

July 5, 1938.

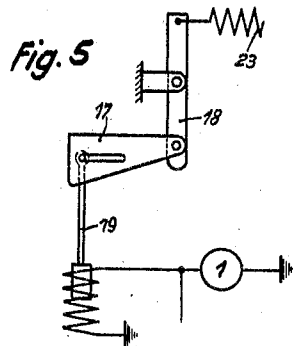
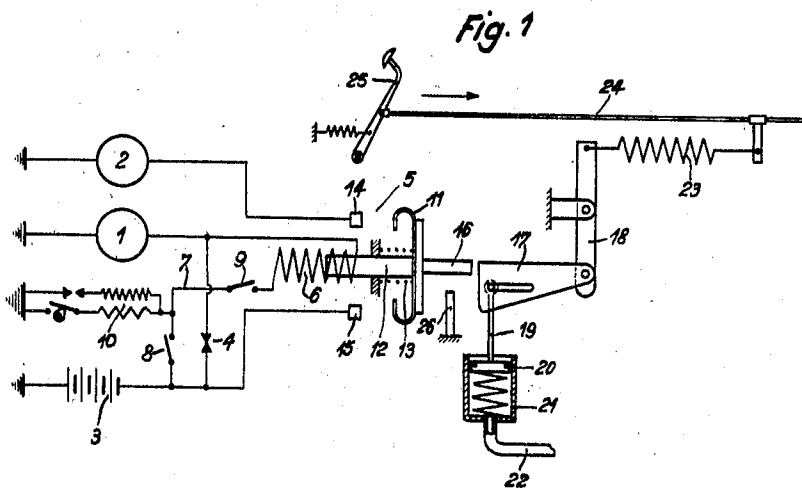
A. CALLSEN

2,123,133

APPARATUS FOR SWITCHING ON THE STARTER OF AN INTERNAL COMBUSTION ENGINE

Filed Jan. 25, 1937

2 Sheets-Sheet 1



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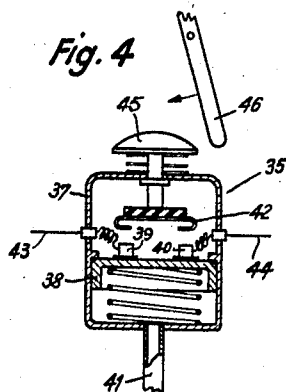
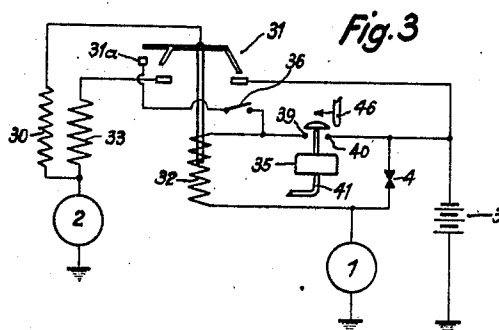
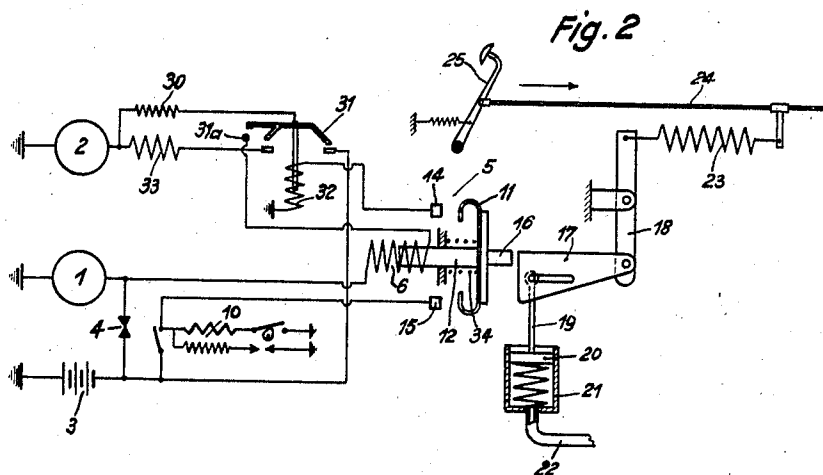
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UNITED STATES PATENT OFFICE

