Aug. 16, 1938. A. J. E. ROUALET 2,127,345

AUTOMATIC CHOKE

Filed Oct. 1, 1930 3 Sheets-Sheet 1

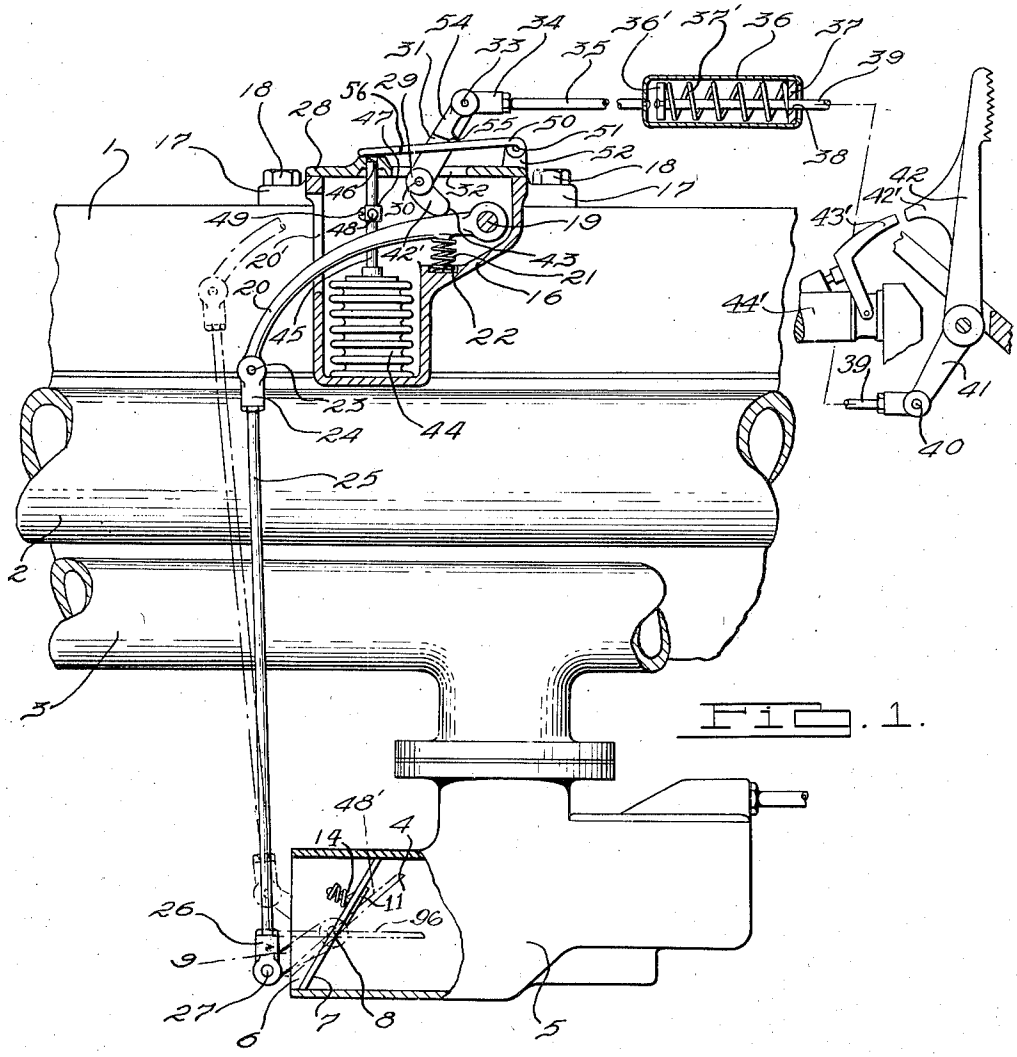

Fig. 1.

