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CONTROL APPARATUS FOR ENGINE STARTERS

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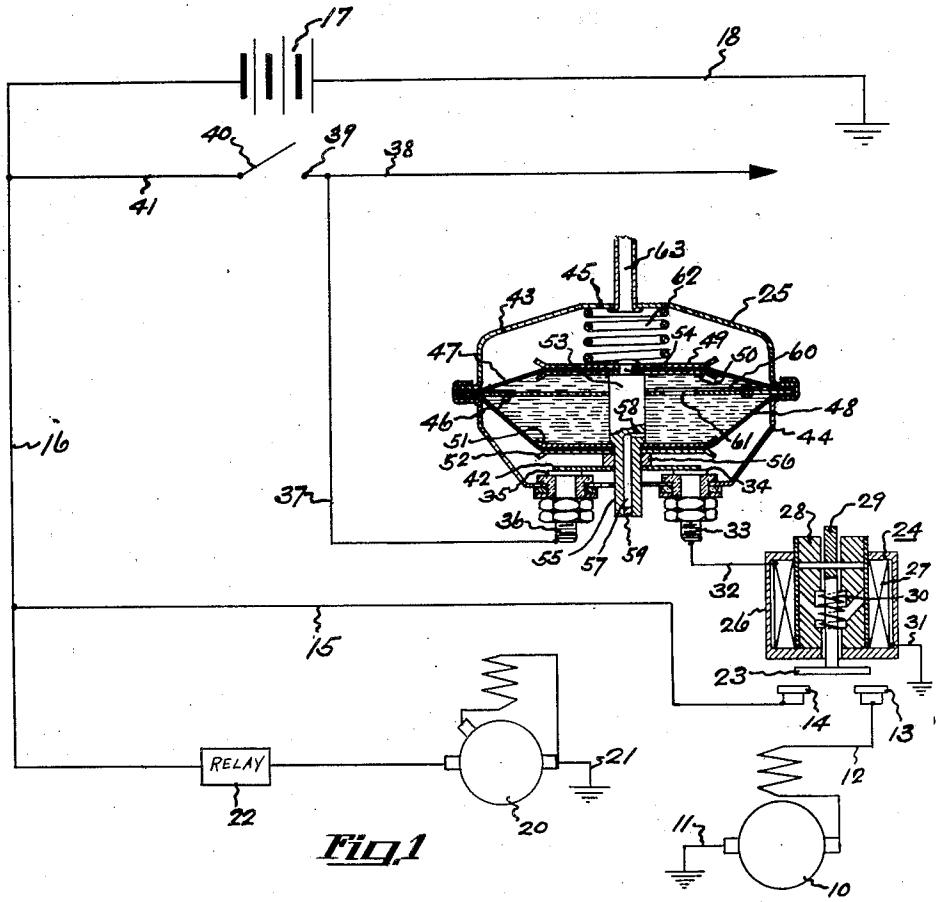


Fig. 1

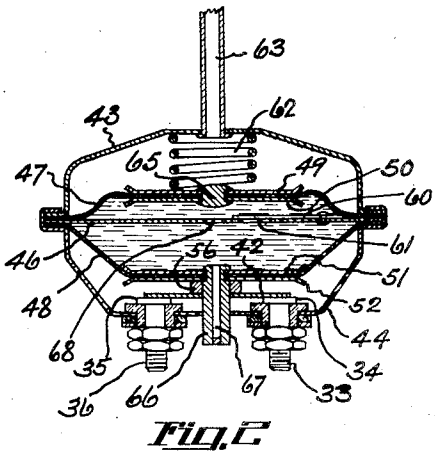


Fig. 2

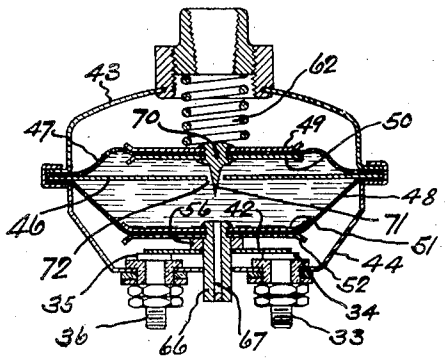


Fig. 3

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CONTROL APPARATUS FOR ENGINE STARTERS

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This invention relates to internal combustion engines and more particularly to devices of this kind which will automatically start the engine whenever the ignition switch is closed and will operate to restart the engine at any time it should stop so long as the ignition switch remains closed.

