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AUTOMATIC CHOKE FOR CARBURETOR

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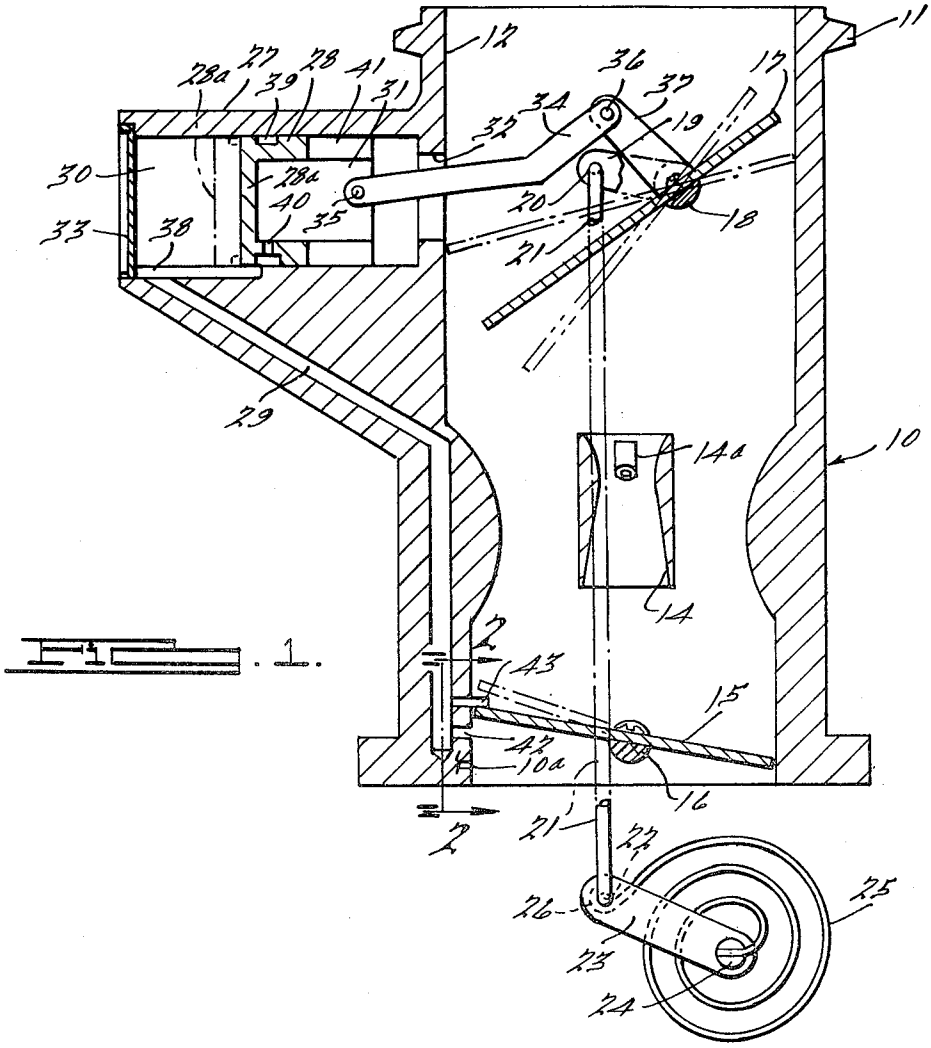


FIG. 1.

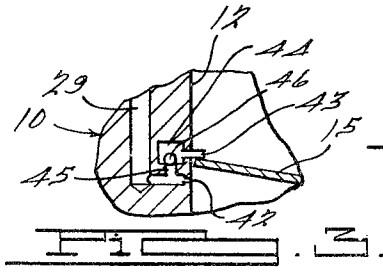


FIG. 3.

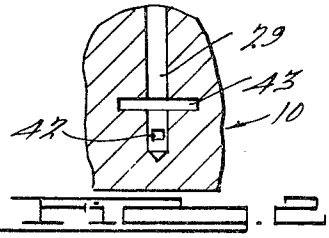


FIG. 2.

