May 29, 1945. M. MALLORY 2,377,256

GOVERNOR FOR INTERNAL-COMBUSTION ENGINES

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FIG. 1.

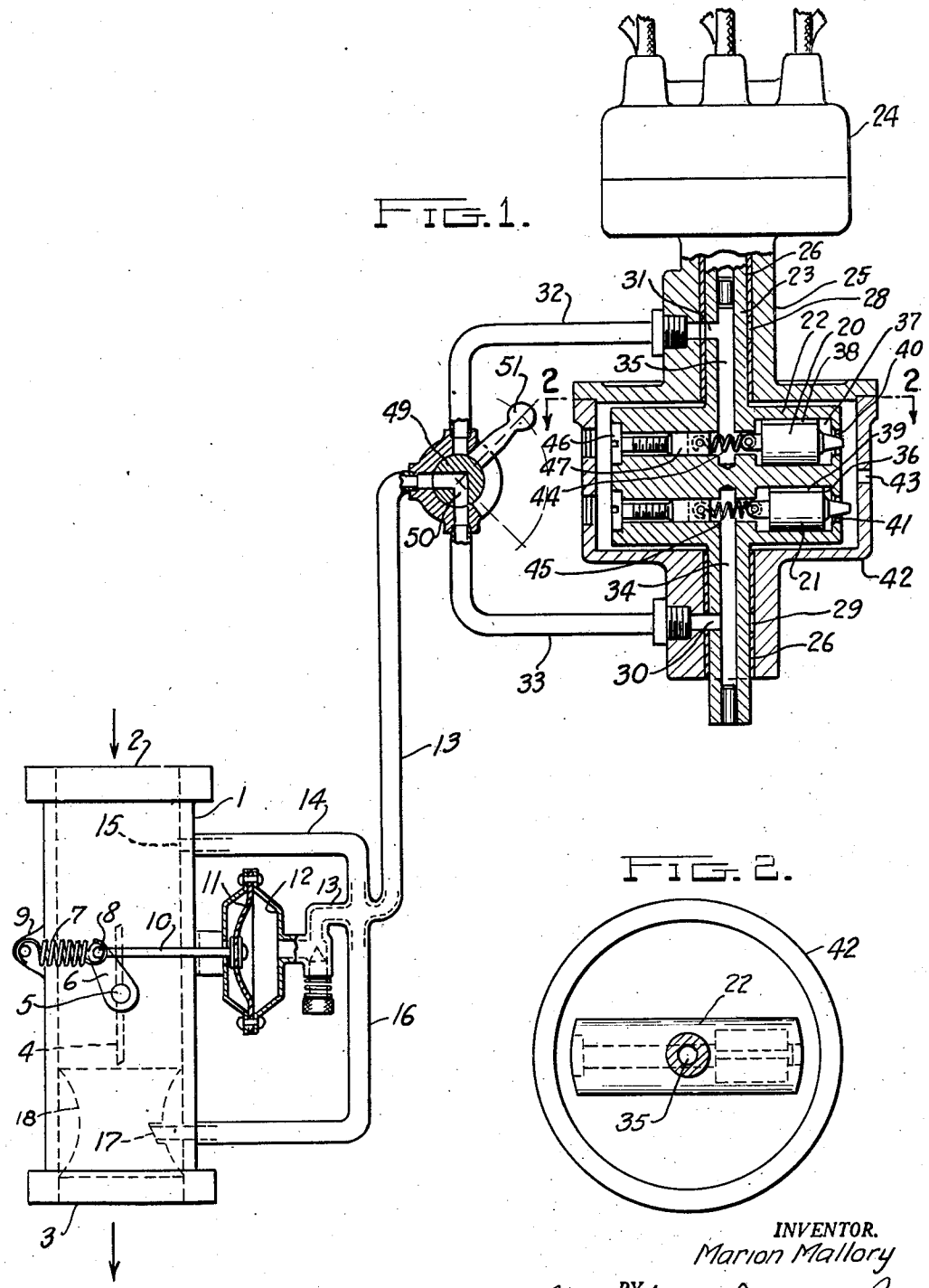

FIG. 2.

