March 21, 1950

W. E. LEIBING

2,501,060

VIBRATION DAMPING DEVICE

Filed Sept. 17, 1945

2 Sheets-Sheet 1

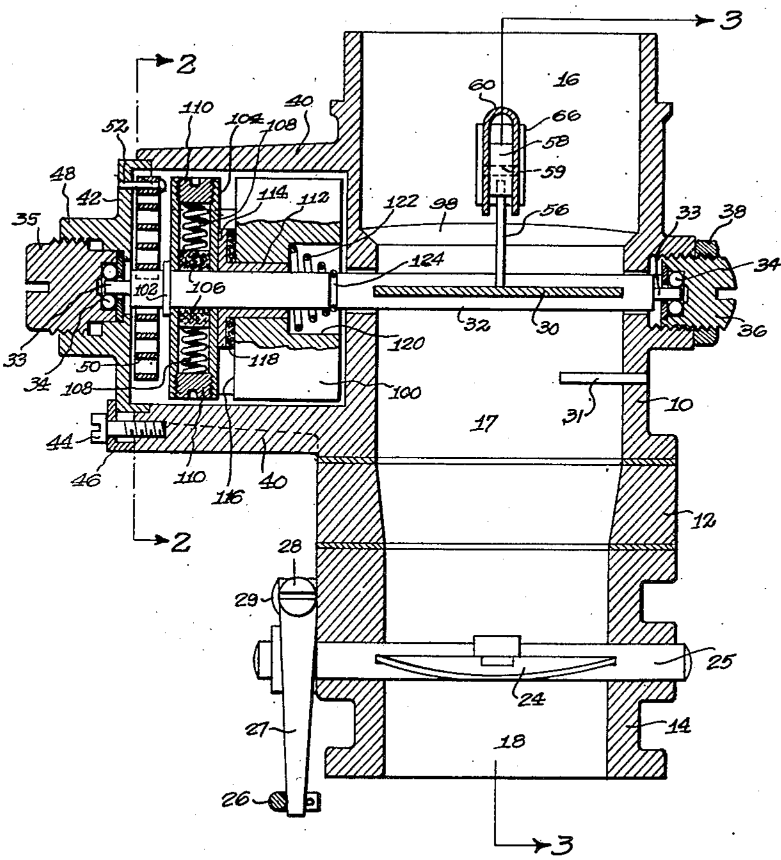
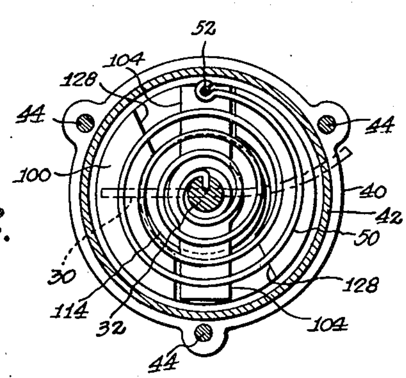


Fig. 1.

Fig. 2.



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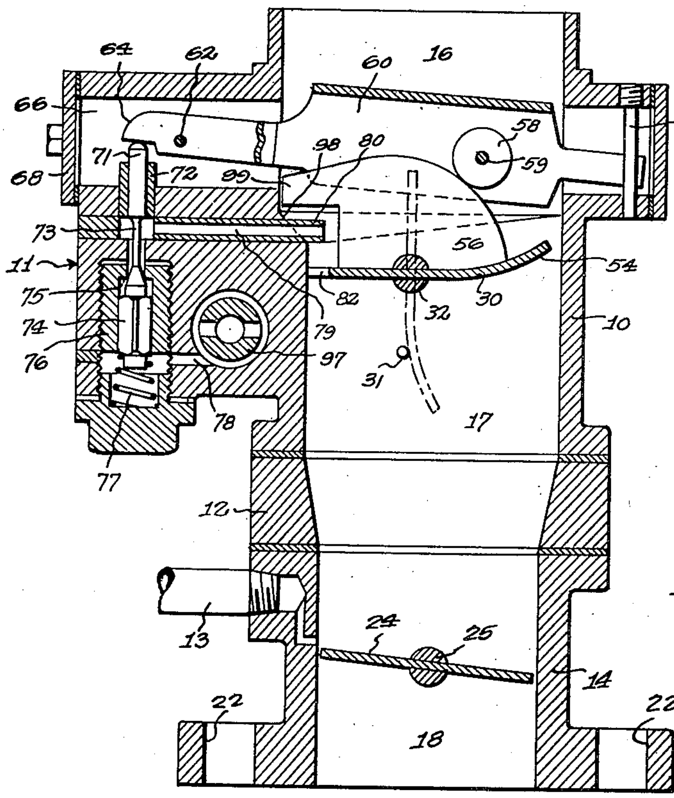

Fig. 3.

