Dec. 22, 1953 H. K. LINKS 2,663,289

REGULATOR FOR INJECTION COMBUSTION ENGINES

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Fig. 1

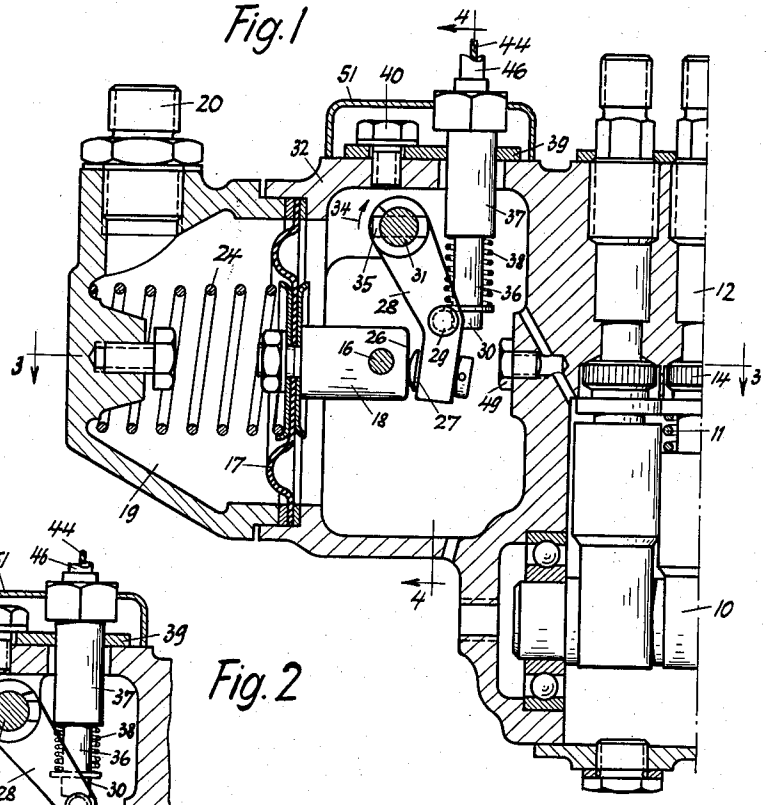


Fig. 2

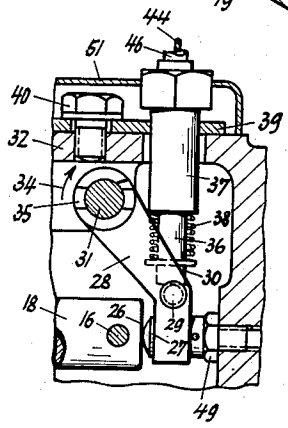
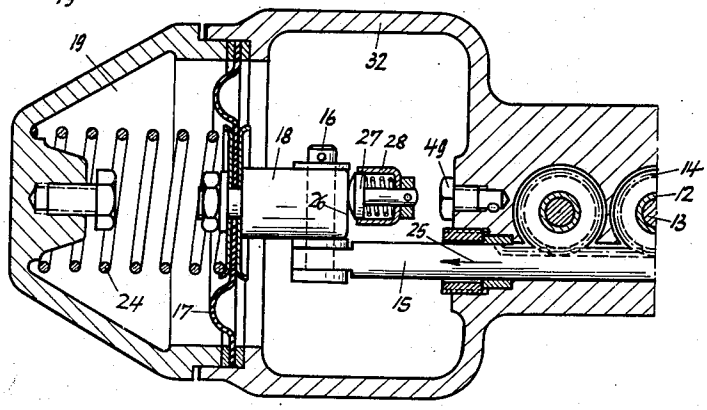


