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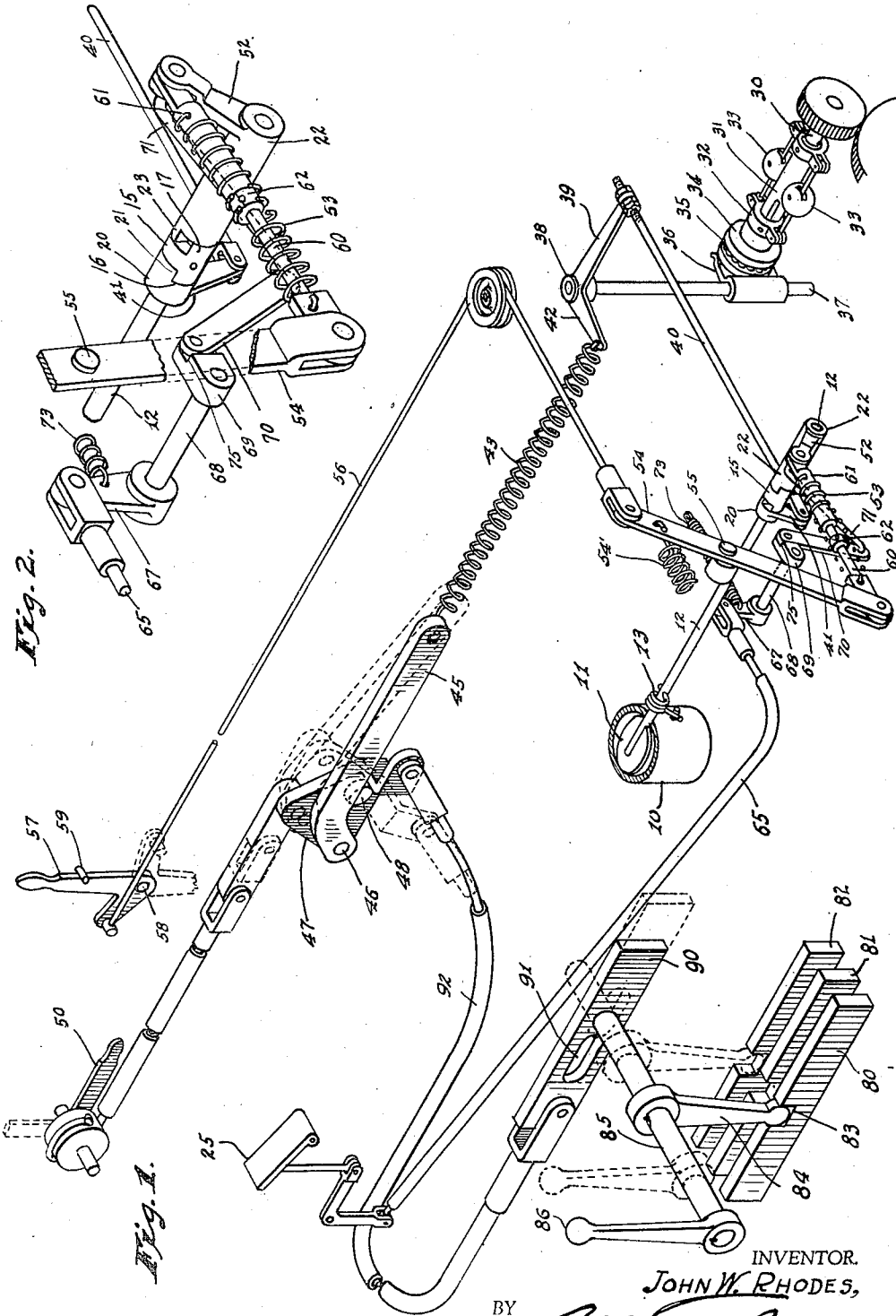
J. W. RHODES

