Nov. 19, 1935. M. P. WHITNEY 2,021,822

TIME DELAY DEVICE FOR AUTOMATIC SWITCHES

Filed April 12, 1930 3 Sheets-Sheet 1

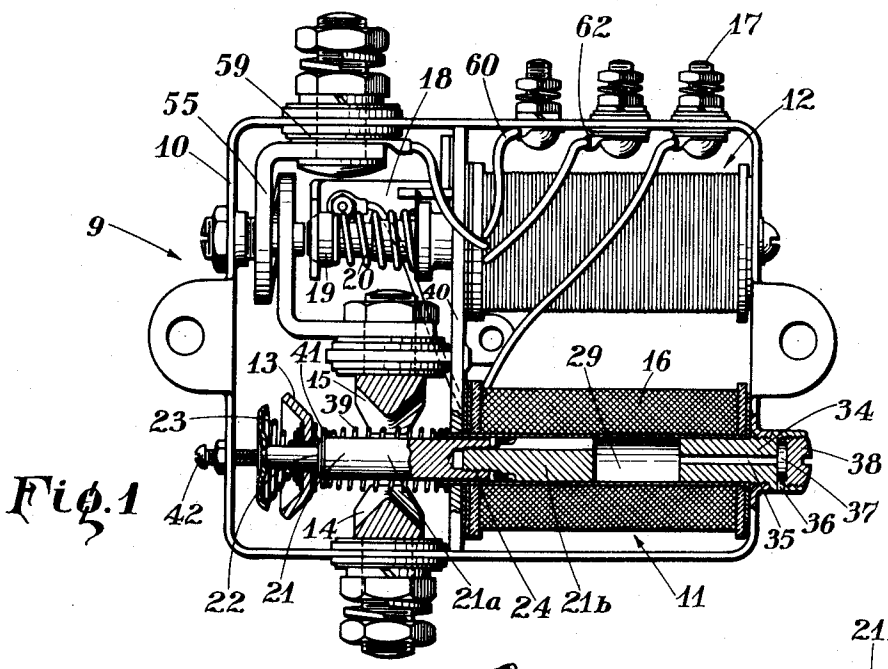


Fig. 1

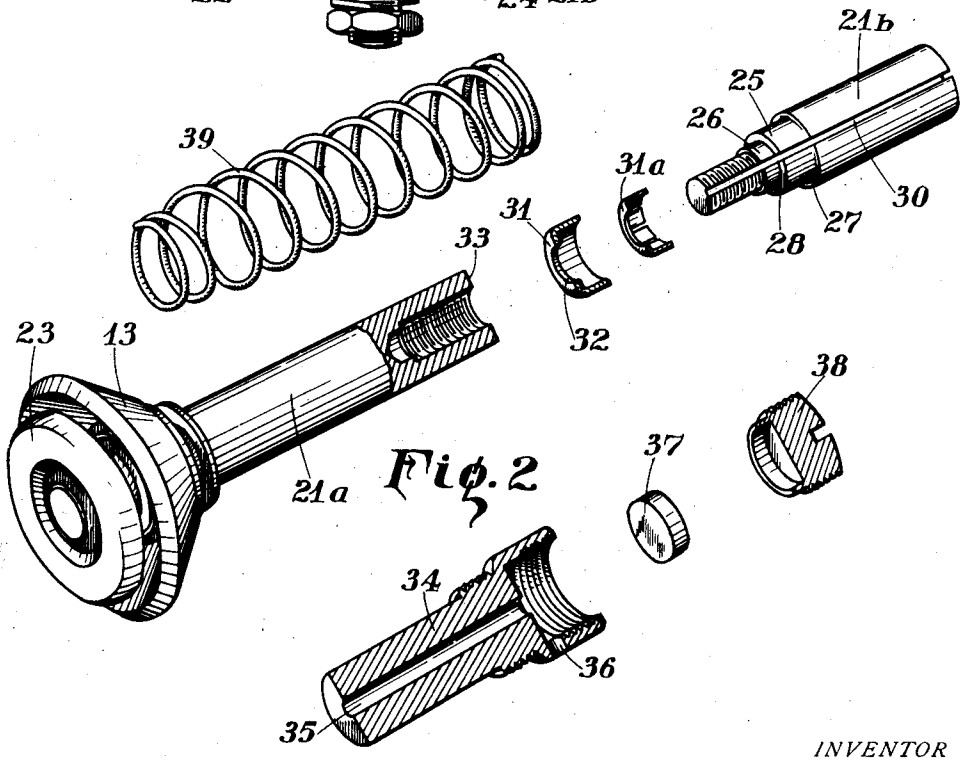


Fig. 2

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TIME DELAY DEVICE FOR AUTOMATIC SWITCHES

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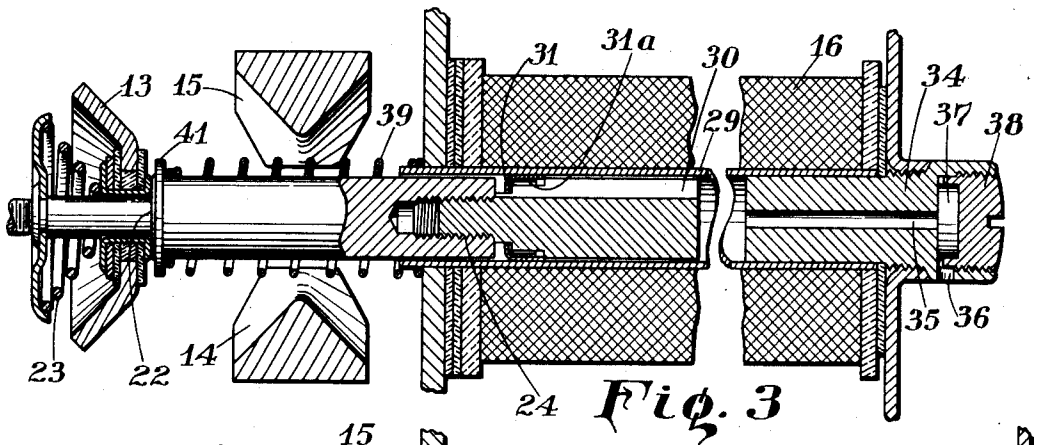