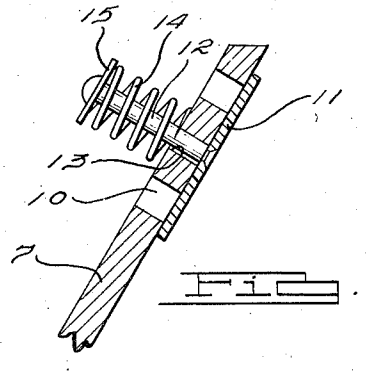

Fig. 6.

INVENTOR
ANDRE J. E. ROUALET.
BY
ATTORNEY

Aug. 16, 1938. A. J. E. ROUALET 2,127,345

AUTOMATIC CHOKE

Filed Oct. 1, 1930 3 Sheets-Sheet 2

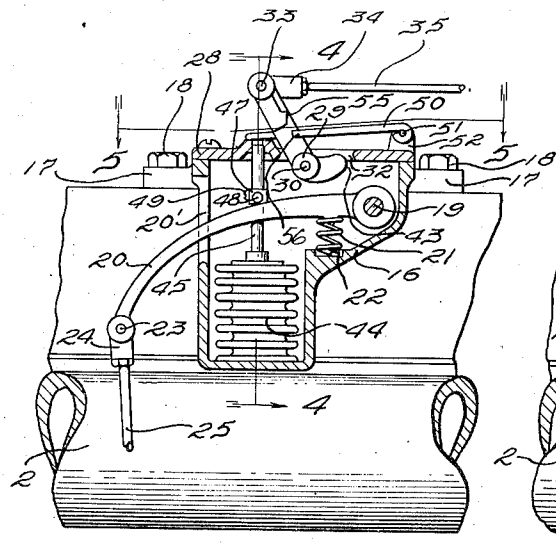

Fig. 2.

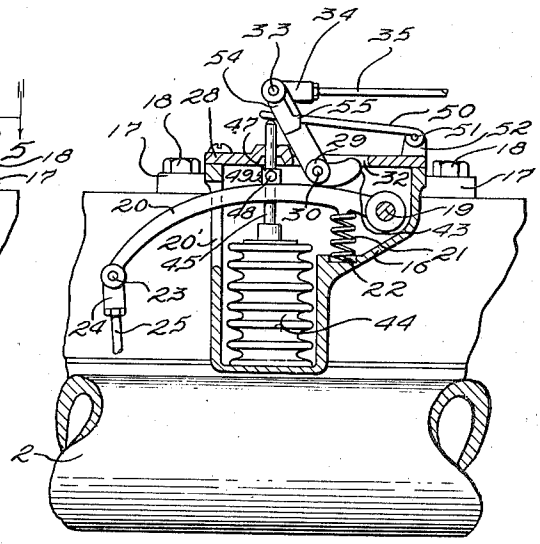

Fig. 3.

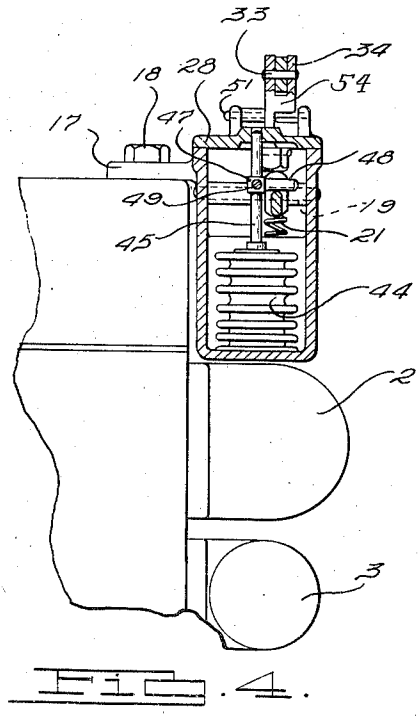

Fig. 4.

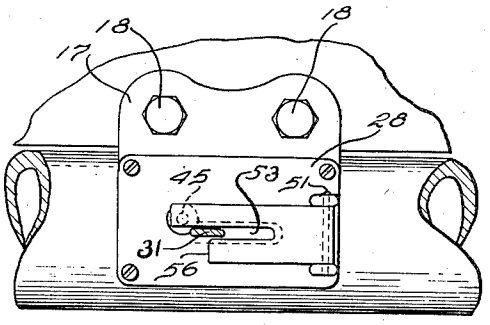

Fig. 5.