2,443,084

ENGINE CONTROL MECHANISM

Filed Dec. 18, 1943

2 Sheets-Sheet 1



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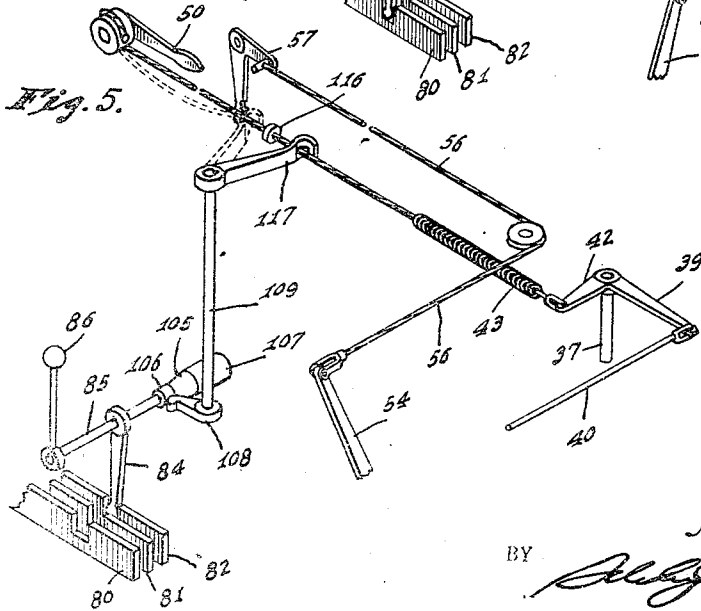
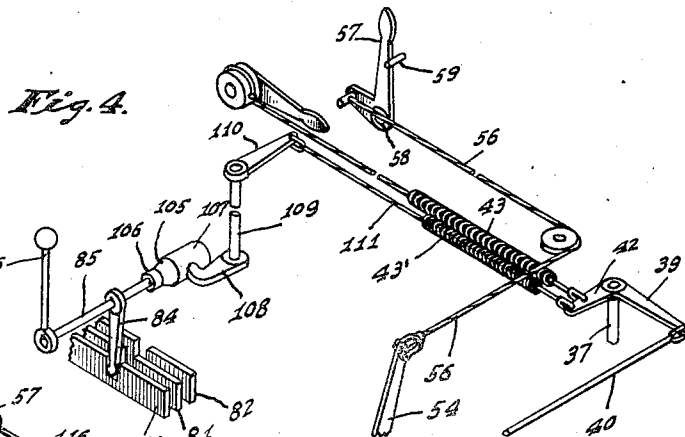
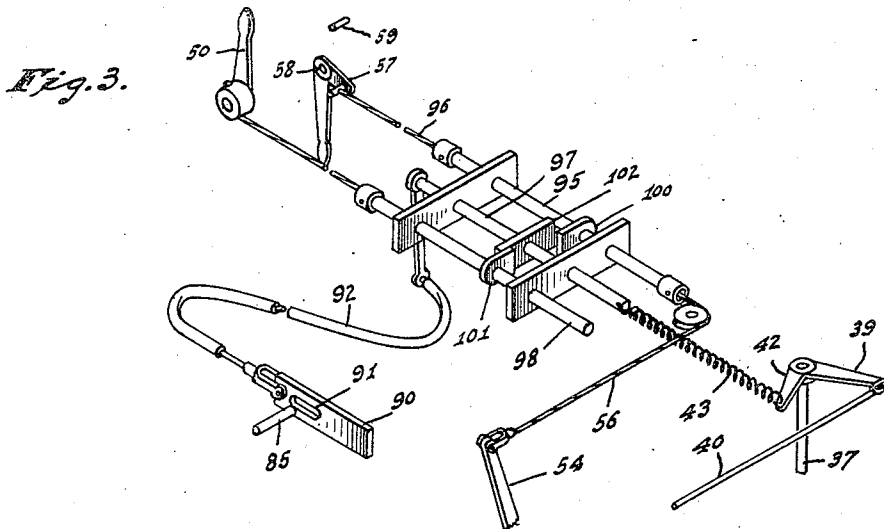
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ENGINE CONTROL MECHANISM

Filed Dec. 18, 1943

2 Sheets-Sheet 2.



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UNITED STATES PATENT OFFICE

2,443,084

ENGINE CONTROL MECHANISM

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Application December 18, 1943, Serial No. 514,743

11 Claims. (Cl. 74-472)

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This invention relates to means for automatically regulating the speed of an internal combustion engine in a manner co-ordinated with the load imposed on the engine, and more particularly to means for preventing the engine from being operated at high speeds when under light load.

In certain situations, as in the case of an automotive road grader, an internal combustion engine will be associated with a change-speed transmission mechanism capable of providing gear-ratios so low that under some circumstances the load on the engine will be extremely light. For example, the operator of an automotive road grader, upon the completion of a cut involving low-gear operation of the vehicle, may desire to increase the speed of the machine and may elect to do so merely by increasing the speed of the engine without changing the setting of the transmission from low gear. With the grader freed from earth reaction against the blade and with the transmission still in low gear, the load on the engine will be very light.

Operation of an internal combustion engine at high speeds and under light load is detrimental to the engine, as it frequently results in undesirably high stresses and rapid wear. Nevertheless, operators are often prone to operate an engine at high speed when the associated transmission is in low gear rather than to take the trouble of readjusting the transmission to provide a higher gear-ratio and thus increase the load on the engine.

It is the object of this invention to prevent excessively high-speed operation of an engine associated with a change-speed transmission mechanism when that mechanism is set to provide a relatively low gear-ratio. Another object of the invention is to provide for an internal combustion engine speed-regulating means which can operate either automatically, to maintain the engine at any desired speed under varying load, or under manual control. A further object of the invention is to so restrict manual control of the engine that engine speed is prevented from attaining any value greater than a predetermined maximum.