Fig. 3



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Fig. 4

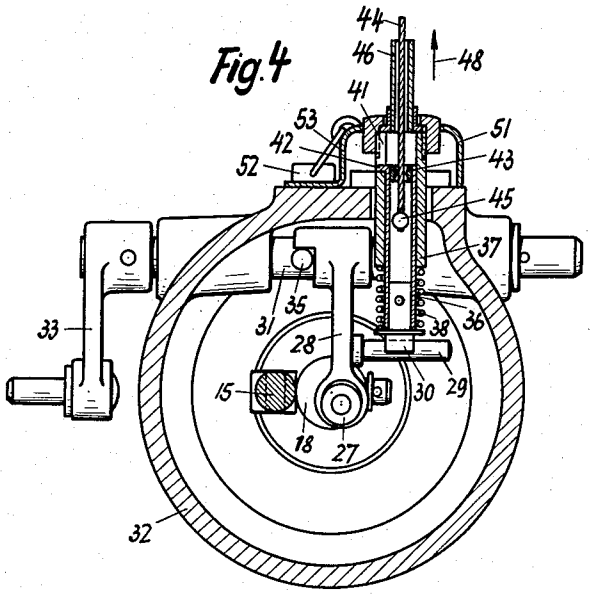
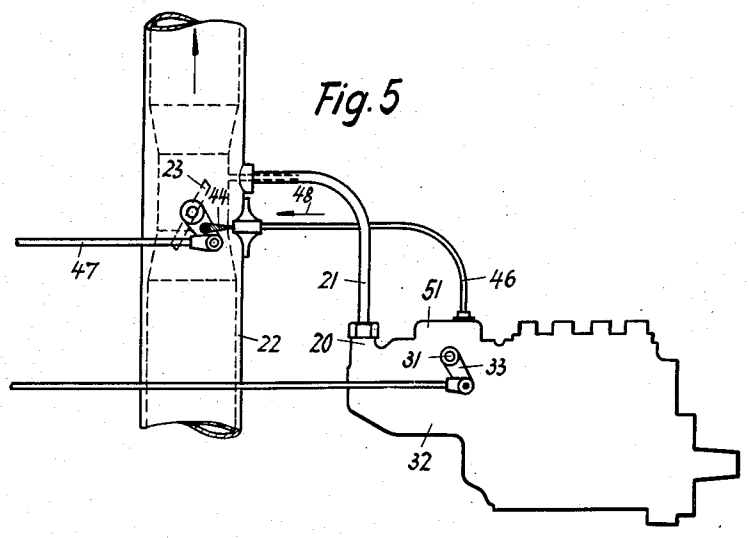


Fig. 5



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REGULATOR FOR INJECTION COMBUSTION ENGINES

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8 Claims. (Cl. 123—140)

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The invention relates to a governor for injection combustion engines automatically controlling the quantity of the fuel injected into the cylinders of the engine in dependence on the load and the number of revolutions of the engine, means being provided for the starting of the engine which permit a temporary increase of the quantity injected beyond the full load limit which is determined by a stop provided in the governor.

It is an object of the present invention to prevent the driver from abusively operating the means provided for increasing the quantity of fuel beyond the full load limit contrary to its destination for the purpose of increasing the power output of the engine, for instance when driving uphill, since such abusive operation would result in a premature wear of important elements of the engine.

More particularly, it is an object of the invention to provide safety means of the character indicated in connection with a pneumatic governor. Accordingly, it is a feature of the invention to so connect a stop with the linkage actuating a throttle valve provided within the intake pipe of the internal combustion engine that such stop will permit the fuel control member, when the throttle valve is closed, to move all the way into starting position, said fuel control member being adjusted by the vacuum prevailing in the intake pipe. When the throttle valve is closed, the fuel control member of the governor cannot move into the starting position unless the engine is stopped because, in that event only, the control spring will be sufficiently relaxed for that purpose whereas, when the engine is running in throttled condition, said spring will rather tend to reduce the quantity of fuel than to increase the same. As a consequence, the fuel control member will advance past the withdrawn stop into the starting position remaining in the latter as soon as the running engine is stopped, the throttle valve being closed coincidentally thereto. The fuel control member will remain in the advanced starting position even if subsequently the throttle valve should be fully re-opened again for the purpose of starting the engine. Not until the throttle valve has been temporarily more or less closed after the engine has started and has caused the fuel control member by its governing means to be pulled back to a position corresponding to a fuel quantity less than the full load quantity, will the movable stop upon a re-opening of the throttle valve return into the path of the fuel control member, being operative henceforth, as long as the engine keeps running, to prevent the fuel control member from moving

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beyond its full load position. Thereby it is ensured that an excess fuel injection exceeding the full load quantity cannot be used except for starting the stopped engine and, more particularly, can never be used for increasing the power output of the running engine.

Further objects and characteristics of the invention as well as its mode of operation result from the following description of an example of construction in connection with the drawing. In the drawing:

Figure 1 shows a vertical longitudinal cut through the regulator part of an injection pump for an air compressing injection combustion engine in the running condition of the latter,

Figure 2 shows a section from Figure 1, in which the regulator parts in question are shown in their positions in the stopped condition of the engine,

Figure 3 shows a horizontal longitudinal cut along the line 3—3 of Figure 1,

Figure 4 shows a cross section along the line 4—4 of Figure 1 and

Figure 5 shows a diagrammatic view from which the connection of the regulator parts with the suction pipe of the combustion engine and with the control linkage of same is visible.

