Feb. 16, 1937. S. R. PUFFER 2,071,177

ENGINE THROTTLE CONTROL

Filed July 25, 1934

Fig. 2.

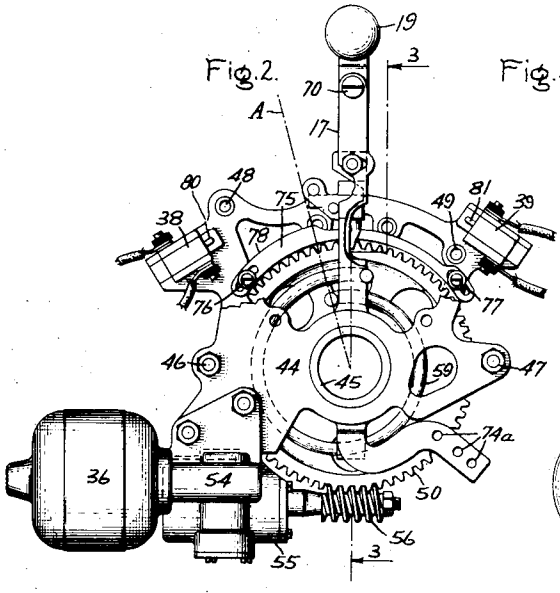


Fig. 3.

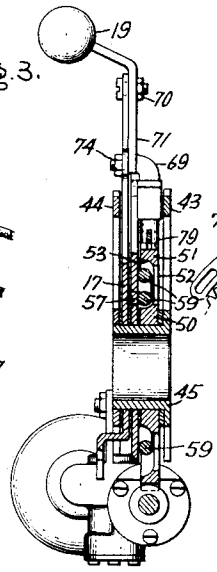
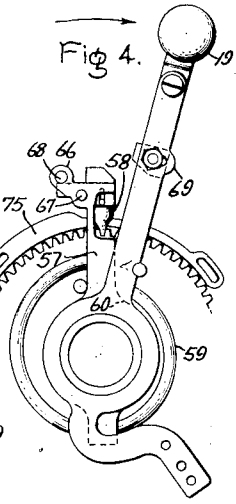


Fig 4.



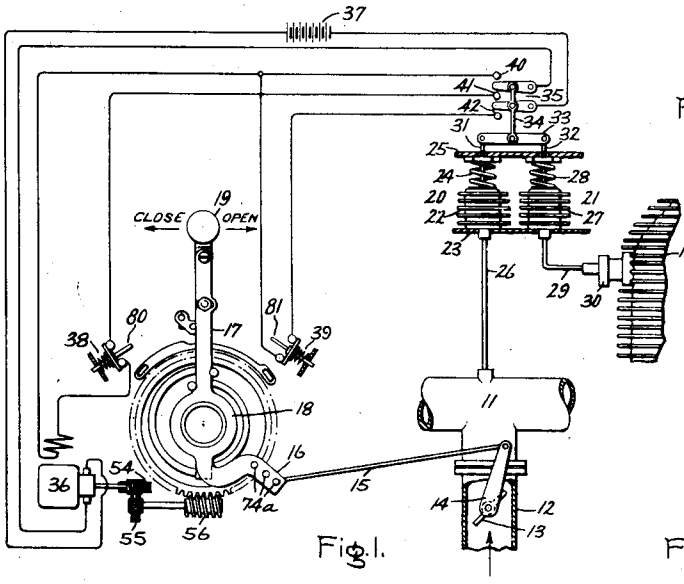


Fig. 1.

Fig. 5.

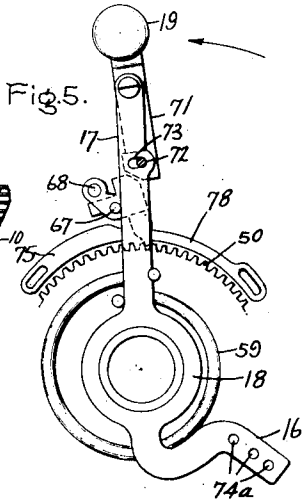
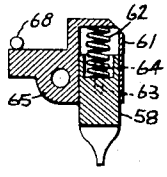


Fig. 6.



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His Attorney.

