June 3, 1930. H. SCHWARZE 1,761,539

ENGINE STARTING APPARATUS

Filed March 16, 1929 2 Sheets-Sheet 1

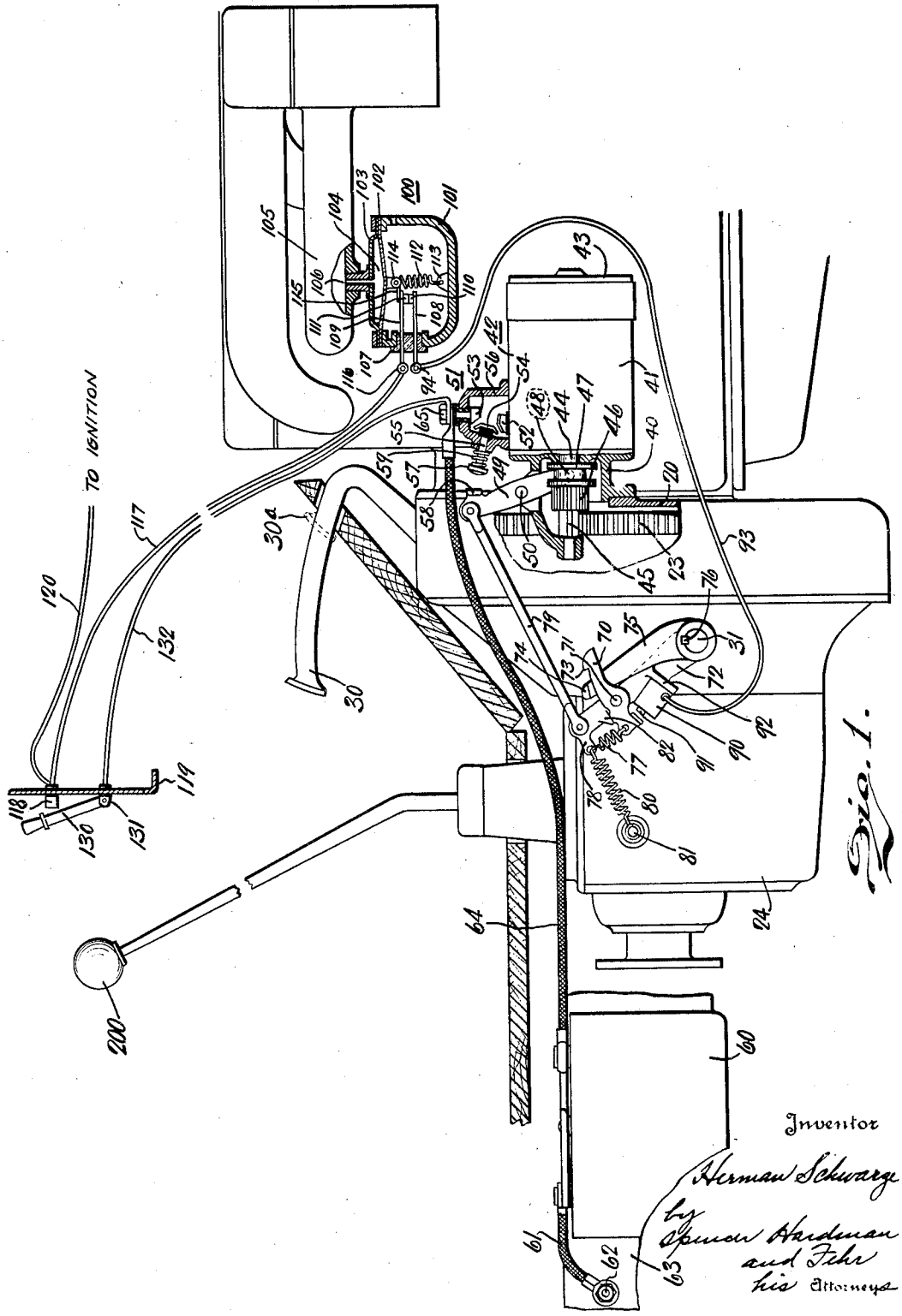


Fig. 1.