Fig. 3

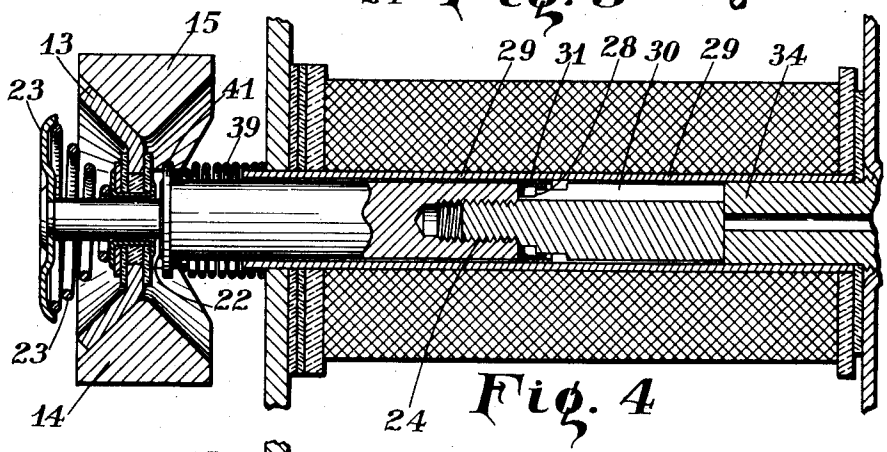


Fig. 4

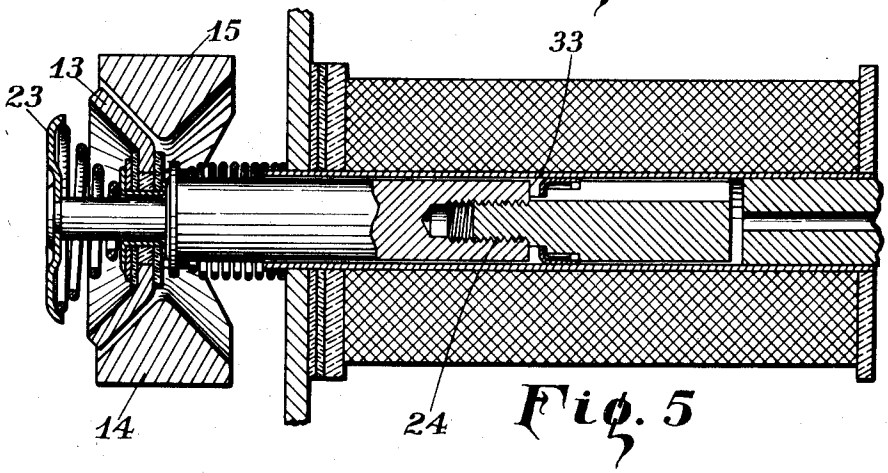


Fig. 5

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TIME