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GOVERNOR FOR INTERNAL-COMBUSTION ENGINES

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14 Claims. (Cl. 123—103)

This invention relates to a multiple speed governor for an internal combustion engine.

It is essential in controlling the speed of some internal combustion engines, especially truck and bus engines, that the engine should be governed at a plurality of speeds depending upon the operating conditions. For example, supposing that the engine of a truck is governed to have a top speed of 2500 R. P. M. to give the vehicle a top speed of 40 miles per hour, if such truck were heavily loaded it would be necessary to shift into very low gear for climbing a hill which would make the vehicle speed very low due to the engine being governed at a top speed of 2500 R. P. M. Under such a condition it would be desirable to have the engine governed at a higher top speed. Similarly in tractors it is necessary to have a different engine speed for plowing than for threshing and filling silos.

It is the object of this invention to produce a governor for controlling an internal combustion engine at different speeds, and more particularly to produce a governor which will control an internal combustion engine at a plurality of different top speeds dependent upon the particular conditions under which the engine is operated.

In the drawing:

Fig. 1 is an elevation partly in section showing my engine multiple speed governor.

Fig. 2 is a section along the line 2—2 of Fig. 1.

Referring more particularly to the drawing there is shown a governor housing 1 having an inlet 2 and an outlet 3. The governor housing is adapted to be connected into the intake manifold of an internal combustion engine on the engine side of the carburetor.

A governor valve 4 of the butterfly type is mounted within the housing on shaft 5 journalled in housing 1. Crank 6 is fixed on shaft 5 outside of the housing 1. A tension spring 7 having one end connected to the crank 6 as at 8 and the other end connected to a lug on the housing as at 9 tends to keep the governor throttle valve 4 open.

A suction device is provided for operating governor valve 4. This suction device comprises a housing 12 and flexible diaphragm 11. Diaphragm 11 is connected by rod 10 to crank 6. Housing 12 to the left of diaphragm 11 communicates with atmosphere whereas housing 12 to the right of diaphragm 11 communicates only with and is connected into, conduit 13. Conduit 13 is shown connected into orifice 15 by conduit 14, but this is merely a preferred arrangement. The device will operate when conduit 14 and orifice 15 are omitted. Conduit 16 communicates at one end with conduit 13 and at the other end with orifice 17 in venturi 18 in the intake passageway on the engine side of valve 4.

Conduit 13 is arranged to communicate with atmosphere but this communication is controlled by a plurality of centrifugally operated or unbalanced valves arranged to close at different speeds.

For purposes of description rather than by way of limitation, the invention is shown as optionally governed at two different top speeds but it is appreciated that by my arrangement the engine can be controlled by any desired number of centrifugally unbalanced valves which close at different engine speeds to control the engine at any given number of different top speeds.

The centrifugal valves are designated 20 and 21. Preferably valves 20 and 21 are mounted within the same housing 22 which is rotated in accordance with the engine speed. Preferably housing 22 is mounted in, and forms a part of the engine distributor shaft 23. The distributor is designated 24. Distributor shaft 23 is journalled in housing 25 by means of a plurality of bushings 26 which are spaced to give circumferential clearances 28 and 29 about shaft 23. Shaft 23 is provided with a diametrical opening 30 which continuously communicates with clearance 29 as the shaft rotates and shaft 25 is also provided with another diametrical opening 31 which continuously communicates with clearance 28 as the shaft rotates. Clearance 28 continuously communicates with conduit 32 and clearance 29 continuously communicates with conduit 33.

The distributor shaft 23 is provided with two separate axial passageways 34 and 35 which communicate respectively with cylinders 36 and 37. Piston valve 20 is mounted in cylinder 37 and piston valve 21 is mounted in cylinder 36. Pistons 20 and 21 are provided with external longitudinal grooves 38 and 39 respectively. Piston valves 20 and 21 control ports 40 and 41 respectively in housing 22. Port 40 communicates with passageway 35 through groove 38 and port 41 communicates with passageway 34 through groove 39.

