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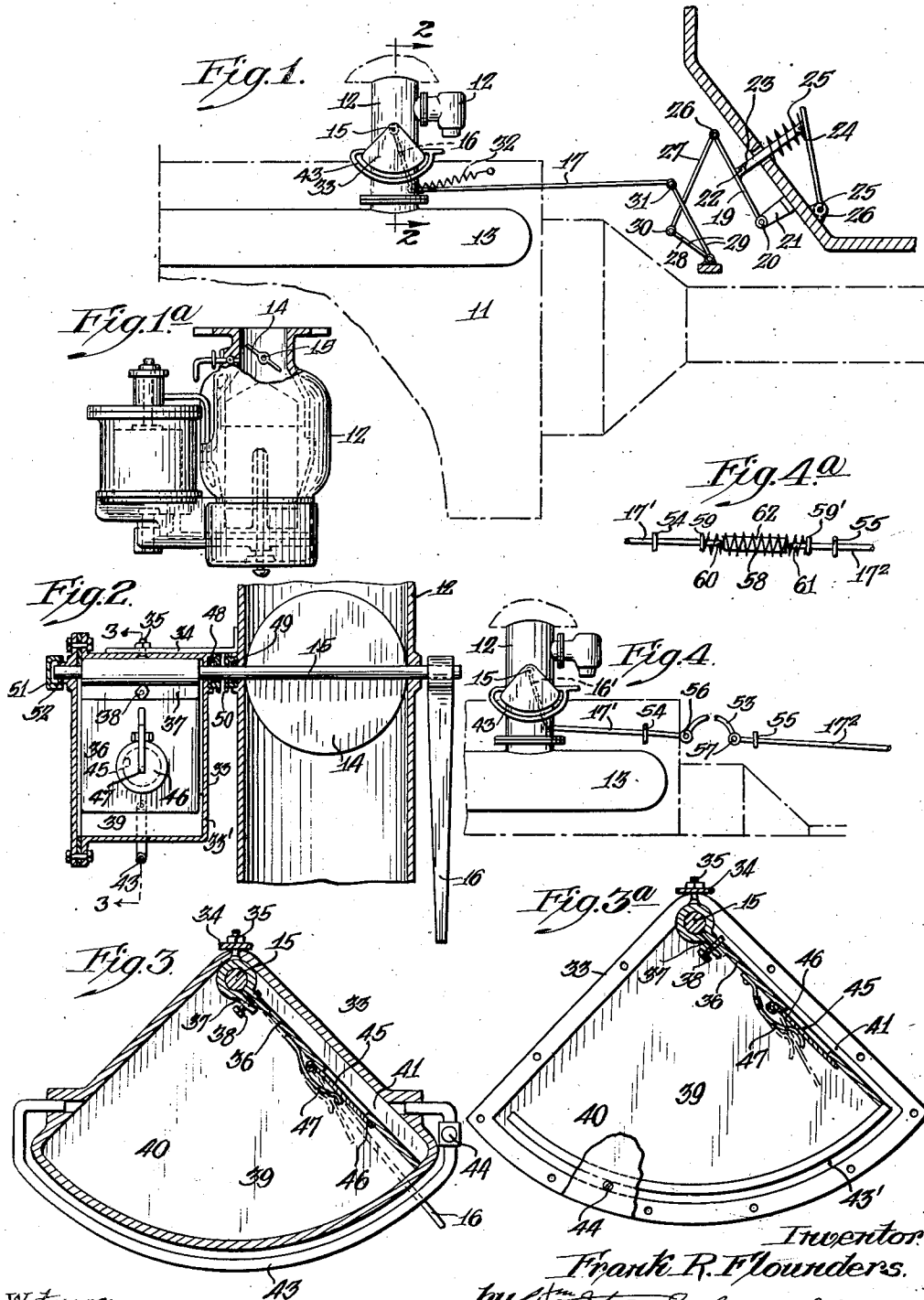
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2,431,659

