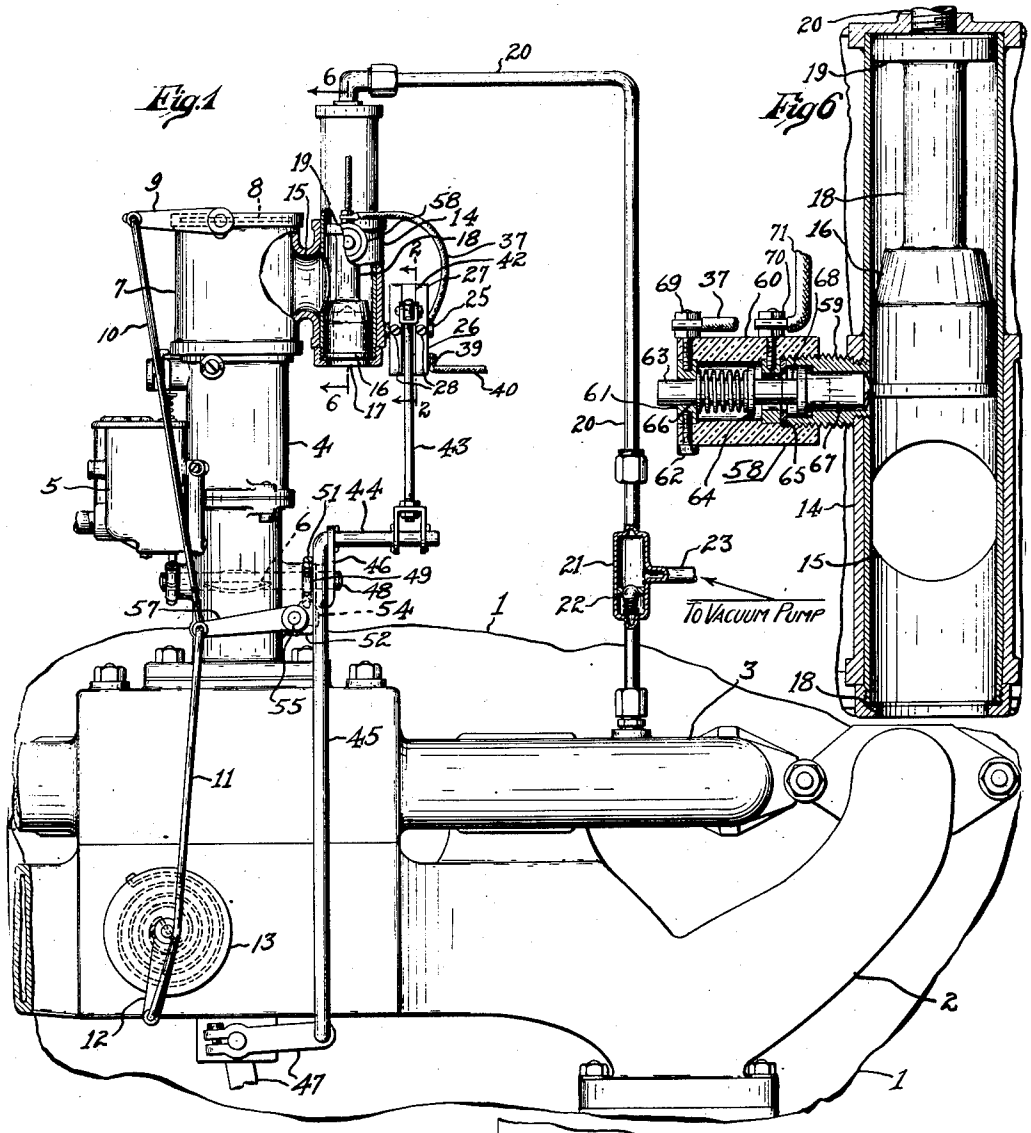
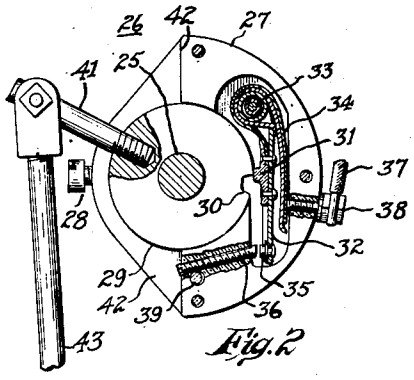
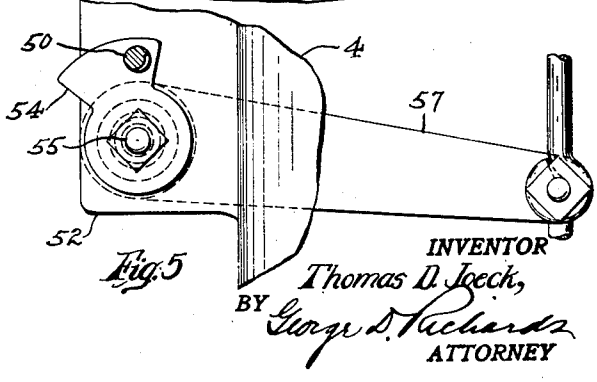
Dec. 24, 1940. T. D. JOECK 2,225,636