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AUTOMATIC CHOKE FOR CARBURETOR

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This invention relates to fuel charging systems for internal combustion engines and in particular to an improved carburetor for an automobile engine which prevents engine stalling due to lean fuel-air mixture at idle following a cold start, without providing an overrich mixture at road load.

It is customary to provide a thermostatically controlled choke valve to restrict the fuel-air induction conduit of a carburetor during cold starting conditions. Immediately after the cold engine is started, the extent of choking required for engine idling is appreciable, but decreases rapidly in the first few seconds of idling in consequence of engine heating and frictional heating of the bearing parts which rapidly reduce the frictional load on the engine.

In order to prevent the engine from stalling immediately after a cold start, the bi-metallic thermostat spring controlling the position of the choke valve is usually predetermined to allow opening of the choke valve approximately 20° of arc from the closed position. Within a few seconds after the engine is started, the aforesaid heating effects, particularly in the bearing parts, enable the engine to idle with a choke opening of approximately 40° of arc. However, the thermostat choke control spring is not readily responsive to these heating effects and restricts the choke opening to the 20° of arc for the first several minutes of idling. During this time, the fuel-air mixture will be excessively rich and poor fuel economy will result.

The initial opening of the choke valve to the idling position in opposition to the force of the themostatic choke control spring is commonly accomplished by pressure actuated means operatively connected with the choke valve and responsive to the low pressure in the induction conduit downstream of the usual throttle valve. When the throttle valve is opened beyond the idling position for operation of the engine at road load conditions, the thermostatic spring normally required to prevent engine stalling within the first few seconds after a cold start exerts too strong a closing force on the choke valve for road load conditions, with consequent poor fuel economy.

An object of the present invention is therefore to provide a simple, economically manufactured and highly efficient choke control for the carburetor of an automobile engine which enables the use of a comparatively lightweight thermostatic spring that readily yields to enable the opening of the choke valve during operation of the cold engine under road load conditions, yet which affords optimum choking to enable rapid starting of the engine without stalling or die-out during cold conditions.

Another object is to provide such a choke control wherein the pressure actuated means operates in stages to open the choke valve to a cold idling position to prevent engine stalling or die-out immediately after a cold start when the low pressure applied to the pressure actuated means is within a first range, and to open the choke valve to a road load condition when the low pressure applied to the pressure actuated means is within a second pressure range lower than the first pressure range, thereby to assure economical operation of the engine while being driven in a cold condition. The pressure actuated means is in communication with the induction conduit by means of ports located both upstream and downstream of the throttle valve when the latter is in is cold idle position, thereby to communicate said first pressure range to the

pressure actuated means, the upstream port being located downstream of the throttle valve when the latter is opened to a driving position, thereby to communicate the second pressure range to the pressure actuated means.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

FIGURE 1 is a schematic view substantially through the mid-section of a carburetor embodying the present invention.

FIGURE 2 is a fragmentary view taken in the direction of the arrows substantially along the line 2—2 of FIGURE 1.

FIGURE 3 is a fragmentary view showing a modification of the communication between the pressure actuated choke control mechanism and the induction conduit at locations upstream and downstream of the throttle valve in the idle position.

It is to be understood that the invention is not limited in its application to the details of construcion and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

Referring to FIGURE 1, a particular embodiment of the present invention is illustrated by way of example comprising a carburetor **10** which may be of conventional construction having an upper annular attachment rim **11** for an air cleaner and a central fuel-air induction conduit **12**, whereby combustion supporting air enters at the top. A large venturi **13** is formed integrally with the side walls of the induction conduit **12** and a small venturi **14** discharging at the throat of the venturi **13** is suitably supported with the conduit **12**. Fuel is admixed at the region of the venturis by means of a nozzle **14***a* discharging in accordance with customary practice into the small venturi **14**. The fuel-air mixture is discharged from the lower end of the conduit **12**. Also idle fuel is added via the customary idle jet **10***a* located downstream of valve **15**.

The discharge of the fuel-air mixture is controlled by a throttle valve **15** pivotally mounted on a transverse shaft **16** at a location downstream of the venturi **13**. A thermostatically controlled choke valve **17** pivotally mounted on transverse shaft **18** is provided in accordance with conventional practice upstream of venturis **13** and **14** for the purpose of providing fuel enrichment during cold operation of the engine.