2,123,133

APPARATUS FOR SWITCHING ON THE
STARTER OF AN INTERNAL COMBUSTION
ENGINE

Albert Callsen, Stuttgart-Botnang, Germany, as-
signor to Robert Bosch Gesellschaft mit be-
schränkter Haftung, a corporation of Ger-
many

Application January 25, 1937, Serial No. 122,261
In Germany February 1, 1936

15 Claims. (Cl. 290—36)

The invention relates to an apparatus for switching on the starter of an internal combustion engine for use on vehicles, in which other elements of the vehicle control besides the starter

are operated by a common operating member.

In known apparatus of this kind, the clutch pedal or accelerator pedal is connected with the switch of the starter by a clutch which is engaged when the engine is stopped, while it is released by the vacuum of the engine induction pipe or by a relay fed from the lighting dynamo when the engine is running, so that the starter switch is uncoupled from the accelerator pedal or clutch pedal. In another known type, the starter switch is also operated by the clutch pedal or accelerator pedal, but the circuit of the starter is opened by vacuum or a relay.

Various drawbacks are inherent in these known apparatus. For example, the reliability is small, because when the throttle is fully open and when going up-hill, the vacuum is almost nil, and therefore a coupling of the accelerator pedal to the starter switch may be possible during the running of the engine. In apparatus in which the circuit is switched off and on in dependence on the vacuum or the voltage, the starter is switched off too early, so that the full starting of the engine is not completed.

A further drawback is also to be seen in the fact that complete freedom of movement of the accelerator or clutch pedal is detrimentally affected by the connection with the starting switch. Thus, for example, in arrangements in which the accelerator pedal is mechanically connected to the starter switch, the accelerator pedal can only be moved a little beyond the idle running position during the starting, and consequently no full gas mixture can be given at starting by operation of the accelerator pedal, which for instance is necessary with a too rich mixture, to enable the engine to be again started.

These drawbacks, some of which are inherent in all, and some only in some of the known apparatus are avoided by the present invention.

According to this invention an impulse only for initiating the switching operation is imparted to the switch device of the starter by the operating member whereupon the switch device is then entirely withdrawn from the influence of the said operating member such as the accelerator pedal and automatically switches on the starting motor and when the engine is running again switches it off.

The advantage of this arrangement is that the accelerator pedal lever can be freely moved dur-

ing the starting exactly as when accelerating. The foot can thus be moved back even into its initial position, and if desired, removed wholly from the pedal.

The invention is more particularly described with reference to the accompanying drawings, in which:—

Figure 1 is a diagrammatic view of one arrangement of switch control apparatus.

Figures 2, 3, and 4 are similar views of alternative constructions.

Figure 5 shows a modification of part of the arrangement of Figure 1.

In Figure 1, 1 denotes a lighting dynamo, 2 a starter, 3 a battery, and 4 an automatic switch situated between the lighting dynamo and the battery. The starter is connected to the battery through an electro-magnetic switch 5, excited by a coil 6, one end of the winding of which is connected to the dynamo, whilst the other end is connected to the battery by a conductor 7. In the conductor 7 is the ignition switch 8 and a second switch 9 which generally is always closed and is only opened in cases of need to switch off the starter. An ignition coil 10 is connected to this conductor. The switch 5 has a contact bridge 11, which is seated on but insulated from a soft iron core 12, which can be drawn into the coil against the pressure of a spring 13. In the drawn in position the contact bridge bears on the contacts 14 and 15, one of which is connected to the starter motor and the other to the battery.

