July 5, 1966 P. E. BRAUN ETAL 3,259,377

AUTOMATIC CHOKE MECHANISM

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FIG. 1

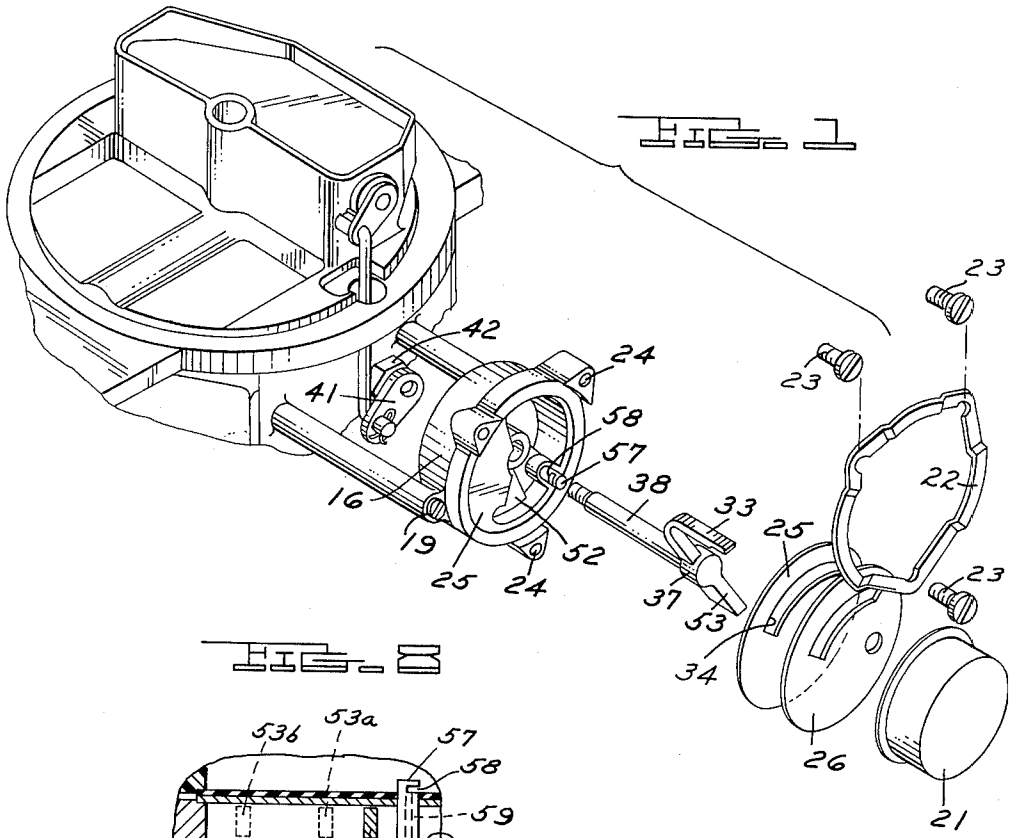
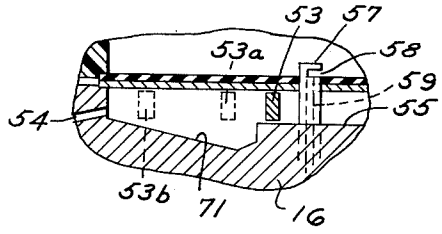


FIG. 2

FIG. 3



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AUTOMATIC CHOKE MECHANISM

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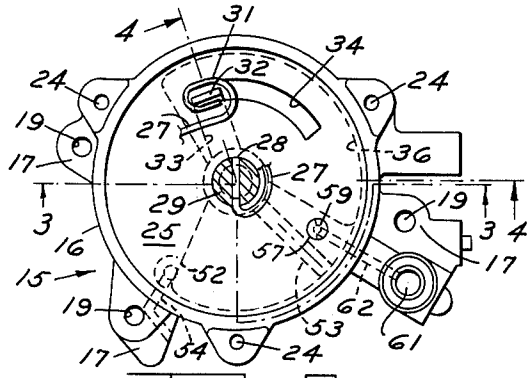