INVENTOR
ANDRE J. E. ROUALET.
BY
Irving Harness
ATTORNEY

Aug. 16, 1938. A. J. E. ROUALET 2,127,345

AUTOMATIC CHOKE

Filed Oct. 1, 1930 3 Sheets-Sheet 3

Fig. 10.

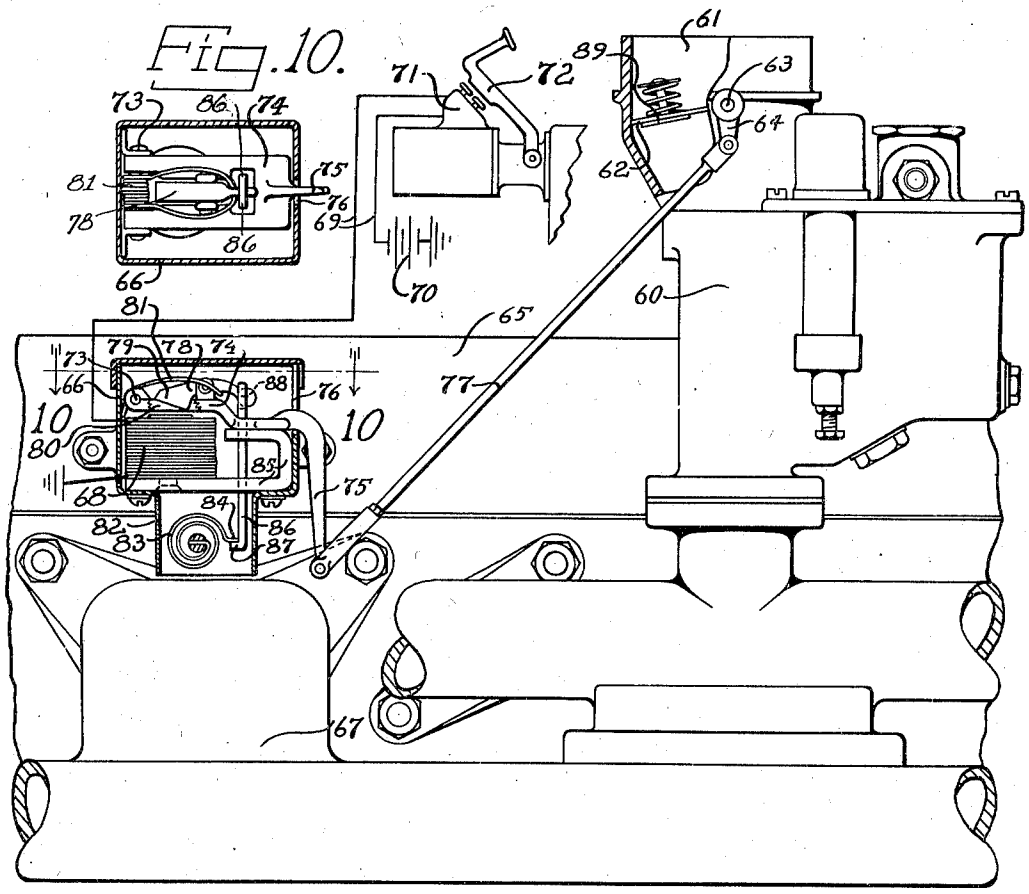

Fig. 7.

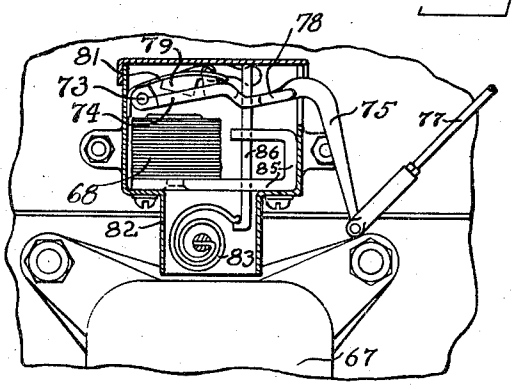

Fig. 8.