The core 12 on which the contact bridge 11 is seated has an extension 16. This extension stands opposite a push member 17; which is pivotally connected to a lever 18. A rod 19, which is moved by a piston 20 of a vacuum cylinder 21 acts on the push-member 17. The vacuum cylinder is connected to the induction pipe of the internal combustion engine to be started by a pipe 22. The lever 18 is connected by a spring 23 to the rod 24 of the accelerator pedal lever 25. 26 is a stop for the push member 17 and limits its movement in such a way that it can move the contact bridge not quite as far as the contacts.

The starting apparatus works in the following way: In order to switch on the starting motor 2, the driver must close the ignition switch 8 and also the emergency switch 9, if the latter is open, which however is generally not the case. The winding 6 of the electro-magnetic switch 5 is now excited, it can however not draw in the core 12 with the contact bridge 11, because it is too distant from the magnet core. In order to close the switch 5, the driver now presses on the ac-

celerator pedal 25, whereby the lever 18 is rocked and the push member 17 pushes the extension 16 with the contact bridge 11 so near to the magnet core that the coil 6 is able to pull the contact bridge fully against the contacts 14, 15. The starting motor is thereby switched on and starts the engine. Even after a few revolutions of the engine, the vacuum in the cylinder 21 is so great that the push-member 17 is drawn out of the range of the extension 16 and therefore the action of the accelerator pedal on the switch device of the starting motor is entirely removed. The accelerator pedal is quite free in its movements at the moment when the contact bridge 11 has been attracted by the magnetic switch. As regards the starting operation, merely a switching operation is initiated by the accelerator pedal which then is quite automatically completed. As the voltage of the lighting dynamo increases the coil 6 is weakened and the switch 5 opened. Should the vacuum after a slow travel with full gas mixture sink quite to zero, the starter cannot be switched on with the accelerator pedal, because the push-member, when the lever 25 is fully depressed, still lies below the extension 16. In order to be able again to operate the switch 5, the push-member must first return into its initial position so that it can come in front of the extension 16. A renewed switching off of the starter is thus dependent on the following suppositions. First, the push-member must lie in front of the extension 16. That is only possible when there is no vacuum and the accelerator pedal lever is in the idle running position. Secondly, the opposing voltage on the magnet coil 6 must be absent so that the contact bridge may be attracted. Thus both the member initiating the starting operation, and also the switch device itself, are influenced by a force that is dependent on the working condition of the engine.

Instead of the vacuum, a coil fed by the lighting dynamo could also be employed to rock the push member (see Fig. 5). The oil pressure, or even the centrifugal force of a governor may also be applied. In the example of construction shown the accelerator pedal forms the operating member. Instead of this pedal the clutch pedal lever could also be employed. The switching operation for starting may also be initiated by the gear-changing lever in the idling position or in a separate gate.

The second form of construction is intended for starters in which the starting operation is effected in two stages, namely by the armature being first moved longitudinally axially by means of a draw-in coil 30 for the engagement of the pinion, and then only fully switched on. In Fig. 2 the parts of the apparatus that are the same as those in Fig. 1 are marked with the same reference numbers. The starting motor 2 is connected to the battery 3 by a two-stage magnetic switch 31, which is excited by a coil 32, and which in the first stage switches on the draw-in coil 30 and in the second stage the main exciting coil 33. One end of the coil 32 is earthed, and the other connected to contact 14. The contact 15 is connected to the ignition switch 8. The exciting coil 6 of the magnetic switch 5 is connected at one end to the dynamo 1, and at the other end to an auxiliary contact 31a of the switch 31.

This second construction works in the following way:—First, the ignition switch 8 must be again closed, and then the accelerator pedal depressed. In this case, the contact bridge 11 is pressed by the push-member 17 fully on the con-

tacts 14, 15. By this means the magnetic switch coil 32, is switched on, and by it the magnetic switch 31 which in the usual way first switches on the draw-in coil 30, and after the engagement of the starter pinion, the main coil 33. At the moment that the switch 31 comes into the second switching stage the switch coil 6 is fully excited and retains the contact yoke 11 until it is de-energized by the opposing voltage of the dynamo, whereupon the contact yoke is raised from the contacts by the spring 34. When the engine is running, the push-member 17 is pulled out of reach of the extension 16 by the vacuum in the cylinder 21.