FUEL ECONOMIZER

Filed Feb. 4, 1942

2 Sheets-Sheet 1



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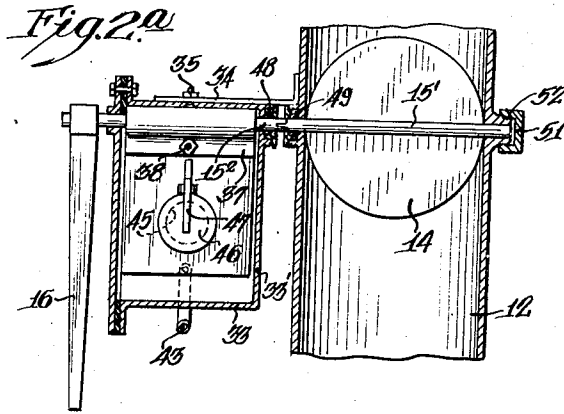
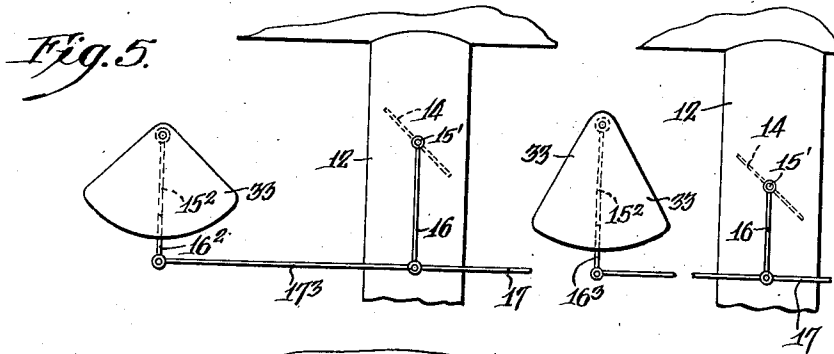
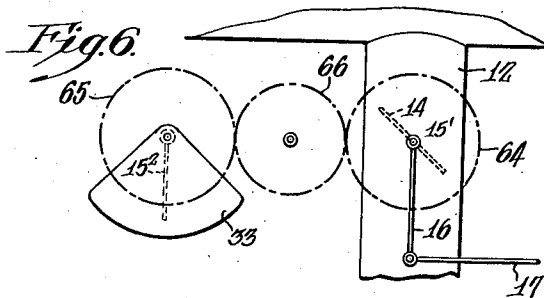
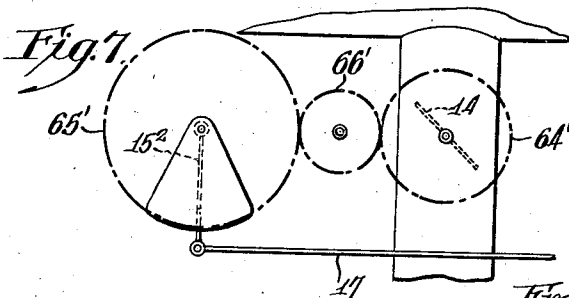
F. R. FLOUNDERS

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FUEL ECONOMIZER

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,431,659

FUEL ECONOMIZER

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Application February 4, 1942, Serial No. 429,585

3 Claims. (Cl. 137—139)

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My invention relates to carburetor control and aims to secure more efficient operation of the induction system during acceleration, with consequent better engine efficiency.

The principal purpose of the invention is to control the maximum rate of and uniformly retard carburetor butterfly angular motion of automotive or other internal combustion engines having a throttle between the engine and carburetor.

A further purpose is to secure more efficient operation of the carburetor against uniform retardation for each angular unit of butterfly movement during periods of speed pick-up in response to quick depression of the accelerator.

A further purpose is adjustably to limit the rate of throttle opening and retard it uniformly per angular unit of butterfly rotation.

A further purpose is to permit abrupt accelerator movement and to smooth out the effect of this operation by hydraulic dash pot carburetor control, introducing a time lag substantially equal throughout the angular range of operation.

A further purpose is to insure regularity of angular movement of the throttle for any given time when the accelerator has been moved to the end of its stroke.

A further purpose is to use a dash-pot to limit acceleration movement of the control of a carburetor and to permit locking of the car by shutting off the flow of fluid at the dash pot.

Further purposes will appear in the specification and in the claims.