DELAY DEVICE FOR AUTOMATIC SWITCHES

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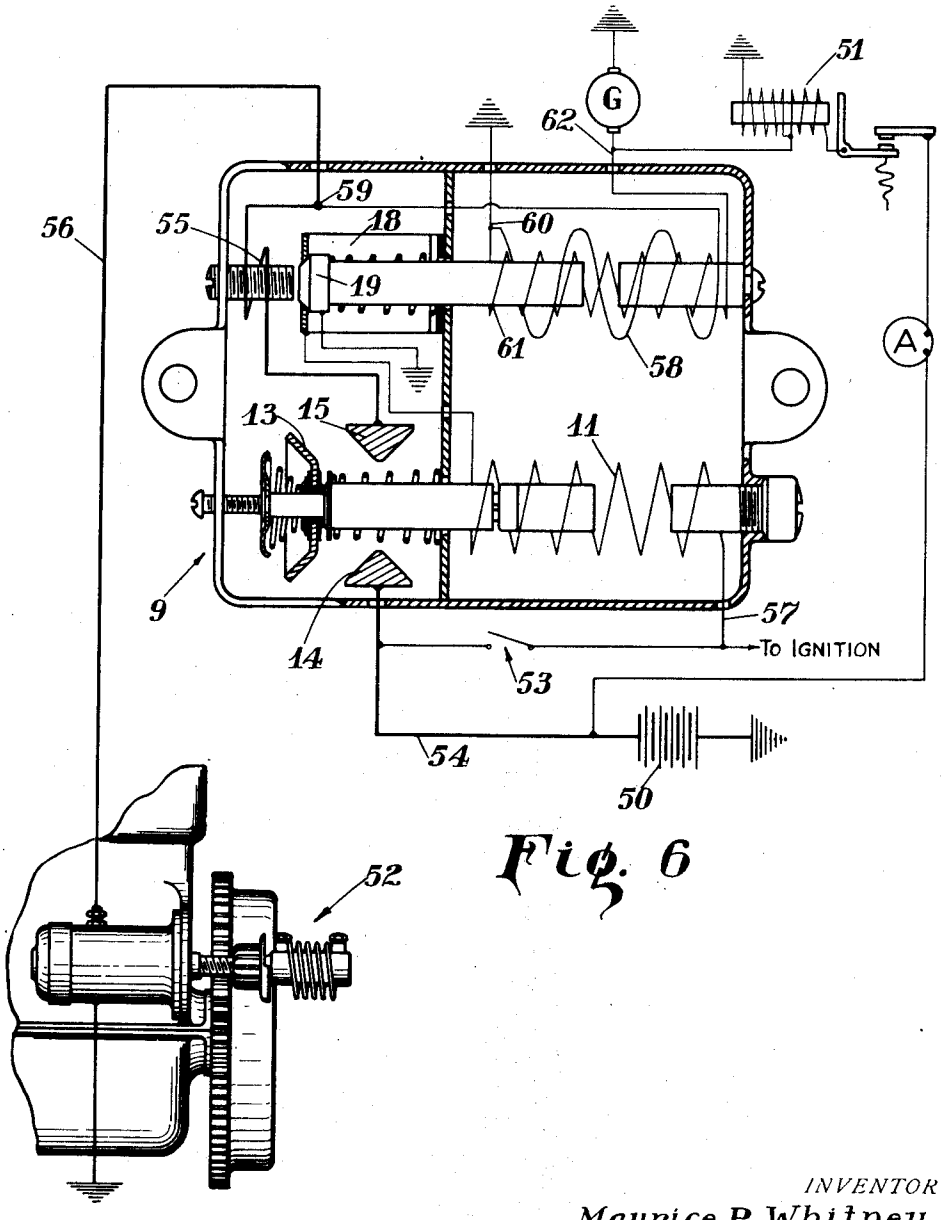