Devices of this general type are shown in the prior art, as for instance, in the patent to Hasselbring No. 1,739,069, granted December 10, 1929.

In starting devices of this general type it is of importance to provide some means to delay the restarting of the engine subsequent to any stopping thereof for at least long enough to permit the shaft of the starting motor to come to rest. If the engine should stall almost immediately after it is started, the shaft of the starting motor may still be turning and if the switch which controls the action of the starting motor were immediately closed again the result might be that the pinion driven by the starting motor would be moved into engagement with the engine flywheel gear or other part driven by said pinion while the pinion was rotating and result in damaged or broken parts. Accordingly, it is one of the principal objects of this invention to provide in a control system of the character referred to, an improved device for delaying the restarting of the engine subsequent to any stopping thereof for an appreciable interval.

It is a further object of the invention to provide a switch, the closing action of which is always retarded so that the movement of the switch from open to closed position is slightly delayed. It will be understood that while this switch is particularly useful in a control system for an engine starting device as disclosed herein, it is also of general application where it is desired to delay the closing of a circuit to some extent.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing wherein a preferred embodiment of one form of the present invention is clearly shown.

In the drawing:

Fig. 1 is a wiring diagram of a control system for an engine starting device constructed in accordance with the present invention and showing the improved form of delayed action switch in detail.

Figs. 2 and 3 are detailed sections of modified forms of the switch.

In the drawing, the starting motor is diagrammatically shown at 10 and is grounded at 11. This starting motor as shown in the drawing is adapted to turn the engine to start it through the medium of the well-known Bendix drive in which a driving pinion driven by the motor shaft is automatically moved into mesh with a suitable gear or some part of the engine to be driven, such as the flywheel, when the circuit of the starting motor is closed and is automatically disengaged from the flywheel when the engine starts to run under its own power. The construction and operation of the Bendix drive is so well-known that further description or illustration thereof is thought unnecessary. It will be understood, however, that other forms of starter drive mechanism may be used with the control system described herein and that such control system is not applicable only to the Bendix drive.

The starting motor 10 is connected by the wire 12 with one fixed contact 13 of an automatically controlled magnetic switch, the other fixed contact 14 of which is connected by a wire 15 with a wire 16 leading from a storage battery 17 grounded at 18 to the generator 20 which is grounded at 21. The usual cutout relay is provided at 22. Cooperating with the fixed contacts 13 and 14 is a movable contact of an automatic magnetic switch indicated in its entirety by the reference numeral 24, which will be hereinafter more fully described. Obviously when the contact 23 engages the contacts 13 and 14, the circuit of the starting motor is closed and the motor will be effective to start the engine. Current will flow from the battery through wires 16 and 15, the switch contacts 14, 23 and 13, wire 12 to the motor through the connection 11 to ground and through connection 18 from ground to the battery. The switch 24 is normally open and is adapted to be closed when a suction operated switch 25 is closed and the ignition switch hereinafter referred to, is also closed. The closing of the ignition switch and the switch 25 will cause the magnetic switch 24 to become energized and to move the contact 23 into engagement with the contacts 14 and 13, as previously described.

To this end the magnetic switch is provided with a housing 26 in which is received the winding 27 of an electromagnet. The magnet is provided with a core 28 having an armature 29 in the form of a rod which supports the movable contact 23. A spring 30 normally holds the armature in such position that the magnetic switch is open when the magnet is not energized. One end of the winding is grounded at 31 and the other end

of the winding is connected by a wire 32 to a binding post 33, which is integral with one fixed contact 34 of the suction operated switch 25. This switch has a second fixed contact 35 connected with the binding post 36 to which a wire 37 is connected. The wire 37 connects with a wire 38 leading from the fixed contact 39 of the ignition switch to the ignition system of the engine which is not shown. The ignition switch also has a movable contact 40 connected by a wire 41 with the wire 16 which leads to the battery. The switch 25 is normally in closed position, as shown in the drawing, said switch having a movable contact 42 which is normally in engagement with the contacts 34 and 35 so that when the ignition switch is closed, current will flow from the battery to ground through the connection 18 and through the wires 16 and 41, the ignition switch, wire 37, contacts 35, 42, and 34, wire 32, the winding of the magnetic switch and wire 31 to ground again. This will energize the magnetic switch and cause the movable contact 23 to engage the contacts 13 and 14 to close the starting motor circuit, as previously described.

