June 7, 1955 J. T. KULHAVY 2,709,993

THROTTLE GOVERNOR

Filed July 23, 1952 2 Sheets-Sheet 1

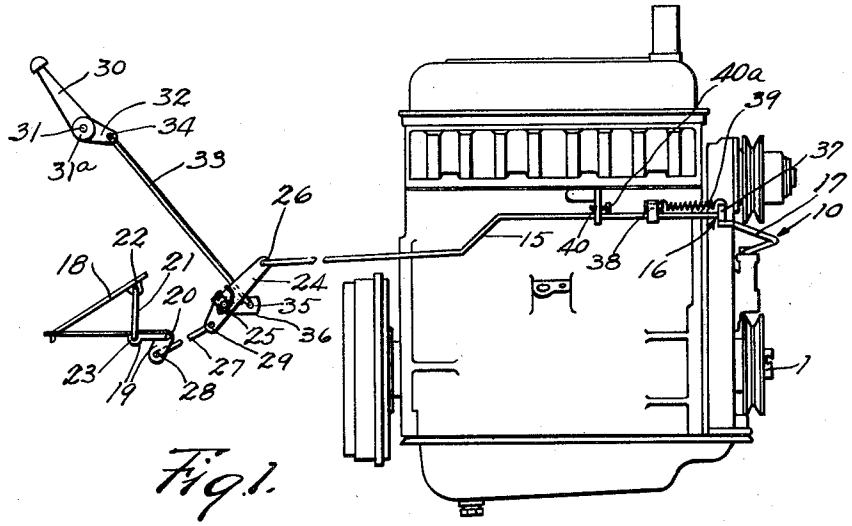

Fig. 1.

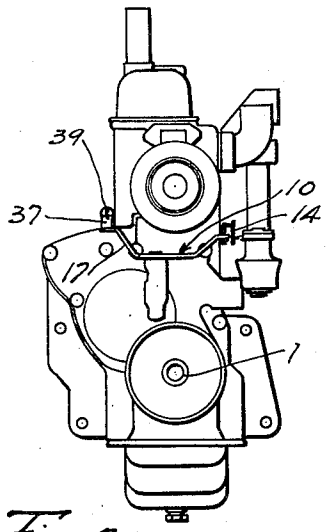

Fig. 3.

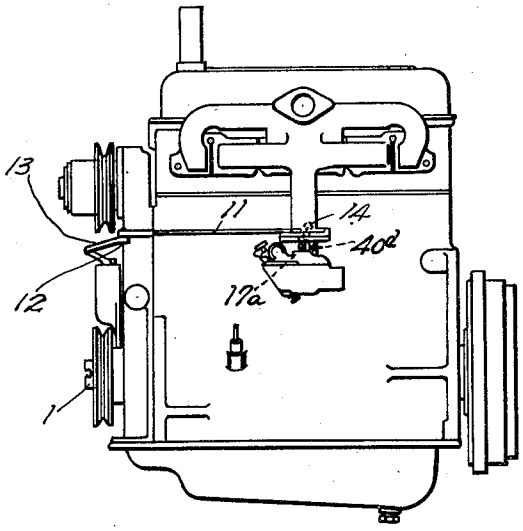

Fig. 2.

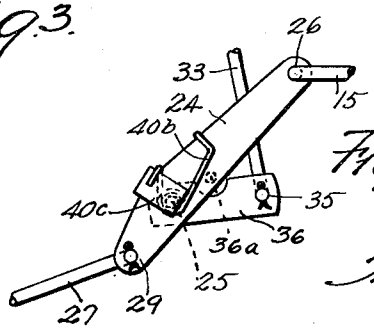

Fig. 6.

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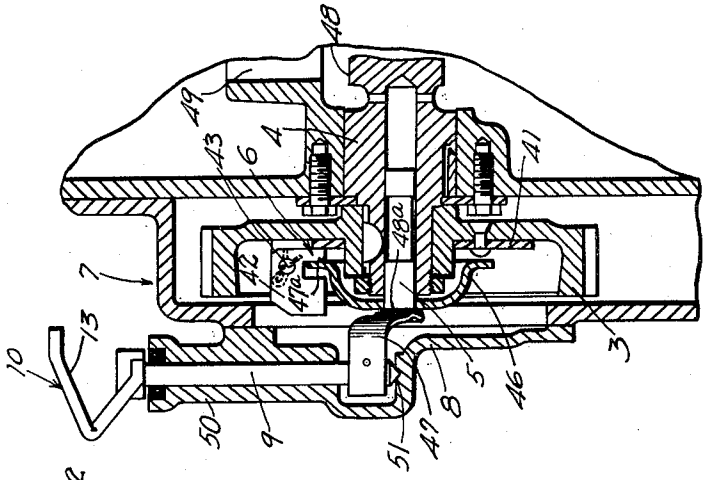

Fig. 5.