In carrying out my invention, I employ manually operable means, such as an accelerator pedal, and speed-responsive means each adapted to control the throttling of the engine and thereby to control engine speed. I also provide mechanism for rendering the manually operable means inoperative to control engine throttling. The speed-responsive means is adjustable to vary the engine speed it maintains when the manually

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operable means is rendered inoperative and also to vary the extent of throttle-opening attainable by the manually operable means when the latter is operative. Associated with a change-speed transmission mechanism driven by the engine I provide a means which is jointly controllable with the aforesaid speed-responsive means and which operates to prevent the transmission mechanism from being set to provide one of its low gear ratios when the speed-responsive means is adjusted to provide an engine-speed greater than a predetermined value and also to prevent the speed-responsive means from being adjusted to provide an engine-speed greater than such predetermined value when the transmission is set to provide one of its low gear ratios.

The accompanying drawings illustrate my invention: Fig. 1 is an isometric, somewhat diagrammatic, view of the complete mechanism showing the condition existing when the accelerator pedal is operative to move the throttle; Fig. 2 is a fragmental view similar to Fig. 1, but on a larger scale, showing the condition existing when the accelerator pedal has been rendered inoperative to control the throttle; and Figs. 3 to 5 are fragmental views similar to Fig. 1 but showing modified constructions.

In the mechanism illustrated in the drawing, it is contemplated that an explosive mixture will be supplied to the engine of the vehicle through a conduit 10 under the control of a throttle 11. The throttle 11 is mounted on a rock shaft 12 and is biased toward open position, or in a clockwise direction in the drawing, by a spring 13. Fixed upon the rock shaft 12 is a collar 15 having on its opposite ends abutments 16 and 17 presented in a clockwise direction. Rotatably mounted at one side of the collar 15 and co-axial with the shaft 12 is a swinging element 20 provided with an abutment 21 engageable with the abutment 16. On the opposite side of the collar 15 is a second swinging element 22 also co-axial with and rotatable relatively to the shaft 12 and provided with an abutment 23 engageable with the abutment 17 on the collar 15. In such an arrangement, the spring 13 will open the throttle 11 to the extent determined by that one of the swinging elements 20 and 22 whose abutment is first engaged by the co-operating abutment (16 or 17) on the collar 15. Either swinging element can close the throttle, but neither can open it beyond the throttle-position which the other swinging element would provide. Each swinging element may be swingable in a clockwise direction to a position in which its abutment will not interfere

with complete opening movement of the throttle under control of the other element.

As will be brought out in greater detail hereinafter, one of the swinging elements, here shown as the element 20, is connected to adjustable governor mechanism responsive to engine speed, while the other is connected to a manually operable member such as the accelerator pedal 25. When the throttle is to be automatically controlled by the governor alone, the element 22 is taken out of control by the accelerator pedal and moved, or permitted to move, to its clockwise limit of movement by mechanism hereinafter described, so that the position of the throttle will thereafter be determined solely by the governor, and the speed of the engine will therefore be determined by the setting of the governor. When it is desired to regulate the engine-speed manually, the element 22 is restored to control by the accelerator pedal. Thereafter, the element 22 can be swung throughout its entire range of movement by operation of the accelerator pedal. In this condition, the governor will operate to limit the maximum engine-speed attainable by operation of the accelerator pedal; for the element 20 remains connected to the governor, and its abutment 21 will limit throttle-opening movement of the collar 15 and shaft 12.

The speed-responsive governor mechanism employed to control the position of the element 20 may take any desired form. That shown in the drawing comprises a shaft 30 operatively connected to the engine so as to rotate at a speed proportionate to engine speed. Slidable upon the shaft 30, but rotatable therewith, is a sleeve 31 which projects through a collar 32 fixed both axially and rotatively relative to the shaft 30. Link mechanism including governor weights 33 interconnect the collar 32 with the sleeve 31 in such a way that as the weights 33 fly outwardly under the influence of centrifugal force the sleeve 31 will be moved rearwardly along the shaft 30. Beyond the collar 32, the sleeve 31 is provided with a flange or head 34 engaging one member of an anti-friction thrust bearing 35 the other member of which is engaged by an arm 36 fixed to and projecting laterally from a vertical shaft 37. Also fixed on the shaft 37 is a bell crank 38 one arm 39 of which is operably connected through a link 40 with an arm 41 projecting from the element 20 previously described. The other arm 42 of the bell crank 38 is connected to a tension spring 43 so arranged as to force the arm 36 on the shaft 37 against the thrust member 35 and thus oppose movement of the sleeve 31 under the influence of centrifugal force acting on the weights 33.

The arrangement of the parts just described is such that any increase in engine speed tends to swing the element 20 in a counter-clockwise direction in opposition to the force exerted by the spring 43. The position of the element 20 for any given engine speed may be controlled by regulating the tension of the spring 43. For this purpose, the spring 43 is connected to a link 45, and the link 45 is in turn pivotally connected, as by a bolt or pin 46, with a plate 47 mounted for swinging movement on a fixed pivot pin 48. To control the position of the plate 47, and thus to vary the tension in the spring 43, the plate is connected through any suitable mechanism with a swinging control lever 50, conveniently positioned so as to be readily accessible for operation by the driver of the vehicle. Associated with the control lever 50 is a friction brake (not shown) or other mech-

anism for retaining the lever fixed in any position of adjustment against the force exerted by the spring 43.