ENGINE STARTING APPARATUS

Filed July 30, 1932 3 Sheets-Sheet 1







INVENTOR
Thomas D. Joeck,
BY George D. Richards
ATTORNEY

Dec. 24, 1940. T. D. JOECK 2,225,636

ENGINE STARTING APPARATUS

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Fig. 4

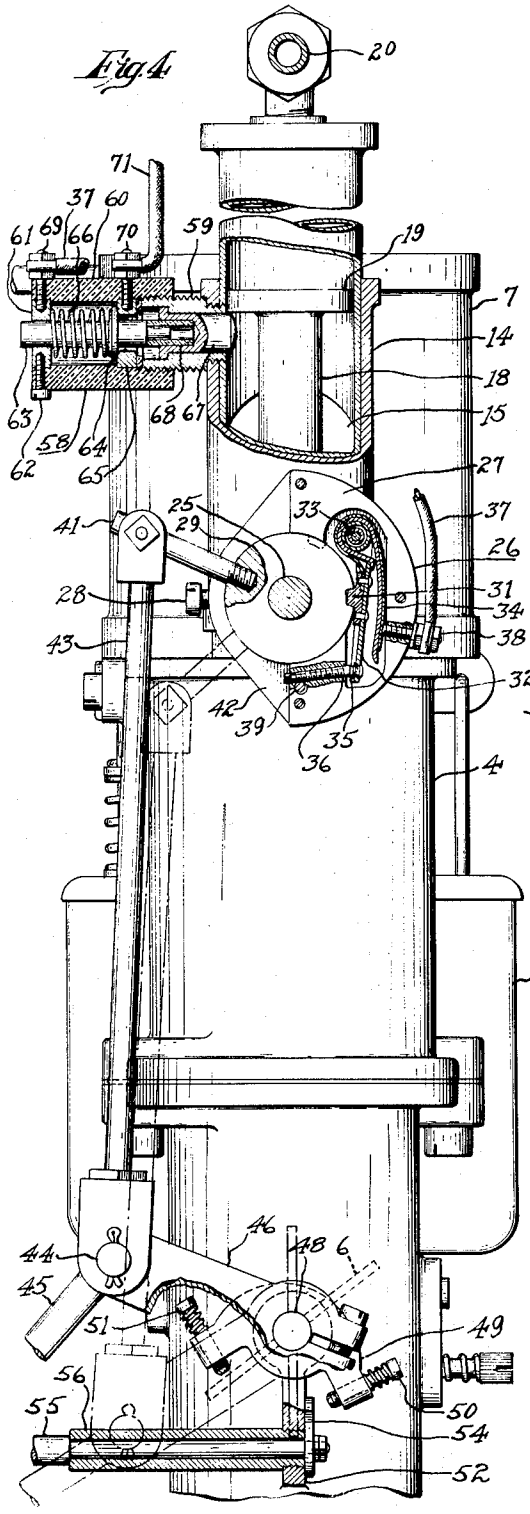
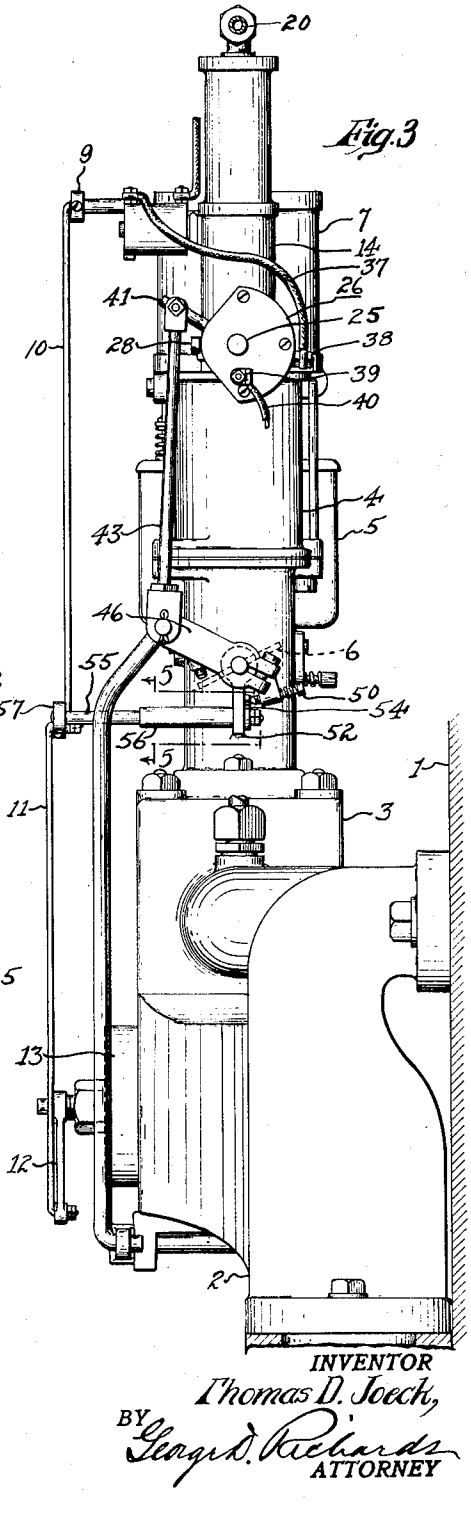


Fig. 3



INVENTOR
Thomas D. Joeck,
BY George D. Richards
ATTORNEY

Dec. 24, 1940. T. D. JOECK 2,225,636

ENGINE STARTING APPARATUS

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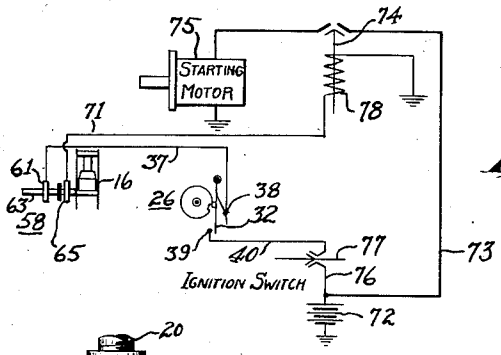


