Jan. 26, 1954 T. M. BALL 2,667,154

CHOKE DEVICE

Filed Aug. 18, 1949 2 Sheets-Sheet 1

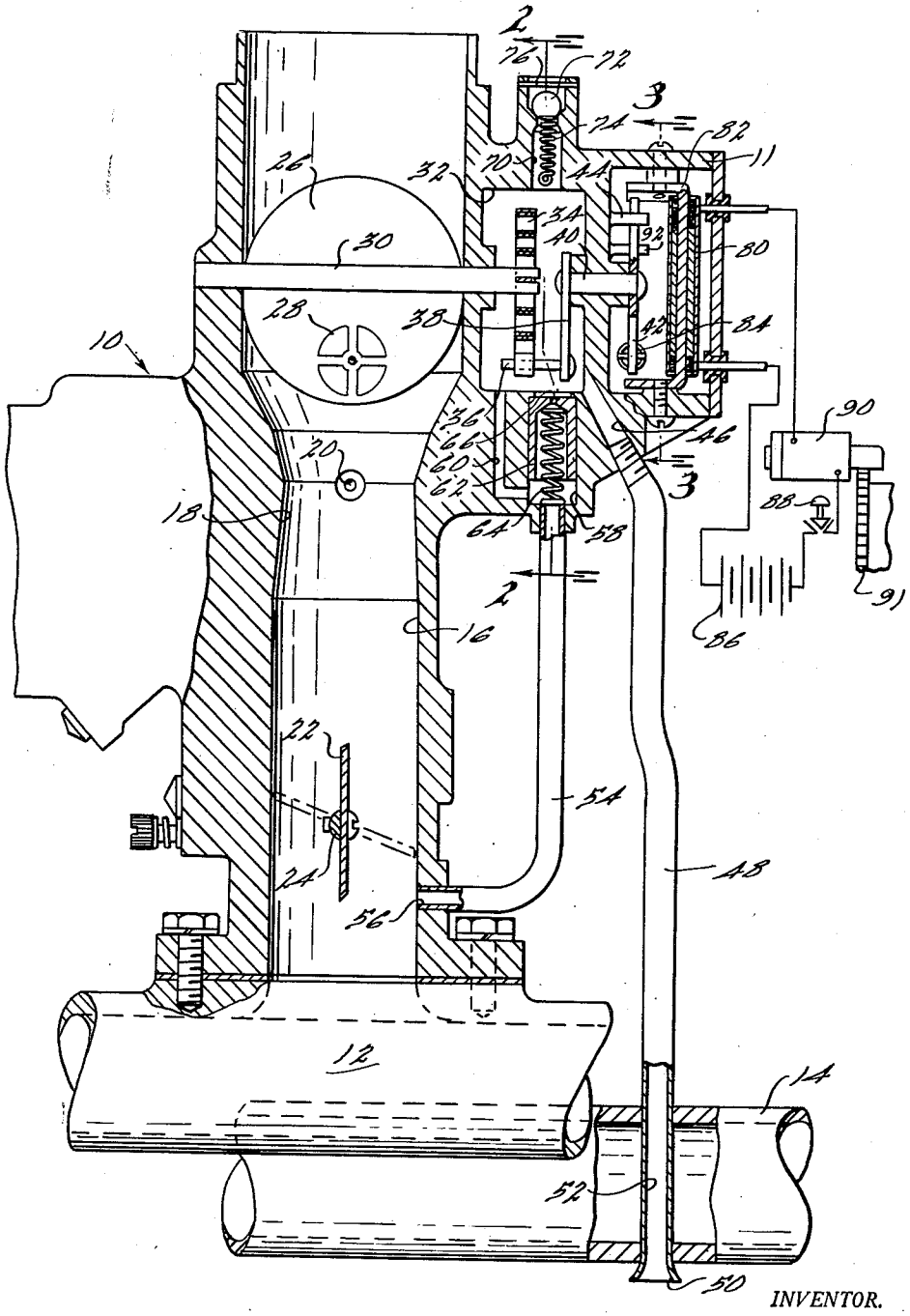

Fig. 1.

