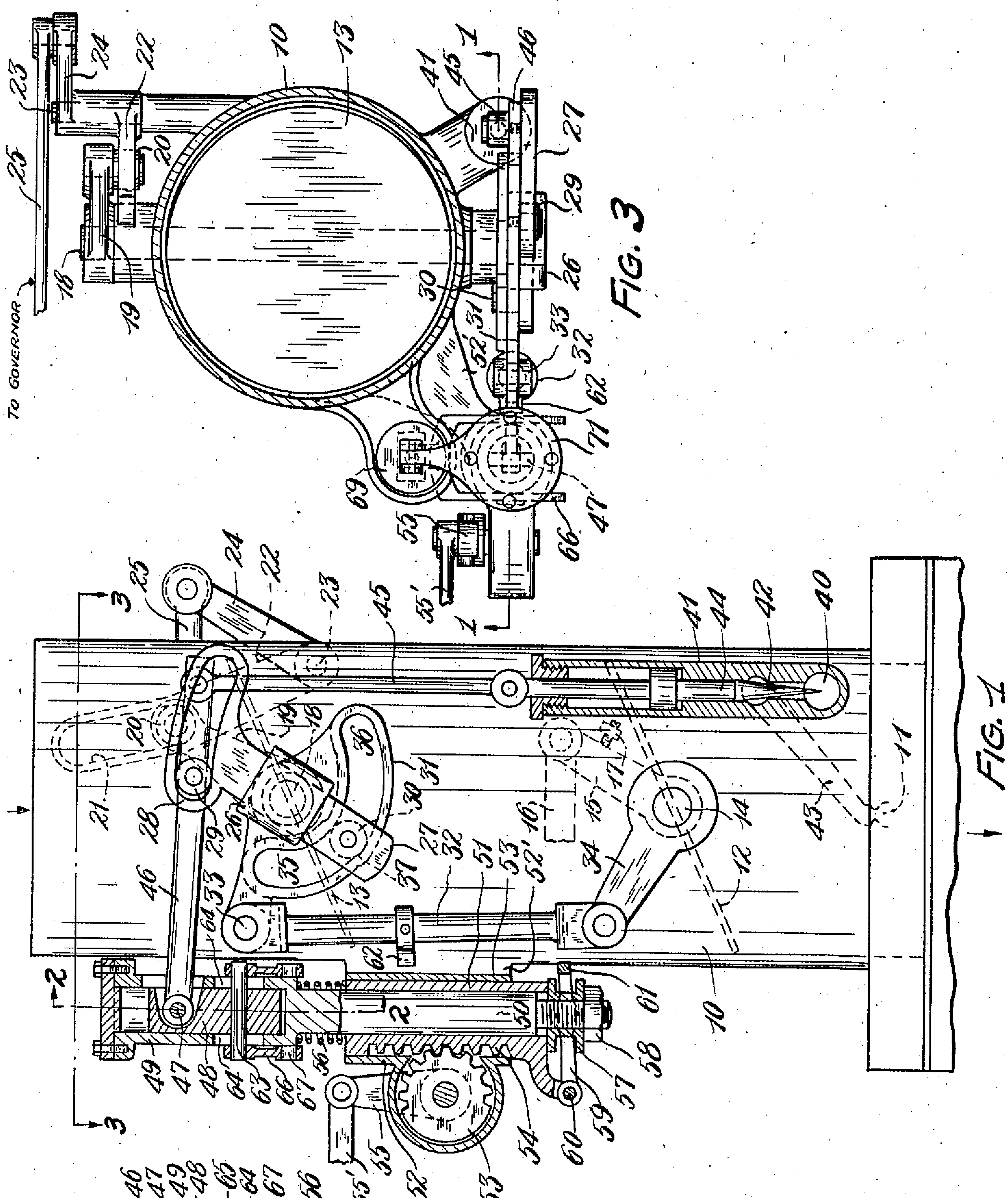
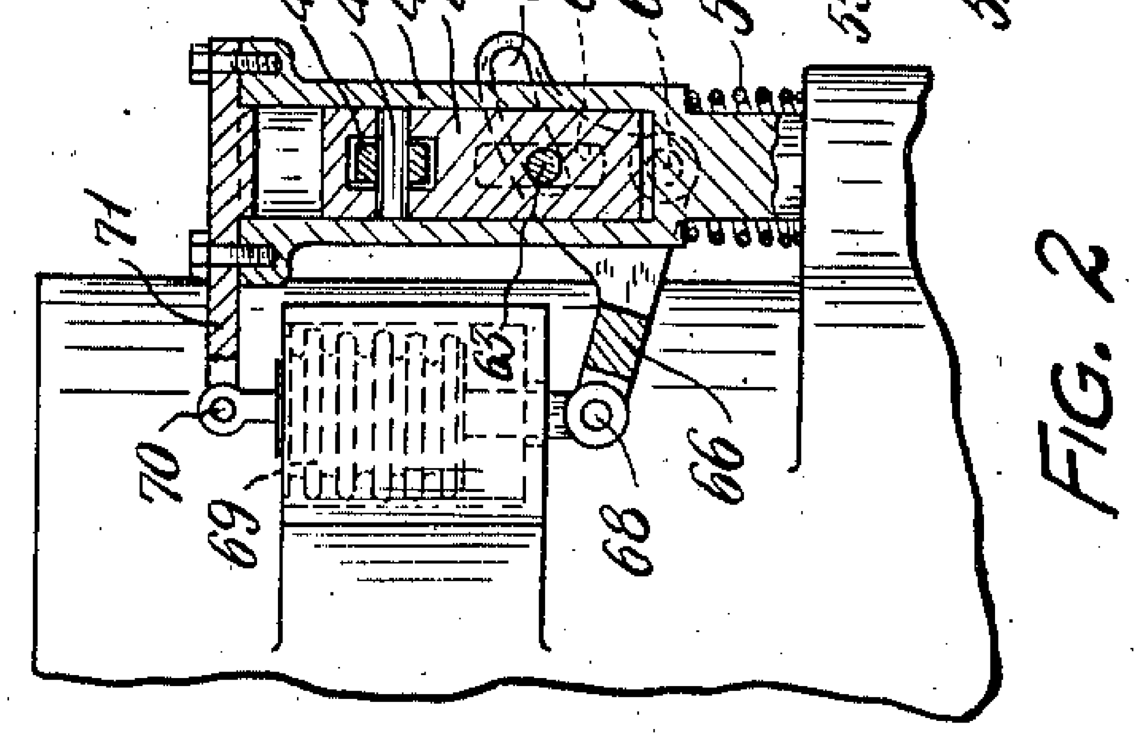
Nov. 11, 1947. L. DE MARCO 2,430,806