Fig. 7

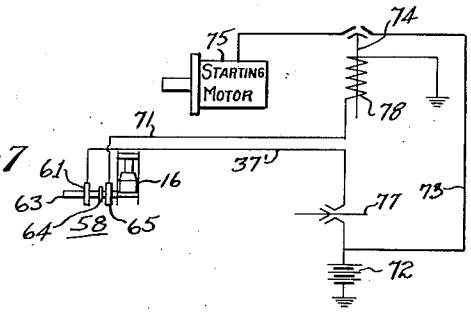


Fig. 11

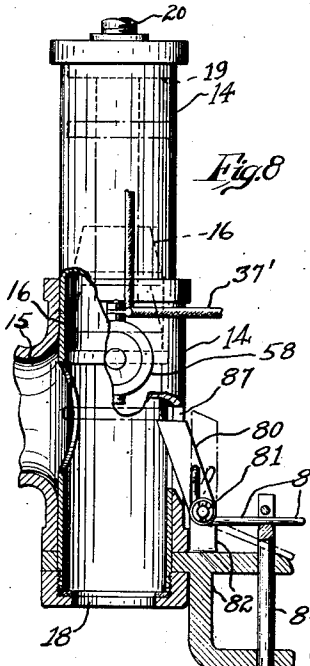


Fig. 8

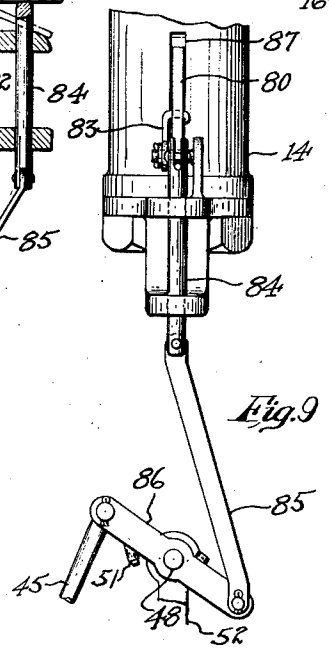


Fig. 9

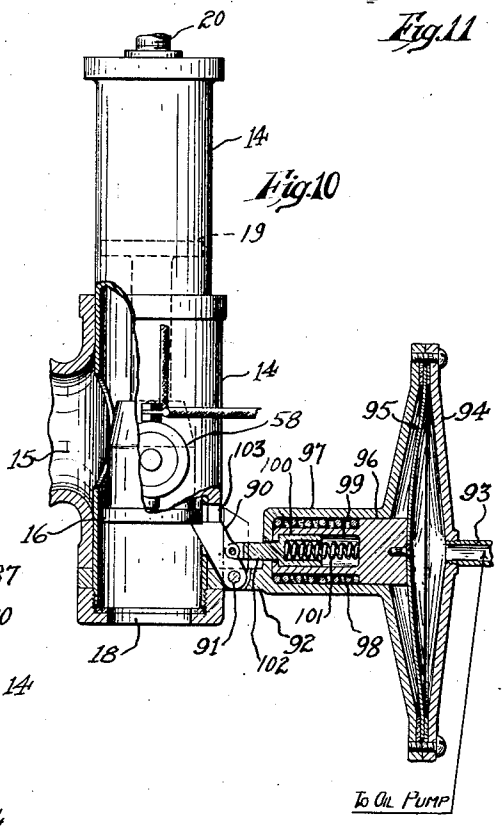


Fig. 10

INVENTOR
Thomas D. Joeck,
BY George S. Richards
ATTORNEY

Patented Dec. 24, 1940 2,225,636

UNITED STATES PATENT OFFICE

2,225,636

ENGINE STARTING APPARATUS

Thomas D. Joeck, Belmar, N. J., assignor to Bendix Stromberg Carburetor Company, South Bend, Ind., a corporation of Illinois

Application July 30, 1932, Serial No. 626,520

15 Claims. (Cl. 123—179)

This invention relates, generally, to the starting of internal combustion engines; and the invention has reference, more particularly, to a novel engine starting apparatus especially adapted for use in connection with the starting of automotive engines. Certain of the subject matter disclosed herein is being claimed in my copending application Serial No. 12,890.

Heretofore, in starting cold internal combustion engines of the automotive type, considerable skill has been required in order to manually operate the starting button or pedal, the choke, and the heater in the proper manner and sequence when prompt starting is desired.

The principal object of the present invention is to provide a novel engine starting apparatus which is adapted to greatly reduce the number of manual operations heretofore necessary in starting a cold engine.

Another object of the present invention lies in the provision of a novel engine starting apparatus which is operable to start the engine with the greatest facility and speed, the said apparatus enabling inexperienced persons to start a cold engine as readily and quickly as one having experience.

Still another object of the present invention is to provide a novel engine starting apparatus of the above character having means for insuring a proper throttle opening during the starting operation, the said apparatus being operable upon the turning of the ignition switch to automatically choke and start the engine.

Still another object of the present invention lies in the provision of a novel engine starting apparatus having means for insuring a proper minimum throttle opening when the engine is running cold, thereby preventing the accidental stalling of the engine due to premature movement of the throttle to normal idling position.

A fifth object of the present invention is to provide a novel engine starting apparatus having means for preventing the starting of the starting motor except when the engine is at rest.

Other objects of this invention, not at this time more particularly enumerated, will be clearly understood from the following detailed description of the same.