The pistons 13, which are moved to and fro in the cylinders 12 of the injection pump by a camshaft 10 and by return springs 11, are in the known manner provided with inclined control edges, so that the quantity of fuel, which is fed by each piston, can be continuously regulated by turning the pistons by means of the gear wheels 14 and of the axially slidable toothed rack 15. The rack 15 is positively connected by a pivot pin 16 with the head 18, which in turn is fastened in the middle of a diaphragm 17 of flexible material. The diaphragm 17 forms the tight seal of a space 19, which is connected by the nipple 20 and a pipe 21 with the air suction pipe 22 of an injection combustion engine, such as a diesel engine. This connection is effected at a point of the suction pipe, which is located behind the throttle valve 23, so that the diaphragm 17 is more or less drawn into the space 19 by the vacuum which exists in the suction pipe when the engine is running, against the tendency of the governor spring 24, the diaphragm taking along the toothed rack 15 in the sense of a decrease of the quantity of fuel, which is fed by the injection pump, i. e. in direction of the arrow 25. This applies primarily to the throttled operation of the engine, when the throttle valve 23 is more or less closed, but as a safety measure it also applies to the full load operation, in order to prevent the engine from

running too fast when the throttle is opened and when the load imposed by road conditions is small.

In ordinary full load operation, when the vacuum in the suction pipe 23, and thus also in the space 19, is weak, the diaphragm 17, which forms together with the head 18 the movable fuel control member, and the tooth rack 15, under the effect of the spring 24, occupy the position shown in Figures 1 and 3. The inner end face 26 of head 18 engages the head 27 of the detent lever 28 and the lever 28 in turn engages a stop 30 by means of a cross pin 29 attached to the detent lever.

Thereby the injection quantity of the pump is limited to the full load quantity, when the engine is running.

Except for the function described, the lever 28 has nothing further to do with the object of the invention. It is pivotally mounted in the regulator casing 32 with assistance of the shaft 31 and serves as a so-called stop lever only for stopping of the engine, for which purpose the shaft 31 is turned in the sense of the arrow 34 by means of a lever 33, which is attached to it outside the casing 32, and thereby rocks the stop lever in the same sense by means of a coupling pin 35. In this operation, the stop lever by means of the head 18 moves the diaphragm 17 and the toothed rack 15 opposite to the effect of the spring 24 in the direction of the arrow 25 so far outwardly that the fuel feed of the injection pump is completely interrupted and the engine is stopped.

The stop tenon 30 is fastened in a bushing 36 and is slidable with it axially and outwardly in a second bushing 37 against the effect of a spring 38. The guide bushing 37 fastened to the governor housing 32 by means of a holding plate 39 and of a screw 40 is provided at its outer end at one side with a slot 41, in which a tongue 42 is guided, which is bent off from the slidable bushing 36. The latter tongue limits the motion of the bushing 36 and thereby the motion of the stop 30 in downward direction, so that the spring 38 can move the stop up to the position only which is shown in the Figures 1, 3 and 4, and in which the cross pin 29 engages the stop. The bushing 36 is at its upper end closed with a metal stopper 43, which is firmly connected with it. Through a narrow bore of this stopper a wire of spring steel or a thin wire cable extends which is provided with an abutment 45 soldered to its inner end. This traction cable is guided in a metal tube 46 extending to the throttle valve 23 in the suction pipe of the combustion engine and there is connected with the control linkage 47 of the throttle valve in such a manner that when the latter is fully opened it occupies the position as shown in Figure 4.

Upon closing of the throttle valve the traction cable 44 is taken along outwardly by the linkage of the valve in the direction of the arrow 48. During this operation it slides first in the bore of the stopper 43, until its abutment 45 pushes against the stopper from below. From then on, i. e. during the last part of the closing motion of the throttle valve, the traction cable takes the bushing 36 and the stop 30 positively along in outward direction whereby the stop is removed out of the way of the cross pin 29. However, while the engine is running this removal of the stop has no influence on the adjustment of the fuel quantity fed by the pump, as the unlatching does not take place until the throttle valve is nearly closed and as then the vacuum in the suction pipe of the engine is so great that it arrests the diaphragm 17 and thereby the toothed rack 15 of the regulator in the idling position of the governor spring 24 being compressed. When the throttle valve is opened again while the engine keeps running, the stop 30 returns already during the first part of the opening motion of the throttle valve under the effect of the spring 38 into the locked position, which is shown in the Figures 1 and 4 and thereby henceforth prevents the governor from the adjustment of a larger injection quantity than the full load quantity.

