest and, therefore, the delay that must be instituted by the vibrating reed is less than would be necessary in case of an earlier release thereof.

It is a further object of the present invention to provide an arrangement wherein the starting relay is first energized over a circuit extending through the back contact of a vibrating reed and is maintained energized by a relay that is responsive to the current taken by the starting motor, and which releases after the current taken by the starting motor drops to a sufficiently low value to indicate that the motor is no longer cranking the engine.

If the starting motor should be spinning by momentum from a previous starting operation, it is desirable to prevent reclosure of the switch **25** until the starting motor stops. This may occur when the engine fires once or twice and then stalls. The starting motor, by its momentum, produces an energizing current flow in coil **22**, since this coil is then in series with the motor **2**, and the current produced in coil **22** when the starting motor is spinning by momentum in its residual field will hold contacts **19** open until this

current is insufficient to hold reed 18 down, whereupon the reed vibrates for a predetermined time before contacts 19 are closed. This allows the starting motor to come to rest before relay 15 is again energized to close switch 25.

It is a further object of the present invention to provide an automatic restarting device which is compact, and may be enclosed in a casing mounted directly upon the starting motor casing, thus reducing the size of the leads extended to the starting motor.

The attainment of the above and further objects of the present invention will be apparent from the following specification taken in conjunction with the accompanying drawing forming a part thereof.

In the drawing:

Figure 1 is a perspective view of my improved restarting device enclosed in its casing;

Figure 2 is a front view of the device with the front portion of the casing cover cut away; and

Figure 3 is a diagram of the circuit involved.

Reference may be had first to the circuit diagram shown in Figure 3. At 1 there is indicated an internal combustion engine of an automobile, said engine being adapted to be coupled to a starting motor 2 by means of the usual cranking mechanism 3 which may comprise a Bendix drive, or the like. At 4 I have indicated one of the spark plugs of the internal combustion engine 1, said spark plug being energized over the usual circuit including a distributor D, an induction coil C, an interruptor I, an ignition switch S, and a battery B. This is the usual ignition circuit of which no further description is necessary.

The automatic starting device of the present invention is indicated at 10 and comprises a starting relay 15, a series relay 16, and a restarting or hold-out relay 17. The armature of the restarting relay comprises a vibrating reed 18 carrying back contacts 19, a weight 20, and an armature portion 21 of iron or the like adapted to be attracted by the core of the restarting relay 17. The restarting relay 17 includes an operating winding 22 and a holding winding 23. The operation of the system shown in Figure 3 is as follows: To start the engine 1 it is merely necessary to close the ignition switch S which is mounted on the dash board or the like. This establishes the ignition circuit through the primary of the coil C and likewise establishes an operating circuit for the starting relay 15, said circuit extending from the grounded battery, through the closed switch S, through the winding of the relay 15, thence through the back contacts 19 of the vibrating reed 18, to ground. The relay 15 operates and at its contacts 25 establishes a circuit for the starting motor 2, said circuit extending from the battery, through the winding of the relay 16 and the closed contacts 25 to the motor 2 and ground. The motor 2 therefore immediately commences to operate to crank the engine 1. The winding of the relay 16 comprises a strap of copper of approximately one turn. The heavy rush of current taken by the starting motor 2 causes the relay 16 to operate and at its contacts 26 establishes a holding circuit for the relay 15, by-passing the contacts 19 of the vibrating reed. Upon operation of the relay 15 there is also established a circuit for the operating winding 22 of the relay 17, said circuit extending through the now closed contacts 25 of the relay 15. The relay 17 operates and opens the contacts 19. At this time the circuit for the relay 15 is maintained through the now closed contacts 25 of the relay 16. When the engine 1 starts, the cranking device 3 declutches the motor 2 from the engine, and since the motor 2 now runs idle, it takes very little current, and the relay 16 therefore releases. The contacts 26 open, thereby opening the circuit for the starting relay 15. The relay 15 falls back and opens the circuit for the starting motor 2. At this time the circuit for the winding 22 of the relay 17 is opened. The holding winding 23 of this relay is connected across the generator G that is driven by the internal combustion engine, and since the armature of the relay 17 is already in its operated position, very little force is required to maintain it in its operated position. The voltage of the generator at this time is sufficient to maintain the armature reed 18 in its operated position, thus maintaining the contacts 19 open. The engine now continues to operate. If, during idling, the engine 1 should stall, my improved device will automatically restart the same. The automatic restarting action is brought about as follows: As the engine speed decreases, there is a decrease in the generated voltage of the generator G. However, the tension on the reed 18 is exceedingly small, hence an exceedingly small magneto-motive force is required to hold the reed 18 in its operative position. The relay 23 will therefore remain energized until the generator voltage G has been reduced almost to zero, which means that the engine speed has been reduced to a very low value. When the relay 17 releases the reed, the reed vibrates, making momentary contact at its contacts 19. During vibration of the reed the momentary contact at the contacts 19 is not sufficient to produce an immediate operation of the relay 15. When the vibration of the reed ceases there is established an operating circuit for the starting relay 15 at the contacts 19. In the meantime the engine has come to complete rest. The relay 15 operates and repeats the cycle of operation that was instituted by the initial closing of the ignition switch S, as previously described. There is thus provided an arrangement for automatically restarting the engine 1 should the engine stall while the ignition switch is closed. The arrangement, however, is such as to delay the closure of the starting motor circuit for a period of time sufficient to make certain that the engine 1 has come to a complete rest, said delay being obtained by the use of the vibrating reed 18, so arranged as to make certain that the reed is not subject to vibration until the generator voltage has been reduced to a very low value, a value below the voltage prevailing during the cranking of the engine 1 by the motor 2. This means that the reed need introduce only a very slight delay, since it takes very little time for the engine 1 to come to rest after its speed has been reduced to a value substantially below its cranking speed.

