H. J. PODLEŠÁK.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED SEPT. 1, 1909.

985,703. Patented Feb. 28, 1911.

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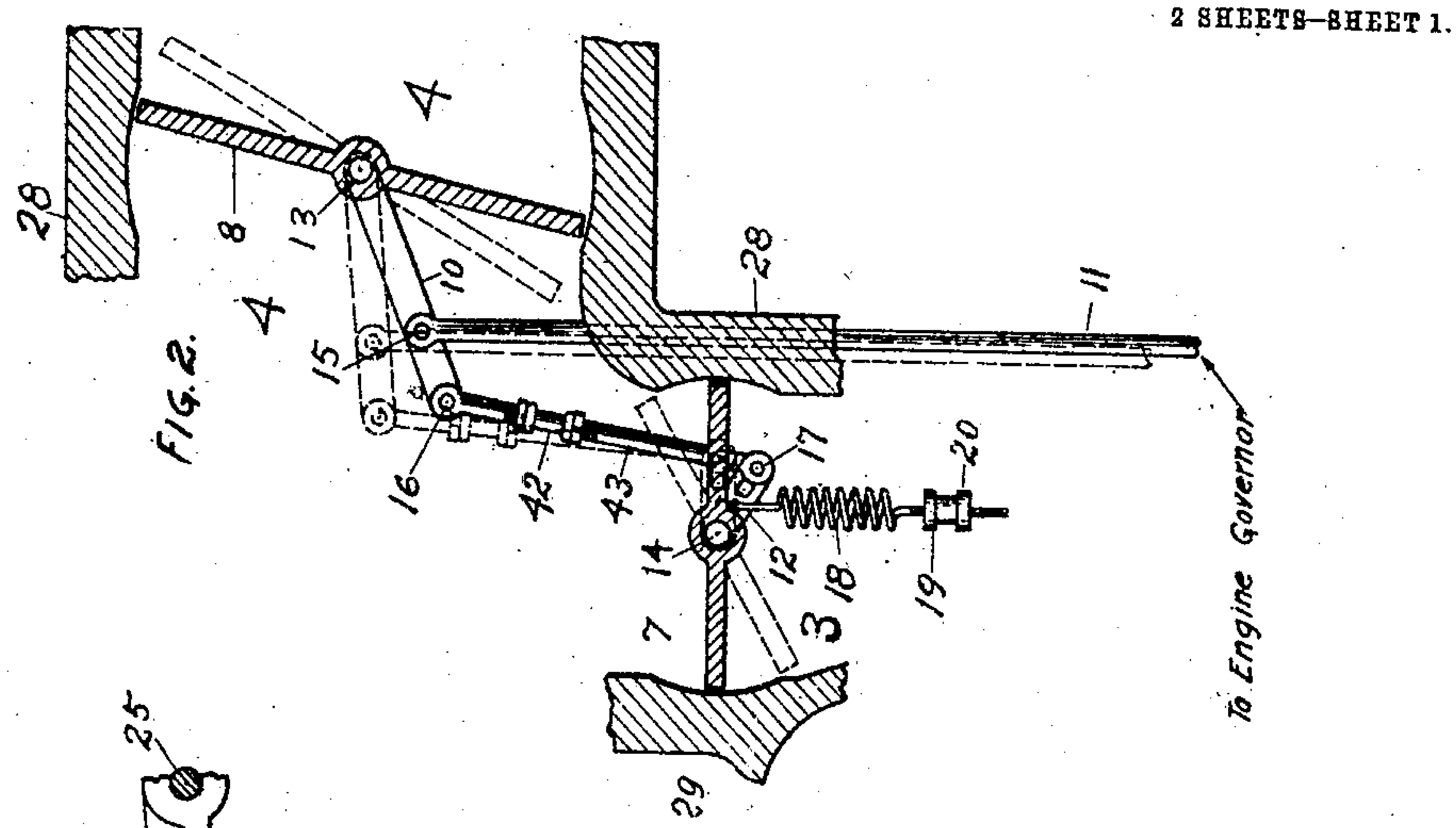