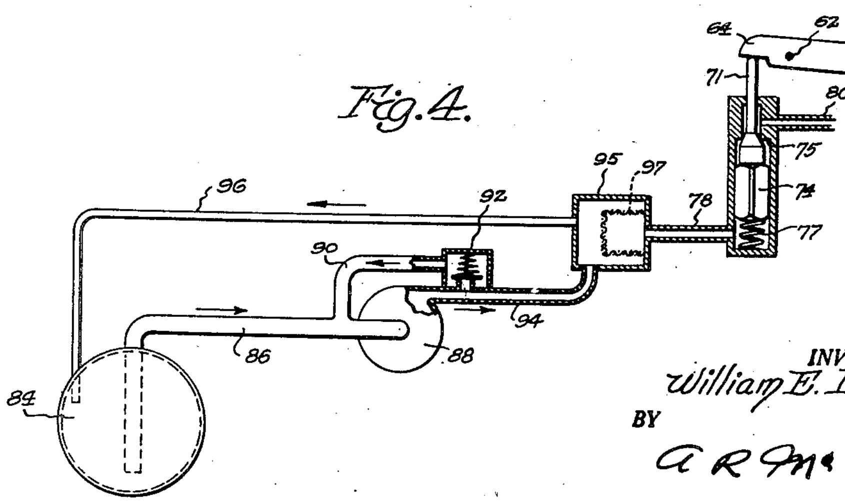

Fig. 4.

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UNITED STATES PATENT OFFICE

2,501,060

VIBRATION DAMPING DEVICE

William E. Leibing, Detroit, Mich., assignor, by mesne assignments, to R. D. Fageol Co., Detroit, Mich., a corporation of Michigan

Application September 17, 1945, Serial No. 616,887

19 Claims. (Cl. 73—228)

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This invention relates to carburetors for internal combustion engines and the like, and more particularly to a carburetor wherein a movable flow responsive member in the induction passage controls the inflow of fuel to the carburetor. This application contains subject matter in common with the copending application of William E. Leibing and Robley D. Fageol, Serial No. 533,848, filed May 3, 1944 now abandoned.

An object of the present invention is to provide an improved carburetor of the type indicated.

A further object of the invention is to provide improved means to prevent fluttering of the flow responsive member.

A further object of the invention is to provide a carburetor having improved means for supplying a fuel mixture of the desired richness to the engine under various operating conditions.

A further object is to provide means for accomplishing the aforesaid objects which shall be simple in construction and reliable in operation, and which may be readily and economically manufactured.

Further objects and advantages of the invention will be apparent from the following description, taken in connection with the appended drawings, in which:

Fig. 1 is a sectional view in elevation of a carburetor embodying the present invention.

Fig. 2 is a fragmentary sectional view taken on the line 2—2 of Fig. 1;

Fig. 3 is a sectional view of the carburetor taken on the line 3—3 of Fig. 1; and

Fig. 4 is a diagrammatic showing of the fuel system of the carburetor.

It is to be understood that the invention is not limited in its application to the details of construction 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.

The carburetor illustrated in the drawings comprises a main body section 10, which may be formed as a die casting, and having an integral lateral extension 11. Below the body section 10 is mounted a gasket 12 formed of heat insulating material, which may be internally tapered as shown. Below the gasket is a throttle body 14, preferably formed as a metal casting and provided with a passage 13 for connection to the engine ignition control or the like, for purposes known in the art. The body section, gasket and

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throttle body are internally bored to form an induction passage comprising an air inlet 16, a mixing chamber 17 and a mixture outlet 18 which communicates with the intake manifold of the engine, not shown. The parts 10, 12 and 14 are secured together by any suitable means, and holes 22 are provided in the lower flange of the throttle body 14 for bolting the carburetor to the intake manifold.