The invention relates not only to methods of operation but to mechanism by which the methods may be carried out.

I have preferred to illustrate one main form only among the various forms in which the invention may appear, selecting a form which is not only practical and effective, but which has been selected because it well illustrates the principles of the invention.

In the drawings:

Figure 1 is a diagrammatic side elevation partly in section of an accelerator and connections illustrating my invention.

Figure 1a is an enlarged side elevation, partly sectioned showing a conventional carburetor.

Figures 2 and 2a are fragmentary enlarged sections taken at the same point, corresponding to line 2—2 of Figure 1 but showing different structures.

Figure 3 is a section taken upon line 3—3 of Figure 2 and corresponding to a front view of a liquid control retarding element used but in which the face plate has been removed.

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Figure 3a is a view corresponding to Figure 3 but showing a modification.

Figures 4 and 4a are fragmentary diagrammatic views showing modified forms.

Figures 5, 5a, 6 and 7 are fragmentary views to enlarged scale corresponding each to a part of Figure 1 but showing modifications.

In the drawing similar numerals indicate like parts.

The present application is a continuation in part of an abandoned application filed by me for Economizer, Serial No. 268,764, filed April 19, 1939.

The fuel supplied to a large majority of the internal combustion engines in use today is blended with air to form a combustible mixture before being inducted into the engine.

Automotive engines of this type have the fuel metered into the air by a carburetor. Fuel issues from normal jets in the carburetor because of the difference in pressures on the fuel in the float bowl and the fuel in the tips of the jets. The fuel is then entrained in the air stream flowing past the normal jets; and it is the function of the carburetor to supply correct proportions of fuel and air for all operating conditions.

The butterfly damper in the throat of the carburetor, between the normal fuel jets and the intake manifold, opposes the pumping action of the engine's pistons and opposes the intake flow of air under the pressure of the atmosphere.

The idling pressure on the intake manifold side of the butterfly will approximate 10 pounds per square inch absolute. The pressure outside the butterfly will be substantially atmospheric pressure, because the butterfly nearly closes the induction system.

It is only within recent years that the effect of the distillation range of a liquid fuel upon its distribution in an intake manifold has been fully realized. Until recently it was thought that more power (heat content) was inherent in and would therefore be developed from a fuel having a final boiling point in the neighborhood of 437 degrees F. than from one having a lower final boiling point. Recently, however, premium fuels designed expressly to provide maximum power as one of their advantages are found to have 90% of their volume volatile at approximately 100 degrees F. lower temperature. This is largely because the 90% point of the temp./vol. distillation curve may be considered indicative of the fuel's distribution characteristics.

Volatility is affected by pressure as well as by temperature. Therefore it is obvious that when liquid fuel is used a marked improvement in

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vaporization and in the uniformity of the air-fuel ratio fed to various cylinders will result from keeping pressures in the intake manifold as low as possible at all times.

In general, the conditions met in the prior art will be about as follows:

In applying power, when the butterfly valve is suddenly rotated to full open position under existing usual conditions the manifold pressure rises to practically atmospheric pressure and momentarily there is almost an equalization of pressure on the fuel in the float bowl and the fuel in the tips of the normal jets. This removes the difference in pressure which is relied upon for fuel flow from these normal jets.

For each engine, and with each operating condition of the engine as to load and speed, there is an optimum limit in the rate of throttle opening for effective carburetion and beyond which carburetion becomes highly inefficient.

It is well known that different drivers get different results in the way of performance and fuel consumption from the same automobile even under conditions of load, speed, etc., that are apparently identical. One of the principal causes for these different results is difference in the manipulation of the accelerator valve (throttle).

If the rate of throttle opening be so controlled as to minimize the rate of pressure change in its induction system, an internal combustion engine will give more powerful acceleration and use less fuel.

My invention provides smooth and gradual opening of the valve against resistance which is uniform per unit angular valve movement and thus controls pressure changes in the induction systems of internal combustion engines. Its inherent novelty resides in limiting the violence and effects of these pressure changes. The methods and combinations suggested use mechanical forms separately well known to the art, now applied to the induction system itself.