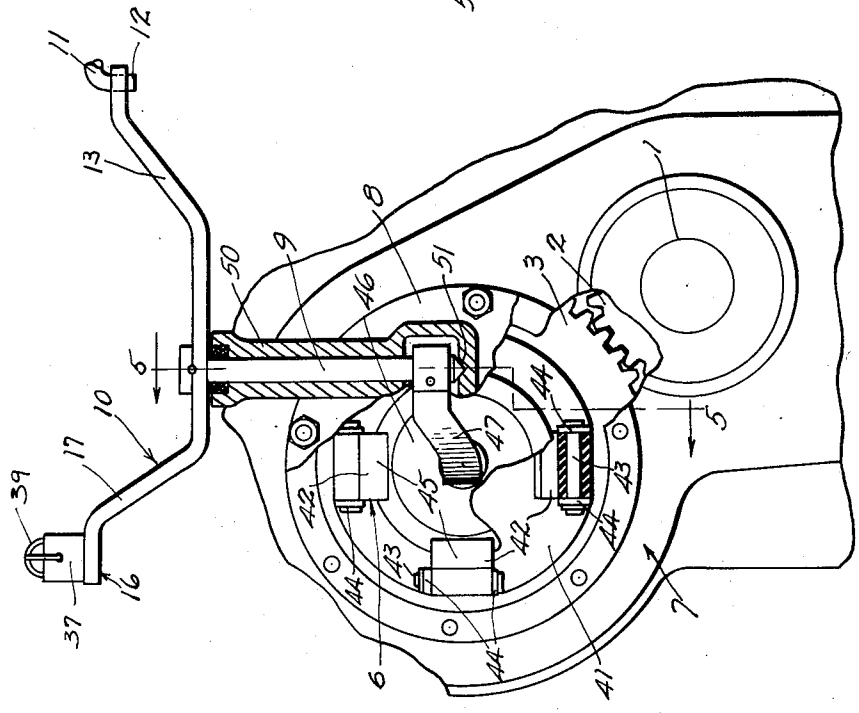

Fig. 4.

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THROTTLE GOVERNOR

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Application July 23, 1952, Serial No. 300,477

16 Claims. (Cl. 123—98)

My invention relates to throttle governors.

This application is a continuation of my copending application Serial No. 767,400, and now abandoned.

One of the objects of my invention is to provide improved speed-controlled means for controlling the throttle valve of an internal combustion engine.

A further object is to provide such a construction in which the throttle control is accomplished by means of a flyweight governor mounted to rotate with a timing gear.

Another object is to provide such a construction in which the transmission between the auxiliary pedal and the throttle valve is yieldable to enable the governor to control the opening movement of the throttle valve.

In the drawings, in which an embodiment of my invention is shown,

Figure 1 is a side elevational view of an internal combustion engine having speed-controlled means for controlling the throttle valve;

Fig. 2 is an elevational view of the side opposite that shown in Fig. 1;

Fig. 3 is a front elevational view;

Fig. 4 is an enlarged front elevational detail view showing the governor and timing gears;

Fig. 5 is a sectional view on the line 5—5 of Fig. 4; and

Fig. 6 is an enlarged detail of a portion of Fig. 1.

Referring to the drawings in detail, the construction shown comprises an internal combustion engine having a crankshaft 1, a timing gear 2 mounted on the crankshaft, a second timing gear 3 meshing with the first timing gear, a valve-controlling cam shaft 4 (Fig. 5) rotatable with the second timing gear, an axially movable actuating plunger 5 slidable longitudinally in the cam shaft and coaxial therewith, a flyweight governor 6 mounted on the second timing gear for actuating the plunger 5, a housing 7 for the timing gears, a detachable cover 8 for this housing, a rockshaft 9 mounted on this cover, a rock arm on the rockshaft actuated by the plunger 5, a two-armed rock lever 10 mounted on the rockshaft 9, a link 11 having one end pivotally connected at 12 to one arm 13 of the rock lever, a carburetor valve lever 14 connected to the other end of the link, a link 15 yieldably connected at 16 with the other arm 17 of said lever, and means for actuating this link.