FIG. 2

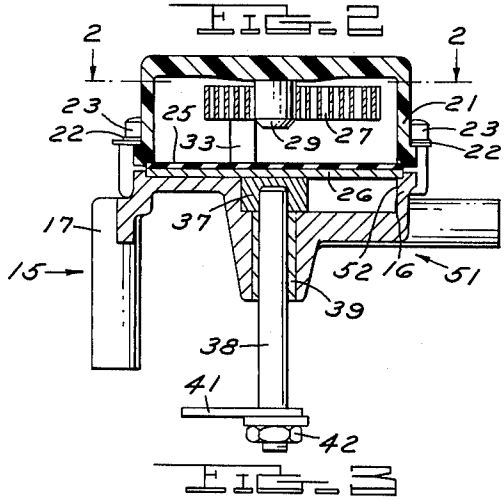


FIG. 3

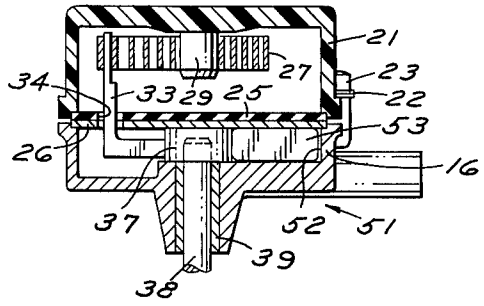


FIG. 4

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FIG. 5

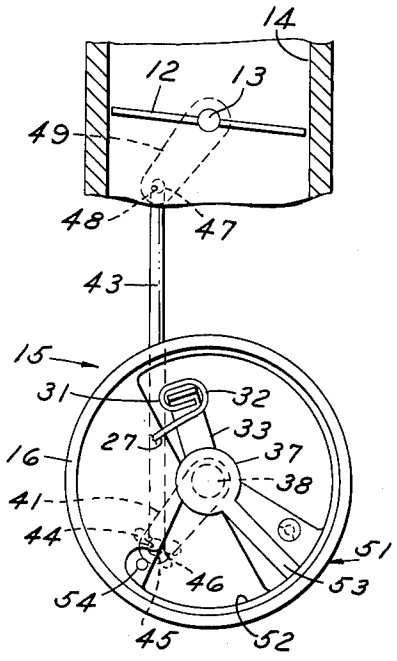


FIG. 6

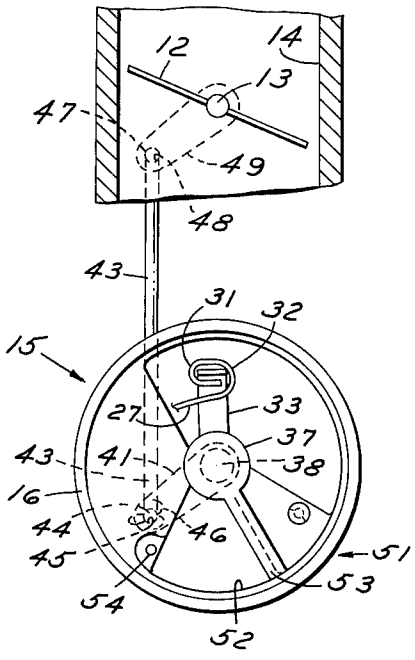
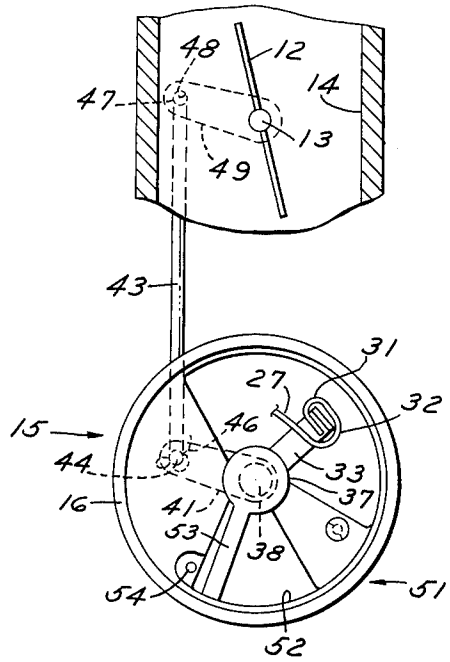


FIG. 7



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United States Patent Office 3,259,377 Patented July 5, 1966

3,259,377

AUTOMATIC CHOKE MECHANISM

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Filed June 20, 1963, Ser. No. 289,201
1 Claim. (Cl. 261—39)

This invention relates to an automatic choke mechanism for the charge forming device of an internal combustion engine and more particularly to an automatic choke mechanism having an improved suction motor for modulating the position of the choke valve in response to engine intake manifold vacuum.