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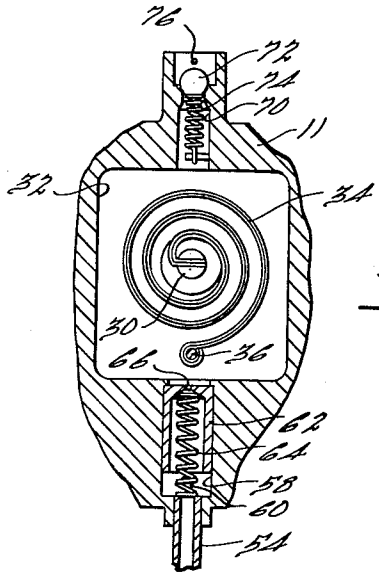

Fig. 2.

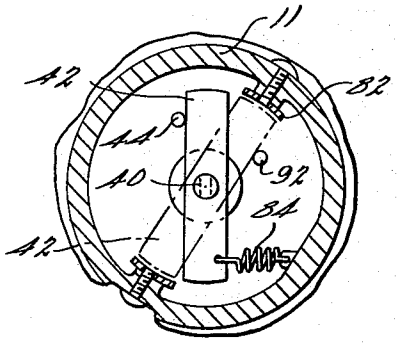

Fig. 3.

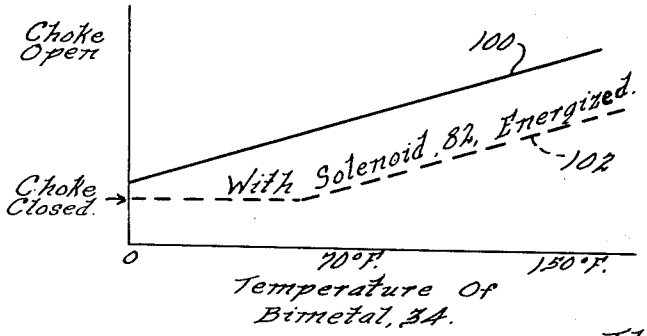

Fig. 4.

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UNITED STATES PATENT OFFICE

2,667,154

CHOKE DEVICE

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11 Claims. (Cl. 123—179)

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This invention relates to an improved choke device for the carburetor of an internal combustion engine.

It is a principal object of this invention to provide a choke control that is automatic in operation and mounted as an integral unit within the carburetor housing thereby eliminating all external linkage between the control and the choke valve. Such external linkage is undesirable because it requires frequent adjustment, is often bent and is exposed to freezing due to the accumulation of snow and ice thereon under winter operating conditions.

It is a further object of the invention to provide a temperature responsive choke control and means to vary the choke setting as an incident to operation of the vehicle starting mechanism.

Temperature responsive choke controls of current designs have been found to possess inadequate control of the supply of heated air thereto and I have found that where a temperature sensitive element is used to control a choke and this element is positioned in an air stream between a first region where the air is heated by the exhaust manifold and a second region subjected to manifold vacuum that even though an air supply having a temperature corresponding to the engine temperature is provided during intervals of engine running that the relationship between engine temperature and air temperature is lost when the engine is stopped due to the fact that the circulation of air induced by the manifold vacuum is also stopped. In systems of this type the choke control then cools too fast and when an effort is made to start the engine after a relatively short interval an excessive choke action is encountered. It is an object of this invention to remedy this defect by providing means for the circulation of heated air over the temperature responsive choke control element when the engine is not operating.

A second defect which exists in the conventional choke control having a temperature responsive element in a path of heated air is that where the air circulation is induced by manifold vacuum the air circulation varies beyond desirable limits due to variations in the manifold vacuum caused by different throttle settings during engine operating conditions. It is a further object of the invention to provide means to meter the air over the temperature responsive choke control element and to vary the size of the effective metering orifice with changes in manifold vacuum so that the quantity of air passed over the temperature responsive control element more nearly approximates a uniform flow throughout various operating conditions of the engine.

In the drawings:

Fig. 1 is a vertical elevation, partly in section, of a carburetor incorporating my novel choke control and showing a schematic electrical circuit for controlling the energization thereof;

Fig. 2 is a section on the line 2—2 of Fig. 1;

Fig. 3 is a section on the line 3—3 of Fig. 1; and

Fig. 4 is a graph illustrating various choke positions in relation to the temperature of the bimetallic control and engine starting conditions.