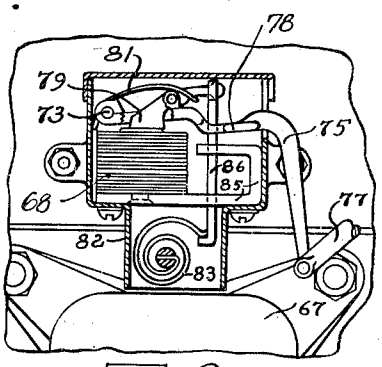

Fig. 9.

INVENTOR
ANDRE J. E. ROUALET.
BY John Harness
ATTORNEY

Patented Aug. 16, 1938

2,127,345

UNITED STATES PATENT OFFICE

2,127,345

AUTOMATIC CHOKE

Andre J. E. Roualet, Detroit, Mich., assignor to Chrysler Corporation, Detroit, Mich., a corporation of Delaware

Application October 1, 1930, Serial No. 485,797

3 Claims. (Cl. 123—179)

This invention relates to an improved method and apparatus for regulating the supply of air to an internal combustion engine, particularly during starting thereof and during the warming up stages which follow starting.

In starting an internal combustion engine it is customary to close the choke valve of the carburetor during the cranking operation so as to shut off the supply of air, thereby applying a substantial suction on the fuel feeding system of the carburetor and providing a rich charge of fuel for effecting the first few explosions. Some air, however, is required in order to form a mixture which will explode readily upon the occurrence of an igniting spark.

Heretofore, the problem of manually setting the choke valve so as to create enough suction to feed sufficient fuel for the initial explosions and at the same time to admit the proper amount of air necessary to form a highly explosive mixture has been left to the operator. This task is generally troublesome and particularly so during cold weather for improper setting of the choke valve frequently results in overloading or flooding of the carburetor, manifold and cylinders of the engine with fuel.

The occurrence of the initial explosions during starting increases the suction upon the fuel feeding means of the carburetor materially above that produced by the cranking operation and unless a change in the setting of the choke valve is immediately made to admit more air, an over-loaded condition results and the engine ceases to run. In warm weather, or when the engine is hot, the choke valve can be completely opened immediately after the initial explosions, but in operating a cold motor at low temperatures it is necessary to drive the vehicle with the choke partly closed for a considerable distance in order to heat the engine sufficiently to permit normal operation of the carburetor. Frequently the choke valve has to be adjusted several times during the warming up stages. With the conventional manually operable choke mechanism, all of these adjustments are a matter of trial and error, and the determining of the stages at which such changes in the setting of the choke valve are needed, are purely a matter of guess work. As a result of this indefiniteness in occurrence and degree of choke valve adjustments, excessively rich mixtures are supplied to the engine causing carbonization and faulty operation, and often the operator forgets to completely open the choke valve after the engine is heated and drives for miles under improper and inefficient carburetor conditions.

The main objects of the invention are to provide a carburetor choking apparatus which is fully automatic in its operation to the extent of requiring no manual effort or attention in addition to that employed in bringing the conventional engine starting mechanism into operation; to provide means for simultaneously closing the choke valve of the carburetor when the starting mechanism of the engine is actuated; to provide an auxiliary air inlet to the carburetor; to provide means for normally closing the auxiliary air inlet which is adapted to be operated by the suction created during cranking of the engine and which is calibrated to admit a predetermined quantity of air under the cranking suction so as to produce, in conjunction with the fuel supplied during cranking, a suitable fuel mixture for effecting the initial explosions.