The shaft **18** extends through the side wall of the conduit **12** and is splined to a crank arm **19** pivotally connected at **20** to a vertically shiftable actuating arm **21** having its lower end pivotally connected at **22** to a crank arm **23** pivotal about the axis of a fixed spindle **24**. A bi-metallic thermostat spring element **25** having one end secured to the spindle **24** extends spirally around the latter and terminates in a free end **26** engaging the lower end of arm **21** at the region of pivot **22**. In the usual instance, the thermostat element **25** will be located so as to be responsive to engine temperature. During cold conditions, the thermostat element **25** is under tension yieldingly urging shaft **21** upward and crank arm **19** clockwise so as to urge choke valve **17** toward the closed position. As the engine temperature rises, the tension in thermostat spring or element **25** relaxes to enable opening of choke valve **17** to a progressively greater extent under any given condition of airflow in the induction conduit **12**.

In order to supplement thermostat spring **25** in con-

trolling the position of choke valve **17** during the initial stages of engine operation after a cold start, a pressure cylinder **27** is provided integrally with the side-wall of carburetor **10** and is in communication with the induction conduit **12** by means of a duct **29**. Reciprocal axially within cylinder **27** is a cylindrical piston **28** having a closed left end **28***a* partitioning cylinder **27** into a low pressure part **30** in communication with duct **29** and a high pressure part **31** in communication with conduit **12** via vent opening **32** located upstream of choke valve **17**. The left end of cylinder **27** is closed by a plate **33**. An arm **34** extending through opening **32** is pivotally connected at **35** to piston **28** and at **36** to the swinging of a crank arm **37** splined to shaft **18**.

The outer cylindrical wall of piston **28** is in fluid sealing engagement with the inner cylindrical wall of cylinder **27** to prevent appreciable leakage of air around the piston **28** when the latter is at its extreme rightward position whereat choke valve **17** is closed. An axially extending groove **38** is provided in the left side-wall portion of cylinder **27** so as to communicate with an annular groove **39** formed in the outer surface of piston **28** when the latter is shifted leftward from the closed position to a first stage or cold idling position illustrated. The groove **39** communicates with the interior **31** through a restricted bleed port **40**, so as to bleed high pressure from the cylinder part **31** into the cylinder part **30** when the piston **28** is at the first stage position illustrated.

A pair of diametrically opposed axially extending slots **41** are provided in the right end of piston **28** to effect communication between cylinder parts **31** and **30** when piston **28** is shifted leftward from the first stage shown to a second stage position illustrated in phantom. The upper end of duct **29** communicates with cylinder portion **30** at the region of groove **38**. The lower end of duct **29** communicates with conduit **12** through a restricted downstream port **42** and an upstream slot or port **43**. The port **42** is located downstream of throttle valve **15**, whereas port **43** is located immediately upstream of the upper edge of throttle valve **15** when the latter is slightly open at a fast or cold idle position illustrated.

In accordance with the foregoing construction, when the engine is first started in a cold condition, the conventional carburetor fast idle mechanism in cooperation with thermostat **25** will maintain throttle valve **15** at the position illustrated during engine idling. The low pressure in conduit **12** downstream of valve **15** will be communicated via port **42** and duct **29** to the low pressure side **30** of cylinder **27**. This low pressure will be maintained at a value appreciably higher than the pressure downstream of valve **15** by reason of the upstream port **43** which partially bypasses cylinder portion **30** from the low pressure at port **42**.

The ports **42** and **43** are dimensioned with respect to the cross-sectional area of piston **28** and the force of thermostat spring **25** so as to cause immediate leftward movement of piston **28** to the first stage position during engine idling, as illustrated, regardless of the temperature condition of the engine and the choke valve closing force exerted by spring **25**. At this position, restricted port **40** will be in communication with groove **38** to prevent further leftward movement of piston **28** during engine idling until the tension in thermostat spring **25** relaxes by warming of the engine.