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A carburetor 10 having a housing 11 is illustrated as mounted in the conventional manner on an engine intake manifold 12 which is positioned in close proximity to an engine exhaust manifold 14. The illustrated carburetor is of the downdraft type and includes an air and fuel mixture passage 16 having a Venturi or throat portion 18 with a fuel discharge orifice 20 located therein in the conventional manner. A throttle blade 22 is mounted on a rotatable shaft 24 which extends transversely of the passage 16 in the region between the throat portion 18 and the intake manifold 12 while a choke valve 26, having the usual relief valve 28 associated therewith, is mounted upon a shaft 30 which is rotatably mounted in the housing of carburetor 10 transversely of the air and fuel mixture passage 16 so that the choke valve may rotate between a first position which substantially obstructs the flow of air to the intake manifold and a second position in which the plane of the choke valve is aligned with the axis of the passage 16 and the obstruction is negligible. The choke valve 26 is preferably eccentrically mounted on shaft 30, as illustrated, so that the air stream urges it to open position.

The housing 11 of carburetor 10 includes an extended portion forming a compartment 32 within which is positioned a spiral bimetallic strip element 34. The element 34 has one end thereof secured to an extended portion of shaft 30 and the other end thereof secured to a pin 36 carried by an arm 38 which is keyed to a shaft 40 projecting through one wall of the compartment 32 and carrying a second arm 42 on the exterior end thereof. A stop 44 carried by the housing 11 obstructs movement of the arm 42 so that the bimetallic strip when contracting and operating to close the choke valve 26 may react thereagainst through the pin 36, arm 38, shaft 40 and arm 42.

Means are provided to circulate air through the compartment 32 to thereby maintain the temperature of the bimetallic strip element 34 at at temperature corresponding to the engine temperature. An air intake passageway is formed by a passageway 46 in housing 11 which extends from the exterior thereof into the compartment 32 and a tube 48 which has one end thereof threaded into the passageway 46 to deliver air thereto and the other end open to the atmosphere as at 50. There is however, provided an inter-

mediate tube portion 52 which penetrates the exhaust manifold 14 so that air entering at 50 must pass in heat exchange relation with exhaust gases in the manifold 14 prior to its entrance into compartment 32.

When the engine is running the flow of air through tube 48 is induced through a second tube 54 which opens into the fuel and air mixture passage 16 of the carburetor downstream of the throttle valve 22, as at 56, so that it is subjected to the manifold vacuum. The other end of the tube 54 opens into a supplemental cylindrically shaped compartment 58 having a passage 60 in fluid flow communication with compartment 32. A piston 62 is slidably mounted in cylindrical compartment 58 and urged upwardly therein by a spring 64. The piston 62 is provided with a hollow interior and a fixed orifice 66 of relatively small cross section as compared to the cross section of passage 60 and is adapted to be moved downwardly in Fig. 1 under the influence of a high manifold vacuum to overcome spring 64 and close off passage 60 so that under these conditions tube 54 is connected with compartment 32 through orifice 66 while under operating conditions in which less manifold vacuum is present the spring 64 elevates piston 62 thereby opening the larger passage 60 for air to flow from compartment 32 to tube 54. It will thus be seen that under high speed engine operating conditions when the manifold vacuum is low that the piston 62 will be elevated and that air will be induced to flow into tube 48 at its entrant portion 50 to be heated by exhaust manifold 14 and thence to enter compartment 32 to heat the bimetallic strip element 34 and then be drawn through passage 60 to tube 54 and the engine intake manifold 12. Under partially closed throttle conditions when the manifold vacuum is higher the piston 62 is moved downwardly by the manifold vacuum and the passage 60 is closed so that air from tube 48 and compartment 32 must find its exit through orifice 66. The relatively small size of the orifice 66 compensates for the fact that the rate of flow of the air is greater due to the increased manifold vacuum.