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UNITED STATES PATENT OFFICE

2,071,177

ENGINE THROTTLE CONTROL

Samuel R. Puffer, Saugus, Mass., assignor to General Electric Company, a corporation of New York

Application July 25, 1934, Serial No. 736,852

16 Claims. (Cl. 123—98)

The present invention relates to engine control mechanisms for controlling a regulating or control element of an engine in response to certain conditions. By "engines" I mean both reciprocating and rotary, as well as stationary engines, such as combustion engines, turbines, and boilers to which an actuating fluid or substance is supplied for operating such engines. By "regulating elements" I mean, for instance, a valve for controlling the supply or the flow of actuating fluid or substance to such engines, and by "certain operating conditions" are meant conditions pertaining to the controlled engines, for instance, the temperature of such engines and the pressure at which actuating fluid or substance is supplied to the engines, as well as conditions such as temperature and pressure pertaining to other engines associated with the controlled engines, and finally, conditions pertaining to the environment of such engines in general, such as temperature and pressure of the atmosphere. More specifically, the invention relates to the kind of control mechanisms for automatically and manually controlling the regulating element or elements of an engine to normally operate the engine at maximum safety and greatest efficiency, and permitting at any time deviation from such maximum safety and greatest efficiency operation at the will of the operator. The invention is particularly advantageous and will be described hereinafter in connection with supercharged, internal combustion engines as are used for the propelling of aircrafts, although it is not necessarily limited thereto.

The general object of my invention is to provide an improved construction and arrangement of the kind of engine control mechanisms above specified. A more specific object of my invention is to provide a manual and automatic engine control mechanism with which the automatic control of an engine becomes effective instantly within a certain range of load control as a certain condition, for instance the temperature of the engine, changes.

For a consideration of what I consider to be novel and my invention, attention is directed to the following description and the claims appended thereto in connection with the accompanying drawing which forms a part of my specification.

In the drawing I have shown in Fig. 1, by way of example, a diagrammatic view of an arrangement embodying my invention in connection with a super-charged internal combustion engine; Fig. 2 is a detail view of the control mechanism of Fig. 1; Fig. 3 is a sectional view along lines 3—3 of Fig. 2; Figs. 4 and 5 show certain elements of Fig. 2 in different operating positions; and Fig. 6 is a detail view of a dog arrangement of Fig. 2.

The arrangement of Fig. 1 comprises a cylinder structure 10 which may be a single or a plurality of cylinders to which a mixture of fuel and compressed air is supplied through a manifold 11. The latter receives such mixture of fuel and compressed air from a carburetor and a supercharger (not shown) connected in series to the manifold by a conduit 12. A throttle valve 13 is disposed within the conduit 12 for controlling the flow of fuel and compressed air to the cylinder or cylinders 10. The valve 13 is connected to a short arm 14, which latter is pivoted to one end of a link 15. The other end of the link 15 is pivoted to a connecting portion 16 of a manually controllable or movable element or lever 17. An intermediate annular portion 18 of the lever 17 is rotatably supported, as will be described more in detail hereafter. The upper portion of the lever is provided with a manually operable handle 19. Movement of the handle to the left causes closing of the valve 13, and movement to the right causes opening of the valve 13. The arrangement is such that the lever 19 may be moved manually at any time and in any direction between closing and full opening position of the valve 13.

Regarding the automatic control of the valve 13, I have indicated in the present instance an apparatus or means for controlling the valve 13 in response to changes in temperature of the cylinders 10, as well as in response to changes in pressure of the supplied mixture of fuel and compressed air. Both temperature and fuel and air pressure affect to a considerable extent the safety and the efficiency of internal combustion engines and these variables of temperature and pressure are especially apparent in the operation of internal combustion engines on aircrafts because the cooling effect of the atmosphere, as well as the pressure of the supplied mixture of fuel and air, are considerably reduced as an aircraft rises to higher altitude, and vice versa, are increased as an aircraft descends towards sea level. Thus, it will be readily understood that a properly supercharged internal combustion engine of an aircraft flying at an altitude of 10,000 feet would be excessively supercharged as the airplane descends towards sea level, were not means provided for automatically controlling the supercharging pressure.