A butterfly throttle valve 24 is mounted in the mixture outlet 18 on a shaft 25 to control the flow of fuel mixture to the engine. The throttle is controlled by the operator in the usual manner, by means of an accelerator pedal and/or lever connected by a rod 26 to a throttle lever 27, which is fastened to the shaft 25. Movement of the throttle in the closing direction is accomplished by means of the usual throttle return spring (not shown) and is limited by contact of an adjustment screw 28 with a fixed stop 29.

An air vane 30 is mounted in the induction passage anterior to the throttle, and controls by its movement the rate of fuel flow to the carburetor as hereinafter described. The air vane is fixed to an off-center shaft 32, so that flow of air into the carburetor tends to rotate the vane and shaft in the clockwise direction as viewed in Figs. 2 and 3, its movement in such direction being limited by a stop pin 31 fixed in the wall of the carburetor. The bearings for this shaft comprise stub shafts 33 fixed in axial bores in the ends of the shaft 32, and rotatable in journals 34, which may be of any suitable anti-friction type requiring no continuous lubrication. The journals 34 are fitted in plugs 35, 36 which are mounted at the respective ends of shaft 32. Sufficient clearance at the ends of the stub shafts is provided to allow for expansion due to temperature changes. The plug 36 is adjustably mounted in a threaded bore in the wall of the main body section 10, and is held in its adjusted position by means of a lock unit 38.

The main body section 10 of the carburetor is formed with an integral cylindrical casing 40 which is provided with a cover 42 adjustably secured thereto by screws 44 and a friction member 46, to permit the cover 42 to be rotated when the screws 44 are loosened. The central portion of the cover 42 is provided with a hub or boss 48, internally threaded to receive the plug 35.

A flat spiral spring 50 is mounted within the casing 40 and has its inner end secured in a slot adjacent the end of the shaft 32, while its outer end is looped and is secured by means of a pin 52 to the cover 42, so that rotation of the cover will adjust the tension of the spring. The spring 50 urges the vane 30 toward the closed position shown in full lines in Fig. 3, but the vane is deflected by air flow towards the position shown in broken lines in the same figure. The spring 50 is weak or easily deflected, and of low "rate," so that the air vane 30 may be moved toward open position by a relatively light force which does not increase rapidly with increased deflection; and the air vane shaft 32 is but slightly displaced from diametric position in the induction passage, so that relatively slight forces are developed by the air flow action upon the vane, even at maximum engine speeds. The initial tension of spring 50 is but little more than sufficient to return the vane 30 to its closed position when the engine is stopped.

The larger wing of the vane 30, shown at the right in Fig. 3, is preferably curved upwardly as indicated at 54, so that a considerable clockwise movement of the air vane from its closed position results in but a slightly increased flow of air therepast, the edge 54 remaining in close proximity to the wall of the mixing chamber until the air vane has moved through a considerable angle in the opening direction. The curved edge 54 also acts as a deflecting member tending to maintain the air vane in wide open position, by means of its lateral projection, when the engine to which the carburetor is attached is operating at maximum speed.

The connecting means between the air vane 30 and the fuel valve of the carburetor comprises a cam 56 fixed to the air vane in any suitable manner, and positioned to contact a roller 58 rotatably mounted on a shaft 59 in a control lever 60. The right hand (Fig. 3) end of the control lever is bifurcated and straddles a guide pin 61, to maintain the alinement of the lever. The lever is preferably formed of a stamping which is folded in the manner shown so that the fold formed at its upper edge minimizes air resistance and forms a shield over the cam surface to protect it from dust, oil, etc. The lever is pivoted by means of a pin 62, adjacent one of its ends 64, in a recess 66 formed in the extension 11 at left (Fig. 3) side of the carburetor and closed by a cover 68. The end 64 of the lever is maintained in operative contact with the upper end of a push rod 71. The push rod is reciprocable within a sleeve 72 and is connected by means of a stem 73 to a fuel valve 74.

Fuel valve 74 is formed with fluted sides to permit the passage of fuel therepast, and cooperates with a valve seat 75 formed as an internal shoulder in a plug 76. A spring 77 urges the valve toward its seat. The fuel valve controls the flow of fuel from a passage 78 past the valve and seat and through a transverse conduit 79 to the fuel discharge nozzle 80. The nozzle 80 is the only source of fuel for the induction passage; the conventional idling nozzle adjacent the throttle valve is unnecessary in the present device.

