# United States Patent

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[72] Inventors **Isamu Goto**
**Tokorozawa-shi;**
**Minoru Inada, Kitaadachi-gun; Minoru Atsumi; Toyoshige Miyazaki, Tokyo; Mitsuaki Ninomiya, Yokohama-shi, Japan**



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[73] Assignees **Honda Gilken Kogyo Kabushiki Kaisha**
**Tokyo, ;**
**Kabushiki Kaisha Keihin Seisakusho**
**Kanagawa-ken, Japan**



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[54] **APPARATUS FOR AUTOMATIC OPERATION OF A CHOKE VALVE IN A CARBURETOR**
**11 Claims, 2 Drawing Figs.**


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[51] **Int. Cl.** ..... **F02m 3/06**
[50] **Field of Search** ..... 261/39.1, 39.2, 52



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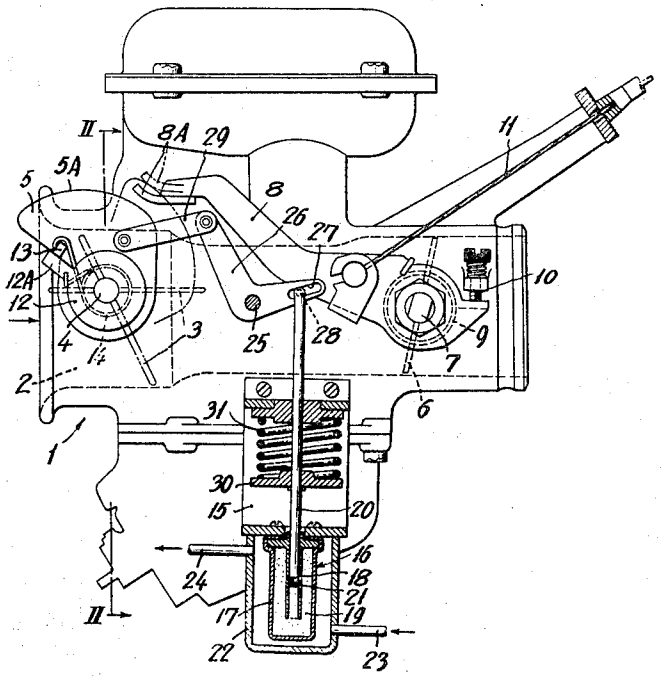
*Primary Examiner*—Tim R. Miles
*Attorney*—Waters, Roditi, Schwartz and Nissen



**ABSTRACT:** A choke valve in a carburetor is controlled by a temperature sensitive element which is directly coupled with a cam in turn coupled to the choke valve so that the valve will be moved in opposite directions in accordance with temperature variation of the engine irrespective of the contact of an operating member of a throttle valve with the cam.

