Nov. 11, 1947. L. DE MARCO 2,430,807

CARBURETOR

Filed Aug. 8, 1945 3 Sheets-Sheet 1

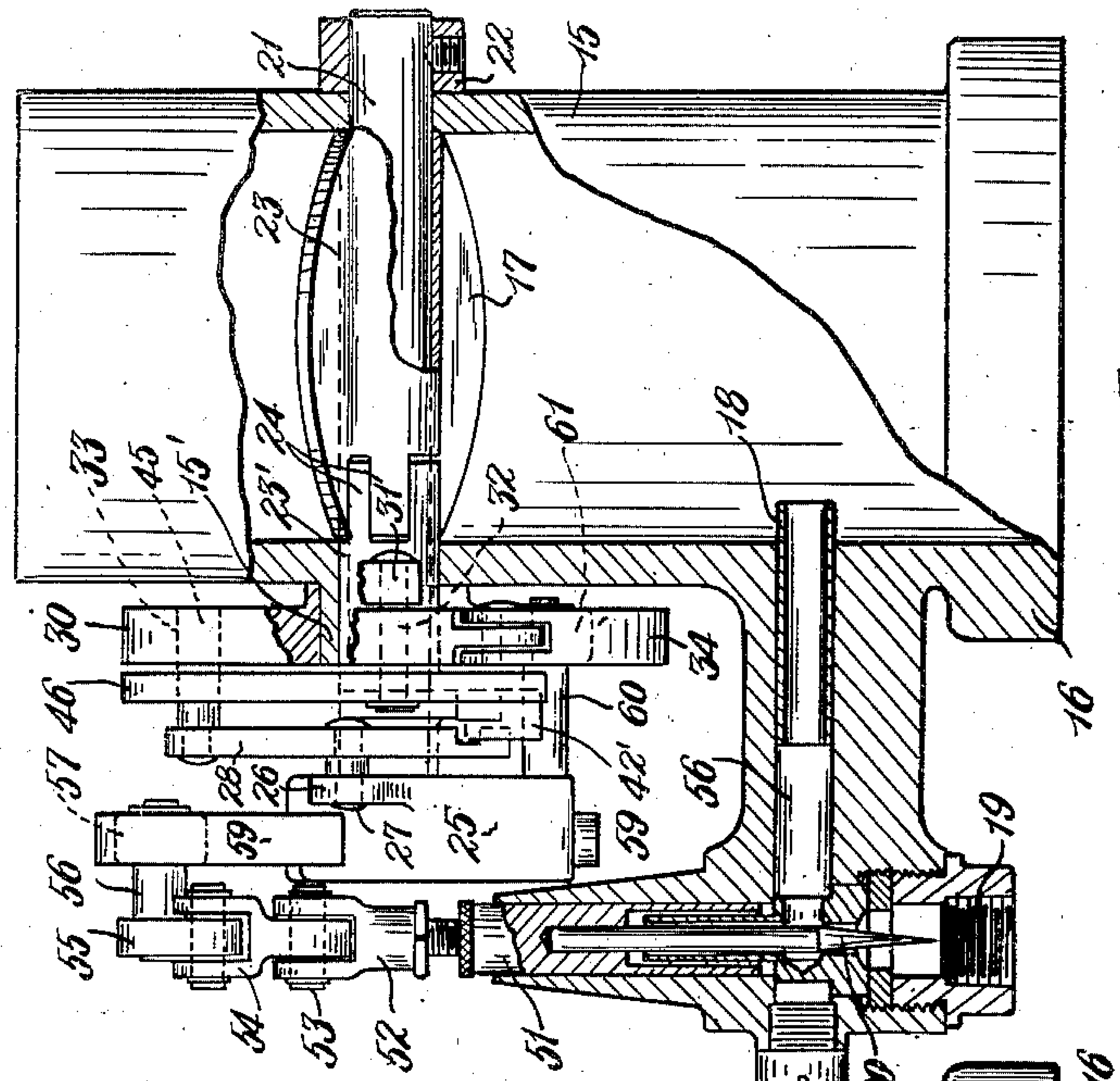

FIG. 2

