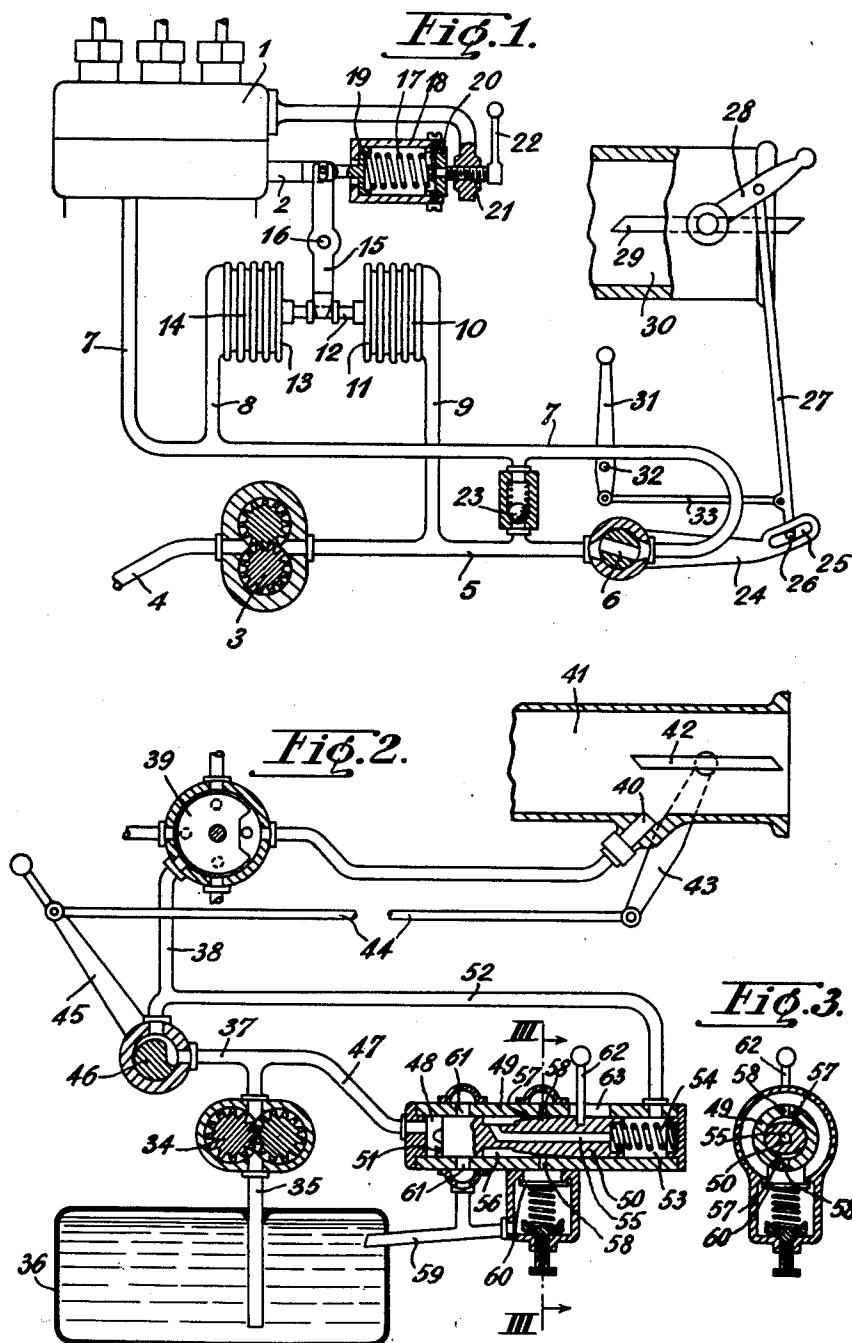


May 17, 1949.