The air vane 30 is provided with a slot 82 which receives or registers with the fuel nozzle 80 when the air vane has moved about 20 to 30 degrees away from the closed position, so that at low engine speeds the velocity of air passing the outlet of the nozzle will be high enough to produce adequate atomization of the fuel. The operating surface of cam 56 may be empirically designed to give any desired ratio between the rate of air flow and the rate of fuel flow at different engine speeds.

The fuel system is shown diagrammatically in

Fig. 4, and comprises the usual fuel tank 84, connected by a conduit 86 to a fuel pump 88, which may be of the construction disclosed in the copending application of William E. Leibing, Serial No. 614,418, filed September 4, 1945 now Pat. No. 2,457,571, issued Dec. 28, 1948, or may be of any standard or known construction. For simplicity, the pump is shown as a centrifugal pump having a bypass 90 leading from its outlet side back to the conduit 86 and controlled by a pressure responsive valve 92. Whatever the type of pump, it should supply fuel to the carburetor at a fairly constant pressure, and should preferably prevent flow through the line when the engine is not operating.

An outlet line 94 leads from the pump to a separating chamber 95, from the upper portion of which a return line 96 conveys excess fuel, together with any vapor which may be present in the line, back to the tank 84. At the outlet of chamber 95 is a filter 97 the outlet of which connects with passage 78 leading to the fuel nozzle 80.

It will be seen from Figs. 1 and 3 that the air inlet 16 is of circular cross section, but of larger diameter than the mixing chamber 17, and is offset therefrom so that a shoulder 98 is formed adjacent the leading edge of the air vane 30. The shoulder 98 serves as a stop against which an extension 99 on the cam 56 abuts, thus limiting the closing movement of the vane. The upper surface of the extension 99 is so shaped as to cooperate with the roller in limiting opening movement of the vane.

When the engine is idling, the throttle is substantially closed, permitting a minimum of mixture to pass to the engine, and because very little suction on the air vane is exerted at idling speed, the air vane will be deflected by only about 10 degrees from the closed position, and will admit only such air as passes around its edges. If the operator then opens the throttle slightly, the suction on the air vane will be increased, causing it to rotate somewhat further in the opening direction. This will permit a slightly increased flow past the leading edge of the air vane, but because of the curved contour of edge 54 but little increase in the air flow around the trailing edge will occur. After 20 or 30 degrees of rotation, however, the leading edge will pass the lower edge of shoulder 98, whereupon the flow will be considerably increased with increased opening movement, to compensate for the restriction at the trailing edge. Upon further opening movement of the vane, the edge 54 will begin to move away from the wall of the mixing chamber, and from then on any further opening movement of the air vane will result in an increase in the air flow around both of its edges.

When the engine is operating at its maximum speed at wide open throttle, the air vane will approach its fully open position, shown in broken lines in Fig. 3, wherein the air pressure on the curved edge 54 maintains the air vane in a position approaching alinement with the axis of the mixing chamber.

The initial tension of the spiral spring 50 is so adjusted that the suction produced by cranking the engine, though slight, is sufficient to rotate the air vane through an angle of approximately 10 degrees, which brings another portion of cam 56 into contact with the roller 58 and moves valve 74 off its seat by a sufficient distance to supply fuel for starting.

It is contemplated that any of the features disclosed in either of the copending applications above identified may be used in connection with the instant invention.

In order to prevent fluttering of the air vane 30, an inertia member 100 is mounted on the shaft 32 within the casing 40. The inertia member is rotatable relative to the shaft, but is connected thereto by frictional means now to be described. The shaft 32 is provided adjacent its end with a collar 102 fixed thereto, and adjacent the collar is secured a stop member 104 which is rotatably mounted on the shaft. Both the inertia member 100 and stop member 104 are balanced on the shaft 32, so that gravity does not tend to rotate them. The member 104 is provided with a longitudinal bore, within which are seated friction members 106 formed of cork, asbestos, or the like, which bear frictionally against the shaft 32 to resist rotary movement of the stop member 104 relative to the shaft. The members 106 are urged into contact with the shaft 32 by adjustable yielding means herein exemplified by a pair of coiled compression springs 108 which may be adjusted by plugs 110 threaded into the outer ends of the bore. By this means, the stop member 104 is caused to rotate with the shaft 32 under normal operating conditions of the carburetor, but upon the occurrence of unusual stresses, relative movement between the shaft and the stop member may take place.