Thus choke valve **17** will be urged to the position shown, a mounting to an opening of appproximately 20° of arc from the closed position so as to assure adequate fuel enrichment through nozzle **14***a* to prevent engine stalling during the first few seconds of operation after a cold start. When throttle valve **15** is opened slightly beyond the cold idling or fast idle position illustrated so as to drive or operate the vehicle under road load conditions, port **43** will then be downstream of the throttle valve **15** and the low pressure communicated by duct **29** to cylinder part **30** will be substantially decreased to

cause leftward movement of piston **28** to the second stage position illustrated in phantom. At this position, the lower slot **41** will be in communication with groove **38** to prevent further leftward movement of piston **28** until the tension in thermostat spring **25** is relaxed by warming of the engine. In the above regard, port **43** comprises a horizontally extending slot in the side-wall of conduit **12**, FIGURE 2, so that an optimum pressure decrease in duct **29** will result with a minimum of opening of throttle valve **15** from the fast idle position illustrated.

The extent of opening of choke valve **17** at the first and second stage positions of piston **28** will depend upon the operating characteristics of the engine and carburetor **10**. In one specific type of carburetor construction, a choke valve opening of approximately 20 degrees at the first stage or cold idle position and approximately 40° at the second stage or cold road load operating position has been found satisfactory to prevent engine stalling immediately after a cold start, while obtaining improved economy during operation at the cold road load condition.

The present construction eliminates the problem of engine stalling immediately after a cold start, regardless of the temperature condition of thermostat spring **25**. Accordingly, greater freedom is made possible in the selection of a thermostat spring **25** having the proper characteristics to assure efficient operation both during and after the warm-up period. This is true because it is no longer necessary to make an arbitary compromise between efficient operation during engine starting and subsequent conditions of operation.

FIGURE 3 illustrates a modification wherein the overall construction is the same as illustrated in FIGURE 1, the only difference being that upstream port **43** opens from a valve chamber **44** in communication with port **42** by a bypass duct **45**. A spherical check valve **46** normally closes duct **45**, so that the low pressure communicated to cylinder portion **30** will depend entirely upon the restricted port **42** when throttle valve **15** is in the idle position shown.

The restricted port **42** in FIGURE 3 is dimensioned with respect to restricted port **40** so that when the throttle valve **15** is in the idle position shown, the resultant low pressure in cylinder part **30** will be sufficient to maintain piston **28** at the first stage position shown regardless of the cold temperature condition of thermostat spring **25**. As the engine temperature increases and the tension in spring **25** relaxes sufficiently, piston **28** will then move progressively to the second stage position illustrated in phantom. This latter action will result with the structure of either FIGURE 1 or FIGURE 3. It is to be noted however in regard to FIGURE 3, inasmuch as check valve **46** prevents a partial bypassing of cylinder part **30** from the low pressure at port **42**, the restriction of the latter in FIGURE 3 will ordinarily be greater than the restriction of port **42** in FIGURE 1.

When the throttle valve **15** is opened beyond the idle position illustrated, so that port **43** is downstream of the throttle valve, check valve **46** immediately opens to bypass restriction **42** and communicate the low pressure of conduit **12** downstream of valve **15** immediately to the low pressure portion **30**, so as to cause movement of piston **28** to the second stage position illustrated in phantom, FIGURE 1. Piston **28** will remain at the second stage position until subsequent warming of the engine relaxes the tension in thermostat spring **25**.

I claim:

1. In a fuel charging system for an automotive internal combustion engine, a fuel-air induction conduit, a choke valve and a throttle valve arranged in said conduit, temperature responsive means for yieldingly urging said choke valve in a closing direction during cold operation of said engine, pressure actuated means operable in opposition to said temperature responsive means for shifting said choke valve to an engine idling position adapted

to effect sufficient fuel enrichment to assure engine idling after a cold start, duct means connecting said pressure actuated means with said conduit at a location downstream of said throttle valve and also at a location upstream of said throttle valve during engine idling, said throttle valve having an edge movable to a position upstream of said upstream location when said throttle valve is opened beyond a fast idle condition.