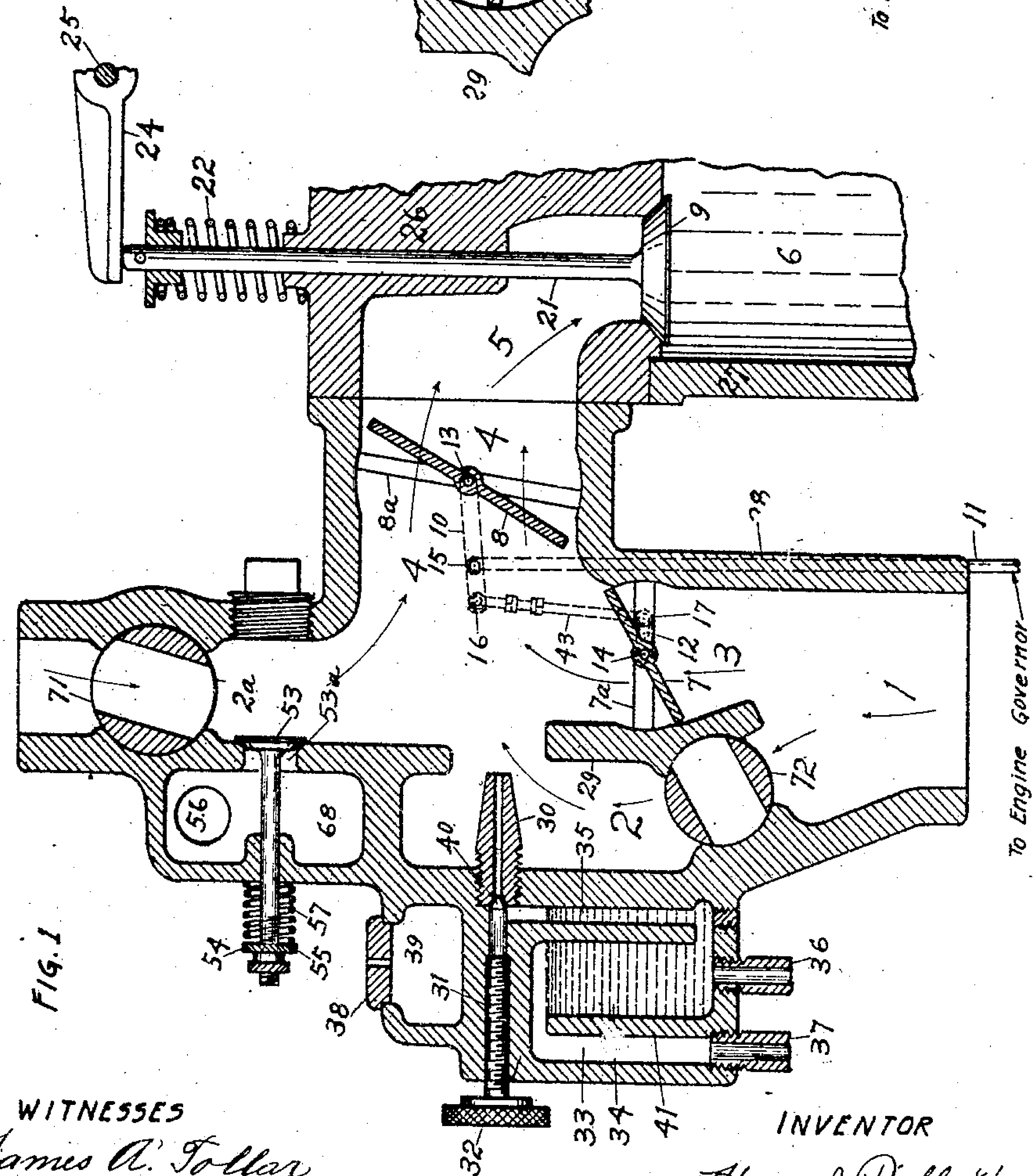

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2 SHEETS—SHEET 2.

FIG. 3.

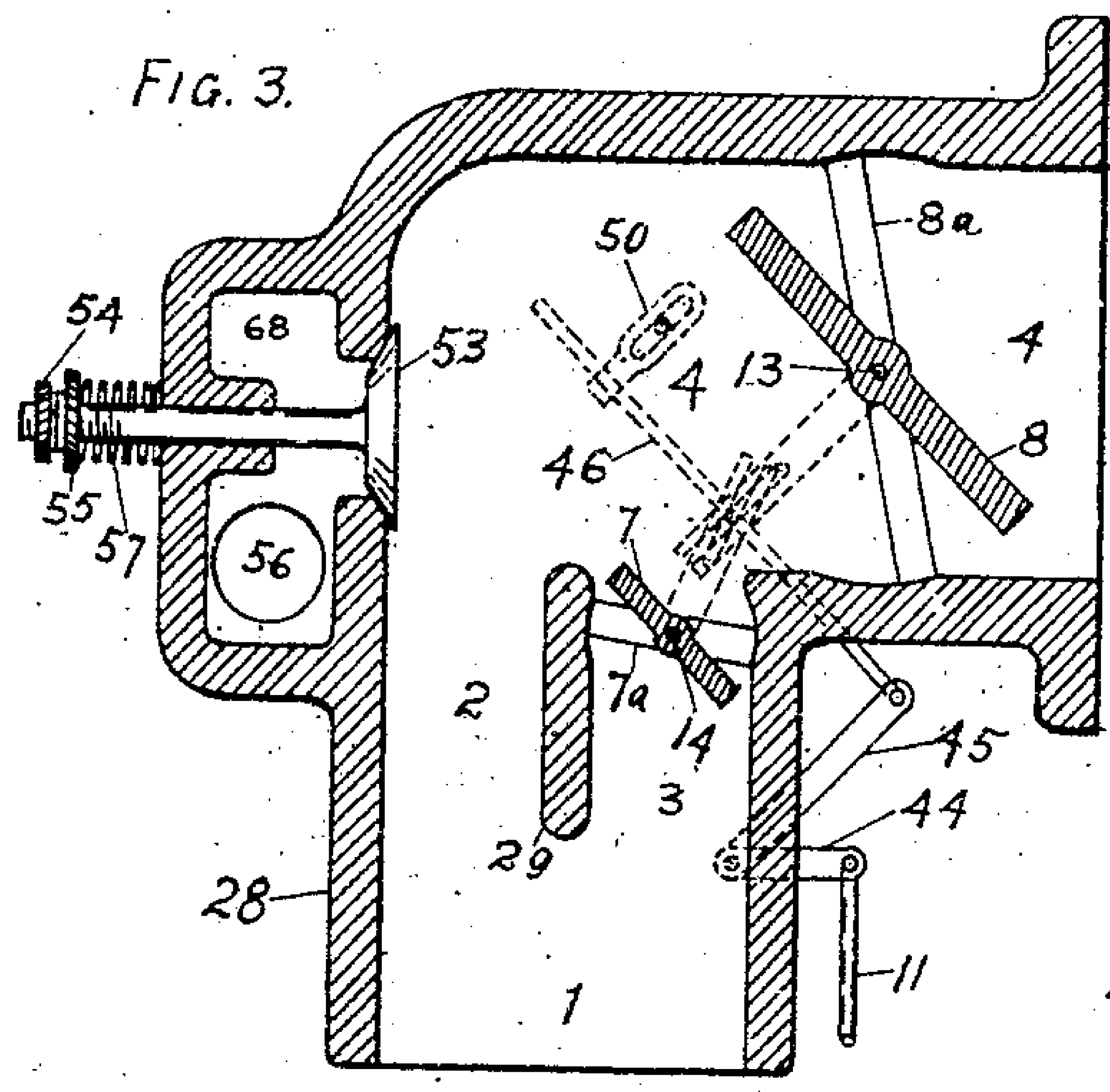


FIG. 4.