Further objects of the invention are to provide regulating means for a carburetor choke valve which automatically permits the latter to rapidly open a sufficient amount immediately upon de-energization of the starting mechanism after the initial explosions occur so as to promptly increase the air supply to the engine, thereby automatically conditioning the carburetor for the follow-through stage of the engine starting operation; to provide thermostatic means which predetermines the degree of the initial opening of the choke valve; to provide means of this kind which is responsive to the temperature changes of the engine and adapted to gradually open the choke valve from its initially opened position to its full open position during the warming up stage of the engine; and to provide means for rendering the choke valve controlling apparatus inoperative when the temperature of the engine is such that choking of the carburetor is undesirable as, for example, when a vehicle engine stalls in traffic so as to prevent over-loading of the carburetor during re-starting of the engine.

An illustrative embodiment of my invention is shown in the accompanying drawings, in which:

Fig. 1 is a fragmentary elevation of a vehicle engine showing my improved choke regulating mechanism, partly in section, and illustrating diagrammatically its connection with the starting mechanism of the engine.

Fig. 2 is a vertical section of the choke valve regulating mechanism showing the parts thereof arranged to hold the choke valve in a partially opened position.

Fig. 3 is a vertical section similar to Fig. 2

showing the valve regulating mechanism in a changed position which corresponds to the full open position of the choke valve.

Fig. 4 is a vertical transverse section taken on the line 4—4 of Fig. 2.

Fig. 5 is a horizontal section taken on the line 5—5 of Fig. 2.

Fig. 6 is an enlarged fragmentary detail of a butterfly type of choke valve showing an auxiliary air inlet and valve therefore.

Fig. 7 is a fragmentary elevation partly in section showing a modified form of my invention.

Fig. 8 is a vertical section showing parts of the regulating mechanism in changed positions.

Fig. 9 is a vertical section showing parts of the regulating mechanism in other positions.

Fig. 10 is a horizontal section taken on the line 10—10 of Fig. 7.

In the form shown, the invention is illustrated in connection with an internal combustion engine which includes a cylinder head 1, an exhaust manifold 2 and an intake manifold 3. Communicating with the intake manifold 3 is an air passage 4 of a carburetor 5 of conventional construction having an air inlet 6 which is provided with a butterfly type choke valve 7. The choke valve is carried by a pin 8 which is journaled in a pair of apertures, one formed in each of the respectively opposite sides of the air inlet 6. A crank arm 9 is rigidly secured to the pin 8 for varying the position of the valve 7.

Formed in the choke valve 7 are a plurality of apertures or air passages 10 which form an auxiliary air inlet to the carburetor. An auxiliary valve, including a disc 11 having a stem 12 thereon slidably mounted in an aperture 13 in the choke valve 7, is carried by the latter valve and is provided with a coil spring 14 which bears between one side of the valve 7 and a washer 15 on the free end of the stem 12. The spring 14 normally holds the valve 11 in a closed position. This auxiliary valve is unobstructed and free to open under the normal carburetor suction when the choke valve 7 is closed. The compression of the spring 14 and the size of the apertures 10 are correspondingly predetermined to admit the correct amount of air under the force of the suction which is created in the air passage 4 during the cranking operation of the engine, so as to produce, in conjunction with the fuel which is fed into the air passage 4 by the suction therein, a fuel mixture which has suitable explosive properties for effecting the initial explosions of the engine. The spring 14 resists opening of the valve 11 with sufficient force to maintain enough vacuum in the air passage 4 to properly proportion the air and fuel for the initial explosion mixture. Throughout the specification and claims, reference to the auxiliary air inlet provided by this valve as being calibrated to produce the desired starting mixture means that the compression of the spring and the size of the openings with which the valve is associated are predetermined to accomplish this result.

The choke valve 7 is provided with automatic regulating mechanism which includes a casing or housing 16 having side flanges 17 by which the housing is rigidly mounted on the cylinder head 1 of the internal combustion engine by bolts 18. The housing extends downwardly at the side of the cylinder head 1 and is located directly over the exhaust manifold 2. The shaft 8 of the choke valve is located below the center of the valve so as to cause the suction created in the inlet 6 to aid in opening the choke valve after the engine is started.

