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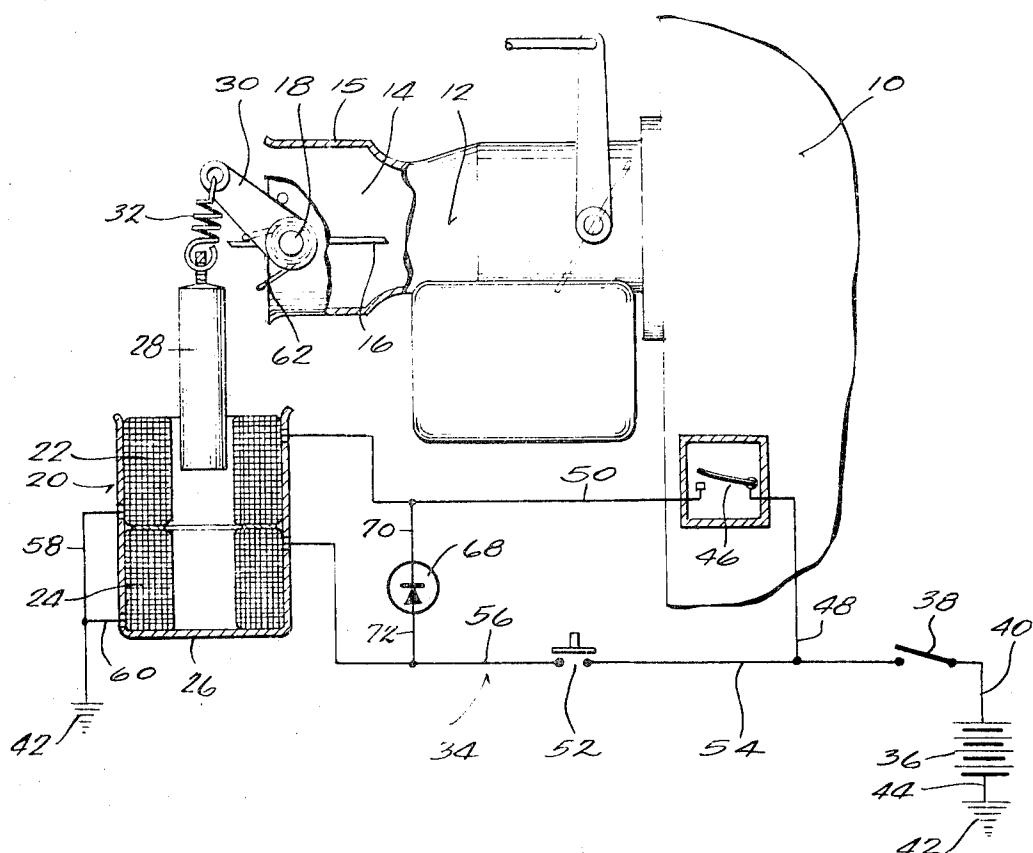
[54] **SOLENOID OPERATED CHOKE**
12 Claims, 3 Drawing Figs.