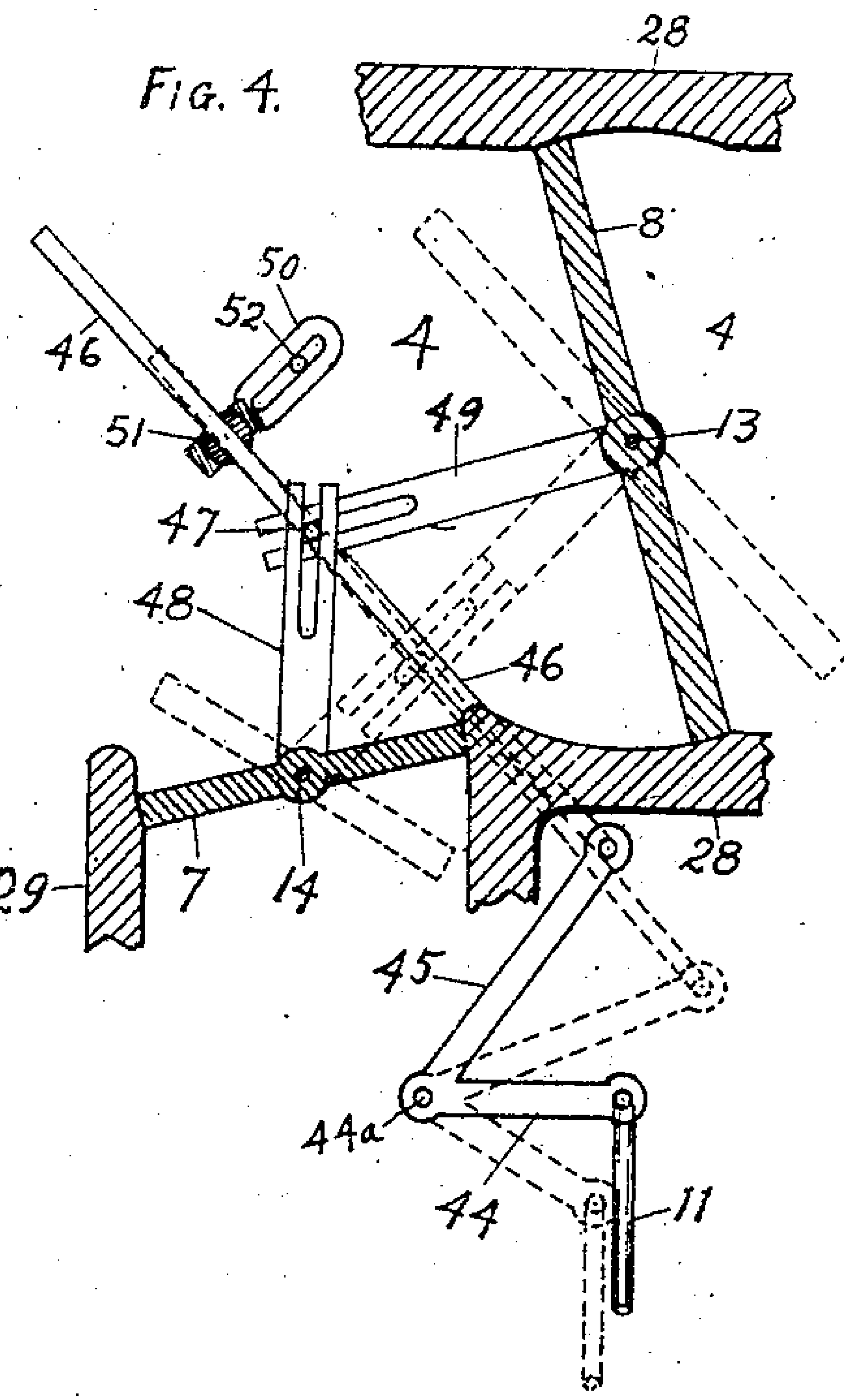
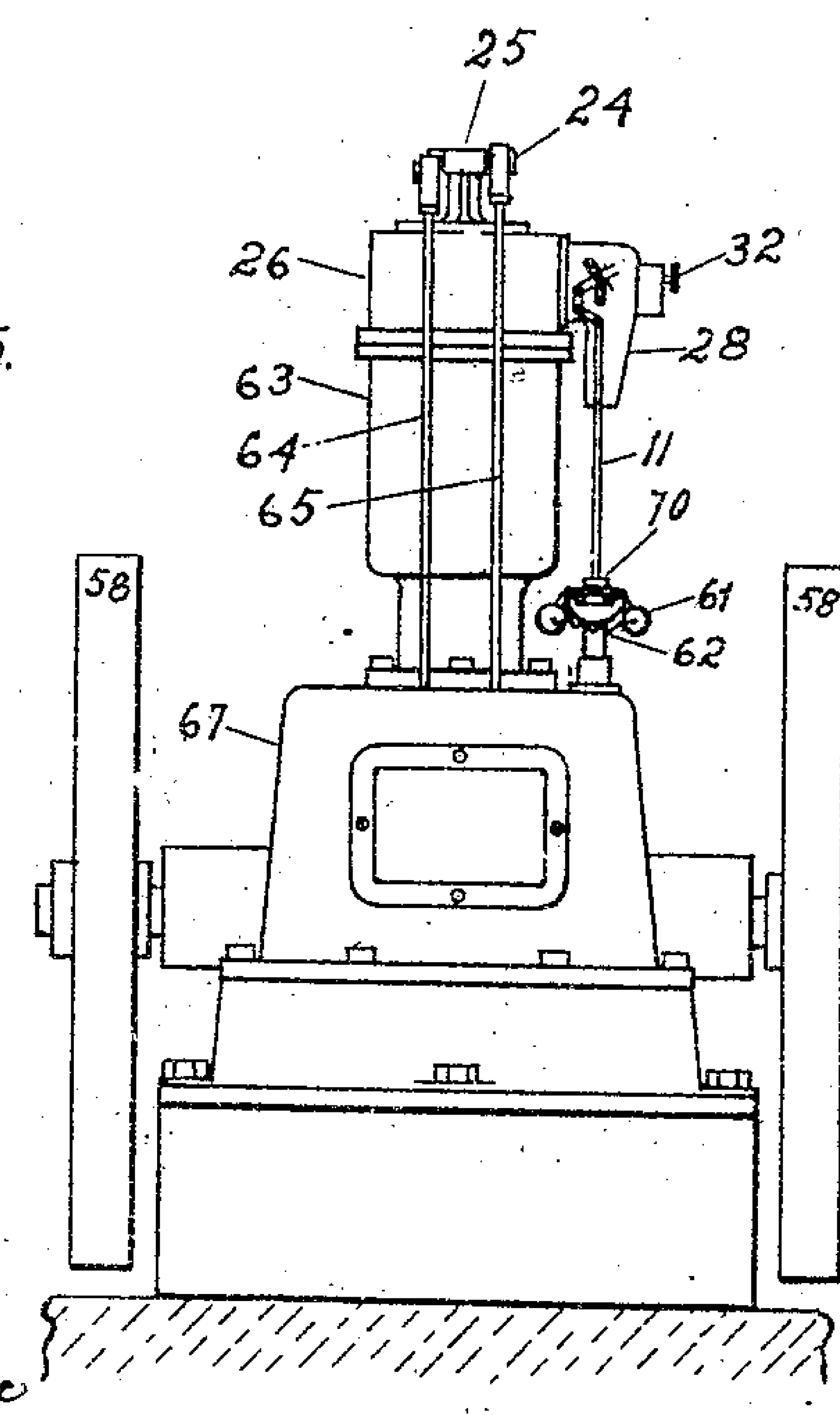


FIG. 5.