The arrangement in the present example (Fig. 3) includes two devices, a pressure responsive

device 20 and a temperature responsive device 21. The pressure responsive device 20 comprises a bellows 22 held on a support 23 and biased towards said support by a spring 24 disposed between the upper end of the bellows 22 and a fixed support 25. The bellows 22 is connected by a pipe 26 to the inlet manifold 11 whereby the bellows expands and collapses as the pressure in the manifold 11 rises and drops respectively. Similarly, the temperature responsive device 21 comprises a bellows 27 and a spring 28 corresponding to and similarly arranged as the bellows 22 and the spring 24 of the device 20. The bellows 27 is connected by a pipe 29 to a bulb 30 suitably secured to and in thermal contact with the cylinder structure 10. The bulb 30 contains a fluid, preferably a liquid which evaporates as the temperature of the cylinder structure 10 rises. The evaporation effects an increase in pressure in the bellows 27 whereby the latter expands. The bellows 22 and 27 have upper ends connected by links 31 and 32 respectively to the ends of a lever 33, which latter has an intermediate point pivoted by a link 34 to a reversing switch 35. The reversing switch 35 serves to connect, disconnect and reverse a reversing motor 36. The circuit for the motor includes a source of electric energy 37 and two limiting switches 38 and 39. If the reversing switch 35 is moved upward in response to increase in pressure or temperature, it effects closing of the motor circuit through an upper contact 40 and an intermediate contact 41 whereby the motor is rotated in a direction to effect closing movement of the valve 13, and when the reversing switch 35 is moved downward, due to a decrease in pressure or temperature or both pressure and temperature, the switch engages the intermediate contact 41 and a lower contact 42 whereby the motor circuit is closed with the motor running in reverse direction, effecting opening movement of the valve 13. An arrangement of this kind is disclosed and more fully described in my copending application, Serial No. 451,107, filed May 9, 1930, and assigned to the same assignee.

The elements connecting the reversing motor 36 with the valve 13 through the intermediary of the hand-operated lever 17, the link 15 and the valve arm 14 are arranged to permit the following functions: First, manual setting of the control at any point below the predetermined conditions for which the automatic member of the control is set; second, limiting such setting of the manual control to said predetermined conditions; third, automatic governing by the control to maintain the conditions for which it is set; fourth, temporary surpassing of the predetermined conditions by application of abnormal force on the manual control member for emergency use; and fifth, automatic return of the control to the governing position immediately upon the removal of the abnormal force on the manual control. The motor 36 and the elements connecting this motor with the lever 17 are arranged to form a single control unit. This control unit comprises a frame having a rear plate 43 and a front plate 44. The rear plate 43 has an opening surrounded by an annular flange or supporting member 45 which is integrally united with the plate 43. The plate 44 has an opening fitting the outer end of the flange 45. The two plates forming the frame are united by bolts 46, 47, Fig. 2, and in addition, the plates are provided with openings 48, 49 for securing the unit to a suitable support which may be an element of an aircraft structure, not shown. The opening defined by the annular portion 18 of the manually controlled lever 17 has a sliding fit with the outer surface of the supporting member 45 and, as best shown in Fig. 3, the lever 17 is held on a front portion of said supporting member 45 adjacent the front plate 44. An automatically movable element or gear 50 is rotatably arranged on the supporting member 45 adjacent the rear plate 43. The gear 50 has a web 51 with openings 52 to make the gear as light as possible and defining an annular recess 53. The gear 50 may be rotated in either direction by the reversing motor 36 through the intermediary of speed reducing means comprising two worm gearings 54 and 55 and a worm 56, which latter meshes with the teeth of the gear 50. The arrangement so far described effects rotation of the gear 50 in counter clockwise and clockwise direction in response to increase and decrease respectively in pressure and temperature of the supercharged internal combustion engine.