The conventional automatic choke mechanism employs a thermally responsive device, generally a thermostatic spring, to position the choke valve in response to temperature variations. During low temperature cranking, the choke valve should be fully closed to permit enough fuel for combustion to be drawn into the cylinders of the engine. The choke valve should partially open once the engine commences to run to allow sufficient air induction for sustained operation.

Engine intake manifold vacuum offers a convenient signal of the air requirements of the engine. It has been common practice, therefore, to employ intake manifold vacuum as a source of power for opening the choke valve once the engine has started. This has been accomplished through the use of an unbalanced choke valve, that is opened in response to the pressure differential on opposite sides of the choke valve, or by the use of a separate suction motor, that acts upon the choke valve through an actuating linkage. It has also been common practice to combine the use of an unbalanced choke valve and a separate suction motor in a single choke mechanism.

Automatic choke mechanisms employing separate suction motors have almost universally resorted to piston type motors. The piston motor is expensive to fabricate and also adds cost to the choke mechanism since a linkage system is required to translate the reciprocatory motion of the piston into rotary movement of the choke valve.

It is, therefore, the principal object of this invention to provide an improved suction motor for an automatic choke mechanism of an internal combustion engine charge forming device.

The thermally responsive element of an automatic choke mechanism is essentially a linear device. That is, the degree of temperature induced choke valve movement bears a direct relation to the change in temperature of the thermally responsive element. The choke requirements of a warming engine do not bear a direct relation to the increase in temperature of the thermally responsive element since the engine can tolerate a progressively decreasing amount of choking as its temperature increases. A conventional choke mechanism, therefore, provides a greater amount of choking at intermediate engine temperatures than is required and decreased fuel economy results.

It is a further object of this invention to provide an improved automatic choke mechanism that accelerates the opening of the choke valve during engine warm up.

An automatic choke mechanism comprising this invention includes a choke valve that is movably supported in an induction passage of a charge forming device. A thermally responsive element is operatively connected to the choke valve for moving the choke valve between an opened and a closed position in response to temperature variations. A suction motor is provided for modulating the position of the choke valve in response to variations in engine intake manifold vacuum. The suction motor

comprises a cavity defined at one side by a movable wall. The cavity is vented to the intake manifold so that the wall will be moved in response to manifold pressure variations. After the wall moves a predetermined amount, a substantially increased amount of leakage is permitted from the cavity to retard further movement of the wall. The air transfer, because of the leakage, is employed to draw heated air across the thermally responsive element.

In one embodiment of the invention, the heating of the thermally responsive element is accelerated as the choke valve opens by permitting an increasing flow of air through the cavity.

In a second embodiment of the invention, the leakage is decreased after an initial increase to permit a strengthened force by the suction motor to accelerate the rate of opening of the choke valve.

The novel suction motor incorporated in this choke mechanism comprises a housing having a cavity in which a vane oscillates to function as the movable wall. The vane is connected by the choke linkage to the choke valve to modulate the position of the choke valve in response to variations in intake manifold vacuum.

Further objects and advantages of this invention will be more apparent as this description proceeds, particularly when considered in conjunction with the accompanying drawings, wherein:

FIGURE 1 is a partially exploded view of a portion of an internal combustion engine charge forming device embodying this invention.

FIGURE 2 is a cross sectional view of a portion of the choke actuating mechanism shown in FIGURE 1 and is taken along line 2—2 of FIGURE 3.

FIGURE 3 is a cross sectional view taken generally along the line 3—3 of FIGURE 2.

FIGURE 4 is a cross sectional view taken generally along line 4—4 of FIGURE 2.

FIGURES 5–7 are schematic views of the automatic choke mechanism showing various stages during the operation.

FIGURE 5 illustrates the position of the mechanism during the cranking of a cold engine.

FIGURE 6 shows the position of the mechanism immediately after the cold engine has started.

FIGURE 7 shows the position of the mechanism when the engine is partially warmed.

FIGURE 8 is a cross sectional view taken along line 8—8 of FIGURE 5.

FIGURE 9 is a cross sectional view in part similar to FIGURE 8 showing another embodiment of the invention.