The governor mechanism operates alternatively either as an ordinary speed governor to provide a maximum engine speed or as a load governor to maintain the engine at a substantially constant speed, depending upon whether or not the element 22 is under control by the accelerator pedal 25. Thus, if the element 22 is being controlled by the accelerator pedal, it can be moved in a counter-clockwise direction to close the throttle 11 completely, or it can be moved in a clockwise direction to permit the throttle to open to any extent up to the maximum permitted by the position of the governor-controlled element 20. If the element 22 is taken out of control by the accelerator pedal, the abutments 16 and 21, on the collar 15 and element 20 respectively, remain always in engagement with each other, and the throttle is under the sole control of the governor, which therefore operates to maintain the engine at a substantially constant speed determined by the setting of the control lever 50.

The means preferably employed for controlling the swinging element 22 includes a spring capable of biasing the element 22 in a counter-clockwise (throttle-closing) direction and mechanism including a lost-motion connection for interconnecting the element 22 with the accelerator pedal whereby the latter may be employed to swing the element 22 in a clockwise direction against the force of the spring. A manually operated device is provided for relieving spring-pressure on the element 22 and/or for swinging such element to the limit of its movement in a clockwise direction where it will not interfere with complete control of the element 20 (and the throttle) by the governor.

To accomplish the purposes just noted, the element 22 is provided with a rigid arm 52 operatively connected to a tension spring 53 which biases the element 22 in a counter-clockwise direction. The opposite end of the spring 53 is operatively connected to the lower end of a lever 54 pivotally supported at 55 from any convenient stationary support and swingable about its pivot to increase or relieve the force which the spring 53 exerts on the element 22. The lever 54 is conveniently biased in one direction, here shown as counterclockwise, by a spring 54', and is arranged to be moved in the opposite direction by a cable 56 connected to a manually operated control lever 57. To retain the lever 54 in the position shown in Fig. 1 against the force exerted upon it by the spring 54', the control lever 57 may be mounted on a pivot 58 so positioned that as the lever 54 approaches the position of Fig. 1 the cable 56 will cross the axis of the pivot 58, whereby tension in the cable will thereafter hold the lever 57 against a suitably positioned stop pin 59.

In the position of the lever 54 shown in Fig. 1, which is the position occupied when the throttle 11 is to be controlled by the pedal 25, the spring 53 exerts on the element 22 a torque great enough to overcome the torque of the spring 13, thereby tending to close the throttle 11. When it is desired to operate the engine under sole control by the governor, the lever 57 is released and the spring 54' swings the lever 54 in a counter-clockwise direction to the limit of movement permitted by the lever 57, or to the position shown in Fig. 2, and thus relieves tension in the spring 53. The extent to which counter-clockwise move-

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ment of the lever 54 relieves tension in the spring 53 may or may not be great enough to prevent the spring 53 from effectively opposing the spring 13.

If in the position of Fig. 2 the spring 53 is capable of overcoming the spring 13, and desirably in any event, I provide means for positively moving the element 22 to the clockwise limit of its movement whenever the engine speed is to be controlled by the governor. To this end, the arm 52 and the lower end of the lever 54 may be interconnected by an extensible link comprising inner and outer telescoping parts 60 and 61 and an abutment collar 62 which is fixed on the inner part 60 and engages the end of the outer part 61 to limit the minimum effective length of the link. In counter-clockwise movement of the lever 54 to the position of Fig. 2, the collar 62 engages the outer telescoping link-part 61 and positively forces the element 22 in a clockwise direction into a position such that its abutment 23 will not interfere with throttle-opening movement of the collar 15 under control by the governor-actuated element 20.

In the condition illustrated in Fig. 1, the element 22, if moved in a clockwise direction against the force exerted on it by the spring 53, would permit throttle-opening movement of the collar 15 and throttle-shaft 12 under the influence of the spring 13. Such clockwise movement of the element 22 may be effected under the control of the accelerator pedal 25 by the mechanism now to be described.

The accelerator pedal 25 is operatively connected by any convenient means 65 with an arm 67 rigid with a rock shaft 68. The latter is provided with a second rigid arm 69 connected through a lost-motion connection with the arm 52 on the element 22. Conveniently this connection is effected by a pair of pivotally interconnected links 70 and 71, the former of which is pivoted to an eccentric point on the arm 69 and the latter of which is pivoted to the arm 52. The lost-motion in this connection is provided by relative movement of the link 70 and arm 69, such lost-motion being limited by an abutment 75 provided on the arm 69 in position to engage the link 70 and limit its clockwise movement under the influence of the spring 53.

When the lever 54 is in the position shown in Fig. 1, the spring 53 acts to hold the link 70 at all times against the abutment 75 so that such link acts as an extension of the arm 69 connected to the arm 52 of the element 22 by the link 71. In consequence, the position of the element 22, and hence the position of the throttle, will be controlled by the shaft 68. However, because of the lost-motion between the arm 69 and link 70, the element 22 can at any time be moved to the clockwise limit of its movement by the arm 54 and link 60-61 without affecting the shaft 68.