CARBURETOR

Filed Sept. 27, 1943 2 Sheets-Sheet 1





INVENTOR.

LOUIS DE MARCO

BY

Kwis Hudson Boughton & Williams

ATTORNEYS

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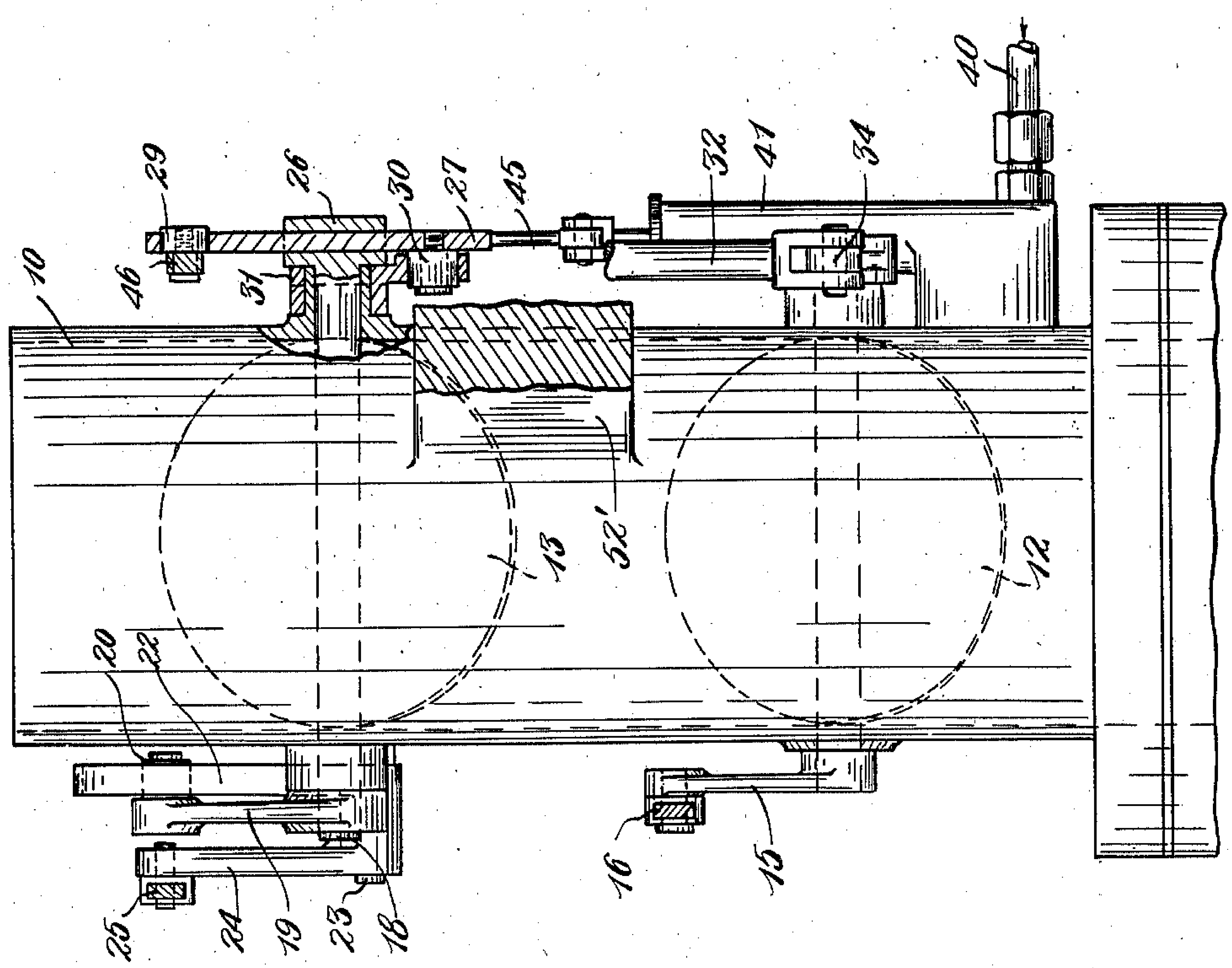