Reference may now be had more particularly to Figures 1 and 2, showing a preferred construction of the restarting apparatus of the present invention. The various parts are mounted on a frame which comprises a back portion 30, having rearwardly extending mounting arms 31 and 32 and rearwardly extending cover receiving arms 33 and 34 formed of a single piece of sheet metal. The arms 31 and 32 are curved to facilitate securing thereof to the casing of the starting motor and are provided with projecting ears 35—35 to facilitate such mounting. A forward extending flange 37 is secured to the upper end of the back portion 30 and a similar flange 38 is

secured to the lower end of the back 30. The mechanism shown within the dotted rectangle of Figure 3 is all mounted in the space between the flanges 37—38, and is enclosed by a removable cover 40 which is of a generally C-shape and has grooves 41 along its upper and lower edges. The cover is inserted over the flanges 37—38 with those flanges riding in the grooves 41 until the cover engages the front edge of the upper and lower flanges 37—38. The front upper and lower edges of the cover 40 are beaded over as indicated at 42 to form an internal groove corresponding to the groove 41 and engaging the front edges of the upper and lower flanges, thereby forming a complete enclosure for the starting mechanism. The cover is secured in place by means of sets of screws 44 and nuts 45 that secure the cover to the rearward projecting portions 33—34 of the back. A battery terminal 48 is secured to the upper flange 37 in insulated relation thereto. A strap 49 extends from this terminal and encircles the core of the relay 16 and then extends to the starting relay 15. The contact 26 is carried upon a plate pivoted adjacent its upper end, and having a spring 65 engaging about its upper end 66 to urge the contact 26 normally out of closed position. A copper disc 50 is carried by the plunger of the relay 15 which, when energized, draws the disc across the gap between this strap and a strap 51 that is connected to a terminal 52 insulated from and mounted on the flange 37 and for connection to the starting motor. The disc 50 is mounted on but insulated from the plunger of the relay 15, which plunger extends upwardly towards the disc and is adapted to be engaged by the push button 28 that slidably extends through the top flange 37, whereby the starting motor circuit may be completed independent of energization of the relay 15. The vibrating reed 18 is mounted upon a bracket arm 55 that is secured to the front side of the back 30. The reed 18 carries the iron portion 21 over the core of the relay 17 so that the reed with its iron portion 21 constitutes the armature of the relay 17. The weight 20 is secured to the end of the reed. The contacts 19 include a contacting portion carried by the reed 18 and a cooperating stationary contact making portion carried by a bracket 56 that is mounted upon a piece of insulation 57 secured to the back portion 30, whereby the bracket 56 is insulated from the back portion 30. A generator terminal lug 60 is secured to the lower arm 38, insulated therefrom, and is connected to the winding of the relay 17 by means of a conductor indicated at 61. The terminal that extends to the ignition switch is indicated at 62, said terminal being secured to the lower arm 38 but insulated therefrom and being connected to one end of the winding of the relay 15 by means of a conductor indicated at 63.