The above description of paths for heated air applies to engine operating conditions, but means are also provided herein which facilitate a flow of heated air over the bimetallic strip element 34 even when the engine is not running. To this end the housing 11 of the carburetor 10 is provided with a passage or orifice 70 which connects compartment 32 with the atmosphere. A ball check valve 72 is seated across the mouth of passage 70 and is normally urged to a position opening passage 70 to the atmosphere by a spring 74. During engine operating conditions when manifold vacuum is present the ball 72 operates to close the passage 70 so that the air paths discussed in the preceding paragraph are operative. However, when the engine is stopped and the manifold vacuum is zero the spring 74 urges ball 72 outwardly against a stop 76 thereby opening passage 70 and compartment 32 to the atmosphere. With ball check valve 72 open and the engine stopped while the engine is still hot a stack or chimney effect is established which provides hot or warm air to the compartment 32 for a considerable time after the engine is shut off. Under these conditions air is induced by the stack effect to enter tube 48 at 50 and to pass in heat exchange relation with the exhaust manifold 14 and thence to rise into compartment 32 and out of the compartment 32 through passage 70. The means thus provided for heating the bimetallic strip element 34 when the engine is stopped serves to prevent the choke from overclosing due to too rapid cooling of element 34 by radiation, convection and conduction so that upon subsequent starting while the engine is still hot a more satisfactory choke operation is obtained.

The choke control has thus far been described as responsive to the temperature of the thermostatic element 34. It is, however, desirable to provide means for varying the choke position as an incident to starting of the engine and, therefore, means are provided herein for urging the choke toward a choke closed position when the engine is started. Referring more particularly to Figs. 1 and 3 it will be seen that the arm 42 forms the armature of a solenoid 80 having poles 82. When the solenoid 80 is not energized the arm 42 is urged to its solid line position in Fig. 3 by a light spring 84 carried by the housing 11 of carburetor 10. The stop 44 limits the rotation of the arm 42 in this direction. The solenoid 80 is connected in an electrical circuit containing a battery 86, a starter switch 88 and a starting motor 90 adapted to rotate an engine flywheel 91 so that upon closing of switch 88 and energization of the starting motor 90 the solenoid 80 is also energized. Energization of the solenoid 80 and poles 82 which are laterally displaced from the solid line position of the arm 42 cause the arm 42 to rotate in a clockwise direction in Fig. 3 to the dotted line position illustrated therein and a stop 92 limits the rotation of the arm 42 in this direction. It will thus be seen that when the clockwise rotation of arm 42 occurs as an incident to energization of solenoid 80 that this rotation is transmitted through shaft 40, arm 38, pin 36 and bimetallic strip element 34 to shaft 30 of choke valve 26 so that the choke valve is urged toward a closed position. The final position of the choke valve is determined both by the temperature of the bimetallic strip 34 and the fact of whether the engine is being started or not. Thus in Fig. 4 the line 100 illustrates the various choke positions corresponding to different temperatures of the bimetallic strip 34 while the dotted line 102 illustrates the final choke position assumed for each temperature when the starter is energized and the choke valve rotated the predetermined amount caused by energization of solenoid 80.

I claim:

1. In a carburetor having a housing and means forming a fuel and air mixture passage adapted to deliver fuel and air to an internal combustion engine having a starter, a choke valve including a shaft extending transversely of said passage, said valve being mounted for rotation between an open position and a closed position in which the flow of air through said passage is restricted, said shaft extending through a wall of said housing and having a portion thereof located exteriorly of said passage, a bimetallic element located exteriorly of said passage with one end thereof secured to said shaft, a solenoid, means to energize said solenoid when said starter is actuated, a movable member adapted to be moved as an incident to energization of said solenoid, and means operatively connecting said member and the other end of said element, said bimetallic element being adapted to move said shaft and said valve toward the closed position of said valve in response to a decrease in temperature of said bimetallic element and said means being operative to transmit torque through said element to

rotate said valve toward its closed position whenever said starter is actuated.

2. In a carburetor having a housing and means forming a fuel and air mixture passage adapted to deliver fuel and air to an internal combustion engine having a a starter, a choke valve including a shaft extending transversely of said passage, said valve being mounted for rotation for varying the capacity of said fuel mixture passage, said shaft extending through a wall of said housing and having a portion thereof located exteriorly of said passage, a bimetallic element of spiral configuration located exteriorly of said passage with one end thereof secured to said shaft, a solenoid, means to energize said solenoid when said starter is actuated, a movable member adapted to be moved as an incident to energization of said solenoid and means operatively connecting said member and the other end of said element whereby movement of said member transmits torque through said element to rotate said valve whenever said starter is actuated, and means to accommodate a flow of air heated by said engine over said element to regulate said valve.