Fig. 6

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TIME DELAY DEVICE FOR AUTOMATIC SWITCHES

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4 Claims. (Cl. 200—97)

This invention relates to a novel time delay device for an automatic switch and particularly to a means for delaying the closing of an automatic switch for starting mechanism.

One object of the device is the provision of a novel time delay for automatic switches which is reliable and efficient and generally superior to those heretofore known.

Another object is to provide such a time delay which is adapted to delay the closing of the switch but which provides for a quick substantially unimpeded opening thereof.

A further object of the invention is the provision of such a device embodying a dash pot for the timing element.

Another object is to provide such a device embodying a dash pot which is located within the body of the switch, thus rendering the device compact and well protected from accidental injury.

A further object is to provide such a device which is readily adjustable to regulate the timing thereof and which accurately maintains such adjustment.

A further object of the invention is the provision of such a device which is economical to manufacture, is easily assembled and requires but few parts to be added to the switch assembly.

Other objects and advantages of the invention will become apparent from the following description taken in connection with the accompanying drawings in which:—

Fig. 1 is an elevation of an automatic switch embodying the present invention, some of the parts being in axial section;

Fig. 2 is an enlarged expanded view in perspective of certain of the parts;

Fig. 3 is an enlarged detail in section of certain parts of the switch shown in normal position;

Fig. 4 is a similar view showing the parts in operative position;

Fig. 5 is a similar view showing the parts in their position at the instant the switch has been opened; and

Fig. 6 is a schematic view of an automatic starting device embodying the improved automatic switch, incorporating the novel time delay element.

Referring first to Fig. 1 of the drawings, the switch 9 comprises a casing 10 of any convenient form having a switch controlling solenoid 11 and a contact controlling solenoid 12 rigidly mounted therein. Solenoid 11 is adapted to control the position of a switch member 13 which when in its closed position bridges a pair of contacts 14 and 15 to complete a starting motor circuit. One end of the coil 16 of solenoid 11 is connected to a binding post 17 while the opposite end of said coil is connected to a bracket 18 mounted rigidly on casing 10 but insulated therefrom. Solenoid 12 is adapted to operate a plunger 19 which normally is held in contact with bracket 18 as by means of a spring 20 thus grounding the bracket to the casing 10 through spring 20 and the adjacent parts.