Referring now in detail to the drawings, a charge forming device for an internal combustion engine is indicated generally at 11. A choke valve 12 is rotatably supported by a choke valve shaft 13 in an induction passage 14 of the charge forming device 11. The choke valve 12 is rotatably positioned in response to variations in engine temperature and intake manifold vacuum by the automatic choke actuating mechanism indicated generally at 15.

The automatic choke mechanism 15 includes a choke housing 16 having three inwardly extending bosses 17. Bolts 18, which extend through apertures 19 formed in the bosses 17, are threaded into the body of the charge forming device 11 to secure the choke housing 16 to the charge forming device. An insulating cover 21 is affixed to the housing 16 by a sheet metal clamp 22 and screws 23 which pass the apertures in the clamp 22 and are secured in threaded apertures 24 formed around the periphery of the housing 16. The interior of the cover 21 is thermally insulated from the choke housing 16 by a steel disc 25 and a composition disc 26 interposed between the cover 21 and the housing 16.

A thermally responsive spring 27 contained within the

cover 21 has its inner end 28 affixed to a slotted inwardly extending projection 29 formed at the center of the cover 21. The outer end of the thermally responsive spring 27 is coiled as at 31 for the reception of an outwardly extending portion 32 of a lever arm 33. The steel and composition discs 25 and 26 are slotted, as at 34 and 35 respectively, to provide clearance for the rotary movement of the lever portion 32. The housing 16 is also provided with a first cavity 36 in which the lever arm 33 oscillates.

The lever arm 3 is connected by an integral hub portion 37 to a choke actuating shaft 38. The choke actuating shaft 38 is journaled in the housing 16 by a bushing 39 and extends inwardly toward the charge forming device 11. A level 41 is affixed to the inner end of the choke actuating shaft 38 by a nut 42. A link 43 has a lower outturned end 44 that extends through an aperture 45 in a lever 1. A cotter key 46 holds the end 44 in engagement with the lever 41 whereby movement of the lever 41 will be transmitted into movement of the link 43. An inwardly extending end 47 of the link 43 extends through an aperture 48 formed in a lever 49 that is affixed to the choke valve shaft 13. A snap ring (not shown) holds the link end 47 within the lever 49. The thermally responsive spring 27 acting through the levers 33 and 41, link 43 and lever 49 position the choke valve 12 in response to temperature variations.

A suction motor, indicated generally at 51, is provided to modulate the position of the choke valve 12 in response to variations in enegine intake manifold vacuum. The suction motor 51 comprises a second cavity 52 formed in the choke housing 16. A vane 53 is supported for oscillation within the second cavity 52. The vane 53 conveniently may be formed integral with the hub 37 and lever arm 33 as a molded one-piece plastic element. The vane 53 acts as a movable wall within the second cavity 52 to define an expansible chamber. The second cavity 52 is exposed to engine intake manifold vacuum on one side of the vane 53 by a passage 54 that extends from the second cavity 52 through one of the bosses 17 of the housing 16 into the charge forming device 11 at a point in the induction passage 14 below the throttle valve (not shown).

Operation

When the engine is cold, the thermally responsive spring 27 will contract and rotate the lever arm 33 in a counterclockwise direction. The choke actuating shaft 38 and lever 41 are also rotated in a counterclockwise direction to draw the link 43 downward. Downward movement of the link 43 is transmitted into counterclockwise rotation of the lever 49 and choke valve shaft 13 to bring the choke valve 12 to a fully closed position (FIGURE 5).

During cranking, insufficient intake manifold vacuum is generated to cause any action of the suction motor 51. As soon as the engine fires and commences to run, however, there will be a sudden increase in intake manifold vacuum. The intake manifold vacuum is exerted through the passage 54 into the second cavity 52 on one side of the vane 53. The decrease in pressure on the one side of vane 53 causes the atmospheric pressure acting on the opposite side of the vane 53 to rotate the vane in a clockwise direction. The clockwise rotation of the vane 53 is transmitted to the choke actuating shaft 38 and lever 41. The rotation causes the link 43 to move upwardly and rotate the lever 49 and choke valve shaft 13 in a clockwise direction to partially open the choke valve 12 (FIGURE 6). The opening of the choke valve 12 permits suffiicent air flow through the induction passage 14 for smooth engine operation.