A sleeve 112 is mounted on the shaft 32 inwardly of the stop member 104, being secured to the shaft by welding, or splined thereon, and is provided with a radial flange 114. Interposed between the flange 114 and the vertical surface 116 of the inertia member is an annular disk 118 of frictional material such as cork or asbestos, designed to resist rotary movement of the inertia member relative to the sleeve 112. The frictional resistance of the disk 118 is preferably equal to the torque exerted by air flow through the carburetor at the intermediate position of the vane 30.

The inertia member 100 is of generally cylindrical shape, and is centrally bored to form a rotating fit upon the sleeve 112. The inertia member is counterbored at its inner end to form a recess 120 within which is mounted a compression spring 122 having one of its ends bearing against the outer end of the recess, its inner end being seated within a circumferential groove 124 formed in the shaft 32. The effect of the spring 122 is to urge the inertia member outwardly and to compress the frictional disk 118, so as to maintain frictional contact between the inertia member and disk. The pressure upon, and area and moment arm of, the disk 118 are so calculated that the torque necessary to cause rotation of the inertia member relative to the shaft is less than that required to cause rotation of the stop member 104 relative to the shaft, so that relative movement between the shaft and inertia member may occur whenever the air vane 30 begins to flutter, as will occur during various operating conditions of the engine.

The outer end of the inertia member 100 is counterbored as indicated in Fig. 2 to permit the flange 114 to be assembled therewith, and is formed with two oppositely disposed segmental slots 128, the surfaces of which are designed to aline with and contact the stop member 104 when the same is rotated relative to the inertia member. The inertia member, it will be noted, is free to travel through a considerable angle of rotation relative to the stop member 104, such travel being limited by contact of the walls of slots 128 with the stop member. In the design of the inertia member, the aforementioned angle will vary with the number of cylinders of the engine, which affects the periodicity of the impulses in the intake manifold, discussed hereinafter. The total travel of the stop member 104 will, however, be approximately 90 degrees if the air vane 30 travels from its fully closed to its fully open position. During any sudden movement of shaft 32, the inertia member 100 tends to remain stationary, and such movement is therefore opposed by the frictional resistance of the disk 118. Continued movement of the stop member 104 relative to the inertia member will terminate in impact between the stop member and the walls of the slots 128, which will tend to arrest such movement, and when combined with the braking effect of the friction disk 118, will damp the force of the oscillation and tend to restore the vane to normal position within a minimum length of time.

When the throttle 24 is, during the operation of the engine, suddenly moved from closed or nearly closed position to open position, the vacuum of the intake manifold is suddenly transmitted to the air vane 30, resulting in rapid movement of the vane toward open position, and this movement may be so violent as to cause rotation of the stop member 104 upon the shaft. The momentum developed in such movement may carry the vane past the intermediate position corresponding to the engine speed at the moment, causing the vane to strike the stop pin 31 violently and to rebound. The accelerations of the shaft 32 relative to the inertia member 100 accompanying such movements are of such order as to overcome not only the frictional resistance of disk 118 but also that of members 106, and thereby cause rotation of the stop member 104 on the shaft. During the excursion of the vane to fully opened position an excess of fuel will be supplied to the engine for acceleration, and thereafter the vane will be restored to normal functioning.

During operation of the engine at low speed with the throttle open, as will occur under heavy load, the vane 30 will be subjected to periodic impulses caused by alternate waves of condensation and rarefaction of the mixture in the intake manifold, due to the operation of the engine pistons and inlet valves. These waves are transmitted to the vane in full force when the throttle is wide open, and set up corresponding oscillations of the vane about a neutral position which represents the correct position of the vane for the engine speed at the moment. Under some conditions, where the periodicity of the impulses correspond to the natural periodicity of the vane or a harmonic thereof, the amplitude of oscillation of the vane tends to increase due to the law of resonance, until the carburetor and engine fail to function, or function in a very erratic manner. However, in the present device the amplitude of the oscillations is limited by the impacts between the stop member 104 and the walls of the slots 128, which impacts bring into play the heavy friction of members 106 and thus damp the oscillating vane and restore it to normal functioning.

Although the invention has been described with reference to a particular embodiment thereof, it may be embodied in other forms within the skill of artisans in this art, and is therefore not limited to the form disclosed, nor otherwise except in accordance with the terms of the following claims.