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 REGULATING AND FEED APPARATUS FOR
 INTERNAL-COMBUSTION ENGINES
 Filed April 13, 1945

2,470,382



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Patented May 17, 1949

2,470,382

UNITED STATES PATENT OFFICE

2,470,382

REGULATING AND FEED APPARATUS FOR
INTERNAL-COMBUSTION ENGINES

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Application April 13, 1945, Serial No. 588,101
In Switzerland January 10, 1945

3 Claims. (Cl. 123-119)

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The present invention relates to a regulating and feed apparatus for internal-combustion engines, which comprises means for making a liquid stream circulate in a pipe at a speed proportional to the rotatory speed of the engine to be fed. It further comprises an adjustable throttle member situated on this pipe and which creates in the latter a pressure drop dependent on the degree of its opening—i. e., on the cross-section of the passage that it offers the liquid. The intake side and the discharge side of this throttle member are connected by pipes to two chambers each having a movable wall, so that each of the pressures on the intake side and the discharge side acts on one of these walls. The two walls in question are rigidly connected with each other and are subjected to the action of a force balancing the resultant of the thrusts due to the two pressures acting on these movable walls, so that these walls assume a position of equilibrium which depends on the difference of pressure thus created in the aforesaid stream, and the aforesaid two movable walls are mechanically connected with a device regulating the delivery of fuel going to the engine.

The annexed drawing represents diagrammatically and as examples two embodiments of the apparatus in accordance with the invention.

Figure 1 represents the first embodiment, certain details being in section.

Figure 2 is a similar view of the second embodiment.

Figure 3 is a cross-section of a detail according to III—III of Figure 2.

In Figure 1, an injector pump for a Diesel engine is represented at 1, and at 2 the rod which governs the delivery of the fuel to be sent to the injectors. At 3 is represented a continuous-delivery pump of the gear type which is driven by the engine (not shown) to be fed. This pump draws in the fuel for the engine through a pipe 4, connected with a reservoir (not shown). The pump 3 forces the fuel successively through a pipe 5, a throttle member 6, a pipe 7, and thence to the pump 1. A liquid stream thus circulates through the pipe system 5 and 7 at a speed proportional to the rotatory speed of the engine to be fed. The pipe 5 situated on the high pressure side of the throttle member 6 is connected by a pipe 9 with the interior of a bellows 10, the movable wall of which is connected in a rigid manner by a stem 12 with the movable wall 13 of a similar bellows 14 communicating with pipe 7 through a channel 8. The stem 12 is coupled with the rod 2 by means of a lever 15 pivoted

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at 16. The throttle member 6 creates a pressure drop along the pipe 5, 7, the result of which is that the thrusts on the movable walls 11 and 13, due to the pressures acting on them, are unequal. A spring 17, acting on the rod 2, supplies the necessary force for balancing the resultant of the thrusts due to the different pressures acting on the movable walls 11 and 13. This spring 17 is enclosed in a cylindrical casing 18. One of the spring ends bears against the free end of the rod 2, which is provided for this purpose with a cup 19. The other end of the spring bears against a spring-plate 20 integral with the casing 18 and co-operating with a screw 21 worked by an adjusting handle 22 for regulating the position of the casing 18. By operating the handle 22, the tension of the spring 17 is regulated, and this determines the position of the rod 2 and, consequently, the delivery from the pump 1. Thus the range of delivery that the apparatus must govern can be varied.

A safety valve 23 is placed between the pipes 5 and 7 on opposite sides of the throttle member 6, so as to obviate any undesirable excess of pressure in the case in which this throttle member is brought into a partially closed position giving too great a choke in relation to the delivery, such as is produced when the engine is "driven."

The revolving part of the throttle member 6 is integral with a lever 24 having, at its free end, a slot 25 co-operating with a pin 26 carried by one end of a link 27, connected at its other end to an adjusting handle 28 serving to operate the air-throttle 29 for regulating the induction of air to the engine through a suction pipe 30. The transmission ratio of the movement between the air-throttle 29 and the throttle member 6, through the lever and link mechanism 24, 25, 26, 27, 28, may be regulated by changing the position of the pin 26 in the slot 25 by means of a control lever 31, pivoting at 32 and connected with the link 27 by a rod 33.