2. In a fuel charging system for an automotive internal combustion engine, a fuel-air induction conduit, a choke valve and a throttle valve arranged in said conduit, temperature responsive means for yieldingly urging said choke valve in a closing direction during cold operation of said engine, pressure actuated means operable in opposition to said temperature responsive means for shifting said choke valve to an engine idling position adapted to effect sufficient fuel enrichment to assure engine idling after a cold start, duct means connecting said pressure actuated means with said conduit at a location downstream of said throttle valve and also at a location upstream of said throttle valve during engine idling, said throttle valve having an edge movable to a position upstream of said upstream location when said throttle valve is opened beyond a fast idle condition, the communication between said pressure actuated means and conduit comprising a slot extending transversely in the sidewall of said conduit to effect an optimum change in the area of communication between said conduit and pressure actuated means with a minimum change in the opening of said throttle valve.

3. In a fuel charging system for an automotive internal combustion engine, a fuel-air induction conduit, a choke valve and a throttle valve arranged in said conduit, temperature responsive means for yieldingly urging said choke valve in a closing direction during cold operation of said engine, a pressure actuated member operably connected with said choke valve, a duct having a downstream port in communication with said conduit at a location downstream of said throttle valve and connecting said port with said member to actuate the latter to urge opening of said choke valve in opposition to said temperature responsive means when said throttle valve is at an idle position, and means partially bypassing the connection between said member and downstream port comprising a bypass duct connected with the first named duct and having an upstream port in communication with said conduit at a location immediately upstream of said throttle valve when the latter is at said idle position, said upstream port being downstream of said throttle valve when the latter is opened slightly beyond said fast position.

4. In a fuel charging system for an automotive internal combustion engine, a fuel-air induction conduit, a choke valve in said conduit, a throttle valve in said conduit movable from a closed position to a fast idle position during cold starting of said engine and being openable beyond said fast idle position to a driving position, temperature responsive means for yieldingly urging closing of said choke valve to effect fuel enrichment during cold starting and operation of said engine, staged pressure actuated means operatively connected with said choke valve and responsive to a first range of low pressures for shifting to a first stage in opposition to said temperature responsive means for opening said choke valve to a cold idling position adapted to assure idling of said engine while in a cold condition, said staged pressure actuated means being responsive to a second range of low pressures lower than said first range of low pressures for shifting to a second stage in opposition to said temperature responsive means for opening said choke valve to a cold driving position adapted to asusre economical driving of said engine while in the cold condition, and duct means connecting said pressure actuated means with said conduit at locations both upstream and downstream of said throttle valve when the latter is in its idle position, thereby to communicate said first pressure range to said pressure actuated means, said upstream location being immediately upstream of said throttle valve in the fast idle position and being downstream of said throttle valve in said driving position to effect communication of said second pressure range to said pressure actuated means.

5. In a fuel charging system for an automotive internal combustion engine, a fuel-air induction conduit, a choke valve in said conduit, a throttle valve in said conduit movable from a closed position to a fast idle position during cold starting of said engine and being openable beyond said fast idle position to a driving position, temperature responsive means for yieldingly urging closing of said choke valve to effect fuel enrichment during cold starting and operation of said engine, staged pressure actuated means operatively connected with said choke valve and responsive to a first range of low pressures for shifting to a first stage in opposition to said temperature responive means for opening said choke valve to a cold idling position adapted to assure idling of said engine while in a cold condition, said staged pressure actuated means being responsive to a second range of low pressures lower than said first range of low pressures for shifting to a second stage in opposition to said temperature responsive mean for opening said choke valve to a cold driving position adapted to assure economical driving of said engine while in the cold condition, and duct means connecting said pressure actuated means with said conduit at locations both upstream and downstream of said throttle valve when the latter is in its idle position, thereby to communicate said first pressure range to said pressure actuated means, said upstream location being downstream of said throttle valve in said driving position to effect communication of said second pressure range to said pressure actuated means.