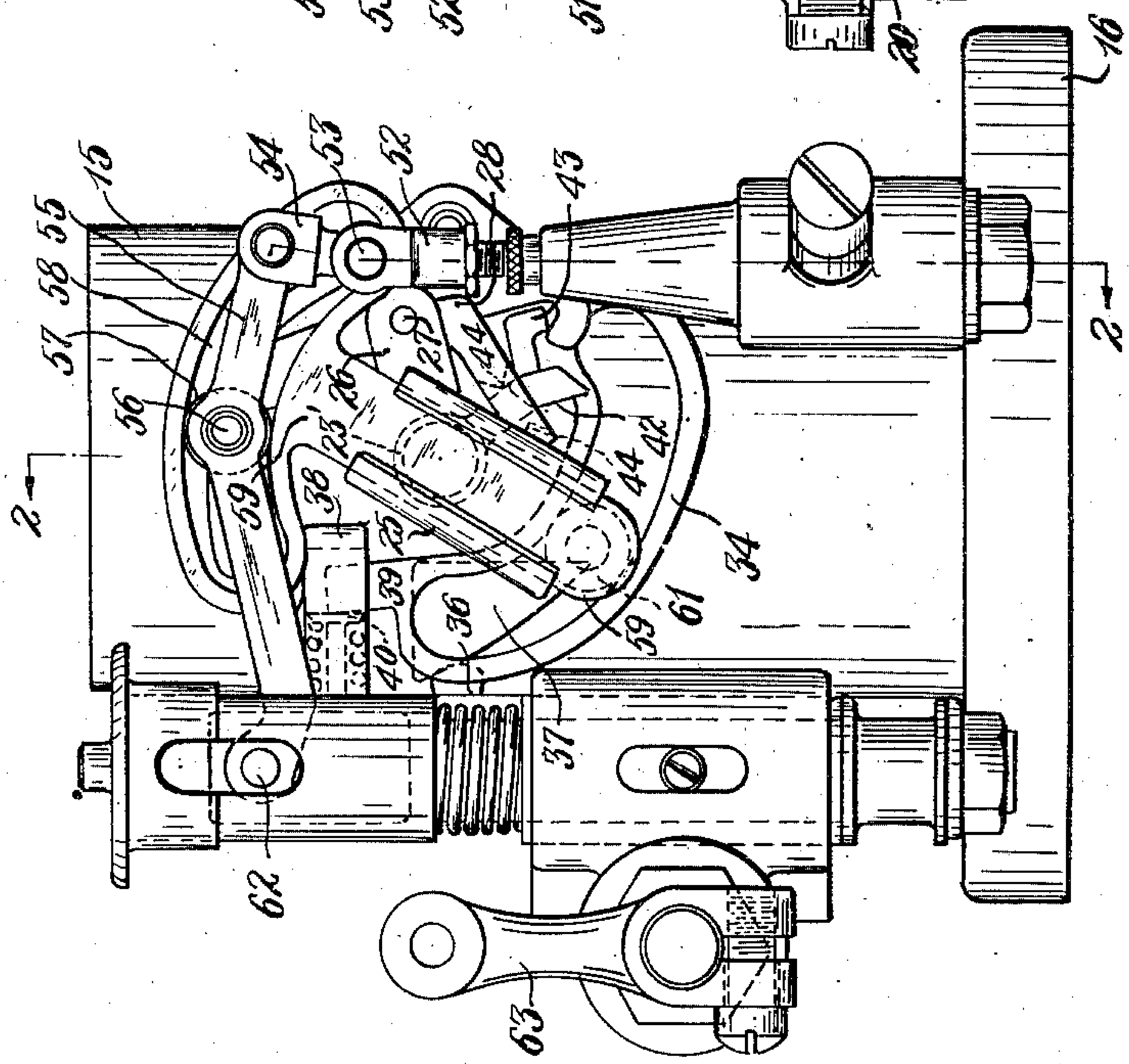

FIG. 1

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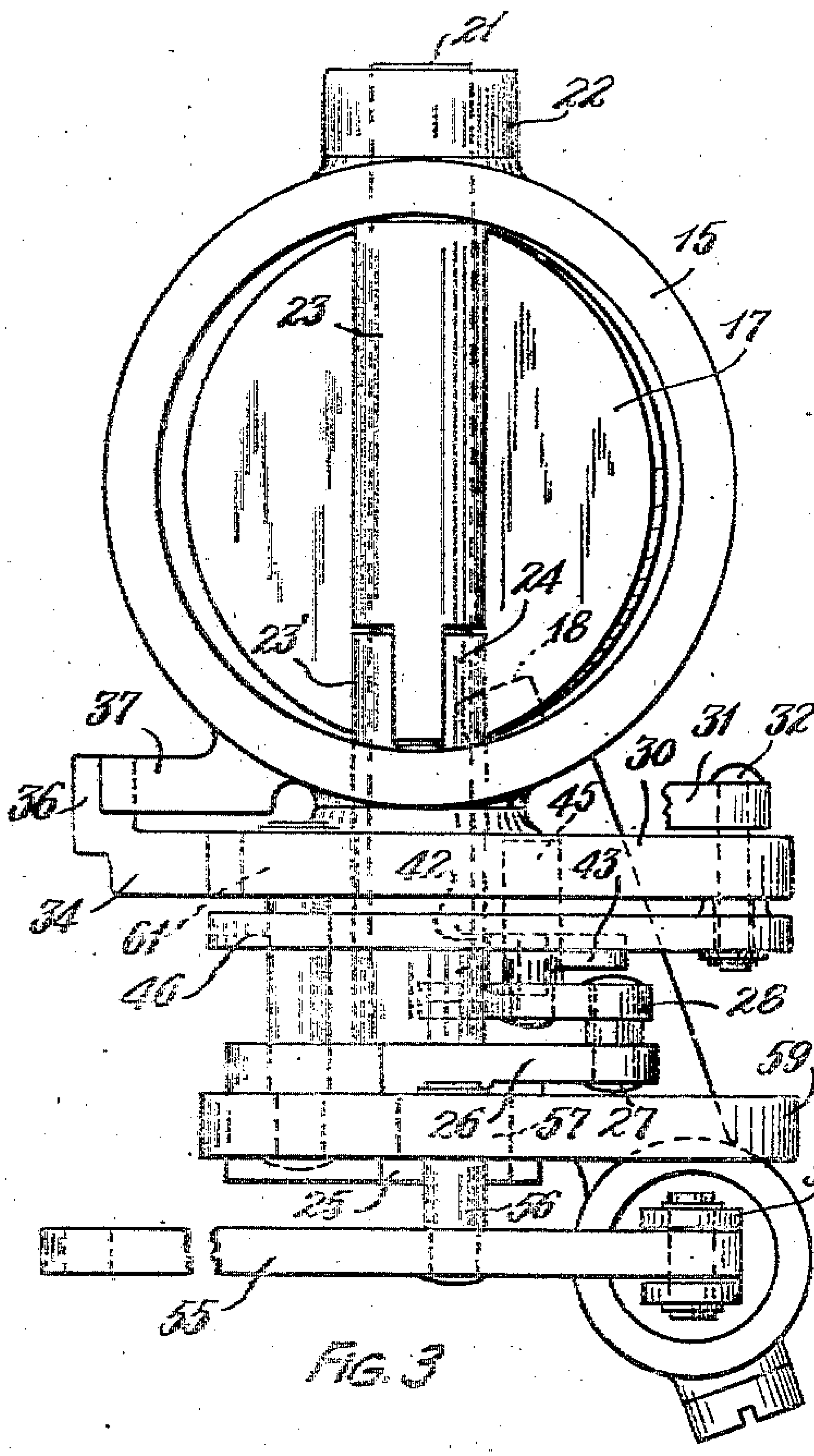