The suction operated switch 25 is adapted to be opened by engine suction when the engine begins to run under its own power in order to break the circuit through the winding of the electromagnetic switch 24 to render the starting motor inoperative and said suction operated switch is adapted to be maintained in open position to prevent any operation of the starting motor as long as the engine continues to run. In the event of the engine's stopping, however, the suction operated switch 25 is adapted to close so that the engine is automatically restarted whenever the ignition switch remains closed without any attention whatever on the part of the operator. The construction of the switch 25 will now be described.

The switch 25 comprises two sheet metal shells 43 and 44, which are flanged, the flange of one of said shells being crimped over the other and brazed, or otherwise secured together to form a fluid-tight joint. Clamped between the flanges of the two shells are a partition member 46 and two flexible diaphragms 47 and 48. On opposite sides of the diaphragm 47 are two sheet metal reinforcing washers or discs 49 and 50, while two similar discs or washers 51 and 52 are placed on opposite sides of the diaphragm 48 to reinforce the diaphragms. A pin 53 has a reduced portion 54 extending through the diaphragm 47 and the disks 49 and 50 being riveted over the disc 49 to secure the assembly together. This pin also extends through an opening in the partition plate 46 and another reduced portion 55 of the pin extends through the diaphragm 48 and the discs 51 and 52 these discs and the diaphragm 48 being clamped between a shoulder formed on the pin and a nut or washer 56 which is secured in position on the reduced portion 55 in any desirable way and also secured to this pin in any desirable manner is the movable switch contact 42 previously referred to.

The pin 53 has a bore 57 which extends through the reduced portion 55 of said pin axially thereof and connects with a bore 58 at its inner end which communicates with the space between the diaphragms. Some suitable liquid such as oil is forced through these bores into the space between the diaphragms and the outer end of the bore 57 is then closed by a plug 59 so that the liquid is sealed within the space between the diaphragms. The partition plate 46 is provided with a resilient flap valve 60 secured thereto at one end and adapted to close an orifice 61 in the partition plate to regulate the flow of liquid from the space on one side of the partition plate 46 to the other side of such plate as the diaphragms move under the influence of engine suction. This valve is adapted to open to permit a free flow of fluid from the space on the lower side of the diaphragm 46 to the space on the upper side, but is adapted to be closed when a flow of fluid takes place from the space above the partition plate to the space below so as to restrict the flow of fluid in that direction for a purpose more fully described hereinafter. A spring 62 is received between the upper shell 43 and the reinforcing disc 49 for the purpose of holding the parts in the position shown in Fig. 1 with the contact 42 in engagement with the contacts 34 and 35. A suitable suction connection 63 is secured to the upper shell 43 in any suitable way and extends to a point on the intake pipe of the engine between the carburetor throttle valve and the intake ports to communicate the engine suction to the space within the shell 43 above the diaphragm 47.

