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ENGINE STARTER CONTROL

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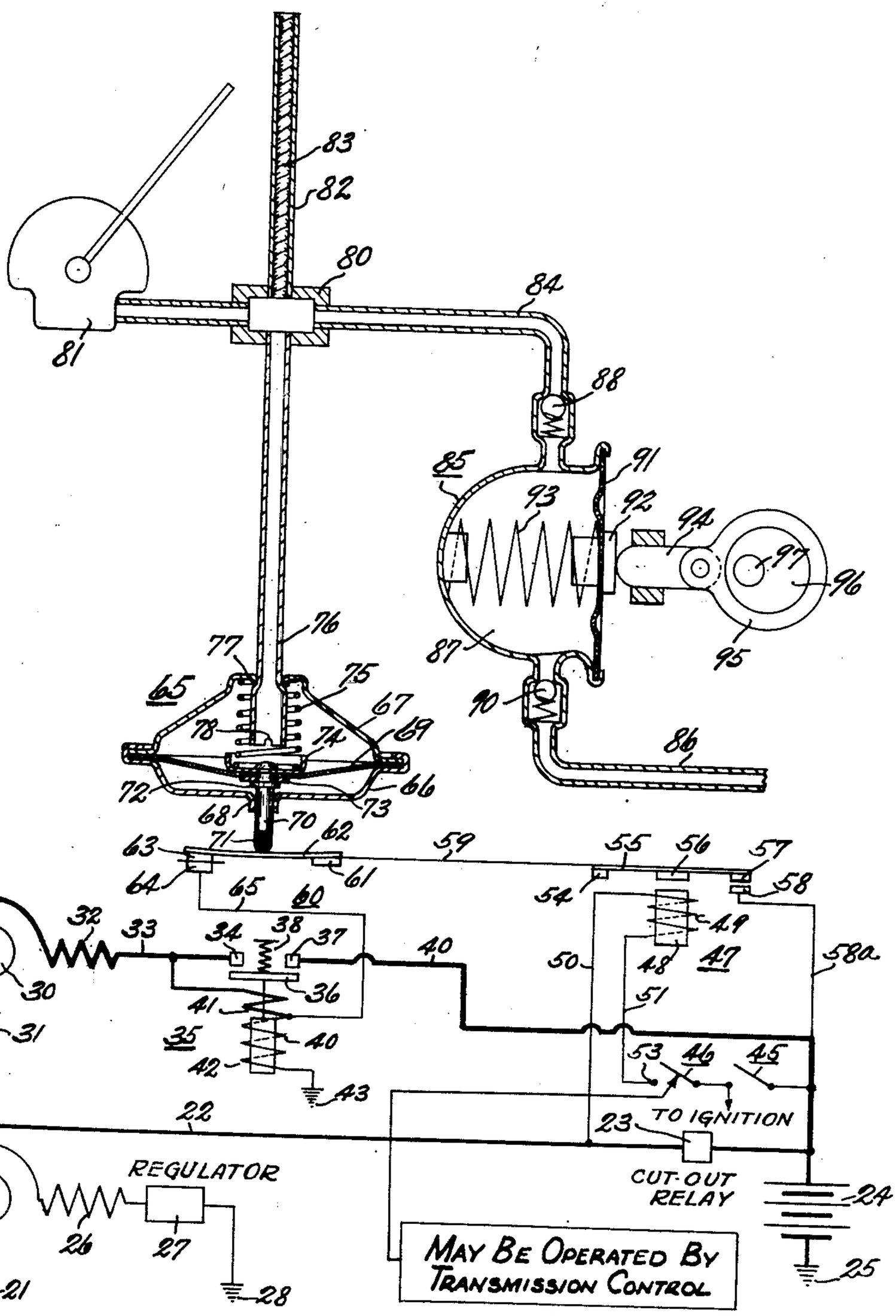

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ENGINE STARTER CONTROL

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2 Claims. (Cl. 290—38)

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This invention relates to engine starter control apparatus by which an engine cranking electric motor is caused to operate by closing a manually controlled switch and by which operation of the motor is prevented while the engine is self-operative..

An object of the present invention is to provide improved means whereby the starting motor cannot be operated while the engine is self-operative. In the disclosed embodiment of the invention, this object is accomplished by the use of a closed switch which is moved to an open position, but which is normally held in a closed position by a relatively strong spring in order that the starting motor circuit will be completed by closure of a manually operated switch. The closed switch remains in a closed position during engine cranking and is opened in response to self operation of the engine and remains open so long as the engine is self-operative. The closure of the switch is accomplished by the relatively strong spring and is maintained closed during cranking of the engine as the engine suction is insufficient to open the switch. The opening of the switch is effected by an engine suction responsive means which operates in opposition to the relatively strong spring. When the engine becomes self-operative, engine suction becomes sufficient to overcome the relatively strong spring and the switch is moved to open position and the operation of the starting motor ceases. So long as the engine remains self-operative, even though the engine suction may decrease substantially as when operating at full load and wide open throttle, this switch, normally held closed by the spring, does not close until suction is reduced to a value lower than occurring at any time during self-operation of the engine.