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HENRY JOSEPH PODLEŠÁK, OF CHICAGO, ILLINOIS.

INTERNAL-COMBUSTION ENGINE.

985,703. Specification of Letters Patent. Patented Feb. 28, 1911.

Original application filed August 10, 1907, Serial No. 388,040. Divided and this application filed September 1, 1909. Serial No. 515,676.

To all whom it may concern:

Be it known that I, HENRY JOSEPH PODLEŠÁK, a citizen of the United States, residing in the city of Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Internal-Combustion Engines, more generally known as "Gas-Engines," of which the following is a specification.

My invention relates to said internal-combustion engines, or, briefly, gas engines, generally, and specifically to those devices that are employed to produce, through the aid of the engine's suction, the explosive mixture charges for the engines and simultaneously regulate the speed of the engine by the throttling method, that is, by controlling the quantity of the explosive mixture for the successive charges. These devices regulate the engine's speed by varying the quantity of the explosive mixture per charge; when the quantity of mixture per charge is varied, the resultant compression is varied and hence also the mean effective pressure, acting during the working stroke, is varied. The turning force is thus varied, proportionate to the power required of the engine. The devices of this character are commonly known as throttling governors, or regulators, though sometimes also as the volume-governor. The throttling valves, or mechanisms, in these governors are preferably operated by hand when a variable speed is desired, but when the speed of the engine is to be maintained uniform, the said valves are operated by a governor driven by the engine.

The herein described invention is a division of the subject matter disclosed in my application for Letters Patent, Serial No. 388,040, filed August 10, 1907.

The object of this invention is to provide means whereby the proportions of fuel and air comprising the mixture are varied when the quantity, and hence compression, is varied; the variations in the proportions of fuel and air for the charge being in such relation as to obtain a mixture that is most suitable for the degree of compression simultaneously obtained. It is well known to those familiar with the operation of gas engines, that, to obtain best results and economy in operation, the mixtures employed must be comparatively richer in fuel when low compression is obtained, or employed, than when the higher compressions are obtained, or employed.

The object of my invention is to produce explosive mixtures in which the fuel constituent of the mixture is automatically varied, and in such relation to the degree of pressure to which the mixture is compressed, as to obtain the best results and economy in operating gas engines. By thus varying the proportional composition of explosive mixture, I overcome the difficulties, such as back firing, sooting up of the engine's valves, the igniter, etc., met with in the present devices, in which the proportions of fuel and air, comprising the mixture, remain unchanged throughout the range of controlling the quantity of mixture fed. With the present devices when it is desired to vary the proportions of fuel and air, either the valve controlling the fuel supply, or the one, if provided, controlling the air supply, is readjusted by hand, or, both are at the same time readjusted. Now, if these adjustments are such that a proper mixture is obtained when the engine is operating under heavy load, a comparatively high compression being thus obtained, that mixture will be too lean, in fuel, for the reduced compression, obtained when the load on the engine is diminished; under these latter conditions, the mixture will burn slowly, produce back firing or explosions in the mixing chamber of the device and much disturb the proper operation of the device and hence for the engine. Furthermore, such mixture is ignited with great difficulty; whenever, during operation of a gas engine, this back firing appears, the engine attendant readjusts the valves so as to obtain a richer mixture, such as will be most suitable for the reduced compression. But this last adjustment of the valves will give too rich a mixture when the load is again increased; too rich mixture produces not only soot, which clogs the engine valves, igniter, etc., but also loss of power, waste of fuel and difficulty in ignition. I overcome these difficulties and attain other advantages, which will hereinafter appear, by constructions illustrated in the preferred forms in the accompanying drawings, wherein:

Figure 1 is a sectional elevation through one form of my device and through a portion of a cylinder head of a gas engine, a portion of whose combustion chamber is also and similarly shown; as shown, the device is arranged to use either liquid hydrocarbon fuels or gaseous fuels. Fig. 2 is a detached detail of Fig. 1 showing the throttling valves and the mechanism for operating these, in enlarged scale. Fig. 3 is a sectional elevation of another form of my device; as shown, the device is arranged to use gaseous fuels. Fig. 4 is a detached detail, enlarged, showing the throttling valves and the operating mechanism. Fig. 5 is an end elevation of stationary gas engine provided with my device, the throttling valves of which are operated by the engine's governor.

Similar reference numerals denote like parts throughout the several views.

In Fig. 1, 26 is a cylinder head, containing the mixture inlet passage 5, and the inlet valve 9, which is held normally closed by spring 22, and suitably opened by valve lever 24; the cylinder head 26 is attached to the engine cylinder 27, directly over the combustion chamber 6. Attached to the cylinder head is a casing 28, having an air inlet passage 1, this passage dividing into two air passages 2 and 3, which communicate with mixture outlet passage 4; 2^a is another air passage communicating with outlet 4; 71 is a plug valve controlling the passage 2^a; it is shown open, as it preferably would be when gaseous fuel is to be used.