The invention is clearly illustrated in the accompanying drawings, in which:

Fig. 1 is a fragmentary view in elevation, with parts broken away, of an internal combustion engine equipped with the novel engine starting apparatus of the present invention, the parts of the said apparatus being shown in the positions assumed by these parts when the engine is cold and at rest.

Fig. 2 is an enlarged fragmentary sectional view taken along line 2—2 of Fig. 1.

Fig. 3 is a view in end elevation of the structure shown in Fig. 1.

Fig. 4 is an enlarged view with parts broken away of a portion of the structure shown in Fig. 3, the parts being shown in the positions assumed thereby during the operation of the starting motor at the starting of the engine.

Fig. 5 is an enlarged, fragmentary sectional view taken along line 5—5 of Fig. 3.

Fig. 6 is an enlarged sectional view taken along line 6—6 of Fig. 1, but illustrates the automaticaly operating choke piston and associated parts in the positions assumed by these members during the normal running of the engine.

Figs. 7 and 11 are wiring diagrams showing the electric circuits involved.

Fig. 8 is a fragmentary view in elevation illustrating a somewhat modified form of the construction.

Fig. 9 is a fragmentary side view of a portion of the structure shown in Fig. 8; and

Fig. 10 is a view similar to Fig. 8 of another modified form of construction.

Similar characters of reference are employed in all of the above described views to indicate corresponding parts.

Referring now to said drawings, the reference numeral 1 designates an internal combustion engine of the automotive type which is illustrated as equipped with the novel engine starting apparatus of the present invention. The reference numeral 2 designates the exhaust manifold of the engine 1, whereas the reference numeral 3 designates the intake manifold. A down draft carburetor 4 having a float chamber 5 and a throttle valve 6, is illustrated as connected to the top of the intake manifold 3.

According to the preferred form of the invention, a hollow cylindrical, open ended choke casing 7 has its lower end attached to the intake end of carburetor 4. Choke casing 7 is provided internally with a choke by-pass valve 8 that is adapted to close the upper end of this casing. Choke by-pass valve 8 has an operating lever 9 connected to the upper end of a depending link 10. Link 10 in turn is connected at its lower end to the upper end of a second depending link 11. The lower end of link 11 is connected to the operating arm 12 of a thermostat 13 of the well known spiral type. When the engine becomes warm in use, the operating arm

12 will be turned in a counterclockwise direction, thereby raising links 11 and 10 and effecting the opening of choke by-pass valve 8.

The choke casing 7 is formed with a vertically extending, cylindrical and laterally offset portion 14 which communicates with the main portion of choke casing 7 by means of a transverse passage 15. A choke valve 16, illustrated as of the piston type, is vertically movable within the cylindrical offset portion 14. Portion 14 of casing 7 is closed at its top and is formed with an air inlet opening 17 at its bottom, which air inlet opening is adapted to be closed by the choke valve 16 when the engine is at rest or at the point of starting. Choke valve 16 is provided with a vertically upstanding stem 18 which has a pneumatic piston 19 secured to its upper end for reciprocation in the upper part of casing portion 14.

The top of casing portion 14 is connected by piping 20 to the intake manifold 3 so that suction created in the intake manifold by the starting of the engine will cause the raising of pneumatic piston 19 and hence will effect the lifting of choke valve 16 off of its seat, thereby opening the air inlet opening 17 and permitting air to enter the carburetor by way of casing portion 14, passage 15 and casing 7. A fitting 21 is illustrated as included in the piping 20, which fitting provides a ball check valve 22 and a branch pipe 23 adapted to be connected to a vacuum pump (not shown) which is suitably driven from the engine in a manner well known to those skilled in the art. The fitting 21 would only be used in those cases where the engine is equipped with a vacuum pump. The use of the fitting 21 in connection with a vacuum pump will insure enough suction being applied to pneumatic piston 19 at all times during the running of the engine so as to retain choke valve 16 in its raised position.

Choke casing portion or extension 14 has a transversely extending pin or stud 25 projecting laterally therefrom. A switch, designated as a whole by the reference numeral 26, having a built-up housing 27 of insulating material, is mounted upon the stud 25. The side walls of the insulating housing 27 are apertured to receive the stud 25. Set screws 28 are threaded into the side walls of housing 27 for engaging stud 25 to thereby lock the housing 27 in desired angularly adjusted position upon stud 25. A cam collar 29 is turnably mounted upon stud 25 within housing 27. Cam collar 29 has a transverse cam groove 30 in the peripheral portion thereof for cooperating with a boss 31 provided on a switch arm 32.

Switch arm 32 is pivotally mounted on a pin 33 carried by the side walls of casing 27. A leaf spring 34 is contained within the housing 27 and urges the switch arm 32 toward cam collar 29 so that boss 31 will be held in engagement with the peripheral surface of this cam collar. In the event that cam groove 30 moves into register with the boss 31, this boss will snap into the cam groove 30, thereby causing a movable contact 35, carried by the free end of switch arm 32, to engage a stationary contact screw 36. A lead 37 is connected to a terminal screw 38, which in turn, engages the leaf spring 34. The stationary contact screw 36 is electrically connected by a terminal screw 39 to another lead 40.

Cam collar 29 has a stud 41 secured thereto, which stud projects outwardly through a slot 42 provided in the housing 27. The outer end portion of stud 41 is pivotally connected to the upper end of a depending link 43, the lower end of which link is pivotally connected to the upper end portion 44 of another depending link 45. The upper end portion 44 of link 45 is also pivotally connected to the operating arm 46 of the throttle valve 6. The lower end portion of link 45 in turn is pivotally connected to a lever system 47 that leads to the throttle operating lever and/or pedal (not shown) of the automotive vehicle in a manner well known to those skilled in the art. The throttle valve stem 48 has an arcuate member 49 secured thereto (see especially Fig. 4), which arcuate member carries motion limiting screws 50 and 51 which are adapted to engage the opposite sides of a stop projection 52 formed on the carburetor to thereby limit the closing and opening movements of the throttle valve 6.