3. In a carburetor having a housing and means forming a fuel and air mixture passage adapted to deliver fuel and air to an internal combustion engine having a starter, a choke valve including a shaft extending transversely of said passage, said valve being mounted for rotation for varying the capacity of said fuel mixture passage, said shaft extending through a wall of said housing and having a portion thereof located exteriorly of said passage, a bimetallic element of spiral configuration located exteriorly of said passage with one end thereof secured to said shaft, a solenoid, means to energize said solenoid when said starter is actuated, an armature device mounted for rotation through a predetermined arc as an incident to energization of said solenoid and an arm carried by said armature device and connected to the other end of said bimetallic element whereby rotation of said armature device through said predetermined arc transmits torque through said bimetallic element to rotate said valve whenever said starter is actuated.

4. In a carburetor having a housing and means forming a fuel and air mixture passage adapted to deliver fuel and air to the intake manifold of an internal combustion engine, a choke valve mounted for movement in said passage between limits to vary the capacity of said passage, means forming a compartment in said housing, a temperature responsive element in said compartment operatively connected to said valve to position the latter in response to temperature changes in said compartment, means forming a fluid flow passageway connecting a source of air and a source of manifold vacuum to said compartment so that air is induced to flow through said compartment by the pressure differential between said sources when said engine is running, said passageway having a portion thereof in heat exchange relation with said engine and valve mechanism positioned in said passageway and including a spring normally urging said valve mechanism to an open position, said valve mechanism being urged to a closed position by manifold vacuum when such vacuum exceeds a predetermined value and being operable independently of the position of said choke valve to reduce the effective capacity of said pasageway when said manifold vacuum exceeds such predetermined value.

5. In a carburetor having a housing and means forming a fuel and air mixture passage adapted to deliver fuel and air to the intake manifold of an internal combustion engine, a choke valve mounted for movement in said passage between limits to vary the capacity of said passage, means forming a compartment in said housing, a temperature responsive element in said compartment operatively connected to said valve to position the latter in response to temperature changes in said compartment, means forming a fluid flow passageway connecting a source of air and a source of manifold vacuum to said compartment so that air is induced to flow through said compartment by the pressure differential between said sources when said engine is running, said passageway having a portion thereof in heat exchange relation with said engine and a manifold vacuum responsive piston device including spring means to urge said piston to a first position in which said passageway is not obstructed, said piston having an orifice of relatively small capacity therein forming a constant fluid flow connection between said compartment and said passageway and said piston being adapted to be moved solely by manifold vacuum in excess of a predetermined value to a second position blocking said passageway whereby said orifice restricts the flow of air through said passageway to a metered amount.

6. In a carburetor having a housing and means forming a fuel and air mixture passage adapted to deliver fuel and air to the intake manifold of an internal combustion engine, a choke valve mounted for movement in said passage between limits to vary the capacity of said passage, means forming a compartment in said housing, a temperature responsive element in said compartment operatively connected to said valve to position the latter in responsive to temperature changes in said compartment, means forming a main fluid flow passageway connecting a source of air and a source of manifold vacuum to said compartment so that air is induced to flow through said compartment by the pressure differential between said sources when said engine is running, said passageway having a portion thereof in heat exchange relation with said engine, a manifold vacuum responsive movable element operable independently of said choke valve and adapted to block a portion of said passageway when said manifold vacuum exceeds a predetermined value, a constantly open bleed passageway of reduced diameter providing a fluid flow connection of limited capacity between said sources regardless of the position of said vacuum responsive movable element whereby said main passageway and bleed passageway provide paths for a relatively large flow of air when the manifold vacuum is less than a predetermined value and the bleed passageway provides a path for a limited amount of air when said manifold vacuum exceeds the predetermined value.