In operation, as the speed of the engine increases, the flyweight governor 6 will cause the plunger 5 to move axially to the left, as viewed in Fig. 5, causing the rockshaft 9 and two-armed rock lever 10 to move counterclockwise as viewed from above, thus moving the link 11 in a direction to effect closing movement of the throttle valve. The throttle valve has a stop 17a to prevent it from being closed entirely. Due to the yielding connection between the two-armed lever and the actuating link 15 for this lever, the governor 6 can exercise this control regardless of the position of the actuating link.

Both foot and hand controls are provided for the actuating link or rod 15. The foot control comprises a spring-returned pedal 18 (Fig. 1) connected to the actuating link 15 in such a way that downward movement of the pedal will tend to move the actuating rod 15 to the left as viewed in Fig. 1 to open the throttle valve wider. This transmission between the pedal 18 and link 15 comprise a bell crank lever 19 pivotally mounted at 20, a link 21 pivotally connected at 22 with the pedal and pivotally connected at 23 with the bell crank lever, a rock lever 24 pivotally mounted at 25 and pivotally connected with the actuating rod 15 at 26, and a link 27 pivotally connected at 28 with the bell crank lever and at 29 with the rock lever 24.

The manual control is provided in part to enable the throttle to be positively closed to idling position, and in part to enable the operator to set the engine to operate at various speeds, each under control of the governor. It comprises a hand lever 30 pivotally mounted at 31 and provided with a friction pad 31a of well known form to maintain the lever in adjusted positions but so as to be readily shifted by overcoming the friction. Lever 30 has an arm 32 connected by a link 33 through pivotal connections 34 and 35 with a short lever 36 adjacent above mentioned lever 24 and which works on above mentioned pivot 25 (see Fig. 6). Lever 24 has a boss 36a overlying lever 36 so that upward rocking of lever 36 will cause corresponding rocking of lever 24, whereas lever 24 is free to rock in this direction without interference from or with lever 36. By means of this mechanism hand lever 30 may be used to set lever 24 in position for any desired engine speed, said speed being increased at any time if desired by pressing on pedal 18. When pedal 18 is released, lever 24 will return to the position determined by the setting of lever 30.

In order to have governor control of the engine, it is necessary that the flyweight governor, which will be more particularly described presently, shall have the capability of controlling the throttle valve throughout the full range of its movement substantially independently of the position or setting of controls 18 and 30, and for this reason link 15 is connected yieldingly to arm 17. The latter has an abutment block 37, while link 15 has an anchor block 38 secured thereto, a coil tension spring 39 being secured at one end to the anchor block 38 and at the other end to the abutment block 37. The end of the link 15 engages the abutment block 37 unless the parts are separated by the action of the controls or the flyweight governor or both.

Inspection of the parts so far described will show that a comparatively small movement of links 15 and 11 will suffice to throw throttle lever 14 from closed or idling position to fully open, or vice versa, while said link 15 is capable of several times this amount of movement. Assuming no-load conditions and slow idling operation, a small downward movement of lever 30 will immediately open the throttle wide. This will be followed immediately by rapid acceleration of the engine. Such speeding up will cause governor 6 to develop sufficient rocking force on shaft 9 to stretch spring 39, separating abutment 37 from link 15 and closing or substantially closing the throttle so as to stop further increase in speed. A load imposed on the engine would reduce its speed whereupon spring 39 would overcome governor 6 and open the throttle to enable the engine to carry the additional load. In practice the spring and governor come to equilibrium with the throttle open just enough to carry the load at the desired speed.

Further movement of link 15 in response to either lever 30 or pedal 18 cannot of course open the throttle more than the movement above described, but serves to stretch spring 39 so as to increase its tension. The forces will then balance at a higher speed than before so that the engine will be under governor control at an increased speed.

A guide bracket 40 is provided for guiding link 15 and

which has an adjustable abutment 40a engageable by anchor block 38 to limit the possible tension in spring 39 and accordingly the maximum speed at which the engine can be run. Throttle lever 14 may be moved to closed or slow idling position when desired by a spring 40b in torsion between the above mentioned lever 24 and an abutment block 40c fixed on pivotal mounting 25. Upon downward movement of lever 36, lever 24 is free to rock in a clockwise direction as seen in Figs. 1 and 6 which will rock throttle lever 14 in a closing direction, as will be apparent, until arrested by the usual idling adjustment screw 40d coming into contact with stop 17a.