If desired, a spring 73 may be employed to urge the shaft 68 in a clockwise direction and the accelerator pedal 25 upwardly.

As previously indicated, one of the objects of my invention is concerned with means for interconnecting the governor control and the change-speed transmission in such a way that it will be impossible to adjust the governor to provide engine speeds above a predetermined value when the transmission is in low gear and impossible to adjust the transmission into low gear when the governor is set to provide an engine-speed above such predetermined value. The exact nature of the means employed to accomplish this

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object will depend to an extent upon the character of the change-speed transmission mechanism associated with the vehicle. The type of change-speed transmission mechanism contemplated in the drawings is one in which the changes of gear-ratio are effected through the medium of a plurality of shift rods any of which may be operably connected to and moved in either direction by a suitable gear-shift lever. As indicated in the drawing, there are three of such shift rods 80, 81, and 82, each of which is provided with a notch 83 for the reception of the outer end of an arm 84 fixed to an axially slidable rock-shaft 85. For the purpose of controlling the shaft 85, there is also fixed to it an arm 86 adapted to be operably connected to the conventional gear-shift lever by means of which the shaft 85 can be moved axially of itself to bring the arm 84 into operative association with any of the shift rods and then rocked to move such shift rod in either direction.

For the purpose of illustration, it is assumed that the lowest gear ratios provided by the change-speed transmission are effected by movement of the rod 82, which as shown lies at the extreme right of the series of shift rods. It is further assumed that restriction of transmission-setting by the governor-control is to extend to both settings obtainable by movement of the rod 82. Mounted for sliding movement transversely of the shaft 85 and adjacent its right-hand end is a bar 90 provided with a slot 91 adapted in certain positions of the bar to receive the shaft 85. The bar 90 is operably connected through any convenient means 92 with an eccentric point on the plate 47, which, as previously set forth, is movable under control of the lever 50. The arrangement of parts is such that the slot 91 will be in position to receive the end of the shaft 85 only when the governor-control lever 50 is adjusted to provide an engine-speed below the predetermined value above which operation of the engine with the transmission in a low-gear is deemed unsafe. If the plate 47 is adjusted to bring the slot 91 into alinement with the shaft 85, the right-hand end of the latter can then enter the slot 91 and permit the operating arm 84 to enter the notch in the low-speed shift rod 82; but in that condition, the presence of the shaft 85 within the slot 91 limits movement of the plate 47 and accordingly limits the extent to which the spring 43 can be stressed in increasing the engine-speed which the governor is to provide.

In considering the operation of the device shown in Figs. 1 and 2, let it be assumed for purposes of illustration that my device is to be used in an automotive vehicle and that the engine of such vehicle may be operated at speeds up to 1400 R. P. M. with the transmission set to provide one of the lower gear-ratios and at speeds up to 2600 R. P. M. with the transmission otherwise set. Such conditions might exist in a motor road grader, the lower gear-ratios being provided for grading operations and the higher for use when the grader is running over a road and doing no work. In such a case, my device would be so designed that with the governor-control lever 50 set to provide maximum load in the spring 43 the governor will operate to provide a maximum engine speed of 2600 R. P. M. At the same time, the slot 91 would be so proportioned as to be at least partially out of alinement with the shaft 85 whenever the governor was adjusted by the lever 50 to maintain any engine

speed over 1400 R. P. M. As a result, when the transmission is set to provide one of the lower gear-ratios and the rock-shaft 85 extends into the slot 91, it will be impossible to adjust the governor to provide an engine speed above 1400 R. P. M. Similarly, if the governor is set to provide a maximum engine speed greater than 1400 R. P. M., it will be impossible to move the rock-shaft to the position necessary in adjusting the transmission to provide one of the lower gear-ratios. Thus, operation of the engine at speeds over 1400 R. P. M. when under light loads is prevented.

In the operation of a vehicle embodying my invention the engine speed can be controlled as desired either by the accelerator pedal 25 or by the governor-control lever 50. If control by the accelerator pedal is desired, the lever 57 is put in the full-line position of Fig. 1, thus placing the lever 54 and the parts associated with it in the condition shown in Fig. 1 and rendering the throttle subject to control by the accelerator pedal as above set forth. If control of engine speed through the governor mechanism is desired, the control lever 57 is put in the dotted-line position of Fig. 1, thus placing the lever 54 in the position shown in Fig. 2. Thereafter, the throttle will be under control by the governor mechanism alone, and engine speed can be varied as desired by moving the governor-control lever 50 in a clockwise direction to increase engine speed and in the opposite direction to reduce it.