A stationary housing 42 is provided about the centrifugal valve housing 22 and is provided with an orifice 43 to atmosphere. Valve 20 is at all times urged toward open position by tension spring 44 and valve 21 is at all times urged toward open position by tension spring 45. Springs 44 and 45 are connected at one end to their respective valves and at the other ends to blocks 47 having threaded fits with screws 46 for adjusting the tension of the springs.

A rotary valve 49 having a passageway 50

therein is connected into conduits 13, 32 and 33. As shown, valve passageway 50 connects conduits 13 and 33 and conduit 32 is shut off. Valve 49 is controlled by lever 51 which can be rotated through 90° clockwise to connect conduit 13 with conduit 32 and to close off conduit 33. Valve lever 51 can be operated either manually or connected to the transmission gear shift lever. The important thing is that valve 49 will be operated either manually or automatically in accordance with the conditions under which the engine is operated so as to give the engine the desired top governed speed for those operating conditions.

As shown in the drawing, spring 45 is adjusted for less tension than spring 44. Thus, spring 45 exerts a lighter pull on valve 21 tending to keep it open and tension spring 44 exerts a heavier pull on valve 20 tending to keep it open so that valve 20 will close at a higher R. P. M. than valve 21.

Let us assume that the tension of spring 45 is adjusted so that valve 21 will close at 2500 R. P. M. and the tension of spring 44 is such that valve 20 will close at an engine speed of 3000 R. P. M. If the vehicle, such, for example, as a truck or bus is operating on level highway, valve 49 will be in the position shown, placing conduit 33 in communication with conduit 13 and closing off conduit 32 and the engine's top governed speed will be, e. g., 2500 R. P. M. If the truck now reaches a hill and is heavily loaded so that the engine must be shifted into low gear, then valve 49 will be rotated 90° either manually or automatically by having lever 51 connected to the engine gear shift lever, thus connecting conduits 13 and 32 and shutting off conduit 33. The speed of the engine is now controlled by centrifugal unbalanced valve 20 and the top governed speed will be, e. g., 3000 R. P. M. Although the road speed of the vehicle will decrease while thus climbing a hill nevertheless the vehicle road speed will not decrease as much as if the top engine speed had remained 2500 R. P. M. Obviously the top governed speed should always be lower than the speed at which the engine would destroy itself. The manner in which the centrifugally unbalanced valves 20 and 21 individually control the speed of the engine is the same as that described in my copending application Serial No. 466,961, filed November 25, 1942, and therefore will not be described in detail herein. Suffice it to say that when valve 49 is in the position shown in Fig. 1, as soon as the engine reaches a speed of, say, 2500 R. P. M., valve 21 will close or almost close orifice 41 thereby shutting off the air bleed to atmosphere of diaphragm 11 which now tends to move throttle 4 toward closed position. The centrifugal force acting to close valve 21 is counterbalanced or played against the tension of spring 45 plus the suction acting on valve 21 so that the speed of the engine is accurately controlled with but a slight variation at, say, 2500 R. P. M. When valve 49 is shifted to connect conduits 13 and 32 and shut off conduit 33, valve 20 acts in the same manner to control the air bleed to suction device 12 and thereby control the engine at a higher governed speed.

It will be seen from the above that the centrifugally unbalanced valves are rotated in accordance with the speed of the engine and can be selected to give the engine desired speeds suitable for different gear ratios. The centrifugally unbalanced valves are all rotated at the same speed and yet are arranged to govern the engine selectively or optionally at different speeds. The valves are preferably mounted in the same housing but obviously could be mounted in separate housings. Mounting of the centrifugally unbalanced valves in separate housings might be desirable where the engine has dual ignition, using two independent ignition distributors. In such case a centrifugally unbalanced valve would be mounted in each distributor housing.

The centrifugally unbalanced valve arrangement for controlling the air bleed to the suction device can be utilized to give the engine desired speeds suitable for different gear ratios. For example, one valve for real low speed, another valve for intermediate speed, a third valve for first gear, and an additional valve for overdrive, the valves all arranged to close at different engine speeds.