The flyweight governor (Figs. 4 and 5) comprises an annular mounting plate 41 secured to the timing gear 3, four governor weights 42 pivotally mounted on pins 43 extending through the governor weights 42 and through ears 44 struck up from the material of the mounting plate. These governor weights have arms 45 extending radially inwardly for engagement with a thrust plate or cup 46 secured to the plunger 5. As the speed of the engine increases, assuming the parts to be in any except slow idling position, the governor weights 42 will move radially outwardly, causing the arms 45 to move the plunger 5 and thrust plate 46 to the left, as viewed in Fig. 5. In this movement, the plunger 5 will engage the arm 47 on the rockshaft 9 and move the rockshaft and the two-armed lever 10 counterclockwise as viewed from above, thus moving the throttle valve toward closed position regardless of the position of the actuating link 15 and pedal 18.

This action calls for a particular and rather critical balance between the outwardly moving tendency of weights 42 under centrifugal force and the resistance of spring 39. It will also be appreciated that the centrifugal force for a given speed of gear wheel 3 will vary with the position of weights 42. In other words, when the weights are further out they travel in a larger circle and the centrifugal force is increased, even though the speed is not. This force increases in accordance with a quadratic function. At the same time, the resistance of spring 39 also increases due to its extension but only as an arithmetic function. However for the governor to be stable, the resistance of spring 39 as the weights 42 move out must increase slightly faster than the centrifugal force of the weights increases, considering only the centrifugal force due to the larger circle of rotation. It will, therefore, be apparent that a rather complicated relation exists between weights 42 and spring 39. In the present instance, it has been found that the necessary compensation or balancing between the two opposed forces can be achieved by making arm 45 with a relatively small rounded corner 47a which bears against thrust plate 46. In this manner, a nearly constant leverage between weights 42 and thrust plate 46 is achieved so that the outward force of the weights 42 against plate 46 is not appreciably multiplied as the weights move out. With this arrangement, a satisfactory balance is achieved between the weights 42 and spring 39, and good regulation of the engine is obtained.

As seen in Figs. 4 and 5, above mentioned plunger 5 has a flat head or surface and arm 47 is provided with a convex abutment portion 48a, preferably in the form of a cylindrical segment formed on the arm in any suitable manner substantially parallel to rockshaft 9. With this construction there is no tendency for wear to form a pit in either member, which would cause the governor to "hang" in some particular position and interfere with close regulation. Although the parts are ordinarily hardened, so that wear is very slight, in spite of such wear plunger 5 remains flat and portion 48a remains round, and accuracy of regulation is maintained over long periods. The vertical rockshaft 9 is rockably mounted in a bearing in the sleeve 50 on the cover plate 8. The weight of the rockshaft 9, rocker 10 and associated parts

is taken care of by a conical thrust bearing 51 in which the lower end of the rockshaft 9 is seated.

The cam shaft 4 is provided with the usual cams 43 for engagement with the valve stems which are slidable in the valve stem guides 49.

Further modifications will be apparent to those skilled in the art and it is desired, therefore, that the invention be limited only by the scope of the appended claims.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. Control apparatus for use with an internal combustion engine having a spring return accelerator pedal, and a carburetor valve, said apparatus comprising a governor controlled by the engine speed, an actuating plunger actuated by said governor, a rockshaft, a rock arm on said rockshaft actuated by said plunger, a two-armed rock lever mounted on said rockshaft, transmission between said one arm of said rock lever and carburetor valve for controlling the opening of the valve and transmission between said pedal and the other arm of said rock lever yieldable to enable the governor to limit the opening movement of the carburetor valve.

2. Control apparatus for use with an internal combustion engine having a spring return accelerator pedal, a carburetor valve and a manual valve closing member, said apparatus comprising a speed controlled governor and transmission between said governor and valve for controlling the opening of the valve and between said pedal and valve yieldable to enable the governor to control the opening movement of the valve and between the manual valve closing member and the valve for positively closing the valve, the transmission for the pedal comprising a rock lever positively positioned by the pedal, the transmission for the manual member comprising a rock lever coaxial with and adjacent said first lever, and means for limiting the relative rocking movement of said rock levers.

3. Control apparatus for use with an internal combustion engine having a fuel control valve, said apparatus comprising a governor controlled by engine speed having a control element mounted for movement back and forth, the movement of which is controlled by the governor, transmission between said control element and said valve effective to transmit force from said element to said valve as said element moves in a direction to close the valve but ineffective to transmit force from said element to said valve as said element moves in the opposite direction, spring means acting to open said valve, a man-operated element movable to different positions, lost-motion positive closing, yielding opening transmission between said man-operated element and valve to move the valve positively toward closing position and to enable said control element to move the valve toward closing position in advance of said positive closing, means for holding said man-operated element in any one of a number of adjusted positions, and man-operated means for operating said valve to move it from the position in which it is held by said holding means, said man-operated means comprising a rock lever, said man-operated member comprising a rock lever coaxial with said first rock lever.