FIG. 3

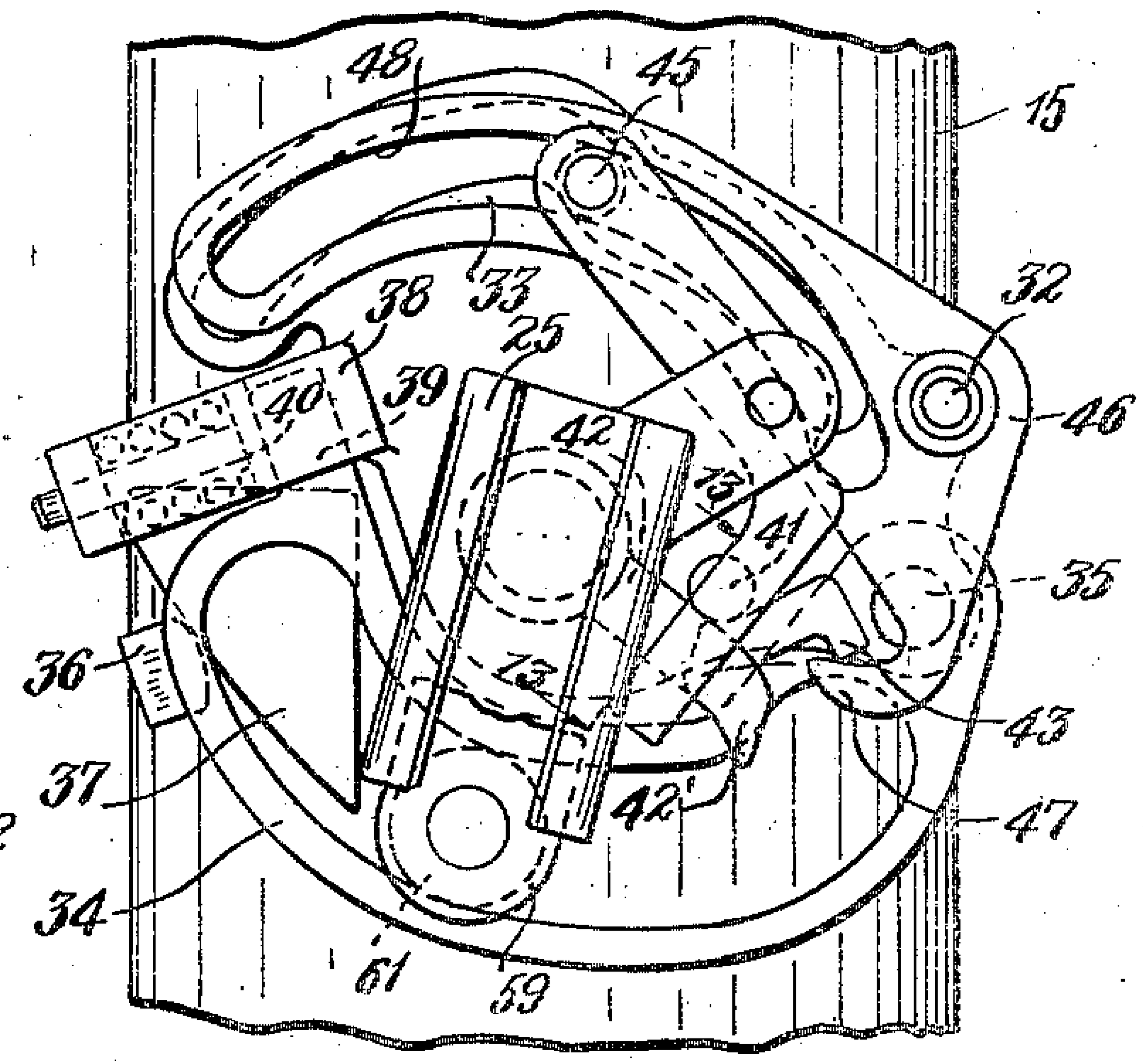

FIG. 4

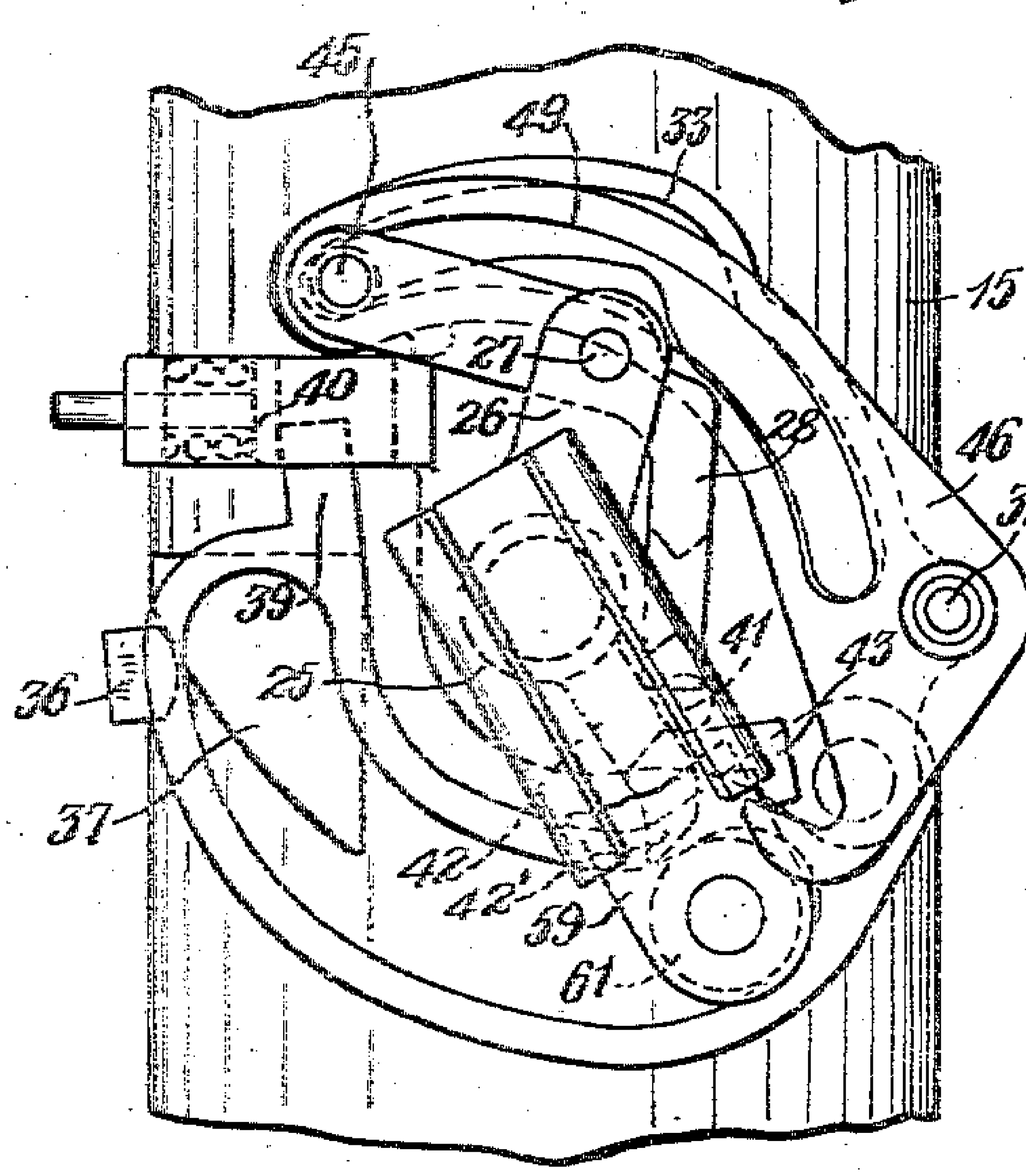

FIG. 5