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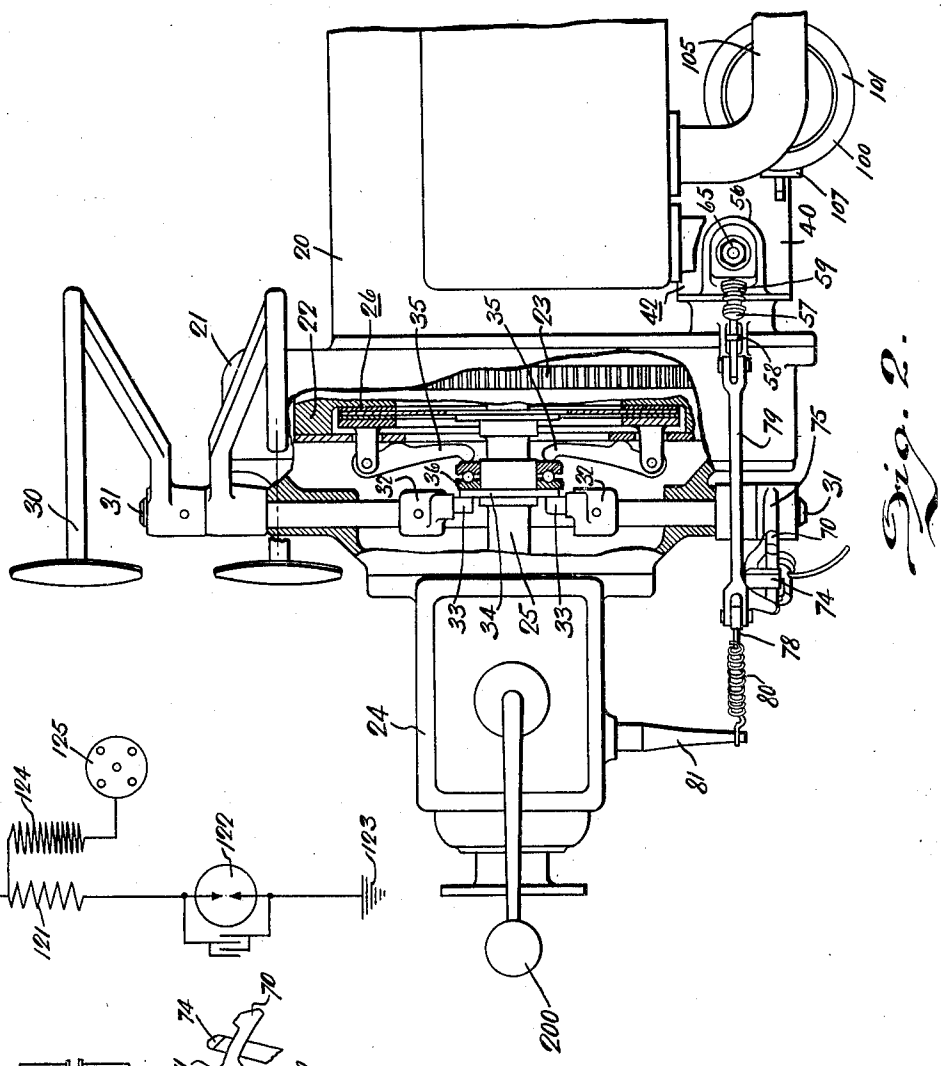


Fig. 2.