Switch member 13 is loosely mounted on plunger 21 of solenoid 11, electrically insulated therefrom, and is yieldably held against a shoulder 22 thereon as by means of a spring 23. Spring 23 is held in position and connected to plunger 21 by suitable means such as a dished washer 23^a riveted on the end of plunger 21 and forming a seat for the outer end of said spring. Plunger 21 is formed in two parts 21^a and 21^b which fit loosely within a cylindrical core 29 of solenoid 11. Parts 21^a and 21^b are fixed together in any suitable way as by means of a threaded connection 24. Part 21^b is provided as best shown in Fig. 2 with portions 25 and 26 of progressively reduced diameters forming shoulders 27 and 28 respectively and cooperating with the end of part 21^a to form annular chambers or spaces within the cylinder 29. Part 21^b is also provided with a longitudinal slot 30 extending throughout its length.

A cup valve of any suitable material is loosely mounted in the space between members 21^a and 21^b with its inturned portion 32 adapted to rest against shoulder 28 and its cylindrical portion adapted to surround the portion 25 of member 21^b. Valve 31 has a working fit within cylinder 29, and may if desired be provided with an expander 31^a therein to ensure an air-tight fit.

It will be noted that the space between the shoulder 28 of member 21^b and shoulder 33 formed by the end of 21^a is considerably greater than the thickness of the inturned portion 32 of the cup valve 31 and of expander 31^a, so that the cup valve is mounted on the plunger 21 with considerable longitudinal lost motion. When cup valve 31 rests against shoulder 33 it forms with such shoulder an obturator preventing the escape of air past the member 21^a, but when the valve rests against the shoulder 28 air can readily pass through the space between shoulder 33 and inturned portion 32 and traverse the longitudinal slot 30.

The end of cylinder 29 opposite that through which plunger 21 protrudes is closed by suitable means such as a plug 34 threaded within cas-

ing 10 and having a tight fit within said cylinder. Plug 34 may be provided with an adjustable bleeder which as illustrated comprises a channel 35 axially traversing the same, and a radial opening 36 intersecting said channel. A plug 37 of suitable compressible material such as rubber or fibre is pressed against the opening of channel 35 as by means of threaded plug 38, the pressure being regulated by adjusting the plug to vary the rate of flow of air through said channel.

Plunger 21 is normally maintained in the position illustrated in Figs. 1 and 3 by means such as a spring 39 bearing against a partition member 40 of casing 10 at one end and against a collar 41 fixed on the plunger 21 at its other end. The length of the stroke of plunger 21 may be regulated by means such as the adjustable stop 42 mounted in casing 10 and forming an abutment for said plunger.

In Fig. 6 of the drawings one form of electrical connections is shown whereby the automatic switch may be used in an automatic starting device for internal combustion engines. A battery 50, engine driven generator G, automatic cut-out 51 and ammeter A are connected as shown or in any usual or preferred manner so that the generator will charge the battery while the engine is running. A starter of the automatic mesh type indicated generally at 52 is adapted to be energized by said battery, and switch 9 is designed to automatically control the actuation thereof whenever the ignition switch 53 is closed by the operator.

For this purpose, a cable 54 is arranged to connect the ungrounded end of battery 50 to contact 14 of switch 9. Contact 15 is connected through a single turn solenoid 55 to cable 56 leading to the starter 52. Switch controlling solenoid 11 is connected to the ignition circuit by a lead 57 so that closure of the ignition switch 53 will energize said solenoid if contacts 19, 18 are closed. A voltage coil 58 forming a part of solenoid 12 is connected to the starter circuit at 59 and to the ground at 60, and a generator coil 61 is connected to the generator circuit at 62 and is also grounded at 60.

In operation, when the ignition switch 53 is closed, solenoid 11 draws plunger 21 down, closing switch 13, 14, 15 and causing the energization of the starter. Series coil 55 and voltage coil 58 are also simultaneously energized and exert opposing forces on contact plunger 19, coil 55 acting to hold the contact closed, and coil 58 tending to open the contact. As long as the starter is cranking the engine the current in the starter circuit is so heavy that coil 55 is stronger than coil 58, and contact 19 is held closed. When the engine starts, however, the load on the starting motor is relieved and the starting current is reduced so that coil 58 overcomes coil 55 and withdraws contact plunger 19 from contact bracket 18, opening the circuit through switch solenoid 11 and releasing switch member 13. The battery connection to the starter is thus broken, but since voltage coil 58 is still connected to the motor, the contact 19 will be held open by the slight current generated by the spinning of the motor armature in its residual field. Before the starting motor has stopped, the generator coil 61 has become sufficiently energized by the generator G to retain the contact 19 open as long as the engine is running.