A segmental stop plate member 54 is fixed to the rear end of a shaft 55 adjacent stop projection 52 (see especially Figs. 3 to 5). Shaft 55 is journaled in a bearing 56 carried by the stop projection 52. The forward end of shaft 55 has an arm 57 fixed thereto, which arm is pivotally connected at its outer end to the point of juncture of links 10 and 11 so that when these links are actuated by the thermostat 13, the arm 57 is also actuated to turn segmental stop plate 54. The stop plate member 54 is so disposed with respect to the motion limiting screw 50 as to underlie this screw when the engine is cold, as illustrated in Figs. 1, 3, 4 and 5 of the drawings, at which time this plate member serves to hold the motion limiting screw 50 somewhat away from stop projection 52, thereby providing for a greater throttle opening when the engine is idling cold. When the engine warms up, however, thermostat 13 operates to effect the turning of the segmental plate 54 from under the motion limiting screw 50. Thus, arm 12 of this thermostat turns counterclockwise (see Fig. 1) as the engine warms up, causing link 11 to move upwardly and effecting clockwise movement of arm 57 so that the stop plate 54 also moves clockwise and outwardly from under the end of limiting screw 50. The large idling throttle opening provided by the presence of stop plate member 54 when the engine is running cold, prevents the accidental stalling of the engine due to too lean a fuel mixture.

A switch, designated as a whole by the reference numeral 58, is mounted upon the choke casing portion or extension 14. As especially shown in Figs. 4 and 6, this switch 58 comprises a fitting 59 that is threaded into an aperture provided in the wall of choke casing extension 14. A cylindrical insulating housing 60 has its inner end portion threaded upon fitting 59 and has a metallic collar 61 inserted into its open outer end, which collar is retained in place within said housing as by a screw 62. The central aperture of collar 61 serves as a bearing support for the outer end portion of a plunger 63. Plunger 63 extends longitudinally within the hollow interior of housing 60 and has an annular flange 64 formed thereon for cooperating with a metallic ring member 65 that is fixed within housing 60.

A coil compression spring 66 is contained within housing 60 in surrounding relation to the plunger 63 and bears at one end against the collar 61 and at its other end against the flange 64, thereby tending to urge the flange 64 into engagement with ring member 65. Plunger 63 has a cylindrical head 67 secured thereto, though in-

sulated therefrom by an insulating sleeve 68 that is interposed between a reduced end portion of plunger 63 and the wall of a receiving recess provided in the head 67, which receiving recess is adapted to tightly receive the insulating sleeve 68.

Head 67 of plunger 63 is adapted to reciprocate slightly within the fitting 59, which fitting serves as a guide bearing for the head 67. With the annular flange 64 of plunger 63 in engagement with ring member 65, under the action of spring 66, the inner end portion of head 67 projects slightly into the interior of casing portion or extension 14, as especially shown in Fig. 4. In this figure the choke valve or piston 16 is illustrated in its lower position and in closing relation to the air inlet opening 17. After the engine has started and the choke valve 16 rises in casing portion 14 due to engine suction exerted on pneumatic piston 19, and this choke valve moves into engagement with the inner end of head 67 of plunger 63 and serves to move this plunger outwardly somewhat and into the position shown in Fig. 6, in which position the spring 66 is compressed and flange 64 is out of engagement with stationary ring member 65.

A terminal screw 69 is threaded into collar 61 and has the lead 37 connected thereto. A second terminal screw 70 is threaded into the stationary ring member 65 and has a lead 71 connected thereto. When the choke valve 16 is in its lower position, as shown in Fig. 4, annular flange 64 is in engagement with ring member 65 so that a circuit may pass through lead 37, terminal screw 69, plunger 63, flange 64, metallic ring member 65 and terminal screw 70 to lead 71. This circuit will be broken by the rising of valve 16 which will act to press the head 67 of plunger 63 outwardly, thereby breaking the connection between flange 64 and ring member 65.

A typical starting motor circuit which may be employed when using the engine starting apparatus of this invention, is illustrated in Fig. 7. In this figure, the battery 72 is adapted to supply starting current through lead 73 and solenoid relay 74 to the starting motor 75. A control circuit for the solenoid relay 74 comprises a lead 76 which extends from the battery 72 to ignition switch 77. Ignition switch 77 is connected by lead 40 to terminal screw 39 of switch 26. Terminal screw 38 of switch 26 is connected by lead 37 to the terminal screw connected to collar 61 of switch 58. Ring member 65 of switch 58 is connected through lead 71 to the solenoid 78 of the solenoid relay 74.

In use, assuming that the engine 1 is cold and at rest and that it is desired to start the same. To start the engine the operator merely closes the ignition switch 77. The choke valve 16 is in its lower position, shown in Fig. 1, thereby closing the air inlet aperture 17 and the switch 58 is closed. If switch 26 is also closed, a circuit will be completed for the solenoid 78 of solenoid relay 74. In order for the switch 26 to be closed, it is necessary that the proper amount of throttle for starting be given to the engine, or, in other words, it is essential that the throttle valve be open a predetermined amount to obtain the quickest starting. If the starting motor does not start upon the turning on of the ignition key, the operator will know that the throttle valve is not properly set for starting and he will move the throttle lever so as to adjust the throttle valve 6. During this adjustment of the throttle lever, the link 43 is moved, thereby turning the cam collar 29 of switch 26 so that boss 31 will enter cam groove 30 at the same instance that the proper throttle opening is obtained, thereby closing the circuit through switch 26.