Pivotally mounted at 19 in the housing 16 is an arcuate shaped lever 20 which extends through a slot 20' in the housing and is normally urged upwardly by a coil spring 21 bearing between a seat 22 in which the spring is received, and the lower side of the lever 20. The free end of the lever 20 is pivotally attached at 23 to a yoke member 24 which is adjustably secured to the upper end of a link 25. Threaded on the lower end of the link 25 is a similar adjustable yoke member 26 which is pivotally attached at 27 to the free end of the crank arm 9 of the choke valve 7.

The housing 16 has a cover 28 on its upper end on which a bell crank lever 29 is pivotally mounted at 30. One arm 31 of the bell crank lever 29 extends outwardly through a slot 32 in the cover 28 and is pivotally attached at 33 to a yoke member 34 which is threaded on a rod 35. The rod 35 carries a tubular casing 36 having a closed rear end 37 in which an aperture 38 is formed. Slidably mounted in the aperture 38 is a rod 39 which is pivotally attached at 40 to an arm 41 formed integrally with the starter control pedal 42, as shown in Fig. 1. The pedal 42 has a lug 42' which operates upon a switch and pinion control lever 43' of a starting motor generally indicated at 44'. For the purpose of illustration, the rod 39 is shown as being broken and its opposite ends are shown to be out of alignment with each other. However, it should be understood that the rod 39 extends substantially directly from the casing 36 to the starter pedal. The extremity of the rod 39 which is located in the casing 36 has a head or washer 36' against which one end of a coil spring 37' bears. The other end of the coil spring 37' bears against the wall 37 of the casing 36. In this manner, the rods 35 and 39 are yieldably connected together. The inner arm 42' of the bell crank lever 29 has a cam face 43 which rides upon the top side of the lever 20 and rotates the same in a counterclockwise direction against the action of the spring 21 when the starter pedal 42 is pressed forwardly or to the left as viewed in Fig. 1.

The choke valve regulating mechanism includes an expansible bellows 44 which is preferably filled with a volatile material, such as sulphur dioxide, and which is located in the housing 16. The lower end of the bellows 44 is secured to the bottom wall of the housing 16 and its upper end is provided with a stem 45 which is slidably mounted in an aperture 46 formed in the cover 28 of the housing. A collar 47 having a laterally extending pin 48 is adjustably mounted on the stem 45 above the lever 20. This collar has a set screw 49 by which it may be securely held in a selected position. The pin 48 registers with the lever 20, as shown in Fig. 4, and normally prevents movement of the lever 20 to the position shown in full lines in Fig. 3 and in dotted lines in Fig. 1 until the temperature of the engine has raised sufficiently to expand the bellows.

The collar 47 is preferably located in spaced relationship to the lowermost position of the lever 20, as illustrated in Fig. 1, so that when the lever is in its lowermost position, that is the position of the lever which corresponds with the completely closed position of the choke valve 7, the pin 48 is out of contact with the lever and the latter is free to be rapidly moved upwardly by the spring 21, thereby causing a sudden initial opening of the choke valve. The position of the lever 20, which corresponds with the partially or initially open

position 48' of the choke valve 7, is illustrated in Fig. 2. After the collar has been fixed in a selected position the bellows 44 regulates the position of the pin 48 with respect to the lever 20 in accordance with the temperature of the engine and in this way the degree of initial opening of the valve 7 is controlled by the temperature of the engine.