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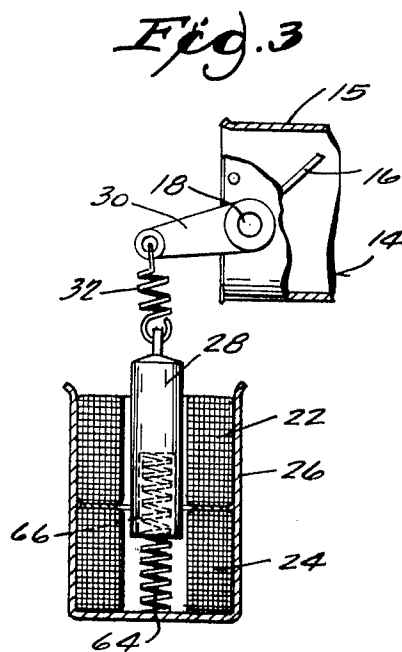
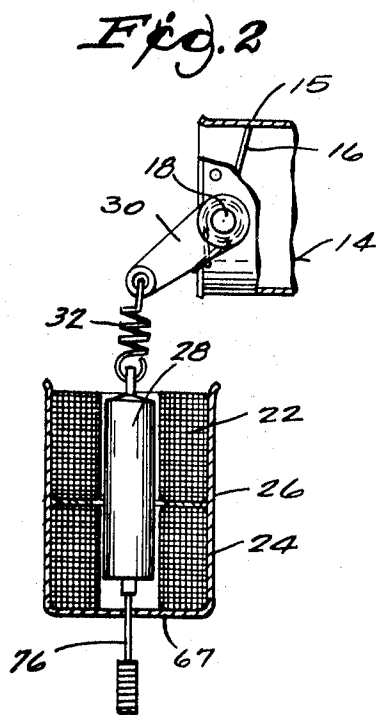
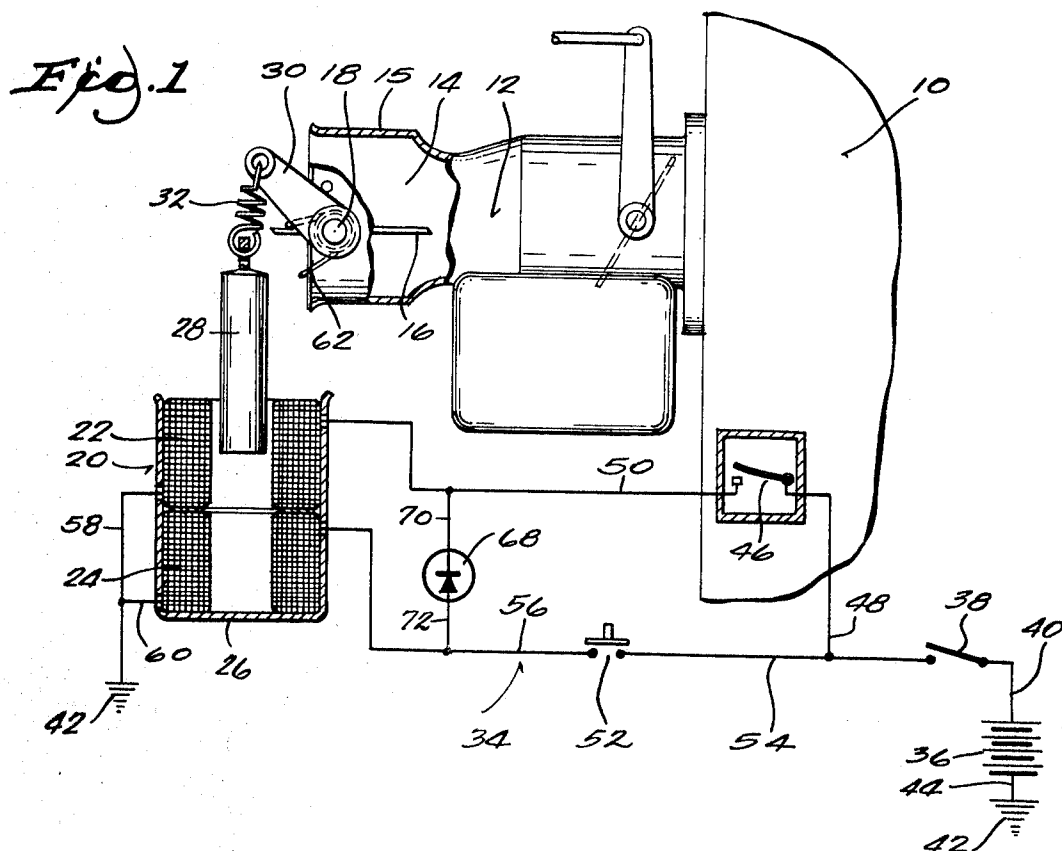
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ABSTRACT: Disclosed herein is a choke for an engine carburetor which operates both manually and automatically to move a choke shutter between a closed full choke position for engine starting, a partial choke position during engine warm up, and a fully open position when the engine is at normal operating temperature. The movement of the choke shutter into and from these positions is accomplished by an electrical solenoid which has an armature connected to the choke shutter. In one embodiment the solenoid has two coils and a circuit to selectively position the choke shutter in the desired position. The circuit includes a push button switch to energize one solenoid coil to position the choke shutter in the closed full choke position. The circuit also has a temperature switch which opens when the engine reaches a predetermined operating temperature, and deenergizes the solenoid coil which maintains the solenoid armature in the partial choke position during warmup.