I claim:

1. In a charge forming device, an induction passage, a pressure responsive air vane in said passage, and vibration damping means for said vane comprising an inertia member having an overrunning frictional connection with said vane and yielding stop means for said inertia member having an overrunning connection with said vane of higher frictional characteristics than said first mentioned connection.

2. In a charge forming device, an induction passage, a pressure responsive air vane in said passage, and vibration damping means for said vane comprising an inertia member having an overrunning frictional connection with said vane and a yielding stop member connected to said vane through frictional means having higher frictional characteristics than said first mentioned connection and tending to limit rotation of the vane relative to the inertia member.

3. A carburetor comprising an induction passage, a rotatable air vane in said induction passage movable toward open position by flow of air therepast, and vibration damping mechanism for said air vane comprising a rotatable inertia member, friction means connecting said inertia member to said vane, and yielding stop means connected to said vane through friction means of higher torque than said first mentioned friction means and tending to limit rotation of said inertia member relative to said vane.

4. A carburetor comprising an induction passage, a shaft extending transversely thereof and offset from the center of the induction passage, an air vane mounted eccentrically on said shaft and movable toward open position by flow of air through the induction passage, and vibration damping mechanism comprising an inertia member mounted on said shaft and rotatable relative thereto, friction means resisting rotation of the inertia member relative to the shaft, a stop member mounted on said shaft and rotatable relative thereto, connecting means between the inertia member and the stop member permitting a limited degree of rotation therebetween, and friction means resisting rotation of the stop member relative to the shaft.

5. A carburetor comprising an induction passage, a shaft, an air vane fixed to the shaft and rotatable by flow of air through the induction passage, an inertia member mounted on the shaft and rotatable relative thereto, friction means resisting rotation of the inertia member relative to the shaft, a stop member mounted on said shaft and rotatable relative thereto, connecting means between the inertia member and the stop member limiting rotation of the stop member relative to the inertia member, and friction means resisting rotation of the stop member relative to the shaft.

6. A carburetor comprising an induction passage, a shaft mounted transversely of said passage an air vane fixed to the shaft and rotatable by flow of air through the induction passage, an inertia member rotatably mounted on the shaft exteriorly of the induction passage, friction means resisting rotation of the inertia member relative to the shaft, a yielding stop member carried by the shaft and having an overrunning connection with the inertia member, and friction means resisting rotation of the stop member relative to the shaft.

7. A carburetor comprising an induction passage, a shaft, an air vane fixed to the shaft and

rotatable therewith by flow of air through the induction passage, an inertia member frictionally rotatable on the shaft, and a stop member frictionally rotatable on the shaft and having an overrunning connection with the inertia member.

8. A carburetor comprising an induction passage, a shaft, an air vane fixed to the shaft and rotatable therewith by flow of air through the induction passage, an inertia member frictionally rotatable on the shaft, said inertia member being of generally cylindrical form and being coaxial with the shaft and having a segmental slot at one end, and a stop member frictionally rotatable on the shaft and positioned to engage the respective walls of said slot upon rotation of the stop member relative to the inertia member through a predetermined angle.

9. A carburetor comprising an induction passage, a shaft, an air vane fixed to the shaft and rotatable therewith by flow of air through the induction passage, an inertia member rotatable on the shaft, said inertia member being of generally cylindrical form and being coaxial with the shaft and having a segmental slot at one end, a yielding stop member frictionally rotatable on the shaft and positioned to engage the respective walls of said slot upon rotation of the stop member relative to the inertia member through a predetermined angle, and a friction disk fixed to the shaft and engaging the inertia member to oppose relative rotation between the shaft and the inertia member.

10. The invention defined in claim 9, comprising in addition resilient means mounted in a conterbore in the inertia member and acting axially thereof to maintain the same in frictional contact with said friction disk.

11. The invention defined in claim 9, comprising in addition positive stop means limiting rotation of the vane relative to the induction passage.

12. A carburetor comprising an induction passage, a shaft journaled in the walls thereof, an air vane fixed to the shaft and rotatable therewith by flow of air through the induction passage, an inertia member rotatable on the shaft, said inertia member being of generally cylindrical form and being coaxial with the shaft and having a segmental slot at one end, a stop member frictionally rotatable on the shaft and positioned to engage the respective walls of said slot upon rotation of the stop member relative to the inertia member through a predetermined angle, and a friction disk fixed to the shaft and engaging the inertia member to oppose relative rotation therebetween with a less frictional torque than that exerted by said stop member.