With the above mechanism, each operation of the starter pedal 42 moves the rod 39 rearwardly and tends to rotate the bell crank lever 29 in a clockwise direction. In order to prevent closing of the choke valve 7 when the engine is heated to a normal running temperature it is necessary to lock the bell crank lever 29 against clockwise rotation. For this purpose, a bar 50 is pivotally mounted as at 51 on lugs 52 formed on the cover 28 of the housing. This bar has a longitudinal slot 53 in which the outer arm 31 of the bell crank lever is received. The free end of the bar 50 is forked and one prong of the fork registers with the aperture 46 in the cover 28 in which the stem 45 is slidably mounted, and is adapted to be engaged by the top extremity of the stem 45 when the latter is urged upwardly by expansion of the bellows 44. A lug 54 having a shoulder 55 is integrally formed on the outer arm 31 of the bell crank lever 29, the shoulder 55 being in registration with the extremity 56 of the other prong of the bar 50 when the latter is raised to its uppermost position, as shown in Fig. 3. The bar 50 securely holds the bell crank lever 29 in an inoperative position when the engine is at a normal running temperature and upon actuation of the starter pedal 42 under these conditions, the spring 37' of the yieldable connection between the rods 35 and 39 is compressed, permitting relative axial movement between these two rods.

In operation, when the engine is cold the locking bar 50 is in its inoperative position, shown in Fig. 1, and upon actuation of the starter pedal 42 the bell crank lever 29 is rotated in a clockwise direction, thereby urging the lever 20, together with the link 25, downwardly and moving the choke valve 7 to a fully closed position.

The starting mechanism, shown generally at 44', turns the shaft of the engine at a cranking speed, and creates a vacuum in the air passage 4 of the carburetor which opens the auxiliary valve 11 admitting air and supplying fuel in predetermined proportions for producing a highly explosive mixture particularly suitable for effecting the initial explosions of the engine. In practice, as soon as the initial explosions occur the started pedal 42 is manually released, thereby allowing the lever 20 to rotate in a clockwise direction until it engages the pin 48 which is carried by the stem 45 of the thermostat. This movement of the lever produces an initial opening of the choke valve 7 which immediately increases the supply of air to the carburetor above that provided by the auxiliary valve 11 and the air passages 10. This increased flow of air changes the fuel ratio of the fuel mixture so as to produce a mixture which is particularly adapted for the follow-through stage of starting operation that immediately follows the occurrence of the initial explosions.

Further opening of the choke valve 7 is controlled by the thermostat, or bellows 44 which gradually raises the stem 45 and the pin 48 thereon ultimately allowing the lever 20 to be rotated to the position shown in Fig. 3 and opening the choke valve 7 to the position shown at 96 in Fig. 1. In this manner, the fuel ratio of the fuel mixture which is supplied to the engine is varied in proportion to the change in temperature of the engine.

When the bellows 44 is in its fully expanded position the stem 45 holds the locking bar 50 in the position shown in Fig. 3 so as to retain the extremity 56 of one prong of the bar in engagement with the shoulder 55 of the lug 54, thus preventing clockwise rotation of the bell crank lever 29. This feature of the invention is particularly important for as is commonly known, choking of the carburetor is sometimes highly undesirable at normal running temperatures of the engine.

In the form of my invention shown in Figs. 7, 8 and 9, the improved choke regulated mechanism is illustrated in connection with a downdraft carburetor 60 having an air inlet 61 in which a choke valve 62 is located. The choke valve is mounted on a shaft 63 which is spaced from the center of the valve so as to provide unequal areas thereof on the respectively opposite sides of the shaft. The shaft 63 has a crank arm 64 by which it is rotated to open and close the valve.

Mounted on a cylinder head 65 of an engine is a casing 66 which has its lower extremity located directly over the exhaust manifold 67. The casing 66 has a solenoid 68 in its upper portion which is electrically connected by conductors 69 with a battery 70 and with a switch 71, the switch 71 being operable by the pressure of the starter pedal 72 as illustrated in Fig. 7. Pivotally mounted at 73 in the upper portion of the casing 66 is an armature 74 which has a downwardly projecting arm 75 extending through a slot 76 in the wall of the casing. The external end of the arm 75 is connected by an adjustable link 77 with the crank arm 64 of the choke valve shaft. When the starter pedal 72 is depressed, a circuit is completed through the solenoid 68 which causes the armature 74 to be urged downwardly to the position shown in Fig. 7 so as to rotate the choke valve 62 to the fully closed position.