The transmission of rotary movement or torque from the gear 50 to the manually operated lever 17 is effected by coupling means comprising a connecting lever 57, a dog 58 held on the lever 57 and normally engaging the teeth of the gear 50 and a yieldable or resilient connecting member, more specifically a spring 59 between the levers 57 and 17. The lever 57 is disposed between the lever 17 and the wheel 50 and has an annular portion 60 (Fig. 4) similar to the portion 18 of the lever 17, which portion 60 is rotatably secured to the supporting member 45. The spring 59 for connecting the connecting means, that is, the lever 57 and the dog 58, with the manually operated lever 17 is disposed in the aforementioned annular recess 53 of the gear 50. The spring in the present instance comprises a single turn with bent ends engaging opposite edges of the two levers to force them into alinement. The aforementioned dog 58 is slidably arranged in a casing 61 and biased towards the gear 50 by a compression spring 62 in said casing (Fig. 6). The dog is prevented from dropping out of the casing by a pin 63 secured to the dog and slidably arranged in a slot 64 of the casing 61. The casing 61 has a lateral projection 65 held on a lateral projection 66 of the connecting lever 57 by means of a pivot 67. Under certain conditions the casing 61 is permitted to turn counterclockwise about the pivot 67 to permit disengagement between the dog 58 and the gear 50 but the casing 61 is always prevented from turning clockwise from the position indicated in Figs. 2 and 4 by the provision of a stop 68 in the form of a pin secured to the lateral projection 66 of the connecting lever 57. Thus, with the arrangement so far described, rotation of the gear 50 in counterclockwise direction, that is, towards closing position of the valve 13, will be always effective as regards the transmission of torque from the gear through the dog to the connecting lever 57. To render the transmission of torque or movement effective with the gear 50 rotating in clockwise direction, that is, towards opening position of the valve 13, means are provided which normally prevent the casing 61 for holding the dog 58 from turning in counterclockwise direction about the pivot 67. This means comprises a stop 69 secured to the lower end of the handle 19. The handle 19 which

forms an extension of the lever 17 is pivotally secured to the upper end of the lever 17 by a screw and nut 70. A portion 71 of the handle carrying at its lower end the stop 69 is normally in alinement with the lever 17 and in this case the stop 69 engages the upper end of the casing 61, preventing tilting or turning movement of the latter. The portion 71 of the handle may be turned about the pivotal connection 70 whereby the stop 69 is moved away from the casing 61 and permits the latter to turn in counterclockwise direction (Fig. 5) about the pivot 67. The turning movement of the handle portion 71 is limited by a pin 72 secured to the portion 71 and projecting through a slot (Fig. 5) 73 of the lever 17. A nut 74 is secured to the front portion of the pin 72 in order to keep the adjacent surfaces of the handle portion 71 and the upper portion of the lever 17 in sliding engagement.

The normal automatic operation of the mechanism is as follows: An increase in pressure in the manifold 11 or temperature of the cylinder structure 10 causes closing movement of the reversing switch 35 due to the expanding of the bellows 22 or 27, and the closing of the switch 35, as pointed out above, causes operation of the reversing motor 36 in a direction to turn the wheel 50 through the intermediary of the worm gearings 54 and 55 and the worm 56 in counterclockwise direction. Turning movement of the wheel 50 in this direction causes the dog with the connecting lever 57 to travel towards the left, that is, in the same direction as the wheel 50. This movement of the dog and the connecting lever 57 is transmitted to the manually movable lever 17 by the biasing spring 59, which latter, as stated before, maintains under normal conditions alinement or a definite angular relation between the connecting lever 57 and the manually movable lever 17 or, from another viewpoint, the spring 59 causes the manually movable lever to follow the movement of the connecting lever. In the present instance, where the connecting lever 57 is moved in counterclockwise direction, it causes the manually movable lever to move in the same direction and to the same extent, whereby the valve 13 being connected to the connecting portion 16 of the manually movable lever is moved towards closing direction. This closing of the valve 13 in the present example reduces the flow of fuel and compressed air to the manifold 11 and the cylinders of the engine, whereby the pressure in the manifold and the temperature of the cylinder structure are reduced.

The operation during a decrease in pressure or temperature, or both, is similar with the different elements moving in opposite direction to effect opening movement of the valve.

The arrangement of the manually movable lever 17, its connecting portion 16, the link 15 and the lever arm 14 is such that the flow of mixture through the conduit 12 changes in proportion to the movement of the manually movable lever 17. The valve 13 has a non-linear characteristic, that is, the flow through the conduit 12 does not change in proportion to the movement of the valve. When the valve is fully open, a slight closing movement of the valve has little effect on the flow, whereas when the valve 13 is closed, such slight movement towards opening considerably changes the rate of flow. This non-linear characteristic of the valve is compensated by providing the lever 17, its connecting portion 16, the link 15 and the lever arm 14 in a definite angular relation so that, as stated above, uniform movement of the lever 17 effects uniform change of flow through the conduit 12. The connecting portion 16 is provided with numerous openings 74a to permit adjustability between the link 15 and the portion 16. In the present instance, as shown in Fig. 1, the link 15 is connected to the outer opening 74a.