7. In a carburetor having a housing and means forming a fuel and air mixture passage adapted to deliver fuel and air to the intake manifold of an internal combustion engine, a choke valve mounted for movement in said passage between limits to vary the capacity of said passage, means forming a compartment in said housing, a temperature responsive element in said compartment operatively connected to said valve to position the latter in response to temperature changes in said compartment, means providing a passage for air which passes in heat exchange relation with said engine and extends to said compartment, means forming a fluid flow connection between said compartment and a source of mani-

fold vacuum so that when said engine is running a flow of air through said passage, said compartment and said connection is induced by said manifold vacuum, means forming an opening to atmosphere for said compartment when said engine is not running so that a stack is created by said passage, said compartment and said atmospheric opening so that heated air passes through said compartment when said engine is not running and manifold vacuum responsive means to close said opening when said engine is running.

8. In a carburetor having a housing and means forming a fuel and air mixture passage adapted to deliver fuel and air to the intake manifold of an internal combustion engine, a choke valve mounted for movement in said passage between limits to vary the capacity of said passage, means forming a compartment in said housing, a temperature responsive element in said compartment operatively connected to said valve to position the latter in response to temperature changes in said compartment, means providing a passage for air which passes in heat exchange relation with said engine extending to said compartment, and means forming a fluid flow connection between the upper portion of said compartment and the atmosphere so that a stack effect is obtained by said passage, said compartment and said connection so that heated air rises and passes through said compartment and over said temperature responsive element to regulate said choke valve when said engine is not running and manifold vacuum responsive means to close said fluid flow connection when said engine is running.

9. In a carburetor having a housing and means forming a fuel and air mixture passage adapted to deliver fuel and air to the intake manifold of an internal combustion engine, a choke valve mounted for movement in said passage between limits to vary the capacity of said passage, means forming a compartment in said housing, a temperature responsive element in said compartment operatively connected to said valve to position the latter in response to temperature changes in said compartment, means providing a passage for air which passes in heat exchange relation with said engine and extends to said compartment, means forming a fluid flow connection between said compartment and a source of manifold vacuum so that when said engine is running a flow of air through said passage, said compartment and said connection is induced by said manifold vacuum, said housing being provided with an orifice communicating between said compartment and the atmosphere and a valve means associated with said orifice and including a spring urging said valve to a first position in which said orifice is open, said valve means being vacuum responsive and operative to close said orifice when said engine is running and said compartment is subjected to manifold vacuum whereby said orifice is inoperative when said engine is running but provides a stack by means of which heated air from said passage and said compartment may escape when the engine is not running.

10. A choke control device for a carburetor having a variably positioned valve operable to control fluid flow to an internal combustion engine having an electrically energized starter; said choke control device comprising a housing, a solenoid supported in said housing and adapted to be energized in response to electrical energization of the starter, said solenoid including pole elements supported within said housing in circumferential relation with respect to the axis of said housing, a member mounted in said housing for rotation on the axis of said housing in first and second directions in a plane normal to the axis of said housing and within the magnetic field of said pole elements, a stop element supported within said housing in fixed relation thereto and extending into the path of rotation of said member to serve as a stop to limit rotation of said member in said first direction, spring means operatively connected to said housing and to said member and urging said member to rotate in said first direction, said solenoid when energized operating through said pole elements to rotate said member in said second direction into close proximity with said pole elements, a bimetallic element of spiral configuration having one end thereof operatively connected to said member and its other end adapted to be operably connected with said valve, said bimetallic element, when so connected with said valve, operating to transmit torque to said valve in response to energization of said solenoid and rotation of said member in said second direction.

11. A choke control device for a carburetor having a housing defining a fuel and air mixture passage for an internal combustion engine having an electrically energized starter and a valve in the passage mounted on a rotatable shaft projecting through a passage forming wall and movable toward a closed position in which the flow of air through said passage is restricted; said choke control device comprising a support, a solenoid mounted on said support and adapted to be energized in response to electrical energization of the starter, a member movably mounted on said support within the magnetic field of said solenoid for movement between a first and a second position as an incident to energization of said solenoid, a bimetallic element having one end thereof operatively connected to said member and the other end thereof adapted to be connected to the projecting end of said rotatable shaft so that a decrease in temperature of said bimetallic element induces movement thereof which is transmitted to said rotatable shaft to thereby move said valve toward its closed position and so that movement of said member from said first position to said second position is transmitted through said bimetallic element to rotate said valve toward its closed position in response to energization of said solenoid.

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