FIG. 5

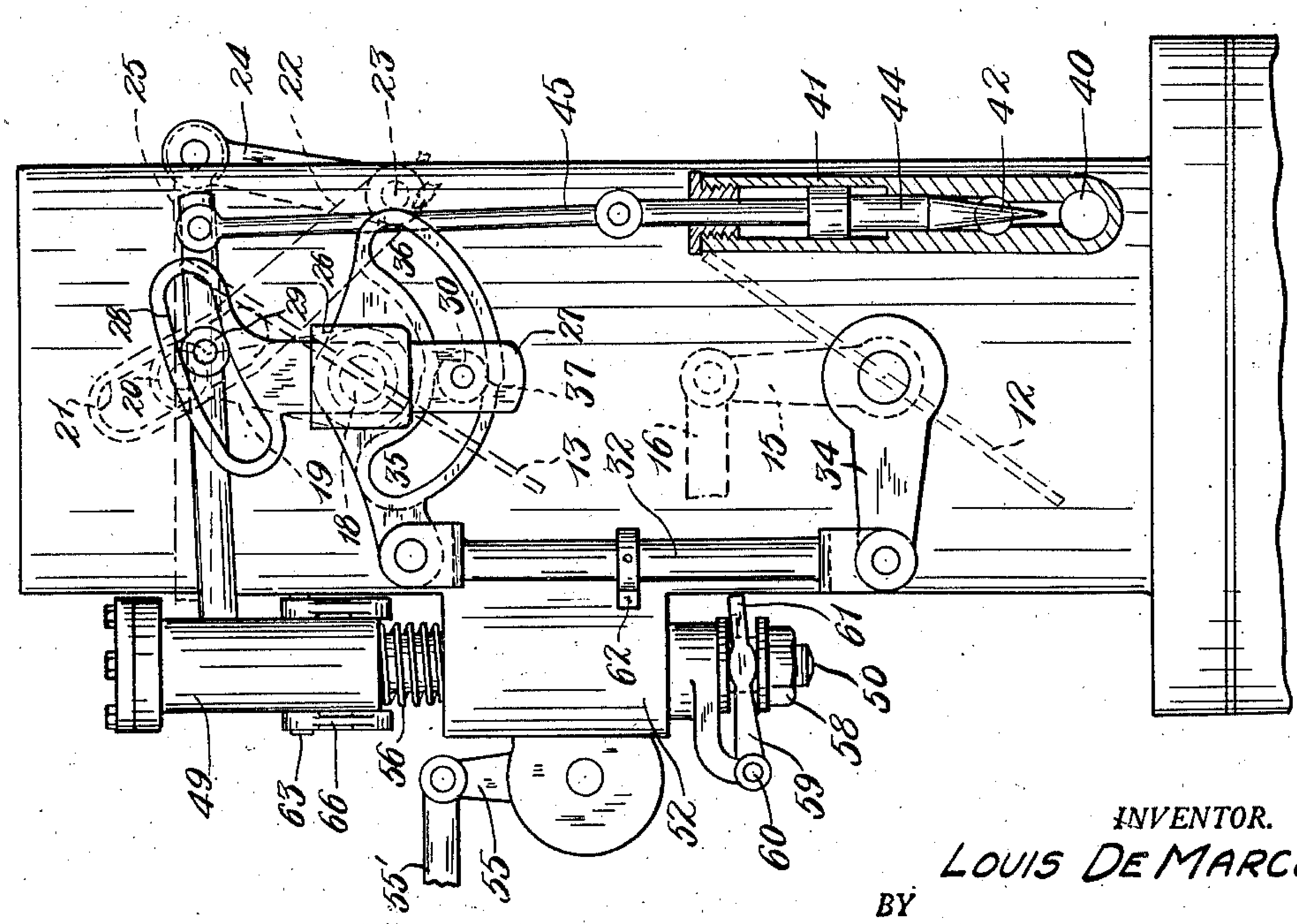

FIG. 4

INVENTOR.
LOUIS DE MARCO
BY
Kwis Hudson Boughton & Williams
ATTORNEYS

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CARBURETOR

Louis De Marco, Cleveland, Ohio

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18 Claims. (Cl. 123—98)

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This invention relates to improvements in carburetors, more particularly carburetors for airplane engines where special conditions and requirements, not present in ground vehicles, are encountered.

One of the objects of the invention is the simplification of airplane carburetor equipment and the consequent simplification of the operation of such equipment, without sacrificing any of the functions heretofore accomplished.

Another object is the provision of a carburetor in which the path for fuel from the pump to the jet shall be short and direct.

Another object is the provision of a carburetor wherein the volume and proportions of the air and gas mixture flowing to the engine shall be best suited to the requirements under all conditions of engine speed, load, acceleration, and deceleration.

Another object is the provision for airplane engines of large capacity of a carburetor employing a single fuel jet.

A further object is the provision of emergency means under control of the pilot for readily increasing or decreasing the opening of the fuel valve proportionately throughout the range of throttle positions to overcome the effects of a partial obstruction in the fuel line or to meet any unusual condition requiring a richer or leaner mixture.

Still another object is the provision of means under control of the pilot's throttle lever for supplying the necessary rich mixture for take off.

Other objects and features of novelty will appear as I proceed with the description of that embodiment of the invention which, for the purposes of the present application, I have illustrated in the accompanying drawings, in which

Fig. 1 is an elevational view, partly in vertical section, of carburetor control mechanism embodying the invention, set at idling position;