Ordinarily, control of engine speed through the governor mechanism will be employed only when the vehicle is to operate for an appreciable interval at substantially constant speed. Because of the nature of the governor mechanism, the response of the engine to changes in adjustment of the governor-control lever 50 are necessarily somewhat sluggish. For that reason, as well as because frequent speed changes are more easily effected by the foot-operated pedal 25 than by the hand-operated lever 50, the operator will usually prefer pedal control when driving along a highway or in other situations where speed-changes are more or less frequent. On the other hand, where a substantially constant vehicle speed is desired, the throttle can be placed under control by the governor and the lever 50 set to maintain that speed, thus leaving the operator free to devote his attention to other matters.

Irrespective of whether the speed of the engine is to be controlled by the pedal 25 or by the lever 50, the latter must be set to provide a maximum engine speed of 1400 R. P. M. or less before the slot 91 in the bar 90 can be brought into alignment with the shaft 85 and the transmission put in low gear. If the lever 57 is in the dotted-line position of Fig. 1 and engine speed therefore under sole control by the governor, the engine will continue to operate at substantially constant speed until the setting of the lever 50 is changed; but as long as the transmission remains in a low gear the shaft 85 will remain in the slot 91 and prevent the lever 50 from being adjusted to provide an engine speed greater than 1400 R. P. M. If the lever 57 is in the full-line position of Fig. 1 and the throttle under control by the accelerator pedal, the governor will operate through the element 20 and abutments 16 and 21 to prevent throttle-opening beyond the point providing an engine-speed corresponding to the setting of the lever 50; and that speed, as set forth above, will necessarily be less than

1400 R. P. M. as long as the transmission is in a low gear.

When the adjustment of the transmission is changed to provide a higher gear-ratio and the shaft 85 consequently moved out of the slot 91 the restriction on adjustment of the lever 50 is removed and the governor can be adjusted to provide any engine speed up to the maximum of 2600 R. P. M. If the lever 57 is in the dotted-line position of Fig. 1, the engine will operate under governor control substantially at the speed determined by the setting of the lever 50, even though the load on the engine varies. If the lever 57 is in the full-line position of Fig. 1, the speed of the engine will be controlled by the accelerator pedal subject only to the restriction placed on maximum engine speed by the governor acting through the element 20 and the abutments 16 and 21.

In the modified arrangement of my invention illustrated in Fig. 3, the lever 57 operates not only to control the position of the lever 54, but also to adjust the governor to its maximum-speed setting. For this purpose, the cable 56 is not directly connected to the lever 57, but instead is connected to the rear end of a longitudinally slidable rod 95, and the latter is in turn connected to the lever 57 by a cable 96. The rod 95 is one of a set of three such rods, the other two of which are designated respectively by the reference numerals 97 and 98. The rear end of the rod 97 is connected to the governor spring 43, while the front end of the rod 98 is connected to the control lever 50. The rods 95 and 98 are provided respectively with abutments 100 and 101 each of which lies in rear of and overlaps laterally an abutment 102 provided on the rod 97. Each of the abutments 100 and 101, in co-operation with the abutment 102, constitutes a lost-motion connection between the rod on which it is mounted and the rod 97. As a result, the rod 97 may be moved forwardly by operation of either the lever 50 or the lever 57 to stress the spring 43 and increase the speed for which the governor is set.

With the parts in the position shown in Fig. 3, the lever 54 is in its counter-clockwise position, the accelerator pedal is therefore disconnected from the throttle in the manner above described, and the governor mechanism operates as a load governor to maintain a substantially constant engine speed irrespective of variations in load. The speed for which the governor mechanism is set is controlled by the position of the lever 50 which, when swung in a clockwise direction will advance the rods 98 and 97 to increase the load on the governor spring 43. When it is desired to adjust the mechanism of Fig. 3 to provide for control of the throttle by the accelerator pedal, the lever 57 is swung in the clockwise direction about its pivot 58 to advance the rod 95 to the limit of its forward movement. In the forward movement of the rod 95, the abutment 100 will strike the abutment 102 and cause the rod 97 to move to the limit of its forward movement, thus placing the maximum load on the spring 43. Since the rod 95 is connected to the lever 54 through the cable 56, forward movement of the rod 95 will swing the lever 54 to the clockwise position of Fig. 1, thus operatively interconnecting the accelerator pedal with the throttle in the manner previously described.

To provide for the interlock between the change-speed transmission mechanism and the governor, the plate 90 previously described is

operatively connected through the means 92 with the rod 97. As in the structure illustrated in Fig. 1, the rock-shaft 85, which controls the setting of the transmission, can be moved into its low-speed position only when the slot 91 in the plate 90 is in alignment with the rock-shaft; and the interconnection of the plate 90 and rod 97 is so arranged that the slot 91 will be out of alignment with the shaft 85 whenever the governor is set to provide an engine speed greater than the maximum deemed safe for light-load operation.

In the structure shown in Fig. 4, the lever 57 is connected through the cable 56 with the lever 54, and the control lever 50 is connected through the spring 43 with the arm 42 on the governor control-shaft 37, all as illustrated in Fig. 1. In this instance, however, the spring 43 is made of such a strength that with the control lever 50 at the clockwise limit of its range of movement, the governor will be set to provide an engine speed corresponding to the maximum considered safe for light-load operation. As a result, no engine speed higher than that maximum can be provided by manipulation of the control lever 50.