13. A carburetor for an internal combustion engine, comprising an induction passage, a shaft journaled transversely in the walls of said induction passage, an air vane fixed to the shaft and rotatable therewith by flow of air through the induction passage, positive means limiting angular movement of said vane, an inertia member rotatable on the shaft, a stop member frictionally rotatable on the shaft and having an overrunning connection with said inertia member, and a friction disk fixed to the shaft and engaging the inertia member to oppose relative rotation therebetween.

14. Vibration damping means for a shaft, comprising an inertia member rotatable on the shaft, said inertia member being of generally cylindrical form and being coaxial with the shaft and

having a segmental slot at one end, a yielding stop member frictionally rotatable on the shaft and positioned to engage the respective walls of said slot upon rotation of the stop member relative to the inertia member through a predetermined angle, and a friction disk fixed to the shaft and engaging the inertia member to oppose relative rotation therebetween with less frictional torque than that exerted on the stop member.

15. A vibration damping device for a shaft, comprising an inertia member rotatable on the shaft and formed with angularly spaced stops, a stop member frictionally rotatable on the shaft and positioned to engage said stops upon rotation of the stop member relative to the inertia member through a predetermined angle, and a friction element engaging the shaft and the inertia member to oppose relative rotation therebetween with less frictional torque than that exerted on the stop member.

16. A device for damping vibration of a shaft, comprising a statically balanced inertia member rotatable on the shaft and having angularly spaced stops, a stop member rotatable on the shaft and positioned to engage the stops upon rotation of the stop member relative to the inertia member through a predetermined angle, a friction element interposed between the stop member and the shaft to oppose relative rotation therebetween, a friction element interposed between the inertia member and the shaft to oppose relative rotation therebetween, and yielding means maintaining the effectiveness of both of said friction elements in such degree that rotation of the inertia member relative to the shaft is opposed by less frictional torque than that opposing rotation of the stop member relative to the shaft.

17. In a charge forming device, an induction passage, a pressure responsive air vane in said passage, and vibration damping means for said vane comprising an inertia member rotatable on the shaft, said inertia member being of generally cylindrical form and being coaxial with the shaft and having a segmental slot at one end, a yielding stop member frictionally rotatable on the shaft and positioned to engage the respective walls of said slot upon rotation of the stop member relative to the inertia member through a predetermined angle, and a friction disk fixed to the shaft and engaging the inertia member to oppose relative rotation therebetween with less frictional torque than that exerted on the stop member.

18. In a charge forming device, an induction passage, a pressure responsive air vane in said passage, and vibration damping means for said vane comprising an inertia member rotatable on the shaft and formed with angularly spaced stops, a stop member frictionally rotatable on the shaft and positioned to engage said stops upon rotation of the stop member relative to the inertia member through a predetermined angle, and a friction element engaging the shaft and the inertia member to oppose relative rotation therebetween with less frictional torque than that exerted on the stop member.

19. In a charge forming device, an induction passage, a pressure responsive air vane in said passage, and vibration damping means for said vane comprising a statically balanced inertia member rotatable on the shaft and having angularly spaced stops, a stop member rotatable on the shaft and positioned to engage the stops upon rotation of the stop member relative to the inertia member through a predetermined angle, a friction element interposed between the stop member and the shaft to oppose relative rotation therebetween, a friction element interposed between the inertia member and the shaft to oppose relative rotation therebetween, and yielding means maintaining the effectiveness of both of said friction elements in such degree that rotation of the inertia member relative to the shaft is opposed by less frictional torque than that opposing rotation of the stop member relative to the shaft.

WILLIAM E. LEIBING.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,010,051	Hoffman	Nov. 28, 1911
1,167,217	Reichenbach	Jan. 4, 1916
1,254,354	Reichenbach	Jan. 22, 1918
2,137,591	Sarazin	Nov. 22, 1938
2,238,333	McCain	Apr. 15, 1941
2,347,059	Mulheim	Apr. 18, 1944

Certificate of Correction

Patent No. 2,501,060 March 21, 1950

WILLIAM E. LEIBING

It is hereby certified that errors appear in the printed specification of the above numbered patent requiring correction as follows:

Column 7, line 64, after the syllable "sage" and before "an" insert a comma; column 10, line 47, list of references cited, for the patent number "1,254,354" read *1,254,355*;

and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 4th day of July, A. D. 1950.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.