In case the self-operation of the engine is only temporary, such as a false start, a means is provided for delaying the closure of the switch by the strong spring. The operation of the strong spring to close the switch is retarded by a restriction in the vent of the diaphragm chamber of the suction responsive means.

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 embodiment of the present invention is clearly shown.

In the drawing:

The figure of the drawing is a diagrammatic view of an engine starter control system embodying the present invention.

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Referring to the drawing, a generator **20**, grounded at **21**, is connected by a wire **22** to a cut-out relay **23** which operates automatically to connect the generator to a battery **24** grounded at **25**. The field winding **26** of the generator is connected to a voltage regulator **27** grounded at **28**.

The starting system for the internal combustion engines includes a starting motor **30** grounded at **31**. The motor **30** has a field winding **32** connected by a wire **33** to a fixed contact **34** of a switch **35**. The switch **35** has a movable contact **36** normally maintained out of engagement with fixed contacts **34** and **37** by a spring **38**. The fixed contact **37** is connected by a wire **40** with the storage battery **24**.

The switch **35** is automatically moved into a closed position by an electromagnetic means including an armature **40** surrounded by a winding **41** of fewer turns of relatively coarse wire and a winding **42** of relatively large number of turns of fine wire. One end of winding **42** is grounded at **43** and one end of winding **41** is connected with the wire **33** which is on the starting motor side of the starting switch **35**.

The energizing circuit for the coils **41** and **42** of the electromagnetic switch **35** is completed by closing an ignition switch **45**, a neutral safety switch **46**, and an electromagnetic relay switch **47** including a core **48** and a coil **49** surrounding the core. One end of the coil **49** is connected by a wire **50** to the wire **22** while the other end of the coil is connected by a wire **51** to a fixed contact **53** of the neutral safety switch **46**. The relay switch **47** includes a support **54** to which one end of a leaf spring **55** is fixed. An armature **56** is fixed to the free end of the leaf spring **55** above the core **48**. The leaf spring **55** supports a contact **57**. A fixed contact **58** is supported in alignment with the movable contact **57**. The contact **58** is connected by a wire **58***a* to the battery **24**.

The leaf spring **55** of the relay switch **47** is connected by a wire **59** to a self-biased switch **60** including a support **61** to which one end of a leaf spring **62** is fixed. The free end of the spring **62** supports a contact **63** which is in alignment with a stationary contact **64** connected by a wire **65** at the junction point between the coils **41** and **42**.

The switch **60** is normally held in a closed position by a suction device **65** which includes cup-shaped shells **66** and **67**. The shell **66** is provided with a tubular flange **68**. The shells **66** and **67** are flanged at their peripheries and are secured together by bending over the peripheral flange of shell **66** to clamp the periphery of a flexible dia-

phragm 69 between the flanges. The central portion of the diaphragm has a plunger 70 attached thereto which extends out of the shell 66 and is slidably supported in the flange 68. The lower end of the plunger has a button 71 of insulating material attached thereto which engages the leaf spring 62. The upper end of the plunger is provided with a collar 72 against which a washer 73 rests. The upper end of the plunger is provided with a reduced portion which extends through apertures provided by the diaphragm 69 and the cup-washer 74 and riveted together to form a unitary diaphragm assembly. The parts of the diaphragm assembly are fabricated separately and assembled in this way for reasons of economy. The cup-washer 74 receives one end of a spring 75 which surrounds a tube 76 attached to a flange 77 of the shell 67. The spring 75 urges the diaphragm down until the plunger causes the leaf spring 62 to move contact 63 into engagement with fixed contact 64. The upward movement of diaphragm 69 is stopped by engagement of washer 74 with the lower end of the tube 76 which is notched at 78 so that suction on the diaphragm continues after said engagement.

The tube 76 is connected with a junction block 80 connected with a suction operated windshield wiper 81. The block 80 is connected with a tube 82 containing a length of porous fibrous material, for an example a smoking pipe cleaner 83. The block 80 is also connected by pipe 84 which in turn is connected with a vacuum booster pump 85. A tube 86 connects the pump with the engine intake manifold, not shown. The pump 85 comprises a chamber 87 connected with the tubes 84 and 86 by biased check valves 88 and 90 respectively. The chamber 87 is closed on one side by a diaphragm 91 carrying a stud 92. A spring 93 urges the stud 92 against a bar 94 attached to an eccentric strap 95 surrounding an eccentric 96 driven by the cam shaft 97 of the engine.