The casing 27 of switch 26 is angularly adjustable on the stud 25 so as to thereby enable this switch to close when the proper throttle valve opening is obtained for starting. If the operator does not have the proper throttle valve opening when he inserts the key, the engine will not start, and it becomes merely necessary for him to move his throttle lever until the engine does start, or in other words, until the boss 31 snaps into cam groove 30, at which time movable contact 35 engages stationary contact 36 of switch 26. The control circuit (see Fig. 7) will be from battery 72 by way of lead 76, ignition switch 77, lead 40, terminal screw 39, switch arm 32, terminal screw 38, lead 37, collar 61, plunger 63, ring member 65, lead 71, solenoid 78 to ground. The energization of solenoid 78 will cause the closure of solenoid relay 74, thereby completing a circuit for the starting motor 75 by way of lead 73.

As soon as the engine starts, the suction created in intake manifold 3, acting through piping 20, will serve to raise pneumatic piston 19 and hence choke valve 16 within the extension 14. The raising of the choke valve 16 serves to permit the entrance of air by way of inlet opening 17, extension 14, passage 15 and choke casing 7 to the carburetor 4. As choke valve 16 rises upon the starting of the engne, it engages the head 67 of plunger 63 of switch 58, thereby pressing this plunger outwardly and effecting the opening of switch 58, thereby deenergizing solenoid 78 and opening the starting motor circuit. The engine is now running cold and if the same should tend to stall, the choke valve 16 will immediately fall downwardly due to decreased suction in the intake manifold, thereby effecting the reclosing of the switch 58 so that the starting motor will automatically start again to crank the engine provided the throttle valve is in proper position for starting. Thus, during the starting operation of the engine, the novel starting apparatus of this invention will serve to automatically choke the engine and control the operation of the starting motor until the engine is under way.

With the engine running cold, if the operator should decide to idle the engine and hence moves the throttle lever to idling position, the segmental stop plate member 54, by stopping the motion of screw 50 in advance of stop 52, serves to establish the idling position of the throttle valve 6 while the engine is running cold, thereby providing a somewhat larger throttle valve opening than normally, and effectively preventing the stalling of the engine. After the engine warms up, the thermostat 13, acting through its operating arm 12, will effect the raising of links 11 and 10, thereby opening choke by-pass valve 8 and permitting air to enter carburetor 4 directly through cylindrical choke casing 7 so as to by-pass the choke valve 16. As link 11 moves upwardly, the arm 57 is turned in a clockwise direction, as viewed in Fig. 1, so as to effect the removal of stop plate 54 from under motion limiting screw 50, thereby permitting the operator to thereafter idle the engine with the screw 50 engaging stop 52, or, in other words, with the engine idling with the throttle in normal idling position.

During the normal running of the engine, the choke valve 16 will be held in its upper position, shown in Fig. 6, in which position switch 58 is

open, so that the starting motor circuit is also open. When the engine is not equipped with a vacuum pump and hence the fitting 21 is not used, there are times when the suction in the intake manifold 3 will decrease to such a low value that the choke valve 16 will fall, thereby permitting switch 58 to close. Thus, when the engine is running under heavy load with the throttle open wide or when the throttle is opened suddenly, the vacuum in the intake manifold will drop resulting in the falling of choke valve 16. The closing of switch 58 would automatically effect the completion of the starting motor circuit were it not for the switch 26 connected to the throttle, which switch is open except when the throttle is opened a predetermined small amount, as during starting. Thus, when the engine is running at a heavy load with the throttle wide open, or when the throttle is opened suddenly, the switch 26 will be open because boss 31 will be riding on the periphery of cam collar 29 at such times and will not be in engagement with cam groove 30 (see dot and dash lines of Fig. 4). It will be remembered that cam groove 30 is so adjusted with respect to throttle valve 6 and to the boss 31 as to engage boss 31 when the throttle valve 6 is open but a limited amount for the starting operation. Thus, the use of switch 26 in conjunction with switch 58 effectively prevents the accidental starting of the starting motor when the engine is running.

When the engine is equipped with a vacuum pump, this pump will always maintain a sufficient vacuum in the upper portion of choke casing extension 14 to retain choke valve 16 in its raised position, in which position the switch 58 is held open. When such an engine is operating under wide throttle opening, even though the vacuum should fall in the intake manifold, the vacuum pump will serve to retain the choke valve in raised position, so that there is no possibility of the starting circuit being closed. In such case, the switch 26 may be omitted altogether, if desired, in which case, switch 58 will be connected directly to the ignition switch as by a lead 37' (see Fig. 11) and the engine could be started regardless of the position of the throttle lever and throttle valve. When the engine is not provided with a vacuum pump, however, it is very necessary to use switch 26 or an equivalent structure, so as to prevent the accidental starting of the starting motor while the engine is running.

If desired, the switch 26 may be omitted when using the starting apparatus of the present invention on an engine not equipped with a vacuum pump, provided means is used to prevent the accidental falling of choke valve 16 while the engine is running. Such a means is disclosed in Figs. 8 and 9 of the drawings, wherein the switch 26 is replaced by a latch 80 which is pivoted upon a pivotal pin 81 that is carried by a bracket 82 attached to the choke cylinder extension 14. A torsion spring 83 encircles the pin 81 and has one end connected to the latch 80 and its other end connected to the upper end of a vertical link 84. The lower end of link 84 is connected by a second link 85 to one end of a lever 86 that is illustrated as turnably mounted upon the throttle valve stem 48. The other end of lever 86 is pivotally connected to the depending link 45 which is connected as before through lever system 47 to the throttle lever or pedal of the vehicle. When the throttle lever or pedal is moved to idling position, the link 45 is moved upwardly, thereby turning lever 86 in a clockwise direction, as viewed in Fig. 9, and causing link 84 to move downwardly, in which position the latch 80 assumes the dot and dash line position shown in Fig. 8. The choke valve 16 can now fall into closing relation to the opening 17 should the engine be stopped.