Upon complete stopping of the engine, which is effected by closing of the throttle valve 23 and momentary operation of the stop lever 28, the conditions are, however different. Coincidentally to the closing of the throttle valve the stop 30 is lifted exactly as before in direction of the arrow 48 and thereby removed out of the way of the cross pin 29. As soon as now the detent lever 28 is released after the stopping of the engine, it is rocked by the governor spring 24 through the diaphragm 17 and the head 18 opposite to the direction of the arrow 34 until the detent lever engages the screw 49 (Figure 2), since now with the engine at rest there is no longer any vacuum in the suction pipe of the engine and the governor spring 24 is consequently relieved. Simultaneously the toothed rack 15 is displaced by the joint bolt 16 opposite to the direction of the arrow 25 beyond the full load position shown in Figure 3 into the starting position, in which it adjusts the pump to feed a larger injection quantity than the full load quantity. When now the throttle valve 23 is opened quite wide for restarting the engine, the stop 30 can no longer place itself in a locking manner before the cross pin 29, but, as can be seen in Figure 2, can under the effect of the spring 38 only engage the latter from above. It cannot rock back the lever 34 in direction of the arrow 34 either, because the spring 38 has a considerably smaller tension than the strong governor spring 24 and the latter is fully relieved when the engine is started, as starting is effected with widely opened throttle valve and small number of revolutions, i. e. without vacuum in the suction pipe of the engine. As soon as the engine has started, the throttle valve 23 is taken back again into the idling position. The toothed rack 15 is thereby restored to the idling position by the diaphragm 17 under the effect of the vacuum which exists now in the suction pipe 22.

From now on, as long as the engine runs, the stop 30 engages in front of the cross pin 29 in a locking manner being permitted by the throttle linkage to do so and prevents the governor from the adjustment of a larger injection quantity than the full load quantity.

Through the described arrangement and construction of the regulator parts absolute assurance is therefore given that the regulator can be adjusted for an injection quantity exceeding the full load quantity only for the starting of the engine. In order to indicate any tampering with the function of the regulator, the fastening screw 40 for the locking parts is arranged in a covered manner under a sheet metal cap 51, the holding screws 52 of which are again secured by a wire loop 53 provided with a lead seal. In a similar manner also the connection of the traction cable 44 with the throttle valve rods 47 can be secured against unauthorized disassembly.

The invention is in the shown example of construction applied to a vacuum regulator. It can

with the same advantages also be applied to a centrifugal governor.

What I claim is:

1. In a pneumatic governor of a fuel injection pump for an internal cumbustion engine of the type having a diaphragm-actuated fuel control member responsive to a throttle in the air intake conduit of the engine, and a stop mounted for common movement with the closing movement of said throttle from an operative position in which it limits the travel of said control member in a fuel-increasing direction to an inoperative position when the throttle is closed, the combination with said stop of a detent adapted to detain said stop in said inoperative position irrespective of the position of said throttle, when sad diaphragm-actuated fuel control member is relaxed upon stoppage of the engine, and to be disengaged from said stop under control by said control member, when the engine is started.

2. In a pneumatic governor of a fuel injection pump for an internal combustion engine of the type having a diaphragm-actuated fuel control member responsive to a throttle in the air intake conduit of the engine, and a stop mounted for common movement with the closing movement of said throttle from an operative position in which it limits the travel of said control member in a fuel-increasing direction to an inoperative position when the throttle is closed, the combination with said stop of a detent adapted to detain said stop in said inoperative position, said detent being so co-ordinated to said diaphragm-actuated control member as to be disabled by the same while said control member is vacuum-actuated and to be enabled to function by said control member while the diaphragm thereof is relaxed.

3. In a pneumatic governor of a fuel injection pump for an internal combustion engine of the type having a diaphragm-actuated fuel control member responsive to a throttle in the air intake conduit of the engine, and a stop mounted for common movement with the closing movement of said throttle from an operative position in which it limits the travel of said control member in a fuel-increasing direction to an inoperative position when the throttle is closed, the combination with said stop of a detent, a spring tending to engage said detent with said stop, when the latter arrives in inoperative position, to detain said stop therein, said spring being so co-ordinated to said diaphragm-actuated fuel control member as to be disabled thereby while the engine is running.

4. The combination claimed in claim 1 in which said stop is constituted by a pin mounted for axial sliding movement transversely to the path of said control member.

5. The combination claimed in claim 1 in which said detent is constituted by a pivotal member adapted to be rocked to locking position by said diaphragm-actuated fuel control member in response to a stoppage of the engine, a spring being provided acting on said stop and adapted, when said control member releases said pivotal member in response to vacuum in said intake conduit, to return said stop to said operative position.

6. The combination claimed in claim 1 in which the means connecting said throttle with said stop include a flexible wire encased in a tube and a lost-motion connection.

7. The combination claimed in claim 1 including connecting means connecting said stop to said throttle and means encasing said connecting means to prevent manual actuation thereof independently of said throttle.

8. The combination claimed in claim 1 including a guide for said stop and sealing means for said guide adapted to indicate any disassembly of said guide.

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