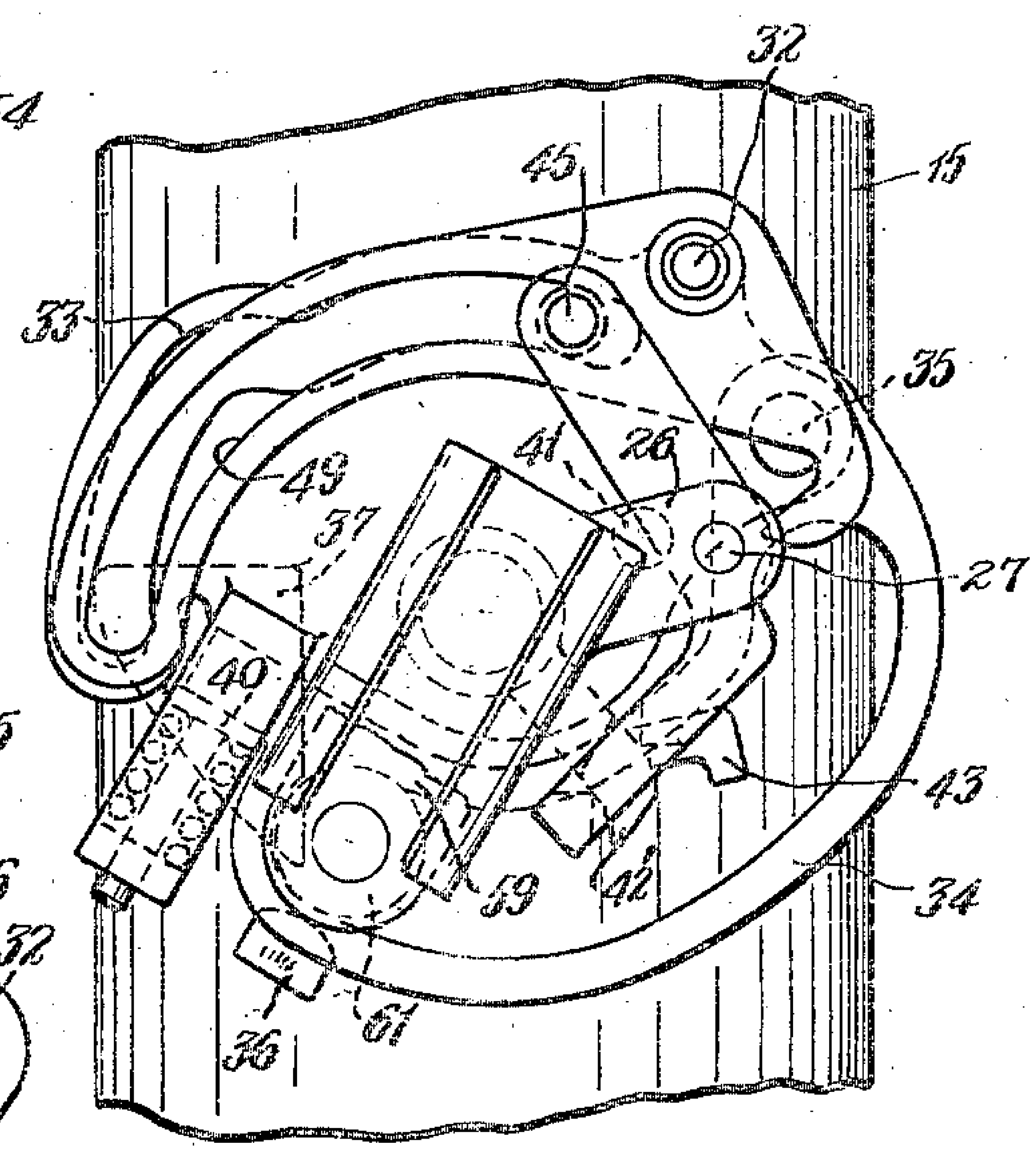

FIG. 6

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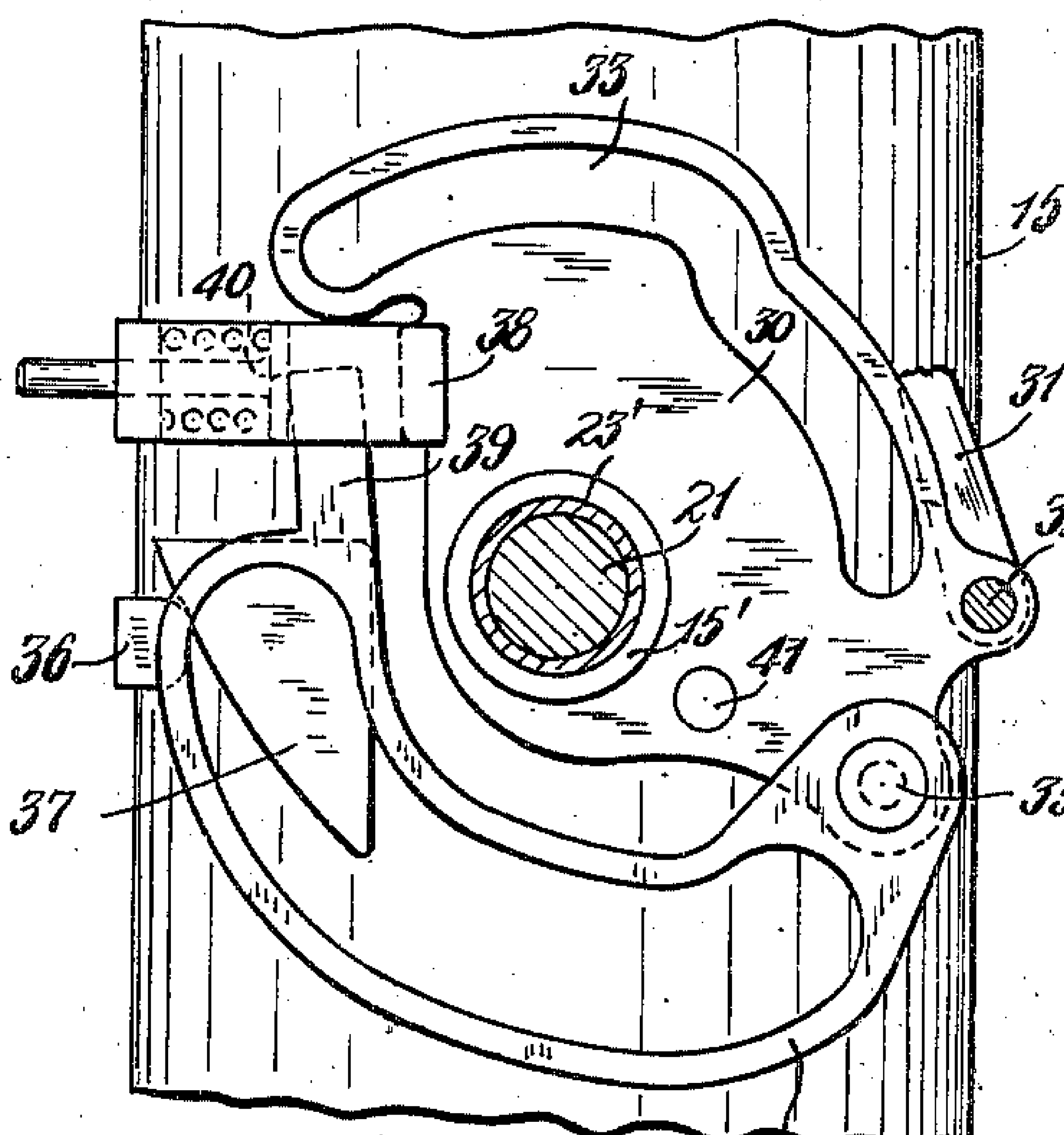