The apparatus described functions as follows: Let it be supposed that the engine is working at full load with the throttle member 6 in the fully open position. If it is desired to slow down the engine, the throttle member 6 is partially closed by operating the handle 28. A difference in pressure is then produced in the pipe 5, 7 between the intake and discharge sides of the throttle member. This difference in pressure depends on the speed of the flow of the liquid through this throttle member and does not depend on the actual amount of pressure in the pipe 5. This

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difference in pressure acting against the movable walls of the bellows 10 and 14 results in the shifting of the rod 2 in the closing direction. The spring 17 expands the ends by balancing the resultant of the thrusts exercised by the liquid on the movable walls 11 and 13, and the rod 2 stops. From that moment, there are no longer any variations in pressure, but, as soon as the engine begins to slow down, the difference in pressure between the pipes 5 and 7 on the intake and the discharge sides of the throttle member decreases and consequently the rod 2 shifts in the opening direction.

Because of the law that governs the flow of liquids, in relation to the pressures in play, a simpler working of the engine is obtained, due to the apparatus described, than with other apparatus in current use, for as soon as the motor tends to accelerate, the thrust against the movable walls 11 and 13, which brings about the throttling, varies in ratio to the square of the velocity—i. e., very rapidly.

If the spring 17, inside the box 18, has a certain initial tension and if its elasticity is sufficient, the following happens when the rise in pressure starts from zero: during the first phase, the rod 2 does not move, the tension of the spring 17 sufficing to immobilise it despite the different pressures acting in 10 and 14. When a certain value in the difference of pressure is reached, the spring begins to yield, which, seeing the relatively great elasticity of this member, results in a relatively abrupt and extensive shifting of the rod 2. The adjustment can thus be made on a fairly restricted number of revolutions thus establishing well-defined speed controls that are analogous with those that can be obtained with a centrifugal-force governor. This adjustment, according to the degree of opening of the throttle member 6, is effective on the entire range of angular speeds of the engine.

Seeing that the pressure existing throughout the liquid stream may vary without the functioning of the apparatus described being altered (since the latter uses the difference in pressure created by the throttle member) any stream can be utilised, in principle, the speed of which is proportional to that of the engine. In other embodiments, then, a water stream could be utilised, put in motion by a pump driven by the engine. Besides, it can be seen that, in the example given in Figure 1, the stream utilised is not directly the one feeding the engine, as, on the contrary, is the case about to be described with reference to Figures 2 and 3.

In a variant of the embodiment according to Figure 1, the connection between 28 and 24 by the rod 27 may be eliminated. Obviously, 24 would then be acted upon directly (and no longer through 28) to produce the pressure drop.

In the embodiment according to Figures 2 and 3, the gear-pump 34, driven by the engine, draws in, through a pipe 35, the liquid fuel contained in the reservoir 36. This pump forces the liquid through a pipe 37, 38, leading to a revolving distributor 39 bringing the fuel at the desired moments to the different injectors of a multicylinder engine. One of the injectors is shown at 40, situated in the air induction pipe 41 of the respective cylinder. The air-throttle 42 regulating the air intake to the cylinder is coupled by a lever 43, a rod 44 and a lever 45 to the revolving part of a throttle member 46 situated on the pipe 37, 38. The purpose of this throttle member 46 is,

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as in the example previously described, to create in the pipe 37, 38 a pressure drop that is utilised for governing the flow of fuel to the injectors.

The intake side 37 of the pipe 37, 38 is connected by a channel 47 with a chamber 48 of a cylinder 49, in which a piston 50 slides. The pressure on the intake side thus acts on one of the end faces 51 of this piston. The discharge side 38 of the same pipe 37, 38 communicates through a channel 52 with a chamber 53 in the cylinder 49 situated at the other end of the latter, so that the pressure on the outgoing side acts on the end face of the piston 50 opposed to 51. A spring 54 placed in the chamber 53 also acts on this same end face 51.