6. In the combination according to claim 5, said staged pressure actuated means comprising a pressure chamber, a shiftable pressure actuated member partitioning said chamber into a low pressure part and a high pressure part, said duct means being connected with said low pressure part, said high pressure part being connected with a source of high pressure upstream of said choke valve, restricted bleed means for bleeding said high pressure into said low pressure part when said member is shifted to said first stage, second bleed means for bleeding said high pressure into said low pressure part when said member is shifted to said second stage, said member being operatively connected with said choke valve to actuate the latter.

7. In the combination according to claim 5, said staged pressure actuated means comprising a pressure chamber, a shiftable pressure actuated member partitioning said chamber into a low pressure part and a high pressure part, said duct means being connected with said low pressure part, said high pressure part being connected with a source of high pressure upstream of said choke valve, said member being shiftable in response to the pressure differential between said low and high pressure parts, restricted bleed means for bleeding said high pressure into said low pressure part when said member is shifted to said first stage, second bleed means for bleeding said high pressure into said low pressure part when said member is shifted to said second stage, said restricted and second bleed means being cooperable in parallelism with each other when said member is at said second stage, and said member being operatively connected with said choke valve to actuate the latter.

8. In a fuel charging system for an automotive internal combustion engine, a fuel-air induction conduit, a choke valve and a throttle valve arranged in said conduit, temperature responsive means for yieldingly urging said choke valve in a closing direction during cold operation of said engine, pressure actuated means operable in opposition to said temperature responsive means for

shifting said choke valve to an engine idling position adapted to effect sufficient fuel enrichment to assure engine idling after a cold start, duct means connecting said pressure actuated means with said conduit at a location downstream of said throttle valve, a bypass port opening into said conduit at a location upstream of said throttle valve when said engine is idling, said duct means also connecting said bypass port with said pressure actuated means, a one way check valve normally closing said bypass duct from said pressure actuated means when the pressure thereat is less than the pressure at said bypass port, said throttle valve having an edge movable to a position upstream of said upstream location when said throttle valve is opened beyond a fast idle condition.

9. In a fuel charging system for an automotive internal combustion engine, a fuel-air induction conduit, a choke valve in said conduit, a throttle valve in said conduit movable from a closed position to a fast idle position during cold starting of said engine and being openable beyond said fast idle position to a driving position, temperature responsive means for yieldingly urging closing of said choke valve to effect fuel enrichment during cold starting and operation of said engine, staged pressure actuated means operatively connected with said choke valve and responsive to a first range of low pressures for shifting to a first stage in opposition to said temperature responsive means for opening said choke valve to a cold idling position adapted to assure idling of said engine while in a cold condition, said staged pressure actuated means being responsive to a second range of low pressures lower than said first range of low pressures for shifting to a second stage in opposition to said temperature responsive means for opening said choke valve to a cold driving position adapted to assure economical driving of said engine while in the cold condition, and duct means connecting said pressure actuated means with said conduit at a location downstream of said throttle valve when the latter is in its idle position, a restriction in said duct means cooperable with said pressure actuated means to effect communication of said first pressure range thereto and to cause shifting of the latter to said first stage in response to the low pressure downstream of said throttle valve at the idle position, said duct means including bypass duct means connected with said conduit at a location upstream of said throttle valve in the idle position and being in parallelism with said restriction, a one way check valve closing said bypass duct when the pressure at said pressure actuated means is less than the pressure at the last named location, the last named location being downstream of said throttle valve when the latter is in said driving position to effect communication of said second pressure range to said pressure actuated means.

10. In the combination according to claim 9, said staged pressure actuated means comprising a pressure chamber, a shiftable pressure actuated member operatively connected with said choke valve to actuate the latter and partitioning said chamber into a low pressure part and a high pressure part, said duct means being connected with said low pressure part, said high pressure part being connected with a source of high pressure upstream of said choke valve, restricted bleed means for bleeding said high pressure into said low pressure part when said member is shifted to said first stage and being cooperable with the restriction to maintain the pressure in said low pressure part within said first pressure range when said throttle valve is at the idle position, second bleed means for bleeding said high pressure into said low pressure part when said member is shifted to said second stage and effective for maintaining said second pressure range in said low pressure part when said throttle valve is shifted to said driving position.

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