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

Fig. 3 is a horizontal sectional view taken substantially on the line 3—3 of Fig. 1;

Fig. 4 is a view similar to Fig. 1, showing the control mechanism in the position which it occupies at partially open throttle; and

Fig. 5 is an elevational view at right angles to that of Fig. 4 showing certain parts in vertical section.

In the drawings 10 represents a conduit for conducting air past a fuel jet which is indicated at 11. Within the conduit 10 there are two butterfly valves 12 and 13 controlling the flow of air through

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the conduit. Valve 12 is a volume control valve, or throttle, manually operated, and valve 13 is a proportioning air valve, governor controlled.

Valve 12 is mounted upon and turns with a shaft 14 to one end of which, outside the conduit, there is attached a crank 15 connected by a link 16 with a throttle control device such as a lever adapted to be operated by the pilot. An adjustable stop 17 determines the idling position of valve 12.

Valve 13 is mounted upon and turns with a shaft 18, to which is attached a crank 19 by means of which the valve is operated. At the free end of this crank there is a roller follower 20 which runs in a cam slot 21 in a lever arm 22 that is adapted to be oscillated upon a pivot pin 23 carried by the conduit 10. The hub of arm 22 also carries a crank 24 to which is pivotally connected a link 25 that is adapted to be moved back and forth by an engine governor, not shown. When engine speed increases lever arm 22 swings toward the left and causes crank 19 to swing in the same direction, opening valve 13. Decreasing engine speed has the opposite effect.

On the end of shaft 18 opposite crank 19 and outside conduit 10, the shaft carries a guide 26 in which a slide 27 is mounted to move endwise. At its upper end this slide is formed to provide a box cam 28 in which runs a roller follower 29 for a purpose which will presently appear.