One of the advantages of placing orifice 17 in venturi 18 is that the Venturi suction improves the closing action of governor valve 4 so that the movement of the governor valve toward closed position follows closely upon the closing of the centrifugally unbalanced air bleed valve and thus avoids surging of the engine speed over its governed speed. For example, if the governor valve is wide open and the engine speed reaches a point where the centrifugally unbalanced valve closes, the Venturi suction will immediately start the governor valve toward closed position whereas the governor valve would start to close much later, for example, 300 to 400 R. P. M. later, than the centrifugal valve if the venturi were not used.

The governor valve 4 can be used either with or without the usual manually controlled throttle valve (not shown). Without the manually controlled throttle valve the engine will run at its governed speed provided the engine is not required to pull a load greater than a load capable of being pulled by the power developed by the engine at its governed speed.

I claim:

1. The combination with an internal combustion engine having an intake passageway provided with a throttle valve for controlling the flow of motive fluid to the engine, means actuated through changes of pressure in the intake passageway on the engine side of said valve for imparting movement to said valve, second means responsive to a predetermined engine speed for changing the force exerted by the intake passageway pressure upon said pressure actuated means to control the engine substantially at said predetermined speed, and third means responsive to a different predetermined engine speed for changing the force exerted by the intake passageway pressure upon said pressure actuated means to control the engine substantially at said different predetermined speed, the said second and third means being selectively operatable to govern the engine at the said different speeds.

2. The combination with an internal combustion engine having an intake passageway provided with a throttle valve for controlling the flow of motive fluid to the engine, a device actuated by suction from a point in said passageway between the throttle valve and the engine and having an operative connection with said throttle valve, means responsive to a predetermined engine speed for changing the degree of suctional force exerted on said device, and a second means responsive to a different predetermined engine speed for changing the degree of suctional force exerted on said device, and a third means operatable to render any one of the aforesaid means

ineffective for changing the degree of suctional force exerted on said device.

3. The combination with an internal combustion engine having an intake passageway provided with a throttle valve for controlling the flow of motive fluid to the engine, a device actuated by suction from a point in said passageway between the throttle valve and the engine and having an operative connection with said throttle valve, first and second air bleeds to atmosphere for said pressure actuated means, centrifugally unbalanced valves rotated in accordance with the engine speed for controlling the air bleeds, the said centrifugally unbalanced valves tending to close their respective air bleeds at different engine speeds, and means for closing off one of said air bleeds from said pressure actuated device whereby the engine is governed substantially at the engine speed at which the centrifugally unbalanced valve for the other air bleed tends to close said other air bleed.

4. The combination with an internal combustion engine having an intake passageway provided with a throttle valve for controlling the flow of motive fluid to the engine, a device actuated by suction from a point in said passageway between the throttle valve and the engine and having an operative connection with said throttle valve, a valve housing rotated in accordance with the speed of the engine having an opening to atmosphere, a passageway connecting said housing with the suction actuated device, a centrifugally unbalanced valve in said housing tending to close said opening to atmosphere at a predetermined engine speed, a second valve housing rotated in accordance with the speed of the engine having an opening to atmosphere, a passageway connecting said second housing with the suction actuated device, a centrifugally unbalanced valve in said second housing tending to close said opening to atmosphere at a different predetermined engine speed, and valve means interposed in said passageways for optionally shutting off one of said valve housings from the suction actuated device.

5. The combination as set forth in claim 4 including rotary means for supporting said first and second valve housings whereby the valve housings rotate at all times at the same speed.

6. The combination as set forth in claim 4 including a single rotary shaft operated in accordance with the engine speed and serving as a support for said first and second valve housings.