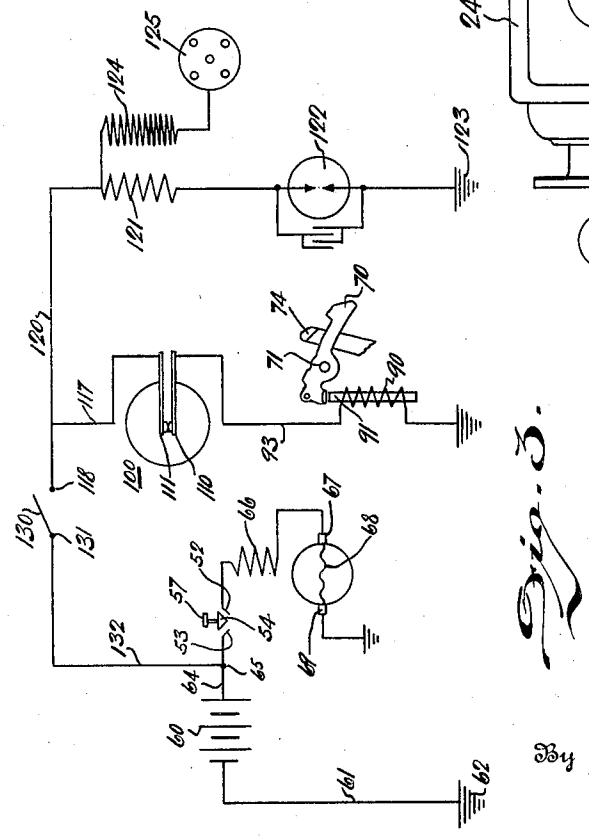


Fig. 3.

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UNITED STATES PATENT OFFICE

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ENGINE-STARTING APPARATUS

Application filed March 16, 1929. Serial No. 347,605.

This invention relates to starting apparatus for internal combustion engines, and particularly for engines which propel automotive vehicles.

The present invention includes among its objects the provision of improvements in engine starters of the type disclosed in the Patent No. 1,150,523, granted August 17, 1915, to Charles F. Kettering. This patent discloses, among other things, an engine starter which is caused to operate to crank the engine by pressing down the clutch pedal to disconnect the engine from the transmission. The clutch pedal is connected with the actuator of the starting apparatus through an electromagnetically controlled latch which, after the engine becomes self-operative, is automatically rendered ineffective to transmit motion from the clutch pedal to the actuator of the starting apparatus.

In order to accomplish these objects the present invention provides a starting motor, a starter actuator for causing the starting motor to operate to crank an engine, a manually operated movable member, such as the clutch pedal of the automobile, means for operatively connecting the starter actuator with the manually operated member, such as the electromagnetically operated latch which has been referred to, and a device which is automatically responsive to the running of the engine for rendering inoperative the connecting means. The disclosed form of the present invention includes a switch in circuit with the electromagnetic controller of the latch, said switch being operated by a suction device connected with the engine intake manifold. When the engine becomes self-operative the switch opens the circuit of the electromagnetic controller in order that the latch will be rendered inoperative to connect the clutch pedal with the starter actuator while the engine is running.

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

In the drawings:

Fig. 1 is a diagrammatic, fragmentary, side elevation of an engine and transmission assembly to which is applied an engine starter embodying the present invention, certain portions being shown in vertical, longitudinal section.

Fig. 2 is a plan view of parts shown in Fig. 1, and shows certain parts broken away and in horizontal, longitudinal section.

Fig. 3 is a wiring diagram showing the circuits of the present invention.

Referring to the drawings, 20 designates the frame of an internal combustion engine, said frame being attached to a flywheel housing 21 enclosing a flywheel 22 carrying a flywheel gear 23. The flywheel housing 21 is attached to a transmission gear housing 24. The housing 24 encloses transmission gears not shown which are driven by a shaft 25 which is connectible with the flywheel 22 by a friction plate clutch 26. The clutch 26 is normally conditioned for transmitting motion from the flywheel 22 to the shaft 25, but may be controlled so that the flywheel 22 may be disconnected from the shaft 25 by moving a clutch pedal 30 from the position shown in full lines in Fig. 1 toward the position indicated at 30^a in broken lines. The pedal 30 is attached to a clutch operating rod 31 operatively connected with lever arms 32 carrying studs 33 located on opposite sides of the shaft 25 and adapted to bear against a collar 34 which is slidably along the shaft 25. Motion is transmitted from the collar 34 to a plurality of clutch throwout arms 35 through an anti-friction thrust bearing 36.