The operation of the switch is relatively simple. When the parts are in normal position with the engine at rest, the switch contact 42 is in engagement with the contacts 34 and 35 as shown. The engine suction which is communicated to the space within the shell 45 during the cranking of the engine by the starting motor is insufficient to overcome the pressure of the spring 62 and accordingly, the suction operated switch remains closed during the cranking operation. As soon as the engine starts to run under its own power, however, the suction which is communicated to the space in shell 45 is enough to overcome the spring pressure and the diaphragm 47 is lifted by the suction. This creates a suction on the fluid within the space between the diaphragms and fluid will flow upwardly through the orifice 61, the valve 60 being moved off its seat to permit such a flow. This flow of fluid will be relatively free and the switch will be opened substantially immediately. As pointed out previously however, in the event of accidental stalling of the engine almost immediately after it has started to run, it is not desirable for the switch to close immediately and to accomplish this function the valve 60 and the orifice controlled thereby are provided. As soon as the engine stops the suction within the shell 45 is relieved and the spring starts to force the diaphragm 47 downwardly. In order for this downward movement of the diaphragm to take place the fluid within the space above the partition 46 must be displaced and forced into the space below the partition. As soon as the suction is relieved, however, the valve 60 is closed so that the flow of fluid from the space above the partition to the space below the partition must take place by leakage around the pin 53, which has a slightly loose fit in the orifice in the plate 46 through which said pin extends. Therefore, the downward movement of the diaphragm 47 and of the switch contact 42 is somewhat retarded by the slow flow of fluid from the space above the partition plate 46 to the space below to accomplish the result desired.

In Fig. 2 a form of suction operated switch is disclosed which is almost the same as that previously described, the only difference in construction residing in the fact that the pin 53 is of somewhat different construction. In this form

of invention the two reinforcing discs 49 and 50 are secured on opposite sides of the diaphragm 46 by means of a simple rivet indicated by the numeral 65. Instead of employing a pin 53 which extends through the partition plate as in the form of the invention previously described, there is shown in Fig. 2 a pin 66 which extends only through the diaphragm 48 and the reinforcing disks 51 and 52. A reduced portion of the pin extends through these elements and is riveted over the disk 51 to secure the assembly together. An axial bore 67 is provided in the pin for the purpose of filling the space between the diaphragms 47 and 48 with fluid and is closed by a plug in the same way as previously described. This pin 66 does not extend through the partition plate 46 and, therefore, there is no space around the pin provided for the leakage of fluid. As a substitute for this space, there is provided in this form of the invention a relatively small port 68 in the partition 46 which is not variable and which is open at all times. Obviously in this form of the invention when the suction of the engine is effective to move the diaphragm 47 upwardly, the flow of fluid from the space below the partition plate will take place through the valve controlled port 61, as in the previously described form of the invention, and also through the small opening 68 but the downward flow of fluid from the space above the partition plate 46 can only take place through the restricted opening 68, thus retarding the downward movement of the diaphragm 47 and the movable contact 42 in the same way as previously described in connection with the form of the invention shown in Fig. 1.

In the form of the invention shown in Fig. 3 the construction of the suction operated switch is exactly the same as that shown in Fig. 2 except that a different form of means for controlling the fluid flow through the partition plate 46 is employed. In this form of the invention, the valve 60 and the port controlled thereby have been eliminated and instead, the diaphragm 47 and the disks 49 and 50 are secured together by a rivet 70 which has formed on its inner side a tapered valve 71 which extends through an orifice 72 at the center of the partition plate 46. This valve normally occupies a position so that the orifice 72 is nearly closed, but on upward movement of the diaphragm 47 under the influence of engine suction, the valve is moved toward open position so as to permit a relatively free flow of fluid. When the engine suction ceases to be effective in the space above the diaphragm 47 and the latter starts to return to normal position under the influence of the spring 62, the valve 70 is moved toward closed position, which restricts the flow of fluid from the space above the diaphragm 46 progressively as the valve moves toward its closed position to secure the desired retarded movement of the switch contact 42 toward its closed position.

While the form of embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. In a control apparatus for engine starting devices, a control switch comprising fixed and movable contacts, a member carrying the movable contact and movable therewith, and means for retarding the movement of said member toward position to effect closing of the switch comprising a liquid dash pot for controlling the movement of said member.

2. In a control apparatus for engine starting devices, a control switch comprising fixed and movable contacts, a member carrying the movable contact and movable therewith, and a liquid dash pot for retarding the movement of said movable contact toward switch closing position, said dash pot comprising a chamber from which liquid is forced during the movement of said movable contact toward the fixed contact, and means for restricting the flow of liquid from said chamber.