To provide the additional loading of the governor necessary to enable it to maintain engine speeds higher than the desired light-load maximum, a second governor-loading spring 43' is employed. One end of the spring 43' is connected with the arm 42 while the other end is connected to mechanism associated with the change-speed transmission and operative to stress the spring 43' whenever the transmission is set to provide one of the higher gear ratios. Such a mechanism may take any desired form, that shown comprising a cam member 105 mounted on the rock-shaft 85 for axial movement therewith. The cam member 105 has a small-diameter portion 106 and a large-diameter portion 107 which co-operate with the end of a cam-following lever 108 mounted on a rock-shaft 109. Also rigidly mounted on the rock-shaft 109 is an arm 110 the outer end of which is connected, as through a cable or wire 111, with the spring 43'.

The cam member 105 is so disposed on the rock-shaft 85 in relation to the cam-follower 108 that the latter rests on the small-diameter portion 106 of the cam whenever the rock shaft 85 is positioned axially of itself to set the transmission for one of the lower gear ratios. In this condition, stress in the spring 43' will be relieved, or reduced to a predetermined minimum such that the sum of the forces exerted both by it and the spring 43 upon the arm 42 can never exceed that necessary to provide the desired light-load maximum engine speed. However, when the shaft 85 is moved to the left into association with shift rods other than the shift rod 82, the large-diameter portion 107 of the cam 105 engages the free end of the lever 108 to rock the shaft 109 and swing the arm 110 in such a direction as will stress the spring 43' and thereby increase the loading of the governor. In this condition, the control lever 50 can be adjusted, if desired, to vary the stress in the spring 43 and thus to modify the maximum engine-speed which the governor will permit; but of course no such adjustment of the lever 50 can reduce the total loading of the governor beyond that resulting from stress in the spring 43'.

The arrangement illustrated in Fig. 5 performs much the same functions as that performed by the mechanism of Fig. 4; but in this instance, only a single governor-loading spring 43 is em-

ployed. As in previous instances, one end of the spring 43 is connected with the arm 42 while the other end is connected through a cable 110 with the control member 50. The control member 50 and spring 43 are arranged in such a way that with the control lever 50 at the clockwise limit of its movement the governor will be loaded to maintain the desired light-load maximum engine speed. The cable 115 has fixed upon it an abutment 116, and between such abutment and the spring 43 there is disposed the free end of an arm 117. The arm 117 is rigidly mounted on the upper end of the rock-shaft 109 which, as in the structure illustrated in Fig. 4, is adapted to be rocked by a cam 105 on the rock-shaft 85.

Whenever the rock-shaft 85 is located axially of itself in the position necessary to set the transmission for one of the lower gear ratios, the free end of the arm 117 is at the rearward or clockwise limit of its movement, where it will not, by striking the abutment 116, interfere with the full range of adjustment of the spring 43 provided by the lever 50. However, when the rock shaft 85 is positioned to provide a gear ratio other than the lower gear ratios, the cam 105 operates to rock the rock-shaft 109 and cause the free end of the arm 117 to move forwardly. In this forward movement of the arm 117, it strikes the abutment 116 on the cable 115 and stresses the spring 43 to an extent beyond that to which it can be stressed by operation of the control lever 50, thus making it possible to operate the engine at speeds higher than those which the governor can be adjusted to permit when the transmission is set to provide one of the lower gear-ratios.

In all the modifications illustrated and described herein, the accelerator pedal and the governor both operate to control a single throttle valve. It is to be understood, however, that my invention is not limited to structures in which only a single throttle is employed.

Each of the devices I have shown provides between the governor control mechanism and the change-speed transmission an interlock which limits the adjustment of the one to an extent dependent upon the adjustment of the other, thus preventing both high-speed operation when the transmission is in low gear and a low-gear setting of the transmission when the governor is set to provide any speed greater than a predetermined maximum deemed safe for light-load operation of the engine.

While I have illustrated and described my invention as embodied in association with an engine the speed of which is controlled by regulating the rate of mixture-supply, my invention is not limited to engines and speed-controlling devices of that particular type. It is therefore to be noted that with obvious modifications the invention can be adapted to internal combustion engines of types other than that in which engine speed is controlled by a throttle in a mixture-supply conduit.

I claim as my invention:

1. In an automotive vehicle having an internal combustion engine and a change-speed transmission selectively adjustable to provide relatively high-speed and low-speed driving ratios, a governor controlling the supply of fuel to said engine and operative to maintain a substantially constant engine-speed, means for adjusting said governor to vary the engine-speed it maintains, and mechanism operable conjointly with said adjusting means for preventing said transmission from being adjusted to provide said low-speed ratio

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when said governor is adjusted to maintain an engine-speed higher than a predetermined speed.