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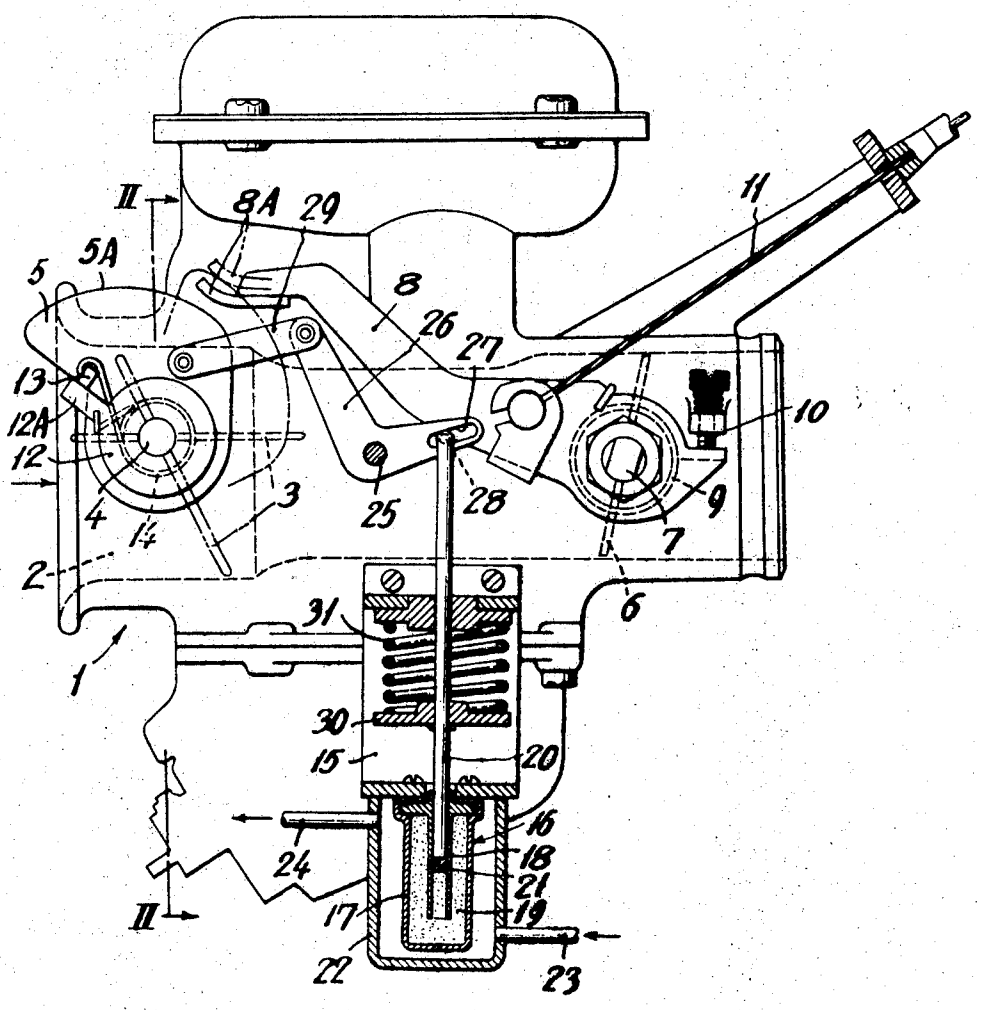
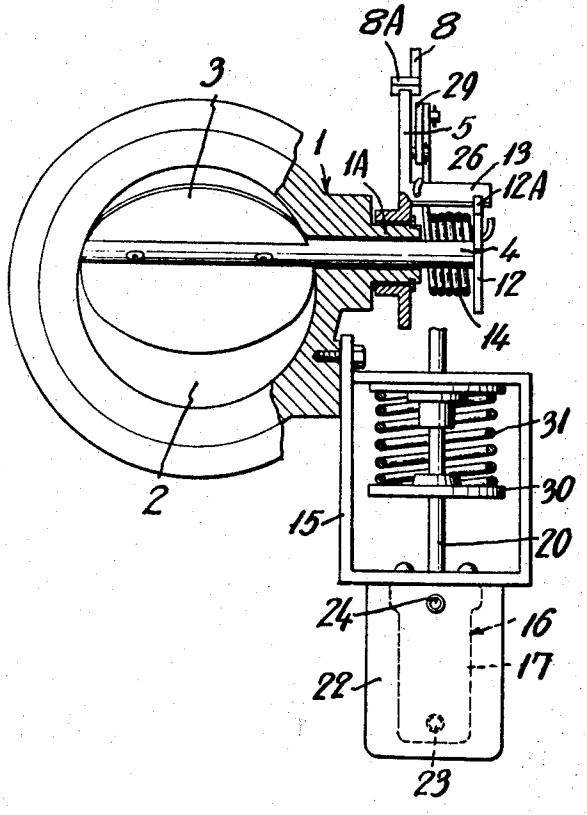
2 Sheets-Sheet 1

FIG. 1




INVENTOR
Isamu Goto
Minoru Imada
BY Minoru Atsumi
Toyoshige Miyazaki
Mitsuaki Ninomiya

FIG. 2




INVENTOR
Isamu Goto
Minoru Inada
BY Minoru Atsumi
Toyohige Miyazaki
Mitsuaki Ninomiya

# APPARATUS FOR AUTOMATIC OPERATION OF A CHOKE VALVE IN A CARBURETOR

## BRIEF SUMMARY OF THE INVENTION

This invention relates to the operation of choke valves in carburetors.

It has been known hitherto that a choke valve in an internal combustion engine for a motorcar, or the like, is provided with a bimetallic element responsive to engine temperature so that the choke valve may be opened automatically as the engine temperature rises. It has also been known hitherto that such choke valve may be provided with a cam for adjusting the degree of opening of a throttle valve so that it increases as the degree of opening of the choke valve is decreased, whereby the engine may properly idle even when cold. In the conventional apparatus as known, however, if the cam connected to the choke valve has been engaged with the throttle valve and thereby the degree of opening of the throttle valve is adjusted by the cam, and moreover since the engaging force between the two is stronger than the operation force of the bimetallic element (the throttle valve is provided with a valve closing spring of strong force for being brought into engagement with the cam), if the engine temperature is subsequently changed, the cam, the choke valve and the throttle valve are immovably retained in that condition and there cannot be effected automatic adjustment of these valves. Accordingly, an unavoidable inconvenience is produced in order to obtain a complete adjustment, namely while the engine is cold, the throttle valve must be manually opened to release the engagement between the cam and the throttle valve so as to free the cam.