Journaled on the armature 74 is a second armature or lever 78 having a shoe portion 79 extending through a slot 80 in the armature 74. The armature 74 is normally urged upwardly about its pivot 73 by a spring 81 which bears at one end against the wall of the casing 66 and at its other end upon the lower side of the lever 78.

Located in the lower section 82 of the casing 66 is a thermostatic bi-metallic element 83 which has an outwardly extending lip 84. Slidably mounted in the supporting structure 85 of the mechanism is a vertically disposed rod 86 which has a projection 87 on its lower extremity on which the lip 84 of the bi-metallic member 83 is seated. The upper end of the bar 86 has a slot 88 in which the right extremity of the lever 78 is received.

When the starter pedal 72 is depressed, the switch 71 of the solenoid circuit is closed, thereby energizing the solenoid which draws the armature 74 and the arm 75 downwardly closing the choke 62. Air is admitted to the carburetor through the auxiliary air valve 89, more clearly described in connection with Figs. 1 to 6 inclusive, during the fully closed period of the choke valve. When the starter pedal 72 is released, the solenoid 68 is de-energized and the valve 62 tends to open under the action of the spring 81 and of the force of suction on the offset valve. A limited opening of the valve is permitted immediately after the solenoid is deenergized and after this initial open-

ing, further movement of the valve to its open position is regulated by the thermostat 83 which, acting through the bar 86, holds the armature 74 against upward rotation under the force of the spring 81 and the suction on the choke valve until a predetermined engine temperature is reached.

When the engine is heated to a normal running temperature, the parts of the mechanism assume the positions as shown in Fig. 8 wherein the thermostat 83 is uncoiled so as to permit the bar 86 to be raised to its upper position, thereby allowing the armature 74 to be rotated under the action of the spring 81 and of the force of suction on the valve 62. At this step of the operation of the mechanism, the choke valve is wide open.

When the starter pedal 72 is operated, while the engine is hot and the parts of the choke regulating mechanism are in the positions shown in Fig. 8, the solenoid 68 rotates the lever 78 about its pivot bringing the shoe 79 into engagement with the core of the solenoid. This action causes a slight, predetermined downward movement of the armature 74 so as to close the choke valve somewhat, but engagement of the shoe with the core of the solenoid shunts the magnetic force of the solenoid and prevents the armature 74 from being moved to its lowermost position. This operation of the mechanism is illustrated in Fig. 9 and corresponds to the conditions which exist when, for example, the engine is started while hot after being stalled in traffic. A fully choked condition is thus prevented when the engine is started while hot.

Although but two specific embodiments of this invention have herein been shown and described, it will be understood that various changes including the size, shape and arrangement of parts, may be made without departing from the spirit of my invention and it is not my intention to limit its scope other than by the terms of the appended claims.

What I claim is:

1. In an internal combustion engine including a carburetor, a valve for controlling the admission of air to said carburetor, means for automatically closing said valve during conditioning of said engine for starting, means responsive to the temperature of said engine for controlling the opening of said valve, and mechanism operable by said temperature responsive means for rendering the automatic valve closing means inoperative at a predetermined temperature of said engine.

2. In an internal combustion engine having starting mechanism and a carburetor, a choke valve in said carburetor, means operable during actuation of said starting mechanism for automatically holding said choke valve closed, means responsive to the temperature of said engine for regulating the opening of said valve, and mechanism operable by said temperature responsive means for rendering the automatic valve closing means inoperative at a predetermined temperature of said engine.

3. In an internal combustion engine including starting mechanism and a fuel mixture supply system provided with an air inlet, a choke valve in said air inlet, means operable during actuation of said starting mechanism for automatically holding said choke valve closed, means responsive to the temperature of said engine for regulating the opening of said valve, and mechanism operable by said temperature responsive means for rendering the automatic valve closing means inoperative at a predetermined temperature of said engine.

ANDRE J. E. ROUALET.