The mechanism also includes means for rendering the automatic control ineffective as soon as the valve has been moved towards closing direction into a predetermined position because, as stated above, it is undesirable, especially where the mechanism serves for operating an aircraft engine, to permit the automatic control to completely shut the valve. This is accomplished by a cam 75 secured to the rear plate 43 of the frame by screws 76 and 77 (Fig. 2). The cam 75 surrounds a portion of the gear and has a cam surface 78. The dog 58, as will be noted in Fig. 3, has a slotted portion 79 which rides on the cam 75 and in a certain valve position is moved radially away from the gear 50, effecting disengagement between the dog and the gear 50. If the mechanism is in the position indicated in Fig. 2, and a change in pressure or temperature calls for closing movement of the valve, such movement will be effected automatically until the valve reaches a certain position indicated in Fig. 2 by a dash-dotted line A. In this position the dog 58 has been removed from its engagement by compression of the spring 62 with the gear 50 and further rotation of the gear in counterclockwise direction therefore will not affect the valve position, that is, will not effect further closing movement of the valve. Such further closing movement and complete closing of the valve is possible only by the manipulation of the manually operated lever 17. If the lever 17 is moved towards closing position it engages in the end position an actuating member 80 of the limiting switch 38 and effects opening of the motor circuit. The limiting switches 38 and 39 are mounted on the rear plate 43 of the frame. Whereas the member 80 is disposed in the plane of the lever 17, a corresponding member 81 of the switch 39 is disposed in the plane of the connecting means 57, 58, 61 and said member 81 is actuated to open the switch 39 when said connecting means is moved into full open position of the valve.

Let us assume the valve has been positioned by the control in the most desirable position as regards safety and efficiency of the engine. If now a certain condition, for instance an emergency condition, calls for further opening of the valve, such further opening may be effected at any time by moving the manually operated lever 17 towards the right. This movement, however, has to be effected against the resistance or biasing force of the spring 59, that is, if the operator wants to open the valve further than is desirable with respect to safety and efficiency of the engine he has to apply a considerable force and the valve will remain in the new position only as long as the operator applies such force to the handle 19 of the lever 17. Such a condition is indicated in Fig. 4 of the drawing in which an arrow indicates the force applied to the handle 19 by the operator. As soon as the operator releases the handle 19, that is removes said force, the handle together with the lever 17 returns automatically into alinement with the connecting lever 57, that is into the position shown in Fig. 2. This is an important feature

of the arrangement because under normal conditions with the setting indicated in Fig. 2, the valve 13 will be always in the most desirable operating position and what is just as important, any change of this position called for by the automatic control means becomes effective instantly as long as the dog 58 engages the gear 50.

Under certain conditions it is desirable to disconnect or render inoperative the automatic control to prevent further opening of the valve. This is accomplished merely by tilting the handle 19 as indicated in Fig. 5. In this position, clockwise movement of the gear 50 calling for further valve opening is not transmitted to the connecting means including the lever 57 and the dog 58.

If, however, in the position of Fig. 5 changing conditions call for closing of the valve, causing counterclockwise rotation of the gear 50, such rotation is transmitted through the dog 58 to the connecting lever 57, irrespective of the tilted position of the handle portion 71. As clearly indicated in Fig. 5, with the casing 61 in tilted position, the dog 58 still projects between two teeth of the gear 50. Clockwise rotation of the gear, however, causes the dog, and hence the casing 61, to move in a counterclockwise manner about the pivot 68, thus raising the dog 50 out of the teeth in the manner of an ordinary ratchet, whereas counterclockwise rotation of the gear 50 at first effects straightening out of the dog, that is, bringing the dog 58 and the casing 61 into alinement with the levers 57, and thereafter effects counterclockwise movement of connecting lever 57, effecting the same movement of the lever 17 and resulting in closing movement of the valve 13.

Let us assume in the position indicated in Fig. 5 the valve 13 be 50% open, whereas safety and efficiency of the engine would permit a 100% or full opening of the valve 13. If under such condition the operator wishes to move the valve into a position, 75% open, he applies a slight pressure to the left side of the handle 19, bringing into alinement the handle portion 71 and the lever 17 to render the stop 69 effective to cause engagement between the dog 58 and the gear 50. When this is accomplished the automatic control will effect turning movement of the gear towards valve opening position and as soon as the valve is approximately 75% open, the operator renders again the automatic control inoperative by a slight pressure to the right side of the handle 19 to remove the stop 69 from the dog casing 61. As will be noted, the right-hand upper edge of the casing 61 and the left-hand lower edge of the stop 69 (Fig. 5) are cut away to permit engagement and disengagement between the casing 61 and the stop 69.