At the lower end of slide 27 there is carried a roller follower 30 which runs in a box cam 31. Cam 31, as shown in Fig. 5, is so mounted as to turn about the axis of shaft 18 through a limited angle independently of that shaft. This movement is imparted to the cam through the movements of a link 32 which is pivotally connected with the cam at 33. The lower end of link 32 has a pivotal connection with a crank arm 34 that is fixed upon shaft 14. Consequently when the butterfly valve 12 is moved toward and away from closed position cam 31 is swung clockwise and counter-clockwise, respectively, as viewed in Figs. 1 and 4. Cam 31 has one continuous slot with which the follower 30 cooperates but this slot is divided into two parts, the part 35 substantially concentric with shaft 18 and the part 36 which is eccentric and the radius of which gradually increases away from the central point of the slot. At the juncture of the two parts 35 and 36 there is a rather sudden transition point 37 which as related to the part 35 is a low spot, and it is at this point that the roller 30 stands except during acceleration or deceleration of the engine.

Fuel enters the carburetor from a conductor

40 which connects with the bottom end of a fuel valve casing 41 having a valve seat 42. Just above this seat a passage 43 extends from casing 41 to fuel jet 11. A needle valve 44 is mounted to slide in casing 41. When in its lowermost position this valve engages seat 42 and cuts off fuel flow to the jet. Needle valve 44 is connected by a link 45 with the free end of a lever 46 which is adapted to swing normally about a pivot 47 and carries intermediate its ends the roller follower 29 previously referred to. When pivot 47 is stationary, as it is normally, movement of follower 29 up or down raises or lowers link 45 and moves needle valve 44 away from or toward its seat 42. As will be apparent from an inspection of the drawings the roller 29 may be actuated either by the longitudinal movement of slide 27, or by the swinging movement thereof caused by the oscillation of shaft 18 and the guide 26 carried thereby.

The adjustment of pivot 47 may be accomplished either manually or automatically, and the automatic adjustment is superimposed upon the manual adjustment. For this purpose the pivot is mounted in a plunger 48 within a cylindrical upper portion 49 of a post 50 that is slidable within a sleeve 51, which in turn is slidable in a housing 52 carried by a bracket 52′ projecting from conduit 10. Sleeve 51 is adapted to be moved up or down by a pinion 53 meshing with rack teeth 54 cut in the sleeve, the pinion 53 being adapted to be rotated by a crank 55 and a link 55 leading to an auxiliary lever on the instrument board of the airplane. Movement of the sleeve 51 upwardly is communicated through a coil spring 56 to the cylindrical upper portion 49 of the post. Downward movement of sleeve 51 is communicated to the post through a grooved collar 57 surrounding the post and bearing against a nut 58 threaded upon the constricted lower extremity of the post. Movement of the post downwardly independently of sleeve 51 may also be effected, and this is accomplished by means of a yoke 59 pivoted at 60 to sleeve 51, straddling collar 57 and having a projection 61 extending laterally far enough to be engaged by a lug 62 which is adjustably mounted upon link 32. The position of lug 62 is such that when the valve 12 is swung to fully open position, as when an airplane is taking off, yoke 59 will be swung down and post 50 lowered to adjust the pivot 47 downwardly, thus swinging lever 26 upon follower 29 as a fulcrum and shifting needle valve 44 away from its seat.

In order that pivot pin 47 may be adjusted automatically to compensate for differences in atmospheric pressure at different elevations, plunger 48 is arranged to be moved within the cylindrical portion 49 of the post. For this purpose a pintle 63 is mounted in plunger 48 and extends in both directions from that plunger through slots 64 in cylinder 49 and into cam slots 65 in the two arms of a bifurcated lever 66, which arms are mounted to turn upon trunnions 67 carried by the post. The outer end of this lever is pivotally connected at 68 to the bottom of a metal bellows 69, the upper end of which is connected at 70 to a plate 71 attached to the cylindrical part 49 of the post. Bellows 69 is filled with a gas which is responsive to pressure changes. Expansion of the bellows as an airplane ascends causes the plunger 48 to rise, lifting pivot 47 correspondingly and swinging lever 46 about follower 29 to lower needle valve 44 and thus reduce fuel flow to compensate for the rarefied air.