8^a is a valve controlled port in outlet passage 4, and 7^a is a valve controlled port in passage 3, the ports being formed by ridges raised in the side walls of the passages or conduits, making it easier to fit in the valves. In the port 7^a is a double winged valve 7, rigidly secured to a pivotal shaft 14, the bearings of this shaft being suitably formed in the sidewalls of the conduit. The shaft is extended outside of the casing to carry an arm 12, fixedly attached to the shaft; likewise, in port 8^a is a double-winged valve 8, rigidly mounted on pivotal shaft 13, which extends through the casing and carries an arm 10, fixedly attached to the shaft. The valve 8 is, as will be apparent, a main throttling valve, controlling the total quantity of mixture for each charge, and the valve 7, an auxiliary throttling valve, controlling the quantity of air passing through the conduit 3 for each charge. The function of this auxiliary throttling valve is to effect disproportionate variations of degree of vacuum in the fuel receiving air conduit (conduits 2 and 2^a) as compared with the degree of vacuum in that portion of the conduit 4 that is ahead of the main throttling valve when this is varied by the action of the main throttling valve. For example, when the valves are in a position as shown in Fig. 1, the auxiliary throttling valve just opening, the degree of vacuum, during suction stroke, will be practically the same in conduit 2^a and conduit 4; now, if the valves are opened farther, the auxiliary throttle will permit air to enter through conduit 3, and thus the degree of vacuum in conduit 2^a will be relatively reduced as compared with that in conduit 4. The object of this is, as will be more fully explained further, to produce variable suction on the fuel feeding mechanisms and thus to obtain mixtures of variable composition of fuel and air. These valves 7 and 8 control the area of effective aperture through their respective ports and by rotating the valves, by means of their shafts and arms, into different positions, (as shown in Fig. 2) different sized apertures through the ports may be obtained, ranging from the largest opening to a complete closing, which is shown in Fig. 2 in full lines; the dotted lines show the valves in partly open position. It will be observed that the arms 10 and 12 are pivotally linked together by a connecting rod 43, (Fig. 2) and that thus the two throttling valves 7 and 8, will move simultaneously; this rod 43 is pivotally attached to arm 10 at 16 and to arm 12 at 17. The rod 43 is constructed so that the distance between the pivot centers 16 and 17 can be varied by changing the length of the rod through means of the turnbuckle 42. The purpose of this adjustment is to facilitate obtaining any desired angular relation of one valve to the other with respect to their closing position. For example, it may be desirable, on account of condition of fuel, etc., to have the valve 7 close somewhat earlier in one case than in another; to obtain earlier closing of valve 7, the rod 43 would be adjusted to be somewhat longer than for the later closing. It is preferable, as will be apparent, to have the valve 7 close before the valve 8 closes; the latter, however, need close only when it is desired to completely shut off the charges. A further adjustment is provided for the purpose of obtaining relatively faster, or slower, rate of movement of valve 7, in correlation with the rate of movement of valve 8. This adjustment is provided for by slotting the end of arm 12, where the pivot 17 is engaged. By securing this pivot 17 at different positions in the slot, the different effective lengths of the arm, operating the valve 7, are obtained. It will be apparent that when the effective arm on valve 7 is changed and the effective arm on valve 8 remains the same, the relative rate of movement of the two valves will be changed.

The purpose of the above adjustment, namely, to secure earlier closing of one valve than the other, or, to secure relatively faster movement of one valve than of the other, or, to secure both conditions simultaneously, is to facilitate obtaining any desired variation of relative degree of vacuum, hence draft, in the air conduits 2 and 3, during suction stroke of the engine. The object, which is to gradually obtain a relatively higher degree of vacuum in the air conduit into which the fuel is charged or fed, which here is the conduit 2^a, than in the air conduit 3 as the main throttling valve 8 is moved toward closing position and is thus reducing the quantity of mixture, and hence reducing the compression; by so increasing the degree of vacuum, or suction, in conduit 2^a, proportionately more fuel is drawn in for the mixture as the compression is reduced, the above adjustments being so made that the variations in proportion of fuel and air are in such correlation with the degree of compression, at any moment obtained, that the mixture obtained is the most suitable one for the compression simultaneously obtained. It will be understood by those familiar with operating gas engines, that by means of these above adjustments, together with a suitable initial adjustment of fuel supply, the suitable and desirable variations in the proportions of fuel and air, in the mixtures, will be obtained automatically, and for almost any range in variation of speed, or of load.

Referring to Fig. 1, with particular reference to the operation of the gas fuel feeder, 53 is a valve controlling a port 53^a, through which gaseous fuel may be admitted, or fed, into the conduit 2^a, the fuel being suitably supplied through a pipe (not shown) having a regulating and cut-off valve, and communicating with chamber 68 through port 56. The valve 53 normally closes the port 53^a, being held against the seat in the port by a spring 57. The tension of this spring is preferably so adjusted, by means of knurled nuts 54 and 55, that the pressure of the gas supply is just barely counter-balanced when there is no partial vacuum in conduit 2^a. 71 is a plug valve by which the opening through conduit 2^a may be varied, or closed altogether. 72 is a similar valve controlling the opening through conduit 2; as shown, the valve 72 is closed and valve 71 partly open. It will be apparent that whenever a partial vacuum is created in conduit 2^a by the engine's piston during the suction stroke, the pressure on the gas in fuel feeder will open the valve 53, when gas will be fed into conduit 2^a, through which air is then being drawn into the engine's cylinder; the gas and air will mix, this mixture passing, after being suitably diluted with air drawn in through conduit 3 to form a suitable explosive mixture charge, into the combustion chamber of the engine, where it will, after being compressed, be ignited when it will burn and expand, producing power. The gas fuel feeder will also operate when the valve 71 is closed and valve 72 open, but, as will be apparent, the gas and air will be more thoroughly mixed when the air is drawn through conduit 2^a than if it were drawn through conduit 2.

Referring now again to Fig. 1, with particular reference to the liquid fuel feeder, 30 is a spraying nozzle, positioned in air conduit 2, and extending into the casing wall where it communicates with a fuel inlet passage 35, through a valve-controlled port 40. The fuel inlet passage communicates with a liquid fuel reservoir 34, to which the fuel is supplied through pipe 36, any surplus of fuel overflowing the bridgewall 41, into conduit 33 and from there through pipe 37; the liquid fuel in the reservoir 34 is thus kept at a constant level, or head. The port or valve-seat 40 is controlled by a needle valve 31, this being adjustable so that different size free openings through port 40 may be obtained to accommodate different conditions of fuel, atmosphere, etc. The arrangement just described is one of a liquid fuel feeder for gasolene engines, now in general use. I prefer to use this fuel feeder as it gives very satisfactory service with stationary engine, to which I show the device attached. However, any form of liquid fuel feeder in which the feeding operation is dependent, more or less, on the engine's suction can be used in combination in my device. When liquid fuel is to be used the plug valve 72 would be open and valve 71 closed.