The present invention takes care of the human element where too rapid acceleration is attempted, by slowing up the operation of the carburetor control to a speed corresponding with proper acceleration, yet, in its best form, permits the operator to force the accelerator "all the way" as some operators have been accustomed to do. The rate of retardation may be regulated.

In the illustration, the engine block is shown at 11 connected with carburetor 12 through manifold 13. The carburetion in the present instance is controlled by a throttle, shown as a butterfly, 14 which is mounted upon and oscillates with throttle shaft 15. This shaft is turned by an arm 16. The shaft 15 is divided in Figure 2a.

The arm 16 is connected by a thrust rod 17 with any type of accelerator. It makes no difference whether this be hand-operated or foot-operated, provided it offers means by which the throttle is controlled. Normally the accelerator is operated by a spring-retracted pedal-operated plunger-and-thrust-rod connection with the lever of a butterfly damper acting as a throttle, very generally called a "butterfly" and for that reason such a form has been illustrated. Spring retraction somewhere in the train is needed.

Accelerator lever 19 is connected at 20 to swing about a bracket 21 and is operated at an intermediate point 22 in its length by plunger 23 from a pedal 24. The pedal presses against a retraction spring 25. The lever 19 extends beyond the

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point of connection with the plunger to 26 from which point it is connected by thrust arm 27 to the arm 28 of a bell crank or rocker arm 29 whose other arm 30 at 31 engages the thrust rod 17. All of the connections above are normally pivotal connections.

The butterfly is commonly retracted as by a spring 32.

I limit the maximum speed of opening movement of the throttle without interfering with the present speed of closing movement. This is in itself a decided benefit but would be objectionable to many drivers if it meant that the accelerator pedal would have to be followed up by the foot until the throttle is fully open. I therefore insert resilient lost motion within the train of operation of the throttle as hereinafter described, so that the entire accelerator pedal movement may be given at once and the follow-up of the retarding mechanism will be accomplished by the resilience of the spring in the lost motion. Since it is the maximum rate of movement of the throttle only which is limited and there is no interference with any movement below this maximum rate, my invention effects no change where the rate of accelerator movement produces a rate of opening of the throttle below the limit provided; and there is no interference with retractive (throttle closing) movement.

In order to point out that retarder control of the maximum rate of throttle opening movement is not dependent upon a particular structure I have illustrated several such structures, all using hydraulic constricted-passage fluid flow devices of dash pot type.

In Figures 1, 2 and 3 the retarding mechanism comprises a fan-shaped hydraulic dash pot 33, supported by bracket 34 and bolt 35. Within it swings a liquid-confining movable vane forming a vane wall 36, for convenience referred to herein as a vane, connected with the shaft 15 along an edge by a shaft-surrounding clamp 37 tightened by bolt 38. The vane thus oscillates with shaft 15.

The interior 39 of the dash pot is partitioned variably by the vane. The compartment 40 in front of the vane is connected with a compartment 41 behind the vane. The liquid, not shown, here termed oil, fills both compartments. A fluid connection between the compartments provides for movement of the vane. In Figure 3 I show this connection by pipe 43 outside the casing and in Figure 3a by a passage within the casing.

Needle valve 44 within the passage makes it possible in either form very exactly to adjust the extent of retardation of opening movement of shaft 15 and hence of the butterfly as provided by flow of the liquid content through the passage with movement of the vane. I thus make the maximum rate of butterfly opening movement adjustable, controlled by the dash pot. The adjustment adapts a single size of dash pot to suit a large range of conditions.

Since retardation of the valve opening movement only of the butterfly is desired i. e., meaning that there shall be no such retardation of the closing movement, free flow through the vane is permitted on butterfly closing movement and is provided by a higher rate of flow made available through aperture 45 when the vane is on its return stroke.

On the forward stroke the opening 45 is closed by a check valve 46 pressed by spring 47.

In Figure 3a a groove 43' within the outer face of the dash pot shell 33' is provided, which groove

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is closed at the outer (side) face, but not at the ends, by a cover plate from which the stem of a valve 44 projects into the groove to a greater or less extent according to the adjustment. This takes the place of the pipe connection between the compartments in Figure 3.