2. In an automotive vehicle having an internal combustion engine and a change-speed transmission selectively adjustable to provide relatively high-speed and low-speed driving ratios, a governor limiting the supply of fuel to said engine to provide a maximum engine speed, means for adjusting said governor to vary the maximum engine-speed it provides, and mechanism operable conjointly with said adjusting means for preventing said transmission from being adjusted to provide said low-speed ratio when said governor is adjusted to provide a maximum engine-speed higher than a predetermined speed.

3. In an automotive vehicle having an internal combustion engine and a change-speed transmission selectively adjustable to provide a plurality of different driving ratios, a governor controlling the supply of fuel to said engine and operative to maintain a substantially constant engine-speed, means for adjusting said governor to vary the engine-speed it maintains, and mechanism for preventing said governor from being adjusted to maintain an engine speed higher than a predetermined speed when said transmission is adjusted to provide one of said driving ratios, said mechanism being inoperative to limit governor-adjustment when said transmission is adjusted to provide another driving ratio, said last named driving ratio being higher than the first named ratio.

4. In an automotive vehicle having an internal combustion engine and a change-speed transmission selectively adjustable to provide a plurality of different driving ratios, a governor limiting the supply of fuel to said engine to provide a maximum engine speed, means for adjusting said governor to vary the maximum engine-speed it provides, and mechanism for preventing said governor from being adjusted to provide a maximum engine speed higher than a predetermined speed when said transmission is adjusted to provide one of said driving ratios, said mechanism being inoperative to limit governor-adjustment when said transmission is adjusted to provide another driving ratio, said last named driving ratio being higher than the first named ratio.

5. In an automotive vehicle having an internal combustion engine and a change-speed transmission selectively adjustable to provide relatively high-speed and low-speed driving ratios, a governor limiting the supply of fuel to said engine to provide a maximum engine speed, means for adjusting said governor to vary the maximum engine-speed it provides, a member manually movable to control the supply of fuel to the engine and regulate engine-speed throughout the range below the maximum provided by said governor, means operable independently of said transmission for rendering said manually movable member inoperative to regulate engine-speed, and mechanism operable conjointly with said adjusting means for restricting the range of adjustment of said transmission.

6. In an automotive vehicle having an internal combustion engine and a change-speed transmission selectively adjustable to provide a plurality of different driving ratios, a governor controlling the supply of fuel to said engine and operative to maintain a substantially constant engine-speed, means for adjusting said governor to vary the engine-speed it maintains, and mechanism operable conjointly with said transmission for restricting the range of adjustment of said ad-

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justing means when said transmission is adjusted to provide one of said driving ratios, said mechanism being inoperative to restrict the range of adjustment of said governor-adjusting means when said transmission is adjusted to provide another driving ratio, said last named driving ratio being higher than the first named ratio.

7. In an automotive vehicle having an internal combustion engine and a change-speed transmission selectively adjustable to provide relatively high-speed and low-speed driving ratios, a governor limiting the supply of fuel to said engine to provide a maximum engine speed, means for adjusting said governor to vary the maximum engine-speed it provides, a member manually movable to control the supply of fuel to the engine and regulate engine-speed throughout the range below the maximum provided by said governor, mechanism operative independently of said transmission for rendering said manually movable member inoperative to regulate engine-speed, means for adjusting said transmission, and an operative connection between said two adjusting means.

8. In an automotive vehicle having an internal combustion engine and a change-speed transmission selectively adjustable to provide relatively high-speed and low-speed driving ratios, a governor controlling the supply of fuel to said engine and operative to maintain a substantially constant engine-speed, manually operable means for adjusting said governor to vary the engine-speed it maintains, means for adjusting said transmission, and mechanism operable by said latter means for changing the adjustment of said governor when said transmission is adjusted to provide said high-speed ratio.

9. In an automotive vehicle having an internal combustion engine and a change-speed transmission selectively adjustable to provide relatively high-speed and low-speed driving ratios, a governor limiting the supply of fuel to said engine to provide a maximum engine speed, manually operable means for adjusting said governor to vary the maximum engine-speed it provides, means for adjusting said transmission, and mechanism operable by said latter means for changing the adjustment of said governor when said transmission is adjusted to provide said high-speed ratio.

10. The invention set forth in claim 4 with the addition of a member manually movable to control the supply of fuel to the engine and regulate engine-speed throughout the range below the maximum provided by said governor, and mechanism for rendering said manually movable member inoperative to regulate engine-speed.

11. In an automotive vehicle having an internal combustion engine and a change-speed transmission selectively adjustable to provide relatively high-speed and low-speed driving ratios, means for so adjusting said transmission, a governor controlling the supply of fuel to said engine and operative to maintain a substantially constant engine-speed, a manually movable member, and governor-control means for adjusting said governor to vary the engine-speed it maintains, said governor-control means being jointly controllable by said manually movable member and said transmission-adjusting means to permit the maintenance of higher engine speeds when the transmission is adjusted to provide a high-speed driving ratio than when the transmission is adjusted to provide a low-speed driving ratio.

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