An object of this invention is to provide a simple and effective apparatus which overcomes the above inconvenience and in which the degree of opening of the choke valve can always be adjusted automatically according to the engine temperature regardless of whether the cam connected to the choke valve is in engagement with the throttle valve or not.

In accordance with the invention, there is provided apparatus for the automatic operation of a choke valve which comprises a throttle valve, a rotatable cam having a smooth, continuous cam surface for adjusting the degree of opening of the throttle valve, a choke valve coupled to said cam for rotation therewith, a member coupled to said throttle valve for movement therewith to contact said cam surface so that the degree of opening of the throttle valve at idle may be increased as the degree of opening of the choke valve is decreased, strong valve closing spring means for closing the choke valve and a temperature sensing device of strong expansion force coupled to said choke valve and including temperature expansion means for expanding upon receiving heat from an internal combustion engine to cause the degree of opening of the choke valve to be automatically adjusted according to the engine temperature regardless of whether the cam surface and said member are in contact one with another.

## BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a side view, partly in section, of the apparatus of this invention, and

FIG. 2 is a sectional view taken along line II–II in FIG. 1.

## DETAILED DESCRIPTION

Referring to FIG. 1, numeral 1 denotes a carburetor, numeral 2 denotes a suction air passage thereof, numeral 3 denotes a choke valve and numeral 4 denotes a rotatable shaft of the choke valve attached at a position displaced upwards from the center of the suction air passage 2. Numeral 5 denotes a cam rotatably mounted on a shaft portion 1A (FIG. 2) projecting from the carburetor 1 and connected to the choke valve shaft 4 as will be explained hereinafter. Numeral 5A denotes a cam surface of cam 5. Numeral 6 denotes a throttle valve mounted on a rotatable shaft 7, and numeral 8 denotes a throttle valve lever rigidly connected to the shaft 7 and having at its top end a contact number 8A adapted for contacting the cam surface 5A. Numeral 9 denotes a return spring attached to the throttle valve lever 8 for urging the throttle valve 6 in its closing direction, numeral 10 denotes an adjustable stop member for establishing the closing limit of the throttle valve 6, and numeral 11 denotes an operation cable for manually opening the throttle valve 6 through the throttle valve lever 8. As clearly shown in FIG. 2, a supporting plate 12 having an engaging portion 12A is fixed to the choke valve shaft 4 and a weak spring 14 is interposed between engaging portion 12A and a stopper 13 projecting from the cam 5 to urge portion 12A toward stopper 13. Accordingly, if the amount of suction air is increased when the choke valve 3 closes the suction air passage 2, the choke valve 3 is opened against the action of the spring 14 by the suction air pressure and thereby the suction air amount is increased. The above is a conventional construction.