The degree of opening of the choke valve 12 is controlled by forming the inner wall of the second cavity 52 in the manner shown in FIGURE 8. The inner wall of the second cavity 52 is formed with a first surface 55 that is closely spaced from the adjacent surface of the vane 53. The closely spaced surfaces permit only very limited air leakage past the vane 53 and substantially the full force of the intake manifold vacuum is exerted upon the vane 53. At a point corresponding to the desired degree of initial choke valve opening, the surface 53 ends and a sharply increased clearance between the vane 53 and a choke housing 16 is provided by the stepped wall surface 56. When the vane moves to the position shown at 53*a* (corresponding to FIGURE 6), a substantially increased rate of air leakage past the vane 53 is permitted. This causes a sudden decrease in the vacuum force acting upon the vane 53 and further opening of the choke valve 12 is retarded.

The air leakage past the vane 53 is employed to draw heated air across the thermally responsive spring 27 in a manner now to be described. A tubular projection 57 extends upwardly from the surface 55 of the choke housing 16 through apertures in the insulating discs 25 and 26 into the interior of the cover 21. Projection 57 is vented at 58 to the interior of the cover 21. The projection 57 is internally bored as at 59 and communicates with an air inlet 61 by means of a passage 62 formed in the choke housing 16 (FIGURE 2). A conduit extends from the air inlet 61 to exhaust manifold heat stove (not shown).

The air leakage across the vane 53 causes a pressure drop on the side of the vane 53 away from the second cavity 52. This decreased pressure is transmitted through the slots 34 and 35 in the discs 25 and 26 to the interior of the choke housing cover 21. Decreased pressure in the cover 21 causes heated air at atmospheric pressure to be drawn across the exhaust manifold stove. The heated air enters the cover 21 through the air inlet 61 and vent 58. After circulation around the thermally responsive spring 27, the air passes through the apertures 34 and 35 into the second cavity 52 past the vane 53. The heated air is discharged into the intake manifold through the passage 54.

As has been earlier noted, it is desired to have the choke valve 12 open more rapidly as engine temperature increases. To accomplish this result, the wall surface 56 of the cavity 52 is formed with an increasing clearance between the vane 53 as the vane 53 rotates in a choke valve opening direction. The increased clearance causes increasing amounts of heated air to be drawn into the choke cover 21. The thermally responsive element 27 is heated more rapidly, therefore, and an accelerated rate of choke valve opening is accomplished.

As the thermally responsive spring 27 becomes further heated, the choke actuating shaft 38 and lever 41 are rotated in a clockwise direction. Clockwise rotation raises the link 43 and rotates the lever 49 and choke valve shaft 13 in a clockwise direction to open the choke valve 12 (FIGURE 7). The position of the vane 53 relative to the wall surface 56 of the cavity 52 during warm engine operation is shown at 53*b* in FIGURE 8.

The accelerated choke valve opening may also be accomplished by forming the inner wall of the second cavity 52 in a manner shown in FIGURE 9. In this embodiment the first surface 55 of the inner wall is also closely spaced from the vane 53 so that minimum air leakage will occur past the vane during initial movement. A stepped surface 71 is provided which permits an increased amount of air flow after the desired initial degree of choke valve movement. Due to the substantially increased clearance, a substantially increased rate of air flow will occur past the vane 53 to retard further opening of the choke valve 12. The surface 71 is then provided with a decreasing amount of clearance as the vane 53 moves toward the choke opened position. Because of the decreasing clearance, an increasing amount of vacuum force will be exerted upon the vane 53 to accelerate the opening of the choke valve 12. In this embodiment the amount of heated air will decrease to some extent as the choke valve opens.

It is to be understood that the invention is not to be limited to the embodiments shown and described, but that further changes and modifications may be made without

departing from the spirit and scope of the invention as defined by the appended claim.

We claim:

An automatic choke mechanism for the charge forming device of an internal combustion engine comprising a choke valve movably supported in an induction passage of the charge forming device, a thermally responsive element, a suction motor for modulating the position of said choke valve in response to changes in intake manifold vacuum, said suction motor comprising a housing having an annular cavity formed therein and means mounting a radially extending vane for rotation in said cavity, at least one wall of said cavity being recessed adjacent said vane to provide a varying clearance with said vane, a lever arm integrally formed with said vane, means affixing said thermally responsive element to said lever arm for exerting a force on said lever arm in response to temperature variations, means operatively connecting said vane and said lever arm to said choke valve, and conduit means connecting a source of intake manifold vacuum with said cavity at one side of said vane for moving said vane in response to pressure variations.

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