Operation.—Valve 12 may be closed only to engine idling position, and valve 13 may be closed to a somewhat less extent than valve 12. Hence sufficient air for idling will always be available. Assuming that the parts are in idling position, as illustrated in Fig. 1, the operator may open his throttle control to any degree desired, swinging the valve 12 toward open position. As much air as can pass valve 13 in the illustrated position then flows past jet 11. At the same time that valve 12 is opened, cam 31 is swung counter-clockwise and the roller follower 30 is thus caused to ride up from the low spot 37 into the concentric part 35 of the slot, the effect upon the follower 30 being the same whether the valve 12 is opened a slight amount only or completely opened. Slide 27 is thus cammed diagonally upward through guide 26 and thereby pushes roller follower 29 upwardly, imparting a lifting movement to needle valve 44. The mixture is thereby enriched during acceleration. As the engine picks up speed the governor, acting through link 25 and crank 24, swings arm 22 to the left, Fig. 1, which works through cam slot 21 and follower 20 to swing crank arm 19 and shaft 18 gradually counter-clockwise, thereby moving valve 13 toward open position. At the same time slide 27 is also swung counter-clockwise and the cam 28 thereby acts upon the follower 29 to swing lever 46 upward and further open the fuel valve in proportion to the air which is permitted to flow through the conduit 10 in response to engine vacuum. The form of cam 28 may be such as to vary the proportions of the mixture to effect the best results for different engine speeds or loads. If we assume that the operator has opened his throttle to the extent indicated in Fig. 4, the gradual swinging of slide 27 counter-clockwise will finally bring it to the position of Fig. 4 when the follower 30 will descend into the cam low spot 37, whereupon the slide 27 will be lowered and the enrichment of the mixture for acceleration will be discontinued. In other words as soon as the valve 13 by action of the governor has followed proportionately the opening movement of valve 12 the mixture is returned to normal. Similarly if the operator should then advance the throttle further cam 31 would be swung further counter-clockwise and the slide 27 would again be raised and held raised until the follower 30 again reached low spot 37. The enrichment of the mixture is not merely momentary, but continues until the acceleration is concluded, when it automatically ceases.

Upon deceleration an opposite effect is experienced. When the operator moves valve 12 from the position of Fig. 4 to that of Fig. 1, thereby suddenly reducing the flow of air, it is obviously desirable that the flow of fuel be correspondingly reduced. The governor however tends to slow down the closing of the fuel valve, in other words to make it proportionate to the gradual deceleration of the engine. Obviously this would be undesirable as the high vacuum induced with the valve 12 closed would draw quantities of raw gas into the engine cylinders. The portion 36 of the slot in cam 31 prevents this condition, for when the valve 12 is swung to closed position from the position of Fig. 4 for example the portion 36 of the cam slot simultaneously pulls down slide 27, which results in an immediate closing movement of needle valve 44. In this way the natural effect of the governor on deceleration is canceled out.

It will be observed, therefore, that upon acceleration from idling position of the throttle, or from any other position thereof below maximum, a rich mixture enabling smooth engine operation will be maintained as long as acceleration is continued, and no longer. Furthermore the volume of the charge will be accurately proportioned to engine speed by the joint operation of valve **13** and the fuel valve, through the action of the governor. In other words, exactly the right amount of mixture will be fed to the engine at each moment of engine acceleration. In addition, the configuration of cam **28** is made such that under any given speed or load condition the ratio of air and gas making up the mixture is the optimum for that condition, that is to say the ratio may be varied gradually from closed throttle to wide open throttle in order to automatically fit the mixture to the requirements of the engine.

An airplane engine must be operated to its full capacity at times, particularly on the take off and also during power dives, and an extra rich mixture should be provided for those relatively short periods, not only because extra power is required at those times but also because the presence of raw gas in the mixture has a cooling effect upon the engine valves. The usual equipment includes a control on the instrument board which must be operated by the pilot, necessitating thought as well as manual action, following as well as preceding the extra power requirement. In accordance with my invention this procedure is simplified. The pilot in operating his engine for the take off, for example, gradually advances his throttle lever to bring the engine up to top speed, and when that has been attained the final actuation of the lever causes lug **62** to engage the extremity **61** of bifurcated lever **59** which results in pulling down pivot pin **47** against the action of spring **56** and imparting an extra lift to needle valve **44**. As soon as the take off is completed the pilot retards the throttle to the extent necessary to reduce engine speed to take care of the reduced load, and the first effect of that retardation is to enable spring **56** to return pivot **47** to its normal position. If desired, of course, the throttle lever may be provided with a catch, the purpose of which is to prevent movement to the extent necessary to operate lever **59**, the catch be adapted to being withdrawn by the actuation of a thumb release or the like. Hence the pilot is enabled to provide extra rich mixture for the take off by manipulation of the throttle lever only, and the operation becomes practically automatic. Furthermore he cannot overlook returning the mixture to normal immediately after the take off is completed.