The liquid stream flows into the pipe 37, 38 and through the throttle member 46, and the difference in pressure on either side of this throttle member acts in a way identical with that described with regard to Figure 1—i. e., so long as the speed of the liquid through the throttle member 46 does not vary, the piston 50 takes up a position of equilibrium under the influence of the two thrusts acting on its opposing end faces and also under the influence of the action of the spring 54 balancing the resultant of these two thrusts. Now, the fuel leaving the throttle member 46 is directed towards the injectors through the medium of the revolving distributor 39. A portion of the fuel which acts on the piston 50 can, however, be released if there is an excess. For this purpose, the piston 50 has an axial hole 55 leading into the chamber 53 through which the liquid in this chamber flows into an annular space 56 situated between a recessed part of the piston and the inner side-wall of the cylinder 49. This recessed part of the piston 50 has a conical portion 57, serving to uncover progressively ports 58 intended to connect the space 56 with an overflow pipe 59, through the medium of a clack-valve 60. When it moves to the right from the position shown in the drawing, the piston 50 thus uncovers the ports 58, and liquid returns to the reservoir 36 from the discharge side 38 of the pipe 37, 38. As the piston 50 moves gradually to the right, the volume of escape offered to the liquid returning to the reservoir continually increases. Hence the possibility of making the superfluous part of the fuel return to the reservoir when the engine is required to furnish a torque below the maximum torque.

However, when the engine is "driven" as is the case, for example, for the engine of a vehicle when the latter is going downhill, seeing that the throttle member 46 can be brought by the driver into a partially closed position corresponding to slow-running speed while the engine is turning at a relatively high speed by reason of the drive exerted on it by the vehicle going downhill, the pressure on the intake side of this member may increase abnormally. To obviate this drawback, ports 61 are provided, connecting the chamber 48 with the overflow pipe 59 when the piston 50 shifts to the right far enough to uncover the ports 61. It is towards the end of its course to the right that this piston uncovers these ports. The fuel on the intake side of the throttle member 46 then finds, through these ports 61, an issue allowing it to return to the reservoir and, at the same time, to relieve its pressure. In the farthest position to the right of the piston 50, the ports 58 are completely uncovered. The pressure on the discharge side of the throttle member 46 may then fall very low, for the delivery still

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flowing through this throttle member is very weak, whereas the return path to the reservoir through the ports 58 and the overflow pipe 59 is wide open. It is thus practically no longer possible for the fuel to reach the injectors, which are normally situated at a higher level. The check-valve 60 then intervenes by preventing the pressure from the discharge side of the throttle member 46 to fall below a certain limit, which keeps the piping filled with fuel so as to allow the engine to accelerate again almost simultaneously.

It is clear that the apparatus described, while ensuring prompt acceleration of the engine, prevents any waste of fuel when the engine is "driven," as is often the case with engines employed for traction.

The structure represented in Figure 2 includes, moreover, means allowing of its application to internal combustion engines capable of operating under conditions liable to change from the point of view of the charge air (engines fitted with compressors).

With that object in view, the conical surface 57 is not a surface of revolution, as can be seen in Figure 3. It is formed of two eccentric conical surfaces. Thus, according to the angular position of this piston in relation to the ports 58, the cross-section of the passage open to the liquid coming from these ports varies for a given axial position of the piston. The cross-section of the passage open to the fuel returning to the reservoir can thus be made to conform with the variations in the charge of air of the engine itself. A handle 62, fixed to the piston 50 and passing through a lateral opening 63 in the wall of the cylinder 49 allows varying the angular position of the piston 50 in relation to this cylinder. It is seen that this arrangement functions similarly to the device described in the case of Figure 1 and which serves to vary the transmission ratio between the air-throttle 29 and the throttle member 6.