7. The combination with an internal combustion engine having an intake passageway provided with a throttle valve for controlling the flow of motive fluid to the engine, a device actuated by suction from a point in said passageway between the throttle valve and the engine and having an operative connection with said throttle valve, a plurality of valve housings all arranged to rotate at the same speed and varying their speed of rotation in accordance with the engine speed, each of said valve housings having an opening to atmosphere and a passageway connecting the same with said suction actuated device, each of said housings also having a centrifugally unbalanced valve tending to close the opening to atmosphere at a predetermined engine speed, each of said centrifugally unbalanced valves tending to close its opening at a different engine speed than the speed at which any other centrifugally unbalanced valve tends to close its respective opening.

8. The combination as set forth in claim 7 including a control valve for controlling the passageways connecting the valve housings with the suction device whereby the suction device can be connected with but a single valve housing at a time for controlling the speed of the engine at substantially the speed at which said valve housing tends to be shut off from atmosphere.

9. The combination as set forth in claim 7 including means for rotating all of said valve housings at the same speed and varying said speed in accordance with variations in the engine speed.

10. A governor for controlling the speed of an internal combustion engine having an intake passageway comprising a throttle valve in said intake passageway for controlling the flow of motive fluid to the engine, a suction actuated device connected into the intake passageway on the engine side of said throttle valve, an air bleed to atmosphere for said suction actuated device, and means selectively operatable at different engine speeds tending to close said air bleed at a selected engine speed, and selector mechanism operatable regardless of the speed at which the engine is running to select one of the aforesaid means for controlling the engine at substantially such speed as the speed at which the selected means operates.

11. The combination with an internal combustion engine having an intake passageway provided with a throttle valve for controlling the flow of motive fluid to the engine, a device actuated by suction from an orifice in a venturi positioned in said passageway between the throttle valve and the engine and having an operative connection with said throttle valve, first and second air bleeds to atmosphere for said pressure actuated means, centrifugally unbalanced valves rotated in accordance with the engine speed for controlling the said air bleeds, the said centrifugally unbalanced valves tending to close their respective air bleeds at different engine speeds, and means for closing off one of said air bleeds from said pressure actuated device whereby the engine is governed substantially at the engine speed at which the centrifugally unbalanced valve for the other air bleed tends to close said other air bleed.

12. The combination with an internal combustion engine having an intake passageway provided with a throttle valve for controlling the flow of motive fluid to the engine, a device actuated by suction from an orifice in a venturi positioned in said passageway between the throttle valve and the engine and having an operative connection with said throttle valve, a valve housing rotated in accordance with the speed of the engine having an opening to atmosphere, a passageway connecting said housing with the suction actuated device, a centrifugally unbalanced valve in said housing tending to close said opening to atmosphere at a predetermined engine speed, a second valve housing rotated in accordance with the speed of the engine having an opening to atmosphere, a passageway connecting said second housing with the suction actuated device, a centrifugally unbalanced valve in said second housing tending to close said opening to atmosphere at a different predetermined engine speed, and valve means interposed in said passageways for optionally shutting off one of said valve housings from the suction actuated device.

13. A governor for controlling the speed of an internal combustion engine having an intake passageway comprising a throttle valve in said intake passageway for controlling the flow of motive fluid to the engine, a suction actuated device connected to an orifice in a venturi positioned in the intake passageway on the engine side of

said throttle valve, an air bleed to atmosphere for said suction actuated device, and means selectively operatable at different engine speeds tending to close said air bleed at a selected engine speed, and selector mechanism operatable regardless of the speed at which the engine is running to select one of the aforesaid means for controlling the engine at substantially such speed as the speed at which the selected means operates.

14. A governor for controlling the speed of an internal combustion engine having an intake passageway comprising a throttle valve in said intake passageway for controlling the flow of motive fluid to the engine, a suction actuated device connected into the intake passageway on the engine side of said throttle valve, a plurality of air bleeds for said suction actuated device, a plurality of control means responding at different engine speeds and thereby tending to close said air bleeds at such different engine speeds, and means for selectively connecting any one of the aforesaid air bleeds with the suction actuated device and for disconnecting the other of said air bleeds from said suction device whereby the speed of the engine is controlled substantially at the speed at which the selected air bleed tends to be closed.

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