The flywheel housing 21 supports a starter gear housing 40 which supports the field frame 41 of an engine starting motor 42. The housing 40 and an end frame 43 attached to the field frame 41 provide bearings for a motor armature shaft 44 having longitudinal splines 45 along which a motor pinion 46 is slidable and is drivingly connected. The motor pinion 46 is operatively connected with a grooved collar 47, the groove of which receives a stud 48 carried by an actuator lever 49 pivoted at 50 upon the gear housing 40.

The circuit of the electric motor is con-

trolled by a switch 51 comprising stationary contacts 52 and 53 engageable by a movable contact 54 mounted upon a switch operating rod 55 which is slidable through an opening in a switch housing 56 which insulatingly supports the contact 53. The rod 55 carries a head or button 57 located so as to be engaged by a pad 58 provided by the lever 49. Hence, when the lever 49 is moved clockwise, as viewed in Fig. 1, the pad 58 will engage the head 57 and will move the contact 54 into engagement with the contacts 52 and 53 of the switch 51. When the lever 49 is moved counter-clockwise a spring 59, encircling the rod 55 and located between the head 57 and the switch case 56, moves the contact 54 into circuit open position, as shown. Therefore, the lever 47 constitutes a starter actuator which, when moved in a clockwise direction, will cause the motor pinion 46 to mesh with the engine flywheel gear 23, and will cause the motor circuit to be closed so that the motor will operate to crank the engine. Current for operating the motor 41 is supplied by a storage battery 60 having one terminal wire 61 grounded at 62 upon the side frame 63 of the automobile chassis. The other terminal wire 64 of the battery 60 is connected at 65 with the motor switch contact 53. The motor switch contact 52 is insulatingly supported by the motor frame 41 and is connected with a motor field winding 66 which is connected with an insulated brush 67, which bears against the usual commutator connected with armature circuits 68 and engageable with a grounded brush 69, as shown diagrammatically in Fig. 3. The grounded brush 69 is grounded upon the motor frame 41 and hence is electrically connected with the terminal wire 61 of the battery 60 through the gear housing 40, flywheel housing 21 and chassis side frame 63 to which the engine frame is attached in the usual manner, not shown.

The clutch pedal lever 30 is operatively connected with the starter actuator 49 by a mechanism which comprises an electro-magnetically controlled latch 70, which is pivoted at 71 upon a lever 72 loosely journalled upon the clutch operating shaft 31. The latch 70 provides a hook 73 engageable with a lug 74 provided by a lever 75 which is connected with the shaft 31 by a key 76. A spring 77 connecting the latch 70 with an extension 78 of the lever 72 maintains the hook 73 out of the path of movement of the lug 74 so that normally the lever 72 will not be moved clockwise, as viewed in Fig. 1, when the clutch pedal 30 is pressed downwardly. A link 79 connects the lever 72 with the starter actuator 49 so that clockwise movement of the lever 72 produces clockwise movement of the actuator 49, and vice versa. A spring 80 attached to the extension 78 of the lever 72 and to a post 81 extending from the transmission housing 24 normally maintains the levers 72 and 49 in the position shown in Fig. 1, and hence, the starting motor pinion 46 out of mesh with the flywheel gear 23. A lug 82 is engaged by the latch 70 to limit movement of the latch 70 in a clockwise direction as produced by the spring 77.

The electromagnetic controller for the latch 70 comprises an electromagnet coil 90 which surrounds a magnetizable core 91 supported by a lug 92 integral with the lever 72. The parts 92, 72 and 70 are made of magnetizable metal so as to constitute a flux path threading the electromagnet coil 90. One end of the coil 90 is grounded through the core 91 and hence electrically connected with the storage battery terminal wire 61. The insulated terminal of the coil 90 is connected by wire 93 with the terminal 94 of an engine suction responsive switch 100 which constitutes a device which is automatically responsive to the running of the engine for rendering the electromagnet coil 90 inoperative to maintain the latch 70 in a position for connecting the levers 75 and 72.