The instrument board control mentioned above as conventional equipment ordinarily has four positions which may be termed full rich, auto rich, auto lean and shut off. The auxiliary lever in my invention, connected to link **55'**, is not needed for full rich control, that being effected by the lug **62** above referred to under control of the throttle, and instead of having definite positions the lever may shift to any position between auto rich and shut off. For cruising the auxiliary lever is retarded somewhat to lean the mixture to whatever extent is required. It is also available as an emergency control to enable the pilot to change the mixture whenever any unusual necessity for so doing may arise. For example if extraneous matter should get into a fuel passage and cause a partial blocking of the same, resulting in reduced power, the pilot may quickly compensate for that condition by manipulation of his auxiliary lever to pull down the pivot **47** and impart a raising movement to the fuel valve. This is an important safety feature and may on occasion spell the difference between reaching a landing field and attempting a forced landing elsewhere. Furthermore, if something should go wrong with the automatic regulation of the mixture for high altitudes, the pilot may operate his auxiliary lever to raise pivot **47** and reduce the richness of the mixture. This lever may also be operated to raise pivot **47** far enough to cause needle valve **44** to engage its seat **42** and thus completely cut off the flow of fuel.

The operation of the herein disclosed means for automatic adjustment of pivot **47** by means of bellows **69** will be obvious without further explanation, but attention should be called to the fact that this adjustment means is superimposed upon the manual regulation of pivot **47**. In other words it functions regardless of the position of the sleeve **51**, which is controlled by the emergency lever.

It is sometimes beneficial to add to the gas and air mixture drawn into an engine a fluid such as alcohol or water or a mixture of the two. The means herein disclosed may be employed to control the addition of such a fluid or any other fluid beneficial to engine operation. Hence where the term fuel is employed herein it should be construed broadly enough to include fluids other than gasoline, whatever their function may be.

In the foregoing description I have necessarily gone somewhat into detail in order to explain fully the particular embodiments of the invention herein illustrated, but I desire it to be understood that such detailed disclosures are not to be construed as amounting to limitations except as they may be included in the appended claims.

Having thus described my invention, I claim:

1. In a carburetor, an intake conduit, two air valves therein, a fuel jet and a fuel valve therefor, manual means operatively connected with one of said air valves for controlling the volume of mixture leaving the carburetor, and governor actuated cam means operatively connected with said fuel valve and the other of said air valves for controlling the quantity and proportions of the mixture.

2. In a carburetor, a fuel jet, a fuel valve, an air intake conduit, two valves in said conduit arranged to control air flow past said jet, manual control means connected with one only of said air valves, means for operatively connecting the second of said air valves to a centrifugal governor, and means operatively associated with said second air valve for moving said fuel valve.

3. In a carburetor, a fuel jet, a fuel valve, an air intake conduit, two valves in said conduit arranged to control air flow past said jet, manual control means connected with one only of said air valves adapted upon opening movement initially to increase the opening of said fuel valve slightly, means for connecting the second of said air valves to a centrifugal governor, and means operatively associated with said second air valve for moving said fuel valve.

4. In a carburetor, a fuel jet, a fuel valve, an air intake conduit, two valves in said conduit arranged to control air flow past said jet, manual control means connected with one only of said air valves adapted upon movement toward closed position initially to reduce the opening of said fuel valve, means for operatively connecting the second of said air valves to a centrifugal governor, and means operatively associated with said sec-

ond air valve for moving said fuel valve in variable ratio therewith.

5. In a carburetor, a valve, and two controls therefor comprising the following parts, an oscillatable guide, a slide movable in said guide, cam means for so moving said slide comprising an element on said slide and an element independently oscillatable about the axis of said guide, and means operatively connected with said valve adapted to be actuated by either the sliding movement or the swinging movement of said slide for operating said valve.

6. In a carburetor, a valve and two controls therefor comprising the following parts, an oscillatable guide, a slide movable in said guide, first cam means for so moving said slide comprising an element on said slide and an element independently oscillatable about the axis of said guide, a second cam means comprising an element on said slide and an element operatively connected with said valve, whereby longitudinal movement of said slide resulting from actuation of said first cam means or swinging of said slide resulting from oscillation of said guide will function through said second cam means to operate said valve.

7. In a carburetor, a valve and two controls therefor comprising the following parts, an oscillatable guide, a slide movable in said guide, a first cam means for so moving said slide comprising an element on said slide and an element independently oscillatable about the axis of said guide, a second cam means comprising a cam on said slide in a plane at right angles to the axis of said guide and a follower, said follower being operatively connected with said valve, whereby longitudinal movement of said slide resulting from actuation of said first cam means or swinging of said slide resulting from oscillation of said guide will function through said second cam means to operate said valve.

8. In a carburetor, a valve, and two controls therefor comprising the following parts, an oscillatable guide, a slide movable in said guide, cam means for so moving said slide comprising an element on said slide and an element independently oscillatable about the axis of said guide, means operatively connected with said valve and adapted to be actuated by either the sliding movement or the swinging movement of said slide for operating said valve, and cam means for oscillating said guide.