The operation of the fuel feeding device just described, in combination with my device, is this: The engine being in motion, a partial vacuum is created by its piston during the suction stroke. The moment this inlet valve 9 is opened, this partial vacuum is extended into the conduits 4, 2 and 3, and 1, and a quantity of air will be drawn in through these conduits. When there is partial vacuum in conduit 2 and the needle valve 31 is open, the liquid fuel will be drawn up (or rather pushed up by the atmospheric pressure acting on the liquid in 34, forcing it up through 35, 40 and 30) into the conduit 2, through nozzle 30; the quantity of fuel so drawn up will depend upon the duration of the suction, the degree of vacuum created and the size of free opening in port 40, the level, or head, of the liquid remaining constant. The liquid so fed is vaporized and co-mingles with the air rushing through the conduit 2 forming a comparatively rich mixture which is diluted in the conduit 4 by air admitted through conduit 3, to such degree as to form a proper explosive mixture for the charge.

The operation of my mixture-producing and speed-regulating device, shown in Fig. 1, is best explained in connection with a stationary gas engine whose speed is to be maintained uniform, in which case the throttling valves 7 and 8 are operated by the engine's governor, through suitable connections, as shown in Fig. 5, for example. The connection for operating the throttling valve by the governor is effected through rod 11, one of whose ends is pivotally secured to arm 10 at 15, and the other end suitably connected to the governor mechanism, whereby the rod 11 may be given reciprocating movement as the speed of the engine, and hence of the governor, tends to vary. As the speed varies, the governor balls 61 are caused to fly into different positions, thus imparting a reciprocating movement to a loose sleeve 70, to which the rod 11 is suitably connected. The adjustment of the connections between the governor and the throttling valves is such that the valve 8 is open to such extent as to admit a full charge before the engine attains the desired speed. The action of the governor upon the rod 11 is such that a variation of small percentage of the engine's speed will suffice to give sufficient movement to the rod 11 to so operate the valve 8 to throttle or vary the quantity of mixture from the largest to the smallest requisite, according to the load.

The starting of a gas engine provided with my throttling governor is done in any of the usual ways, and the cyclic operations of inhaling the charge, compressing, igniting and expanding, and exhausting, are also the usual. The difference in action of my device, as compared with similar present devices, is in automatically varying the proportional composition of the mixture with the variations in degree of compression, the variations in degree of compression being effected by the throttling valve 8, this by its action varying the quantity of mixture per charge. It will be noted, from a reference to Figs. 1 and 3, that the stream of air inhaled during the suction stroke through the device is divided, a part passing through the fuel receiving air conduit (2, 2^a), and another part through conduit 3. Now when the throttling valve 8 is in such position of opening as to permit a full charge, the greatest quantity of mixture to be inhaled by the engine, the needle valve, or fuel valve 31, when liquid fuel is used, is adjusted to permit the proper quantity of fuel to be drawn in, by the degree of vacuum than in the fuel receiving air conduit, to form a mixture most suitable for the compression then obtained. If now the speed of the engine tends to rise above the normal, the governor operates the valve 8 to constrict or reduce the area of free aperture through port 8^a. By this reduction of free aperture in the mixture outlet passage 4, the quantity of mixture that it is possible to pass through in a given time, as the duration of suction stroke at or near normal speed of engine, is reduced; the resulting compression is lowered, and also the degree of suction in conduits 2 (or 2^a, as the case may be) and 3 is lowered, and hence also the quantity of air and of fuel drawn in is lessened. In my device the lessening of the quantity of fuel is not in uniform proportion with the lessening of the quantity of air as it is in the present devices. By the action of the throttling valves 7 and 8 of my device, (which action, of simultaneously disproportionately varying the free apertures through ports 7^a and 8^a to obtain relatively higher degree of vacuum in conduit 2 as the free apertures are being reduced and vice versa, has been herein explained) such relation of the degree of vacuum in conduits 2 and 3 is obtained that proportionately more fuel will be drawn in as the quantity of air for the charge, and hence the compression, is reduced. Again, should now the speed of the engine tend to fall below the normal, the governor will so operate the valves as to increase the free apertures through their ports, thus increasing the quantity of the air charge, and hence, also the compression, but now the proportion of fuel will be decreased, the auxiliary throttling valve 7 so operating as to admit proportionately more air through its port 7^a, thereby proportionately decreasing the vacuum in conduit 2, or conduit 2^a, whichever one may be used, or in both, if both are used simultaneously. Thus the proportional composition of the mixture will be varied when the compression is varied, and in such degree as to obtain the best results and economy in operation. The requisite degree in the variation of the proportions of fuel and air is attained by making suitable adjustments of rod 43 in length and in the position of pivot 17 in the slot of arm 12, as already explained.

In Fig. 2 a spring 18 is shown. One end of this spring is secured to arm 12, the other passing through a lug 19, suitably cast on or fastened to the outside of the casing, and having a nut 20, which rests against the lug 19, for adjusting its tension. The primary function of this spring is to keep the slack, or lost motion, in the connections between the valves and the governor always taken up in the same direction, to secure uniform action of the valves when the rod 11 is moved back and forth to thus secure closer regulation of speed. As shown, this spring 18 will, by its tension, tend to close the valves, thus acting against the governor-ball springs 62, (Fig. 5) and with the centrifugal force of the governor balls. If the spring 18 were so placed that its action would tend to open the valves, the primary function would still be then obtained, though the tension on the governor-ball springs 62 would have to be reduced to obtain same speed on engine as before, since now the spring 18 would act against the centrifugal force of the governor balls, which force is also acted against by springs 62. It will also be apparent that the speed of the engine can be changed, to some extent, by varying the tension on the spring 18, and this can be done while the engine is in motion. The initial adjustments to obtain the desired speed are made in the adjustments provided for in the governor and its connections to the valves.