With my invention I have accomplished an improved construction and arrangement of control mechanisms for manually and automatically controlling a regulating or control element of an engine. The automatic control causes operation of the engine at greatest efficiency and maximum safety. This is particularly important and advantageous in cases where the engine is subject to considerable variation in operating conditions. The operator is relieved of the necessity of watching closely the operation of the engine in order to maintain maximum safe load. At the same time, however, the operator is in a position to readily effect changes in the setting of the regulated element by the automatic control, and the arrangement is such as to enable the operator to differentiate between the manual operation beyond and below safe load condition because manual movement of the regulated element beyond safe load condition has to be effected by the continuous application of considerable force. The manually movable element of the control mechanism is normally in alinement or in definite relative position with an element of the automatic control means which has the distinct advantage that any change called for by the automatic control means becomes effective immediately. The automatic control means is automatically put out of operation or rendered ineffective as the valve reaches a certain closing position, and the automatic control may be rendered ineffective in the direction of safe movement by a simple manipulation of the handle of the manually movable lever.

Having described the method of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof, I desire to have it understood that the apparatus shown is only illustrative and that the invention may be carried out by other means.

What I claim as new and desire to secure by Letters Patent of the United States is:—

1. In an engine control mechanism, the combination of a manually movable element having a handle for moving it and a connecting portion for moving a controlled member, another element to be moved automatically in response to changes of a certain operating condition, and coupling means for transmitting motion between said elements and for normally maintaining a definite relative position between said elements, the coupling means including a resilient member connected to the manually movable element to cause said element to return into said relative position when manually moved out of said relative position, and means for automatically disengaging the coupling means to render the automatically operated element inoperative.

2. In an engine control mechanism, the combination of a manually movable element having a handle for moving it and a connecting portion for moving a controlled member, another element to be moved automatically in response to changes of a certain operating condition, coupling means for transmitting motion between said elements and for normally maintaining a definite relative position between said elements, and means for automatically disengaging the coupling means to render movement of the automatically actuated element ineffective within a predetermined range of its total movement.

3. In an engine control mechanism, the combination of a manually movable element having a handle for moving it and a connecting portion for moving a controlled member, another element to be moved automatically in response to changes of a certain operating condition, coupling means for transmitting motion between said elements and for normally maintaining a definite relative position between said elements, and means for rendering the coupling means inoperative in response to movement of the automatically operated element beyond a fixed position.

4. In an engine control mechanism, the combination of an engine member to be controlled an element having a handle for manually moving the element and a portion positively connecting the element to the engine member to be controlled, another element to be moved automatically in response to certain operating conditions, and coupling means for moving the first named

element in response to movement of the other element, said coupling means comprising means including a pawl engaging the other element, a connecting lever supporting the pawl and a spring connecting said lever to the first named element and normally biasing said means into a definite relative position with respect to the first named element, said coupling means permitting manual movement of the engine member without interfering with the operation of the other element.

5. In an engine control mechanism, the combination of a rotatable element having a handle for manually moving the element and a portion for positively connecting the element to an engine member to be controlled, another element to be moved automatically in response to certain operating conditions, and coupling means for moving the first named element in response to movement of the other element and permitting manual movement of the rotatable element without interfering with the automatic operation of the other element, said coupling means comprising a rotatable connecting lever engaging the other element and a spring biasing the connecting lever into alinement with the first named element whereby movement of the connecting lever in response to movement of the other element effects instantaneous movement of the first named element.

6. In an engine control mechanism, the combination of an element having a handle for manually moving the element and a portion for connecting the element to an engine member to be controlled, another element to be moved automatically in response to certain operating conditions, coupling means for moving the first named element in response to movement of the other element, said coupling means comprising a connecting lever, a movable member on the lever engaging the other element, a stop on the handle engaging said movable member, and resilient means biasing the connecting lever into alinement with the first named lever, the handle being pivoted to the first named element so that turning movement of the handle about its pivot causes the stop to be removed from said movable member and the coupling rendered ineffective.