For the proper operation of an internal combustion engine, it is useful to keep fairly constant the composition of the mixture, the delivery of which must generally vary according to the rotatory speed of the engine and the opening of the air-throttle. To obtain this result, the handle 62 should be connected with the handle 43 of the air-throttle 42. Due to this arrangement, the desired aim is achieved. The cross-section of the passage open to the liquid passing through the ports 58 being of appropriate dimension in relation to the outlet volume of the injector, the amount of liquid escaping through these ports 58 can be regulated so that it varies progressively towards the limit at which the delivery going to the injector is just sufficient to turn the engine over. Now, this variation should correspond to the intake of air allowed by the air-throttle 42. The pressure drop that is thus engendered in the stream of air circulating in 41 obeys practically the same law as the pressure drop that is created in the liquid stream by means of the throttle member 46. It results from this that the pressures on the intake side and on the discharge side of the throttle member can make the piston 50 shift and give the necessary cross-section of the passage for the excess fuel so as to ensure the working of the engine with a mixture of practically constant composition.

In providing between the levers 43 and 45 for an arrangement similar to that which was described in the case of Figure 1, for varying the transmission ratio of the movement between the

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air-throttle 29 and the throttle member 6, variations in the composition of the mixture can be devised and made to depend on the speed of the engine. A more economical working may thus be realised and one which is better adapted to the special conditions of use of the engine itself.

The apparatus represented in Figures 2 and 3 offers the advantage of an important simplification of the structure in that the same pump, 34, serves at the same time to feed the engine in fuel and to regulate the working of this engine. In fact, it is the liquid stream actuated by this pump which is utilised by the apparatus to produce this regulation.

What I claim is:

1. A regulating and fuel feeding apparatus for internal combustion engines comprising a pump driven by the engine and producing a flow of fuel through a conduit at a speed proportional to the rotary speed of the engine, an adjustable throttle member in said conduit for producing a pressure drop in said conduit, the degree of which varies inversely with the degree of opening of said throttle, a cylinder, a piston slidably mounted in said cylinder intermediate the ends thereof dividing said cylinder into two opposed chambers with the ends of the piston forming movable walls of the two opposed chambers, pipes connecting one chamber with said conduit anteriorly of said throttle and the other chamber with said conduit posteriorly of said throttle, whereby the pressures in said conduit on opposite sides of the throttle will act upon said movable walls to balance the resultant thrust on said walls produced by the pressures in said conduit to cause the walls to assume a position of equilibrium, a reservoir for supplying fuel to said conduit, said cylinder having at least one first port communicating with said reservoir, said piston cooperating with said port for returning to the reservoir excess fuel in the conduit on the posterior side of the throttle in said conduit, to regulate the fuel feed to the motor according to the position of the adjustable throttle, said cylinder having at least one additional port communicating with said reservoir, said piston cooperating with said additional port, for returning to the reservoir, fuel in the conduit on the anterior side of the throttle, said additional port being open at the end of the displacement of said piston in the cylinder, by complete opening of the first port.

2. A regulating and fuel feeding apparatus for internal combustion engines comprising a conduit, means for producing a flow of fuel through said conduit at a speed proportional to the rotary speed of the engine, an adjustable throttle member in said conduit for producing in said conduit, at will, a pressure drop also proportional to the rotary speed of the engine, two chambers, a movable wall associated to each of said chambers, said two movable walls being rigidly connected together, pipes connecting one chamber with said conduit anteriorly of said throttle and the other chamber with said conduit posteriorly of said throttle, so that the pressure in said conduit on opposite sides of the throttle act in opposition on the device constituted by said movable walls, means exerting a force for balancing the resultant thrust of the thrusts produced on the two movable walls by the pressures established in each of said chambers, means actuated by said device controlling the fuel quantity flowing from said throttle to the engine and from said throttle to a return pipe to the fuel tank, for regulating the fuel delivery to the motor, an air pipe for the en-

gine in which the air flows at a speed proportional to the speed of rotation of the engine, an air throttle member in said air pipe producing in said pipe a pressure drop proportional to the speed of rotation of the engine, a mechanical linkage synchronizing the movements of the two aforesaid throttle members, in order to assume a substantially constant relation between fuel and air delivery, in weight, to the engine.

3. A regulating and fuel feeding apparatus, according to claim 2, wherein the linkage comprises means for adjusting the ratio of movement between said two throttles.

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