From the description thus far given, it is apparent that the vibrating reed 18 may be made of sufficient flexibility whereby only a very small amount of force is required to hold the armature portion 21 against the core of the relay 17 once the armature portion 21 has been brought adjacent said core, as by energization of the relay through the winding 22. It is only when this force becomes exceedingly small that the reed will be released and permitted to vibrate. The vibration of the reed is obtained merely by releasing the same from the core of the relay 17 rather than by plucking it.

In compliance with the requirements of the patent statutes I have herein shown and described a preferred embodiment of my invention. It is, however, to be understood that the invention is not limited to the precise construction and circuit arrangement herein shown, the same being merely illustrative of the principles of the invention.

What I consider new and desire to secure by Letters Patent is:

1. A system of the class described comprising an internal combustion engine, a cranking motor therefor, a starting relay for establishing a circuit for the motor, a holdout relay for opening the initial energizing circuit of the starting relay and maintaining it open during operation of the engine, and a series relay in series with the starting motor circuit for by-passing the holdout relay and maintaining a circuit for the starting relay during the starting operation of the motor, said holdout relay including an armature comprising a vibrating reed maintained against the core of the relay while the relay is energized and set into vibration when released from the core, and including a back contact for reestablising the initial operating circuit for the starting relay when the reed comes to rest.

2. Apparatus of the class described comprising a motor starting relay, a holdout relay having normally closed contacts in the circuit of the starting relay, a series relay the winding of which is connected in series with the contacts of the starting relay, said series relay including normally open contacts paralleling the normally closed contacts of the holdout relay, means for establishing an operating circuit for the holdout relay to open said normally closed contacts responsive to the operation of the starting relay and simultaneously closing said series relay contacts, whereby the starting relay circuit is maintained only by the series relay during energization of the starting relay circuit, and means effective under predetermined conditions for maintaining the holdout relay energized independent of the operated condition of the starting relay, whereby upon release of the series relay the starting relay releases and remains released until its operating circuit is reestablished by the release of the holdout relay upon the termination of said predetermined conditions, the armature of the holdout relay comprising a vibrating reed that is set into vibration upon release from the core of the holdout relay, and the closed contact of the holdout relay being on the reed.

3. In combination, a housing, a starting relay disposed in said housing, a pair of terminal members carried by said housing, means for effecting electrical connection between said members upon energization of said relay, a pair of relays extending normal to said first relay on opposite sides thereof, one of said relays being connected in series with said terminal members, a pair of normally spaced contacts adapted to be engaged by energization of said series-connected relay upon initial actuation of said starting relay, a vibrating reed armature adjacent said other normally extending relay and having contact portions disposed on opposite surfaces thereof, one of said contact portions being normally engaged, and means connecting said second relay in parallel with said terminal members to disengage said normally engaged contact upon initial actuation of said starting relay.

4. The combination with a starting circuit for an engine including an ignition circuit for said engine, a starting motor for said engine, and

means operable upon initial actuation of said ignition circuit to energize said starting motor circuit, said means including a pair of parallel paths, one of said paths being opened upon initial energization of said circuit and the other of said paths being closed upon said initial energization, of means for opening said first path comprising a relay having an energizing coil actuatable upon initial energization of said motor circuit, a vibrating reed armature in said first path attracted by said relay to open said path, said relay having a weighted portion at its free end and a pair of opposed intermediate contact portions, and a holding coil for said relay operable to hold said first path open during operation of said engine after deenergization of said starting circuit, said weighted portion of said armature being adapted to provide a time delay between deenergization of said holding coil and closing of said first path.

5. In an automatic starter control for internal combustion engines a starting circuit including a magnetic starting switch, a control circuit for said starting switch including two sets of contacts in parallel, one set being normally closed and the other set normally open, means energized by closure of the starting switch for closing the normally open contacts and opening the normally closed contacts, means for holding open the normally closed contacts during self-operation of the engine, and means operative upon release of said holding means for vibrating said normally closed contacts a predetermined time before permitting effective closure thereof.

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