Upon restarting the engine, the choke valve 16 will again rise to the full line position shown in Fig. 8, thereby uncovering the opening 17 and effecting the opening of switch 58 to cut off the starting motor, as previously described. As the throttle valve is opened during the running of the engine, the link 45 is moved downwardly, thereby causing link 84 to move upwardly, resulting in the turning of latch 80 inwardly through an opening 87 provided in the wall of extension 14. Latch 80 will thus be projected into the path of downward movement of choke valve 16 so that should this choke valve tend to fall down when the throttle is opened wide, the same will be stopped in its downward movement by the supporting action of the latch 80, which will hold the choke valve in the dot and dash line position shown in Fig. 8. The latch 80 will hold the choke valve 16 at a point where the same serves to still retain the switch 58 in open position, thereby preventing the closure of the starting motor control circuit. In the event that latch 80 should be projected into opening 87 when choke valve 16 is down, this latch will not prevent the subsequent upward movement of the choke valve for the choke valve can ride up and over the latch 80 by reflecting torsion spring 83. Thus, for example, if the engine should be started with a wide throttle opening and consequently with latch 80 projecting inwardly through opening 87, the choke valve 16 can nevertheless rise by riding over the beveled portion of latch 80 and forcing this latch outwardly.

In the form of the invention shown in Fig. 10, a latch 90 is also used for preventing the falling of choke valve 16 during the running of the engine. Latch 90 is controlled in its operation by the oil pressure created in the engine oil circulating system while the engine is running. Latch 90 is pivoted upon a pin 91 which is carried by a bracket 92 attached to the casing extension 14. Oil pressure from the oil circulating system of the engine is conveyed by a pipe 93 to a diaphragm casing 94 having a diaphragm 95 therewithin. The pressure of the oil supply by pipe 93, acting upon diaphragm 95, tends to move this diaphragm towards the latch 90.

A plunger 96 operates within a cylindrical extension 97 provided on the diaphragm casing 94 and has one end thereof connected to the diaphragm 95. The other end portion of plunger 96 is reduced and is surrounded by a coil compression spring 98 which opposes the oil pressure acting upon diaphragm 95 and which serves to return the diaphragm 95 to a central position within casing 94 when the oil pressure ceases upon the stopping of the engine. Plunger 96 has a cylindrical interior recess 99 within which a small piston 100 is adapted to move. A light compression spring 101 tends to urge piston 100 outwardly of recess 99. Piston 100 has a stem 102 projecting outwardly through an aperture provided in the end of cylindrical extension 97. The outer end of stem 102 is pivotally connected to latch 90 for operating this latch.

In this form of the invention, after the engine starts and as long as the engine continues to run, the oil pressure exerted upon diaphragm

95 will serve to press plunger 96 toward the latch 90 and will cause spring 101 to urge piston 100 outwardly so that the latter causes latch 90 to project inwardly through an opening 103 provided in the side wall of casing extension 14. Thus, in the event that the choke valve 16 should tend to fall during the operation of the engine, as when the throttle is opened wide during heavy load periods, the latch 90 will nevertheless serve to prevent the falling of this choke sufficiently to close switch 58 so that this switch is held opened. Thus, this switch 58 is held open at all times during engine operation. The presence of spring 101 permits latch 90 to yield in the event that the choke valve 16 moves upwardly past this latch.

It will be apparent that the novel engine starting apparatus of this invention enables the automatic starting of the engine upon the mere turning of the ignition key, the said apparatus serving to properly choke the engine regardless of the temperature or weather conditions, and to also control the action of the starting motor so that the said motor does not run after the engine is started. Also, means is provided to prevent the starting of the starting motor during all operations of the engine; but, should the engine stall at any time, the starting motor will be immediately energized to effect the restarting of the engine.

It will be apparent that the piston 16 need not be used as a choke valve, but could be mounted in a cylinder, such as the cylinder extension 14, at any point desired, which may be near or remote with respect to the carburetor 4, and yet this piston would nevertheless serve as a means for controlling the operation of the switch 58. Such an arrangement is illustrated in Fig. 6.

Certain features disclosed but not claimed herein are claimed in my copending application Serial No. 12,890 filed March 25, 1935, as a division of the instant application.

What is claimed is:

1. In an engine starting apparatus of the character described, a starting motor circuit, a carburetor choke valve responsive to the operation of the engine, a carburetor throttle valve, and switch means connected in said starting motor circuit, said switch means being operable in response to movement of said choke and throttle valves for controlling the completion and interruption of said starting motor circuit.

2. In an engine starting apparatus of the character described, a starting motor circuit, a carburetor choke valve responsive to the operation of the engine, a carburetor throttle valve, and switch means connected in said starting motor circuit for controlling the completion and interruption of said circuit, one switch of said switch means being operable in response to movement of said choke valve and another switch of said switch means being operable in response to movement of said throttle valve.