3. In a control apparatus for engine starting devices, a control switch comprising fixed and movable contacts, a suction operated member carrying the movable contact and movable therewith as the contact is moved toward and away from the fixed contact, and a liquid dash pot for retarding the movement of said movable contact toward switch closing position, said dash pot comprising a chamber containing liquid from which liquid is forced during the movement of the movable contact toward closed position, and a valve for regulating the rate of flow from said chamber.

4. In a control apparatus for engine starting devices, a control switch comprising fixed and movable contacts, a suction operated member carrying the movable contact and movable therewith as the contact is moved toward and away from the fixed contact, a liquid dash pot for retarding the movement of said movable contact toward switch closing position, said dash pot comprising a chamber containing liquid from which liquid is forced during the movement of the movable contact toward closed position, a valve for regulating the rate of flow from said chamber, and a fixed orifice permitting a limited flow of liquid from said chamber independently of the valve.

5. In a control apparatus for engine starting devices, a control switch comprising fixed and movable contacts, and means for delaying the movement of the movable contact toward closed position said means comprising two flexible diaphragms movable to different positions as the switch is opened and closed, said diaphragms forming a fluid tight liquid chamber between them and operable when moved to move the movable switch contact, a partition within the liquid dividing said chamber into two chambers so arranged that liquid is forced back and forth from one chamber to another as the diaphragms are moved, and means permitting a free flow of liquid through the partition plate on opening of the switch and restricting the flow of liquid on closing of the switch, whereby closing of the switch is delayed.

6. In a control apparatus for engine starting devices, a control switch comprising fixed and movable contacts, and means for delaying the movement of the movable contact toward closed position said means comprising two flexible diaphragms movable to different positions as the switch is opened and closed, said diaphragms forming a fluid tight liquid chamber between them and operable when moved to move the movable switch contact, a partition within the liquid dividing said chamber into two chambers so arranged that liquid is forced back and forth from one chamber to another, as the diaphragms are moved, and means permitting a free flow of liquid through the partition plate on opening of the switch and restricting the flow of liquid on closing of the switch, a valve opening in one partition adapted to permit a free flow of fluid through the partition when the switch is opened and re-

stricting the flow through the partition when the switch is closed, whereby closing of the switch is delayed.

7. In a control apparatus for engine starting devices, a control switch comprising fixed and movable contacts and means for delaying the movement of the movable contact toward closed position said means comprising two flexible diaphragms movable to different positions as the switch is opened and closed, said diaphragms forming a fluid tight liquid chamber between them and operable when moved to move the movable switch contact, a partition within the liquid dividing said chamber into two chambers so arranged that liquid is forced back and forth from one chamber to another, as the diaphragms are moved, and means permitting a free flow of liquid through the partition plate on opening of the switch and restricting the flow of liquid on closing of the switch, a valve opening in one partition adapted to permit a free flow of fluid through the partition when the switch is opened and restricting the flow through the partition when the switch is closed, whereby closing of the switch is delayed and a fixed orifice in the partition permitting a limited flow in both opening and closing of the switch.

8. In a control apparatus for engine starting devices, a control switch comprising fixed and movable contacts, and means for delaying the movement of the movable contact toward closed position said means comprising two flexible diaphragms movable to different positions as the switch is opened and closed, said diaphragms forming a fluid tight liquid chamber between them and operable when moved to move the movable switch contact, a partition within the liquid dividing said chamber into two chambers so arranged that liquid is forced back and forth from one chamber to another as the diaphragms are moved, and means permitting a free flow of liquid through the partition plate on opening of the switch and restricting the flow of liquid on closing of the switch, and means to move the diaphragms to position to open the switch.

9. In a control apparatus for engine starting devices, a control switch comprising fixed and movable contacts, and means for delaying the movement of the movable contact toward closed position said means comprising two flexible diaphragms movable to different positions as the switch is opened and closed, said diaphragms forming a fluid tight liquid chamber between them and operable when moved to move the movable switch contact, a partition within the liquid dividing said chamber into two chambers so arranged that liquid is forced back and forth from one chamber to another, as the diaphragms are moved, and means permitting a free flow of liquid through the partition plate on opening of the switch and restricting the flow of liquid on closing of the switch, and means for communicating suction to said diaphragms to move the diaphragms to switch open position.