FIG. 7

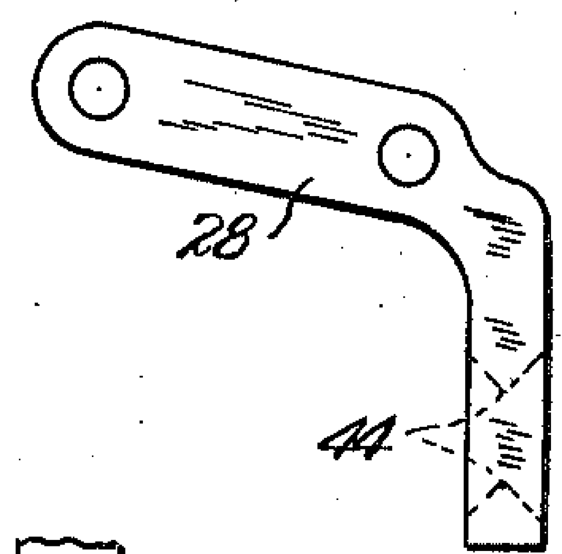

FIG. 11

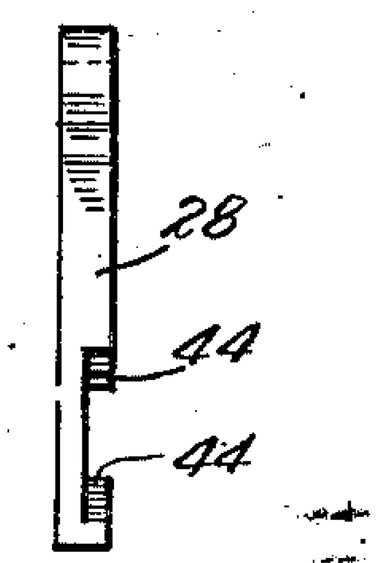

FIG. 12

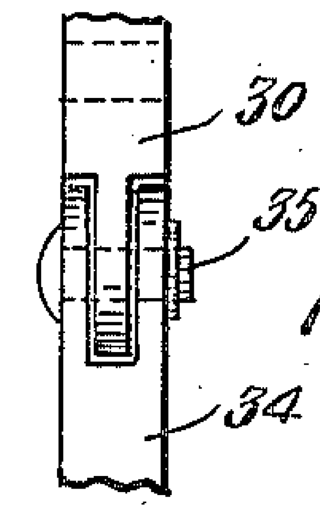

FIG. 8

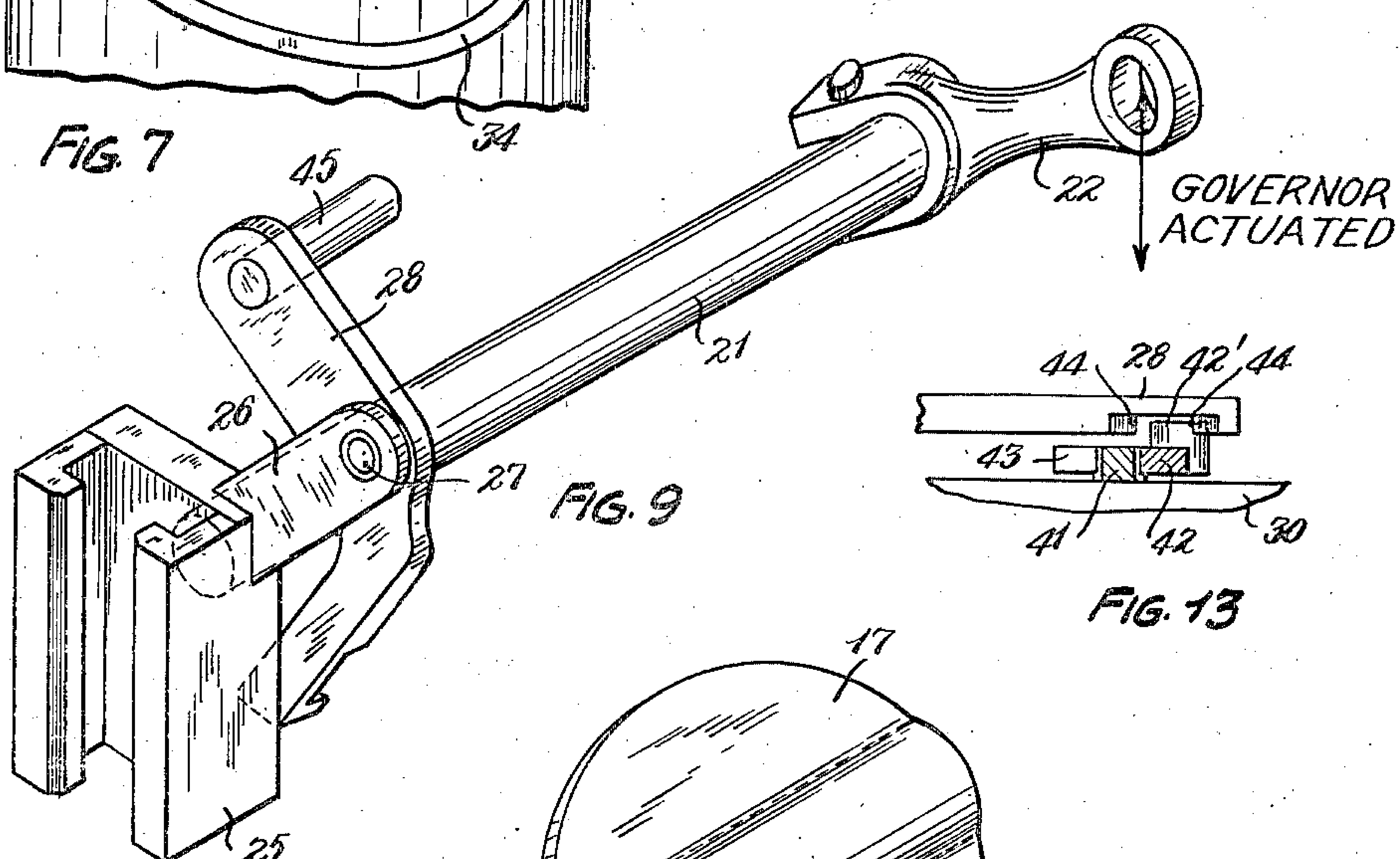

FIG. 9

FIG. 13

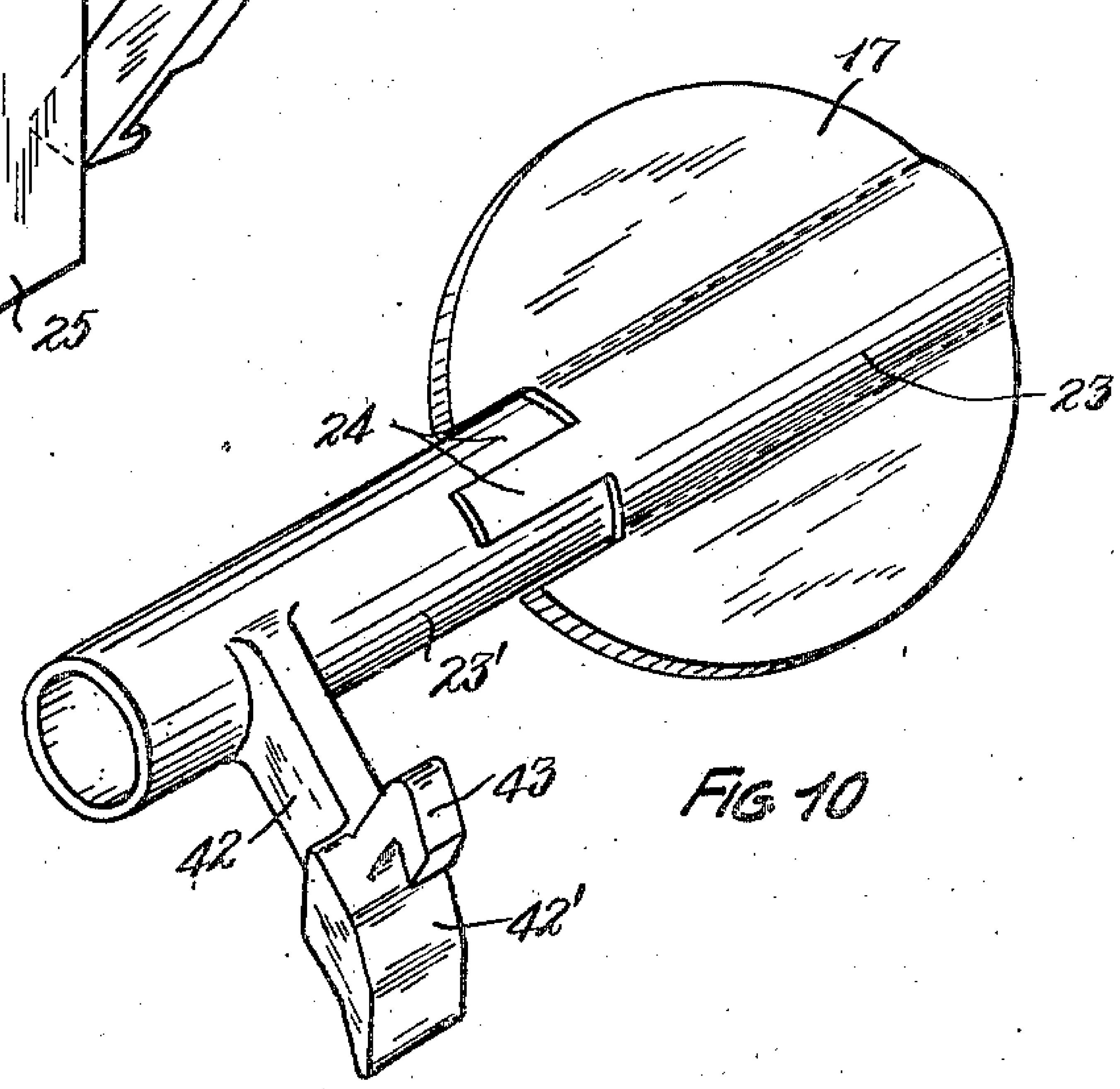

FIG. 10

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CARBURETOR

Louis De Marco, Cleveland, Ohio

Application August 8, 1945, Serial No. 609,527

13 Claims. (Cl. 123—123)

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This invention relates to improvements in carburetors, and has reference particularly to a type of carburetor disclosed in my copending application Serial No. 503,935, wherein the engine served by the carburetor drives a governor which functions to maintain the fuel and air valves of the carburetor in correct relation to provide an accurate, predetermined fuel and air ratio throughout the speed range of the engine under prevailing load conditions.