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SOLENOID OPERATED CHOKE

This application is a continuation of application 637,584 filed May 10, 1967 now abandoned.

SUMMARY OF INVENTION

The invention provides an automatic choke for an engine carburetor which includes a solenoid with first and second solenoid coils and a solenoid armature which is connected to the choke shutter located in the carburetor air inlet passage. The invention also includes a solenoid control circuit for selectively energizing the coils to position the armature and accordingly the choke shutter in the desired position. The circuit for the first solenoid coil includes a temperature switch which is located on the engine power head. A push button switch energizes the second solenoid coil. Electrical energy is supplied to the solenoid coils by a small battery of the type commonly associated with the engine for engine starting, or the type utilized for lights, accessories, etc.

The three choke positions afforded by the invention are a closed full choke position for engine starting which is effected by energizing the second coil using the push button switch, a partial choke position which is maintained until the engine reaches operating temperature, and a fully open position. The choke shutter moves to the partial choke position as the push button is released and the second coil is deenergized, thus permitting the solenoid armature to center in the first coil which is energized through the temperature switch which is normally in an on position when the engine is cold. When the engine reaches a predetermined operating temperature, the temperature switch opens and deenergizes the first coil. When this occurs, neither solenoid coil is energized and the choke shutter is spring biased to the fully open position in which the carburetor air inlet passage is unobstructed.

Manual control of the full choke position with the push button assures engine starting even though the temperature switch becomes inoperative.

In other embodiments of the invention, a single solenoid can be used to position the choke shutter in one of the three positions, and manual means can be employed as alternate means to position the choke shutter in one or all of the positions.

Further objects and advantages of the present invention will become apparent from the following description and accompanying drawings.

DRAWINGS

FIG. 1 is a diagrammatic view of an automatic choke and circuit in accordance with the invention with the choke shutter in an open position.

FIG. 2 is a fragmentary view of the choke of FIG. 1 with the choke shutter in a closed position.

FIG. 3 is a fragmentary view of the choke shutter in FIG. 1 with the choke shutter in a partially open position.

DETAILED DESCRIPTION

In the drawings there is shown a fragmentary portion of an engine 10 which has a carburetor 12 with an intake manifold or an air inlet passage 14 defined by a wall 15, together with a choke shutter 16 pivotally mounted on a choke shaft 18 within the air inlet passage 14.

In accordance with the invention, there is provided a solenoid which is generally designated 20, and which has first and second coaxial coils 22 and 24 respectively mounted within a ferrous metal frame 26. The solenoid 20 includes a plunger or armature 28. Means are provided for connecting the armature 28 to the choke shutter 16. Such means includes an arm 30 and a spring 32 which has one end secured to the armature 28 and the other end secured to the arm 30. The spring 32 affords breathing of the choke shutter 16 when in a full choke position as shown in FIG. 2. Engine vacuum can withdraw the shutter 16 from engagement with wall 15 and thus permit a slight air flow.

The invention also provides a solenoid energizing circuit which is referred to generally by the numeral 34 and which includes a battery 36 and an ignition switch 38. The battery 36 is connected to the ignition switch 38 by a lead 40 and is connected to ground 42 by a lead 44. Also included in the solenoid circuit is a temperature switch 46 which is located on the engine 10, and which is normally closed until the engine reaches a predetermined operating temperature. The temperature switch 46 is connected to the ignition switch by a lead 48, and is connected to the first solenoid coil 22 by a lead 50. The circuit 34 further includes a push button switch 52 connected to the ignition switch by a lead 54 and to the second coil 24 by a lead 56. The coils 22 and 24 are connected to ground 42 by leads 58 and 60.

The solenoid 20 and the solenoid energizing circuit 34 afford three choke shutter positions including a fully open position as shown in FIG. 1 with the choke shutter 16 in a position parallel to the direction of air flow in the air inlet passage 14, a full choke or closed position as shown in FIG. 2 and a partial choke position as shown in FIG. 3.