The switch 100 includes a case 101 to the upper edge of which are clamped a flexible diaphragm 102 and a cover 103. The space between the cover 103 and the diaphragm 102 provides a suction chamber 104 which communicates with the engine intake 105 through a pipe 106 by which the device 100 is suspended from the manifold 105. The case 101 carries a non-conducting plug 107 which insulatingly supports blades 108 and 109 carrying contacts 110 and 111 respectively which are normally maintained in engagement by a spring 112 having one end attached at 113 to the bottom of the case 101 and having the other end attached to a lug 114 carried by the diaphragm 102. The lug 114 and the switch blade 109 are operatively connected by a non-conducting member 115. The blade 109 is connected with a terminal 116 connected by wire 117 to a switch contact 118 insulatingly supported by the dashboard 119 of the vehicle. The contact 118 is connected by wire 120 with ignition apparatus including an ignition coil primary winding 121 in circuit with an ignition timer 122 grounded at 123. The ignition coil has a secondary winding 124 which is grounded through the ignition primary 121 and timer 122. The insulated end of the secondary 124 is connected with the usual distributor 125. The switch contact 118 is connected by a movable contact blade 130 with a terminal 131 which is connected with the storage battery 60 by a wire 132 leading to switch terminal 65 which is connected by wire 64 with the battery.

Mode of operation

To start the engine, the operator will first turn on the ignition by moving the switch blade 130 into engagement with the contact

118. This will cause the ignition primary circuit to be connected with the battery 60 through the following connections: battery 60, wire 64, terminal 65, wire 132, contact 131, switch blade 130, contact 118, wire 120, ignition primary coil 121, timer 122, ground circuit 123, 62, and wire 61. When the ignition circuit is closed the electromagnet coil 90 will be connected with the battery by wire 117, switch contacts 110 and 111, wire 93. When the coil 90 is energized, the latch 70 will be moved electromagnetically in a counter-clockwise direction, thereby locating the hook 73 of the latch 70 in the path of movement of the lug 74 of lever 75. Thus, the clutch pedal lever 30 is operatively connected with the starting motor actuator 49. When the lever 30 is pushed downwardly the lug 74 will move in a clockwise direction as viewed in Fig. 1, and will engage the hook 73, thereby causing the levers 72 and 49 to move clockwise about their pivots in order to cause the motor pinion 46 to engage the engine gear 23 and to close the motor switch 51 as previously described. After the engine has been started, the operator will release the clutch pedal 30 thereby permitting the spring 80 to return the levers 72 and 49 to normal position. When the engine becomes self-operative, subatmospheric pressure in the suction chamber 104 will result in the upward movement of the diaphragm 102 and the separation of the contact 111 from the contact 110. When this occurs the circuit to the electromagnet coil 90 will be interrupted. Therefore, the clutch pedal 30 will be operatively disconnected from the starter actuator 49 because, when the coil 90 is de-energized the spring 77 will move the latch 70 against the stop 82, thereby moving the hook 73 away from the path of movement of the lug 74 of lever 75.

From the foregoing description of the construction and mode of operation of the present invention, it is apparent that certain advantages are afforded. The clutch pedal serves to operate the clutch and to control the starter, thereby dispensing with the use of a starter pedal or button extending above the floor-board. When the starter is operated by the clutch pedal the clutch is thrown out so that while the engine is being cranked it is disconnected from the transmission gears. This is an advantage, especially in cold weather when the oil or grease surrounding the gears is relatively stiff at the start. After the engine has been started and before the pedal 30 is released, the starting motor actuator 49 may return to normal position to open the motor switch and to disconnect the pinion 46 from the engine gear 23. This may occur because the spring 77 can be made strong enough to retract the latch 70 from the lever lug 74 after the suction responsive switch 100 opens the circuit of the coil 90, although the pedal 30 may still be pressed downward. Before releasing the pedal 30 to connect the engine with the transmission, the gear shift lever 200 may be operated to select the proper gearing for starting the vehicle into motion. This feature is particularly desirable when driving in heavy traffic, making frequent stopping necessary. Instead of running the engine idle, the engine may be easily stopped when the vehicle stops by opening the ignition switch. While the vehicle is at rest, the driver generally moves the gear shift lever into neutral position. After receiving the traffic signal to proceed the driver may quickly start by closing the ignition switch and pressing the clutch pedal, holding the latter down after the engine becomes self-operative, and then shifting the transmission gears into low speed.