If the engine should stall for any reason, the generator coil 61 becomes deenergized, allowing contact 19 to close and the operation is repeated as long as the ignition switch remains closed.

The time delay device which forms the subject matter of the present invention is provided in order to allow the engine to come completely to rest before the switch 13, 14, 15 is allowed to close. This time delay is furnished by the dash pot action of the valve 31 in cylinder 29 since during the inward stroke of plunger 21 valve 31 rests against the shoulder 33 and forms therewith a tight piston. The time delay may be regulated either by adjusting the plug 38 to vary the rate of escape of air through the channel 35 or by varying the stroke of plunger 21 by means of the adjustable stop 42.

Since large amounts of current are carried in the starting circuit, it is obvious that contacts 13, 14, and 15 will be subject to heavy arcing if the break of said contacts is not instantaneous. With this purpose in view, the valve 31 is given the lost motion referred to with respect to plunger 21, so that return movement of plunger 21 is unimpeded by the friction of said valve in the cylinder 29.

This operation is best illustrated in Figs. 4 and 5 of the drawings. Fig. 4 illustrates the position of the parts when the switch is closed. It will be noted that valve 31 rests against shoulder 33 and spring 23 is slightly compressed in holding switch member 13 against contacts 14 and 15. When the circuit through coil 16 is broken by the control solenoid 12, (Fig. 1) spring 39 immediately expands and moves plunger 21 outwardly to the position shown in Fig. 5. As there illustrated, it will be seen that a clean break of the contacts is obtained by the time the lost motion between valve 31 and plunger 21 has been taken up.

Although but one embodiment of the invention has been illustrated and described in detail, it will be understood that this structure is not exclusive and further embodiments will now suggest themselves to those skilled in the art and certain parts may be combined, altered or omitted and changes made in the arrangement and mode of operation thereof without departing from the spirit of the invention.

Reference will therefore be had to the claims hereto appended for a definition of the scope of the invention.

What is claimed is:—

1. An automatic electric switch including a fixed pole piece, a movable armature cooperating therewith, a contact element, a yielding connection between the armature and contact which is loaded when the switch is closed and permits the armature to engage the pole piece to close the magnetic circuit therethrough, means for retarding the switch closing motion of the armature, said retarding means having a lost motion connection with said armature to allow an unimpeded initial switch opening movement thereof to unload the yielding connection and break away said contact.

2. An automatic electric switch including a fixed pole piece, a movable armature cooperating therewith, a contact element, a yielding connection between the armature and contact which is loaded when the switch is closed and permits the armature to engage the pole piece to close the magnetic circuit therethrough, means for retarding the switch closing motion of the armature, said retarding means having a lost motion connection with said armature to allow an un-

impeded initial switch opening movement thereof to unload the yielding connection and break away said contact, said armature having an abutment adapted to engage the contact element to break open the switch during the lost motion of the armature with respect to the retarding means.

3. A magnetic switch for automatic starting mechanism including fixed and movable contacts, operating means for the movable contact including a yielding connection for maintaining the engagement of the contacts, retarding means for said operating means, and means for rendering the retarding means inoperative for a portion of the stroke of the operating means greater than that which loads the yielding connection.

4. A magnetic switch for automatic starting mechanism including fixed and movable contacts, operating means for the movable contact including a magnetic plunger and a spring loaded by final closing movement of the plunger for holding the contacts closed, and retarding means for the plunger having a lost motion connection thereto which allows a sufficient free movement of the plunger to unload said spring and break said contacts.

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