Means are provided for biasing the shutter 16 to the open position. In the construction disclosed in FIG. 1, the biasing means comprises a spring 62 with one end secured to arm 30. Various other means for biasing the choke shutter 16 to the open position can be utilized. For instance, with the solenoid located above the choke, gravity can be used to position the armature in the FIG. 1 position. In the construction disclosed in FIG. 3, a coil spring 64 located between frame 26 and extending into axial aperture 66 in armature 28 provides the biasing means. When neither of the coils 22, 24 are energized, the shutter is biased to the open position shown in FIG. 1. This position is also the normal operating position.

The full choke or closed shutter position for engine starting, as illustrated in FIG. 2, is effectuated by depressing the push button 52 to energize the second coil 24.

In movement of the armature 28 from the open position shown in FIG. 1 to the full choke position shown in FIG. 2, for instance, when the ignition switch is turned on, and the engine is to be started, the first coil 22 will be normally energized when the engine is cold, thus moving the armature from the FIG. 1 position to the FIG. 3 position. With the armature in the FIG. 3 position it is possible for the second coil 24 to move the armature to the FIG. 2 position against the field of the first coil 22 because of the greater field strength in the second coil 24 due to the presence and magnetization of base 67 of the frame 26. However, when the engine is warm and the temperature switch is in an off position, the first coil 22 is not energized and the second coil 24 may not have a sufficient field strength to move the armature from the FIG. 1 position against the biasing of spring 62 or 64 to the FIG. 2 position.

To assist movement of the armature from the FIG. 1 position to the full choke FIG. 2 position, the solenoid circuit 34 can include a diode 68 to energize the first coil 22 when the engine is at operating temperature and the temperature switch is closed or inoperative. The diode 68 is connected to the first coil lead 50 by a lead 70 and to the second coil lead 56 by a lead 72. The diode 68 will afford current flow and energization of the first coil 22 when the push button switch 52 is actuated, thus moving the armature 28 to the position shown in FIG. 3, with the armature centered in the first coil 22. With the armature 28 in the FIG. 3 position, the second coil 24 will take over and move the armature from center position in the first coil 22. Since the diode only affords one-way flow of current, the second coil 24 will not be energized when the temperature switch is closed and the first coil 24 is energized.

The partial choke shutter position of FIG. 3 occurs during operation as the push button 52 is released when the engine starts, thus deenergizing the second coil 24. The solenoid armature 28 will then move to the partial choke position shown in FIG. 3 with the armature centered in the first coil 22 which remains energized until the engine temperature reaches a predetermined operating temperature. The partial choke position provides smooth engine operation until the engine attains operating temperature.

Once this temperature is reached the temperature switch 46 will open and deenergize the first coil 22. With both coils deenergized, the choke shutter is spring biased to the open position of FIG. 1.

The provision of a manually actuated switch such as push button 52 and the diode 68 in the circuit assures operation of the choke to start the engine, though the temperature switch is inoperative or the engine is at normal operating temperature and the temperature switch is open.

It is within the purview of the invention to use various arrangements of solenoid coils and manual means to position the choke shutter in the desired positions. Such arrangements can be used alternately as dual means for effectuating any particular shutter position or used cooperatively with a solenoid with one or more coils being utilized to position the choke shutter in one or more of the three positions and the manual means being employed to position the choke shutter in the other of the positions. For instance, a single solenoid coil 22 can be used with a temperature switch 46 to maintain the partial choke position shown in FIG. 3. A push-pull cable 76 or lever (not shown) can be connected to the arm 30 or armature 28 to move the shutter 16 to a full choke or choke open position or even the partial choke position when the temperature switch is inoperative. A similar arrangement can be employed utilizing both solenoid coils 22, 24 with circuit 34 and the manual means being used as an alternate.

Although the drawings disclose a choke shutter located within the air inlet passage 14, the invention can be utilized with a choke shutter or valve located outside and adjacent to the entrance of the inlet passage 14 in a manner generally such as disclosed in U.S. Pat. No. 1,115,120.