Figs. 3 and 4 show a third construction, which, like the second one, is intended also for starters having two switching stages. Here again, the starter 2 is connected to the battery 3 through a two-stage switch 31. The exciting coil 32 of the switch is connected at one end to the dynamo 1, while the other end is connected by a switch 35 to the battery. From the same end a conductor goes to the auxiliary contact 31a of the switch 31. In this conductor is an emergency switch 36, which however is opened only in special cases.

The switch 35 is shown on an enlarged scale in Fig. 4. It consists of a cylinder casing 37, in which is mounted a piston 38, which carries two contacts 39, 40, insulated from each other. The casing is connected by a pipe 41 to the induction pipe of an internal combustion engine. In the cover of the casing is a press-knob 45 carrying a contact bridge 42. Leads 43 and 44 from the contacts 39 and 40 are led out of the casing. The switch is so arranged that the knob 45 lies in the path of the accelerator pedal lever 46, and therefore is depressed by the latter when it slides over it.

To start, the driver presses down the accelerator pedal. The switch 35 is thereby closed, the coil 32 excited and the switch 31 closed in the first stage. After the engagement of the starter, the switch 31 comes into the second switching stage, and thereby connects the coil 32 to the battery through the switch 31, 31a. As soon as the opposing voltage of the lighting dynamo is sufficiently great, the switch 31 opens. A fresh switching on during the running of the engine is not possible, because the contacts 39, 40 of the switch 35 are removed from the reach of the press-knob switch member 42, 45 by the vacuum. I declare that what I claim is:

1. A controlling device for the switches of the electric starters of internal combustion engines comprising a control element for the engine controlling a part other than the starter, a starting switch, electrical means to operate said switch, said electrical means being incapable of operating said switch until after a displaceable part thereof has been moved into the range of said electrical operating means, means operated by the said control element to bring a displaceable part of said switch into range of said electrical operating means, and means to disconnect said control element from said means operated thereby on the starting of the engine.

2. A controlling device for the switches of the electric starters of internal combustion engines comprising a control element for the engine controlling a part other than the starter, a starting switch including a movable element, electrical means operable to bring said movable element into effective switching operation, yieldable means normally operative to hold said moving element out of effective range of said means, means con-

nected to said control element to bring said movable element into effective range of operation of said electrical means, and means to disconnect said control element from said means operated thereby on the running of the engine.

3. A controlling device for the switches of electric starters of internal combustion engines including a starter switch, yieldable means normally holding said switch in open position, a switch operating member operated by hand or foot, means holding said switch in closed position after operation by said operating member, means operable to release said switch after starting of the engine, an intermediate coupling member between said switch and operating member, and means to displace said coupling member dependent on the working state of the engine.

4. A controlling device for the switches of electric starters of internal combustion engines including a starter switch, electro-magnetic operating means, a switch operating element, a control element for an engine part other than the starter, means connected thereto to bring said operating element into range of the electromagnetic operating means, said electromagnetic operating means including a holding coil operable to disconnect said control element from said switch operating element.

5. A controlling device for the switches of electric starters of internal combustion engines including a starter switch, electro-magnetic operating means, a switch operating element, a control element for an engine part other than the starter, means connected thereto to bring said operating element into range of the electromagnetic operating means, said electromagnetic means including a holding coil operable to disconnect said control element from said switch operative element, and means to control the operation of said electromagnetic means according to the voltage of a lighting dynamo driven from the engine and independently of the position of the control member.

6. A controlling device for the switches of electric starters of internal combustion engines including a starter switch device dependent on the working state of the engine, an operating member operated by hand or foot, an intermediate coupling member, and means to displace said coupling member dependent on the working state of the engine, a stop limiting displacement of said intermediate coupling member and a spring interposed between the coupling member and said operating member.