When the engine is not running the spring 75 urges the diaphragm assembly down, as viewed in the drawing, causing the plungers 70, 71 to move the leaf spring 62 in a direction against its own resiliency so that the contacts 63, 64 are in engagement. The operation of the present invention is as follows: The closure of the ignition switch 45 and the neutral safety switch 46 completes a circuit through the battery 24, switches 45, 46, wire 51, coil 49, wire 50, wire 22, generator 20, and ground 21 whereby the coil 49 is energized to attract armature 56 to close contacts 57, 58. When that occurs, current will flow from the battery 24, wire 58*a*, contacts 58, 57, leaf spring 56, wire 59, contacts 63, 64, wire 65, coil 42 to ground 43 and coil 41 through motor 30 to ground 31. The energization of the coils 41 and 42 closes the switch 35. The starting circuit is then completed, thereby causing the starting motor 30 to crank the engine.

When the engine becomes self-operative and drives the generator at such speed that the counter voltage opposes the battery voltage impressed on the relay coil 49 the coil will be deenergized and the contacts 57, 58 will separate. Therefore, the operation of the starting motor will cease even if there were no other means for effecting cessation. The present invention, however provides means for effecting discontinuance of the operation of the starting motor independently of the status of the relay coil 49.

During the cranking of the engine, the suction produced in the intake manifold will not be sufficient to elevate the diaphragm 69 against the

force of the spring 75, thus the plungers 70, 71 are held under pressure against the leaf spring 62 to maintain the contacts 63 and 64 in engagement. When the engine starts there is a falling of pressure within the intake manifold below atmospheric pressure which results in a pressure upon the upper side of the diaphragm 69 compressing the spring 75, moving the plungers 70, 71 away from the leaf spring 62. This allows the leaf spring 62, due to its own resiliency, to lift automatically the contact 63 from engagement with contact 64 to open the starting motor circuit. Upward movement of the diaphragm 69 is stopped by engagement of the washer 74 with the lower end of tube 76, the notches 78 permitting suction to continue on the diaphragm after the washer engages the tube 76.

In case of a false start the present invention provides a time delay in lowering of the vacuum above the diaphragm 69. When the engine stops, the vacuum booster pump 85 stops with its valves 88 and 90 closed. Air is permitted to enter slowly in the pipe 82 past the fibrous member 83 whose length included with the pipe 82 is such that the lapse of 5 seconds, for example, is required before the spring 75 returns the diaphragm 69 and plungers 70, 71 to the position which causes the switch 60 to close. The fibrous material or pipe cleaner 83 is adjusted longitudinally to effect that time delay required for a pinion, not shown, associated with the starting motor 30 to coast to a stop after a false start. This time delay, is an important feature in case of wide open throttle to accelerate accompanied by an inadvertent movement of the selecting lever from the "drive" position to "neutral" position instead of "drive" to "low," the switch 60 would not close for 5 seconds. At such times, however, the operator may have time to discover his mistake and shift from "neutral" to "low."

It is pointed out that the switch 46 may be a manually operated switch located on the instrument panel of the vehicle or it may be a neutral safety switch under control by a transmission selecting lever, not shown. When the engine is propelling the vehicle, the neutral safety switch 46 is opened because it is under control of the transmission selecting lever which on being shifted from "neutral" to "drive" or "reverse" causes the opening of the switch 46. Therefore coil 49 of relay switch 47 is deenergized. If the transmission selecting lever is moved to "neutral" while the engine is running the starting switch 35 cannot be closed because the suction device 65 holds the plungers 70, 71 in a position so that the leaf spring 62 will be biased to a position to maintain the contacts 63, 64 separated.

The cranking starting motor 30 is caused to operate by closing the ignition switch 45 provided the transmission selecting lever is in "neutral" or "park" position. The selection of any other position renders the starter motor control ineffective. If the engine stops while the transmission is in one of its driving positions with the ignition switch turned to "on" position, the engine is started merely by moving the transmission selecting lever to "neutral" or "park" position. This application is an improvement of the copending application of Paul L. Schneider, Ser. No. 85,231, filed April 2, 1949.

While the embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. In an engine starting system including a starting motor and controls therefor, the combination comprising three independent electrical circuits, each being separably connectible to a common source, the first of said circuits, including the starting motor, and an electromagnetically operated normally open switch therefor; the second of said circuits comprising an electromagnetically operated normally open switch, a normally closed switch responsive to engine operation in series with the second electromagnetically operated switch, and electromagnetic means for operating the starter switch, said third circuit including two normally open control switches in series with the electromagnetic means for operating the normally open electromagnetic switch in the said second circuit, the sequences of operation of said circuits being a three, two, one, order.

2. In an engine starting system including a starting motor and controls therefor, the combination comprising three independent electrical circuits, each being separably connectible to a common source, the first of said circuits including the starting motor, and an electromagnetically operated normally open switch therefor; the second of said circuits comprising an electromagnetically operated normally open switch, a normally closed switch responsive to engine operation in series with the second electromagnetically operated switch, and electromagnetic means for operating the started switch, said third

circuit including two normally open control switches in series with the electromagnetic means for operating the normally open electromagnetic switch in the said second circuit, said system being rendered operative by closure of both of said normally open control switches in the third circuit whereby the electromagnetically operated switch in the second circuit closes to energize said circuit for closing the starter switch to energize the starting motor, said system remaining operative until said switch responsive to engine operation is opened.

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