As thus far described the invention is fully operative for control, with or without the adjustment but requires continued opening pressure for continued movement.

For the reason that the mechanism (which rotates shaft 15 or an equivalent shaft) (in Figure 2 shown as spring lever arm 16) may connect with either end of the shaft 15, I have shown in Figure 2a a construction corresponding generally with Figure 2 except that the dash pot end of the shaft is driven directly and the rotation of the butterfly is effected by reason of angular movement of the shaft carrying the dash pot vane. An important thing is that the angular movements of the butterfly and vane shall be equal or proportional, one to the other, at equal angular ranges of movement at whatever portion of the butterfly movement; and shall be coincident. Preferably they correspond in extent for any given energy applied.

Because such a construction if used without the resilient lost motion would prove objectionable in requiring the continuing follow-up pressure upon the accelerator, making the accelerator operation different from that of normal cars lacking the invention, I introduce a spring lost motion into the connections between the accelerator and the throttle at any convenient point.

To protect against withdrawal of the oil from the dash pot by reason of vacuum adjacent the throttle, which might take place otherwise, the shaft 15 is provided with packing at 48 and 49, with a space 50 between which is open to atmospheric pressure. At the opposite end of the shaft from the butterfly a cap 51 surrounds the end of the shaft, being fastened to a threaded sleeve 52 sealed to the left-hand outer wall of the dash pot.

I show different lost motion devices in Figures 1 and 2 on the one hand and 4 and 4a on the other.

In Figures 1 and 2 the arm 16 constitutes a spring and bends when the accelerator is depressed at a rate more rapid than the dash pot will permit, storing energy in the spring. The tendency of the spring to return to its initial shape continues opening movement of the butterfly at its maximum rate until the vane is moved to the limit which has been set for it. The spring is tapered, with the greater thickness close to the shaft, in order to distribute the bend throughout a considerable part of the length of the arm. It will be noted that the spring arm can be pushed or, if the vane start from the other end of its stroke, pulled, to open the throttle. I have preferred to illustrate by the pressure operated form rather than by the tension opened form, though either could be used.

The arm may be made highly resilient so as to yield to accommodate a large part or all of the movement of the thrust rod 17 and still continue to resist and tend to return. This recovery impulse causes the spring to pull the shaft carrying the butterfly in the direction of the thrust rod's movement until turning of the throttle permits the arm 16 again to become straight. However it is to be noted that as bending of arm 16 causes turning pull upon the butterfly shaft the shaft begins to turn (and the butterfly also) so that by the time the thrust rod 17 has moved

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its full stroke the butterfly has rotated a part of its opening movement and the arm 17 is not required to bend the full distance which would have been required if the shaft and the butterfly upon it had remained stationary.

It will be seen that movement of the pedal at a rate faster than that contemplated by the limit of maximum opening movement of the throttle stores energy for subsequent follow up movement of the throttle. Instead of storing this energy within a spring arm it may be stored in some other kind of a spring, at some other part of the connections of the train of movement between the pedal and the throttle.

In Figure 2a the coupling between the two shafts permits the two shafts to vary somewhat in longitudinal position so that the damper and retarder need not be set with the same exactness as otherwise would be necessary.

In Figure 4 a bow spring 53 is provided within which the energy may be stored, the subsequent expansion of the spring providing the follow up necessary to continue to open the throttle after the accelerator has been operated. In this form the thrust rods 17' and 17² are guided by bearings 54 and 55 in order that the bow spring may be pivoted to these rod sections at 56 and 57. In this case the arm 16' may be rigid or may be of spring material to provide a part of the resilience, the rest of the resilience being provided by the bow spring.

In Figure 4a spiral compression spring 58 may be used, compressed between discs 59 and 59' attached to thrust rods 17' and 17². The spring may surround rod extensions 60, 61 and may be supported and prevented from buckling by a sleeve 62 riding on these extensions.