7. In an engine control mechanism, the combination of a lever having a handle for manually moving it and a portion for connecting it to an engine member to be controlled, a gear to be controlled automatically, and coupling means for transmitting movement of the gear to the lever comprising connecting means engaging the gear and resilient means intermediate the connecting means and the lever to move the lever in response to gear movement and to bias the lever into a definite relative position to the gear, said resilient means permitting manual movement of the lever in one direction by the manual application of a considerable force.

8. In an engine control mechanism, the combination of a lever having a handle for manually moving it and a portion for connecting it to an engine member to be controlled, a gear to be controlled automatically, and coupling means for transmitting movement of the gear to the lever comprising a connecting lever, a dog on the connecting lever engaging the gear and a spring biasing the connecting lever into alinement with the first named lever.

9. In an engine control mechanism, the combination of a lever having a handle for manually moving it and a portion for connecting it to an engine member to be controlled, a gear to be controlled automatically, coupling means for transmitting movement of the gear to the lever comprising a connecting lever, a dog on the connecting lever engaging the gear and a spring biasing the connecting lever into alinement with the first named lever, and means for rendering the automatic control inoperative in certain range of gear movement comprising cam means cooperating with the dog and disengaging the dog from the gear as the gear with the dog reaches a certain position.

10. In an engine control mechanism, the combination of a lever having a handle for manually moving it and a portion for connecting it to an engine member to be controlled, a gear to be controlled automatically, coupling means for transmitting movement of the gear to the lever comprising a connecting lever, a dog on the connecting lever engaging the gear and a spring biasing the connecting lever into alinement with the first named lever, and means for rendering the automatic control inoperative in at least one direction of gear movement comprising a movable stop secured to the handle for normally holding the dog in cooperative relation with the gear.

11. In an engine control mechanism, the combination of a lever, a handle pivoted to the lever for manually moving it and a portion on the lever for connecting it to an engine member to be controlled, a frame having a support for rotatably supporting the lever, a rotatable gear on the support to be moved automatically in response to changes of a certain operating condition, a connecting lever rotatably supported on the support, a dog pivotally secured to the connecting lever, a stop on said handle for effecting engagement between the dog and the gear, and a spring biasing the connecting lever into alinement with the manually movable lever.

12. In an engine control mechanism, a unit comprising in combination a frame, a manually movable lever having a portion rotatably supported on the frame, a handle pivoted to said lever portion and another portion united with the first named portion for connecting the lever to an engine member to be controlled, a gear concentrically supported with the lever on the frame, a motor and speed reducing means secured to the frame for driving the gear in response to changes of a certain operating condition, and coupling means including a spiral spring disposed in an annular recess of the gear for moving the lever in response to gear movement.

13. In an engine control mechanism, the combination of a controllable engine element, a manually movable lever positively connected to the element, and means for automatically moving the lever in response to a certain operating condition, said means including a rotatable gear, a connecting lever connected to the gear and a resilient member normally biasing the movable lever into a definite position relative to the connecting lever, said resilient member permitting the movable lever to be moved manually by the application of a considerable force without interfering with the operation of the means for automatically moving the lever.

14. In an engine control mechanism, the combination of a valve for controlling the flow of an actuating fluid to an engine, a pivotally supported manually movable lever, means connecting a portion of the lever to the valve, said means and said portion being arranged so that uniform

lever movement causes uniform change in flow, and means for automatically moving the lever in response to changes of a certain operating condition comprising a spring connected to the lever to permit manual valve opening movement beyond the position set by the automatic operating means against the biasing force of said spring, and means including said spring for returning the manually movable lever when manually moved beyond the position set by the automatic operating means to said set position as soon as the force exerted on the lever is removed.

15. In an engine control mechanism, the combination of manually controlled means, an automatically controlled element limiting said manually controlled means to a predetermined condition of engine operation, and means including a spring connecting said manually controlled means to said automatically controlled element, said spring permitting movement of the manually controlled means by the application of a force sufficient to overcome the biasing force of said spring without interfering with the operation and the position of the automatically controlled element.

16. In an engine control mechanism, the combination of a machine element to be controlled, manually movable means positively secured to the machine element for manually positioning the element, another element, means for automatically positioning the other element in response to certain operating conditions, and connecting means including a yieldable member connecting the other element to the manually movable means to effect control of the machine element in response to movement of the other element through the intermediary of the manually movable means, said connecting means normally effecting a definite relative position between the manually movable means and the other element and permitting actuation of the manually movable means without interfering with the operation of the other element.

SAMUEL R. PUFFER.