The carburetor 1 is provided with a supporting housing 15 fixed thereto, and there is fixedly provided below the housing a temperature sensing device 16 adapted to produce a strong thermal expansion force. This temperature sensing device 16 comprises, for example, a tightly closed outer tube 17, a supporting pipe 18, which is fixed in the interior thereof and is opened at its lower end, and a thermal expansion material such as ether enclosed between the two. A movable rod 20 is inserted in the supporting pipe 18 and a slidable sealing member 21 is tightly mounted in the supporting pipe 18 below the lower end of the movable rod 20. Numeral 22 denotes a tubular housing member for the temperature sensing device 16 and member 22 has an inlet 23 and an outlet 24 for a fluid so that the temperature sensing device 16 may be kept nearly equal to the engine temperature by the engine exhaust gases or the lubrication oil, or the like, flowing therein through the inlet 23. The carburetor 1 is provided with a multiplication lever 26 pivoted at 25, and a pin 28 provided at the top end of the movable rod 20 is loosely mounted in a slot 27 formed in one end of the lever 26 the other end of which is connected to the cam 5 through a connecting rod 29. Numeral 30 denotes a spring receiving plate fixed to the middle of the movable rod 20 and numeral 31 denotes a strong valve closing spring urging the movable rod 20 toward the temperature sensing device 16. Accordingly, if the temperature of the engine increases, as measured by the temperature sensing device 16, the thermal expansion material 19 is expanded to displace the movable rod 20 from the temperature sensing device 16 against the action of the valve closing spring 31 and the movement of rod 20 is multiplied by the lever 26 for opening the choke valve 3. If the temperature of the temperature sensing device 16, that is, the engine is lowered, the thermal expansion material 19 is contracted so that in accordance therewith the movable rod 20 is displaced into the temperature sensing device 16 by the valve closing spring 31 for closing the choke valve 3. In the case when the engine temperature is lower than the ordinary operation temperature thereof, the contact member 8A of the throttle valve lever 8 is pressed strongly against the cam surface 5A of the cam 5 by the return spring 9 and there is caused a large friction force between the cam surface and the contact member. However, in accordance with this invention, it is so arranged that the choke valve 3 is operated by the temperature sensing device of strong expansion force and the strong valve closing spring 31 and, additionally, the cam surface 5A is formed as a smooth continuous curved surface, so that the expansion force of the temperature sensing device 16 and the resilient force of the valve closing spring 31 can overcome the friction force mentioned above, whereby the choke valve 5 may be always rotated automatically in accordance with the change of the engine temperature and, at the same time, the degree of opening of the throttle valve is automatically adjusted in accordance therewith.

Thus, according to this invention, it is possible that the choke valve and the throttle valve are always automatically adjusted positively in accordance with the variation of engine

temperature so that it is not required that the throttle valve operating cable **11** be manually operated as in conventional arrangements.

We claim:

**1**. Apparatus for the automatic operation of a rotatable choke valve in a carburetor, said apparatus comprising a throttle valve, a rotatable cam having a smooth, continuous cam surface for adjusting the degree of opening of the throttle valve, a choke valve coupled to said cam for rotation therewith about a common axis, a member coupled to said throttle valve for movement therewith about a common axis, said member resting in peripheral contact with said cam surface to follow rotation of said choke valve and cause the degree of opening of the throttle valve at idle to increase as the degree of opening of the choke valve is decreased, strong valve closing spring means for closing the choke valve and a temperature sensing device of strong expansion force coupled to said choke valve and including temperature expansion means for expanding upon receiving heat from an internal combustion engine to cause the degree of opening of the choke valve to the automatically adjusted according to the engine temperature regardless of whether the cam surface and said member are in contact one with another.

**2**. Apparatus as claimed in claim **1** wherein said member is in frictional contact with said cam surface when the engine temperature is below a predetermined operating temperature, said temperature expansion means applying a force to said cam to turn the same against the frictional force of the contact of the cam with said member to open the choke valve as the engine temperature increases.

**3**. Apparatus as claimed in claim **2** wherein said temperature expansion means acts in opposition to said spring means.

**4**. Apparatus as claimed in claim **2** wherein said temperature expansion means comprises a temperature sensitive element and a displaceable rod coupled to said element and said cam for rotating the latter as the element senses increased temperature.

**5**. Apparatus as claimed in claim **4** wherein said temperature sensitive element comprises an enclosed chamber containing a substance which expands with increasing temperature, and means for passing a substance whose temperature is a measure of engine temperature into contact with said enclosure, said rod extending into said enclosure and being displaced by expansion of the substance therein.

**6**. Apparatus as claimed in claim **5** wherein said strong valve closing means acts on said rod to urge the same into the enclosed chamber, said valve closing means having a sufficient strength to displace the rod against the frictional force of contact of said member with the cam surface.

**7**. Apparatus as claimed in claim **6** comprising a lever between said rod and cam for multiplying the effect on said cam of the displacement of said rod.

**8**. Apparatus as claimed in claim **6** wherein said means for passing the substance whose temperature is a measure of the engine temperature into contact with the enclosure comprises a housing surrounding said enclosure and an inlet and an outlet in said housing for said substance.

**9**. Apparatus as claimed in claim **8** wherein said enclosure is hermetically sealed and said substance in the enclosure is a fluid.

**10**. Apparatus as claimed in claim **9** wherein said rod is vertical and moves upward during expansion of the fluid substance and downwards under the action of the spring means.

**11**. Apparatus as claimed in claim **2** wherein said strong valve closing means comprises a spring having a strength to close the choke valve against the opposition of the friction force of contact of the cam with said member.