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. Engine starting apparatus comprising, in combination with an engine, a starting motor, a starter actuator for causing the starting motor to operate to crank the engine, a manually operated movable member, means for operatively connecting the starter actuator with the manually operated member, and a device automatically responsive to the running of the engine for rendering the connecting means inoperative.

2. Engine starting apparatus according to claim 1 in which a device responsive to engine suction renders the connecting means inoperative.

3. Engine starting apparatus according to claim 1 in which the connecting means includes an electromagnetically operated instrumentality, and the device which is responsive to the running of the engine includes a switch in circuit with the electro-magnet.

4. Engine starting apparatus according to claim 1, in which the connecting means includes an electromagnetically operated instrumentality, and the device which is responsive to the running of the engine includes a switch responsive to engine suction and located in circuit with the electro-magnet.

5. Engine starting apparatus comprising in combination with an engine, a starting motor, a starter actuator for causing the starting motor to crank the engine, a manually operated, movable member, engine ignition apparatus, means for operatively connecting the starter actuator with the manually operated member, control means for rendering the ignition apparatus operative and said connecting means operative, and means responsive to the running of the engine for rendering the connecting means inoperative.

6. Engine starting apparatus according to claim 5, in which a device responsive to en-

gine suction renders the connecting means inoperative.

7. Engine starting apparatus according to claim 5, in which the connecting means includes an electro-magnetically operated instrumentality, and the device which is responsive to the running of the engine includes a switch in circuit with the electro-magnet.

8. Engine starting apparatus according to claim 5, in which the connecting means includes an electro-magnetically operated instrumentality, and the device which is responsive to the running of the engine, includes a switch responsive to engine suction and located in circuit with the electro-magnet.

9. Engine starting apparatus, comprising in combination with an engine, a starting motor, a starter actuator for causing the starting motor to crank the engine, a manually operated movable member, electrical ignition apparatus for the engine, an electro-magnetically controlled means for operatively connecting the starter actuator with the manually operated member, a switch for rendering the ignition apparatus and electro-magnetically controlled connecting means operative, and a switch actuated in response to the running of the engine for rendering inoperative said electro-magnetically controlled connecting means.

10. Engine starting apparatus, comprising in combination with an engine, a starting motor, a starter actuator for causing the starting motor to crank the engine, a manually operated movable member, electrical ignition apparatus for the engine, an electro-magnetically controlled means for operatively connecting the starter actuator with the manually operated member, a switch for rendering the ignition apparatus and electro-magnetically controlled connecting means operative, and an engine suction responsive switch for rendering inoperative said electro-magnetically controlled connecting means.

11. Engine starting apparatus comprising in combination with an engine, a starting motor, a starter actuator for causing the starting motor to crank the engine, a manually operated lever, a second lever fulcrumed concentrically with the first lever, a latch pivoted on one lever and engageable with the other lever, means connecting the second lever with the starter actuator, an electro-magnet for causing the latch to connect the levers, and means responsive to engine operation for rendering the electro-magnet inoperative.

12. Engine starting apparatus comprising in combination with an engine, a starting motor, a starter actuator for causing the starting motor to crank the engine, a manually operated lever, a second lever fulcrumed concentrically with the first lever, a latch pivoted on one lever and engageable with the other lever, means connecting the second lever with the starter actuator, an electro-magnet for causing the latch to connect the levers, and an engine suction responsive switch for open-circuiting the electro-magnet.

In testimony whereof I hereto affix my signature.

HERMAN SCHWARZE.