3. In an engine starting apparatus of the character described, a starting motor circuit, a carburetor choke valve responsive to the operation of the engine, a carburetor throttle valve, and switch means connected in said starting motor circuit for controlling the completion and interruption of said circuit, one switch of said switch means being operable in response to movement of said choke valve and another switch of said switch means being operable in response to movement of said throttle valve, said first named switch being closed upon the closing of said choke valve and said second named switch portion being closed upon the partial closure of said throttle valve.

4. In an engine starting apparatus of the character described, a starting motor circuit, a carburetor choke valve responsive to the operation of the engine, and switch means connected in said starting motor circuit, said switch means being operable in response to movement of said choke valve.

5. In an engine starting apparatus of the character described, a starting motor circuit, a carburetor choke valve responsive to the operation of the engine, switch means connected in said starting motor circuit, said switch means being operable in response to movement of said choke valve for controlling the completion and interruption of said starting motor circuit, and means operable from the engine throttle and cooperating with said switch means for aiding in controlling the completion and interruption of said starting motor circuit.

6. In an engine starting apparatus of the character described, a starting motor circuit, a carburetor choke valve responsive to the operation of the engine, a switch being normally biased to closed position and being arranged to be moved to open position upon the opening of said choke valve, a second switch connected in said starting motor circuit, said second switch begin normally in open position and arranged to close upon movement of the engine throttle to a predetermined starting position.

7. In an engine starting apparatus of the character described, a starting motor circuit, a pneumatically operated carburetor choke valve responsive to suction developed by the operation of the engine, a switch connected in said starting motor circuit, spring means for biasing said switch to closed position, said switch being arranged to be moved to open position against the tension of said spring means upon the opening of said choke valve, and a second switch connected in said starting motor circuit and arranged to be closed upon movement of the engine throttle valve to a predetermined starting position.

8. In an engine starting apparatus of the character described, a starting motor circuit, a carburetor choke valve responsive to the operation of the engine, a switch connected in said starting motor circuit, said switch being arranged to be moved to open position by the action of said carburetor choke valve in moving to open position, and latch means arranged to be projected into the path of movement of said choke valve during the operation of the engine for preventing the closing of said switch.

9. In an engine starting apparatus of the character described, a starting motor circuit, a pneumatically operated carburetor choke valve responsive to suction developed by the operation of the engine, a switch connected in said starting motor circuit, spring means for biasing said switch to closed position, said switch being arranged to be moved to open position by said choke valve and against the tension of said spring means upon the opening of said choke valve, and latch means connected to the engine throttle valve and arranged to be projected into the path of movement of said choke valve, when said throttle valve is opened with the engine running, to prevent the closure of said choke valve and thereby prevent the closure of said switch during the running of the engine.

10. In an engine starting apparatus of the char-

acter described, a starting motor circuit, a pneumatically operated carburetor choke valve responsive to suction developed by the operation of the engine, a choke by-pass valve, thermal control means operating in response to the temperature of the engine for controlling the operation of said choke by-pass valve, a switch connected in said starting motor circuit, spring means for biasing said switch to closed position, said switch being arranged to be moved to open position by said choke valve and against the tension of said spring means upon the opening of said choke valve, and latch means connected to the engine throttle valve and arranged to be projected into the path of movement of said choke valve, when said throttle valve is opened with the engine running, to prevent the closure of said choke valve and thereby prevent the closure of said switch during the running of the engine.

11. In an engine starting apparatus of the character described, a carburetor, a choke valve for said carburetor, said choke valve being operated by suction derived from the operation of the engine, a throttle valve for said carburetor, stop means for determining the normal idling position of said throttle valve, additional stop means for determining the idling position of said throttle valve when the engine is cold as during the starting of the engine, a starting motor circuit, a switch included in said starting motor circuit, said switch being biased to closed position and being arranged to be opened by said choke valve when the latter moves to open position.

12. In an engine starting apparatus of the character described, a carburetor, a choke valve for said carburetor, said choke valve being operated by suction derived from the operation of the engine, a throttle valve for said carburetor, stop means for determining the normal idling position of said throttle valve, additional stop means for determining the idling position of said throttle valve when the engine is cold as during the starting of the engine, a choke by-pass valve, thermal means responsive to engine temperature for controlling the operation of said additional stop means and said choke by-pass valve, a starting motor circuit, a switch included in said starting motor circuit, said switch being biased to closed position and being arranged to be opened by said choke valve when the latter moves to open position, and means associated with said throttle valve for preventing the closing of said starting motor circuit during the running of the engine.

13. In an engine starting apparatus of the character described, a starting motor circuit, a carburetor choke valve responsive to the operation of the engine, a carburetor throttle valve, switch means connected in said starting motor circuit, said switch means being operable in response to movement of said choke and throttle valves for controlling the completion and interruption of said starting motor circuit, and a thermostatically operated valve responsive to the engine temperature for by-passing said choke valve.

14. In an engine starting apparatus of the character described, a starting motor circuit, a carburetor choke valve responsive to the operation of the engine, a carburetor throttle valve, switch means connected in said starting motor circuit for controlling the completion and interruption of said circuit, one switch of said switch means being operable in response to movement of said choke valve and another switch of said switch means being operable in response to movement of said throttle valve, said first named switch being closed upon the closing of said choke valve and said second named switch being closed upon the partial closure of said throttle valve, and a thermostatically operated valve responsive to the engine temperature for by-passing said choke valve.

15. In an engine starting apparatus of the character described, a starting motor circuit, carburetor choke operating means responsive to the operation of the engine, a carburetor throttle valve, and switch means connected in said starting motor circuit, said switch means being operable in response to movement of said choke operating means and said throttle valve for controlling the completion and interruption of said starting motor circuit.

THOMAS D. JOECK.