One of the objects of the invention is the provision of a carburetor of the character stated embodying a single air valve, thereby shortening the carburetor and improving air flow as compared with the two valve construction of the above identified application.

Another object is the provision of improved means for controlling the mixture during acceleration.

A further object is the provision of means for compensating against the tendency of engine suction to draw too rich a mixture when the air valve approaches closed position, and to draw too lean a mixture when the air valve approaches full opening.

Still another object is the provision of means for subjecting the air valve arm to operation by the manual control member during deceleration and momentarily at the beginning of acceleration, and for subjecting it to operation by the governer control member during the major part of each acceleration period.

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 of a carburetor embodying the invention, the parts being shown in idling position.

Fig. 2 is an elevational view at right angles to that of Fig. 1, certain parts being shown in vertical section taken substantially on the line 2—2 of Fig. 1.

Fig. 3 is a top plan view upon a somewhat larger scale.

Figs. 4, 5 and 6 are elevational views also upon a larger scale of the mechanism for operating the air valve and a portion of the mechanism for operating the fuel valve of the invention, Fig. 4 showing the parts in a normal running position at part throttle, Fig. 5 showing them in the position which they take at the moment the manual control means is shifted from full throttle to full deceleration, and Fig. 6 showing them in the position which they take at the moment the manual control means is shifted from idling to full acceleration.

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Fig. 7 is an elevational view of the manual control member with its associated parts.

Fig. 8 is a fragmental elevational view at right angles to that of Fig. 7.

Fig. 9 is a detail perspective view of the governor control means.

Fig. 10 is a detail perspective view of the butterfly air valve and its operating arm.

Figs. 11 and 12 are detail elevational views at right angles to each other of a locking lever comprising part of the governor control means, and

Fig. 13 is a detail view, partly in section on the line 13—13 of Fig. 4.

In the drawings there is indicated at 15 a tubular air induction pipe having at its down stream end a flange 16 for attachment to a supercharger or engine manifold, as the case may be. 17 is a butterfly air valve and 18 is a fuel nozzle opening into the air induction pipe on the down stream side of valve 17. Gasoline or other liquid fuel enters the apparatus through a fitting 19, and its rate of flow is under control of a needle valve 20. The mechanism of the present invention functions to control the positions of valves 17 and 20 at all engine speeds in such a manner as to maintain a predetermined ratio of fuel and air forming the combustible mixture entering the engine. This is accomplished in the present invention by the use of a single air valve which is moved directly by the manual control means when the latter is turned toward a lower speed position, but which is free from the manual control and locked to the governor control when the manual control member is moved to a higher speed setting, except for a slight opening of the air valve when the manual control member is first moved toward a higher speed setting. Thus the air valve or throttle is under control of the governor during acceleration, while on deceleration it is under control of the manual operating means. The control of the fuel valve in this invention as well as in that covered by my said copending application, is also under the governor during acceleration and under the manual control means during deceleration.

The governor control means comprises a shaft 21 extending diametrically through the induction pipe 15 and having at one end beyond that pipe a crank 22, by means of which the shaft 21 may be oscillated in response to speed variations in a governor, not shown, which is geared to the engine served by the carburetor. Within the air conductor 15 the shaft 21 is surrounded by a sleeve 23 which turns freely upon the shaft and carries the butterfly valve 17. Sleeve 23 in effect extends through the forward side of air conductor 15, where it constitutes a bearing for shaft 21. However, in order to facilitate assembly the sleeve is made of two parts, the forward part 23′ being non-rotatably connected with the rear part by a dog clutch or coupling 24. Rigidly connected with the forward end of the shaft 21 directly beyond the forward end of sleeve member 23′ there is a guide member 25, hereafter sometimes referred to as the governor control member, from which there projects in a diagonal direction an ear 26 carrying a pivot 27 upon which is supported a bell crank lever 28.

A manual control member 30 is oscillatably mounted on a boss 15′ integral with the air conductor 15. It is adapted to be turned through an angle, of the order of 60°, from full acceleration position to full deceleration position or vice versa. Any convenient means under control of the operator may be provided for swinging the member 30, which means may include for example a link 31 mounted on the rear end of a pivot 32. Manual control member 30 has a cam slot 33 formed therein, the principal portions of which are concentric with the axis of rotation of the member but are joined by an eccentric portion which constitutes the active part of the cam.

Manual control member 30 also carries a lower box cam which however is formed in a separate member 34 that is mounted to tilt upon a pivot 35 carried by the member 30. When control member 30 is turned clockwise a bumper 36 on the member 34 engages a stationary cam 37 mounted upon the conductor 15 and is thereby tilted away from the axis of member 30. 38 is a bracket integral with member 30 having a guide slot within which is received an extension 39 on the end of cam member 34. A spring-pressed plunger 40 bears against extension 39 and tends to hold bumper 36 against cam 37. Member 30 also carries a stop pin 41 for a purpose which will presently appear.

Sleeve member 23′ carries an operating arm 42 which extends in a substantially radial direction for the major portion of its length and then turns downwardly as shown in Fig. 1, for example. The radial portion is of less thickness than the end portion 42′, the increased thickness of the latter causing it to extend forward beyond the portion 42, the rear surfaces of these parts being flush with each other. Arm 42 also carries a hook 43 offset from the portion 42′ and of the same thickness as the part 42. The lower arm of bell crank lever 28 is adapted to pass the thinner part 42 of the sleeve arm. It is also cut away on its rear side so that it may pass over the thicker part 42′ of the sleeve arm, as shown in Figs. 6 and 13. The cut away portion is so formed that two opposed points 44 are left for engagement with the thicker part 42′ of the sleeve arm. When the parts are thus engaged the arm 42 is locked to the bell crank lever 28, and rotation of the shaft 21 counterclockwise moves arm 42 and sleeve 23′, 23, and therefore butterfly 17, counterclockwise. This follows a manual setting of the control member 30 for acceleration. When the manual control member is set for deceleration on the other hand, the lower arm of bell crank lever 28 is swung inwardly by means of cam 33 toward the axis of sleeve 23′, clearing the thicker part 42′ of the arm, after which the arm may be swung

clockwise without interference from the bell crank lever.

As above stated, the movements of the bell crank lever 28 are effected by means of the cam slot 33. The upper arm of lever 28 carries a follower pin 45 which extends into the cam slot. While pin 45 runs in the outer arc of the slot, as in Fig. 5 of the drawing, the lower arm of lever 28 is withdrawn from connection with the thick portion 42′ of the sleeve arm. When the pin 45 runs in the inner arc of the slot, as in Fig. 6, the lower arm of lever 28 is in engagement with the thick portion of the sleeve arm. In a normal running position, illustrated for example in Fig. 4, the pin 45 stands in the eccentric portion of slot 33 ready to shift the lever either way, dependent upon the direction of the next movement of the manual control member 30 carrying the cam.