In Figure 5 the butterfly and the retarding dash pot are laterally spaced, the dash pot vane being located upon the shaft 15' parallel to the butterfly shaft 15' but laterally spaced from it. The two arms in Figure 5 are of equal length and the thrust rod 17 is connected so as to operate both of them. It does not matter whether it connects first with the butterfly arm 16 as in Figure 5 or with the dash pot operating arm 16². It connects first with the arm 16 operating the butterfly shaft 15' and then with arm 16² operating the dash pot vane 15². An auxiliary thrust rod 17³ connects the two arms.

In Figure 5 the arms 16 and 16² are of equal length and the two shafts turn through equal angles, so that the dash pot vane must turn as far as the butterfly, or approximately 90 degrees.

By making the arms 16 and 16² of different lengths any desired proportions of angular movement can be given. In Figure 5a the angular movement of the butterfly is approximately 90 degrees while that of the vane is approximately 60 degrees. Either arm can be longer than the other.

Much the same flexible and equal or different but proportionate range of angular extents of movement of the butterfly and the dash pot vane may be accomplished in other ways, of which one is shown in Figures 6 and 7. Here the thrust rod 17 is connected with one of laterally spaced shafts, either the butterfly shaft or the dash pot vane shaft and the two shafts are connected by intermeshing gearing of equal or of selectively different diameters.

The construction is of the same general form as that of Figures 5 and 5a, with the difference that the equal or differing ratios of angular movement are provided by gears 64 and 65 or 64 and

65' in Figures 6 and 7 on the butterfly and vane shafts, respectively. These may be geared directly, reversing the shaft directions of rotation or, if it be desired that the shafts shall rotate in the same direction, with an idler 66 or 66' between them. In either event if the gears 64 and 65 be equal the angular rates will be equal. If the gear sizes be unequal there will be proportionate differences in angular movement, the shaft having the larger gear turning through the smaller angle. Thus if gear 64 be of but two-thirds the diameter of the gear 65', as in Figure 7, for example, and it be desired to provide approximately ninety degrees angular movement of the butterfly shaft the dash pot vane shaft will turn but 60 degrees, with the same proportions of the extents of rotation during parts of this range of movement.

It will be noted that in the forms shown in Figures 1 and 2 on the one hand and 6 on the other hand the several mechanisms are in series giving a minimum of lost motion and a maximum of control. In Figures 1 and 2, viewed from the accelerator end, the butterfly valve is followed in the order of arrangement by the dash pot and the presence of the dash pot vane upon the same shaft as that of the butterfly valve insures that the rate of flow of oil necessary to accommodate any given angular movement of the butterfly is the same throughout the entire range of movement.

In Figure 6 on the other hand the dash pot in the order of arrangement precedes the butterfly valve. In both the spring lies between the accelerator and the dash pot.

It will be noted also that oil, suggested as a liquid in the dash pot is quite desirable for this purpose because its viscosity is greatest when the engine is started, as should be the case because of the desirability of slowing up butterfly valve change at this time.

In view of my invention and disclosure variations and modifications to meet individual whim or particular need will doubtless become evident to others skilled in the art, to obtain all or part of the benefits of my invention without copying the structure shown, and I, therefore, claim all such in so far as they fall within the reasonable spirit and scope of my invention.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. Carburetor control mechanism comprising an accelerator, a rotary throttle, connections between

the accelerator and throttle, resilient lost motion within the connections, a dash pot having an oscillatory liquid-confining vane wall connected to turn the vane the same angular distance for one angular portion of turn of the throttle as for other equal angular turns of the throttle, a liquid retardant engaged by the vane wall, means permitting the liquid retardant to move restrictedly from one side of the vane wall to another, and means permitting free flow of the liquid in one direction from one side to the other of the vane wall.

2. Carburetor control mechanism operating during initial opening movement of the throttle, including a casing, an accelerator, a butterfly type throttle operating in the casing, an hydraulic dash pot having an angularly movable liquid-confining vane wall, a shaft mounting both the throttle and vane and operating connections for opening the throttle, including resilience between the shaft and the accelerator.

3. Carburetor control mechanism operating during initial opening movement of the throttle including an accelerator, a throttle, an hydraulic dash pot having an angularly movable liquid-confining vane wall, a spring check valve in the dash pot, a shaft mounting and operating the throttle and dash pot and operating connections between the shaft and accelerator adapted to open the throttle.

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