In Fig. 3 is shown a modification employing different valve actuating mechanism, which is more clearly shown in Fig. 4. Here the valves 7 and 8 derive their movement through their respective arms 48 and 49, which are slotted to receive a pin 47 in rod 46; this rod receives movement of the governor rod 11 through bell-crank lever 44, 45. One end of the rod 46 is pivoted in arm 45; the other end is carried in ball 51, being adapted to slide in this ball 51, which is loosely carried in a socket formed in a support piece 50. This support piece is slotted as to be adjustable, up and down; bolt 52 serves to secure the piece 50 in any desired position. It will be noted that by lowering the slotted piece 50, a lowering of the pin 47 in the rod 46 will be effected and thus the effective lengths of the slotted arms 48 and 49 will be changed; that of arm 48 being shortened while that of arm 49 is lengthened. The relative speeds of rotative movement of valves 7 and 8 will be changed, the valve 7 being moved relatively faster, in either direction, than valve 8 when the rod 46 is moved to and fro. Thus the same conditions will obtain as will obtain by moving pivot 17 into different positions in the slot of arm 12 of the device shown in Figs. 1 and 2. It will be noted that in the modification shown in Figs. 3 and 4 this adjustment can readily be made while the engine is in motion. The adjustment of the relative angular advance of one valve with respect to that of the other is here effected in the fastening of the slotted arms to their shafts, and may be by means of set screws, or by means of a supplemental arm, rigidly secured to one of the shafts, preferably shaft 14, and adapted to pivotally carry the slotted arm and some suitable means to secure these arms, the supplemental and the slotted, together in the desired position of adjustment. This last arrangement may also be made so that the adjustment may be made while the engine is in motion. It will be seen that same adjustments, correspondingly, in the valve actions of the form shown in Fig. 3 can be made as in the form of the device shown in Fig. 1. The same conditions of relative degree of suction in air conduits 2 and 3 are thus obtained in both forms. The form of my device, shown in Fig. 3, is shown adapted to use gaseous fuels. The gas is suitably supplied through a pipe (not shown) having a regulating and cut-off valve, and communicating with chamber 68 through port 56. This gas chamber 68 communicates with air conduit 2 through a port controlled by a valve 53. This valve 53 normally closes the port; the valve being held against its seat in the port by a spring 57. The tension of this spring is preferably so adjusted, by means of knurled nuts 54 and 55, that the pressure of gas supply, acting to open the valve, is just barely counterbalanced when there is no partial vacuum in conduit 2. Thus adjusted, it will permit valve to readily open, to permit feeding of gas, as soon as a partial vacuum is created, in conduit 2, during the suction stroke. Thus adjusted, the valve 53 will operate as a check valve on the gas and also as a pressure regulator to a certain extent. Where the gaseous fuel is supplied by a suction gas producer, the valve 53 serves to prevent air from rushing into the gas pipe after the completion of suction stroke; there being a partial vacuum in such gas producer plant during operation. Where the gas supply is under pressure and an effective pressure reducing and regulating device is employed, the valve 53 may be dispensed with to simplify the construction. However, it is advantageous to include this valve in my device, even where the gas pressure regulating device employed is capable of reducing pressure to that of atmosphere. The mixture producing operations of the modification in Fig. 3 are similar to those in the form shown in Fig. 1. The relative degree of vacuum in conduits 2 and 3 is varied in the same manner, being relatively increased in port 2, to draw in or inhale, proportionately more fuel, when the quantity of the charge and hence the compression, is decreased. Thus it will be apparent that the liquid fuel feeder shown in Fig. 1 can be substituted for the gaseous fuel feeder shown in Fig. 2, and vice versa. Also, that the fuel feeders need not be cast integral with the device, but that these can be made separable and interchangeable.

Fig. 5 shows a stationary single cylinder gas engine having my mixture-producing and speed-regulating device attached to it. As here shown, the form of the device is that shown in Fig. 3, but having a liquid fuel feeder, to use such fuels as alcohol, gasolene, benzol, distillate, etc. 26 is the cylinder head in which are the exhaust and the inlet valves. These valves are operated in the usual way, by cams, on a camshaft, within crank chamber 67 and driven from the crank shaft 59, through means of a valve rod 64 and 65 and suitable valve levers. The igniter and its mechanism may be of any desired form. The governor balls 60, suitably driven from the crank shaft, actuates the rod 11 through suitable connections, causing this rod to move up or down as the speed varies. The rod 11, by its movements, operates the throttling valve mechanism in such manner as to obtain the valve actions, before described, namely, to control the quantity of each successive charge of mixture, varying the quantity in such relation to the load as to maintain a uniform speed, and to control the proportions of fuel and air comprising the mixture for the successive charges, varying the proportion in such relation as to quantity in the charge as to obtain uniform and most economical operation of the gas engine.

Although I show my device attached to a single cylinder gas engine, it is obvious that the device can readily, by means of a suitable manifold, be attached to engines having two or more cylinders. Also, that instead of the double-winged throttling valves, which I prefer on account of their simplicity and their inherent balancing when under the air pressure, other forms of valves, such as the mushroom or puppet valves, piston valves, slide valves, etc., may be employed, if desired. It is understood that the throttling valves should preferably be so designed and arranged that their action is not affected much by the action of the variable suction. Such details as these, however, are matters of design for any particular adaptation and for manufacture, and may be varied and made to suit different conditions. For example, it may be desired to adapt my device to use liquid fuels and gaseous fuels interchangeably, or even simultaneously. This condition would be met by suitably proportioning the various conduits, ports and parts in my device, and suitably equipping it with two or more fuel feeders, all to feed fuel into conduit 2, which could be divided into two conduits, if desired, as shown in Fig. 1.