10. In a control apparatus for engine starting devices, a control switch comprising fixed and movable contacts, and means for delaying the movement of the movable contact toward closed position said means comprising two flexible diaphragms movable to different positions as the switch is opened and closed, said diaphragms forming a fluid tight liquid chamber between them and operable when moved to move the movable switch contact, a partition within the liquid dividing said chamber into two chambers so arranged that liquid is forced back and forth from one chamber to another as the diaphragms are moved and means permitting a free flow of liquid through the partition plate on opening of the switch and restricting the flow of liquid on closing of the switch, means for communicating suction to said diaphragms to move the diaphragms to switch open position.

11. In a control apparatus for engine starting devices, a control switch comprising fixed and movable contacts and means for delaying the movement of the movable contact toward closed position said means comprising two flexible diaphragms movable to different positions as the switch is opened and closed, and one of which supports the movable switch contact, said diaphragms forming a fluid tight liquid chamber between them and operable when moved to move the movable switch contact, a partition within the liquid dividing said chamber into two chambers so arranged that liquid is forced back and forth from one chamber to another, as the diaphragms are moved, and means permitting a free flow of liquid through the partition plate on opening of the switch and restricting the flow of liquid on closing of the switch, whereby closing of the switch is delayed.

12. In a device of the character described a control switch having fixed and movable contacts, means for delaying the closing of the switch comprising a member carrying the movable contact and movable therewith, a liquid dash pot controlling the movement of said member, and comprising a chamber filled with liquid when the switch is open and from which liquid is forced by the movement of said member when the movable contact is moved toward the fixed contact, and means for restricting the flow of liquid from said chamber during such movement of said contact, whereby the closing of the switch is delayed.

13. In a device of the character described a control switch having fixed and movable contacts, means for delaying the closing of the switch said means comprising two flexible diaphragms movable to different positions as the switch is opened and closed, said diaphragms forming a fluid tight liquid chamber between them and operable when moved to move the movable switch contact, a partition within the liquid dividing said chamber into two chambers so arranged that liquid is forced back and forth from one chamber to another as the diaphragms are moved, and means permitting a free flow of liquid through the partition plate on opening of the switch and restricting the flow of liquid on closing of the switch whereby closing of the switch is delayed.

14. In a control apparatus for engine starting devices, a control switch comprising fixed and movable contacts, and means for delaying the movement of the movable contact toward closed position said means comprising two flexible diaphragms movable to different positions as the switch is opened and closed, said diaphragms forming a fluid tight liquid chamber between them and operable when moved to move the movable switch contact, a partition within the liquid dividing said chamber into two chambers so arranged that liquid is forced back and forth from one chamber to another as the diaphragms are moved, and means for progressively increasing the rates of flow through said partition as the switch is opened and progressively decreasing the rate of flow through the partition when the switch is closed.

15. In an automatic starter control, a circuit

controlling device including contacts, means responsive to self-operation of the engine for actuating said contacts, and means for returning the contacts to idle position after a predetermined time delay including a plurality of flexible diaphragms and a partition therebetween having an opening for metering the passage of fluid therethrough.

16. In an automatic starter control, a circuit controlling device including normally closed contacts, means responsive to self-operation of the engine for opening said contacts, and means for returning the contacts to closed position after a predetermined time delay including a plurality of flexible diaphragms forming chamber walls and a partition therebetween having an opening for metering the passage of fluid therethrough.

17. In a circuit controlling device, a set of contacts, a flexible diaphragm arranged to control said contacts, a second flexible diaphragm and a partition separating said diaphragms and forming chambers therewith and having an opening for metering the passage of fluid therebetween, whereby the first diaphragm is sluggishly responsive to forces applied to the second diaphragm.

18. In an automatic starting control for internal combustion engines, a circuit controlling device including a set of contacts, a flexible diaphragm arranged when distended to close said contacts, a second flexible diaphragm, a partition separating said diaphragms and forming chambers therewith and having an opening for metering the passage of fluid therebetween, and means for flexing the second diaphragm in accordance with operating conditions of the engine to be started.

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