When the manual control member 30 is turned clockwise, or toward a lower speed position, from a running position such as illustrated in Fig. 4, the lower arm of bell crank 28 moves inwardly to clear the thick part 42′ of the sleeve arm and pin 41 then engages arm 42 and swings the sleeve and butterfly valve toward closed position. At the same time a locking lever 46 which has a hook 47 on its lower end swings to grip hook 43 on the sleeve arm and hold the latter against the pin 41, thereby locking the arm to the manual control member. The movements of locking lever 46, which is mounted on pivot 32 previously referred to, are controlled by follower pin 45 which projects through an arcuate slot 48 in the lever. Thus, as the pin 45 is deflected by the cam slot 33 in member 30, it serves to swing lever 46.

The downturned or deflected end 42′ of the sleeve arm acts as a cam when the points 44 travel outwardly upon it, to impart a short angular movement to the arm whenever the operator by movement of the manual control member calls for greater speed. The throttle is thus given an initial opening, and as the engine gains speed and the guide 25 turns counterclockwise in response to governer control, the throttle opens gradually until the called for speed is attained, when the control members assume their relative positions illustrated in Fig. 4 and the points 44 draw away from the thicker part 42′ of the sleeve arm, this latter action being brought about by the pin 45 running into the eccentric part of cam sleeve 33, as previously explained.

Referring now to the fuel valve and the mechanism controlling it, the liquid fuel as previously indicated flows upwardly through the fitting 19 around needle valve 20 and into a horizontal passage 50 leading to the discharge nozzle 18. The needle 20 is fixed within a vertical slide 51 which is adjustably connected with a yoke 52 pivotally connected at 53 with a second yoke 54 in which is pivoted one end of a lever 55. At an intermediate point of the latter there is a pin 56 which carries a roller 57 that runs in a cam slot 58 which is formed in the T-head of a slide 59, the shank of which is movable up and down in oscillatable guide 25, previously referred to as being rigid with shaft 21. The lower end of this slide carries a pin 60 upon which is rotatably mounted a follower roller 61 that runs in the slot of tiltable cam member 34.

The end of lever 55 opposite its connection with yoke 54 turns upon a fulcrum 62 which, for the purposes of the present invention, may be considered as fixed. As a matter of fact the fulcrum 62 is adjustable up and down by means of a control crank 63 in order to enable the operator to increase or decrease the richness of the mixture for special conditions. This mechanism and its operation are fully described in my aforesaid copending application, to which reference may be had for a complete understanding of this feature of the apparatus. The action of the needle valve 20 is controlled partly by the cam 58 which is slightly eccentric to the axis of rotation of guide 25. As the latter turns counterclockwise the roller 57 is lifted somewhat, causing the lever 55 to swing upwardly about its fulcrum 62 and thereby raising yokes 52 and 54 and moving slide 51 and needle 20 upward. The needle valve is also partly controlled by the cam in cam member 34. When the member 30 is turned counterclockwise by the operator the cam in member 34 shifts roller 61 towards the axis of rotation of guide 25 and moves the slide 59 upwardly in that guide, thereby imparting upward bodily movement to the cam 58 which carries the roller 57 upwardly to a slight extent and thereby raises the needle valve. This slight initial opening of the needle valve accompanied by the slight initial opening of the air valve previously described causes the engine speed to increase. Then the guide 25, under the influence of the governor, revolves about its axis counterclockwise until the arm 42 strikes the stop pin 41, and at the same time the pin 45 comes into the eccentric part of slot 33, when it shifts lever 46 about pivot 32 to cause hook 47 to engage hook 43. Then even though the governor control member 25 should tend to turn farther in the counterclockwise direction, the air butterfly would not be affected and the engine speed would quickly decrease to correspond with the setting of the manual control member.

Assuming that the manual control member is set for a given engine speed and the control mechanism is in the position illustrated in Fig. 4, if the airplane should then suddenly pass into a dense air pocket the engine speed would rapidly decrease and the guide 25 would rotate clockwise through a small angle. This would not affect the butterfly arm 42, because a certain amount of movement of the bell crank lever 28 from the running position of Fig. 4 is necessary before the hook 43 is released by the hook 47, and during this interval no movement of the air valve takes place. The small clockwise movement of guide 25 however, because of the action of cam 34 upon follower 61 and slide 59, lifts the fuel valve, and since the air valve is not affected the mixture is enriched and the additional power resulting therefrom tends to bring back the engine speed to that called for by the setting of the manual control. Similarly, if the engine speed should increase, due to the airplane passing into a thin air pocket, the governor would be correspondingly affected, which would swing guide 25 counterclockwise through a small angle. This counterclockwise movement would not affect the butterfly arm at all, but would merely pull the bell crank lever 28 away from engagement with the thickened end 42′ of the bell crank. The air valve therefore would not be affected. However, movement of the guide counterclockwise would cause cam 34 to pull the slide 59 downward, which would pull the needle valve down toward closed position, leaning the mixture. The tendency for the engine speed to increase would therefore be counteracted, and the speed called for by the manual control setting would tend to be maintained. Movement of the guide 25 affects the follower 57 and the follower 61 oppositely, but the cam 34 has a sharper gradient than cam 58, and consequently cam 34 controls the result where both cams are involved.

Operation.—With the parts in the idling position illustrated in Figs. 1 and 2, let us assume that the operator wishes to accelerate to maximum speed. He accordingly turns manual control member 30 counterclockwise as far as it will go, namely to the position indicated in Fig. 6. This will cause the roller 61 to ride into the innermost end of the cam slot in cam member 34, thereby slightly increasing the opening of the fuel valve. The pin 45 at the same time will ride over the eccentric part of cam slot 33 into the inner concentric part of that slot, which will shift the lower arm of the bell crank into locking relation with the sleeve arm 42. While this locking action is taking place the deflected thick part 42′ of the arm is shifted a slight amount counterclockwise to open the air valve a corresponding amount. This slight opening of both valves causes the speed of the engine to increase, and as it increases the governor control member 25 swings counterclockwise gradually, which gradually moves arm 42 counterclockwise, opening the air valve. At the same time the slide 59 is swung counterclockwise with the result that the roller 57 is cammed upwardly a slight distance, gradually opening the fuel valve. When the governor control member 25 is turned sufficiently to carry the roller 45 into the eccentric part of cam slot 33 the bell crank lever 28 will swing to unlock the sleeve arm 42, and the latter arm will contact the stop pin 41. At the same time the lever 46 will swing into position to cause hook 47 to engage hook 43. The controls will then remain stationary and the engine will run at maximum speed for the load encountered.

Now, assume that it be desired to decelerate to idling speed, the operator will then turn manual control member 30 clockwise to the extreme of its possible movement, as indicated in Fig. 5. The initial effect of this movement so far as the fuel valve is concerned will be to cause roller 61 to pull down slide 59, which will close the fuel valve almost completely, in other words leaving only sufficient opening to support idling speed. With respect to the air valve the initial effect will be to cause pin 45 to run into the outer concentric part of cam slot 33, thereby unlocking the bell crank from the sleeve arm 42, 42′ and shifting lever 46 so as to cause hook 47 to interengage with hook 43. Then, as the operator swings control member 30 further clockwise, the pin 41 will swing the sleeve arm 42 down to the position of Fig. 5, closing the air valve down to idling position. The engine speed will then decrease gradually and the governor control member 25 will turn clockwise. This latter movement of the governor control member will have no effect whatever upon engine operation, but will merely again bring the governor control means into proper position relative to the manual control means. In other words, it will shift the pin 45 from its position of Fig. 5 to a position in which it will enter the eccentric part of the cam slot 33, so that the parts 42, 28 and 46 will be arranged with respect to each other as they are in Fig. 4.