7. A controlling device for the electric switches of starters for internal combustion engines including a starter motor, a battery, a pair of switches in cascade, a control element for an engine part other than the starter, means to operate one switch from said control element, said means being movable to make said switch inoperable by said control element, engine suction operated means controlling the operation of said means, and means to control the other switch by means operating only when the engine is running.

8. A controlling device for the electric switches of starters for internal combustion engines including a starter motor, a battery, a pair of switches in cascade, a control element for an engine part other than the starter, a displaceable element operating one of said switches, an electromagnet displacing said element, means to hold said element out of effective range of said electromagnet, coupling means operated by

said control element to bring said displaceable element into range of said electromagnet, and an auxiliary switch control operated by said starter switch, said electromagnet operating as a holding coil which is excited on operation of said auxiliary switch.

9. A controlling device for the electric switches of starters for internal combustion engines including a starter motor, a battery, a pair of switches in cascade, a control element for an engine part other than the starter, a displaceable element operating one of said switches, an electromagnet displacing said element, means to hold said element out of effective range of said electromagnet, coupling means operated by said control element to bring said displaceable element into range of said electromagnet, an auxiliary switch control operated by said starter switch, said electromagnet being excited on operation of said auxiliary switch, and means to open said auxiliary switch on the running of the engine.

10. A controlling device for the electric switches of starters for internal combustion engines including a starter motor, a battery, a pair of switches in cascade, a control element for an engine part other than the starter, a displaceable element operating one of said switches, an electromagnet displacing said element, means to hold said element out of effective range of said electromagnet, coupling means operated by said control element to bring said displaceable element into range of said electromagnet, an auxiliary switch control operated by said starter switch, said electromagnet being excited on operation of said auxiliary switch, a member disconnecting the control element from the switch operative element, and engine suction operated means controlling said member.

11. Starting apparatus for internal combustion engines comprising a starter switch, yieldable means normally holding said switch in open position, a switch operating member, electrical means for temporarily holding said switch in closed position and for releasing said switch after starting of said engine, an intermediate coupling member between said switch and operating member, and means to displace said coupling member and move it to uncoupling position depending on the working state of the engine.

12. A controlling device for the switches of electric starters of internal combustion engines including a starter switch, electromagnetic operating means, a switch operating element, a control element for an engine part other than the starter, means connected thereto to bring said operating element into range of the electromagnetic operating means, and means controlled by the engine controlling the operation of said last-mentioned means.

13. Starting apparatus for internal combustion engines comprising, a starter switch, means normally holding said switch in open position, means including a control element for the engine and a displaceable coupling member for initially operating said switch, means dependent upon the operation of the engine for holding said switch in closed position after initial operation thereof and for releasing said switch after starting of the engine, and means dependent upon the operation of the engine for displacing said coupling member after starting of the engine.

14. Starting apparatus for internal combustion engines comprising, a starter switch, yieldable means normally holding said switch in open

position, mechanical means including a control element for the engine and a displaceable coupling member for initially operating said switch, electrical means dependent upon the operation
 5 of the engine for withdrawing said switch from the path of movement of said operating means and for holding said switch in closed position after initial operation thereof, means permitting said holding means to release said switch after
 10 starting of the engine, and means dependent upon the operation of the engine for displacing said coupling member after starting of the engine.

15. Starting apparatus for internal combustion engines comprising a switch controlling a starter circuit, means for initially operating said switch, means responsive to engine operation for holding
 5 said switch in closed position independently of said operating means after initial operation and for releasing said switch after starting of the engine, and means responsive to engine operation
 10 controlling said operating means.

ALBERT CALLSEN.

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DISCLAIMER

2,123,133.—*Albert Callsen*, Stuttgart-Botnang, Germany. APPARATUS FOR SWITCH-
 ING ON THE STARTER OF AN INTERNAL COMBUSTION ENGINE. Patent dated
 July 5, 1938. Disclaimer filed May 2, 1939, by the assignee, *Robert Bosch*
Gesellschaft mit beschränkter Haftung.

Hereby enters this disclaimer to claims 4 and 5 of said Letters Patent.
 [Official Gazette May 23, 1939.]