4. Control apparatus for use with an internal combustion engine having a fuel control valve, said apparatus comprising a governor controlled by engine speed having a control element mounted for movement back and forth, the movement of which is controlled by the governor, transmission between said control element and said valve effective to transmit force from said element to said valve as said element moves in a direction to close the valve but ineffective to transmit force from said element to said valve as said element moves in the opposite direction, spring means acting to open said valve, a man-operated element movable to different positions, lost-motion positive closing, yielding opening transmission between said man-operated element and valve to move the valve positively toward closing position and to enable said control

element to move the valve toward closing position in advance of said positive closing, means for holding said man-operated element in any one of a number of adjusted positions, man-operated means for operating said valve to move it from the position in which it is held by said holding means, and spring means for returning said valve to the position in which it was held by said holding means, said man-operated means comprising a rock lever, said man-operated member comprising a rock lever coaxial with said first rock lever, and means for limiting the relative rocking movement of said rock levers.

5. Control apparatus for use with an internal combustion engine having a carburetor valve, said apparatus comprising a tubular cam shaft, a cam mounted thereon, a bearing through which said shaft extends, a timing gear mounted on said shaft on the opposite side of said bearing from said cam, a flyweight governor mounted on said gear on the side remote from the bearing, and a plunger slidable in the tubular shaft actuated by the flyweight governor to project it from the end of the shaft into engagement with a controller for the carburetor valve, said controller being on that side of the gear remote from said bearing.

6. Control apparatus for use with an internal combustion engine having a carburetor valve, said apparatus comprising a tubular cam shaft, a cam mounted thereon, a bearing through which said shaft extends, a timing gear mounted on said shaft on the opposite side of said bearing from said cam, a flyweight governor mounted on said gear on the side remote from the bearing, and a plunger slidable in the tubular shaft actuated by the flyweight governor to project it from the end of the shaft into engagement with a controller for the carburetor valve, said controller being on that side of the gear remote from said bearing, said plunger having an outwardly extending flange engaged by said flyweight governor.

7. Control apparatus for use with an internal combustion engine having a carburetor valve, said apparatus comprising a tubular cam shaft, a cam mounted thereon, a bearing through which said shaft extends, a timing gear mounted on said shaft on the opposite side of said bearing from said cam, a flyweight governor mounted on said gear on the side remote from the bearing, and a plunger slidable in the tubular shaft actuated by the flyweight governor to project it from the end of the shaft into engagement with a controller for the carburetor valve, said controller being on that side of the gear remote from said bearing, said gear having a recess therein surrounded by the rim and teeth of the gear in which recess said flyweight governor is mounted.

8. Apparatus for controlling the flow of gas to an internal combustion engine comprising valve means for controlling the passage of gas, means controlled by engine speed for controlling said valve means to hold down the speed of the engine, spring means urging the valve means toward higher speed position and opposing the hold-down action of said valve-controlling means, and operator-controlled variable position means cooperating with said speed control means for controlling said valve, acting through said spring means for urging said valve means toward high speed position, and having means for positively moving said valve means to lowest speed position, and being movable, when not prevented by said speed-controlled speed-controlling means, to move said valve means through said spring means to the highest speed position of the valve means and said operator-controlled variable position means being movable beyond the highest speed valve position for increasing the opposing action of the spring means to increase the engine speed required to overcome the spring action.

9. Apparatus for controlling the flow of gas to an internal combustion engine comprising valve means for controlling the passage of gas, centrifugal means controlled by engine speed for controlling said valve means

to hold down the speed of the engine, spring means urging the valve means toward higher speed position and opposing the hold-down action of said valve-controlling means, and operator-controlled variable position means cooperating with said speed control means for controlling said valve, acting through said spring means for urging said valve means toward high speed position, and having means for positively moving said valve means to lowest speed position, and being movable, when not prevented by said speed-controlled speed-controlling means, to move said valve means through said spring means to the highest speed position of the valve means and said operator-controlled variable position means being movable beyond the highest speed valve position for increasing the opposing action of the spring means to increase the engine speed required to overcome the spring action.