When the fuels that are to be used interchangeably differ much in their respective heat values, as, for instance, alcohol used interchangeably with blast furnace gas, or producer gas, some means of regulating the air supply should be provided, for instance, a plug valve in the conduit 2, or as shown in Fig. 1; this valve being ahead of the fuel supply port so that the air supply can be throttled and reduced to compensate for the necessary extra large quantity of lean fuel (blast furnace gas, etc.) when this is to be used, and to again increase the supply of air when the richer fuel is to be used. Those familiar with the art understand that when the lean gases, such as producer gas, are used, the explosive mixture comprises about equal quantities of the gas and air, while when richer fuels, such as natural gas or alcohol vapor, the relative quantities are in the neighborhood of one of fuel to nine of air; hence, the necessity of regulating the air supply when such fuels are to be used interchangeably and the engine desired to deliver its greatest power. In suction gas producer plants, the heat value of producer gas is apt to vary during operation, the heat value being higher just after charging in fresh coal; hence it is also desirable to be able to regulate the air supply while this fuel is being used. Of course, the gas supply could here be regulated by a valve, to compensate for the variations in heat value of the gas, but it is obvious that then the charges will be relatively smaller than when the air supply is regulated. However, such arrangements of parts in my structure as will be most suitable for any particular condition, or conditions, and the many advantages of my device, will readily occur to those familiar with the art.

What I claim as my invention, and desire to secure by Letters-Patent, is:

1. A mixture-producing and speed-governing device for gas engines, comprising, in combination, a plurality of air conduits, each communicating with an air supply, a valve in one of said conduits adapted to vary the free opening therethrough, a fuel inlet port controlled by an adjustable valve and adapted to feed fuel into the other of said air conduits, means for supplying fuel at constant pressure to the fuel inlet port, an outlet conduit in communication with said air conduits for the mixture of air and fuel, a valve in said outlet conduit and adapted to vary the free opening therethrough, and means for actuating the valves in the conduits to vary the opening therethrough simultaneously and disproportionately.

2. A mixture-producing and speed-regulating device for gas engines, comprising, in combination, a casing having two air conduits therein and communicating with an air supply, a fuel supply, a fuel inlet port suitably adapted to feed fuel from said fuel supply into one of said air conduits, a valve in the other of said air conduits and adapted to vary opening therethrough, a mixture outlet conduit communicating with said two air conduits, a valve in said outlet conduit adapted to vary the opening therethrough, means to effect simultaneous action of the two said valves controlling the openings through the conduits whereby said openings are varied in size, and means to obtain relatively faster variation in one opening than in the other.

3. In a mixture-producing and speed-governing device for gas engines, the combina-

tion of an air supply, a fuel supply; a pair of air conduits, an adjustable fuel port adapted to convey fuel from the fuel supply into one of said air conduits, a mixture outlet passage in communication with said air conduits, a valve in said outlet passage adapted to vary free apertures therethrough, a valve in the other of said conduits adapted to vary free aperture therethrough, means for operating said valves simultaneously, means operative to regulate rate of movement of said valves, and means to adjust correlative positions of said valves.

4. In a mixture-producing and speed-governing device for gas engines, the combination of an air supply, a fuel supply, a plurality of air conduits communicating with an air supply, a valve controlled fuel inlet port for conveying fuel from the fuel supply to one of said air conduits, a mixture outlet passage in communication with said air conduits, means for controlling the quantity of mixture of fuel and air passing through the mixture outlet passage, and means for controlling, simultaneously with the controlling of the quantity of mixture, the relative quantities of air passing through each air conduit.

5. In a mixture-producing and speed-governing device for gas engines, the combination of a plurality of air conduits in communication with an air supply, a valve-controlled fuel port adapted to convey fuel from a fuel supply to one of the air conduits, an outlet passage adapted to receive the air and fuel mixture from the air conduits and convey same to the inlet port of a gas engine, means operative to vary and control the quantity of mixture passing through the outlet passage, means operatively connected with said quantity controlling means to vary, simultaneously with variations of quantity of mixture, the relative quantities of air passing through each air conduit, and means to operate the quantity controlling means.

6. In a mixture-producing and speed-governing device for gas engines, the combination, of an air supply, a fuel supply, plurality of air conduits, each in communication with the air supply, valve-controlled fuel port, communicating the fuel supply with one of the air conduits, an outlet conduit in communication with the air conduits, means to induce a flow of air and fuel into the air conduits and through the outlet conduit, operative means for controlling and varying the quantity of mixture passing through the outlet conduit, and means, operating conjunctively with said operative means, for effecting a relatively disproportionate flow of air through, and reduction of the internal air pressure in, said air conduits, for the purpose of varying the proportions of fuel and air comprising the mixture.

7. In a mixture-producing and speed-governing device for gas engines, the combination of air supply, plurality of air conduits, plurality of fuel supplies, each adapted to supply fuel into one of the air conduits through a valve-controlled port, an outlet passage adapted to receive the air and mixture of fuel and air from the air conduits and convey same into a combustion chamber, means to regulate the supply of air into one of the air conduits, operative means to vary and control the quantity of the mixture of fuel and air passing through the outlet passage, and means to vary, simultaneously with variations of quantity of mixture the relative quantities of air passing through each air conduit.

8. In a mixture-producing and speed-governing device for gas engines, the combination of plurality of air ports communicating with an air supply, plurality of valve-controlled fuel ports, each communicating one of the air conduits with fuel supply, outlet passage affording communication between the air conduits and the combustion chamber of a gas engine, a gas engine whose mechanisms are adapted to reduce the internal air pressure in its combustion chamber, the air conduits and the outlet passage, and thus inhale charges of mixture of fuel and air, operative means for varying and controlling the quantity of mixture for the charges, and means for effecting, simultaneously with variations of quantity of mixture for the charges, a relatively disproportionate reduction of internal pressure in the air conduits.

9. In a mixture-producing and speed-governing device for gas engines, the combination of a gas engine provided with governor, with a plurality of air conduits communicating with an air supply, valve-controlled fuel port communicating one of the air conduits with fuel supply, outlet passage affording communication between the air conduits and the inlet port of the gas engine, means for varying and controlling the quantity of mixture inhaled by the gas engine during the suction strokes, means cooperative with said quantity varying and controlling means, to simultaneously and disproportionately vary the quantity of air passing through each air conduit, and an operative connection between the engine's governor and the means for varying and controlling the quantity of mixture for the charges.

10. In a mixture-producing and speed-governing device for gas engines, the combination, of an air supply, a fuel supply, two air conduits, each in communication

with the air supply, an outlet conduit in communication with the air conduits, a valve-controlled fuel port, communicating the fuel supply with one of the air conduits, a valve in the other air conduit adapted to vary the free aperture therethrough, a valve in the outlet conduit adapted to vary the free aperture therethrough, and means to operate said valves simultaneously, but in disproportionate ratio.

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