Various of the features of the invention are set forth in the claims.

I claim:

1. In an engine having a carburetor with an air inlet passage and a choke shutter mounted for movement relative to said air inlet passage between full choke and choke open positions, the improvement in combination therewith comprising first and second coaxial solenoid coils, a solenoid armature movable within said coils, means connecting said armature to said choke shutter, an operating circuit including switch means for selectively energizing said solenoid coils to move said armature in only one direction and said choke shutter between full choke and partial choke shutter positions.

2. The improvement of claim 1 including means for biasing said choke shutter to an open position when neither of said coils is energized.

3. The improvement of claim 1 wherein said circuit includes a temperature responsive switch adapted to be located on an engine to sense engine temperature, said switch being in a closed position to maintain one of said first and second coils in a state of energization when the engine is cold, and being in an open position when the engine reaches a predetermined operating temperature to deenergize said coil.

4. The improvement of claim 2 wherein said circuit includes a switch for energizing the other of said coils to position said shutter in a closed position.

5. An engine in accordance with claim 1 wherein said means for biasing said choke shutter to an open position includes a frame around said solenoid coil and a spring located between one end of said armature and the frame.

6. An engine in accordance with claim 4 wherein said armature has an axial aperture and said spring extends into said aperture.

7. The improvement of claim 1 wherein said means connecting said armature to said choke shutter comprises an arm connected to said choke shutter, and a spring having one end

connected to said arm and the other end connected to said solenoid armature.

8. An engine in accordance with claim 1 wherein said circuit includes a temperature responsive switch connected to said engine, a power source, a lead connecting said temperature responsive switch to said power source, a lead connecting said temperature responsive switch to one end of said first coil, a second switch connected to said power source, a lead connecting one end of said second coil to said second switch, a lead connecting the other ends of said first and second coils to said power source, and means connecting said first and second coils to afford energization of said first coil when said second coil is energized and said temperature responsive switch is in an open condition.

9. An engine in accordance with claim 8 wherein said means connecting said first and second coils comprises a diode.

10. In an engine having a carburetor with an air inlet passage and a choke shutter mounted for movement relative to said passage, the improvement in combination therewith comprising first and second coaxial solenoid coils, a solenoid armature movable within said coils, means connecting said armature to said choke shutter, means including temperature responsive means for energizing said second solenoid coil to position said choke shutter in a partial choke position when the engine is below a predetermined operating temperature, means for energizing said first solenoid coil, and a diode connected between said first and second coils to energize said second coil when said first coil is energized and when the said temperature responsive means is open.

11. In an engine having a carburetor with an air inlet passage and a choke shutter mounted for movement relative to said air inlet passage between full choke and choke open positions, the improvement in combination therewith comprising first and second coaxial solenoid coils, a solenoid armature movable within said coils, means connecting said armature to said choke shutter, circuit means for energizing said coils including a switch connected to said first coil to energize said first coil and move said armature to a first position and move said choke shutter to the full choke position, and temperature responsive means connected to said engine and to said second coil for energizing said second coil for moving said armature to a second position and for moving said choke to a partially open position when said engine is below a predetermined operating temperature and upon deenergizing said first coil, said temperature responsive means being operative to deenergize said second solenoid coil when said engine temperature attains said predetermined temperature, and means connected to said armature to move said armature to a third position and move said choke shutter to the open position when said first coil is deenergized and said engine attains said predetermined operating temperature, whereby said temperature responsive means deenergizes said second coil.

12. A choke mechanism comprising a carburetor with an air inlet passage, a choke shutter mounted for movement relative to said passage between an open choke position, a partial choke position, and a closed choke position, a solenoid coil, a solenoid armature movable within said coil, means connecting said armature to said choke shutter for movement relative to first, second and third positions corresponding respectively to said open, partial, and closed choke positions, means including a temperature responsive switch for connecting said solenoid coil to an energy source for energizing said coil at only one energy level so as to position and maintain said armature in said second position and said choke shutter in partial choke position when the engine is below a predetermined operating temperature, and manually operable means excluding said temperature responsive switch for moving said armature to said third position and said choke shutter to said closed choke position.