10. Apparatus for controlling the flow of gas to an internal combustion engine comprising valve means for controlling the passage of gas, means controlled by engine speed for controlling said valve means to hold down the speed of the engine, spring means urging the valve means toward higher speed position and opposing the hold-down action of said valve-controlling means, operator-controlled variable position settable means cooperating with said speed control means for controlling said valve, acting through said spring means for urging said valve means toward high speed position, and having means for positively moving said valve means to lowest speed position, and being movable, when not prevented by said speed-controlled speed-controlling means, to move said valve means through said spring means to the highest speed position of the valve means and said operator-controlled variable position means being movable beyond the highest speed valve position for increasing the opposing action of the spring means to increase the engine speed required to overcome the spring action, and operator-controlled variable position means for increasing the spring force opposing said hold-down action.

11. Control apparatus for use with an internal combustion engine having a crankshaft and a carburetor valve, said apparatus comprising a flyweight governor rotatable in synchronism with the crankshaft, a plunger controlled by said governor, a tubular shaft about which said governor is mounted to rotate, said plunger being slidable in said shaft, and a dished thrust member secured to the end of said plunger, surrounding and embracing the end of said shaft and having a flange engaged by said flyweight governor.

12. Control apparatus for use with an internal combustion engine having a crankshaft and a carburetor valve, said apparatus comprising a flyweight governor rotatable in synchronism with the crankshaft, a plunger controlled by said governor, a tubular shaft with which said governor is mounted to rotate, said plunger being slidable in said shaft, and extending outside the end thereof for engagement with said flyweight governor, and transmission between the outside extension of said plunger and the valve comprising a rockshaft and a lever arm secured to said rockshaft to rock therewith, said outside extension having a flat central circular portion, said lever having a convex cylindrical abutment portion for linear diametral engagement with the central circular portion of said outside extension.

13. The combination with an internal combustion engine having a crank shaft, a timing gear mounted on the crank shaft, a flyweight governor, a valve-controlling cam shaft, a second timing gear on said shaft meshing with the crank shaft gear on which second timing gear the governor is mounted, an axially movable actuating plunger carried by said cam shaft, coaxial therewith and actuated by the governor, a housing for said cam shaft timing gear, rockable transmission means extending in front of the engine comprising a rockshaft mounted on said housing, a rock arm on said rockshaft actuated by said plunger, and a two-armed rock lever mounted on said

rockshaft, a link having one end connected to one arm of said rock lever at one side of the engine, a carburetor valve lever connected with the other end of said link, a link connected with the other arm of said lever at the other side of the engine, and means for actuating the last said link, said links extending longitudinally of the cam shaft on opposite sides of the engine.

14. Control apparatus for use with an internal combustion engine having a valve controlling cam shaft and a carburetor valve lever, said apparatus comprising a flyweight governor rotatable with said shaft, an axially movable actuating plunger carried by said cam shaft and coaxial therewith and actuated by said governor, rockable transmission means extending in front of the engine comprising a rockshaft, a rock arm on said rockshaft actuated by said plunger, and a two-armed rock lever mounted on said rockshaft, a link having one end connected to one arm of said rock lever at one side of the engine, a carburetor valve lever connected with the other end of said link, a link connected with the other arm of said lever at the other side of the engine, and means for actuating the last said link, said links extending longitudinally of the cam shaft on opposite sides of the engine.

15. Control apparatus for use with an internal combustion engine having a valve controlling cam shaft, a timing gear for transmitting power to said cam shaft and a carburetor valve, said apparatus comprising a flyweight governor rotatable with said timing gear, an axially movable actuating plunger coaxial with said gear and actuated by said governor, rockable transmission means extending in front of the engine comprising a rockshaft, a rock arm on said rockshaft actuated by said plunger, and a two-

armed rock lever mounted on said rockshaft, a link having one end connected to one arm of said rock lever at one side of the engine, a carburetor valve lever connected with the other end of said link, a link connected with the other arm of said lever at the other side of the engine, and means for actuating the latter link, said links extending longitudinally of the cam shaft on opposite sides of the engine.

16. Control apparatus for use with an internal combustion engine having a spring return accelerator pedal, and a carburetor valve, said apparatus comprising a governor controlled by engine speed and in front of the engine and transmission between said governor and valve comprising a fore-and-aft reciprocable link extending along one side of the engine for controlling the opening of the valve and transmission between said pedal and valve comprising a fore-and-aft reciprocable link extending along the other side of the engine yieldable to enable the governor to control the opening movement of the valve.

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