In every running position from idling to highest speed, the pin 45 will stand in the eccentric part of the cam slot 33, the bell crank 28 will be at an intermediate position where a slight movement in one direction will cause it to disengage the thick part 42′ of the arm and a slight movement in the opposite direction will cause it to engage the thick part 42'. Also the hook 47 by a slight movement in one direction will disengage the hook 43, while a slight movement in the opposite direction will cause it to fully engage hook 43. It will be seen therefore that in every running position the relative positions of the manual control member 30 and the governor control member 25 will be the same, that is substantially as illustrated in Figs. 1 and 4. When the manual control member is shifted counterclockwise to call for a higher speed, the governor control member follows gradually until that speed is attained and the two control members are in their proper running relation to each other, and when the manual control member is shifted clockwise to call for a lower speed, the governor control follows until the same relation between the control members is again reached, but in this latter deceleration movement the carburetor is released from control by the governor.

Because of the fact that at high engine speeds engine suction is relatively low and the pull on the nozzle 18 correspondingly weak, while at low engine speeds engine suction is relatively high and the pull on the nozzle 18 is correspondingly strong, I mount the cam member 34 on a pivot as shown and tilt it on that pivot automatically in order that this variable suction effect may be compensated. In the high speed setting of the manual control member illustrated in Fig. 6, spring plunger 40 holds the free end of cam member 34 inward so that the slide 59 is pushed up and the fuel valve opened accordingly. On the other hand when the manual control is set for idle position, as in Fig. 5, the free end of cam member 34 is swung outwardly by reason of the contact of bumper 36 with fixed cam 37. Hence the slide 59 is depressed and the fuel valve opening decreased relatively. The effect of engine speed upon suction is proportionately felt throughout the speed range, but by reason of the tilting of cam 34 compensation is supplied for all intermediate speeds as well as for top and bottom speeds.

Having thus described my invention, I claim:

1. In a carburetor, a single air valve, a fuel valve, manual control means, governor control means, said manual control means being settable to limit the opening of said air valve to any degree desired without materially affecting said fuel valve, said governor control means being arranged to open said air and fuel valves gradually as the speed of the governor increases, and said manual control means being adapted to move both of said valves simultaneously toward closed position.

2. In a carburetor, a single air valve, a fuel valve, manual control means and governor control means, said manual control means being settable to limit the opening of said air valve to any degree desired while opening said fuel valve to a predetermined small extent, said governor control means being arranged to move said air and fuel valves gradually toward open position as the speed of the governor increases, and said manual control means being adapted to move both of said valves simultaneously toward closed position.

3. In a carburetor, a single air valve, a manual control member and a governor control member rotatable about a common axis, said manual control member carrying a stop, said manual control member when moved to set said stop for higher engine speed leaving said governor control means free to move said air valve toward open position in response to an increase in governor

speed, and the stop on said manual control member moving said air valve toward closed position independently of said governor control member.

4. In a carburetor, a single air valve, manual control means rotatable about the axis of said valve and carrying a stop, governor control means comprising a member rotatable about the same axis, said manual control means when moved to set said stop for higher engine speed leaving said governor control means free to move said air valve toward open position in response to increase in governor speed, interengaging means between said member and said manual control means effective when the latter is moved toward low speed position for disabling the connection from said member to said air valve and permitting said stop to move said air valve independently of said governor control means.

5. In a carburetor, a single air valve, a manual control member and a governor control member rotatable about a common axis, said manual control member having a stop thereon adapted to move said air valve toward closed position when the manual member is turned toward a lower speed setting, said two members having interrelated means adapted to connect said governor member with said air valve when said manual member is turned toward a higher speed setting, and to free said governor member from said air valve when said manual member is moved toward a lower speed setting.

6. In a carburetor, a single air valve, an operating arm attached thereto, a manual control member and a governor control member rotatable about a common axis, and mechanism carried by said two members functioning when the manual control member is turned toward a lower speed setting for locking said arm to said manual control member and when said manual control member is turned toward a higher speed setting for locking said arm to said governor control member, whereby the air valve is moved toward closed position immediately when the manual control member is turned toward a lower speed setting and whereby the air valve is opened gradually in response to governor action when the manual control member is turned toward a higher speed setting.

7. In a carburetor, a manual control member and a governor control member mounted to turn on a common axis, an air valve having an operating arm mounted to turn on the same axis, and means for connecting and disconnecting said arm and said governor control member comprising a lever pivotally mounted on said governor control member, cam means on said manual control member engaging said lever for swinging the same upon its pivot, and means on said lever adapted to engage or disengage said arm.

8. In a carburetor, a manual control member and a governor control member mounted to turn on a common axis, an air valve having an operating arm mounted to turn on the same axis, and means for connecting and disconnecting said arm and said governor control member comprising a lever pivotally mounted on said governor control member, cam means on said manual control member engaging one end of said lever for swinging the same upon its pivot, means on the opposite end of said lever adapted to engage or disengage said arm, and lever means carried by said manual control member moving in response to the movements of said first named lever for locking said arm to said manual con-

trol member when it is disengaged from said governor control member.

9. In a carburetor, a manual control member and a governor control member mounted to turn on a common axis, an air valve having an operating arm mounted to turn on the same axis, said manual control member being settable in different angular positions corresponding to different engine speeds, said governor control member following said manual control member to each setting, whereby in all running positions the angular relation of said members to each other is the same, and mechanism responsive to the movement of said manual control member toward a lower speed position for locking said arm to said manual control member and responsive to the movement of said manual control member toward a higher speed setting for unlocking said arm from said manual control member and locking it to said governor control member.

10. In a carburetor, an air conductor, an air valve therein, a fuel nozzle subjected to suction in said air conductor, a fuel valve controlling the flow of fuel to said nozzle, means responsive to engine speed tending to maintain a correct ratio of opening of said valves, and means functioning automatically to increase the relative opening of said fuel valve when the air valve approaches fully open position and the suction effective at said nozzle is accordingly decreased, and to decrease the relative opening of said fuel valve when the air valve approaches closed position and the suction effective at said nozzle is accordingly increased.

11. In a carburetor, a fuel valve and a control therefor comprising a guide, a slide movable in said guide, an operative connection between said slide and said fuel valve, a manual control member oscillatable about an axis, a cam pivotally mounted on said manual control member, a follower on said slide cooperating with said cam for moving said slide in said guide in response to movement of said manual control member on its axis, and means for tilting said cam upon

its pivot as said manual control member turns on said axis, for modifying the action of said cam.

12. In a carburetor, a fuel valve, a guide oscillatable about a given axis in response to governor action, a slide movable in said guide, an operative connection between said slide and said fuel valve, a manual control member oscillatable about said given axis and settable for a desired engine speed, a cam pivotally mounted on said manual control member, a follower on said slide cooperating with said cam for moving said slide in said guide as said guide turns upon said axis, and means for tilting said cam upon its pivot as said manual control member turns on said axis, whereby the action of said cam is modified for different speed settings.

13. In a carburetor, a fuel valve, a guide oscillatable about a given axis in response to governor action, a slide movable in said guide, a cam carried at one end of said slide, an operative connection between said cam and said fuel valve, a manual control member oscillatable about said given axis and settable for a desired engine speed, a cam pivotally mounted on said control member, a follower on said slide cooperating with said last named cam for moving said slide in said guide as said guide turns upon said axis, and means for tilting said cam upon its pivot as said manual control member turns on said axis, whereby the movements of said slide in response to governor action are varied for different speed settings of said manual control member.

LOUIS DE MARCO.

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