9. In a carburetor, a fuel valve, an air valve, an oscillatable cam, a slide carrying a follower cooperating with said cam, an operative connection between said slide and said fuel valve, an operative connection between said air valve and said cam, said cam being so shaped that at the start only of each movement of said air valve toward open position said slide will be moved toward fuel valve opening position, and means dependent upon increase of engine speed for causing said follower to resume its original position relative to the cam.

10. In a carburetor, manual control means settable to call for a given engine speed, and governor controlled means for supplying and proportioning the necessary air and fuel during acceleration to the engine speed corresponding with that setting and for running economically at that speed under existing load conditions.

11. In a carburetor, manual control means settable to call for a given engine speed, governor controlled means for supplying the necessary air and fuel for the engine speed corresponding with that setting under existing load conditions, and means actuated by the movement of said manual control means to a lower speed setting for immediately reducing the air and fuel supply.

12. In a carburetor, manual control means settable to call for a given engine speed, governor controlled means for supplying the necessary air and fuel for the engine speed corresponding with that setting under existing load conditions, said manual control means functioning also to add a predetermined increment to the fuel supply upon movement of the manual control means to a higher speed setting, and said governor controlled means acting through said manual control means to subtract a corresponding increment from the fuel supply when the engine speed increases to the point called for by said manual control means.

13. In a carburetor, manual control means settable to call for a given engine speed, and governor controlled means for supplying the necessary air and fuel for the engine speed corresponding with that setting under existing load conditions, said manual control means when moved toward idling position functioning independently of said governor controlled means for reducing the fuel admitted to the carburetor.

14. In a carburetor, a fuel valve, manual control means settable to call for a given engine speed, governor controlled means for supplying the necessary air and fuel for the engine speed corresponding with that setting, a lever having three pivot points, one constituting a fulcrum, one operatively connected with said fuel valve and one constituting a point of force application responsive to movements of said governor controlled means, said manual control means when set at a point in the maximum speed range under heavy load conditions functioning further to set said fulcrum pivot in a position to augment the fuel valve opening ability of said governor controlled means.

15. In a carburetor, a fuel valve, an oscillatable manual control means embodying a cam, said means being settable to call for a given engine speed, a guide oscillatable about the axis of said manual control means, a slide in said guide having a follower cooperating with said cam and occupying a given relation with said cam under normal running conditions, an operative connection between said slide and said fuel valve, said cam being so shaped that movement of said control means in one direction will act through said follower to shift said slide toward fuel valve opening position, and means dependent upon engine speed, following a setting of said manual control for higher speed, for causing said follower to resume its normal position relative to said cam.

16. In a carburetor, a fuel valve, an oscillatable manual control means embodying a cam, said means being settable to call for a given engine speed, a guide oscillatable about the axis of said manual control means, a slide in said guide having a follower cooperating with said cam and occupying a given relation with said cam under normal running conditions, an operative connection between said slide and said fuel valve, said cam being so shaped that movement of said control means in one direction will act through said follower to shift said slide toward fuel valve closing position, and means dependent upon engine speed, following a setting of said manual control for lower speed, for causing said follower to resume its normal position relative to said cam.

17. In a carburetor, manual control means set-

table to call for a given engine speed, governor controlled means for supplying the necessary air and fuel for the engine speed corresponding with that setting under existing load conditions, said manual control means functioning also to increase the fuel supply upon movement of the manual control means to a higher speed setting, and said governor controlled means acting through said manual control means to decrease the fuel supply by a corresponding amount when the engine speed increases to the extent called for by said manual control means.

18. In a carburetor, manual mechanism for opening the fuel valve to an idling extent and for providing a power demand by setting a limit upon air flow, and automatic mechanism responsive to variations in engine speed for providing and proportioning the fuel and air required for that power demand.

LOUIS DE MARCO.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
1,582,239	Barbarou	Apr. 27, 1926
1,881,637	Johnson	Oct. 11, 1932
1,381,208	McCarthy	June 14, 1921
1,821,909	Girin	Sept. 1, 1931
2,278,305	Culp	Mar. 31, 1942
1,076,268	Carpenter	Oct. 21, 1913
970,429	Davies	Sept. 13, 1910
1,395,170	Ashworth	Oct. 25, 1921
1,816,070	Berry	July 28, 1931

FOREIGN PATENTS

Number	Country	Date
291,152	Great Britain	May 24, 1928
383,378	Great Britain	Nov. 17, 1932
572,393	Germany	Mar. 15, 1933